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# TEST REPORT

**Product Name** ..... : Cube

**Trademark** ..... : AQara

**Model/Type reference** ..... : MFKZQ01LM

**Test Standards** ..... : **Draft ETSI EN 301 489-1 V2.2.0 (2017-03)**  
: **Draft ETSI EN 301 489-17 V3.2.0 (2017-03)**

**Applicant** ..... : Lumi United Technology Co., Ltd.

**Address of applicant** ..... : 8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave,  
Taoyuan Residential District, Nanshan District, Shenzhen, China.

**Date of Receipt** ..... : Mar. 16, 2018

**Date of Test Date**..... : Mar. 17, 2018 to Mar. 20, 2018

**Date of Issue**..... : Mar. 21, 2018

|                    |               |
|--------------------|---------------|
| <b>Test result</b> | <b>Pass *</b> |
|--------------------|---------------|

\* In the configuration tested, the EUT complied with the standards specified above



The CE mark as shown above can be used, under the responsibility of the manufacturer, after completion of an EC Declaration of Conformity and compliance with all relevant EC Directives. The protection requirements with respect to electromagnetic compatibility contained in Directive 2014/53/EU are considered.

| GENERAL DESCRIPTION OF EUT |   |
|----------------------------|---|
| Equipment:                 | Cube  |
| Model Name:                | MFKZQ01LM   |
| Adding Model(s)            | /   |
| Model difference           | /   |
| Manufacturer:              | Lumi United Technology Co., Ltd.  |
| Manufacturer Address:      | 8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China. |
| Power Rating:              | Input: DC 3V,25mA. (This is powered by the CR2032 battery)  |

Compiled By:



(Zaki Zhang)

Reviewed By:



(Gavin Shi)

Approved By:



(Walter Chen)

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# 1. SUMMARY

## 1.1. Test Standards

**Draft ETSI EN 301 489-1 V2.2.0 (2017-03)**– ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU

**Draft ETSI EN 301 489-17 V3.2.0 (2017-03)**-ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU

## 1.2. Test Description

| ETSI EN 301 489-1/ requirements                  |     |      |
|--|-----|------|
| Conducted Emission( AC Mains)                    | 7.1 | N/A  |
| Radiated Emission                                | 7.1 | PASS |
| Conducted Emission<br>( Telecommunication Ports) | 7.1 | N/A  |
| Harmonic Current Emissions                       | 7.1 | N/A  |
| Voltage Fluctuations and Flicker                 | 7.1 | N/A  |
| Electrostatic Discharge                          | 7.2 | PASS |
| RF Electromagnetic Field                         | 7.2 | PASS |
| Fast Transients Common Mode                      | 7.2 | N/A  |
| Surges   | 7.2 | N/A  |
| RF Common Mode 0,15 MHz to 80 MHz                | 7.2 | N/A  |
| Transients and Surges                            | 7.2 | N/A  |
| Voltage Dips and Interruptions                   | 7.2 | N/A  |

Remark: (1)The measurement uncertainty is not included in the test result.  
(2) "N/A" does not tested because the EUT battery powered.

### 1.3. Test Facility

#### 1.3.1 Address of the test laboratory

**Shenzhen General Testing & Inspection Technology Co., Ltd.**

Add: 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China

#### 1.3.2 Laboratory accreditation

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

##### IC Registration No.: 9783A

The 3m alternate test site of Shenzhen GTI Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

##### FCC-Registration No.: 951311

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

### 1.4. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements and is documented in the Shenzhen General Testing & Inspection Technology Co., Ltd quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for General Testing & Inspection laboratory is reported:

#### A. Conducted Measurement:

| Test Site | Method | Measurement Frequency Range | U , (dB) | NOTE |
|-----------|--------|-----------------------------|----------|------|
| C01       | ANSI   | 150 KHz ~ 30MHz             | 3.2      |      |

#### B. Radiated Measurement:

| Test              | Range      | Measurement Uncertainty | Notes |
|-------------------|------------|-------------------------|-------|
| Radiated Emission | 30~1000MHz | 4.7 dB                  | (1)   |
| Radiated Emission | 1~18GHz    | 5.0 dB                  | (1)   |

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

## 2. GENERAL INFORMATION

### 2.1. General Description of EUT

|                       |  |
|-----------------------|--|
| Product Name:         | Cube   |
| Model/Type reference: | MFKZQ01LM  |
| Adding models:        | /  |
| Power supply:         | Input: DC 3V,25mA. (This is powered by the CR2032 battery) |
| Hardware version:     | V1.0.5   |
| Software version:     | V1.0.1   |
| <b>Zigbee</b>         |  |
| Supported type:       | ZigBee IEEE 802.15.4                                       |
| Modulation:           | O-QPSK   |
| Operation frequency:  | 2405-2480MHz   |
| Channel number:       | 16   |
| Channel separation:   | 5 MHz  |
| Antenna type:         | PCB Antenna  |
| Antenna gain:         | 2.0dBi   |

## 2.2. Description of Test Modes

As the function of the EUT, test mode selected to test as below to conform this standard:

| Pretest Mode | Description                |
|--------------|----------------------------|
| Mode 1       | Zigbee connect hub working |

Pre-scan above all test mode, found below test mode which it was worse case mode.

| Test item                | Test mode (Worse case operation mode) |
|--------------------------|---------------------------------------|
| Radiated emission        | Mode 1                                |
| Electrostatic Discharge  | Mode 1                                |
| RF Electromagnetic Field | Mode 1                                |



### 2.3. Measurement Instruments List

| Conducted Emission |                   |              |           |            |                  |
|--------------------|-------------------|--------------|-----------|------------|------------------|
| Item               | Test Equipment    | Manufacturer | Model No. | Serial No. | Calibrated until |
| 1                  | LISN              | R&S          | ENV216    | 101112     | Jan. 04, 2019    |
| 2                  | LISN              | R&S          | ENV216    | 101113     | Jan. 04, 2019    |
| 3                  | EMI Test Receiver | R&S          | ESCI      | 100920     | Jan. 04, 2019    |
| 4                  | ISN CAT6          | Schwarzbeck  | NTFM 8158 | 8158-0046  | Jan. 04, 2019    |

| Radiated Emission |                         |              |            |            |                  |
|-------------------|-------------------------|--------------|------------|------------|------------------|
| Item              | Test Equipment          | Manufacturer | Model No.  | Serial No. | Calibrated until |
| 1                 | Bilog Antenna           | Schwarzbeck  | CBL6141A   | 4180       | Jan. 04, 2019    |
| 2                 | Spectrum Analyzer       | R&S          | FSU26      | 100105     | Jan. 04, 2019    |
| 3                 | Horn Antenna            | Schwarzbeck  | BBHA 9120D | 647        | Jan. 04, 2019    |
| 4                 | Low Noise Pre-Amplifier | HP           | 8447D      | 1937A03050 | Jan. 04, 2019    |
| 5                 | Low Noise Pre-Amplifier | EMCI         | EMC051835  | 980075     | Jan. 04, 2019    |
| 6                 | Test Receiver           | R&S          | ESCI7      | 100967     | Jan. 04, 2019    |
| 7                 | Antenna Mast            | UC           | UC3000     | N/A        | N/A              |
| 8                 | Turn Table              | UC           | UC3000     | N/A        | N/A              |

| Harmonic Current Emissions & Voltage Fluctuations and Flicker |                              |              |           |              |                  |
|---|------------------------------|--------------|-----------|--------------|------------------|
| Item  | Test Equipment               | Manufacturer | Model No. | Serial No.   | Calibrated until |
| 1   | Universal Power Analyzer     | Voltech      | PM6000    | 200006700723 | Jan. 04, 2019    |
| 2   | Programmable AC Power Source | Mtoni        | PHF1530   | MTPS001      | Jan. 04, 2019    |

| Electrostatic Discharge |                |              |           |             |                  |
|-------------------------|----------------|--------------|-----------|-------------|------------------|
| Item                    | Test Equipment | Manufacturer | Model No. | Serial No.  | Calibrated until |
| 1                       | ESD Simulator  | EM TEST      | DITO      | V1113109156 | Jan. 04, 2019    |

| RF Electromagnetic Field |                               |                 |                       |            |                  |
|--------------------------|-------------------------------|-----------------|-----------------------|------------|------------------|
| Item                     | Test Equipment                | Manufacturer    | Model No.             | Serial No. | Calibrated until |
| 1                        | Integrated Measurement System | R&S             | IMS                   | 100008     | Jan. 04, 2019    |
| 2                        | Field probe                   | ETS             | HI-6005               | 89587      | Jan. 04, 2019    |
| 3                        | RS Antenna                    | R&S             | HL046E                | 100037     | Jan. 04, 2019    |
| 4                        | POWER AMPLIFIER               | BONN ELEKTRONIK | BLWA 0830-160/100/40D | 076788     | Jan. 04, 2019    |

| Fast Transients Common Mode |                                     |              |           |            |                  |
|-----------------------------|-------------------------------------|--------------|-----------|------------|------------------|
| Item                        | Test Equipment                      | Manufacturer | Model No. | Serial No. | Calibrated until |
| 1                           | Electrical fast transient generator | 3ctest       | EFT-4003G | EC0471140  | Jan. 04, 2019    |
| 2                           | Coupling/Decoupling Clamp           | 3ctest       | EFTC      | EC0441141  | Jan. 04, 2019    |



| Surges |                         |              |             |            |                  |
|--------|-------------------------|--------------|-------------|------------|------------------|
| Item   | Test Equipment          | Manufacturer | Model No.   | Serial No. | Calibrated until |
| 1      | Surge generator         | 3ctest       | SG-5006G    | EC5581149  | Jan. 04, 2019    |
| 2      | Surge CDN               | 3ctest       | SGN-20G     | EC5551128  | Jan. 04, 2019    |
| 3      | Network Surge Generator | 3ctest       | CWS 600T    | ES0311603  | Jan. 04, 2019    |
| 4      | Network Surge CDN       | 3ctest       | CDN 405T8AI | ES2731605  | Jan. 04, 2019    |

| RF Common Mode |                                    |              |           |               |                  |
|----------------|------------------------------------|--------------|-----------|---------------|------------------|
| Item           | Test Equipment                     | Manufacturer | Model No. | Serial No.    | Calibrated until |
| 1              | Conducted Disturbances Test System | Schloder     | CDG 6000  | 126A1266/2013 | Jan. 04, 2019    |
| 2              | Coupling/Decoupling                | Schloder     | CDN-M2+3  | A2210251/2013 | Jan. 04, 2019    |
| 3              | Coupling and Decoupling Network    | TESEQ GmbH   | CDN T8-10 | 45011         | Jan. 04, 2019    |

| Voltage dips and interruptions |                               |              |           |            |                  |
|--------------------------------|-------------------------------|--------------|-----------|------------|------------------|
| Item                           | Test Equipment                | Manufacturer | Model No. | Serial No. | Calibrated until |
| 1                              | Voltage dips and up generator | 3ctest       | VDG-1105G | EC0171116  | Jan. 04, 2019    |

## 2.4. DESCRIPTION TEST PERIPHERAL AND EUT PERIPHERAL

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Note |
|------|-----------|-----------|----------------|------------|------|
| 1    | Hub       | AQara     | ZHWG11LM       | /          | /    |
|      |           |           |                |            |      |

| Item | Shielded Type | Ferrite Core | Length | Note |
|------|---------------|--------------|--------|------|
|      |               |              |        |      |
|      |               |              |        |      |

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
- (3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.

## 2.5. EMC EMISSION TEST

### 2.6. Conducted Emission (AC Mains)

#### LIMIT

#### POWER LINE CONDUCTED EMISSION (Frequency Range 150KHz-30MHz)

| FREQUENCY (MHz) | Class A (dBuV) |         | Class B (dBuV) |           |
|-----------------|----------------|---------|----------------|-----------|
|                 | Quasi-peak     | Average | Quasi-peak     | Average   |
| 0.15 -0.5       | 79.00          | 66.00   | 66 - 56 *      | 56 - 46 * |
| 0.50 -5.0       | 73.00          | 60.00   | 56.00          | 46.00     |
| 5.0 -30.0       | 73.00          | 60.00   | 60.00          | 50.00     |

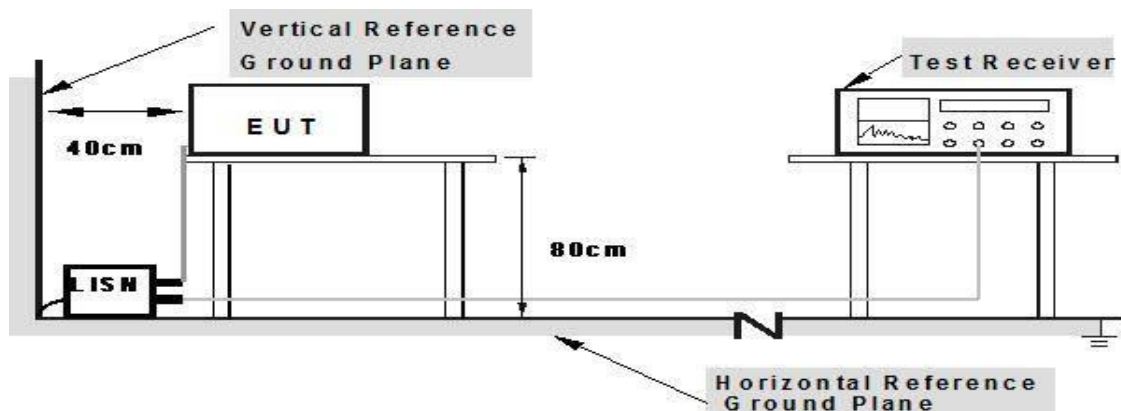
Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " \* " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

#### TEST PROCEDURE

- a) The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- d) LISN at least 80 cm from nearest part of EUT chassis.
- e) For the actual test configuration, please refer to the related Item –EUT Test Photos.

#### TEST SETUP



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

## TEST RESULTS

The test is not applicable in this Test Report.

## 2.7. Conducted Emission (Telecommunication Ports)

### LIMIT

#### POWER LINE CONDUCTED EMISSION (Frequency Range 150KHz-30MHz)

| FREQUENCY (MHz) | Class A (dBuV) |          | Class B (dBuV) |          |
|-----------------|----------------|----------|----------------|----------|
|                 | Quasi-peak     | Average  | Quasi-peak     | Average  |
| 0.15 -0.5       | 97 to 87       | 84 to 74 | 84 to 74       | 74 to 64 |
| 0.5 -30.0       | 87             | 74       | 74             | 64       |

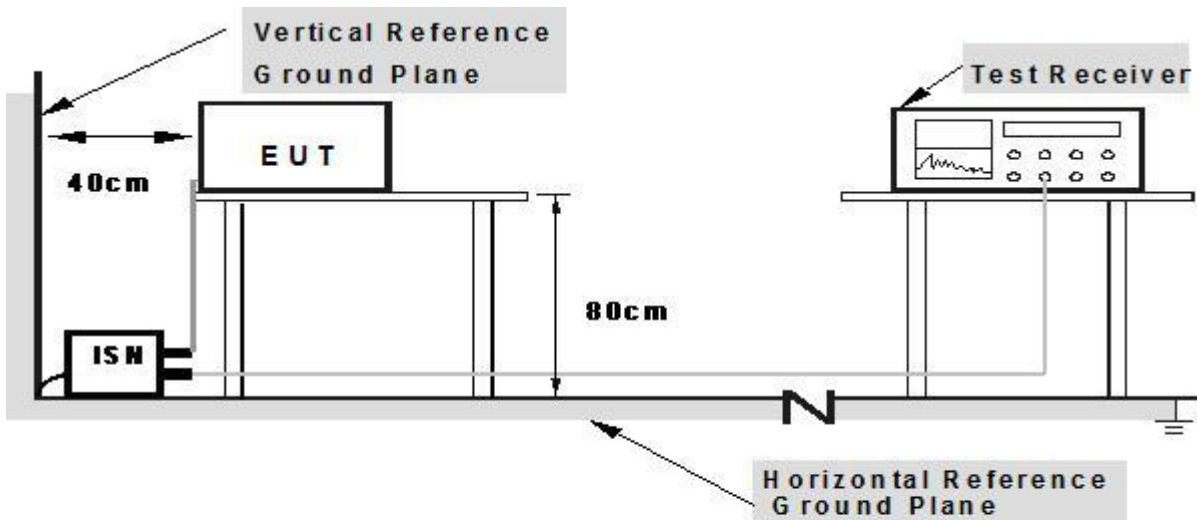
NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2 The current and voltage disturbance limits are derived for use with an impedance stabilization network

(ISN) which presents a common mode (asymmetric mode) impedance of  $150 \Omega$  to the telecommunication port under test (conversion factor is  $20 \log_{10} 150 / 1 = 44 \text{ dB}$ ).

### TEST PROCEDURE

- The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.



**Note: 1. Support units were connected to second LISN.**

**2. Both of ISM (LISN) are 80 cm from EUT and at least 80 from other units and other metal planes**

## TEST RESULTS

The test is not applicable in this Test Report .



## 2.8. Radiated Emission

### LIMITS

#### LIMITS OF RADIATED EMISSION MEASUREMENT (Below 1000MHz)

| FREQUENCY (MHz) | Class A (at 10m) | Class B (at 10m) |
|-----------------|------------------|------------------|
|                 | dBuV/m           | dBuV/m           |
| 30 – 230        | 40               | 30               |
| 230 – 1000      | 47               | 37               |

#### LIMITS OF RADIATED EMISSION MEASUREMENT(Above 1000MHz)

| FREQUENCY (MHz) | Class A (at 10m) dBuV/m |     | Class B (at 10m) dBuV/m |     |
|-----------------|-------------------------|-----|-------------------------|-----|
|                 | Peak                    | Avg | Peak                    | Avg |
| 1000-3000       | 76                      | 56  | 70                      | 50  |
| 3000-6000       | 80                      | 60  | 74                      | 54  |

Notes:

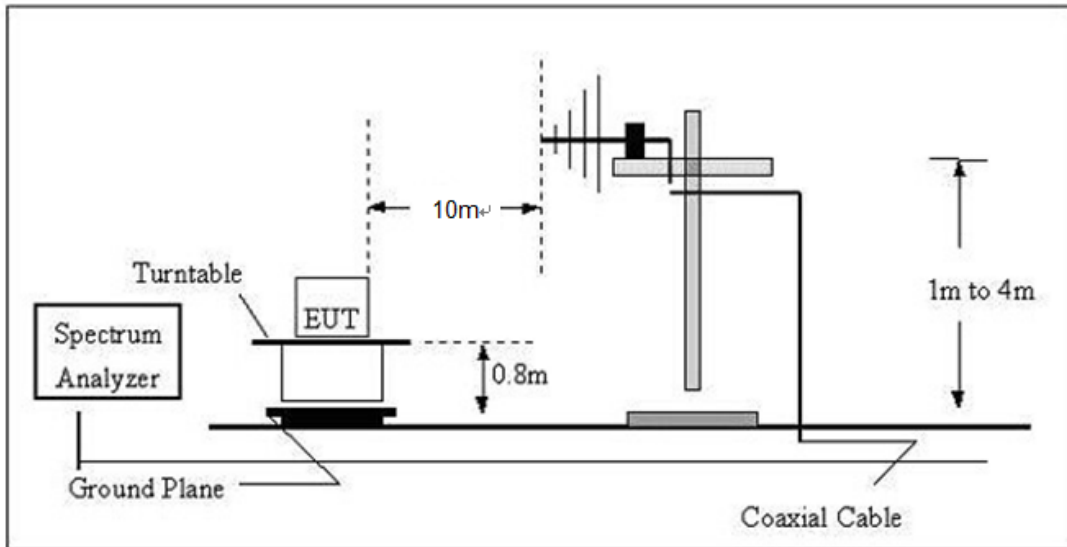
- 1) The limit for radiated test was performed according to as following:  
CISPR 22/ FCC PART 15B /ICES-003.
- 2) The tighter limit applies at the band edges.
- 3) Emission level (dBuV/m)=20log Emission level (uV/m).

### TEST PROCEDURE

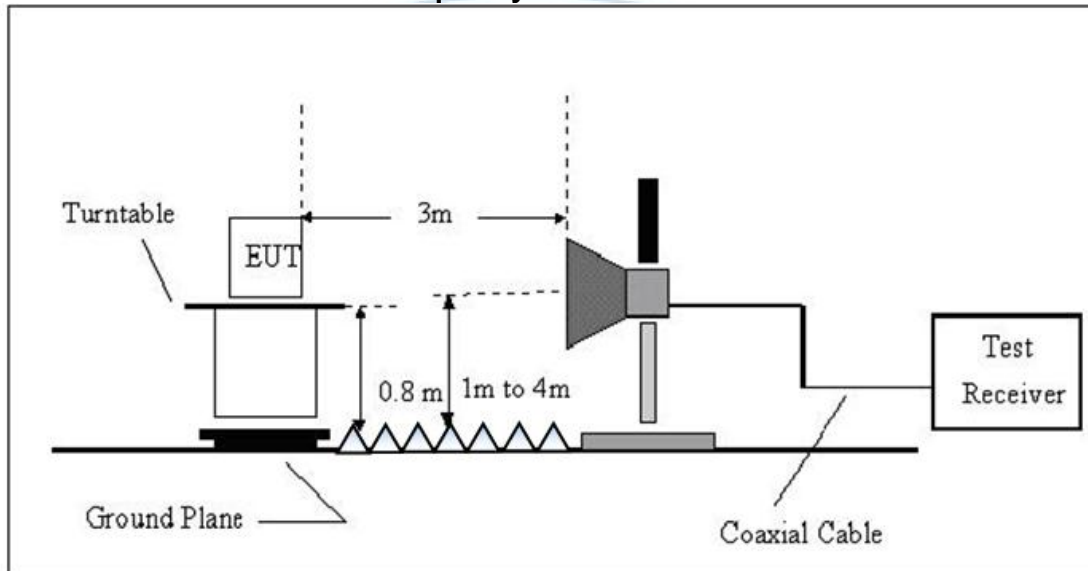
- a) The measuring distance of at 10 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- b) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- c) The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- e) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- f) For the actual test configuration, please refer to the related Item –EUT Test Photos.

### TEST SETUP

#### (A) Radiated Emission Test Set-Up Frequency Below 1 GHz

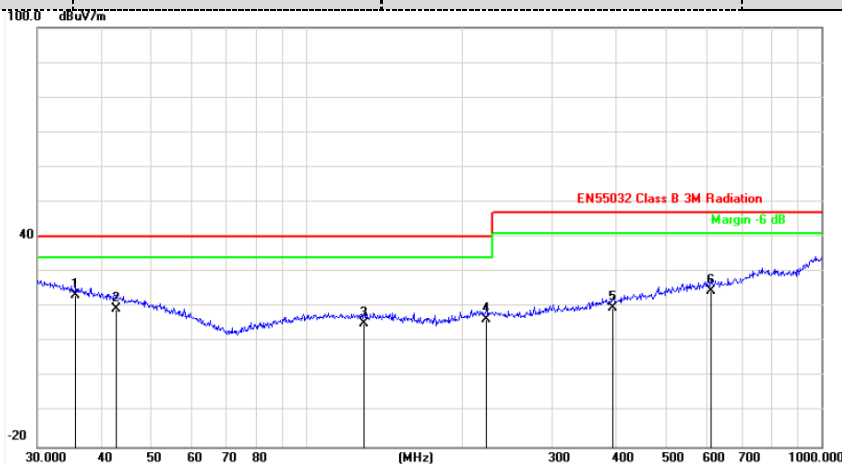


#### (B) Radiated Emission Test Set-Up Frequency above 1GHz

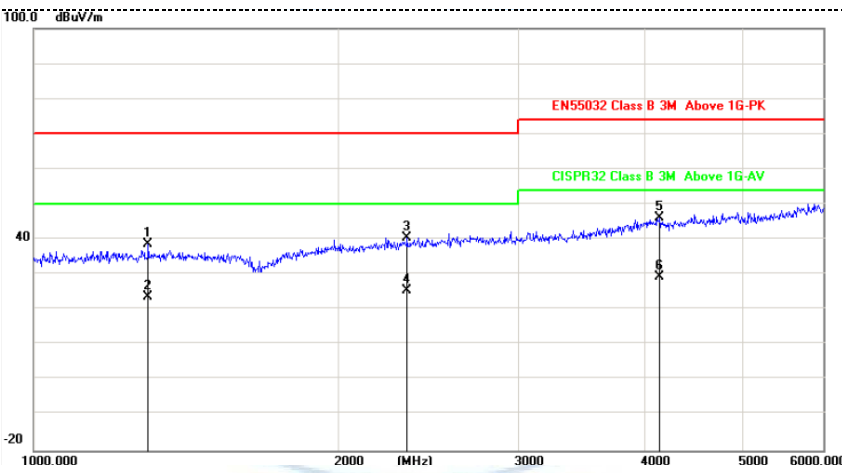


**TEST RESULTS**

|                   |               |                      |                   |
|-------------------|---------------|----------------------|-------------------|
| <b>Test mode:</b> | <b>Mode 1</b> | <b>Polarization:</b> | <b>Horizontal</b> |
|-------------------|---------------|----------------------|-------------------|



| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Azimuth ( ) | P/F | Remark |
|-----|-----------------|---------------|----------------|----------------|----------------|-------------|----------|-------------|-------------|-----|--------|
| 1   | 35.6238         | -6.15         | 29.55          | 23.40          | 40.00          | -16.60      | QP       |             |             | P   |        |
| 2   | 42.5998         | -8.22         | 27.82          | 19.60          | 40.00          | -20.40      | QP       |             |             | P   |        |
| 3   | 129.4677        | -13.58        | 28.78          | 15.20          | 40.00          | -24.80      | QP       |             |             | P   |        |
| 4   | 223.7333        | -12.29        | 28.59          | 16.30          | 40.00          | -23.70      | QP       |             |             | P   |        |
| 5   | 393.4723        | -8.81         | 28.51          | 19.70          | 47.00          | -27.30      | QP       |             |             | P   |        |
| 6   | 609.9215        | -5.02         | 29.52          | 24.50          | 47.00          | -22.50      | QP       |             |             | P   |        |



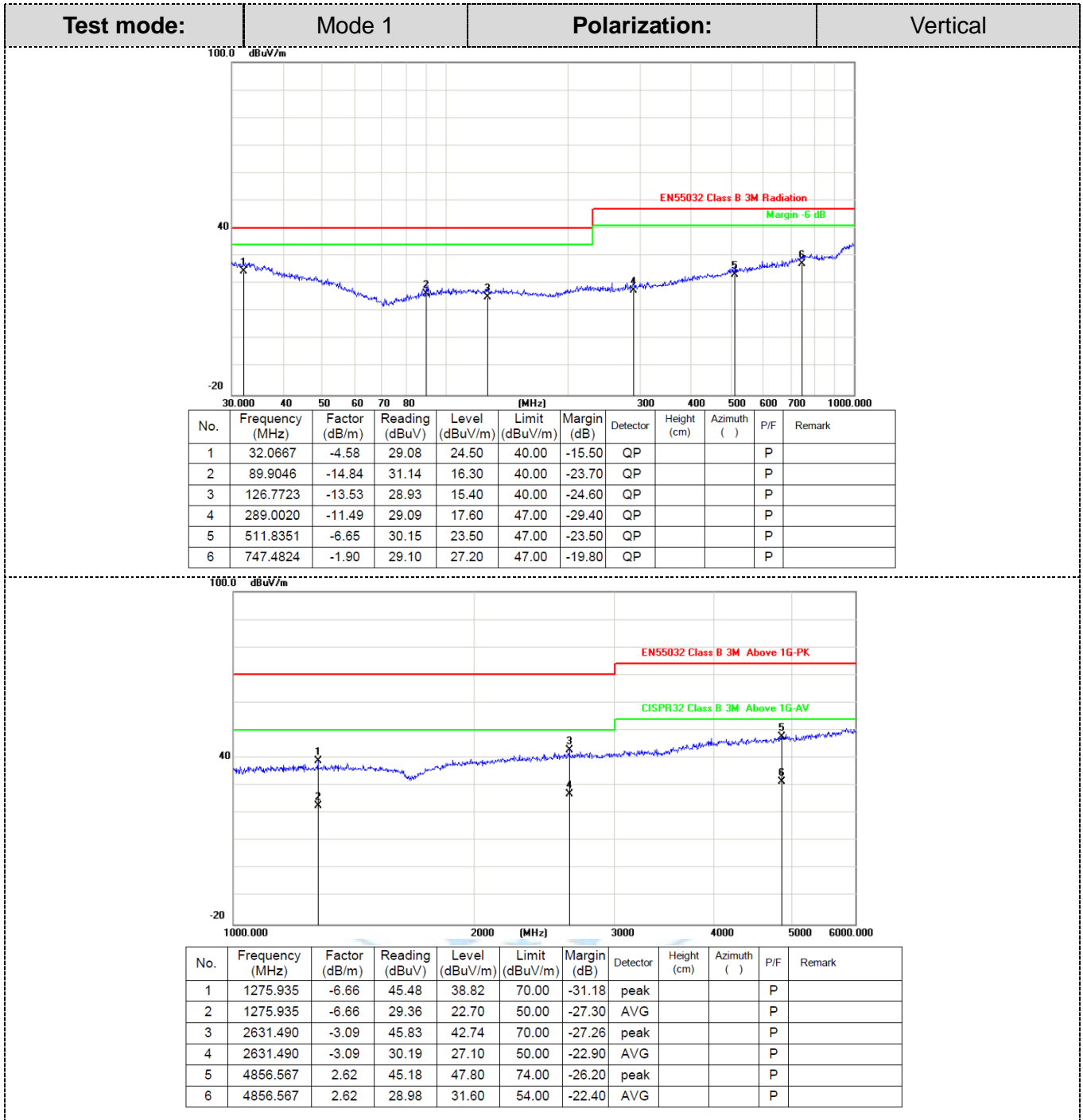
| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Azimuth ( ) | P/F | Remark |
|-----|-----------------|---------------|----------------|----------------|----------------|-------------|----------|-------------|-------------|-----|--------|
| 1   | 1296.677        | -6.58         | 45.26          | 38.68          | 70.00          | -31.32      | peak     |             |             | P   |        |
| 2   | 1296.677        | -6.58         | 30.18          | 23.60          | 50.00          | -26.40      | AVG      |             |             | P   |        |
| 3   | 2333.810        | -3.76         | 44.18          | 40.42          | 70.00          | -29.58      | peak     |             |             | P   |        |
| 4   | 2333.810        | -3.76         | 29.16          | 25.40          | 50.00          | -24.60      | AVG      |             |             | P   |        |
| 5   | 4140.702        | 1.27          | 44.96          | 46.23          | 74.00          | -27.77      | peak     |             |             | P   |        |
| 6   | 4140.702        | 1.27          | 28.03          | 29.30          | 54.00          | -24.70      | AVG      |             |             | P   |        |

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For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : [yz.cncaic.cn](http://yz.cncaic.cn)



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For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : [yz.cncaic.cn](http://yz.cncaic.cn)



## 2.9. Harmonic Current Emissions

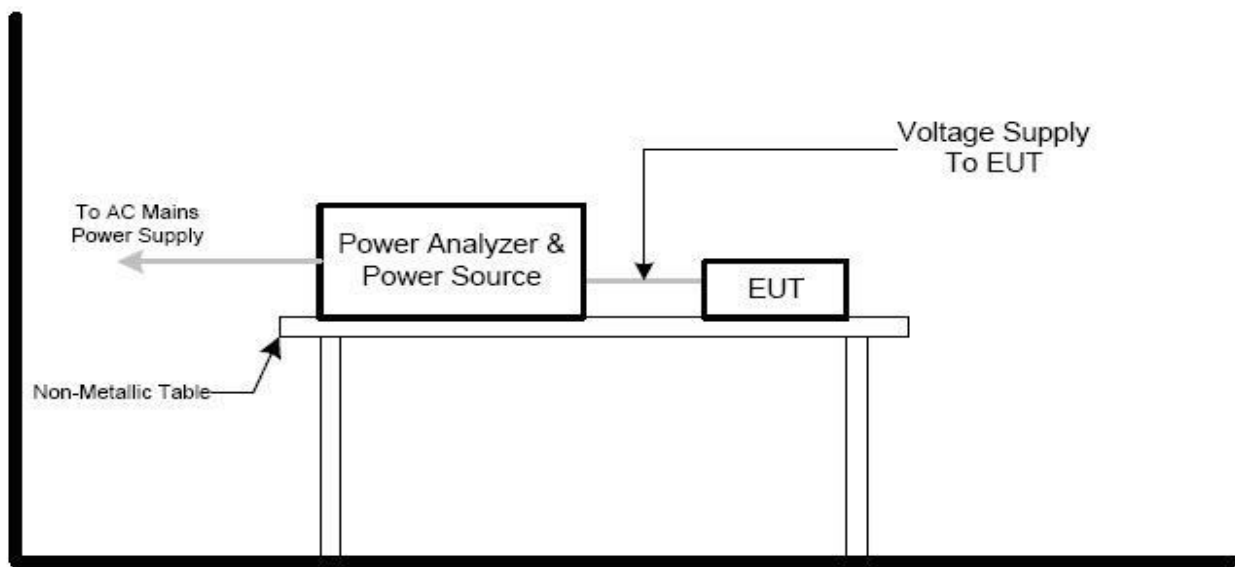
### LIMITS

| EN 61000-3-2/IEC 61000-3-2  |   |                    |                  |   |        |
|-----------------------------|---|--------------------|------------------|---|--------|
| Equipment Category          | Max. Permissible Harmonic Current (in Amperes)                                | Equipment Category | Harmonic Order n | Max. Permissible Harmonic Current (in A) (mA/w) |        |
| Class A                     | Same as Limits Specified in 4-2.1, Table - I, but only odd harmonics required | Class D            | 3                | 2.30  | 3.4    |
|                             |   |                    | 5                | 1.14  | 1.9    |
|                             |   |                    | 7                | 0.77  | 1.0    |
|                             |   |                    | 9                | 0.40  | 0.5    |
|                             |   |                    | 11               | 0.33  | 0.35   |
|                             |   |                    | 13 ≤ n ≤ 39      | see Table I                                     | 3.85/n |
| only odd harmonics required |   |                    |                  |   |        |

### TEST PROCEDURE

- The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the maximum harmonic components under normal operating conditions.
- The classification of EUT is according to section 5 of EN 61000-3-2: 2000. The EUT is classified as follows:
  - Class A: Balanced three-phase equipment, Household appliances excluding equipment as Class D, Tools excluding portable tools, Dimmers for incandescent lamps, audio equipment, equipment not specified in one of the three other classes.
  - Class B: Portable tools. Portable tools.; Arc welding equipment which is not professional equipment.
  - Class C: Lighting equipment.
  - Class D: Equipment having a specified power less than or equal to 600 W of the following types: Personal computers and personal computer monitors and television receivers.
- The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the time necessary for the EUT to be exercised.
- For the actual test configuration, please refer to the related item –EUT Test Photos.

### TEST SETUP



**TEST RESULTS**

The test is not applicable in this Test Report .

**2.10. Voltage Fluctuations and Flicker**

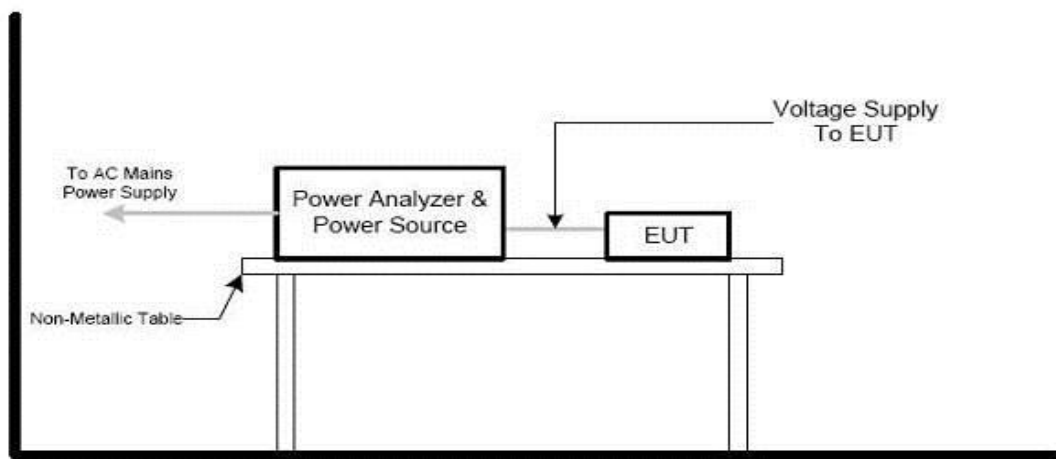
**LIMITS**

| Tests | Limits             |                     | Descriptions                     |
|-------|--------------------|---------------------|----------------------------------|
|       | IEC555-3           | IEC/EN 61000-3-3    |                                  |
| Pst   | ≤ 1.0, Tp= 10 min. | ≤ 1.0, Tp= 10 min.  | Short Term Flicker Indicator     |
| Plt   | N/A                | ≤ 0.65, Tp=2 hr.    | Long Term Flicker Indicator      |
| dc    | ≤ 3%               | ≤ 3.3%              | Relative Steady-State V-Chang    |
| dmax  | ≤ 4%               | ≤ 4%                | Maximum Relative V-change        |
| d (t) | N/A                | ≤ 3.3% for > 500 ms | Relative V-change characteristic |

**TEST PROCEDURE**

- a) Harmonic Current Test:  
Test was performed according to the procedures specified in Clause 5.0 of IEC555-2 and/or Sub-clause 6.2 of IEC/EN 61000-3-2 depend on which standard adopted for compliance
- b) Fluctuation and Flickers Test:  
Tests was performed according to the Test Conditions/Assessment of Voltage Fluctuations specified in Clause 5.0/6.0 of IEC555-3 and/or Clause 6.0/4.0 of IEC/EN 61000-3-3 depend on which standard adopted for compliance measurement.
- c) All types of harmonic current and/or voltage fluctuation in this report are assessed by direct measurement using flicker-meter.
- d) For the actual test configuration, please refer to the related Item –EUT Test Photos.

**TEST SETUP**



## TEST RESULTS

The test is not applicable in this Test Report .



### 3. EMC IMMUNITY TEST

#### 3.1. Performance criteria

##### A. EN301489-17

###### General performance criteria

- Performance criteria A for immunity tests with phenomena of a continuous nature;
- Performance criteria B for immunity tests with phenomena of a transient nature;
- Performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following.

| Criteria | During test  | After test   |
|----------|--|--|
| A        | Shall operate as intended.<br>May show degradation of performance (see note 1).<br>Shall be no loss of function.<br>Shall be no unintentional transmissions. | Shall operate as intended.<br>Shall be no degradation of performance (see note 2).<br>Shall be no loss of function.<br>Shall be no loss of stored data or user programmable functions.                         |
| B        | May show loss of function (one or more).<br>May show degradation of performance (see note 1).<br>No unintentional transmissions.                             | Functions shall be self-recoverable.<br>Shall operate as intended after recovering.<br>Shall be no degradation of performance (see note 2).<br>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.<br>Shall operate as intended after recovering.<br>Shall be no degradation of performance (see note 2).   |

**NOTE 1:**

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 2:**

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.

**Performance criteria for Continuous phenomena applied to Transmitters (CT)**

The performance criteria A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

**Performance criteria for Transient phenomena applied to Transmitters (TT)**

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

**Performance criteria for Continuous phenomena applied to Receivers (CR)**

The performance criteria A shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

**Performance criteria for Transient phenomena applied to Receivers (TR)**

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criteria C shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

## 3.2. Electrostatic Discharge

### TEST SPECIFICATION

|                             |   |
|-----------------------------|---|
| <b>Basic Standard:</b>      | IEC/EN 61000-4-2  |
| <b>Discharge Impedance:</b> | 330 ohm / 150 pF  |
| <b>Required Performance</b> | B   |
| <b>Discharge Voltage:</b>   | Air Discharge : 2kV/4kV/8kV (Direct)<br>Contact Discharge : 2kV/4kV (Direct/Indirect)         |
| <b>Polarity:</b>            | Positive & Negative   |
| <b>Number of Discharge:</b> | Air Discharge: min. 20 times at each test point<br>Contact Discharge: min. 200 times in total |
| <b>Discharge Mode:</b>      | AC Discharge  |
| <b>Discharge Period:</b>    | 1 second minimum  |

### TEST PROCEDURE

The test generator necessary to perform direct and indirect application of discharges to the EUT in the following manner:

- a) Contact discharge was applied to conductive surfaces and coupling planes of the EUT. During the test, it was performed with single discharges. For the single discharge time between successive single discharges was at least 1 second. The EUT shall be exposed to at least 200 discharges, 100 each at negative and positive polarity, at a minimum of four test points. One of the test points shall be subjected to at least 50 indirect discharges to the center of the front edge of the horizontal coupling plane. The remaining three test points shall each receive at least 50 direct contact discharges.

If no direct contact test points are available, then at least 200 indirect discharges shall be applied in the indirect mode. Test shall be performed at a maximum repetition rate of one discharge per second.

Vertical Coupling Plane (VCP):

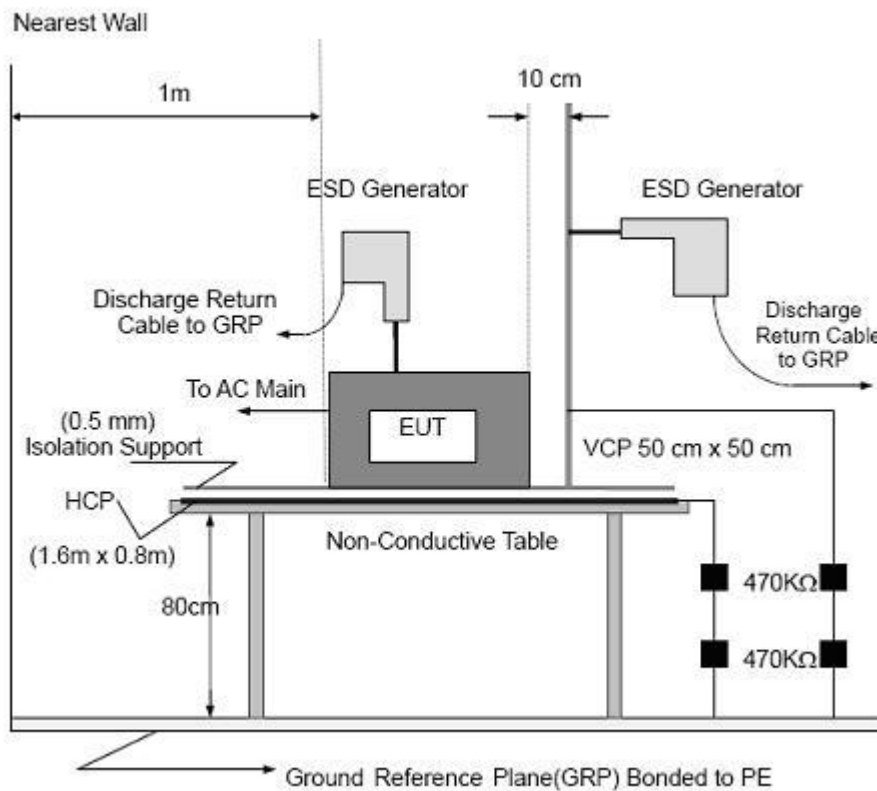
The coupling plane, of dimensions 0.5m x 0.5m, is placed parallel to, and positioned at a distance 0.1m from, the EUT, with the Discharge Electrode touching the coupling plane. The four faces of the EUT will be performed with electrostatic discharge.

Horizontal Coupling Plane (HCP):

The coupling plane is placed under to the EUT. The generator shall be positioned vertically at a distance of 0.1m from the EUT, with the Discharge Electrode touching the coupling plane. The four faces of the EUT will be performed with electrostatic discharge.

- b) Air discharges at insulation surfaces of the EUT. It was at least ten single discharges with positive and negative at the same selected point.
- c) For the actual test configuration, please refer to the related Item –EUT Test Photos.

**TEST SETUP**



Note:

**TABLE-TOP EQUIPMENT**

The configuration consisted of a wooden table 0.8 meters high standing on the Ground Reference Plane. The GRP consisted of a sheet of aluminum at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system. A Horizontal Coupling Plane (1.6m x 0.8m) was placed on the table and attached to the GRP by means of a cable with 940k total impedance. The equipment under test, was installed in a representative system as described in section 7 of IEC /EN 61000-4-2, and its cables were placed on the HCP and isolated by an insulating support of 0.5mm thickness. A distance of 1-meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

**FLOOR-STANDING EQUIPMENT**

The equipment under test was installed in a representative system as described in section 7 of IEC/EN 61000-4-2, and its cables were isolated from the Ground Reference Plane by an insulating support of 0.1-meter thickness. The GRP consisted of a sheet of aluminum that is at least 0.25mm thick, and 2.5meters square connected to the protective grounding system and extended at least 0.5 meters from the EUT on all sides.

**TEST RESULTS**

|             |  |   |       |            |             |
|-------------|--|---|-------|------------|-------------|
| Test Mode   | Mode1  |   |       |            |             |
| Test Points | Test Voltage   | Kind  | times | Phenomenon | Test Result |
| GAP         | <input checked="" type="checkbox"/> ±2 KV ; <input checked="" type="checkbox"/> ±4KV<br><input type="checkbox"/> ±6 KV ; <input checked="" type="checkbox"/> ±8KV<br><input type="checkbox"/> ±10 K ; <input type="checkbox"/> ±15KV | <input checked="" type="checkbox"/> Air     | ±10   | B          | Pass        |
| HCP         | <input checked="" type="checkbox"/> ±2 KV ; <input checked="" type="checkbox"/> ±4KV<br><input type="checkbox"/> ±6 KV ; <input type="checkbox"/> ±8KV<br><input type="checkbox"/> ±10 KV ; <input type="checkbox"/> ±15KV           | <input checked="" type="checkbox"/> Contact | ±25   | B          | Pass        |
| VCP         | <input checked="" type="checkbox"/> ±2 KV ; <input checked="" type="checkbox"/> ±4KV<br><input type="checkbox"/> ±6 KV ; <input type="checkbox"/> ±8KV<br><input type="checkbox"/> ±10 KV ; <input type="checkbox"/> ±15KV           | <input checked="" type="checkbox"/> Contact | ±25   | B          | Pass        |

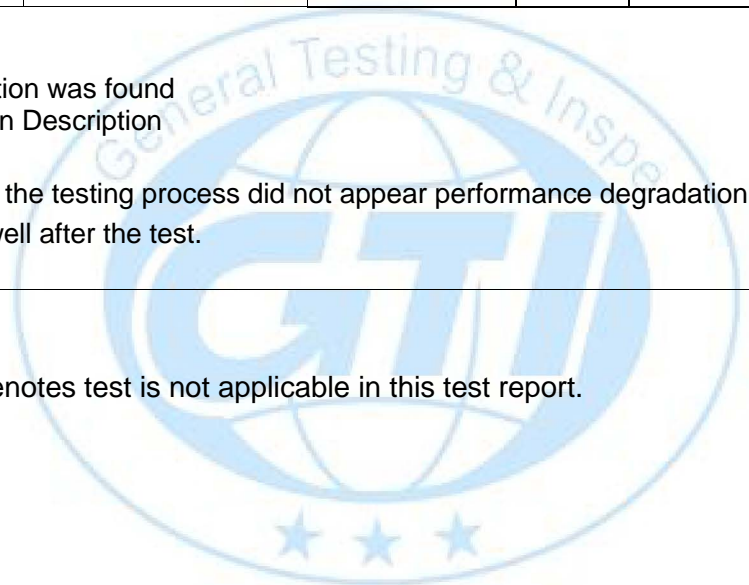
\* Comment:

- No degradation was found
- Phenomenon Description

Test products in the testing process did not appear performance degradation phenomenon, the product works well after the test.

Note:

- 1) N/A - denotes test is not applicable in this test report.





### 3.3. RF Electromagnetic Field

#### TEST SPECIFICATION

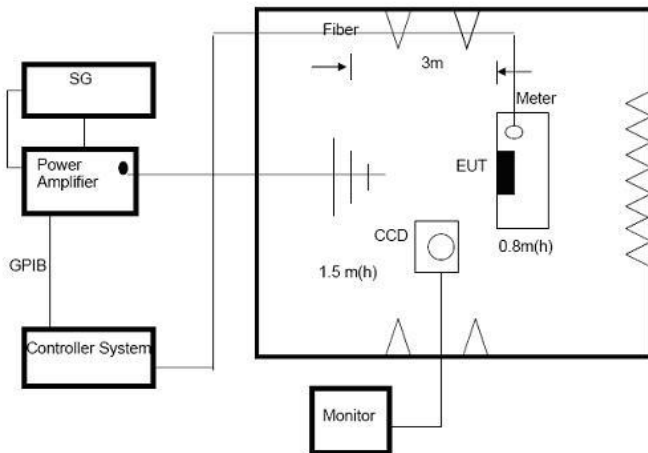
|                             |  |
|-----------------------------|--|
| <b>Basic Standard:</b>      | IEC/EN 61000-4-3                                     |
| <b>Required Performance</b> | A  |
| <b>Frequency Range:</b>     | 80 MHz - 1000 MHz , 1000MHz-2700MHz, 2700MHz-6000MHz |
| <b>Field Strength:</b>      | 3 V/m  |
| <b>Modulation:</b>          | 1kHz Sine Wave, 80%, AM Modulation                   |
| <b>Frequency Step:</b>      | 1 % of fundamental                                   |
| <b>Polarity of Antenna:</b> | Horizontal and Vertical                              |
| <b>Test Distance:</b>       | 3 m  |
| <b>Antenna Height:</b>      | 1.5 m  |
| <b>Dwell Time:</b>          | at least 3 seconds                                   |

#### TEST PROCEDURE

The EUT and support equipment, which are placed on a table that is 0.8 meter above ground and the testing was performed in a fully-anechoic chamber. The testing distance from antenna to the EUT was 3 meters. The other condition as following manner:

- a) The field strength level was 3V/m.
- b) The frequency range is swept from 80 MHz to 1000 MHz, & 1400MHz - 2700MHz & 2700MHz - 6000MHz ;with the signal 80% amplitude modulated with a 1 kHz sine wave. The rate of sweep did not exceed  $1.5 \times 10^{-3}$  decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
- c) The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
- d) The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.
- e) For the actual test configuration, please refer to the related Item –EUT Test Photos.

**TEST SETUP**



Note:

**TABLE-TOP EQUIPMENT**

The EUT installed in a representative system as described in section 7 of IEC/EN 61000-4-3 was placed on a non-conductive table 0.8 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

**FLOOR-STANDING EQUIPMENT**

The EUT installed in a representative system as described in section 7 of IEC/EN 61000-4-3 was placed on a non-conductive wood support 0.1 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

**TEST RESULTS**

|           |       |
|-----------|-------|
| Test Mode | Mode1 |
|-----------|-------|

| EUT Position | Frequency range 1<br>80MHz-1000MHz<br>Level:3V/m |         | Frequency range 2<br>1000MHz-2700MHz<br>Level:<br>3V/m |         | Frequency range 3<br>2700MHz-6000MHz<br>Level:<br>3V/m |         | Test Result |
|--------------|--|---------|--|---------|--|---------|-------------|
|              | Horizo<br>ntal                                   | Verical | Horizo<br>ntal   | Verical | Horizo<br>ntal   | Verical |             |
| from         | A *  | A *     | A *  | A *     | A *  | A *     | Pass        |
| right        | A *  | A *     | A *  | A *     | A *  | A *     | Pass        |
| back         | A *  | A *     | A *  | A *     | A *  | A *     | Pass        |
| left         | A *  | A *     | A *  | A *     | A *  | A *     | Pass        |

\* Comment:

- No degradation was found
- Phenomenon Description

Note:

- 1) N/A - denotes test is not applicable in this test report.

### 3.4. Fast Transients Common Mode

#### TEST SPECIFICATION

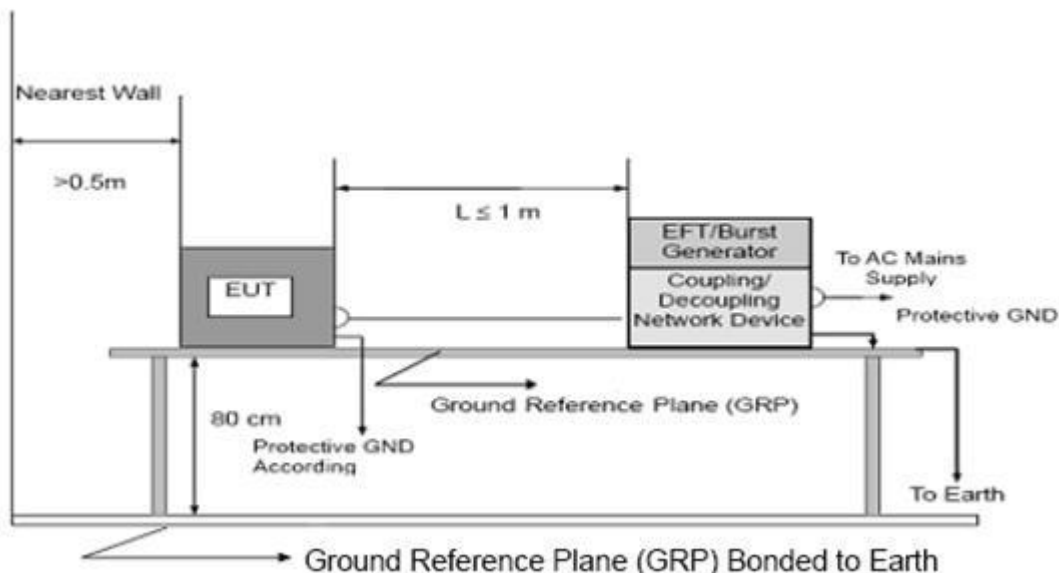
|                             |   |
|-----------------------------|---|
| <b>Basic Standard:</b>      | IEC/EN 61000-4-4                              |
| <b>Required Performance</b> | B   |
| <b>Test Voltage:</b>        | Power Line:1 Kv<br>Signal/Control Line:0.5 KV |
| <b>Polarity:</b>            | Positive & Negative                           |
| <b>Impulse Frequency:</b>   | 5 kHz   |
| <b>Impulse Wave shape :</b> | 5/50 ns                                       |
| <b>Burst Duration:</b>      | 15 ms   |
| <b>Burst Period:</b>        | 300 ms  |
| <b>Test Duration:</b>       | Not less than 1 min.                          |

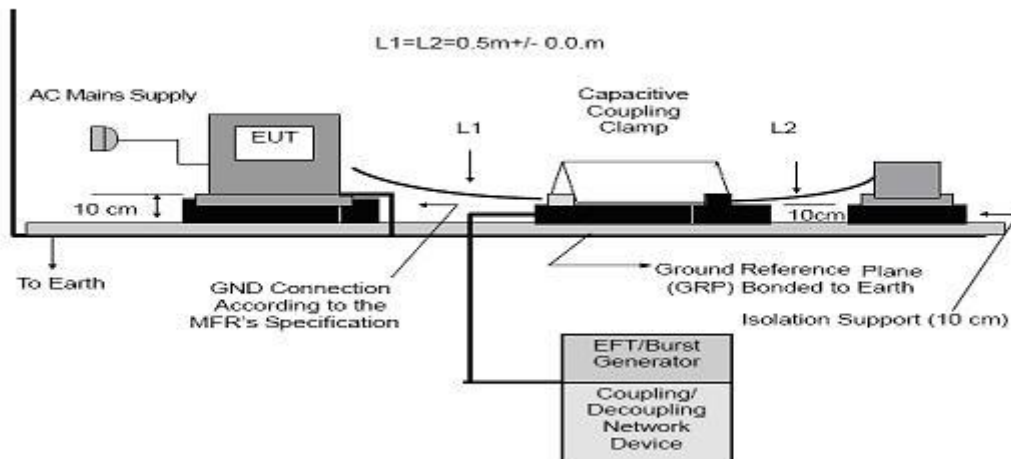
#### TEST PROCEDURE

The EUT and support equipment, are placed on a table that is 0.8 meter above a metal ground plane measured 1m\*1m min. and 0.65mm thick min. The other condition as following manner:

- The length of power cord between the coupling device and the EUT should not exceed 1 meter.
- Both positive and negative polarity discharges were applied.
- The duration time of each test sequential was 1 minute
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

#### EST SETUP





Note:

#### TABLE-TOP EQUIPMENT

The configuration consisted of a wooden table (0.8m high) standing on the Ground Reference Plane. The GRP consisted of a sheet of aluminum (at least 0.25mm thick and 2.5m square) connected to the protective grounding system. A minimum distance of 0.5m was provided between the EUT and the walls of the laboratory or any other metallic structure.

#### FLOOR-STANDING EQUIPMENT

The EUT installed in a representative system as described in section 7 of IEC/EN 61000-4-4 and its cables, were isolated from the Ground Reference Plane by an insulating support that is 0.1-meter thick. The GRP consisted of a sheet of aluminum (at least 0.25mm thick and 2.5m square) connected to the protective grounding system.

### **TEST RESULTS**

The test is not applicable in this Test Report .

### 3.5. SURGE Testing

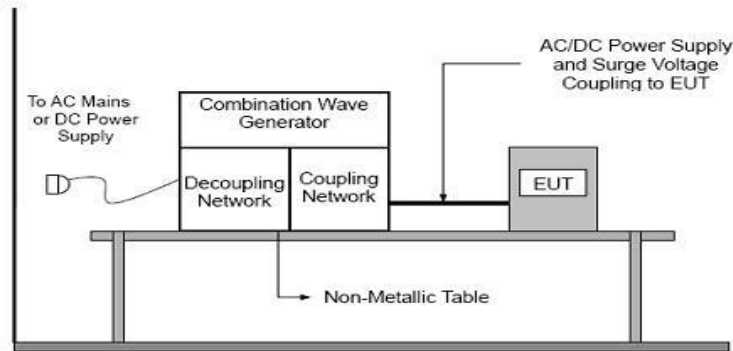
#### TEST SPECIFICATION

|                               |  |
|-------------------------------|--|
| <b>Basic Standard:</b>        | IEC/EN 61000-4-5   |
| <b>Required Performance</b>   | B  |
| <b>Wave-Shape:</b>            | Combination Wave<br>1.2/50 us Open Circuit Voltage<br>8 /20 us Short Circuit Current |
| <b>Test Voltage:</b>          | Power Line: $\pm 1$ Kv<br>RJ45 Line: $\pm 0.5$ Kv                                    |
| <b>Surge Input /Output:</b>   | L1-L2,<br>RJ45   |
| <b>Generator Source:</b>      | 2 ohm between networks   |
| <b>Impedance:</b>             | 12 ohm between network and ground  |
| <b>Polarity:</b>              | Positive/Negative  |
| <b>Phase Angle:</b>           | 0 /90/180/270  |
| <b>Pulse Repetition Rate:</b> | 1 time / min. (maximum)  |
| <b>Number of Tests:</b>       | 5 positive and 5 negative at selected points   |

#### TEST PROCEDURE

- a) For EUT power supply:  
The surge is to be applied to the EUT power supply terminals via the capacitive coupling network. Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines, and to provide sufficient decoupling impedance to the surge wave. The power cord between the EUT and the coupling/decoupling networks shall be 2meters in length (or shorter).
- b) For test applied to unshielded unsymmetrical operated interconnection lines of EUT:  
The surge is applied to the lines via the capacitive coupling. The coupling /decoupling networks shall not influence the specified functional conditions of the EUT. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).
- c) For test applied to unshielded symmetrically operated interconnection /telecommunication lines of EUT: The surge is applied to the lines via gas arrestors coupling. Test levels below the ignition point of the coupling arrestor cannot be specified. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).
- d) For the actual test configuration, please refer to the related Item –EUT Test Photos.

**TEST SETUP**



**TEST RESULTS**

The test is not applicable in this Test Report .

**3.6. RF Common Mode**

**TEST SPECIFICATION**

|                             |                                    |
|-----------------------------|------------------------------------|
| <b>Basic Standard:</b>      | IEC/EN 61000-4-6                   |
| <b>Required Performance</b> | A                                  |
| <b>Frequency Range:</b>     | 0.15 MHz - 80 MHz                  |
| <b>Field Strength:</b>      | 3 V rms                            |
| <b>Modulation:</b>          | 1kHz Sine Wave, 80%, AM Modulation |
| <b>Frequency Step:</b>      | 1 % of fundamental                 |
| <b>Dwell Time:</b>          | at least 3 seconds                 |

**TEST PROCEDURE**

The EUT and support equipment, are placed on a table that is 0.8 meter above a metal ground plane measured 1m\*1m min. and 0.65mm thick min. The other condition as following manner:

- a) The field strength level was 3V.
- b) The frequency range is swept from 150 KHz to 80 MHz, with the signal 80%amplitude modulated with a 1kHz sine wave. The rate of sweep did not exceed 1.5x 10<sup>-3</sup> decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
- c) The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
- d) For the actual test configuration, please refer to the related Item –EUT Test Photos.



### 3.7. Voltage Dips and Interruptions

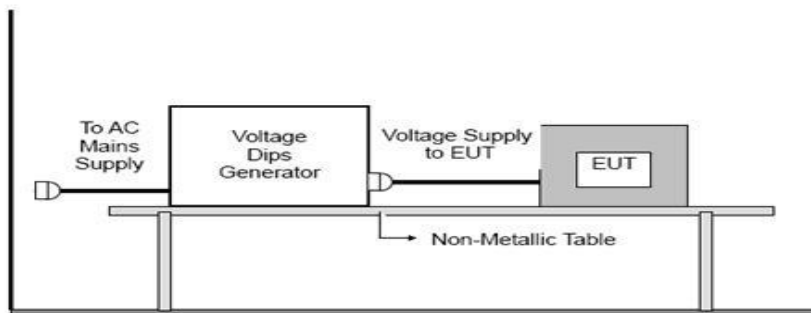
#### TEST SPECIFICATION

|                                |   |
|--------------------------------|---|
| <b>Basic Standard:</b>         | IEC/EN 61000-4-11   |
| <b>Required Performance</b>    | B (For 0% Voltage Dips)<br>C (For 70% Voltage Dips)<br>C (For 0% Voltage Interruptions) |
| <b>Test Duration Time:</b>     | Minimum three test events in sequence   |
| <b>Interval between Event:</b> | Minimum ten seconds   |
| <b>Phase Angle:</b>            | 0°/45°/90°/135°/180°/225°/270°/315°/360°  |
| <b>Test Cycle:</b>             | 3 times   |

#### TEST PROCEDURE

The EUT shall be tested for each selected combination of test levels and duration with a sequence of three dips/interruptions with intervals of 10 s minimum (between each test event). Each representative mode of operation shall be tested. Abrupt changes in supply voltage shall occur at zero crossings of the voltage waveform.

#### TEST SETUP



For the actual test configuration, please refer to the related Item –EUT Test Photos.

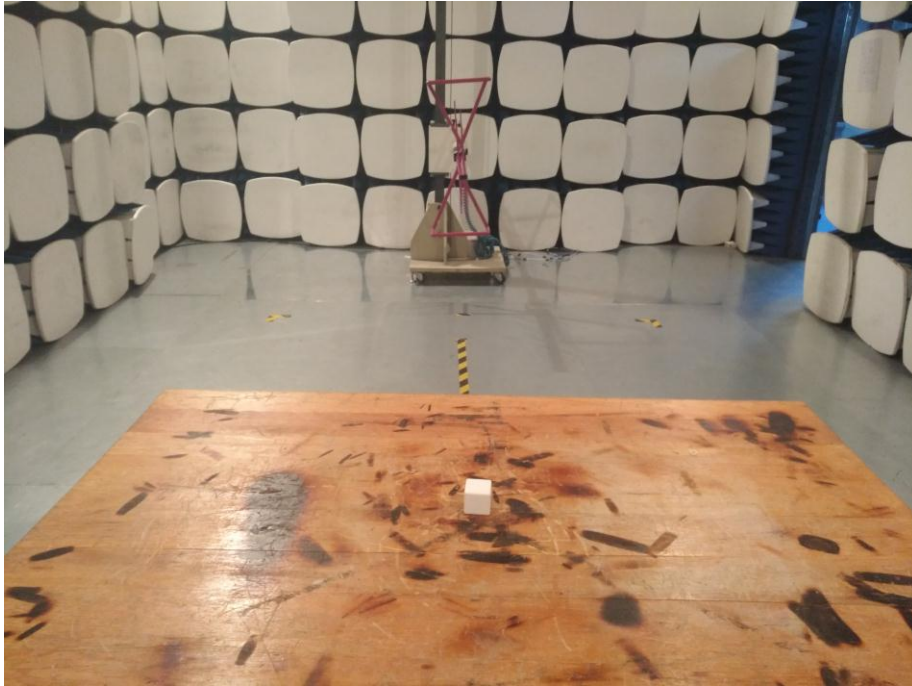
#### TEST RESULTS

The test is not applicable in this Test Report .



## 4. EUT TEST PHOTO

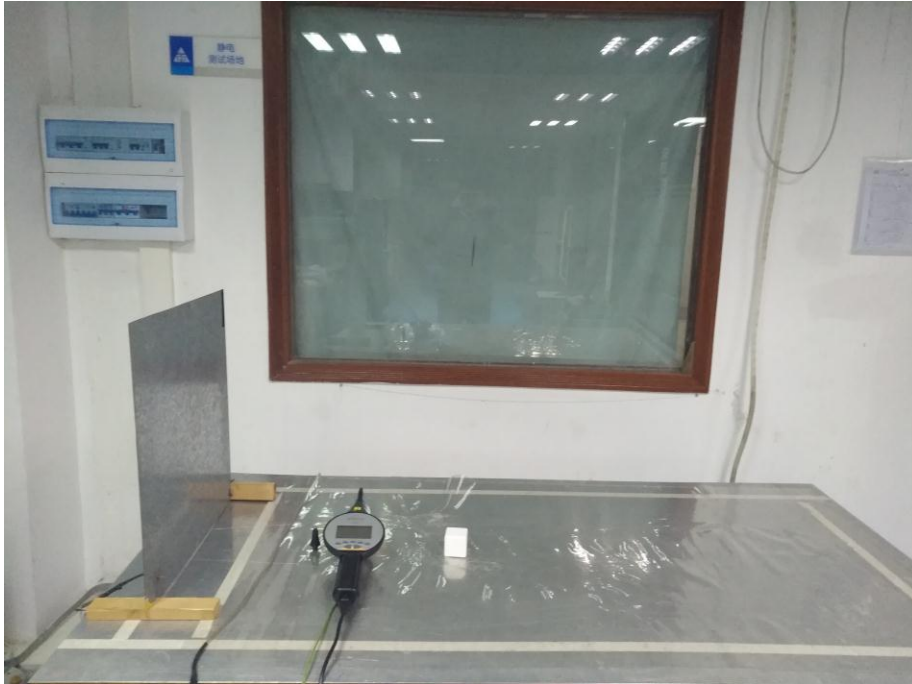
Radiated Measurement (30MHz~1000MHz)



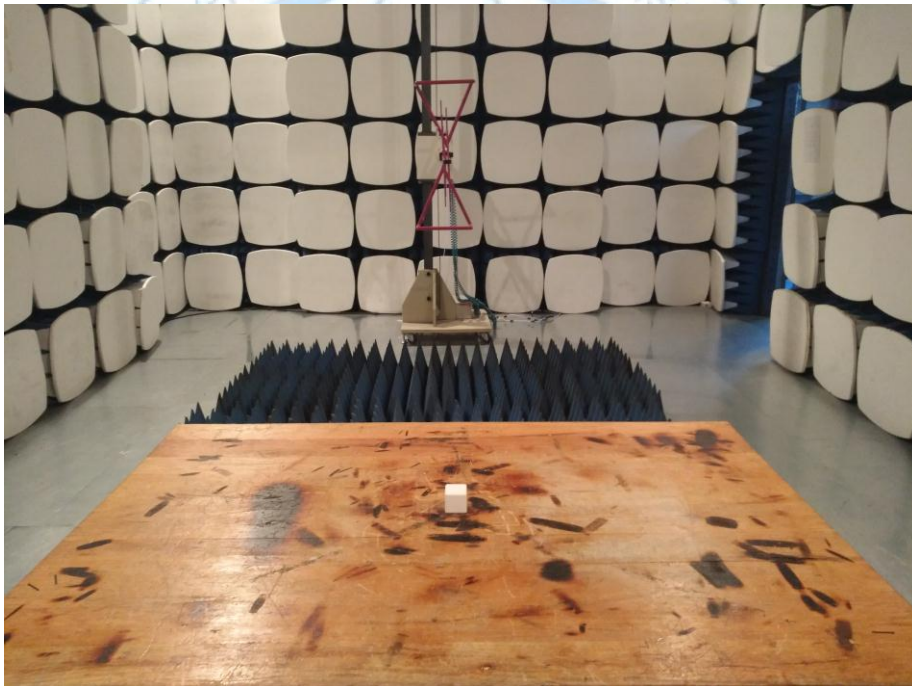
Radiated Measurement (1000~6000MHz)



### Electrostatic Discharge

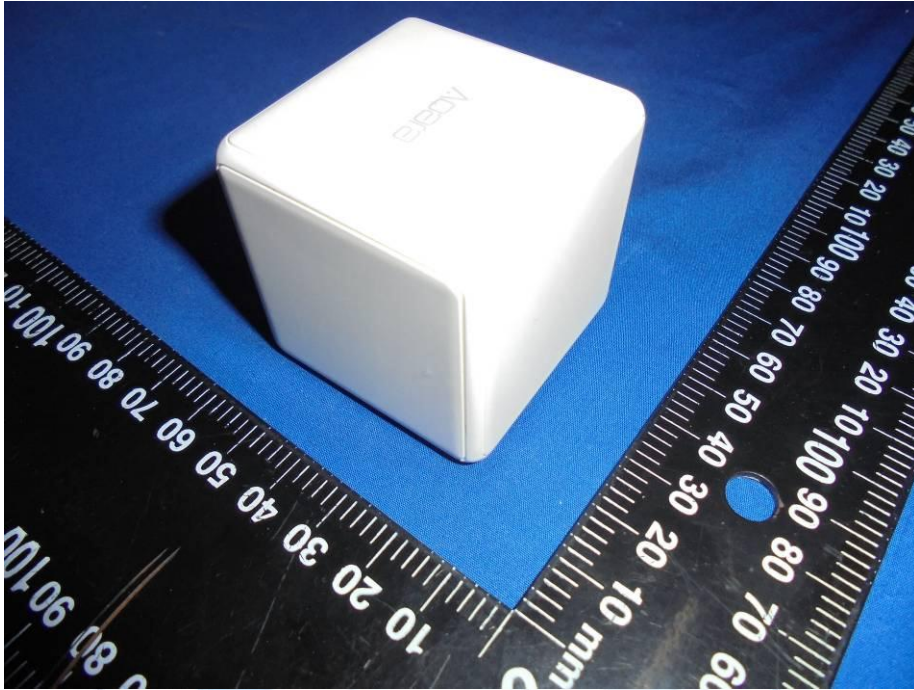


### RF electromagnetic field

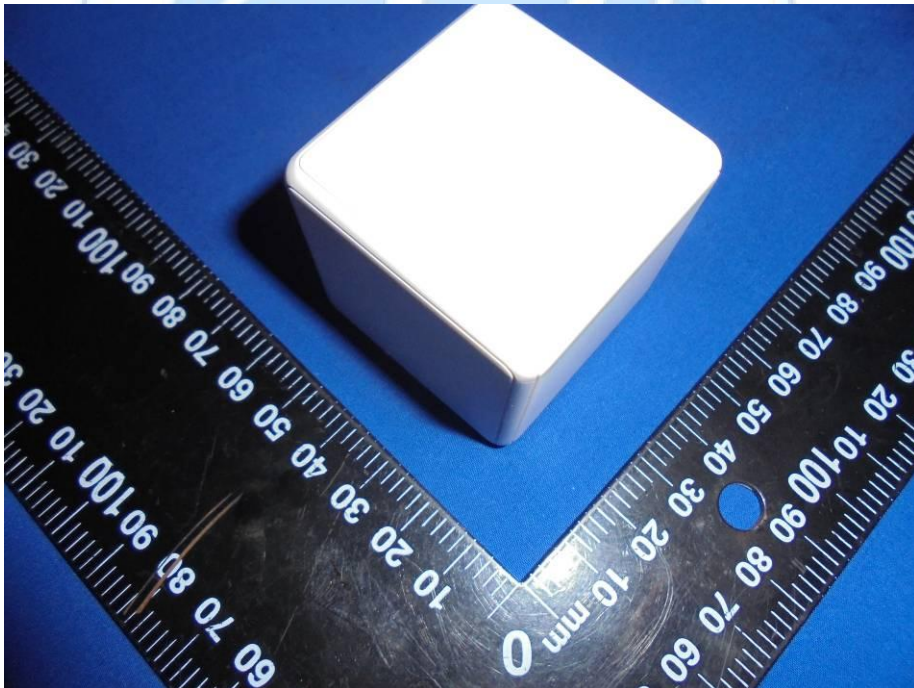


## 5. PHOTOGRAPHS OF EUT CONSTRUCTIONAL

### 1. Photo



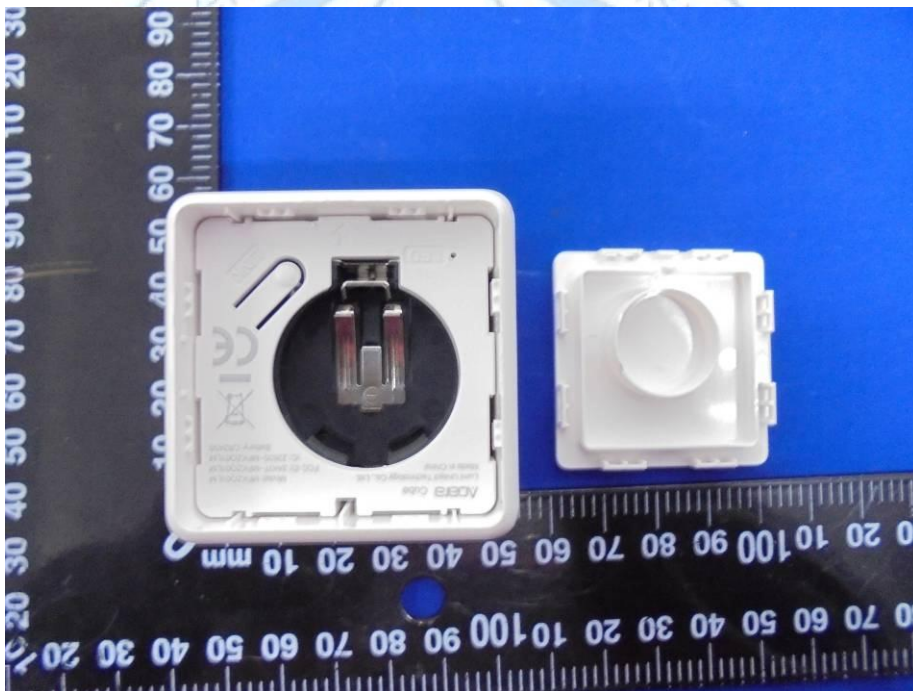
### 2. Photo



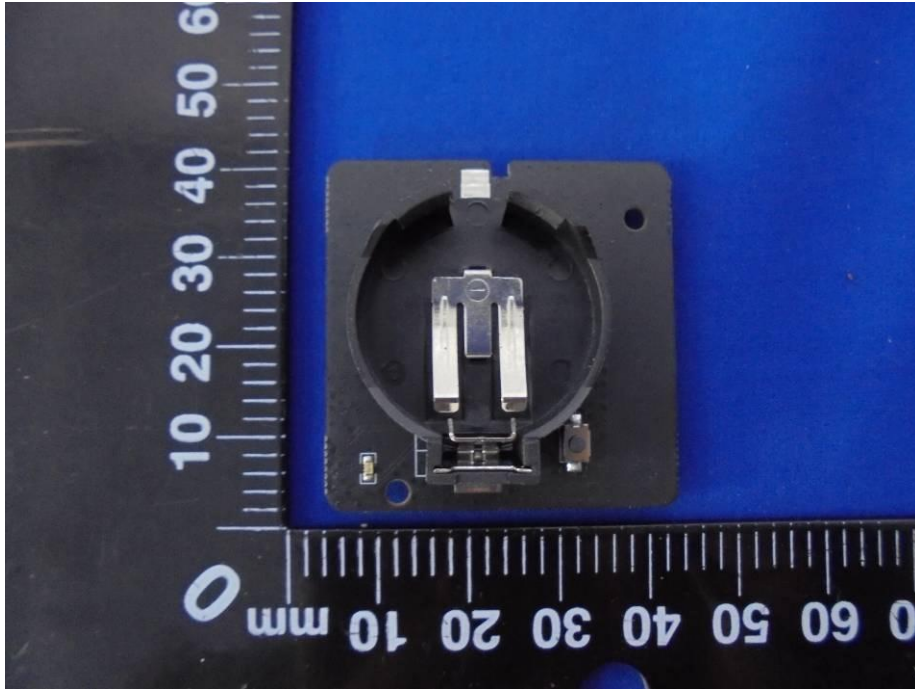
3. Photo



4. Photo

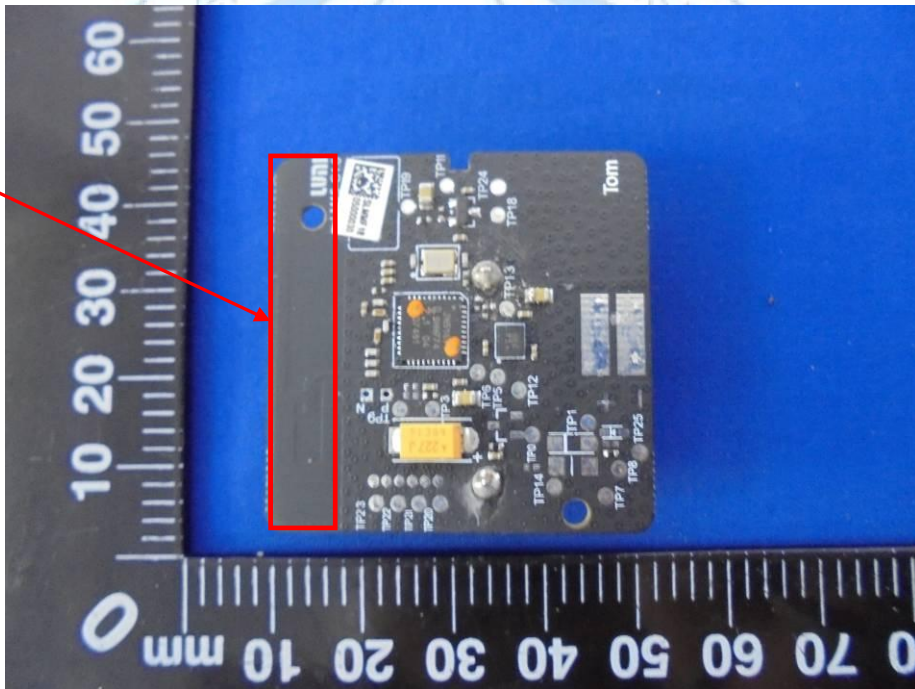


5. Photo

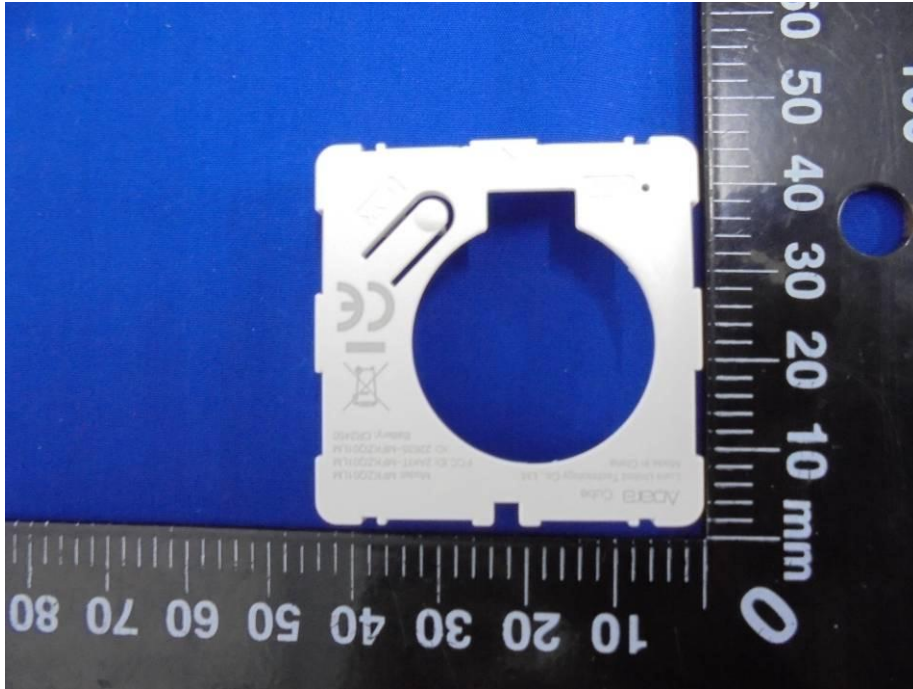


6. Photo

Antenna



7. Photo



\*\*\*\*\*THE END\*\*\*\*\*

