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EMC Test report for Angle Grinder

Model: AG9

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By order of Lee Yeong Industrial Co., Ltd. at Yunlin County 64057, Taiwan

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DEKRA Testing and Certification (Shanghai) Ltd.
Document

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1 CONCLUSION

The equipment under test (EUT) does meet the essential requirements of the EMC Directive 2004/108/EC.

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 an angle grinder; model AG9 intended for residential use. This product has electronic control circuit but no earth connection.



Figure 1 Overview



Figure 2 Overview



Figure 3 Internal view

The operating modes as stated in the user manual are on and off modes.

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 with no internal clock higher than 15 MHz.
	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 55014-2	1997	Immunity - Household appliances, electric tools and similar
A1	2001	
A2	2008	
EN 61000-3-2	2006	Limits for harmonic currents emissions
A1	2009	
A2	2009	
EN 61000-3-3	2008	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	Angle Grinder
Trade mark	AGP
Tested Type	AG9
Ratings	220-240 V; 50-60 Hz; 2200 W; M14; Ø 230 mm; n=6500 min ⁻¹ ; Class II

3.2 Customer Information

Applicant/Manufacturer	Lee Yeong Industrial Co., Ltd.
Contact person	Ms. Diane Wu
Telephone	+886 5 551 8689
Telefax	+886 5 551 8635
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Contact person	Ms. Diane Wu
Telephone	+886 5 551 8689
Telefax	+886 5 551 8635
Address	No.2, Kejia Road, Douliu City, Yunlin County 64057, Taiwan

3.3 Test data

Location	Global Certification Corp.
Address	No.146, Sec. 2, Xiangzhang Rd., Xizhi Dist., New Taipei City 221, Taiwan
Date	Feb. 2012
Supervised by	Richie Tang

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%

Measurement Uncertainty

Conducted Emission Expanded Uncertainty: $U = 3.38$ dB

Disturbance Power Expanded Uncertainty: $U = 3.92$ dB

4 EMISSION TEST RESULTS

4.1 Mains conducted disturbance voltage

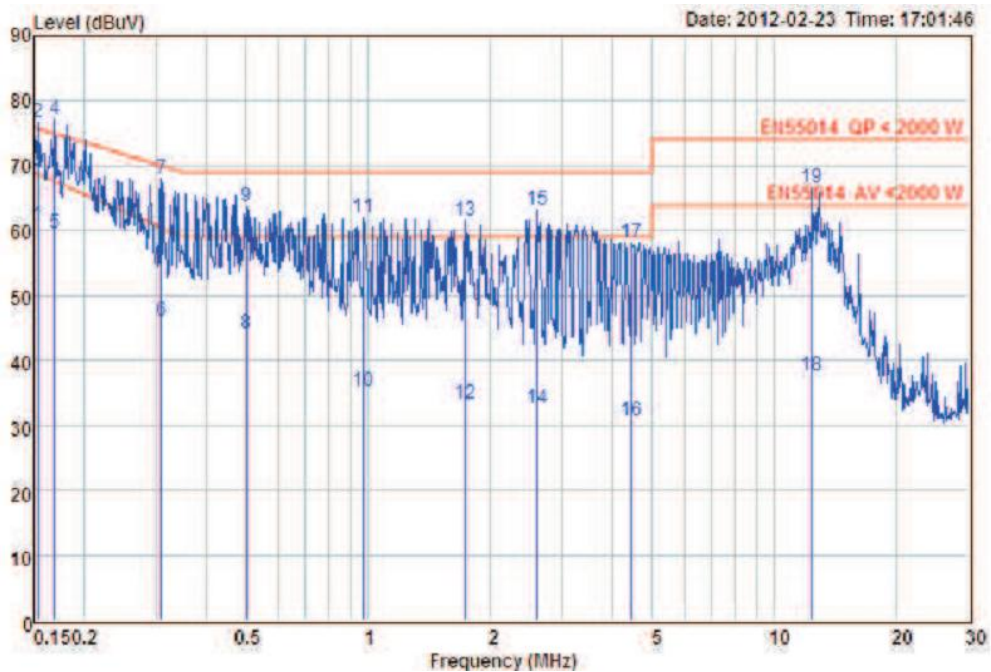
Standard	EN 55014-1 (Tools)	
Frequency [MHz]	QP [dB(μV)]	AV [dB(μV)]
0,15 – 0,35	66 – 59 *)	59 – 49 *)
0,35 – 5	59	49
5 – 30	64	54

*) Limits decreasing linearly with the logarithm of the frequency

	Rated motor power not exceeding 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

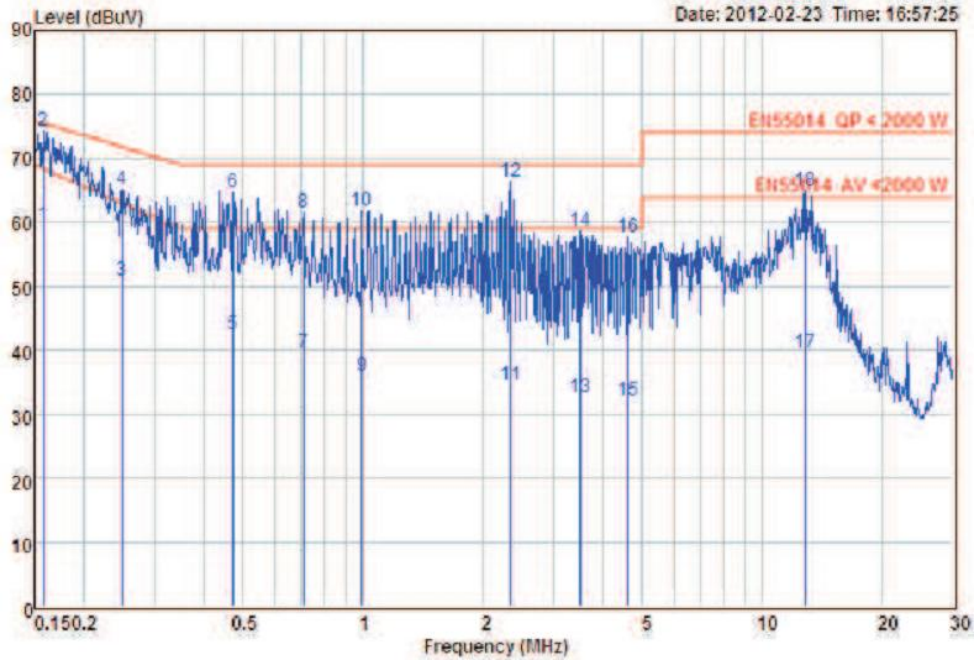
Port	AC mains
Test method	LISN
Mode	On mode with an artificial hand, no load

Line



	Read		Limit	Over			
	Freq	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.15	50.49	10.32	60.81	68.69	-7.88	Average
2 *	0.15	66.48	10.32	76.80	75.78	1.02	Peak
3	0.15	58.89	10.32	69.21	75.78	-6.57	QP
4 *	0.17	66.89	10.31	77.20	75.04	2.16	Peak
5	0.17	49.30	10.31	59.61	75.04	-15.43	QP
6	0.31	35.70	10.30	46.00	60.50	-14.50	Average
7	0.31	57.67	10.30	67.97	70.05	-2.08	Peak
8	0.50	33.80	10.31	44.11	59.00	-14.89	Average
9	0.50	53.32	10.31	63.63	69.00	-5.37	Peak
10	0.97	24.80	10.35	35.15	59.00	-23.85	Average
11	0.97	51.69	10.35	62.04	69.00	-6.96	Peak
12	1.73	22.90	10.42	33.32	59.00	-25.68	Average
13	1.73	51.12	10.42	61.54	69.00	-7.46	Peak
14	2.61	22.20	10.48	32.68	59.00	-26.32	Average
15	2.61	52.71	10.48	63.19	69.00	-5.81	Peak

Neutral



	Read		Limit	Over		
	Freq	Level	Factor	Level	Line	Limit Remark
	MHz	dBuV	dB	dBuV	dBuV	dB
1	0.16	49.30	10.28	59.58	68.37	-8.79 Average
2	0.16	64.15	10.28	74.43	75.56	-1.13 Peak
3	0.25	40.60	10.25	50.85	63.06	-12.21 Average
4	0.25	54.79	10.25	65.04	71.84	-6.80 Peak
5	0.47	32.29	10.26	42.55	59.00	-16.45 Average
6	0.47	54.47	10.26	64.73	69.00	-4.27 Peak
7	0.71	29.29	10.29	39.58	59.00	-19.42 Average
8	0.71	51.26	10.29	61.55	69.00	-7.45 Peak
9	0.99	25.60	10.31	35.91	59.00	-23.09 Average
10	0.99	51.58	10.31	61.89	69.00	-7.11 Peak
11	2.35	24.10	10.41	34.51	59.00	-24.49 Average
12	2.35	55.85	10.41	66.26	69.00	-2.74 Peak

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 *)

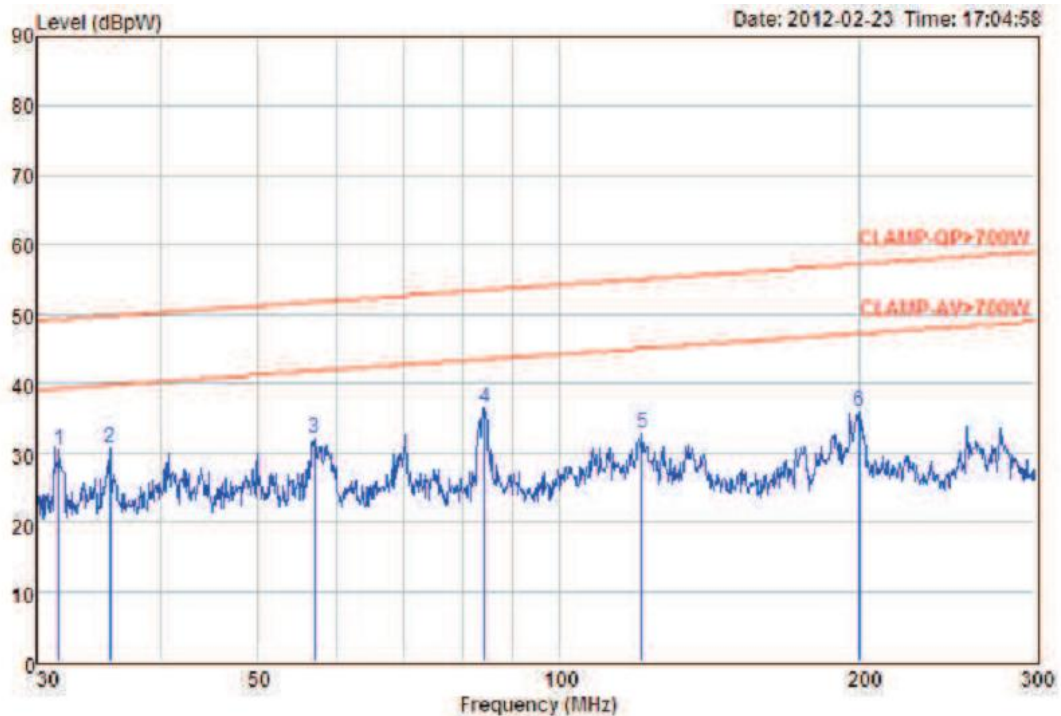
*) Limits increasing linearly with the frequency

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

	Rated motor power not exceeding 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



	Read		Limit	Over		
	Freq	Level	Factor	Level	Line	Limit Remark
	MHz	dBpW	dB	dBpW	dBpW	dB
1	31.56	29.87	0.62	30.49	49.23	-18.74 Peak
2	35.49	29.88	0.66	30.54	49.74	-19.20 Peak
3	56.90	31.19	0.87	32.06	51.79	-19.73 Peak
4	84.16	35.42	1.04	36.46	53.49	-17.03 Peak
5	121.09	31.53	1.40	32.93	55.07	-22.14 Peak
6	199.58	34.01	2.00	36.01	57.24	-21.23 Peak

No other significant emissions were measured at the frequency range of interest employing both the QP and AV detectors.

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	2200 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

Test completed, Result: PASSED

Order	Freq. [Hz]	Iavg [A]	Irms [A]	Irms% [%]	Irms%L [%]	Imax [A]	Imax%L [%]	Limit [A]	Status	Vrms [V]	Phase [deg]
1	60	3.0458	2.8723	86.635		3.4399				230.40	0.00
2	120	0.0672	0.0641	1.9330	5.9340	0.0793	7.3468	1.0800		0.2454	0.00
3	180	1.6625	1.5930	48.049	69.262	1.7841	77.568	2.3000		0.1227	0.00
4	240	0.0672	0.0671	2.0250	15.614	0.0720	16.749	0.4300		0.0982	0.00
5	300	0.5377	0.5334	16.090	46.794	0.5438	47.704	1.1400		0.1227	0.00
6	360	0.0385	0.0427	1.2887	14.242	0.0446	14.852	0.3000		0.0491	0.00
7	420	0.1412	0.1514	4.5655	19.658	0.1526	19.817	0.7700		0.0982	0.00
8	480	0.0000	0.0122	0.3682	5.3074	0.0140	6.1035	0.2300		0.0491	0.00
9	540	0.0172	0.0336	1.0125	8.3923	0.0354	8.8501	0.4000		0.0982	0.00
10	600	0.0000	0.0067	0.2025	3.6488	0.0183	9.9514	0.1840		0.0982	0.00
11	660	0.0450	0.0409	1.2334	12.392	0.0525	15.906	0.3300		0.0982	0.00
12	720	0.0000	0.0085	0.2577	5.5728	0.0146	9.5533	0.1533		0.0491	0.00
13	780	0.0379	0.0348	1.0493	16.567	0.0446	21.217	0.2100		0.0736	0.00
14	840	0.0000	0.0104	0.3130	7.8948	0.0128	9.7524	0.1314		0.0245	0.00
15	900	0.0313	0.0354	1.0677	23.600	0.0360	24.007	0.1500		0.0491	0.00
16	960	0.0000	0.0116	0.3498	10.084	0.0122	10.615	0.1150		0.0245	0.00
17	1020	0.0253	0.0256	0.7732	19.368	0.0275	20.752	0.1324		0.0736	0.00
18	1080	0.0000	0.0110	0.3314	10.747	0.0122	11.942	0.1022		0.0245	0.00
19	1140	0.0000	0.0079	0.2393	6.7003	0.0165	13.916	0.1184		0.0736	0.00
20	1200	0.0000	0.0067	0.2025	7.2977	0.0098	10.615	0.0920		0.0245	0.00
21	1260	0.0000	0.0122	0.3682	11.393	0.0122	11.393	0.1071		0.0491	0.00

22	1320	0.0000	0.0055	0.1657	6.5679	0.0092	10.947	0.0836	0.0491	0.00
23	1380	0.0000	0.0134	0.4050	13.726	0.0146	14.974	0.0978	0.0736	0.00
24	1440	0.0000	0.0055	0.1657	7.1650	0.0067	8.7572	0.0767	0.0245	0.00
25	1500	0.0000	0.0153	0.4602	16.954	0.0195	21.701	0.0900	0.0491	0.00
26	1560	0.0000	0.0061	0.1841	8.6245	0.0073	10.349	0.0708	0.0245	0.00
27	1620	0.0000	0.0146	0.4418	17.578	0.0153	18.311	0.0833	0.0491	0.00
28	1680	0.0000	0.0073	0.2209	11.146	0.0079	12.074	0.0657	0.0245	0.00
29	1740	0.0000	0.0092	0.2761	11.800	0.0098	12.587	0.0776	0.0245	0.00
30	1800	0.0000	0.0049	0.1473	7.9611	0.0079	12.937	0.0613	0.0491	0.00
31	1860	0.0000	0.0055	0.1657	7.5684	0.0104	14.296	0.0726	0.0491	0.00
32	1920	0.0000	0.0049	0.1473	8.4918	0.0073	12.738	0.0575	0.0245	0.00
33	1980	0.0000	0.0055	0.1657	8.0566	0.0067	9.8470	0.0682	0.0245	0.00
34	2040	0.0000	0.0061	0.1841	11.278	0.0061	11.278	0.0541	0.0245	0.00
35	2100	0.0000	0.0043	0.1289	6.6460	0.0061	9.4944	0.0643	0.0491	0.00
36	2160	0.0000	0.0037	0.1105	7.1650	0.0043	8.3592	0.0511	0.0245	0.00
37	2220	0.0000	0.0067	0.2025	11.041	0.0085	14.052	0.0608	0.0491	0.00
38	2280	0.0000	0.0031	0.0920	6.3025	0.0043	8.8236	0.0484	0.0245	0.00
39	2340	0.0000	0.0055	0.1657	9.5215	0.0073	12.695	0.0577	0.0245	0.00
40	2400	0.0000	0.0037	0.1105	7.9611	0.0043	9.2880	0.0460	0.0245	0.00

Urms = 230.5V Freq = 59.981 Range: 10 A
Irms = 3.315A Ipk = 7.437A cf = 2.243
P = 539.9W S = 764.2VA pf = 0.707
THDi = 50.8 % THDu = 0.20 %

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*
dt > 3,3%	≤ 500 ms
d _C	≤ 3,3%
d _{MAX}	≤ 7%

Results

Relative voltage change characteristic dt	0,0 ms
Maximum voltage change d _{MAX}	3,548%
Relative Voltage change d _C	0,836%
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.

* 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)

Performed tests

Tested Voltage; Port	1 kV; AC input power port (Line to line)		
Mode	On mode		
Polarity	✓	Positive	✓ 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-M2	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 4 Conducted Emission test setup



Figure 5 Disturbance power test setup



Figure 6 Harmonics & Flicker & Surge & DIPS test setup



Figure 7 ESD test setup



Figure 8 EFT test setup



Figure 9 RF Conducted immunity test setup

-----END-----