TESTING FOR THE VERIFICATION OF COMPLIANCE OF ENERGY STORAGE CONVERTER WITH:

UL1741 SUPPLEMENT SB– GRID SUPPORT UTILITY – INTERACTIVE INVERTERS AND CONVERTERS BASED UPON IEEE 1547-2018, IEEE 1547a-2020, AND IEEE 1547.1-2020.

IEEE1547-2018: IEEE STANDARD FOR INTERCONNECTION AND INTEROPERABILITY OF DISTRIBUTED ENERGY RESOURCES WITH ASSOCIATED ELECTRIC POWER SYSTEMS INTERFACES

IEEE1547.1-2020 IEEE STANDARD CONFORMANCE TEST PROCEDURES FOR EQUIPMENT INTERCONNECTING DISTRIBUTED ENERGY RESOURCES WITH ELECTRIC POWER SYSTEMS AND ASSOCIATED INTERFACES

HAWAIIAN ELECTRIC IEEE 1547.1-2020 STANDARD SOURCE REQUIREMENTS DOCUMENT VERSION 2.0

Test Report Number ..... :	**GZES250400749902**
Trademark ..... :	EPEVER
Tested Model ..... :	**ELD12K**
Variant Models ..... :	ELD6K, ELD8K, ELD10K, ELD15K

APPLICANT

Name ..... :	Huizhou Epever Technology Co., Ltd.
Address ..... :	No. 6 Laowu Road, Start-up Area of China-Korea (Huizhou) Industrial Park, Zhongkai District, Huizhou, Guangdong, China

TESTING LABORATORY

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Conducted (tested) by ..... :	Sunny Lin (Project Engineer)
Reviewed & Approved by ..... :	Roger Hu (Technical Reviewer)
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1 SCOPE

SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch has been contracted by Huizhou Epever Technology Co., Ltd. in order to perform the testing according to following standards:

- UL 1741 Supplement SB – Grid support utility – Interactive inverters and converters based upon IEEE 1547-2018 and IEEE 1547.1-2020 (Ed.3, revision September 28, 2021)
- IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces – IEEE Std 1547:2018 (Revision of IEEE Std 1547:2003), approved 15 February 2018.
- IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces – IEEE Std 1547.1:2020, approved 5 March 2020.
- IEEE Std 1547a™-2020 (Amendment to IEEE Std 1547-2018)

2 GENERAL INFORMATION

2.1 TESTING PERIOD AND CLIMATIC CONDITIONS

The necessary testing has been performed between the 26th Apr. 2025 and the 18th Nov. 2025.
All the tests and checks have been performed in accordance with the reference Standard (the tests are done at 25 ± 5ºC, 96 kPa ± 10 kPa and 65% 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/ Installation ..... :	On-Grid Hybrid Inverter / Fixed installation
Manufacturer/ Supplier/ Installer ..... :	Huizhou Epever Technology Co., Ltd.
Trade mark ..... :	EPEVER
Model/ Type ..... :	ELD12K
Serial Number ..... :	071603714523DIC2-00010
Hardware Version ..... :	HV: 1.00
Firmware Version ..... :	SV: 1.000
Rated Characteristics ..... :	**ELD12K** Max PV input voltage: 500Vdc Rang of mppt operating voltage: 90-450Vdc Max PV input current: 20Adc*4 Battery input/output voltage range: 40-60Vdc Battery max charging/discharging current: 275Adc/275Adc Rated AC on-grid output/input voltage: 120/240Vac (Split phase), 120/208Vac (2/3 phase) Rated AC on-grid output active power: 12000W Rate AC on-grid output apparent power: 12000VA Max AC on-grid output current: 50Aac Max AC on-grid input current: 80Aac Rated AC on-grid output/input frequency: 50/60Hz AC on-grid power factor: >0.99 (0.8leading-0.8lagging) Rated AC off-grid output voltage: 120/240Vac (Split phase), 120/208Vac (2/3 phase) Rated AC off-grid output active power: 12000W Rate AC off-grid output apparent power: 12000VA Max AC off-grid output current: 50Aac Rated AC off-grid output frequency: 50/60Hz Rated generator input voltage: 120/240Vac (Split phase) Rated generator input current: 50Aac Rated generator input apparent power: 12000VA Rated generator input frequency: 50/60Hz

Communication Protocol .....: N/A

Date of manufacturing: 2025

Test item particulars

Input.....: DC

Output..... AC

Normal Operating Performance Category .....: Category B

Abnormal operating performance Category .....: Category III

Degree of protection against moisture .....: Type 3R

Cooling group ..... Fan

Modular..... No

Internal Transformer ..... Transformer less

Copy of marking plate:

EPEVER® On-Grid Hybrid Inverter

Model:	ELD15K
Display:	☑LED ☐LCD
PV	
Pmax.PV	22500W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 4
Isc PV	25A x 4
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	275A
Max.Discharging Current	275A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	62.5A
Max.Current From Utility	80A
Rated Power To Utility	15000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	62.5A
Rated Power	15000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	62.5A
Rated Power	15000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
UL 1741, CSA C22.2 NO.107.1	
IEEE 1547-2018, IEEE 1547.1-2020	



HUIZHOU EPEVER TECHNOLOGY CO.,LTD.
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Grid Support Utility-interactive Inverter
MADE IN CHINA www.epever.com

EPEVER® On-Grid Hybrid Inverter

Model:	ELD12K
Display:	☑LED ☐LCD
PV	
Pmax.PV	18000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 4
Isc PV	25A x 4
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	275A
Max.Discharging Current	275A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	50A
Max.Current From Utility	80A
Rated Power To Utility	12000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	50A
Rated Power	12000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	50A
Rated Power	12000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
UL 1741, CSA C22.2 NO.107.1	
IEEE 1547-2018, IEEE 1547.1-2020	



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EPEVER® On-Grid Hybrid Inverter

Model:	ELD10K
Display:	☑LED ☐LCD
PV	
Pmax.PV	15000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 4
Isc PV	25A x 4
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	240A
Max.Discharging Current	240A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	41.6A
Max.Current From Utility	80A
Rated Power To Utility	10000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	41.6A
Rated Power	10000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	41.6A
Rated Power	10000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
UL 1741, CSA C22.2 NO.107.1	
IEEE 1547-2018, IEEE 1547.1-2020	



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EPEVER® On-Grid Hybrid Inverter

Model:	ELD8K
Display:	☑LED ☐LCD
PV	
Pmax.PV	12000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 3
Isc PV	25A x 3
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	185A
Max.Discharging Current	185A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	33.3A
Max.Current From Utility	66.6A
Rated Power To Utility	8000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	33.3A
Rated Power	8000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	33.3A
Rated Power	8000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
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EPEVER® On-Grid Hybrid Inverter

Model:	ELD6K
Display:	☑LED ☐LCD
PV	
Pmax.PV	9000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 2
Isc PV	25A x 2
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	140A
Max.Discharging Current	140A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	25A
Max.Current From Utility	50A
Rated Power To Utility	6000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	25A
Rated Power	6000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	25A
Rated Power	6000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
UL 1741, CSA C22.2 NO.107.1	
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EPEVER® On-Grid Hybrid Inverter

Model:	ELD15K
Display:	☐LED ☑LCD
PV	
Pmax.PV	22500W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 4
Isc PV	25A x 4
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	275A
Max.Discharging Current	275A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	62.5A
Max.Current From Utility	80A
Rated Power To Utility	15000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	62.5A
Rated Power	15000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	62.5A
Rated Power	15000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
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EPEVER® On-Grid Hybrid Inverter

Model:	ELD12K
Display:	☐ LED ☑ LCD
PV	
Pmax.PV	18000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 4
Isc PV	25A x 4
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	275A
Max.Discharging Current	275A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	50A
Max.Current From Utility	80A
Rated Power To Utility	12000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	50A
Rated Power	12000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	50A
Rated Power	12000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
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Model:	ELD10K
Display:	☐ LED ☑ LCD
PV	
Pmax.PV	15000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 4
Isc PV	25A x 4
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	240A
Max.Discharging Current	240A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	41.6A
Max.Current From Utility	80A
Rated Power To Utility	10000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	41.6A
Rated Power	10000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	41.6A
Rated Power	10000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
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EPEVER® On-Grid Hybrid Inverter	
Model:	**ELD8K**
Display:	☐ LED ☑ LCD
PV	
Pmax.PV	12000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 3
Isc PV	25A x 3
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	185A
Max.Discharging Current	185A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	33.3A
Max.Current From Utility	66.6A
Rated Power To Utility	8000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	33.3A
Rated Power	8000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	33.3A
Rated Power	8000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
Overvoltage Category	II (DC), III (AC)
PV DC AFCI	Type 1
UL 1741, CSA C22.2 NO.107.1	
IEEE 1547-2018, IEEE 1547.1-2020	



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EPEVER® On-Grid Hybrid Inverter	
Model:	**ELD6K**
Display:	☐ LED ☑ LCD
PV	
Pmax.PV	9000W
Vmax.PV	500V
MPPT Range	90V ... 450V
Max.Current	20A x 2
Isc PV	25A x 2
BATTERY	
Type	Lithium/Lead Acid
Voltage Range	40V ... 60V
Max.Charging Current	140A
Max.Discharging Current	140A
GRID	
Nominal Voltage	L1/L2/N/PE 120/240V (208V 2/3 phase)
Max.Current To Utility	25A
Max.Current From Utility	50A
Rated Power To Utility	6000VA
Frequency	50/60Hz
Power Factor	0.99
Power Factor Range	-0.80~+0.80
BACK-UP	
Rated Voltage	L1/L2/N /PE120/240V (208V 2/3 phase)
Rated Current	25A
Rated Power	6000VA
Frequency	50/60Hz
GEN	
Rated Voltage	L1/L2/N/PE 120/240V
Rated Current	25A
Rated Power	6000VA
Frequency	50/60Hz
OTHER	
Operating Ambient Temp	-25°C ... +60°C
Protective Class	I
PV.Inverter Topology	No-isolated
Ingress Protection	3R
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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. SGS NA Listed Mark shall be at least 5 mm high. Other letters shall be at least 2.4 mm high.
4. “CAUTION” shall be at lease 3.2mm high, the remaining letters shall not be less tan 1.6mm high
5. The S/N number should be pasted on every end product, every S/N number denotes the date code or other dating of manufacture.

Equipment under testing:

- **ELD12K**

Variant Models:

- ELD6K
- ELD8K
- ELD10K
- ELD15K

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 between 50% and 200% of the rated output power or the EUT or Modular inverters
- Same Firmware Version

The test results on the model ELD12K are essentially valid for the derived model derived model ELD6K, ELD8K, ELD10K, ELD15K.

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.

The parameters of the converter models are as following:

According to Table 65.1 of UL 1741 (Third Edition, Dated September 28, 2021)		
Model:	ELD6K	ELD8K
PV INPUT RATINGS:		
Maximum input voltage	500 V dc	
Range of mppt input operating voltage	90 V dc to 450 V dc	
Maximum input current (dc)	20A	
Number of inputs	2	3
INPUT/OUTPUT RATINGS (Grid terminal, Bi-directional):		
Output power factor rating	default >0.99 (-0.8~+0.8 adjustable)	
Number of phases	Split phase or 2/3 phase	
Nominal output voltage (ac)	120/240V or 120/208V	
Nominal output frequency	50/60 Hz	
Maximum continuous output current (ac)	25A	33.3A
Maximum continuous output power (ac)	6000W	8000W
Maximum continuous output apparent power (ac)	6000VA	8000VA
Maximum output fault current (ac) and duration	273Apk, 116.6Arms, 103ms; 104.5 Arms@1cycle; 117.8 Arms@3cycle;122.9 Arms@5cycle	
Maximum Input Current (ac)	50A	66.6A
OUTPUT RATINGS (Backup):		
Number of phases	Split phase or 2/3 phase	
Nominal output voltage (ac)	120/240V or 120/208V	
Nominal output frequency	50/60 Hz	
Maximum continuous output power (ac)	6000W	8000W
Maximum continuous output apparent power (ac)	6000VA	8000VA
Maximum continuous output current (ac)	25A	33.3A
Maximum output fault current (ac) and duration	273Apk, 116.6Arms, 103ms; 104.5 Arms@1cycle; 117.8 Arms@3cycle;122.9 Arms@5cycle	
BATTERY INPUT:		
Battery type	Lithium/Lead Acid	

According to Table 65.1 of UL 1741 (Third Edition, Dated September 28, 2021)		
Model:	ELD6K	ELD8K
Battery Voltage Range (V)	40-60Vdc (Rated 48Vdc)	
Max. Continuous Charging/DischargingCurrent (A）	140A	185A
GENERATOR INPUT:		
Nominal input voltage (ac)	120/240V	
Nominal input frequency	50/60 Hz	
Maximum continuous input power (ac)	6000W	8000W
Maximum continuous input current (ac)	25A	33.3A
Others:		
Normal operation temperature range	-25ºC to 60ºC (>45ºC derating)	
Enclosure Rating Type	Type 3R	
Weigh (kg)	53kg	
Dimension (WxHxD mm)	513×840×283	

According to Table 65.1 of UL 1741 (Third Edition, Dated September 28, 2021)		
Model:	ELD10K	ELD12K
PV INPUT RATINGS:		
Maximum input voltage	500 V dc	
Range of mppt input operating voltage	90 V dc to 450 V dc	
Maximum input current (dc)	20A	
Number of inputs	4	
INPUT/OUTPUT RATINGS (Grid terminal, Bi-directional):		
Output power factor rating	default >0.99 (-0.8~+0.8 adjustable)	
Number of phases	Split phase or 2/3 phase	
Nominal output voltage (ac)	120/240V or 120/208V	
Nominal output frequency	50/60 Hz	
Maximum continuous output current (ac)	41.6A	50A
Maximum continuous output power (ac)	10000W	12000W
Maximum continuous output apparent power (ac)	10000VA	12000VA
Maximum output fault current (ac) and duration	273Apk, 116.6Arms, 103ms; 104.5 Arms@1cycle; 117.8 Arms@3cycle;122.9 Arms@5cycle	
Maximum Input Current (ac)	80A	80A
OUTPUT RATINGS (Backup):		
Number of phases	Split phase or 2/3 phase	
Nominal output voltage (ac)	120/240V or 120/208V	
Nominal output frequency	50/60 Hz	
Maximum continuous output power (ac)	10000W	12000W
Maximum continuous output apparent power (ac)	10000VA	12000VA
Maximum continuous output current (ac)	41.6A	50A
Maximum output fault current (ac) and duration	273Apk, 116.6Arms, 103ms; 104.5 Arms@1cycle; 117.8 Arms@3cycle;122.9 Arms@5cycle	
BATTERY INPUT:		
Battery type	Lithium/Lead Acid	
Battery Voltage Range (V)	40-60Vdc (Rated 48Vdc)	
Max. Continuous Charging/DischargingCurrent (A）	240A	275A
GENERATOR INPUT:		
Nominal input voltage (ac)	120/240V	
Nominal input frequency	50/60 Hz	
Maximum continuous input power (ac)	10000W	12000W
Maximum continuous input current (ac)	41.6A	50A
Others:		

According to Table 65.1 of UL 1741 (Third Edition, Dated September 28, 2021)		
Model:	ELD10K	ELD12K
Normal operation temperature range	-25ºC to 60ºC (>45ºC derating)	
Enclosure Rating Type	Type 3R	
Weigh (kg)	53kg	
Dimension (WxHxD mm)	513×840×283	

According to Table 65.1 of UL 1741 (Third Edition, Dated September 28, 2021)	
Model:	ELD15K
PV INPUT RATINGS:	
Maximum input voltage	500 V dc
Range of mppt input operating voltage	90 V dc to 450 V dc
Maximum input current (dc)	20A
Number of inputs	4
INPUT/OUTPUT RATINGS (Grid terminal, Bi-directional):	
Output power factor rating	default >0.99 (-0.8~+0.8 adjustable)
Number of phases	Split phase or 2/3 phase
Nominal output voltage (ac)	120/240V or 120/208V
Nominal output frequency	50/60 Hz
Maximum continuous output current (ac)	62.5A
Maximum continuous output power (ac)	15000W
Maximum continuous output apparent power (ac)	15000VA
Maximum output fault current (ac) and duration	273Apk, 116.6Arms, 103ms; 104.5 Arms@1cycle; 117.8 Arms@3cycle;122.9 Arms@5cycle
Maximum Input Current (ac)	80A
OUTPUT RATINGS (Backup):	
Number of phases	Split phase or 2/3 phase
Nominal output voltage (ac)	120/240V or 120/208V
Nominal output frequency	50/60 Hz
Maximum continuous output power (ac)	15000W
Maximum continuous output apparent power (ac)	15000VA
Maximum continuous output current (ac)	62.5A
Maximum output fault current (ac) and duration	273Apk, 116.6Arms, 103ms; 104.5 Arms@1cycle; 117.8 Arms@3cycle;122.9 Arms@5cycle
BATTERY INPUT:	
Battery type	Lithium/Lead Acid
Battery Voltage Range (V)	40-60Vdc (Rated 48Vdc)
Max. Continuous Charging/DischargingCurrent (A）	275A
GENERATOR INPUT:	
Nominal input voltage (ac)	120/240V
Nominal input frequency	50/60 Hz
Maximum continuous input power (ac)	15000W
Maximum continuous input current (ac)	62.5A
Others:	
Normal operation temperature range	-25ºC to 60ºC (>45ºC derating)
Enclosure Rating Type	Type 3R
Weigh (kg)	53kg
Dimension (WxHxD mm)	513×840×283

2.3 SGS TEST EQUIPMENT LIST

	No.	Equipment Name	MARK/Model No.	Equipment No.	Equipment calibration due date
STIEE & BALUN	1	Digital oscilloscope	Tektronix / MSO4054B	BZ-DGD-L064	2025/01/06 to 2026/01/05
	2	Voltage probe	Tektronix / TPP0500	BZ-DGD-L028-1	2025/01/06 to 2026/01/05
	3	Voltage probe	Tektronix / TPP0500	BZ-DGD-L028-4	2025/01/06 to 2026/01/05
	4	Voltage probe	CYBERTEK / VP5200A	BZ-DGD-L241-1	2025/01/07 to 2026/01/06
	5	Temperature Chamber	OK-TS-6000	BZ-DGB-L028	2025/01/10 to 2026/01/09
	6	Power analyzer	DEWETRON / TRIONet3	BZ-DGD-L349-2	2024/07/04 to 2025/07/03 2025/02/20 to 2026/02/19
	7	Data recorder	Agilent / 34970A	BZ-DGB-L034-1	2025/01/10 to 2026/01/09
	8	Temperature & Humidity meter	CEM/DT-322	BZ-DGD-L271	2024/08/05 to 2025/08/04 2025/08/05 to 2026/08/04
	9	Current Transformer	HIOKI / CT6873	BZ-DGD-L315-1	2024/08/05 to 2025/08/04 2025/07/30 to 2026/07/29
	10	Current Transformer	HIOKI / CT6873	BZ-DGD-L315-2	2024/08/05 to 2025/08/04 2025/01/16 to 2026/01/15
	11	Current Transformer	HIOKI / CT6873	BZ-DGD-L315-3	2024/08/05 to 2025/08/04 2025/07/30 to 2026/07/29
	12	Current Transformer	HIOKI / CT6873	BZ-DGD-L315-4	2024/08/05 to 2025/08/04 2025/07/30 to 2026/07/29
	13	Signal Generator	Agilent/ N5181A	BZ-DGE-L001	2025/01/06 to 2026/01/05
	14	SURGE coupling network (AC/DC Ports)	HTEC/ SCDN303P7	BZ-DGE-L035	2025/01/06 to 2026/01/05
	15	SURGE Generator (AC/DC Ports)	HTEC/ HCWG 70	BZ-DGE-L036	2025/01/06 to 2026/01/05
	16	Ring Wave Generator	HTEC/ HIM 412	BZ-DGE-L143-3	2024/05/22 to 2025/05/21 2025/01/07 to 2026/01/06
	17	EFT Test System	HTEC/ HEFT 51	BZ-DGE-L033	2025/01/06 to 2026/01/05
	18	Safety tester	Chroma/ 19032	BZ-DGD-L066	2025/01/09 to 2026/01/08
SGS	19	True RMS Multimeter	FLUKE / 177C	GZE012-71	2024/10/29 to 2025/10/28 2025/09/28 to 2026/09/27

2.4 Testing equipment requirements

1) AC test source requirements

Parameters	Limit
Voltage Harmonics (THD)	3.0%
Voltage	±1%*$U_{setting}$
Frequency	±0.1Hz
Voltages Balance (L-N or L-L)	±3%*U_n
Phase Displacement	±3º
Negative Sequence Voltage	1.5%

2) DC test source requirements

If the testing agency and the DER manufacturer agree that the following two conditions are true, it shall be permitted to use substitute hardware to emulate the prime mover or DER input energy source:

- The emulation system adequately captures the dynamics of the real prime mover or input energy source for all time scales relevant to the test for which it is to be used.
- Vulnerabilities including DER auxiliary systems that may affect the DER's ability to perform the test are properly captured. Auxiliary systems (for example, control power supplies, pumps, etc.) may be of particular concern in ride-through tests.

3) Measurement system requirements

Test system measurements shall have an uncertainty of no more than 0.5 times the minimum required DER measurement accuracy for steady-state measurements in Table 3 of IEEE Std 1547-2018.

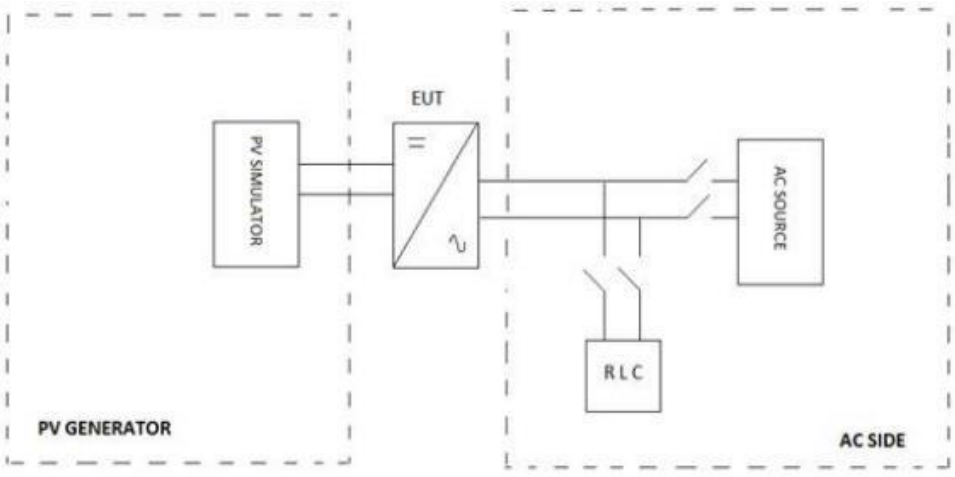
Table 3—Minimum measurement and calculation accuracy requirements for manufacturers[a]

Time frame	Steady-state measurements			Transient measurements		
Parameter	Minimum measurement accuracy	Measure-ment window	Range	Minimum measurement accuracy	Measure-ment window	Range
Voltage, RMS	(± 1% V_{nom})	10 cycles	0.5 p.u. to 1.2 p.u.	(± 2% V_{nom})	5 cycles	0.5 p.u. to 1.2 p.u.
Frequency[b]	10 mHz	60 cycles	50 Hz to 66 Hz	100 mHz	5 cycles	50 Hz to 66 Hz
Active Power	(± 5% S_{rated})	10 cycles	0.2 p.u. < P < 1.0 p.u.	Not required	N/A	N/A
Reactive Power	(± 5% S_{rated})	10 cycles	0.2 p.u. < Q < 1.0 p.u.	Not required	N/A	N/A
Time	1% of measured duration	N/A	5 s to 600 s	2 cycles	N/A	100 ms < 5 s

[a]Measurement accuracy requirements specified in this table are applicable for voltage THD < 2.5% and individual voltage harmonics <1.5%.
[b]Accuracy requirements for frequency are applicable only when the fundamental voltage is greater than 30% of the nominal voltage.

2.5 Test set up.

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:

Test bench Equipment	Trademark / Model	Serial number / ID	Characteristics
DC Source	Chroma/ WPLA-330 200KVA	Vac/ 5-650Vac/ 45-65Hz 0-320A/ 0-160A	--
AC Source	WPLA-150KW	50 – 1500 Vdc; 0 – 200 A	--
RLC Load	Qunlin / ACLT38160H	563.3kW, 563.3 kVAr	--

2.6 Definitions

AGIR	authority governing interconnection requirements	CSV	comma-separated value
CT	current transformer	DER	distributed energy resource
DRTS	digital real-time simulator	EMI	electromagnetic interference
EPS	electric power system	EUT	equipment under test
GFOV	ground fault overvoltage	HIL	hardware-in-the-loop
HVRT	high-voltage ride-through	I/O	input/output
IA	interface algorithm	ID	identifier
kV	kilovolt	kVA	kilovolt ampere
kvar	kilovolt ampere reactive	kW	kilowatt
LROV	load rejection overvoltage	LVRT	low-voltage ride-through
MRA	minimum required accuracy (per Table 3 of IEEE Std 1547-2018)	MVA	megavolt ampere
NRTL	Nationally Recognized Testing Laboratory	PCC	point of common coupling
p.f.	power factor	PDF	portable document format
PHIL	power hardware-in-the-loop	PoC	point of [distributed energy resource (DER)] connection
p.u.	per unit	PUT	parameter under test
OPR	owner's project requirements	QF	quality factor
RLC	resistance, inductance, and capacitance	rms	root mean square
ROCOF	rate of change of frequency	RPA	reference point of applicability
RVC	rapid voltage changes	THD	total harmonic distortion
TLS	transport layer security	TRD	total rated-current distortion
UI	unintentional islanding	var	volt-ampere reactive
VT	voltage transformer or transducer, synonymous with potential transformer or transducer	W	watt

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

REPORT SECTION	UL1741SB (Ed.3)	IEEE1547: 2018	STANDARD REQUIREMENTS IEEE Std 1547.1:2020 TEST		RESULTS
4.1	SB4.3.5.3	4.4	5.3	Temperature stability	P
4.2	SB4.3.5.4	6.4	5.4	Test for response to voltage disturbances	P
4.2.1	SB4.3.5.4.2	6.4.1	5.4.2	Test for overvoltage trip	P
	SB4.3.5.4.3		5.4.3	Test for undervoltage trip	P
4.2.2.1	SB4.3.5.4.4	6.4.2.1 6.4.2.3	5.4.4	Low-voltage ride-through tests	P
4.2.2.2		6.4.2.2	5.4.5	Test for voltage disturbances within continuous operating region	P
		6.4.2.6	5.4.6	Test for dynamic voltage support	N/A
4.2.2.3	SB4.3.5.4.7	6.4.2.1 6.4.2.4	5.4.7	High-voltage ride-through tests	P
4.3	SB4.3.5.5	6.5	5.5	Test for response to frequency disturbances	P
4.3.1	SB4.3.5.5.1	6.5.1	5.5.1	Test for overfrequency trip	P
	SB4.3.5.5.2		5.5.2	Test for underfrequency trip	P
4.3.2.1	SB4.3.5.5.3	6.5.2.1 6.5.2.3	5.5.3	Test for low-frequency ride-through	P
4.3.2.2	SB4.3.5.5.4	6.5.2.1 6.5.2.4	5.5.4	Test for high-frequency ride-through	P
4.3.2.1 4.3.2.2		6.5.2.5	5.5.5	Test for rate of change of frequency (ROCOF)	P
4.4	SB4.3.5.5.6	6.5.2.6	5.5.6	Test for voltage phase-angle change ride-though	P
4.5		4.10.2 4.10.3 6.6	5.6	Enter service	P
4.6		4.10.4	5.7.4	Synchronization control function test for equipment with no synchronizing disable capability (variation 3)	P
4.7		4.11	5.8	Interconnection integrity	P
4.7.1	SB4.3.5.8.1	4.11.1	5.8.1	Protection from electromagnetic interference (EMI) test	P
4.7.2	SB4.3.5.8.2	4.11.2	5.8.2	Surge withstand performance test	P
4.8		4.11.3	5.8.3	Paralleling device tests	P
4.9		7.1	5.9	Limitation of dc injection for inverters	P
4.10	SB4.3.5.10	8.1	5.10	Unintentional islanding	--
4.10.1	SB4.3.5.10.2	8.1.1	5.10.2	Balanced generation to load unintentional islanding test	P
4.10.2	SB4.3.5.10.3		5.10.3	Powerline conducted permissive signal test	N/A
			5.10.4	Permissive hardware-input test	N/A
	SB4.3.5.10.5		5.10.5	Reverse or minimum import active-power flow	N/A
4.11		6.2.2	5.11	Open phase	P

REPORT SECTION	UL1741SB (Ed.3)	IEEE1547: 2018	STANDARD REQUIREMENTS IEEE Std 1547.1:2020 TEST		RESULTS
4.12		7.3	5.12	Current distortion	P
4.12.1			5.12.2	Current distortion test for DER not capable of operation isolated from external source	P
4.12.2			5.12.3	Current distortion test for DER capable of operation isolated from external source	N/A
4.13		4.6.2	5.13	Limit active power	P
4.14		5.3	5.14	Voltage regulation	P
4.14.1	SB4.3.5.14.3	5.3.2	5.14.3	Test for constant power factor (p.f.) mode	P
4.14.2	SB4.3.5.14.4	5.3.3	5.14.4	Test for voltage-reactive power (volt-var) mode	P
4.14.3	SB4.3.5.14.5		5.14.5	Test for voltage-reactive power (volt-var) mode (VRef test)	P
4.14.4	SB4.3.5.14.6		5.14.6	Test for voltage - reactive power (volt-var) mode with an imbalanced grid	N/A
4.14.5	SB4.3.5.14.7	5.3.4	5.14.7	Test for active power-reactive power mode (watt-var)	P
4.14.6	SB4.3.5.14.8	5.3.5	5.14.8	Test for constant reactive power (var) mode	P
4.14.7	SB4.3.5.14.9	5.4.2	5.14.9	Test for voltage-active power (volt-watt) mode	P
4.14.8			5.14.10	Test for voltage-active power (volt-watt) mode with an imbalanced grid	N/A
4.15	SB4.3.5.15		5.15	Frequency support	P
4.15.1	SB4.3.5.15.2	6.5.2.7	5.15.2	Test for frequency-droop (frequency-power or frequency-watt) capability—above nominal frequency	P
4.15.2	SB4.3.5.15.3		5.15.3	Test for frequency-droop (frequency-power or frequency-watt) capability—below nominal frequency	P
4.16	SB4.3.5.16	4.7	5.16	Test for prioritization of DER responses	P
4.16.1			5.16.2	Test for voltage and frequency regulation priority	P
4.17	SB4.3.5.17	7.4	5.17	Limitation of overvoltage contribution	P
4.17.1	SB4.3.5.17.1	7.4.1	5.17.1	Ground fault overvoltage (GFOV) test	N/A
4.17.2	SB4.3.5.17.2	7.4.2	5.17.2	Load rejection overvoltage (LROV) test	P
4.18		11.4	5.18	Fault current tests	N/A
4.18.1		11.4.2	5.18.1	Fault current tests for inverters	N/A
4.18.2		11.4.3	5.18.2	Fault current characterization for rotating machines	N/A
4.19		--	5.19	Persistence of DER parameter settings	P
4.20	SB4.3.6 SB4.3.6.8.2	10	6 6.8.2	Interoperability tests (IEEE2030.5 Protocol used)	N/A
4.20.1.1			6.4 6.8.2.1	Nameplate data test	N/A
4.20.1.2	SB4.3.6.5.2		6.5 6.8.2.2	Configuration information test	N/A
4.20.1.3	SB4.3.6.6		6.6 6.8.2.3	Monitoring information test	N/A
4.20.1.4	SB4.3.6.7		6.7 6.8.2.4	Management information test	N/A

REPORT SECTION	UL1741SB (Ed.3)	IEEE1547a: 2020	STANDARD REQUIREMENTS IEEE Std 1547.1:2020 TEST		RESULTS
4.2.3		6.4.1	5.4.3	Test for undervoltage trip	P

REPORT SECTION	UL1741SB (Ed.3)	SRD 2.0	STANDARD REQUIREMENTS IEEE Std 1547.1:2020 TEST		RESULTS
4.5		PART II.A	5.6	Enter service	P
4.3.2.3		PART II.B	5.5.3	Test for low-frequency ride-through	P
4.3.2.4			5.5.4	Test for high-frequency ride-through	P
4.15.3		PART II.C	5.15.2	Test for frequency-droop (frequency-power or frequency-watt) capability—above nominal frequency	P
4.15.4			5.15.3	Test for frequency-droop (frequency-power or frequency-watt) capability—below nominal frequency	P

4 TEST RESULTS

4.1 Temperature Stability

This test verifies that the EUT maintains measurement accuracy of parameters as required in Table 3 of IEEE Std 1547-2018 over its specified operating temperature range.

Table 3—Minimum measurement and calculation accuracy requirements for manufacturers[a]

Time frame	Steady-state measurements			Transient measurements		
Parameter	Minimum measurement accuracy	Measure-ment window	Range	Minimum measurement accuracy	Measure-ment window	Range
Voltage, RMS	(± 1% V_{nom})	10 cycles	0.5 p.u. to 1.2 p.u.	(± 2% V_{nom})	5 cycles	0.5 p.u. to 1.2 p.u.
Frequency[b]	10 mHz	60 cycles	50 Hz to 66 Hz	100 mHz	5 cycles	50 Hz to 66 Hz
Active Power	(± 5% S_{rated})	10 cycles	0.2 p.u. < P < 1.0 p.u.	Not required	N/A	N/A
Reactive Power	(± 5% S_{rated})	10 cycles	0.2 p.u. < Q < 1.0 p.u.	Not required	N/A	N/A
Time	1% of measured duration	N/A	5 s to 600 s	2 cycles	N/A	100 ms < 5 s

[a]Measurement accuracy requirements specified in this table are applicable for voltage THD < 2.5% and individual voltage harmonics <1.5%.
[b]Accuracy requirements for frequency are applicable only when the fundamental voltage is greater than 30% of the nominal voltage.

The following parameter configurations are declared by the Manufacturer:

Time Frame	Steady-state measurements		
Parameter	Minimum measurement accuracy	Measurement window	Range
Voltage, RMS	± 1% Vnom	10 cycles	0.5 p.u. to 1.2 p.u.
Frequency	0.01 Hz	60 cycles	50 Hz to 66 Hz
Active Power	± 5% Srated	10 cycles	0 p.u. to 1.0 p.u.
Reactive Power	± 5% Srated	10 cycles	0 p.u. to 1.0 p.u.
Time	1). 1% of measured duration (>= 5 s) 2). 32 ms (< 5 s)	N/A	0~ 1000 s
Minimum Operating Temperatures (°C)		Maximum Operating Temperatures (°C)	
-25 °C		60 °C (> 45 °C derating)	

Test Matrix:

		Voltage			Active Power			Reactive Power			Frequency		
		Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
Min. Operating Tem.	1	X				X			X			X	
	2		X			X			X			X	
	3			X		X			X			X	
	4		X		X				X			X	
	5		X			X			X			X	
	6		X				X		X			X	
	7		X			X		X				X	
	8		X			X			X			X	
	9		X			X				X		X	
	10		X			X			X		X		
	11		X			X			X			X	
	12		X			X			X				X
Max. Operating Tem.	1	X				X			X			X	
	2		X			X			X			X	
	3			X		X			X			X	
	4		X		X				X			X	
	5		X			X			X			X	
	6		X				X		X			X	
	7		X			X		X				X	
	8		X			X			X			X	
	9		X			X				X		X	
	10		X			X			X		X		
	11		X			X			X			X	
	12		X			X			X				X

This test has been performed according to the point 5.3.3 of IEEE 1547.1:2020 standard.

Before testing, the EUT has reached each of the desired stabilize temperature after a minimum of 2.5 h.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/05/08	100 ms	5 kHz
MSO4054B	2025/05/08	--	500 kS/s
Temperature Chamber	2025/05/08	--	--

Model: **ELD12K**

L1-L2: 240V		Attempt-1		Attempt-2		Attempt-3		Attempt-4		Attempt-5	
#	Type	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.
Min. Operating Tem.											
1	U (p.u.)	0.502	0.499	0.502	0.500	0.502	0.500	0.502	0.500	0.502	0.500
2	U (p.u.)	1.006	1.004	1.006	1.004	1.006	1.004	1.006	1.004	1.006	1.004
3	U (p.u.)	1.201	1.201	1.201	1.203	1.201	1.203	1.201	1.203	1.201	1.201
4	P (p.u.)	-1.004	-0.976	-1.005	-0.997	-1.005	-0.999	-1.005	-0.996	-1.004	-0.994
5	P (p.u.)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	P (p.u.)	1.008	1.012	1.008	1.013	1.008	1.013	1.008	1.015	1.008	1.013
7	Q (p.u.)	-0.629	-0.607	-0.629	-0.612	-0.630	-0.609	-0.603	-0.604	-0.633	-0.605
8	Q (p.u.)	0.000	-0.047	-0.004	-0.049	-0.004	-0.049	0.000	-0.041	0.000	-0.043
9	Q (p.u.)	0.601	0.564	0.608	0.565	0.601	0.562	0.608	0.568	0.602	0.564
10	F (Hz)	49.99	49.99	49.99	50.00	49.99	50.00	49.99	49.99	49.99	50.00
11	F (Hz)	59.99	59.99	59.99	59.99	59.99	59.99	59.99	59.99	59.99	59.99
12	F (Hz)	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00

L1-L2: 240V		Attempt-1		Attempt-2		Attempt-3		Attempt-4		Attempt-5	
#	Type	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.
Max. Operating Tem.											
1	U (p.u.)	0.502	0.501	0.502	0.501	0.502	0.501	0.502	0.502	0.502	0.501
2	U (p.u.)	1.006	1.004	1.006	1.004	1.006	1.004	1.006	1.004	1.006	1.004
3	U (p.u.)	1.201	1.203	1.201	1.203	1.200	1.201	1.201	1.203	1.200	1.201
4	P (p.u.)	-0.998	-1.005	-0.993	-1.005	-0.998	-1.005	-0.995	-1.005	-0.998	-1.005
5	P (p.u.)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	P (p.u.)	1.009	1.012	1.008	1.012	1.009	1.015	1.009	1.012	1.008	1.013
7	Q (p.u.)	-0.607	-0.647	-0.611	-0.647	-0.607	-0.641	-0.604	-0.647	-0.607	-0.647
8	Q (p.u.)	0.000	-0.047	0.000	-0.046	0.000	-0.047	0.000	-0.047	0.000	-0.046
9	Q (p.u.)	0.602	0.560	0.609	0.569	0.609	0.567	0.609	0.567	0.608	0.568
10	F (Hz)	49.99	50.00	49.99	50.00	49.99	50.00	49.99	50.00	49.99	50.00
11	F (Hz)	59.99	59.99	59.99	60.00	59.99	60.00	59.99	60.00	59.99	59.99
12	F (Hz)	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00

L1-L2: 208V		Attempt-1		Attempt-2		Attempt-3		Attempt-4		Attempt-5	
#	Type	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.
Min. Operating Tem.											
1	U (p.u.)	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501
2	U (p.u.)	1.001	1.003	1.001	1.003	1.001	1.005	1.001	1.005	1.001	1.003
3	U (p.u.)	1.199	1.201	1.200	1.201	1.200	1.200	1.200	1.201	1.200	1.201
4	P (p.u.)	-1.016	-0.995	-1.016	-0.999	-1.016	-0.995	-1.016	-0.995	-1.016	-0.996
5	P (p.u.)	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000
6	P (p.u.)	0.986	1.010	0.986	1.010	0.986	1.010	0.986	1.009	0.986	1.009
7	Q (p.u.)	-0.580	-0.599	-0.580	-0.605	-0.580	-0.605	-0.580	0.599	-0.580	-0.599
8	Q (p.u.)	0.000	-0.040	0.030	-0.040	0.000	-0.040	0.030	-0.040	0.000	-0.040
9	Q (p.u.)	0.609	0.578	0.609	0.574	0.609	0.578	0.609	0.578	0.609	0.574
10	F (Hz)	49.99	50.00	49.99	49.99	49.99	49.99	49.99	49.99	49.99	49.99
11	F (Hz)	59.99	59.99	59.99	59.99	59.99	59.99	59.99	60.00	59.99	59.99
12	F (Hz)	65.99	65.99	65.99	66.00	65.99	66.00	65.99	66.00	65.99	66.00

L1-L2: 208V		Attempt-1		Attempt-2		Attempt-3		Attempt-4		Attempt-5	
#	Type	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.
Max. Operating Tem.											
1	U (p.u.)	0.501	0.501	0.501	0.501	0.501	0.500	0.501	0.501	0.501	0.501
2	U (p.u.)	1.001	1.001	1.001	1.003	1.001	1.001	1.001	1.002	1.001	1.001
3	U (p.u.)	1.200	1.201	1.200	1.201	1.200	1.201	1.200	1.201	1.200	1.201
4	P (p.u.)	-1.016	-0.998	-1.016	-0.997	-1.016	-0.998	-1.016	-0.997	-1.016	-0.997
5	P (p.u.)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	P (p.u.)	0.985	1.001	0.987	1.001	0.987	1.000	0.987	1.000	0.985	1.000
7	Q (p.u.)	-0.580	-0.605	-0.580	-0.607	-0.580	-0.604	-0.580	-0.605	-0.580	-0.604
8	Q (p.u.)	0.000	-0.032	0.000	-0.035	0.000	-0.038	0.050	-0.036	0.000	-0.036
9	Q (p.u.)	0.609	0.576	0.609	0.580	0.609	0.578	0.609	0.578	0.609	0.576
10	F (Hz)	49.99	49.99	49.99	49.99	49.99	49.99	49.99	49.99	49.99	49.99
11	F (Hz)	59.99	59.99	59.99	60.00	59.99	59.99	59.99	59.99	59.99	59.99
12	F (Hz)	65.99	65.99	65.99	65.99	65.99	65.99	65.99	65.99	65.99	65.99

L1-N: 120V		Attempt-1		Attempt-2		Attempt-3		Attempt-4		Attempt-5	
#	Type	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.
Min. Operating Tem.											
1	U (p.u.)	0.500	0.501	0.499	0.501	0.499	0.500	0.500	0.500	0.500	0.500
2	U (p.u.)	1.003	1.001	1.003	1.000	1.003	1.000	1.003	1.001	1.003	1.001
3	U (p.u.)	1.203	1.200	1.203	1.201	1.203	1.200	1.203	1.200	1.203	1.201
4	P (p.u.)	-1.015	-0.997	-1.015	-0.994	-1.015	-0.994	-1.015	-0.994	-1.015	-0.999
5	P (p.u.)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	P (p.u.)	0.991	1.001	0.991	1.001	0.991	1.000	0.991	1.001	0.991	1.000
7	Q (p.u.)	-0.588	-0.606	-0.580	-0.605	-0.596	-0.597	-0.585	-0.605	-0.585	-0.600
8	Q (p.u.)	-0.004	-0.034	-0.003	-0.041	-0.016	-0.034	-0.004	-0.034	-0.002	-0.034
9	Q (p.u.)	0.605	0.573	0.605	0.576	0.605	0.574	0.608	0.578	0.605	0.578
10	F (Hz)	49.99	49.99	49.99	49.99	49.99	49.99	49.99	49.99	49.99	49.99
11	F (Hz)	60.00	59.99	59.99	59.99	60.00	59.99	60.00	59.99	60.00	59.99
12	F (Hz)	66.00	65.99	66.00	66.00	65.99	65.99	66.00	66.00	66.00	65.99

L1-N: 120V		Attempt-1		Attempt-2		Attempt-3		Attempt-4		Attempt-5	
#	Type	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.	Cal. Meas.	EUT Meas.
Max. Operating Tem.											
1	U (p.u.)	0.500	0.502	0.500	0.501	0.499	0.501	0.499	0.501	0.500	0.501
2	U (p.u.)	1.004	1.001	1.004	1.000	1.004	1.001	1.004	1.001	1.004	1.000
3	U (p.u.)	1.203	1.202	1.203	1.200	1.203	1.202	1.203	1.202	1.203	1.201
4	P (p.u.)	-1.015	-0.999	-1.015	-0.999	-1.015	-0.997	-1.015	-0.997	-1.015	-0.998
5	P (p.u.)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	P (p.u.)	0.991	1.007	0.991	1.010	0.991	1.010	0.991	1.001	0.991	1.000
7	Q (p.u.)	-0.585	-0.603	-0.576	-0.605	-0.576	-0.605	-0.589	-0.602	-0.588	-0.599
8	Q (p.u.)	-0.041	-0.040	0.010	-0.030	0.015	-0.030	0.011	-0.030	0.015	-0.030
9	Q (p.u.)	0.615	0.571	0.615	0.578	0.613	0.580	0.615	0.599	0.615	0.578
10	F (Hz)	49.99	49.99	49.99	49.99	49.99	49.99	49.99	50.00	49.99	49.99
11	F (Hz)	59.99	59.99	59.99	59.99	59.99	60.00	59.99	59.99	60.00	59.99
12	F (Hz)	65.99	66.01	65.99	66.00	65.99	66.00	65.99	66.00	65.99	66.00

For the clearing time test shall be conducted at the high end of the temperature range (60 °C).

L1-L2: 240V Parameter Setting			Attempts	1	2	3	4	5
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.52Un to 0.48Un	L1L2	Trip Time (s)	1.978	1.978	1.978	1.978	1.978
UV1 = 0.88Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.90Un to 0.86Un	L1L2	Trip Time (s)	20.95	20.97	20.97	20.95	20.97
OV1 = 1.10Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.08Un to 1.12Un	L1L2	Trip Time (s)	0.984	0.984	0.980	0.980	0.980
OV2 = 1.20Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 1.18Un to 1.22Un	L1L2	Trip Time (s)	0.141	0.147	0.148	0.151	0.143
UF2 = 57.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 57.02Hz to 56.98Hz	L1L2	Trip Time (s)	0.151	0.153	0.153	0.156	0.156
UF1 = 59.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 59.02Hz to 58.98Hz	L1L2	Trip Time (s)	0.159	0.141	0.150	0.152	0.159
OF1 = 61.0Hz	**Trip time test:** 1, Min. Clearing time set 180 s 2, Step from 60.98Hz to 61.02Hz	L1L2	Trip Time (s)	179.02	179.05	179.04	179.04	179.10
OF2 = 66.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 65.98Hz to 66.02Hz	L1L2	Trip Time (s)	0.144	0.159	0.157	0.157	0.157

L1-L2: 208V Parameter Setting			Attempts	1	2	3	4	5
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.52Un to 0.48Un	L1L2	Trip Time (s)	1.985	1.995	1.990	1.990	1.990
UV1 = 0.88Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.90Un to 0.86Un	L1L2	Trip Time (s)	20.99	20.98	20.98	20.97	20.97
OV1 = 1.10Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.08Un to 1.12Un	L1L2	Trip Time (s)	0.987	0.977	0.976	0.977	0.977
OV2 = 1.20Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 1.18Un to 1.22Un	L1L2	Trip Time (s)	0.135	0.150	0.135	0.147	0.133
UF2 = 57.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 57.02Hz to 56.98Hz	L1L2	Trip Time (s)	0.146	0.137	0.149	0.144	0.134
UF1 = 59.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 59.02Hz to 58.98Hz	L1L2	Trip Time (s)	0.144	0.148	0.139	0.134	0.136
OF1 = 61.0Hz	**Trip time test:** 1, Min. Clearing time set 180 s 2, Step from 60.98Hz to 61.02Hz	L1L2	Trip Time (s)	179.92	179.92	179.92	179.92	179.92
OF2 = 66.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 65.98Hz to 66.02Hz	L1L2	Trip Time (s)	0.150	0.129	0.133	0.141	0.143

L1-N: 120V Parameter Setting			Attempts	1	2	3	4	5
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.52Un to 0.48Un	L1N	Trip Time (s)	1.980	1.970	1.970	1.970	1.978
UV1 = 0.88Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.90Un to 0.86Un	L1N	Trip Time (s)	20.98	20.98	20.97	20.97	20.97
OV1 = 1.10Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.08Un to 1.12Un	L1N	Trip Time (s)	0.981	0.981	0.981	0.981	0.981
OV2 = 1.20Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 1.18Un to 1.22Un	L1N	Trip Time (s)	0.135	0.132	0.134	0.139	0.133
UF2 = 57.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 57.02Hz to 56.98Hz	L1N	Trip Time (s)	0.151	0.155	0.152	0.154	0.152
UF1 = 59.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 59.02Hz to 58.98Hz	L1N	Trip Time (s)	0.152	0.147	0.143	0.136	0.139
OF1 = 61.0Hz	**Trip time test:** 1, Min. Clearing time set 180 s 2, Step from 60.98Hz to 61.02Hz	L1N	Trip Time (s)	179.00	179.00	179.02	179.01	179.00
OF2 = 66.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 65.98Hz to 66.02Hz	L1N	Trip Time (s)	0.149	0.154	0.131	0.148	0.158

For an Enter Service test which shall be conducted at the low end of the operating temperature (-25 °C) range to verify that measurement accuracy of time is acceptable, please refer to section 4.5 of this report, the test case 2 was completed at -25 °C, due to the ES delay time and ES ramp time are same with test case 1.

4.2 Test for Response to Voltage Disturbances

Testing Method Used for voltage variation		Comments
Grid simulator	☒	Changed Grid simulator frequency and recorded the Unit output.
Alternative test method	☐	Signal injection
Sensor Location	☒	Intergrated in the EUT, tested at the EUT terminals.
	☐	Remote sensing, tested at the remote sensing terminals.

4.2.1 Test for Overvoltage&Undervoltage Trip

The purpose of this test is to verify that the EUT ceases to energize the area EPS and trips within the clearing time specified in IEEE Std 1547 with respect to overvoltage & undervoltage conditions.

Table 13—DER response (shall trip) to abnormal voltages for DER of abnormal operating performance Category III (see Figure H.9)

Shall trip—Category III				
Shall trip function	Default settings[a]		Ranges of allowable settings[b]	
	Voltage (p.u. of nominal voltage)	Clearing time (s)	Voltage (p.u. of nominal voltage)	Clearing time (s)
OV2	1.20	0.16	fixed at 1.20	fixed at 0.16
OV1	1.10	13.0	1.10–1.20	1.0–13.0
UV1	0.88	21.0	0.0–0.88	21.0–50.0
UV2	0.50	2.0	0.0–0.50	2.0–21.0

The following parameter configurations are declared by the Manufacturer:

Shall trip—Category III				
Shall trip function	Default settings		Ranges of allowable settings	
	Voltage (p.u.)	Clearing time (s)	Voltage (p.u.)	Clearing time (s)
OV2	1.20	0.16	fixed at 1.20	fixed at 0.16
OV1	1.10	13.0	1.10 ~ 1.20	1.0 ~ 13.0
UV1	0.88	21.0	0.0 ~ 0.88	21.0 ~ 50.0
UV2	0.50	2.0	0.0~0.50	2.0 ~ 21.0

This test has been performed according to the point 5.4.2 and 5.4.3 of IEEE 1547.1:2020 standard.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
MSO4054B	2025/08/07 to 2025/08/10	--	500 kS/s

Test Condition Recorded:

Input		Output			
$V_{d.c.}$ (V)	$P_{d.c.}$ (kW)	$V_{a.c.}$ (V)	$I_{a.c.}$ (A)	$P_{a.c.}$ (kW)	Fre. (Hz)
359.8	12.4	240.1	49.2	11.9	59.99

L1-L2: 240V Parameter Setting			Attempts	1	2	3	4	5
UV2' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	1.980	1.985	1.985	1.990	1.985
	Trip time test: 1, Max. Clearing time set 21 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	20.98	20.98	20.96	20.99	20.97
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	1.987	1.977	1.988	1.987	1.988
	Trip time test: 1, Max. Clearing time set 21 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	20.95	20.96	20.96	20.96	20.96
UV1' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	20.95	20.97	20.98	20.97	20.98
	Trip time test: 1, Max. Clearing time set 50 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	49.96	49.97	49.96	49.95	49.99
UV1 = 0.88Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	20.99	20.97	20.98	20.98	20.97
	Trip time test: 1, Max. Clearing time set 50 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	49.98	49.97	49.98	49.98	49.98
OV1 = 1.10Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.08Un to 1.12Un	L1-L2	Trip Time (s)	0.988	0.981	0.978	0.979	0.983
	Trip time test: 1, Max. Clearing time set 13 s 2, Step from 1.08Un to 1.12Un	L1-L2	Trip Time (s)	12.98	12.97	12.98	12.98	12.98
OV1' = 1.20Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	0.984	0.981	0.974	0.975	0.972
	Trip time test: 1, Max. Clearing time set 13 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	12.97	12.97	12.98	12.98	12.98
OV2 = 1.20Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	0.144	0.141	0.150	0.146	0.148

L1-L2: 208V Parameter Setting			Attempts	1	2	3	4	5
UV2' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	1.985	1.985	1.985	1.983	1.989
	Trip time test: 1, Max. Clearing time set 21 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	20.98	20.97	20.98	20.99	20.98
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	1.982	1.972	1.975	1.977	1.990
	Trip time test: 1, Max. Clearing time set 21 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	20.97	20.97	20.98	20.97	20.98
UV1' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	20.98	20.98	20.98	20.98	20.98
	Trip time test: 1, Max. Clearing time set 50 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	49.98	49.97	49.98	49.98	49.98
UV1 = 0.88Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	20.98	20.98	20.97	20.97	20.98
	Trip time test: 1, Max. Clearing time set 50 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	49.98	49.97	49.97	49.97	49.99
OV1 = 1.10Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.08Un to 1.12Un	L1-L2	Trip Time (s)	0.984	0.984	0.984	0.984	0.984
	Trip time test: 1, Max. Clearing time set 13 s 2, Step from 1.08Un to 1.12Un	L1-L2	Trip Time (s)	12.99	12.97	12.97	12.97	12.99
OV1' = 1.20Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	0.992	0.994	0.978	0.980	0.988
	Trip time test: 1, Max. Clearing time set 13 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	12.97	12.97	12.97	12.98	12.98
OV2 = 1.20Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	0.144	0.151	0.144	0.145	0.145

L1-N: 120V Parameter Setting			Attempts	1	2	3	4	5
UV2' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	1.988	1.988	1.999	1.989	1.989
	Trip time test: 1, Max. Clearing time set 21 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	20.99	20.99	20.99	20.99	20.89
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	1.977	1.984	1.985	1.982	1.986
	Trip time test: 1, Max. Clearing time set 21 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	20.98	20.97	20.98	20.97	20.84
UV1' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	20.99	20.98	20.99	20.99	20.99
	Trip time test: 1, Max. Clearing time set 50 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	49.99	49.99	49.99	49.99	49.99
UV1 = 0.88Un	**Trip time test:** 1, Min. Clearing time set 21 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	20.97	20.99	20.97	20.97	20.97
	Trip time test: 1, Max. Clearing time set 50 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	49.98	49.98	49.98	49.97	49.98
OV1 = 1.10Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.08Un to 1.12Un	L1-L2	Trip Time (s)	0.981	0.998	0.990	0.992	0.994
	Trip time test: 1, Max. Clearing time set 13 s 2, Step from 1.08Un to 1.12Un	L1-L2	Trip Time (s)	12.98	12.98	12.97	12.97	12.95
OV1' = 1.20Un	**Trip time test:** 1, Min. Clearing time set 1 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	0.982	0.988	0.998	0.980	0.988
	Trip time test: 1, Max. Clearing time set 13 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	12.98	12.98	12.98	12.97	12.98
OV2 = 1.20Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 1.18Un to 1.22Un	L1-L2	Trip Time (s)	0.146	0.148	0.146	0.140	0.142

4.2.2 Voltage Disturbance Ride-through

The voltage ride-through test verifies the ability of the EUT to ride through voltage sags without tripping in accordance with the requirements in 6.4.2 of IEEE Std 1547-2018.

Table 16—Voltage ride-through requirements for DER of abnormal operating performance Category III (see Figure H.9)

Voltage range (p.u.)	Operating mode/response	Minimum ride-through time (s) (design criteria)	Maximum response time (s) (design criteria)
$V > 1.20$	Cease to Energize[a]	N/A	0.16
$1.10 < V \leq 1.20$	Momentary Cessation[b]	12	0.083
$0.88 \leq V \leq 1.10$	Continuous Operation	Infinite	N/A
$0.70 \leq V < 0.88$	Mandatory Operation	20	N/A
$0.50^{c} \leq V < 0.70$	Mandatory Operation	10	N/A
$V < 0.50^{c}$	Momentary Cessation[b]	1	0.083

The following parameter configurations are declared by the Manufacturer:

Region	Voltage range (p.u.)	Operating mode/response	Minimum ride-through time (s) (design criteria)	Maximum response time (s) (design criteria)
--	V > 1.20	Cease to Energize	N/A	0.16
HVRT1	1.10 < V ≤ 1.20	Momentary Cessation	12	0.083
--	0.88 ≤ V ≤ 1.10	Continuous Operation	Infinite	N/A
LVRT1	0.70 ≤ V < 0.88	Mandatory Operation	20	N/A
LVRT2	0.50c ≤ V < 0.70	Mandatory Operation	10	N/A
LVRT3	V < 0.50	Momentary Cessation	1	0.083

- **Cease to Energize**, Cessation of current exchange of DER with Area EPS in not more than the maximum specified time and with no intentional delay.
- **Mandatory Operation**, the EUT shall not trip, shall maintain synchronism and maintain its total apparent current during the disturbance period at or above 80% of the pre-disturbance value.
- **Momentary Cessation**, the EUT shall cease to energize the ac test source.

4.2.2.1 Low-voltage ride-through tests (LVRT)

This test has been performed according to the point 5.4.4 of IEEE 1547.1:2020 standard.

Before the LVRT test, the following function settings should be checked:

☒ Magnitude and duration of undervoltage tripping functions shall be disabled or set so as not to influence the outcome of the test.
☒ The voltage-reactive power control mode (Q(U)) of the EUT shall be enabled and set to the default settings specified in Table 8 of IEEE Std 1547-2018.
☒ The voltage-active power control mode shall be disabled.
☒ The frequency-active power control mode of the EUT shall be enabled and set to the default settings.

Dynamic voltage support Configuration	
With Dynamic voltage support	☐
Without Dynamic voltage support	☒
Restore output with dynamic voltage support	☐
Restore output without dynamic voltage support	☒
K-factor (K=2)	☐

IEEE 1547.1-2020 Table 5 (modified)
Category III LVRT Test Conditions
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Disturbance set	Test condition	Allowable test voltage range	Minimum duration[a] (s)	Time interval in Figure 3	Required DER mode of operation[b]
1	A	0.88–1.00	5	t_0–t_1	Continuous Operation
	B	0.00–0.05	1	t_1–t_2	Momentary Cessation
	C	0.00–0.50	10	t_1–t_3	Mandatory Operation[c]
	D	0.50–0.70	20	t_1–t_4	Mandatory Operation
2	A	0.88–1.00	5	t_0–t_1	Continuous Operation
	B	0.00–0.05	1	t_1–t_2	Momentary Cessation
	C	0.00–0.50	10	t_1–t_3	Mandatory Operation[c]
	D	0.50–0.70	20	t_1–t_4	Mandatory Operation
3	A	0.88–1.00	5	t_0–t_1	Continuous Operation
	B	0.00–0.05	1	t_1–t_2	Momentary Cessation
	C	0.00–0.50	10	t_1–t_3	Mandatory Operation[c]
	D	0.50–0.70	20	t_1–t_4	Mandatory Operation
	E	0.88–1.00	120	t_4–t_5	Continuous Operation
4[e]	A	0.88–1.00	5	t_0–t_1	Continuous Operation
	B	0.00–0.05	1	t_1–t_2	Momentary Cessation
	C'	0.52–0.70	20	t_1–t_4	Mandatory Operation[b]
	E	0.88–1.00	120	t_4–t_5	Continuous Operation

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/08/13	50 ms	10 kHz

- **High-power Test (>=90%Pn)**

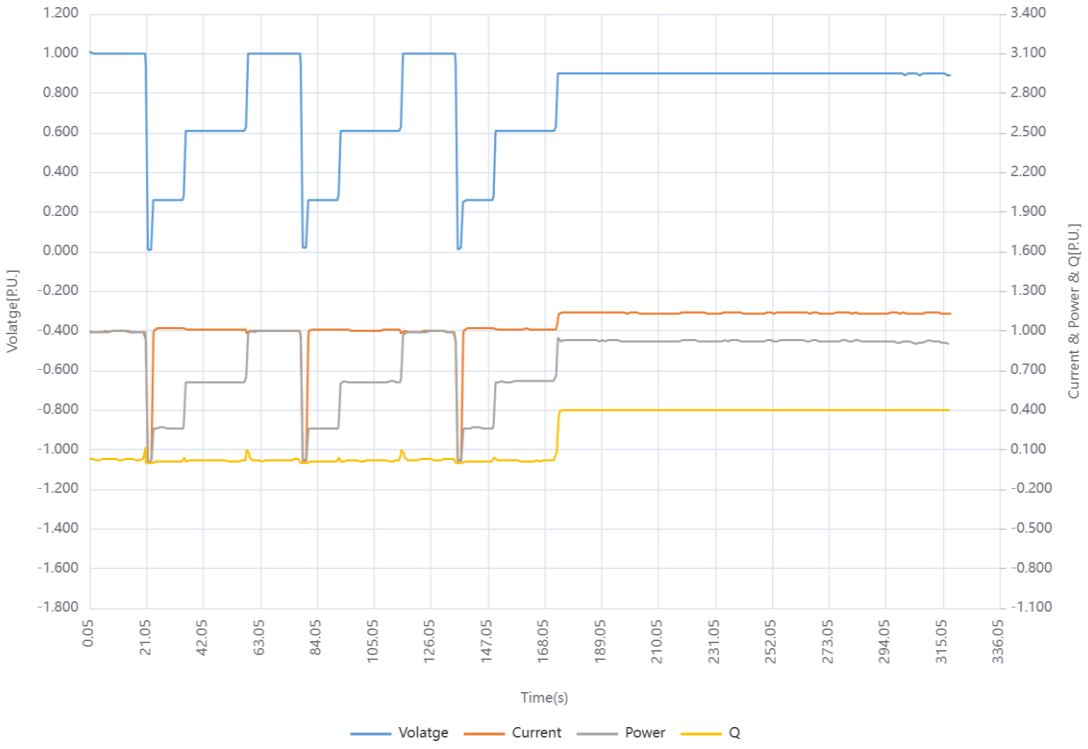
Power Level Set	Fault Phase	Test Condition	Residual Voltage Set (p.u.)	Residual Voltage Meas. (p.u.)	Fault Duration Meas. (s)	Reactive Power Meas(p.u.)
Disturbance set 1 to 3						
100%Pn	L1-L2	A	1.000	1.000	19.85	0.026
		B	0.012	0.012	1.30	0.000
		C	0.262	0.262	12.25	0.011
		D	0.610	0.610	22.55	0.018
		A	0.999	0.999	19.75	0.024
		B	0.013	0.013	1.30	0.000
		C	0.262	0.262	12.20	0.011
		D	0.610	0.610	22.60	0.017
		A	0.999	0.999	19.75	0.029
		B	0.014	0.014	1.30	0.000
		C	0.262	0.262	12.30	0.011
		D	0.610	0.610	22.65	0.018
		E	0.899	0.899	145.25	0.400

- **Low-Power Test (25%Sn to 50%Sn)**

Power Level Set	Fault Phase	Test Condition	Residual Voltage Set (p.u.)	Residual Voltage Meas. (p.u.)	Fault Duration Meas. (s)	Reactive Power Meas(p.u.)
Disturbance set 1 to 3						
40%Sn	L1-L2	A	0.991	0.991	20.05	0.017
		B	0.018	0.018	1.30	0.000
		C	0.254	0.254	12.25	0.001
		D	0.604	0.604	22.55	0.010
		A	0.989	0.989	19.80	0.030
		B	0.017	0.017	1.30	0.000
		C	0.258	0.258	12.25	0.001
		D	0.607	0.607	22.55	0.010
		A	0.990	0.990	19.70	0.024
		B	0.017	0.017	1.30	0.000
		C	0.257	0.257	12.25	0.001
		D	0.603	0.603	22.65	0.010
		E	0.895	0.895	146.90	0.400

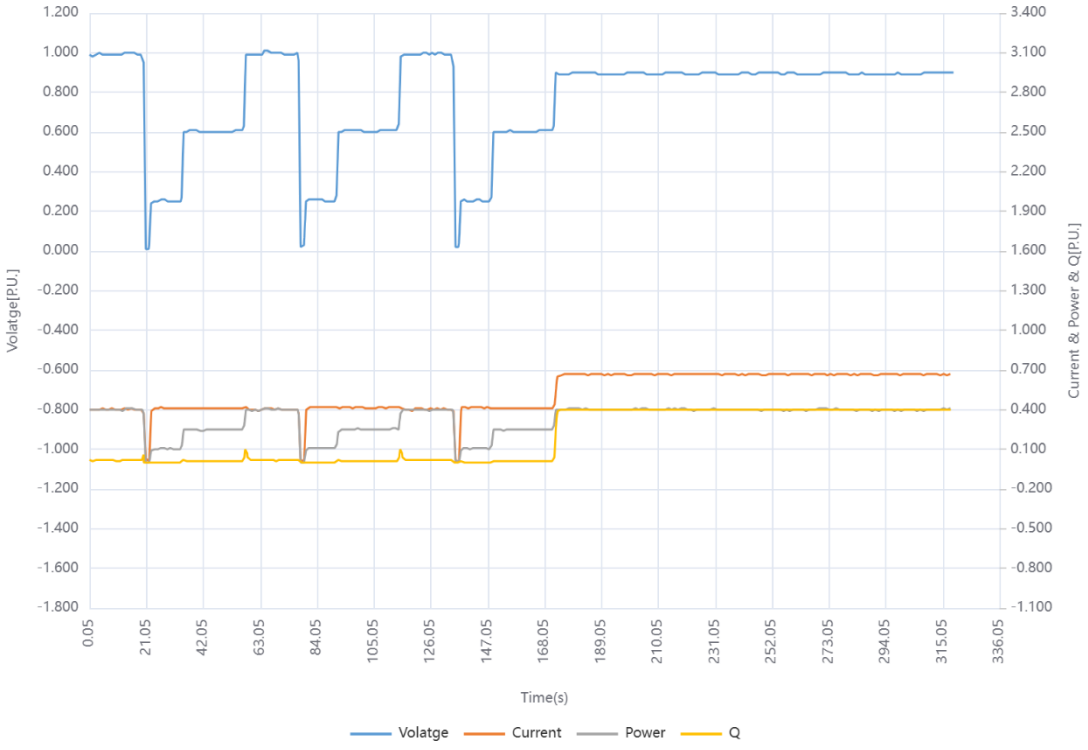
Over View: 100%Pn - Single Phase - Disturbance set 1 to 3

RMS Phase-to-Phase voltage & current & Active Power & Reactive Power



Over View: 25-50%Pn - Single Phases - Disturbance set 1 to 3

RMS Phase-to-phase voltage & current & Active Power & Reactive Power



4.2.2.2 Test for voltage disturbances within continuous operating region

The purpose of this test is to verify that multiphase DERs continue to operate, as specified in 6.4.2.2 of IEEE Std 1547-2018, during voltage disturbances where the applicable voltage remains within the continuous operating region as defined by IEEE Std 1547.

Voltage disturbances within continuous operation region should remains within Rang B as defined by ANSI C84.1.

This test has been performed according to the point 5.4.5 of IEEE 1547.1:2020 standard.

Table 6—DER unbalanced voltage test conditions

Test condition	Negative sequence voltage (p.u.)	Duration (s)
A	≥ 0.1	≥ 60
B	≥ 0.05	≥ 300

Not applicable. This test is not applicable to single phase.

4.2.2.3 High-voltage ride-through tests (HVRT)

This test has been performed according to the point 5.4.7 of IEEE 1547.1:2020 standard.

Before the HVRT test, the following function settings should be checked:

☒ Magnitude and duration of undervoltage tripping functions shall be disabled or set so as not to influence the outcome of the test.
☒ The voltage-active power control mode shall be disabled.
☒ The frequency-active power control mode of the EUT shall be enabled and set to the default settings.
☒ The voltage-reactive power control mode of the EUT shall be set to the default settings specified in Table 8 of IEEE Std 1547-2018 for the applicable performance category and enabled.

Dynamic voltage support Configuration	
With Dynamic voltage support	☐
Without Dynamic voltage support	☒
Restore output with dynamic voltage support	☐
Restore output without dynamic voltage support	☒
K-factor (K=N/A)	☐

IEEE 1547.1-2020 Table 8 (modified)
Category III HVRT Test Conditions
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Disturbance set	Test condition	Allowable test voltage range	Minimum duration[a] (s)	Time interval in Figure 5	Required DER mode of operation[b]
1	A	1.00–1.10	5	t_0–t_1	Continuous Operation
	B	1.18–1.20	12	t_1–t_2	Momentary Cessation
2	A	1.00–1.10	5	t_0–t_1	Continuous Operation
	B	1.18–1.20	12	t_1–t_2	Momentary Cessation
3	A	1.00–1.10	5	t_0–t_1	Continuous Operation
	B	1.18–1.20	12	t_1–t_2	Momentary Cessation
	C	1.00–1.10	120	t_2–t_3	Continuous Operation
4[c]	A	1.00–1.10	5	t_0–t_1	Continuous Operation
	B'	1.12–1.20	12	t_1–t_2	Momentary Cessation[b]
	C	1.00–1.10	120	t_2–t_3	Continuous Operation

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/09/09	50 ms	10 kHz

- **High-Power Test (>=90%Pn)**

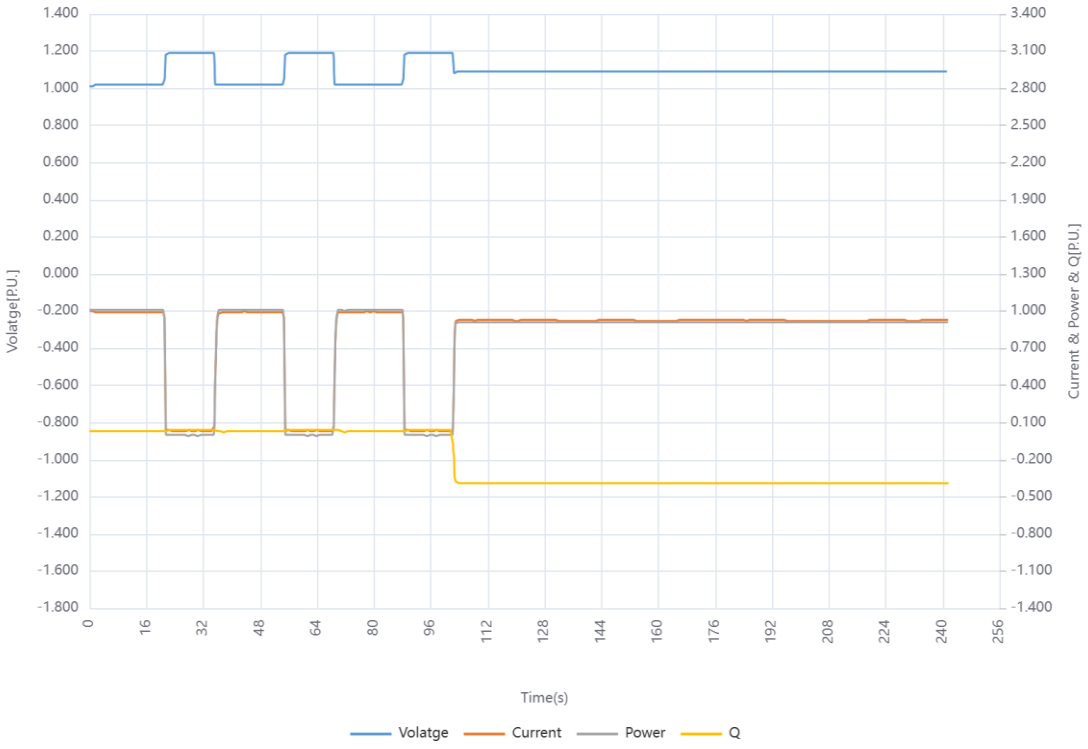
Power Level Set	Fault Phase	Test Condition	Residual Voltage Set (p.u.)	Residual Voltage Meas. (p.u.)	Fault Duration Meas. (s)	Reactive Power Meas. (p.u.)
Disturbance set 1 to 3						
100%Pn	L1-L2	A	1.02	1.02	21.10	0.01
		B	1.19	1.19	13.60	0.01
		A	1.02	1.02	19.35	0.01
		B	1.19	1.19	13.60	0.01
		A	1.02	1.02	19.25	0.01
		B	1.19	1.19	13.65	0.01
		C	1.09	1.09	139.35	-0.07

- **Low-Power Test (25%Sn to 50%Sn)**

Power Level Set	Fault Phase	Test Condition	Residual Voltage Set (p.u.)	Residual Voltage Meas. (p.u.)	Fault Duration Meas. (s)	Reactive Power Meas. (p.u.)
Disturbance set 1 to 3						
40%Sn	L1-L2	A	1.02	1.02	1.25	0.02
		B	1.19	1.19	13.25	0.04
		A	1.01	1.01	20.00	0.02
		B	1.19	1.19	13.30	0.04
		A	1.01	1.01	20.00	0.02
		B	1.19	1.19	13.30	0.04
		C	1.09	1.09	145.00	-0.39

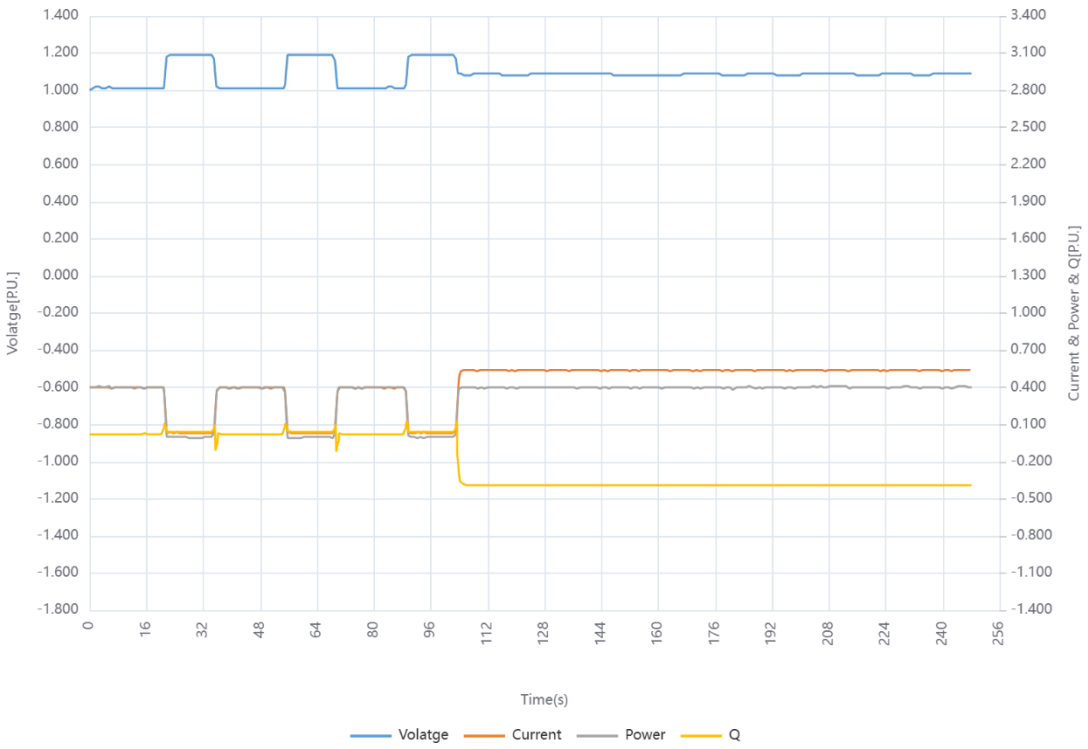
Over View: 100%Pn - Single Phase - Disturbance set 1 to 3

RMS Phase-to- Phase voltage & current & Active Power & Reactive Power



Over View: 40%Pn - Single Phase - Disturbance set 1 to 3

RMS Phase-to-phase voltage & current & Active Power & Reactive Power



4.2.3 Test for Undervoltage Trip – IEEE 1547a:2020

The purpose of this test is to verify that the EUT ceases to energize the area EPS and trips within the clearing time specified in IEEE Std 1547a with respect to overvoltage & undervoltage conditions.

Table 13—DER response (shall trip) to abnormal voltages for DER of abnormal operating performance Category III (see Figure H.9)

Shall trip—Category III				
Shall trip function	Default settings[a]		Ranges of allowable settings[b]	
	Voltage (p.u. of nominal voltage)	Clearing time (s)	Voltage (p.u. of nominal voltage)	Clearing time (s)
OV2	1.20	0.16	fixed at 1.20	fixed at 0.16
OV1	1.10	13.0	1.10 – 1.20	1.0 – 13.0
UV1	0.88	21.0	0.0 – 0.88	~~21.0~~ 2.0 – 50.0
UV2	0.50	2.0	0.0 – 0.50	~~2.0~~ 0.16 – 21.0

The following parameter configurations are declared by the Manufacturer:

Shall trip—Category III				
Shall trip function	Default settings		Ranges of allowable settings	
	Voltage (p.u.)	Clearing time (s)	Voltage (p.u.)	Clearing time (s)
UV1	0.88	21.0	0.0 ~ 0.88	2.0 ~ 50.0
UV2	0.50	2.0	0.0 ~ 0.50	0.16 ~21.0

This test has been performed according to the point 5.4.3 of IEEE 1547.1:2020 standard.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
MSO4054B	2025/08/07	--	500 kS/s

Test Condition Recorded:

Input		Output			
$V_{d.c.}$ (V)	$P_{d.c.}$ (kW)	$V_{a.c.}$ (V)	$I_{a.c.}$ (A)	$P_{a.c.}$ (kW)	Fre. (Hz)
360.1	12.3	241.9	49.2	11.9	59.99

L1-L2: 240V Parameter Setting			Attempts	1	2	3	4	5
UV2' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	0.155	0.154	0.154	0.154	0.148
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	0.141	0.147	0.151	0.151	0.149
UV1 = 0.04Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	1.996	1.996	1.996	1.990	1.999
UV1' = 0.88Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	1.975	1.975	1.975	1.988	1.986

L1-L2: 208V Parameter Setting			Attempts	1	2	3	4	5
UV2' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	0.156	0.157	0.149	0.157	0.156
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	0.146	0.146	0.150	0.147	0.145
UV1 = 0.04Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	1.984	1.992	1.992	1.992	1.992
UV1' = 0.88Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	1.986	1.986	1.974	1.998	1.985

L1-N: 120V Parameter Setting			Attempts	1	2	3	4	5
UV2' = 0.04Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	0.153	0.152	0.155	0.148	0.153
UV2 = 0.50Un	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 0.52Un to 0.48Un	L1-L2	Trip Time (s)	0.146	0.159	0.155	0.155	0.159
UV1 = 0.04Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.06Un to 0.02Un	L1-L2	Trip Time (s)	1.975	1.996	1.992	1.993	1.996
UV1' = 0.88Un	**Trip time test:** 1, Min. Clearing time set 2 s 2, Step from 0.90Un to 0.86Un	L1-L2	Trip Time (s)	1.989	1.986	1.971	1.983	1.979

4.3 TEST FOR RESPONSE TO FREQUENCY DISTURBANCES

Testing Method Used for voltage variation		Comments
Grid simulator	☐	Changed Grid simulator frequency and recorded the Unit output.
Alternative test method	☒	Signal injection

4.3.1 Test for Overfrequency&Underfrequency Trip

The purpose of this test is to verify that the EUT ceases to energize the area EPS and trips within the clearing time specified in IEEE Std 1547 with respect to overfrequency & underfrequency conditions.

Table 18—DER response (shall trip) to abnormal frequencies for DER of abnormal operating performance Category I, Category II, and Category III (see Figure H.10)

Shall trip function	Default settings[a]		Ranges of allowable settings[b]	
	Frequency[c] (Hz)	Clearing time (s)	Frequency (Hz)	Clearing time (s)
OF2	62.0	0.16	61.8–66.0	0.16–1 000.0
OF1	61.2	300.0	61.0–66.0	180.0–1 000.0
UF1	58.5	300.0[c]	50.0–59.0	180.0–1 000
UF2	56.5	0.16	50.0–57.0	0.16–1 000

The following parameter configurations are declared by the Manufacturer:

Shall trip—Category III				
Shall trip function	Default settings		Ranges of allowable settings	
	Frequency (Hz)	Clearing time (s)	Frequency (Hz)	Clearing time (s)
OF2	62.0	0.16	61.8~66.0	0.16~1000.0
OF1	61.2	300.0	61.0~66.0	180.0~1000.0
UF1	58.5	300.0	50.0~59.0	180.0~1000.0
UF2	56.5	0.16	50.0~57.0	0.16~1000.0

This test has been performed according to the point 5.5.1 and 5.5.2 of IEEE 1547.1:2020 standard.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/08/07	50ms	5 kHz

Test Condition Recorded:

Input		Output			
$V_{d.c.}$ (V)	$P_{d.c.}$ (kW)	$V_{a.c.}$ (V)	$I_{a.c.}$ (A)	$P_{a.c.}$ (kW)	Fre. (Hz)
359.4	12.5	241.9	49.2	11.9	60.00

Parameter Setting			Attempts	1	2	3	4	5
UF2' = 50.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 50.02Hz to 49.98Hz	L1-L2	Trip Time (s)	0.151	0.156	0.157	0.143	0.158
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 50.02Hz to 49.98Hz	L1-L2	Trip Time (s)	995.3	996.6	996.4	996.4	996.7
UF2 = 57.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 57.02Hz to 56.98Hz	L1-L2	Trip Time (s)	0.159	0.148	0.154	0.152	0.156
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 57.02Hz to 56.98Hz	L1-L2	Trip Time (s)	996.0	995.3	996.0	995.4	996.7
UF1' = 50.0Hz	**Trip time test:** 1, Min. Clearing time set 180 s 2, Step from 50.02Hz to 49.98Hz	L1-L2	Trip Time (s)	179.8	179.8	179.8	179.8	179.8
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 50.02Hz to 49.98Hz	L1-L2	Trip Time (s)	995.9	996.4	996.7	997.1	996.9
UF1 = 59.0Hz	**Trip time test:** 1, Min. Clearing time set 180 s 2, Step from 59.02Hz to 58.98Hz	L1-L2	Trip Time (s)	179.0	179.0	179.0	179.0	179.0
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 59.02Hz to 58.98Hz	L1-L2	Trip Time (s)	995.1	996.1	995.7	996.8	997.0
OF1' = 66.0Hz	**Trip time test:** 1, Min. Clearing time set 180 s 2, Step from 65.98Hz to 66.02Hz	L1-L2	Trip Time (s)	179.0	179.0	179.0	179.0	179.9
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 65.98Hz to 66.02Hz	L1-L2	Trip Time (s)	996.6	995.6	996.6	996.3	996.4
OF1 = 61.0Hz	**Trip time test:** 1, Min. Clearing time set 180 s 2, Step from 60.98Hz to 61.02Hz	L1-L2	Trip Time (s)	179.0	179.0	179.0	179.0	179.0
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 60.98Hz to 61.02Hz	L1-L2	Trip Time (s)	995.9	995.8	995.6	997.0	995.6
OF2' = 66.0Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 65.98Hz to 66.02Hz	L1-L2	Trip Time (s)	0.152	0.149	0.147	0.147	0.159
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 65.98Hz to 66.02Hz	L1-L2	Trip Time (s)	995.6	995.6	996.0	996.0	996.2
OF2 = 61.8Hz	**Trip time test:** 1, Min. Clearing time set 0.16 s 2, Step from 61.78Hz to 61.82Hz	L1-L2	Trip Time (s)	0.153	0.146	0.157	0.152	0.155
	Trip time test: 1, Max. Clearing time set 1000 s 2, Step from 61.78Hz to 61.82Hz	L1-L2	Trip Time (s)	995.7	995.6	995.9	997.0	995.9

4.3.2 Frequency Disturbance Ride-through

The voltage ride-through test verifies the ability of the EUT to ride through voltage sags without tripping in accordance with the requirements in 6.5.2 of IEEE Std 1547-2018.

Table 19—Frequency ride-through requirements for DER of abnormal operating performance Category I, Category II, and Category III (see Figure H.10)

Frequency range (Hz)	Operating mode	Minimum time (s) (design criteria)
$f > 62.0$	No ride-through requirements apply to this range	
$61.2 < f \leq 61.8$	Mandatory Operation[a]	299
$58.8 \leq f \leq 61.2$	Continuous Operation[a,b]	Infinite[c]
$57.0 \leq f < 58.8$	Mandatory Operation[b]	299
$f < 57.0$	No ride-through requirements apply to this range	

The following parameter configurations are declared by the Manufacturer:

Region	Voltage range (p.u.)	Operating mode/response	Minimum ride-through time (s) (design criteria)
--	f > 62.0	No ride-through requirements apply to this range	
HFRT	61.2 < f ≤ 61.8	Mandatory Operation	299
--	58.8 ≤ f ≤ 61.2	Continuous Operation	Infinite
LFRT	57.0 ≤ f < 58.8	Mandatory Operation	299
--	f < 57.0	No ride-through requirements apply to this range	

- **Mandatory Operation**, the EUT shall not trip, shall maintain synchronism and maintain its total apparent current during the disturbance period at or above 80% of the pre-disturbance value.

4.3.2.1 Low-Frequency ride-through tests (LFRT)

This test has been performed according to the point 5.5.3 and 5.5.5 of IEEE 1547.1:2020 standard.

Before the LFRT test, the following function settings should be checked:

☒ Magnitude and duration of undervoltage tripping functions shall be disabled or set so as not to influence the outcome of the test.
☒ Set the frequency droop function and droop values to make the active power change with respect to frequency as small as possible.

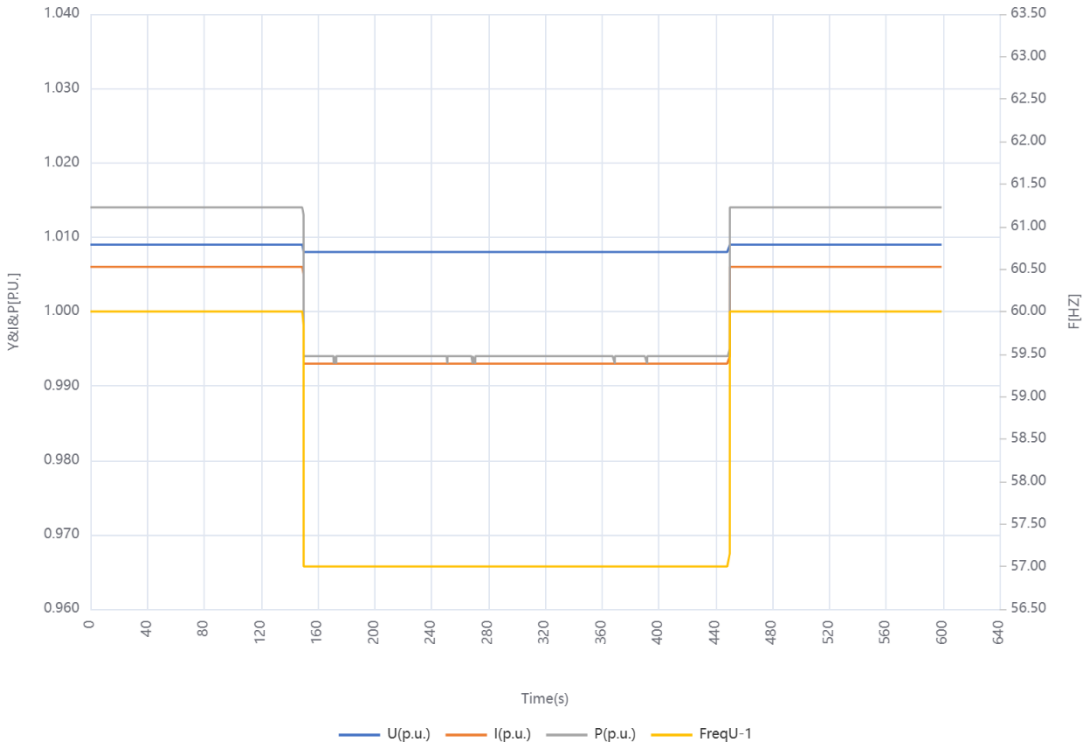
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/04/26	50ms	5 kHz

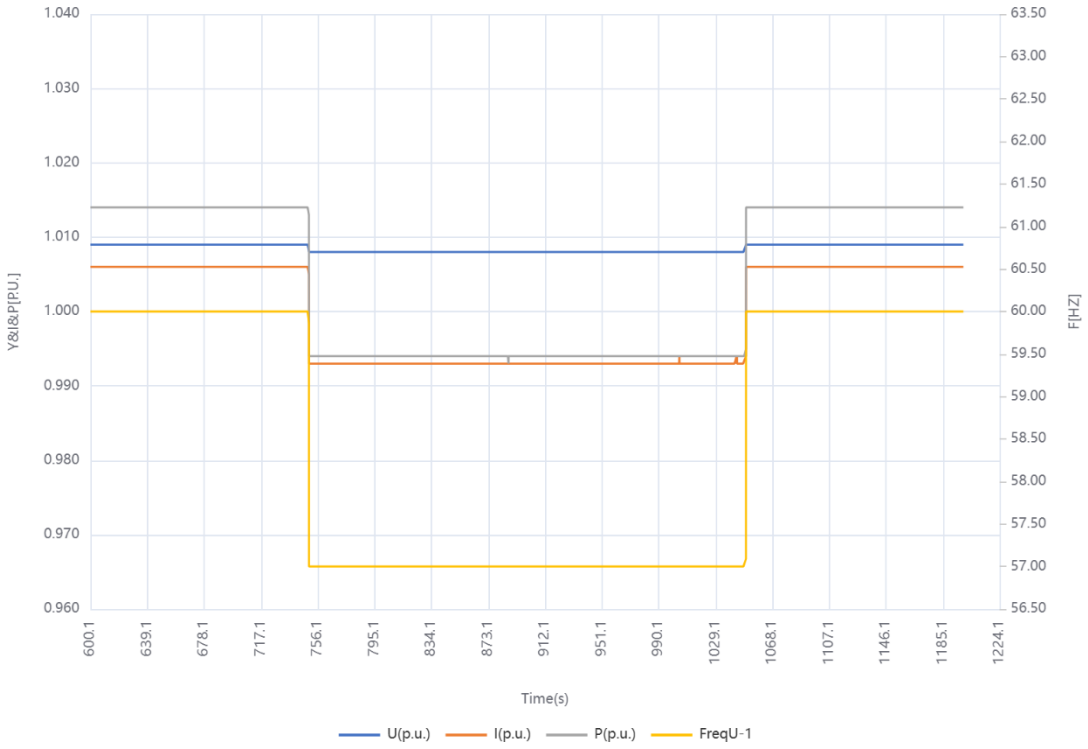
Power Level Set	Attempt	Step	Residual Frequency Set (Hz)	Residual Frequency Meas. (Hz)	Fault Duration Meas. (s)	ROCOF Meas. (Hz/s)
100%Pn	1	1	60.00	60.00	--	--
		2	57.00	57.00	299.90	30.00
		3	60.00	60.00	--	30.00
100%Pn	2	1	60.00	60.00	--	--
		2	57.00	57.00	299.95	30.00
		3	60.00	60.00	--	58.20
100%Pn	3	1	60.00	60.00	--	--
		2	57.00	57.00	299.95	58.00
		3	60.00	60.00	--	59.40

Note: The step 2 Pu is less than or equal to 57 Hz.

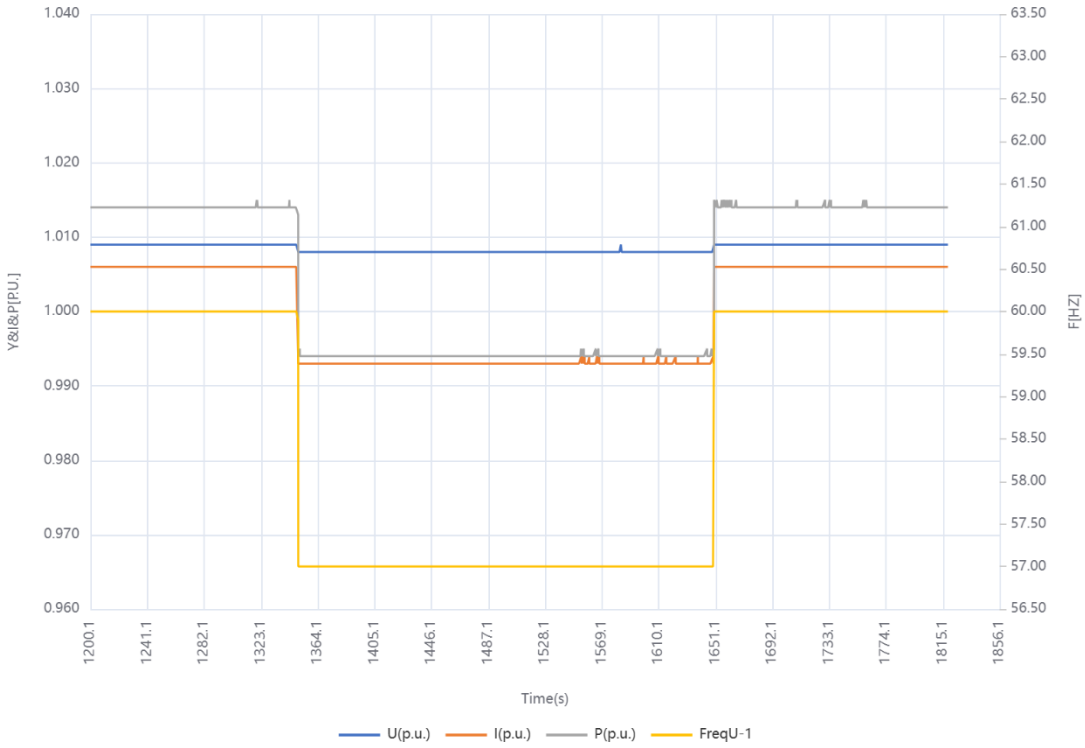
Attempt1- RMS voltage & current & Active Power & Frequency



Attempt2- RMS voltage & current & Active Power & Frequency



Attempt3- RMS voltage & current & Active Power & Frequency



4.3.2.2 High-Frequency ride-through tests (HFRT)

This test has been performed according to the point 5.5.4 and 5.5.5 of IEEE 1547.1:2020 standard.

Before the HFRT test, the following function settings should be checked:

☒ Magnitude and duration of undervoltage tripping functions shall be disabled or set so as not to influence the outcome of the test.
☒ Set the frequency droop function and droop values to make the active power change with respect to frequency as small as possible.

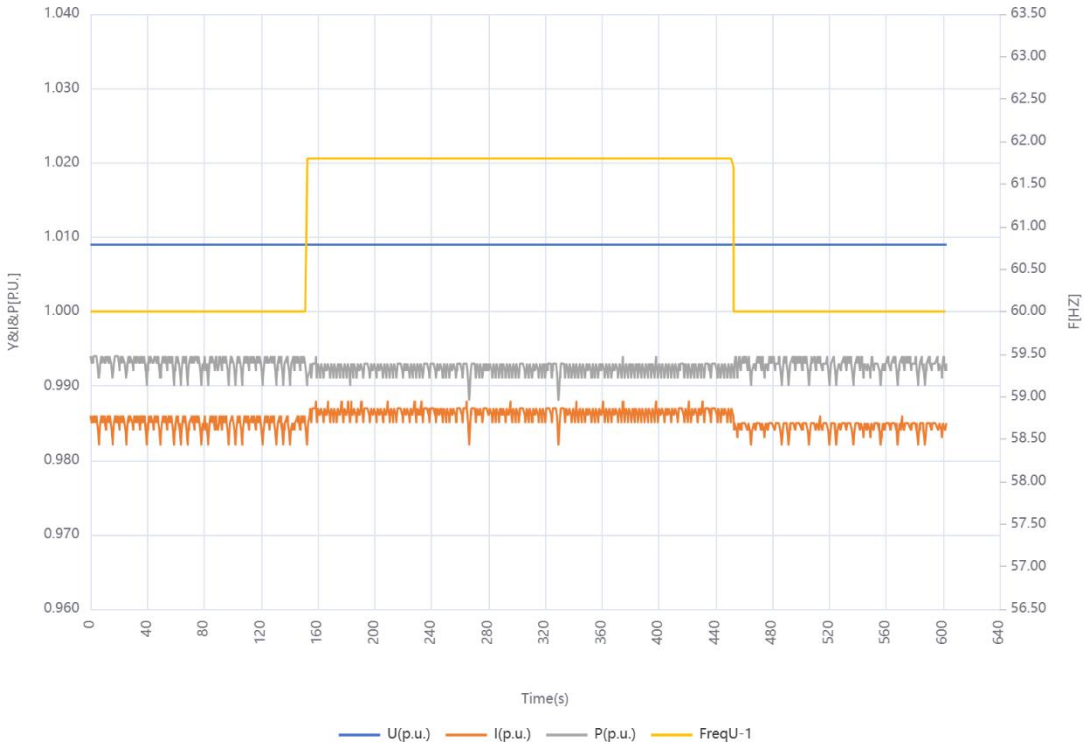
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/08/29	50ms	5 kHz

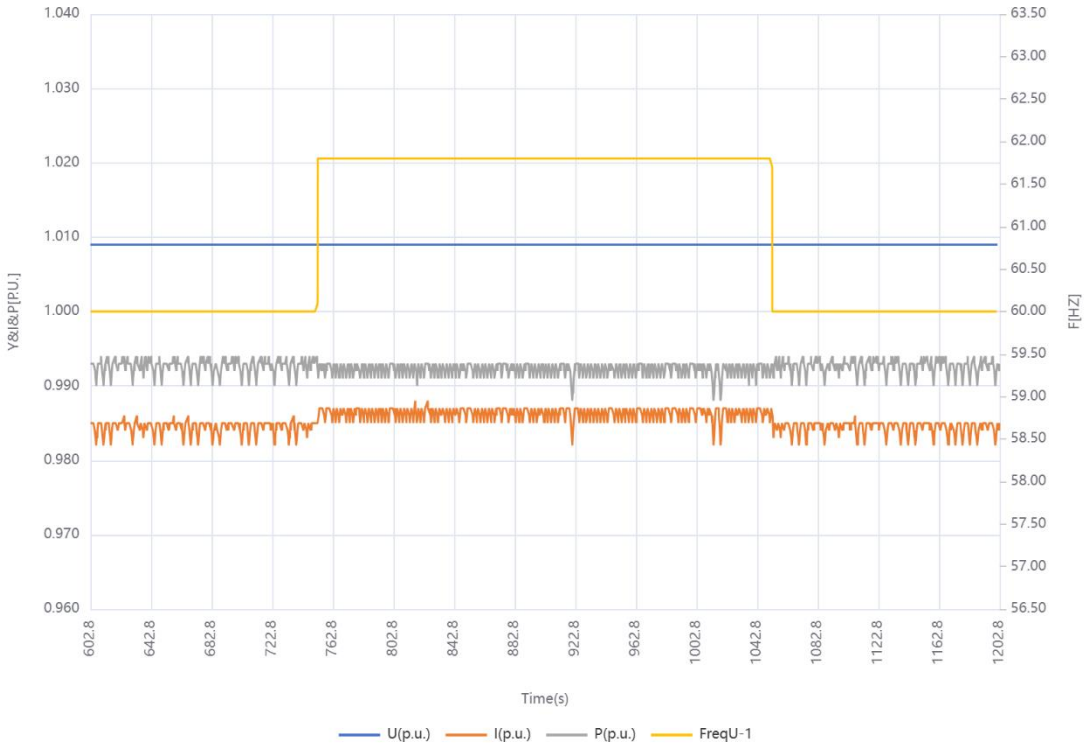
Power Level Set	Attempt	Step	Residual Frequency Set (Hz)	Residual Frequency Meas. (Hz)	Fault Duration Meas. (s)	ROCOF Meas. (Hz/s)
100%Pn	1	1	60.00	60.00	--	--
		2	61.80	61.80	300.00	35.600
		3	60.00	60.00	--	34.000
100%Pn	2	1	60.00	60.00	--	--
		2	61.80	61.80	299.90	17.100
		3	60.00	60.00	--	34.000
100%Pn	3	1	60.00	60.00	--	--
		2	61.80	61.80	299.90	17.100
		3	60.00	60.00	--	34.800

Note: The step 2 Pu is greater than or equal to 61.8 Hz.

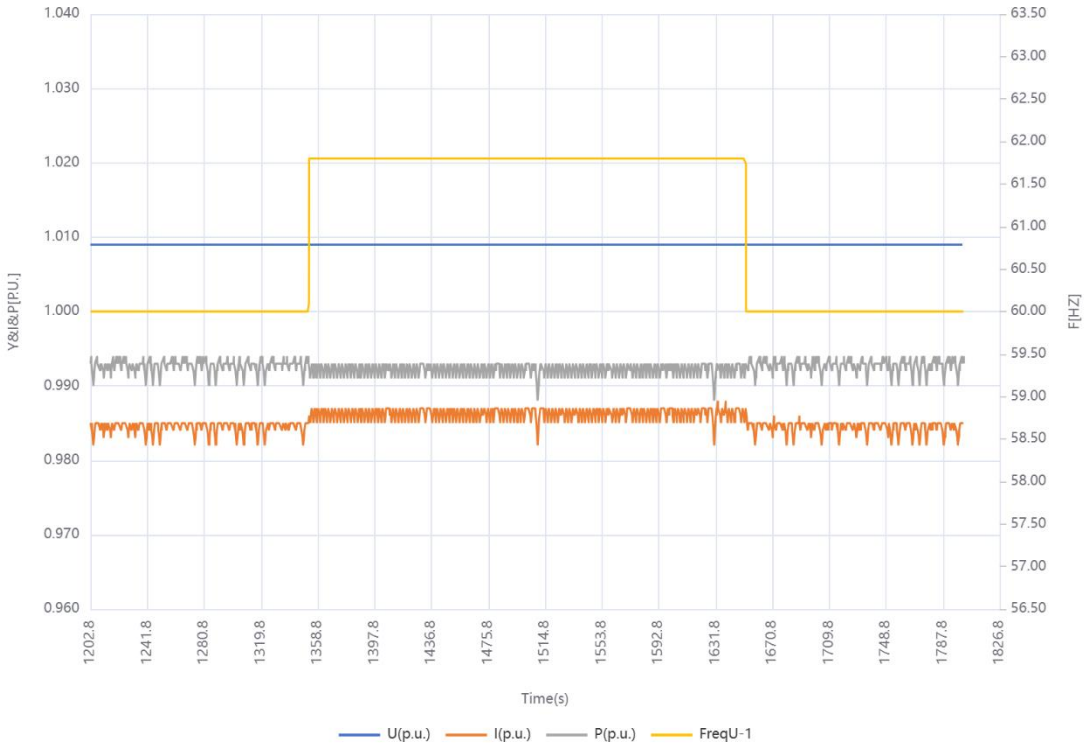
Attempt1- RMS voltage & current & Active Power & Frequency



Attempt2- RMS voltage & current & Active Power & Frequency



Attempt3- RMS voltage & current & Active Power & Frequency



4.3.2.3 Low-Frequency ride-through tests (LFRT) – SRD 2.0

This test has been performed according to the point Part II Section B of SRD V2.0, point 5.5.3 and 5.5.5 of IEEE 1547.1:2020 standard.

Category III					
Frequency range (Hz)		Operating mode		Minimum time (s) (design criteria)	
1547-2018	SRD V2.0	1547-2018	SRD V2.0	1547-2018	SRD V2.0
f > 62.0	f > 65.0	No ride-through requirements apply to this range			
61.2 < f ≤ 61.8	63.0 < f ≤ 65.0	Mandatory Operation	Mandatory Operation	299	299
58.8 ≤ f ≤ 61.2	57.0 ≤ f ≤ 63.0	Continuous Operation	Continuous Operation	Infinite	Indefinite
57.0 ≤ f < 58.8	50.0 ≤ f < 57.0	Mandatory Operation	Mandatory Operation	299	299
f < 57.0	f < 50.0	No ride-through requirements apply to this range			

Before the LFRT test, the following function settings should be checked:

☒ Magnitude and duration of undervoltage tripping functions shall be disabled or set so as not to influence the outcome of the test.
☒ Set the frequency droop function and droop values to make the active power change with respect to frequency as small as possible.

Measurement equipment settings used for this test are shown in the following table:

Not Applicable.

4.3.2.4 High-Frequency ride-through tests (HFRT) - SRD 2.0

This test has been performed according to the point Part II Section B of SRD V2.0, point 5.5.4 and 5.5.5 of IEEE 1547.1:2020 standard.

Category III					
Frequency range (Hz)		Operating mode		Minimum time (s) (design criteria)	
1547-2018	SRD V2.0	1547-2018	SRD V2.0	1547-2018	SRD V2.0
f > 62.0	f > 65.0	No ride-through requirements apply to this range			
61.2 < f ≤ 61.8	63.0 < f ≤ 65.0	Mandatory Operation	Mandatory Operation	299	299
58.8 ≤ f ≤ 61.2	57.0 ≤ f ≤ 63.0	Continuous Operation	Continuous Operation	Infinite	Indefinite
57.0 ≤ f < 58.8	50.0 ≤ f < 57.0	Mandatory Operation	Mandatory Operation	299	299
f < 57.0	f < 50.0	No ride-through requirements apply to this range			

Before the HFRT test, the following function settings should be checked:

☒ Magnitude and duration of undervoltage tripping functions shall be disabled or set so as not to influence the outcome of the test.
☒ Set the frequency droop function and droop values to make the active power change with respect to frequency as small as possible.

Measurement equipment settings used for this test are shown in the following table:

Not Applicable.

4.4 Test for voltage phase-angle change ride-though (PCRT)

The phase-angle change ride-through (PCRT) test verifies the ability of the EUT to ride through sudden voltage phase-angle changes without tripping in accordance with the requirements in 6.5.2.6 of IEEE Std 1547-2018.

Testing Method Used for voltage variation		Comments
Grid simulator variation 1	☒	capable of independent phase-angle change
Grid simulator variation 2	☐	not capable of independent phase-angle changes, such as an actual utility or a rotating machine

Before the PCRT test, the following function settings should be checked:

- Magnitude and duration of undervoltage and overvoltage tripping functions shall be disabled or set so as not to influence the outcome of the test.
- Active and reactive power control functions and frequency trip settings shall be set to the default states and values specified in IEEE Std 1547
- Tripping functions, including those for circuit protection and those specifically required by IEEE Std 1547, and the associated voltage and frequency monitoring shall not be disabled. This includes tripping in response to unintentional islanding. Any active frequency or phase shift controls present in the EUT (for example as may be used in unintentional islanding controls) may be disabled.

Table 9—PCRT test conditions (variation 1)

Test condition	Phase A voltage angle (degrees, relative to initial phase A angle) (see NOTE 1)	Phase B voltage angle (degrees, relative to initial phase A angle)	Phase C voltage angle (degrees, relative to initial phase A angle)	Duration (s)
A	0	120	240	30–40
B	60 or 300	120	240	0.320–0.500
C	0	60 or 180	240	0.320–0.500
D	0	120	180 or 300	0.320–0.500
E	20	140	260	55–65
F	340	100	220	55–65

NOTE 1—All single-phase angle values are specified in the same direction, leading or lagging relative to the initial phase angle of an arbitrarily assigned phase A during test condition A.
NOTE 2—In some test cases two phase angles are given to allow for either forward (leading) or reverse (lagging) phase shift, and either test condition may be used.

Note:

- Tolerance on voltage phase-angles specified in Table 9 shall be ± 3°. Step changes from one voltage phase angle to the next shall be as short as possible and shall not exceed 1 cycle.
- If the DER ceases to energize the area EPS, it shall be considered in compliance only if it restores its apparent current output to greater than 80% of the pre-disturbance active current within 0.5 s as specified in 6.5.2.6 of IEEE Std 1547-2018
- Test sequence:
  1) For single phase EUT: A-B-A.
  2) For three phase EUT: A-B-A, A-C-A, A-D-A, A-E-A and A-F-A.

Measurement equipment settings used for this test are shown in the following table:

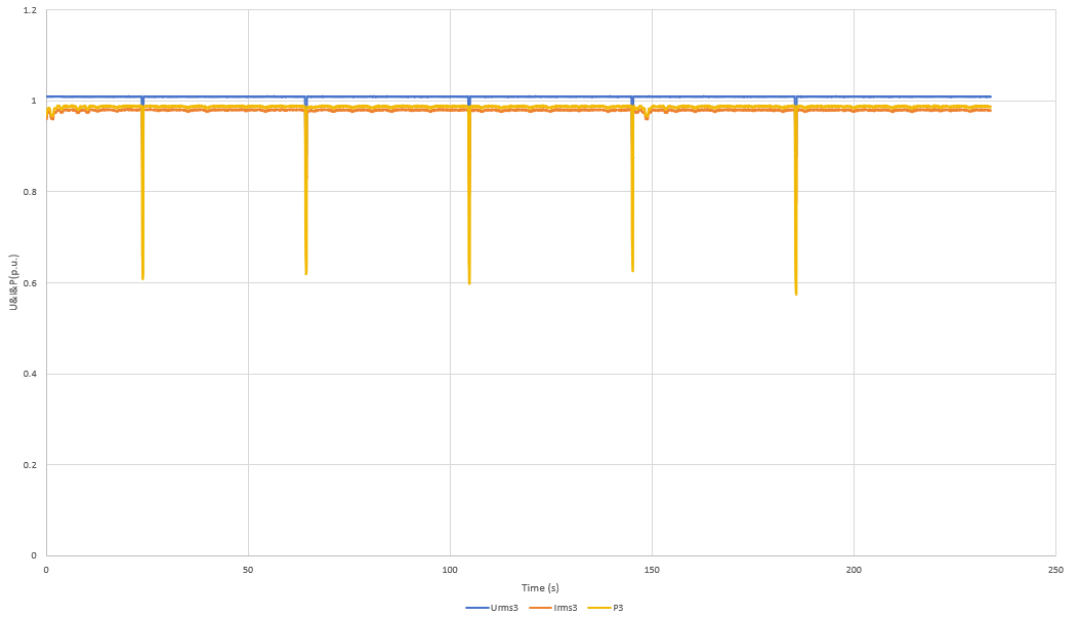
Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/09/08	50 ms	5 kHz

The ride-through tests shall be performed at any active power level greater than 90% of the EUT nameplate active power rating and at any convenient power factor greater than 0.90.

Test Condition Recorded:

Input		Output				
$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$V_{a.c.}$ (V)	$I_{a.c.}$ (A)	$P_{a.c.}$ (W)	Fre. (Hz)	PF
309.1	12566.2	241.8	48.9	11807.7	60.00	0.999

Test Sequences A-B-A						
Attempt	Test Condition	Phase A Voltage Angle meas.	Phase B Voltage Angle meas.	Phase C Voltage Angle meas.	Test Duration set (s)	Test Duration meas. (s)
1	A	0.0	119.8	-120.3	--	23.9
	B	60.0	119.8	-120.3	0.320–0.500	0.350
	A	0.0	119.8	-120.3	30–40	40
2	A	0.0	119.8	-120.3	30–40	40
	B	60.0	119.8	-120.3	0.320–0.500	0.400
	A	0.0	119.8	-120.3	30–40	40
3	A	0.0	119.8	-120.3	30–40	40
	B	60.0	119.8	-120.3	0.320–0.500	0.400
	A	0.0	119.8	-120.3	30–40	40
4	A	0.0	119.8	-120.3	30–40	40
	B	60.0	119.8	-120.3	0.320–0.500	0.350
	A	0.0	119.8	-120.3	30–40	40
5	A	0.0	119.8	-120.3	30–40	40
	B	60.0	119.8	-120.3	0.320–0.500	0.400
	A	0.0	119.8	-120.3	--	45
Phase Angle over time						



4.5 Enter service

The tests in this subclause confirm compliance with the following enter service requirements (subclause numbers in parentheses refer to IEEE Std 1547-2018):

- Capability to disable permit service (4.6.1)
- Prioritization of DER responses (4.7 a)
- Enter service criteria (4.10.2)
- Performance during entering service (4.10.3)

This test also confirms that disabling the permit service setting persists following a power cycle.

Test Sequence:

Table 11—Enter service test cases

Test case	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values			
				ES voltage high (p.u.)	ES voltage low (p.u.)	ES frequency high (Hz)	ES frequency low (Hz)	Initial voltage (p.u.)	Final voltage (p.u.)	Initial frequency (Hz)	Final frequency (Hz)
1 (Defaults)	300	300	NA	1.05	0.917	60.1	59.5	0.897	0.937	60.0	60.0
2	0	NA	300	1.05	0.917	60.1	59.5	1.0	1.0	59.48	59.52
3 (Maxima)	600	1000	NA	1.06	0.95	61.0	59.9	1.08	1.04	60.0	60.0
4	0	NA	1000	1.06	0.95	61.0	59.9	1.0	1.0	61.02	60.98
5 (Minima)	0	1	NA	1.05	0.88	60.1	59.0	0.86	0.90	60.0	60.0
6	0	NA	1	1.05	0.88	60.1	59.0	1.0	1.0	58.98	59.92
NOTE—Voltages are in per unit (p.u.) of the nominal EUT ac voltage.											

Note:
☐ If the randomized delay time is implemented, test case 4 shall be repeated for a sufficient number of trials, with a minimum of ten trials, such that the mean delay time of all trials is between 400 s and 600 s, and the standard deviation of the delay times is greater than 250 s.
☒ For EUT that do not implement an ES period (ramp), test cases 1, 3, and 5 shall use the ES randomized delay parameters from test cases 2, 4, and 6, respectively.
☒ For EUT that do not implement a randomized delay, test cases 2, 4, and 6 shall use the ES period (ramp) parameters from test cases 1, 3, and 5, respectively.

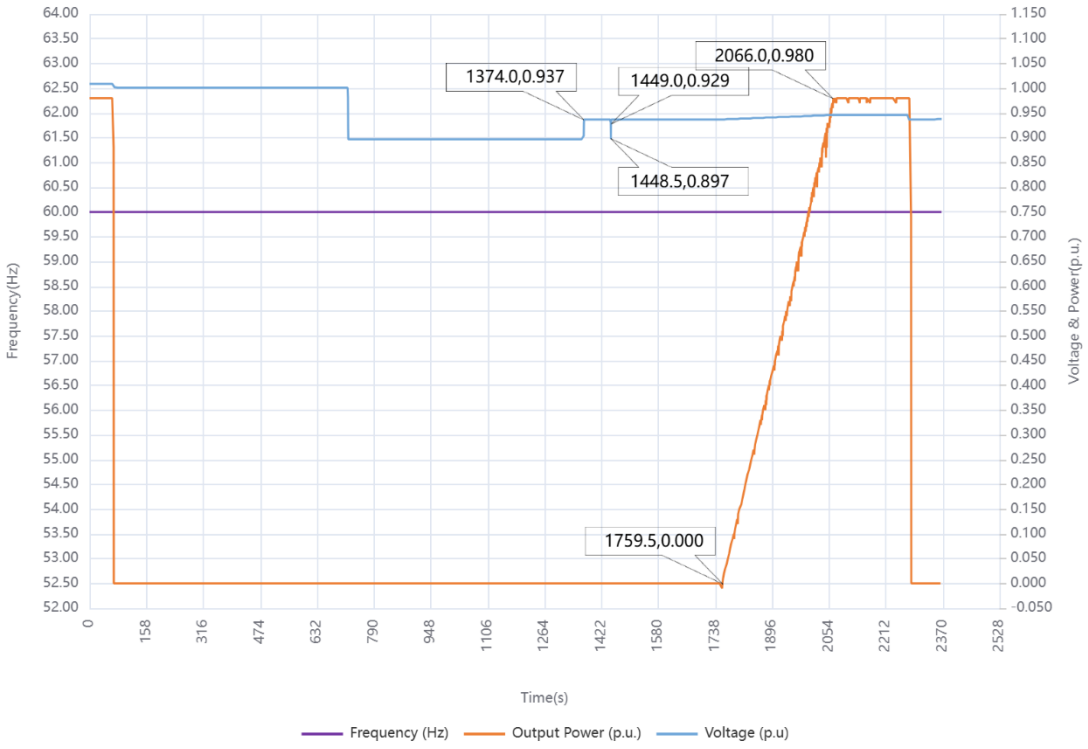
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/09/06-2025/09/08	500 ms	5 kHz

- **Test Case 1 L1-L2:240V**

Step	Disable/ Enable the permit service	Step keep Duration (s)	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values	
						ES voltage high (p.u.)	ES voltage Low (p.u.)	ES frequency High (p.u.)	ES frequency Low (p.u.)	voltage (p.u.)	frequency (Hz)
1	Enable	60	300	300	NA	1.05	0.917	60.1	59.5	1	60
2	Disable		300	300	NA	1.05	0.917	60.1	59.5	1	60
3	Disable	650	300	300	NA	1.05	0.917	60.1	59.5	1	60
4	Enable		300	300	NA	1.05	0.917	60.1	59.5	0.897	60
5	Enable	650	300	300	NA	1.05	0.917	60.1	59.5	0.897	60
6	Enable	75	300	300	NA	1.05	0.917	60.1	59.5	0.937	60
7	Enable	0.08	300	300	NA	1.05	0.917	60.1	59.5	0.897	60
8	Enable	800	300	300	NA	1.05	0.917	60.1	59.5	0.937	60
9	Disable	30	300	300	NA	1.05	0.917	60.1	59.5	0.937	60
10	Enable	30	300	300	NA	1.05	0.917	60.1	59.5	0.937	60

Test Curve over Time

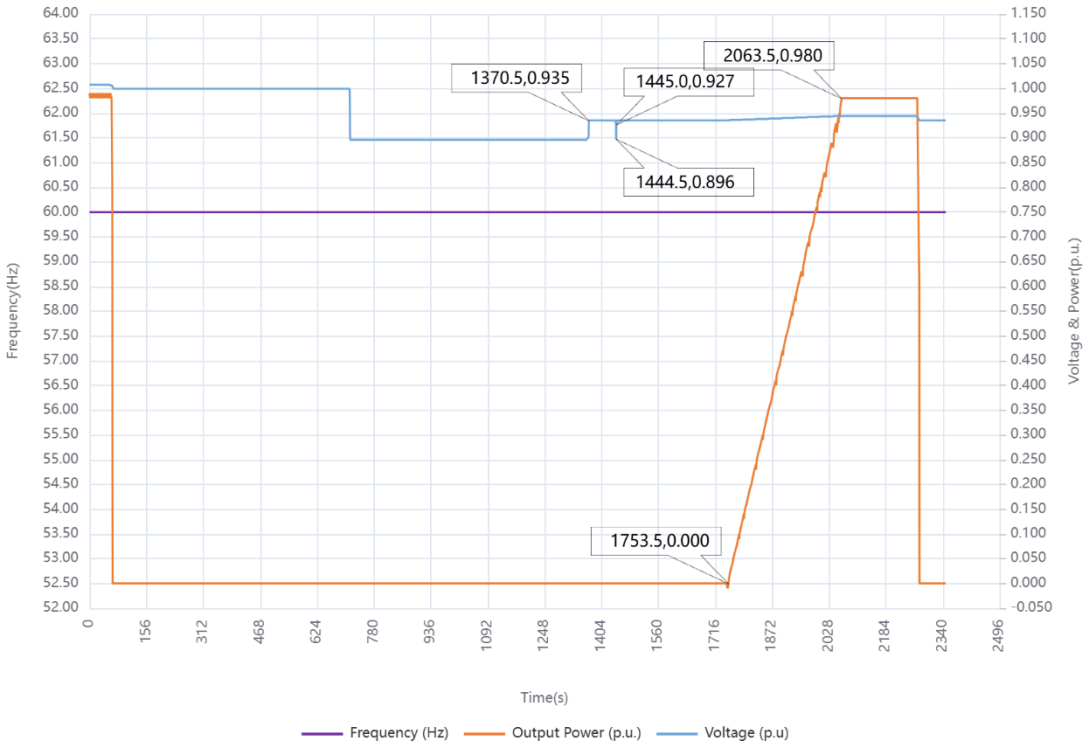


ES Delay measured:	**ES Ramp measured**:
1759.5-1449.0=310.5(s)	2066.0-1759.5=306.5(s)

- **Test Case 1 L1-L2:208V**

Step	Disable/ Enable the permit service	Step keep Duration (s)	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values	
						ES voltage high (p.u.)	ES voltage Low (p.u.)	ES frequency High (p.u.)	ES frequency Low (p.u.)	voltage (p.u.)	frequency (Hz)
1	Enable	60	300	300	NA	1.05	0.917	60.1	59.5	1	60
2	Disable		300	300	NA	1.05	0.917	60.1	59.5	1	60
3	Disable	650	300	300	NA	1.05	0.917	60.1	59.5	1	60
4	Enable		300	300	NA	1.05	0.917	60.1	59.5	0.897	60
5	Enable	650	300	300	NA	1.05	0.917	60.1	59.5	0.897	60
6	Enable	75	300	300	NA	1.05	0.917	60.1	59.5	0.937	60
7	Enable	0.08	300	300	NA	1.05	0.917	60.1	59.5	0.897	60
8	Enable	800	300	300	NA	1.05	0.917	60.1	59.5	0.937	60
9	Disable	30	300	300	NA	1.05	0.917	60.1	59.5	0.937	60
10	Enable	30	300	300	NA	1.05	0.917	60.1	59.5	0.937	60

Test Curve over Time



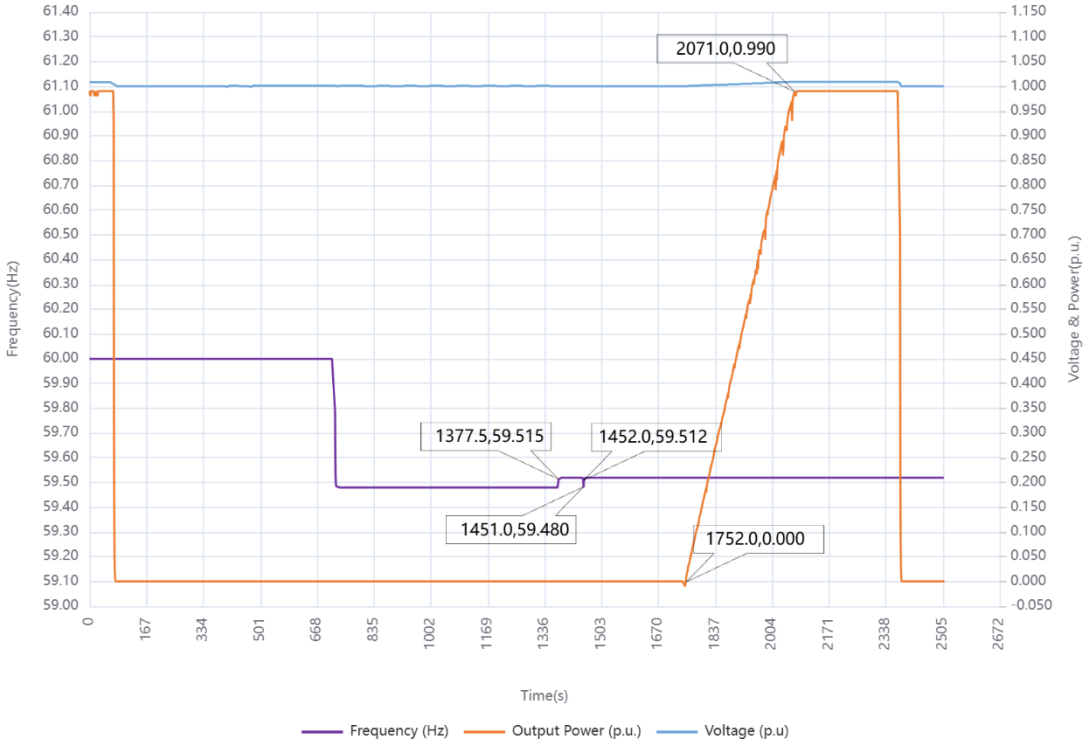
ES Delay measured:	**ES Ramp measured**:
1753.5-1445.0=308.5(s)	2063.5-1753.5=310.0(s)

(*) Due to current limitations, it is not possible to reach full load under low voltage conditions.

- **Test Case 2**

Step	Disable/ Enable the permit service setting	Step keep Duration (s)	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values	
						ES voltage high (p.u.)	ES voltage Low (p.u.)	ES frequency High (p.u.)	ES frequency Low (p.u.)	voltage (p.u.)	frequency (Hz)
1	Enable	60	300	300	NA	1.05	0.917	60.1	59.5	1	60
2	Disable		300	300	NA	1.05	0.917	60.1	59.5	1	60
3	Disable	650	300	300	NA	1.05	0.917	60.1	59.5	1	60
4	Enable		300	300	NA	1.05	0.917	60.1	59.5	1	59.48
5	Enable	650	300	300	NA	1.05	0.917	60.1	59.5	1	59.48
6	Enable	75	300	300	NA	1.05	0.917	60.1	59.5	1	59.52
7	Enable	0.08	300	300	NA	1.05	0.917	60.1	59.5	1	59.48
8	Enable	800	300	300	NA	1.05	0.917	60.1	59.5	1	59.52
9	Disable	30	300	300	NA	1.05	0.917	60.1	59.5	1	59.52
10	Enable	30	300	300	NA	1.05	0.917	60.1	59.5	1	59.52

Test Curve over Time



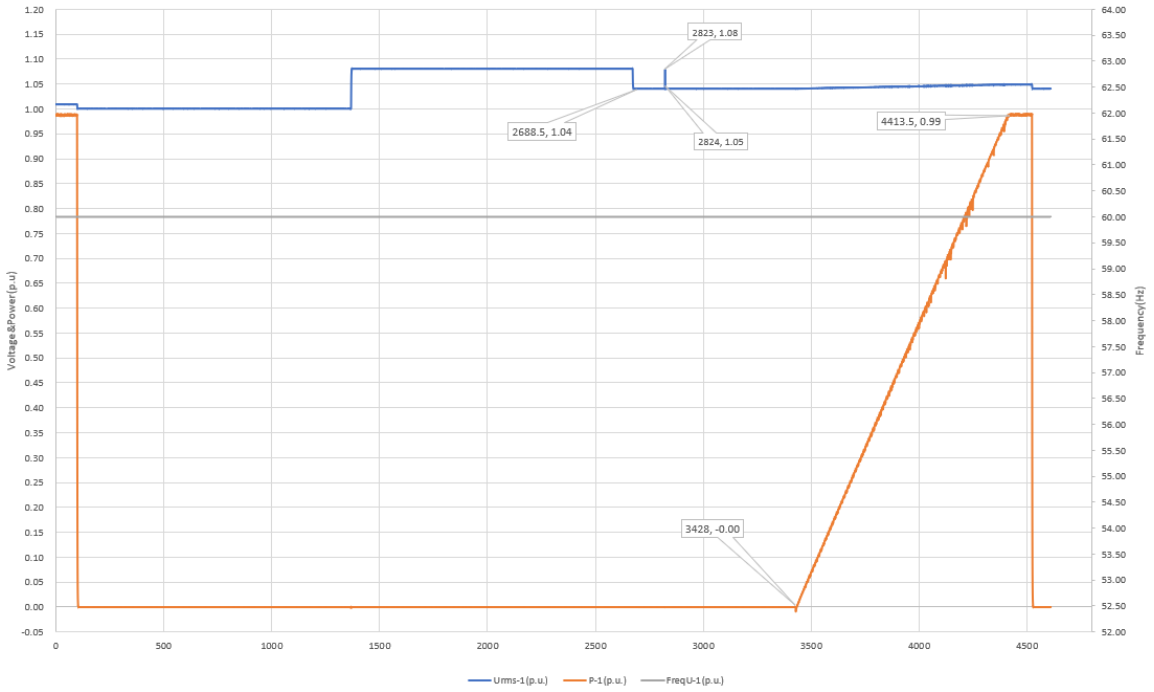
ES Delay measured:	**ES Ramp measured**:
1752.0-1452.0=300.0(s)	2071.0-1752.0=319.0(s)

Note: This test case was completed at -25 C temperature.

- **Test Case 3**

Step	Disable/ Enable the permit service setting	Step keep Duration (s)	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values		Note
						ES voltage high (p.u.)	ES voltage Low (p.u.)	ES frequency High (p.u.)	ES frequency Low (p.u.)	voltage (p.u.)	frequency (Hz)	
1	Enable	60	600	1000	NA	1.06	0.95	61	59.9	1	60	
2	Disable		600	1000	NA	1.06	0.95	61	59.9	1	60	Disable
3	Disable	1300	600	1000	NA	1.06	0.95	61	59.9	1	60	
4	Enable		600	1000	NA	1.06	0.95	61	59.9	1.08	60	Enable
5	Enable	1300	600	1000	NA	1.06	0.95	61	59.9	1.08	60	
6	Enable	150	600	1000	NA	1.06	0.95	61	59.9	1.04	60	
7	Enable	0.08	600	1000	NA	1.06	0.95	61	59.9	1.08	60	
8	Enable	1800	600	1000	NA	1.06	0.95	61	59.9	1.04	60	
9	Disable	30	600	1000	NA	1.06	0.95	61	59.9	1.04	60	Disable
10	Enable	30	600	1000	NA	1.06	0.95	61	59.9	1.04	60	Enable

Test Curve over Time

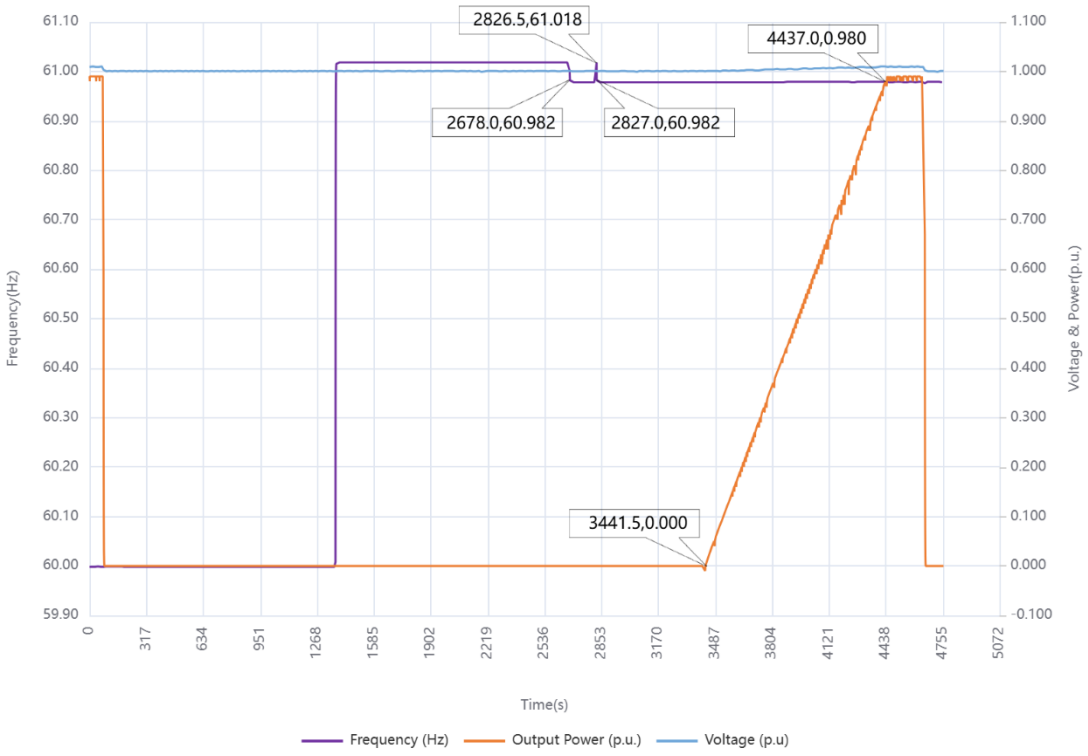


ES Delay measured:	**ES Ramp measured**:
3428-2824=604.0(s)	4413.5-3428=985.5(s)

- **Test Case 4**

Step	Disable/ Enable the permit service setting	Step keep Duration (s)	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values	
						ES voltage high (p.u.)	ES voltage Low (p.u.)	ES frequency High (p.u.)	ES frequency Low (p.u.)	voltage (p.u.)	frequency (Hz)
1	Enable	60	600	1000	NA	1.06	0.95	61	59.9	1	60
2	Disable		600	1000	NA	1.06	0.95	61	59.9	1	60
3	Disable	1300	600	1000	NA	1.06	0.95	61	59.9	1	60
4	Enable		600	1000	NA	1.06	0.95	61	59.9	1	61.02
5	Enable	1300	600	1000	NA	1.06	0.95	61	59.9	1	61.02
6	Enable	150	600	1000	NA	1.06	0.95	61	59.9	1	60.98
7	Enable	0.08	600	1000	NA	1.06	0.95	61	59.9	1	61.02
8	Enable	1800	600	1000	NA	1.06	0.95	61	59.9	1	60.98
9	Disable	30	600	1000	NA	1.06	0.95	61	59.9	1	60.98
10	Enable	30	600	1000	NA	1.06	0.95	61	59.9	1	60.98

Test Curve over Time

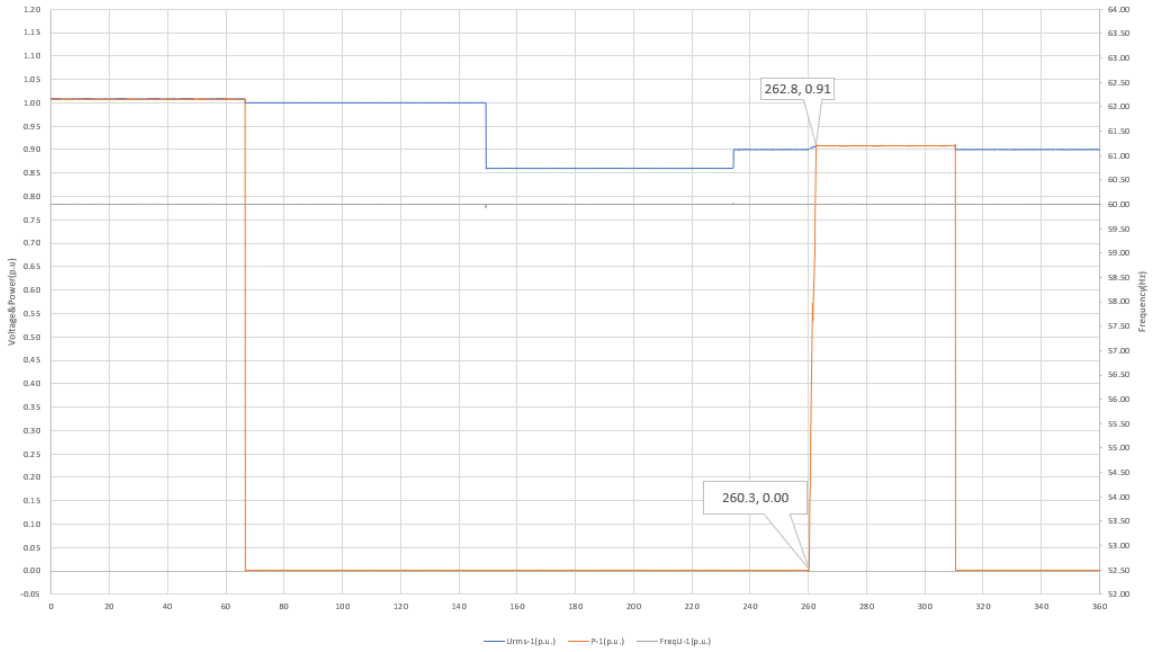


ES Delay measured:	**ES Ramp measured**:
3441.5-2827.0=614.5(s)	4437.0-3441.5=995.5(s)

- **Test Case 5**

Step	Disable/ Enable the permit service setting	Step keep Duration (s)	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values		Note
						ES voltage high (p.u.)	ES voltage Low (p.u.)	ES frequency High (p.u.)	ES frequency Low (p.u.)	voltage (p.u.)	frequency (Hz)	
1	Enable	60	0	1	NA	1.05	0.88	60.1	59	1	60	
2	Disable		0	1	NA	1.05	0.88	60.1	59	1	60	Disable
3	Disable	80	0	1	NA	1.05	0.88	60.1	59	1	60	
4	Enable		0	1	NA	1.05	0.88	60.1	59	0.86	60	Enable
5	Enable	80	0	1	NA	1.05	0.88	60.1	59	0.86	60	
6	Enable	60	0	1	NA	1.05	0.88	60.1	59	0.9	60	
7	Disable	30	0	1	NA	1.05	0.88	60.1	59	0.9	60	Disable

Test Curve over Time



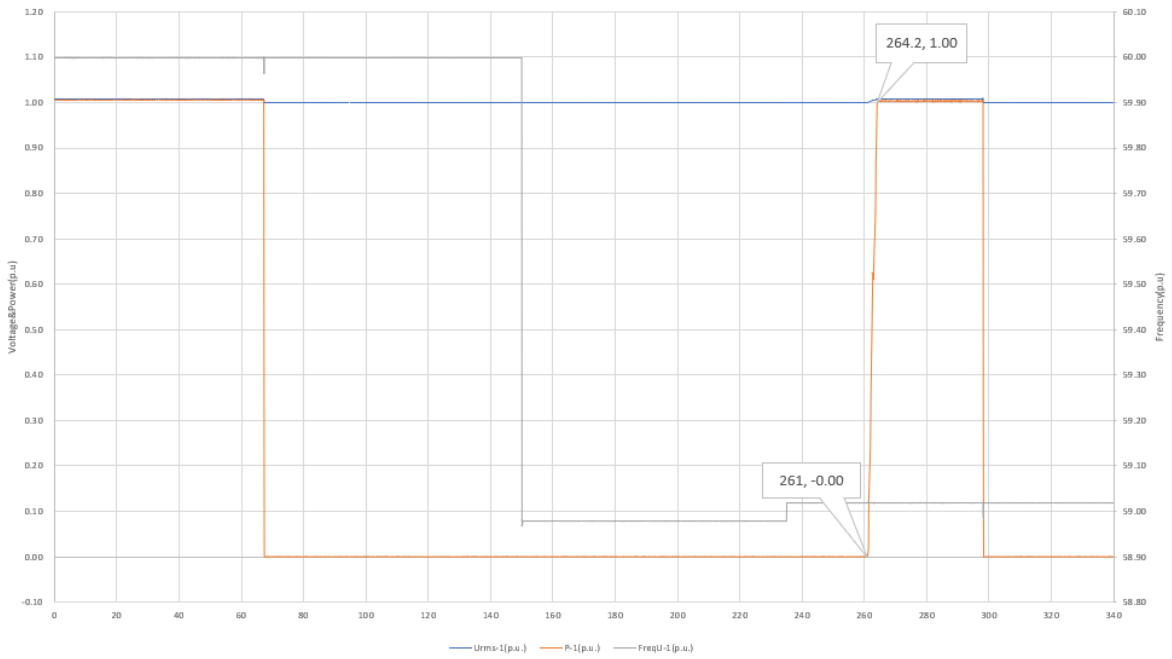
ES Delay measured:	**ES Ramp measured**:
Note: Due to the PCS approximately needs a 20 s duration to close the breaker, so it's not possible to measure the actual delay time, which was set as zero.	262.8-260.3=2.5(s)

(*) Due to current limitations, it is not possible to reach full load under low voltage conditions.

- **Test Case 6**

Step	Disable/ Enable the permit service setting	Step keep Duration (s)	ES delay (s)	ES period (ramp) (s)	Randomized delay setting (s)	Enter service criteria settings				AC test source values	
						ES voltage high (p.u.)	ES voltage Low (p.u.)	ES frequency High (p.u.)	ES frequency Low (p.u.)	voltage (p.u.)	frequency (Hz)
1	Enable	60	0	1	NA	1.05	0.88	60.1	59	1	60
2	Disable		0	1	NA	1.05	0.88	60.1	59	1	60
3	Disable	80	0	1	NA	1.05	0.88	60.1	59	1	60
4	Enable		0	1	NA	1.05	0.88	60.1	59	1	58.98
5	Enable	80	0	1	NA	1.05	0.88	60.1	59	1	58.98
6	Enable	60	0	1	NA	1.05	0.88	60.1	59	1	59.02
7	Disable	30	0	1	NA	1.05	0.88	60.1	59	1	59.02

Test Curve over Time



ES Delay measured:	**ES Ramp measured**:
Note: Due to the PCS approximately needs a 20 s duration to close the breaker, so it's not possible to measure the actual delay time, which was set as zero.	264.2-261.0=3.2(s)

4.6 Synchronization

The purpose of the tests in this subclause is to demonstrate that the EUT will synchronize to the area EPS according to the tolerances specified in Table 5 of IEEE Std 1547-2018.

Table 5—Synchronization parameter limits for synchronous interconnection to an EPS, or an energized Local EPS to an energized Area EPS

Aggregate rating of DER units (kVA)	Frequency difference (Δf, Hz)	Voltage difference (ΔV, %)	Phase angle difference ($\Delta\Phi$, °)
0–500	0.3	10	20
> 500–1 500	0.2	5	15
> 1 500	0.1	3	10

The DER shall parallel with the Area EPS without causing step changes in the RMS voltage at the PCC exceeding 3% of nominal when the PCC is at medium voltage, or exceeding 5% of nominal when the PCC is at low voltage.

4.6.1 Synchronization control function test for equipment with no synchronizing disable capability (variation 3)

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/08/13	50 ms	5 kHz

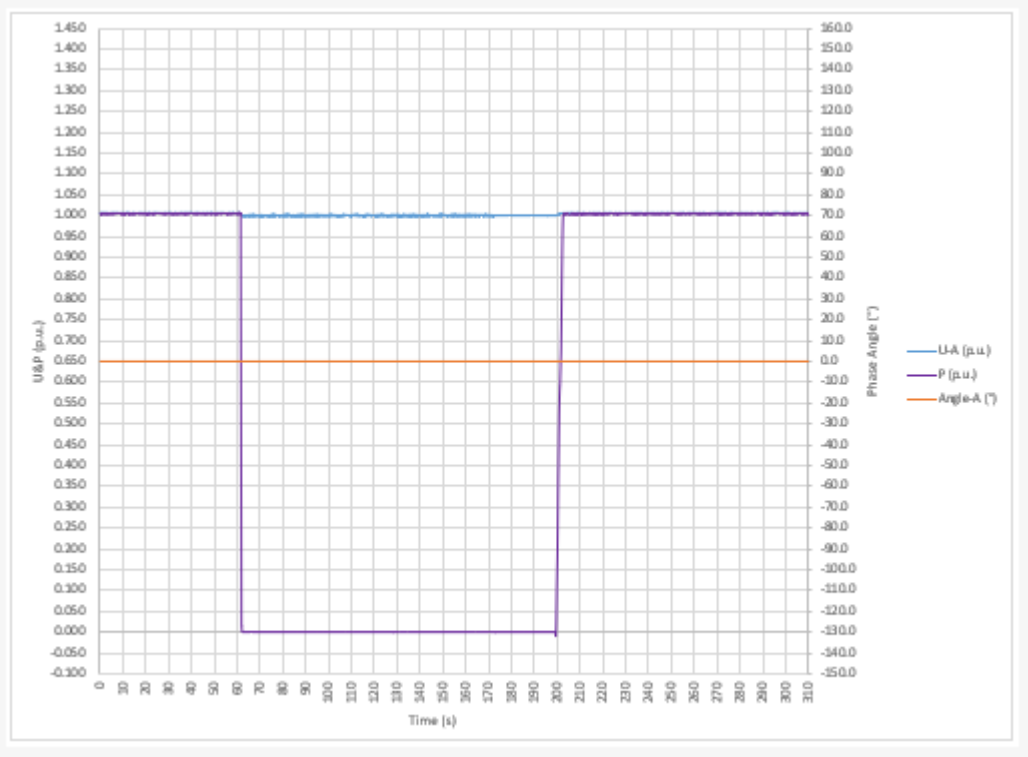
Attempt-1				
Voltage Meas. (%)		**Phase angle Meas. (°)**		**Frequency (Hz)**
Ua (V)	100.6	Phase A (°)	0.0	60.00
Ub (V)	--	Phase B (°)	--	
Uc (V)	--	Phase C (°)	--	
Disconnect the ac test source from the EUT and Reapply the ac test source				
Parameters Meas. (Max. deviation value during disconnect and reapply) (%)		**Voltage difference Meas. (ΔV, %)**	**Voltage difference Limit (ΔV, %)**	**Comments**
Ua (V)	99.4	1.2%	3	Pass
Ub (V)	--	--	--	Pass
Uc (V)	--	--	--	Pass
Parameters Meas.		--	--	--
F (Hz)	60.00	0.00	0.1	Pass
Parameters Meas.		**Phase angle difference Meas. (ΔΦ, °)**	**Phase angle difference Limit (ΔΦ, °)**	**Comments**
Phase A (°)	0.0	0.0	10	Pass
Phase B (°)	--	--	--	Pass
Phase C (°)	--	--	--	Pass

Attempt-2				
Voltage Meas. (%)		**Phase angle Meas. (°)**		**Frequency (Hz)**
Ua (V)	100.6	Phase A (°)	0.0	60.00
Ub (V)	--	Phase B (°)	--	
Uc (V)	--	Phase C (°)	--	
Disconnect the ac test source from the EUT and Reapply the ac test source				
Parameters Meas. (Max. deviation value during disconnect and reapply) (%)		**Voltage difference Meas. (ΔV, %)**	**Voltage difference Limit (ΔV, %)**	**Comments**
Ua (V)	100.6	0.9	3	Pass
Ub (V)	--	--	--	Pass
Uc (V)	--	--	--	Pass
Parameters Meas.		**Frequency difference Meas. (Δf, Hz)**	**Frequency difference Limit (Δf, Hz)**	**Comments**
F (Hz)	60.00	0.00	0.1	Pass
Parameters Meas.		**Phase angle difference Meas. (ΔΦ, °)**	**Phase angle difference Limit (ΔΦ, °)**	**Comments**
Phase A (°)	0.0	0.0	10	Pass
Phase B (°)	--	--	--	Pass
Phase C (°)	--	--	--	Pass

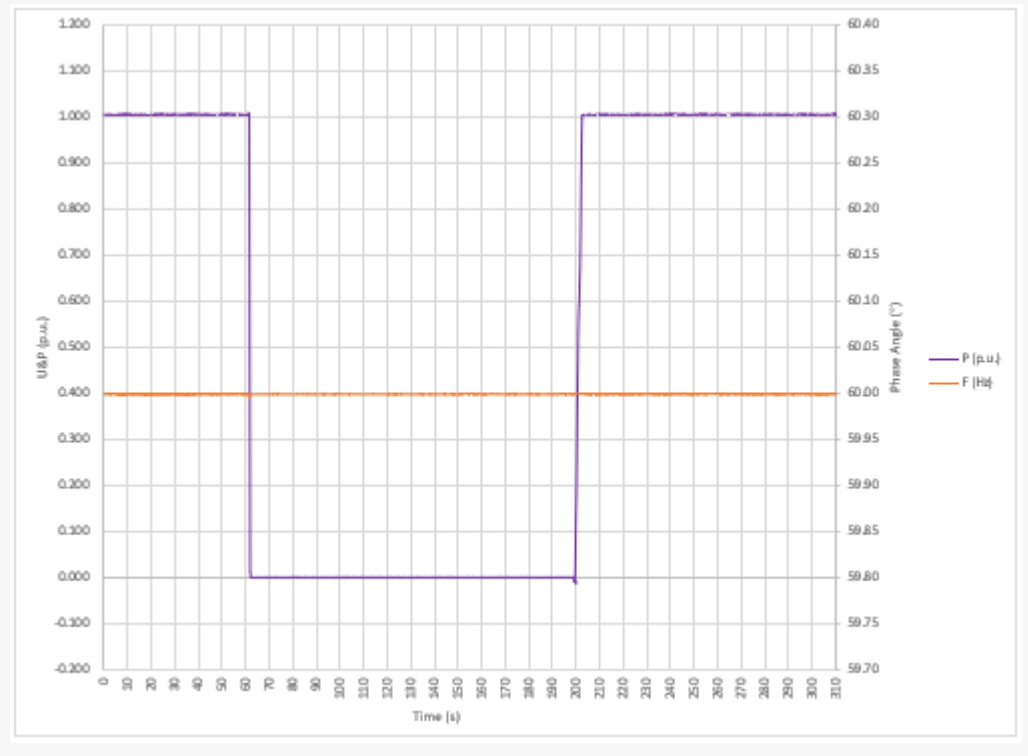
Attempt-3				
Voltage Meas. (%)		**Phase angle Meas. (°)**		**Frequency (Hz)**
Ua (V)	100.6	Phase A (°)	0.0	60.00
Ub (V)	--	Phase B (°)	--	
Uc (V)	--	Phase C (°)	--	
Disconnect the ac test source from the EUT and Reapply the ac test source				
Parameters Meas. (Max. deviation value during disconnect and reapply) (%)		**Voltage difference Meas. (ΔV, %)**	**Voltage difference Limit (ΔV, %)**	**Comments**
Ua (V)	100.6	0.9	3	Pass
Ub (V)	--	--	--	Pass
Uc (V)	--	--	--	Pass
Parameters Meas.		**Frequency difference Meas. (Δf, Hz)**	**Frequency difference Limit (Δf, Hz)**	**Comments**
F (Hz)	60.00	0.00	0.1	Pass
Parameters Meas.		**Phase angle difference Meas. (ΔΦ, °)**	**Phase angle difference Limit (ΔΦ, °)**	**Comments**
Phase A (°)	0.0	0.0	10	Pass
Phase B (°)	--	--	--	Pass
Phase C (°)	--	--	--	Pass

Attempt-1

Voltage & Phase Angle & Active Power Vs Time

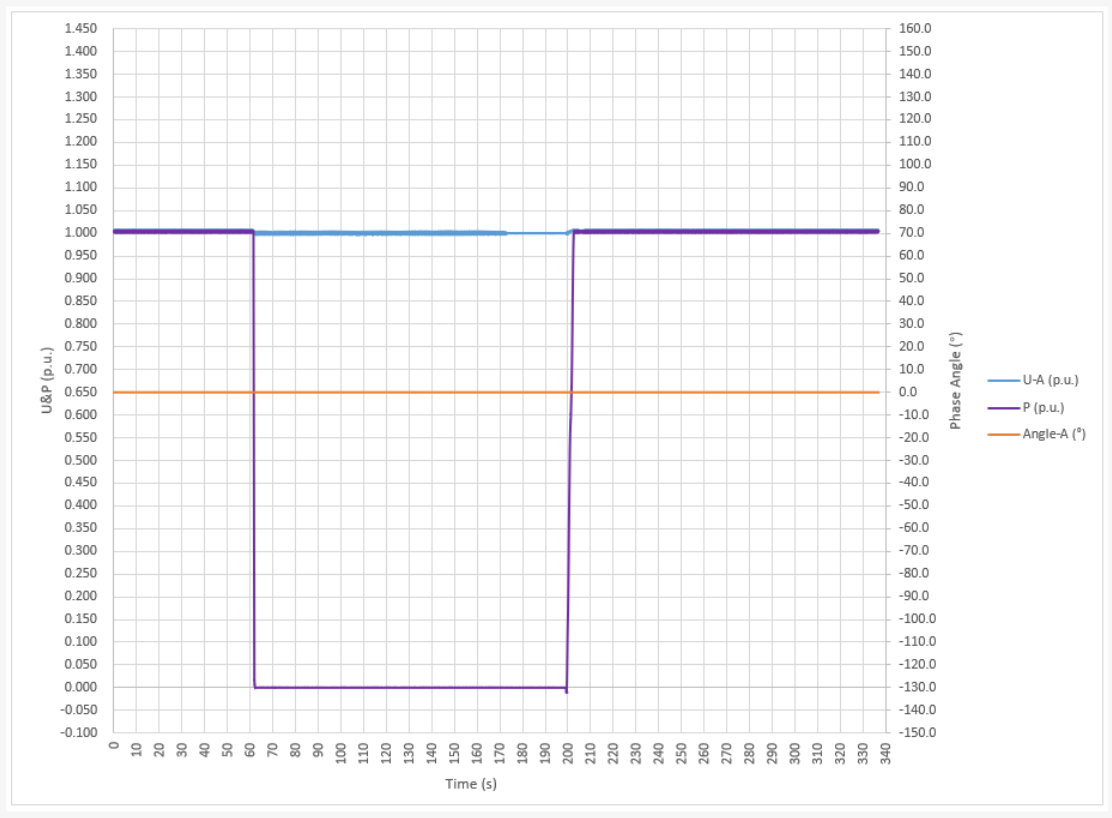


Frequency & Active Power Vs Time

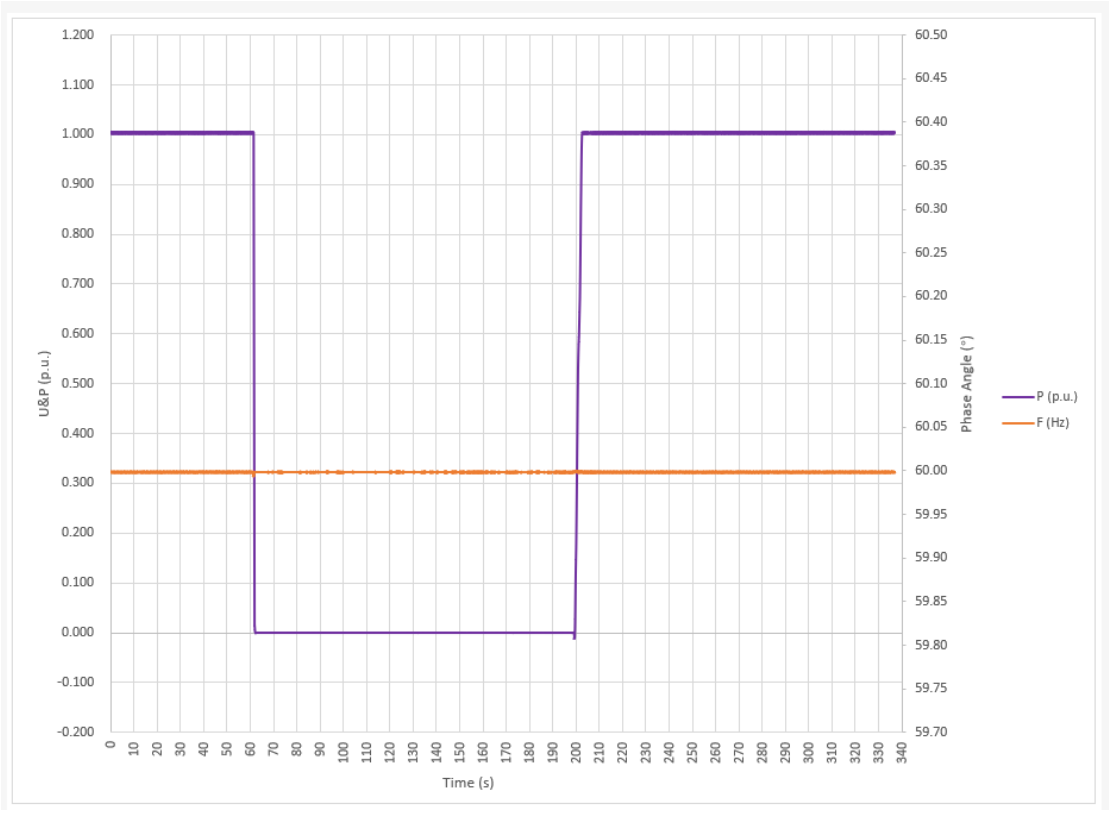


Attempt-2

Voltage & Phase Angle & Active Power Vs Time

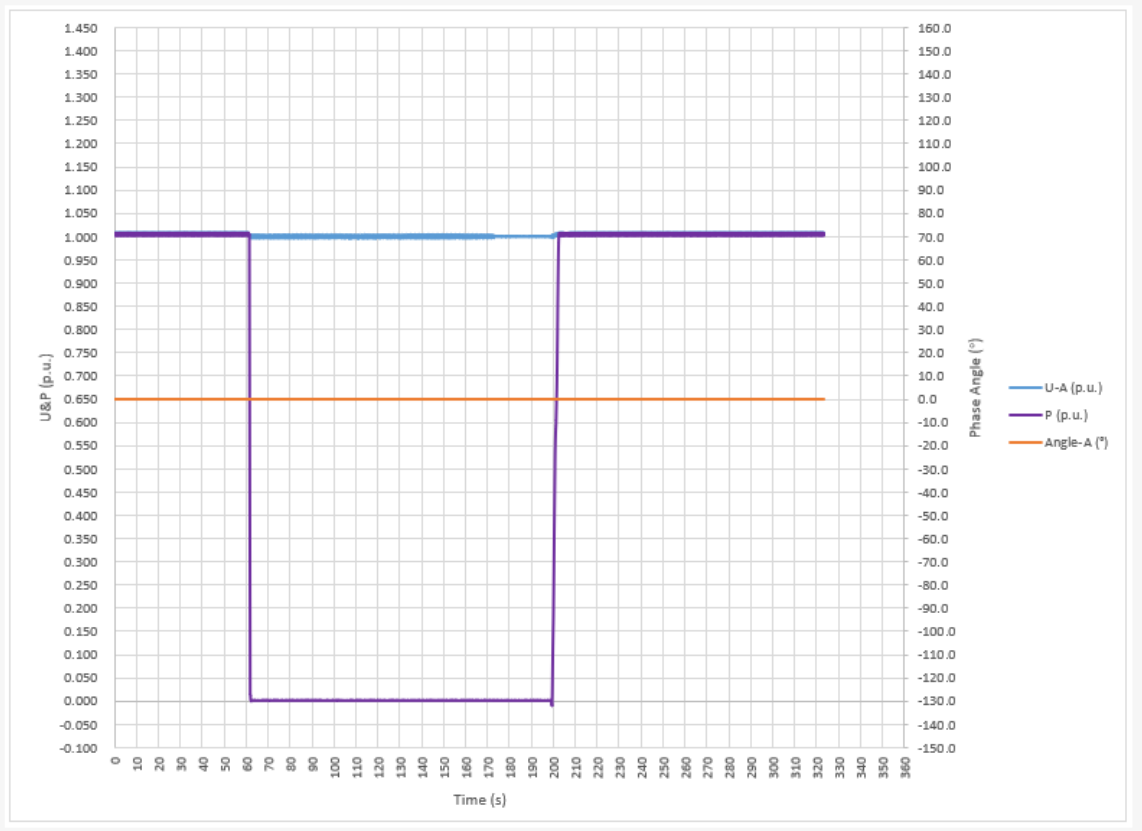


Frequency & Active Power Vs Time

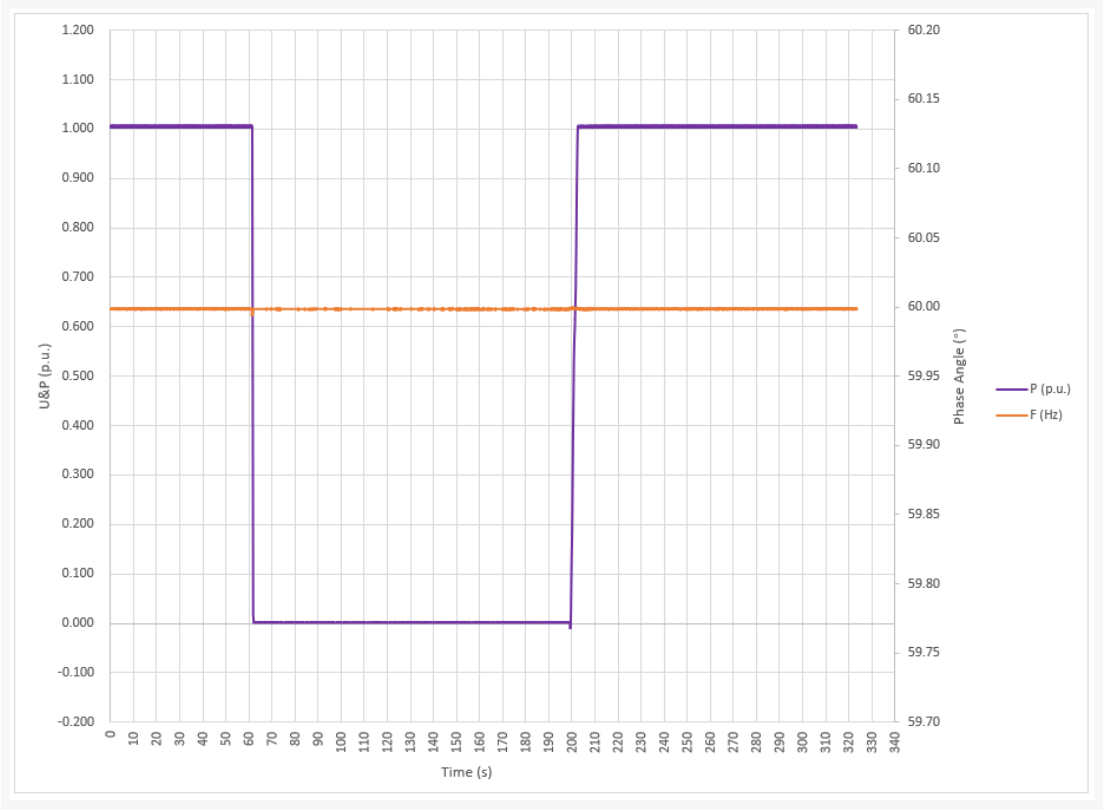


Attempt-3

Voltage & Phase Angle & Active Power Vs Time



Frequency & Active Power Vs Time



4.7 Interconnection integrity

4.7.1 Protection from electromagnetic interference (EMI) test

The purpose of these tests is to verify that the EUT's protection from EMI is in compliance with Clause 4.11.1 of IEEE Std 1547.

The interconnection equipment of the EUT shall be tested in accordance with IEEE Std C37.90.2 or IEC 61000-4-3 using a signal having a strength of 20 Vrms/m prior to modulation. The carrier signal shall reach at least 35 V/m maximum rms field strength after it is modulated with a 1 kHz signal.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Anechoic Chamber	2025/10/21	--	--
Signal Generator	2025/10/21	--	--
Power Amplifier	2025/10/21	--	--
Power Amplifier	2025/10/21	--	--
Power Meter	2025/10/21	--	--
Feld Strength Meter	2025/10/21	--	--
Test Antenna-Bi-Log	2025/10/21	--	--
Test Antenna-Horn	2025/10/21	--	--

Part-1: Frequency sweep or step test:

Test Mode	Full System				
Frequency Range (MHz)	EUT Position (Angle)	Ant. Polarity (Hor. Or Ver)	Field Strength (V/m)	Performance Criterion	Remark
80~1000	0	H	20	A	PASS
80~1000	0	V	20	A	PASS

Note:

Modulation Condition: 80% AM (1KHz)

Dwell Time: 3s

Stepped Frequency: 1%

Angle 0 was considered as the worst case

Part-2: Keying test:

Test Mode	Full System				
Frequency Range (MHz)	EUT Position (Angle)	Ant. Polarity (Hor. Or Ver)	Field Strength (V/m)	Performance Criterion	Remark
80~1000	0	H	20	A	PASS
80~1000	0	V	20	A	PASS

Note:

Modulation Condition: Square wave 50% Duty Cycle

Dwell Time: 3s

Stepped Frequency: 1%

Angle 0 was considered as the worst case

Part-3: Spot frequency test:

Test Mode	Full System				
Frequency Range (MHz)	EUT Position (Angle)	Ant. Polarity (Hor. Or Ver)	Field Strength (V/m)	Performance Criterion	Remark
80	0	H	20	A	PASS
180	0	H	20	A	PASS
450	0	H	20	A	PASS
900	0	H	20	A	PASS
900[P]	0	H	20	A	PASS
80	0	V	20	A	PASS
180	0	V	20	A	PASS
450	0	V	20	A	PASS
900	0	V	20	A	PASS
900[P]	0	V	20	A	PASS

Note:

Modulation Condition: 90% AM (1KHz)

Dwell Time: 3s

[P]: Square wave 50% Duty Cycle (200Hz), Dwell Time: 3s

Angle 0 was considered as the worst case

4.7.2 Surge withstand performance test

The EUT shall be tested to verify the level of surge withstand protection as specified by the manufacturer and in accordance with either or both of the following standards as defined by the manufacturer: IEEE Std C62.41.2 and/or IEEE Std C37.90.1. If the EUT's instructions require specific external surge suppression as part of the installation, the EUT shall be tested with the specified surge protection installed.

a) Apply IEEE Std C37.90.1 to test appropriate EUT external signal and control circuits.
b) Apply IEEE Std C62.41.2 and IEEE Std C62.45 to test appropriate EUT power circuits

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
SURGE Generator (AC/DC Ports)	2025/10/21 to 2025/10/26	--	--
SURGE coupling network (AC/DC Ports)	2025/10/21 to 2025/10/26	--	--
Ring Wave Generator	2025/10/21 to 2025/10/26	--	--
Oscillatory waveform Generator	2025/10/21 to 2025/10/26	--	--
EFT Test System	2025/10/21 to 2025/10/26	--	--
EFT coupling network	2025/10/21 to 2025/10/26	--	--
EFT coupling network	2025/10/21 to 2025/10/26	--	--

Input		Output				
$V_{d.c.}$ (V)	$P_{d.c.}$ (kW)	$V_{a.c.}$ (V)	$I_{a.c.}$ (A)	$P_{a.c.}$ (kW)	Fre. (Hz)	PF
360.2	5.96	240.4	24.08	5.79	60.00	0.97

1) **Combination Wave** (1.2/50us) 6kV/3kA, 2 ohms effective impedance, positive and negative pulses, 5 pulses for each phase angle (0, 90, 180, 270)

Wave Type	Coupling Location	Angle	Polarity Attempts		Voltage(V)	Result
			Positive	Negative		
CWG	L1-L2	0	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.

		180	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		270	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
	L1-N	0	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		270	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can

						automatically restore to the grid connection state before the testing.
	L2-N	0	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		270	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
	L1-G	0	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	6000	Pass, During the testing

						process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		270	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
	L2-G	0	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the

						grid connection state before the testing.
		270	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.

2) **Ring Wave** (0.5us-100kHz) 6kV/0.5kA, 12 ohms effective impedance, positive and negative pulses, 5 pulses for each phase angle (0, 90, 180, 270)

Wave Type	Coupling Location	Angle	Polarity Attempts		Voltage(V)	Result
			Positive	Negative		
RING	L1-L2	0	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		270	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can

						automatically restore to the grid connection state before the testing.
	L1-N	0	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		270	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
	L2-N	0	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		90	5	5	3000	Pass, During the testing

						process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		270	5	5	3000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
	L1-G	0	5	5	6000	Pass
		90	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.
		180	5	5	6000	Pass
		270	5	5	6000	Pass
	L2-G	0	5	5	6000	Pass
		90	5	5	6000	Pass, During the testing process, the grid connection was interrupted. After the testing is completed, it can automatically restore to the grid connection state before the testing.

		180	5	5	6000	Pass
		270	5	5	6000	Pass

3) **Oscillatory waveform**

a) Waveform envelope: A damped oscillatory wave, with the envelope decaying to 50% of peak valuebetween the third and sixth periods.
b) Frequency: 1 MHz (tolerance ± 10%)
c) Rise time of first peak: 75 ns (tolerance ± 20%), as measured between 10% and 90% of the peak value.
d) Test voltage magnitude: Initial crest of 2.5 kV for common mode tests and for transverse tests (tolerance + 0 / – 10%).
e) Repetition rate: 6–10 bursts per period of the power system frequency. Bursts shall be nonsynchronous with the power system frequency.
f) Duration: 2 seconds (tolerance + 10% / – 0%). For relays with an operating time greater than 2 seconds, it is recommended that the test be carried out with a minimum time setting. In such cases, the period of application of the test signal shall be at least as long as the operating time of the relay under test.
g) Source impedance: 200 ohm resistive at 1 MHz (tolerance ± 20%).

Wave Type	Coupling Location	Polarity Attempts		Voltage (V)	Result
		Positive	Negative		
OSC	RS485	5	5	2500	PASS

4) **Fast transient** test waveform
a) Waveform polarity: Positive and negative
b) Rise time: 5 ns (tolerance ± 30%)
c) Magnitude: 4 kV crest value (tolerance ± 10%)
d) Pulse duration: 50 ns (tolerance ± 30%) (50% value)
e) Repetition rate: The waveform consists of bursts of pulses that repeat periodically.
f) Burst duration: 15 ms (tolerance ± 20%)
g) Repetition rate during bursts: 2.5 kHz (tolerance ± 20%)
h) Burst period: 300 ms (tolerance ± 20%)
i) Duration: Not less than 1 minute, each polarity
j) Source impedance: 50 ohm (tolerance ± 20%) between 1 MHz and 100 MHz

Wave Type	Coupling Location	Polarity Attempts		Voltage (V)	Result
		Positive	Negative		
EFT	RS485	5	5	4000	PASS

4.8 Paralleling device tests

This test is applied to non-semiconductor switching devices that parallel an EUT with the EPS.

This test is intended to validate that the paralleling device of the EUT is able to withstand a voltage of 1000 V plus two times the 110% upper limit of nominal operating voltage.

Note:
A dc test voltage of 220% of the nominal ac peak voltage plus 1400 V may be used for the dielectric test.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Safety tester	2025/07/09	--	--

Applied points:	Applied voltage (V):	Test Duration (s)	Breakdown or flashover ? (Yes/No)
AC output to G	1480Vac/2100Vdc	1 min	No

4.9 Limitation of dc injection for inverters

The purpose of this test is to verify inverter compliance with the dc injection limit specified in section 7.1 of IEEE Std 1547, and it is intended for inverters that do not have dc-isolation line-frequency output transformers.

The DER shall not inject dc current greater than 0.5% of the full rated output current at the reference point of applicability (RPA).

Operating power levels in this procedure have a tolerance of ± 5%. Minimum a period of 5 min recorded.

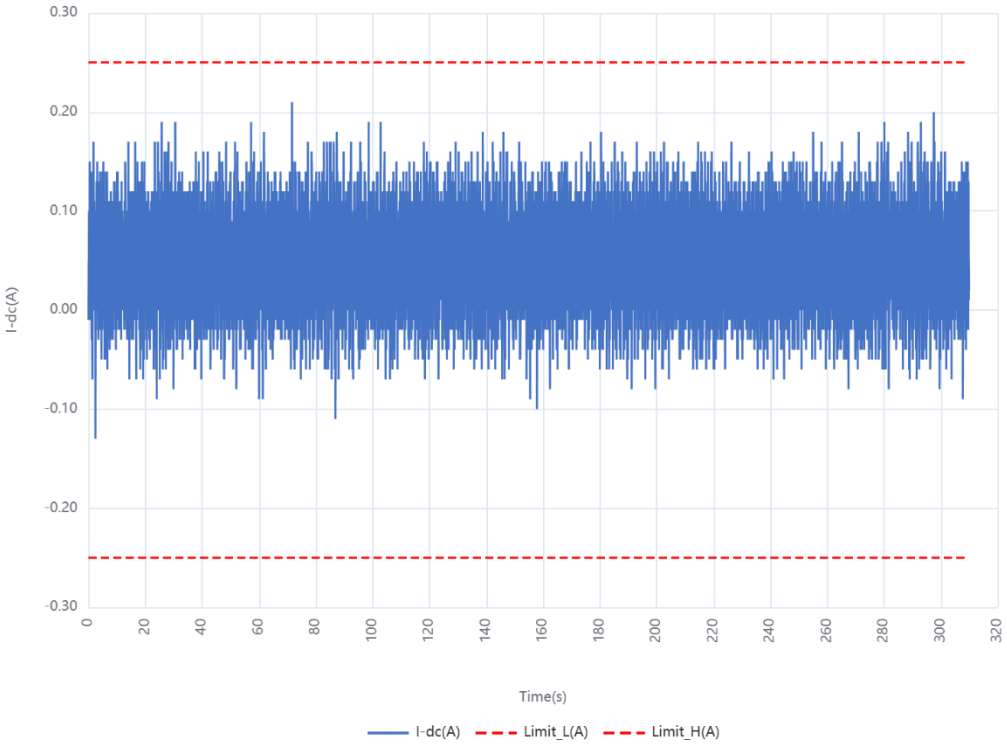
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
Power analyzer	2025/09/06	10 ms	5 kHz

$P_{desired}$ (kW)	$P_{measured}$ (W)	DC input Voltage	Phase	$U_{measured}$ (Vac)	$I_{measured}$ (Aac)	$I_{DCI\text{-}measured}$ (mA)	Pass/Fail
100%Prated	12116.61	298.70	L1-L2	242.25	50.05	55.92	Pass

Note: the DCI limit = 50 A * 0.5% ≈ 0.25 A

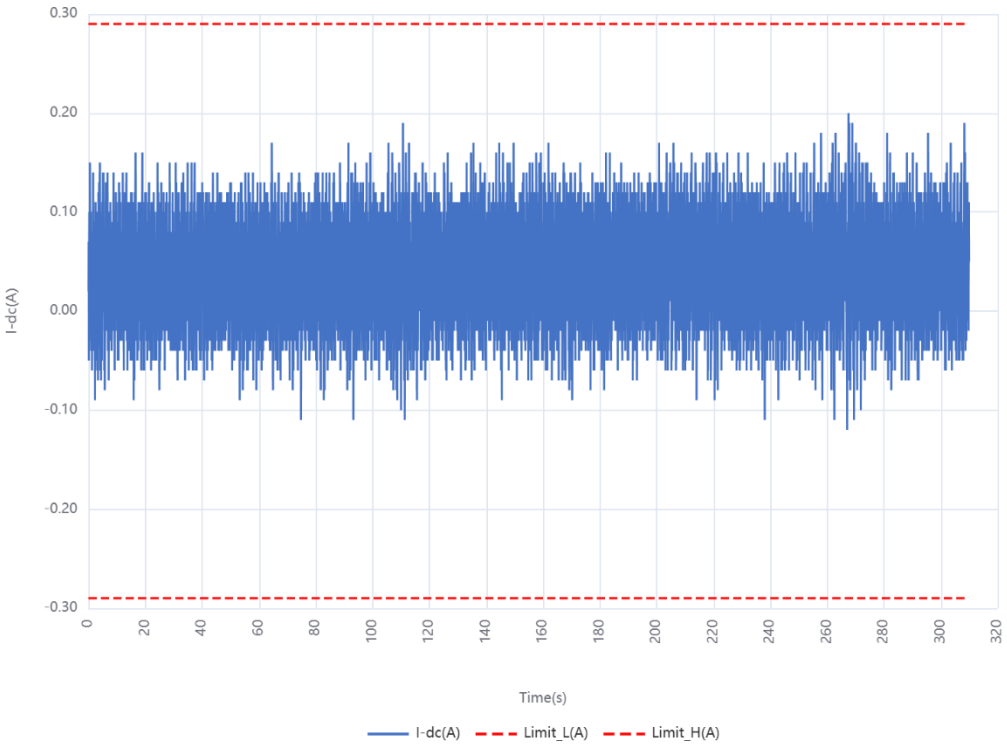
TEST RESULT



$P_{desired}$ (kW)	$P_{measured}$ (W)	DC input Voltage	Phase	$U_{measured}$ (Vac)	$I_{measured}$ (Aac)	$I_{DCI\text{-}measured}$ (mA)	Pass/Fail
100%Prated	12031.08	298.74	L1-L2	209.92	49.84	50.35	Pass

Note: the DCI limit = 50 A * 0.5% ≈ 0.25 A

TEST RESULT



4.10 Unintentional islanding

Unintentional Islanding Protection Method Used		Comments
Balanced generation to load unintentional islanding test	☒	Full compliance
Powerline conducted permissive signal test	☐	Partial compliance
Permissive hardware-input test	☐	Partial compliance
Reverse or minimum import active-power flow	☐	Full compliance

4.10.1 Balanced generation to load unintentional islanding test

- **Test Sequence**

Table 14—Balanced load unintentional islanding test matrix for Category B

Test case	EUT power level (p.u.) [a]		Reactive power mode			Active power mode settings		Initial RLC load (p.u.) [a]			Effective quality factor [b]
	P_{EUT}	Q_{EUT}	Mode and setting		Response time (s)	VW	FW	$P_R+P_L+P_C$	Q_C		QF
1B	1.00	0.00	Constant power factor	p.f. = 1.00	n/a	Default	Default	−1.00	1.00		1.00
2B	0.50	0.00						−0.50	0.50	−0.50	1.00
3B	0.90	−0.44	Constant power factor	p.f. = −0.90	n/a	Off	LA	−0.90	0.90	−0.46	1.00
4B	0.90	0.44		p.f. = 0.90				−0.90	0.46	−0.90	1.00
5B	1.00	0.00	Voltage-reactive power	MA	1	MA	MA	−1.00	1.00	−1.00	1.00
6B	0.50	0.00		Default	10			−0.50	0.50	−0.50	1.00
7B	0.50	0.00	Active power-reactive power	Default	n/a			−0.50	0.50	−0.50	1.00
8B	1.00	0.00		MA				−1.00	1.00	−1.00	1.00
9B	0.50	−0.44	Constant reactive power	Q = −0.44	n/a			−0.50	0.50	−0.06	1.00
10B	0.50	0.44		Q = 0.44				−0.50	0.06	−0.50	1.00

NOTE—LA = least aggressive; MA = most aggressive, as indicated in Table 16 through Table 19.

[a] (p.u.) is per unit of the EUT KVA rating.

[b] Effective quality factor is provided for information only to help readers compare these test requirements with earlier versions of this standard. See Annex D for details.

- **Modified according to UL1741SB for test case 8B**

Table SB.1
Expected Balanced Load Conditions with Watt-VAr Active

EUT power level (pu)				Balanced RLC load (pu)		
Test case	PEUT	QEUT	SEUT	PR+PL+PC	QC	QL
8A	0.97	-0.25	1.00	-0.97	0.97	-0.72
8B	0.93	-0.38	1.00	-0.93	0.93	-0.55

- **Test Plateform Circuit**

Figure 7 presents a balanced generation to load unintentional islanding test configuration.

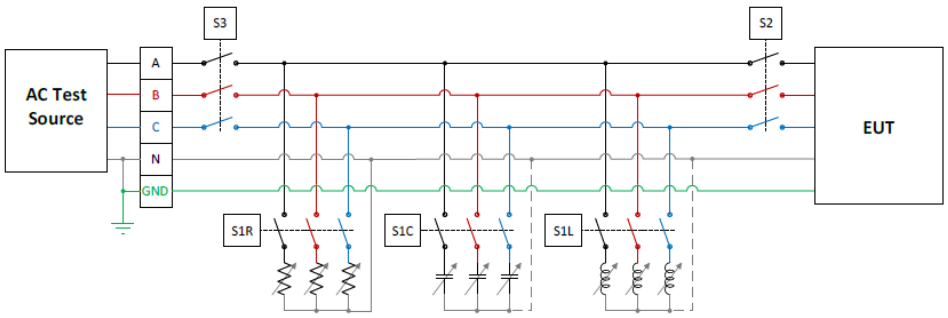


Figure 7—Balanced generation to load unintentional islanding test configuration[48, 49]

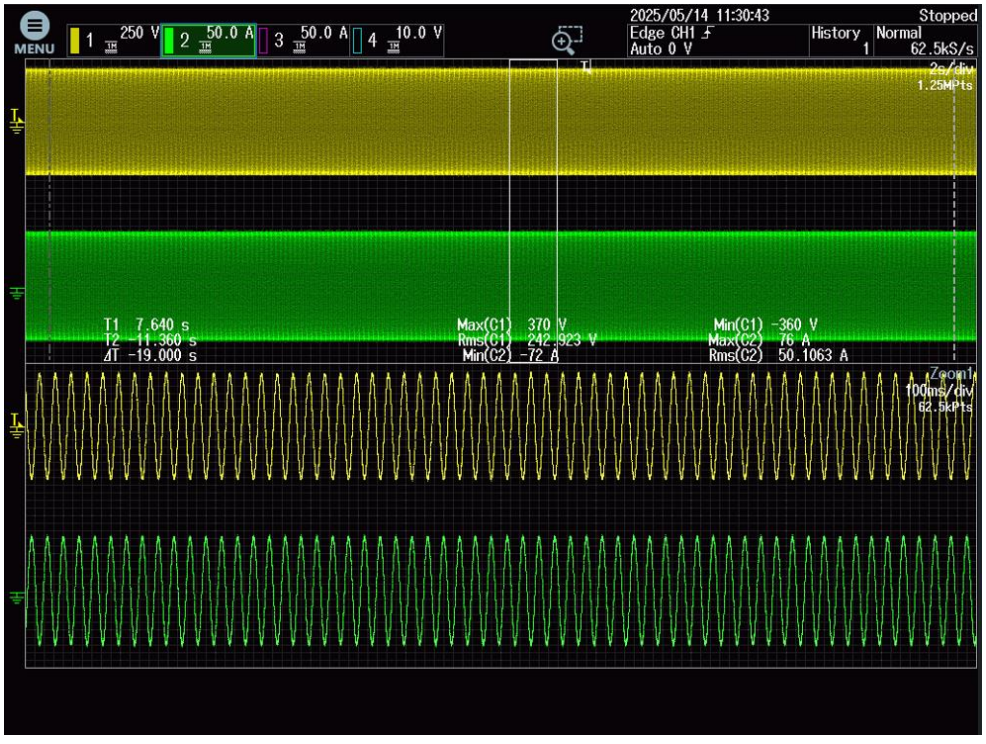
Note: Active and reactive power measurements shall be the fundamental frequency component.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
MSO4054B	2025/05/12 to 2025/05/15	--	1 MHz
DEWE2-PA7		100 ms	10 kHz

1) Test Case 1B

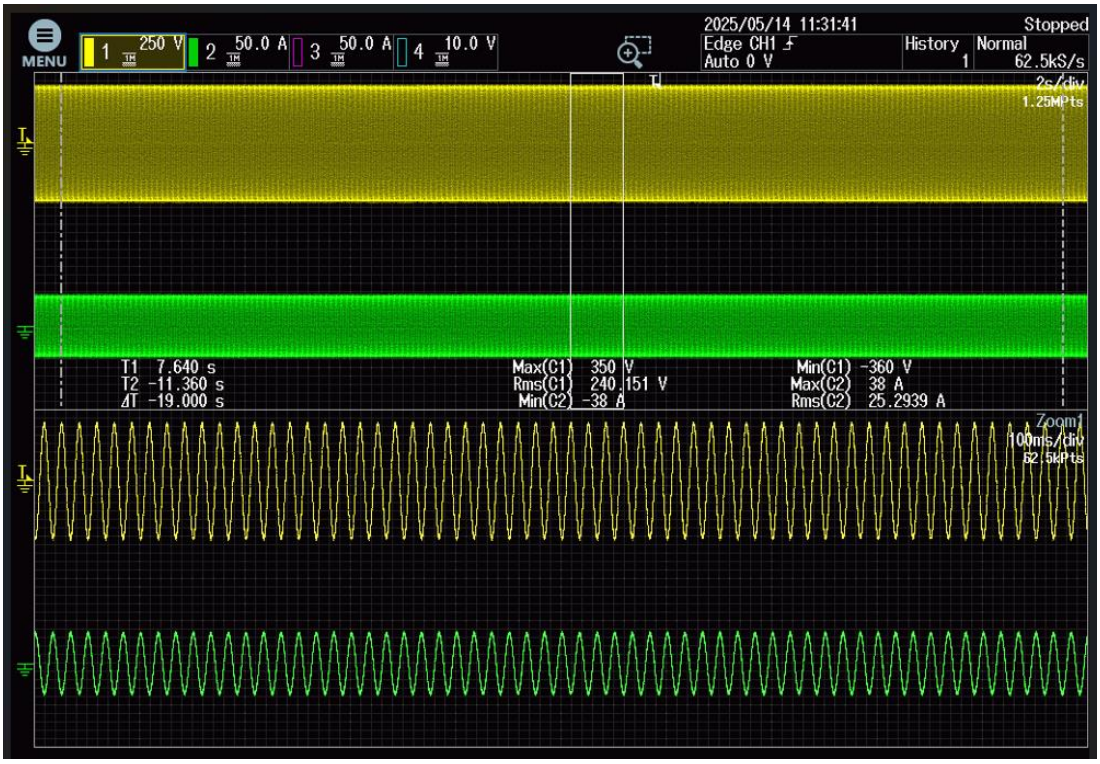
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.06	U_A (V)	240.06	R Load (kW)	11.58
U_B (V)	--	U_B (V)	--	L Load (kVAr)	11.59
U_C (V)	--	U_C (V)	--	C Load (kVAr)	12.20
I_A (A)	50.59	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	12.14	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	12.14	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	0.05	Q_{EUT} (kVar)	--		
PF	0.99	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.06				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	11.60	296.0	324.0	337.0
	96%	11.71	394.0	330.0	365.0
	97%	11.83	384.0	296.0	294.0
	98%	11.95	326.0	381.0	335.0
	99%	12.07	363.0	333.0	369.0
Balance	100%	12.20	419.0	407.0	380.0
Inductive	101%	12.32	394.0	373.0	342.0
	102%	12.44	294.0	331.0	346.0
	103%	12.56	414.0	343.0	314.0
	104%	12.68	346.0	297.0	327.0
	105%	12.81	320.0	296.0	291.0
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

2) Test Case 2B

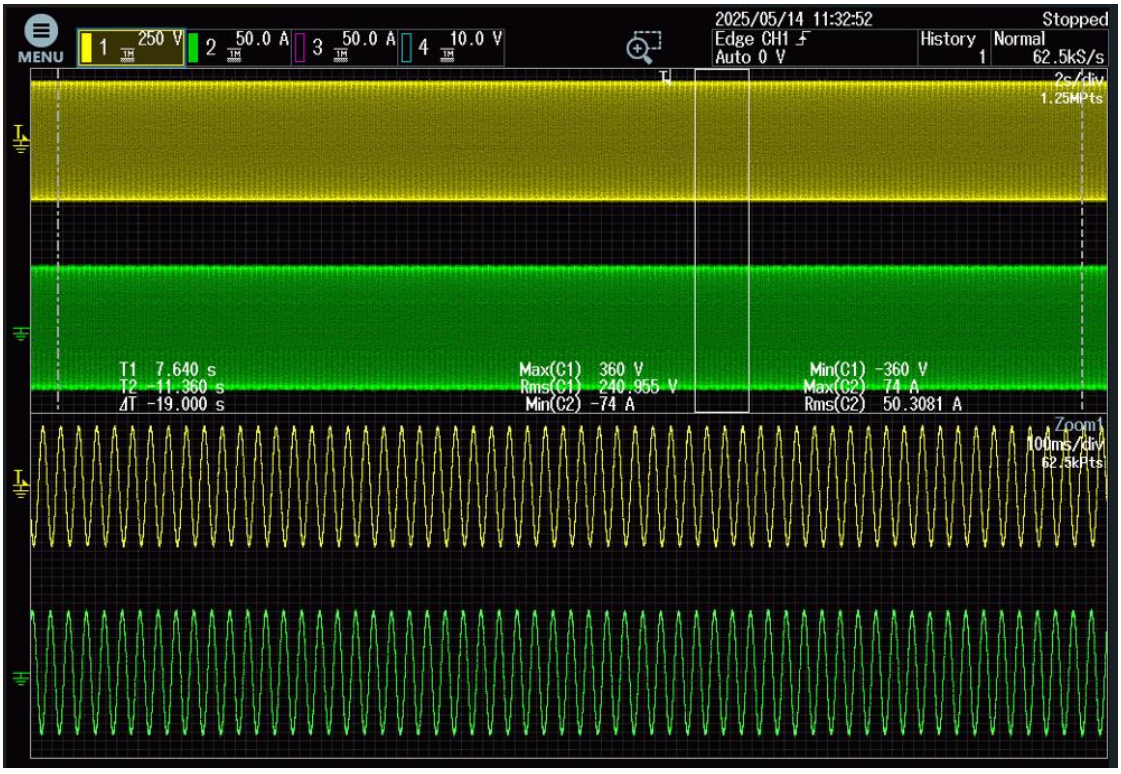
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.08	U_A (V)	240.08	R Load (kW)	5.86
U_B (V)	--	U_B (V)	--	L Load (kVAr)	6.09
U_C (V)	--	U_C (V)	--	C Load (kVAr)	6.07
I_A (A)	25.03	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	6.01	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	6.01	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	0.01	Q_{EUT} (kVar)	--		
PF	1.00	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.08				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	5.78	368.0	--	--
	96%	5.82	396.0	354.0	323.0
	97%	5.88	311.0	412.0	330.0
	98%	5.94	377.0	413.0	360.0
	99%	6.00	343.0	416.0	415.0
Balance	100%	6.07	422.0	426.0	419.0
Inductive	101%	6.13	300.0	--	--
	102%	6.19	364.0	--	--
	103%	6.25	362.0	--	--
	104%	6.31	336.0	--	--
	105%	6.37	291.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

3) Test Case 3B

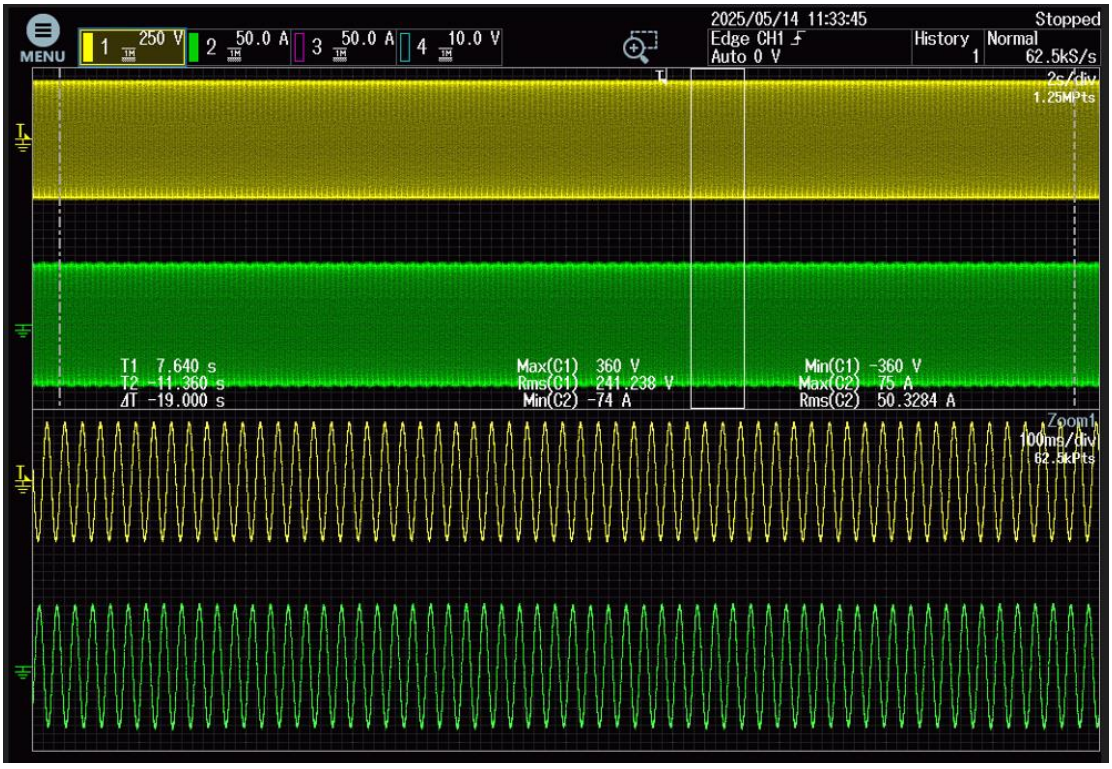
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.06	U_A (V)	240.06	R Load (kW)	10.53
U_B (V)	--	U_B (V)	--	L Load (kVAr)	8.4
U_C (V)	--	U_C (V)	--	C Load (kVAr)	13.95
I_A (A)	50.72	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	10.93	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	10.93	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	5.37	Q_{EUT} (kVar)	--		
PF	0.90	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.06				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	13.25	349.0	--	--
	96%	13.39	358.0	--	--
	97%	13.53	331.0	--	--
	98%	13.67	405.0	--	--
	99%	13.81	415.0	360.0	346.0
Balance	100%	13.95	424.0	423.0	432.0
Inductive	101%	14.08	413.0	409.0	307.0
	102%	14.22	317.0	--	--
	103%	14.36	295.0	--	--
	104%	14.50	393.0	--	--
	105%	14.64	330.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

4) Test Case 4B

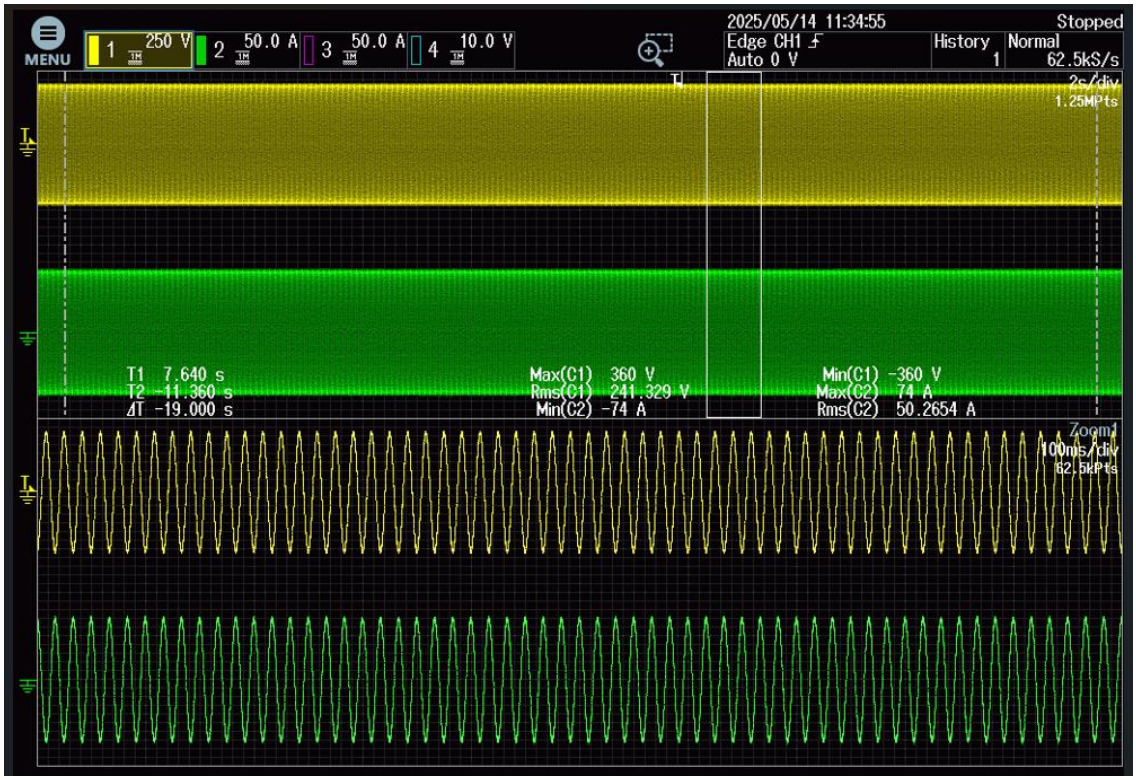
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.07	U_A (V)	240.07	R Load (kW)	10.62
U_B (V)	--	U_B (V)	--	L Load (kVAr)	13.92
U_C (V)	--	U_C (V)	--	C Load (kVAr)	8.64
I_A (A)	50.09	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	10.90	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	10.90	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	5.08	Q_{EUT} (kVar)	--		
PF	0.90	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.07				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	8.20	325.0	--	--
	96%	8.29	343.0	--	--
	97%	8.38	331.0	--	--
	98%	8.46	308.0	--	--
	99%	8.55	340.0	--	--
Balance	100%	8.64	411.0	417.0	398.0
Inductive	101%	8.72	405.0	401.0	347.0
	102%	8.81	400.0	338.0	379.0
	103%	8.89	295.0	--	--
	104%	8.98	356.0	--	--
	105%	9.07	345.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

5) Test Case 5B

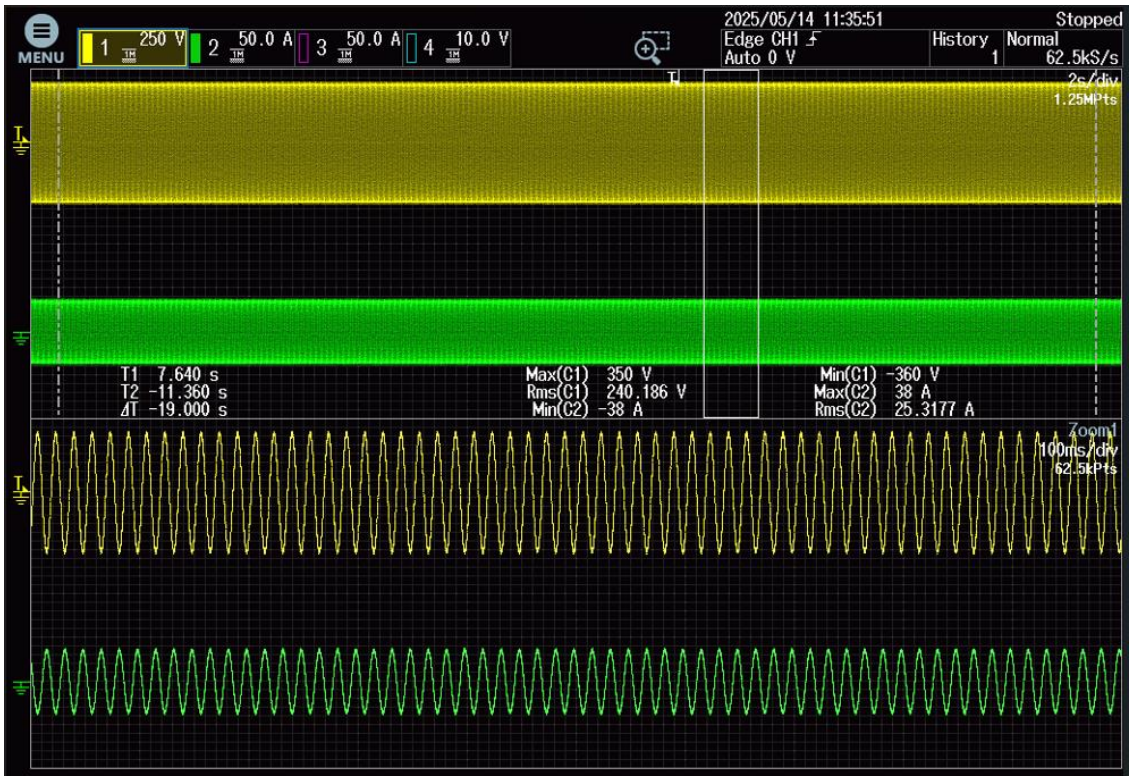
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.07	U_A (V)	240.07	R Load (kW)	11.7
U_B (V)	--	U_B (V)	--	L Load (kVAr)	11.99
U_C (V)	--	U_C (V)	--	C Load (kVAr)	12.06
I_A (A)	50.55	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	12.13	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	12.13	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	0.05	Q_{EUT} (kVar)	--		
PF	0.99	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.07				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	11.45	321.0	--	--
	96%	11.57	335.0	--	--
	97%	11.69	291.0	--	--
	98%	11.81	403.0	341.0	334.0
	99%	11.93	381.0	319.0	305.0
Balance	100%	12.06	415.0	414.0	397.0
Inductive	101%	12.18	403.0	301.0	330.0
	102%	12.30	347.0	--	--
	103%	12.42	331.0	--	--
	104%	12.54	326.0	--	--
	105%	12.66	311.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

6) Test Case 6B

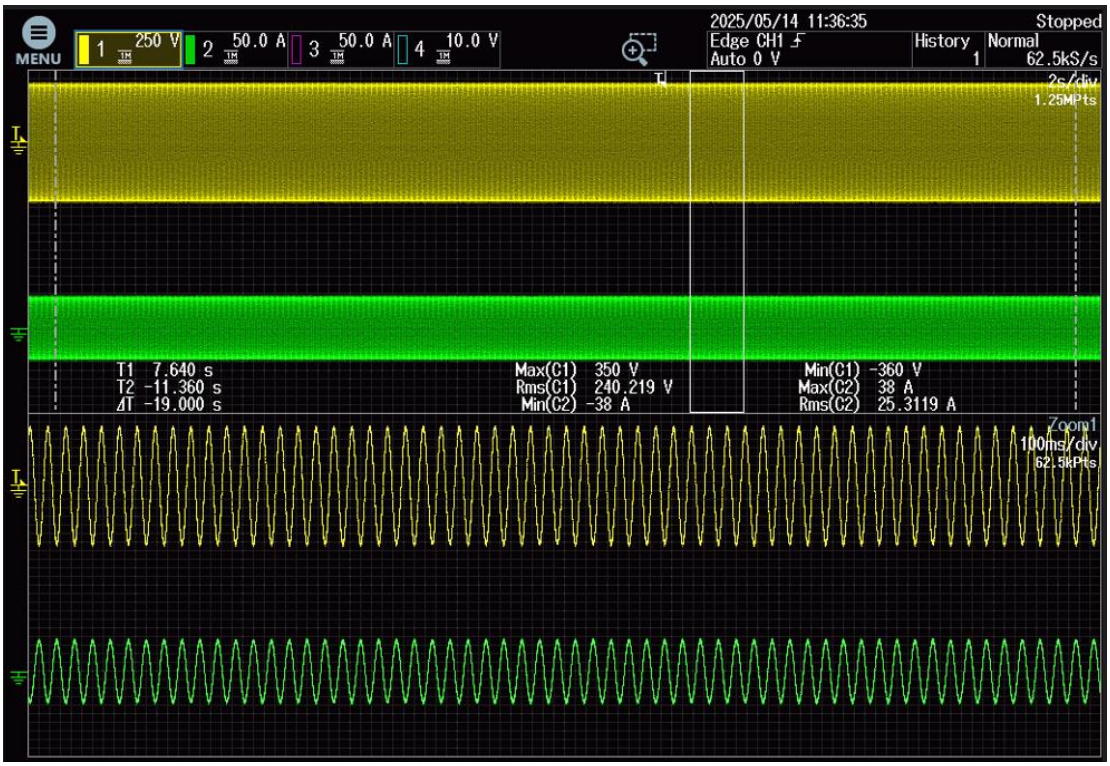
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.06	U_A (V)	240.06	R Load (kW)	5.75
U_B (V)	--	U_B (V)	--	L Load (kVAr)	6.01
U_C (V)	--	U_C (V)	--	C Load (kVAr)	5.93
I_A (A)	25.02	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	6.01	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	6.01	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	0.01	Q_{EUT} (kVar)	--		
PF	1.00	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.06				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	5.63	332.0	--	--
	96%	5.69	343.0	--	--
	97%	5.75	351.0	--	--
	98%	5.81	317.0	--	--
	99%	5.87	325.0	--	--
Balance	100%	5.93	406.0	423.0	419.0
Inductive	101%	5.98	392.0	411.0	361.0
	102%	6.04	324.0	327.0	328.0
	103%	6.10	360.0	321.0	382.0
	104%	6.16	328.0	363.0	347.0
	105%	6.22	298.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

7) Test Case 7B

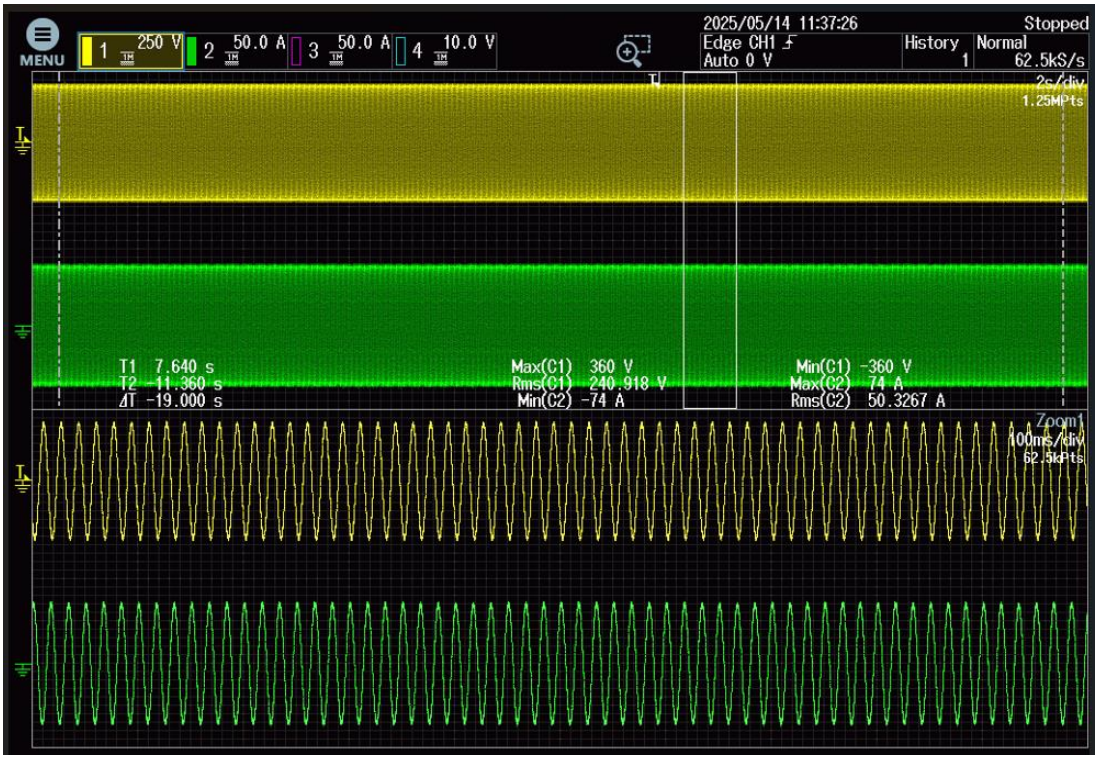
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.08	U_A (V)	240.08	R Load (kW)	5.85
U_B (V)	--	U_B (V)	--	L Load (kVAr)	6.10
U_C (V)	--	U_C (V)	--	C Load (kVAr)	6.04
I_A (A)	25.02	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	6.01	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	66.01	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	0.01	Q_{EUT} (kVar)	--		
PF	1.00	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.08				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	5.73	369.0	--	--
	96%	5.79	378.0	--	--
	97%	5.85	340.0	308.0	286.0
	98%	5.91	394.0	346.0	378.0
	99%	5.97	297.0	364.0	352.2
Balance	100%	6.04	392.0	422.0	425.0
Inductive	101%	6.10	364.0	--	--
	102%	6.16	288.0	--	--
	103%	6.22	383.0	--	--
	104%	6.28	303.0	--	--
	105%	6.34	284.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

8) Test Case 8B

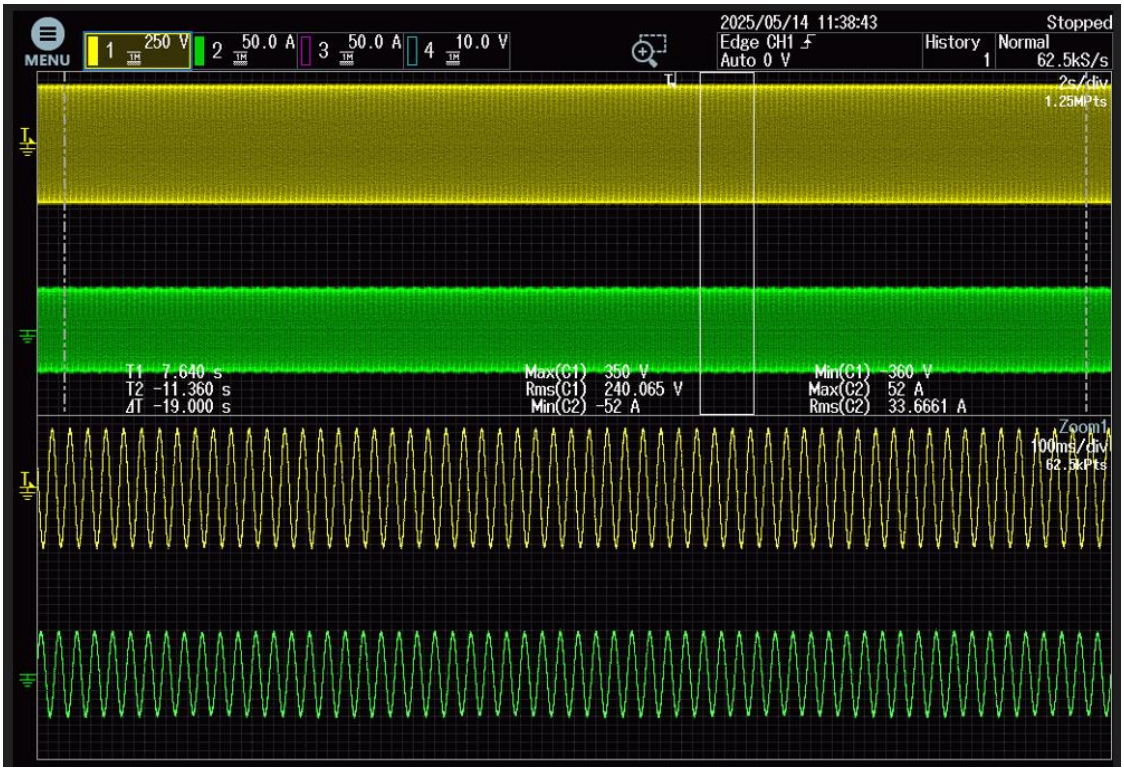
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.06	U_A (V)	240.06	R Load (kW)	10.66
U_B (V)	--	U_B (V)	--	L Load (kVAr)	8.58
U_C (V)	--	U_C (V)	--	C Load (kVAr)	13.97
I_A (A)	50.21	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	10.93	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	10.93	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	5.08	Q_{EUT} (kVar)	--		
PF	0.90	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.06				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	13.27	330.0	--	--
	96%	13.41	394.0	329.0	350.0
	97%	13.55	360.0	394.0	356.0
	98%	13.69	322.0	301.0	316.0
	99%	13.83	332.0	375.0	354.0
Balance	100%	13.97	422.0	417.0	424.0
Inductive	101%	14.10	310.0	370.0	302.0
	102%	14.24	416.0	388.0	356.0
	103%	14.38	360.0	--	--
	104%	14.52	330.0	--	--
	105%	14.66	298.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

9) Test Case 9B

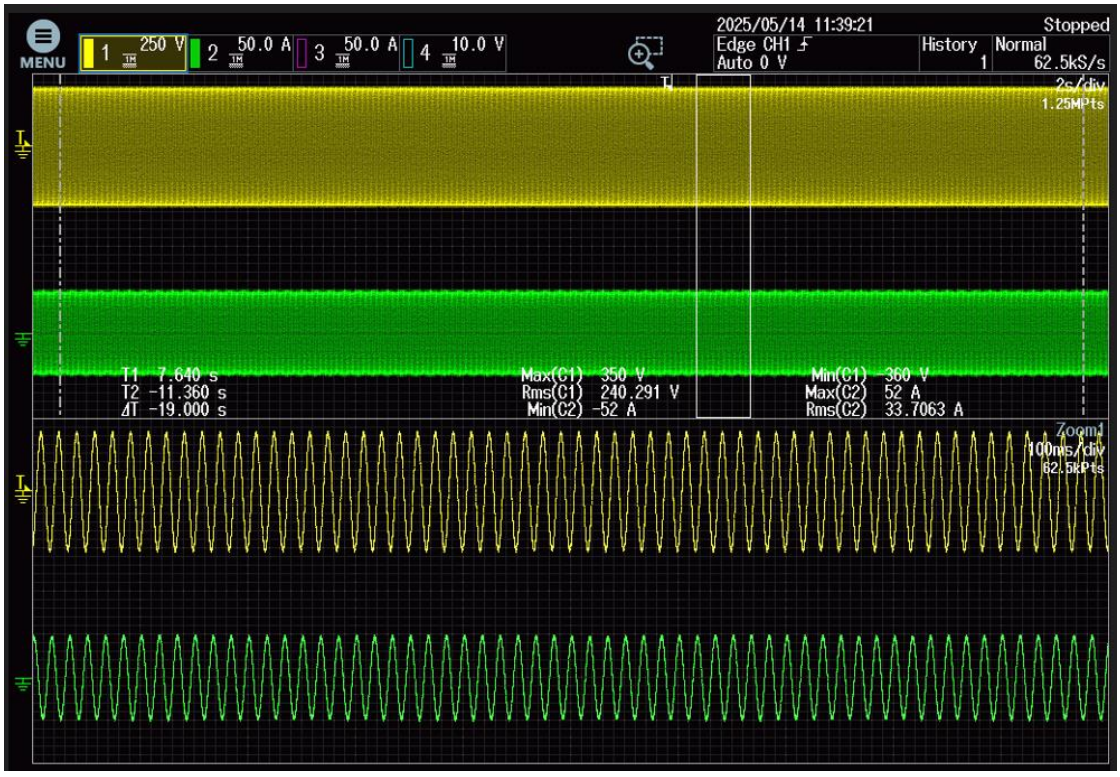
Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.07	U_A (V)	240.07	R Load (kW)	5.87
U_B (V)	--	U_B (V)	--	L Load (kVAr)	3.88
U_C (V)	--	U_C (V)	--	C Load (kVAr)	9.26
I_A (A)	33.02	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	6.07	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	6.07	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	5.10	Q_{EUT} (kVar)	--		
PF	0.77	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.07				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	8.79	293.0	--	--
	96%	8.88	364.0	--	--
	97%	8.98	370.0	--	--
	98%	9.07	428.0	365.0	345.0
	99%	9.16	415.0	321.0	328.0
Balance	100%	9.26	403.0	416.0	406.0
Inductive	101%	9.35	345.0	--	--
	102%	9.44	402.0	--	--
	103%	9.53	308.0	--	--
	104%	9.63	346.0	--	--
	105%	9.72	297.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

10) Test Case 10B

Part-1: Verify the test setup can sustain an island					
Before opening switch S3					
Parameters Measured at S2		Parameters Measured at S3		Parameters Measured of RLC Load	
U_A (V)	240.10	U_A (V)	240.10	R Load (kW)	5.78
U_B (V)	--	U_B (V)	--	L Load (kVAr)	9.07
U_C (V)	--	U_C (V)	--	C Load (kVAr)	3.93
I_A (A)	32.70	I_A (A)	< 2%I_{rated}	Qf	1.00
I_B (A)	--	I_B (A)	< 2%I_{rated}	*Note: Disable the unintentional islanding protection during the verification.*	
I_C (A)	--	I_C (A)	< 2%I_{rated}		
P_A (kW)	5.94	P_A (kW)	--		
P_B (kW)	--	P_B (kW)	--		
P_C (kW)	--	P_C (kW)	--		
P_{EUT} (kW)	5.94	P_{EUT} (kW)	--		
Q_{EUT} (kVar)	5.13	Q_{EUT} (kVar)	--		
PF	0.75	PF	--		
Fre. (Hz)	59.99	Fre. (Hz)	59.99		
After opening switch S3					
Parameters Measured at S2		the island circuit remains energized more than 10s, refer to the waveform recorded below.			
U_A (V)	240.10				
U_B (V)	--				
U_C (V)	--				
Fre. (Hz)	59.99				



Part-2: Clearing time tests					
Reactive Load		Q (kVAr)	Default Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%	3.73	325.0	--	--
	96%	3.77	336.0	--	--
	97%	3.81	366.0	--	--
	98%	3.85	298.0	--	--
	99%	3.89	356.0	--	--
Balance	100%	3.93	421.0	418.0	410.0
Inductive	101%	3.96	343.0	412.0	402.0
	102%	4.00	366.0	350.0	319.0
	103%	4.04	403.0	406.0	297.0
	104%	4.08	352.0	--	--
	105%	4.12	289.0	--	--
Reactive Load		Q (kVAr)	Minimum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				
Reactive Load		Q (kVAr)	Maximum Trip Times (ms)		
			Attempt-1	Attempt-2	Attempt-3
Capacitive	95%				
	96%				
	97%				
	98%				
	99%				
Balance	100%				
Inductive	101%				
	102%				
	103%				
	104%				
	105%				

4.10.2 Reverse or minimum import active-power flow

IEEE Std 1547 requires DER units to cease to energize the area EPS during unintentional islanding conditions. One of the ways in which this requirement may be met is with reverse or minimum import active-power flow protection.

Not Applicable. The sample doesn’t provide this method.

4.11 Open phase

The purpose of this test is to verify that the DER ceases to energize the area EPS upon loss of an individual phase at the point of DER connection.
The DER shall cease to energize and trip within 2.0 s requirement specified in 6.2.2 of IEEE Std 1547-2018 for open phase conditions

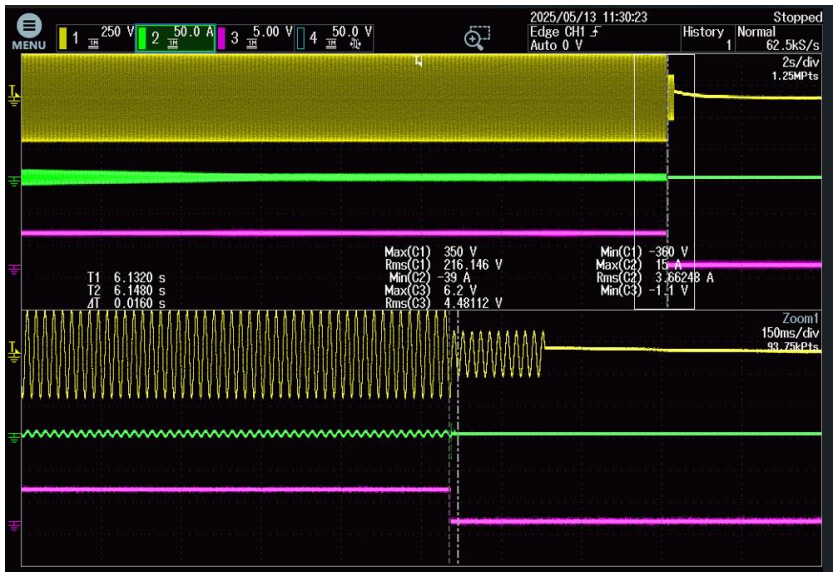
Transformer Information	
Tested with an isolation transformer	☐
	open phase condition shall be applied on the area EPS side of the transformer. (Model: N/A) **Ratio:** N/A
Tested without an isolation transformer	☒

Open one phase conductor disconnect while the EUT is operating at the greater of
1) 5% of rated output current or
2) The EUT's minimum output current rating.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
MSO4054B	2025/05/13	--	500 kS/s

DC input (Vdc)	359.4	Power input (W)	12670.50	--	--
AC output (Vac)	241.9	Power output (W)	12073.40	I_{output} (A)	49.92

	Attempt 1 (s)	Attempt 2 (s)	Attempt 3 (s)	Attempt 4 (s)	Attempt 5 (s)
Phase A	0.016	0.007	0.007	0.007	0.007
Phase B	--	--	--	--	--
Phase C	--	--	--	--	--
Max Disconnect time					

4.12 Current distortion

The purpose of this test is to measure the harmonic current distortion, inter-harmonic current distortion and total rated-current distortion (TRD) of the DER interconnection component or system under normal operating conditions. The results shall comply with the section 7.3 requirements of IEEE Std 1547-2018.

4.12.1 Current distortion test for DER not capable of operation isolated from external source

Transformer Information	
Tested with an isolation transformer	☐
	Current distortion condition shall be applied on the area EPS side of the transformer. (Model: N/A) **Ratio:**
Tested without an isolation transformer	☒

Test sequence:

Table 20—Current distortion test cases for DER not capable of operation isolated from external source

Test case	EUT conditions
1	Rated kVA at maximum injection p.f., minimum rated Vdc (if applicable)
2	Unity p.f., nominal rated Vdc, 100% of rated active power
3	Rated kVA at maximum absorption p.f., maximum rated Vdc (if applicable)
4	Apparent power level at which manufacturer has declared % TRD is maximum

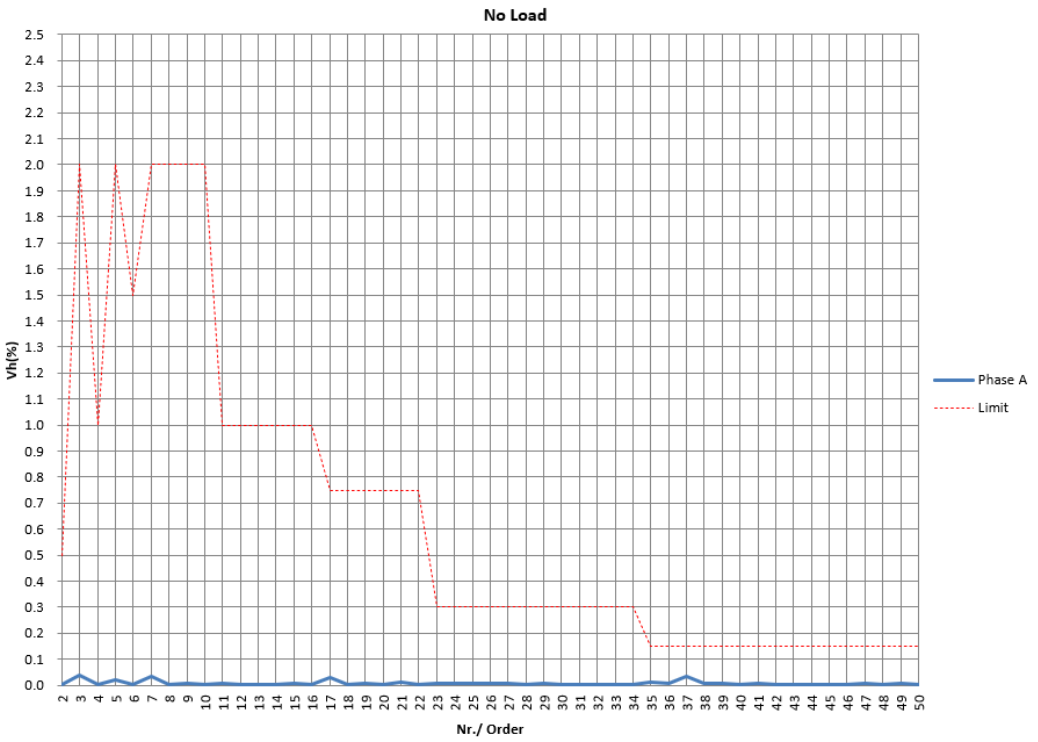
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/11/18	200 ms	5 kHz

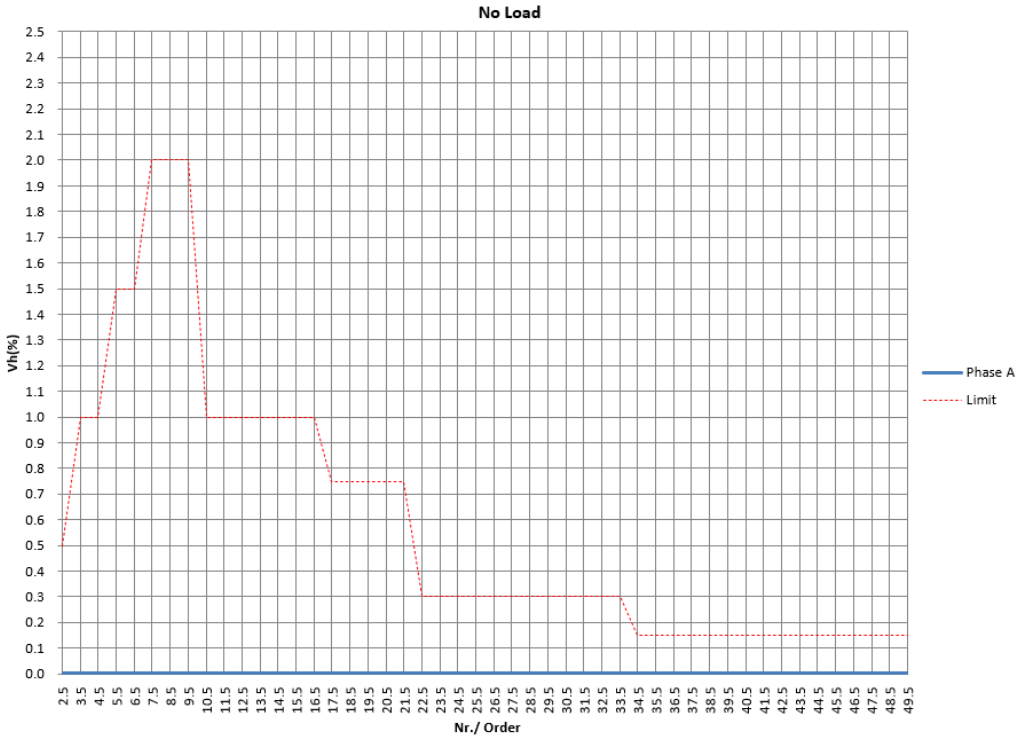
240V AC test Source harmonic voltage distortion				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2	0.003	--	--	0.5
3	0.039	--	--	2.0
4	0.002	--	--	1.0
5	0.023	--	--	2.0
6	0.001	--	--	1.5
7	0.033	--	--	2.0
8	0.004	--	--	2.0
9	0.009	--	--	2.0
10	0.002	--	--	2.0
11	0.009	--	--	1.0
12	0.001	--	--	1.0
13	0.002	--	--	1.0
14	0.002	--	--	1.0
15	0.007	--	--	1.0
16	0.001	--	--	1.0
17	0.031	--	--	0.75
18	0.004	--	--	0.75
19	0.007	--	--	0.75
20	0.002	--	--	0.75
21	0.009	--	--	0.75
22	0.003	--	--	0.75
23	0.005	--	--	0.3
24	0.008	--	--	0.3
25	0.009	--	--	0.3
26	0.006	--	--	0.3
27	0.007	--	--	0.3
28	0.002	--	--	0.3
29	0.008	--	--	0.3
30	0.002	--	--	0.3
31	0.002	--	--	0.3
32	0.003	--	--	0.3
33	0.004	--	--	0.3
34	0.004	--	--	0.3
35	0.010	--	--	0.15
36	0.007	--	--	0.15
37	0.032	--	--	0.15
38	0.006	--	--	0.15
39	0.009	--	--	0.15
40	0.003	--	--	0.15
41	0.009	--	--	0.15
42	0.001	--	--	0.15
43	0.003	--	--	0.15
44	0.002	--	--	0.15
45	0.003	--	--	0.15
46	0.003	--	--	0.15
47	0.009	--	--	0.15
48	0.003	--	--	0.15
49	0.006	--	--	0.15
50	0.002	--	--	0.15
THD	0.080	--	--	3.0

240V AC test Source inter-harmonic voltage distortion				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.003	--	--	0.5
3.5	0.003	--	--	1.0
4.5	0.003	--	--	1.0
5.5	0.003	--	--	1.5
6.5	0.003	--	--	1.5
7.5	0.003	--	--	2.0
8.5	0.003	--	--	2.0
9.5	0.003	--	--	2.0
10.5	0.003	--	--	1.0
11.5	0.003	--	--	1.0
12.5	0.003	--	--	1.0
13.5	0.003	--	--	1.0
14.5	0.003	--	--	1.0
15.5	0.003	--	--	1.0
16.5	0.003	--	--	1.0
17.5	0.003	--	--	0.75
18.5	0.003	--	--	0.75
19.5	0.003	--	--	0.75
20.5	0.003	--	--	0.75
21.5	0.003	--	--	0.75
22.5	0.003	--	--	0.3
23.5	0.003	--	--	0.3
24.5	0.003	--	--	0.3
25.5	0.003	--	--	0.3
26.5	0.003	--	--	0.3
27.5	0.003	--	--	0.3
28.5	0.003	--	--	0.3
29.5	0.003	--	--	0.3
30.5	0.003	--	--	0.3
31.5	0.003	--	--	0.3
32.5	0.003	--	--	0.3
33.5	0.003	--	--	0.3
34.5	0.003	--	--	0.15
35.5	0.003	--	--	0.15
36.5	0.003	--	--	0.15
37.5	0.003	--	--	0.15
38.5	0.003	--	--	0.15
39.5	0.003	--	--	0.15
40.5	0.003	--	--	0.15
41.5	0.003	--	--	0.15
42.5	0.003	--	--	0.15
43.5	0.003	--	--	0.15
44.5	0.003	--	--	0.15
45.5	0.003	--	--	0.15
46.5	0.003	--	--	0.15
47.5	0.003	--	--	0.15
48.5	0.003	--	--	0.15
49.5	0.003	--	--	0.15

AC test Source harmonic voltage distortion Chart



AC test Source inter-harmonic voltage distortion Chart

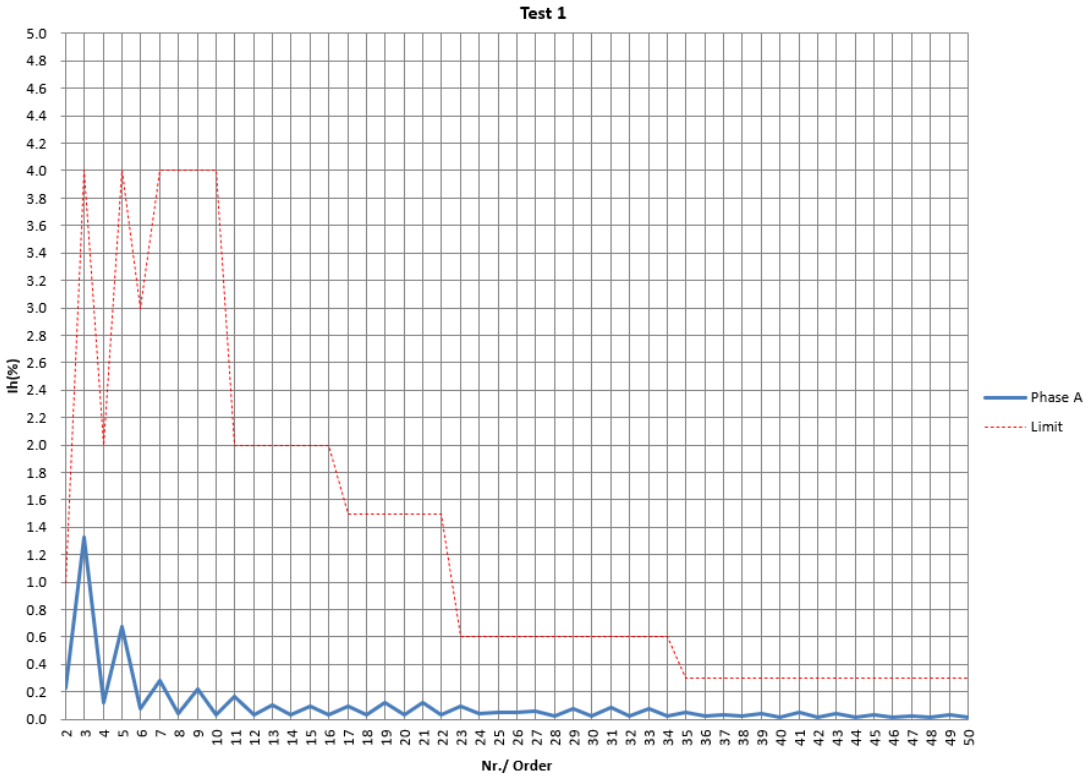


Test Case 1 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
163.53	10.69	239.80	51.232	9.980	6.079	12.000	60.000	0.695

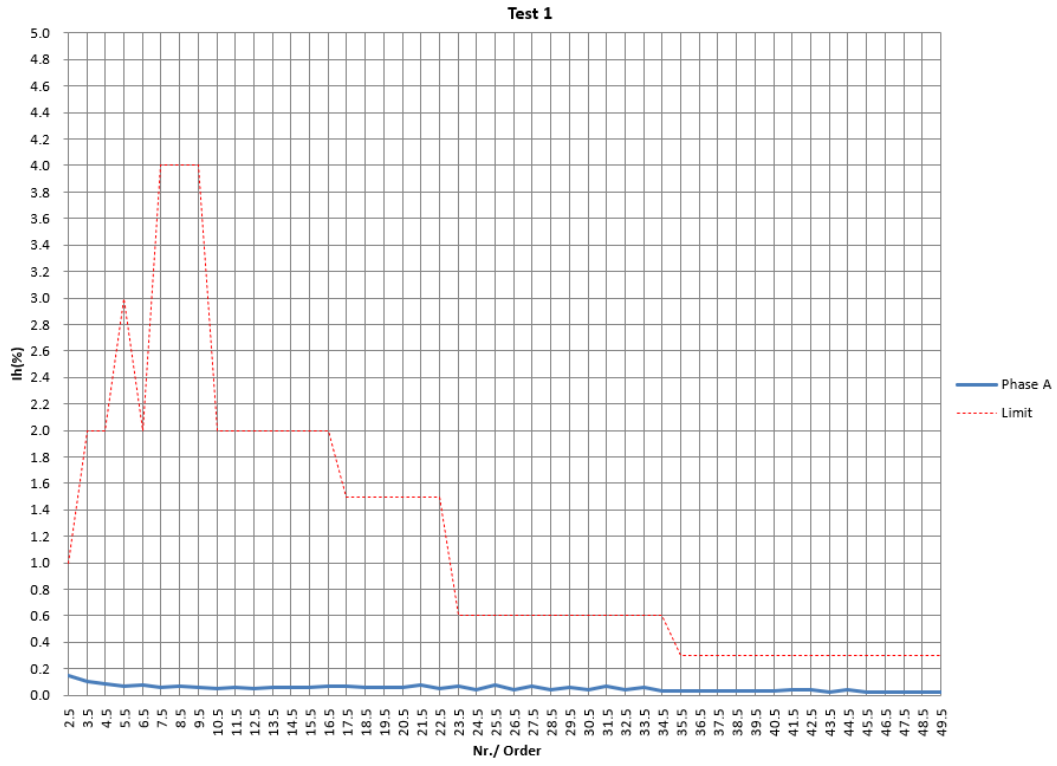
harmonic current distortion – Test Case 1				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2	0.227	--	--	1.0
3	1.329	--	--	4.0
4	0.124	--	--	2.0
5	0.674	--	--	4.0
6	0.080	--	--	3.0
7	0.279	--	--	4.0
8	0.038	--	--	4.0
9	0.222	--	--	4.0
10	0.035	--	--	4.0
11	0.168	--	--	2.0
12	0.033	--	--	2.0
13	0.099	--	--	2.0
14	0.030	--	--	2.0
15	0.093	--	--	2.0
16	0.030	--	--	2.0
17	0.092	--	--	1.5
18	0.030	--	--	1.5
19	0.124	--	--	1.5
20	0.030	--	--	1.5
21	0.124	--	--	1.5
22	0.032	--	--	1.5
23	0.096	--	--	0.6
24	0.041	--	--	0.6
25	0.051	--	--	0.6
26	0.046	--	--	0.6
27	0.056	--	--	0.6
28	0.022	--	--	0.6
29	0.078	--	--	0.6
30	0.022	--	--	0.6
31	0.083	--	--	0.6
32	0.021	--	--	0.6
33	0.080	--	--	0.6
34	0.023	--	--	0.6
35	0.046	--	--	0.3
36	0.022	--	--	0.3
37	0.032	--	--	0.3
38	0.019	--	--	0.3
39	0.042	--	--	0.3
40	0.017	--	--	0.3
41	0.050	--	--	0.3
42	0.017	--	--	0.3
43	0.045	--	--	0.3
44	0.017	--	--	0.3
45	0.036	--	--	0.3
46	0.015	--	--	0.3
47	0.024	--	--	0.3
48	0.013	--	--	0.3
49	0.032	--	--	0.3
50	0.011	--	--	0.3
TRD	1.603	--	--	5.0

inter-harmonic current distortion – Test Case 1				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.144	--	--	1.0
3.5	0.102	--	--	2.0
4.5	0.088	--	--	2.0
5.5	0.070	--	--	3.0
6.5	0.073	--	--	2.0
7.5	0.059	--	--	4.0
8.5	0.066	--	--	4.0
9.5	0.056	--	--	4.0
10.5	0.053	--	--	2.0
11.5	0.055	--	--	2.0
12.5	0.048	--	--	2.0
13.5	0.058	--	--	2.0
14.5	0.058	--	--	2.0
15.5	0.056	--	--	2.0
16.5	0.069	--	--	2.0
17.5	0.064	--	--	1.5
18.5	0.056	--	--	1.5
19.5	0.062	--	--	1.5
20.5	0.055	--	--	1.5
21.5	0.080	--	--	1.5
22.5	0.047	--	--	1.5
23.5	0.070	--	--	0.6
24.5	0.042	--	--	0.6
25.5	0.081	--	--	0.6
26.5	0.043	--	--	0.6
27.5	0.067	--	--	0.6
28.5	0.042	--	--	0.6
29.5	0.060	--	--	0.6
30.5	0.040	--	--	0.6
31.5	0.065	--	--	0.6
32.5	0.038	--	--	0.6
33.5	0.055	--	--	0.6
34.5	0.035	--	--	0.6
35.5	0.035	--	--	0.3
36.5	0.032	--	--	0.3
37.5	0.031	--	--	0.3
38.5	0.031	--	--	0.3
39.5	0.036	--	--	0.3
40.5	0.029	--	--	0.3
41.5	0.039	--	--	0.3
42.5	0.043	--	--	0.3
43.5	0.027	--	--	0.3
44.5	0.040	--	--	0.3
45.5	0.025	--	--	0.3
46.5	0.027	--	--	0.3
47.5	0.025	--	--	0.3
48.5	0.025	--	--	0.3
49.5	0.026	--	--	0.3

harmonic current distortion – Test Case 1



inter-harmonic current distortion – Test Case 1

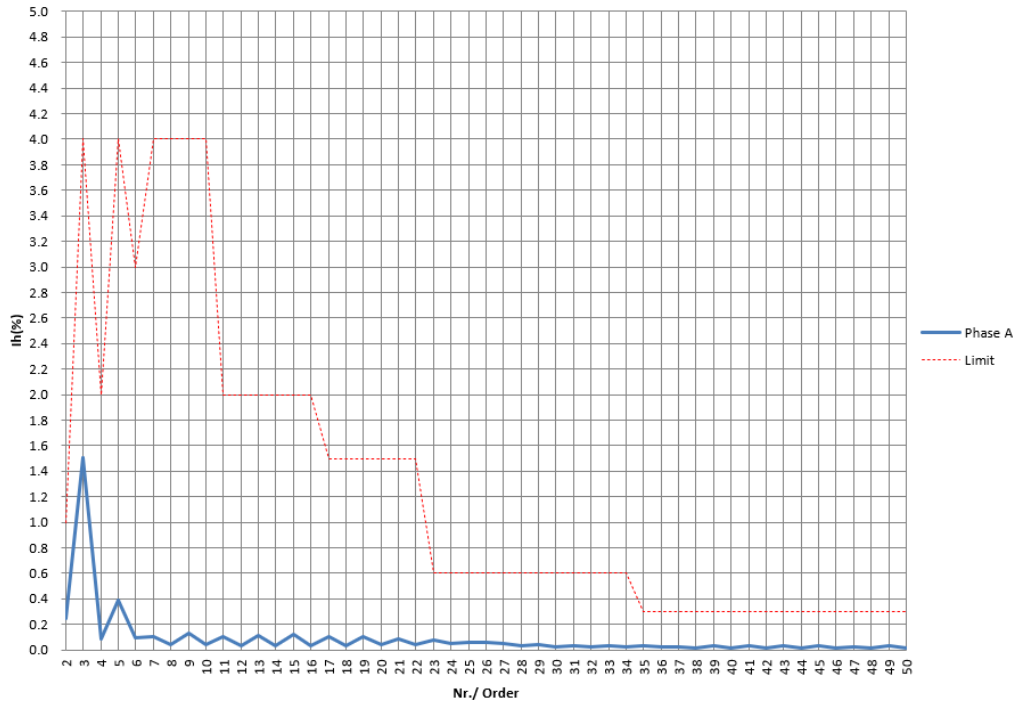


Test Case 2 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
298.22	12.772	240.03	50.785	12.181	0.466	12.190	59.998	0.999

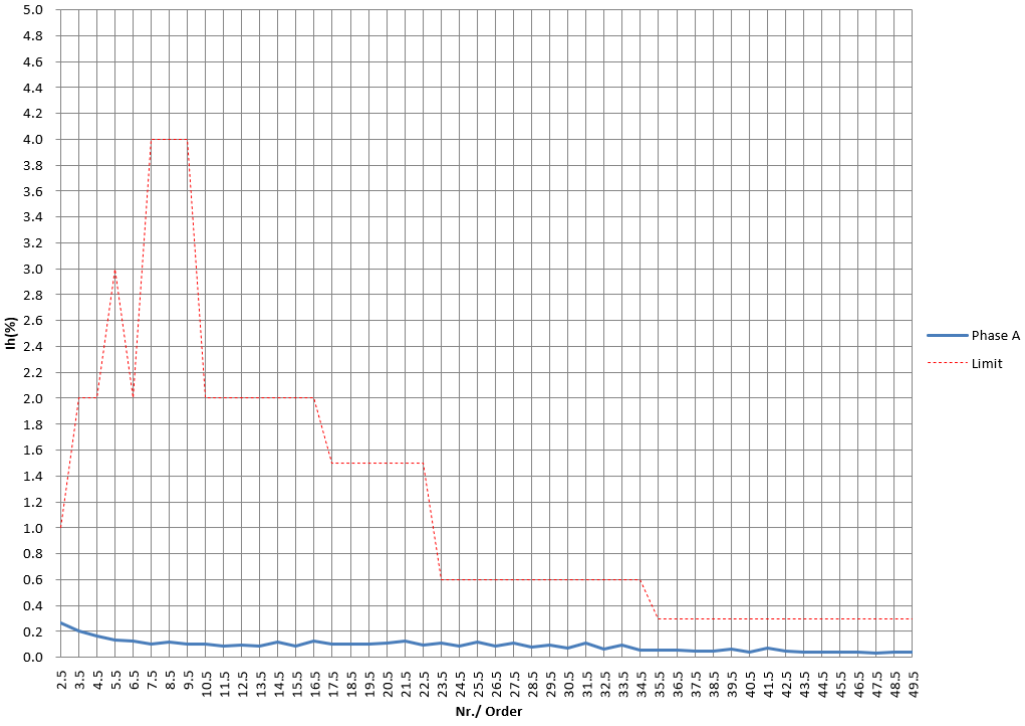
harmonic current distortion – Test Case 2				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2	0.247	--	--	1.0
3	1.508	--	--	4.0
4	0.089	--	--	2.0
5	0.385	--	--	4.0
6	0.095	--	--	3.0
7	0.103	--	--	4.0
8	0.044	--	--	4.0
9	0.134	--	--	4.0
10	0.039	--	--	4.0
11	0.103	--	--	2.0
12	0.036	--	--	2.0
13	0.108	--	--	2.0
14	0.034	--	--	2.0
15	0.126	--	--	2.0
16	0.034	--	--	2.0
17	0.105	--	--	1.5
18	0.035	--	--	1.5
19	0.102	--	--	1.5
20	0.038	--	--	1.5
21	0.087	--	--	1.5
22	0.041	--	--	1.5
23	0.077	--	--	0.6
24	0.051	--	--	0.6
25	0.061	--	--	0.6
26	0.058	--	--	0.6
27	0.046	--	--	0.6
28	0.029	--	--	0.6
29	0.041	--	--	0.6
30	0.027	--	--	0.6
31	0.032	--	--	0.6
32	0.027	--	--	0.6
33	0.030	--	--	0.6
34	0.027	--	--	0.6
35	0.029	--	--	0.3
36	0.025	--	--	0.3
37	0.027	--	--	0.3
38	0.018	--	--	0.3
39	0.033	--	--	0.3
40	0.016	--	--	0.3
41	0.032	--	--	0.3
42	0.016	--	--	0.3
43	0.034	--	--	0.3
44	0.016	--	--	0.3
45	0.032	--	--	0.3
46	0.017	--	--	0.3
47	0.019	--	--	0.3
48	0.014	--	--	0.3
49	0.029	--	--	0.3
50	0.014	--	--	0.3
TRD	1.626	--	--	5.0

inter-harmonic current distortion – Test Case 2				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.267	--	--	1.0
3.5	0.200	--	--	2.0
4.5	0.162	--	--	2.0
5.5	0.134	--	--	3.0
6.5	0.128	--	--	2.0
7.5	0.105	--	--	4.0
8.5	0.119	--	--	4.0
9.5	0.100	--	--	4.0
10.5	0.099	--	--	2.0
11.5	0.090	--	--	2.0
12.5	0.095	--	--	2.0
13.5	0.084	--	--	2.0
14.5	0.115	--	--	2.0
15.5	0.084	--	--	2.0
16.5	0.127	--	--	2.0
17.5	0.098	--	--	1.5
18.5	0.104	--	--	1.5
19.5	0.105	--	--	1.5
20.5	0.106	--	--	1.5
21.5	0.122	--	--	1.5
22.5	0.097	--	--	1.5
23.5	0.113	--	--	0.6
24.5	0.089	--	--	0.6
25.5	0.114	--	--	0.6
26.5	0.086	--	--	0.6
27.5	0.111	--	--	0.6
28.5	0.078	--	--	0.6
29.5	0.094	--	--	0.6
30.5	0.068	--	--	0.6
31.5	0.110	--	--	0.6
32.5	0.062	--	--	0.6
33.5	0.091	--	--	0.6
34.5	0.059	--	--	0.6
35.5	0.056	--	--	0.3
36.5	0.055	--	--	0.3
37.5	0.050	--	--	0.3
38.5	0.049	--	--	0.3
39.5	0.062	--	--	0.3
40.5	0.042	--	--	0.3
41.5	0.067	--	--	0.3
42.5	0.044	--	--	0.3
43.5	0.041	--	--	0.3
44.5	0.042	--	--	0.3
45.5	0.037	--	--	0.3
46.5	0.040	--	--	0.3
47.5	0.035	--	--	0.3
48.5	0.039	--	--	0.3
49.5	0.037	--	--	0.3

harmonic current distortion – Test Case 2



inter-harmonic current distortion – Test Case 2

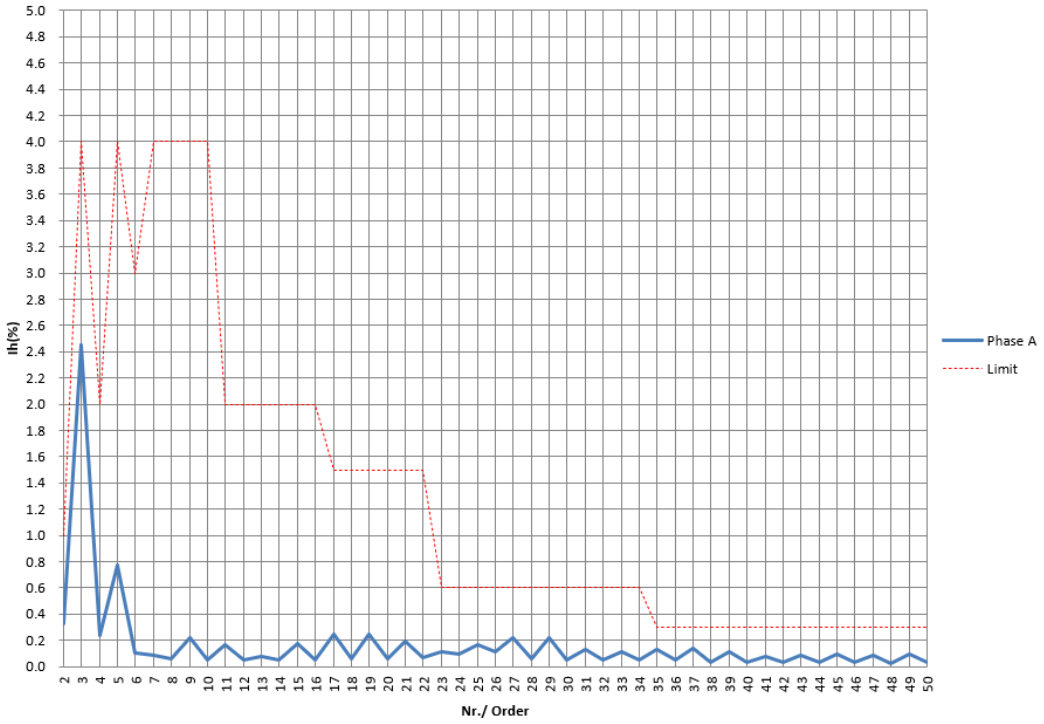


Test Case 3 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
476.02	10.199	239.49	50.400	9.693	-7.183	12.070	59.998	0.803

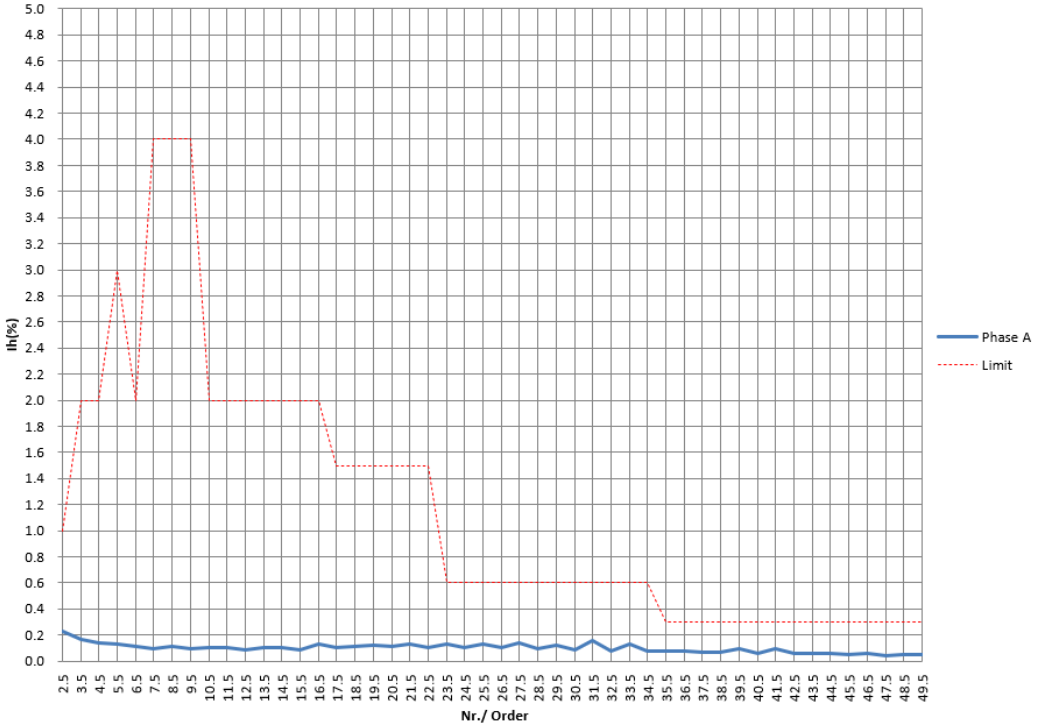
harmonic current distortion – Test Case 3				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2	0.324	--	--	1.0
3	2.447	--	--	4.0
4	0.237	--	--	2.0
5	0.772	--	--	4.0
6	0.102	--	--	3.0
7	0.088	--	--	4.0
8	0.057	--	--	4.0
9	0.224	--	--	4.0
10	0.053	--	--	4.0
11	0.167	--	--	2.0
12	0.054	--	--	2.0
13	0.078	--	--	2.0
14	0.054	--	--	2.0
15	0.171	--	--	2.0
16	0.053	--	--	2.0
17	0.246	--	--	1.5
18	0.057	--	--	1.5
19	0.246	--	--	1.5
20	0.063	--	--	1.5
21	0.191	--	--	1.5
22	0.064	--	--	1.5
23	0.110	--	--	0.6
24	0.095	--	--	0.6
25	0.170	--	--	0.6
26	0.111	--	--	0.6
27	0.220	--	--	0.6
28	0.056	--	--	0.6
29	0.224	--	--	0.6
30	0.048	--	--	0.6
31	0.131	--	--	0.6
32	0.048	--	--	0.6
33	0.111	--	--	0.6
34	0.052	--	--	0.6
35	0.130	--	--	0.3
36	0.050	--	--	0.3
37	0.137	--	--	0.3
38	0.037	--	--	0.3
39	0.110	--	--	0.3
40	0.033	--	--	0.3
41	0.076	--	--	0.3
42	0.030	--	--	0.3
43	0.082	--	--	0.3
44	0.033	--	--	0.3
45	0.095	--	--	0.3
46	0.032	--	--	0.3
47	0.082	--	--	0.3
48	0.026	--	--	0.3
49	0.092	--	--	0.3
50	0.029	--	--	0.3
TRD	2.712	--	--	5.0

inter-harmonic current distortion – Test Case 3				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.232	--	--	1.0
3.5	0.169	--	--	2.0
4.5	0.142	--	--	2.0
5.5	0.130	--	--	3.0
6.5	0.112	--	--	2.0
7.5	0.097	--	--	4.0
8.5	0.112	--	--	4.0
9.5	0.091	--	--	4.0
10.5	0.103	--	--	2.0
11.5	0.101	--	--	2.0
12.5	0.090	--	--	2.0
13.5	0.105	--	--	2.0
14.5	0.106	--	--	2.0
15.5	0.089	--	--	2.0
16.5	0.130	--	--	2.0
17.5	0.102	--	--	1.5
18.5	0.112	--	--	1.5
19.5	0.121	--	--	1.5
20.5	0.109	--	--	1.5
21.5	0.131	--	--	1.5
22.5	0.105	--	--	1.5
23.5	0.131	--	--	0.6
24.5	0.101	--	--	0.6
25.5	0.127	--	--	0.6
26.5	0.103	--	--	0.6
27.5	0.140	--	--	0.6
28.5	0.097	--	--	0.6
29.5	0.121	--	--	0.6
30.5	0.087	--	--	0.6
31.5	0.157	--	--	0.6
32.5	0.081	--	--	0.6
33.5	0.127	--	--	0.6
34.5	0.080	--	--	0.6
35.5	0.074	--	--	0.3
36.5	0.078	--	--	0.3
37.5	0.072	--	--	0.3
38.5	0.068	--	--	0.3
39.5	0.093	--	--	0.3
40.5	0.058	--	--	0.3
41.5	0.091	--	--	0.3
42.5	0.060	--	--	0.3
43.5	0.055	--	--	0.3
44.5	0.059	--	--	0.3
45.5	0.049	--	--	0.3
46.5	0.058	--	--	0.3
47.5	0.045	--	--	0.3
48.5	0.053	--	--	0.3
49.5	0.049	--	--	0.3

harmonic current distortion – Test Case 3



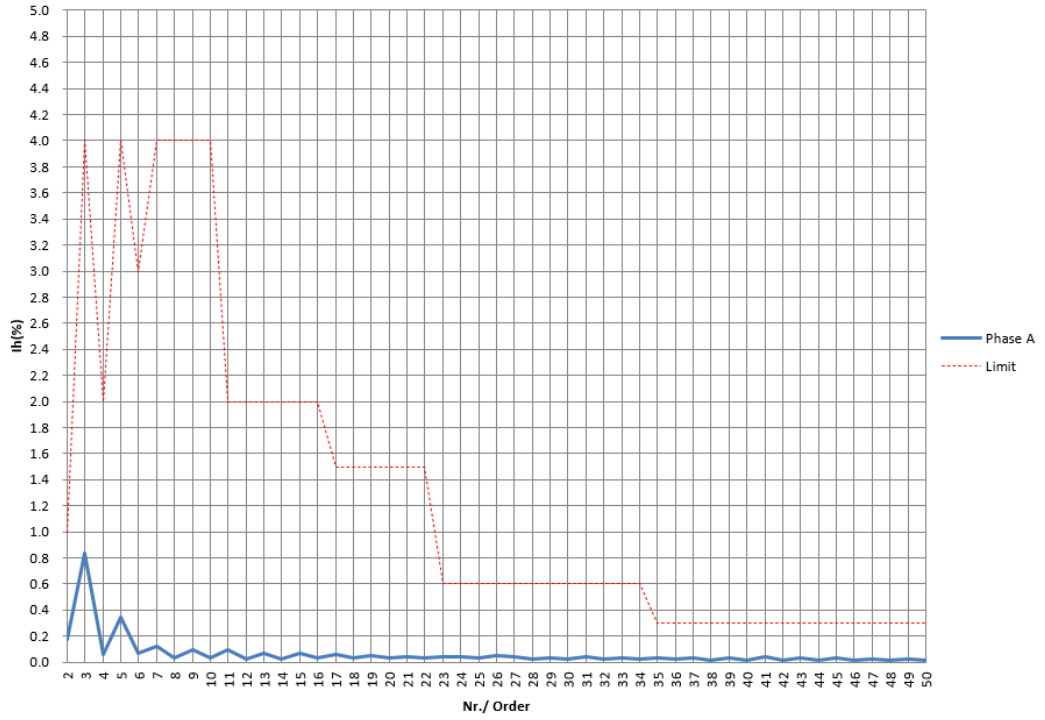
inter-harmonic current distortion – Test Case 3



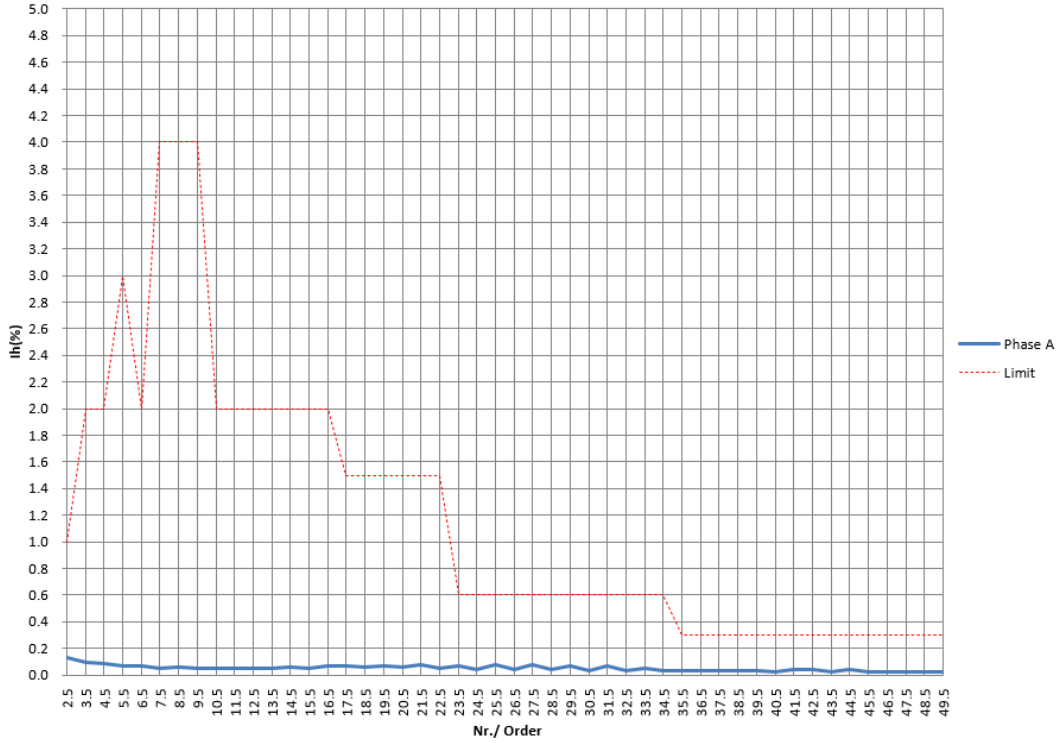
Test Case 4 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
299.17	8.863	239.43	35.41	8.470	0.369	8.478	59.998	0.999
harmonic current distortion – Test Case 4								
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**				
2	0.179	--	--	1.0				
3	0.837	--	--	4.0				
4	0.062	--	--	2.0				
5	0.341	--	--	4.0				
6	0.067	--	--	3.0				
7	0.120	--	--	4.0				
8	0.032	--	--	4.0				
9	0.099	--	--	4.0				
10	0.030	--	--	4.0				
11	0.091	--	--	2.0				
12	0.027	--	--	2.0				
13	0.070	--	--	2.0				
14	0.027	--	--	2.0				
15	0.065	--	--	2.0				
16	0.029	--	--	2.0				
17	0.061	--	--	1.5				
18	0.032	--	--	1.5				
19	0.047	--	--	1.5				
20	0.034	--	--	1.5				
21	0.045	--	--	1.5				
22	0.036	--	--	1.5				
23	0.039	--	--	0.6				
24	0.039	--	--	0.6				
25	0.033	--	--	0.6				
26	0.046	--	--	0.6				
27	0.037	--	--	0.6				
28	0.024	--	--	0.6				
29	0.034	--	--	0.6				
30	0.021	--	--	0.6				
31	0.039	--	--	0.6				
32	0.020	--	--	0.6				
33	0.034	--	--	0.6				
34	0.021	--	--	0.6				
35	0.035	--	--	0.3				
36	0.020	--	--	0.3				
37	0.033	--	--	0.3				
38	0.016	--	--	0.3				
39	0.037	--	--	0.3				
40	0.015	--	--	0.3				
41	0.037	--	--	0.3				
42	0.016	--	--	0.3				
43	0.032	--	--	0.3				
44	0.017	--	--	0.3				
45	0.029	--	--	0.3				
46	0.018	--	--	0.3				
47	0.024	--	--	0.3				
48	0.016	--	--	0.3				
49	0.027	--	--	0.3				
50	0.013	--	--	0.3				
TRD	0.969	--	--	5.0				

inter-harmonic current distortion – Test Case 4				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.126	--	--	1.0
3.5	0.094	--	--	2.0
4.5	0.082	--	--	2.0
5.5	0.067	--	--	3.0
6.5	0.065	--	--	2.0
7.5	0.054	--	--	4.0
8.5	0.060	--	--	4.0
9.5	0.050	--	--	4.0
10.5	0.051	--	--	2.0
11.5	0.047	--	--	2.0
12.5	0.050	--	--	2.0
13.5	0.048	--	--	2.0
14.5	0.060	--	--	2.0
15.5	0.052	--	--	2.0
16.5	0.068	--	--	2.0
17.5	0.063	--	--	1.5
18.5	0.058	--	--	1.5
19.5	0.065	--	--	1.5
20.5	0.057	--	--	1.5
21.5	0.076	--	--	1.5
22.5	0.049	--	--	1.5
23.5	0.071	--	--	0.6
24.5	0.045	--	--	0.6
25.5	0.078	--	--	0.6
26.5	0.044	--	--	0.6
27.5	0.078	--	--	0.6
28.5	0.040	--	--	0.6
29.5	0.065	--	--	0.6
30.5	0.036	--	--	0.6
31.5	0.071	--	--	0.6
32.5	0.034	--	--	0.6
33.5	0.053	--	--	0.6
34.5	0.032	--	--	0.6
35.5	0.032	--	--	0.3
36.5	0.032	--	--	0.3
37.5	0.030	--	--	0.3
38.5	0.030	--	--	0.3
39.5	0.033	--	--	0.3
40.5	0.027	--	--	0.3
41.5	0.040	--	--	0.3
42.5	0.043	--	--	0.3
43.5	0.027	--	--	0.3
44.5	0.040	--	--	0.3
45.5	0.023	--	--	0.3
46.5	0.025	--	--	0.3
47.5	0.022	--	--	0.3
48.5	0.024	--	--	0.3
49.5	0.025	--	--	0.3

harmonic current distortion – Test Case 4



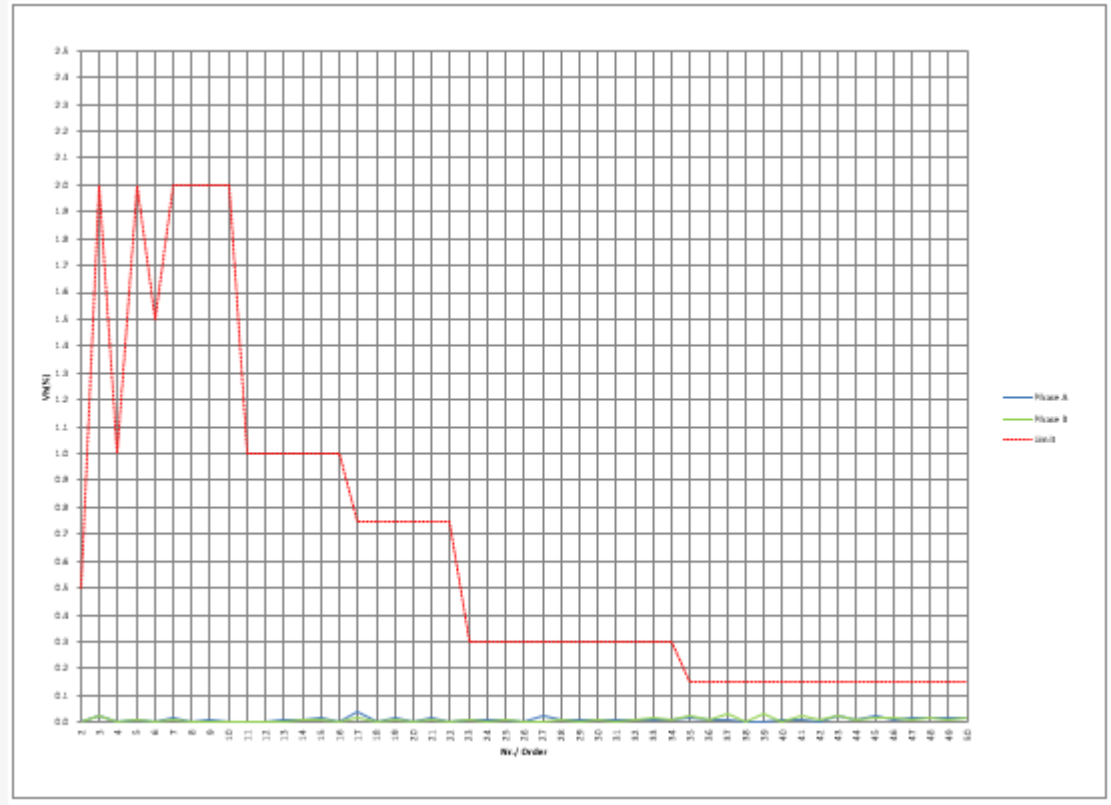
inter-harmonic current distortion – Test Case 4



208V AC test Source harmonic voltage distortion				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2	0.003	0.002	--	0.5
3	0.017	0.017	--	2.0
4	0.002	0.001	--	1.0
5	0.009	0.008	--	2.0
6	0.004	0.003	--	1.5
7	0.009	0.011	--	2.0
8	0.005	0.001	--	2.0
9	0.001	0.001	--	2.0
10	0.005	0.007	--	2.0
11	0.003	0.010	--	1.0
12	0.006	0.007	--	1.0
13	0.005	0.005	--	1.0
14	0.006	0.004	--	1.0
15	0.004	0.021	--	1.0
16	0.004	0.003	--	1.0
17	0.010	0.024	--	0.75
18	0.004	0.001	--	0.75
19	0.004	0.014	--	0.75
20	0.002	0.001	--	0.75
21	0.009	0.017	--	0.75
22	0.001	0.002	--	0.75
23	0.003	0.008	--	0.3
24	0.003	0.006	--	0.3
25	0.005	0.013	--	0.3
26	0.007	0.001	--	0.3
27	0.009	0.002	--	0.3
28	0.008	0.007	--	0.3
29	0.002	0.010	--	0.3
30	0.005	0.006	--	0.3
31	0.004	0.004	--	0.3
32	0.004	0.004	--	0.3
33	0.013	0.016	--	0.3
34	0.005	0.001	--	0.3
35	0.014	0.006	--	0.15
36	0.003	0.004	--	0.15
37	0.019	0.017	--	0.15
38	0.002	0.005	--	0.15
39	0.013	0.003	--	0.15
40	0.002	0.003	--	0.15
41	0.010	0.014	--	0.15
42	0.002	0.002	--	0.15
43	0.006	0.006	--	0.15
44	0.002	0.001	--	0.15
45	0.004	0.006	--	0.15
46	0.002	0.002	--	0.15
47	0.004	0.006	--	0.15
48	0.002	0.005	--	0.15
49	0.003	0.009	--	0.15
50	0.003	0.004	--	0.15
THD	0.152	0.160	--	3.0

208V AC test Source inter-harmonic voltage distortion				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.003	0.002	--	0.5
3.5	0.002	0.001	--	1.0
4.5	0.002	0.001	--	1.0
5.5	0.002	0.001	--	1.5
6.5	0.002	0.001	--	1.5
7.5	0.001	0.001	--	2.0
8.5	0.001	0.001	--	2.0
9.5	0.001	0.001	--	2.0
10.5	0.001	0.002	--	1.0
11.5	0.001	0.001	--	1.0
12.5	0.001	0.002	--	1.0
13.5	0.001	0.001	--	1.0
14.5	0.001	0.002	--	1.0
15.5	0.001	0.002	--	1.0
16.5	0.002	0.002	--	1.0
17.5	0.002	0.002	--	0.75
18.5	0.002	0.002	--	0.75
19.5	0.002	0.002	--	0.75
20.5	0.002	0.002	--	0.75
21.5	0.002	0.002	--	0.75
22.5	0.002	0.002	--	0.3
23.5	0.002	0.002	--	0.3
24.5	0.002	0.002	--	0.3
25.5	0.002	0.002	--	0.3
26.5	0.002	0.002	--	0.3
27.5	0.002	0.002	--	0.3
28.5	0.002	0.002	--	0.3
29.5	0.002	0.002	--	0.3
30.5	0.002	0.002	--	0.3
31.5	0.002	0.002	--	0.3
32.5	0.002	0.002	--	0.3
33.5	0.002	0.002	--	0.3
34.5	0.002	0.002	--	0.15
35.5	0.002	0.002	--	0.15
36.5	0.002	0.002	--	0.15
37.5	0.002	0.002	--	0.15
38.5	0.002	0.002	--	0.15
39.5	0.002	0.002	--	0.15
40.5	0.002	0.002	--	0.15
41.5	0.002	0.002	--	0.15
42.5	0.002	0.002	--	0.15
43.5	0.002	0.002	--	0.15
44.5	0.002	0.002	--	0.15
45.5	0.002	0.002	--	0.15
46.5	0.004	0.002	--	0.15
47.5	0.002	0.002	--	0.15
48.5	0.002	0.002	--	0.15
49.5	0.006	0.011	--	0.15

AC test Source harmonic voltage distortion Chart



AC test Source inter-harmonic voltage distortion Chart

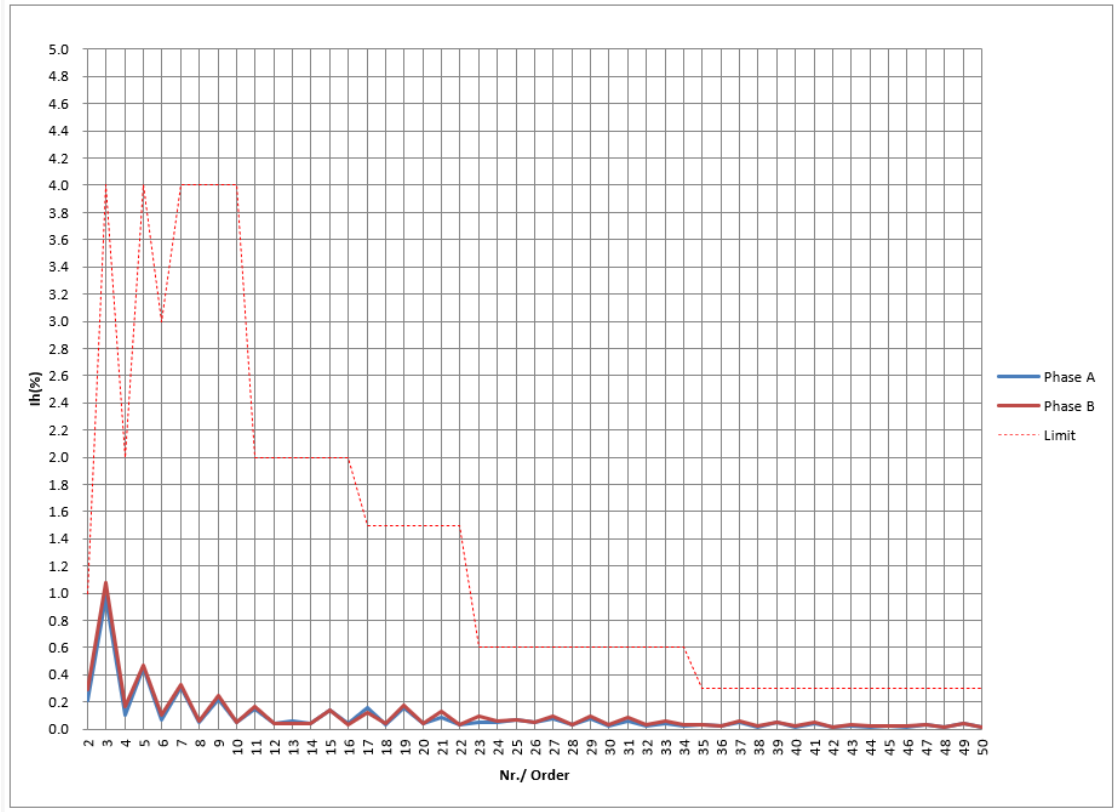


Test Case 1 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
158.000	10.200	209.00	49.840	9.480	7.350	12.000	60.00	0.793

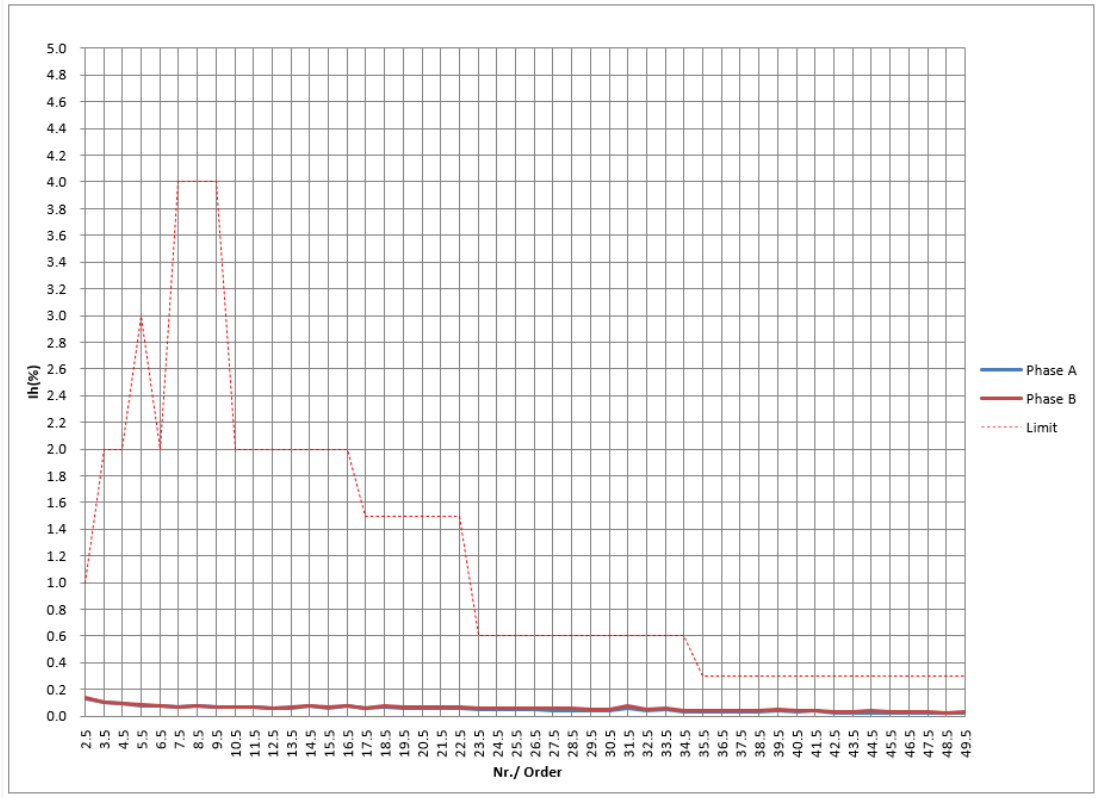
harmonic current distortion – Test Case 1				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2	0.209	0.291	--	1.0
3	0.969	1.080	--	4.0
4	0.103	0.165	--	2.0
5	0.448	0.465	--	4.0
6	0.066	0.102	--	3.0
7	0.305	0.325	--	4.0
8	0.052	0.060	--	4.0
9	0.218	0.243	--	4.0
10	0.048	0.051	--	4.0
11	0.152	0.162	--	2.0
12	0.045	0.042	--	2.0
13	0.057	0.043	--	2.0
14	0.037	0.038	--	2.0
15	0.141	0.137	--	2.0
16	0.038	0.035	--	2.0
17	0.153	0.121	--	1.5
18	0.035	0.038	--	1.5
19	0.158	0.176	--	1.5
20	0.037	0.040	--	1.5
21	0.082	0.128	--	1.5
22	0.034	0.036	--	1.5
23	0.049	0.093	--	0.6
24	0.054	0.057	--	0.6
25	0.067	0.065	--	0.6
26	0.049	0.053	--	0.6
27	0.081	0.097	--	0.6
28	0.031	0.031	--	0.6
29	0.073	0.099	--	0.6
30	0.025	0.032	--	0.6
31	0.055	0.085	--	0.6
32	0.024	0.032	--	0.6
33	0.041	0.061	--	0.6
34	0.022	0.028	--	0.6
35	0.033	0.031	--	0.3
36	0.020	0.025	--	0.3
37	0.054	0.056	--	0.3
38	0.018	0.021	--	0.3
39	0.050	0.053	--	0.3
40	0.017	0.020	--	0.3
41	0.044	0.047	--	0.3
42	0.016	0.019	--	0.3
43	0.027	0.028	--	0.3
44	0.016	0.019	--	0.3
45	0.023	0.025	--	0.3
46	0.015	0.020	--	0.3
47	0.028	0.028	--	0.3
48	0.012	0.015	--	0.3
49	0.040	0.042	--	0.3
50	0.012	0.015	--	0.3
TRD	1.225	1.365	--	5.0

inter-harmonic current distortion – Test Case 1				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.135	0.138	--	1.0
3.5	0.101	0.103	--	2.0
4.5	0.091	0.093	--	2.0
5.5	0.079	0.084	--	3.0
6.5	0.078	0.078	--	2.0
7.5	0.066	0.068	--	4.0
8.5	0.075	0.076	--	4.0
9.5	0.065	0.068	--	4.0
10.5	0.066	0.067	--	2.0
11.5	0.067	0.068	--	2.0
12.5	0.059	0.060	--	2.0
13.5	0.063	0.065	--	2.0
14.5	0.076	0.074	--	2.0
15.5	0.059	0.064	--	2.0
16.5	0.079	0.077	--	2.0
17.5	0.059	0.062	--	1.5
18.5	0.067	0.080	--	1.5
19.5	0.063	0.065	--	1.5
20.5	0.059	0.066	--	1.5
21.5	0.058	0.065	--	1.5
22.5	0.058	0.068	--	1.5
23.5	0.054	0.061	--	0.6
24.5	0.050	0.061	--	0.6
25.5	0.047	0.055	--	0.6
26.5	0.047	0.057	--	0.6
27.5	0.044	0.060	--	0.6
28.5	0.045	0.057	--	0.6
29.5	0.042	0.053	--	0.6
30.5	0.041	0.052	--	0.6
31.5	0.059	0.077	--	0.6
32.5	0.037	0.047	--	0.6
33.5	0.049	0.062	--	0.6
34.5	0.034	0.040	--	0.6
35.5	0.034	0.042	--	0.3
36.5	0.033	0.040	--	0.3
37.5	0.031	0.037	--	0.3
38.5	0.029	0.037	--	0.3
39.5	0.040	0.049	--	0.3
40.5	0.028	0.041	--	0.3
41.5	0.038	0.045	--	0.3
42.5	0.025	0.031	--	0.3
43.5	0.026	0.032	--	0.3
44.5	0.027	0.037	--	0.3
45.5	0.025	0.030	--	0.3
46.5	0.024	0.030	--	0.3
47.5	0.024	0.028	--	0.3
48.5	0.023	0.027	--	0.3
49.5	0.024	0.033	--	0.3

harmonic current distortion – Test Case 1



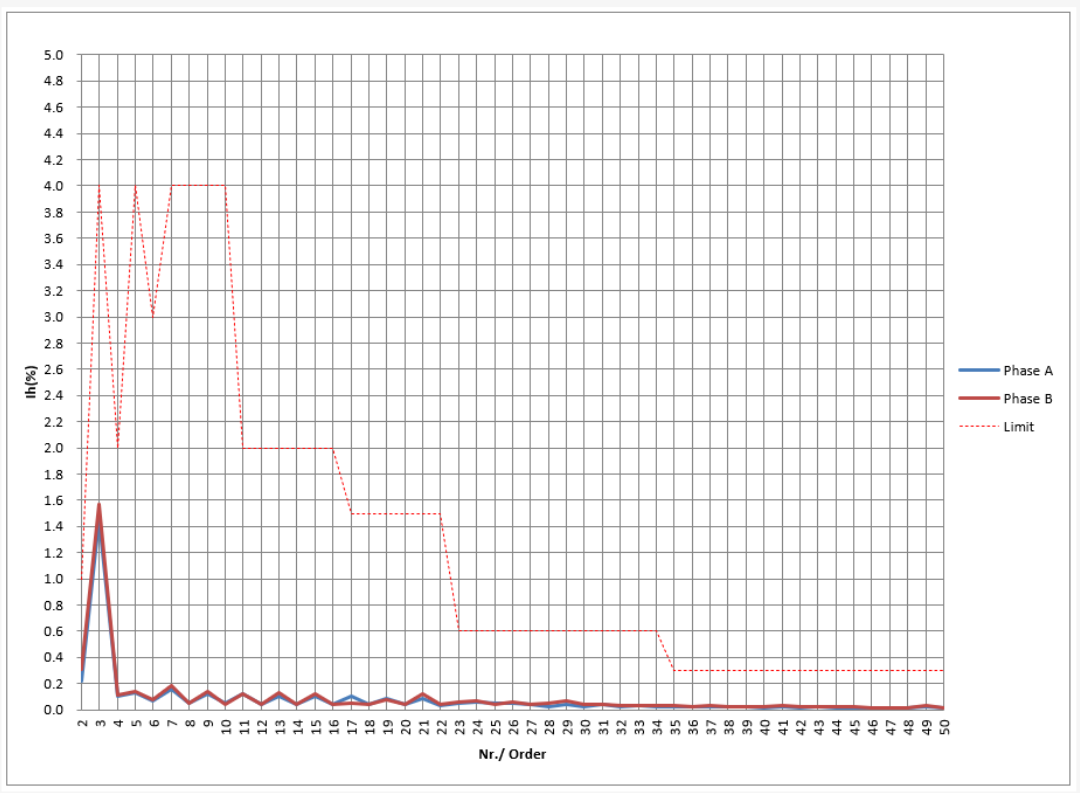
inter-harmonic current distortion – Test Case 1



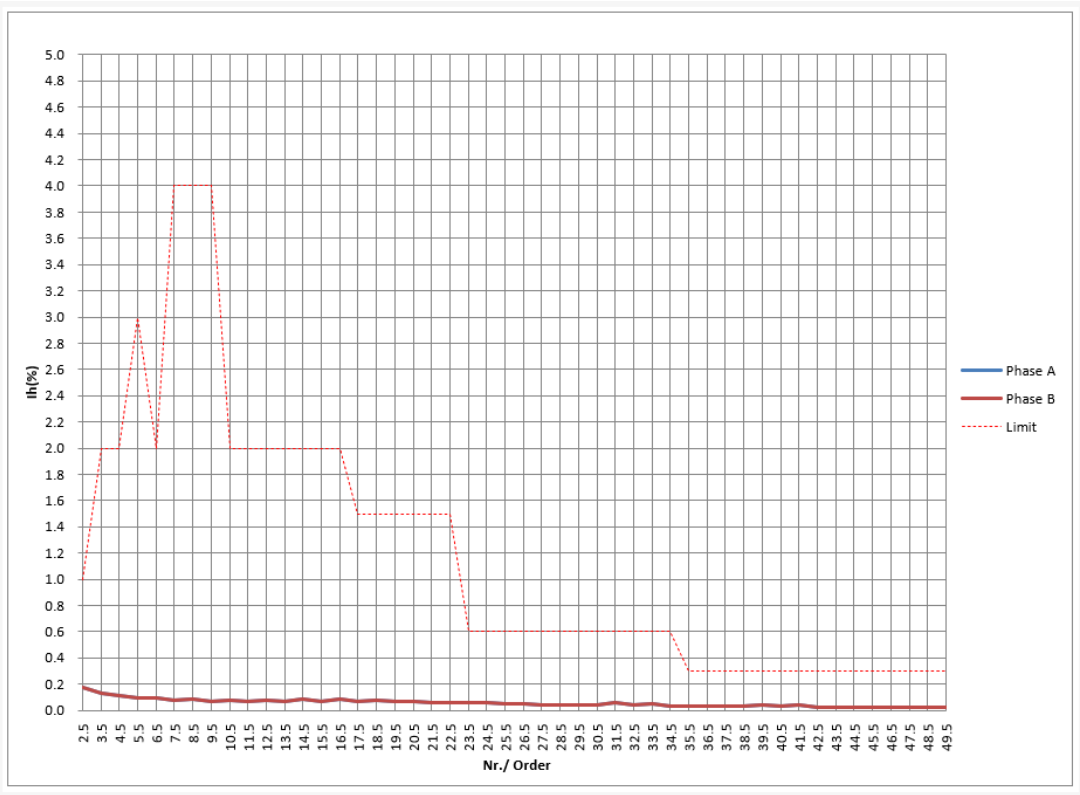
Test Case 2 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
299.465	12.500	209.00	49.529	11.900	0.369	11.900	60.00	1.000
harmonic current distortion – Test Case 2								
Order	**Phase A (%)**		**Phase B (%)**		**Phase C (%)**		**Limit (%)**	
2	0.220		0.305		--		1.0	
3	1.461		1.563		--		4.0	
4	0.107		0.109		--		2.0	
5	0.133		0.143		--		4.0	
6	0.066		0.078		--		3.0	
7	0.159		0.184		--		4.0	
8	0.050		0.051		--		4.0	
9	0.125		0.140		--		4.0	
10	0.047		0.043		--		4.0	
11	0.125		0.124		--		2.0	
12	0.043		0.041		--		2.0	
13	0.107		0.127		--		2.0	
14	0.043		0.041		--		2.0	
15	0.107		0.119		--		2.0	
16	0.044		0.042		--		2.0	
17	0.101		0.046		--		1.5	
18	0.039		0.040		--		1.5	
19	0.090		0.079		--		1.5	
20	0.037		0.040		--		1.5	
21	0.082		0.119		--		1.5	
22	0.036		0.042		--		1.5	
23	0.052		0.058		--		0.6	
24	0.060		0.065		--		0.6	
25	0.049		0.043		--		0.6	
26	0.052		0.057		--		0.6	
27	0.038		0.041		--		0.6	
28	0.027		0.046		--		0.6	
29	0.042		0.068		--		0.6	
30	0.023		0.039		--		0.6	
31	0.040		0.042		--		0.6	
32	0.025		0.032		--		0.6	
33	0.031		0.032		--		0.6	
34	0.026		0.028		--		0.6	
35	0.027		0.032		--		0.3	
36	0.026		0.024		--		0.3	
37	0.022		0.028		--		0.3	
38	0.020		0.021		--		0.3	
39	0.019		0.027		--		0.3	
40	0.017		0.020		--		0.3	
41	0.020		0.031		--		0.3	
42	0.016		0.019		--		0.3	
43	0.019		0.025		--		0.3	
44	0.017		0.019		--		0.3	
45	0.018		0.020		--		0.3	
46	0.016		0.018		--		0.3	
47	0.016		0.016		--		0.3	
48	0.014		0.016		--		0.3	
49	0.028		0.031		--		0.3	
50	0.014		0.015		--		0.3	
TRD	1.537		1.658		--		5.0	

inter-harmonic current distortion – Test Case 2				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.173	0.173	--	1.0
3.5	0.129	0.129	--	2.0
4.5	0.112	0.112	--	2.0
5.5	0.096	0.096	--	3.0
6.5	0.096	0.096	--	2.0
7.5	0.078	0.078	--	4.0
8.5	0.086	0.086	--	4.0
9.5	0.071	0.071	--	4.0
10.5	0.073	0.073	--	2.0
11.5	0.068	0.068	--	2.0
12.5	0.073	0.073	--	2.0
13.5	0.065	0.065	--	2.0
14.5	0.089	0.089	--	2.0
15.5	0.065	0.065	--	2.0
16.5	0.089	0.089	--	2.0
17.5	0.065	0.065	--	1.5
18.5	0.073	0.073	--	1.5
19.5	0.064	0.064	--	1.5
20.5	0.066	0.066	--	1.5
21.5	0.060	0.060	--	1.5
22.5	0.062	0.062	--	1.5
23.5	0.055	0.055	--	0.6
24.5	0.055	0.055	--	0.6
25.5	0.049	0.049	--	0.6
26.5	0.051	0.051	--	0.6
27.5	0.044	0.044	--	0.6
28.5	0.045	0.045	--	0.6
29.5	0.042	0.042	--	0.6
30.5	0.040	0.040	--	0.6
31.5	0.058	0.058	--	0.6
32.5	0.038	0.038	--	0.6
33.5	0.049	0.049	--	0.6
34.5	0.035	0.035	--	0.6
35.5	0.032	0.032	--	0.3
36.5	0.032	0.032	--	0.3
37.5	0.031	0.031	--	0.3
38.5	0.029	0.029	--	0.3
39.5	0.040	0.040	--	0.3
40.5	0.028	0.028	--	0.3
41.5	0.038	0.038	--	0.3
42.5	0.025	0.025	--	0.3
43.5	0.026	0.026	--	0.3
44.5	0.026	0.026	--	0.3
45.5	0.024	0.024	--	0.3
46.5	0.023	0.023	--	0.3
47.5	0.023	0.023	--	0.3
48.5	0.022	0.022	--	0.3
49.5	0.024	0.024	--	0.3

harmonic current distortion – Test Case 2



inter-harmonic current distortion – Test Case 2

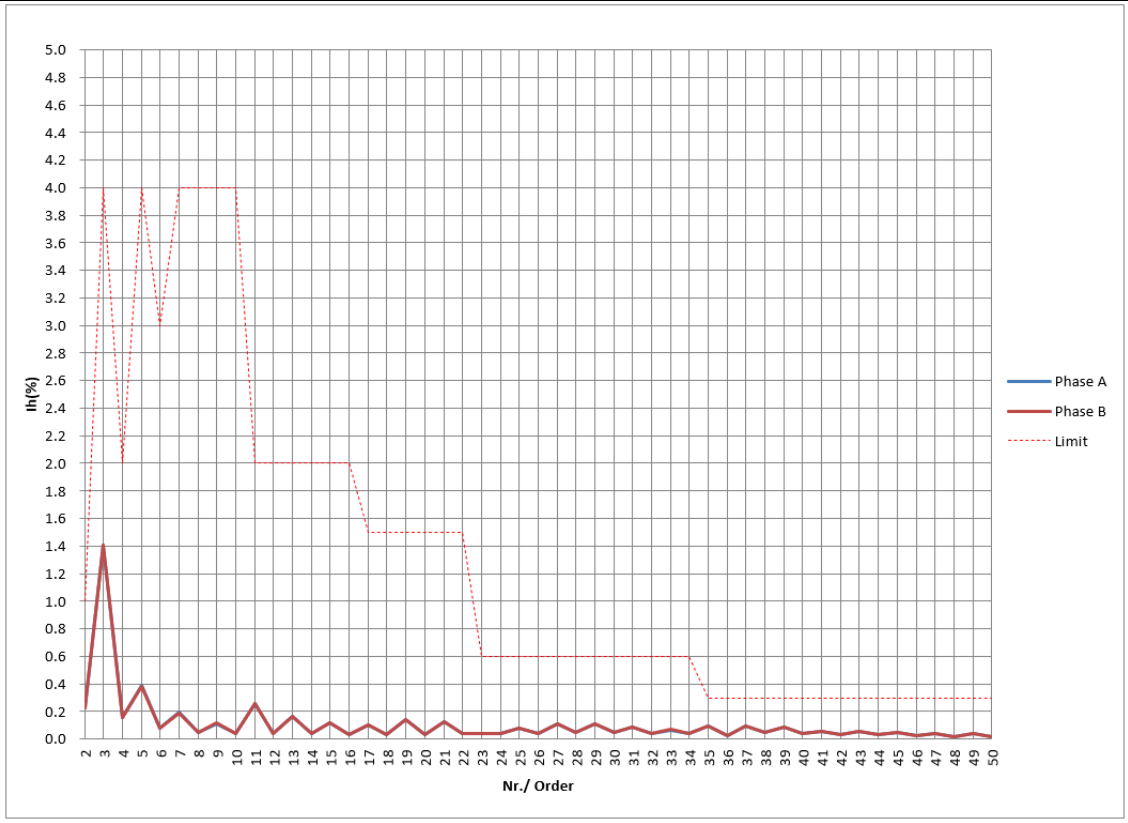


Test Case 3 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
450.44	10.03	208.79	49.170	9.530	-7.025	11.839	60.00	0.805

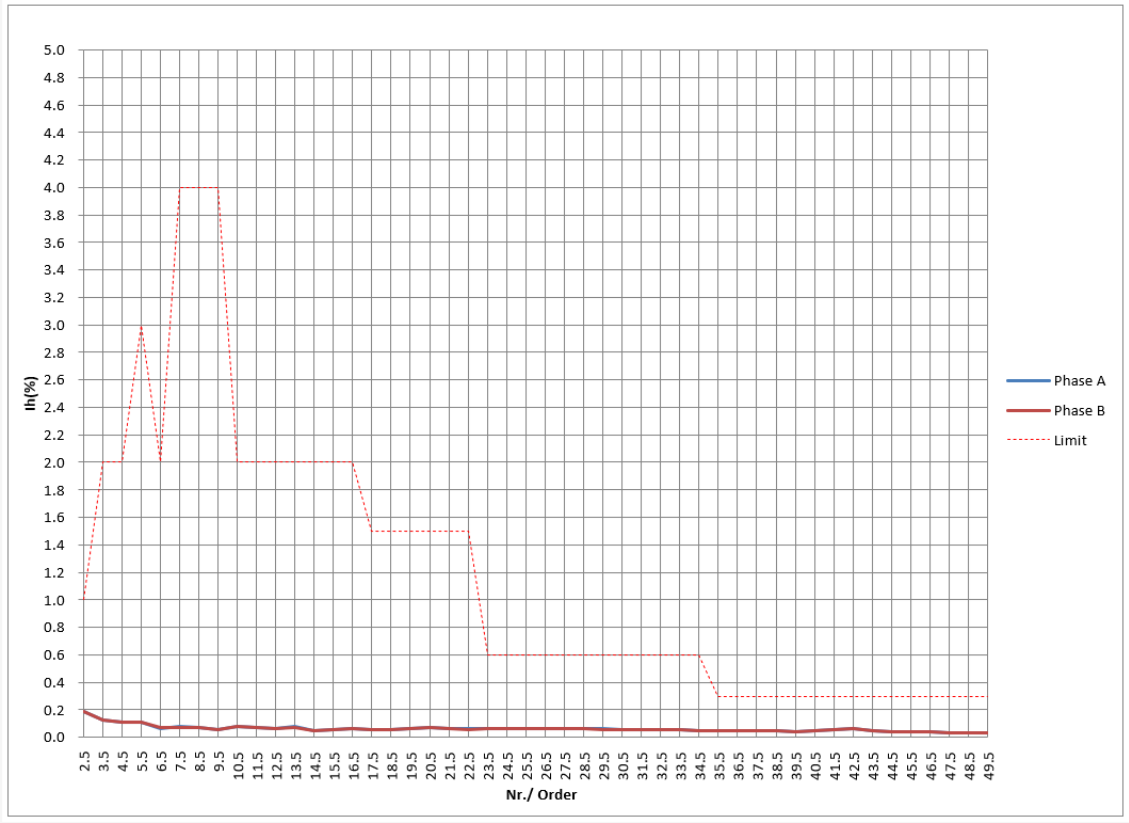
harmonic current distortion – Test Case 3				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2	0.224	0.228	--	1.0
3	1.408	1.408	--	4.0
4	0.154	0.155	--	2.0
5	0.388	0.385	--	4.0
6	0.078	0.078	--	3.0
7	0.194	0.188	--	4.0
8	0.047	0.045	--	4.0
9	0.110	0.116	--	4.0
10	0.038	0.037	--	4.0
11	0.258	0.256	--	2.0
12	0.039	0.039	--	2.0
13	0.166	0.164	--	2.0
14	0.039	0.039	--	2.0
15	0.116	0.118	--	2.0
16	0.028	0.028	--	2.0
17	0.101	0.101	--	1.5
18	0.031	0.031	--	1.5
19	0.140	0.140	--	1.5
20	0.033	0.033	--	1.5
21	0.126	0.126	--	1.5
22	0.040	0.040	--	1.5
23	0.039	0.040	--	0.6
24	0.039	0.040	--	0.6
25	0.080	0.081	--	0.6
26	0.039	0.038	--	0.6
27	0.107	0.108	--	0.6
28	0.051	0.051	--	0.6
29	0.110	0.111	--	0.6
30	0.051	0.051	--	0.6
31	0.090	0.090	--	0.6
32	0.040	0.040	--	0.6
33	0.066	0.067	--	0.6
34	0.041	0.041	--	0.6
35	0.094	0.094	--	0.3
36	0.027	0.027	--	0.3
37	0.093	0.093	--	0.3
38	0.046	0.046	--	0.3
39	0.085	0.085	--	0.3
40	0.039	0.039	--	0.3
41	0.054	0.054	--	0.3
42	0.035	0.035	--	0.3
43	0.053	0.053	--	0.3
44	0.034	0.034	--	0.3
45	0.050	0.050	--	0.3
46	0.024	0.024	--	0.3
47	0.043	0.042	--	0.3
48	0.018	0.018	--	0.3
49	0.037	0.037	--	0.3
50	0.017	0.017	--	0.3
TRD	1.589	1.589	--	5.0

inter-harmonic current distortion – Test Case 3				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.191	0.186	--	1.0
3.5	0.123	0.124	--	2.0
4.5	0.109	0.107	--	2.0
5.5	0.109	0.111	--	3.0
6.5	0.066	0.067	--	2.0
7.5	0.076	0.072	--	4.0
8.5	0.073	0.070	--	4.0
9.5	0.056	0.057	--	4.0
10.5	0.080	0.081	--	2.0
11.5	0.073	0.072	--	2.0
12.5	0.062	0.064	--	2.0
13.5	0.076	0.074	--	2.0
14.5	0.049	0.048	--	2.0
15.5	0.056	0.055	--	2.0
16.5	0.063	0.063	--	2.0
17.5	0.053	0.053	--	1.5
18.5	0.059	0.059	--	1.5
19.5	0.061	0.061	--	1.5
20.5	0.068	0.068	--	1.5
21.5	0.065	0.065	--	1.5
22.5	0.059	0.059	--	1.5
23.5	0.066	0.066	--	0.6
24.5	0.063	0.063	--	0.6
25.5	0.061	0.060	--	0.6
26.5	0.060	0.060	--	0.6
27.5	0.060	0.060	--	0.6
28.5	0.066	0.066	--	0.6
29.5	0.059	0.058	--	0.6
30.5	0.056	0.057	--	0.6
31.5	0.055	0.054	--	0.6
32.5	0.058	0.058	--	0.6
33.5	0.055	0.054	--	0.6
34.5	0.047	0.046	--	0.6
35.5	0.045	0.045	--	0.3
36.5	0.050	0.049	--	0.3
37.5	0.050	0.050	--	0.3
38.5	0.044	0.044	--	0.3
39.5	0.041	0.041	--	0.3
40.5	0.045	0.045	--	0.3
41.5	0.056	0.056	--	0.3
42.5	0.060	0.060	--	0.3
43.5	0.050	0.050	--	0.3
44.5	0.043	0.043	--	0.3
45.5	0.042	0.042	--	0.3
46.5	0.038	0.038	--	0.3
47.5	0.030	0.030	--	0.3
48.5	0.030	0.030	--	0.3
49.5	0.032	0.032	--	0.3

harmonic current distortion – Test Case 3



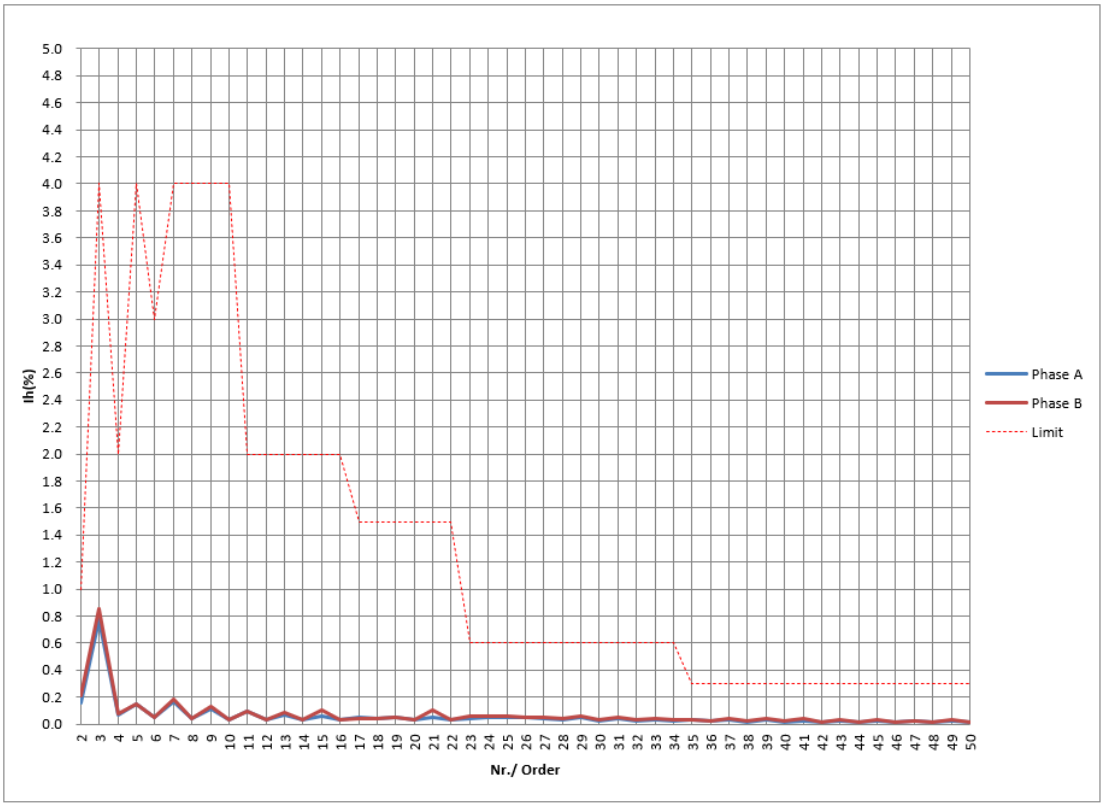
inter-harmonic current distortion – Test Case 3



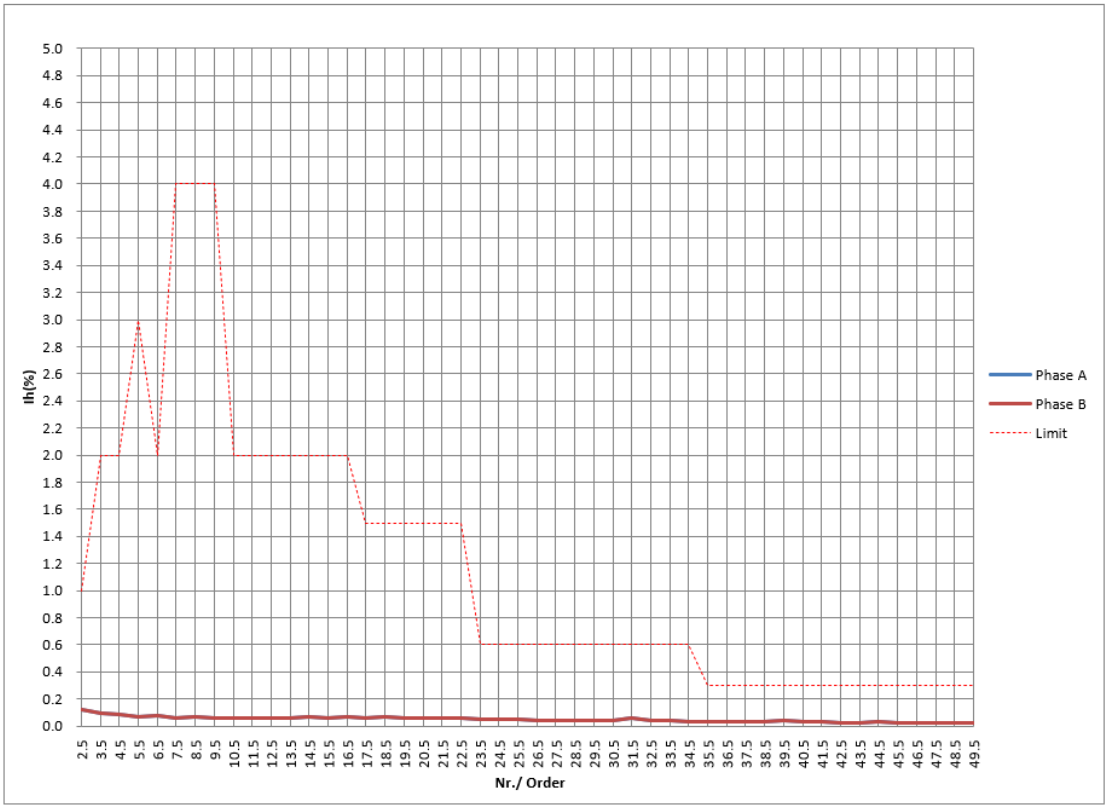
Test Case 4 – Test Condition								
$V_{d.c.}$ input (V)	$P_{d.c.}$ input (kW)	$V_{a.c.}$ output (V)	$I_{a.c.}$ output (A)	$P_{a.c.}$ output (kW)	$Q_{a.c.}$ output (kVAr)	$S_{a.c.}$ output (kVA)	Fre. (Hz)	PF
316.00	8.750	209.00	34.70	8.339	0.263	8.407	60.00	1.000
harmonic current distortion – Test Case 3								
Order	**Phase A (%)**		**Phase B (%)**		**Phase C (%)**		**Limit (%)**	
2	0.159		0.214		--		1.0	
3	0.777		0.849		--		4.0	
4	0.068		0.073		--		2.0	
5	0.146		0.146		--		4.0	
6	0.047		0.053		--		3.0	
7	0.162		0.187		--		4.0	
8	0.038		0.038		--		4.0	
9	0.110		0.132		--		4.0	
10	0.035		0.034		--		4.0	
11	0.093		0.097		--		2.0	
12	0.034		0.035		--		2.0	
13	0.070		0.089		--		2.0	
14	0.035		0.034		--		2.0	
15	0.058		0.104		--		2.0	
16	0.036		0.036		--		2.0	
17	0.050		0.038		--		1.5	
18	0.037		0.037		--		1.5	
19	0.053		0.053		--		1.5	
20	0.035		0.036		--		1.5	
21	0.046		0.100		--		1.5	
22	0.032		0.036		--		1.5	
23	0.044		0.058		--		0.6	
24	0.047		0.055		--		0.6	
25	0.050		0.061		--		0.6	
26	0.046		0.046		--		0.6	
27	0.045		0.051		--		0.6	
28	0.029		0.042		--		0.6	
29	0.047		0.059		--		0.6	
30	0.025		0.033		--		0.6	
31	0.045		0.052		--		0.6	
32	0.022		0.028		--		0.6	
33	0.034		0.038		--		0.6	
34	0.023		0.029		--		0.6	
35	0.029		0.032		--		0.3	
36	0.020		0.026		--		0.3	
37	0.029		0.037		--		0.3	
38	0.018		0.023		--		0.3	
39	0.028		0.039		--		0.3	
40	0.017		0.021		--		0.3	
41	0.027		0.039		--		0.3	
42	0.016		0.019		--		0.3	
43	0.022		0.032		--		0.3	
44	0.015		0.019		--		0.3	
45	0.023		0.028		--		0.3	
46	0.015		0.018		--		0.3	
47	0.021		0.022		--		0.3	
48	0.013		0.017		--		0.3	
49	0.026		0.030		--		0.3	
50	0.012		0.017		--		0.3	
TRD	0.869		0.970		--		5.0	

inter-harmonic current distortion – Test Case 4				
Order	**Phase A (%)**	**Phase B (%)**	**Phase C (%)**	**Limit (%)**
2.5	0.120	0.120	--	1.0
3.5	0.091	0.091	--	2.0
4.5	0.082	0.082	--	2.0
5.5	0.070	0.070	--	3.0
6.5	0.074	0.074	--	2.0
7.5	0.063	0.063	--	4.0
8.5	0.069	0.069	--	4.0
9.5	0.059	0.059	--	4.0
10.5	0.061	0.061	--	2.0
11.5	0.057	0.057	--	2.0
12.5	0.060	0.060	--	2.0
13.5	0.057	0.057	--	2.0
14.5	0.070	0.070	--	2.0
15.5	0.058	0.058	--	2.0
16.5	0.072	0.072	--	2.0
17.5	0.060	0.060	--	1.5
18.5	0.064	0.064	--	1.5
19.5	0.060	0.060	--	1.5
20.5	0.057	0.057	--	1.5
21.5	0.056	0.056	--	1.5
22.5	0.055	0.055	--	1.5
23.5	0.053	0.053	--	0.6
24.5	0.049	0.049	--	0.6
25.5	0.048	0.048	--	0.6
26.5	0.045	0.045	--	0.6
27.5	0.045	0.045	--	0.6
28.5	0.041	0.041	--	0.6
29.5	0.042	0.042	--	0.6
30.5	0.038	0.038	--	0.6
31.5	0.055	0.055	--	0.6
32.5	0.038	0.038	--	0.6
33.5	0.044	0.044	--	0.6
34.5	0.034	0.034	--	0.6
35.5	0.032	0.032	--	0.3
36.5	0.033	0.033	--	0.3
37.5	0.031	0.031	--	0.3
38.5	0.031	0.031	--	0.3
39.5	0.037	0.037	--	0.3
40.5	0.031	0.031	--	0.3
41.5	0.035	0.035	--	0.3
42.5	0.027	0.027	--	0.3
43.5	0.026	0.026	--	0.3
44.5	0.029	0.029	--	0.3
45.5	0.025	0.025	--	0.3
46.5	0.024	0.024	--	0.3
47.5	0.024	0.024	--	0.3
48.5	0.023	0.023	--	0.3
49.5	0.025	0.025	--	0.3

harmonic current distortion – Test Case 4



inter-harmonic current distortion – Test Case 4



4.12.2 Current distortion test for DER capable of operation isolated from external source

Transformer Information	
Tested with an isolation transformer	☐
	Current distortion condition shall be applied on the area EPS side of the transformer. (Model: N/A) **Ratio:**
Tested without an isolation transformer	☒

Test sequence:

Table 23—Current distortion test cases for DER capable of operation isolated from external source

Test case	EUT conditions
1	Rated kVA at maximum injection p.f., minimum rated Vdc (if applicable)
2	Unity p.f., nominal rated Vdc, 100% of rated active power
3	Rated kVA at maximum absorption p.f., maximum rated Vdc (if applicable)
4	Apparent power at which manufacturer has declared % TRD is maximum

Not aplicable. The sample is grid-connected.

4.13 Limit active power

This test confirms the EUT's capability to limit active power as required in 4.6.2 of IEEE Std 1547-2018. It also confirms that the EUT properly prioritizes voltage-active power mode (VW) requirements and frequency-droop response requirements over active power limiting as required in 4.7 of IEEE Std 1547-2018.

The DER shall limit its active power output to not greater than the active power limit set point in no more than 30 s or in the time it takes for the primary energy source to reduce its active power output to achieve the requirements of the active power limit set point, whichever is greater.

- voltage-active power mode (VW) default setting:

Table 10—Voltage-active power settings for Category A and Category B DER

Voltage-active power parameters	Default settings	Ranges of allowable settings	
		Minimum	Maximum
V_1	1.06 V_N	1.05 V_N	1.09 V_N
P_1	P_{rated}	N/A	N/A
V_2	1.1 V_N	V_1 + 0.01 V_N	1.10 V_N
P_2 (*applicable to DER that can only generate active power*)	The lesser of 0.2 P_{rated} or P_{min}[a]	P_{min}	P_{rated}
P'_2 (*applicable to DER that can generate and absorb active power*)	0[b]	0	P'_{rated}
Open Loop Response Time	10 s[c]	0.5 s	60 s

- frequency-droop response (FW) default setting:

Table 24—Parameters of frequency-droop (frequency-power) operation for DER of abnormal operating performance Category I, Category II, and Category III

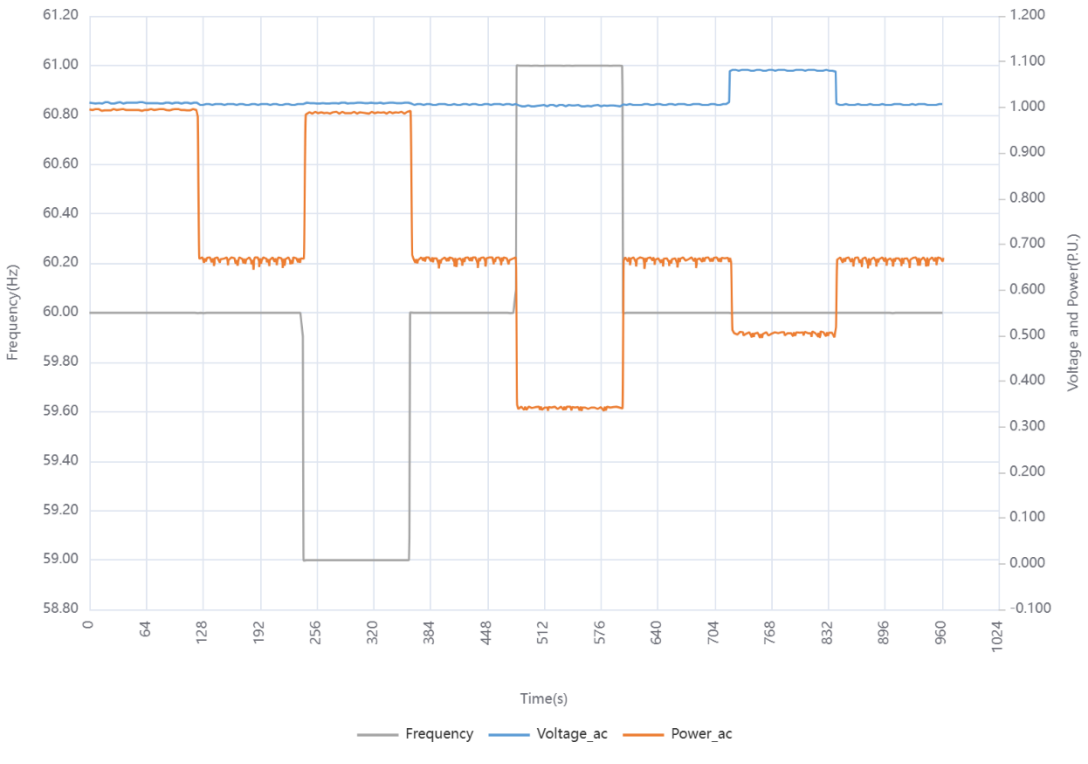
Parameter	Default settings[a]			Ranges of allowable settings[b]		
	Category I	Category II	Category III	Category I	Category II	Category III
db_{OF}, db_{UF} (Hz)	0.036	0.036	0.036	0.017[c]–1.0	0.017[c]–1.0	0.017[c]–1.0
k_{OF}, k_{UF}	0.05	0.05	0.05	0.03–0.05	0.03–0.05	0.02–0.05
$T_{response}$ (small-signal) (s)	5	5	5	1–10	1–10	0.2–10

Measurement equipment settings used for this test are shown in the following table:

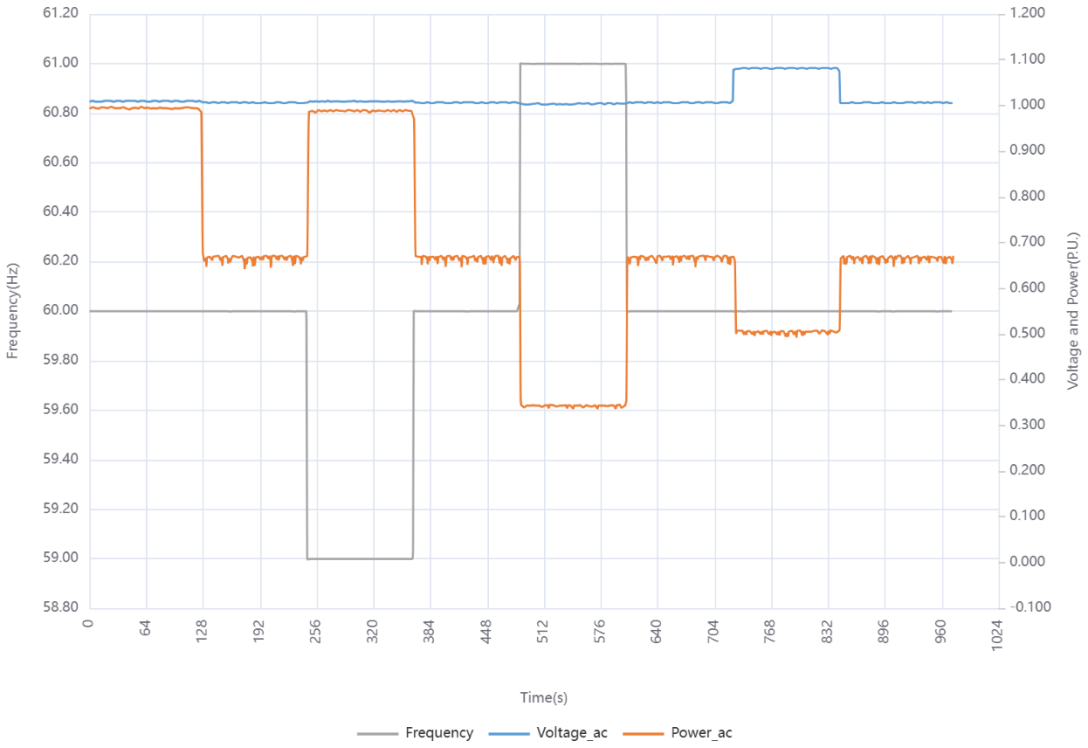
Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/08/28	100 ms	5 kHz

	Step	P Set (%)	Vol. Set (p.u.)	Fre. Set (Hz)	Test duration (s)	P Desired (p.u.)	P Meas. (p.u.)	Vol. Meas (p.u.)	Fre. Meas. (Hz)
Attempt-1	1	100	1	60	>60	1.000	0.994	1.009	59.999
	2	66	1	60	>60	0.660	0.667	1.006	59.987
	3	66	1	59	>60	0.981	0.987	1.009	59.013
	4	66	1	60	>60	0.660	0.668	1.006	60.000
	5	66	1	61	>60	0.339	0.342	1.003	60.997
	6	66	1	60	>60	0.660	0.667	1.008	59.999
	7	66	1.08	60	>60	0.500	0.505	1.081	59.999
	8	66	1	60	>60	0.660	0.667	1.006	59.999
Attempt-2	1	100	1	60	>60	1.000	0.994	1.009	59.999
	2	66	1	60	>60	0.660	0.667	1.006	59.992
	3	66	1	59	>60	0.981	0.987	1.009	59.010
	4	66	1	60	>60	0.660	0.667	1.006	60.001
	5	66	1	61	>60	0.339	0.343	1.003	60.997
	6	66	1	60	>60	0.660	0.667	1.008	59.999
	7	66	1.08	60	>60	0.500	0.505	1.081	59.999
	8	66	1	60	>60	0.660	0.667	1.006	59.999
Attempt-3	1	100	1	60	>60	1.000	0.995	1.009	59.999
	2	66	1	60	>60	0.660	0.667	1.006	59.991
	3	66	1	59	>60	0.981	0.988	1.009	59.005
	4	66	1	60	>60	0.660	0.667	1.006	60.000
	5	66	1	61	>60	0.339	0.341	1.003	60.996
	6	66	1	60	>60	0.660	0.667	1.008	59.999
	7	66	1.08	60	>60	0.500	0.504	1.081	59.999
	8	66	1	60	>60	0.660	0.667	1.006	59.999

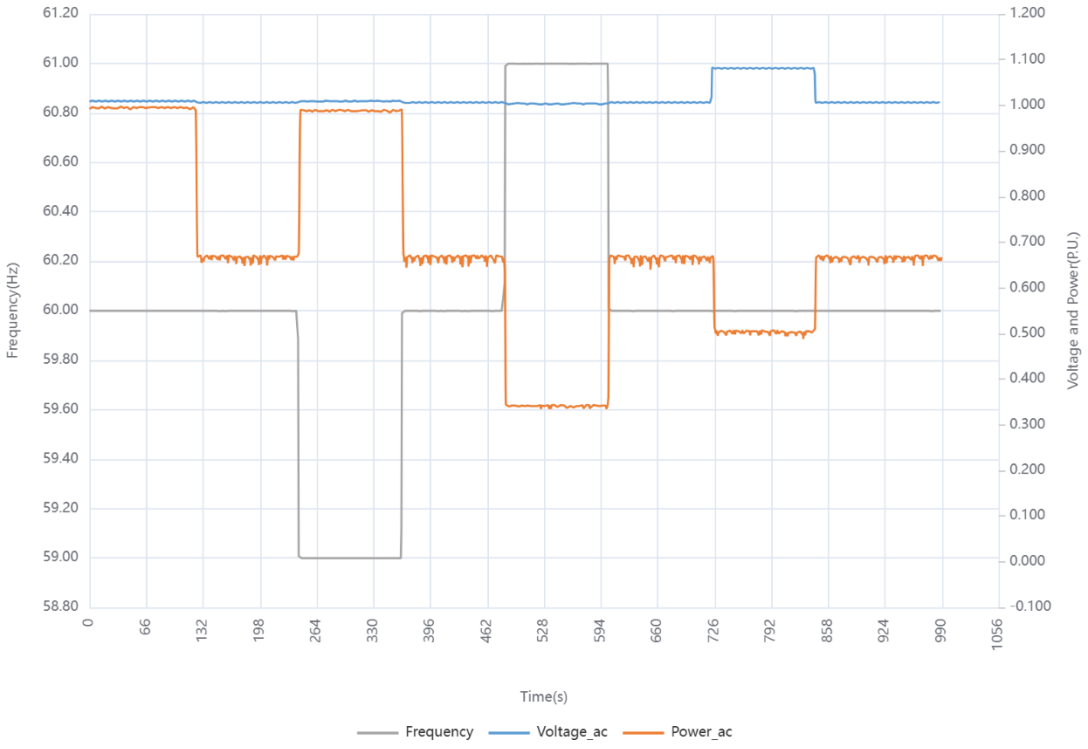
Test cureve for Limit Active Power_Limit to 66%Pn Attempt-1



Test cureve for Limit Active Power_Limit to 66%Pn Attempt-2

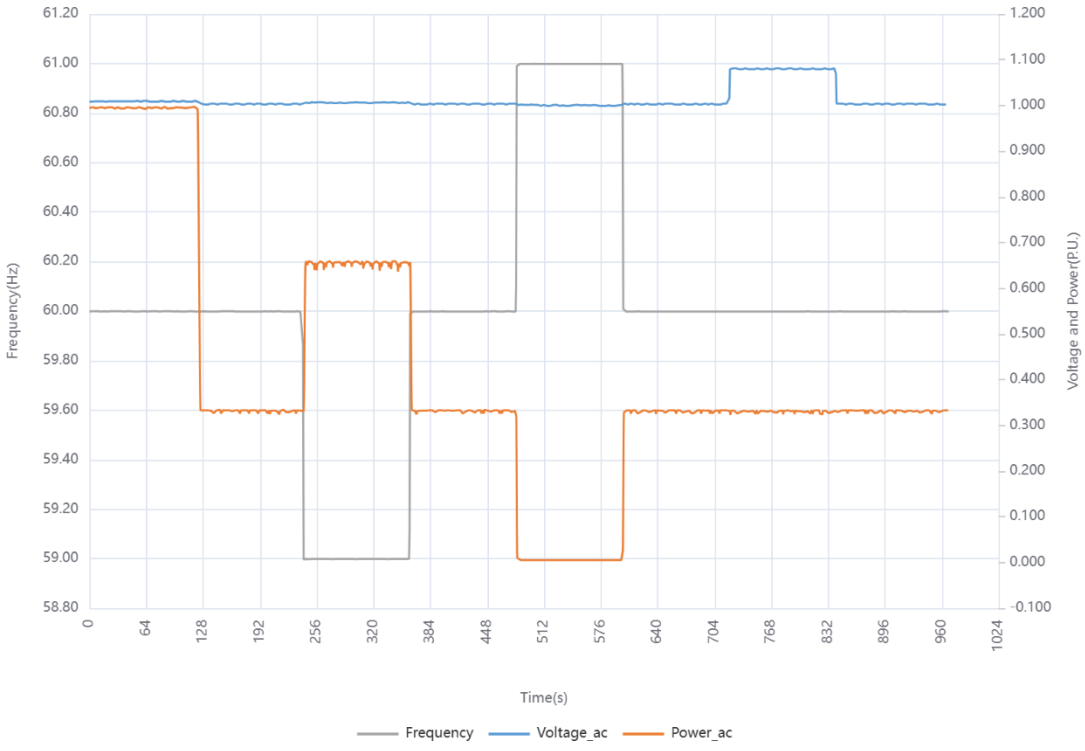


Test cureve for Limit Active Power_Limit to 66%Pn Attempt-3

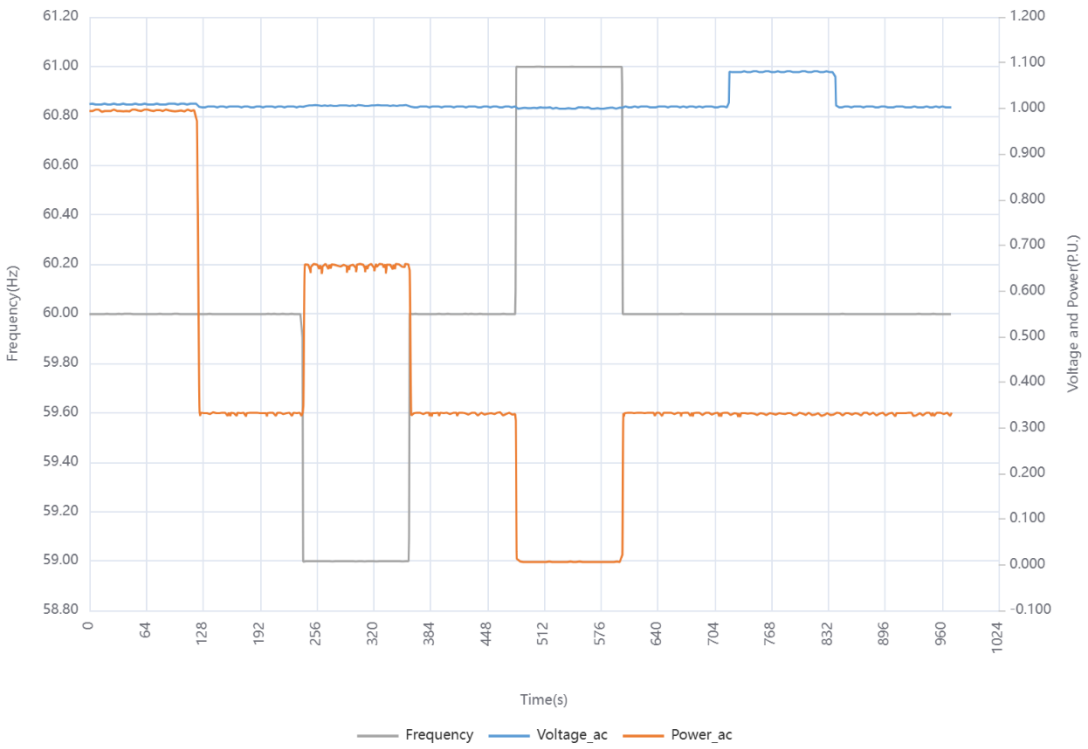


	Step	P Set (%)	Vol. Set (p.u.)	Fre. Set (Hz)	Test duration (s)	P Desired (p.u.)	P Meas. (p.u.)	Vol. Meas (p.u.)	Fre. Meas. (Hz)
Attempt-1	1	100	1	60	>60	1.000	0.994	1.009	59.999
	2	33	1	60	>60	0.330	0.332	1.003	59.989
	3	33	1	59	>60	0.651	0.655	1.006	59.007
	4	33	1	60	>60	0.330	0.332	1.003	60.000
	5	33	1	61	>60	0.009	0.005	1.000	60.996
	6	33	1	60	>60	0.330	0.331	1.003	59.998
	7	33	1.08	60	>60	0.330	0.331	1.080	59.998
	8	33	1	60	>60	0.330	0.332	1.003	59.998
Attempt-2	1	100	1	60	>60	1.000	0.995	1.009	59.998
	2	33	1	60	>60	0.330	0.332	1.003	59.989
	3	33	1	59	>60	0.651	0.656	1.006	59.006
	4	33	1	60	>60	0.330	0.332	1.003	60.000
	5	33	1	61	>60	0.009	0.006	1.000	60.996
	6	33	1	60	>60	0.330	0.331	1.003	59.998
	7	33	1.08	60	>60	0.330	0.331	1.080	59.998
	8	33	1	60	>60	0.330	0.332	1.003	59.998
Attempt-3	1	100	1	60	>60	1.000	0.995	1.009	59.998
	2	33	1	60	>60	0.330	0.332	1.003	59.990
	3	33	1	59	>60	0.651	0.655	1.006	59.007
	4	33	1	60	>60	0.330	0.332	1.003	60.000
	5	33	1	61	>60	0.009	0.005	1.000	60.996
	6	33	1	60	>60	0.330	0.332	1.003	59.998
	7	33	1.08	60	>60	0.330	0.331	1.079	59.998
	8	33	1	60	>60	0.330	0.995	1.009	59.998

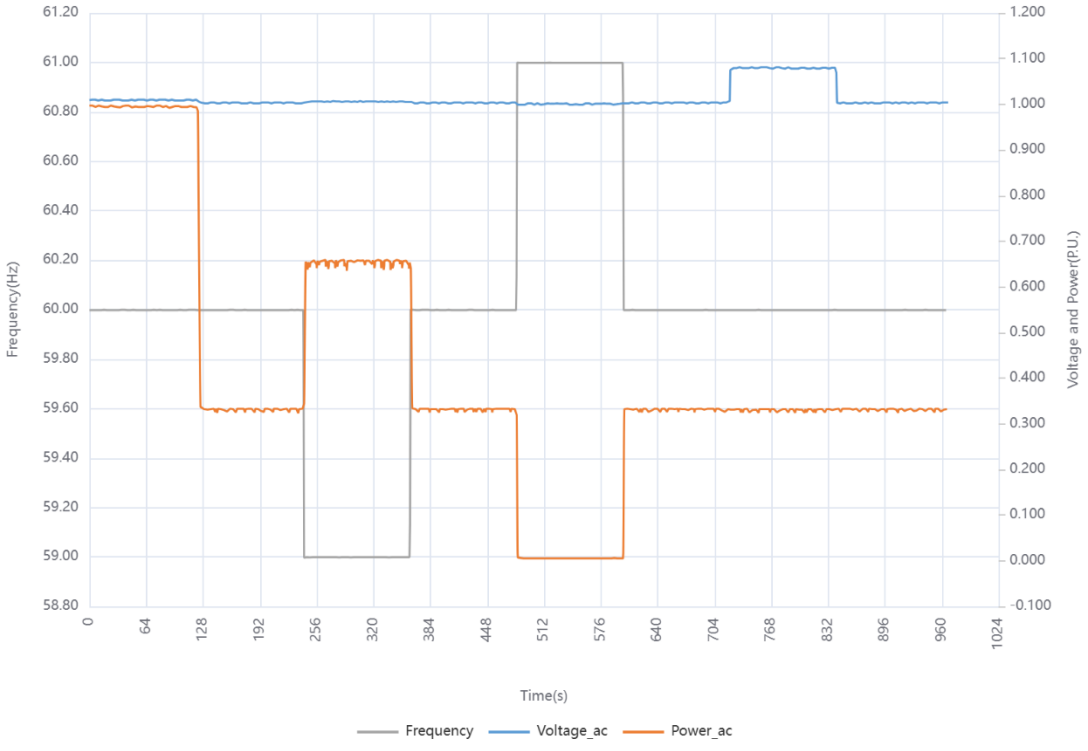
Test cureve for Limit Active Power_Limit to 33 %Pn Attempt-1



Test cureve for Limit Active Power_Limit to 33 %Pn Attempt-2

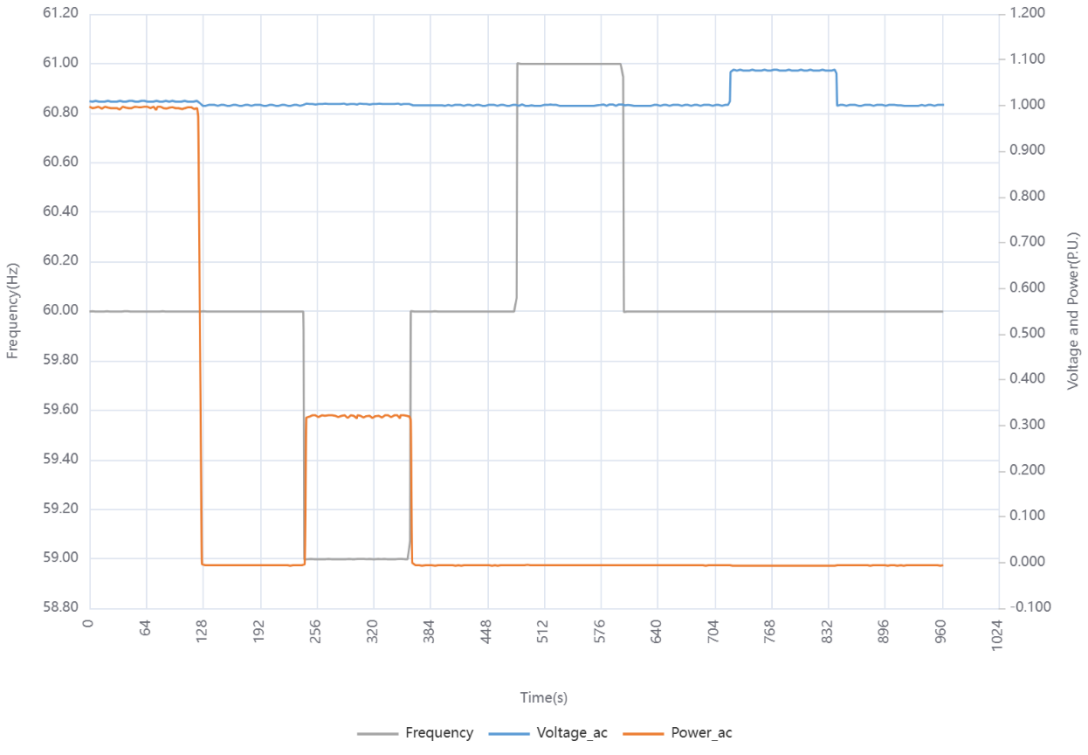


Test cureve for Limit Active Power_Limit to 33 %Pn Attempt-3

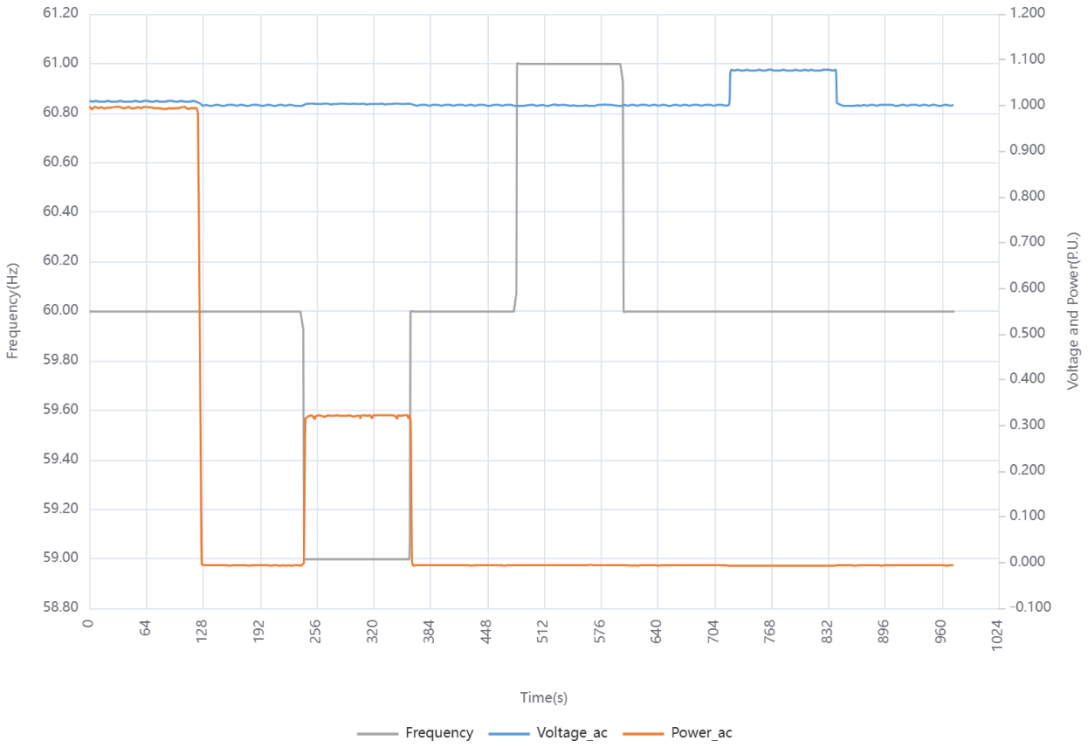


	Step	P Set (%)	Vol. Set (p.u.)	Fre. Set (Hz)	Test duration (s)	P Desired (p.u.)	P Meas. (p.u.)	Vol. Meas (p.u.)	Fre. Meas. (Hz)
Attempt-1	1	100	1	60	>60	1.000	0.995	1.009	59.998
	2	0	1	60	>60	0.000	-0.006	1.000	59.985
	3	0	1	59	>60	0.321	0.320	1.003	59.005
	4	0	1	60	>60	0.000	-0.006	1.000	59.998
	5	0	1	61	>60	0.000	-0.006	1.000	60.998
	6	0	1	60	>60	0.000	-0.006	1.000	59.998
	7	0	1.08	60	>60	0.000	-0.007	1.077	59.998
	8	0	1	60	>60	0.000	-0.006	1.000	59.998
Attempt-2	1	100	1	60	>60	1.000	0.995	1.009	59.998
	2	0	1	60	>60	0.000	-0.006	1.000	59.991
	3	0	1	59	>60	0.321	0.320	1.003	59.007
	4	0	1	60	>60	0.000	-0.006	1.000	59.998
	5	0	1	61	>60	0.000	-0.006	1.000	60.998
	6	0	1	60	>60	0.000	-0.006	1.000	59.998
	7	0	1.08	60	>60	0.000	-0.007	1.077	59.998
	8	0	1	60	>60	0.000	-0.006	1.000	59.998
Attempt-3	1	100	1	60	>60	1.000	0.995	1.009	59.998
	2	0	1	60	>60	0.000	-0.006	1.000	59.988
	3	0	1	59	>60	0.321	0.320	1.003	59.006
	4	0	1	60	>60	0.000	-0.006	1.000	59.998
	5	0	1	61	>60	0.000	-0.006	1.000	60.998
	6	0	1	60	>60	0.000	-0.006	1.000	59.998
	7	0	1.08	60	>60	0.000	-0.007	1.077	59.998
	8	0	1	60	>60	0.000	-0.006	1.000	59.998

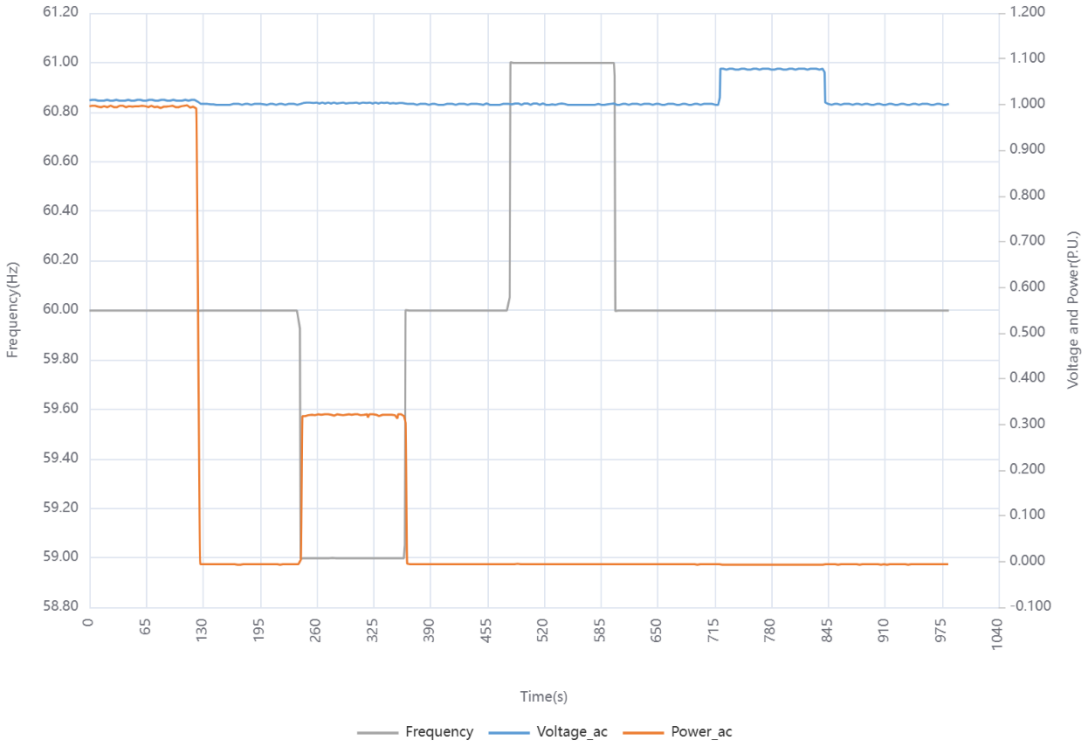
Test cureve for Limit Active Power_Limit to 0 %Pn Attempt-1



Test cureve for Limit Active Power_Limit to 0 %Pn Attempt-2



Test cureve for Limit Active Power_Limit to 0 %Pn Attempt-3



4.14 Voltage regulation

The tests in this subclause verify an EUT's reactive power capability and verifies the operation of the various voltage regulation modes described in IEEE Std 1547. Five categories of voltage regulation testing follow:

- Constant power factor mode
- Voltage-reactive power (volt-var) mode
- Voltage-active power (volt-watt) mode
- Active power-reactive power (watt-var or P-Q) mode
- Constant reactive power mode

4.14.1 Test for constant power factor (p.f.) mode

This test verifies the EUT's operation at a fixed power factor is compliant with 5.3.2 of IEEE Std 1547-2018.
The maximum DER response time to maintain constant power factor shall be 10 s or less.

The manufacturer states the following parameters of the EUT	
Model:	**ELD12K**
a) Apparent Power Rating (kVA) – Smax:	12
b) Output Power Rating (kW) – Prated:	12
c) DC Input voltage range with function enabled (V):	[90, 450]
d) Nominal AC voltage (V) – Vnom:	120/240V split phase; 120/208V 2/3 phase;
e) AC voltage range with function enabled (V):	0.88-1.1Pu (211.2-264V)
f) AC voltage measurement accuracy– MSAVac:	1%Vnom
g) Power Factor Accuracy – MSAPF:	±0.01
h) Power Factor Settling Time (s):	<10 s
i) PF: The commanded power factor	0.99 (Adjustable from 0.8 leading to 0.8 lagging)
j) PFmin, inj: Minimum injected power factor,	0.8
k) PFmin, ab: Minimum absorbed power factor,	0.8
l) PFmid, inj:	0.9
m) PFmid, ab:	0.9

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/08/20 to 2025/08/21	100 ms	5 kHz

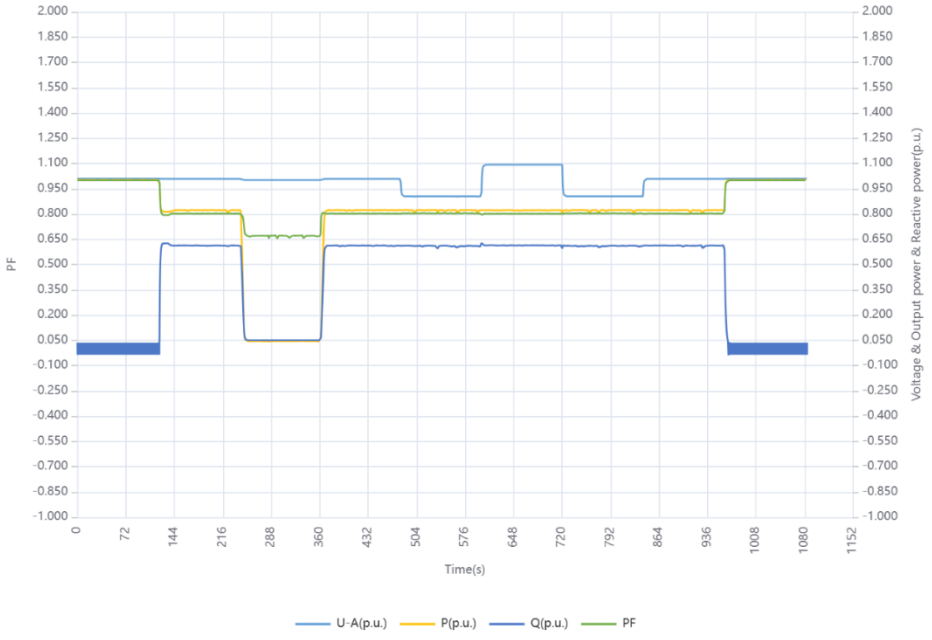
Note: the duration of imbalances (step 8 and 10 in the following test sequence) shall be held for at least 300 s to verify that units do not trip off in accordance with 6.4.2.2 of IEEE Std 1547-2018

- **Test-1: $PF_{-min,\ inj}$ & V_{dc-nom}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vnom	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vnom		X				Vnom	Vnom	Vnom	100%
Step 3	Enable	Vnom		X				Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vnom		X				Vnom	Vnom	Vnom	100%
Step 5	Enable	Vnom		X				V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vnom		X				V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vnom		X				V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vnom		X				>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vnom		X				Vnom	Vnom	Vnom	100%
Step 10	Enable	Vnom		X				<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vnom		X				Vnom	Vnom	Vnom	100%
Step 12	Disable	Vnom		X				Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	298.7	12576.6	1.009	--	--	0.994	--	--	1.003	0.018	1.003	0.999	60.000
2	317.5	10362.4	1.008	--	--	1.016	--	--	0.820	0.612	1.024	0.801	60.000
3	329.3	673.2	1.001	--	--	0.068	--	--	0.045	0.050	0.068	0.669	60.000
4	317.5	10372.0	1.008	--	--	1.016	--	--	0.821	0.611	1.023	0.802	60.000
5	317.3	10430.9	0.904	--	--	1.131	--	--	0.821	0.609	1.022	0.803	60.000
6	317.5	10351.8	1.092	--	--	0.938	--	--	0.821	0.612	1.024	0.802	60.000
7	317.3	10436.8	0.904	--	--	1.132	--	--	0.822	0.609	1.023	0.803	60.000
8	Skip												
9													
10													
11	317.4	10378.4	1.008	--	--	1.016	--	--	0.821	0.611	1.024	0.802	60.000
12	298.7	12574.5	1.009	--	--	0.994	--	--	1.002	0.019	1.003	0.999	60.000

Test cureve Over time

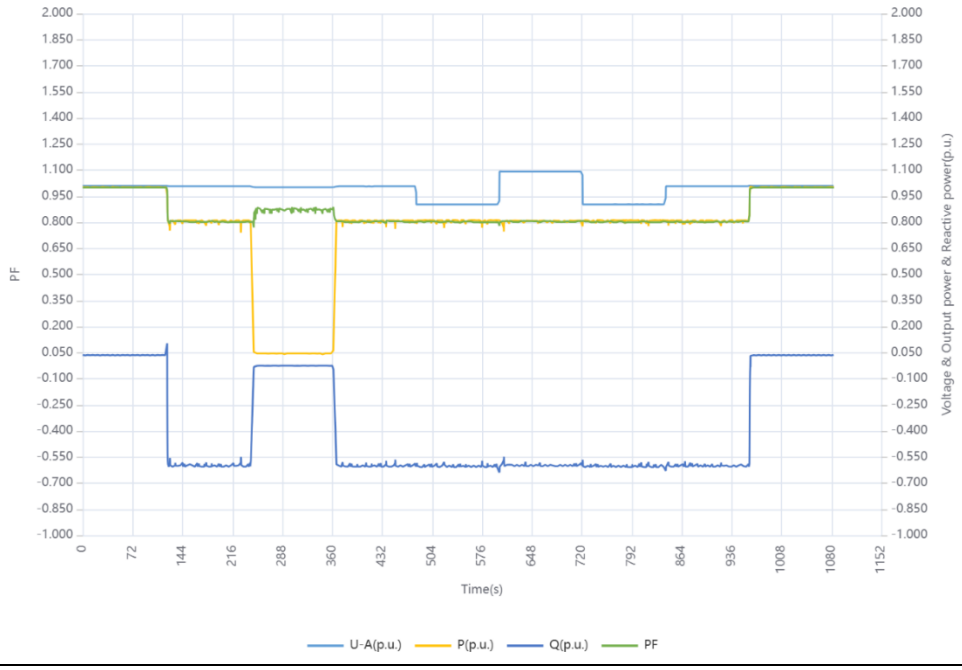


- **Test-2: $PF_{-min,\ ab}$ & $V_{dc\text{-}nom}$**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vnom	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vnom			X			Vnom	Vnom	Vnom	100%
Step 3	Enable	Vnom			X			Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vnom			X			Vnom	Vnom	Vnom	100%
Step 5	Enable	Vnom			X			V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vnom			X			V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vnom			X			V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vnom			X			>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vnom			X			Vnom	Vnom	Vnom	100%
Step 10	Enable	Vnom			X			<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vnom			X			Vnom	Vnom	Vnom	100%
Step 12	Disable	Vnom			X			Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	298.6	12575.1	1.009	--	--	0.994	--	--	1.002	0.036	1.003	0.999	60.000
2	317.6	10308.2	1.007	--	--	1.001	--	--	0.809	-0.601	1.008	0.803	60.000
3	329.3	677.9	1.001	--	--	0.052	--	--	0.045	-0.025	0.052	0.874	60.000
4	317.6	10306.8	1.007	--	--	1.002	--	--	0.810	-0.601	1.008	0.803	60.000
5	317.5	10367.7	0.902	--	--	1.119	--	--	0.810	-0.603	1.010	0.802	60.000
6	317.7	10271.3	1.091	--	--	0.921	--	--	0.808	-0.598	1.005	0.804	60.000
7	317.5	10371.3	0.902	--	--	1.120	--	--	0.810	-0.603	1.010	0.802	60.000
8	Skip												
9													
10													
11	317.6	10312.8	1.007	--	--	1.002	--	--	0.810	-0.601	1.008	0.803	60.000
12	298.8	12574.9	1.009	--	--	0.994	--	--	1.002	0.035	1.003	0.999	60.000

Test cureve Over time

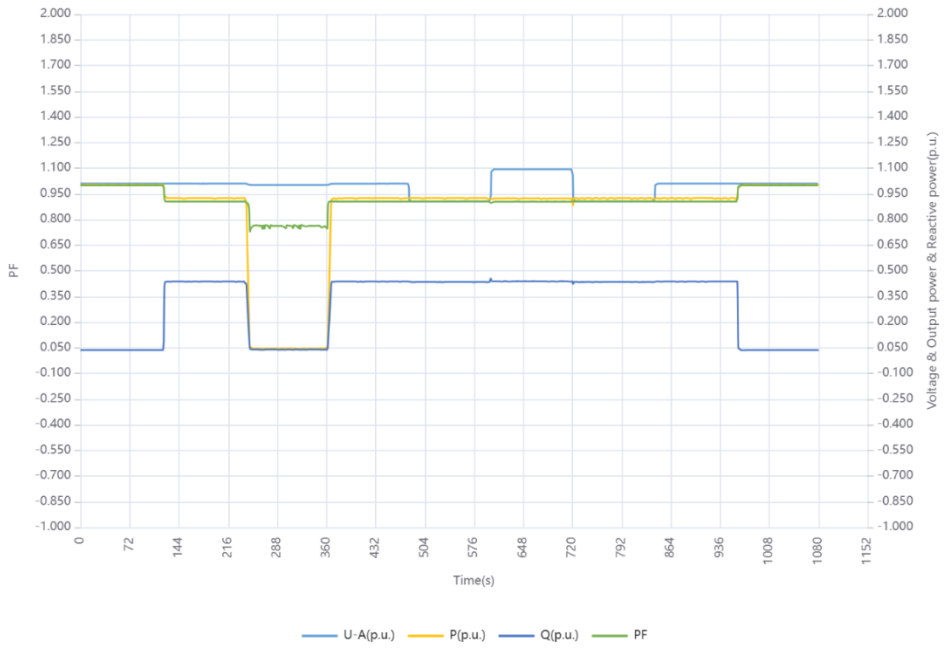


- **Test-3: $PF_{-mid,\ inj}$ & V_{dc-nom}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vnom	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vnom				X		Vnom	Vnom	Vnom	100%
Step 3	Enable	Vnom				X		Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vnom				X		Vnom	Vnom	Vnom	100%
Step 5	Enable	Vnom				X		V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vnom				X		V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vnom				X		V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vnom				X		>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vnom				X		Vnom	Vnom	Vnom	100%
Step 10	Enable	Vnom				X		<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vnom				X		Vnom	Vnom	Vnom	100%
Step 12	Disable	Vnom				X		Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	298.9	12578.7	1.009	--	--	0.995	--	--	1.003	0.036	1.003	0.999	60.000
2	312.2	11626.6	1.009	--	--	1.013	--	--	0.924	0.436	1.022	0.904	60.000
3	329.3	670.4	1.001	--	--	0.059	--	--	0.045	0.039	0.059	0.761	60.000
4	312.2	11622.9	1.008	--	--	1.013	--	--	0.924	0.436	1.022	0.904	60.000
5	311.8	11691.2	0.904	--	--	1.129	--	--	0.924	0.435	1.021	0.905	60.000
6	312.3	11596.3	1.093	--	--	0.935	--	--	0.923	0.438	1.021	0.903	60.000
7	311.8	11694.6	0.905	--	--	1.129	--	--	0.925	0.435	1.022	0.905	60.000
8	Skip												
9													
10													
11	312.1	11632.8	1.009	--	--	1.013	--	--	0.924	0.437	1.022	0.904	60.000
12	298.5	12565.6	1.009	--	--	0.993	--	--	1.001	0.036	1.002	0.999	60.000

Test cureve Over time

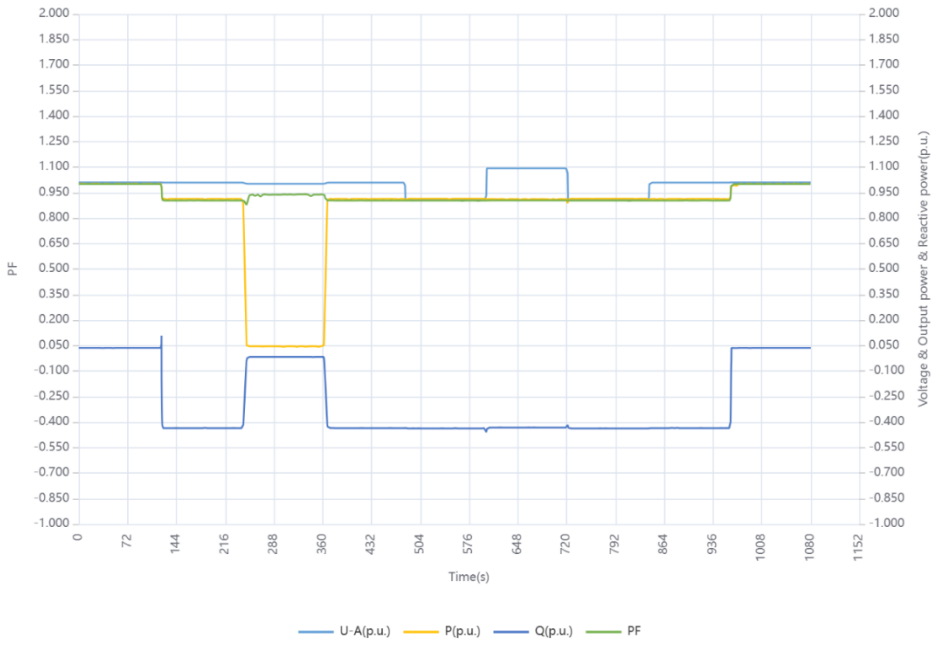


- **Test-4: $PF_{-mid,\ ab}$ & V_{dc-nom}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vnom	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vnom					X	Vnom	Vnom	Vnom	100%
Step 3	Enable	Vnom					X	Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vnom					X	Vnom	Vnom	Vnom	100%
Step 5	Enable	Vnom					X	V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vnom					X	V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vnom					X	V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vnom					X	>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vnom					X	Vnom	Vnom	Vnom	100%
Step 10	Enable	Vnom					X	<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vnom					X	Vnom	Vnom	Vnom	100%
Step 12	Disable	Vnom					X	Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	298.8	12562.0	1.009	--	--	0.993	--	--	1.001	0.036	1.002	0.999	60.000
2	312.7	11552.1	1.008	--	--	1.003	--	--	0.913	-0.436	1.011	0.903	60.000
3	329.3	675.1	1.001	--	--	0.048	--	--	0.045	-0.017	0.048	0.936	60.000
4	312.8	11547.4	1.008	--	--	1.004	--	--	0.913	-0.436	1.011	0.902	60.000
5	312.4	11611.2	0.904	--	--	1.121	--	--	0.913	-0.438	1.013	0.902	60.000
6	313.0	11508.3	1.092	--	--	0.923	--	--	0.911	-0.433	1.008	0.903	60.000
7	312.4	11612.4	0.904	--	--	1.121	--	--	0.913	-0.438	1.013	0.902	60.000
8	Skip												
9													
10													
11	312.7	11552.0	1.008	--	--	1.003	--	--	0.913	-0.436	1.011	0.902	60.000
12	298.4	12555.1	1.009	--	--	0.992	--	--	1.000	0.035	1.001	0.999	60.000

Test cureve Over time

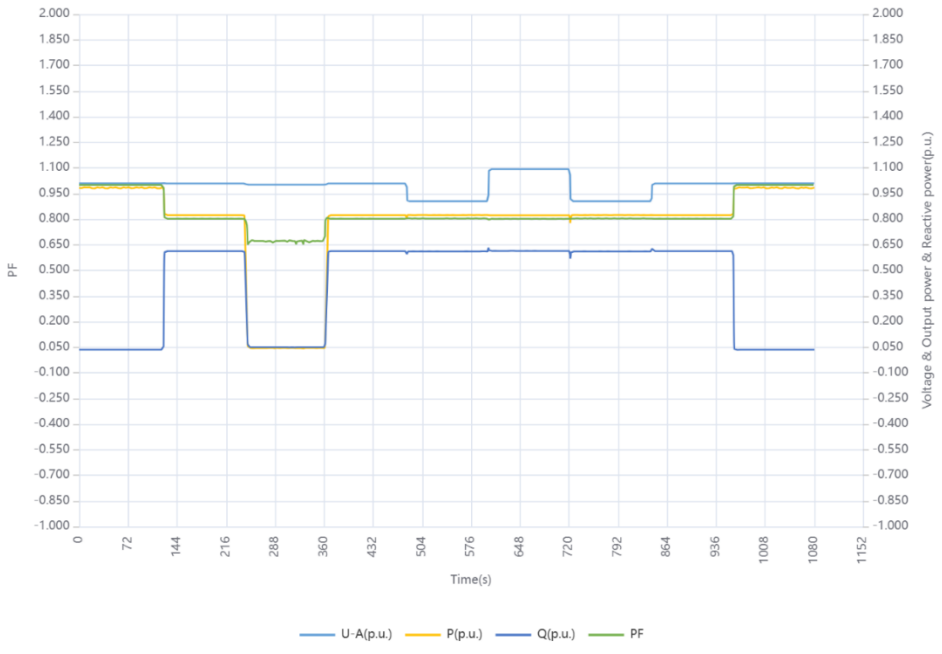


- **Test-5: $PF_{-min,\ inj}$ & V_{dc-min}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmin	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmin		X				Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmin		X				Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmin		X				Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmin		X				V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmin		X				V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmin		X				V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmin		X				>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmin		X				Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmin		X				<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmin		X				Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmin		X				Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	164.6	12558.5	1.009	--	--	0.975	--	--	0.983	0.035	0.984	0.999	60.000
2	173.5	10570.6	1.008	--	--	1.018	--	--	0.823	0.612	1.026	0.802	60.000
3	175.9	683.0	1.001	--	--	0.067	--	--	0.045	0.050	0.067	0.670	60.000
4	173.6	10562.2	1.008	--	--	1.018	--	--	0.823	0.612	1.026	0.802	60.000
5	173.5	10626.5	0.904	--	--	1.134	--	--	0.823	0.610	1.025	0.803	60.000
6	173.6	10542.3	1.092	--	--	0.939	--	--	0.822	0.613	1.026	0.802	60.000
7	173.4	10628.1	0.904	--	--	1.134	--	--	0.823	0.610	1.025	0.803	60.000
8	Skip												
9													
10													
11	173.5	10571.3	1.008	--	--	1.017	--	--	0.823	0.612	1.026	0.802	60.000
12	164.6	12556.4	1.009	--	--	0.975	--	--	0.983	0.035	0.983	0.999	60.000

Test cureve Over time

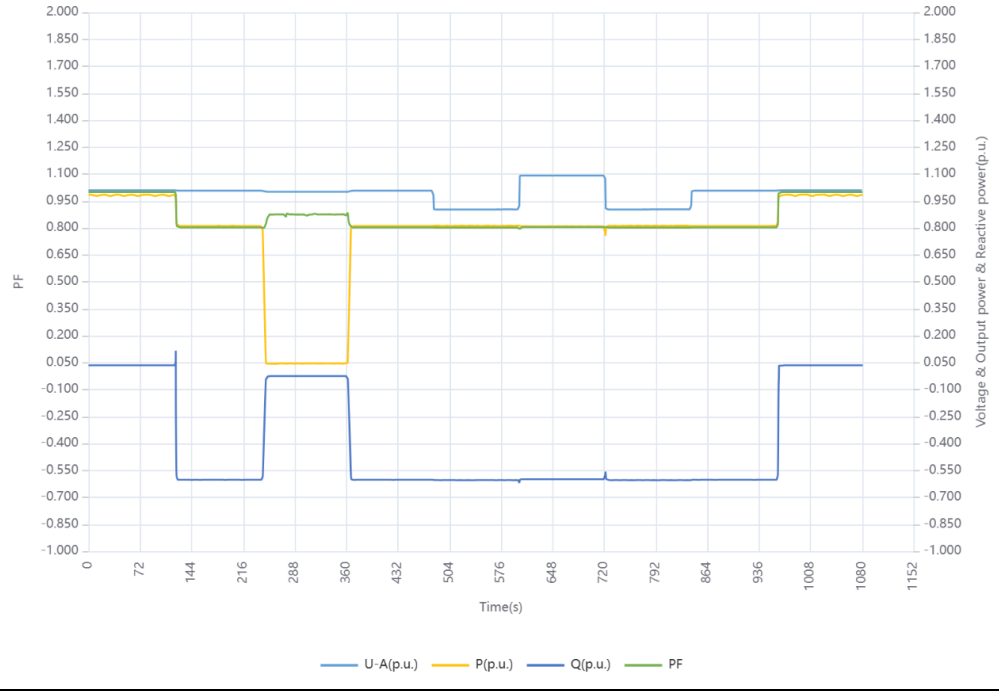


- **Test-6: $PF_{-min,\ ab}$ & V_{dc-min}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmin	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmin			X			Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmin			X			Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmin			X			Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmin			X			V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmin			X			V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmin			X			V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmin			X			>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmin			X			Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmin			X			<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmin			X			Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmin			X			Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	162.6	12563.4	1.009	--	--	0.974	--	--	0.982	0.035	0.983	0.999	60.000
2	173.6	10506.9	1.007	--	--	1.004	--	--	0.811	-0.602	1.010	0.803	60.000
3	175.9	688.4	1.001	--	--	0.052	--	--	0.045	-0.025	0.052	0.874	60.000
4	173.7	10495.2	1.007	--	--	1.004	--	--	0.811	-0.602	1.010	0.803	60.000
5	173.6	10556.3	0.902	--	--	1.121	--	--	0.812	-0.604	1.012	0.802	60.000
6	173.7	10462.6	1.091	--	--	0.923	--	--	0.809	-0.599	1.007	0.804	60.000
7	173.6	10558.0	0.902	--	--	1.121	--	--	0.811	-0.604	1.012	0.802	60.000
8	Skip												
9													
10													
11	173.6	10505.5	1.007	--	--	1.004	--	--	0.811	-0.602	1.010	0.803	60.000
12	162.6	12563.0	1.009	--	--	0.974	--	--	0.982	0.034	0.983	0.999	60.000

Test cureve Over time

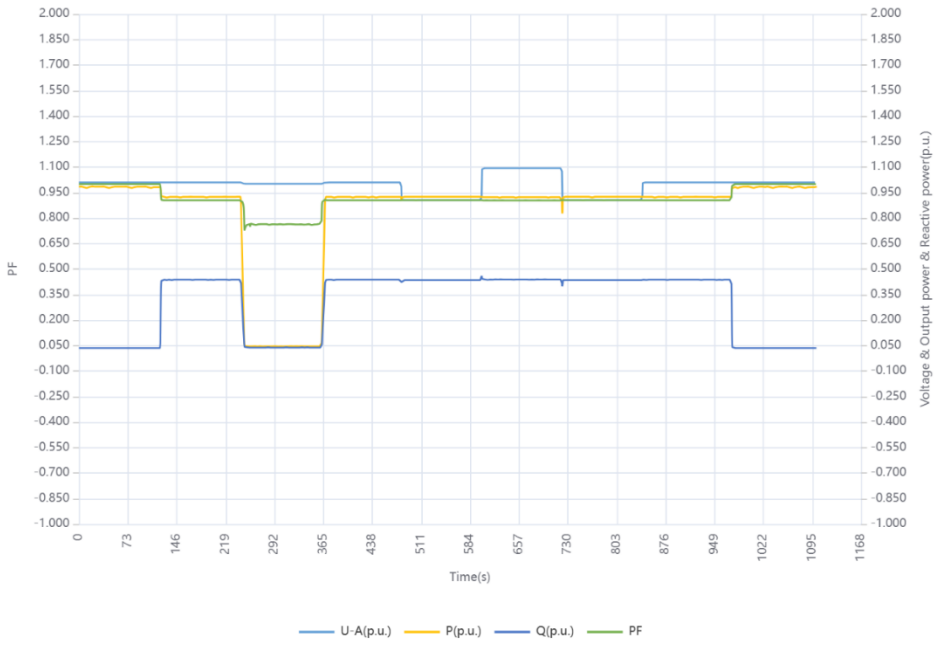


- **Test-7: $PF_{-mid,\ inj}$ & V_{dc-min}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmin	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmin				X		Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmin				X		Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmin				X		Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmin				X		V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmin				X		V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmin				X		V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmin				X		>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmin				X		Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmin				X		<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmin				X		Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmin				X		Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	162.7	12564.5	1.009	--	--	0.974	--	--	0.982	0.035	0.983	0.999	60.000
2	170.3	11843.4	1.009	--	--	1.013	--	--	0.924	0.437	1.022	0.904	60.000
3	175.8	679.4	1.001	--	--	0.059	--	--	0.045	0.038	0.059	0.762	60.000
4	170.3	11830.5	1.009	--	--	1.013	--	--	0.924	0.437	1.022	0.904	60.000
5	170.1	11897.8	0.905	--	--	1.129	--	--	0.924	0.435	1.021	0.905	60.000
6	170.4	11810.6	1.093	--	--	0.934	--	--	0.923	0.438	1.021	0.903	60.000
7	170.0	11898.9	0.905	--	--	1.129	--	--	0.924	0.435	1.021	0.905	60.000
8	Skip												
9													
10													
11	170.3	11842.7	1.009	--	--	1.013	--	--	0.924	0.437	1.022	0.904	60.000
12	162.6	12563.2	1.009	--	--	0.974	--	--	0.982	0.035	0.983	0.999	60.000

Test cureve Over time

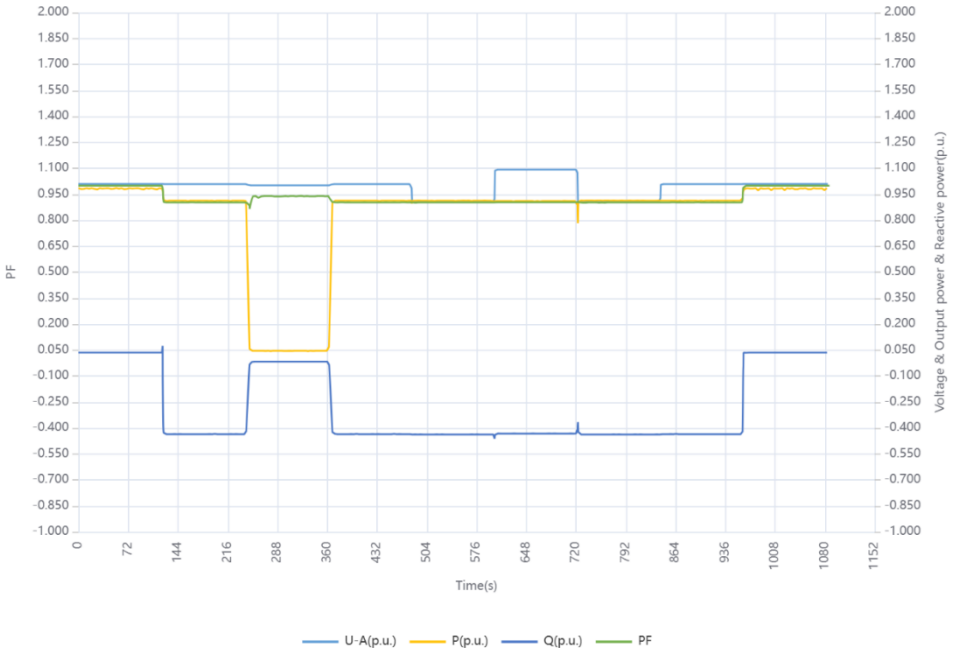


- **Test-8: $PF_{-mid, ab}$ & V_{dc-min}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmin	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmin					X	Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmin					X	Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmin					X	Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmin					X	V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmin					X	V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmin					X	V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmin					X	>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmin					X	Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmin					X	<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmin					X	Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmin					X	Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	164.6	12555.3	1.009	--	--	0.974	--	--	0.982	0.035	0.983	0.999	60.000
2	170.6	11759.7	1.008	--	--	1.003	--	--	0.913	-0.436	1.011	0.902	60.000
3	175.8	685.7	1.001	--	--	0.048	--	--	0.045	-0.017	0.048	0.937	60.000
4	170.7	11748.7	1.008	--	--	1.004	--	--	0.913	-0.436	1.011	0.902	60.000
5	170.5	11810.0	0.904	--	--	1.121	--	--	0.913	-0.438	1.013	0.902	60.000
6	170.8	11719.3	1.092	--	--	0.923	--	--	0.911	-0.433	1.009	0.903	60.000
7	170.5	11807.9	0.904	--	--	1.120	--	--	0.913	-0.438	1.012	0.902	60.000
8	Skip												
9													
10													
11	170.7	11761.9	1.008	--	--	1.004	--	--	0.913	-0.436	1.011	0.902	60.000
12	164.7	12551.2	1.009	--	--	0.974	--	--	0.982	0.034	0.982	0.999	60.000

Test cureve Over time

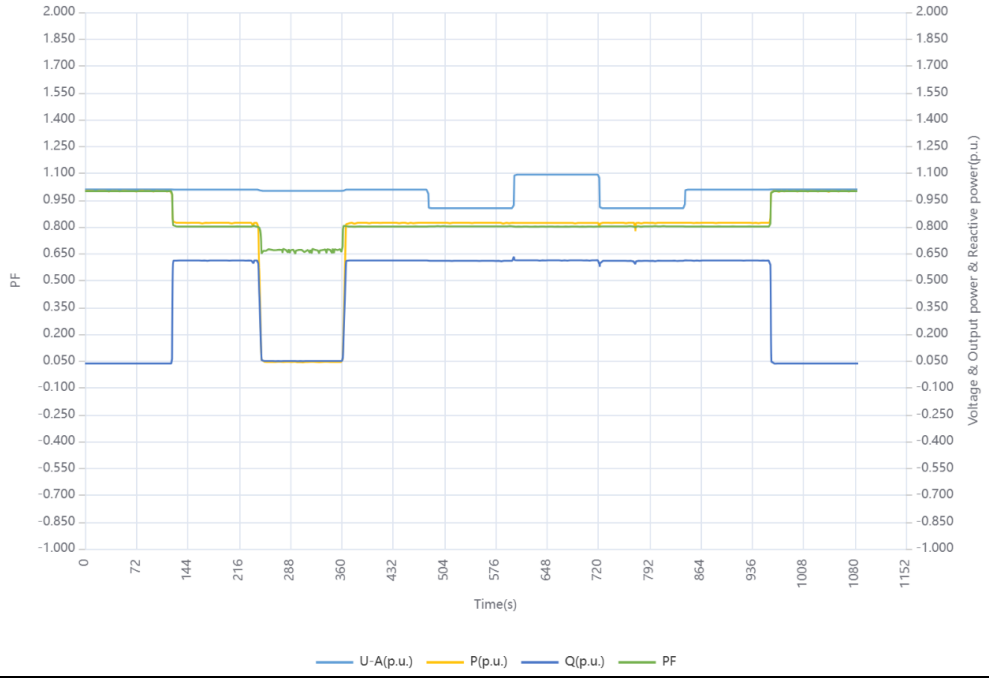


- **Test-9: $PF_{-min,\ inj}$ & V_{dc-max}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmax	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmax		X				Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmax		X				Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmax		X				Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmax		X				V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmax		X				V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmax		X				V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmax		X				>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmax		X				Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmax		X				<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmax		X				Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmax		X				Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	448.5	12630.7	1.009	--	--	0.992	--	--	1.000	0.036	1.001	0.999	60.000
2	465.3	10447.7	1.008	--	--	1.017	--	--	0.822	0.611	1.025	0.802	60.000
3	476.5	678.6	1.001	--	--	0.067	--	--	0.045	0.050	0.067	0.669	60.000
4	465.3	10443.2	1.008	--	--	1.017	--	--	0.822	0.612	1.025	0.802	60.000
5	465.2	10507.7	0.904	--	--	1.133	--	--	0.823	0.610	1.024	0.803	60.000
6	465.4	10418.8	1.092	--	--	0.938	--	--	0.821	0.613	1.025	0.802	60.000
7	465.2	10504.0	0.904	--	--	1.132	--	--	0.822	0.610	1.024	0.803	60.000
8	Skip												
9													
10													
11	465.3	10450.4	1.008	--	--	1.017	--	--	0.822	0.612	1.025	0.802	60.000
12	448.8	12629.3	1.009	--	--	0.991	--	--	1.000	0.036	1.000	0.999	60.000

Test cureve Over time

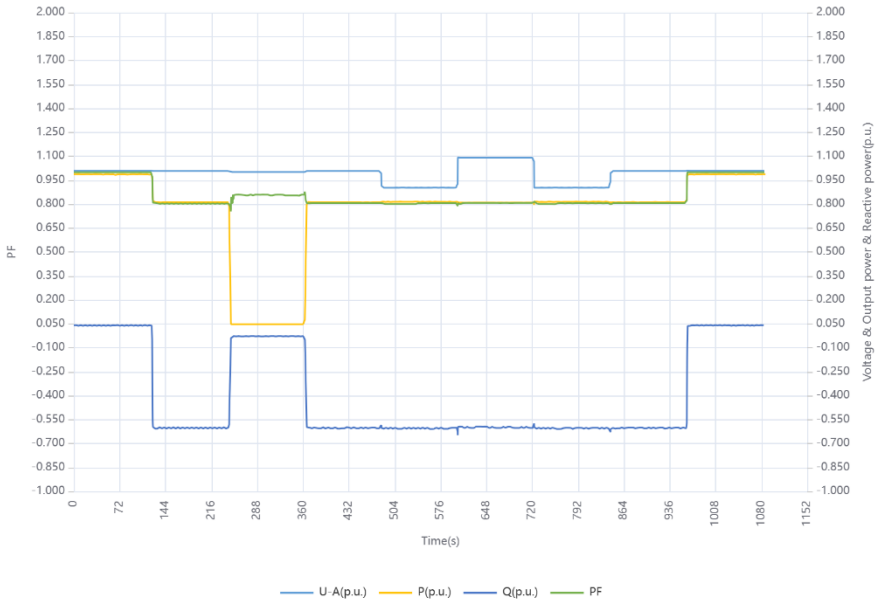


- **Test-10: $PF_{-min,\ ab}$ & V_{dc-max}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmax	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmax			X			Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmax			X			Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmax			X			Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmax			X			V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmax			X			V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmax			X			V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmax			X			>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmax			X			Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmax			X			<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmax			X			Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmax			X			Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	445.2	12248.5	1.009	--	--	0.977	--	--	0.985	0.039	0.986	0.999	60.000
2	471.4	10228.9	1.007	--	--	1.004	--	--	0.812	-0.603	1.011	0.803	60.000
3	488.4	681.6	1.001	--	--	0.055	--	--	0.047	-0.028	0.055	0.857	60.000
4	471.4	10226.5	1.007	--	--	1.004	--	--	0.812	-0.602	1.011	0.803	60.000
5	470.9	10327.4	0.902	--	--	1.124	--	--	0.814	-0.605	1.014	0.803	60.000
6	471.7	10149.2	1.091	--	--	0.923	--	--	0.810	-0.599	1.007	0.804	60.000
7	470.9	10328.8	0.902	--	--	1.124	--	--	0.814	-0.605	1.014	0.803	60.000
8	Skip												
9													
10													
11	471.4	10230.1	1.007	--	--	.004	--	--	0.812	-0.603	1.011	0.803	60.000
12	444.6	12249.8	1.009	--	--	.977	--	--	0.986	0.039	0.986	0.999	60.000

Test cureve Over time

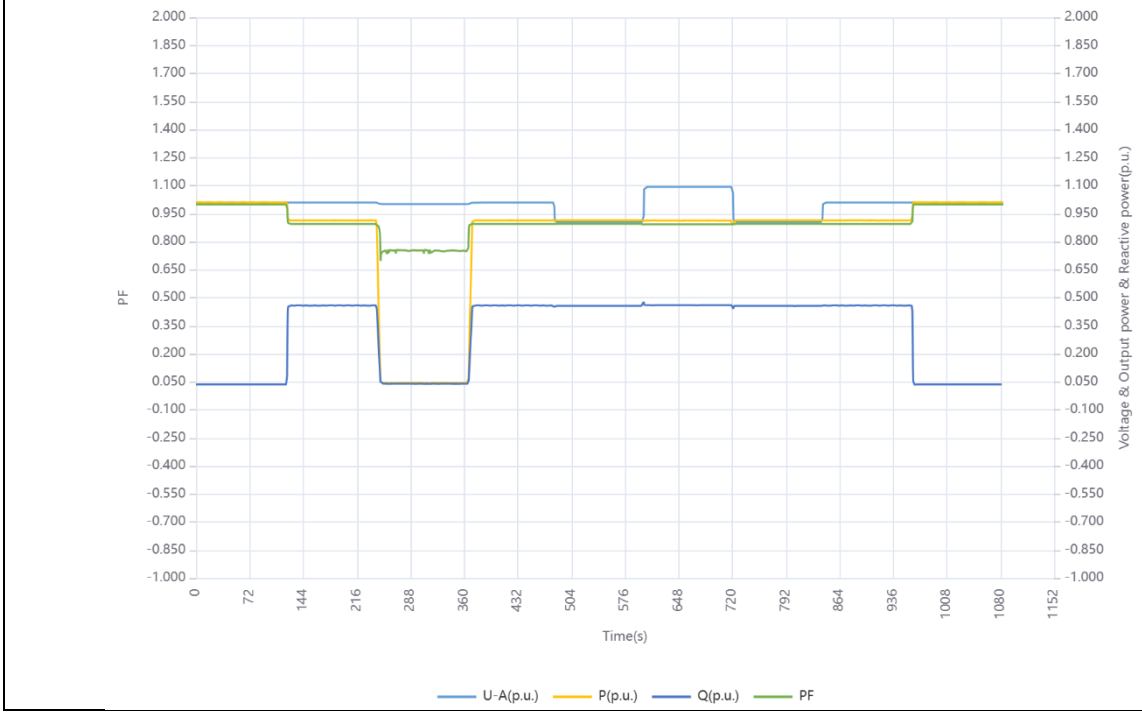


- **Test-11: $PF_{-mid,\ inj}$ & V_{dc-max}**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmax	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmax				X		Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmax				X		Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmax				X		Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmax				X		V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmax				X		V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmax				X		V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmax				X		>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmax				X		Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmax				X		<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmax				X		Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmax				X		Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	448.7	12676.4	1.009	--	--	1.002	--	--	1.010	0.036	1.011	0.999	60.000
2	465.7	11512.8	1.009	--	--	1.014	--	--	0.914	0.458	1.023	0.894	60.000
3	484.6	664.5	1.001	--	--	0.060	--	--	0.045	0.040	0.060	0.750	60.000
4	465.7	11508.4	1.009	--	--	1.014	--	--	0.914	0.459	1.023	0.894	60.000
5	465.4	11576.7	0.905	--	--	1.131	--	--	0.915	0.457	1.023	0.895	60.000
6	465.8	11478.3	1.093	--	--	0.935	--	--	0.913	0.460	1.023	0.893	60.000
7	465.4	11577.7	0.905	--	--	1.131	--	--	0.915	0.457	1.023	0.895	60.000
8	Skip												
9													
10													
11	465.7	11514.3	1.009	--	--	1.014	--	--	0.914	0.459	1.023	0.894	60.000
12	448.8	12675.3	1.009	--	--	1.001	--	--	1.010	0.036	1.011	0.999	60.000

Test cureve Over time

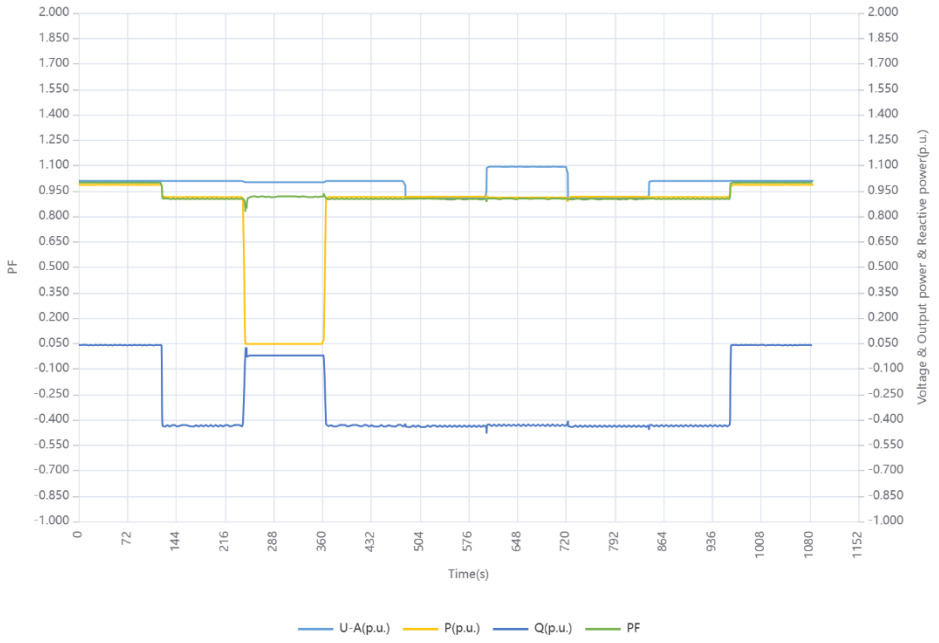


- **Test-12: $PF_{-mid,\ ab}$ & $V_{dc\text{-}max}$**

Step	Reactive/active power Function Condition (Enable/Disable)	Voltage_in (Vdc)	PF					Voltage_AC			P-output (%)
			PF-nom	PF-min,inj	PF-min,ab	PF-mid,inj	PF-mid,ab	Phase A	Phase B	Phase C	
Step 1	Disable	Vmax	X					Vnom	Vnom	Vnom	100%
Step 2	Enable	Vmax					X	Vnom	Vnom	Vnom	100%
Step 3	Enable	Vmax					X	Vnom	Vnom	Vnom	Pmin
Step 4	Enable	Vmax					X	Vnom	Vnom	Vnom	100%
Step 5	Enable	Vmax					X	V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 6	Enable	Vmax					X	V_{H-av}	V_{H-av}	V_{H-av}	100%
Step 7	Enable	Vmax					X	V_{L+av}	V_{L+av}	V_{L+av}	100%
Step 8	Enable	Vmax					X	>=1.07*Vnom	<=0.91*Vnom	<=0.91*Vnom	100%
Step 9	Enable	Vmax					X	Vnom	Vnom	Vnom	100%
Step 10	Enable	Vmax					X	<=0.91*Vnom	>=1.07*Vnom	>=1.07*Vnom	100%
Step 11	Enable	Vmax					X	Vnom	Vnom	Vnom	100%
Step 12	Disable	Vmax					X	Vnom	Vnom	Vnom	100%

Step	DC Input Measured		AC Output Measured										
	Vdc (V)	Pdc (W)	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	I1 (p.u.)	I2 (p.u.)	I3 (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	444.7	12249.4	1.009	--	--	0.977	--	--	0.985	0.039	0.986	0.999	60.000
2	464.4	11431.2	1.008	--	--	1.004	--	--	0.913	-0.436	1.012	0.902	60.000
3	488.4	677.8	1.001	--	--	0.052	--	--	0.047	-0.021	0.052	0.915	60.000
4	464.4	11431.1	1.008	--	--	1.004	--	--	0.914	-0.436	1.012	0.902	60.000
5	463.5	11531.8	0.904	--	--	1.123	--	--	0.915	-0.438	1.015	0.902	60.000
6	465.1	11351.8	1.093	--	--	0.924	--	--	0.911	-0.433	1.009	0.903	60.000
7	463.5	11532.7	0.904	--	--	1.123	--	--	0.915	-0.439	1.015	0.902	60.000
8	Skip												
9													
10													
11	464.4	11433.3	1.008	--	--	1.004	--	--	0.913	-0.436	1.012	0.902	60.000
12	445.1	12249.0	1.009	--	--	0.977	--	--	0.985	0.039	0.986	0.999	60.000

Test cureve Over time



4.14.2 Test for voltage-reactive power (volt-var) mode

This test verifies the EUT's operation with voltage-reactive power (volt-var) mode enabled is compliant with 5.3.3 of IEEE Std 1547-2018.

The parameters in Figure 9, Table 25, Table 26, and Table 27 define the volt-var characteristics to be tested.

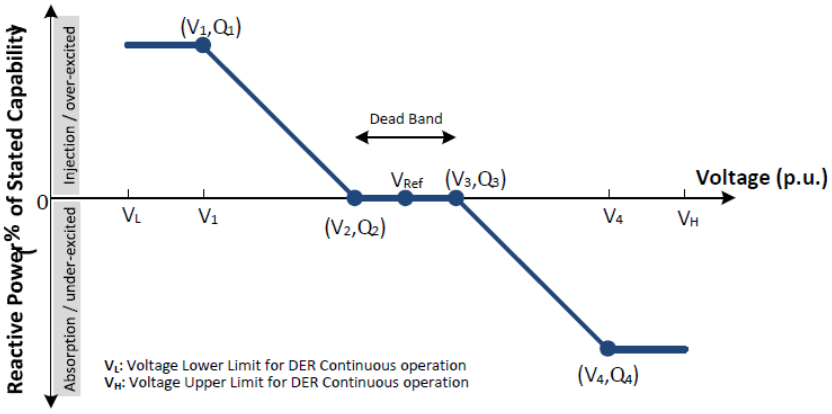


Figure 9—Example voltage-reactive power characteristic

Table 25—Characteristic 1:
Default voltage-reactive power settings for normal operating performance
Category A and Category B DER

Voltage-reactive power parameters	Default values for DER	
	Category A	Category B
V_{Ref}	V_N	V_N
V_2	V_N	0.98 V_N
Q_2	0	0
V_3	V_N	1.02 V_N
Q_3	0	0
V_1	0.9 V_N	0.92 V_N
Q_1	25% of nameplate apparent power rating, injection	44% of nameplate apparent power rating, injection
V_4	1.1 V_N	1.08 V_N
Q_4	25% of nameplate apparent power rating, absorption	44% of nameplate apparent power rating, absorption
Open loop response time, T_r	10 s	5 s

Table 26 —Characteristic 2:
Voltage-reactive power settings for normal operating performance
Category A and Category B DER

Voltage-reactive power parameters	Values for DER	
	Category A	Category B
V_{Ref}	1.05 V_N	1.05 V_N
V_2	1.04 V_N	1.04 V_N
Q_2	50% of nameplate reactive power capability, injection	50% of nameplate reactive power capability, injection
V_3	1.07 V_N	1.07 V_N
Q_3	50% of nameplate reactive power capability, injection	50% of nameplate reactive power capability, injection
V_1	0.88 V_N	0.88 V_N
Q_1[a]	100% of nameplate reactive power capability, injection	100% of nameplate reactive power capability, injection
V_4	1.1 V_N	1.1 V_N
Q_4	100% of nameplate reactive power capability, absorption	100% of nameplate reactive power capability, absorption
Open loop response time, T_r	1 s	1 s

Table 27—Characteristic 3:
Voltage-reactive power settings for normal operating performance
Category A and Category B DER

Voltage-reactive power parameters	Values for DER	
	Category A	Category B
V_{Ref}	0.95 V_N	0.95 V_N
V_2	0.93 V_N	0.93 V_N
Q_2	50% of nameplate reactive power capability, absorption	50% of nameplate reactive power capability, absorption
V_3	0.96 V_N	0.96 V_N
Q_3	50% of nameplate reactive power capability, absorption	50% of nameplate reactive power capability, absorption
V_1	0.9 V_N	0.9 V_N
Q_1[a]	100% of nameplate reactive power capability, injection	100% of nameplate reactive power capability, injection
V_4	1.1 V_N	1.1 V_N
Q_4	100% of nameplate reactive power capability, absorption	100% of nameplate reactive power capability, absorption
Open loop response time, T_r	90 s	90 s

As a guideline, at 2 times the open loop response time setting, the steady-state error is 1%;

After each voltage, the open loop response time, T_r, is evaluated. The expected reactive power output, $Q(T_r)$, at one time the open loop response time, is calculated as 90% × (Q_{final} – $Q_{initial}$) + $Q_{initial}$.

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/08/23 to 2025/08/25	100 ms	5 kHz

Note: Throughout the testing process, V_H=1.1Un and V_L=0.88Un were set.

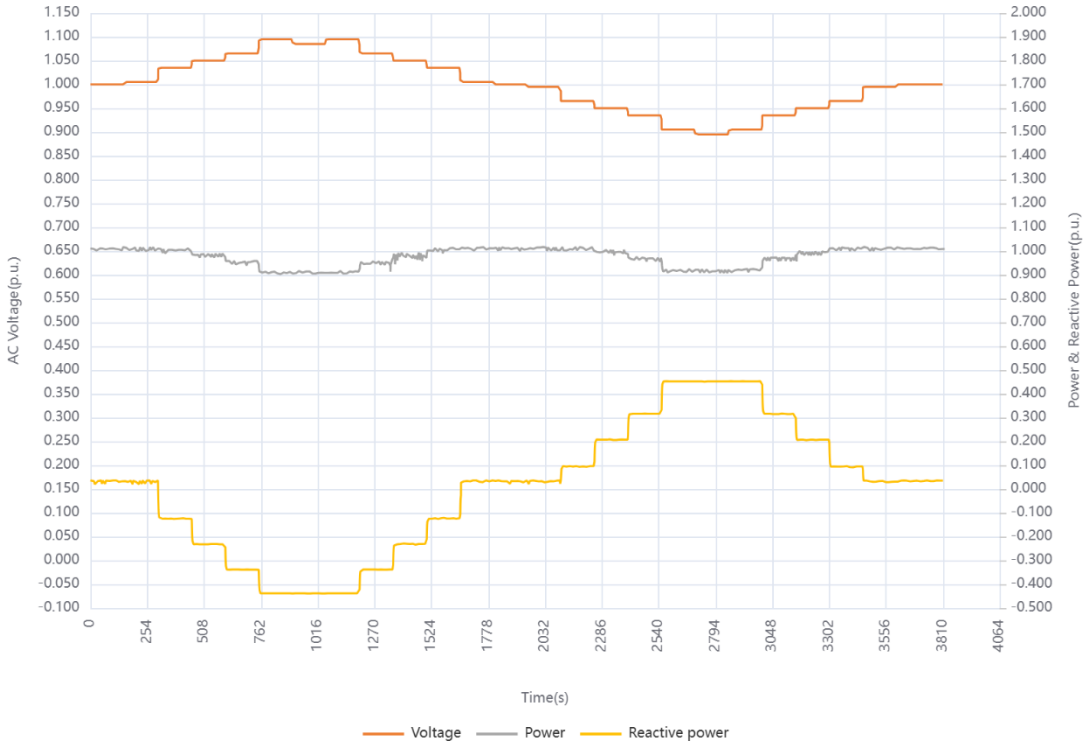
The EUT meets the following requirements.

#	Description	Direction for NRTL
1	Was the volt/var curve tested with reactive power priority enabled (Y or N)	Y
2	Was the volt/var curve tested with active power priority enabled? (Y, N, or N/A)	N

1) Characteristic 1_V_{ref} =1.0Un_100%Pn level: L1-L2:240V

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_{ref}	1.000	298.7	12677.5	1.000	1.011	1.011	0.031	1.011	1.000	60.000
2	V_3-a_v	1.005	298.7	12678.7	1.005	1.003	1.008	0.032	1.009	0.999	60.000
3	V_3+a_v	1.035	299.7	12663.7	1.035	0.971	1.005	-0.125	1.013	0.992	60.000
4	(V_3+V_4)/2	1.050	308.2	12409.1	1.050	0.936	0.983	-0.231	1.010	0.973	60.000
5	V_4-a_v	1.065	312.3	12016.2	1.065	0.897	0.956	-0.339	1.014	0.943	60.000
6	V_4+a_v	1.095	315.8	11497.9	1.095	0.829	0.908	-0.438	1.008	0.901	60.000
7	V_H-a_v	1.085	315.7	11501.0	1.085	0.840	0.912	-0.438	1.012	0.901	60.000
8	V_4+a_v	1.095	315.8	11495.6	1.095	0.833	0.912	-0.438	1.011	0.901	60.000
9	V_4-a_v	1.065	312.6	11995.8	1.065	0.893	0.951	-0.339	1.010	0.942	60.000
10	(V_3+V_4)/2	1.050	308.9	12371.9	1.050	0.933	0.979	-0.232	1.006	0.973	60.000
11	V_3+a_v	1.035	300.7	12662.2	1.035	0.973	1.007	-0.124	1.015	0.992	60.000
12	V_3-a_v	1.005	298.5	12676.6	1.005	1.004	1.009	0.034	1.010	0.999	60.000
13	V_{Ref}	1.000	299.2	12680.4	1.000	1.011	1.010	0.033	1.011	0.999	60.000
14	V_2+a_v	0.995	298.8	12677.2	0.995	1.015	1.010	0.031	1.010	1.000	60.000
15	V_2-a_v	0.965	298.2	12674.1	0.965	1.046	1.010	0.095	1.014	0.996	60.000
16	(V_2+V_1)/2	0.950	305.4	12546.5	0.950	1.047	0.995	0.207	1.016	0.979	60.000
17	V_1+a_v	0.935	310.6	12218.3	0.935	1.034	0.967	0.316	1.017	0.951	60.000
18	V_1-a_v	0.905	315.3	11598.2	0.905	1.014	0.918	0.452	1.023	0.897	60.000
19	V_L+a_v	0.895	315.2	11605.8	0.895	1.024	0.916	0.452	1.022	0.897	60.000
20	V_1-a_v	0.905	315.4	11599.0	0.905	1.015	0.918	0.452	1.024	0.897	60.000
21	V_1+a_v	0.935	310.5	12221.3	0.935	1.035	0.967	0.315	1.017	0.951	60.000
22	(V_2+V_1)/2	0.950	304.9	12547.3	0.950	1.054	1.001	0.207	1.022	0.979	60.000
23	V_2-a_v	0.965	298.3	12673.7	0.965	1.049	1.012	0.095	1.017	0.996	60.000
24	V_2+a_v	0.995	298.7	12675.3	1.000	1.012	1.012	0.033	1.013	0.999	60.000
25	V_{Ref}	1.000	299.4	12677.5	1.000	1.008	1.008	0.035	1.008	0.999	60.000

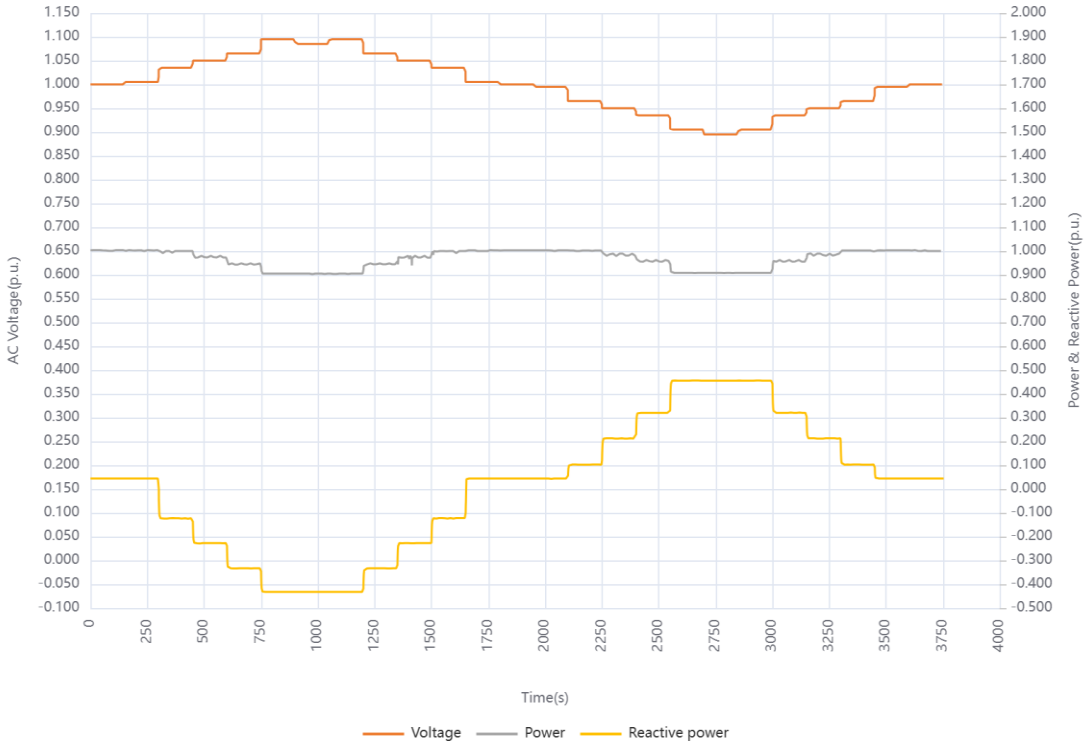
Volt-Var Over time



2) Characteristic 1_V_{ref} =1.0Un_100%Pn level: L1-L2:208V

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_{ref}	1.000	298.4	12678.6	1.000	0.997	1.003	0.044	1.004	0.999	60.000
2	V_3-a_v	1.005	298.6	12678.2	1.005	0.992	1.003	0.044	1.004	0.999	60.000
3	V_3+a_v	1.035	300.6	12664.2	1.035	0.967	0.999	-0.123	1.007	0.992	60.000
4	$(V_3+V_4)/2$	1.050	308.2	12407.2	1.050	0.951	0.979	-0.227	1.005	0.973	60.000
5	V_4-a_v	1.065	312.4	12015.9	1.065	0.937	0.947	-0.333	1.004	0.942	60.000
6	V_4+a_v	1.095	315.7	11497.8	1.095	0.911	0.905	-0.432	1.003	0.900	60.000
7	V_H-a_v	1.085	315.8	11500.9	1.085	0.919	0.905	-0.432	1.003	0.900	60.000
8	V_4+a_v	1.095	315.7	11498.9	1.095	0.911	0.905	-0.432	1.003	0.900	60.000
9	V_4-a_v	1.065	312.5	12018.7	1.065	0.937	0.947	-0.333	1.004	0.942	60.000
10	$(V_3+V_4)/2$	1.050	308.2	12406.7	1.050	0.951	0.979	-0.227	1.005	0.973	60.000
11	V_3+a_v	1.035	300.7	12661.6	1.035	0.967	0.999	-0.123	1.006	0.992	60.000
12	V_3-a_v	1.005	298.8	12677.6	1.005	0.992	1.003	0.044	1.004	0.999	60.000
13	V_{Ref}	1.000	298.5	12676.6	1.000	0.997	1.003	0.044	1.003	0.999	60.000
14	V_2+a_v	0.995	299.2	12678.1	0.995	1.002	1.003	0.044	1.004	0.999	60.000
15	V_2-a_v	0.965	298.4	12676.0	0.965	1.036	1.002	0.102	1.007	0.995	60.000
16	$(V_2+V_1)/2$	0.950	305.4	12548.2	0.950	1.055	0.988	0.213	1.011	0.979	60.000
17	V_1+a_v	0.935	310.3	12216.5	0.935	1.074	0.961	0.320	1.013	0.951	60.000
18	V_1-a_v	0.905	315.3	11598.3	0.905	1.112	0.908	0.455	1.016	0.897	60.000
19	V_L+a_v	0.895	315.2	11605.6	0.895	1.124	0.908	0.455	1.015	0.897	60.000
20	V_1-a_v	0.905	315.4	11600.9	0.905	1.112	0.908	0.455	1.016	0.897	60.000
21	V_1+a_v	0.935	310.5	12220.3	0.935	1.074	0.961	0.320	1.013	0.950	60.000
22	$(V_2+V_1)/2$	0.950	305.4	12547.2	0.950	1.055	0.988	0.213	1.011	0.979	60.000
23	V_2-a_v	0.965	298.6	12678.2	0.965	1.036	1.002	0.103	1.007	0.995	60.000
24	V_2+a_v	0.995	298.6	12675.5	0.995	1.001	1.002	0.044	1.003	0.999	60.000
25	V_{Ref}	1.000	298.8	12676.6	1.000	0.997	1.003	0.044	1.004	0.999	60.000

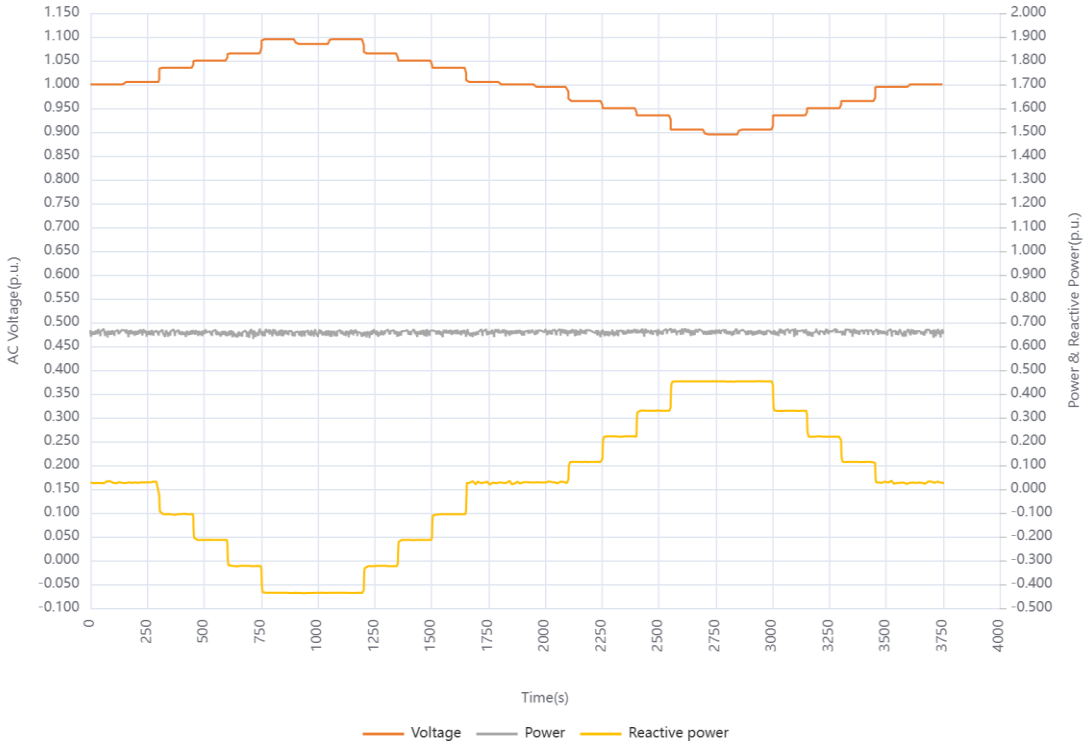
Volt-Var Over time



3) Characteristic 1_V_{ref} =1.0Un_66%Pn level:

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_{ref}	1.000	325.7	8339.4	1.000	0.661	0.664	0.027	0.664	0.999	60.000
2	V_3-a_v	1.005	325.7	8330.8	1.005	0.657	0.664	0.028	0.664	0.999	60.000
3	V_3+a_v	1.035	325.7	8339.2	1.035	0.645	0.662	-0.106	0.671	0.987	60.000
4	(V_3+V_4)/2	1.050	325.6	8354.6	1.050	0.659	0.661	-0.214	0.695	0.951	60.000
5	V_4-a_v	1.065	325.6	8386.2	1.065	0.690	0.664	-0.324	0.738	0.899	60.000
6	V_4+a_v	1.095	325.5	8411.1	1.095	0.723	0.664	-0.436	0.795	0.836	60.000
7	V_H-a_v	1.085	325.5	8415.3	1.085	0.729	0.664	-0.437	0.795	0.836	60.000
8	V_4+a_v	1.095	325.5	8406.5	1.095	0.723	0.663	-0.436	0.794	0.836	60.000
9	V_4-a_v	1.065	325.6	8383.9	1.065	0.691	0.663	-0.323	0.737	0.899	60.000
10	(V_3+V_4)/2	1.050	325.6	8357.8	1.050	0.662	0.666	-0.214	0.700	0.952	60.000
11	V_3+a_v	1.035	325.7	8339.1	1.035	0.646	0.663	-0.106	0.671	0.988	60.000
12	V_3-a_v	1.005	325.7	8333.5	1.005	0.659	0.666	0.026	0.666	0.999	60.000
13	V_{Ref}	1.000	325.7	8347.4	1.000	0.662	0.665	0.026	0.665	0.999	60.000
14	V_2+a_v	0.995	325.7	8335.6	0.995	0.665	0.666	0.027	0.666	0.999	60.000
15	V_2-a_v	0.965	325.7	8338.8	0.965	0.695	0.665	0.114	0.674	0.986	60.000
16	(V_2+V_1)/2	0.950	325.6	8364.2	0.950	0.734	0.666	0.221	0.702	0.949	60.000
17	V_1+a_v	0.935	325.6	8388.2	0.935	0.790	0.667	0.329	0.744	0.897	60.000
18	V_1-a_v	0.905	325.5	8443.6	0.905	0.886	0.670	0.452	0.808	0.829	60.000
19	V_L+a_v	0.895	325.5	8435.2	0.895	0.893	0.668	0.452	0.806	0.828	60.000
20	V_1-a_v	0.905	325.5	8444.2	0.905	0.884	0.667	0.452	0.806	0.828	60.000
21	V_1+a_v	0.935	325.6	8386.3	0.935	0.789	0.667	0.329	0.743	0.897	60.000
22	(V_2+V_1)/2	0.950	325.6	8363.1	0.950	0.733	0.667	0.220	0.702	0.949	60.000
23	V_2-a_v	0.965	325.6	8355.5	0.965	0.696	0.667	0.114	0.676	0.986	60.000
24	V_2+a_v	0.995	325.7	8339.1	0.995	0.664	0.664	0.026	0.664	0.999	60.000
25	V_{Ref}	1.000	325.7	8325.6	1.000	0.661	0.665	0.026	0.666	0.999	60.000

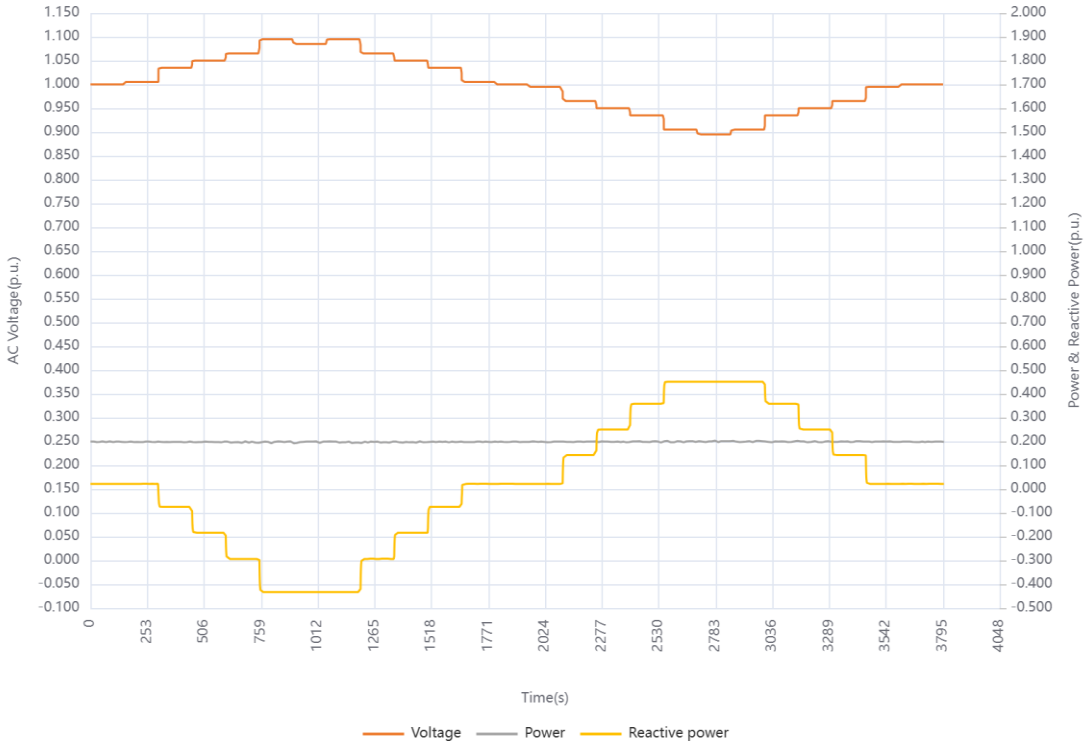
Volt-Var Over time



4) Characteristic 1_V_{ref}=1.0Un_20%Pn level:

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	Vref	1.000	318.9	2556.1	1.000	0.199	0.199	0.021	0.200	0.994	60.000
2	V3-av	1.005	318.9	2556.9	1.005	0.198	0.198	0.022	0.200	0.994	60.000
3	V3+av	1.035	318.7	2569.1	1.035	0.204	0.198	-0.075	0.212	0.934	60.000
4	(V3+V4)/2	1.050	318.2	2591.8	1.050	0.257	0.197	-0.184	0.270	0.731	60.000
5	V4-av	1.065	317.5	2620.9	1.065	0.332	0.197	-0.294	0.354	0.557	60.000
6	V4+av	1.095	316.6	2665.3	1.095	0.434	0.199	-0.433	0.476	0.417	60.000
7	VH-av	1.085	316.7	2666.0	1.085	0.438	0.197	-0.433	0.476	0.414	60.000
8	V4+av	1.095	316.8	2664.5	1.095	0.434	0.196	-0.433	0.475	0.413	60.000
9	V4-a	1.065	317.6	2620.2	1.065	0.331	0.197	-0.293	0.353	0.557	60.000
10	(V3+V4)/2	1.050	318.1	2591.5	1.050	0.256	0.197	-0.184	0.269	0.732	60.000
11	V3+av	1.035	318.7	2568.0	1.035	0.204	0.198	-0.075	0.212	0.935	60.000
12	V3-av	1.005	318.9	2556.4	1.005	0.198	0.198	0.022	0.199	0.994	60.000
13	VRef	1.000	319.0	2556.5	1.000	0.199	0.198	0.021	0.200	0.994	60.000
14	V2+av	0.995	319.0	2556.0	0.995	0.200	0.198	0.021	0.199	0.994	60.000
15	V2-av	0.965	319.0	2556.9	0.965	0.253	0.199	0.143	0.245	0.812	60.000
16	(V2+V1)/2	0.950	318.7	2571.5	0.950	0.335	0.198	0.250	0.319	0.621	60.000
17	V1+av	0.935	318.2	2603.6	0.935	0.437	0.198	0.358	0.409	0.484	60.000
18	V1-av	0.905	317.5	2644.0	0.905	0.543	0.199	0.451	0.493	0.404	60.000
19	VL+av	0.895	317.3	2647.9	0.895	0.549	0.200	0.451	0.493	0.406	60.000
20	V1-av	0.905	317.4	2643.5	0.905	0.544	0.201	0.451	0.494	0.407	60.000
21	V1+av	0.935	318.2	2603.1	0.935	0.437	0.199	0.358	0.410	0.486	60.000
22	(V2+V1)/2	0.950	318.7	2571.6	0.950	0.335	0.198	0.250	0.318	0.621	60.000
23	V2-av	0.965	319.0	2557.0	0.965	0.253	0.199	0.143	0.245	0.813	60.000
24	V2+av	0.995	319.0	2557.0	0.999	0.199	0.198	0.021	0.199	0.994	60.000
25	VRef	1.000	318.9	2556.1	1.000	0.199	0.199	0.021	0.200	0.994	60.000

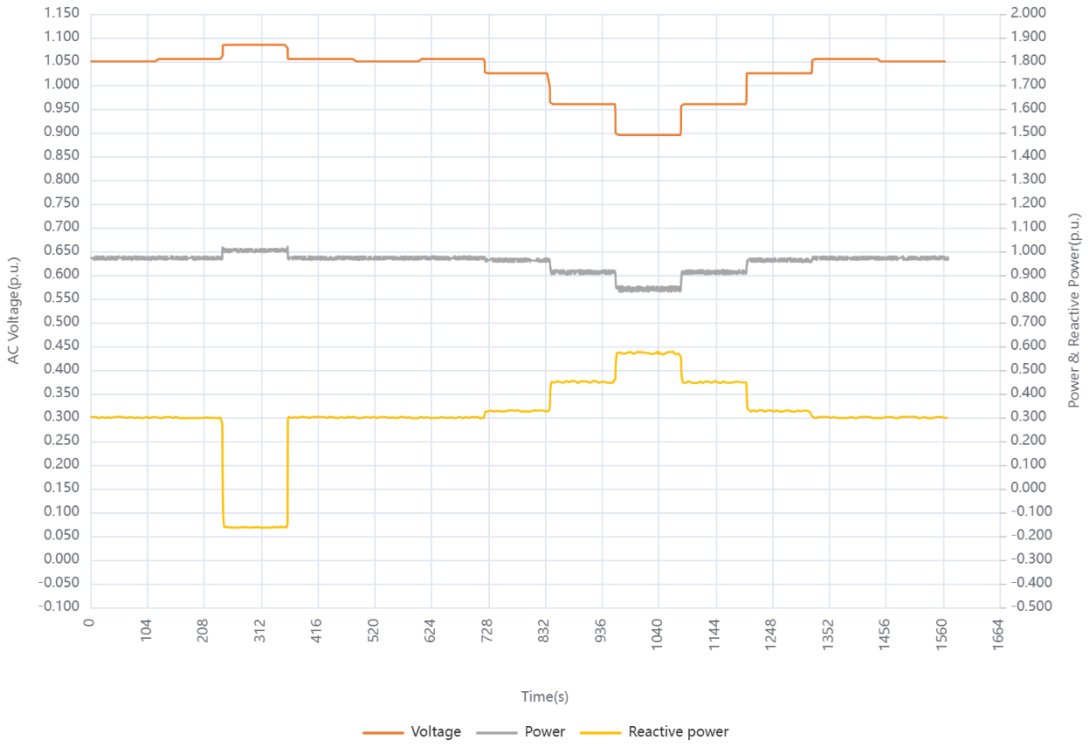
Volt-Var Over time



5) Characteristic 2_V_{ref} =1.05Un_100%Pn level:

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_H	1.050	300.0	12075.4	1.050	0.924	0.971	0.300	1.016	0.955	60.000
2	V_3-a_v	1.055	300.0	12084.7	1.055	0.920	0.972	0.297	1.016	0.956	60.000
3	V_3+a_v	1.085	300.0	12483.0	1.085	0.925	1.004	-0.162	1.017	0.987	60.000
4	$(V_3+V_4)/2$	1.085	Skip, same voltage step with step 3								
5	V_4-a_v	1.085	Skip, V4 is not less than V_H, also same voltage steps with step 3								
6	V_4+a_v	1.085									
7	V_H-a_v	1.085	Skip, same voltage step with step 3								
8	V_4+a_v	1.085	Skip, If V4 is not less than V_H, also same voltage steps with step 3								
9	V_4-a_v	1.085									
10	$(V_3+V_4)/2$	1.085	Skip, same voltage step with step 3								
11	V_3+a_v	1.085									
12	V_3-a_v	1.055	300.0	12080.9	1.055	0.920	0.971	0.300	1.017	0.956	60.000
13	V_{Ref}	1.050	300.0	12073.1	1.050	0.924	0.971	0.300	1.016	0.955	60.000
14	V_2+a_v	1.055	300.0	12080.0	1.055	0.921	0.971	0.300	1.017	0.956	60.000
15	V_2-a_v	1.025	300.0	11975.1	1.025	0.939	0.963	0.327	1.017	0.947	60.000
16	$(V_2+V_1)/2$	0.960	300.0	11344.2	0.960	0.950	0.912	0.449	1.017	0.897	60.000
17	V_1+a_v	0.895	Skip, V1 is not greater than V_L								
18	V_1-a_v	0.865									
19	V_L+a_v	0.895	300.0	10461.7	0.895	0.940	0.841	0.571	1.017	0.827	60.000
20	V_1-a_v	0.895	Skip, V1 is not greater than V_L								
21	V_1+a_v	0.895	Skip, same voltage step with step 19								
22	$(V_2+V_1)/2$	0.960	300.0	11345.7	0.960	0.950	0.912	0.449	1.017	0.897	60.000
23	V_2-a_v	1.025	300.0	11972.4	1.025	0.939	0.963	0.327	1.017	0.947	60.000
24	V_2+a_v	1.055	300.0	12080.6	1.054	0.921	0.971	0.300	1.017	0.955	60.000
25	V_{Ref}	1.050	300.0	12083.8	1.050	0.925	0.972	0.300	1.017	0.956	60.000

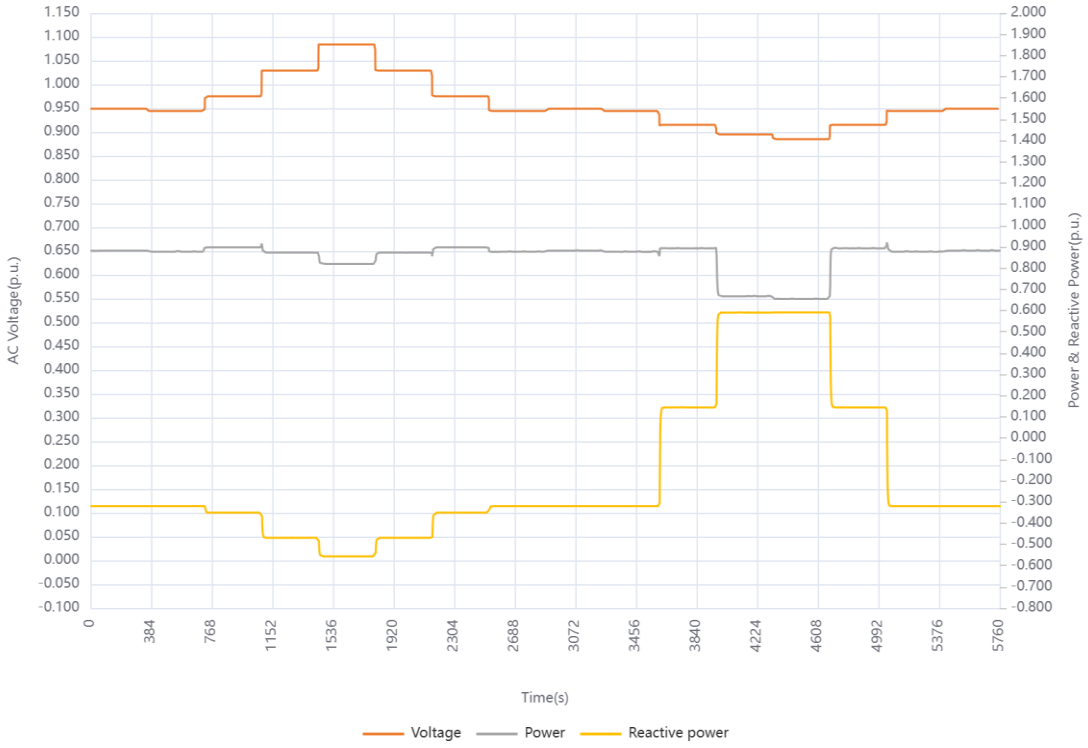
Volt-Var Over time



6) Characteristic 3_V_{ref} =0.95Un_100%Pn level:

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_{ref}	0.950	316.9	11188.5	0.949	0.988	0.882	-0.321	0.938	0.940	60.000
2	V_3-a_v	0.945	317.2	11127.1	0.944	0.989	0.877	-0.321	0.934	0.939	60.000
3	V_3+a_v	0.975	316.0	11370.2	0.975	0.988	0.897	-0.351	0.963	0.931	60.000
4	(V_3+V_4)/2	1.030	317.4	11071.6	1.029	0.963	0.873	-0.470	0.991	0.881	60.000
5	V_4-a_v	1.085	Skip, V4 is not less than V_H								
6	V_4+a_v	1.115									
7	V_H-a_v	1.085	320.0	10410.3	1.084	0.913	0.819	-0.557	0.991	0.827	60.000
8	V_4+a_v	1.115	Skip, V4 is not less than V_H								
9	V_4-a_v	1.085									
10	(V_3+V_4)/2	1.030	317.4	11071.5	1.029	0.963	0.873	-0.470	0.991	0.881	60.000
11	V_3+a_v	0.975	316.0	11369.1	0.975	0.988	0.897	-0.351	0.963	0.931	60.000
12	V_3-a_v	0.945	317.2	11129.3	0.944	0.989	0.877	-0.321	0.934	0.939	60.000
13	V_{Ref}	0.950	316.9	11188.4	0.949	0.988	0.882	-0.321	0.938	0.940	60.000
14	V_2+a_v	0.945	317.2	11127.7	0.944	0.989	0.877	-0.321	0.934	0.939	60.000
15	V_2-a_v	0.915	316.3	11313.9	0.915	0.988	0.893	0.144	0.904	0.987	60.000
16	(V_2+V_1)/2	0.915	Skip, same voltage step with step 15								
17	V_1+a_v	0.915									
18	V_1-a_v	0.885	Skip, V1 is greater than V_L								
19	V_L+a_v	0.895	324.7	8582.2	0.895	0.996	0.667	0.590	0.891	0.749	60.000
20	V_1-a_v	0.885	325.0	8423.0	0.885	0.996	0.654	0.591	0.882	0.742	60.000
21	V_1+a_v	0.915	316.3	11313.6	0.915	0.988	0.892	0.144	0.904	0.987	60.000
22	(V_2+V_1)/2	0.915	Skip, same voltage step with step 21								
23	V_2-a_v	0.915									
24	V_2+a_v	0.945	317.2	11130.3	0.944	0.989	0.877	-0.321	0.934	0.939	60.000
25	V_{Ref}	0.950	316.9	11190.1	0.949	0.988	0.882	-0.321	0.938	0.940	60.000

Volt-Var Over time



4.14.3 Test for voltage-reactive power (volt-var) mode (Vref test)

This test verifies the EUT's operation with voltage-reactive power (volt-var) mode enabled is compliant with 5.3.3 of IEEE Std 1547-2018. This test verifies the EUT's response to changes in voltage magnitude when connected to *a ac test source* with an autonomously adjusting reference voltage, V_{Ref}.

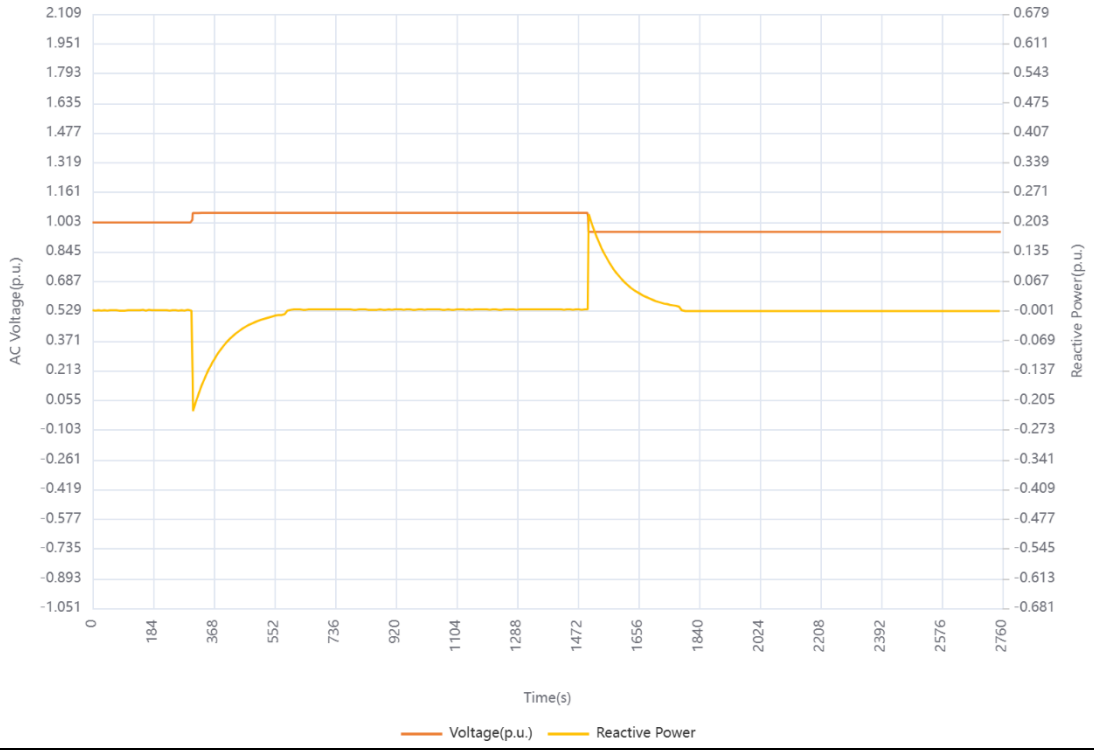
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/08/21 to 2025/08/24	100 ms	5 kHz

1) Characteristic 1_V_{ref}_Tref=300s

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (w)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_{ref}	1.000	300.33	12405.80	1.000	0.991	0.991	0.001	0.992	1.000	60.000
2	$(V_3+V_4)/2$	1.050	300.20	12414.10	1.051	0.945	0.993	0.003	0.994	1.000	60.000
3	$(V_1+V_2)/2$	0.950	300.27	12398.30	0.950	1.040	0.989	-0.001	0.989	1.000	60.000

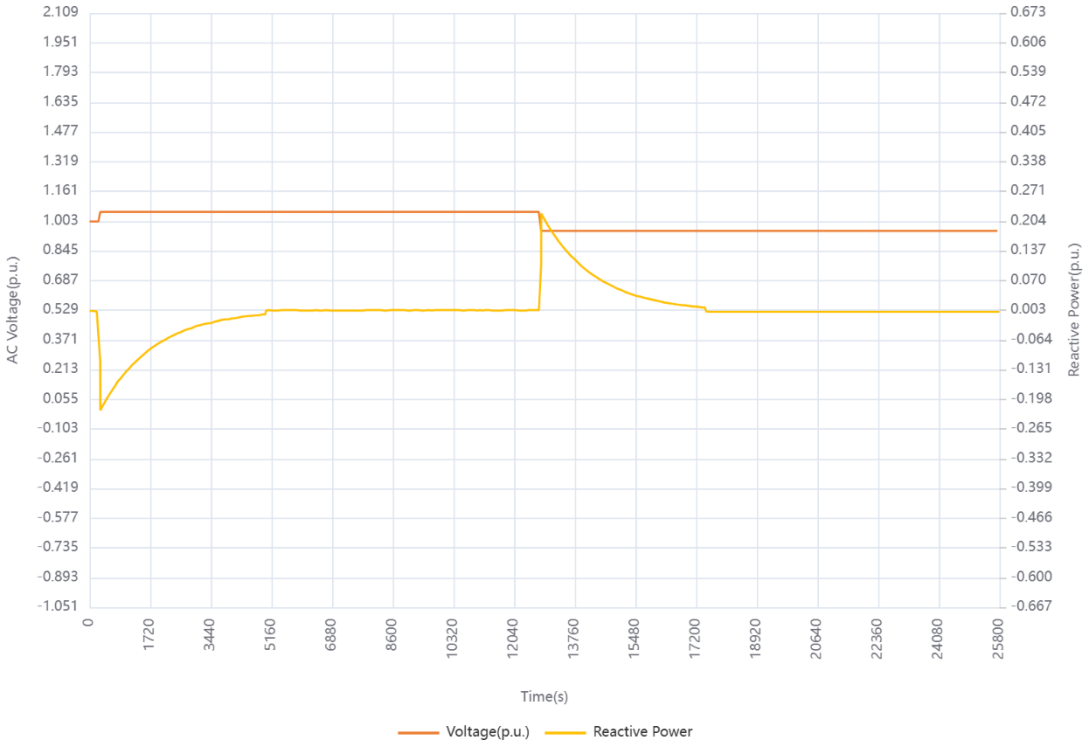
Volt-Var Over time



2) Characteristic 1_V_{ref}_Tref=5000s

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (w)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_{ref}	1.000	300.68	12393.40	1.000	0.993	0.989	0.001	0.990	1.000	60.000
2	$(V_3+V_4)/2$	1.050	298.93	12401.30	1.051	0.947	0.991	0.003	0.992	1.000	60.000
3	$(V_1+V_2)/2$	0.950	301.79	12383.30	0.950	1.043	0.988	-0.001	0.988	1.000	60.000

Volt-Var Over time



4.14.4Test for voltage-reactive power (volt-var) mode with an imbalanced grid

This test verifies the EUT's operation with voltage-reactive power (volt-var) mode enabled is compliant with 5.3.3 of IEEE Std 1547-2018 during voltage disturbances within the continuous operation range defined in 6.4.2.2 of IEEE Std 1547-2018 with an imbalanced grid (i.e., with a nonzero negative sequence component).

EUT volt-var parameters to the values specified by the default volt-var settings in Characteristic 1. All other function should be turned off. Turn off the autonomously adjusting reference voltage.

Table 24—Imbalanced voltage test cases

	Phase A (p.u.)	Phase B (p.u.)	Phase C (p.u.)
Case A	≥1.07	≤0.91	≤0.91
Case B	≤0.91	≥1.07	≥1.07

NOTE—Choose any phase as A, B, or C. Order does not matter.

Voltage-reactive power (volt-var) mode respond according to:	
☐	individual phase voltages
☐	the average of the three-phase effective (rms) values
☒	the positive sequence of voltages

Not applicable. This test is not applicable to single phase.

4.14.5 Test for active power-reactive power mode (watt-var)

This test verifies the EUT's operation with active power-reactive power (watt-var) mode enabled is compliant with 5.3.4 of IEEE Std 1547-2018.

The parameters in Figure 10, Table 28, Table 29, and Table 30 define a watt-var characteristic to be tested.

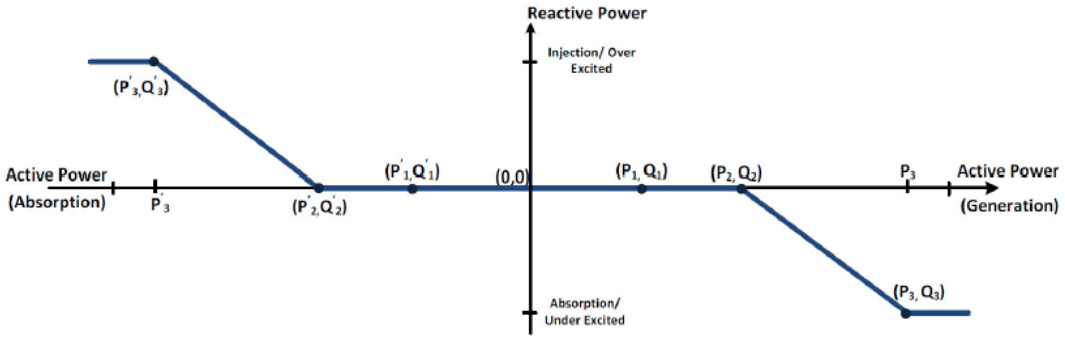


Figure 10—Example active power-reactive power characteristic

Table 28—Characteristic 1:
Default active power-reactive power settings for normal operating performance Category A and Category B DER

Active power-reactive power parameters	Default values for DER	
	Category A	Category B
P_3	P_{rated}	
P_2	0.5 P_{rated}	
P_1	The greater of 0.2 P_{rated} and P_{min}	
P'_1	The lesser of 0.2 P'_{rated} and P'_{min}	
P'_2	0.5 P'_{rated}	
P'_3	P'_{rated}	
Q_3	25% of nameplate apparent power rating, absorption	44% of nameplate apparent power rating, absorption
Q_2	0	
Q_1	0	
Q'_1	0	
Q'_2	0	
Q'_3	44% of nameplate apparent power rating, injection	

NOTE—P_{rated} is the nameplate active power rating of the DER.
P'_{rated} is the maximum active power that the DER can absorb.
P_{min} is the minimum active power output of the DER.
P'_{min} is the minimum, in amplitude, active power that the DER can absorb.
P' parameters are negative in value.

Table 29—Characteristic 2:
Active power-reactive power settings for normal operating performance
Category A and Category B DER

Active power-reactive power parameters	Values for DER	
	Category A	Category B
P_3	P_{rated}	
P_2	0.5 P_{rated}	
P_1	The greater of 0.2 P_{rated} and P_{min}	
P'_1	The lesser of 0.2 P'_{rated} and P'_{min}	
P'_2	0.5 P'_{rated}	
P'_3	P'_{rated}	
Q_3	25% of nameplate apparent power rating, absorption	44% of nameplate apparent power rating, absorption
Q_2	13% of nameplate apparent power rating, absorption	22% of nameplate apparent power rating, absorption
Q_1	13% of nameplate apparent power rating, absorption	22% of nameplate apparent power rating, absorption
Q'_1	22% of nameplate apparent power rating, injection	
Q'_2	22% of nameplate apparent power rating, injection	
Q'_3	44% of nameplate apparent power rating, injection	
NOTE—P_{rated} is the nameplate active power rating of the DER. P'_{rated} is the maximum active power that the DER can absorb. P_{min} is the minimum active power output of the DER. P'_{min} is the minimum, in amplitude, active power that the DER can absorb. P' parameters are negative in value.		

Table 30—Characteristic 3:
Active power-reactive power settings for normal operating performance
Category A and Category B DER

Active power-reactive power parameters	Values for DER	
	Category A	Category B
P_3	P_{rated}	
P_2	0.5 P_{rated}	
P_1	The greater of 0.2 P_{rated} and P_{min}	
P'_1	The lesser of 0.2 P'_{rated} and P'_{min}	
P'_2	0.5 P'_{rated}	
P'_3	P'_{rated}	
Q_3	25% of nameplate apparent power rating, absorption	44% of nameplate apparent power rating, absorption
Q_2	25% of nameplate apparent power rating, absorption	44% of nameplate apparent power rating, absorption
Q_1	0	
Q'_1	0	
Q'_2	44% of nameplate apparent power rating, injection	
Q'_3	44% of nameplate apparent power rating, injection	
NOTE—P_{rated} is the nameplate active power rating of the DER. P'_{rated} is the maximum active power that the DER can absorb. P_{min} is the minimum active power output of the DER. P'_{min} is the minimum, in amplitude, active power that the DER can absorb. P' parameters are negative in value.		

Set EUT watt-var parameters to the values specified by Characteristic 1. All other functions should be turned off.

Measurement equipment settings used for this test are shown in the following table:

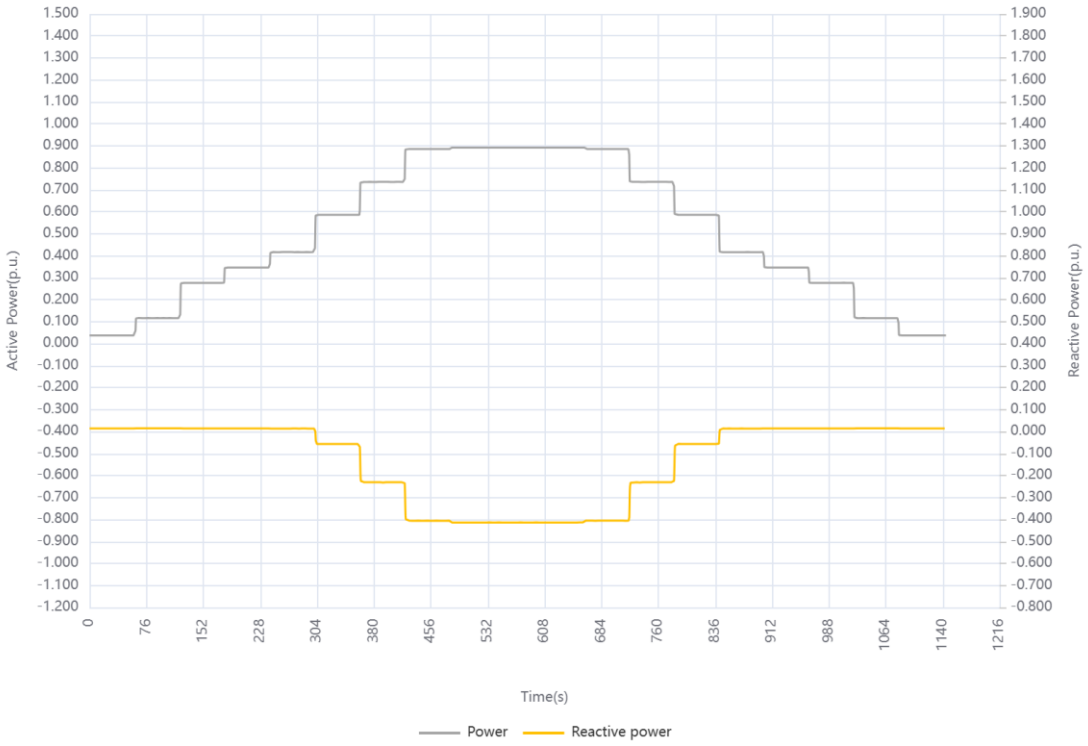
Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/08/23	100 ms	5 kHz

1) Characteristics 1_ Generating Active Power Direction

Step		P_{set} (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	$Q_{desired}$ (p.u.)	Q (p.u.)	PF	F (Hz)
1	P_{min}	0.005	50.0	-597.9	0.999	0.049	0.037	0.000	0.014	0.762	60.00
2	P_1-a_p	0.125	49.9	-1573.9	1.000	0.121	0.117	0.000	0.015	0.961	60.00
3	P_1+a_p	0.275	49.8	-3569.4	1.000	0.279	0.277	0.000	0.014	0.992	60.00
4	(P_1+P_2)/2	0.350	49.8	-4451.1	1.001	0.348	0.347	0.000	0.014	0.994	60.00
5	P_2-a_p	0.425	49.7	-5344.4	1.001	0.418	0.417	0.000	0.013	0.996	60.00
6	P_2+a_p	0.575	49.6	-7543.0	1.002	0.589	0.586	-0.076	-0.057	0.993	60.00
7	(P_2+P_3)/2	0.750	49.5	-9555.0	1.002	0.771	0.736	-0.208	-0.231	0.952	60.00
8	P_3-a_p	0.925	49.4	-11650.2	1.003	0.975	0.887	-0.341	-0.408	0.907	60.00
9	P_3+a_p (*)	1.075	49.4	-11719.6	1.003	0.982	0.892	-0.345	-0.414	0.906	60.00
10	P_{rated}	1.000	49.4	-11722.3	1.003	0.982	0.892	-0.345	-0.414	0.906	60.00
11	P_3+a_p (*)	1.075	49.4	-11692.2	1.003	0.979	0.890	-0.343	-0.411	0.907	60.00
12	P_3-a_p	0.925	49.4	-10950.4	1.003	0.906	0.836	-0.296	-0.349	0.922	60.00
13	(P_2+P_3)/2	0.750	49.5	-9560.3	1.002	0.770	0.735	-0.207	-0.231	0.952	60.00
14	P_2+a_p	0.575	49.6	-7545.1	1.002	0.588	0.585	-0.075	-0.057	0.993	60.00
15	P_2-a_p	0.425	49.7	-5344.4	1.001	0.418	0.416	0.000	0.013	0.996	60.00
16	(P_1+P_2)/2	0.350	49.8	-4449.1	1.001	0.348	0.346	0.000	0.014	0.994	60.00
17	P_1+a_p	0.275	49.8	-3565.0	1.000	0.278	0.276	0.000	0.014	0.992	60.00
18	P_1-a_p	0.125	49.9	-1571.7	1.000	0.121	0.116	0.000	0.015	0.960	60.00
19	P_{min}	0.005	49.9	-594.3	0.999	0.049	0.037	0.000	0.014	0.757	60.00

(*) Limited by max. active power rating, these steps only can reach 100%Pn.

Test Results Over time

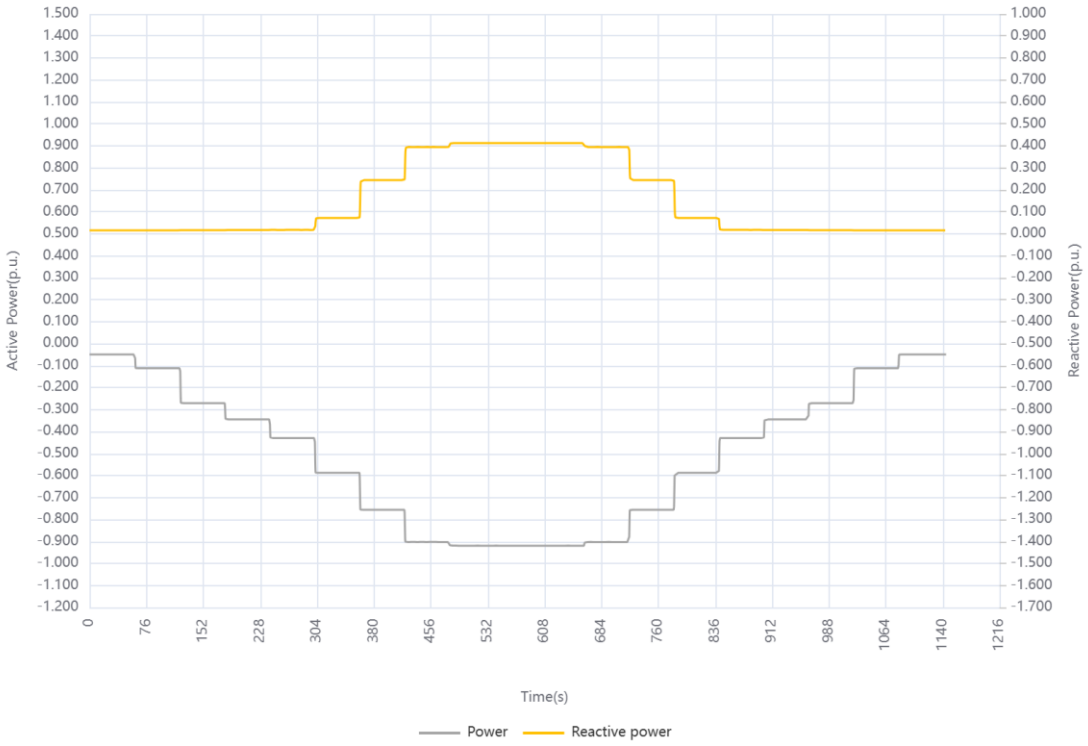


2) Characteristics 1_ Absorpting Active Power Direction

Step		P_{set} (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	$Q_{desired}$ (p.u.)	Q (p.u.)	PF	F (Hz)
1	P'_{min}	-0.005	50.0	435.1	0.999	0.060	-0.050	0.000	0.015	-0.830	60.00
2	P'_1+a_p	-0.125	50.0	1170.5	0.999	0.118	-0.113	0.000	0.015	-0.956	60.00
3	P'_1-a_p	-0.275	50.1	2999.2	0.998	0.275	-0.272	0.000	0.016	-0.990	60.00
4	$(P'_1+P'_2)/2$	-0.350	50.2	3835.0	0.998	0.348	-0.345	0.000	0.017	-0.994	60.00
5	P'_2+a_p	-0.425	50.2	4787.7	0.997	0.433	-0.430	0.000	0.017	-0.995	60.00
6	P'_2-a_p	-0.575	50.3	6543.1	0.996	0.596	-0.588	0.077	0.072	-0.990	60.00
7	$(P'_2+P'_3)/2$	-0.750	50.4	8355.1	0.996	0.800	-0.756	0.225	0.244	-0.950	60.00
8	P'_3+a_p	-0.925	50.5	9953.1	0.995	0.999	-0.908	0.359	0.400	-0.914	60.00
9	P'_3-a_p (*)	-1.075	50.5	10070.9	0.995	1.014	-0.920	0.370	0.412	-0.912	60.00
10	P'_{rated}	-1.000	50.5	10070.6	0.995	1.014	-0.920	0.370	0.412	-0.912	60.00
11	P'_3-a_p (*)	-1.075	50.5	10011.5	0.995	1.007	-0.914	0.364	0.406	-0.913	60.00
12	P'_3+a_p	-0.925	50.4	9383.8	0.995	0.928	-0.854	0.312	0.345	-0.926	60.00
13	$(P'_2+P'_3)/2$	-0.750	50.4	8351.1	0.996	0.799	-0.756	0.225	0.244	-0.950	60.00
14	P'_2-a_p	-0.575	50.3	6540.3	0.996	0.596	-0.588	0.077	0.072	-0.990	60.00
15	P'_2+a_p	-0.425	50.2	4786.8	0.997	0.433	-0.430	0.000	0.018	-0.995	60.00
16	$(P'_1+P'_2)/2$	-0.350	50.2	3833.8	0.998	0.348	-0.345	0.000	0.017	-0.994	60.00
17	P'_1-a_p	-0.275	50.1	2993.8	0.998	0.274	-0.271	0.000	0.016	-0.990	60.00
18	P'_1+a_p	-0.125	50.0	1169.1	0.999	0.118	-0.112	0.000	0.015	-0.956	60.00
19	P'_{min}	-0.005	50.0	433.6	0.999	0.059	-0.049	0.000	0.015	-0.829	60.00

(*) Limited by max. active power rating, these steps only can reach -100%Pn.

Test Results Over time

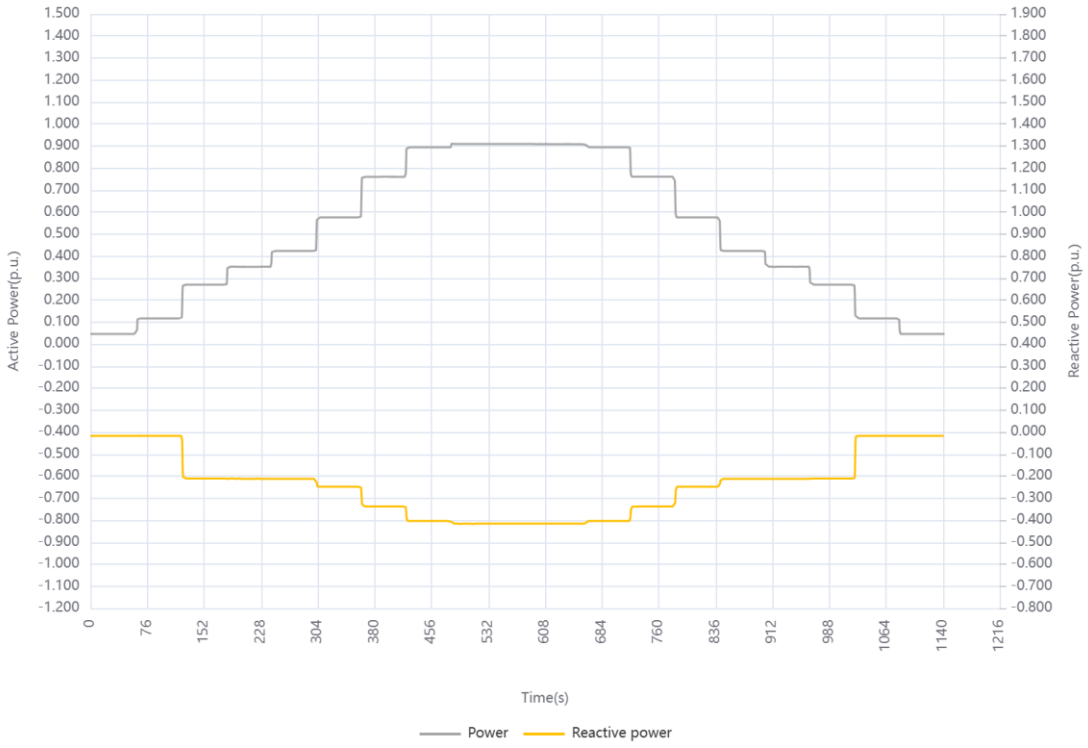


3) Characteristics 2_ Generating Active Power Direction

Step		P_{set} (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	$Q_{desired}$ (p.u.)	Q (p.u.)	PF	F (Hz)
1	P_{min}	0.005	50.0	691.3	1.001	0.046	0.046	0.000	-0.017	0.940	60.00
2	P_1-a_p	0.125	49.9	1561.8	1.001	0.117	0.117	0.000	-0.017	0.989	60.00
3	P_1+a_p	0.275	49.8	3498.0	1.002	0.270	0.270	-0.220	-0.211	0.787	60.00
4	(P_1+P_2)/2	0.350	49.7	4522.4	1.003	0.351	0.352	-0.220	-0.212	0.856	60.00
5	P_2-a_p	0.425	49.6	5429.6	1.003	0.422	0.423	-0.220	-0.212	0.893	60.00
6	P_2+a_p	0.575	49.5	7417.8	1.005	0.574	0.576	-0.253	-0.248	0.918	60.00
7	(P_2+P_3)/2	0.750	49.3	9891.2	1.006	0.756	0.761	-0.335	-0.338	0.913	60.00
8	P_3-a_p	0.925	48.9	11793.6	1.007	0.892	0.899	-0.396	-0.408	0.910	60.00
9	P_3+a_p (*)	1.075	48.9	11945.2	1.007	0.902	0.909	-0.400	-0.416	0.908	60.00
10	P_{rated}	1.000	48.9	11944.4	1.007	0.902	0.909	-0.400	-0.416	0.908	60.00
11	P_3+a_p (*)	1.075	48.9	11877.9	1.007	0.897	0.904	-0.398	-0.412	0.909	60.00
12	P_3-a_p	0.925	49.0	11139.8	1.007	0.844	0.850	-0.374	-0.383	0.911	60.00
13	(P_2+P_3)/2	0.750	49.3	9903.2	1.006	0.756	0.760	-0.334	-0.338	0.913	60.00
14	P_2+a_p	0.575	49.5	7422.2	1.005	0.573	0.576	-0.253	-0.248	0.918	60.00
15	P_2-a_p	0.425	49.6	5431.2	1.004	0.421	0.423	-0.220	-0.212	0.893	60.00
16	(P_1+P_2)/2	0.350	49.7	4522.1	1.003	0.350	0.351	-0.220	-0.212	0.856	60.00
17	P_1+a_p	0.275	49.8	3493.4	1.002	0.269	0.270	-0.220	-0.211	0.787	60.00
18	P_1-a_p	0.125	49.9	1559.5	1.001	0.117	0.117	0.000	-0.017	0.989	60.00
19	P_{min}	0.005	50.0	689.6	1.001	0.046	0.046	0.000	-0.017	0.940	60.00

(*) Limited by max. active power rating, these steps only can reach 100%Pn.

Test Results Over time

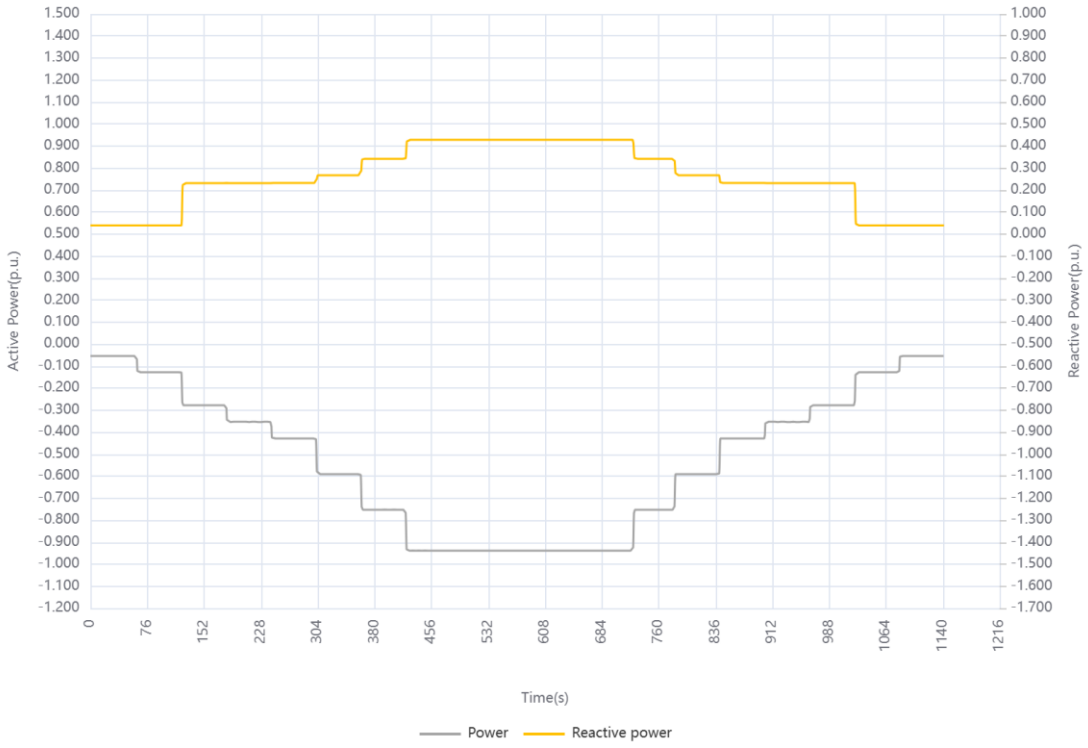


4) Characteristics 2_ Absorpting Active Power Direction

Step		P_{set} (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	$Q_{desired}$ (p.u.)	Q (p.u.)	PF	F (Hz)
1	P'_{min}	-0.005	50.0	-499.0	1.000	0.066	-0.054	0.000	0.039	-0.811	60.00
2	P'_1+a_p	-0.125	50.1	-1362.5	0.999	0.135	-0.128	0.000	0.039	-0.955	60.00
3	P'_1-a_p	-0.275	50.2	-3050.1	0.998	0.363	-0.278	0.220	0.231	-0.768	60.00
4	$(P'_1+P'_2)/2$	-0.350	50.3	-3900.6	0.998	0.424	-0.354	0.220	0.231	-0.835	60.00
5	P'_2+a_p	-0.425	50.3	-4741.6	0.997	0.490	-0.429	0.220	0.232	-0.878	60.00
6	P'_2-a_p	-0.575	50.4	-6514.4	0.996	0.652	-0.591	0.260	0.267	-0.909	60.00
7	$(P'_2+P'_3)/2$	-0.750	50.5	-8245.8	0.994	0.833	-0.753	0.331	0.342	-0.909	60.00
8	P'_3+a_p	-0.925	50.7	-10186.6	0.993	1.041	-0.939	0.413	0.428	-0.908	60.00
9	P'_3-a_p (*)	-1.075	50.7	-10185.3	0.993	1.041	-0.939	0.413	0.428	-0.908	60.00
10	P'_{rated}	-1.000	50.7	-10184.5	0.993	1.041	-0.939	0.413	0.428	-0.908	60.00
11	P'_3-a_p (*)	-1.075	50.7	-10182.7	0.993	1.041	-0.939	0.413	0.428	-0.908	60.00
12	P'_3+a_p	-0.925	50.7	-9695.4	0.993	0.989	-0.892	0.392	0.407	-0.908	60.00
13	$(P'_2+P'_3)/2$	-0.750	50.6	-8237.1	0.994	0.833	-0.752	0.331	0.342	-0.909	60.00
14	P'_2-a_p	-0.575	50.4	-6506.5	0.996	0.652	-0.590	0.260	0.267	-0.909	60.00
15	P'_2+a_p	-0.425	50.3	-4737.2	0.997	0.490	-0.429	0.220	0.232	-0.878	60.00
16	$(P'_1+P'_2)/2$	-0.350	50.3	-3896.4	0.998	0.424	-0.353	0.220	0.231	-0.835	60.00
17	P'_1-a_p	-0.275	50.2	-3045.5	0.998	0.362	-0.278	0.220	0.231	-0.768	60.00
18	P'_1+a_p	-0.125	50.1	-1360.1	0.999	0.134	-0.128	0.000	0.039	-0.955	60.00
19	P'_{min}	-0.005	50.0	-497.9	1.000	0.066	-0.054	0.000	0.039	-0.810	60.00

(*) Limited by max. active power rating, these steps only can reach -100%Pn.

Test Results Over time

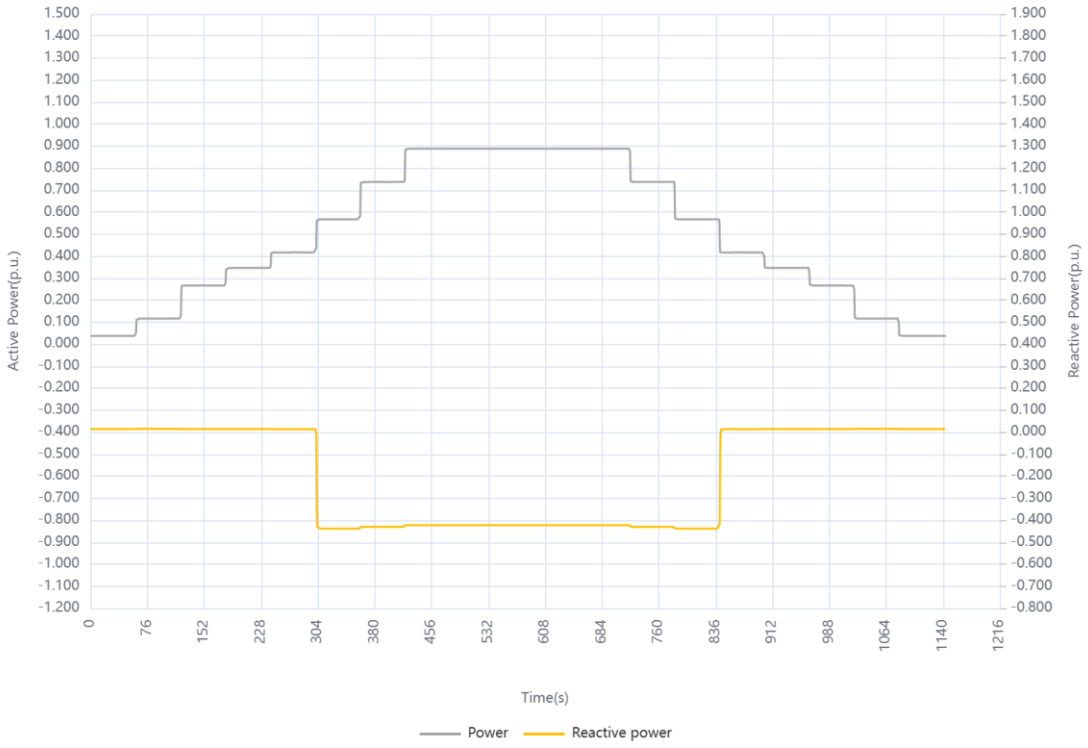


5) Characteristics 3_ Generating Active Power Direction

Step		P_{set} (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	$Q_{desired}$ (p.u.)	Q (p.u.)	PF	F (Hz)
1	P_{min}	0.005	49.9	-597.2	0.999	0.049	0.037	0.000	0.014	0.758	60.00
2	P_1-a_p	0.125	49.9	-1573.8	1.000	0.122	0.117	0.000	0.015	0.961	60.00
3	P_1+a_p	0.275	49.8	-3443.9	1.000	0.269	0.267	0.000	0.014	0.991	60.00
4	(P_1+P_2)/2	0.350	49.8	-4449.8	1.001	0.348	0.346	0.000	0.014	0.994	60.00
5	P_2-a_p	0.425	49.7	-5343.9	1.001	0.418	0.417	0.000	0.013	0.996	60.00
6	P_2+a_p	0.575	49.6	-7392.4	1.001	0.717	0.567	-0.440	-0.439	0.789	60.00
7	(P_2+P_3)/2	0.750	49.5	-9628.9	1.002	0.853	0.737	-0.440	-0.431	0.862	60.00
8	P_3-a_p	0.925	49.4	-11664.2	1.003	0.982	0.888	-0.440	-0.423	0.902	60.00
9	P_3+a_p (*)	1.075	49.4	-11669.2	1.003	0.982	0.888	-0.440	-0.423	0.902	60.00
10	P_{rated}	1.000	49.4	-11671.9	1.003	0.982	0.888	-0.440	-0.423	0.902	60.00
11	P_3+a_p (*)	1.075	49.4	-11674.4	1.003	0.982	0.888	-0.440	-0.423	0.902	60.00
12	P_3-a_p	0.925	49.4	-11025.6	1.003	0.940	0.839	-0.440	-0.426	0.889	60.00
13	(P_2+P_3)/2	0.750	49.5	-9635.8	1.002	0.853	0.737	-0.440	-0.431	0.862	60.00
14	P_2+a_p	0.575	49.6	-7396.8	1.001	0.717	0.567	-0.440	-0.439	0.789	60.00
15	P_2-a_p	0.425	49.7	-5344.7	1.001	0.418	0.416	0.000	0.013	0.996	60.00
16	(P_1+P_2)/2	0.350	49.8	-4449.3	1.001	0.348	0.346	0.000	0.014	0.994	60.00
17	P_1+a_p	0.275	49.8	-3439.2	1.000	0.268	0.266	0.000	0.014	0.991	60.00
18	P_1-a_p	0.125	49.9	-1571.8	1.000	0.121	0.116	0.000	0.015	0.960	60.00
19	P_{min}	0.005	49.9	-593.6	0.999	0.049	0.037	0.000	0.014	0.756	60.00

(*) Limited by max. active power rating, these steps only can reach 100%Pn.

Test Results Over time

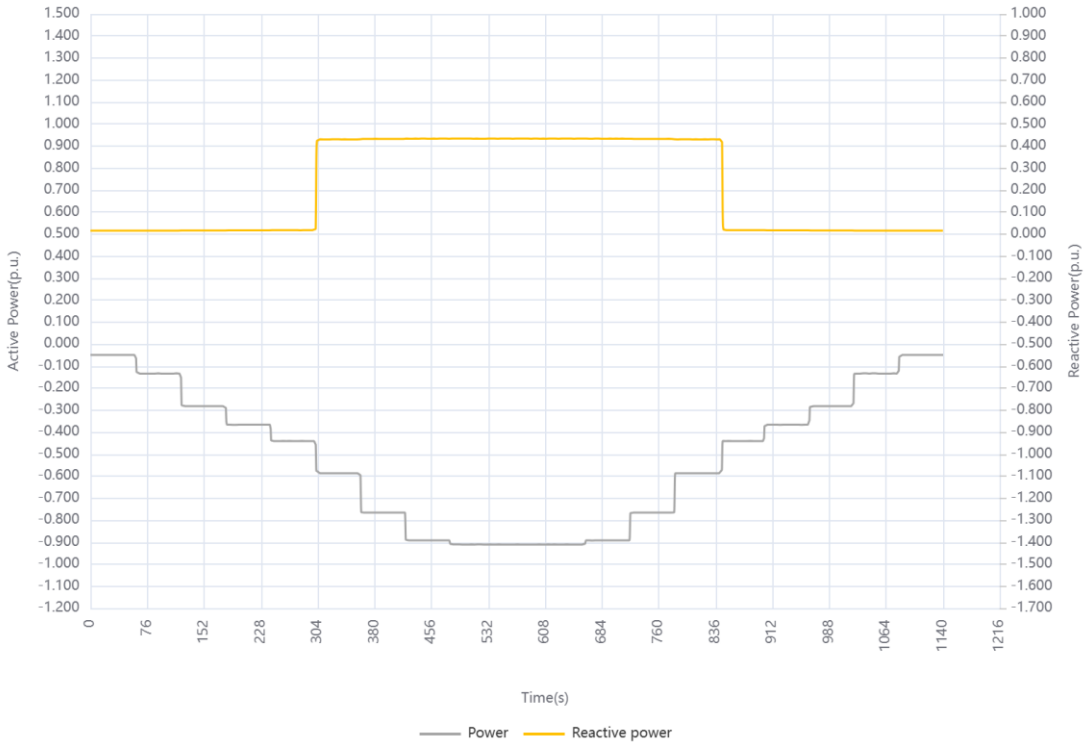


6) Characteristics 3_ Absorpting Active Power Direction

Step		P_{set} (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	$Q_{desired}$ (p.u.)	Q (p.u.)	PF	F (Hz)
1	P'_{min}	0.000	50.0	435.4	0.999	0.060	-0.049	0.000	0.015	-0.830	60.00
2	P'_1+a_p	-0.125	50.0	1415.6	0.999	0.138	-0.134	0.000	0.015	-0.968	60.00
3	P'_1-a_p	-0.275	50.1	3117.3	0.998	0.285	-0.282	0.000	0.016	-0.991	60.00
4	$(P'_1+P'_2)/2$	-0.350	50.2	4075.0	0.998	0.370	-0.367	0.000	0.017	-0.994	60.00
5	P'_2+a_p	-0.425	50.2	4907.6	0.997	0.444	-0.441	0.000	0.018	-0.996	60.00
6	P'_2-a_p	-0.575	50.3	6467.9	0.997	0.732	-0.587	0.440	0.430	-0.805	60.00
7	$(P'_2+P'_3)/2$	-0.750	50.4	8418.8	0.996	0.885	-0.766	0.440	0.432	-0.870	60.00
8	P'_3+a_p	-0.925	50.4	9837.6	0.995	1.004	-0.898	0.440	0.434	-0.899	60.00
9	P'_3-a_p (*)	-1.075	50.4	9966.7	0.995	1.015	-0.911	0.440	0.434	-0.902	60.00
10	P'_{rated}	-1.000	50.5	9965.3	0.995	1.015	-0.911	0.440	0.434	-0.902	60.00
11	P'_3-a_p (*)	-1.075	50.4	9901.1	0.995	1.010	-0.905	0.440	0.434	-0.901	60.00
12	P'_3+a_p	-0.925	50.4	9329.0	0.995	0.961	-0.851	0.440	0.433	-0.889	60.00
13	$(P'_2+P'_3)/2$	-0.750	50.4	8412.0	0.996	0.884	-0.766	0.440	0.432	-0.870	60.00
14	P'_2-a_p	-0.575	50.3	6462.2	0.997	0.732	-0.587	0.440	0.430	-0.805	60.00
15	P'_2+a_p	-0.425	50.2	4901.7	0.997	0.443	-0.440	0.000	0.018	-0.996	60.00
16	$(P'_1+P'_2)/2$	-0.350	50.2	4070.9	0.997	0.369	-0.366	0.000	0.017	-0.994	60.00
17	P'_1-a_p	-0.275	50.1	3114.6	0.998	0.285	-0.282	0.000	0.016	-0.991	60.00
18	P'_1+a_p	-0.125	50.0	1414.3	0.999	0.138	-0.133	0.000	0.015	-0.967	60.00
19	P'_{min}	0.000	50.0	434.8	0.999	0.059	-0.049	0.000	0.015	-0.829	60.00

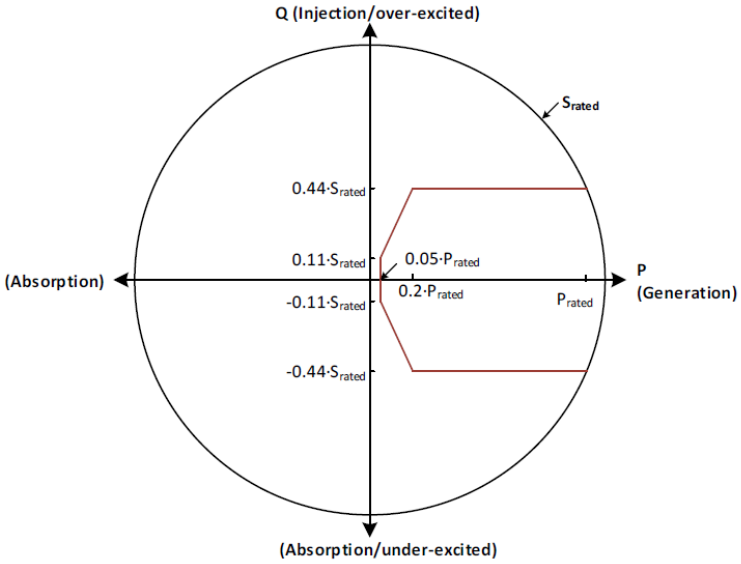
(*) Limited by max. active power rating, these steps only can reach -100%Pn.

Test Results Over time



4.14.6 Test for constant reactive power (var) mode

This test verifies the EUT's operation at a constant reactive power setting is compliant with 5.3.5 of IEEE Std 1547-2018 and the reactive power capabilities of the EUT defined in 5.2 of IEEE Std 1547-2018.



Category B

Note: The simples can absorb or inject reactive power Q = 100%Pn within active power P between [-100%Pn. 100%Pn].

Table 24—Imbalanced voltage test cases

	Phase A (p.u.)	Phase B (p.u.)	Phase C (p.u.)
Case A	≥1.07	≤0.91	≤0.91
Case B	≤0.91	≥1.07	≥1.07

NOTE—Choose any phase as A, B, or C. Order does not matter.

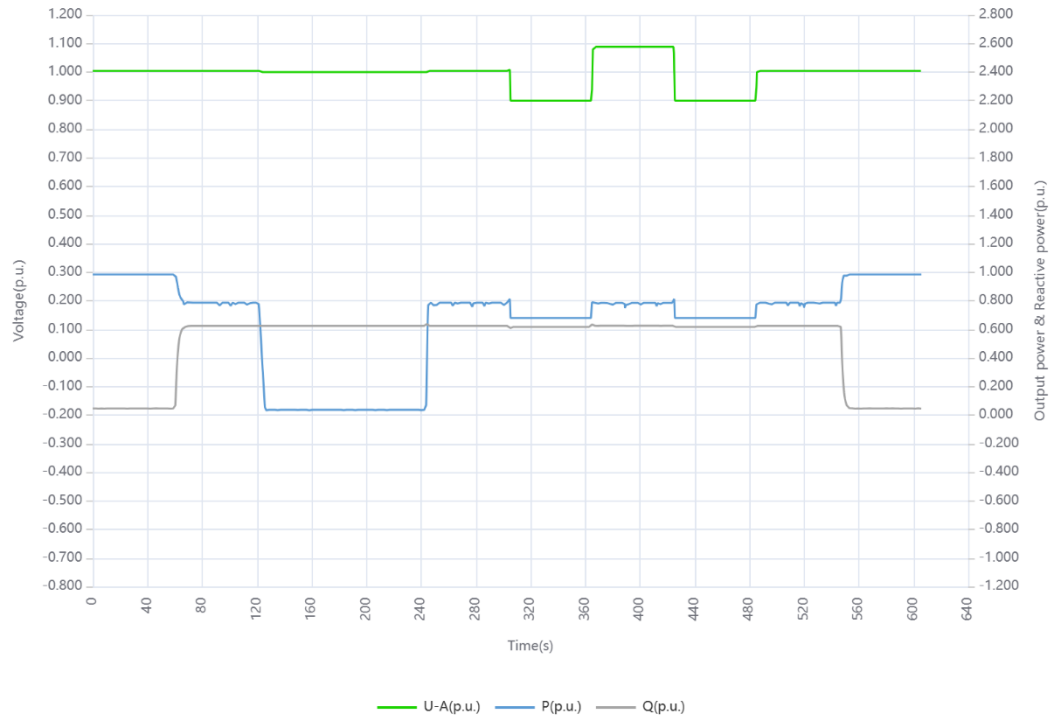
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025//08/21 to 2025/08/23	100 ms	5 kHz

1) Constant Reactive Power (Var) = $Q_{max, inj}$_V_{in-nom}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	298.7	12481.8	1.004	0.982	0.983	0.046	0.983	0.999
Enable constant var mode and set the EUT reactive power command to Qmax,inj											
2	P_{rated}	1.000	1.000	321.0	9993.6	1.004	0.998	0.785	0.621	0.999	0.784
3	P_{min} or 0.2*P_{rated}	0.050	1.000	329.0	718.4	1.000	0.624	0.036	0.622	0.623	0.057
4	P_{min} or 0.05*P_{rated}	0.050	1.000	329.0	717.7	1.000	0.624	0.036	0.623	0.623	0.057
5	P_{rated}	1.000	1.000	321.0	9969.5	1.004	0.998	0.783	0.623	0.999	0.782
6	V_L+a_v	1.000	0.895	300.0	8628.3	0.900	1.014	0.679	0.611	0.914	0.743
7	V_H-a_v	1.000	1.085	321.1	9941.5	1.087	0.922	0.782	0.625	0.998	0.781
8	V_L+a_v	1.000	0.895	300.0	8628.3	0.900	1.014	0.679	0.611	0.914	0.743
9	V_N	1.000	1.000	321.1	9971.7	1.004	0.998	0.784	0.623	0.999	0.782
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	298.4	12482.0	1.004	0.982	0.983	0.047	0.983	0.999

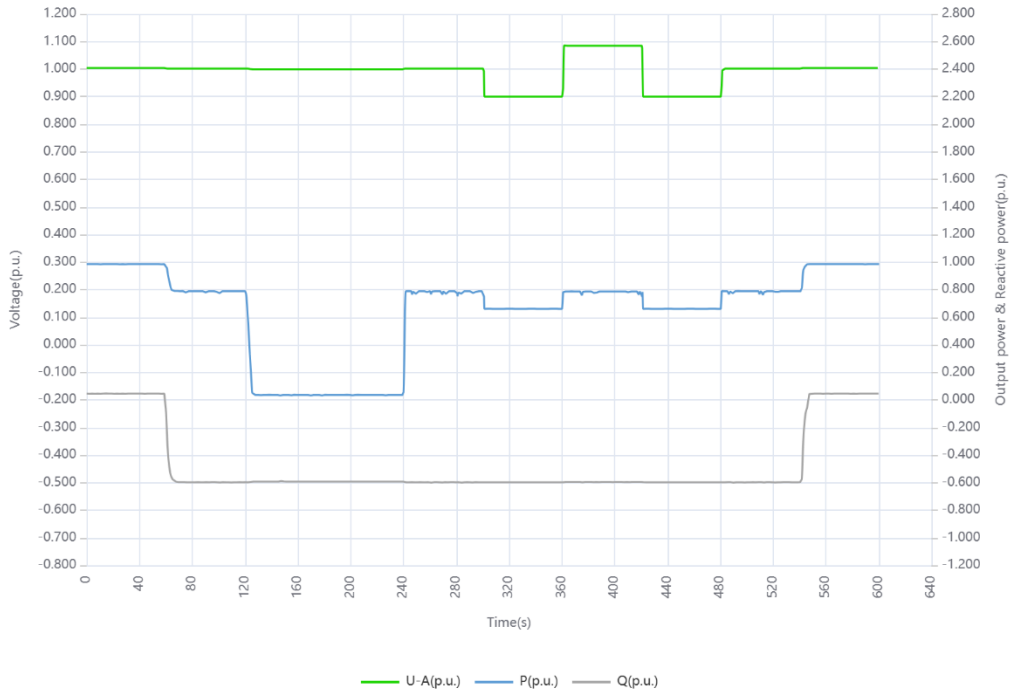
Result over time



2) Constant Reactive Power (Var) = $Q_{max, ab_}V_{in-nom}$

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	298.2	12456.9	1.004	0.982	0.985	0.045	0.986	0.999
Enable constant var mode and set the EUT reactive power command to Qmax,ab											
2	P_{rated}	1.000	1.000	320.9	10093.1	1.002	0.985	0.787	-0.596	0.987	0.797
3	P_{min} or $0.2*P_{rated}$	0.200	1.000	329.3	786.9	0.999	0.595	0.035	-0.593	0.594	0.059
4	P_{min} or $0.05*P_{rated}$	0.050	1.000	329.3	778.9	0.999	0.595	0.035	-0.593	0.594	0.059
5	P_{rated}	1.000	1.000	321.0	10061.2	1.002	0.985	0.785	-0.598	0.987	0.796
6	V_L+a_v	1.000	0.895	299.6	8632.2	0.900	0.993	0.660	-0.603	0.894	0.738
7	V_H-a_v	1.000	1.085	321.1	10030.0	1.085	0.907	0.784	-0.595	0.984	0.796
8	V_L+a_v	1.000	0.895	299.6	8632.2	0.900	0.993	0.660	-0.603	0.894	0.738
9	V_N	1.000	1.000	321.0	10073.6	1.002	0.985	0.786	-0.598	0.987	0.796
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	298.9	12456.8	1.004	0.982	0.985	0.042	0.986	0.999

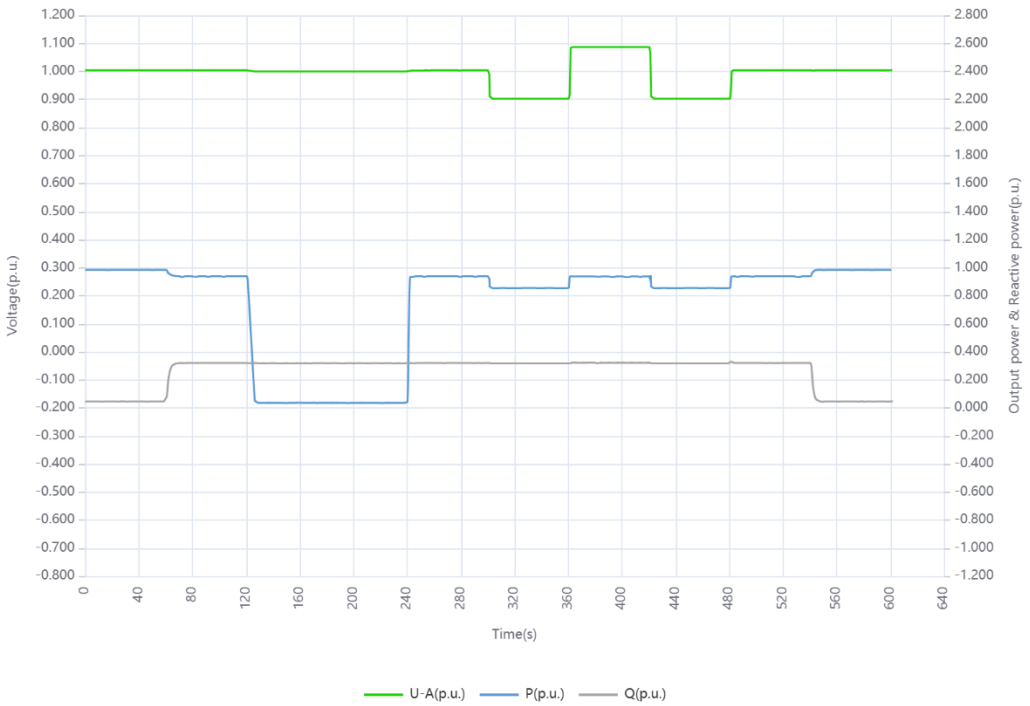
Result over time



3) Constant Reactive Power (Var) = 0.5*$Q_{max, inj}$_V_{in-nom}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	299.1	12458.4	1.004	0.982	0.985	0.046	0.986	0.999
Enable constant var mode and set the EUT reactive power command to 0.5Qmax,inj											
2	P_{rated}	1.000	1.000	311.4	11898.0	1.004	0.988	0.939	0.318	0.991	0.947
3	P_{min} or 0.2*P_{rated}	0.200	1.000	329.4	678.7	1.000	0.322	0.040	0.319	0.322	0.121
4	P_{min} or 0.05*P_{rated}	0.050	1.000	329.4	611.4	1.000	0.321	0.035	0.319	0.320	0.110
5	P_{rated}	1.000	1.000	311.6	11881.6	1.003	0.988	0.938	0.320	0.991	0.947
6	V_L+a_v	1.000	0.895	299.6	10785.5	0.903	1.005	0.854	0.318	0.907	0.942
7	V_H-a_v	1.000	1.085	312.0	11846.7	1.087	0.912	0.937	0.321	0.991	0.946
8	V_L+a_v	1.000	0.895	299.6	10785.5	0.903	1.005	0.854	0.318	0.907	0.942
9	V_N	1.000	1.000	311.5	11885.9	1.004	0.988	0.938	0.319	0.991	0.947
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	298.7	12453.5	1.004	0.982	0.985	0.046	0.986	0.999

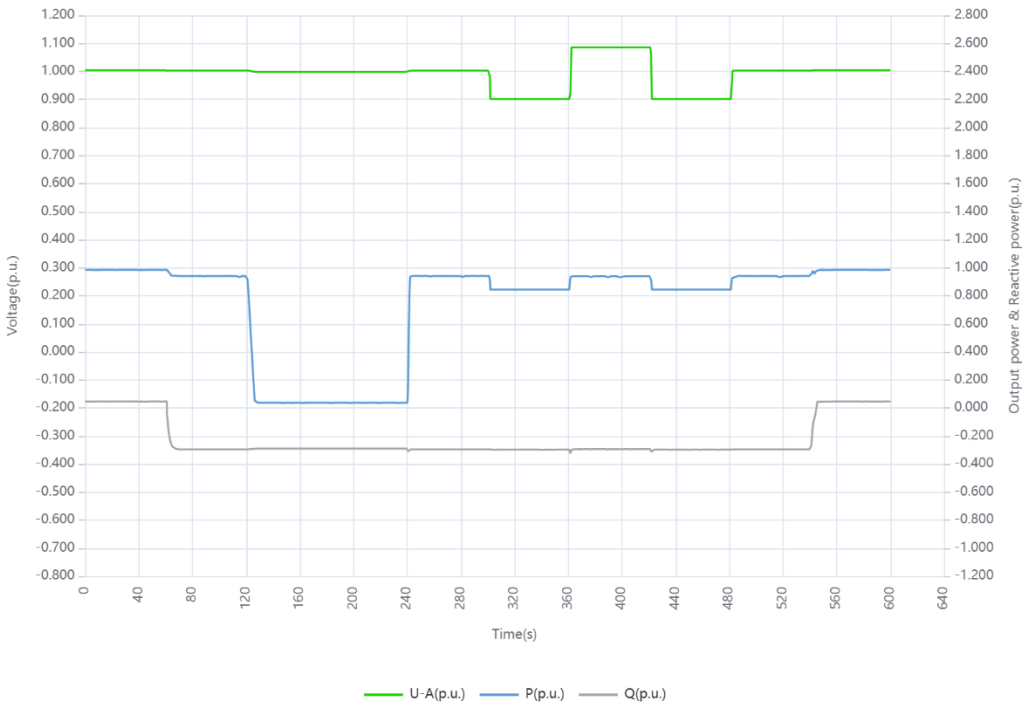
Result over time



4) Constant Reactive Power (Var) = 0.5*$Q_{max, ab}$_V_{in-nom}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	298.3	12457.6	1.004	0.982	0.985	0.045	0.986	0.999
Enable constant var mode and set the EUT reactive power command to 0.5Qmax,ab											
2	P_{rated}	1.000	1.000	310.7	11939.8	1.003	0.982	0.940	-0.294	0.985	0.954
3	P_{min} or 0.2*P_{rated}	0.200	1.000	329.5	697.1	0.999	0.293	0.038	-0.290	0.293	0.130
4	P_{min} or 0.05*P_{rated}	0.050	1.000	329.5	653.6	0.999	0.292	0.036	-0.290	0.292	0.122
5	P_{rated}	1.000	1.000	311.0	11929.6	1.003	0.982	0.940	-0.296	0.985	0.954
6	V_L+a_v	1.000	0.895	299.5	10770.8	0.902	0.996	0.843	-0.298	0.898	0.953
7	V_H-a_v	1.000	1.085	311.2	11891.8	1.086	0.905	0.938	-0.294	0.983	0.954
8	V_L+a_v	1.000	0.895	299.5	10770.8	0.902	0.996	0.843	-0.298	0.898	0.953
9	V_N	1.000	1.000	310.6	11931.4	1.003	0.982	0.939	-0.296	0.985	0.954
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	297.9	12445.3	1.004	0.982	0.984	0.042	0.985	0.999

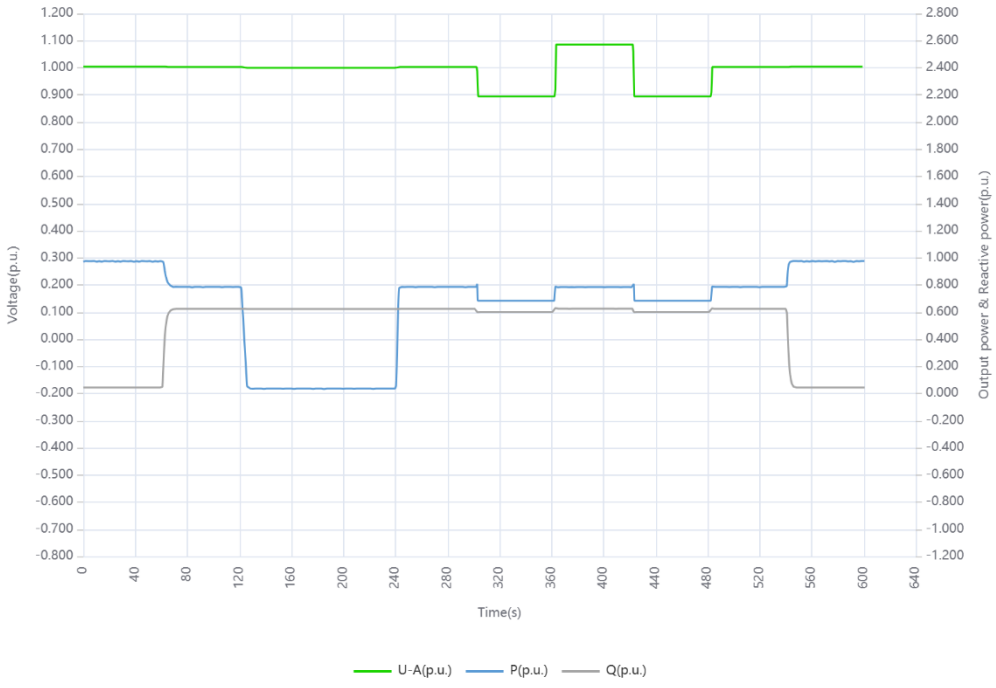
Result over time



5) Constant Reactive Power (Var) = $Q_{max, inj}$_V_{in-min}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	157.7	12556.3	1.004	0.972	0.974	0.043	0.975	0.999
Enable constant var mode and set the EUT reactive power command to Qmax,inj											
2	P_{rated}	1.000	1.000	170.4	10196.7	1.003	1.000	0.787	0.621	1.003	0.785
3	P_{min} or 0.2*P_{rated}	0.200	1.000	175.3	730.2	1.000	0.624	0.036	0.622	0.623	0.057
4	P_{min} or 0.05*P_{rated}	0.050	1.000	175.3	732.7	1.000	0.624	0.036	0.622	0.623	0.058
5	P_{rated}	1.000	1.000	170.4	10166.5	1.003	1.000	0.786	0.623	1.003	0.783
6	V_L+a_v	1.000	0.895	170.3	8745.4	0.895	1.013	0.684	0.605	0.913	0.784
7	V_H-a_v	1.000	1.085	170.5	10141.8	1.086	0.923	0.785	0.625	1.003	0.782
8	V_L+a_v	1.000	0.895	170.3	8748.4	0.895	1.013	0.684	0.605	0.913	0.784
9	V_N	1.000	1.000	170.4	10175.0	1.003	1.000	0.786	0.623	1.003	0.783
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	157.8	12557.3	1.004	0.972	0.974	0.044	0.975	0.999

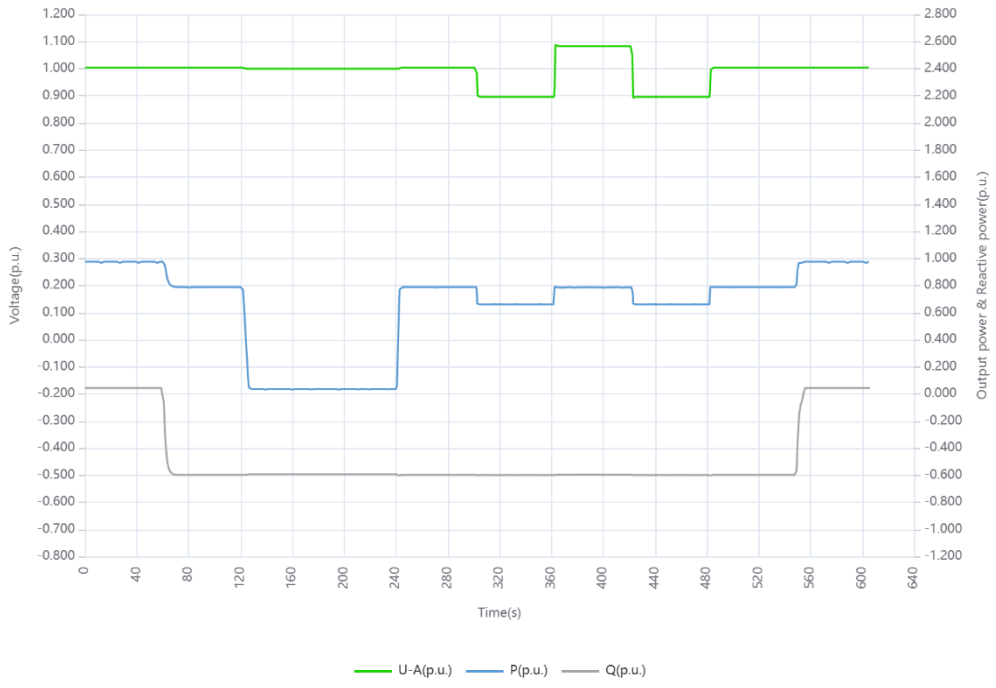
Result over time



6) Constant Reactive Power (Var) = $Q_{max, ab}$_V_{in-min}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	1.000	1.000	157.8	12572.0	1.004	0.971	0.974	0.043
Enable constant var mode and set the EUT reactive power command to Qmax,ab											
2	P_{rated}	1.000	1.000	170.0	10311.9	1.004	0.986	0.789	-0.595	0.991	0.798
3	P_{min} or $0.2*P_{rated}$	0.200	1.000	175.8	802.4	1.000	0.594	0.035	-0.593	0.594	0.059
4	P_{min} or $0.05*P_{rated}$	0.050	1.000	175.8	796.1	1.000	0.594	0.035	-0.593	0.594	0.059
5	P_{rated}	1.000	1.000	170.0	10292.9	1.004	0.986	0.788	-0.598	0.991	0.797
6	V_L+a_v	1.000	0.895	170.0	8682.5	0.896	0.993	0.660	-0.599	0.894	0.796
7	V_H-a_v	1.000	1.085	170.0	10199.8	1.083	0.908	0.786	-0.595	0.983	0.797
8	V_L+a_v	1.000	0.895	170.0	8684.6	0.896	0.993	0.660	-0.599	0.894	0.796
9	V_N	1.000	1.000	170.0	10296.5	1.004	0.986	0.788	-0.597	0.991	0.797
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	157.7	12569.8	1.004	0.971	0.974	0.038	0.974	0.999

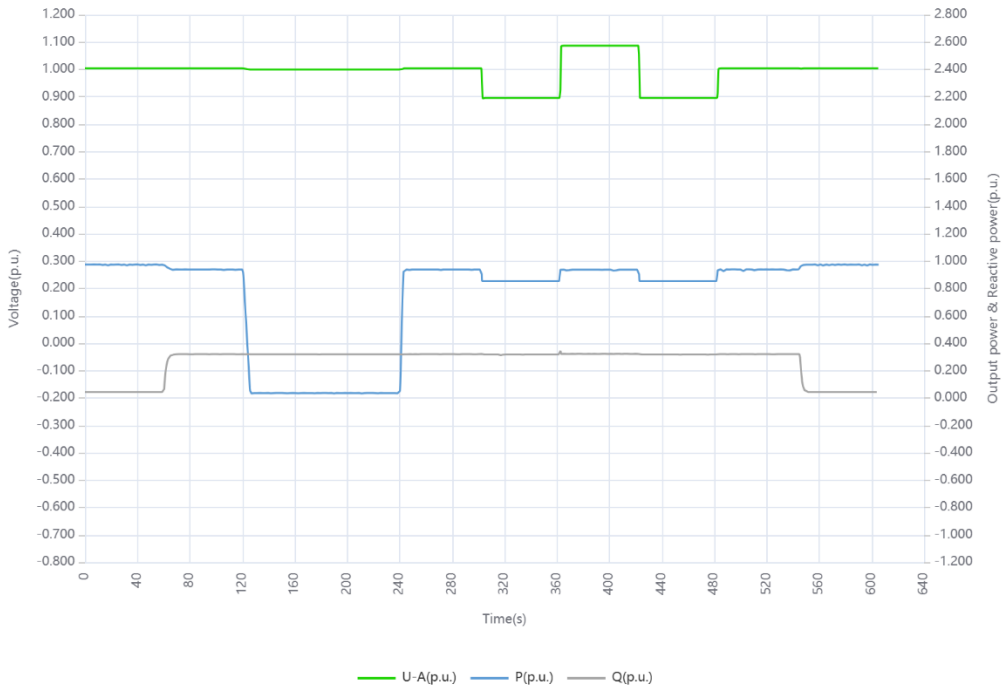
Result over time



7) Constant Reactive Power (Var) = 0.5*$Q_{max, inj}$_V_{in-min}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	157.8	12555.6	1.004	0.971	0.974	0.043	0.975	0.999
Enable constant var mode and set the EUT reactive power command to 0.5Qmax,inj											
2	P_{rated}	1.000	1.000	164.7	12129.2	1.004	0.988	0.939	0.317	0.992	0.947
3	P_{min} or 0.2*P_{rated}	0.200	1.000	175.3	658.9	1.000	0.321	0.037	0.319	0.321	0.116
4	P_{min} or 0.05*P_{rated}	0.050	1.000	175.3	621.2	1.000	0.321	0.035	0.319	0.321	0.110
5	P_{rated}	1.000	1.000	164.9	12105.6	1.004	0.988	0.939	0.320	0.992	0.947
6	V_L+a_v	1.000	0.895	164.5	10845.5	0.896	1.004	0.854	0.318	0.907	0.947
7	V_H-a_v	1.000	1.085	164.8	12080.6	1.087	0.912	0.937	0.321	0.991	0.946
8	V_L+a_v	1.000	0.895	164.2	10845.5	0.896	1.004	0.854	0.318	0.907	0.947
9	V_N	1.000	1.000	164.6	12111.6	1.004	0.988	0.938	0.319	0.991	0.947
10	Case A	1.000	≥1.07	--		--		--		--	
			≤0.91			--					
			≤0.91								
11	V_N	1.000	1.000	--		--		--		--	
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	157.1	12547.0	1.004	0.970	0.973	0.044	0.974	0.999

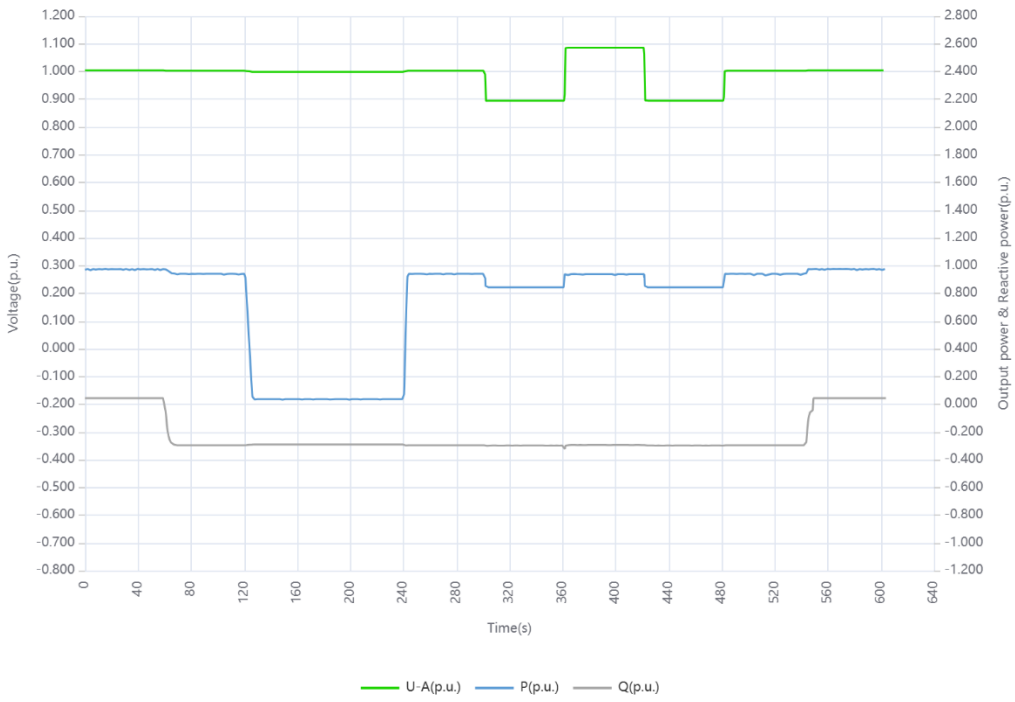
Result over time



8) Constant Reactive Power (Var) = 0.5*$Q_{max, ab}$_V_{in-min}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	157.1	12546.3	1.004	0.970	0.973	0.043	0.974	0.999
Enable constant var mode and set the EUT reactive power command to 0.5Qmax, ab											
2	P_{rated}	1.000	1.000	164.3	12178.1	1.003	0.982	0.941	-0.294	0.985	0.954
3	P_{min} or 0.2*P_{rated}	0.200	1.000	175.9	704.2	0.999	0.293	0.038	-0.290	0.293	0.129
4	P_{min} or 0.05*P_{rated}	0.050	1.000	175.9	660.6	0.999	0.292	0.036	-0.290	0.292	0.122
5	P_{rated}	1.000	1.000	164.6	12157.0	1.003	0.983	0.940	-0.296	0.986	0.954
6	V_L+a_v	1.000	0.895	164.1	10830.3	0.895	0.995	0.843	-0.298	0.898	0.953
7	V_H-a_v	1.000	1.085	164.6	12124.9	1.086	0.905	0.938	-0.294	0.983	0.954
8	V_L+a_v	1.000	0.895	164.0	10830.3	0.895	0.995	0.843	-0.299	0.898	0.953
9	V_N	1.000	1.000	164.3	12151.7	1.003	0.982	0.939	-0.296	0.984	0.954
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	157.7	12555.7	1.004	0.971	0.974	0.038	0.975	0.999

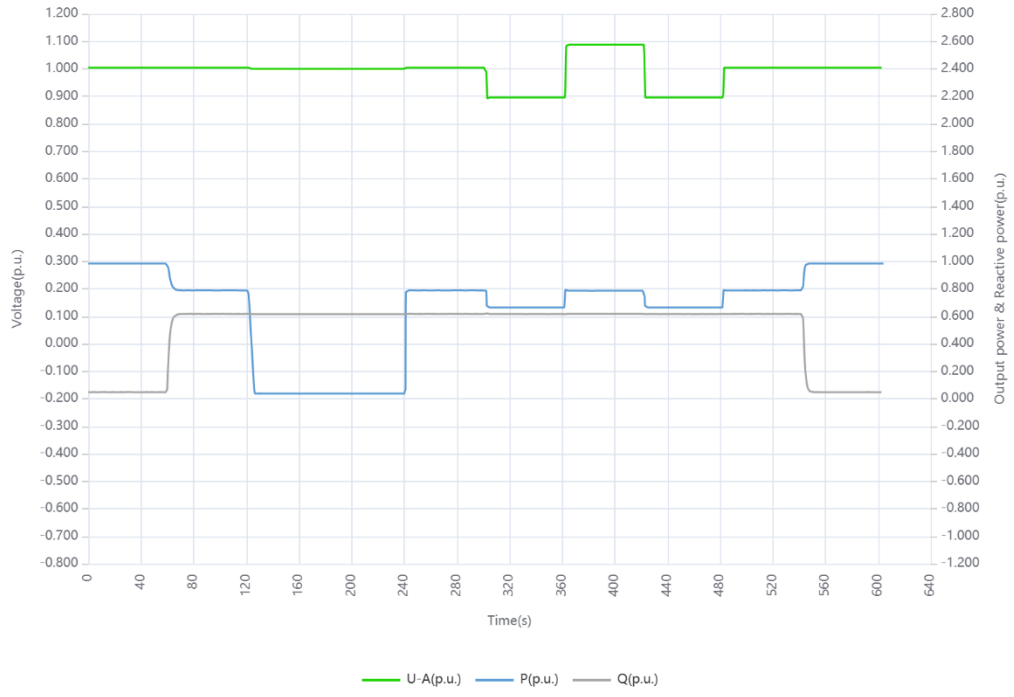
Result over time



9) Constant Reactive Power (Var) = $Q_{max, inj}$_V_{in-max}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	458.0	12300.0	1.004	0.982	0.983	0.047	0.983	0.998
Enable constant var mode and set the EUT reactive power command to Qmax,inj											
2	P_{rated}	1.000	1.000	477.9	9958.9	1.004	1.002	0.789	0.615	1.008	0.785
3	P_{min} or 0.2*P_{rated}	0.200	1.000	494.0	768.2	1.000	0.624	0.039	0.615	0.624	0.063
4	P_{min} or 0.05*P_{rated}	0.050	1.000	494.0	751.4	1.000	0.624	0.038	0.615	0.624	0.061
5	P_{rated}	1.000	1.000	478.0	9938.1	1.004	1.002	0.787	0.617	1.008	0.783
6	V_L+a_v	1.000	0.895	477.0	8404.0	0.896	1.000	0.663	0.616	0.901	0.784
7	V_H-a_v	1.000	1.085	478.0	9870.3	1.087	0.926	0.786	0.618	1.008	0.782
8	V_L+a_v	1.000	0.895	477.0	8404.5	0.896	1.000	0.663	0.616	0.901	0.784
9	V_N	1.000	1.000	478.0	9940.9	1.004	1.002	0.787	0.617	1.008	0.783
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	458.0	12300.0	1.004	0.982	0.983	0.048	0.983	0.998

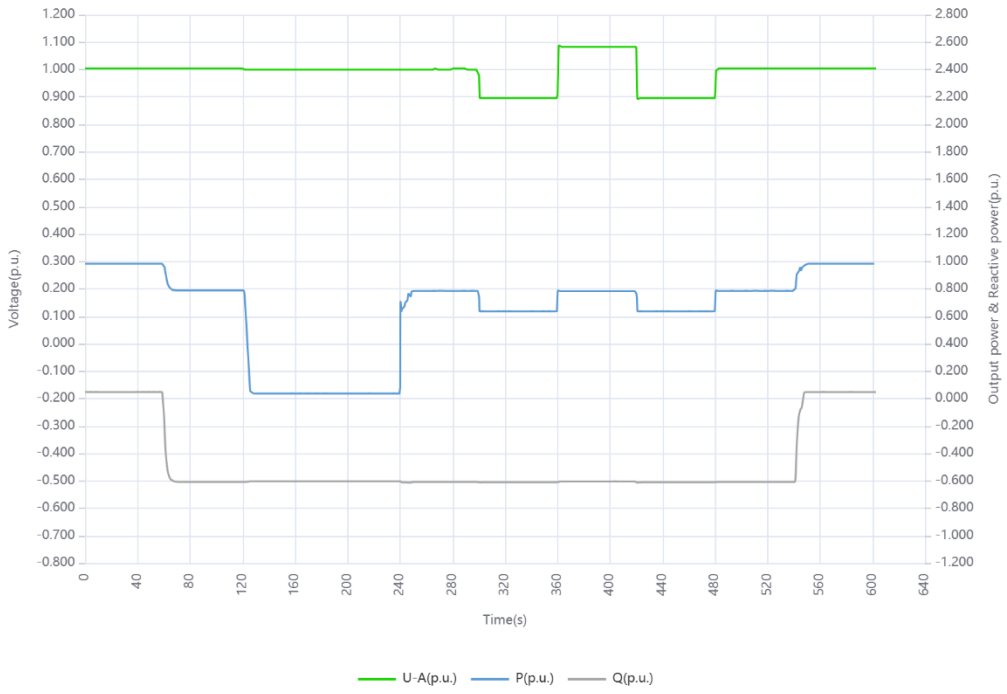
Result over time



10) Constant Reactive Power (Var) = $Q_{max, ab}$_V_{in-max}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	458.0	12300.0	1.004	0.982	0.983	0.047	0.983	0.998
Enable constant var mode and set the EUT reactive power command to Qmax, ab											
2	P_{rated}	1.000	1.000	476.9	10020.8	1.004	0.988	0.789	-0.606	0.992	0.798
3	P_{min} or 0.2*P_{rated}	0.200	1.000	494.0	841.4	1.000	0.596	0.039	-0.603	0.596	0.065
4	P_{min} or 0.05*P_{rated}	0.050	1.000	494.0	810.5	1.000	0.596	0.037	-0.603	0.596	0.063
5	P_{rated}	1.000	1.000	477.4	9975.0	1.002	0.986	0.785	-0.608	0.991	0.795
6	V_L+a_v	1.000	0.895	477.0	8379.7	0.896	0.976	0.637	-0.611	0.879	0.794
7	V_H-a_v	1.000	1.085	478.0	9908.6	1.083	0.908	0.783	-0.605	0.983	0.796
8	V_L+a_v	1.000	0.895	477.0	8382.9	0.896	0.976	0.637	-0.611	0.879	0.794
9	V_N	1.000	1.000	477.6	9980.5	1.004	0.986	0.785	-0.608	0.992	0.795
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	458.5	12280.5	1.004	0.978	0.982	0.042	0.982	0.998

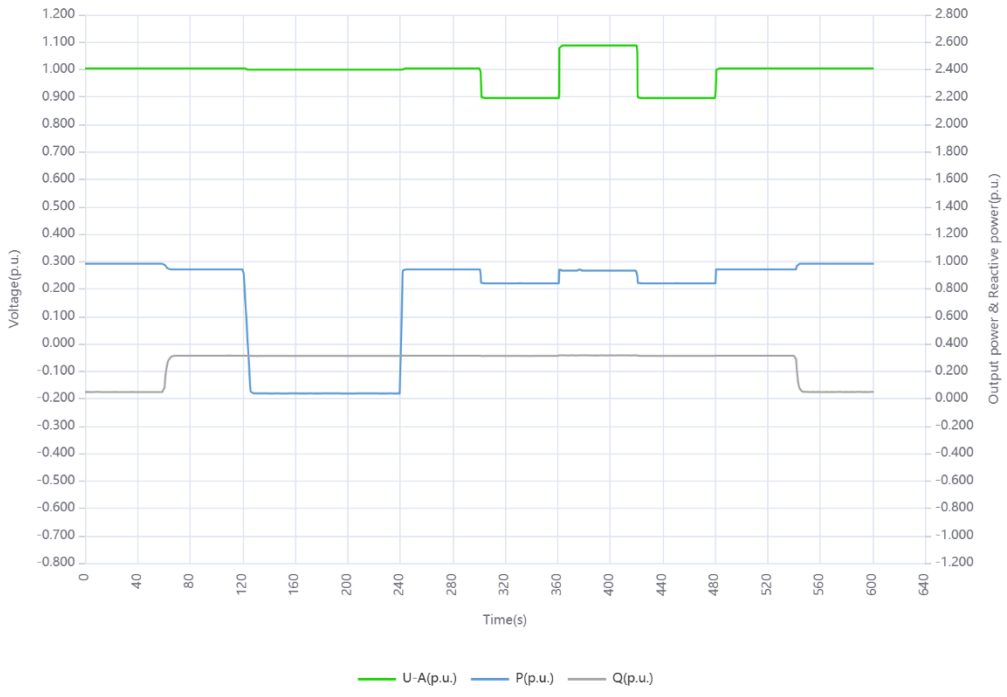
Result over time



11) Constant Reactive Power (Var) = 0.5*$Q_{max, inj}$_V_{in-max}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	458.0	12300.0	1.004	0.981	0.983	0.047	0.983	0.998
Enable constant var mode and set the EUT reactive power command to 0.5Qmax, inj											
2	P_{rated}	1.000	1.000	466.9	11805.5	1.004	0.988	0.942	0.311	0.992	0.947
3	P_{min} or 0.2*P_{rated}	0.200	1.000	495.0	692.0	1.000	0.323	0.041	0.312	0.323	0.126
4	P_{min} or 0.05*P_{rated}	0.050	1.000	495.0	635.9	1.000	0.322	0.037	0.312	0.322	0.116
5	P_{rated}	1.000	1.000	467.0	11800.0	1.004	0.988	0.942	0.313	0.992	0.946
6	V_L+a_v	1.000	0.895	466.0	10573.2	0.896	0.990	0.840	0.312	0.894	0.947
7	V_H-a_v	1.000	1.085	468.0	11700.3	1.087	0.912	0.934	0.315	0.992	0.945
8	V_L+a_v	1.000	0.895	466.0	10574.9	0.896	0.990	0.840	0.312	0.894	0.947
9	V_N	1.000	1.000	467.0	11800.5	1.004	0.988	0.942	0.313	0.992	0.946
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	458.0	12300.0	1.004	0.982	0.983	0.048	0.983	0.998

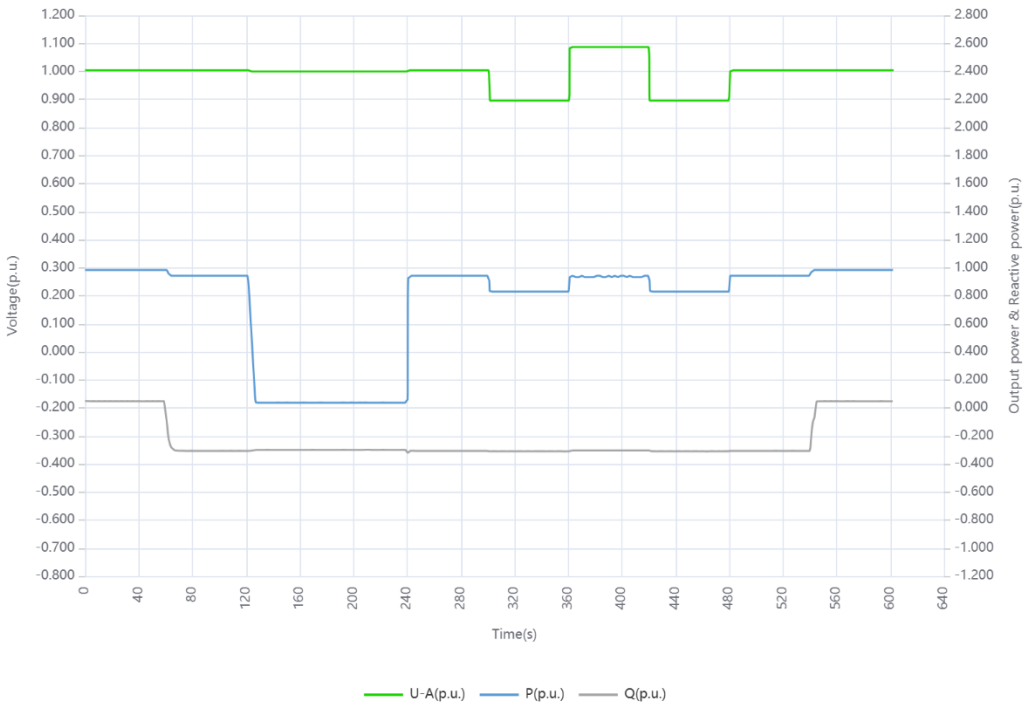
Result over time



12) Constant Reactive Power (Var) = 0.5*Q $_{max, ab}$_V_{in-max}

Step		P_{set} (p.u.)	V_{set} (p.u.)	DC Input		AC Output					
				$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF
1	P_{rated}	1.000	1.000	458.0	12298.8	1.004	0.980	0.983	0.047	0.983	0.998
Enable constant var mode and set the EUT reactive power command to 0.5Qmax, ab											
2	P_{rated}	1.000	1.000	466.8	11806.3	1.004	0.982	0.942	-0.304	0.983	0.954
3	P_{min} or 0.2*P_{rated}	0.200	1.000	494.8	788.5	1.000	0.298	0.046	-0.300	0.297	0.146
4	P_{min} or 0.05*P_{rated}	0.050	1.000	495.0	672.2	1.000	0.294	0.037	-0.300	0.294	0.127
5	P_{rated}	1.000	1.000	467.0	11798.8	1.004	0.982	0.942	-0.307	0.983	0.953
6	V_L+a_v	1.000	0.895	465.0	10565.1	0.896	0.981	0.830	-0.309	0.883	0.952
7	V_H-a_v	1.000	1.085	466.9	11697.6	1.087	0.905	0.937	-0.304	0.983	0.954
8	V_L+a_v	1.000	0.895	465.0	10571.5	0.896	0.981	0.830	-0.309	0.884	0.952
9	V_N	1.000	1.000	466.9	11797.7	1.004	0.982	0.941	-0.306	0.983	0.953
10	Case A	1.000	≥1.07	--	--	--	--	--	--	--	--
			≤0.91			--					
			≤0.91			--					
11	V_N	1.000	1.000	--	--	--	--	--	--	--	--
12	Case B	1.000	≤0.91	--	--	--	--	--	--	--	--
			≥1.07			--					
			≥1.07			--					
13	V_N	1.000	1.000	--	--	--	--	--	--	--	--
Disable constant reactive power mode. Reactive power should return to zero											
14	V_N	1.000	1.000	458.0	12298.8	1.004	0.980	0.983	0.044	0.983	0.998

Result over time



4.14.7 Test for voltage-active power (volt-watt) mode

This test verifies the EUT's operation with voltage-active power (volt-watt) mode enabled is compliant with 5.4.2 of IEEE Std 1547-2018. This test verifies the EUT's response to changes in voltage magnitude when connected to a ac test source. This test is optional for Category A equipment.

The parameters in Figure 11, Table 31, Table 32, and Table 33 define a voltage-active power characteristic to be tested.

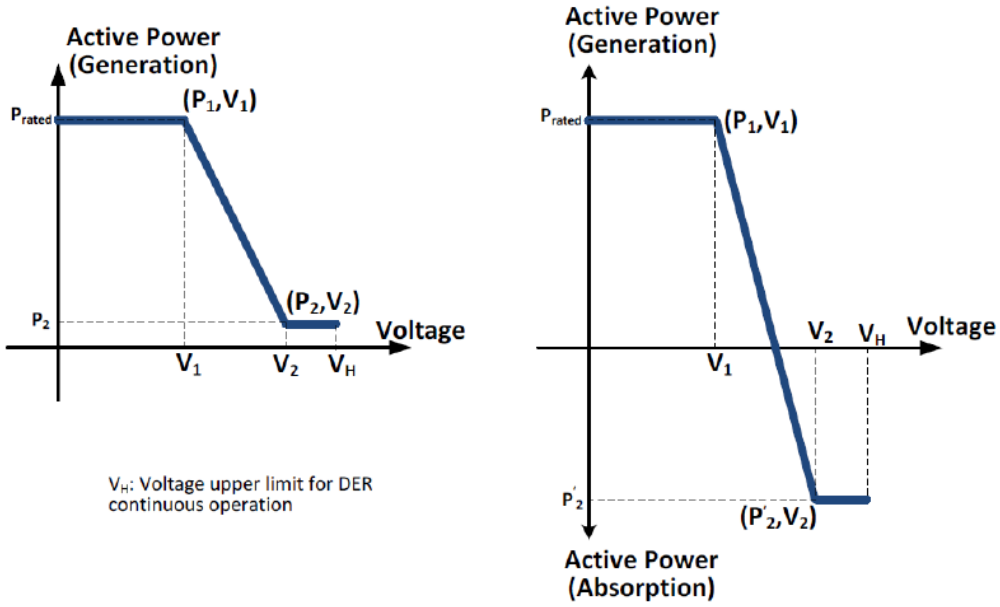


Figure 11—Example voltage-active power characteristic

Table 31—Characteristic 1:
Default voltage-active power settings for normal operating performance Category A and Category B DER

Voltage-active power parameters	Default values for DER	
	Category A	Category B
V_1	1.06 V_N	1.06 V_N
P_1	P_{rated}	P_{rated}
V_2	1.1 V_N	1.1 V_N
P_2 (applicable to DER that can only generate active power)	The lesser of 0.2 P_{rated} or P_{min}	The lesser of 0.2 P_{rated} or P_{min}
P'_2 (applicable to DER that can generate and absorb active power)	0	0
Open loop response time	10 s	10 s

Table 32—Characteristic 2:
Voltage-active power settings for normal operating performance
Category A and Category B DER

Voltage-active power parameters	Values for DER	
	Category A	Category B
V_1	1.05 V_N	1.05 V_N
P_1	P_{rated}	P_{rated}
V_2	1.1 V_N	1.1 V_N
P_2 (applicable to DER that can only generate active power)	The lesser of 0.2 P_{rated} or P_{min}	The lesser of 0.2 P_{rated} or P_{min}
P'_2 (applicable to DER that can generate and absorb active power)	P'_{rated}	P'_{rated}
Open loop response time	90 s	90 s

Note: *Modified according to SB4.3.5.14.9, 60 s was used as the open loop response time for Charateristic 2.*

Table 33—Characteristic 3:
Voltage-active power settings for normal operating performance
Category A and Category B DER

Voltage-active power parameters	Values for DER	
	Category A	Category B
V_1	1.09 V_N	1.09 V_N
P_1	P_{rated}	P_{rated}
V_2	1.1 V_N	1.1 V_N
P_2 (applicable to DER that can only generate active power)	The lesser of 0.2 P_{rated} or P_{min}	The lesser of 0.2 P_{rated} or P_{min}
P'_2 (applicable to DER that can generate and absorb active power)	P'_{rated}	P'_{rated}
Open loop response time	0.5 s	0.5 s

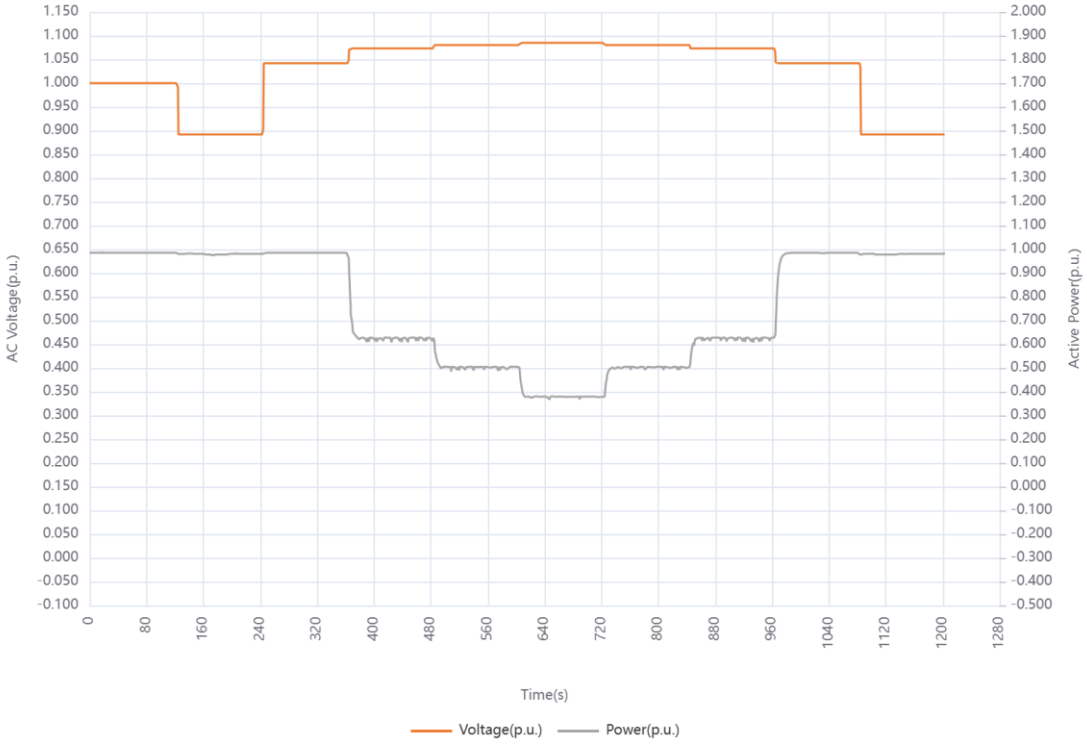
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/08/21 to 2025/08/26	100 ms	5 kHz

1) Characteristic 1_100%P_{rated} Level_$V_{in\text{-}nom}$ L1-L2: 240V

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	298.70	12457.20	1.000	0.983	0.985	0.046	0.986	0.999	60.000
2	V_L+a_v	0.895	297.90	12453.70	0.892	1.096	0.981	0.043	0.982	0.999	60.000
3	V_1-a_v	1.045	298.10	12457.10	1.042	0.943	0.985	0.049	0.986	0.999	60.000
4	$V_{1+}a_v$	1.075	326.00	7906.20	1.073	0.578	0.626	0.042	0.627	0.998	60.000
5	$(V_1+V_2)/2$	1.080	328.40	6363.20	1.080	0.462	0.503	0.040	0.504	0.997	60.000
6	V_2-a_v	1.085	330.42	4815.50	1.085	0.346	0.378	0.039	0.380	0.995	60.000
7	$V_{2+}a_v$	1.115	V_H is ≤ $(V_{2+}a_v)$ skip this step								
8	V_H-a_v	1.085									
9	$V_{2+}a_v$	1.115									
10	V_2-a_v	1.085									
11	$(V_1+V_2)/2$	1.080	328.40	6364.40	1.080	0.462	0.503	0.040	0.505	0.997	60.000
12	$V_{1+}a_v$	1.075	326.00	7907.40	1.073	0.578	0.626	0.042	0.628	0.998	60.000
13	V_1-a_v	1.045	298.70	12458.80	1.042	0.943	0.985	0.049	0.986	0.999	60.000
14	V_L+a_v	0.895	297.90	12454.00	0.892	1.092	0.981	0.044	0.982	0.999	60.000

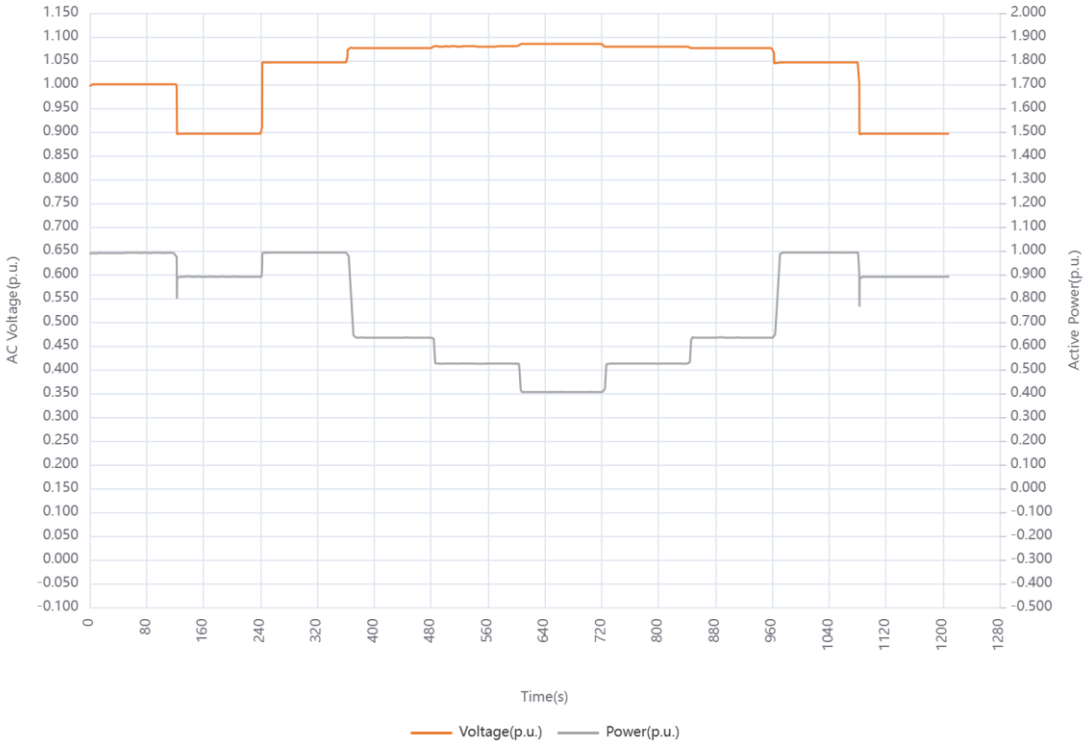
Test Results Over time



2) Characteristic 1_100%P_{rated} Level_$V_{in\text{-}nom}$ L1-L2: 208V

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	300.60	12494.00	1.000	0.993	0.991	0.032	0.991	0.999	60.000
2	V_L+a_v	0.895	316.40	11284.00	0.896	0.996	0.890	0.027	0.891	0.999	60.000
3	V_1-a_v	1.045	300.40	12492.80	1.046	0.951	0.992	0.032	0.992	0.999	60.000
4	$V_{1+}a_v$	1.075	325.90	7984.30	1.076	0.592	0.634	0.023	0.635	0.999	60.000
5	$(V_1+V_2)/2$	1.080	328.10	6615.30	1.079	0.488	0.525	0.022	0.525	0.999	60.000
6	V_2-a_v	1.085	329.94	5170.60	1.085	0.378	0.408	0.020	0.409	0.999	60.00
7	$V_{2+}a_v$	1.115	V_H is ≤ $(V_{2+}a_v)$ skip this step								
8	V_H-a_v	1.085									
9	$V_{2+}a_v$	1.115									
10	V_2-a_v	1.085									
11	$(V_1+V_2)/2$	1.080	328.10	6616.00	1.079	0.488	0.525	0.022	0.525	0.999	60.000
12	$V_{1+}a_v$	1.075	325.90	7983.40	1.076	0.592	0.634	0.023	0.635	0.999	60.000
13	V_1-a_v	1.045	299.20	12492.80	1.046	0.951	0.992	0.032	0.992	0.999	60.000
14	V_L+a_v	0.895	316.50	11282.60	0.896	0.996	0.890	0.027	0.891	0.999	60.000

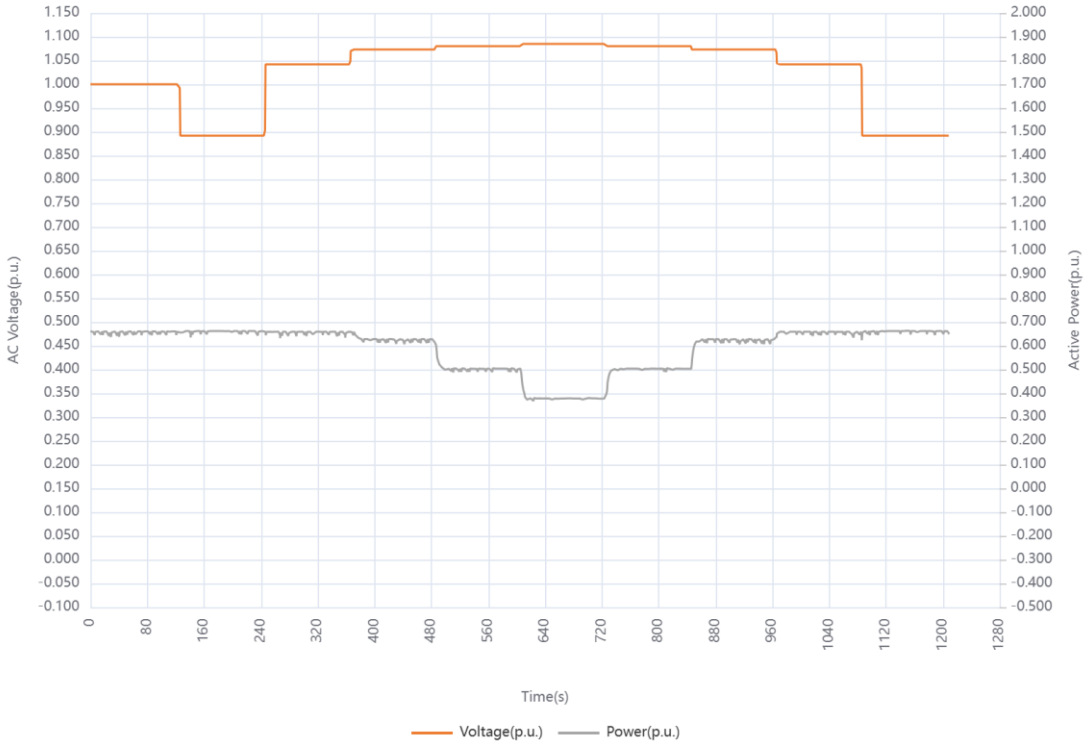
Test Results Over time



3) Characteristic 1_66%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_H	1.000	325.00	8309.70	1.000	0.658	0.658	0.039	0.659	0.998	60.00
2	V_L+a_v	0.895	325.01	8365.50	0.892	0.740	0.660	0.037	0.661	0.998	60.00
3	V_1-a_v	1.045	325.10	8276.60	1.042	0.629	0.656	0.041	0.657	0.998	60.00
4	$V_{1+}a_v$	1.075	326.00	7894.80	1.073	0.577	0.625	0.042	0.627	0.998	60.00
5	$(V_1+V_2)/2$	1.080	328.13	6355.10	1.080	0.462	0.502	0.040	0.504	0.997	60.00
6	V_2-a_v	1.085	330.00	4808.90	1.085	0.345	0.378	0.039	0.380	0.995	60.00
7	$V_{2+}a_v$	1.115	V_H is ≤ $(V_{2+}a_v)$ skip this step								
8	V_H-a_v	1.085									
9	$V_{2+}a_v$	1.115									
10	V_2-a_v	1.085									
11	$(V_1+V_2)/2$	1.080	328.11	6354.50	1.080	0.461	0.502	0.040	0.504	0.997	60.00
12	$V_{1+}a_v$	1.075	326.00	7882.30	1.073	0.576	0.624	0.042	0.626	0.998	60.00
13	V_1-a_v	1.045	325.02	8293.70	1.042	0.630	0.657	0.041	0.658	0.998	60.00
14	V_L+a_v	0.895	325.00	8357.30	0.892	0.725	0.660	0.038	0.661	0.998	60.00

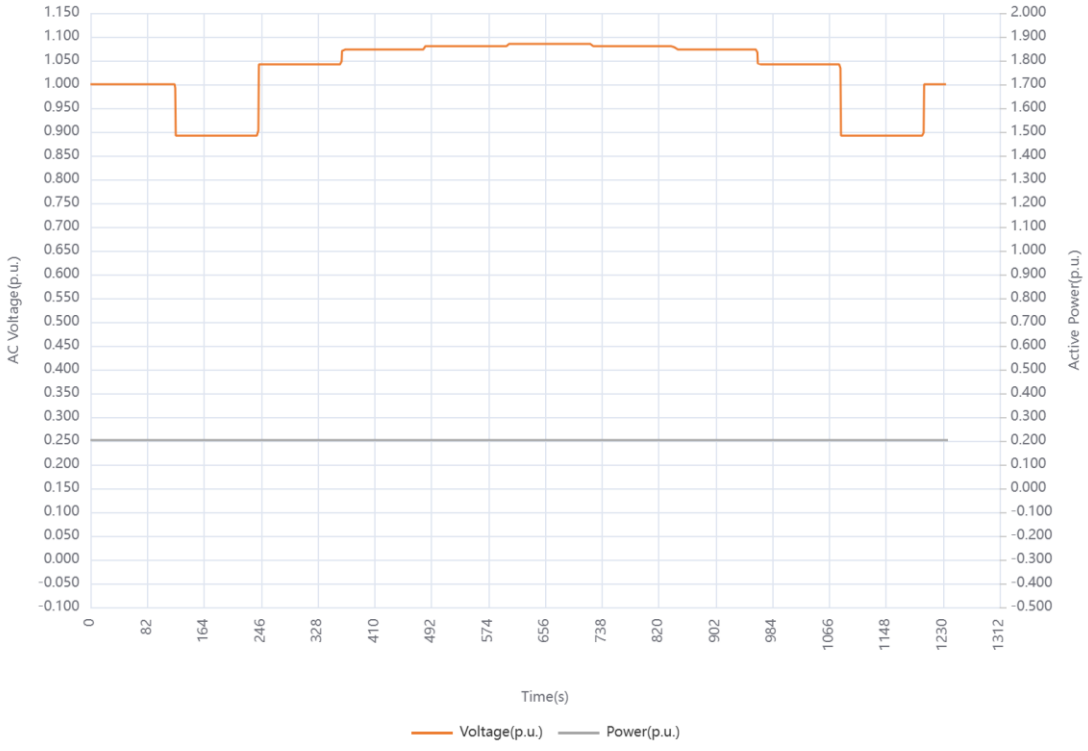
Test Results Over time



4) Characteristic 1_20%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_H	1.000	332.71	2608.10	1.000	0.203	0.203	0.031	0.200	0.988	60.00
2	V_L+a_v	0.895	332.69	2634.80	0.892	0.230	0.203	0.028	0.200	0.991	60.00
3	V_1-a_v	1.045	332.72	2601.70	1.042	0.195	0.203	0.033	0.200	0.986	60.00
4	$V_{1+}a_v$	1.075	332.72	2594.70	1.073	0.188	0.203	0.035	0.200	0.985	60.00
5	$(V_1+V_2)/2$	1.080	332.73	2592.60	1.080	0.187	0.203	0.035	0.200	0.984	60.00
6	V_2-a_v	1.085	332.72	2594.70	1.085	0.186	0.203	0.036	0.200	0.984	60.00
7	$V_{2+}a_v$	1.115	V_H is ≤ $(V_{2+}a_v)$ skip this step								
8	V_H-a_v	1.085									
9	$V_{2+}a_v$	1.115									
10	V_2-a_v	1.085									
11	$(V_1+V_2)/2$	1.080	332.71	2590.50	1.080	0.187	0.203	0.035	0.200	0.984	60.00
12	$V_{1+}a_v$	1.075	332.72	2592.90	1.073	0.188	0.203	0.035	0.200	0.985	60.00
13	V_1-a_v	1.045	332.71	2600.80	1.042	0.194	0.203	0.034	0.200	0.986	60.00
14	V_L+a_v	0.895	332.69	2635.00	0.892	0.230	0.203	0.028	0.200	0.991	60.00

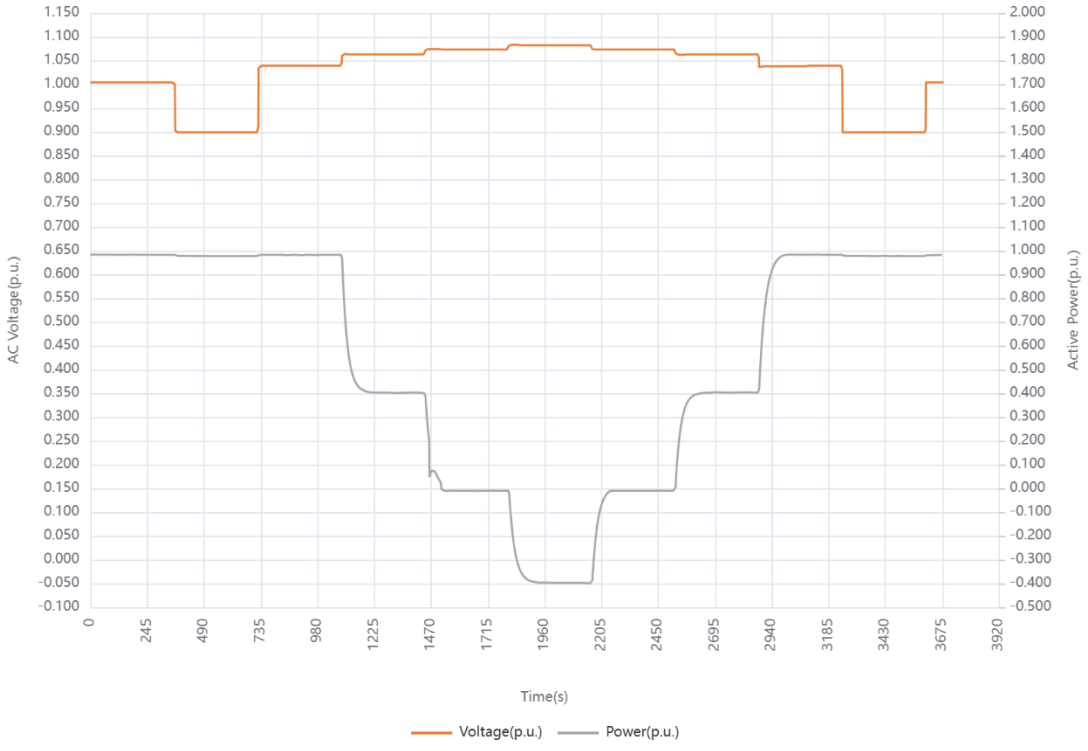
Test Results Over time



5) Characteristic 2_100%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	299.30	-12280.30	1.004	0.979	0.982	-0.038	0.983	-1.000	60.000
2	V_L+a_v	0.895	299.30	-12276.50	0.899	1.087	0.977	-0.034	0.978	-1.000	60.000
3	V_1-a_v	1.035	299.30	-12273.30	1.039	0.946	0.982	-0.038	0.983	-1.000	60.000
4	$V_{1+}a_v$	1.065	299.70	-5041.30	1.063	0.379	0.402	0.026	0.403	1.000	60.000
5	$(V_1+V_2)/2$	1.075	299.90	33.00	1.073	0.030	-0.010	0.030	0.032	0.330	60.000
6	V_2-a_v	1.085	299.90	-5033.00	1.083	0.390	-0.400	0.030	0.032	0.330	60.000
7	$V_{2+}a_v$	1.115	V_H is ≤ $(V_{2+}a_v)$ skip this step								
8	V_H-a_v	1.085									
9	$V_{2+}a_v$	1.115									
10	V_2-a_v	1.085									
11	$(V_1+V_2)/2$	1.075	300.20	4576.10	1.082	0.369	-0.010	0.031	0.400	1.000	60.000
12	$V_{1+}a_v$	1.065	299.90	31.50	1.073	0.030	-0.010	0.030	0.032	0.325	60.000
13	V_1-a_v	1.035	299.30	-12276.50	1.038	0.947	0.982	-0.038	0.983	-1.000	60.000
14	V_L+a_v	0.895	299.20	-12279.10	0.899	1.087	0.977	-0.034	0.978	-1.000	60.000

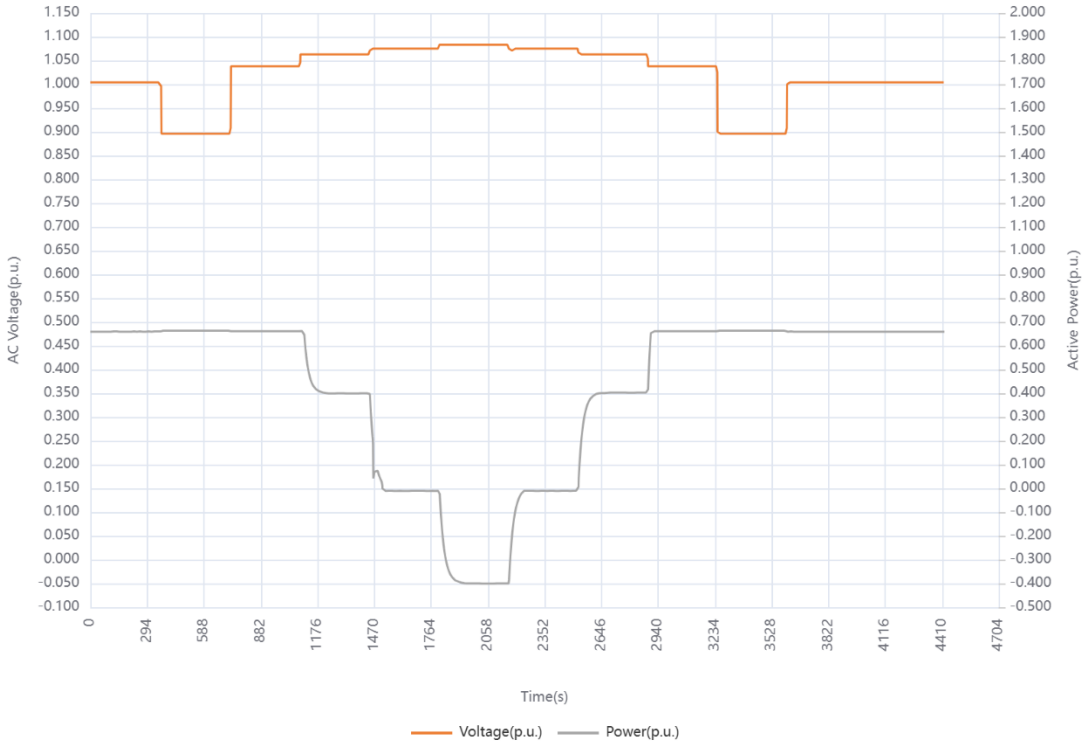
Test Results Over time



6) Characteristic 2_66%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	299.00	-8240.00	1.004	0.658	0.660	0.028	0.660	0.999	60.000
2	V_L+a_v	0.895	299.00	-8310.00	0.896	0.738	0.663	0.024	0.663	0.999	60.000
3	V_1-a_v	1.035	299.00	-8257.60	1.038	0.638	0.661	0.029	0.661	0.999	60.000
4	$V_{1+}a_v$	1.065	300.00	-5016.80	1.063	0.377	0.400	0.026	0.401	0.998	60.000
5	$(V_1+V_2)/2$	1.075	300.00	33.20	1.075	0.030	-0.010	0.030	0.032	0.329	60.000
6	V_2-a_v	1.085	300.00	-5002.20	1.085	0.390	-0.400	0.030	0.032	0.329	60.000
7	$V_{2+}a_v$	1.115	V_H is ≤ $(V_{2+}a_v)$ skip this step								
8	V_H-a_v	1.085									
9	$V_{2+}a_v$	1.115									
10	V_2-a_v	1.085									
11	$(V_1+V_2)/2$	1.075	300.00	33.50	1.075	0.030	-0.010	0.030	0.032	0.328	60.000
12	$V_{1+}a_v$	1.065	300.00	-5047.50	1.063	0.380	0.403	0.026	0.404	0.998	60.000
13	V_1-a_v	1.035	299.00	-8251.40	1.037	0.638	0.661	0.029	0.662	0.999	60.000
14	V_L+a_v	0.895	299.00	-8310.00	0.896	0.738	0.663	0.024	0.663	0.999	60.000

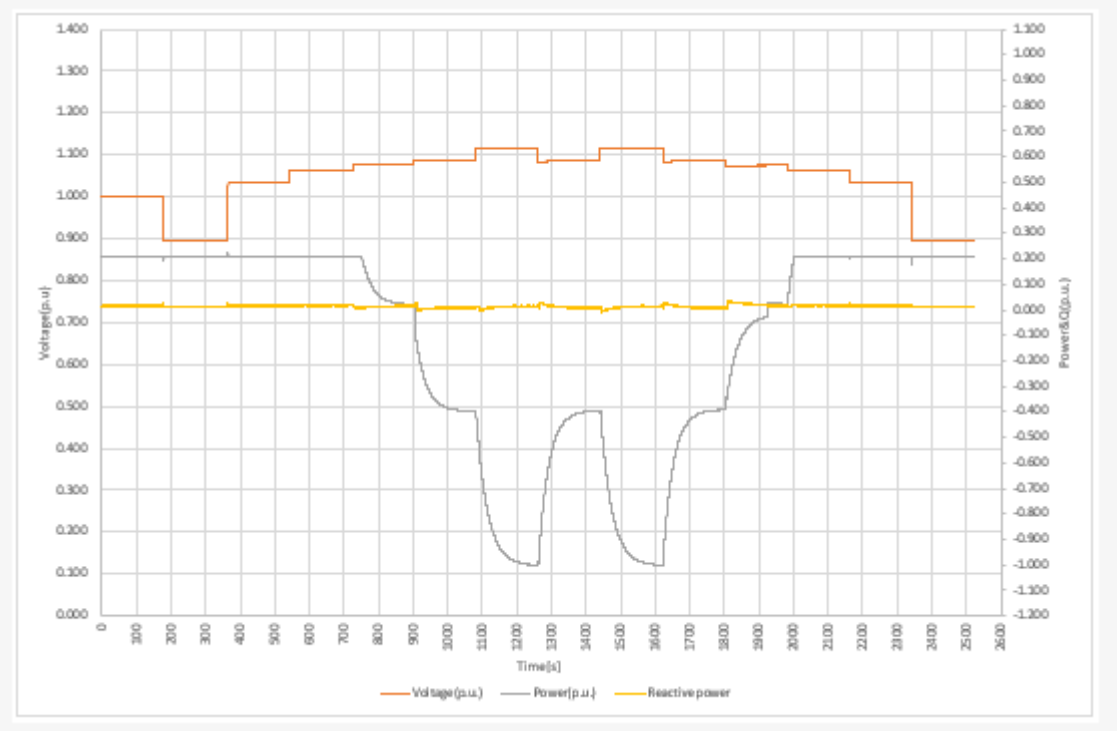
Test Results Over time



7) Characteristic 2_20%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	359.90	2479.40	1.000	0.200	0.200	-0.005	0.200	1.000	60.000
2	V_L+a_v	0.895	360.00	2479.20	0.895	0.224	0.200	-0.005	0.200	1.000	60.000
3	V_1-a_v	1.035	359.90	2479.20	1.035	0.194	0.200	-0.005	0.200	1.000	60.000
4	$V_{1+}a_v$	1.065	360.00	2502.00	1.065	0.188	0.200	-0.006	0.200	0.999	60.000
5	$(V_1+V_2)/2$	1.075	360.00	22.00	1.075	0.001	0.001	0.000	0.001	1.000	60.000
6	V_2-a_v	1.085	360.00	-5051.03	1.085	0.364	-0.395	0.008	0.399	1.000	60.00
7	$V_{2+}a_v$	1.115	V_H is ≤ $(V_{2+}a_v)$ skip this step								
8	V_H-a_v	1.085									
9	$V_{2+}a_v$	1.115									
10	V_2-a_v	1.085									
11	$(V_1+V_2)/2$	1.075	360.00	22.00	1.075	0.001	0.001	0.000	0.001	1.000	60.000
12	$V_{1+}a_v$	1.065	360.00	2478.70	1.065	0.188	0.200	-0.006	0.200	1.000	60.000
13	V_1-a_v	1.035	360.00	2479.00	1.035	0.194	0.200	-0.005	0.200	1.000	60.000
14	V_L+a_v	0.895	360.00	2479.00	0.895	0.224	0.200	-0.005	0.200	1.000	60.000

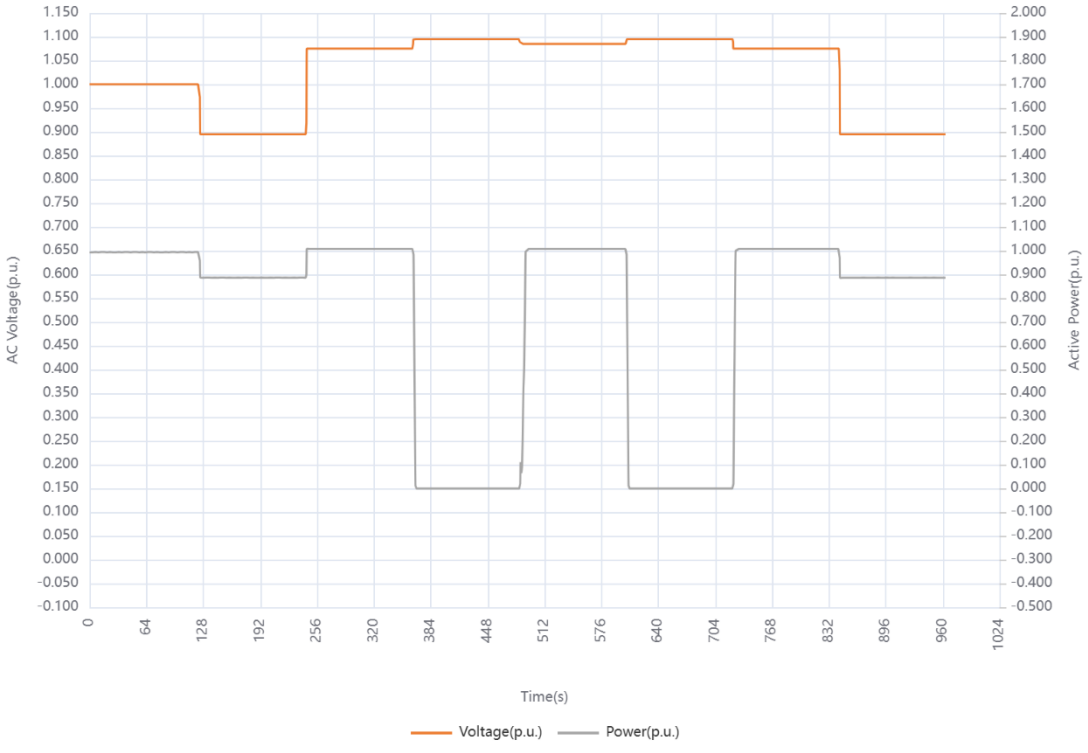
Test Results Over time



8) Characteristic 3_100%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	359.50	12507.80	1.000	0.986	0.994	0.021	0.994	1.000	60.000
2	V_L+a_v	0.895	359.50	11213.40	0.895	0.982	0.886	-0.013	0.887	1.000	60.000
3	V_1-a_v	1.075	359.50	12668.90	1.075	0.930	1.007	0.029	1.007	1.000	60.000
4	$V_{1+}a_v$	1.105	V_H is ≤ ($V_{1+}a_v$) skip this step								
5	$(V_1+V_2)/2$	1.095	360.10	101.80	1.095	0.018	-0.001	-0.020	0.020	-0.045	60.000
6	V_2-a_v	1.085	359.50	12665.00	1.085	0.921	1.006	0.029	1.006	1.000	60.000
7	$V_{2+}a_v$	1.115	V_H is ≤ ($V_{2+}a_v$) skip this step								
8	V_H-a_v	1.085	Same voltage step with step 6, skip this step								
9	$V_{2+}a_v$	1.115	V_H is ≤ ($V_{2+}a_v$) skip this step								
10	V_2-a_v	1.085	Same voltage step with step 6, skip this step								
11	$(V_1+V_2)/2$	1.095	360.10	101.85	1.095	0.018	-0.001	-0.020	0.021	-0.045	60.000
12	$V_{1+}a_v$	1.105	V_H is ≤ ($V_{1+}a_v$) skip this step								
13	V_1-a_v	1.075	359.50	12668.40	1.075	0.930	1.007	0.029	1.007	1.000	60.000
14	V_L+a_v	0.895	359.50	11214.70	0.895	0.982	0.886	-0.007	0.887	1.000	60.000

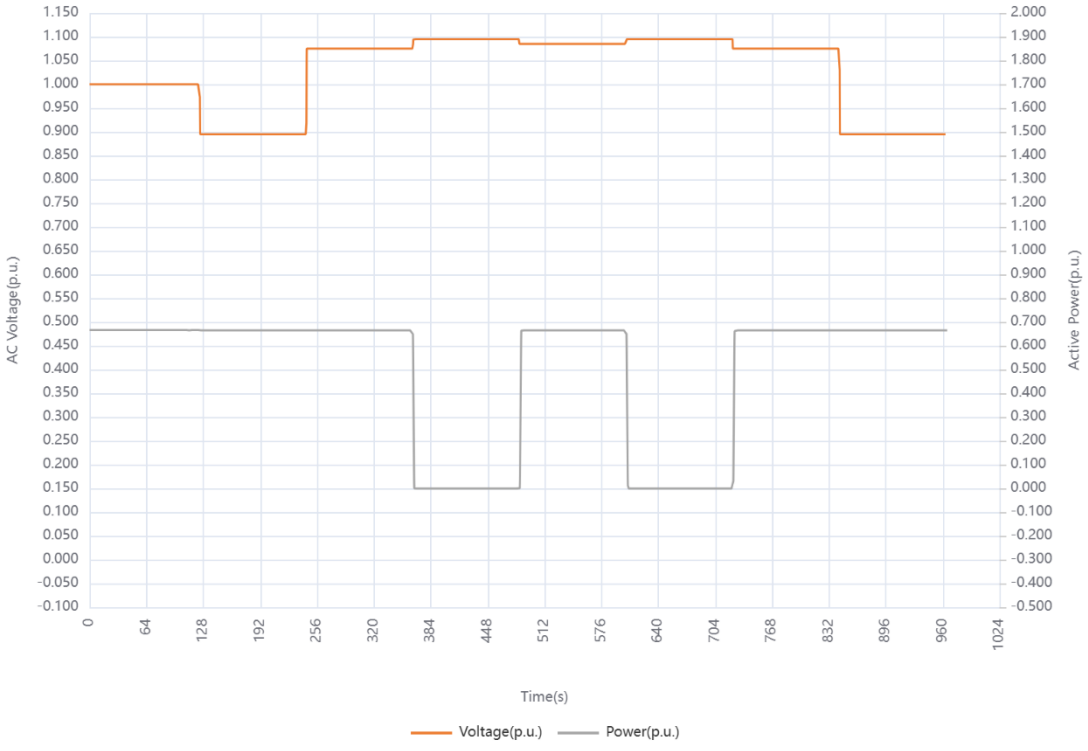
Test Results Over time



9) Characteristic 3_66%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	359.70	8365.90	1.000	0.663	0.666	0.020	0.666	1.000	60.000
2	V_L+a_v	0.895	359.70	8396.90	0.895	0.737	0.665	0.020	0.665	1.000	60.000
3	V_1-a_v	1.075	359.70	8360.30	1.075	0.616	0.665	0.021	0.665	0.999	60.000
4	$V_{1+}a_v$	1.105	V_H is ≤ ($V_{1+}a_v$) skip this step								
5	$(V_1+V_2)/2$	1.095	360.10	101.20	1.095	0.018	-0.001	-0.020	0.020	-0.047	60.000
6	V_2-a_v	1.085	359.70	8354.30	1.085	0.609	0.664	0.022	0.664	0.999	60.000
7	$V_{2+}a_v$	1.115	V_H is ≤ ($V_{2+}a_v$) skip this step								
8	V_H-a_v	1.085	Same voltage step with step 6, skip this step								
9	$V_{2+}a_v$	1.115	V_H is ≤ ($V_{2+}a_v$) skip this step								
10	V_2-a_v	1.085	Same voltage step with step 6, skip this step								
11	$(V_1+V_2)/2$	1.095	360.10	102.50	1.095	0.018	-0.001	-0.020	0.021	-0.047	60.000
12	$V_{1+}a_v$	1.105	V_H is ≤ ($V_{1+}a_v$) skip this step								
13	V_1-a_v	1.075	359.70	8358.60	1.075	0.617	0.665	0.022	0.665	0.999	60.000
14	V_L+a_v	0.895	359.70	8394.50	0.895	0.738	0.665	0.019	0.665	1.000	60.000

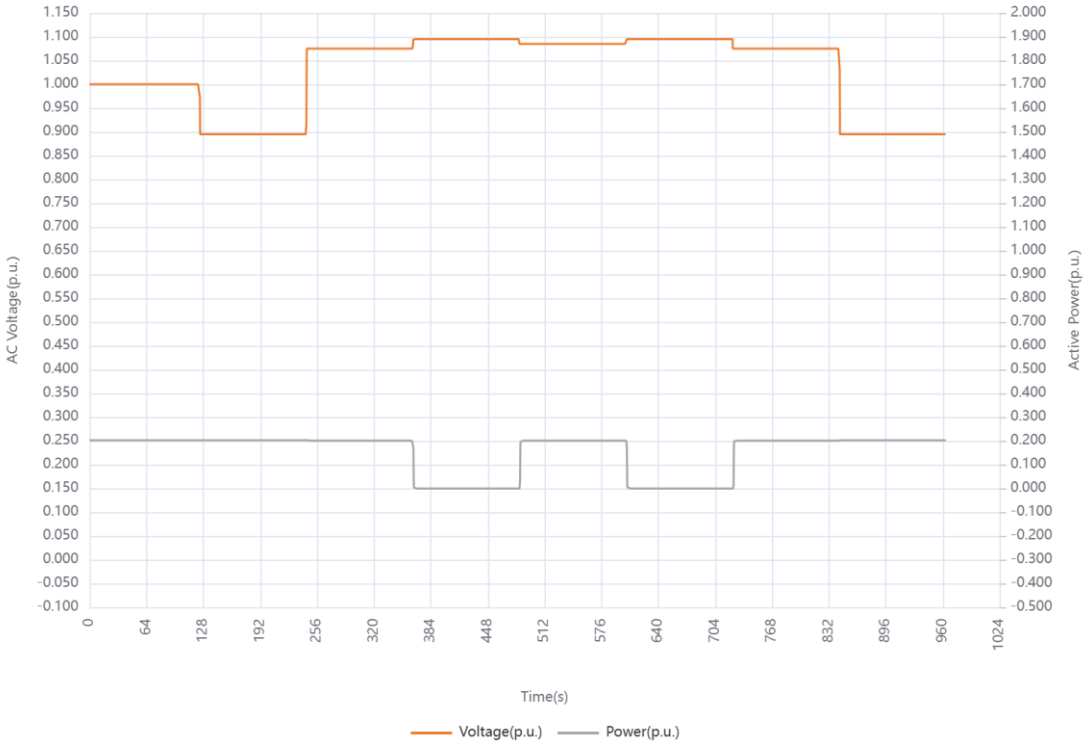
Test Results Over time



10) Characteristic 3_20%P_{rated} Level_$V_{in\text{-}nom}$

Step		Vset (p.u.)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
1	V_N	1.000	360.00	2587.30	1.000	0.202	0.202	0.019	0.203	0.996	60.000
2	V_L+a_v	0.895	360.00	2593.10	0.895	0.226	0.202	0.015	0.202	0.997	60.000
3	V_1-a_v	1.075	360.00	2593.90	1.075	0.188	0.201	0.022	0.203	0.994	60.000
4	$V_{1+}a_v$	1.105	V_H is ≤ ($V_{1+}a_v$) skip this step								
5	$(V_1+V_2)/2$	1.095	360.10	101.10	1.095	0.018	-0.001	-0.020	0.020	-0.047	60.000
6	V_2-a_v	1.085	360.00	2593.90	1.085	0.186	0.201	0.022	0.202	0.994	60.000
7	$V_{2+}a_v$	1.115	V_H is ≤ ($V_{2+}a_v$) skip this step								
8	V_H-a_v	1.085	Same voltage step with step 6, skip this step								
9	$V_{2+}a_v$	1.115	V_H is ≤ ($V_{2+}a_v$) skip this step								
10	V_2-a_v	1.085	Same voltage step with step 6, skip this step								
11	$(V_1+V_2)/2$	1.095	360.30	101.50	1.095	0.018	-0.001	-0.020	0.021	-0.047	60.000
12	$V_{1+}a_v$	1.105	V_H is ≤ ($V_{1+}a_v$) skip this step								
13	V_1-a_v	1.075	360.00	2593.60	1.075	0.188	0.201	0.022	0.203	0.994	60.000
14	V_L+a_v	0.895	360.00	2592.80	0.895	0.226	0.202	0.015	0.202	0.997	60.000

Test Results Over time



4.14.8 Test for voltage-active power (volt-watt) mode with an imbalanced grid

This test verifies the EUT's operation with voltage-active power (volt-watt) mode enabled is compliant with 5.4.2 of IEEE Std 1547-2018 during voltage disturbances within the continuous operation range defined in 6.4.2.2 of IEEE Std 1547-2018 that cause an imbalanced grid with a negative sequence component. This test verifies the EUT's response to changes in voltage magnitude when connected to a ac test source. This test is optional for Category A equipment.

EUT volt-watt parameters to the values specified by the default volt-var settings in Characteristic 1.
All other function should be turned off. Turn off the autonomously adjusting reference voltage.

Table 24—Imbalanced voltage test cases

	Phase A (p.u.)	Phase B (p.u.)	Phase C (p.u.)
Case A	≥1.07	≤0.91	≤0.91
Case B	≤0.91	≥1.07	≥1.07

NOTE—Choose any phase as A, B, or C. Order does not matter.

Voltage-reactive power (volt-var) mode respond according to:	
☐	individual phase voltages
☐	the average of the three-phase effective (rms) values
☒	the positive sequence of voltages

Not applicable. This test is not applicable to single phase.

4.15 Frequency support

The tests in this subclause verify the operation of the EUT's frequency support function as defined in IEEE Std 1547-2018. If a communication protocols from Table 41 in IEEE Std 1547-2018 is used to change EUT settings, these tests may be used to verify interoperability.

Communication Protocols Used		Comments
IEEE Std 2030.5 (SEP2)	☒	
IEEE Std 1815 (DNP3)	☐	
SunSpec Modbus	☐	
Not tested with Communication Protocols	☐	

4.15.1 Test for frequency-droop (frequency-power or frequency-watt) capability-above nominal frequency

This test verifies the EUT's operation with frequency-active power (freq-watt) mode enabled is compliant with 6.5.2.7 of IEEE Std 1547-2018.

- **Frequency Droop Equation**

Operation for low-frequency conditions	Operation for high-frequency conditions
$p = \min_{f<60-db_{UF}} \left\{ p_{pre} + \frac{(60-db_{UF})-f}{60 \cdot k_{UF}}; p_{avl} \right\}$	$p = \max_{f>60+db_{OF}} \left\{ p_{pre} - \frac{f-(60+db_{OF})}{60 \cdot k_{OF}}; p_{min} \right\}$

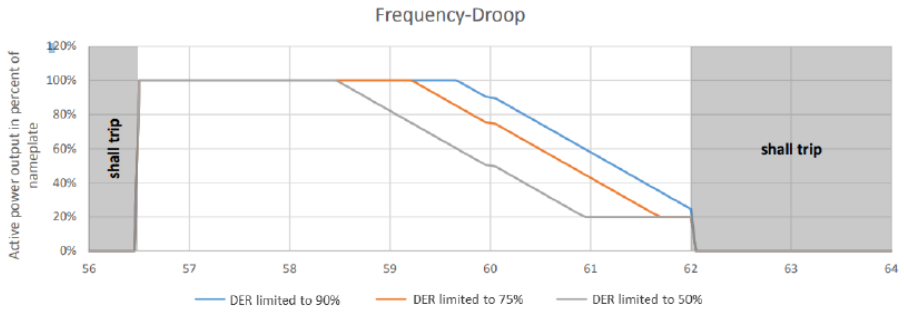


Figure 12—Example of a frequency droop function

The parameters in Table 34 and Table 35 define a frequency-watt characteristic to be tested.

Table 34—Characteristic 1:
Default frequency-power power settings for abnormal operating performance Category I, II, and III DER

Parameter	Category I	Category II	Category III
db_{OF} (Hz)	0.036	0.036	0.036
k_{OF}	0.05	0.05	0.05
T_r (s) (small signal)	5	5	5

Table 35—Characteristic 2:
Frequency-power power settings for abnormal operating performance Category I, II, and III DER

Parameter	Category I	Category II	Category III
db_{OF} (Hz)	0.017	0.017	0.017
k_{OF}	0.03	0.03	0.02
T_r (s) (small signal)	1	1	0.2

Characteristic 1		Characteristic 2	
db_{OF} (Hz)	0.036	db_{OF} (Hz)	0.017
k_{OF}	0.05	k_{OF}	0.02
Tr(s)	5	Tr(s)	0.2
Gradient (%Pn/Hz)	33.3	Gradient (%Pn/Hz)	83.3
f_N (Hz)	60	f_N (Hz)	60
f_H (Hz)	61.2	f_H (Hz)	61.2
f_L (Hz)	58.8	f_L (Hz)	58.8
ΔP_{small} (%Pn)	5	ΔP_{small} (%Pn)	5
Δf_{small} (Hz)	0.15	Δf_{small} (Hz)	0.06
$F_{accuracy}$ (Hz)	0.01	$F_{accuracy}$ (Hz)	0.01
a_f (Hz)	0.015	a_f (Hz)	0.015

Frequency shall be ramped to each new value at the ROCOF ride-through limit for the EUT's category as defined in 6.5.2.5 in IEEE Std 1547-2018.

Table 21—Rate of change of frequency (ROCOF) ride-through requirements for DER of abnormal operating performance Category I, Category II, and Category III

Category I	Category II	Category III
0.5 Hz/s	2.0 Hz/s	3.0 Hz/s

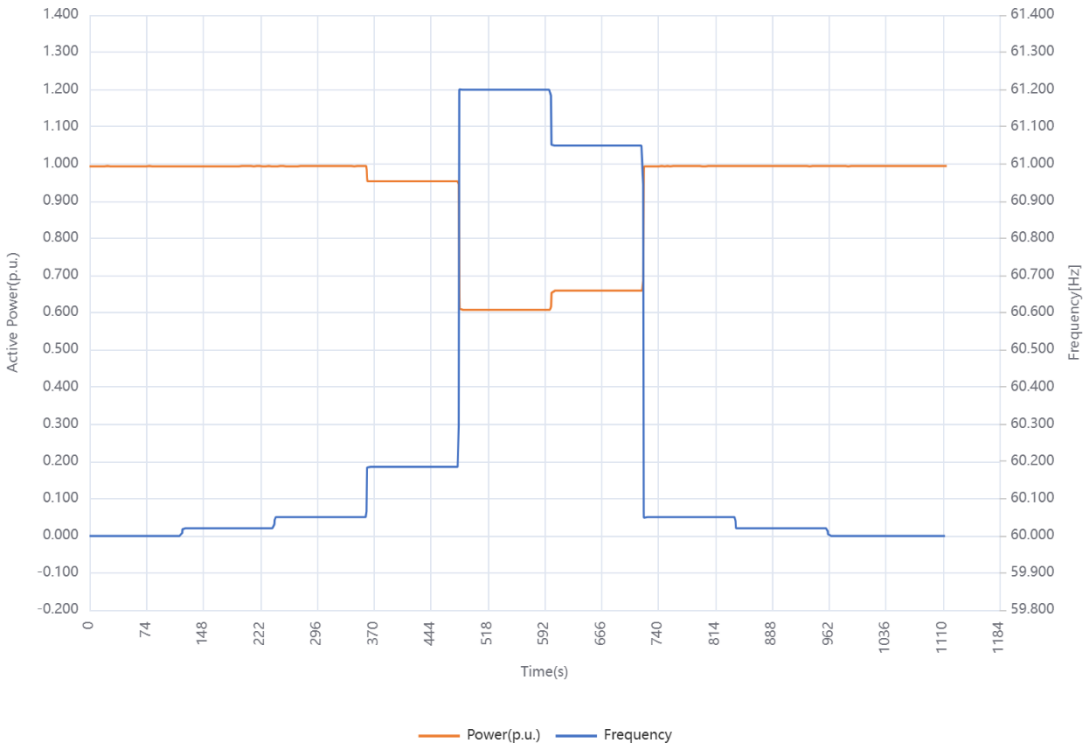
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/10/17-2025/10/18	100 ms	5 kHz

1) Characteristic 1_100%P_{rated} Level_OF

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	359.5	12504.5	1.008	0.985	0.993	0.993	-0.019	1.000	59.999
2	(f_N+db_{OF}) $-a_f$	60.021	359.5	12505.5	1.008	0.985	0.993	0.993	0.019	1.000	60.020
3	(f_N+db_{OF}) $+a_f$	60.051	359.5	12508.0	1.008	0.985	0.989	0.994	0.019	1.000	60.049
4	Δf_{small} + f_N+db_{OF}	60.186	359.5	11993.7	1.008	0.946	0.944	0.953	0.018	1.000	60.184
5	f_H	61.200	359.7	7629.5	1.005	0.605	0.605	0.607	0.034	0.998	61.199
6	f_H - Δf_{small}	61.050	359.7	8269.9	1.005	0.656	0.655	0.659	0.032	0.999	61.049
7	(f_N+db_{OF}) $+a_f$	60.051	359.5	12504.0	1.008	0.986	0.989	0.993	0.019	1.000	60.049
8	(f_N+db_{OF}) $-a_f$	60.021	359.5	12508.4	1.008	0.986	0.994	0.994	0.019	1.000	60.020
9	f_N	60.000	359.5	12508.6	1.008	0.985	0.994	0.994	-0.019	1.000	59.999

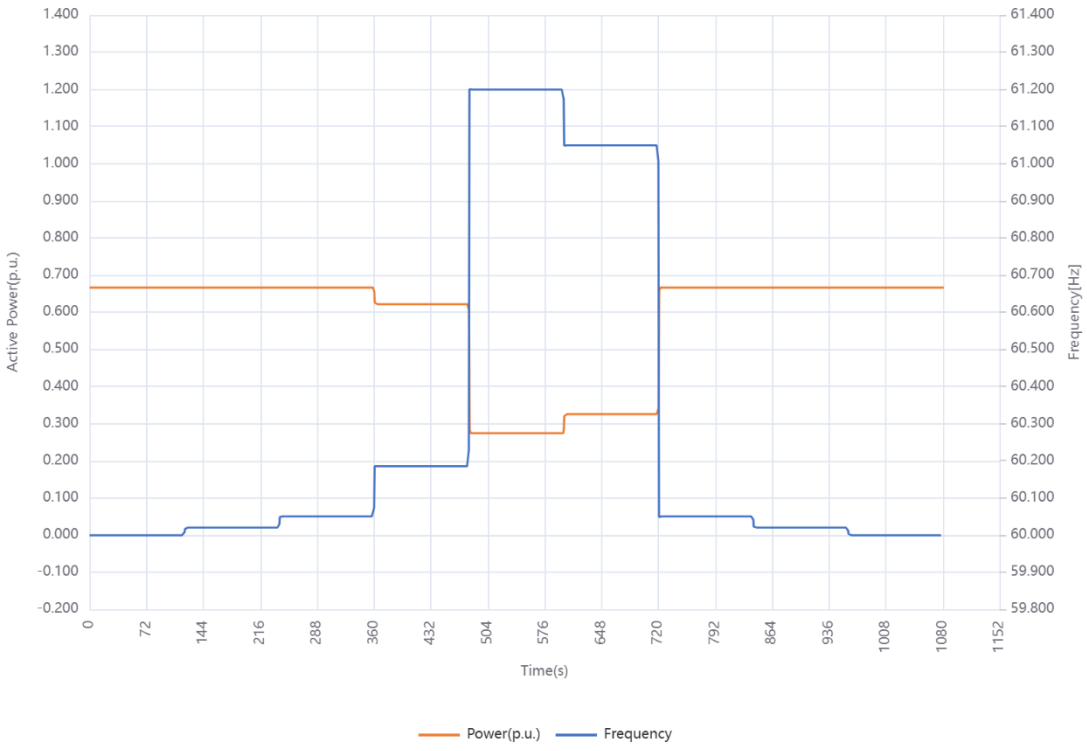
Test Results Over time (P Vs F)



2) Characteristic 1_66%P_{rated} Level_OF

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	359.7	8362.6	1.006	0.662	0.666	0.666	0.014	1.000	59.999
2	(f_N+db_{OF}) $-a_f$	60.021	359.7	8362.9	1.006	0.662	0.666	0.666	0.014	1.000	60.020
3	(f_N+db_{OF}) $+a_f$	60.051	359.7	8363.0	1.006	0.662	0.661	0.666	0.014	1.000	60.050
4	$\Delta f_{small}+$ f_N+db_{OF}	60.186	359.7	7801.3	1.005	0.618	0.616	0.621	0.016	1.000	60.185
5	f_H	61.200	360.0	3477.5	1.002	0.275	0.278	0.274	0.028	0.995	61.199
6	$f_H - \Delta f_{small}$	61.050	359.9	4110.8	1.003	0.325	0.328	0.325	0.027	0.997	61.049
7	(f_N+db_{OF}) $+a_f$	60.051	359.7	8358.4	1.006	0.662	0.661	0.666	0.014	1.000	60.050
8	(f_N+db_{OF}) $-a_f$	60.021	359.7	8362.0	1.006	0.662	0.666	0.666	0.014	1.000	60.020
9	f_N	60.000	359.7	8362.1	1.006	0.662	0.666	0.666	0.014	1.000	59.999

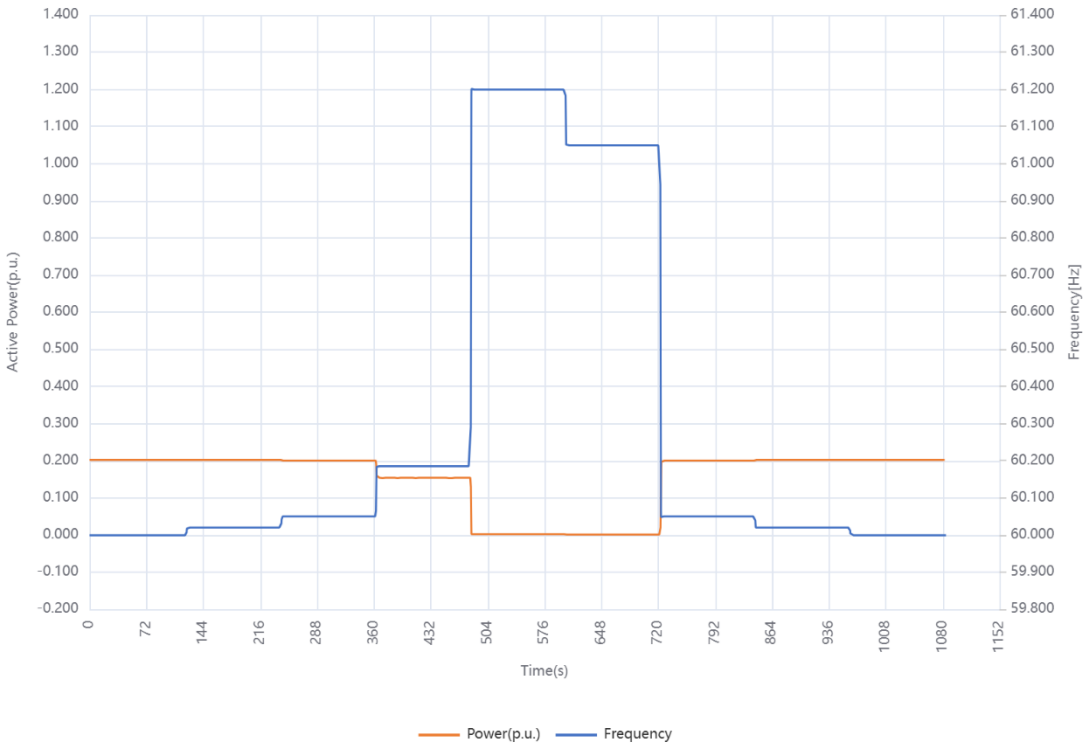
Test Results Over time (P Vs F)



3) Characteristic 1_20%P_{rated} Level_OF

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	360.0	2588.7	1.002	0.202	0.202	0.202	0.018	0.996	59.999
2	(f_N+db_{OF}) $-a_f$	60.021	360.0	2588.8	1.002	0.202	0.202	0.202	0.018	0.996	60.020
3	(f_N+db_{OF}) $+a_f$	60.051	360.0	2565.3	1.002	0.201	0.197	0.200	0.019	0.996	60.050
4	$\Delta f_{small}+$ f_N+db_{OF}	60.186	360.1	1991.2	1.001	0.155	0.152	0.154	0.020	0.991	60.185
5	f_H	61.200	360.1	123.8	1.000	0.017	0.000	0.002	-0.017	0.101	61.199
6	$f_H - \Delta f_{small}$	61.050	360.1	120.3	1.000	0.017	0.000	0.001	-0.017	0.086	61.049
7	(f_N+db_{OF}) $+a_f$	60.051	360.0	2563.2	1.002	0.201	0.198	0.200	0.019	0.996	60.049
8	(f_N+db_{OF}) $-a_f$	60.021	360.0	2589.0	1.002	0.202	0.202	0.202	0.018	0.996	60.020
9	f_N	60.000	360.0	2588.9	1.002	0.202	0.202	0.202	0.018	0.996	59.999

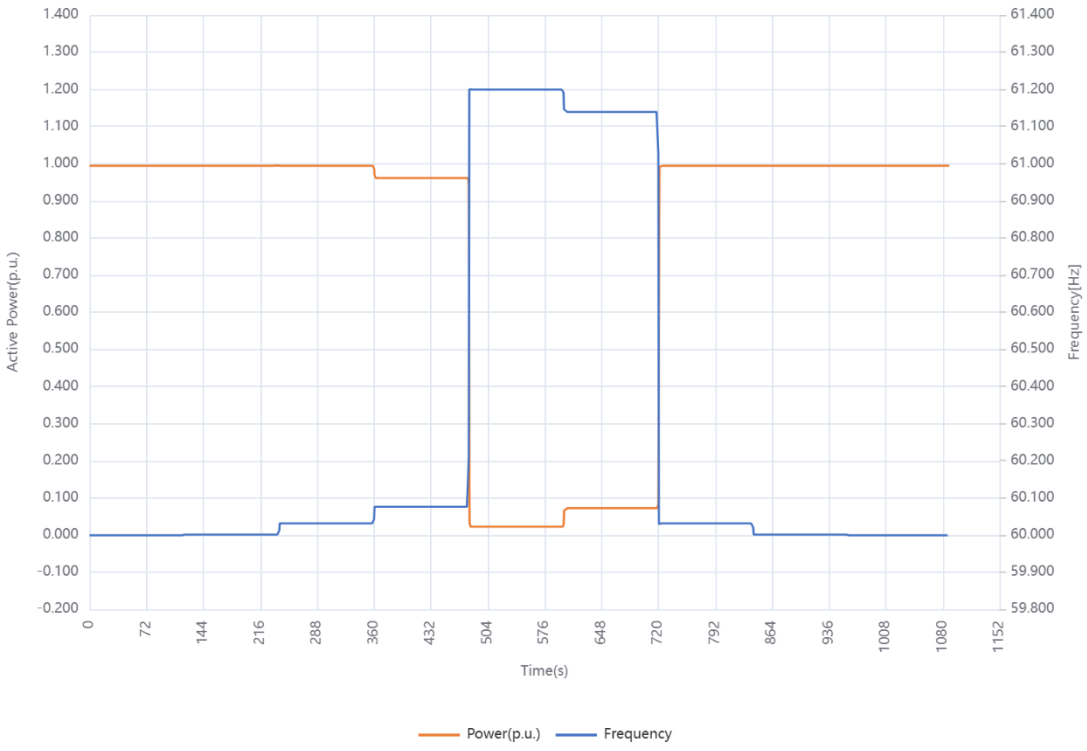
Test Results Over time (P Vs F)



4) Characteristic 2_100%P_{rated} Level_OF

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	359.5	12518.0	1.008	0.986	0.994	0.994	-0.016	1.000	59.999
2	(f_N+db_{OF}) $-a_f$	60.002	359.5	12519.4	1.008	0.986	0.994	0.994	-0.003	1.000	60.001
3	(f_N+db_{OF}) $+a_f$	60.032	359.5	12522.5	1.008	0.986	0.982	0.994	0.019	1.000	60.031
4	Δf_{small} + f_N+db_{OF}	60.077	359.5	12099.7	1.008	0.953	0.945	0.961	0.018	1.000	60.076
5	f_H	61.200	360.2	373.4	1.000	0.031	0.010	0.022	0.022	0.714	61.198
6	f_H - Δf_{small}	61.140	360.1	986.8	1.001	0.076	0.059	0.072	0.023	0.952	61.139
7	(f_N+db_{OF}) $+a_f$	60.032	359.5	12495.8	1.008	0.985	0.983	0.993	0.019	1.000	60.030
8	(f_N+db_{OF}) $-a_f$	60.002	359.5	12522.3	1.008	0.986	0.994	0.994	0.016	1.000	60.000
9	f_N	60.000	359.5	12523.8	1.008	0.986	0.994	0.994	0.019	1.000	59.999

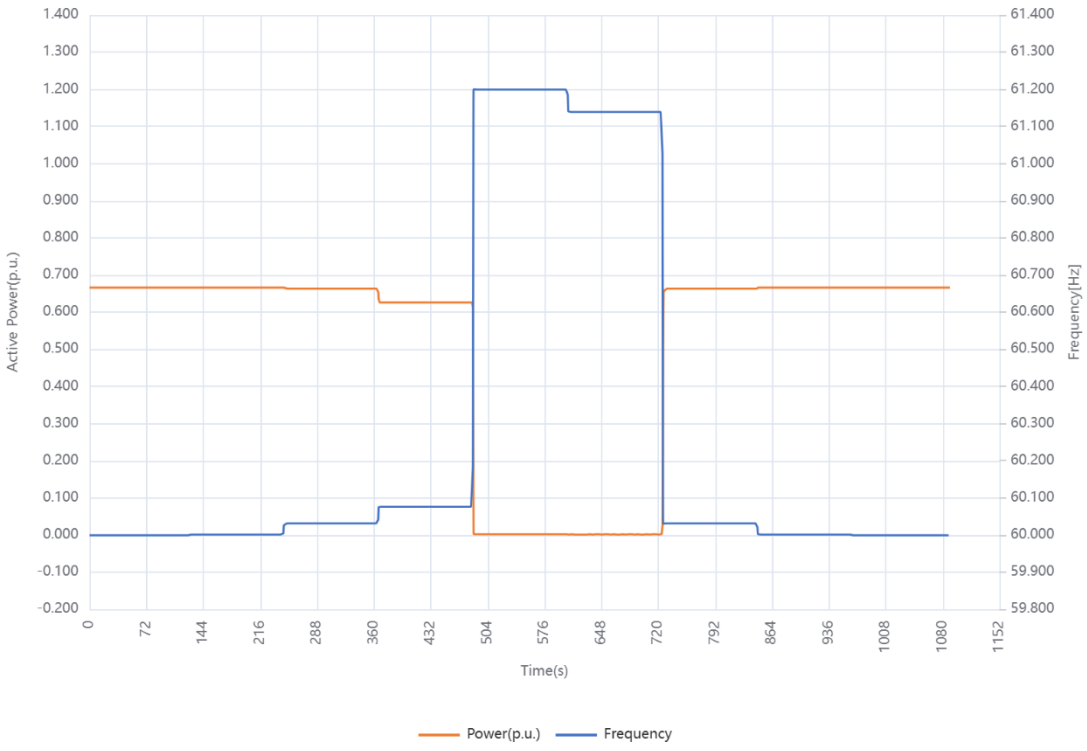
Test Results Over time (P Vs F)



5) Characteristic 2_66%P_{rated} Level_OF

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	359.7	8372.1	1.006	0.662	0.666	0.666	0.014	1.000	59.999
2	(f_N+db_{OF}) $-a_f$	60.002	359.7	8372.2	1.006	0.662	0.666	0.666	0.014	1.000	60.001
3	(f_N+db_{OF}) $+a_f$	60.032	359.7	8340.7	1.006	0.660	0.654	0.663	0.014	1.000	60.031
4	$\Delta f_{small}+$ f_N+db_{OF}	60.077	359.7	7869.4	1.005	0.623	0.617	0.626	0.015	1.000	60.076
5	f_H	61.200	360.2	125.3	1.000	0.017	0.000	0.002	-0.017	0.095	61.199
6	$f_H - \Delta f_{small}$	61.140	360.2	121.7	1.000	0.017	0.000	0.001	-0.017	0.089	61.139
7	(f_N+db_{OF}) $+a_f$	60.032	359.7	8325.2	1.006	0.659	0.654	0.663	0.014	1.000	60.031
8	(f_N+db_{OF}) $-a_f$	60.002	359.7	8370.4	1.006	0.662	0.666	0.666	0.014	1.000	60.001
9	f_N	60.000	359.7	8371.0	1.006	0.662	0.666	0.666	0.014	1.000	59.999

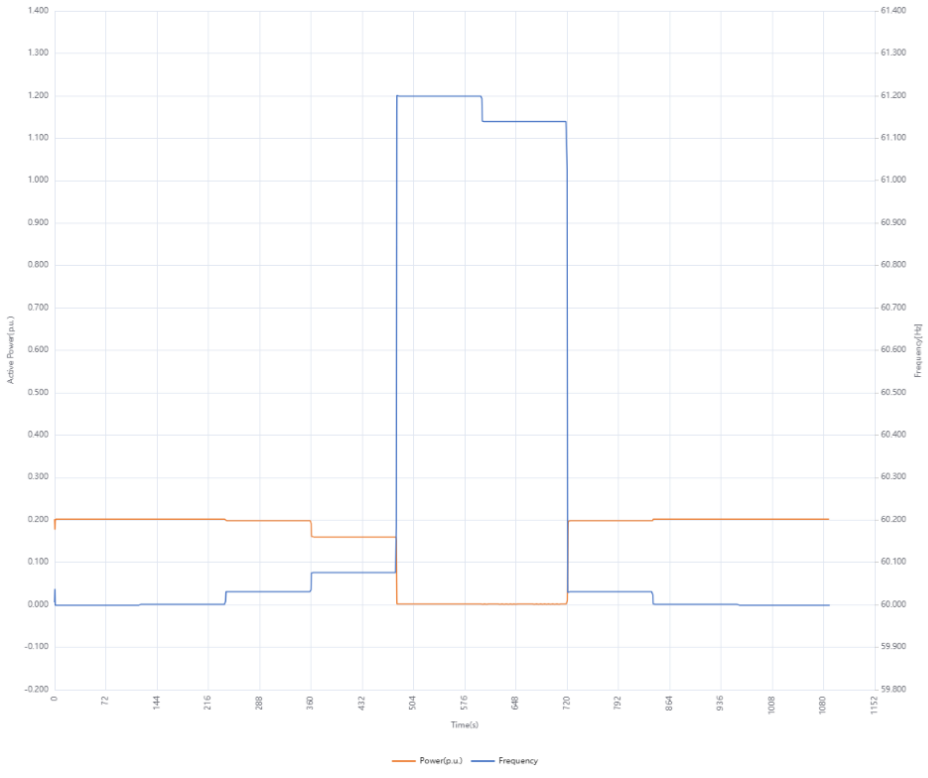
Test Results Over time (P Vs F)



6) Characteristic 2_20%P_{rated} Level_OF

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	360.0	2588.5	1.002	0.202	0.202	0.202	0.018	0.996	59.999
2	(f_N+db_{OF}) $-a_f$	60.002	360.1	2591.4	1.002	0.202	0.202	0.202	0.018	0.996	60.001
3	(f_N+db_{OF}) $+a_f$	60.032	360.1	2573.9	1.002	0.201	0.208	0.201	0.018	0.996	60.010
4	$\Delta f_{small}+$ f_N+db_{OF}	60.077	360.1	2449.7	1.002	0.191	0.194	0.191	0.019	0.995	60.026
5	f_H	61.200	360.2	123.4	1.000	0.017	0.000	0.002	-0.017	0.096	61.199
6	$f_H - \Delta f_{small}$	61.140	360.2	121.9	1.000	0.017	0.000	0.002	-0.017	0.090	61.139
7	(f_N+db_{OF}) $+a_f$	60.032	360.1	2537.5	1.002	0.198	0.190	0.198	0.019	0.996	60.031
8	(f_N+db_{OF}) $-a_f$	60.002	360.1	2591.0	1.002	0.202	0.202	0.202	0.018	0.996	60.001
9	f_N	60.000	360.1	2590.9	1.002	0.202	0.202	0.202	0.018	0.996	59.999

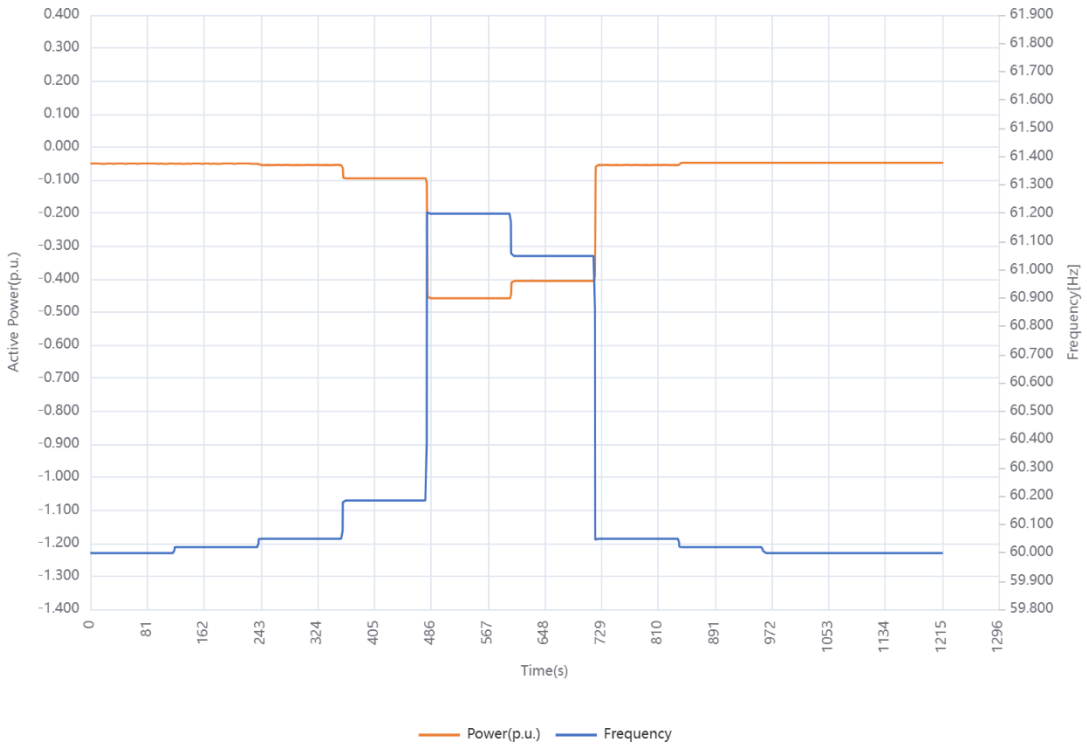
Test Results Over time (P Vs F)



7) Characteristic 1_100%P_{rated} Level_OF with absorbing function

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	49.9	499.2	1.000	0.053	-0.050	-0.050	0.017	0.946	59.998
2	(f_N+db_{OF}) $-a_f$	60.021	49.9	499.3	1.000	0.053	-0.050	-0.050	0.017	0.946	60.019
3	(f_N+db_{OF}) $+a_f$	60.051	49.9	550.9	0.999	0.057	-0.055	-0.054	0.017	0.955	60.049
4	$\Delta f_{small}+$ f_N+db_{OF}	60.186	49.9	1021.6	0.999	0.097	-0.100	-0.095	0.017	0.985	60.184
5	f_H	61.200	50.2	5218.1	0.995	0.460	-0.438	-0.457	0.027	0.998	61.198
6	$f_H - \Delta f_{small}$	61.050	50.2	4640.2	0.996	0.408	-0.388	-0.406	0.024	0.998	61.049
7	(f_N+db_{OF}) $+a_f$	60.051	49.9	574.2	0.999	0.059	-0.055	-0.056	0.017	0.955	60.050
8	(f_N+db_{OF}) $-a_f$	60.021	49.9	477.4	1.000	0.051	-0.048	-0.048	0.017	0.943	60.019
9	f_N	60.000	49.9	477.4	1.000	0.051	-0.048	-0.048	0.017	0.944	59.998

Test Results Over time (P Vs F)



4.15.2 Test for frequency-droop (frequency-power or frequency-watt) capability-below nominal frequency

This test verifies the EUT's operation with frequency-active power (freq-watt) mode enabled is compliant with 6.5.2.7 of IEEE Std 1547-2018.

- **Frequency Droop Equation**

Operation for low-frequency conditions	Operation for high-frequency conditions
$p = \min_{f<60-db_{UF}} \left\{ p_{pre} + \frac{(60-db_{UF})-f}{60 \cdot k_{UF}}; p_{avl} \right\}$	$p = \max_{f>60+db_{OF}} \left\{ p_{pre} - \frac{f-(60+db_{OF})}{60 \cdot k_{OF}}; p_{min} \right\}$

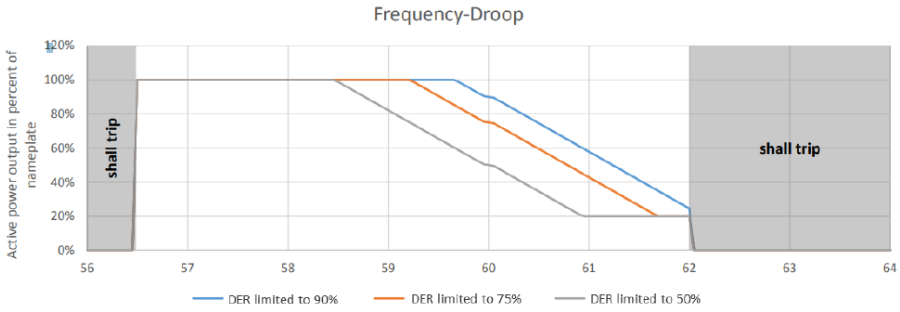


Figure 13—Example of a frequency droop function

The parameters in Table 36 and Table 37 define a frequency-watt characteristic to be tested.

Table 36—Characteristic 1:
Default frequency-power power settings for abnormal operating performance Category I, II, and III DER

Parameter	Category I	Category II	Category III
db_{UF} (Hz)	0.036	0.036	0.036
k_{UF}	0.05	0.05	0.05
T_r (s) (small-signal)	5	5	5

Table 37—Characteristic 2:
Frequency-power power settings for abnormal operating performance Category I, II, and III DER

Parameter	Category I	Category II	Category III
db_{UF} (Hz)	0.017	0.017	0.017
k_{UF}	0.03	0.03	0.02
T_r (s) (small-signal)	1	1	0.2

Characteristic 1		Characteristic 2	
db_{UF} (Hz)	0.036	db_{UF} (Hz)	0.017
k_{UF}	0.05	k_{UF}	0.02
Tr(s)	5	Tr(s)	0.2
Gradient (%Pn/Hz)	33.3	Gradient (%Pn/Hz)	83.3
f_N (Hz)	60	f_N (Hz)	60
f_H (Hz)	61.2	f_H (Hz)	61.2
f_L (Hz)	58.8	f_L (Hz)	58.8
ΔP_{small} (%Pn)	5	ΔP_{small} (%Pn)	5
Δf_{small} (Hz)	0.15	Δf_{small} (Hz)	0.06
$F_{accuracy}$ (Hz)	0.01	$F_{accuracy}$ (Hz)	0.01
a_f (Hz)	0.015	a_f (Hz)	0.015

Frequency shall be ramped to each new value at the ROCOF ride-through limit for the EUT's category as defined in 6.5.2.5 in IEEE Std 1547-2018.

Table 21—Rate of change of frequency (ROCOF) ride-through requirements for DER of abnormal operating performance Category I, Category II, and Category III

Category I	Category II	Category III
0.5 Hz/s	2.0 Hz/s	3.0 Hz/s

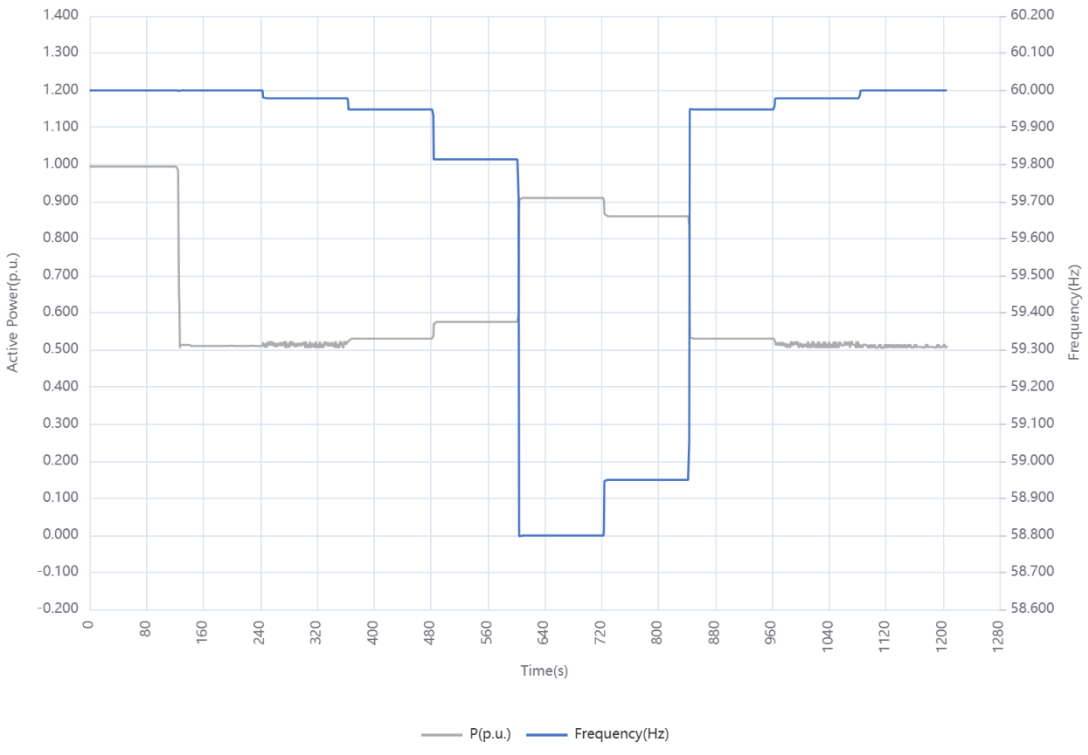
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/04/27	100 ms	5 kHz

1) Characteristic 1_50%P_{rated} Level_UF

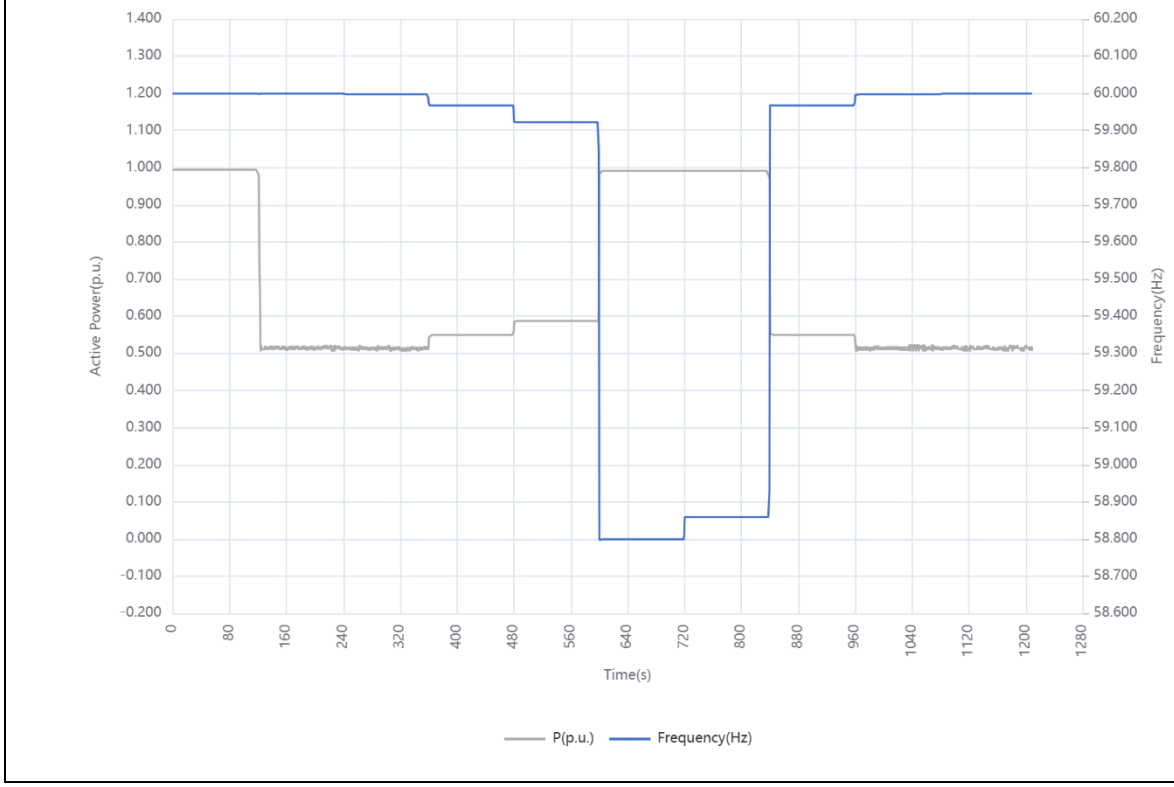
Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	359.5	12505.0	1.008	0.986	0.994	0.994	0.019	1.000	59.999
Set the EUT's output power to 50% of Prated											
2	f_L	60.000	359.8	6552.5	1.004	0.519	0.521	0.521	0.014	1.000	59.999
3	$(f_N\text{-}db_{uF})$ $+a_f$	59.979	359.8	6444.2	1.004	0.511	0.513	0.513	0.014	1.000	59.978
4	$(f_N\text{-}db_{uF})$ $-a_f$	59.949	359.8	6659.2	1.004	0.528	0.518	0.530	0.013	1.000	59.948
5	$f_N\text{-}\Delta f_{small}$ $\text{-}db_{uF}$	59.814	359.7	7218.3	1.005	0.572	0.563	0.575	0.012	1.000	59.813
6	f_L	58.800	359.5	11427.4	1.008	0.903	0.901	0.909	0.041	0.999	58.799
7	$f_L +$ Δf_{small}	58.950	359.6	10810.3	1.007	0.854	0.851	0.860	0.033	0.999	58.949
8	$(f_N\text{-}db_{uF})$ $-a_f$	59.949	359.8	6662.4	1.004	0.528	0.518	0.530	0.013	1.000	59.948
9	$(f_N\text{-}db_{uF})$ $+a_f$	59.979	359.8	6444.6	1.004	0.511	0.513	0.513	0.014	1.000	59.978
10	f_N	60.000	359.8	6400.3	1.004	0.508	0.510	0.510	0.014	1.000	59.999

Test Results Over time (P Vs F)



2) Characteristic 2_50%P_{rated} Level_UF

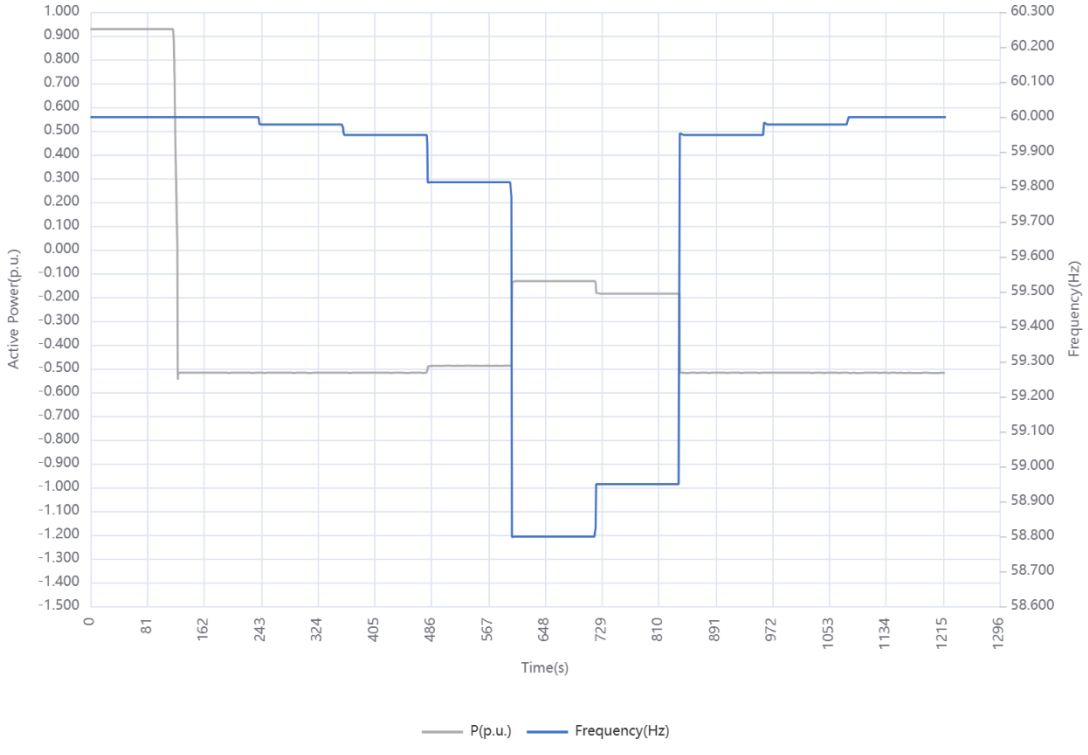
Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	359.5	12505.7	1.008	0.986	0.994	0.994	0.019	1.000	59.999
Set the EUT's output power to 50% of Prated											
2	f_N	60.000	359.8	6540.1	1.004	0.517	0.520	0.520	0.014	1.000	59.999
3	$(f_N\text{-}db_{uF})$ $+a_f$	59.998	359.8	6459.4	1.004	0.512	0.514	0.514	0.014	1.000	59.997
4	$(f_N\text{-}db_{uF})$ $-a_f$	59.968	359.7	6901.6	1.005	0.547	0.527	0.549	0.014	1.000	59.967
5	$f_N\text{-}\Delta f_{small}$ $\text{-}db_{uF}$	59.923	359.7	7372.0	1.005	0.584	0.565	0.587	0.013	1.000	59.922
6	f_L	58.800	359.5	12475.5	1.008	0.984	1.000	0.991	0.047	0.999	58.799
7	$f_L +$ Δf_{small}	58.860	359.5	12481.5	1.008	0.984	1.000	0.991	0.045	0.999	58.859
8	$(f_N\text{-}db_{uF})$ $-a_f$	59.968	359.7	6911.4	1.005	0.547	0.527	0.550	0.014	1.000	59.967
9	$(f_N\text{-}db_{uF})$ $+a_f$	59.998	359.8	6457.8	1.004	0.512	0.514	0.514	0.014	1.000	59.997
10	f_N	60.000	359.8	6446.8	1.004	0.511	0.513	0.513	0.014	1.000	59.999
Test Results Over time (P Vs F)											



3) Characteristic 1_50%P_{rated} Level_UF with absorbing function

Ramp Step		F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	$P_{desired}$ (p.u.)	P (p.u.)	Q (p.u.)	PF	F (Hz)
1	f_N	60.000	49.6	-12092.9	1.009	0.921	0.928	0.928	0.018	1.000	59.999
Set the EUT's output power to -50% of Prated											
2	f_N	60.000	50.3	5701.5	0.995	0.513	-0.499	-0.499	0.012	1.000	59.999
3	$(f_N - db_{uF}) + a_f$	59.979	50.3	5931.8	0.995	0.521	-0.518	-0.518	0.012	1.000	59.978
4	$(f_N - db_{uF}) - a_f$	59.949	50.3	5932.0	0.995	0.521	-0.513	-0.518	0.012	1.000	59.948
5	$f_N - \Delta f_{small} - db_{uF}$	59.814	50.3	5596.8	0.995	0.491	-0.468	-0.489	0.010	1.000	59.813
6	f_L	58.800	49.9	1458.2	0.999	0.133	-0.130	-0.132	0.012	0.996	58.799
7	$f_L + \Delta f_{small}$	58.950	50.0	2075.0	0.998	0.186	-0.180	-0.185	0.010	0.998	58.949
8	$(f_N - db_{uF}) - a_f$	59.949	50.3	5932.0	0.995	0.521	-0.513	-0.518	0.012	1.000	59.948
+9	$(f_N - db_{uF}) + a_f$	59.979	50.3	5931.8	0.995	0.521	-0.518	-0.518	0.012	1.000	59.978
10	f_N	60.000	50.3	5935.0	0.995	0.521	-0.519	-0.519	0.012	1.000	59.999

Test Results Over time (P Vs F)



4.15.3 Test for frequency-droop (frequency-power or frequency-watt) capability-above nominal frequency – SRD 2.0

This test verifies the EUT's operation with frequency-active power (freq-watt) mode enabled is compliant with Part II Section C Frequency-droop of SRD 2.0.

- **Frequency Droop Equation**

Operation for low-frequency conditions	Operation for high-frequency conditions
$p = \min_{f<60-db_{UF}} \left\{ p_{pre} + \frac{(60-db_{UF})-f}{60 \cdot k_{UF}}; p_{avl} \right\}$	$p = \max_{f>60+db_{OF}} \left\{ p_{pre} - \frac{f-(60+db_{OF})}{60 \cdot k_{OF}}; p_{min} \right\}$

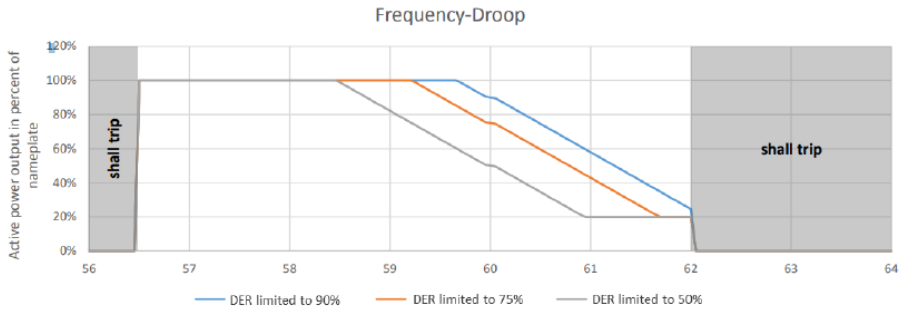


Figure 12—Example of a frequency droop function

For certification testing purposes, the use of SRD V2.0 values are required.

IEEE 1547-2018 Table 24
Parameters of frequency-droop (frequency-power) operation for DER of abnormal operating performance
Category III

Parameter	Ranges of allowable settings [a]	
	1547-2018 Category III	SRD V2.0
dbOF, dbUF (Hz)	0.017[b]–1.0	0.017 -1.0
kOF, kUF	0.02–0.05	0.02 - 0.07
$T_{response}$ (small-signal) (s)	0.2–10	0.2-10

Characteristic 1		Characteristic 2	
db_{OF} (Hz)	0.036	db_{OF} (Hz)	0.017
k_{OF}	0.07	k_{OF}	0.02
Tr(s)	5	Tr(s)	0.2
Gradient (%Pn/Hz)	23.8	Gradient (%Pn/Hz)	83.3
f_N (Hz)	60	f_N (Hz)	60
f_H (Hz)	63	f_H (Hz)	63
f_L (Hz)	57	f_L (Hz)	57
ΔP_{small} (%Pn)	5	ΔP_{small} (%Pn)	5
Δf_{small} (Hz)	0.21	Δf_{small} (Hz)	0.06
$F_{accuracy}$ (Hz)	0.01	$F_{accuracy}$ (Hz)	0.01
a_f (Hz)	0.015	a_f (Hz)	0.015

Note: For HAWAIIAN ELECTRIC SRD2.0, the Continuous Operation range is [57Hz, 63Hz]

Frequency shall be ramped to each new value at the ROCOF ride-through limit for the EUT's category as defined in 6.5.2.5 in IEEE Std 1547-2018.

Table 21—Rate of change of frequency (ROCOF) ride-through requirements for DER of abnormal operating performance Category I, Category II, and Category III

Category I	Category II	Category III
0.5 Hz/s	2.0 Hz/s	3.0 Hz/s

Measurement equipment settings used for this test are shown in the following table:

Not Applicable.

4.15.4 Test for frequency-droop (frequency-power or frequency-watt) capability-below nominal frequency – SRD 2.0

This test verifies the EUT's operation with frequency-active power (freq-watt) mode enabled is compliant with 6.5.2.7 of IEEE Std 1547-2018.

- **Frequency Droop Equation**

Operation for low-frequency conditions	Operation for high-frequency conditions
$p = \min_{f<60-db_{UF}} \left\{ p_{pre} + \frac{(60-db_{UF})-f}{60 \cdot k_{UF}}; p_{avl} \right\}$	$p = \max_{f>60+db_{OF}} \left\{ p_{pre} - \frac{f-(60+db_{OF})}{60 \cdot k_{OF}}; p_{min} \right\}$

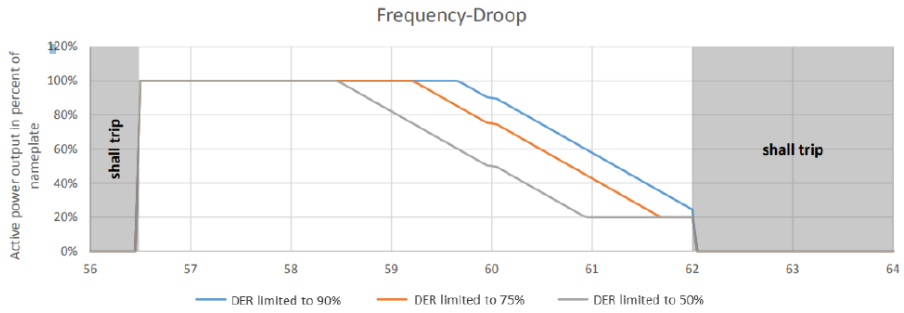


Figure 13—Example of a frequency droop function

For certification testing purposes, the use of SRD V2.0 values are required.

IEEE 1547-2018 Table 24 Parameters of frequency-droop (frequency-power) operation for DER of abnormal operating performance Category III		
Parameter	Ranges of allowable setting	
	IEEE 1547-2018 Category III	SRD V2.0
dbOF, dbUF (Hz)	0.017 ~ 1.0	0.017 ~ 1.0
KOf, kUF	0.02 ~ 0.05	0.02 ~ 0.07
$T_{response}$ (small-signal) (s)	0.2 ~ 10	0.2 ~ 10

Characteristic 1		Characteristic 2	
db_{UF} (Hz)	0.036	db_{UF} (Hz)	0.017
k_{UF}	0.07	k_{UF}	0.02
Tr(s)	5	Tr(s)	0.2
Gradient (%Pn/Hz)	23.8	Gradient (%Pn/Hz)	83.3
f_N (Hz)	60	f_N (Hz)	60
f_H (Hz)	63	f_H (Hz)	63
f_L (Hz)	57	f_L (Hz)	57
ΔP_{small} (%Pn)	5	ΔP_{small} (%Pn)	5
Δf_{small} (Hz)	0.15	Δf_{small} (Hz)	0.06
$F_{accuracy}$ (Hz)	0.01	$F_{accuracy}$ (Hz)	0.01
a_f (Hz)	0.015	a_f (Hz)	0.015

Note: For HAWAIIAN ELECTRIC SRD2.0, the Continuous Operation range is [57Hz, 63Hz]

Frequency shall be ramped to each new value at the ROCOF ride-through limit for the EUT's category as defined in 6.5.2.5 in IEEE Std 1547-2018.

Table 21—Rate of change of frequency (ROCOF) ride-through requirements for DER of abnormal operating performance Category I, Category II, and Category III

Category I	Category II	Category III
0.5 Hz/s	2.0 Hz/s	3.0 Hz/s

Measurement equipment settings used for this test are shown in the following table:

Not Applicable.

4.16 Test for prioritization of DER responses

4.16.1 Test for voltage and frequency regulation priority

This test verifies the EUT's operation and prioritization with multiple voltage and frequency regulation functions enabled.

Table 39 —Category B voltage and frequency regulation priority test steps and expected results

Step	AC test source voltage (p.u.)	AC test source frequency (Hz)	Expected active power (p.u. of rated power) (For PV)	Expected active power (p.u. of rated power) (For storage)	Expected reactive power for each enabled mode			
					volt-var (p.u. of rated power)	var (p.u. of rated power)	Power factor (unitless)	watt-var (p.u. of rated power)
1	1	60	0.5	0.5	0	0.44 inj	0.9 inj	0
2	1.09	60	0.4	0.25	0.44 abs	0.44 inj	0.9 inj	0
3	1.09	60.33	0.3	0.15	0.44 abs	0.44 inj	0.9 inj	0
4	1.09	60	0.4	0.25	0.44 abs	0.44 inj	0.9 inj	0
5	1.09	59.36	0.4	0.25	0.44 abs	0.44 inj	0.9 inj	0
6	1	59.36	0.6	0.45	0	0.44 inj	0.9 inj	0.09 abs
7	1	60	0.5	0.5	0	0.44 inj	0.9 inj	0
8	1	59.36	0.7	0.7	0	0.44 inj	0.9 inj	0.18 abs

Function Setting		Comments
Voltage And Frequency Trip Parameters	☒	Set to the widest range of adjustability
Frequency-Watt Parameters	☒	Enabled with default values for the EUT's category
Volt-Watt Parameters	☒	Enabled with default values for the EUT's category, P_2=0.2*P_{rated} For EUT that can absorb power, set P_2=0
Volt-Var Parameters	☒	Enabled with default values for the EUT's category
Watt-Var Parameters	☒	Enabled with default values for the EUT's category

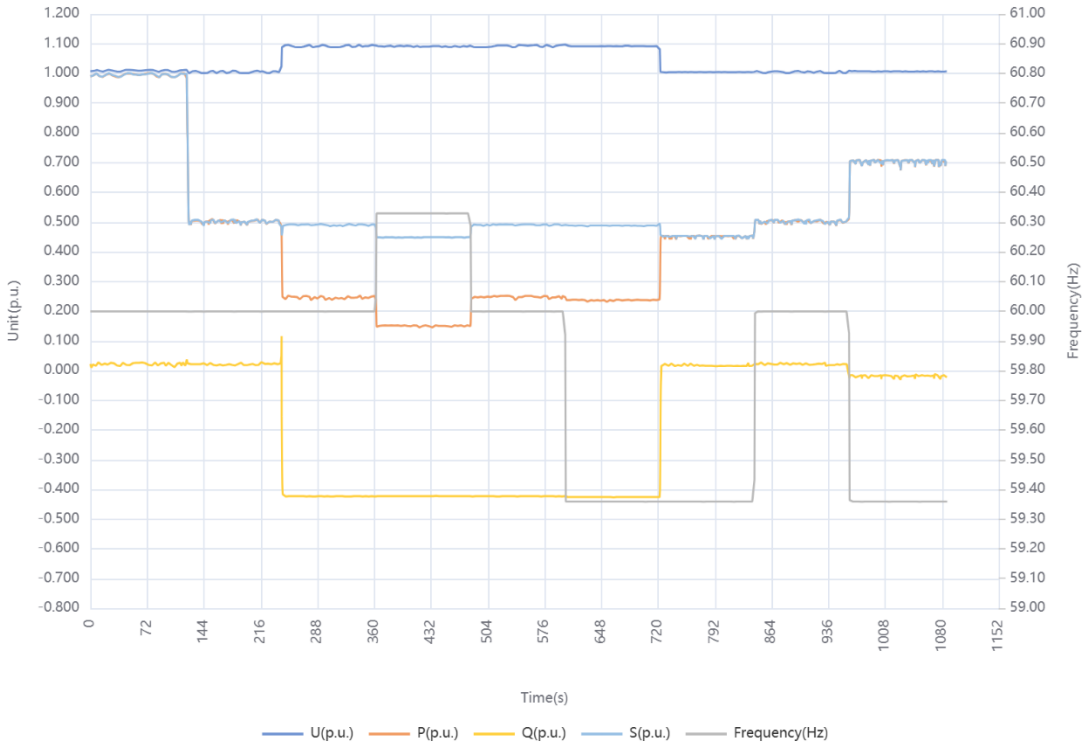
Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/08/29	100 ms	5 kHz

1) Test-1: With only Volt-Var function enabled

#	V_{set} (p.u.)	F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
0	1.00	60.00	299.0	12476.4	1.009	0.986	0.995	0.021	0.995	1.000	59.998
Set the EUT's active power limit signal to 50% of P_{rated}											
1	1.00	60.00	328.7	6305.3	1.004	0.500	0.502	0.021	0.502	0.999	59.998
2	1.09	60.00	332.3	3273.8	1.091	0.448	0.247	-0.422	0.489	0.504	59.999
3	1.09	60.33	333.4	2084.7	1.091	0.411	0.150	-0.423	0.448	0.334	60.328
4	1.09	60.00	332.3	3258.3	1.092	0.449	0.248	-0.423	0.490	0.505	59.999
5	1.09	59.36	332.4	3133.2	1.092	0.446	0.236	-0.426	0.487	0.485	59.359
6	1.00	59.36	329.6	5661.8	1.004	0.449	0.451	0.015	0.451	0.998	59.359
7	1.00	60.00	328.7	6304.3	1.004	0.500	0.502	0.021	0.502	0.999	59.998
8	1.00	59.36	324.3	8827.3	1.007	0.700	0.705	-0.019	0.705	1.000	59.359

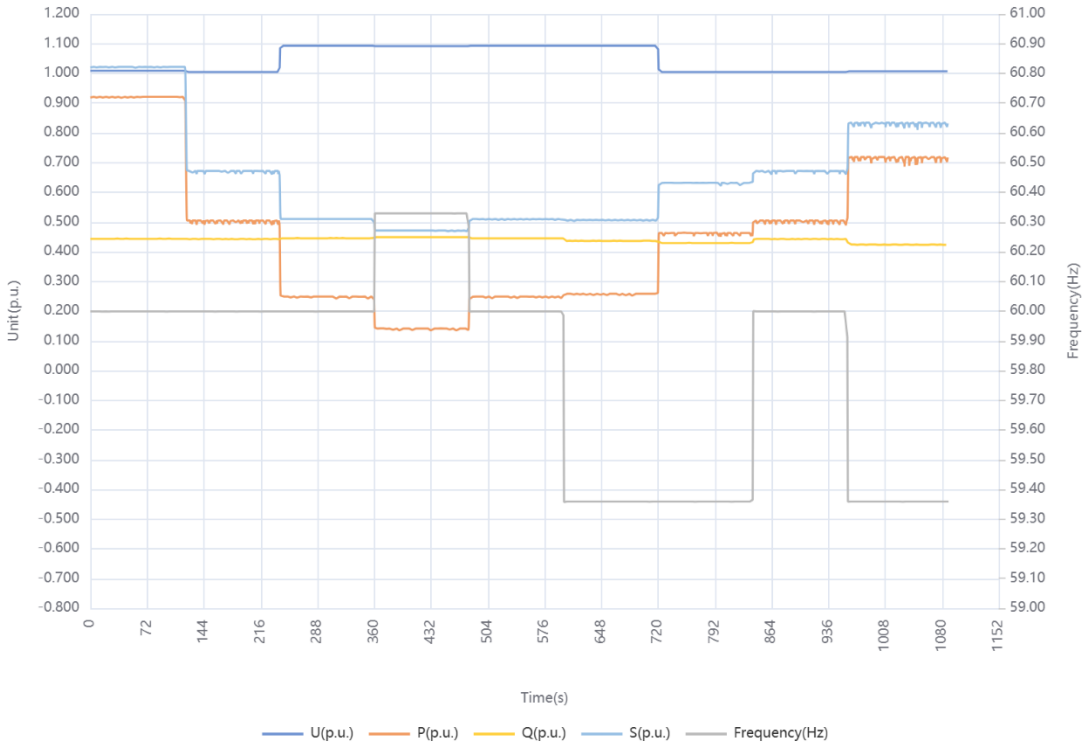
Test Results Over time



2) Test-2: With only Constant Reactive Power function enabled

#	V_{set} (p.u.)	F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
0	1.00	60.00	313.7	11585.6	1.009	1.013	0.920	0.443	1.022	0.901	59.998
Set the EUT's active power limit signal to 50% of P_{rated}											
1	1.00	60.00	328.6	6357.1	1.005	0.666	0.503	0.443	0.670	0.751	59.998
2	1.09	60.00	332.3	3226.6	1.093	0.467	0.248	0.445	0.510	0.486	59.999
3	1.09	60.33	333.5	1916.7	1.092	0.431	0.140	0.449	0.471	0.299	60.328
4	1.09	60.00	332.3	3214.4	1.093	0.466	0.248	0.445	0.509	0.485	59.999
5	1.09	59.36	332.2	3327.3	1.093	0.464	0.257	0.436	0.507	0.507	59.359
6	1.00	59.36	329.3	5833.2	1.005	0.627	0.461	0.429	0.630	0.732	59.359
7	1.00	60.00	328.6	6353.0	1.005	0.666	0.503	0.443	0.670	0.751	59.998
8	1.00	59.36	324.0	8986.1	1.007	0.825	0.715	0.424	0.831	0.860	59.359

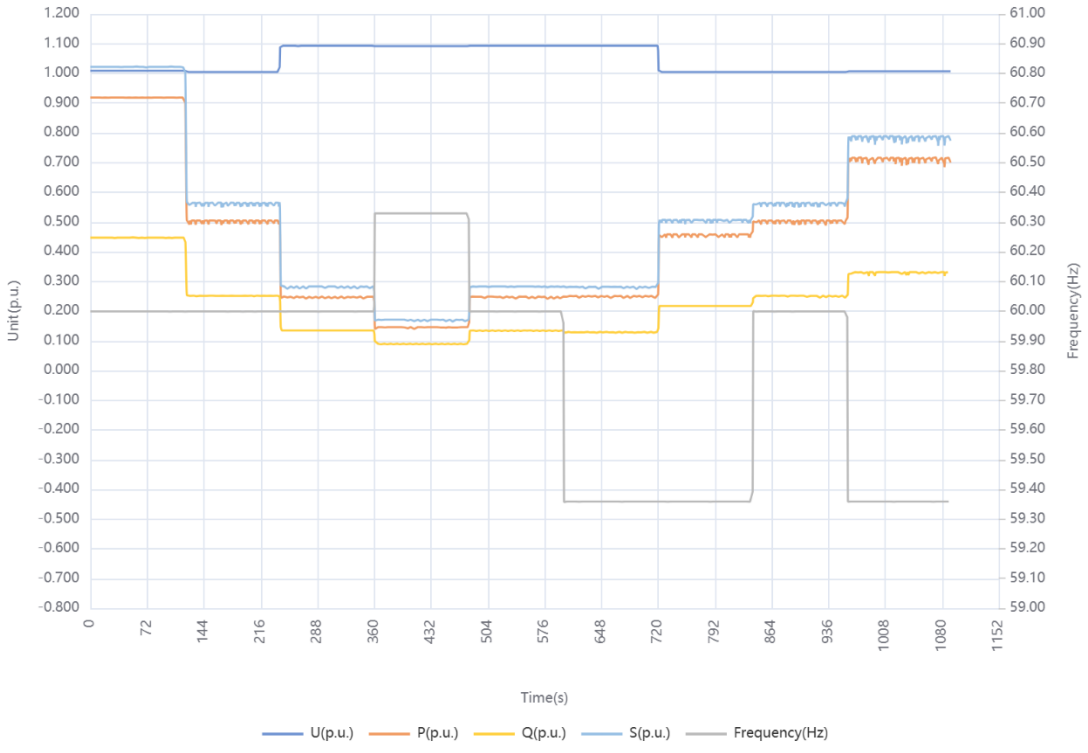
Test Results Over time



3) Test-3: With only Constant Power Factor function enabled

#	V_{set} (p.u.)	F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	$U_{a.c.}$ (p.u.)	$I_{a.c.}$ (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
0	1.00	60.00	313.9	11568.0	1.009	1.013	0.919	0.447	1.022	0.899	59.999
Set the EUT's active power limit signal to 50% of P_{rated}											
1	1.00	60.00	328.7	6321.4	1.005	0.559	0.503	0.251	0.562	0.895	59.999
2	1.09	60.00	332.4	3178.8	1.093	0.259	0.248	0.135	0.283	0.878	59.999
3	1.09	60.33	333.5	1901.6	1.092	0.156	0.145	0.090	0.170	0.850	60.328
4	1.09	60.00	332.4	3155.4	1.093	0.257	0.247	0.134	0.281	0.878	59.999
5	1.09	59.36	332.3	3185.0	1.093	0.257	0.250	0.129	0.281	0.888	59.359
6	1.00	59.36	329.5	5724.6	1.005	0.502	0.456	0.216	0.504	0.904	59.359
7	1.00	60.00	328.7	6315.5	1.005	0.559	0.503	0.251	0.561	0.895	59.998
8	1.00	59.36	324.1	8937.3	1.007	0.779	0.712	0.329	0.785	0.908	59.359

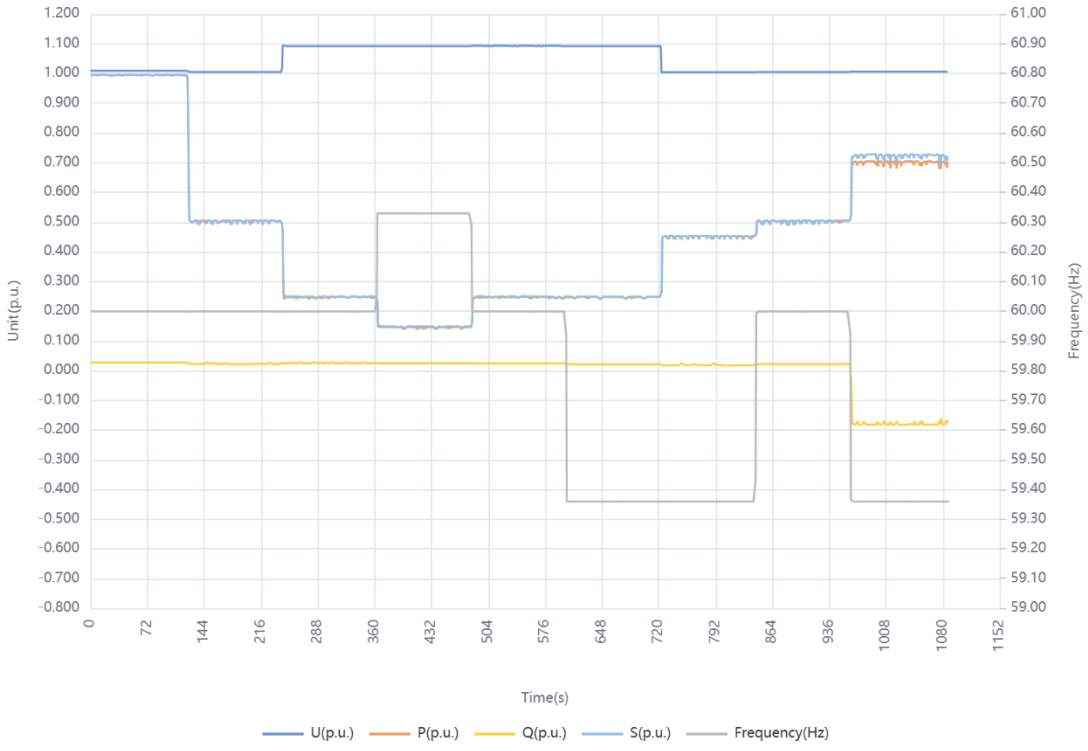
Test Results Over time



4) Test-4: With only Watt-Var function enabled

#	V_{set} (p.u.)	F_{set} (Hz)	DC input		AC Output						
			$V_{d.c.}$ (V)	$P_{d.c.}$ (W)	Ua.c. (p.u.)	Ia.c. (p.u.)	P (p.u.)	Q (p.u.)	S (p.u.)	PF	F (Hz)
0	1.00	60.00	298.5	12473.1	1.009	0.985	0.994	0.027	0.994	1.000	59.998
Set the EUT's active power limit signal to 50% of P_{rated}											
1	1.00	60.00	328.7	6306.9	1.005	0.501	0.502	0.023	0.503	0.999	59.998
2	1.09	60.00	332.4	3186.6	1.092	0.229	0.249	0.025	0.250	0.995	59.999
3	1.09	60.33	333.5	1919.2	1.092	0.136	0.146	0.026	0.148	0.985	60.328
4	1.09	60.00	332.4	3149.6	1.093	0.227	0.246	0.025	0.248	0.995	59.999
5	1.09	59.66	332.4	3152.4	1.092	0.227	0.247	0.022	0.248	0.996	59.359
6	1.00	59.36	329.6	5643.5	1.004	0.448	0.450	0.000	0.450	0.999	59.359
7	1.00	60.00	328.7	6296.7	1.005	0.500	0.502	0.023	0.502	0.999	59.998
8	1.00	59.36	324.4	8789.5	1.006	0.718	0.700	-0.179	0.722	0.969	59.359

Test Results Over time



4.17 Limitation of overvoltage contribution

4.17.1 Ground fault overvoltage (GFOV) test (Optionl)

This test is optional for all DERs. DERs may perform this test to generate information that can be used in the DER evaluation for compliance with 7.4.1 of IEEE Std 1547-2018.

As a optional function, GFOV has not been evaluated.

4.17.2 Load rejection overvoltage (LROV) test

The purpose of this test is to obtain necessary information for DER evaluation in order to verify the effects of the DER system on overvoltage on the area EPS when switching action creates a generation-load island. The EUT is tested at various output power and load combinations including no load.

- LROV test limit

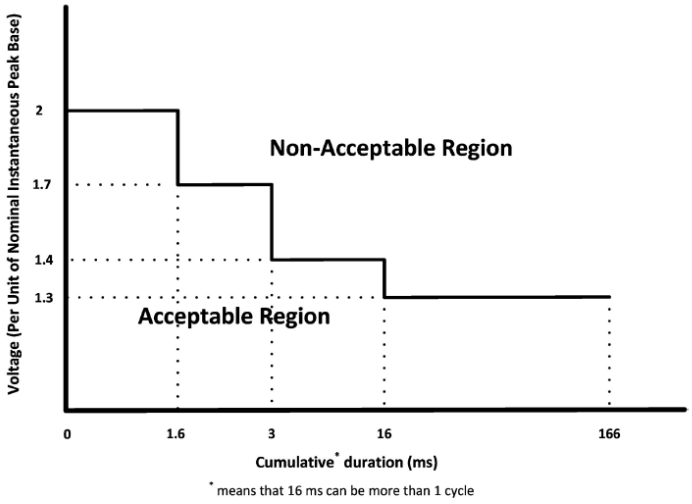


Figure 3 —Transient overvoltage limits

- LROV Test circuit

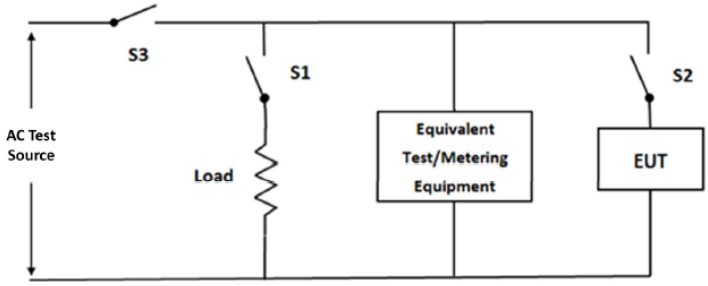


Figure 15—LROV test circuit

- LROV Test sequence

Table 40—Tests to be performed

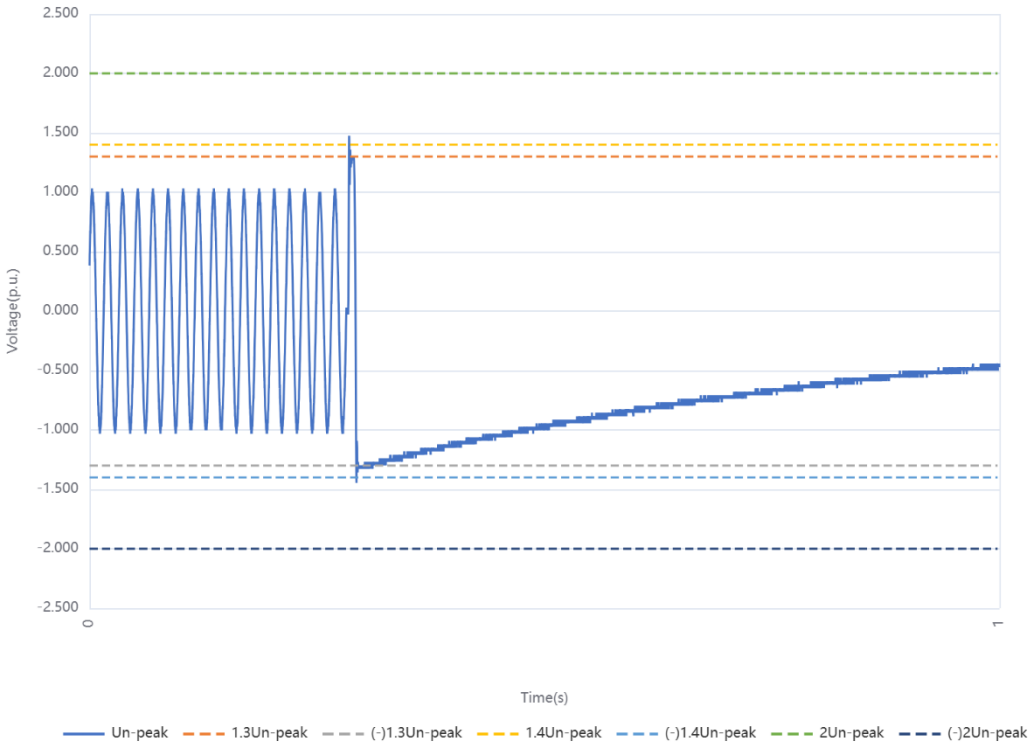
EUT output	Load value (percent of tested power level)			
	50%	33%	10%	0%
100%	Yes	Yes	Yes	Yes
66%	Yes	Yes	Yes	Yes
33%	No	No	Yes	Yes

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
PA6000H	2025/10/10 to 2025/10/16	100 ms	5 kHz

1) Test-1: EUT output level = 100%P_{rated} & Load level = 50%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.23	49.76	11997.00	6077.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	6.2	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

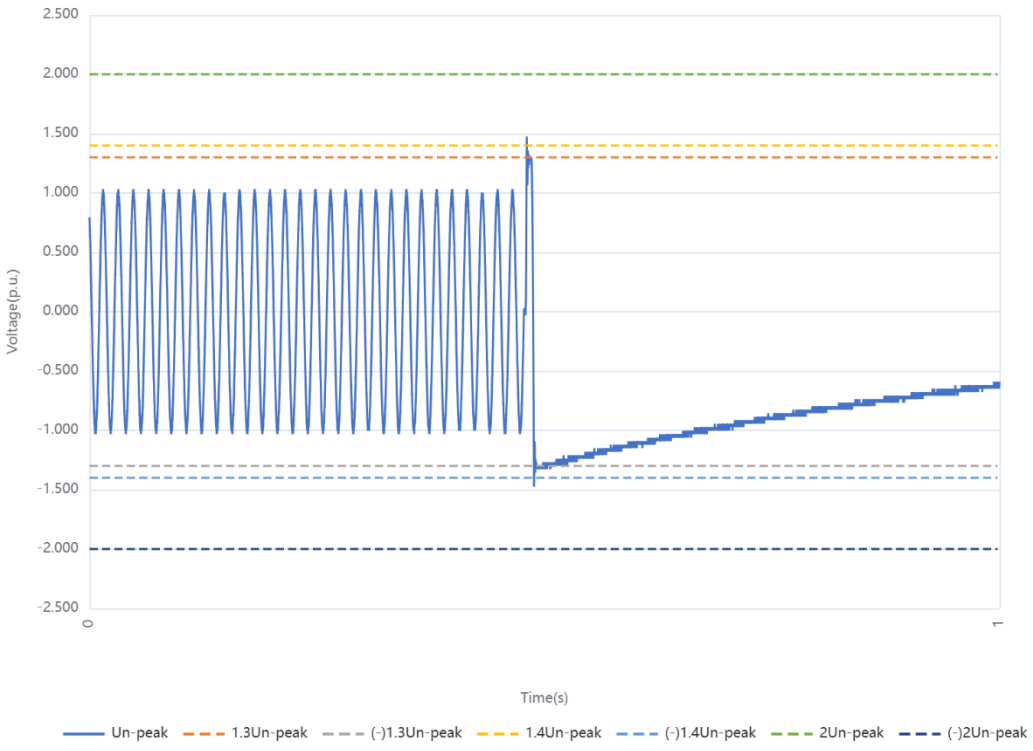


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.23	49.76	11997.00	6077.00

Attempt-2

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	6.9	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

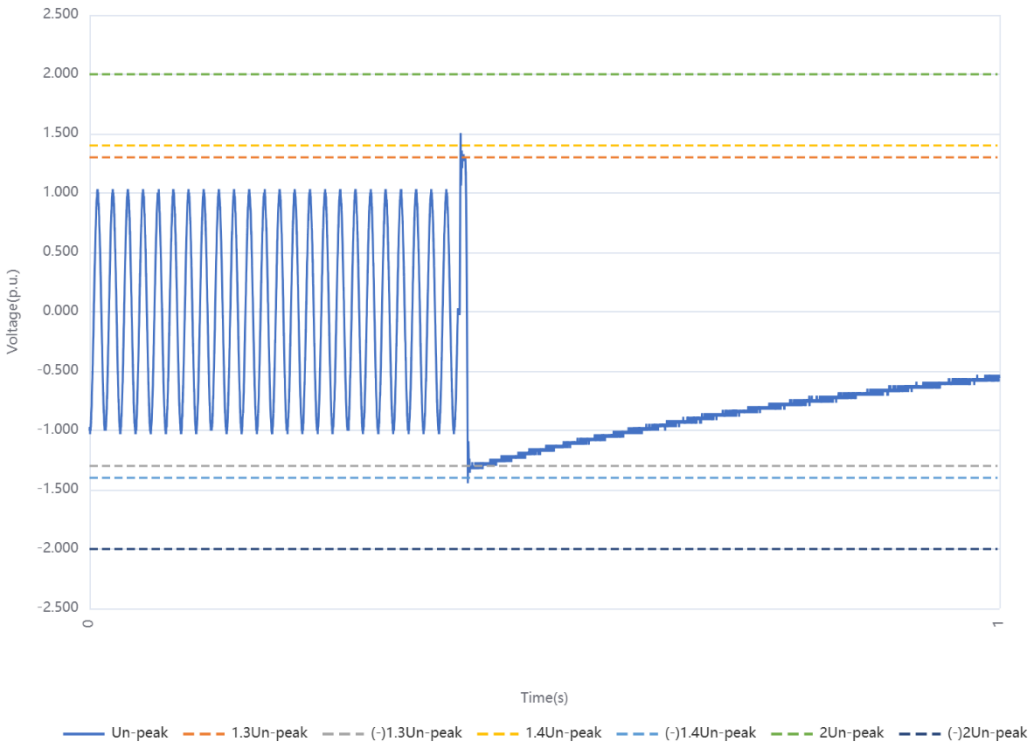


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.23	49.76	11997.00	6077.00

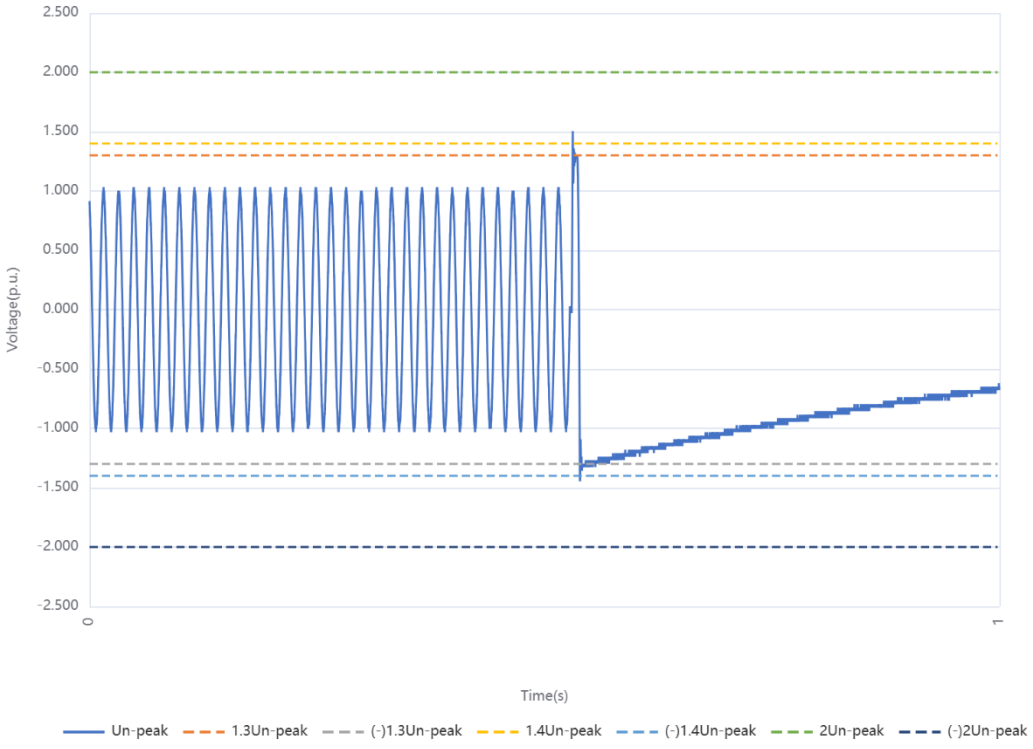
Attempt-3

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	6.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

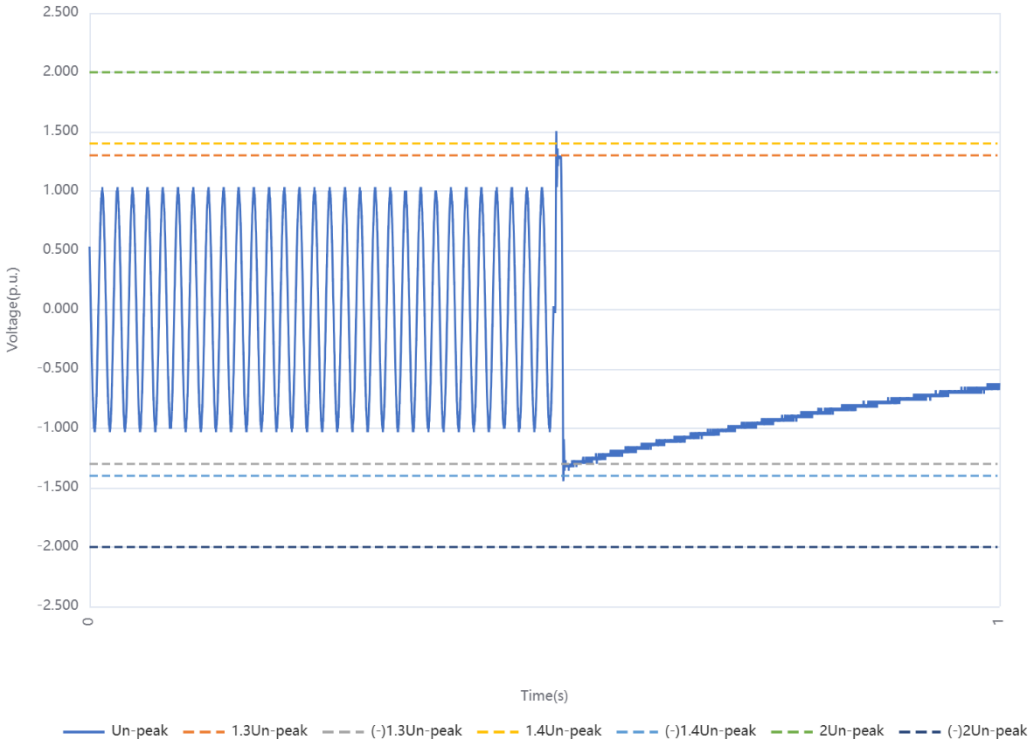
Result Chart



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.23	49.76	11997.00	6077.00
Attempt-4			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	5.7	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

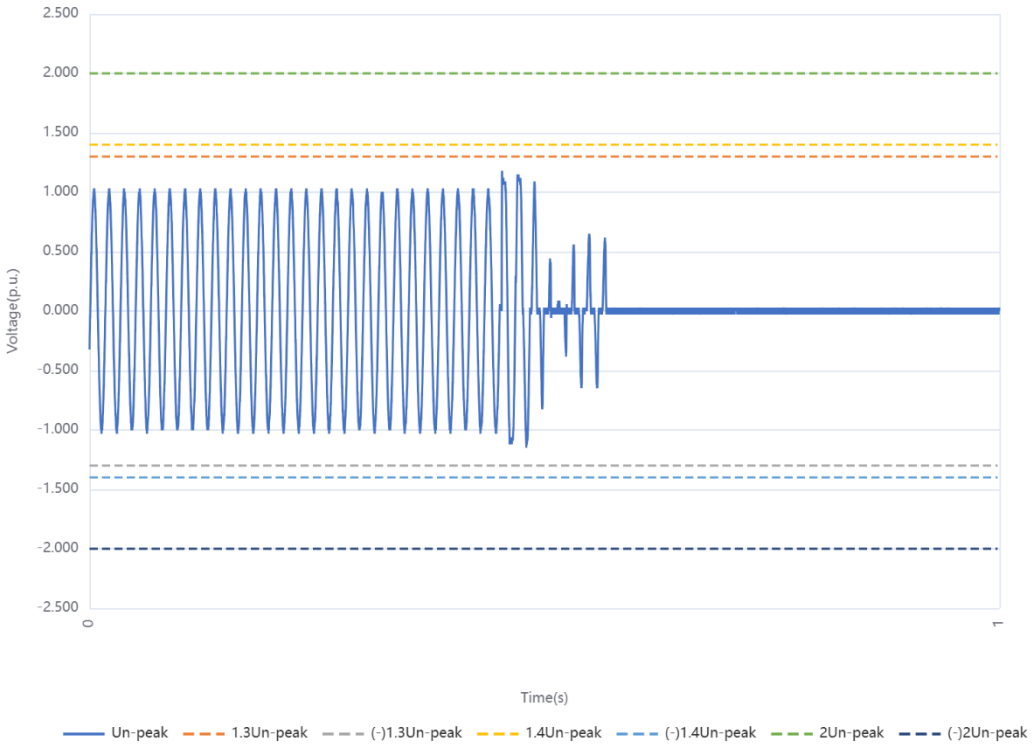


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.23	49.76	11997.00	6077.00
Attempt-5			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	5.2	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

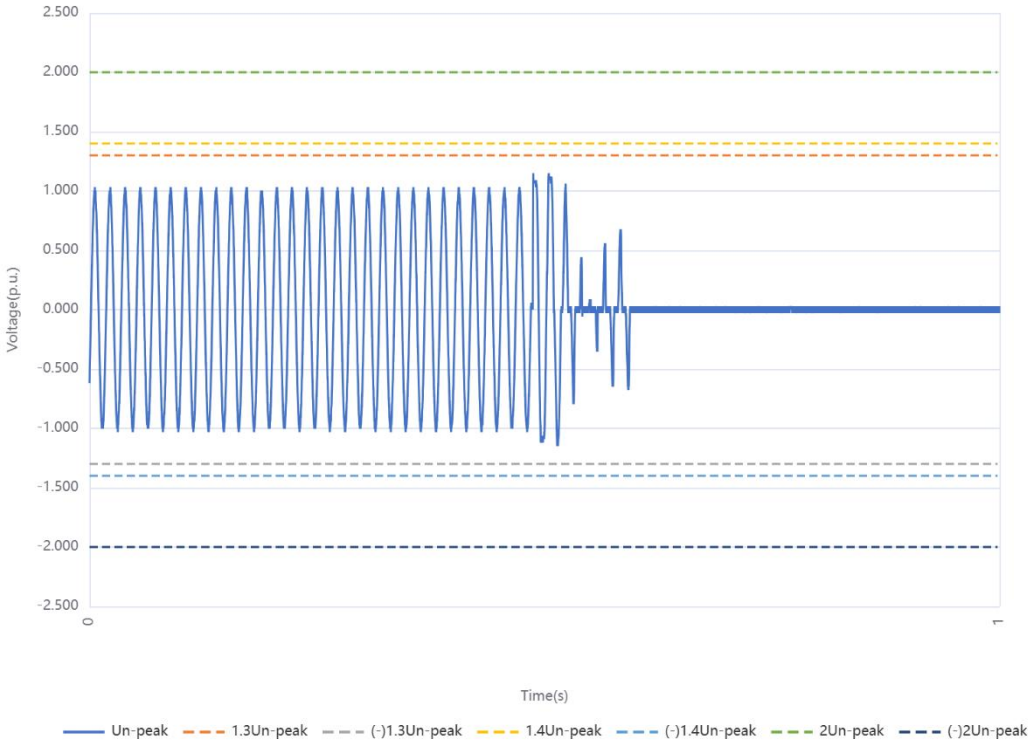


2) Test-2: EUT output level = 100%P_{rated} & Load level = 33%P_{rated}

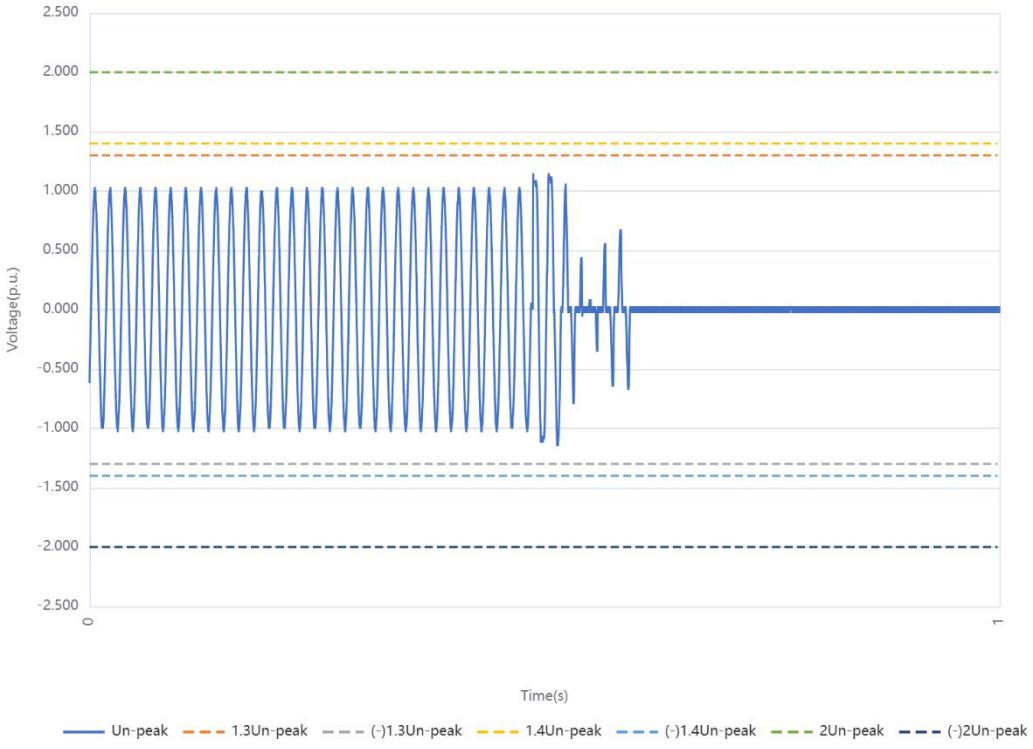
Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.55	49.69	11997.20	3885.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



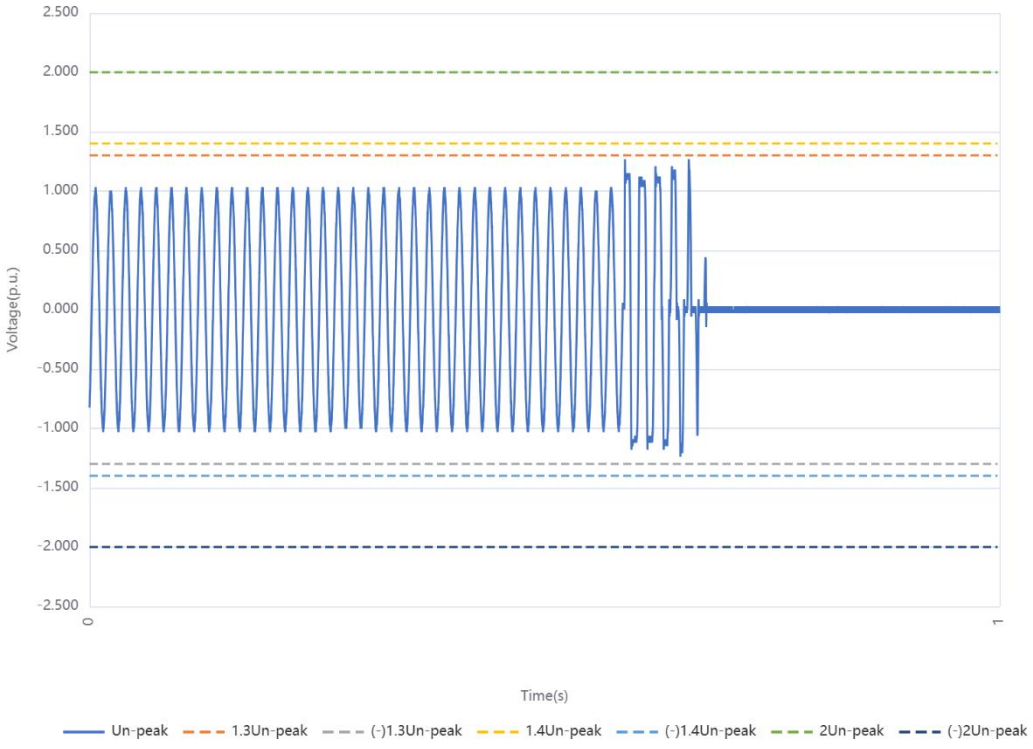
Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.55	49.69	11997.20	3885.00
Attempt-2			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



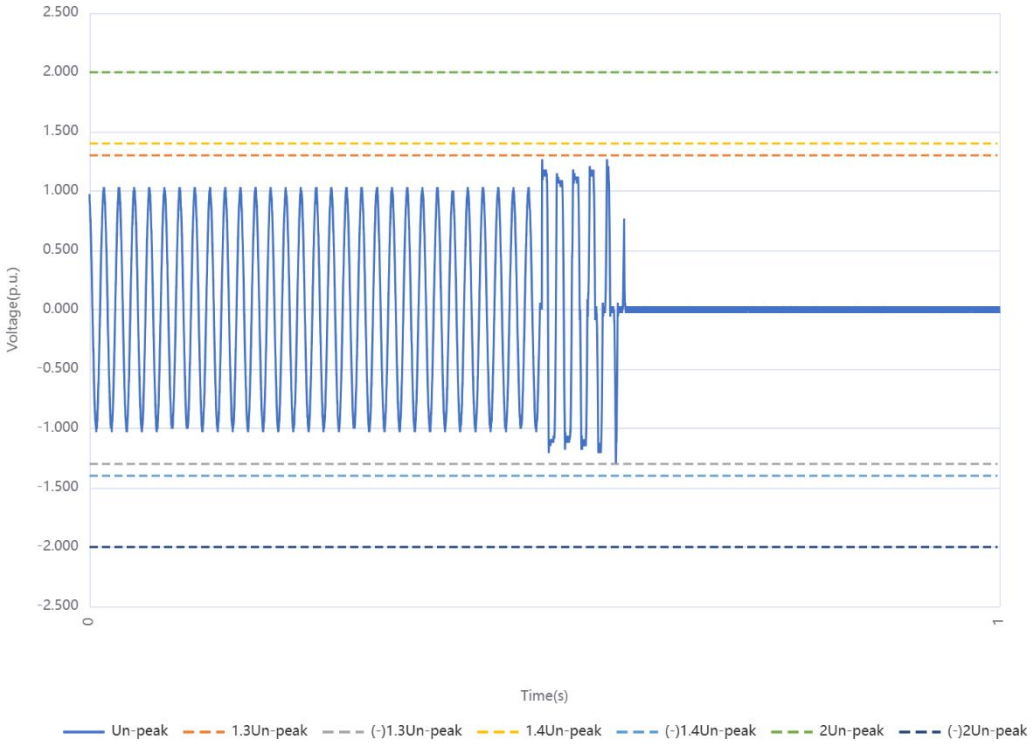
Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.55	49.69	11997.20	3885.00
Attempt-3			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.55	49.69	11997.20	3885.00
Attempt-4			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

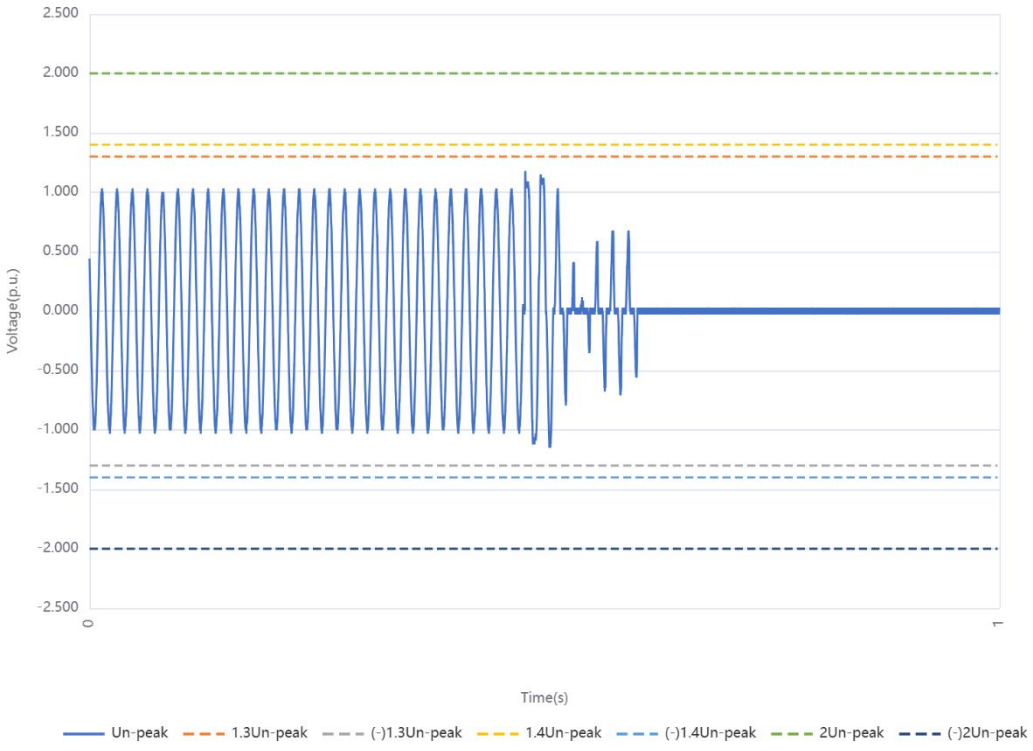


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.55	49.69	11997.20	3885.00
Attempt-5			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

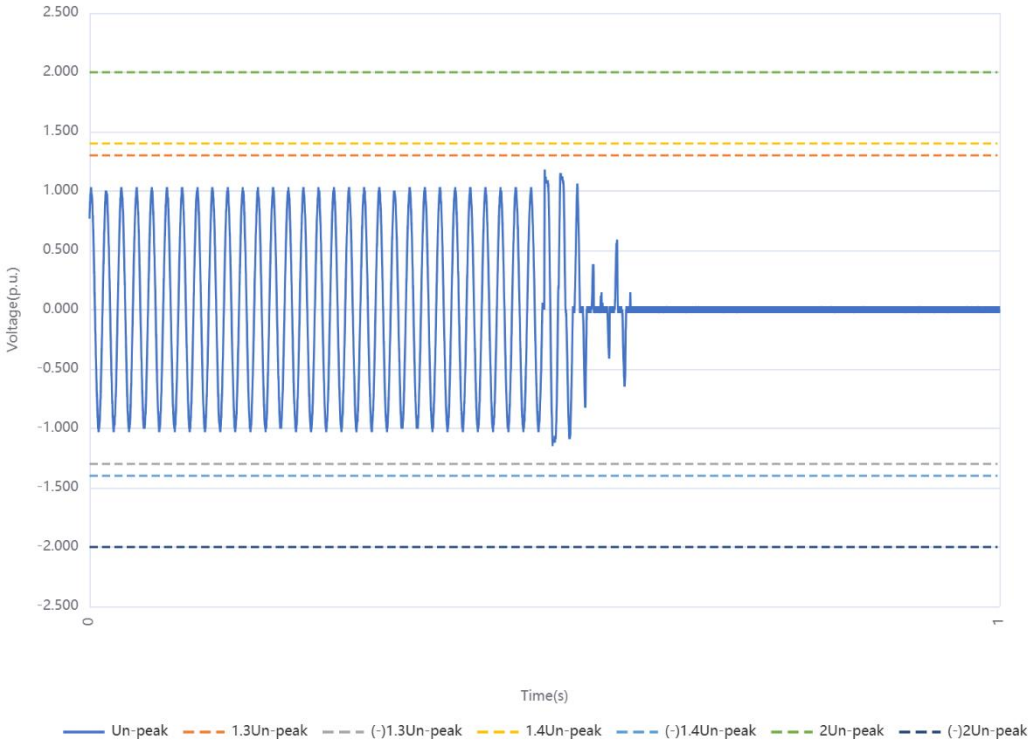


3) Test-3: EUT output level = 100%P_{rated} & Load level = 10%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.04	49.59	11996.3	1182.50
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.04	49.59	11996.3	1182.50
Attempt-2			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

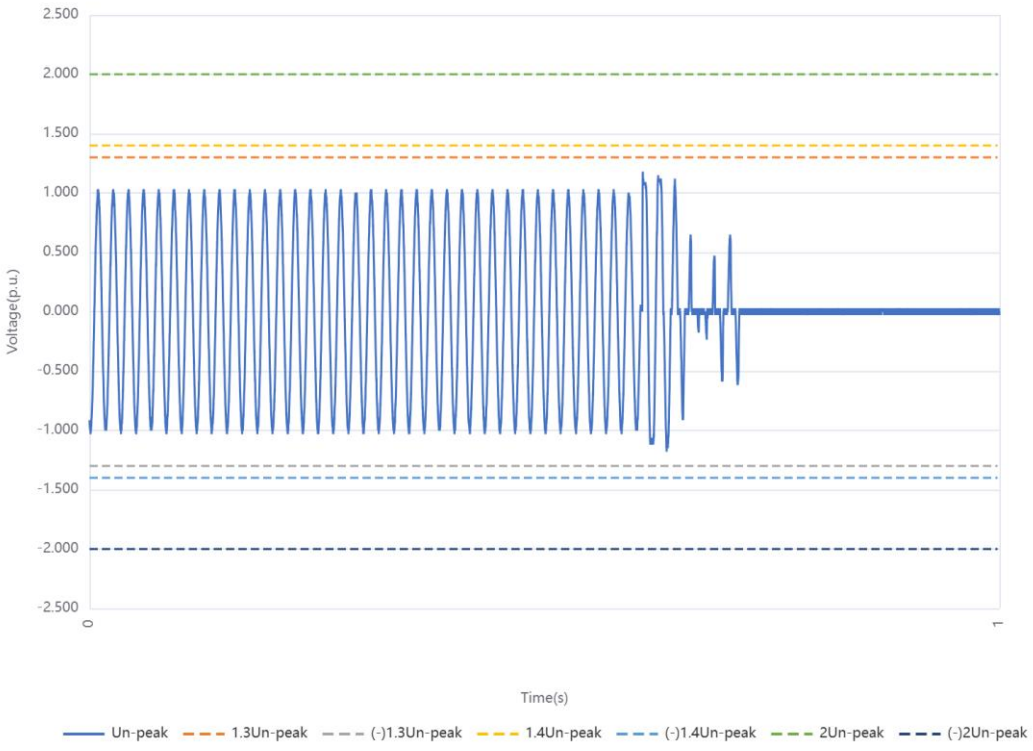


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.04	49.59	11996.3	1182.50

Attempt-3

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

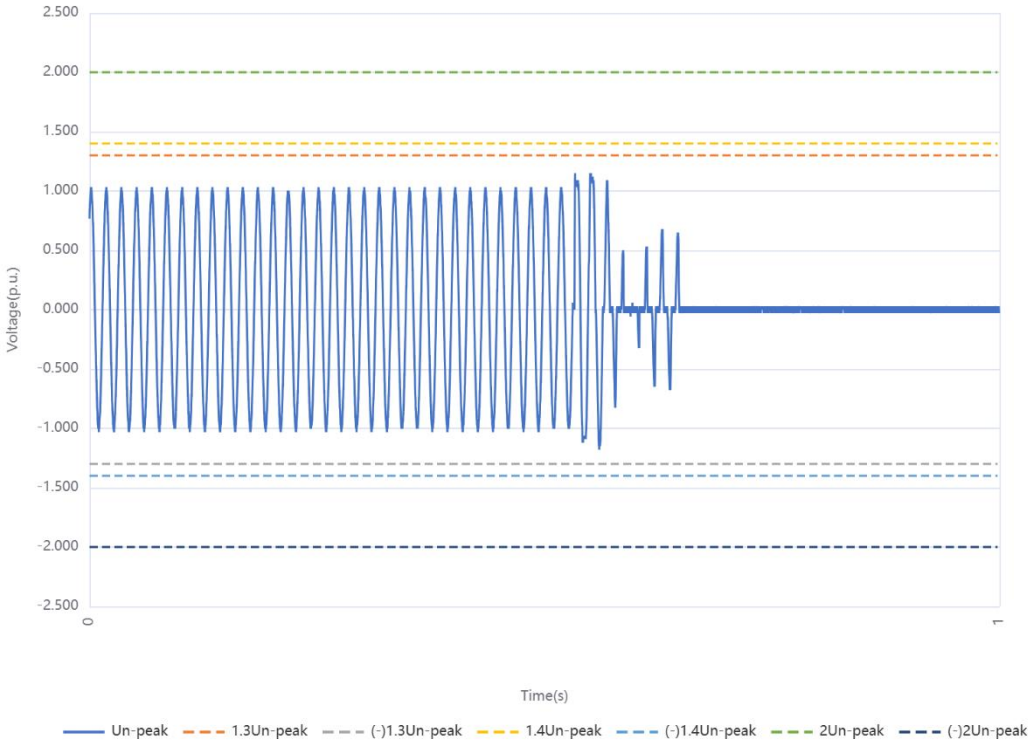


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.04	49.59	11996.3	1182.50

Attempt-4

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

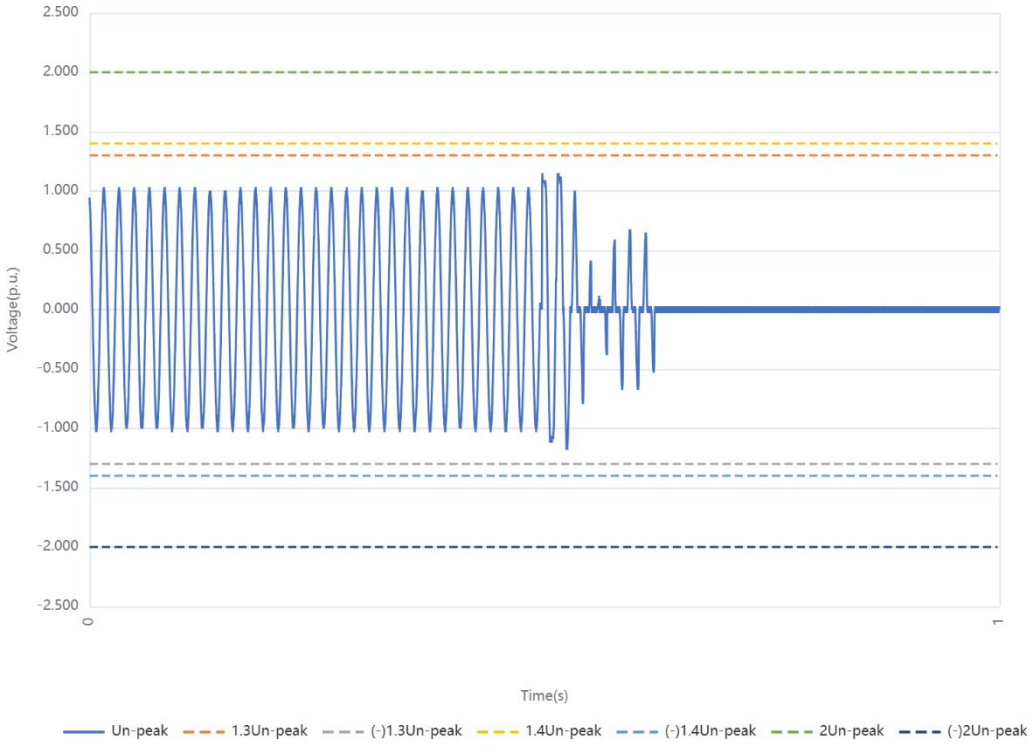


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.04	49.59	11996.3	1182.50

Attempt-5

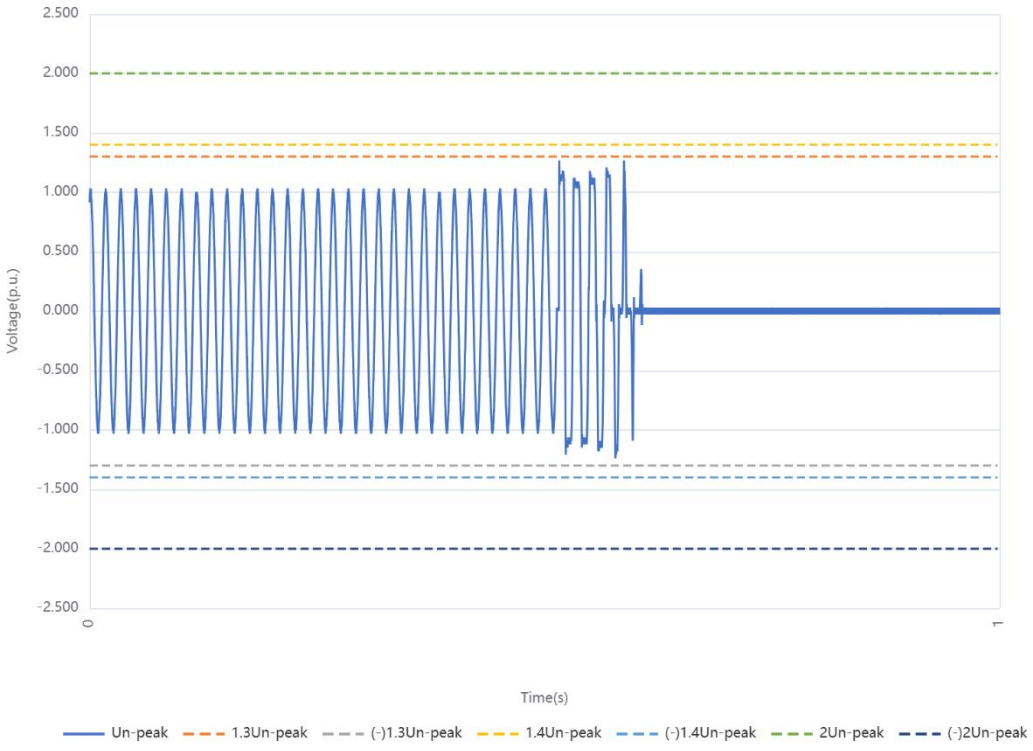
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart



4) Test-4: EUT output level = 100%P_{rated} & Load level = 0%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.19	48.60	11767.76	1.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

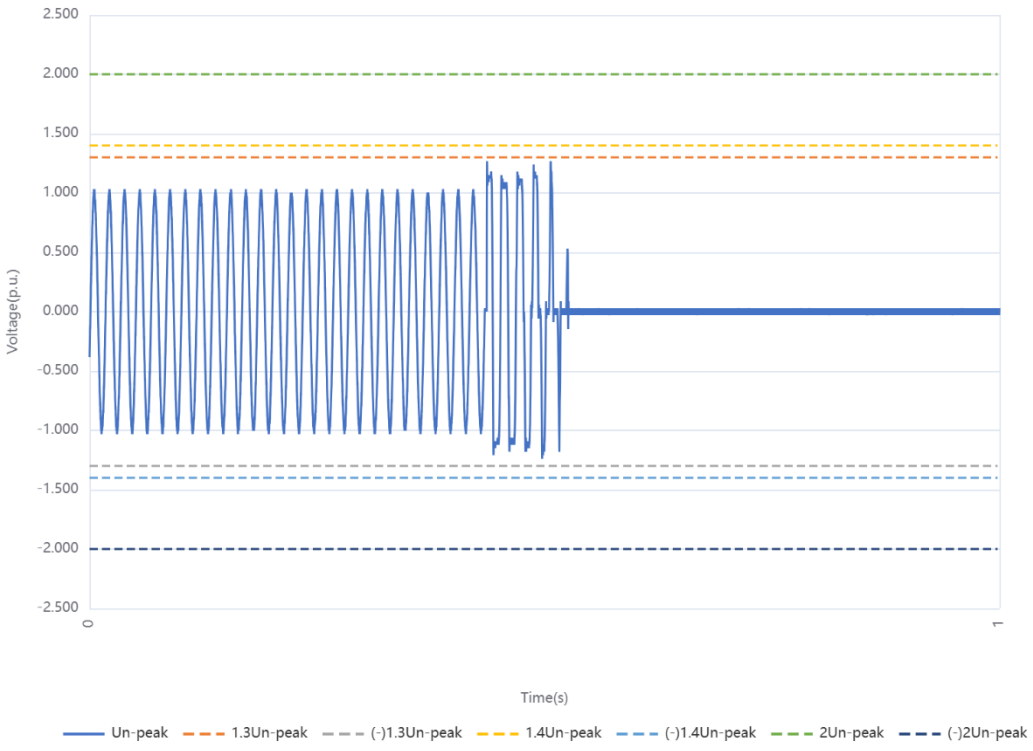


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.19	48.60	11767.76	1.00

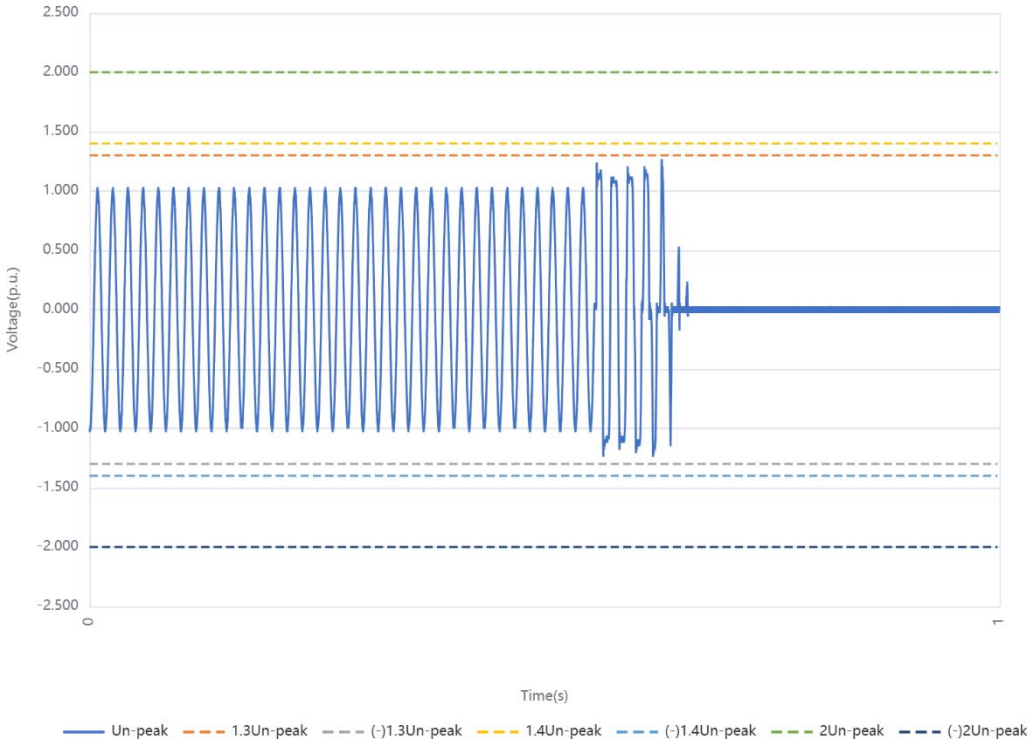
Attempt-2

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.19	48.60	11767.76	1.00
Attempt-3			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

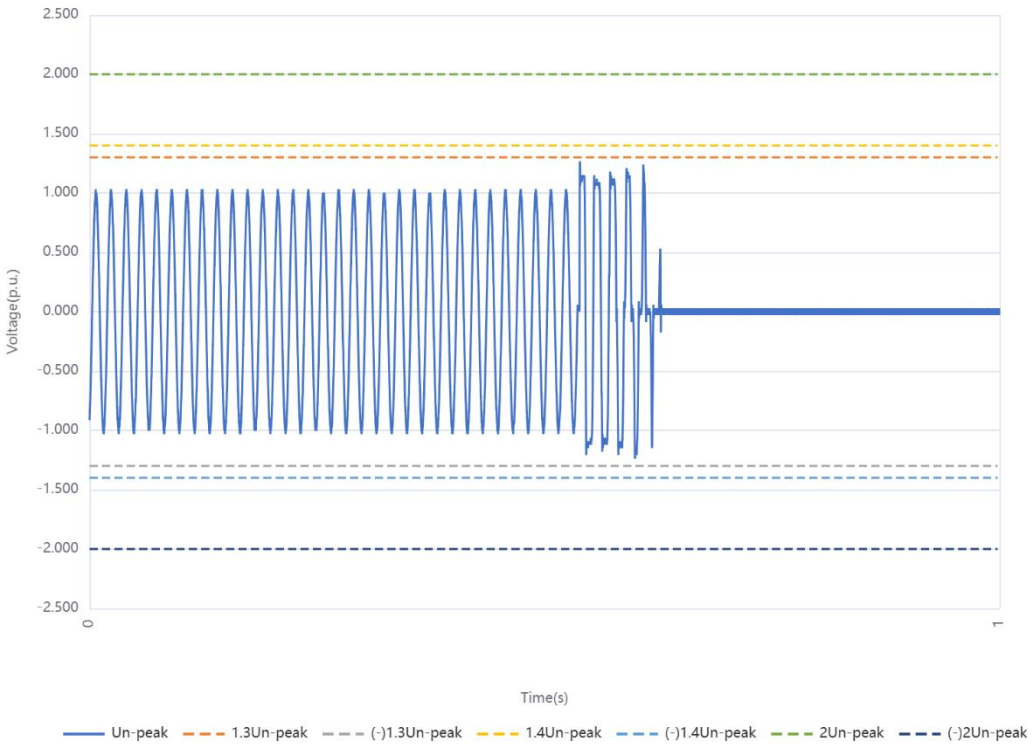


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.19	48.60	11767.76	1.00

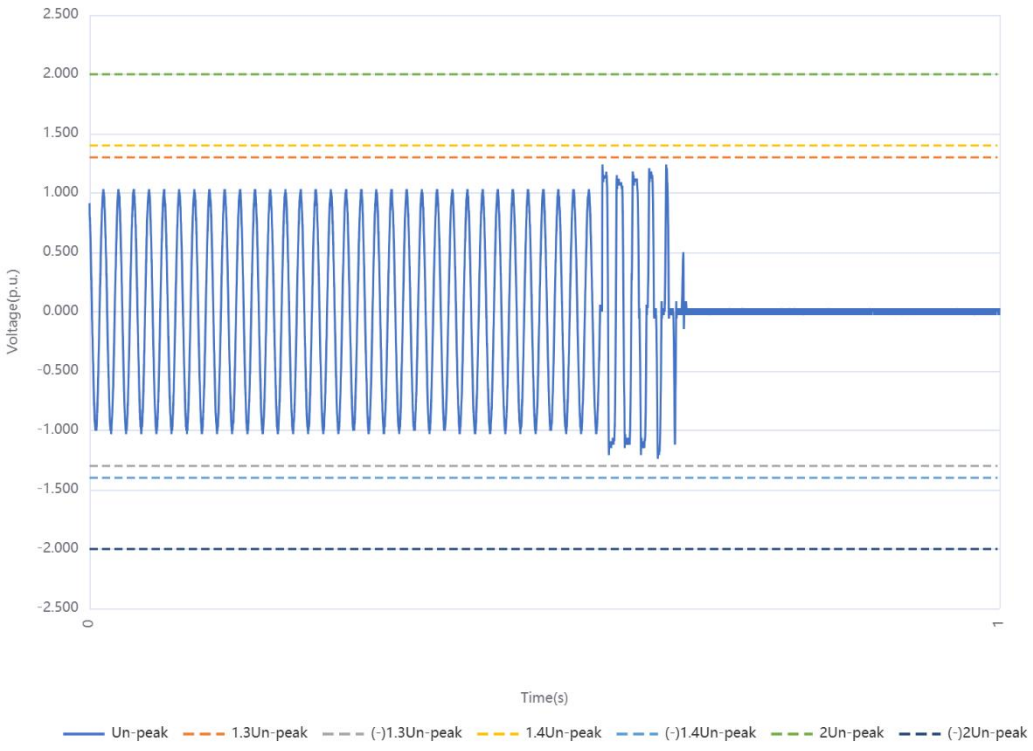
Attempt-4

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

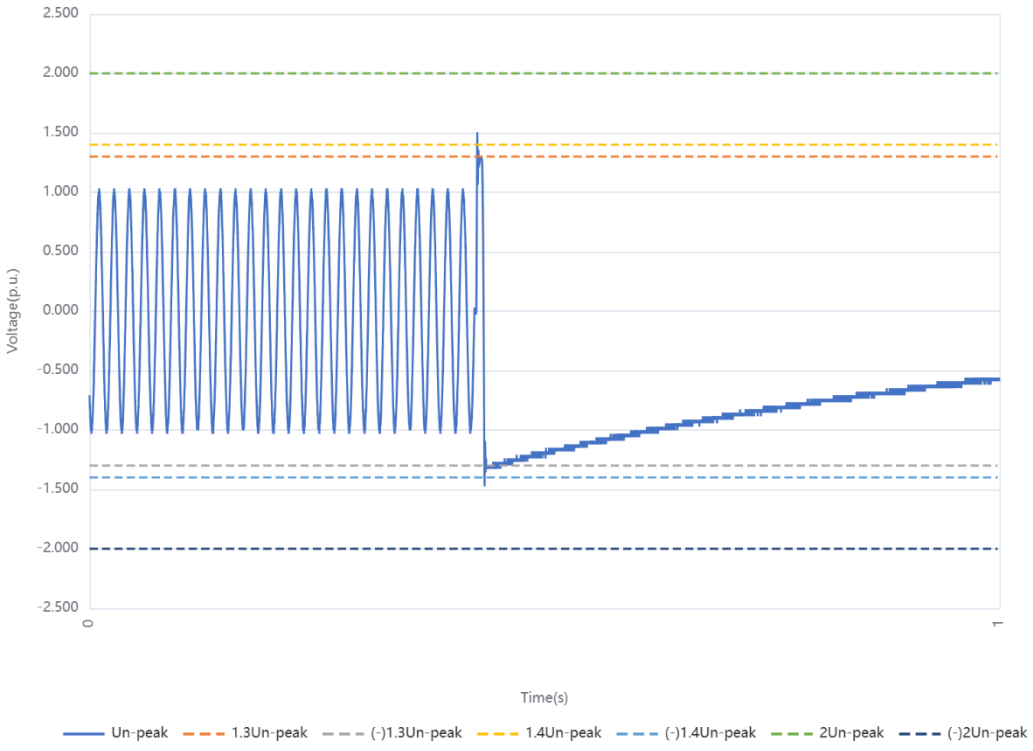


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
242.19	48.60	11767.76	1.00
Attempt-5			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



5) Test-5: EUT output level = 66%P_{rated} & Load level = 50%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.57	33.07	7951.00	6048.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	5.3	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.6	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

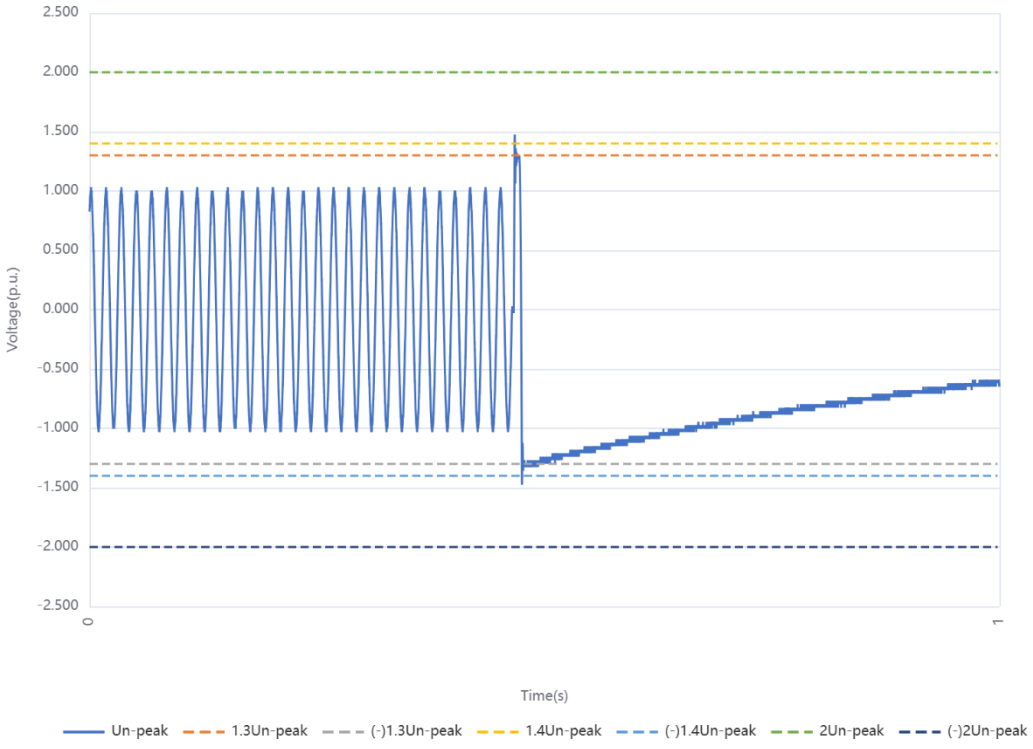


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.57	33.07	7951.00	6048.00

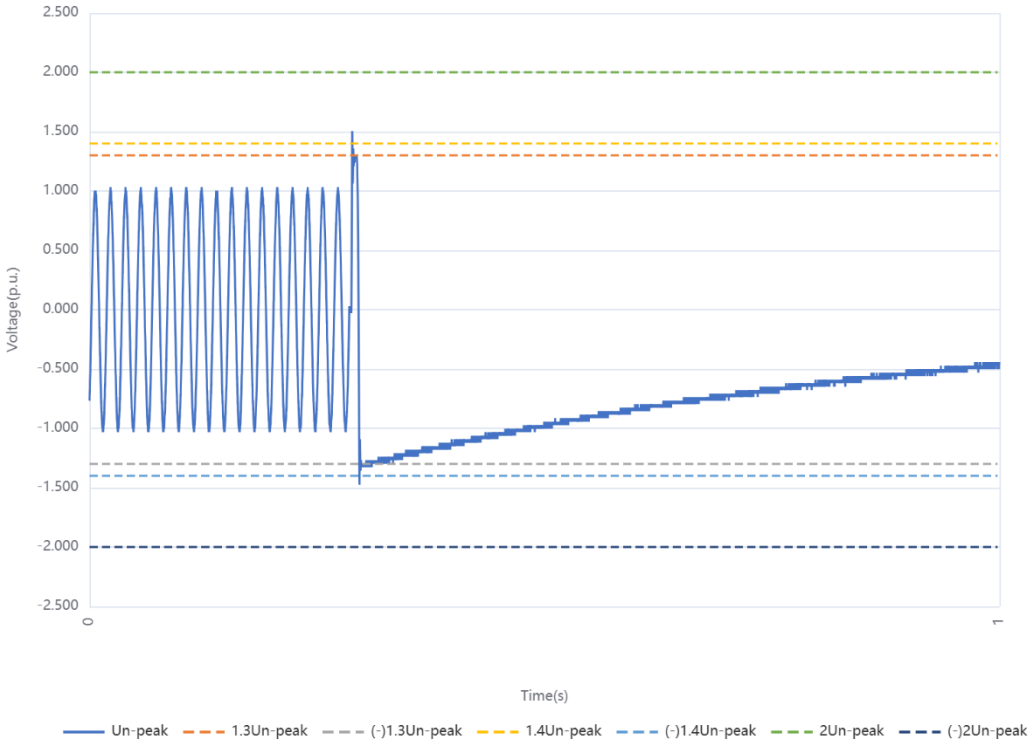
Attempt-2

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	5.4	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.6	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.57	33.07	7951.00	6048.00
Attempt-3			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	5.4	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.4	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

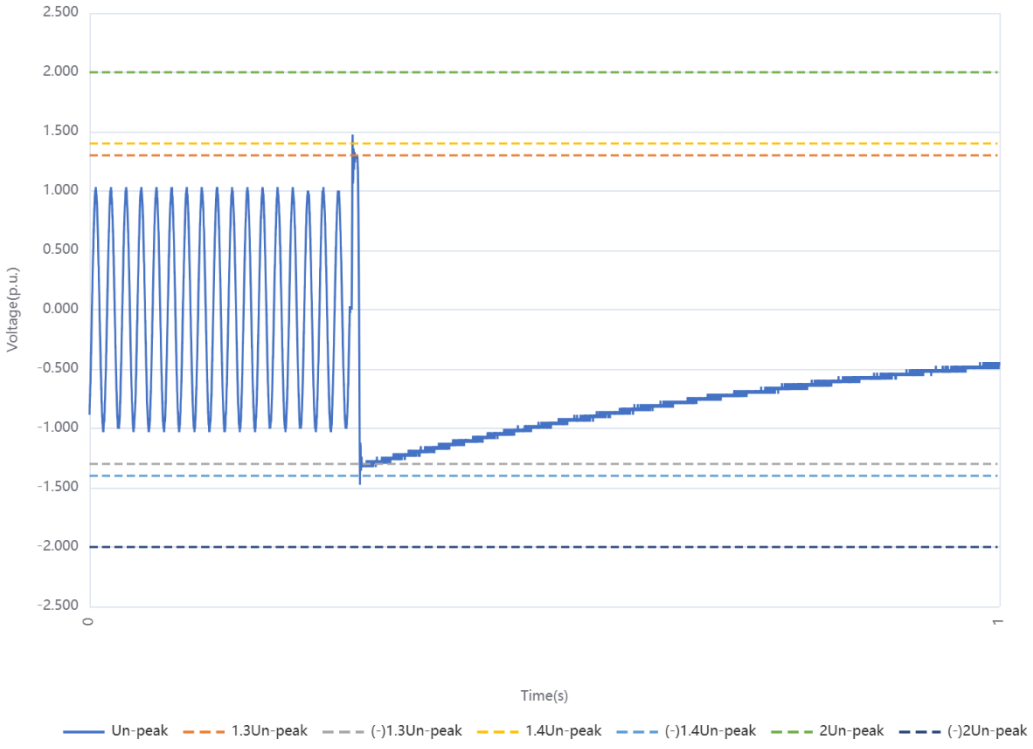


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.57	33.07	7951.00	6048.00

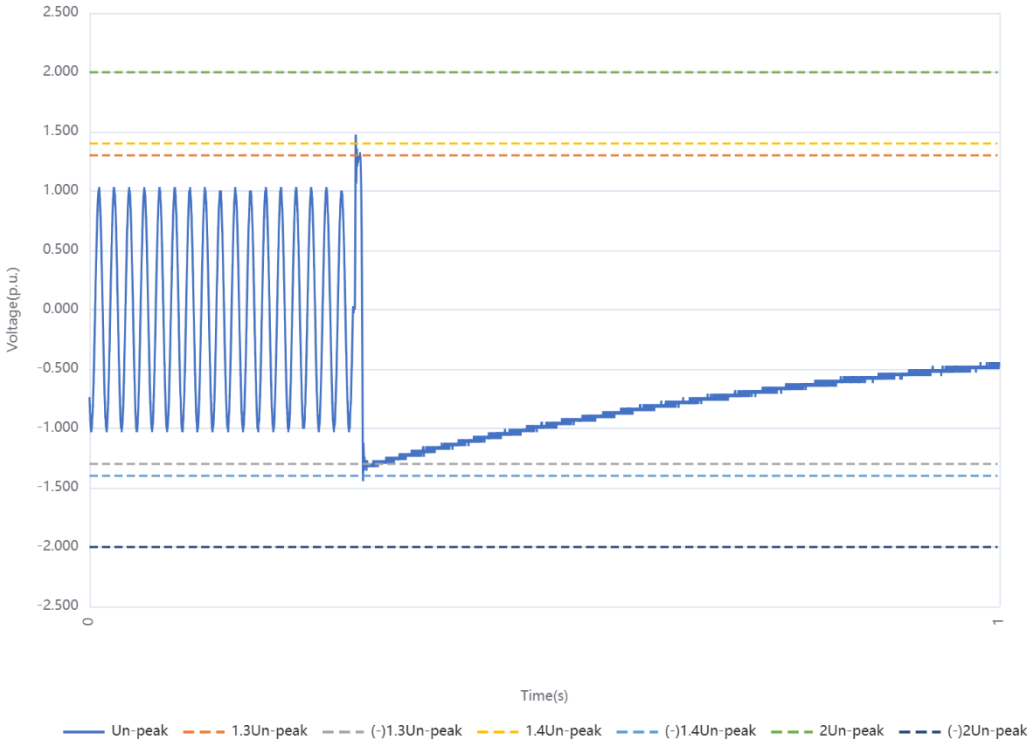
Attempt-4

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	6.6	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

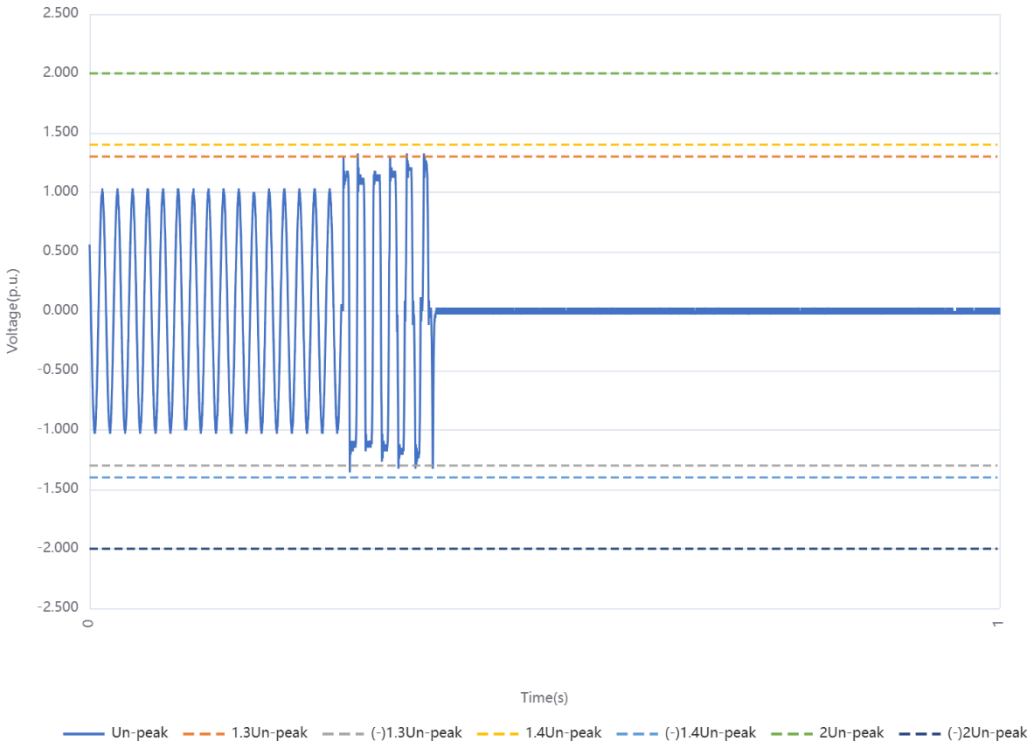


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.57	33.07	7951.00	6048.00
Attempt-5			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	5.9	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



6) Test-6: EUT output level = 66%P_{rated} & Load level = 33%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.8	33.04	7915.00	3846.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.8	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

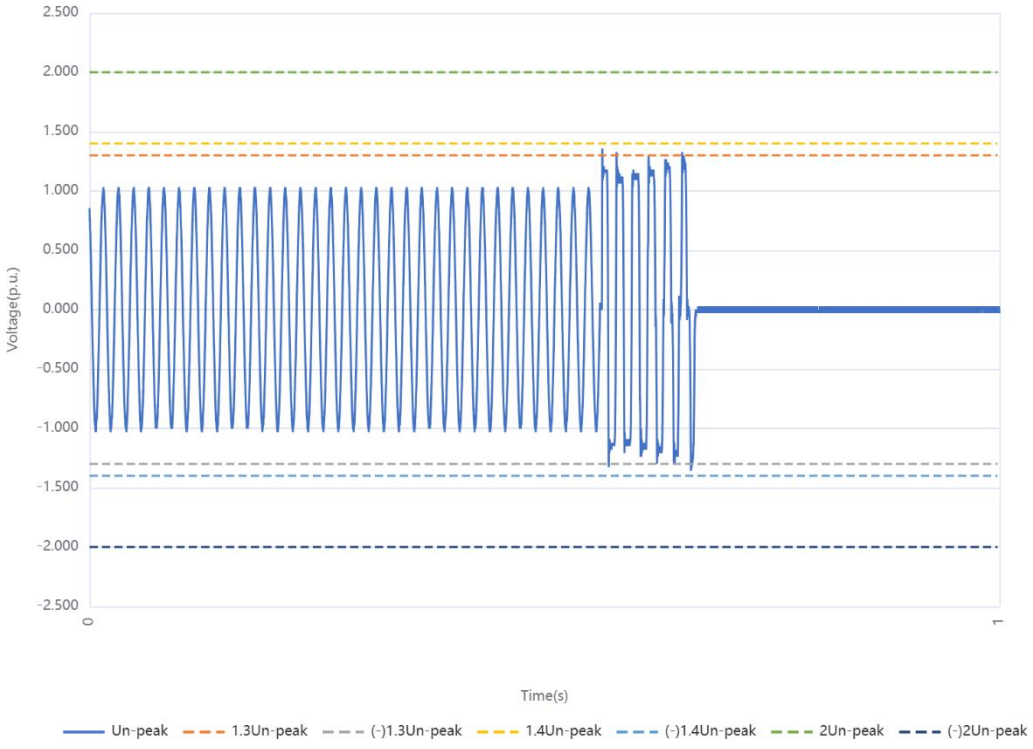


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.8	33.04	7915.00	3846.00

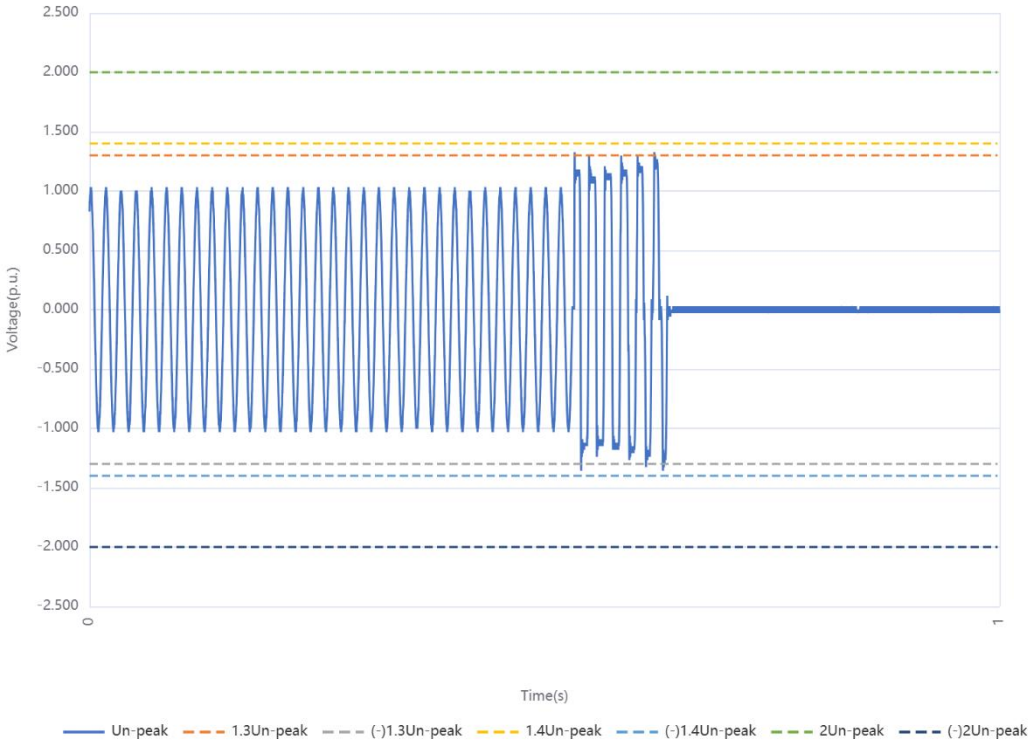
Attempt-2

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.9	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.8	33.04	7915.00	3846.00
Attempt-3			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.5	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

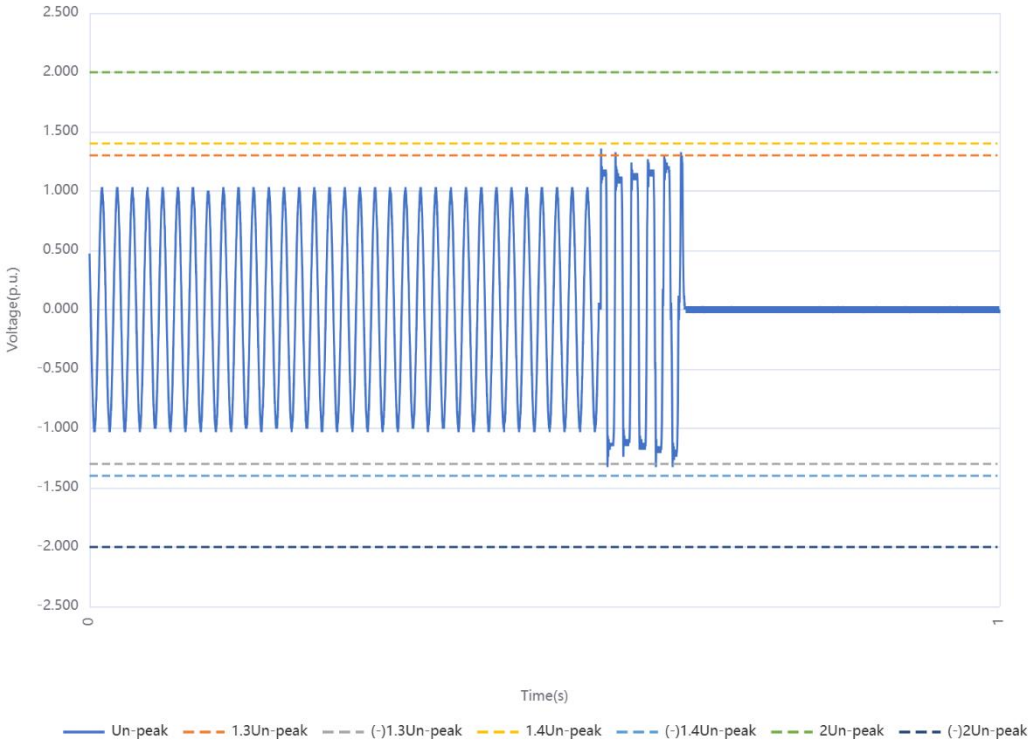


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.8	33.04	7915.00	3846.00

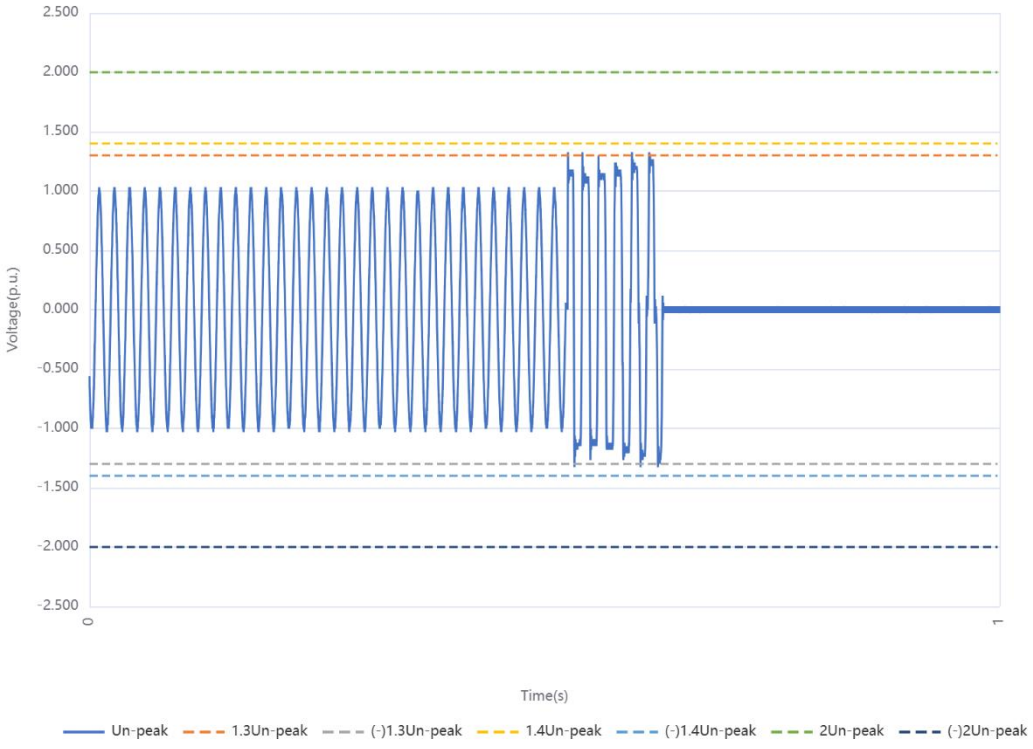
Attempt-4

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.8	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

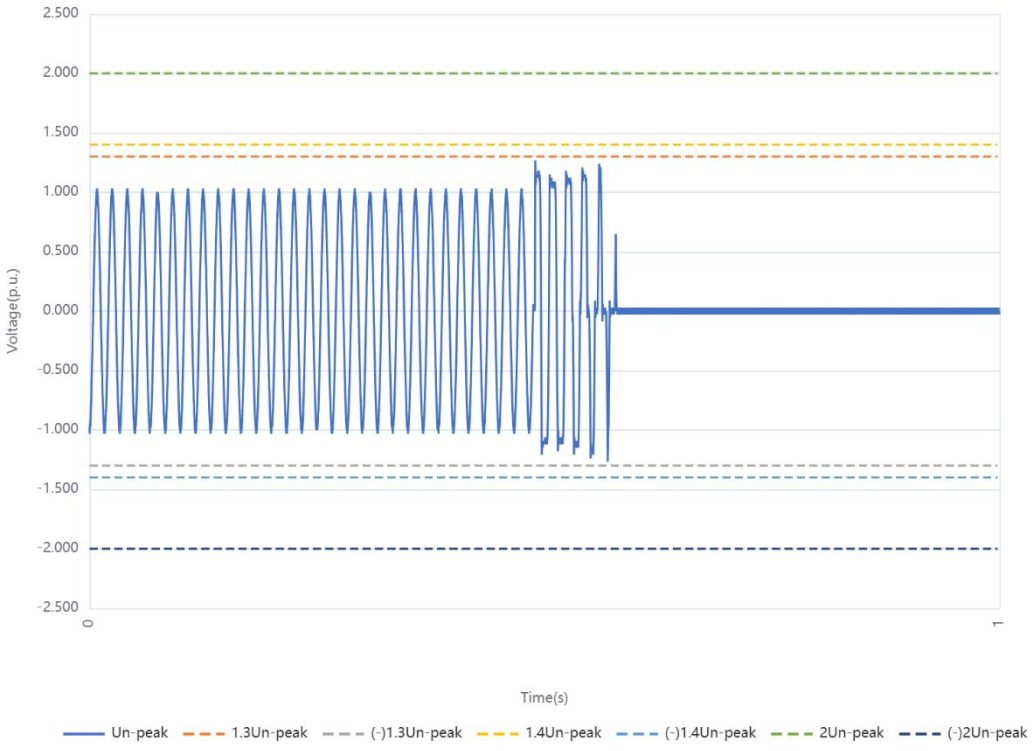


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.8	33.04	7915.00	3846.00
Attempt-5			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.4	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



7) Test-7: EUT output level = 66%P_{rated} & Load level = 10%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.33	32.30	7787.00	1177.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

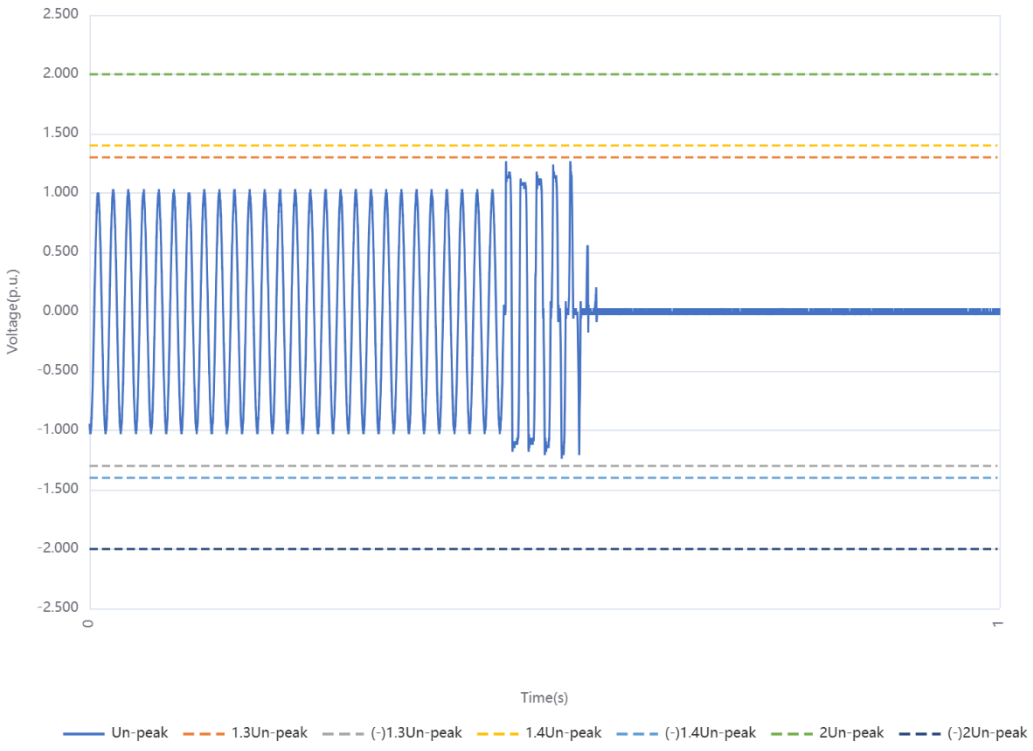


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.33	32.30	7787.00	1177.00

Attempt-2

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

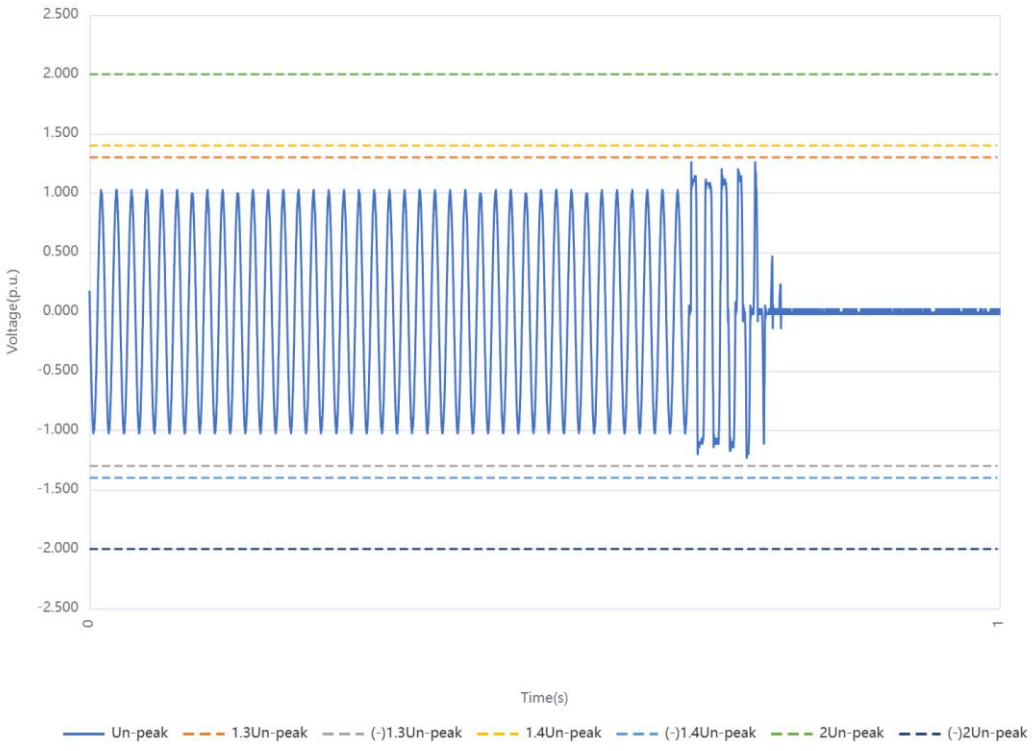


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.33	32.30	7787.00	1177.00

Attempt-3

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

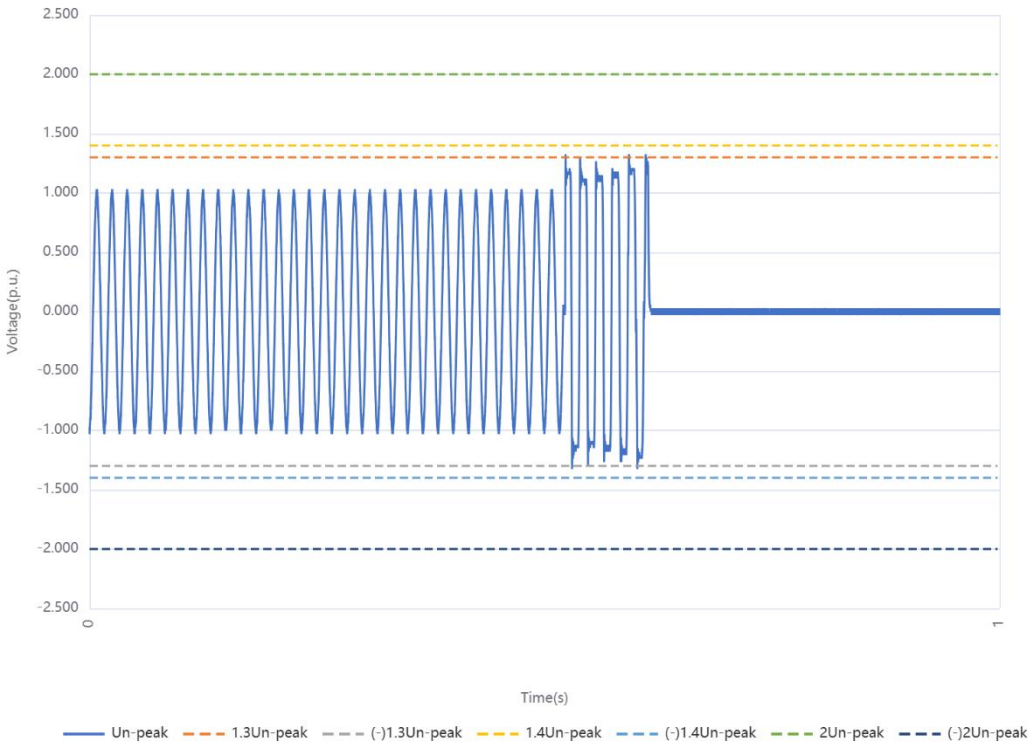


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.33	32.30	7787.00	1177.00

Attempt-4

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

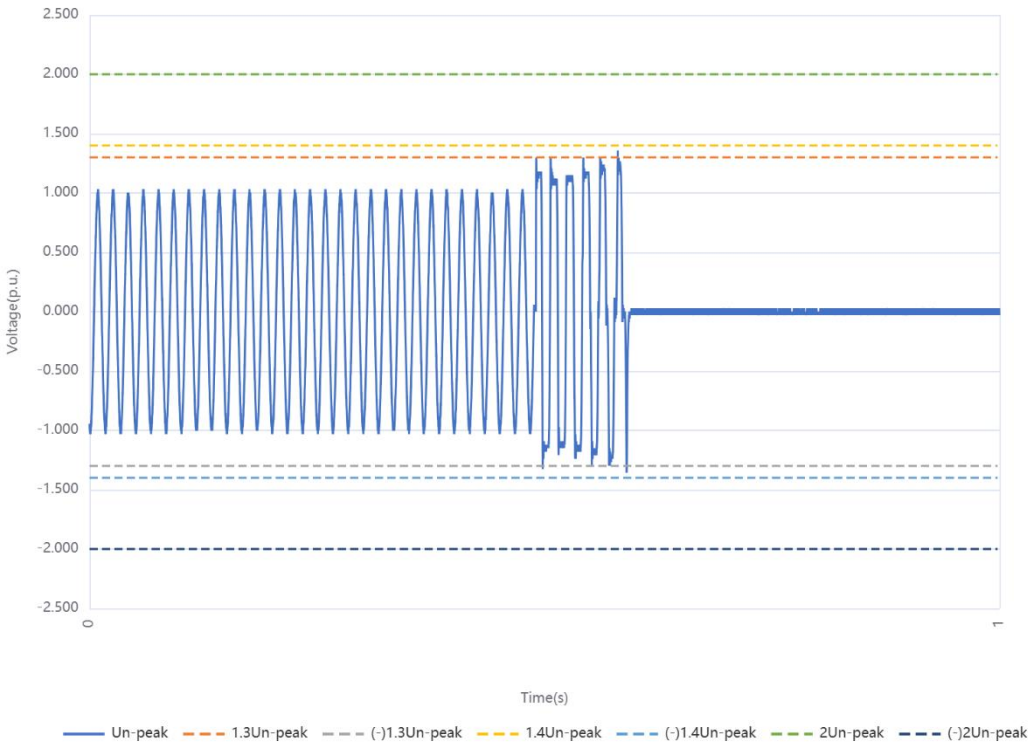


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.33	32.30	7787.00	1177.00

Attempt-5

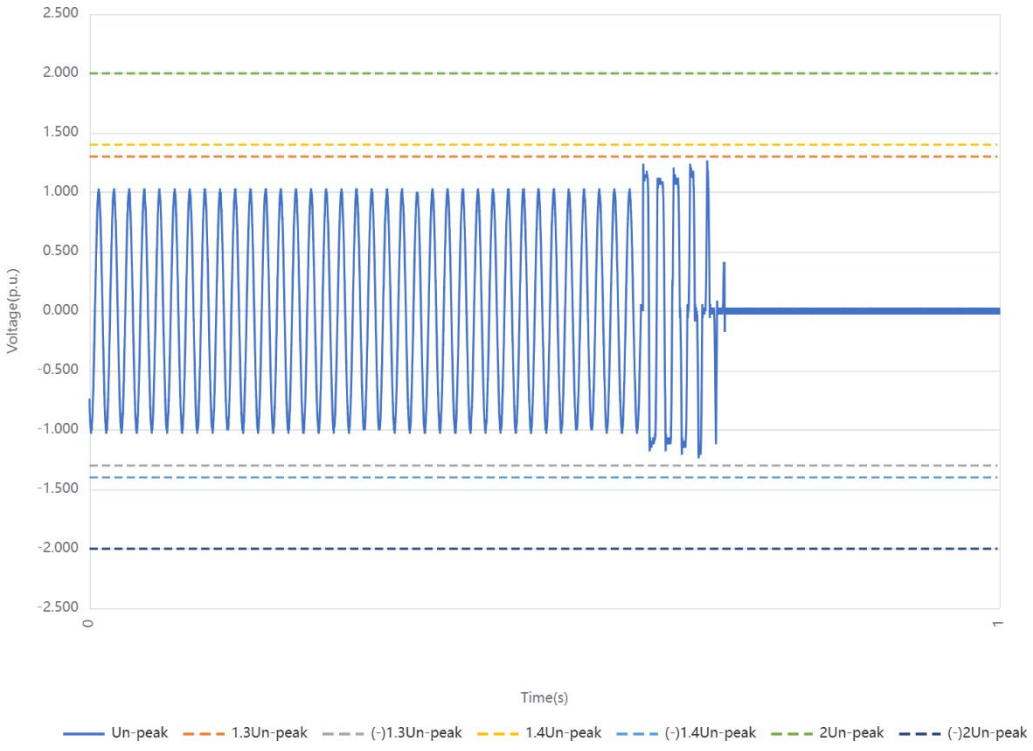
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart



8) Test-8: EUT output level = 66%P_{rated} & Load level = 0%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.48	32.56	7854.00	1.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

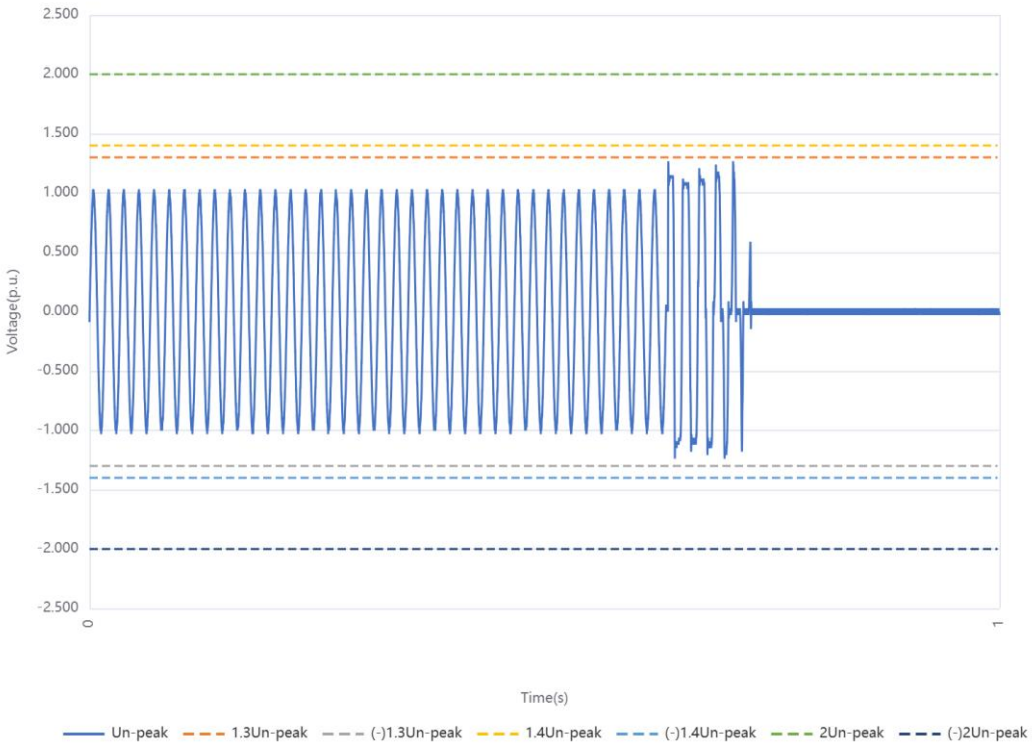


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.48	32.56	7854.00	1.00

Attempt-2

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

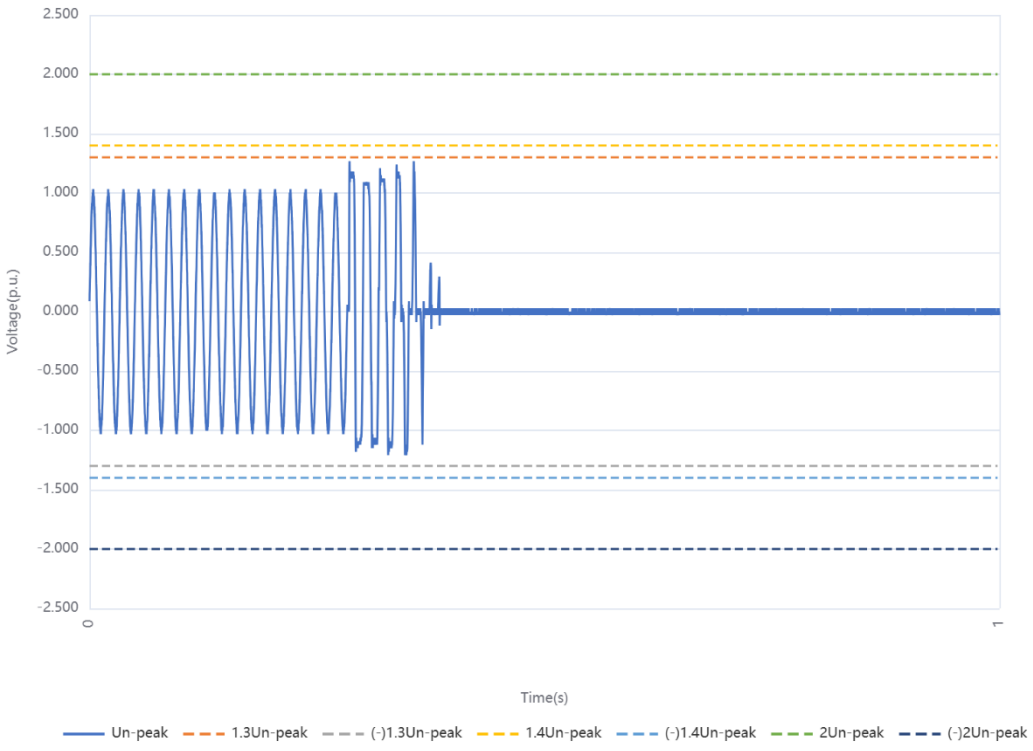


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.48	32.56	7854.00	1.00

Attempt-3

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

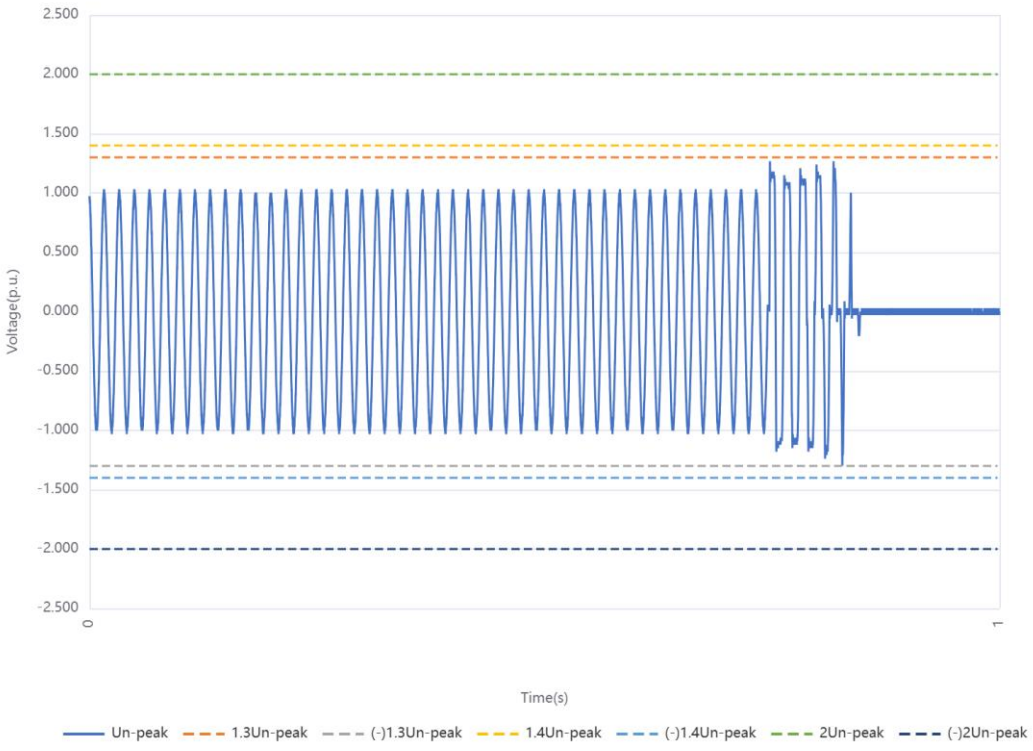


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.48	32.56	7854.00	1.00

Attempt-4

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

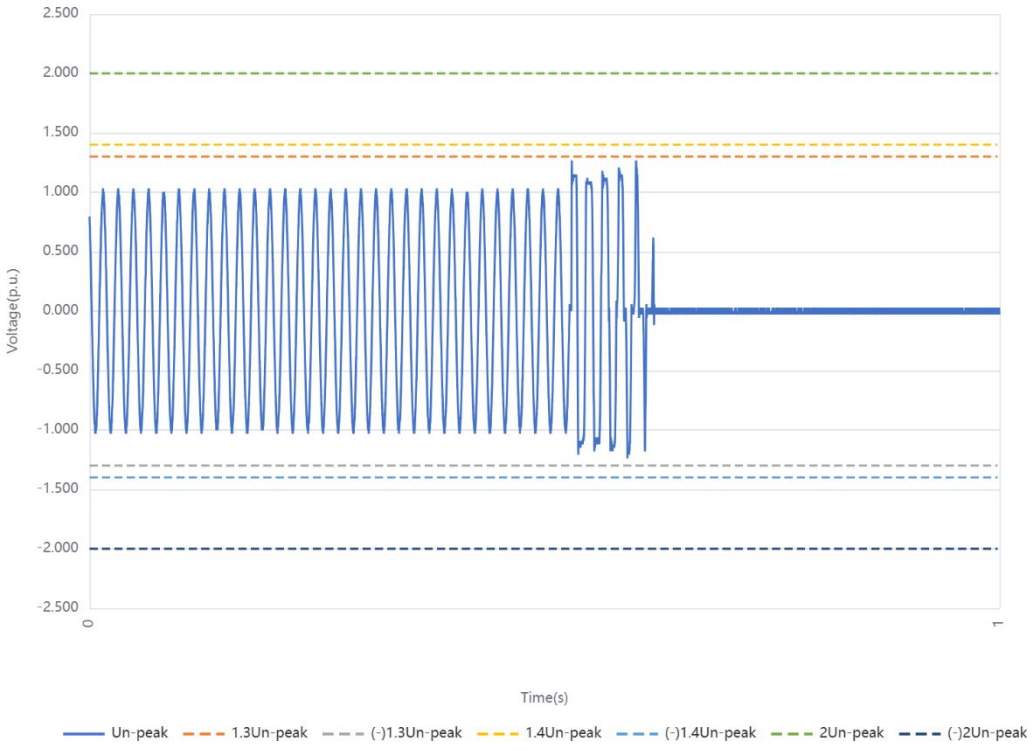


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
241.48	32.56	7854.00	1.00

Attempt-5

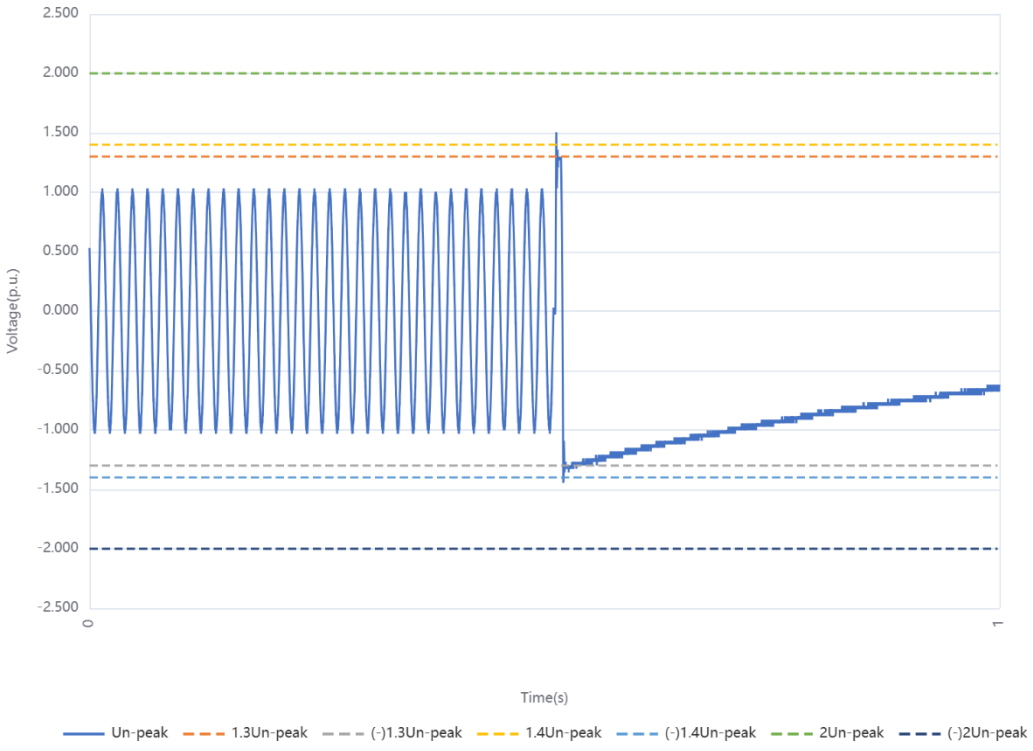
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart



9) Test-9: EUT output level = 33%P_{rated} & Load level = 10%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.63	16.11	3863.00	1274.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	5.2	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

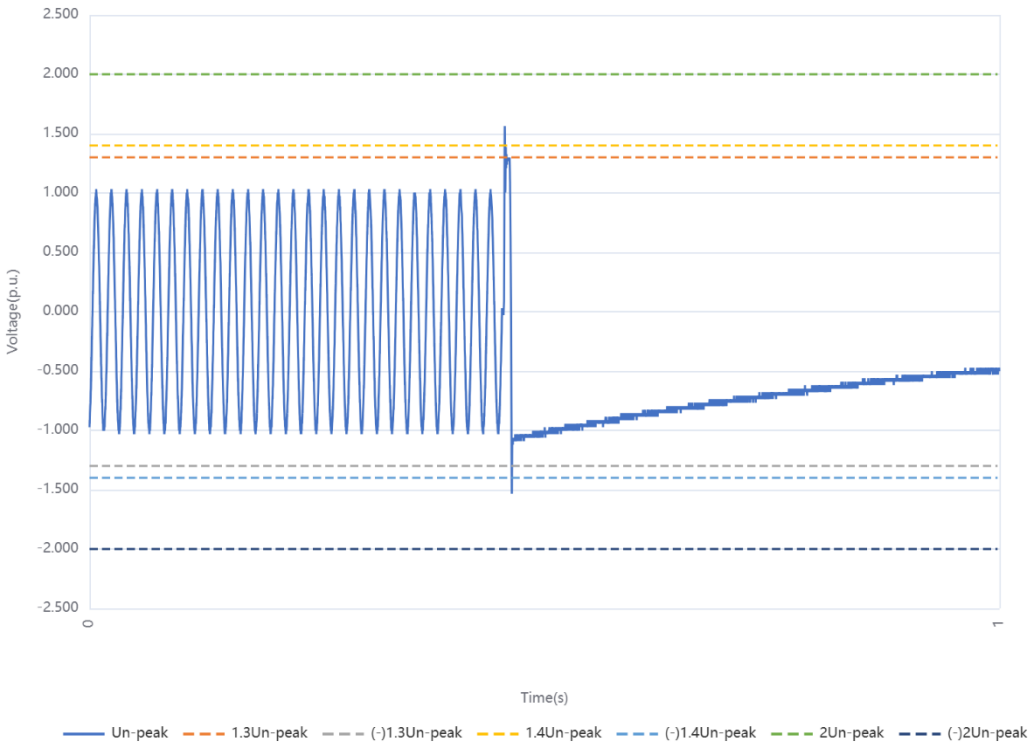


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.63	16.11	3863.00	1274.00

Attempt-2

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.8	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

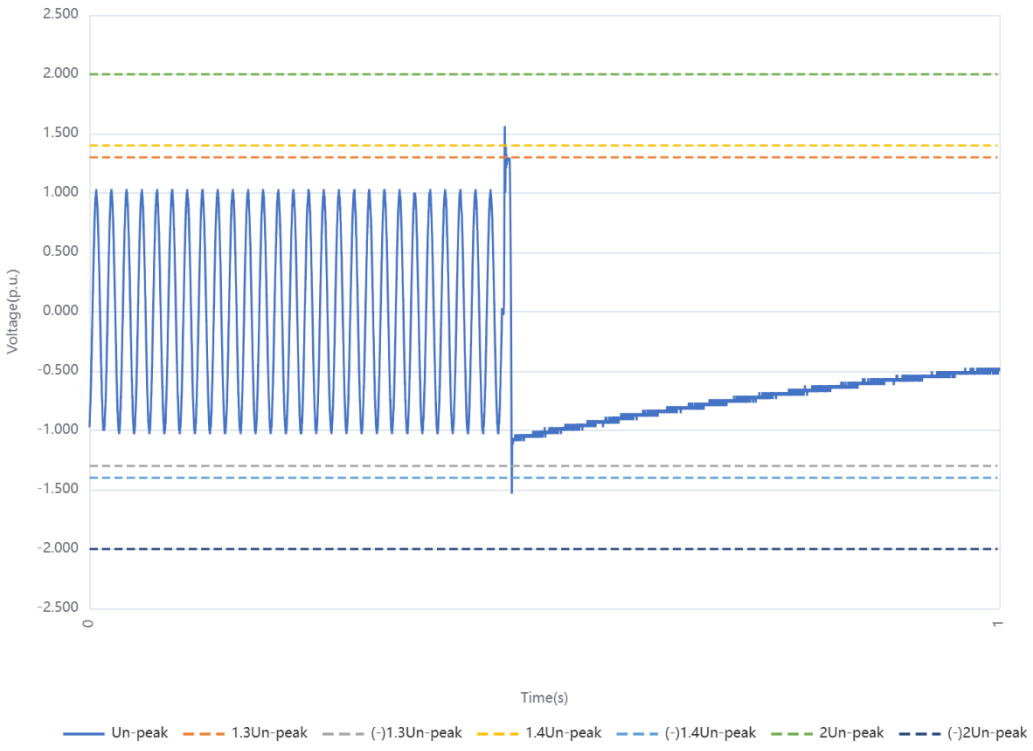


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.63	16.11	3863.00	1274.00

Attempt-3

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.8	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.5	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

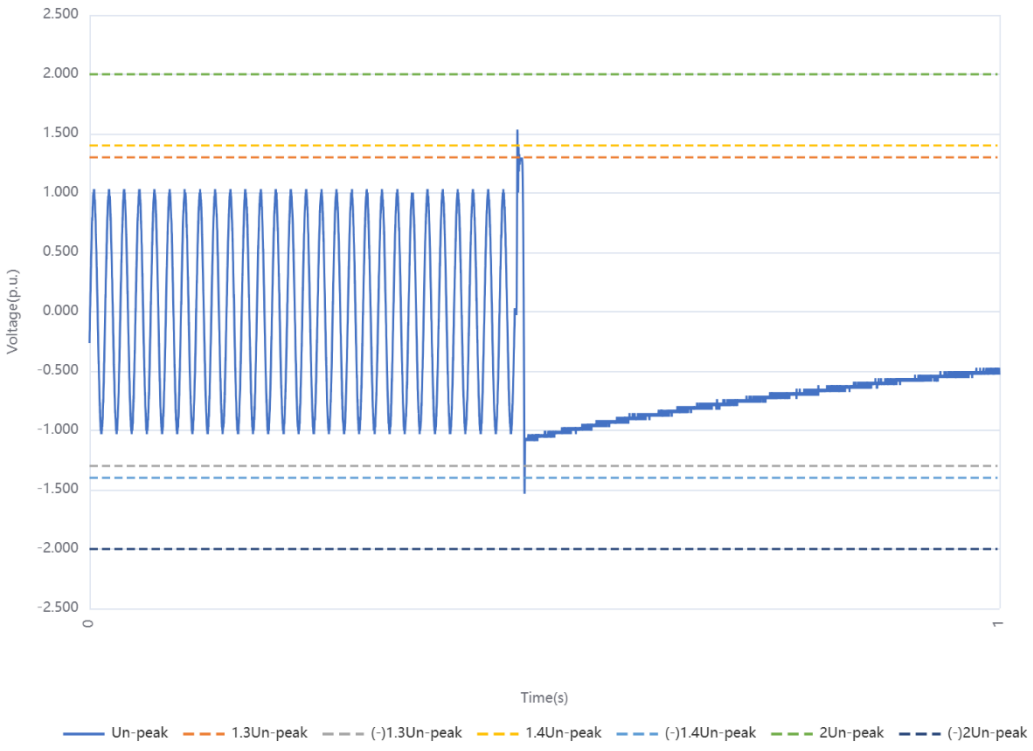


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.63	16.11	3863.00	1274.00

Attempt-4

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.6	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.6	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

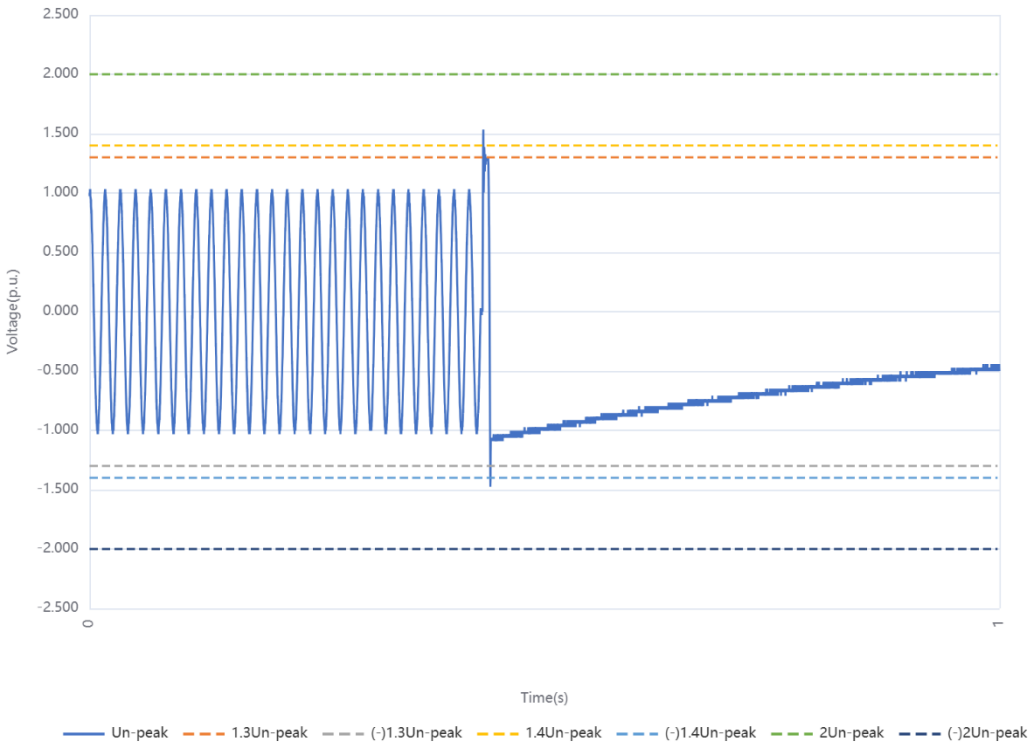


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.63	16.11	3863.00	1274.00

Attempt-5

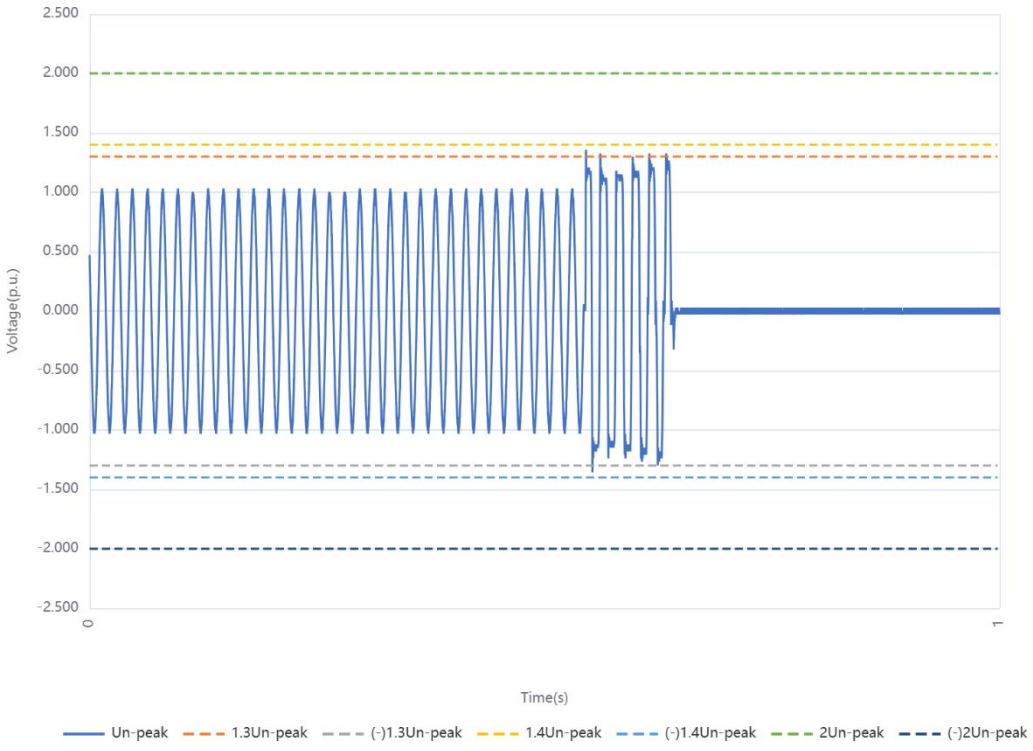
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.5	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.6	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

Result Chart

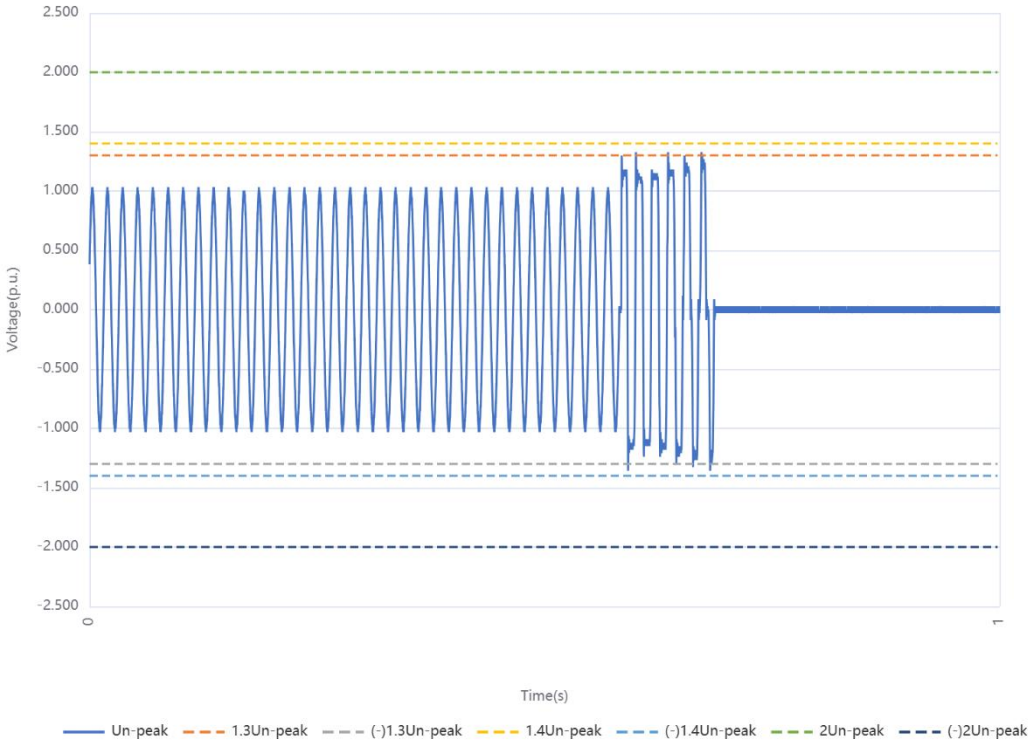


10) Test-10: EUT output level = 33%P_{rated} & Load level = 0%P_{rated}

Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.84	16.53	3971.9	0.00
Attempt-1			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.6	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.84	16.53	3971.9	0.00
Attempt-2			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.7	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.0	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			

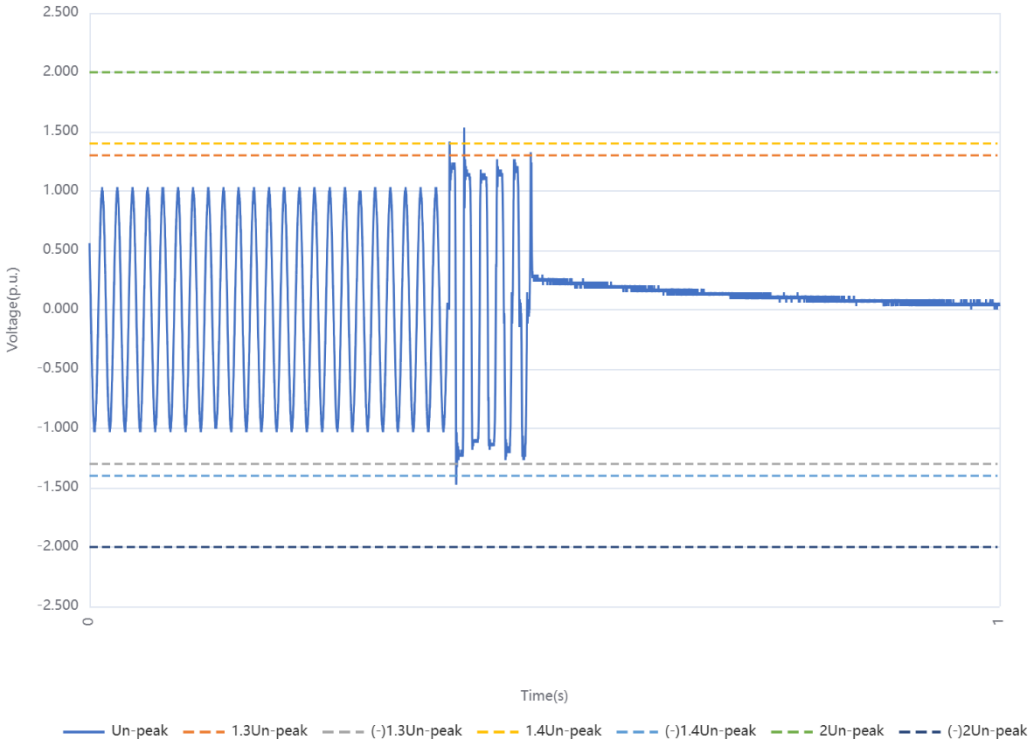


Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.84	16.53	3971.9	0.00

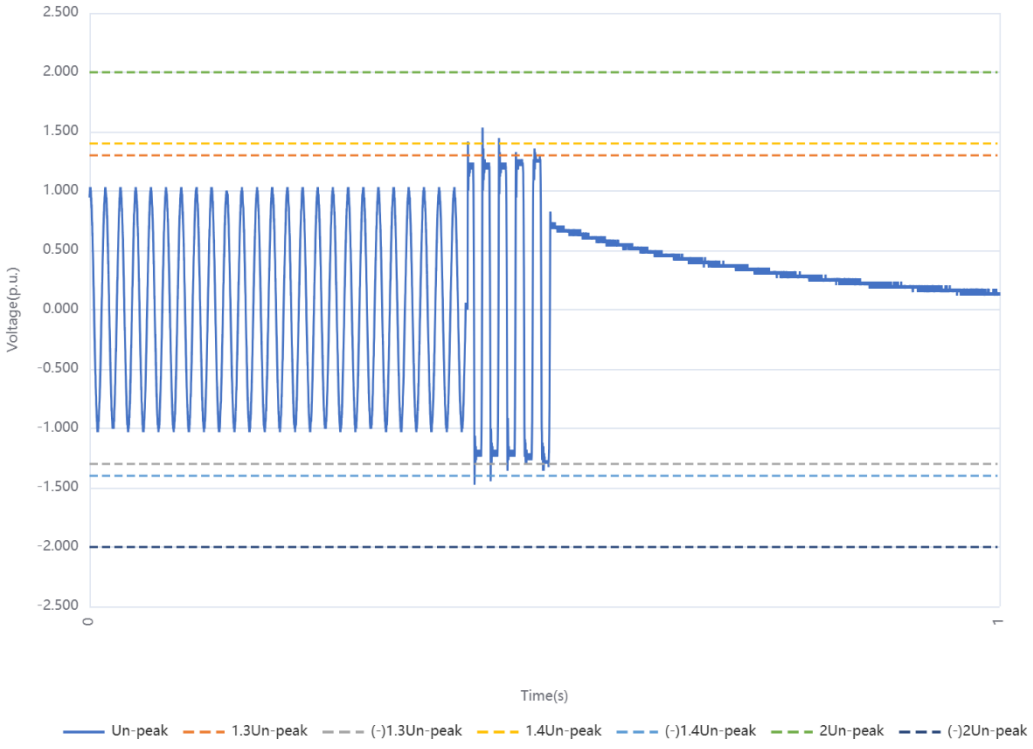
Attempt-3

Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	0.5	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.6	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0

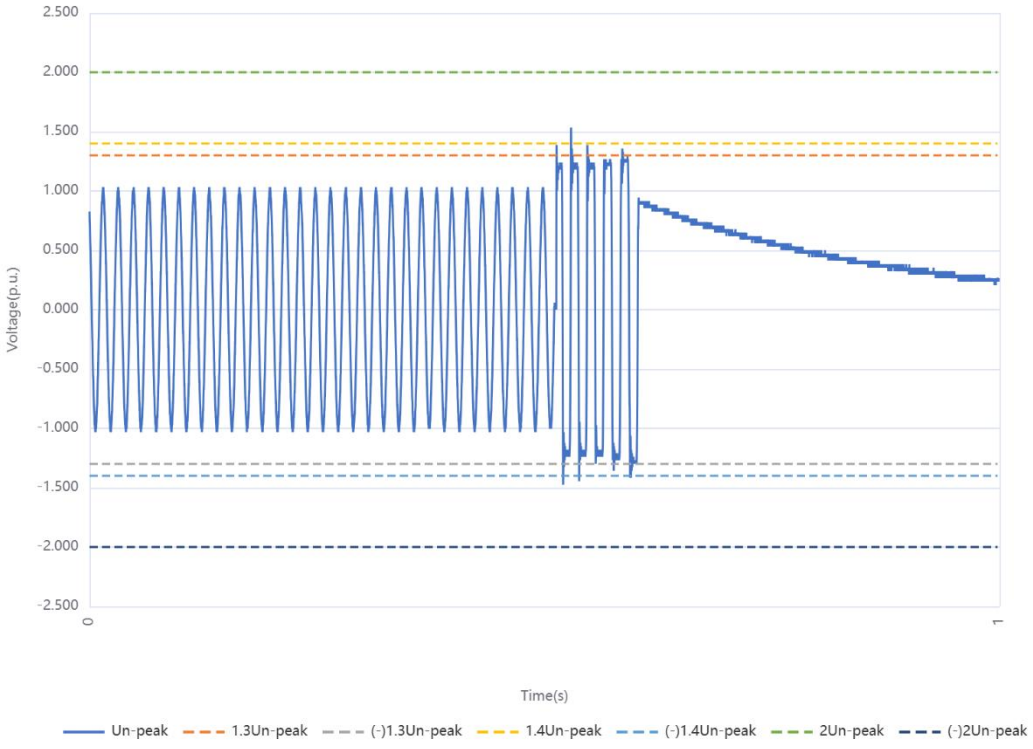
Result Chart



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.84	16.53	3971.9	0.00
Attempt-4			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	2.0	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.8	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



Test Condition			
AC Voltage (V)	AC Current (A)	EUT AC Power (W)	Consumption of Load value (W)
240.84	16.53	3971.9	0.00
Attempt-5			
Region	Phase	Total Duration Meas. (ms)	Duration Limit (ms)
$1.3*U_{n\text{-}peak}<U_{peak}<=1.4*U_{n\text{-}peak}$	L1 to L2	2.2	16.0
$1.4*U_{n\text{-}peak}<U_{peak}<=1.7*U_{n\text{-}peak}$	L1 to L2	0.7	3.0
$1.7*U_{n\text{-}peak}<U_{peak}<=2.0*U_{n\text{-}peak}$	L1 to L2	0.0	1.6
$U_{peak}>2.0*U_{n\text{-}peak}$	L1 to L2	0.0	0.0
Result Chart			



4.18 Fault current tests

The purpose of these requirements is to characterize the DER response to short-circuit faults on the distribution system as specified in 11.4 in IEEE Std 1547-2018.

Not aplicable, Aggregate Rated Capacity < 500kVA

4.18.1 Fault current tests for inverters

DER Information		Comments
Aggregate Rated Capacity >= 500kVA	☐	
Three-Phase Systems	☐	
Three-Phase Systems Comprised Of Three Sets Of Single-Phase Systems	☐	
Without Isolation Transformer	☐	
With Internal Isolation Transformer	☐	
With a Specific External Transformer	☐	

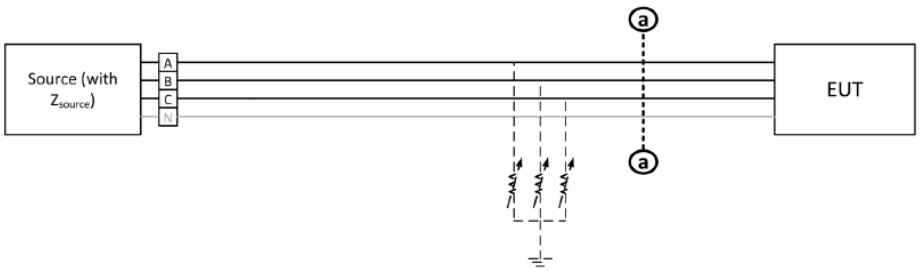


Figure 16—Test apparatus for measuring fault current response of an EUT

Note: AC Source Z_{source} = 0.1 ohm

Not aplicable, Aggregate Rated Capacity < 500kVA

4.18.2 Fault current characterization for rotating machines

Not Applicable.

4.19 Persistence of DER parameter settings

The purpose of this test is to confirm that DER parameter settings persist following a power cycle of the DER, when appropriate.

Power cycles: Remove ac test source voltage and disconnecting EUT input source power or shutting down EUT generation and verifying that voltage at the control component responsible for storing parameter settings has been removed for at least 60 s.

- Total of three repetitions, selecting different parameters each time:

Function Set	Attempt			Comments
	1	2	3	
IEEE 1547:2018 Table 30: Constant power factor mode parameters	☐	☐	☐	
IEEE 1547:2018 Table 31: Voltage-reactive power mode parameters	☐	☐	☐	
IEEE 1547:2018 Table 32: Active power-reactive power mode parameters	☐	☐	☐	
IEEE 1547:2018 Table 33: Constant reactive power mode parameters	☒	☒	☒	Checked
IEEE 1547:2018 Table 34: Voltage-active power mode parameters	☒	☒	☒	Checked
IEEE 1547:2018 Table 35: Voltage trip parameters	☐	☐	☐	
IEEE 1547:2018 Table 36: Momentary cessation parameters (not mandatory)	☐	☐	☐	
IEEE 1547:2018 Table 37: Frequency parameters	☐	☐	☐	
IEEE 1547:2018 Table 38: Frequency droop parameters	☐	☐	☐	
IEEE 1547:2018 Table 39: Enter service after trip parameters	☐	☐	☐	
IEEE 1547:2018 Table 40: Limit maximum active power parameters	☒	☒	☒	Checked

Measurement equipment settings used for this test are shown in the following table:

Measurement device	Date of measurement	Recording	Sampling frequency
--	--	--	--

	Parameter	Range	Parameters Set-Point	Parameters Measured
Table 30	Constant Power Factor Mode Enable	On/Off	--	--
	Constant Power Factor	0−1	--	--
	Constant Power Factor Excitation	Over-excited or under-excited	--	--
Table 31	Voltage-Reactive Power Mode Enable	On/Off	--	--
	V_{Ref}	0.95–1.05 p.u. Vn	--	--
	Autonomous V_{Ref} adjustment enable	On/Off	--	--
	V_{Ref} adjustment time constant	300 s to 5000 s	--	--
	V/Q Curve Points	See Table 8	--	--
	Open Loop Response Time	1 s to 90 s	--	--

	Parameter	Range	Parameters Set-Point	Parameters Measured
Table 32	Active Power-Reactive Power Mode Enable	On/Off	--	--
	P/Q Curve Points	See Table 9	--	--
Table 33	Constant Reactive Power Mode Enable	On/Off	On	On
	Constant Reactive Power	Refer to Table 7	50	50
Table 34	Voltage-Active Power Mode Enable	On/Off	On	On
	V/P Curve Points	See Table 10	(V1:1.09, P1:1.0) (V2:1.10, P2:0.2)	(V1:1.09, P1:1.0) (V2:1.10, P2:0.2)
	Open Loop Response Time	0.5–60 s	10	10
Table 35	HV Trip Curve Points	See Table 11 through Table 13	--	--
	LV Trip Curve Points	See Table 11 through Table 13	--	--
Table 36	HV Momentary Cessation Curve Points	Refer to 6.4.2.7.3	--	--
	LV Momentary Cessation Curve Points	Refer to 6.4.2.7.3	--	--
Table 37	HF Trip Curve Points	See Table 18	--	--
	LF Trip Curve Points	See Table 18	--	--
Table 38	Overfrequency Droop db_{OF}	See Table 24	--	--
	Underfrequency Droop db_{UF}	See Table 24	--	--
	Overfrequency Droop k_{OF}	See Table 24	--	--
	Underfrequency Droop k_{UF}	See Table 24	--	--
	Open Loop Response Time	See Table 24	--	--
Table 39	Permit service	Enabled/Disabled	--	--
	ES Voltage High	See Table 4	--	--
	ES Voltage Low	See Table 4	--	--
	ES Frequency High	See Table 4	--	--
	ES Frequency Low	See Table 4	--	--
	ES Delay	0–600 s	--	--
	ES Randomized Delay	1–1000 s	--	--
	ES Ramp Rate	1–1000 s	--	--
Table 40	Limit Active Power Enable	On/Off	ON	ON
	Maximum Active Power	Refer to 4.6.2	70%Pn	70%Pn

--END OF THE REPORT--