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EMC Test report for Vacuum Pump

Model: VP140

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By order of LEE YEONG Industrial Co., Ltd. at Tou Liu City, Yunlin County, Taiwan

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1 CONCLUSION

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

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 vacuum pump, model VP140 intended for residential use. The EUT has electronic control circuit and earth connection.



Figure 1 model VP140

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	
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
Radiated emission	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	Vacuum Pump
Trade mark	AGP
Tested Type	VP140
U nominal	110-120 Vac or 220-240 Vac; 50-60 Hz
P rated	200 W

3.2 Customer Information

Applicant/Manufacturer	LEE YEONG Industrial Co., Ltd.
Contact person	Mr. Larry Yang
Telephone	+886 5 5571 635
Telefax	+886 5 5571 716
Address	No.29 Fu Hsien Rd., Tou Liu City, Yunlin County, Taiwan

Factory	LEE YEONG Industrial Co., Ltd.
Contact person	Mr. Larry Yang
Telephone	+886 5 5571 635
Telefax	+886 5 5571 716
Address	No.29 Fu Hsien Rd., Tou Liu City, Yunlin County, Taiwan

3.3 Test data

Location	Global Certification Corp.
Address	No.146, Sec. 2, Xiangzhang Rd., Xizhi Dist., New Taipei City 221, Taiwan
Date	Sep. 2011
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%

4 EMISSION TEST RESULTS

4.1 Mains conducted disturbance voltage

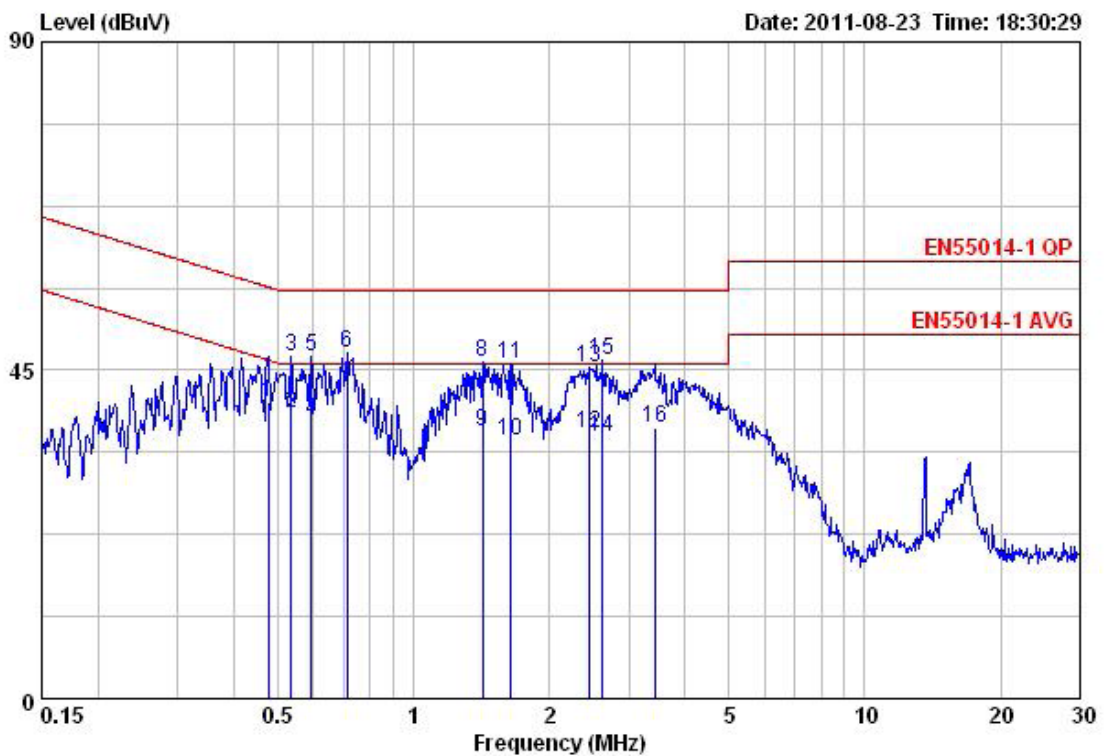
Standard	EN 55014-1					
Frequency [MHz]	QP [dB(μV)]			AV [dB(μV)]		
0,15 – 0,50	66	–	56 *)	59	–	46 *)
0,50 – 5	56			46		
5 – 30	60			50		

*) Limits decreasing linearly with the logarithm of the frequency

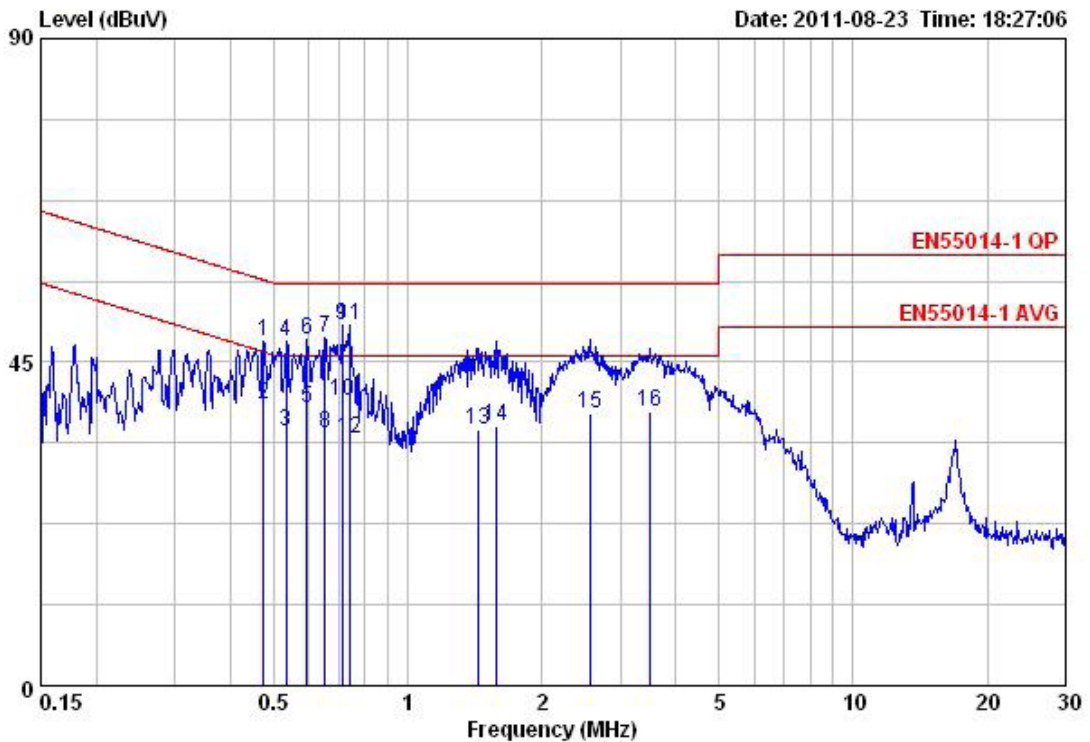
Port	AC mains
Test method	LISN
Mode	On mode

Results

Line



Neutral



Frequency [MHz]	QP [dB(μV)]		AV [dB(μV)]	
	Level	Limit	Level	Limit
0,470	47,77	56,45	39,08	46,45
0,590	48,12	56,00	38,49	46,00
0,650	48,49	56,00	35,11	46,00
0,710	50,05	56,00	39,51	46,00
1,430	46,04	56,00	36,68	46,00
2,450	45,41	56,00	36,23	46,00
2,620	46,41	56,00	35,85	46,00

"QP" and "AV" are levels and limits referring to measurements with the quasi-peak and average detector. If the measured level "QP" does not exceed the limit for "AV", then no average measurement is necessary.

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.

Conclusion:

PASS

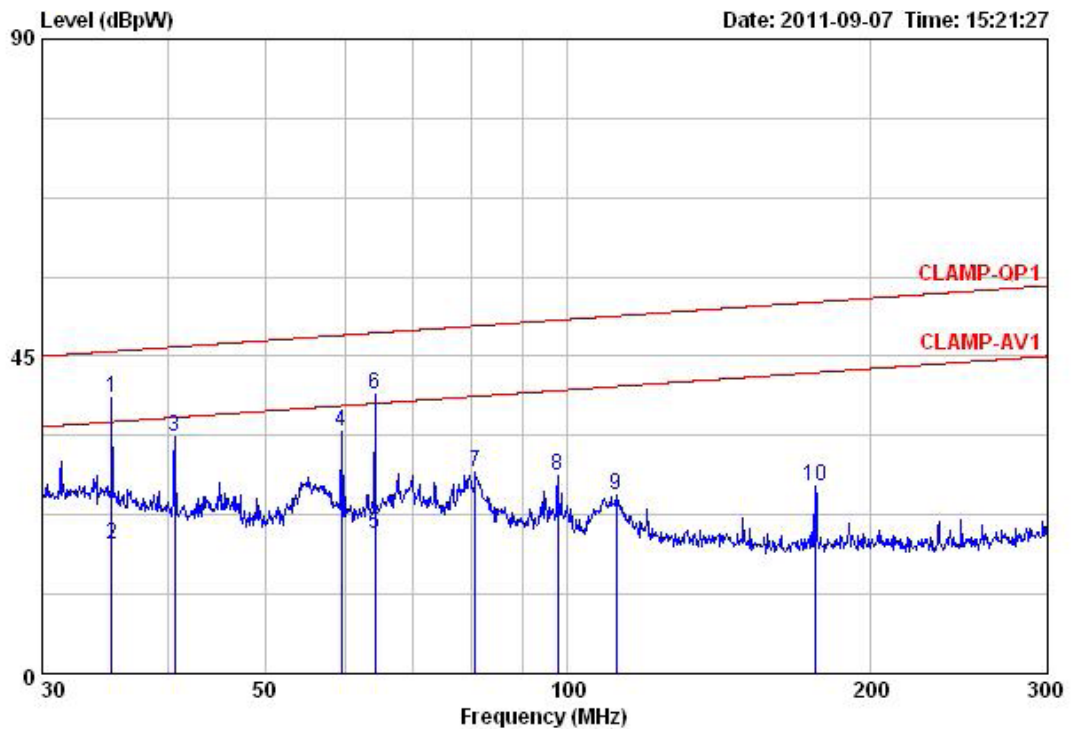
4.2 Radiated emission

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

*) Limits increasing linearly with the frequency

Port	AC Mains
Mode	On mode

Results



Frequency [MHz]	QP [dB(pW)]		AV [dB(pW)]	
	Level	Limit	Level	Limit
35,17	39,16	45,70	18,38	35,70
40,66	33,55	46,33	17,45	36,33
59,58	34,23	47,99	18,28	37,99
64,29	39,59	48,32	19,84	38,32

"QP" and "AV" are levels and limits referring to measurements with the quasi-peak and average detector. If the measured level "QP" does not exceed the limit for "AV", then no average measurement is necessary.

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 55014-1:2006+A1:2009):

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:

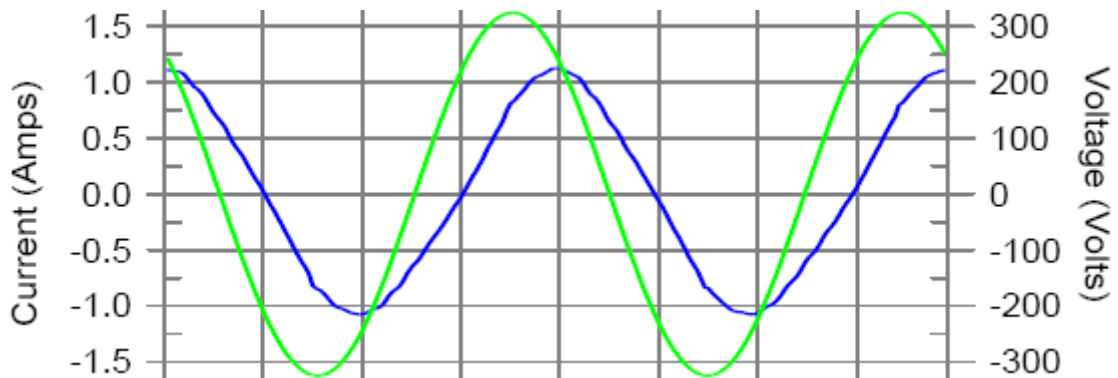
PASS

4.3 Harmonic currents

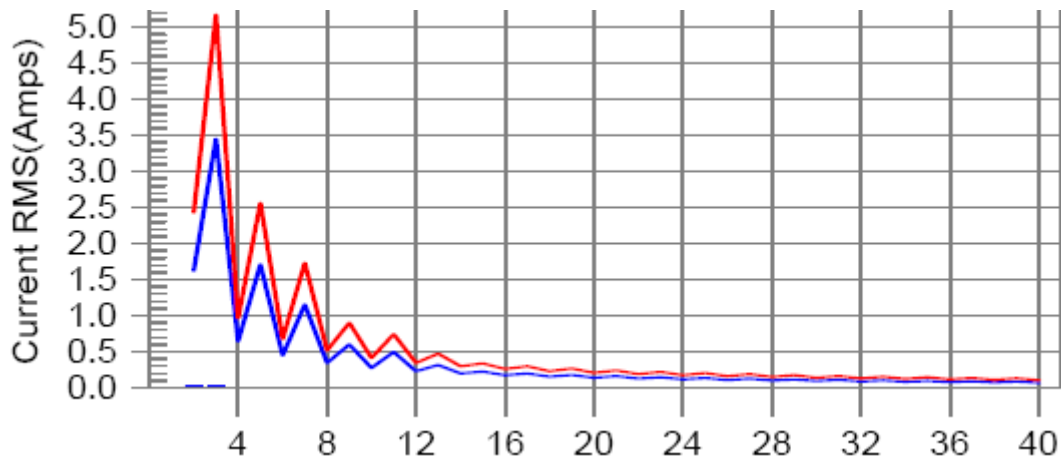
Standard	EN 61000-3-2
Port	AC Mains supply
Rated power	200 W
Mode	On mode

✓	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

Current & voltage waveforms



Harmonics



Test Result: Pass Source qualification: Normal
 THC(A): 0.03 I-THD(%): 4.35 POHC(A): 0.000 POHC Limit(A): 0.480
 Highest parameter values during test:
 V_{RMS} (Volts): 229.36 Frequency(Hz): 50.00
 I_{Peak} (Amps): 1.129 I_{RMS} (Amps): 0.752
 I_{Fund} (Amps): 0.743 Crest Factor: 1.611
 Power (Watts): 131.0 Power Factor: 0.776

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.016	1.620	1.0	0.017	2.430	0.70	Pass
3	0.027	3.450	0.8	0.028	5.175	0.55	Pass
4	0.001	0.645	0.0	0.001	0.968	0.00	Pass
5	0.007	1.710	0.4	0.007	2.565	0.28	Pass
6	0.000	0.450	0.0	0.000	0.675	0.00	Pass
7	0.004	1.155	0.0	0.004	1.733	0.00	Pass
8	0.000	0.345	0.0	0.000	0.518	0.00	Pass
9	0.002	0.600	0.0	0.002	0.900	0.00	Pass
10	0.000	0.276	0.0	0.000	0.414	0.00	Pass
11	0.002	0.495	0.0	0.002	0.743	0.00	Pass
12	0.000	0.230	0.0	0.000	0.344	0.00	Pass
13	0.002	0.315	0.0	0.002	0.473	0.00	Pass
14	0.000	0.197	0.0	0.000	0.296	0.00	Pass
15	0.002	0.225	0.0	0.002	0.338	0.00	Pass
16	0.000	0.173	0.0	0.000	0.259	0.00	Pass
17	0.002	0.199	0.0	0.002	0.297	0.00	Pass
18	0.000	0.153	0.0	0.000	0.230	0.00	Pass
19	0.002	0.178	0.0	0.002	0.266	0.00	Pass
20	0.000	0.138	0.0	0.000	0.207	0.00	Pass
21	0.002	0.161	0.0	0.002	0.241	0.00	Pass
22	0.000	0.125	0.0	0.000	0.188	0.00	Pass
23	0.002	0.147	0.0	0.002	0.220	0.00	Pass
24	0.000	0.115	0.0	0.000	0.173	0.00	Pass
25	0.002	0.135	0.0	0.002	0.203	0.00	Pass
26	0.000	0.106	0.0	0.000	0.159	0.00	Pass
27	0.001	0.125	0.0	0.001	0.188	0.00	Pass
28	0.000	0.099	0.0	0.000	0.148	0.00	Pass
29	0.001	0.116	0.0	0.001	0.175	0.00	Pass
30	0.000	0.092	0.0	0.000	0.138	0.00	Pass
31	0.001	0.110	0.0	0.001	0.163	0.00	Pass
32	0.000	0.086	0.0	0.000	0.129	0.00	Pass
33	0.001	0.102	0.0	0.001	0.153	0.00	Pass
34	0.000	0.081	0.0	0.000	0.122	0.00	Pass
35	0.001	0.096	0.0	0.001	0.145	0.00	Pass
36	0.000	0.077	0.0	0.000	0.115	0.00	Pass
37	0.001	0.092	0.0	0.001	0.137	0.00	Pass
38	0.000	0.073	0.0	0.000	0.109	0.00	Pass
39	0.001	0.087	0.0	0.001	0.130	0.00	Pass
40	0.000	0.069	0.0	0.000	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}	≤ 1
P _{LT}	Not applicable*
dt > 3,3%	≤ 500 ms
d _C	≤ 3,3%
d _{MAX}	≤ 4%

Results

Relative voltage change characteristic dt	0,0 ms
Maximum voltage change d _{MAX}	0,280%
Relative Voltage change d _C	<0,050%
Short term flicker P _{ST}	0,064
Long term flicker P _{LT}	Not applicable*

Tests and mode of operation

The measurements were performed with the following mode of operation: on mode

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 earth)

Performed tests

Tested Voltage; Port	1 kV; AC input power port (Line to line) 2 kV; AC input power port (Line to earth)		
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-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, 240 V _{AC}		
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 2 Conducted Emission test setup



Figure 3 Disturbance power test setup