

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

TEST REPORT

For

Shenzhen MingZhan Information Technology Co., Ltd

8th floor, Huaqiang electronic world building 2-02, Shenzhen Huaqiang North Street,
Futian District, Shenzhen, China

Tested Model: M5Stack-CORE

Report Type: Original Report	Product Type: WIFI & Bluetooth Development Board
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Report Number: RSHA170928002-00A	
Report Date: 2017-11-30	
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FINAL

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Shenzhen MingZhan Information Technology Co., Ltd
Test Model	M5Stack-CORE
Product	WIFI & Bluetooth Development Board
Rate Voltage	DC 3.7V by battery and DC 5V from USB port
Highest Operating Frequency	2480MHz
Dimension	54mm(L)×54mm(W) ×12.6mm(H)

**All measurement and test data in this report was gathered from production sample serial number: 20170928001 (Assigned by BACL, Kunshan). The EUT supplied by the applicant was received on 2017-09-28.*

Objective

This test report is prepared on behalf of Shenzhen MingZhan Information Technology Co., Ltd in accordance with:

ETSI EN 301489-1 V2.2.0 (2017-03), ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements.

ETSI EN 301489-17 V3.2.0 (2017-03), ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems.

The objective is to determine compliance with ETSI EN 301489-1 V2.2.0 (2017-03), ETSI EN 301489-17 V3.2.0 (2017-03).

Test Methodology

All measurements contained in this report were conducted with ETSI EN 301 489-1 V2.2.0 (2017-03).

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

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

Test mode: Wifi Link & Bluetooth Link & Communication

EUT Exercise Software

No exercise software to test.

Equipment Modifications

No modifications were made to the EUT.

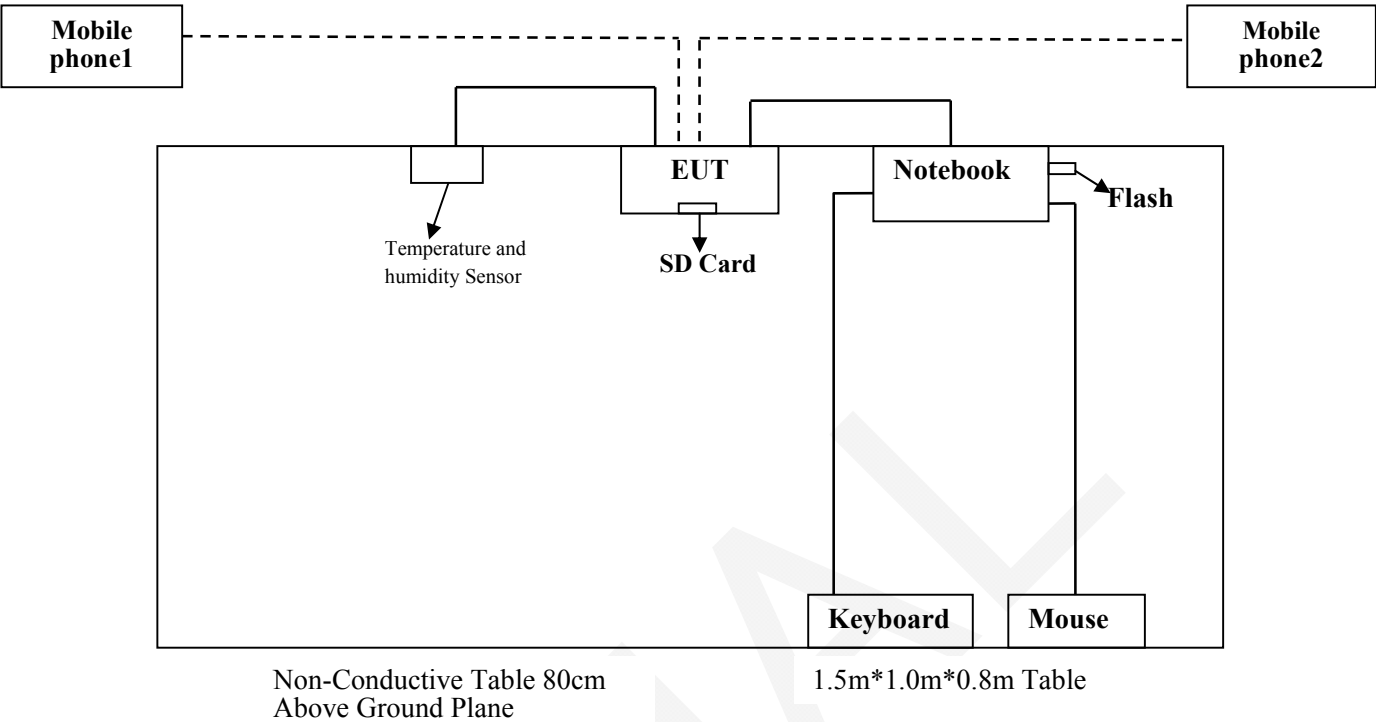
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Notebook	E6410	3094742521
Logitech	Keyboard	Y-U0009	1648MG010PW8
Logitech	Mouse	M-U0026	HS529HB
Lenovo	Flash	T180	0A1266865200521
Sandisk	SD Card	8GB	/
AOSONG	Temperature and humidity Sensor	DHT12	/
SAMSUNG	Mobile phone2	SM-A7100	R28H20BW8PW
HUAWEI	Mobile phone1	EVA-TL00	862266039775394

External I/O Cable

Cable Description	Length (m)	From/Port	To
Keyboard USB Cable	1.5	Notebook	Keyboard
Power Cable	0.2	EUT	Sensor
Mouse USB Cable	1.5	Notebook	Mouse
USB Cable	1.0	EUT	Notebook

Configuration of Radiation Test Setup



SUMMARY OF TEST RESULTS

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

Not Applicable: This equipment has no wired network ports. EUT connected to a dedicated AC/DC power supply.

Not Applicable*: This equipment will not be used in the vehicular environment.

Note:

Immunity test performance criteria:

“A “ means : CT/CR Reference to clauses EN 301 489-1 §6.1 /EN 301 489-17 §6.3 §6.5

“B” means : TT/TR Reference to clauses EN 301 489-1 §6.2 /EN 301 489-17 §6.4 §6.6

7.1 - CONDUCTED EMISSIONS

Measurement Uncertainty

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cispr} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

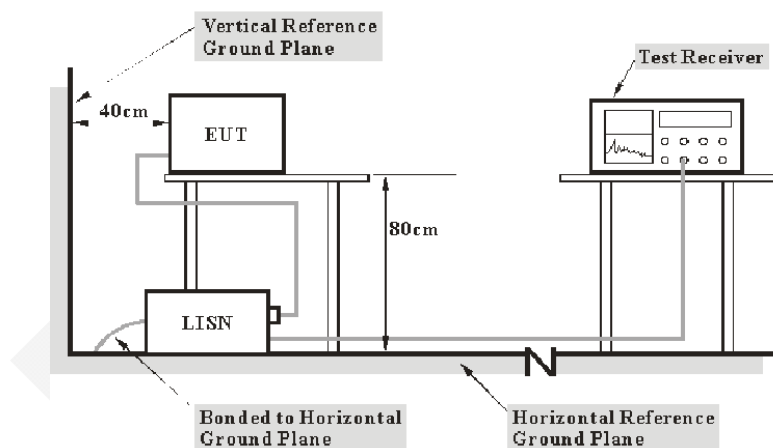
If U_{lab} is greater than U_{cispr} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit.

Table 1 – Values of U_{cispr}

Item		Measurement Uncertainty	U_{cispr}
AMN	150kHz~30MHz	3.19 dB	3.4~3.8 dB

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per EN 301489-1 measurement procedures. The specification used was with the EN 301 489-1 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

The adapter was connected to 230V/50Hz power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2017-11-12	2018-11-11
ROHDE&SCHWARZ	LISN	ENV216	3560655016	2017-11-12	2018-11-11
BACL	BACL-EMC	V1.0	CE001	--	--
MICRO-COAX	Coaxial Cable	Cable-6	006	2017-09-08	2018-09-07

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test Procedure

During the conducted emission test, the adapter was connected to the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

V_C : corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN or ISN

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the maximum limit. The equation for margin calculation is as follows:

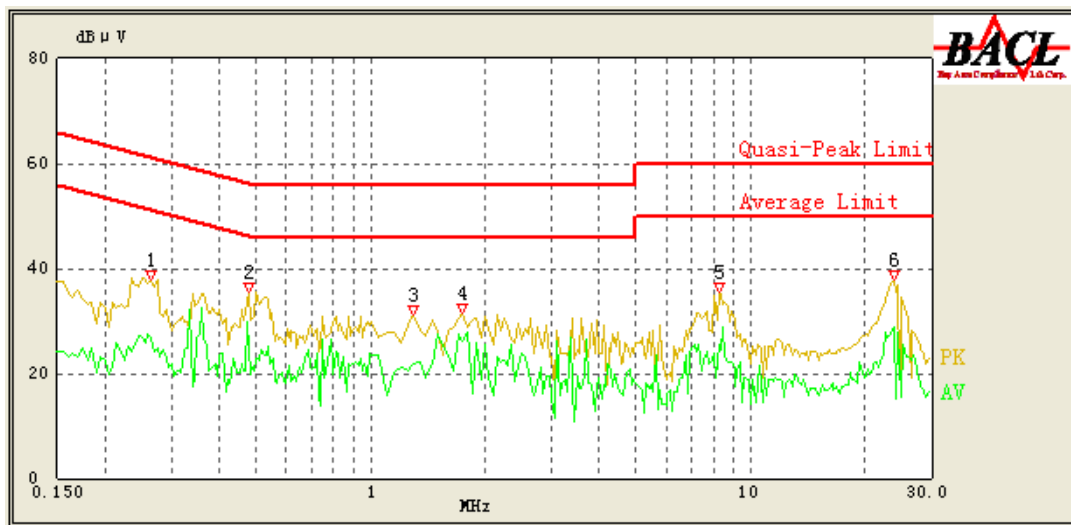
$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data**Environmental Conditions**

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Phil Zhu on 2017-11-30.

Test mode: Wifi Link & Bluetooth Link & Communication

Line

No.	Frequency (MHz)	Reading (dBμV)	Correction (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/AV/QP)
1	0.265	37.71	16.03	62.71	25.00	QP
2	0.265	26.69	16.03	52.71	26.02	AV
3	0.480	35.62	16.08	56.57	20.95	QP
4	0.475	29.86	16.07	46.71	16.85	AV
5	1.300	31.06	15.87	56.00	24.94	QP
6	1.300	21.98	15.87	46.00	24.02	AV
7	1.750	31.46	15.86	56.00	24.54	QP
8	1.750	26.24	15.86	46.00	19.76	AV
9	8.250	35.65	16.01	60.00	24.35	QP
10	8.250	25.43	16.01	50.00	24.57	AV
11	23.850	37.68	16.46	60.00	22.32	QP
12	23.900	28.74	16.46	50.00	21.26	AV

Neutral:

No.	Frequency (MHz)	Reading (dB μ V)	Correction (dB)	Limit (dB μ V)	Margin (dB)	Detector (PK/AV/QP)
1	0.260	35.95	16.06	62.86	26.91	QP
2	0.260	24.02	16.06	52.86	28.84	AV
3	0.520	38.36	16.10	56.00	17.64	QP
4	0.515	13.45	16.10	46.00	32.55	AV
5	2.500	28.31	15.90	56.00	27.69	QP
6	2.500	21.98	15.90	46.00	24.02	AV
7	3.700	25.65	15.89	56.00	30.35	QP
8	3.700	19.96	15.89	46.00	26.04	AV
9	7.650	34.14	15.94	60.00	25.86	QP
10	7.650	20.92	15.94	50.00	29.08	AV
11	8.700	36.17	15.96	60.00	23.83	QP
12	8.700	24.65	15.96	50.00	25.35	AV

7.1 - RADIATED EMISSIONS

Measurement Uncertainty

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cispr} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} of Table 1, then:

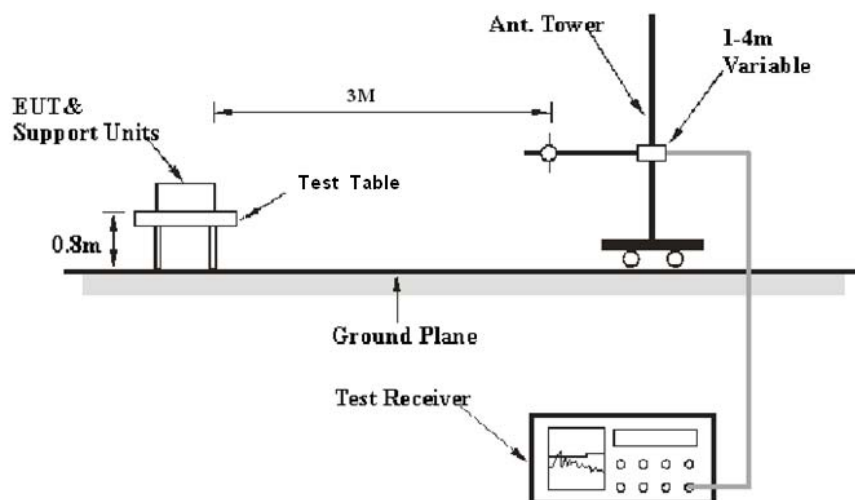
- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit.

Table 1 – Values of U_{cispr}

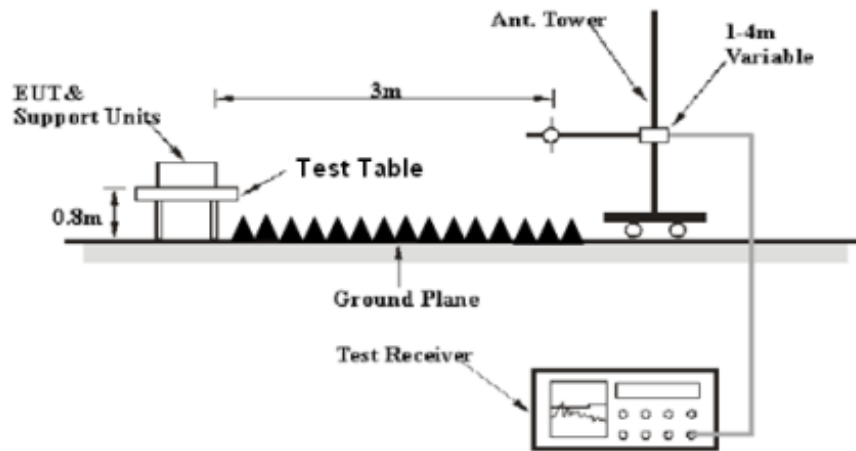
Item		Measurement Uncertainty	U_{cispr}
Radiated Emission	30MHz~1GHz	5.91dB	6.3 dB
	1GHz~6GHz	4.68dB	5.2 dB

Test System Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ETSI EN 301 489-1 V2.2.0 (2017-03). The specification used was the ETSI EN 301 489-1 V2.2.0 (2017-03).

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 6 GHz.

During the radiated emission test, the EMI test receiver Setup was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector Type
30MHz – 1000 MHz	120 kHz	300 kHz	120kHz	QP
Above 1 GHz	1MHz	3 MHz	/	Peak
	1MHz	10 Hz	/	Peak

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrument	Amplifier	310N	171205	2017-08-14	2018-08-13
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
ETS	Horn Antenna	3115	6229	2016-01-11	2019-01-10
Rohde & Schwarz	EMI Receiver	ESU40	100207	2017-08-27	2018-08-26
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-12-12	2017-12-11
R&S	Auto test Software	EMC32	100361	-	-
MICRO-COAX	Coaxial Cable	Cable-8	001	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-9	002	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-10	003	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-4	004	2016-12-12	2017-12-11
MICRO-COAX	Coaxial Cable	Cable-5	005	2016-12-12	2017-12-11

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test Procedure

During the radiated emissions, the adapter was connected to the first AC floor outlet.

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

All data was recorded in the Quasi-peak detection mode from 30MHz to 1GHz, Peak and average detection mode above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter reading. The basic equation is as follows:

$$\text{Corr. Amp.} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

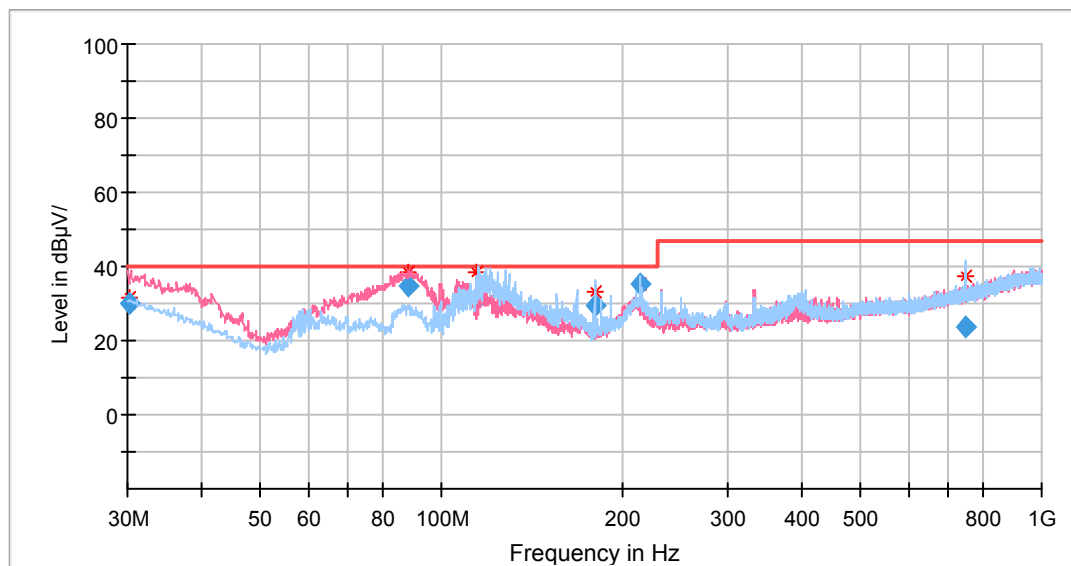
$$\text{Margin} = \text{Limit} - \text{Corrected Amp}$$

Test Data**Environmental Conditions**

Temperature:	24.1°C
Relative Humidity:	55%
ATM Pressure:	101.2 kPa-

* The testing was performed by Phil Zhu on 2017-10-13.

Test mode: Wifi Link& Bluetooth Link &Communication

1) Below 1GHz

Frequency (MHz)	Quasi-Peak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB /m)
30.113550	30.19	40.00	9.81	101.0	V	77.0	-4.5
88.203250	34.79	40.00	5.21	101.0	V	252.0	-18.0
114.313550	30.87	40.00	9.13	199.0	H	163.0	-12.7
179.958050	29.62	40.00	10.38	199.0	H	188.0	-14.1
214.761550	35.24	40.00	4.76	199.0	H	219.0	-12.7
747.124900	23.74	47.00	23.26	101.0	H	207.0	-2.3

Above 1 GHz:

Frequency (MHz)	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1519.716519	43.59	---	70.00	26.41	100.0	V	18.0	-8.0
1524.564519	---	21.58	50.00	28.42	100.0	V	18.0	-7.9
1592.775584	49.91	---	70.00	20.09	100.0	V	29.0	-7.6
1593.651584	---	26.69	50.00	23.31	100.0	V	29.0	-7.6
1771.860779	30.35	---	70.00	39.65	200.0	V	78.0	-6.9
1773.128779	---	16.46	50.00	33.54	200.0	V	78.0	-6.9
2405.007896	---	22.89	50.00	27.11	200.0	V	48.0	-4.9
2405.851896	54.84	---	70.00	15.16	200.0	V	48.0	-4.9
3215.888208	---	41.20	54.00	12.80	200.0	H	314.0	-1.5
3215.992208	45.10	---	74.00	28.90	100.0	H	299.0	-1.5
4823.356831	49.11	---	74.00	24.89	200.0	V	16.0	2.5
4823.864831	---	31.01	54.00	22.99	200.0	V	16.0	2.5

§7.1 – HARMONIC CURRENT EMISSIONS

According to EN 61000-3-2:2014 section 7: Equipment with a rated power of 75 W or less, other than discharge lighting equipment, are not included in this standard.

FINAL

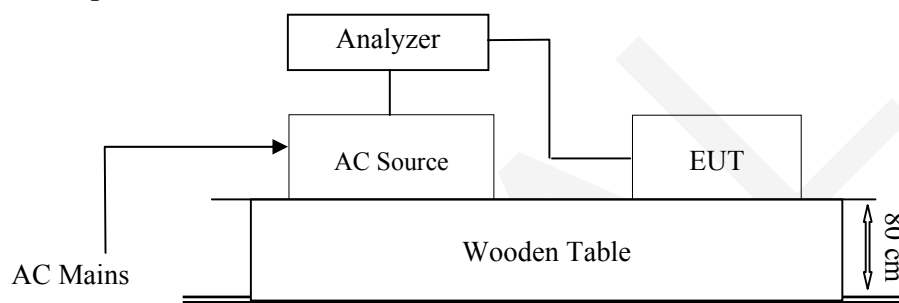
§7.1-VOLTAGE FLUCTUATION AND FLICKER

Test Equipment

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
EM TEST	Harmonic & Flicker Analyzer	DPA 500N	P1402129120	2017-11-12	2018-11-11
EM TEST	AC Power Source	ACS 500N	P1251107475	2017-11-21	2018-11-20

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements, traceable to National Primary Standards and International System of Units (SI).

Test System Setup



Test Standard

EN 61000-3-3:2013

Flicker Test Limits:

The limits shall be applicable to voltage fluctuations and flicker at the supply terminals of the equipment under test, measured or calculated according to clause 4 under test conditions described in clause 6 and annex A. Tests made to prove compliance with the limits are considered to be type tests.

The following limits apply:

- the value of Pst shall not be greater than 1,0;
- the value of Plt shall not be greater than 0,65;
- the value of d(t) during a voltage change shall not exceed 3,3 % for more than 500 ms;
- the relative steady-state voltage change, dc, shall not exceed 3,3 %;
- the maximum relative voltage change dmax, shall not exceed
 - a) 4 % without additional conditions;
 - b) 6 % for equipment which is:
 - switched manually, or
 - switched automatically more frequently than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds), or manual restart, after a power supply interruption.

Note: The cycling frequency will be further limited by the Pst and Plt limit. For example: a dmax of 6 % producing a rectangular voltage change characteristic twice per hour will give a Plt of about 0.65.

c) 7 % for equipment which is– attended whilst in use (for example: hair dryers, vacuum cleaners, kitchen equipment such as mixers, garden equipment such as lawn mowers, portable tools such as electric drills), or– switched on automatically, or is intended to be switched on manually, no more than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds) or manual restart, after a power supply interruption.

In the case of equipment having several separately controlled circuits in accordance with 6.6, limits b) and c) shall apply only if there is delayed or manual restart after a power supply interruption; for all equipment with automatic switching which is energized immediately on restoration of supply after a power supply interruption, limits a) shall apply; for all equipment with manual switching, limits b) or c) shall apply depending on the rate of switching. Pst and Plt requirements shall not be applied to voltage changes caused by manual switching. The limits shall not be applied to voltage changes associated with emergency switching or emergency interruptions.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

Date of test:	15:19 30.November 2017
Tester:	Phil Zhu
Standard used:	EN/IEC 61000-3-3 Flicker
Short time (Pst):	10 min
Observation time:	10 min (1 Flicker measurement)
Flicker meter:	230V / 50Hz
Flicker Impedance:	Zref (IEC 60725)
Customer:	Shenzhen MingZhan Information Technology Co., Ltd
E. U. T.:	WIFI & Bluetooth Development Board
Test Model:	M5Stack-CORE
EUT operation mode	<i>Test mode: Wifi Link & Bluetooth Link & Communication</i>

Maximum Flicker results

	EUT values	Limit	Result
Pst	0.034	1.00	Pass
Plt	0.034	0.65	Pass
dc [%]	0.000	3.30	Pass
dmax [%]	0.193	4.00	Pass
dt [s]	0.000	0.50	Pass

7.2 - ELECTROSTATIC DISCHARGE

Measurement Uncertainty

U_{lab} (measurement uncertainty of lab) and U_{EN} (measurement uncertainty of EN 61000-4-2) please refer to the following:

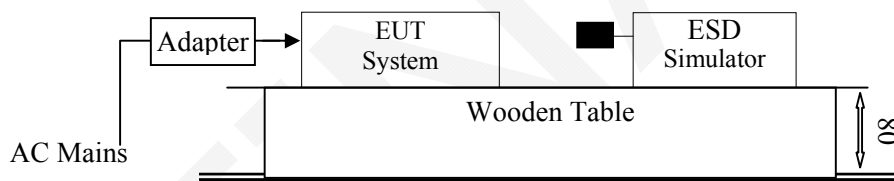
Parameter	U_{EN}	U_{lab}
Rise time t_r	$\leq 15\%$	15%
Peak current I_p	$\leq 7\%$	6.30%
Current at 30 ns	$\leq 7\%$	6.30%
Current at 60 ns	$\leq 7\%$	6.30%

Test Equipment

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
EM Test	ESD Simulator	Dito	V0824103870	2017-10-11	2018-10-10

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements, traceable to National Primary Standards and International System of Units (SI).

Test System Setup



Remark: ■ is the tip of the electrode

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

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

Test Standard

ETSI EN 301 489-1 V2.2.0 (2017-03) / EN 61000-4-2: 2009

Test Level 3 for Air Discharge at ± 8 kV

Test Level 2 for Contact Discharge at ± 4 kV

Test Level

Level	Test Voltage Contact Discharge (±kV)	Test Voltage Air Discharge (±kV)
1.	2	2
2.	4	4
3.	6	8
4.	8	15
X.	Special	Special

Performance criterion: B**Test Procedure****Air Discharge:**

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

Contact Discharge:

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

Indirect discharge for horizontal coupling plane

At least 50 single discharges shall be applied to the horizontal coupling plane, at points on each side of the EUT. The discharge electrode positions vertically at a distance of 0.1m from the EUT and with the discharge electrode touching the coupling plane.

Indirect discharge for vertical coupling plane

At least 50 single discharges shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the EUT. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the EUT are completely illuminated.

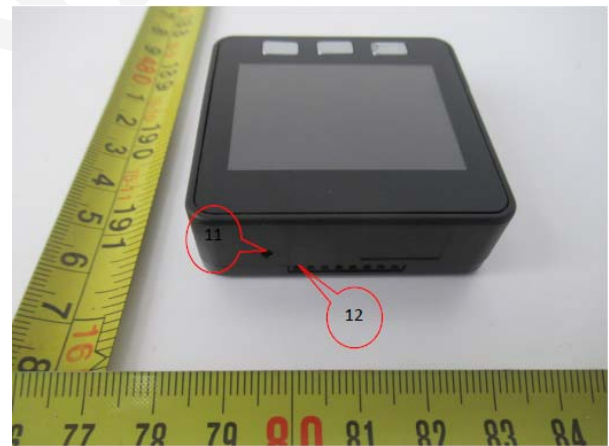
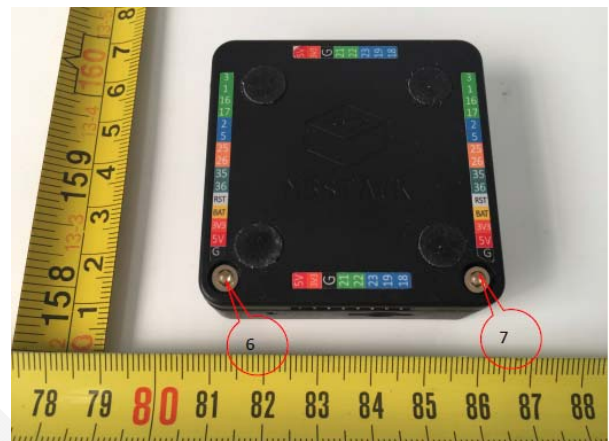
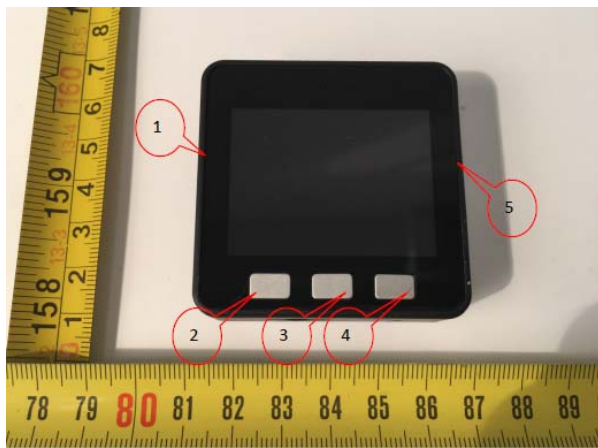
Test Data and Setup Photo**Environmental Conditions**

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Phil Zhu on 2017-10-15.

Test mode: Wifi Link& Bluetooth Link &Communication

	Contact discharge				Air discharge			
Test Points	±2kV	±4kV	±6kV	±8kV	±2kV	±4kV	±8kV	±15kV
VCP	A	A	/	/	/	/	/	/
HCP	A	A	/	/	/	/	/	/
1~5	/	/	/	/	A	A	A	/
6~7	A	A	/	/	/	/	/	/
8~18	/	/	/	/	A	A	A	/





7.2 -RF ELECTROMAGNETIC FIELD (80 MHz - 6000MHz)

Measurement Uncertainty

U_{lab} (measurement uncertainty of lab) and U_{EN} (measurement uncertainty of EN 61000-4-3) please refer to the following:

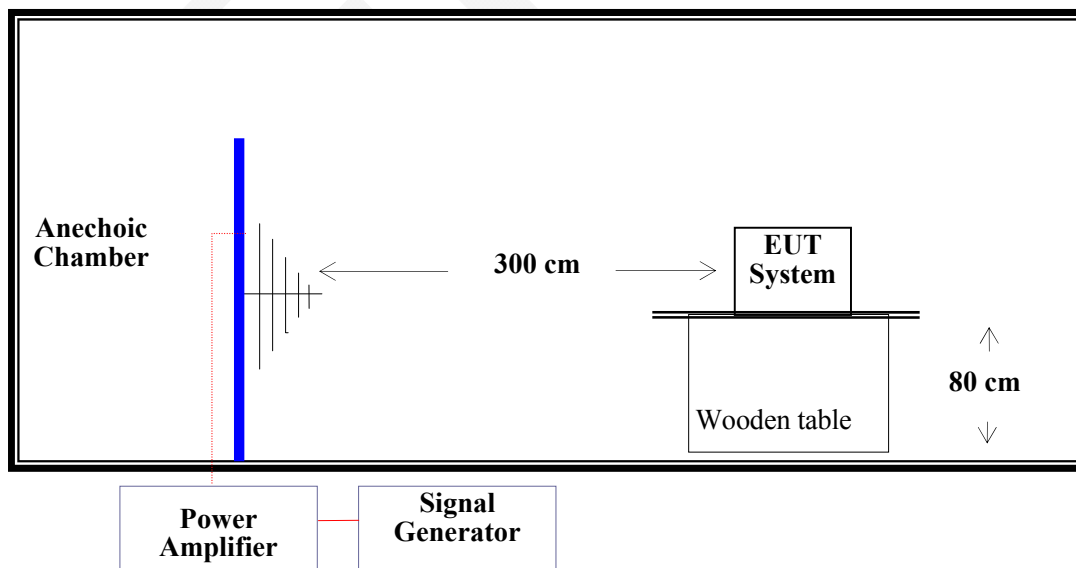
Parameter	U_{EN}	U_{lab}
Calibration process	1.88 dB	1.88 dB
Level setting	2.19 dB	2.19 dB

Test Equipment

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Signal Generator	E4421B	US38440505	2015-11-25	2017-11-24
Agilent	Signal Generator	8665B	3744A01692	2017-01-12	2018-01-12
Amplifier Research	Power Amplifier	200W1000M3A	18062	NCR	NCR
A&R	Power Amplifier	500W100B	0348446	NCR	NCR
A&R	Power Amplifier	60S1G6	0348712	NCR	NCR
Sunol Sciences	Bi-log Antenna	JB3	A040904-1	2016-01-09	2019-01-08
Amplifier Research	Power Amplifier	10S1GRM1	18060	NCR	NCR
ETS	Horn Antenna	3115	6229	2016-01-11	2019-01-10

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test System Setup



Test Standard

ETSI EN 301 489-1 V2.2.0 (2017-03) / EN 61000-4-3:2006+A1:2008+A2:2010
Test Level 2 at 3V / m
Test Levels and Performance Criterion

Test Level

Level	Field Strength V/m
1.	1
2.	3
3.	10
X.	Special

Performance Criterion: A**Test Procedure**

The EUT and its simulators are placed on a turn table which is 0.8 meter above the ground. The EUT is set 3 meters away from the Receiving antenna which is mounted on an antenna tower. Both horizontal and vertical polarizations of the antenna are set on test. Each of the four sides of EUT must be faced this Receiving antenna and measured individually. In order to judge the EUT performance, a CCD camera is used to monitor the EUT. And observe the status of the EUT through apps provide by the client which meet the requirements of the standard.

All the scanning conditions are as follows:

Condition of Test	Remarks
1. Field Strength	3 V/m (Test Level 2)
2. Radiated Signal	1 kHz, 80% AM, sine wave
3. Scanning Frequency	80 MHz– 6000 MHz
4. Scanning Frequency Step	1%
5. Dwell Time	3 Sec.

Test Data and Setup Photo**Environmental Conditions**

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Phil Zhu on 2017-10-15.

Test mode: Wifi Link& Bluetooth Link &Communication

Frequency Range (MHz)	Front Side (3 V/m)		Rear Side (3 V/m)		Left Side (3 V/m)		Right Side (3 V/m)	
	VERT	HORI	VERT	HORI	VERT	HORI	VERT	HORI
80-6000	A	A	A	A	A	A	A	A

Note: “A” stand for, during test, operate as intended No loss function, no degradation of performance, no unintentional transmissions and after test, no degradation of performance, no loss of function, no loss of stored data or user programmable functions.

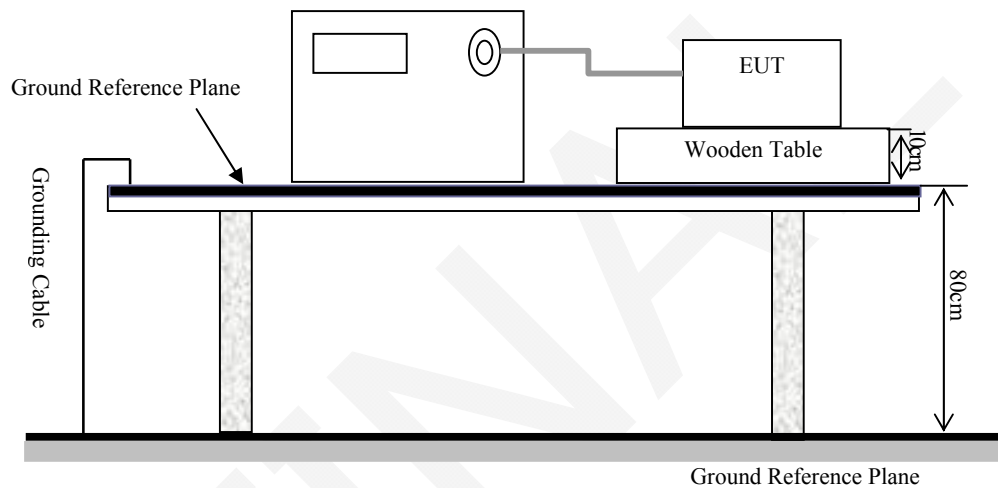
§7.2 - ELECTRICAL FAST TRANSIENT IMMUNITY

Test Equipment

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
EM TEST	Auto Transformer	MV2616	V0939105172	NCR	NCR
EM TEST	Ultra Compact Generator	UCS 500 N5	P1406130994	2017-07-24	2018-07-23

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements, traceable to National Primary Standards and International System of Units (SI).

Test System Setup



Test Standard

ETSI EN 301 489-1 V2.2.0 (2017-03)/ EN 61000-4-4: 2012
AC Mains: Test level 2 at 1 kV

Test Level

Open Circuit Output Test Voltage $\pm 10\%$				
Level	Power ports, earth port(PE)		Signal and control ports	
	Voltage(kV)	Repetition frequency(kHz)	Voltage(kV)	Repetition frequency(kHz)
1	0.5	5 or 100	0.25	5 or 100
2	1		0.5	
3	2		1	
4	4		2	
X	Special	Special	Special	Special

Performance Criterion: B

Test Procedure

The EUT was arranged for Power Line Coupling and for I/O Line Coupling through a capacitive clamp, where applicable. (Note: The I/O coupling test using a capacitive clamp is performed on the I/O interface cables that are longer in length than 3 meters.) A metal ground plane 2.4 meter by 2.0 meter was placed between the floor and the table and is connected to the earth by a 2.0 meter ground rod. The ground rod is connected to the test facility's electrical earth.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Phil Zhu on 2017-11-30.

Test mode: Wifi Link& Bluetooth Link & Communication

EN 61000-4-4 Test Points		Test Levels (kV) Repetition frequency(5kHz)							
		+0.5	-0.5	+1.0	-1.0	+2.0	-2.0	+4.0	-4.0
AC Mains Power Input Ports	L/N	A	A	A	A	/	/	/	/
	L/ PE	A	A	A	A	/	/	/	/
	N/PE	A	A	A	A	/	/	/	/
	L/N/PE	A	A	A	A				
Signal Port	/	/	/	/	/	/	/	/	/

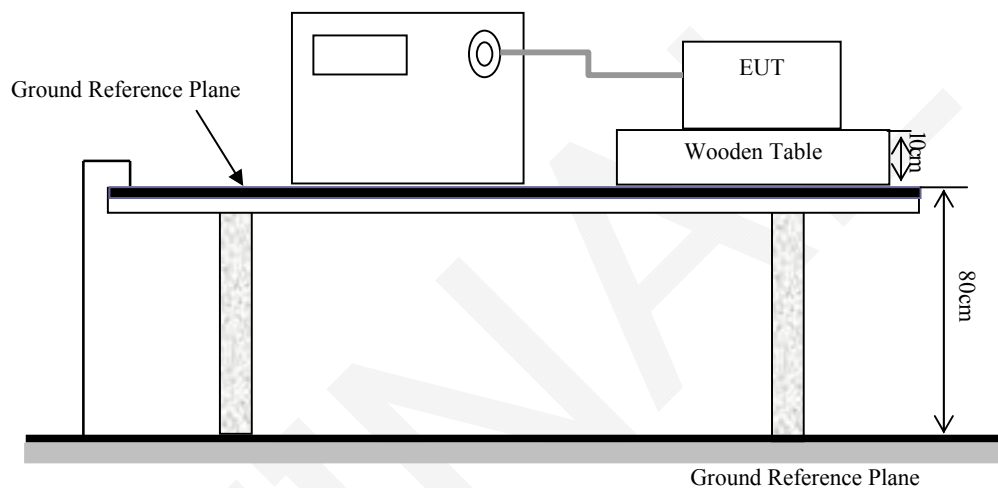
§7.2 - SURGES, LINE TO LINE AND LINE TO GROUND

Test Equipment

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
EM TEST	Auto Transformer	MV2616	V0939105172	N/A	N/A
EM TEST	Ultra Compact Generator	UCS500-N	P1406130994	2017-07-24	2018-07-23

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements, traceable to National Primary Standards and International System of Units (SI).

Test System Setup



Test Standard

ETSI EN 301 489-1 V2.2.0 (2017-03) / EN 61000-4-5: 2014
 AC Mains: L-N: Test level 2 at 1 kV
 AC Mains: L-PE;N-PE: Test level 3 at 2 kV

Test Level

Level	Open Circuit Output Test Voltage $\pm 10\%$	Performance Criterion	
		AC Mains	Signal Port
1	0.5 kV	B	B
2	1 kV	B	B
3	2 kV	B	B
4	4 kV	B	B
X	Special	/	/

Test Procedure

1. For line to line coupling mode, provide a 1.2/50 μ s voltage surge (at open-circuit condition) and an 8/20 μ s current surge into a short circuit.
2. For telecommunication port, provide a 10/700 μ s voltage surge (at open-circuit condition) and a 5/320 μ s current surge into a short circuit.
3. At least 5 positive and 5 negative (polarity) tests with a maximum 1/min repetition rate are conducted during test.
4. Different phase angles are done individually.
5. Record the EUT operating situation during compliance test and decide the EUT immunity criterion for above each test.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Phil Zhu on 2017-11-30.

Test mode: Wifi Link& Bluetooth Link & Communication

EN61000-4-5 Test Points		Test Levels (kV)							
		+0.5	-0.5	+1.0	-1.0	+2.0	-2.0	+4.0	-4.0
AC Mains power input ports	L+N	A	A	A	A	/	/	/	/
	L + PE	A	A	A	A	A	A	/	/
	N + PE	A	A	A	A	A	A	/	/

7.2 - RF COMMON MODE

Measurement Uncertainty

U_{lab} (measurement uncertainty of lab) and U_{EN} (measurement uncertainty of EN 61000-4-6) please refer to the following:

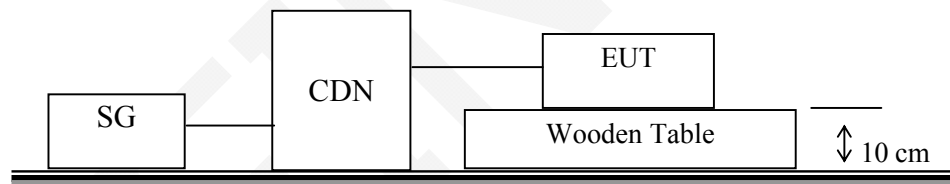
Parameter	U_{EN}	U_{lab}
CDN calibration process	1.27 dB	1.27 dB
CDN test process	1.36 dB	1.36 dB

Test Equipment

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Signal Generator	8648C	3537A01810	2017-07-24	2018-07-23
R&S	Power Amplifier	500A100M2	18117	NCR	NCR
Dressler	Attenuator	ATT 6/75	510020010004	NCR	NCR
EM TEST	CDN	CDN M2/M3	0707-13	2017-01-19	2018-01-19
EM TEST	CDN	CDN M3/32	510010320018	2017-01-19	2018-01-19

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test Setup



Test Standard

EN 301 489-1 V2.2.0(2017-03)/EN 61000-4-6: 2014

Test level 2 at 3 V (r.m.s.), 0.15 MHz ~ 80 MHz,

Test Level

Level	Voltage Level (r.m.s.) (U_0)
1	1
2	3
3	10
X	Special

Performance Criterion: A

Test Procedure

- 1) Let the EUT work in test mode and test it.
- 2) The EUT are placed on an insulating support 0.1m high above a ground reference plane. CDN (coupling and decoupling device) is placed on the ground plane about 0.3m from EUT. Cables between CDN and EUT are as short as possible, and their height above the ground reference plane shall be between 30 and 50mm (where possible).
- 3) The disturbance signal described below is injected to EUT through CDN.
- 4) The EUT operates within its operational mode(s) under intended climatic conditions after power on.
- 5) The frequency range is swept from 150 kHz to 80 MHz using 3V signal level, and with the disturbance signal 80% amplitude modulated with a 1 kHz sine wave.
- 6) The rate of sweep shall not exceed 1.5×10^{-3} decades/s. Where the frequency is swept incrementally, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value.
- 7) Recording the EUT operating situation during compliance testing and decide the EUT immunity criterion.

Test Data

Environmental Conditions

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

* The testing was performed by Phil Zhu on 2017-11-30

Test mode: Wifi Link & Bluetooth Link & Communication

EN61000-4-6 Test Ports	Test Equipment	Frequency Range (MHz)	Voltage Level (e.m.f.) U_0			
			1V	3V	10V	X
AC mains power input ports	M2	0.15-80	/	/	/	/
	M3	0.15-80	/	A	/	/

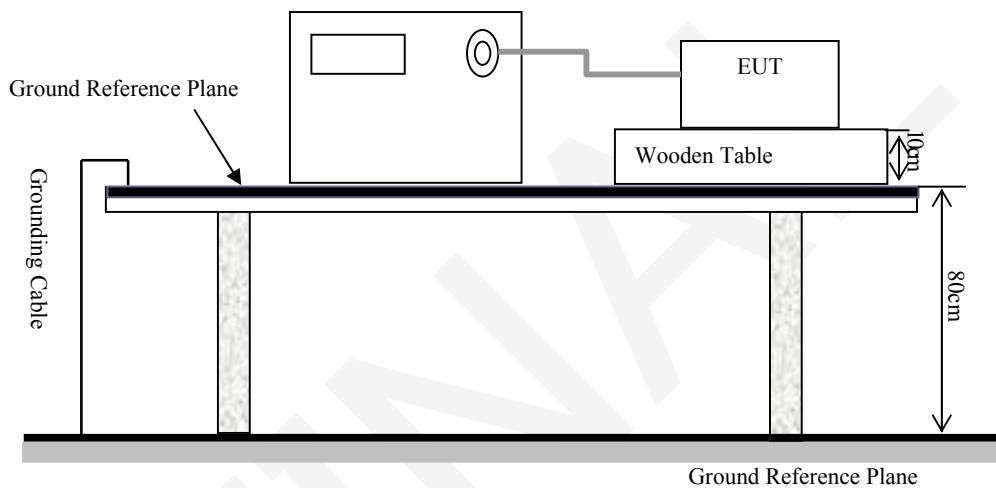
§7.2 - VOLTAGE DIPS AND INTERRUPTIONS IMMUNITY TEST

Test Equipment

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
EM TEST	Auto Transformer	MV2616	V0939105172	N/A	N/A
EM TEST	Ultra Compact Generator	UCS500-N5	P1406130994	2017-07-24	2018-07-23

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements, traceable to National Primary Standards and International System of Units (SI).

Test Setup



Test Standard

ETSI EN 301 489-1 V2.2.0 (2017-03) / EN 61000-4-11: 2004
Test levels and Performance Criterion

Test Level

Test Level	Test Level	Td (ms)	Performance criterion:
1	Voltage dip : 0% residual voltage	10	B
2	Voltage dip : 0% residual voltage	20	B
3	Voltage dip : 70% residual voltage	500	B
4	Voltage interruptions : 0% residual voltage	5000	B

Test Procedure

1. The interruption is introduced at selected phase angles with specified duration.
2. Record any degradation of performance.

Test Data**Environmental Conditions**

Temperature:	19 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Phil Zhu on 2017-11-30.

Test mode: Wifi Link& Bluetooth Link &Communication

Test Level	Td (ms)	Phase Angle	Result
Voltage dip : 0% residual voltage	10	0°/90 ° /180 ° /270 °	A
Voltage dip : 0% residual voltage	20	0° /90° /180° /270°	A
Voltage dip : 70% residual voltage	500	0° /90° /180°/270°	A
Voltage interruptions : 0% residual voltage	5000	0° /90° /180° /270°	A

EXHIBIT A - EUT PHOTOGRAPHS

EUT – Top View



EUT – Bottom View



EUT – Front View



EUT – Rear View



EUT – Left View



EUT – Right View



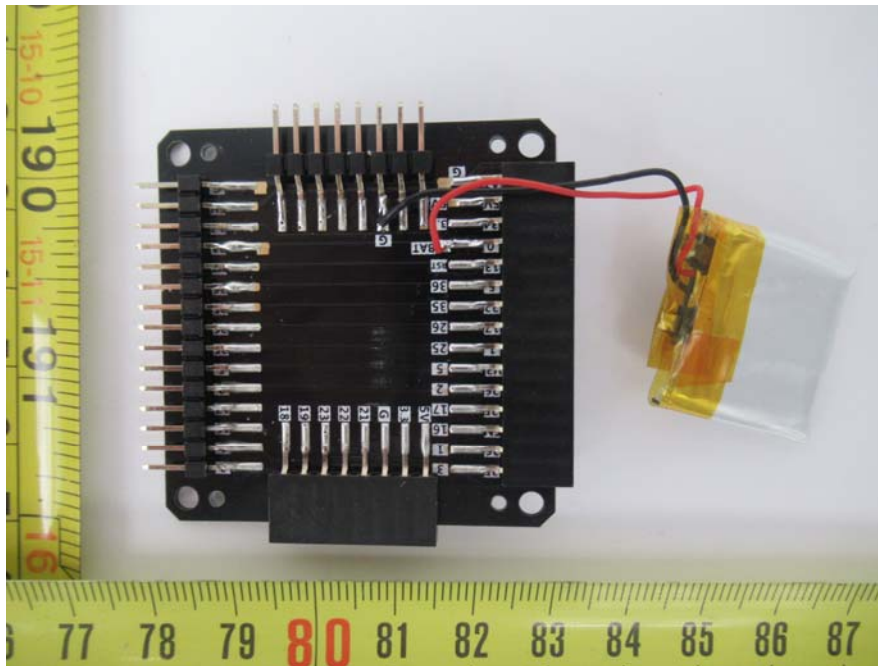
EUT – Cover off View-1



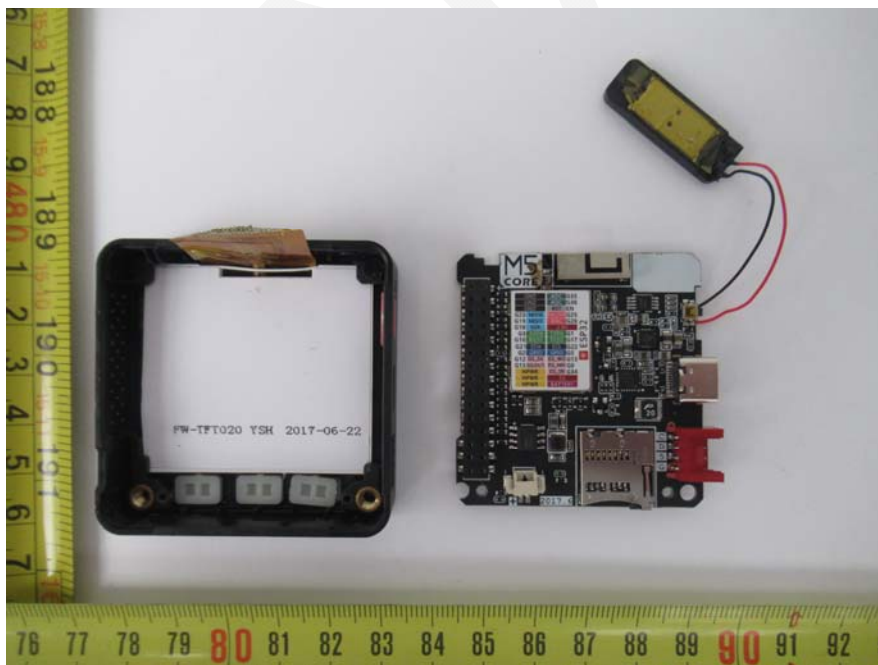
EUT – Cover off View-2



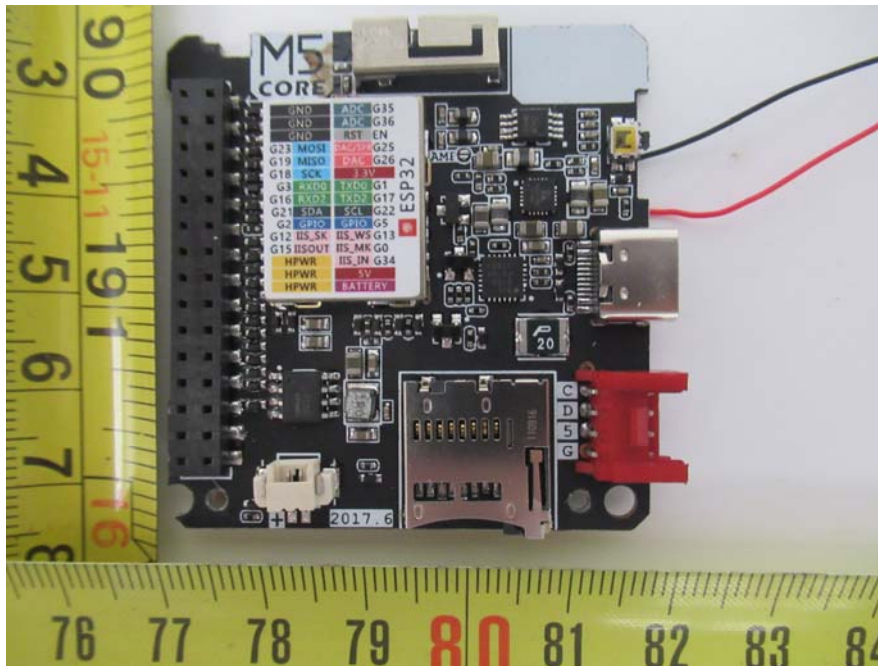
EUT – Cover off View-3



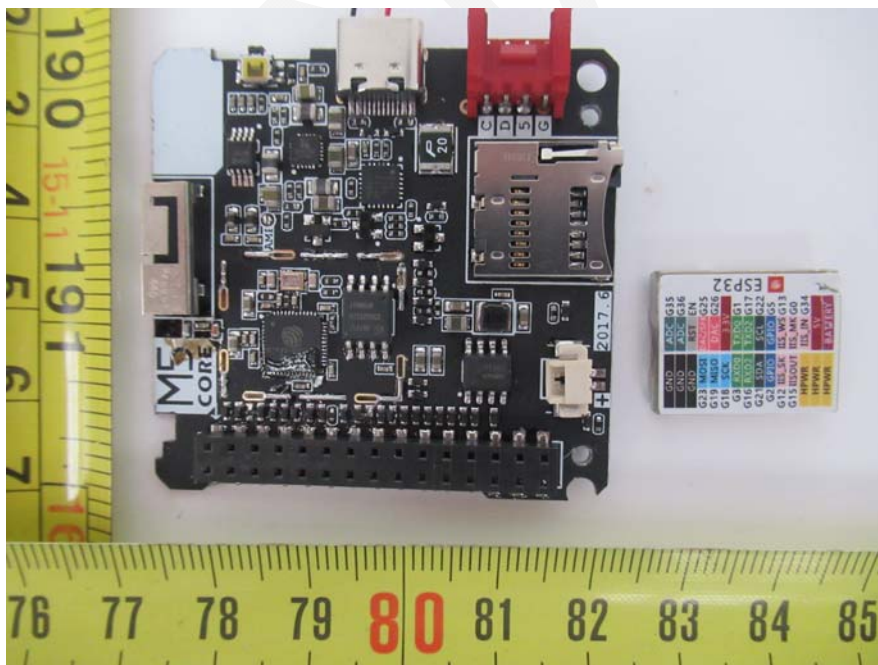
EUT – Cover off View-4



EUT – Main Board Top View



EUT – Main Board Top Shielding off View



EUT – Main Board Bottom View

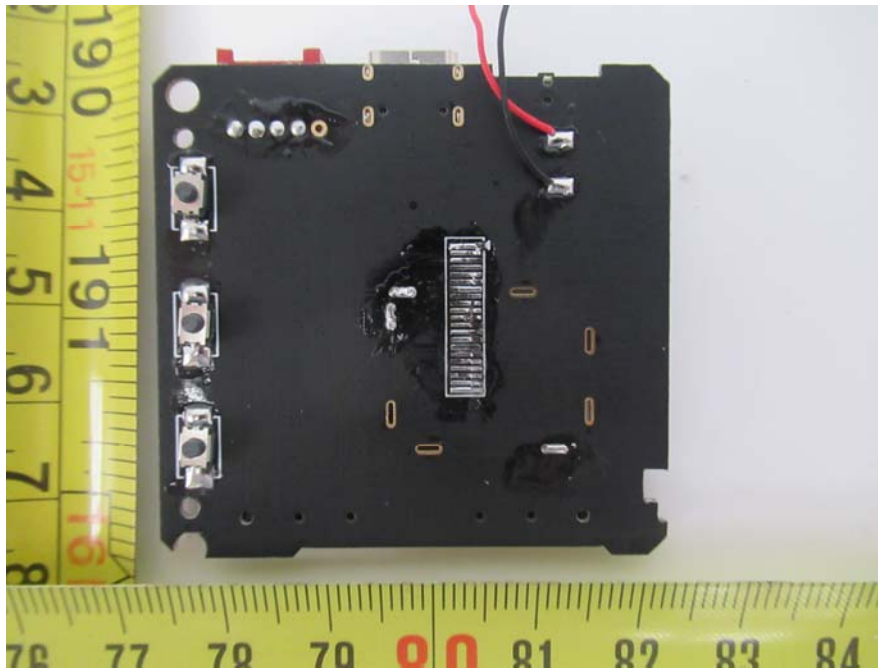
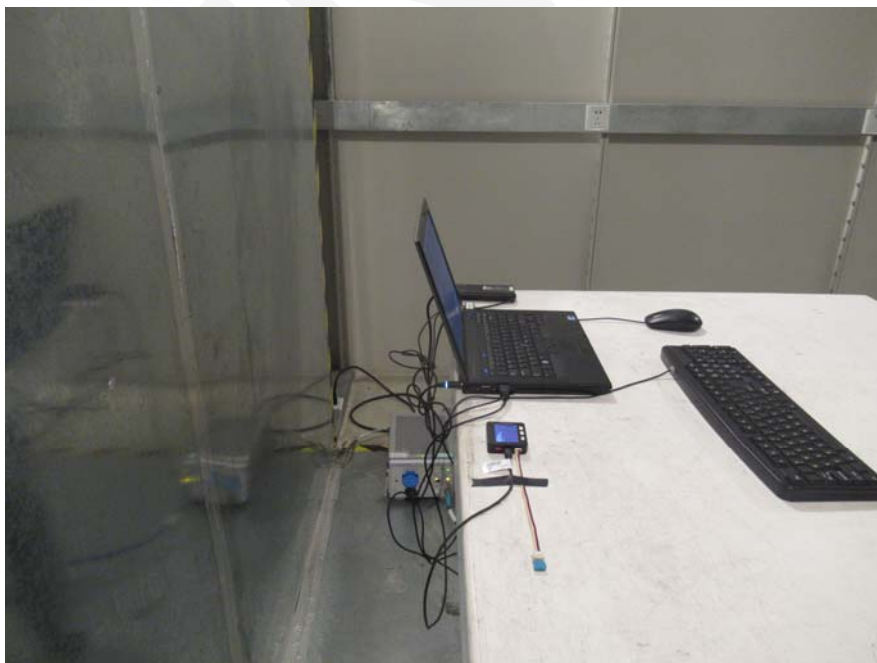


EXHIBIT B – TEST SETUP PHOTOGRAPHS

Conducted Emissions- Front View



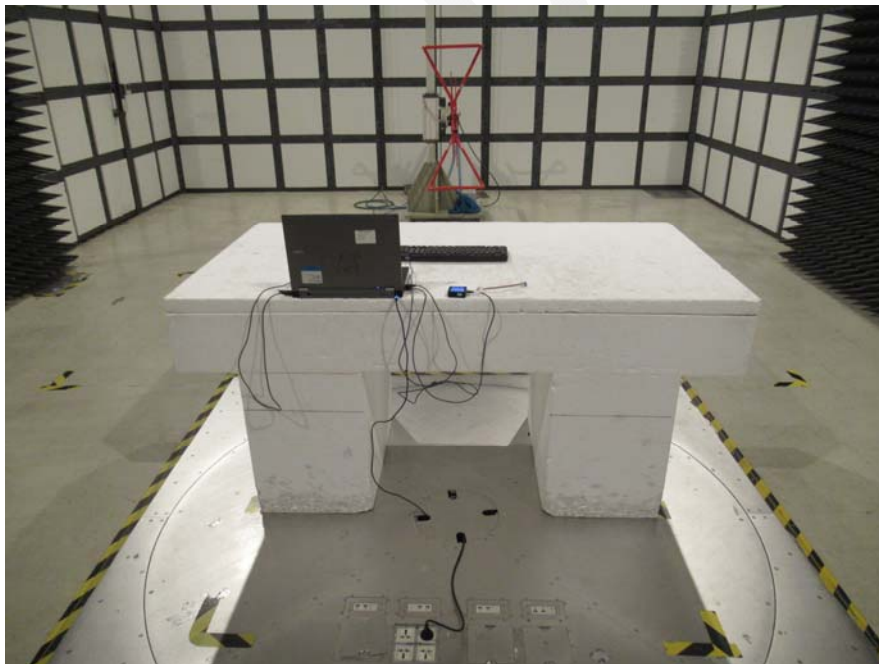
Conducted Emissions- Rear View



Radiated Emissions- Front View (Below 1GHz)



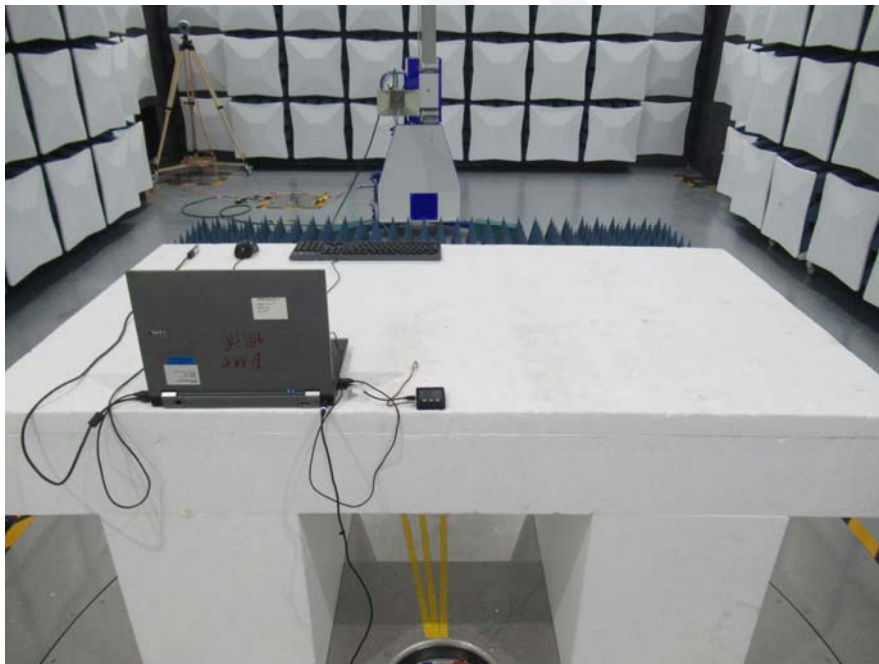
Radiated Emissions- Rear View (Below 1 GHz)



Radiated Emissions- Front View (Above 1 GHz)



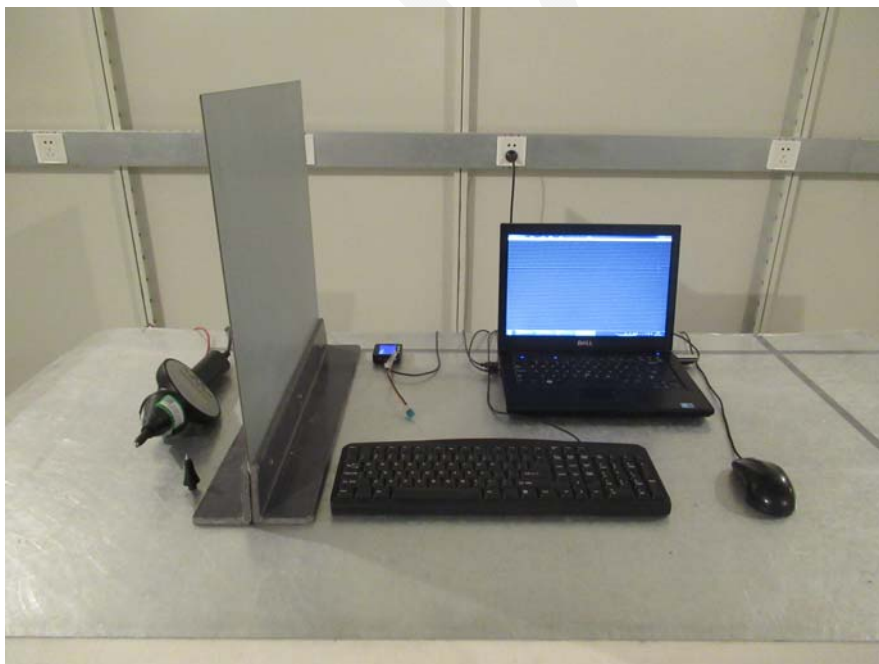
Radiated Emissions- Rear View (Above 1 GHz)



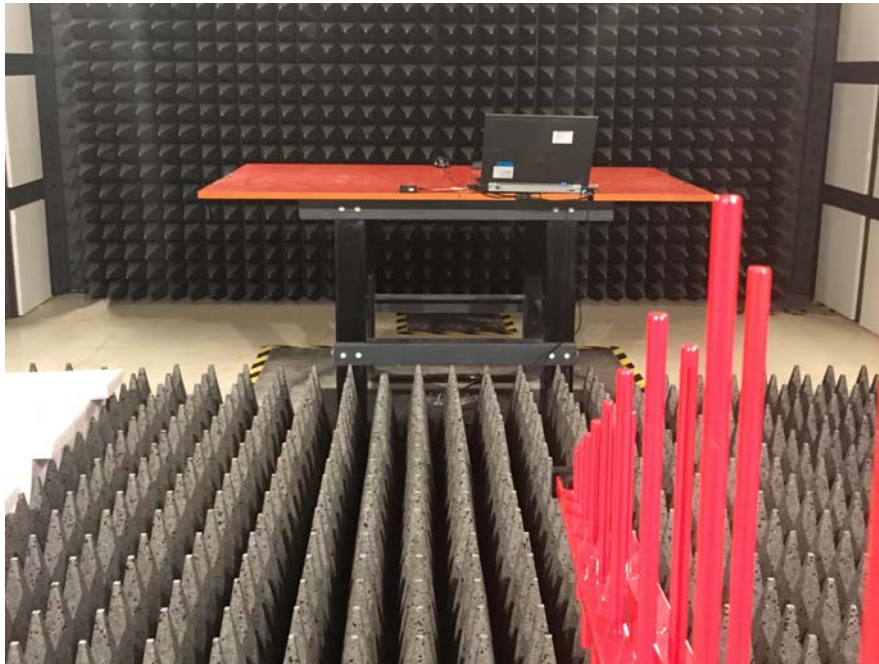
Flicker Test Setup Photo



ESD Test Setup Photo



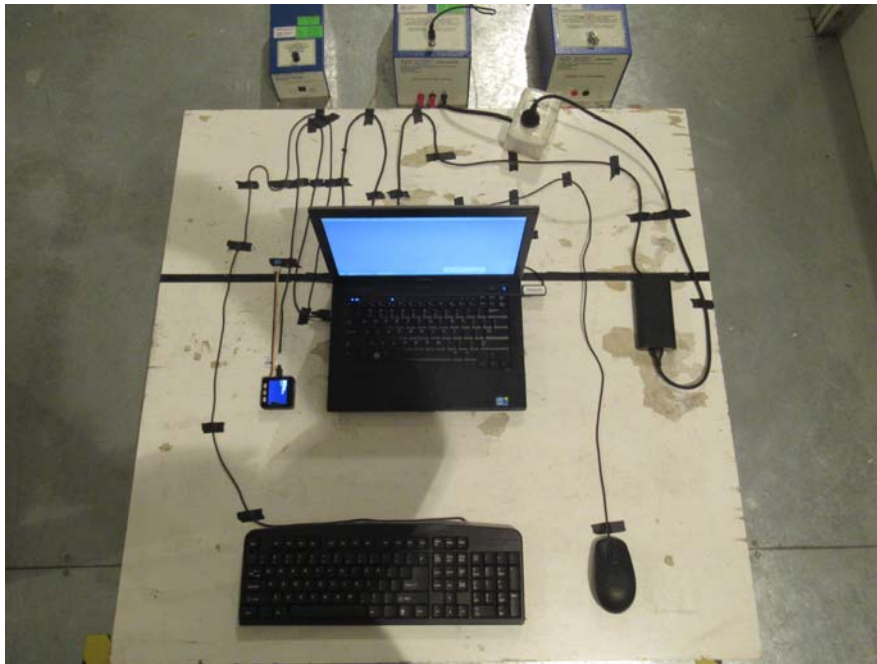
RS Test Setup photo (Below 1GHz)



RS Test Setup photo (Above 1GHz)



CS Test Setup photo



DIPS Test Setup Photo



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