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EMC Test report for Diamond Core Drill

**Models: DM2; CD2; CD21; CD50; CD501; DM21; DM50; DM501; DM2P;
DM21P; DM50P; DM501P**

Shanghai, date of issue: 2018-01-26

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DEKRA Testing and Certification (Shanghai) Ltd.

SH-F-PC4-005 v1.1

Document

CONTENTS

1	Conclusion	3
1.1	Model description	3
1.2	Environment.....	5
1.3	Classification.....	5
2	Summary	6
2.1	Applied standards	6
2.2	Overview of results	6
3	General Information	7
3.1	Product Information.....	7
3.2	Customer Information.....	7
3.3	Test data.....	8
3.4	Environmental conditions	8
3.5	Measurement Uncertainty	8
3.6	Equipment List	9
4	Emission test results	10
4.1	Mains conducted disturbance voltage	10
4.2	Disturbance Power.....	15
4.3	Harmonic currents.....	19
4.4	Voltage fluctuations (Flicker).....	21
5	Immunity test results	22
5.1	Electrostatic discharge immunity	22
5.2	Electrical Fast Transient immunity.....	23
5.3	Surge transient immunity	24
5.4	RF Conducted immunity.....	25
5.5	Power supply interruptions and dips.....	26
6	Identification of the equipment under test.....	27

1 CONCLUSION

The tests described in this report do not result in the right to use any approval mark as conferred by DEKRA. As far as the tests were based on certain specifications, these are mentioned in the report.

The conclusion and results stated in this test report are based on a non-recurrent examination of sample(s) provided by the applicant.

1.1 Model description

The apparatus as supplied for the test is a diamond core drill; models DM2; CD2; CD21; CD50; CD501; DM21; DM50; DM501; DM2P; DM21P; DM50P and DM501P intended for residential use. This product has electronic control circuit and earth connection.

According to the declaration from manufacturer, all models share the same construction and components except the types are different.

Due to the similarity of them, model DM2 was selected for the full tests and the corresponding data is representative for other models as well.



Figure 1 Overview



Figure 2 Overview

1.2 Environment

The requirements and standards apply to equipment intended for use in:

✓	Residential (domestic) environment
	Commercial and light-industrial environment
	Industrial environment
	Medical environment

1.3 Classification

The standard EN 55014-2 is subdivided in four categories. For each category, the specific immunity requirements are formulated.

	Category 1	Apparatus containing no electronic control circuitry
✓	Category 2	Apparatus containing electronic control circuitry with no internal clock or oscillator frequency higher than 15 MHz.
	Category 3	Battery powered apparatus containing electronic control circuitry.
	Category 4	All other apparatus.

2 SUMMARY

This chapter presents an overview of standards and results. Refer to the next chapters for details of measured test results and applied test levels.

2.1 Applied standards

Standard	Year	Title
EN 55014-1	2006	Emission – Electrical motor-operated and thermal appliances for household and similar purposes, electrical tools and similar electrical apparatus
A1	2009	
A2	2011	
EN 55014-1	2017	
EN 55014-2	2015	Immunity - Household appliances, electric tools and similar
EN 61000-3-2	2014	Limits for harmonic currents emissions
EN 61000-3-3	2013	Limitation of voltage fluctuations and flicker

2.2 Overview of results

Emission tests	Result
Mains conducted disturbance voltage	PASS
Disturbance Power	PASS
Harmonic current emission	PASS
Limitation of voltage fluctuations (flicker)	PASS

Immunity tests	Result
Electrostatic Discharges (ESD)	PASS
Electrical fast transient (EFT)	PASS
Surge transients	PASS
Conducted RF disturbances	PASS
Power supply voltage interruptions & dips	PASS

3 GENERAL INFORMATION

3.1 Product Information

Equipment under test	Diamond Core Drill
Trade mark	AGP
Tested Type	DM2
Representative types	CD2; CD21; CD50; CD501; DM21; DM50; DM501; DM2P; DM21P; DM50P; DM501P
Ratings	110-120 V; 50/60 Hz; 1800 W; $n_0=6500 \text{ min}^{-1}$; Class I 220-240 V; 50/60 Hz; 1800 W; $n_0=6500 \text{ min}^{-1}$; Class I

3.2 Customer Information

Applicant/Manufacturer	LEE YEONG INDUSTRIAL CO., LTD.
Address	No.2, Kejia Rd., Douliu City, Yunlin County 64057, Taiwan

Manufacturer	LEE YEONG INDUSTRIAL CO., LTD.
Address	No.2, Kejia Rd., Douliu City, Yunlin County 64057, Taiwan

Factory	LEE YEONG INDUSTRIAL CO., LTD.
Address	No.2, Kejia Rd., Douliu City, Yunlin County 64057, Taiwan

3.3 Test data

Location	DEKRA Testing and Certification (Shanghai) Ltd.
Address	3 F., No. 250, Jiangchangsan Road, Shanghai City, China
Date	Jan. 2018
Supervised by	Zuyao Fan

3.4 Environmental conditions

Tests have been performed in a controlled laboratory environment, where the environmental conditions are maintained within the applicable ranges.

Ambient temperature	15 °C – 35 °C
Relative Humidity air	30% - 60%

3.5 Measurement Uncertainty

Conducted Emission Expanded Uncertainty: $U = 3.22$ dB

Disturbance Power Expanded Uncertainty: $U = 2.38$ dB

3.6 Equipment List

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
EMI test receiver	R&S	ESCI	101351	2018-8-5
2-line V-network	R&S	ENV216	101620	2018-8-5
EMC Shielding room	Changzhou FeiTe	8 x 5 x 3 mm	Nil	2018-12-24
3-dimensional large loop antenna	SCHWARZBECK	HXYZ 9170	HXYZ9170-245	2018-8-5
Harmonic currents and flick tester	California Instruments	CTS	1306A00135	2018-5-18
AC power source	California Instruments	5001iX-CTS-400	1306A00135	2018-5-18
ESD generator	TESEQ	NSG 435	6716	2018-8-5
EFT, Surge, DIPS all-in-one	TESEQ	NSG-3040-MF	2006/EFT:0535 /SURGE:1234 /DIPS:2062	2018-8-5
Compact immunity test system (RF)	TESEQ	NSG 4070-30	35895	2018-8-5
Coupling decoupling network (CDN)	TESEQ	CDN M016S	34640	2018-8-5
Attenuator	TESEQ	ANT 6050	34847	2018-8-5

4 EMISSION TEST RESULTS

4.1 Mains conducted disturbance voltage

Standard	EN 55014-1 (Tools)					
Frequency [MHz]	QP [dB(μV)]			AV [dB(μV)]		
0,15 – 0,35	66	–	59 *)	59	–	49 *)
0,35 – 5	59			49		
5 – 30	64			54		

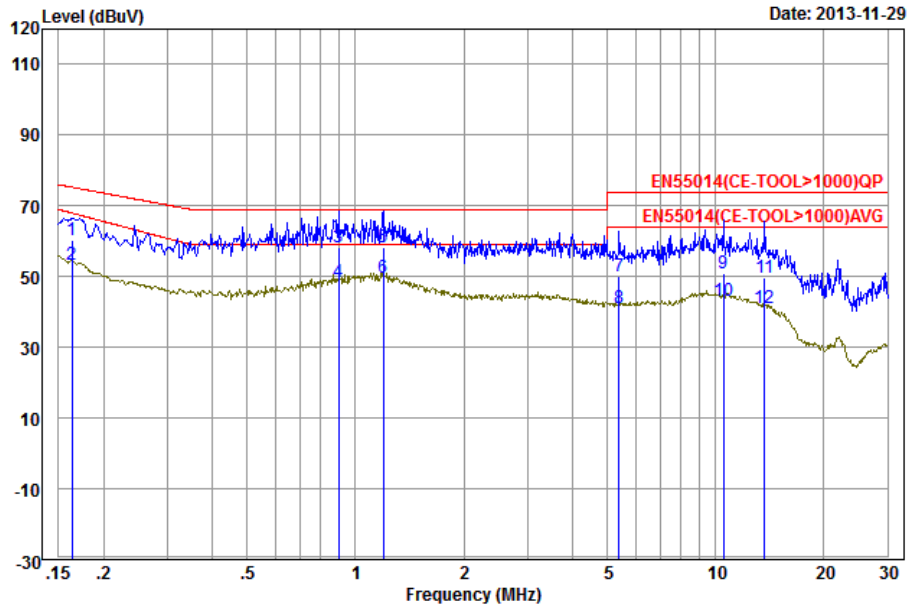
*) Limits decreasing linearly with the logarithm of the frequency

	Rated power below 700 W	Limits as above
	Rated motor power above 700 and not exceeding 1000 W	Limits +4 dB
✓	Rated power above 1000 W	Limits +10 dB

Port	AC mains
Test method	LISN
Mode	On mode with no load

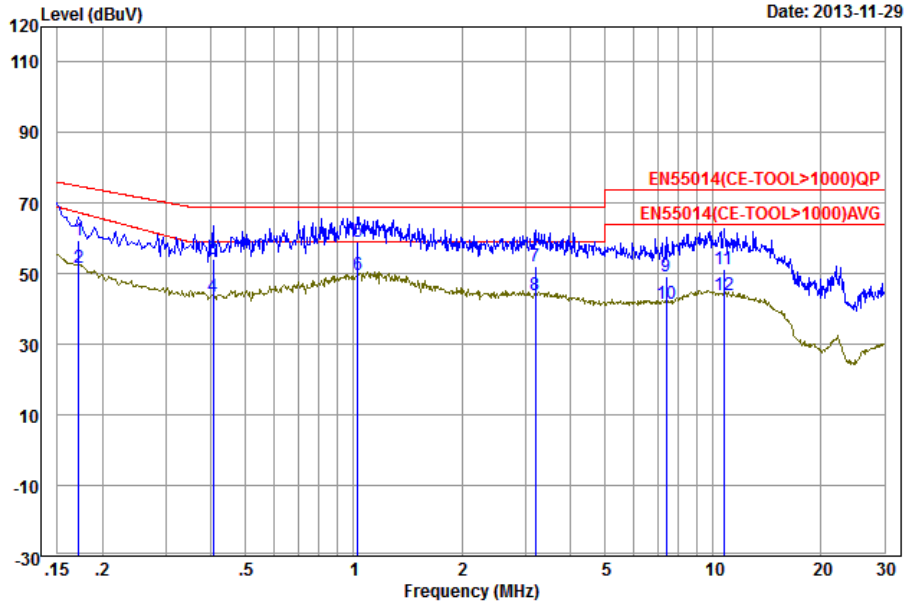
Results with 110-120 Vac

Line



	Freq	Limit	Level	Read	Cable	Over	Remark
	MHz	dBuV	dBuV	Level	Loss	Limit	
				Factor			
				dB	dB	dB	
1	0.16	75.30	60.53	49.71	10.82	1.16	-14.77 QP
2	0.16	68.00	53.39	42.57	10.82	1.16	-14.61 Average
3	0.90	69.00	58.11	47.17	10.94	1.30	-10.89 QP
4	0.90	59.00	48.46	37.52	10.94	1.30	-10.54 Average
5	1.20	69.00	58.48	47.51	10.97	1.33	-10.52 QP
6	1.20	59.00	49.84	38.87	10.97	1.33	-9.16 Average
7	5.39	74.00	49.95	38.98	10.97	1.31	-24.05 QP
8	5.39	64.00	41.04	30.07	10.97	1.31	-22.96 Average
9	10.51	74.00	51.09	39.97	11.12	1.44	-22.91 QP
10	10.51	64.00	43.27	32.15	11.12	1.44	-20.73 Average
11	13.70	74.00	49.83	38.50	11.33	1.63	-24.17 QP
12	13.70	64.00	41.12	29.79	11.33	1.63	-22.88 Average

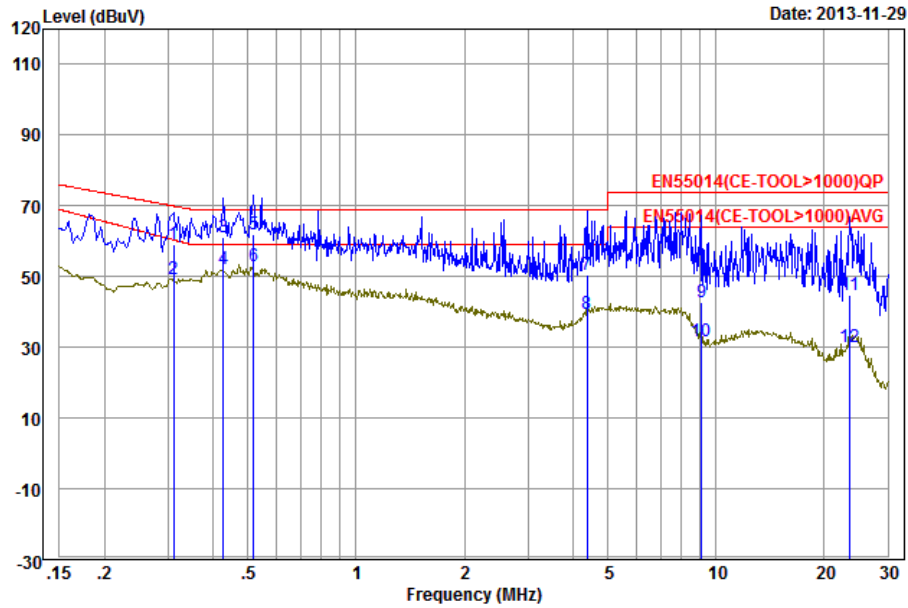
Neutral



	Freq	Limit Line	Level	Read Level	Cable Factor	Over Loss	Over Limit	Remark
	MHz	dBuV	dBuV	dBuV	dB	dB	dB	
1	0.17	74.86	59.55	48.71	10.84	1.15	-15.31	QP
2	0.17	67.37	51.87	41.03	10.84	1.15	-15.50	Average
3	0.41	69.00	54.09	43.36	10.73	1.10	-14.91	QP
4	0.41	59.00	43.71	32.98	10.73	1.10	-15.29	Average
5 qp	1.03	69.00	59.22	48.29	10.93	1.30	-9.78	QP
6 pp	1.03	59.00	49.55	38.62	10.93	1.30	-9.45	Average
7	3.21	69.00	52.30	41.29	11.01	1.35	-16.70	QP
8	3.21	59.00	44.16	33.15	11.01	1.35	-14.84	Average
9	7.41	74.00	49.38	38.34	11.04	1.36	-24.62	QP
10	7.41	64.00	41.43	30.39	11.04	1.36	-22.57	Average
11	10.73	74.00	51.31	40.13	11.18	1.45	-22.69	QP
12	10.73	64.00	43.98	32.80	11.18	1.45	-20.02	Average

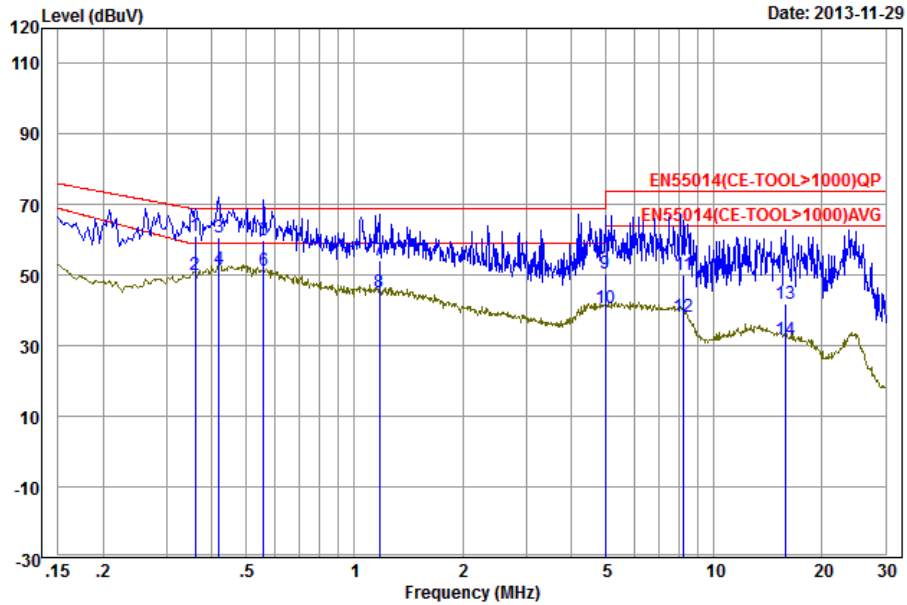
Results with 220-240 Vac

Line



	Freq	Limit Line	Level	Read Level	Factor	Cable Loss	Over Limit	Remark
	MHz	dBuV	dBuV	dBuV	dB	dB	dB	
1	0.31	69.96	59.07	48.39	10.68	1.10	-10.89	QP
2	0.31	60.37	49.34	38.66	10.68	1.10	-11.03	Average
3	0.43	69.00	61.16	50.47	10.69	1.10	-7.84	QP
4	0.43	59.00	52.05	41.36	10.69	1.10	-6.95	Average
5	0.52	69.00	62.05	51.33	10.72	1.12	-6.95	QP
6	0.52	59.00	52.82	42.10	10.72	1.12	-6.18	Average
7	4.38	69.00	50.63	39.66	10.97	1.31	-18.37	QP
8	4.38	59.00	39.55	28.58	10.97	1.31	-19.45	Average
9	9.11	74.00	42.65	31.58	11.07	1.39	-31.35	QP
10	9.11	64.00	31.66	20.59	11.07	1.39	-32.34	Average
11	23.51	74.00	44.72	34.84	9.88	0.18	-29.28	QP
12	23.51	64.00	30.12	20.24	9.88	0.18	-33.88	Average

Neutral



	Limit	Read	Cable	Over					
	Freq	Line	Level	Level	Factor	Loss	Limit		
	MHz	dBuV	dBuV	dBuV	dB	dB	dB		
1	qp	0.36	69.00	61.22	50.48	10.74	1.10	-7.78	QP
2		0.36	59.00	50.30	39.56	10.74	1.10	-8.70	Average
3		0.42	69.00	60.85	50.12	10.73	1.10	-8.15	QP
4	pp	0.42	59.00	51.59	40.86	10.73	1.10	-7.41	Average
5		0.56	69.00	59.88	49.10	10.78	1.16	-9.12	QP
6		0.56	59.00	51.38	40.60	10.78	1.16	-7.62	Average
7		1.17	69.00	54.13	43.18	10.95	1.32	-14.87	QP
8		1.17	59.00	45.17	34.22	10.95	1.32	-13.83	Average
9		4.98	69.00	50.42	39.45	10.97	1.30	-18.58	QP
10		4.98	59.00	40.91	29.94	10.97	1.30	-18.09	Average
11		8.24	74.00	50.21	39.15	11.06	1.37	-23.79	QP
12		8.24	64.00	38.28	27.22	11.06	1.37	-25.72	Average
13		15.89	74.00	41.76	30.27	11.49	1.74	-32.24	QP
14		15.89	64.00	31.58	20.09	11.49	1.74	-32.42	Average

Refer to chapter 6 for the test set-up.

Conclusion:

PASS

4.2 Disturbance Power

Standard	EN 55014-1	
Frequency [MHz]	QP [dB(pW)]	AV [dB(pW)]
30 – 300	45 – 55 *)	35 – 45 *)

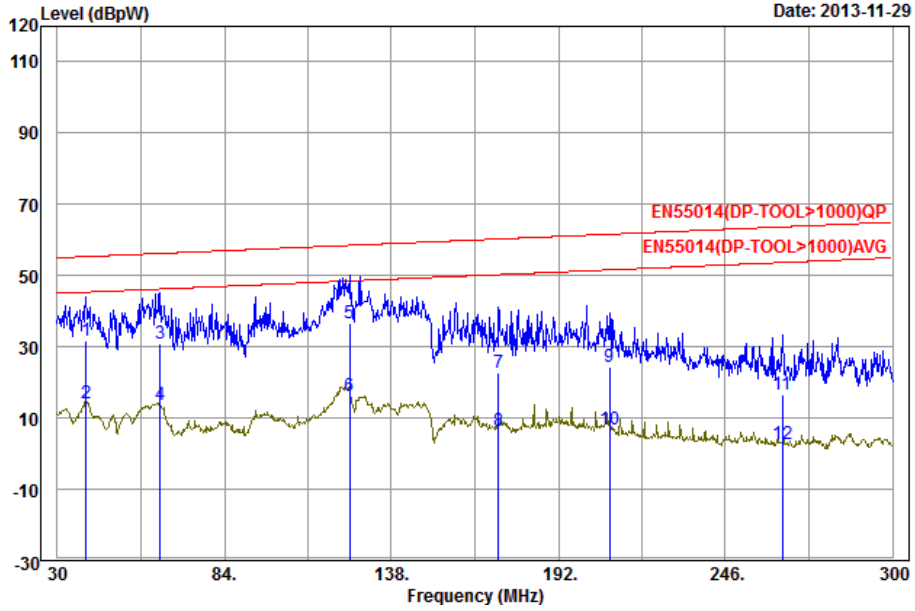
*) Limits increasing linearly with the frequency

For tools the following limits apply to the AC Mains port:

	Rated power below 700 W	Limits as above
	Rated motor power above 700 and not exceeding 1000 W	Limits +4 dB
✓	Rated power above 1000 W	Limits +10 dB

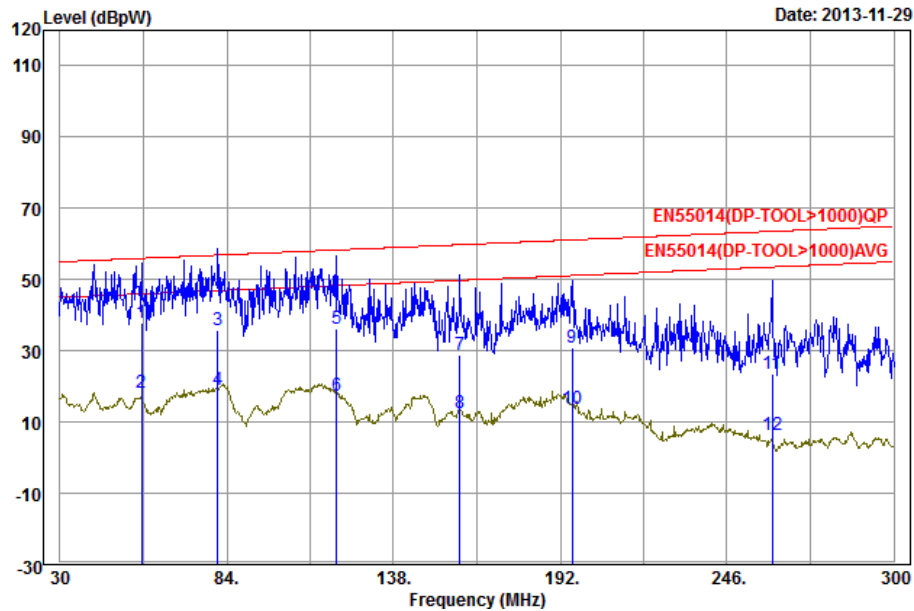
Port	AC Mains
Mode	On mode with no load

Results with 110-120 Vac



	Limit	Read	Cable	Over	Remark				
	Freq	Line	Level	Level	Factor	Loss	Limit		
	MHz	dBpW	dBpW	dBpW	dB	dB	dB		
1	39.18	55.35	31.83	11.06	20.77	1.23	-23.52	QP	
2	av	39.18	45.35	14.24	-6.53	20.77	1.23	-31.11	Average
3	63.21	56.24	30.93	12.17	18.76	1.33	-25.31	QP	
4	63.21	46.24	13.63	-5.13	18.76	1.33	-32.61	Average	
5	pp	124.50	58.51	36.75	18.62	18.13	1.60	-21.76	QP
6	124.50	48.51	16.23	-1.90	18.13	1.60	-32.28	Average	
7	172.56	60.29	22.81	4.33	18.48	1.90	-37.48	QP	
8	172.56	50.29	6.57	-11.91	18.48	1.90	-43.72	Average	
9	208.47	61.62	24.53	5.90	18.63	2.05	-37.09	QP	
10	208.47	51.62	6.81	-11.82	18.63	2.05	-44.81	Average	
11	264.36	63.69	16.61	-2.42	19.03	2.57	-47.08	QP	
12	264.36	53.69	2.65	-16.38	19.03	2.57	-51.04	Average	

Results with 220-240 Vac



		Limit	Read	Cable	Over				
	Freq	Line	Level	Level	Factor	Loss			
	MHz	dBpW	dBpW	dBpW	dB	dB			
1	pp	56.46	55.99	37.84	18.84	19.00	1.10	-18.15	QP
2	av	56.46	45.99	18.32	-0.68	19.00	1.10	-27.67	Average
3		81.03	56.90	35.86	17.11	18.75	1.43	-21.04	QP
4		81.03	46.90	18.95	0.20	18.75	1.43	-27.95	Average
5		119.64	58.33	36.23	18.28	17.95	1.42	-22.10	QP
6		119.64	48.33	17.25	-0.70	17.95	1.42	-31.08	Average
7		159.60	59.81	28.66	10.04	18.62	2.05	-31.15	QP
8		159.60	49.81	12.35	-6.27	18.62	2.05	-37.46	Average
9		195.78	61.15	31.08	12.25	18.83	2.23	-30.07	QP
10		195.78	51.15	13.85	-4.98	18.83	2.23	-37.30	Average
11		260.58	63.55	23.61	4.81	18.80	2.33	-39.94	QP
12		260.58	53.55	6.42	-12.38	18.80	2.33	-47.13	Average

Refer to chapter 6 for the test set-up.

According to clause 4.1.2.3.2 (EN 55014-1):

Appliances are deemed to comply in the frequency range from 300 MHz to 1 000 MHz if both of the following conditions (1) and 2)) are fulfilled:

- 1) all emission readings from the equipment under test shall be lower than the applicable limits (Table 2a) reduced by the margin (Table 2b);
- 2) the maximum clock frequency shall be less than 30 MHz.

Conclusion:

PASS

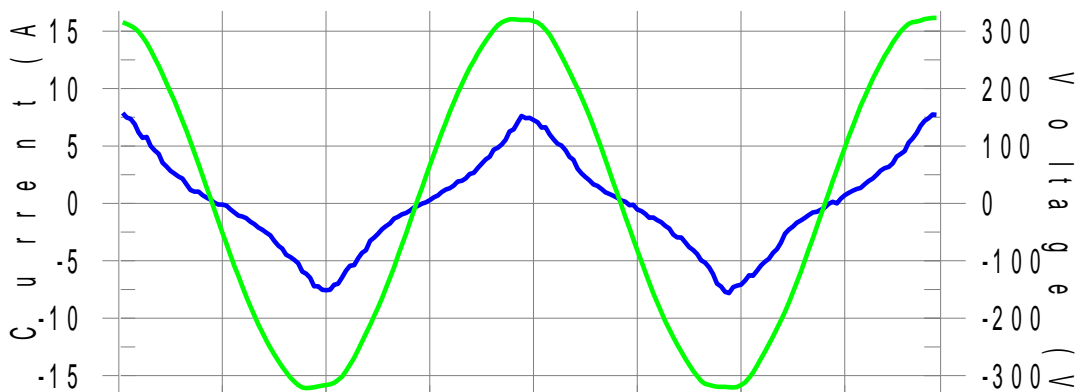
4.3 Harmonic currents

Standard	EN 61000-3-2
Port	AC Mains supply
Rated power	1800 W

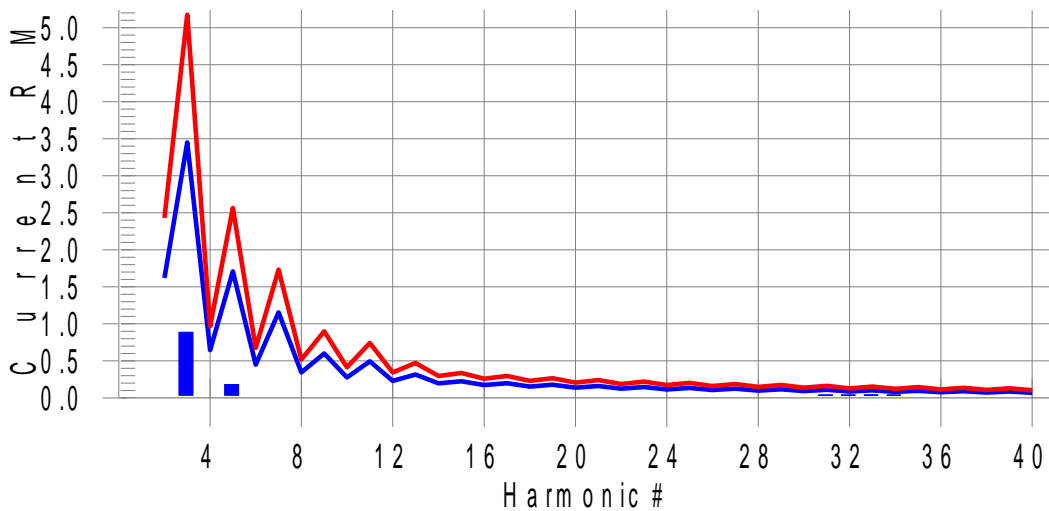
	Class A	All apparatus not classified as Class B, C or D
✓	Class B	Portable tools
	Class C	Lighting equipment
	Class D	Personal computers, television receivers

Results

Current & voltage waveforms



Harmonics and Class B limit line European Limits



Test Result: Pass Source qualification: Normal

THC(A): 0.79 I-THD(%): 21.95 POHC(A): 0.000 POHC Limit(A): 0.377

Highest parameter values during test:

V_RMS (Volts): 229.67	Frequency(Hz): 50.00
I_Peak (Amps): 8.068	I_RMS (Amps): 4.202
I_Fund (Amps): 3.926	Crest Factor: 1.942
Power (Watts): 894.5	Power Factor: 0.971

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.005	1.620	0.3	0.007	2.430	0.00	Pass
3	0.775	3.450	22.5	0.886	5.175	17.12	Pass
4	0.003	0.645	0.5	0.005	0.968	0.00	Pass
5	0.164	1.710	9.6	0.181	2.565	7.07	Pass
6	0.003	0.450	0.6	0.004	0.675	0.00	Pass
7	0.004	1.155	0.4	0.014	1.733	0.00	Pass
8	0.003	0.345	0.7	0.004	0.518	0.00	Pass
9	0.014	0.600	2.3	0.016	0.900	0.00	Pass
10	0.002	0.276	0.8	0.003	0.414	0.00	Pass
11	0.013	0.495	2.6	0.017	0.743	0.00	Pass
12	0.002	0.230	1.0	0.003	0.344	0.00	Pass
13	0.009	0.315	2.8	0.011	0.473	0.00	Pass
14	0.002	0.197	1.3	0.004	0.296	0.00	Pass
15	0.008	0.225	3.7	0.030	0.338	8.86	Pass
16	0.002	0.173	1.4	0.006	0.259	0.00	Pass
17	0.008	0.199	4.2	0.031	0.297	10.36	Pass
18	0.002	0.153	1.4	0.004	0.230	0.00	Pass
19	0.007	0.178	3.7	0.010	0.266	0.00	Pass
20	0.002	0.138	1.4	0.006	0.207	0.00	Pass
21	0.006	0.161	3.6	0.009	0.241	0.00	Pass
22	0.002	0.125	1.4	0.005	0.188	0.00	Pass
23	0.005	0.147	3.5	0.007	0.220	0.00	Pass
24	0.002	0.115	1.7	0.006	0.173	0.00	Pass
25	0.005	0.135	3.5	0.007	0.203	0.00	Pass
26	0.002	0.106	1.8	0.005	0.159	0.00	Pass
27	0.004	0.125	3.6	0.006	0.188	0.00	Pass
28	0.002	0.099	2.0	0.004	0.148	0.00	Pass
29	0.004	0.116	3.7	0.009	0.175	0.00	Pass
30	0.003	0.092	2.8	0.009	0.138	0.00	Pass
31	0.006	0.110	5.1	0.038	0.163	23.27	Pass
32	0.009	0.086	10.0	0.038	0.129	29.83	Pass
33	0.005	0.102	5.4	0.041	0.153	26.96	Pass
34	0.009	0.081	11.1	0.039	0.122	31.59	Pass
35	0.004	0.096	3.7	0.006	0.145	0.00	Pass
36	0.002	0.077	2.0	0.003	0.115	0.00	Pass
37	0.003	0.092	3.6	0.004	0.137	0.00	Pass
38	0.002	0.073	2.5	0.004	0.109	0.00	Pass
39	0.003	0.087	3.7	0.007	0.130	0.00	Pass
40	0.002	0.069	3.0	0.006	0.104	0.00	Pass

Conclusion:

PASS

4.4 Voltage fluctuations (Flicker)

Standard	EN 61000-3-3
Port	AC Mains supply
Voltage	230 V _{AC}
Mode	On mode

Equipment intended to be connected to 230/400 V_{AC} 50 Hz supply systems may not produce voltage fluctuations in the supply systems due to variation of the input current above the limits as stated below.

P _{ST}	Not applicable*
P _{LT}	Not applicable*
T _{max} (dt > 3,3%)	≤ 500 ms
d _C	≤ 3,3%
d _{MAX}	≤ 7%

Results

T _{max} (dt > 3,3%)	0,0 ms
Maximum voltage change d _{MAX}	0,943%
Relative Voltage change d _C	0,342%
Short term flicker P _{ST}	Not applicable*
Long term flicker P _{LT}	Not applicable*

In addition, this test was conducted in accordance with Annex B of EN 61000-3-3:2008.

* The EUT belongs to hand-held tools (portable tools without heating elements), according to EN 61000-3-3, clause A.9, P_{ST} and P_{LT} shall not be evaluated.

Conclusion:

PASS

5 IMMUNITY TEST RESULTS

5.1 Electrostatic discharge immunity

Electrostatic discharges (ESD) are the result of persons or objects that accumulate static electricity due to for instance walking on synthetic carpets. The ESD can influence the operation of equipment or damage its electronics, either by a direct discharge or indirectly by coupling or radiation. Both effects are simulated during the tests.

Requirements

Standard	EN 55014-2
Basic standard	EN 61000-4-2
Port	Enclosure
Performance criterion	B; During the test degradation is allowed. No change of operating state or stored data is allowed.
Air discharges	8 kV
Contact discharges	4 kV
Mode	On mode

Performed tests

Air discharges	✓	4 kV	✓	8 kV		15 kV		
Contact discharges	✓	2 kV	✓	4 kV		8 kV		
Via coupling planes	✓	Horizontal			✓	Vertical		
Polarity	✓	Positive			✓	Negative		
Set-up	✓	Table-top				Floor standing		
Ambient temperature	21 °C							
Relative Humidity air	48%							

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

Conclusion:

PASS

5.2 Electrical Fast Transient immunity

The EFT immunity test simulates disturbances by bursts of very short transients caused for example by switching off loads such as an AC motor or bouncing relay contacts. The transients are likely to disturb electronics but less likely to cause damage.

Requirements

Standard	EN 55014-2			
Basic standard	EN 61000-4-4			
Performance criterion	B; During the test degradation is allowed. No change of operating state or stored data is allowed.			
Pulse characteristics	5/50 ns			
Peak Voltage; Port	1 kV; AC input power port			
Repetition frequency	✓	5 kHz		2,5 kHz

Performed tests

Tested Voltage; Port	1 kV; AC input power port			
Mode	On mode			
Injection method	✓	CDN		Capacitive clamp
Polarity	✓	Positive	✓	Negative
Set-up	✓	Table-top		Floor standing

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

Conclusion:

PASS

5.3 Surge transient immunity

The surge transient immunity test simulates the surges that are caused by overvoltages due to indirect (induced) lightning transients. The pulse is a slow transient with high-energy contents and due to its long duration may cause damage to an unprotected EUT.

Requirements

Standard	EN 55014-2
Basic standard	EN 61000-4-5
Performance criterion	B; During the test degradation is allowed. No change of operating state or stored data is allowed.
Pulse characteristics	1,2/50 μ s
Peak Voltage; Port	1 kV; AC input power port (Line to line) 2 kV; AC input power port (Line to ground)

Performed tests

Tested Voltage; Port	1 kV; AC input power port (Line to line) 2 kV; AC input power port (Line to ground)			
Mode	On mode			
Polarity	<input checked="" type="checkbox"/>	Positive	<input checked="" type="checkbox"/>	Negative

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

Conclusion:

PASS

5.4 RF Conducted immunity

During this test the immunity of the equipment for induced or conducted electromagnetic fields is checked. Fields generated by radio and other transmitters cause RF voltages in long cables like the mains network. This test reproduces these induced disturbing voltages by injecting them to the EUT via the cabling.

Requirements

Standard	EN 55014-2
Basic standard	EN 61000-4-6
Performance criterion	A; Operation as intended
Frequency range	0,15 – 230 MHz
Modulation	1 kHz – 80% AM
Test level; Port	3 V; AC input power port

Performed tests

Tested level; Port	3 V; AC input power port		
Mode	On mode		
Frequency range	0,15 – 230 MHz		
Dwell time	3 seconds		
Injection method	✓	CDN-M3	EM clamp

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

Conclusion:

PASS

5.5 Power supply interruptions and dips

Requirements

Basic standard	EN 61000-4-11
Performance criterion	B; During the test degradation is allowed. No change of operating state or stored data is allowed. C; Temporary, self-recoverable loss of function is allowed.

Standard	EN 55014-2			
AC input power port			50 Hz	60 Hz
	C	$U_{NOM} - 30\%$	(25 periods)	(30 periods)
	C	$U_{NOM} - 60\%$	(10 periods)	(12 periods)
	C	$U_{NOM} - 100\%$	(0,5 period)	(0,5 period)

Performed tests

Tested voltage	AC input power port		
Mode	On mode		
AC input power port	50 Hz		60 Hz
	$U_{NOM} - 30\%$ (25 periods)		$U_{NOM} - 30\%$ (30 periods)
	$U_{NOM} - 60\%$ (10 periods)		$U_{NOM} - 60\%$ (12 periods)
	$U_{NOM} - 100\%$ (0,5 period)		$U_{NOM} - 100\%$ (0,5 period)

Observations

During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance was observed.

Conclusion:

PASS

6 IDENTIFICATION OF THE EQUIPMENT UNDER TEST

The photograph shows the tested device.



Figure 3 Conducted Emission test setup



Figure 4 Disturbance power test setup

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