





## EMC TEST REPORT

**Report No.** : ATL20191108787E01  
**Applicant** : SHENZHEN RAKwireless Technology Co., Ltd.  
**Equipment Under Test (EUT)**  
**EUT Name** : LoRa module  
**Model No.** : RAK4260(H)  
**Series Model No.** : N/A  
**Brand Name** : N/A  
**Receipt Date** : 2019-12-16  
**Test Date** : 2019-12-16 to 2020-01-15  
**Issue Date** : 2020-01-15  
**Standards** : Draft ETSI EN 301 489-1 V2.2.0: 2017  
Final draft EN 301 489-3 V2.1.1: 2017  
**Conclusions** : **PASS**

In the configuration tested, the EUT complied with the standards specified above. The EUT technically complies with the Council Directive 2014/53/EU relating to radio equipment.

**Test/Witness Engineer** :  (Rose Fang)

**Engineer Supervisor** :  (Jane He)

**Engineer Manager** :  (July Yan)



This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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[illegible]

# 1. General Information

## 1.1 Client Information

<b>Applicant</b>	:	SHENZHEN RAKwireless Technology Co., Ltd.
<b>Address</b>	:	Room 506, Bldg B, New Compark, Pingshan First Road, Taoyuan Street, XiLi town Nanshan District, Shenzhen, China
<b>Manufacturer</b>	:	SHENZHEN RAKwireless Technology Co., Ltd.
<b>Address</b>	:	Room 506, Bldg B, New Compark, Pingshan First Road, Taoyuan Street, XiLi town Nanshan District, Shenzhen, China

## 1.2 General Description of EUT (Equipment Under Test)

<b>EUT Name</b>	:	LoRa module	
<b>Model No.</b>	:	RAK4260(H)	
<b>Model Difference</b>	:	N/A	
<b>Product Description</b>	:	Operation Frequency:	K:863MHz-865MHz L:865MHz-868MHz M:868MHz-868.6MHz N:868.7MHz-869.2MHz P:869.4MHz-869.65MHz Q:869.7MHz-870MHz
		Modulation Type:	ASK
<b>Power Rating</b>	:	DC 3.3V	
<b>Software Version</b>	:	V1.0	
<b>Hardware Version</b>	:	V2.0	
<b>Connecting I/O Port(S)</b>	:	Please refer to the User's Manual	

### Note:

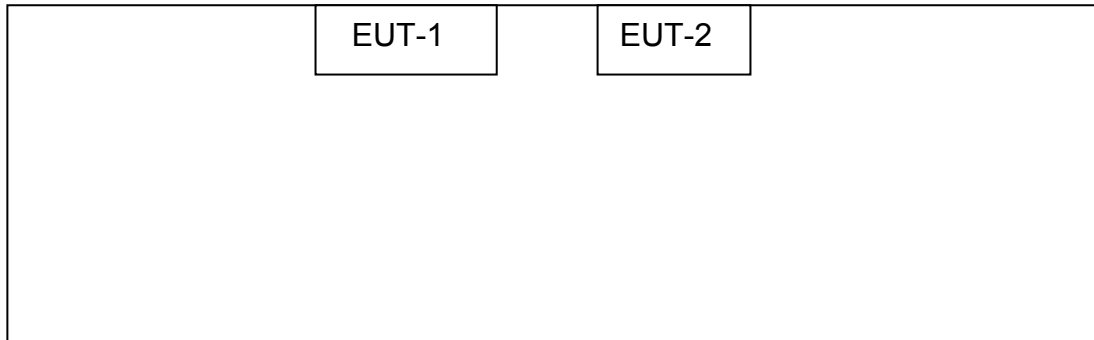
- (1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
- (2) More information about the RF function, please refer the RF test reports.

## 1.3 Product Description

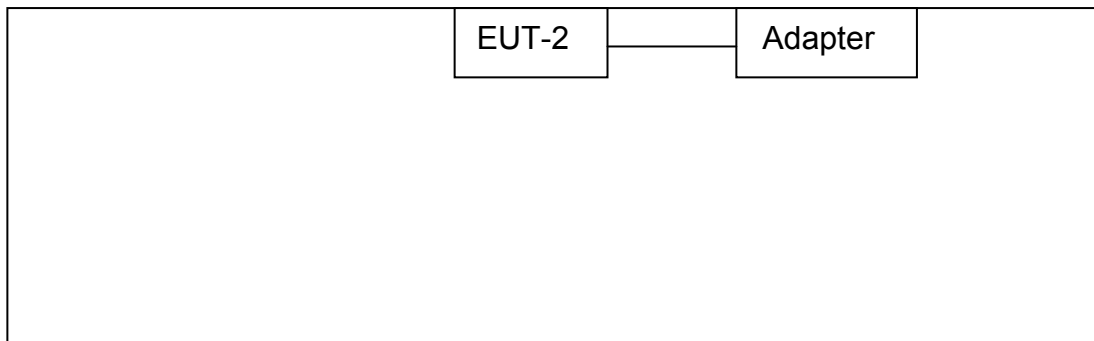
LoRa module is a multifunction module, its operation frequency is between 863MHz to 870MHz.

## 1.4 Block Diagram Showing the Configuration of System Tested

Normal Mode



Charging Mode



EUT-1: TX  
EUT-1: RX

## 1.5 Description of Support Units

Equipment Information				
Name	Model	FCC ID/DOC	Manufacturer	Used “√”
AC/DC Adapter	TEKA012	VOC	TEKA	√
AC/DC Adapter: Input:100~240V, 50/60Hz, 0.2A. Output: 5V, 1A				
Cable Information				
Number	Shielded Type	Ferrite Core	Length	Note
Cable 1	NO	NO	1.2M	Accessorise

## 1.6 Description of Operating Mode

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
RAK4260(H)	Normal Mode
RAK4260(H)	Charging Mode

The EUT system operated these modes were found to be the worst case during the pre-scanning test as Following:

For EMI Test	
Final Test Mode	Description
RAK4260(H)	Normal Mode
RAK4260(H)	Charging Mode
For EMS Test	
Final Test Mode	Description
RAK4260(H)	Normal Mode
RAK4260(H)	Charging Mode

## 1.7 Test Conditions

For the purpose of the present document, the test conditions of EN 301 489-1[1], clause 4, shall apply as appropriate. Further product related test conditions for digital cellular mobile and portable radio equipment are specified in the present document.

### (1) General

For emission and immunity tests the test modulation, test arrangements, etc., as specified in the present document, clauses 4.1 to 4.5, shall apply.

Whenever the Equipment Under Test (EUT) is provided with a detachable antenna, the EUT shall be tested with the antenna fitted in a manner typical of normal intended use, unless specified otherwise.

### (2) Arrangements for test signals

The provisions of EN 301 489-1, clause 4.2 shall apply.

#### a. Arrangements for establishing a communications link

The nominal frequency of the wanted RF input signal (for the receivers) shall be selected by setting the Absolute Radio Frequency Channel Number (ARFCN) to an appropriate number (e.g. in case of GSM 900 MHz this is 60 to 65, and in case of GSM 1 800 MHz this is 690 to 706).

A communication link shall be set up with a suitable base station simulator.

When the EUT is required to be in the transmit/receive mode, the following conditions shall be met:

- the EUT shall be commanded to operate at maximum transmit power;
- the downlink RXQUAL shall be monitored.

#### b. Arrangements for test signals at the input of transmitters

The provisions of EN 301 489-1, clause 4.2.1 shall apply with the following modifications.

The test system shall command the EUT to disable Discontinuous Transmission (DTX).

A communication link shall be set up between the EUT and the test system.

#### c. Arrangements for test signals at the output of transmitters

The provisions of EN 301 489-1, clause 4.2.2 shall apply with the following modifications.

Where the equipment incorporates an external 50Ω RF antenna connector that is normally connected via a coaxial cable, then the wanted signal to establish a communication link shall be delivered from that connector by a coaxial cable.

Where the equipment incorporates an external 50Ω RF antenna connector, but this port is not normally connected via a coaxial cable, and where the equipment does not incorporate an external 50Ω RF connector (integral antenna equipment), then the wanted signal, to establish a communication link, shall be delivered from the equipment to an antenna located within the test environment.



d. Arrangements for test signals at the input of receivers

The provisions of EN 301 489-1, clause 4.2.3 shall apply with the following modifications.

Where the equipment incorporates an external 50Ω RF antenna connector that is normally connected via a coaxial cable, then the wanted signal to establish a communication link shall be delivered to that connector by a coaxial cable.

Where the equipment incorporates an external 50Ω RF antenna connector, but this port is not normally connected via a coaxial cable, and where the equipment does not incorporate an external 50Ω RF connector (integral antenna equipment), then the wanted signal, to establish a communication link, shall be presented to the equipment from an antenna located within the test environment.

The wanted RF input signal level shall be set to 40 dB above the reference sensitivity level.

e. Arrangements for test signals at the output of receivers

The provisions of EN 301 489-1, clause 4.2.4 shall apply.

f. Idle mode

When the EUT is required to be in the idle mode, the test system shall simulate a Base Station(BS) with Broadcast Control Channel/Common Control Channel (BCCH/CCCH) on one carrier. The EUT shall be synchronized to the BCCH, listening to the CCCH and able to respond to paging messages. Periodic Location Updating shall be disabled.

## 1.8 Performance Criterion

### (1) Final draft EN 301 489-3

According to **Final draft EN 301 489-3** standard, the general performance criteria as following:

- performance criterion A applies for immunity tests with phenomena of a continuous nature;
- performance criterion B applies for immunity tests with phenomena of a transient nature.

**NOTE:** Whether a phenomenon is considered transient, continuous or otherwise is indicated in the test procedures for the phenomenon in ETSI EN 301 489-1 [1], clause 9.

### Performance Requirements

Criterion	During test	After test
A	Operate as intended No loss of function No unintentional responses	Operate as intended No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May show loss of function No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions

### The Requirement of Performance Criteria

1	Performance criteria for continuous phenomena applied to transmitters (CT)	Criterion A of the applicable class shall apply
2	Performance criteria for transient phenomena applied to transmitters (TT)	Criterion B of the applicable class shall apply
3	Performance criteria for continuous phenomena applied to receivers (CR)	Criterion A of the applicable class shall apply
4	Performance criteria for transient phenomena applied to transmitters (TR)	Criterion B of the applicable class shall apply

## 1.9 Measurement Uncertainty

The reported uncertainty of measurement  $y \pm U$ , where expanded uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95 %.

Test	Parameters	Expanded Uncertainty ( $U_{Lab}$ )	Expanded Uncertainty ( $U_{Cispr}$ )
Conducted Emission	Level Accuracy: 9kHz~150kHz 150kHz to 30MHz	$\pm 3.42$ dB $\pm 3.42$ dB	$\pm 4.0$ dB $\pm 3.6$ dB
Power Disturbance	Level Accuracy: 30MHz to 300 MHz	$\pm 4.10$ dB	$\pm 4.5$ dB
Electromagnetic Radiated Emission(3-loop)	Level Accuracy: 9kHz to 30 MHz	$\pm 3.60$ dB	N/A
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	$\pm 4.60$ dB	N/A
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	$\pm 4.40$ dB	$\pm 5.2$ dB
Radiated Emission	Level Accuracy: Above 1000MHz	$\pm 4.20$ dB	N/A
Mains Harmonic	Voltage	$\pm 3.11\%$	N/A
Voltage Fluctuations & Flicker	Voltage	$\pm 3.25\%$	N/A

## 1.10 Test Facility

The testing report were performed by the Shenzhen ATL Testing Technology Co., Ltd., in their facilities located at Floor.5,Genesis Zhongye Building,No.22,Puzai Road,Pingdi Street,Longgang District,Shenzhen,Guangdong,China. At the time of testing, the following bodies accredited the Laboratory:

## 2 Test Results Summary

Test procedures according to the technical standards:

Requirement Standard:		Draft ETSI EN 301 489-1 V2.2.0: 2017 Final draft EN 301 489-3 V2.1.1: 2017		
EMC Emission				
Test Standard	Test Item	Limit	Judgment	Remark
EN 55032:2015	Conducted Emission	Class B	PASS	
	Radiated Emission	Class B	PASS	
EN 61000-3-2:2014	Harmonic Current Emission	Class A or D NOTE(2)	N/A	
EN 6000-3-3:2013	Voltage Fluctuations& Flicker		N/A	
EMC Immunity				
Test Standard	Test Item	Performance Criteria	Judgment	Remark
EN61000-4-2: 2009	Electrostatic Discharge	B	PASS	
EN 61000-4-3:2006 +A2:2010	RF electromagnetic field	A	PASS	
EN 61000-4-4:2012	Fast transients	B	PASS	
EN 61000-4-5:2014+ A1:2017	Surges	B	PASS	
EN 61000-4-6: 2014 +AC:2015	Injected Current	A	PASS	
EN 61000-4-11: 2004 +A1:2017	Volt. Interruptions Volt. Dips	B /B/ C / C NOTE (3)	PASS	

NOTE:

(1) "N/A" denotes test is not applicable in this Test Report

(2) The power consumption of EUT is less than 75W and no Limits apply.

(3) Voltage dip: 0% residual 0.5 cycle– Performance Criteria B

Voltage dip: 0% residual 1 cycle– Performance Criteria B

Voltage dip: 70% residual 25 cycles – Performance Criteria C

Voltage Interruption: 0% residual voltage 250 cycles – Performance Criteria C

### 3 Test Equipment Used

Radiation Emission Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 20, 2020	Jul. 19, 2020
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Jul. 20, 2020	Jul. 19, 2020
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar.25, 2019	Mar. 24, 2020
Bilog Antenna	ETS-LINDGREN	3142E	00117542	Mar.25, 2019	Mar. 24, 2020
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.24, 2019	Mar. 23, 2020
Horn Antenna	ETS-LINDGREN	3117	00143209	Mar.24, 2019	Mar. 23, 2020
Pre-amplifier	HP	11909A	185903	Mar.24, 2019	Mar. 23, 2020
Pre-amplifier	HP	8449B	3008A00849	Mar.25, 2019	Mar. 24, 2020
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar. 24, 2018	Mar. 23, 2020
Signal Generator	Rohde & Schwarz	SML03	IKW682-054	Mar. 24, 2018	Mar. 23, 2020
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A
Radiated Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Signal Generator	Rohde & Schwarz	SMT03	200754	Mar. 24, 2018	Mar. 23, 2020
Power Meter	Rohde & Schwarz	NRVD	110562	Feb. 14, 2019	Feb. 13, 2020
Voltage Probe	Rohde & Schwarz	URV5-Z2	12056	Feb. 14, 2019	Feb. 13, 2020
Voltage Probe	Rohde & Schwarz	URV5-Z2	12074	Feb. 14, 2019	Feb. 13, 2020
RF Amplifier	AR	50S1G4A	326720	Feb. 14, 2019	Feb. 13, 2020
Bilog Antenna	ETS	3142C	00047662	Feb. 14, 2019	Feb. 13, 2020
Horn Antenna	ARA	DRG-118A	16554	Feb. 14, 2019	Feb. 13, 2020
Conducted Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
RF Generator	FRANKONIA	CIT-10/75	126B1126	Jul. 20, 2020	Jul. 19, 2020
Attenuator	FRANKONIA	59-6-33	A413	Jul. 20, 2020	Jul. 19, 2020
M-CDN	LUTHI	L-801 M2/M3	2599	Jul. 20, 2020	Jul. 19, 2020
AF2-CDN	LUTHI	L-801:AF2	2538	Mar.25, 2019	Mar. 24, 2020
EM Injection Clamp	LUTHI	EM101	35958	Jul. 20, 2020	Jul. 19, 2020
<b>Note: The test equipments of the above project valid until Mar. 24, 2020. Because of the EUT test time across March and April, So the new calibrated equipment please see below test equipments.</b>					

Test Equipment Used					
Conducted Emission Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Jul. 20, 2020	Jul. 19, 2020
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Jul. 20, 2020	Jul. 19, 2020
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Jul. 20, 2020	Jul. 19, 2020
LISN	Rohde & Schwarz	ENV216	101131	Jul. 21, 2019	Jul. 20, 2020
ISN	SCHWARZBECK	NTFM 8131	8131-193	Jul. 03, 2019	Jul. 02, 2020
ISN	SCHWARZBECK	CAT3 8158	cat3 5158-0094	Jul. 03, 2019	Jul. 02, 2020
ISN	SCHWARZBECK	NTFM5158	NTFM5158 0145	Jul. 03, 2019	Jul. 02, 2020
ISN	SCHWARZBECK	CAT 8158	cat5 8158-179	Jul. 03, 2019	Jul. 02, 2020
Radiation Emission Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 20, 2020	Jul. 19, 2020
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Jul. 20, 2020	Jul. 19, 2020
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar.16, 2019	Mar. 15, 2020
Bilog Antenna	ETS-LINDGREN	3142E	00117542	Mar.16, 2019	Mar. 15, 2020
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.16, 2019	Mar. 15, 2020
Horn Antenna	ETS-LINDGREN	3117	00143209	Mar.16, 2019	Mar. 15, 2020
Pre-amplifier	HP	11909A	185903	Mar.17, 2019	Mar. 16, 2020
Pre-amplifier	HP	8449B	3008A00849	Mar.17, 2019	Mar. 16, 2020
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar.17, 2019	Mar. 16, 2020
Signal Generator	Rohde & Schwarz	SML03	IKW682-054	Mar.17, 2019	Mar. 16, 2020
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A
Harmonic Current and Voltage Fluctuation and Flicker Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Harmonic Flicker Test System	CI	5001ix-CTS-400	100321	Jul. 20, 2020	Jul. 19, 2020
5K VA	CI	500liX	59468	Jul. 20, 2020	Jul. 19, 2020

Discharge Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
ESD Tester	TESEQ	NSG437	304	Jul. 21, 2019	Jul. 20, 2020
Radiated Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Signal Generator	Rohde & Schwarz	SMT03	200754	Mar. 22, 2019	Mar. 21, 2020
Power Meter	Rohde & Schwarz	NRVD	110562	Feb. 12, 2019	Feb. 11, 2020
Voltage Probe	Rohde & Schwarz	URV5-Z2	12056	Feb. 12, 2019	Feb. 11, 2020
Voltage Probe	Rohde & Schwarz	URV5-Z2	12074	Feb. 12, 2019	Feb. 11, 2020
RF Amplifier	AR	50S1G4A	326720	Feb. 12, 2019	Feb. 11, 2020
Bilog Antenna	ETS	3142C	00047662	Feb. 12, 2019	Feb. 11, 2020
Horn Antenna	ARA	DRG-118A	16554	Feb. 12, 2019	Feb. 11, 2020
Electrical Fast Transient/ Surge/ Voltage Dip and Interruption Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal.Due Date
Simulator	EMTEST	UCS500N5	V0948105575	Jul. 20, 2020	Jul. 19, 2020
Auto-transformer	EMTEST	V4780S2	0109-41	Jul. 20, 2020	Jul. 19, 2020
Coupling Clamp	EMTEST	HFK	1109-04	Jul. 20, 2020	Jul. 19, 2020
Conducted Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
RF Generator	FRANKONIA	CIT-10/75	126B1126	Jul. 20, 2020	Jul. 19, 2020
Attenuator	FRANKONIA	59-6-33	A413	Jul. 20, 2020	Jul. 19, 2020
M-CDN	LUTHI	L-801 M2/M3	2599	Jul. 20, 2020	Jul. 19, 2020
AF2-CDN	LUTHI	L-801:AF2	2538	Mar.16, 2019	Mar. 15, 2020
EM Injection Clamp	LUTHI	EM101	35958	Jul. 20, 2020	Jul. 19, 2020

## 4 Conducted Disturbance Test

### 4.1 Test Standard and Limit

#### 4.1.1 Test Standard

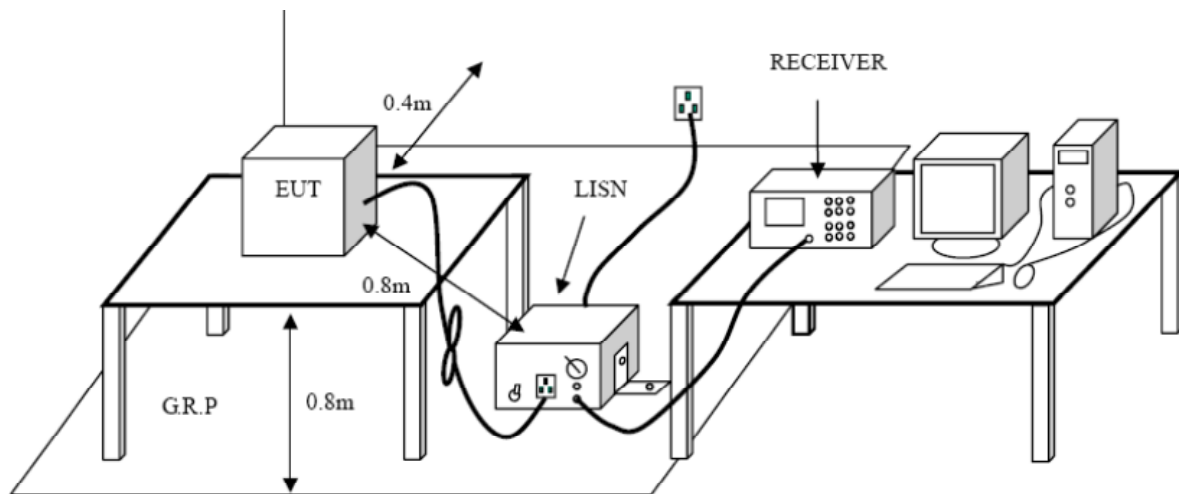
Draft ETSI EN 301 489-1 Clause 8.4  
Final draft EN 301 489-3  
EN 55032: 2015 Class B

#### 4.1.2 Test Limit

**Conducted Disturbance Test Limit**

Frequency	Maximum RF Line Voltage (Db $\mu$ V)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50
Remark: *Decreasing linearly with logarithm of the frequency		

### 4.2 Test Setup





### 4.3 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.

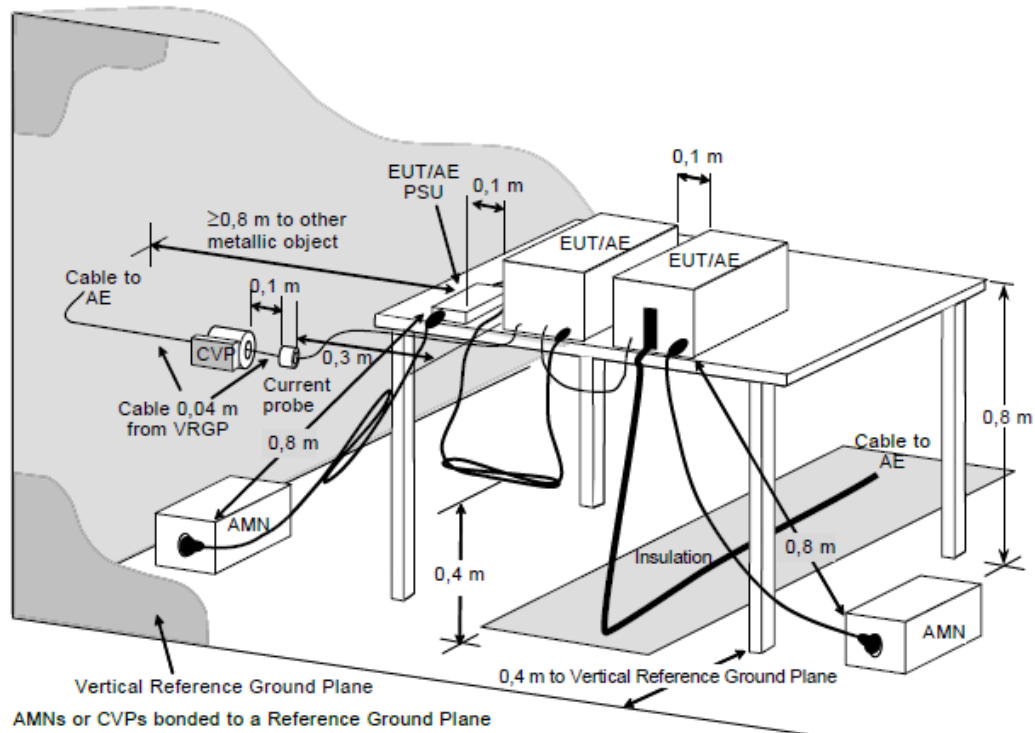
I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

LISN at least 80 cm from the nearest part of EUT chassis.

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

### 4.4 Test Data

Please refer to the Attachment A.



- [illegible]

- [illegible]

### 5.3 Test Setup and Test Procedure

Detailed test procedure was following clause C.4.1 of EN 55032.

Frequency range 150kHz – 30MHz was checked and EMI receiver measurement bandwidth was set to 9 kHz.

Data Port	Measurement type	Coupling device	No. of Pairs
Balanced Unscreened	Voltage	AAN	≤ 4
Balanced Unscreened	Voltage and Current	CVP & Current probe	>4 or unable to AAN
Screened or Coaxial	Voltage	AAN	N/A
Screened or Coaxial	Voltage or Current	Current probe / “150Ω to 50Ω adaptor” / high impedance probe	N/A
Unbalanced cables	Voltage and Current	CVP & Current probe	N/A

### 5.4 Test Data

The test is not applicable.

## 6 Radiated Disturbance Test

### 6.1 Test Standard and Limit

#### 6.1.1 Test Standard

Draft ETSI EN 301 489-1 Clause 8.2  
Final draft EN 301 489-3  
EN 55032: 2015 Class B

#### 6.1.2 Test Limit

**Radiated Disturbance Test Limit**

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

Notes:

- (1) The limit for radiated test was performed according to as following: EN 55032
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

**Limits of Radiated Emission Measurement (Above 1000MHz)**

FREQUENCY (MHz)	Class A (dBuV/m) (at 3m)		Class B (dBuV/m) (at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
1000-3000	76	56	70	50
3000-6000	80	60	74	54

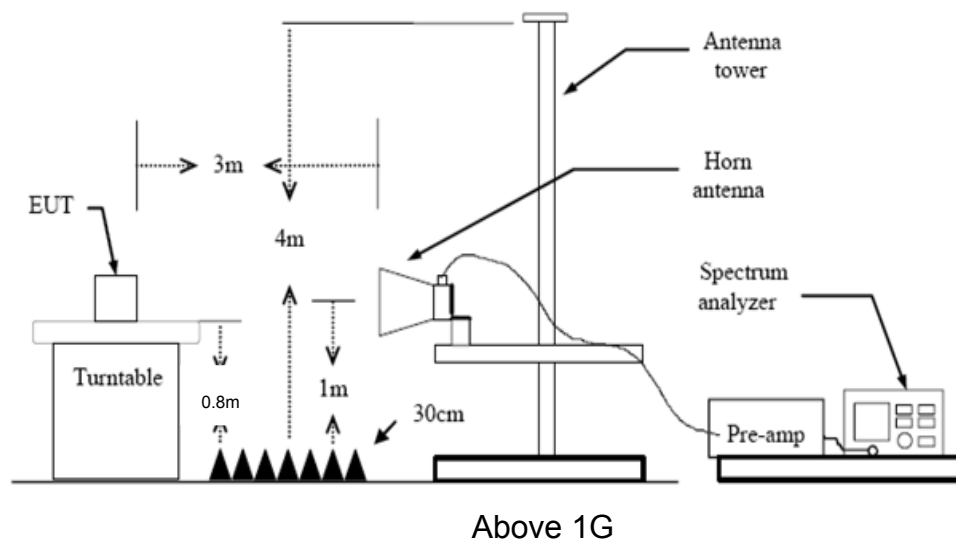
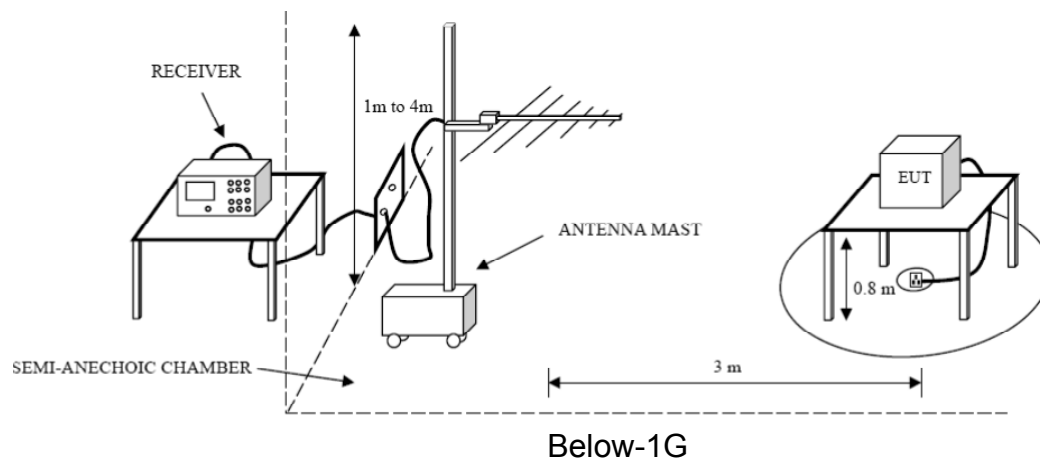
Notes:

- (1) The lower limit applies at the transition frequency.

**Frequency Range of Radiated Measurement**

Highest frequency generated or Upper frequency of measurement used in the device or on which the device operates or tunes (MHz)	Range (MHz)
Below 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5th harmonic of the highest frequency or 6 GHz, whichever is lower

## 6.2 Test Setup



## 6.3 Test Procedure

The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3m. The table was rotated 360 degrees to determine the position of the highest radiation.

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.

The initial step in collecting radiated emission data is a spectrum Quasi Peak detector mode scanning the measurement frequency range.

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.

## 6.4 Test Data

Please refer to the Attachment B.

## 7 Harmonic Current Emission Test

### 7.1 Test Standard and Limit

#### 7.1.1 Test Standard

Draft ETSI EN 301 489-1 Clause 8.5  
Final draft EN 301 489-3  
EN 61000-3-2

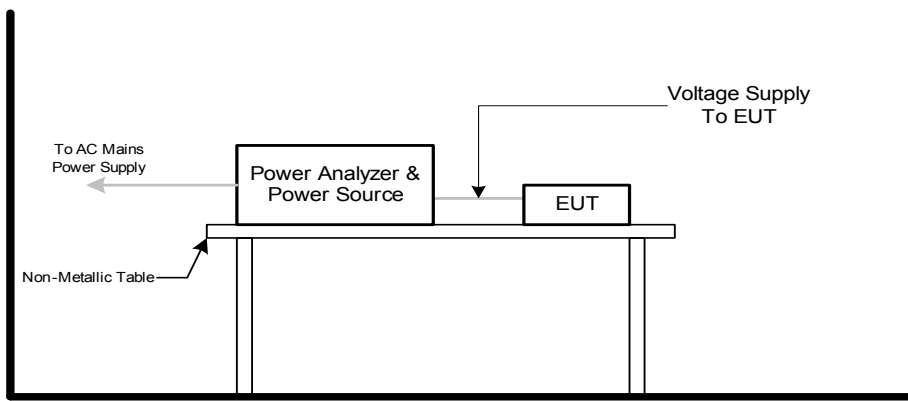
#### 7.1.2 Limits

IEC 555-2					
Table- I			Table- II		
Equipment Category	Harmonic order n	Max. permissible harmonic current (in Amperes)	Equipment Category	Harmonic order n	Max. permissible harmonic current (in Amperes)
NonPortable Toolsor TV Receivers	odd harmonics		TV Receivers	odd harmonics	
	3	2.30		3	0.8
	5	1.14		5	0.65
	7	0.77		7	0.45
	9	0.40		9	0.30
	11	0.33		11	0.17
	13	0.21		13	0.12
	15≤n≤39	0.15·15/n		15≤n≤39	0.10·15/n
	even harmonics			even harmonics	
	2	1.08		2	0.30
	4	0.43		4	0.15
	8	0.30			
	8≤n≤40	0.23·8/n		DC	0.05



EN 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 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
			8≤n≤40	See Tabel I	3.85/n
			Only odd harmonics required		

## 7.2 Test Setup



## 7.3 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. 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. 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.

## 7.4 Test Data

No requirement for this test item

## 8 Voltage Fluctuation and Flicker Test

### 8.1 Test Standard and Limit

#### 8.1.1 Test Standard

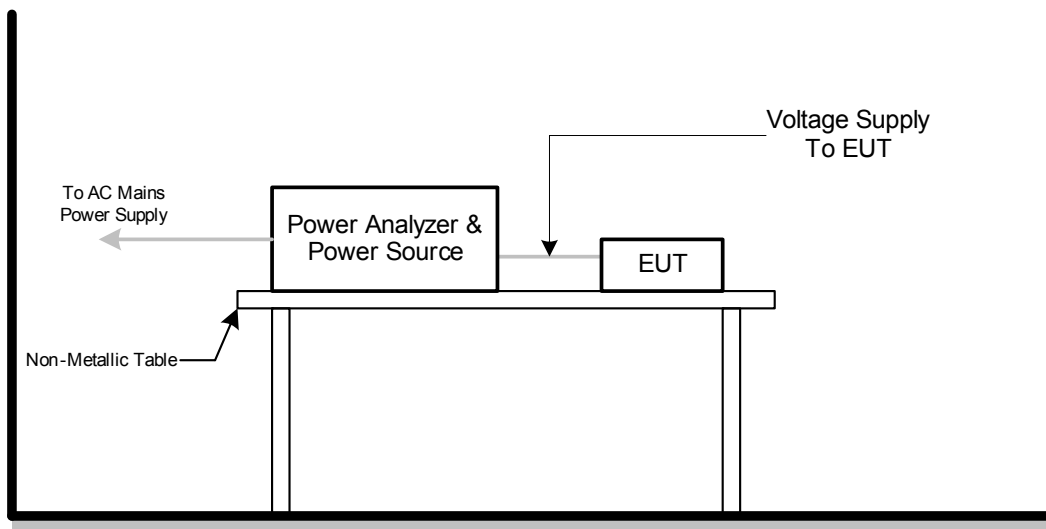
Draft ETSI EN 301 489-1 Clause 8.4  
Final draft EN 301 489-3  
EN 61000-3-3

#### 8.1.2 Limit

**Flicker Test Limit**

Tests	Limits		Descriptions
	IEC555-3	IEC 61000-3-3	
Pst	$\leq 1.0$ , $T_p = 10$ min.	$\leq 1.0$ , $T_p = 10$ min.	Short Term Flicker Indicator
Plt	N/A	$\leq 0.65$ , $T_p = 2$ hr.	Long Term Flicker Indicator
dc	$\leq 3\%$	$\leq 3\%$	Relative Steady-State V-Change
dmax	$\leq 4\%$	$\leq 4\%$	Maximum Relative V-change
d (t)	N/A	$\leq 3\%$ for $> 200$ ms	Relative V-change characteristic

### 8.2 Test Setup



## 8.3 Test Procedure

### 8.3.1 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.

8.3.2 All types of harmonic current and/or voltage fluctuation in this report are assessed by direct measurement using flicker-meter.

8.3.3 For the actual test configuration, please refer to the related Item –Block Diagram of system tested.

## 8.4 Test Data

No requirement for this test item

## 9 Electrostatic Discharge Immunity Test

### 9.1 Test Requirements

#### 9.1.1 Test Standard

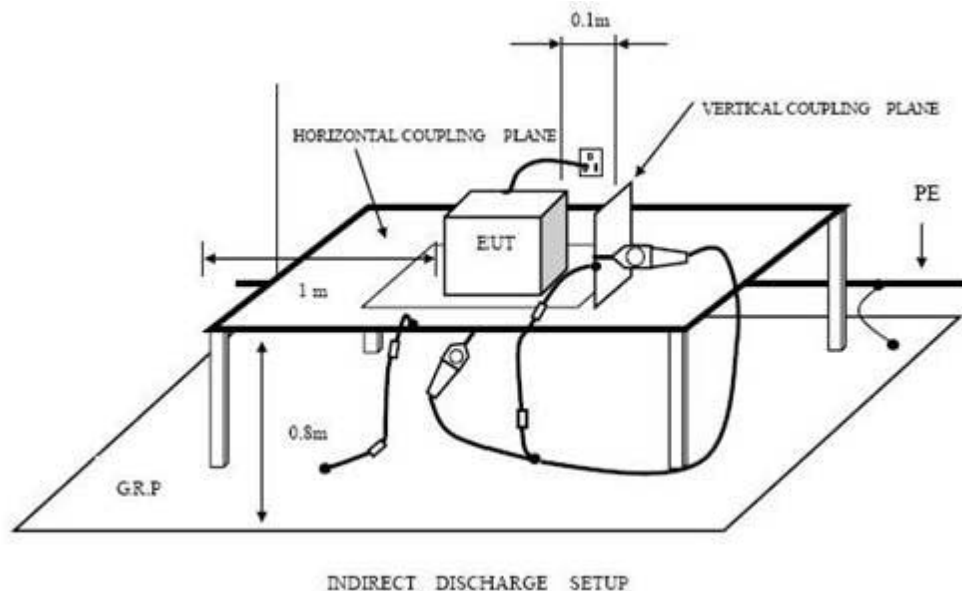
Draft ETSI EN 301 489-1 Clause 9.3  
Final draft EN 301 489-3  
EN 61000-4-2

#### 9.1.2 Test Level

<b>Discharge Impedance:</b>	330 ohm/ 150pF
<b>Discharge Voltage:</b>	Air Discharge: 2kV/4kV/8kV(Direct) 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 Contact Discharge: min.200 times in total
<b>Discharge Mode:</b>	Single Discharge
<b>Discharge Period:</b>	1 second minimum

#### 9.1.3 Performance criterion: B

### 9.2 Test Setup



## 9.3 Test Procedure

### 9.3.1 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.

### 9.3.2 Contact Discharge:

All the procedure shall be same as air discharge. Except that the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

### 9.3.3 Indirect discharge for horizontal coupling plane

At least 10 single discharges (in the most sensitive polarity) shall be applied at the front edge of each HCP opposite the center point of each unit (if applicable) of the EUT and 0.1m from the front of the EUT. The long axis of the discharge electrode shall be in the plane of the HCP and perpendicular to its front edge during the discharge.

### 9.3.4 Indirect discharge for vertical coupling plane

At least 10 single discharges (in the most sensitive polarity) 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.

## 9.4 Test Data

Please refer to the Attachment C.

## 10 Radiated Electromagnetic Field Immunity test

### 10.1 Test Requirements

#### 10.1.1 Test Standard

Draft ETSI EN 301 489-1 Clause 9.2  
Final draft EN 301 489-3  
EN 61000-4-3

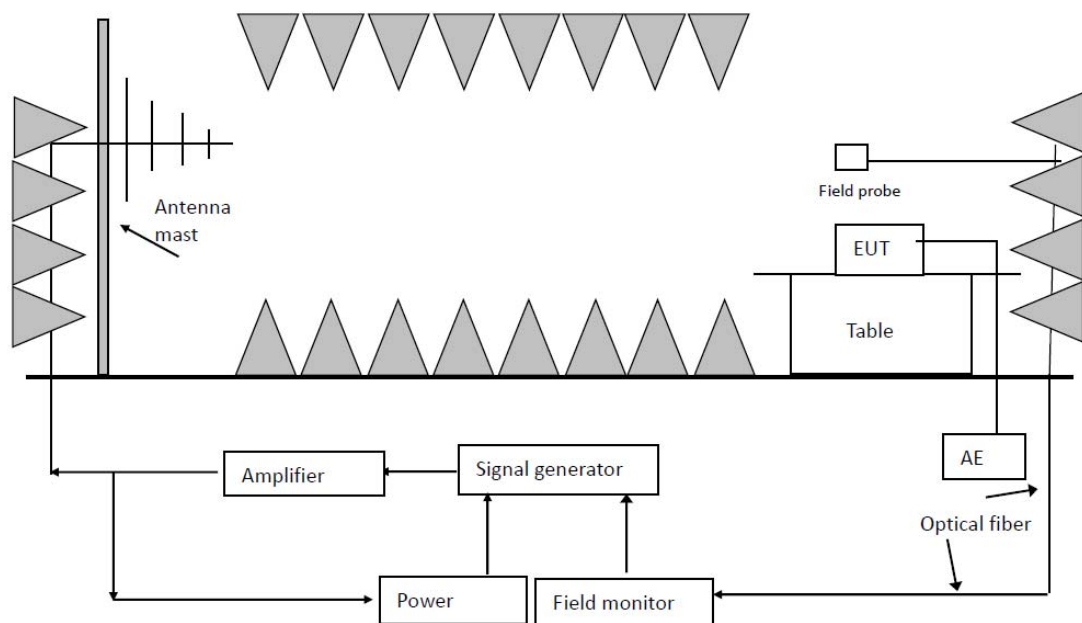
#### 10.1.2 Test Level

##### Test Level for Radiated Electromagnetic Field Immunity Test

Port	Test Specification
Enclosure Port	80-6000MHz 3 V/m 80 % AM (1kHz)

#### 10.1.3 Performance criterion: A

### 10.2 Test Setup



### 10.3 Test Procedure

The EUT are placed on a table, which is 0.8 meter high above the ground. The EUT is set 3 meters away from the transmitting antenna, which is mounted on an antenna tower. Both horizontal and vertical polarization of the antenna is set on test. Each of the four sides of the EUT must be faced this transmitting antenna and measured individually.

In order to judge the EUT performance, a camera is used to monitor its screen.

All the scanning conditions are as following:

Condition of Test	Remark
Fielded Strength	3V/m
Radiated Signal	80%AM,1kHz Since Wave
Scanning Frequency	80-6000MHz
Sweep time of radiated	0.0015 Decade/s
Dwell Time	3 Sec.

### 10.4 Test Data

Please refer to the Attachment D.

## 11Electrical Fast Transient/Burst Test

### 11.1 Test Requirements

#### 11.1.1 Test Standard

Draft ETSI EN 301 489-1 Clause 9.4  
Final draft EN 301 489-3  
EN 61000-4-4

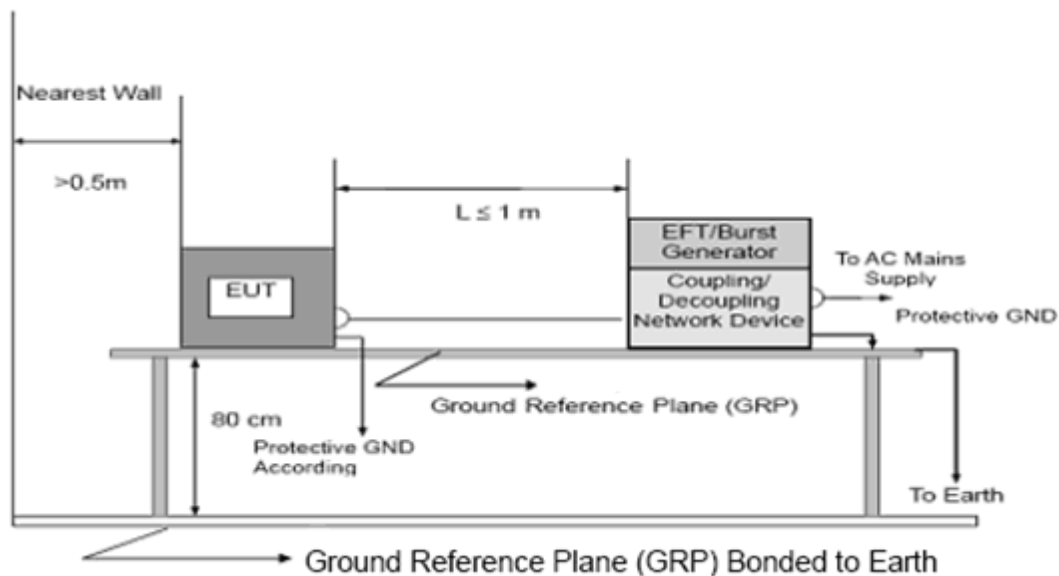
#### 11.1.2 Test Level

**Test Level for Electrical Fast Transient Test**

	On Switching Adapter Lines	On I/O (Input/Output) Signal data and control lines
<b>Test Voltage:</b>	1 KV	0.5 KV
<b>Polarity:</b>	Positive& Negative	
<b>Impulse Wave Shape:</b>	5/50ns	
<b>Burst Duration:</b>	15ms	
<b>Burst Period:</b>	300ms	
<b>Test Duration:</b>	Not less than 1 min	

#### 11.1.3 Performance criterion: B

### 11.2 Test Setup





## 11.3 Test Procedure

### 11.3.1 For input and output AC power ports:

The EUT is connected to the power mains by using a coupling device which couples the EFT interference signal to AC power lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 1minute.

### 11.3.2 For signal lines and control lines ports:

A coupling clamp is use to couple the EFT interference signal to the signal and control lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 1 minute.

### 11.3.3 For DC input and DC output power ports:

The EUT is connected to the power mains by using a coupling device which couples the EFT interference signal to DC power lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 1 minute.

## 11.4 Test Data

Please refer to the Attachment E.

## 12 Surge Immunity Test

### 12.1 Test Requirements

#### 12.1.1 Test Standard

Draft ETSI EN 301 489-1 Clause 9.8  
Final draft EN 301 489-3  
EN 61000-4-5

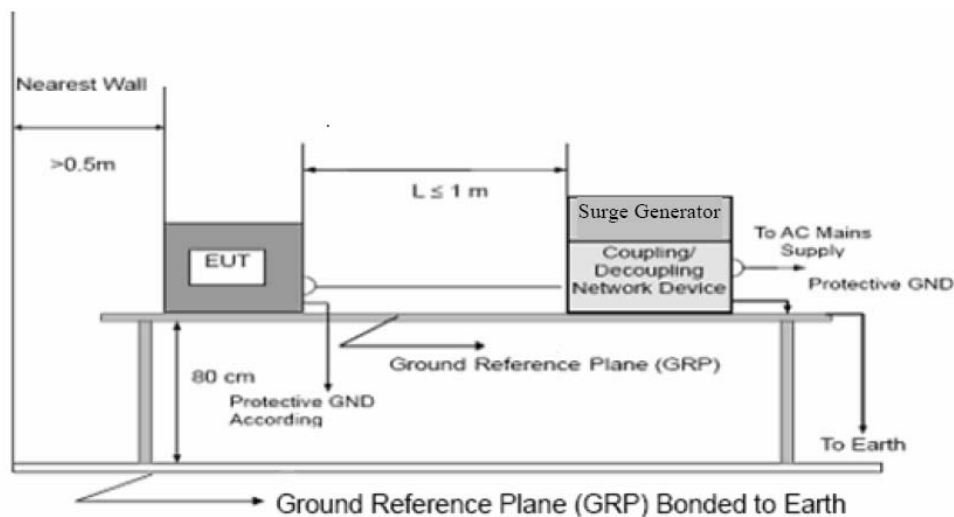
#### 12.1.2 Level

**Test Level for Surge Immunity Test**

<b>Basic Standard:</b>	<b>EN 61000-4-5</b>
<b>Wave-Shape:</b>	Combination Wave 1.2/50us Open Circuit Voltage 8/20us Short Circuit Current
<b>Test Voltage</b>	Power Line:0.5kV,1kV,2kV
<b>Surge Input/Output:</b>	L1-L2,L1-PE,L2-PE
<b>Generator Source:</b>	2 ohm between networks
<b>Impedance:</b>	12ohm 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

#### 12.1.3 Performance criterion: B

### 12.2 Test Setup



## 12.3 Test Procedure

12.3.1 Set up the EUT and test generator.

12.3.2 For line to line coupling mode, provide a 1.0 KV 1.2/50us voltage surge

12.3.3 (at open-circuit condition) and 8/20us current surge to EUT selected points.

12.3.4 At least 5 positive and 5 negative (polarity) tests with a maximum 1/min repetition rate are conducted during test.

12.3.5 Different phase angles are done individually.

12.3.6 Record the EUT operating situation during compliance test and decide the EUT immunity criterion for above each test.

## 12.4 Test Data

Please refer to the Attachment F.

## 13RF Common Mode

### 13.1 Test Requirements

#### 13.1.1 Test Standard

Draft ETSI EN 301 489-1 Clause 9.5  
Final draft EN 301 489-3  
EN 61000-4-6

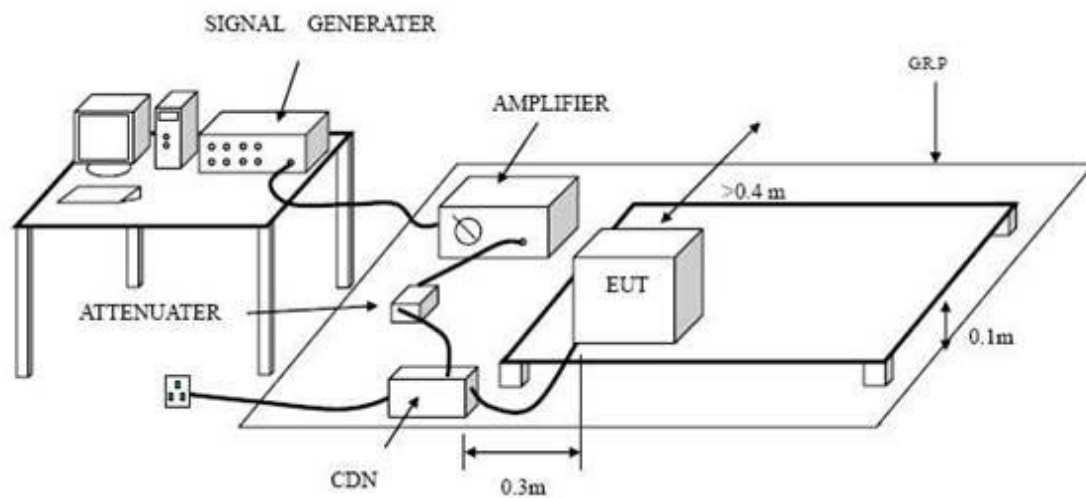
#### 13.1.2 Test Level

**Test Level for RF Common Mode**

Port	Test Specification
Input AC power port	0.15MHz~80MHz 3V(r.m.s.) (unmodulated)

#### 13.1.3 Performance criterion: A

### 13.2 Test Setup



### 13.3 Test Procedure

13.3.1 Set up the EUT, CDN and test generators.

13.3.2 Let the EUT work in test mode and test it.

13.3.3 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 50 mm (where possible).

13.3.4 The disturbance signal description below is injected to EUT through CDN.

13.3.5 The EUT operates within its operational mode(s) under intended climatic conditions after power on.

13.3.6 The frequency range is swept from 0.150MHz to 230MHz using 3V signal level, and with the disturbance signal 80% amplitude modulated with a 1KHz sine wave.

13.3.7 The rate of sweep shall not exceed  $1.5 \times 10^{-3}$  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.

13.3.8 Recording the EUT operating situation during compliance testing and decide the EUT immunity criterion.

### 13.4 Test Data

Please refer to the Attachment G.

## 14 Voltage Dips and Interruptions Immunity Test

### 14.1 Test Requirements

#### 14.1.1 Test Standard

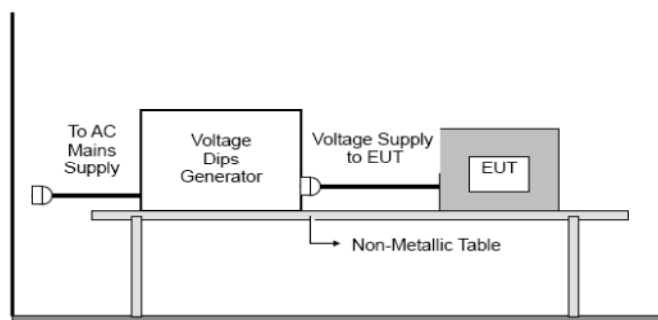
Draft ETSI EN 301 489-1 Clause 9.7  
Final draft EN 301 489-3  
EN 61000-4-11

#### 14.1.2 Level

##### Test Level for Voltage Dips and Interruptions

<b>Basic Standard:</b>	<b>EN 61000-4-11</b>
<b>Required Performance:</b>	B(For 100% Voltage Dips) B(For 100% Voltage Dips) C(For 30% Voltage Dips) C(For 100% 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

### 14.2 Test Setup



### 14.3 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.

### 14.4 Test Data

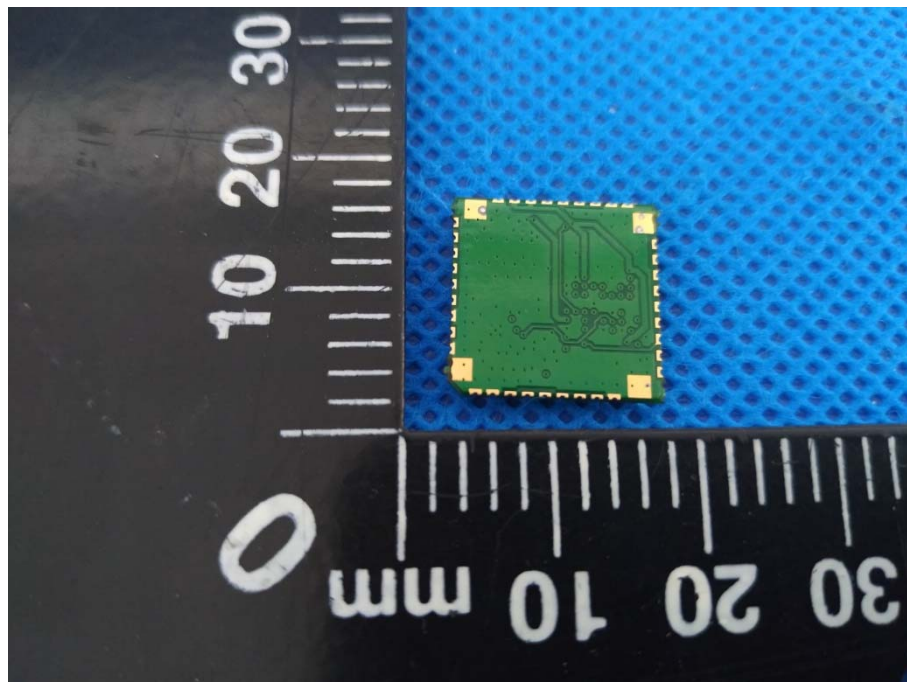
Please refer to the Attachment H.

## 15Photographs - Constructional Details

Photo 1



Photo 2



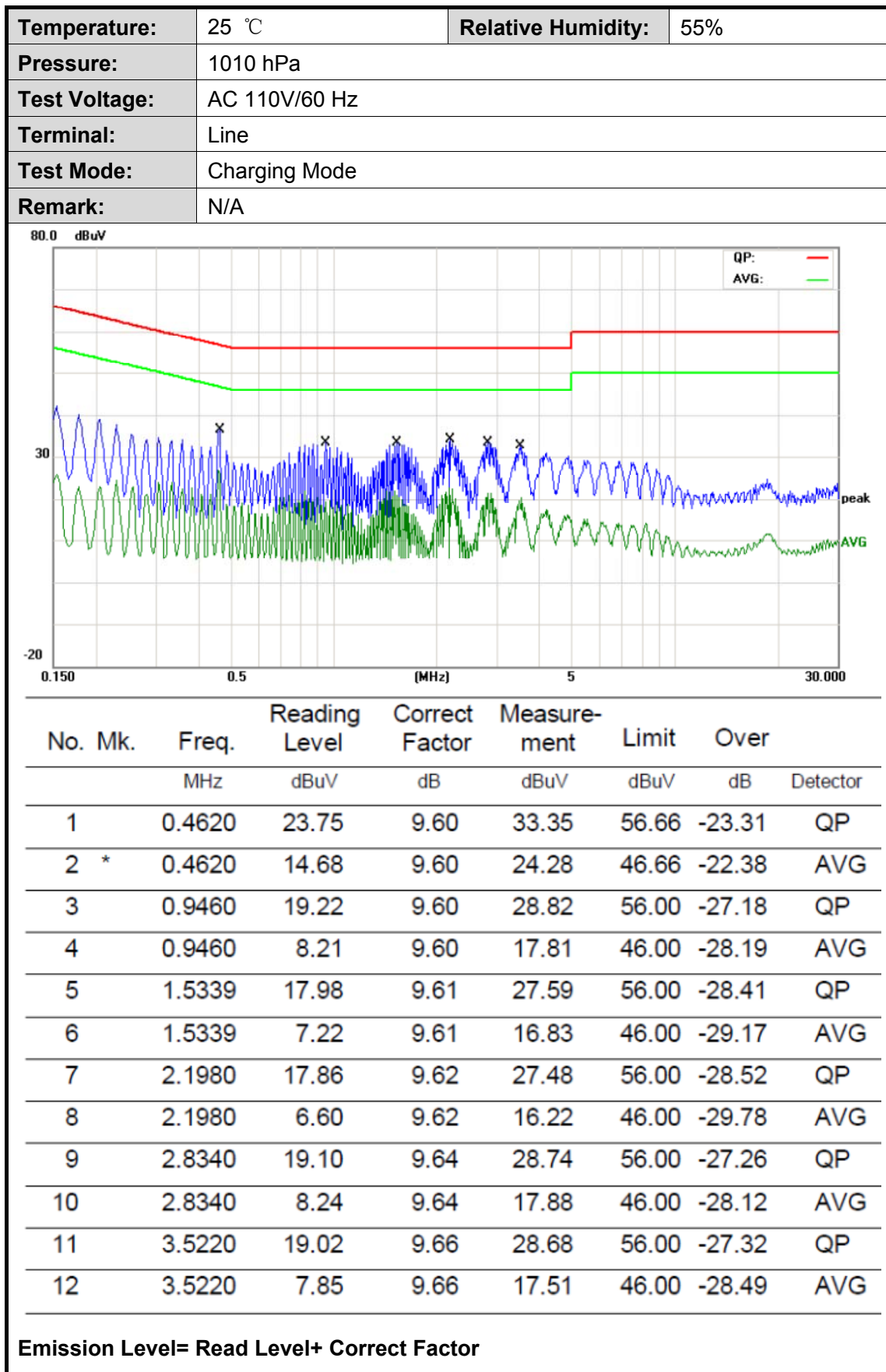
## 16Photographs –Test Setup

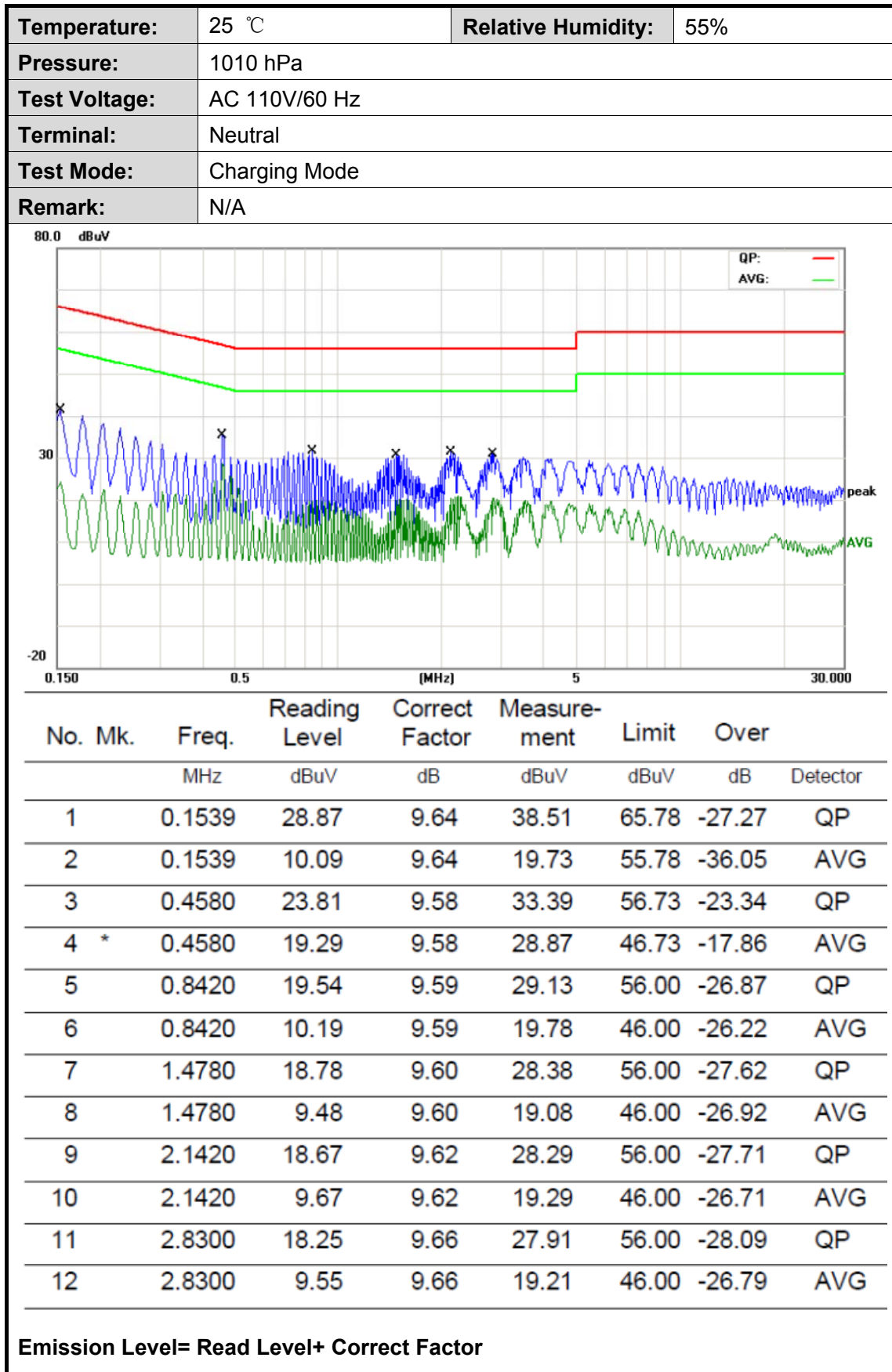
Radiated Measurement

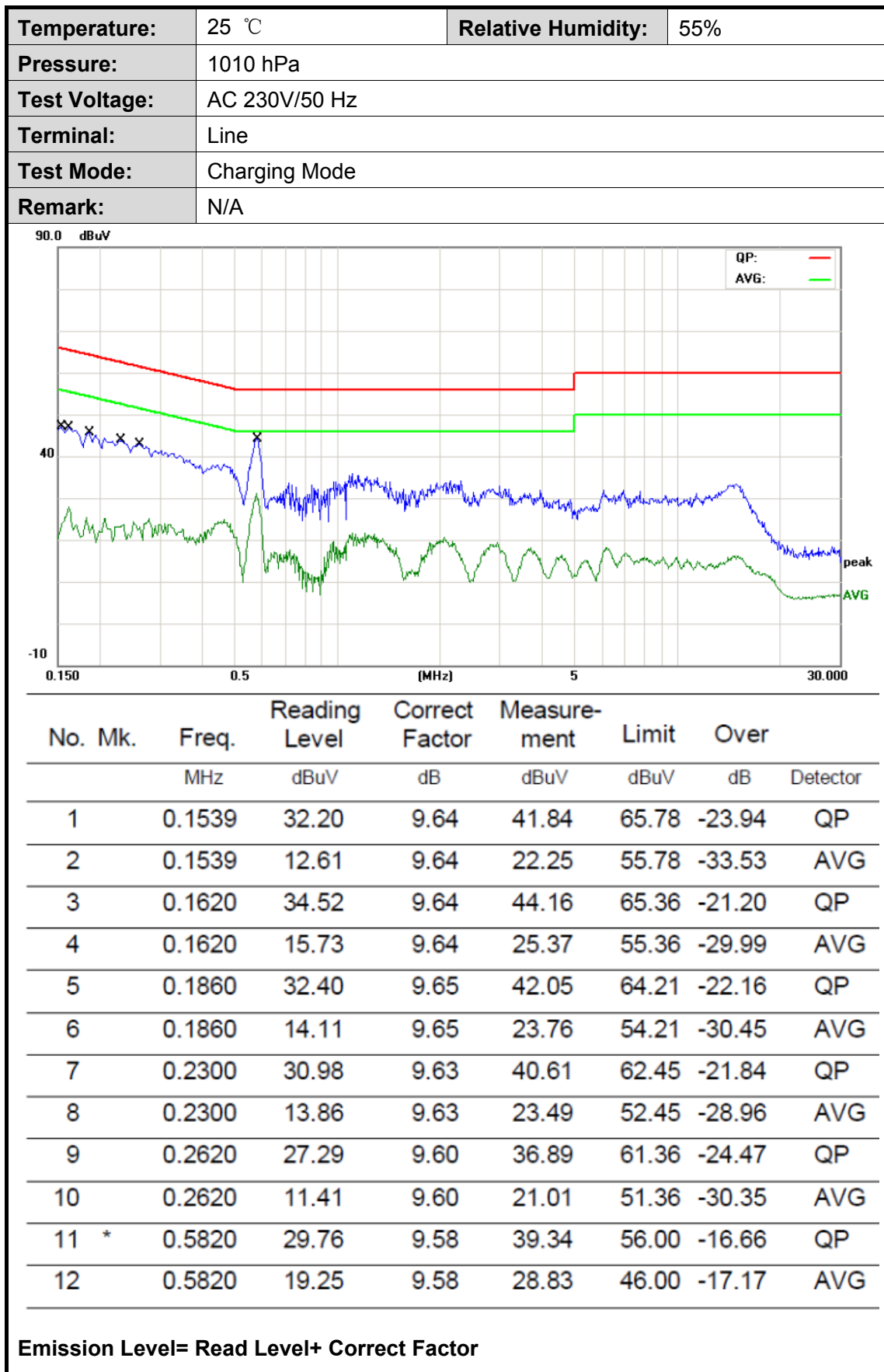


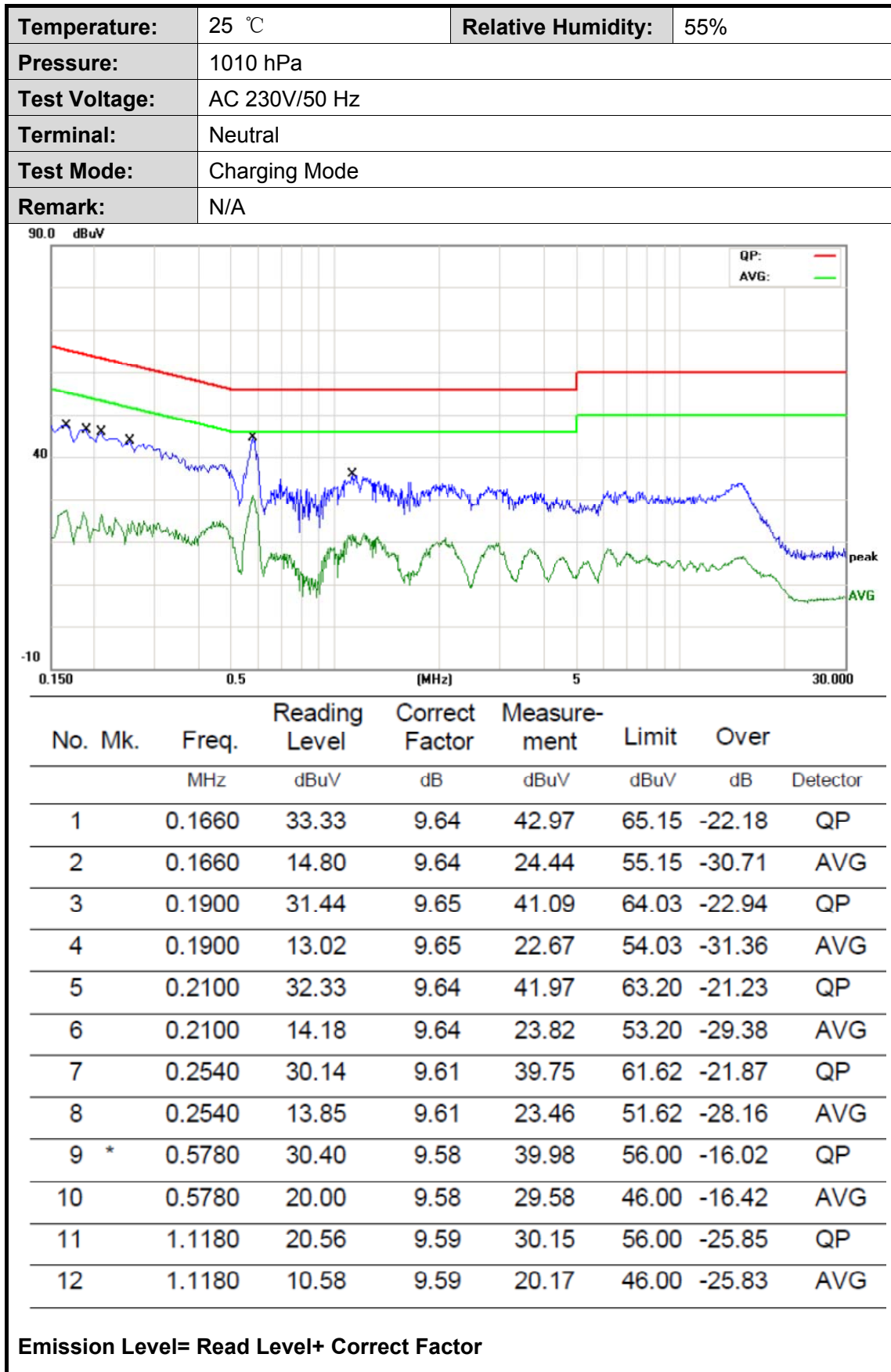


## Attachment A--Conducted Emission Data



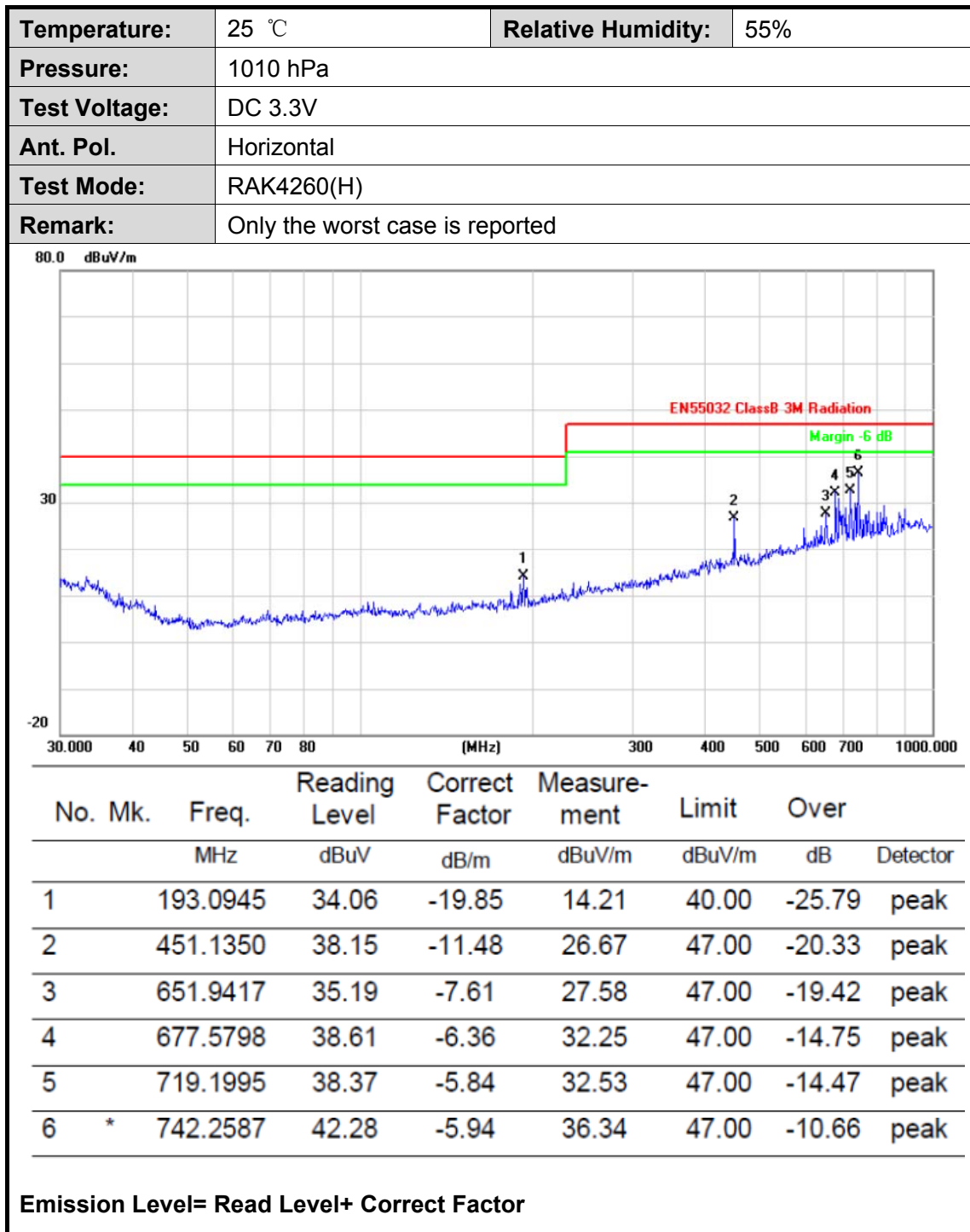


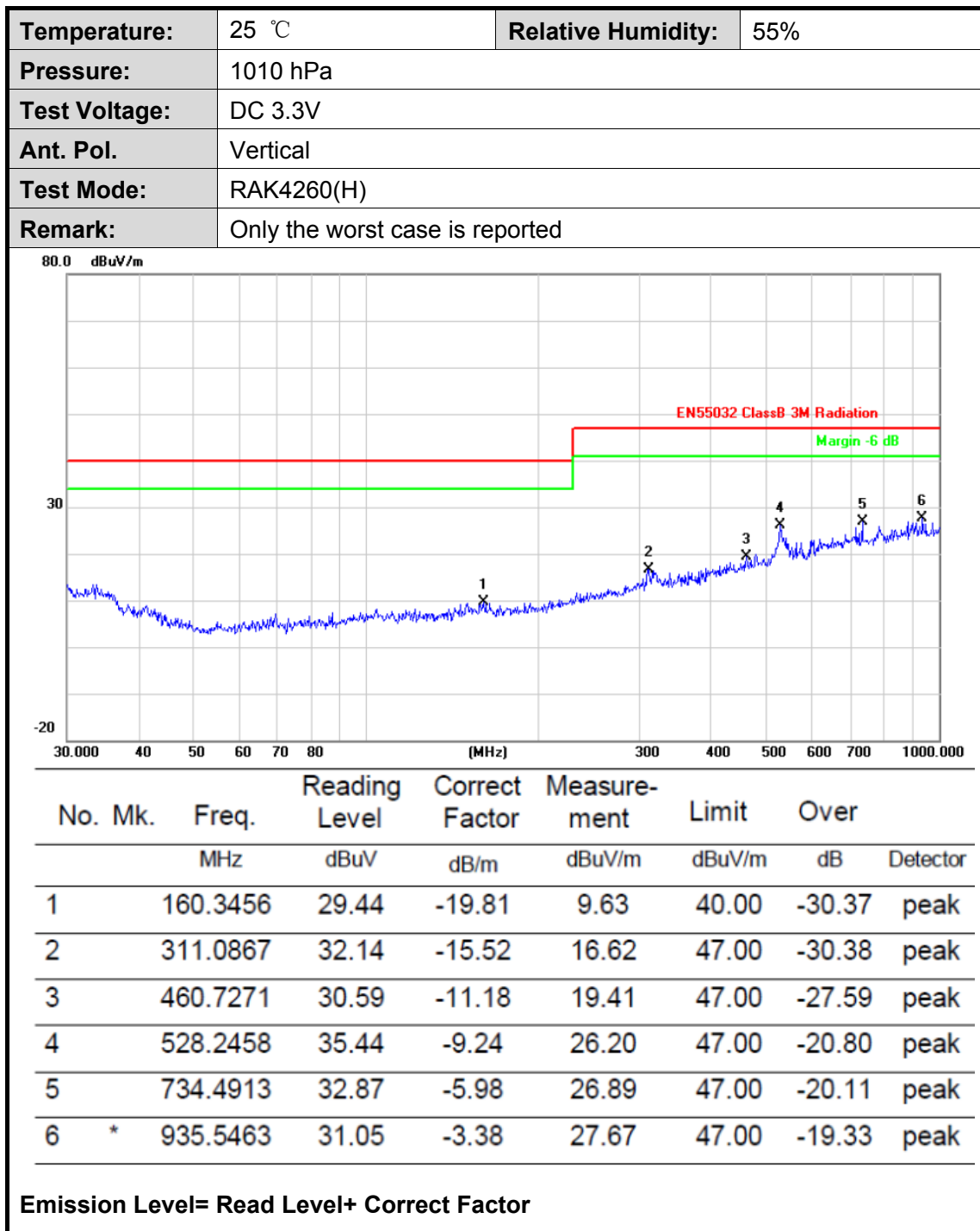




## Attachment B--Radiated Emission Test Data

-----Below 1G





Temperature:	25 °C	Relative Humidity:	55%
Pressure:	1010 hPa		
Test Voltage:	DC 3.3V		
Ant. Pol.	Horizontal		
Test Mode:	RAK4260(H)		
Remark:	Only the worst case is reported		

80.0 dBuV/m

EN55032 ClassB 3M Radiation

Margin -6 dB

1 2 3 4 5 6

30.000 40 50 60 70 80 (MHz) 300 400 500 600 700 1000.000

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		56.9912	42.75	-23.89	18.86	40.00	-21.14	peak
2		166.0680	39.97	-20.17	19.80	40.00	-20.20	peak
3		236.6447	36.35	-17.74	18.61	47.00	-28.39	peak
4		339.5888	37.31	-14.15	23.16	47.00	-23.84	peak
5		729.3583	36.77	-6.00	30.77	47.00	-16.23	peak
6	*	782.3453	36.30	-5.45	30.85	47.00	-16.15	peak

Emission Level= Read Level+ Correct Factor



Temperature:	25 °C	Relative Humidity:	55%
Pressure:	1010 hPa		
Test Voltage:	DC 3.3V		
Ant. Pol.	Vertical		
Test Mode:	RAK4260(H)		
Remark:	Only the worst case is reported		

80.0 dBuV/m

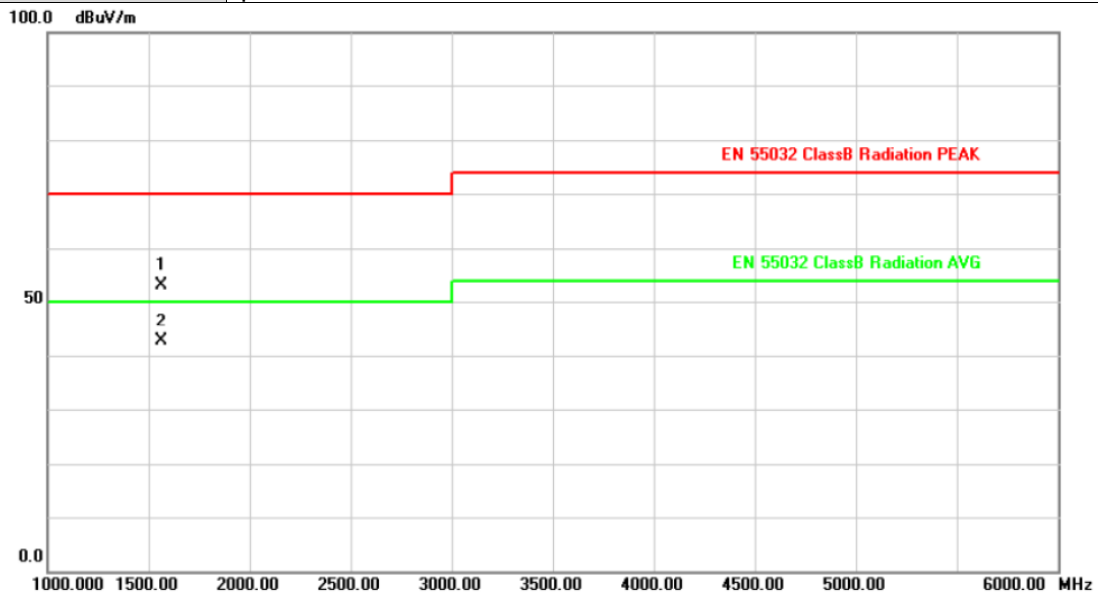
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		49.1865	52.19	-23.46	28.73	40.00	-11.27	peak
2		54.0711	48.41	-23.85	24.56	40.00	-15.44	peak
3		64.8865	48.80	-23.51	25.29	40.00	-14.71	peak
4		121.5486	45.86	-21.83	24.03	40.00	-15.97	peak
5		156.4578	48.58	-20.05	28.53	40.00	-11.47	peak
6	*	166.6514	49.75	-20.21	29.54	40.00	-10.46	peak

  
Emission Level= Read Level+ Correct Factor



-----Above 1G

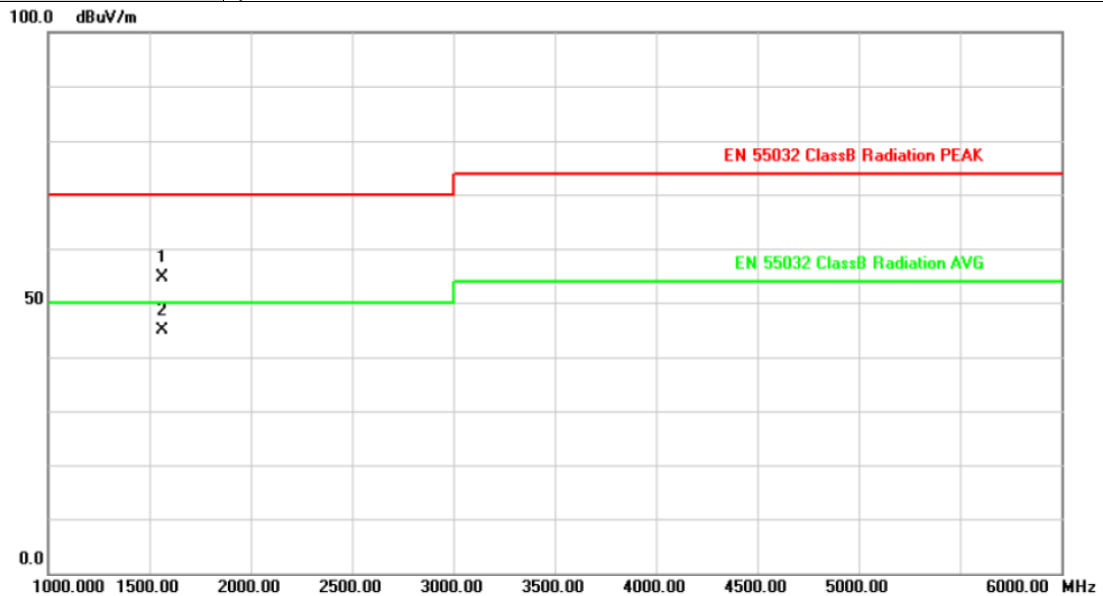
Temperature:	25 °C	Relative Humidity:	55%
Pressure:	1010 hPa		
Test Voltage:	DC 3.3V		
Ant. Pol.	Horizontal		
Test Mode:	RAK4260(H)		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		1565.840	54.32	-1.18	53.14	70.00	-16.86	peak
2	*	1565.840	43.76	-1.18	42.58	50.00	-7.42	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Pressure:	1010 hPa		
Test Voltage:	DC 3.3V		
Ant. Pol.	Vertical		
Test Mode:	RAK4260(H)		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		1565.840	55.79	-1.18	54.61	70.00	-15.39	peak
2	*	1565.840	46.03	-1.18	44.85	50.00	-5.15	AVG

Emission Level= Read Level+ Correct Factor

## Attachment C--Electrostatic Discharge Test Data

Temperature:	22°C	Humidity :	50%
Power Supply:	DC 3.3V	Test Mode :	RAK4260(H)
Test Engineer :	Jason		
Air Discharge: ±2kV/±4kV/±8kV Contact Discharge: ±2kV/±4kV For each point positive 10 times and negative 10 times discharge.			
Location	Test Level (kV)	No. of Discharge	Result
A1	±2kV ±4kV ±8kV	20	A
A2		20	A
A3		20	A
A4		20	A
A5		20	A
A6		20	A
/	±2kV	/	/
/	±4kV	/	/
HCP	±4kV	40	A
VCP	±4kV	40	A
Note: "/" Representative the test not applicable			
Note: 1) Criteria A: There was no change operated with initial operating during the test. 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test. 3) Criteria C: The system shut down during the test.			

## Attachment D--RF Field Strength Susceptibility Test Data

Temperature : 22°C Humidity : 50%

Power supply : DC 3.3V Test Mode : RAK4260(H)

### Required Performance Criteria: A

Modulation: AM 80%

Pulse: 1 kHz

EUT Position	Actual Performance Criteria				Judgment
	Frequency Range 1: 80~1000MHz		Frequency Range 2: 1000~6000MHz		
	Horizontal	Vertical	Horizontal	Vertical	
Front	A	A	A	A	PASS
Right	A	A	A	A	PASS
Rear	A	A	A	A	PASS
Left	A	A	A	A	PASS

### Remark:

- 1) Criteria A: There was no change operated with initial operating during the test.
- 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.
- 3) Criteria C: The system shut down during the test.

## Attachment E--Electrical Fast Transient/Burst Test Data

Temperature : 22°C

Humidity : 50%

Power

supply : AC 230V/50Hz

Test Mode : RAK4260(H)

### Required Performance Criteria: B

Line : ☒ AC Mains Coupling : ☒ Direct

Line : ☐ Signal ☐ I/O Cable Coupling : ☐ Capacitive

Line		Voltage(kV)	Required Performance Criteria		Actual Performance Criteria		Judgment
			(+)	(-)	(+)	(-)	
AC LINE	L	1.0	B	B	A	A	PASS
	N	1.0	B	B	A	A	PASS
	L-N	1.0	B	B	A	A	PASS
	L-PE	1.0	/	/	/	/	/
	N-PE	1.0	/	/	/	/	/
	L-N-PE	1.0	/	/	/	/	/
DC LINE		/	/	/	/	/	/
Signal Line		/	/	/	/	/	/

### Remark:

- 1) Criteria A: There was no change operated with initial operating during the test.
- 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.
- 3) Criteria C: The system shut down during the test.

Temperature : 22℃		Humidity : 50%				
Power supply : AC 230V/50Hz		Test Mode : RAK4260(H)				
Required Performance Criteria: B						
Injected Line	Voltage (kV)	Phase	Actual Performance Criteria		Result	
			(+)	(-)	(+)	(-)
L, N, L-N	1.0	0°	A	A	PASS	PASS
		90°	A	A	PASS	PASS
		180°	A	A	PASS	PASS
		270°	A	A	PASS	PASS
L/N-PE	2.0	0°	/	/	/	/
		90°	/	/	/	/
		180°	/	/	/	/
		270°	/	/	/	/
L-N-PE	2.0	0°	/	/	/	/
		90°	/	/	/	/
		180°	/	/	/	/
		270°	/	/	/	/
Signal Line	1.0	+/-	/	/	/	/
Remark: 1) Criteria A: There was no change operated with initial operating during the test. 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test. 3) Criteria C: The system shut down during the test.						

## Attachment G--Conducted Immunity Test Data

Temperature : 22°C Humidity : 50%

Power supply : AC 230V/50Hz Test Mode : RAK4260(H)

**Required Performance Criteria: A**

Frequency Range (MHz)	Injected Position	Voltage Level (e.m.f.)	Required Performance Criteria	Actual Performance Criteria	Result
0.15 ~ 80	AC Mains	3V(rms), AM 80% Modulated with 1 kHz	A	A	PASS
0.15 ~ 80	DC Mains	3V(rms), AM 80% Modulated with 1 kHz	A	/	/
0.15 ~ 80	Signal Line	3V(rms), AM 80% Modulated with 1 kHz	A	/	/

**Remark:**

- 1) Criteria A: There was no change operated with initial operating during the test.
- 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.
- 3) Criteria C: The system shut down during the test.

## Attachment H--Voltage Dips and Interruptions Test Data

Temperature :	22℃	Humidity :	50 %	
Power Supply :	AC 230V/50Hz	Test Mode :	RAK4260(H)	
Required Performance Criteria: B&C				
Test Results Description				
Voltage Reduction	Cycles	Perform Criteria	Results	Judgment
Voltage dip 100%	0.5	B	A	PASS
Voltage dip 100%	1	B	A	PASS
Voltage dip 30%	25	C	B	PASS
Voltage Interruption100%	250	C	C	PASS
Remark: 1) Criteria A: There was no change operated with initial operating during the test. 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test. 3) Criteria C: The system shut down during the test.				

-----END OF REPORT-----