TEST REPORT

Grid-connected Inverter Regulation of Provincial Electricity Authority(PEA)

Report Number. .....:	ES190510002P
Date of issue.....:	May 10. 2019
Total number of pages.....	48 pages
Testing Laboratory Name .....:	EMTEK (SHENZHEN) CO., LTD.
Address.....:	Bldg 69. Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China
Applicant's name.....:	Shenzhen ATESS Power Technology Co.,Ltd
Address.....:	1st Floor of Building 3 at Sector B and 3rd Floor of Building 9, Henglong Industrial Park, No.4 Industrial Zone, Shuitian Community, Shiyan Street, Baoan District, Shenzhen
Test specification:	
Standard .....:	IEC 61727-2004. IEC 62116-2014
Non-standard test method…….....:	N/A
Test item description……..:	Hybrid Power systems
Trade mark…….....	ATESS
Reference……..:	N/A
Number……..:	HPS100
Firmware version……:	TI1.0
Date of receipt of test item.....:	May 05. 2019
Date(s) of performance of test.....:	May 05. 2019 to May 10. 2019
Date of report issue .....:	May 10. 2019

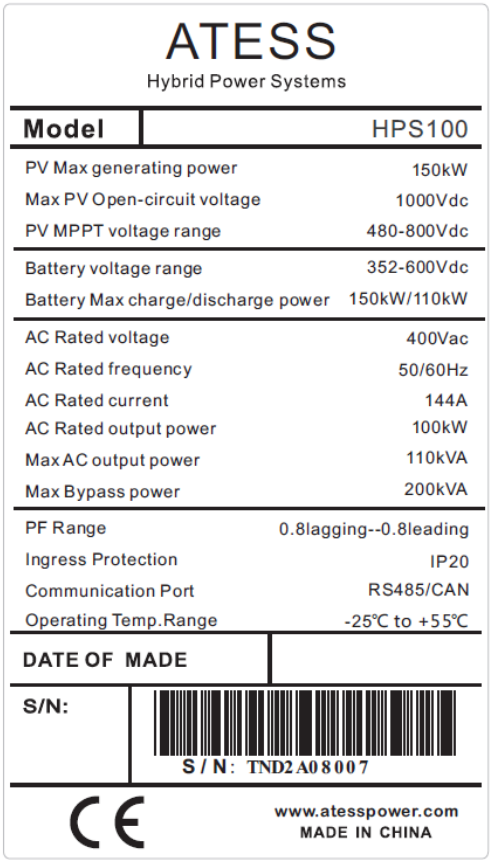
Tested by	Review by	Approved by
Tom Tao	Double Lee	
(Mr. Tom Tao)	(Mr. Double Lee)	(Mr. Paladin Hu)
Testing Engineer	Project Engineer	Department Manager
(2019-05-10)	(2019-05-10)	(2019-05-10)

Summary of testing

Test result of Hybrid power systems model HPS100, It was tested by SHENZHEN EMTEK CO., LTD and complied according to requirements on grid connection of Provincial Electricity Authority (PEA) as following

Clause	Item	Standard method	Result
1	Harmonics	IEC 61000-3-2	PASS
2	Voltage Fluctuation	IEC 61000-3-5	PASS
3	Direct Current Injection	IEC 61727	PASS
4	Reactive Power Control	PEA	PASS
5	Active Power Control	PEA	PASS
6	Low Voltage Fault Ride Through	PEA	PASS
7	Under and Over Voltage Protection	IEC 61727	PASS
8	Under and Over Frequency Protection	IEC 61727	PASS
9	Anti-Islanding	IEC 62116	PASS
10	Response to Utility Recovery	IEC 61727	PASS

Copy of marking plate:



Test item particulars .....

Type of the Test……..: [x] Design Test []Routine Test

Rating

MPP DC voltage range [V] ..... : 480-820Vd.c

Input DC voltage max [V] ..... : 820Vd.c

Input DC current max [A]..... : 250A

Output AC voltage [V]..... : 400Va.c

Output AC current rated [A] .....: 144A

Output power [W]..... : 100kW

Equipment mobility ..... : [x] movable [] hand-held
[] stationary []fixed
[] transportable [] for building-in

Connection to the mains..... : []pluggable equipment [] direct plug-in
[x] permanent connection [] for building-in

Mass of equipment (kg) .....: For Inverter: 1465kg

IP protection class .....: IP20

Possible test case verdicts:

– test case does not apply to the test object ... N/A

– test object does meet the requirement ..... Pass (P)

– test object does not meet the requirement .... Fail (F)

General remarks:

"(see Attachment #)" refers to additional information appended to the report.

"(see table)" refers to a table appended to the report.

The tests results presented in this report relate only to the object tested.

This report shall not be **reproduced** except in full without the written approval of the testing laboratory. List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attachments to this report.

Throughout this report a comma /point is used as the decimal separator.

GRID-CONNECTED INVERTER REGULATION OF PROVINCIAL ELECTRICITY AUTHORITY (PEA)			
Clause	Requirement – Test	Result – Remark	Verdict
1	Harmonics		P
	The power generating system of VSPP must not inject harmonic current to the grid system exceeding the limit based on the PEA's rules concerning the Regulations of Grid Connection B.E.2559. In terms of verification at other levels of voltage beyond the aforementioned requirements, the appropriate standard of IEC must be applied.	See table 1	P
2	Voltage Fluctuation		P
	The power generating system of VSPP must not create voltage fluctuation exceeding the limit based on the PEA's rules concerning the Regulations on Grid Connection B.E.2559.		P
	Inverters shall not cause voltage fluctuation beyond the limits defined by the IEC 61000-3-3 (2008) for inverters with rated current ≤ 16 A		N
	IEC 61000-3-5 (2009) for inverters with rated currents greater than 75 A or	See table 2	P
	IEC 61000-3-11 (2000) for inverters with rated currents ≤75 A.		N
3	Direct Current Injection		P
	The power generating system of VSPP must not supply direct current to the grid system exceeding the limit based on the PEA's regulations concerning the Regulations on Grid Connection B.E.2559.	See table 3	P
4	Reactive Power Control		P
	The power generating system of VSPP must be able to control power factor (PF) or reactive power to maintain voltage level at PCC aligned with PEA's standards. The power generating system of service applicants must have capacity as stated in Table 1.	See table 4	P
4.1	Voltage Level at PCC is Low voltage Capacity in Adjusting Power Factor at 0.95 lagging to 0.95 leading as a minimum Reactive Power Control Methods: At least one method can control which is a fixed displacement factor cos θ	See table 4.1	P
4.2	Voltage Level at PCC is moderate voltage or high voltage (electrical installation not exceeding 500 kilowatt). Capacity in Adjusting Power Factor at 0.95 lagging to 0.95 leading as a minimum Reactive Power Control Methods: At least one method can control which is a fixed displacement factor cos θ		N

GRID-CONNECTED INVERTER REGULATION OF PROVINCIAL ELECTRICITY AUTHORITY (PEA)			
Clause	Requirement – Test	Result – Remark	Verdict
4.3	Voltage Level at PCC is Moderate voltage or high voltage (electrical installation exceeding 500 kilowatt). Capacity in Adjusting Power Factor at 0.90 lagging to 0.90 leading as a minimum		N
	Reactive Power Control Methods: can control which a fixed displacement factor cos θ		N
	Reactive Power Control Methods: can control which a variable reactive power depending on the voltage Q(U)		N
5	Active Power Control		P
	The power generating system of VSPP must be capable of reducing electric power from 100% to zero by decreasing 10% electric power per one minute. In this regard, if there is any abnormality occurred in the grid system or any incident considered by PEA as an impact affecting safety and stability of the grid system, PEA would inform and/or give an order to the VSPP to reduce electric power as appropriate.	See table 5	P
6	Low Voltage Fault Ride Through		P
	The power system of VSPP must not disconnect itself from the grid system within the required period during temporary low voltage of the grid system. The voltage at PCC is determined as shown in Table 2. Table 2. Duration of Low Voltage Fault Ride Through	See table 6	P
7	Under and Over Voltage Protection		P

Voltage at PCC	Duration Time (Second)
1) Low voltage 2) Moderate voltage or high voltage (electrical installation not exceeding 500kilowatt)	Not required
3) Moderate voltage or high voltage (electrical installation exceeding 500kilowatt).	As shown in Picture 1.

GRID-CONNECTED INVERTER REGULATION OF PROVINCIAL ELECTRICITY AUTHORITY (PEA)			
Clause	Requirement – Test	Result – Remark	Verdict
	The power system of VSPP must disconnect itself from the grid system if voltage level of line to neutral in the utility system is out of ranges as stated in Table 3 Table 3. The Disconnect Duration of Falling Voltage Out of Rated Voltage Ranges	see table 7	P
8	Under and Over Frequency Protection		P
	The power generating system of VSPP must disconnect itself from the grid system within 0.1 seconds if the frequency at PCC is not in the range of 47Hz-52Hz.	See table 8	P
9	Anti-Islanding		P
	In order to prevent anti-islanding while there is no electricity in grid system to be supplied to the power system of VSPP, the power generating system of VSPP must disconnect itself from the utility system within 1 seconds	See table 9	P
10	Response to Utility Recovery		P
	After the power generating system of VSPP disconnect itself from the grid system because of power outage or voltage/frequency is out of the ranges, when the grid system is back to normal, the power system of VSPP must delay the time to reconnect itself to the grid system at a minimum of 20 seconds to 5 minutes.	See table 10	P

1	TABLE: Current Harmonics								P
	Condition of test						Power(kW)		
	supplying power to balance linear loads 33% ±5%						33.290		P
	supplying power to balance linear loads 66 %±5%						66.656		P
	supplying power to balance linear loads 100 %±5%						99.946		P
	Output Current Harmonics Measurement							Limit (% of output current)	Result
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase		
	(A)	(%)	(A)	(%)	(A)	(%)			
1	47.683	99.938	96.704	99.945	144.954	99.963	L1	-	P
2	0.072	0.188	0.140	0.181	0.234	0.202	L1	<1%	P
3	0.187	0.491	0.397	0.513	0.561	0.484	L1	<4%	P
4	0.071	0.187	0.153	0.198	0.232	0.200	L1	<1%	P
5	0.482	1.264	1.454	1.880	2.383	2.054	L1	<4%	P
6	0.029	0.075	0.066	0.085	0.104	0.090	L1	<1%	P
7	0.167	0.439	0.849	1.098	1.576	1.359	L1	<4%	P
8	0.043	0.112	0.090	0.116	0.137	0.118	L1	<1%	P
9	0.051	0.134	0.110	0.142	0.157	0.135	L1	<4%	P
10	0.040	0.106	0.097	0.126	0.143	0.123	L1	<1%	P
11	0.129	0.339	0.431	0.557	0.992	0.855	L1	<2%	P
12	0.046	0.121	0.097	0.125	0.151	0.130	L1	<0.5%	P
13	0.134	0.350	0.271	0.350	0.688	0.593	L1	<2%	P
14	0.055	0.143	0.114	0.148	0.193	0.166	L1	<0.5%	P
15	0.064	0.168	0.135	0.174	0.210	0.181	L1	<2%	P
16	0.060	0.158	0.132	0.170	0.195	0.168	L1	<0.5%	P
17	0.151	0.397	0.180	0.233	0.556	0.479	L1	<1.5%	P
18	0.066	0.173	0.135	0.175	0.209	0.180	L1	<0.375%	P
19	0.104	0.272	0.187	0.242	0.430	0.371	L1	<1.5%	P
20	0.076	0.199	0.151	0.195	0.244	0.210	L1	<0.375%	P
21	0.076	0.200	0.157	0.203	0.251	0.216	L1	<1.5%	P
22	0.079	0.207	0.162	0.210	0.248	0.214	L1	<0.375%	P
23	0.119	0.313	0.222	0.287	0.389	0.335	L1	<0.6%	P
24	0.085	0.124	0.176	0.127	0.264	0.128	L1	<0.15%	P
25	0.106	0.279	0.211	0.273	0.327	0.282	L1	<0.6%	P
26	0.093	0.045	0.191	0.047	0.293	0.053	L1	<0.15%	P
27	0.097	0.253	0.199	0.257	0.296	0.255	L1	<0.6%	P
28	0.099	0.060	0.203	0.062	0.309	0.066	L1	<0.15%	P
29	0.119	0.013	0.246	0.038	0.355	0.066	L1	<0.6%	P
30	0.105	0.075	0.215	0.078	0.324	0.079	L1	<0.15%	P
31	0.132	0.346	0.234	0.302	0.342	0.295	L1	<0.6%	P
32	0.114	0.099	0.235	0.094	0.349	0.091	L1	<0.15%	P
33	0.115	0.302	0.238	0.308	0.355	0.306	L1	<0.6%	P
34	0.008	0.022	0.043	0.056	0.013	0.011	L1	<0.15%	P
35	0.023	0.059	0.020	0.026	0.009	0.008	L1	<0.3%	P
36	0.005	0.013	0.015	0.019	0.002	0.002	L1	<0.075%	P
37	0.038	0.100	0.087	0.113	0.010	0.009	L1	<0.3%	P
38	0.014	0.037	0.011	0.014	0.009	0.008	L1	<0.075%	P
39	0.006	0.015	0.015	0.020	0.003	0.003	L1	<0.3%	P
40	0.020	0.053	0.008	0.010	0.007	0.006	L1	<0.075%	P
THDi	---	2.770	---	2.680	---	3.140	L1	≤ 5%	P
Supplementary information:									

1	TABLE: Current Harmonics								P
	Condition of test						Power (kW)		
	supplying power to balance linear loads 33% ±5%						33.290		P
	supplying power to balance linear loads 66 %±5%						66.656		P
	supplying power to balance linear loads 100 %±5%						99.946		P
	Output Current Harmonics Measurement							Limit (% of output current)	Result
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase		
	(A)	(%)	(A)	(%)	(A)	(%)			
1	48.113	99.923	96.000	99.945	145.013	99.969	L2		P
2	0.376	0.985	0.690	0.892	1.150	0.991	L2	<1%	P
3	0.165	0.433	0.326	0.421	0.757	0.653	L2	<4%	P
4	0.049	0.128	0.132	0.171	0.252	0.217	L2	<1%	P
5	0.799	2.095	1.338	1.730	3.234	2.788	L2	<4%	P
6	0.018	0.046	0.071	0.092	0.125	0.108	L2	<1%	P
7	0.478	1.254	0.923	1.193	1.830	1.578	L2	<4%	P
8	0.017	0.045	0.042	0.054	0.071	0.061	L2	<1%	P
9	0.043	0.114	0.097	0.126	0.187	0.161	L2	<4%	P
10	0.035	0.091	0.053	0.069	0.179	0.154	L2	<1%	P
11	0.293	0.767	0.399	0.516	1.348	1.162	L2	<2%	P
12	0.014	0.038	0.024	0.031	0.060	0.052	L2	<0.5%	P
13	0.233	0.610	0.380	0.491	0.796	0.686	L2	<2%	P
14	0.035	0.093	0.061	0.079	0.152	0.131	L2	<0.5%	P
15	0.098	0.256	0.217	0.280	0.168	0.145	L2	<2%	P
16	0.075	0.197	0.105	0.136	0.387	0.334	L2	<0.5%	P
17	0.278	0.729	0.552	0.713	0.536	0.462	L2	<1.5%	P
18	0.019	0.050	0.036	0.047	0.065	0.056	L2	<0.375%	P
19	0.137	0.358	0.331	0.428	0.495	0.427	L2	<1.5%	P
20	0.030	0.079	0.050	0.065	0.184	0.159	L2	<0.375%	P
21	0.032	0.085	0.071	0.092	0.166	0.143	L2	<1.5%	P
22	0.025	0.065	0.030	0.039	0.052	0.045	L2	<0.375%	P
23	0.077	0.201	0.108	0.140	0.510	0.440	L2	<0.6%	P
24	0.005	0.012	0.015	0.020	0.051	0.044	L2	<0.15%	P
25	0.044	0.115	0.040	0.052	0.316	0.272	L2	<0.6%	P
26	0.010	0.027	0.008	0.010	0.063	0.054	L2	<0.15%	P
27	0.006	0.017	0.013	0.017	0.029	0.025	L2	<0.6%	P
28	0.004	0.010	0.004	0.005	0.030	0.026	L2	<0.15%	P
29	0.018	0.046	0.019	0.024	0.148	0.128	L2	<0.6%	P
30	0.004	0.010	0.003	0.004	0.023	0.020	L2	<0.15%	P
31	0.027	0.071	0.023	0.030	0.153	0.132	L2	<0.6%	P
32	0.007	0.019	0.010	0.013	0.041	0.035	L2	<0.15%	P
33	0.003	0.007	0.002	0.003	0.023	0.020	L2	<0.6%	P
34	0.003	0.008	0.004	0.005	0.026	0.022	L2	<0.15%	P
35	0.007	0.018	0.003	0.004	0.068	0.059	L2	<0.3%	P
36	0.003	0.009	0.005	0.006	0.015	0.013	L2	<0.075%	P
37	0.020	0.052	0.008	0.010	0.116	0.100	L2	<0.3%	P
38	0.006	0.016	0.002	0.003	0.043	0.037	L2	<0.075%	P
39	0.006	0.015	0.009	0.011	0.017	0.015	L2	<0.3%	P
40	0.008	0.022	0.003	0.004	0.061	0.053	L2	<0.075%	P
THDi	---	2.204	---	1.982	---	2.643	L2	≤ 5%	P
Supplementary information:									

1	TABLE: Current Harmonics								P
	Condition of test						Power(kW)		
	supplying power to balance linear loads 33% ±5%						33.290		P
	supplying power to balance linear loads 66 %±5%						66.656		P
	supplying power to balance linear loads 100 %±5%						99.946		P
	Output Current Harmonics Measurement							Limit (% of output current)	Result
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase		
	(A)	(%)	(A)	(%)	(A)	(%)			
1	48.075	99.946	97.144	99.965	145.000	99.973	L3		P
2	0.087	0.227	0.184	0.238	0.295	0.254	L3	<1%	P
3	0.140	0.367	0.323	0.417	0.469	0.404	L3	<4%	P
4	0.074	0.195	0.151	0.195	0.227	0.196	L3	<1%	P
5	0.468	1.228	1.386	1.792	2.275	1.961	L3	<4%	P
6	0.028	0.074	0.060	0.078	0.101	0.087	L3	<1%	P
7	0.202	0.529	0.948	1.226	1.724	1.486	L3	<4%	P
8	0.041	0.108	0.087	0.113	0.133	0.115	L3	<1%	P
9	0.055	0.144	0.142	0.184	0.187	0.161	L3	<4%	P
10	0.041	0.107	0.104	0.134	0.146	0.126	L3	<1%	P
11	0.120	0.315	0.406	0.525	0.920	0.793	L3	<2%	P
12	0.046	0.121	0.098	0.127	0.150	0.129	L3	<0.5%	P
13	0.150	0.393	0.306	0.396	0.781	0.673	L3	<2%	P
14	0.054	0.141	0.112	0.145	0.187	0.161	L3	<0.5%	P
15	0.071	0.187	0.134	0.173	0.217	0.187	L3	<2%	P
16	0.061	0.161	0.134	0.173	0.200	0.172	L3	<0.5%	P
17	0.132	0.346	0.191	0.247	0.516	0.445	L3	<1.5%	P
18	0.066	0.174	0.136	0.176	0.205	0.177	L3	<0.375%	P
19	0.122	0.321	0.183	0.236	0.495	0.427	L3	<1.5%	P
20	0.076	0.199	0.151	0.195	0.239	0.206	L3	<0.375%	P
21	0.093	0.244	0.157	0.203	0.261	0.225	L3	<1.5%	P
22	0.080	0.209	0.163	0.211	0.247	0.213	L3	<0.375%	P
23	0.109	0.287	0.207	0.267	0.378	0.326	L3	<0.6%	P
24	0.085	0.124	0.175	0.126	0.266	0.129	L3	<0.15%	P
25	0.109	0.286	0.227	0.294	0.358	0.309	L3	<0.6%	P
26	0.093	0.144	0.190	0.145	0.287	0.147	L3	<0.15%	P
27	0.097	0.254	0.207	0.267	0.302	0.26	L3	<0.6%	P
28	0.099	0.066	0.203	0.062	0.310	0.067	L3	<0.15%	P
29	0.115	0.302	0.227	0.294	0.345	0.297	L3	<0.6%	P
30	0.105	0.076	0.217	0.078	0.322	0.078	L3	<0.15%	P
31	0.132	0.347	0.248	0.321	0.353	0.304	L3	<0.6%	P
32	0.113	0.097	0.233	0.101	0.345	0.097	L3	<0.15%	P
33	0.126	0.329	0.251	0.324	0.357	0.308	L3	<0.6%	P
34	0.006	0.016	0.026	0.034	0.014	0.012	L3	<0.15%	P
35	0.026	0.067	0.029	0.038	0.006	0.005	L3	<0.3%	P
36	0.004	0.01	0.018	0.023	0.008	0.007	L3	<0.075%	P
37	0.036	0.095	0.012	0.015	0.008	0.007	L3	<0.3%	P
38	0.013	0.034	0.070	0.091	0.005	0.004	L3	<0.075%	P
39	0.008	0.021	0.009	0.012	0.003	0.003	L3	<0.3%	P
40	0.021	0.055	0.010	0.013	0.003	0.003	L3	<0.075%	P
THDi	---	2.15	---	2.76	---	3.14	L3	≤ 5%	P
Supplementary information:									

1	TABLE: Voltage Harmonics								P
	Condition of test					Power(kW)			
	supplying power to balance linear loads 33% ±5%					33.290			P
	supplying power to balance linear loads 66 %±5%					66.656			P
	supplying power to balance linear loads 100 %±5%					99.946			P

	Output Voltage Harmonics Measurement								
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase	Limit (% of output current)	Result
	(V)	(%)	(V)	(%)	(V)	(%)			
1	230.09	99	230.26	99	230.18	99	L1	-	P
2	0.182	0.082	0.172	0.078	0.169	0.077	L1	<2%	P
3	1.735	0.784	1.714	0.779	1.773	0.806	L1	<4%	P
4	0.018	0.008	0.035	0.016	0.565	0.257	L1	<2%	P
5	0.207	0.094	0.268	0.122	0.264	0.120	L1	<4%	P
6	0.002	0.001	0.015	0.007	0.018	0.008	L1	<2%	P
7	0.139	0.063	0.216	0.098	0.207	0.094	L1	<4%	P
8	0.020	0.009	0.002	0.001	0.002	0.001	L1	<2%	P
9	0.099	0.045	0.154	0.070	0.139	0.063	L1	<4%	P
10	0.026	0.012	0.015	0.007	0.020	0.009	L1	<2%	P
11	0.403	0.183	0.095	0.043	0.099	0.045	L1	<4%	P
12	0.026	0.012	0.022	0.010	0.026	0.012	L1	<2%	P
13	0.048	0.020	0.044	0.015	0.403	0.183	L1	<4%	P
14	0.009	0.010	0.022	0.009	0.145	0.066	L1	<2%	P
15	0.044	0.038	0.084	0.040	0.097	0.044	L1	<4%	P
16	0.013	0.009	0.020	0.010	0.048	0.022	L1	<2%	P
17	0.095	0.043	0.095	0.045	0.451	0.205	L1	<4%	P
18	0.013	0.006	0.013	0.007	0.048	0.022	L1	<2%	P
19	0.062	0.028	0.062	0.027	0.354	0.161	L1	<4%	P
20	0.009	0.004	0.011	0.005	0.011	0.005	L1	<2%	P
21	0.092	0.042	0.099	0.045	0.099	0.045	L1	<4%	P
22	0.004	0.002	0.009	0.004	0.009	0.004	L1	<2%	P
23	0.048	0.022	0.048	0.022	0.048	0.022	L1	<4%	P
24	0.009	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
25	0.031	0.014	0.044	0.020	0.044	0.020	L1	<4%	P
26	0.011	0.005	0.013	0.006	0.013	0.006	L1	<2%	P
27	0.042	0.019	0.042	0.019	0.048	0.022	L1	<4%	P
28	0.015	0.007	0.013	0.006	0.081	0.037	L1	<2%	P
29	0.029	0.013	0.035	0.016	0.097	0.044	L1	<4%	P
30	0.013	0.006	0.015	0.007	0.015	0.007	L1	<2%	P
31	0.022	0.010	0.022	0.010	0.112	0.051	L1	<4%	P
32	0.009	0.004	0.007	0.003	0.048	0.022	L1	<2%	P
33	0.004	0.002	0.009	0.004	0.033	0.015	L1	<4%	P
34	0.007	0.003	0.004	0.002	0.125	0.057	L1	<2%	P
35	0.004	0.002	0.007	0.003	0.062	0.028	L1	<4%	P
36	0.007	0.003	0.009	0.004	0.035	0.016	L1	<2%	P
37	0.040	0.018	0.037	0.017	0.092	0.042	L1	<4%	P
38	0.009	0.004	0.011	0.005	0.013	0.006	L1	<2%	P
39	0.033	0.015	0.035	0.016	0.013	0.006	L1	<4%	P
40	0.007	0.003	0.004	0.002	0.013	0.006	L1	<2%	P
THDv	--	0.813	--	0.875	--	0.899	L1	≤ 5%	P

Supplementary information:

1	TABLE: Voltage Harmonics								P
	Condition of test					Power(kW)			
	supplying power to balance linear loads 33% ±5%					33.290			P
	supplying power to balance linear loads 66 %±5%					66.656			P
	supplying power to balance linear loads 100 %±5%					99.946			P
	Output Voltage Harmonics Measurement							Limit (% of output current)	Result
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase		
	(V)	(%)	(V)	(%)	(V)	(%)			
1	230.11	99	230.31	99	230.01	99	L2	-	P
2	0.169	0.082	0.178	0.081	0.172	0.077	L2	<2%	P
3	1.773	0.784	1.701	0.773	1.714	0.806	L2	<4%	P
4	0.565	0.008	0.033	0.015	0.035	0.257	L2	<2%	P
5	0.264	0.094	0.299	0.136	0.268	0.120	L2	<4%	P
6	0.018	0.001	0.009	0.004	0.015	0.008	L2	<2%	P
7	0.207	0.063	0.174	0.079	0.216	0.094	L2	<4%	P
8	0.002	0.009	0.004	0.002	0.002	0.001	L2	<2%	P
9	0.139	0.045	0.136	0.062	0.154	0.063	L2	<4%	P
10	0.020	0.012	0.015	0.007	0.015	0.009	L2	<2%	P
11	0.099	0.183	0.059	0.027	0.095	0.045	L2	<4%	P
12	0.026	0.012	0.020	0.009	0.022	0.012	L2	<2%	P
13	0.403	0.020	0.026	0.012	0.044	0.183	L2	<4%	P
14	0.009	0.010	0.018	0.008	0.022	0.066	L2	<2%	P
15	0.044	0.038	0.084	0.038	0.097	0.044	L2	<4%	P
16	0.013	0.009	0.015	0.007	0.048	0.022	L2	<2%	P
17	0.095	0.043	0.088	0.040	0.451	0.205	L2	<4%	P
18	0.013	0.006	0.011	0.005	0.048	0.022	L2	<2%	P
19	0.062	0.028	0.070	0.032	0.354	0.161	L2	<4%	P
20	0.009	0.004	0.011	0.005	0.011	0.005	L2	<2%	P
21	0.092	0.042	0.088	0.040	0.099	0.045	L2	<4%	P
22	0.004	0.002	0.007	0.003	0.009	0.004	L2	<2%	P
23	0.048	0.022	0.064	0.029	0.048	0.022	L2	<4%	P
24	0.009	0.004	0.011	0.005	0.009	0.004	L2	<2%	P
25	0.031	0.014	0.033	0.015	0.044	0.020	L2	<4%	P
26	0.011	0.005	0.015	0.007	0.013	0.006	L2	<2%	P
27	0.042	0.019	0.048	0.022	0.048	0.022	L2	<4%	P
28	0.015	0.007	0.020	0.009	0.081	0.037	L2	<2%	P
29	0.029	0.013	0.029	0.013	0.097	0.044	L2	<4%	P
30	0.013	0.006	0.015	0.007	0.015	0.007	L2	<2%	P
31	0.022	0.010	0.013	0.006	0.112	0.051	L2	<4%	P
32	0.009	0.004	0.009	0.004	0.048	0.022	L2	<2%	P
33	0.004	0.002	0.007	0.003	0.033	0.015	L2	<4%	P
34	0.007	0.003	0.009	0.004	0.125	0.057	L2	<2%	P
35	0.004	0.002	0.004	0.002	0.062	0.028	L2	<4%	P
36	0.007	0.003	0.009	0.004	0.035	0.016	L2	<2%	P
37	0.040	0.018	0.040	0.018	0.092	0.042	L2	<4%	P
38	0.009	0.004	0.009	0.004	0.013	0.006	L2	<2%	P
39	0.033	0.015	0.035	0.016	0.013	0.006	L2	<4%	P
40	0.007	0.003	0.007	0.003	0.013	0.006	L2	<2%	P
THDv	--	0.842	--	0.878	--	0.906	L2	≤ 5%	P
Supplementary information:									

1	TABLE: Voltage Harmonics								P
	Condition of test					Power(kW)			
	supplying power to balance linear loads 33% ±5%					33.290			P
	supplying power to balance linear loads 66 %±5%					66.656			P
	supplying power to balance linear loads 100 %±5%					99.946			P

	Output Voltage Harmonics Measurement							Limit (% of output current)	Result
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase		
	(V)	(%)	(V)	(%)	(V	(%)			
1	230.10	100	230.13	100	230.01	100	L3	-	P
2	0.182	0.082	0.172	0.078	0.169	0.077	L3	<2%	P
3	1.735	0.784	1.714	0.779	1.773	0.806	L3	<4%	P
4	0.018	0.008	0.035	0.016	0.565	0.257	L3	<2%	P
5	0.207	0.094	0.268	0.122	0.264	0.120	L3	<4%	P
6	0.002	0.001	0.015	0.007	0.018	0.008	L3	<2%	P
7	0.139	0.063	0.216	0.098	0.207	0.094	L3	<4%	P
8	0.020	0.009	0.002	0.001	0.002	0.001	L3	<2%	P
9	0.099	0.045	0.154	0.070	0.139	0.063	L3	<4%	P
10	0.026	0.012	0.015	0.007	0.020	0.009	L3	<2%	P
11	0.403	0.183	0.095	0.043	0.099	0.045	L3	<4%	P
12	0.026	0.012	0.022	0.010	0.026	0.012	L3	<2%	P
13	0.048	0.020	0.044	0.015	0.403	0.183	L3	<4%	P
14	0.009	0.010	0.022	0.009	0.145	0.066	L3	<2%	P
15	0.044	0.038	0.084	0.040	0.097	0.044	L3	<4%	P
16	0.013	0.009	0.020	0.010	0.048	0.022	L3	<2%	P
17	0.095	0.043	0.095	0.045	0.451	0.205	L3	<4%	P
18	0.013	0.006	0.013	0.007	0.048	0.022	L3	<2%	P
19	0.062	0.028	0.062	0.027	0.354	0.161	L3	<4%	P
20	0.009	0.004	0.011	0.005	0.011	0.005	L3	<2%	P
21	0.092	0.042	0.099	0.045	0.099	0.045	L3	<4%	P
22	0.004	0.002	0.009	0.004	0.009	0.004	L3	<2%	P
23	0.048	0.022	0.048	0.022	0.048	0.022	L3	<4%	P
24	0.009	0.004	0.009	0.004	0.009	0.004	L3	<2%	P
25	0.031	0.014	0.044	0.020	0.044	0.020	L3	<4%	P
26	0.011	0.005	0.013	0.006	0.013	0.006	L3	<2%	P
27	0.042	0.019	0.042	0.019	0.048	0.022	L3	<4%	P
28	0.015	0.007	0.013	0.006	0.081	0.037	L3	<2%	P
29	0.029	0.013	0.035	0.016	0.097	0.044	L3	<4%	P
30	0.013	0.006	0.015	0.007	0.015	0.007	L3	<2%	P
31	0.022	0.010	0.022	0.010	0.112	0.051	L3	<4%	P
32	0.009	0.004	0.007	0.003	0.048	0.022	L3	<2%	P
33	0.004	0.002	0.009	0.004	0.033	0.015	L3	<4%	P
34	0.007	0.003	0.004	0.002	0.125	0.057	L3	<2%	P
35	0.004	0.002	0.007	0.003	0.062	0.028	L3	<4%	P
36	0.007	0.003	0.009	0.004	0.035	0.016	L3	<2%	P
37	0.040	0.018	0.037	0.017	0.092	0.042	L3	<4%	P
38	0.009	0.004	0.011	0.005	0.013	0.006	L3	<2%	P
39	0.033	0.015	0.035	0.016	0.013	0.006	L3	<4%	P
40	0.007	0.003	0.004	0.002	0.013	0.006	L3	<2%	P
THDv	--	0.824	--	0.869	--	0.897	L3	≤ 5%	P

Supplementary information:

2	TABLE: Voltage Fluctuation				P
Flicker measurement 1	EUT values			Limit	Result
	L1	L2	L3		
Pst	0.24	0.25	0.26	1.00	P
Plt	0.25	0.21	0.21	0.65	P
dc [%]	0.06	0.05	0.06	3.30	P
dmax [%]	0.80	0.79	0.78	4.00	P
dt [s]	0	0	0	--	-
Supplementary information:					

3	TABLE: Direct Current Injection							P
	Condition of test						Output Power [kW]	
	supplying power to balance linear loads 33% ±5%						33.290	P
	supplying power to balance linear loads 66% ±5%						66.656	P
	supplying power to balance linear loads 100% ±5%						99.946	P
	Normal rated output current						144A	
Phase	Output DC current Measurement						Limit [%]	Verdict [P/F]
	33% of rated output current		66% of rated output current		100% of rated output current			
	(A)	(%)	(A)	(%)	(A)	(%)		
L1	0.021	0.055	0.022	0.017	0.028	0.024	≤0.5	P
L2	0.022	0.058	0.027	0.021	0.026	0.022	≤0.5	P
L3	0.019	0.050	0.024	0.018	0.029	0.025	≤0.5	P
Supplementary information:								

4	TABLE : Reactive power control						P
-Q max							
Power Set [%]	Active Power		Reactive power		DC power		Power factor
	kW	p.u.	kVAR	p.u.	(kW)	p.u.	
1	2.200	0.035	-100.940	-1.011	2.510	0.037	0.034158
10	9.240	0.093	-100.580	-1.007	9.980	0.099	0.091485
20	21.250	0.213	-98.740	-0.989	22.880	0.226	0.210396
30	30.330	0.304	-96.340	-0.965	32.200	0.318	0.300297
40	39.250	0.393	-93.060	-0.932	41.220	0.407	0.388614
50	50.240	0.503	-87.620	-0.877	51.680	0.511	0.497426
60	60.780	0.609	-80.660	-0.808	62.280	0.615	0.601782
70	70.360	0.704	-72.460	-0.726	71.940	0.711	0.696634
80	80.250	0.804	-61.320	-0.614	81.640	0.807	0.794554
90	90.230	0.903	-45.380	-0.454	91.600	0.905	0.893366
100	99.880	1.000	-15.000	-0.214	101.200	1.000	0.998911

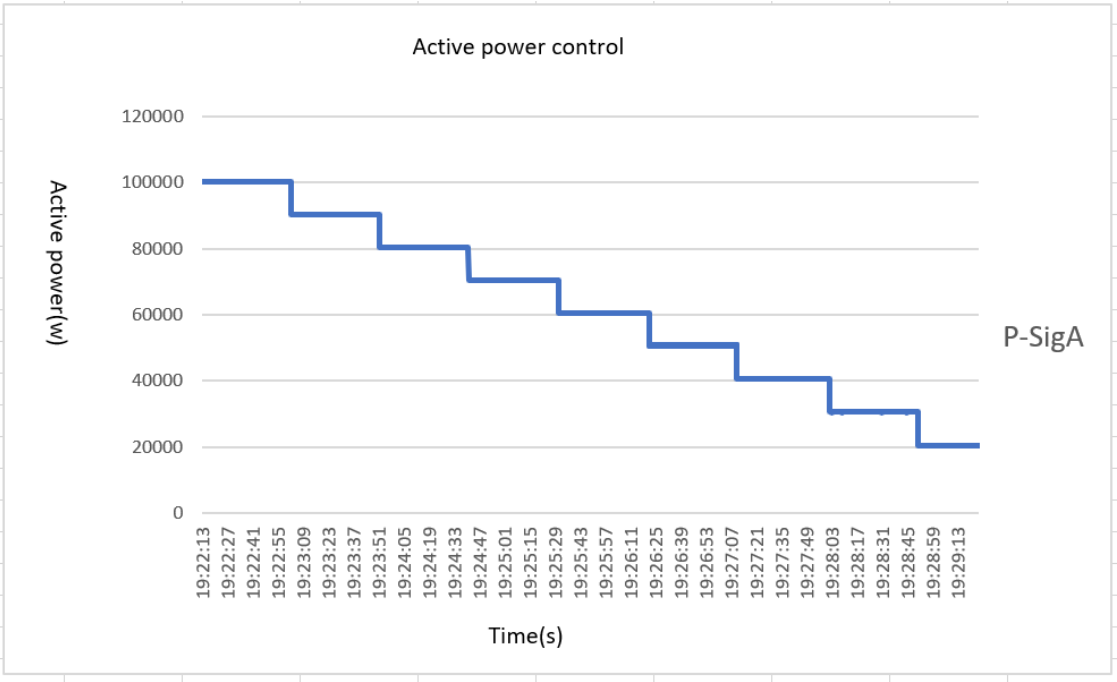
+Q max							
Power Set	Active Power [W]		Reactive power [Var]		DC power		Power factor
	kW	p.u.	kVAR	p.u.	(kW)	p.u.	
1	2.400	0.037	100.940	1.011	4.000	0.040	0.036139
10	9.470	0.095	100.560	1.007	10.060	0.099	0.093762
20	21.780	0.218	98.620	0.987	22.880	0.226	0.215644
30	31.650	0.317	95.920	0.960	32.700	0.323	0.313366
40	39.360	0.394	93.020	0.931	40.240	0.397	0.389703
50	50.440	0.505	87.500	0.876	51.320	0.506	0.499406
60	60.320	0.604	81.000	0.811	61.240	0.604	0.597228
70	70.210	0.703	72.600	0.727	71.640	0.707	0.695149
80	80.750	0.808	60.660	0.607	82.240	0.811	0.799505
90	90.510	0.906	44.820	0.449	91.880	0.907	0.896139
100	99.930	1.000	14.660	0.147	101.340	1.000	0.989406

4.1	TABLE : Reactive power control			P
4.1 fixed displacement factor cos Ø				
P (setting)	PF (setting)	P (measuring)	Q (max measuring)	PF (measuring)
P.F. setting 0.95 lagging				
0% (1%)	0.95 lagging	2.240	-1.264	0.9498
10%	0.95 lagging	9.470	-2.560	0.9497
20%	0.95 lagging	19.020	-4.936	0.9502
30%	0.95 lagging	28.570	-7.352	0.9503
40%	0.95 lagging	37.890	-10.328	0.9495
50%	0.95 lagging	47.660	-12.088	0.9502
60%	0.95 lagging	56.990	-15.048	0.9496
70%	0.95 lagging	66.280	-17.944	0.9497
80%	0.95 lagging	76.230	-19.400	0.9509
90%	0.95 lagging	85.560	-22.288	0.9508
100%	0.95 lagging	95.080	-24.648	0.9502
P.F. setting 0.95 leading				
0% (1%)	0.95 leading	2.250	1.240	0.9509
10%	0.95 leading	9.480	2.536	0.9494
20%	0.95 leading	19.040	4.920	0.9506
30%	0.95 leading	28.570	7.304	0.9505
40%	0.95 leading	37.990	10.032	0.9495
50%	0.95 leading	47.430	12.712	0.9498
60%	0.95 leading	57.180	14.648	0.9503
70%	0.95 leading	66.570	17.232	0.9504
80%	0.95 leading	75.820	20.392	0.9498
90%	0.95 leading	85.560	22.432	0.9502
100%	0.95 leading	95.170	24.608	0.9505
P.F. setting 0.9 lagging				
0% (1%)	0.90 lagging	2.12	-1.03	0.8999
10%	0.90 lagging	8.97	-4.35	0.8998

20%	0.90 lagging	18.02	-8.73	0.9003
30%	0.90 lagging	27.07	-13.11	0.9004
40%	0.90 lagging	35.90	-17.39	0.8996
50%	0.90 lagging	45.15	-21.87	0.9003
60%	0.90 lagging	53.99	-26.16	0.8997
70%	0.90 lagging	62.79	-30.42	0.8998
80%	0.90 lagging	72.22	-34.99	0.9010
90%	0.90 lagging	81.06	-39.27	0.9009
100%	0.90 lagging	90.08	-43.64	0.9003
P.F. setting 0.9 leading				
0% (1%)	0.90 leading	2.13	1.03	0.9010
10%	0.90 leading	8.98	4.35	0.8995
20%	0.90 leading	18.04	8.74	0.9007
30%	0.90 leading	27.07	13.11	0.9006
40%	0.90 leading	35.99	17.44	0.8996
50%	0.90 leading	44.93	21.77	0.8999
60%	0.90 leading	54.17	26.24	0.9004
70%	0.90 leading	63.07	30.55	0.9005
80%	0.90 leading	71.83	34.80	0.8999
90%	0.90 leading	81.06	39.27	0.9003
100%	0.90 leading	90.16	43.68	0.9006
P.F. setting PF 1.0				
0% (1%)	1.0	4.930	-0.632	0.9872
10%	1.0	9.910	-1.016	0.9916
20%	1.0	19.870	-1.808	0.9931
30%	1.0	29.840	-2.400	0.9944
40%	1.0	39.880	-2.432	0.9968
50%	1.0	49.860	-2.704	0.9975
60%	1.0	59.930	-2.328	0.9987
70%	1.0	69.930	-2.312	0.9990
80%	1.0	79.980	-1.912	0.9995
90%	1.0	89.990	-1.384	0.9998
100%	1.0	100.030	-1.056	0.9999

5	TABLE : Active power control			P
Power Setting		Power Measuring [kW]	Power Deviation of set point	
Power [%]	Power [kW]		Power [kW]	Power [%]
100%	100	100.004	-0.005	-0.01
90%	90	89.990	0.010	0.02
80%	80	79.993	0.010	0.03
70%	70	69.985	0.020	0.06
60%	60	59.979	0.045	0.15
50%	50	49.978	0.055	0.22
40%	40	39.945	0.095	0.48
30%	30	29.954	0.095	0.63
20%	20	19.960	0.080	0.80
10%	10	9.966	0.045	0.09

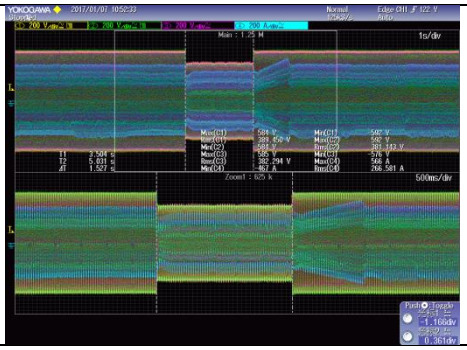
Supplementary information:



6	Low Voltage Fault Ride Through（90% Power）	P
List of tests	Residual amplitude of phase-to-phase voltage V/Vnom	Duration Time (sec)
file:1-three-phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.518
	0.3-0.5 (V2/Vnom)	0.162
	0-0.049 (V3/Vnom)	0.162
file:2-A-phase – B- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.503
	0.3-0.5 (V2/Vnom)	0.163
	0-0.049 (V3/Vnom)	0.165
file:3-B-phase – C- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.496
	0.3-0.5 (V2/Vnom)	0.162
	0-0.049 (V3/Vnom)	0.166
file:4-A-phase – C- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.518
	0.3-0.5 (V2/Vnom)	0.160
	0-0.049 (V3/Vnom)	0.160
file:5- A-phase symmetrical faults	0.7-0.8 (V4/Vnom)	1.520
	0.3-0.5 (V5/Vnom)	0.166
	0-0.049 (V6/Vnom)	0.166
file:6- B-phase symmetrical faults	0.7-0.8 (V7/Vnom)	1.520
	0.3-0.5 (V8/Vnom)	0.161
	0-0.049 (V9/Vnom)	0.162
file:7- C-phase symmetrical faults	0.7-0.8 (V7/Vnom)	1.532
	0.3-0.5 (V8/Vnom)	0.160
	0-0.049 (V9/Vnom)	0.160
Low Voltage Fault Ride Through（30% Power）		
List of tests	Residual amplitude of phase-to-phase voltage V/Vnom	Duration Time (sec)
file:1-three-phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.520
	0.3-0.5 (V2/Vnom)	0.161
	0-0.049 (V3/Vnom)	0.162
file:2-A-phase – B- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.532
	0.3-0.5 (V2/Vnom)	0.160
	0-0.049 (V3/Vnom)	0.160
file:3-B-phase – C- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.527
	0.3-0.5 (V2/Vnom)	0.160
	0-0.049 (V3/Vnom)	0.162
file:4-A-phase – C- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.527
	0.3-0.5 (V2/Vnom)	0.162
	0-0.049 (V3/Vnom)	0.161
file:5- A-phase symmetrical faults	0.7-0.8 (V4/Vnom)	1.532
	0.3-0.5 (V5/Vnom)	0.166
	0-0.049 (V6/Vnom)	0.160
file:6- B-phase symmetrical faults	0.7-0.8 (V7/Vnom)	1.532
	0.3-0.5 (V8/Vnom)	0.160
	0-0.049 (V9/Vnom)	0.160
file:7- C-phase symmetrical faults	0.7-0.8 (V7/Vnom)	1.522
	0.3-0.5 (V8/Vnom)	0.160
	0-0.049 (V9/Vnom)	0.160
Low Voltage Fault Ride Through（10% Power）		
List of tests	Residual amplitude of phase-to-phase voltage V/Vnom	Duration Time (sec)
file:1-three-phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.532
	0.3-0.5 (V2/Vnom)	0.160
	0-0.049 (V3/Vnom)	0.160
file:2-A-phase – B- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.507
	0.3-0.5 (V2/Vnom)	0.161
	0-0.049 (V3/Vnom)	0.161
file:3-B-phase – C- phase symmetrical	0.7-0.8 (V1/Vnom)	1.527
	0.3-0.5 (V2/Vnom)	0.162

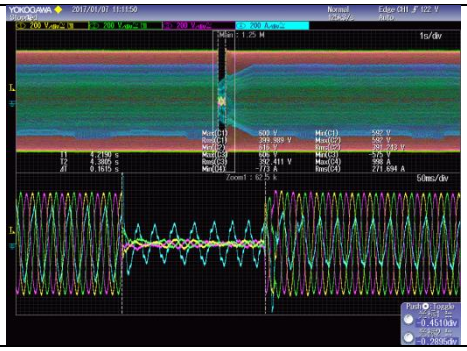
faults	0-0.049 (V3/Vnom)	0.161
file:4-A-phase – C- phase symmetrical faults	0.7-0.8 (V1/Vnom)	1.501
	0.3-0.5 (V2/Vnom)	0.161
	0-0.049 (V3/Vnom)	0.161
file:5- A-phase symmetrical faults	0.7-0.8 (V4/Vnom)	1.527
	0.3-0.5 (V5/Vnom)	0.167
	0-0.049 (V6/Vnom)	0.166
file:6- B-phase symmetrical faults	0.7-0.8 (V7/Vnom)	1.537
	0.3-0.5 (V8/Vnom)	0.162
	0-0.049 (V9/Vnom)	0.162
file:7- C-phase symmetrical faults	0.7-0.8 (V7/Vnom)	1.532
	0.3-0.5 (V8/Vnom)	0.160
	0-0.049 (V9/Vnom)	0.162

Supplementary information(90% Power):

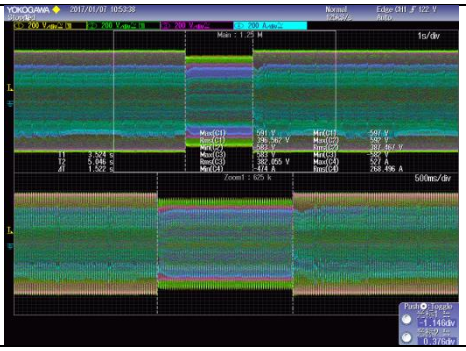


Three-phase faults 0.7-0.8 Vn

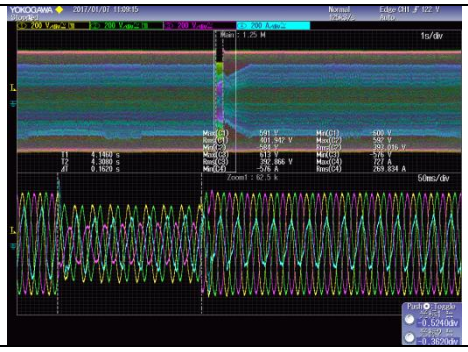
Three-phase faults 0.3-0.5 Vn



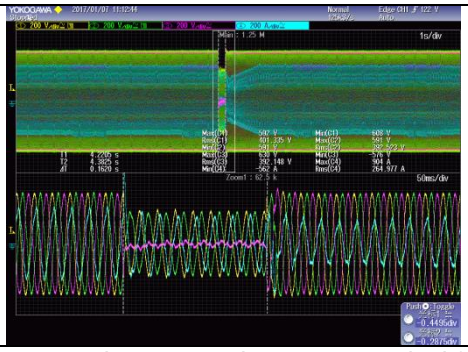
Three-phase faults 0-0.049 Vn



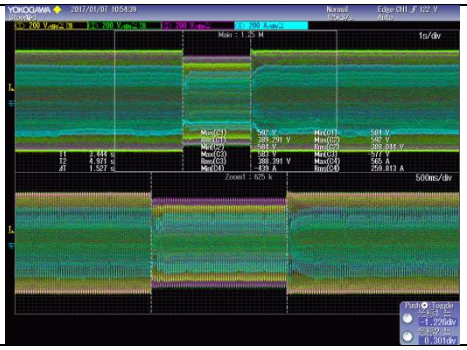
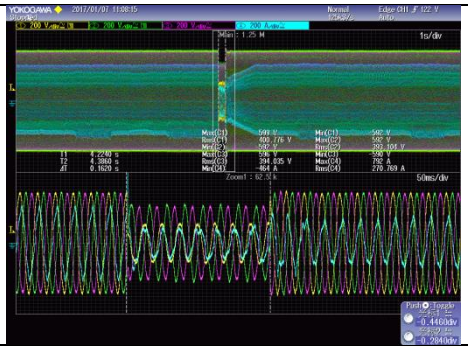
A-phase – B- phase symmetrical faults 0.7-0.8 Vn



A-phase – B- phase symmetrical faults 0.3-0.5 Vn



A-phase – B- phase symmetrical faults 0-0.049 Vn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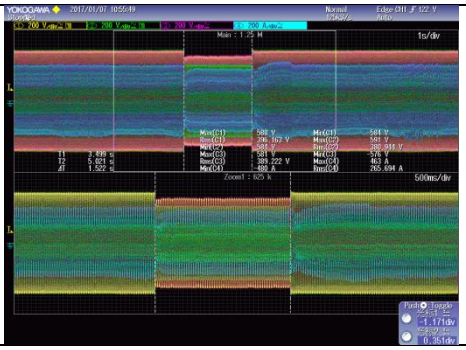
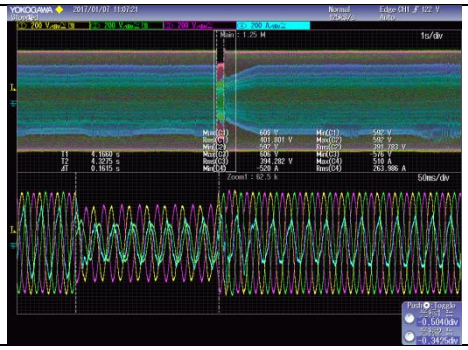
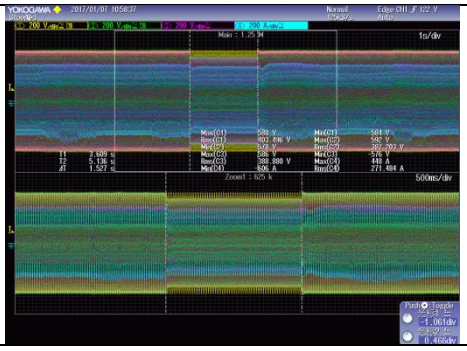
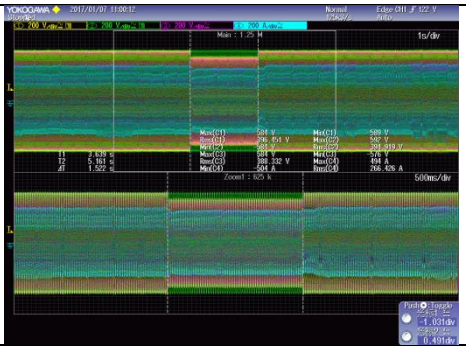
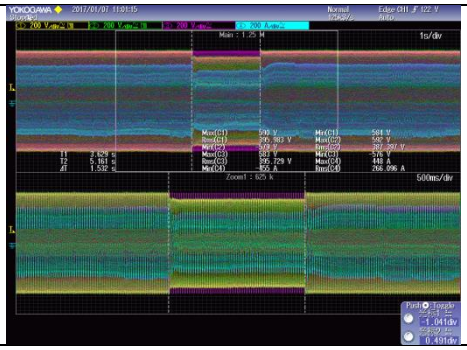
	
B-phase – C- phase symmetrical faults 0-0.049 Vn	A-phase – C- phase symmetrical faults 0.7-0.8 Vn
	
A-phase – C- phase symmetrical faults 0.3-0.5 Vn	A-phase – C- phase symmetrical faults 0-0.049 Vn
	
A-phase symmetrical faults 0.7-0.8 Vn	A-phase symmetrical faults 0.3-0.5 Vn

			
A-phase symmetrical faults 0-0.049 Vn		B-phase symmetrical faults 0.7-0.8 Vn	
			
B-phase symmetrical faults 0.3-0.5 Vn		B-phase symmetrical faults 0-0.049 Vn	
			
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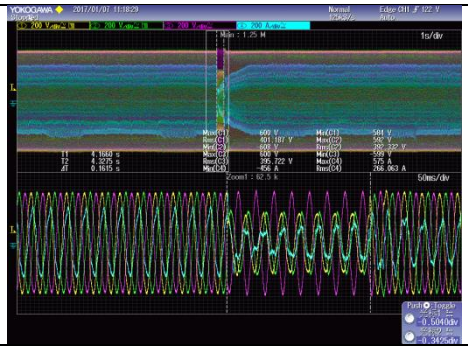		--	
C- phase symmetrical faults 0-0.049 Vn		--	
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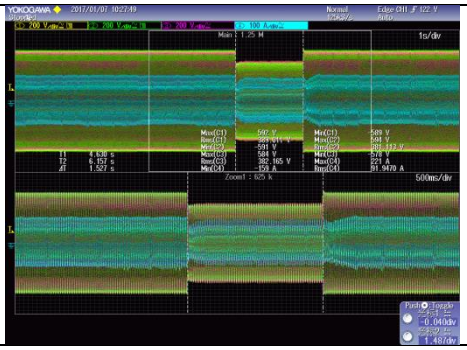
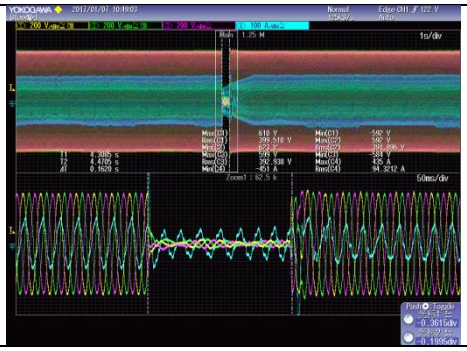
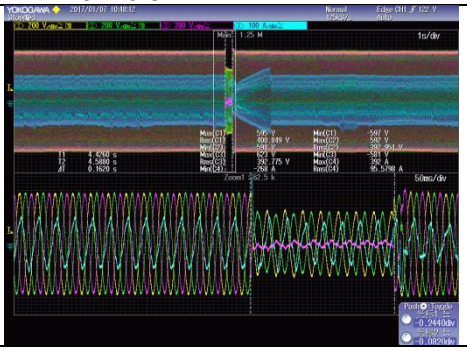
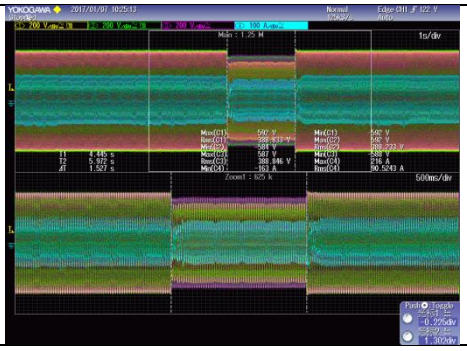
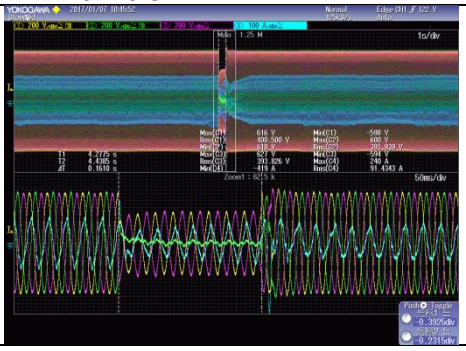
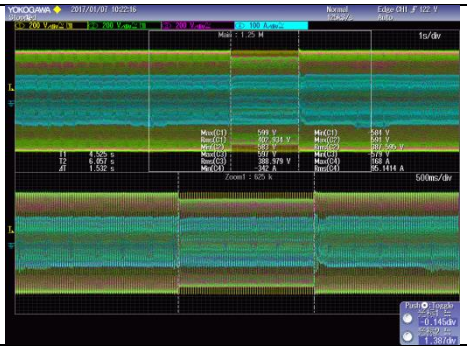
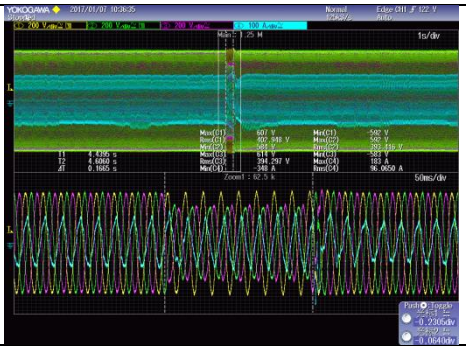
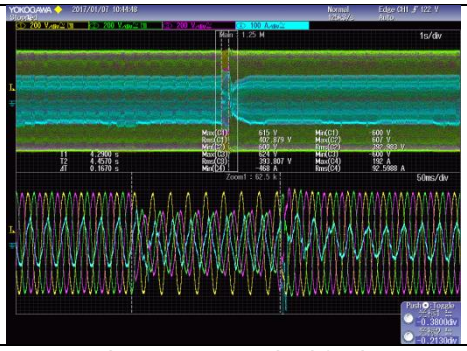
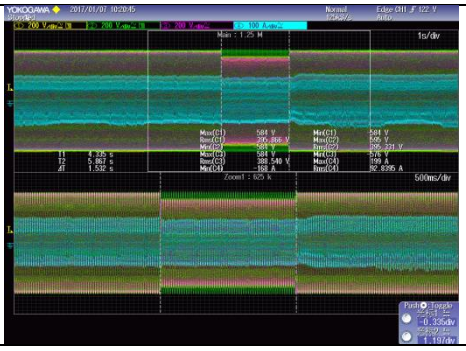
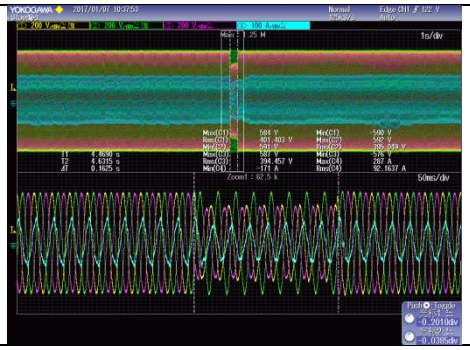
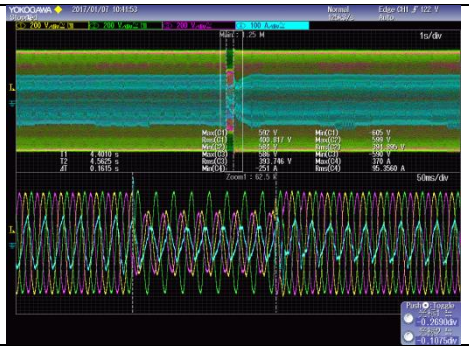
	
Three-phase faults 0.7-0.8 Vn	Three-phase faults 0.3-0.5 Vn
	
Three-phase faults 0-0.049 Vn	A-phase – B- phase symmetrical faults 0.7-0.8 Vn
	
A-phase – B- phase symmetrical faults 0.3-0.5 Vn	A-phase – B- phase symmetrical faults 0-0.049 Vn
	
B-phase – C- phase symmetrical faults 0.7-0.8 Vn	B-phase – C- phase symmetrical faults 0.3-0.5 Vn

	
B-phase – C- phase symmetrical faults 0-0.049 Vn	A-phase – C- phase symmetrical faults 0.7-0.8 Vn
	
A-phase – C- phase symmetrical faults 0.3-0.5 Vn	A-phase – C- phase symmetrical faults 0-0.049 Vn
	
A-phase symmetrical faults 0.7-0.8 Vn	A-phase symmetrical faults 0.3-0.5 Vn
	
A-phase symmetrical faults 0-0.049 Vn	B-phase symmetrical faults 0.7-0.8 Vn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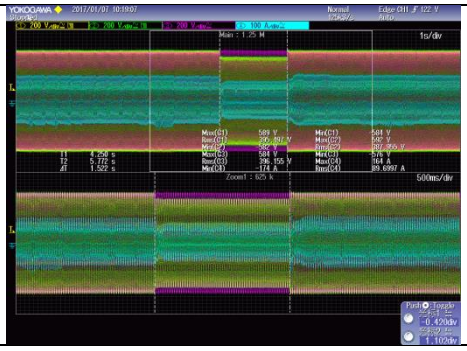			
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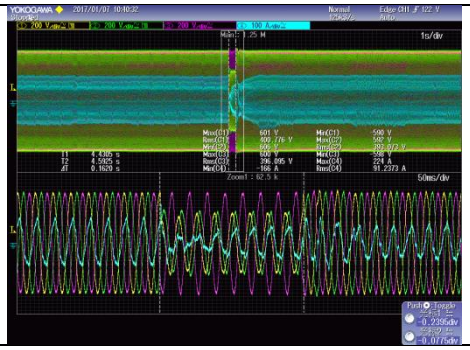
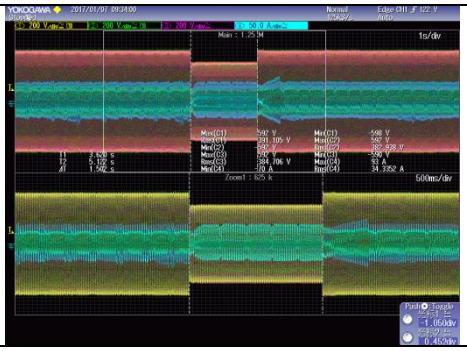
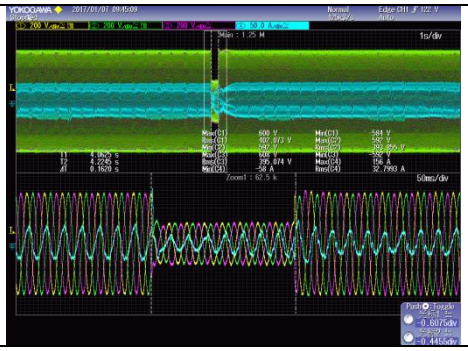
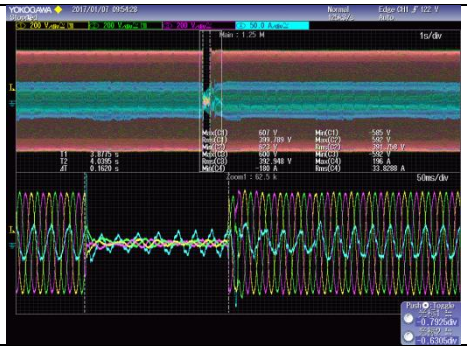
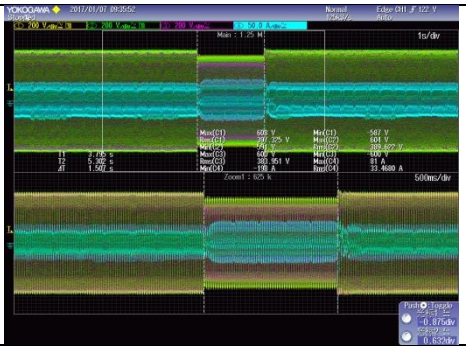
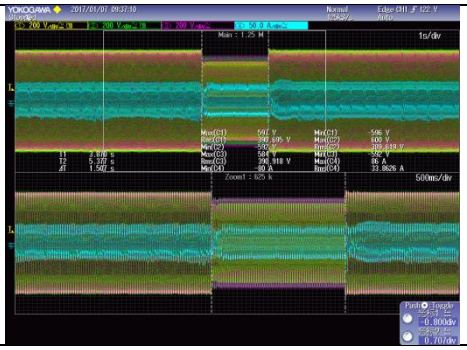
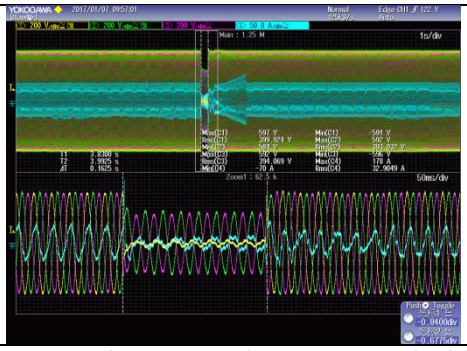
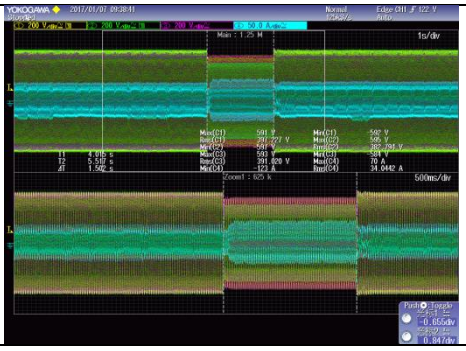
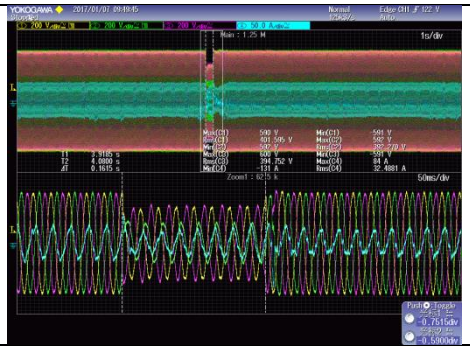
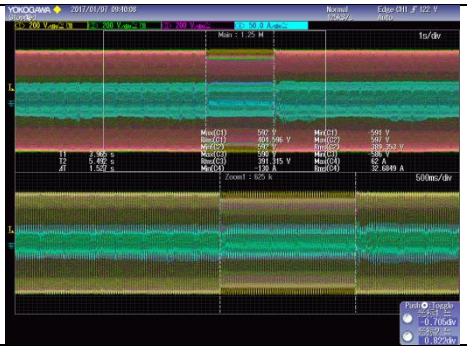
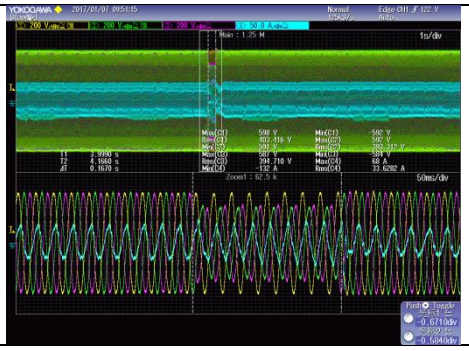
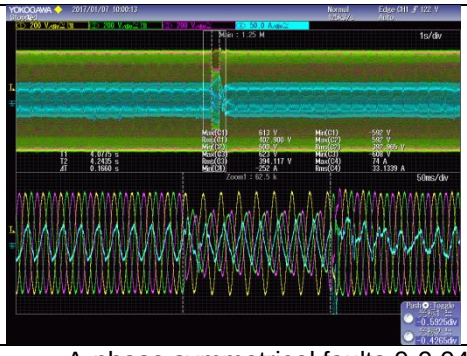
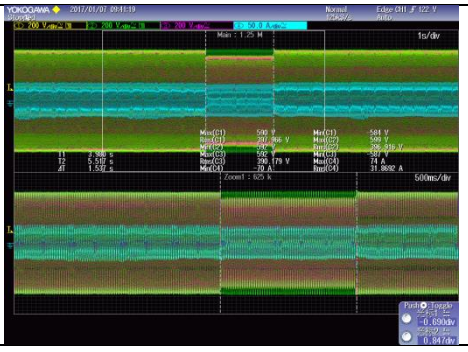
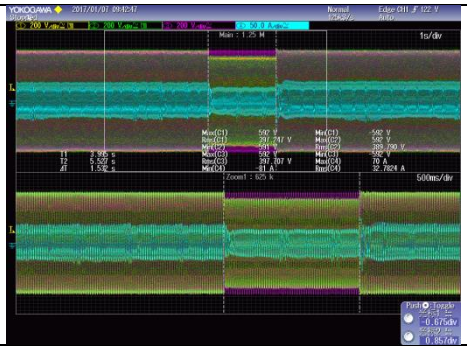
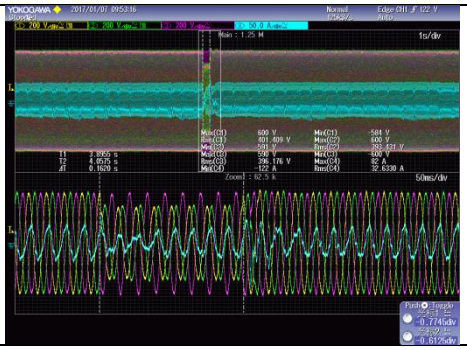
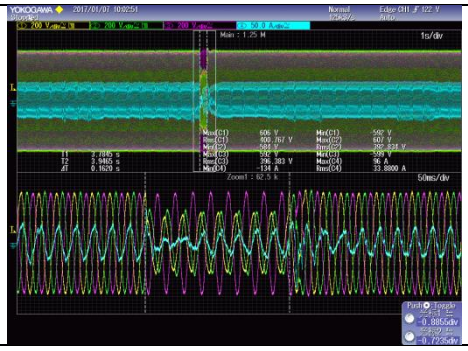
		--	
C- phase symmetrical faults 0-0.049 Vn		--	
Supplementary information(10% Power):			
			
Three-phase faults 0.7-0.8 Vn		Three-phase faults 0.3-0.5 Vn	

	
Three-phase faults 0-0.049 Vn	A-phase – B- phase symmetrical faults 0.7-0.8 Vn
	
A-phase – B- phase symmetrical faults 0.3-0.5 Vn	A-phase – B- phase symmetrical faults 0-0.049 Vn
	
B-phase – C- phase symmetrical faults 0.7-0.8 Vn	B-phase – C- phase symmetrical faults 0.3-0.5 Vn
	
B-phase – C- phase symmetrical faults 0-0.049 Vn	A-phase – C- phase symmetrical faults 0.7-0.8 Vn

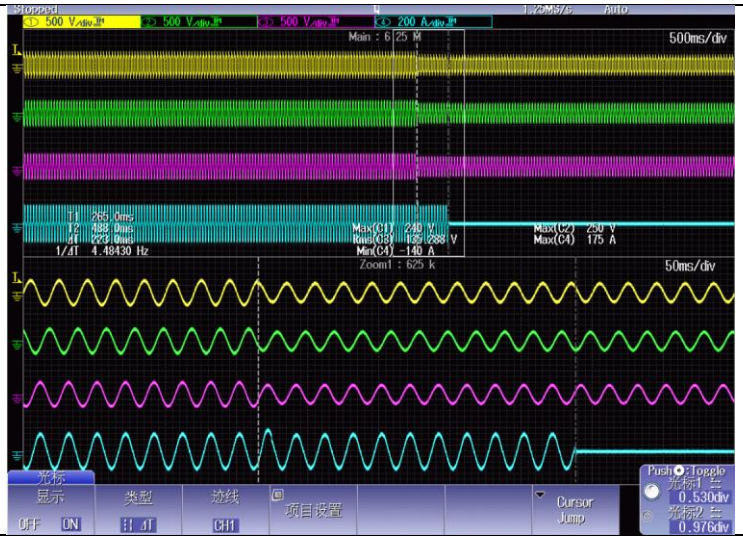
	
A-phase – C- phase symmetrical faults 0.3-0.5 Vn	A-phase – C- phase symmetrical faults 0-0.049 Vn
	
A-phase symmetrical faults 0.7-0.8 Vn	A-phase symmetrical faults 0.3-0.5 Vn
	
A-phase symmetrical faults 0-0.049 Vn	B-phase symmetrical faults 0.7-0.8 Vn
	
B-phase symmetrical faults 0.3-0.5 Vn	B-phase symmetrical faults 0-0.049 Vn

		
C-phase symmetrical faults 0.7-0.8 Vn		C-phase symmetrical faults 0.3-0.5 Vn
		--
C- phase symmetrical faults 0-0.049 Vn		--

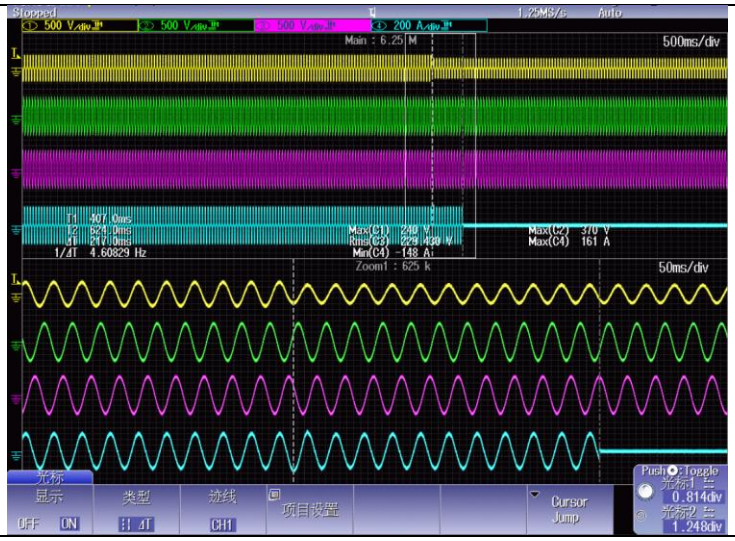
7	TABLE: Operating Voltage Range						P
No.	Voltage Range (V)	Setting voltage (V)	Setting time (s)	Test voltage (V)	Disconnecting time (s)	Max. Disconnecting time (s)	Result
1	V<50%	L1 = L2 = L3 =110V	0.1	L1 = L2 = L3 =109V	0.223	0.3	P
		L1 = 110 V, L2 = L3 = 220 V		L1 = 109V, L2 = L3 = 220 V	0.217	0.3	P
		L2 = 110V, L1 = L3 = 220 V		L2 = 109V, L1 = L3 = 220 V	0.211	0.3	P
		L3 = 110 V, L1 = L2 = 220 V		L3 = 109 V, L1 = L2 = 220 V	0.207	0.3	P
2	50%≤V<90%	L1 = L2 = L3 =111 V	0.1	L1 = L2 = L3 =112 V	1.808	2	P
		L1 = 111 V, L2 = L3 = 220 V	0.1	L1 = 112 V, L2 = L3 = 220 V	1.795	2	P
		L2 = 111 V, L1 = L3 = 220 V	0.1	L2 = 112 V, L1 = L3 = 220 V	1.800	2	P
		L3 = 111 V, L1 = L2 = 220 V	0.1	L3 = 112 V, L1 = L2 = 220 V	1.798	2	P
		L1 = L2 = L3 =197 V	0.1	L1 = L2 = L3 =196 V	1.818	2	P
		L1 = 197 V, L2 = L3 = 220 V	0.1	L1 = 196 V, L2 = L3 = 220 V	1.795	2	P
		L2 = 197 V, L1 = L3 = 220 V	0.1	L2 = 196 V, L1 = L3 = 220 V	1.814	2	P

		L3 = 197 V, L1 = L2 = 220 V	0.1	L3 = 196 V, L1 = L2 = 220 V	1.806	2	P
3	90%≤V≤110%	L1 = L2 = L3 =197 V	--	L1 = L2 = L3 =198 V	CONTINUE	CONTINUE	P
4		L1 = L2 = L3 =241V	--	L1 = L2 = L3 =240V	CONTINUE	CONTINUE	P
5	110%<V<120%	L1 = L2 = L3 =241V	0.1	L1 = L2 = L3 =242V	0.802	1	P
		L1 = 241 V, L2 = L3 = 220 V	0.1	L1 = 242V, L2 = L3 = 220 V	0.797	1	P
		L2 = 241 V, L1 = L3 = 220 V	0.1	L2 = 242 V, L1 = L3 = 220 V	0.820	1	P
		L3 = 241 V, L1 = L2 = 220 V	0.1	L3 = 242 V, L1 = L2 = 220 V	0.820	1	P
		L1 = L2 = L3 =262V	0.1	L1 = L2 = L3 =261 V	0.804	1	P
		L1 = 262 V, L2 = L3 = 220 V	0.1	L1 = 261V, L2 = L3 = 220 V	0.807	1	P
		L2 = 262 V, L1 = L3 = 220 V	0.1	L2 = 261V, L1 = L3 = 220 V	0.799	1	P
		L3 = 262 V, L1 = L2 = 220 V	0.1	L3 = 261 V, L1 = L2 = 220 V	0.820	1	P
6	V≥120%	L1 = L2 = L3 =263V	0.1	L1 = L2 = L3 =264 V	0.100	0.16	P
		L1 = 263 V, L2 = L3 = 220 V	0.1	L1 = 264 V, L2 = L3 = 220 V	0.115	0.16	P
		L2 = 263 V, L1 = L3 = 220 V	0.1	L2 = 264 V, L1 = L3 = 220 V	0.120	0.16	P
		L3 = 263 V, L1 = L2 = 220 V	0.1	L3 = 264 V, L1 = L2 = 220 V	0.108	0.16	P

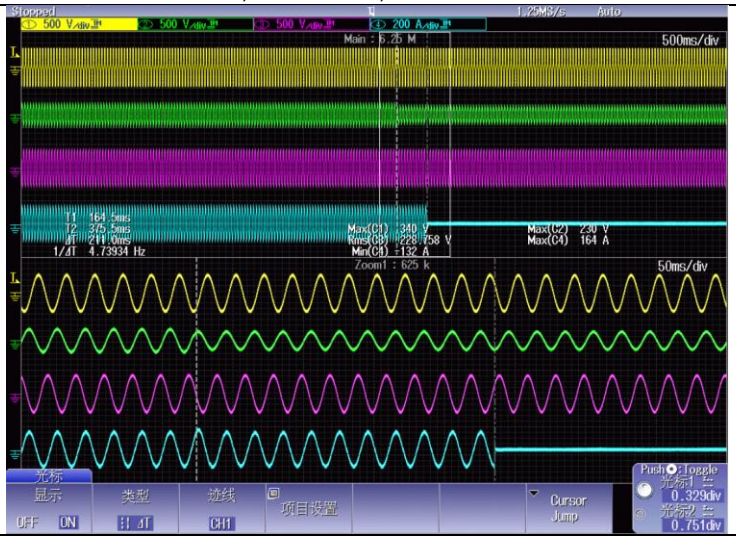
Supplementary information:



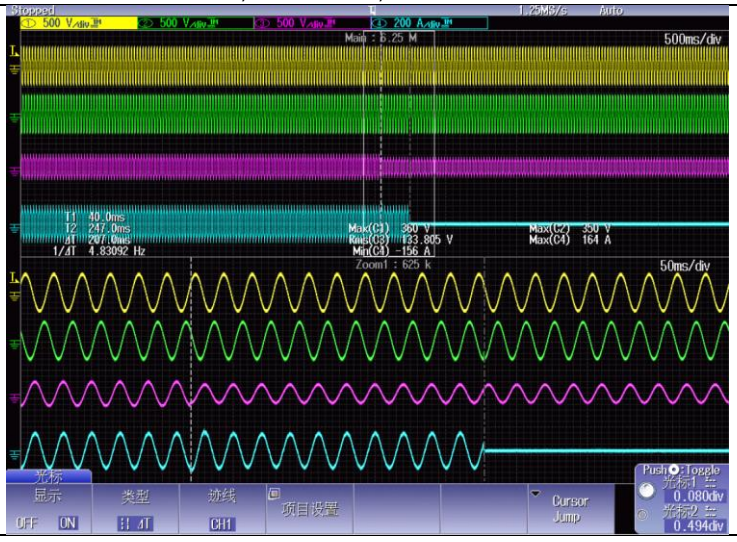
V<50%, L1 = L2 = L3 =109V



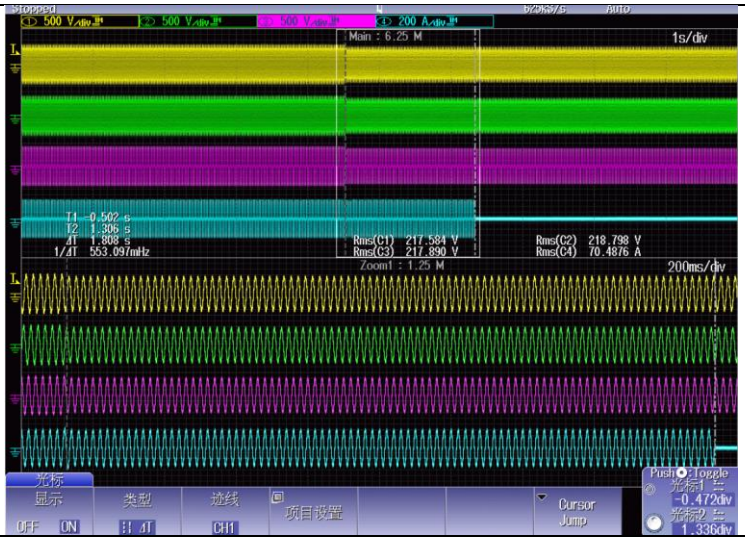
V<50%, L1 = 109V, L2 = L3 = 220 V



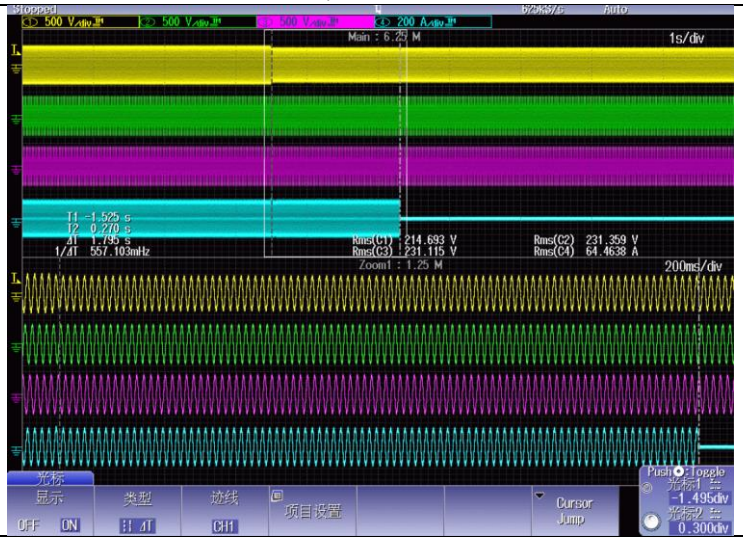
V<50%, L2 = 109V, L1 = L3 = 220 V



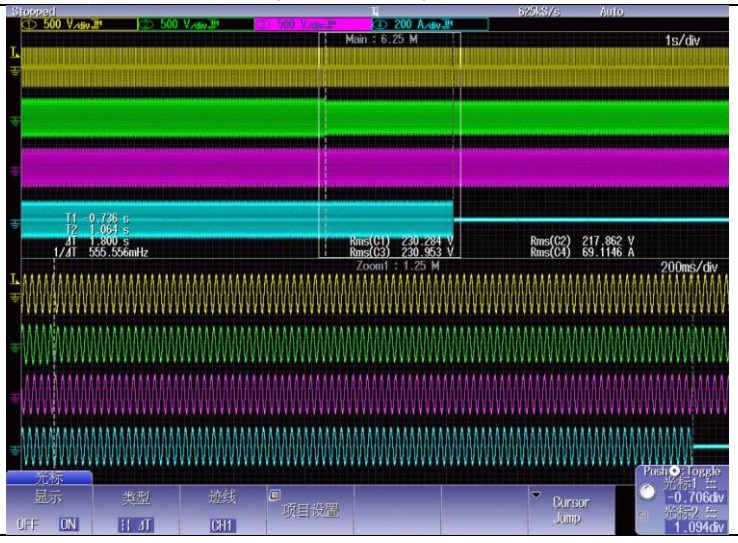
V<50%, L3 = 109V, L1 = L2 = 220 V



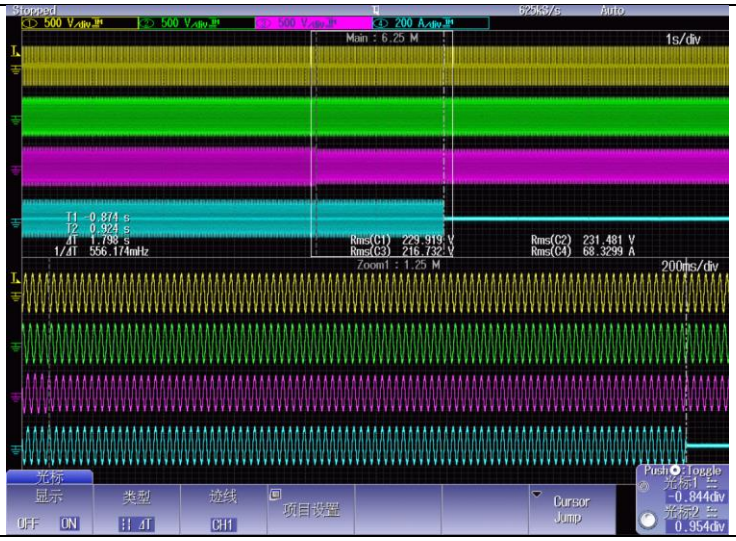
50%≤V<90%, L1 = L2 = L3 =112 V



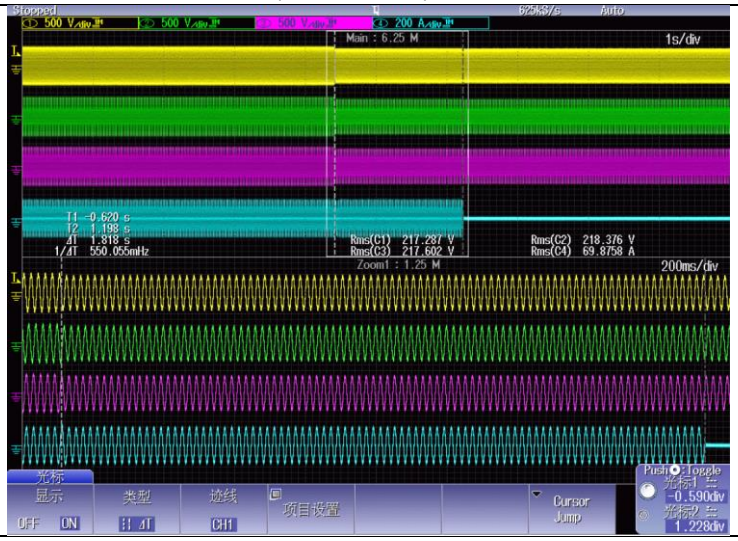
50%≤V<90%, L1 = 112 V, L2 = L3 = 220 V



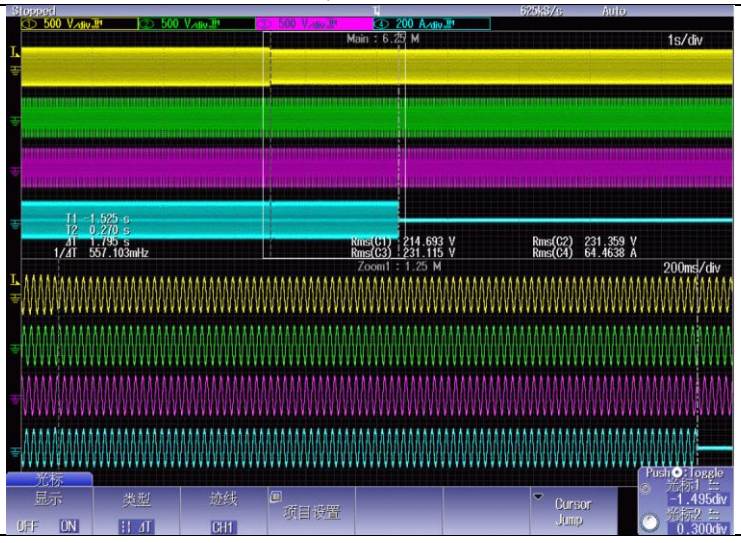
50%≤V<90%, L2 = 112 V, L1 = L3 = 220 V



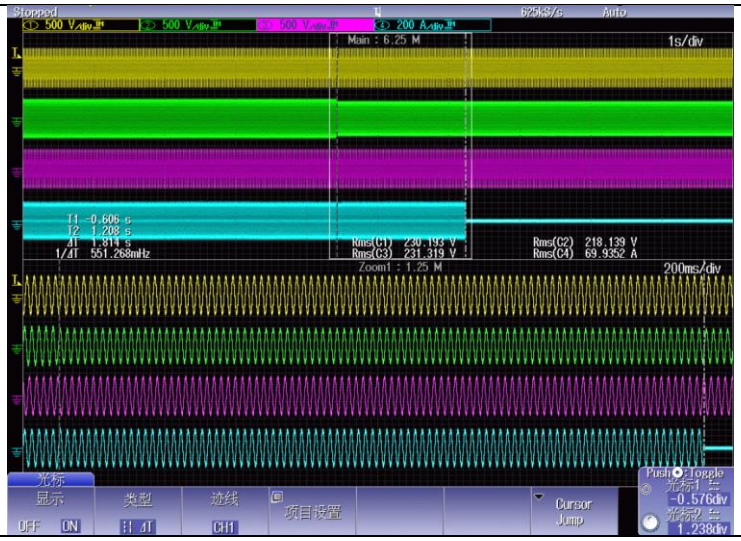
50%≤V<90%, L3 = 112 V, L1 = L2 = 220 V



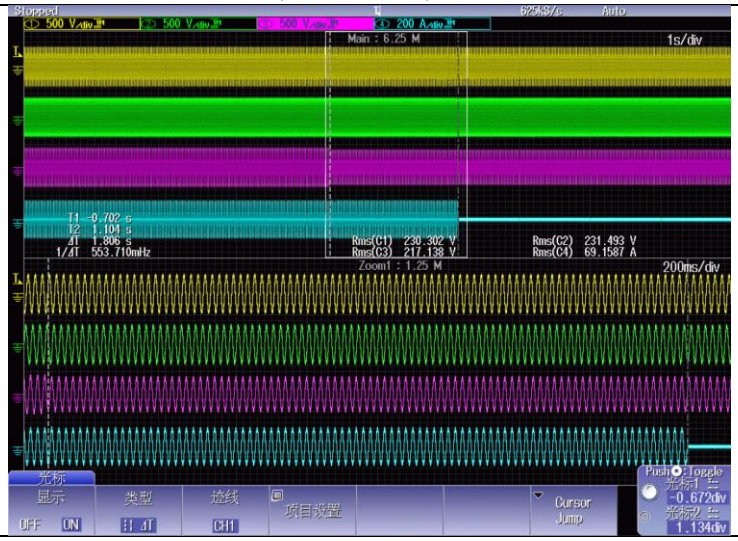
50%≤V<90%, L1 = L2 = L3 =196 V



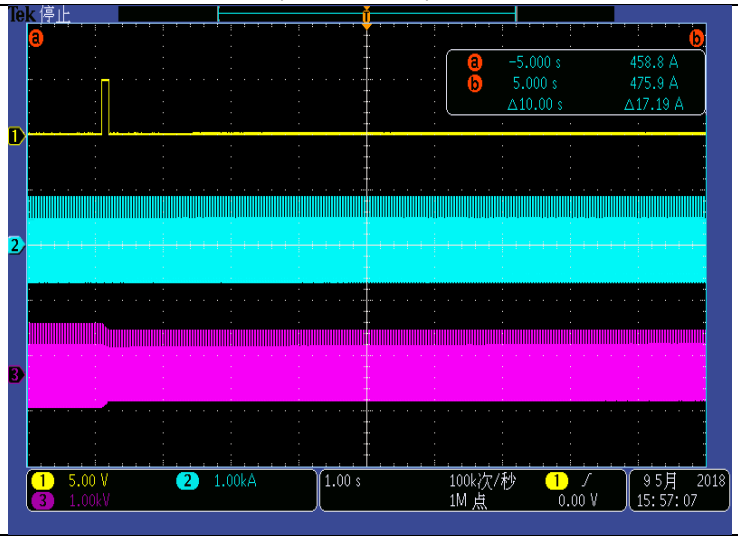
50%≤V<90%, L1 = 196 V, L2 = L3 = 220 V



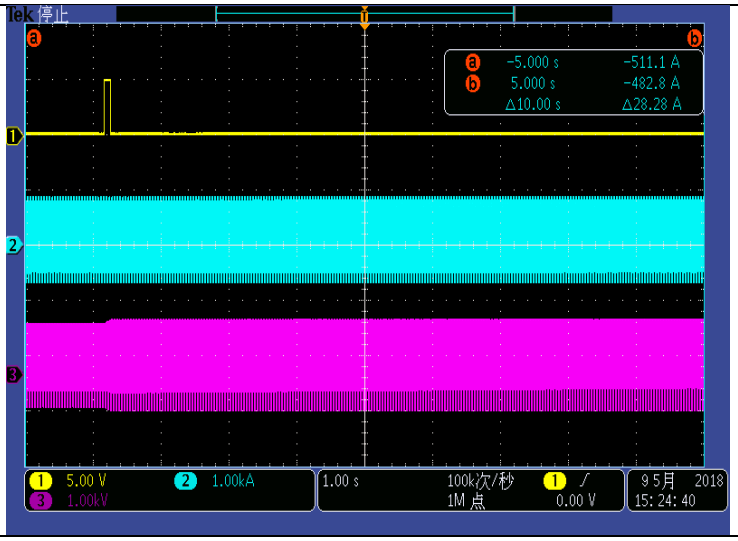
50%≤V<90%, L2 = 196 V, L1 = L3 = 220 V



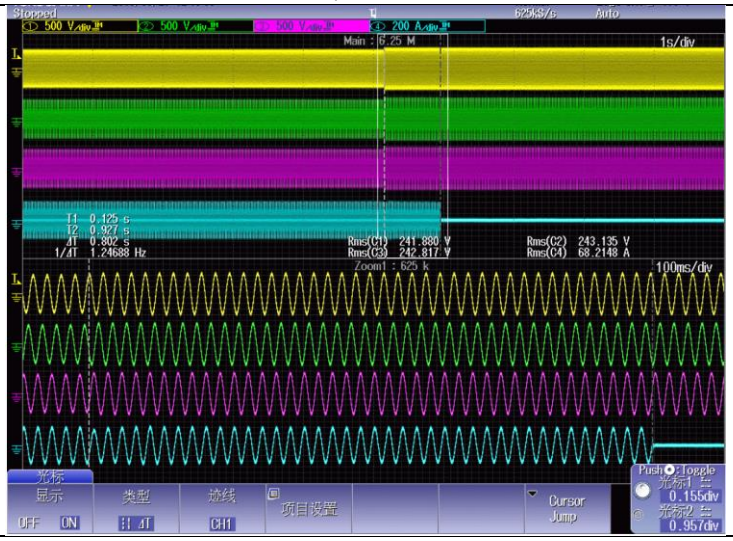
50%≤V<90%, L3 = 196 V, L1 = L2 = 220 V



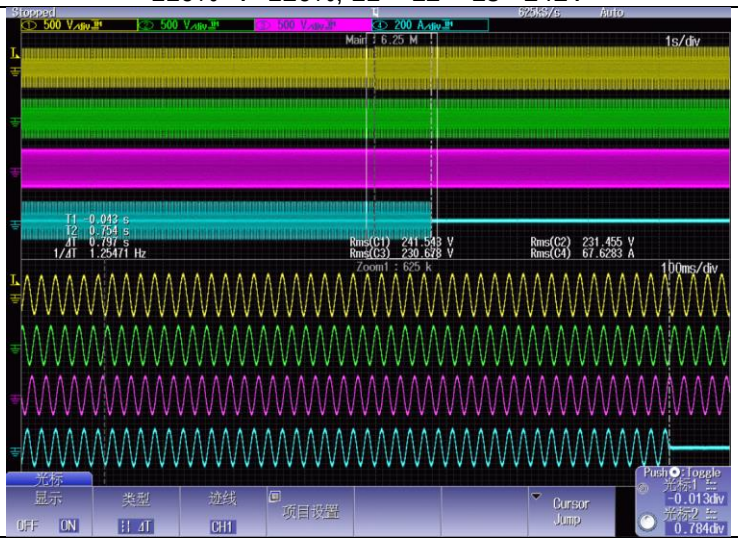
90%≤V≤110%, L1 = L2 = L3 =198 V



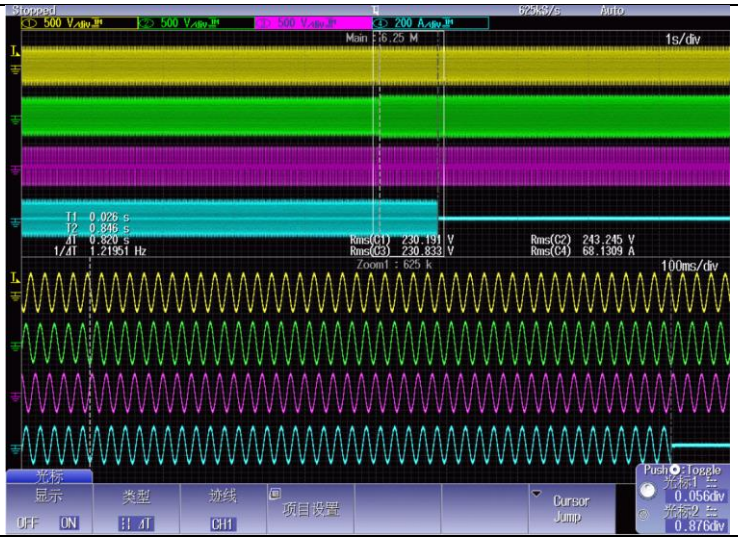
90%≤V≤110%, L1 = L2 = L3 =240 V



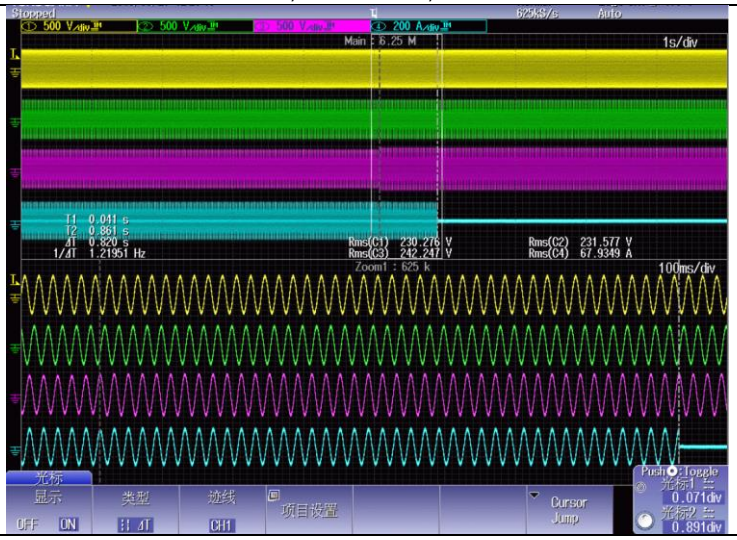
110%<V<120%, L1 = L2 = L3 =242V



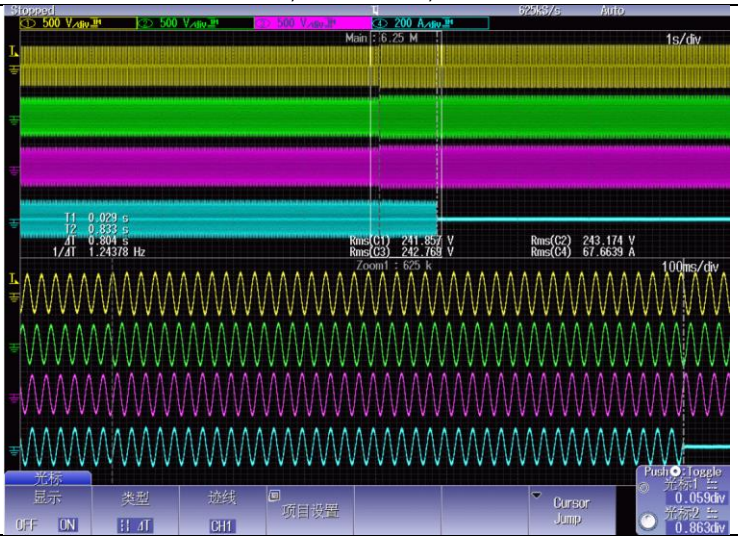
110%<V<120%, L1 = 242V, L2 = L3 = 220 V



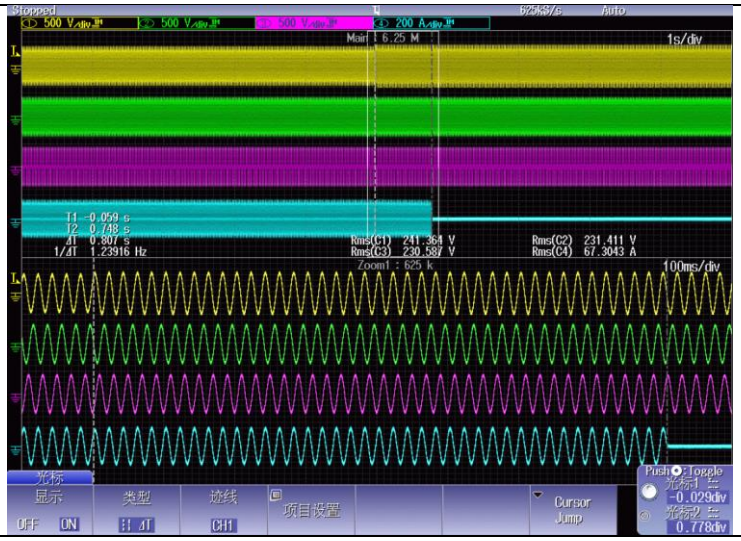
110%<V<120%, L2 = 242V, L1 = L3 = 220 V



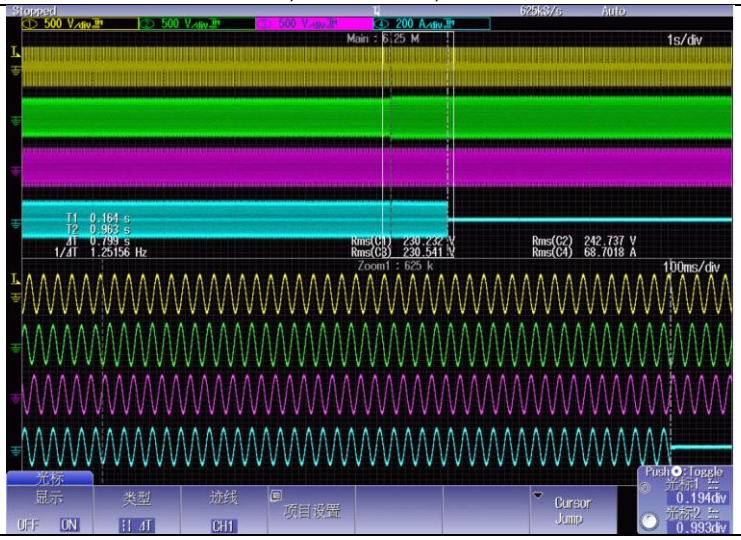
110%<V<120%, L3 = 242V, L1 = L2 = 220 V



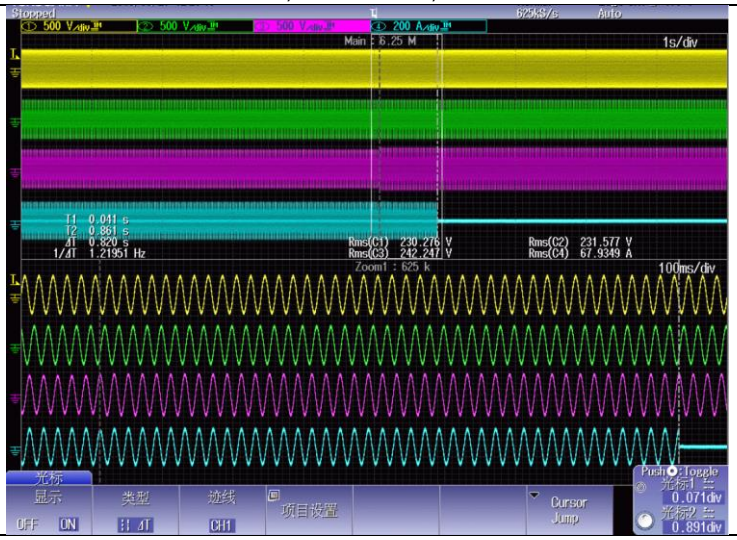
110%<V<120%, L1 = L2 = L3 = 261 V



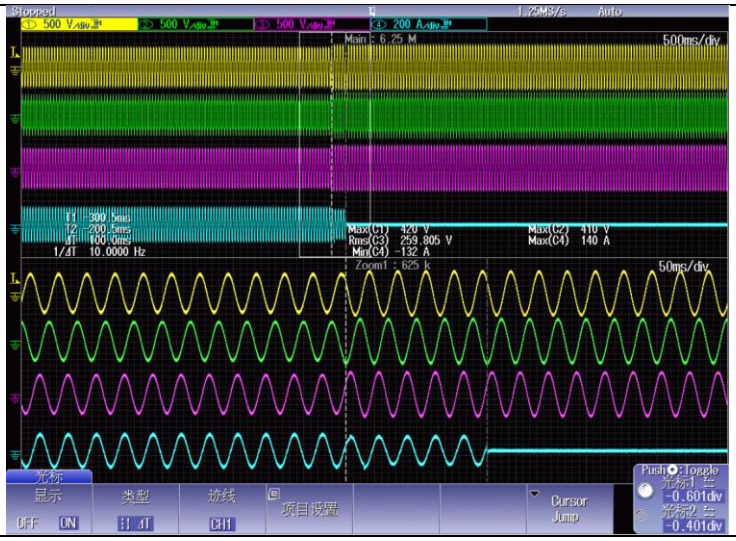
110%<V<120%, L1 = 261 V, L2 = L3 = 220 V



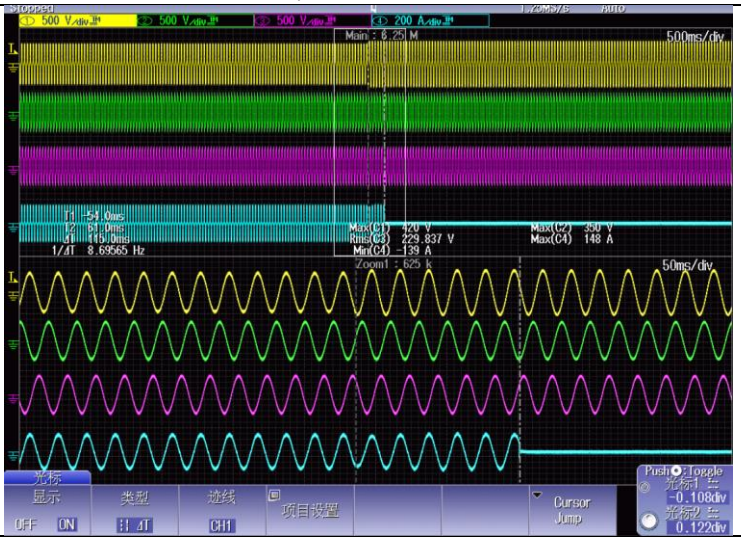
110%<V<120%, L2 = 261 V, L1 = L3 = 220 V



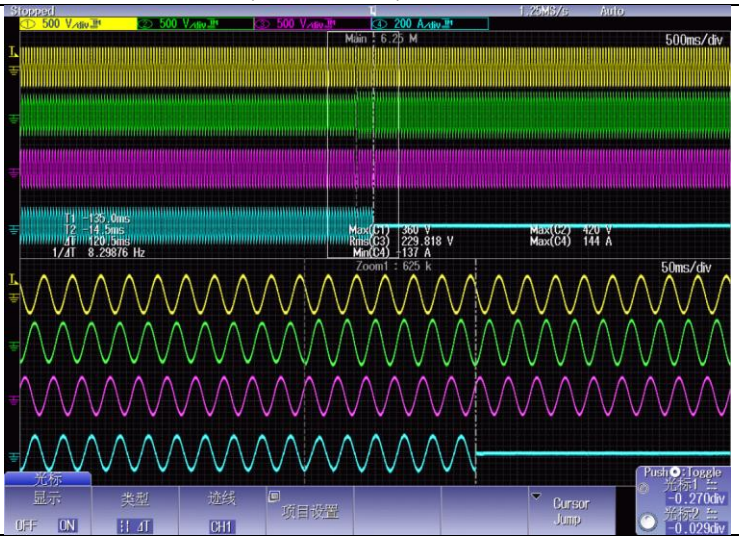
110%<V<120%, L3 = 261 V, L1 = L2 = 220 V



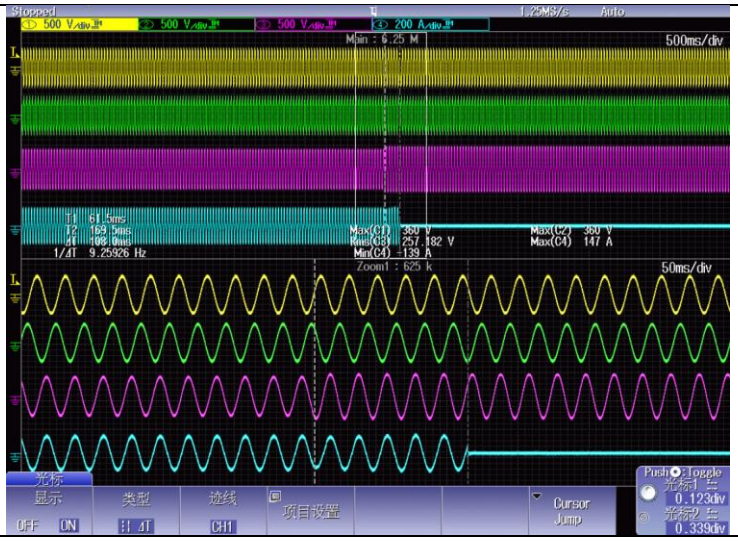
V≥120%, L1 = L2 = L3 =264 V



V≥120%, L1 = 264 V, L2 = L3 = 220 V



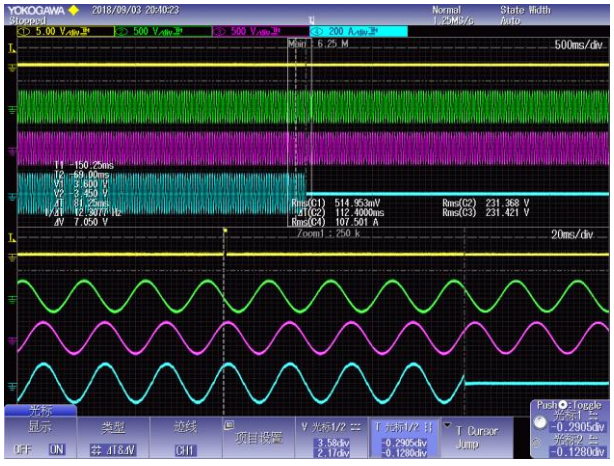
V≥120%, L2 = 264 V, L1 = L3 = 220 V



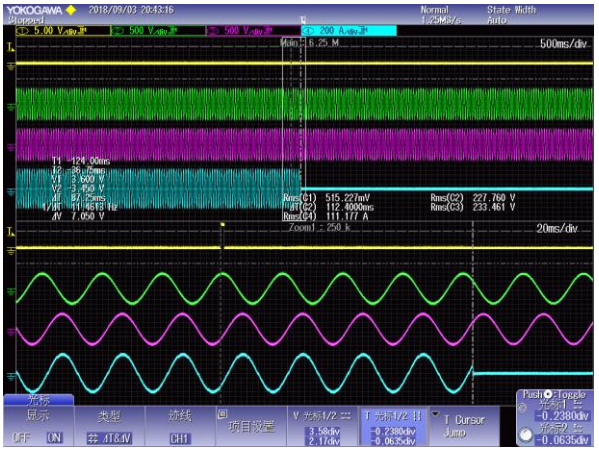
V≥120%, L3 = 264 V, L1 = L2 = 220 V

8	TABLE: Operating Frequency Range						P
No.	Frequency Range (Hz)	Setting Frequency (Hz)	Setting time (s)	Test Frequency (Hz)	Disconnecting Time (S)	Max. Disconnecting Time (S)	Result
1	99%UFT	46.9	0.06	46.9	0.0813	0.1	P
2	110%UFT	47.1	--	47.1	Cont.	Cont.	P
3	90%OFT	51.9	--	51.9	Cont.	Cont.	P
4	101%OFT	52.1	0.06	52.1	0.0872	0.1	P

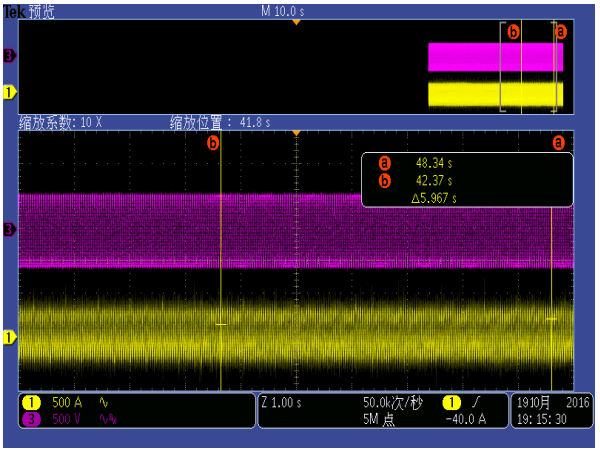
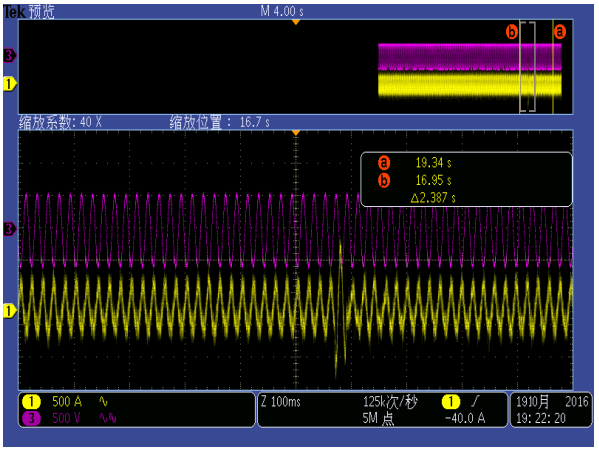
Supplementary information:
OFT: Over frequency Trip Setting
UFT: Under frequency Trip Setting
Cont.: Continuous operated



Under frequency < 46.9 Hz



Over frequency > 52.1 Hz

	
Frequency = 47.1 Hz	Frequency = 51.9Hz

9	TABLE: Islanding protection (EUT output = 100%)	P
Test conditions	Frequency: 50+/-0.1Hz UN=220+/-3Vac Distortion factor of chokes < 2% Quality =1	
Disconnection limit	2s for PEA	

No	1) PEUT (% of EUT rating)	Reactive load (% of QL in 6.1.d) 1)	2) PAC (% of nominal)	3) QAC (% of nominal)	Run on Time (ms)	PEUT (kW per phase)	Actual Qf	V (V)	Remarks4)
1	100	100	0	0	176	33.193	0.997	748	Test A at BL
2	100	100	-5	-5	152	33.193	1.023	748	Test A at IB
3	100	100	-5	0	154	33.193	1.049	748	Test A at IB
4	100	100	-5	+5	170	33.193	1.075	748	Test A at IB
5	100	100	0	-5	124	33.193	0.971	748	Test A at IB
6	100	100	0	+5	172	33.193	1.021	748	Test A at IB
7	100	100	+5	-5	166	33.193	0.925	748	Test A at IB
8	100	100	+5	0	162	33.193	0.949	748	Test A at IB
9	100	100	+5	+5	164	33.193	0.973	748	Test A at IB
10	100	100	-10	+10	143	33.193	1.002	748	Test A at IB
11	100	100	-5	+10	164	33.193	1.007	748	Test A at IB
12	100	100	0	+10	118	33.193	1.012	748	Test A at IB
13	100	100	+5	+10	172	33.193	1.017	748	Test A at IB
14	100	100	+10	+10	165	33.193	1.022	748	Test A at IB
15	100	100	-10	+5	158	33.193	1.027	748	Test A at IB
16	100	100	+10	+5	138	33.193	0.986	748	Test A at IB

17	100	100	-10	0	167	33.193	0.991	748	Test A at IB
18	100	100	+10	0	162	33.193	0.996	748	Test A at IB
19	100	100	-10	-5	152	33.193	1.001	748	Test A at IB
20	100	100	+10	-5	169	33.193	1.006	748	Test A at IB
21	100	100	-10	-10	121	33.193	1.011	748	Test A at IB
22	100	100	-5	-10	164	33.193	1.016	748	Test A at IB
23	100	100	0	-10	113	33.193	1.021	748	Test A at IB
24	100	100	+5	-10	172	33.193	0.986	748	Test A at IB
25	100	100	-10	-10	156	33.193	0.991	748	Test A at IB

Parameter at 0% per phase	L= 18.07 mH	R= 6.39Ω	C= 603.00 µF
IAC fundamental current at balance condition	L1:103 mA	L2: 146 mA	L3: 368 mA

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power

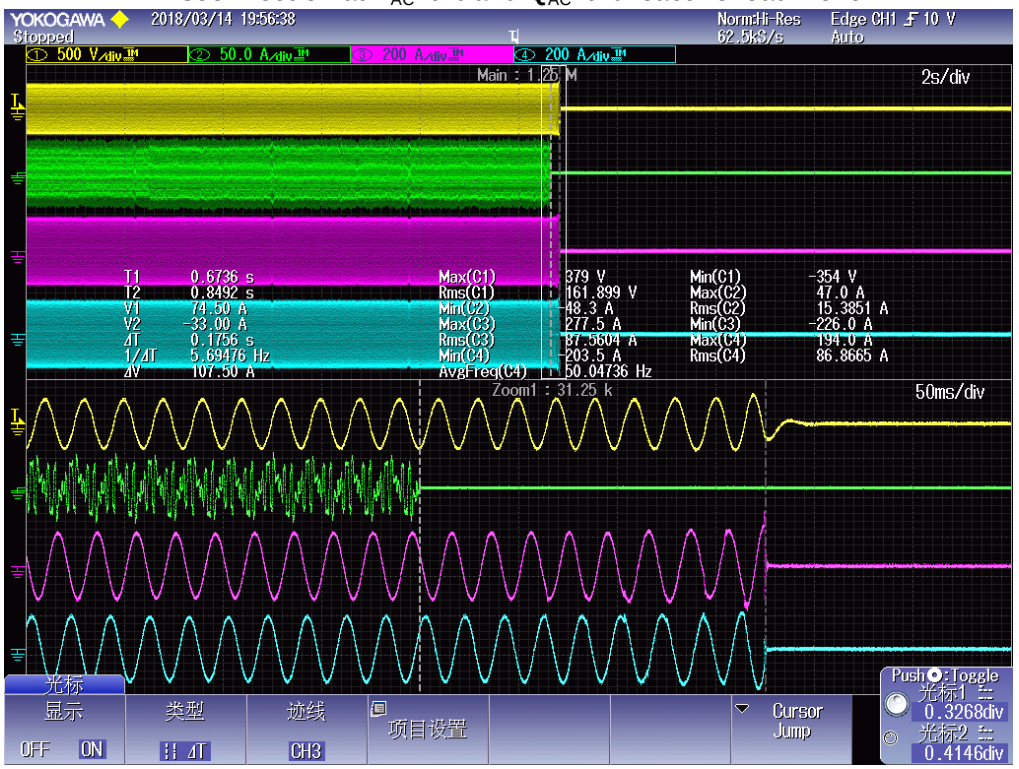
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition A:
EUT output power PEUT = Maximum5)
EUT input voltage 6) = 100% of rated input voltage range

5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0.9 × (Y – X). Y shall not exceed 0.8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load No. 6



Attention:
For Thailand only picture with all three current phases L1. L2 and L3 are accepted
All relays are direct coupled and open directly by receiving the islanding signal from the controller.

Note:
CH1. CH2. CH3: L1. L2. L3 current of EUT(8A/div); CH4. CH5. CH6: L1. L2. L3 I_{AC}(2A/div).

9	TABLE: **Islanding protection (EUT output = 66%)**	**P**
Test conditions	Frequency: 50+/-0.1Hz UN=220+/-3Vac Distortion factor of chokes < 2% Quality =1	
Disconnection limit	2s for PEA	

No	1) PEUT (% of EUT rating)	Reactive load (% of QL in 6.1.d) 1)	2) PAC (% of nominal)	3) QAC (% of nominal)	Run on Time (ms)	PEUT (kW per phase)	Actual Qf	V (V)	Remarks4)
1	66	66	0	-5	192	22.091	0.977	640	Test B at IB
2	66	66	0	-4	120	22.091	0.982	640	Test B at IB
3	66	66	0	-3	127	22.091	0.987	640	Test B at IB
4	66	66	0	-2	164	22.091	0.992	640	Test B at IB
5	66	66	0	-1	127	22.091	0.997	640	Test B at IB
6	66	66	0	0	183	22.091	1.002	640	Test B at BL
7	66	66	0	1	172	22.091	1.007	640	Test B at IB
8	66	66	0	2	182	22.091	1.012	640	Test B at IB

9	66	66	0	3	124	22.091	1.017	640	Test B at IB
10	66	66	0	4	162	22.091	1.022	640	Test B at IB
11	66	66	0	5	176	22.091	1.027	640	Test B at IB

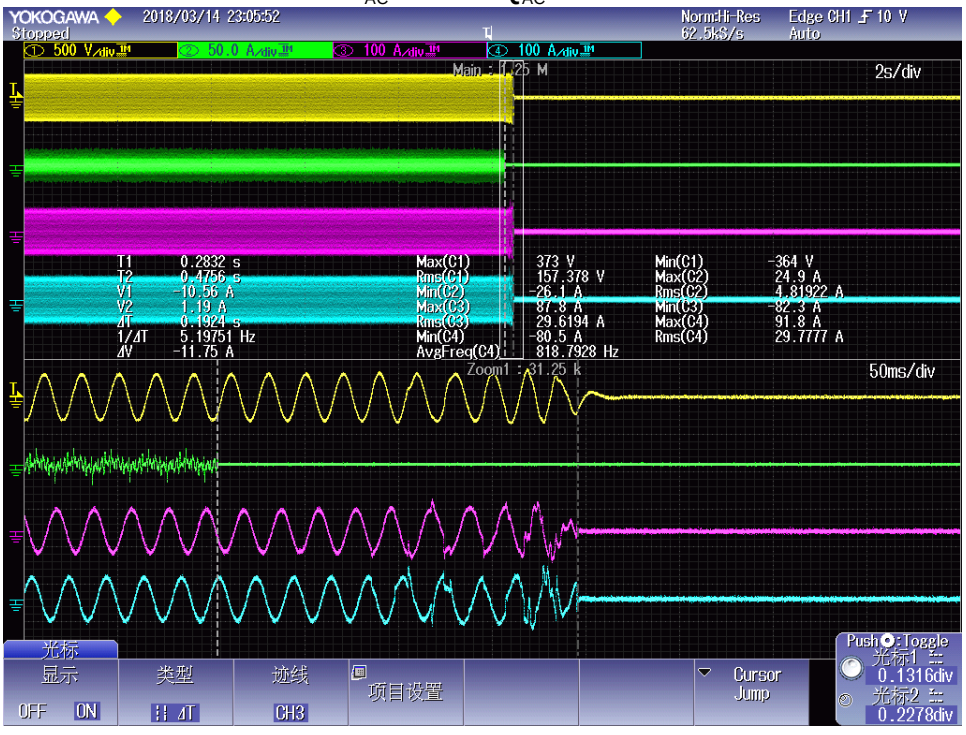
Parameter at 0% per phase	L= 80.30 mH	R= 25.30 Ω	C= 126.00 µF
IAC fundamental current at balance condition	L1: 18 mA	L2: 41 mA	L3: 47 mA

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) PEUT: EUT output power

2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

3) QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum 5)
EUT input voltage 6) = 66% of rated input voltage range
5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0.9 × (Y – X). Y shall not exceed 0.8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load No. 1



Attention:
For Thailand only picture with all three current phases L1. L2 and L3 are accepted
All relays are direct coupled and open directly by receiving the islanding signal from the controller.

Note:
CH1. CH2. CH3: L1. L2. L3 current of EUT(8A/div); CH4. CH5. CH6: L1. L2. L3 I_{AC}(0.8A/div).

9	TABLE: **Islanding protection (EUT output = 33%)**	**P**

Test conditions	Frequency: 50+/-0.1Hz UN=220+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s for PEA

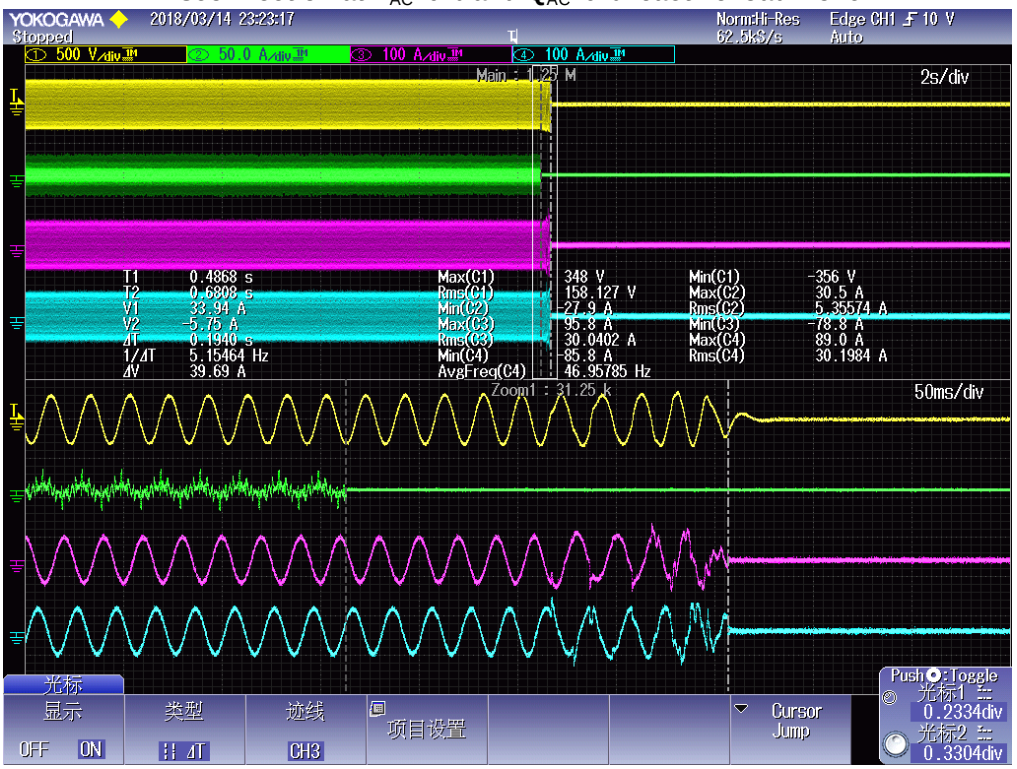
No	1) PEUT (% of EUT rating)	Reactive load (% of QL in 6.1.d) 1)	2) PAC (% of nominal)	3) QAC (% of nominal)	Run on Time (ms)	PEUT (kW per phase)	Actual Qf	V (V)	Remarks4)
1	33	33	0	-5	194	10.994	0.971	485	Test C at IB
2	33	33	0	-4	182	10.994	0.986	485	Test C at IB
3	33	33	0	-3	164	10.994	0.986	485	Test C at IB
4	33	33	0	-2	160	10.994	0.991	485	Test C at IB
5	33	33	0	-1	162	10.994	0.996	485	Test C at IB
6	33	33	0	0	154	10.994	1.001	485	Test C at BL
7	33	33	0	1	156	10.994	1.006	485	Test C at IB
8	33	33	0	2	182	10.994	1.011	485	Test C at IB
9	33	33	0	3	174	10.994	1.016	485	Test C at IB
10	33	33	0	4	182	10.994	1.021	485	Test C at IB
11	33	33	0	5	190	10.994	1.026	485	Test C at IB

Parameter at 0% per phase	L= 52.17 mH	R= 16.76 Ω	C= 201.54 μF
IAC fundamental current at balance condition	L1: 82mA	L2: 96mA	L3: 147mA

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) PEUT: EUT output power
2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition A:
EUT output power PEUT = Maximum 5)
EUT input voltage 6) = 33% of rated input voltage range
5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0.9 × (Y – X). Y shall not exceed 0.8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

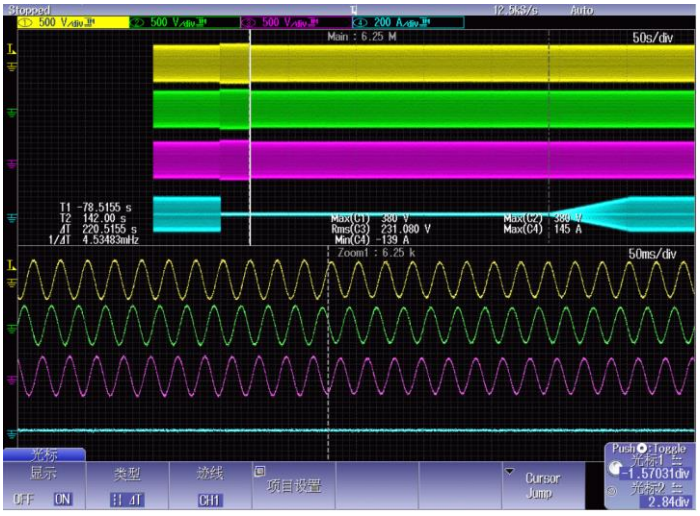
Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load No. 6



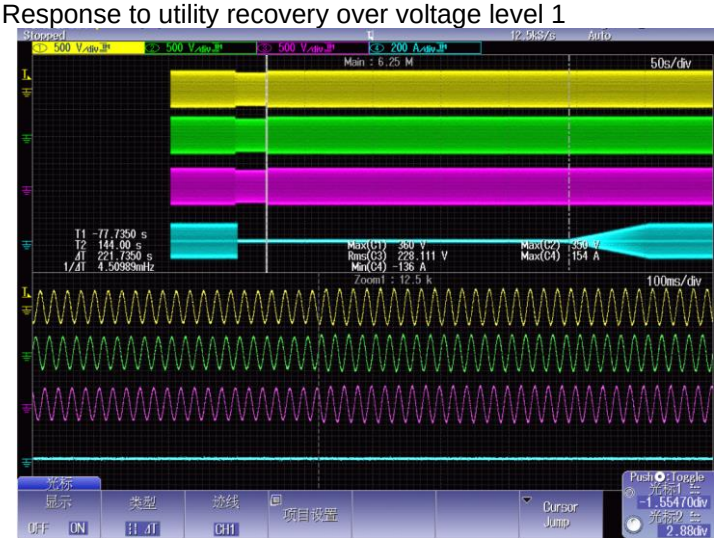
Attention:
For Thailand only picture with all three current phases L1. L2 and L3 are accepted
All relays are direct coupled and open directly by receiving the islanding signal from the controller.

Note:
CH1. CH2. CH3: L1. L2. L3 current of EUT(2A/div); CH4. CH5. CH6: L1. L2. L3 I_{AC}(0.8A/div).

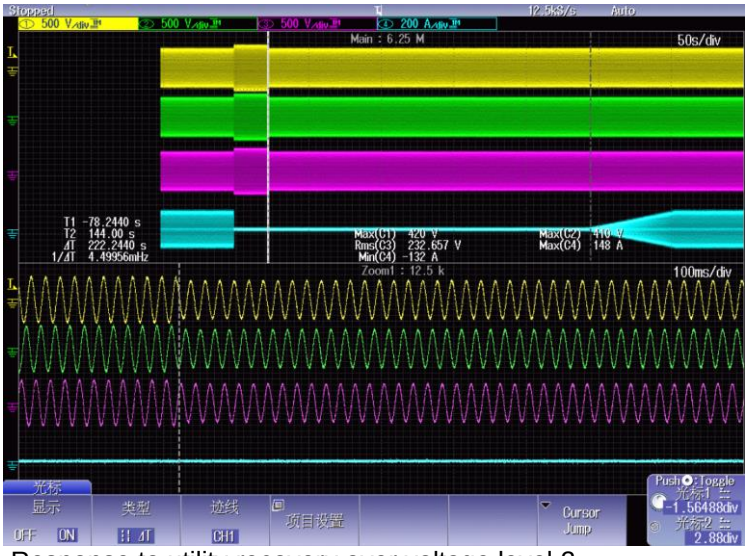
	Table: Response to Utility recovery test			P
Test condition	Limit (sec)	Actual Setting (sec)	Test Result (sec)	Result
Under frequency (46.9Hz)	20 - 300	27	228	P
Over frequency (52.1 Hz)		27	225	P
Under voltage level 1 (355 V)		27	221	P
Over voltage level 1 (443 V)		27	220	P
Under voltage level 2 (200 V)		27	223	P
Over voltage level 2 (478 V)		27	222	P
Supplementary				



Response to utility recovery over voltage level 1

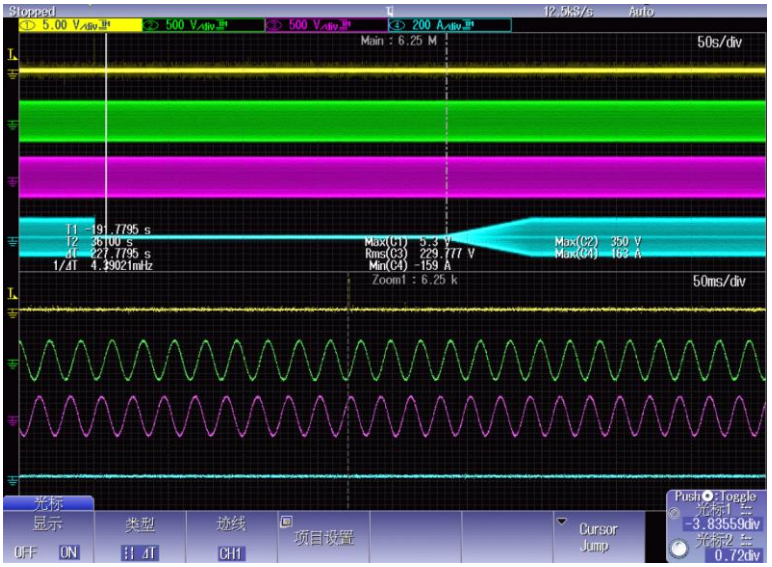


Response to utility recovery under voltage level 1



Response to utility recovery over voltage level 2

Response to utility recovery under voltage level 2



Response to utility recovery under Frequency

Response to utility recovery over Frequency

Annex I
Equipment of test

Equipment name	Trade name	Model	S/N	Cal. Due. Date
Power Analyzer	YOKOGAVA	WT3000	EP-011	2020/09/24
Programmable DC Power supply	ATESS	DC1000	RD.02.100	--
Programmable AC Source	ATESS	AC1000	RD.02.101	--
Programmable DC Power supply	Kewell	TVS-630kW	EP-027	--
Programmable AC Source	APC	AFG-S-33800	EP-026	--
Programmable RLC Load	Qunling	ACLT-38160H	EP-028	--
Digital oscilloscope	YOKOGAVA	DL850	EP-001	2020/09/05
Differential probe	CYBERTEK	VP5200	EP-003	2020/09/05
Current probe	YOKOGAVA	CT-1000	EP-012	2020/09/24
Current probe	YOKOGAVA	CT-1000	EP-013	2020/09/24
Current probe	YOKOGAVA	CT-1000	EP-014	2020/09/24
Three phase impedance	Teseq	CCN 1000-3	EE206-1	2020/08/23
Signal conditioning Unit	Teseq/Germany	INA2197/37A	EE206-2	N/A
Three phase impedance	Teseq/Germany	INA 2196/75A	EE206-3	N/A

Annex II
Specification of Inverter

Annex IV
Laboratory Accreditation Certificate

China National Accreditation Service for Conformity Assessment

LABORATORY ACCREDITATION CERTIFICATE

(Registration No. CNAS L2291)

EMTEK (Shenzhen) Co., Ltd.

Building 69, Majialong Industry Zone,

Nanshan District, Shenzhen, Guangdong, China

is accredited in accordance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories(CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence to undertake the service described in the schedule attached to this certificate.

The scope of accreditation is detailed in the attached schedule bearing the same registration number as above. The schedule form an integral part of this certificate.

Date of Issue: 2016-10-24

Date of Expiry: 2022-10-28

Date of Initial Accreditation: 2005-11-02

Signed on behalf of China National Accreditation Service for Conformity Assessment

China National Accreditation Service for Conformity Assessment(CNAS) is authorized by Certification and Accreditation Administration of the People's Republic of China (CNCA) to operate the national accreditation schemes for conformity assessment. CNAS is a signatory of the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA) and the Asia Pacific Laboratory Accreditation Cooperation Mutual Recognition Arrangement (APLAC MRA).

The validity of the certificate can be checked on CNAS website at http://www.cnas.org.cn/english/findanaccreditedbody/index.shtml

Finger 3 Laboratory Accreditation Certificate