TESTING FOR THE VERIFICATION OF COMPLIANCE OF PV INVERTER WITH :

ENGINEERING RECOMMENDATION G98 ISSUE 1-AMENDMENT 6 SEPTEMBER 2021,

REQUIREMENTS FOR THE CONNECTION OF FULLY TYPE TESTED MICRO-GENERATORS (UP TO AND INCLUDING 16 A PER PHASE) IN PARALLEL WITH PUBLIC LOW VOLTAGE DISTRIBUTION NETWORKS ON OR AFTER 27 APRIL 2019

Test Report Number	:	**GZES240300433002**
Type	:	Hybrid Inverter
Tested Model	:	ED3600A
Variant Models	:	/

APPLICANT

Hired by	:	Huizhou Foryou Optoelectronics Technology Co., Ltd
Address	:	Building 6, B Area, No.1 North Shangxia Road, Dongjiang High-Tech Industry Park, Huizhou, Guangdong, China

TESTING LABORATORY

Name	:	SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch
Address	:	198 Kezhu Road, Science City, Economic & Technology Development Area, Guangzhou, Guangdong, China
Conducted (tested) by	:	Doris Tao (Project Engineer)
Approved by	:	Roger Hu (Technical Reviewer)

Date of issue	:	2024-05-16
Number of pages	:	115

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Test Report Historical Revision:

Test Report Version	Date	Resume
GZES240300433002	2024-05-16	First issuance **Remarks:** According to the declaration from the applicant, the only difference between the EUT (test samples in this report) and testing sample of report GZES220801676702, which was issued by SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch as below: -Update applicant, manufacturer, trademark, models name, label, appearance and equipment type ect. After evaluation, no clause needs to retest. All test data originate from the report GZES220801676702, which was issued by SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch.

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1 SCOPE

SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch has been contract by Huizhou Foryou Optoelectronics Technology Co., Ltd, in order to perform the testing according the “Engineering Recommendation G98 Issue 1 - Amendment 6 September 2021, Requirements For The Connection Of Fully Type Tested Micro-Generators (Up To And Including 16 A Per Phase) In Parallel With Public Low Voltage Distribution Networks On Or After 27 April 2019”.

2 GENERAL INFORMATION

2.1 TESTING PERIOD AND CLIMATIC CONDITIONS

The necessary testing has been performed along between the 28th of February and 13th of April of 2023. All the tests and checks have been performed at 25 ± 5ºC, 96 kPa ± 10 kPa and 50% RH ± 10% RH).

SITE TEST

Name.....: **Dongguan BALUN Testing Technology Co., Ltd.**

Address.....: Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China.

2.2 EQUIPMENT UNDER TESTING

Apparatus type ..... : Hybrid Inverter

Installation ..... : Fixed installation

Manufacturer ..... : **Huizhou Foryou Optoelectronics Technology Co., Ltd**

Address ..... : Building 6, B Area, No.1 North Shangxia Road, Dongjiang High-Tech Industry Park, Huizhou, Guangdong, China

Trade mark ..... : ADAYO

Model / Type reference ..... : ED3600A

Serial Number ..... : DN22222222

Software Version ..... : GA01.001-001-001

Rated Characteristics ..... : DC input: 150-500 V, Max. 2× 15 A
AC output: L/N/PE 230 V, 50 Hz, 15.6 A (17.2 A), 3600 W

Date of manufacturing: 2020

Test item particulars

Input ..... : DC

Output..... AC

Class of protection against electric shock... : Class I

Degree of protection against moisture ..... : IP 65

Type of connection to the main supply ..... : TN

Cooling group..... : See model list on page 8

Modular ..... : No

Internal Transformer..... : No

Copy of marking plate（representative）:

Model Name:	ADAYO	ED3600A
PV Input:		
PV max power :		5200W
PV max Voltage:		500Vdc
PV input voltage range		150-500Vdc
MPPT Voltage rang		120-430Vdc
Max input Current per string of trackerA/tracker B:		15A/15A
Starting Volatge:		150Vdc
AC Output:		
Norminal operating voltge:		230Vac
Max operating currrnt:		17.2Aac
Norminal operating frequency:		50Hz
Maximum power:		3600W
Power Factor Range:		±0.8
Back-Up Output:		
Output Power:		3600W
Output Voltage:	230Vac ±2%, 50Hz(60Hz Optional)±0.2%	
Battery:		
Battery voltage range:		41.6V-58.5V
Maximum battery current(charge/discharge):		80A/85A
General Data:		
Dimension(H/W/D):		230*350*580mm
Weight		25Kg
Transformer		Transformerless
Protect Class:		IP65
Cooling		Naturalcooling
Interface:	USB/RS485/CAN	
Display:		LCD
This Grid support interactive inverter complies with IEC 62109-1:2010,IEC 62109-2:2011 EN IEC 61000-6-1:2019 EN IEC 61000-6-3:2021 EN 50549-1:2019 VDE-AR-N 4105:2018 G99:2021 & G98:2021 NTs:2021-09 & UEN 217002:2020 CEI-021:2019		

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 **ED3600A**'s except the parameters of rating.

Equipment Under Testing:

- **ED3600A**

The variants models are:

- N/A

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 1/√10 and 2 times of the rated output power or the EUT or Modular inverters.
- Same Firmware Version

Following table shows the full ratings of the all models referenced in this report, marked in **bold letters** the ones subjected to testing:

Model	**ED3600A**
PV Input	
Max. input voltage	500 Vdc
Start-up operating voltage	150 Vdc
Rated input voltage	360 Vdc
MPPT operating voltage range	150-500 Vdc
Full power MPPT voltage range	150-430 Vdc
Max. input current	15 A/15 A
Max. short current	19.8 A/19.8 A
Battery Input	
operating voltage range	41.6V-58.5 Vdc
Maximum battery charge current	80 A
Maximum battery discharge current)	85 A
AC Output	
Nominal grid voltage	L/N/PE, 230 V
Nominal grid frequency	50 Hz
Rated AC power	3600 W
Max. AC power	3960 VA
Rated AC current	15.6 A
Max. AC current	17.2 A
Output power factor	1 default (adjustable+/-0.8)
General Data	
Operating temperature range	-30 ºC ~ +60 ºC
Protection degree	IP65
Protective class	Class I
Cooling method	Natural Cooling
Topology	Transformerless

The results obtained apply only to the particular sample tested that is the subject of the present test report. The most unfavorable result values of the verifications and tests performed are contained herein.

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

2.3 MANUFACTURER AND FACTORY INFORMATION

Manufacturer Name..... : **Huizhou Foryou Optoelectronics Technology Co., Ltd**

Manufacturer Address..... : Building 6, B Area, No.1 North Shangxia Road, Dongjiang High-Tech Industry Park, Huizhou, Guangdong, China

Factory Name..... : **Shenzhen Donnergy Power Technology Co. Ltd .**

Factory Address..... : A305, Zongtai E-commerce Science and Innovation Park, Shiyan Street, Baoan District, Shenzhen, China.

2.4 TEST EQUIPMENT LIST

From	No.	Equipment Name	Trademark / Model No.	Equipment No.	Calibration Period
Balun	1	Power analyzer	ZLG/ PA6000H	BZ-DGD- L059	2022/10/13 to 2023/10/12
	2	Current probe	HIOKI/ CT6863-05	BZ-DGD- L026-1	2023/02/20 to 2024/02/19
	3	Current probe	HIOKI/ CT6863-05	BZ-DGD- L026-2	2023/02/20 to 2024/02/19
	4	Current probe	HIOKI/ CT6863-05	BZ-DGD- L026-4	2023/02/20 to 2024/02/19
	5	Voltage probe	CYBERTEK/ VP5200A	BZ-DGD-L241-1	2022/03/01 to 2023/02/28 2023/03/09 to 2024/03/08
	6	Voltage probe	CYBERTEK/ VP5200A	BZ-DGD-L241-2	2022/03/01 to 2023/02/28 2023/03/09 to 2024/03/08
	7	Voltage probe	CYBERTEK/ VP5200A	BZ-DGD-L241-3	2022/03/01 to 2023/02/28 2023/03/09 to 2024/03/08
	8	Temperature & Humidity meter	CEM/ DT-322	BZ-DGD-L005	2022/03/01 to 2023/02/28 2023/03/13 to 2024/03/12
	9	Digital oscilloscope	TEKTRONIX/ MS04054B	BZ-DGD-L064	2022/03/01 to 2023/02/28 2023/03/07 to 2024/03/06
	10	Power Analyzer	DEWETRON / TRIONet	BZ-DGD-L305	2022/08/18 to 2023/08/17
SGS	11	True RMS Multimeter	Fluke/187	GZE012-16	2022/05/21 to 2023/05/20

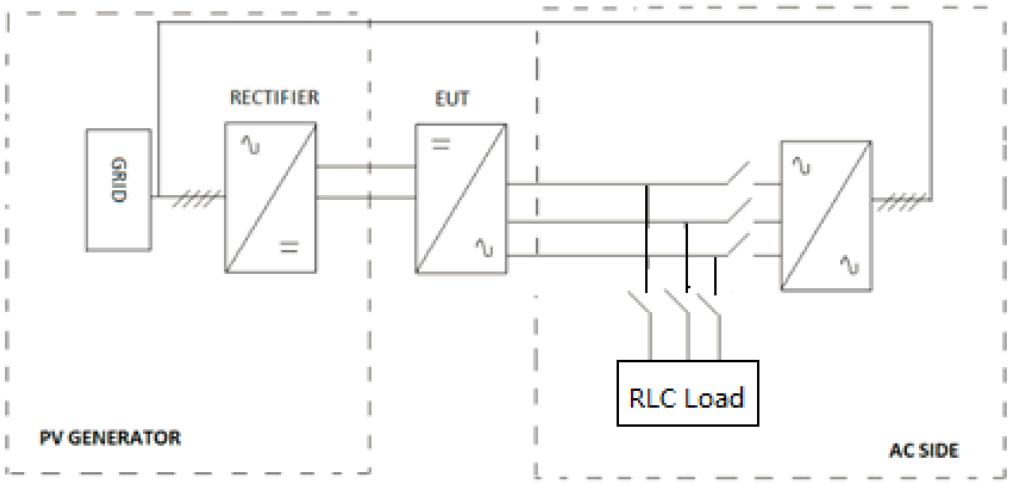
2.5 MEASUREMENT UNCERTAINTY

Associated uncertainties through measurements showed in this this report are the maximum allowable uncertainties.

Magnitude	Uncertainty
Voltage measurement	±0.05 %
Current measurement	±0.05 %
Frequency measurement	±0.001 Hz
Time measurement	±0.001s
Power measurement	±0.5 %
Phase Angle	±0.1º
Temperature	±3º C
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 solicitant. Note2: Where the standard requires lower uncertainties that those in this table. Most restrictive uncertainty has been considered.	

2.6 TEST SET UP OF THE DIFFERENT STANDARD

Below is the simplified construction of the test set up.



Different equipment has been used to take measures as it shows in chapter 2.3. Current and voltage clamps have been connected to the inverter input / output for all the tests.
All the tests described in the following pages have used this specified test setup.

The test bench used includes:

EQUIPMENT	MARK / MODEL	RATED CHARACTERISTICS	OWNER / ID. CODE
AC source	KEWELL / KACM-75-33	60 kVA max. 45-65 Hz	BZ-DGD-L193
PV source	CHROMA / Chroma 6215011-1000s	15 kVA max.	BZ-DGD-L009
RLC load	QunLing / ACTL-3820	68 kW,68 kvar	BZ-DGD-L063

2.7 Definitions

EUT	Equipment Under Testing	Hz	Hertz
A	Ampere	V	Volt
VAr	Volt-Ampere reactive	W	Watt
EMC	Electromagnetic Compatibility	p.u	Per unit
Un	Nominal Voltage	Pn	Nominal Active Power
In	Nominal Current	Qn	Nominal Reactive Power
Ia	Active Current	Sn	Nominal Apparent Power
Ir	Reactive Current	THD	Total Harmonic Distortion
I_h	Harmonic Current	TDD	Total Demand Distortion
PWHD	Partial Weighted Harmonic Distortion	PLT	Severity of Flicker Long-Term
		d(t)	Variation of Voltage
PST	Severity of Flicker Short-Term	OV	Over Voltage
d max	Maximum Absolute Value of Voltage Variation	OF	Over Frequency
UV	Under Voltage	UF	Under Frequency

3 RESUME OF TEST RESULTS

INTERPRETATION KEYS

Test object does meet the requirement ..... **P** Pass
Test object does not meet the requirement..... **F** Fails
Test case does not apply to the test object ..... **N/A** Not applicable
To make a reference to a table or an annex. ..... See additional sheet
To indicate that the test has not been realized ..... **N/R** Not realized

STANDAARD CLAUSE	STANDARD REQUIREMENTS		RESULT
	G98 Issue 1 Amendment 3 March 2019		
	TEST	REMARKS	
EN 50438 D.3.1.	Operating Range		P
EREC G98 Annex A1 A1.3.1	Harmonics		P
EREC G98 Annex A1 A1.3.3	Voltage fluctuations and Flicker		P
EN 50438 Annex D.3.10	DC injection		P
EN 50538 Annex D.3.4.1	Power factor		P
EREC G98 Annex A1 A.1.2.3	Frequency tests		P
EREC G98 Annex A1 A.1.2.2	Voltage tests		P
BS EN 62116	Loss of Mains test		P
EREC G98 Annex A1 A.1.2.6	Frequency change, Vector Shift Stability test		P
EREC G98 Annex A1 A.1.2.6	Frequency change, RoCoF Stability test		P
EN 50438 Annex D.3.3	Overfrequency test		P
EN 50438 Annex D.3.2	Power output with falling frequency test		P
EN 50438 Annex A12	Re-connection timer.		P
EREC G98 Annex A1 A.1.3.5	Fault level contribution		P
EREC G98 Annex A1 A.1.3.6	Self-Monitoring solid state switching	No solid state switching devices	N/A
EREC G98 Annex A1 A.1.3.7	Electromagnetic Compatibility (EMC)		N/R ([1])
EREC G98 9.4.4	Logic Interface		P
EREC G98 9.7	Cyber security		P

The compliances with these requirements are stated in the following test reports:
([1])EMC Test Report: Test Report no. GZEM220800488101C11, issued by SGS-CST Standards Technical Services Co., Ltd. Guangzhou Branch on May 06 of 2024.

4 TEST RESULTS

4.1 Operating Range

This test should be carried out as specified in EN 50438 D.3.1.

Active Power shall be recorded every second. The tests will verify that the Micro-generator can operate within the required ranges for the specified period of time.

The Interface Protection shall be disabled during the tests.

In case of a PV Micro-generator the PV primary source may be replaced by a DC source.

In case of a full converter Micro-generator (eg wind) the primary source and the prime mover Inverter/rectifier may be replaced by a DC source.

In case of a DFIG Micro-generator the mechanical drive system may be replaced by a test bench motor.

Test 1
Voltage = 85% of nominal (195.5 V)
Frequency = 47.0 Hz
Power factor = 1
Period of test 20 seconds

Test 2:

Voltage = 85% of nominal (195.5 V)

Frequency = 47.5 Hz

Power factor = 1

Period of test 90 minutes

Test 3:

Voltage = 110% of nominal (253 V).

Frequency = 51.5 Hz

Power factor = 1

Period of test 90 minutes

Test 4:

Voltage = 110% of nominal (253 V).

Frequency = 52.0 Hz

Power factor = 1

Period of test 15 minutes

Test 5
Voltage = 100% of nominal (230 V).
Frequency = 50.0 Hz
Power factor = 1
Period of test 90 minutes

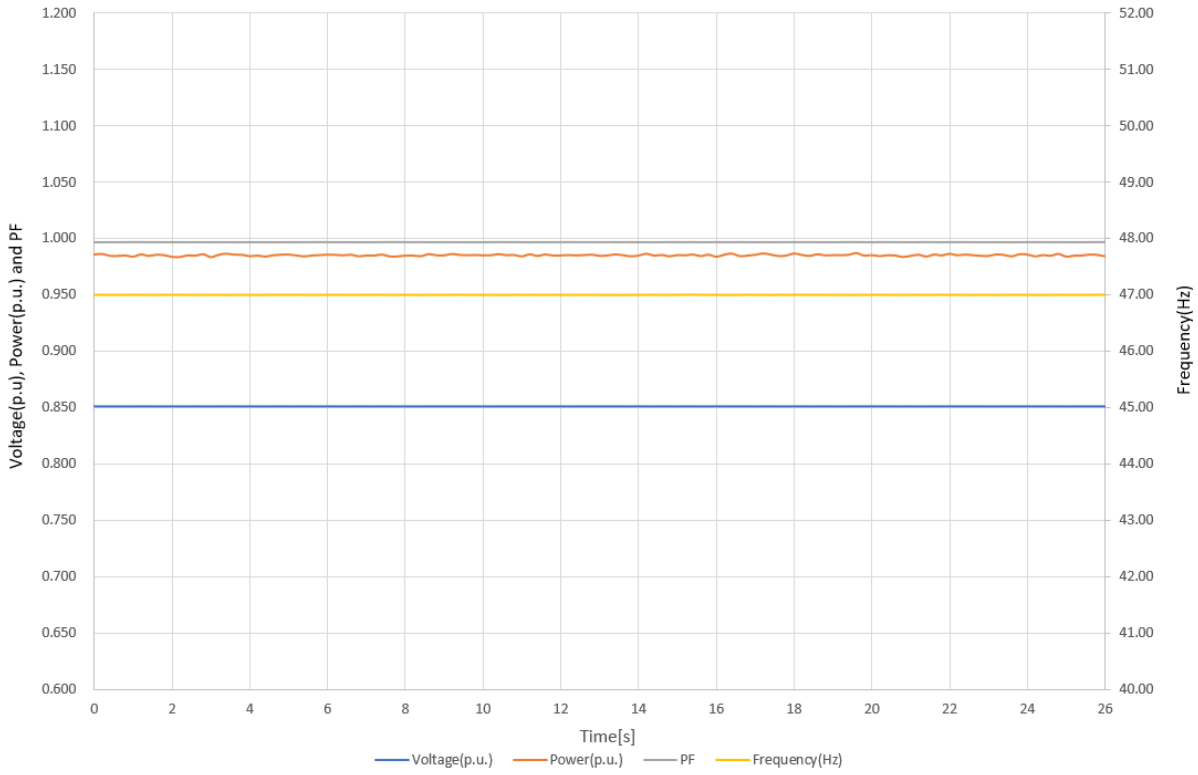
Test 6 RoCoF withstand

Confirm that the **Micro-Generating Plant** is capable of staying connected to the **Distribution Network** and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms.

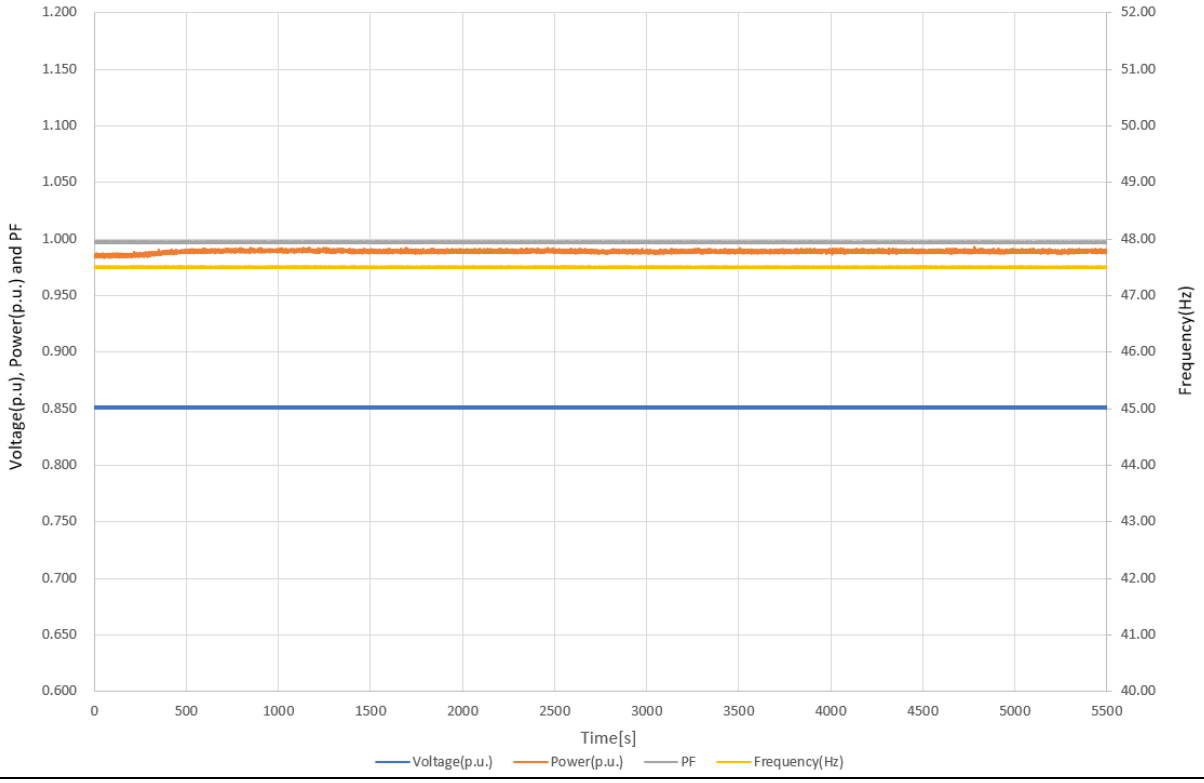
This is not expected to be demonstrated on site.

Test results are graphically shown in following pages.

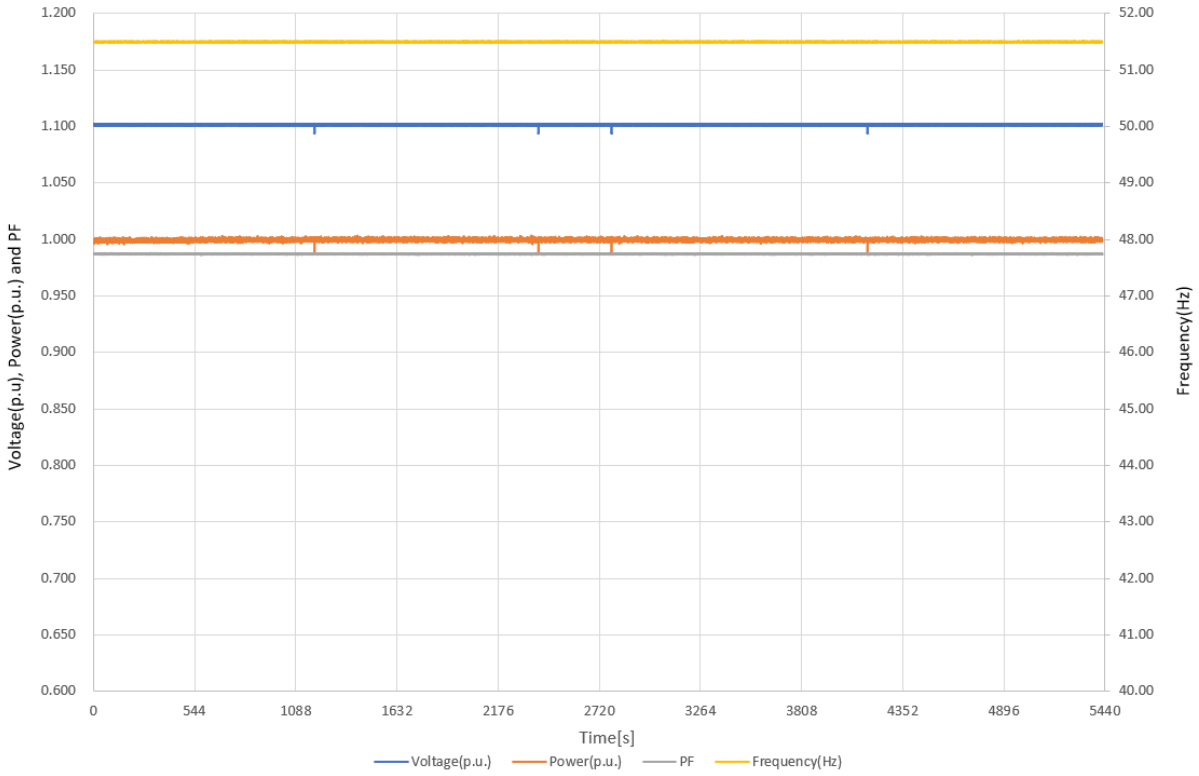
Test 1



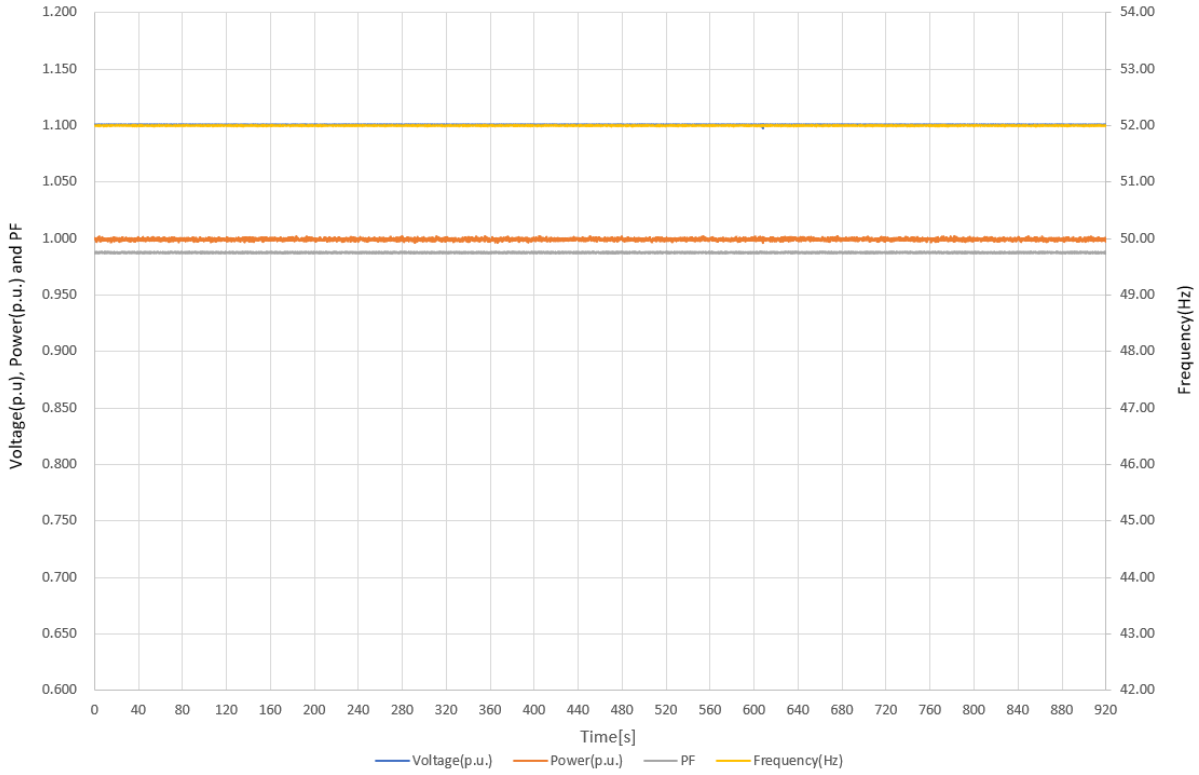
Test 2



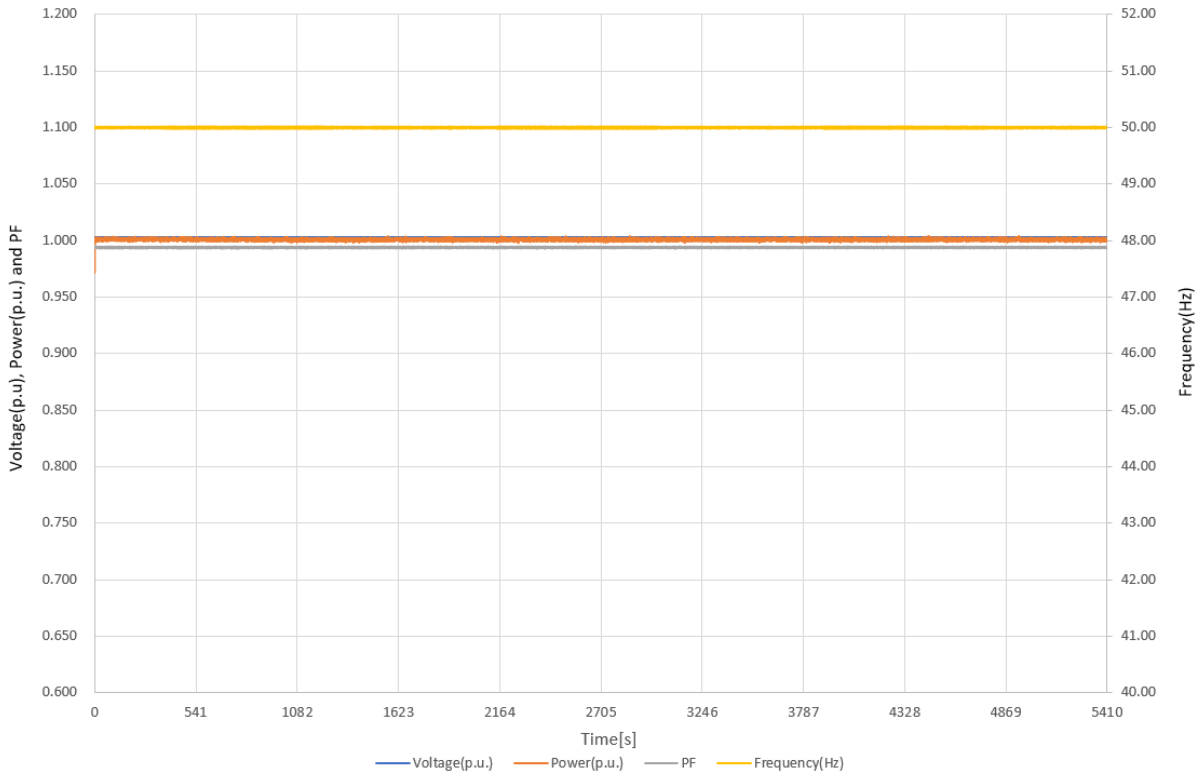
Test 3


Voltage(p.u), Power(p.u.) and PF
Frequency(Hz)
Time[s]
Voltage(p.u.)
Power(p.u.)
PF
Frequency(Hz)

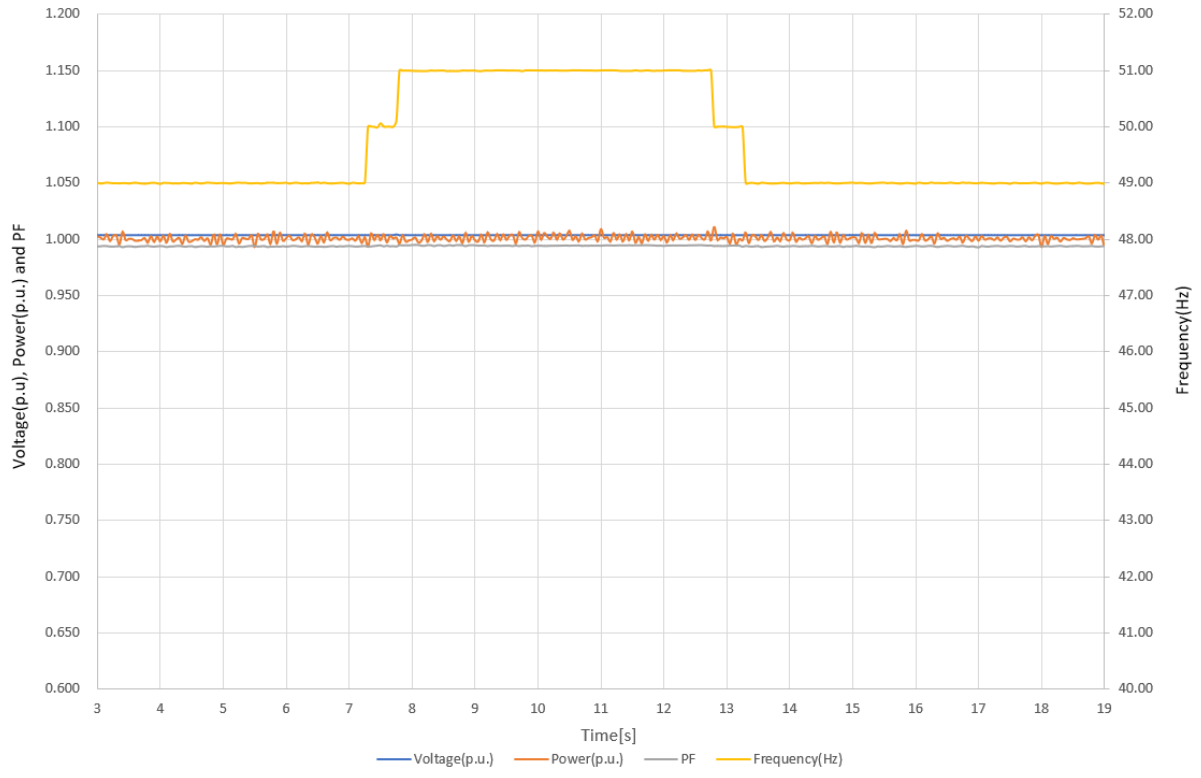
Test 4


Voltage(p.u), Power(p.u.) and PF
Frequency(Hz)
Time[s]
Voltage(p.u.)
Power(p.u.)
PF
Frequency(Hz)

Test 5


Voltage(p.u), Power(p.u.) and PF
Frequency(Hz)
Time[s]
Voltage(p.u.)
Power(p.u.)
PF
Frequency(Hz)

Test 6


Voltage(p.u), Power(p.u.) and PF
Frequency(Hz)
Time[s]
Voltage(p.u.)
Power(p.u.)
PF
Frequency(Hz)

4.2 POWER QUALITY

4.2.1 Current Harmonics

The tests should be carried out as specified in BS EN 61000-3-2 and can be undertaken with a fixed source of energy at two power levels firstly between 45 and 55% and at 100% of Registered Capacity. The test requirements are specified in Annex A1 A.1.3.1 (Inverter connected) or Annex A2 A.2.3.1 (Synchronous).

Measures have been repeated at 50%P_n and 100%P_n.

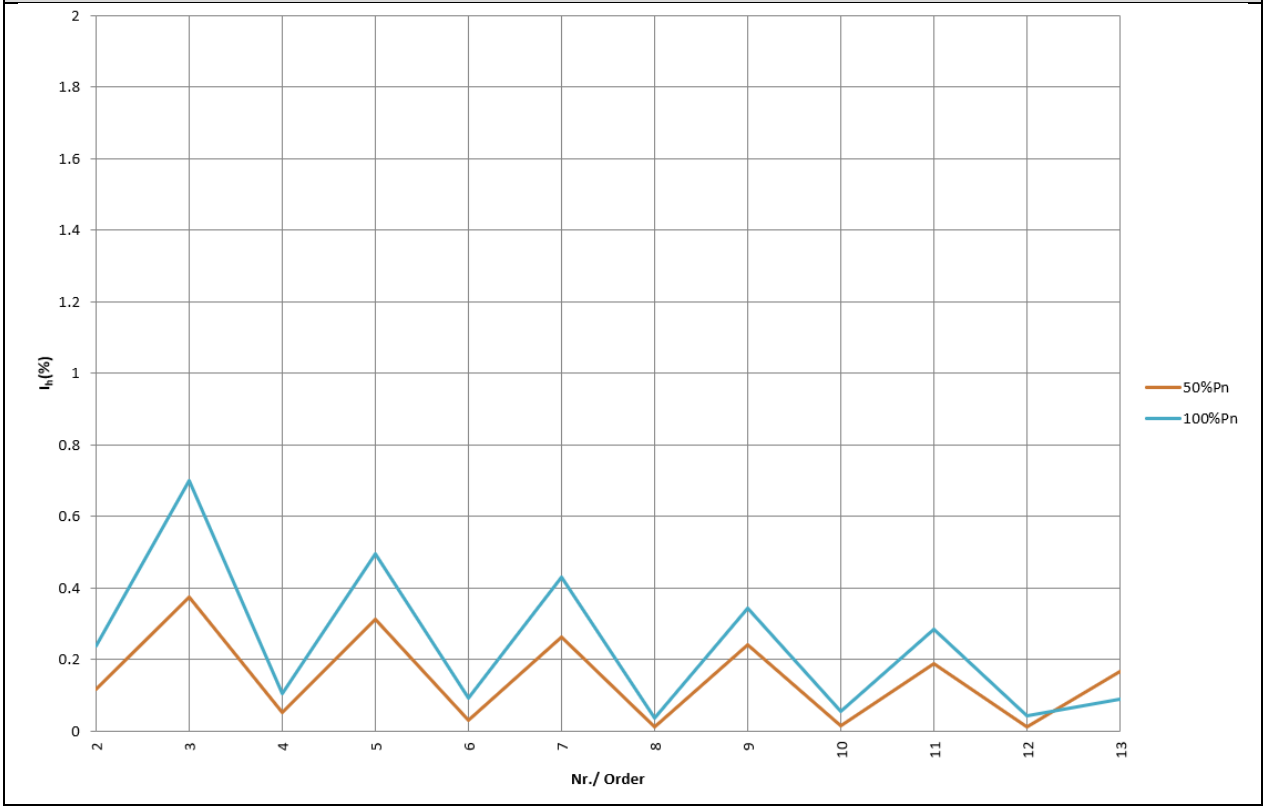
Following tables show the test results:

Micro-generator rating per phase (rpp)			3.6	kW		
Harmonic	At 45-55% of **Registered Capacity**		100% of **Registered Capacity**			
	Measured Value MV in Amps	Ih(%)	Measured Value MV in Amps	Ih(%)	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.019	0.116	0.038	0.236	1.080	
3	0.060	0.373	0.112	0.700	2.300	
4	0.008	0.051	0.017	0.105	0.430	
5	0.050	0.311	0.079	0.494	1.140	
6	0.005	0.031	0.015	0.091	0.300	
7	0.042	0.262	0.069	0.430	0.770	
8	0.002	0.010	0.006	0.036	0.230	
9	0.038	0.240	0.055	0.342	0.400	
10	0.002	0.015	0.009	0.055	0.184	
11	0.030	0.189	0.045	0.283	0.330	
12	0.002	0.011	0.007	0.041	0.153	
13	0.026	0.166	0.014	0.089	0.210	
14	0.001	0.004	0.002	0.014	0.131	
15	0.021	0.133	0.011	0.072	0.150	
16	0.001	0.008	0.003	0.022	0.115	
17	0.017	0.105	0.019	0.121	0.132	
18	0.001	0.006	0.002	0.015	0.102	
19	0.015	0.095	0.016	0.100	0.118	
20	0.001	0.005	0.002	0.014	0.092	
21	0.010	0.064	0.010	0.065	0.107	0.160
22	0.001	0.004	0.002	0.010	0.084	
23	0.010	0.065	0.007	0.042	0.098	0.147
24	0.001	0.006	0.001	0.008	0.077	
25	0.007	0.046	0.006	0.037	0.090	0.135
26	0.001	0.006	0.001	0.006	0.071	
27	0.006	0.037	0.003	0.021	0.083	0.124
28	0.001	0.007	0.001	0.004	0.066	
29	0.005	0.031	0.003	0.021	0.078	0.117
30	0.001	0.005	0.001	0.008	0.061	
31	0.003	0.020	0.003	0.016	0.073	0.109
32	0.001	0.006	0.001	0.004	0.058	
33	0.003	0.021	0.002	0.013	0.068	0.102
34	0.001	0.006	0.001	0.005	0.054	
35	0.002	0.010	0.003	0.020	0.064	0.096
36	0.001	0.004	0.001	0.006	0.051	
37	0.002	0.014	0.003	0.018	0.061	0.091

38	0.001	0.005	0.001	0.004	0.048	
39	0.002	0.010	0.003	0.017	0.058	0.087
40	0.001	0.007	0.002	0.013	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

Current Harmonics



4.2.2 Voltage fluctuations and Flicker

These tests should be undertaken in accordance with EREC G98 Annex A1 A.1.3.3 (Inverter connected) or Annex A2 A.2.3.3 (Synchronous).

The measurements of voltage fluctuations have been measured according to the standard, at 100 % of the nominal power value of the inverter.

The test impedance is recorded in the table below:

Test Impedance	R	0.24	Ω	X	0.15	Ω
Standard Impedance	R	0.24	Ω	X	0.15	Ω
Maximum Impedance	R	0.24	Ω	X	0.15	Ω

Starting operation and Stopping operation			
Pbin (%)	**100%**		
	Limit	**Starting measured values**	**Stopping measured values**
PST	≤ 1	0.131	0.034
PLT	≤ 0.65	0.105	0.105
dc	≤ 3.30%	0.250%	0.000%
d(t)	≤ 3.30%	0.000%	0.000%
dmax	4%	0.345%	0.000%

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

1. Starting operation
2. Stopping operation

All values are the most unfavorable of the two steps.

Starting operation and Stopping operation

100% Pn

Running operation 2 hours		
Pbin (%)	100%	
	Limit	Measured values
PST	≤ 1	0.078
PLT	≤ 0.65	0.068
dc	≤ 3.30%	0.127%
d(t)	≤ 3.30%	0.000%
dmax	4%	0.203%

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

100% Pn

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.110	Pass	0.187	Pass	0.0	Pass	0.075	Pass		
2	0.110	Pass	0.185	Pass	0.0	Pass	0.076	Pass		
3	0.107	Pass	0.180	Pass	0.0	Pass	0.078	Pass		
4	0.108	Pass	0.170	Pass	0.0	Pass	0.078	Pass		
5	0.101	Pass	0.165	Pass	0.0	Pass	0.070	Pass		
6	0.104	Pass	0.166	Pass	0.0	Pass	0.064	Pass		
7	0.104	Pass	0.162	Pass	0.0	Pass	0.065	Pass		
8	0.101	Pass	0.203	Pass	0.0	Pass	0.059	Pass		
9	0.127	Pass	0.186	Pass	0.0	Pass	0.059	Pass		
10	0.115	Pass	0.168	Pass	0.0	Pass	0.058	Pass		
11	0.115	Pass	0.182	Pass	0.0	Pass	0.060	Pass		
12	0.107	Pass	0.168	Pass	0.0	Pass	0.065	Pass		
Result		Pass		Pass		Pass		Pass	0.068	Pass

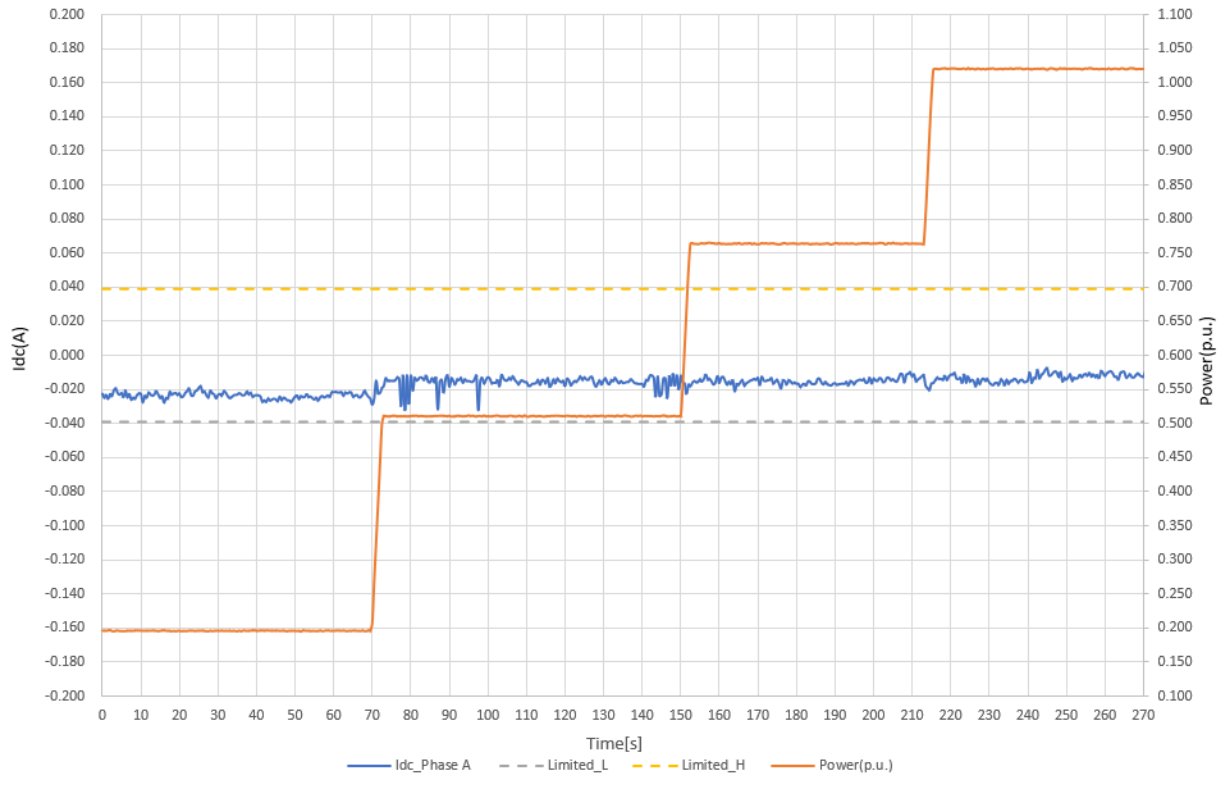
4.2.3 DC Injection

The DC component shall be measured under steady-state conditions for the following power levels: 20 %, 50 %, 75 %, and 100 % of nominal power with a tolerance of ± 5 % of nominal power and as far as adjustable for the tested micro-generator. These tests should be undertaken in accordance with Annex A1.3.4.

Following tables show the test results:

Power quality – DC injection: This test should be carried out in accordance with EN 50438 Annex D.3.10				
Test power level	20%	50%	75%	100%
Recorded value in Amps	0.024	0.016	0.015	0.013
as % of rated AC current	0.153	0.102	0.096	0.083
Limit	0.25%	0.25%	0.25%	0.25%

DC injection test result



4.2.4 Power Factor

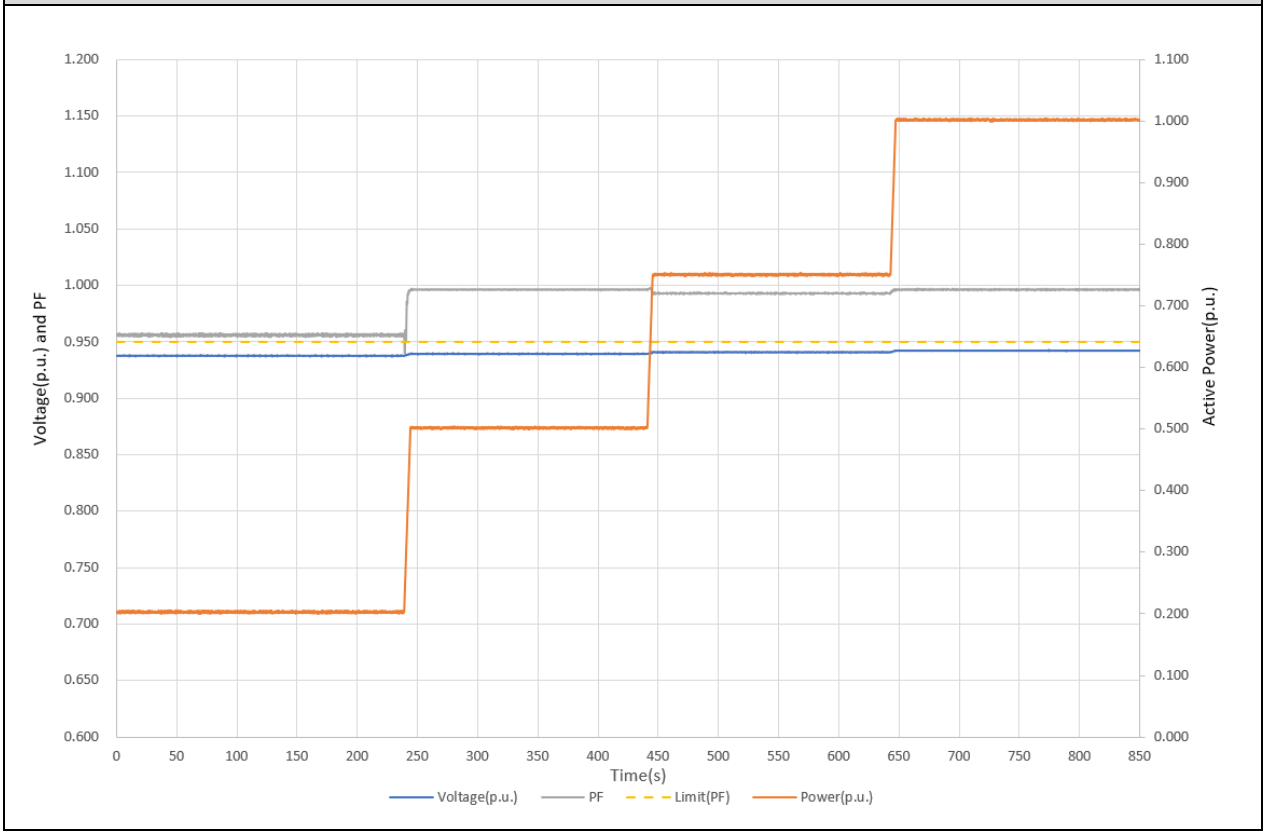
This test shall be carried out in accordance with EN 50538 Annex D.3.4.1 but with nominal voltage -6% and +10%. Voltage to be maintained within ±1.5% of the stated level during the test.

The following table shows the test results at required voltage levels:

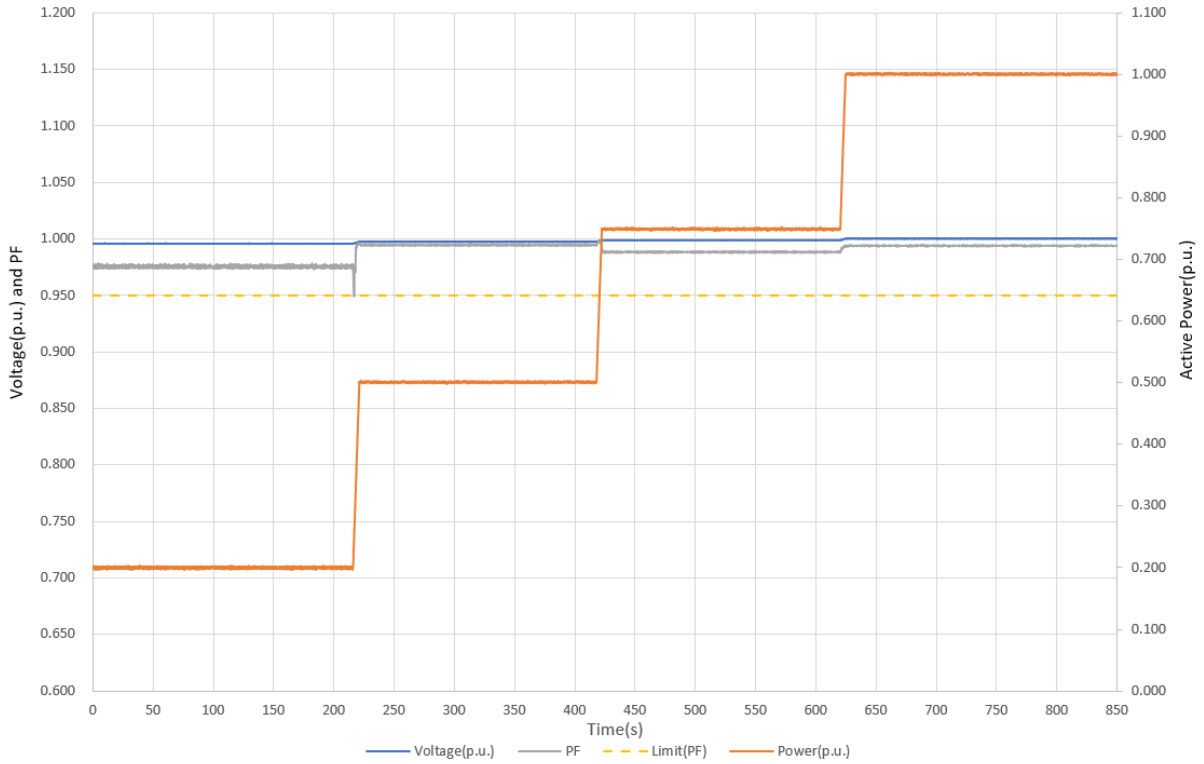
	216.2 V	230 V	253 V
20% of **Registered Capacity**	0.956	0.976	0.961
50% of **Registered Capacity**	0.996	0.994	0.986
75% of **Registered Capacity**	0.993	0.988	0.994
100% of **Registered Capacity**	0.996	0.994	0.986
Limit	>0.95	>0.95	>0.95

Test results are graphically shown below.

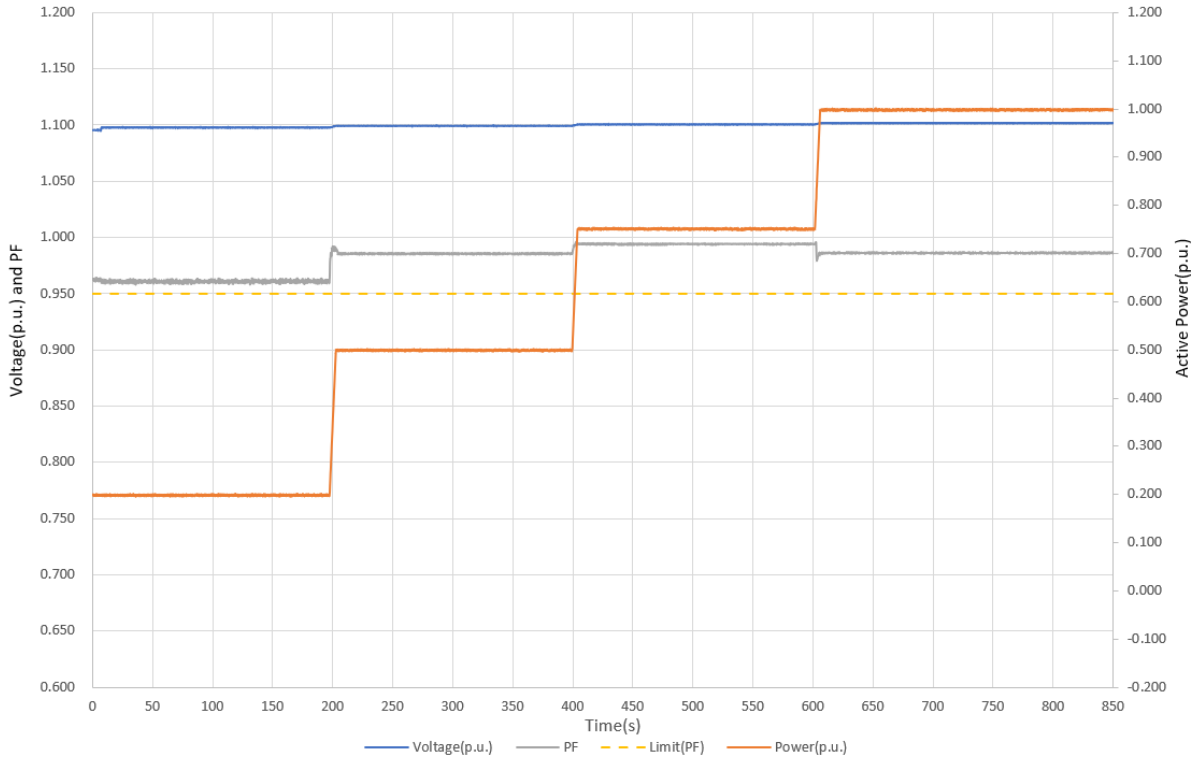
Power Factor 216.2V



Power Factor 230V



Power Factor 253V



4.3 PROTECTION

4.3.1 Frequency tests

These tests should be carried out in accordance with EN 50438 Annex D.2.4 and the notes in EREC G98 Annex A1 A.1.2.3 (Inverter connected) or Annex A2 A.2.2.3 (Synchronous).

To establish a trip frequency, the test frequency should be applied in a slow ramp rate of less than 0.1 Hz/s, or if this is not possible in steps of 0.05 Hz for a duration that is longer than the trip time delay.

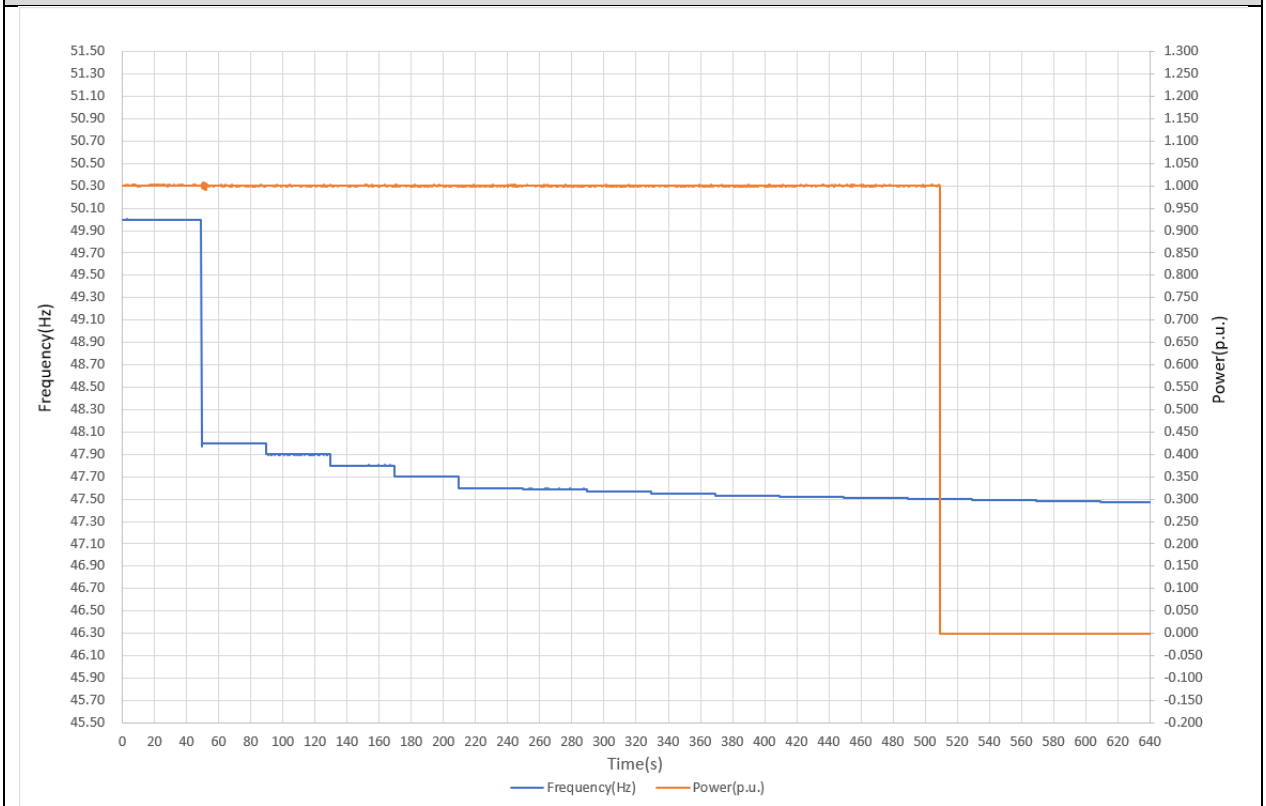
To establish the trip time, the test frequency should be applied starting from 0.3 Hz below or above the recorded trip frequency and should be changed to 0.3 Hz above or below the recorded trip frequency in a single step. For each trip setting five tests shall be carried out.

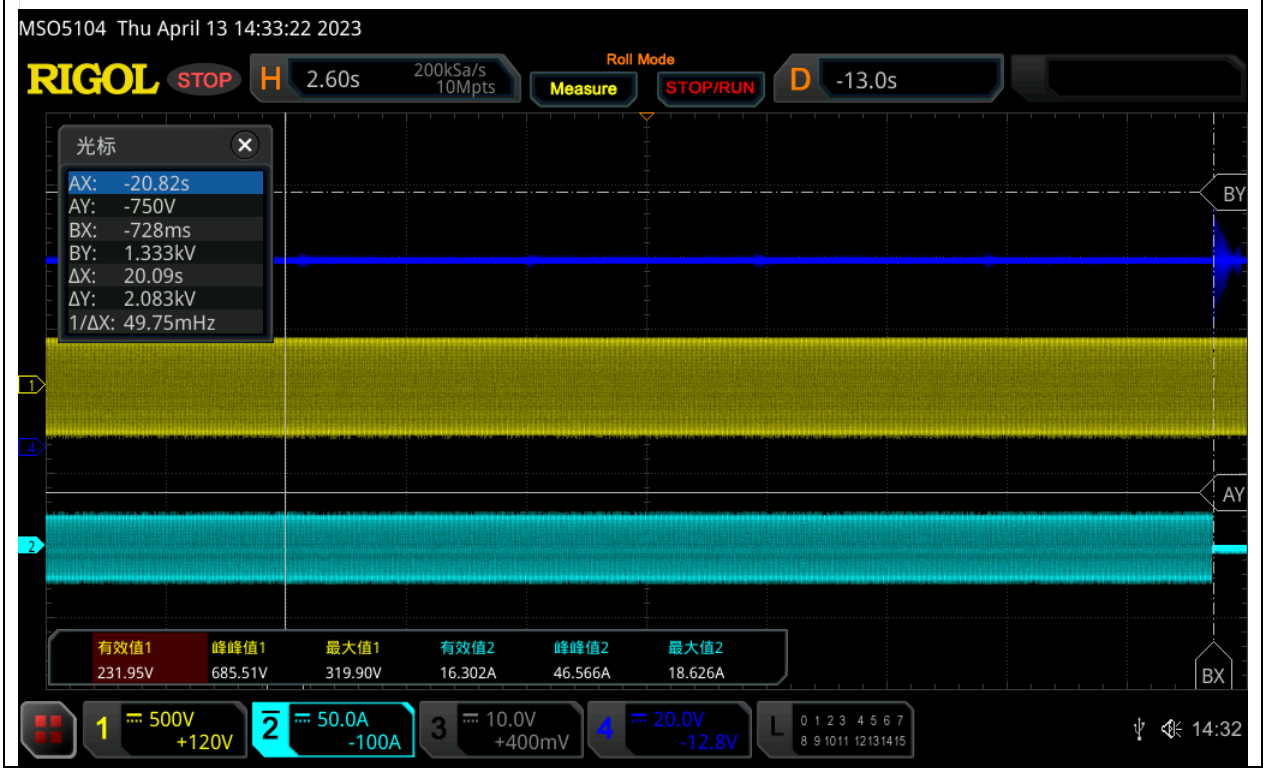
Following tables show the test results:

Function	Setting		Trip test (5 times)		"No trip tests"	
	Frequency	Time delay	Frequency (Hz)	Time delay (s)	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.50	20.090	47.7 Hz / 30 s	Pass
			47.50	20.090		
			47.50	20.070		
			47.50	20.070		
			47.50	20.040		
U/F stage 2	47 Hz	0.5 s	47.00	0.545	47.2 Hz / 19.5 s	Pass
			47.00	0.560		
			47.00	0.555		
			47.00	0.555		
			47.00	0.540		
					46.8 Hz / 0.45 s	Pass
O/F stage 1	52 Hz	0.5 s	52.01	0.575	51.8 Hz / 120 s	Pass
			52.02	0.575		
			52.02	0.585		
			52.02	0.565		
			52.02	0.570		
					52.2 Hz / 0.45 s	Pass

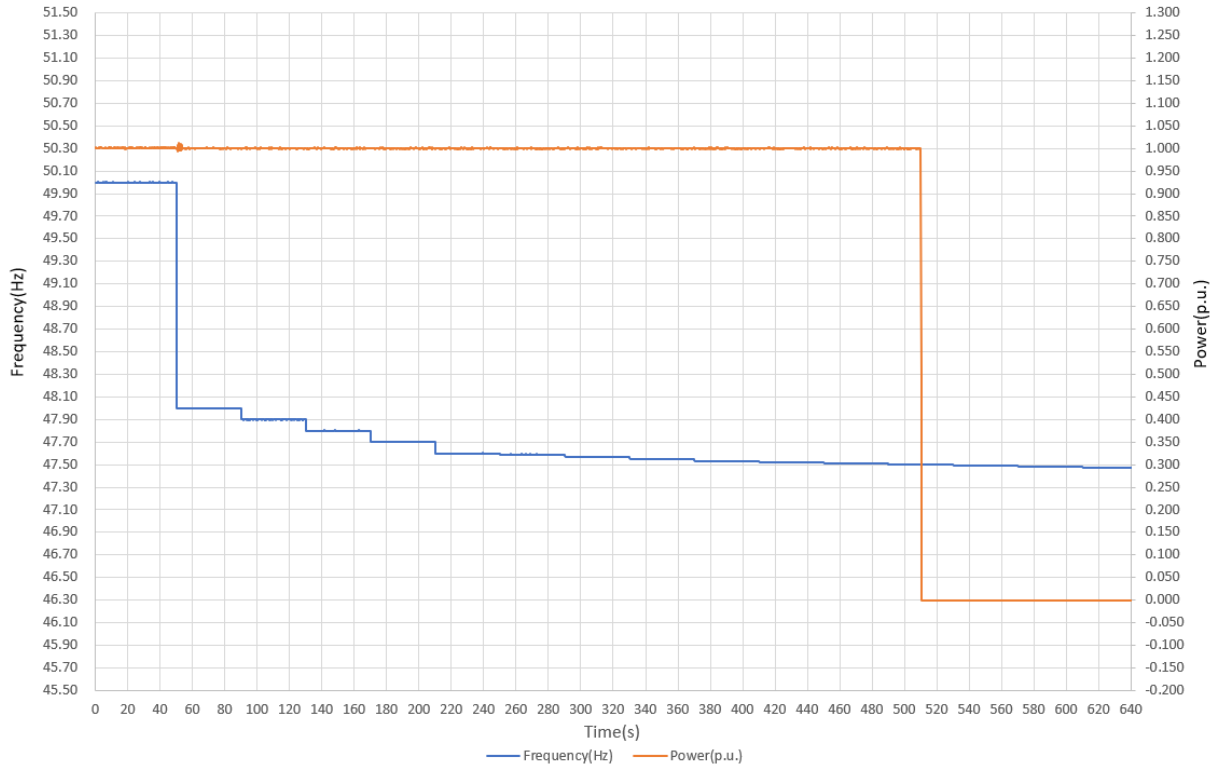
Test results are graphically shown below.

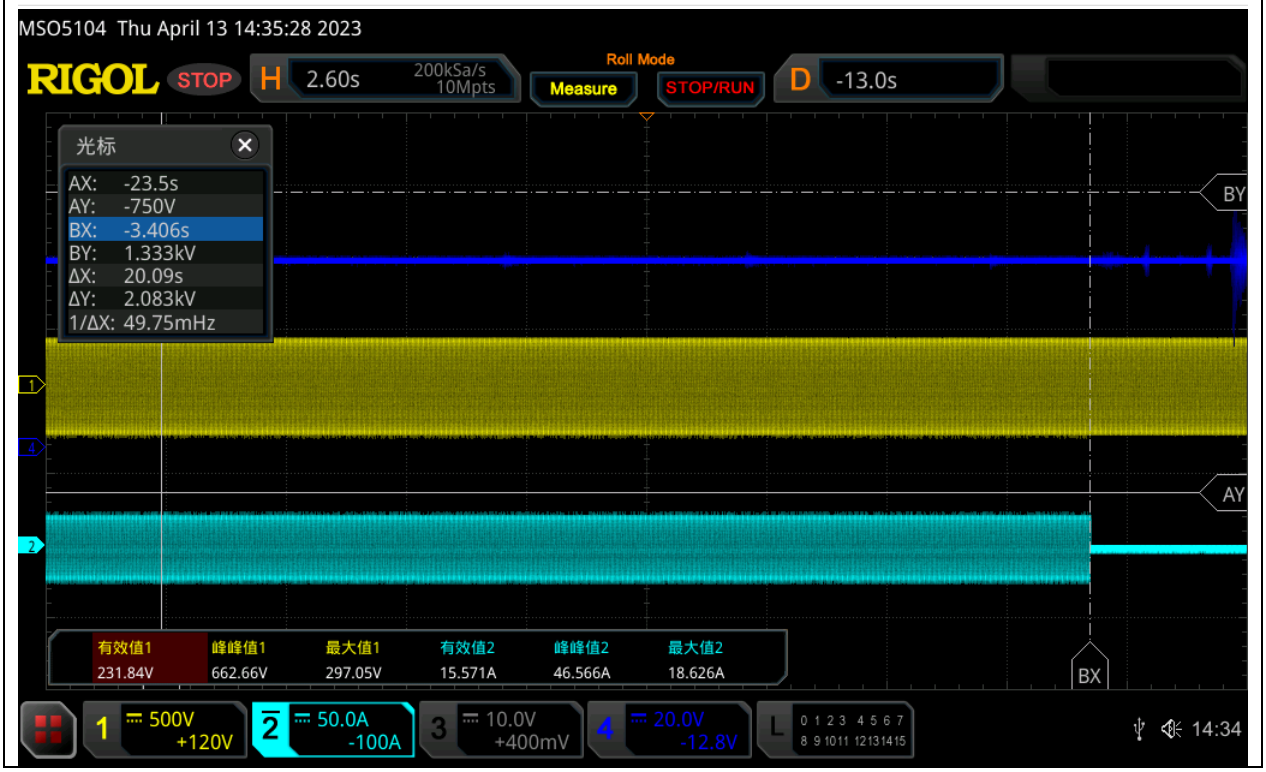
U/F stage 1-1



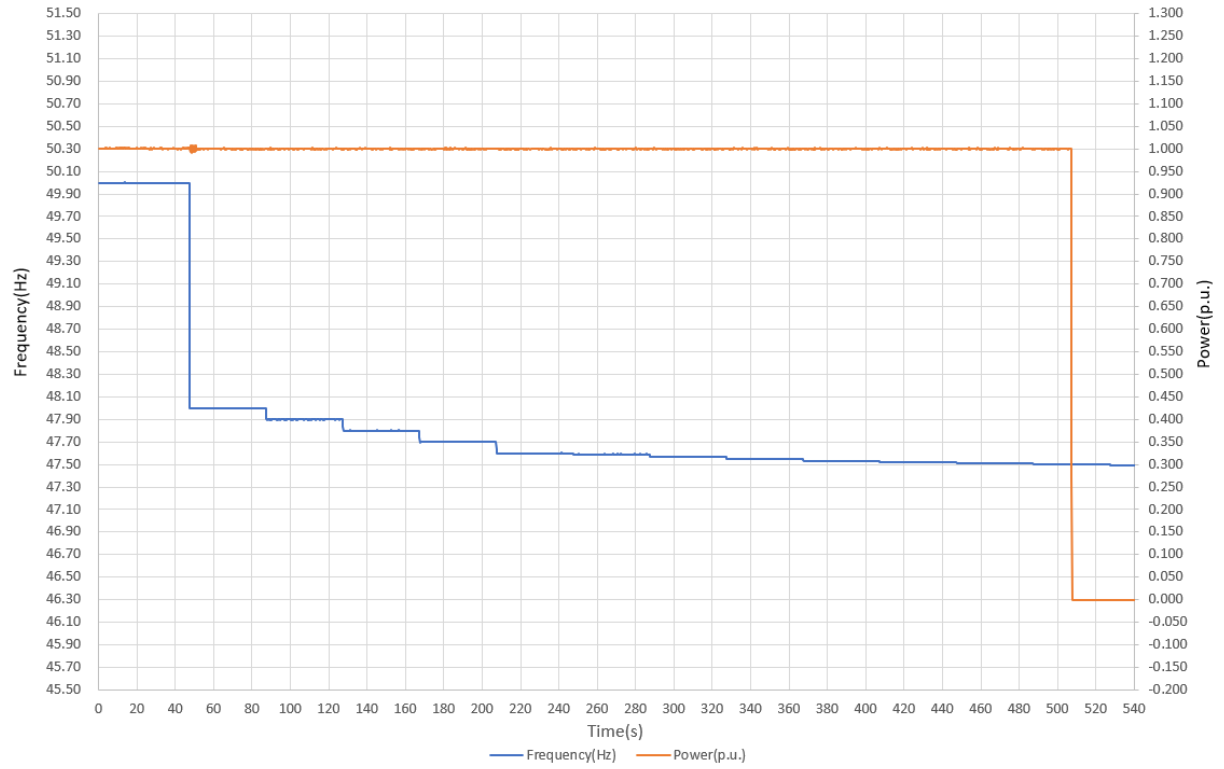


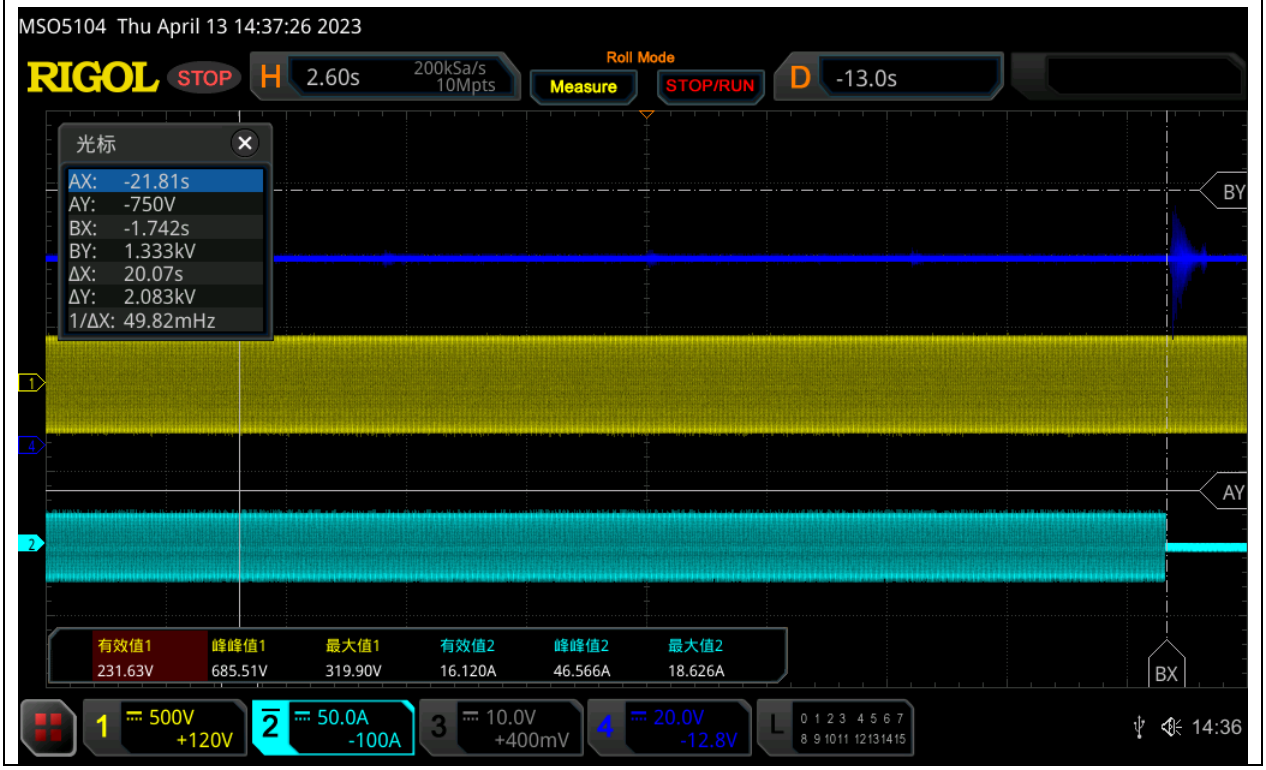
U/F stage 1-2


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

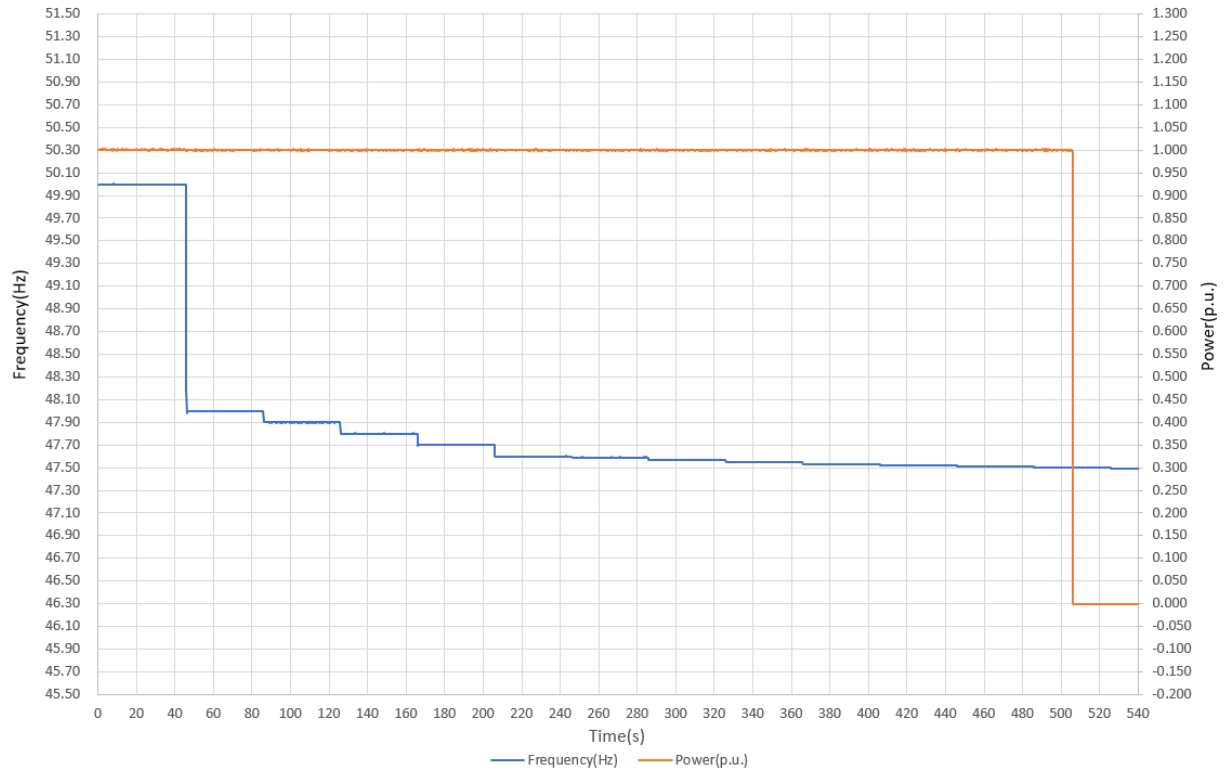

MSO5104 Thu April 13 14:35:28 2023
RIGOL
STOP
H 2.60s
200kSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -13.0s
光标
AX: -23.5s
AY: -750V
BX: -3.406s
BY: 1.333kV
ΔX: 20.09s
ΔY: 2.083kV
1/ΔX: 49.75mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
231.84V 662.66V 297.05V 15.571A 46.566A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:34

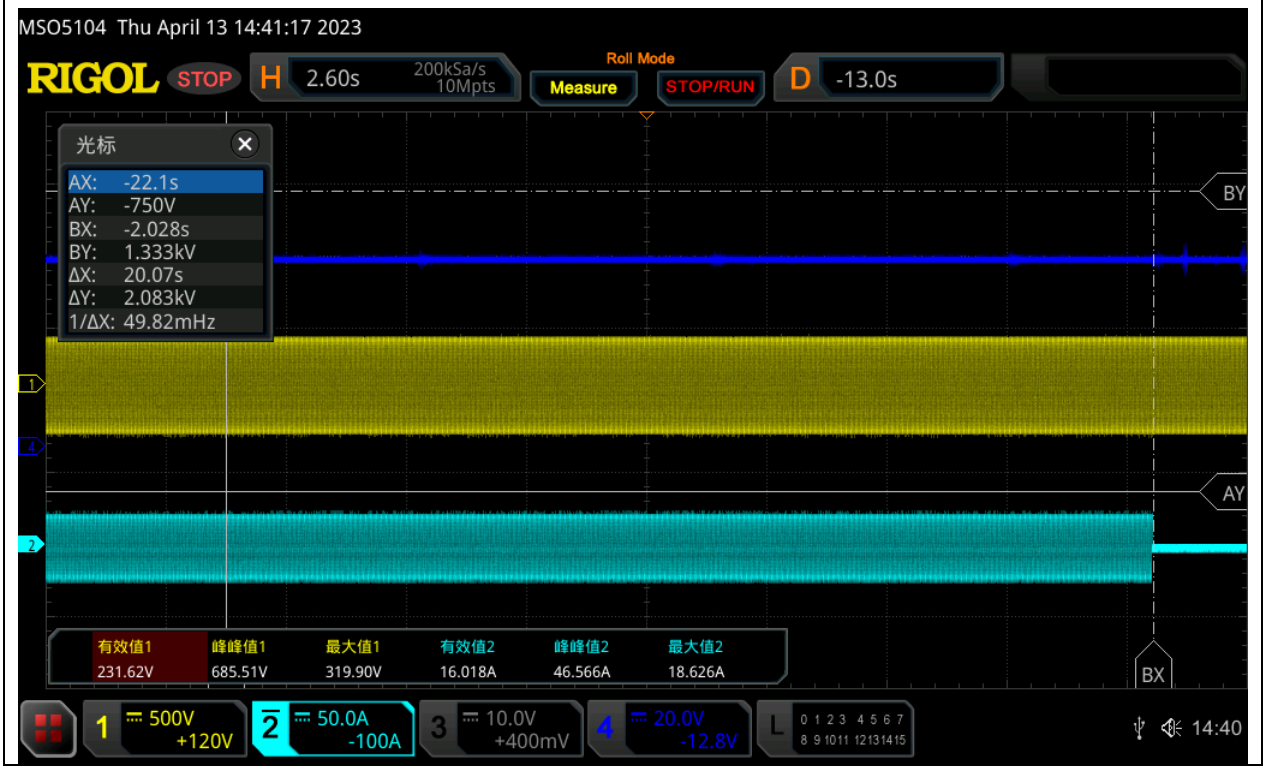
U/F stage 1-3


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

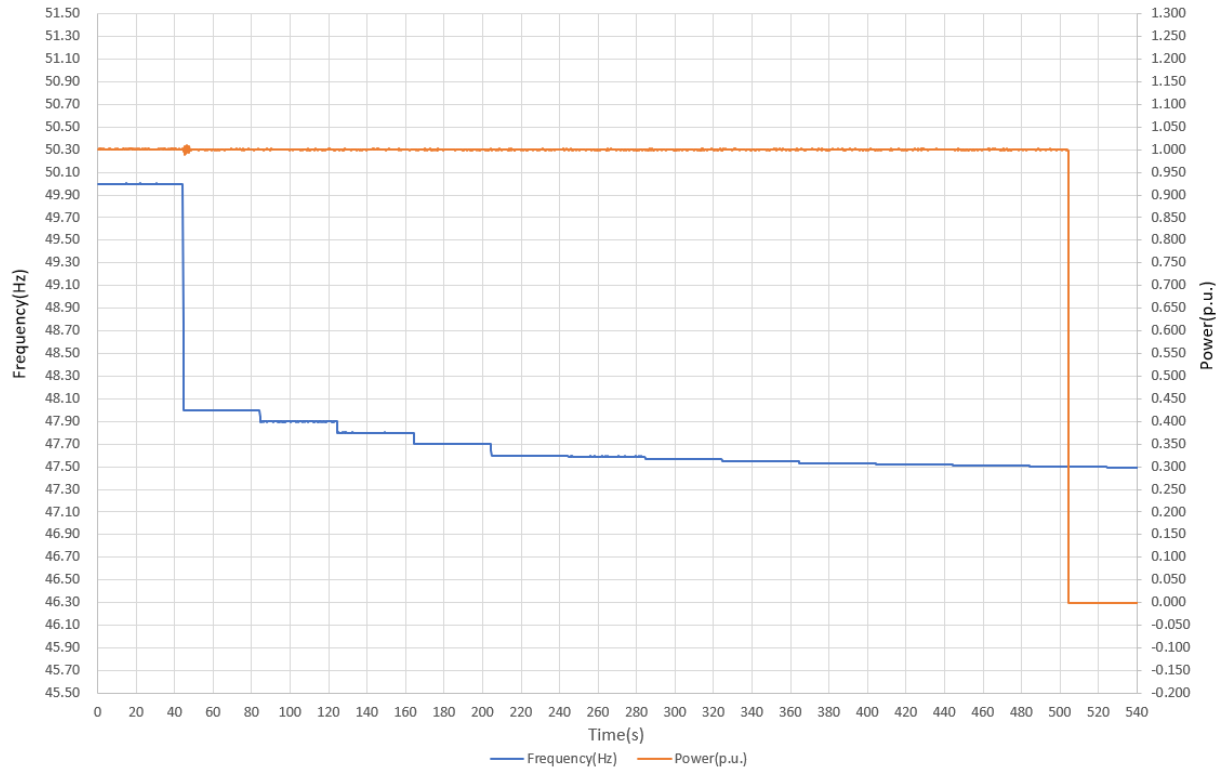

MSO5104 Thu April 13 14:37:26 2023
RIGOL
STOP
H 2.60s
200kSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -13.0s
光标
AX: -21.81s
AY: -750V
BX: -1.742s
BY: 1.333kV
ΔX: 20.07s
ΔY: 2.083kV
1/ΔX: 49.82mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
231.63V 685.51V 319.90V 16.120A 46.566A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:36

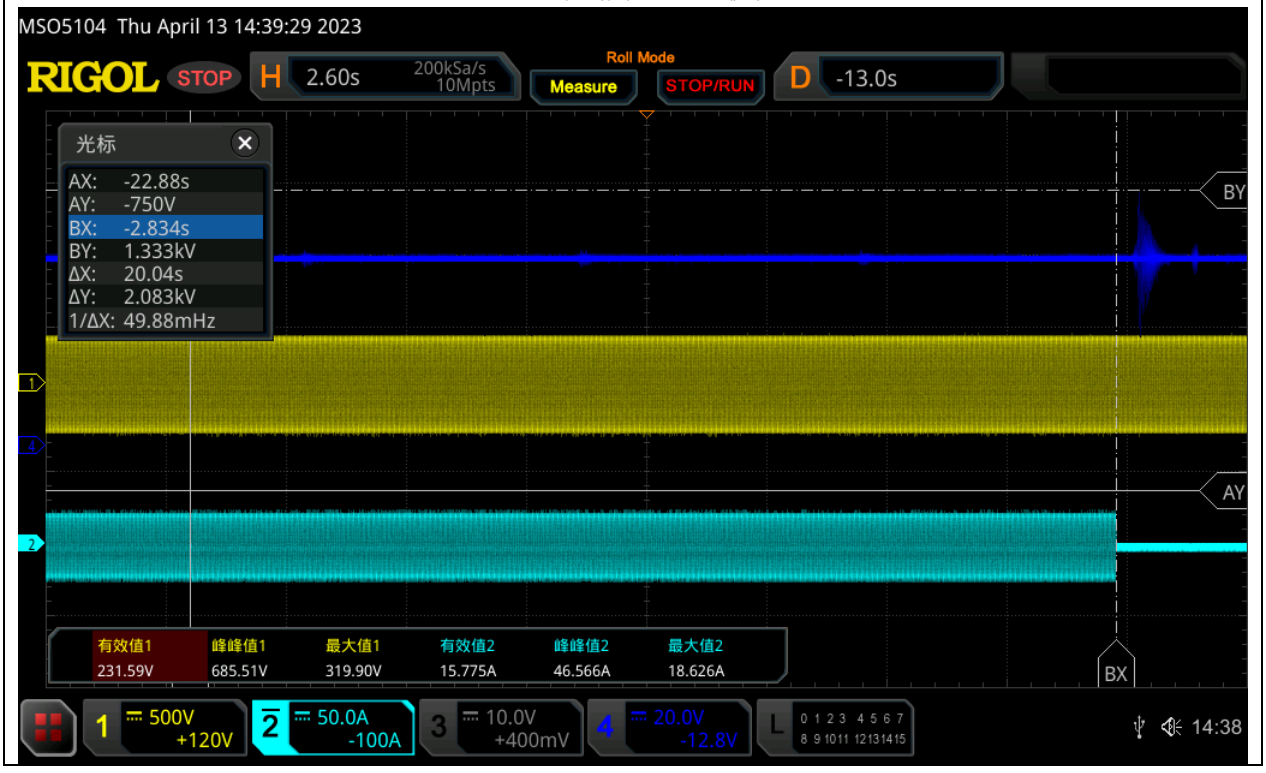
U/F stage 1-4


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

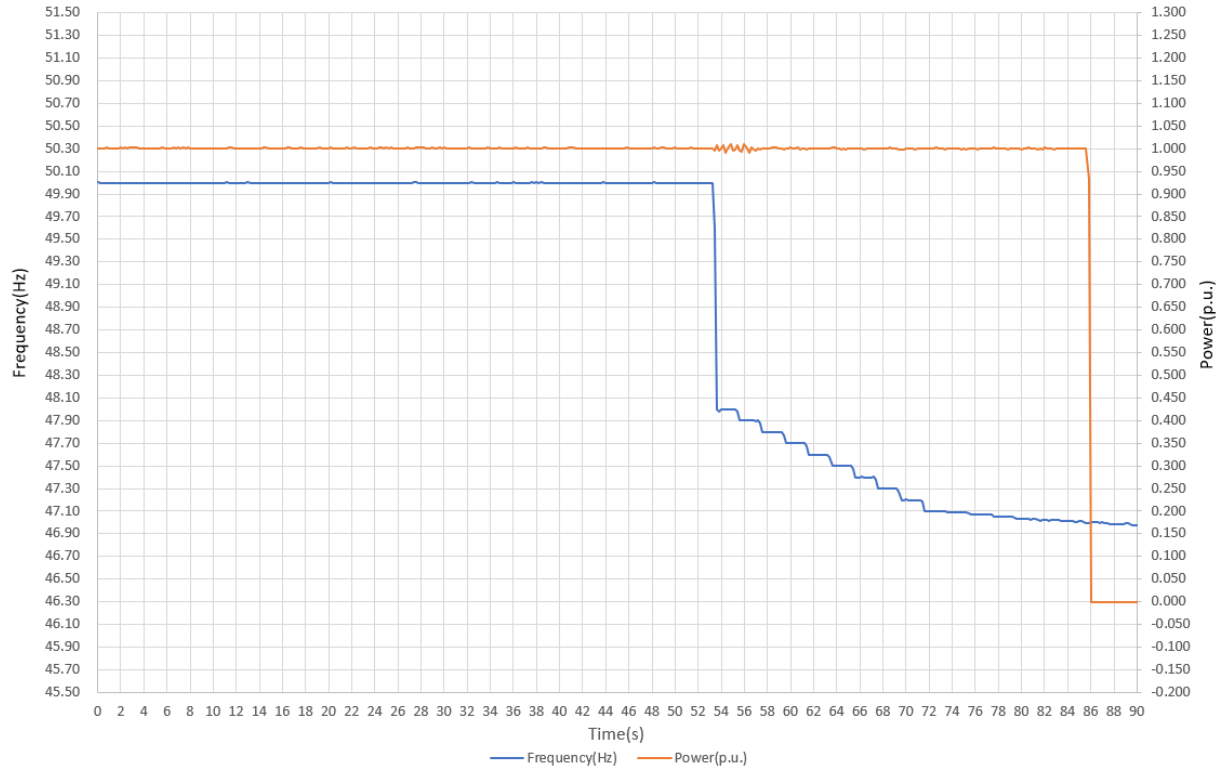

MSO5104 Thu April 13 14:41:17 2023
RIGOL
STOP
H 2.60s
200kSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -13.0s
光标
AX: -22.1s
AY: -750V
BX: -2.028s
BY: 1.333kV
ΔX: 20.07s
ΔY: 2.083kV
1/ΔX: 49.82mHz
BY
AY
BX
有效值1 231.62V
峰峰值1 685.51V
最大值1 319.90V
有效值2 16.018A
峰峰值2 46.566A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:40

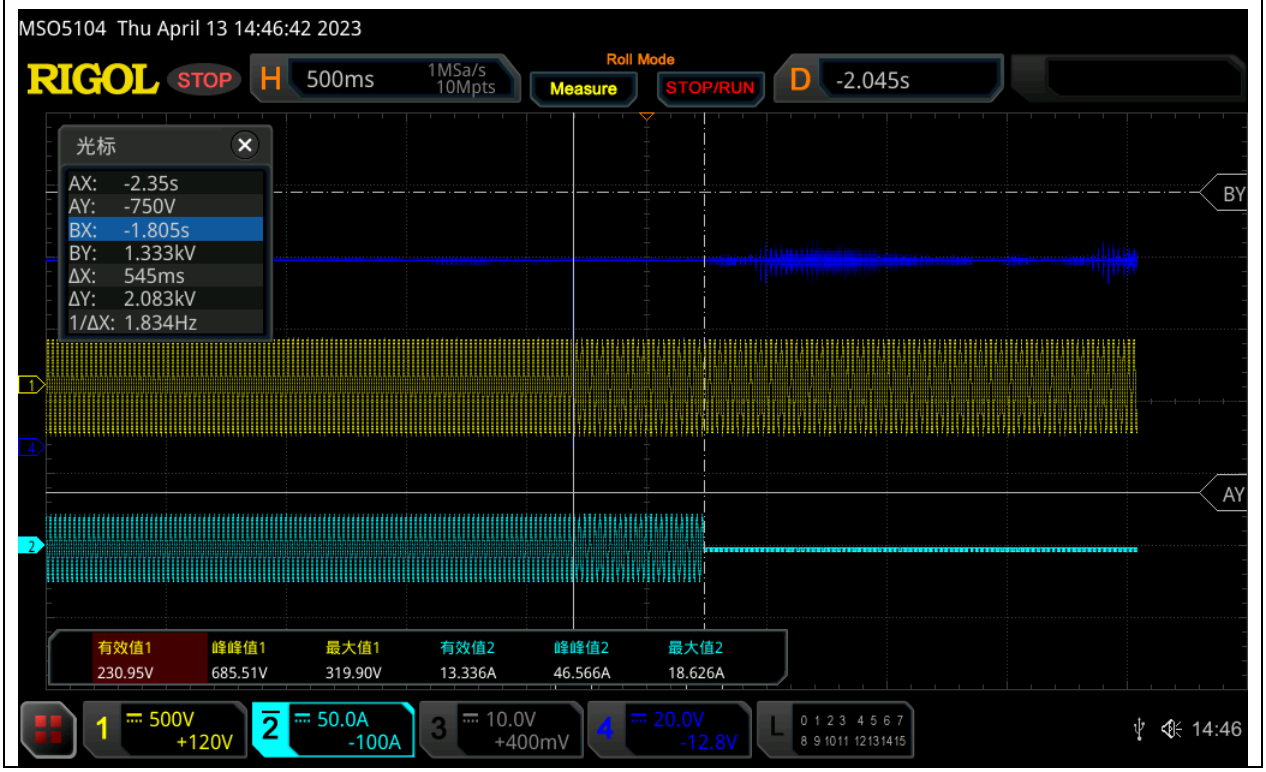
U/F stage 1-5


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

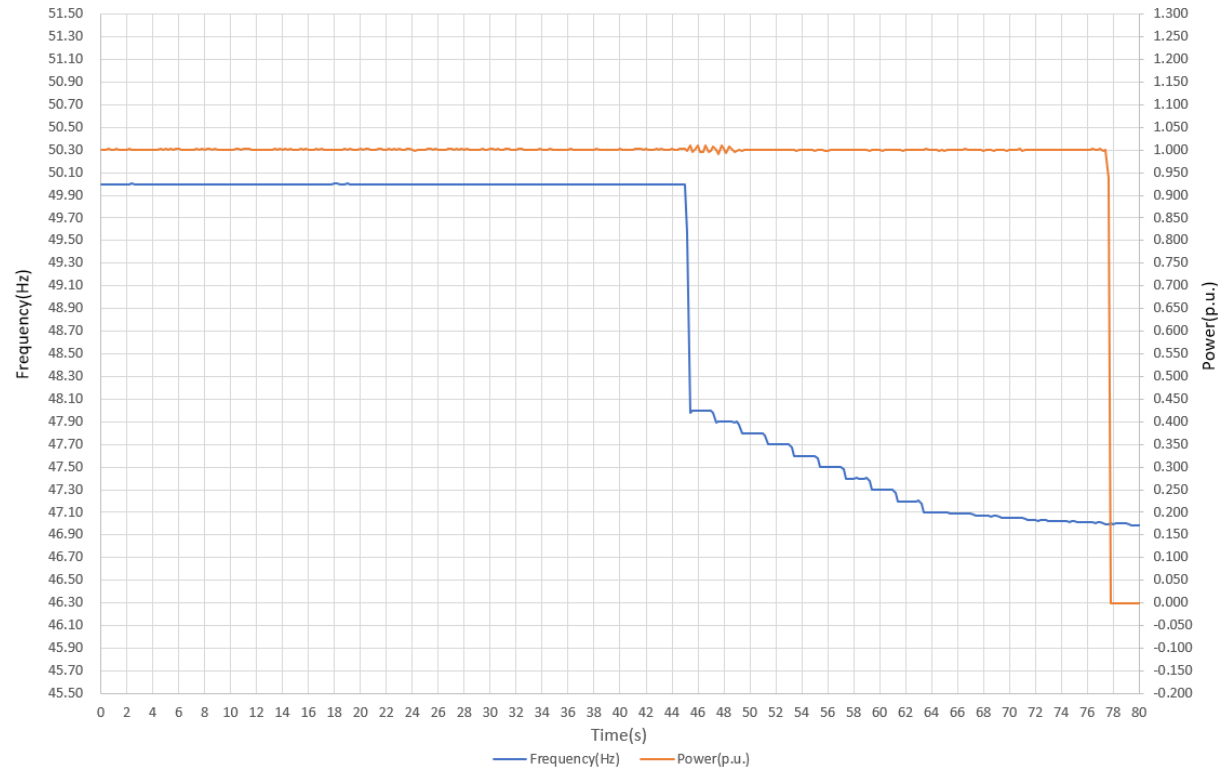

MSO5104 Thu April 13 14:39:29 2023
RIGOL
STOP
H 2.60s
200kSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -13.0s
光标
AX: -22.88s
AY: -750V
BX: -2.834s
BY: 1.333kV
ΔX: 20.04s
ΔY: 2.083kV
1/ΔX: 49.88mHz
BY
AY
BX
有效值1 231.59V
峰峰值1 685.51V
最大值1 319.90V
有效值2 15.775A
峰峰值2 46.566A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:38

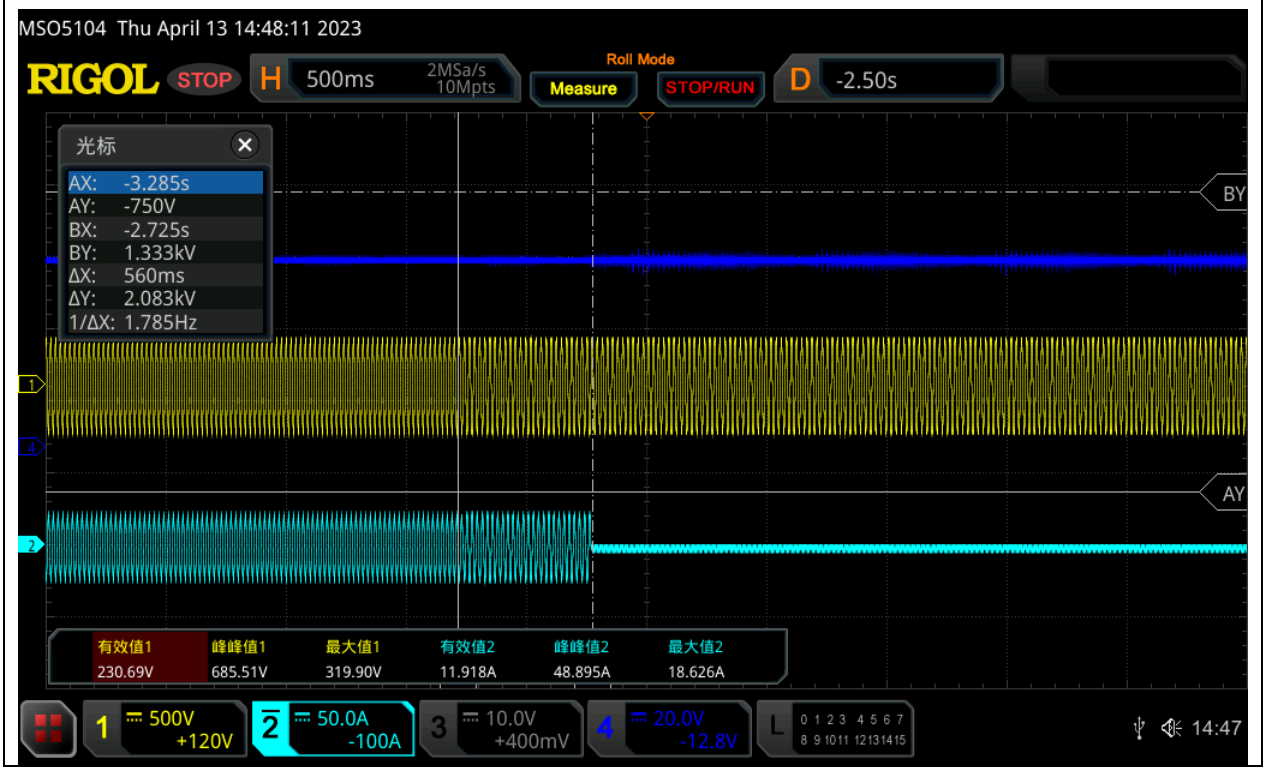
U/F stage 2-1


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

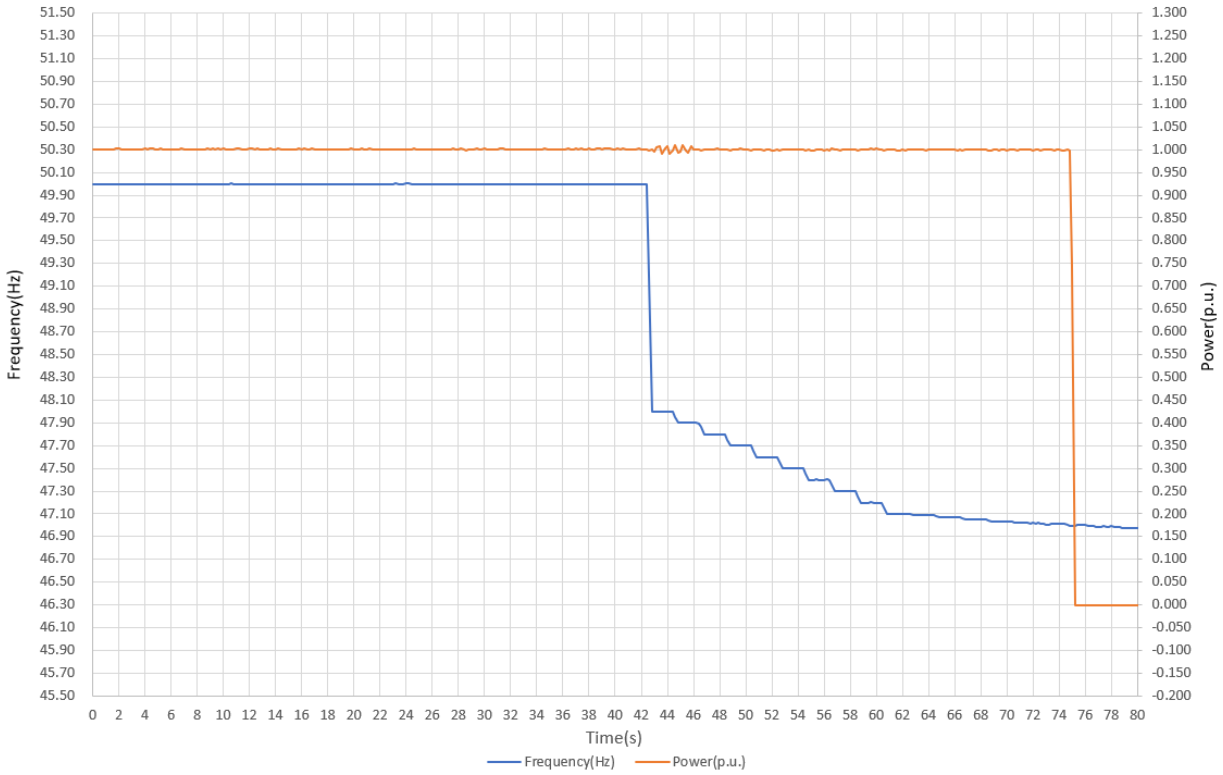

MSO5104 Thu April 13 14:46:42 2023
RIGOL
STOP
H 500ms
1MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.045s
光标
AX: -2.35s
AY: -750V
BX: -1.805s
BY: 1.333kV
ΔX: 545ms
ΔY: 2.083kV
1/ΔX: 1.834Hz
BY
AY
有效值1 230.95V
峰峰值1 685.51V
最大值1 319.90V
有效值2 13.336A
峰峰值2 46.566A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:46

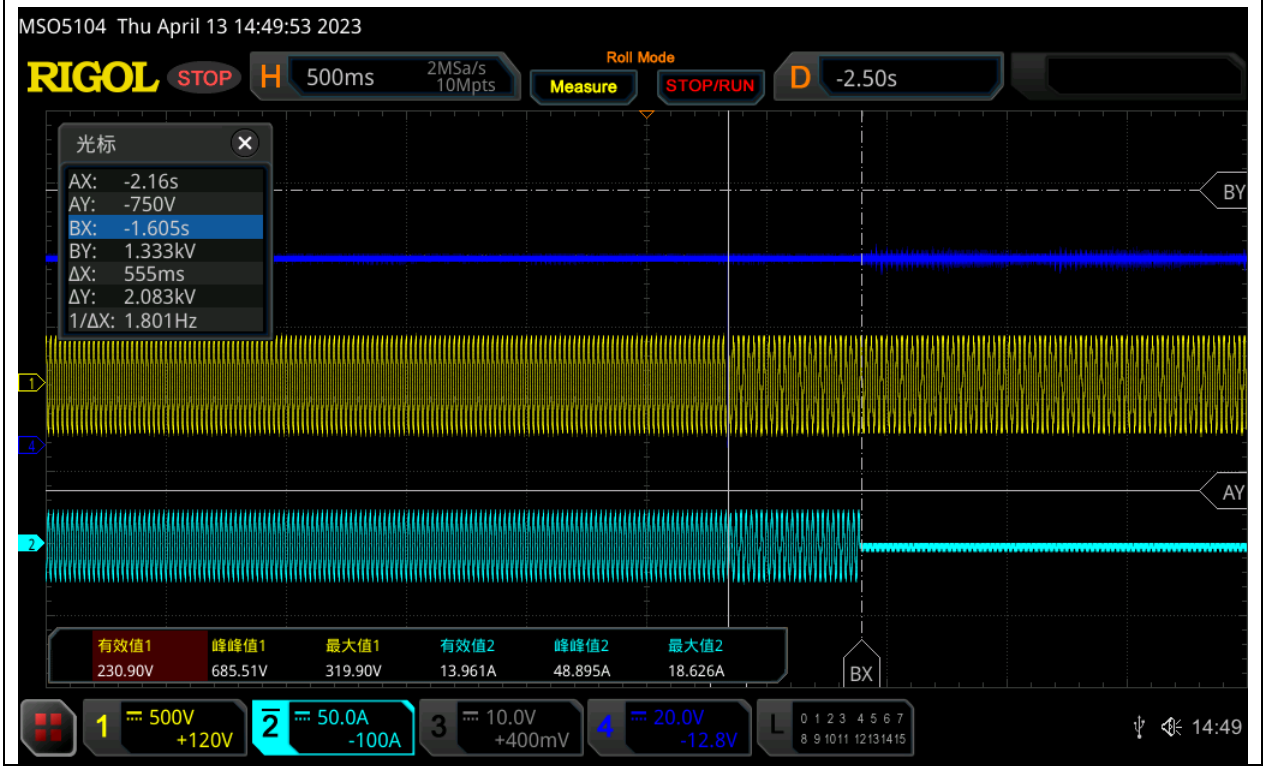
U/F stage 2-2


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

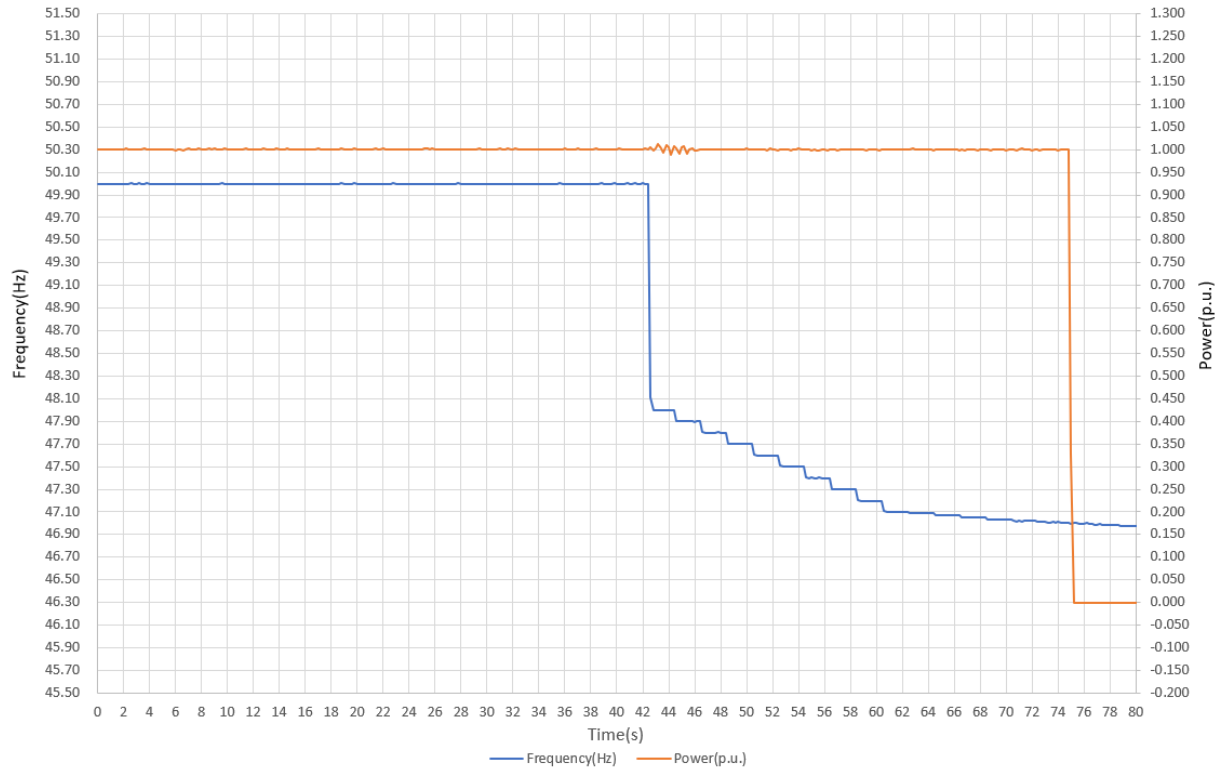

MSO5104 Thu April 13 14:48:11 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -3.285s
AY: -750V
BX: -2.725s
BY: 1.333kV
ΔX: 560ms
ΔY: 2.083kV
1/ΔX: 1.785Hz
BY
AY
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
230.69V 685.51V 319.90V 11.918A 48.895A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:47

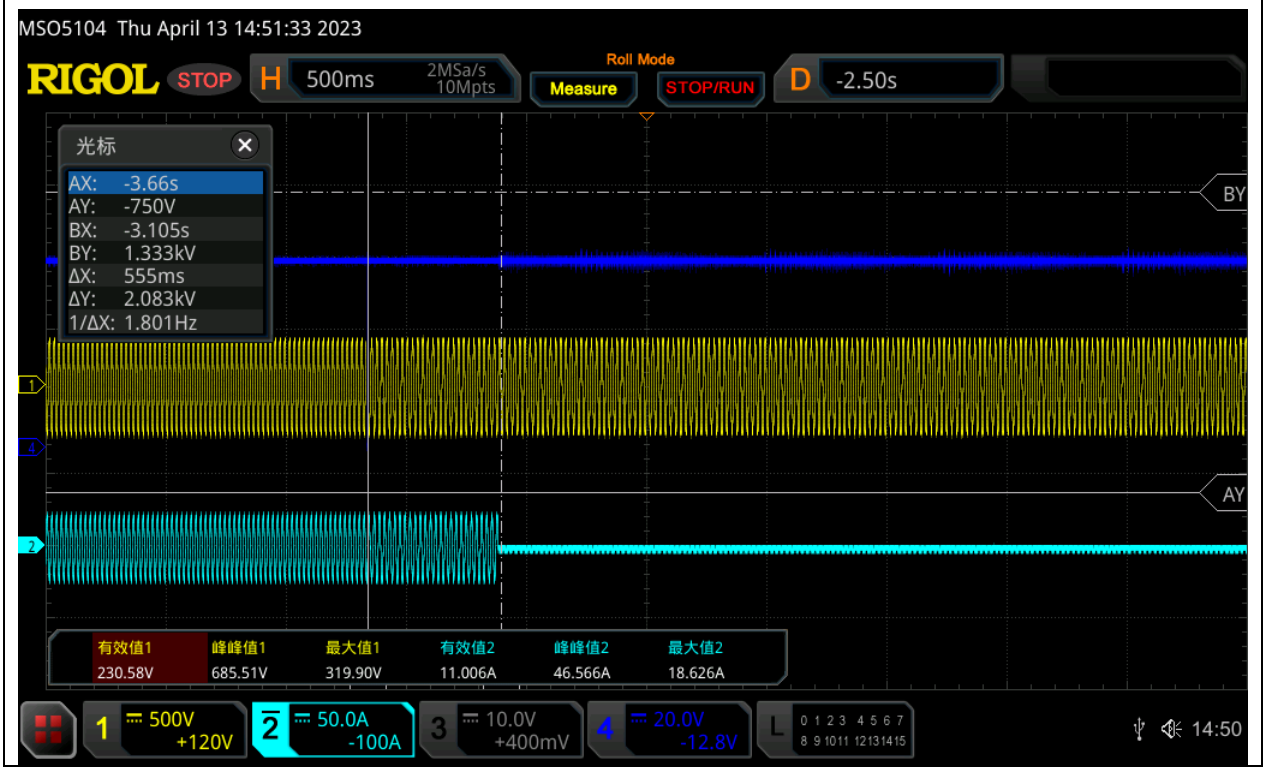
U/F stage 2-3


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

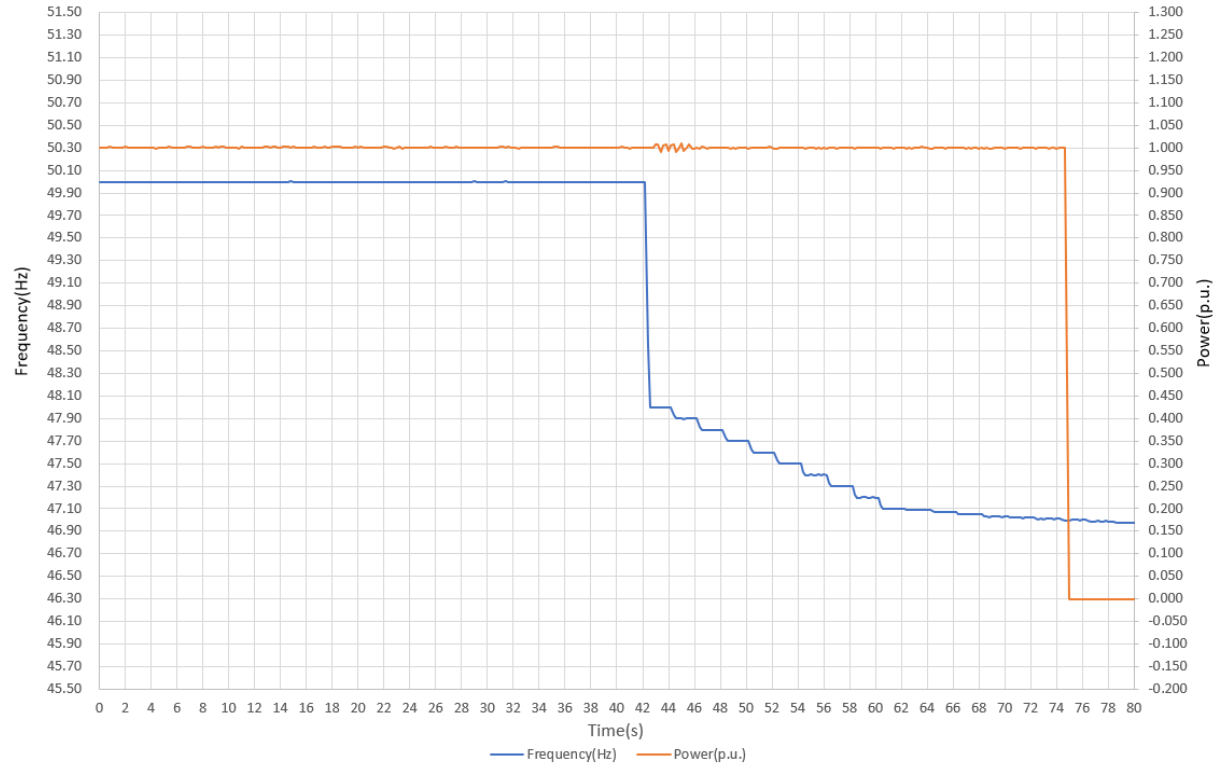

MSO5104 Thu April 13 14:49:53 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -2.16s
AY: -750V
BX: -1.605s
BY: 1.333kV
ΔX: 555ms
ΔY: 2.083kV
1/ΔX: 1.801Hz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
230.90V 685.51V 319.90V 13.961A 48.895A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:49

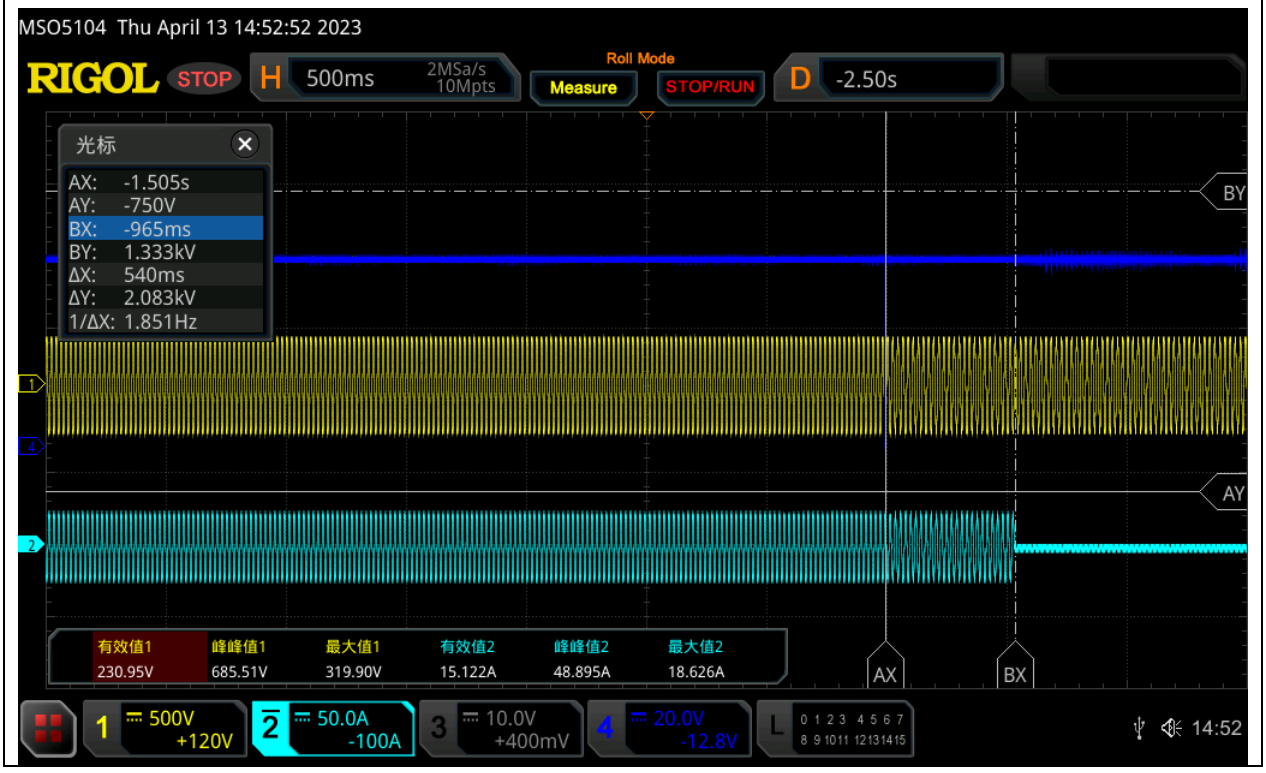
U/F stage 2-4


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

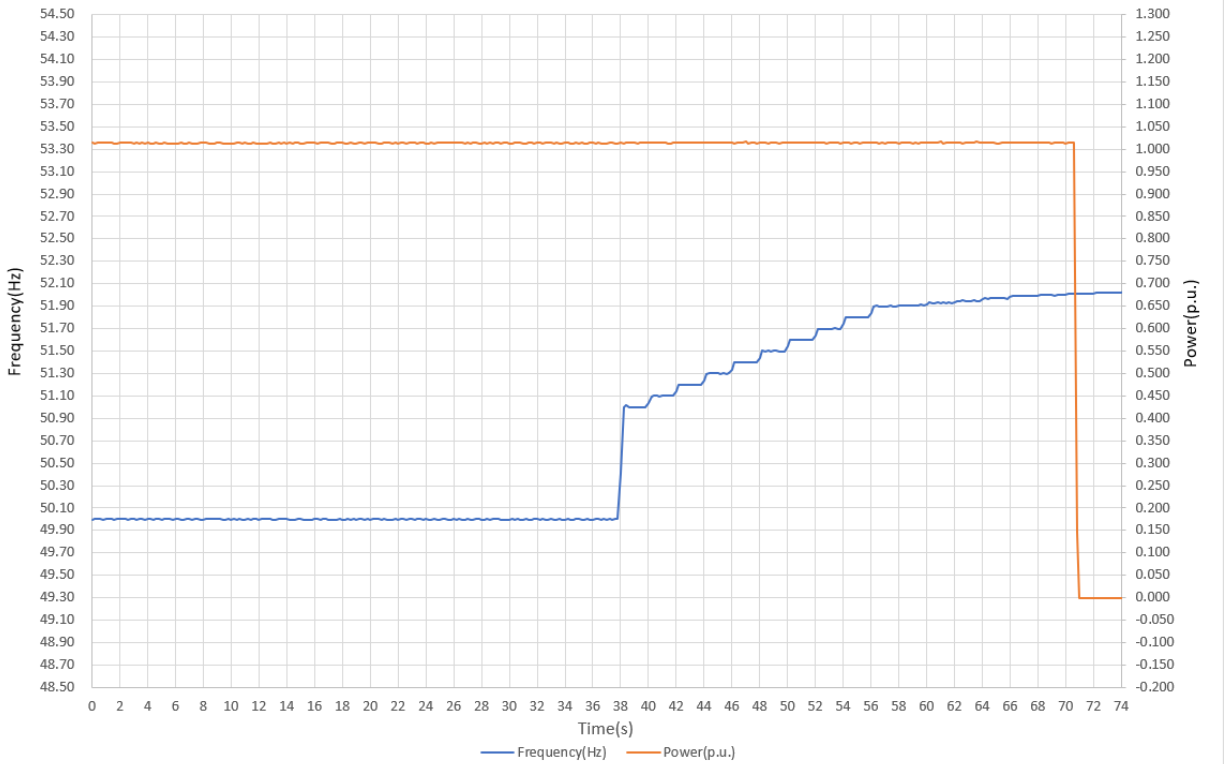

MSO5104 Thu April 13 14:51:33 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -3.66s
AY: -750V
BX: -3.105s
BY: 1.333kV
ΔX: 555ms
ΔY: 2.083kV
1/ΔX: 1.801Hz
BY
AY
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
230.58V 685.51V 319.90V 11.006A 46.566A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:50

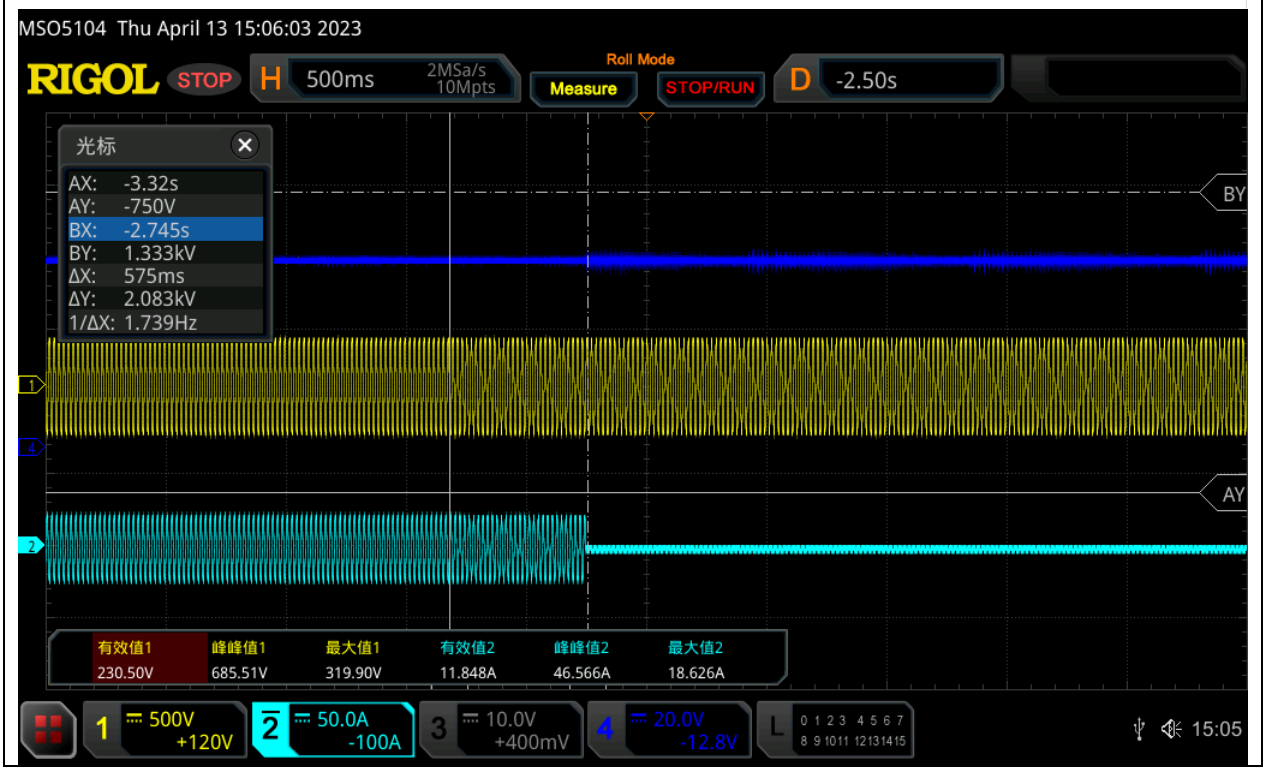
U/F stage 2-5


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

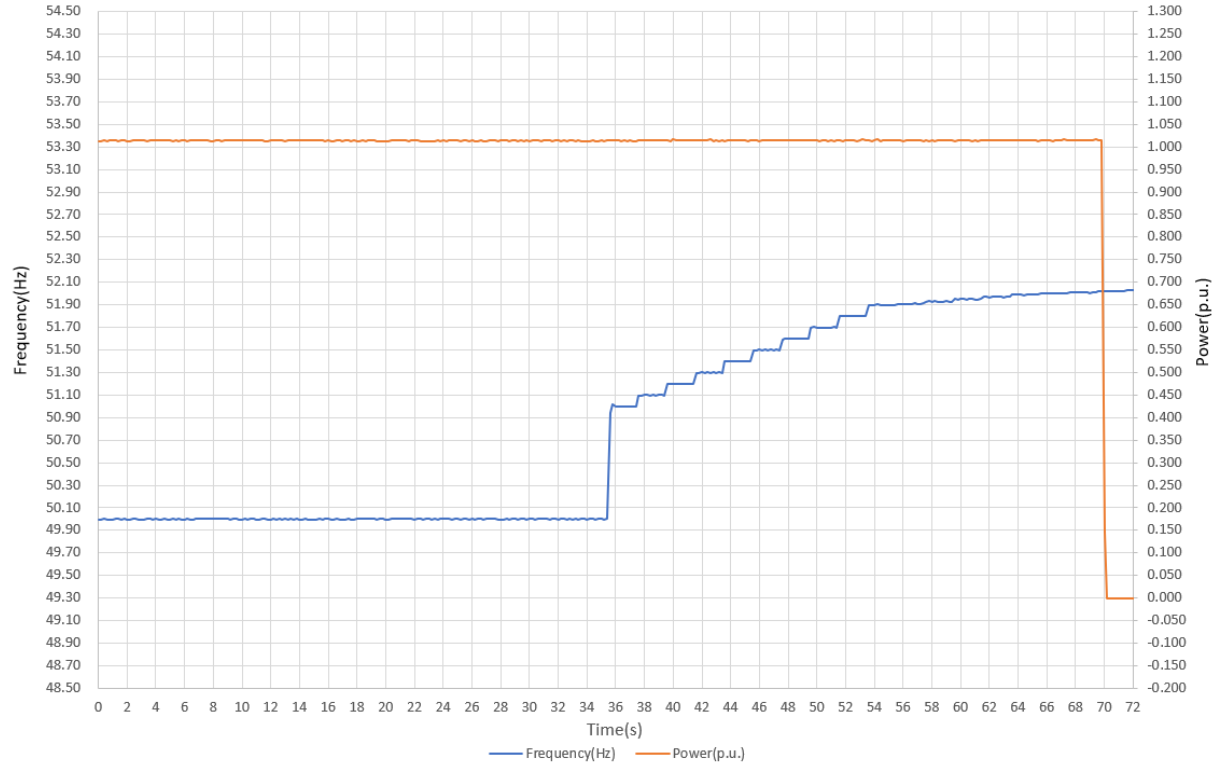

MSO5104 Thu April 13 14:52:52 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -1.505s
AY: -750V
BX: -965ms
BY: 1.333kV
ΔX: 540ms
ΔY: 2.083kV
1/ΔX: 1.851Hz
BY
AY
AX
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
230.95V 685.51V 319.90V 15.122A 48.895A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:52

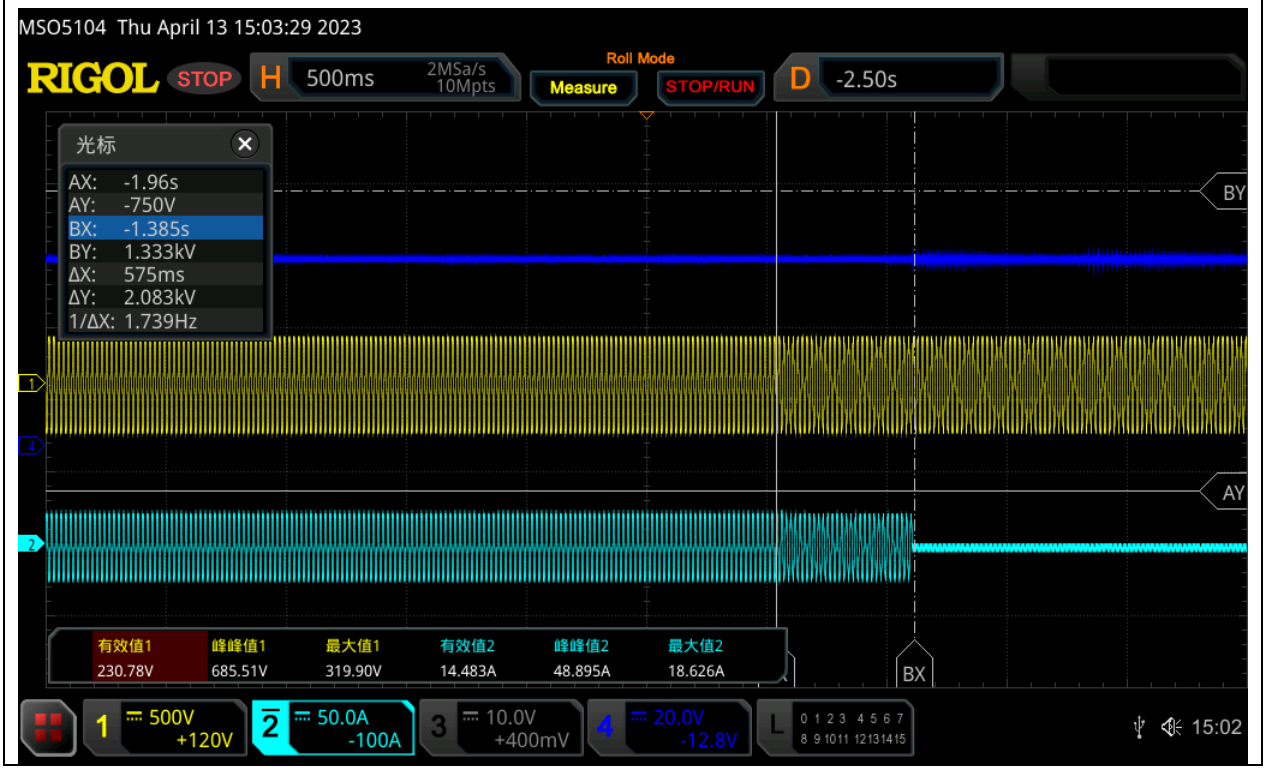
O/F stage 1-1


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

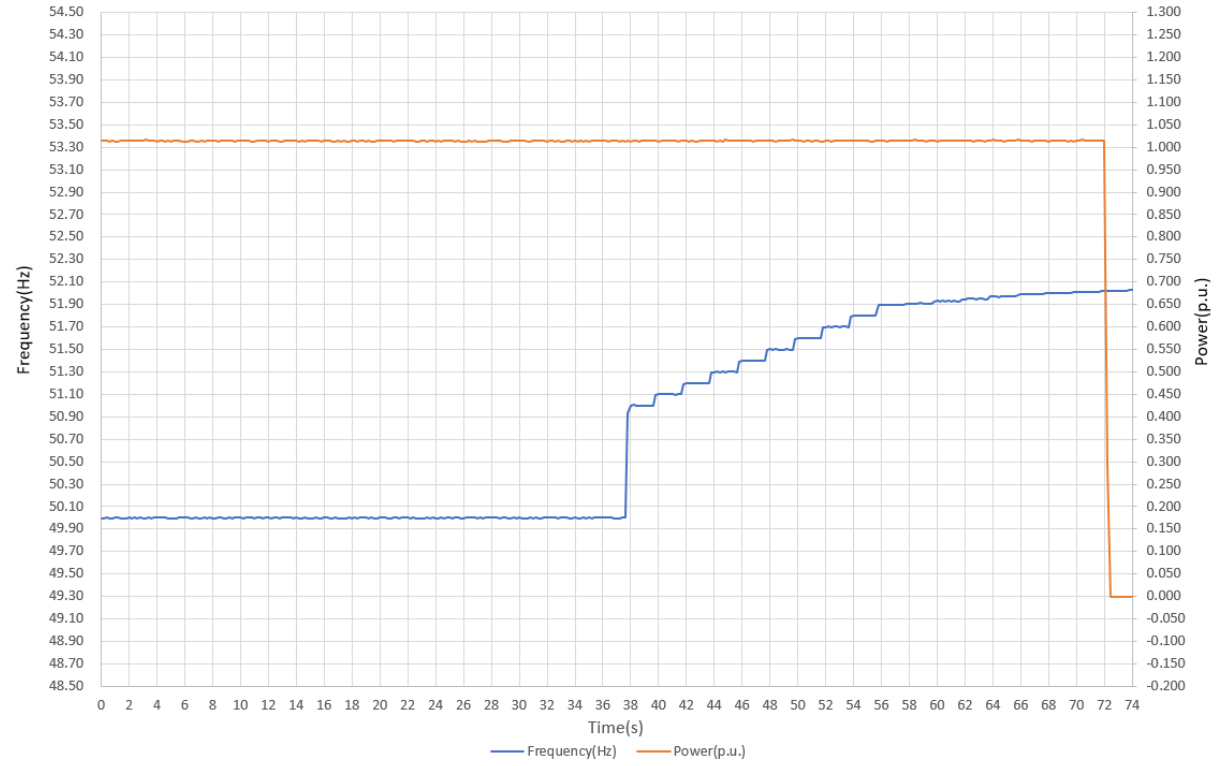

MSO5104 Thu April 13 15:06:03 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -3.32s
AY: -750V
BX: -2.745s
BY: 1.333kV
ΔX: 575ms
ΔY: 2.083kV
1/ΔX: 1.739Hz
BY
AY
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
230.50V 685.51V 319.90V 11.848A 46.566A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:05

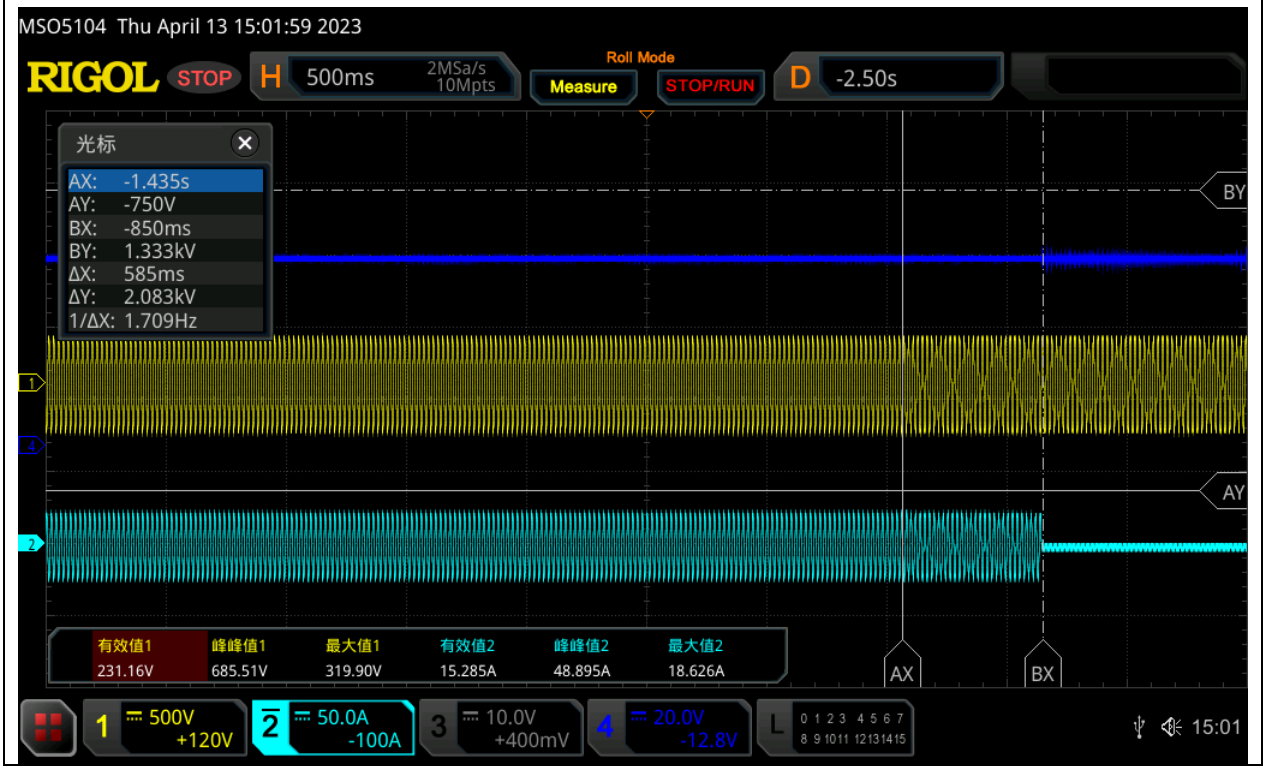
O/F stage 1-2


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

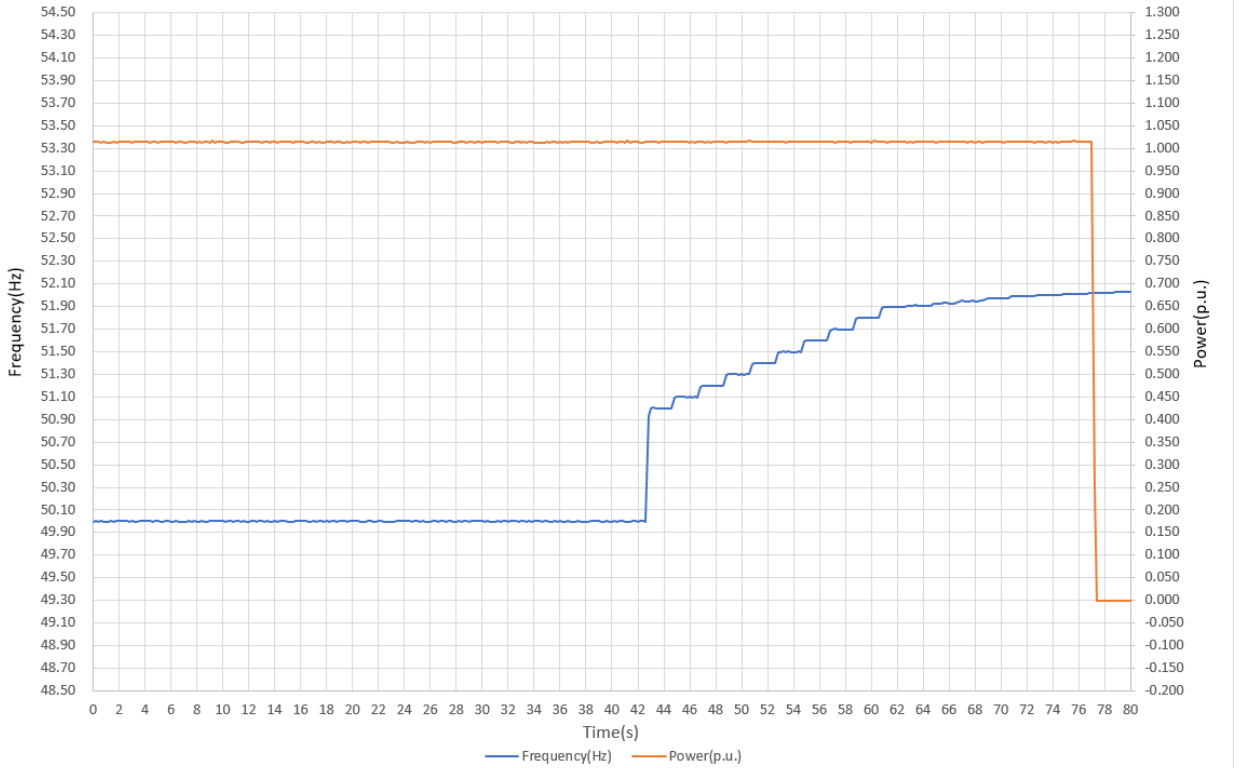

MSO5104 Thu April 13 15:03:29 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -1.96s
AY: -750V
BX: -1.385s
BY: 1.333kV
ΔX: 575ms
ΔY: 2.083kV
1/ΔX: 1.739Hz
BY
AY
BX
有效值1 230.78V
峰峰值1 685.51V
最大值1 319.90V
有效值2 14.483A
峰峰值2 48.895A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:02

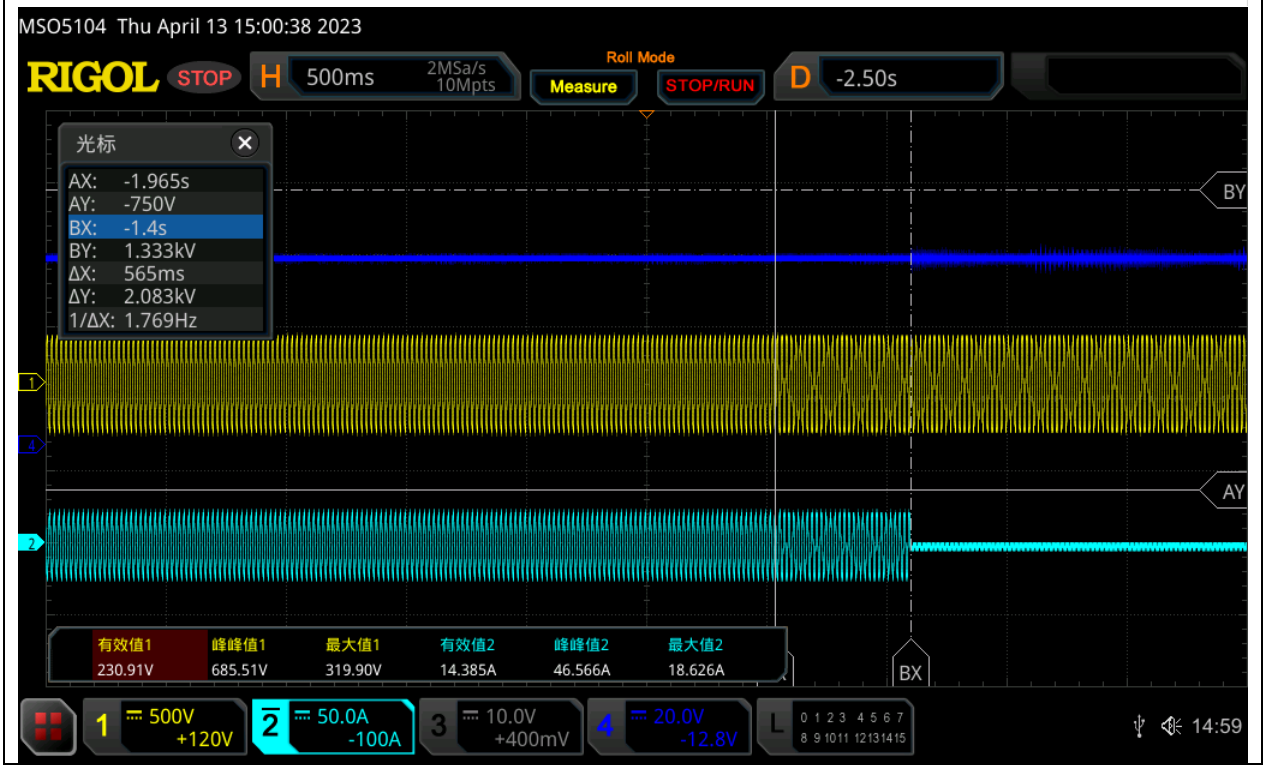
O/F stage 1-3


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

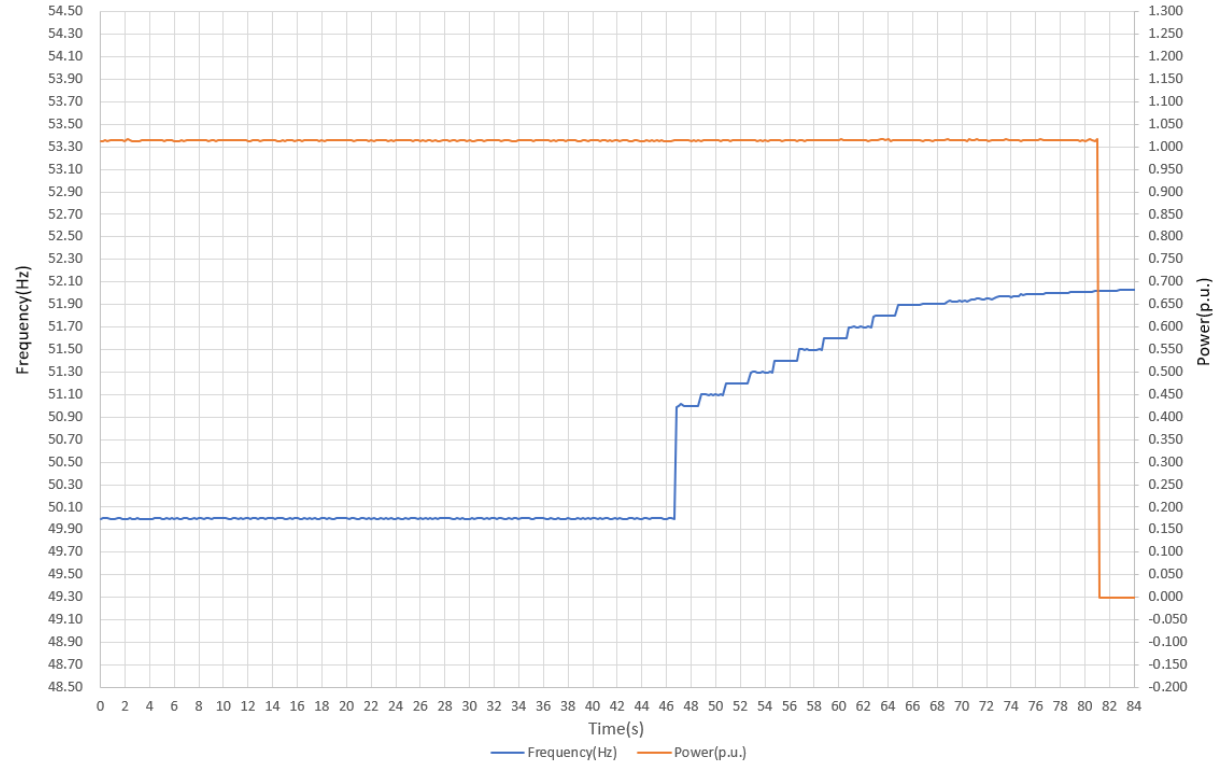

MSO5104 Thu April 13 15:01:59 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -1.435s
AY: -750V
BX: -850ms
BY: 1.333kV
ΔX: 585ms
ΔY: 2.083kV
1/ΔX: 1.709Hz
BY
AY
AX
BX
有效值1 231.16V
峰峰值1 685.51V
最大值1 319.90V
有效值2 15.285A
峰峰值2 48.895A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:01

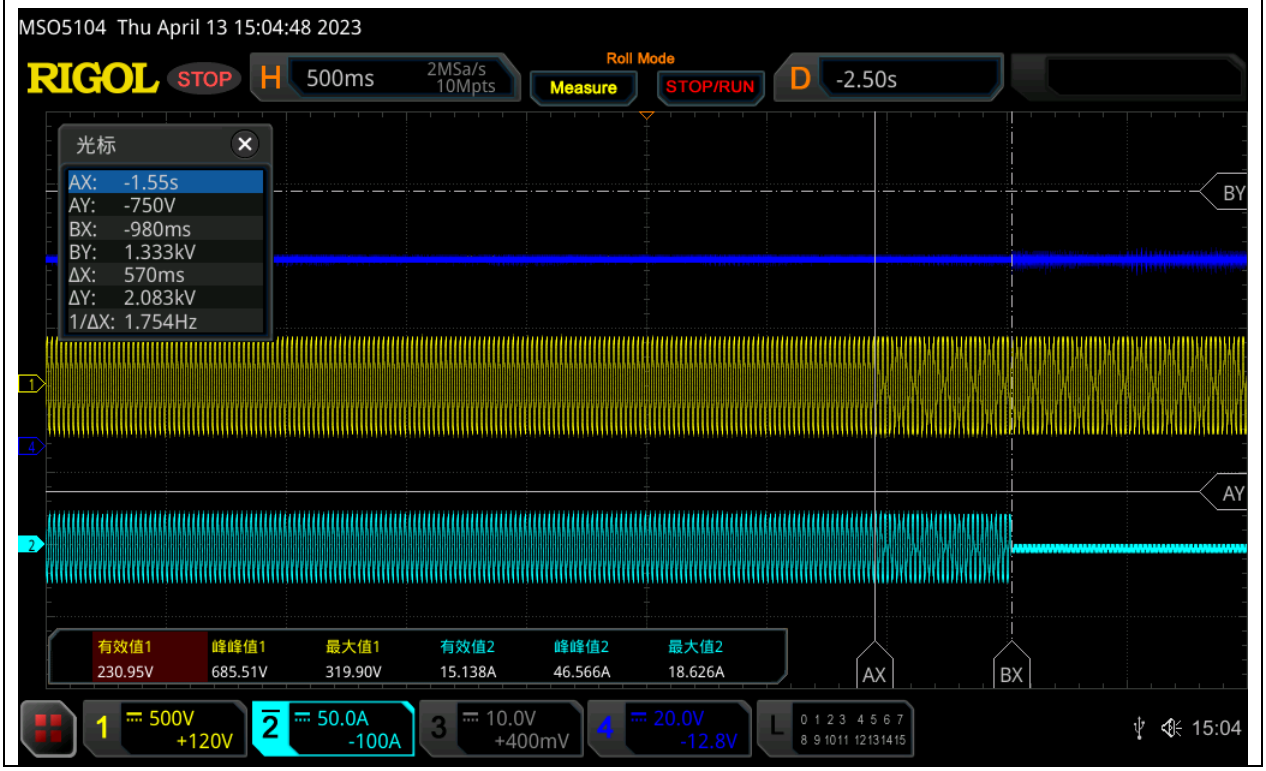
O/F stage 1-4


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

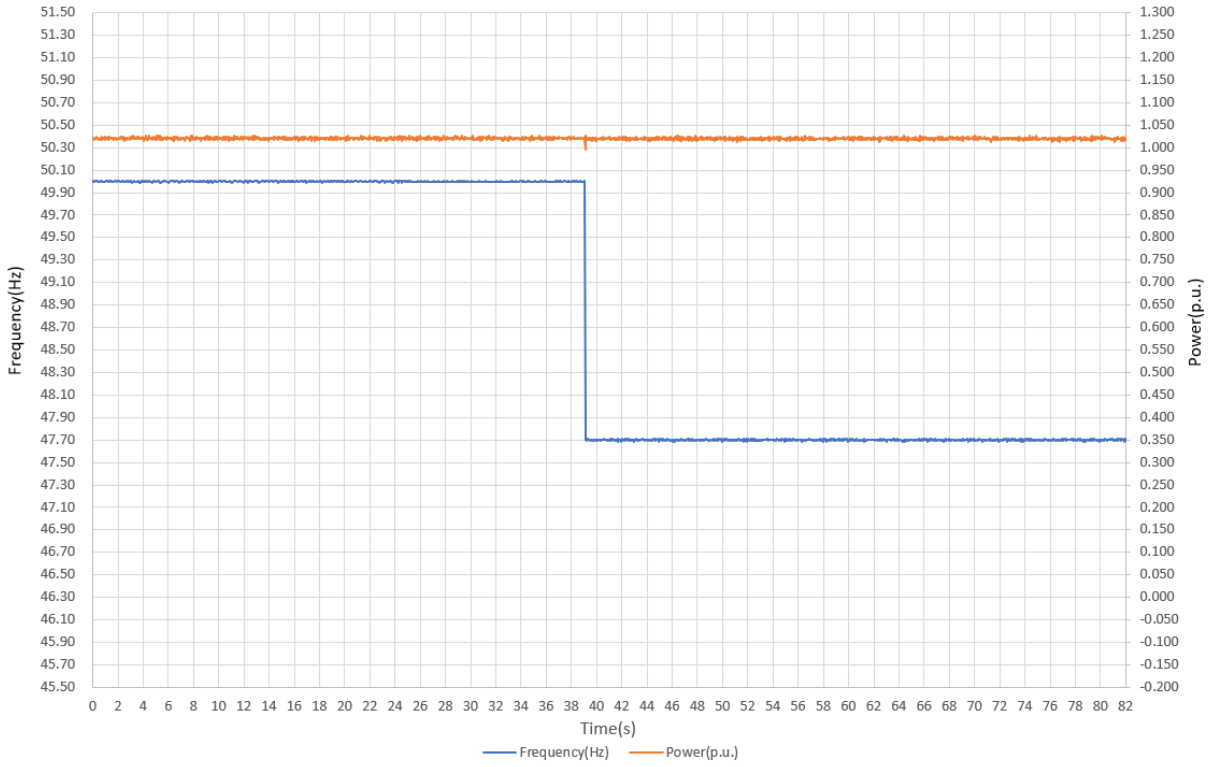

MSO5104 Thu April 13 15:00:38 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -1.965s
AY: -750V
BX: -1.4s
BY: 1.333kV
ΔX: 565ms
ΔY: 2.083kV
1/ΔX: 1.769Hz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
230.91V 685.51V 319.90V 14.385A 46.566A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
14:59

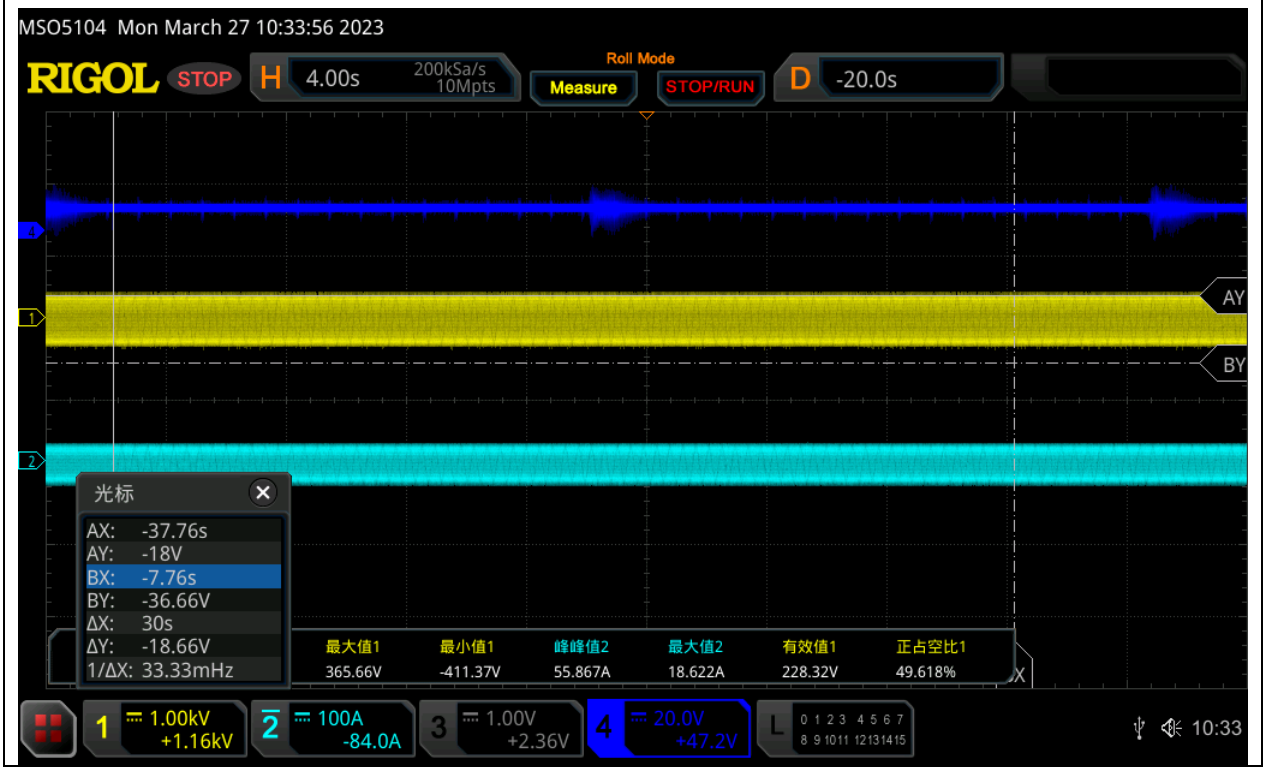
O/F stage 1-5


Frequency(Hz)
Power(p.u.)
Time(s)
Frequency(Hz)
Power(p.u.)

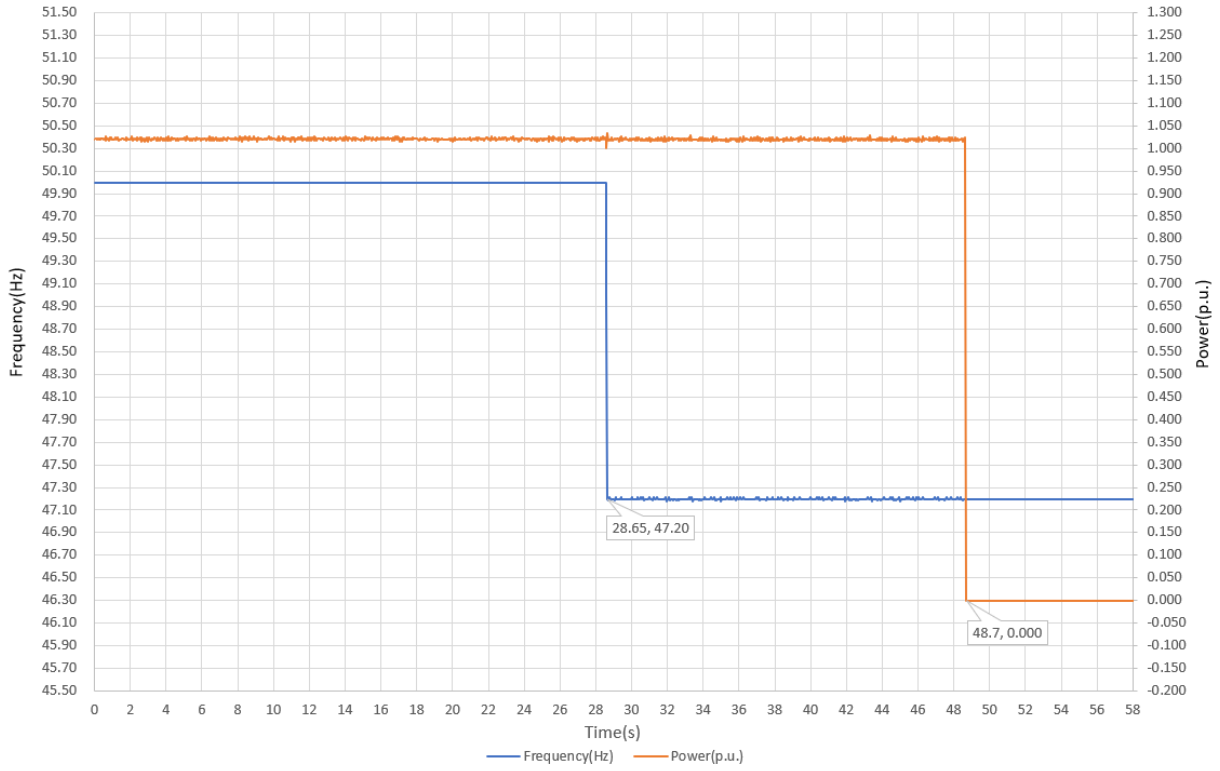

MSO5104 Thu April 13 15:04:48 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -1.55s
AY: -750V
BX: -980ms
BY: 1.333kV
ΔX: 570ms
ΔY: 2.083kV
1/ΔX: 1.754Hz
BY
AY
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
230.95V 685.51V 319.90V 15.138A 46.566A 18.626A
AX
BX
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:04

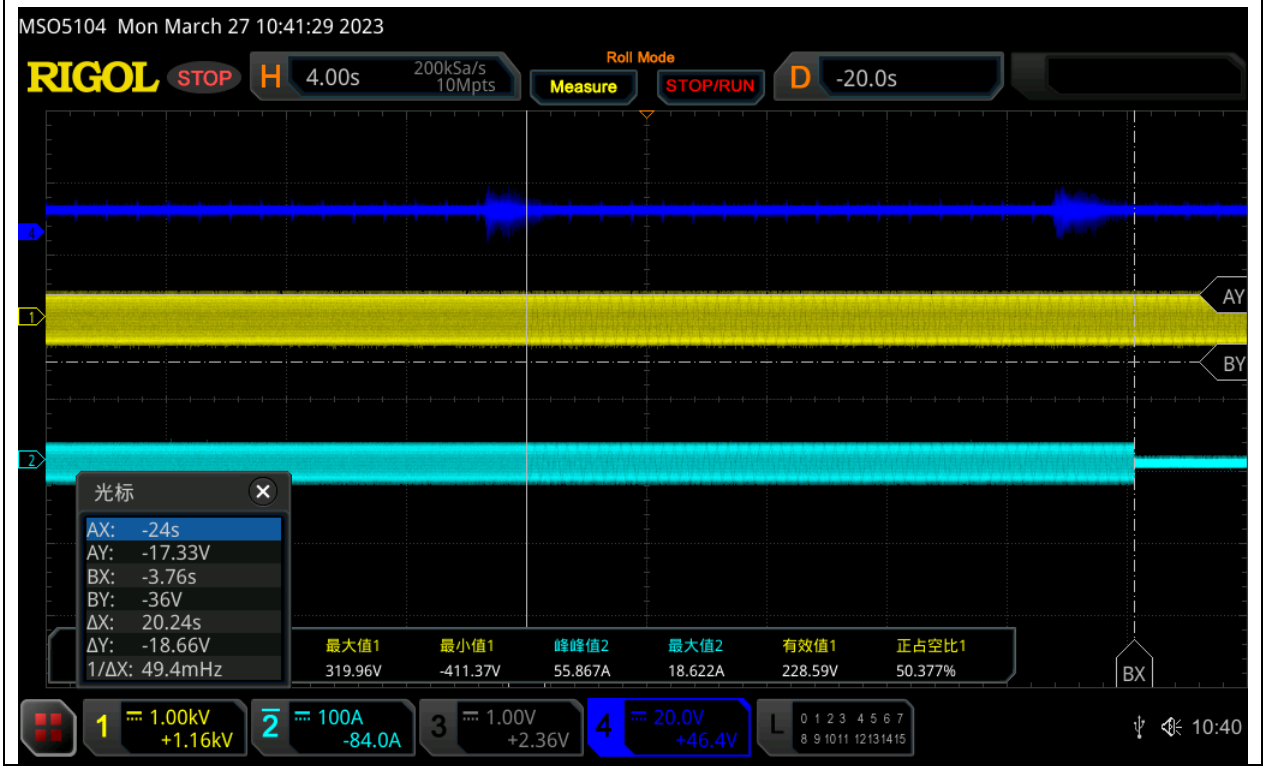
No trip tests - 47.7Hz



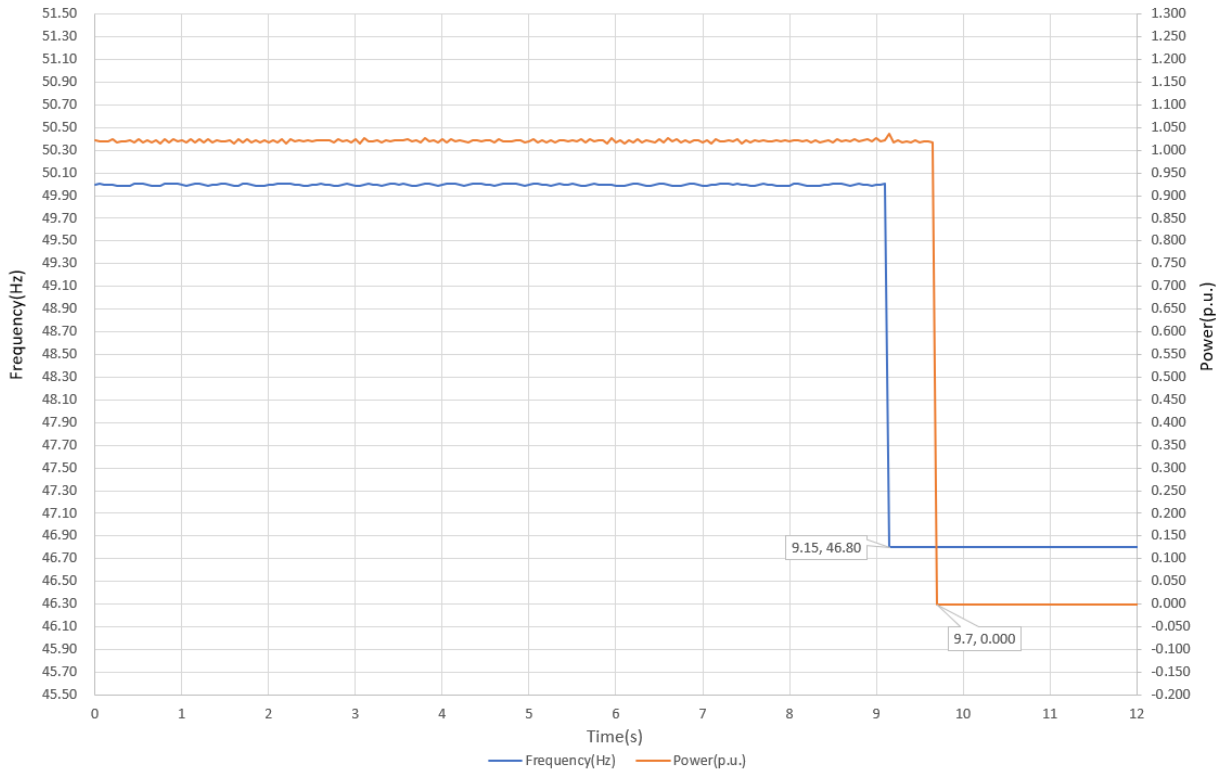


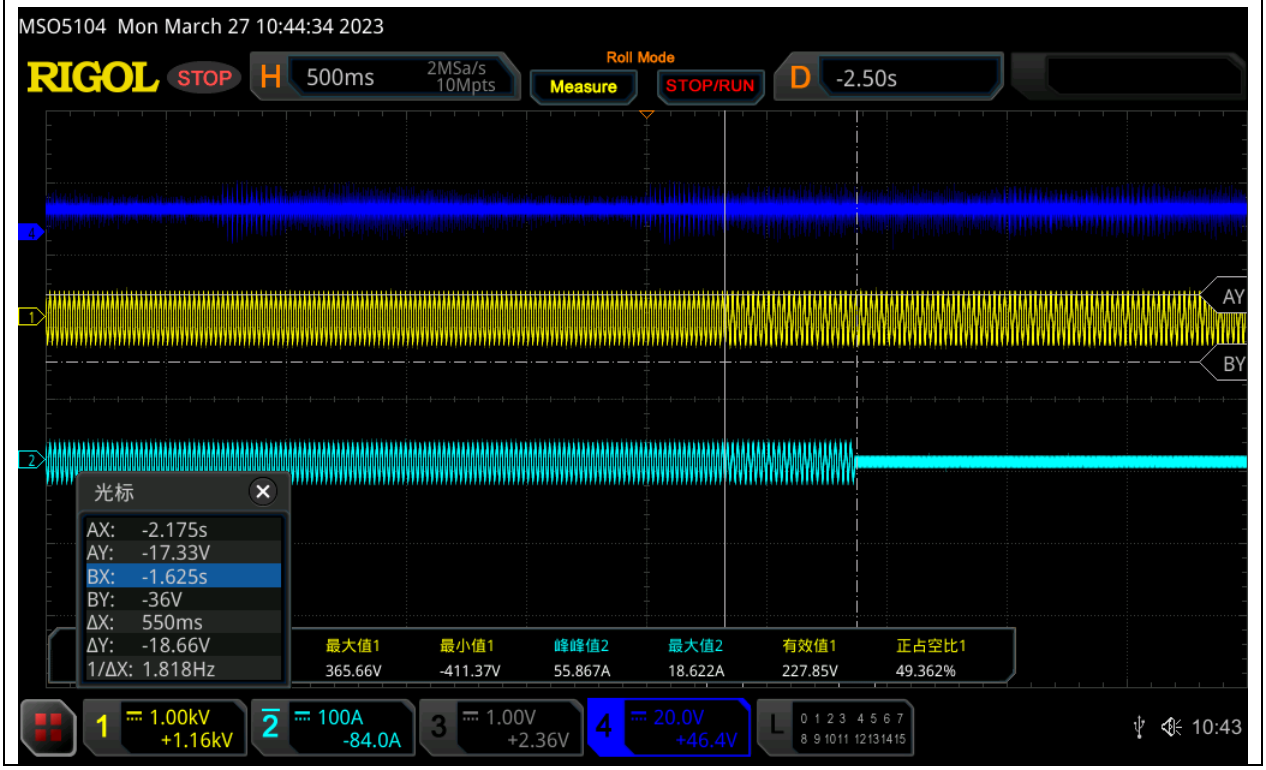
No trip tests – 47.2Hz



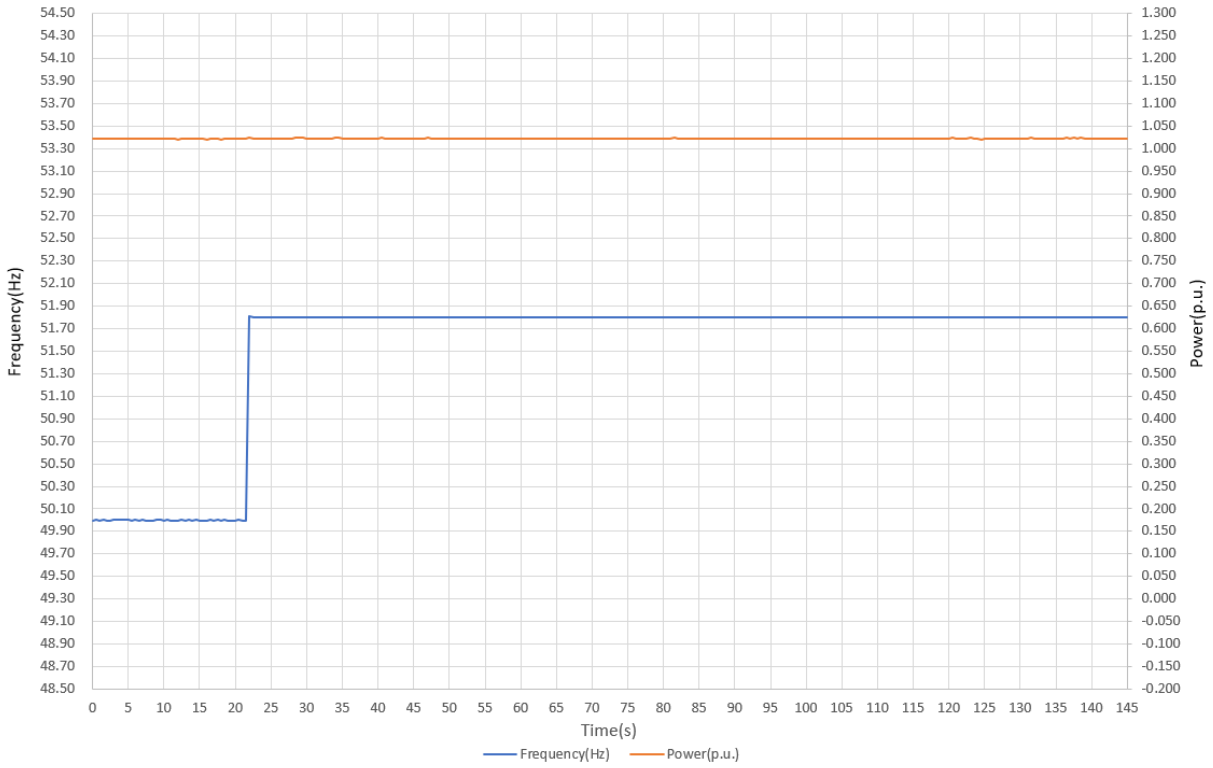


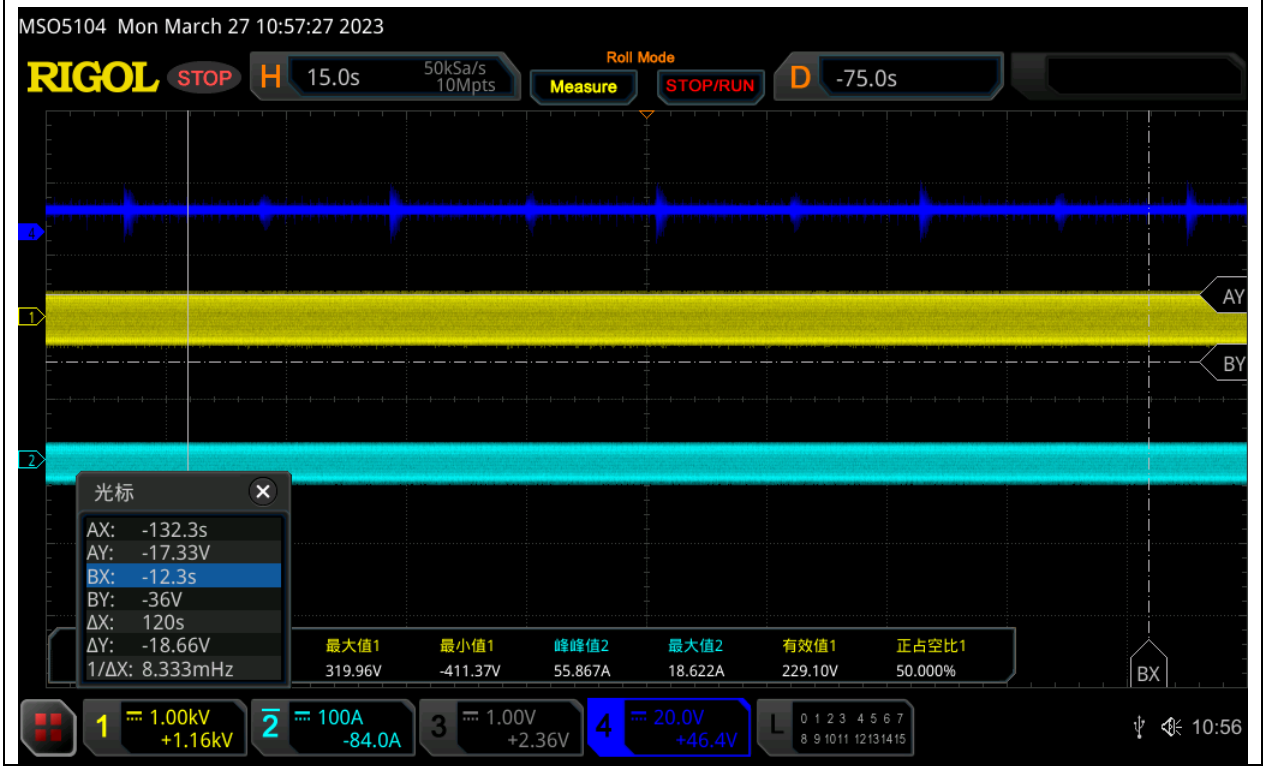
No trip tests – 46.8Hz



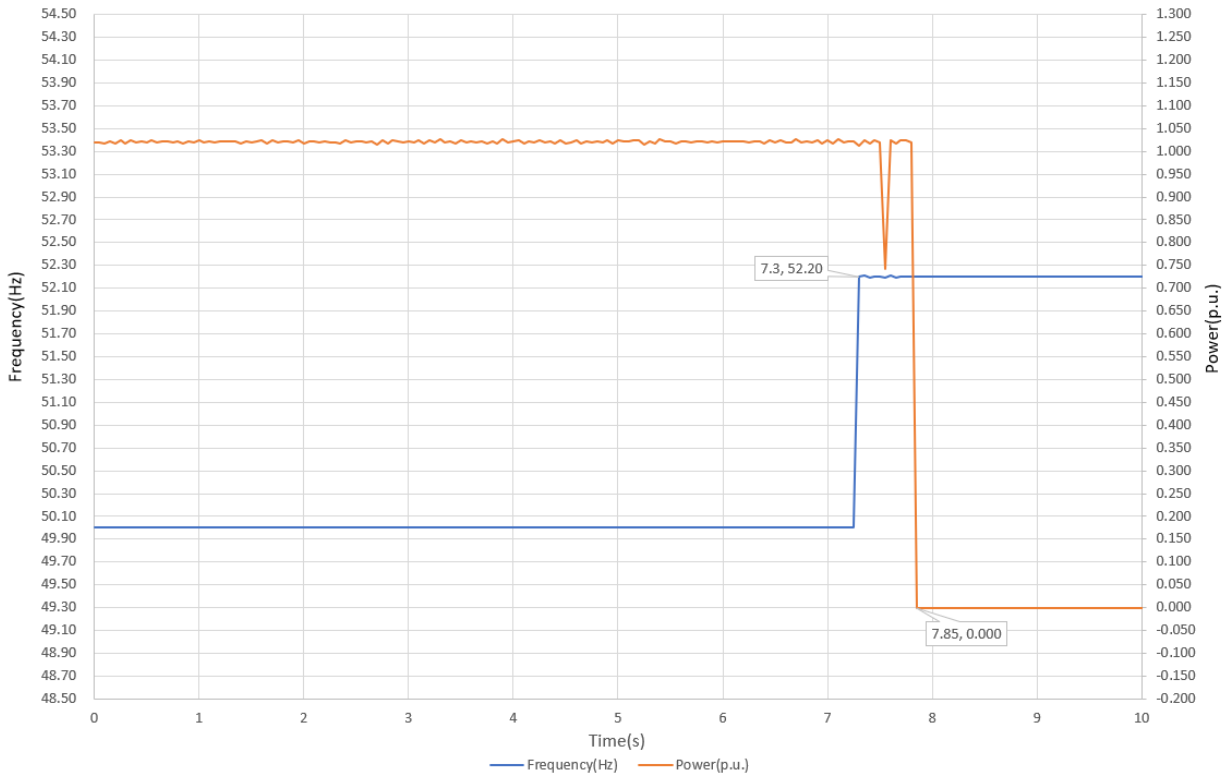


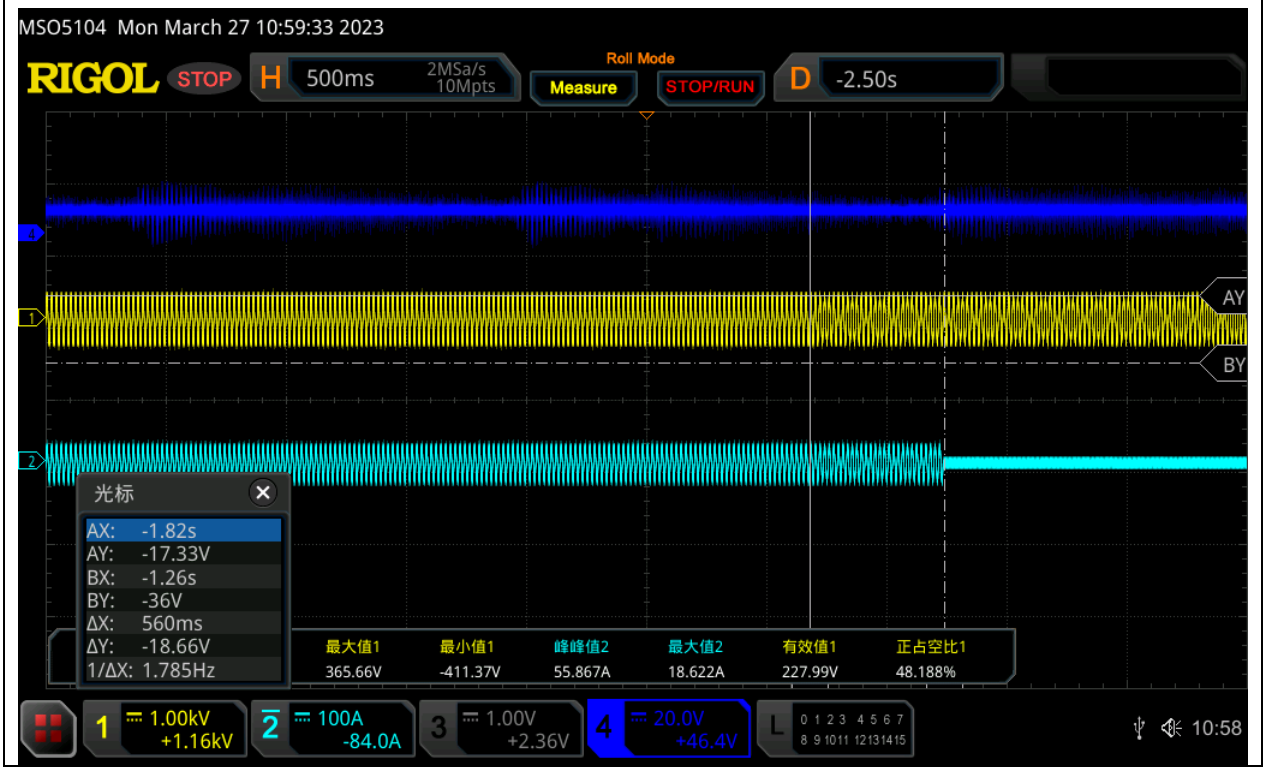
No trip tests - 51.8Hz





No trip tests – 52.2Hz





4.3.2 Voltage tests

To establish the certified trip voltage, the test voltage should be applied in steps of ± 0.5% of setting for a duration that is longer than the trip time delay.

To establish the certified trip time, the test voltage should be applied starting from ± 1.8% below the certified trip voltage in a step of at least ± 0.5% of setting for a duration that is longer than the trip time delay. For each trip setting five tests shall be carried out.

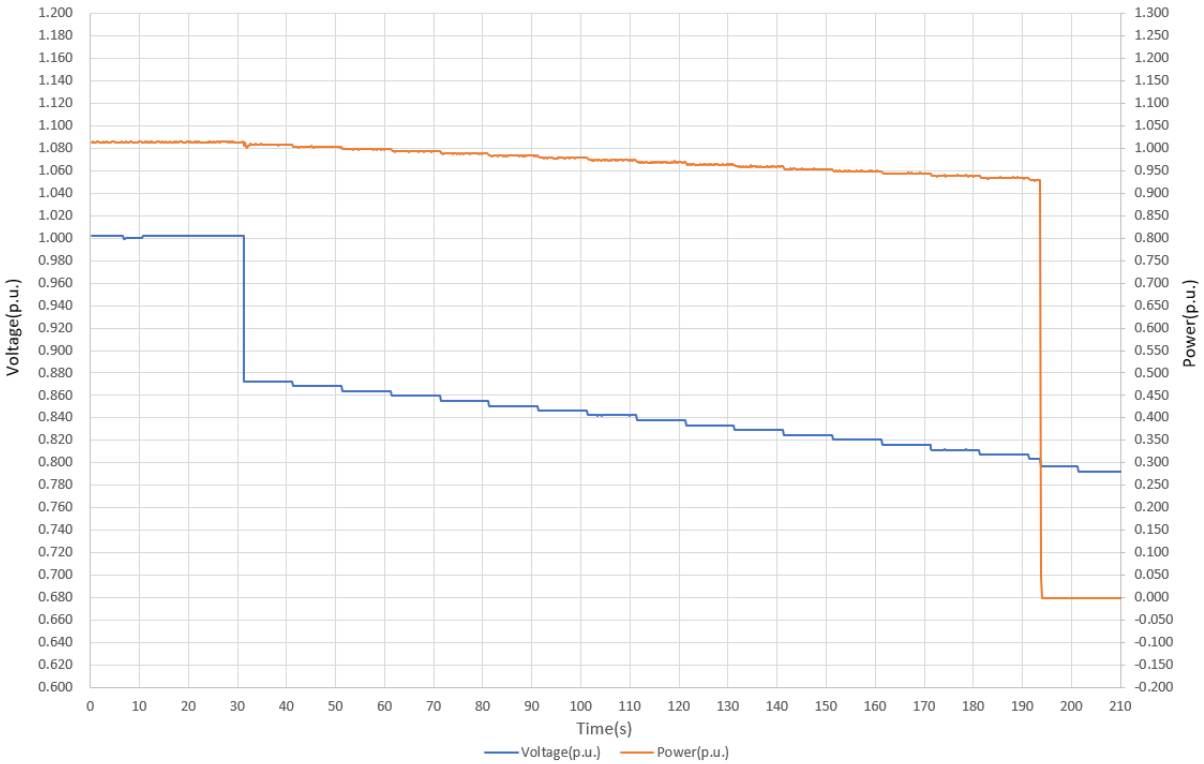
Following tables show the test results:

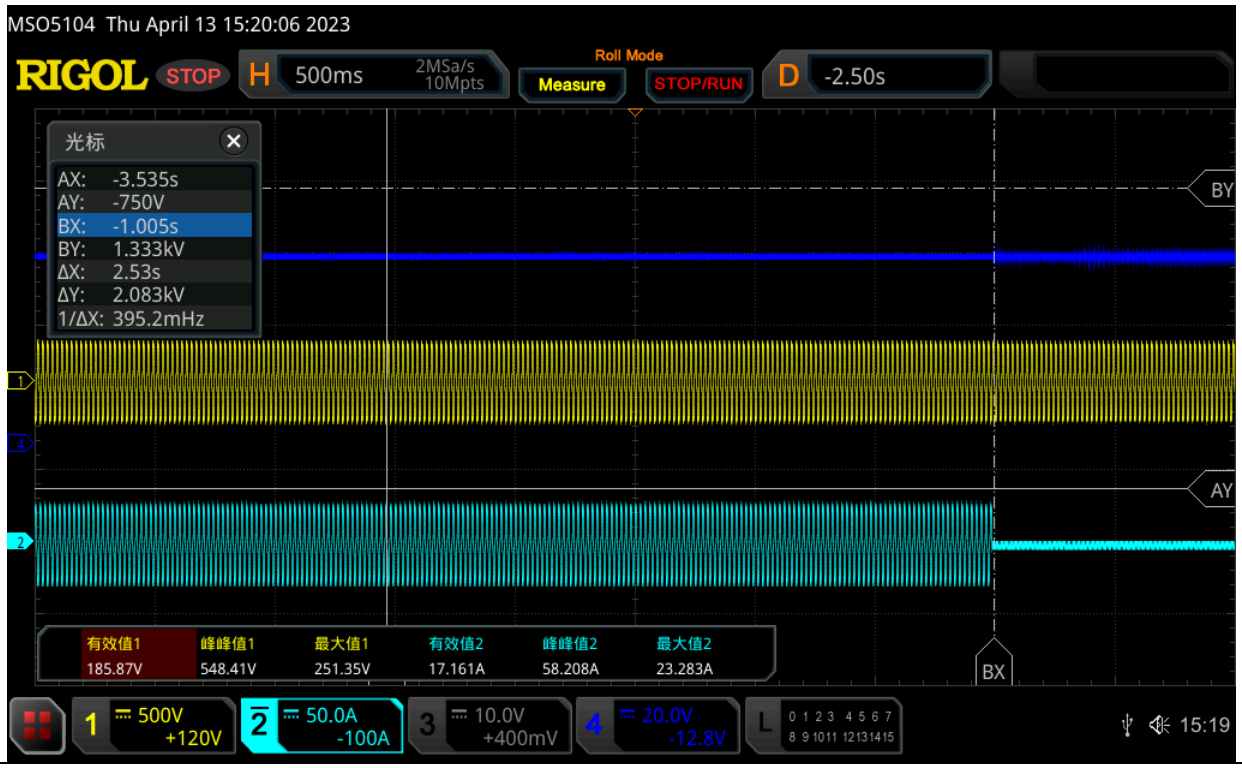
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage (V)	Time delay (s)	Voltage /time	Confirm no trip
U/V	184 V	2.5 s	184.17	2.530	188 V / 5.00 s	Pass
			184.37	2.535		
			184.35	2.505		
			184.16	2.530		
			184.23	2.510		
					180 V / 2.45 s	Pass
O/V stage 1	262.2 V	1.0 s	261.82	1.060	258.2 V / 5.00 s	Pass
			262.03	1.055		
			262.17	1.055		
			262.13	1.045		
			262.35	1.055		
O/V stage 2	273.7 V	0.5 s	274.34	0.555	269.7 V / 0.95 s	Pass
			274.98	0.585		
			273.91	0.570		
			273.84	0.555		
			274.05	0.560		
					277.7 V / 0.45 s	Pass

Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

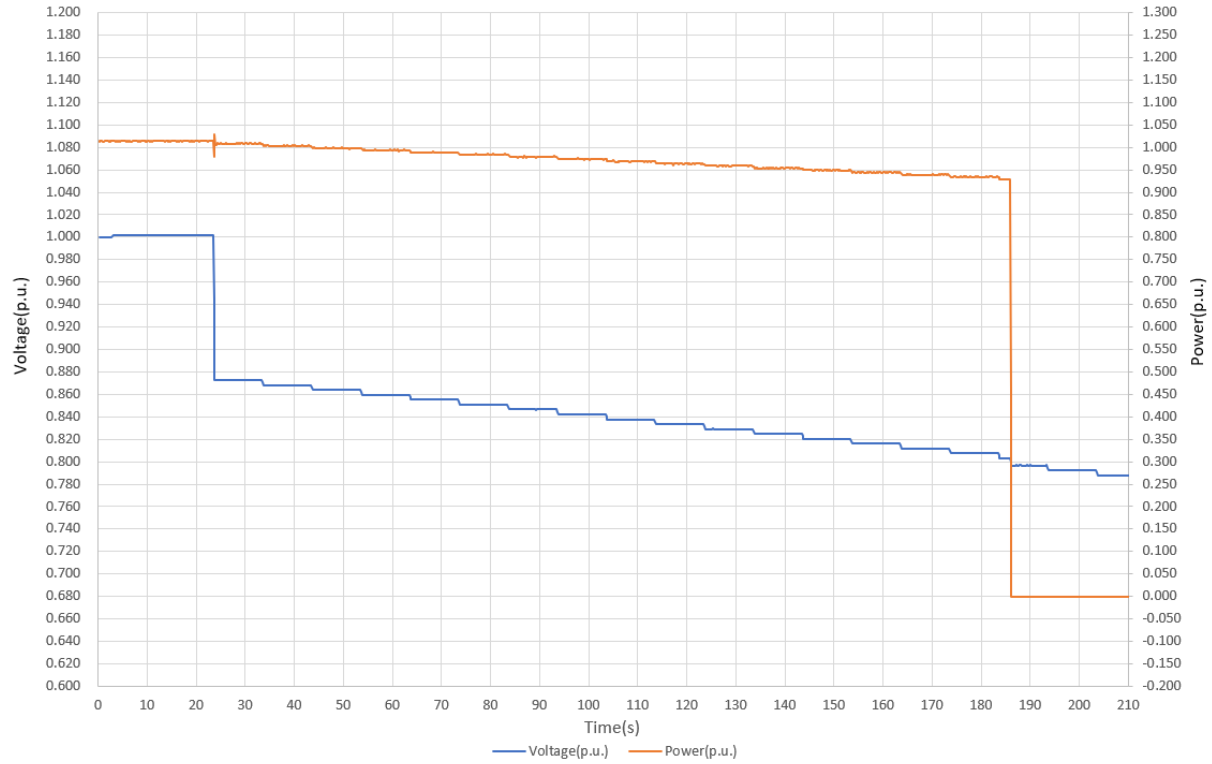
Test results are graphically shown in following pages.

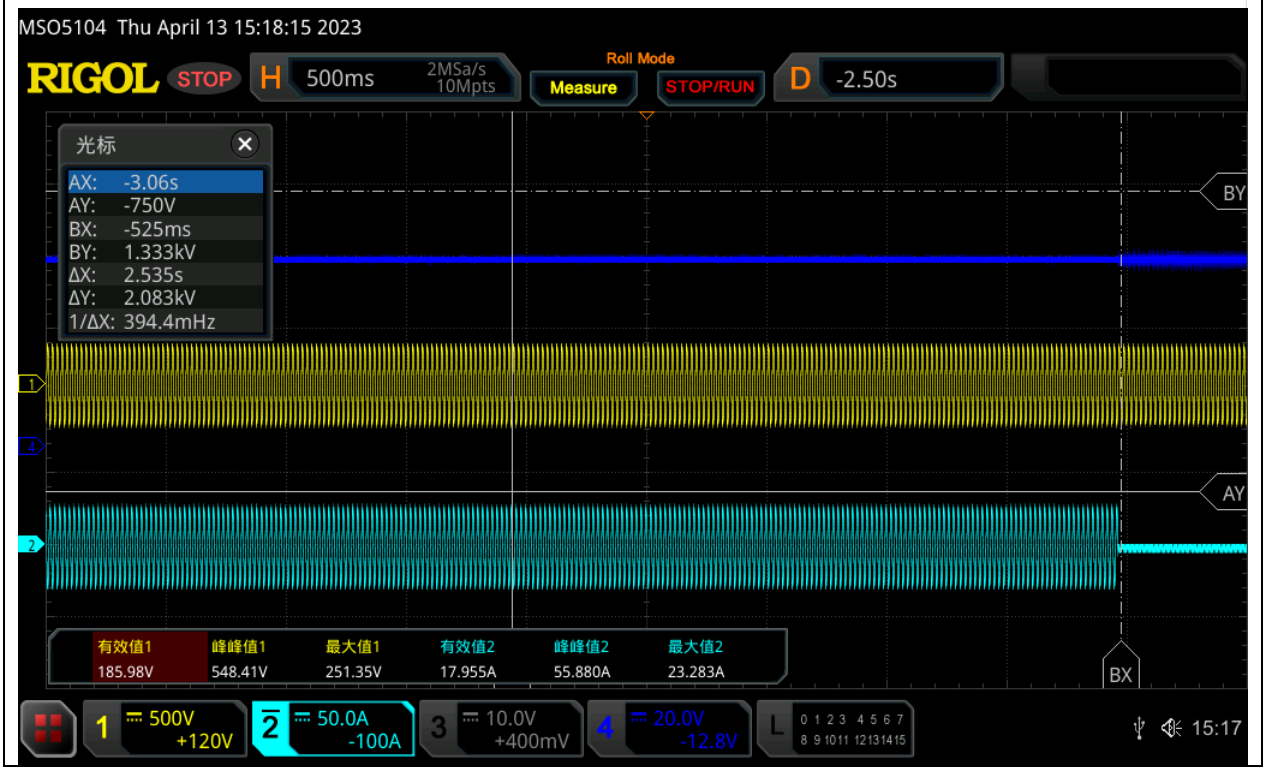
U/V -1



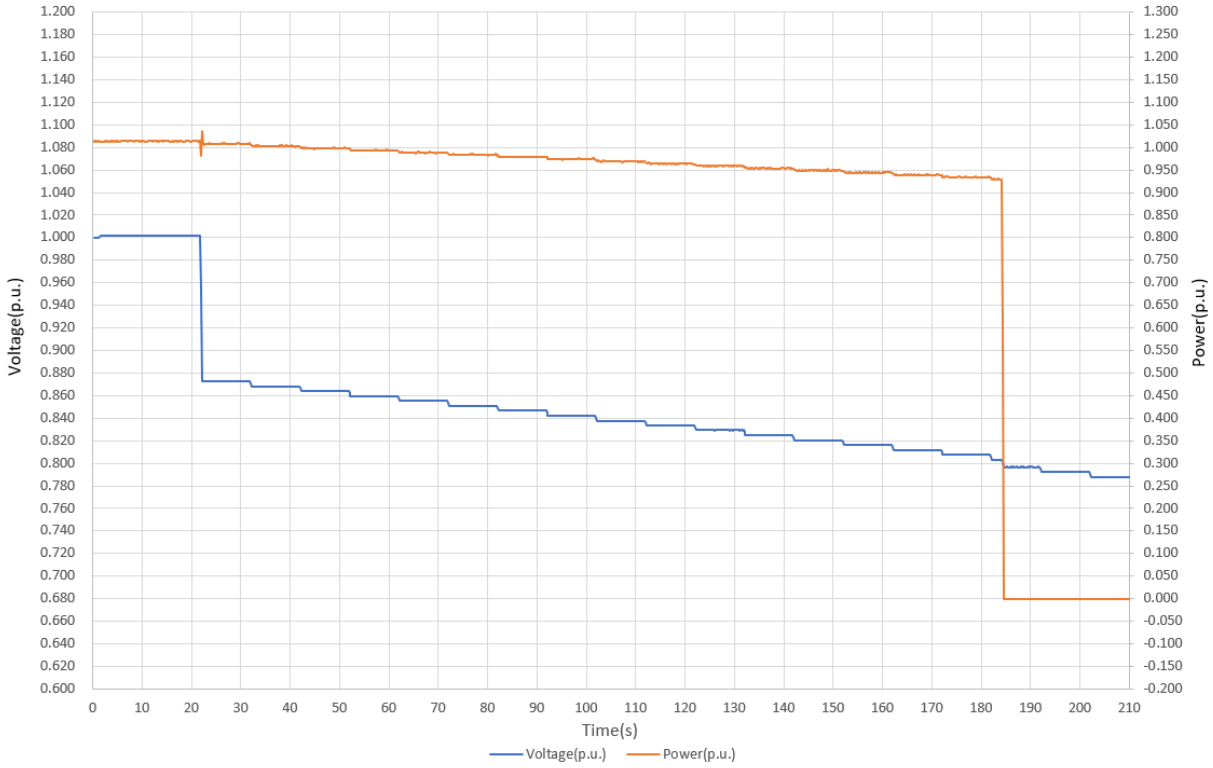


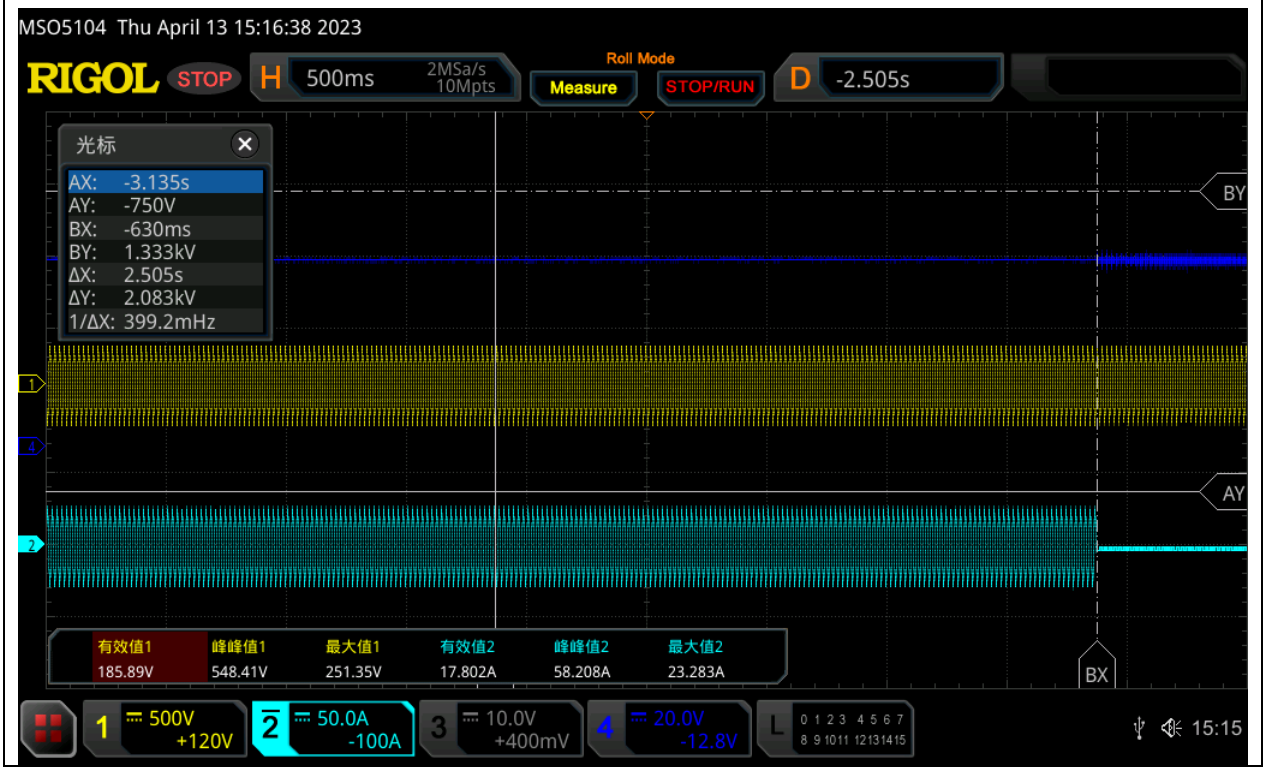
U/V -2


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

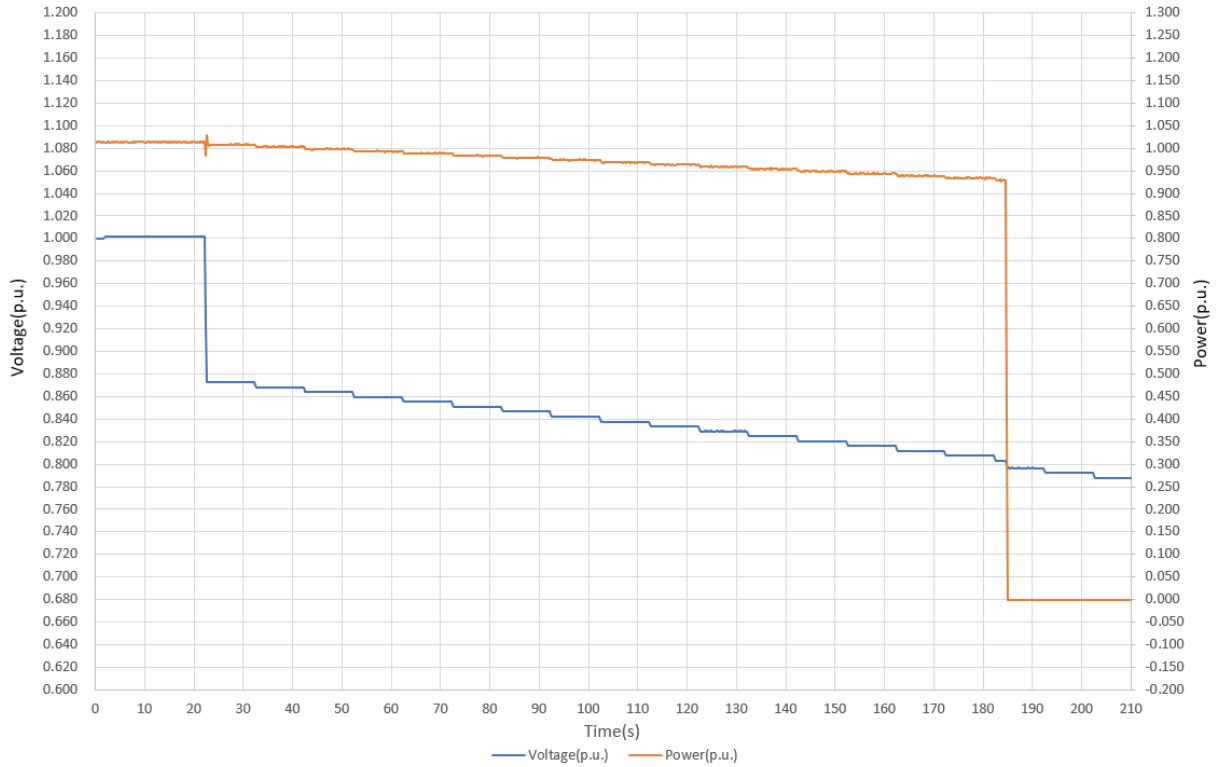

MSO5104 Thu April 13 15:18:15 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -3.06s
AY: -750V
BX: -525ms
BY: 1.333kV
ΔX: 2.535s
ΔY: 2.083kV
1/ΔX: 394.4mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
185.98V 548.41V 251.35V 17.955A 55.880A 23.283A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:17

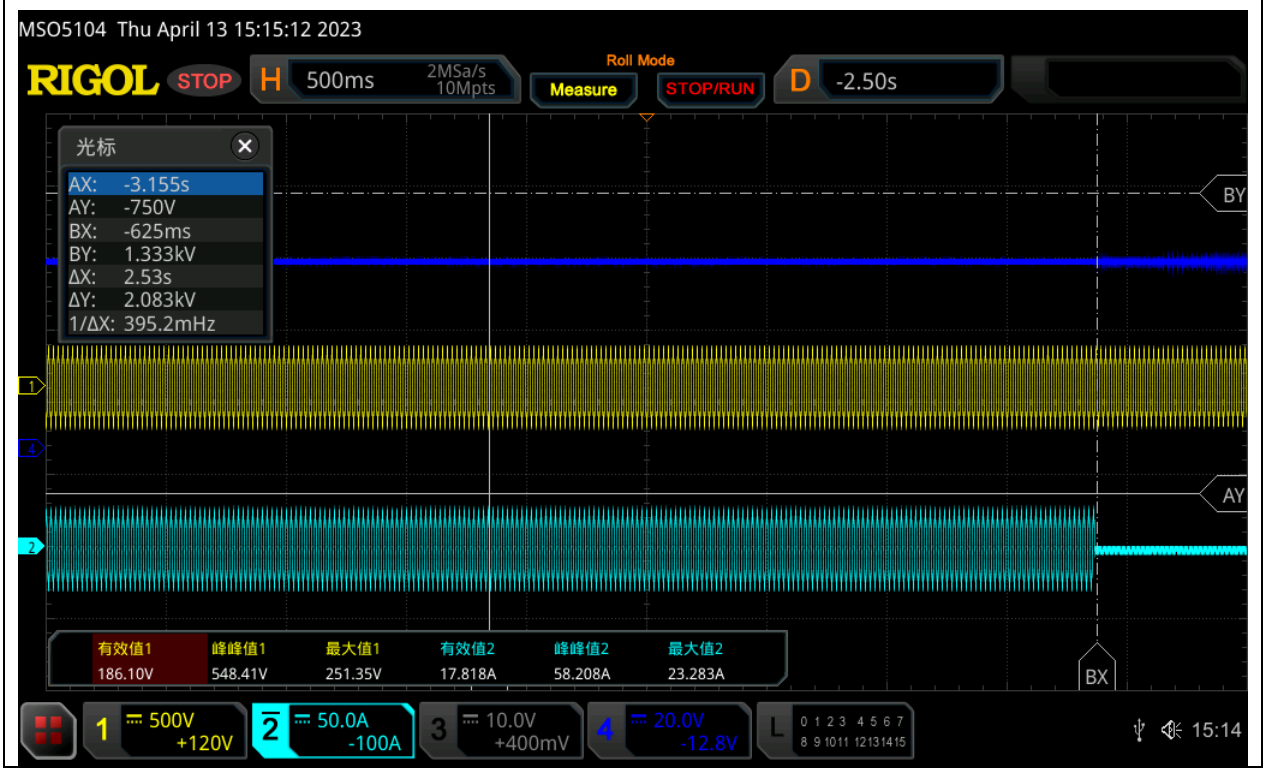
U/V -3


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

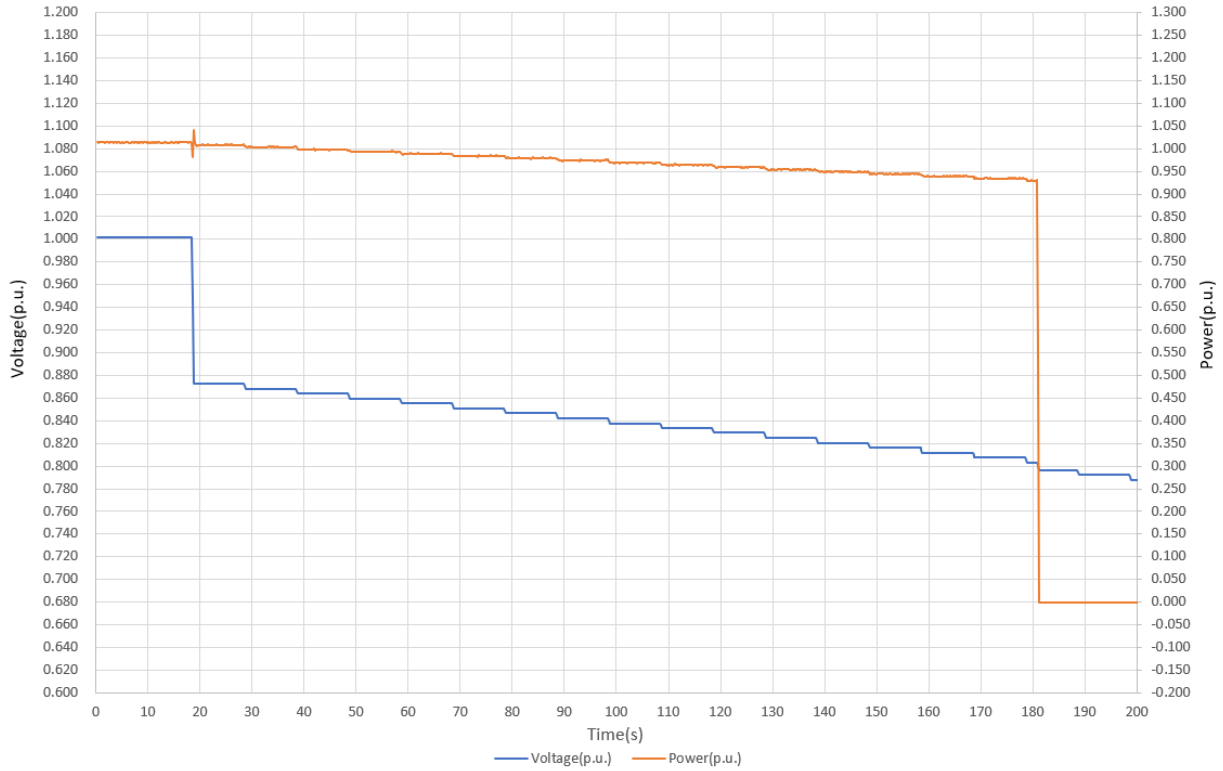

MSO5104 Thu April 13 15:16:38 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.505s
光标
AX: -3.135s
AY: -750V
BX: -630ms
BY: 1.333kV
ΔX: 2.505s
ΔY: 2.083kV
1/ΔX: 399.2mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
185.89V 548.41V 251.35V 17.802A 58.208A 23.283A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:15

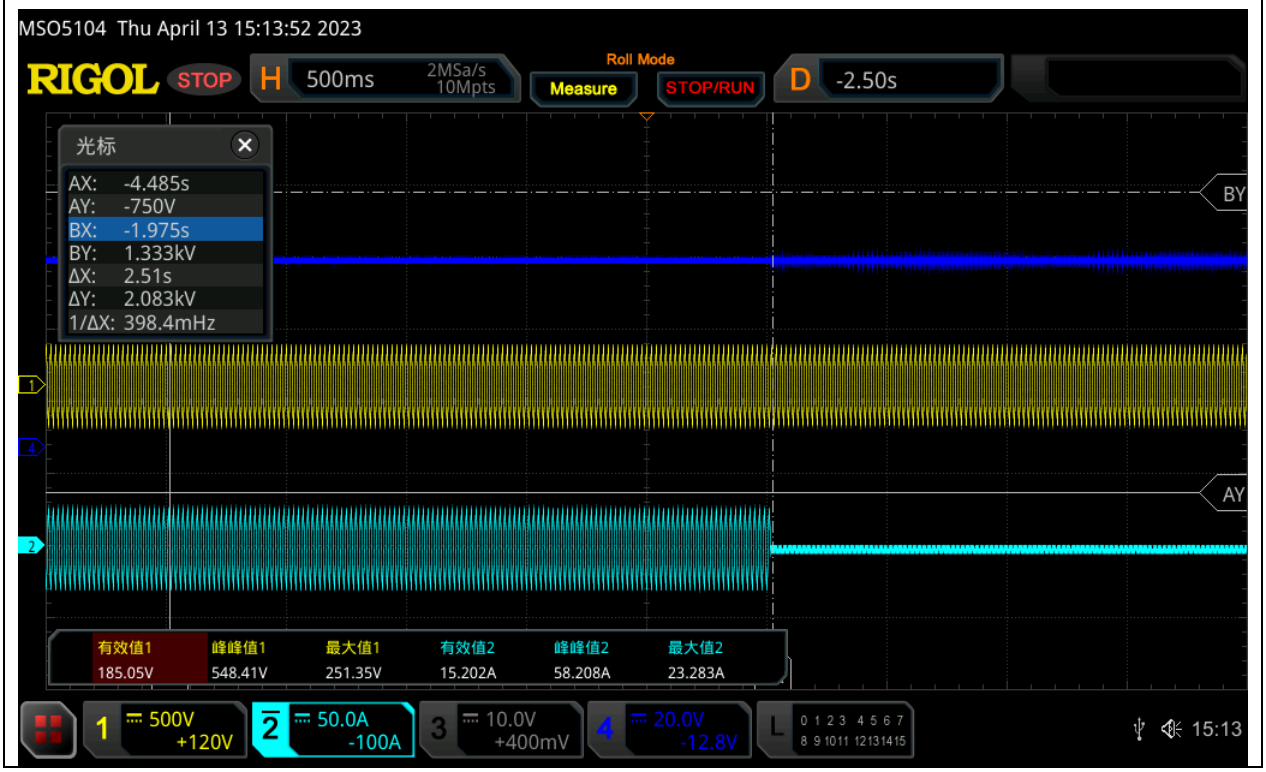
U/V -4


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

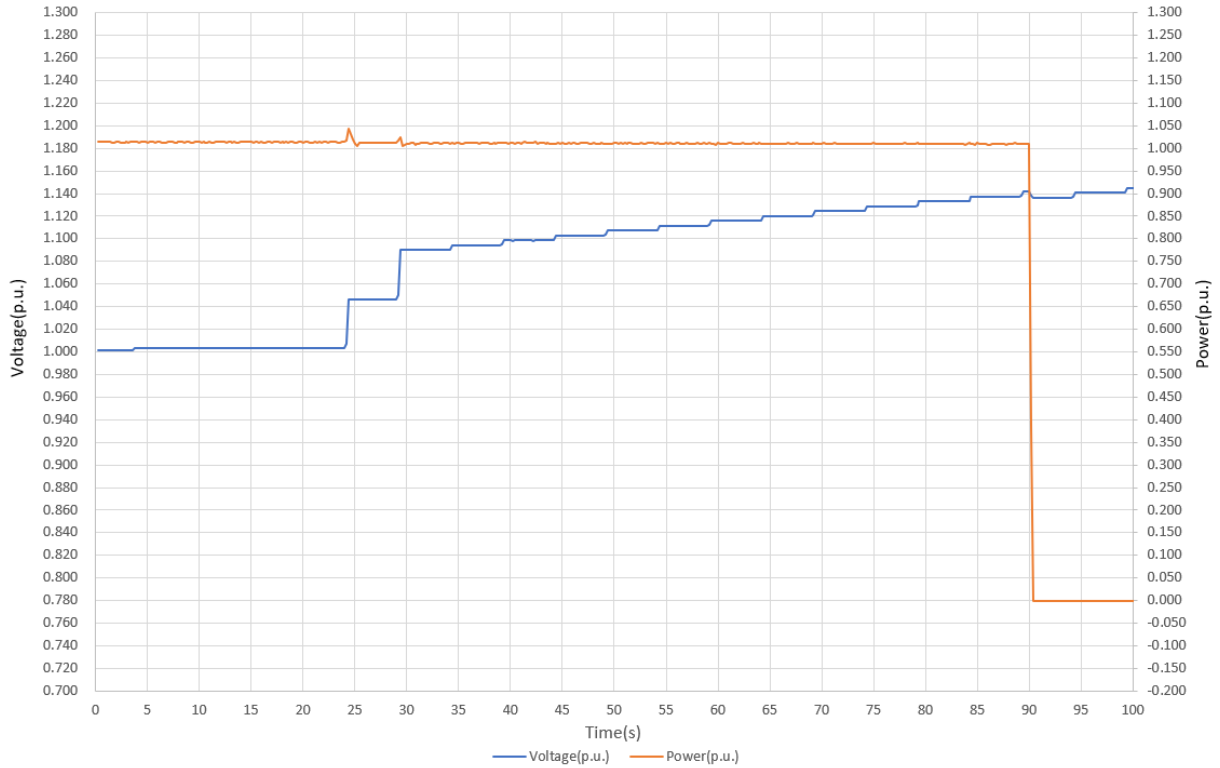

MSO5104 Thu April 13 15:15:12 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -3.155s
AY: -750V
BX: -625ms
BY: 1.333kV
ΔX: 2.53s
ΔY: 2.083kV
1/ΔX: 395.2mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
186.10V 548.41V 251.35V 17.818A 58.208A 23.283A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:14

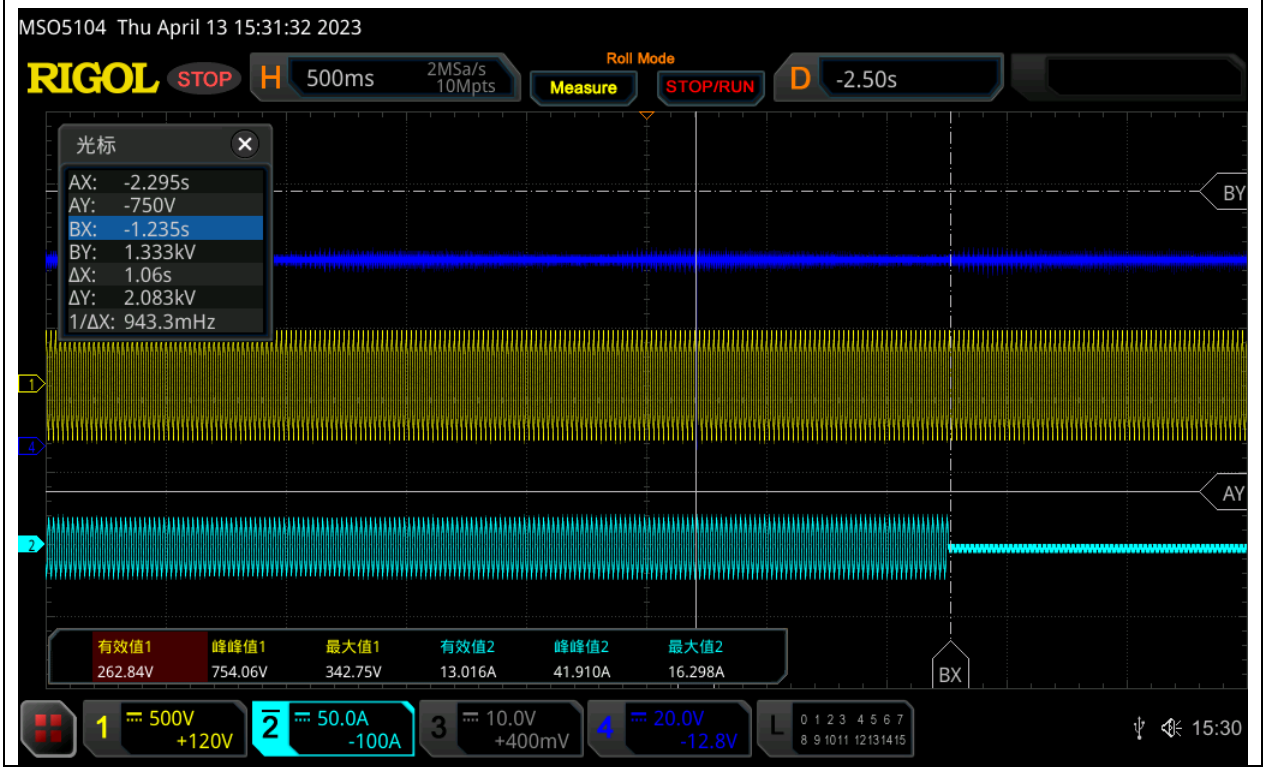
U/V -5


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

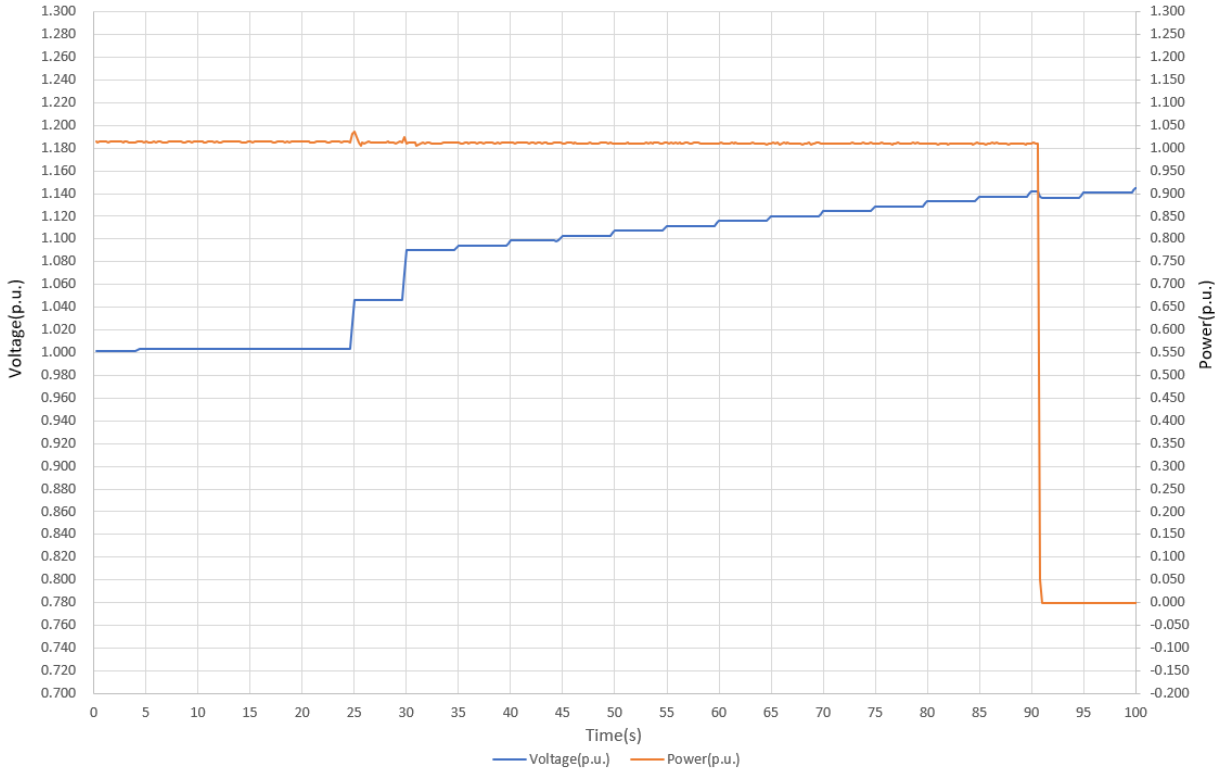

MSO5104 Thu April 13 15:13:52 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -4.485s
AY: -750V
BX: -1.975s
BY: 1.333kV
ΔX: 2.51s
ΔY: 2.083kV
1/ΔX: 398.4mHz
BY
AY
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
185.05V 548.41V 251.35V 15.202A 58.208A 23.283A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:13

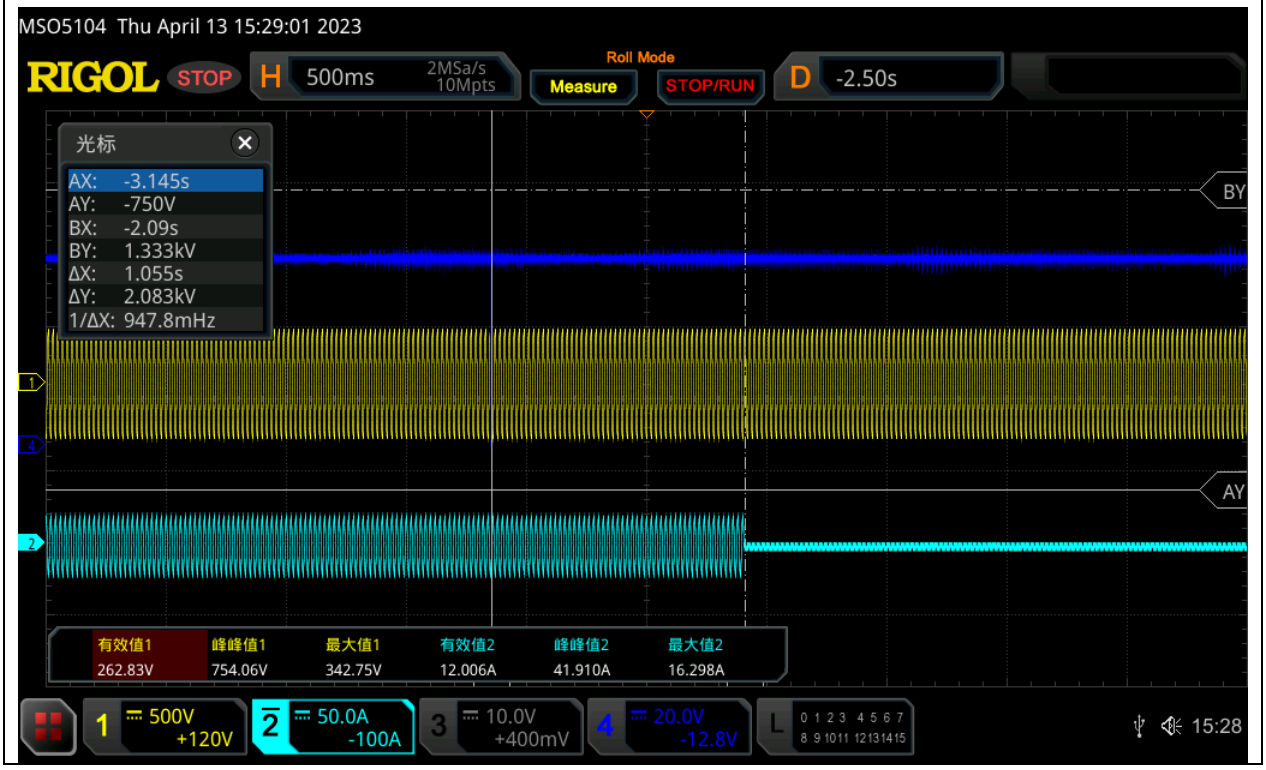
O/V stage 1-1


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

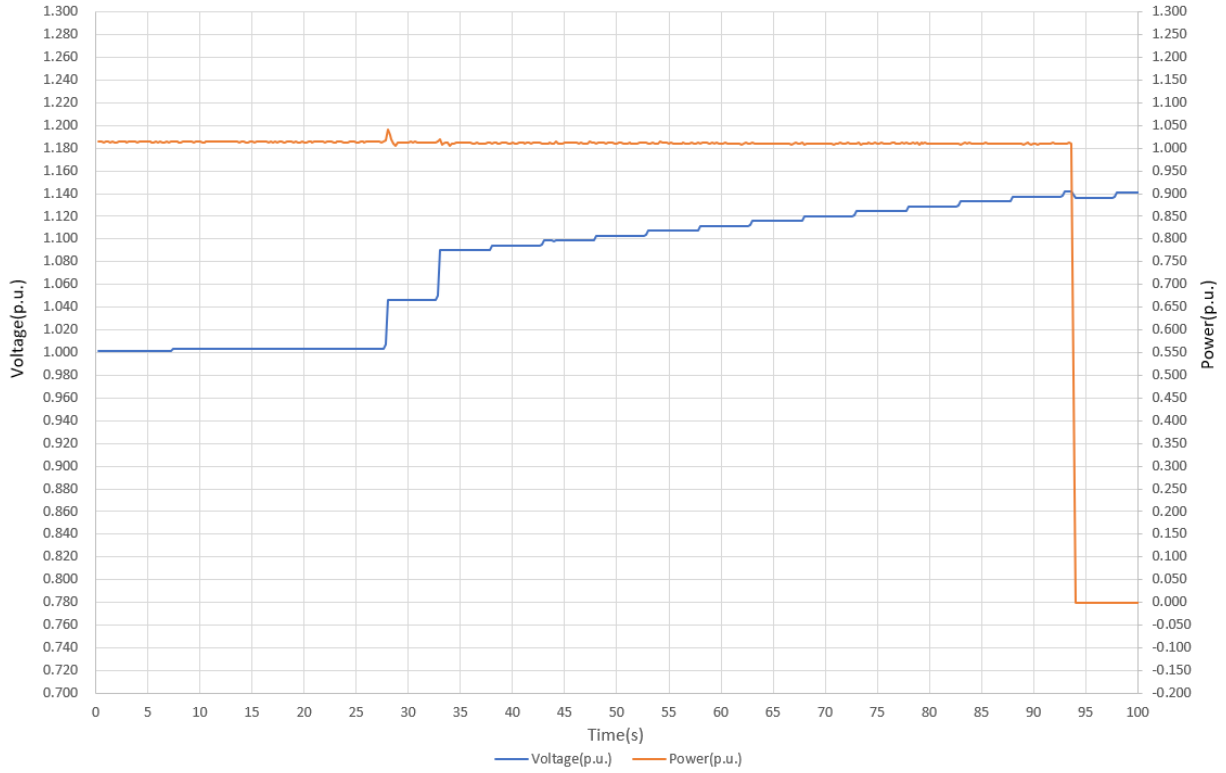

MSO5104 Thu April 13 15:31:32 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -2.295s
AY: -750V
BX: -1.235s
BY: 1.333kV
ΔX: 1.06s
ΔY: 2.083kV
1/ΔX: 943.3mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
262.84V 754.06V 342.75V 13.016A 41.910A 16.298A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:30

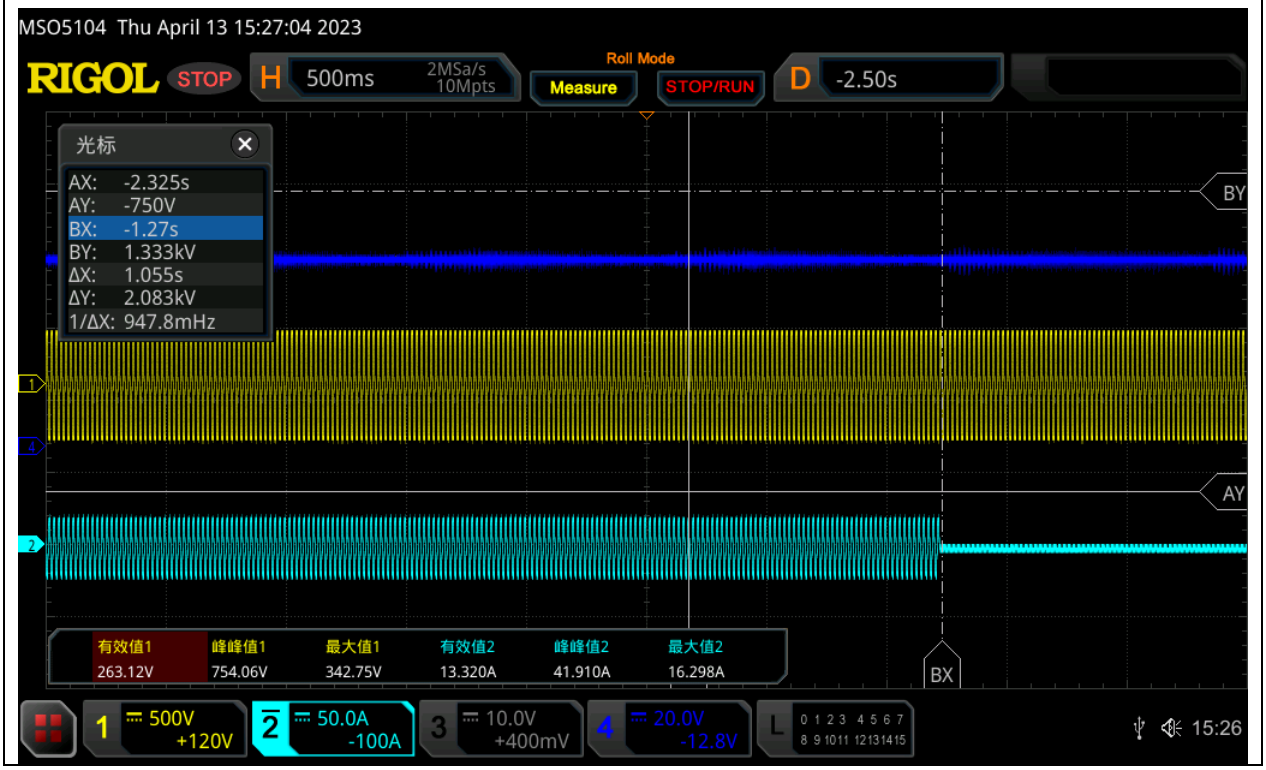
O/V stage 1-2


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

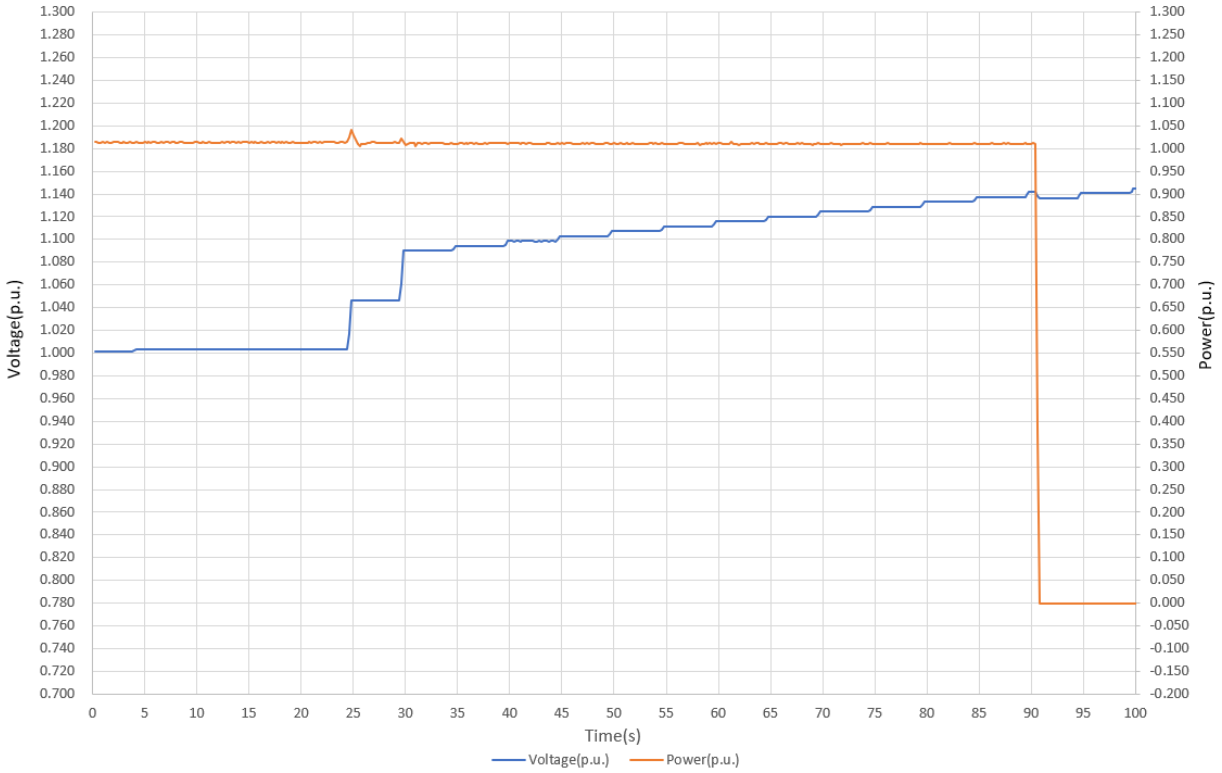

MSO5104 Thu April 13 15:29:01 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -3.145s
AY: -750V
BX: -2.09s
BY: 1.333kV
ΔX: 1.055s
ΔY: 2.083kV
1/ΔX: 947.8mHz
BY
AY
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
262.83V 754.06V 342.75V 12.006A 41.910A 16.298A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:28

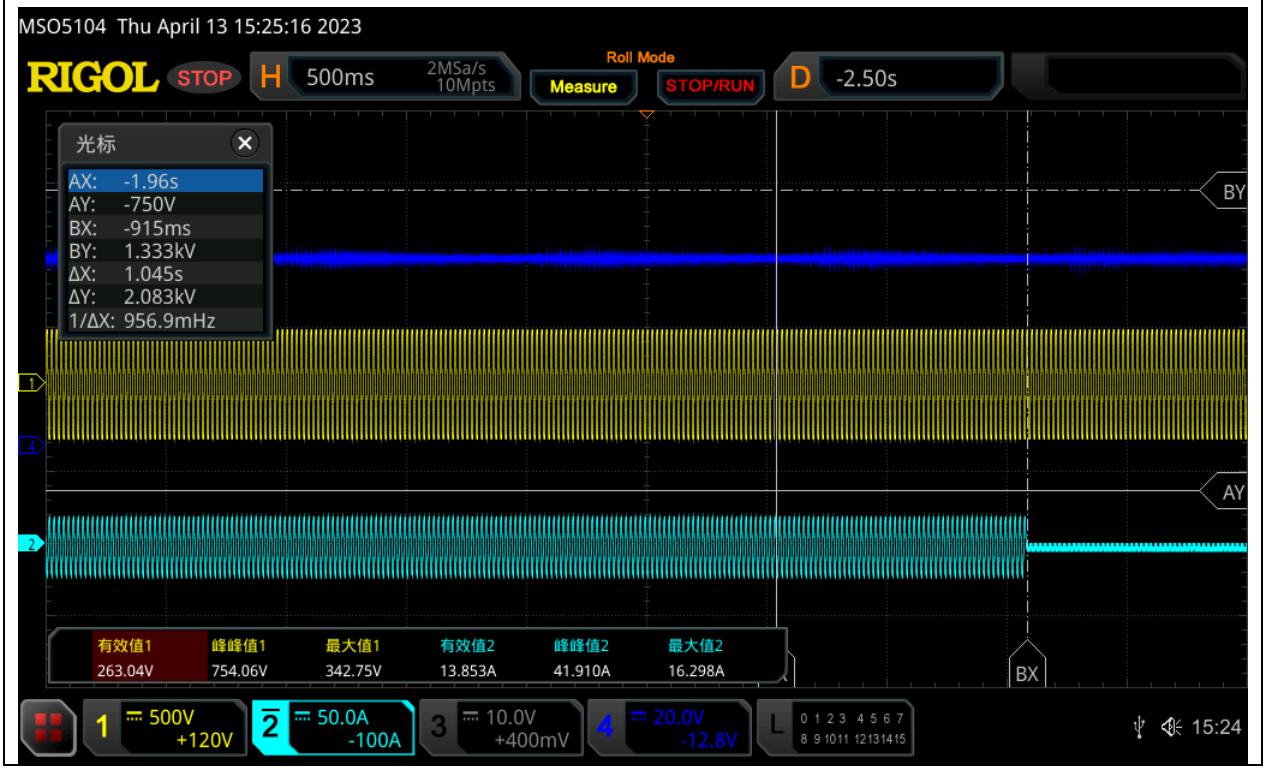
O/V stage 1-3


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

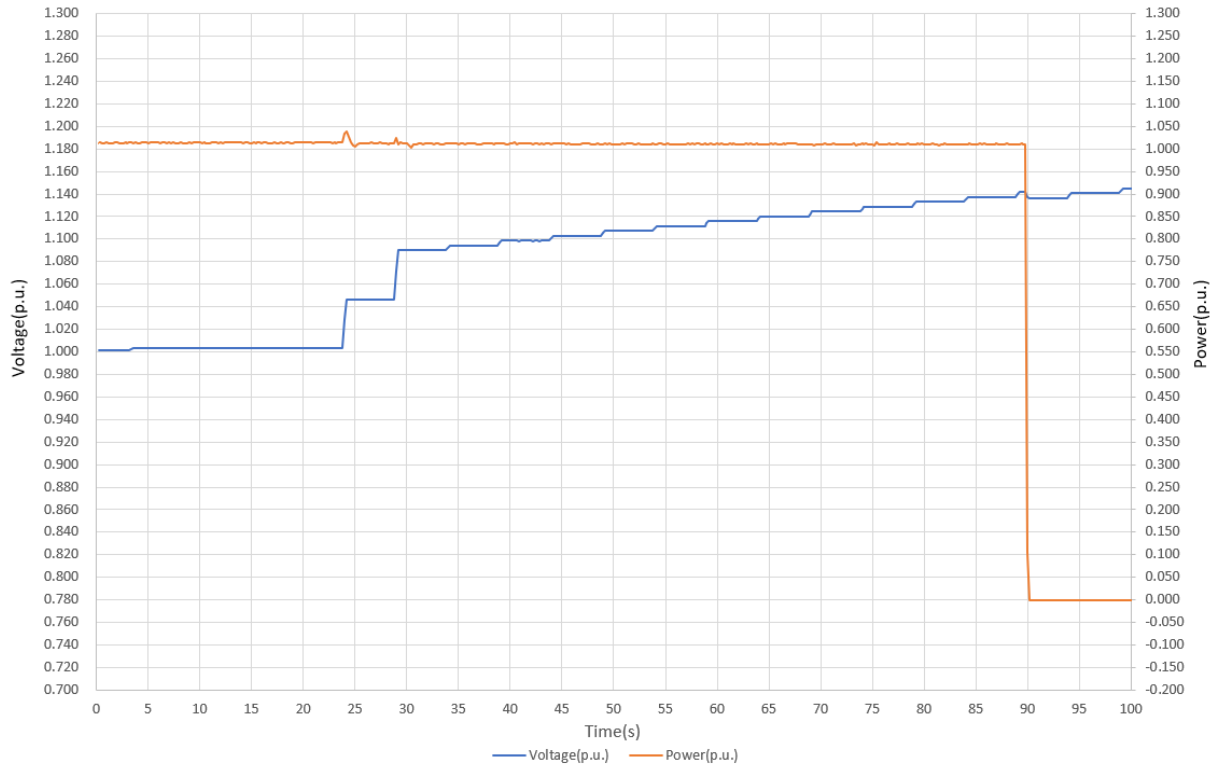

MSO5104 Thu April 13 15:27:04 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -2.325s
AY: -750V
BX: -1.27s
BY: 1.333kV
ΔX: 1.055s
ΔY: 2.083kV
1/ΔX: 947.8mHz
BY
AY
BX
有效值1 263.12V
峰峰值1 754.06V
最大值1 342.75V
有效值2 13.320A
峰峰值2 41.910A
最大值2 16.298A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:26

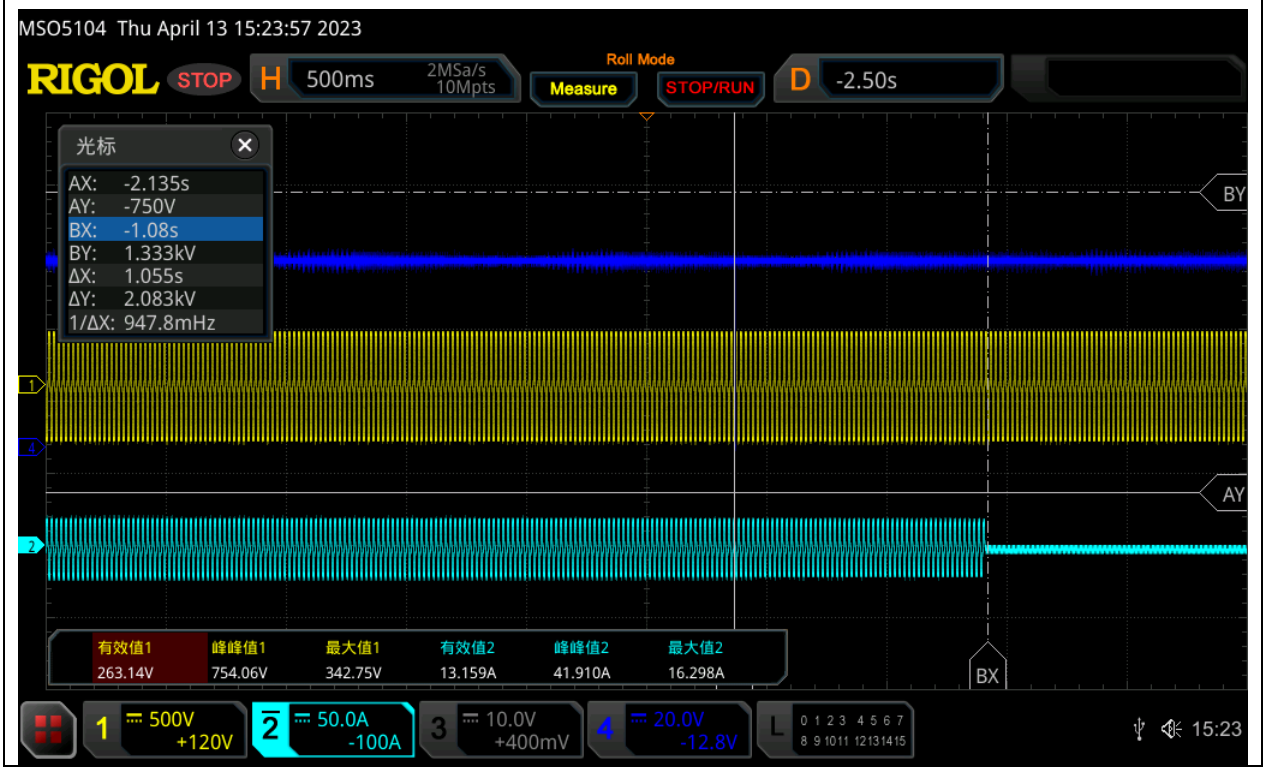
O/V stage 1-4


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

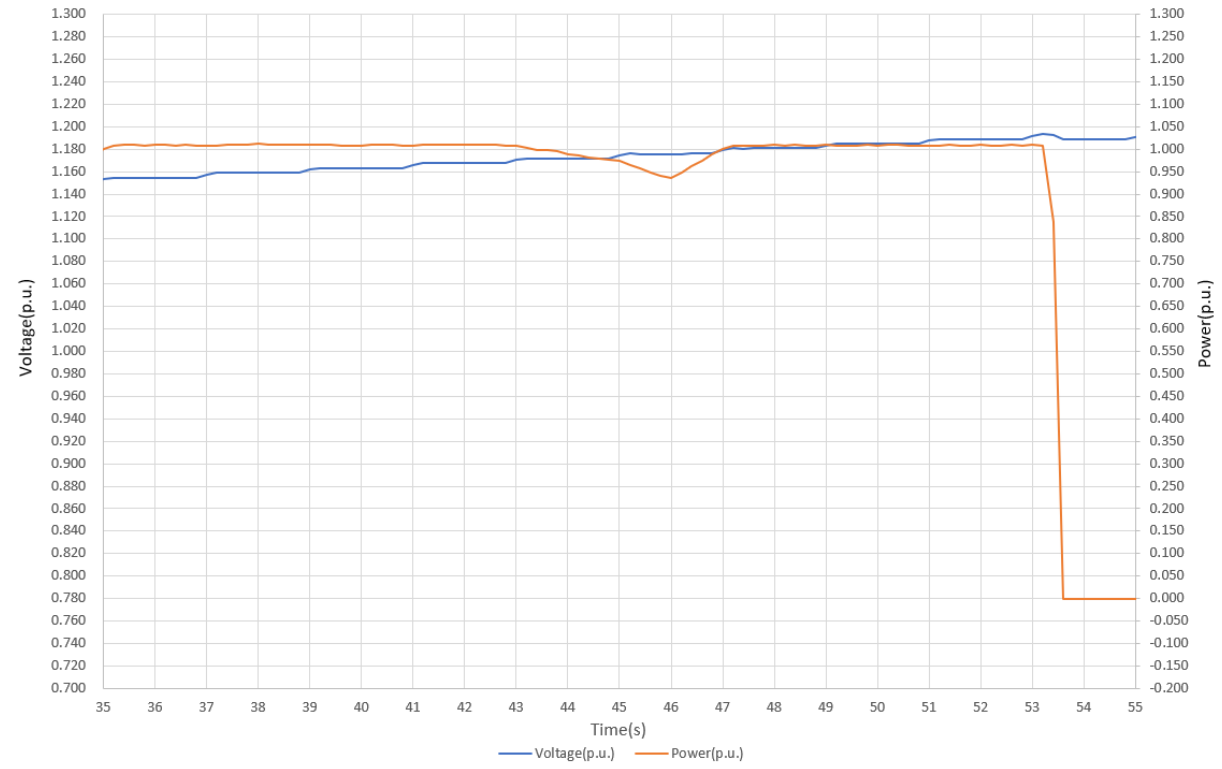

MSO5104 Thu April 13 15:25:16 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -1.96s
AY: -750V
BX: -915ms
BY: 1.333kV
ΔX: 1.045s
ΔY: 2.083kV
1/ΔX: 956.9mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
263.04V 754.06V 342.75V 13.853A 41.910A 16.298A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:24

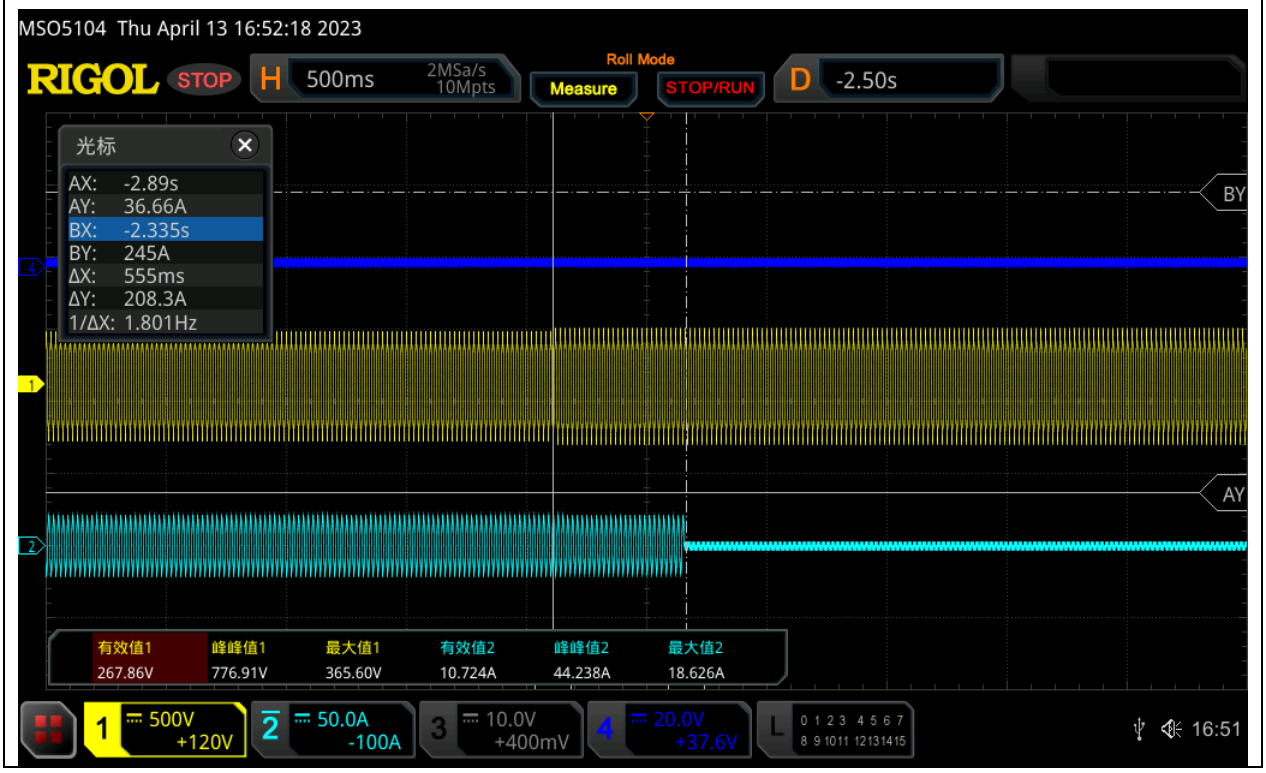
O/V stage 1-5


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

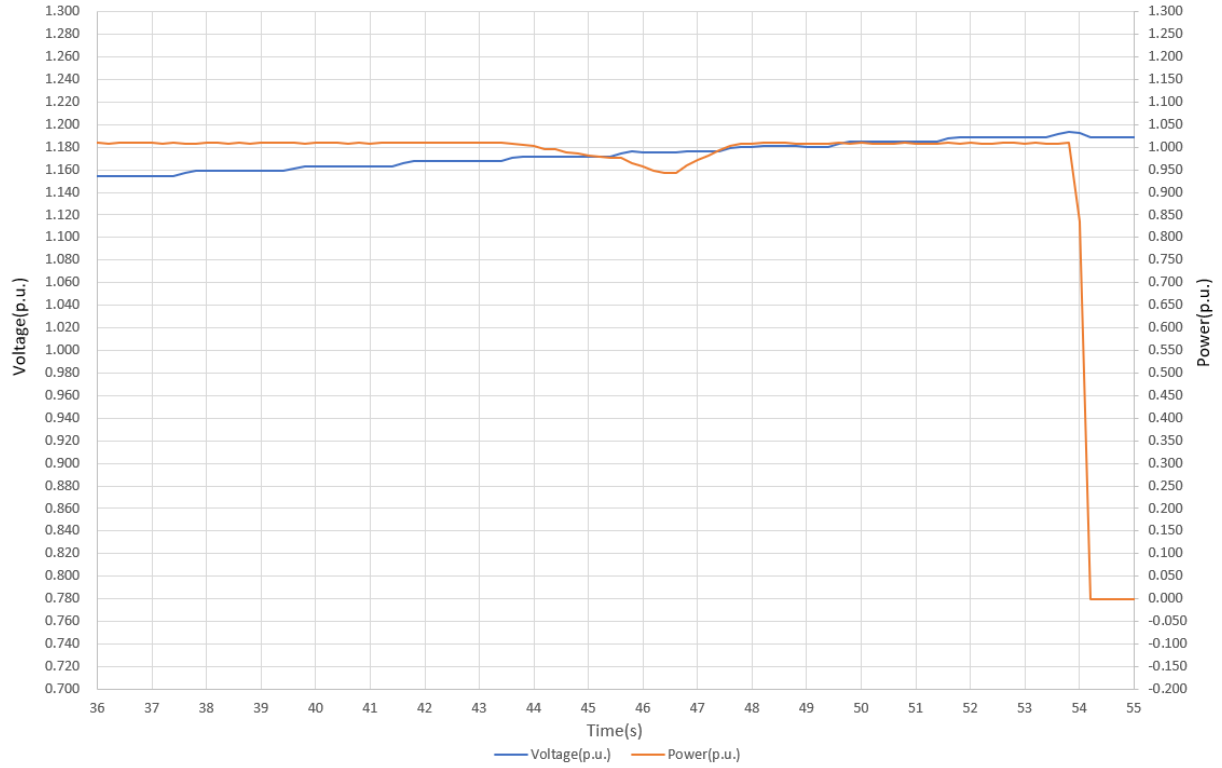

MSO5104 Thu April 13 15:23:57 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -2.135s
AY: -750V
BX: -1.08s
BY: 1.333kV
ΔX: 1.055s
ΔY: 2.083kV
1/ΔX: 947.8mHz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
263.14V 754.06V 342.75V 13.159A 41.910A 16.298A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V -12.8V
15:23

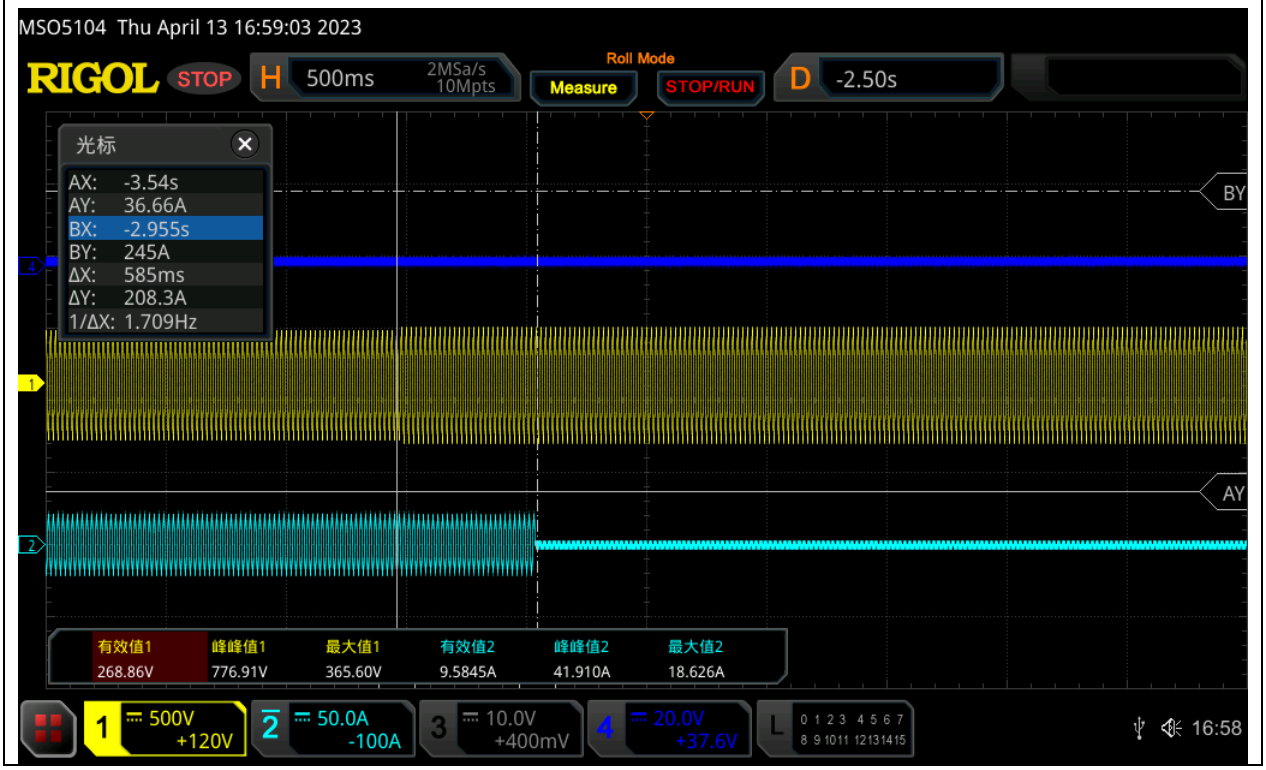
O/V stage 2-1


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

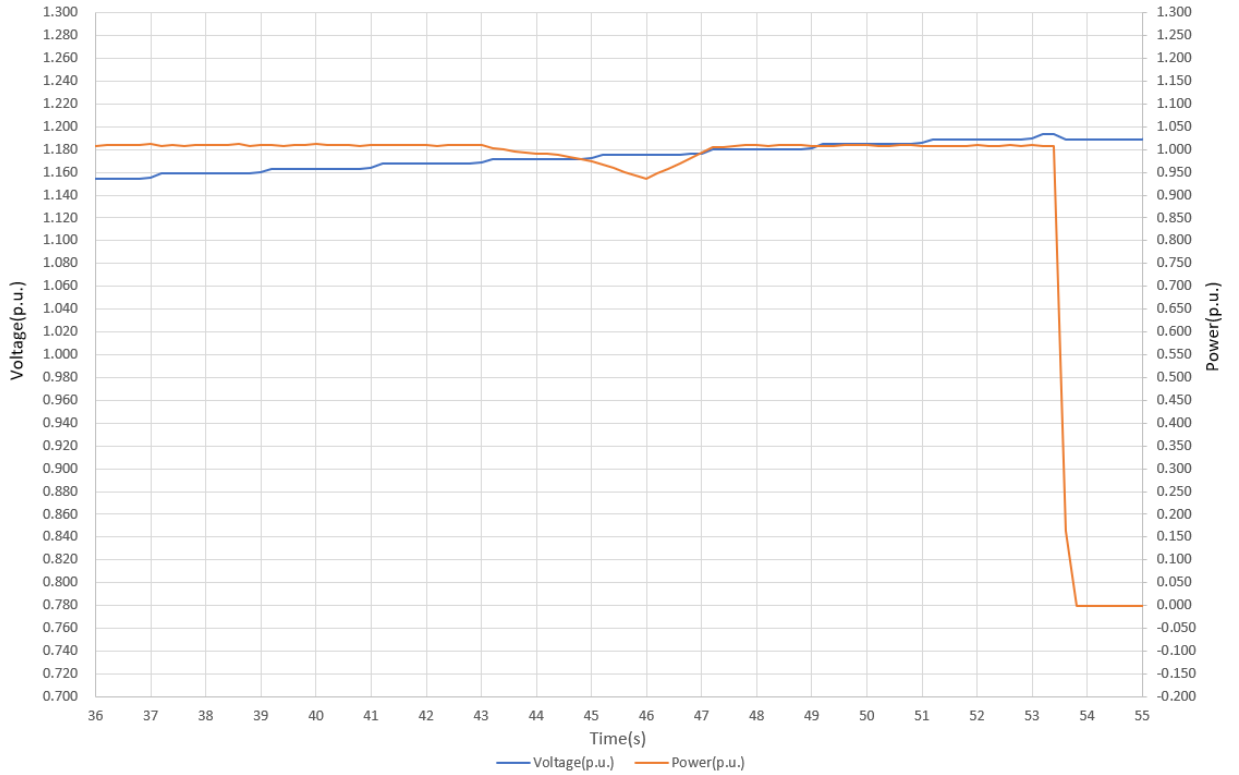

MSO5104 Thu April 13 16:52:18 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -2.89s
AY: 36.66A
BX: -2.335s
BY: 245A
ΔX: 555ms
ΔY: 208.3A
1/ΔX: 1.801Hz
BY
AY
有效值1 267.86V
峰峰值1 776.91V
最大值1 365.60V
有效值2 10.724A
峰峰值2 44.238A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V +37.6V
16:51

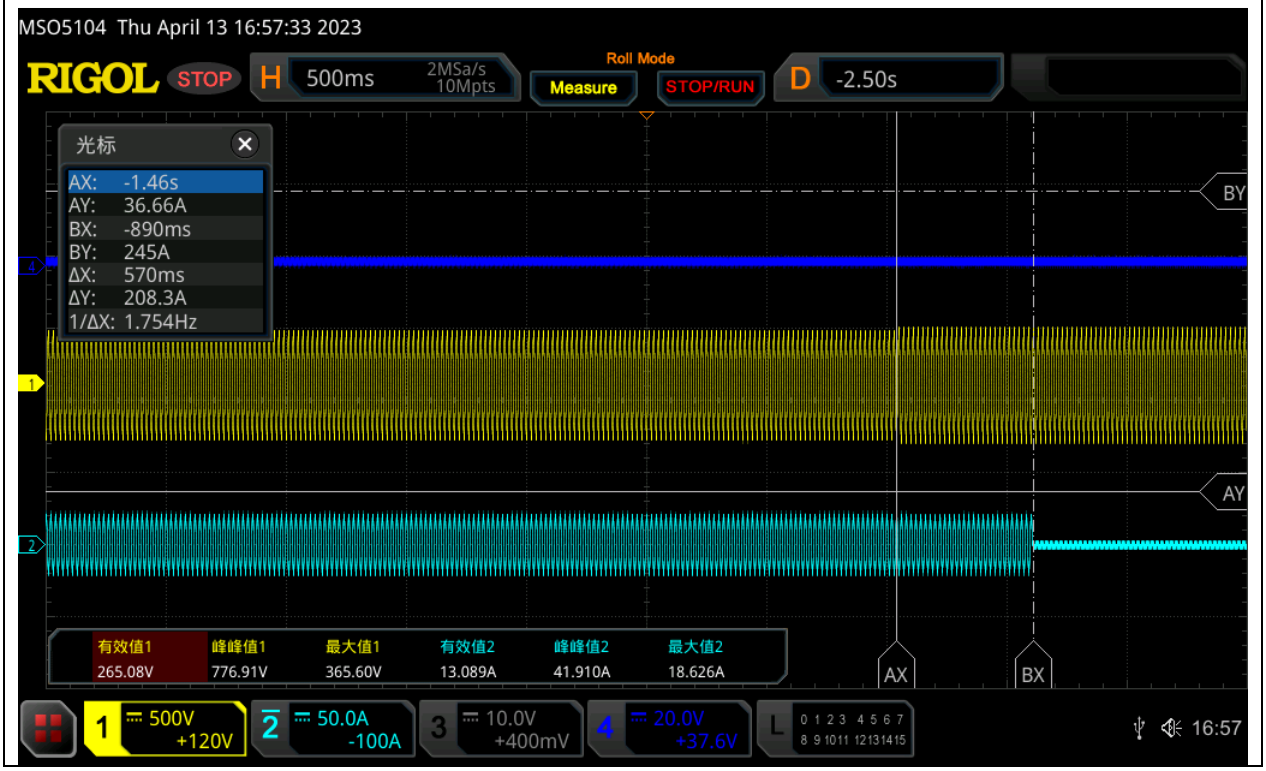
O/V stage 2-2


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

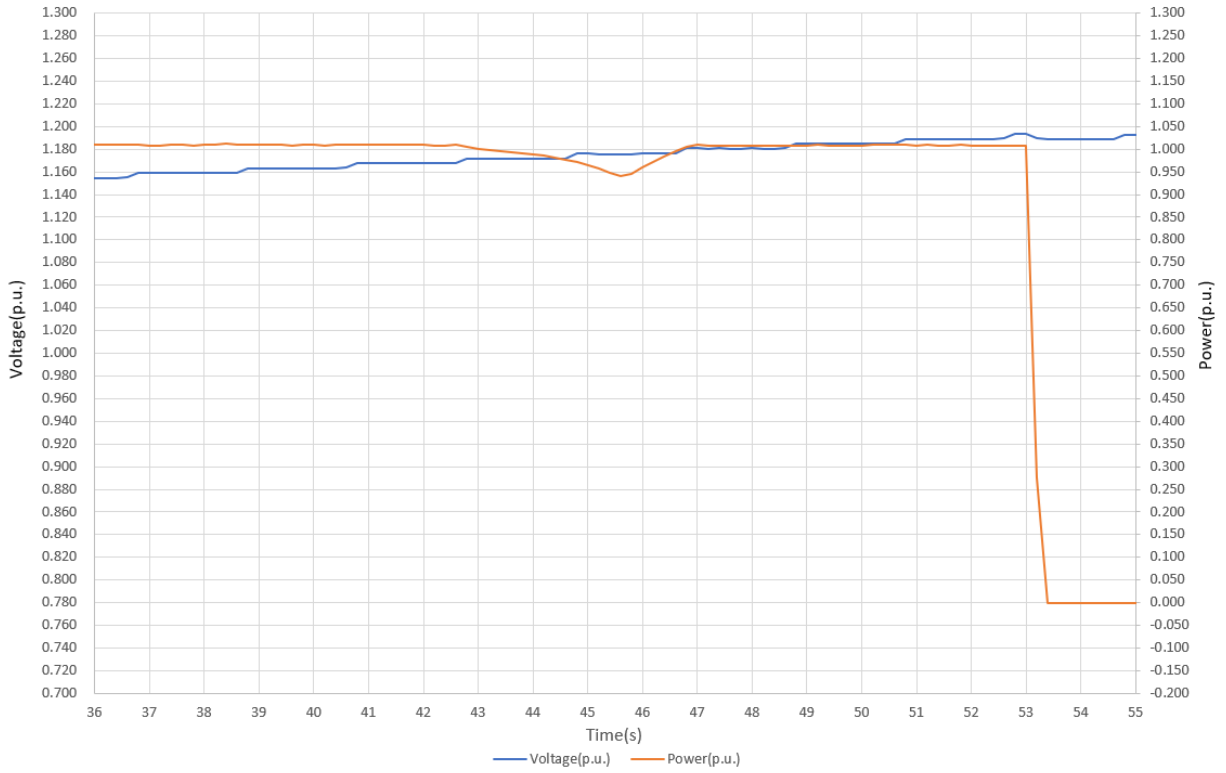

MSO5104 Thu April 13 16:59:03 2023
RIGOL
STOP
H 500ms
2MSa/s
10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -3.54s
AY: 36.66A
BX: -2.955s
BY: 245A
ΔX: 585ms
ΔY: 208.3A
1/ΔX: 1.709Hz
BY
AY
有效值1 268.86V
峰峰值1 776.91V
最大值1 365.60V
有效值2 9.5845A
峰峰值2 41.910A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V +37.6V
16:58

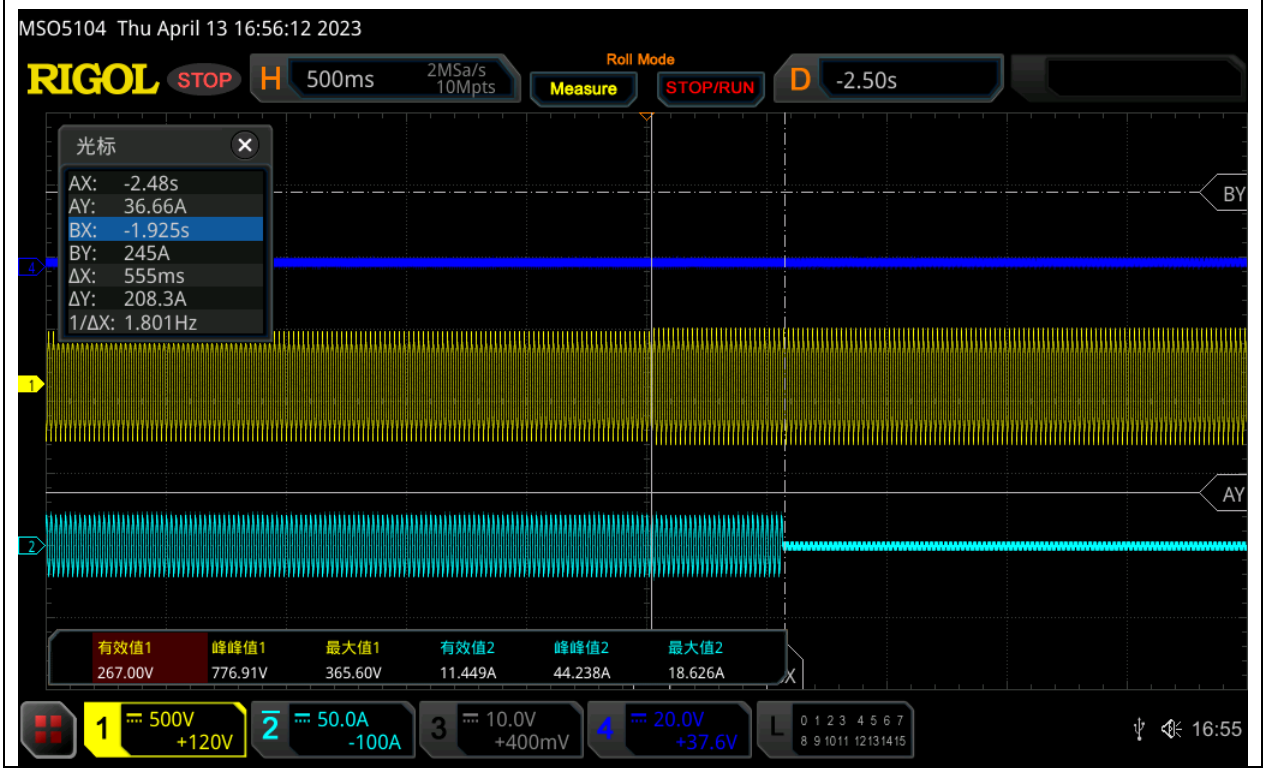
O/V stage 2-3


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

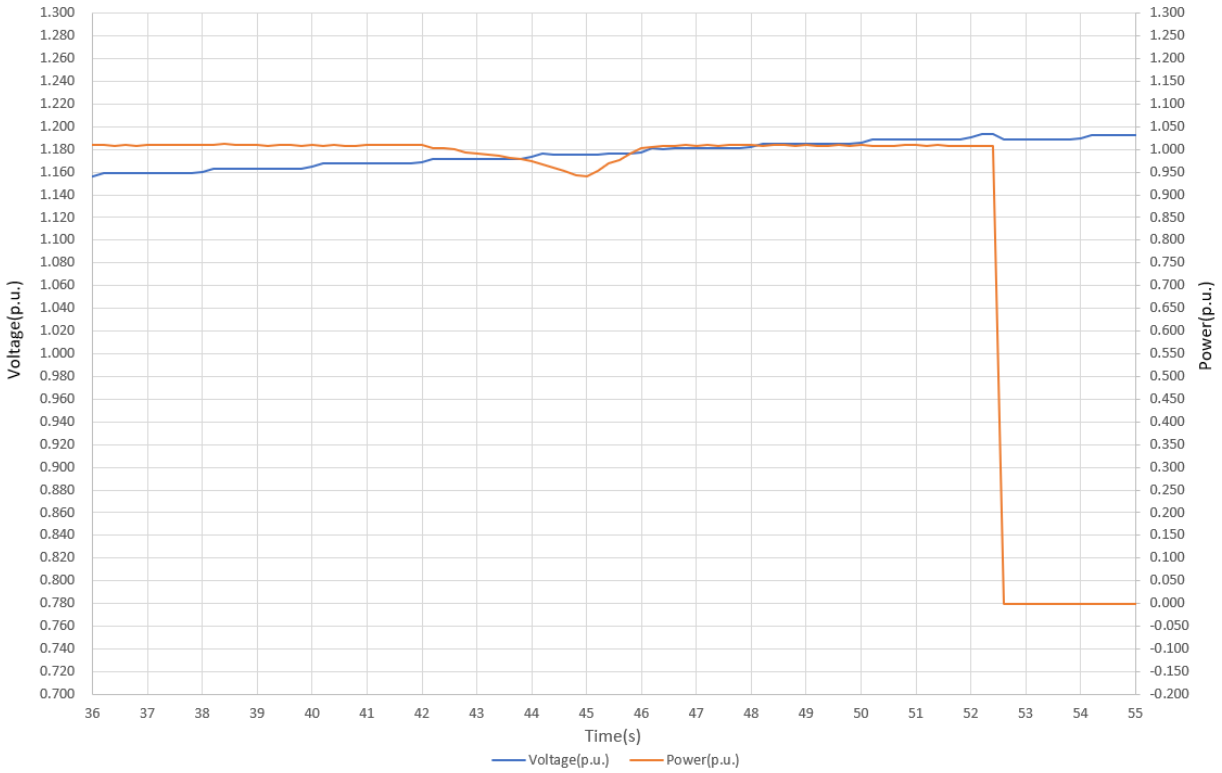

MSO5104 Thu April 13 16:57:33 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -1.46s
AY: 36.66A
BX: -890ms
BY: 245A
ΔX: 570ms
ΔY: 208.3A
1/ΔX: 1.754Hz
BY
AY
AX
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
265.08V 776.91V 365.60V 13.089A 41.910A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V +37.6V
16:57

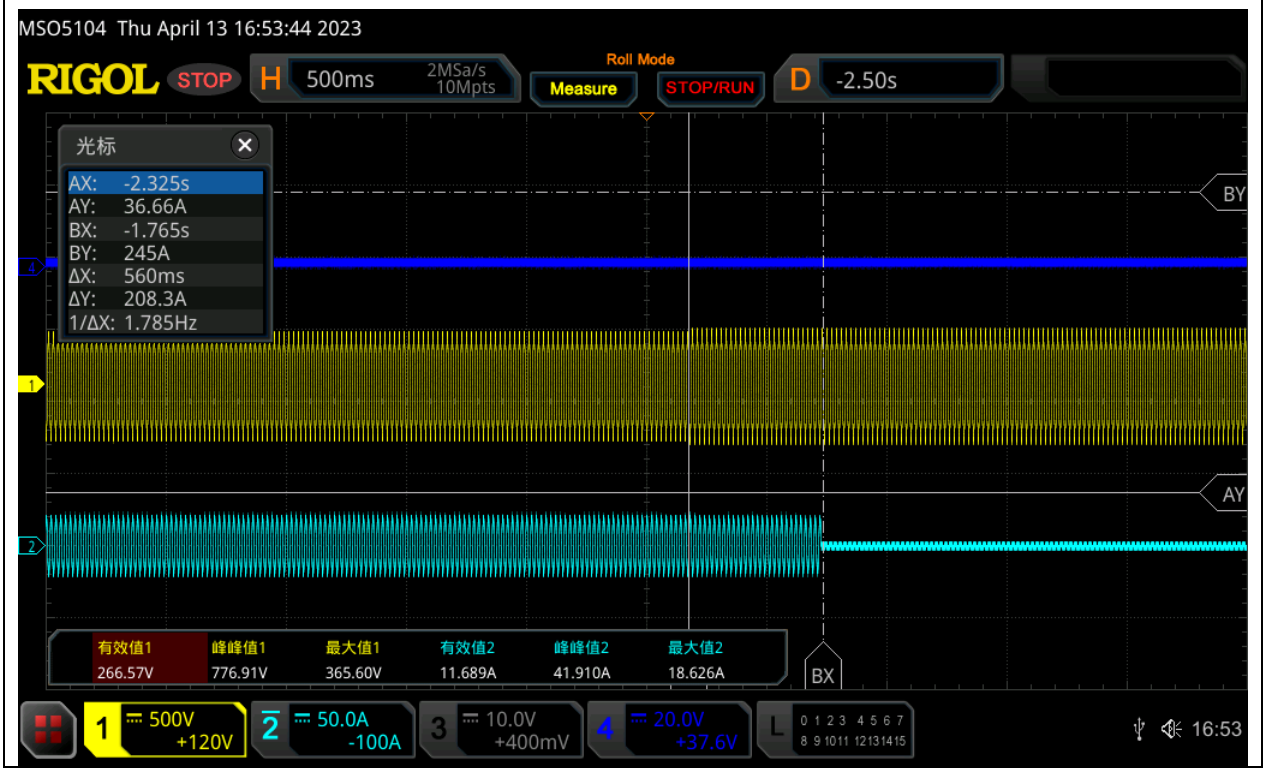
O/V stage 2-4


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

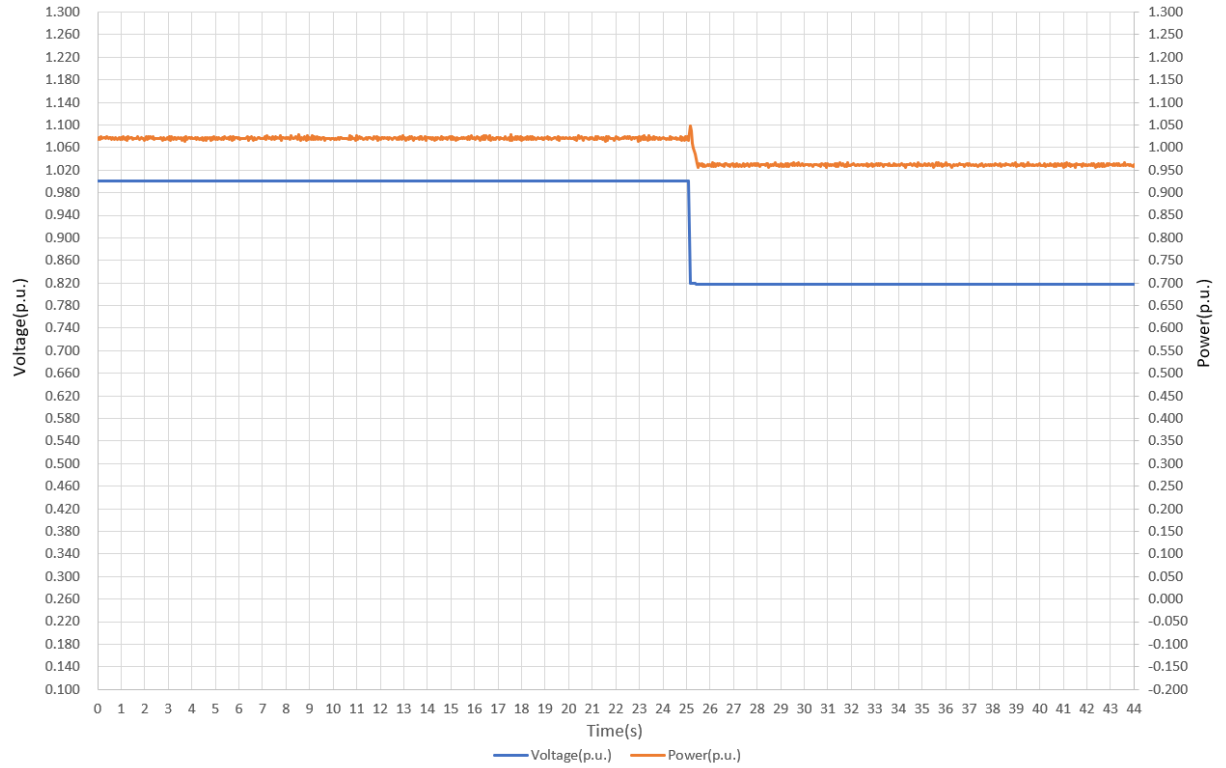

MSO5104 Thu April 13 16:56:12 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -2.48s
AY: 36.66A
BX: -1.925s
BY: 245A
ΔX: 555ms
ΔY: 208.3A
1/ΔX: 1.801Hz
BY
AY
有效值1 267.00V
峰峰值1 776.91V
最大值1 365.60V
有效值2 11.449A
峰峰值2 44.238A
最大值2 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V +37.6V
16:55

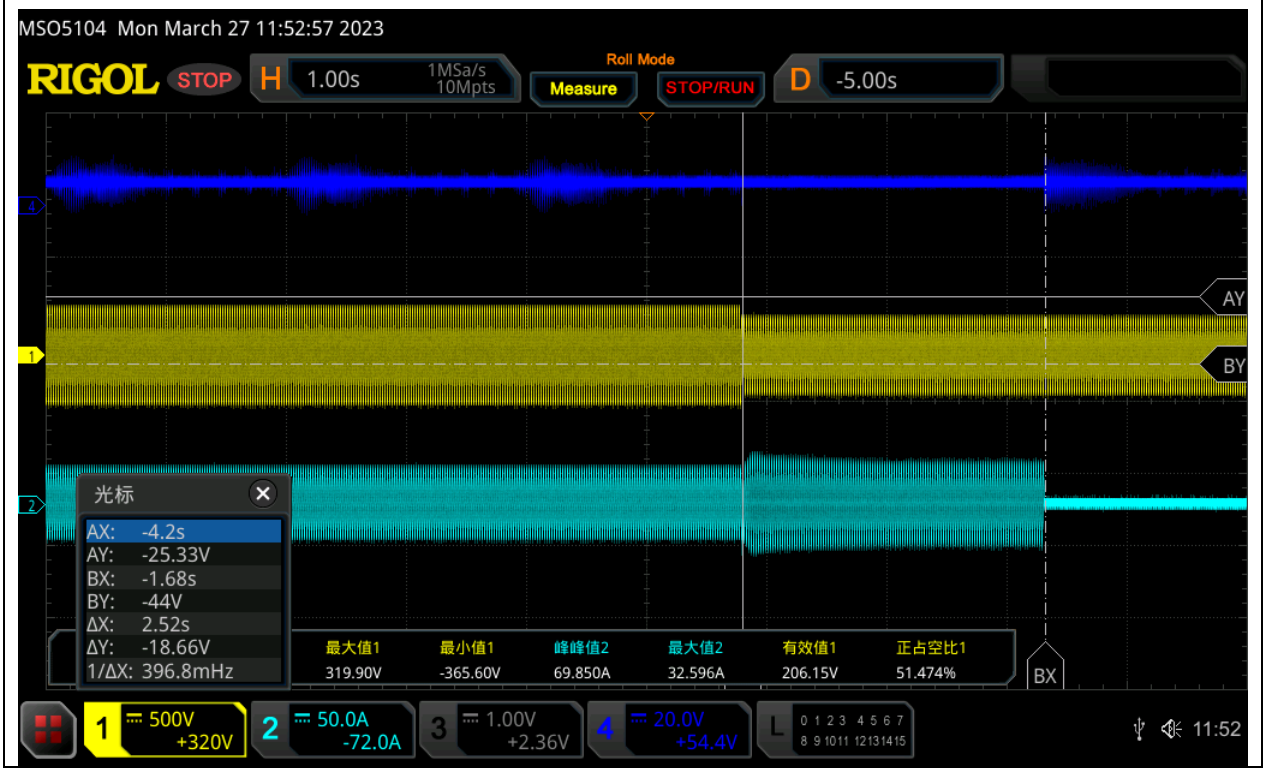
O/V stage 2-5


Voltage(p.u.)
Power(p.u.)
Time(s)
Voltage(p.u.)
Power(p.u.)

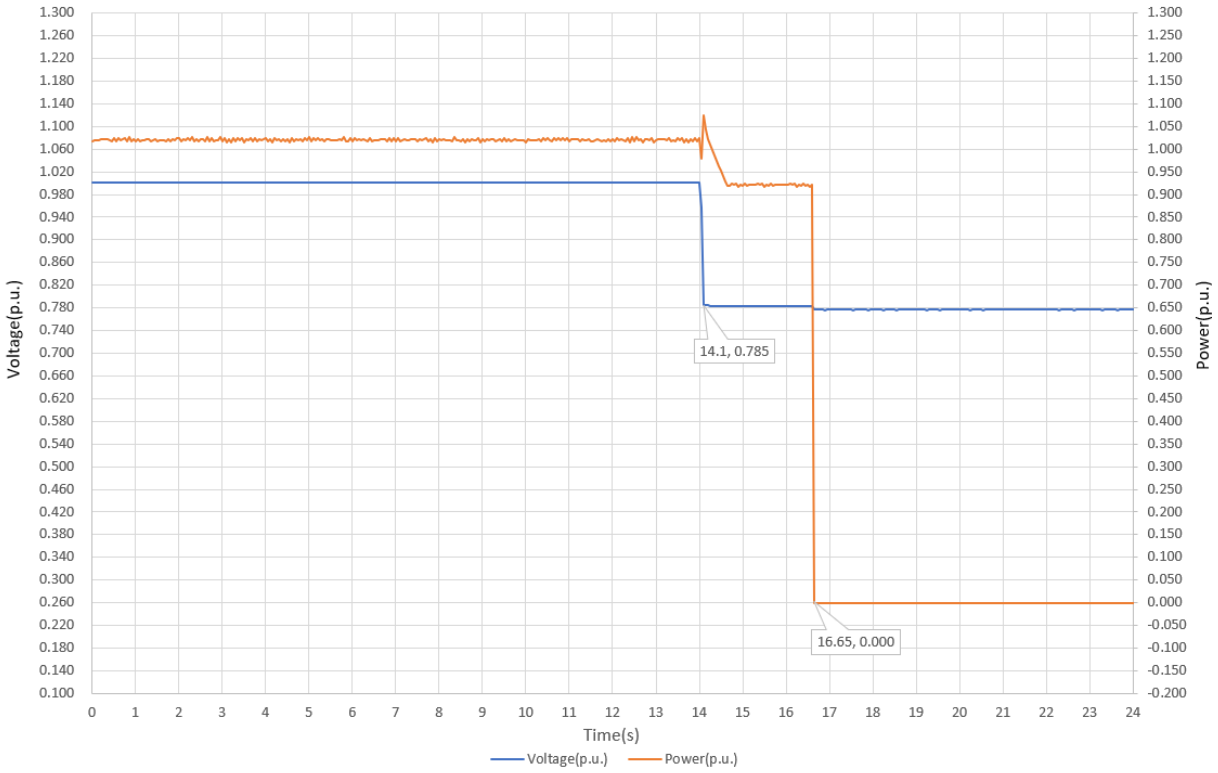

MSO5104 Thu April 13 16:53:44 2023
RIGOL
STOP
H 500ms 2MSa/s 10Mpts
Roll Mode
Measure
STOP/RUN
D -2.50s
光标
AX: -2.325s
AY: 36.66A
BX: -1.765s
BY: 245A
ΔX: 560ms
ΔY: 208.3A
1/ΔX: 1.785Hz
BY
AY
BX
有效值1 峰峰值1 最大值1 有效值2 峰峰值2 最大值2
266.57V 776.91V 365.60V 11.689A 41.910A 18.626A
1 500V +120V
2 50.0A -100A
3 10.0V +400mV
4 20.0V +37.6V
16:53

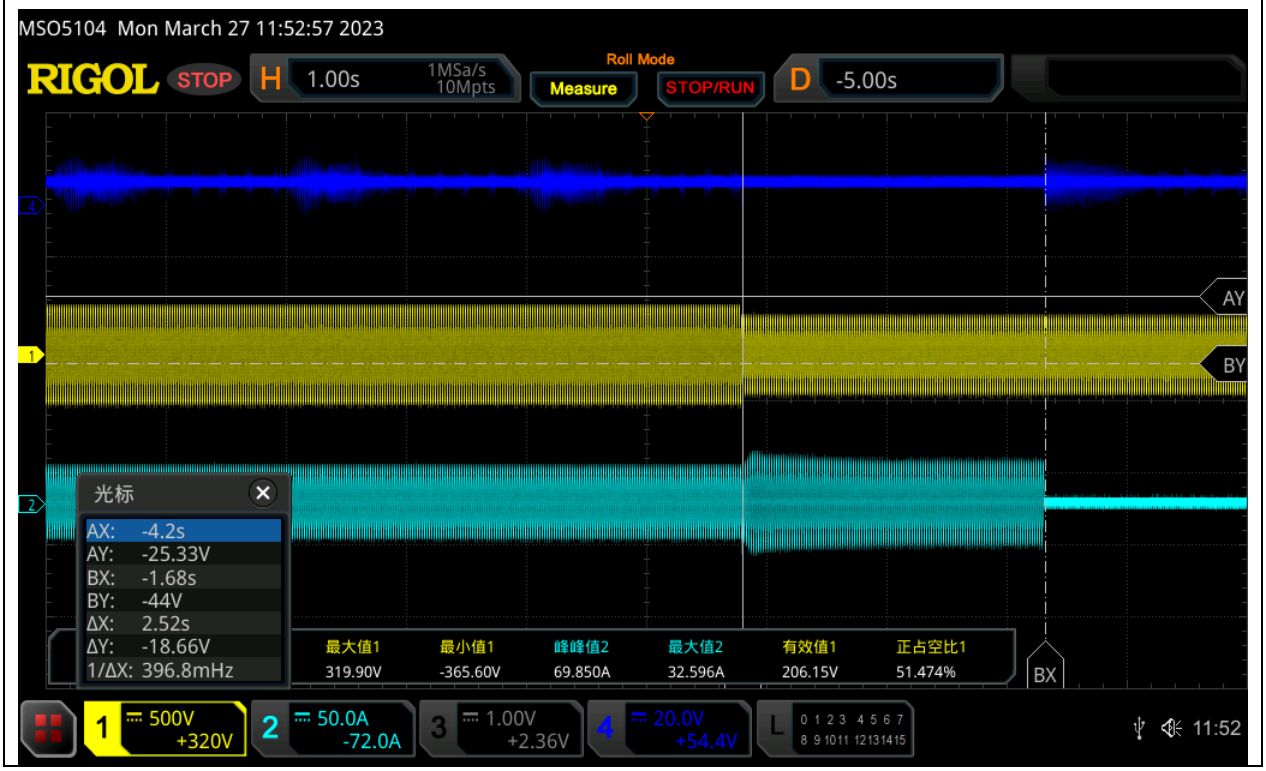
No trip tests – 188V



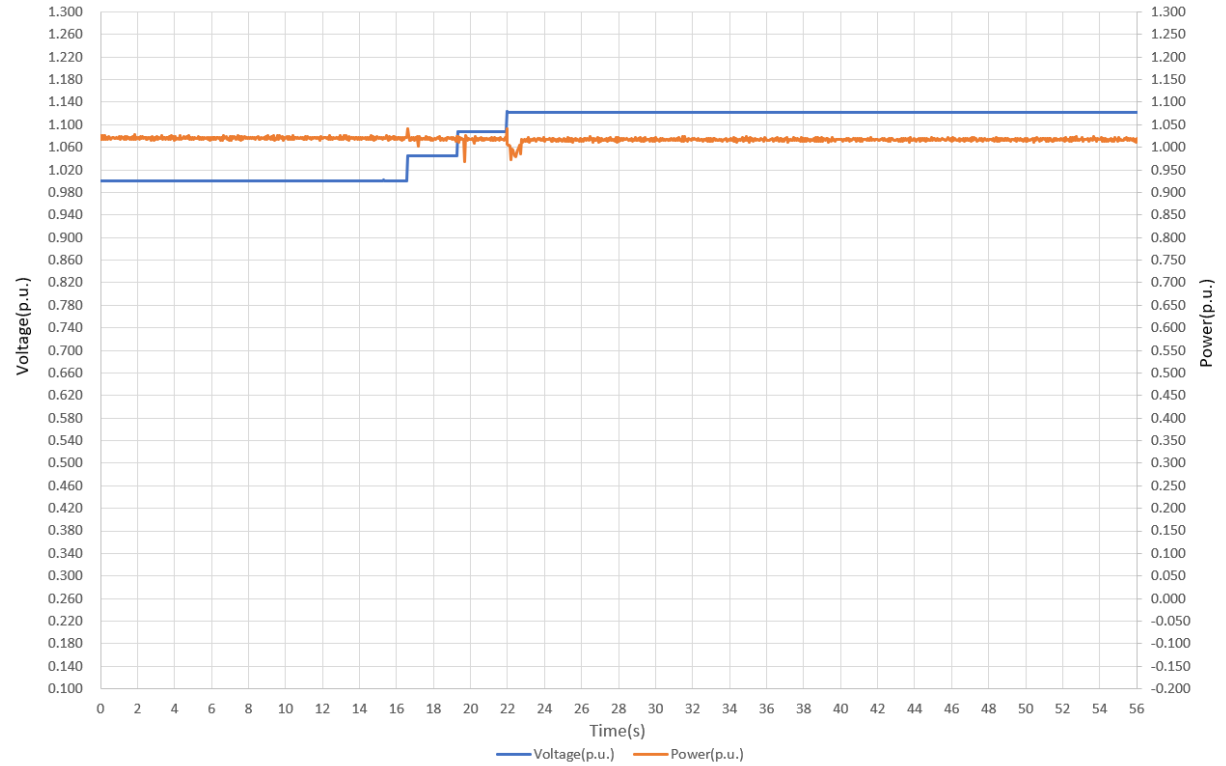


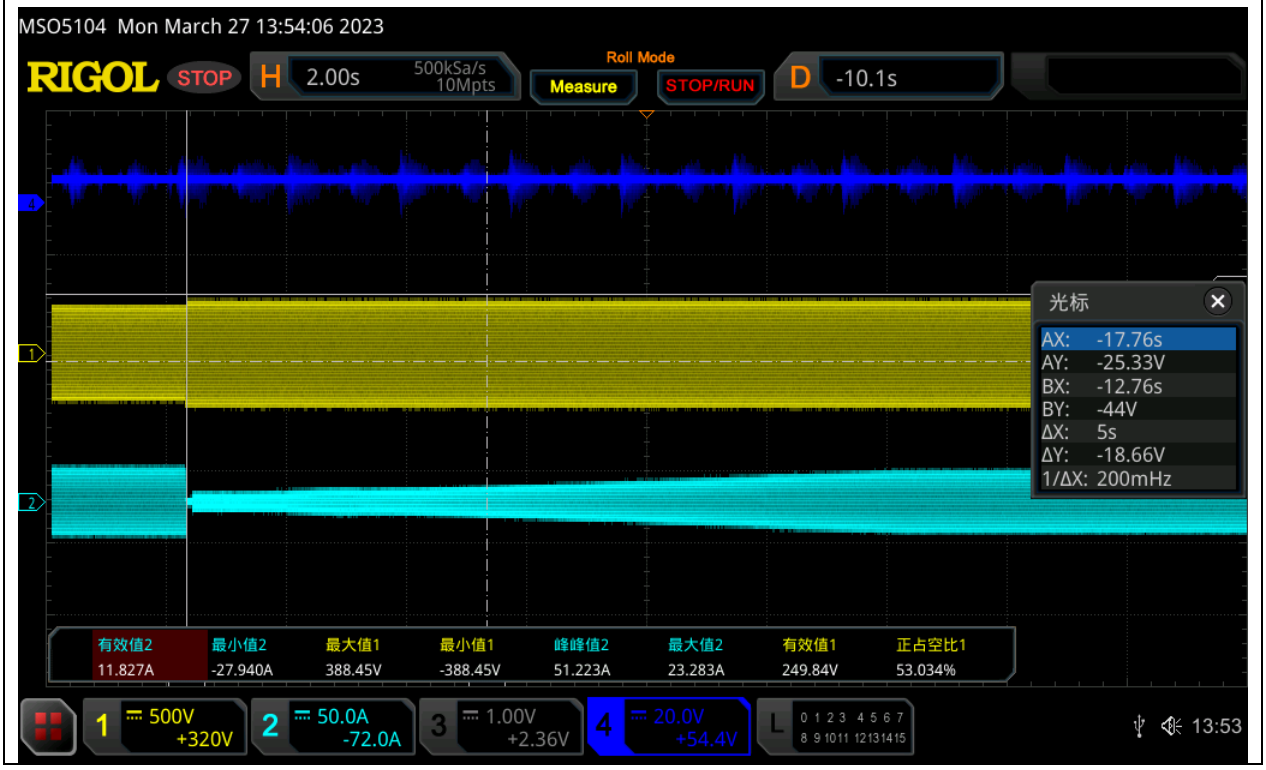
No trip tests – 180V



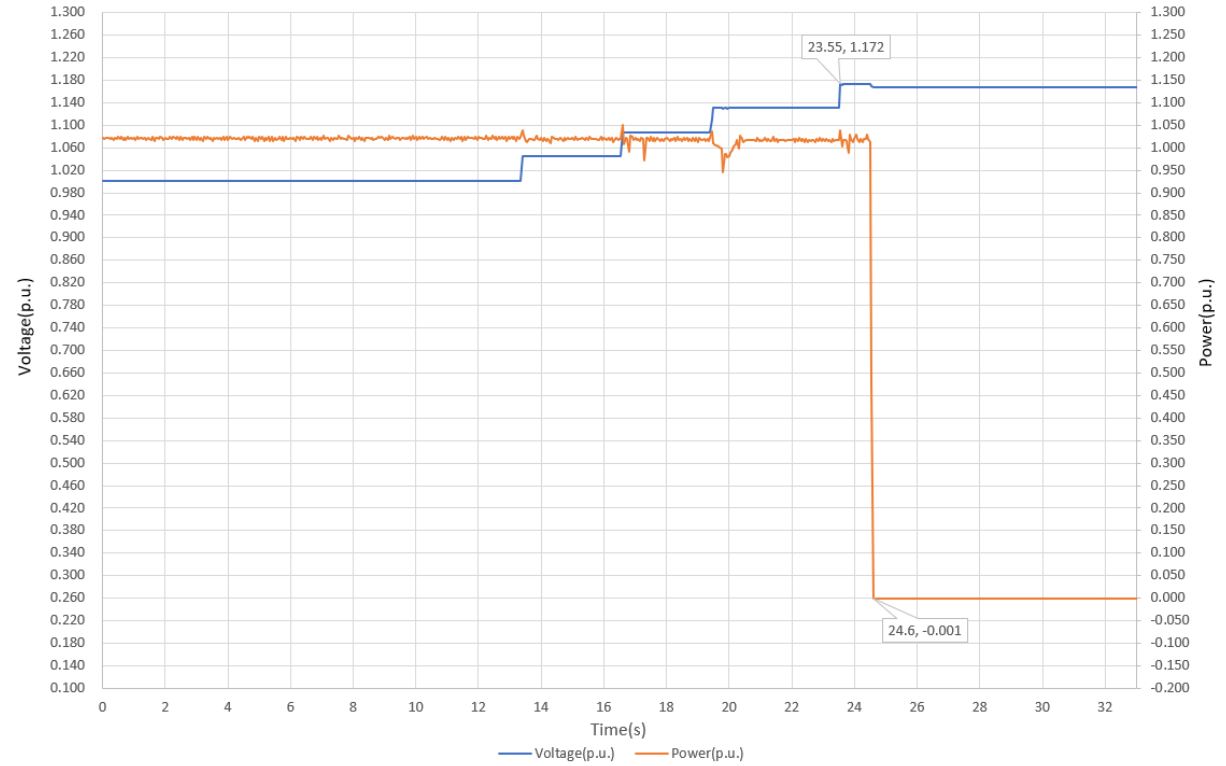


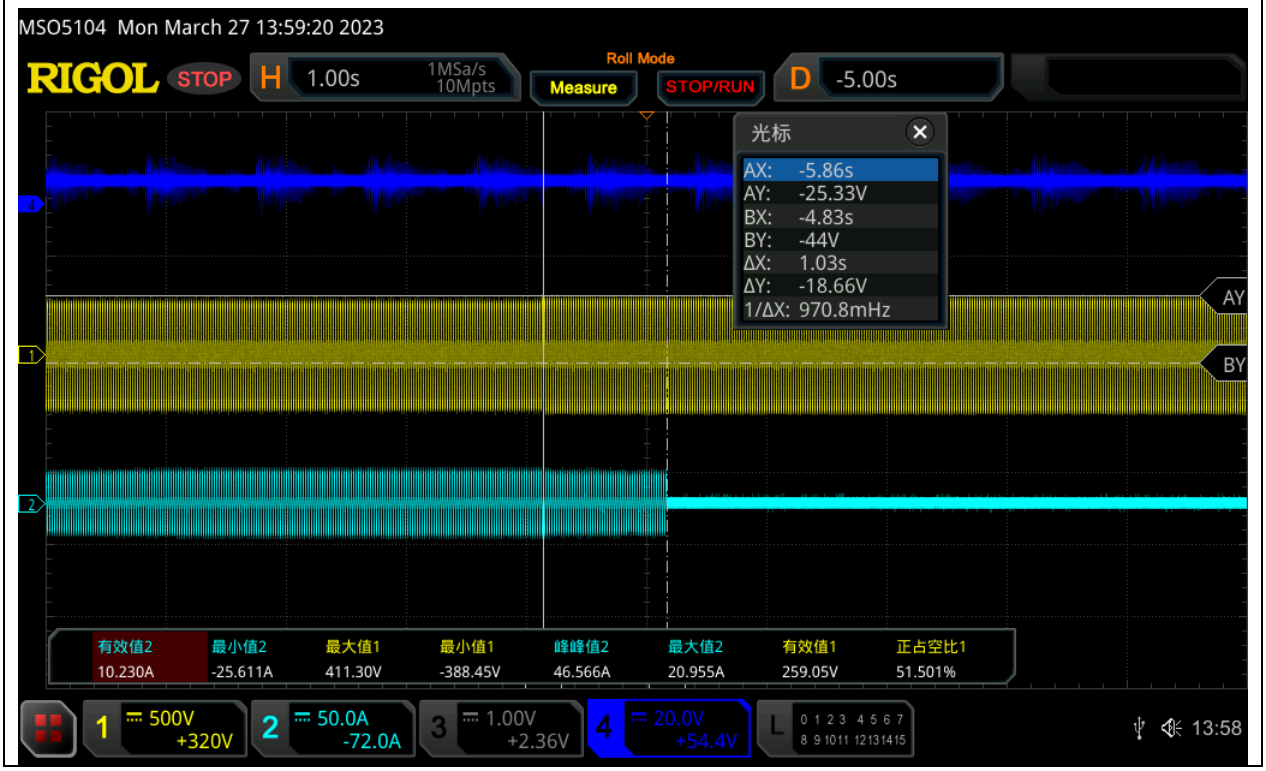
No trip tests – 258.2V



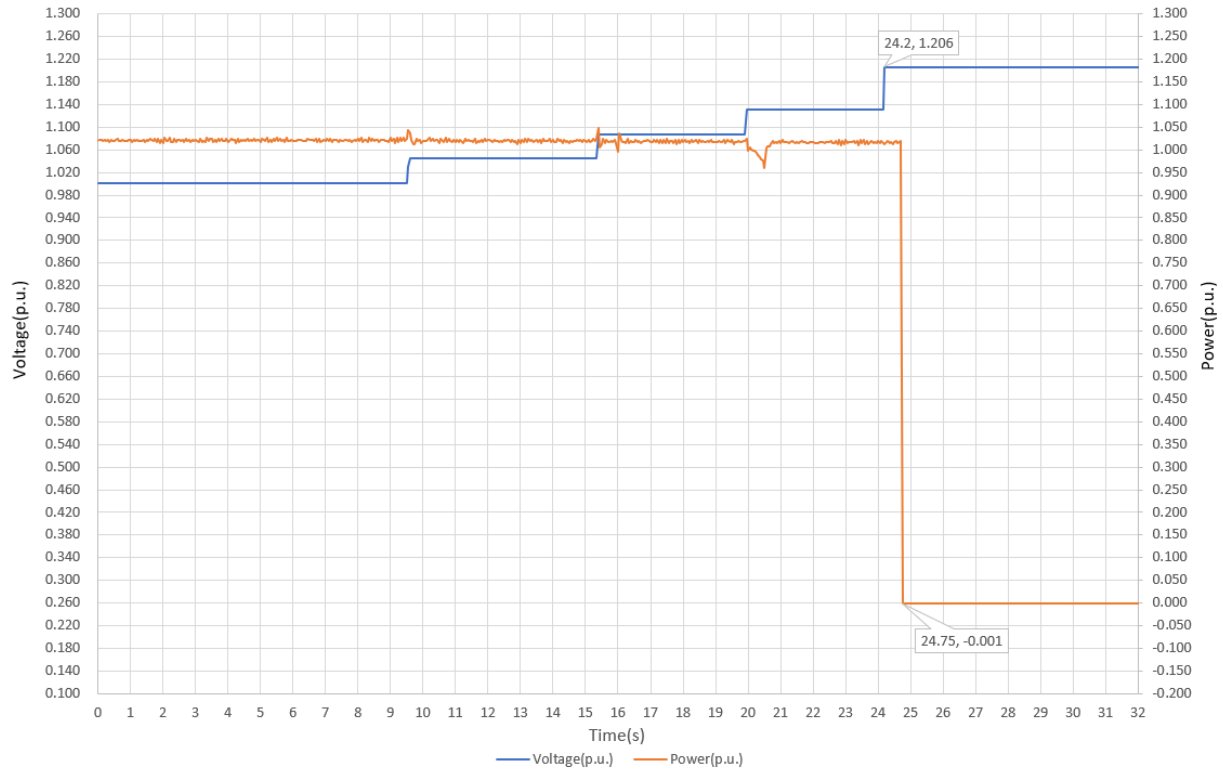


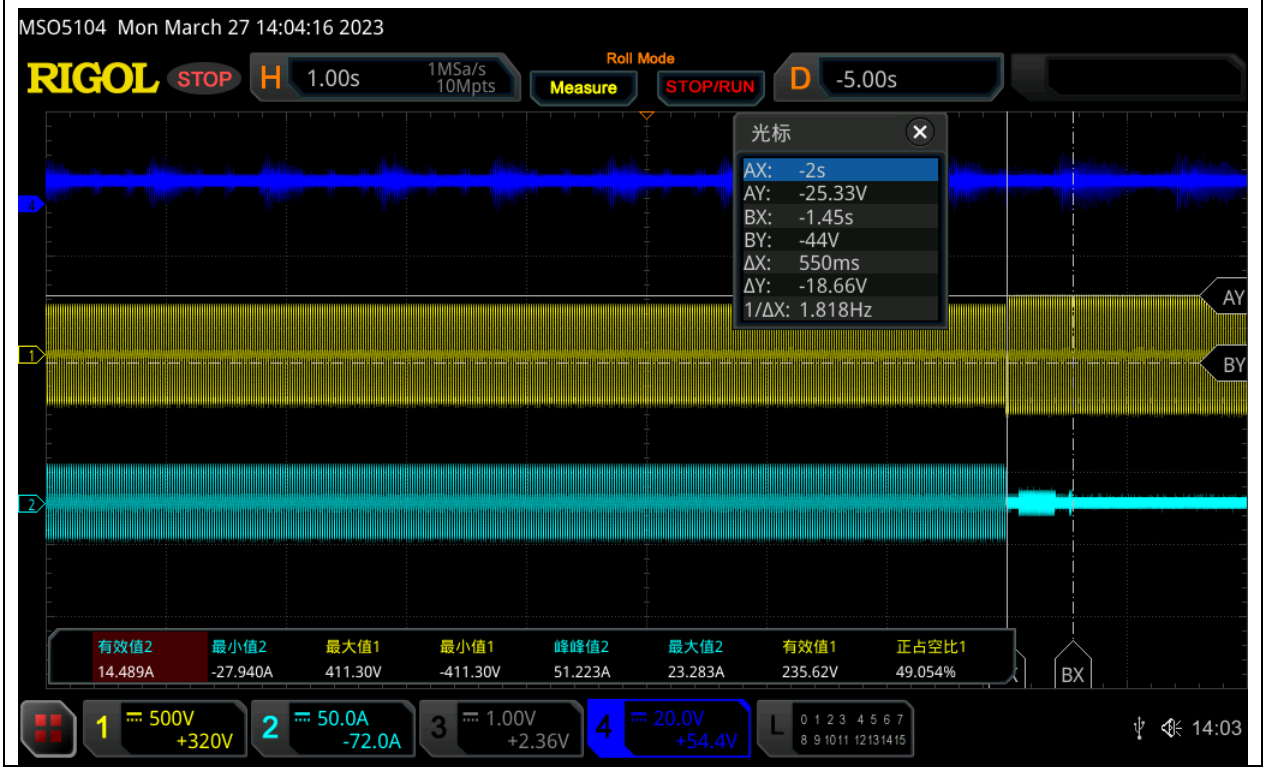
No trip tests – 269.7V





No trip tests – 277.7V





4.3.3 Loss of Mains test

For PV Inverters shall be tested in accordance with BS EN 62116.

The maximum trip time is 0.5 s.

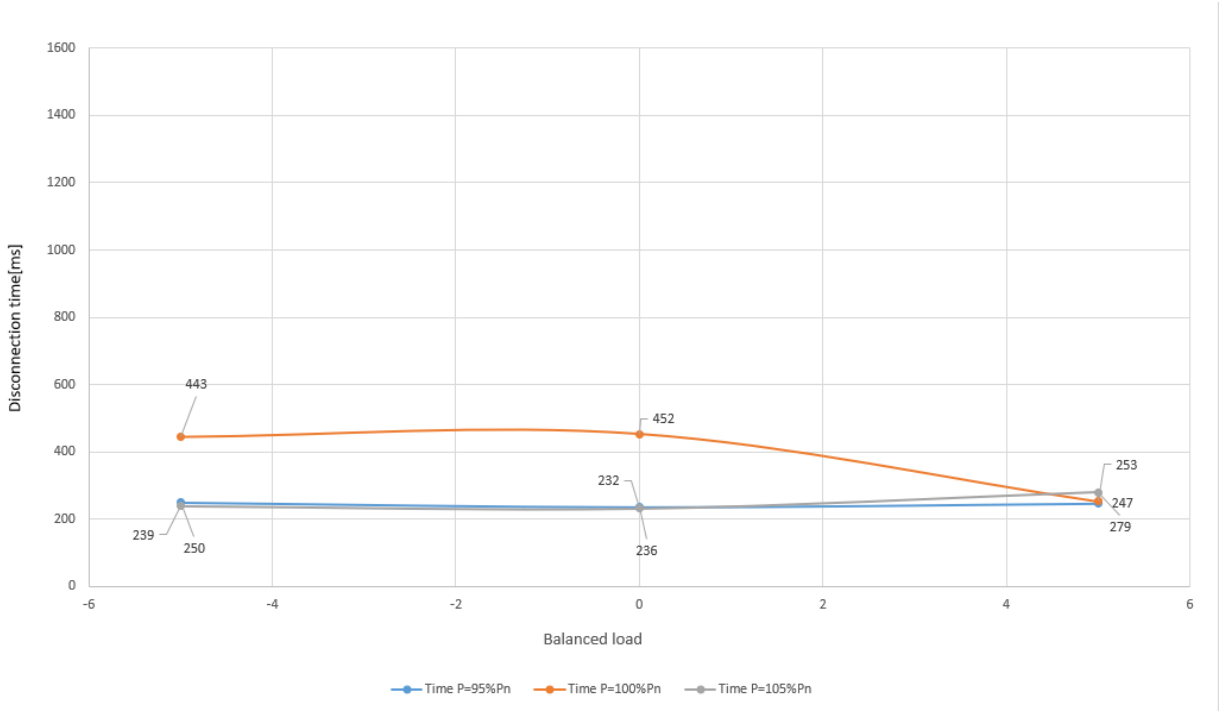
Note for technologies which have a substantial shut down time this can be added to the 0.5 s in establishing that the trip occurred in less than 0.5 s. Maximum shut down time could therefore be up to 1.0 s for these technologies.

Following tables show the test results:

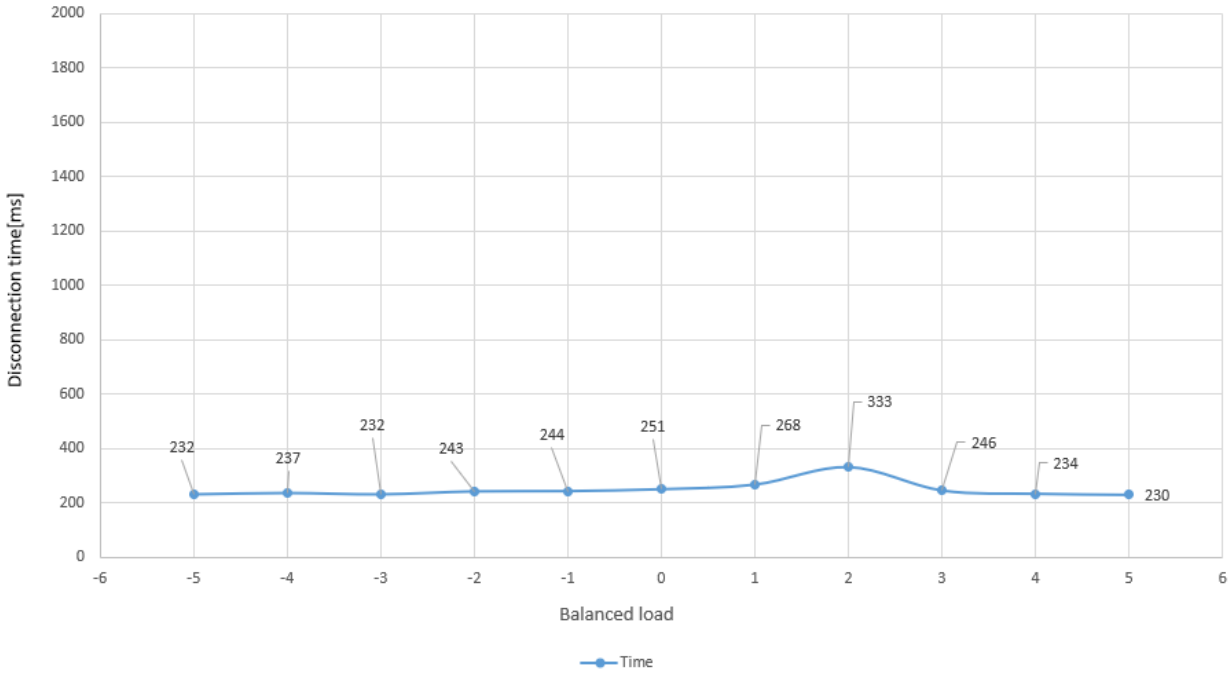
	Table: tested condition and trip time					P
No.	P_{EUT} (% of EUT rating)	Reactive load (% of normial)	P_{AC}	Q_{AC}	Trip time(s)	Which load is selected to be adjusted (R or L)
Test condition A						
1	100	100	0	0	0.452	--
2	100	100	-5	-5	0.250	R/L
3	100	100	-5	0	0.236	R
4	100	100	-5	+5	0.247	R/L
5	100	100	0	-5	0.443	L
6	100	100	0	+5	0.253	L
7	100	100	+5	-5	0.239	R/L
8	100	100	+5	0	0.232	R
9	100	100	+5	+5	0.279	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
25	100	100	-10	+5	--	R/L
Test condition B						
1	66	66	0	0	0.251	--
2	66	66	0	-5	0.232	L
3	66	66	0	-4	0.237	L
4	66	66	0	-3	0.232	L
5	66	66	0	-2	0.243	L
6	66	66	0	-1	0.244	L
7	66	66	0	1	0.268	L
8	66	66	0	2	0.333	L
9	66	66	0	3	0.246	L
10	66	66	0	4	0.234	L
11	66	66	0	5	0.230	L
Test condition C						
1	33	33	0	0	0.249	--
2	33	33	0	-5	0.241	L
3	33	33	0	-4	0.243	L
4	33	33	0	-3	0.245	L
5	33	33	0	-2	0.238	L
6	33	33	0	-1	0.232	L
7	33	33	0	1	0.240	L
8	33	33	0	2	0.232	L
9	33	33	0	3	0.228	L
10	33	33	0	4	0.230	L
11	33	33	0	5	0.228	L

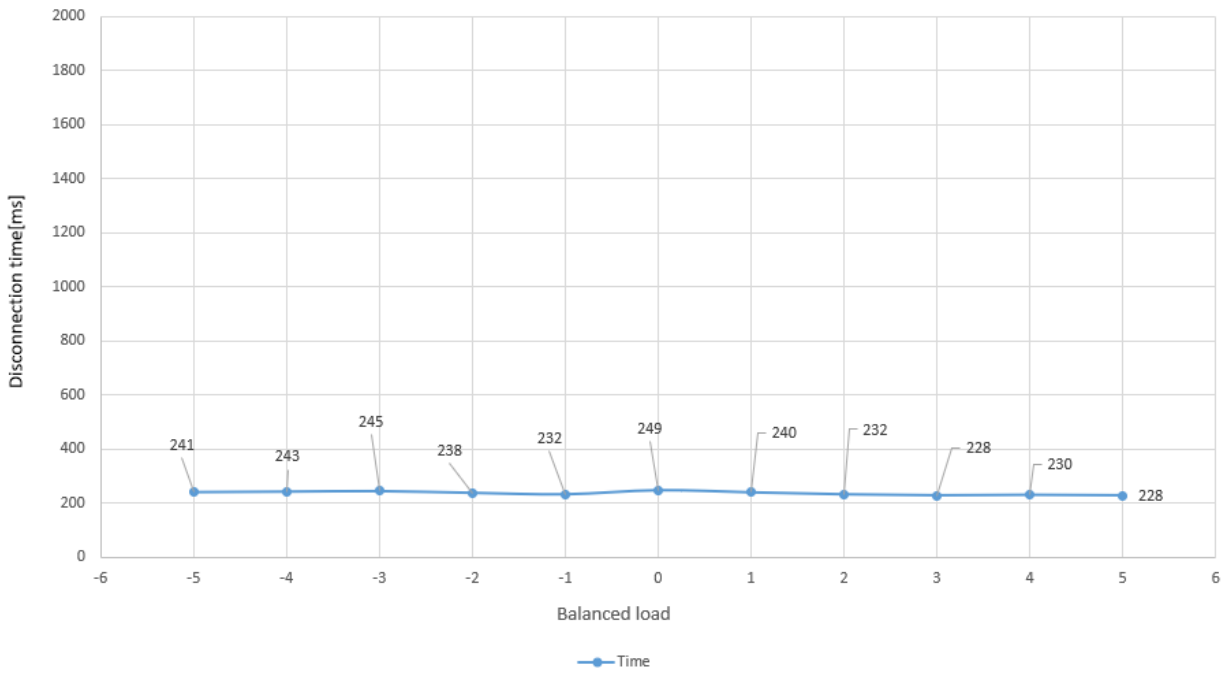
Test results are graphically shown in following pages.

Test Condition A

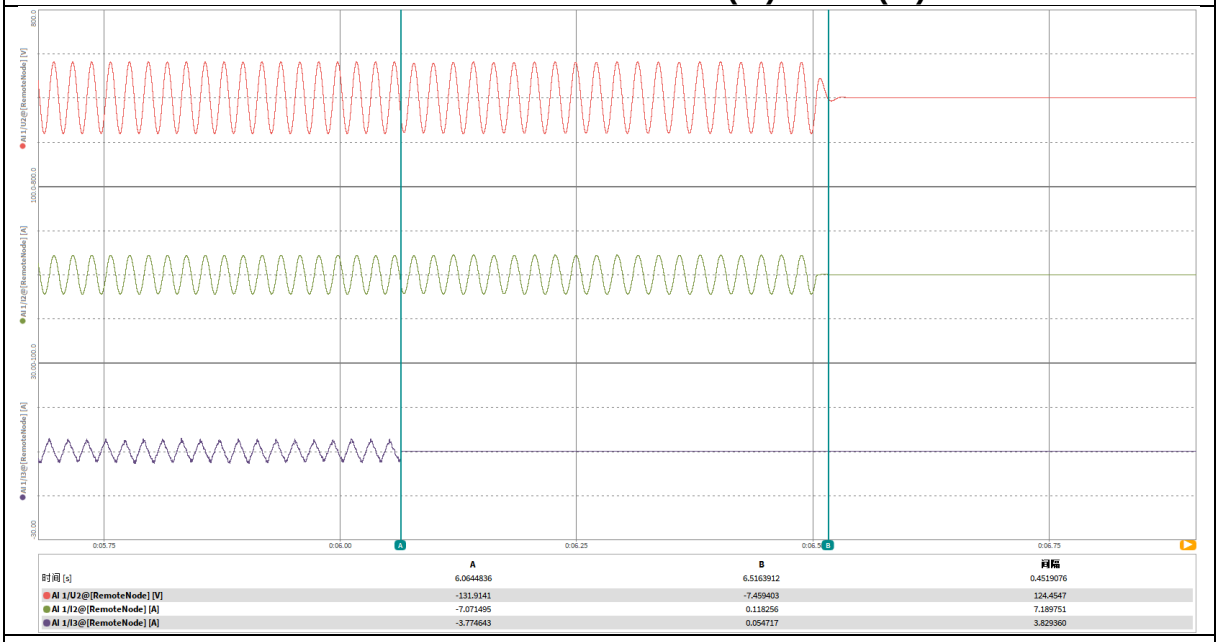


Test Condition B



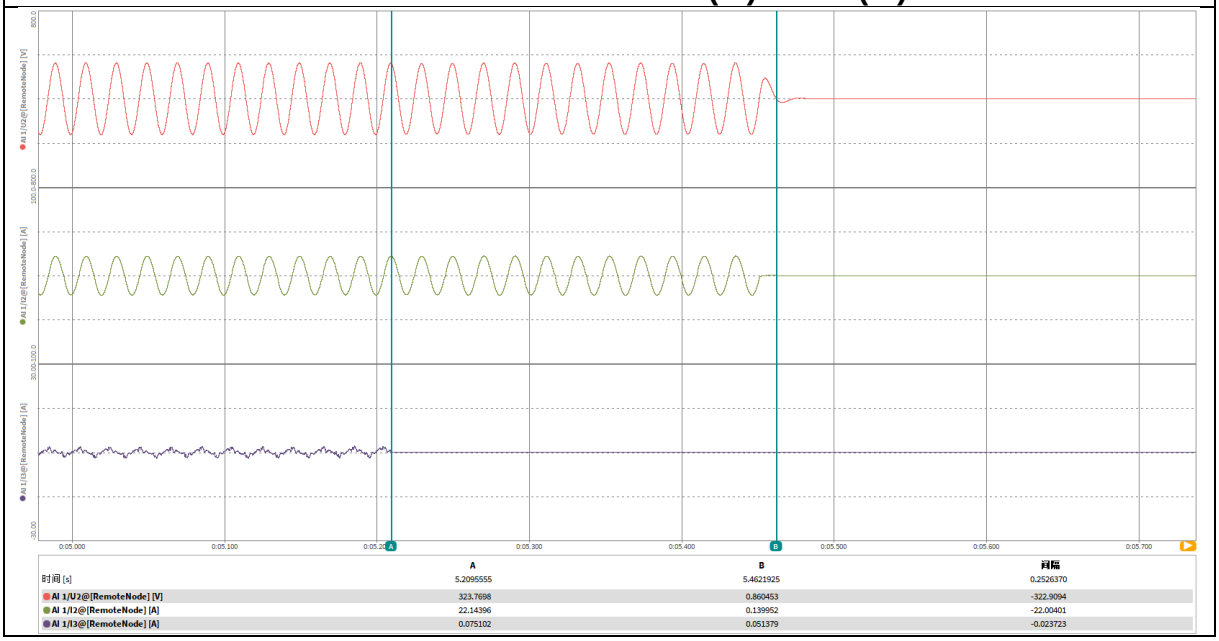
Test Condition C


Test A M(%)=0 & N(%)=0



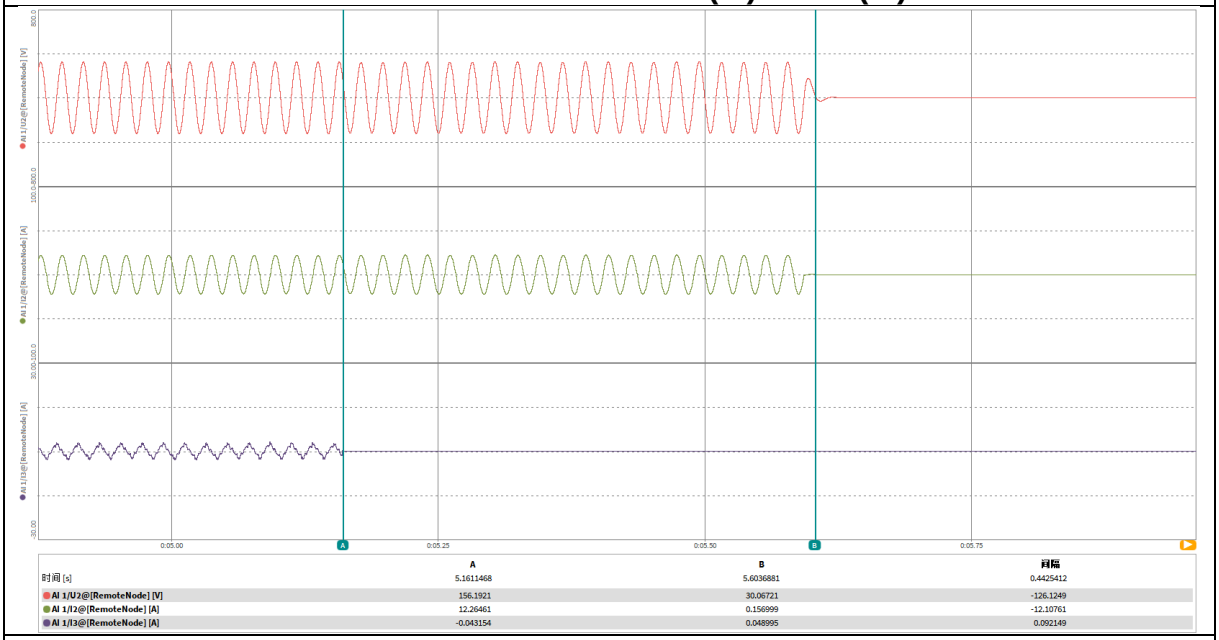
时间 [s]	A 6.0644836	B 6.5163912	间隔 0.4519076
AI 1/U2@[RemoteNode] [V]	-131.9141	-7.459403	124.4547
AI 1/I2@[RemoteNode] [A]	-7.071495	0.118256	7.189751
AI 1/I3@[RemoteNode] [A]	-3.774643	0.054717	3.829360

Test A M(%)=0 & N(%)=+5



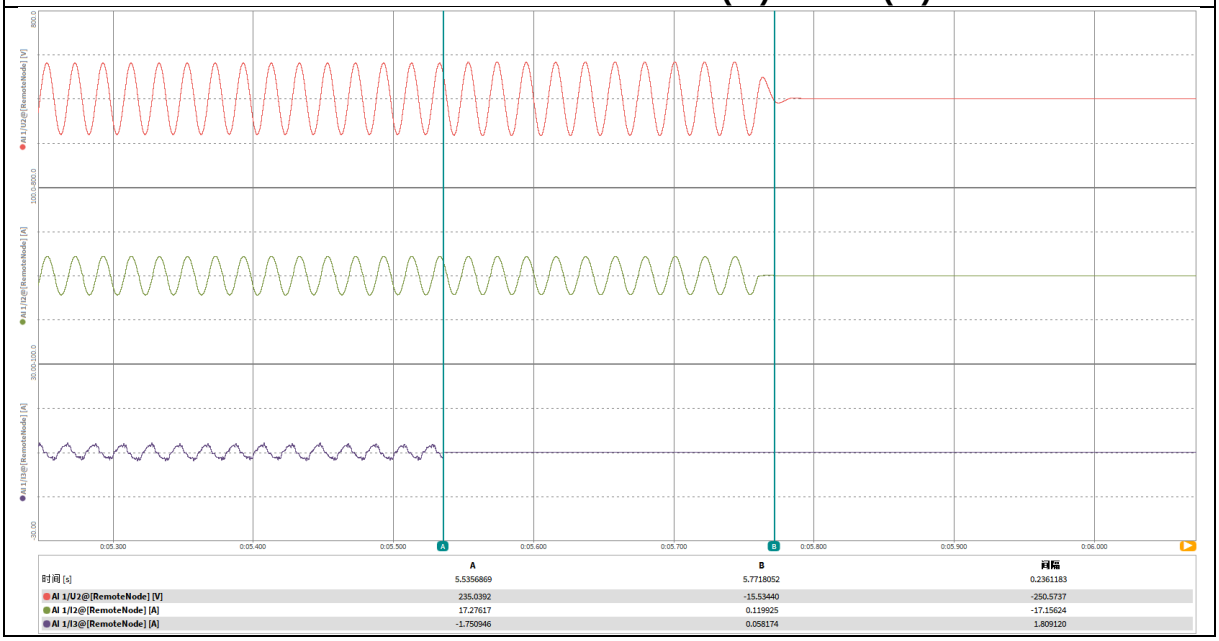
时间 [s]	A 5.2095555	B 5.4621925	间隔 0.2526370
AI 1/U2@[RemoteNode] [V]	323.7698	0.860453	-322.9094
AI 1/I2@[RemoteNode] [A]	22.14396	0.139952	-22.00401
AI 1/I3@[RemoteNode] [A]	0.075102	0.051379	-0.023723

Test A **M(%)=0 & N(%)=-5**



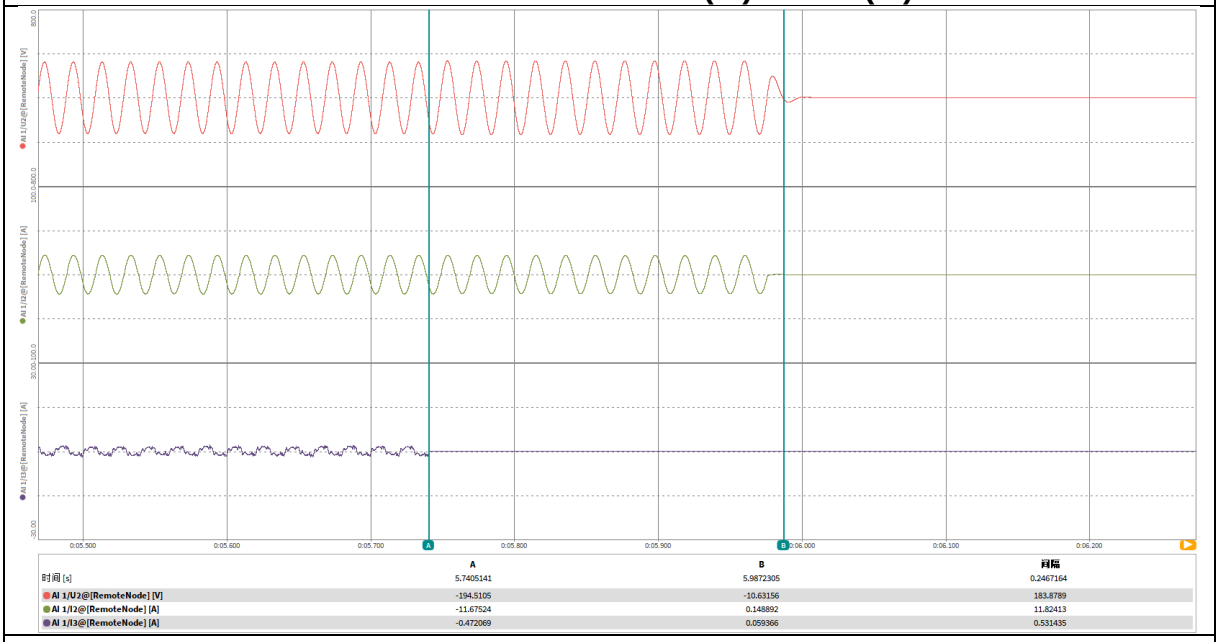
	A	B	间隔
时间 [s]	5.1611468	5.6036881	0.4425412
AI 1/U2@[RemoteNode] [V]	156.1921	30.06721	-126.1249
AI 1/I2@[RemoteNode] [A]	12.26461	0.156999	-12.10761
AI 1/I3@[RemoteNode] [A]	-0.043154	0.048995	0.092149

Test A **M(%)=-5 & N(%)=0**



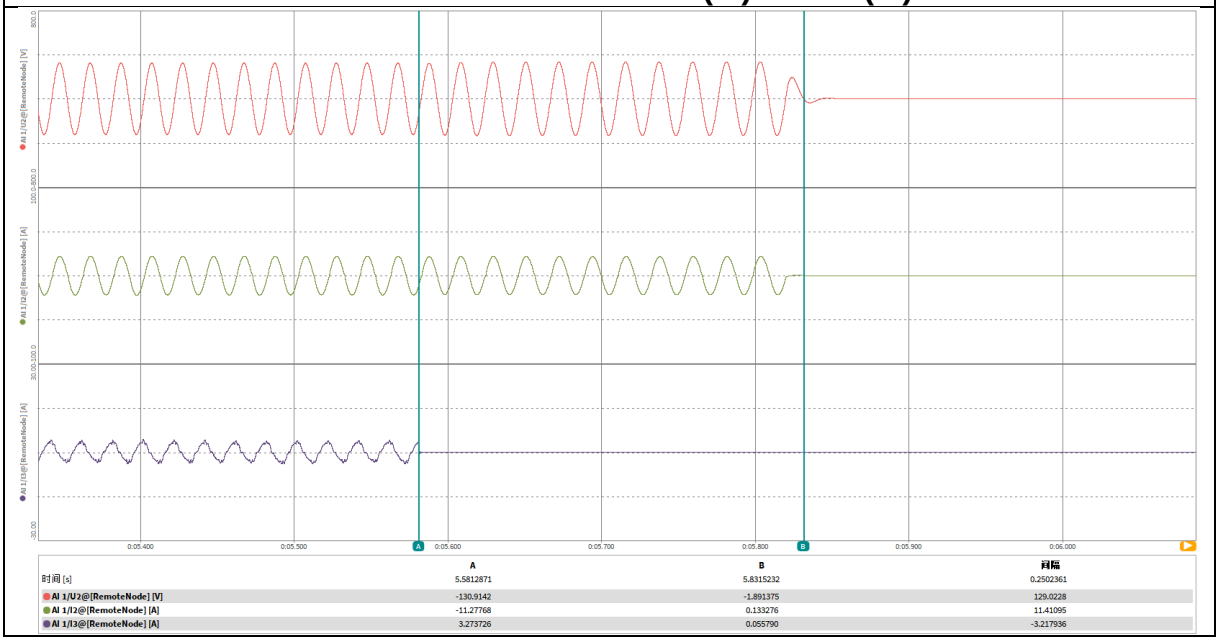
	A	B	间隔
时间 [s]	5.5356869	5.7718052	0.2361183
AI 1/U2@[RemoteNode] [V]	235.0392	-15.53440	-250.5737
AI 1/I2@[RemoteNode] [A]	17.27617	0.119925	-17.15624
AI 1/I3@[RemoteNode] [A]	-1.750946	0.058174	1.809120

Test A M(%)=-5 & N(%)=+5



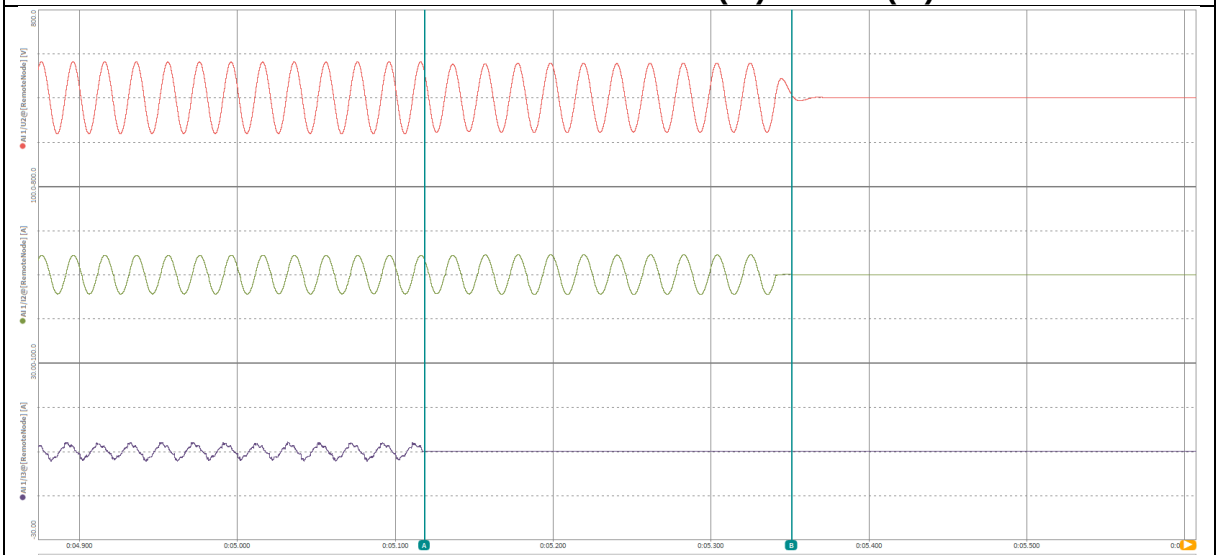
	A	B	间隔
时间 [s]	5.7405141	5.9872305	0.2467164
AI 1/U2@[RemoteNode] [V]	-194.5105	-10.63156	183.8789
AI 1/I2@[RemoteNode] [A]	-11.67524	0.148892	11.82413
AI 1/I3@[RemoteNode] [A]	-0.472069	0.059366	0.531435

Test A M(%)=-5 & N(%)=-5



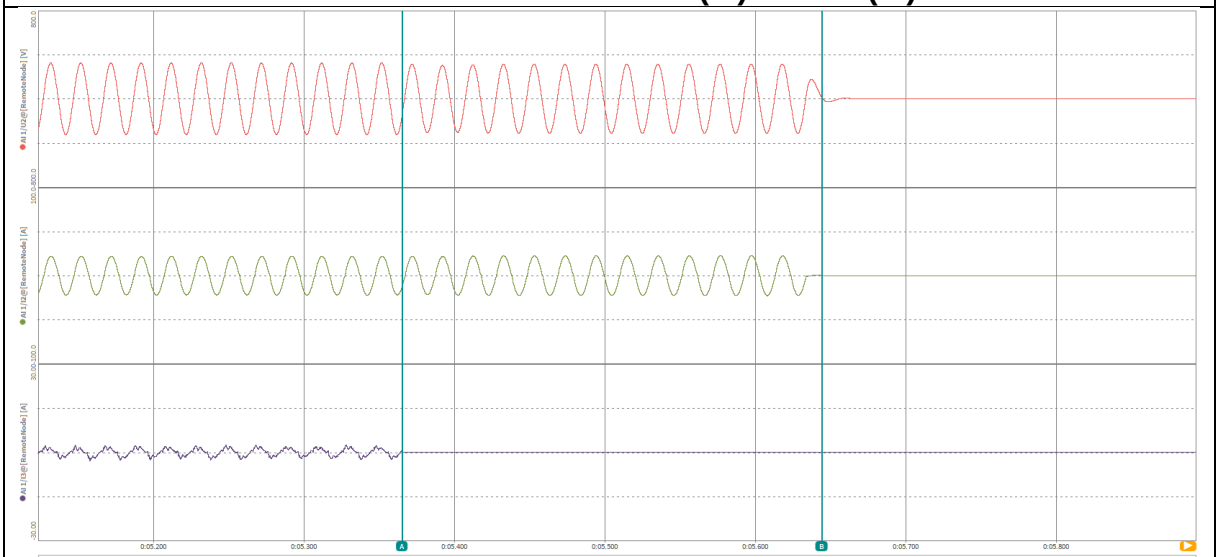
	A	B	间隔
时间 [s]	5.5812871	5.8315232	0.2502361
AI 1/U2@[RemoteNode] [V]	-130.9142	-1.891375	129.0228
AI 1/I2@[RemoteNode] [A]	-11.27768	0.133276	11.41095
AI 1/I3@[RemoteNode] [A]	3.273726	0.055790	-3.217936

Test A **M(%)=+5 & N(%)=0**



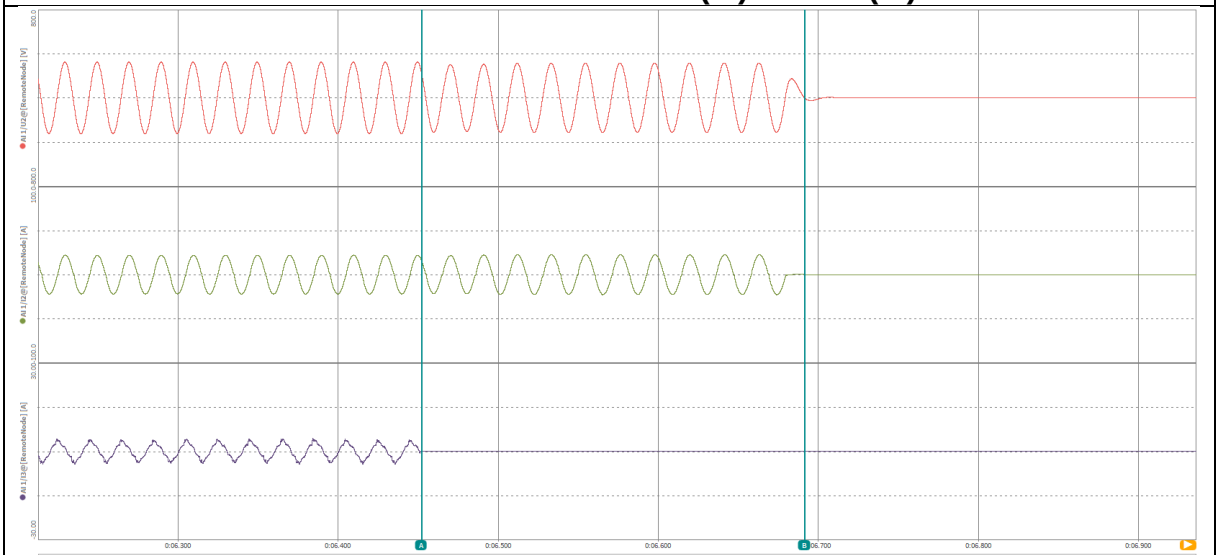
	A	B	间隔
时间 [s]	5.1186216	5.3510079	0.2323864
AI 1/U2@[RemoteNode] [V]	237.5138	28.99599	-208.5178
AI 1/I2@[RemoteNode] [A]	17.37440	0.154972	-17.21943
AI 1/I3@[RemoteNode] [A]	0.061631	0.055909	-5.722e-3

Test A **M(%)=+5 & N(%)=+5**



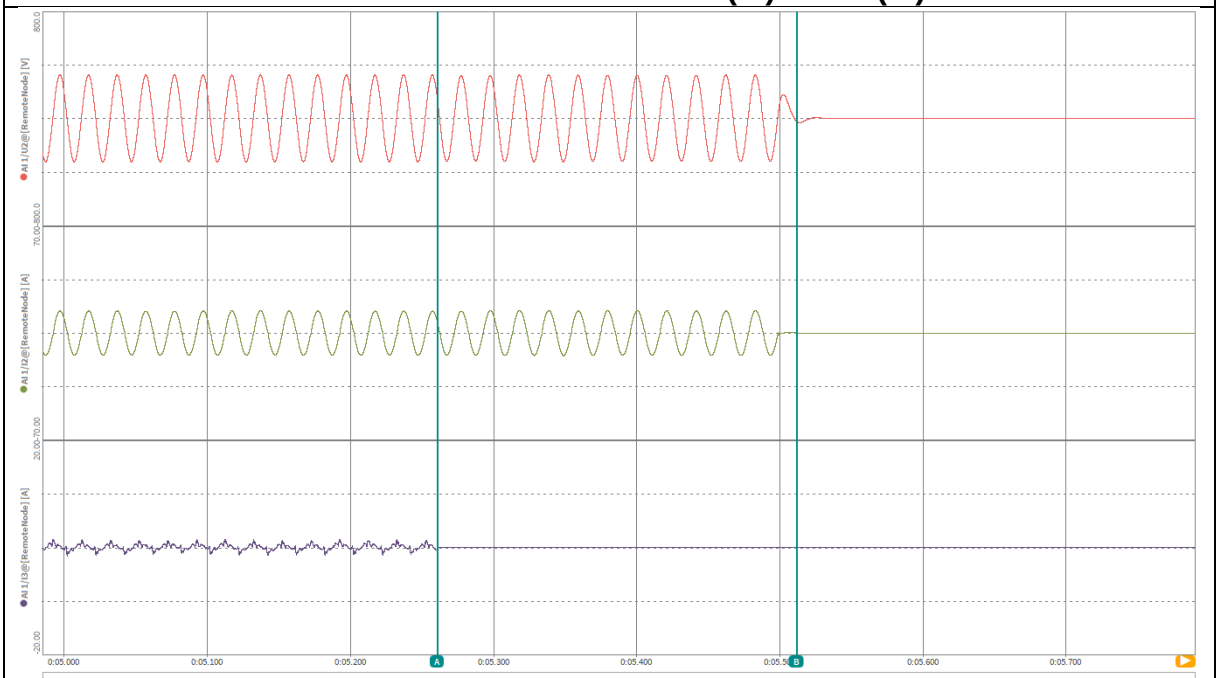
	A	B	间隔
时间 [s]	5.3654303	5.6442620	0.2788317
AI 1/U2@[RemoteNode] [V]	-143.5425	11.46460	155.0071
AI 1/I2@[RemoteNode] [A]	-12.05421	0.131369	12.18557
AI 1/I3@[RemoteNode] [A]	-0.058293	0.055313	0.113606

Test A M(%)=+5 & N(%)=-5



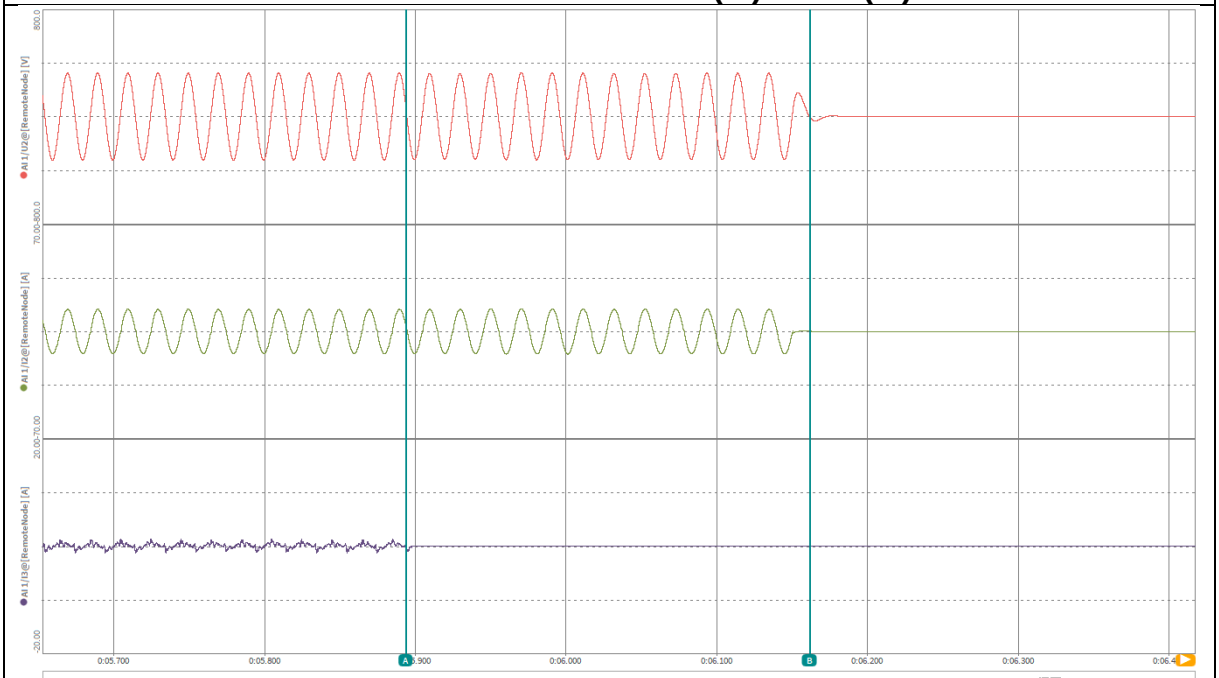
时间 [s]	A 6.4522428	B 6.6914753	间隔 0.2392325
AI 1/U2@[RemoteNode] [V]	241.8966	2.249003	-239.6476
AI 1/I2@[RemoteNode] [A]	17.31432	0.125527	-17.18879
AI 1/I3@[RemoteNode] [A]	0.063896	0.058532	-5.364e-3

Test B M(%)=0 & N(%)=0



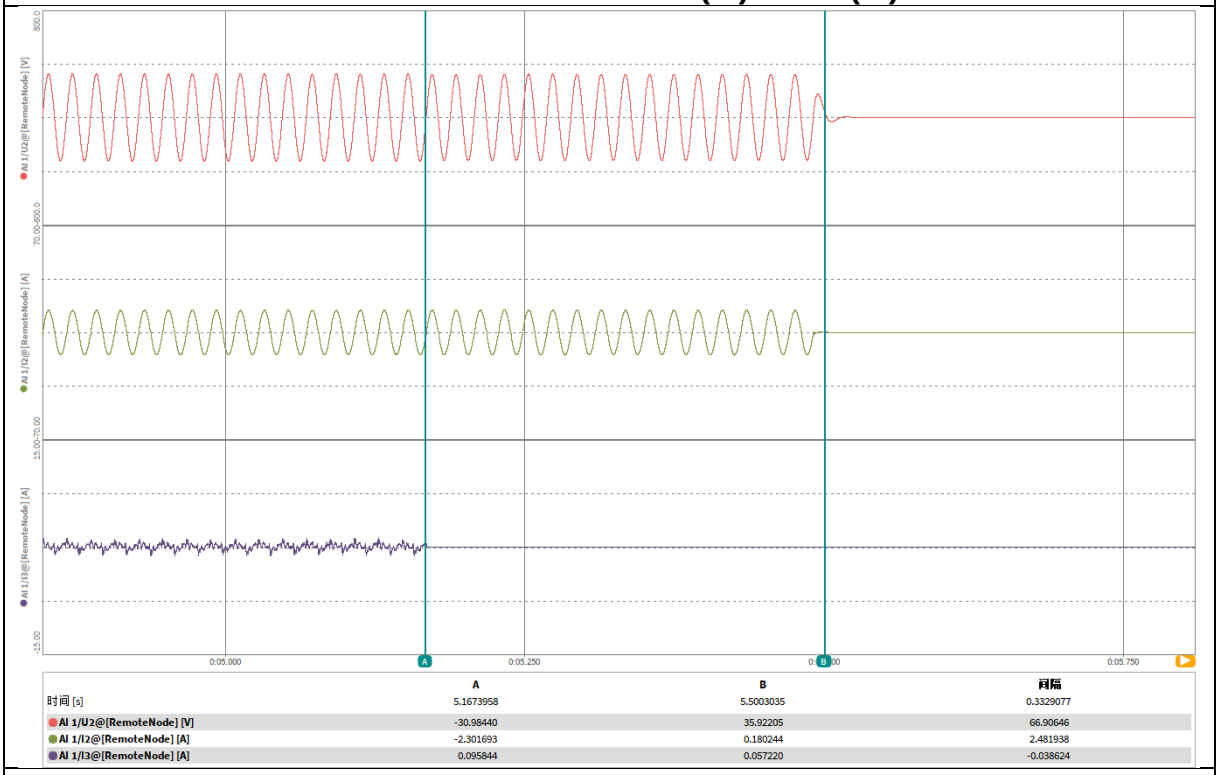
	A	B	间隔
时间 [s]	5.2609739	5.5118415	0.2508676
AI 1/U2@[RemoteNode] [V]	136.6508	-24.10197	-160.7528
AI 1/I2@[RemoteNode] [A]	6.859661	0.069976	-6.789685
AI 1/I3@[RemoteNode] [A]	-0.254869	0.055075	0.309944

Test B M(%)=0 & N(%)=+1



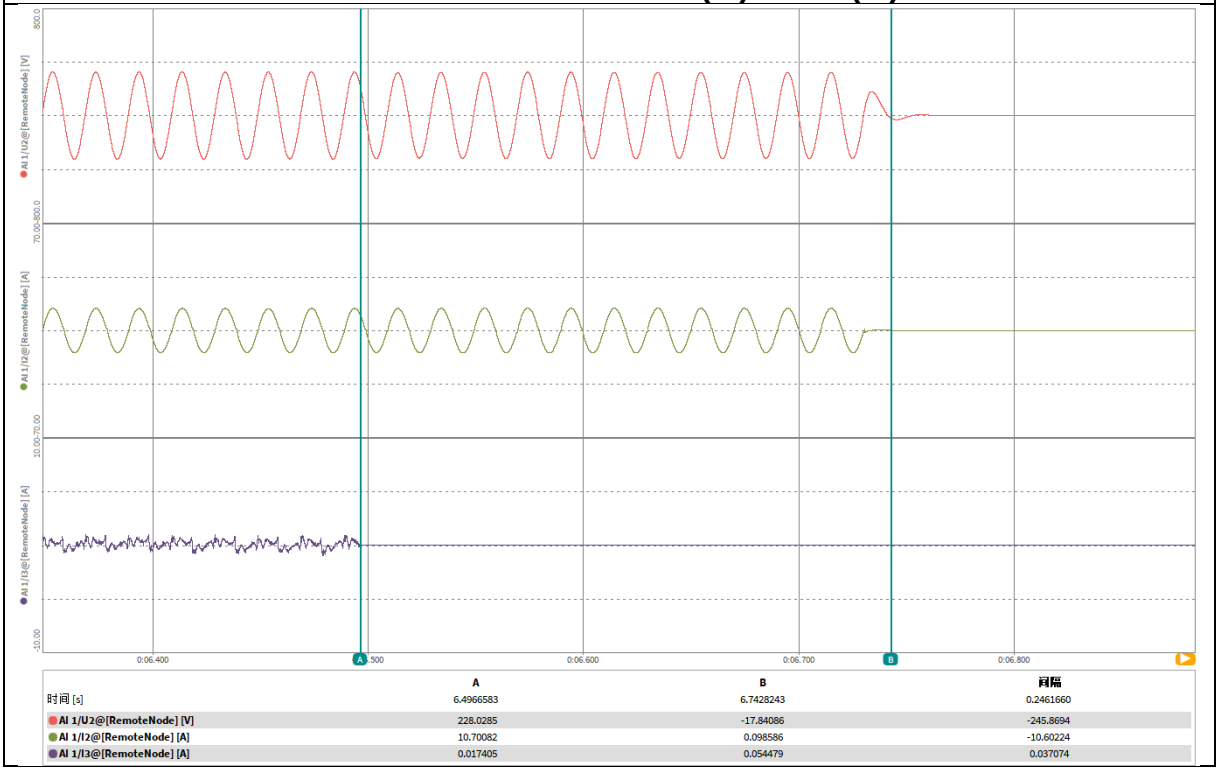
	A	B	间隔
时间 [s]	5.8940611	6.1617879	0.2677268
AI 1/U2@[RemoteNode] [V]	41.17632	-6.193877	-47.37020
AI 1/I2@[RemoteNode] [A]	2.452850	0.114799	-2.338052
AI 1/I3@[RemoteNode] [A]	-0.111341	0.056982	0.168324

Test B **M(%)=0 & N(%)=+2**



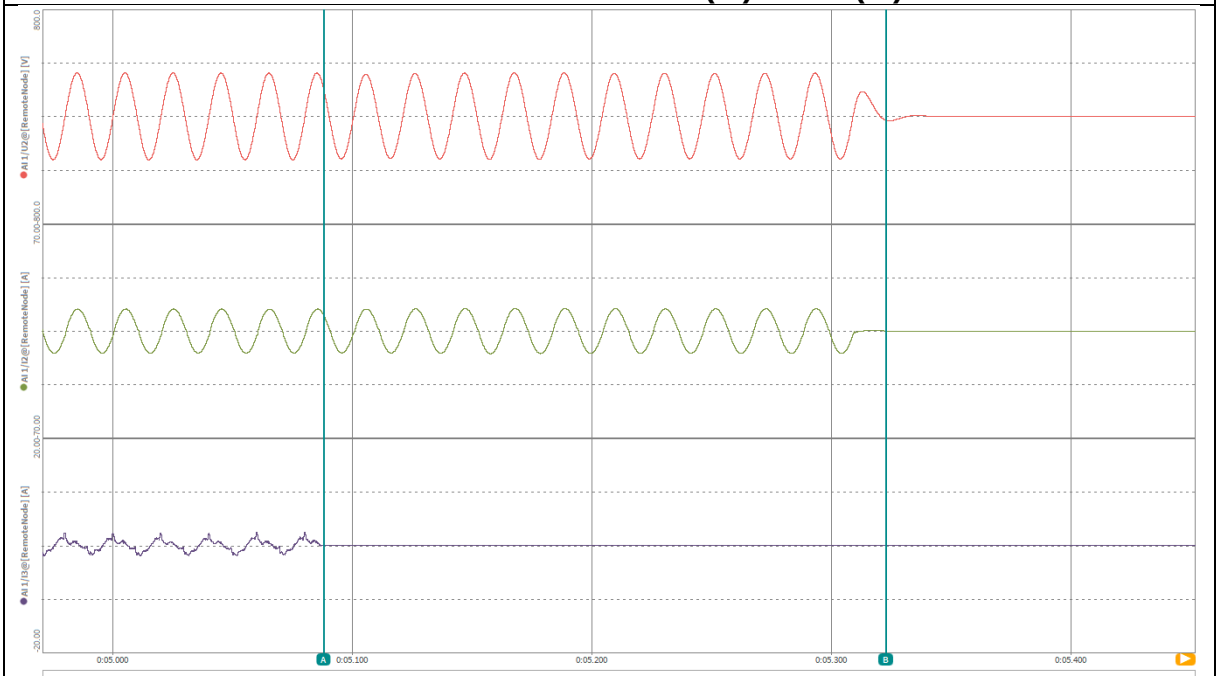
	A	B	间隔
时间 [s]	5.1673958	5.5003035	0.3329077
AI 1/U2@[RemoteNode] [V]	-30.98440	35.92205	66.90646
AI 1/I2@[RemoteNode] [A]	-2.301693	0.180244	2.481938
AI 1/I3@[RemoteNode] [A]	0.095844	0.057220	-0.038624

Test B **M(%)=0 & N(%)=+3**



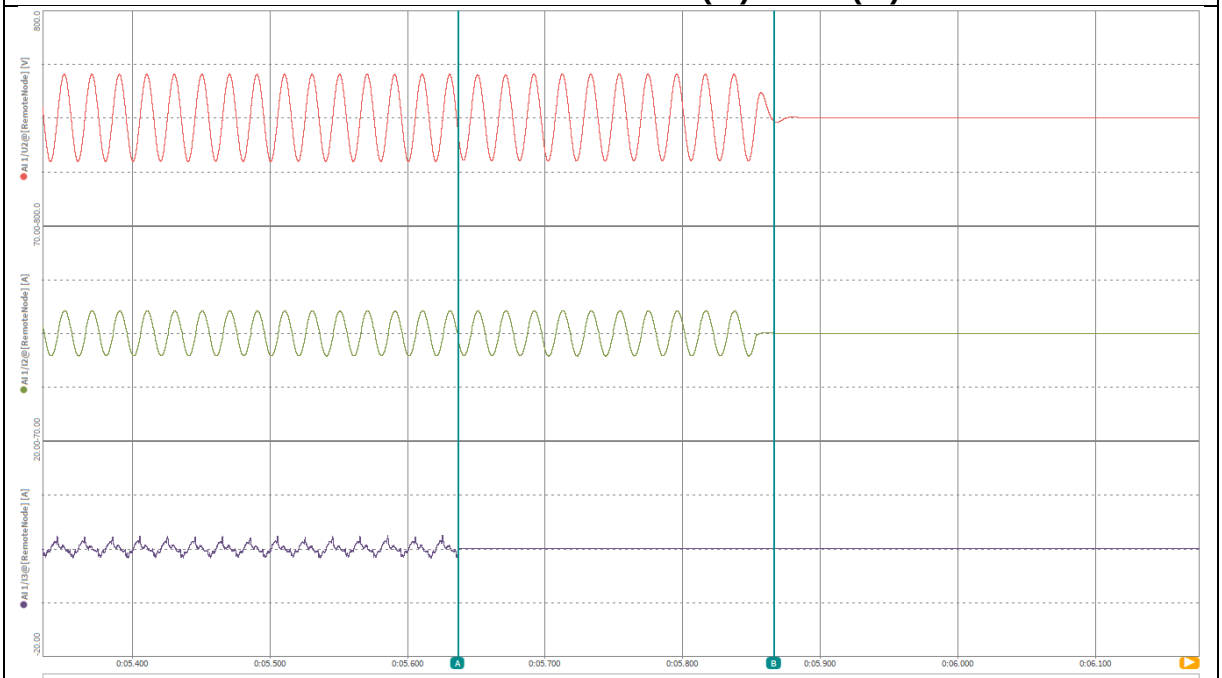
	A	B	间隔
时间 [s]	6.4966583	6.7428243	0.2461660
AI 1/U2@[RemoteNode] [V]	228.0285	-17.84086	-245.8694
AI 1/I2@[RemoteNode] [A]	10.70082	0.098586	-10.60224
AI 1/I3@[RemoteNode] [A]	0.017405	0.054479	0.037074

Test B M(%)=0 & N(%)=+4



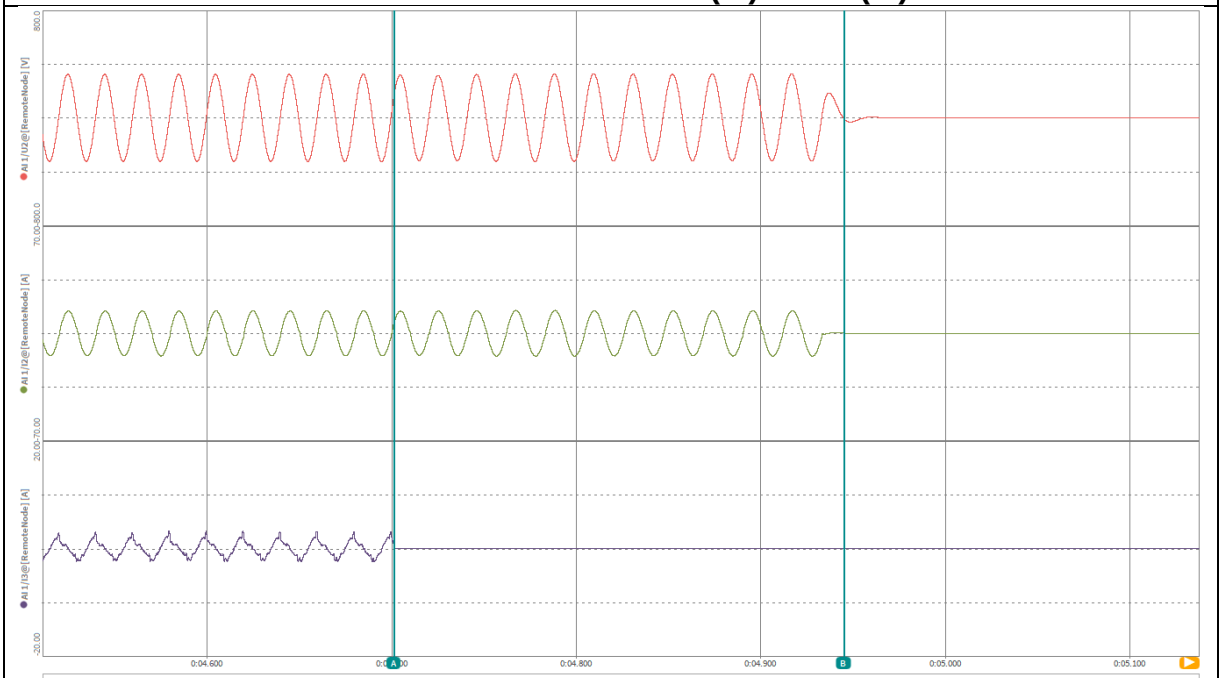
	A	B	间隔
时间 [s]	5.0884301	5.3228484	0.2344183
AI 1/U2@[RemoteNode] [V]	191.1306	-30.00283	-221.1335
AI 1/I2@[RemoteNode] [A]	9.806991	0.050545	-9.756446
AI 1/I3@[RemoteNode] [A]	0.065446	0.056505	-8.941e-3

Test B M(%)=0 & N(%)=+5



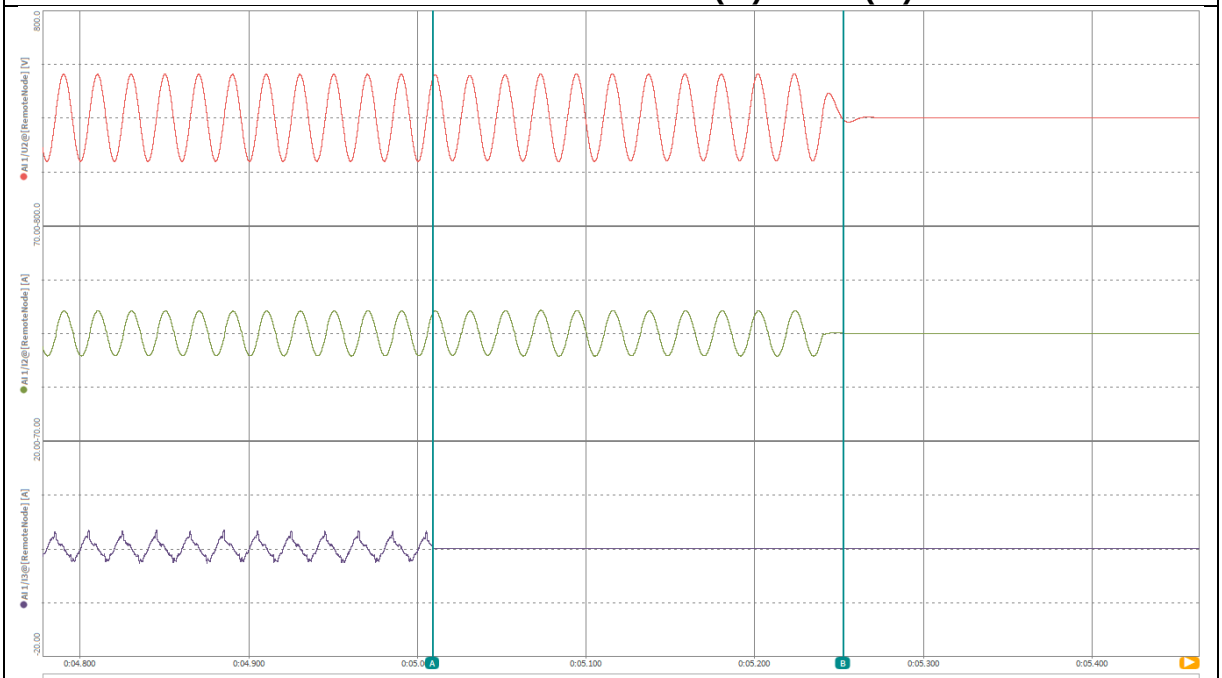
	A	B	间隔
时间 [s]	5.6367826	5.8665727	0.2297901
AI 1/U2@[RemoteNode] [V]	-111.0745	-29.46758	81.60687
AI 1/I2@[RemoteNode] [A]	-3.012538	0.068307	3.080845
AI 1/I3@[RemoteNode] [A]	-1.491189	0.058889	1.550078

Test B M(%)=0 & N(%)=-1



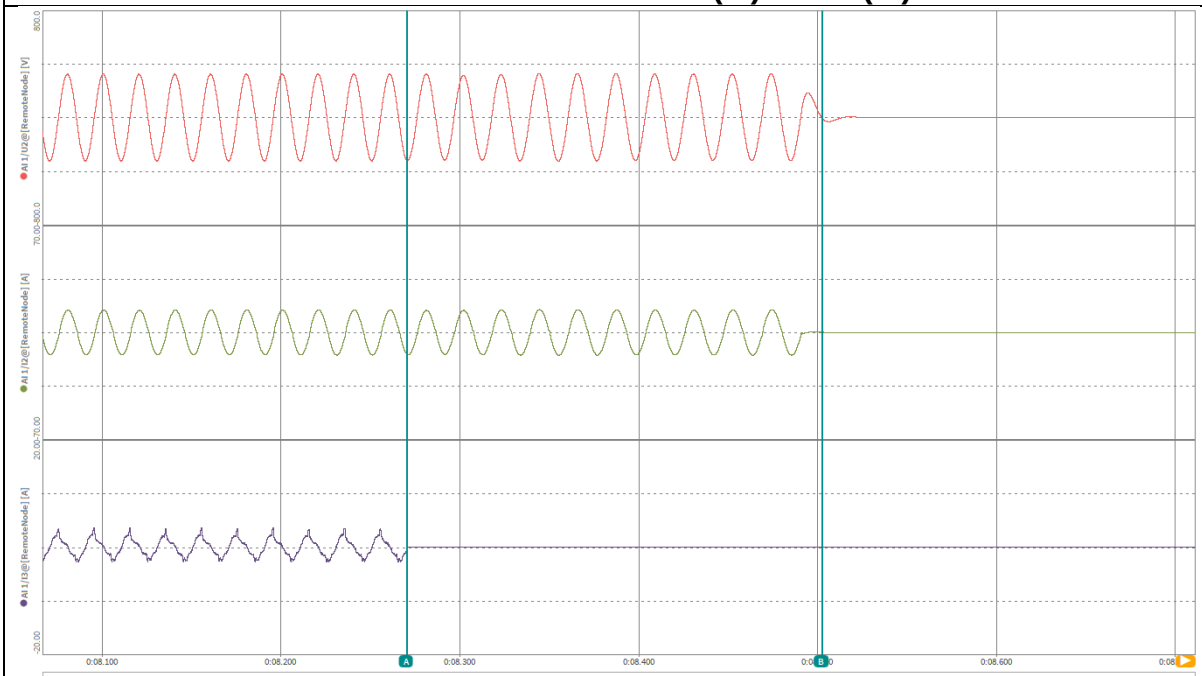
	A	B	间隔
时间 [s]	4.7014084	4.9451812	0.2437728
AI 1/U2@[RemoteNode] [V]	174.5098	-8.000136	-182.5099
AI 1/I2@[RemoteNode] [A]	7.156372	0.094533	-7.061840
AI 1/I3@[RemoteNode] [A]	0.627041	0.055313	-0.571728

Test B M(%)=0 & N(%)=-2



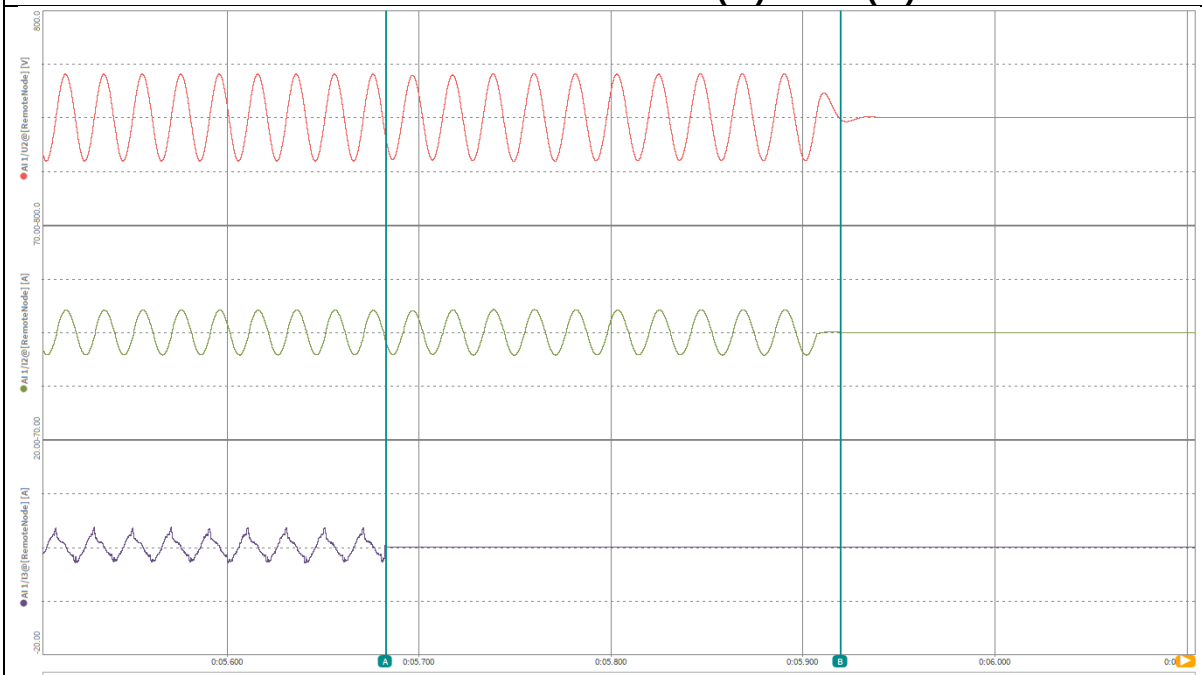
	A	B	间隔
时间 [s]	5.0092122	5.2524760	0.2432637
AI 1/U2@[RemoteNode] [V]	295.0661	-12.35366	-307.4198
AI 1/I2@[RemoteNode] [A]	12.88557	0.109911	-12.77566
AI 1/I3@[RemoteNode] [A]	0.748396	0.057101	-0.691295

Test B M(%)=0 & N(%)=-3



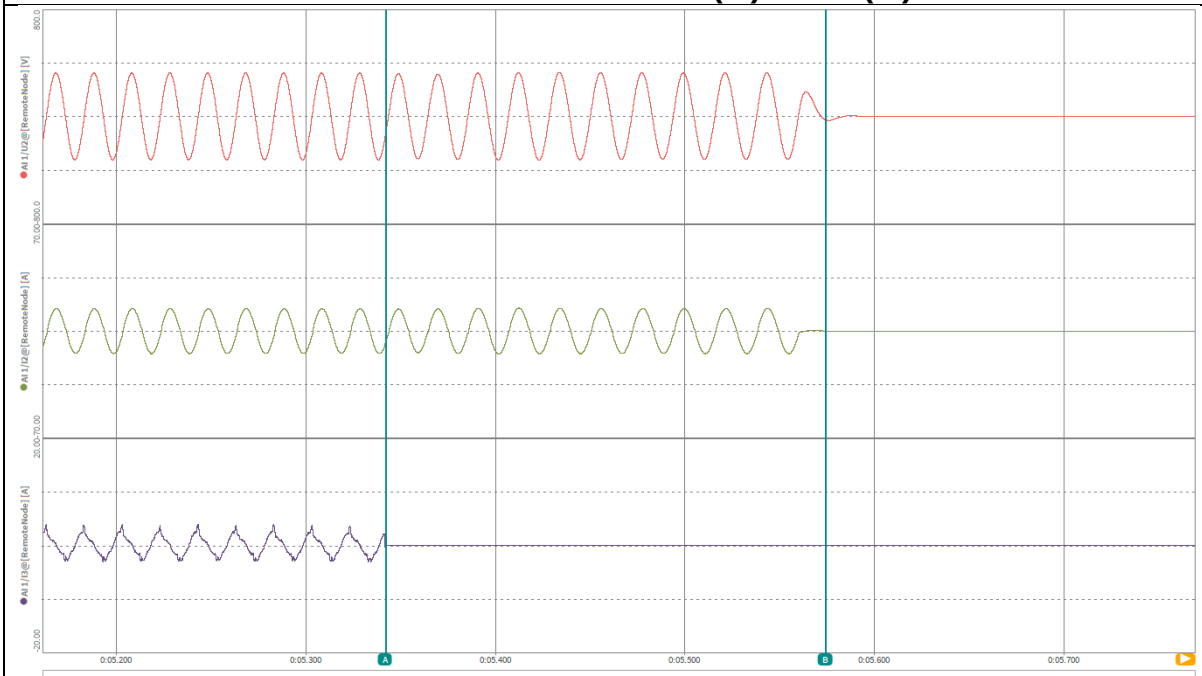
	A	B	间隔
时间 [s]	8.2703089	8.5024095	0.2321006
AI 1/U2@[RemoteNode] [V]	-320.6482	-2.970457	317.6778
AI 1/I2@[RemoteNode] [A]	-14.25409	0.122309	14.37640
AI 1/I3@[RemoteNode] [A]	0.076771	0.054479	-0.022292

Test B M(%)=0 & N(%)=-4



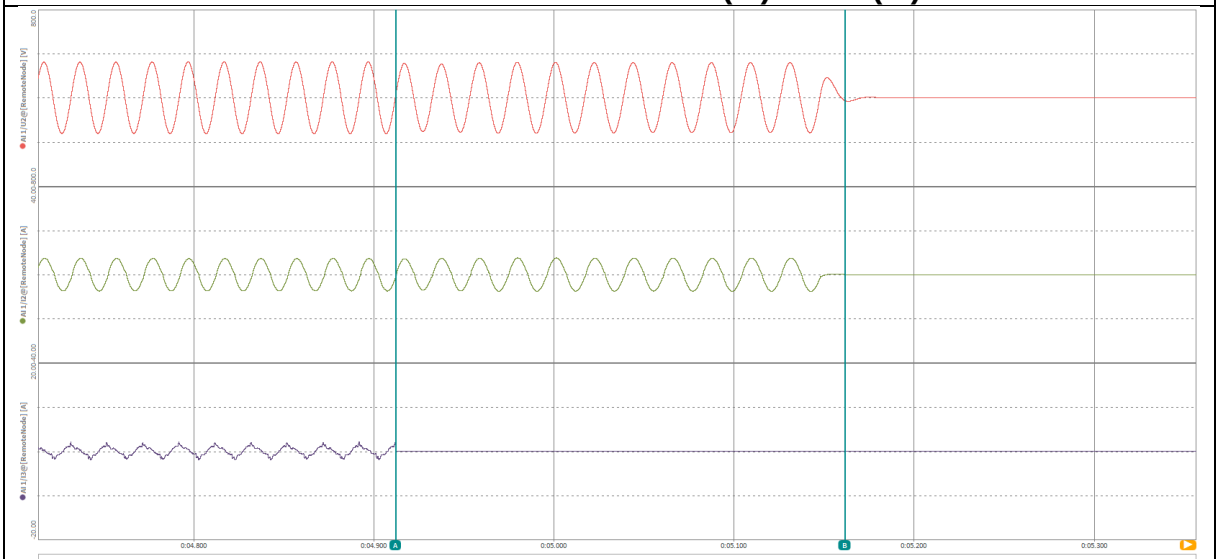
	A	B	间隔
时间 [s]	5.6827879	5.9195796	0.2367918
AI 1/U2@[RemoteNode] [V]	-135.6115	-12.37154	123.2400
AI 1/I2@[RemoteNode] [A]	-5.273462	0.105023	5.378485
AI 1/I3@[RemoteNode] [A]	0.128508	0.059962	-0.068545

Test B **M(%)=0 & N(%)=-5**



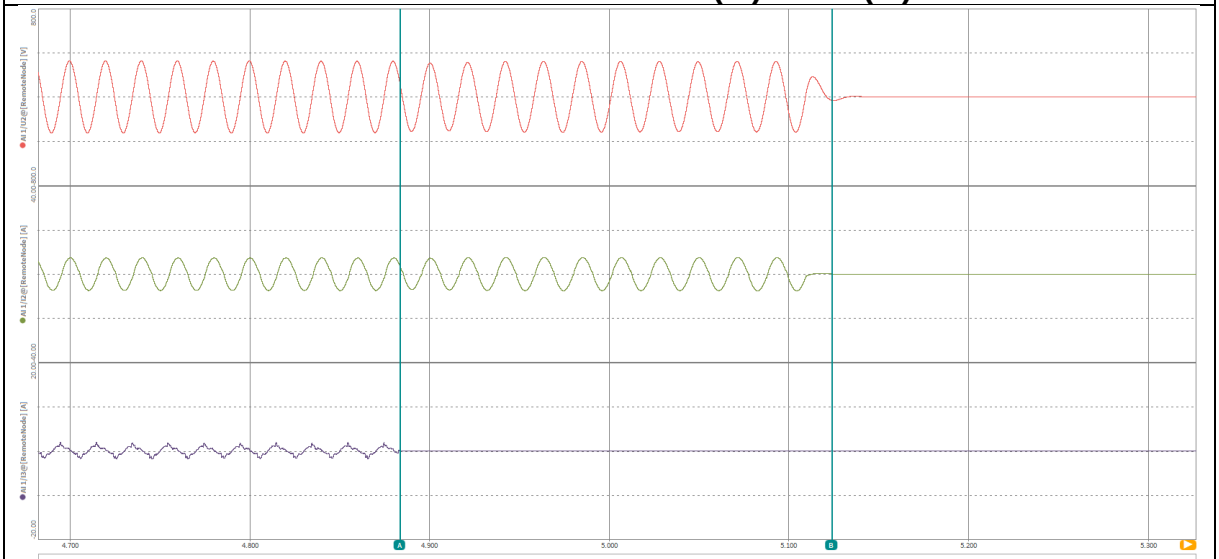
	A	B	间隔
时间 [s]	5.3422288	5.5742479	0.2320191
AI 1/U2@[RemoteNode] [V]	-162.7154	-25.12455	137.5909
AI 1/I2@[RemoteNode] [A]	-9.339810	0.049591	9.389401
AI 1/I3@[RemoteNode] [A]	0.746012	0.056744	-0.689268

Test C M(%)=0 & N(%)=0



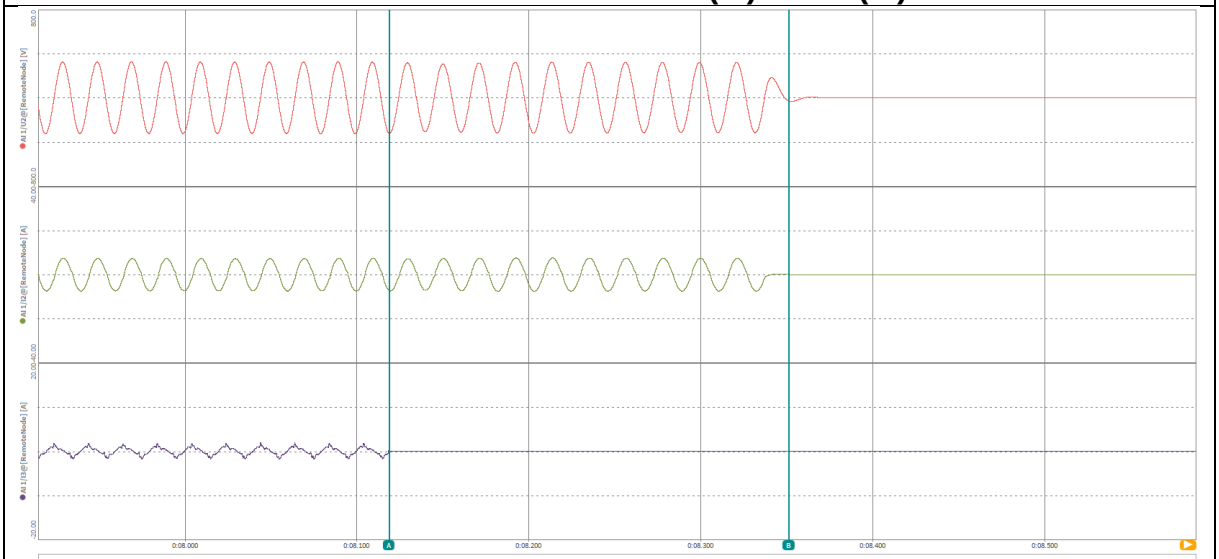
	A	B	间隔
时间 [s]	4.9122403	5.1615592	0.2493189
AI 1/U2@[RemoteNode] [V]	17.42077	-24.88494	-42.30571
AI 1/I2@[RemoteNode] [A]	-1.682758	0.058532	1.741290
AI 1/I3@[RemoteNode] [A]	1.440406	0.051260	-1.389146

Test C M(%)=0 & N(%)=+1



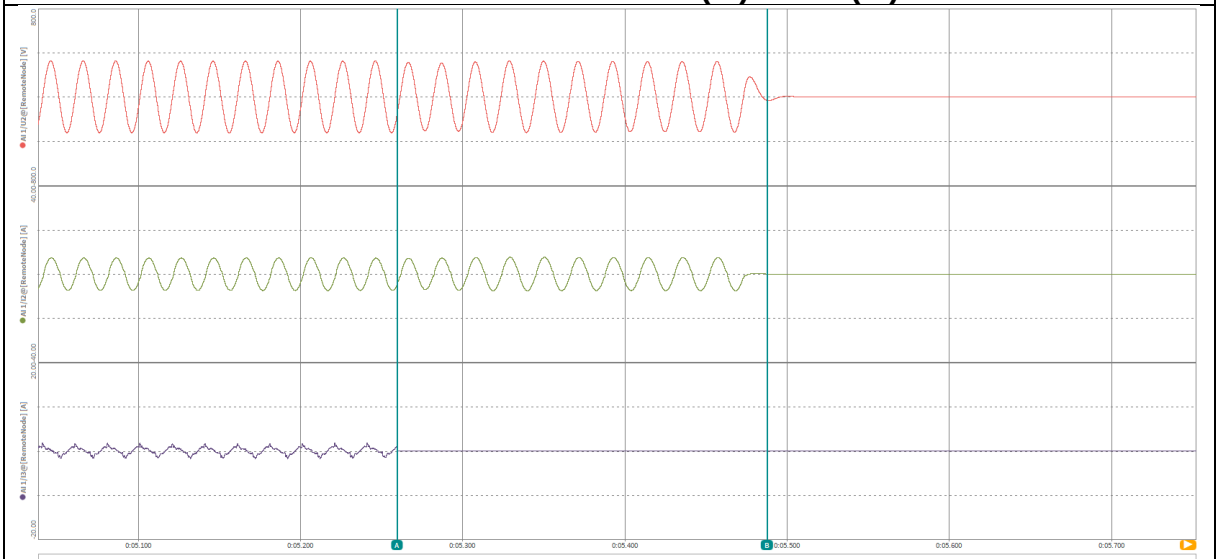
	A	B	间隔
时间 [s]	4.8836525	5.1238756	0.2402231
AI 1/U2@[RemoteNode] [V]	143.9235	-30.04885	-173.9724
AI 1/I2@[RemoteNode] [A]	4.060388	0.058532	-4.001856
AI 1/I3@[RemoteNode] [A]	0.071287	0.054240	-0.017047

Test C M(%)=0 & N(%)=+2



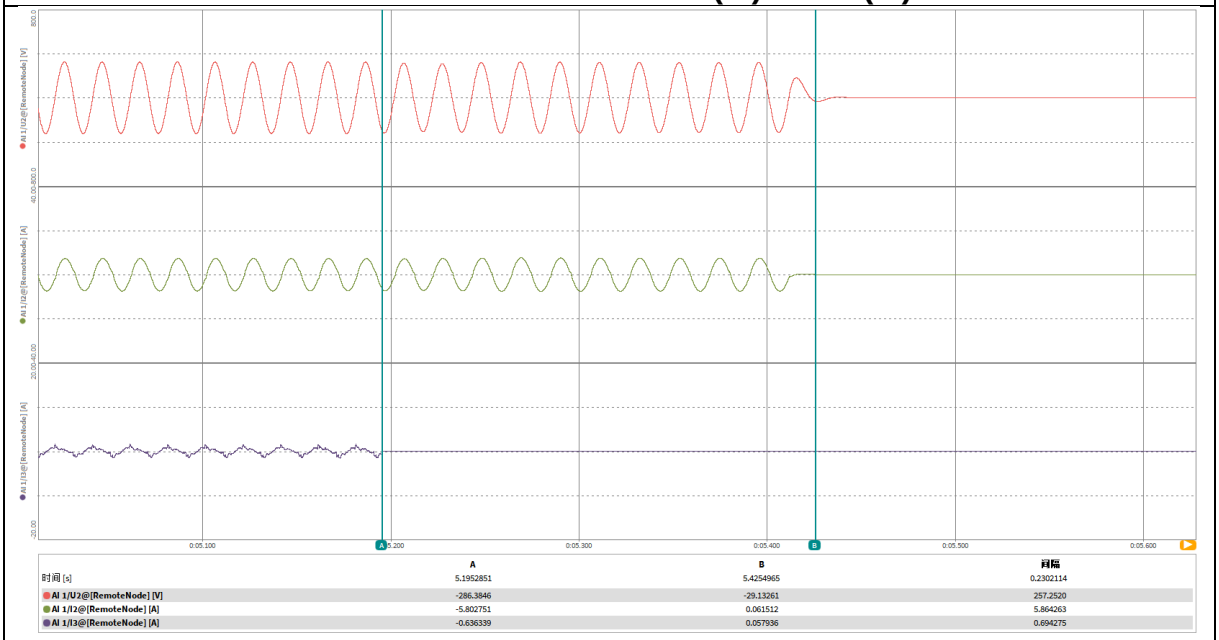
	A	B	间隔
时间 [s]	8.1188998	8.3513219	0.2324221
AI 1/U2@[RemoteNode] [V]	-323.5779	-30.23148	293.3464
AI 1/I2@[RemoteNode] [A]	-7.390738	0.051379	7.442117
AI 1/I3@[RemoteNode] [A]	0.099540	0.056624	-0.042915

Test C M(%)=0 & N(%)=+3



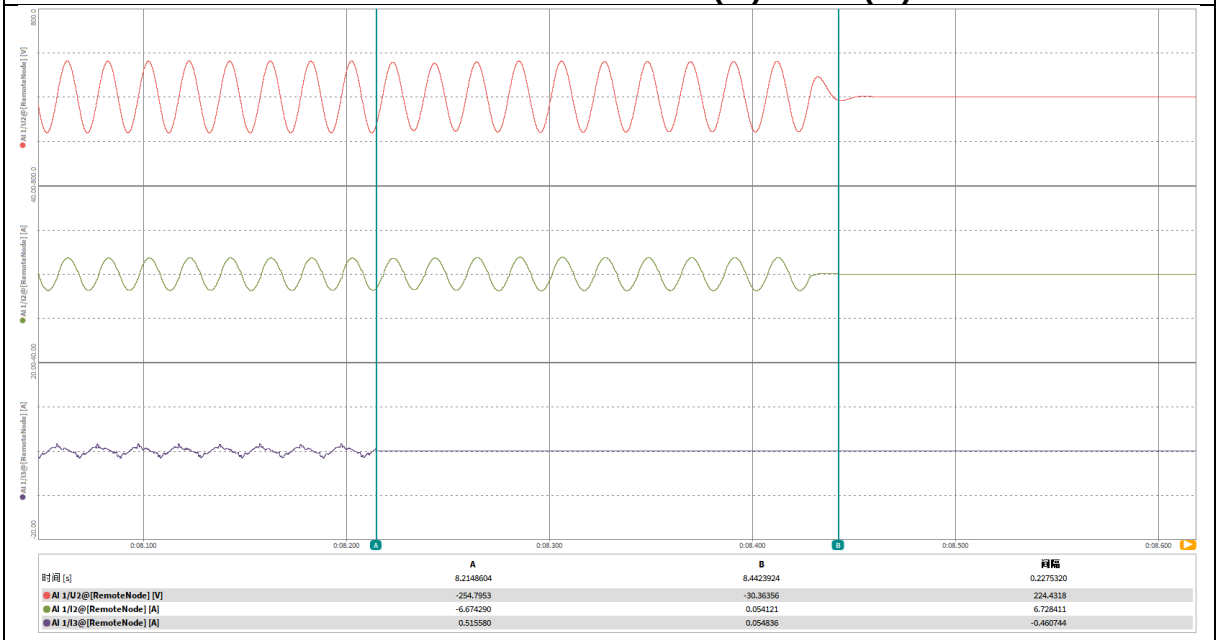
	A	B	间隔
时间 [s]	5.2599709	5.4878809	0.2279100
AI 1/U2@[RemoteNode] [V]	-138.6137	-32.62639	105.9873
AI 1/I2@[RemoteNode] [A]	-4.233361	0.030160	4.263520
AI 1/I3@[RemoteNode] [A]	0.076175	0.053883	-0.022292

Test C M(%)=0 & N(%)=+4



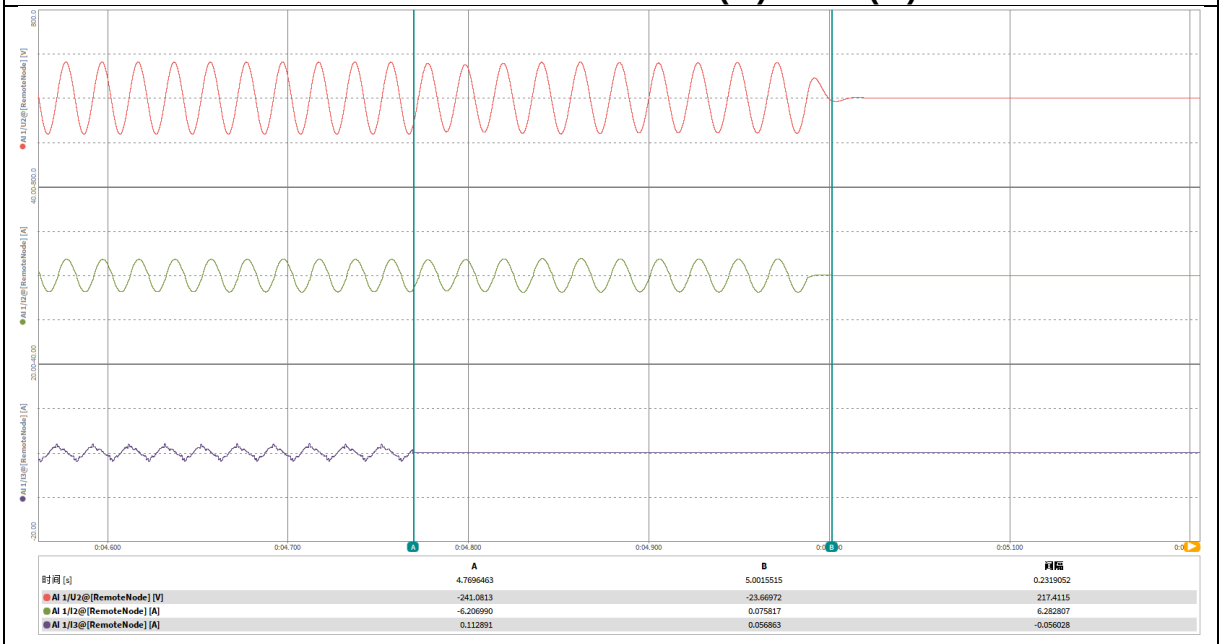
	A	B	间隔
时间 [s]	5.1952851	5.4254965	0.2302114
AI 1/U2@[RemoteNode] [V]	-286.3846	-29.13261	257.2520
AI 1/I2@[RemoteNode] [A]	-5.802751	0.061512	5.864263
AI 1/I3@[RemoteNode] [A]	-0.636339	0.057936	0.694275

Test C M(%)=0 & N(%)=+5



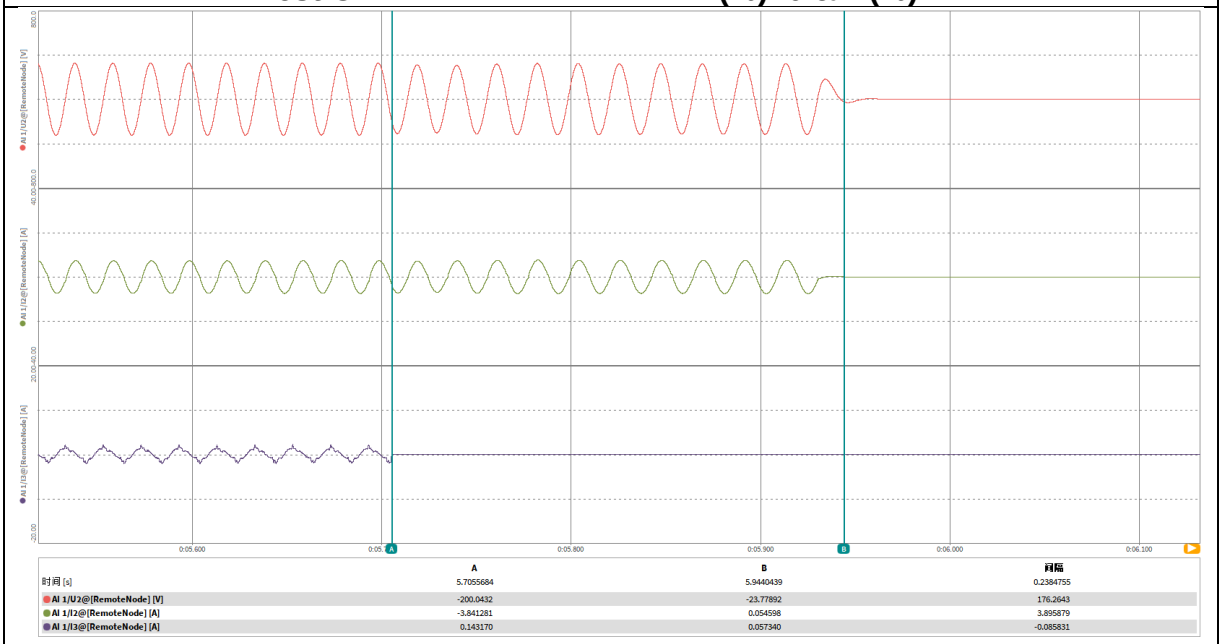
	A	B	间隔
时间 [s]	8.2148604	8.4423924	0.2275320
AI 1/U2@[RemoteNode] [V]	-254.7953	-30.36356	224.4318
AI 1/I2@[RemoteNode] [A]	-6.674290	0.054121	6.728411
AI 1/I3@[RemoteNode] [A]	0.515580	0.054836	-0.460744

Test C M(%)=0 & N(%)=-1



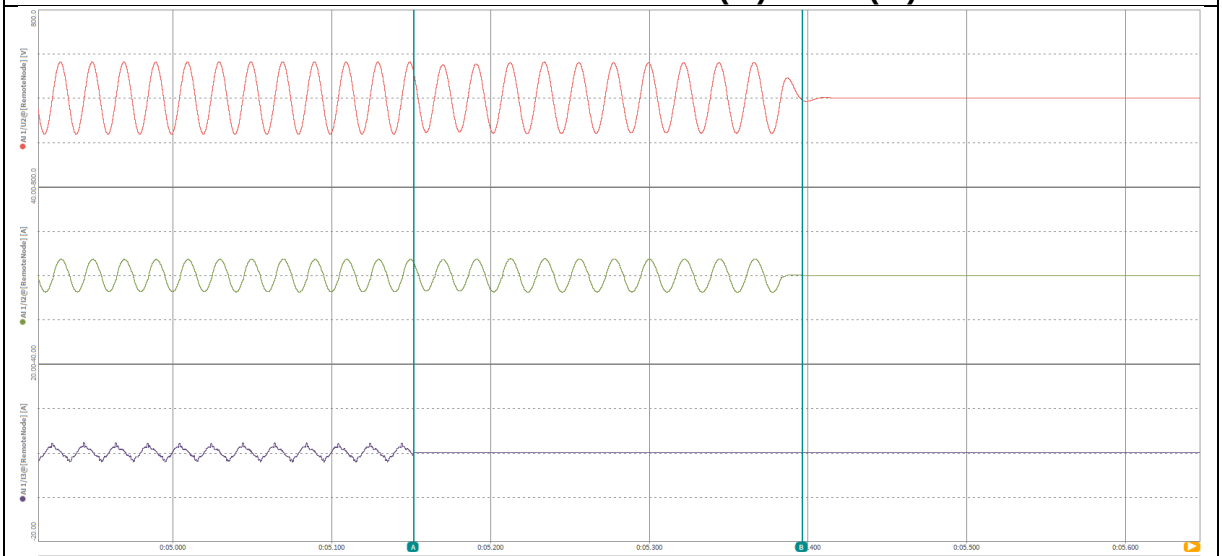
	A	B	间隔
时间 [s]	4.7696463	5.0015515	0.2319052
AI 1/U2@[RemoteNode] [V]	-241.0813	-23.66972	217.4115
AI 1/I2@[RemoteNode] [A]	-6.206990	0.075817	6.282807
AI 1/I3@[RemoteNode] [A]	0.112891	0.056863	-0.056028

Test C M(%)=0 & N(%)=-2



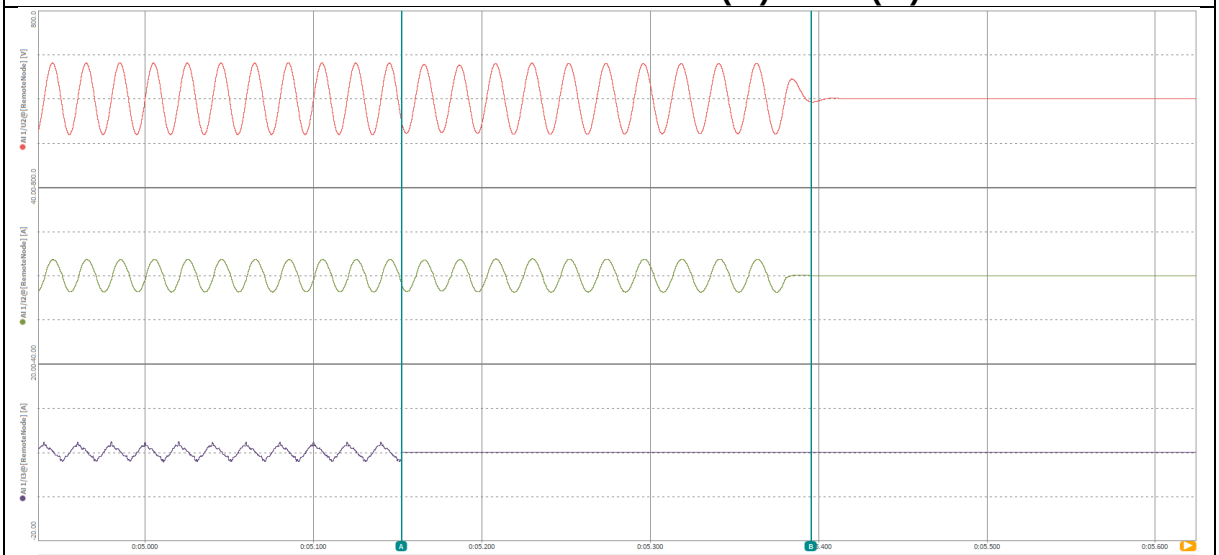
	A	B	间隔
时间 [s]	5.7055684	5.9440439	0.2384755
AI 1/U2@[RemoteNode] [V]	-200.0432	-23.77892	176.2643
AI 1/I2@[RemoteNode] [A]	-3.841281	0.054598	3.895879
AI 1/I3@[RemoteNode] [A]	0.143170	0.057340	-0.085831

Test C M(%)=0 & N(%)=-3



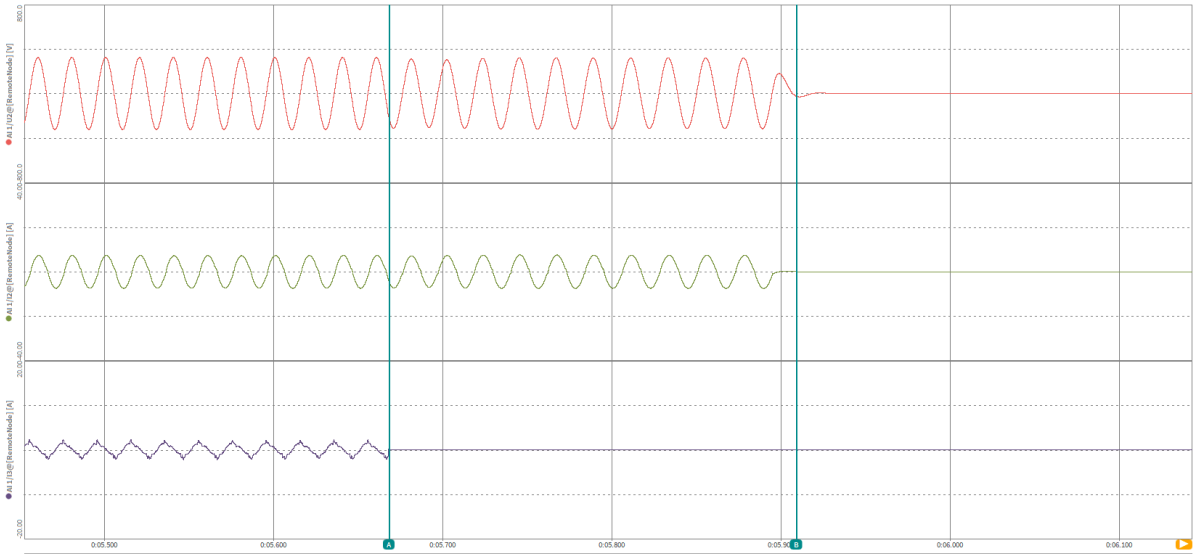
	A	B	间隔
时间 [s]	5.1515030	5.3963671	0.2448641
AI 1/U2@[RemoteNode] [V]	246.2471	-18.79859	-265.0457
AI 1/I2@[RemoteNode] [A]	6.273032	0.079989	-6.193042
AI 1/I3@[RemoteNode] [A]	-0.571728	0.055909	0.627637

Test C M(%)=0 & N(%)=-4



	A	B	间隔
时间 [s]	5.1525803	5.3956207	0.2430404
AI 1/U2@[RemoteNode] [V]	-203.2473	-28.63598	174.6113
AI 1/I2@[RemoteNode] [A]	-3.538966	0.041485	3.580451
AI 1/I3@[RemoteNode] [A]	-1.226425	0.051141	1.277566

Test C	M(%)=0 & N(%)=-5



	A	B	间隔
时间 [s]	5.6686652	5.9092831	0.2406179
AI 1/U2@[RemoteNode] [V]	-235.6792	-25.81167	209.8675
AI 1/I2@[RemoteNode] [A]	-4.986644	0.040293	5.026937
AI 1/I3@[RemoteNode] [A]	0.081062	0.056028	-0.025034

4.3.4 Frequency change, Vector Shift Stability test and RoCoF Stability test

Four tests are required to be carried out with all protection functions enabled including loss of mains. For each stability test the Micro-generator should not trip during the test.

For the step change test the Micro-generator should be operated with a measurable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 s to complete the test. The Micro-generator should not trip during this test.

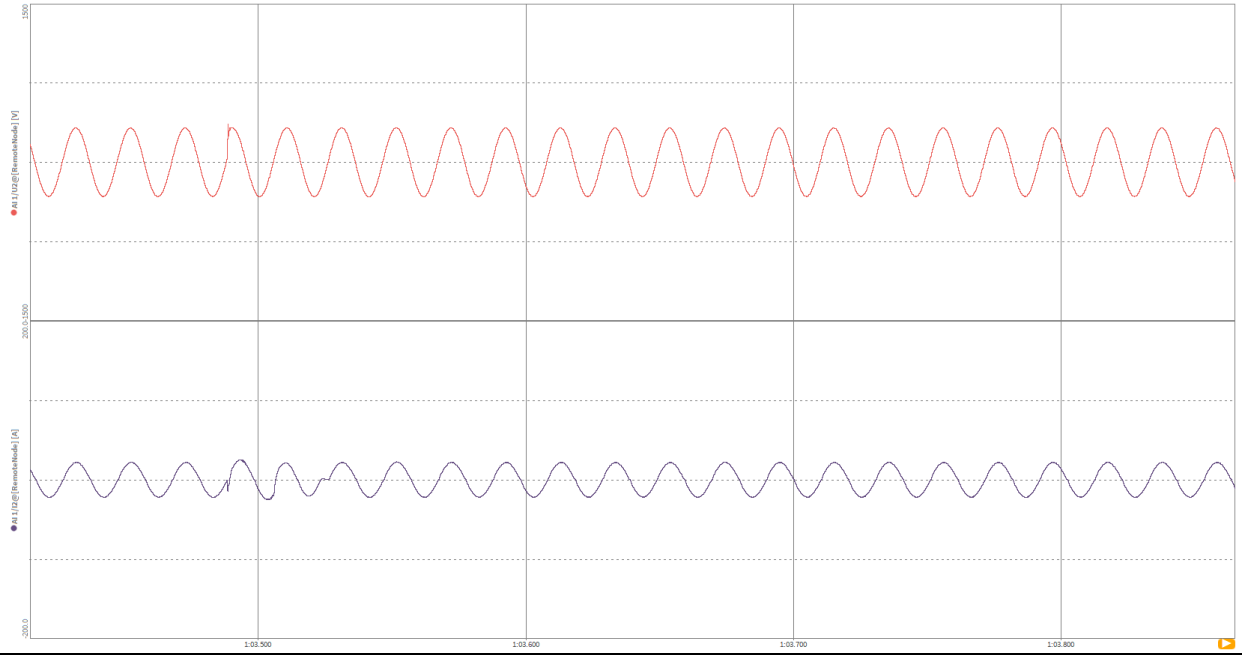
For frequency drift tests the Micro-generator should be operated with a measurable output at the start frequency and then the frequency changed in a ramp function at 0.95 Hzs-1 to the end frequency. On reaching the end frequency it should be maintained for a period of at least 10 s. The Micro-generator should not trip during this test.

Test results are graphically shown in following pages.

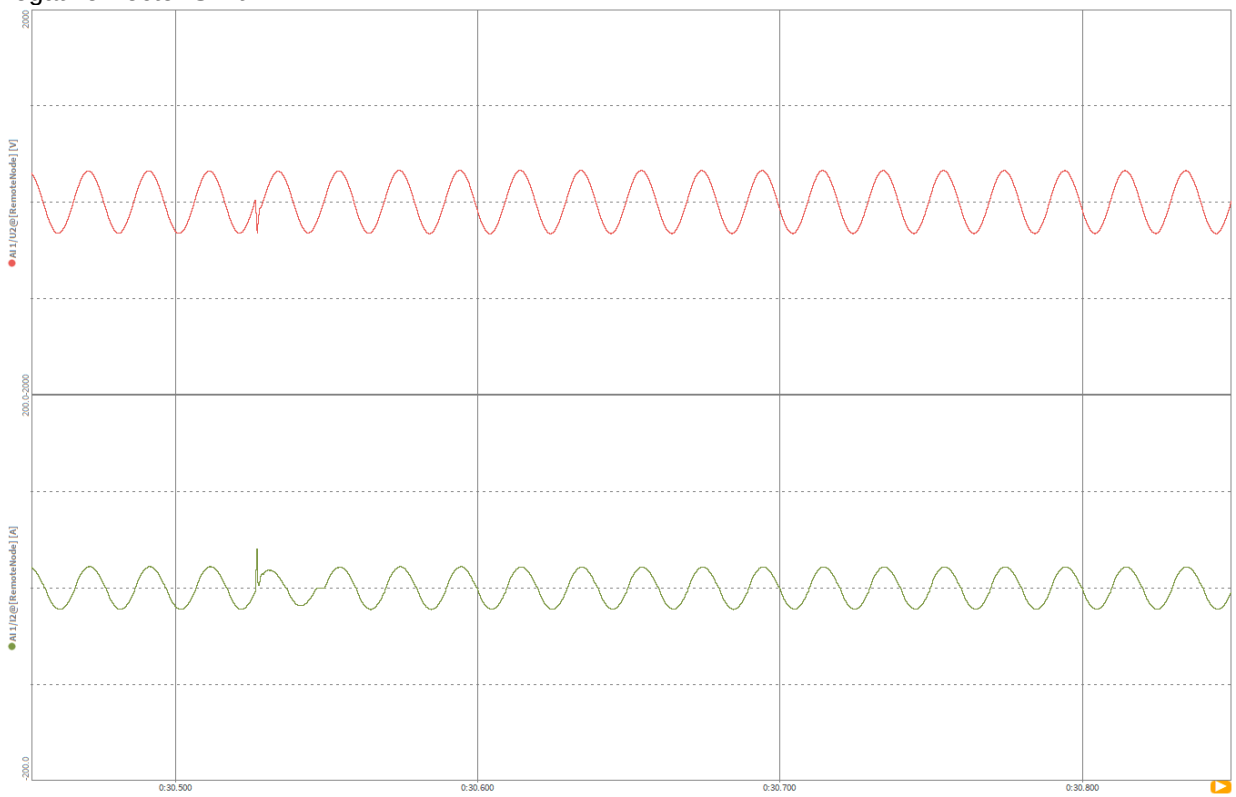
Protection – Frequency change, Vector Shift Stability test: This test should be carried out in accordance with EREC G98 Annex A1 A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous).

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.0 Hz	+50 degrees	Pass
Negative Vector Shift	50.0 Hz	- 50 degrees	Pass

Positive Vector Shift:



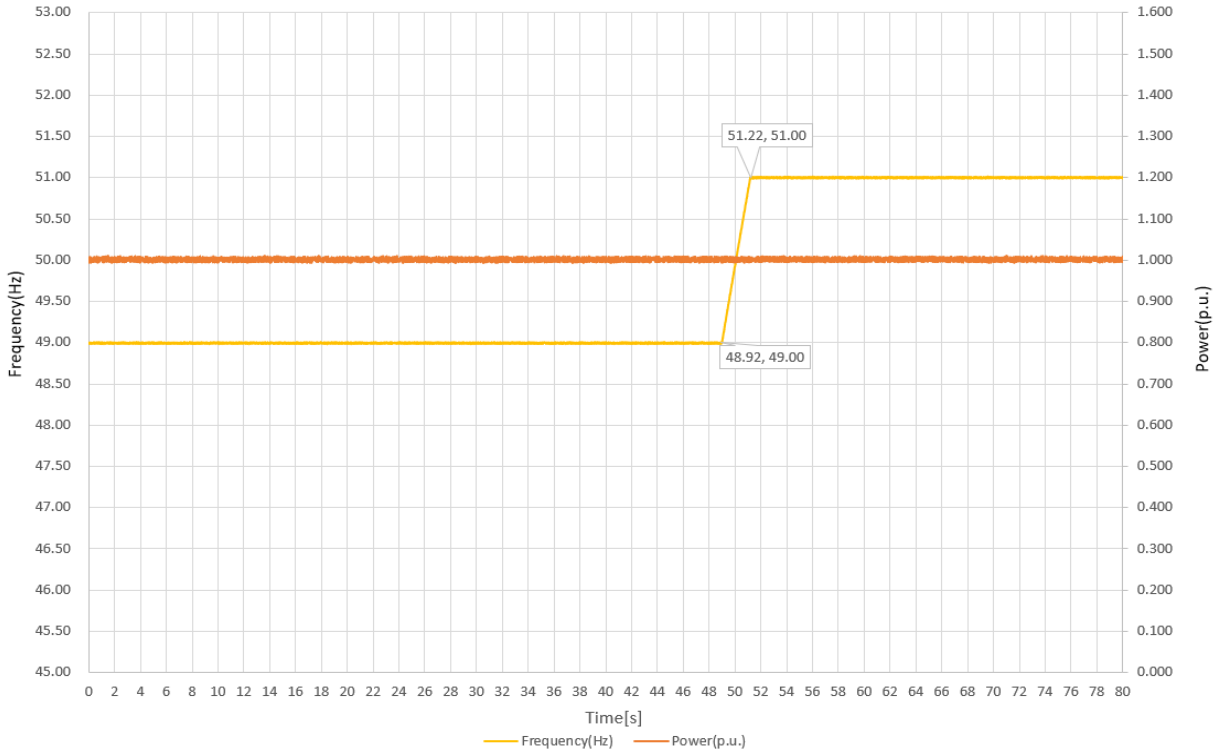
Negative Vector Shift:



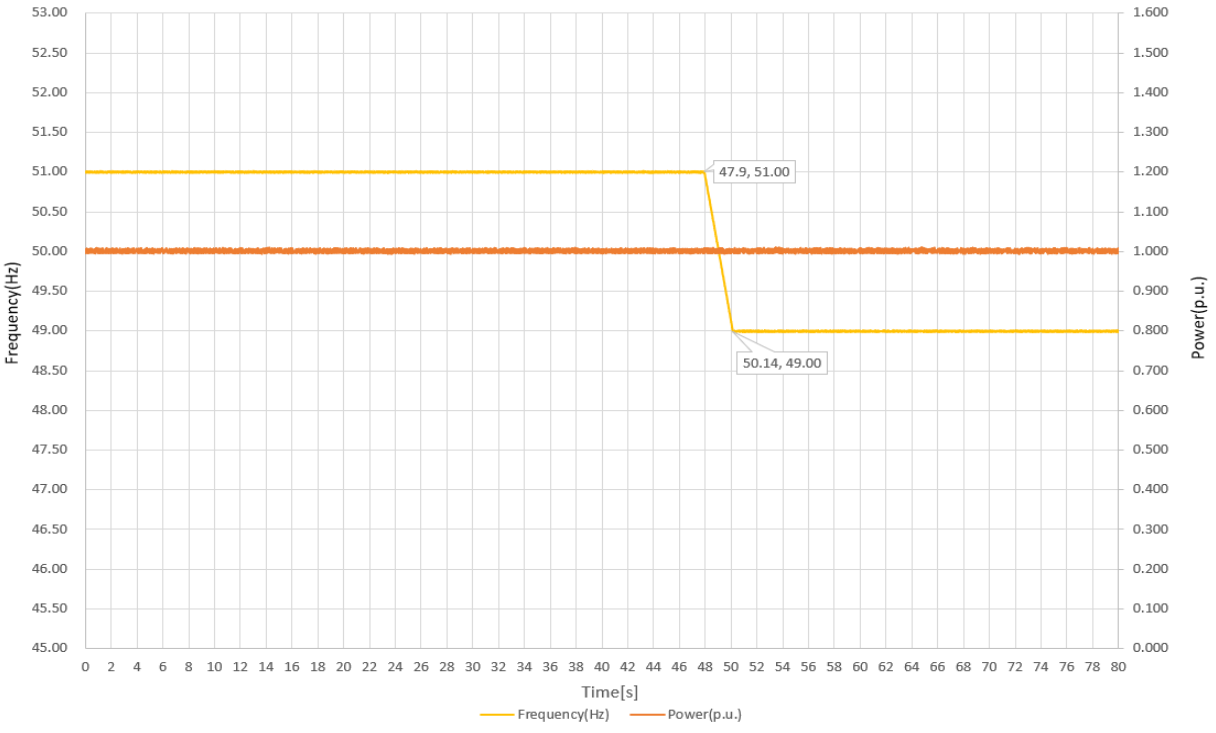
Protection – Frequency change, RoCoF Stability test: The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous).

Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}	2.30 s	Pass
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.24 s	Pass

+0.95 Hz/s:



-0.95 Hz/s:



4.4 Limited Frequency Sensitive Mode - Overfrequency test

The test serves to verify the active power reduction of the micro-generator at over-frequency. We perform the test according to EN 50438 Annex D.3.3 Power response to over-frequency.

The tests for providing evidence of the frequency dependent active power feed-in of the micro-generator shall be carried out on a network simulator.

The test should be carried out using the specific threshold frequency of 50.4 Hz and Droop of 10%.

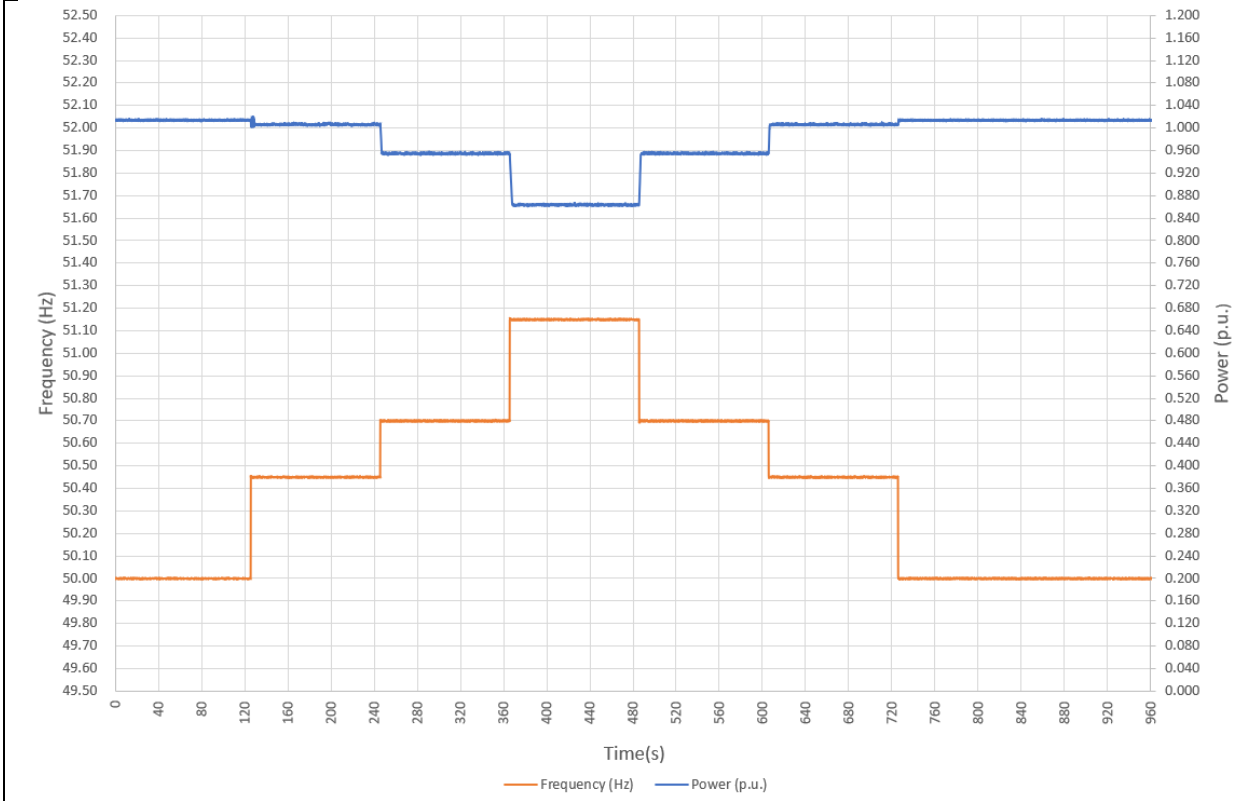
Following tables show the test results:

Test sequence at Registered Capacity >80%	Measured Active Power Output (W)	Frequency (Hz)	Primary Power Source	Active Power Gradient(%)
Step a) 50.00 Hz ±0.01 Hz	3650.28	50.00	DC Source	N/A
Step b) 50.45 Hz ±0.05 Hz	3622.38	50.45		12.9
Step c) 50.70 Hz ±0.10 Hz	3437.32	50.70		10.1
Step d) 51.15 Hz ±0.05 Hz	3108.77	51.15		10.0
Step e) 50.70 Hz ±0.10 Hz	3437.52	50.70		10.2
Step f) 50.45 Hz ±0.05 Hz	3622.86	50.45		13.1
Step g) 50.00 Hz ±0.01 Hz	3649.96	50.00		N/A

Test sequence at Registered Capacity 40% - 60%	Measured Active Power Output (W)	Frequency (Hz)	Primary Power Source	Active Power Gradient(%)
Step a) 50.00 Hz ±0.01 Hz	1804.66	50.00	DC Source	N/A
Step b) 50.45 Hz ±0.05 Hz	1767.43	50.45		9.7
Step c) 50.70 Hz ±0.10 Hz	1583.32	50.70		9.8
Step d) 51.15 Hz ±0.05 Hz	1252.24	51.15		9.8
Step e) 50.70 Hz ±0.10 Hz	1573.04	50.71		9.3
Step f) 50.45 Hz ±0.05 Hz	1767.42	50.45		9.7
Step g) 50.00 Hz ±0.01 Hz	1804.50	50.00		N/A

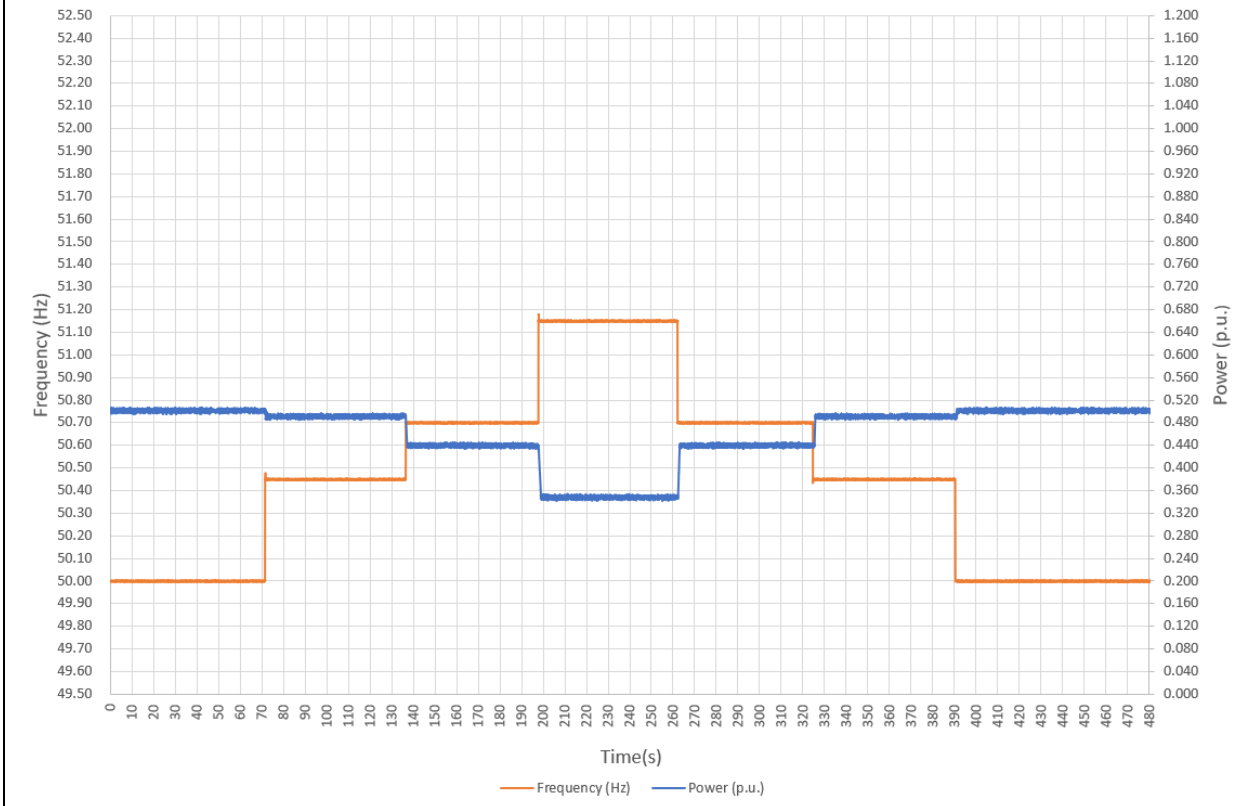
Test results are graphically shown in following pages.

Over-frequency curve (droop of 10 % at 100% Pn)



Remark:Test for frequency threshold 50.4Hz with droop 10%, intentional delay is setting to 0s.

Over-frequency curve (droop of 10 % at 50% Pn)



Remark:Test for frequency threshold 50.4Hz with droop 10%, intentional delay is setting to 0s.

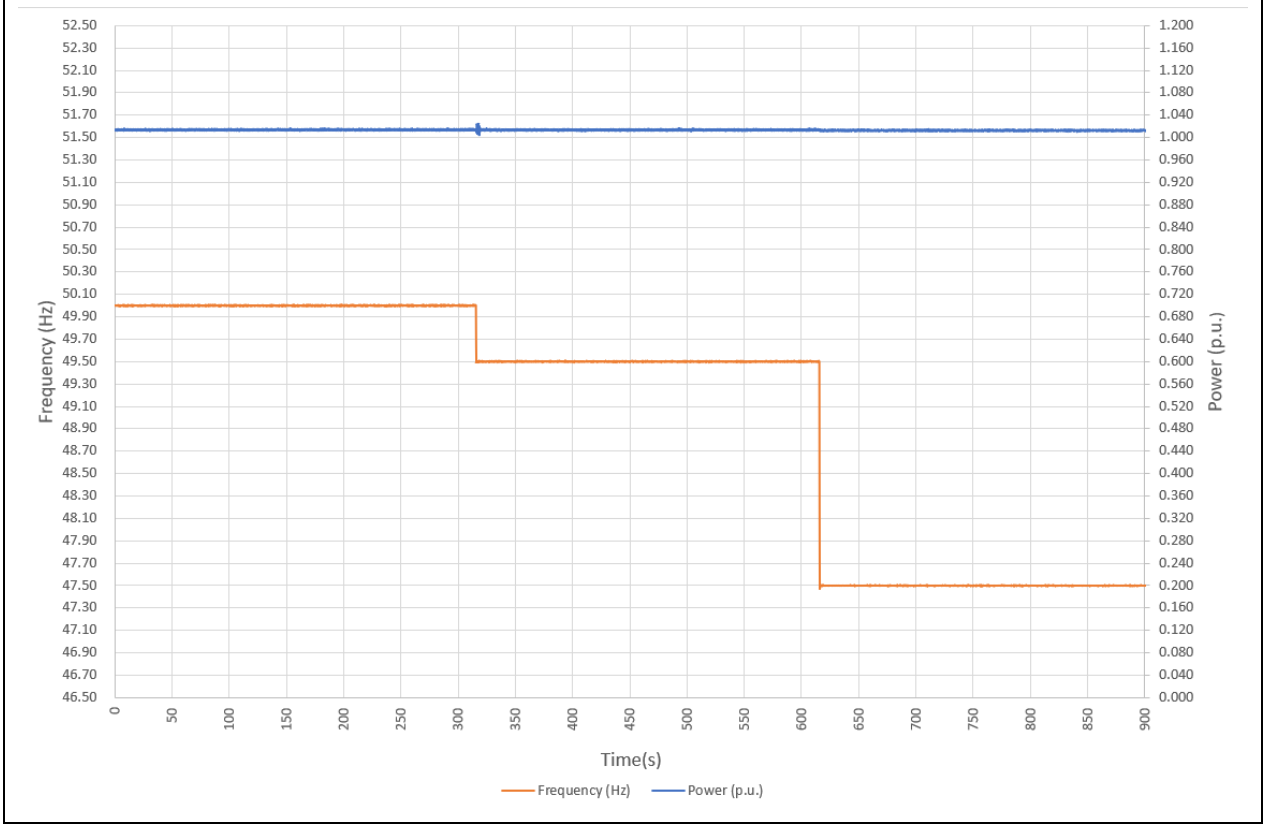
4.5 Power output with falling frequency test

This test should be carried out in accordance with EN 50438 Annex D.3.2 active power feed-in at under-frequency.

Test sequence	Measured Active Power Output (W)	Frequency (Hz)	Primary power source
Test a) 50 Hz ± 0.01 Hz	3650.25	50.00	-
Test b) Point between 49.5 Hz and 49.6 Hz	3648.76	49.50	-
Test c) Point between 47.5 Hz and 47.6 Hz	3645.45	47.50	-
NOTE: The operating point in Test (b) and (c) shall be maintained for at least 5 minutes			

Test results are graphically shown in following pages.

POWER OUTPUT WITH FALLING FREQUENCY TEST



4.6 Re-connection timer

Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 2. These tests should be undertaken in accordance with Annex A.2.2.5.

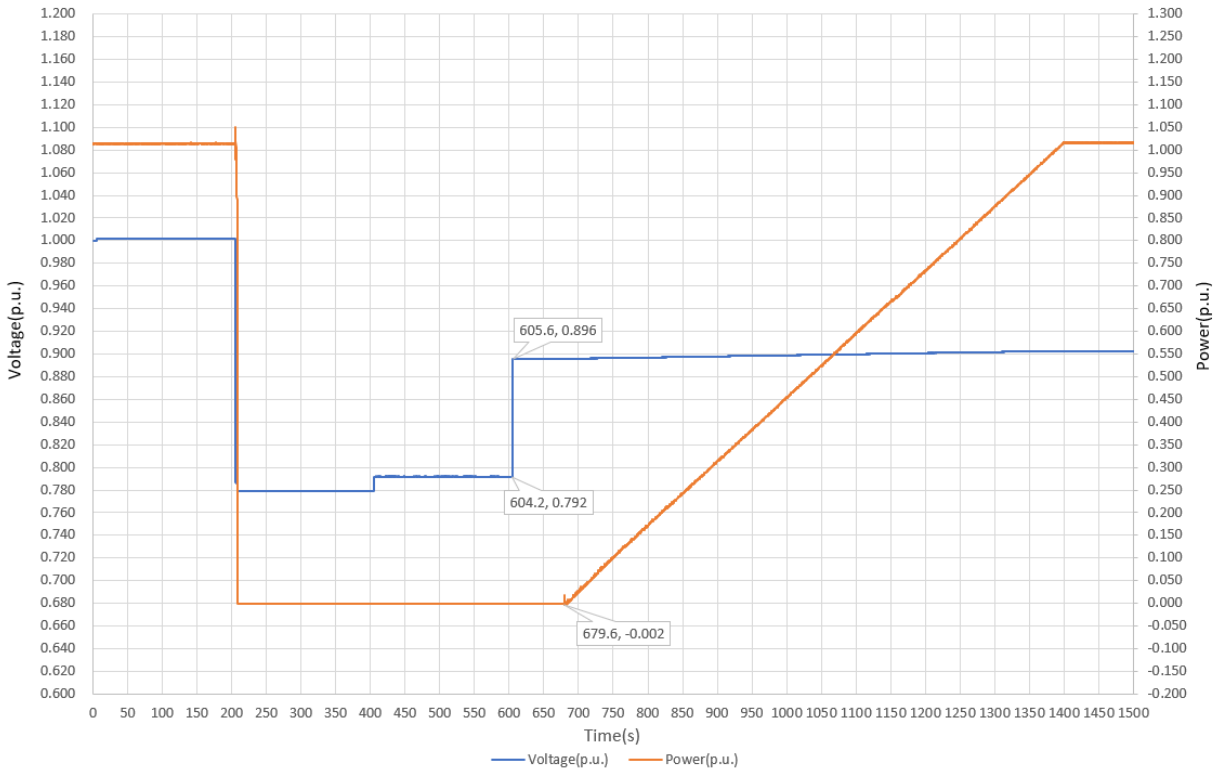
4.6.1 Voltage Reconnection Conditions

The following table detail tests performed.

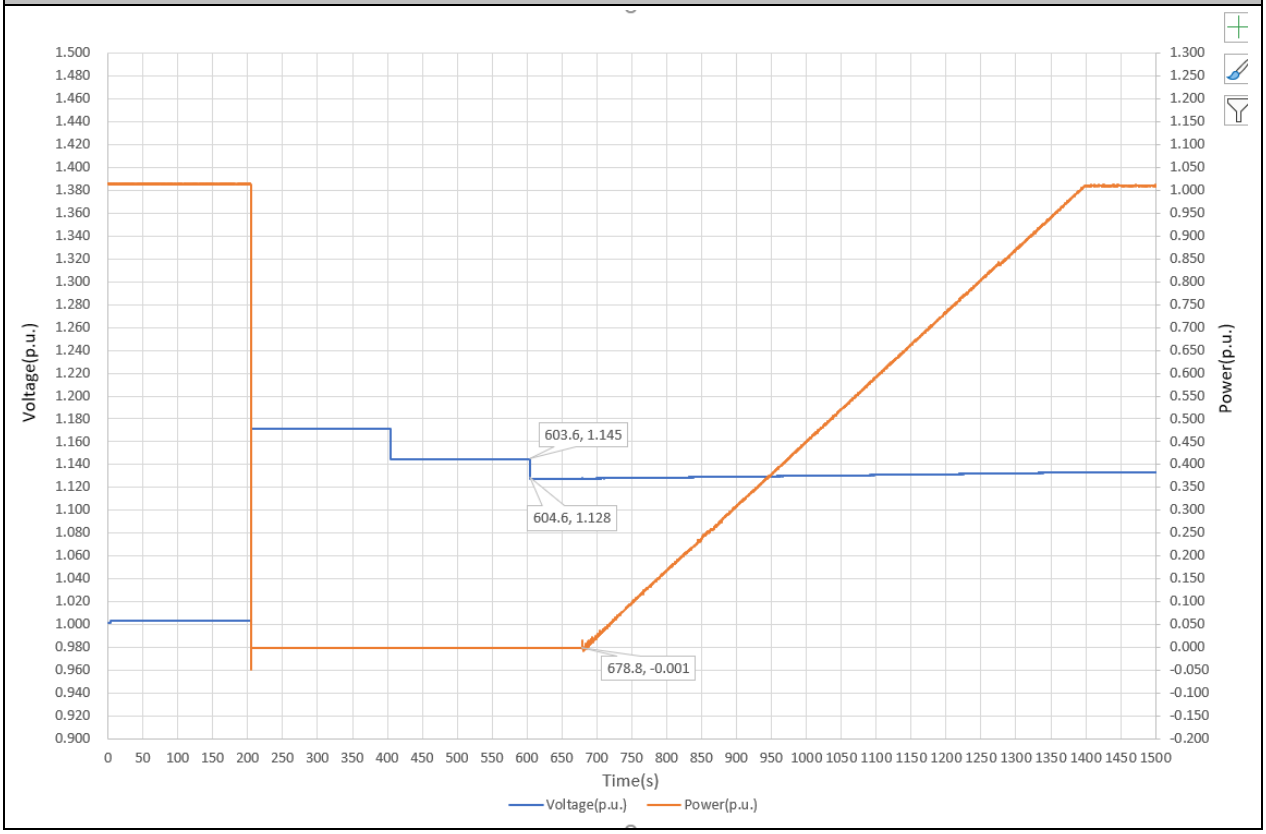
Test at	Time delay setting(s)	Measured delay(s)	Checks on no reconnection when voltage is brought to just outside stage 1 limits of table 1.	
UV	60.0	74.0	At 266.2V	At 180.0 V
OV	60.0	74.2		
Confirmation that the Micro-generator does not re-connect.			Not reconnection	Not reconnection

Test results are graphically shown below.

Under voltage reconnection



Over voltage reconnection



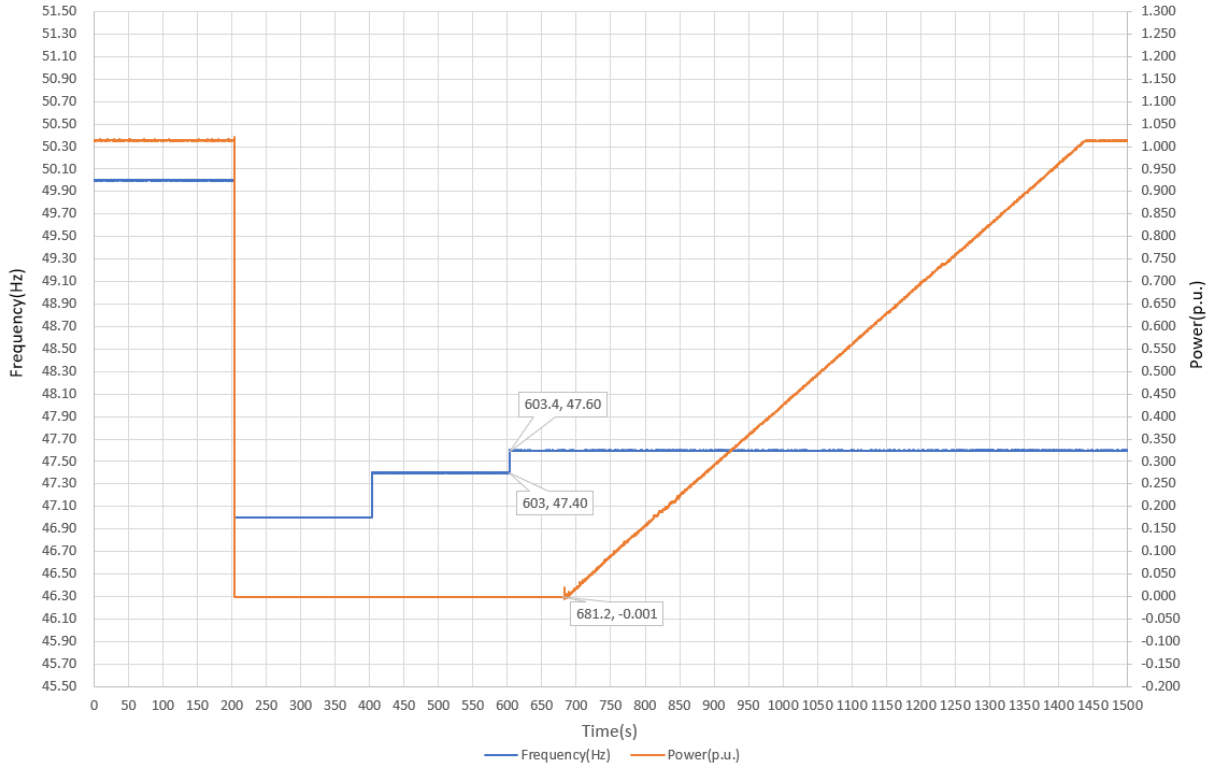
4.6.2 Frequency Reconnection Conditions

The following table detail tests performed.

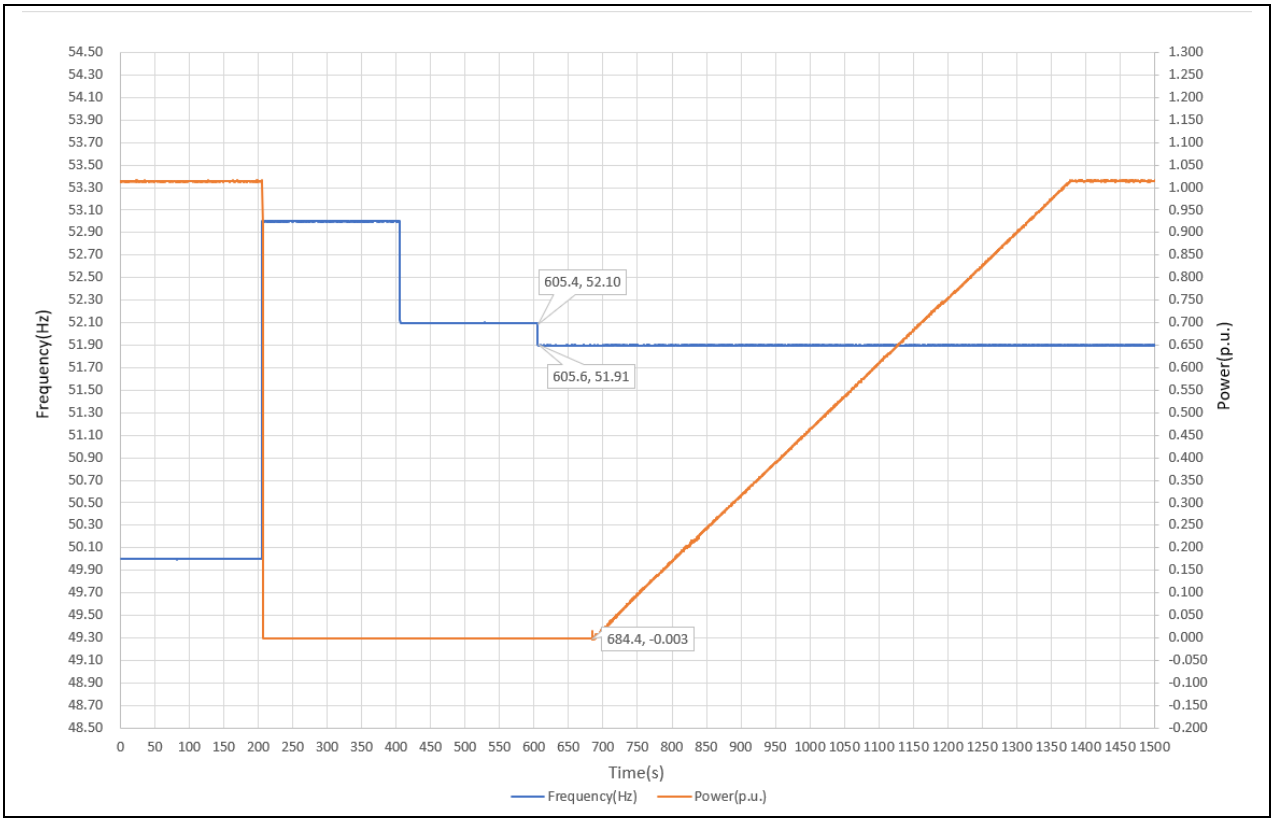
Test at	Time delay setting(s)	Measured delay(s)	Checks on no reconnection when frequency is brought to just outside stage 1 limits of table 1.	
UF	60	77.8	At 47.4Hz	At 52.1Hz
OF	60	78.8		
Confirmation that the Micro-generator does not re-connect.			Not reconnection	Not reconnection

Test results are graphically shown below.

Under frequency reconnection



Over frequency reconnection


Frequency(Hz)
Power(p.u.)
Time(s)
605.4, 52.10
605.6, 51.91
684.4, -0.003
Frequency(Hz)
Power(p.u.)

4.7 Fault level contribution

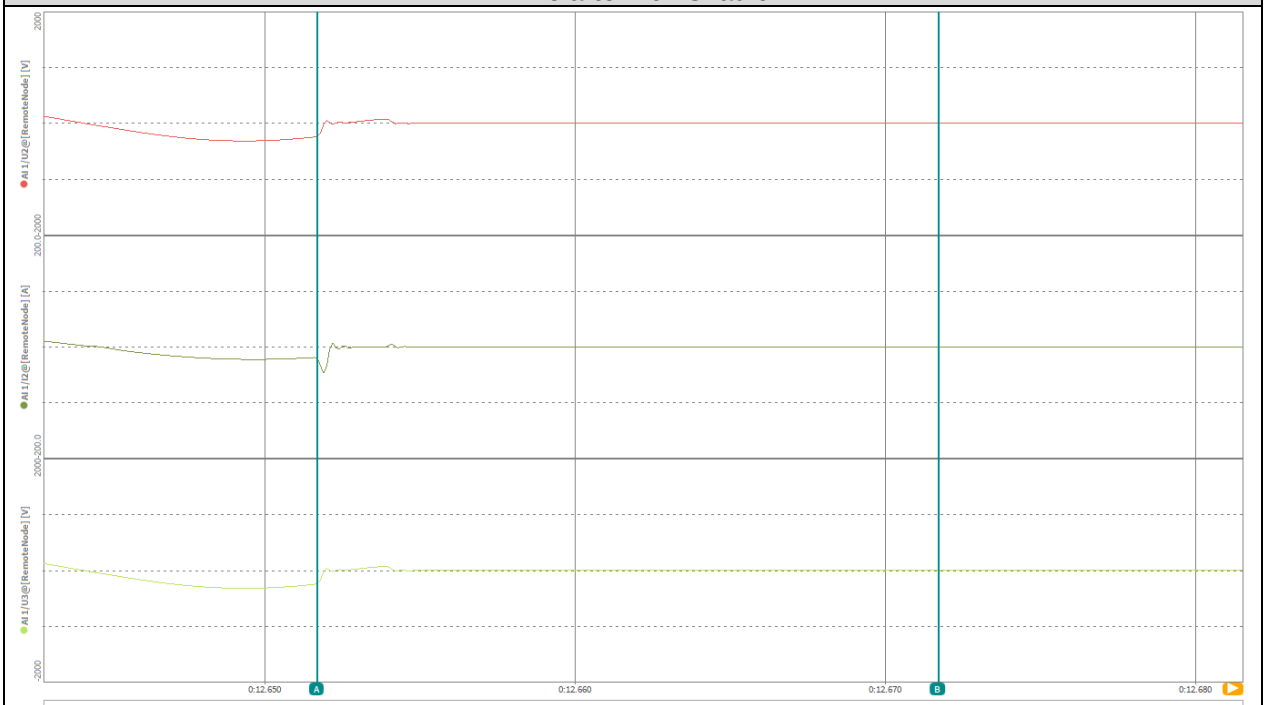
These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 (Inverter connected) and Annex A2 A.2.3.4 (Synchronous).

They have been performed different short circuit tests that are detailed in the table and pictures below.

Short circuit current		
Time after fault	**Volts(V)**	**Amps(A)**
20ms	0.075	-0.401
100ms	0.060	-0.405
250ms	0.046	-0.403
500ms	0.044	-0.410
Time to trip	0.004	In seconds

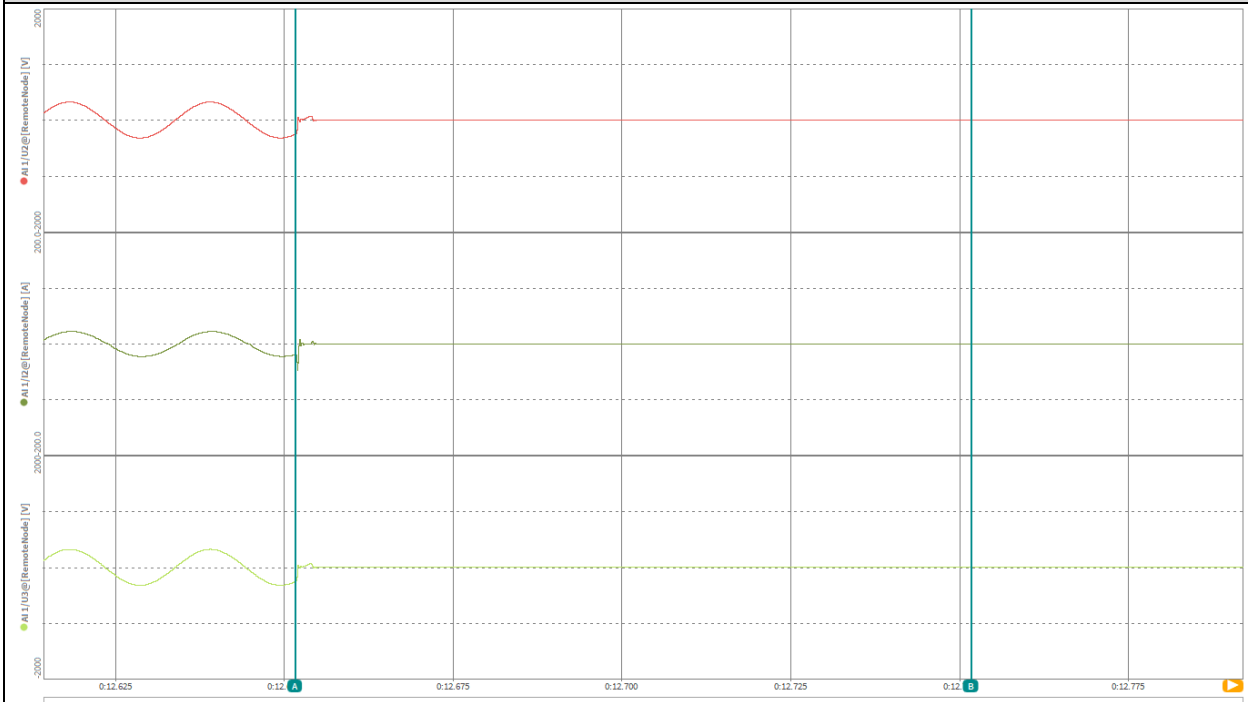
L1-N

Time after 20ms fault



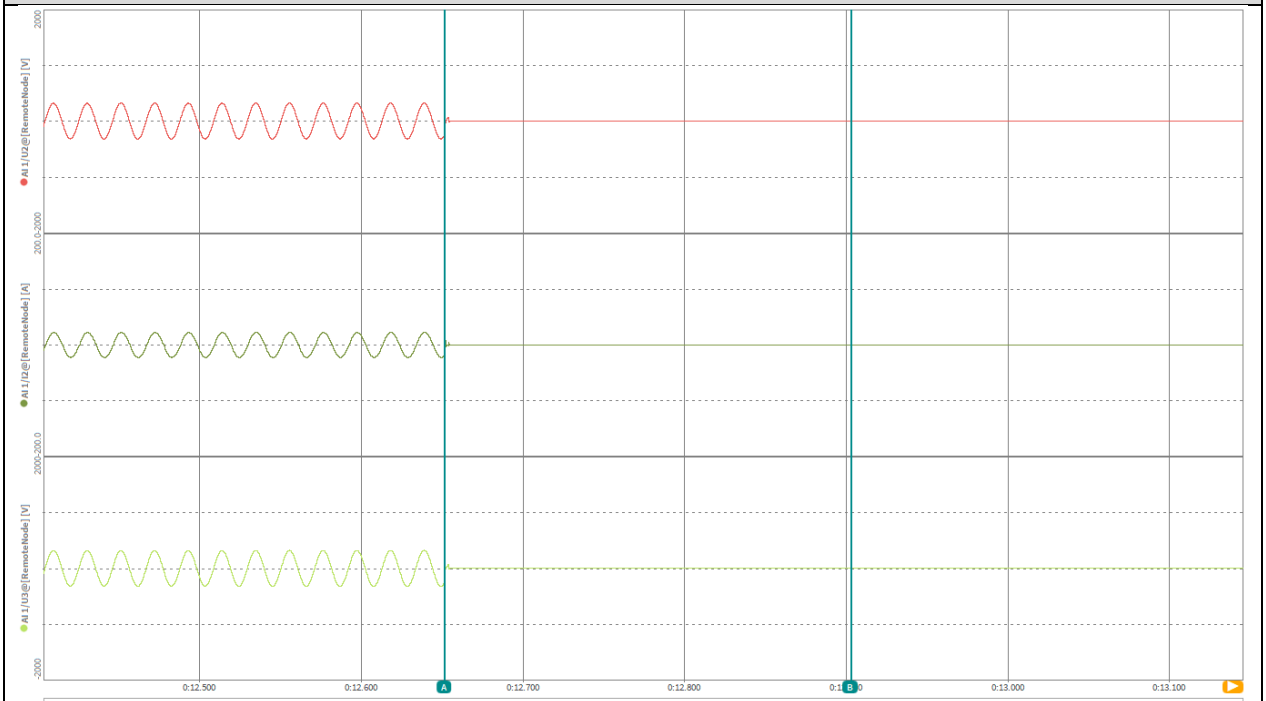
	A	B	间隔
时间 [s]	0:12.65169733	0:12.67169745	0.02000011
AI 1/U2@[RemoteNode] [V]	-251.3557	0.075102	251.4308
AI 1/I2@[RemoteNode] [A]	-19.29295	-0.400782	18.89217
AI 1/U3@[RemoteNode] [V]	-251.3054	0.183821	251.4892

Time after 100ms fault



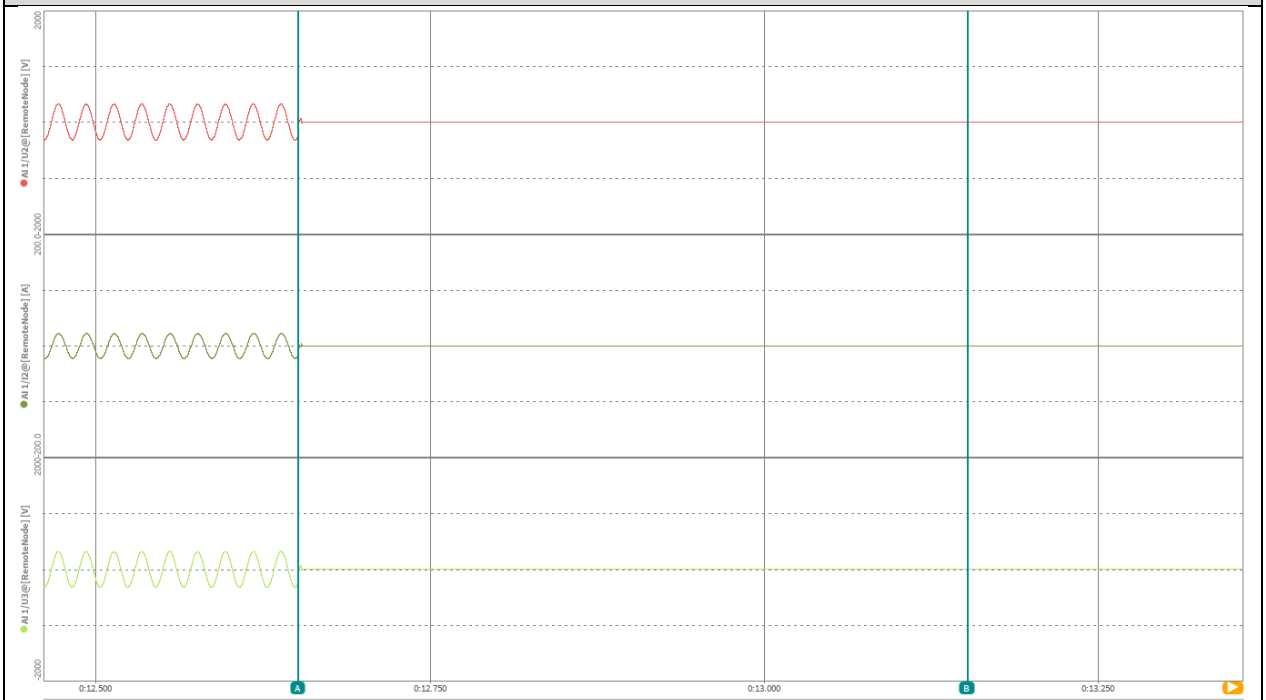
	A	B	间隔
时间 [s]	0:12.65169733	0:12.75170045	0.10000312
AI 1/U2@[RemoteNode] [V]	-251.3557	0.059843	251.4155
AI 1/I2@[RemoteNode] [A]	-19.29295	-0.404954	18.88800
AI 1/U3@[RemoteNode] [V]	-251.3054	0.178814	251.4842

Time after 250ms fault



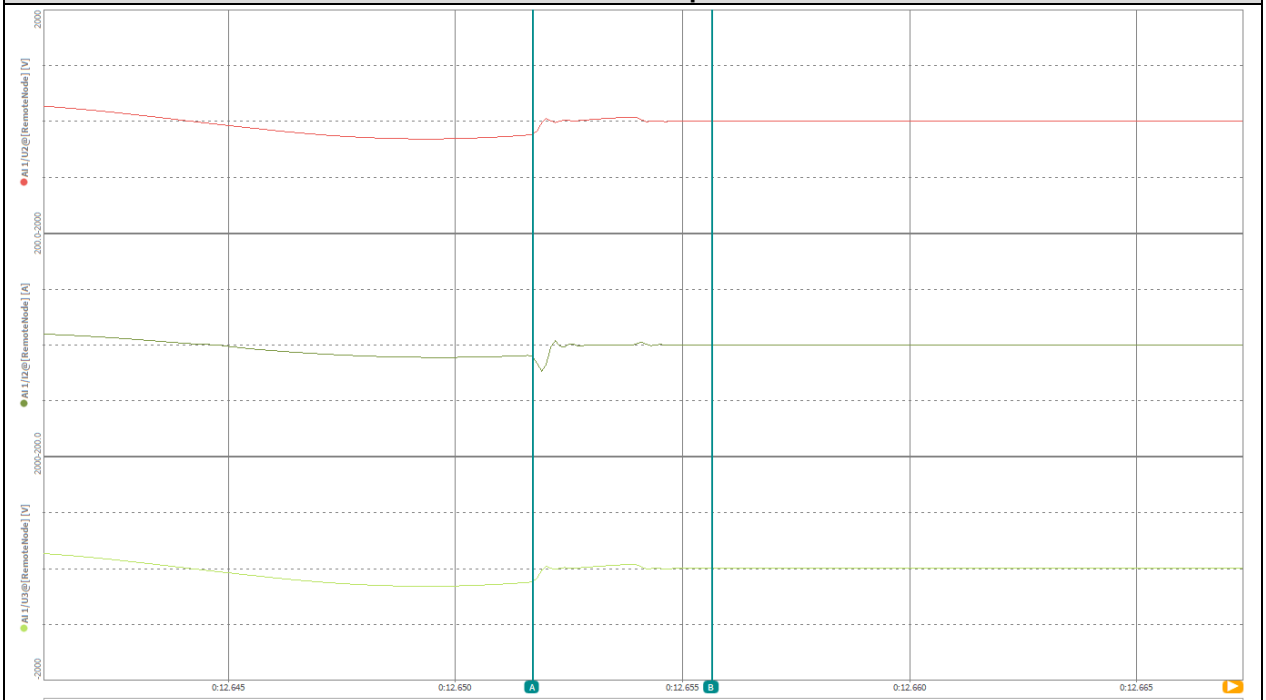
时间 [s]	A 0:12.65169733	B 0:12.90268251	间隔 0.25098518
AI 1/U2@[RemoteNode] [V]	-251.3557	0.045538	251.4012
AI 1/I2@[RemoteNode] [A]	-19.29295	-0.402689	18.89026
AI 1/U3@[RemoteNode] [V]	-251.3054	0.175953	251.4813

Time after 500ms fault



时间 [s]	A 0:12.65169733	B 0:13.15213310	间隔 0.50043577
AI 1/U2@[RemoteNode] [V]	-251.3557	0.044346	251.4000
AI 1/I2@[RemoteNode] [A]	-19.29295	-0.409961	18.88299
AI 1/U3@[RemoteNode] [V]	-251.3054	0.174046	251.4794

Time to trip



	A	B	间隔
时间 [s]	0:12.65169733	0:12.65564245	0.00394512
AI 1/U2@[RemoteNode] [V]	-251.3557	0.267267	251.6229
AI 1/I2@[RemoteNode] [A]	-19.29295	-0.400901	18.89205
AI 1/U3@[RemoteNode] [V]	-251.3054	0.319719	251.6251

4.8 SELF-MONITORING SOLID STATE SWITCHING

The evaluation of this point has been made according to EREC G98 Annex A1 A.1.3.6.

This test does not apply because in the inverter there are not solid-state switching devices.

4.9 ELECTROMAGNETIC COMPATIBILITY (EMC)

All equipment shall conform to the generic EMC standards: BS EN61000-6-3: Electromagnetic Compatibility, Generic Emission Standard; and BS EN61000-6-1: Electromagnetic Compatibility, Generic Immunity Standard.

The compliances with these requirements are stated in the following test report:

- EN IEC 61000-6-3: 2011; EN IEC 61000-6-1: 2019: Test Report no. GZEM220800488101C11, issued by SGS-CST Standards Technical Services Co., Ltd. Guangzhou Branch on May 06 of 2024.

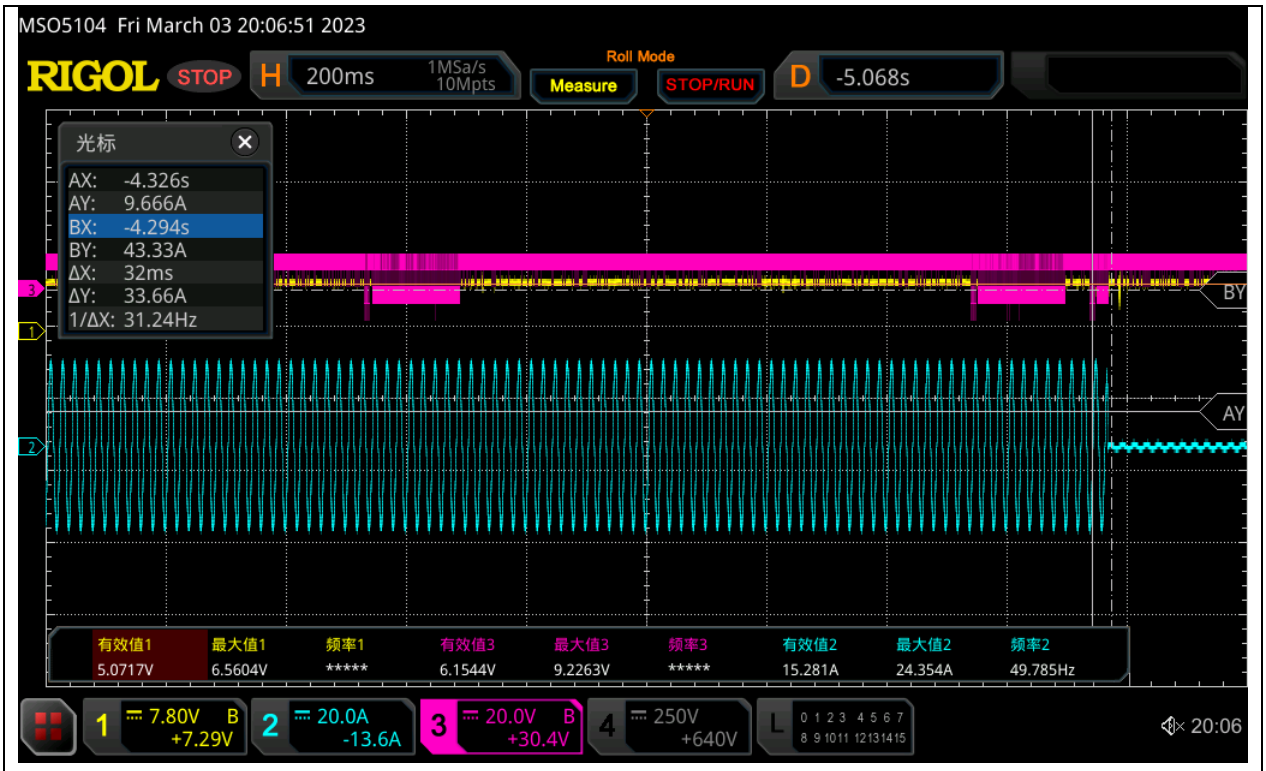
4.10 LOGIC INTERFACE.

Confirm that an input port is provided and can be used to shut down the module.

The evaluation of this point has been made according to Clause 9.4.3 of the standard.

Power Generating Modules connected to the DNO's Distribution Network shall be equipped with a logic interface (input port) in order to cease Active Power output within 5 s following an instruction being received at the input port.

Test results are graphically shown as below.



Ch1: AC Voltage

Ch2: Output Current

Ch3: Signal of logic interface.

4.11 CYBER SECURITY

Confirm that the Manufacturer or Installer of the Micro-generator has provided a statement describing how the Micro-generator has been designed to comply with cyber security requirements, as detailed in 9.7.

The Manufacturer of the Micro-generator has provided a statement describing how the Micro-generator has been designed to comply with cyber security requirements in 9.7.

Additional comments.

The DNO logic interface will take the form of a simple binary output that can be operated by the switch. When the switch is turned off the Power Generating Module can operate normally. When the switch is turned on the Power Generating Module will reduce its Active Power to zero within 5 s. The signal from the Power Generating Module that is being switched is DC (maximum value 3.3Vdc)

5 PICTURES

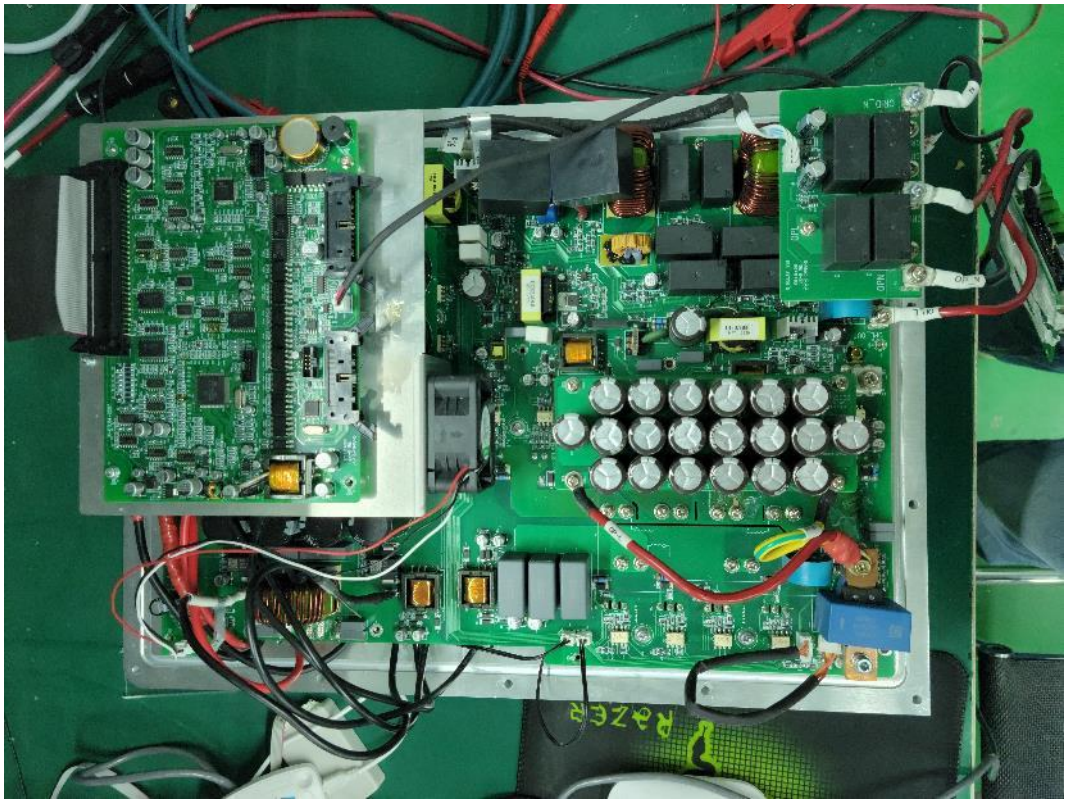
Front view

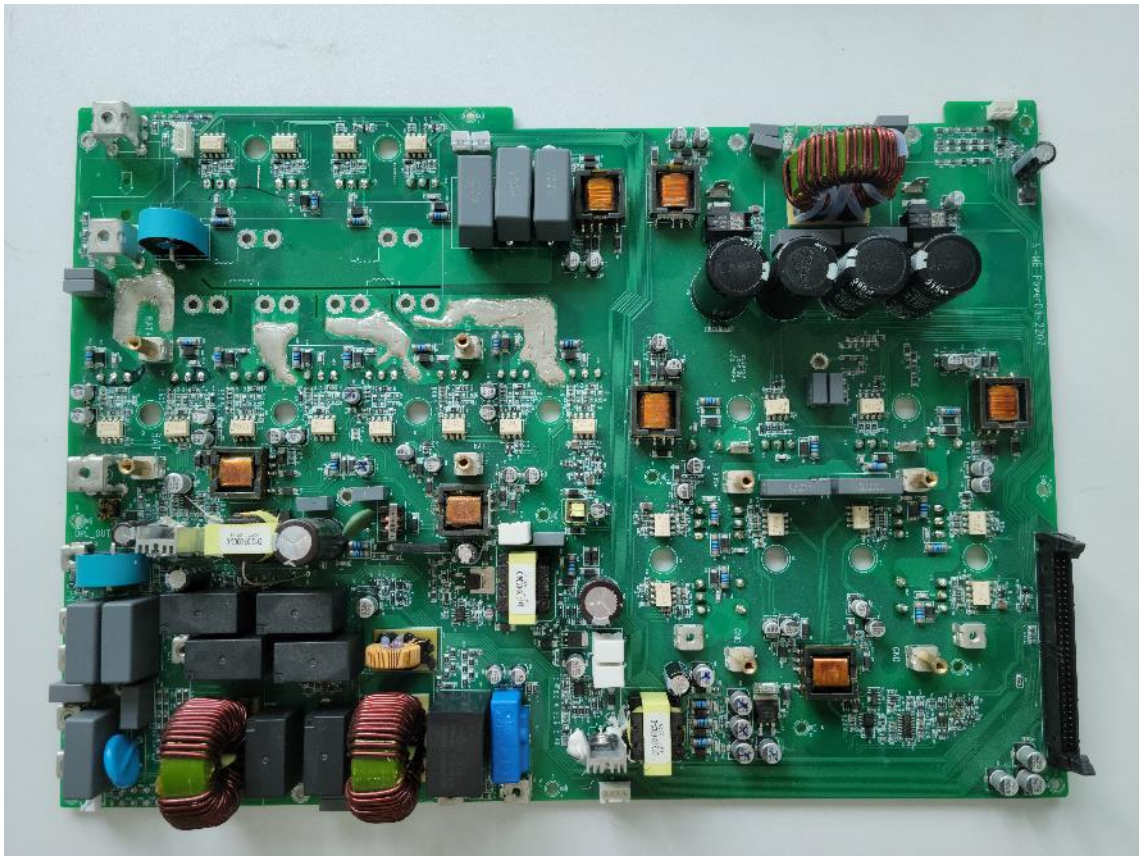
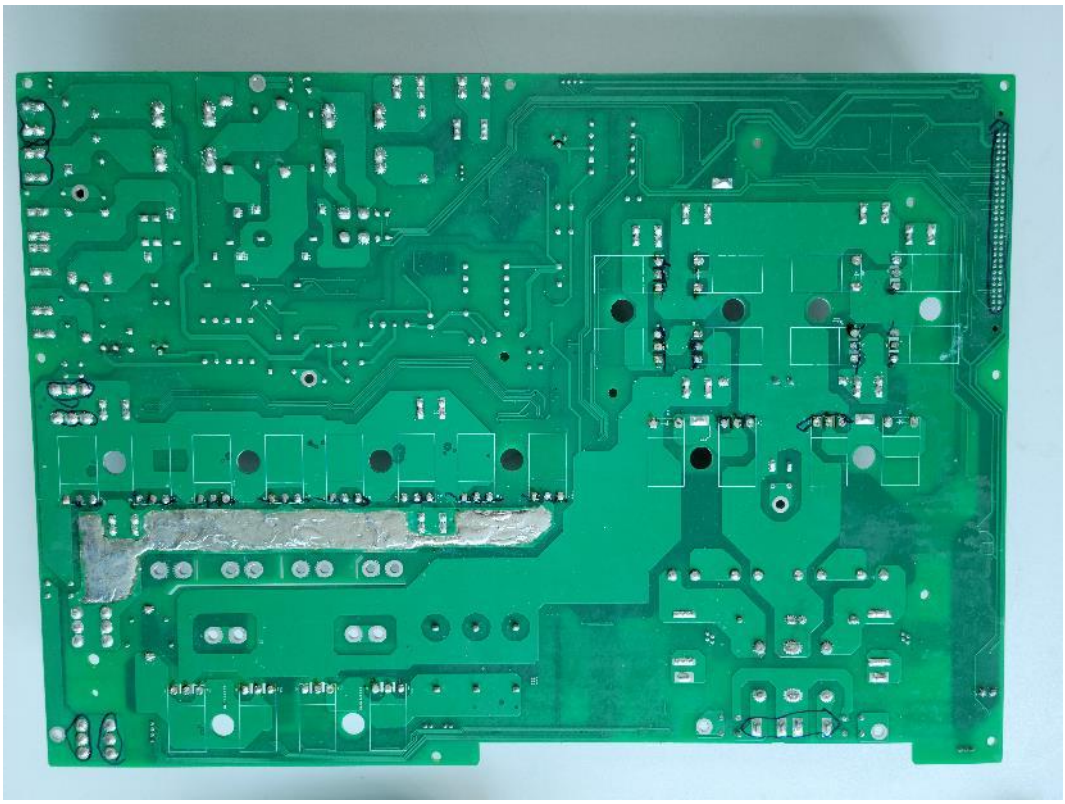
Back Side


Connection interface

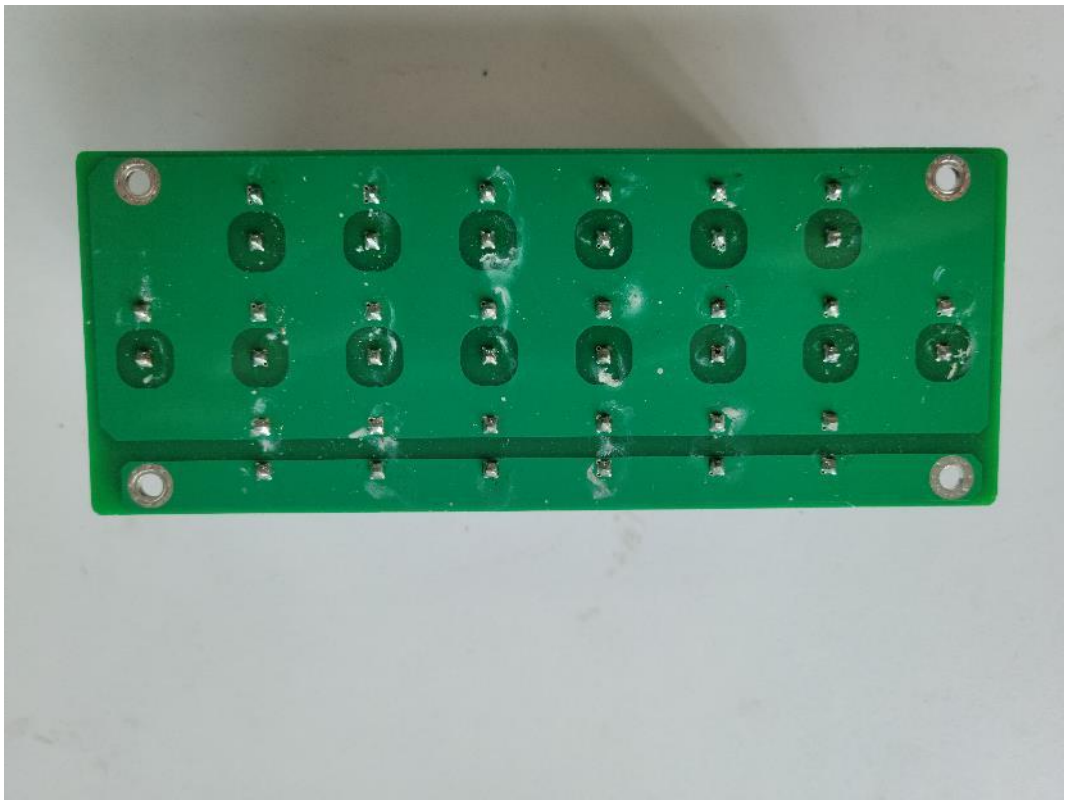
Top Side


External grounding

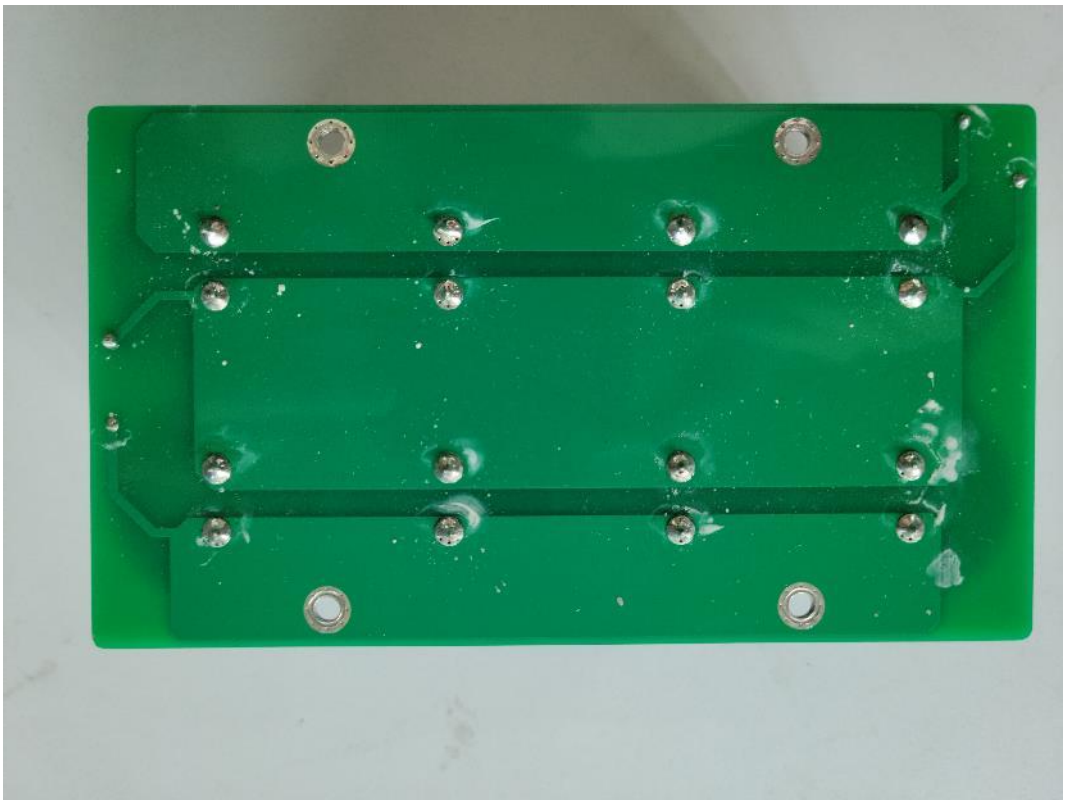
General Internal view of inverter


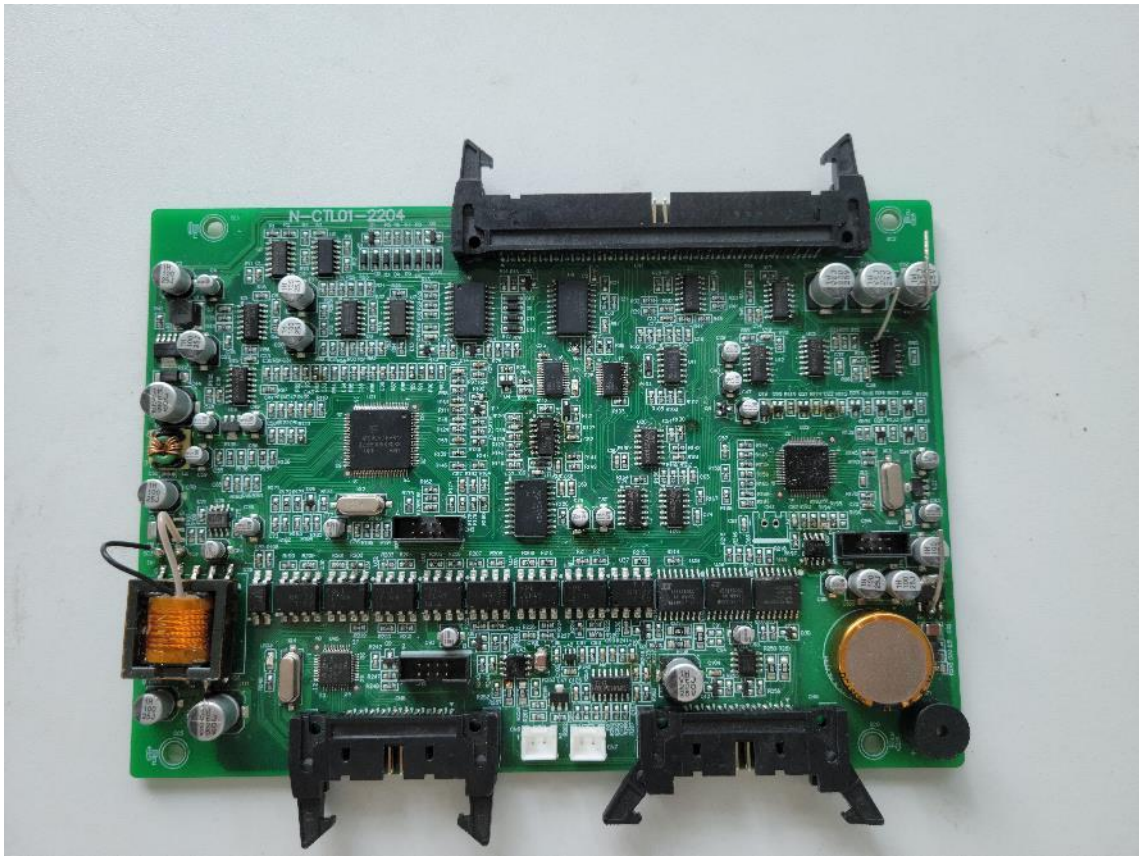
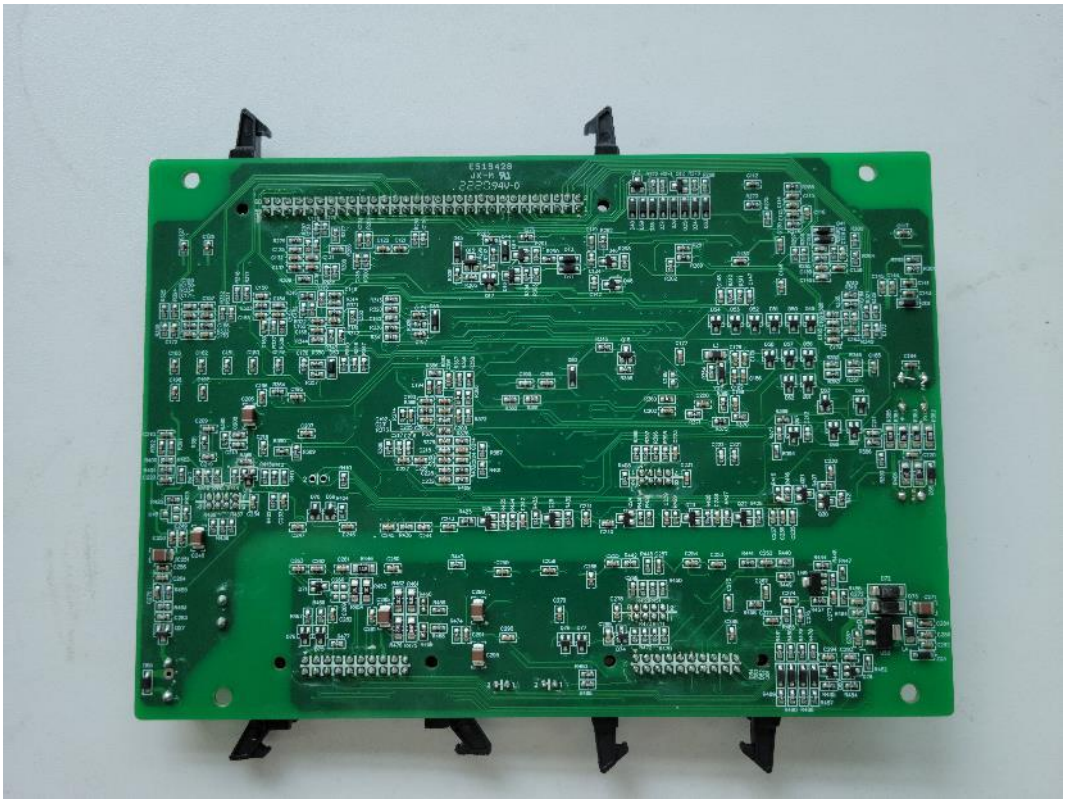
Front of main power board

Back of main power board


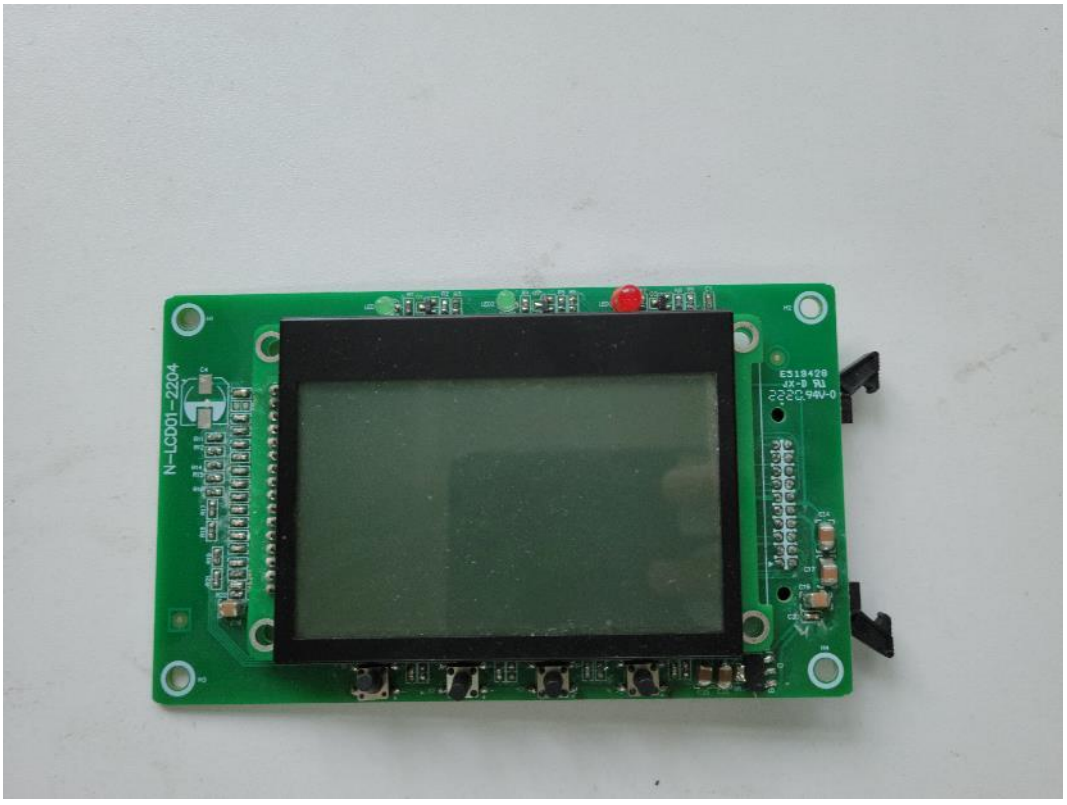
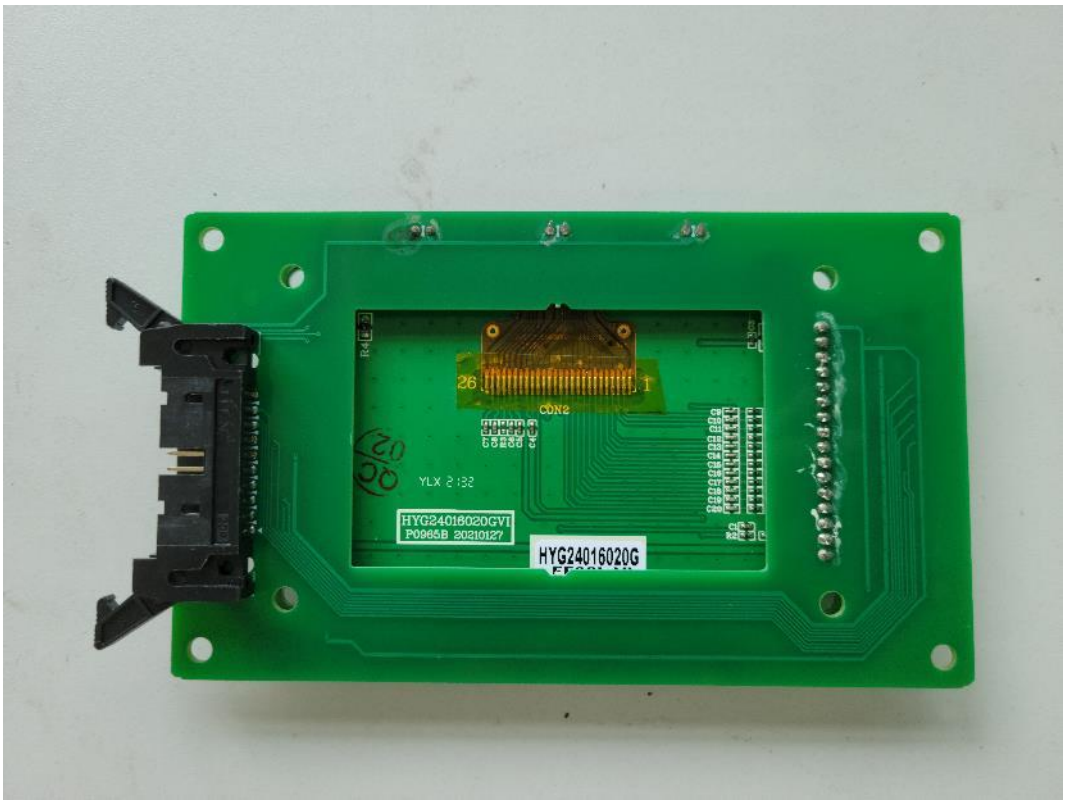
Front of Bus capacitance board

Back of Bus capacitance board


Front of capacitance board

Back of capacitance board


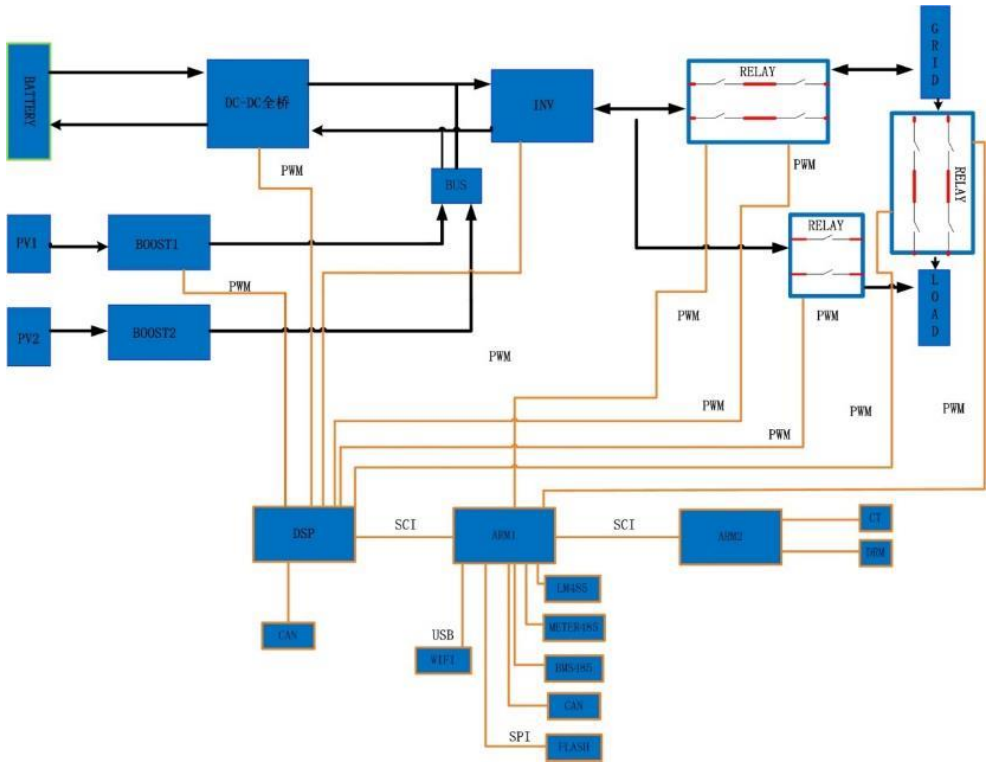
Front of control board

Back of control board


Front of display board

Back of control board


Serial Number


6 ELECTRICAL SCHEME

Electrical Scheme of EUT



----------END OF REPORT----------