Manufacture Declaration for Denmark

Micro-generator Type reference	X3-Hybrid-5.0-D-C X3-Hybrid-5.0-D-E X3-Hybrid-5.0-N-C X3-Hybrid-5.0-N-E	X3-Hybrid-6.0-D-C X3-Hybrid-6.0-D-E X3-Hybrid-6.0-N-C X3-Hybrid-6.0-N-E	X3-Hybrid-8.0-D-C X3-Hybrid-8.0-D-E X3-Hybrid-8.0-N-C X3-Hybrid-8.0-N-E X3-Fit-8.0C X3-Fit-8.0E	X3-Hybrid-10.0-D-C X3-Hybrid-10.0-D-E X3-Hybrid-10.0-N-C X3-Hybrid-10.0-N-E X3-Fit-10.0C X3-Fit-10.0E
Maximum continuous rating	5000VA	6000VA	8000VA	10000VA
Manufacturer	SolaX Power Network Technology (Zhe jiang) Co. , Ltd.			
Address	No.288 Shizhu Road, Tonglu Economic Development Zone, Tonglu City, Zhejiang Province 310000, P. R. CHINA.			
Tel	+86(0571)-56260011			
Fax	+86(0571)-56075753			
Email	info@soalxpower.com			
Web site	www.solaxpower.com			
standard	Technical regulation 3.3.1 for electrical energy storage facilities			
Signed	Guo Huawei			
On behalf of	SolaX Power Network Technology (Zhe jiang) Co. , Ltd.			

the generating unit manufacturer/supplier declaration.

I certify on behalf of the company named above as a manufacturer/supplier of generating units, that all products manufactured/supplied by the company with the above generating unit Type reference number will be manufactured and tested to ensure that they perform as stated in this Type Verification Test Report, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of 'standard' as above.

1、Voltage and frequency protection

Protection. Frequency tests				**P**
Function	Default setting		Trip test	
	Frequency	Disconnection time limit	Frequency	Disconnection time
U/F stage 1	47.5Hz	0.2s	47.50Hz	0.122s
O/F stage 1	51.5Hz	0.2s	51.51Hz	0.107s

Protection. Under Voltage				**P**
Parameter	Voltage	Disconnection time limit	Voltage	Disconnection time limit
Protection limit	0.85Un	50s	0.80Un	0.2s
Actual Setting	195.5V	50s	184.0V	0.2s
Trip test	Voltage	Disconnection time	Voltage	Disconnection time
L1	195.1V	49.8s	183.6V	0.181s
L2	195.6V	50.0s	184.1V	0.182s
L3	194.9V	49.8s	183.6V	0.176s
ALL	196.5V	49.8s	184.0V	0.177s

Protection.Over Voltage				**P**
Parameter	Voltage	Disconnection time limit	Voltage	Disconnection time limit
Protection limit	1.10Un	60s	1.15Un	0.2s
Actual Setting	253.0V	60s	264.5V	0.2s
Trip test	Voltage	Disconnection time	Voltage	Disconnection time
L1	253.2V	59.8s	264.0V	0.192s
L2	253.8V	59.8s	264.6V	0.166s
L3	253.1V	59.8s	263.8V	0.186s
ALL	253.2V	59.8s	263.8V	0.173s

2、Tolerance of frequency deviations

a) Frequency Change

Rate of change of frequency (ROCOF) immunity					P
	Frequency		Change	Result (disconnect or not)	Requirement
	Begin	End			
a)	49.0 Hz	51.0 Hz	+ 2Hz/s	Stay connected	Stay connected
b)	51.0 Hz	49.0 Hz	- 2Hz/s	Stay connected	Stay connected
Note: The ROCOF immunity is defined with a sliding measurement window of 500 ms.					

b) Power response to under-frequency

Active power at under-frequency					P
Test sequence	Voltage (V)	Current (A)	Frequency (Hz)	Active Power (W)	Primary source
Test a)	230.2	14.5	50.00	9995.8	PV generator
Test b)	230.2	14.5	49.50	9995.1	PV generator
Test c)	230.2	14.5	49.00	10000.6	PV generator
Test d)	230.2	14.5	48.50	10002.2	PV generator
Test e)	230.2	14.5	48.00	9998.7	PV generator
Test f)	230.2	14.5	47.50	9997.2	PV generator
Supplementary information: During the test, under-frequency protection is disabled.					

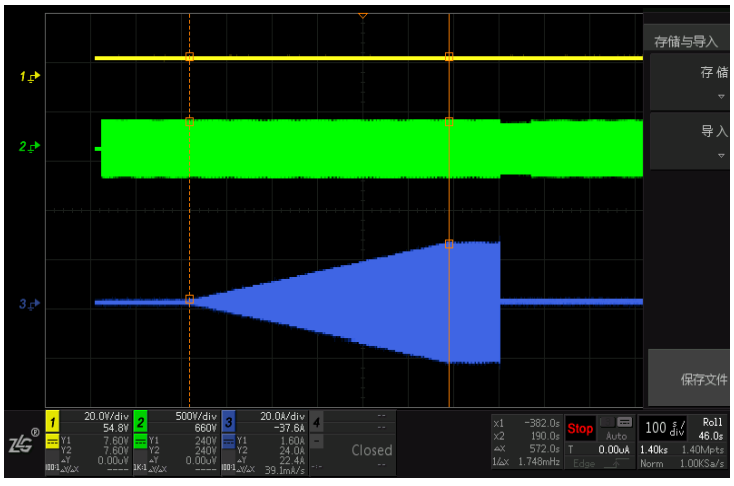
c) Transient voltage phase jumps

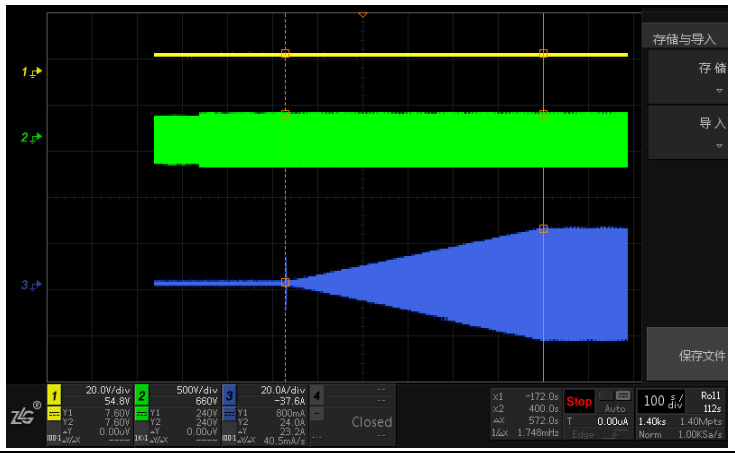
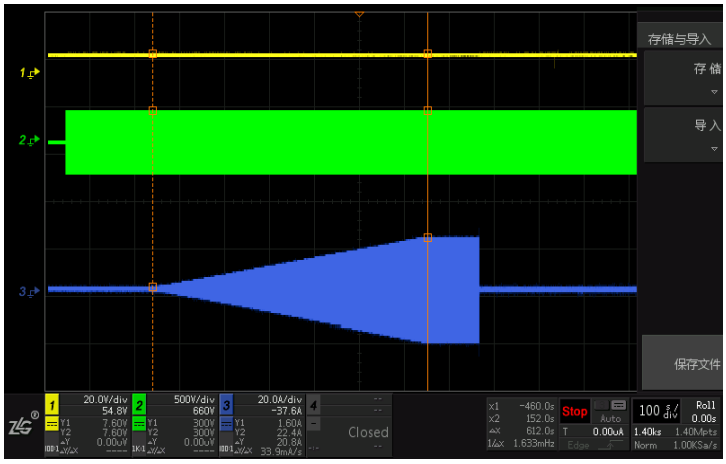
Transient voltage phase jumps			P
	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.5 Hz	+20 degrees	No trip
Negative Vector Shift	50.5 Hz	-20 degrees	No trip

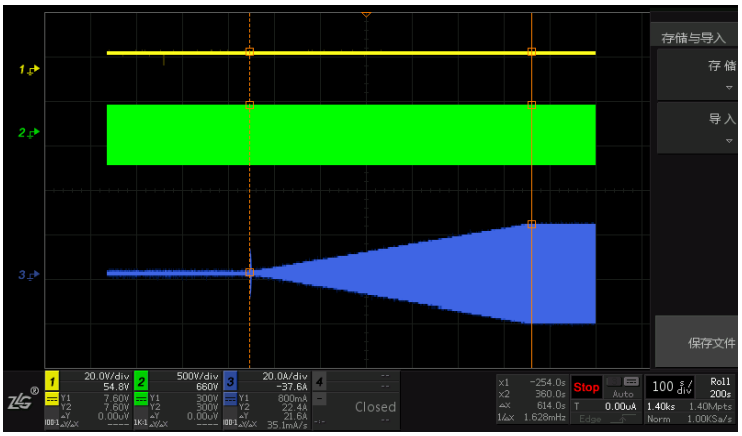
3、 Start-up and reconnection

a）Eastern Denmark

Starting to generate electrical power Automatic reconnection after tripping		**P**
Setting values	Min.voltage for connected to grid	195.5V
	Max.voltage for connected to grid	253.0 V
	Min.Frequency for connected to grid	49.9Hz
	Max.Frequency for connected to grid	50.1Hz
	Observation time (180s)	180s

Test:		
	Voltage conditions	
a) start up for voltage range	＜85%U_n for twice of setting observation time	＞110%U_n for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	
b) in voltage range at start up	□≥85%U_n within twice of setting observation time	□≤110%U_n within twice of setting observation time
Reconnection time[s]	194s	190s
Limit:	Reconnection after setting observation time(180s)	
Gradient		
c) In voltage range after voltage failture	⩾85%U_n for twice of setting observation time	⩽110%U_n for twice of setting observation time
Reconnection time[s]	192s	188s
Limit:	Reconnection after setting observation time(≥180s)	

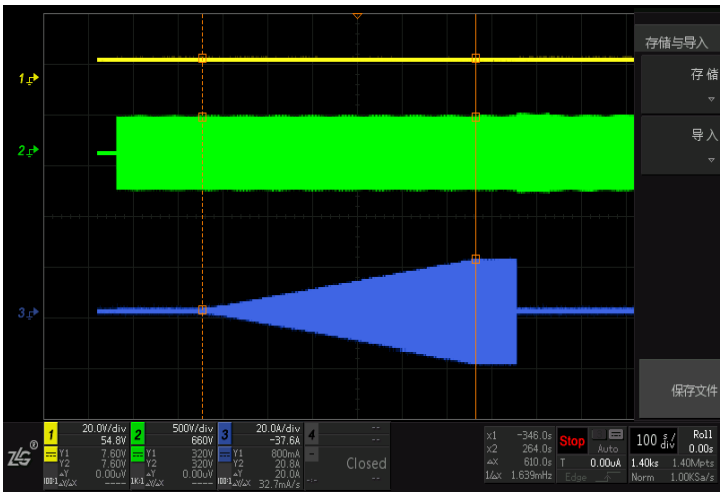
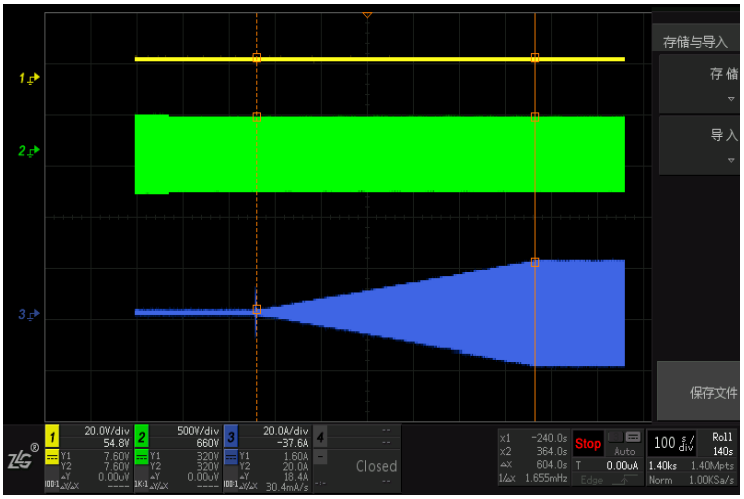
Gradient		
	Frequency conditions	
d) start up for frequency range	＜49.9Hz for twice of setting observation time	＞50.1Hz for twice of setting observation time
Connection	No connection	No connection
Limit	No connection allowed	
e) in frequency range at start up	⩾49.9Hz witnin twice of setting observation time	⩽50.1Hz witnin twice of setting observation time
Reconnection time[s]	194s	190s
Limit:	Reconnection after setting observation time(≥180s)	
Gradient		
f) In frequency range after frequency failture	≥49.9Hz for twice of setting observation time	≤50.1Hz for twice of setting observation time
Reconnection time[s]	190s	182s
Limit:	Reconnection after setting observation time(≥180s)	

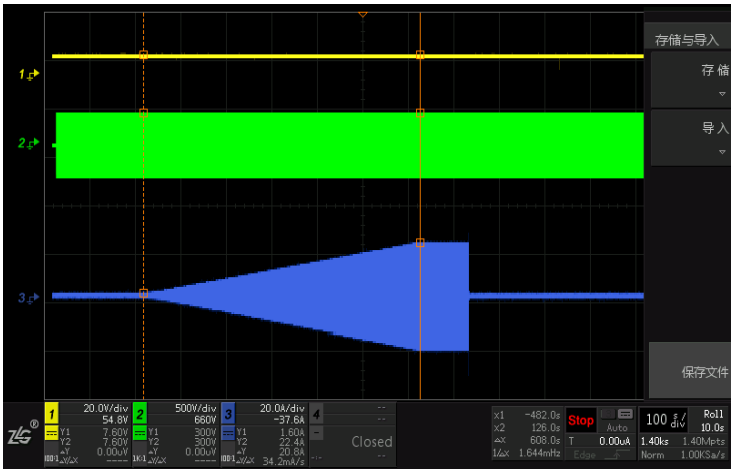
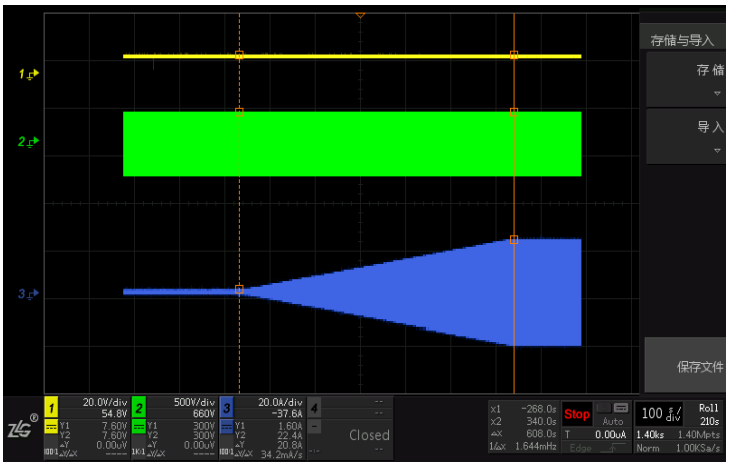
Gradient	

b) Western Denmark

Starting to generate electrical power Automatic reconnection after tripping		**P**
Setting values	Min.voltage for connected to grid	195.5V
	Max.voltage for connected to grid	253.0 V
	Min.Frequency for connected to grid	49.8Hz
	Max.Frequency for connected to grid	50.2Hz
	Observation time (180s)	180s

Test:		
	Voltage conditions	
a) start up for voltage range	＜85%U_n for twice of setting observation time	＞110%U_n for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	
b) in voltage range at start up	□≥85%U_n within twice of setting observation time	□≤110%U_n within twice of setting observation time
Reconnection time[s]	194s	192s
Limit:	Reconnection after setting observation time(180s)	

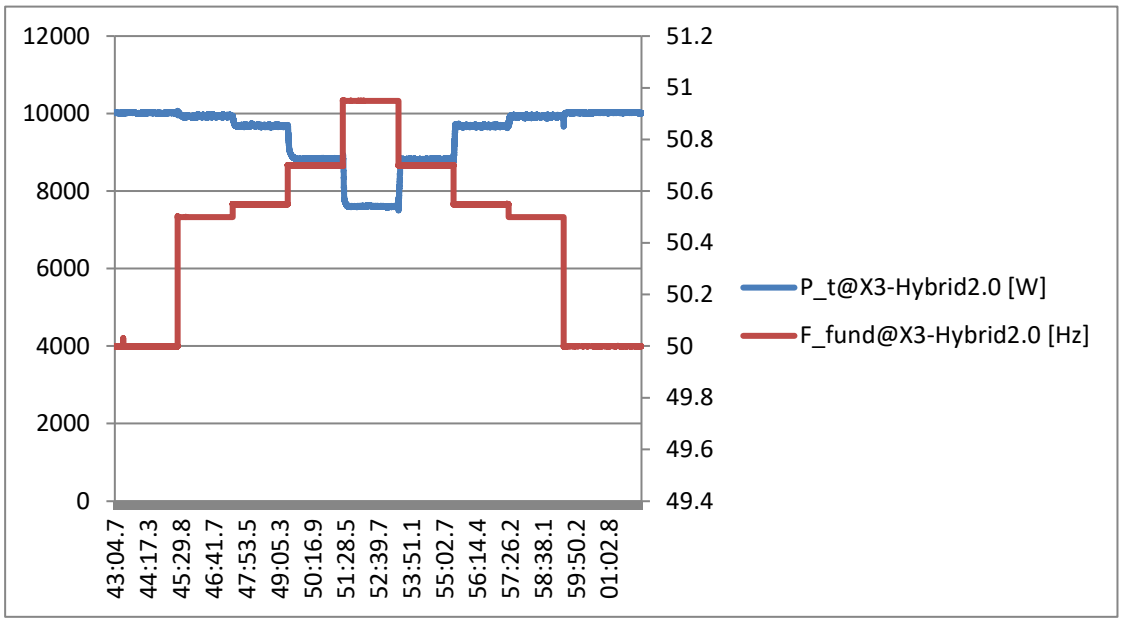
Gradient		
c) In voltage range after voltage failture	⩾85%U_n for twice of setting observation time	⩽110%U_n for twice of setting observation time
Reconnection time[s]	192s	192s
Limit:	Reconnection after setting observation time(≥180s)	
Gradient		
	Frequency conditions	
d) start up for frequency range	＜49.8Hz for twice of setting observation time	＞50.2Hz for twice of setting observation time
Connection	No connection	No connection
Limit	No connection allowed	
e) in frequency range at start up	⩾49.8Hz witnin twice of setting observation time	⩽50.2Hz witnin twice of setting observation time
Reconnection time[s]	192s	191s
Limit:	Reconnection after setting observation time(≥180s)	

Gradient		
f) In frequency range after frequency failture	≥49.8Hz for twice of setting observation time	≤50.2Hz for twice of setting observation time
Reconnection time[s]	194s	194s dso_38
Limit:	Reconnection after setting observation time(≥180s)	
Gradient		

4、 power response to overfrequency

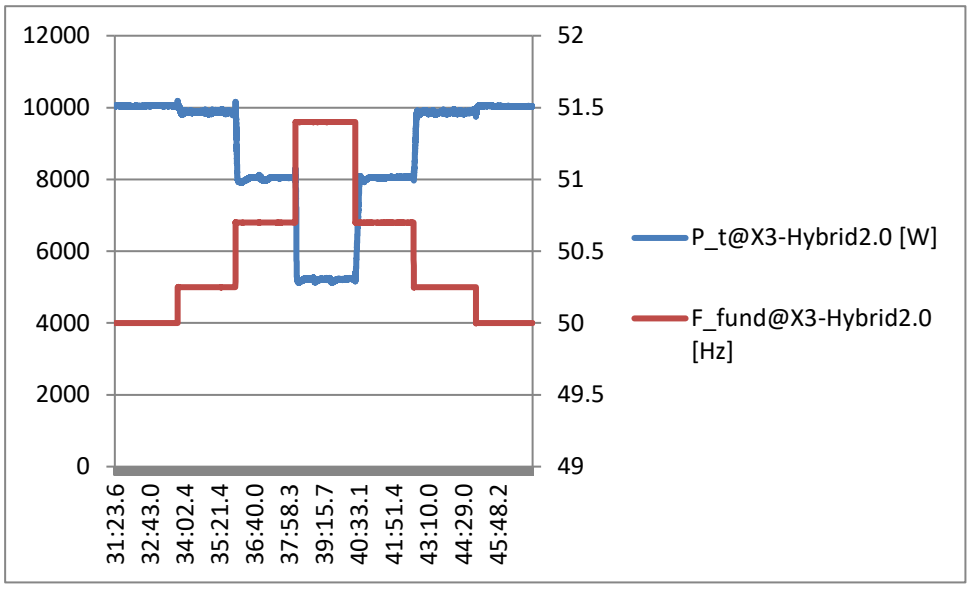
a) Eastern Denmark

Power response to overfrequency						**P**
Setting values	Parameter		Range		Default setting	
	Threshold frequency f_{RO}		50.2 Hz to 50.5 Hz		50.5 Hz	
	Droop		2 % to 12 %		4 %	
Test:						
2-min mean value	a) 50.00Hz	b) 50.50Hz	c) 50.55Hz	d) 50.70Hz	e) 50.95Hz	f) 50.70Hz
	g) 50.55Hz		H) 50.50Hz		i) 50.00Hz	
Graph of Measurement a) to i) : Active power output>80%P_{Emax}						



b) Western Denmark

Power response to overfrequency							**P**
Setting values	Parameter		Range		Default setting		
	Threshold frequency f_{RO}		50.2 Hz to 50.5 Hz		50.2 Hz		
	Droop		2 % to 12 %		5 %		
Test:							
2-min mean value	a) 50.00Hz	b) 50.25Hz	c) 50.70Hz	d) 51.40Hz	e) 50.70Hz	f) 50.25Hz	g) 50.00Hz
Graph of Measurement a) to g) : Active power output>80%P_{Emax}							



5、Reactive power control

Reactive power control	**P**

Test 1:Power Factor control

Cos φ set=0.9 (inductive)

Power - Bin (P/Sn)	Active power [W]	Apparent power [VA]	Reactive power [Var]	Power factor [cosφ]	ΔCosφ	LIMIT Δcosφ_max
10%	1047.9	1171.9	-512.9	0.898	-0.002	±0.01
20%	1972.9	2207.5	-985.1	0.895	-0.005	±0.01
30%	2995.3	3339.1	-1472.0	0.897	-0.003	±0.01
40%	4035.2	4489.6	-1964.7	0.899	-0.001	±0.01
50%	5057.2	5621.4	-2450.9	0.900	0.000	±0.01
60%	6059.5	6731.8	-2928.2	0.900	0.000	±0.01
70%	7102.6	7888.1	-3426.0	0.901	0.001	±0.01
80%	8092.9	8986.2	-3899.3	0.901	0.001	±0.01
90%	9088.5	10088.7	-4371.1	0.901	0.001	±0.01
100%	9217.7	10231.2	-4431.3	0.901	0.001	±0.01

Cos φ set=0.9 (capacitive)

Power - Bin (P/Sn)	Active power [W]	Apparent power [VA]	Reactive power [Var]	Power factor [cosφ]	ΔCosφ	LIMIT Δcosφ_max
10%	1034.6	1157.5	495.0	0.894	-0.006	±0.01
20%	2034.0	2251.5	953.9	0.903	0.003	±0.01
30%	3020.4	3349.7	1441.3	0.902	0.002	±0.01
40%	4007.1	4448.4	1925.7	0.901	0.001	±0.01
50%	5008.4	5565.2	2420.6	0.900	0.000	±0.01
60%	5997.6	6667.3	2906.4	0.900	0.000	±0.01
70%	6998.9	7784.2	3400.0	0.899	-0.001	±0.01
80%	7989.6	8890.7	3900.1	0.899	-0.001	±0.01
90%	8983.7	9997.8	4377.0	0.899	-0.001	±0.01
100%	8985.6	9999.7	4377.4	0.899	-0.001	±0.01

Cos φ set=1.0

Power - Bin (P/Sn)	Active power [W]	Apparent power [VA]	Reactive power [Var]	Power factor [cosφ]	ΔCosφ	LIMIT Δcosφ_max

10%	1026.5	1032.8	113.3	0.994	-0.006	±0.01
20%	2028.8	2031.4	103.5	0.999	-0.001	±0.01
30%	3041.4	3043.4	108.1	0.999	-0.001	±0.01
40%	4039.8	4041.5	119.7	0.999	-0.001	±0.01
50%	5027.9	5029.7	134.5	1.000	0.000	±0.01
60%	6020.3	6022.3	155.2	1.000	0.000	±0.01
70%	7023.7	7026.0	179.5	1.000	0.000	±0.01
80%	8053.2	8055.8	207.2	1.000	0.000	±0.01
90%	9012.0	9015.4	249.2	1.000	0.000	±0.01
100%	10018.1	10022.5	299.4	1.000	0.000	±0.01

Test 2: Automatic Power Factor control

Lock-in: 1.05Vn (Vn and 1.1 Vn with steps of 0.01)

Lock-out: 1.00Vn (0.9 Vn and Vn with steps of 0.01)

P/Pn[%] setpoint	P[W]	P/Pn [%]	Vout/Vn	Q[Var]	Cosφ measured	Cosφ Set-point	ΔCosφ	LIMIT Δcosφ_max
10	1045.4	10.5	1.02	108.9	0.995	1.00	-0.005	±0.01
20	2045.3	20.5	1.02	110.4	0.999	1.00	-0.001	±0.01
30	3064.1	30.6	1.02	119.7	0.999	1.00	-0.001	±0.01
50	5082.6	50.8	1.02	148.2	1.000	1.00	0.000	±0.01
60	5986.1	59.9	1.02	166.8	1.000	1.00	0.000	±0.01
60	6039.8	60.4	1.06	-1230.0	0.979	0.98	-0.001	±0.01
75	7490.6	74.9	1.06	-2396.5	0.952	0.95	0.002	±0.01
100	9416.6	94.2	1.06	-4107.5	0.917	0.90	0.017	±0.01
100	10018.2	100.2	0.98	304.4	1.000	1.00	0.000	±0.01

Response time measurement: Standard characteristic curve for cos φ (P)

Power step under applied cosφ(P)-curve setted through control panel	Measured cosφ	Active Power [W]	Apparent Power [VA]	Reactive Power [Var]	Response time to new reactive power set value [s]	Settling time limit [s]
20% P_{max}, cosφ=1.0	0.999	1995.3	1999.7	103.8	--	--
50% P_{max}, cosφ=1.0	0.999	5019.8	5020.9	161.9	--	--
90% P_{max}, cosφ=0.92	0.924	9060.3	9806.2	-3761.4	1.0	10

90% P_{max}, cosφ=0.92	0.924	9059.9	9810.9	-3761.9	--	--
50% P_{max}, cosφ=1.0	0.999	5018.5	5021.4	159.9	1.0	10
20% P_{max}, cosφ=1.0	0.999	1996.5	1999.1	101.6	--	--

Test 3: Q control

$Q=Q_{cmax}$ (Q_{cmax}=43.6% Sn)

Power-Bin (P/Sn)	Active power [W]	Apparent power [VA]	Reactive Power [VAr]	Reactive Power/Sn	Reactive Power/Sn setpoint	Deviation [%]	ΔQ/Sn limit [%]
10%	1045.7	4509.0	4384.8	43.8%	43.6%	0.2%	+/-2%
20%	2010.2	4804.2	4361.9	43.6%	43.6%	0.0%	+/-2%
30%	3040.0	5316.0	4358.9	43.6%	43.6%	0.0%	+/-2%
40%	4030.3	5938.5	4358.7	43.6%	43.6%	0.0%	+/-2%
50%	5042.0	6667.3	4359.0	43.6%	43.6%	0.0%	+/-2%
60%	6056.0	7463.2	4357.2	43.6%	43.6%	0.0%	+/-2%
70%	7066.6	8305.7	4352.1	43.5%	43.6%	0.1%	+/-2%
80%	8083.4	9188.3	4360.6	43.6%	43.6%	0.0%	+/-2%
90%	8992.4	9998.4	4360.4	43.6%	43.6%	0.0%	+/-2%
100%	8983.9	9990.6	4360.1	43.6%	43.6%	0.0%	+/-2%

$Q= Q_{Lmax}$ (Q_{Lmax} = -43.6% Sn)

Power-Bin (P/Sn)	Active power [W]	Apparent power [VA]	Reactive Power [VAr]	Reactive Power/Sn	Reactive Power/Sn setpoint	Deviation [%]	ΔQ/Sn limit [%]
10%	1062.7	4552.2	-4425.8	-44.3%	-43.6%	0.7%	+/-2%
20%	2074.3	4906.5	-4445.7	-44.5%	-43.6%	0.9%	+/-2%
30%	2990.1	5356.1	-4442.6	-44.4%	-43.6%	0.8%	+/-2%
40%	3999.6	5980.6	-4444.9	-44.4%	-43.6%	0.8%	+/-2%
50%	5013.5	6701.6	-4444.8	-44.4%	-43.6%	0.8%	+/-2%
60%	6001.7	7468.6	-4442.1	-44.4%	-43.6%	0.8%	+/-2%
70%	7092.3	8371.1	-4442.5	-44.4%	-43.6%	0.8%	+/-2%
80%	8094.7	9237.7	-4445.0	-44.5%	-43.6%	0.9%	+/-2%
90%	9056.3	10091.8	-4445.0	-44.5%	-43.6%	0.9%	+/-2%
100%	9172.1	10196.8	-4446.7	-44.5%	-43.6%	0.9%	+/-2%

6、Control functions

Control functions	**P**

Test 1: Absolute power constraint

Pnl is the designation for rated power supplied by an energy storage facility.

Pno denotes the nominal power absorbed by an energy storage facility.

Set-point P/ P_{nl} [%]	Set-point P [W]	Measured P [W]	Accuracy [%]	Required accuracy of Set-point P [%]
10%	1000.0	1002.5	0.25	±5%
20%	2000.0	2002.3	0.12	±5%
30%	3000.0	3032.6	1.08	±5%
40%	4000.0	4035.5	0.89	±5%
50%	5000.0	5039.2	0.78	±5%
60%	6000.0	6049.5	0.83	±5%
70%	7000.0	7079.1	1.13	±5%
80%	8000.0	8067.8	0.85	±5%
90%	9000.0	9084.8	0.94	±5%
100%	10000.0	10098.1	0.98	±5%

Note:

Accuracy of the control performed and of the set point must not deviate by more than ±5% of the set point value or ±0.5% of rated power, depending which yields the highest tolerance.

Set-point P/ P_{no} [%]	Set-point P [W]	Measured P [W]	Accuracy [%]	Required accuracy of Set-point P [%]
10%	-1000	-1025.1	2.51	±5%
20%	-2000	-2058.7	2.94	±5%
30%	-3000	-3063.3	2.11	±5%
40%	-4000	-4071.5	1.79	±5%
50%	-5000	-5096.4	1.93	±5%
60%	-6000	-6100.0	1.67	±5%
70%	-7000	-7121.7	1.74	±5%
80%	-8000	-8145.3	1.82	±5%
90%	-9000	-9153.3	1.70	±5%
100%	-10000	-10179.4	1.79	±5%

Test 2: Ramp rate constraint function					
Test sequence	Measured stable active power of start point P[W]	Measured stable active power of end point P[W]	Time elapsed [s] (from start to time for output power last entered 5% tolerance band around the set-point)	Power gradient [%P_n/min]	Ramp rate limit[%P_n/min]
100% P_{nl} to 5% P_{nl}	10092.2	498.9	567	10.15	≥1% and ≤20%
5% P_{nl} to 100% P_{nl}	497.1	10100.1	564	10.22	≥1% and ≤20%
100% P_{no} to 5% P_{no}	-10163.6	-510.1	566	10.23	≥1% and ≤20%
5% P_{no} to 100% P_{no}	-527.9	-10177.8	566	10.23	≥1% and ≤20%