

Prüfbericht-Nr.: Test report no.:	CN24X43P 001	Auftrags-Nr.: Order no.:	180291372	Seite 1 von 33 Page 1 of 33
Kunden-Referenz-Nr.: Client reference no.:	N/A	Auftragsdatum: Order date:	2024.04.15	
Auftraggeber: Client:	Ningbo Deli tools Co., Ltd. No.128, Chezhan West Road, Huangtan Town, Ninghai County, Ningbo, 315000 Zhejiang P.R. China			
Prüfgegenstand: Test item:	Electric hammer			
Bezeichnung / Typ-Nr.: Identification / Type no.:	DL-DC26-E1, DL-DC26-E2, DL-DC28-E2, DL-DC28-E3			
Auftrags-Inhalt: Order content:	TÜV Rheinland – EMC Service			
Prüfgrundlage: Test specification:	EN IEC 55014-1:2021 EN IEC 55014-2:2021 EN 61000-3-3:2013+A1+A2 EN IEC 61000-3-2:2019+A1			
Wareneingangsdatum: Date of sample receipt:	2024.05.06			
Prüfmuster-Nr.: Test sample no.:	A003696599-007-008			
Prüfzeitraum: Testing period:	2024.05.23-2024.07.05			
Ort der Prüfung: Place of testing:	Refer to section 1.1			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland / CCIC (Ningbo) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:	genehmigt von: authorized by:			
Datum: Date: 2024.09.06				
Stellung / Position:	Shey Zheng/PE	Ausstelltdatum: Issue date: 2024.09.06		
Sonstiges / Other:	Refer to page 6 for further information.			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet				
* Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
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Anmerkungen

Remarks

- | | |
|---|--|
| 1 | <p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.</p> <p>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system.</i></p> <p><i>Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p> |
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| 3 | <p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p> |
| 4 | <p>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</p> <p><i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i></p> |

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TEST SUMMARY

5.1.1 HARMONICS ON AC MAINS

Result:

Pass

5.1.2 VOLTAGE CHANGES, VOLTAGE FLUCTUATIONS AND FLICKER ON AC MAINS

Result:

Pass

5.1.3 MAINS TERMINAL CONTINUOUS DISTURBANCE VOLTAGE

Result:

Pass

5.1.4 DISCONTINUOUS INTERFERENCE ON AC MAINS

Result:

N/A

5.2.1 DISTURBANCE POWER

Result:

Pass

5.2.2 RADIATED DISTURBANCE IN THE FREQUENCY RANGE FROM 30MHZ TO 1000MHZ

Result:

Pass

6.1.1 ELECTROSTATIC DISCHARGE

Result:

Pass

6.1.2 RADIO FREQUENCY ELECTROMAGNETIC FIELD

Result:

Pass

6.2.1 FAST TRANSIENTS ON AC POWER LINES

Result:

Pass

6.2.2 INJECTED CURRENT INTO AC POWER PORT

Result:

Pass

6.2.3 SURGES TO AC POWER PORT

Result:

Pass

6.2.4 VOLTAGE DIPS AND INTERRUPTIONS TO AC POWER PORT

Result:

Pass

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1 Test Sites

1.1 Test Facilities

Laboratory A: TÜV Rheinland /CCIC(Ningbo) Co., Ltd.

1st Floor, Building 11, Scholar Innovation Park, No.1188 Zhongguan Road, Zhenhai District, Ningbo 315200 P.R. China.

The used test equipment is in accordance with CISPR 16-1 series standards for measurement of radio interference.

1.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment of Laboratory

No.	Equipment	Model	Serial no.	Cal. due date
1.	EMI test receiver	ESR3	102331	2024.10.29
2.	LISN	ENV216	102250	2024.10.29
3.	EMI test receiver	ESR3	102362	2024.10.29
4.	Absorbing clamp	MDS-21	100857	2024.11.02
5.	Harmonic power supply	5001IX-CTS-400-413	1735A02292	2024.11.02
6.	Harmonics/voltage fluctuation Analyser	PACS-1	1736A00799	2024.11.02
7.	ESD generator	NX30.1	11744	2024.10.31
8.	CS immunity test	NSG 4070C-80	47606	2024.10.29
9.	CDN	CDN M016S	47812	2024.11.02
10.	Attenuator	ATN 6150	17032903	N/A
11.	EFT & Surge & Dips Immunity test system	IMU4000F-S-D-V	1574	2024.10.29

1.3 Measurement Uncertainty of Laboratory

Table 2: Measurement Uncertainty of Laboratory

Test Item	Expanded Measurement Uncertainty (k=2)
Conducted Emission (9-150kHz)	3.70dB
Conducted Emission (150k-30MHz)	3.30dB
Disturbance Power	4.27dB
Radiated Emission (30-1000MHz)	4.39dB
Radiated Emission (1-18GHz)	4.67dB
Radiated Emission (CDNE method)	4.05dB

2 General Product Information

2.1 Product Function and Intended Use

The EUT (equipment under test) is an ordinary Electric hammer for household and similar use. For the further information, refer to the user's manual.

2.2 Ratings and System Details

Rated voltage	: AC 220-240V	For all models
Frequency	: 50-60Hz	For all models
Rated power	: 800W	For DL-DC26-E1 and DL-DC26-E2
	1000W	For DL-DC28-E2 and DL-DC28-E3
Protection class	: II	For all models
Highest clock frequency F_x	: < 15 MHz	

Other aspects:

1. Models DL-DC26-E1 and DL-DC26-E2 are same as each other except for the model number. So did for models DL-DC28-E2 and DL-DC28-E3. Models DL-DC26-E1 and DL-DC28-E2 are same except for the motor and TPE covered area of handle.
2. Therefore, all EMC tests listed in the below table were performed.

Model	DV	DP	RE	Har	Flicker	ESD	RS	EFT	Surge	CS	Dips
DL-DC26-E1	√	√		√	√						
DL-DC28-E2	√	√		√	√	√		√	√	√	√

Refer to the user's manual for further information.

2.3 Independent Operation Modes

The basic operation modes are: "On" or "Off".
Refer to the user's manual for further information.

2.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit diagram.

2.5 Submitted Documents

Circuit diagram, labels and user's manual, etc.

3 Test Set-up and Operation Modes

3.1 Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test conditions were adapted accordingly in reference to the instructions for use.

Refer to the related paragraph of this report.

Immunity: The equipment under test (EUT) was configured to have its highest possible susceptibility against the tested phenomena. The test conditions were adapted accordingly in reference to the instructions for use.

Refer to the related paragraph of this report.

3.2 Physical Configuration for Testing

Refer to the related paragraph of this report.

3.3 Test Operation and Test Software

Refer to the related paragraph of this report. No software was used.

3.4 Special Accessories and Auxiliary Equipment

None.

3.5 Countermeasures to achieve EMC Compliance

The tested sample contained no noise suppression components as described in the circuit diagram. No special measure is employed to achieve the requirement.

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4 Conformity Decision Rule

For all EMI tests (when included in this report), as measurement uncertainties are less than the values U_{CISPR} given in CISPR 16-4-2, compliance with the limits is determined by comparing measurement results directly with corresponding limits without taking into consideration of measurement uncertainties. For all EMS tests (when included in this report), measurement uncertainties are not considered as well according to corresponding test standards.

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5 Test Results EMISSION

5.1 Emission in the Frequency Range up to 30 MHz

5.1.1 Harmonics on AC Mains

Result:	Pass
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Date of testing : 2024.07.05
Test procedure : EN IEC 61000-3-2:2019+A1
Test duration : 2.5min
Harmonic order : 2 – 40th
Frequency range : 0 – 2kHz
Test voltage : AC 230V, 50Hz
Ambient Condition : Temperature: 22 °C; Relative Humidity: 57%

The harmonics on AC Mains in the frequency from 0 to 2kHz were measured in accordance with EN IEC 61000-3-2:2019+A1.

The measurement was conducted with an automatic current harmonic analyzing system. This equipment is in compliance with the requirements of EN IEC 61000-3-2:2019+A1.

The results indicated in the following tables and figures were those measured and recorded by an automatic measuring system.

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Table 3: Harmonic currents measurement results for DL-DC26-E1

Test category: Class-B

Test Result: Pass

Source qualification: Normal

THC(A): 0.194

I-THD(%): 13.8

POHC(A): 0.002

POHC Limit(A): 0.377

Highest parameter values during test:

V_RMS (Volts): 229.51

Frequency(Hz): 50.00

I_Peak (Amps): 2.479

I_RMS (Amps): 1.425

I_Fund (Amps): 1.402

Crest Factor: 1.751

Power (Watts): 320.1

Power Factor: 0.986

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.620	N/A	0.002	2.430	N/A	Pass
3	0.190	3.450	5.5	0.196	5.175	3.8	Pass
4	0.001	0.645	N/A	0.001	0.968	N/A	Pass
5	0.039	1.710	2.3	0.041	2.565	1.6	Pass
6	0.001	0.450	N/A	0.001	0.675	N/A	Pass
7	0.001	1.155	N/A	0.001	1.733	N/A	Pass
8	0.001	0.345	N/A	0.001	0.518	N/A	Pass
9	0.002	0.600	N/A	0.002	0.900	N/A	Pass
10	0.000	0.276	N/A	0.001	0.414	N/A	Pass
11	0.001	0.495	N/A	0.001	0.743	N/A	Pass
12	0.000	0.230	N/A	0.001	0.345	N/A	Pass
13	0.001	0.315	N/A	0.001	0.473	N/A	Pass
14	0.000	0.197	N/A	0.001	0.295	N/A	Pass
15	0.001	0.225	N/A	0.001	0.338	N/A	Pass
16	0.001	0.173	N/A	0.001	0.260	N/A	Pass
17	0.001	0.199	N/A	0.001	0.299	N/A	Pass
18	0.001	0.153	N/A	0.003	0.230	N/A	Pass
19	0.000	0.178	N/A	0.001	0.267	N/A	Pass
20	0.001	0.138	N/A	0.003	0.207	N/A	Pass
21	0.000	0.161	N/A	0.001	0.241	N/A	Pass
22	0.000	0.125	N/A	0.001	0.188	N/A	Pass
23	0.000	0.147	N/A	0.001	0.221	N/A	Pass
24	0.001	0.115	N/A	0.003	0.173	N/A	Pass
25	0.000	0.135	N/A	0.002	0.203	N/A	Pass
26	0.001	0.106	N/A	0.004	0.159	N/A	Pass
27	0.001	0.125	N/A	0.003	0.188	N/A	Pass
28	0.002	0.099	N/A	0.006	0.149	N/A	Pass
29	0.001	0.116	N/A	0.001	0.174	N/A	Pass
30	0.001	0.092	N/A	0.002	0.138	N/A	Pass
31	0.001	0.110	N/A	0.001	0.164	N/A	Pass
32	0.002	0.086	N/A	0.002	0.129	N/A	Pass
33	0.001	0.102	N/A	0.001	0.153	N/A	Pass
34	0.001	0.081	N/A	0.001	0.122	N/A	Pass
35	0.000	0.096	N/A	0.001	0.144	N/A	Pass
36	0.000	0.077	N/A	0.001	0.116	N/A	Pass
37	0.000	0.092	N/A	0.001	0.137	N/A	Pass
38	0.000	0.073	N/A	0.001	0.110	N/A	Pass
39	0.000	0.087	N/A	0.001	0.131	N/A	Pass
40	0.000	0.069	N/A	0.000	0.104	N/A	Pass

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Table 4: Harmonic currents measurement results for DL-DC28-E2

Test category: Class-B

Test Result: Pass

Source qualification: Normal

THC(A): 0.447

I-THD(%): 22.3

POHC(A): 0.004

POHC Limit(A): 0.377

Highest parameter values during test:

V_RMS (Volts): 229.51

Frequency(Hz): 50.00

I_Peak (Amps): 3.916

I_RMS (Amps): 2.063

I_Fund (Amps): 2.005

Crest Factor: 1.903

Power (Watts): 455.6

Power Factor: 0.967

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.620	N/A	0.003	2.430	N/A	Pass
3	0.431	3.450	12.5	0.454	5.175	8.8	Pass
4	0.001	0.645	N/A	0.001	0.968	N/A	Pass
5	0.120	1.710	7.0	0.125	2.565	4.9	Pass
6	0.000	0.450	N/A	0.001	0.675	N/A	Pass
7	0.008	1.155	N/A	0.009	1.733	N/A	Pass
8	0.000	0.345	N/A	0.001	0.518	N/A	Pass
9	0.007	0.600	N/A	0.008	0.900	N/A	Pass
10	0.001	0.276	N/A	0.001	0.414	N/A	Pass
11	0.003	0.495	N/A	0.003	0.743	N/A	Pass
12	0.000	0.230	N/A	0.002	0.345	N/A	Pass
13	0.001	0.315	N/A	0.002	0.473	N/A	Pass
14	0.000	0.197	N/A	0.002	0.295	N/A	Pass
15	0.001	0.225	N/A	0.002	0.338	N/A	Pass
16	0.001	0.173	N/A	0.002	0.260	N/A	Pass
17	0.001	0.199	N/A	0.001	0.299	N/A	Pass
18	0.002	0.153	N/A	0.008	0.230	N/A	Pass
19	0.001	0.178	N/A	0.003	0.267	N/A	Pass
20	0.002	0.138	N/A	0.006	0.207	N/A	Pass
21	0.001	0.161	N/A	0.005	0.241	N/A	Pass
22	0.001	0.125	N/A	0.004	0.188	N/A	Pass
23	0.002	0.147	N/A	0.007	0.221	N/A	Pass
24	0.000	0.115	N/A	0.001	0.173	N/A	Pass
25	0.001	0.135	N/A	0.001	0.203	N/A	Pass
26	0.001	0.106	N/A	0.001	0.159	N/A	Pass
27	0.001	0.125	N/A	0.002	0.188	N/A	Pass
28	0.002	0.099	N/A	0.003	0.149	N/A	Pass
29	0.001	0.116	N/A	0.002	0.174	N/A	Pass
30	0.001	0.092	N/A	0.002	0.138	N/A	Pass
31	0.001	0.110	N/A	0.002	0.164	N/A	Pass
32	0.002	0.086	N/A	0.002	0.129	N/A	Pass
33	0.001	0.102	N/A	0.001	0.153	N/A	Pass
34	0.001	0.081	N/A	0.002	0.122	N/A	Pass
35	0.000	0.096	N/A	0.001	0.144	N/A	Pass
36	0.000	0.077	N/A	0.001	0.116	N/A	Pass
37	0.001	0.092	N/A	0.001	0.137	N/A	Pass
38	0.000	0.073	N/A	0.002	0.110	N/A	Pass
39	0.000	0.087	N/A	0.001	0.131	N/A	Pass
40	0.000	0.069	N/A	0.001	0.104	N/A	Pass

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5.1.2 Voltage changes, voltage fluctuations and flicker on AC mains

Result:

Pass

Date of testing : 2024.07.05
Test procedure : EN 61000-3-3:2013+A1+A2
Ambient Condition : Temperature: 20 °C; Relative Humidity: 57%

According to the characteristics of the sample, as specified by clause 5 of the basic standard, following limits apply:

- the value of $d(t)$ during a voltage change shall not exceed 3.3% for more than 500ms;
- the relative steady-state voltage change, d_c , shall not exceed 3.3%;
- the maximum relative voltage change d_{max} , shall not exceed 7%.

Following are the measurement results obtained via an automatic testing system.

Table 5: Voltage fluctuations and flicker measurement results for DL-DC26-E1

	d_c	$d_{max} (average)$	$d(t)$	P_{st}	P_{lt}
Limits	3.3%	7%	3.3%/500ms	N/A	N/A
Result	0.31%	2.97%	0ms	N/A	N/A

Table 6: Voltage fluctuations and flicker measurement results for DL-DC28-E2

	d_c	$d_{max} (average)$	$d(t)$	P_{st}	P_{lt}
Limits	3.3%	7%	3.3%/500ms	N/A	N/A
Result	0.48%	4.06%	20ms	N/A	N/A

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5.1.3 Mains Terminal Continuous Disturbance Voltage

Result:	Pass
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Date of testing : 2024.07.05
Test procedure : EN IEC 55014-1:2021 and CISPR 16-1 series standards
Frequency range : 0.15 – 30MHz
Kind of test site : EMC Shielded room
Ambient Condition : Temperature: 21 °C; Relative Humidity: 55%

Test Setup

Input Voltage : AC 230V, 50Hz
Operational mode : ON
Artificial hand : Applied
Earthing : through artificial hand to AMN. (as class II equipment)

The measurement setup was made according to EN IEC 55014-1:2021 in an EMC Shielded room.

The measurement equipment like test receiver, quasi-peak detector and Artificial Mains Network (AMN) are in compliance with CISPR 16-1 series standards. The tested object was operated under its rated voltage and its rated frequency. Prior to the measurements the test object operated about 15 minutes (warm-up) in order to stabilize its operating conditions and to ensure reliable measurement values.

Furthermore an internal calibration with the test receiver was conducted prior to each measurement.

The tested object was set-up on a wooden table. The EUT was set 0.8m away from the AMN. The EUT (Equipment under Test) was wrapped with artificial hand which was earthed through the Artificial Mains Network (AMN).

The Interference Voltage was determined according to clause 4.3.3 of EN IEC 55014-1:2021 while measuring the line and neutral conductor by turns.

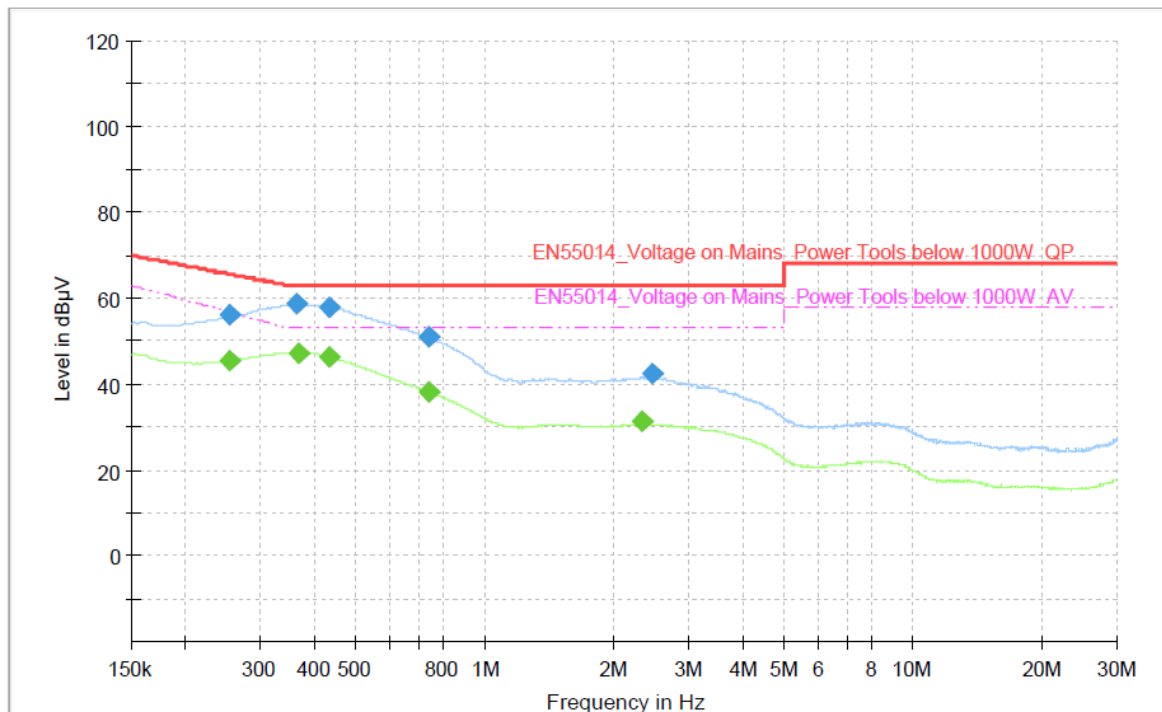
The following figures and tables were those measured by an automatic measuring system. Both Quasi Peak and Average Value were measured. Quasi-Peak and Average Value were measured and listed respectively where they had a maximum in previous scanning survey. In the Figures, the symbol “◆” with blue color means Quasi-Peak Value and the symbol “◆” with green color means Average Value which was measured in final measurement.

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Figure 1: Spectral Diagrams, Conducted Emission, 150kHz - 30MHz, L, DL-DC26-E1

Full Spectrum



Final Result

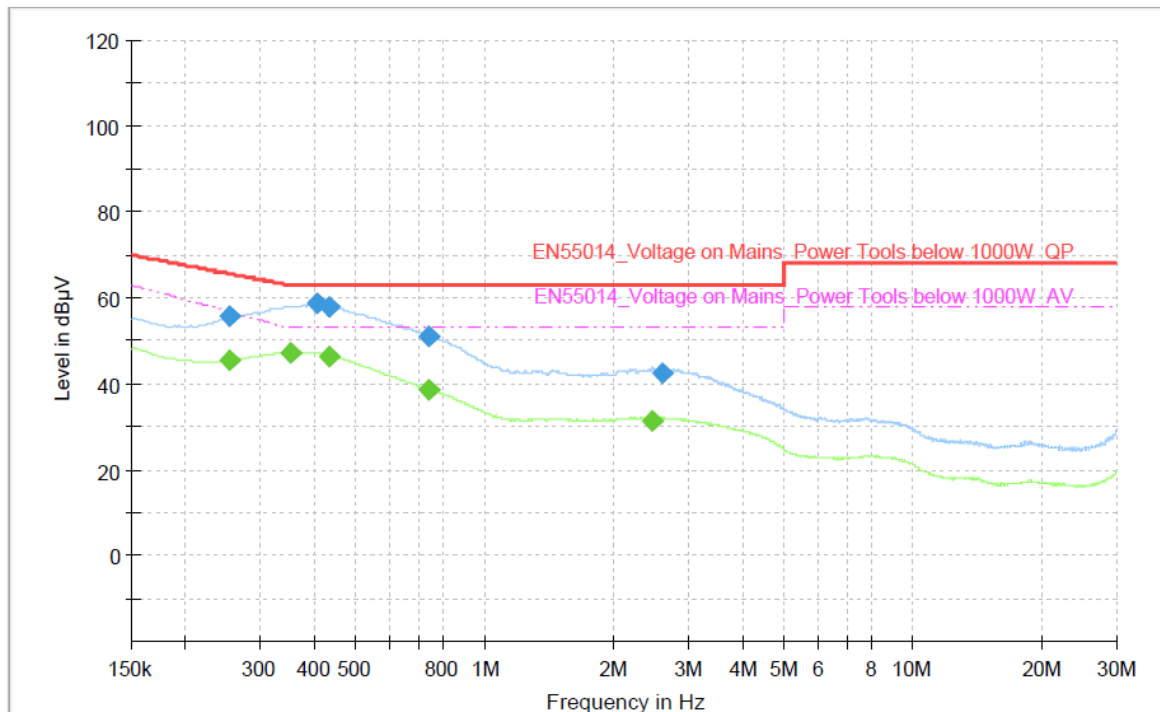
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.253500	---	45.69	56.81	11.12	1000.0	9.000	L1	ON	9.6
0.253500	56.18	---	65.67	9.49	1000.0	9.000	L1	ON	9.6
0.361500	58.62	---	63.00	4.38	1000.0	9.000	L1	ON	9.6
0.368250	---	47.43	53.00	5.57	1000.0	9.000	L1	ON	9.6
0.433500	57.74	---	63.00	5.26	1000.0	9.000	L1	ON	9.6
0.433500	---	46.46	53.00	6.54	1000.0	9.000	L1	ON	9.6
0.737250	51.04	---	63.00	11.96	1000.0	9.000	L1	ON	9.6
0.737250	---	38.27	53.00	14.73	1000.0	9.000	L1	ON	9.6
2.337000	---	31.38	53.00	21.62	1000.0	9.000	L1	ON	9.7
2.447250	42.66	---	63.00	20.34	1000.0	9.000	L1	ON	9.7

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Figure 2: Spectral Diagrams, Conducted Emission, 150kHz - 30MHz, N, DL-DC26-E1

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.253500	---	45.37	56.81	11.43	1000.0	9.000	N	ON	9.6
0.253500	55.94	---	65.67	9.72	1000.0	9.000	N	ON	9.6
0.352500	---	47.19	53.00	5.81	1000.0	9.000	N	ON	9.6
0.404250	58.73	---	63.00	4.27	1000.0	9.000	N	ON	9.6
0.433500	57.94	---	63.00	5.06	1000.0	9.000	N	ON	9.6
0.433500	---	46.45	53.00	6.55	1000.0	9.000	N	ON	9.6
0.737250	51.03	---	63.00	11.97	1000.0	9.000	N	ON	9.6
0.737250	---	38.58	53.00	14.42	1000.0	9.000	N	ON	9.6
2.460750	---	31.36	53.00	21.64	1000.0	9.000	N	ON	9.7
2.595750	42.44	---	63.00	20.56	1000.0	9.000	N	ON	9.7

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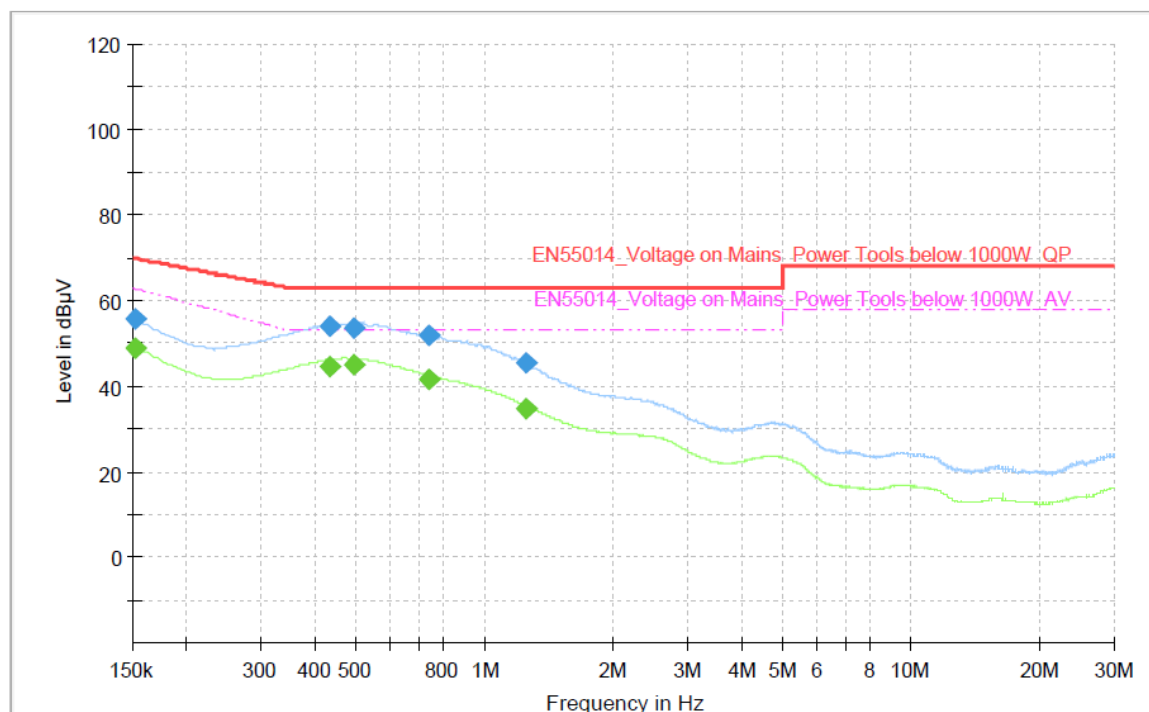
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Figure 3: Spectral Diagrams, Conducted Emission, 150kHz - 30MHz, L, DL-DC28-E2

Full Spectrum



Final Result

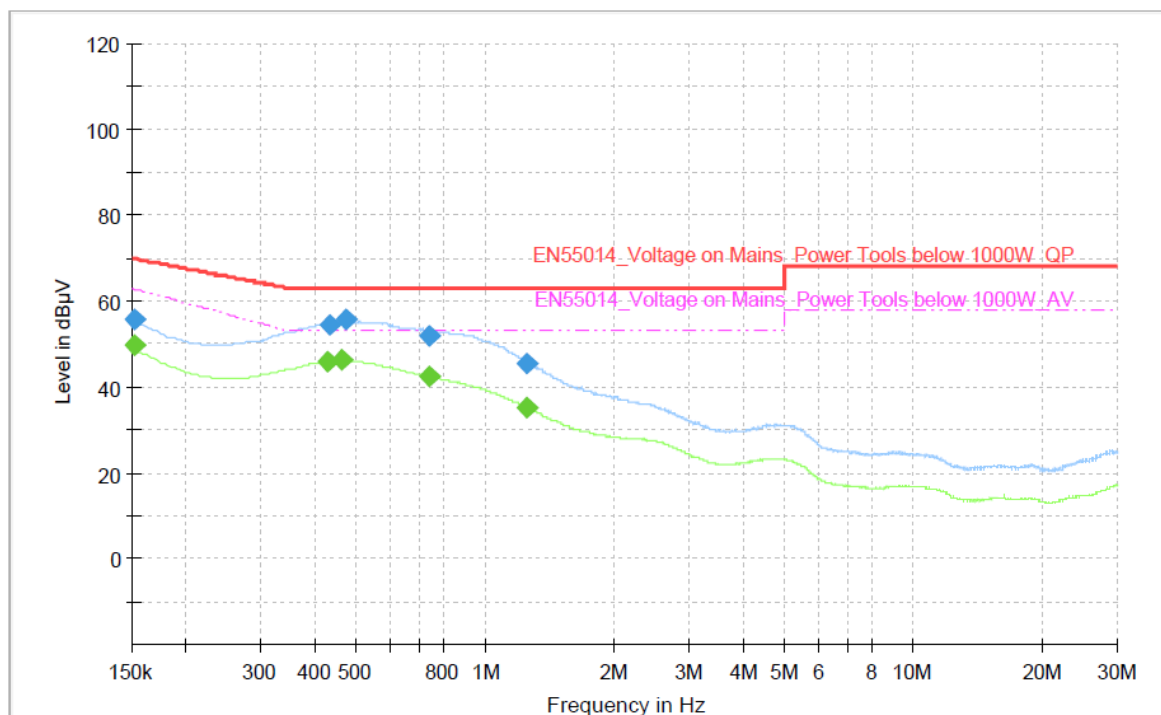
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.152250	---	48.99	62.82	13.83	1000.0	9.000	L1	ON	9.7
0.152250	55.66	---	69.88	14.22	1000.0	9.000	L1	ON	9.7
0.431250	---	44.66	53.00	8.34	1000.0	9.000	L1	ON	9.6
0.431250	54.06	---	63.00	8.94	1000.0	9.000	L1	ON	9.6
0.494250	53.85	---	63.00	9.15	1000.0	9.000	L1	ON	9.6
0.494250	---	45.25	53.00	7.75	1000.0	9.000	L1	ON	9.6
0.739500	---	41.77	53.00	11.23	1000.0	9.000	L1	ON	9.6
0.741750	52.00	---	63.00	11.00	1000.0	9.000	L1	ON	9.6
1.250250	---	34.74	53.00	18.26	1000.0	9.000	L1	ON	9.6
1.250250	45.55	---	63.00	17.45	1000.0	9.000	L1	ON	9.6

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Figure 4: Spectral Diagrams, Conducted Emission, 150kHz - 30MHz, N, DL-DC28-E2

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.152250	---	49.83	62.82	12.99	1000.0	9.000	N	ON	9.7
0.152250	55.77	---	69.88	14.11	1000.0	9.000	N	ON	9.7
0.429000	---	46.02	53.00	6.98	1000.0	9.000	N	ON	9.6
0.431250	54.70	---	63.00	8.30	1000.0	9.000	N	ON	9.6
0.462750	---	46.19	53.00	6.81	1000.0	9.000	N	ON	9.6
0.474000	55.73	---	63.00	7.27	1000.0	9.000	N	ON	9.6
0.737250	51.93	---	63.00	11.07	1000.0	9.000	N	ON	9.6
0.737250	---	42.49	53.00	10.51	1000.0	9.000	N	ON	9.6
1.250250	---	35.39	53.00	17.61	1000.0	9.000	N	ON	9.6
1.250250	45.42	---	63.00	17.58	1000.0	9.000	N	ON	9.6

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5.1.4 Discontinuous Interference on AC Mains

Result:	N/A
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5.2 Emission in the Frequency Range above 30 MHz

5.2.1 Disturbance Power

Result:	Pass
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Date of testing : 2024.05.23-2024.07.05
Port : Mains
Basic Standard : EN IEC 55014-1:2021
Frequency Range : 30 – 300MHz
Limit : EN IEC 55014-1:2021, clause 4.3.4.4, Table 7
Ambient Condition : Temperature: 17 °C; Relative Humidity: 56%

Test Setup

Input Voltage : AC 230V, 50Hz
Operational mode : ON
Earthing : No

Measuring configuration and description

The measurement setup was made according to EN IEC 55014-1:2021.

The measurement equipment like test receiver and absorption clamp are in compliance with CISPR 16-1 series standards. The test object has been operated by its rated voltage. Prior to the measurements the test objects operated about 10 minutes (warm-up) in order to stabilize their operating conditions and to ensure reliable measurement values.

Furthermore an internal calibration with the test receiver was conducted prior to each measurement.

Before measurement, a survey was made to determine in which state the maximum disturbance was obtained. And the measurement was made in the state the maximum disturbance was obtained.

The tested object was set-up on a wooden table.

The Disturbance Power was determined according to clause 4.3.4 of EN IEC 55014-1:2021. The length of power cord of EUT plus that of the extension cord was 6.0m.

The measurement was performed by operating the EUT in normal operation mode. The figures and tables below were those measured in the operation mode. Both Quasi Peak and Average Value were measured. In final measurement, by moving the absorption clamp along the power supply cord and the extension-power cord from the test object, Quasi-Peak and Average Value were measured and listed respectively where they had a maximum in previous scanning survey. In the Figures, the symbol “x” with red colour means Quasi-Peak Value and the symbol “+” with blue colour means Average Value which was measured in final measurement.

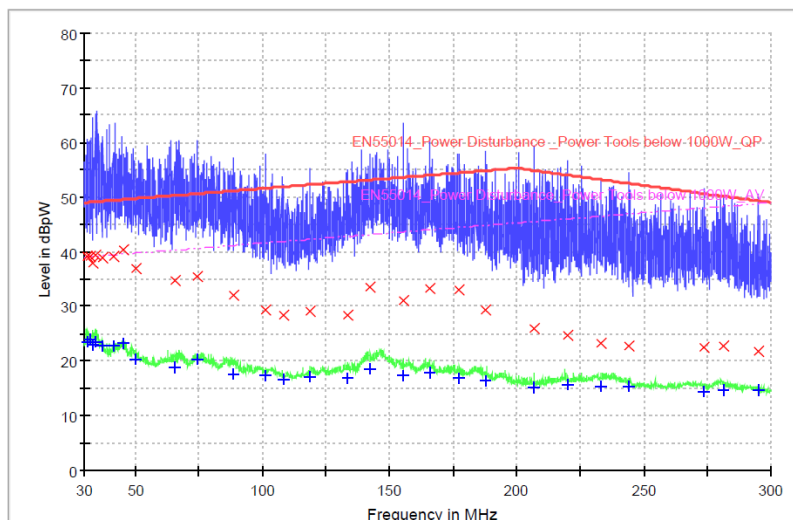
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Figure 5: Spectral Diagrams, Power Disturbance, Mains, 30–300MHz, DL-DC26-E1



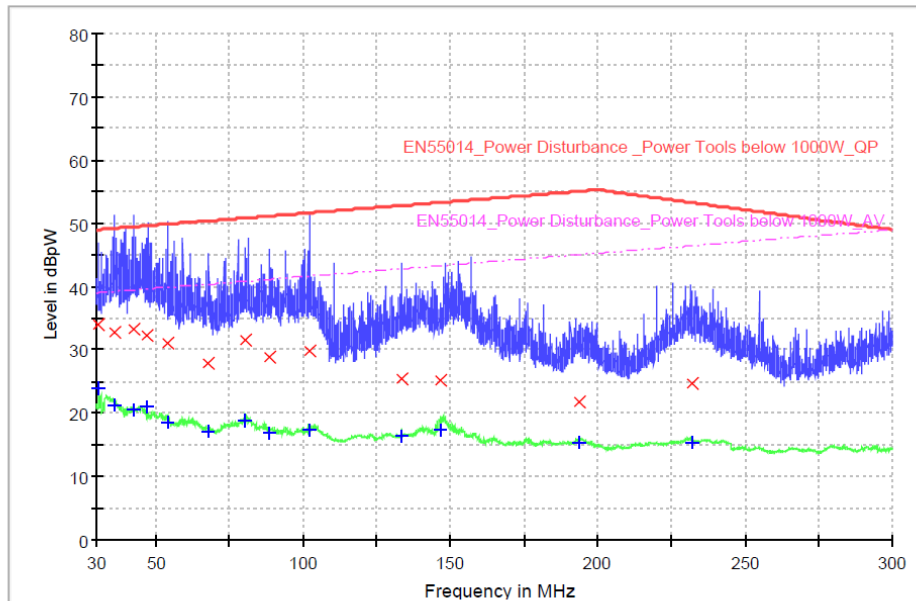
Limit and Margin-QP

Frequency (MHz)	QuasiPeak (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit - QPK (dBpW)
31.240000	39.2	1000.0	120.000	11.1	9.8	49.0
32.320000	39.1	1000.0	120.000	11.1	10.0	49.1
33.480000	37.9	1000.0	120.000	11.0	11.2	49.1
34.560000	39.5	1000.0	120.000	10.9	9.7	49.2
37.360000	39.0	1000.0	120.000	10.4	10.3	49.3
41.320000	39.2	1000.0	120.000	9.9	10.2	49.4
45.520000	40.3	1000.0	120.000	9.9	9.3	49.6
50.320000	37.0	1000.0	120.000	10.1	12.8	49.8
65.640000	34.8	1000.0	120.000	8.4	15.5	50.3
74.400000	35.5	1000.0	120.000	8.3	15.2	50.6
88.680000	32.0	1000.0	120.000	7.6	19.2	51.2
101.000000	29.5	1000.0	120.000	7.4	22.2	51.6
108.160000	28.3	1000.0	120.000	7.3	23.6	51.9
118.680000	29.1	1000.0	120.000	7.5	23.2	52.3
133.720000	28.5	1000.0	120.000	6.7	24.4	52.8
142.360000	33.5	1000.0	120.000	6.9	19.7	53.2
155.360000	31.0	1000.0	120.000	6.4	22.7	53.6
165.760000	33.2	1000.0	120.000	6.3	20.8	54.0
177.560000	32.9	1000.0	120.000	5.8	21.5	54.5
187.520000	29.3	1000.0	120.000	5.8	25.5	54.8
206.800000	25.8	1000.0	120.000	5.3	29.1	54.9
219.920000	24.7	1000.0	120.000	5.4	29.3	54.0
233.000000	23.2	1000.0	120.000	5.3	30.0	53.2
244.040000	22.7	1000.0	120.000	5.4	29.9	52.5
273.840000	22.4	1000.0	120.000	5.0	28.2	50.6
281.640000	22.7	1000.0	120.000	5.5	27.4	50.2
294.800000	21.7	1000.0	120.000	5.3	27.6	49.3

Limit and Margin-AV

Frequency (MHz)	Average (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBpW)
31.240000	23.5	1000.0	120.000	11.1	15.5	39.0
32.320000	24.0	1000.0	120.000	11.1	15.1	39.1
33.480000	22.9	1000.0	120.000	11.0	16.2	39.1
34.560000	23.5	1000.0	120.000	10.9	15.6	39.2
37.360000	22.9	1000.0	120.000	10.4	16.4	39.3
41.320000	22.6	1000.0	120.000	9.9	16.8	39.4
45.520000	23.3	1000.0	120.000	9.9	16.3	39.6
50.320000	20.4	1000.0	120.000	10.1	19.3	39.8
65.640000	18.7	1000.0	120.000	8.4	21.6	40.3
74.400000	20.3	1000.0	120.000	8.3	20.3	40.6
88.680000	17.7	1000.0	120.000	7.6	23.5	41.2
101.000000	17.3	1000.0	120.000	7.4	24.3	41.6
108.160000	16.7	1000.0	120.000	7.3	25.2	41.9
118.680000	17.2	1000.0	120.000	7.5	25.1	42.3
133.720000	16.9	1000.0	120.000	6.7	26.0	42.8
142.360000	18.6	1000.0	120.000	6.9	24.6	43.2
155.360000	17.4	1000.0	120.000	6.4	26.3	43.6
165.760000	17.8	1000.0	120.000	6.3	26.3	44.0
177.560000	17.0	1000.0	120.000	5.8	27.5	44.5
187.520000	16.5	1000.0	120.000	5.8	28.3	44.8
206.800000	15.1	1000.0	120.000	5.3	30.5	45.5
219.920000	15.6	1000.0	120.000	5.4	30.4	46.0
233.000000	15.4	1000.0	120.000	5.3	31.1	46.5
244.040000	15.5	1000.0	120.000	5.4	31.5	46.9
273.840000	14.4	1000.0	120.000	5.0	33.7	48.0
281.640000	14.8	1000.0	120.000	5.5	33.6	48.3
294.800000	14.6	1000.0	120.000	5.3	34.2	48.8

Figure 6: Spectral Diagrams, Power Disturbance, Mains, 30–300MHz, DL-DC28-E2



Limit and Margin-QP

Frequency (MHz)	QuasiPeak (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBpW)
30.640000	34.1	1000.0	120.000	11.2	14.9	49.0
36.080000	32.9	1000.0	120.000	10.7	16.3	49.2
42.800000	33.4	1000.0	120.000	9.9	16.1	49.5
47.200000	32.3	1000.0	120.000	10.0	17.4	49.6
54.320000	31.0	1000.0	120.000	8.9	18.9	49.9
67.800000	27.9	1000.0	120.000	8.2	22.5	50.4
80.440000	31.5	1000.0	120.000	8.7	19.4	50.9
88.600000	28.9	1000.0	120.000	7.6	22.2	51.2
102.320000	29.8	1000.0	120.000	7.4	21.9	51.7
133.680000	25.5	1000.0	120.000	6.7	27.4	52.8
146.720000	25.1	1000.0	120.000	6.6	28.2	53.3
193.600000	21.8	1000.0	120.000	5.9	33.3	55.1
232.160000	24.7	1000.0	120.000	5.3	28.6	53.3

Limit and Margin-AV

Frequency (MHz)	Average (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBpW)
30.640000	23.9	1000.0	120.000	11.2	15.2	39.0
36.080000	21.4	1000.0	120.000	10.7	17.9	39.2
42.800000	20.5	1000.0	120.000	9.9	18.9	39.5
47.200000	21.0	1000.0	120.000	10.0	18.6	39.6
54.320000	18.7	1000.0	120.000	8.9	21.2	39.9
67.800000	17.1	1000.0	120.000	8.2	23.3	40.4
80.440000	18.9	1000.0	120.000	8.7	22.0	40.9
88.600000	17.0	1000.0	120.000	7.6	24.2	41.2
102.320000	17.5	1000.0	120.000	7.4	24.2	41.7
133.680000	16.3	1000.0	120.000	6.7	26.6	42.8
146.720000	17.3	1000.0	120.000	6.6	26.0	43.3
193.600000	15.5	1000.0	120.000	5.9	29.5	45.1
232.160000	15.5	1000.0	120.000	5.3	31.0	46.5

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5.2.2 Radiated Disturbance in the Frequency Range from 30MHz to 1000MHz

Result:

Pass

Port : Enclosure
Basic Standard : EN IEC 55014-1:2021 and CISPR16-2-3
Frequency Range : 30 –1000MHz
Limit : EN IEC 55014-1:2021, clause 4.3.4.5, Table 9.

According to a) of clause 4.3.4.2 of EN IEC 55014-1:2021:

“The EUT shall be also deemed to comply with the requirement of this standard in the frequency range from 300 MHz to 1 000 MHz without further testing if both conditions 1) and 2) below are fulfilled:”

- 1): the disturbance power emission from the EUT is lower than the limits of Table 7 reduced by the values of Table 8;
- 2): the maximum clock frequency is less than 30 MHz

Because the EUT meets the two conditions mentioned above, the EUT is deemed to meet the radiated requirements without actual testing.

6 Test Results I M M U N I T Y

According to the electrical characteristics above and EN IEC 55014-2:2021, the EUT belongs to category II equipment.

“Category II: mains powered motor operated appliances, tools, heating appliances and similar electric apparatus (for example – UV radiators, IR radiators and microwave ovens) containing electronic control circuitry with no internal clock frequency or oscillator frequency higher than 15MHz.”

“Category III: equipment which in normal use, is not connected to a power network and has no cables attached.”

During the immunity tests, the EUT was operated under conditions specified by clause 3.1 of this report.

Performance criterion A: The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended.

Performance criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed.

Performance criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or by any operation specified in the instructions for use.

Date of testing: 2024.07.05

Room temperature	:	20°C
Relative humidity	:	57%
Atmospheric pressure	:	102.1 kPa

6.1 Enclosure

6.1.1 Electrostatic Discharge

Result:	Pass
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The immunity against electrostatic discharge was tested in accordance with EN IEC 55014-2:2021. Test setup and ESD-Generator are according to EN 61000-4-2 which is specified by EN IEC 55014-2:2021.

The EUT is placed on 0,1m wood table above the ground plane. And the minimum distance between the EUT and all other conductive structures except the ground plane beneath the EUT is more than 0,5m.

The reference ground plane is an aluminium sheet of 0.25mm minimum thickness. The reference ground plane is connected to the protective earth. The size of the ground plane is 2m × 2m.

A horizontal coupling plane (HCP), 1.6m × 0.8m, is placed on the table and isolated from the EUT and cables by an insulating support 0.5mm thick. Vertical coupling plane (VCP) of dimensions 0.5m × 0.5m is placed parallel to and positioned at a distance of 0.1m from the EUT.

Charge voltage : ±4.0kV (Contact Discharge), ±8.0kV (Air Discharge)
Polarity : positive / negative
Number of discharges : ≥10
Performance criteria : B

Table 7: ESD, Positive / Negative Polarity

Position	Kind of Discharge	Result	Remarks
Nonmetal Enclosure	Air discharge ±8kV	Pass	No disturbance of function
Button	Air discharge ±8kV	Pass	No disturbance of function
Metal Enclosure	Contact discharge ±4kV	Pass	No disturbance of function
Coupling plane (Both HCP and VCP)	Contact discharge ±4kV	Pass	No disturbance of function

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6.1.2 Radio Frequency Electromagnetic Field

Result:

Pass

The immunity against radio-frequency electromagnetic fields in the frequency range between 80MHz and 1000MHz was tested in accordance to EN 61000-4-3 which is specified by clause 5.5 in EN IEC 55014-2:2021.

The test was performed inside a 3m modified semi-anechoic chamber. During the test the part of the ground plane between the field generating antenna and the equipment under test was covered by absorbing material. The distance between the tip of the antenna and the side of the system tested is 3m. The field uniformity of the 1.5mx1.5m plane where the surface of the EUT tested coincides with is regularly calibrated to ensure the 0-6 dB field uniformity criterion as specified by EN 61000-4-3 is met.

Test Level : 3V/m
Frequency Range : 80-1000MHz
Modulation : 80%AM, 1kHz
Frequency Sweep Speed : ≤0.005 octave/s (1.5×1E-3 decades/s)
Performance Criteria : A

Table 8: Radiated Susceptibility, Field Strength 3V/m

Position	Observation	Result
Antenna in vertical orientation	No disturbance of function	Pass
Antenna in horizontal orientation	No disturbance of function	Pass

6.2 Input and Output AC Power Ports

6.2.1 Fast Transients on AC Power Lines

Result:

Pass

The immunity against fast transients on AC power lines was tested in accordance to EN IEC 55014-2:2021. Test setup and the fast transient noise generator are according to EN 61000-4-4 which is specified by EN IEC 55014-2:2021.

The EUT is placed on 0.1m wood table above the ground plane. And the minimum distance between the EUT and all other conductive structures except the ground reference plane is more than 0.5m.

The length between the coupling device and the EUT is less than 1m. The cord length more than 1m, the excess length of the cable shall gathered into a flat coil with a 0,4m diameter, and situated at a distance of 0,1m above the ground reference plane.

The reference ground plane is an aluminium sheet of 0.25mm minimum thickness. The reference ground plane is connected to the protective earth. The size of the ground plane is 2m × 2m.

Test Voltage	: 1kV
Polarity	: negative/positive
Repetition frequency	: 5kHz
Test duration	: ≥120sec
Tr/Tn	: 5ns/50ns
Performance criteria	: B

Table 9: Burst, AC Power lines, Positive and Negative Polarity

Coupling Method: Direct Injection		
Coupling Port	Test Voltage / Result	Remark
AC mains: L1 (L), L2 (N), --	±1000V Pass	No disturbance of function

6.2.2 Injected Current into AC Power Port

Result:

Pass

The immunity against injected current into AC power port was tested according to EN IEC 55014-2:2021 in a shielded room. The Test setup and the test generator are according to EN 61000-4-6 which is specified by EN IEC 55014-2:2021.

The EUT is placed on 0,1m wood table above the ground plane. And the minimum distance between the EUT and all other conductive structures except the reference ground plane is more than 0.5m.

The EUT comprised a single unit. The coupling and decoupling networks were inserted on the power supply connection. The coupling and decoupling networks was placed on the ground reference plane, making direct contact with it at about 0.1-0.3 meter from EUT. The cable between EUT and CDN is as short as possible and not bundled nor wrapped. The height of cable between the EUT and the coupling and decoupling networks above the ground reference plane was 50mm.

Voltage Level	: 3V(rms)(unmodulated)
Environmental phenomena	: r.f. current, common mode, 1kHz, 80%AM
Source impedance	: 150 Ω
Frequency range	: 0.15 - 230 MHz
Sweeping rate	: $\leq 1,5 \times 10^{-3}$ decades/s
Performance criteria	: A

Table 10: Injected current, AC Power Port

Coupling Port	Coupling Method:	Result	Remark
AC mains: L1 (L), L2 (N), --	CDN M-2	Pass	No disturbance of function

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6.2.3 Surges to AC Power Port

Result:

Pass

The immunity against surges to AC power port was tested in accordance to EN IEC 55014-2:2021. Test setup and the Combination Wave Generator (CWG) are according to EN 61000-4-5 which is specified by EN IEC 55014-2:2021.

Open-circuit Test Voltage : 1kV (phase to neutral)
 Tr/Tn : 1.2/50µs (open-circuit voltage)
 8/20µs (short-circuit current)
 Test numbers : 5 positive and 5 negative pulses
 Test angle : 90° and 270°
 Repetition rate : 1 surge/min
 Performance criteria : B

Table 11: Surges to AC Power lines, positive/negative

Line	Tested voltage/coupling phase	Result	Remarks
Phase to neutral	+1.0kV, $+\pi/2$ (5 times)	Pass	No disturbance of function
	-1.0kV, $-\pi/2$ (5 times)	Pass	No disturbance of function

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6.2.4 Voltage dips and interruptions to AC Power Port

Result:

Pass

The immunity against voltage dips and interruptions to AC power port was tested in accordance to EN IEC 55014-2:2021. Test setup and the test generator are according to EN 61000-4-11 which is specified by EN IEC 55014-2:2021. The EUT was placed directly on the table of aluminum.

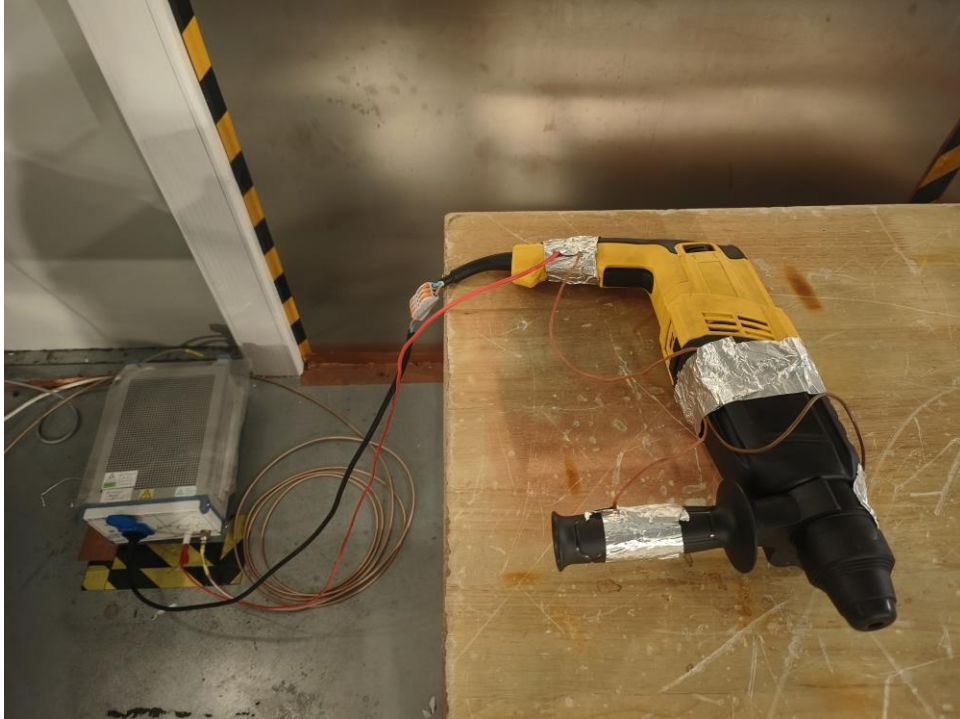
Performance criteria	:	C	
Test level (in % UT) and	:	0	0.5/0.5 periods(50/60Hz)
duration (in periods of the		40	10/12 periods(50/60Hz)
rated frequency)		70	25/30 periods(50/60Hz)

Table 12: Test condition and Test Result for Voltage dips and Short interruptions

Test level (in % UT)	Duration	Performance criteria	Result	Remarks
0	0.5/0.5	C	Pass	No disturbance of function
40	10/12	C	Pass	During the test, the speed of EUT was changed. After the disturbance ceased, it could be restored.
70	25/30	C	Pass	

7 Photographs of the Test Set-Up

Photograph 1: Set-up for Disturbance Voltage



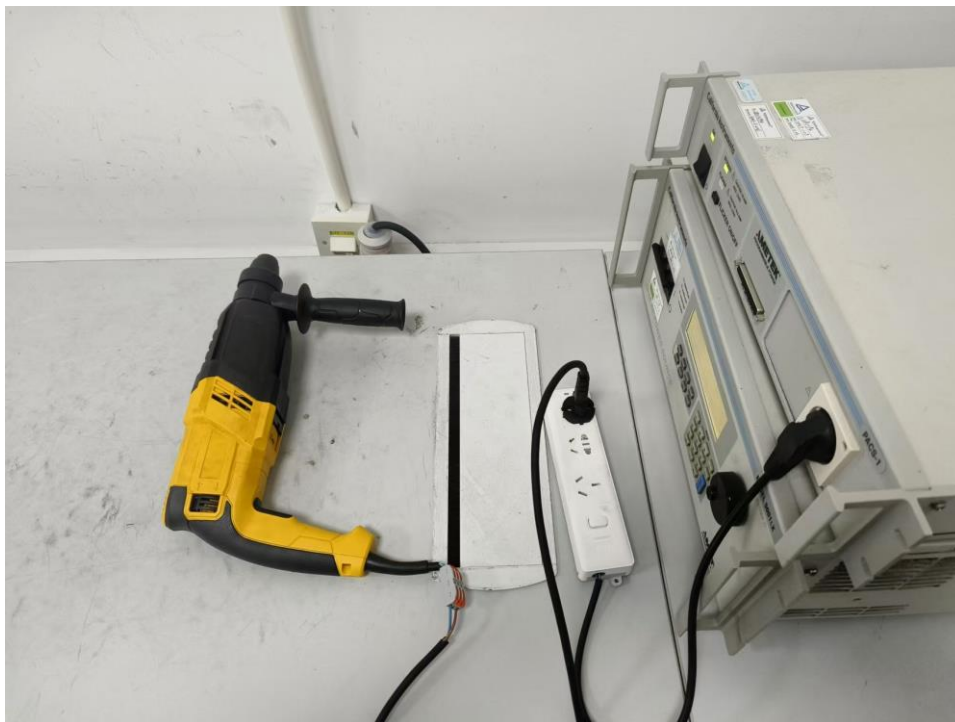
Photograph 2: Set-up for Disturbance Power



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Photograph 3: Set-up for Harmonic, Voltage Fluctuation and Flicker



Photograph 4: Set-up for ESD



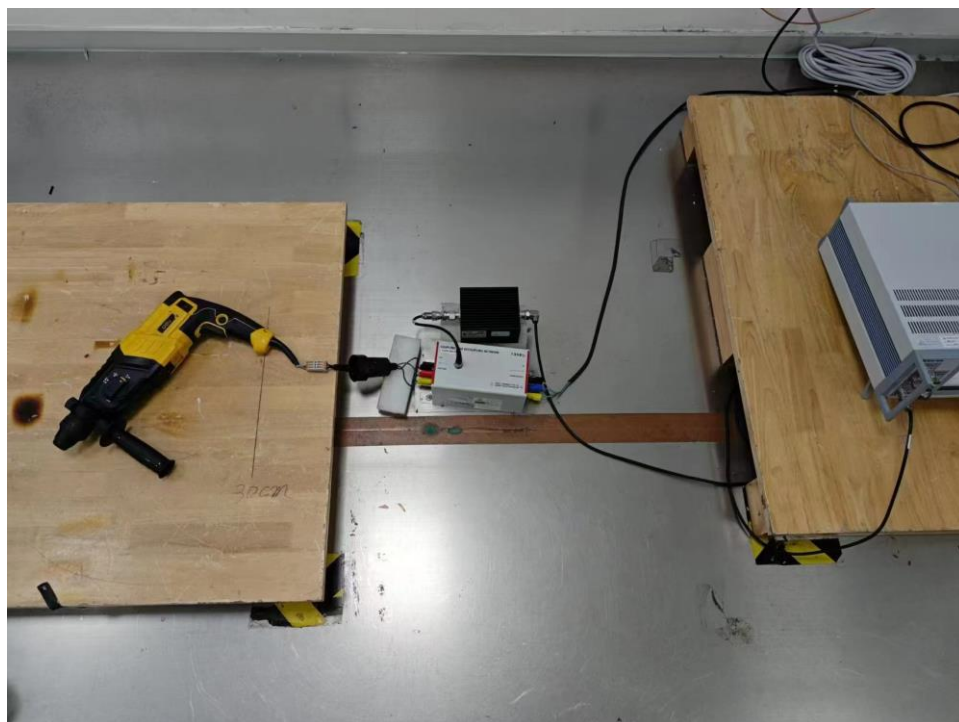
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Photograph 5: Set-up for Surge, EFT and Voltage Dips



Photograph 6: Set-up for Injected Current



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