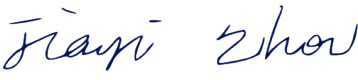


Prüfbericht-Nr.: Test Report No.:	50330413 001	Auftrags-Nr.: Order No.:	244188289	Seite 1 von 31 Page 1 of 31
Kunden-Referenz-Nr.: Client Reference No.:	2061587	Auftragsdatum: Order date.:	22.11.2019	
Auftraggeber: Client:	Bestway (Hong Kong) International Ltd. Suite 713, 7/Floor, East Wing, Tsim Sha Tsui Centre, 66 Mody Road, Kowloon, Hong Kong			
Prüfgegenstand: Test item:	SPA			
Bezeichnung / Typ-Nr.: Identification / Type No.:	S100101, S100102, S100103			
Auftrags-Inhalt: Order content:	EMC test			
Prüfgrundlage: Test specification:	EN 55014-1:2006+A1+A2	EN 55014-1:2017	EN 55014-2:2015	
	EN IEC 61000-3-2:2019	EN 61000-3-3:2013		
Wareneingangsdatum: Date of receipt:	31.12.2019			
Prüfmuster-Nr.: Test sample No.:	A00103341-002			
Prüfzeitraum: Testing period:	Refer to test report			
Ort der Prüfung: Place of testing:	EMC laboratory			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von / tested by:		kontrolliert von / reviewed by:		
 14.04.2020 Liky Zhu/Senior project engineer		 14.04.2020 Jiayi Zhou/Senior manager		
Datum Date	Name/Stellung Name/Position	Unterschrift Signature	Datum Date	Name/Stellung Name/Position
Sonstiges / Other:				
Refer to clause 2.2 for the detail information.				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specifications(s) F(ail) = failed a.m. test specifications(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

TEST SUMMARY

4.1.1 HARMONICS ON AC MAINS

Result:

Passed

4.1.2 VOLTAGE FLUCTUATIONS ON AC MAINS

Result:

Passed

4.1.3 MAINS TERMINAL CONTINUOUS DISTURBANCE VOLTAGE

Result:

Passed

4.1.4 DISCONTINUOUS INTERFERENCE ON AC MAINS

Result:

Passed

4.2.1 DISTURBANCE POWER

Result:

Passed

4.2.2 RADIATED EMISSION

Result:

Passed

5.1.1 ELECTROSTATIC DISCHARGE

Result:

Passed

5.2.1 FAST TRANSIENTS ON AC POWER LINES

Result:

Passed

5.2.2 INJECTED CURRENT INTO AC POWER PORT

Result:

Passed

5.2.3 SURGES TO AC POWER PORT

Result:

Passed

5.2.4 VOLTAGE DIPS AND INTERRUPTIONS TO AC POWER PORT

Result:

Passed

Contents

1	TEST SITES.....	4
1.1	TEST FACILITIES.....	4
2	GENERAL PRODUCT INFORMATION	5
2.1	PRODUCT FUNCTION AND INTENDED USE	5
2.2	RATINGS AND SYSTEM DETAILS.....	5
2.3	INDEPENDENT OPERATION MODES.....	5
2.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS.....	5
2.5	SUBMITTED DOCUMENTS	5
3	TEST SET-UP AND OPERATION MODES.....	6
3.1	PRINCIPLE OF CONFIGURATION SELECTION.....	6
3.2	PHYSICAL CONFIGURATION FOR TESTING	6
3.3	TEST OPERATION AND TEST SOFTWARE.....	6
3.4	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	6
3.5	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE.....	6
4	TEST RESULTS EMISSION	7
4.1	EMISSION IN THE FREQUENCY RANGE UP TO 30 MHz	7
4.1.1	Harmonics on AC Mains.....	7
4.1.2	Voltage Fluctuations on AC Mains	9
4.1.3	Mains Terminal Continuous Disturbance Voltage.....	10
4.1.4	Discontinuous Interference on AC Mains	13
4.2	EMISSION IN THE FREQUENCY RANGE ABOVE 30 MHz	14
4.2.1	Disturbance Power	14
4.2.2	Radiated emission	18
5	TEST RESULTS IMMUNITY	19
5.1	ENCLOSURE.....	20
5.1.1	Electrostatic Discharge.....	20
5.2	INPUT AND OUTPUT AC POWER PORTS	21
5.2.1	Fast Transients on AC Power Lines.....	21
5.2.2	Injected Current into AC Power Port	22
5.2.3	Surges to AC Power Port.....	23
5.2.4	Voltage dips and interruptions to AC Power Port	24
6	PHOTOGRAPHS OF THE TEST SET-UP	25
7	LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	30
8	LIST OF TABLES.....	31
9	LIST OF FIGURES.....	31
10	LIST OF PHOTOGRAPHS.....	31

Prüfbericht - Nr.: 50330413 001*Test Report No.:***Seite 4 von 31***Page 4 of 31*

1 Test Sites

1.1 Test Facilities

Laboratory: TÜV Rheinland (Shanghai) Co., Ltd.**Address: No.177, 178, Lane 777 West Guangzhong Road, Jing'an District, Shanghai, China**

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

Refer to clause 7 for test and measurement instruments.

2 General Product Information

2.1 Product Function and Intended Use

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

2.2 Ratings and System Details

Rated input : AC 220-240 V, 50 Hz

Rated power : Heating: 2050 W; Heating + Bubble: 1850 W (for all models)

Protection class : I

Identities and differences:

The models are same in electrical characteristics. The differences among them are type designation, mechanical aspects and the appearance. Therefore, all the EMC tests were performed on model S100101.

For this product, the requirements of EN 55014-1:2017 can be covered by those of EN 55014-1:2006+A1+A2.

Refer to the circuit diagram for further information.

2.3 Independent Operation Modes

The basic operation modes are: "On" or "Off".

Refer to the circuit diagram for further information.

2.4 Noise Generating and Noise Suppressing Parts

Refer to the circuit diagram for further information.

2.5 Submitted Documents

Circuit diagram and rating label.

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 emission 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

No special measure is employed to achieve the requirement.

Prüfbericht - Nr.: 50330413 001

Test Report No.:

Seite 7 von 31

Page 7 of 31

4 Test Results EMISSION

4.1 Emission in the Frequency Range up to 30 MHz

4.1.1 Harmonics on AC Mains

Result:	Passed
----------------	---------------

Date of testing : 28.02.2020

Test procedure : EN IEC 61000-3-2:2019

Test duration : 2.5 min

Harmonic order : 2 – 40th

Frequency range : 0 – 2 kHz

Ambient condition : Temperature: 21.4 °C; Relative humidity: 43.7 %

Following are the measurement results, which were obtained via an automatic measurement system.

Table 1: Harmonic currents measurement result

Equipment category: Class A; Test voltage: AC 229.447 V, 50 Hz

Fundamental current I₁: 9.878 A; Power factor: 0.992; Active input power: 2266.8 W.

Harmonic order	Measured result (A)	Limits (A)	Harms(max) (A)	150%Limit (A)	Result
2	0.005	1.080	0.008	1.620	Pass
3	1.218	2.300	1.273	3.450	Pass
4	0.003	0.430	0.004	0.645	Pass
5	0.167	1.140	0.180	1.710	Pass
6	0.001	0.300	0.001	0.450	Pass
7	0.069	0.770	0.074	1.155	Pass
8	0.001	0.230	0.001	0.345	Pass
9	0.018	0.400	0.020	0.600	Pass
10	0.001	0.184	0.001	0.276	Pass
11	0.023	0.330	0.025	0.495	Pass
12	0.000	0.153	0.001	0.230	Pass
13	0.006	0.210	0.007	0.315	Pass
14	0.001	0.131	0.001	0.197	Pass
15	0.011	0.150	0.012	0.225	Pass
16	0.000	0.115	0.001	0.173	Pass
17	0.005	0.132	0.005	0.199	Pass
18	0.001	0.102	0.001	0.153	Pass
19	0.006	0.118	0.006	0.178	Pass
20	0.001	0.092	0.001	0.138	Pass
21	0.003	0.107	0.004	0.161	Pass
22	0.000	0.084	0.001	0.125	Pass
23	0.003	0.098	0.003	0.147	Pass
24	0.000	0.077	0.000	0.115	Pass
25	0.002	0.090	0.002	0.135	Pass
26	0.000	0.071	0.000	0.106	Pass
27	0.000	0.083	0.001	0.125	Pass
28	0.000	0.066	0.000	0.099	Pass
29	0.001	0.078	0.001	0.116	Pass
30	0.000	0.061	0.000	0.092	Pass
31	0.001	0.073	0.001	0.109	Pass
32	0.000	0.058	0.000	0.086	Pass
33	0.001	0.068	0.001	0.102	Pass
34	0.000	0.054	0.000	0.081	Pass
35	0.001	0.064	0.002	0.096	Pass
36	0.000	0.051	0.000	0.077	Pass
37	0.001	0.061	0.001	0.091	Pass
38	0.000	0.048	0.000	0.073	Pass
39	0.001	0.058	0.001	0.087	Pass
40	0.001	0.046	0.001	0.069	Pass

4.1.2 Voltage Fluctuations on AC Mains

Result:	Passed
----------------	---------------

Date of testing : 28.02.2020
 Test procedure : EN 61000-3-3:2013
 Ambient condition : Temperature: 21.4 °C; Relative humidity: 43.7 %

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

- the value of P_{st} shall not be greater than 1.0;
- the value of P_{lt} shall not be greater than 0.65;
- T_{max} , the accumulated time value of $d(t)$ with a deviation exceeding 3.3 % during a single voltage change at the EUT terminals, shall not exceed 500 ms;
- the relative steady-state voltage change d_c , shall not exceed 3.3 %;
- the maximum relative voltage change d_{max} , shall not exceed 6 %.

Table 2: Voltage fluctuations and flicker measurement results

	d_c	d_{max} (average)	T_{max}	P_{st}	P_{lt}
Limits	3.3 %	6 %	500 ms	1.0	0.65
Result	1.55 %	1.58 %	0 ms	0.230	0.176

4.1.3 Mains Terminal Continuous Disturbance Voltage

Result:	Passed
----------------	---------------

Date of testing : 02.03.2020
Test procedure : EN 55014-1:2006+A1+A2/EN 55014-1:2017
and CISPR 16-1 series standards
Frequency range : 0.15 – 30 MHz
Kind of test site : shielded room
Ambient condition : Temperature: 21.4 °C; Relative humidity: 43.7 %
Expanded :
measurement 4.32 dB
uncertainty ($k=2$)

Test Setup

Input voltage : AC 264 V, 50 Hz
Operational mode : Continuously work with water as load
Artificial hand : N/A
Earthing : Earthed through power cord (as class I equipment)

The measurement setup was made according to EN 55014-1:2006+A1+A2/EN 55014-1:2017 in a shielded room.

The measurement equipment like test receivers, 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.

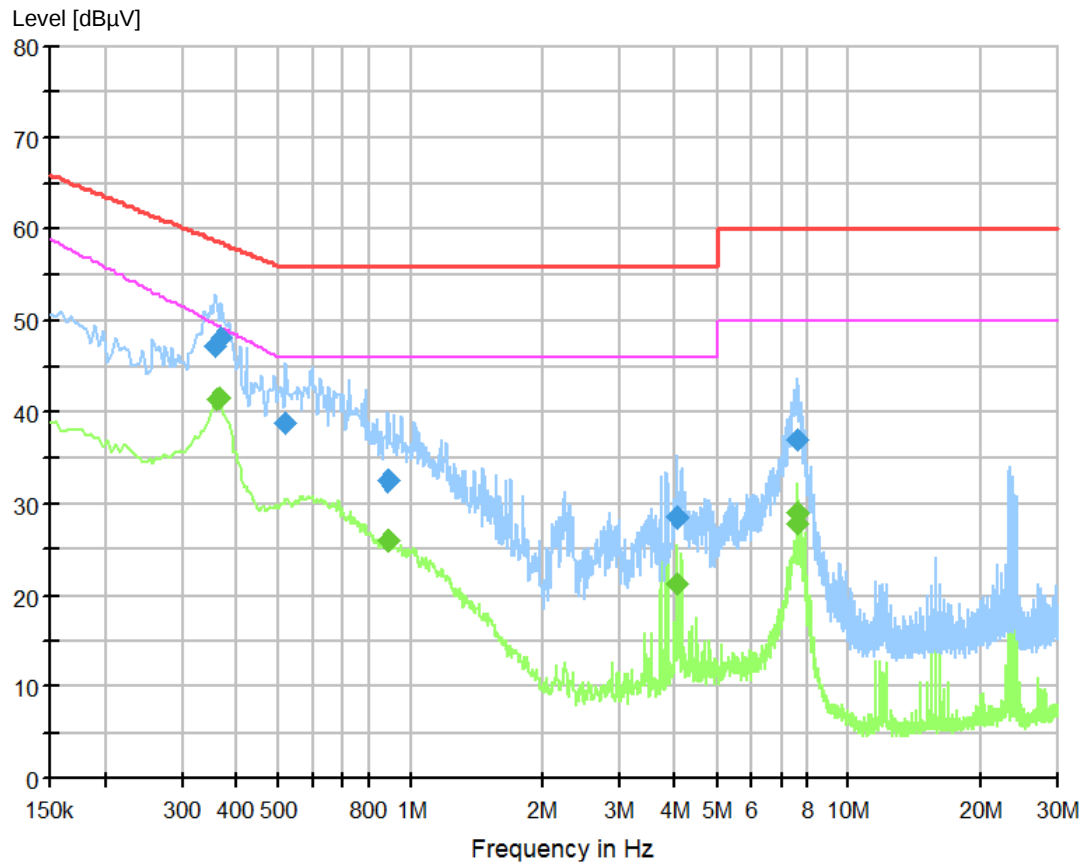
Furthermore an internal calibration with the test receiver was conducted prior to each measurement.

The tested object was set-up on a wooden support. The EUT was set 0.8 m away from the AMN. The cord longer than necessary to be connected to the AMN was folded forth and back parallel so as to form a bundle with a length between 0.3 m and 0.4 m.

The Interference Voltage was determined according to clause 5/5.2 of EN 55014-1:2006+A1+A2/EN 55014-1:2017 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.

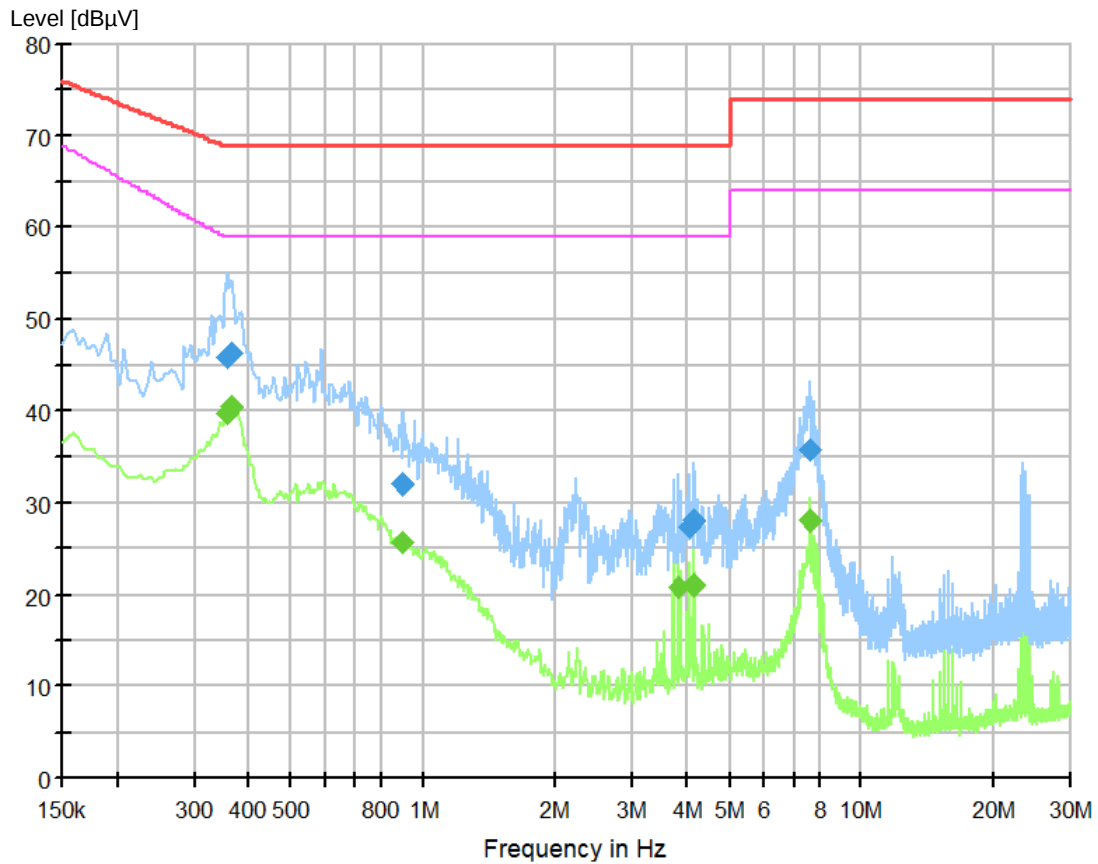
In the Figures, “◆” means Quasi-Peak Value and “◆” means Average Value which was measured in final measurement.

Figure 1: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L line

Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.357000	47.16	58.80	11.64	1000.0	9.000	L1	10.4
0.370500	48.13	58.49	10.36	1000.0	9.000	L1	10.4
0.519000	38.89	56.00	17.11	1000.0	9.000	L1	10.4
0.888000	32.41	56.00	23.59	1000.0	9.000	L1	10.5
4.042500	28.53	56.00	27.47	1000.0	9.000	L1	10.6
7.642500	36.98	60.00	23.02	1000.0	9.000	L1	10.8

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.361500	41.45	49.50	8.05	1000.0	9.000	L1	10.4
0.366000	41.56	49.37	7.81	1000.0	9.000	L1	10.4
0.888000	26.01	46.00	19.99	1000.0	9.000	L1	10.5
4.047000	21.38	46.00	24.62	1000.0	9.000	L1	10.6
7.606500	28.96	50.00	21.04	1000.0	9.000	L1	10.8
7.642500	27.88	50.00	22.12	1000.0	9.000	L1	10.8

Figure 2: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N line

Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.357000	45.85	69.00	23.15	1000.0	9.000	N	10.4
0.366000	46.32	69.00	22.68	1000.0	9.000	N	10.4
0.901500	32.08	69.00	36.92	1000.0	9.000	N	10.5
4.056000	27.38	69.00	41.62	1000.0	9.000	N	10.6
4.155000	28.09	69.00	40.91	1000.0	9.000	N	10.6
7.642500	35.69	74.00	38.31	1000.0	9.000	N	10.8

Final_Result_CAV

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.357000	39.77	59.00	19.23	1000.0	9.000	N	10.4
0.366000	40.44	59.00	18.56	1000.0	9.000	N	10.4
0.892500	25.84	59.00	33.16	1000.0	9.000	N	10.5
3.844500	20.78	59.00	38.22	1000.0	9.000	N	10.6
4.159500	21.00	59.00	38.00	1000.0	9.000	N	10.6
7.606500	28.10	64.00	35.90	1000.0	9.000	N	10.8

4.1.4 Discontinuous Interference on AC Mains

Result:	Passed
----------------	---------------

Date of testing	: 02.03.2020
Test procedure	: EN 55014-1:2006+A1+A2/EN 55014-1:2017 and CISPR 16-1 series standards
Kind of test site	: Shielded room
Port	: Mains
Basic standard	: EN 55014-1:2006+A1+A2/EN 55014-1:2017
Frequency range	: 0.15 – 30 MHz
Limit	: EN 55014-1:2006+A1+A2/EN 55014-1:2017, clause 4.2/4.4 (Household Appliance)
Operating condition	: EN 55014-1:2006+A1+A2/EN 55014-1:2017, clause 7.3.4.5/A.4.6
Ambient condition	: Temperature: 20.7 °C; Relative humidity: 45.6 %

The discontinuous interference on AC mains in the frequency range from 0.15 to 30 MHz was measured in accordance to EN 55014-1:2006+A1+A2/EN 55014-1:2017.

The measurement setup was made according to EN 55014-1:2006+A1+A2/EN 55014-1:2017, clause 4.2/4.4 in a shielded room. A discontinuous interference analyzer was used for the measurement of clicks.

The EUT was operated in a manner specified by clause 7.3.4.5/A.4.6 of EN 55014-1:2006+A1+A2/EN 55014-1:2017. “Thermal and non-thermal storage water heater shall be operated in usual position of use, filled with typical quantity of water; no water to be drawn off during test. The click rate N shall be determined with the highest setting of any control device fitted.”

Table 3: Result of Discontinuous Interference

Measured Frequency (MHz)	0.15	0.5	1.4	30
Continuous disturbance limit (dB μ V)	66.0	56.0	56.0	60.0
Last Time T	120 min			
Click Number n1 of <10 ms	5	6	4	0
Click Number n2 of >10 ms	0	0	0	0
Total Click Number m=n1+n2	5	6	4	0
Switch operations s	18	18	18	18
Click rate N	0.15	0.15	0.15	0.15

Above are the click measurement results. The EUTs are deemed to comply with the limits because click rate $N < 5$ and the caused clicks have a duration less than 10 ms.

4.2 Emission in the Frequency Range above 30 MHz

4.2.1 Disturbance Power

Result:	Passed
----------------	---------------

Date of testing	: 28.02.2020
Port	: AC Mains and AC Ports
Basic standard	: EN 55014-1:2006+A1+A2/EN 55014-1:2017
Frequency range	: 30 - 300MHz
Limit	: EN 55014-1:2006+A1+A2/EN 55014-1:2017, clause 4.1.2/4.3.4.4
Ambient condition	: Temperature: 21.4 °C; Relative humidity: 43.7 %
Expanded measurement uncertainty (k=2)	: 4.32 dB

Test Setup

Input voltage	: AC 264 V; 50 Hz
Operational mode	: Continuously work with water as load
Earthing	: Earthed through power cord (as class I equipment)

Measuring configuration and description

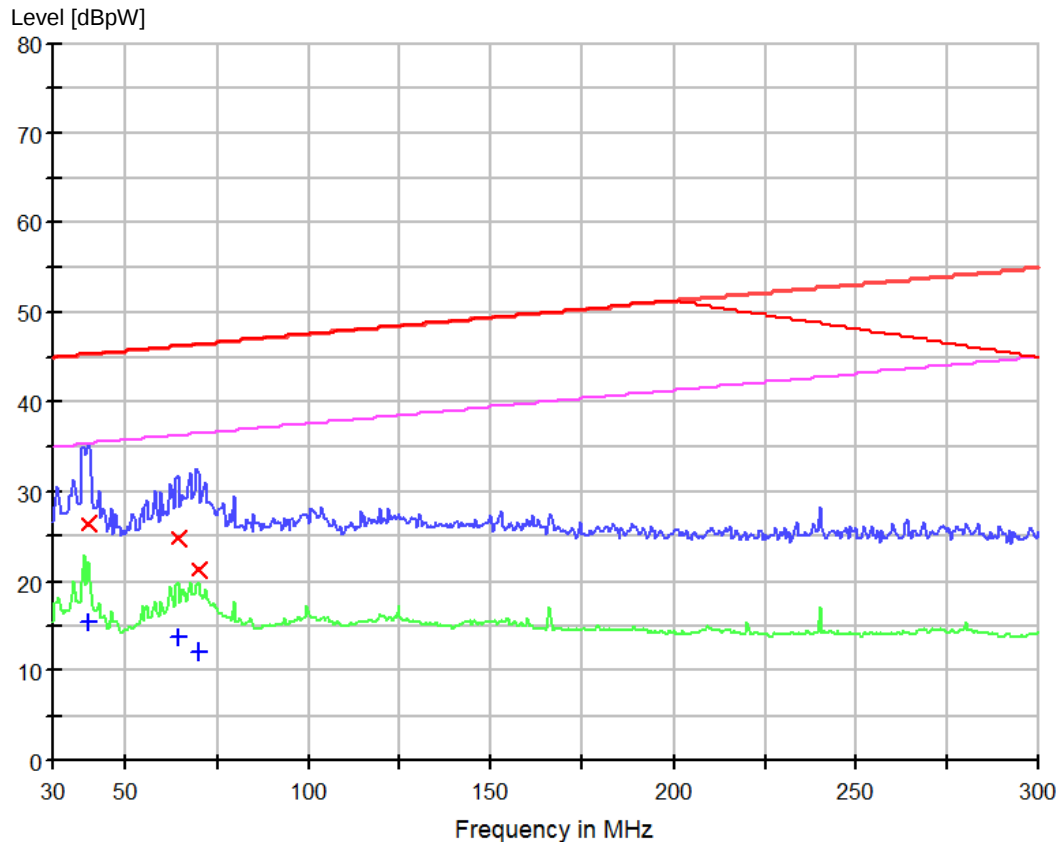
The measurement setup was made according to EN 55014-1:2006+A1+A2/EN 55014-1:2017.

The measurement equipment like test receivers and absorption clamp are in compliance with CISPR 16-1 series standards. The test object has been operated under its rated voltage and rated frequency. 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.

The disturbance power was determined according to clause 6/5.2.3 of EN 55014-1:2006+A1+A2/EN 55014-1:2017. The length of power cord of EUT plus that of the extension cord was 6.0m.

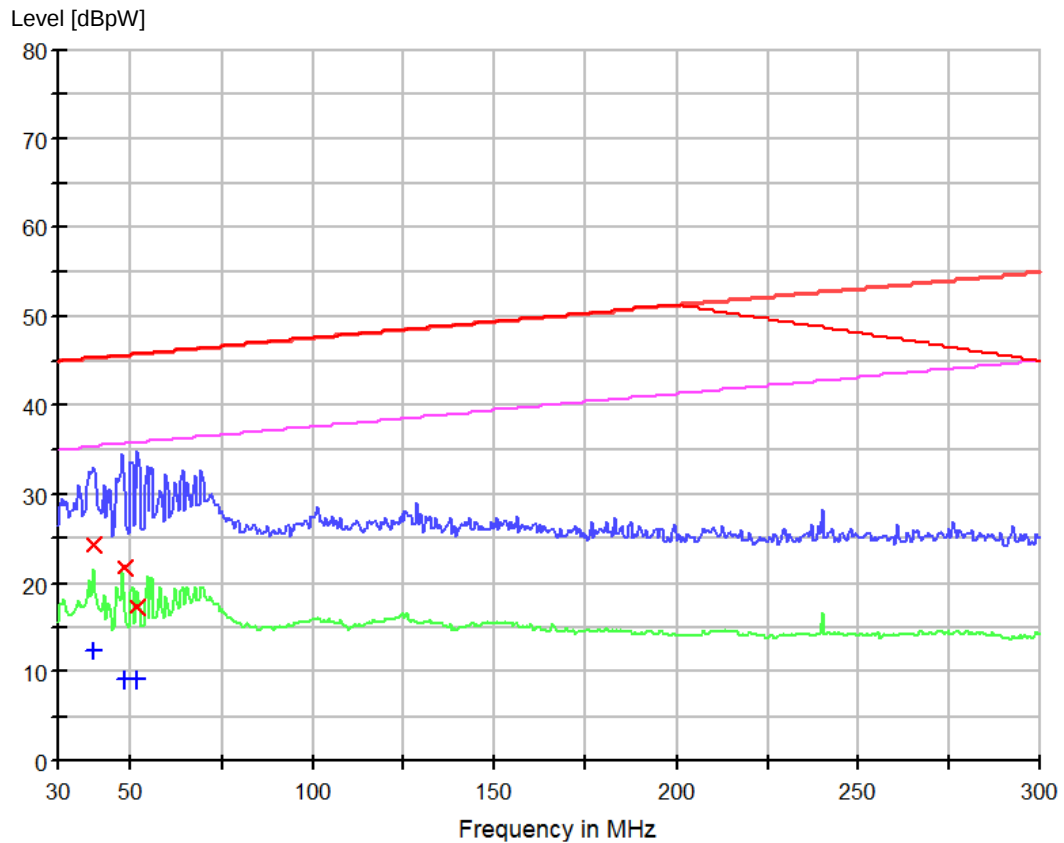
The measurement was performed by operating the EUT in normal operation mode. The figures and tables below were those measured in the operation mode. Both Quasi-Peak and Average Value were measured. In final measurement, by moving the absorption clamp along the power supply cord and the extension-power 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, “×” means Quasi-Peak Value and “+” means Average Value which was measured in final measurement.

Figure 3: Spectral Diagrams, Disturbance Power, AC Mains, 30 – 300 MHz

Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBpW)
39.720000	26.5	1000.0	120.000	8.0	18.9	45.4
64.020000	24.9	1000.0	120.000	7.7	21.4	46.3
69.960000	21.3	1000.0	120.000	8.8	25.2	46.5

Limit and Margin AV

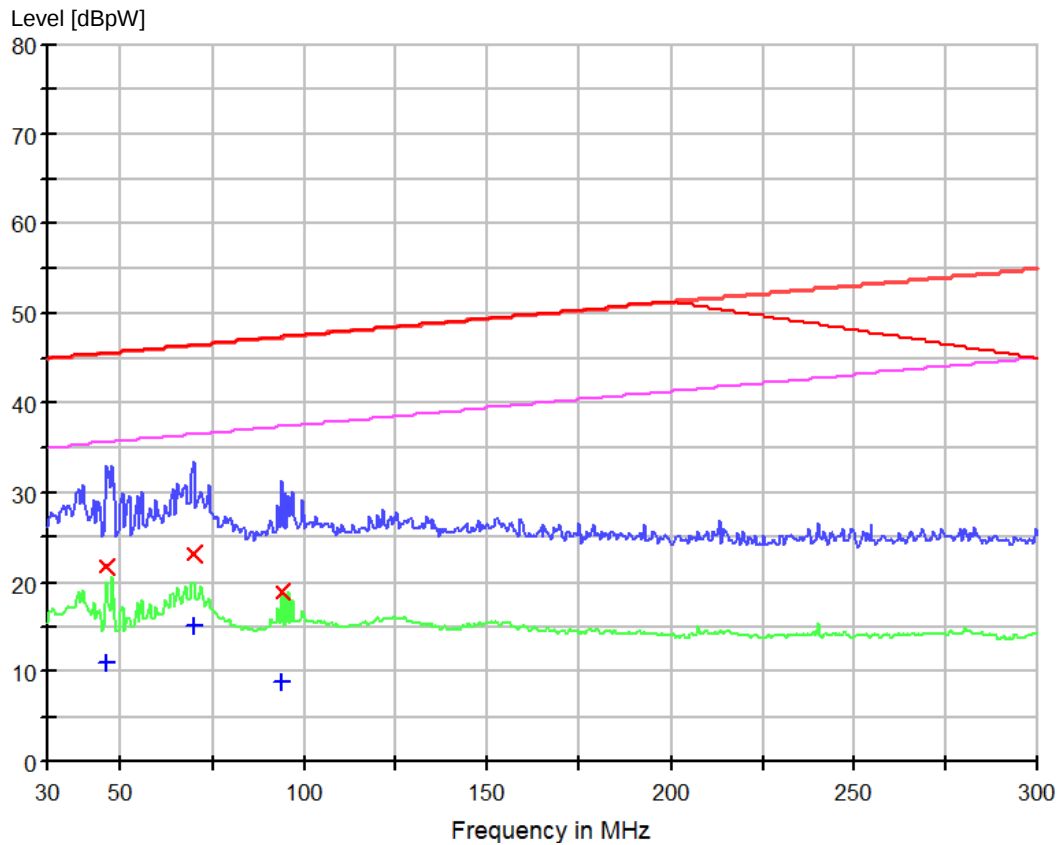
Frequency (MHz)	CAverage (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - CAV (dB)	Limit - CAV (dBpW)
39.720000	15.4	1000.0	120.000	8.0	20.0	35.4
64.020000	13.8	1000.0	120.000	7.7	22.5	36.3
69.960000	12.2	1000.0	120.000	8.8	24.3	36.5

Figure 4: Spectral Diagrams, Disturbance Power, AC Ports, host to PRCD, 30 – 300 MHz

Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBpW)
39.720000	24.3	1000.0	120.000	8.0	21.0	45.4
48.360000	21.7	1000.0	120.000	4.9	24.0	45.7
51.600000	17.3	1000.0	120.000	5.2	28.5	45.8

Limit and Margin AV

Frequency (MHz)	CAverage (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - CAV (dB)	Limit - CAV (dBpW)
39.720000	12.3	1000.0	120.000	8.0	23.0	35.4
48.360000	9.1	1000.0	120.000	4.9	26.6	35.7
51.600000	9.1	1000.0	120.000	5.2	26.7	35.8

Figure 5: Spectral Diagrams, Disturbance Power, AC Ports, PRCD to host, 30 – 300 MHz

Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBpW)
46.200000	21.7	1000.0	120.000	5.0	23.9	45.6
69.960000	23.1	1000.0	120.000	8.8	23.4	46.5
93.720000	18.9	1000.0	120.000	5.7	28.5	47.4

Limit and Margin AV

Frequency (MHz)	CAverage (dBpW)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin - CAV (dB)	Limit - CAV (dBpW)
46.200000	10.9	1000.0	120.000	5.0	24.7	35.6
69.960000	15.1	1000.0	120.000	8.8	21.4	36.5
93.720000	8.9	1000.0	120.000	5.7	28.5	37.4

4.2.2 Radiated emission**Result:****Passed**

Test procedure : EN 55014-1:2006+A1+A2/EN 55014-1:2017
and CISPR 16-2-3

Test port : Enclosure

Frequency range : 30 – 1000 MHz

Limit : Quasi-peak limits (3 m test distance):
30-230 MHz, 40 dB μ V/m;
230-1000 MHz, 47 dB μ V/m;

According to a) of Clause 4.1.2.3.2/4.3.4.2 of EN 55014-1:2006+A1+A2/EN 55014-1:2017:
“ Appliances are deemed to comply in the frequency range from 300 MHz to 1000 MHz if
both 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.”

The EUT is deemed to meet the requirements without actual testing, as the EUT fulfilled the
two conditions from test results of Clause 4.2.1/4.3.4.2 and the circuit diagram.

5 Test Results I M M U N I T Y

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. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if 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, however no change of actual operating state or stored data is allowed to persist after the test. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

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: 27.02.2020-28.02.2020

Room temperature	:	19.7-20.6 °C
Relative humidity	:	43.8-51.3 %
Atmospheric Pressure	:	101.3 kPa

According to the electrical characteristics and EN 55014-2:2015, the EUT belongs to category II equipment.

5.1 Enclosure

5.1.1 Electrostatic Discharge

Result:	Passed
----------------	---------------

The immunity against electrostatic discharge was tested in accordance with EN 55014-2:2015. Test setup and ESD-Generator are according to IEC 61000-4-2 which is specified by EN 55014-2:2015.

The EUT is placed on 0.1 m wood support 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 0.5 m.

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

A vertical coupling plane of dimensions 0.5 m x 0.5 m is placed parallel to and positioned at a distance of 0.1 m from the EUT.

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

Table 4: ESD, Positive / Negative Polarity

Position	Kind of Discharge	Result	Remarks
Plastic enclosure	Air discharge ± 8 kV	Pass	No disturbance of function
Button	Air discharge ± 8 kV	Pass	No disturbance of function
LED	Air discharge ± 8 kV	Pass	No disturbance of function
Screen	Air discharge ± 8 kV	Pass	No disturbance of function
Screw	Contact Discharge ± 4 kV	Pass	No disturbance of function
Enclosure(Metallic)	Contact Discharge ± 4 kV	Pass	No disturbance of function
Coupling plane (VCP)	Contact Discharge ± 4 kV	Pass	No disturbance of function

5.2 Input and Output AC Power Ports

5.2.1 Fast Transients on AC Power Lines

Result:	Passed
----------------	---------------

The immunity against fast transients on AC power lines was tested in accordance to EN 55014-2:2015. Test setup and the fast transient noise generator were according to IEC 61000-4-4 which is specified by EN 55014-2:2015.

The EUT is placed on 0.1 m wood support 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 0.5 m.

The length between the coupling device and the EUT is about 0.5 m. The excess length was folded to avoid a flat coil and situated at a distance of 0.1 m above the ground reference plane.

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

Test voltage	: 1 kV
Polarity	: negative/positive
Repetition frequency	: 5 kHz
Test duration	: ≥ 120 sec
T_r/T_d	: 5 ns/50 ns
Performance criteria	: B

Table 5: Burst, AC Power lines, Positive and Negative Polarity

Line	Result	Remarks
AC Input ports	± 1 kV Pass	No disturbance of function

5.2.2 Injected Current into AC Power Port

Result:**Passed**

The immunity against injected current into AC power port was tested according to EN 55014-2:2015 in a shielded room. The Test setup and the test generator were according to IEC 61000-4-6 which is specified by EN 55014-2:2015.

The EUT is placed on a ground reference plane and shall be insulated from it by an insulating support 0.1 m thick. And the minimum distance between the EUT and all other conductive structures except the ground plane beneath the EUT is more than 0.5 m.

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 50 mm.

Voltage level	: 3 V(rms)(unmodulated)
Environmental phenomena	: r.f. current, common mode, 1 kHz, 80 % AM
Source impedance	: 150 Ω
Frequency range	: 0.15 -230 MHz
Frequency step	: 1 %
Dwell time	: 3 s
Performance criteria	: A

Table 6: Injected current, AC Power Port

Line	Result	Remarks
AC Input port	Pass	No disturbance of function

5.2.3 Surges to AC Power Port

Result:**Passed**

The immunity against surges to AC power port was tested in accordance to EN 55014-2:2015. Test setup and the Combination Wave Generator (CWG) were according to IEC 61000-4-5 which is specified by EN 55014-2:2015.

The EUT is placed on 0.1 m wood support above the ground plane.

Open-circuit test voltage : 1 kV (phase to neutral)
2 kV (phase/neutral to protection earth)
 T_r/T_d : 1.2/50 μ s (open-circuit voltage)
8/20 μ s (short-circuit current)
Test numbers : 5 positive and 5 negative pulses
Repetition rate : 1 surge/min
Performance criteria : B

Table 7: Surges to AC Power lines, positive/negative

Line	Result	Remarks
Phase to neutral 1 kV	Pass	No disturbance of function
Phase to protective earth 2 kV	Pass	No disturbance of function
Neutral to protective earth 2 kV	Pass	No disturbance of function

5.2.4 Voltage dips and interruptions to AC Power Port

Result:
Passed

The immunity against voltage dips and interruptions to AC power port was tested in accordance to EN 55014-2:2015. Test setup and the test generator were according to IEC 61000-4-11 which is specified by EN 55014-2:2015.

Performance criteria	:	C
Test level (in % U_T) and	0	0.5 periods
duration (in periods of the	:	40 10 periods
rated frequency)	70	25 periods

Table 8: Test condition and Test Result for Voltage dips

Test level (in % U_T)	Duration	Performance criteria	Result	Remarks
0	0.5 (10 ms)	B	Pass	The function of the pumping for EUT stopped working during testing and after the disturbance ceased, it could be restored automatically.
40	10 (200 ms)	B	Pass	The function of the pumping for EUT stopped working during testing and after the disturbance ceased, it could be restored automatically.
70	25(500 ms)	B	Pass	The function of the pumping for EUT stopped working during testing and after the disturbance ceased, it could be restored automatically.

6 Photographs of the Test Set-Up

Photograph 1: Set-up for measurement of harmonics and voltage fluctuation



Photograph 2: Set-up for measurement of disturbance voltage



Photograph 3: Set-up for measurement of discontinuous interference



Photograph 4: Set-up for measurement of disturbance power



AC Mains



AC Ports

Photograph 5: Set-up for immunity of ESD



Prüfbericht - Nr.: 50330413 001

Test Report No.:

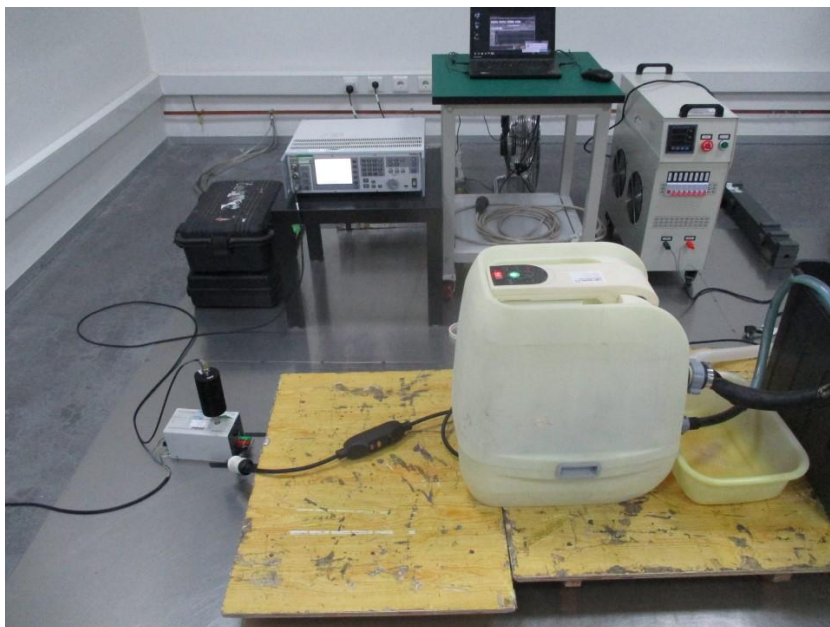
Seite 28 von 31

Page 28 of 31

Photograph 6: Set-up for immunity of EFT and surge



Photograph 7: Set-up for immunity of injected current



Prüfbericht - Nr.: 50330413 001

Test Report No.:

Seite 29 von 31

Page 29 of 31

Photograph 8: Set-up for immunity of voltage dips



7 List of Test and Measurement Instruments

Equip.	Description	Model	Manufacturer	Last Date	Due Date
				DD.MM.YYYY	DD.MM.YYYY
1811421	3-phase harmonics/fluctuation tester	ProfLine 2145-400	Teseq	01.03.2019	01.03.2021
1811420	45kVA AC power source	NSG 1007-45	Teseq	01.03.2018	01.03.2020
1825639	Harmonics/flicker measurement software	Win2105 (V2.22)	Teseq	N/A	N/A
1811426	Discontinuous disturbance analyser	DDA55	AFJ	09.07.2019	09.07.2020
1811427	Artificial mains network	LT32C/10	AFJ	09.07.2019	09.07.2020
1825642	Click measurement software	Click meter(Ver3.07)	AFJ	N/A	N/A
1830003	Artificial mains network	ENV432	Rohde & Schwarz	01.11.2019	01.11.2020
1820376	Absorbing clamp	MDS-21	Rohde&Schwarz	23.05.2019	23.05.2020
1811381	ESD generator	NSG 435	Schaffner	26.07.2019	26.07.2020
1811396	Barometer	DYM3	Ningbo Jiangshan Glass	04.04.2018	04.04.2021
1811409	EMC test system	NSG 3040	Teseq	01.11.2019	01.11.2020
1814624	Coupling/decoupling network	CDN M016	Schaffner	09.02.2018	09.02.2021
1811423	Conducted immunity test system	NSG 4070B-75	Teseq	17.09.2019	17.09.2020
1811428	3-phase voltage dips simulator	CSS-20P3	Shanghai Skylark	30.10.2019	30.10.2020
1811405	EMI test receiver	ESCI	Rohde&Schwarz	14.02.2019	14.02.2021

8 List of Tables

Table 1: Harmonic currents measurement result	8
Table 2: Voltage fluctuations and flicker measurement results.....	9
Table 3: Result of Discontinuous Interference	13
Table 4: ESD, Positive / Negative Polarity	20
Table 5: Burst, AC Power lines, Positive and Negative Polarity	21
Table 6: Injected current, AC Power Port	22
Table 7: Surges to AC Power lines, positive/negative	23
Table 8: Test condition and Test Result for Voltage dips	24

9 List of Figures

Figure 1: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L line	11
Figure 2: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N line	12
Figure 3: Spectral Diagrams, Disturbance Power, AC Mains, 30 – 300 MHz	15
Figure 4: Spectral Diagrams, Disturbance Power, AC Ports, host to PRCD, 30 – 300 MHz.....	16
Figure 5: Spectral Diagrams, Disturbance Power, AC Ports, PRCD to host, 30 – 300 MHz.....	17

10 List of Photographs

Photograph 1: Set-up for measurement of harmonics and voltage fluctuation.....	25
Photograph 2: Set-up for measurement of disturbance voltage.....	25
Photograph 3: Set-up for measurement of discontinuous interference	26
Photograph 4: Set-up for measurement of disturbance power.....	26
Photograph 5: Set-up for immunity of ESD	27
Photograph 6: Set-up for immunity of EFT and surge	28
Photograph 7: Set-up for immunity of injected current.....	28
Photograph 8: Set-up for immunity of voltage dips	29

End of Test Report