



**TEST REPORT
IEC 61727
Photovoltaic (PV) systems –
Characteristics of the utility interface**

Report Number..... : GZES191002576301

Date of issue..... : 07/11/2019

Total number of pages 19

Name of Testing Laboratory preparing the Report : SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

Applicant's name : EVOLVE ENERGY GROUP CO., LIMITED

Address..... : RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK

Test specification:

Standard : IEC 61727:2004 (Second Edition)

Test procedure : Characteristic Examination

Non-standard test method : N/A

Test Report Form No. : IEC61727A

Test Report Form(s) Originator : TÜV SÜD Product Service GmbH

Master TRF : Dated 2014-11



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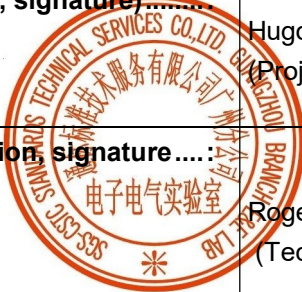
General disclaimer:

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

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Test item description	Solar Grid-tied Inverter
Trade Mark	
Manufacturer	EVOLVE ENERGY GROUP CO., LIMITED
Address	RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
Model/Type reference	EVVO 3200TL-AV, EVVO 3000TL-AV, EVVO 2700TL-AV, EVVO 2200TL-AV, EVVO 1600TL-AV, EVVO 1100TL-AV
Ratings	See model list in Page 2.
	Serial Number: SA3ES033K4P001, SA3ES027K4P020
	Firmware version: V100

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input type="checkbox"/>	CB Testing Laboratory:	
Testing location/ address.....:		
<input type="checkbox"/>	Associated CB Testing Laboratory:	
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Approved by (name, function, signature)....:		
<input checked="" type="checkbox"/>	Testing procedure: TMP/CTF Stage 1:	Shenzhen SOFAR SOLAR Co., Ltd.
Testing location/ address		401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China
Tested by (name, function, signature).....:		Hugo Zhang (Project Engineer)
Approved by (name, function, signature)....:		Roger Hu (Technical Reviewer)
<input type="checkbox"/>	Testing procedure: WMT/CTF Stage 2:	
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Witnessed by (name, function, signature) ..:		
Approved by (name, function, signature)....:		
<input type="checkbox"/>	Testing procedure: SMT/CTF Stage 3 or 4:	
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Witnessed by (name, function, signature) ..:		
Approved by (name, function, signature)....:		
Supervised by (name, function, signature):		



List of Attachments (including a total number of pages in each attachment):		
50 Hz		
Attachment #	Description	Pages
Attachment I	Pictures of the EUT and Electrical Schemes	12 pages
Attachment II	Testing Information	4 pages
Attachment III	Graphs and Screenshots of Test Results	21 pages
Summary of testing:		
<p>Tests performed (name of test and test clause):</p> <p>The equipment has been tested according to the standard: IEC 61727:2004. Testing has been carried out at 50 Hz</p> <p>All applicable tests according to the above specified standard have been carried out.</p> <p>From the result of inspection and tests on the submitted sample, we conclude that it complies with the requirements of the standard.</p> <p>Remarks: All the test results are from the report below:</p> <ul style="list-style-type: none"> - IEC 61727:2004 (Second Edition) <p>Test Report No: 2219 / 0185-A-E1 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory) on 26/07/2019</p>	<p>Testing location:</p> <p>Shenzhen SOFAR SOLAR Co., Ltd. 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China (All clauses)</p>	
Summary of compliance with National Differences:		
No National Differences are addressed to this test report		

Copy of marking plate(representative):

EVVO Solar Grid-tied Inverter	
Model No:	EVVO 3200TL - AV
Max.DC Input Voltage	550V
Operating MPPT Voltage Range	50~550V
Max. Input Current	12A
Max. PV Isc	15A
Nominal Grid Voltage	L/N/PE, 230Vac
Max. Output Current	16A
Nominal Grid Frequency	50/60Hz
Max. Output Power	3300VA
Power Factor	1 (adjustable +/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-30°C~+60°C
Protective Class	Class I
Inverter Topology	Non-Isolated
Factory - Shenzhen China	
Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED	
Address : RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST	
SHEUNG WAN, HK	
Global Head Quarters	
371 Sidco Industrial Estate	
Chennai 600098 India	
VDE0126-1-1,VDE-AR-N4105, IEC61727, IEC62116, UTE C15-712-1, AS4777	

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation
3. Labels of other models are as the same with EVVO 3200TL-AV's except the parameters of rating.

Test item particulars: Solar Grid-tied Inverter (Single Phase Inverter)	
Classification of installation and use: Fixed (permanent connection)	
Supply Connection: DC; PV	
.....: AC; Grid connection	
Possible test case verdicts:	
- test case does not apply to the test object.....: N/A	
- test object does meet the requirement.....: P (Pass)	
- test object does not meet the requirement.....: F (Fail)	
Testing: CTF Stage 1 procedure	
Date of receipt of test item: N/A	
Date (s) of performance of tests: From 16/04/2019 to 11/06/2019	
General remarks:	
<p>"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.</p> <p>This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at www.sgs.com/terms_and_conditions.htm and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_e-document.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.</p>	
<p>Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.</p>	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC 61727:	
<p>The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided</p>	<p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable</p>
When differences exist; they shall be identified in the General product information section.	
<p>Name and address of factory (ies): Dongguan SOFAR SOLAR Co.,Ltd. 1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City, Guangdong Province, P.R. China.</p>	

General product information:

Product covered by this report is grid-connected PV inverter for indoor or outdoor installation. The connection to the DC input and AC output are through connectors.

The Solar inverter converts DC voltage into AC voltage.

The input and output are protected by varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit can operate in case of one error.

Equipment Under Testing:

- EVVO 3200TL-AV

Variant models:

- EVVO 3000TL-AV
- EVVO 2700TL-AV
- EVVO 2200TL-AV
- EVVO 1600TL-AV
- EVVO 1100TL-AV

Model Number	EVVO 3200TL-AV	EVVO 3000TL-AV	EVVO 2700TL-AV	EVVO 2200TL-AV	EVVO 1600TL-AV	EVVO 1100TL-AV
Max. input voltage	550Vd.c.			500Vd.c		
Max. input current	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.
Operating MPPT voltage range	50-550Vd.c.			50-500Vd.c.		
Full load DC Voltage Range	300-500 Vd.c.	275-500 Vd.c.	250-500 Vd.c.	200-450 Vd.c.	150-450 Vd.c.	110-450 Vd.c.
Rated voltage	360V					
Rated grid voltage	230Va.c.					
Rated grid frequency	50Hz					
Rated output power	3.3kW	3.0kW	2.7kW	2.2kW	1.6kW	1.1kW
Rated output current	13Aa.c.	13 Aa.c.	11.8Aa.c.	9.6Aa.c.	7Aa.c.	4.8Aa.c.
Max. Output Current	16Aa.c.	14.5 Aa.c.	13Aa.c.	10.6Aa.c.	7.7Aa.c.	5.3Aa.c.
Power factor	0.8 leading to 0.8 lagging					
Ambient temperature	-30 °C ~60°C					
Ingress protection	IP65					
Protective class	Class I					

The variants models have been included in this test report without tests because the following features don't change regarding to the tested model:

- Same connection system and hardware topology
- Same control algorithm.
- Output power within 2.5 and 2/3 of the EUT or Modular inverters.
- Same Firmware Version

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict
4	UTILITY COMPATIBILITY		P
	The quality of power provided by the PV system for the on-site AC loads and for power delivered to the utility is governed by practices and standards on voltage, flicker, frequency, harmonics and power factor.		P
	Deviation from these standards represents out-of-bounds conditions and may require the PV system to sense the deviation and properly disconnect from the utility system.		P
4.1	Voltage, current and frequency		P
	The PV system AC voltage, current and frequency are compatible with the utility system.		P
4.2	Normal voltage operating range		P
	Utility-interconnected PV systems do not normally regulate voltage, they inject current into the utility. Therefore, the voltage operating range for PV inverters is selected as a protection function that responds to abnormal utility conditions, not as a voltage regulation function.		P
4.3	Flicker		P
	The operation of the PV system is not cause voltage flicker in excess of limits stated in the relevant sections of IEC 61000-3-3 for systems less than 16 A or IEC 61000-3-5 for systems with current of 16 A and above.	(see appended table)	P
4.4	DC injection		P
	The PV system is not inject DC current greater than 1 % of the rated inverter output current, into the utility AC interface under any operating condition.	(see appended table)	P
4.5	Normal frequency operating range		P
	The PV system operates in synchronism with the utility system, and within the frequency trip limits defined in 5.2.2.		P
4.6	Harmonics and waveform distortion		P
	Total harmonic current distortion is less than 5 % at rated inverter output. Each individual harmonic is limited to the percentages listed in Table 1.	(see appended table)	P
	Even harmonics in these ranges is less than 25 % of the lower odd harmonic limits listed.		P

IEC 61727																			
Clause	Requirement + Test	Result - Remark	Verdict																
	<p align="center">Table 1 – Current distortion limits</p> <table border="1"> <thead> <tr> <th>Odd harmonics</th> <th>Distortion limit</th> </tr> </thead> <tbody> <tr> <td>3rd through 9th</td> <td>Less than 4,0 %</td> </tr> <tr> <td>11th through 15th</td> <td>Less than 2,0 %</td> </tr> <tr> <td>17th through 21st</td> <td>Less than 1,5 %</td> </tr> <tr> <td>23rd through 33rd</td> <td>Less than 0,6 %</td> </tr> <tr> <th>Even harmonics</th> <th>Distortion limit</th> </tr> <tr> <td>2nd through 8th</td> <td>Less than 1,0 %</td> </tr> <tr> <td>10th through 32nd</td> <td>Less than 0,5 %</td> </tr> </tbody> </table>	Odd harmonics	Distortion limit	3 rd through 9 th	Less than 4,0 %	11 th through 15 th	Less than 2,0 %	17 th through 21 st	Less than 1,5 %	23 rd through 33 rd	Less than 0,6 %	Even harmonics	Distortion limit	2 nd through 8 th	Less than 1,0 %	10 th through 32 nd	Less than 0,5 %		P
Odd harmonics	Distortion limit																		
3 rd through 9 th	Less than 4,0 %																		
11 th through 15 th	Less than 2,0 %																		
17 th through 21 st	Less than 1,5 %																		
23 rd through 33 rd	Less than 0,6 %																		
Even harmonics	Distortion limit																		
2 nd through 8 th	Less than 1,0 %																		
10 th through 32 nd	Less than 0,5 %																		
4.7	The PV system has a lagging power factor greater than 0,9 when the output is greater than 50 % of the rated inverter output power.	(see appended table)	P																
5	PERSONNEL SAFETY AND EQUIPMENT PROTECTION		P																
	This Clause provides information and considerations for the safe and proper operation of the utility-connected PV systems.		P																
5.1	Loss of utility voltage		P																
	To prevent islanding, a utility connected PV system ceases to energize the utility system from a de-energized distribution line irrespective of connected loads or other generators within specified time limits.		P																
	A utility distribution line can become de-energized for several reasons. For example, a substation breaker opening due to fault conditions or the distribution line switched out during maintenance.		P																
5.2	Over/under voltage and frequency		P																
	The abnormal utility conditions of concern are voltage and frequency excursions above or below the values stated in this Clause, and the complete disconnection of the utility, presenting the potential for a distributed resource island.	(see appended table)	P																
5.2.1	Over/under voltage		P																
	When the interface voltage deviates outside the conditions specified in Table 2, the photovoltaic system ceases to energize the utility distribution system. This applies to any phase of a multiphase system.	(see appended table)	P																
	<p align="center">Table 2 – Response to abnormal voltages</p> <table border="1"> <thead> <tr> <th>Voltage (at point of utility connection)</th> <th>Maximum trip time*</th> </tr> </thead> <tbody> <tr> <td>$V < 0,5 \times V_{nominal}$</td> <td>0,1 s</td> </tr> <tr> <td>$50 \% \leq V < 85 \%$</td> <td>2,0 s</td> </tr> <tr> <td>$85 \% \leq V \leq 110 \%$</td> <td>Continuous operation</td> </tr> <tr> <td>$110 \% < V < 135 \%$</td> <td>2,0 s</td> </tr> <tr> <td>$135 \% \leq V$</td> <td>0,05 s</td> </tr> </tbody> </table> <p>* Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the "reconnect" feature.</p>	Voltage (at point of utility connection)	Maximum trip time*	$V < 0,5 \times V_{nominal}$	0,1 s	$50 \% \leq V < 85 \%$	2,0 s	$85 \% \leq V \leq 110 \%$	Continuous operation	$110 \% < V < 135 \%$	2,0 s	$135 \% \leq V$	0,05 s		P				
Voltage (at point of utility connection)	Maximum trip time*																		
$V < 0,5 \times V_{nominal}$	0,1 s																		
$50 \% \leq V < 85 \%$	2,0 s																		
$85 \% \leq V \leq 110 \%$	Continuous operation																		
$110 \% < V < 135 \%$	2,0 s																		
$135 \% \leq V$	0,05 s																		
5.2.2	Over/under frequency		P																

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict
	When the utility frequency deviates outside the specified conditions the photovoltaic system ceases to energize the utility line. The unit does not have to cease to energize if the frequency returns to the normal utility continuous operation condition within the specified trip time.	(see appended table)	P
	When the utility frequency is outside the range of ± 1 Hz, the system ceases to energize the utility line within 0,2 s. The purpose of the allowed range and time delay is to allow continued operation for short-term disturbances and to avoid excessive nuisance tripping in weak-utility system conditions.		P
5.3	Islanding protection		P
	The PV system must cease to energize the utility line within 2 s of loss of utility.	Test according IEC 62116: 2014 Refer to Test report No: GZES191002576302	P
5.4	Response to utility recovery		P
	Following an out-of-range utility condition that has caused the photovoltaic system to cease energizing, the photovoltaic system is not energize the utility line for 20 s to 5 min after the utility service voltage and frequency have recovered to within the specified ranges.	(see appended table)	P
5.5	Earthing		P
	The utility interface equipment is earthed/grounded in accordance with IEC 60364-7-712.		P
5.6	Short circuit protection		P
	The photovoltaic system has short-circuit protection in accordance with IEC 60364-7-712.		P
5.7	Isolation and switching		P
	A method of isolation and switching is provided in accordance with IEC 60364-7-712.		P

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict

4.3	TABLE: Flicker				P
	Starting	Stopping	Running		
Limit	4%	4%	Pst = 1.0	Plt = 0.65	
33%Pn					
Test value	0.10	0.34	0.07	0.07	
66%Pn					
Test value	0.10	0.12	0.07	0.07	
100%Pn					
Test value	0.10	0.54	0.07	0.07	
Supplementary information: Reference IEC 61000-3-3 as the standard applicable for <16A					

4.4	TABLE: Direct current injection							P	
Rated output current (A)	Ratio of rated output power (VA)	Measured DC output current between terminals (A)						Isolated transformer ? (Yes/No)	Limit (A)
		L1-L2	L1-L3	L2-L3	L1-N	L2-N	L3-N		
13	33%	--	--	--	0.016	--	--	No	0.130
13	66%	--	--	--	0.014	--	--	No	0.130
13	100%	--	--	--	0.016	--	--	No	0.130
Supplementary information: N/A									

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict

4.6(a)	Table: harmonics and waveform distortion (at 33%Pn)					P
Harmonic	% of fundamental	Limits (% of fundamental)	Harmonic	% of fundamental	Limits (% of fundamental)	
02	0.184	1	03	0.649	4	
04	0.112	1	05	0.123	4	
06	0.127	1	07	0.068	4	
08	0.053	1	09	0.148	4	
10	0.065	0.5	11	0.122	2	
12	0.027	0.5	13	0.062	2	
14	0.026	0.5	15	0.106	2	
16	0.040	0.5	17	0.092	1.5	
18	0.064	0.5	19	0.077	1.5	
20	0.043	0.5	21	0.100	1.5	
22	0.049	0.5	23	0.072	0.6	
24	0.046	0.5	25	0.092	0.6	
26	0.025	0.5	27	0.098	0.6	
28	0.042	0.5	29	0.101	0.6	
30	0.037	0.5	31	0.103	0.6	
32	0.029	0.5	33	0.088	0.6	
THD	0.811	5	--	--	--	
Supplementary information:						

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict

4.6(b)	Table: harmonics and waveform distortion (at 66%Pn)					P
Harmonic	% of fundamental	Limits (% of fundamental)	Harmonic	% of fundamental	Limits (% of fundamental)	
2	0.070	1	3	0.420	4	
4	0.098	1	5	0.115	4	
6	0.071	1	7	0.129	4	
8	0.075	1	9	0.099	4	
10	0.061	0.5	11	0.077	2	
12	0.020	0.5	13	0.055	2	
14	0.015	0.5	15	0.050	2	
16	0.015	0.5	17	0.047	1.5	
18	0.032	0.5	19	0.043	1.5	
20	0.018	0.5	21	0.058	1.5	
22	0.025	0.5	23	0.046	0.6	
24	0.022	0.5	25	0.046	0.6	
26	0.014	0.5	27	0.043	0.6	
28	0.011	0.5	29	0.044	0.6	
30	0.013	0.5	31	0.041	0.6	
32	0.010	0.5	33	0.027	0.6	
THD	0.528	5	--	--	--	
Supplementary information:						

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict

4.6(c)	Table: harmonics and waveform distortion (at 100%Pn)					P
Harmonic	% of fundamental	Limits (% of fundamental)	Harmonic	% of fundamental	Limits (% of fundamental)	
02	0.033	1	03	1.074	4	
04	0.102	1	05	0.525	4	
06	0.048	1	07	0.339	4	
08	0.031	1	09	0.319	4	
10	0.047	0.5	11	0.130	2	
12	0.024	0.5	13	0.088	2	
14	0.008	0.5	15	0.066	2	
16	0.020	0.5	17	0.097	1.5	
18	0.029	0.5	19	0.058	1.5	
20	0.016	0.5	21	0.045	1.5	
22	0.018	0.5	23	0.049	0.6	
24	0.022	0.5	25	0.043	0.6	
26	0.012	0.5	27	0.032	0.6	
28	0.009	0.5	29	0.052	0.6	
30	0.008	0.5	31	0.037	0.6	
32	0.012	0.5	33	0.021	0.6	
THD	1.312	5	--	--	--	
Supplementary information:						

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict

4.7	TABLE: Power factor							P
No	Input			Output				Rated output (V.A)
	Voltage (V d.c.)	Current (A d.c.)	Power (W)	Voltage (V a.c.)	Current (A a.c.)	Power (W)	Power factor	
1	413.9	1.6	683	230.1	2.9	660	0.993(a) 0.993(b) N/A (c)	(20±5)%
2	411.8	2.5	1020	230.2	4.3	991	0.997(a) 0.997(b) N/A (c)	(30±5)%
3	409.3	3.3	1322	230.3	5.8	1322	0.998(a) 0.998(b) N/A (c)	(40±5)%
4	406.4	4.2	1699	230.4	7.2	1653	0.998(a) 0.999(b) N/A (c)	(50±5)%
5	403.0	5.1	2041	230.6	8.6	1984	0.999(a) 0.999(b) N/A (c)	(60±5)%
6	398.8	6.0	2383	230.7	10.0	2316	0.999(a) 0.999(b) N/A (c)	(70±5)%
7	393.3	7.0	2727	230.8	11.5	2648	0.999(a) 0.999(b) N/A (c)	(80±5)%
8	385.1	8.0	3070	230.9	12.9	2978	0.999(a) 0.999(b) N/A (c)	(90±5)%
9	359.2	9.5	3408	231.0	14.3	3303	0.999(a) 0.999(b) N/A (c)	(100±5)%

Supplementary information:

Power factor with “+” indicating leading and “-“ indicating lagging

Each power stage has been maintained during 60 seconds for measurements with a sampling rate of 0.1 s.

Values offered correspond with the 60s average measured with each corresponding stage.

Except for power factor measurements, where:

The value a) indicates the average of measured absolute PF values during each 60s stage of measurement.

The value b) indicates the maximum leading PF value measured during each 60s stage of measurement.

The value c) indicates the maximum lagging PF value measured during each 60s stage of measurement.

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict

5.2.1 & 5.4		TABLE: Under-and over-voltage trip settings and reconnection test						P
(1) Under voltage disconnection procedure								
Rated output voltage (V)	Output power (VA)	Required min. voltage (V)	Value of PCE trip settings (V)	Ratio of decreased (V / s)	Interval time (ms)	Measured tripped voltage (V)	Measured disconnection time (ms)	
50 % V _n ≤ V < 85 % V _n								
230	3300	195.5	195	--	2000	194.3	1615	
230	3300	155	155	--	2000	154.4	1626	
230	3300	117	117	--	2000	116.0	1668	
V < 50%V _n								
230	3300	114	114	--	100	113.8	41	
(2) Under voltage reconnection procedure								
Ratio of voltage rapidly decreased (V / s)			Reconnection voltage (V)		Reconnection time (s)			
37			231.8		78.8			
(3) Over voltage disconnection procedure								
Rated output voltage (V)	Output power (VA)	Required max. voltage (V)	Value of PCE trip settings (V)	Ratio of increased (V / s)	Interval time (ms)	Measured tripped voltage (V)	Measured disconnection time (ms)	
110 % V _n < V < 135 % V _n								
230	3300	253	255	--	2000	255.0	1630	
230	3300	282	282	--	2000	282.3	40	
230	3300	309	309	--	2000	308.9	6	
135 % V _n ≤ V								
230	3300	312	312	--	50	312.9	3	
(4) Over voltage reconnection procedure								
Ratio of voltage rapidly decreased (V / s)			Reconnection voltage (V)		Reconnection time (s)			
22			230		79.2			
Supplementary information: N/A								

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Clause	Requirement + Test	Result - Remark	Verdict

5.2.2 & 5.4		TABLE: Over/under frequency trip settings and reconnection test						Pass
(1) Under frequency disconnection procedure								
Rated output frequency (Hz)	Output power (VA)	Required min. frequency (Hz)	Value of PCE trip settings (Hz)	Ratio of decreased (Hz / s)	Interval time (ms)	Measured tripped frequency (Hz)	Measured disconnection time (ms)	
50	3300	49	49	--	200	49	179	
(2) Under frequency reconnection procedure								
Ratio of voltage rapidly decreased (Hz / s)		Reconnection frequency (Hz)			Reconnection time (s)			
2		50			79.0			
(3) Over frequency disconnection procedure								
Rated output frequency (Hz)	Output power (VA)	Required max. frequency (Hz)	Value of PCE trip settings (Hz)	Ratio of increased (Hz / s)	Interval time (ms)	Measured tripped frequency (Hz)	Measured disconnection time (ms)	
50	3300	51	51	--	200	51.1	174	
(4) Over frequency reconnection procedure								
Ratio of voltage rapidly decreased (Hz / s)		Reconnection frequency (Hz)			Reconnection time (s)			
2		50			79.2			
Supplementary information: N/A								

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict

5.3	Table: tested condition and run-on time								P
No.	P _{EUT} (% of EUT rating)	Reactive load (% of normal)	P _{AC}	Q _{AC}	Run-on time(ms)	P _{EUT} (W)	Actual Q _f	V _{DC} (d.c.V)	Which load is selected to be adjusted (R or L)
Test condition A									
1	100	100	0	0	408	2698	1.00	464.9	--
2	100	100	-5	-5	324	2701	1.05	465.9	R/L
3	100	100	-5	0	364	2700	1.05	465.9	R
4	100	100	-5	+5	320	2701	1.02	466.1	R/L
5	100	100	0	-5	284	2698	1.03	465.0	L
6	100	100	0	+5	322	2689	0.98	460.3	L
7	100	100	+5	-5	318	2689	0.98	460.0	R/L
8	100	100	+5	0	332	2675	0.96	455.3	R
9	100	100	+5	+5	288	2696	0.95	462.9	R/L
10	100	100	-10	+10	--	--	--	--	R/L
11	100	100	-5	+10	--	--	--	--	R/L
12	100	100	0	+10	--	--	--	--	L
13	100	100	+10	+10	--	--	--	--	R/L
14	100	100	+10	+5	--	--	--	--	R/L
15	100	100	+10	0	--	--	--	--	R
16	100	100	+10	-5	--	--	--	--	R/L
17	100	100	+10	-10	--	--	--	--	R/L
18	100	100	+5	-10	--	--	--	--	R/L
19	100	100	+5	10	--	--	--	--	R/L
20	100	100	0	-10	--	--	--	--	L
21	100	100	-5	-10	--	--	--	--	R/L
22	100	100	-10	-10	--	--	--	--	R/L
23	100	100	-10	-5	--	--	--	--	R/L
24	100	100	-10	0	--	--	--	--	R/L
25	100	100	-10	+5	--	--	--	--	R/L

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Clause	Requirement + Test				Result - Remark				Verdict
Test condition B									
10	66	66	0	0	434	299.6	1.00	1783	--
11	66	66	0	-5	292	299.5	1.02	1783	L
12	66	66	0	-4	352	299.4	1.02	1782	L
13	66	66	0	-3	338	298.1	1.01	1782	L
14	66	66	0	-2	340	298.6	1.01	1783	L
15	66	66	0	-1	308	299.6	1.00	1782	L
16	66	66	0	1	352	300.1	1.00	1782	L
17	66	66	0	2	344	298.9	0.99	1782	L
18	66	66	0	3	312	299.8	0.99	1783	L
19	66	66	0	4	360	298.0	0.99	1781	L
20	66	66	0	5	314	297.6	0.98	1780	L
21	66	66	0	6	--	--	--	--	L
Test condition C									
22	33	33	0	0	332	143.9	1.00	904	--
24	33	33	0	-5	264	143.6	1.03	897	L
25	33	33	0	-4	318	144.1	1.02	897	L
26	33	33	0	-3	330	143.9	1.01	897	L
27	33	33	0	-2	316	144.2	1.01	899	L
28	33	33	0	-1	326	145.2	1.01	899	L
29	33	33	0	1	314	143.0	1.00	900	L
30	33	33	0	2	312	144.9	0.99	903	L
31	33	33	0	3	300	143.3	0.99	901	L
32	33	33	0	4	286	144.2	0.98	903	L
33	33	33	0	5	142	143.6	0.97	900	L
34	33	33	0	6	--	--	--	--	L
<p>Remark:</p> <p>For test condition A: If any of the recorded run-on times are longer than the one recorded for the rated balance condition, then the non-shaded parameter combinations also require testing.</p> <p>For test condition B and C: If run-on times are still increasing at the 95 % or 105 % points, additional 1 % increments is taken until run-on times begin decreasing.</p> <p>The compliances with these requirements are stated in the following test report: IEC 62116: test report n° GZES191002576302</p>									

--- End of test report---

Attachment I

(Pictures of the EUT and Electrical Schemes)

1 PICTURES

Front view 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)



Back view 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)



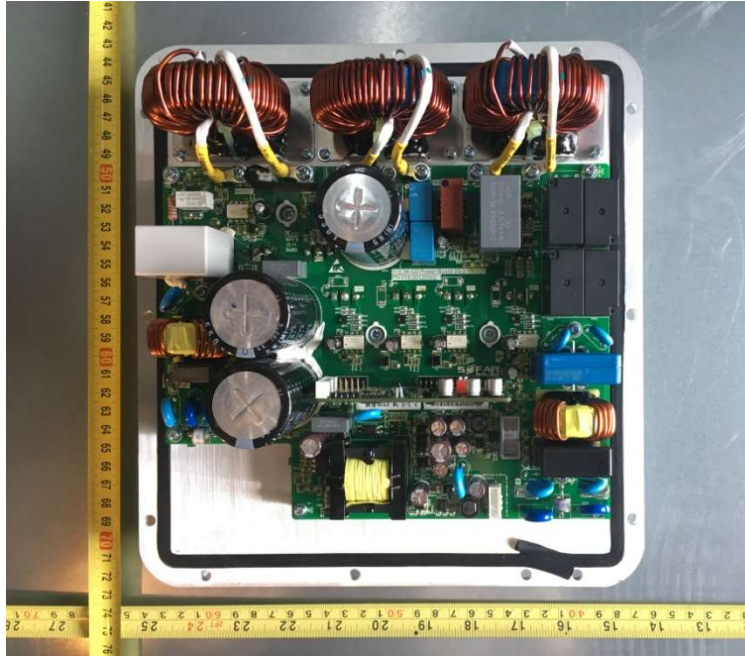
Front view 2 (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)



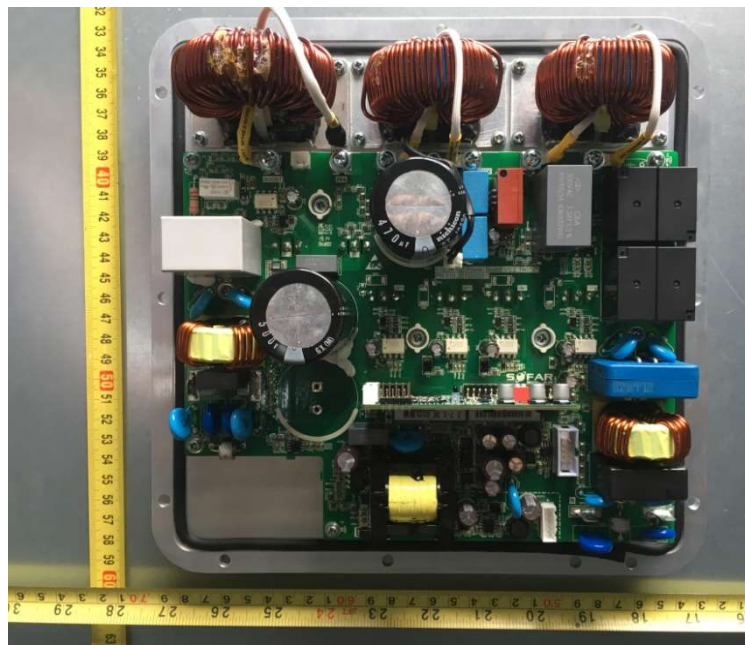
Back view 2 (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)



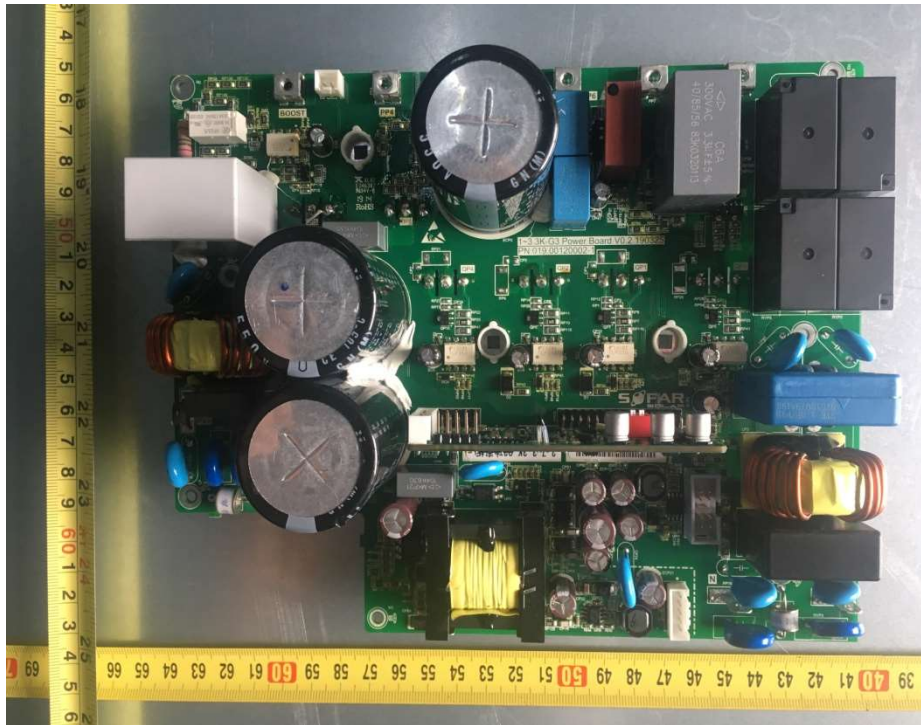
Internal view of enclosure (EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)



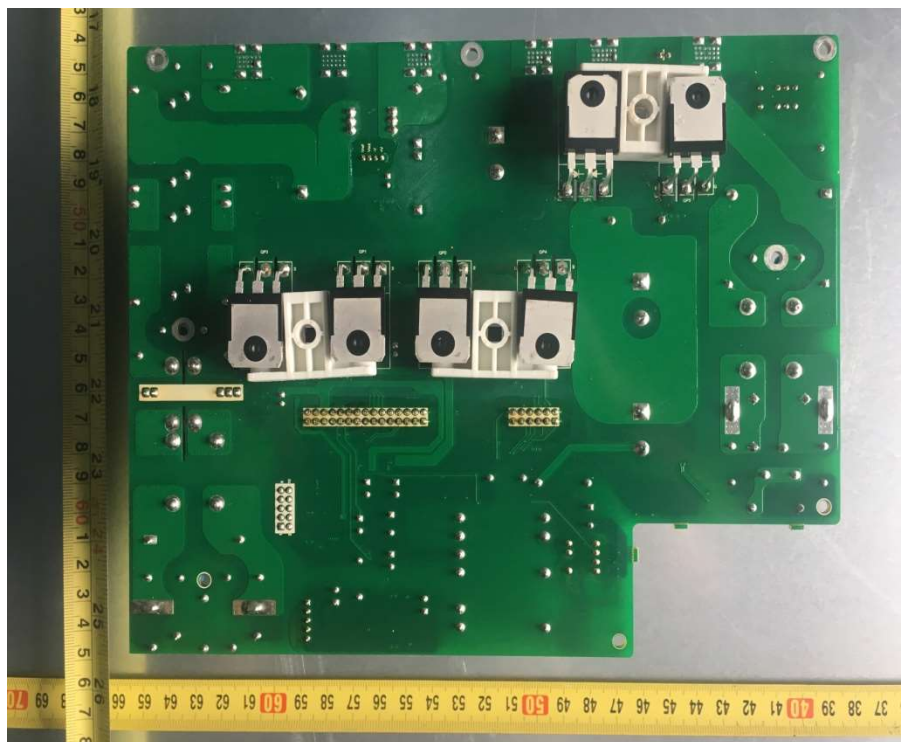
Internal view of enclosure (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)



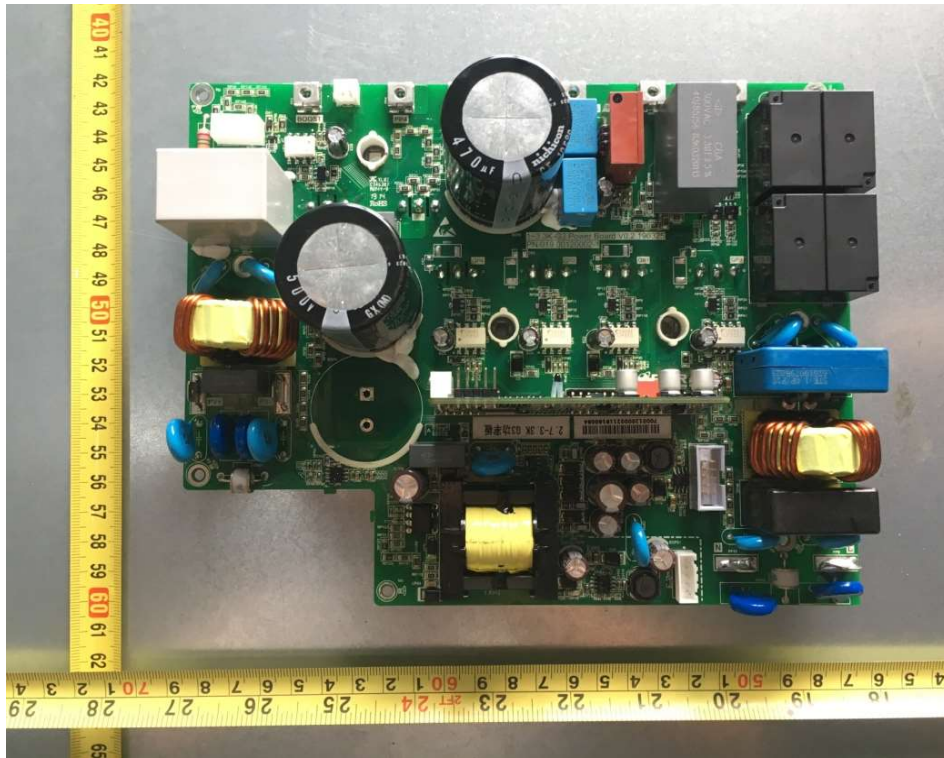
Front side of main board 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)



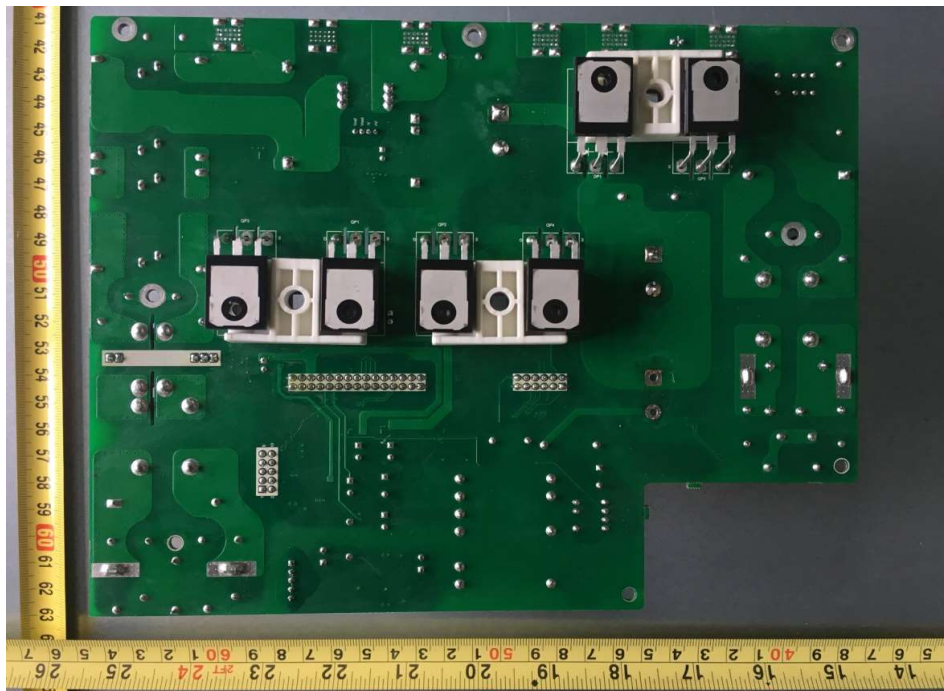
Back side of main board 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)



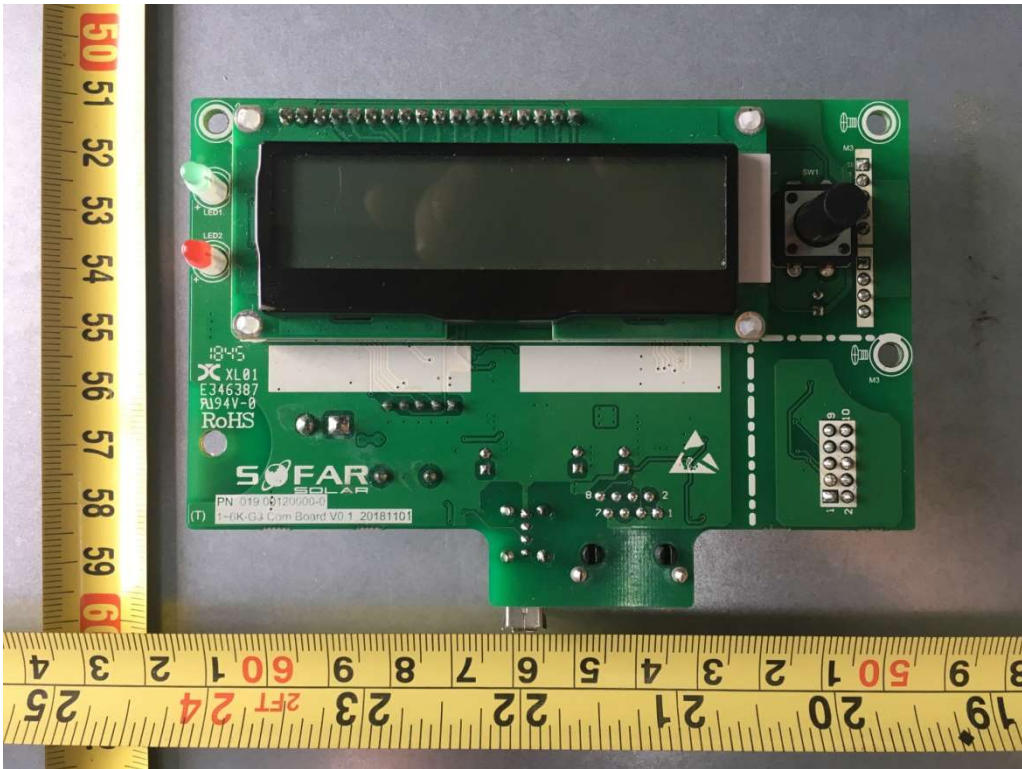
Front side of main board 2 (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)



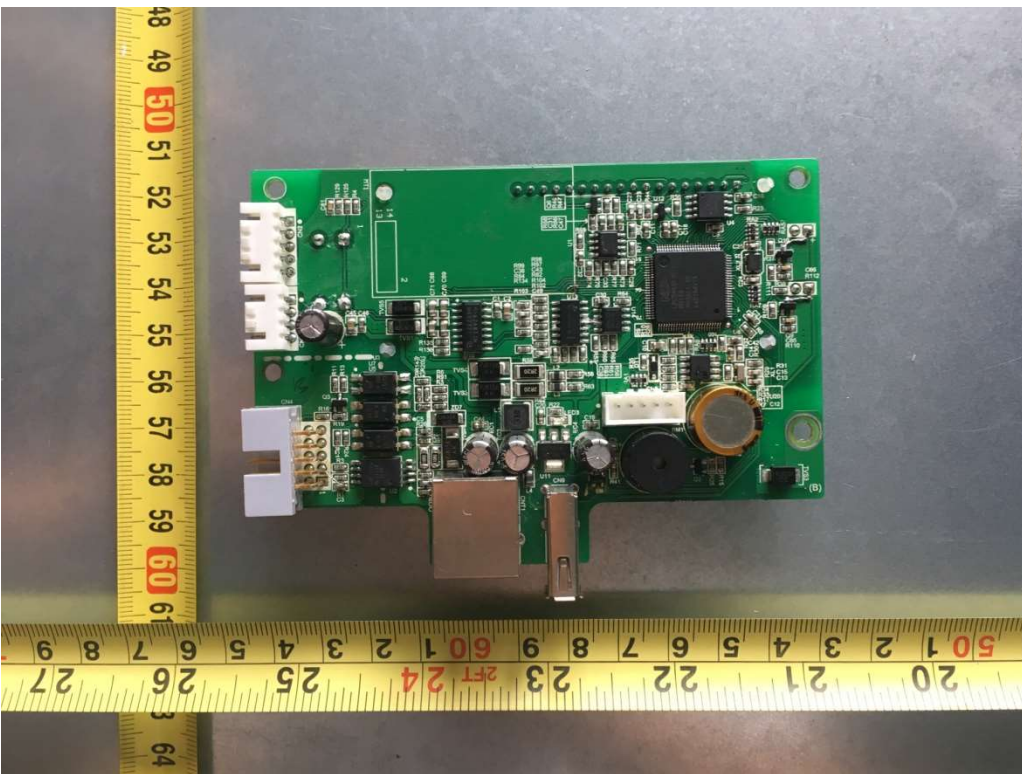
Back side of main board (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)



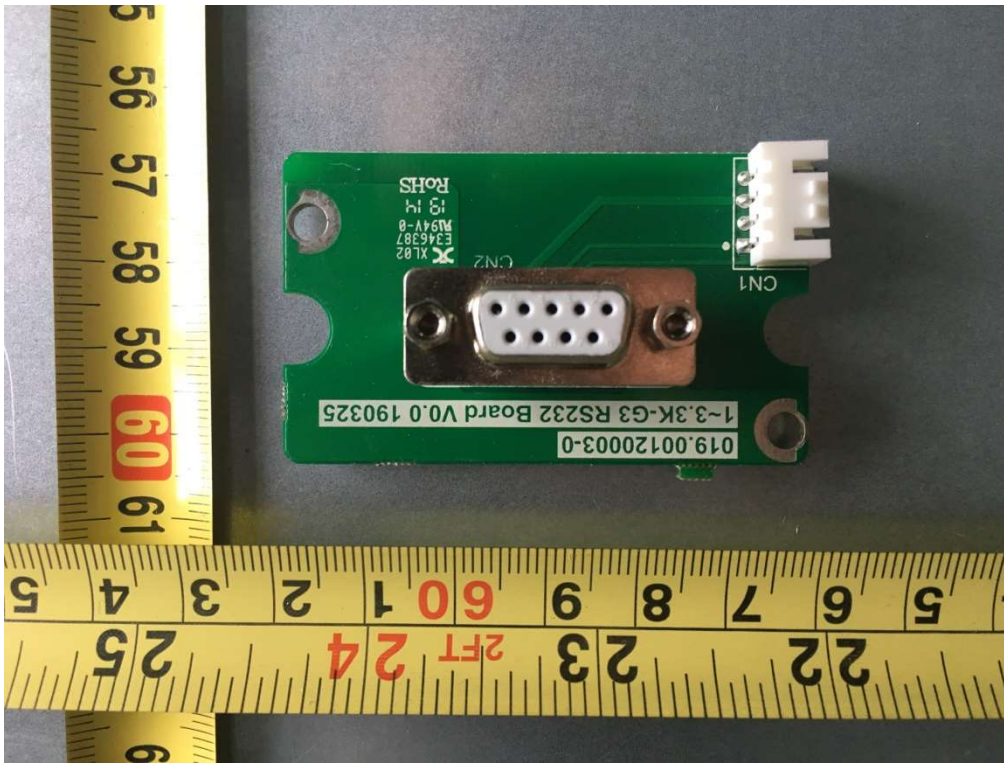
Front side of Control board



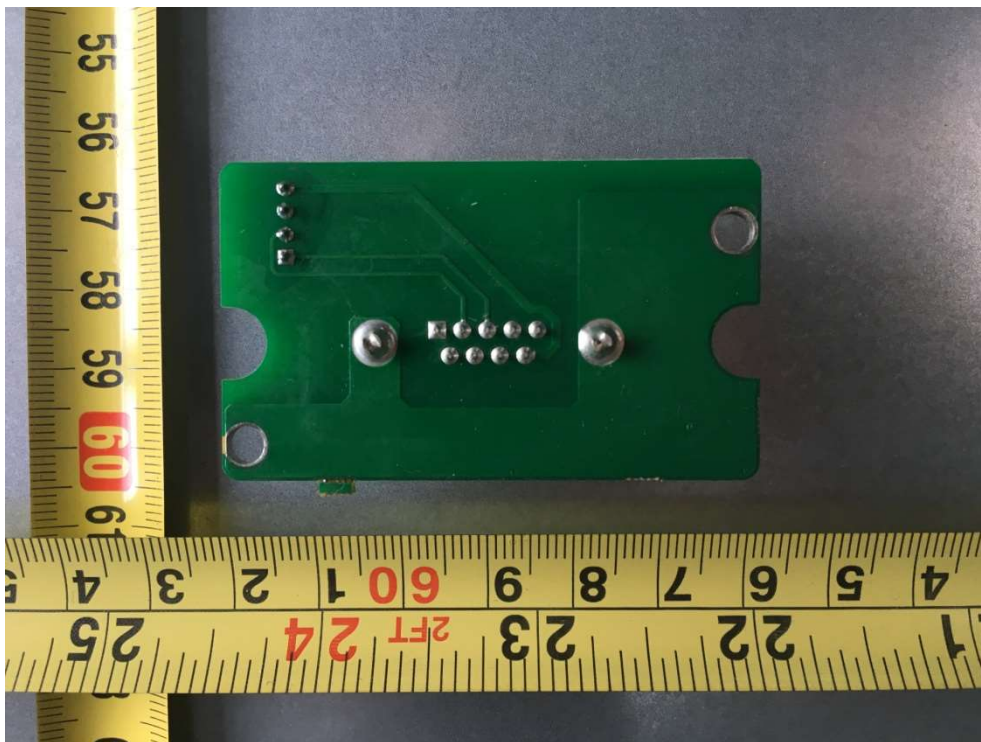
Back side of Control board



Front view of RS 232 board



Back view of RS 232 board



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Connection interface



Side View



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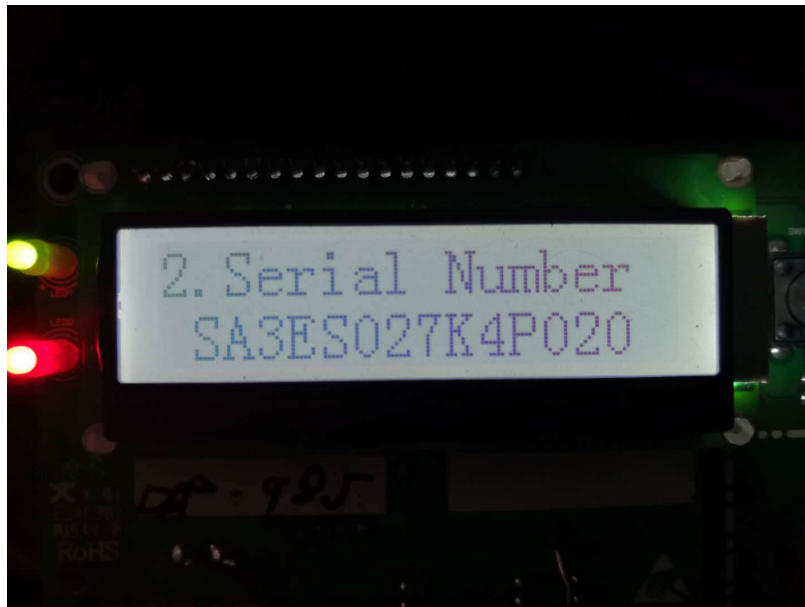
Grounding



Software Number (EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)



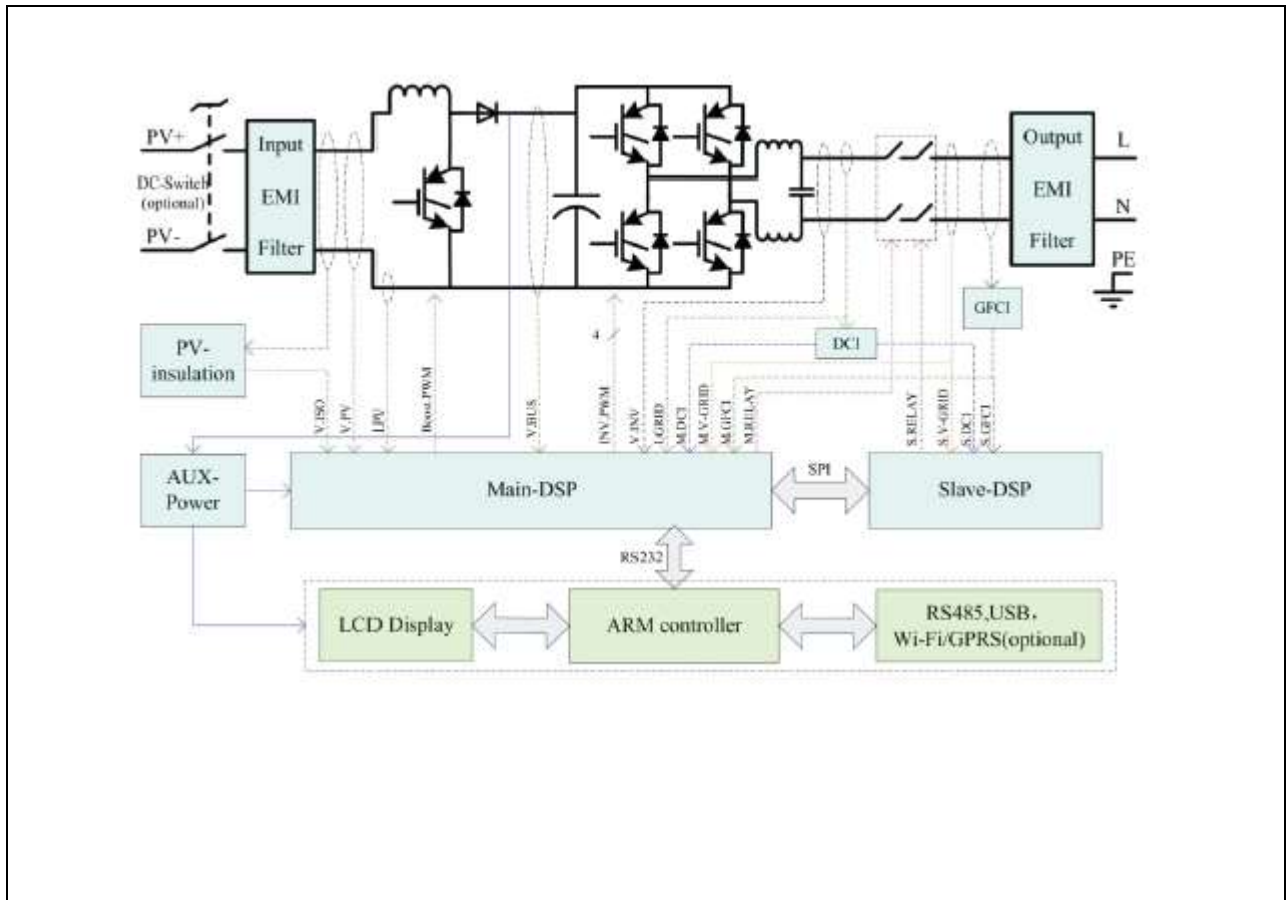
Software Number (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)



Software version



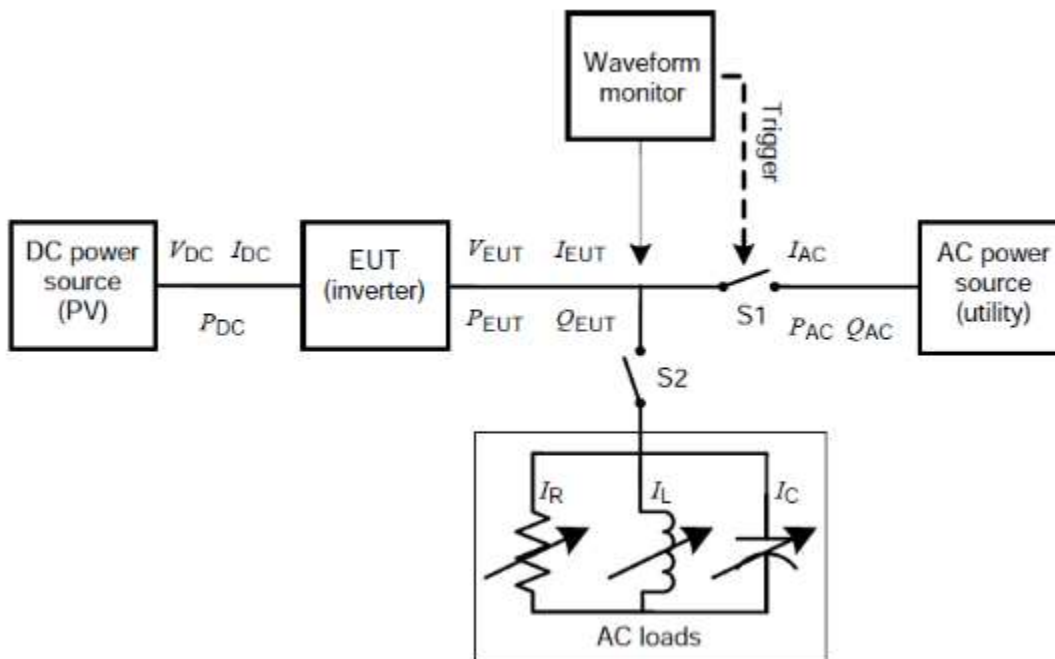
2 ELECTRICAL SCHEMES



Attachment II

(Testing information)

1 TESTING CIRCUIT



Current and voltage clamps have been connected to the inverter input/output for all the tests.

All the tests and checks have been performed in accordance with the reference standard under testing.

2 TESTING EQUIPMENT

From	No.	Equipment Name	Model No.	Equipment No.	Calibration Date	Equipment calibration due date
Sofarsolar	1	Digital oscilloscope	DS05014A	MY50070266	2019-02-13	2020-02-12
	2	Voltage probe	SI-9110	111541	2019-02-13	2020-02-12
	3	Voltage probe	SI-9110	152627	2019-02-13	2020-02-12
	4	Voltage probe	SI-9110	111134	2019-02-13	2020-02-12
	5	Power analyzer	WT3000	91N610888	2019-02-13	2020-02-12
	6	Current probe	i1000s	29503223	2019-02-13	2020-02-12
	7	Current probe	i1000s	30413448	2019-02-13	2020-02-12
	8	Current probe	CP5150	C150150008	2019-02-13	2020-02-12
	9	Temperature & Humidity meter	TH101B	201030245220	2019-02-13	2020-02-12
	10	Temperature & Humidity Chamber	HGTP -225R	HG13030801	2019-02-13	2020-02-12
SGS	11	True RMS Multimeter	Fluke / 289C	GZE012-53	2019-02-26	2020-02-25

Items	Specifications
1) PV array simulator	
a) Voltage range	0 – 1000Vdc (0.01V step)
b) Current range	0 – 40A (0.01A step)
2) AC power source	
a) Output wiring	Three phase
b) Output capacity	30KVA
c) Output voltage	10-300Vrms
d) Output frequency	45-65Hz
e) Voltage stability	± 100ppm/°C
f) Output voltage distortion	0.05% max.
3) Digital meter	
a) Voltage range	0 – 1000Vdc, 0 – 600Vrms
b) Current range	0 – 30A

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c) Frequency range (accuracy)	0.2%
d) Measurement items	Voltage (V) Current (A) Active power (W) Reactive power (Var) Volt-ampere (VA) Power factor (PF) Frequency (Hz) Electric energy (Wh)
4) Waveform recorder	
a) Sampling speed	1M/s
b) Recording device	Memory record and USB reading
c) Time accuracy	± 500ppm
5) AC load	
a) Resistive load	Maximum voltage: 300Vrms Current range: 0 – 100A Capacity: 30KW
b) Inductive load	Maximum voltage: 300Vrms Current range: 0 – 100A Capacity: 30KVA
c) Capacitive load	Maximum voltage: 300Vrms Current range: 0 – 100A Capacity: 30KVA

3 MEASUREMENT UNCERTAINTY

Magnitude	Uncertainty
Voltage measurement	±1.5 %
Current measurement	±2.0 %
Frequency measurement	±0.2 %
Time measurement	±0.2 %
Power measurement	±2.5 %
Phase Angle	±1°
Temperature	±3° C
<p>Note1: Measurements uncertainties showed in this table are maximum allowable uncertainties. The measurement uncertainties associated with other parameters measured during the tests are in the laboratory at disposal of the petitioner.</p> <p>Note2: Where the standard requires lower uncertainties that those in this table. Most restrictive uncertainty has been considered.</p>	

Attachment III

(GRAPHS AND SCREENSHORTS OF TEST RESULTS)

Flickers

The measurements of voltage fluctuations have been measured at 33 %, 66% and 100 % of the nominal power value of the inverter.

As it can be seen in the next screenshots, this test has two steps:

- 1.Starting operation
- 2.Stopping operation

The values took of Dmax of the two steps.

Starting operation and Stopping operation					
33% Pn					
Flicker Mode		Uover: ■ ■ ■ ■ Iover: ■ ■ ■ ■		YOKOGAWA ◆ Flicker:Complete 0:20:00	
Count		2/2			
Interval		10m00s/10m00s			
Element 1					
Volt Range 300V/50Hz		Element1 Judgement: Pass			
Un (Set) 230.000 V		Total Judgement: Pass			
Freq(U1) 49.999 Hz		(Element1)			
	dc[%]	dmax[%]	d(t)[ms]	Pst	P1t
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.10 Pass	0.10 Pass	0 Pass	0.07 Pass	
2	0.30 Pass	0.34 Pass	0 Pass	0.08 Pass	
Result	Pass	Pass	Pass	Pass	0.04 Pass
Update 600		2019/04/25 14:11:16			
66% Pn					
Flicker Mode		Uover: ■ ■ ■ ■ Iover: ■ ■ ■ ■		YOKOGAWA ◆ Flicker:Complete 0:20:00	
Count		2/2			
Interval		10m00s/10m00s			
Element 1					
Volt Range 300V/50Hz		Element1 Judgement: Pass			
Un (Set) 230.000 V		Total Judgement: Pass			
Freq(U1) 50.000 Hz		(Element1)			
	dc[%]	dmax[%]	d(t)[ms]	Pst	P1t
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.07 Pass	0.10 Pass	0 Pass	0.07 Pass	
2	0.11 Pass	0.12 Pass	0 Pass	0.07 Pass	
Result	Pass	Pass	Pass	Pass	0.04 Pass
Update 600		2019/04/25 13:50:00			

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100% Pn

Flicker Mode Uover: ■ ■ ■ ■ I1 : 30A YOKOGAWA ◆
 Iover: ■ ■ ■ ■ Flicker: Complete 0:20:00

Count **2/2**
 Interval **10m00s/10m00s**

Element 1
 Volt Range 300V/50Hz Element1 Judgement: Pass
 Un (Set) 230.000 V Total Judgement: Pass
 Freq(U1) 49.999 Hz (Element1)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.09 Pass	0.10 Pass	0 Pass	0.07 Pass	
2	0.48 Pass	0.54 Pass	0 Pass	0.10 Pass	
Result	Pass	Pass	Pass	Pass	0.05 Pass

Update 600 2019/04/25 11:16:59

As it can be seen in the next screenshots is running operation. The values took of Pst and Plt are the most unfavorable of the twelve steps.

Running operation

33% Pn

Flicker Mode Uover: ■ ■ ■ ■ YOKOGAWA ◆
 Iover: ■ ■ ■ ■ Flicker: Complete 2:00:00

Count **12/12**
 Interval **10m00s/10m00s**

Element 1
 Volt Range 300V/50Hz Element1 Judgement: Pass
 Un (Set) 230.000 V Total Judgement: Pass
 Freq(U1) 50.000 Hz (Element1)

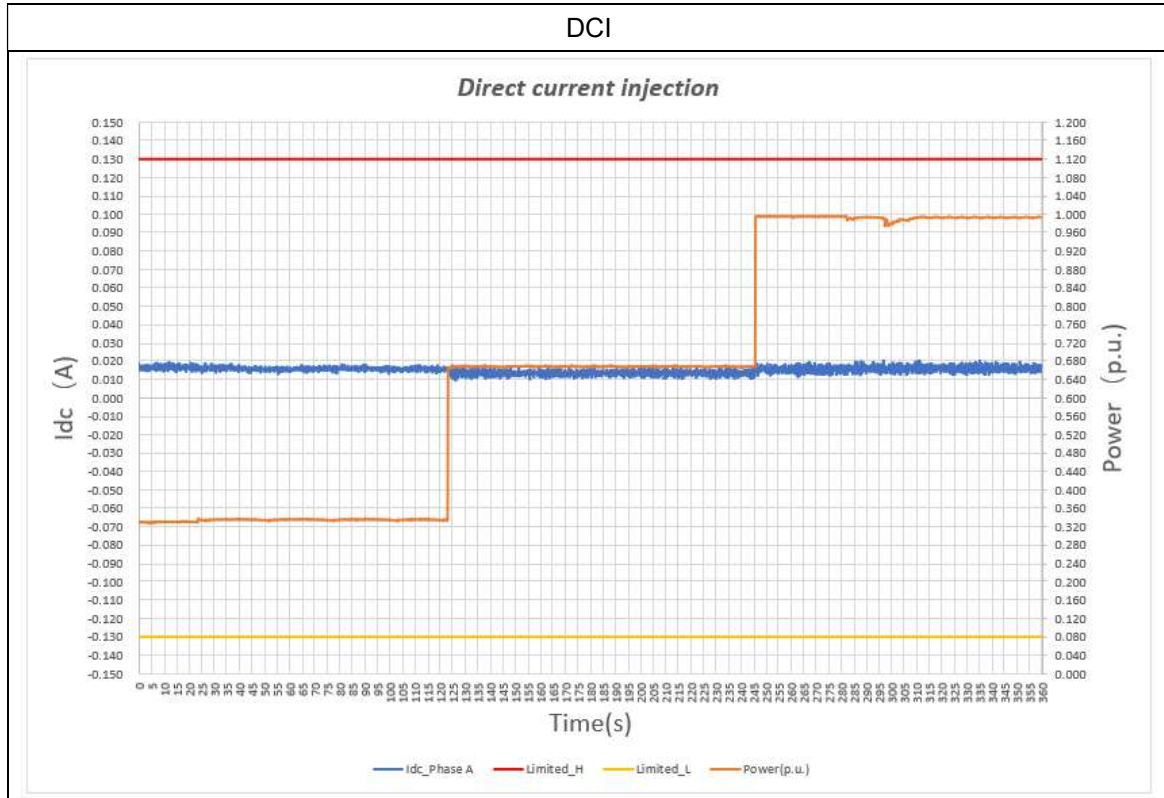
	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
2	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
3	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
4	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
5	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
6	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
7	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
8	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
9	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
10	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
11	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
12	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
Result	Pass	Pass	Pass	Pass	0.07 Pass

Update 3600 2019/04/25 13:27:59

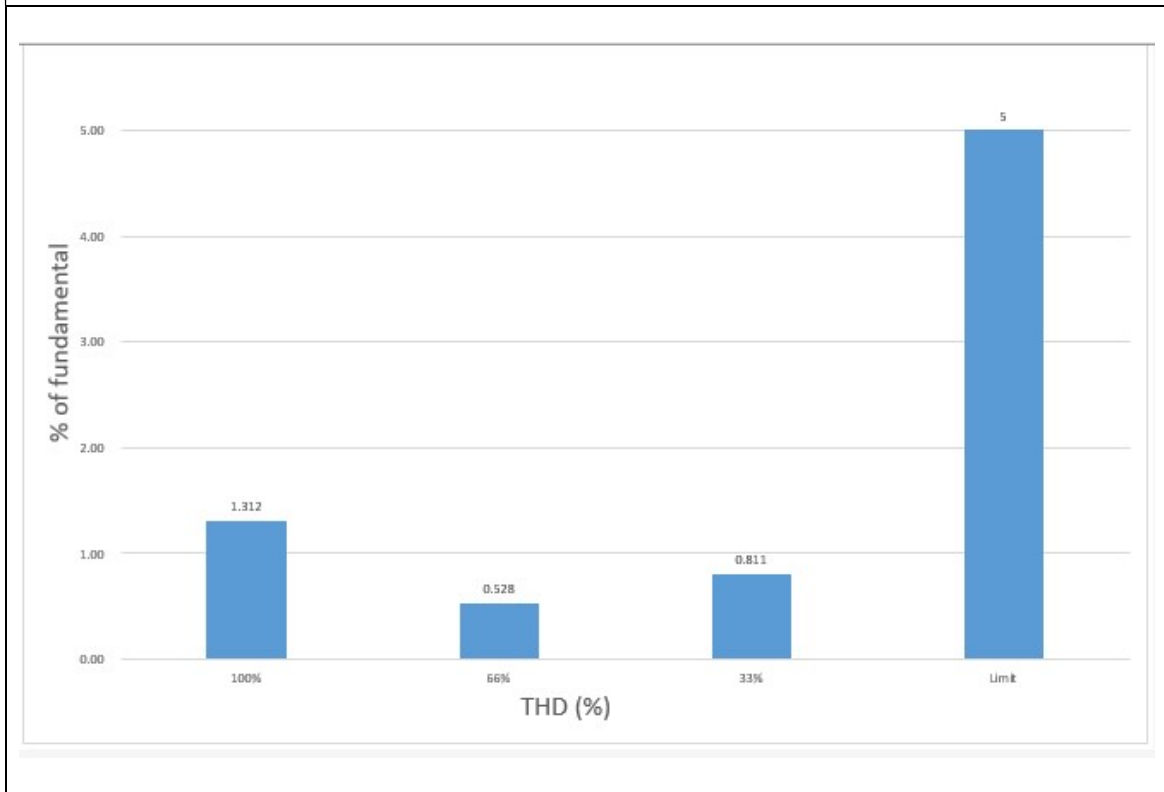
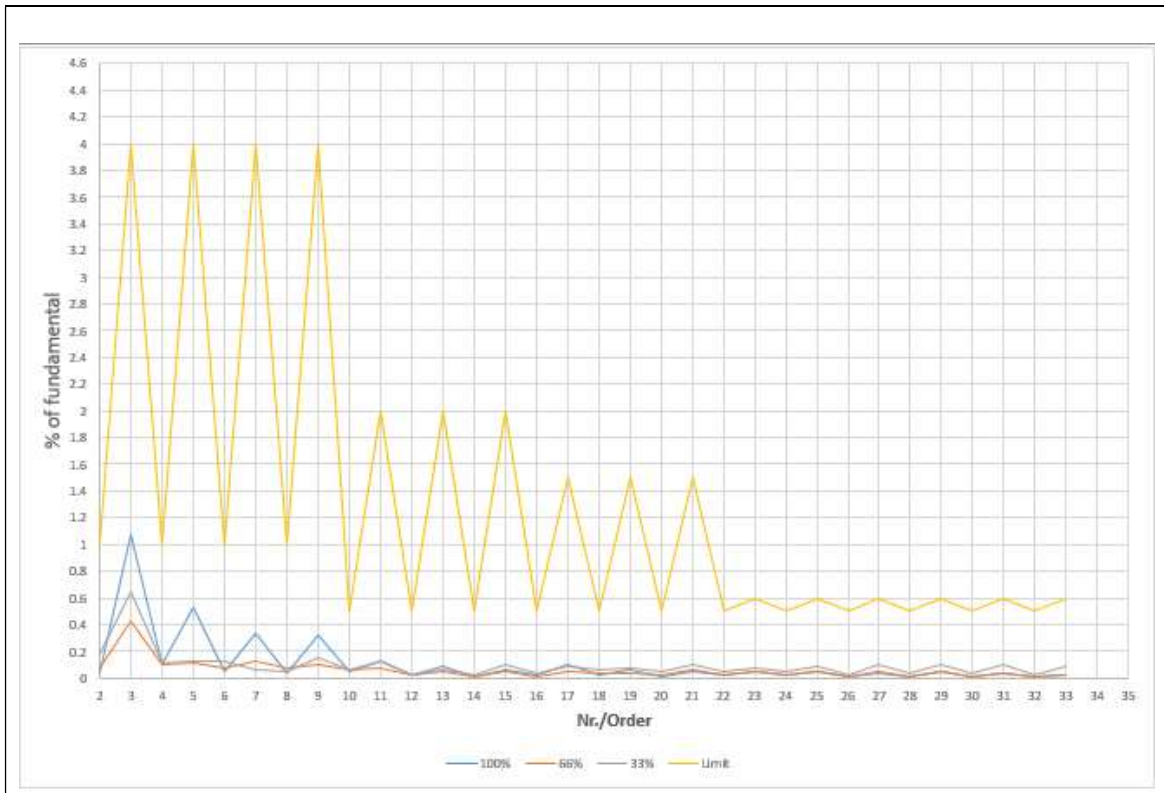
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66% Pn					
Flicker Mode		Uover: ■ ■ ■ ■		YOKOGAWA ◆	
		Iover: ■ ■ ■ ■		Flicker:Complete 2:00:00	
		Count	██████████		12/12
		Interval	██████████		10m00s/10m00s
Element	1				
Volt Range	300V/50Hz	Element1 Judgement: Pass			
Un (Set)	230.000 V	Total Judgement: Pass			
Freq(U1)	50.000 Hz	(Element1)			
Limit	dc[%]	dmax[%]	d(t)[ms]	Pst	P1t
	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
2	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
3	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
4	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
5	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
6	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
7	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
8	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
9	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
10	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
11	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
12	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
Result	Pass	Pass	Pass	Pass	0.07 Pass
Update 3600		2019/04/25 18:19:10			
100% Pn					
Flicker Mode		Uover: ■ ■ ■ ■		YOKOGAWA ◆	
		Iover: ■ ■ ■ ■		Flicker:Complete 2:00:00	
		Count	██████████		12/12
		Interval	██████████		10m00s/10m00s
Element	1				
Volt Range	300V/50Hz	Element1 Judgement: Pass			
Un (Set)	230.000 V	Total Judgement: Pass			
Freq(U1)	49.999 Hz	(Element1)			
Limit	dc[%]	dmax[%]	d(t)[ms]	Pst	P1t
	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
2	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
3	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
4	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
5	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
6	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
7	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
8	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
9	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
10	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
11	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
12	0.00 Pass	0.00 Pass	0 Pass	0.07 Pass	
Result	Pass	Pass	Pass	Pass	0.07 Pass
Update 3600		2019/04/25 16:16:56			

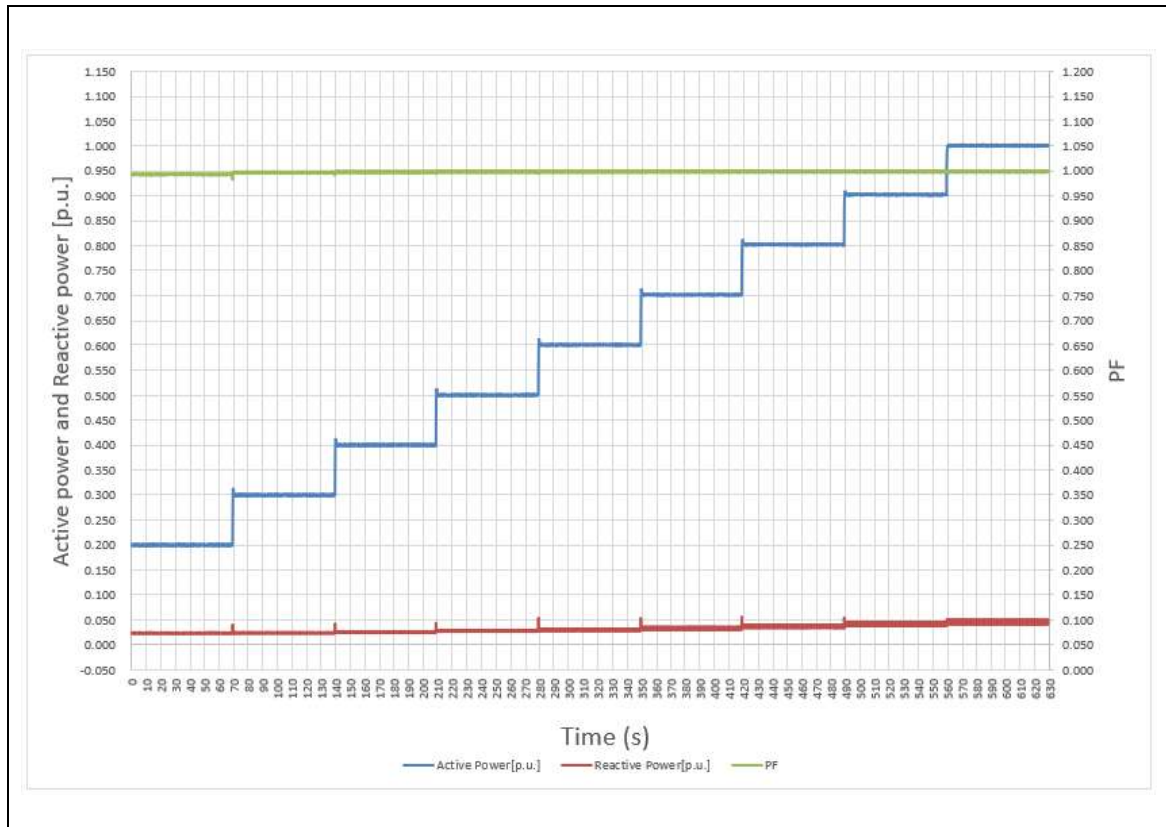
Direct current injection



Harmonics and waveform distortion



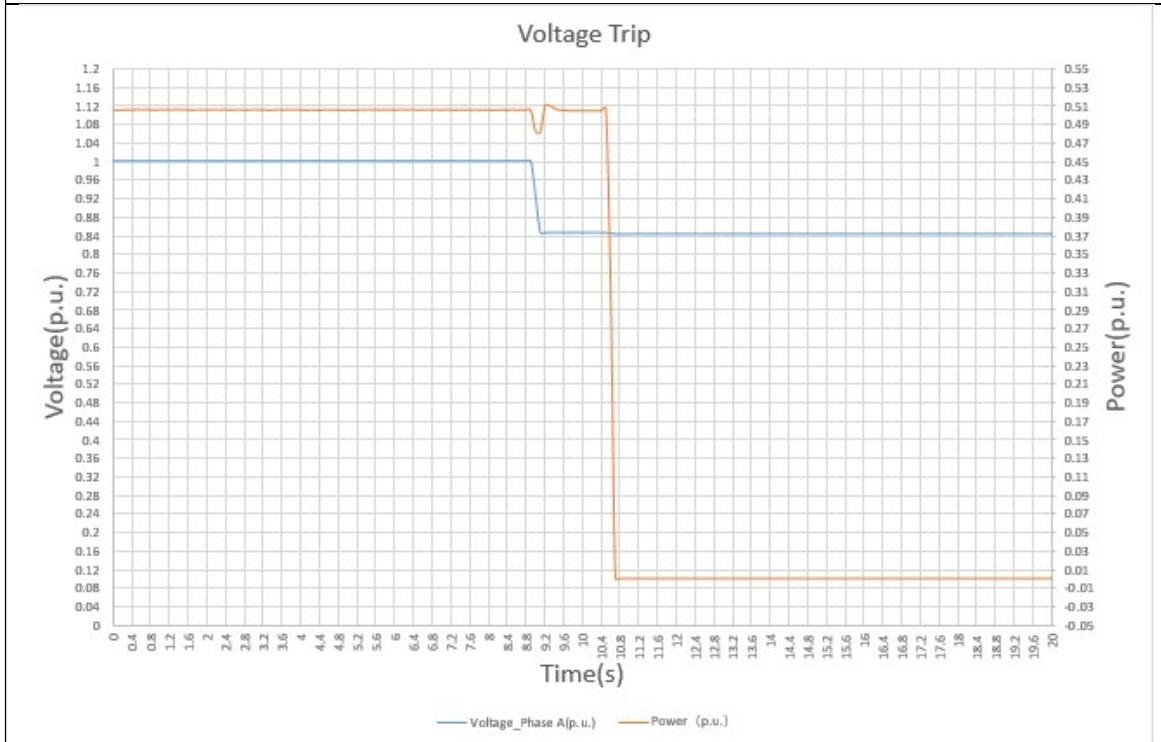
Power factor



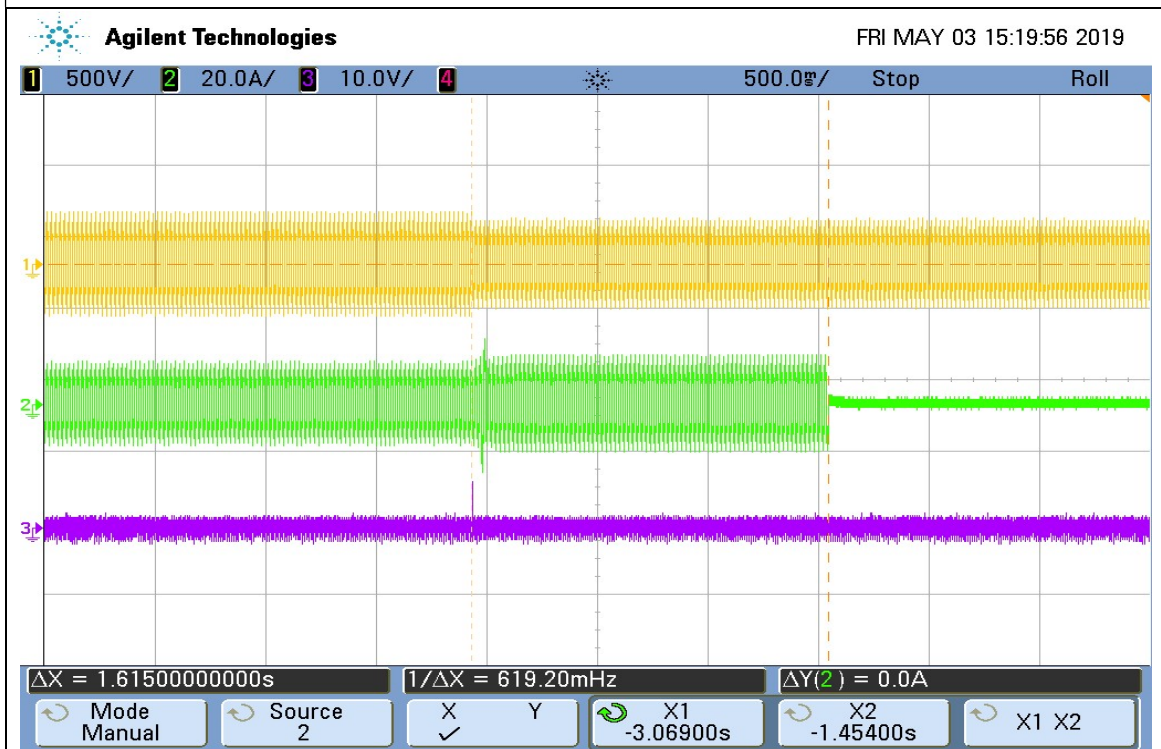
Under-and over-voltage trip settings and reconnection test

50 %Vn ≤ V < 85 %Vn (setting at 195V)

Trip Value

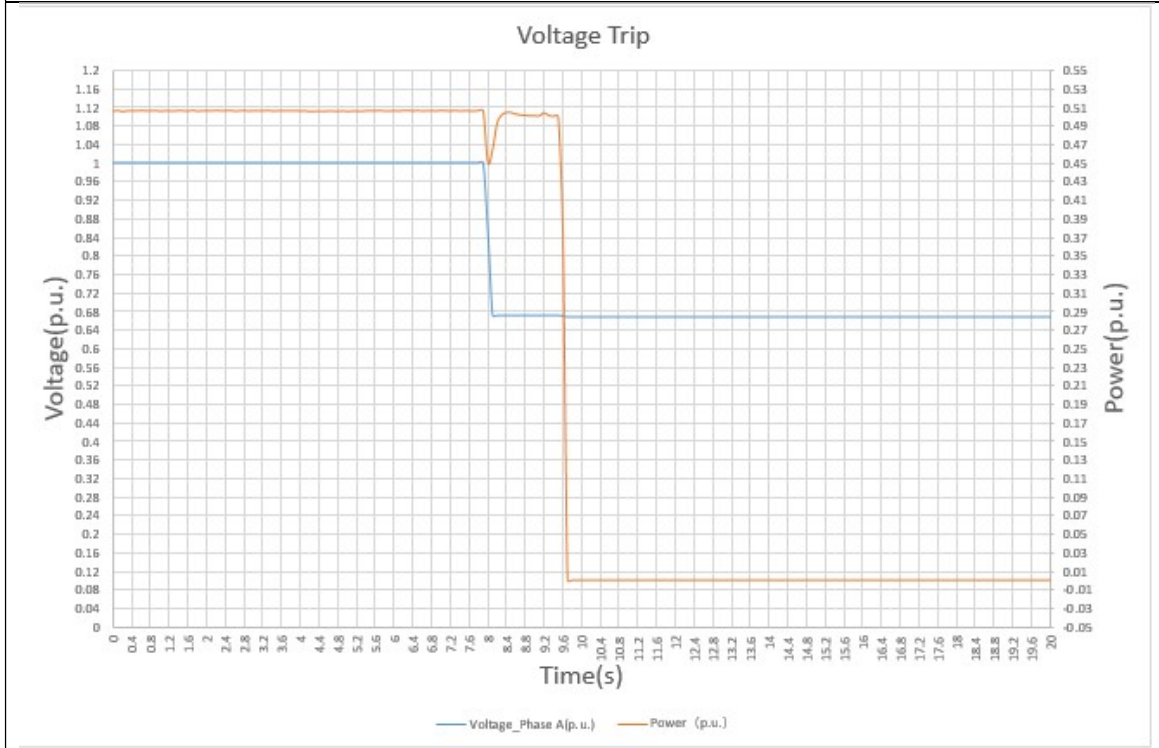


Disconnection Time

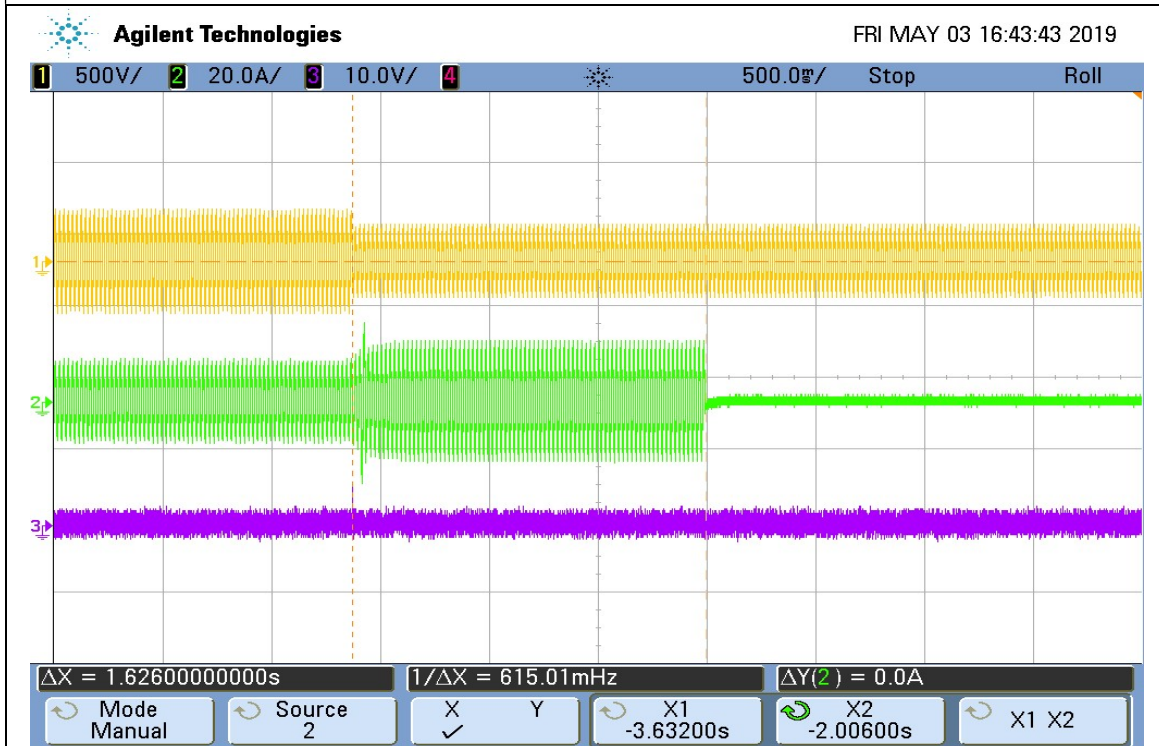


50 % ≤ V < 85 % (setting at 155V)

Trip Value

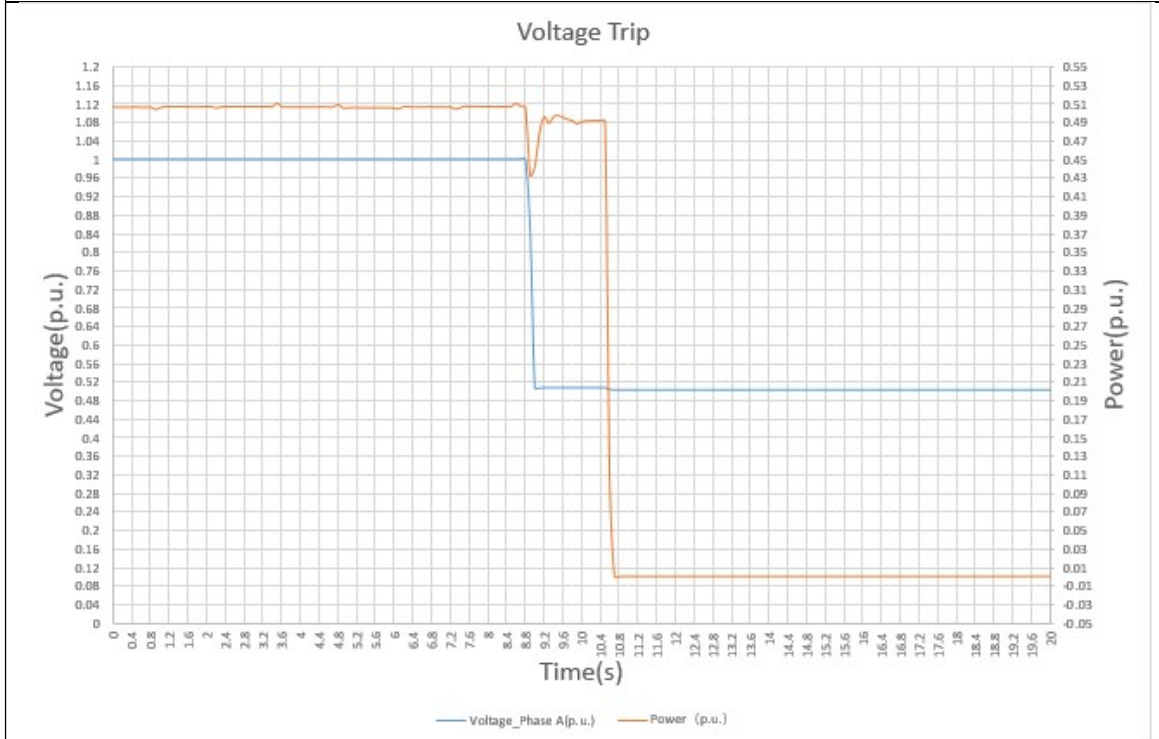


Disconnection Time



50 %Vn ≤ V < 85 %Vn (setting at 117V)

Trip Value



— Voltage_Phase A(p.u.) — Power (p.u.)

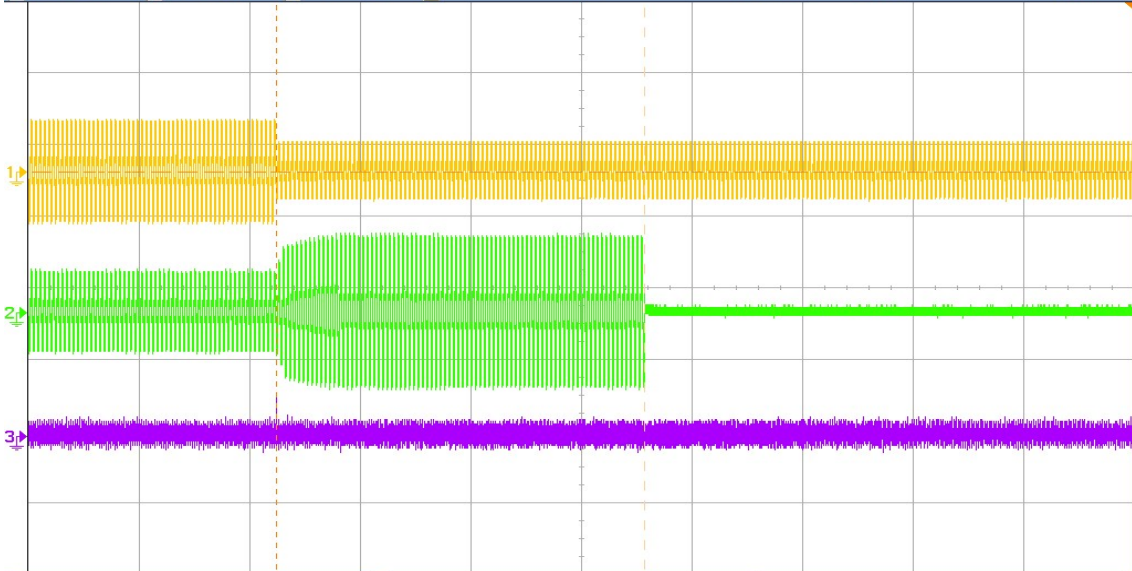
Disconnection Time



Agilent Technologies

FRI MAY 03 16:55:16 2019

1 500V/ 2 20.0A/ 3 10.0V/ 4 500.0g/ Stop Roll



ΔX = 1.668000000000s

1/ΔX = 599.52mHz

ΔY(2) = 0.0A

Mode Manual

Source 2

X ✓

Y

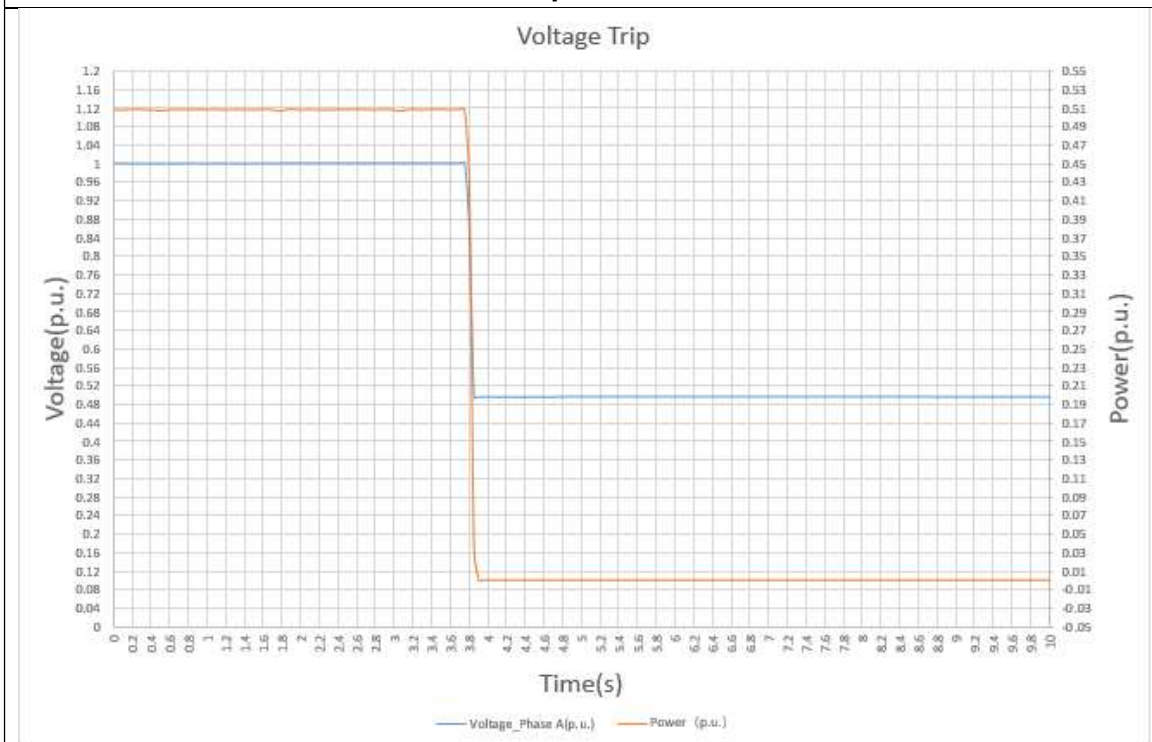
X1 -3.88200s

X2 -2.21400s

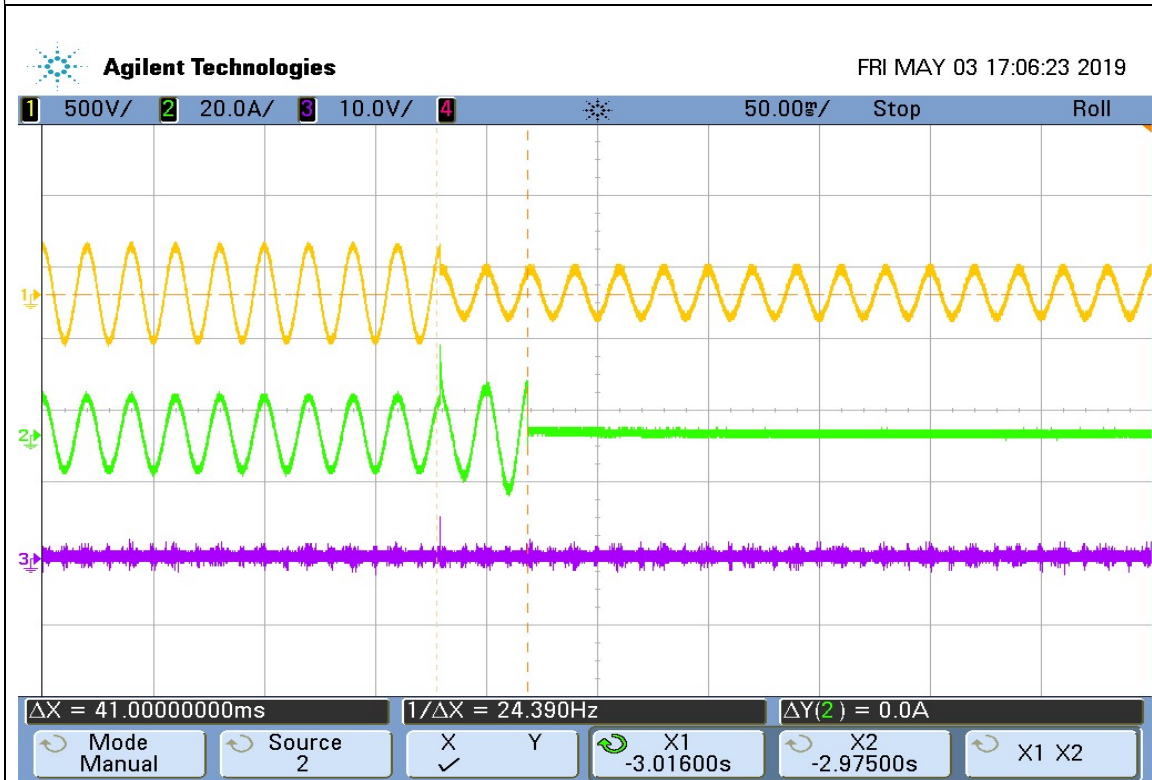
X1 X2

V < 50%Vn(setting at 114V)

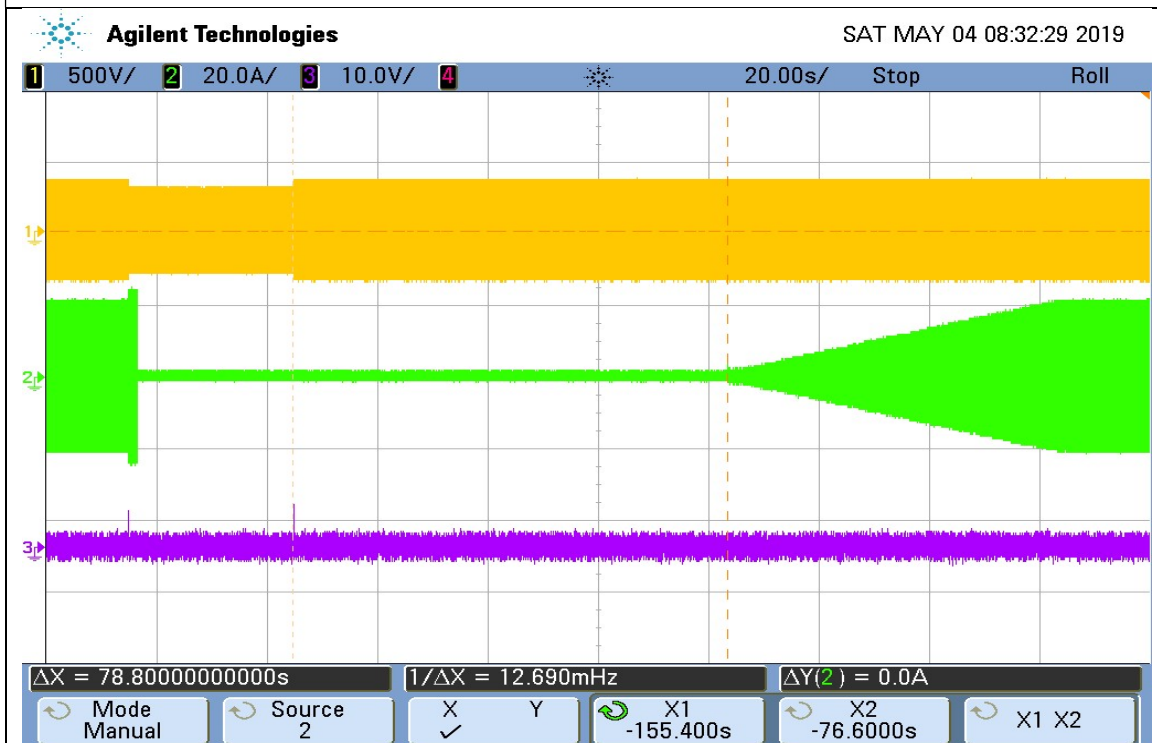
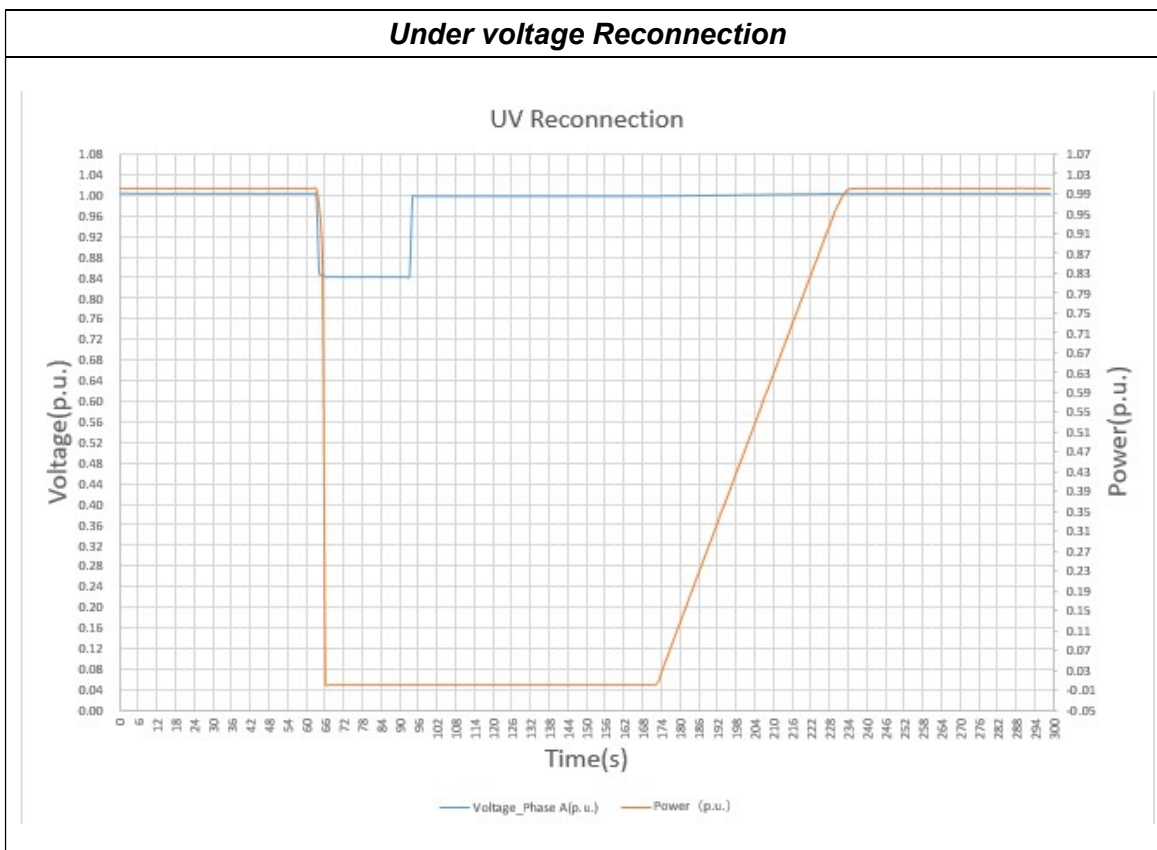
Trip Value



Disconnection Time

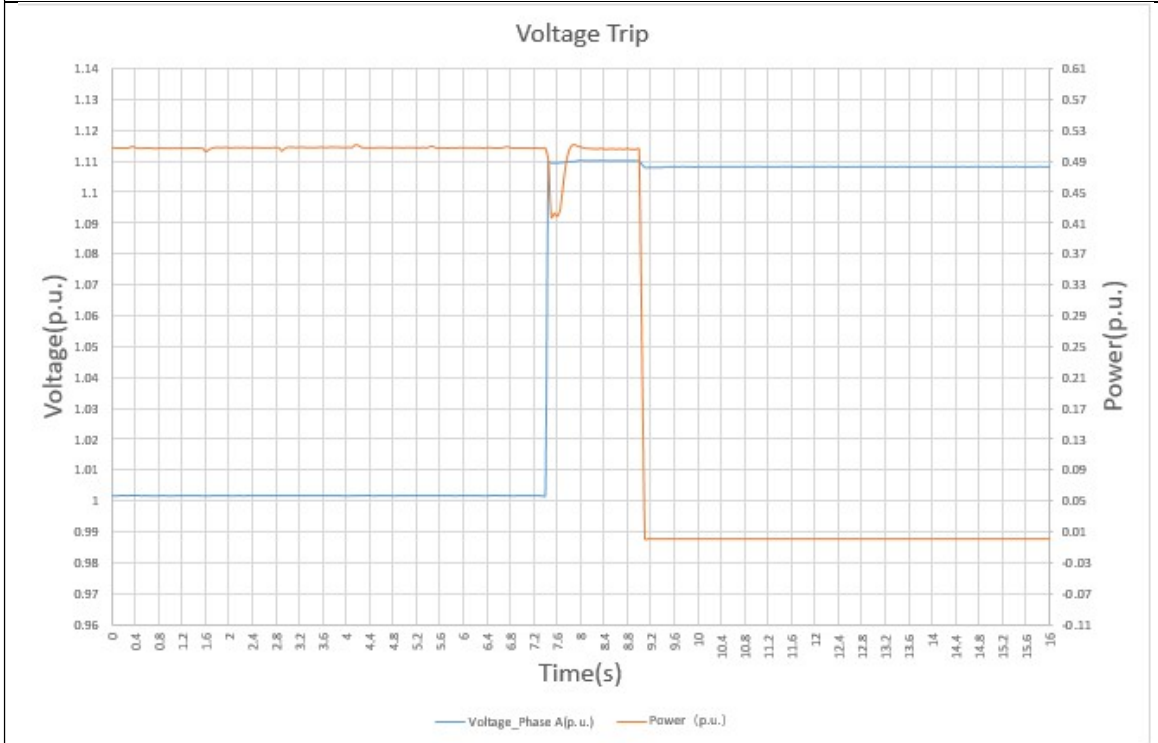


Under voltage Reconnection

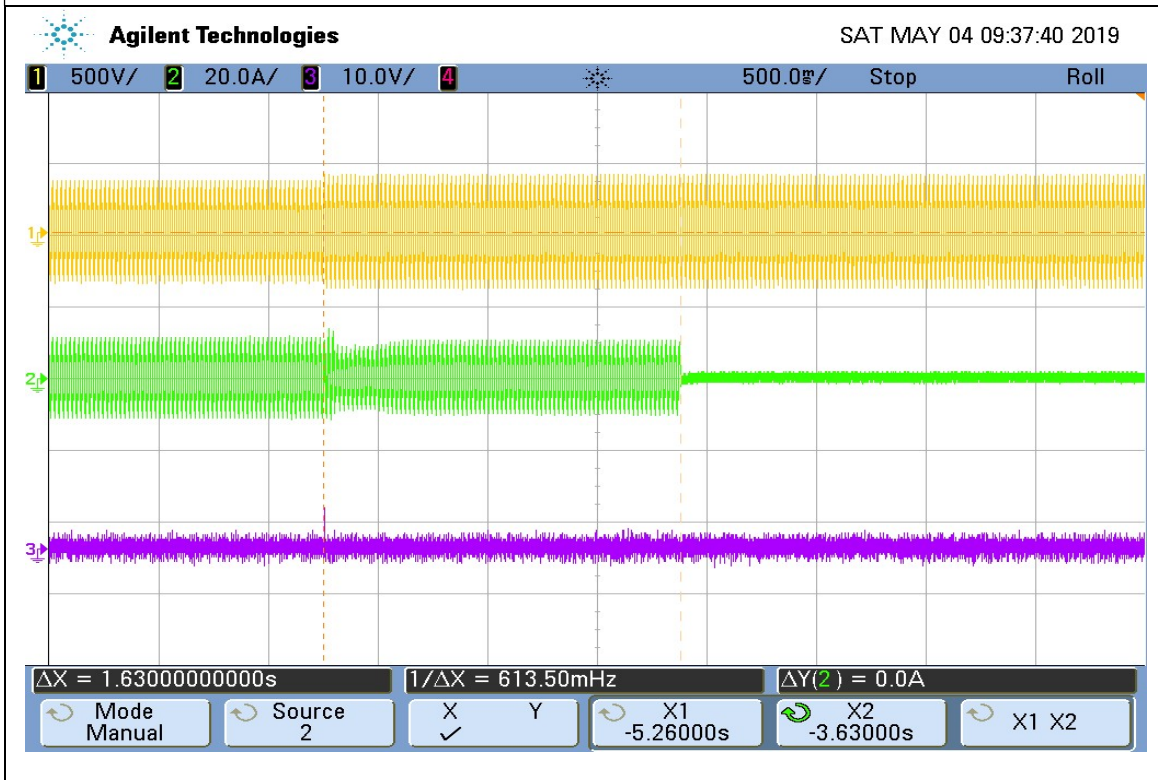


110 %Vn < V < 135 %Vn(setting at 255V)

Trip value



Disconnection Time

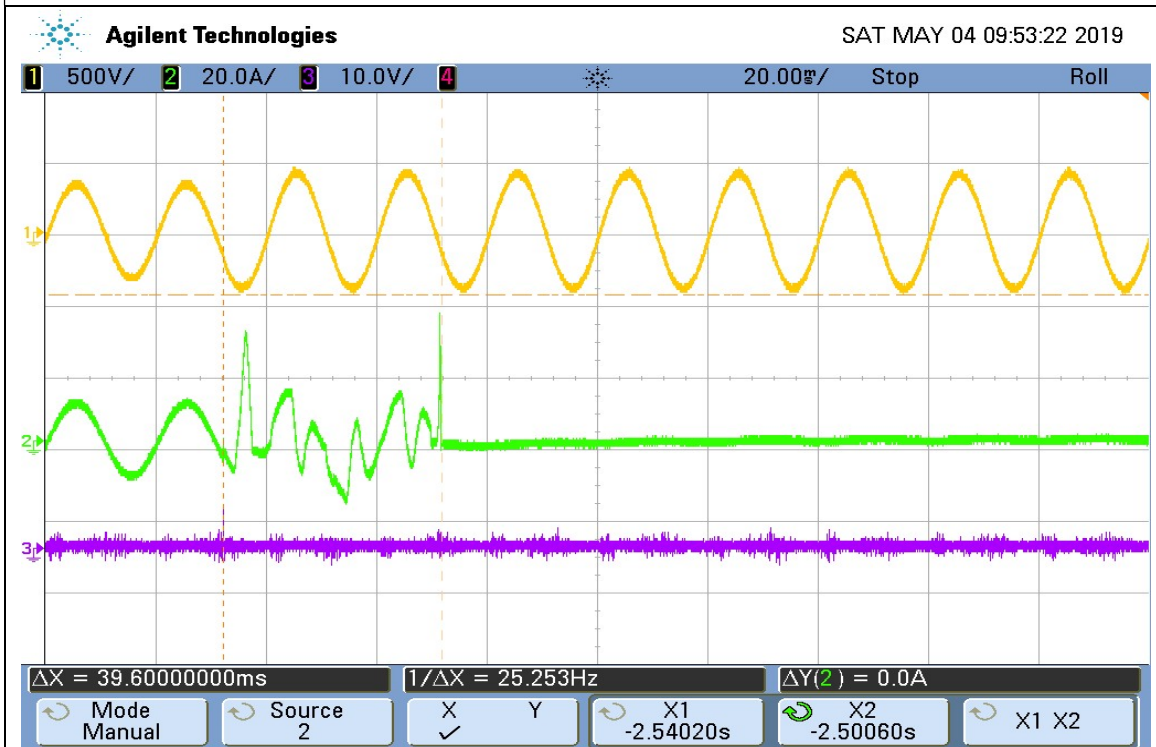


110 %Vn < V < 135 %Vn(setting at 282V)

Trip value

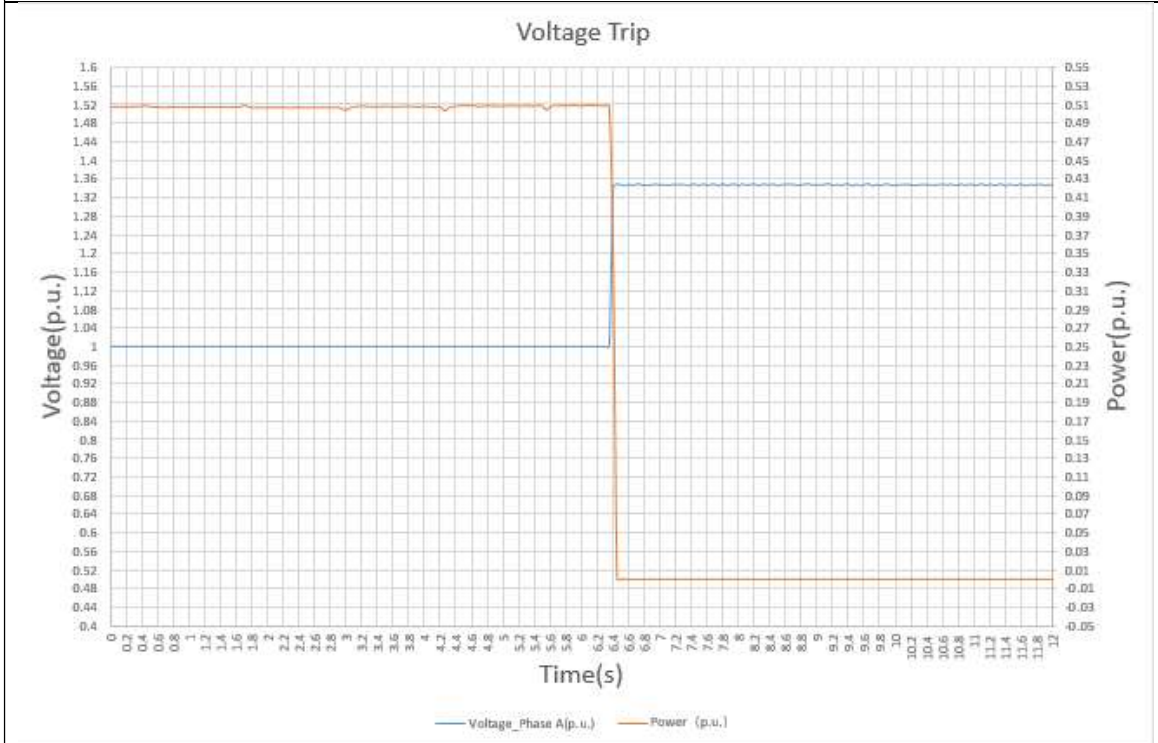


Disconnection Time

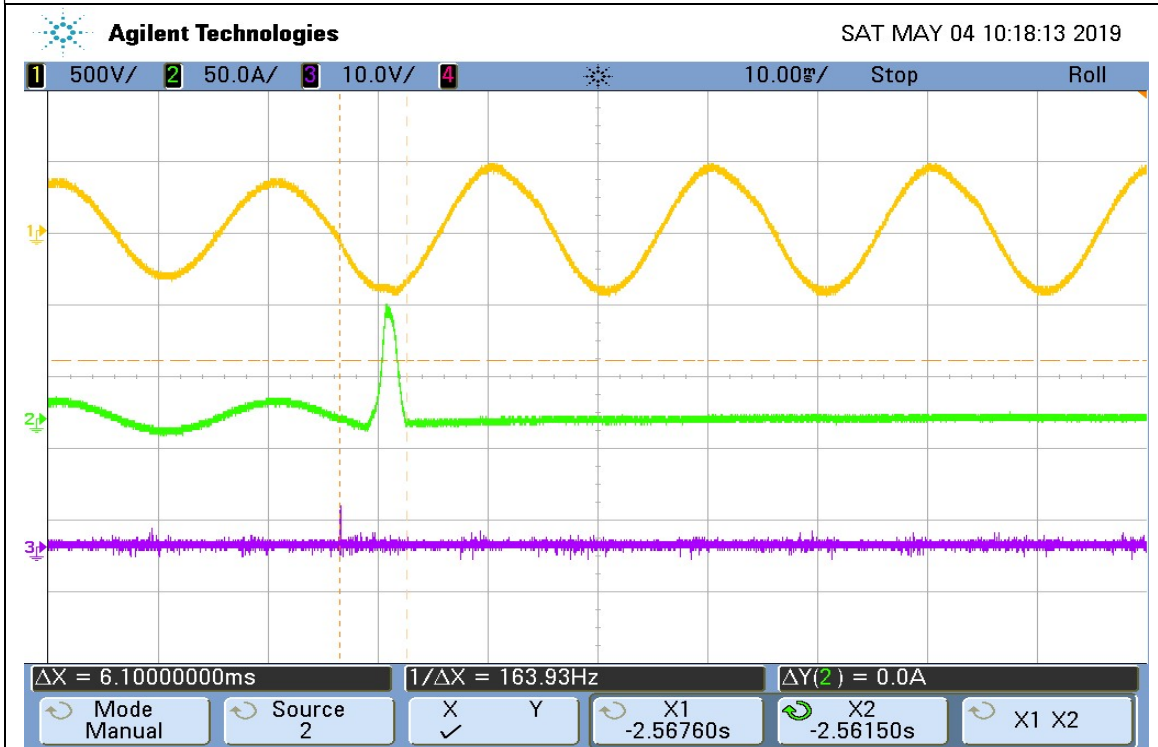


110 %Vn < V < 135 %Vn(setting at 309V)

Trip value

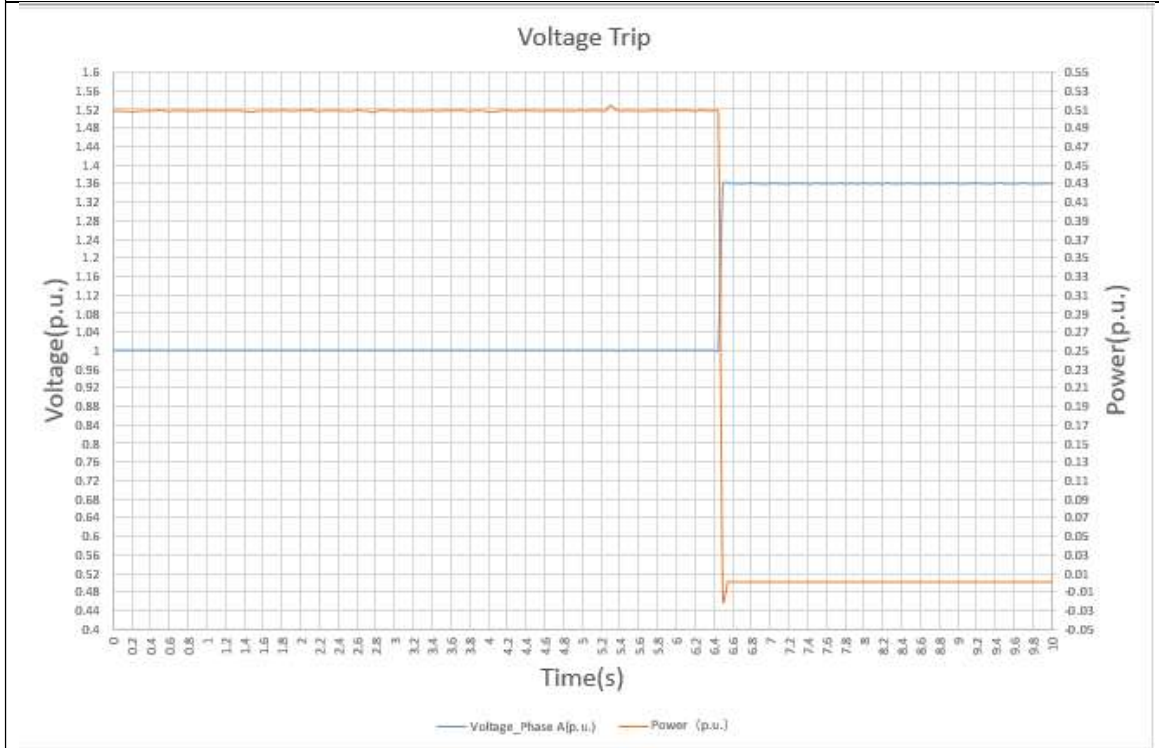


Disconnection Time

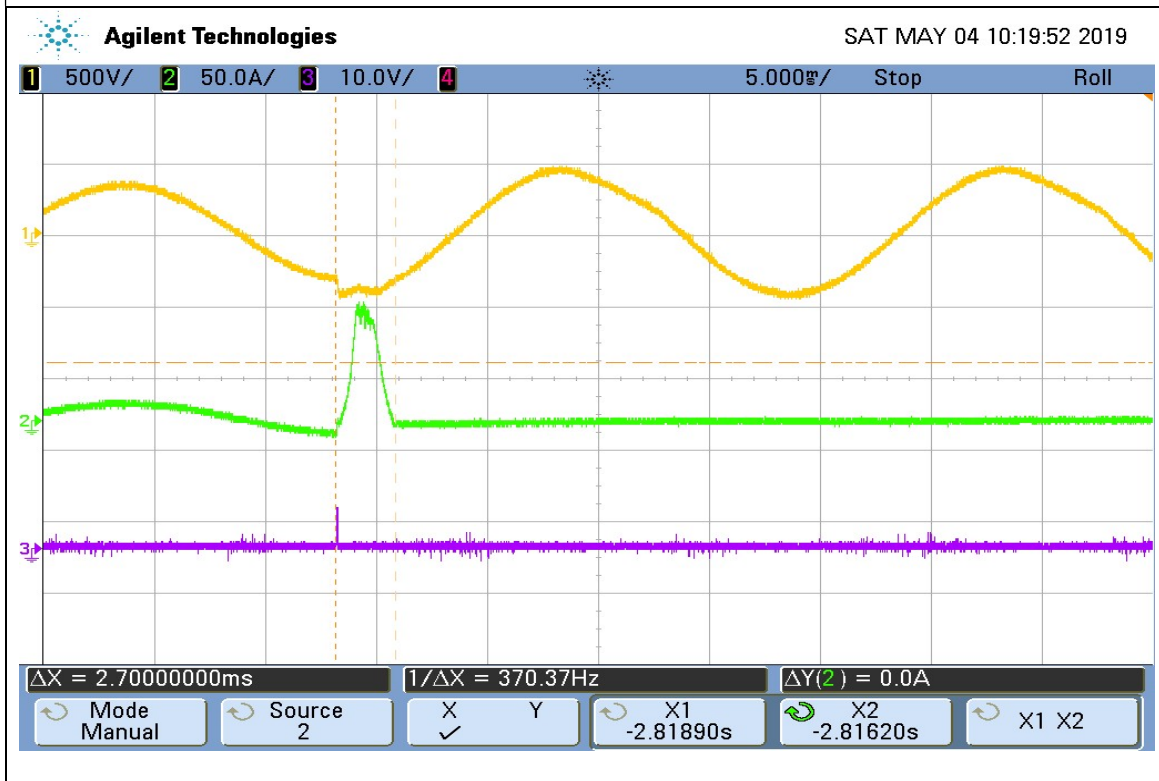


135%Vn ≤ V(setting at 312)

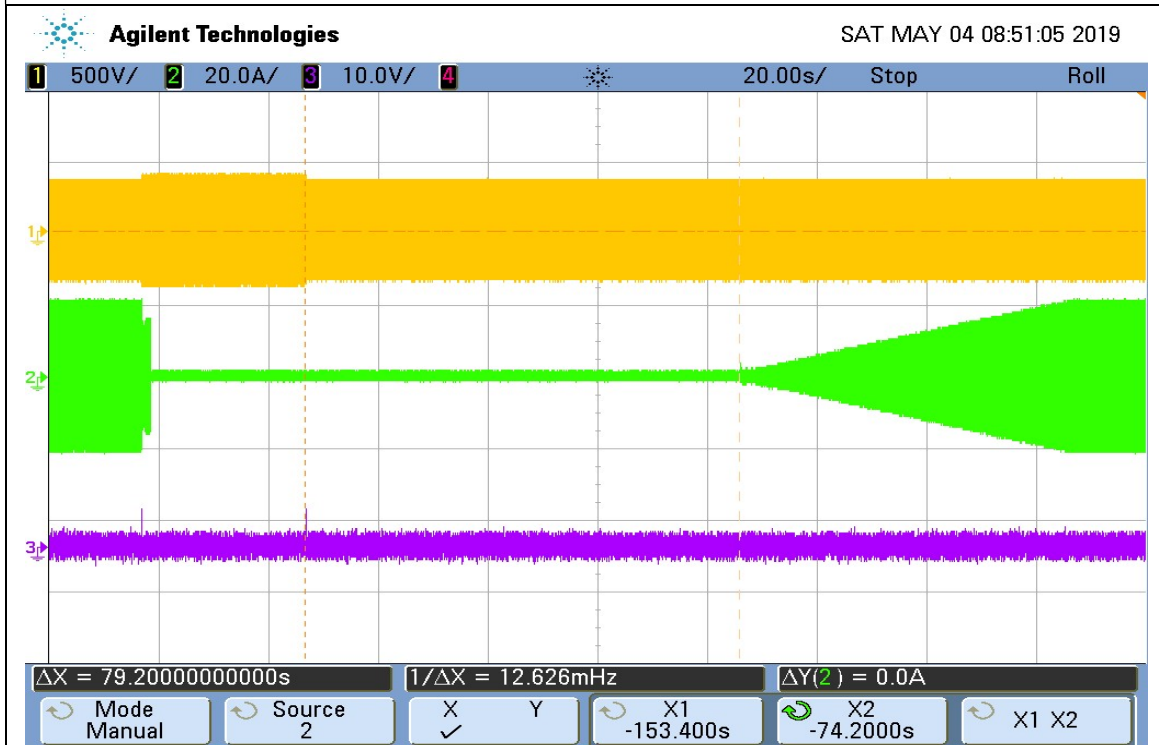
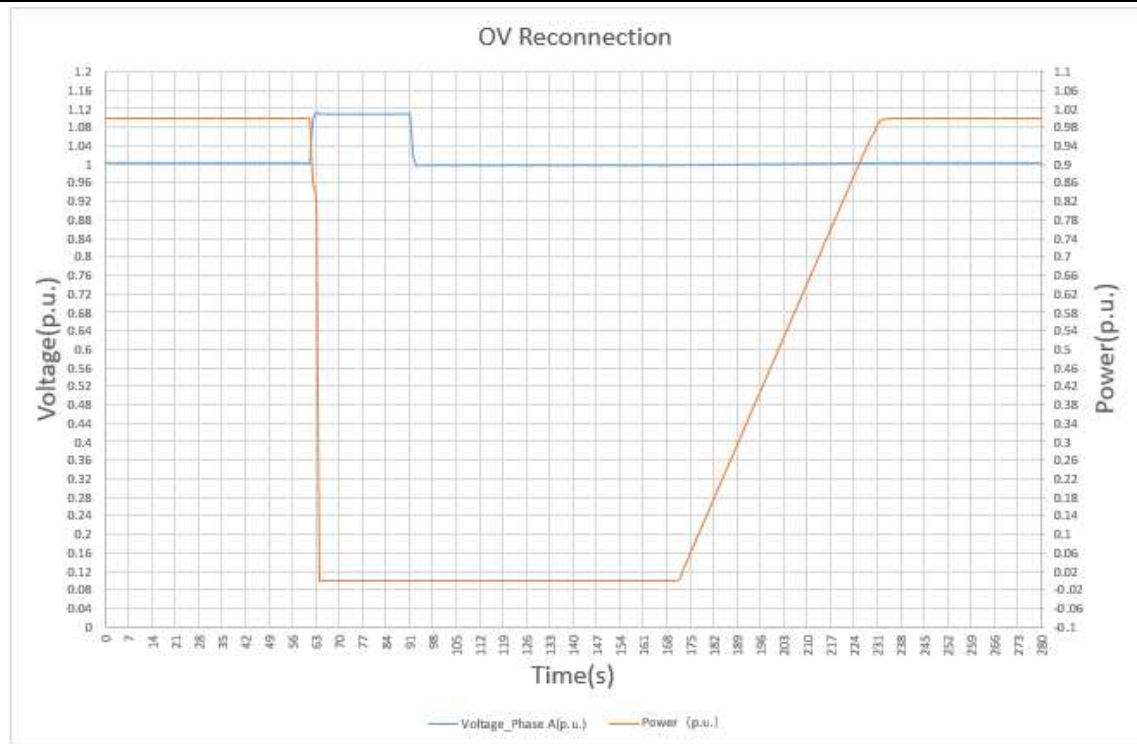
Trip value



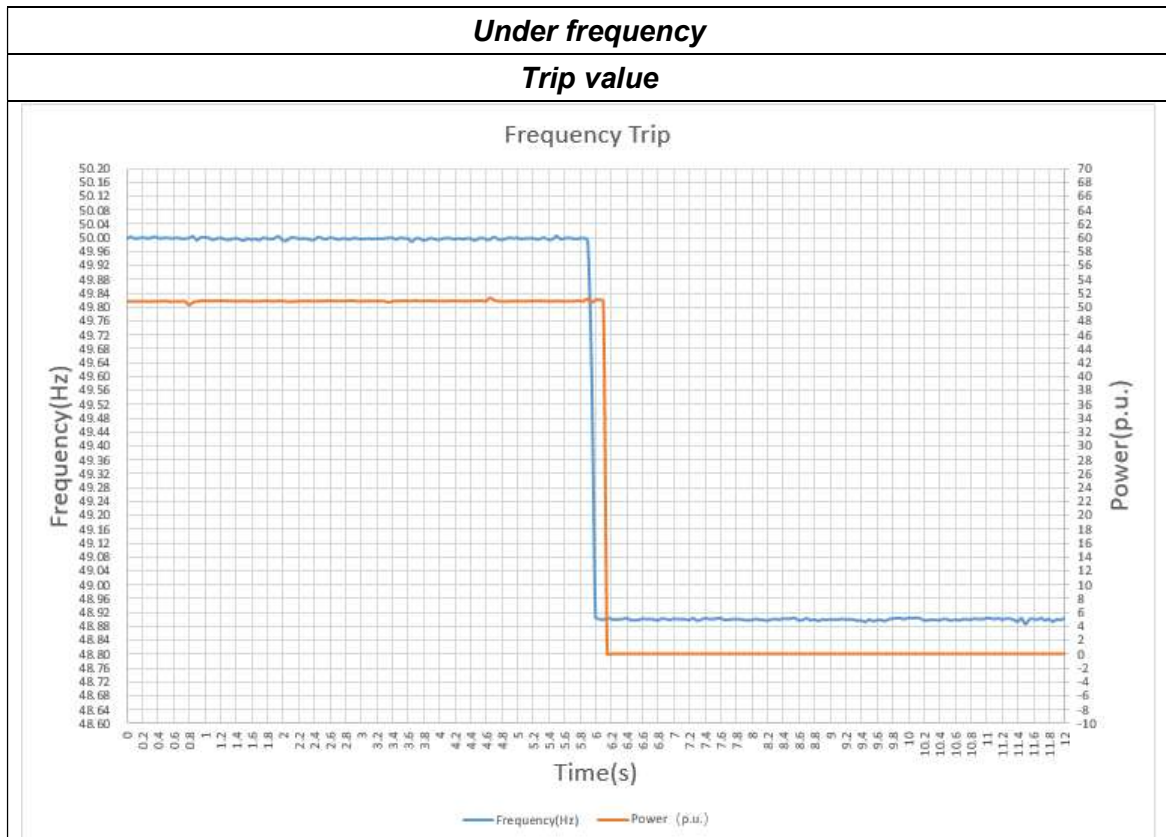
Disconnection Time



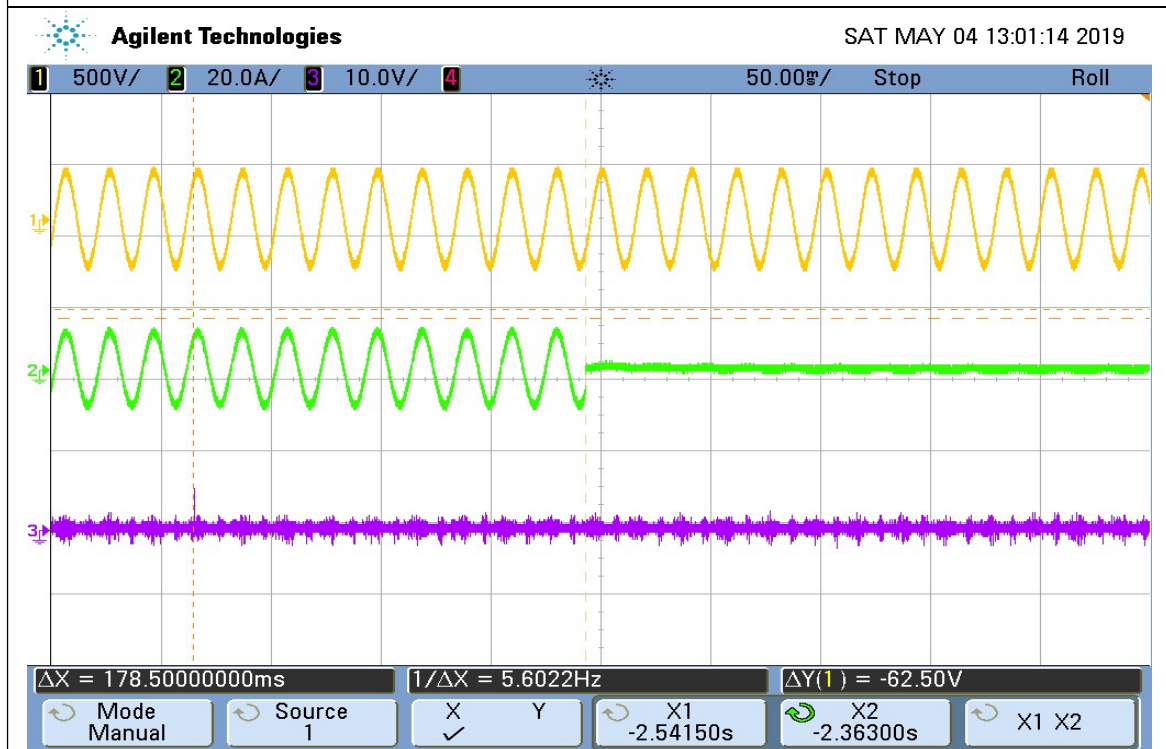
Over voltage reconnection



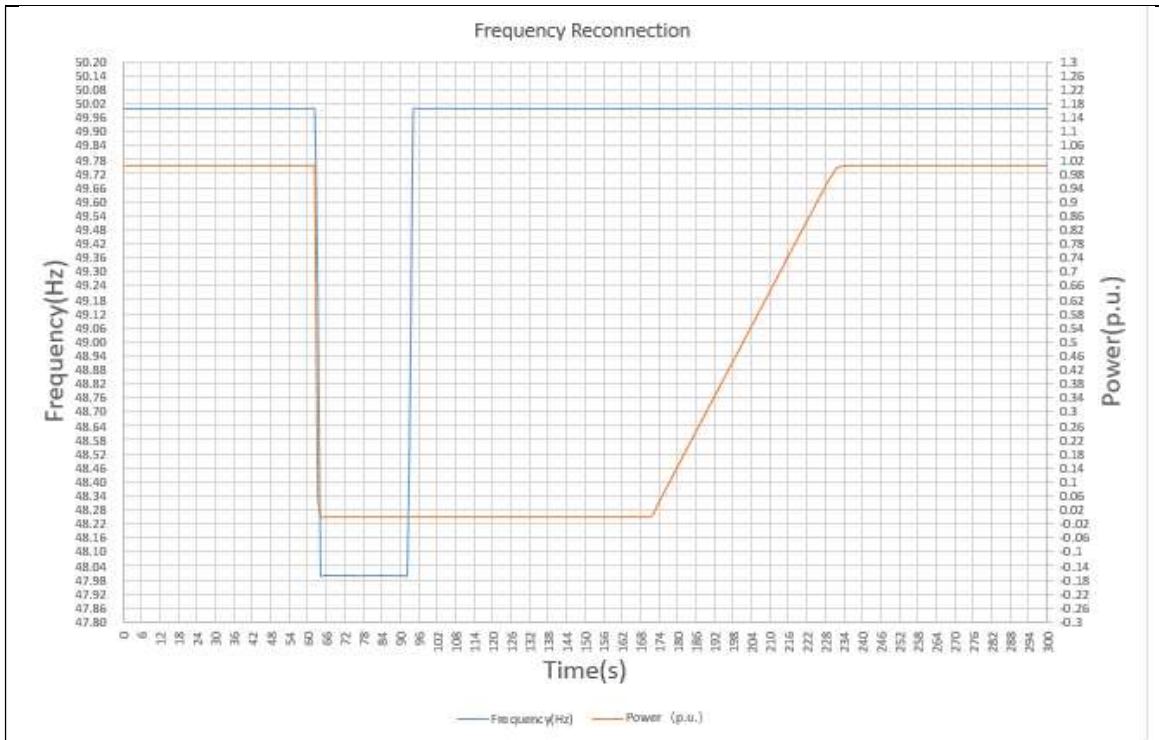
Over/under frequency trip settings and reconnection test



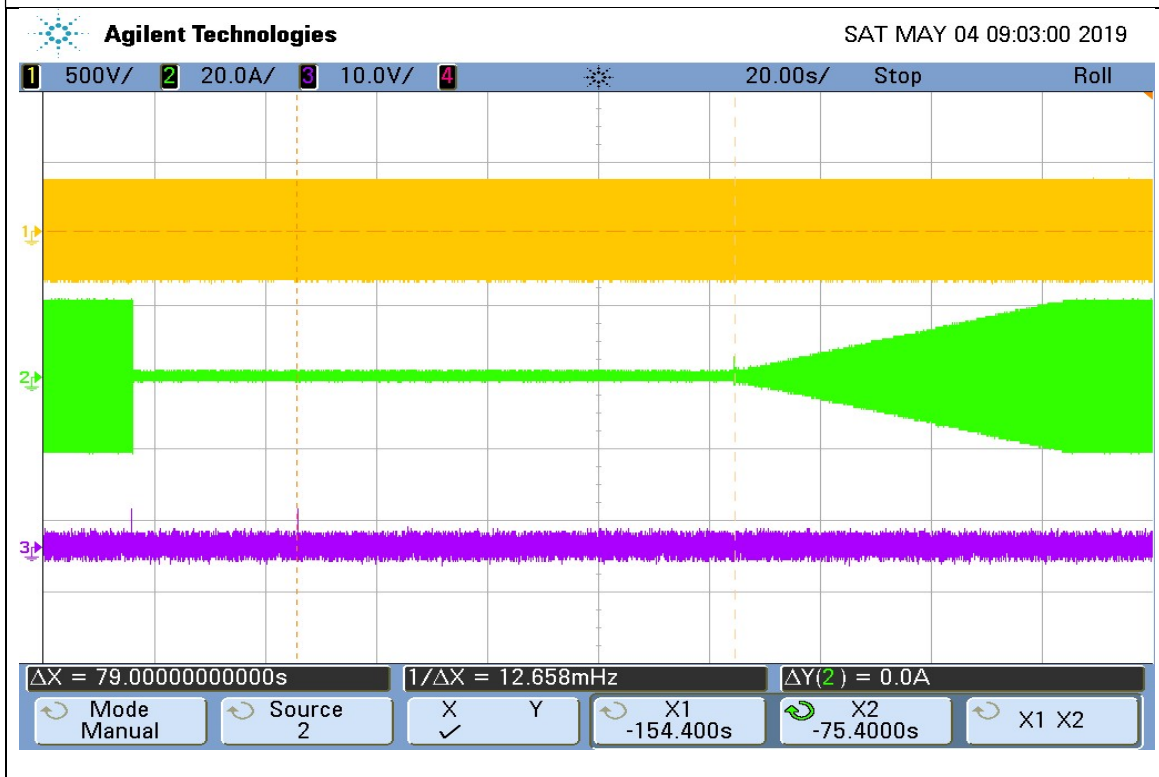
Disconnection time



Under frequency reconnection

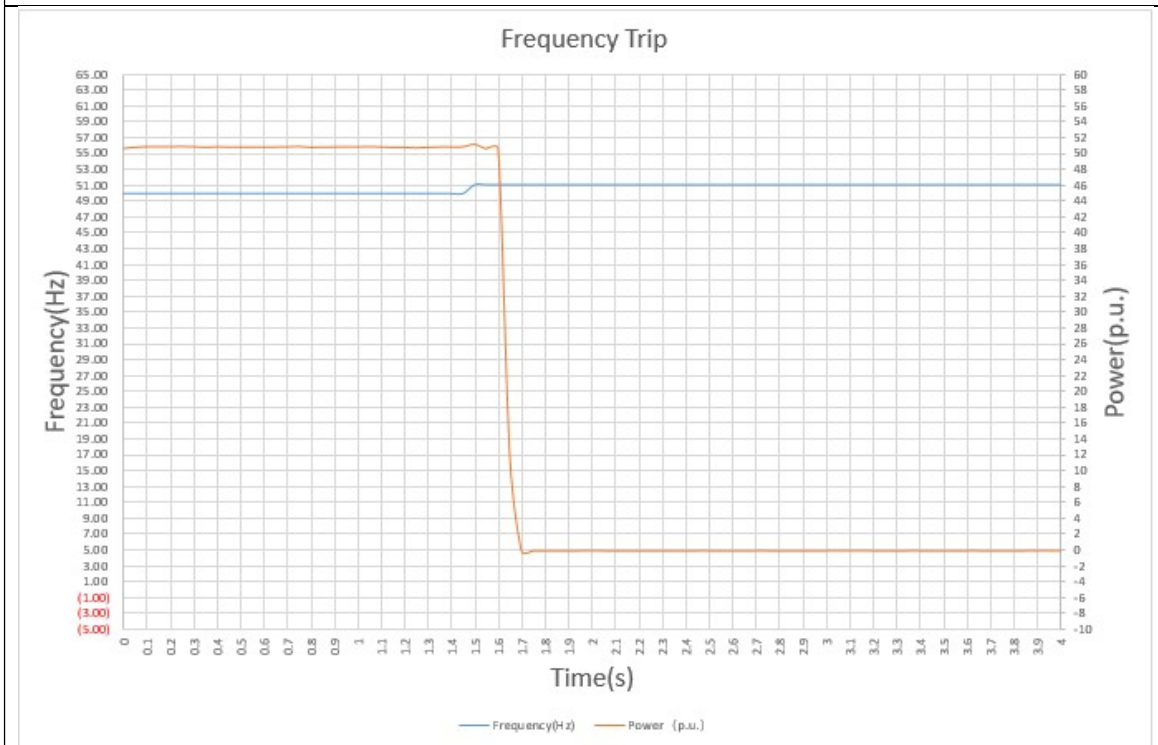


Disconnection time

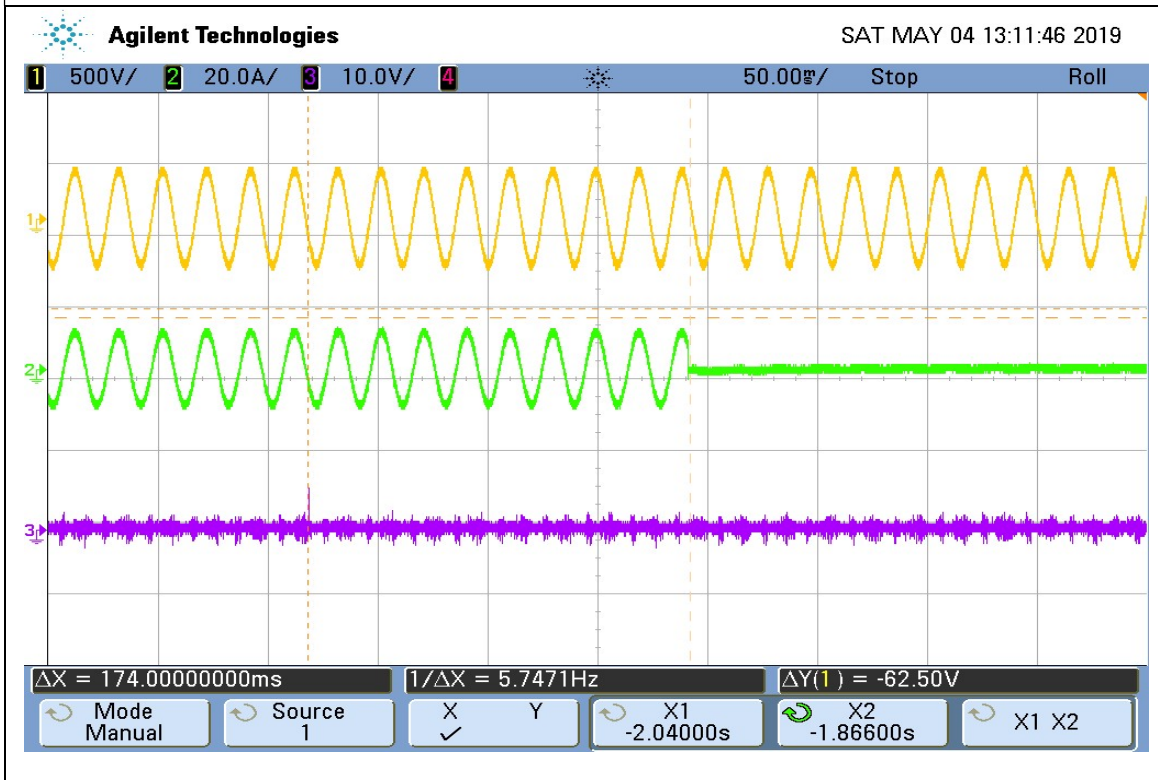


Over frequency

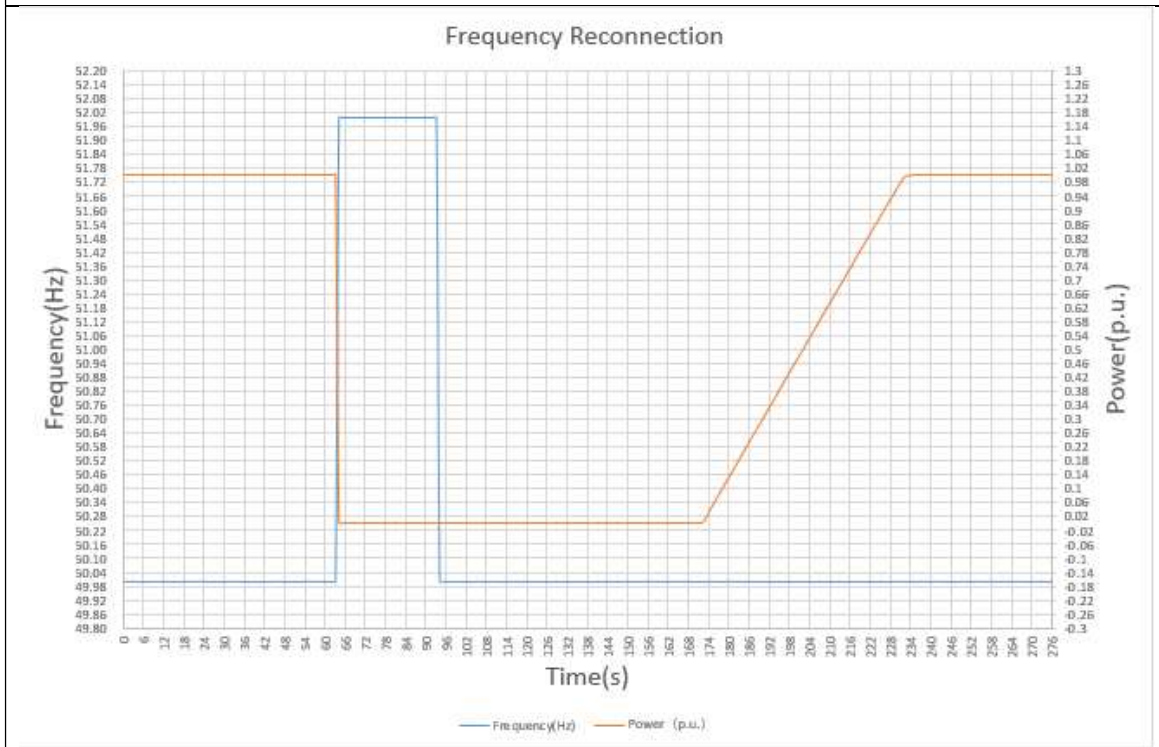
Trip value



Disconnection time



Over frequency reconnection



Disconnection time

