



TEST REPORT

Reference No. : WTS18S05113608-2W

Manufacturer * : Shenzhen EBELONG Technology Co., Ltd

Address : Shenzhen wisdom innovation center Suite A.607, Qianjin 2nd Road,
Baoan District, ShenZhen, Guangdong, China

Factory : Shenzhen EBELONG Technology Co., Ltd

Address : Shenzhen wisdom innovation center Suite A.607, Qianjin 2nd Road,
Baoan District, ShenZhen, Guangdong, China

Product : RX: WIFI wireless controller
TX: Batteryless wireless switch

Model(s) : RX: ERC309, ERC309-H, ERC609
TX: Refer to section 5.3

Standards : EN 300 220-1 V3.1.1:2017
EN 300 220-2 V3.1.1:2017
Draft ETSI EN 301 489-1 V2.2.0:2017
Final Draft ETSI EN 301 489-3 V2.1.1:2017
Draft ETSI EN 301 489-17 V3.2.0: 2017
EN 62479: 2010

Date of Receipt sample : 2018-06-02

Date of Test : 2018-06-02 to 2018-06-11

Date of Issue : 2018-06-12

Test Result : **Pass**

Remarks:

1. The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.
2. "Manufacturer" means any natural or legal person who manufactures radio equipment or has radio equipment designed or manufactured, and markets that equipment under his name or trade mark.

Prepared By:

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Jack Wen / Project Engineer

Philo Zhong

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2 Laboratories Introduction

Waltek Services (Shenzhen) Co., Ltd is a professional third-party testing and certification laboratory with multi-year product testing and certification experience, established strictly in accordance with ISO/IEC 17025 requirements, and accredited by ILAC (International Laboratory Accreditation Cooperation) member. A2LA (American Association for Laboratory Accreditation) of USA, Meanwhile, Waltek has got recognition as registration and accreditation laboratory from EMSD (Electrical and Mechanical Services Department), and American Energy star, FCC(The Federal Communications Commission), CEC(California energy efficiency), IC(Industry Canada). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as Intertek(ETL-SEMKO), TÜV Rheinland, TÜV SÜD, etc.



Waltek Services (Shenzhen) Co., Ltd is one of the largest and the most comprehensive third party testing laboratory in China. Our test capability covered four large fields: safety test. ElectroMagnetic Compatibility(EMC), and energy performance, wireless radio. As a professional, comprehensive, justice international test organization, we still keep the scientific and rigorous work attitude to help each client satisfy the international standards and assist their product enter into globe market smoothly.



2.1 Test Facility

A. Accreditations for Conformity Assessment (International)

Country/Region	Accreditation Body	Scope	Note
USA	A2LA (Certificate No.: 4243.01)	FCC ID \ DOC \ VOC	1
Canada		IC ID \ VOC	2
Japan		MIC-T \ MIC-R	-
Europe		EMCD \ RED	-
Taiwan		NCC	-
Hong Kong		OFCA	-
Australia		RCM	-
India	International Services	WPC	-
Thailand		NTC	-
Singapore		IDA	-
Note:			
1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.			
2. IC Canada Registration No.: 7760A			

B.TCBs and Notify Bodies Recognized Testing Laboratory.

Recognized Testing Laboratory of ...	Notify body number
TUV Rheinland	Optional.
Intertek	
TUV SUD	
SGS	
Phoenix Testlab GmbH	0700
Element Materials Technology Warwick Ltd	0891
Timco Engineering, Inc.	1177
Eurofins Product Service GmbH	0681



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**4 Revision History**

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS18S05113608-2W	2018-06-02	2018-06-02 to 2018-06-11	2018-06-12	original	-	Valid

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5 General Information

5.1 General Description of E.U.T

Product:	RX: WIFI wireless controller TX: Batteryless wireless switch
Model(s):	RX: ERC309, ERC309-H, ERC609 TX: Refer to section 5.3
Model Description:	RX: Only the model names and shapes are different. TX: Refer to section 5.3
Hardware Version:	RX: ERC309, ERC309-H, ERC609: V1.3 TX: N/A
Software Version:	RX: ERC309, ERC309-H, ERC609: 1.1 TX: N/A

5.2 Details of E.U.T

Frequency Range:	433.28MHz
Type of Modulation:	FSK
Antenna installation:	Integrated Antenna

5.3 Details of product

TX:

Product	Model	Description
Batteryless wireless switch	ES2154	S2 series white one-button switch
	ES2254	S2 series white double button switches
	ES2354	S2 series white three-button switches
	ES2111	S2 series grey one-button switch
	ES2211	S2 series grey double button switches
	ES2311	S2 series grey three-button switches
	ES2165	S2 series gold one-button switch
	ES2265	S2 series gold two-button switches
	ES2365	S2 series gold three-button switches
	ES2187	S2 series silver one-button switch
	ES2287	S2 series silver two-button switches
	ES2387	S2 series silver three-button switches



5.4 Annex D (informative): Application form for testing

D.1 Introduction

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the application form in this annex so that it can be used for its intended purposes and may further publish the completed application form. The form contained in this annex may be used by the manufacturer to comply with the requirement contained in clause 4 to provide the necessary information about the equipment to the test laboratory prior to the testing. It contains product information as well as other information which might be required to define which configurations are to be tested, which tests are to be performed as well the test conditions. This application form should form an integral part of the test report.

D.2 Information to declare according to ETSI EN 300 220-2

In accordance with ETSI EN 300 220-2 clause 4, the following information is provided by the manufacturer.

a) The name of the manufacturer or his trademark:
.....Shenzhen EBELONG Technology Co., Ltd.....
b) The type equipment designation:
.....SRD.....
c) The Application(s) of the equipment:
.....RX: WIFI wireless controller, TX: Batteryless wireless switch.....
d) The operating frequency(ies):
.....433.31MHz.....
e) The operational frequency band(s):
.....433.050 MHz to 434.790MHz.....
f) The operating channel(s) width(s):
.....191.62kHz.....
The operating channel is less than or equal to 25 kHz? <input type="checkbox"/>
g) Maximum radio-frequency power transmitted in the frequency band(s) in which the radio equipment operates:
.....-14.18dBm.....
h) What is the spectrum access mechanism of the equipment?:
<input checked="" type="checkbox"/> Duty cycle
<input type="checkbox"/> Polite spectrum access
i) In case of polite spectrum access:
The CCA time implemented by the equipment is..... ms.
The minimal unit of deferral period is:
The deadtime TDIS isms.
j) Is the equipment battery powered?
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
k) Is the equipment frequency agile?
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
l) Is the equipment declared as FHSS?
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
m) In case of FHSS equipment:
The declared hop channel bandwidth iskHz.
The number of non-overlapping channels or hopping positions separated by the declared hop channel bandwidth is.....
The dwell time per channel is ms.
The return time to a hop channel is ms.
Is CCA implemented in the equipment? <input type="checkbox"/> Yes <input type="checkbox"/> No



5.5 Standards Applicable for Testing

The tests were performed according to following standards:

EN 300 220-1 V3.1.1:2017

Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 1: Technical characteristics and methods of measurement

EN 300 220-2 V3.1.1:2017

Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 2: Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for non specific radio equipment



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6 Test Summary

RF PART		
Test	Applicable Standard	Result
Operating frequency	EN 300 220-2	Pass
Unwanted emissions in the spurious domain for TX mode	EN 300 220-2	Pass
Unwanted emissions in the spurious domain for RX mode	EN 300 220-2	Pass
Effective Radiated Power	EN 300 220-2	Pass
Maximum e.r.p. spectral density	EN 300 220-2	N/A
Duty Cycle	EN 300 220-2	Pass
Occupied Bandwidth	EN 300 220-2	Pass
Tx Out of Band Emissions	EN 300 220-2	Pass
Transient power	EN 300 220-2	Pass
Adjacent Channel Power	EN 300 220-2	N/A
TX behaviour under Low Voltage Conditions	EN 300 220-2	N/A
Adaptive Power Control	EN 300 220-2	N/A
FHSS equipment	EN 300 220-2	N/A
Short term behaviour	EN 300 220-2	N/A
RX sensitivity	EN 300 220-2	N/A
Blocking	EN 300 220-2	Pass
Clear Channel Assessment threshold	EN 300 220-2	N/A
Polite spectrum access timing parameters	EN 300 220-2	N/A
Adaptive Frequency Agility	EN 300 220-2	N/A
EMC PART		
Test	Applicable Standard	Result
Radiated emission	EN 301 489-1/3/17	Pass
Conducted emissions: DC power input/output ports	EN 301 489-1/3/17	N/A



Conducted emissions: AC mains power input/output ports	EN 301 489-1/3/17	Pass
Harmonic current emission (AC mains input port)	EN 301 489-1/3/17	Pass
Voltage fluctuations and flicker (AC mains input ports)	EN 301 489-1/3/17	Pass
Conducted emissions: Wired network ports	EN 301 489-1/3/17	N/A
Radio frequency electromagnetic field (80 MHz to 6 000 MHz)	EN 301 489-1/3/17	Pass
Electrostatic discharge	EN 301 489-1/3/17	Pass
Fast transients common mode	EN 301 489-1/3/17	Pass
RF common mode 0.15MHz to 80MHz	EN 301 489-1/3/17	Pass
Transients and surges (DC power input ports)	EN 301 489-1/3/17	N/A
Voltage dips and interruptions	EN 301 489-1/3/17	Pass
Surges, line to line and line to ground	EN 301 489-1/3/17	Pass
HEALTH PART		
Test	Applicable Standard	Result
RF Exposure	EN 62479	Pass
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable		

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7 Equipment Used during Test

7.1 Equipments List

Conducted Emission						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMI Test Receiver	R&S	ESCI	100947	2017-09-12	2018-09-11
2	LISN	R&S	ENV216	100115	2017-09-12	2018-09-11
3	Cable	Top	TYPE16(3.5M)	-	2017-09-12	2018-09-11
3m Semi-anechoic Chamber for Radiated Emission						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP	100091	2018-04-28	2019-04-27
2	Amplifier	Agilent	8447D	2944A10178	2018-01-11	2019-01-10
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	0703	2017-10-17	2018-10-16
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2018-04-06	2019-04-05
5	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2017-09-12	2018-09-11
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2018-04-06	2019-04-05
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2018-04-06	2019-04-05
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	2018-04-06	2019-04-05
Electrostatic discharge						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Electrostatic Discharge Simulator	SCHLODER	SESD 216	606144	2017-11-14	2018-11-13
RF common mode 0.15MHz to 80MHz						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	RF Generator	TESEQ	NSG4070	25781	2017-09-12	2018-09-11
2	CDN M-Type	TESEQ	CDN M016	25112	2017-09-12	2018-09-11
3	EM-Clamp	TESEQ	KEMZ 801	25453	2017-09-12	2018-09-11
4	Attenuator 6dB	TESEQ	ATN6050	25365	2017-09-12	2018-09-11
Fast transients common mode, Voltage dips and interruptions, Surge, line to line and line to ground						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	All Modules Generator	SCHAFFNER	6150	34579	2017-09-22	2018-09-21
2	EMS Modules	EMC PARTNER	2000	494	2017-09-22	2018-09-21



	Generator	TRANSIENT				
3	Capacitive Coupling Clamp	SCHAFFNER	CDN 8014	25311	2017-09-22	2018-09-21
4	Signal and Data Line Coupling Network	SCHAFFNER	CDN 117	25627	2017-09-22	2018-09-21
Radio-frequency electromagnetic fields (80MHz to 6000MHz)						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Signal Generator	R&S	SMB100A	105942	2017-09-12	2018-09-11
2	RF Power Amplifier	BONN Elektronik	BLWA0830-160/100/40D	128740	2017-09-12	2018-09-11
3	RF Power Amplifier	NJNT	NTWPAS-2560025	2560025	2018-04-14	2019-04-13
4	Gestockte Breitband (S tacked) Log.-per.Antenna	SCHWARZBECK	STLP9128D	043	2017-09-12	2018-09-11
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2018-04-06	2019-04-05
6	Power Meter	R&S	NRP2	102031	2017-09-12	2018-09-11
3m Semi-anechoic Chamber for Radiated Emission						
Item	Equipment	Manufacturer	Model No.	Serial No	Last Calibration Date	Calibration Due Date
1	Test Receiver	R&S	ESCI	101296	2018-04-06	2019-04-05
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2018-04-06	2019-04-05
3	Amplifier	ANRITSU	MH648A	M43381	2018-04-06	2019-04-05
4	Cable	HUBER+SUHNER	CBL2	525178	2018-04-06	2019-04-05
RF Conducted Test						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	Spectrum Analyzer	Agilent	N9020A	MY49100060	2017-09-22	2018-09-21
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	2017-09-12	2018-09-11
3.	Humidity Chamber	GF	GTH-225-40-1P	IAA061213	2017-08-14	2018-08-13
4.	EXA Signal Analyzer	Keysight	N9010A	MY50520207526B25MPBW7X	2018-04-06	2019-04-05
5.	ESG VECTOR SIGNAL GENERATOR	Keysight	4438C	MY45092536005506601UNJ	2018-04-06	2019-04-05
6.	EXG Analog Signal Generator	Keysight	N5171B	MY53050845503	2017-09-12	2018-09-11
7.	USB Wideband Power	Keysight	U2021XA	SG5440003	2018-04-06	2019-04-05



	Sensor					
8.	Trilog Broadband Antenna	SCHWARZBEC K	VULB9163	336	2018-04-06	2019-04-05
9.	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2017-09-12	2018-09-11
10.	Broad-band Horn Antenna	SCHWARZBEC K	BBHA 9120 D	667	2018-04-06	2019-04-05
11.	Broad-band Horn Antenna	SCHWARZBEC K	BBHA 9120 D	669	2018-04-06	2019-04-05
12.	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2018-04-06	2019-04-05
13.	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	2018-04-06	2019-04-05
14.	Universal Radio Communication Tester	Rohde & Schwarz	CMW500	127818	2018-04-06	2019-04-05

ETSI Test software:

Software name: ETSI family

Software version: V2.1.1

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7.2 Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	$\pm 5\%$
RF output power, conducted	$\pm 1.5\text{dB}$
Power Spectral Density, conducted	$\pm 3\text{dB}$
Unwanted Emissions, conducted	$\pm 3\text{dB}$
All emissions, radiated	$\pm 6\text{dB}$
Time	$\pm 5\%$
Duty Cycle	$\pm 5\%$
Temperature	$\pm 1^\circ\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 3\%$
Radiated Emission(30MHz~1GHz)	$\pm 5.03\text{dB}$
Radiated Emission(1GHz~18GHz)	$\pm 5.47\text{dB}$

7.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by GUANG ZHOU GRG METROLOGY & TEST CO., LTD. Address is No.163, Pingyun Rd. West of Huangpu Ave, Tianhe District, Guangzhou, Guangdong, China.

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8 RF Requirements

1. Normal Test Conditions:

Voltage, Temperature: 3.3VDC, 20 °C

Relative humidity: 52.3 %

2. Extreme Test Conditions:

Extreme Temperature: -20-55°C;

Extreme Voltage: 2.7VDC to 3.3VDC;

For tests at extreme temperatures, extreme voltage, measurements shall be made over the extremes of the operating temperature and voltage range as declared by the manufacturer.

Test Conditions	Normal	LTLV	LTHV	HTHV	HTLV
Temperature (°C)	20	-20	-20	55	55
Voltage (VDC)	3.3	3	3.6	3.6	3

3. Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Modulation	Test mode	Test channel
FSK	Transmitting	433.31MHz
FSK	Receiving	433.31MHz

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8.1 Operating frequency

8.1.1 Description

The nominal Operating Frequency is the centre of a channel of width OCW.

8.1.2 Conformance

Operating Frequency

Value	Notes
Operational Frequency band or bands	433.050MHz to 434.790MHz
Nominal Operating Frequency or Frequencies	433.31MHz
Operating Channel width(s) - OCW	191.62kHz



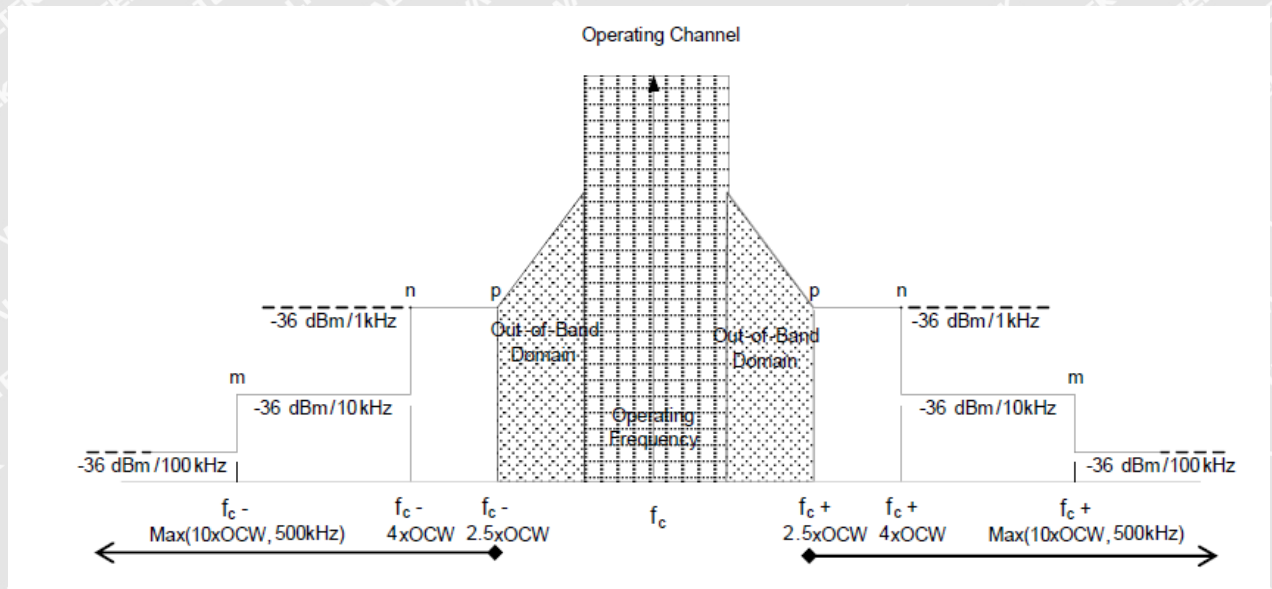
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8.2 Unwanted emissions in the spurious domain for TX mode

8.2.1 Description

Unwanted emissions for a TX mode



Unwanted emissions for all other modes

Spurious radiations from the EUT are components, at any frequency, radiated by the equipment and antenna.

8.2.2 Limit

Spurious domain emission limits

Frequency	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
State			
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

8.2.3 Conformance

Test conditions for TX mode

The EUT shall be operated in a mode representative of normal operation.

For EUT without an external conventional 50 Ω coaxial antenna connector, the spurious emissions levels shall be established by the radiated measurement procedure in clause 5.9.3.3.2.

For all other EUT the spurious emissions levels shall be established as both:

- the conducted measurement procedure in clause 5.9.3.3.1; and
- the radiated measurement procedure in clause 5.9.3.3.2, with the antenna port terminated in a dummy load.

1) The transmitter shall be performed on the lowest and the highest Operating Frequency declared by the manufacturer. Additional frequencies may be tested.

2) The measurement shall be performed with the EUT operating at its maximum operating power level, as declared by the manufacturer, and also with the EUT in powered-on stand-by mode.

3) The RBW of measuring receiver are shown in Table 20.

**Table 20: Parameters for TX Spurious Radiations Measurement**

Operating Mode	Frequency Range	RBW _{REF} (see note 2)
Transmit mode	$9 \text{ kHz} \leq f < 150 \text{ kHz}$	1 kHz
	$150 \text{ kHz} \leq f < 30 \text{ MHz}$	10 kHz
	$30 \text{ MHz} \leq f < f_c - m$	100 kHz
	$f_c - m \leq f < f_c - n$	10 kHz
	$f_c - n \leq f < f_c - p$	1 kHz
	$f_c + p < f \leq f_c + n$	1 kHz
	$f_c + n < f \leq f_c + m$	10 kHz
	$f_c + m < f \leq 1 \text{ GHz}$	100 kHz
	$1 \text{ GHz} < f \leq 6 \text{ GHz}$	1 MHz
NOTE 1: f is the measurement frequency. f_c is the Operating Frequency. m is 10 x OCW or 500 kHz, whichever is the greater. n is 4 x OCW or 100 kHz, whichever is the greater. p is 2,5 x OCW. NOTE 2: If the value of RBW used for measurement is different from RBW _{REF} , use bandwidth correction from clause 4.3.10.1.		

The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range.

The EUT was programmed to be in continuously transmitting mode.

8.2.4 Test Procedure

According to ETSI EN 300 220-1 clause C.1

8.2.5 Frequency range

Spurious Radiations radiated Measurement Frequency Range

Frequency Range	
25 MHz to 6 GHz	
NOTE:	The measurements need only to be performed over the frequency range 4 GHz to 6 GHz if emissions are detected within 10 dB of the specified limit between 1,5 GHz and 4 GHz.



8.2.6 Measurement Record (Result: Compliance)

Frequency	Receiver Reading	Turn table Angle	RX Antenna		Substituted			Test Condition: Normal		
			Height	Polar	SG Level	Cable	Antenna Gain	Absolute Level	Limit	Margin
(MHz)	(dB μ V)	Degree	(m)	(H/V)	(dBm)	(dB)	(dB)	(dBm)	(dBm)	(dB)
866.56	53.24	129	1.9	H	-41.74	0.22	0.00	-41.96	-36	-5.96
866.56	49.09	180	1.0	V	-45.83	0.22	0.00	-46.05	-36	-10.05
1299.84	48.87	267	1.3	H	-49.39	0.28	8.00	-41.67	-30	-11.67
1299.84	45.20	158	1.5	V	-48.25	0.28	8.00	-40.53	-30	-10.53
1733.12	44.54	92	1.8	H	-49.71	0.31	10.40	-39.62	-30	-9.62
1733.12	43.04	8	1.3	V	-50.53	0.31	10.40	-40.44	-30	-10.44

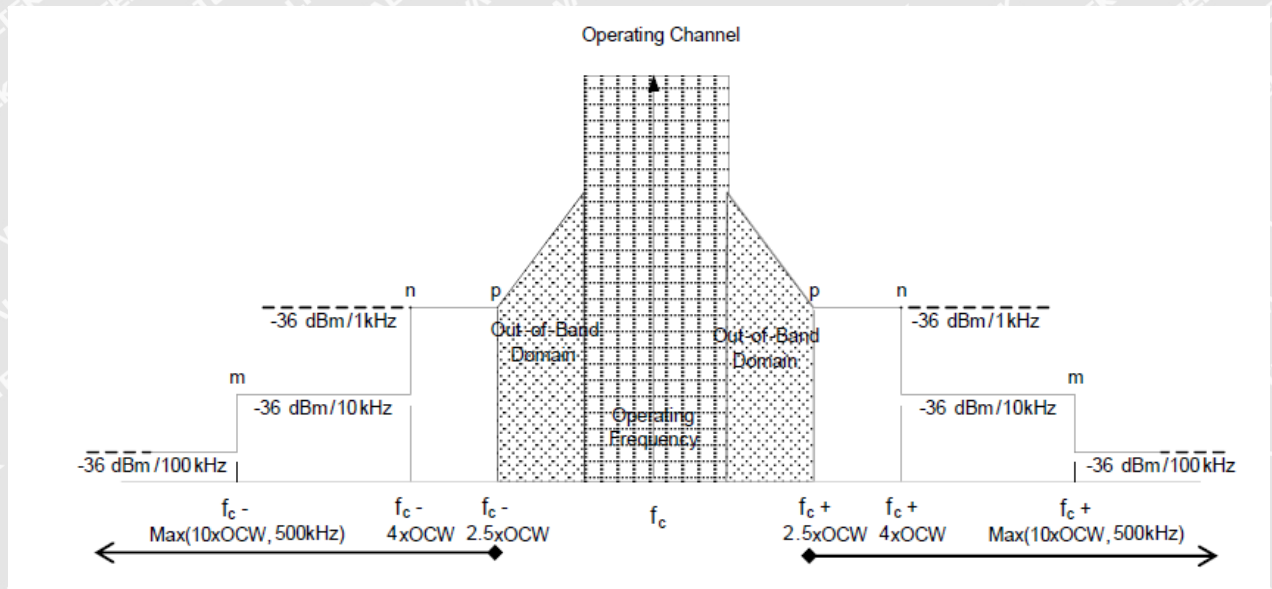
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8.3 Unwanted emissions in the spurious domain for RX mode

8.3.1 Description

Unwanted emissions for a TX mode



Unwanted emissions for all other modes

Spurious radiations from the EUT are components, at any frequency, radiated by the equipment and antenna.

8.3.2 Limit

Spurious domain emission limits

Frequency	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
State			
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

8.3.3 Conformance

Test conditions for TX mode

The EUT shall be operated in a mode representative of normal operation.

For EUT without an external conventional 50 Ω coaxial antenna connector, the spurious emissions levels shall be established by the radiated measurement procedure in clause 5.9.3.3.2.

For all other EUT the spurious emissions levels shall be established as both:

- the conducted measurement procedure in clause 5.9.3.3.1; and
- the radiated measurement procedure in clause 5.9.3.3.2, with the antenna port terminated in a dummy load.

1) The transmitter shall be performed on the lowest and the highest Operating Frequency declared by the manufacturer. Additional frequencies may be tested.

2) The measurement shall be performed with the EUT operating at its maximum operating power level, as declared by the manufacturer, and also with the EUT in powered-on stand-by mode.

3) The RBW of measuring receiver are shown in Table 20.

**Table 20: Parameters for TX Spurious Radiations Measurement**

Operating Mode	Frequency Range	RBW _{REF} (see note 2)
Transmit mode	$9 \text{ kHz} \leq f < 150 \text{ kHz}$	1 kHz
	$150 \text{ kHz} \leq f < 30 \text{ MHz}$	10 kHz
	$30 \text{ MHz} \leq f < f_c - m$	100 kHz
	$f_c - m \leq f < f_c - n$	10 kHz
	$f_c - n \leq f < f_c - p$	1 kHz
	$f_c + p < f \leq f_c + n$	1 kHz
	$f_c + n < f \leq f_c + m$	10 kHz
	$f_c + m < f \leq 1 \text{ GHz}$	100 kHz
	$1 \text{ GHz} < f \leq 6 \text{ GHz}$	1 MHz
NOTE 1: f is the measurement frequency. f_c is the Operating Frequency. m is 10 x OCW or 500 kHz, whichever is the greater. n is 4 x OCW or 100 kHz, whichever is the greater. p is 2,5 x OCW. NOTE 2: If the value of RBW used for measurement is different from RBW _{REF} , use bandwidth correction from clause 4.3.10.1.		

The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range.

The EUT was programmed to be in continuously transmitting mode.

8.3.4 Test Procedure

According to ETSI EN 300 220-1 clause C.1

8.3.5 Frequency range

Spurious Radiations radiated Measurement Frequency Range

Frequency Range
25 MHz to 6 GHz
NOTE: The measurements need only to be performed over the frequency range 4 GHz to 6 GHz if emissions are detected within 10 dB of the specified limit between 1,5 GHz and 4 GHz.



8.3.6 Measurement Record (Result: Compliance)

Frequency	Receiver Reading	Turn table Angle	RX Antenna		Substituted			Test Condition: Normal		
			Height	Polar	SG Level	Cable	Antenna Gain	Absolute Level	Limit	Margin
(MHz)	(dB μ V)	Degree	(m)	(H/V)	(dBm)	(dB)	(dB)	(dBm)	(dBm)	(dB)
188.32	44.98	199	1.5	H	-64.73	0.15	0.00	-64.88	-57	-7.88
188.32	43.38	280	1.1	V	-63.94	0.15	0.00	-64.09	-57	-7.09
2063.72	40.69	77	1.0	H	-71.69	0.36	10.40	-61.65	-47	-14.65
2063.72	42.46	37	1.5	V	-69.30	0.36	10.40	-59.26	-47	-12.26



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8.4 Effective Radiated Power

8.4.1 Description

The effective radiated power (e.r.p) is the power radiated in the direction of the maximum radiated power under specified conditions of measurements for any condition of modulation. For equipment with a permanent or temporary antenna connection it may be taken as the power delivered from that connector taking into account the antenna gain.

8.4.2 Limit

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

	H	433,050 MHz to 434,790 MHz	10 mW	10 %	The whole band	44b, 45b	20, 125
	I	433,050 MHz to 434,790 MHz	1 mW e.r.p. -13 dBm/10 kHz PSD for bandwidth modulation larger than 250 kHz	No requirement	The whole band	Audio and video applications are excluded.	44a, 45a 61, 63
	J	434,040 MHz to 434,790 MHz	10 mW	No requirement	25 kHz	Audio and video applications are excluded.	45c 65
					The whole band		

8.4.3 Conformance

- 1) The measurement shall be performed on the lowest and the highest Operating Frequencies declared by the manufacturer. Additional frequencies may be tested.
- 2) These measurements shall be performed at the highest power level at which the transmitter is intended to operate
- 3) The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test. D-M1 test signal (unmodulated carrier) shall not be used for equipment with non-constant envelope modulation.
- 4) The RBW of the spectrum analyser shall be wide enough to cover the complete power envelope (\geq OCW) of the signal of the EUT.
- 5) In the case of a removable antenna, the antenna shall be fitted in a manner representative of normal use.
- 6) For measurement in extreme temperature conditions, it is preferable to use an internal or a temporary connector rather than a test fixture.

8.4.4 Test Procedure

According to ETSI EN 300 220-1 clause C.1, C.5.1, C.5.2, C.5.3

8.4.5 Measurement Record

Effective Radiated Power

Value	Notes
Test environment	Normal operation
Centre frequency	433.31MHz
Measure of Effective Radiated Power	-14.18dBm
NOTE: In case of a removable antenna the antenna gain (in dB, i.e. relative to a dipole) is declared by the manufacturer.	



8.5 Occupied Bandwidth

8.5.1 Description

The occupied bandwidth (OBW) is the Frequency Range in which 99 % of the total mean power of a given emission falls. The residual part of the total power being denoted as β , which, in cases of symmetrical spectra, splits up into $\beta/2$ on each side of the spectrum. Unless otherwise specified, $\beta/2$ is taken as 0,5 % as described in Figure 3.

The maximum occupied bandwidth includes all associated side bands above the appropriate emissions level and the frequency error or drift under extreme test conditions.

8.5.2 Limit

H	433,050 MHz to 434,790 MHz	10 mW	10 %	The whole band	Calculated	44b, 45b	20, 125
I	433,050 MHz to 434,790 MHz	1 mW e.r.p. -13 dBm/10 kHz PSD for bandwidth modulation larger than 250 kHz	No requirement	The whole band	Audio and video applications are excluded.	44a, 45a	61, 63
J	434,040 MHz to 434,790 MHz	10 mW	No requirement	25 kHz	Audio and video applications are excluded.	45c	65
				The whole band			

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high} .

8.5.3 Conformance

- 1) The measurement shall be performed on the lowest and the highest Operating Frequencies declared by the manufacturer. Additional frequencies may be tested.
- 2) The measurement shall be performed with a spectrum analyser.
- 3) For devices with e.r.p. ≤ -30 dBm, OBW may be either measured or taken as equal to the OCW within the operational frequency band.

8.5.4 Test Procedure

The spectrum analyser shall be configured as appropriate for the parameters shown in Table 12.

Table 12: Test Parameters for Max Occupied Bandwidth Measurement

Setting	Value	Notes
Centre frequency	The nominal Operating Frequency	The highest or lowest Operating Frequency as declared by the manufacturer
RBW	1 % to 3 % of OCW without being below 100 Hz	
VBW	3 x RBW	Nearest available analyser setting to 3 x RBW
Span	At least 2 x Operating Channel width	Span should be large enough to include all major components of the signal and its side bands
Detector Mode	RMS	
Trace	Max hold	

If the equipment is capable of producing an unmodulated carrier and the test in clause 5.7 is performed, then the OBW measurements need only be performed under normal test conditions. Any required results for Maximum OBW under extreme conditions are obtained by addition and subtraction of the upper and lower frequency error results to each bandwidth measurement obtained in this test.

Step 1:

Operation of the EUT shall be started, on the highest operating frequency as declared by the manufacturer,

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with the appropriate test signal.

The signal attenuation shall be adjusted to ensure that the signal power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals on either side of the power envelope being included in the measurement.

Step 2:

When the trace is completed the peak value of the trace shall be located and the analyser marker placed on this peak.

Step 3:

The 99 % occupied bandwidth function of the spectrum analyser shall be used to measure the occupied bandwidth of the signal.

8.5.5 Measurement Record

Occupied Bandwidth

Value	Notes
Test environment	Normal
Test signal	D-M2
Centre Frequency	433.31MHz
Occupied Bandwidth	191.62kHz



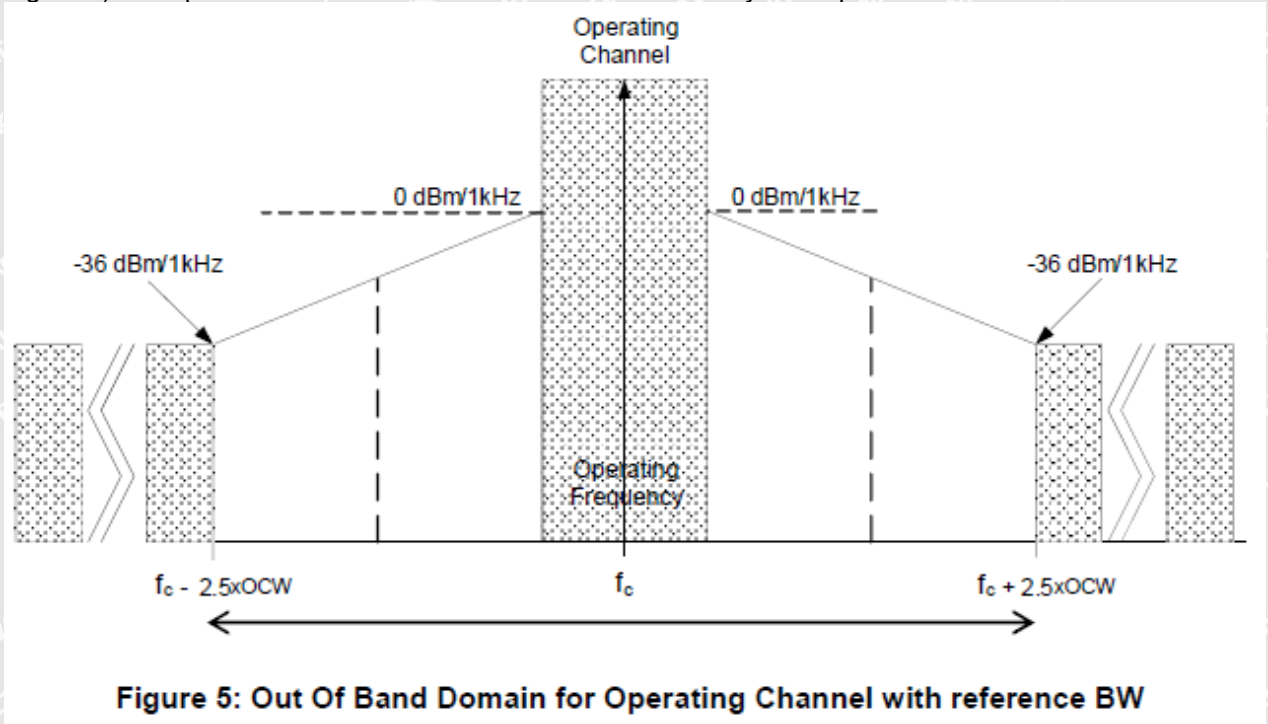
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8.6 TX out Of Band Emissions

8.6.1 Description

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.



Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.

The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

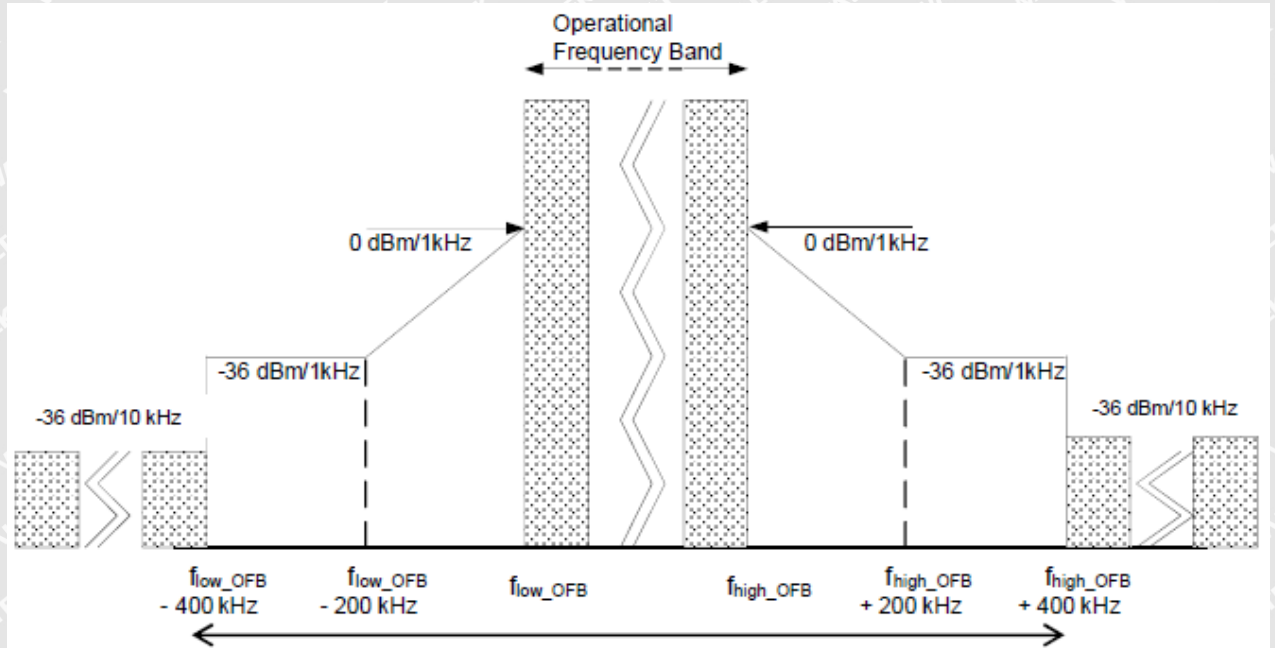


Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.

NOTE: f_{low_OFB} is the lower edge of the Operational Frequency Band.

f_{high_OFB} is the upper edge of the Operational Frequency Band.

8.6.2 Limit

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

**Table 15: Emission limits in the Out Of Band domains**

Domain	Frequency Range	RBW _{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \leq f_{\text{low_OFB}} - 400 \text{ kHz}$	10 kHz	-36 dBm
	$F_{\text{low_OFB}} - 400 \text{ kHz} \leq f \leq f_{\text{low_OFB}} - 200 \text{ kHz}$	1 kHz	-36 dBm
	$f_{\text{low}} - 200 \text{ kHz} \leq f < f_{\text{low_OFB}}$	1 kHz	See Figure 6
	$f = f_{\text{low_OFB}}$	1 kHz	0 dBm
	$f = f_{\text{high_OFB}}$	1 kHz	0 dBm
	$F_{\text{high_OFB}} < f \leq f_{\text{high_OFB}} + 200 \text{ kHz}$	1 kHz	See Figure 6
	$F_{\text{high_OFB}} + 200 \text{ kHz} \leq f \leq f_{\text{high_OFB}} + 400 \text{ kHz}$	1 kHz	-36 dBm
	$F_{\text{high_OFB}} + 400 \text{ kHz} \leq f$	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c - 2.5 \times \text{OCW}$	1 kHz	-36 dBm
	$f_c - 2.5 \times \text{OCW} \leq f \leq f_c - 0.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c - 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f = f_c + 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f_c + 0.5 \times \text{OCW} \leq f \leq f_c + 2.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c + 2.5 \times \text{OCW}$	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
 f_c is the Operating Frequency.
 $F_{\text{low_OFB}}$ is the lower edge of the Operational Frequency Band.
 $F_{\text{high_OFB}}$ is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

8.6.3 Conformance

- 1) If the clause 5.7 is performed then the measurements may be made under normal test conditions only, with the upper and lower frequency error results added and subtracted to the masks of this test.
- 2) An EUT without a permanent or temporary antenna connector shall be tested according to clause 5.8.3.2.
- 3) An EUT with a permanent or temporary antenna connector shall be tested according to clause 5.8.3.3.
- 4) For measurement in extreme temperature conditions, it is preferable to use an internal or a temporary connector rather than a test fixture.

8.6.4 Test Procedure

Table 16: Test Parameters for Out Of Band for Operating Channel Measurement

Spectrum Analyser Setting	Value	Notes
Centre frequency	Operating Frequency	
Span	6 x Operating Channel width	
RBW	1 kHz (see note)	Resolution bandwidth for Out Of Band domain measurements
Detector Function	RMS	
Trace Mode	Linear AVG	Applies only for EUT generating D-M2 test signal. An appropriate number of samples should be averaged to give a stable reading
	Max Hold	Applies only for EUT generating D-M2a or D-M3 test signal.

NOTE: If the value of RBW used is different from RBW_{REF} in clause 5.8.2, use the bandwidth correction in clause 4.3.10.1.

The test equipment shall be configured as appropriate for the parameters shown in Table 16.

Step 1:

Operation of the EUT shall be started, on the highest operating frequency as declared by the manufacturer,

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with the appropriate test signal.

The signal shape is recorded when stable and shall be below the spectrum mask Out Of Band for operating channel.

Step 2:

The test equipment shall be reconfigured as appropriate for the parameter shown in Table 17.

Table 17: Test Parameter Setting for Lower Out Of Band Measurement

Spectrum Analyser Setting	Value	Notes
Centre frequency	$f_{c_{low}}$	The lowest Operating Frequency in the band
Span	$2 \times (500 \text{ kHz} + f_{c_{low}} - f_{low_OFB})$	Ensures that the left most mask specification remains within the span
NOTE: f_{low_OFB} is the lower edge of the Operational Frequency Band.		

Operation of the EUT is restarted, with the appropriate test signal, on the lowest operating frequency as declared by the manufacturer.

If the equipment is using only one operating Frequency in the operational Frequency Band, measurement shall be performed the nominal operating frequency.

The signal shape is recorded when stable; and shall be below the spectrum mask for operating channel and the spectrum mask for operational frequency band.

Step 3:

The test equipment shall be reconfigured as appropriate for the parameter shown in Table 18.

Table 18: Test Parameter Setting for upper Out Of Band Measurement

Spectrum Analyser Setting	Value	Notes
Centre frequency	$f_{c_{high}}$	the highest Operating Frequency in the band
Span	$2 \times (500 \text{ kHz} + f_{high_OFB} - f_{c_{high}})$	Ensures that the rightmost mask specification remains within the span
NOTE: f_{high_OFB} is the higher edge of the operational frequency Band.		

Operation of the EUT is restarted, with the appropriate test signal, on the highest Operating Frequency as declared by the manufacturer.

If the equipment is using only one Operating Frequency in the Operational Frequency Band, measurement shall be performed at the nominal Operating Frequency

The signal shape is recorded when stable and shall be below the spectrum mask for Out Of Band emissions for operating channel and for operational Frequency Band.

Step 4:

For frequency agile devices, the measurement shall be repeated in each Operational Frequency Band.

Step 5:

Where required (see clause 5.8.3.1 condition 1), the measurements in step 1 to step 5 shall be repeated under extreme test conditions.

8.6.5 Measurement Record



TX out Of Band Emissions

Domain	Frequency Range	RBW _{REF}	Max power limit	Result
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \leq f_{\text{low_OFB}} - 400 \text{ kHz}$	10KHz	-36 dBm	Compliance
	$F_{\text{low_OFB}} - 400 \text{ kHz} \leq f \leq f_{\text{low_OFB}} - 200 \text{ kHz}$	1KHz	-36 dBm	Compliance
	$f_{\text{low_OFB}} - 200 \text{ kHz} \leq f < f_{\text{low_OFB}}$	1KHz	See Figure 6	Compliance
	$f = f_{\text{low_OFB}}$	1KHz	0 dBm	Compliance
	$f = f_{\text{high_OFB}}$	1KHz	0 dBm	Compliance
	$F_{\text{high_OFB}} < f \leq f_{\text{high_OFB}} + 200 \text{ kHz}$	1KHz	See Figure 6	Compliance
	$F_{\text{high_OFB}} + 200 \text{ kHz} \leq f \leq f_{\text{high_OFB}} + 400 \text{ kHz}$	1KHz	-36 dBm	Compliance
	$F_{\text{high_OFB}} + 400 \text{ kHz} \leq f$	10KHz	-36 dBm	Compliance
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c - 2.5 \times \text{OCW}$	1KHz	-36 dBm	Compliance
	$f_c - 2.5 \times \text{OCW} \leq f \leq f_c - 0.5 \times \text{OCW}$	1KHz	See Figure 5	Compliance
	$f = f_c - 0.5 \times \text{OCW}$	1KHz	0 dBm	Compliance
	$f = f_c + 0.5 \times \text{OCW}$	1KHz	0 dBm	Compliance
	$f_c + 0.5 \times \text{OCW} \leq f \leq f_c + 2.5 \times \text{OCW}$	1KHz	See Figure 5	Compliance
	$f = f_c + 2.5 \times \text{OCW}$	1KHz	-36 dBm	Compliance
NOTE: f is the measurement frequency. f_c is the Operating Frequency. $F_{\text{low_OFB}}$ is the lower edge of the Operational Frequency Band. $F_{\text{high_OFB}}$ is the upper edge of the Operational Frequency Band. OCW is the operating channel bandwidth.				



8.7 Transient Power

8.7.1 Description

Transmitter transient power is power falling into frequencies other than the operating channel as a result of the transmitter being switched on and off.

8.7.2 Limit

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW _{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

8.7.3 Conformance

- 1) The measurement shall be performed on the lowest and the highest operating Frequency declared by the manufacturer. Additional frequencies may be tested.
- 2) These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

8.7.4 Test Procedure

The output of the EUT shall be connected to a spectrum analyser or equivalent measuring equipment. The measurement shall be undertaken in zero span mode. The analyser's centre frequency shall be set to an offset from the operating centre frequency. These offset values and their corresponding RBW configurations are listed in Table 24.

Table 24: RBW for Transient Measurement

Measurement points: offset from centre frequency	Analyser RBW	RBW _{REF}
-0,5 x OCW - 3 kHz 0,5 x OCW + 3 kHz Not applicable for OCW < 25 kHz	1 kHz	1kHz
±12,5 kHz or ±OCW whichever is the greater	Max (RBW pattern 1, 3, 10 kHz) ≤ Offset frequency/6 (see note)	1 kHz
-0,5 x OCW - 400 kHz 0,5 x OCW + 400 kHz	100 kHz	1 kHz
-0,5 x OCW -1 200 kHz 0,5 x OCW + 1 200 kHz	300 kHz	1 kHz
NOTE: Max (RBW pattern 1, 3, 10 kHz) means the maximum bandwidth that falls into the commonly implemented 1, 3, 10 kHz RBW filter bandwidth incremental pattern of spectrum analysers. EXAMPLE: If OCW is 25 kHz then the RBW value corresponding to one OCW offset frequency is 3 kHz. The rest of the analyser settings are listed in Table 25, and if OCW is 250 kHz then the RBW value corresponding to one OCW offset frequency is 30 kHz.		

**Table 25: Parameters for Transient Measurement**

Spectrum Analyser Setting	Value	Notes
VBW/RBW	10	At higher RBW values VBW may be clipped to its maximum value
Sweep time	500 ms	
RBW filter	Gaussian	
Trace Detector Function	RMS	
Trace Mode	Max hold	
Sweep points	501	
Measurement mode	Continuous sweep	
NOTE: The ratio between the number of sweep points and the sweep time shall be the same ratio as above if different number of sweep points is used.		

The used modulation shall be D-M3. The analyser shall be set to the settings of Table 25 and a measurement shall be started for each offset frequency. The EUT shall transmit at least five D-M3 test signal. The peak value shall be recorded and the measurement shall be repeated at each offset frequency mentioned in Table 24.

The recorded power values shall be converted to power values measured in RBWREF by the formula in clause 4.3.10.1

8.7.5 Measurement Record

Transmitter Transient Power

Absolute offset from centre frequency	RBW _{REF}	Peak power limit applicable at measurement points	Result
≤ 400 kHz	1 kHz	0 dBm	Compliance
> 400 kHz	1 kHz	-27 dBm	Compliance

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8.8 TX behaviour under Low Voltage Conditions

8.8.1 Description

The TX behaviour under low voltage condition is the ability of the equipment to maintain its operating frequency and not produce emissions which exceed any relevant limit when the battery voltage falls below the lower extreme voltage level.

8.8.2 Limit

The equipment shall either:

- a) remain in the Operating Channel OC without exceeding any applicable limits (e.g. Duty Cycle); or
 - b) reduce its effective radiated power below the Spurious Emission limits without exceeding any applicable limits (e.g. Duty Cycle); or
 - c) shut down, (ceasing function);
- as the voltage falls below the manufacturers declared operating voltage.

8.8.3 Conformance

The test shall be performed on Operating Frequency declared by the manufacturer.

8.8.4 Test Procedure

Step 1:

Operation of the EUT shall be started, on Operating Frequency as declared by the manufacturer, with the appropriate test signal and with the EUT operating at nominal operating voltage. The centre frequency of the transmitted signal shall be measured and noted.

Step 2:

The operating voltage shall be reduced by appropriate steps until the voltage reaches zero. The centre frequency of the transmitted signal shall be measured and noted.

Any abnormal behaviour shall be noted.

8.8.5 Measurement Record

N/A

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8.9 Blocking & RX Sensitivity

8.9.1 Description

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels or bands.

The receiver sensitivity is the minimum signal power input to the receiver which produces the general performance criterion stated in clause 4.1. The test input signal is generated at the nominal operating frequency and modulated with normal modulation.

8.9.2 Limit

Table 40: Blocking level parameters for RX category 3

Requirement	Limits
	Receiver category 3
Blocking at ± 2 MHz from OC edge f_{high} and f_{low}	≥ -80 dBm
Blocking at ± 10 MHz from OC edge f_{high} and f_{low}	≥ -60 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -60 dBm

Table 41: Blocking level parameters for RX category 2

Requirement	Limits
	Receiver category 2
Blocking at ± 2 MHz from OC edge f_{high} and f_{low}	≥ -69 dBm
Blocking at ± 10 MHz from OC edge f_{high} and f_{low}	≥ -44 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -44 dBm

Table 42: Blocking level parameters for RX category 1.5

Requirement	Limits
	Receiver category 1.5
Blocking at ± 2 MHz from OC edge f_{high} and f_{low}	≥ -43 dBm
Blocking at ± 10 MHz from OC edge f_{high} and f_{low}	≥ -33 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -33 dBm

Table 43: Blocking level parameters for RX category 1

Requirement	Limits
	Receiver category 1
Blocking at ± 2 MHz from Centre Frequency	≥ -20 dBm
Blocking at ± 10 MHz from Centre Frequency	≥ -20 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -20 dBm

The sensitivity for receivers shall be below or equal to Table 32 level.

Table 32: Limits for Receiver sensitivity

$$S = 10 \log RB_{\text{kHz}} - 4 \text{ dB}\mu\text{V emf}; \text{ or}$$

$$S_p = 10 \log RB_{\text{kHz}} - 117 \text{ dBm}$$

where:

- S_p is the sensitivity in dBm.
- RB is the declared receiver bandwidth in kHz.

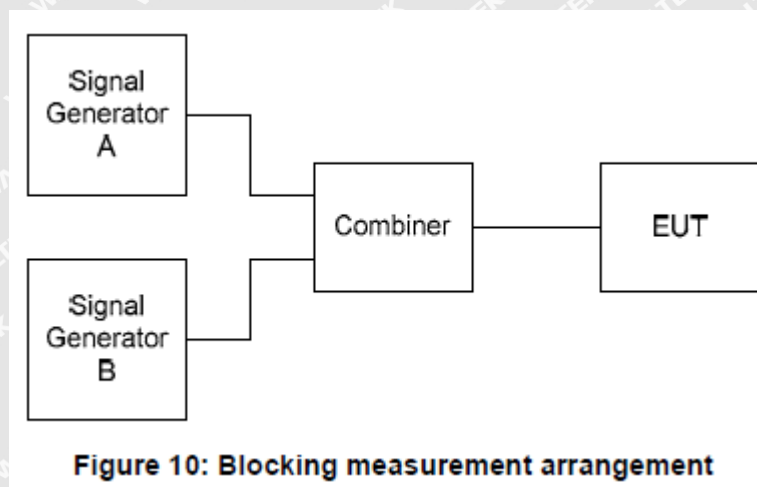


8.9.3 Conformance

- 1) The measurement is performed at an operating frequency declared by the manufacturer.
- 2) An EUT without a permanent or temporary antenna connector shall be tested according to clause 5.18.6.2.
- 3) An EUT with a permanent or temporary antenna connector shall be tested according to clause 5.18.6.3.
- 4) The measurements shall be performed on the operating frequency as declared by the manufacturer.
- 5) If possible the EUT shall be operated with any FEC or automatic retransmission facility disabled.
- 6) An EUT without a permanent or temporary antenna connector shall be tested according to clause 5.14.3.2.
- 7) An EUT with a permanent or temporary antenna connector shall be tested according to clause 5.14.3.3.

8.9.4 Test Procedure

Two signal generators A and B shall be connected to the EUT via a combining network as shown in Figure 10.



Signal generator A shall be set to an appropriate modulated test signal at the operating frequency of the EUT receiver.

Signal generator B shall be unmodulated.

Measurements shall be carried out at frequencies of the unwanted signal at approximately the frequency(ies) offset(s) defined in technical requirement avoiding those frequencies at which spurious responses occur.

Additional measurement points may be requested by technical requirements clause.

If several operational frequency bands are used by the equipment, at least one blocking measurement by bands has to be performed.

Step 1:

Signal generator B shall be powered off. Signal generator A shall be set to the minimum level which gives the wanted performance criterion of EUT or the reference level in Table 32, whichever is the higher. The output level of generator A shall then be increased by 3 dB unless otherwise specified in technical requirement.

Step 2:

Signal generator B is powered on and set to operate at the nominal operating frequency - offset frequency. Signal generator B is then switched on and the signal amplitude is adjusted to the minimum level at which the wanted performance criterion is not achieved.

With signal generator B settings unchanged, the receiver shall be replaced with a suitable RF power measuring equipment. The power into the measuring equipment shall be measured and noted.

The blocking level is then the conducted power received from generator B at the EUT antenna connector. This can either be measured on the antenna connector for conducted test or be calculated for radiated test (see clause C.5.4).

The blocking level shall be higher or equal to the blocking power level requested in the technical requirement



clause.

Step 3:

The measurement in steps 1 to 3 shall be repeated with signal offsets at required frequencies.

Step 4:

The information shown in Table 44 shall be recorded in the test report for each measured signal level and unwanted signal offset.

For equipment using CCA whatever is the receiver category, steps 1 to 4 shall be repeated with signal generator A level adjusted +13 dB higher than in the measurements in clause 5.18.6.4.

8.9.5 Measurement Record

Blocking (receiver category 2)

Value	Notes					
Operating Frequency	433.31MHz					
Signal generator A	-93.33dBm					
Blocking level	Blocking at ± 2 MHz from OC edge fhigh and flow		Blocking at ± 10 MHz from OC edge fhigh and flow		Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	
	431.800MHz	432.040MHz	423.800MHz	440.040MHz	412.200MHz	455.620MHz
	-55.12	-51.35	-40.34	-42.24	-32.24	-32.93
Limits	≥ -69 dBm	≥ -69 dBm	≥ -44 dBm	≥ -44 dBm	≥ -44 dBm	≥ -44 dBm

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8.10 Clear Channel Assessment threshold

8.10.1 Description

The CCA threshold is defined as the received signal level above which the EUT determines that the channel is not available for use.

8.10.2 Limit

The CCA threshold shall not exceed the limits given in Table 45.

Table 45: CCA radiated threshold limits

Parameter	Value
CCA threshold for EUT with e.r.p < 100 mW	15 dB above Rx sensitivity level limit as given in Table 32
CCA threshold for EUT with e.r.p from 100 mW to 500 mW	11 dB above Rx sensitivity level limit as given in Table 32
NOTE: The limits are based on an antenna gain of 0 dB relative to a dipole (i.e. +2,15 dBi) maximum. For other antenna gains different to 0 dB the limits shall be adjusted accordingly.	
EXAMPLE: With antenna gain of -5 dB, the CCA threshold shall be corrected and increased by 5 dB at the RF front end.	

8.10.3 Conformance

- 1) The measurement is performed on an Operating Frequency declared by the manufacturer. The frequency shall correspond to a nominal channel centre frequency consistent with the highest and lowest frequencies and channel spacing declared by the manufacturer.
- 2) An EUT without a permanent or temporary antenna connector shall be tested according to clause 5.21.2.3.2.
- 3) An EUT with a permanent or temporary antenna connector shall be tested according to clause 5.21.2.3.3.

8.10.4 Test Procedure

A suitable test site shall be selected from those described in clause C.1.

Signal generators together with the combiner/coupler, shown in Figure 11, shall be placed outside the test site.

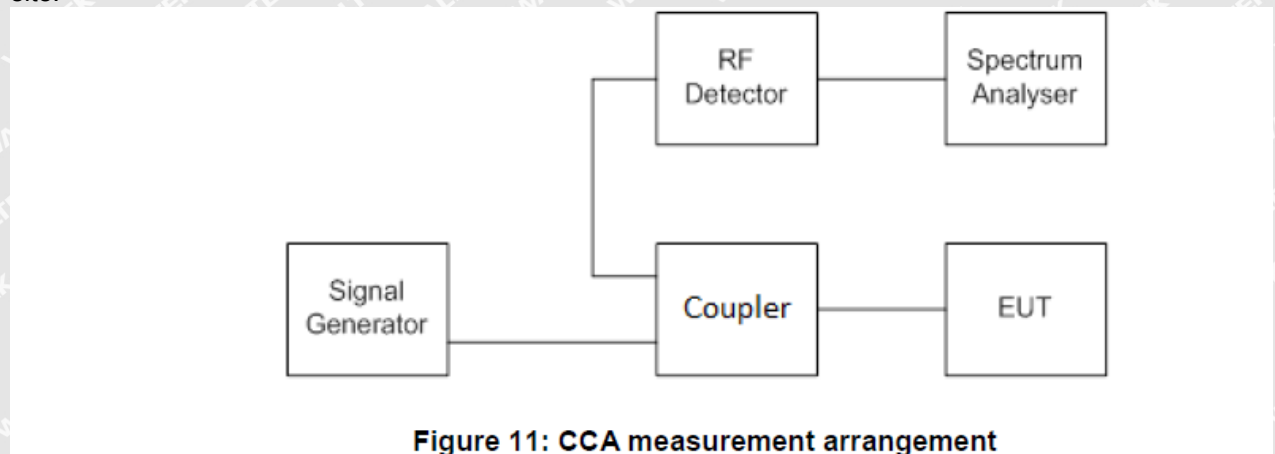


Figure 11: CCA measurement arrangement

The output of the combiner shall be connected to a transmit test antenna with the same antenna polarization as the EUT. The transmit test antenna shall be placed in the test site.

The EUT shall be placed at the location of the turntable at the orientation of the most sensitive position.

The measurement in clause 5.21.2.3.4 shall be performed using appropriate radiated measurement methods described in clause C.5.

**Table 46: Test Parameters Settings for CCA Threshold Measurement**

Setting	Value
Centre frequency	The nominal EUT operating frequency
RBW	Approximately 3 x Operating Channel width OCW
VBW	3 x RBW
Span	Zero span
Detector Mode	RMS
Trace Mode	Max. Hold
NOTE: The nominal operating frequency is agreed between the test laboratory and the manufacturer. The nominal operating frequency shall be consistent with the highest and lowest operating frequencies and channel spacing as declared by the manufacturer. Channel Spacing is declared by the manufacturer.	

The spectrum analyser shall be configured as shown in Table 46.

Step 1:

Operation of the EUT as a receiver shall be started with its CCA function active.

The signal generator, with normal test modulation, shall be adjusted to the nominal operating frequency.

The spectrum analyser levels and RBW shall be adjusted to provide satisfactory display of the signal generator signal.

Step 2:

The output power level of the signal generator shall be set to approximately 20 dB above the EUT receiver reference sensitivity.

The EUT shall be instructed to transmit.

NOTE 1: The means of instructing the EUT to transmit is determined by the manufacturer.

The presence of any signal from the EUT detected by the spectrum analyser shall be noted.

Step 3:

The level of the signal generator shall be reduced in steps of 1 dB until the equipment starts to transmit.

NOTE 2: There may be a delay due to collision avoidance operation before the EUT begins to transmit once the CCA threshold has been reached. Ensure that any such delay is taken into account in the rate at which the signal generator level is reduced.

The signal generator level present at the receiver input of the EUT when transmission begins is the CCA threshold and shall be noted.

Step 4:

Step 2 and step 3 shall be repeated.

Step 5:

The information shown in Table 47 shall be recorded in the test report.



8.10.5 Measurement Record

N/A.



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8.11 Duty Cycle

8.11.1 Description

Duty cycle is the ratio expressed as a percentage, of the cumulative duration of transmissions T_{on_cum} within an observation interval T_{obs} . $DC = \left(\frac{T_{on_cum}}{T_{obs}} \right) \times 100\%$ on an observation bandwidth F_{obs} .

Unless otherwise specified, T_{obs} is 1 hour and the observation bandwidth F_{obs} is the operational frequency band. Each transmission consists of an RF emission, or sequence of RF emissions separated by intervals $< T_{Dis}$.

An equipment may operate on several bands simultaneously (i.e. multi transmissions), Duty Cycle limit of each individual band applies to each transmission within that band.

In case of a multicarrier modulation in a band, the duty cycle applies to the whole signal used for a transmission (e.g. OFDM).

It has to be noted that on some bands Duty Cycle value may depend on the presence of a primary radio service.

Equipment may be triggered manually, by internal timing or by external stimulus. Depending on the method of triggering the timing may be predictable or random.

8.11.2 Limit

The Duty Cycle at the operating frequency shall not be greater than values in annex B or C for the chosen operational frequency band(s).

8.11.3 Conformance

An assessment of the overall Duty Cycle shall be made for a representative period of T_{obs} over the observation bandwidth F_{obs} . Unless otherwise specified, T_{obs} is 1 hour and the observation bandwidth F_{obs} is the operational frequency band.

The representative period shall be the most active one in normal use of the device. As a guide "Normal use" is considered as representing the behaviour of the device during transmission of 99 % of transmissions generated during its operational lifetime.

Procedures such as setup, commissioning and maintenance are not considered part of normal operation.

Where an acknowledgement is used, the additional transmitter on-time from a message responder shall be declared only once whether included in the message initiator Duty Cycle or in the message responder Duty Cycle.

NOTE: The intention of this rule is not to allow EUT to exceed the maximum duty cycle value.

8.11.4 Measurement Record

The Duty cycle is declared by manufacturer.



9 RF Exposure Evaluation

8.1 Limit

According to Council Recommendation: the criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation.

Reference levels for electric, magnetic and electromagnetic fields (10MHz to 300GHz) Low-power electronic and electrical equipment is deemed to comply with the provisions of this standard if it can be demonstrated using routes B, C or D that the available antenna power and/or the average total radiated power is less than or equal to the applicable low-power exclusion level P_{max} .

Annex A contains example values for P_{max} derived from existing exposure limits listed in the bibliography, such as the ICNIRP guidelines [1], IEEE Std C95.1-1999 [2], and IEEE Std C95.1-2005 [3].

For wireless devices operated close to a person's body with available antenna powers and/or average total radiated powers higher than the P_{max} values given in Annex A, the alternative P_{max} values (called P_{max}'), described in Annex B can also be used.

For low power equipment using pulsed signals, other limits may apply in addition to those considered in Annex A and Annex B. Both ICNIRP guidelines [1] and IEEE standards [2], [3] have specific restrictions on exposures to pulsed fields, and the requirements of those standards with respect to exposure to pulses shall be met. Annex C discusses this topic further.

8.2 RF Exposure Evaluation

P_{max}	20mW/13dBm
ERP	-14.18dBm

Remark: Since the ERP is less than the applicable low-power exclusion level P_{max} , this device is deemed to comply with the provisions of this standard without further testing.



10 EMC Requirements

1. Test Conditions:

Power Supply	Test Voltage
RX	AC 230V
TX	DC 3.3V

2. Performance Criteria Description

EN 301 489-1V2.2.0 Clause 6 requirements:

The performance criteria are used to take a decision on whether a radio equipment passes or fails immunity tests.

For the purpose of the present document four categories of performance criteria apply:

- Performance criteria for continuous phenomena applied to transmitters and receivers
 - Performance criteria for transient phenomena applied to transmitters and receivers
 - Performance criteria for equipment which does not provide a continuous communication link
 - Performance criteria for ancillary equipment tested on a stand alone basis

Normally, the performance criteria depend on the type of radio equipment. Thus, the present document only contains general performance criteria commonly used for the assessment of radio equipment. More specific and product-related performance criteria for a dedicated type of radio equipment may be found in the part of EN 301 489 series [i.13] dealing with the particular type of radio equipment.

Performance Criteria	Description
Performance criteria for continuous phenomena applied to transmitters and receivers	If no further details are given in the relevant part of EN 301 489 series [i.13] dealing with the particular type of radio equipment, the following general performance criteria for continuous phenomena shall apply. During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.
Performance	If no further details are given in the relevant part of EN 301 489 series [i.13]



criteria for transient phenomena applied to transmitters and receivers	<p>dealing with the particular type of radio equipment, the following general performance criteria for transient phenomena shall apply.</p> <p>For surges applied to symmetrically operated wired network ports intended to be connected directly to outdoor lines the following criteria applies:</p> <ul style="list-style-type: none"> For products with only one symmetrical port intended for connection to outdoor lines, loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A SW reboot is not allowed. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost. For products with more than one symmetrical port intended for connection to outdoor lines, loss of function on the port under test is allowed, provided the function is self-recoverable. A SW reboot is not allowed. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost. <p>For all other ports the following applies:</p> <ul style="list-style-type: none"> After the test, the equipment shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the equipment is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.
Performance criteria for equipment which does not provide a continuous communication link	<p>For radio equipment which does not provide a continuous communication link, the performance criteria described in clauses 6.1 and 6.2 are not appropriate, in these cases the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation. The related specifications set out in clause 5.3 have also to be taken into account. The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in clauses 6.1 and 6.2.</p>
Performance criteria for	<p>If ancillary equipment is intended to be tested on a stand alone basis, the performance criteria described in clauses 6.1 and 6.2 are not appropriate, in</p>



ancillary equipment tested on a stand alone basis	these cases the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation. The related specifications set out in clause 5.3 have also to be taken into account. The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in clauses 6.1 and 6.2.
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EN 301 489-3 V2.1.1 Clause 6 requirements:

- 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.

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

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. Where "operate as intended" or "no loss of function" is specified, the EUT shall demonstrate correct functioning as described in clause 5. Where the EUT has more than one mode of operation (see clause 4.5.2), an unplanned transition from one mode to another is considered as an unintentional response. The EUT shall be tested in sufficient modes to confirm there are no such unintentional responses.

Emission
1. General EN 301 489-1, table 1 contains the applicability of EMC emission measurements to the relevant ports of radioequipment.
Immunity
1. General EN 301 489-1, table 2, contains the applicability of EMC immunity measurements to the relevant ports of radioequipment.



3. Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Conducted emissions: AC mains power input ports	
TM1	Communication mode(WIFI + 433MHz)
Radiated Emissions	
TM1	Communication mode(WIFI + 433MHz)
Voltage Fluctuations and Flicker	
TM1	Communication mode(WIFI + 433MHz)
Electrostatic discharge	
TM1	Communication mode(WIFI + 433MHz)
Radio frequency electromagnetic field (80 MHz to 6 000 MHz)	
TM1	Communication mode(WIFI + 433MHz)
Fast transients common mode, Voltage dips and interruptions, Surge, line to line and line to ground	
TM1	Communication mode(WIFI + 433MHz)
RF common mode 0.15MHz to 80MHz	
TM1	Communication mode(WIFI + 433MHz)

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10.1 Conducted Disturbance at Mains Terminal

Test Method	: EN 301 489-1, EN 55032
Frequency Range	: 150kHz to 30MHz
Class/Severity	: Class B/ CENELEC EN 55032 [1], annex A table A.10
Detector	: Peak for pre-scan (9kHz Resolution Bandwidth)

10.1.1 E.U.T. Operation

Operating Environment:

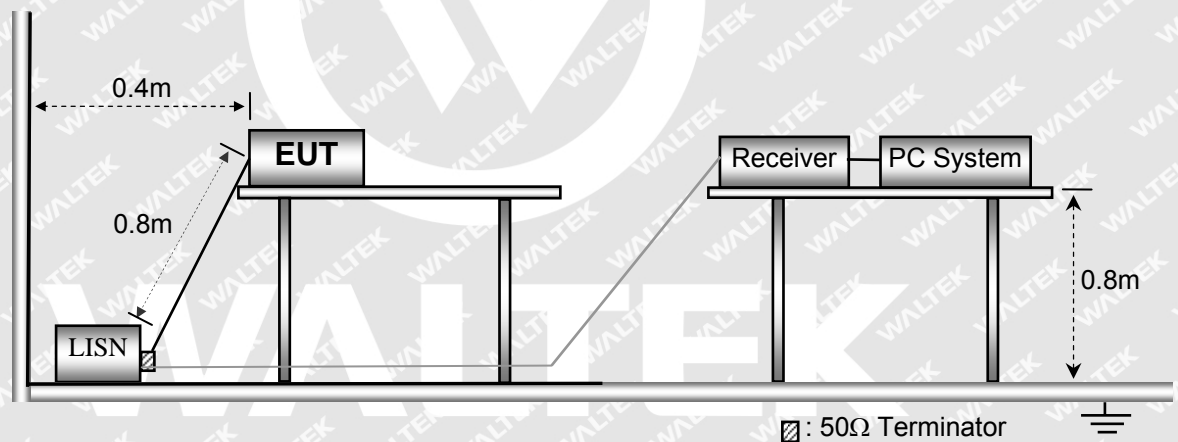
Temperature	: 23.1°C
Humidity	: 52.6%RH
Atmospheric Pressure	: 101.2kPa

EUT Operation:

Refer to section 10(3).

10.1.2 Block Diagram of Test Setup

The Conducted Disturbance at Mains Terminal tests were performed in accordance with the EN 55032.



10.1.3 Measurement Description

An initial pre-scan was performed on the live and neutral lines.

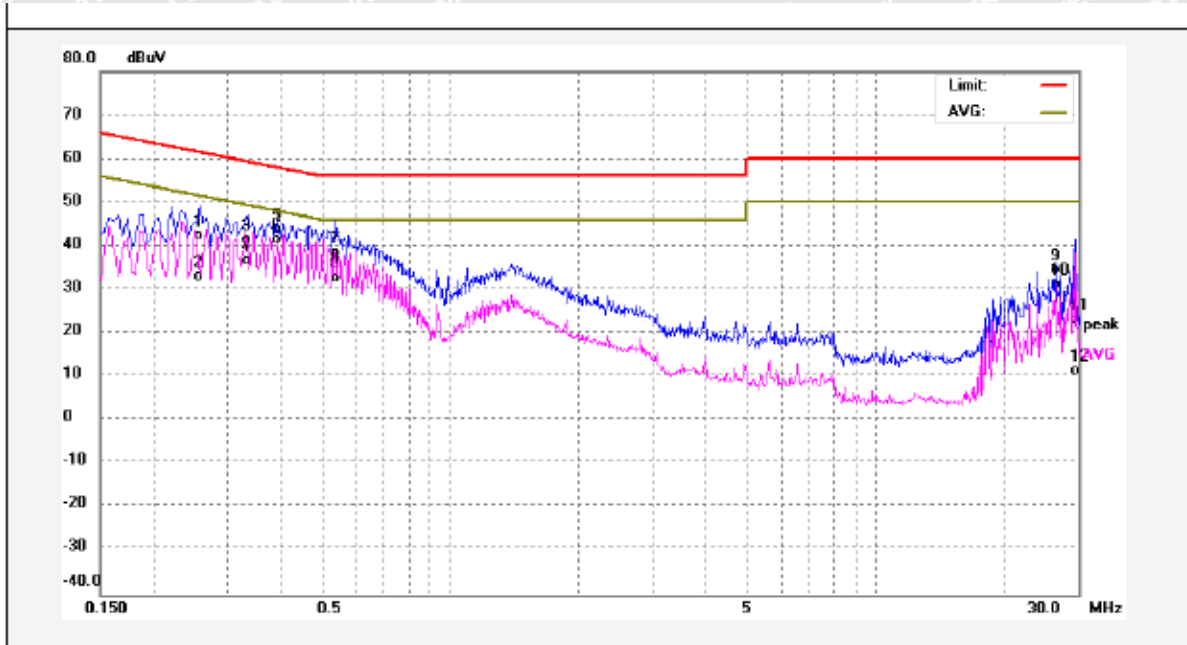
No further quasi-peak or average measurements were performed since no peak emissions were detected within 10dB line below the average limit.

Please refer to the following peak scan graph for reference.



10.1.4 Conducted Disturbance at Mains Terminal Test Data

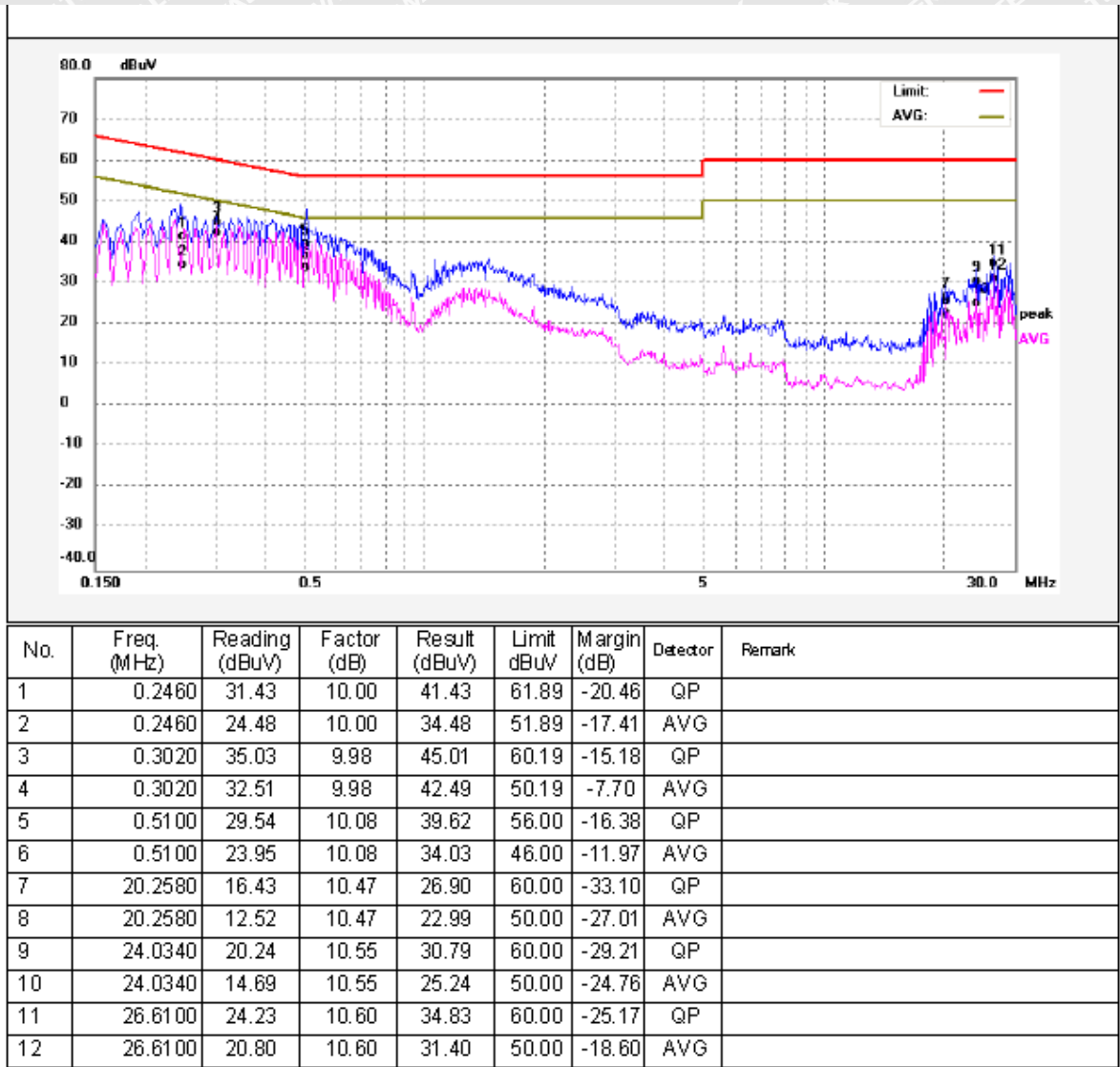
Live Line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.2580	32.34	10.01	42.35	61.49	-19.14	QP	
2	0.2580	23.15	10.01	33.16	51.49	-18.33	AVG	
3	0.3339	31.49	10.03	41.52	59.35	-17.83	QP	
4	0.3339	26.54	10.03	36.57	49.35	-12.78	AVG	
5	0.3899	33.88	10.04	43.92	58.06	-14.14	QP	
6	0.3899	31.41	10.04	41.45	48.06	-6.61	AVG	
7	0.5380	28.33	10.07	38.40	56.00	-17.60	QP	
8	0.5380	22.67	10.07	32.74	46.00	-13.26	AVG	
9	26.6100	23.87	10.60	34.47	60.00	-25.53	QP	
10	26.6100	20.57	10.60	31.17	50.00	-18.83	AVG	
11	29.5940	12.61	10.65	23.26	60.00	-36.74	QP	
12	29.5940	0.95	10.65	11.60	50.00	-38.40	AVG	



Neutral Line:





10.2 Radiated Emissions

Test Method	: EN 301 489-1, EN 55032
Frequency Range	: 30MHz to 1GHz, 1GHz to 6GHz
Class/Severity	: Class B/ CENELEC EN 55032 [1], annex A Tables A.4 (30MHz to 1GHz) Class B/ CENELEC EN 55032 [1], annex A Tables A.5 (1GHz to 6GHz)
Detector	: Peak for pre-scan (120kHz Resolution Bandwidth Below 1GHz; 1MHz Resolution Bandwidth Above 1GHz)

10.2.1 EUT Operation:

Operating Environment :

Temperature : 22.5°C

Humidity : 52.1 % RH

Atmospheric Pressure : 101.2kPa

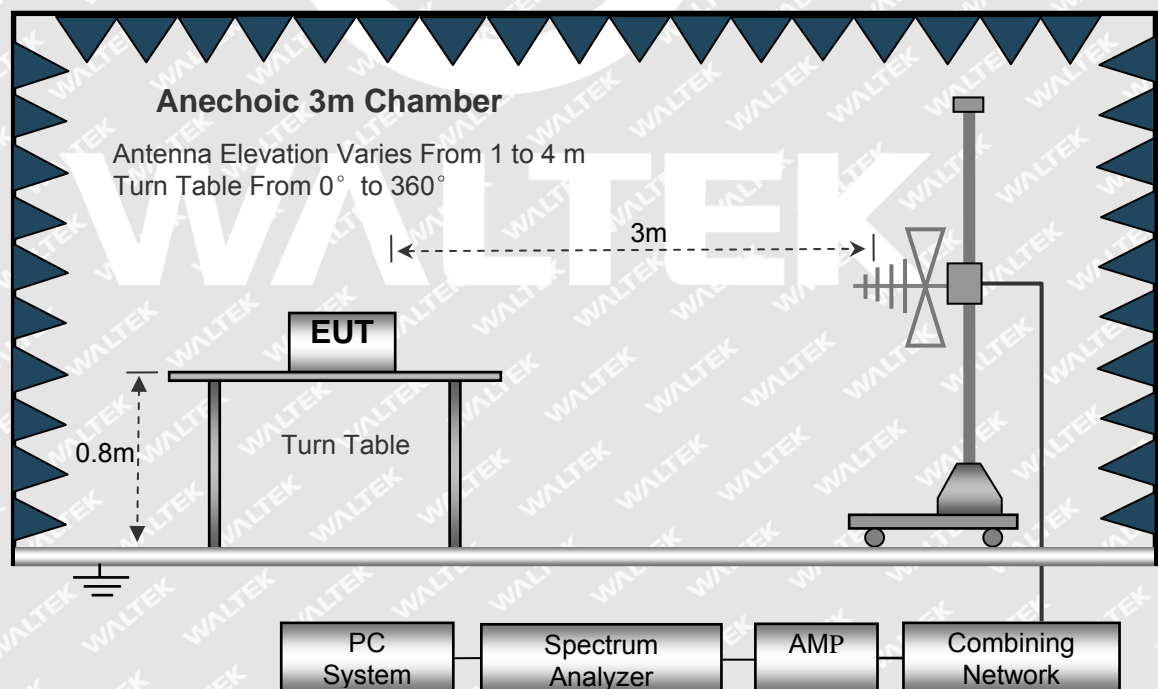
EUT Operation :

Refer to section 10(3).

10.2.2 Test Setup

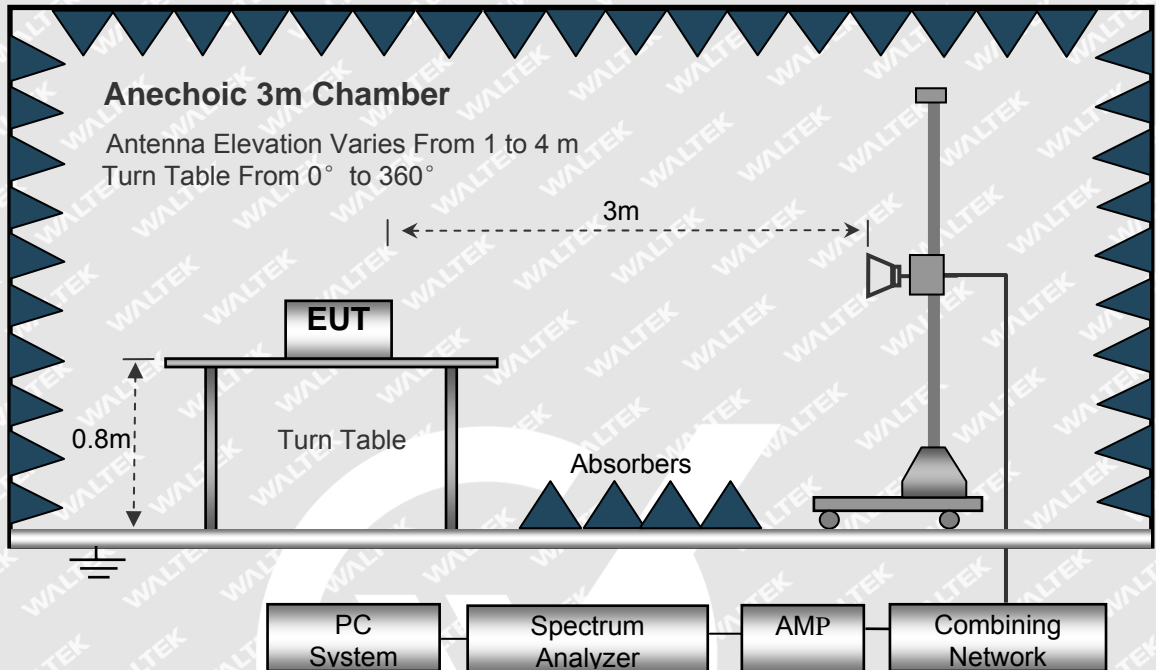
The radiated emission tests were performed using the setup accordance with the EN 55032.

Frequency Range: Below 1 GHz





Frequency Range: Above 1 GHz



10.2.3 Corrected Amplitude & Margin Calculation

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

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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

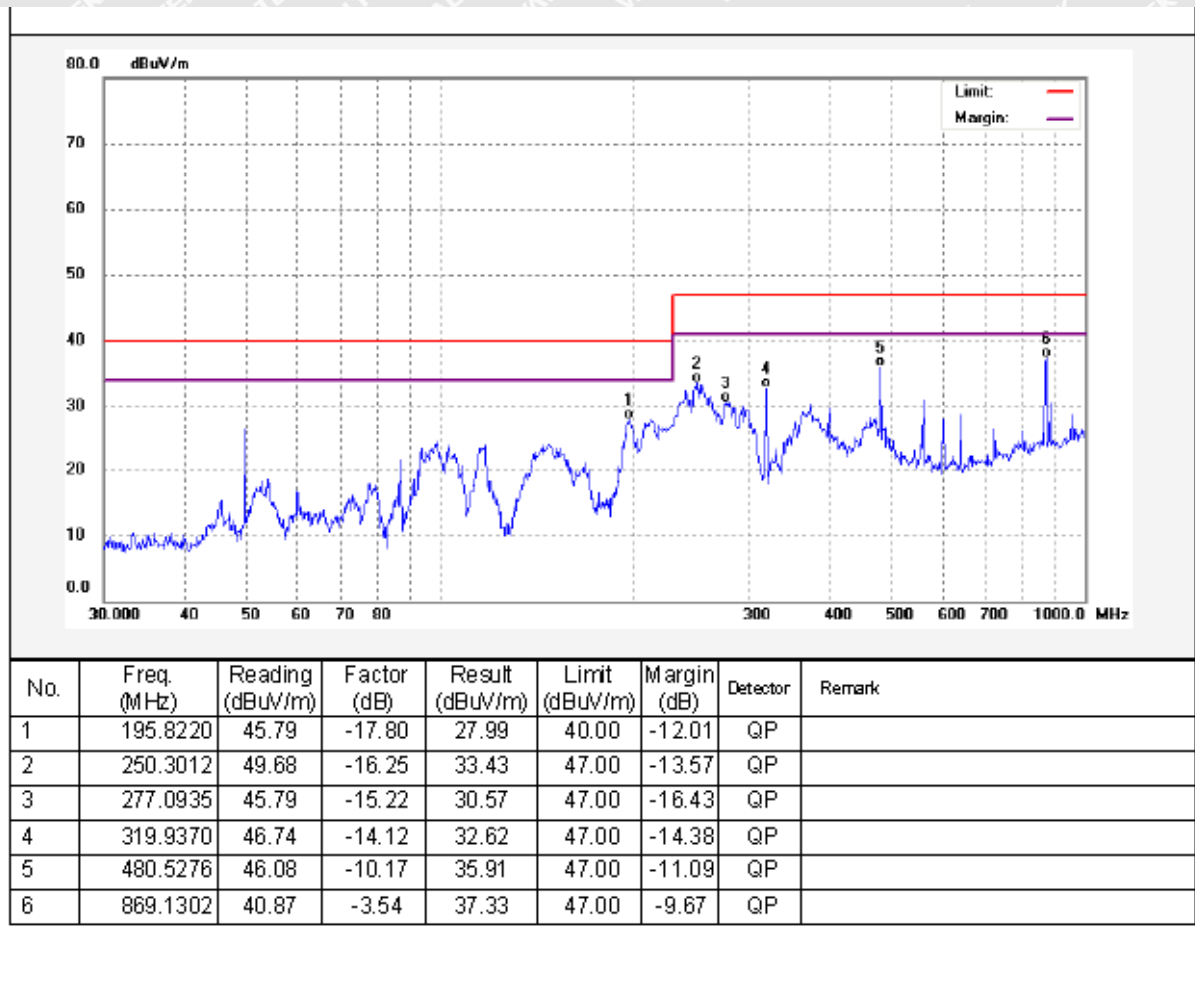
$$\text{Margin} = \text{Corr. Ampl.} - \text{Class B Limit}$$



10.2.4 Test Result

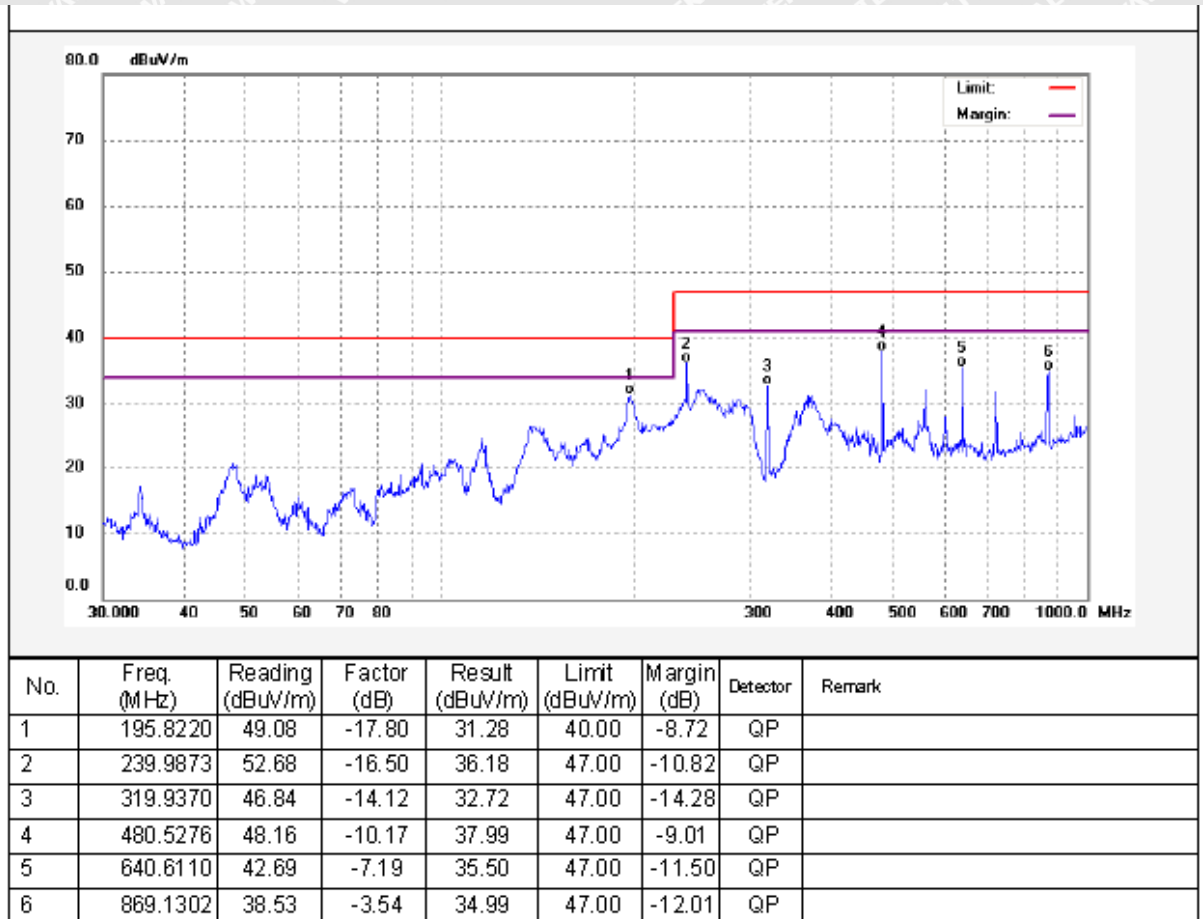
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Horizontal





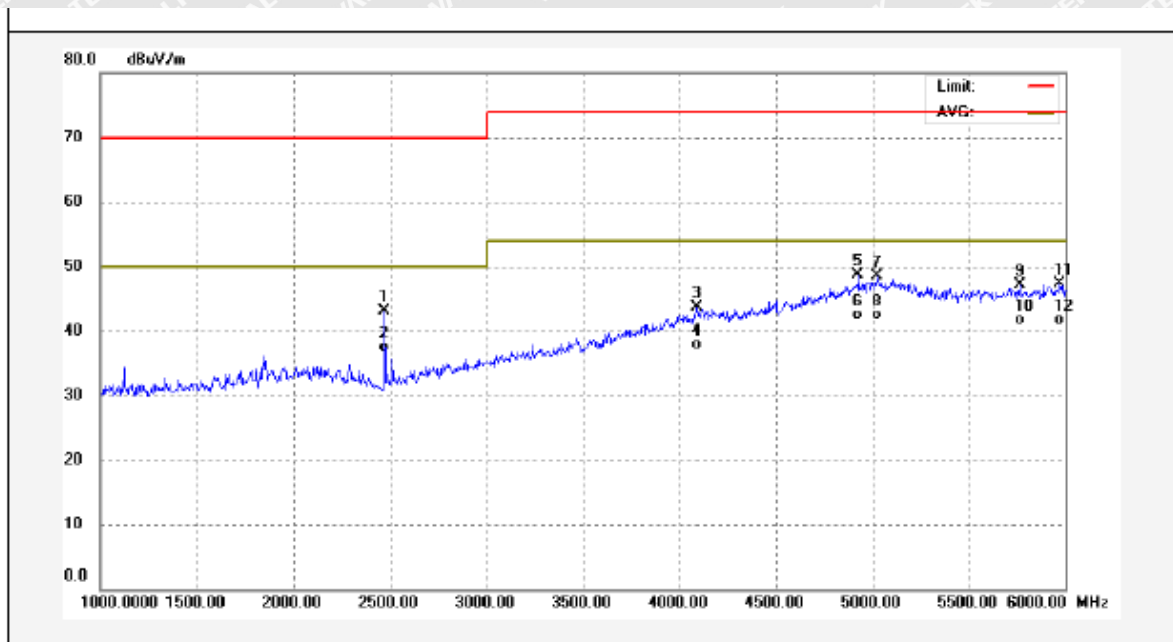
Antenna Polarization: Vertical





Frequency Range: 1GHz ~ 6GHz

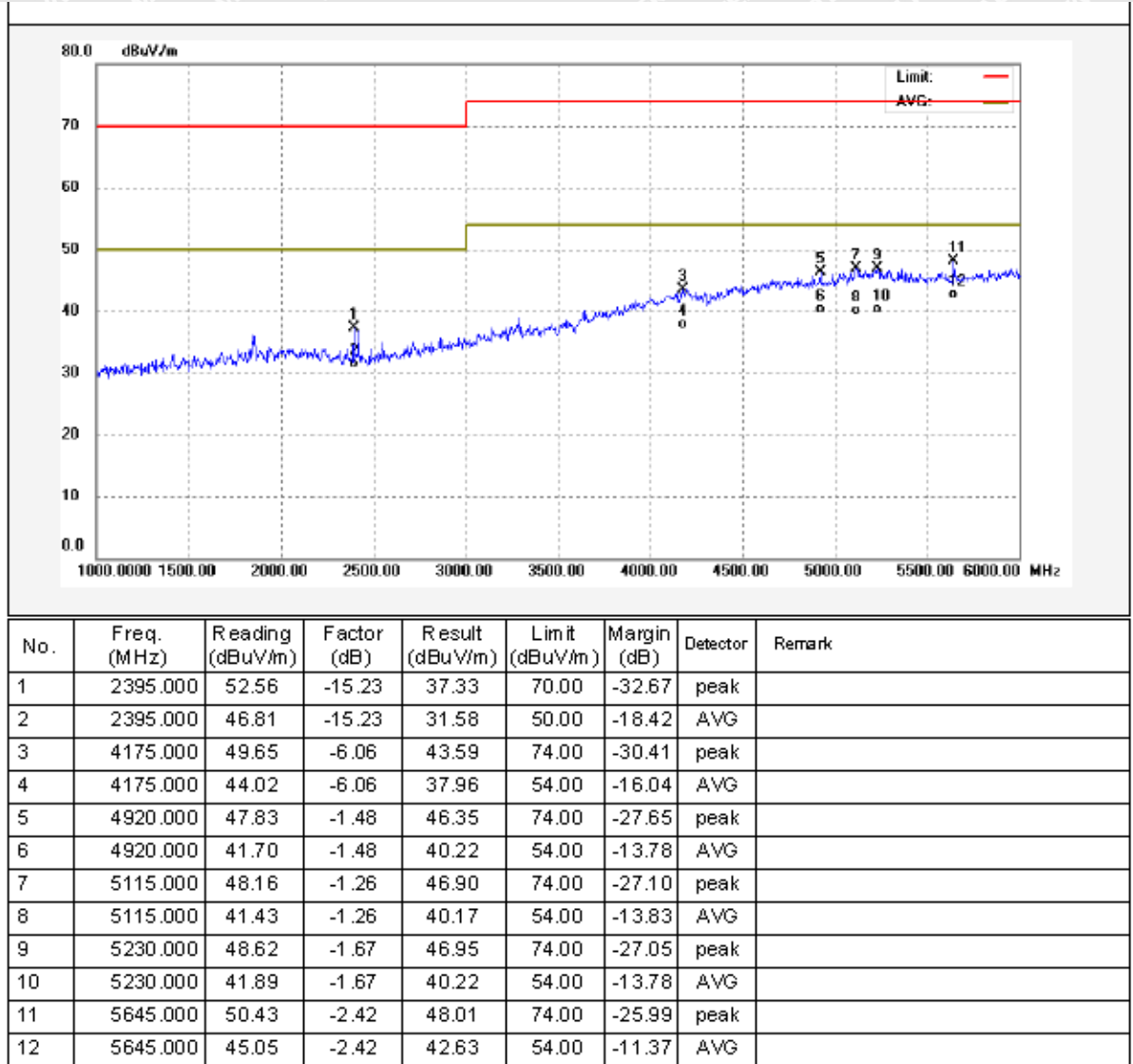
Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2470.000	58.50	-15.36	43.14	70.00	-26.86	peak	
2	2470.000	52.94	-15.36	37.58	50.00	-12.42	AVG	
3	4090.000	50.17	-6.38	43.79	74.00	-30.21	peak	
4	4090.000	44.34	-6.38	37.96	54.00	-16.04	AVG	
5	4925.000	50.22	-1.45	48.77	74.00	-25.23	peak	
6	4925.000	44.00	-1.45	42.55	54.00	-11.45	AVG	
7	5025.000	49.42	-0.93	48.49	74.00	-25.51	peak	
8	5025.000	43.44	-0.93	42.51	54.00	-11.49	AVG	
9	5760.000	49.41	-2.23	47.18	74.00	-26.82	peak	
10	5760.000	43.92	-2.23	41.69	54.00	-12.31	AVG	
11	5970.000	49.18	-1.89	47.29	74.00	-26.71	peak	
12	5970.000	43.55	-1.89	41.66	54.00	-12.34	AVG	



Antenna Polarization: Vertical





10.3 Voltage Fluctuation and Flicker

Test Method : EN 301 489-1, CENELEC EN 61000-3-3 [9]

Test Result : PASS

10.3.1 E.U.T. Operation

Operating Environment :

Temperature : 21.5°C

Humidity : 52.2 % RH

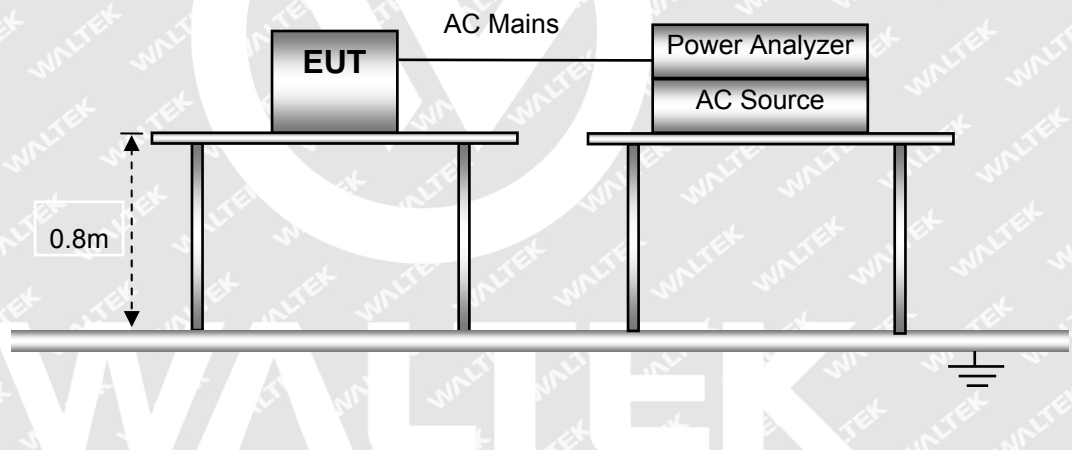
Atmospheric Pressure : 101.2kPa

EUT Operation :

Refer to section 10(3).

10.3.2 Block Diagram of Setup

The Voltage Fluctuation and Flicker test was performed in accordance with the EN 61000-4-15.





10.3.3 Voltage Fluctuation and Flicker Test Data

Flicker Test Summary per EN/IEC61000-3-3 Ed. 3.0 (2013) (Run time)

Test category: All parameters (European limits)

Test Margin: 100

Test date: 2018/6/7 Start time: 11:22:03

End time: 11:32:30

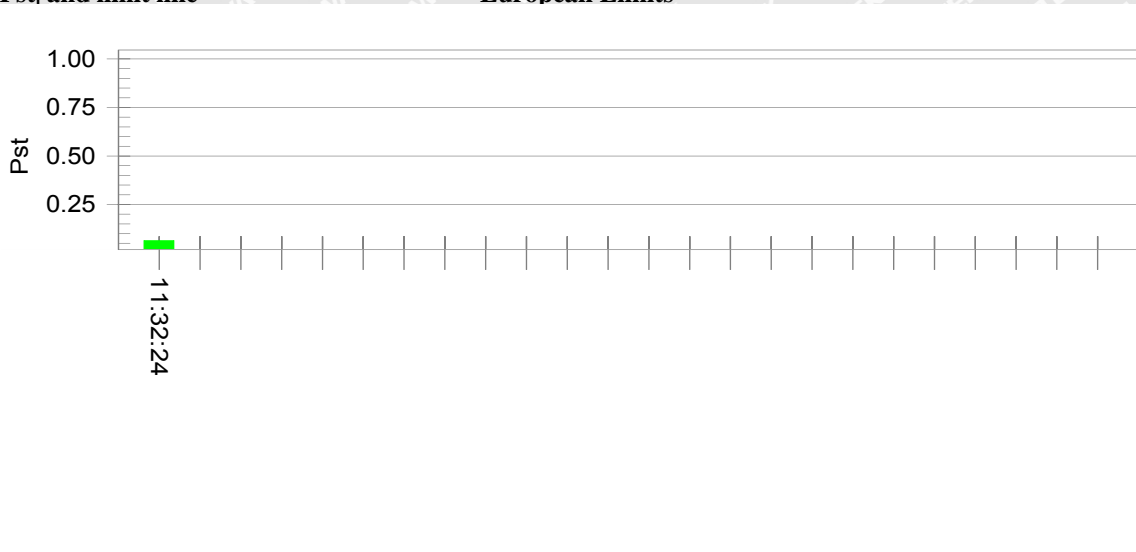
Test duration (min): 10

Data file name: F-000510.cts_data

Test Result: Pass Status: Test Completed

Pst_i and limit line

European Limits



Plt and limit line

**Parameter values recorded during the test:**

Vrms at the end of test (Volt): 228.77

T-max (mS): 0

Highest dc (%): 0.00

Highest dmax (%): 0.00

Highest Pst (10 min. period): 0.064

Highest Plt (2 hr. period): 0.028

Test limit (mS): 500.0 Pass

Test limit (%): 3.30 Pass

Test limit (%): 4.00 Pass

Test limit: 1.000 Pass

Test limit: 0.650 Pass



8.3 Harmonics Current Emission

Test Requirement..... : EN 301489-1
Test Method : EN 61000-4-7
Test Result..... : Pass
Class/Severity : Class A

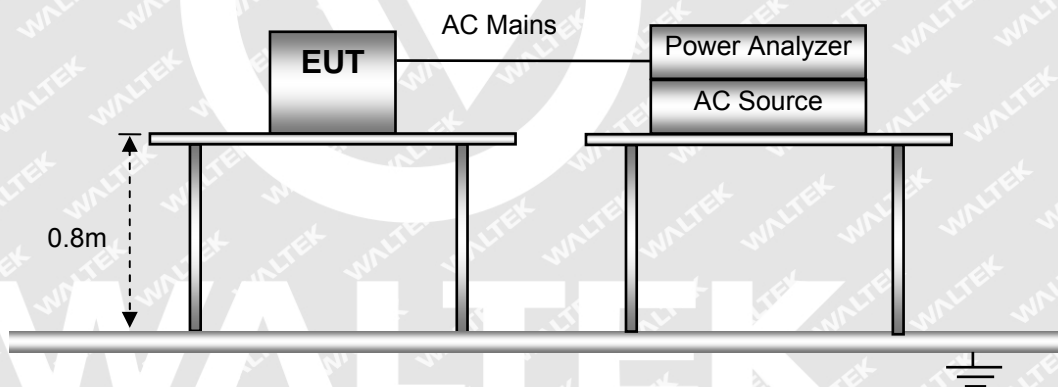
8.3.1 E.U.T. Operation

Operating Environment:

Temperature : 25°C
Humidity : 52.6%RH
Barometric Pressure : 101.4kPa
EUT Operation..... : Refer to section 10(3).

8.3.2 Block Diagram of Test Setup

The Harmonics Current emission test was performed in accordance with EN 61000-4-7.





8.3.3 Test Data

Harmonics – Class-A per Ed. 4.0 (2014)(Run time)

Test category: Class-A per Ed. 4.0 (2014) (European limits)

Test Margin: 100

Test date: 2018/6/7 Start time: 11:16:55

End time: 11:19:36

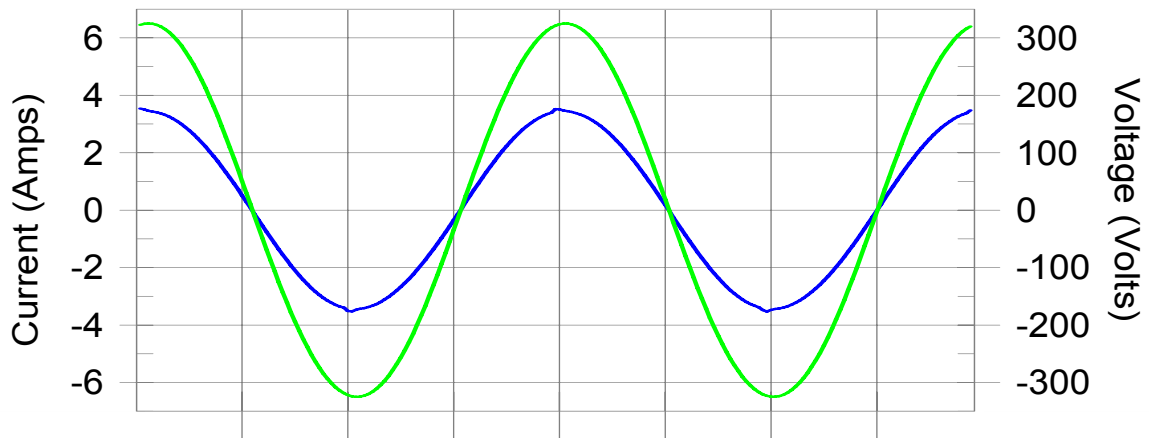
Test duration (min): 2.5

Data file name: H-000509.cts_data

Test Result: Pass

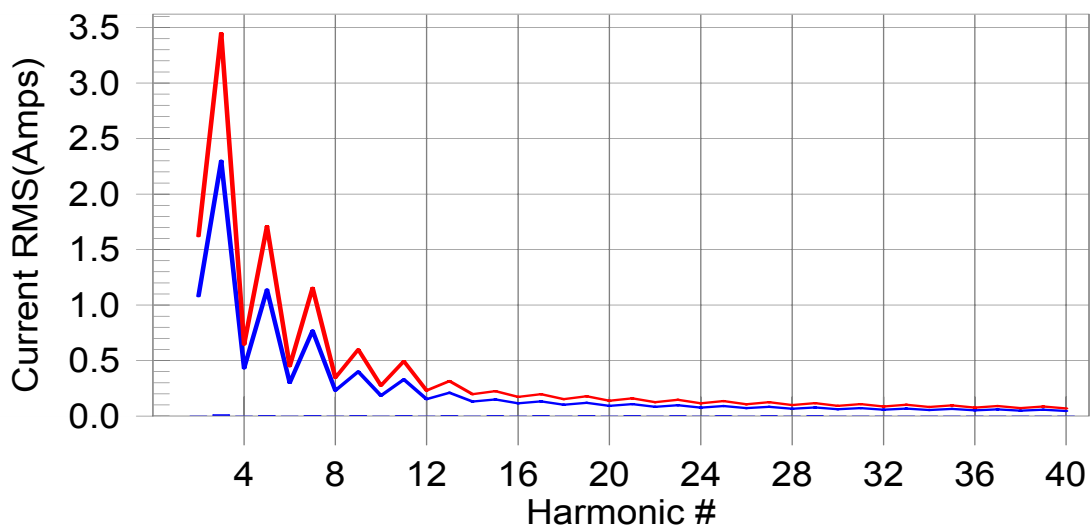
Source qualification: Normal

Current & voltage waveforms



Harmonics and Class A limit line

European Limits



Test result: Pass Worst harmonics H0-0.0% of 150% limit, H0-0% of 100% limit



Current Test Result Summary (Run time)

Test category: Class-A per Ed. 4.0 (2014) (European limits)

Test Margin: 100

Test date: 2018/6/7 Start time: 11:16:55

End time: 11:19:36

Test duration (min): 2.5

Data file name: H-000509.cts_data

Test Result: Pass

Source qualification: Normal

THC(A): 0.020

I-THD(%): 0.8

POHC(A): 0.007

POHC Limit(A): 0.251

Highest parameter values during test:

V_RMS (Volts): 229.94

Frequency(Hz): 50.00

I_Peak (Amps): 3.556

I_RMS (Amps): 2.444

I_Fund (Amps): 2.444

Crest Factor: 1.455

Power (Watts): 561.9

Power Factor: 1.000

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	N/A	0.001	1.620	N/A	Pass
3	0.013	2.300	N/A	0.013	3.450	N/A	Pass
4	0.001	0.430	N/A	0.001	0.645	N/A	Pass
5	0.006	1.140	N/A	0.006	1.710	N/A	Pass
6	0.000	0.300	N/A	0.000	0.450	N/A	Pass
7	0.005	0.770	N/A	0.005	1.155	N/A	Pass
8	0.001	0.230	N/A	0.001	0.345	N/A	Pass
9	0.005	0.400	N/A	0.005	0.600	N/A	Pass
10	0.001	0.184	N/A	0.001	0.276	N/A	Pass
11	0.005	0.330	N/A	0.005	0.495	N/A	Pass
12	0.001	0.153	N/A	0.001	0.230	N/A	Pass
13	0.005	0.210	N/A	0.005	0.315	N/A	Pass
14	0.001	0.131	N/A	0.001	0.197	N/A	Pass
15	0.004	0.150	N/A	0.004	0.225	N/A	Pass
16	0.001	0.115	N/A	0.001	0.173	N/A	Pass
17	0.004	0.132	N/A	0.004	0.198	N/A	Pass
18	0.000	0.102	N/A	0.001	0.153	N/A	Pass
19	0.004	0.118	N/A	0.004	0.178	N/A	Pass
20	0.001	0.092	N/A	0.001	0.138	N/A	Pass
21	0.003	0.107	N/A	0.003	0.161	N/A	Pass
22	0.001	0.084	N/A	0.001	0.125	N/A	Pass
23	0.003	0.098	N/A	0.003	0.147	N/A	Pass
24	0.000	0.077	N/A	0.001	0.115	N/A	Pass
25	0.003	0.090	N/A	0.003	0.135	N/A	Pass
26	0.001	0.071	N/A	0.001	0.107	N/A	Pass
27	0.002	0.083	N/A	0.002	0.125	N/A	Pass
28	0.000	0.066	N/A	0.001	0.099	N/A	Pass
29	0.002	0.078	N/A	0.002	0.116	N/A	Pass
30	0.000	0.061	N/A	0.001	0.092	N/A	Pass
31	0.002	0.073	N/A	0.002	0.109	N/A	Pass
32	0.000	0.058	N/A	0.001	0.086	N/A	Pass
33	0.002	0.068	N/A	0.002	0.102	N/A	Pass
34	0.000	0.054	N/A	0.001	0.081	N/A	Pass
35	0.001	0.064	N/A	0.001	0.096	N/A	Pass
36	0.000	0.051	N/A	0.001	0.077	N/A	Pass
37	0.001	0.061	N/A	0.001	0.091	N/A	Pass
38	0.000	0.048	N/A	0.000	0.073	N/A	Pass
39	0.001	0.058	N/A	0.001	0.087	N/A	Pass
40	0.000	0.046	N/A	0.000	0.069	N/A	Pass



Voltage Source Verification Data (Run time)

Test category: Class-A per Ed. 4.0 (2014) (European limits)

Test Margin: 100

Test date: 2018/6/7 Start time: 11:16:55

End time: 11:19:36

Test duration (min): 2.5

Data file name: H-000509.cts_data

Test Result: Pass

Source qualification: Normal

Highest parameter values during test:

Voltage (Vrms):	229.94	Frequency(Hz):	50.00
I _{Peak} (Amps):	3.556	I _{RMS} (Amps):	2.444
I _{Fund} (Amps):	2.444	Crest Factor:	1.455
Power (Watts):	561.9	Power Factor:	1.000

Harm# Harmonics V-rmsLimit V-rms% of Limit Status

2	0.062	0.460	13.38	OK
3	0.488	2.069	23.61	OK
4	0.056	0.460	12.10	OK
5	0.053	0.920	5.75	OK
6	0.033	0.460	7.11	OK
7	0.023	0.690	3.31	OK
8	0.010	0.460	2.24	OK
9	0.032	0.460	6.92	OK
10	0.010	0.460	2.28	OK
11	0.012	0.230	5.44	OK
12	0.014	0.230	6.01	OK
13	0.009	0.230	3.80	OK
14	0.006	0.230	2.48	OK
15	0.007	0.230	3.22	OK
16	0.008	0.230	3.64	OK
17	0.007	0.230	3.03	OK
18	0.009	0.230	3.70	OK
19	0.012	0.230	5.13	OK
20	0.020	0.230	8.64	OK
21	0.012	0.230	5.15	OK
22	0.003	0.230	1.12	OK
23	0.005	0.230	2.14	OK
24	0.004	0.230	1.55	OK
25	0.006	0.230	2.56	OK
26	0.003	0.230	1.23	OK
27	0.006	0.230	2.52	OK
28	0.003	0.230	1.23	OK
29	0.007	0.230	2.85	OK
30	0.002	0.230	1.02	OK
31	0.004	0.230	1.55	OK
32	0.002	0.230	0.83	OK
33	0.004	0.230	1.63	OK
34	0.002	0.230	1.01	OK
35	0.003	0.230	1.30	OK
36	0.002	0.230	0.79	OK
37	0.003	0.230	1.26	OK
38	0.002	0.230	0.82	OK
39	0.004	0.230	1.80	OK
40	0.011	0.230	4.60	OK



10.4 Electrostatic Discharge(ESD)

Test Method	: EN 301 489-1, CENELEC EN 61000-4-2 [2], clause 8.
Discharge Impedance	: 330 Ω / 150 pF
Discharge Voltage	: Air Discharge: +/-2,4,8 KV Contact Discharge: +/-2,4 kV HCP & VCP: +/-2,4 kV
Polarity	: Positive & Negative
Discharge Repeat Times	: At Least 20 times at each test point
Discharge Mode	: Single Discharge
Discharge Period	: 1 second minimum

10.4.1 E.U.T. Operation

Operating Environment:

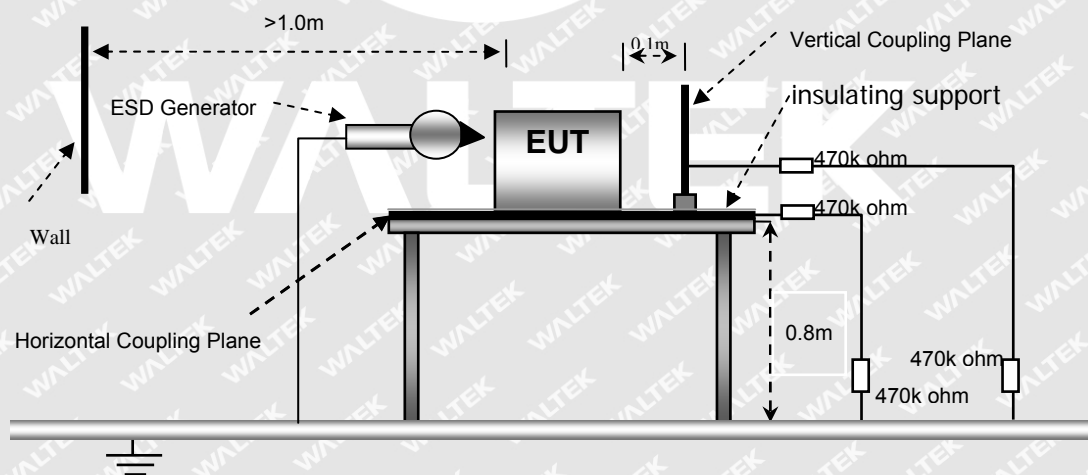
Temperature	: 21.5°C
Humidity	: 52.0 % RH
Barometric Pressure	: 101.3kPa

EUT Operation:

Refer to section 10(3).

10.4.2 Block Diagram of Setup

The ESD test was performed in accordance with the EN 61000-4-2.





10.4.3 Test Results

Indirect Application			Performance Criteria	
Discharge Level(kV)	Polarity(+/-)	Test Point	Horizontal Coupling	Vertical Coupling
2,4	+/-	1	Pass	Pass
Remark: Test points : 1. All sides(Front/Top/Back/Left/Right Sides).				

Direct Application			Performance Criteria	
Discharge Level (kV)	Polarity(+/-)	Test Point	Contact Discharge	Air Discharge
2,4,8	+/-	1	N/A	Pass
2,4	+/-	2	Pass	N/A
Remark: Test points : 1. All Exposed Surface & Seams; 2. All metallic part N/A: Not applicable.				

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10.5 Radio frequency electromagnetic field (80MHz to 6000MHz)

Test Method	: EN 301 489-1, CENELEC EN 61000-4-3 [3], clause 7 and 8
Face Under Test	: Three Mutually Orthogonal Faces
Severity	: 3V/m, 1kHz, 80% Amp. Mod. from 80MHz to 6GHz
Test Result	: PASS

10.5.1 E.U.T. Operation

Operating Environment:

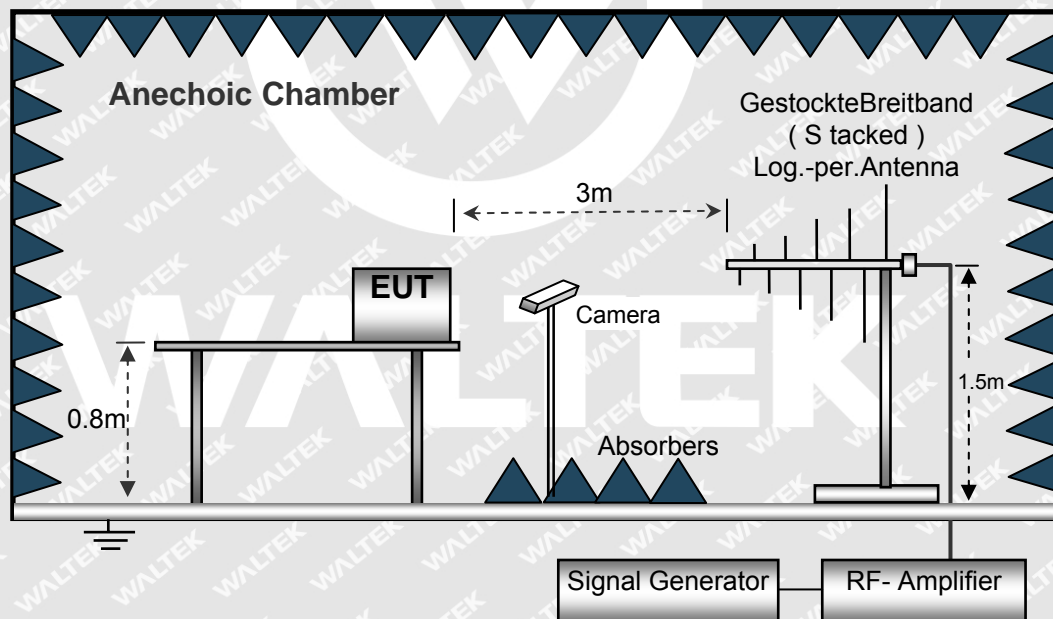
Temperature	: 21.4°C
Humidity	: 52.1 % RH
Barometric Pressure	: 101.2kPa

EUT Operation :

Refer to section 9(3).

10.5.2 Block Diagram of Setup

The Radiated Immunity test was performed in accordance with the EN 61000-4-3.



10.5.3 Test Results

Frequency	Level	Modulation	EUT Face	Performance Criteria
80MHz -1GHz,	3V/m	1kHz, 80%, Amp. Mod.	Front,Back Left,Right	A
1GHz - 6GHz	3V/m	1kHz, 80%, Amp. Mod.	Front,Back Left,Right	A



10.6 Electrical Fast Transients (EFT)

Test Method	:	EN 301 489-1, CENELEC EN 61000-4-4 [4], clause 7 and 8
Polarity	:	Positive & Negative
Repetition Frequency	:	5kHz
Burst Duration	:	300ms
Test Duration	:	2 minutes per level & polarity

10.6.1 E.U.T. Operation

Operating Environment:

Temperature : 21.5°C

Humidity : 52.2 % RH

Barometric Pressure : 101.2kPa

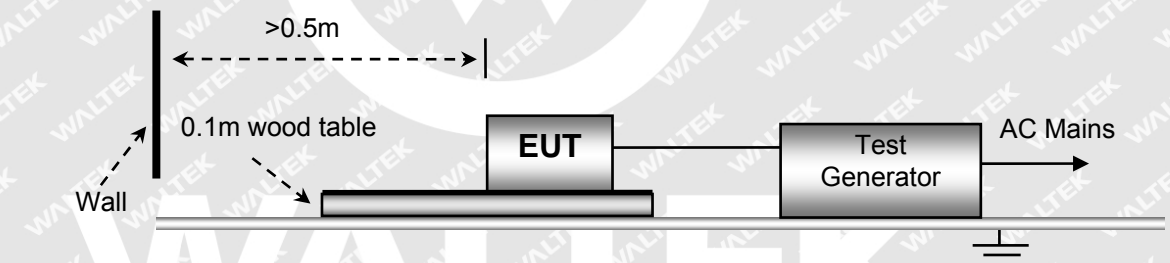
EUT Operation:

Refer to section 10(3).

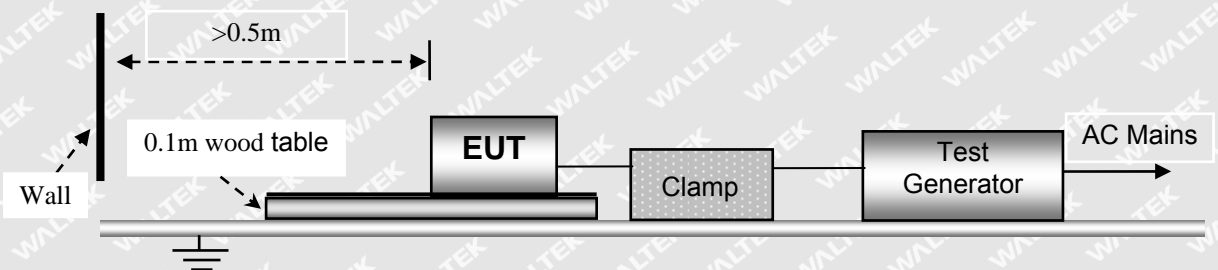
10.6.2 Block Diagram of Test Setup

The Electrical Fast Transients Immunity test was performed in accordance with the IEC 61000-4-4.

For AC Mains or DC Ports:



For Signal or Teletransmitting Ports:





10.6.3 Test Results

Lead under Test	Test Level	Test Voltage	Performance Criteria
AC mains power input port	2	± 1.0 kV	PASS
DC power input port	1	± 0.5 kV	N/A
Signal port	1	± 0.5 kV	N/A



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10.7 Surges

Test Method : EN 301 489-1, CENELEC EN 61000-4-5 [5], clause 8
Interval : 60s between each surge
No. of surges : 5 positive, 5 negative at 0°, 90°, 180°, 270°.

10.7.1 E.U.T. Operation

Operating Environment:

Temperature : 21.6°C
Humidity : 52.1 % RH
Barometric Pressure : 101.2kPa

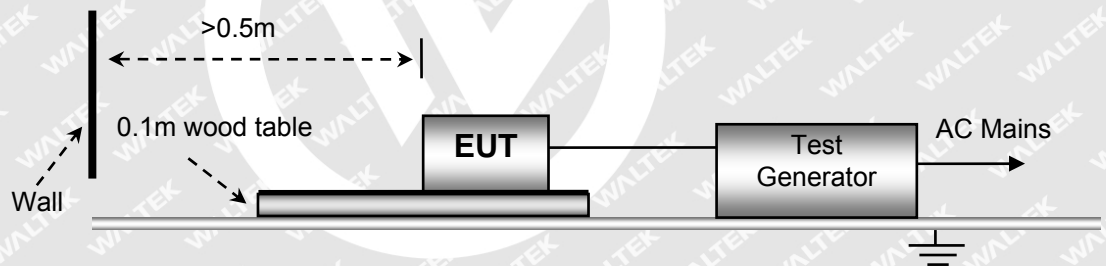
EUT Operation:

Refer to section 10(3).

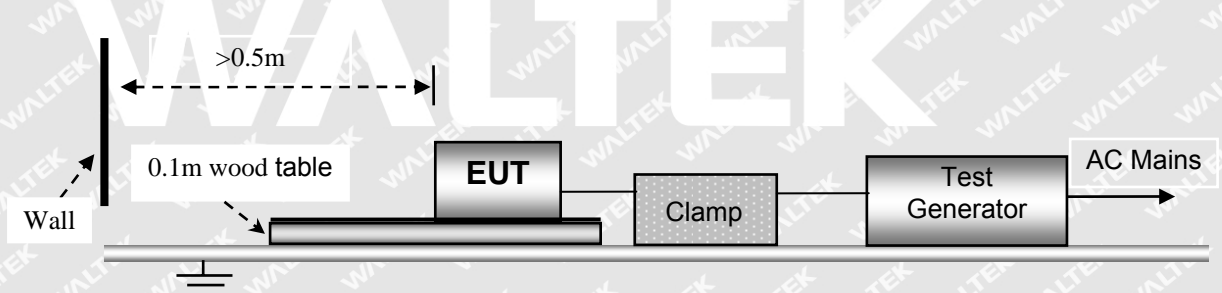
10.7.2 Block Diagram of Test Setup

The Surges Immunity test was performed in accordance with the IEC 61000-4-5.

For AC Mains or DC Ports:



For Signal or Teletransmitting Ports:





10.7.3 Test Results

Lead under Test	Test Level	Test Voltage	Path	Performance Criteria
AC Mains	2	$\pm 1\text{kV}$	Line to Line	PASS
AC Mains	3	$\pm 2\text{kV}$	Line to Ground	N/A
Telecom port	1	$\pm 0.5\text{kV}$	Line to Line	N/A
Telecom port	2	$\pm 1\text{kV}$	Line to Ground	N/A



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10.8 Conducted Immunity

Test Method	: EN 301 489-1, CENELEC EN 61000-4-6 [6], clause 8
Test level	: 3V rms (unmodulated emf into 150 Ω)
Modulation	: 80%, 1kHz Amplitude Modulation.

10.8.1 E.U.T. Operation

Operating Environment :

Temperature : 21.5°C

Humidity : 52.1 % RH

Barometric Pressure : 101.3kPa

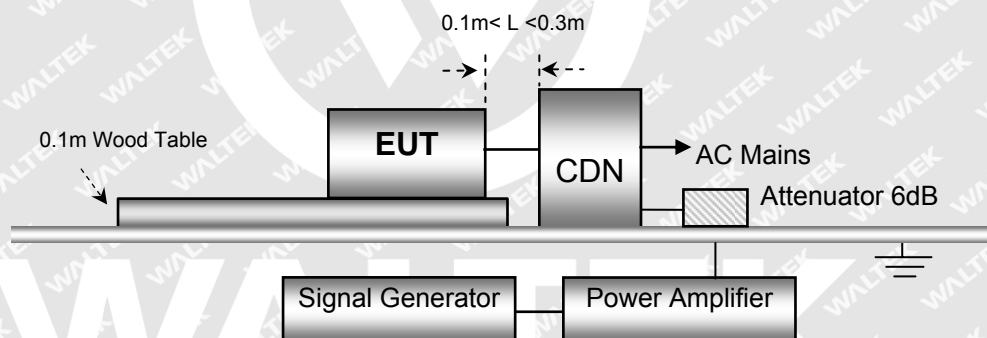
EUT Operation :

Refer to section 10(3).

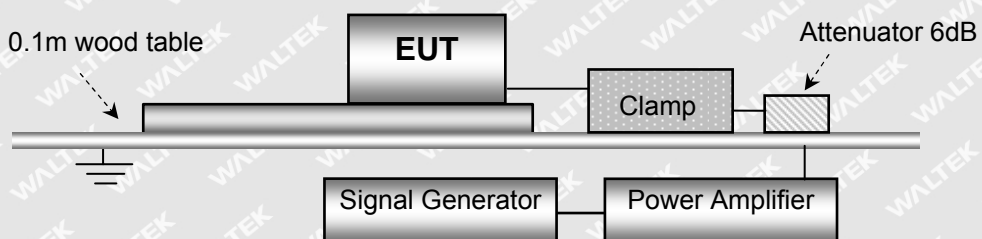
10.8.2 Block Diagram of Test Setup

The Injected Currents Immunity test was performed in accordance with the IEC 61000-4-6.

For AC Mains or DC Input:



For Signal or Teletransmitting Ports:





10.8.3 Test Results

Line	Frequency	Test Level	Voltage Level	Modulation	Step Size	Dwell Time	Performance Criteria
AC Mains	0.15MHz to 80MHz	2	3Vrms	80%, 1kHz Amp. Mod.	1%	1s	A
Signal port	0.15MHz to 80MHz	2	3Vrms	80%, 1kHz Amp. Mod.	1%	1s	N/A



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10.9 Voltage Dips and Interruptions

Test Method : EN 301 489-1, CENELEC EN 61000-4-11 [7], clause 8

No. of Dips / Interruptions : 3 per Level at 10ms intervals

10.9.1 E.U.T. Operation

Operating Environment:

Temperature : 21.5°C

Humidity : 52.1 % RH

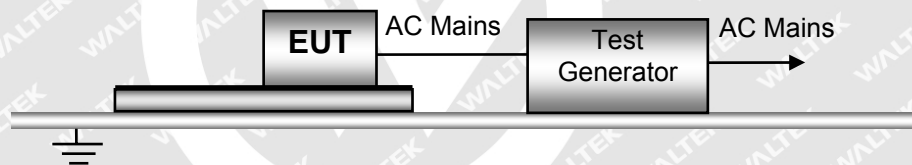
Barometric Pressure : 101.2kPa

EUT Operation:

Refer to section 10(3).

10.9.2 Block Diagram of Setup

The Voltage Dips and Interruptions Immunity test was performed in accordance with the IEC 61000-4-11.



10.9.3 Test Results

Type	Residual Voltage (%)	Phase	Cycle	No of dropout	Performance Criteria
Voltage Dips	0	0°	0.5	3	B
	0	0°	1	3	B
	70	0°	25	3	B
Voltage Interruption	0	0°	250	3	B

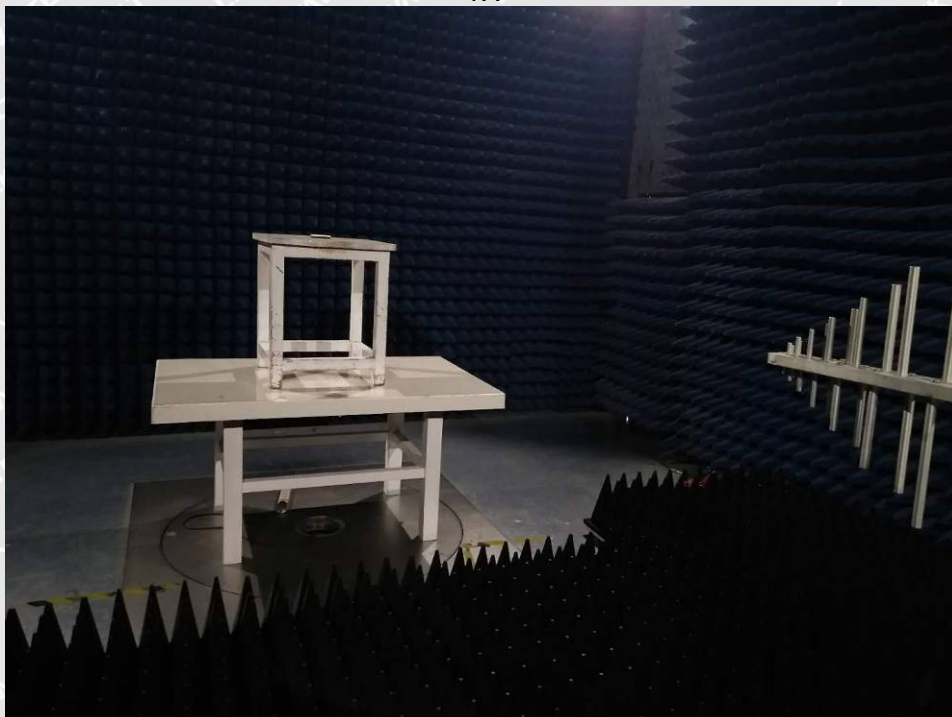


11 Photographs — Test setup

11.1 Photograph - Spurious Emissions Test Setup

For 30MHz-1000MHz

TX



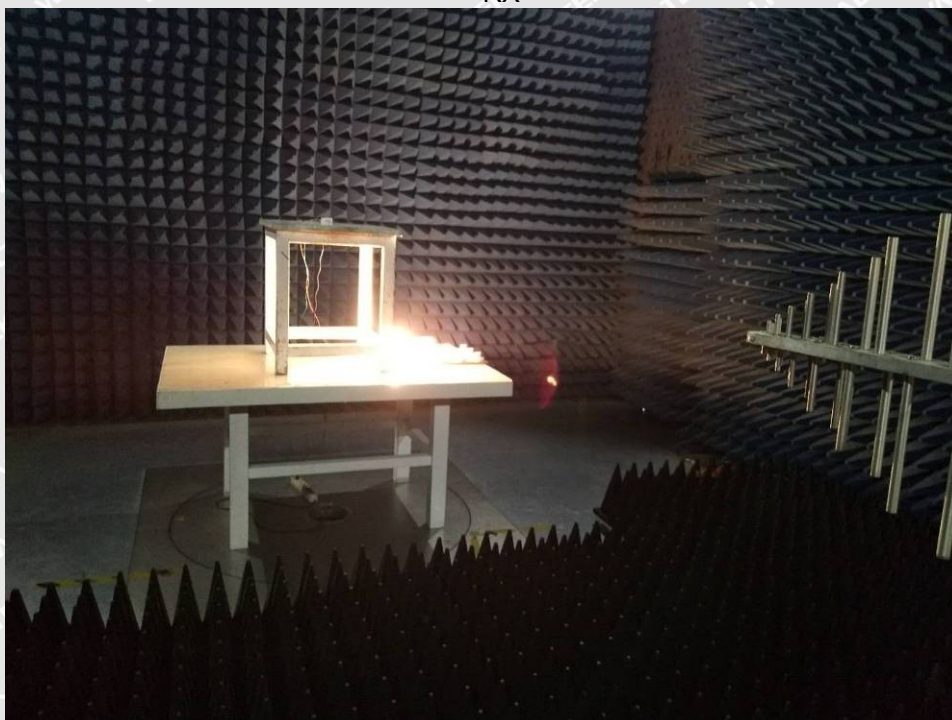
For Above 1GHz

TX

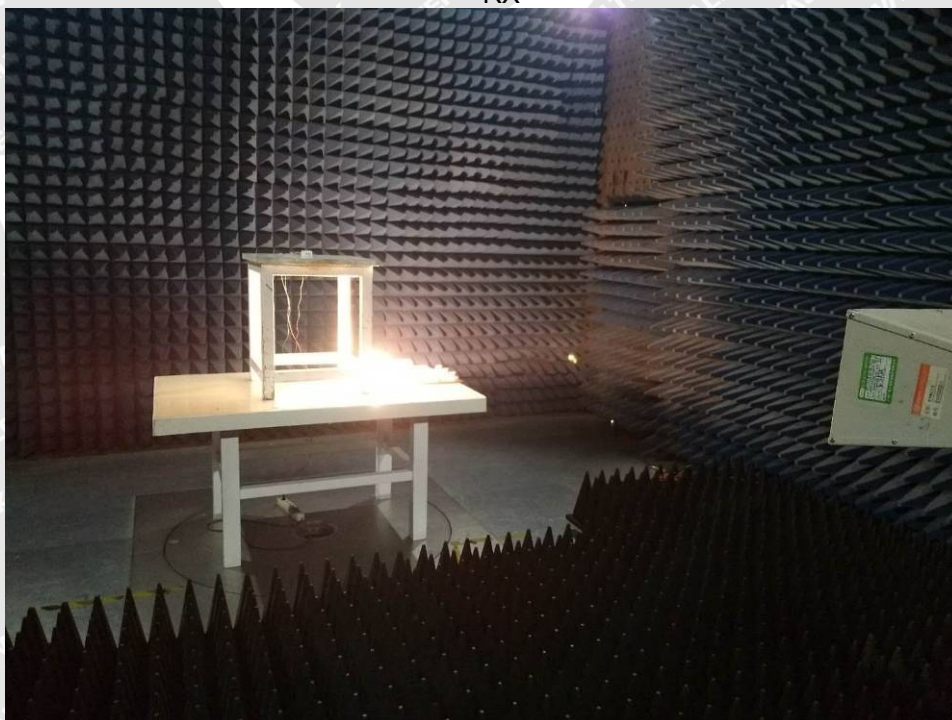




For 30MHz-1000MHz
RX



For Above 1GHz
RX





11.2 Photograph –Conducted Disturbance at Mains Terminal(AC) Test Setup



11.3 Photograph – Radiated Emission Test Setup for Below 1GHz

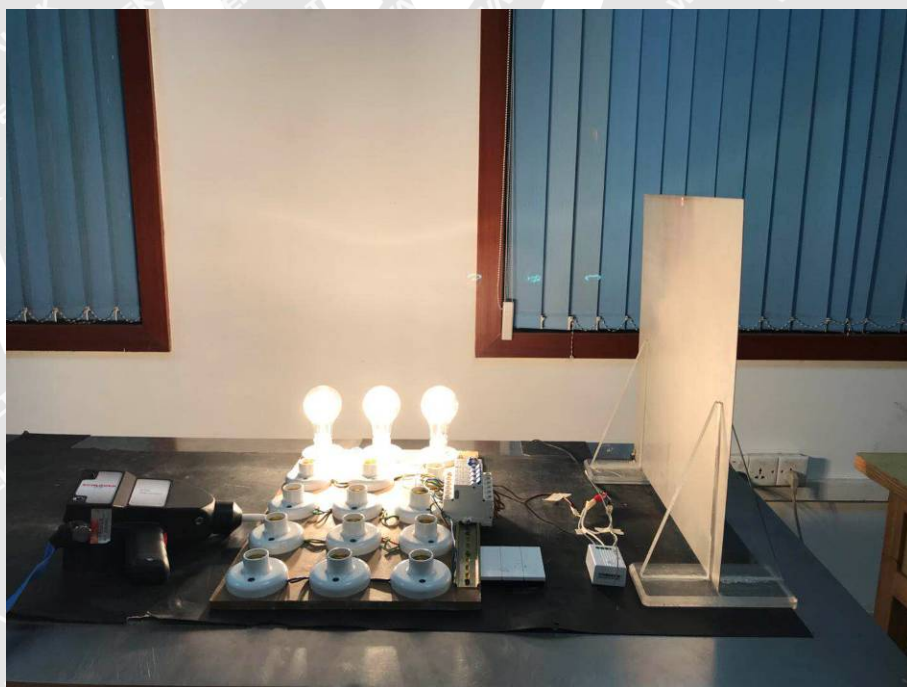




11.4 Photograph –Voltage Fluctuation and Flicker / Harmonics Test Setup

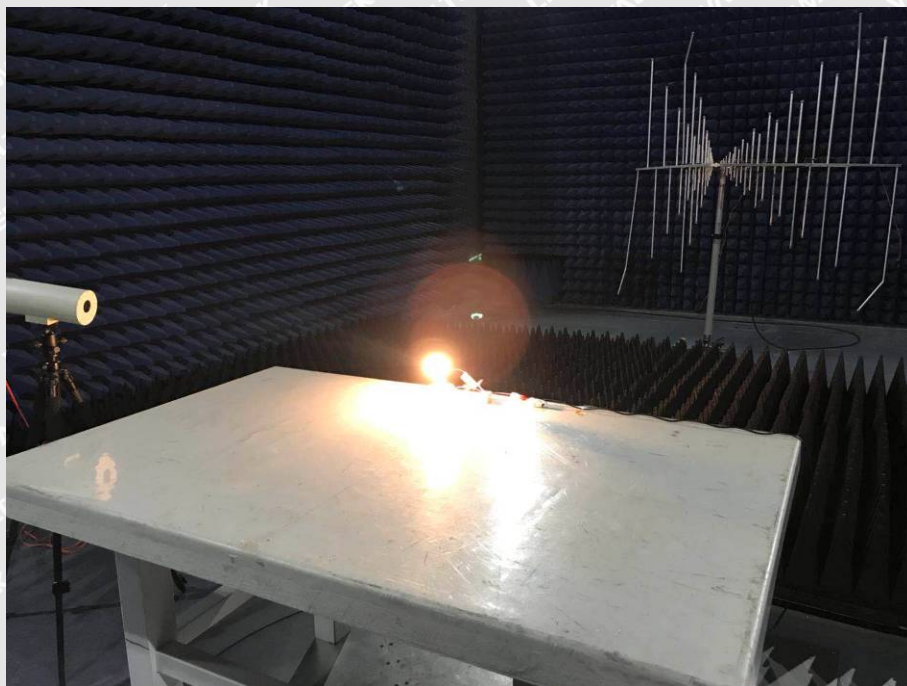


11.5 Photograph – ESD Immunity Test Setup





11.6 Photograph – Radio-frequency electromagnetic fields Test Setup

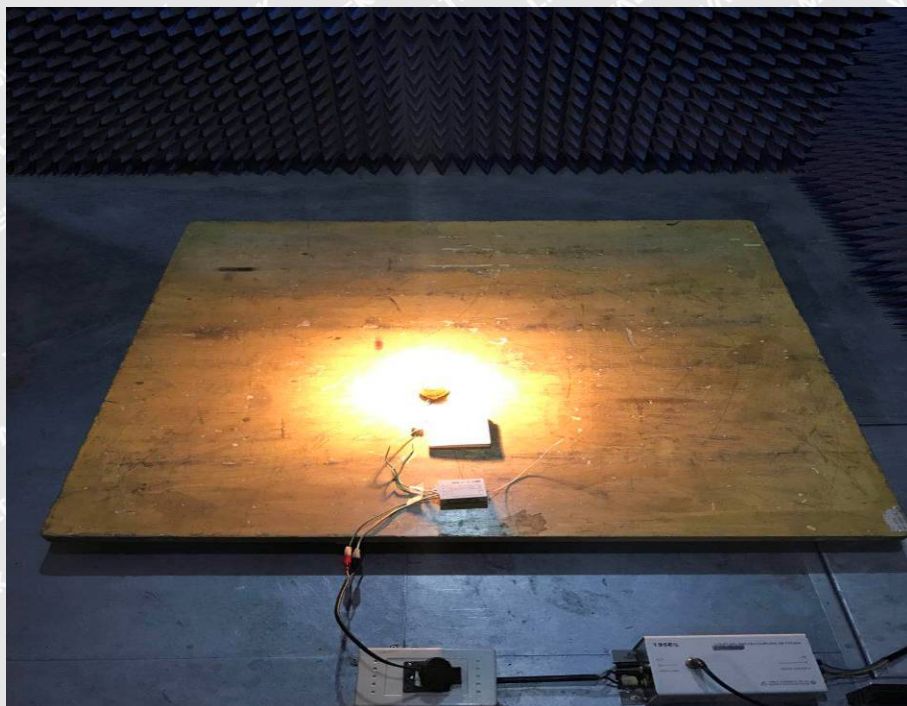


11.7 Photograph – EFT & Surges & Dips Immunity AC Mains Test Setup





11.8 Photograph – Injected Currents Immunity AC Mains Test Setup

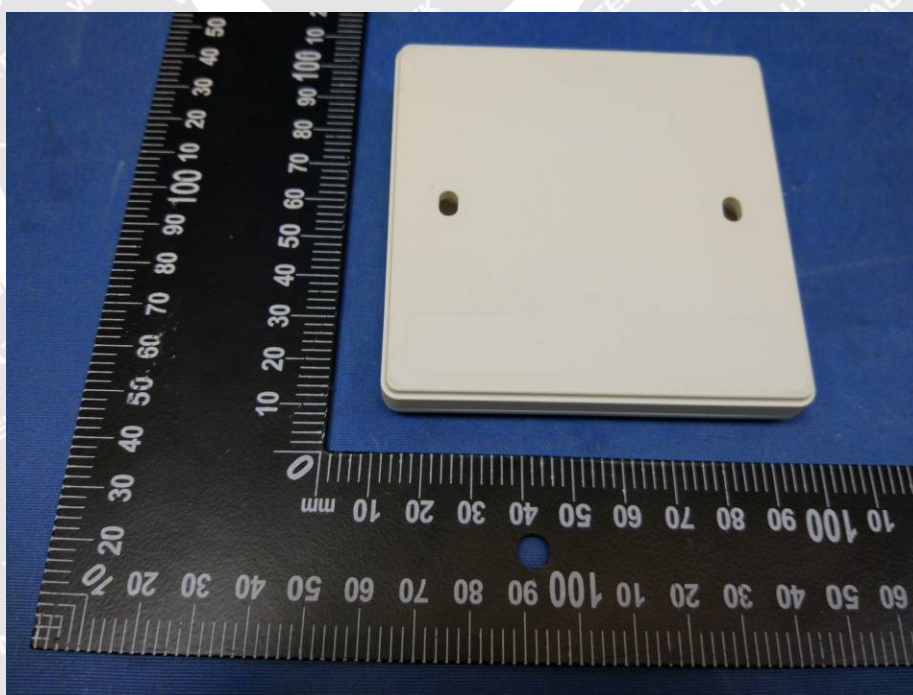
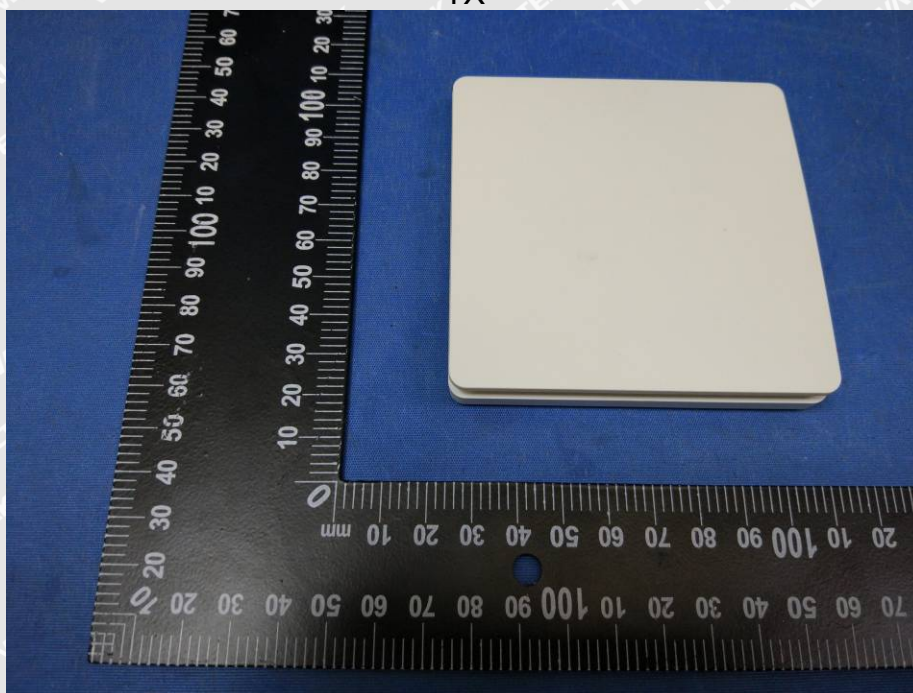


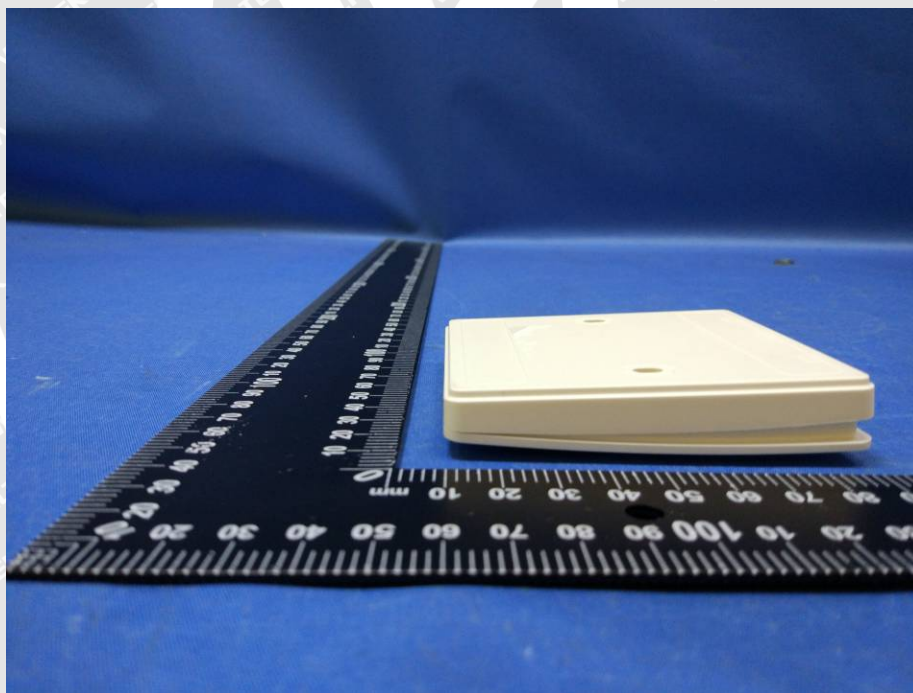
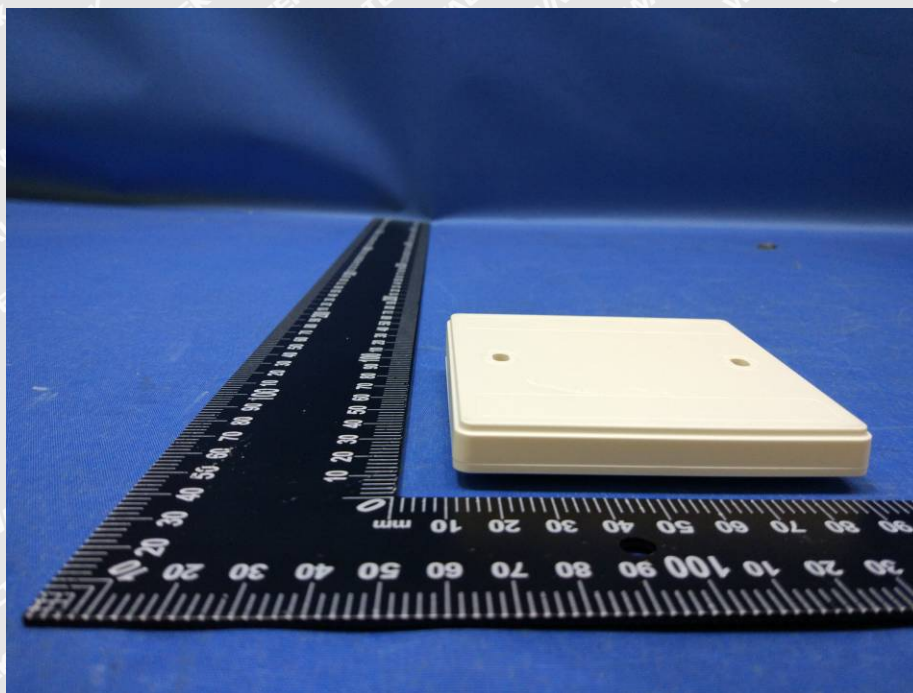


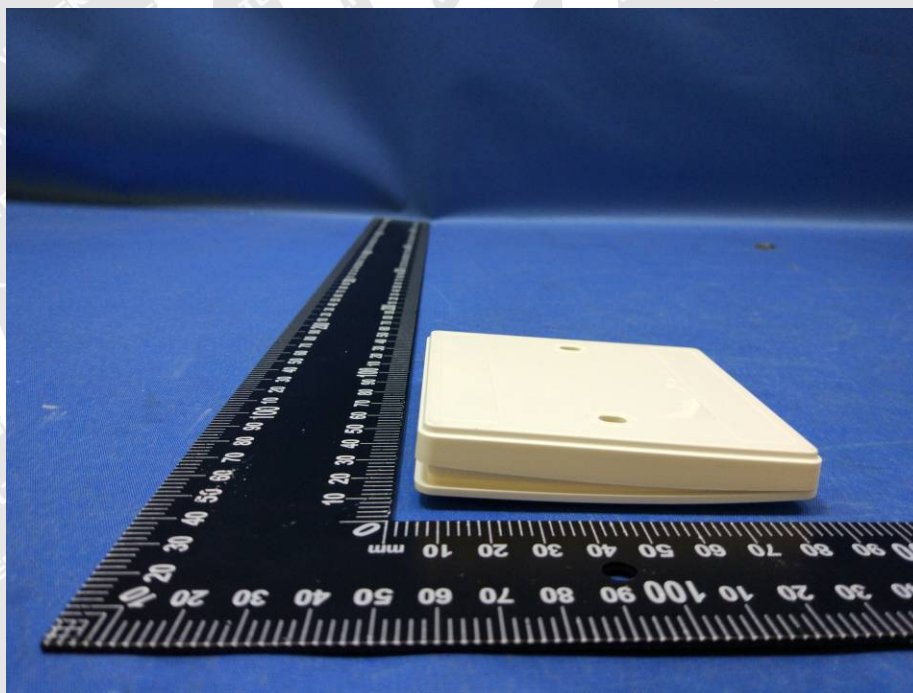
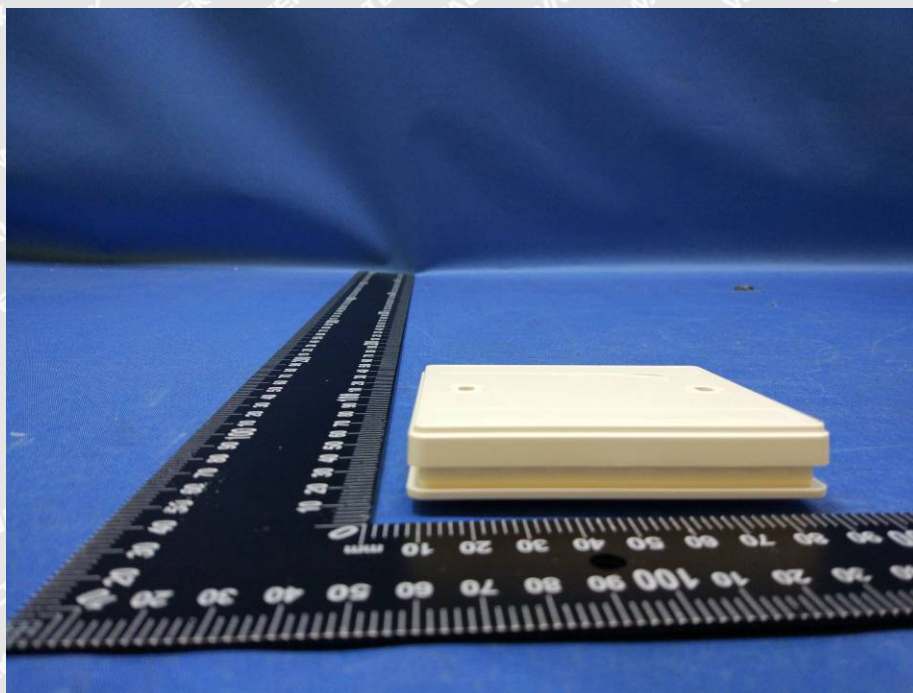
12 Photographs – Constructional Details

12.1 EUT – Appearance View

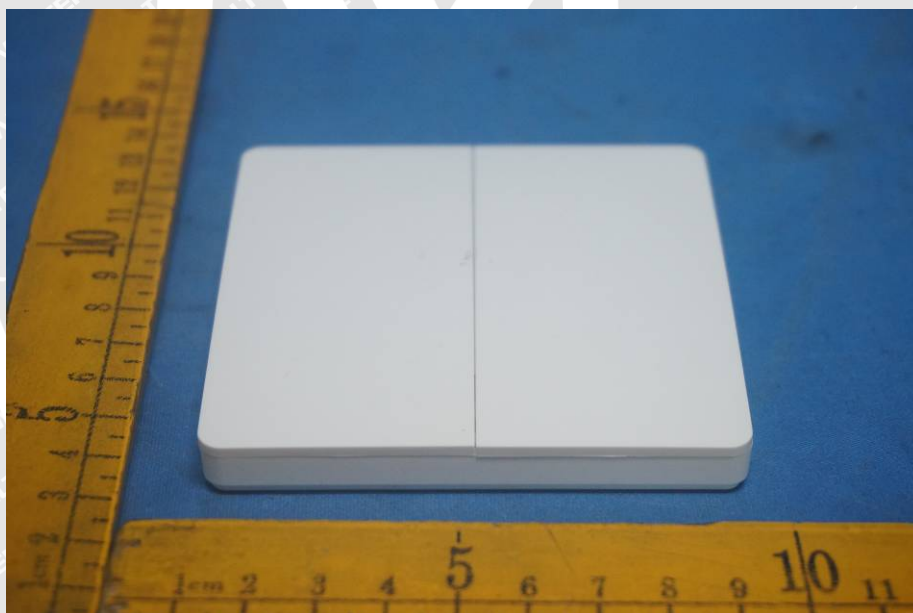
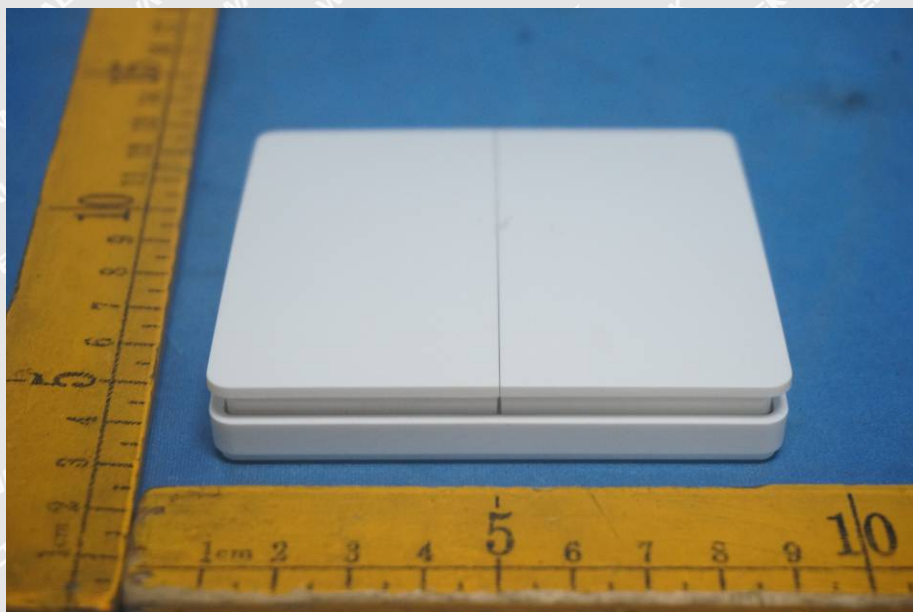
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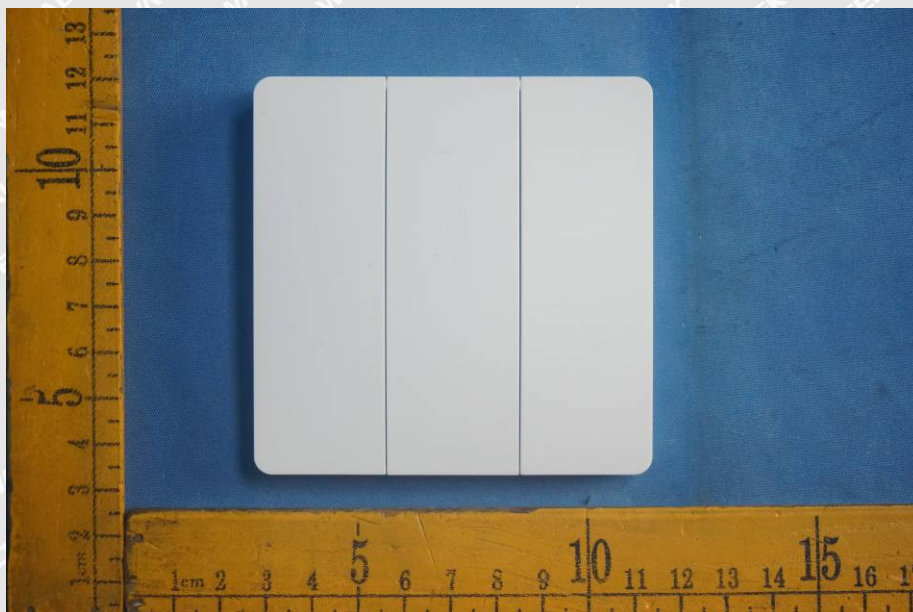


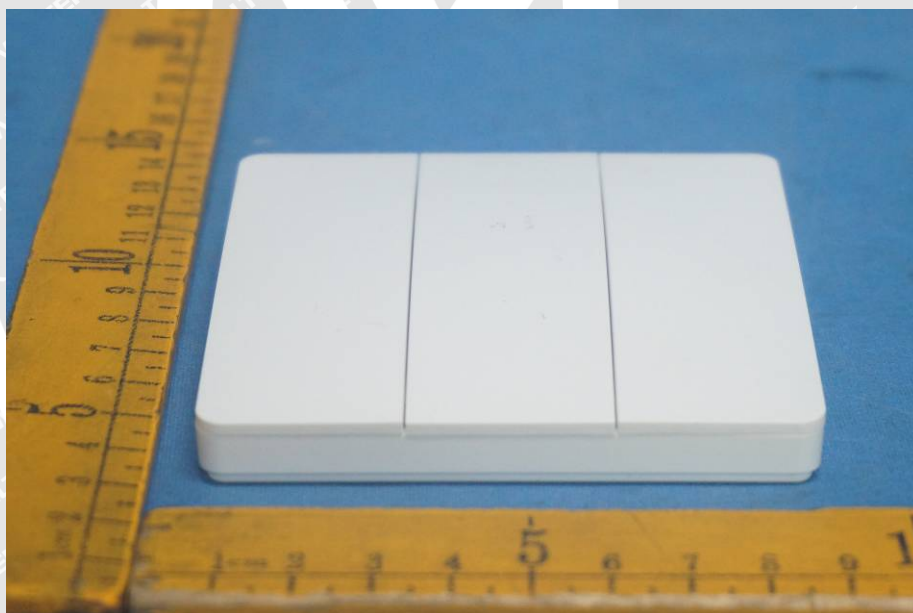








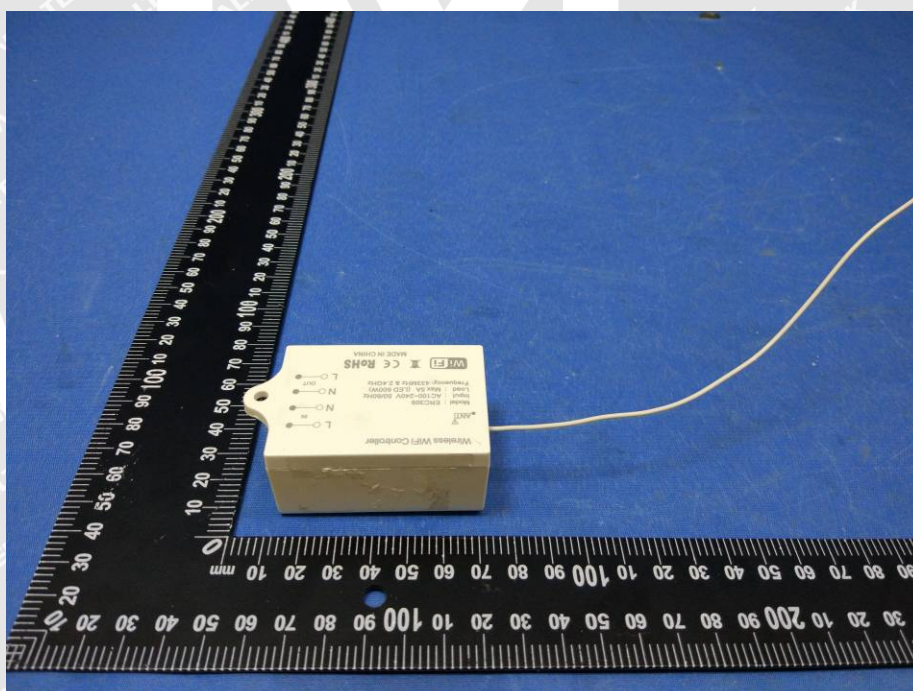
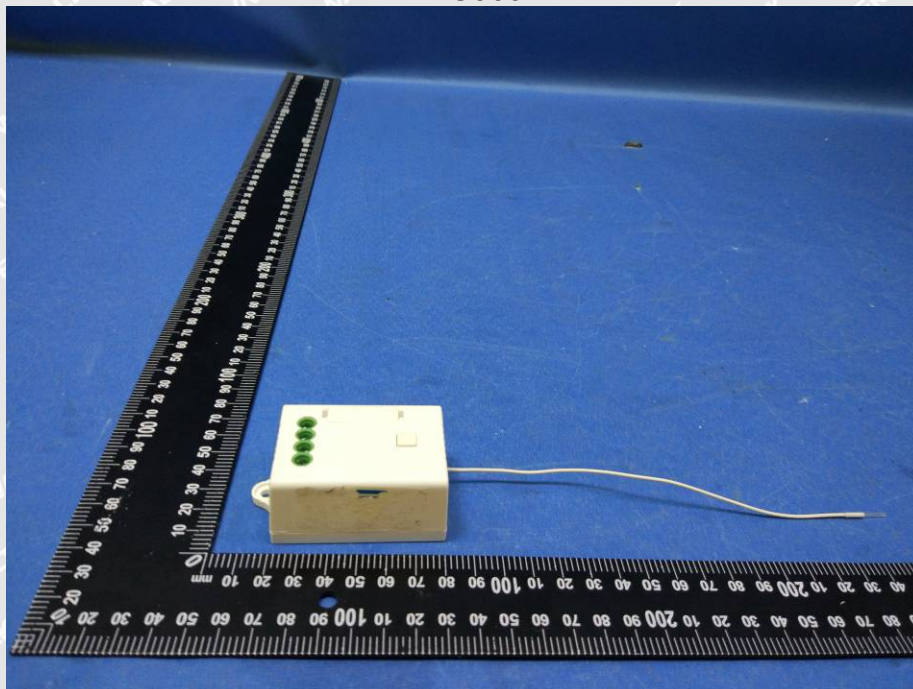


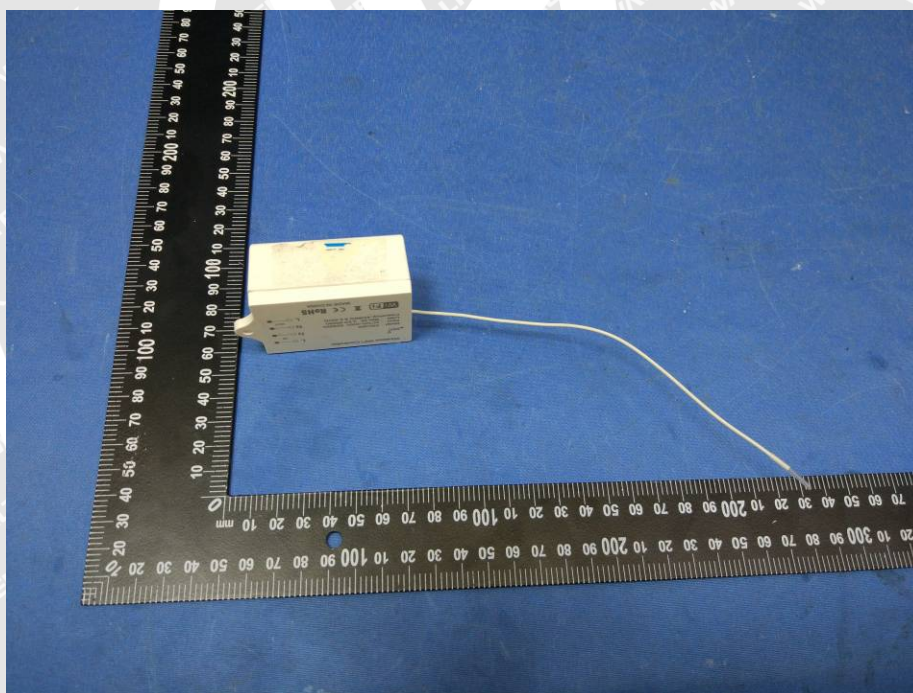
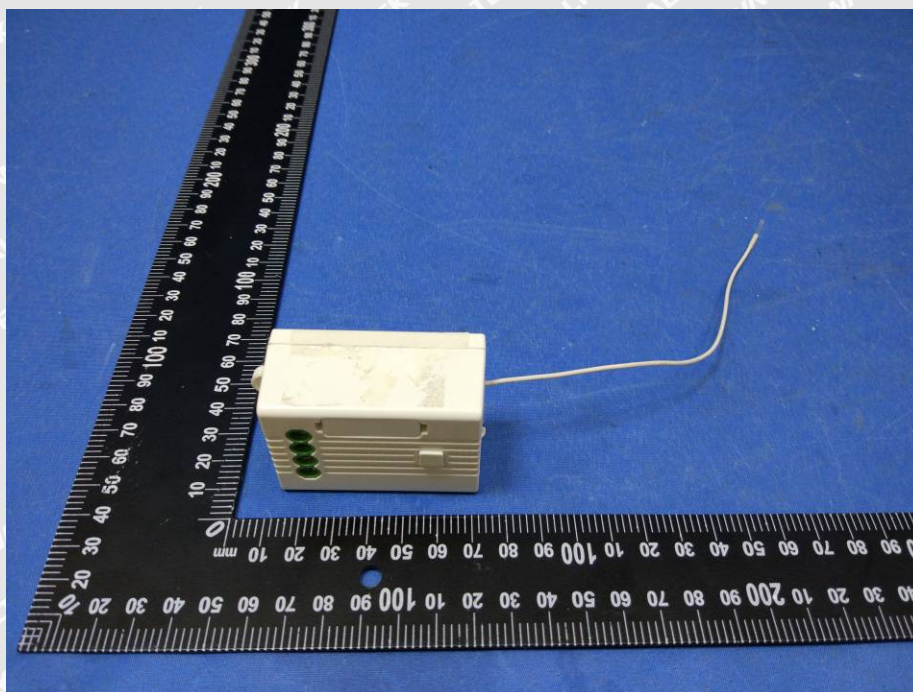


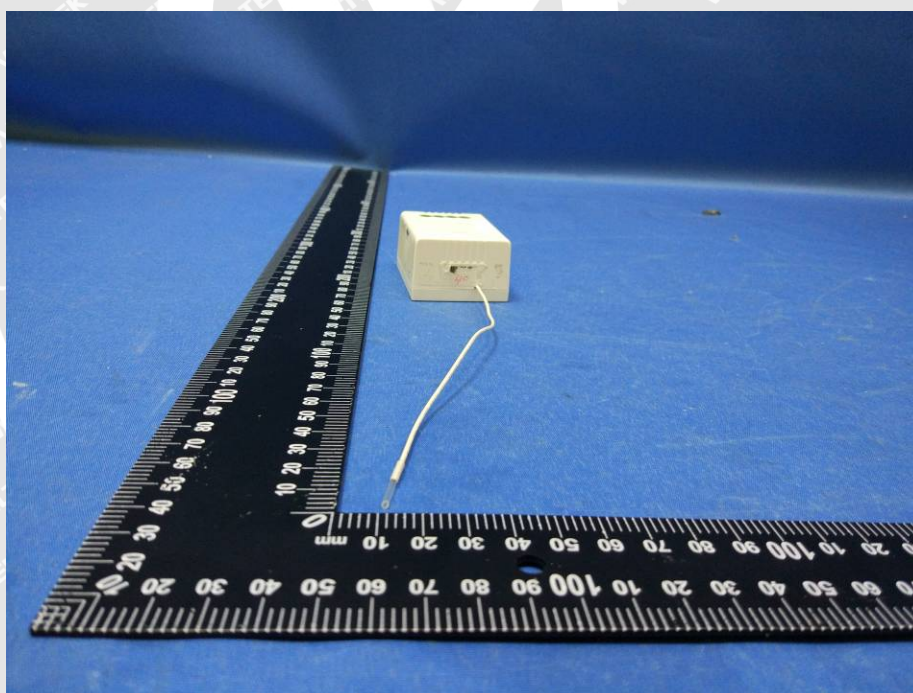
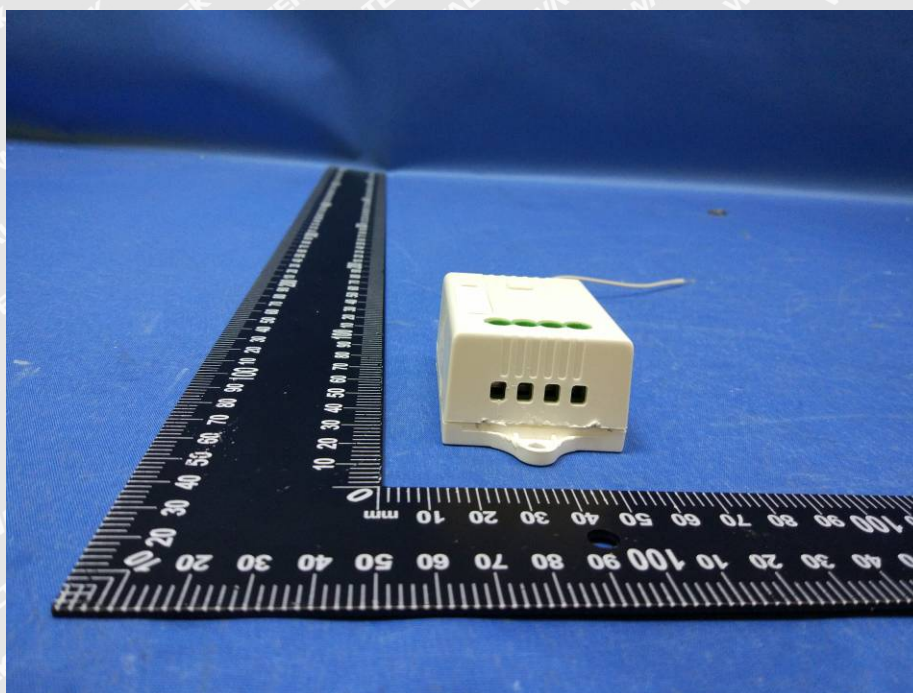




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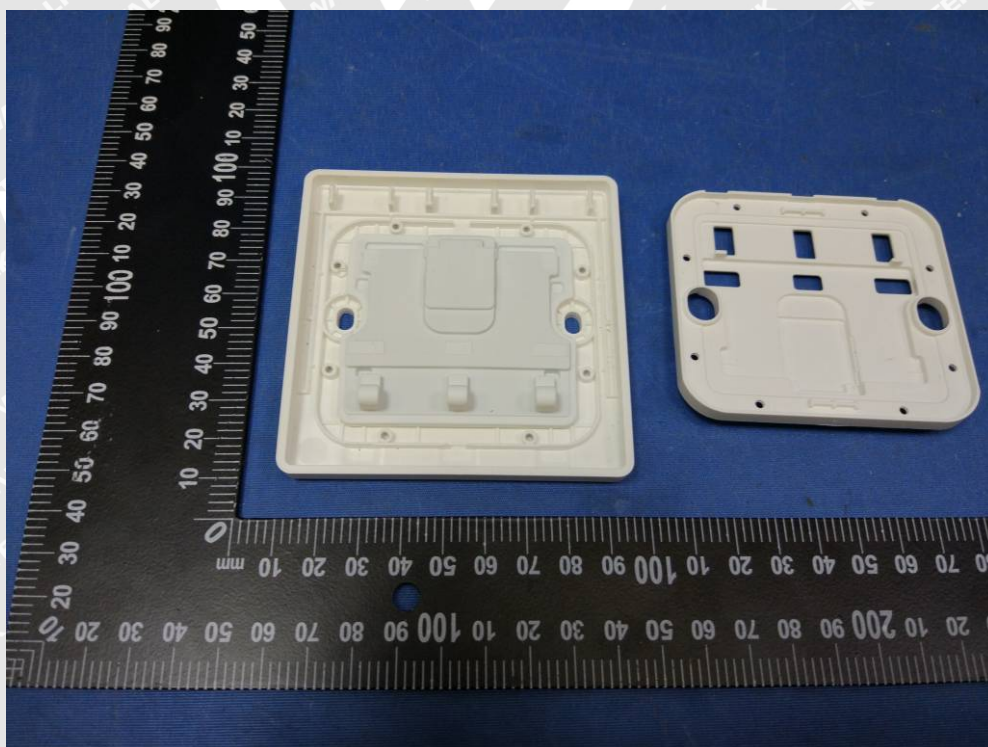
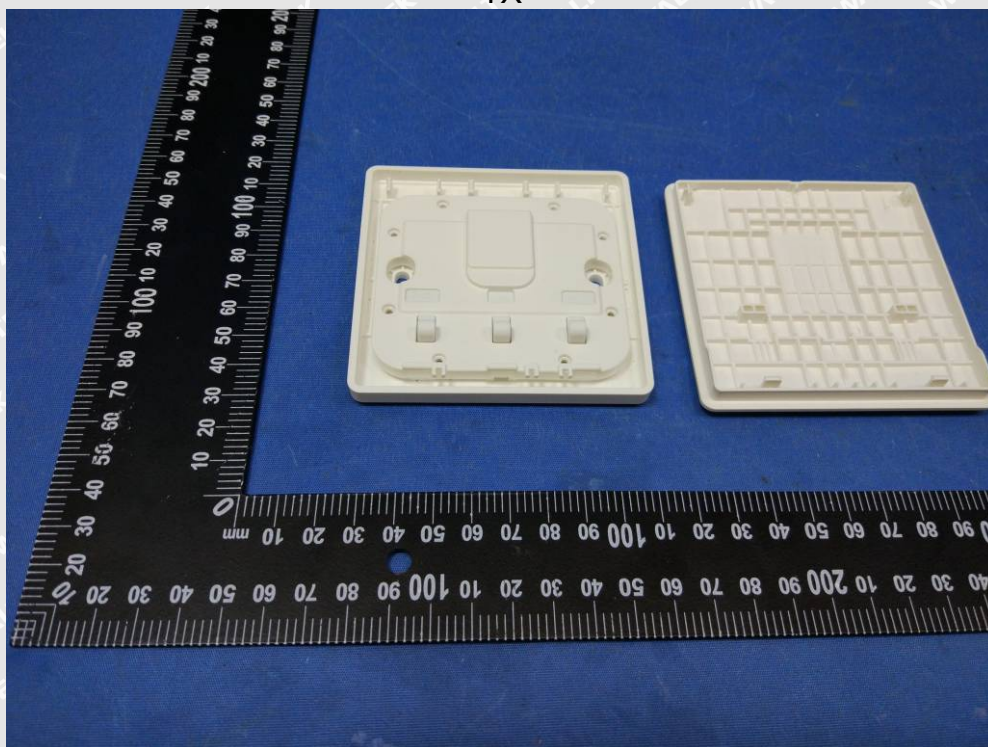


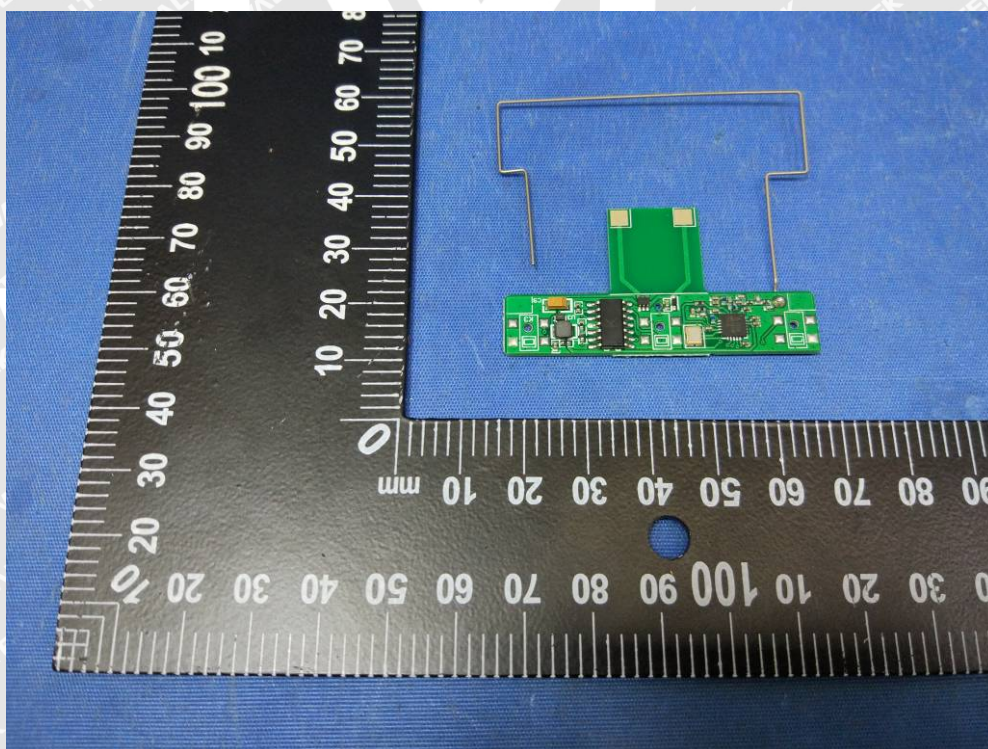
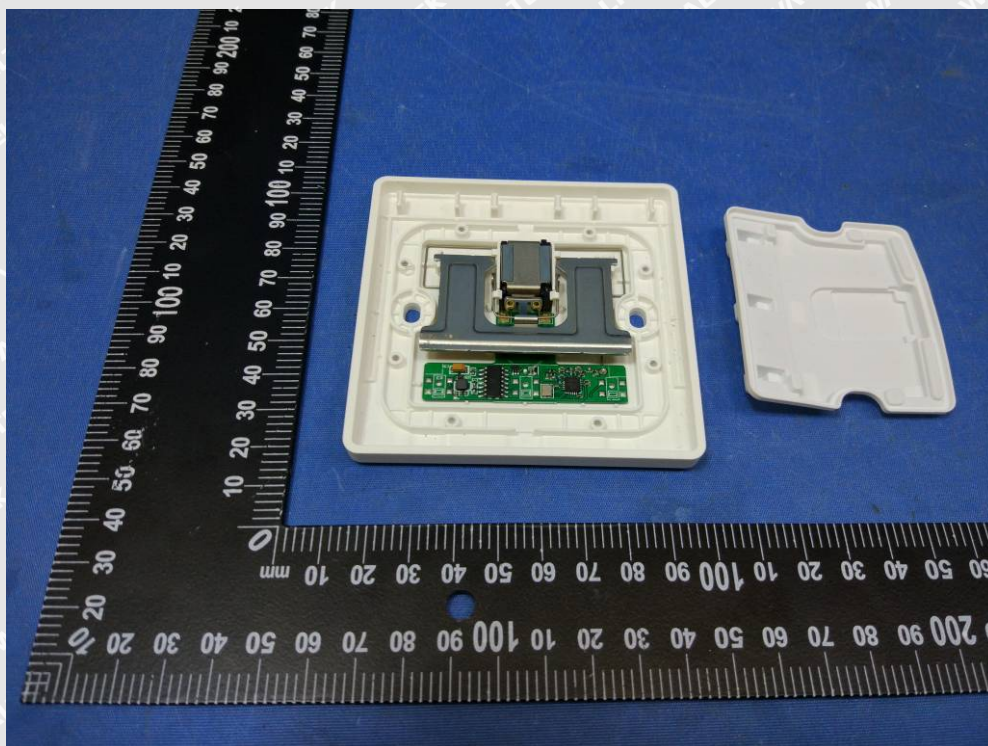


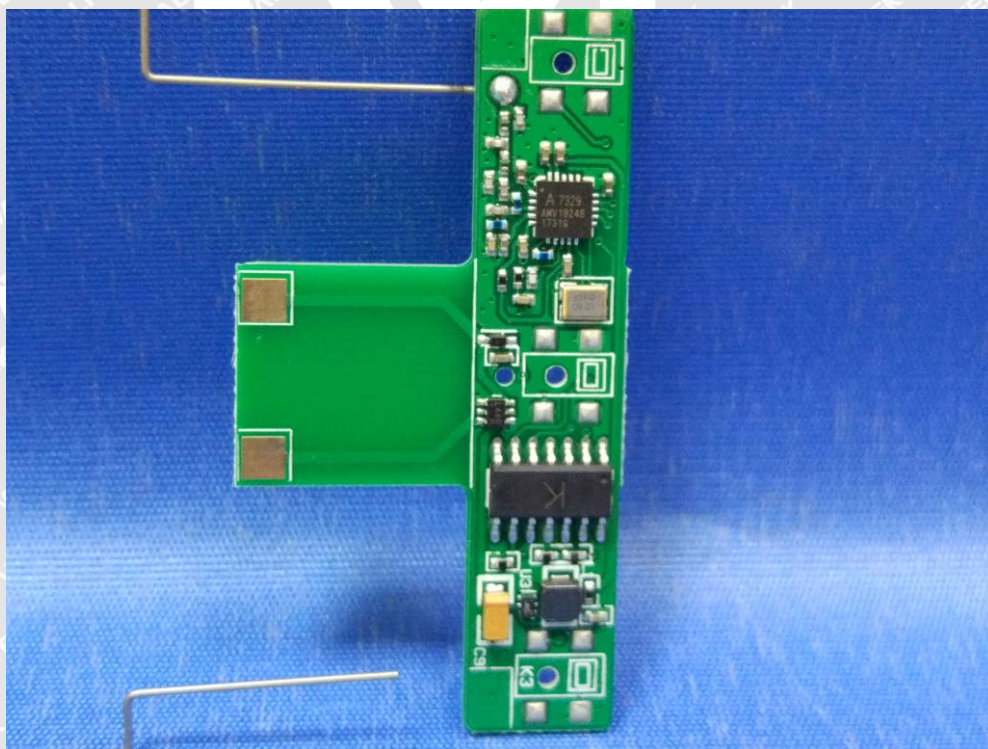
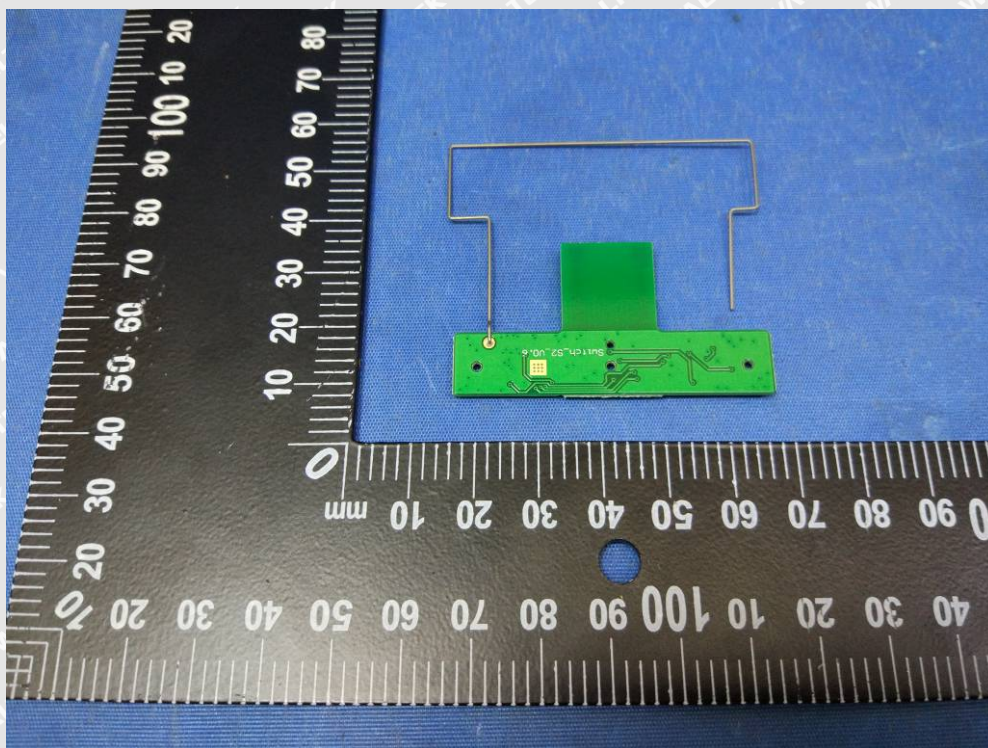


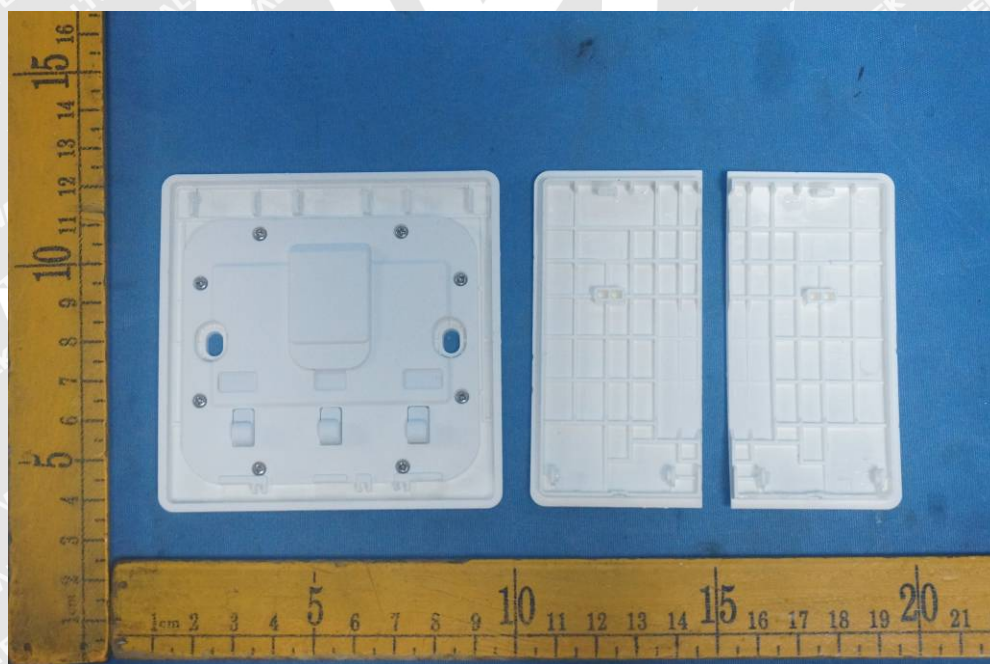
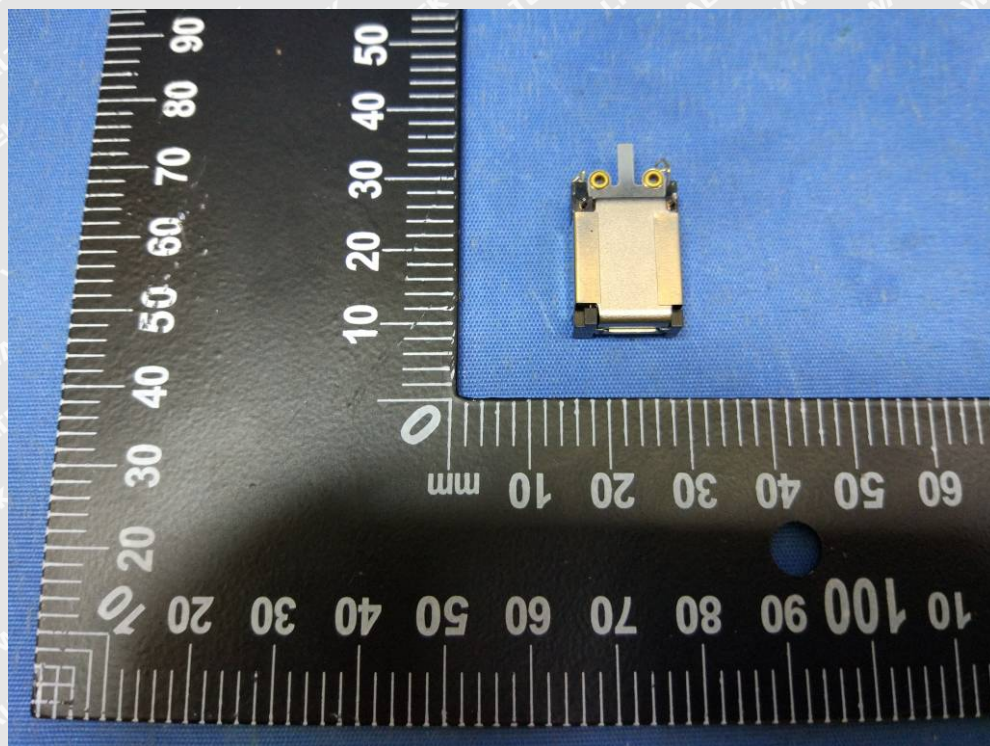
12.2 Internal Photos

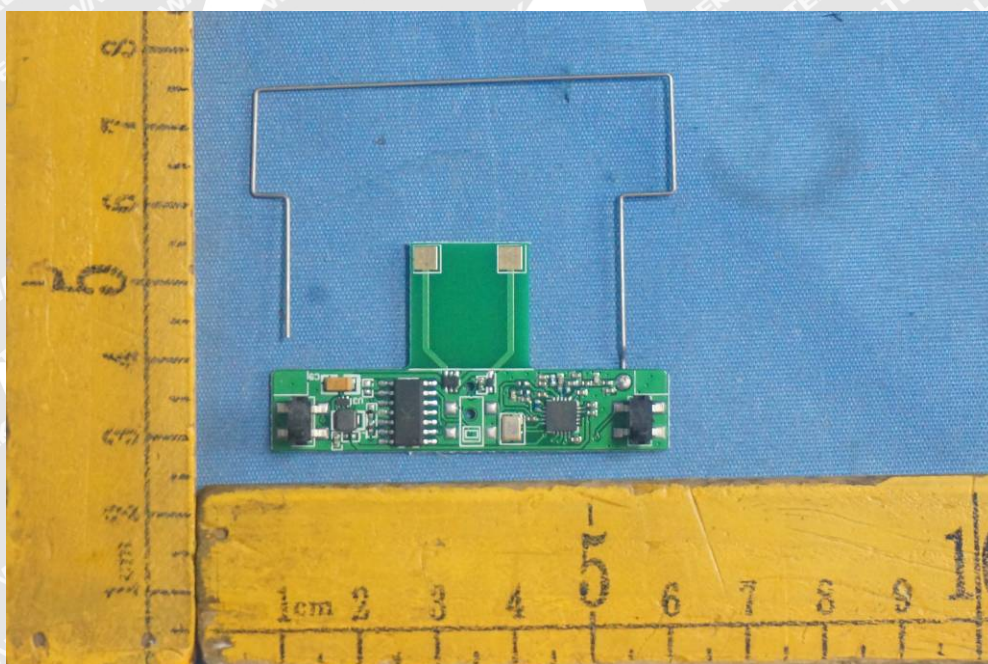
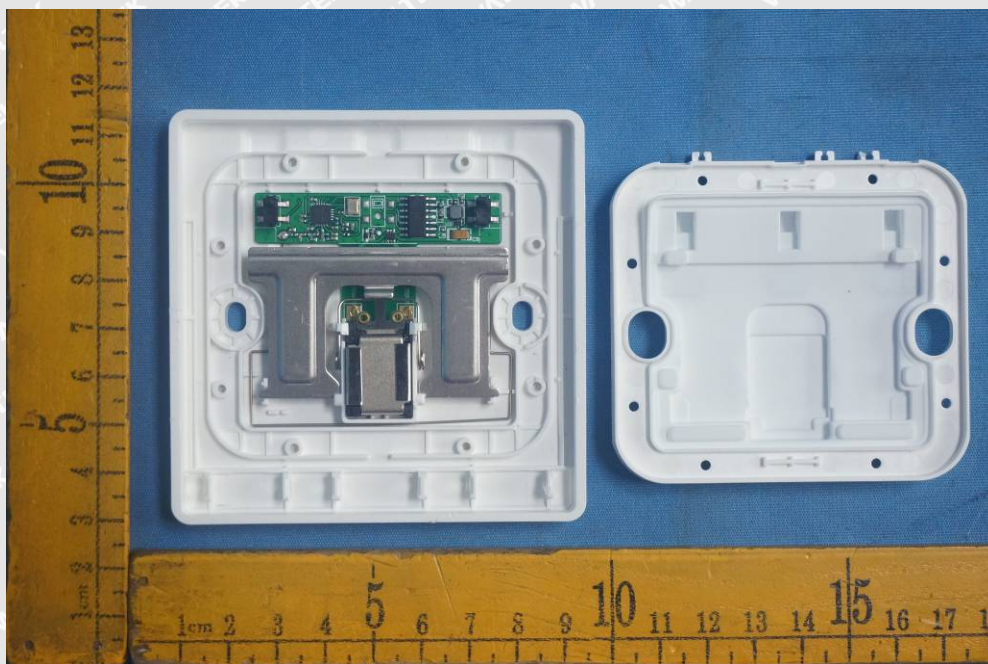
TX

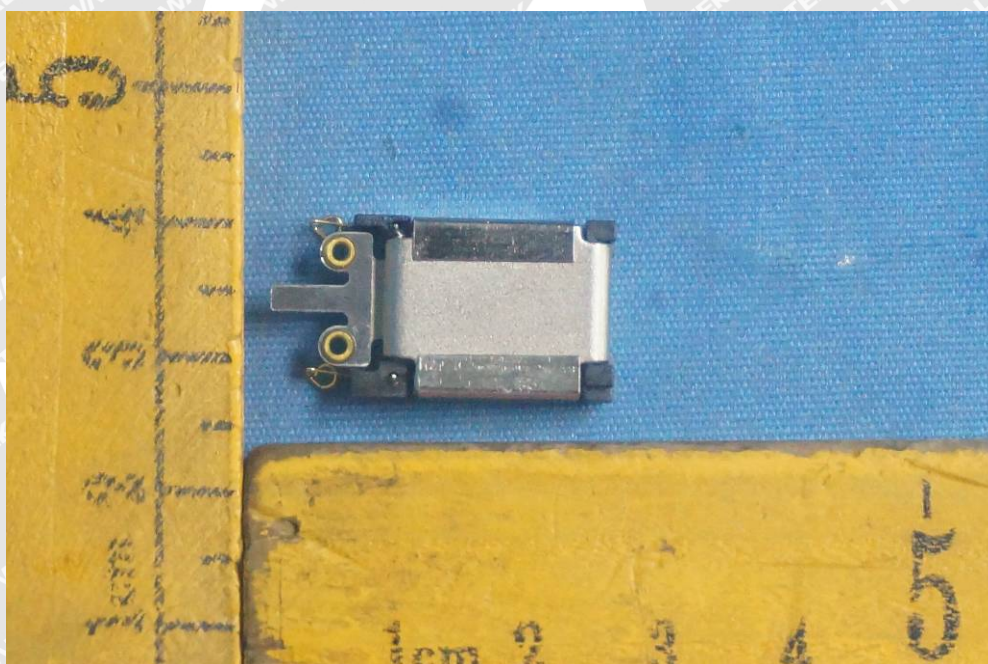
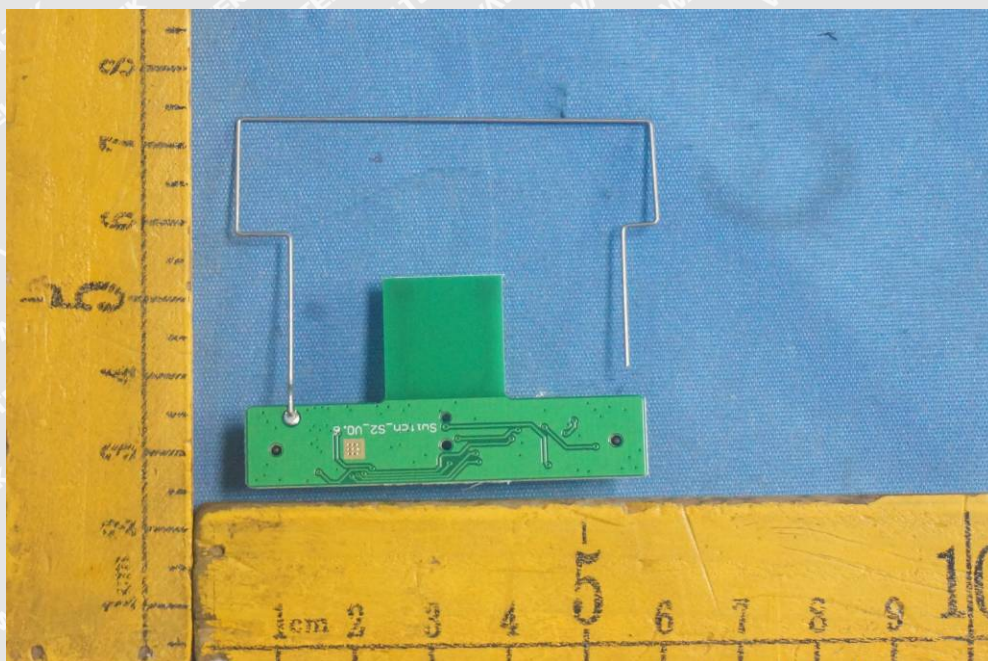


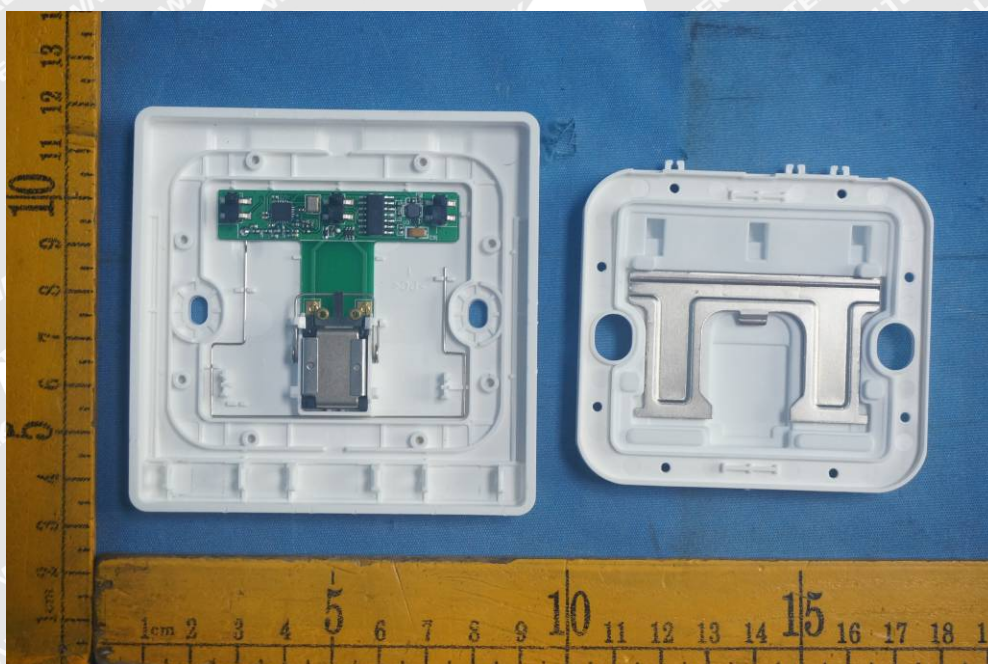
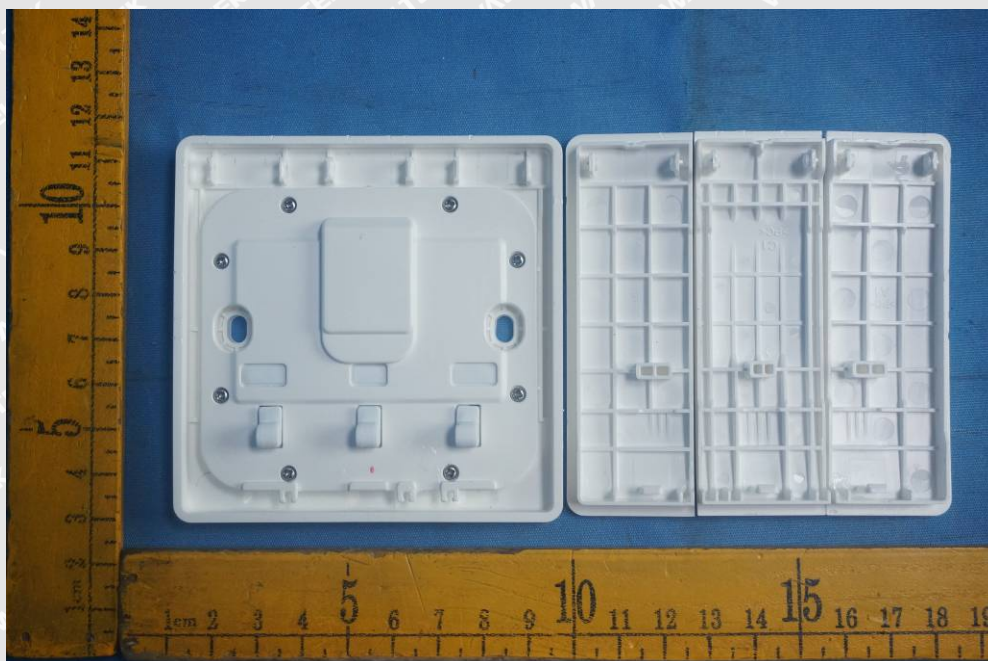


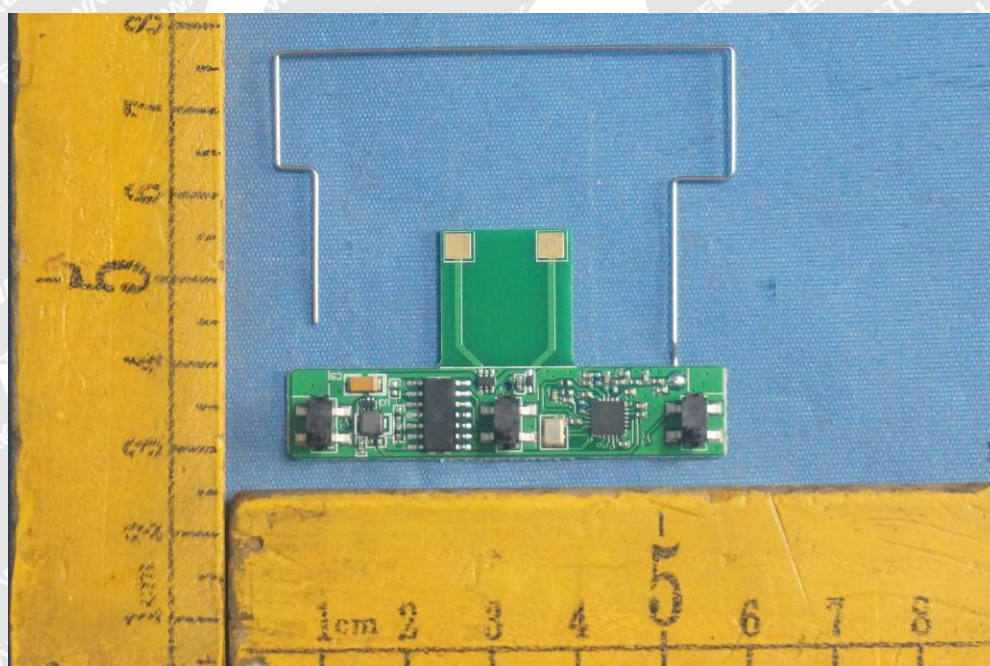
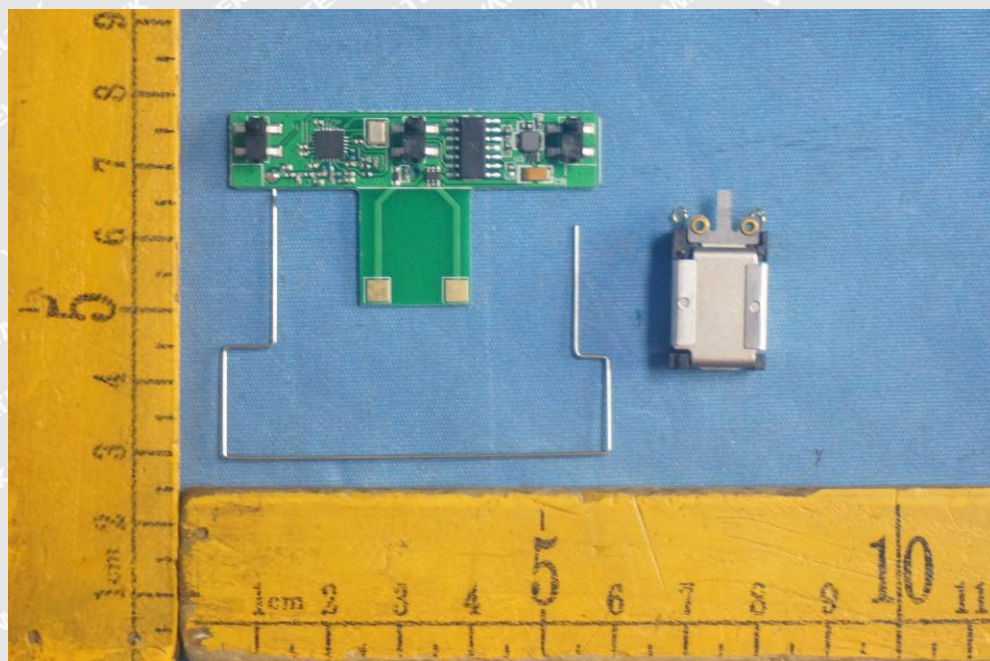


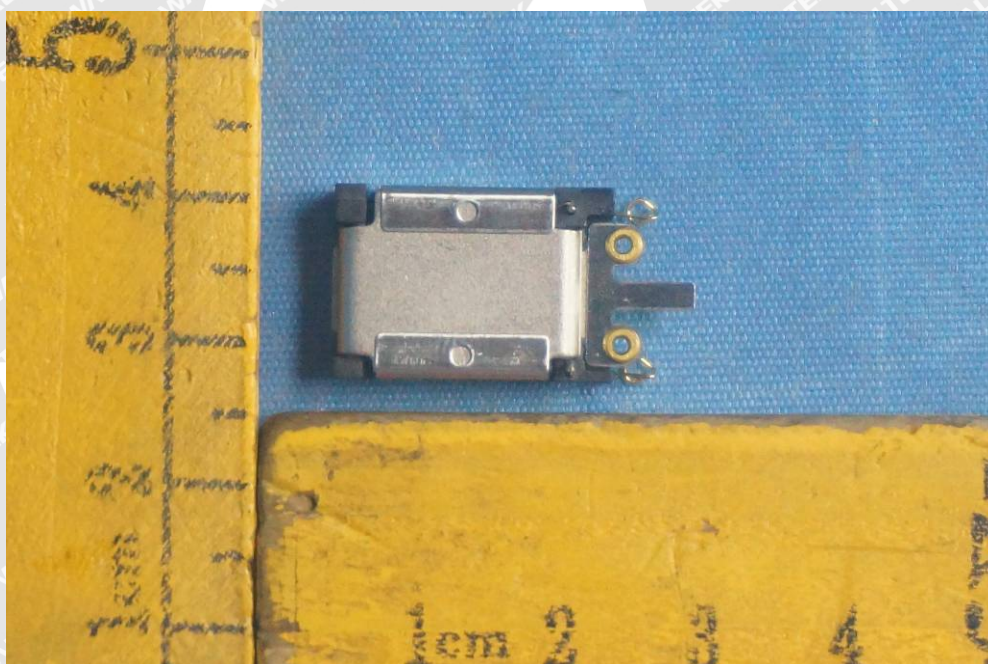
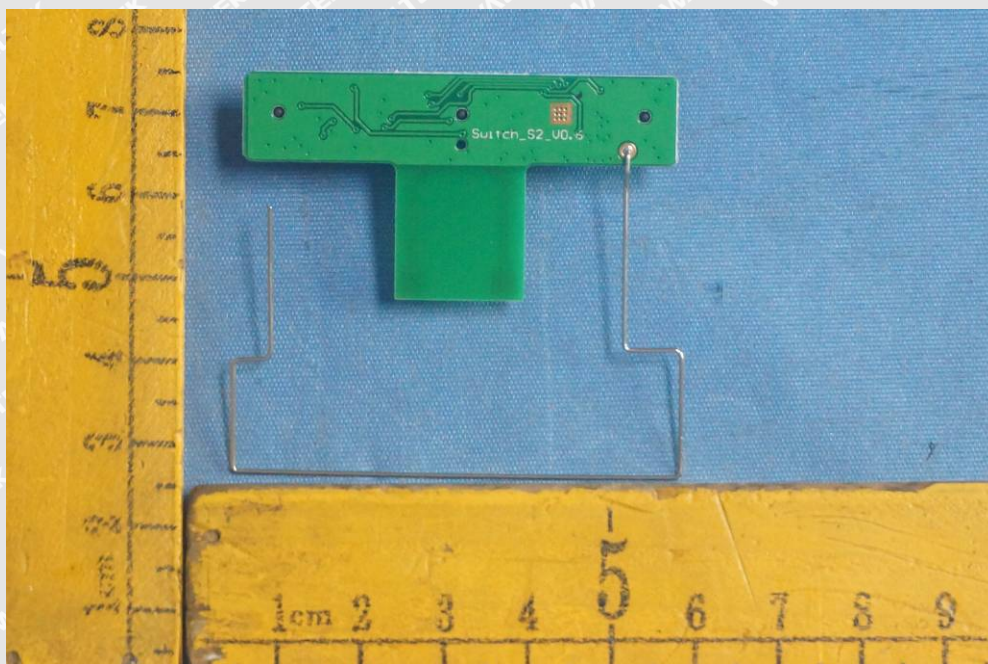






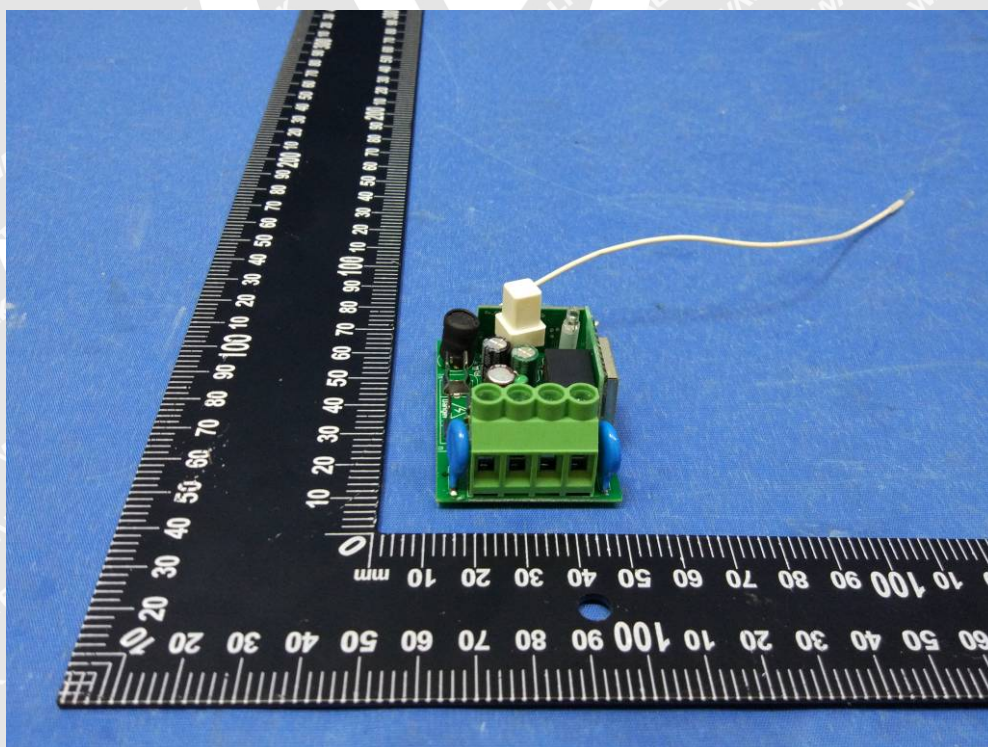
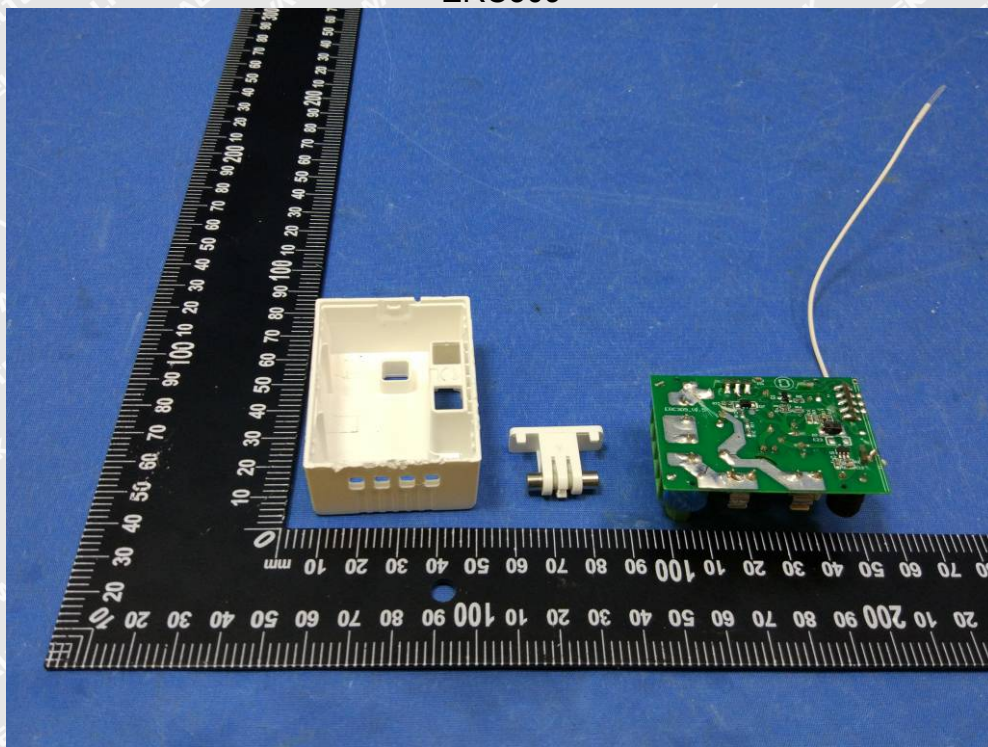


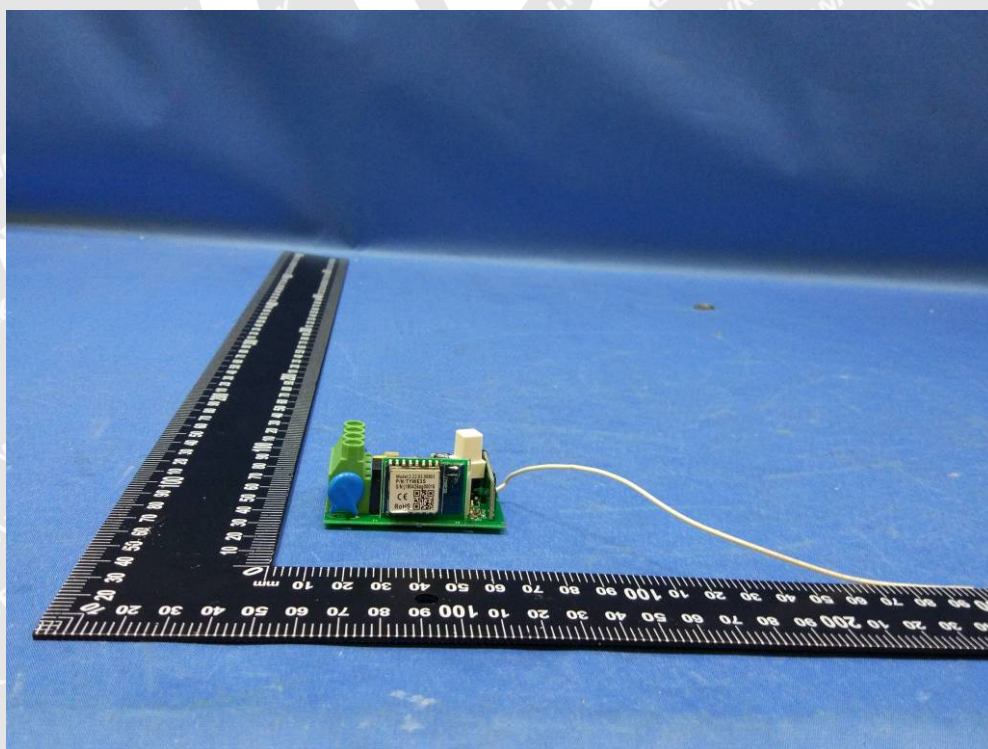
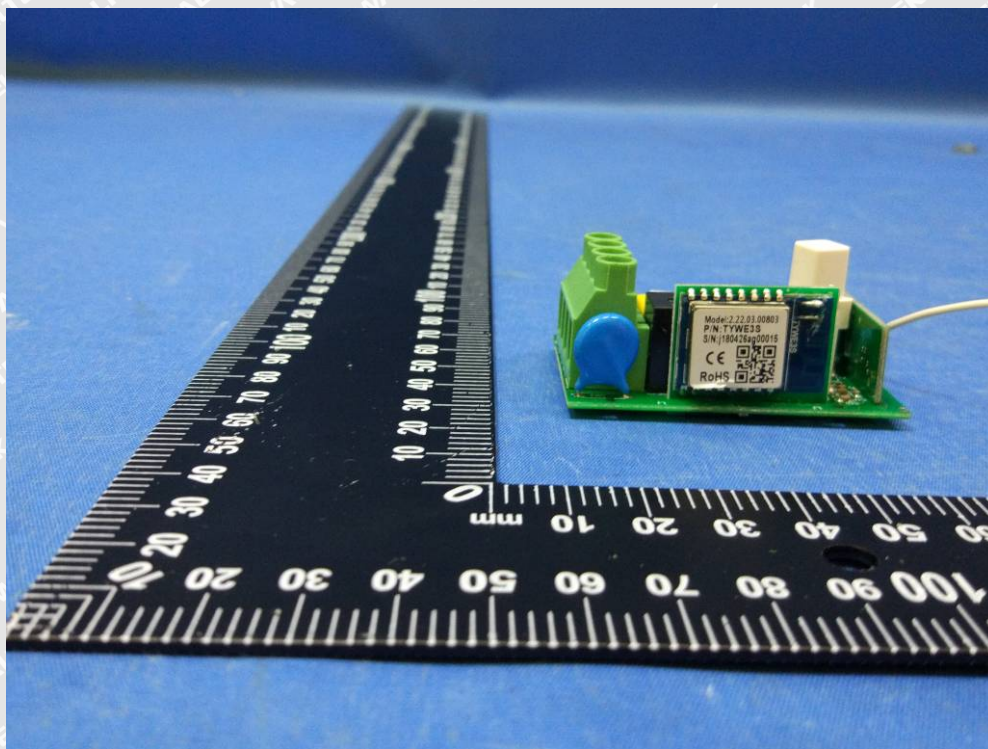


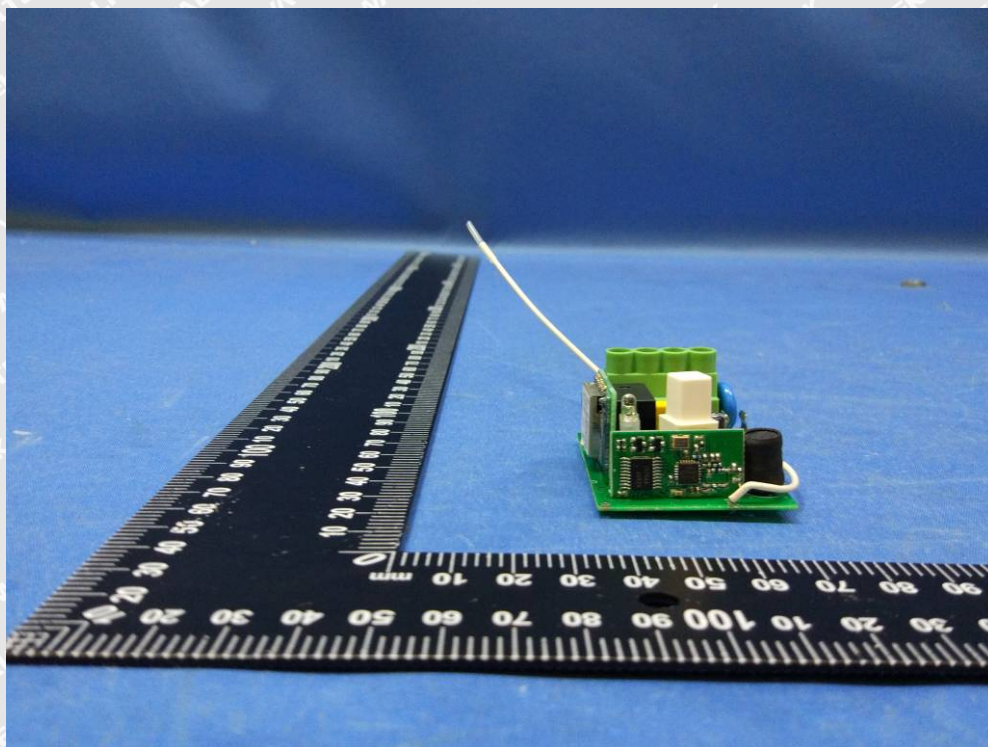




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=====End of Report=====

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