

TEST REPORT

Product Name : DMX512APP
Model Number : GFC007

Prepared for : Shenzhen Greatfavian Electronic CO., LTD
Address : 5F, Tongfuyu Industrial Park, Lezhujiao, Zhoushi Road,
Baoan District, Shenzhen, China 518126

Prepared by : EMTEK(DONGGUAN) CO., LTD.
Address : Room 111&112, Building 8, -1&2/F., Office Building2, Zone
A, Zhongda Marine Biotechnology Research and
Development Base, No.9, Xincheng Avenue, Songshan
Lake High-Tech Industrial Development Zone, Dongguan,
Guangdong, China

Tel : +86-0769-22807078
Fax: +86-0769-22807079

Report Number : EDG2408190171E00102R
Date(s) of Tests : Aug 19, 2024 to Oct 10, 2024
Date of issue : Oct 11, 2024



TABLE OF CONTENTS

Description	Page
1. TEST REPORT DESCRIPTION	4
2. GENERAL INFORMATION	6
3. DESCRIPTION OF STANDARDS AND RESULTS (EUT)	7
4. TEST METHODOLOGY	8
4.1. GENERAL DESCRIPTION OF APPLIED STANDARDS	8
4.2. MEASURING DEVICE AND TEST EQUIPMENT	8
4.3. DESCRIPTION OF TEST MODES	11
4.4. BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM	12
4.5. SUPPORT EQUIPMENT	12
5. FACILITIES AND ACCREDITATIONS	13
5.1. FACILITIES	13
5.2. LABORATORY ACCREDITATIONS AND LISTINGS	13
5.3. Measurement Uncertainty	14
6. CONDUCTED EMISSIONS FROM THE AC MAINS POWER PORTS	15
6.1. Block Diagram of Test Setup	15
6.2. Measuring Standard	15
6.3. Limits	15
6.4. Test Procedure	15
6.5. Measuring Results	16
7. CONDUCTED EMISSIONS FROM THE DC MAINS POWER PORTS	19
7.1. Block Diagram of Test Setup	19
7.2. Measuring Standard	19
7.3. Conducted Emission Limits	19
7.4. Test Procedure	19
7.5. Measuring Results	20
8. ASYMMETRIC MODE CONDUCTED EMISSIONS AT WIRED NETWORK PORTS	21
8.1. Block Diagram of Test Setup	21
8.2. Measuring Standard	21
8.3. Limits	21
8.4. Test Procedure	22
8.5. Measuring Results	22
9. RADIATED EMISSION	23
9.1. Block Diagram of Test Setup	23
9.2. Measuring Standard	23
9.3. Radiated Limit	24
9.4. Test Procedure	24
9.5. Measuring Results	25
10. HARMONIC CURRENT EMISSION MEASUREMENT	30
10.1. Block Diagram of Test Setup	30
10.2. Measuring Standard	30
10.3. Standard Limits	30
10.4. Test Procedure	31
10.5. Test Results	31
11. VOLTAGE FLUCTUATION AND FLICKER MEASUREMENT	32
11.1. Block Diagram of Test Setup	32
11.2. Measuring Standard	32
11.3. Standard Limits	32
11.4. Test Procedure	32
11.5. Test Results	32

12. PERFORMANCE CRITERIA	34
12.1. General performance criteria	34
12.2. Performance table	34
13. ELECTROSTATIC DISCHARGE	35
13.1. Test Specification	35
13.2. Block Diagram of Test Setup	35
13.3. Test Procedure	35
13.4. Test Results	36
14. CONTINUOUS RF ELECTROMAGNETIC FIELD DISTURBANCES	37
14.1. Test Specification	37
14.2. Block Diagram of Test Setup	37
14.3. Test procedure	37
14.4. Test results	38
15. ELECTRICAL FAST TRANSIENTS/BURST	39
15.1. Test Specification	39
15.2. Block Diagram of Test Setup	39
15.3. Test Procedure	40
15.4. Test Results	40
16. SURGES	41
16.1. Test Specification	41
16.2. Block Diagram of Test Setup	41
16.3. Test Procedure	41
16.4. Test results	42
17. CONTINUOUS INDUCED RF DISTURBANCES	43
17.1. Test Specification	43
17.2. Block Diagram of Test Setup	43
17.3. Test Procedure	43
17.4. Test results	44
18. TRANSIENTS AND SURGES IN THE VEHICULAR ENVIRONMENT	45
18.1. Test Specification	45
18.2. Block Diagram of Test Setup	45
18.3. Test Procedure	45
18.4. Test Results	46
19. VOLTAGE DIPS AND INTERRUPTIONS	47
19.1. Test Specification	47
19.2. Block Diagram of Test Setup	47
19.3. Test Procedure	47
19.4. Test results	48
20. PHOTOGRAPHS	49
20.1. Photos of Conducted Emissions from the AC Mains Power Ports	49
20.2. Photos of Radiation Emission Measurement	50
20.3. Photo of Harmonic / Flicker Measurement	51
20.4. Photo of Electrostatic Discharges	52
20.5. Continuous RF electromagnetic field disturbances	52
20.6. Photos of Electrical Fast Transients/Burst	53
20.7. Photos of Surges	53
20.8. Photos of Continuous Induced RF Disturbances	54
20.9. Photo of Voltage Dips and Interruptions	54
21. PHOTOS OF EUT	55

1. TEST REPORT DESCRIPTION

Applicant : Shenzhen Greatfavian Electronic CO., LTD
Address : 5F, Tongfuyu Industrial Park, Lezhujiao , Zhoushi Road, Baoan District, Shenzhen, China 518126
Manufacturer : Shenzhen Greatfavian Electronic CO., LTD
Address : 5F, Tongfuyu Industrial Park, Lezhujiao , Zhoushi Road, Baoan District, Shenzhen, China 518126
Factory : Shenzhen Greatfavian Electronic CO., LTD
Address : 5F, Tongfuyu Industrial Park, Lezhujiao , Zhoushi Road, Baoan District, Shenzhen, China 518126
EUT : DMX512APP

Model Name : GFC007

Trademark : GFLAI

Measurement Procedure Used:

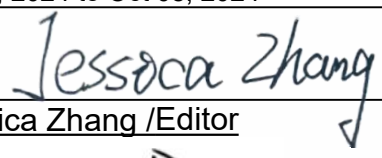
APPLICABLE STANDARDS	
STANDARD	TEST RESULT
ETSI EN 301 489-1 V2.2.3: 2019	PASS
ETSI EN 301 489-3 V2.3.2: 2023	PASS
ETSI EN 301 489-17 V3.2.4: 2020	PASS

The device described above is tested by EMTEK(DONGGUAN) CO., LTD. and EMTEK(SHENZHEN) CO., LTD. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and EMTEK(DONGGUAN) CO., LTD. is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the ETSI EN 301 489-1 and ETSI EN 301 489-3 requirements.


This report applies to above tested sample only and shall not be reproduced in part without written approval of EMTEK(DONGGUAN) CO., LTD.

Date of Test : Jul 04, 2024 to Oct 08, 2024


Prepared by :


Jessica Zhang /Editor

Reviewer :


Warren Deng /Supervisor

Approve & Authorized Signer :


Sam Lv / Manager

Modified History

Version	Report No.	Revision Date	Summary
	EDG2408190171E00102R	/	Original Report



2. GENERAL INFORMATION

Product:	DMX512APP
Model Number:	GFC007
Device Type:	SRD
Sample Number:	#1
Modulation:	433:ASK BLE:GFSK
Operating Frequency:	Band H: 433.05-434.79MHz BLE:2402-2480MHz
Number of Channels:	1 channel for 433 40 channels for BLE
Power Support:	DC 6V from adapter Adapter:Model:ZF-0601000 INPUT:100-240V~50/60Hz 0.65A Max OUTPUT:6V/1000mA
Test Voltage:	DC 6V from adapter.
Temperature Range:	-10°C to +55°C

Note: for more details, please refer to the user's manual of the EUT.

3. DESCRIPTION OF STANDARDS AND RESULTS (EUT)

Applicable Standard: ETSI EN 301 489-1 v2.2.3: 2019				
EMISSION				
Description of Test Item		Standard	Limits	Results
Conducted Emissions From the AC Mains Power Ports		EN 55032	Class B	Pass
Conducted Emissions From the DC Mains Power Ports			Class B	N/A
Asymmetric mode conducted emissions Wired network ports			Class B	N/A
Radiated emissions at frequencies up to 1 GHz			Class B	Pass
Radiated emissions at frequencies above 1 GHz			Class B	Pass
Harmonic Current Emissions		EN IEC 61000-3-2: 2019	Class A	N/A
Voltage Fluctuation and Flicker		EN 61000-3-3:2013/ A1:2019	Section 5	Pass
IMMUNITY				
Description of Test Item		Basic Standard	Performance Criteria	Results
Electrostatic Discharge	Enclosure ports	EN 61000-4-2:2009	B	Pass
Continuous RF electromagnetic field disturbances	Enclosure ports	EN 61000-4-3:2006+ A1:2008+A2:2010	A	Pass (note2)
Electrical fast transients/burst	AC mains power ports	EN 61000-4-4:2012	B	Pass
	Analogue/digital data ports		B	N/A
	DC network power ports		B	N/A
Surges	AC mains power ports	EN 61000-4-5:2014	B	Pass
	Analogue/digital data ports		B	N/A
Continuous induced RF disturbances	AC mains power ports	EN 61000-4-6:2014	A	Pass
	Analogue/digital data ports		A	N/A
	DC network power ports		A	N/A
Vehicular transients and surges	DC power input ports	ISO 7637-2:2004	A & B	N/A
Voltage dips and interruptions	AC mains power ports	EN 61000-4-11:2004	B & C	Pass
Note1: N/A is an abbreviation for not applicable.				
Note2: Tested by EMTEK(SHENZHEN) CO., LTD.				

4. TEST METHODOLOGY

4.1. GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:

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

ETSI EN 301 489-3 : ElectroMagnetic Compatibility (EMC) standard for radio equipment and services;
Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz;
Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU

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

4.2. MEASURING DEVICE AND TEST EQUIPMENT

For Conducted Disturbances at the AC mains port

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	EMI Test Receiver	Rohde&Schwarz	ESCI	100137	2024/4/29	1 Year
2.	AMN	Rohde&Schwarz	ENV216	101209	2024/4/28	1 Year
3.	Test Software	Farad	Ver. CON-03A1	--	N/A	N/A

For Radiated Emission

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	EMI Test Receiver	Rohde&Schwarz	ESCI	101415	2024/4/28	1 Year
2.	Bi-log Hybrid Antenna	Schwarzbeck	VULB9163	141	2024/5/5	1 Year
3.	Pre-Amplifie	HP	8447F	OPH64	2024/4/28	1 Year
4.	Signal Analyzer	R&S	FSV30	103039	2024/4/28	1 Year
5.	Horn Antenna	Schwarzbeck	BBHA9120D	1272	2024/5/5	1 Year
6.	Pre-Amplifie	LUNAR EM	PM1-18-40	J10100000081	2024/4/28	1 Year
7.	Test Software	Farad	Ver. RA-03A1	--	N/A	N/A

For Harmonic / Flicker Measurement

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	AC variable frequency power supply	Teseq	100-CTS-230-TESQ	1804A03259	2024/4/29	1 Year
2.	Harmonic current and voltage fluctuation	Teseq	50011X-CTS-400-SCH	1805A03008	2024/4/29	1 Year

	analyzer					
--	----------	--	--	--	--	--

For Electrostatic Discharge Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	ESD Tester	TESEQ	NSG 437	409	2024/5/7	1 Year

For Continuous RF Electromagnetic Field Disturbances Immunity

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Power Amplifier	MILMEGA	AS0102-55	1018770	2024/5/10	1 Year
2.	50ohm Diode Power Sensor	BOONTON	51011EMC	34236	2024/5/10	1 Year
3.	RF Power Meter. Dual Channel	BOONTON	4232A	10539	2024/5/10	1 Year
4.	Log.-Per. Antenna	SCHWARZBECK	STLP 9129-7/16	3050	N/A	N/A
5.	Signal Generator	Agilent	N5181A	MY50145187	2024/5/10	1 Year
6.	Broad-Band Horn Antenna	SCHWARZBECK	STLP 9149	9149-227	N/A	N/A
7.	Field Strength Meter	DARE	RSS1006A	10100037SN022	2024/5/10	1 Year
8.	Multi-function interface system	DARE	CTR1009B	12100250SN072	N/A	N/A
9.	Automatic switch group	DARE	RSW1004A	N/A	N/A	N/A
10.	Power Amplifier	MILMEGA	AS1860-50	1059346	2024/5/10	1 Year
11.	Power Amplifier	Vectawave	VBA 1000-600C	133627	2023/10/23	1 Year
12.	Directional Coupler	BONN	BDC 0810-50/1500	2229689	2023/10/23	1 Year
13.	Audio Analyzer	R&S	UPV	101473	2024/5/10	1 Year
14.	Audio Test System	AUDIO PRECISION	ATS-1	41100	2024/5/10	1 Year

For Fast Transients Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	EMS comprehensive tester	HTEC	HCOMPACT7	190305	2024/4/29	1 Year
2.	Capacitive Coupling Clamp	RMTEST	HFK	0605-10	2024/4/29	1 Year

For Surge Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	EMS comprehensive tester	HTEC	HCOMPACT7	190305	2024/4/29	1 Year
2.	Communication waves	HTEC	HTSG 70	223001	2024/1/17	1 Year

	surge generator					
3.	Coupling Module	HTEC	HCN 8	232403	2024/1/17	1 Year
4.	Coupling Module	HTEC	HDEC 8	224705	2024/1/17	1 Year

For Injected Currents Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Signal generator	Rohde& Schwarz	SMB100A	103042	2024/4/28	1 Year
2.	Single channel power meter	Rohde& Schwarz	NRVS	101761	2024/4/28	1 Year
3.	6 db attenuator	AR-WORLDWIDE	6dB/50FH-006-100	324011	2024/4/28	1 Year
4.	CDN	SKET	CDN M2+M3	204303	2024/4/28	1 Year
5.	Power amplifier	BONN Elektronik	BSA 1515-25	97483	2024/4/28	1 Year
6.	CDN	SKET	CDN 150K80M-T8	212309	2024/4/28	1 Year
7.	CDN	SKET	CDN 150K80M-T8	212310	2024/4/28	1 Year

For Power Frequency Magnetic Field Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Magnetic Field Tester	HAEFELY	MAG100	250040.1	2024/1/17	1 Year

For Voltage Dips and Interruptions Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	EMS comprehensive tester	HTEC	HCOMPACT7	190305	2024/4/29	1 Year
2.	Dips module	HTEC	HV1P16T	190302	2024/4/29	1 Year

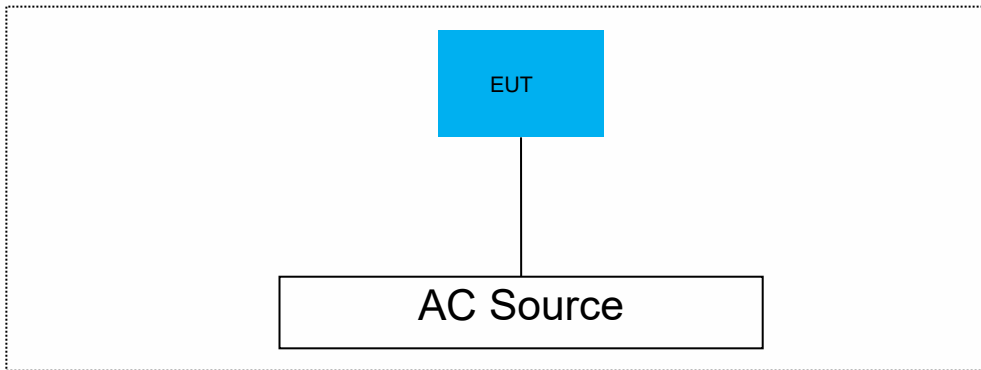
4.3.DESCRPTION OF TEST MODES

Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Mode	Description
1	433MHz
2	BLE
3	



4.4. BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM



4.5. SUPPORT EQUIPMENT

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

5. FACILITIES AND ACCREDITATIONS

5.1. FACILITIES

All measurement facilities used to collect the measurement data are located at Room 111&112, Building 8, -1&2/F., Office Building2, Zone A, Zhongda Marine Biotechnology Research and Development Base, No.9, Xincheng Avenue, Songshan Lake High-Tech Industrial Development Zone, Dongguan, Guangdong, China

5.2. LABORATORY ACCREDITATIONS AND LISTINGS

Site Description
EMC Lab.

: **Accredited by CNAS**

The Laboratory has been assessed and proved to be in compliance with CNAS/CL01:2018
The Certificate Registration Number is L3150

Accredited by FCC

Designation Number: CN1300
Test Firm Registration Number: 945551

Accredited by A2LA

The Certificate Registration Number is 4321.02

Accredited by Industry Canada

The Certificate Registration Number is CN0113

Name of Firm

: EMTEK(DONGGUAN) CO., LTD.

Site Location

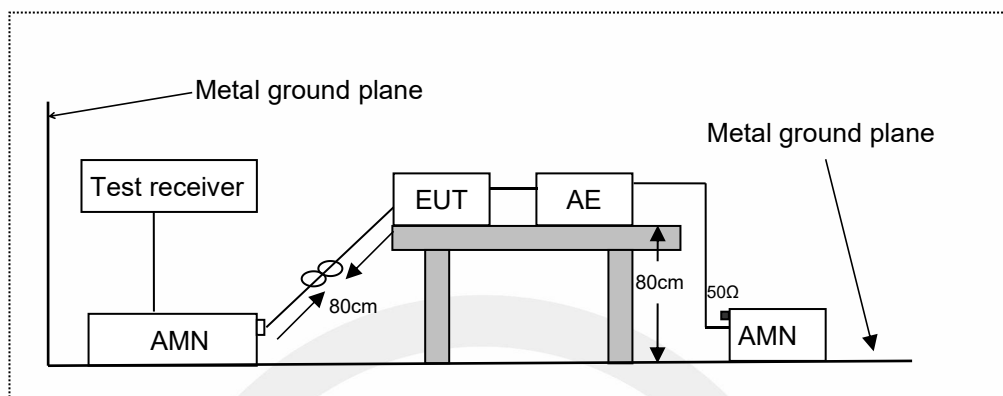
: Room 111&112, Building 8, -1&2/F., Office Building2, Zone A, Zhongda Marine Biotechnology Research and Development Base, No.9, Xincheng Avenue, Songshan Lake High-Tech Industrial Development Zone, Dongguan, Guangdong, China

5.3. Measurement Uncertainty

Test Item	Uncertainty
Conducted Emission Uncertainty	: 2.08dB(9k~150kHz Conduction 1#) 2.42dB(150k-30MHz Conduction 1#)
Radiated Emission Uncertainty (3m Chamber)	: 3.32dB (30M~1GHz Polarize: H) 3.34dB (30M~1GHz Polarize: V) 4.98dB (1~6GHz) 5.20dB (6~18GHz)
Radiated Emission Uncertainty (Loop)	: 2.54dB
Disturbance Power Uncertainty	: 3.66dB
Uncertainty for Flicker test	: 0.514%
Uncertainty for Harmonic test	: 3.6%
Uncertainty for ESD test	: 6%
Uncertainty for EFT test	: 8.6%
Uncertainty for Surge test	: 0.36%
Uncertainty for C/S Test	: 0.2dB(Using CDN Test)
Uncertainty for R/S Test	: 2.10dB(80MHz-200MHz) 1.76dB(200MHz-1000MHz)
Uncertainty for test site temperature and humidity	: 0.6°C 4%

6. CONDUCTED EMISSIONS FROM THE AC MAINS POWER PORTS

6.1. Block Diagram of Test Setup



AMN: Artificial Mains Network
AE: Associated equipment
EUT: Equipment under test

6.2. Measuring Standard

ETSI EN 301 489-1 Clause 8.4
EN 55032: 2015 /A11:2020 Clause A.3

6.3. Limits

EN 55032, Class B, Table A.10

Frequency range MHz	Coupling device (see Table A.8)	Detector type / bandwidth	Class B limits dB(μ V)
0.15 to 0.5	AMN	Quasi Peak / 9 kHz	66 to 56
0.5 to 5			56
5 to 30			60
0.15 to 0.5	AMN	Average / 9 kHz	56 to 46
0.5 to 5			46
5 to 30			50

6.4. Test Procedure

The EUT was placed on a desk 0.8 m height from the metal ground plane and 0.4 m from the conducting wall of the shielding room and it was kept at least 0.8 m from any other grounded conducting surface. The size of the table will nominally be 1.5 m x1.0 m.

The rear of the arrangement shall be flush with the back of the supporting tabletop unless that would not be possible or typical of normal use.

All units of equipment forming the system under test (includes the EUT as well as connected

peripherals and associated equipment or devices) shall be arranged such that a nominal 0.1 m separation is achieved between the neighboring units.

Connect EUT to the power mains through a artificial mains network (AMN). Where the mains cable supplied by the manufacturer is longer than 1 m, the excess should be folded at the centre into a bundle no longer than 0.4 m, so that its length is shortened to 1 m.

All the support units are connecting to the other AMN.

The AMN provides 50 ohm coupling impedance for the measuring instrument.

The CISPR states that the AMN with 50 ohm and 50 microhenry should be used.

Both sides of AC line were checked for maximum conducted interference.

The bandwidth of the receiver is set at 9 kHz in 150 kHz~30 MHz. The frequency range from 150 kHz to 30 MHz is investigated.

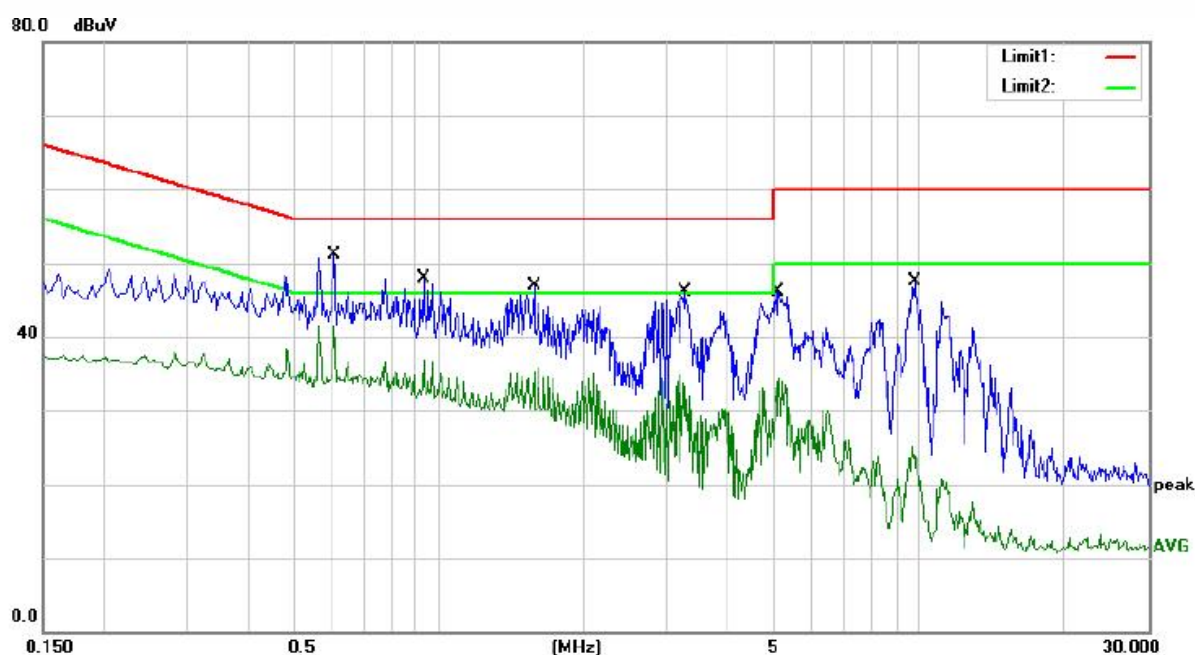
Set the test-receiver system to quasi peak detect function and average detect function, and to measure the conducted emissions values.

Test results were obtained from the following equation:
Measurement (dBμV) =Correct Factor (dB) + Reading (dBμV)
Over (dB) = Measurement (dBμV) - Limit (dBμV)

6.5.Measuring Results

PASS.

All the modes were tested and the data of the worst modes are attached the following pages.



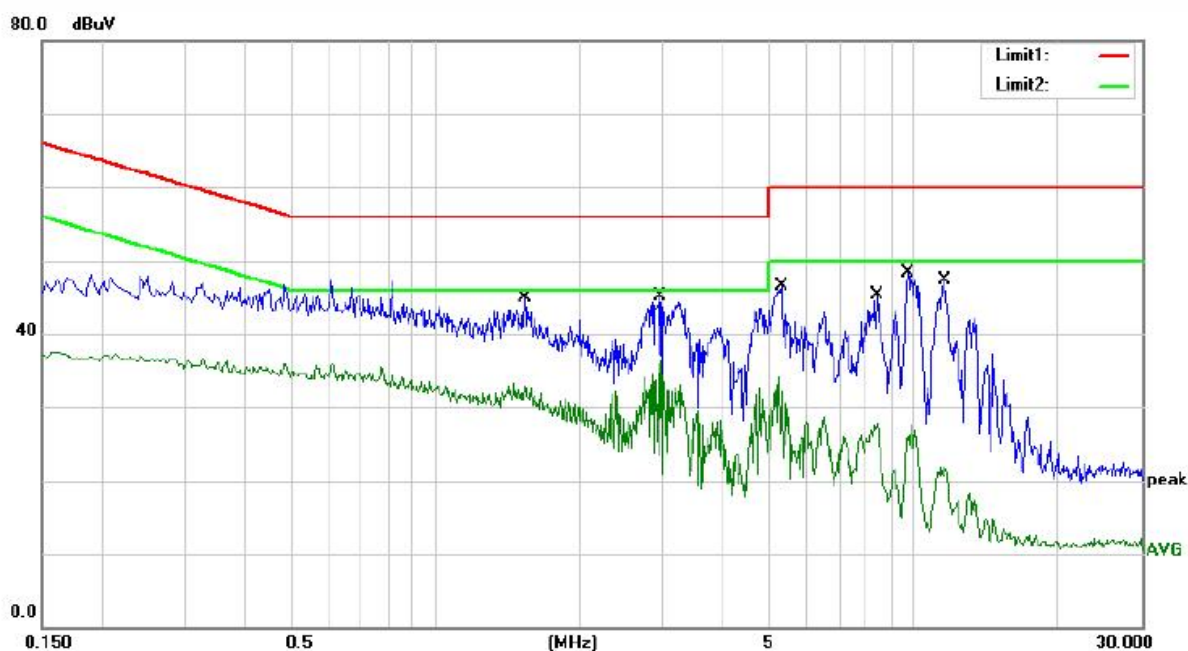
Site site #1

Phase: L1

Temperature: 22.5

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.6060	34.01	17.06	51.07	56.00	-4.93	QP	
2	*	0.6060	24.53	17.06	41.59	46.00	-4.41	AVG	
3		0.9300	30.97	17.03	48.00	56.00	-8.00	QP	
4		0.9300	19.84	17.03	36.87	46.00	-9.13	AVG	
5		1.5780	29.78	17.08	46.86	56.00	-9.14	QP	
6		1.5780	18.64	17.08	35.72	46.00	-10.28	AVG	
7		3.2540	29.19	17.01	46.20	56.00	-9.80	QP	
8		3.2540	17.83	17.01	34.84	46.00	-11.16	AVG	
9		5.0980	29.07	16.96	46.03	60.00	-13.97	QP	
10		5.0980	17.27	16.96	34.23	50.00	-15.77	AVG	
11		9.7940	30.50	16.99	47.49	60.00	-12.51	QP	
12		9.7940	8.17	16.99	25.16	50.00	-24.84	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver. Operator: Jian



Site site #1

Phase: N

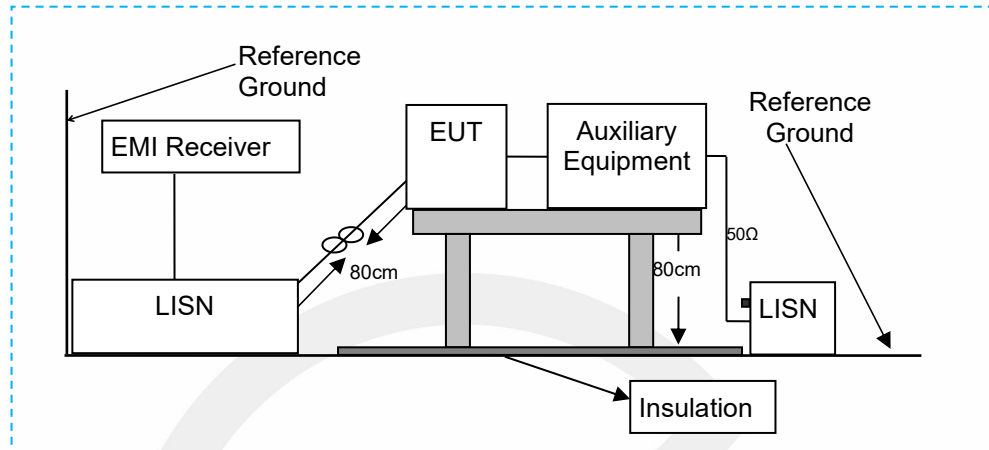
Temperature: 22.5

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		1.5420	27.73	17.07	44.80	56.00	-11.20	QP	
2		1.5420	16.17	17.07	33.24	46.00	-12.76	AVG	
3		2.9580	28.01	17.02	45.03	56.00	-10.97	QP	
4	*	2.9580	19.19	17.02	36.21	46.00	-9.79	AVG	
5		5.2780	29.59	16.97	46.56	60.00	-13.44	QP	
6		5.2780	17.21	16.97	34.18	50.00	-15.82	AVG	
7		8.3740	28.21	17.02	45.23	60.00	-14.77	QP	
8		8.3740	10.68	17.02	27.70	50.00	-22.30	AVG	
9		9.7500	31.32	16.99	48.31	60.00	-11.69	QP	
10		9.7500	10.58	16.99	27.57	50.00	-22.43	AVG	
11		11.6460	30.39	16.95	47.34	60.00	-12.66	QP	
12		11.6460	5.03	16.95	21.98	50.00	-28.02	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver. Operator: Jian

7. CONDUCTED EMISSIONS FROM THE DC MAINS POWER PORTS

7.1. Block Diagram of Test Setup



7.2. Measuring Standard

ETSI EN 301 489-1 Clause 8.3
CISPR 25

7.3. Conducted Emission Limits

Power Line Conducted Emission Limits

Table clause	Frequency range MHz	Coupling device	Detector type / bandwidth	limits dB(μV)
A9.1	0,15 to 0,5	AMN	Quasi Peak / 9 kHz	79 to 73
	0,5 to 30			73
A9.2	0,15 to 0,5	AMN	Average / 9 kHz	66 to 60
	5 to 30			60
Apply A9.1 and A9.2 across the entire frequency range.				

7.4. Test Procedure

For mobile radio and ancillary equipment intended to be connected to the vehicle's onboard DC mains, an Artificial Network (AN) as specified in CISPR 25 [10] annex D shall be used and be connected to a DC power source.

The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies (see clause 4.3 of the present document) for measurements in the transmit mode of operation.

For emission measurements on DC output ports the relevant port shall be connected via an AMN/AN to a load drawing the rated current of the source.

The bandwidth of the receiver is set at 9 kHz in 150 kHz~30 MHz. The frequency range from 150 kHz to 30 MHz is investigated.

Test results were obtained from the following equation:

Measurement (dBμV) = Correct Factor (dB) + Reading (dBμV)

Over (dB) = Measurement (dBμV) - Limit (dBμV)

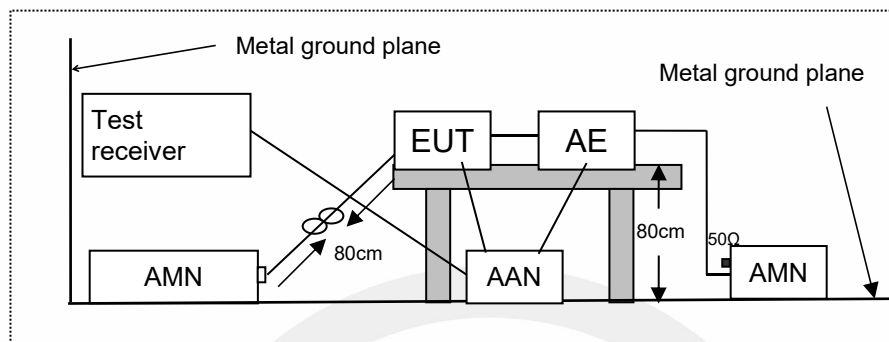
7.5. Measuring Results

Not Applicable



8. ASYMMETRIC MODE CONDUCTED EMISSIONS AT WIRED NETWORK PORTS

8.1. Block Diagram of Test Setup



AMN: Artificial mains network
AE: Associated equipment
EUT: Equipment under test
AAN: Asymmetric artificial network

8.2. Measuring Standard

ETSI EN 301 489-1 Clause 8.7
EN 55032: 2015 /A11:2020 Clause A.3

8.3. Limits

EN 55032, Class B, Table A.12

Frequency range (MHz)	Coupling device (see Table A.8)	Detector type / bandwidth	Class B voltage limits dB(μV)	Class B current limits dB(μA)
0.15 to 0.5	AAN	Quasi Peak / 9 kHz	84 to 74	N/A
0.5 to 30			74	
0.15 to 0.5	AAN	Average / 9 kHz	74 to 64	
0.5 to 30			64	
0.15 to 0.5	CVP and current probe	Quasi Peak / 9 kHz	84 to 74	40 to 30
0.5 to 30			74	30
0.15 to 0.5	CVP and current probe	Average / 9 kHz	74 to 64	30 to 20
0.5 to 30			64	20
0.15 to 0.5	Current Probe	Quasi Peak / 9 kHz	N/A	40 to 30
0.5 to 30				30
0.15 to 0.5	Current Probe	Average / 9 kHz		30 to 20
0.5 to 30				20

8.4. Test Procedure

The EUT is put on the plane 0.8m high above the ground by insulating support and connected to the AC mains through artificial mains network(AMN) or connected to the wired network port through an asymmetric artificial network(ANN). AMN provided a 50ohm coupling impedance for the tested equipment AC mains port, ANN provided a common mode (asymmetric mode) impedance of 150 Ω to the wired network port under test. the wired network line are investigated to find out the maximum conducted emission according to the EN 55032 regulations during conducted emission measurement.

The bandwidth of the receiver is set at 9 kHz in 150 kHz~30 MHz. The frequency range from 150 kHz to 30 MHz is investigated.

Test results were obtained from the following equation:

Measurement (dB μ V) =Correct Factor (dB) + Reading (dB μ V)

Over (dB) = Measurement (dB μ V) - Limit (dB μ V)

8.5. Measuring Results

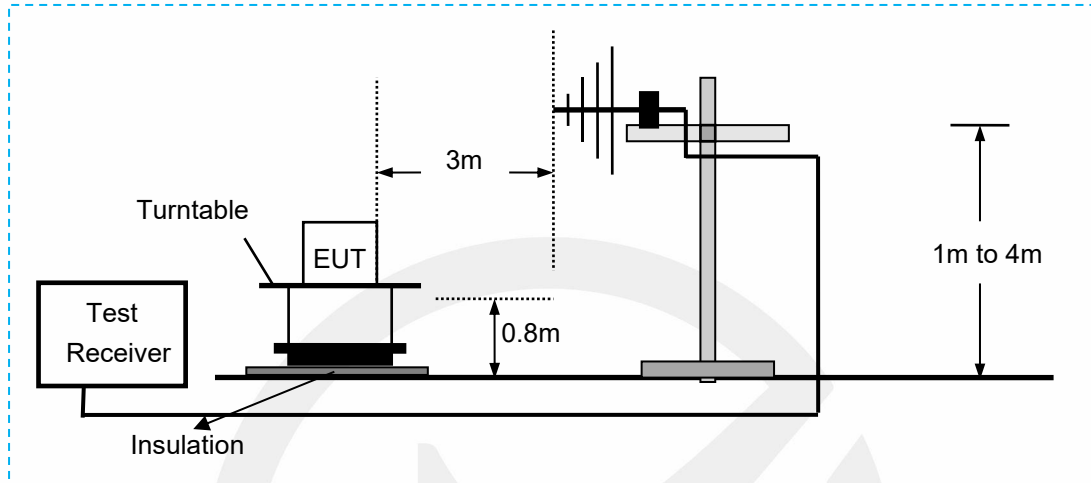
Not Applicable



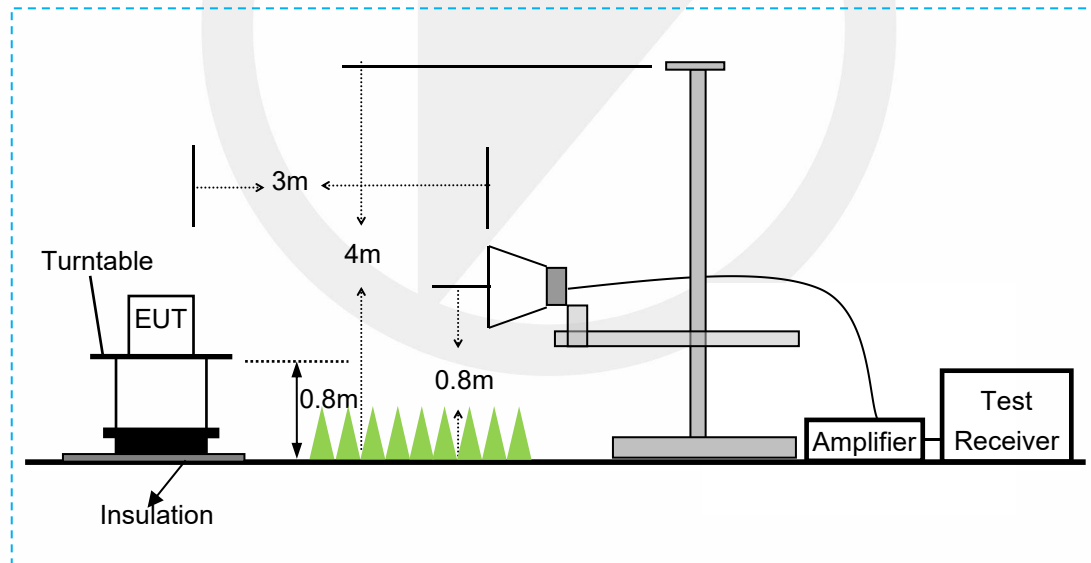
9. RADIATED EMISSION

9.1. Block Diagram of Test Setup

Below 1GHz



Above 1GHz



9.2. Measuring Standard

ETSI EN 301 489-1 Clause 8.2

EN 55032: 2015 /A11:2020 Clause A.2

9.3. Radiated Limit

EN 55032, Class B, Table A.4

Frequency range MHz	Measurement			Class B limits dB(μV/m)
	Facility	Distance (m)	Detector type / bandwidth	
30 to 230	OATS/SAC	10	Quasi Peak / 120 kHz	30
230 to 1 000				37
30 to 230	OATS/SAC	3		40
230 to 1 000				47

EN 55032, Class B, Table A.5

Frequency range (MHz)	Measurement			Class B limits dB(μV/m)
	Facility	Distance (m)	Detector type/ bandwidth	
1000 to 6000	FSOATS	3	Average / 1 MHz	54
1000 to 6000			Peak / 1 MHz	74

Note: The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. If the highest frequency of the internal sources of the EUT is less than 108 MHz, the measurement shall only be made up to 1 GHz. If the highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz the measurement shall only be made up to 2 GHz. If the highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz, the measurement shall only be made up to 5 GHz. If the highest frequency of the internal sources of the EUT is above 1 GHz, the measurement shall be made up to 5 times the highest frequency or 6 GHz, whichever is less.

9.4. Test Procedure

The EUT was placed on a non-conductive table whose total height equaled 80cm. All units of equipment forming the system under test (includes the EUT as well as connected peripherals and associated equipment or devices) shall be arranged such that a nominal 0.1 m separation is achieved between the neighboring units. Where the mains cable supplied by the manufacturer is longer than 1 m, the excess should be folded at the centre into a bundle no longer than 0.4 m, so that its length is shortened to 1 m.

The EUT was set 3 meters (or 10 meters) away from the receiving antenna that was mounted on a non-conductive mast. The antenna can move up and down between 1 to 4 meters to find out the maximum emission level.

The turntable can rotate 360 degree to determine the position of the maximum emission level.

The initial testing identified the frequency that has the highest disturbance relative to the limit while operating the EUT in typical modes of operation and cable positions in a test setup representative of typical system configuration.

The identification of the frequency of highest emission with respect to the limit was found by investigating emissions at a number of significant frequencies. The probable frequency of maximum emission had been found and that the associated cable and EUT configuration and mode of operation had been identified.

The 30 MHz-1GHz bandwidth of the Receiver is set at 120 kHz, above 1GHz Receiver is set at 1MHz

Test results were obtained from the following equation:

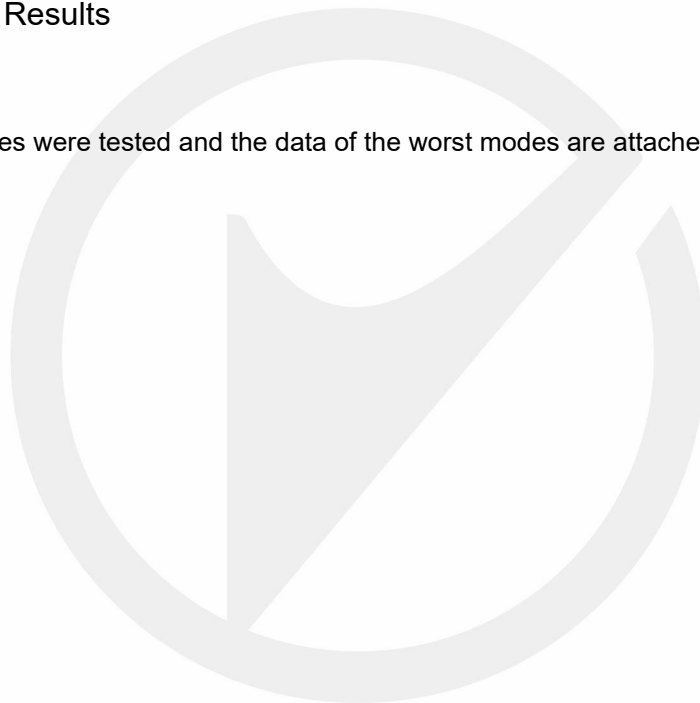
Measurement (dBμV) = Correct Factor (dB) + Reading (dBμV)

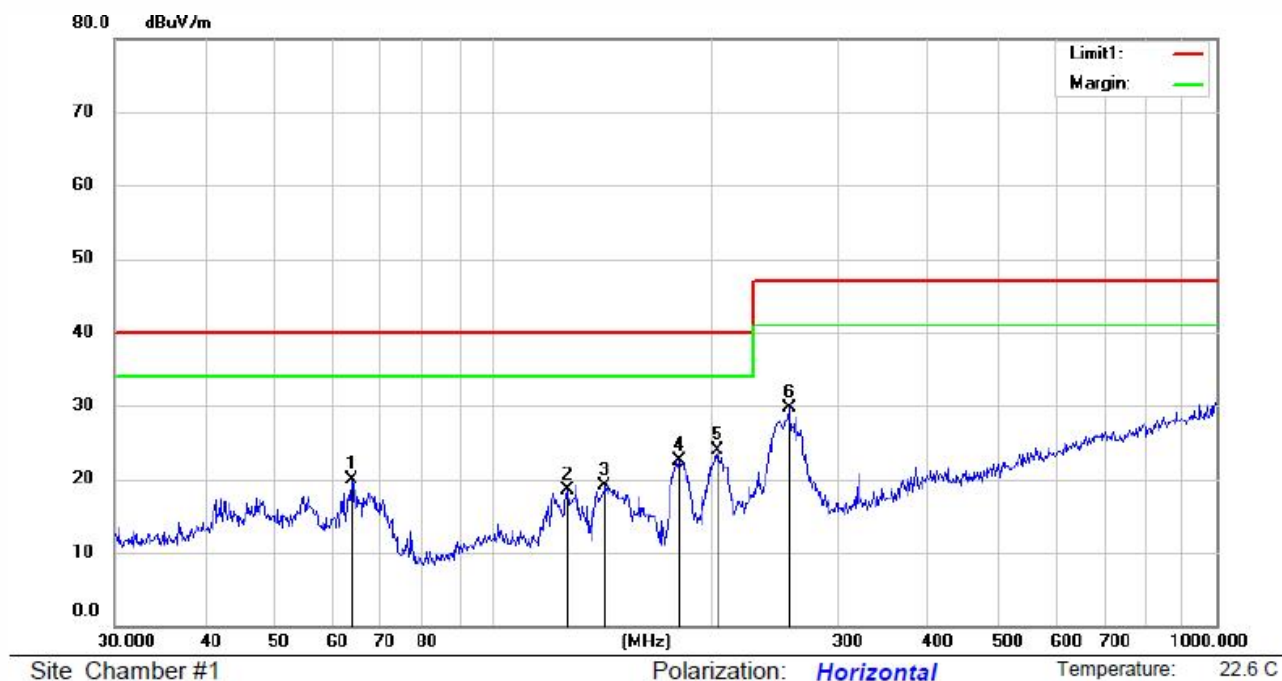
Over (dB) = Measurement (dBμV) - Limit (dBμV)

9.5. Measuring Results

PASS.

All the modes were tested and the data of the worst modes are attached the following pages.

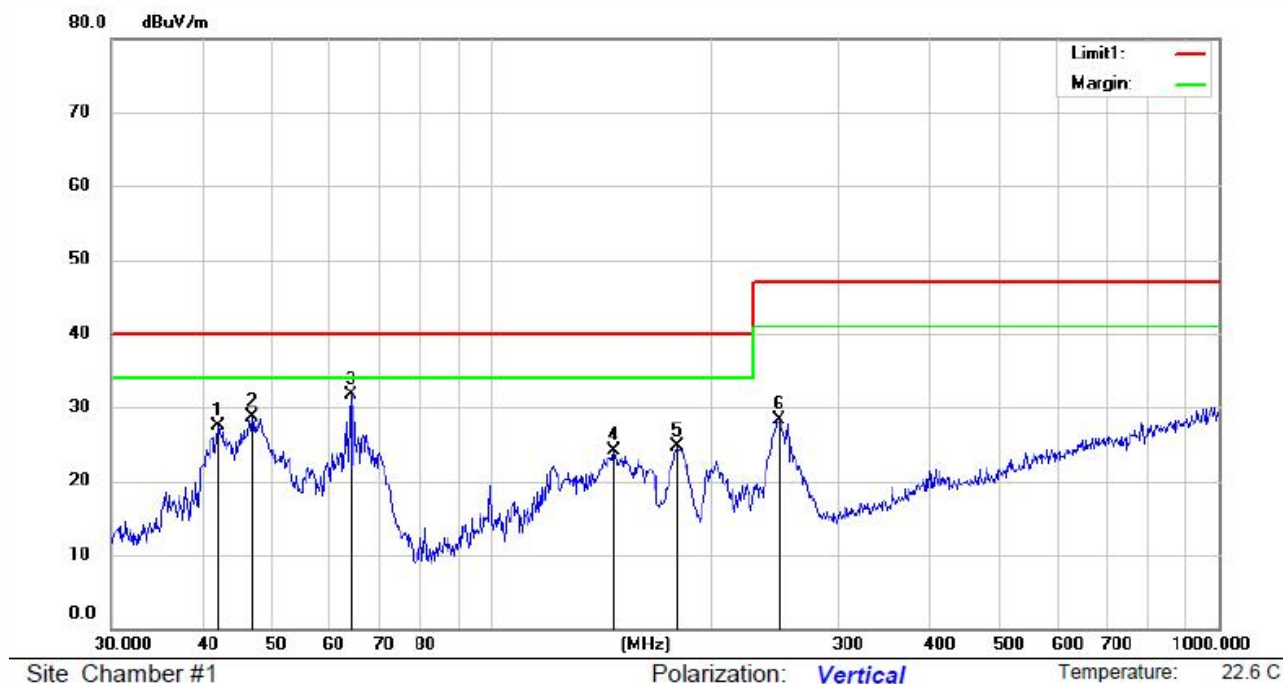




No.	Mk.	Freq.	Reading	Ant.	Pre Amp	Cable	Measure-	Limit	Over	HI	Degree	
		MHz	dBuV	Factor	Gain	loss	ment	dBuV/m	dB	Detector	cm	deg.
1		63.7588	38.16	11.25	30.53	1.07	19.95	40.00	-20.05	QP		
2		126.7723	39.13	8.85	30.75	1.27	18.50	40.00	-21.50	QP		
3		142.8243	40.13	8.27	30.66	1.39	19.13	40.00	-20.87	QP		
4		180.6488	41.67	9.78	30.46	1.6	22.59	40.00	-17.41	QP		
5	*	204.2377	40.83	11.72	30.34	1.74	23.95	40.00	-16.05	QP		
6		256.5211	44.45	13.12	30.06	2.13	29.64	47.00	-17.36	QP		

*:Maximum data x:Over limit !:over margin

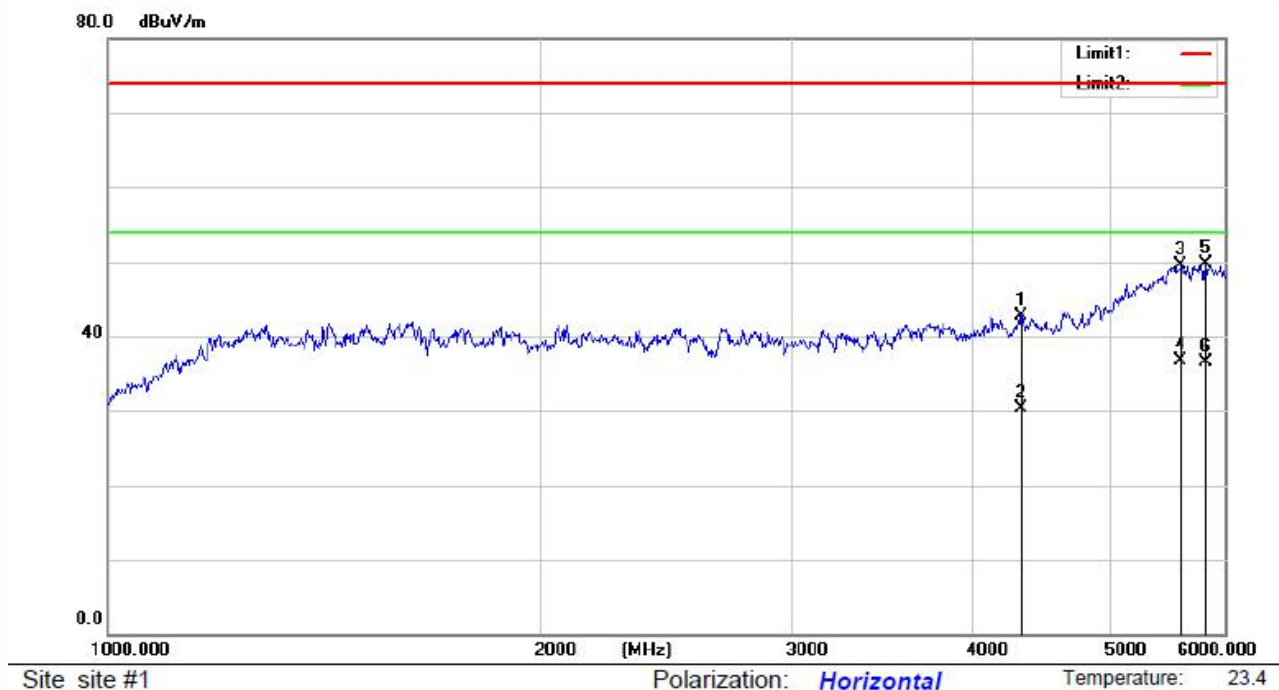
Operator: Ccyf



No.	Mk.	Freq. MHz	Reading Level dBuV	Ant. Factor dB/m	Pre Amp Gain dB	Cable loss dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	HI	Degree	Comment
1		42.1542	43.99	13.29	30.52	0.65	27.41	40.00	-12.59	QP		
2		46.8303	44.63	13.87	30.49	0.73	28.74	40.00	-11.26	QP		
3	*	63.9828	49.95	11.18	30.53	1.07	31.67	40.00	-8.33	QP		
4		147.4036	44.85	8.45	30.64	1.42	24.08	40.00	-15.92	QP		
5		180.0165	43.86	9.7	30.47	1.6	24.69	40.00	-15.31	QP		
6		248.5520	43.40	12.96	30.1	2.12	28.38	47.00	-18.62	QP		

*:Maximum data x:Over limit !:over margin

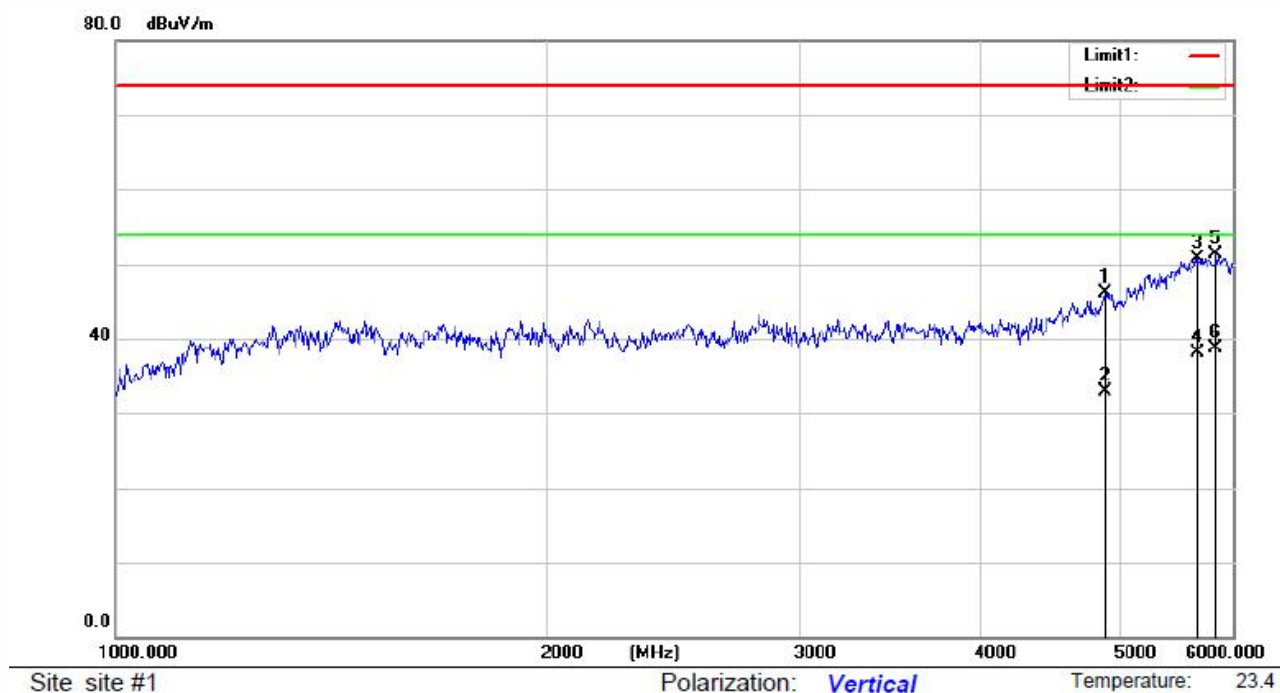
Operator: Ccyf



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		4330.397	47.16	-4.36	42.80	74.00	-31.20	peak		
2		4330.397	34.68	-4.36	30.32	54.00	-23.68	AVG		
3		5595.042	48.80	0.78	49.58	74.00	-24.42	peak		
4	*	5595.042	35.93	0.78	36.71	54.00	-17.29	AVG		
5		5819.996	47.67	2.01	49.68	74.00	-24.32	peak		
6		5819.996	34.58	2.01	36.59	54.00	-17.41	AVG		

*:Maximum data x:Over limit !:over margin

Operator: Ccyf



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		4891.499	47.95	-1.82	46.13	74.00	-27.87	peak		
2		4891.499	34.74	-1.82	32.92	54.00	-21.08	AVG		
3		5675.819	49.56	1.22	50.78	74.00	-23.22	peak		
4		5675.819	36.90	1.22	38.12	54.00	-15.88	AVG		
5		5840.889	49.23	2.05	51.28	74.00	-22.72	peak		
6	*	5840.889	36.57	2.05	38.62	54.00	-15.38	AVG		

*:Maximum data x:Over limit !:over margin

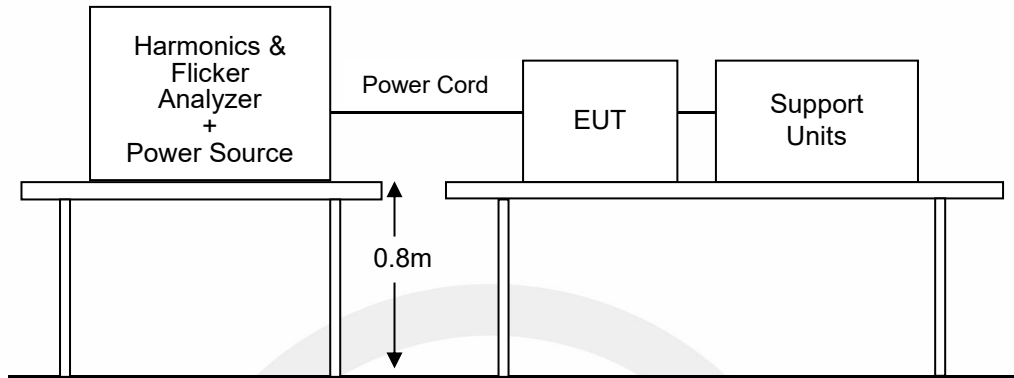
Operator: Ccyf

Remark:

1. Measurement (dBμV/m) = Antenna Factor(dB) -Amp Factor(dB) +Cable Loss(dB) + Reading(dBμV/m)
2. Over (dB) = Measurement (dBμV/m) - Limit (dBμV/m)

10. HARMONIC CURRENT EMISSION MEASUREMENT

10.1. Block Diagram of Test Setup



10.2. Measuring Standard

ETSI EN 301 489-1 Clause 8.5
EN IEC 61000-3-2:2019

10.3. Standard Limits

EN 61000-3-2, CLASS D

Harmonic current emissions evaluate the potential for the EUT to cause distortion on the AC power lines. It is applicable to electrical and electronic equipment having an input current ≤ 16 A per phase, and intended to be connected to public low-voltage distribution systems

Table 3 – Limits for Class D equipment

Harmonic order n	Maximum permissible harmonic current per watt mA/W	Maximum permissible harmonic current A
3	3.4	2.30
5	1.9	1.14
7	1.0	0.77
9	0.5	0.40
11	0.35	0.33
$13 \leq n \leq 39$ (odd harmonics only)	$3.85/n$	See Table 1

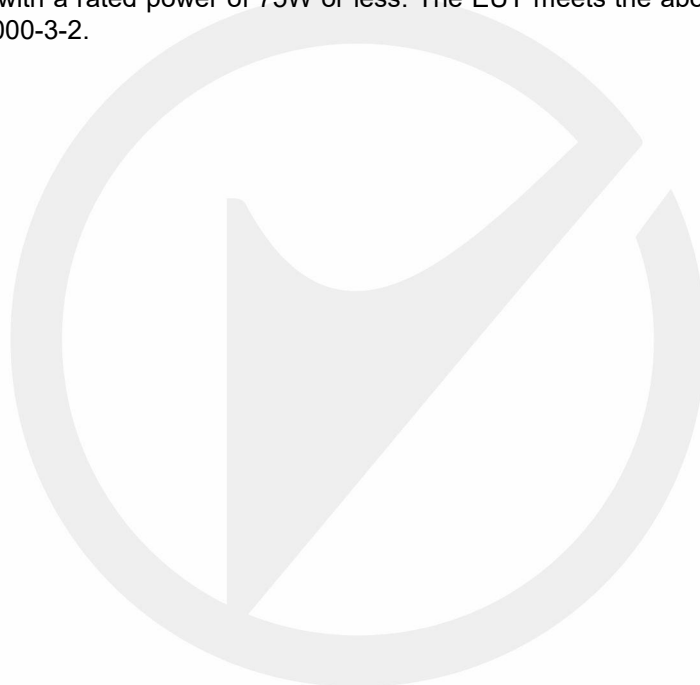
10.4. Test Procedure

The measurement of harmonic currents shall be performed as follows: i. For each harmonic order, measure the 1.5 s smoothed r.m.s. harmonic current in each DFT time window as defined in EN / IEC 61000-4-7:2009. ii. Calculate the arithmetic average of the measured values from the DFT time windows, over the entire observation period Short cyclic ($T_{\text{cycle}} \leq 2.5 \text{ min}$). Because of synchronisation to meet the requirements for repeatability in 5%.

10.5. Test Results

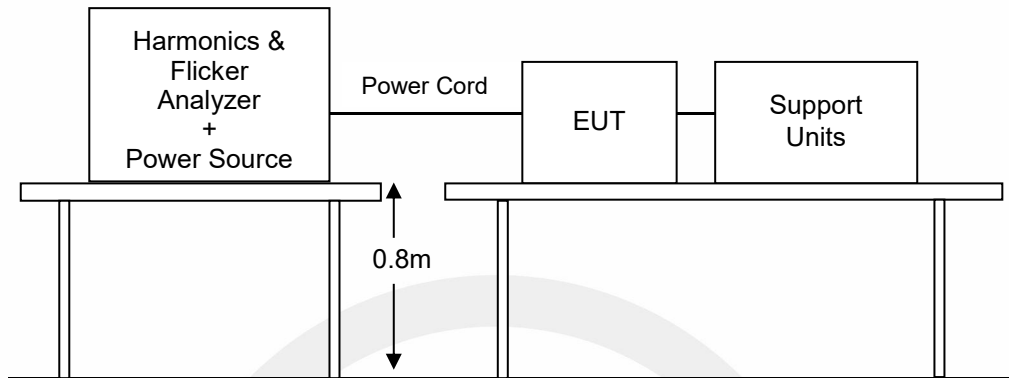
N/A

As specified on section 7 and above figure of EN IEC 61000-3-2, the limits are not specified for equipment with a rated power of 75W or less. The EUT meets the above condition, so it conforms to EN IEC 61000-3-2.



11. VOLTAGE FLUCTUATION AND FLICKER MEASUREMENT

11.1. Block Diagram of Test Setup



11.2. Measuring Standard

ETSI EN 301 489-1 Clause 8.6
EN 61000-3-3:2013/ A1:2019

11.3. Standard Limits

EN 61000-3-3 Limits

The objective of voltage changes, voltage fluctuations and flicker in public low voltage supply systems during equipment with rated current ≤ 16 A per phase, ensures that home appliances and certain other electrical equipment do not adversely affect lighting equipment when connected to the same power system.

Voltage Fluctuation and Flicker Limits:

- the value of P_{st} shall not be greater than 1.0;
- the value of Plt shall not be greater than 0.65;
- the value of $d(t)$ during a voltage change shall not exceed 3.3 % for more than 500 ms;
- the relative steady-state voltage change, dc , shall not exceed 3.3 %;
- the maximum relative voltage change, d_{max} , shall not exceed 4.0 %;

11.4. Test Procedure

The total impedance of the test circuit, excluding the appliance under test, but including the internal impedance of the supply source, shall be equal to the reference impedance. The stability and tolerance of the reference impedance shall be adequate to ensure that the overall accuracy of 8% is achieved during the whole assessment procedure.

11.5. Test Results

PASS.

Flicker Test Summary per IEC61000-3-3:2013/AMD1:2017 (Run time)

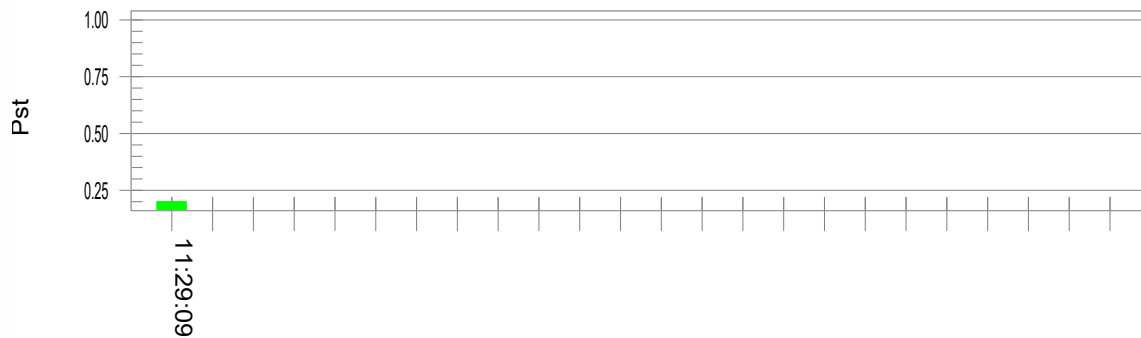
EUT: GFC007
 Test category: All parameters (European limits)
 Test date: 2024/9/2
 Test duration (min): 10
 Comment: ON
 Customer: Customer

Tested by: CHENLI
 Test Margin: 100
 End time: 11:29:15
 Data file name: F-000803.cts_data

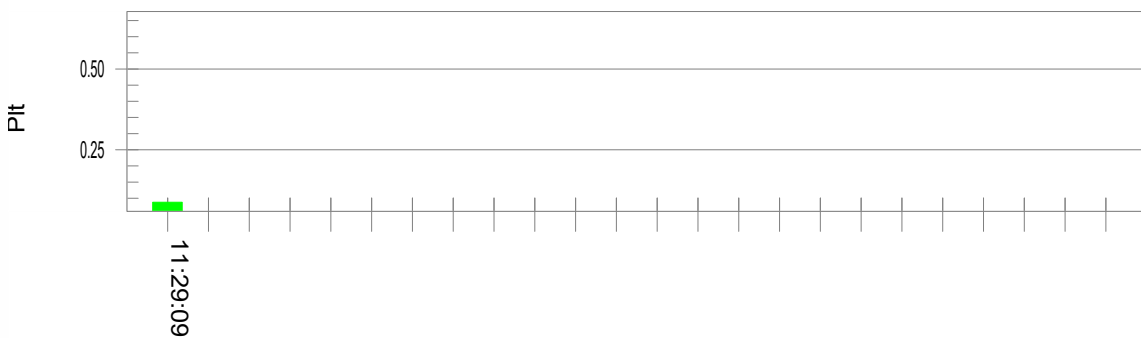
Test Result: Pass Status: Test Completed

Pst_i and limit line

European Limits



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	229.90		
Highest dt (%):		Test limit (%):	
T-max (mS):	0	Test limit (mS):	500.0 Pass
Highest dc (%):	0.00	Test limit (%):	3.30 Pass
Highest dmax (%):	0.00	Test limit (%):	4.00 Pass
Highest Pst (10 min. period):	0.200	Test limit:	1.000 Pass

12. PERFORMANCE CRITERIA

12.1. General performance criteria

The performance criteria are:

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

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

12.2. Performance table

ETSI 301 489-3/-17 Performance criteria;

Criteria	During test	After test ((i.e. as a result of the application of the test))
A	Shall operate as intended. (see note). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance. Shall be no loss of function. Shall be no loss of critical stored data.
B	May be loss of function	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no loss of critical stored data.
C	May be loss of function.	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no loss of critical stored data.
NOTE: Operate as intended during the test allows a level of degradation in accordance with clause 6.2.2.		

Minimum performance level

For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10 %.

For equipment that does not support a PER or a FER, the minimum performance level shall be no loss of the wireless transmission function needed for the intended use of the equipment.

Performance criteria for Continuous phenomena

The performance criteria A shall apply.

Where the EUT is a transmitter in standby mode, unintentional transmission shall not occur during the test.

Where the EUT is a transceiver in receive mode, unintentional transmission shall not occur during the test.

Performance criteria for Transient phenomena

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

Where the EUT is a transmitter in standby mode, unintentional transmission shall not occur as a result of the application of the test.

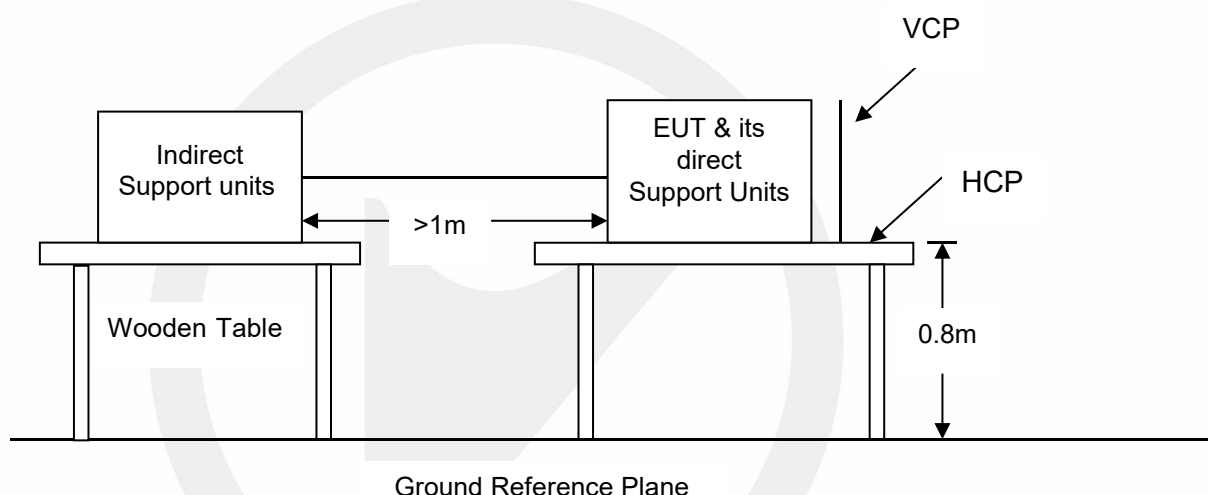
Where the EUT is a transceiver in receive mode, unintentional transmission shall not occur as a result of the application of the test.

13. ELECTROSTATIC DISCHARGE

13.1. Test Specification

Test standard	: ETSI EN 301 489-1
Basic standard	: EN 61000-4-2
Performance criterion	: B
Test level	: $\pm 8.0\text{kV}$ (Air discharge) $\pm 4.0\text{kV}$ (Contact discharge)

13.2. Block Diagram of Test Setup



13.3. Test Procedure

Please refer to ETSI EN 301 489-1 Clause 9.3.2 and EN 61000-4-2 for the measurement methods.

a. In the case of air discharge testing, the climatic conditions shall be within the following ranges:

- ambient temperature: 15°C to 35°C ;
- relative humidity : 30% to 60%;
- atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar)

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

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

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

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

discharge, shall be closed.

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

g. The test shall be performed with both air discharge and contact discharge. The test shall be performed with single discharges. On each pre-selected point at least 10 single discharges (in the most sensitive polarity) shall be applied. For the time interval between successive single discharges an initial value of 1 s is recommended. Longer intervals may be necessary to determine whether a system failure has occurred.

h. Ensure that the applied charge on the EUT has been dis-charged before next ESD pulse.

i. At least ten single discharges (in the most sensitive polarity) were applied to the Horizontal Coupling Plane at points on each side of the Product. The ESD generator was positioned vertically at a distance of 0.1 meters from the Product with the discharge electrode touching the HCP.

J. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the Vertical Coupling Plane in sufficiently different positions that the four faces of the Product were completely illuminated. The VCP (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the Product.

13.4. Test Results

PASS

Temperature : 25.6° C
Humidity : 56.3%
Atmospheric Pressure : 101kpa
Test Engineer : Chenli
Test Date : 2024-10-08

Air Discharge:

Test Voltage	Location	Actual criterion	Required performance criterion	Result (Pass/Fail)
±2; 4; 8 kV	Gap	B	B	Pass
±2; 4; 8 kV	Non-Metal part	B	B	Pass

Contact Discharge

Test Voltage	Location	Actual criterion	Required performance criterion	Result (Pass/Fail)
±2; 4kV	Metal part	B	B	Pass

Indirect Discharge

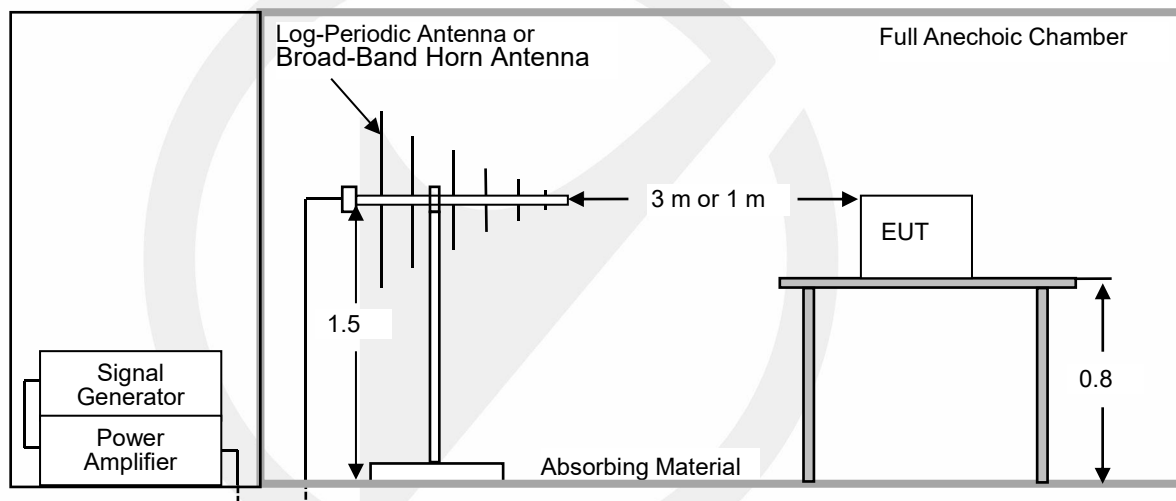
Test Voltage	Location	Actual criterion	Required performance criterion	Result (Pass/Fail)
±2; 4 kV	HCP	A	B	Pass
±2; 4 kV	VCP	A	B	Pass

14. CONTINUOUS RF ELECTROMAGNETIC FIELD DISTURBANCES

14.1. Test Specification

Test standard	: ETSI EN 301 489-1	
Basic standard	: EN 61000-4-3	
Performance criterion	: A	
Frequency range &	: <input checked="" type="checkbox"/> 80M-6000MHz	3V/m
Test level	: <input checked="" type="checkbox"/> Spot frequency	3V/m
	: <input type="checkbox"/> Additional spot frequency	3V/m
Modulation	: AM, 80%, 1kHz sine-wave	

14.2. Block Diagram of Test Setup



14.3. Test procedure

Please refer to ETSI EN 301 489-1 Clause 9.2.2 and EN 61000-4-3 for the measurement methods. The procedure defined in this part requires the generation of electromagnetic fields within which the test sample is placed and its operation observed. To generate fields that are useful for simulation of actual (field) conditions may require significant antenna drive power and the resultant high field strength levels. To comply with local regulations and to prevent biological hazards to the testing personnel, it is recommended that these tests be carried out in a shielded enclosure or semi-anechoic chamber.

The test level shall be 3 V/m (measured undulated). The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 000 Hz. If the wanted signal is modulated at 1 000 Hz, then an audio signal of 400 Hz shall be used;

The test shall be performed over the frequency range 80 MHz to 6 000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers (see clause 4.3), as appropriate; For receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency;

The dwell time of the test phenomena at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond;

The test is performed with the antenna facing the front and back sides of the EUT with. Both vertical and horizontal polarizations from antenna are tested.

14.4. Test results

PASS

Temperature : 24.8° C
 Humidity : 58.4%
 Atmospheric Pressure : 101kpa
 Test Engineer : CSL
 Test Date : 2024-09-20

☒ 80M-6000MHZ:

Freq. Range (MHz)	Field	Modulation	Polarity	Position (°)	Actual criterion	Required performance criterion	Result
80-6000	3V/m	AM, 80%	H / V	0, 90, 180, 270	A	A	Pass

☒ Spot frequency:

Freq (MHz)	Field	Modulation	Polarity	Position (°)	Actual criterion	Required performance criterion	Result
1800, 2600, 3500, 5000	3V/m	AM, 80%	H / V	0, 90, 180, 270	A	A	Pass

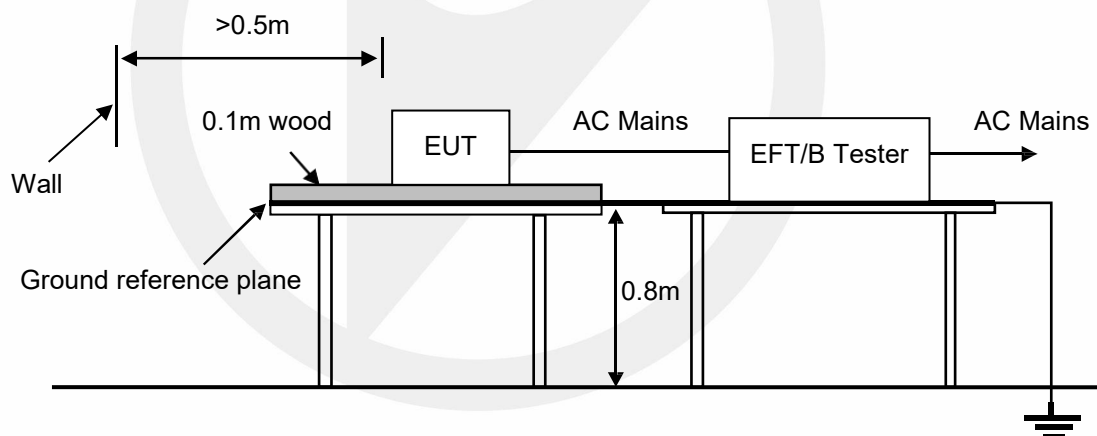
15. ELECTRICAL FAST TRANSIENTS/BURST

15.1. Test Specification

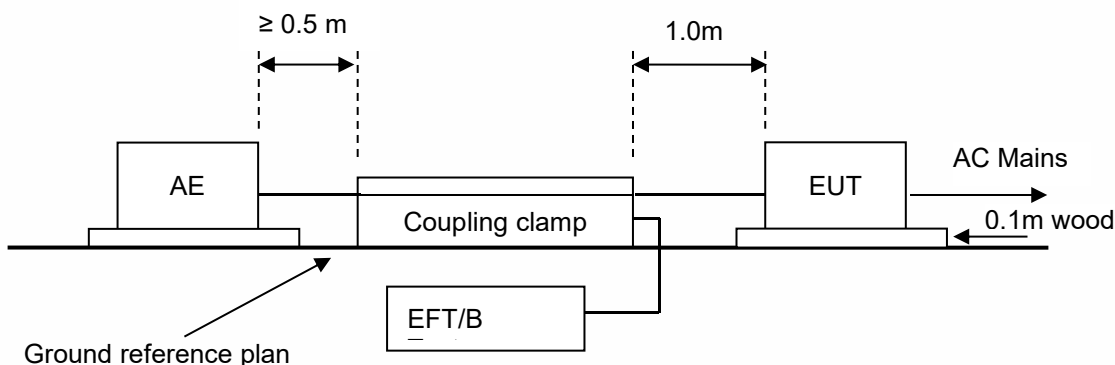
Test standard	: ETSI EN 301 489-1
Basic standard	: EN 61000-4-4
Performance criterion	: B
Test level	: <input checked="" type="checkbox"/> 1kV, AC mains power ports <input type="checkbox"/> 0.5kV, DC network power ports <input type="checkbox"/> 0.5kV, Analogue/digital data ports
Repetition frequency	: <input checked="" type="checkbox"/> 5kHz, <input type="checkbox"/> 100kHz(Only xDSL ports)
Tr/Th:	: 5/50ns
Burst period	: 300ms
Test time :	: 120s

15.2. Block Diagram of Test Setup

AC Lines:



Signal lines:



15.3. Test Procedure

Please refer to ETSI EN 301 489-1 Clause 9.4.2 and EN 61000-4-4 for the measurement methods. The EUT is put on the table that is 0.8 meter high above the ground. This reference ground plane shall project beyond the EUT by at least 0.1m on all sides and the minimum distance between EUT and all other conductive structure, except the ground plane beneath the EUT, shall be more than 0.5m.

15.4. Test Results

PASS

Temperature : 26.2° C
Humidity : 58.4%
Atmospheric Pressure : 101kpa
Test Engineer : Chen Li
Test Date : 2024-09-02

Injection Line	Voltage (kV)	Injected Method	Actual criterion	Required performance criterion	Result (Pass/Fail)
<input checked="" type="checkbox"/> AC mains power ports	± 1	<input checked="" type="checkbox"/> CDN <input type="checkbox"/> Direct injection <input type="checkbox"/> Capacitive coupling clamp	A	B	Pass
<input type="checkbox"/> DC network power ports	± 0.5	<input type="checkbox"/> CDN <input type="checkbox"/> Direct injection <input type="checkbox"/> Capacitive coupling clamp	N/A	N/A	N/A
<input type="checkbox"/> Analogue/digital data ports (LAN 1)	± 0.5	<input type="checkbox"/> CDN <input type="checkbox"/> Direct injection <input type="checkbox"/> Capacitive coupling clamp	N/A	N/A	N/A
<input type="checkbox"/> Analogue/digital data ports (Signal Line)	± 0.5	<input type="checkbox"/> CDN <input type="checkbox"/> Direct injection <input type="checkbox"/> Capacitive coupling clamp	N/A	N/A	N/A

Observation: All the functions were operated as normal after the test.

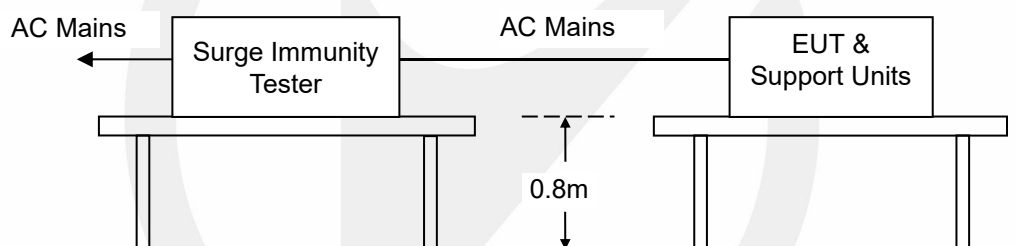
Conclusion: The EUT can meet the requirement of Performance Criterion B

16. SURGES

16.1. Test Specification

Test standard	: ETSI EN 301 489-1
Basic standard	: EN 61000-4-5
Test level	: <input checked="" type="checkbox"/> 1kV, Line to Line, AC mains power ports, Criterion B <input type="checkbox"/> 2kV, Line to Earth, AC mains power ports, Criterion B <input type="checkbox"/> 1.0kV, Lines to Ground, Unshielded symmetrical, Criterion B <input type="checkbox"/> 1.0kV, Lines to Ground, Unshielded non-symmetrically, Criterion B <input type="checkbox"/> 0.5kV, Shield to ground, CoaCalvinl or shielded port, Criterion B
Number of surges	: 5 (for each combination of parameters)
Repetition rate	: 1 minute / time
Polarity:	: Positive / Negative
Phase angle:	: 0°, 90°, 180°, 270° (Only AC mains power ports)

16.2. Block Diagram of Test Setup



16.3. Test Procedure

Please refer to ETSI EN 301 489-1 Clause 9.8.2 and EN 61000-4-5 for the measurement methods

This test simulates a lightning event by inducing transients onto the AC/DC power supply lines in common mode (Line to Ground) and differential mode (Line to Line). Each device was tested in a total of two surge configurations: Line to Ground (L-G): Combination Wave, Line to Protective Earth with 9uF and 10Ohm and Neutral to Protective Earth with 9uF and 10Ohm, common mode, generator earthed.

Line to Line (L-L): Combination Wave,

Line to Neutral with 18uF, differential mode, generator floated.

2 ohm : the source impedance of the low-voltage power supply network.

12 ohm : the source impedance of the low-voltage power supply network and ground.

a. If not otherwise specified the surges have to be applied synchronized to the voltage phase at the zero-crossing and the peak value of the a.c. voltage wave (positive and negative).

b. The surges have to be applied line to line and line to earth. When testing line to earth, the test voltage has to be applied successively between each of the lines and earth, if there is no other specification.

c. The test procedure shall also consider the non-linear current-voltage characteristics of the equipment under test. Therefore the test voltage has to be increased by steps up to the test level specified in the product standard or test plan. All lower levels including the selected test level shall be satisfied.

- d. For testing the secondary protection, the output voltage of the generator shall be increased up to the worst-case voltage breakdown level (let-through level) of the primary protection.
- e. Testing shall be performed according to a Test Plan, which shall be included in the test report.
- f. To find all critical points of the duty cycle of the equipment, a sufficient number of positive and negative test pulses shall be applied.

16.4. Test results

PASS

Temperature : 26.2° C
Humidity : 58.4%
Atmospheric Pressure : 101kpa
Test Engineer : Chen Li
Test Date : 2024-09-02

☒ AC mains power ports:

Coupling Line	Voltage (kV)	Waveform (μs)	Polarity	Actual criterion	Required performance criterion	Result (Pass/Fail)
<input checked="" type="checkbox"/> Line to line	1	1.2/50 (8/20)	Pos./ Neg.	A	B	Pass
<input type="checkbox"/> Line to earth	2	1.2/50 (8/20)	Pos./ Neg.	N/A	B	N/A

☐ DC network power ports:

Coupling Line	Voltage (kV)	Waveform (μs)	Polarity	Actual criterion	Required performance criterion	Result (Pass/Fail)
Line to Reference ground	0.5	1.2/50 (8/20)	Pos./ Neg.	N/A	B	N/A

☐ Analogue/digital data ports:

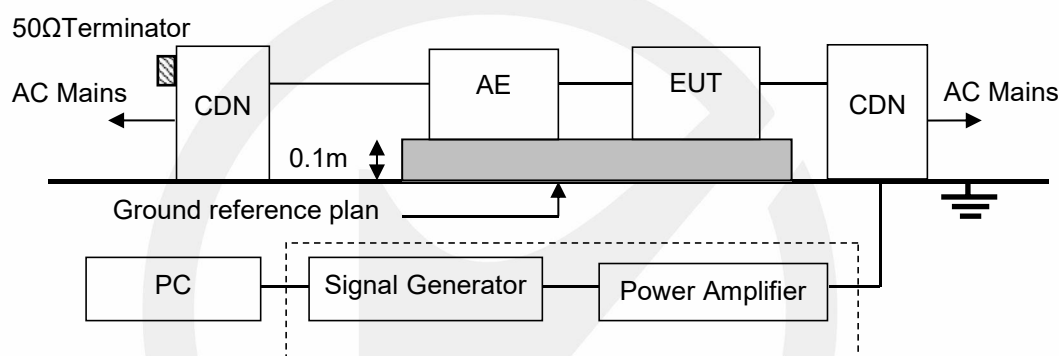
Port type	Coupling Line	Voltage (kV)	Waveform (μs)	Polarity	Actual criterion	Required performance criterion	Result (Pass/Fail)
<input type="checkbox"/> Unshielded symmetrical (Wired network port)	Lines to ground	1	1.2/50 (8/20)	Pos./ Neg.	N/A	B	N/A
<input type="checkbox"/> Unshielded symmetrical (Signal Line)	Lines to ground	1	10/700 (5/320)	Pos./ Neg.	N/A	B	N/A
<input type="checkbox"/> Unshielded symmetrical	Lines to ground	0.5	10/700 (5/320)	Pos./ Neg.	N/A	B	N/A
<input type="checkbox"/> Coaxial or shielded (.....)	Shield to ground	0.5	1.2/50 (8/20)	Pos./ Neg.	N/A	B	N/A

17. CONTINUOUS INDUCED RF DISTURBANCES

17.1. Test Specification

Test standard	: ETSI EN 301 489-1
Basic standard	: EN 61000-4-6
Performance criterion	: A
Frequency range & Test level	: 0.15M to 80MHz, 3V
Modulation	: AM 80%, 1kHz sine-wave
Frequency Step	: 1% of fundamental

17.2. Block Diagram of Test Setup



17.3. Test Procedure

Please refer to ETSI EN 301 489-1 Clause 9.5.2 and EN 61000-4-6 for the measurement methods.

a. The EUT shall be operated within its intended climatic conditions. The temperature and relative humidity should be recorded.

b. The EUT is placed on a 0.1m high test table, and a well grounded cable is connected to metallic plane above the test table.

c. All cables/wires must be laid out on test plate (3cm in thickness), and the EUT is set up on test plate (10 cm in thickness) as shown in test setup photo, and the cables/wires must not be in mid-air, they should be touching the surface of test plate. Ensure that the EUT is properly connected to the accessory equipment. d. The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn while the other non-excited RF-input ports of the coupling devices are terminated by a 50 ohm load resistor.

e. The frequency range is swept from 150 kHz to 80 MHz, using the signal levels established during the setting process, and with the disturbance signal 80% amplitude modulated with a 1 kHz sine wave, pausing to adjust the RF-signal level or to switch coupling devices as necessary. The rate of sweep shall no exceed 1.5×10^{-3} decades/s. Where the frequency is swept incrementally, the step size shall no exceed 1% of the start and thereafter 1% of the preceding frequency value.

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

g. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility

h. Testing shall be performed according to a Test Plan, which shall be included in the test report.

17.4.Test results

PASS

Temperature : 26.2° C
Humidity : 58.4%
Atmospheric Pressure : 101kpa
Test Engineer : Chen Li
Test Date : 2024-09-02

Range (MHz)	Levers (V)	Injection port	Coupling type	Actual criterion	Required performance criterion	Result (Pass/Fail)
0.15-80	3	<input checked="" type="checkbox"/> AC mains power ports	<input checked="" type="checkbox"/> CDN <input type="checkbox"/> EM Clamp <input type="checkbox"/> Current Clamp <input type="checkbox"/> Direct injection	A	A	Pass
0.15-80	3	<input type="checkbox"/> DC network power ports	<input type="checkbox"/> CDN <input type="checkbox"/> EM Clamp <input type="checkbox"/> Current Clamp <input type="checkbox"/> Direct injection	N/A	N/A	N/A
0.15-80	3	<input type="checkbox"/> Analogue/digital data ports (Signal Line)	<input type="checkbox"/> CDN <input type="checkbox"/> EM Clamp <input type="checkbox"/> Current Clamp <input type="checkbox"/> Direct injection	N/A	N/A	N/A
0.15-80	3	<input type="checkbox"/> Analogue/digital data ports (LAN 1)	<input type="checkbox"/> CDN <input type="checkbox"/> EM Clamp <input type="checkbox"/> Current Clamp <input type="checkbox"/> Direct injection	N/A	N/A	N/A

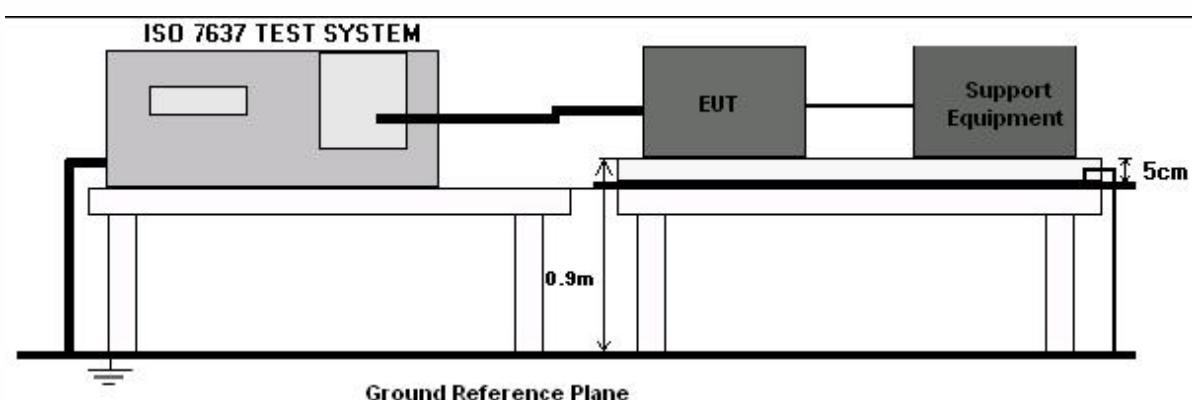
Observation: All the functions were operated as normal after the test.
Conclusion: The EUT can meet the requirement of Performance Criterion A

18. TRANSIENTS AND SURGES IN THE VEHICULAR ENVIRONMENT

18.1. Test Specification

Test standard	: ETSI EN 301 489-1
Basic standard	: ISO 7637-2
Performance criterion	: A & B
Number of pulses	: 10 pulses
duration	: 20 min

18.2. Block Diagram of Test Setup



18.3. Test Procedure

According to ETSI EN 301 489-1 Clause 9.6 and ISO 7637-2 [8] Severity Levels and Performance Criterion

Test pulse number	Immunity test level	Required functional status
1	III	B
2a	III	B
2b	III	B
3a	III	A
3b	III	A
4	III	B

These tests are applicable to radio and ancillary equipment intended for vehicular use.

These tests shall be performed on nominal 12 V and 24 V DC supply voltage input ports of mobile radio and ancillary equipment, which are also intended for mobile use in vehicles.

These tests shall be performed on a representative configuration of the mobile radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

These tests assess the ability of the EUT to operate as intended in the event of transients and surges present on their DC power input ports in a vehicular environment

The test method shall be in accordance with ISO 7637-2 [8], clause 4 for 12 V DC and 24 V DC powered equipment.

The test method shall be in accordance with ISO 7637-2 [8], clause 4, applying pulses 1, 2a, 2b, 3a, 3b, and 4, using immunity test level III. For the purpose of EMC testing it is sufficient to apply pulses 1, 2a, 2b and 4, 10 times each, and apply the test pulses 3a and 3b for 20 minutes each.

18.4. Test Results

Not applicable.

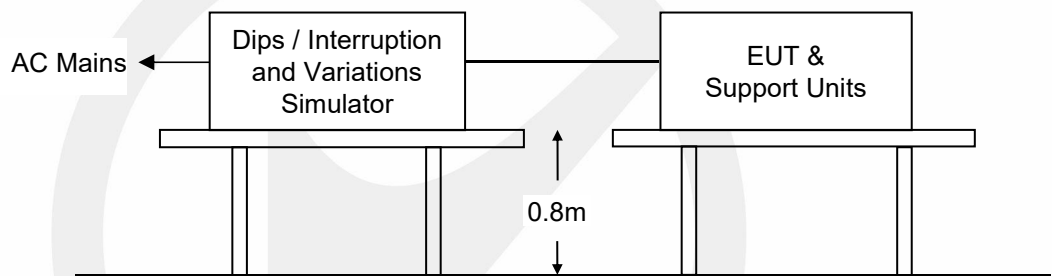


19. VOLTAGE DIPS AND INTERRUPTIONS

19.1. Test Specification

Test standard	: ETSI EN 301 489-1
Basic standard	: EN 61000-4-11
Test level	: <input checked="" type="checkbox"/> 0%, 0.5 period, Criterion B
	<input checked="" type="checkbox"/> 0%, 1 periods for 50Hz, Criterion C
	<input checked="" type="checkbox"/> 70%, 25 periods for 50Hz, Criterion C
	<input checked="" type="checkbox"/> 0%, 250 periods for 50Hz, Criterion C

19.2. Block Diagram of Test Setup



19.3. Test Procedure

- Please refer to ETSI EN 301 489-1 Clause 9.7.2 and EN 61000-4-11 for the measurement methods.
- Where the equipment has a rated voltage the following shall apply - If the voltage range does not exceed 20% of the lower voltage specified for the rated voltage range, a single voltage within that range may be specified as a basis for test level specification.
 - In all other cases, the test procedure shall be applied for both the lowest and highest voltages declared in the voltage range.
 - Test Conditions
 - Select operated voltage and frequency of EUT - Test of interval: 10 sec.
 - Level and duration: Sequence of 3 dips/interrupts.
 - Voltage rise (and fall) time: 1.5 μ s.

19.4. Test results

PASS

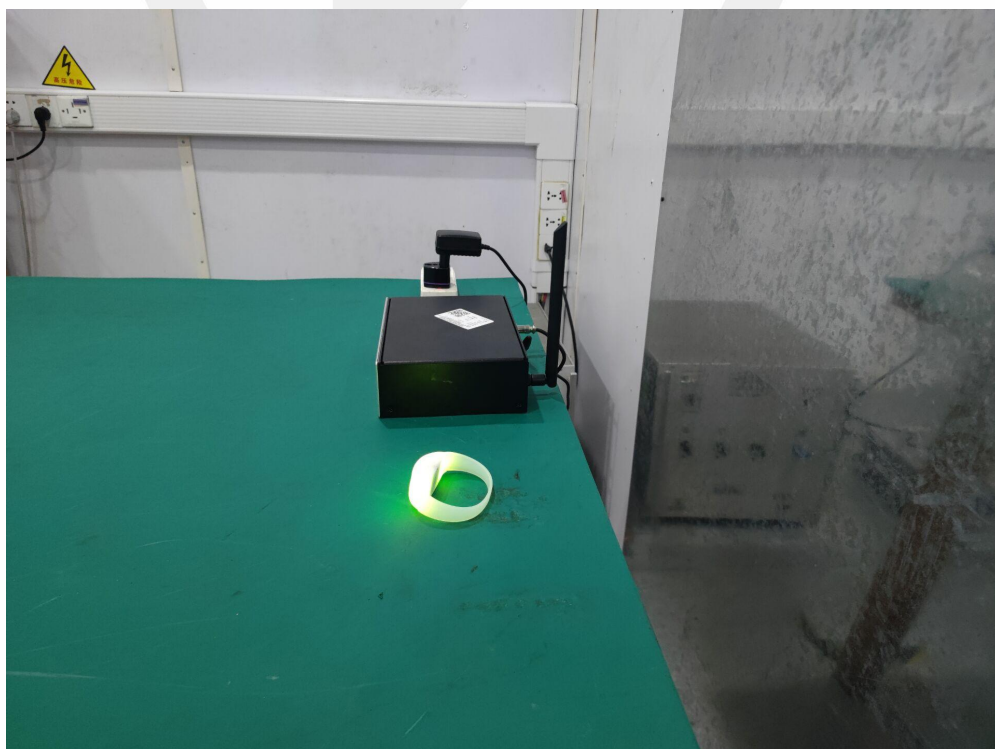
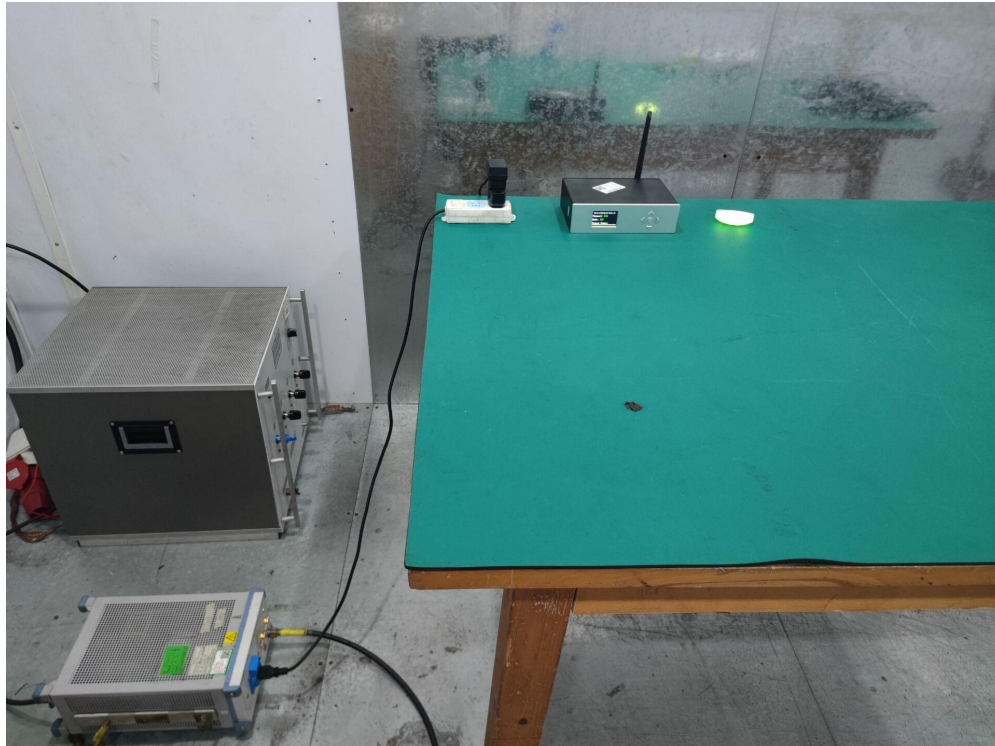
Temperature : 26.2° C
Humidity : 58.8%
Atmospheric Pressure : 101kpa
Test Engineer : Chen Li
Test Date : 2024-09-02

	Test Level (% UT)	Phase angle (°)	Input Voltage (V)	Freq (Hz)	Duration (periods)	Actual criterion	Required performance criterion	Result (Pass /Fail)
<input checked="" type="checkbox"/> Voltage dips	0%	0°, 180°	AC 100V	50	0.5	A	B	Pass
<input checked="" type="checkbox"/> Voltage dips	0%	0°, 180°	AC 240V	50	0.5	A	B	Pass
<input checked="" type="checkbox"/> Voltage dips	70%	0°, 180°	AC 100V	50	25	A	C	Pass
<input checked="" type="checkbox"/> Voltage dips	70%	0°, 180°	AC 240V	50	25	A	C	Pass
<input checked="" type="checkbox"/> Voltage dips	70%	0°, 180°	AC 100V	60	30	A	C	Pass
<input checked="" type="checkbox"/> Voltage dips	70%	0°, 180°	AC 240V	60	30	A	C	Pass
<input checked="" type="checkbox"/> Voltage interruptions	0%	0°, 180°	AC 100V	50	250	B	C	Pass
<input checked="" type="checkbox"/> Voltage interruptions	0%	0°, 180°	AC 240V	50	250	B	C	Pass
<input checked="" type="checkbox"/> Voltage interruptions	0%	0°, 180°	AC 100V	60	300	B	C	Pass
<input checked="" type="checkbox"/> Voltage interruptions	0%	0°, 180°	AC 240V	60	300	B	C	Pass

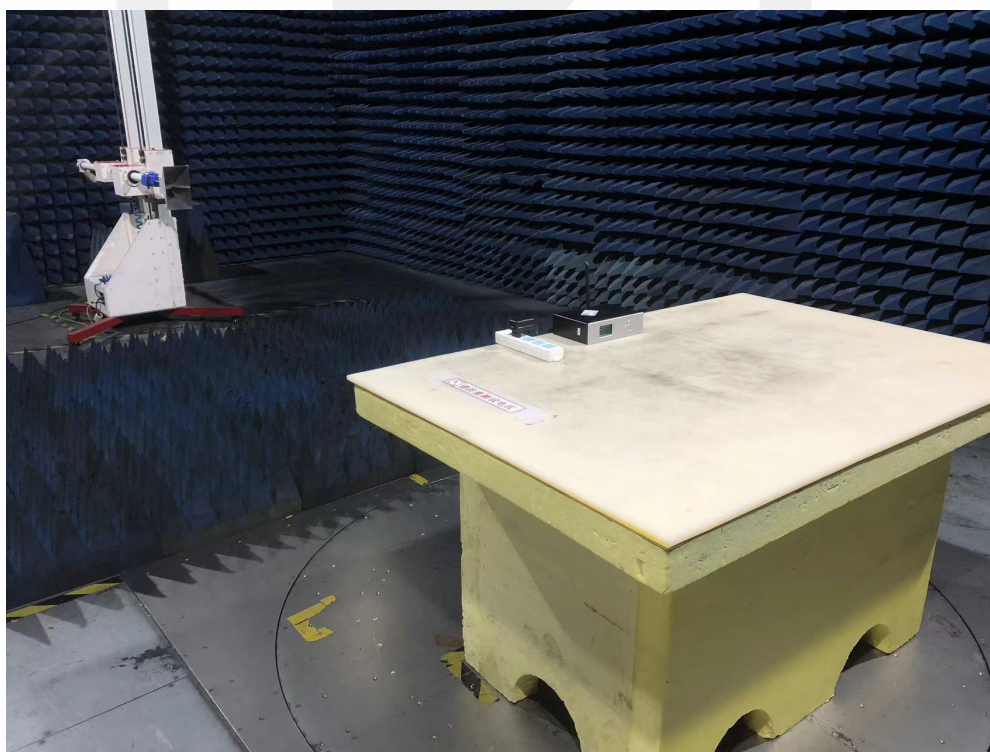
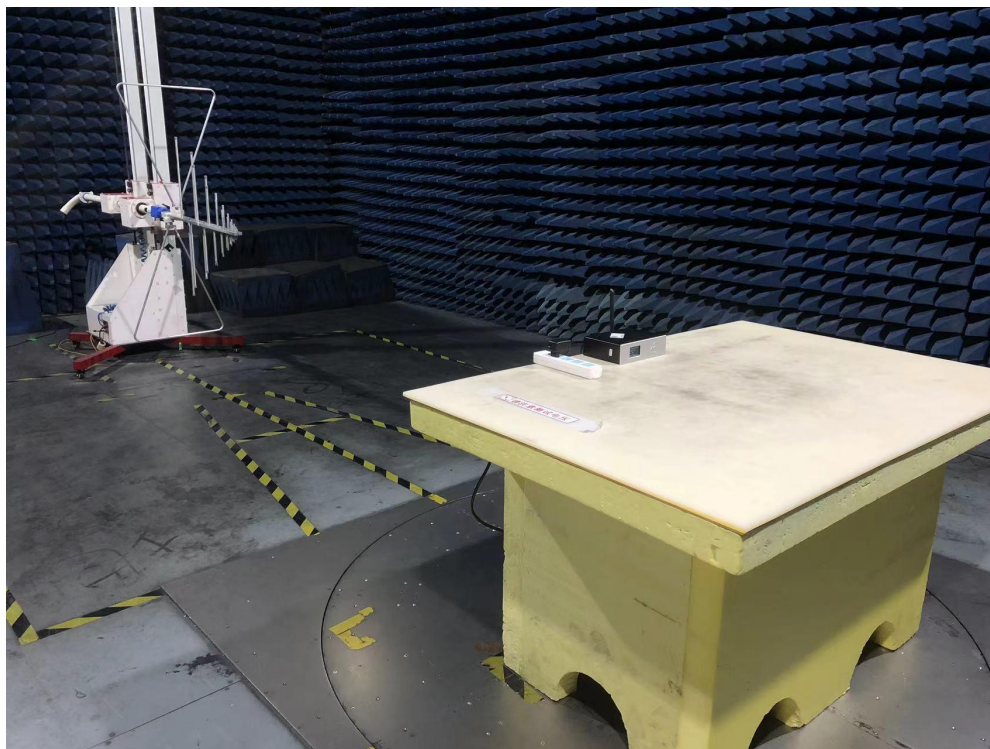
Note: C: During the test, the EUT shut down, after the test, it can be reset by user.

20. PHOTOGRAPHS

20.1. Photos of Conducted Emissions from the AC Mains Power Ports



20.2.Photos of Radiation Emission Measurement





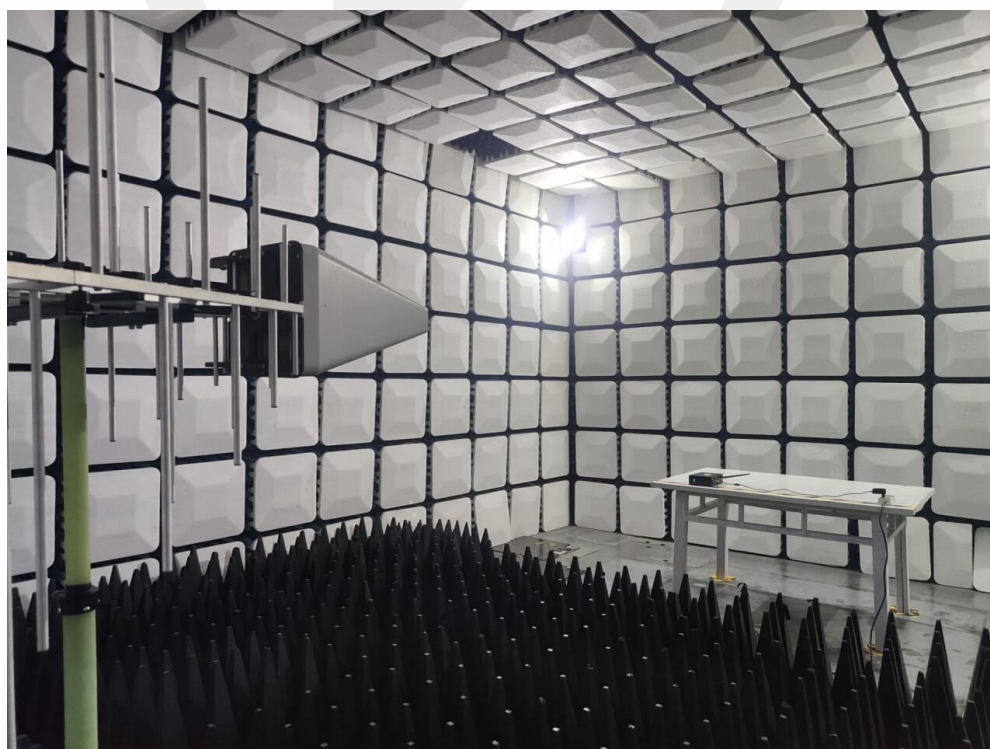
20.3.Photo of Harmonic / Flicker Measurement



20.4.Photo of Electrostatic Discharges



20.5.Continuous RF electromagnetic field disturbances



20.6.Photos of Electrical Fast Transients/Burst



20.7.Photos of Surges



20.8.Photos of Continuous Induced RF Disturbances

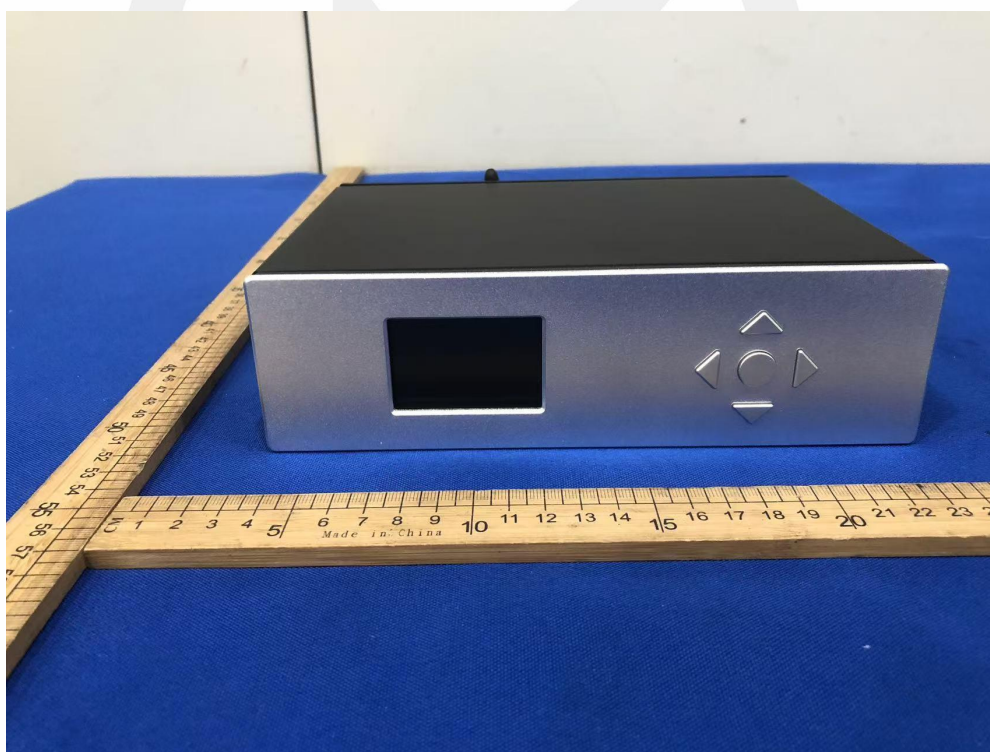
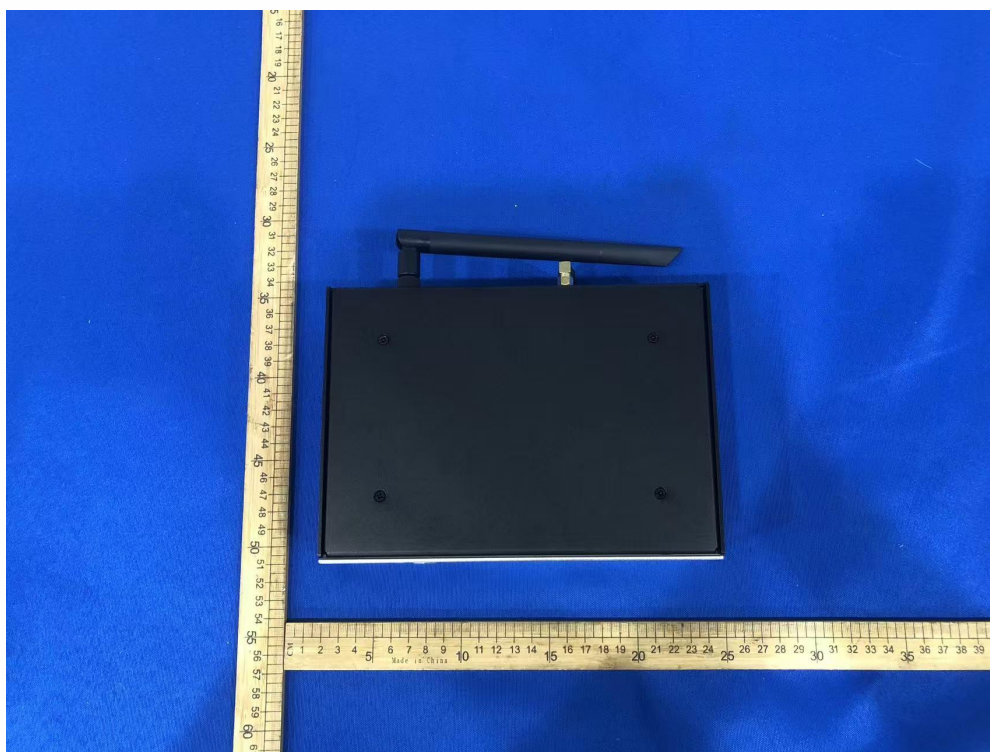


20.9.Photo of Voltage Dips and Interruptions



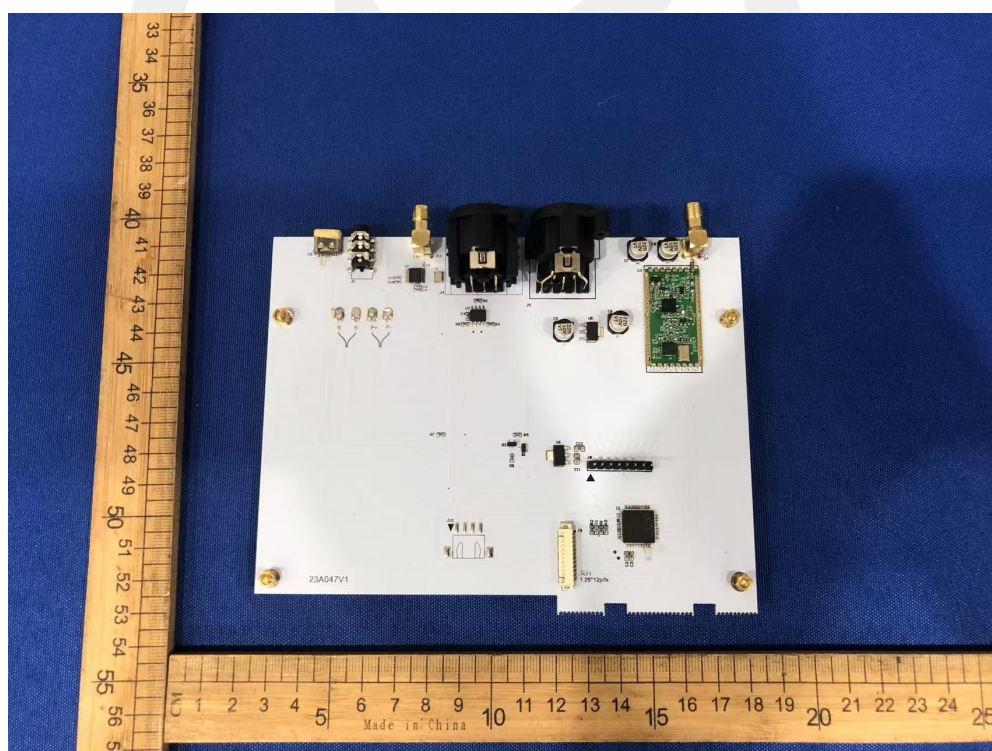
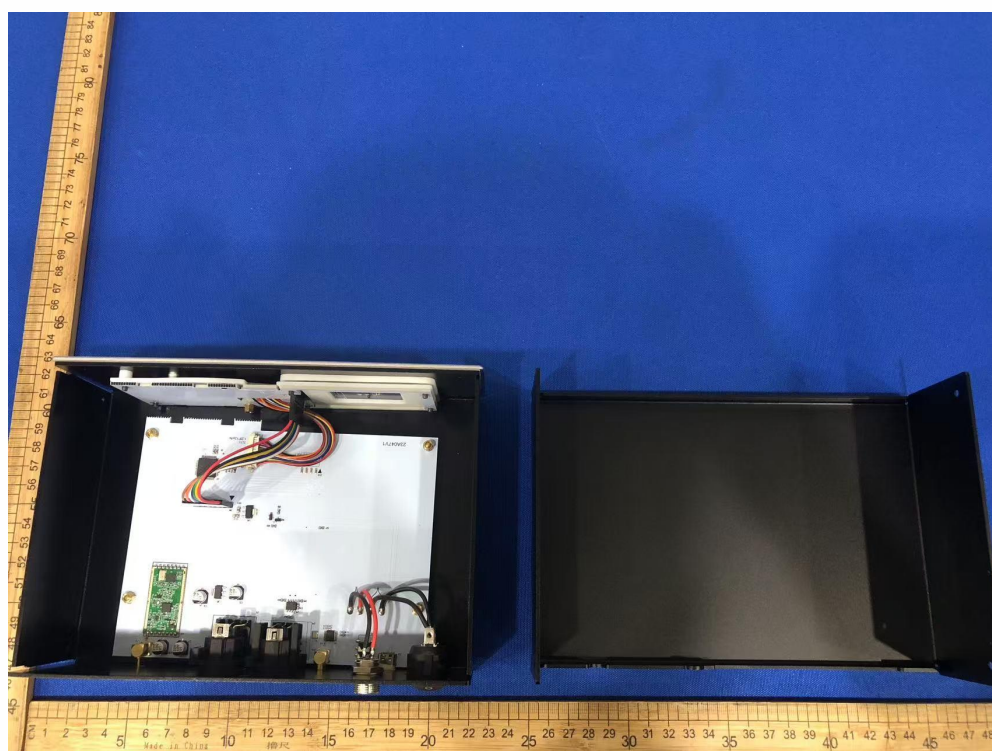
21. PHOTOS OF EUT

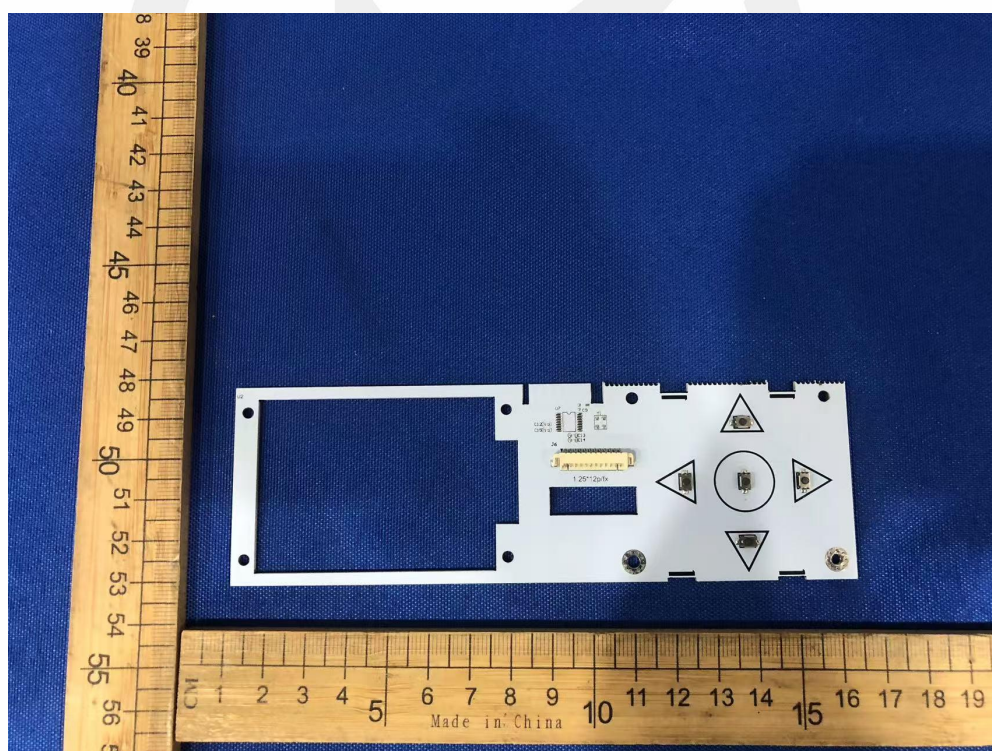
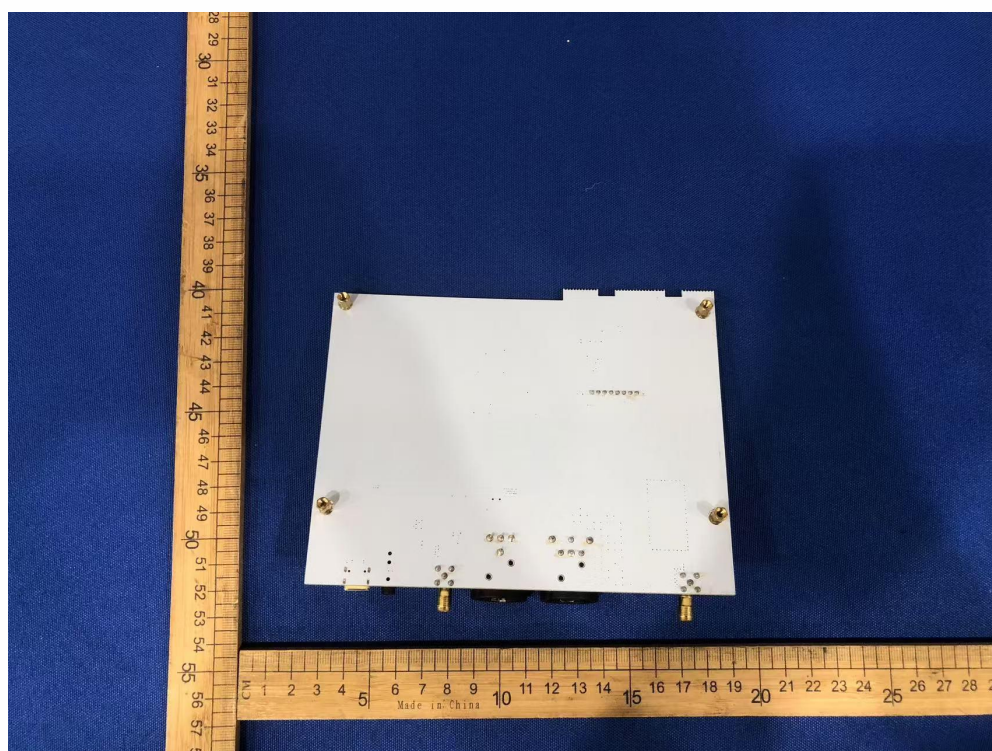


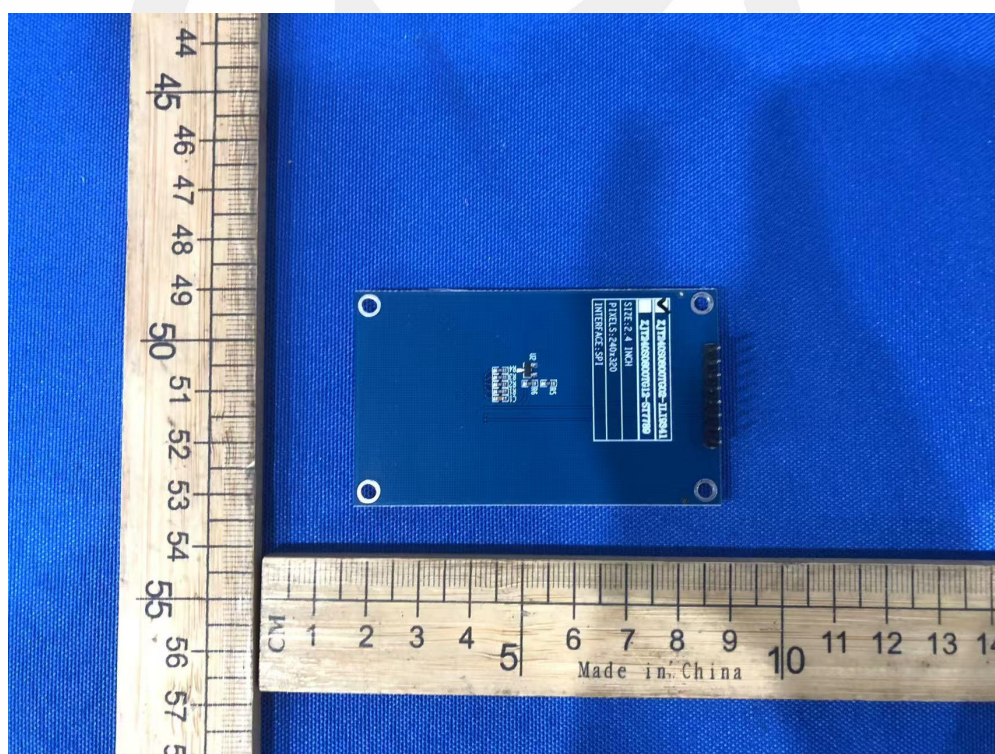
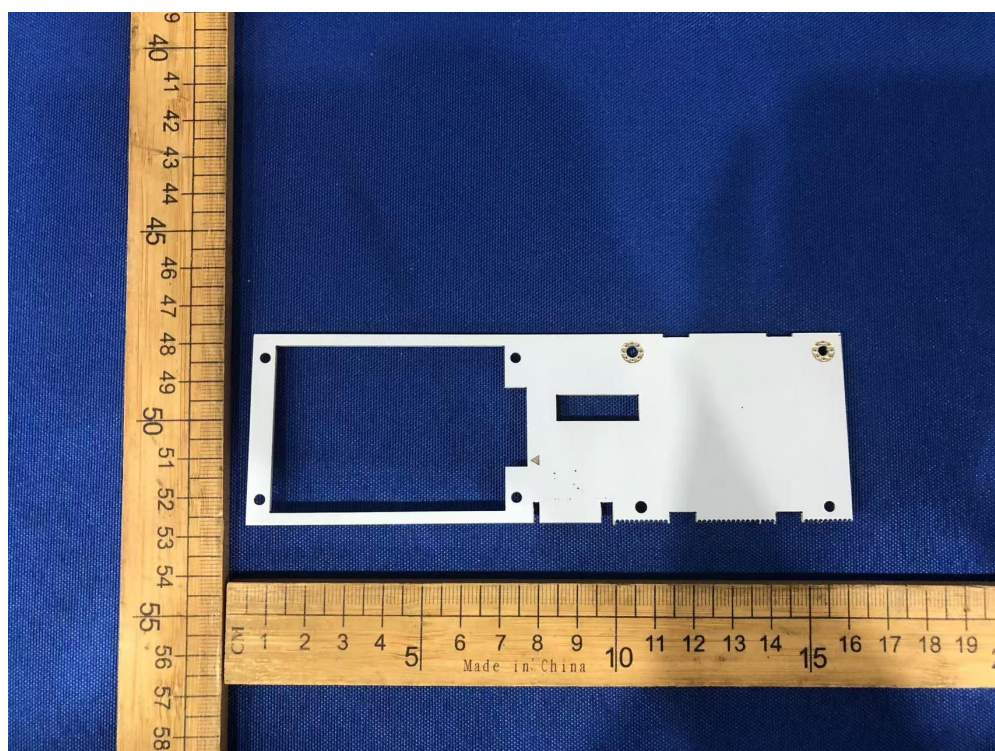


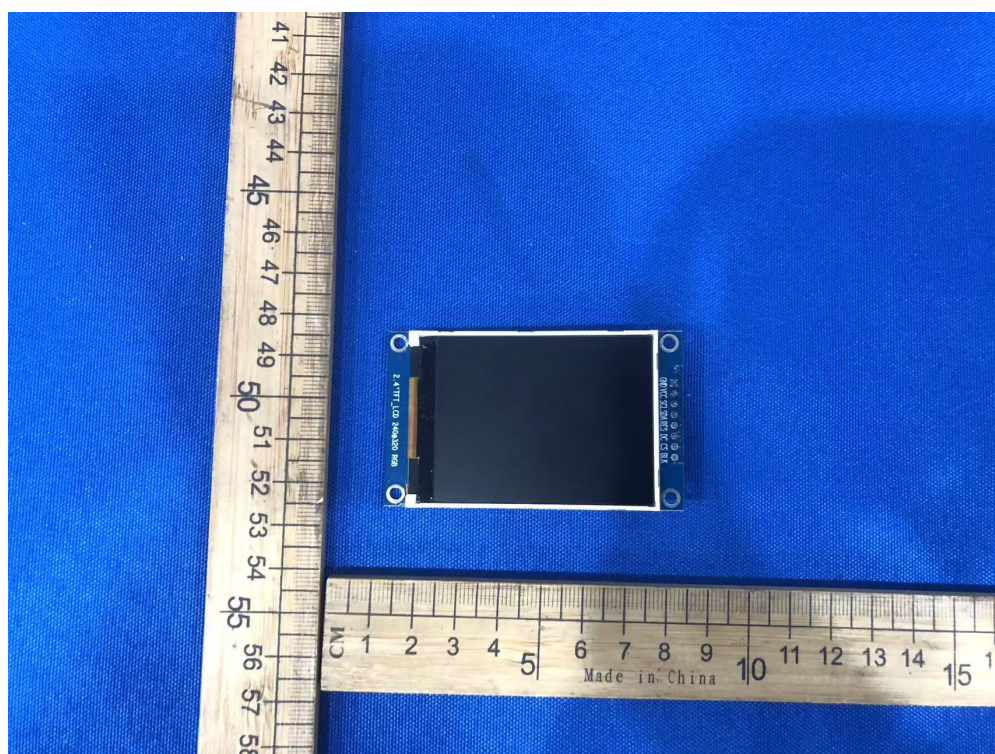












*** End of Report ***

声明 Statement

1. 本报告无授权批准人签字及“检验检测专用章”无效；

This report will be void without authorized signature or special seal for testing report.

2. 未经许可本报告不得部分复制；

This report shall not be copied partly without authorization.

3. 本报告的检测结果仅对送测样品有效，委托方对样品的代表性和资料的真实性负责；

The test results or observations are applicable only to tested sample. Client shall be responsible for representativeness of the sample and authenticity of the material.

4. 本检测报告中检测项目标注有特殊符号则该项目不在资质认定范围内，仅作为客户委托、科研、教学或内部质量控制等目的使用；

The observations or tests with special mark fall outside the scope of accreditation, and are only used for purpose of commission, research, training, internal quality control etc.

5. 本检测报告以实测值进行符合性判定，未考虑不确定度所带来的风险，本实验室不承担相关责任，特别约定、标准或规范中有明确规定的除外；

The test results or observations are provided in accordance with measured value, without taking risks caused by uncertainty into account. Without explicit stipulation in special agreements, standards or regulations, EMTEK shall not assume any responsibility.

6. 对本检测报告若有异议，请于收到报告之日起 20 日内提出；

Objections shall be raised within 20 days from the date receiving the report.