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CEI 0-16:2022-03 Annex Nbis.

EXPOFIN SOLID POWER

HV 261 KWH

EXPOFIN E.S.Co. srl

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DICHIARAZIONE SOSTITUTIVA DI ATTO NOTORIO AI SENSI DEL D.P.R. 28 DICEMBRE 2000 N. 445

Dichiarazione di conformità alle prescrizioni della norma CEI 0-16:2022-03
Declaration of compliance with the requirements of the CEI 0-16:2022-03

Regola tecnica di riferimento per la connessione di utenti attivi e passivi alle reti MT e AT delle imprese distributrici di energia elettrica
Reference technical rules for the connection of active and passive consumers to the MV and HV electrical networks of distribution companies.

Con la presente si attesta che il prodotto:
We hereby declare that the product

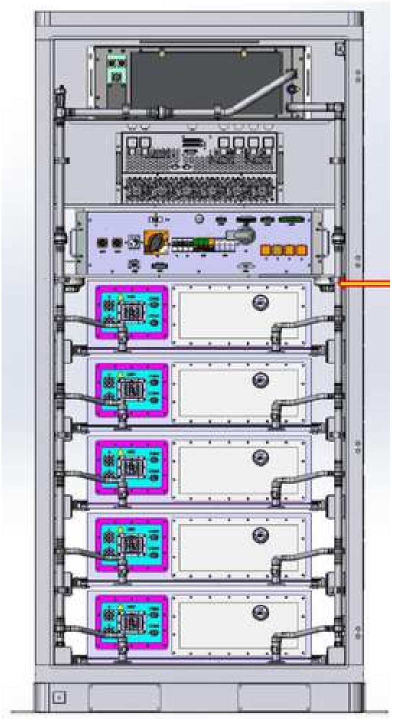
Famiglia di generatori – sistemi di accumulo
Family of generators – storage systems

Definiti da:
Defined by:

Expofin Solid Power HV 261

È CONFORME AGLI STANDARD
Is compliant to the standards

CEI 0-16:2022-03 Annex Nbis.



1) **Expofin Solid Power HV 261**

Informazioni tecniche e descrizione del prodotto:
Il sistema trova applicazione principalmente in scenari industriali e commerciali.
1. Il sistema di accumulo di energia comprende un rack per batterie, un armadio PCS, un armadio di distribuzione dell'energia, un sistema di distribuzione ausiliario, un sistema di aria condizionata, una scatola di controllo BMS e un sistema antincendio.
a) La scatola di distribuzione ausiliaria serve a fornire l'alimentazione ausiliaria per l'intero sistema di controllo BMS e per il sistema di aria condizionata.
b) L'armadio della batteria si collega al PCS tramite la convergenza della barra collettrice e il PCS converte la corrente continua generata dalle batterie di accumulo di energia in corrente alternata, necessaria per il collegamento alla rete tramite trasformatori e altri componenti o richiesta dal cliente.
c) L'ESS è dotato di un controller locale nell'armadio di distribuzione dell'alimentazione e raccoglie informazioni sul funzionamento del PCS, della batteria e di altri dispositivi nel sistema. Inoltre carica le informazioni nel sistema di gestione dell'energia tramite lo sfondo e facilita la gestione del sistema di accumulo dell'energia.
d) La funzione di controllo principale integrata nella scatola di controllo BMS.

Technical Information and product description:
The system is mainly applied in industrial and commercial scenarios.
1. The Energy Storage System which include one battery rack, one PCS cabinet, one power distribution cabinet, auxiliary distribution system, Air-condition system, BMS control box and fire suppression system.
a) The auxiliary distribution box is for providing the auxiliary power for whole BMS control system, air-condition system.
b) Battery cabinet connects to PCS through the busbar convergence, and the PCS converts the DC power generated by the energy storage batteries into AC power which required for connecting to the grid through transformers and other components or required by client.
c) The ESS is equipped with the local controller in Power distribution cabinet, it collects running information of the PCS, battery, and other devices in the system. And it uploads the information to the energy management system via the background and facilitate the management of energy storage system.
d) The master control function integrated in BMS control box.

DICHIARA

che il sistema di accumulo energetico EXPOFIN SOLID POWER HV 261 è stato sottoposto a verifiche di conformità presso TÜV Rheinland secondo la norma CEI 0-16:2022-03 e successive varianti applicabili (V1, V2, V3, V3/EC, V3/EC2, V4), con esito positivo; che i relativi rapporti di prova originali sono conservati presso EXPOFIN S.r.l.; che la documentazione tecnica completa potrà essere resa disponibile, su richiesta motivata, ai soggetti aventi titolo, nel rispetto degli obblighi di riservatezza e delle condizioni d'uso dei documenti emessi dal laboratorio

Test Report - Products

Cliente: **Client:**	EXPOFIN S.R.L. VIALE DELL'INDUSTRIA, N.19 – 35129 PADOVA (PD) – ITALY
Elemento di prova: **Test item:**	Energy Storage System (Integrated Battery Energy Storage System)
Identificazione / Numero di tipo: **Identification / Type no.:**	SOLID POWER HV 261
Specifiche del test: **Test specification:**	CEI 0-16:2022-03 CEI 0-16;V1:2022-11 CEI 0-16;V2:2023 CEI 0-16;V3:2024-01 CEI 0-16;V3/EC:2024 CEI 0-16;V3/EC2:2024 CEI 0-16;V4:2025-02
Laboratorio di prova: **Testing laboratory:**	TÜV Rheinland (Shanghai) Co., Ltd.
Risultato del test*: **Test result*:**	Pass/Approvato

TEST REPORT

CEI 0-16:2022-03
CEI 0-16; V1:2022-11
CEI 0-16; V2:2023
CEI 0-16; V3:2024-01
CEI 0-16; V3/EC:2024
CEI 0-16; V3/EC2:2024
CEI 0-16; V4:2025-02

Norme tecniche di riferimento per il collegamento dei consumatori attivi e passivi alle reti elettriche HV e MV della società di distribuzione

/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

Nome e indirizzo del richiedente: Applicant's name and Address:	EXPOFIN S.R.L. VIALE DELL'INDUSTRIA, N.19 – 35129 PADOVA (PD) – ITALY
Descrizione dell'elemento di prova: Test item description:	Energy Storage System (Integrated Battery Energy Storage System)
Marchio: Trade Mark:	expofin E.S.CO
Produttore: Manufacturer:	EXPOFIN S.R.L. VIALE DELL'INDUSTRIA, N.19 – 35129 PADOVA (PD) – ITALY

NORME DI RIFERIMENTO:
Reference Standard:

CEI 0-16:2022-03
Regola tecnica di riferimento per la connessione di Utenti attivi e passivi alle reti AT ed MT delle imprese distributrici di energia elettrica
/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

CEI 0-16; V1:2022-11
Regola tecnica di riferimento per la connessione di Utenti attivi e passivi alle reti AT ed MT delle imprese distributrici di energia elettrica
/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

CEI 0-16; V2:2023
Regola tecnica di riferimento per la connessione di Utenti attivi e passivi alle reti AT ed MT delle imprese distributrici di energia elettrica
/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

CEI 0-16;V3:2024-01/01.24
Regola tecnica di riferimento per la connessione di Utenti attivi e passivi alle reti AT ed MT delle imprese distributrici di energia elettrica
/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

CEI 0-16;V3/EC:2024
Regola tecnica di riferimento per la connessione di Utenti attivi e passivi alle reti AT ed MT delle imprese distributrici di energia elettrica
/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

CEI 0-16;V3/EC2:2024
Regola tecnica di riferimento per la connessione di Utenti attivi e passivi alle reti AT ed MT delle imprese distributrici di energia elettrica
/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

CEI 0-16;V4:2025-02

Regola tecnica di riferimento per la connessione di Utenti attivi e passivi alle reti AT ed MT delle imprese distributrici di energia elettrica

/Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution Company

The standard refers to the following standards:

IEC 61400-21:2008-08 Ed.2 (§. 7.4)

Wind turbines

Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines

FGW TR3

Technical Guidelines for Power Generating Units - Part 3

Determination of electrical characteristics of power generating units connected to MV, HV and EHV grids

N.2 Elenco delle prove e condizioni di riferimento *\/Testing list at reference conditions*			
Test	**§**	**Ref. standard**	**Result**
EMC	N.2	CEI EN 61000-6-2 CEI EN 61000-6-3/-4	Note[1]
Misure per la qualità della tensione */Voltage quality measure*	N.3	CEI 0-16:2022-03	N/A
Verifica del campo di funzionamento in tensione e frequenza */Voltage-frequency working range*	N.4	CEI 0-16:2022-03	N/A
Verifica delle condizioni di sincronizzazione e presa di carico */syncronization and re-connection*	N.5	CEI 0-16:2022-03	N/A
Verifica dei requisiti costruttivi circa lo scambio di potenza reattiva */Reactive power capability*	N.6	CEI 0-16:2022-03	N/A
Verifica dei requisiti costruttivi circa la regolazione di potenza attiva */Active power regulation*	N.7	CEI 0-16:2022-03	N/A
Verifica della insensibilità agli abbassamenti di tensione */LVRT capability*	N.8	CEI 0-16:2022-03	N/A
Verifica della insensibilità alle richiusure automatiche in discordanza di fase */Check of the insensibility to the re-closures when phases are in discordance*	N.9	CEI 0-16:2022-03	N/A
Misure per la qualità della tensione */Voltage quality measure*	Nbis.3	CEI 0-16:2022-03	P
Verifica del campo di funzionamento in tensione e frequenza */Voltage-frequency working range*	Nbis.4	CEI 0-16:2022-03	P
Verifica delle condizioni di sincronizzazione e presa di carico */syncronization and re-connection*	Nbis.5	CEI 0-16:2022-03	P
Verifica dei requisiti costruttivi circa lo scambio di potenza reattiva */Reactive power capability*	Nbis.6	CEI 0-16:2022-03	P
Verifica dei requisiti costruttivi circa la regolazione di potenza attiva */Active power regulation*	Nbis.7	CEI 0-16:2022-03	P
Verifica della insensibilità agli abbassamenti di tensione */LVRT capability*	Nbis.8	CEI 0-16:2022-03	P
Verifica della insensibilità alle richiusure automatiche in discordanza di fase */Check of the insensibility to the re-closures when phases are in discordance*	Nbis.9	CEI 0-16:2022-03	P
Regolazioni del sistema di protezione dei gruppi generatori */ System protection regulations for generators*	Annex Z	CEI 0-16:2022-03 CEI 0-16; V3:2024-01	P

Sample 1: Hybrid inverter and battery are housed in a single cabinet, model name:
- **Expofin Solid Power HV 261**

C.2.4.7.4 Compatibilità Climatica / Climatic compatibility

Test	§	Ref. standard	Result	Sample
Compatibilità Climatica /Climatic compatibility **Storage conditions**	**C.2.4.7.4** **D.3.6** **E.4.5** (limit conditions)	Caldo secco / Dry heat test CEI EN 60068-2-2 (Test B) - **Tab.12**	PASS	1
		Umidità / Humidity test CEI EN 60068-2-78 (Test Cab) - **Tab.12**	PASS	1
		Freddo / Cold test CEI EN 60068-2-1 (Test A) - **Tab.12**	PASS	1
		Ciclo termico /changing temperature CEI EN 60068-2-14 - **Tab.12**	PASS	1
Compatibilità Climatica /Climatic compatibility **Inverter in working conditions**	**C.2.4.7.4** **D.3.6** **E.4.5** (limit conditions)	Caldo secco / Dry heat test CEI EN 60068-2-2 (Test B) - **Tab.12**	PASS	1
		Umidità / Humidity test CEI EN 60068-2-78 (Test Cab) - **Tab.12**	PASS	1
		Freddo / Cold test CEI EN 60068-2-1 (Test A) - **Tab.12**	PASS	1
		Ciclo termico /changing temperature CEI EN 60068-2-14 - **Tab.12**	PASS	1

C.2.4.7.4 Prove di isolamento */Insulating test*

Test	Ref. CEI 0-21	Ref. standard	Result	Sample
Tenuta ad impulso /Pulse test	**C.2.4.7.4** **D.3.6** **E.4.5**	CEI EN 60255-5 Note[1]	PASS	1
Rigidità Dielettrica /Dielectric Strength		CEI EN 60255-5 Note [1]	PASS	1
Resistenza di Isolamento /insulation resistance		CEI EN 60255-5 Note [1]	PASS	1

N.3 Misure per la qualità della tensione
/Voltage quality measure

Test	§	Requirement	Ref. standard	Result	Sample
Misura di correnti armoniche *∕Harmonics current*	N.3.1	N.3	CEI 0-16:2022-03	N/A	N/A
	7.4	--	IEC 61400-21	N/A	N/A
Misura di fluttuazioni di tensione dovute a manovre di sezionamento/separazione */ Voltage fluctuactions caused by Switching operations*	N.3.2	N.3	CEI 0-16:2022-03	N/A	N/A
	7.3.4	--	IEC 61400-21	N/A	N/A
Misura di fluttuazioni di tensione (flicker) in condizioni di funzionamento continuo */Voltage fluctuations (Flickers) during Continuous operation*	N.3.3	N.3	CEI 0-16:2022-03	N/A	N/A
	6.3.2 7.3.3	--	IEC 61400-21	N/A	N/A

N.4 Verifica del campo di funzionamento in tensione e frequenza
/Voltage-frequency working range

Test	Ref. CEI 0-16	Ref. standard	Result	Sample
Prove a piena potenza su rete simulata */full power test with grid simulator*	N.4.1.1	CEI 0-16:2022-03	N/A	N/A

N.5 Verifica delle condizioni di sincronizzazione e presa di carico
/syncronization and re-connection

Test	Ref. CEI 0-16	Ref. standard	Result	Sample
Sincronizzazione e riconnessione. */Syncronization*	N.5.1	CEI 0-16:2022-03	N/A	N/A
Verifica della erogazione graduale della potenza attiva (presa di carico) */ gradually erogation of the power*	N.5.2	CEI 0-16:2022-03	N/A	N/A

N. 6 Verifica dei requisiti costruttivi circa lo scambio di potenza reattiva */Reactive power capability*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Verifica della capability di erogazione della potenza reattiva */reactive power production capability*	N.6.1	CEI 0-16:2022-03	N/A	N/A
Scambio di potenza reattiva secondo un livello assegnato */Reactive power production according to an assigned level*	N.6.2 Annex I	CEI 0-16:2022-03	N/A	N/A
Tempo di risposta ad una variazione a gradino del livello assegnato */Reaction time after a step variation of the assigned level.*	N.6.2.1	CEI 0-16:2022-03	N/A	N/A
Regolazione automatica di potenza reattiva secondo una curva caratteristica cosφ = f(P) */Automatic reactive power production according to a characteristic curve cos(phi)=f(P)*	N.6.3	CEI 0-16:2022-03	N/A	N/A
Erogazione/assorbimento automatico di potenza reattiva secondo una curva caratteristica Q=f(V) applicabile a generatori con capability rettangolare */Automatic reactive power production according to a characteristic curve Q=f(V)*	N.6.4	CEI 0-16:2022-03	N/A	N/A

N. 7 Verifica dei requisiti costruttivi circa lo scambio di potenza reattiva *Reactive power capability*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Limitazione automatica in logica locale, per valori di tensione prossimi al 110% *Active power limitation for voltage values near to 100 % di Un*	N.7.1 8.8.6.4.1 Annex J (§. J.2)	CEI 0-16:2022-03	N/A	N/A
Limitazione automatica per transitori di sovrafrequenza originatisi sulla rete */ Active power regulation in coincidence with transitory on the transmission grid*	N.7.2 8.8.6.4.2 Annex J (§. J.3)	CEI 0-16:2022-03	N/A	N/A
Incremento automatico per transitori di sottofrequenza originatisi sulla rete */automatic increasing of active power in coincidence with underfrequency transients.*	N.7.2 8.8.6.4.3 Annex K	CEI 0-16:2022-03	N/A	N/A
Limitazione su comando esterno proveniente dal Distributore, e/o in logica centralizzata */Active power limitation in coincidence with external command coming from the Electricity Distributor*	N.7.4 8.8.6.3 Annex M	CEI 0-16:2022-03	N/A	N/A
Verifica del tempo di assestamento ad un comando di riduzione di potenza */settling time verification after a power limitation command.*	N.7.4.1	CEI 0-16:2022-03	N/A	N/A

N.8 VFRT capability				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
VFRT Capability	N.8 8.8.6.1	CEI 0-16:2022-03	N/A	N/A
Test procedure for static converter	N.8.1	CEI 0-16:2022-03		

N.9 Verifica della insensibilità alle richiusure automatiche in discordanza di fase */Check of the insensibility to the re-closures when phases are in discordance*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Verifica della insensibilità alle richiusure automatiche in discordanza di fase */Check of the insensibility to the re-closures when phases are in discordance*	N.9	CEI 0-16:2022-03	N/A	N/A

Nbis.3 Misure per la qualità della tensione */Voltage quality measure*					
Test	**§**	**Requirement**	**Ref. standard**	**Result**	**Sample**
Misura di correnti armoniche */Harmonics current*	Nbis.3.1	Nbis.3	CEI 0-16:2022-03	PASS	1
	7.4	--	IEC 61400-21	PASS	1
Misura di fluttuazioni di tensione dovute a manovre di sezionamento/separazione */ Voltage fluctuactions caused by Switching operations*	Nbis.3.2	Nbis.3	CEI 0-16:2022-03	PASS	1
	7.3.4	--	IEC 61400-21	PASS	1
Misura di fluttuazioni di tensione (flicker) in condizioni di funzionamento continuo */Voltage fluctuations (Flickers) during Continuous operation*	Nbis.3.3	Nbis.3	CEI 0-16:2022-03	PASS	1
	6.3.2 7.3.3	--	IEC 61400-21	PASS	1

Nbis.4 Verifica del campo di funzionamento in tensione e frequenza */Voltage-frequency working range*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Prove a piena potenza su rete simulata */full power test with grid simulator*	Nbis.4	CEI 0-16:2022-03	PASS	1

Nbis.5 Verifica delle condizioni di sincronizzazione e presa di carico */syncronization and re-connection*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Sincronizzazione e riconnessione. */Syncronization*	Nbis.5.1	CEI 0-16:2022-03	PASS	1
Verifica della erogazione graduale della potenza attiva (presa di carico) */ gradually erogation of the power*	Nbis.5.2	CEI 0-16:2022-03	PASS	1

Nbis. 6 Verifica dei requisiti costruttivi circa lo scambio di potenza reattiva */Reactive power capability*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Verifica della capability di erogazione della potenza reattiva */reactive power production capability*	Nbis.6.1	CEI 0-16:2022-03	PASS	1
Scambio di potenza reattiva secondo un livello assegnato */Reactive power production according to an assigned level*	Nbis.6.4	CEI 0-16:2022-03	PASS	1
Tempo di risposta ad una variazione a gradino del livello assegnato */Reaction time after a step variation of the assigned level.*	Nbis.6.5	CEI 0-16:2022-03	PASS	1
Regolazione automatica di potenza reattiva secondo una curva caratteristica cosφ = f(P) */Automatic reactive power production according to a characteristic curve cos(phi)=f(P)*	Nbis.6.7	CEI 0-16:2022-03	PASS	1
Erogazione/assorbimento automatico di potenza reattiva secondo una curva caratteristica Q=f(V) applicabile a generatori con capability rettangolare */Automatic reactive power production according to a characteristic curve Q=f(V)*	Nbis.6.8	CEI 0-16:2022-03	PASS	1

Nbis. 7 Verifica dei requisiti costruttivi circa lo scambio di potenza reattiva *Reactive power capability*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Limitazione automatica in logica locale, per valori di tensione prossimi al 110% *Active power limitation for voltage values near to 110 % di Un*	Nbis.7.1	CEI 0-16:2022-03	PASS	1
Limitazione automatica per transitori di sovrafrequenza originatisi sulla rete *Active power regulation in coincidence with transitory on the transmission grid*	Nbis.7.2	CEI 0-16:2022-03	PASS	1
Incremento automatico per transitori di sottofrequenza originatisi sulla rete */automatic increasing of active power in coincidence with underfrequency transients.*	Nbis.7.3	CEI 0-16:2022-03 CEI 0-16; V3/EC2:2024-03 CEI 0-16;V4:2025-03	PASS	1
Verifica della regolazione della potenza attiva su comando esterno proveniente dal Distributore *Verification of the regulation of the active power on an external command coming from the Distributor*	Nbis.7.4	CEI 0-16:2022-03	PASS	1
Verifica del tempo di assestamento ad un comando di incremento/riduzione di potenza *Check the settling time at an increase / decrease commandof power*	Nbis.7.4.1	CEI 0-16:2022-03	PASS	1

Nbis.8 VFRT capability				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
VFRT Capability	Nbis.8	CEI 0-16:2022-03	PASS	1

Nbis.9 Verifica della insensibilità alle richiusure automatiche in discordanza di fase */Check of the insensibility to the re-closures when phases are in discordance*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Verifica della insensibilità alle richiusure automatiche in discordanza di fase */Check of the insensibility to the re-closures when phases are in discordance*	Nbis.9	CEI 0-16:2022-03	PASS	1

Annex Z Regolazioni del sistema di protezione dei gruppi generatori */ System protection regulations for generator*				
Test	**Ref. CEI 0-16**	**Ref. standard**	**Result**	**Sample**
Regolazioni del sistema di protezione dei gruppi generatori */ System protection regulations for generators*	Annex Z	CEI 0-16:2022-03 CEI 0-16; V3:2024-01	PASS	1

Test item particulars :	
Equipment mobility :	☐ Stationary ☒ Fixed
Connection to the mains :	☒ Permanent connection
Enviromental category :	☒ Outdoor
Over voltage category Mains :	☒ OVC III (when used in TT or TN system) ☐ OVC II (when used in IT system)
Over voltage category PV :	N/A
Mains supply tolerance (%) :	--
Tested for power systems :	--
IT testing, phase-phase voltage (V) :	--
Class of equipment :	☒ Class I
Mass of equipment (kg) :	See model list
Pollution degree :	☐ PD 1 ☒ PD 2 (Inside) ☒ PD 3(Outside)
IP protection class :	IP55
Testing	Type Test
Date of receipt of test item(s) :	See page 1
Dates tests performed :	See page 1
Possible test case verdicts:	
test case does not apply to the test object :	N/A
test object does meet the requirement :	Pass (P)
test object does not meet the requirement :	Fail (F)

General remarks:

"(see Attachment #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.
The tests results presented in this report relate only to the object tested.
This report shall not be reproduced except in full without the written approval of the testing laboratory.
List of test equipment must be kept on file and available for review.
Additional test data and/or information provided in the attachments to this report.
Throughout this report a point is used as the decimal separator.

Definitions:

- (RI) Reinforced insulation; (BI) Basic insulation; (FI) Functional Insulation

Informazioni generali sul prodotto / *General product information*:	
Product:	☐ Static generator (Solar Grid tied inverter) ☐ Wind Full converter (FC) ☐ Wind Doubly Fed Induction Generator ☒ Energy Storage System
License Holder: *Address:*	EXPOFIN S.R.L. VIALE DELL'INDUSTRIA, N.19 – 35129 PADOVA (PD) – ITALY
Model(s):	SOLID POWER HV 261
Testing Location: *Address:*	***§. N.1 Esecuzione delle prove – accreditamento*** *N.1 Testing - Accreditation* ☒ CEI UNI EN ISO/IEC 17025:2005 testing Laboratory *(See testing laboratory address)* ☐ Manufacturing Plant / Customer facility CEI UNI EN ISO/IEC 17025:2005 *testing Laboratory* *(see Manufacturing plant address)*
Testing Laboratory: *Address:*	TÜV Rheinland (Shanghai) Co., Ltd.
Potenza massima dell'impianto di destinazione: *Maximum power of the destination plant:*	☐ P_{plant} < 400 KW * ☒ $P_{plant} \geq$ 400 KW * ** Only for static generator (wind converter not included)*
Input Voltage (Rated):	See modle list
Output Voltage (Rated):	See modle list
Firmware version:	DSP: 1.2.0.5 ARM: 1.9.1.7 EMU: V1.2

TECHNICAL INFORMATION:

Product Description:

The system is mainly applied in industrial and commercial scenarios.

1. The Energy Storage System which include one battery rack, one PCS cabinet, one power distribution cabinet, auxiliary distribution system, Air-condition system, BMS control box and fire suppression system.

a) The auxiliary distribution box is for providing the auxiliary power for whole BMS control system, air-condition system.

b) Battery cabinet connects to PCS through the busbar convergence, and the PCS converts the DC power generated by the energy storage batteries into AC power which required for connecting to the grid through transformers and other components or required by client.

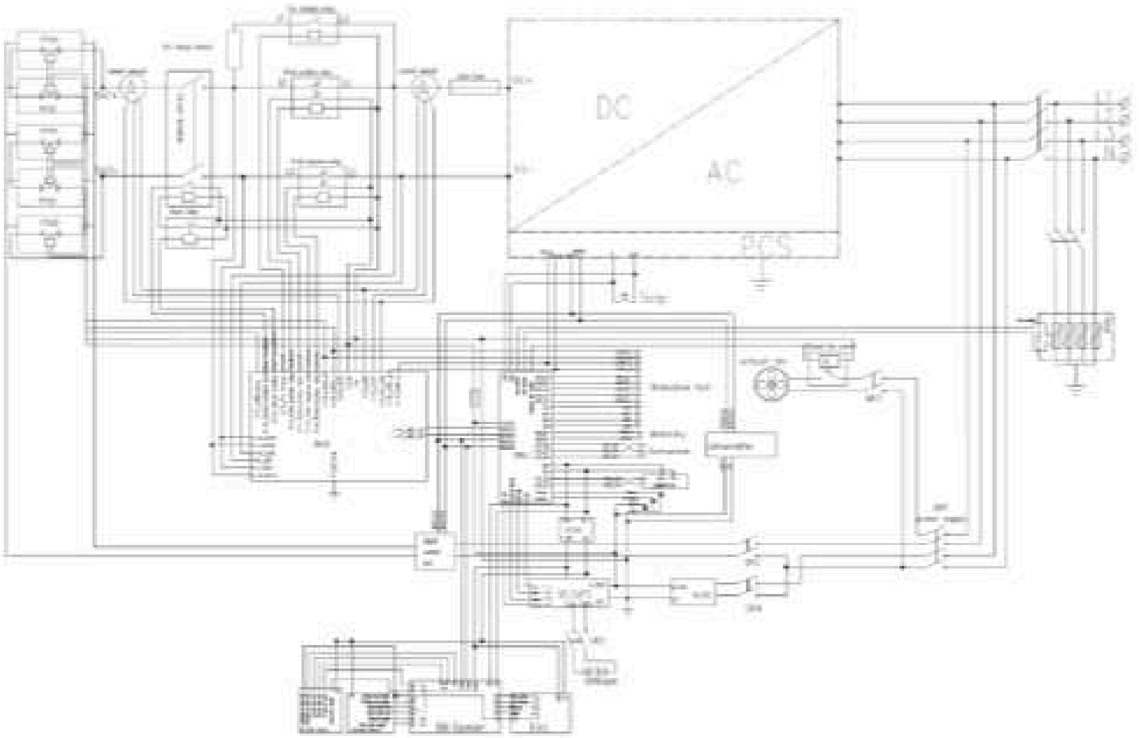
c) The ESS is equipped with the local controller in Power distribution cabinet, it collects running information of the PCS, battery, and other devices in the system. And it uploads the information to the energy management system via the background and facilitate the management of energy storage system.

d) The master control function integrated in BMS control box.

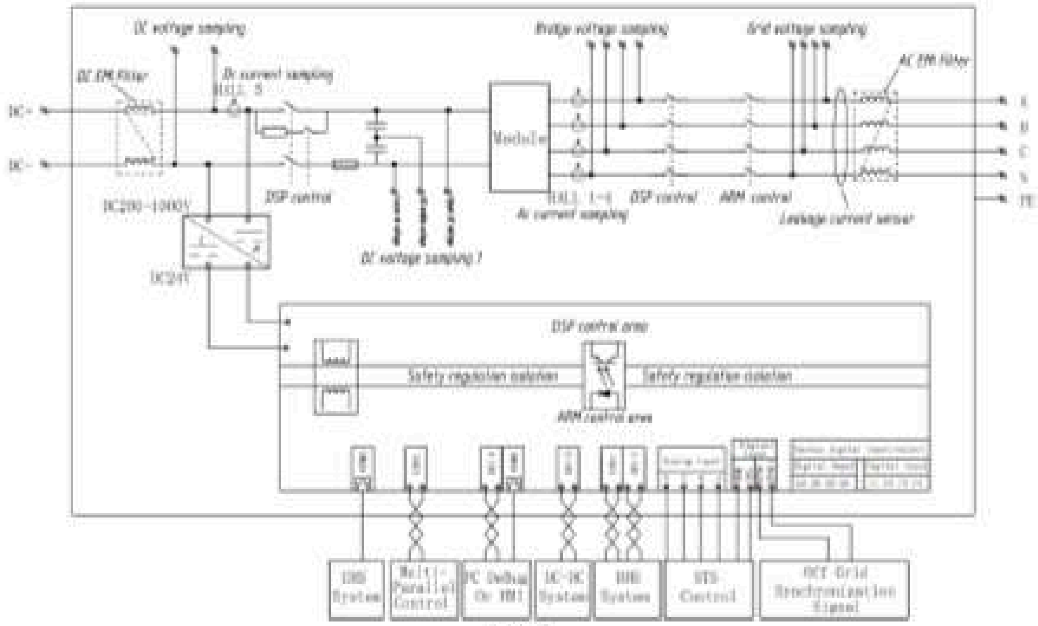
2. There are built-in relays inside of the inverter's on-grid and back-up ports. There are two sets of relays in the grid port, which controlled by DSP and ARM respectively.

When the inverters are the off-grid mode, the built-in on-grid relay will be opened; while the inverters are grid-tied mode, the built-in on-grid relay will be closed.

Block Diagram:



BESS



PCS

<u>Description of change(s):</u>
N/A

<u>The product was tested on:</u>
SOLID POWER HV 261

<u>Firmware version:</u>
DSP: 1.2.0.5
ARM: 1.9.1.7
EMU: V1.2

<u>Test condition:</u>
Temperature: 25°C   Relative humidity: 65%

Copy of marking plates:

Product Name	Semi-Solid State Battery Energy Storage System Rechargeable Li-ion Battery System
Battery Designation	IFpP73/176/208/[I]52S]6S(M)-30+50/86
Product Model	SOLID POWER HV 261
Nominal Voltage	832Vd.c
Rated Energy	261KWh
Rated Capacity	314Ah
Max. Charge Voltage	949Vd.c
Max. Charge Current	157A
Cut-off Discharge Voltage	650Vd.c
Max. Discharge Current	157A
Available SOC Range	10%~100%
Rate AC Voltage	400Va.c(3L+N)
Frequency	50/60Hz
Max. AC Current	150A
Aux Voltage	220Va.c 50/60Hz
Aux Rate Power	2.0KW
Ambient Temperature	-30℃ to +55℃
Dimensions (W*D*H)	1100*1400*2360mm
Weight	2440kg
Protection Class	I
Enclosure	IP55
CooLing Mode	Liquid-cooled
Working Altitude	≤3000m
Production Date	22-Sep.-2025
Series Number	EB250055-00001
manufacturer	EXPOFIN S.R.L.

CAUTION

Please read user manual before operating the system

Emergency Situations

Made in China

DATASHEET

Note: The information of importer provided on product prior marketing.

The main features of the product are shown as below:

	Cell	Module
Product	Solid State Battery Cell	Solid State Battery
Type/model	EFS314	GTEFS-166V52.25K-M05P
Cell Capacity [Ah]	314	314
Cell Quantity	1	52
Battery structure	-	1P52S
Nominal voltage [V]	3.2	166.4
Rated capacity [Wh]	1004.8	52249.6
Upper limit charging voltage [V]	3.8	197.6
Recommend charging current [A]	157	157
Maximum charging current [A]	314	195
Recommend discharging current [A]	157	157
Maximum discharging current [A]	314	195
Discharge cut-off voltage [V]	2.5	130
Lower limit discharging voltage [V]	2.0	104
Temperature range for charging [°C]	0 to 55	-30 to 50
Temperature range for discharging [°C]	-30 to 60	-30 to 50
Temperature threshold for protection	-	53
Overcharge protected voltage supply by battery system	-	≥197.6V
Recommend charging method by manufacturer	Charging the cell with 157A constant current until to 3.65V, then constant voltage 3.65V until charging current reduces to 15A	At constant Power 26100W till cell voltage reaches 3.65 V.
Dimension [mm]	TxWxH: (71.95±0.5) x (174.8±0.5) x (207.1±0.5)	1152±3*800±3*238±3
Weight [kg]	5.63±0.2	340±5
Ingress Protection (IP)	-	IP67
Protective Class	-	I
Cooling type	-	Liquid cooling
Altitude [m]	-	≤3000
Notes:		

	Battery system
Product	Integrated Battery Energy Storage System
Type/model	SOLID POWER HV 261
Cell Capacity [Ah]	314
Cell Quantity	260
Battery structure	(1P52S)5S
Nominal voltage [V]	832
Rated capacity [Wh]	261248
Upper limit charging voltage [V]	936
Recommend charging current [A]	157
Maximum charging current [A]	195
Recommend discharging current [A]	157
Maximum discharging current [A]	195
End-of-charge voltage [V]	936
Discharge cut-off voltage [V]	728
Temperature range for charging [°C]	-30 to 50*
Temperature range for discharging [°C]	-30 to 50
Operating ambient temperature [°C]	-30 to 50
Temperature threshold for protection	53
Overcharge protected voltage supply by battery system	≥3.7V/cell
Recommend charging method by manufacturer	At constant Power 125kW till cell voltage reaches 3.65 V
Dimension [mm]	1100*1400*2350
Weight [kg]	2440
Ingress Protection (IP)	IP55
Protective Class	I
Cooling type	Liquid-cooled
Altitude[m]	≤3000
*Notes: When the cell temperature is less than 0°C, the battery system will stop working and the liquid cooling unit will start heating. It will start derating when ambient temperature is 0°C to 10°C and more than 45°C.	

2. PCS Cabinet:

	MODELS LIST	INPPCS-125/0.4-W-14-A2-OS
DC Side	VMAX DC [Vdc]	1000
	Voltage Range V[Vdc]	600-1000
	Max. DC current [Ad.c.]	198
	Rated DC power [kW]	125
	Max. DC power [kW]	137.5
	Overvoltage Category (OVC)	II
AC Side	Rated Output Voltage Ur [Vac]	3L / N / PE, 230 / 400
	AC rated Input /Output active Power PE [kW]	125
	Rated Output Frequency FNETZ [Hz]	50/60±2.5
	Harmonic (THDi)	≤5% (at nominal Power)
	Max. AC Input/Output current [Aa.c.]	180
	AC voltage tolerance	-15%~+15%
	Adjustable reactive Power range	-100%–100%
	Power Factor cosφ [λ]	-0.99-+0.99, At nominal Power
	Overvoltage Category (OVC)	III
System	Max. efficiency	99%
	Protective Class	I
	Ingress Protection (IP)	IP20
	Operating Temperature Range [ºC]	-30 to 50(>45 derating)
	Cooling Type	Air Cooling
	Pollution degree (PD)	3
	Altitude [m]	3000(>2,000 derating)
	Weight [kg]	70
	Size [mm]	W520×H240×D680

3. Energy Storage System

MODELS LIST		Integrated Battery Energy Storage System
DC side	VMAX DC[Vdc]	936
	Battery Nominal Voltage [Vd.c.]	832
	Rated capacity[Wh]	261248
	Max. Current Imax [A]	195
	Voltage Range [Vd.c.]	728 to 936
AC side	PCS Cabinet Model	INPPCS-125/0.4-W-14-A2-OS
	Rated H.V. voltage [kVa.c.]	400
	Rated H.V. current [A a.c.]	180
	Rated grid frequency [Hz]	50/60
	Max. Current [A a.c.]	198
	Rated AC power [kVA]	125
	Overvoltage Category (OVC)	III
Battery Energy Storage System	IP rating/ Enclosure index / type	IP55
	Protective Class	I
	Operating Temperature Range [°C]	-30 to 50 (>45 derating)
	Pollution degree (PD)	PD3 (PD2 inside)
	Altitude [m]	≤3000 (>2000 derating)
	Weight [kg]	2440
	Size (W x D x H) [mm]	1100*1400*2350

TESTING RESULTS

C.2.4.7.3 **D.3.5** **E.4.4**	**TABLE : Dry heat (Test B) – storage conditions.**	P

CEI EN 60068-2-2:2008-11
Prove ambientali - Parte 2-2: Prove - Prova B: Caldo secco
/Environmental testing - Part 2-2: Tests - Test B: Dry heat

Condizioni di test */Test conditions*	dissipa calore /heat -dissipating
Tipo di campione */Specimen type*	Bb: graduale / gradual
Tipo di ventilazione */Air circulation*	forzata / forced air
Temperatura misurata */Measured temperature:*	70 °C
Duration:	16 h

Precondizionamento */Preconditioning*
--

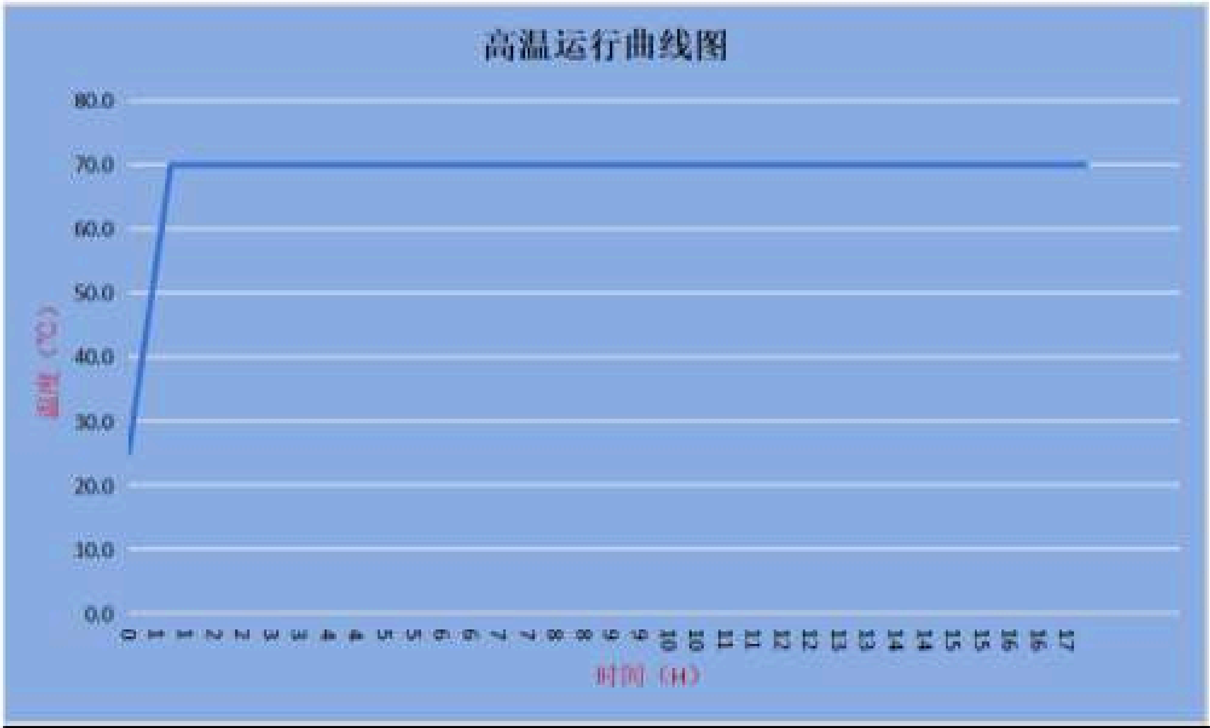
Verifiche iniziali */Initial measurement*
Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality*
Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*

Verifiche finali */Final measurement*
Dopo il ciclo termico / *after thermal cycle*
Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality*
Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*

Condizioni particolari di prova */Particular test condition*
Apparato non operativo (non alimentato) / device not operative (not powered)

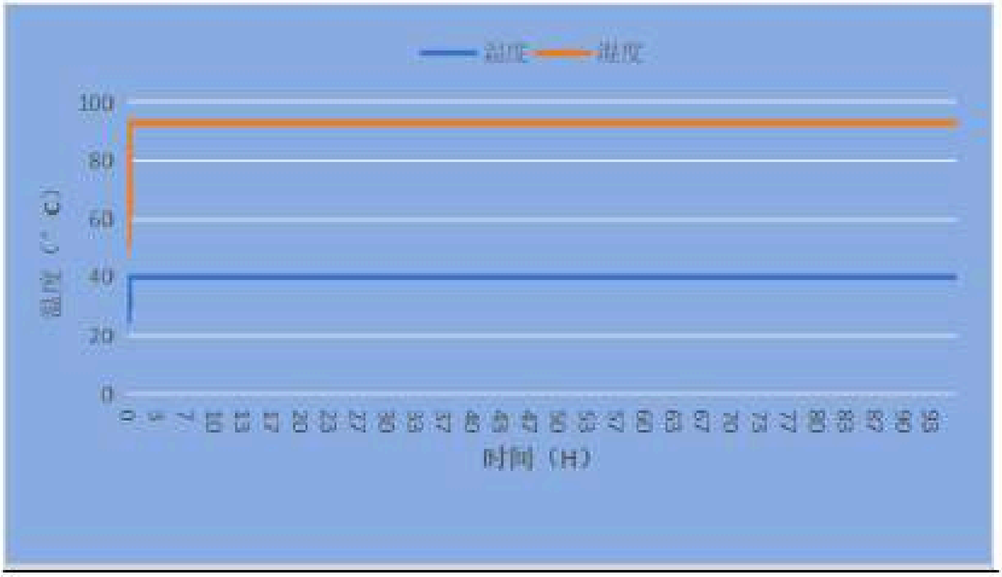
Supplementary information:
After the conditions, the inverter still work without any problem.

Image: Dry heat (Test B) – storage conditions.



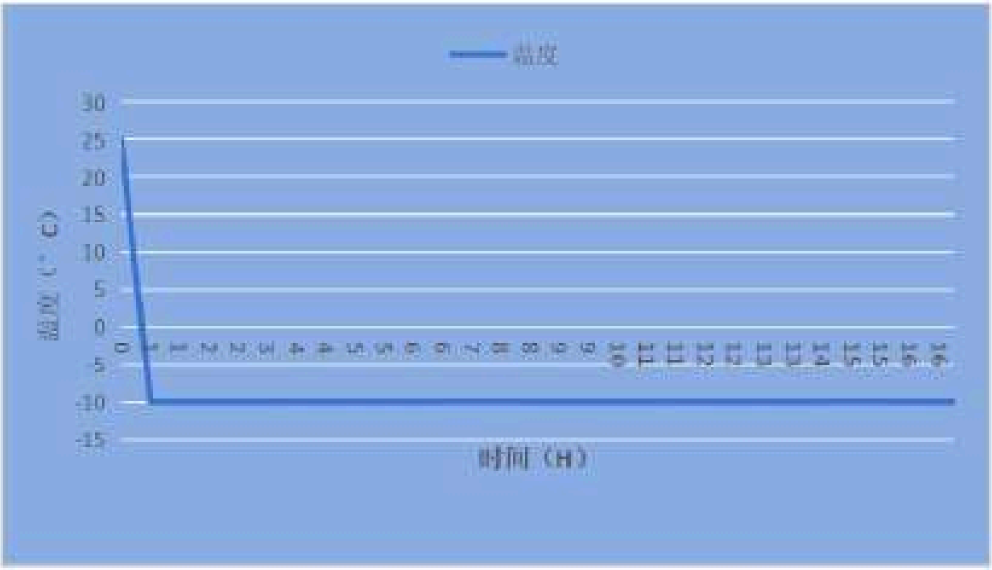
C.2.4.7.3 D.3.5 E.4.4	**TABLE : Humidity test (Test Cab) - storage conditions.**	P
CEI EN 60068-2-78:2002:03 Prove ambientali - Parte 2-78: Prove - Prova Cab: Caldo umido, regime stazionario /Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state		
Temperatura misurata */Measured temperature:*	40 °C	
Umidità misurata */measured humidity:*	93 RH%	
Duration:	96 h	
Instrumentation list	See table "Measurement equipment and instrumentation"	
Uncertainty	See table	
Precondizionamento */Preconditioning* -		
Verifiche iniziali */Initial measurement* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*		
Verifiche finali */Final measurement* Dopo il ciclo termico / *after thermal cycle* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*		
Condizioni particolari di prova */Particular test condition* Apparato non operativo (non alimentato) / device not operative (not powered)		
Supplementary information: After the conditions, the inverter still work without any problem.		

Image: Humidity test (Test Cab) - storage conditions.



C.2.4.7.3 D.3.5 E.4.4	TABLE : Cold test (Test A) – storage conditions.	P

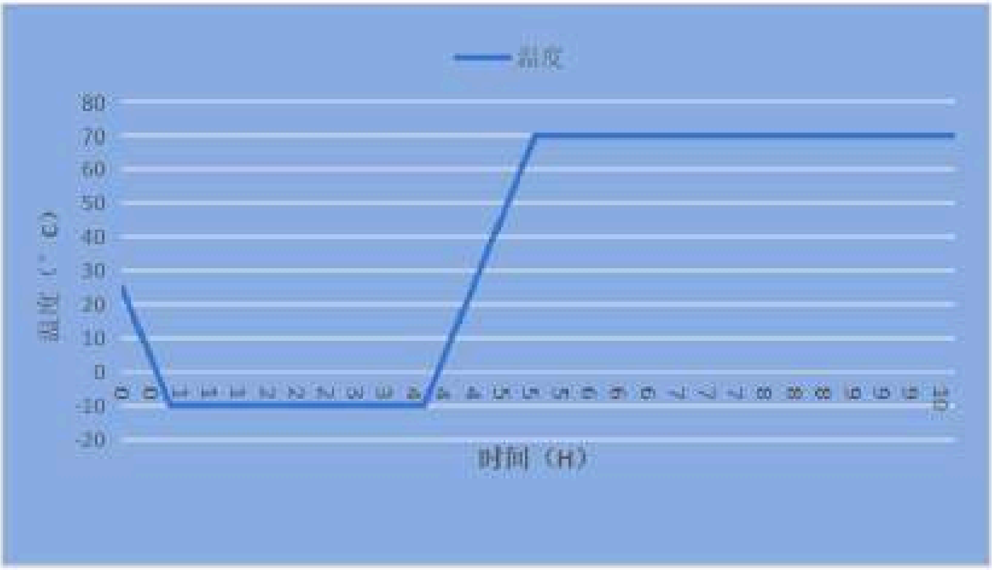
CEI EN 60068-2-1:2007:11 Prove ambientali - Parte 2-1: Prove - Prova A: Freddo */Environmental testing - Part 2-1: Tests - Test A: Cold*	
Condizioni di test */Test conditions*	dissipa calore /heat -dissipating
Tipo di campione */Specimen type*	Bb: graduale / gradual
Tipo di raffreddamento del campione */Specimen cooling type*	senza raffreddamneto artificiale /without artificial cooling
Tipo di ventilazione */Air circulation*	forzata / forced air
Temperatura misurata */Measured temperature:*	-10 °C
Duration:	16 h
Instrumentation list:	See table "Measurement equipment and instrumentation"
Uncertainty:	See table
Precondizionamento */Preconditioning* -	
Verifiche iniziali */Initial measurement* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Verifiche finali */Final measurement* Dopo il ciclo termico / *after thermal cycle* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Condizioni particolari di prova */Particular test condition* Apparato non operativo (non alimentato) / device not operative (not powered)	
Supplementary information: After the conditions, the inverter still work without any problem.	

Image: Cold test (Test A) – storage conditions


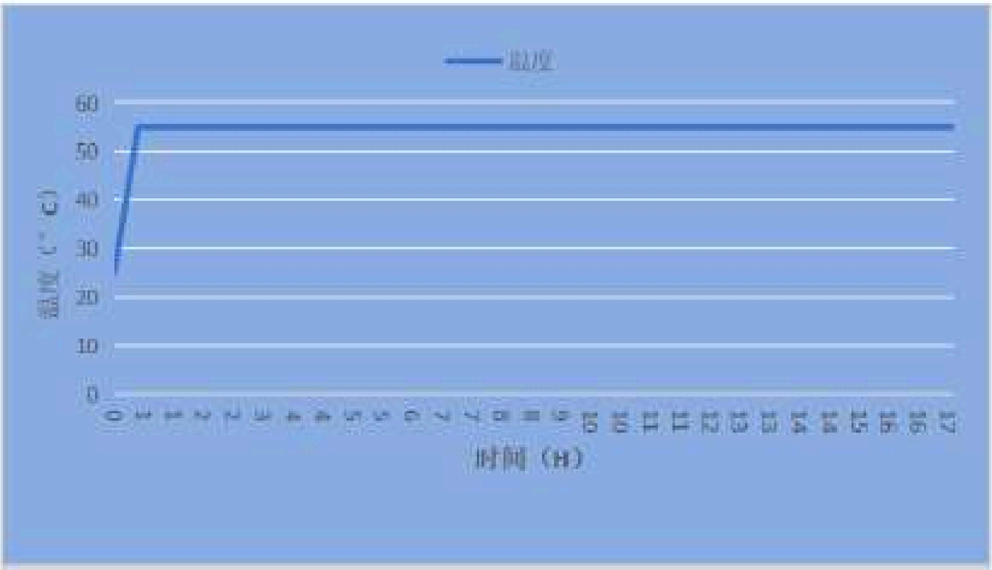
C.2.4.7.3 D.3.5 E.4.4	**TABLE : Change of temperature (Test N) – storage conditions.**	P

CEI EN 60068-2-14:2023 Prove ambientali - Parte 2-14: Prove - Prova N: Cambio di temperatura */Environmental testing - Part 2-14: Tests - Test N: Change of temperature*	
Prova/*Test*	NB: Cambio a velocità controllata */NB Change with specified rate of change*
Tipo di ventilazione */Air circulation*	forzata / forced air
N° cicli */Number of cycle:*	1
Temperatura minima T_A */Minimum temperature T_A* ....:	- 10 ± 2 °C
Temperatura massima T_B */Maximum temperature T_B* :	+70 ± 2°C
Durata di esposizione t1 */Exposure time t_1* ....:	3 h
Tempo di trasferimento t_2 */Transition time t_2* ...:	3 h
Instrumentation list:	See table "Measurement equipment and instrumentation"
Uncertainty:	See table
Precondizionamento */Preconditioning* -	
Verifiche iniziali */Initial measurement* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Verifiche finali */Final measurement* Dopo il ciclo termico / *after thermal cycle* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Condizioni particolari di prova */Particular test condition* Apparato non operativo (non alimentato) / *device not operative (not powered)*	
Supplementary information: After the conditions, the inverter still work without any problem.	

Image: Change of temperature (Test N) – storage conditions.

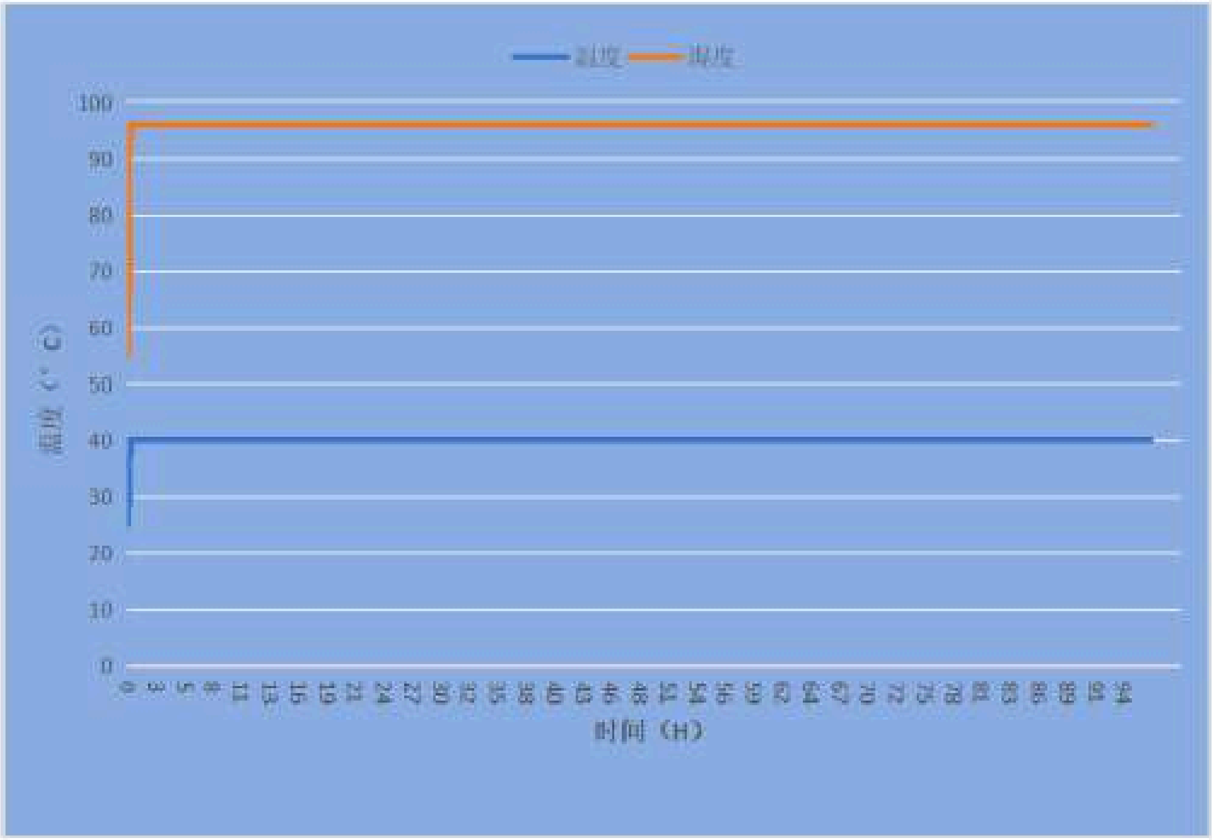


C.2.4.7.3 D.3.5 E.4.4	**TABLE : Dry heat (Test B) – working conditions.**	P
CEI EN 60068-2-2:2008-11 Prove ambientali - Parte 2-2: Prove - Prova B: Caldo secco */Environmental testing - Part 2-2: Tests - Test B: Dry heat*		
Condizioni di test */Test conditions*	dissipa calore /heat -dissipating	
Tipo di campione */Specimen type*	Bb: graduale / gradual	
Tipo di ventilazione */Air circulation*	forzata / forced air	
Temperatura misurata */Measured temperature:*	55 °C	
Duration:	16 h	
Precondizionamento */Preconditioning* –		
Verifiche iniziali */Initial measurement* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*		
Verifiche finali */Final measurement* Dopo il ciclo termico / *after thermal cycle* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*		
Condizioni particolari di prova */Particular test condition* Apparato non operativo (non alimentato) / device not operative (not powered)		
Supplementary information: After the conditions, the inverter still work without any problem.		

Image: Dry heat (Test B) – working conditions.


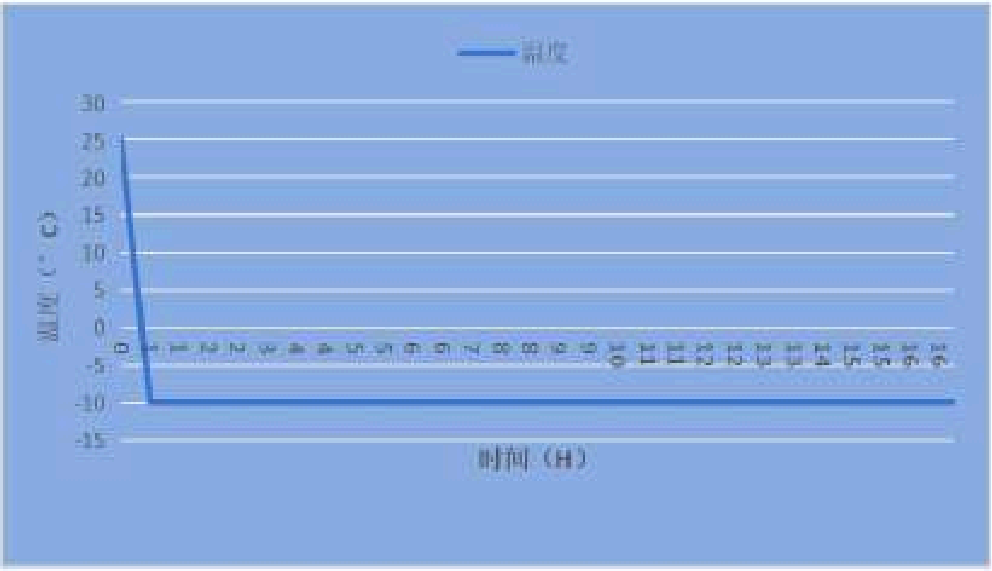
C.2.4.7.3 D.3.5 E.4.4	**TABLE : Humidity test (Test Cab) - working conditions.**	P

CEI EN 60068-2-78:2002:03 Prove ambientali - Parte 2-78: Prove - Prova Cab: Caldo umido, regime stazionario /Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	
Temperatura misurata */Measured temperature:*	40 °C
Umidità misurata */measured humidity:*	93 RH%
Duration:	96 h
Instrumentation list	See table "Measurement equipment and instrumentation"
Uncertainty	See table
Precondizionamento */Preconditioning* -	
Verifiche iniziali */Initial measurement* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Verifiche finali */Final measurement* Dopo il ciclo termico / *after thermal cycle* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Condizioni particolari di prova */Particular test condition* Apparato non operativo (non alimentato) / device not operative (not powered)	
Supplementary information: After the conditions, the inverter still work without any problem.	

Image: Humidity test (Test Cab) - working conditions.


C.2.4.7.3 D.3.5 E.4.4	**TABLE : Cold test (Test A) – working conditions.**	P

CEI EN 60068-2-1:2007:11 Prove ambientali - Parte 2-1: Prove - Prova A: Freddo */Environmental testing - Part 2-1: Tests - Test A: Cold*	
Condizioni di test */Test conditions*	dissipa calore /heat -dissipating
Tipo di campione */Specimen type*	Bb: graduale / gradual
Tipo di raffreddamento del campione */Specimen cooling type*	senza raffreddamneto artificiale /without artificial cooling
Tipo di ventilazione */Air circulation*	forzata / forced air
Temperatura misurata */Measured temperature:*	-10 °C
Duration:	16 h
Instrumentation list:	See table "Measurement equipment and instrumentation"
Uncertainty:	See table
Precondizionamento */Preconditioning* -	
Verifiche iniziali */Initial measurement* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Verifiche finali */Final measurement* Dopo il ciclo termico / *after thermal cycle* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*	
Condizioni particolari di prova */Particular test condition* Apparato non operativo (non alimentato) / device not operative (not powered)	
Supplementary information: After the conditions, the inverter still work without any problem.	

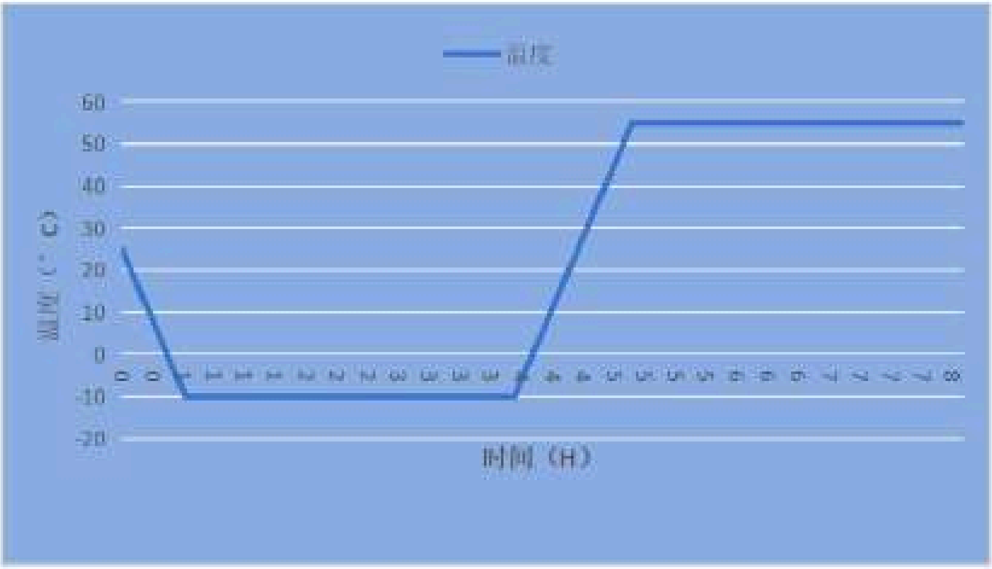
Image: Cold test (Test A) – working conditions


C.2.4.7.3 D.3.5 E.4.4	TABLE : Change of temperature (Test N) – working conditions.	P

CEI EN 60068-2-14:2023 Prove ambientali - Parte 2-14: Prove - Prova N: Cambio di temperatura */Environmental testing - Part 2-14: Tests - Test N: Change of temperature*	
Prova/*Test*	NB: Cambio a velocità controllata */NB Change with specified rate of change*
Tipo di ventilazione */Air circulation*	forzata / forced air
N° cicli */Number of cycle:*	1
Temperatura minima T_A */Minimum temperature* T_A ....:	- 10 ± 2 °C
Temperatura massima T_B */Maximum temperature* T_B :	+55 ± 2°C
Durata di esposizione t1 */Exposure time* t_1 ....:	3 h
Tempo di trasferimento t_2 */Transition time* t_2 ...:	3 h
Instrumentation list:	See table "Measurement equipment and instrumentation"
Uncertainty:	See table

Precondizionamento */Preconditioning* -
Verifiche iniziali */Initial measurement* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*
Verifiche finali */Final measurement* Dopo il ciclo termico / *after thermal cycle* Verifica della corretta funzionalità del dispositivo / *verification of correct device functionality* Verifica del corretto funzionamento della protezione di interfaccia / *verification of correct interface protection*
Condizioni particolari di prova */Particular test condition* Apparato non operativo (non alimentato) / device not operative (not powered)
Supplementary information: After the conditions, the inverter still work without any problem.

Image: Change of temperature (Test N) – working conditions.



C.2.4.7.4 D.3.6 E.4.5	**TABLE: Insulation tests**	P

☒ CEI EN 60255-5:2001-11

Parte 5: Coordinamento dell'isolamento per i relè di misura e per i dispositivi di protezione

Prescrizioni e prove

/Electrical Relays - Part 5: Insulation coordination for measuring relays and protection equipment – Requirements and tests

☐ CEI EN 60146-1-1:1997 + A1:1998
Convertitori a semiconduttori - Prescrizioni generali e convertitori commutati dalla linea
Prove di isolamento (§ 4.2.1).
/ Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements Insulation tests (§. 4.2.1).

Ambient temperature (°C) .... :	20°C ± 2°C
Humidity (RH %) .... :	35% - 75% RH
Instrumentation list.. :	See table "Measurement equipment and instrumentation"
Uncertainty .... :	See table

Resistenza di isolamento /Insulation Resistance			
Test	Test Voltage (V)	R measured	Limit
Between PE and AC output shorted	500 Vdc	>50G	≥100MΩ
Between PE and DC input shorted	500 Vdc	>50G	≥100MΩ
Between PE and DC + AC shorted	500 Vdc	>50G	≥100MΩ

Prova di rigidità dielettrica/ Dielectric strenght test			
Test	Test Voltage (V)	R Measured after MΩ @ 500Vdc test	Comments
Between PE and AC output shorted	2 kVa.c.	>50G	No discharge.
Between PE and DC + AC shorted	2 kVa.c.	>50G	No discharge.

Allegato Nbis: Prove sui generatori statici, eolici FC (Full converter) e DFIG (Doubly Fed Induction Generator). *Annex Nbis: Testing on static converter, FC (Full converter) and DFIG (Doubly Fed Induction Generator) wind converter.*

Nbis.3 Misura di correnti armoniche ***/Harmonics current*** Reference standard: **IEC 61400-21:2008-08 Ed.2 (§. 7.4)** *Wind turbines* *Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines*	
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list...:	See table "Measurement equipment and instrumentation"

Supplementary information:
For integrated EESS test has to carry out @ P_{SMAX} (Max. Disharging Power) or P_{NINV} (Nominal Power Inverter)
For EESS connected to bi-directional converter test has to carry out @ P_{CMAX} (Max. Charging Power)
Tollerance of the Power: **5% S_N** (S_N = Nominal Power of the Converter).

Notes on recording:
- Samplerate at least 40 kHz
- Record at least U and I per phase digitally
- Record at least 600 s per power bin

***Standard current harmonics up to order 50**
Note: The current harmonics up to order 50 .

Harmonics Current

Order	0 % P/P_{SMAX}	20 % P/ P_{SMAX}	40 % P/ P_{SMAX}	60 % P/ P_{SMAX}	80 % P/ P_{SMAX}	100 % P/ P_{SMAX}
	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]
2	0.020	0.032	0.038	0.074	0.073	0.261
3	0.467	1.047	1.124	1.249	1.410	0.898
4	0.021	0.073	0.073	0.094	0.083	0.122
5	0.512	0.697	0.709	0.712	0.710	0.717
6	0.067	0.131	0.127	0.111	0.066	0.247
7	0.456	0.181	0.441	0.559	0.630	0.489
8	0.094	0.064	0.050	0.034	0.044	0.049
9	0.492	0.186	0.198	0.252	0.294	0.049
10	0.060	0.115	0.135	0.150	0.158	0.032
11	0.261	0.238	0.194	0.183	0.239	0.337
12	0.037	0.024	0.028	0.028	0.032	0.043
13	0.191	0.190	0.163	0.349	0.442	0.239
14	0.030	0.031	0.040	0.044	0.049	0.038
15	0.180	0.158	0.103	0.283	0.374	0.152
16	0.030	0.015	0.036	0.030	0.024	0.028
17	0.140	0.089	0.053	0.182	0.259	0.172
18	0.021	0.018	0.021	0.016	0.014	0.035
19	0.117	0.113	0.050	0.111	0.171	0.222
20	0.010	0.013	0.011	0.008	0.010	0.027
21	0.106	0.153	0.060	0.080	0.115	0.084
22	0.007	0.018	0.013	0.012	0.011	0.025
23	0.088	0.140	0.066	0.075	0.086	0.220
24	0.009	0.021	0.014	0.013	0.015	0.035
25	0.064	0.093	0.060	0.076	0.073	0.375
26	0.009	0.013	0.010	0.007	0.007	0.009
27	0.052	0.053	0.057	0.076	0.070	0.088
28	0.008	0.007	0.008	0.006	0.005	0.030
29	0.048	0.039	0.054	0.073	0.071	0.210
30	0.005	0.006	0.008	0.006	0.005	0.027
31	0.039	0.039	0.054	0.069	0.072	0.275
32	0.005	0.006	0.006	0.005	0.004	0.013
33	0.032	0.037	0.058	0.064	0.071	0.102
34	0.005	0.006	0.005	0.004	0.004	0.033
35	0.027	0.031	0.059	0.058	0.070	0.225
36	0.004	0.006	0.004	0.004	0.004	0.025
37	0.025	0.019	0.056	0.052	0.070	0.182
38	0.004	0.005	0.005	0.005	0.004	0.009
39	0.023	0.017	0.049	0.041	0.064	0.035
40	0.004	0.005	0.006	0.006	0.006	0.017
41	0.021	0.018	0.042	0.030	0.053	0.004
42	0.004	0.005	0.005	0.005	0.006	0.007
43	0.017	0.021	0.038	0.025	0.046	0.004
44	0.004	0.005	0.005	0.005	0.006	0.006
45	0.014	0.016	0.034	0.023	0.041	0.007
46	0.004	0.005	0.004	0.004	0.005	0.006
47	0.013	0.011	0.030	0.021	0.035	0.054
48	0.003	0.004	0.004	0.004	0.005	0.042
49	0.011	0.009	0.025	0.019	0.030	0.044
50	0.003	0.004	0.003	0.003	0.004	0.021

Note: The maximum average value for each three phase was recorded.

Table: Inter-Harmonics

Order	0 % P/P$_{SMAX}$	20 % P/ P$_{SMAX}$	40 % P/ P$_{SMAX}$	60 % P/ P$_{SMAX}$	80 % P/ P$_{SMAX}$	100 % P/ P$_{SMAX}$
	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]
75	0.097	0.112	0.146	0.167	0.182	0.192
125	0.043	0.049	0.070	0.078	0.082	0.087
175	0.052	0.061	0.079	0.082	0.083	0.082
225	0.070	0.082	0.106	0.123	0.126	0.129
275	0.055	0.064	0.095	0.111	0.111	0.108
325	0.077	0.090	0.135	0.169	0.179	0.187
375	0.051	0.060	0.110	0.140	0.157	0.170
425	0.044	0.052	0.093	0.107	0.119	0.136
475	0.044	0.051	0.073	0.086	0.096	0.111
525	0.038	0.044	0.058	0.065	0.072	0.081
575	0.036	0.041	0.051	0.057	0.063	0.070
625	0.030	0.035	0.046	0.047	0.051	0.055
675	0.029	0.033	0.043	0.042	0.047	0.050
725	0.027	0.031	0.039	0.038	0.041	0.043
775	0.025	0.029	0.037	0.035	0.037	0.040
825	0.023	0.027	0.033	0.033	0.034	0.035
875	0.022	0.025	0.033	0.031	0.031	0.033
925	0.021	0.024	0.030	0.029	0.029	0.030
975	0.020	0.023	0.029	0.027	0.027	0.028
1025	0.019	0.022	0.028	0.025	0.025	0.026
1075	0.018	0.021	0.027	0.025	0.024	0.024
1125	0.017	0.020	0.025	0.024	0.022	0.022
1175	0.017	0.020	0.024	0.023	0.021	0.021
1225	0.016	0.018	0.021	0.021	0.019	0.019
1275	0.016	0.018	0.021	0.021	0.018	0.018
1325	0.015	0.017	0.018	0.019	0.017	0.017
1375	0.014	0.016	0.018	0.018	0.016	0.016
1425	0.014	0.016	0.017	0.017	0.016	0.016
1475	0.013	0.015	0.016	0.016	0.015	0.015
1525	0.013	0.015	0.015	0.015	0.014	0.014
1575	0.012	0.014	0.014	0.014	0.014	0.013
1625	0.012	0.014	0.013	0.013	0.013	0.013
1675	0.012	0.014	0.013	0.013	0.012	0.012
1725	0.012	0.014	0.012	0.013	0.012	0.012
1775	0.012	0.014	0.013	0.012	0.012	0.011
1825	0.012	0.012	0.013	0.013	0.012	0.012
1875	0.012	0.012	0.015	0.014	0.013	0.013
1925	0.013	0.013	0.016	0.017	0.016	0.016
1975	0.012	0.012	0.016	0.017	0.016	0.016

Note: The maximum average value for each three phase was recorded.

Table: High Frequency Harmonics

Freq. [Hz]	0 % P/P_{SMAX}	20 % P/ P_{SMAX}	40 % P/ P_{SMAX}	60 % P/ P_{SMAX}	80 % P/ P_{SMAX}	100 % P/ P_{SMAX}
	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]
2100	0.035	0.040	0.045	0.069	0.060	0.093
2300	0.026	0.030	0.034	0.054	0.043	0.064
2500	0.021	0.024	0.024	0.038	0.034	0.047
2700	0.017	0.020	0.020	0.027	0.029	0.033
2900	0.017	0.019	0.017	0.021	0.026	0.023
3100	0.016	0.018	0.015	0.017	0.023	0.016
3300	0.016	0.018	0.015	0.015	0.020	0.015
3500	0.016	0.018	0.014	0.014	0.018	0.015
3700	0.020	0.023	0.018	0.019	0.023	0.025
3900	0.030	0.035	0.045	0.045	0.054	0.070
4100	0.030	0.034	0.037	0.041	0.053	0.070
4300	0.024	0.028	0.023	0.018	0.022	0.024
4500	0.023	0.027	0.019	0.013	0.016	0.015
4700	0.024	0.028	0.020	0.015	0.016	0.016
4900	0.026	0.030	0.020	0.016	0.016	0.016
5100	0.026	0.030	0.019	0.019	0.016	0.017
5300	0.028	0.032	0.020	0.022	0.016	0.017
5500	0.028	0.032	0.019	0.025	0.018	0.017
5700	0.025	0.029	0.019	0.025	0.020	0.020
5900	0.023	0.027	0.021	0.029	0.025	0.023
6100	0.020	0.023	0.020	0.028	0.028	0.022
6300	0.016	0.018	0.020	0.025	0.024	0.026
6500	0.014	0.016	0.017	0.025	0.025	0.022
6700	0.013	0.015	0.013	0.018	0.018	0.016
6900	0.011	0.013	0.013	0.016	0.017	0.017
7100	0.013	0.015	0.009	0.012	0.013	0.012
7300	0.012	0.014	0.007	0.009	0.011	0.010
7500	0.010	0.011	0.007	0.008	0.010	0.010
7700	0.012	0.014	0.006	0.007	0.009	0.010
7900	0.011	0.013	0.007	0.008	0.009	0.011
8100	0.009	0.010	0.006	0.006	0.008	0.010
8300	0.009	0.010	0.005	0.006	0.008	0.009
8500	0.007	0.008	0.005	0.006	0.007	0.009
8700	0.006	0.007	0.005	0.005	0.006	0.008
8900	0.005	0.006	0.004	0.005	0.005	0.007

Note: The maximum average value for each three phase was recorded.

Additional information:

The emission of current harmonics, interharmonics and higher frequency components from the device is specified for in percent of *In* for operation of the device within the power bins 0. 20. . , 100 % of *Pn*.

Harmonics Current

Order	20 % P/ P_{CMAX}	40 % P/ P_{CMAX}	60 % P/ P_{CMAX}	80 % P/ P_{CMAX}	100 % P/ P_{CMAX}
	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]
2	0.033	0.042	0.077	0.078	0.368
3	1.093	1.204	1.316	1.509	0.348
4	0.076	0.078	0.099	0.089	0.406
5	0.727	0.760	0.751	0.760	0.797
6	0.136	0.136	0.116	0.070	0.120
7	0.190	0.472	0.589	0.674	0.255
8	0.067	0.053	0.036	0.047	0.052
9	0.195	0.212	0.266	0.315	0.079
10	0.119	0.145	0.158	0.169	0.044
11	0.248	0.208	0.194	0.256	0.064
12	0.025	0.030	0.030	0.034	0.031
13	0.199	0.175	0.368	0.473	0.203
14	0.032	0.043	0.046	0.053	0.022
15	0.165	0.110	0.299	0.401	0.028
16	0.015	0.038	0.032	0.026	0.015
17	0.093	0.057	0.193	0.277	0.307
18	0.019	0.022	0.016	0.014	0.026
19	0.117	0.054	0.116	0.183	0.058
20	0.013	0.011	0.008	0.010	0.028
21	0.160	0.064	0.084	0.123	0.108
22	0.019	0.014	0.012	0.011	0.029
23	0.145	0.071	0.079	0.092	0.146
24	0.022	0.015	0.013	0.016	0.049
25	0.097	0.064	0.080	0.078	0.314
26	0.013	0.010	0.007	0.007	0.022
27	0.056	0.061	0.080	0.075	0.054
28	0.007	0.008	0.006	0.005	0.023
29	0.040	0.058	0.076	0.076	0.197
30	0.006	0.008	0.006	0.005	0.051
31	0.040	0.058	0.072	0.077	0.220
32	0.006	0.006	0.005	0.004	0.032
33	0.038	0.062	0.067	0.076	0.053
34	0.006	0.005	0.004	0.004	0.013
35	0.032	0.063	0.061	0.075	0.196
36	0.006	0.004	0.004	0.004	0.061
37	0.023	0.060	0.055	0.075	0.043
38	0.006	0.005	0.005	0.004	0.027
39	0.020	0.052	0.043	0.068	0.055
40	0.006	0.006	0.006	0.006	0.036
41	0.022	0.045	0.032	0.057	0.368
42	0.005	0.005	0.005	0.006	0.012
43	0.022	0.041	0.027	0.048	0.010
44	0.005	0.005	0.005	0.006	0.010
45	0.016	0.036	0.024	0.042	0.010
46	0.005	0.004	0.004	0.005	0.011
47	0.011	0.032	0.022	0.036	0.042
48	0.004	0.004	0.004	0.005	0.006
49	0.009	0.026	0.020	0.031	0.030
50	0.004	0.003	0.003	0.004	0.012

Table: Inter-Harmonics

Order	20 % P/ P_{CMAX}	40 % P/ P_{CMAX}	60 % P/ P_{CMAX}	80 % P/ P_{CMAX}	100 % P/ P_{CMAX}
	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]
75	0.156	0.180	0.197	0.205	0.214
125	0.074	0.085	0.088	0.093	0.095
175	0.083	0.089	0.089	0.088	0.089
225	0.111	0.133	0.135	0.137	0.140
275	0.100	0.120	0.119	0.114	0.113
325	0.141	0.182	0.193	0.200	0.203
375	0.115	0.152	0.168	0.181	0.195
425	0.098	0.115	0.128	0.144	0.156
475	0.077	0.094	0.103	0.117	0.134
525	0.062	0.070	0.077	0.087	0.099
575	0.055	0.061	0.068	0.074	0.086
625	0.047	0.051	0.055	0.059	0.066
675	0.044	0.046	0.050	0.054	0.059
725	0.040	0.042	0.044	0.045	0.050
775	0.038	0.038	0.040	0.042	0.046
825	0.034	0.036	0.036	0.037	0.040
875	0.034	0.034	0.033	0.035	0.037
925	0.031	0.032	0.031	0.032	0.034
975	0.030	0.030	0.029	0.030	0.031
1025	0.029	0.028	0.027	0.028	0.029
1075	0.028	0.027	0.026	0.026	0.027
1125	0.026	0.025	0.024	0.024	0.025
1175	0.025	0.024	0.023	0.023	0.024
1225	0.022	0.022	0.021	0.021	0.022
1275	0.022	0.022	0.020	0.020	0.021
1325	0.019	0.020	0.019	0.019	0.019
1375	0.019	0.019	0.018	0.018	0.018
1425	0.018	0.018	0.017	0.016	0.017
1475	0.016	0.017	0.016	0.015	0.016
1525	0.015	0.016	0.015	0.014	0.014
1575	0.014	0.015	0.015	0.013	0.013
1625	0.013	0.014	0.014	0.013	0.012
1675	0.013	0.014	0.012	0.012	0.012
1725	0.012	0.014	0.012	0.012	0.012
1775	0.013	0.012	0.012	0.011	0.011
1825	0.013	0.014	0.012	0.012	0.012
1875	0.015	0.015	0.014	0.013	0.012
1925	0.016	0.018	0.017	0.016	0.014
1975	0.016	0.018	0.017	0.016	0.016

Table: High Frequency Harmonics

Freq. [Hz]	20 % P/ P_{CMAX}	40 % P/ P_{CMAX}	60 % P/ P_{CMAX}	80 % P/ P_{CMAX}	100 % P/ P_{CMAX}
	I_h [%]	I_h [%]	I_h [%]	I_h [%]	I_h [%]
2100	0.048	0.072	0.064	0.099	0.131
2300	0.035	0.057	0.045	0.068	0.090
2500	0.025	0.040	0.036	0.050	0.075
2700	0.021	0.029	0.031	0.035	0.058
2900	0.018	0.022	0.028	0.025	0.045
3100	0.016	0.018	0.025	0.018	0.032
3300	0.016	0.015	0.022	0.016	0.025
3500	0.015	0.014	0.020	0.016	0.022
3700	0.019	0.020	0.025	0.027	0.033
3900	0.047	0.047	0.058	0.075	0.094
4100	0.038	0.043	0.057	0.075	0.095
4300	0.024	0.019	0.024	0.026	0.032
4500	0.020	0.013	0.016	0.016	0.022
4700	0.021	0.015	0.016	0.017	0.023
4900	0.021	0.016	0.016	0.017	0.022
5100	0.020	0.020	0.016	0.019	0.021
5300	0.021	0.023	0.018	0.019	0.023
5500	0.020	0.026	0.020	0.019	0.023
5700	0.020	0.027	0.022	0.022	0.023
5900	0.022	0.031	0.027	0.025	0.030
6100	0.021	0.030	0.030	0.024	0.031
6300	0.021	0.027	0.026	0.028	0.030
6500	0.018	0.026	0.027	0.024	0.030
6700	0.014	0.019	0.020	0.018	0.023
6900	0.014	0.016	0.019	0.019	0.024
7100	0.009	0.012	0.013	0.012	0.013
7300	0.007	0.009	0.011	0.010	0.011
7500	0.007	0.008	0.010	0.010	0.010
7700	0.006	0.007	0.009	0.010	0.010
7900	0.007	0.008	0.009	0.011	0.012
8100	0.006	0.006	0.008	0.010	0.010
8300	0.005	0.006	0.008	0.009	0.010
8500	0.005	0.006	0.007	0.009	0.012
8700	0.005	0.005	0.006	0.008	0.007
8900	0.004	0.005	0.005	0.007	0.007

Nbis.3.2 Misura di fluttuazioni di tensione dovute a manovre di sezionamento/separazione
/ Voltage fluctuactions caused by Switching operations

Reference standard:
IEC 61400-21:2008-08 Ed.2 (§. 7.3.4)
Wind turbines
Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines

The voltage-change-factor $k_u(\Psi_k)$, the flicker-form-factor $k_f(\Psi_k)$ and the maximum switchcurrent-factor k_{imax} has been calculated for every switching action and every phase.

Voltage-change-factor $k_u(\Psi_k)$

The voltage-change-factor is a standardized rate of the voltage change, due to switching activities of the PGU. The voltage-change-factor is dependent on the phase angle of the grid and thus the voltage change-factor will be calculated for four phase angles of the fictive grid:

$$\Psi_k = 30°, 50°, 70°, 85°$$

30degree: 0.46+j0.27
50degree: 0.34+j0.41
70degree: 0.18+j0.50
85degree: 0.05+j0.53

On test configuration the voltage change factor were evaluated in performing the tests at each grid impedance.
Following impediance was been used:

Phase angle	Inductive impedance R/ Ω	Resistive impedance R/ Ω
32	0.240	0.150
50	0.181	0.216
70	0.097	0.265
85	0.025	0.281

The voltage-change-factor will be calculated with following formula:

$$k_u(\Psi_k) = \sqrt{3} \cdot \frac{U_{fic,max} - U_{fic,min}}{U_n} \cdot \frac{S_{k,fic}}{S_n}$$

Where:

$U_{fic,min}$ and $U_{fic,max}$:	are the minimum and maximum one period RMS value of the phase-to-neutral voltage on the fictitious grid during the switching operation;
U_n :	is the nominal phase-to-phase voltage;
S_n :	is the rated apparent power of the wind turbine;
$S_{k,fic}$:	is the short-circuit apparent power of the fictitious grid.

The calculation should be made for every switching activity and for every phase for the different phase Angle Ψ_k . From these values an average for every phase angle will be evaluated, which corresponds to the final voltage-change-factor.

Flicker-form-factor $k_f(\Psi_k)$

The flicker-form-factor is a standardized rate of the flicker-emission due to a switching activity on a PGU. The flicker-form-factor is to determine after following formula:

$$k_f(\Psi_k) = \frac{1}{130} \times \frac{S_{k,fic}}{S_n} \times P_{st,fic} \times T_p^{0,31}$$

Where:

T_p:	is the measurement period, long enough to ensure that the transient of the switching operation has abated, though limited to exclude possible power fluctuations due to turbulence;
$P_{st,fic}$:	is the flicker emission from the wind turbine on the fictitious grid;
S_n:	is the rated apparent power of the wind turbine;
$S_{k,fic}$:	is the short-circuit apparent power of the fictitious grid.

Also for the flicker-form-factor, the calculation should be made for every switching activity and for every phase for the different phase angle Ψ_k. From these values an average for every phase angle will be evaluated, which corresponds to the final flicker form factor.

Supplementary information:

For integrated EESS test has to carry out @ P_{SMAX} (Max. Disharging Power) or P_{NINV} (Nominal Power Inverter)

For EESS connected to bi-directional converter test has to carry out @ P_{CMAX} (Max. Charging Power)

Tollerance of the Power: **5% S_N** (S_N = Nominal Power of the Converter).

Notes on recording:

- Samplerate at least 10 kHz
- Record at least U and I per phase digitally

Declaration of the switching operations:

N_{10}= 10

N_{120}= 120

- Swithcing on @ 10% P/Pn (12 times)
- Switching on @ 100% P/Pn (12 times)

Integrated EESS

Table N.3.2a: Flicker step factor and voltage change factor for switching at: 100% of P_{SMAX} (or P_{INV} for integrated EESS)				
Max. no. of switchin operations N_{10}			10	
Max. no. of switchin operations N_{120}			120	
Network impedance angle	30°	50°	70°	85°
Flicker step factor $k_f(\Psi_k)$	0.024	0.026	0.027	0.029
Voltage change factor $k_u(\Psi_k)$	0.877	0.735	0.557	0.409

Table N.3.2b: Flicker step factor and voltage change factor for switching at: 10% of P_{SMAX}(or P_{INV} for integrated EESS)				
Max. no. of switchin operations N_{10}			10	
Max. no. of switchin operations N_{120}			120	
Network impedance angle	30°	50°	70°	85°
Flicker step factor $k_f(\Psi_k)$	0.017	0.018	0.020	0.022
Voltage change factor $k_u(\Psi_k)$	0.412	0.394	0.377	0.364

Table N.3.2c: Flicker step factor and voltage change factor for switching off at: 100% of P_{SMAX}(or P_{INV} for integrated EESS)				
Max. no. of switchin operations N_{10}			10	
Max. no. of switchin operations N_{120}			120	
Network impedance angle	30°	50°	70°	85°
Flicker step factor $k_f(\Psi_k)$	0.245	0.180	0.101	0.048
Voltage change factor $k_u(\Psi_k)$	0.318	0.268	0.203	0.149

Table N.3.2d: Maximum current step factor measured:			
Condition:	Switch on: 10% of P_{SMAX}(or P_{INV} for integrated EESS)	Switch on: 100% of P_{SMAX}(or P_{INV} for integrated EESS)	Switch off: 100% of P_{SMAX}(or P_{INV} for integrated EESS)
$K_{i,max}$	0.100	1.000	1.000

EESS connected to bi-directional converter

Table N.3.2a': Flicker step factor and voltage change factor for <u>switching</u> at: 100% of P_{CMAX}				
Max. no. of switchin operations N_{10}		10		
Max. no. of switchin operations N_{120}		120		
Network impedance angle	30°	50°	70°	85°
Flicker step factor $k_f(\Psi_k)$	0.024	0.027	0.027	0.029
Voltage change factor $k_u(\Psi_k)$	0.885	0.757	0.561	0.412

Table N.3.2b': Flicker step factor and voltage change factor for <u>switching</u> at: 10% of P_{CMAX}				
Max. no. of switchin operations N_{10}		10		
Max. no. of switchin operations N_{120}		120		
Network impedance angle	30°	50°	70°	85°
Flicker step factor $k_f(\Psi_k)$	0.017	0.018	0.020	0.022
Voltage change factor $k_u(\Psi_k)$	0.416	0.406	0.380	0.367

Table N.3.2c': Flicker step factor and voltage change factor for <u>switching off</u> at: 100% of P_{CMAX}	
Max. no. of switchin operations N_{10}	10

Max. no. of switchin operations N_{120}		120	

Network impedance angle	30°	50°	70°	85°
Flicker step factor $k_f(\Psi_k)$	0.248	0.186	0.102	0.048
Voltage change factor $k_u(\Psi_k)$	0.321	0.276	0.204	0.150

Table N.3.2d[I]: Maximum current step factor measured:

Condition:	Switch on: 10% of P_{CMAX}	Switch on: 100% of P_{CMAX}	Switch off: 100% of P_{CMAX}
$K_{i,max}$	0.100	1.000	1.000

Nbis.3.3 Misura di fluttuazioni di tensione (flicker) in condizioni di funzionamento continuo */Voltage fluctuations (Flickers) during Continuous operation* Reference standard: **IEC 61400-21:2008-08 Ed.2 (§. 6.3.2 and 7.3.3)** *Wind turbines* *Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines*	
Testing Method	☐ on site test (procedure IEC 61400-21) ☐ on site test with DC simulator or AC simulator ☒ test with AC simulator (*) *(change of angle of network change 30°, 50°, 70° e 85°)* (*) to use a flicker meter compliance with IEC 61000-4-15
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list..:	See table "Measurement equipment and instrumentation"

Supplementary information:
For integrated EESS test has to carry out @ P_{SMAX} (Max. Disharging Power) or P_{NINV} (Nominal Power Inverter)
For EESS connected to bi-directional converter test has to carry out @ P_{CMAX} (Max. Charging Power)
Tollerance of the Power: **5% S_N** (S_N = Nominal Power of the Converter).

Test conditions:

- Procedure according to IEC 61400-21 (same time-series used as for harmonics)

Notes on recording:

- Samplerate at least 10 kHz
- Record at least U and I per phase digitally
- Record at least 600 s per power bin

For the calculation of each flicker coefficient following calculation was been performed:

$$c(\psi_k) = P_{st,fic} \cdot \frac{S_{k,fic}}{S_n}$$

$c\ \Psi_k$ = flicker coefficient
$P_{st,fic}$ = measured value
$S_{k,fic}$ = calculated short circuit apparent power of the grid
S_n = rated apparent power of the PGU

Discharge mode:

Table N.3.3a:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.2663	0.3616	0.3724	0.3940	0.4175	0.4351	0.4588	0.4695	0.4652	0.4853
Pst	0.0129	0.0176	0.0186	0.0198	0.0206	0.0216	0.0233	0.0242	0.0234	0.0244
Angle of network impedance Ψ_k							30 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Table N.3.3b:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.2653	0.3538	0.3802	0.3920	0.4106	0.4165	0.4307	0.2653	0.3538	0.3802
Pst	0.0129	0.0176	0.0186	0.0198	0.0206	0.0206	0.0213	0.0129	0.0176	0.0186
Angle of network impedance Ψ_k							50 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Table N.3.3c:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.2633	0.3734	0.3606	0.3871	0.4155	0.4430	0.4724	0.4880	0.4819	0.5015
Pst	0.0129	0.0186	0.0176	0.0198	0.0206	0.0225	0.0233	0.0245	0.0240	0.0252
Angle of network impedance Ψ_k							70 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Table N.3.3d:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.3861	0.3508	0.3734	0.4099	0.4390	0.4753	0.4831	0.4900	0.4925	0.3783
Pst	0.0198	0.0176	0.0186	0.0208	0.0216	0.0235	0.0243	0.0245	0.0250	0.0194
Angle of network impedance Ψ_k							85 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Charge mode:

Table N.3.3a:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.2653	0.3538	0.3802	0.3920	0.4106	0.4165	0.4307	0.4371	0.4320	0.4501
Pst	0.0129	0.0176	0.0186	0.0198	0.0206	0.0206	0.0213	0.0216	0.0221	0.0223
Angle of network impedance Ψ_k							30 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Table N.3.3b:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.2663	0.3616	0.3724	0.3940	0.4175	0.4351	0.4588	0.4694	0.4646	0.4850
Pst	0.0129	0.0176	0.0186	0.0198	0.0206	0.0216	0.0233	0.0235	0.0230	0.0243
Angle of network impedance Ψ_k							50 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Table N.3.3c:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.2633	0.3734	0.3606	0.3871	0.4155	0.4430	0.4724	0.4880	0.4819	0.5015
Pst	0.0129	0.0186	0.0176	0.0198	0.0206	0.0225	0.0233	0.0245	0.0240	0.0252
Angle of network impedance Ψ_k							70 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Table N.3.3d:

	10% S_N	20% S_N	30% S_N	40% S_N	50% S_N	60% S_N	70% S_N	80% S_N	90% S_N	100% S_N
$c\ \Psi_k$	0.3861	0.3508	0.3734	0.4099	0.4390	0.4753	0.4831	0.4900	0.4925	0.3783
Pst	0.0198	0.0176	0.0186	0.0208	0.0216	0.0235	0.0243	0.0245	0.0250	0.0194
Angle of network impedance Ψ_k							85 ° ±2°			
$S_{k,flc}$ [KVA]							2500			
Sn [KVA]							125			

Remark:
Formula for additional impedance to simulate the grid on an AC simulator:

$$S_k = \frac{U_n^2}{\sqrt{R^2 + X^2}}$$

$$R = \frac{3U_n^2}{S_k\sqrt{1+\tan(\Psi)^2}}$$

$$\tan(\Psi) = \frac{X}{R} = \frac{2 \cdot \pi \cdot f \cdot L}{R}$$

$$L = \tan(\Psi) \cdot \frac{R}{2 \cdot \pi \cdot f}$$

$$\Psi = 70^\circ$$

$$S_k / S_n = 20...50$$

if S_n unknown: $S_n \approx P_n$

Nbis.4 Verifica del campo di funzionamento in tensione e frequenza *⁄Voltage-frequency working range*	
Aim of the test:	Verification of the capability of the generator to work in the ranges: Output voltage: 85% ÷ 110 % Un Line frequency: 47.5Hz and 51.5Hz (default values) (*) (*) *frequency range regulation: 49 Hz and 51 Hz*
Nominal Grid frequency f [Hz]:	50
Nominal Grid voltage U_n [V]:	400/230
Testing Method:	**N.4.1** Generatori statici ☒ **N.4.1.1** - Prove a piena potenza su rete simulata *⁄full power test with grid simulator* ☐ **N.4.1.2** - Prove a potenza ridotta su rete simulata *⁄limited power test with grid simulator*
Ambient temperature (°C) ...:	25 °C ± 5 °C
Humidity (RH %) ...:	65%
Instrumentation list ...:	See table "Measurement equipment and instrumentation"

TEST RESULT

Set Values	Measured Value	Time [min.]	Result
V=85%*V_n; f=47,5Hz; P=100%*P_{SMAX} (or P_{INV} for integrated EESS) Cosϕ=1	See Figure N.4.1.1: Test 1	>5	No disconnection of the equipment.
V=110%*V_n; f=51,5Hz; P=100%*P_{SMAX} (or PINV for integrated EESS) Cosϕ=1	See Figure N.4.1.1: Test 2	>5	No disconnection of the equipment.
V=85%*V_n; f=47,5Hz; P=100%*P_{CMAX} (for EESS connected to Bi-directional converter) Cosϕ=1	See Figure N.4.1.1: Test 3	>5	No disconnection of the equipment.
V=110%*V_n; f=51,5Hz; P=100%* P_{CMAX} (for EESS connected to Bi-directional converter) Cosϕ=1	See Figure N.4.1.1: Test 4	>5	No disconnection of the equipment.

Test 1 & Test 3: Power limitation is allowed reached the I_{max} limit during the test conditions.

Additional Information:

- Sampling frequency = at least 1 samples/s.
- Under/over frequency power limitation function disable during measurement.
- During measurement Frequency and active Power has to be recorded.
- Power must be stable within ±5% S_N (S_N = Nominal Power of the Converter).

Test Point	Range of operation	Pout [W]	Cosφ	Test time [s]	Limit [%]	Result
Test 1	85% U_n – 47.5Hz	100% Ps_{max} (o P_{NINV})	1.00	at least 300	±5% Sn	No Disconnection
Test 2	110% U_n - 51.5Hz	100% Ps_{max} (o P_{NINV})	1.00	at least 300	±5% Sn	No Disconnection
Test 3	85% U_n – 47.5Hz	100% Pc_{max}	1.00	at least 300	±5% Sn	No Disconnection
Test 4	110% U_n - 51.5Hz	100% Pc_{max}	1.00	at least 300	±5% Sn	No Disconnection

Grafico Test 1: 110% U_n - 51.5Hz / 100%Ps_{max}

/ Graph Test 1: 110% Un - 51.5Hz

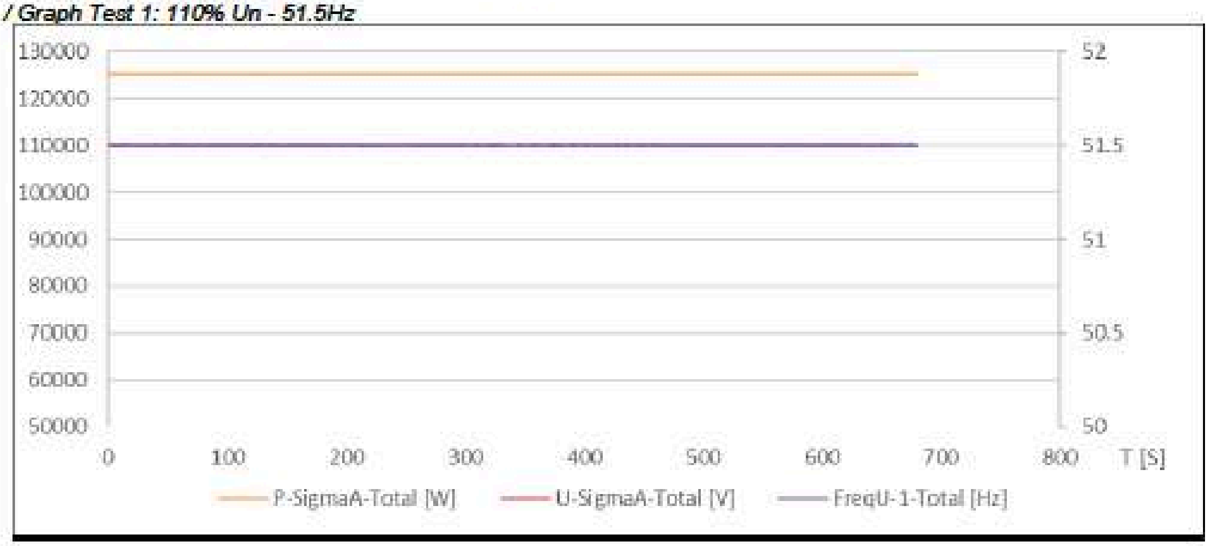


Grafico Test 2: 85% U_n – 47.5Hz / 100%Ps_{max}

/ Graph Test 2: 85% Un – 47.5Hz

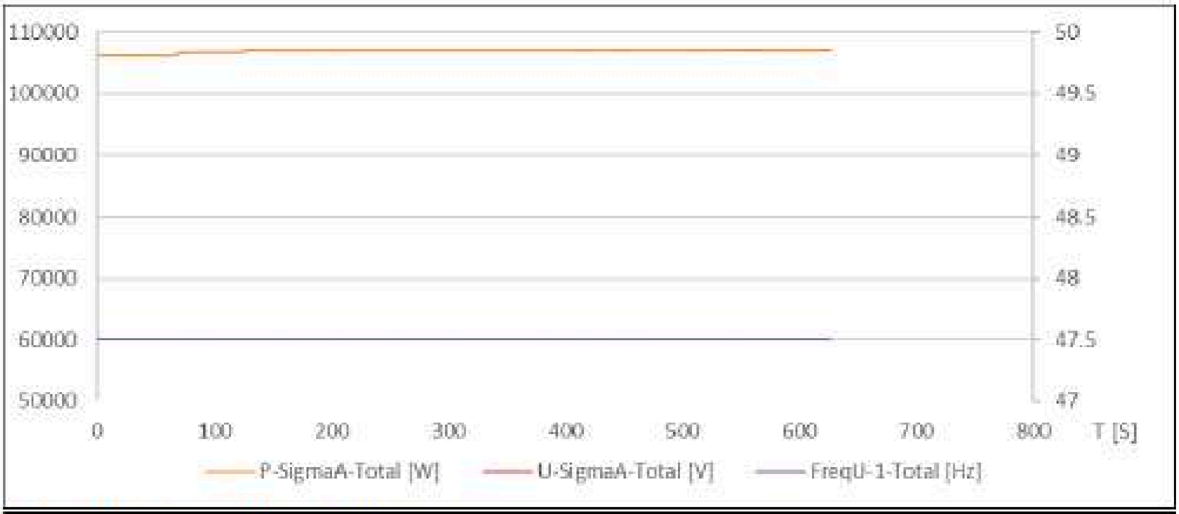


Grafico Test 3: 110% U_n - 51.5Hz / 100%Pc_{max}

/ Graph Test 1: 110% Un - 51.5Hz

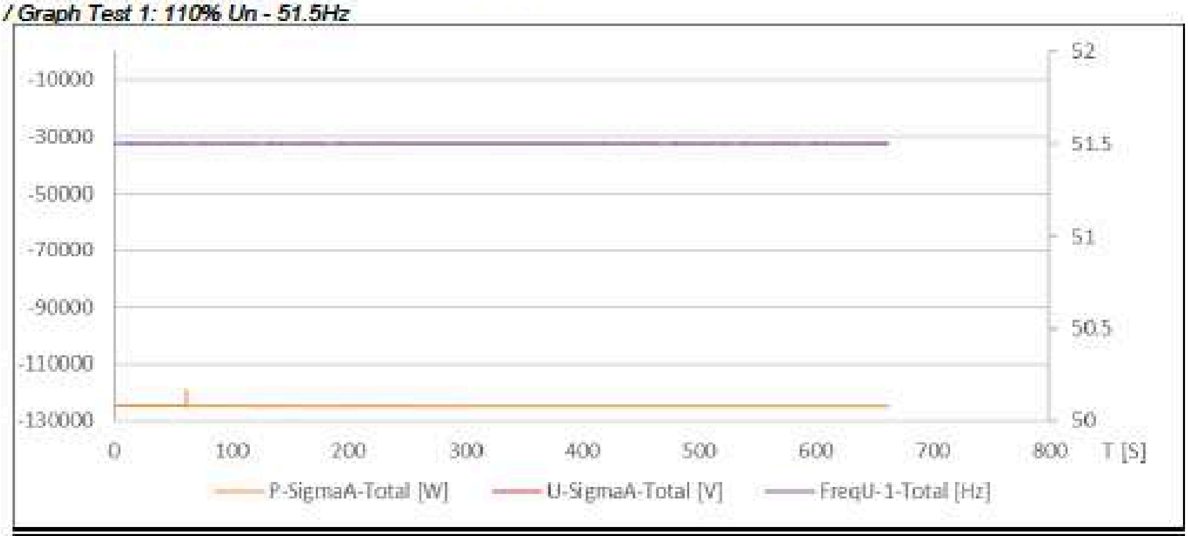
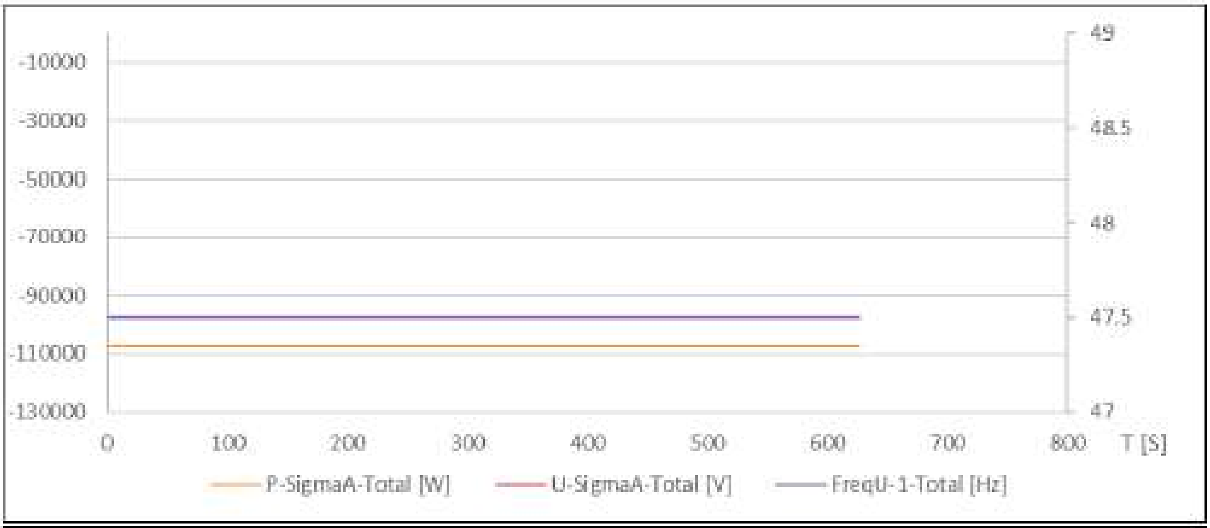


Grafico Test 4: 85% U_n – 47.5Hz / 100%Pc_{max}

/ Graph Test 4: 85% Un – 47.5Hz



Nbis.5 Verifica delle condizioni di sincronizzazione e presa di carico * /syncronization and re-connection* **Nbis.5.1 Syncronization** **Nbis.5.2 Gradual erogation of the power**	
Ambient temperature (°C) .... :	25 °C ± 5 °C
Humidity (RH %) .... :	65%
Instrumentation list .... :	See table "Measurement equipment and instrumentation"
Uncertainty .... :	See table
Minimum permanence time: T=30s → first connection, maintenance, no SPI disconnection T=300s → after SPI disconnection (programmable value from 0s ÷ 900s with step of 5 s)	
Is T=300 s a programmable value?	☒ YES ☐ NO

Supplementary information:

Records:	Average 1 minute of RMS-200ms samples
Gradient:	20%P_{SMAX}/min (or 20%$_{PINV}$/min for integrated EESS) 20%P_{CMAX}/min
Limit:	P<0.333% P_{SMAX}/s (or P_{INV}/s) from power level > 10%* P_{SMAX} (or P_{INV} for integrated EESS) P<0.333% P_{CMAX}/s from power level > 10%*P_{CMAX}
Sampling:	Record Active output power with a min. sampling of 1 sample/sec
Tolerance:	2.5%*S_N - 2.5% S_N for EESS connected to bi-directional converter.

Discharge mode									
U [Vac] Set Value	Limit [Vac]	f [Hz] Set Value	Limits [Hz]	Out Power [%] Note 1	Reconnection Time [sec]	Ramp Time(sec) [sec]	Ramp gradient [% Pn/s]	Acceptability criteria	Remark
1.12Un	U > 110%	50	49.90 Hz <F< 50.10 Hz	---	---	---	---	no connection after 300 s	OV Ref. b) – § 8.4.1.3
1.08Un	90% <Un< 110%	50	49.90 Hz <F< 50.10 Hz	100	143	330	0.31	Connection Delay for Reconnection ≥30 s	Connection to grid after an input undervoltage Ref. a) – § 8.4.1.3
0.88Un	U < 90%	50	49.90 Hz <F< 50.10 Hz	---	---	---	---	no connection after 300 s	UV Ref. b) – § 8.4.1.3
0.92Un	90% <U< 110%	50	49.90 Hz <F< 50.10 Hz	93	313	307	0.32	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery Ref. b) – § 8.4.1.3
1.12Un	U>110%	50	49.90 Hz <F< 50.10 Hz	---	---	---	---	no connection after 300 s	OV Ref. b) – § 8.4.1.3
1.08Un	90% <U< 110%	50	49.90 Hz <F< 50.10 Hz	100	341	331	0.29	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery Ref. b) – § 8.4.1.3
Un	90% <U< 110%	48.85	F< 49.90Hz	---	---	---	---	no connection after 300 s	UF Ref. b) – § 8.4.1.3
Un	90% <U< 110%	49.95	49.90 Hz <F< 50.10 Hz	100	313	330	0.30	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery Ref. b) – § 8.4.1.3
Un	90% <U< 110%	50.15	F > 51.10 Hz	---	---	---	---	no connection after 300 s	OF Ref. b) – § 8.4.1.3
Un	90% <U< 110%	50.05	49.90 Hz <F< 50.10 Hz	100	313	330	0.31	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery Ref. b) – § 8.4.1.3

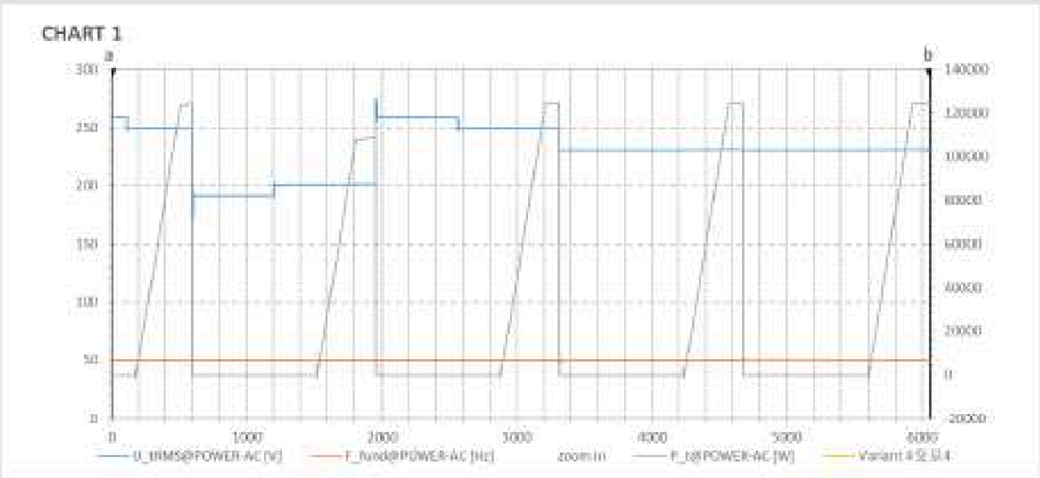
Note 1:
For integrated EESS test has to carry out @ P_{SMAX} (Max. Disharging Power) or P_{NINV} (Nominal Power Inverter)
For EESS connected to bi-directional converter test has to carry out @ P_{CMAX} (Max. Charging Power)

Charge mode									
U [Vac] Set Value	Limit [Vac]	f [Hz] Set Value	Limits [Hz]	Out Power [%] Note 1	Reconnection Time [sec]	Ramp Time(sec) [sec]	Ramp gradient [% Pn/s]	Acceptability criteria	Remark
1.12Un	U > 110%	50	49.90 Hz <F< 50.10 Hz	---	---	---	---	no connection after 300 s	OV **Ref. b) – § 8.4.1.3**
1.08Un	90% <Un< 110%	50	49.90 Hz <F< 50.10 Hz	100	152	330	0.30	Connection Delay for Reconnection ≥30 s	Connection to grid after an input undervoltage **Ref. a) – § 8.4.1.3**
0.88Un	U < 90%	50	49.90 Hz <F< 50.10 Hz	---	---	---	---	no connection after 300 s	UV **Ref. b) – § 8.4.1.3**
0.92Un	90% <U< 110%	50	49.90 Hz <F< 50.10 Hz	92	313	303	0.30	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery **Ref. b) – § 8.4.1.3**
1.12Un	U>110%	50	49.90 Hz <F< 50.10 Hz	---	---	---	---	no connection after 300 s	OV **Ref. b) – § 8.4.1.3**
1.08Un	85% <U< 110%	50	49.90 Hz <F< 50.10 Hz	100	314	333	0.30	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery **Ref. b) – § 8.4.1.3**
Un	85% <U< 110%	48.85	F< 49.90Hz	---	---	---	---	no connection after 300 s	UF **Ref. b) – § 8.4.1.3**
Un	85% <U< 110%	49.95	49.90 Hz <F< 50.10 Hz	100	313	333	0.30	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery **Ref. b) – § 8.4.1.3**
Un	85% <U< 110%	50.15	F > 51.10 Hz	---	---	---	---	no connection after 300 s	OF **Ref. b) – § 8.4.1.3**
Un	85% <U< 110%	50.05	49.90 Hz <F< 50.10 Hz	100	312	331	0.30	Connection Delay for Reconnection ≥300 s	Reconnection after fault recovery **Ref. b) – § 8.4.1.3**

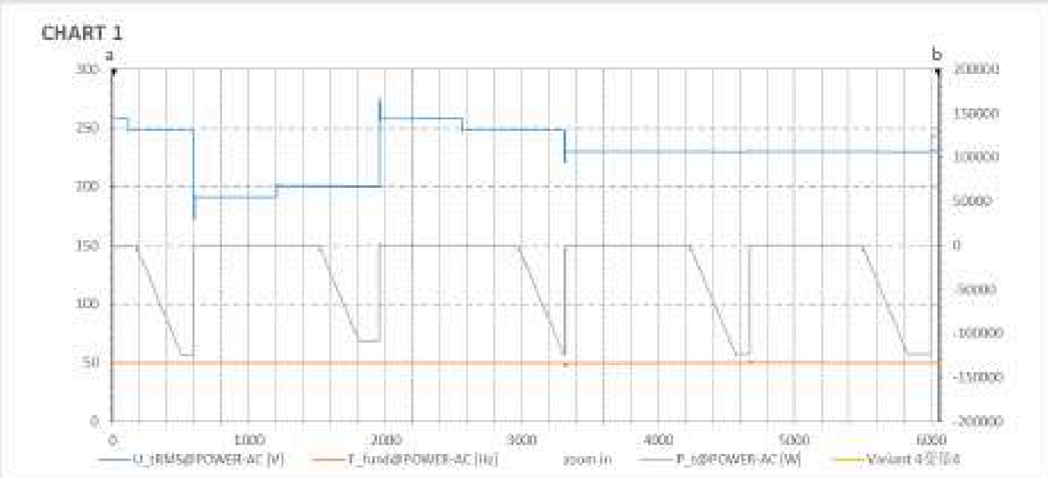
Note 1:
For integrated EESS test has to carry out @ P_{SMAX} (Max. Disharging Power) or P_{NINV} (Nominal Power Inverter)
For EESS connected to bi-directional converter test has to carry out @ P_{CMAX} (Max. Charging Power)

Grafico Bbis.5.2: Verifica della erogazione graduale della Potenza attiva
/ Graph Bbis.5.2: *Check of the gradual increase of the power production*

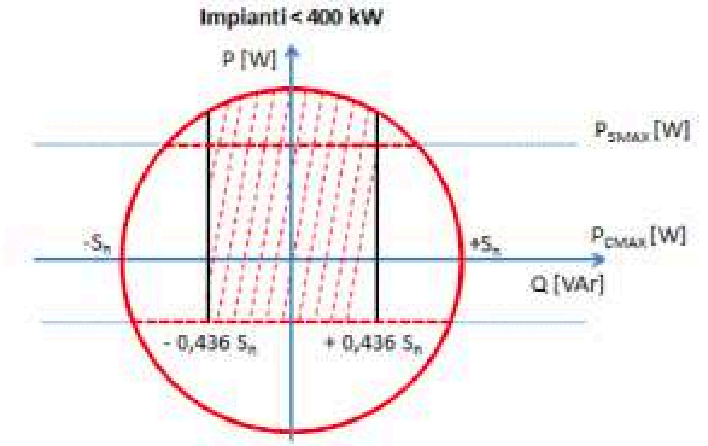
Test in discharging mode (Ps_{max})



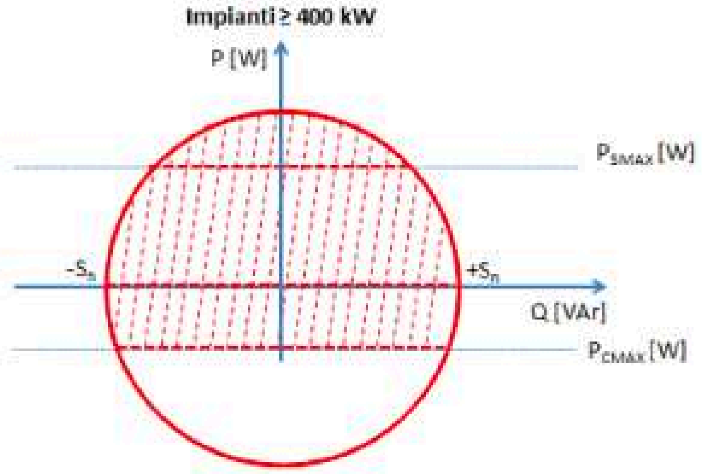
Test in charging mode (Pc_{max})



Nbis.6 Verifica della capability di erogazione della potenza reattiva *\/reactive power production capability*	
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list...:	See table "Measurement equipment and instrumentation"
Potenza massima dell'impianto di destinazione: *Maximum power of the destination plant:*	☐ PV $_{plant}$ < 400 KW *(see picture 1A)* ☒ PV $_{plant}$ ≥ 400 KW *(see picture 1B)*



Picture 1A

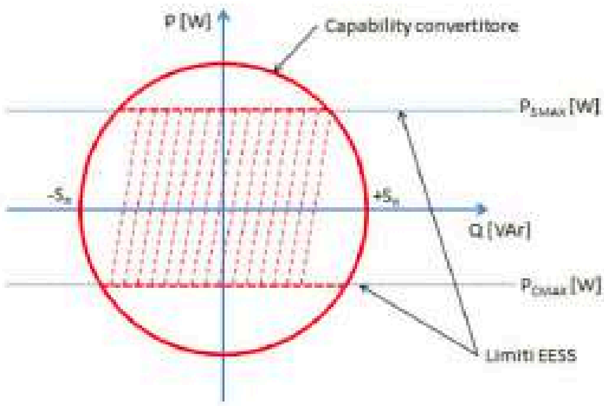


Picture 1B

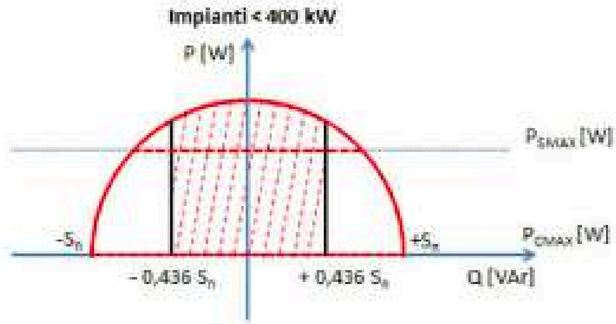
Nbis.6.1 / Nbis.6.2
Modalità di esecuzione e registrazione della prova applicabile a generatori statici
/ test execution and recording modes (applicable to static generators)

The maximum absorption capability (Q min) and delivery (Qmax) of reactive power resulting from the sequence of the above measures and that for Q = 0 has to be documented in tabular form.
The test is passed successfully if the detected value of maximum reactive power, reported in a P-Q diagram, is external or at least coincident with the perimeter of the minimum capability of Picture 1B.

Not integrated EESS refer to below P-Q Diagram



Integrated EESS capability is made by contribute of the battery and the static converter.



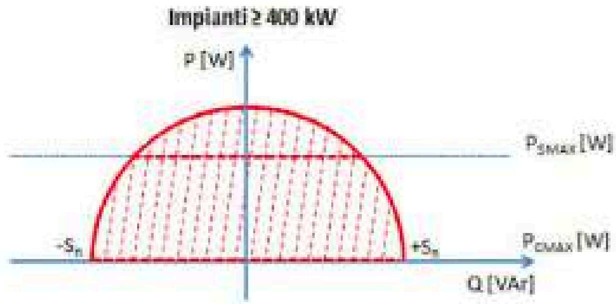


Table 6.1a: Maximum capability P-Q (Q=0)

TABLE: Reactive power production with set point Q = 0								
Power Step	Active Power		Reactive Power		Power Factor	Deviation	Target value	Limit
	[W]	[%Sn]	[VAr]	[%Sn]	Cosφ	ΔQ/Sn[%]	Q/Sn[%]	ΔQ/Sn
90% - 100% Ps_{max}	124317	99.5	246.0912	0.002	1.00	0.002	0	<±5%
70% - 80% Ps_{max}	99807	79.8	55.98046	0.000	1.00	0.000	0	<±5%
50% - 60% Ps_{max}	75952	60.8	43.0424	0.000	1.00	0.000	0	<±5%
30% - 40% Ps_{max}	50479	40.4	15.8946	0.000	1.00	0.000	0	<±5%
10% - 20% Ps_{max}	25879	20.7	-98.5046	-0.001	1.00	-0.001	0	<±10%
10% - 20% Pc_{max}	-25583	-20.5	-54.2855	0.000	1.00	0.000	0	<±10%
30% - 40% Pc_{max}	-50240	-40.2	-158.48	-0.009	1.00	-0.009	0	<±5%
50% - 60% Pc_{max}	-75572	-60.5	61.38192	0.000	1.00	0.000	0	<±5%
70% - 80% Pc_{max}	-100233	-80.2	-143.762	-0.001	1.00	-0.001	0	<±5%
90% - 100% Pc_{max}	-124922	-99.9	-449.185	-0.004	1.00	-0.004	0	<±5%

Table 6.1b: Maximum capability P-Q (Q=Qmax|cap)

TABLE: Reactive power produced with set point Q = Qmax								
Power Step	Active Power		Reactive Power		Power Factor	Deviation	Target value	Limit
	[W]	[%Sn]	[VAr]	[%Sn]	Cosφ	ΔQ/Sn[%]	Q/Sn[%]	ΔQ/Sn
90% - 100% Ps_{max}	3185	2.5	125350	100.3	0.025	0.3	100	<±5%
70% - 80% Ps_{max}	2320	1.9	125315	100.3	0.017	0.3	100	<±5%
50% - 60% Ps_{max}	3186	2.5	125350	100.3	0.025	0.3	100	<±5%
30% - 40% Ps_{max}	3184	2.5	125357	100.3	0.025	0.3	100	<±5%
10% - 20% Ps_{max}	3182	2.5	125360	100.3	0.025	0.3	100	<±5%
10% - 20% Pc_{max}	-5861	-4.7	125343	100.3	-0.047	0.3	100	<±5%
30% - 40% Pc_{max}	-5858	-4.7	125339	100.3	-0.047	0.3	100	<±5%
50% - 60% Pc_{max}	-5859	-4.7	125349	100.3	-0.047	0.3	100	<±5%
70% - 80% Pc_{max}	-6711	-5.4	125309	100.2	-0.0	0.2	100	<±5%
90% - 100% Pc_{max}	-5959	-4.8	125306	100.2	-0.047	0.2	100	<±5%

Table 6.1c: Maximum capability P-Q (Q=Qmin|ind)

TABLE: Reactive power adsorbed with set point Q = Qmin								
Power Step	Active Power		Reactive Power		Power Factor	Deviation	Target value	Limit
	[W]	[%Sn]	[VAr]	[%Sn]	Cosφ	ΔQ/Sn	Q/Sn[%]	ΔQ/Sn
90% - 100% Ps_{max}	4797	3.8	-125171	-100.1	-0.034	0.1	-100	<±5%
70% - 80% Ps_{max}	3783	3.0	-125201	-100.2	-0.034	0.2	-100	<±5%
50% - 60% Ps_{max}	2878	2.3	-125262	-100.2	-0.032	0.2	-100	<±5%
30% - 40% Ps_{max}	3779	3.0	-125223	-100.2	-0.034	0.2	-100	<±5%
10% - 20% Ps_{max}	3783	3.0	-125020	-100.0	-0.034	0	-100	<±5%
10% - 20% Pc_{max}	-4270	-3.4	-125151	-100.1	-0.034	0.1	-100	<±5%
30% - 40% Pc_{max}	-4365	-3.5	-125173	-100.1	-0.034	0.1	-100	<±5%
50% - 60% Pc_{max}	-5112	-4.1	-125199	-100.2	-0.033	0.2	-100	<±5%
70% - 80% Pc_{max}	-4276	-3.4	-125150	-100.1	-0.034	0.1	-100	<±5%
90% - 100% Pc_{max}	-4273	-3.4	-125149	-100.1	-0.034	0.1	-100	<±5%

Nbis.6.3 Scambio di potenza reattiva secondo un livello assegnato */Reactive power provision according to an assigned level*	
Nbis.6.4 Modalità di esecuzione della prova e registrazione dei risultati applicabile a generatori statici (ipotesi di reg. tramite Q) */ Procedure for static generators (regulation through Q).*	
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list..:	See table "Measurement equipment and instrumentation"

Test Execution:

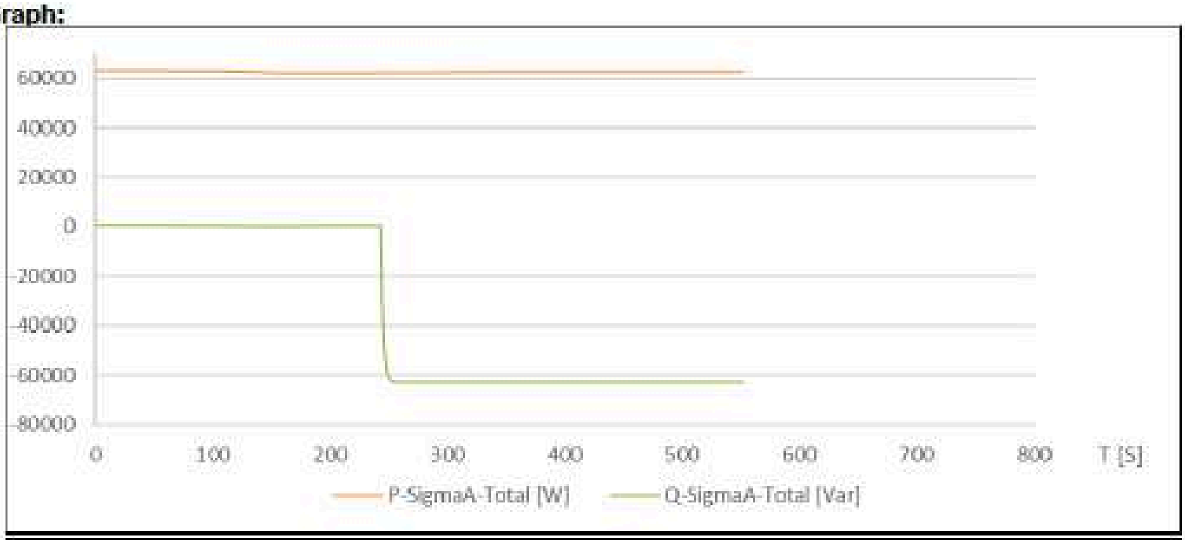
Step 1: Set the generator with P=50%Pnom
Step 2: Set a set-point of inductive reactive power Q_{IND}=50%S_N
Step 3: mantein the set-point of step 2 for 60s.

During all steps monitoring:
- Active Power
- Reactive Power (at least 30s ahead Step 2).

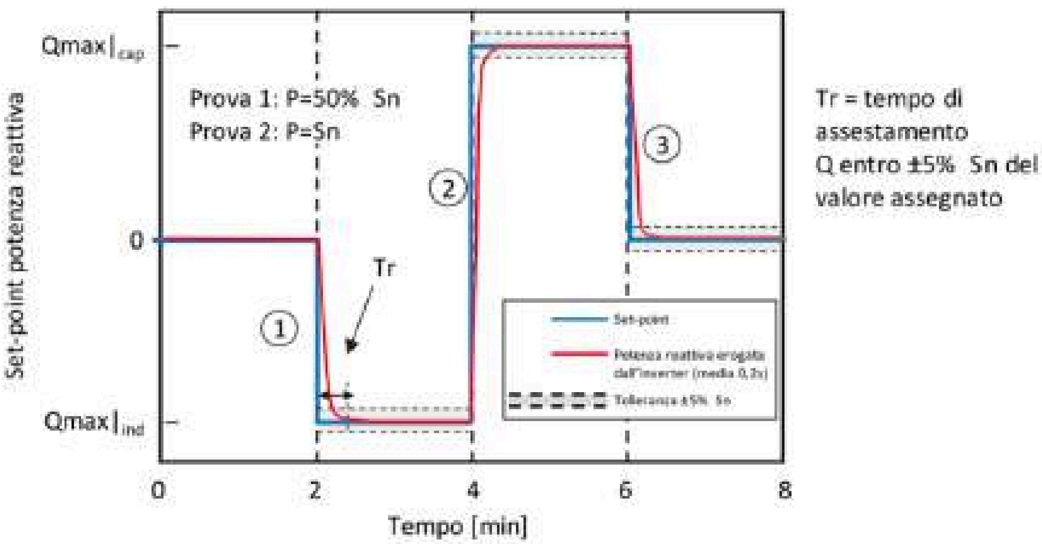
Samples rate: RMS-200ms (1 min. everage value)

Acceptance Criteria: ΔQ ≤ 5% S_N or Δcosφ ≤ ± 0.02 (set-point throught power factor).

Graph:



Nbis.6.5 Tempo di risposta ad una variazione a gradino del livello assegnato *(Reaction time after a step variation of the assigned level.*	
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list..:	See table "Measurement equipment and instrumentation"



Test execution:

The values of $Q_{max}|_{cap}$ and $Q_{max}|_{ind}$ at 50%Pn of 100%P_{SMAX} (or P_{INV} for integrated EESS) and 100%P_{CMAX} (for EESS connected to Bi-directional converter).

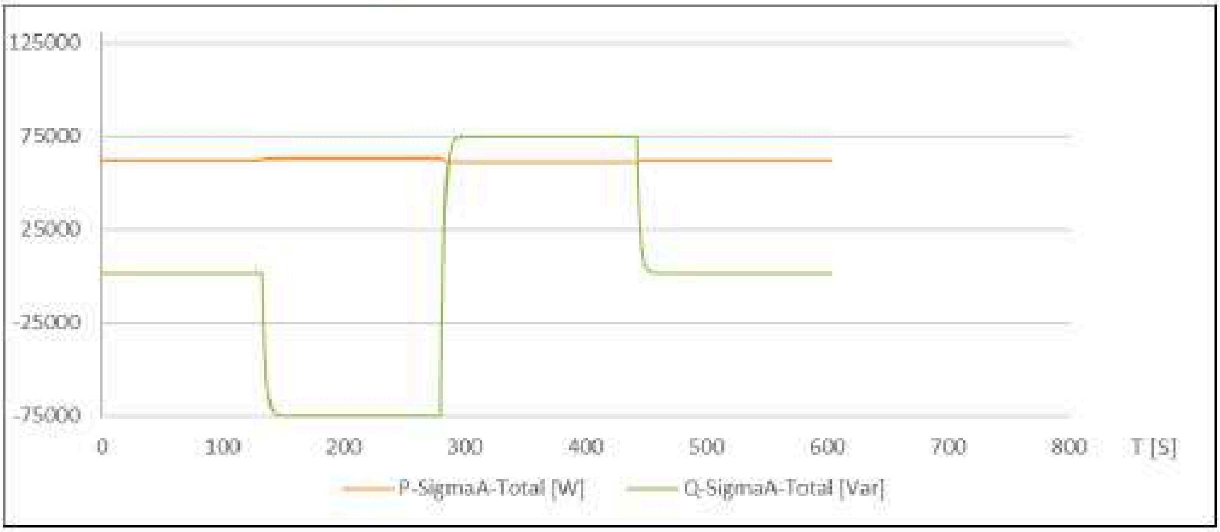
Sample rate: RMS-200ms
Maximum settling time: 10s

Q-step response @ P = 50% Ps_{max}

Table 6.5a: Q-step response

Setpoint	P [W]	Q [VAr]	cos φ	U [V]
1. Q_0 = 0 VAr	63490	239	0.99	228.58
Settling time [s]	9.2			
2. -Q_{max} = - 75000VAr	62982	-74875	0.66	228.58
Settling time [s]	9.6			
3. +Q_{max} = 75000 VAr	61371	74920	0.67	231.71
Settling time [s]	9.4			
4. Step Q_0 - 0 VAr	62244	1281	0.99	230.18
Maximum settling time [s]:			10	

Figure 6.5a – Q-step response @ P = 50% Psmax

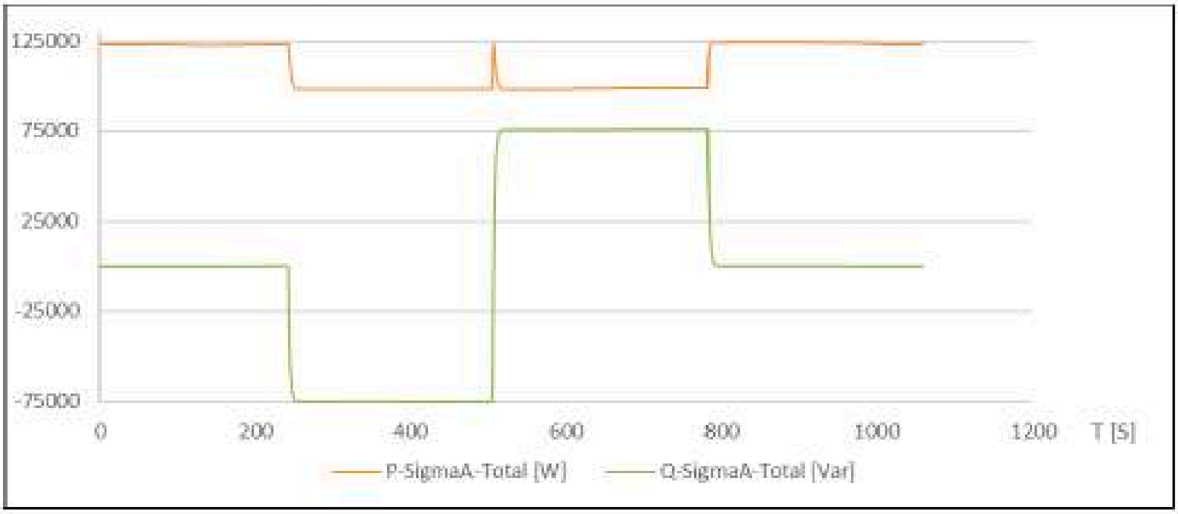


Q-step response @ P = 100%Ps_{max}

Table 6.5b: Q-step response

Setpoint	P [W]	Q [VAr]	cos φ	U, [V]
1. Q_0 = 0 VAr	124349	166	0.99	230.45
Settling time [s]		7.4		
2. -Q_{max} = - XXXX VAr	99266	-74046	0.80	229.98
Settling time [s]		8.4		
3. +Q_{max} = XXXX VAr	98807	75264	0.79	231.04
Settling time [s]		8.0		
4. Step Q_0 - 0 VAr	123517	115	0.99	230.57
Maximum settling time [s]:			10	

Figure 6.5b – Q-step response @ P = 100% Ps_{max}

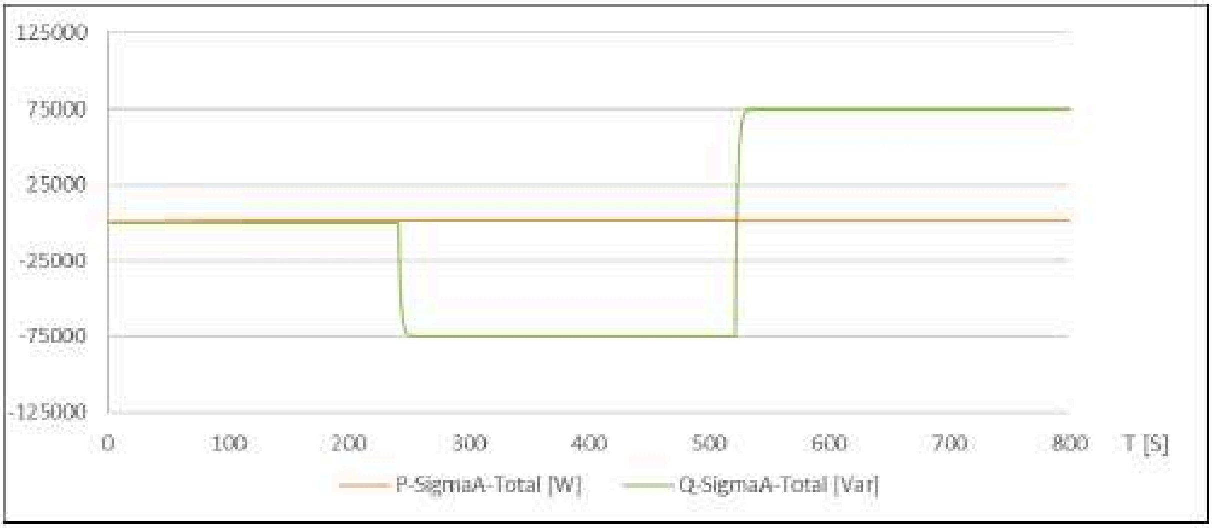


Q-step response @ P = 0% Pc_{max}

Table 6.5a: Q-step response

Setpoint	P [W]	Q [VAr]	cos φ	U [V]
1. Q_0 = 0 VAr	915	6.4	0.64	230.22
Settling time [s]		8.0		
2. $-Q_{max}$ = - XXXX VAr	1802	-74884	0.02	229.73
Settling time [s]		8.6		
3. $+Q_{max}$ = XXXX VAr	1505	74997	0.02	230.81
Settling time [s]		8.4		
4. Step Q_0 - 0 VAr	1711	88.4	0.99	230.29
Maximum settling time [s]:			10	

Figure 6.5a – Q-step response @ P = 0% Pcmax

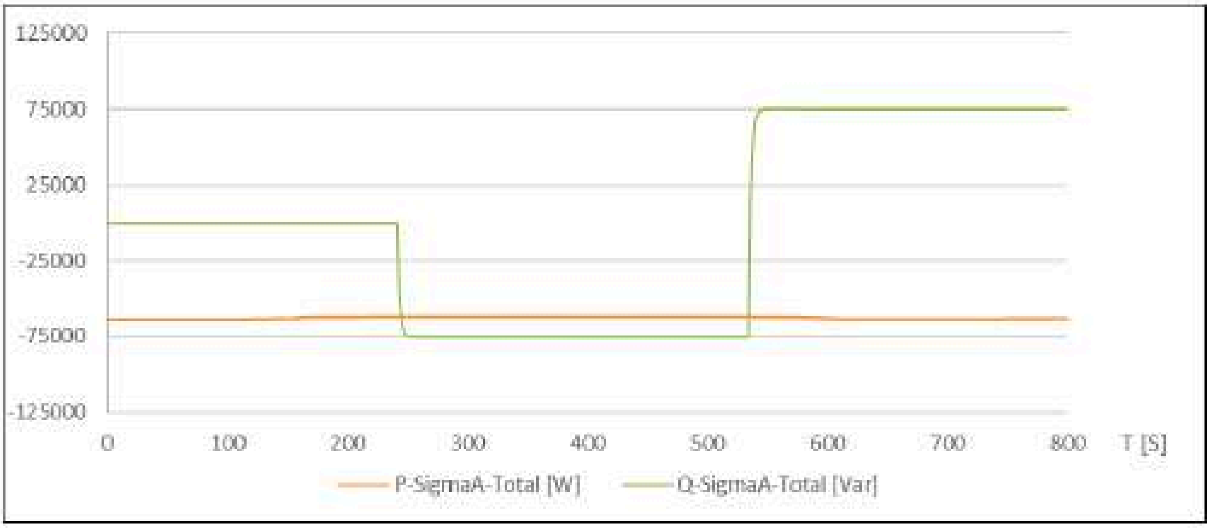


Q-step response @ P = 50% Pc_{max}

Table 6.5a: Q-step response

Setpoint	P [W]	Q [VAr]	cos φ	U [V]
1. Q_0 = 0 VAr	-63307	-131	-0.99	230.08
Settling time [s]	8.2			
2. $-Q_{max}$ = - XXXX VAr	-61950	-75424	-0.63	229.54
Settling time [s]	8.4			
3. $+Q_{max}$ = XXXX VAr	-63192	75190	-0.64	230.63
Settling time [s]	8.2			
4. Step Q_0 - 0 VAr	-62192	-212	-0.99	230.05
Maximum settling time [s]:				

Figure 6.5a – Q-step response @ P = 50% Pcmax

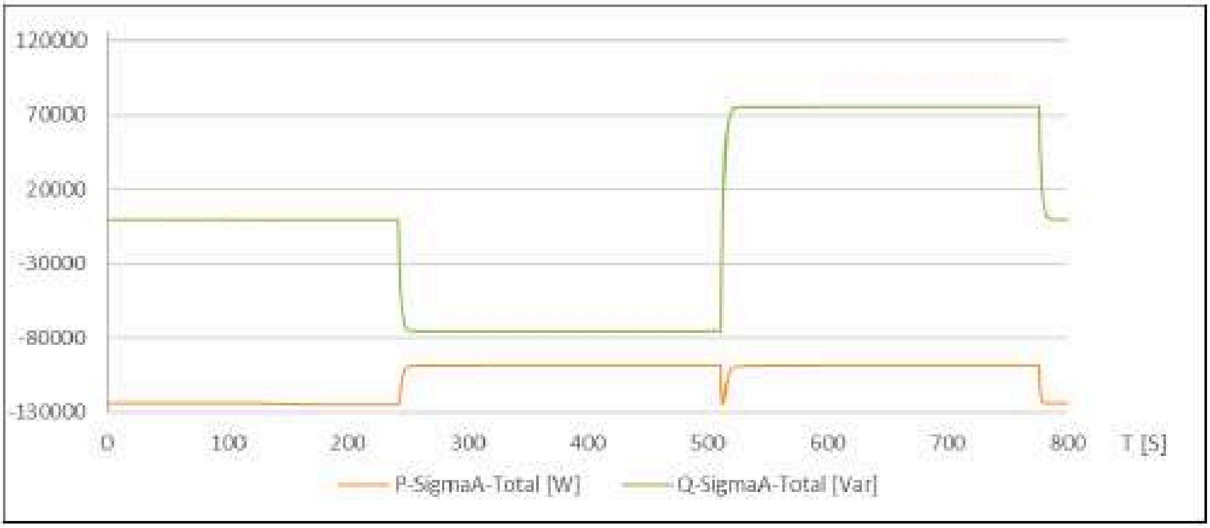


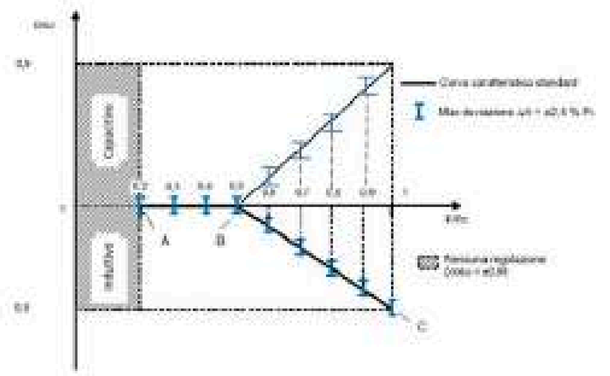
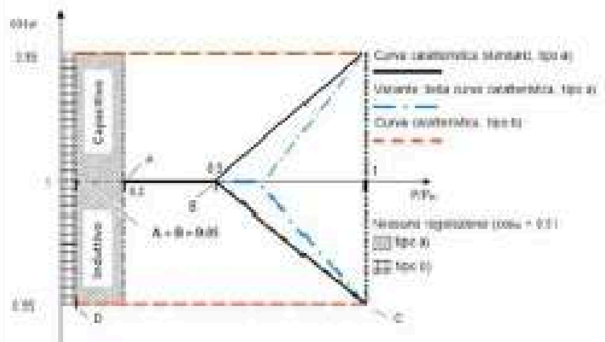
Q-step response @ P = 100%Pc_{max}

Table 6.5b: Q-step response

Setpoint	P [W]	Q [VAr]	cos φ	U [V]
1. Q_0 = 0 VAr	-123687	-201	-0.99	229.92
Settling time [s]	8.6			
2. -Q_{max} = - XXXX VAr	-98313	-75301	-0.79	230.50
Settling time [s]	7.8			
3. +Q_{max} = XXXX VAr	-98101	75163	-0.79	230.50
Settling time [s]	8.0			
4. Step Q_0 - 0 VAr	-124711	-309	-0.99	229.88
Maximum settling time [s]:			10	

Figure 6.5b – Q-step response @ P = 100% Pc_{max}



Nbis.6.6 Regolazione automatica di potenza reattiva secondo una curva caratteristica cosφ = f(P) */Automatic reactive power production according to a characteristic curve cos(phi)=f(P)*	
Nbis.6.7 Verifica di rispondenza alle modalità di applicazione della curva standard di erogazione cosφ = f(P) */Testin procedure of Automatic reactive power production function according to a characteristic curve cos(phi)=f(P)*	
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65% ± 5% RH
Instrumentation list..:	See table "Measurement equipment and instrumentation"
Set value..:	Lock-in: 1.05 Vn (Induttivo) *(Vn and 1.1 Vn with steps of 0.01)* Lock-out: 230 V or 50%PS_{max} *(0.9 Vn and Vn with steps of 0.01)* Lock-in: 0.95 Vn (Capacitivo) *(0.9 Vn and Vn with steps of 0.01)* Lock-out: 230 V or 50%PS_{max} *(Vn and 1.1 Vn with steps of 0.01)*
	

Supplementary information:

- Function must be anable by a local command of the converter.
- Each value must be reach in < 10s.
- Describe the Lock-in value defined by the manufacturer

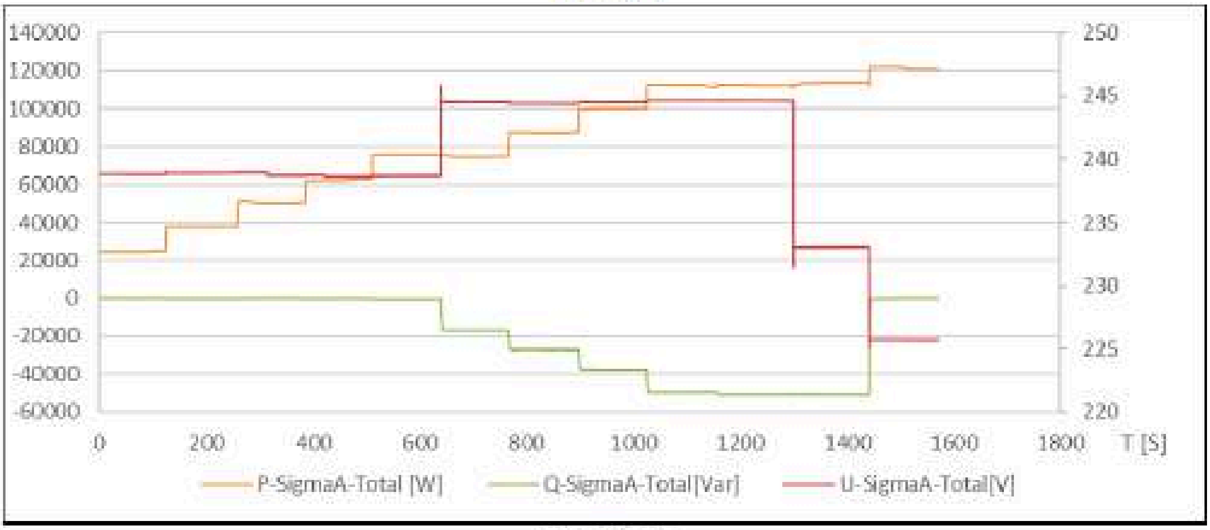
Table 6.6: Verification of reactive power provision according to the standard characteristic curve cosphi=f(P)

Induttivo								
P/Pn[%]	P[W]	Vout[V]	Q[Var]	Cosφ measured	Cosφ Set-point	ΔCosφ	LIMIT Δcosφ_max	RESULT
20 %	25263	239.24	1116	0.9999	1.00	0.89%	≤ ± 0.01	PASS
30 %	37961	239.29	958	0.9999	1.00	0.77%	≤ ± 0.01	PASS
40 %	50625	239.34	804	1.0000	1.00	0.64%	≤ ± 0.01	PASS
50 %	63336	239.40	675	1.0000	1.00	0.54%	≤ ± 0.01	PASS
60 %	75992	239.45	533	1.0000	1.00	0.43%	≤ ± 0.01	PASS
60 %	76213	244.04	-14852	0.9802	0.98	0.50%	≤ ± 0.01	PASS
70 %	89082	244.08	-25463	0.9601	0.96	0.42%	≤ ± 0.01	PASS
80 %	99334	244.13	-34311	0.9400	0.94	1.39%	≤ ± 0.01	PASS
90 %	113399	244.17	-47288	0.9209	0.92	0.82%	≤ ± 0.01	PASS
100%	116810	244.19	-50650	0.9154	0.90*	4.74%	≤ ± 0.01	PASS
100 %	116990	232.72	-50771	0.9153	0.90*	4.71%	≤ ± 0.01	PASS
100 %	123455	225.89	-267	1.0000	1.00	-0.21%	≤ ± 0.01	PASS
Note*:Reduced reactive power output is permitted for the reason that the apparent power is limited.								

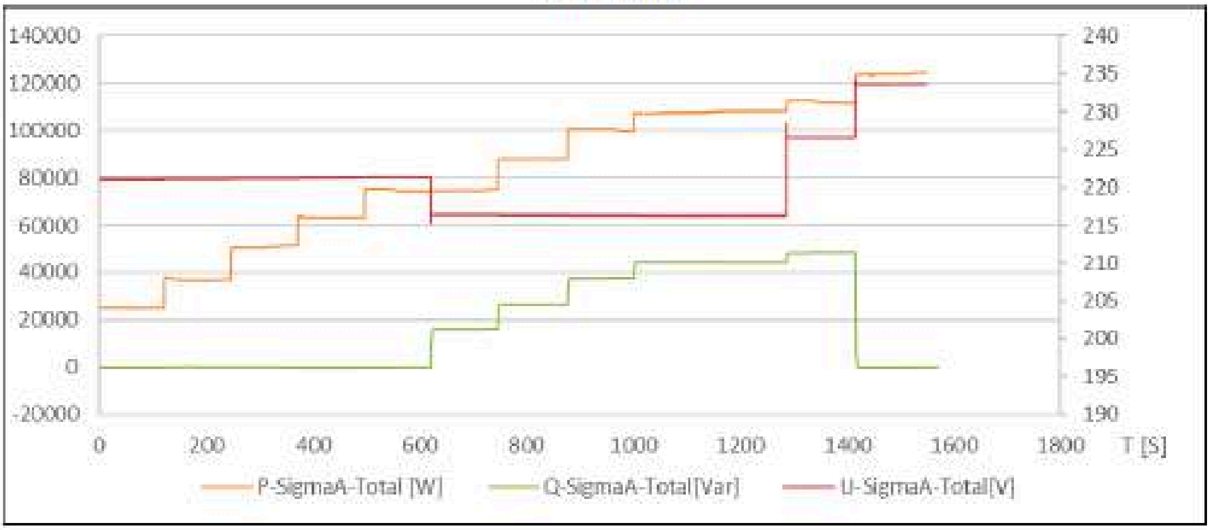
Capacitivo								
P/Pn[%]	P[W]	Vout[V]	Q[Var]	Cosφ measured	Cosφ Set-point	ΔCosφ	LIMIT Δcosφ_max	RESULT
20 %	25588	220.86	-979	0.9998	1.00	-0.78%	≤ ± 0.01	PASS
30 %	38298	220.91	-1183	0.9999	1.00	-0.95%	≤ ± 0.01	PASS
40 %	51121	220.97	-1346	0.9999	1.00	-1.08%	≤ ± 0.01	PASS
50 %	63694	221.02	-1466	1.0000	1.00	-1.17%	≤ ± 0.01	PASS
60 %	75171	221.07	-1600	1.0000	1.00	-1.28%	≤ ± 0.01	PASS
60 %	74976	216.49	12856	0.9817	0.98	-1.89%	≤ ± 0.01	PASS
70 %	87528	216.55	23209	0.9617	0.96	-1.86%	≤ ± 0.01	PASS
80 %	100021	216.60	33965	0.9424	0.94	-1.87%	≤ ± 0.01	PASS
90 %	115382	216.66	48613	0.9225	0.92	-0.43%	≤ ± 0.01	PASS
100%	115411	216.68	48638	0.9184	0.90*	-5.81%	≤ ± 0.01	PASS
100 %	115365	228.14	48759	0.9183	0.90*	-5.69%	≤ ± 0.01	PASS
100 %	123626	235.06	-2133	1.0000	1	-1.71%	≤ ± 0.01	PASS
Note*:Reduced reactive power output is permitted for the reason that the apparent power is limited.								

Figure 6.6 erogazione automatica di potenza reattiva secondo una curva caratteristica cosφ= f(P)
/ Graph reactive power production according to a characteristic curve cos(phi) = f(P)

Induttivo

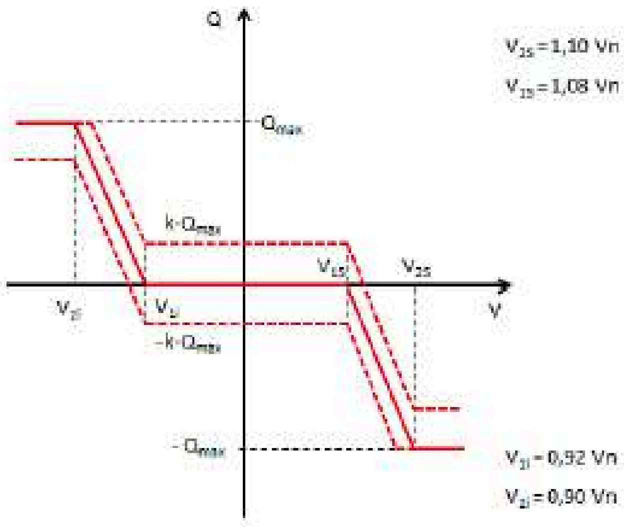


Capacitivo



Nbis.6.8 Erogazione/assorbimento automatico di potenza reattiva secondo una curva caratteristica Q=f(V)
/Automatic reactive power production according to a characteristic curve Q=f(V)
Nbis.6.9 Verifica di rispondenza alle modalità di applicazione della curva caratteristica Q=f(V)
/characteristic curve Q=f(V) verification

Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list......................................:	See table "Measurement equipment and instrumentation"
Set value......................................:	Lock-in: 0.2 P_{SMAX} 0.2 P_{NINV} for Integrated EESS 0.2 P_{CMAX} for EESS connected to bi-directional converter. *(0.1 Pn and Pn with steps of 0.1 Pn)* Lock-out: 0.05 Pn
Activation settings ....:	Activation of the protection with a delay from 0 to 30 s with step of 1 s (Default setting: 3 s)



Q=f(V) standard curve settings:	Default value:	Settable?
V2i	0.90	*0.9 Vn ÷ 1.1Vn with steps of 0.01 Vn* ☒ YES ☐ NO
V1i	0.92	
V1s	1.08	
V2s	1.10	

K	± 0.1	*-1÷1 with steps of 0.01* ☒ YES ☐ NO

Supplementary information:

Records: Average 1 minute of RMS-200ms samples.

According to CEI 0-21:2014 VARIANTE V1 this function has an intentional delay settable from 0 to 30s with step 1s (default setting 3s). Delay have been verified with 0, 3s, 15s, and30s

Test must be performed at K, -K, and at default value (0.1).

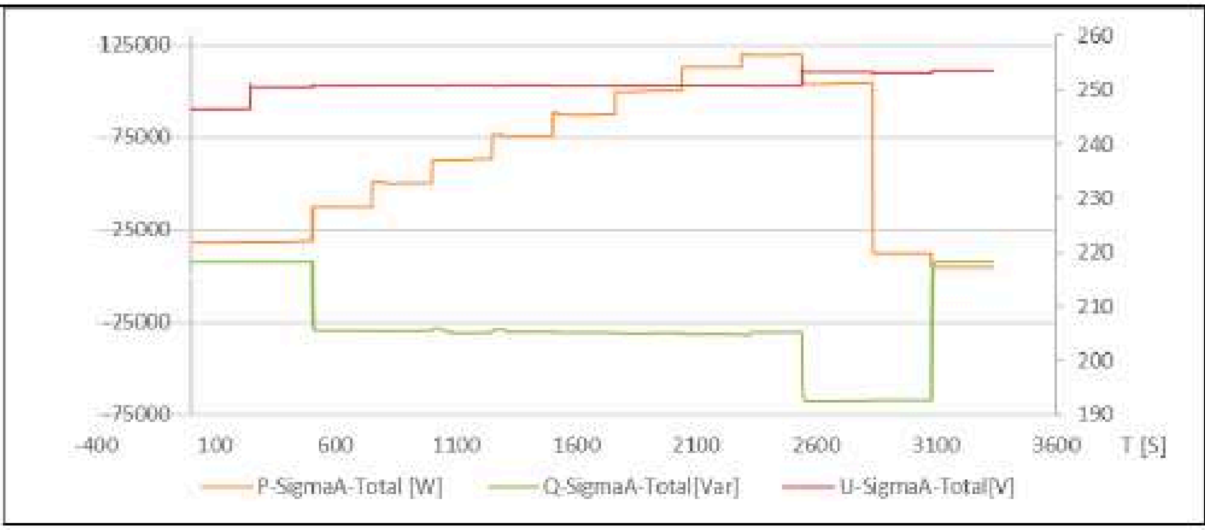
Discharge mode: Ps_{max} ; k=0.1	V_{1s} = 1.08%Vn	V_{2s} = 1.1%Vn	Table A.1
	V_{1i} = 0.92%Vn	V_{2i} = 0.9%Vn	Table A.2
Discharge mode: Ps_{max} ; k= -0.1	V_{1s} = 1.08%Vn	V_{2s} = 1.1%Vn	Table A.3
	V_{1i} = 0.92%Vn	V_{2i} = 0.9%Vn	Table A.4
Charge mode: Pc_{max} ; k=0.1	V_{1s} = 1.08%Vn	V_{2s} = 1.1%Vn	Table B.1
	V_{1i} = 0.92%Vn	V_{2i} = 0.9%Vn	Table B.2
Charge mode: Pc_{max} ; k= -0.1	V_{1s} = 1.08%Vn	V_{2s} = 1.1%Vn	Table B.3
	V_{1i} = 0.92%Vn	V_{2i} = 0.9%Vn	Table B.4

Table A.1: Discharge mode with k=0.1

Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Ps_{max} [%]	V/Vn	P/Ps_{max} [%]	Vout [V]	Q [Var]				
<20%	1.07	14.30	246.35	7739	≈k Q_{max} (< ± 5 % Sn)	0.2	≤ ± 5% Sn	P
<20%	1.09	14.49	250.83	7788	≈k Q_{max} (< ± 5 % Sn)	0.2	≤ ± 5% Sn	P
<20 % → 30 %	1.09	29.72	250.86	-29565	-0.4 Q_{max} (< 10 sec)	0.3	≤ ± 5% Sn	P
40%	1.09	40.39	250.89	-29598	-0.4 Q_{max}	0.3	≤ ± 5% Sn	P
50%	1.09	50.73	250.80	-30610	-0.4 Q_{max}	-0.5	≤ ± 5% Sn	P
60%	1.09	60.35	250.84	-30810	-0.4 Q_{max}	-0.6	≤ ± 5% Sn	P
70%	1.09	69.99	250.83	-30573	-0.4 Q_{max}	-0.5	≤ ± 5% Sn	P
80%	1.09	79.80	250.86	-30991	-0.4 Q_{max}	-0.8	≤ ± 5% Sn	P
90%	1.09	90.12	250.86	-31128	-0.4 Q_{max}	-0.9	≤ ± 5% Sn	P
100%	1.09	96.01	250.82	-30462	-0.4 Q_{max}	-0.4	≤ ± 5% Sn	P
100%	1.10	83.83	253.23	-67524	-0.9 Q_{max}	0.1	≤ ± 5% Sn	P
100 % → 10%	1.10	9.84	253.00	-67687	-0.9 Q_{max}	0.1	≤ ± 5% Sn	P
10 % → ≤ 5%	1.10	3.84	253.14	7558	≈k Q_{max} (< ± 5 % Sn)	0.2	≤ ± 5% Sn	P

Table A.2: Discharge mode with k= 0.1								
Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Ps$_{max}$ [%]	V/Vn	P/Ps$_{max}$ [%]	Vout [V]	Q [Var]				
<20%	0.93	15.15	214.18	7673	≈k Q$_{max}$ (<± 5 % Sn)	0.14	≤ ± 5% Sn	P
<20%	0.91	15.07	209.25	7621	≈k Q$_{max}$ (<± 5 % Sn)	0.10	≤ ± 5% Sn	P
<20 % → 30 %	0.91	29.89	209.35	44789	0.6 Q$_{max}$ (< 10 sec)	-0.17	≤ ± 5% Sn	P
40%	0.91	40.34	209.28	45492	0.6 Q$_{max}$	0.39	≤ ± 5% Sn	P
50%	0.91	50.53	209.27	44972	0.6 Q$_{max}$	-0.02	≤ ± 5% Sn	P
60%	0.91	59.93	209.22	45182	0.6 Q$_{max}$	0.15	≤ ± 5% Sn	P
70%	0.91	69.91	209.15	46160	0.6 Q$_{max}$	0.93	≤ ± 5% Sn	P
80%	0.91	79.80	209.25	44487	0.6 Q$_{max}$	-0.41	≤ ± 5% Sn	P
90%	0.91	82.21	209.26	44486	0.6 Q$_{max}$	-0.41	≤ ± 5% Sn	P
100%	0.91	83.63	209.06	43944	0.6 Q$_{max}$	-0.84	≤ ± 5% Sn	P
100%	0.90	67.42	207.16	74299	Q$_{max}$	-0.56	≤ ± 5% Sn	P
100 % → 10%	0.90	9.05	206.96	75618	Q$_{max}$	0.49	≤ ± 5% Sn	P
10 % → ≤ 5%	0.90	3.34	206.36	7307	≈k Q$_{max}$ (<± 5 % Sn)	-0.15	≤ ± 5% Sn	P

Graph curve Q=f(V)
Curve A.1



Graph curve Q=f(V)
Curve A.2

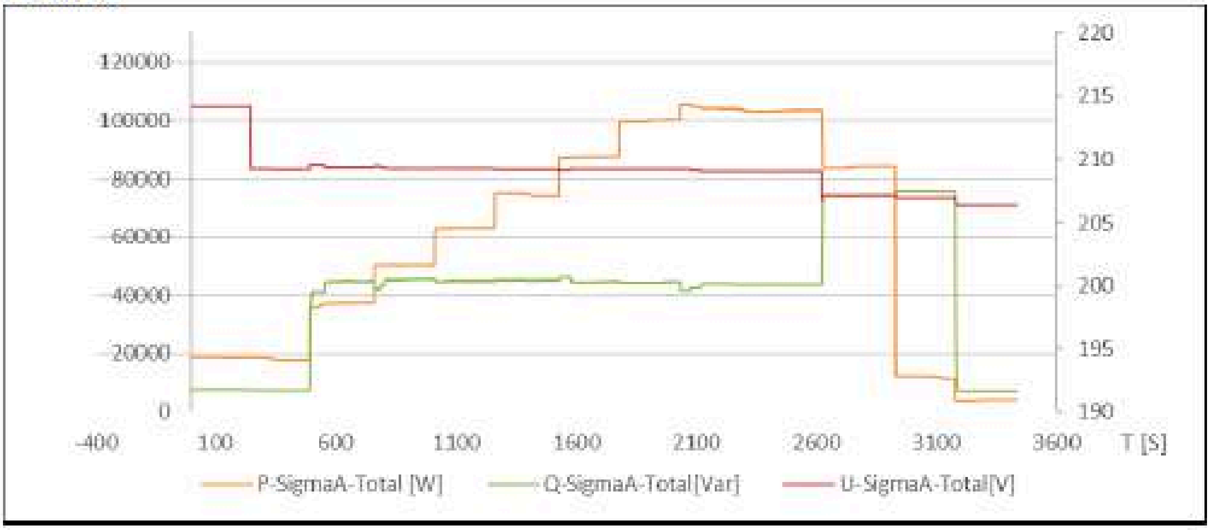
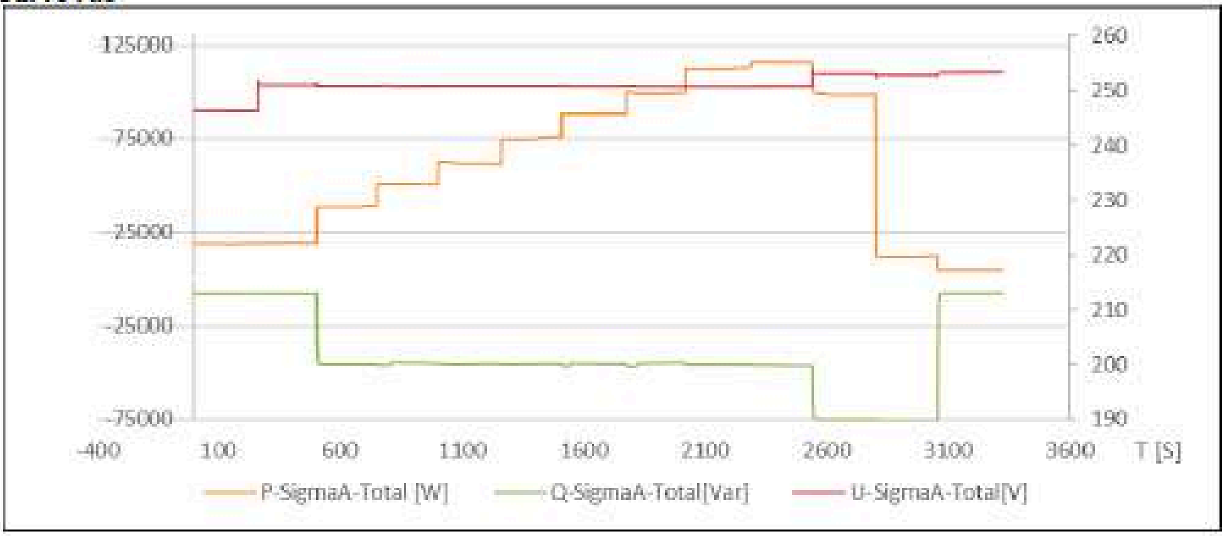


Table A.3: Discharge mode with k= -0.1								
Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Ps$_{max}$ [%]	V/Vn	P/Ps$_{max}$ [%]	Vout [V]	Q [Var]				
<20%	1.07	15.01	246.30	-7421	≈-k Q_{max} (< ± 5 % Sn)	0.06	≤ ± 5% Sn	P
<20%	1.09	15.24	251.10	-7340	≈-k Q_{max} (< ± 5 % Sn)	0.13	≤ ± 5% Sn	P
<20 % → 30 %	1.09	31.10	250.91	-45489	-0.6 Q_{max} (< 10 sec)	-0.39	≤ ± 5% Sn	P
40%	1.09	40.95	250.94	-45926	-0.6 Q_{max}	-0.74	≤ ± 5% Sn	P
50%	1.09	49.97	250.90	-45461	-0.6 Q_{max}	-0.37	≤ ± 5% Sn	P
60%	1.09	59.62	250.89	-45395	-0.6 Q_{max}	-0.32	≤ ± 5% Sn	P
70%	1.09	70.77	250.92	-46385	-0.6 Q_{max}	-1.11	≤ ± 5% Sn	P
80%	1.09	79.57	250.79	-44926	-0.6 Q_{max}	0.06	≤ ± 5% Sn	P
90%	1.09	89.85	250.81	-45543	-0.6 Q_{max}	-0.43	≤ ± 5% Sn	P
100%	1.09	92.62	250.81	-45930	-0.6 Q_{max}	-0.74	≤ ± 5% Sn	P
100%	1.10	78.86	253.09	-75211	-Q_{max}	-0.17	≤ ± 5% Sn	P
100 % → 10%	1.10	9.64	252.83	-75774	-Q_{max}	-0.62	≤ ± 5% Sn	P
10 % → ≤ 5%	1.10	3.74	253.30	-7239	≈-k Q_{max} (< ± 5 % Sn)	0.21	≤ ± 5% Sn	P

Table A.4: Discharge mode with k= -0.1								
Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Ps_{max} [%]	V/Vn	P/Ps_{max} [%]	Vout [V]	Q [Var]				
<20%	0.93	14.77	214.25	-7690	≈-k Q_{max} (< ± 5 % Sn)	-0.15	≤ ± 5% Sn	P
<20%	0.91	15.27	208.93	-7735	≈-k Q_{max} (< ± 5 % Sn)	-0.19	≤ ± 5% Sn	P
<20 % → 30 %	0.91	30.79	209.32	30606	0.4 Q_{max} (< 10 sec)	0.48	≤ ± 5% Sn	P
40%	0.91	39.72	209.35	29440	0.4 Q_{max}	-0.45	≤ ± 5% Sn	P
50%	0.91	50.02	209.36	28471	0.4 Q_{max}	-1.22	≤ ± 5% Sn	P
60%	0.91	60.66	209.15	31592	0.4 Q_{max}	1.27	≤ ± 5% Sn	P
70%	0.91	69.48	209.17	30327	0.4 Q_{max}	0.26	≤ ± 5% Sn	P
80%	0.91	79.75	209.11	29751	0.4 Q_{max}	-0.20	≤ ± 5% Sn	P
90%	0.91	86.95	209.18	29312	0.4 Q_{max}	-0.55	≤ ± 5% Sn	P
100%	0.91	87.25	209.12	29853	0.4 Q_{max}	-0.12	≤ ± 5% Sn	P
100%	0.90	71.13	206.85	67093	0.9 Q_{max}	-0.33	≤ ± 5% Sn	P
100 % → 10%	0.90	10.17	206.62	68233	0.9 Q_{max}	0.59	≤ ± 5% Sn	P
10 % → ≤ 5%	0.90	3.88	206.22	-7586	≈-k Q_{max} (< ± 5 % Sn)	-0.07	≤ ± 5% Sn	P

Graph curve Q=f(V)
Curve A.3



Graph curve Q=f(V)
Curve A.4

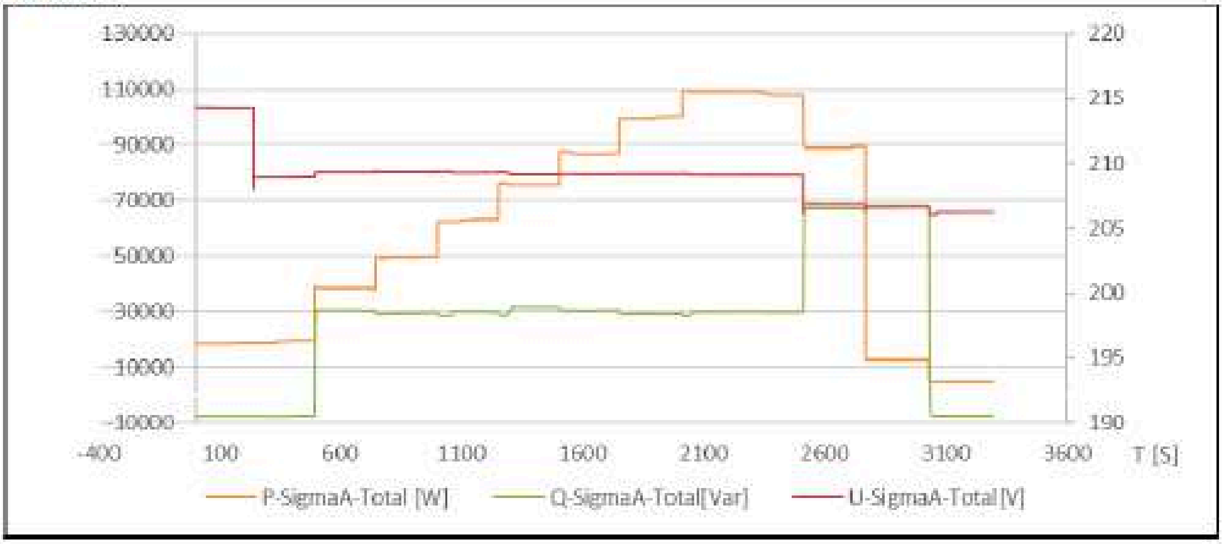
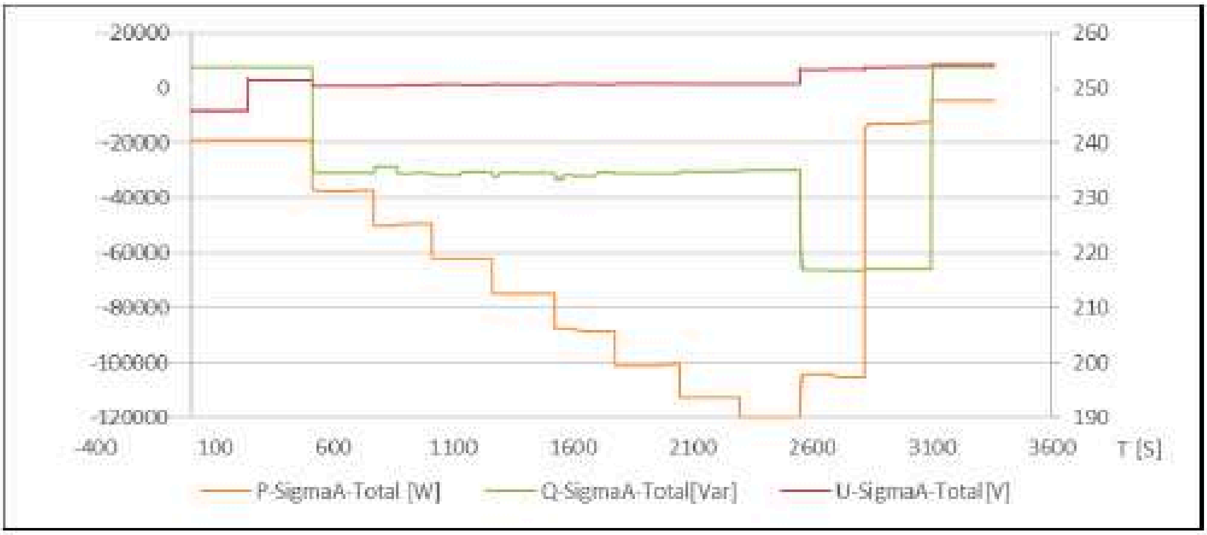


Table B.1: Charge mode with k=0.1								
Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Pc$_{max}$ [%]	V/Vn	P/Pc$_{max}$ [%]	Vout [V]	Q [Var]				
<20%	1.07	-15.20	245.95	7422	≈-k Q_{max} (< ± 5 % Sn)	-0.06	≤ ± 5% Sn	P
<20%	1.09	-15.46	251.53	7189	≈ -k Q_{max} (< ± 5 % Sn)	-0.25	≤ ± 5% Sn	P
<20 % → 30 %	1.09	-29.75	250.47	-30997	-0.4 Q_{max} (< 10 sec)	-0.80	≤ ± 5% Sn	P
40%	1.09	-39.33	250.65	-31118	-0.4 Q_{max}	-0.89	≤ ± 5% Sn	P
50%	1.09	-49.53	250.67	-30554	-0.4 Q_{max}	-0.44	≤ ± 5% Sn	P
60%	1.09	-59.74	250.74	-31006	-0.4 Q_{max}	-0.80	≤ ± 5% Sn	P
70%	1.09	-70.74	250.75	-30682	-0.4 Q_{max}	-0.55	≤ ± 5% Sn	P
80%	1.09	-80.77	250.88	-31132	-0.4 Q_{max}	-0.91	≤ ± 5% Sn	P
90%	1.09	-90.00	250.85	-30462	-0.4 Q_{max}	-0.37	≤ ± 5% Sn	P
100%	1.09	-96.11	250.83	-29953	-0.4 Q_{max}	0.04	≤ ± 5% Sn	P
100%	1.10	-83.44	253.28	-66155	-0.9 Q_{max}	1.08	≤ ± 5% Sn	P
100 % → 10%	1.10	-10.29	253.67	-65793	-0.9 Q_{max}	1.37	≤ ± 5% Sn	P
10 % → ≤ 5%	1.10	-3.71	254.27	7590	≈-k Q_{max} (< ± 5 % Sn)	0.07	≤ ± 5% Sn	P

Table B.2: Charge mode with k=0.1								
Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Pc_{max} [%]	V/Vn	P/Pc_{max} [%]	Vout [V]	Q [Var]				
<20%	0.93	-15.12	214.39	7688	≈k Q_{max} (< ± 5 % Sn)	0.15	≤ ± 5% Sn	P
<20%	0.91	-15.04	209.46	7636	≈k Q_{max} (< ± 5 % Sn)	0.11	≤ ± 5% Sn	P
<20 % → 30 %	0.91	-29.83	209.56	44879	0.6 Q_{max} (< 10 sec)	-0.10	≤ ± 5% Sn	P
40%	0.91	-40.26	209.49	45583	0.6 Q_{max}	0.47	≤ ± 5% Sn	P
50%	0.91	-50.43	209.48	45062	0.6 Q_{max}	0.05	≤ ± 5% Sn	P
60%	0.91	-59.81	209.43	45272	0.6 Q_{max}	0.22	≤ ± 5% Sn	P
70%	0.91	-69.77	209.36	46252	0.6 Q_{max}	1.00	≤ ± 5% Sn	P
80%	0.91	-79.64	209.46	44576	0.6 Q_{max}	-0.34	≤ ± 5% Sn	P
90%	0.91	-82.05	209.47	44575	0.6 Q_{max}	-0.34	≤ ± 5% Sn	P
100%	0.91	-83.46	209.27	44032	0.6 Q_{max}	-0.77	≤ ± 5% Sn	P
100%	0.90	-68.29	207.37	74448	Q_{max}	-0.44	≤ ± 5% Sn	P
100 % → 10%	0.90	-9.03	207.17	75769	Q_{max}	0.62	≤ ± 5% Sn	P
10 % → ≤ 5%	0.90	-3.33	206.57	7322	≈k Q_{max} (< ± 5 % Sn)	-0.14	≤ ± 5% Sn	P

Graph curve Q=f(V)
Curve B.1



Graph curve Q=f(V)
Curve B.2

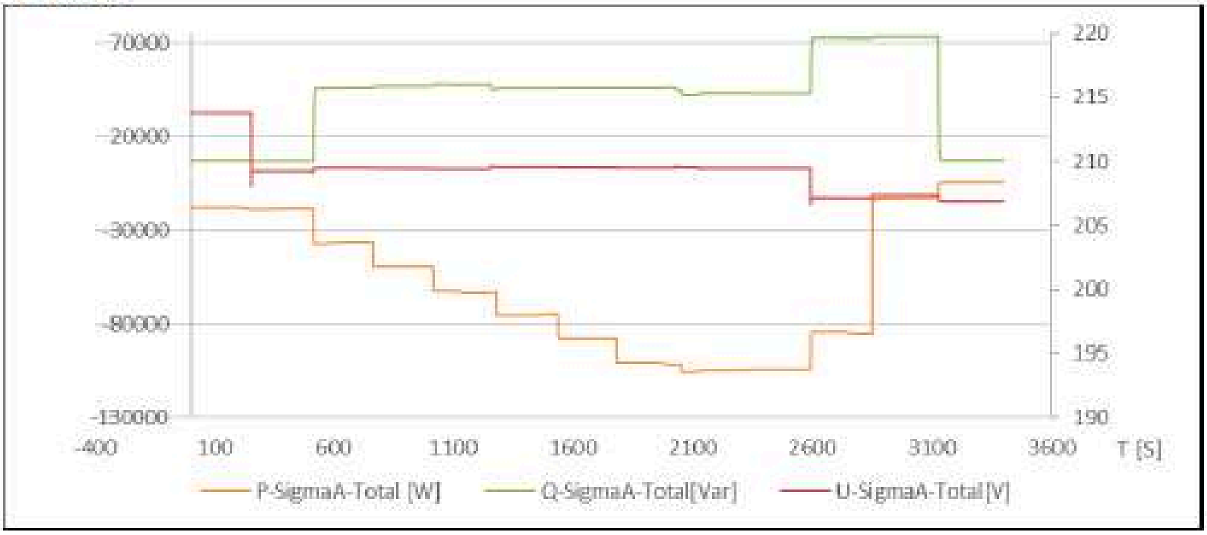
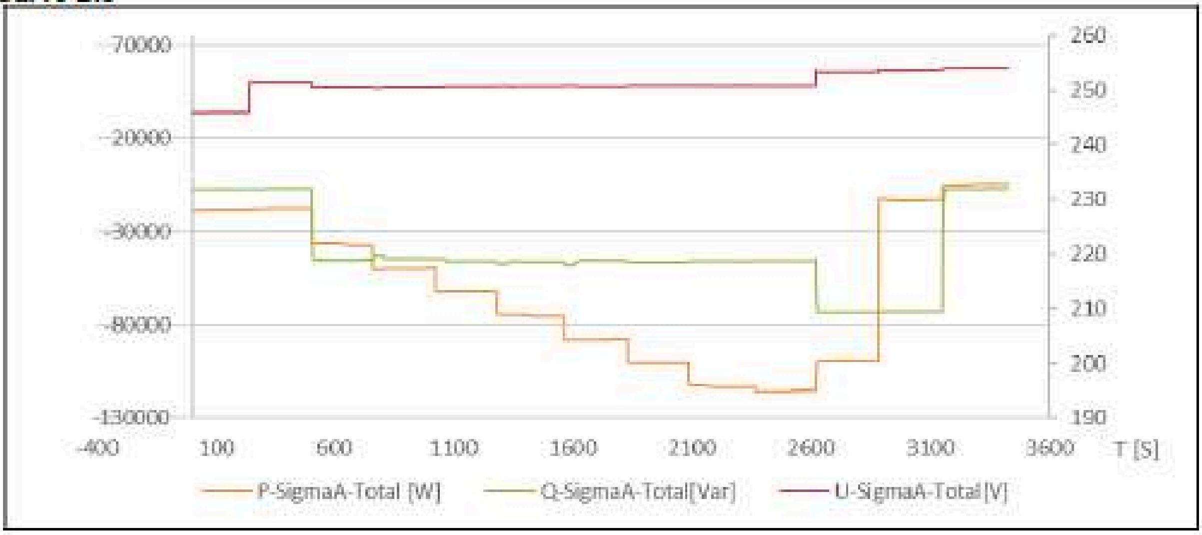


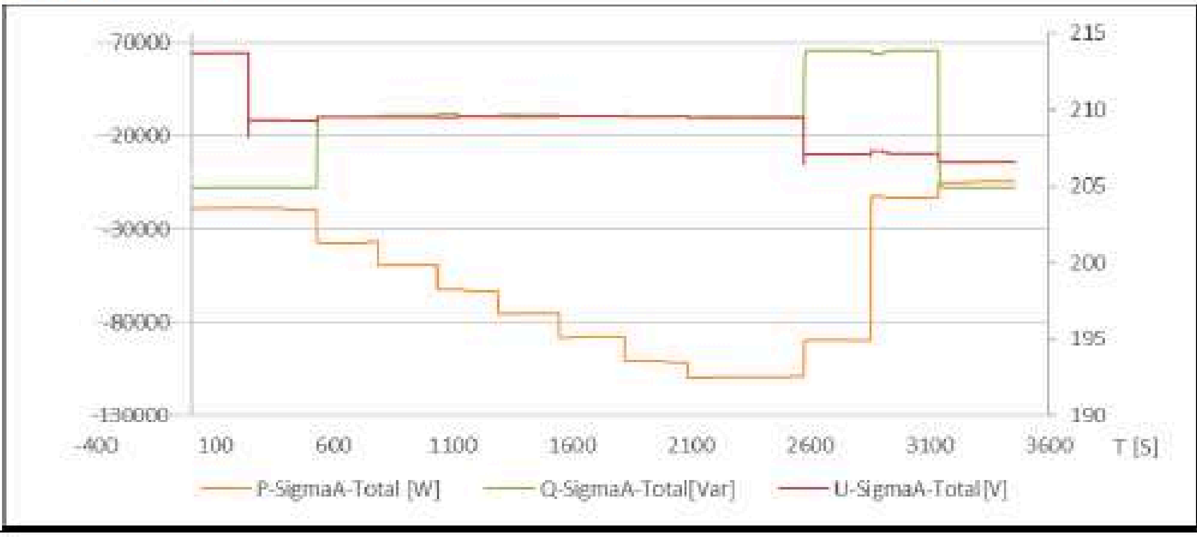
Table B.3: Charge mode with k= -0.1								
Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Pc$_{max}$ [%]	V/Vn	P/Pc$_{max}$ [%]	Vout [V]	Q [Var]				
<20%	1.07	-15.04	246.79	-7436	≈-k Q$_{max}$ (< ± 5 % Sn)	0.05	≤ ± 5% Sn	P
<20%	1.09	-15.27	251.60	-7355	≈-k Q$_{max}$ (< ± 5 % Sn)	0.12	≤ ± 5% Sn	P
<20 % → 30 %	1.09	-31.16	251.41	-45580	-0.6 Q$_{max}$ (< 10 sec)	-0.46	≤ ± 5% Sn	P
40%	1.09	-41.03	251.44	-46018	-0.6 Q$_{max}$	-0.81	≤ ± 5% Sn	P
50%	1.09	-50.07	251.40	-45552	-0.6 Q$_{max}$	-0.44	≤ ± 5% Sn	P
60%	1.09	-59.74	251.39	-45486	-0.6 Q$_{max}$	-0.39	≤ ± 5% Sn	P
70%	1.09	-70.91	251.42	-46478	-0.6 Q$_{max}$	-1.18	≤ ± 5% Sn	P
80%	1.09	-79.73	251.29	-45016	-0.6 Q$_{max}$	-0.01	≤ ± 5% Sn	P
90%	1.09	-90.03	251.31	-45634	-0.6 Q$_{max}$	-0.51	≤ ± 5% Sn	P
100%	1.09	-92.81	251.31	-46022	-0.6 Q$_{max}$	-0.82	≤ ± 5% Sn	P
100%	1.10	-79.02	253.60	-75361	-Q$_{max}$	-0.29	≤ ± 5% Sn	P
100 % → 10%	1.10	-9.66	253.34	-75926	-Q$_{max}$	-0.74	≤ ± 5% Sn	P
10 % → ≤ 5%	1.10	-3.75	253.81	-7253	≈-k Q$_{max}$ (< ± 5 % Sn)	0.20	≤ ± 5% Sn	P

Table B.4: Charge mode with k= -0.1								
Set Point		Measure			Q/Qn[%] expected	Δ Q %	LIMIT	RESULT
P/Pc$_{max}$ [%]	V/Vn	P/Pc$_{max}$ [%]	Vout [V]	Q [Var]				
<20%	0.93	-14.81	214.68	-7713.07	≈-k Q_{max} (< ± 5 % Sn)	-0.17	≤ ± 5% Sn	P
<20%	0.91	-15.32	209.35	-7758.21	≈-k Q_{max} (< ± 5 % Sn)	-0.21	≤ ± 5% Sn	P
<20 % → 30 %	0.91	-30.88	209.74	30697.82	0.4 Q_{max} (< 10 sec)	0.56	≤ ± 5% Sn	P
40%	0.91	-39.84	209.77	29528.32	0.4 Q_{max}	-0.38	≤ ± 5% Sn	P
50%	0.91	-50.17	209.78	28556.41	0.4 Q_{max}	-1.15	≤ ± 5% Sn	P
60%	0.91	-60.84	209.57	31686.78	0.4 Q_{max}	1.35	≤ ± 5% Sn	P
70%	0.91	-69.69	209.59	30417.98	0.4 Q_{max}	0.33	≤ ± 5% Sn	P
80%	0.91	-79.99	209.53	29840.25	0.4 Q_{max}	-0.13	≤ ± 5% Sn	P
90%	0.91	-87.21	209.60	29399.94	0.4 Q_{max}	-0.48	≤ ± 5% Sn	P
100%	0.91	-87.51	209.54	29942.56	0.4 Q_{max}	-0.05	≤ ± 5% Sn	P
100%	0.90	-71.34	207.26	67294.28	0.9 Q_{max}	-0.16	≤ ± 5% Sn	P
100 % → 10%	0.90	-10.20	207.03	68437.70	0.9 Q_{max}	0.75	≤ ± 5% Sn	P
10 % → ≤ 5%	0.90	-3.93	206.63	-7601.17	≈-k Q_{max} (< ± 5 % Sn)	-0.08	≤ ± 5% Sn	P

Graph curve Q=f(V)
Curve B.3



Graph curve Q=f(V)
Curve B.4



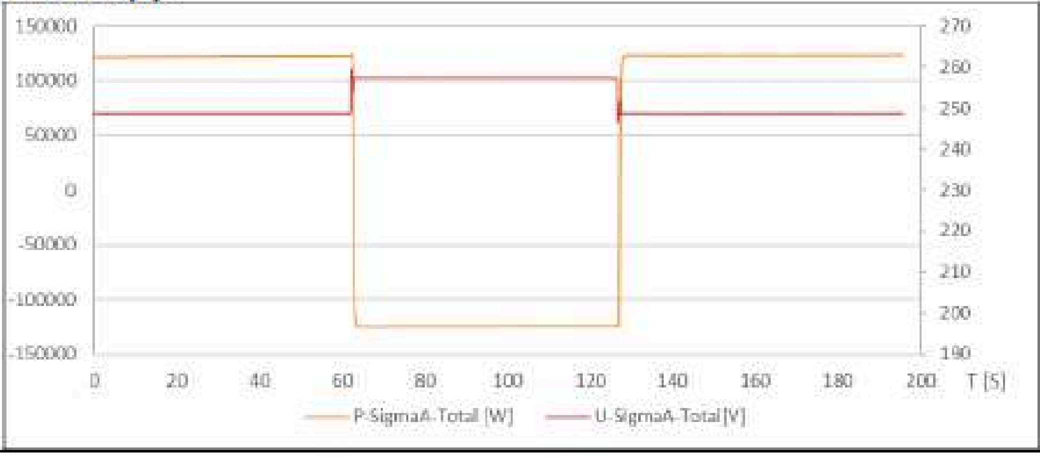
8.8.6.3.1 Nbis.7.1	**TABLE: Limitazione della potenza attiva per valori di tensione prossimi al 110 % di Un** */ Active power limitation for voltage values near to 110 % di Un*
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list..........:	See table "Measurement equipment and instrumentation"

Supplementary information:

- *The value for the reduction power activation's is defined from the manufacturer:*
- *Recorder the value of active power with average of 1 second.*

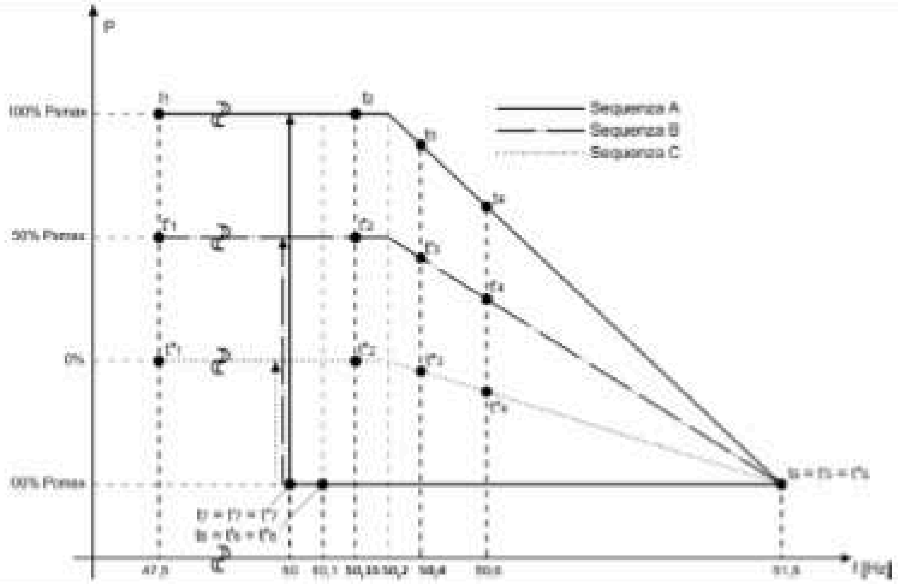
Set Point	Measure		Limits	Result
$V/V_{110\%}$ [%]	P_{out} [W]	V_{out} [V]		
-2%	121917	248.6	-	P
+2%	-125026	257.5	≤ 20% P_{Smax} *(for unidirectional)* ≥ 80% P_{Cmax} *(for bidirectional)*	P
-2%	123501	248.6	-	P

Graph curve P=f(V) :



8.8.6.3.2 Nbis.7.2	TABLE: Regolazione della potenza attiva in presenza di transitori sulla rete di trasmissione */Active power regulation in coincidence with transitory on the transmission grid*

Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list..:	See table "Measurement equipment and instrumentation"



Supplementary information:

- Recorder the value of active power with average of 0,2 second.
- The storage must have energy equal to 80% of CUS
- The Sequence A start to 100%Ps_{max} (or P_{inv} for ESS integrated)
- The Sequence B start to 50%Ps_{max} (or P_{inv} for ESS integrated)
- The Sequence C start to 0%Ps_{max} (or P_{inv} for ESS integrated) and it's applicable only for Bidirectional converter

Tollerance of the Power: 2.5% S_N (S_N = Nominal Power of the Converter).

Sequence A						
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
1	100% Ps_{max}	47.50	125000	123373	± 2.5% S_n	t1
2	100% Ps_{max}	50.15	125000	123325	± 2.5% S_n	t2
3	100% Ps_{max}	50.40	84275	84825	± 2.5% S_n	t3
4	100% Ps_{max}	50.60	46225	46659	± 2.5% S_n	t4
5	100% Ps_{max}	51.49	-123097	-125631	± 2.5% S_n	t5
6	100% Ps_{max}	50.11	-123097	-125614	± 2.5% S_n	t6
Step #	Set output power [%]	frequency [Hz]	Wait time [s]	Power Gradient [% P_{ref}/min]	Limits	
					Wait time [s]	Power Gradient [% P_{ref}/min]
6→7	100% Ps_{max}	50.00	601	9.03	≥ 300	≤20%
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
7	100% Ps_{max}	50.00	125000	122355	± 2.5% S_n	t7
Sequence B						
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	limits	Graph point
1	50% Ps_{max}	47.50	62500	62030	± 2.5% S_n	t1'
2	50% Ps_{max}	50.15	62500	62001	± 2.5% S_n	t2'
3	50% Ps_{max}	50.40	33832	34070	± 2.5% S_n	t3'
4	50% Ps_{max}	50.60	4958	5141	± 2.5% S_n	t4'
5	50% Ps_{max}	51.49	-123534	-125899	± 2.5% S_n	t5'

6	50% Ps_{max}	50.11	-123534	-125853	± 2.5% S_n	t6'
Step #	**Set output power [%]**	**frequency [Hz]**	**Wait time [s]**	**Power Gradient [% P_{ref}/min]**	**Limits**	
					Wait time [s]	**Power Gradient [% P_{ref}/min]**
6→7	100% Ps_{max}	50.00	602	9.02	≥ 300	≤20%
Step #	**Set output power [%]**	**frequency [Hz]**	**Expected power value [W]**	**Actual power values [W]**	**Limits**	**Graph point**
7	50% Ps_{max}	50.00	62500	62931	± 2.5% S_n	t7'
Sequence C*						
Step #	**Set output power [%]**	**frequency [Hz]**	**Expected power value [W]**	**Actual power values [W]**	**limits**	**Graph point**
1	0% PS_{max}	47.50	0	-841	± 2.5% S_n	t1''
2	0% PS_{max}	50.15	0	-909	± 2.5% S_n	t2''
3	0% PS_{max}	50.40	-19995	-20963	± 2.5% S_n	t3''
4	0% PS_{max}	50.60	-39082	-40463	± 2.5% S_n	t4''
5	0% PS_{max}	51.49	-123550	-126476	± 2.5% S_n	t5''
6	0% PS_{max}	50.11	-123550	-126419	± 2.5% S_n	t6''
Step #	**Set output power [%]**	**frequency [Hz]**	**Wait time [s]**	**Power Gradient [% P_{ref}/min]**	**Limits**	
					Wait time [s]	**Power Gradient [% P_{ref}/min]**
6→7	100% Ps_{max}	50.00	601	9.02	≥ 300	≤20%
Step #	**Set output power [%]**	**frequency [Hz]**	**Expected power value [W]**	**Actual power values [W]**	**Limits**	**Graph point**
7	0% Ps_{max}	50.00	0	-686	± 2.5% S_n	t7''

Sequence C applicable only for bidirectional converters.

Grafico Sequenza A: Curva di limitazione della potenza attiva rispetto alla frequenza
/ Graph Sequence A: Active power regulation in coincidence with transitory on the transmission grid

Sequence A line graph:

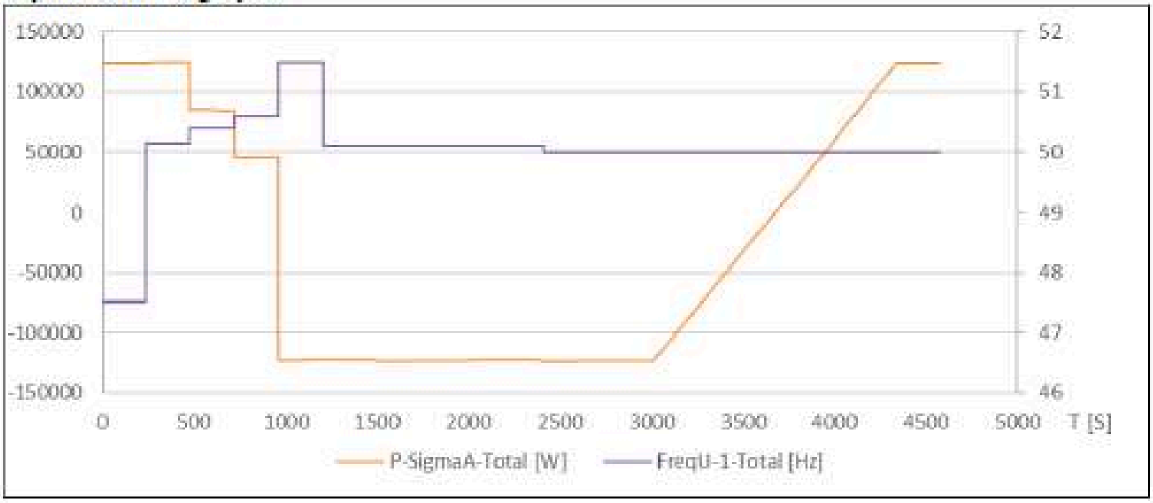


Grafico Sequenza B: Curva di limitazione della potenza attiva rispetto alla frequenza
/ Graph Sequence B: Active power regulation in coincidence with transitory on the transmission grid

Sequence B line graph:

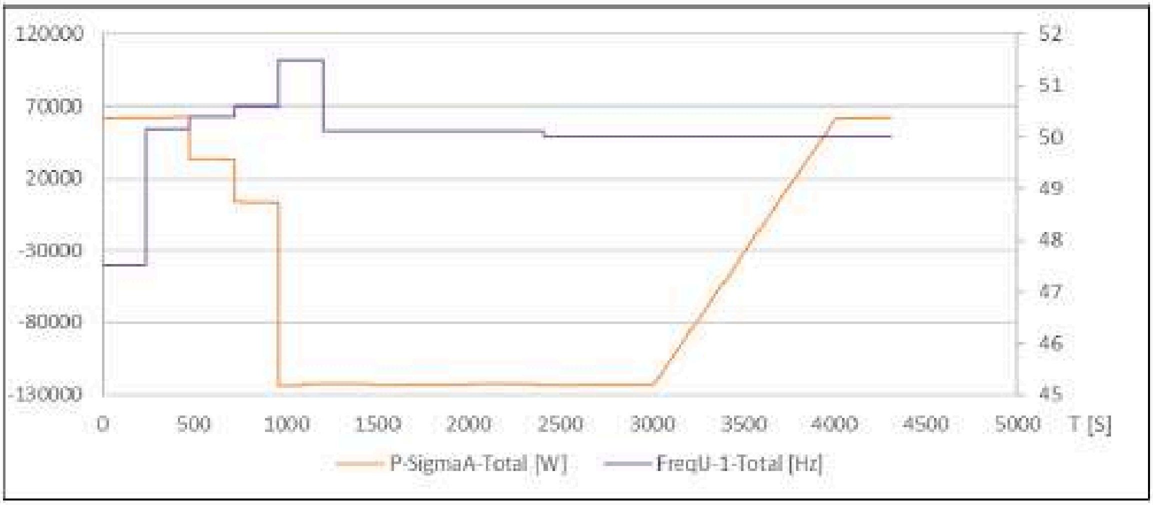
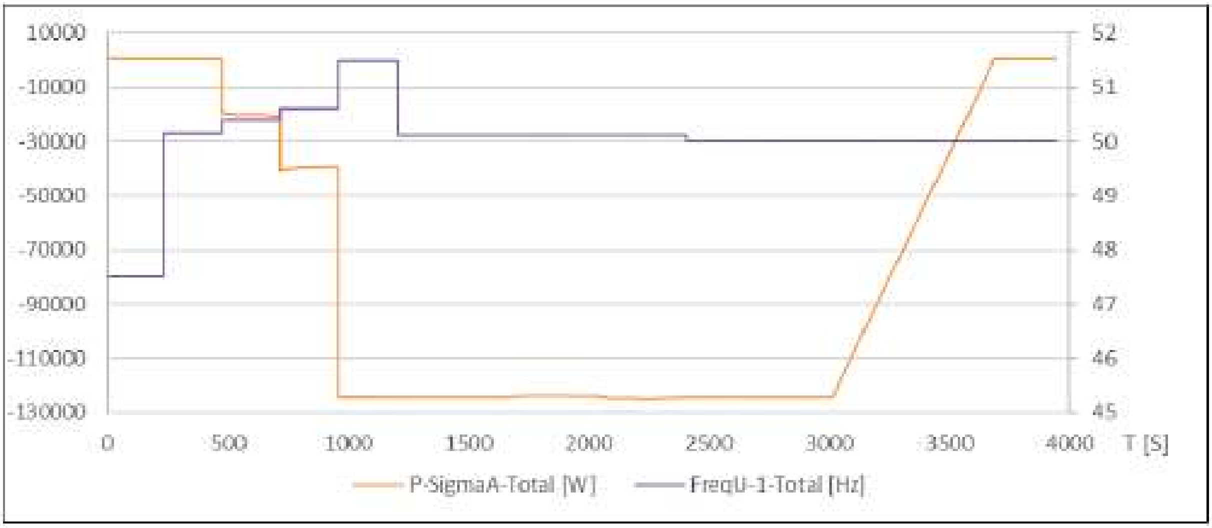


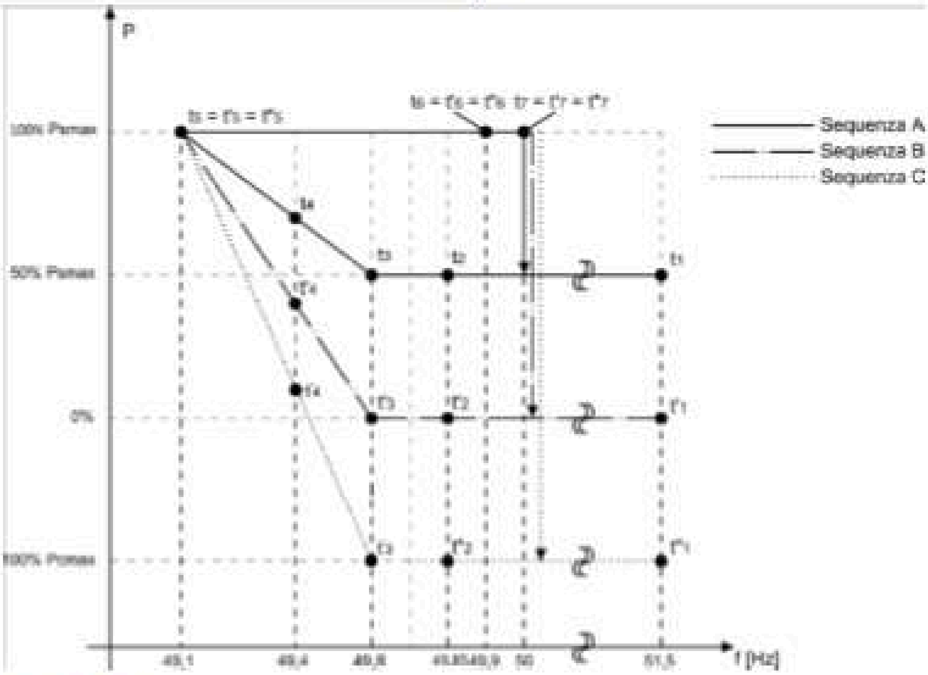
Grafico Sequenza C*: Curva di limitazione della potenza attiva rispetto alla frequenza

/ Graph Sequence C: Active power regulation in coincidence with transitory on the transmission grid*

Sequence C line graph:



8.8.6.3.3 Nbis.7.3	TABLE: Regolazione della potenza attiva in presenza di transitori sulla rete di trasmissione */Active power regulation in coincidence with transitory on the transmission grid*
Ambient temperature (°C) .... :	25 °C ± 5 °C
Humidity (RH %) .... :	65%
Instrumentation list... :	See table "Measurement equipment and instrumentation"



Supplementary information:

- Recorder the value of active power with average of 0,2 second.
- The storage must have energy equal to 80% of CUS
- The Sequence A start to 50%$P_{S max}$ (or P_{inv} for ESS integrated)
- The Sequence B start to 0%$P_{S max}$ (or P_{inv} for ESS integrated)
- The Sequence C start to 1000%$P_{C max}$ (or P_{inv} for ESS integrated) and it's applicable only for Bidirectional converter

Tollerance of the Power: 2.5% S_N (S_N = Nominal Power of the Converter).

Sequence A						
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	limits	Graph point
1	50% PS_{max}	51.50	62500	62590	± 2.5% S_n	t1
2	50% PS_{max}	49.85	62500	62532	± 2.5% S_n	t2
3	50% PS_{max}	49.60	80452	80599	± 2.5% S_n	t3
4	50% PS_{max}	49.40	98271	97633	± 2.5% S_n	t4
5	50% PS_{max}	49.11	124109	123275	± 2.5% S_n	t5
6	50% PS_{max}	49.89	124109	123256	± 2.5% S_n	t6
Step #	Set output power [%]	frequency [Hz]	Wait time [s]	Power Gradient [% P_{ref}/min]	Limits	
					Wait time [s]	Power Gradient [% P_{ref}/min]
6→7	50% PS_{max}	50.00	603	9.04	≥ 300	20%
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
7	50% PS_{max}	50.00	62500	62648	± 2.5% S_n	t7

Sequence B						
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	limits	Graph point
1	0% PS_{max}	51.50	0	-140	± 2.5% S_n	t1'
2	0% PS_{max}	49.85	0	-137	± 2.5% S_n	t2'
3	0% PS_{max}	49.60	34804	35074	± 2.5% S_n	t3'
4	0% PS_{max}	49.40	70882	70796	± 2.5% S_n	t4'
5	0% PS_{max}	49.11	123196	122264	± 2.5% S_n	t5'

6	0% PS_{max}	49.89	123196	122224	± 2.5% S_n	t6'
Step #	Set output power [%]	frequency [Hz]	Wait time [s]	Power Gradient [% P_{ref}/min]	Limits Wait time [s]	Limits Power Gradient [% P_{ref}/min]
6→7	0% PS_{max}	50.00	604	9.02	≥ 300	20%
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
7	0% PS_{max}	50.00	0	-475	± 2.5% S_n	t7'

Sequence C*						
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	limits	Graph point
1	100% Pc_{max}	51.50	-125000	-125742	± 2.5% S_n	t1''
2	100% Pc_{max}	49.85	-125000	-125732	± 2.5% S_n	t2''
3	100% Pc_{max}	49.60	-54094	-52231	± 2.5% S_n	t3''
4	100% Pc_{max}	49.40	17544	19009	± 2.5% S_n	t4''
5	100% Pc_{max}	49.11	121418	121688	± 2.5% S_n	t5''
6	100% Pc_{max}	49.89	121418	121971	± 2.5% S_n	t6''
Step #	Set output power [%]	frequency [Hz]	Wait time [s]	Power Gradient [% P_{ref}/min]	Limits Wait time [s]	Limits Power Gradient [% P_{ref}/min]
6→7	100% Pc_{max}	50.00	605	9.04	≥ 300	20%
Step #	Set output power [%]	frequency [Hz]	Expected power value [W]	Actual power values [W]	Limits	Graph point
7	100% Pc_{max}	50.00	-125000	-125624	± 2.5% S_n	t7''

Sequence C applicable only for bidirectional converters.

Grafico Sequenza A: Curva di limitazione della potenza attiva rispetto alla frequenza

/ Graph Sequence A: Active power regulation in coincidence with transitory on the transmission grid

Sequence A line graph:

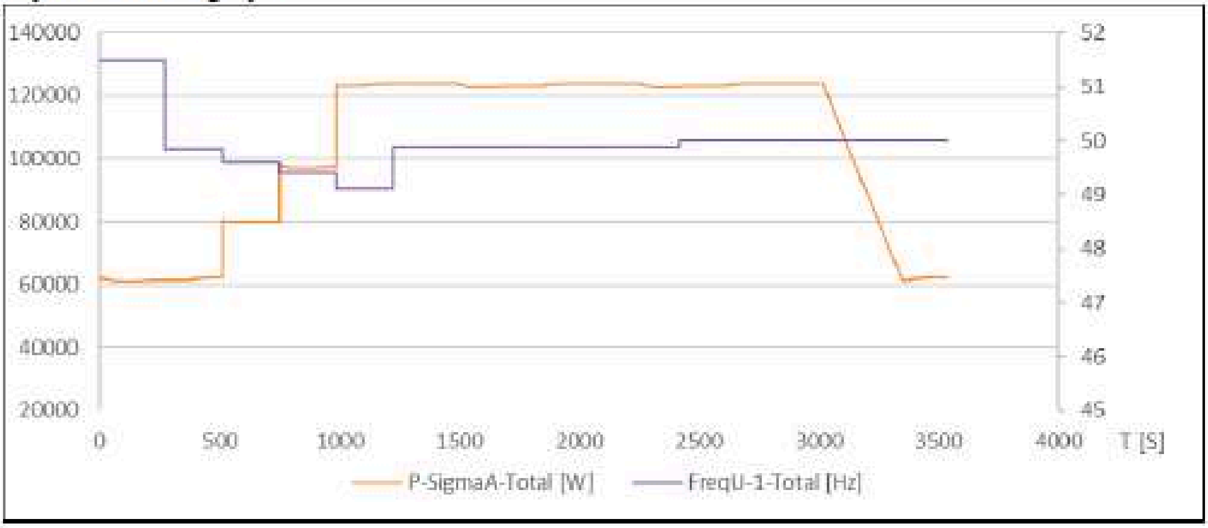


Grafico Sequenza B: Curva di limitazione della potenza attiva rispetto alla frequenza

/ Graph Sequence B: Active power regulation in coincidence with transitory on the transmission grid

Sequence B line graph:

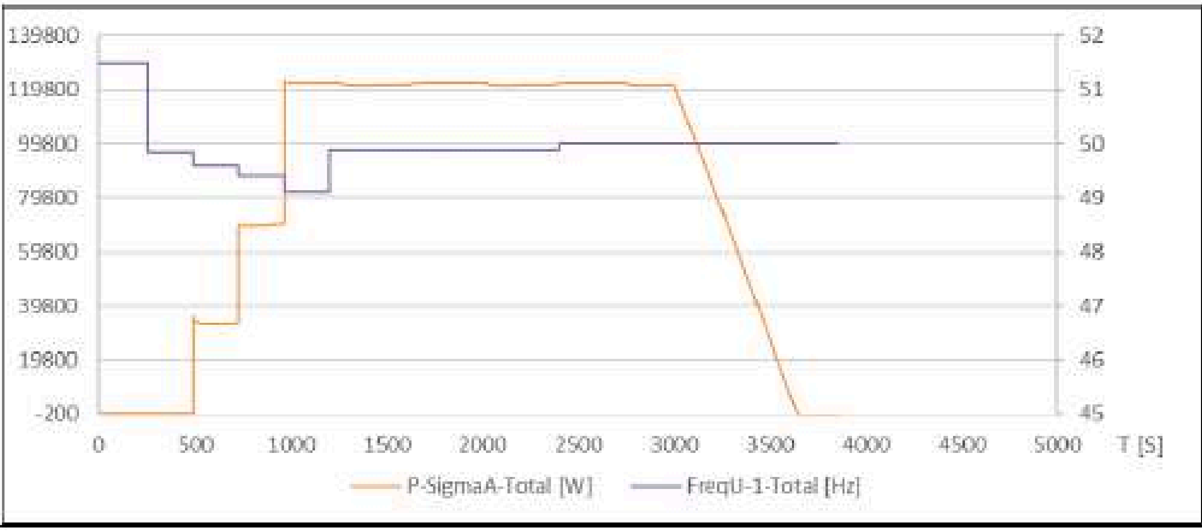
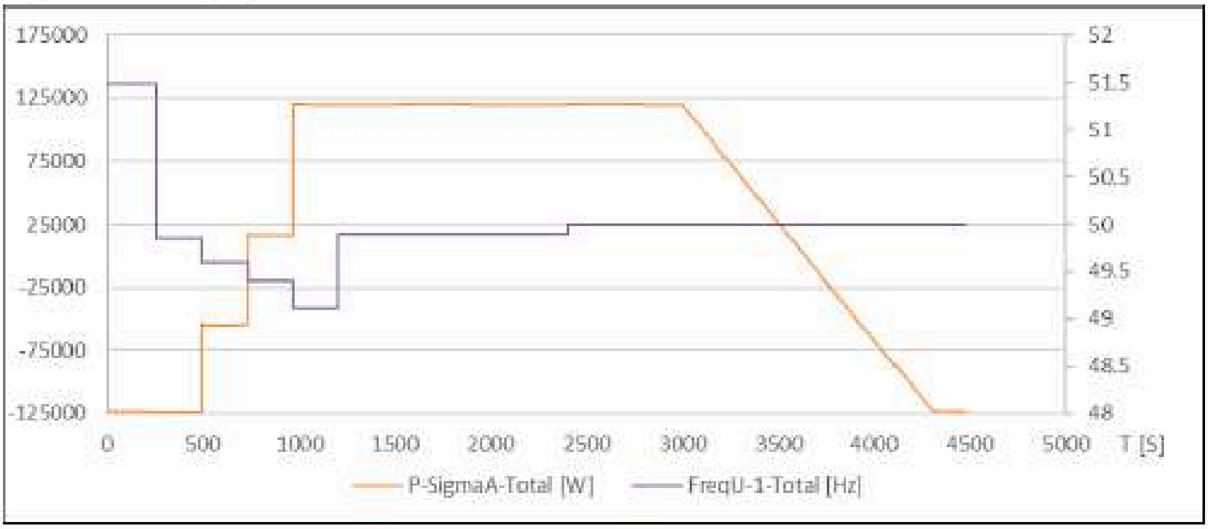


Grafico Sequenza C*: Curva di limitazione della potenza attiva rispetto alla frequenza

/ Graph Sequence C: Active power regulation in coincidence with transitory on the transmission grid*

Sequence C line graph:



8.8.6.3 Nbis.7.4	**TABLE: Limitazione della potenza attiva su comando esterno proveniente dal Distributore** ***/ Active power limitation in coincidence with external command coming from the Electricity Distributor***
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list....................................:	See table "Measurement equipment and instrumentation"
Uncertainty ....:	See table
Supplementary information: Start test with output power at 50%Ps_{max} The setting point time's of active power command is 60 seconds. The active power measure's is checked at least after 30 seconds from the set-point of active power command. The test with set-point of 30% Pcmax is applicable only for bidirectional converters.	
Operator ....:	See cover page
Supervisor ....:	See cover page
Test Date....................................:	See cover page

Test	Set Point	Output Power expected [W]	Output Power measured [W]	Δ P/Pn [%]	Limit [%]	RESULT
1	50%PS_{max} → 30%PS_{max}	37500	37614	0.09	± 2.5% PS_{max}	P
2	50%PS_{max} →30% Pc_{max}*	-37500	-37681	0.09	± 2.5% PS_{max}	P

****Test applicable only for bidirectional converters.***

Grafico Test 1: Limitazione della potenza attiva in risposta a comando esterno
/ Graph Test 1: Active power limitation in coincidence with external command coming from the Electricity Distributor

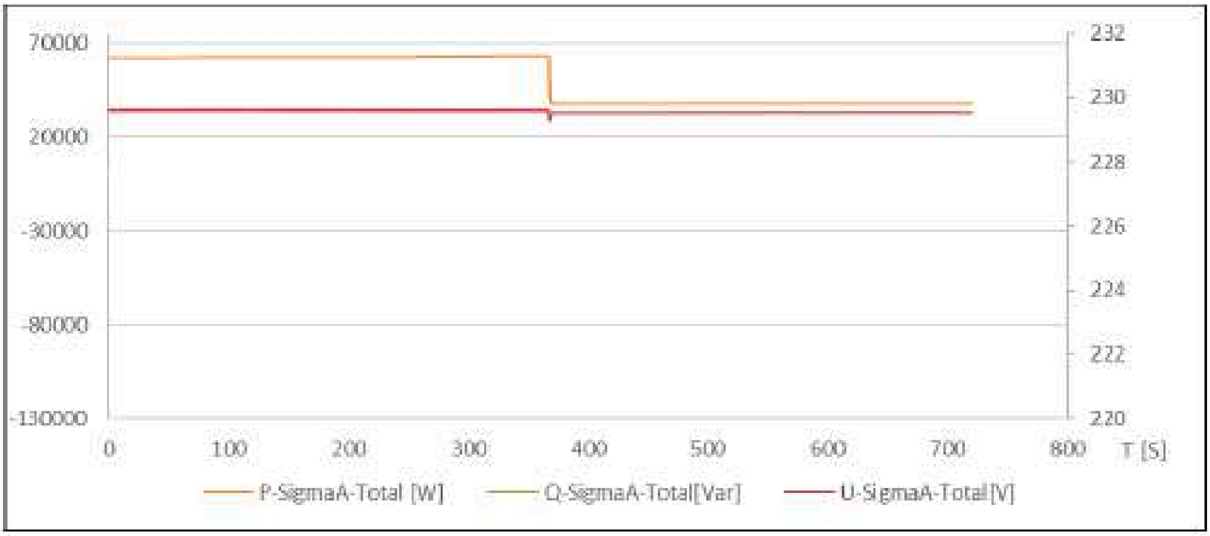
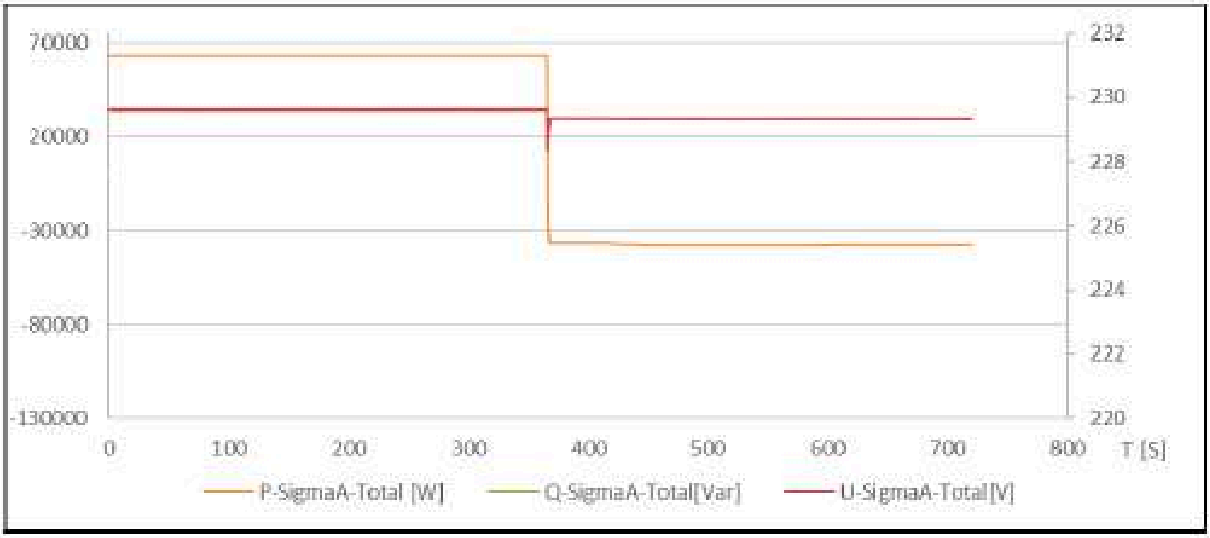


Grafico Test 2: Limitazione della potenza attiva in risposta a comando esterno
/ Graph Test 2: Active power limitation in coincidence with external command coming from the Electricity Distributor



Nbis.7.4.1	TABLE: **Verifica del tempo di assestamento ad un comando di incremento/riduzione di potenza** */ Check the settling time with external command to increase/decrease the power*
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list......................................:	See table "Measurement equipment and instrumentation"
Supplementary information: - Table A is applicable only for bidirectional converters. - Table B is applicable only for unidirectional converters.	
Operator ....:	See cover page
Supervisor ....:	See cover page
Test Date......................................:	See cover page

Tabella A: Tempo di assestamento ad un comando di riduzione della potenza attiva */ Table A: Time of allignment after an active power reduction command*							
Test	**Set Point**	**Output Power expected [W]**	**Output Power measured [W]**	**Output Power limit [%]**	**Settling Time [s]**	**Settling Time limit [s]**	**RESULT**
A.1*	100% Ps_{max} → 30% Pc_{max}	-37500	-38423	± 2.5% S_n	1.4	< 50	P
A.2	100% Ps_{max} → 30% Ps_{max}	37500	36491	± 2.5% S_n	1.2	< 50	P
Table B: Tempo di assestamento ad un comando di incremento della potenza attiva */ Table B: Time of allignment after an active power increasing command*							
Test	**Set Point**	**Output Power expected [W]**	**Output Power measured [W]**	**Output Power limit [%]**	**Settling Time [s]**	**Settling Time limit [s]**	**RESULT**
B.1*	100% Pc_{max} → 50% Ps_{max}	62500	63204	± 2.5% S_n	1.0	< 50	P
B.2	0% Ps_{max} → 50% Ps_{max}	62500	62062	± 2.5% S_n	1.0	< 50	P

***Test applicable only for bidirectional converters.**

Grafico Test A.1: Limitazione della potenza attiva in risposta a comando esterno

/ Graph Test A.1: Active power limitation in coincidence with external command coming from the Electricity Distributor

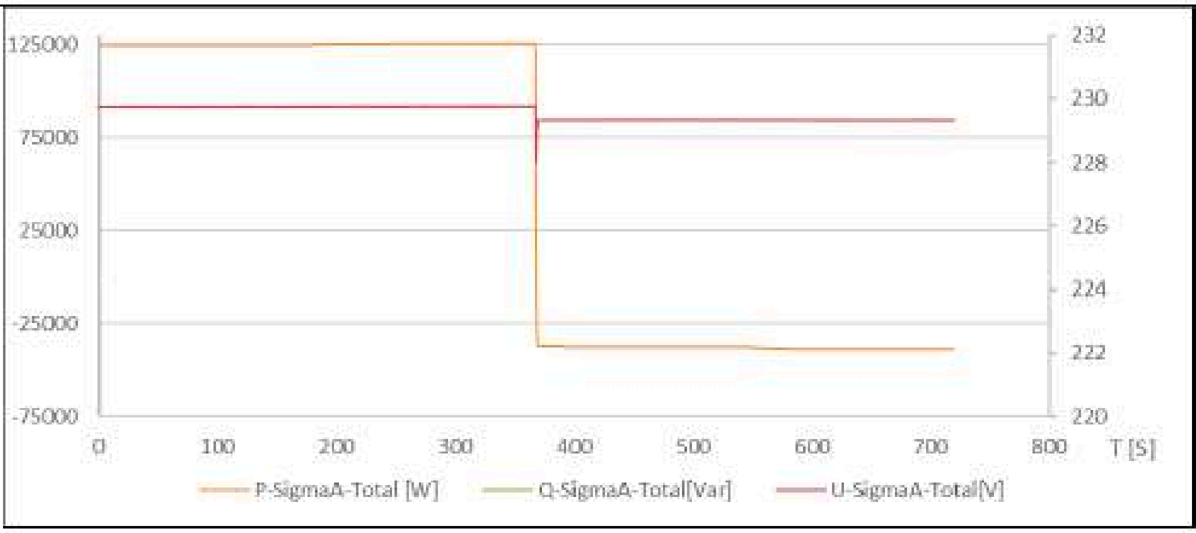


Grafico Test A.2: Limitazione della potenza attiva in risposta a comando esterno
/ Graph Test A.2: Active power limitation in coincidence with external command coming from the Electricity Distributor

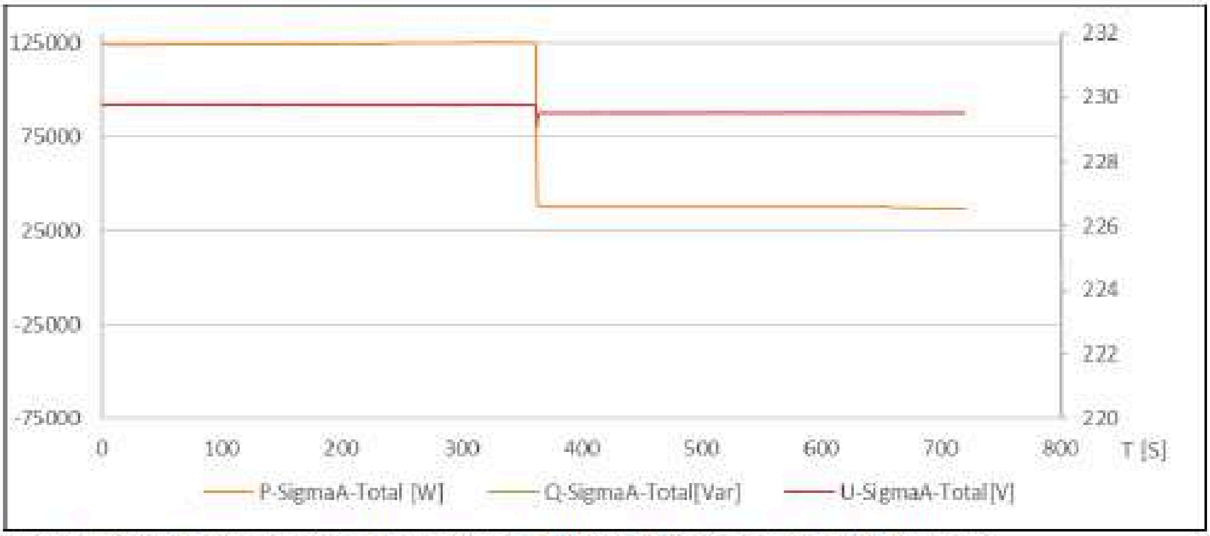


Grafico Test B.1: Limitazione della potenza attiva in risposta a comando esterno
/ Graph Test B.1: Active power limitation in coincidence with external command coming from the Electricity Distributor

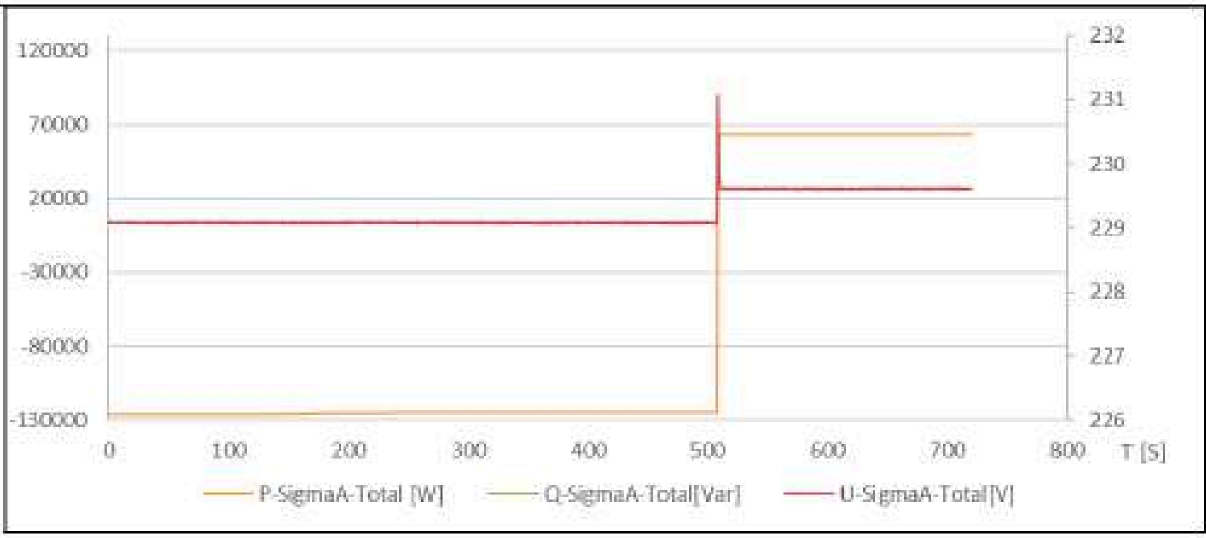
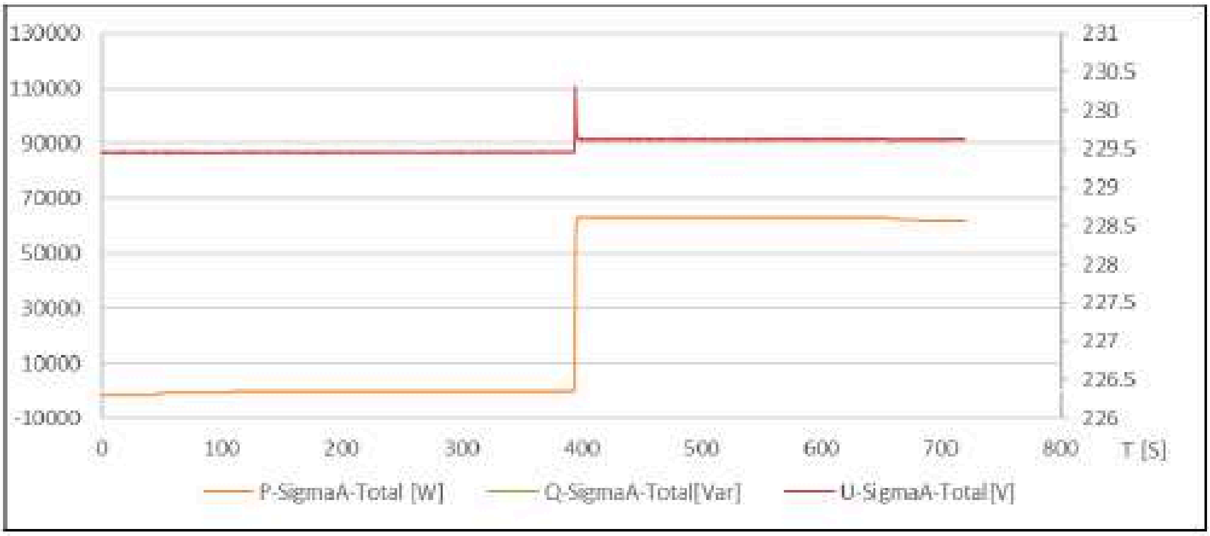
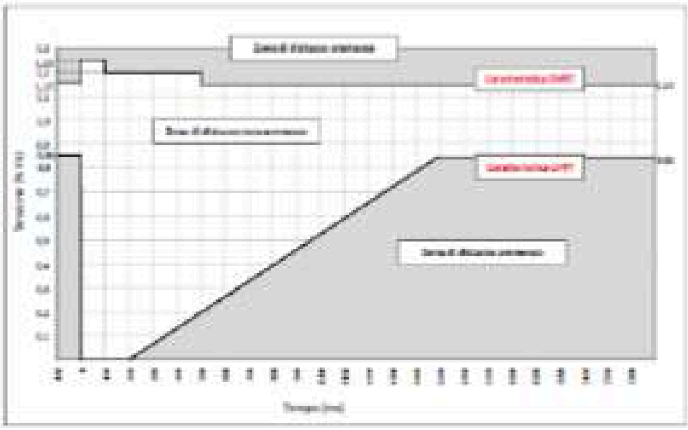


Grafico Test B.2: Limitazione della potenza attiva in risposta a comando esterno
/ Graph Test B.2: Active power limitation in coincidence with external command coming from the Electricity Distributor



8.8.6.1 **Nbis. 8 - VFRT Capability** */ VFRT Capability*	
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list...:	See table "Measurement equipment and instrumentation"



Supplementary information:

Test is performed in the following conditions:

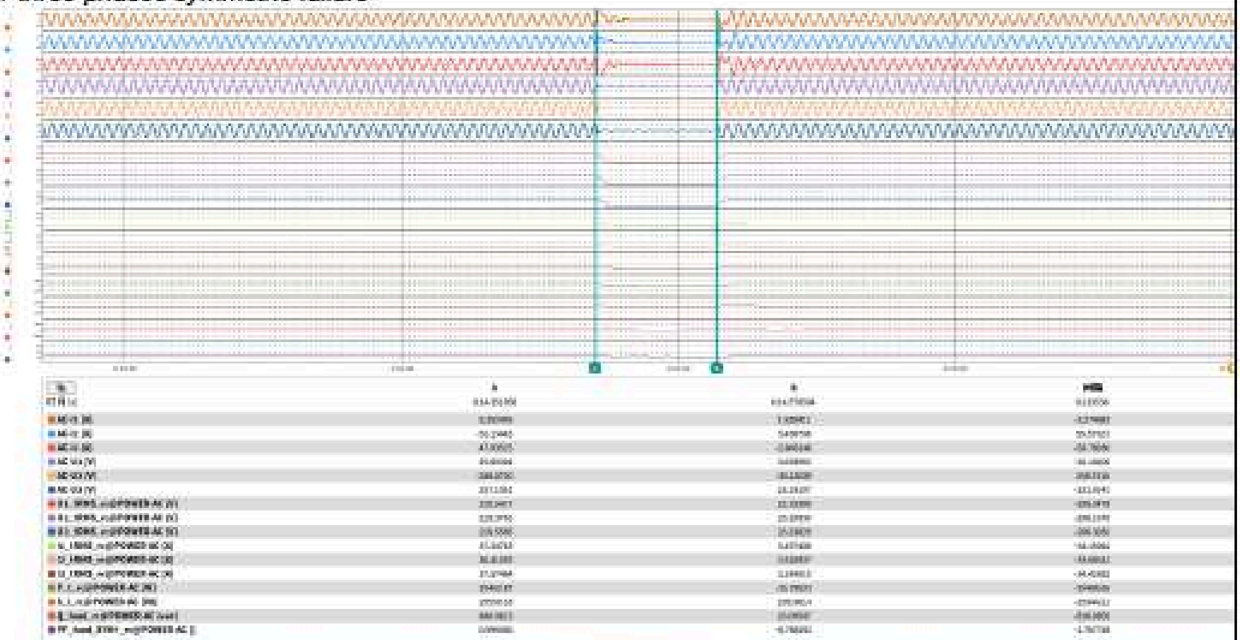
- Output Voltage: 230Vac p-n @ 50Hz

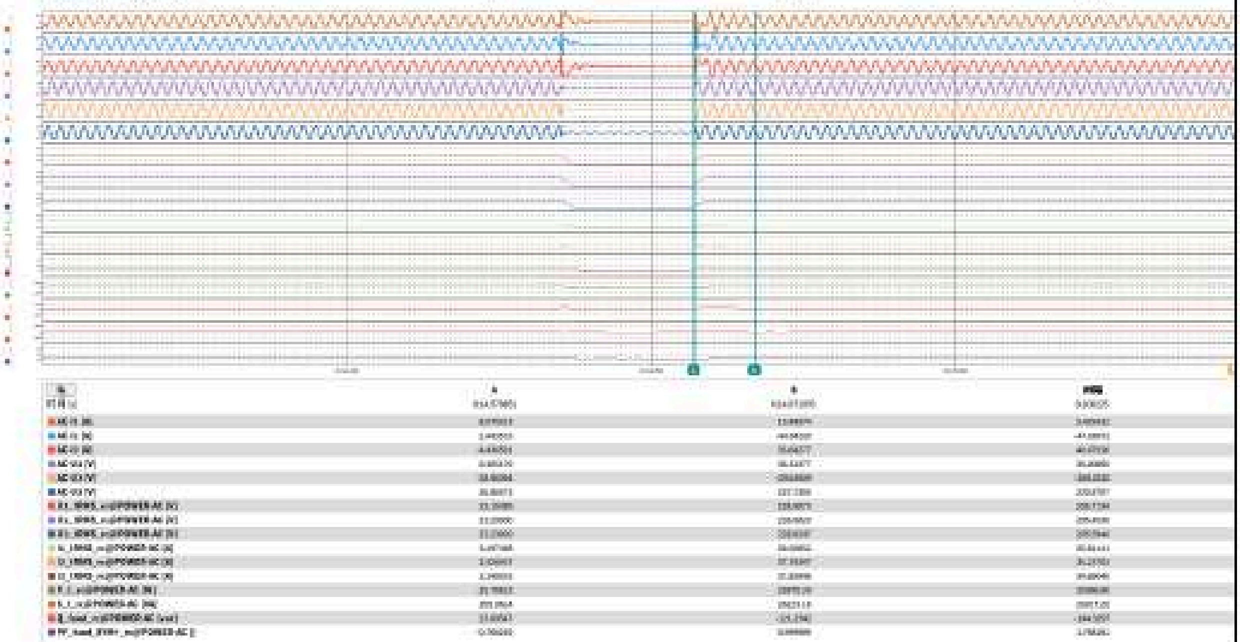
Sample Rate Data Acquisition= 200k Sample/sec
Undersampling= 0.0001 sec
MovingAverage= 0.0100 sec
Average= 0.0100 sec

TABLE Nbis.8 Output power: 25000W				Limit: from 10 % to 30% P_{Smax}.					
Test	Residual magnitude [V/Vn]			phase angle [°]			Duration	Recovery time	Recovery time limit
	R	S	T	φ_1	φ_2	φ_3	[ms]	[ms]	[ms]
1s – guasto simmetrico trifase / *three phases symmetric failure*	0.10 ± 0.05	0.10 ± 0.05	0.10 ± 0.05	0°	-120°	120°	200 ± 20	100	400
1a – guasto asimmetrico bifase / *two phases asymmetric failure*	0.87 ± 0.05	0.87 ± 0.05	0.10 ± 0.05	27°	-147°	120°	200 ± 20	102	400
2s – guasto simmetrico trifase / *three phases symmetric failure*	0.25 ± 0.05	0.25 ± 0.05	0.25 ± 0.05	0°	-120°	120°	400 ± 20	110	400
2a – guasto asimmetrico bifase / *two phases asymmetric failure*	0.88 ± 0.05	0.88 ± 0.05	0.25 ± 0.05	22°	-142°	120°	400 ± 20	102	400
3s – guasto simmetrico trifase / *three phases symmetric failure*	0.50 ± 0.05	0.50 ± 0.05	0.50 ± 0.05	0°	-120°	120°	850 ± 20	104	400
3a – guasto asimmetrico bifase / *two phases asymmetric failure*	0.90 ± 0.05	0.90 ± 0.05	0.50 ± 0.05	14°	-134°	120°	850 ± 20	107	400
4s – guasto simmetrico trifase / *three phases symmetric failure*	0.75 ± 0.05	0.75 ± 0.05	0.75 ± 0.05	0°	-120°	120°	1300 ± 20	134	400
4a – guasto simmetrico bifase / *two phases asymmetric failure*	0.94 ± 0.05	0.94 ± 0.05	0.75 ± 0.05	7°	-127°	120°	1300 ± 20	107	400
5 OV1 - three-phase symmetrical overvoltage	1.25± 0.05	1.25± 0.05	1.25± 0.05	0°	-120°	120	100± 20	114	400
6 OV2 - three-phase symmetrical overvoltage	1.20± 0.05	1.20± 0.05	1.20± 0.05	0°	-120°	120	500± 20	142	400

TABLE Nbis. 8a TESTS REUSULT

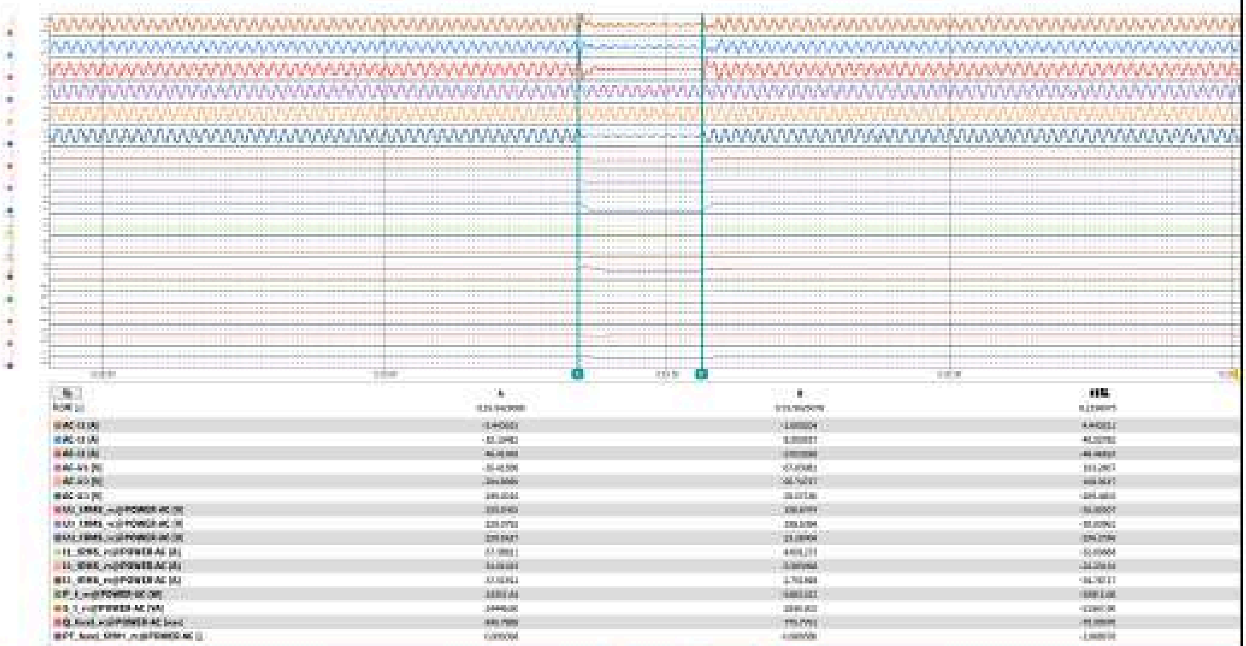
Test 1s -- guasto simmetrico trifase
/ three phases symmetric failure

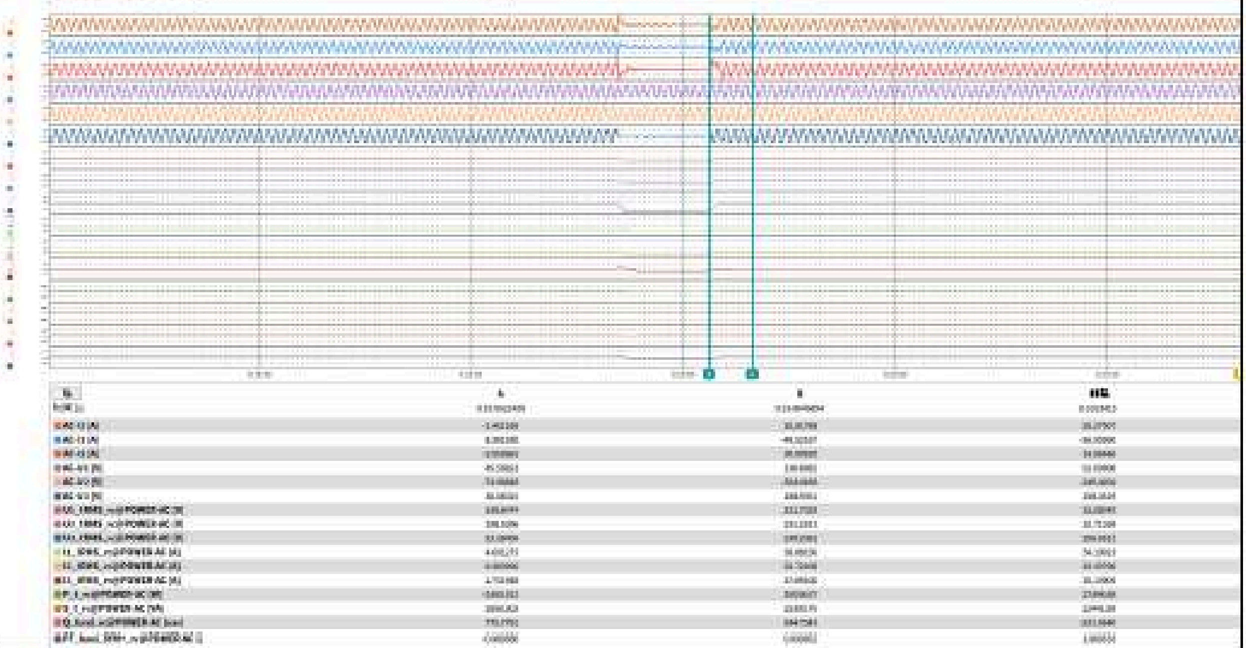




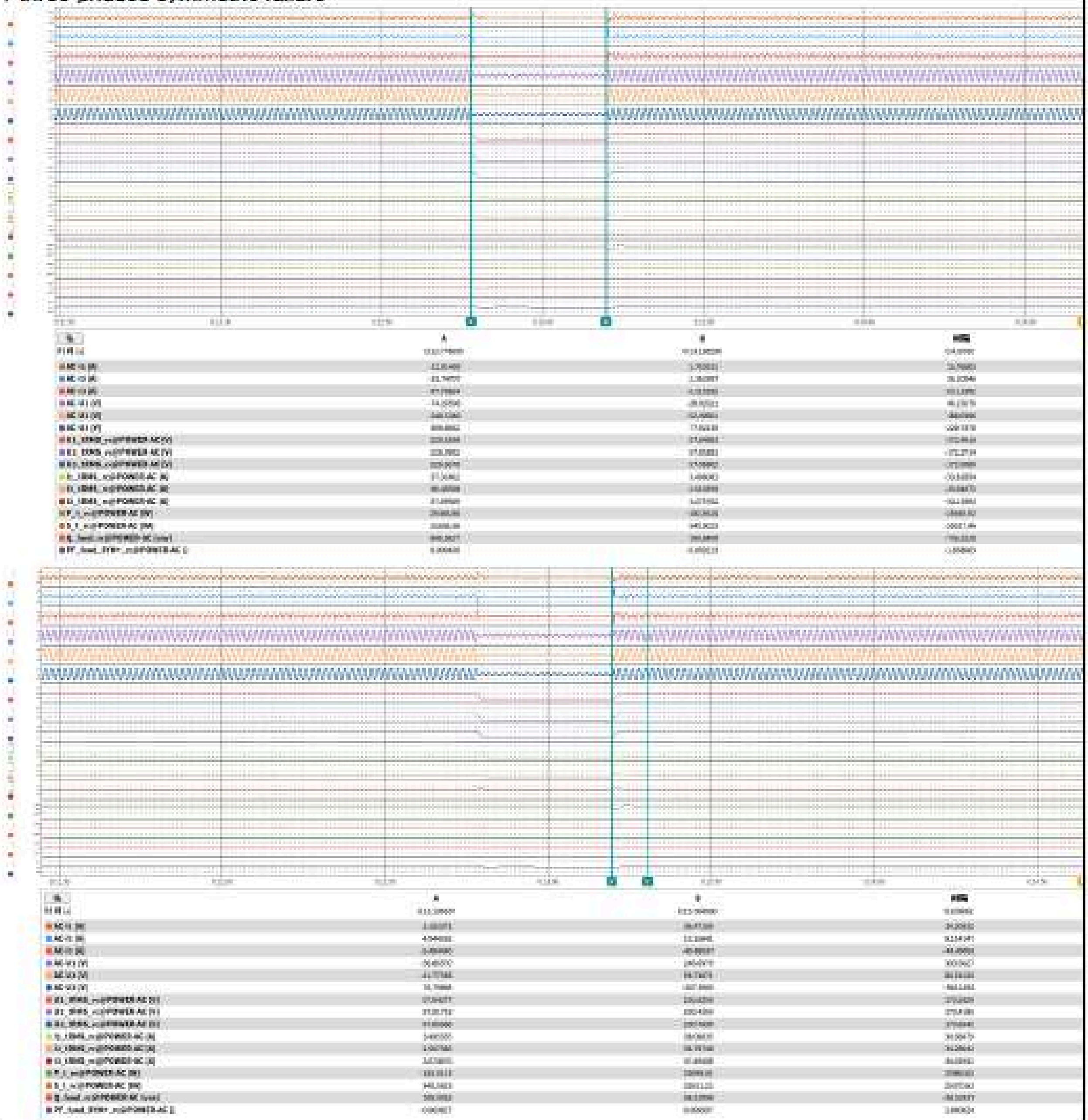
Test 1a -- guasto asimmetrico bifase

/ two phases asymmetric failure



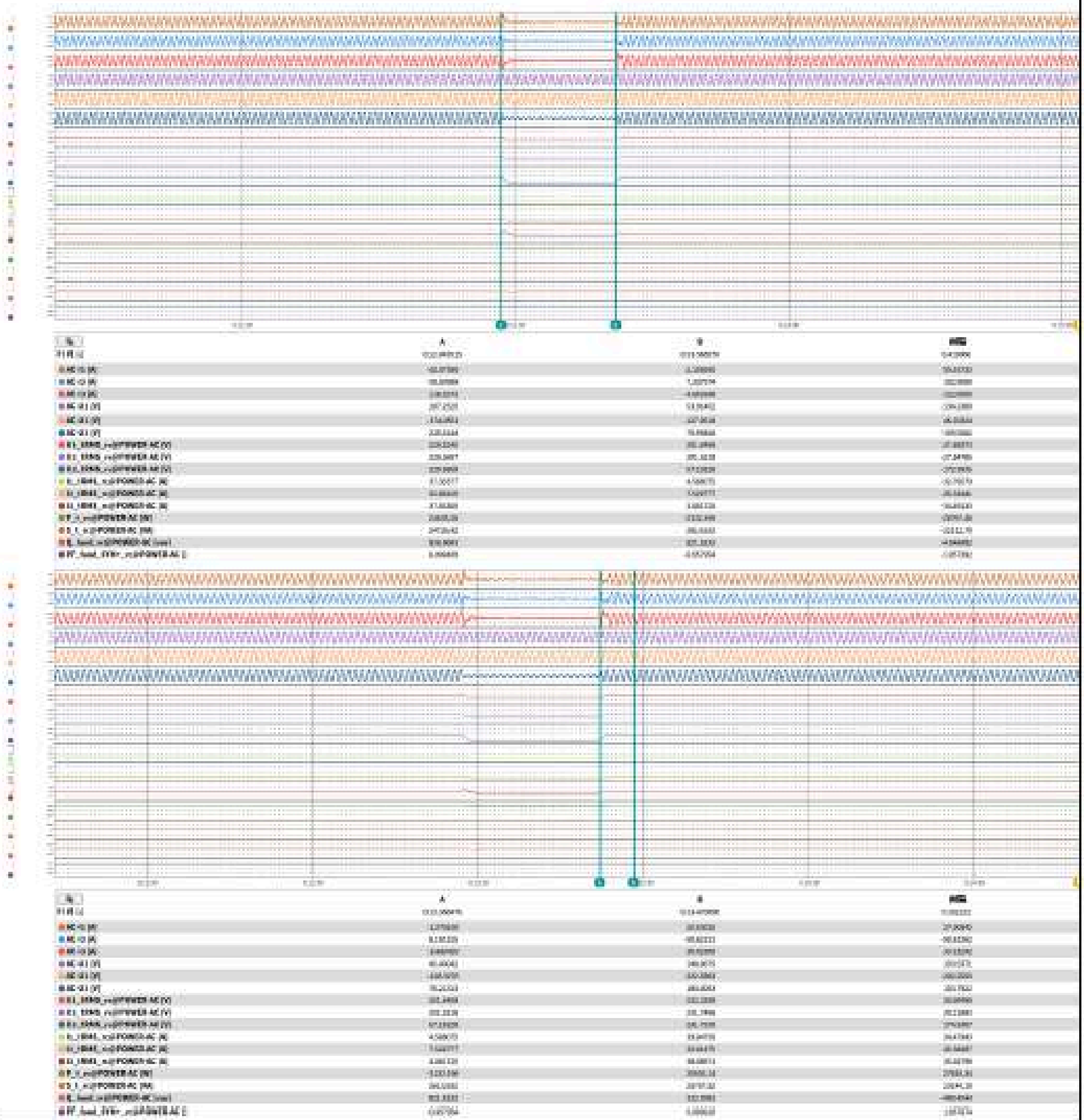


Test 2s -- guasto simmetrico trifase
/ three phases symmetric failure



Test 2a -- guasto asimmetrico bifase

/ two phases asymmetric failure



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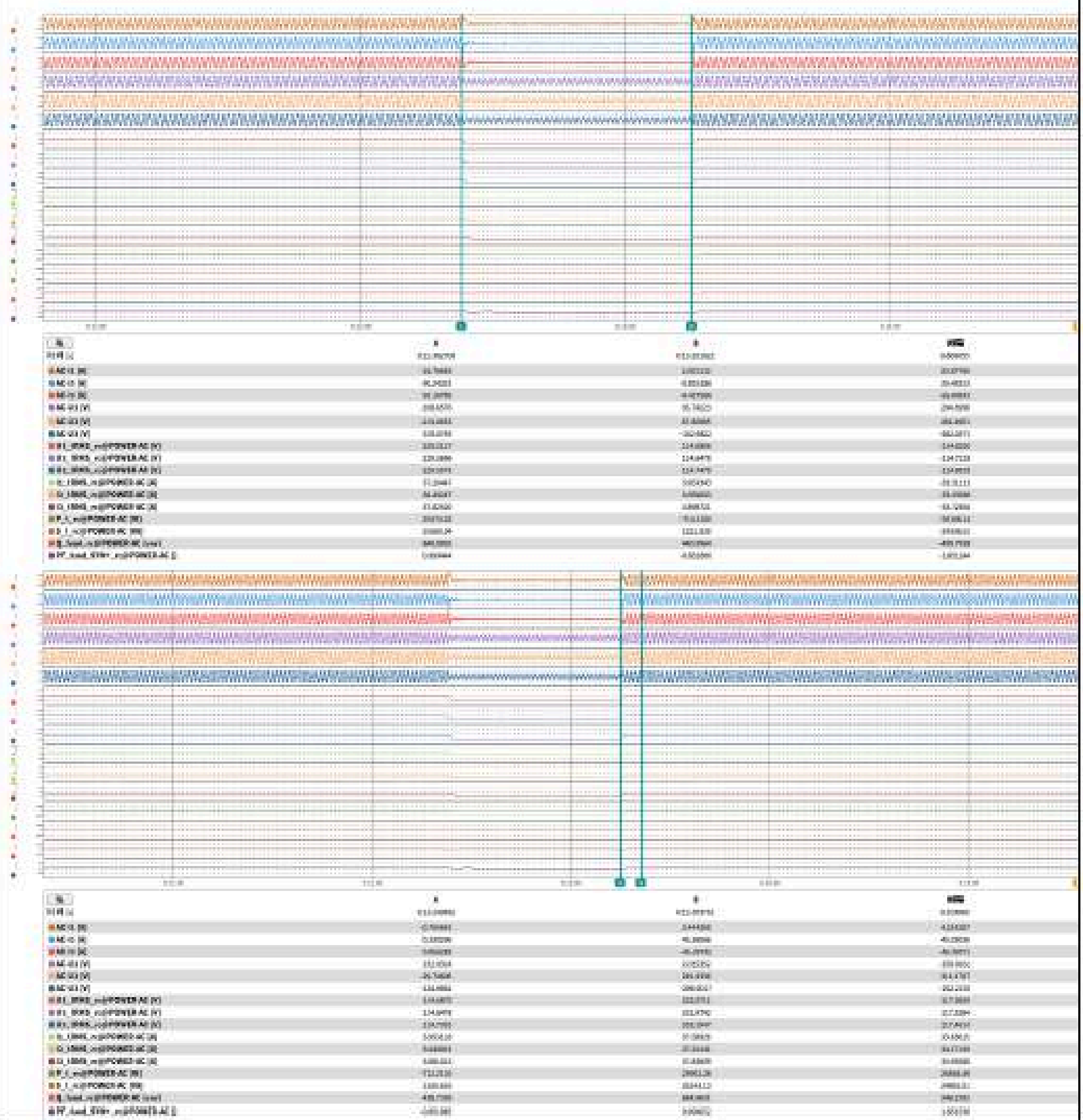
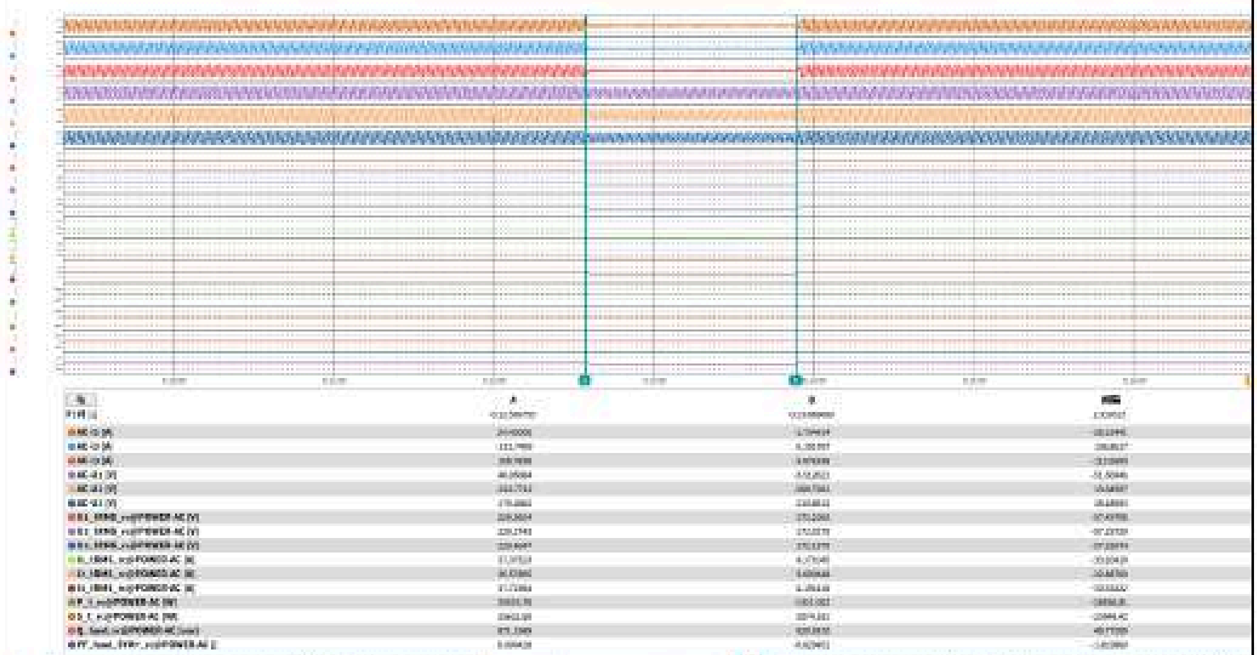
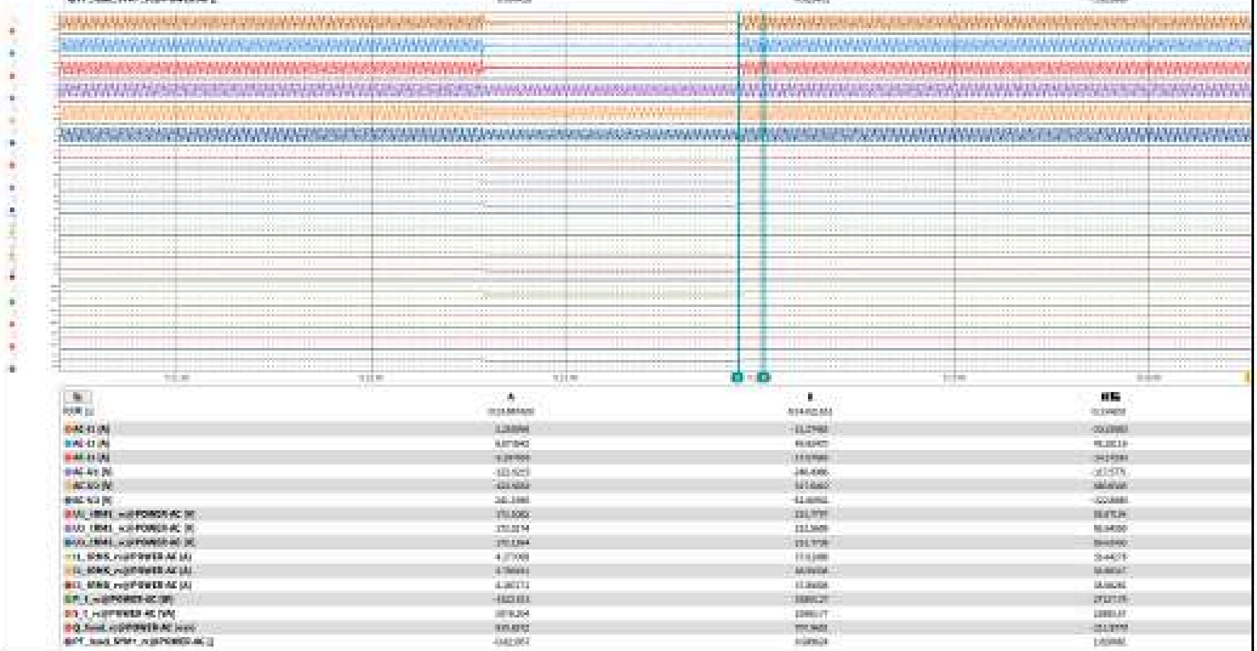
Test 3s -- guasto simmetrico trifase
/ three phases symmetric failure



Test 3a -- guasto asimmetrico bifase
/ two phases asymmetric failure

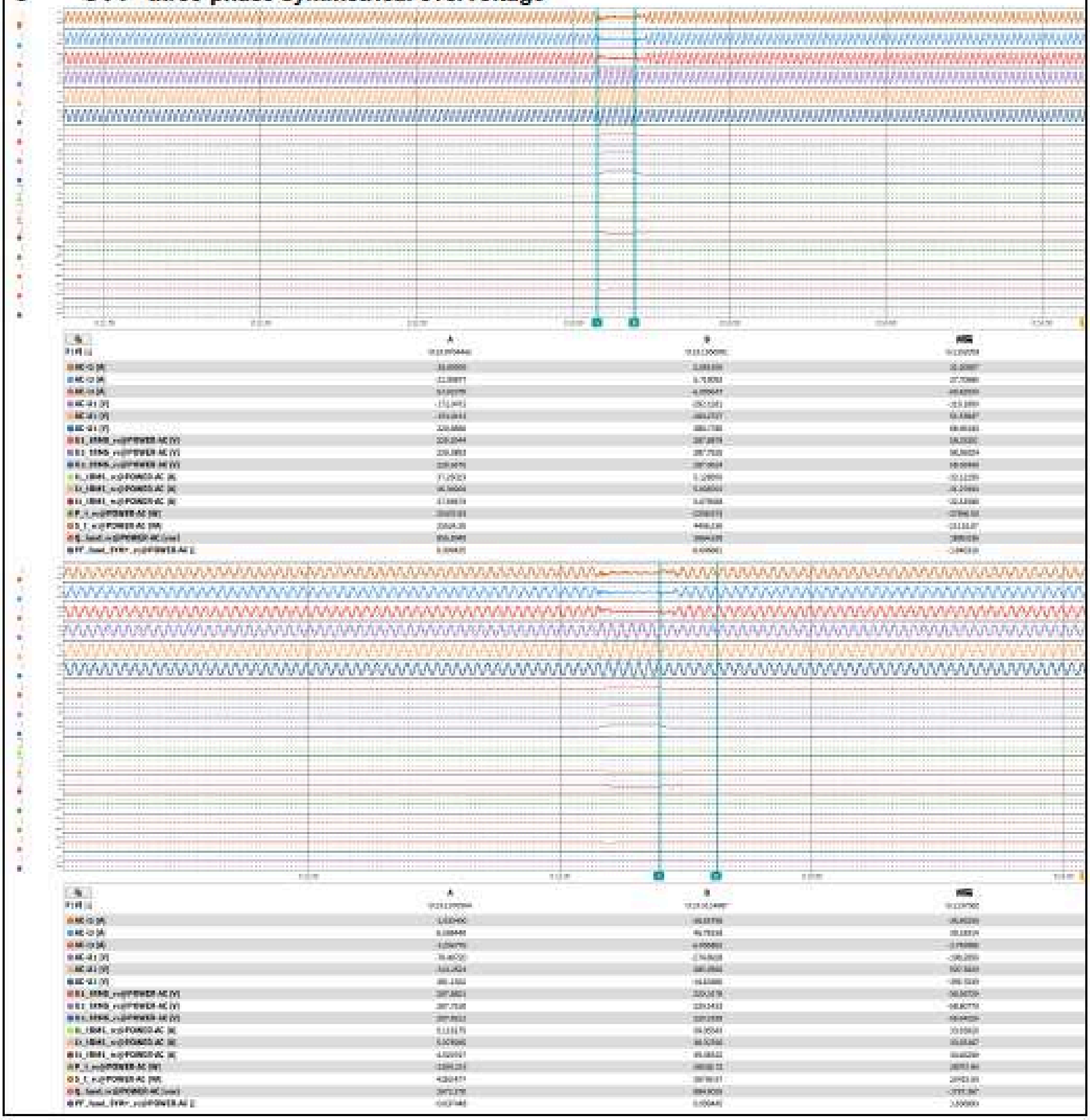
Test 4s -- guasto simmetrico trifase
/ three phases symmetric failure



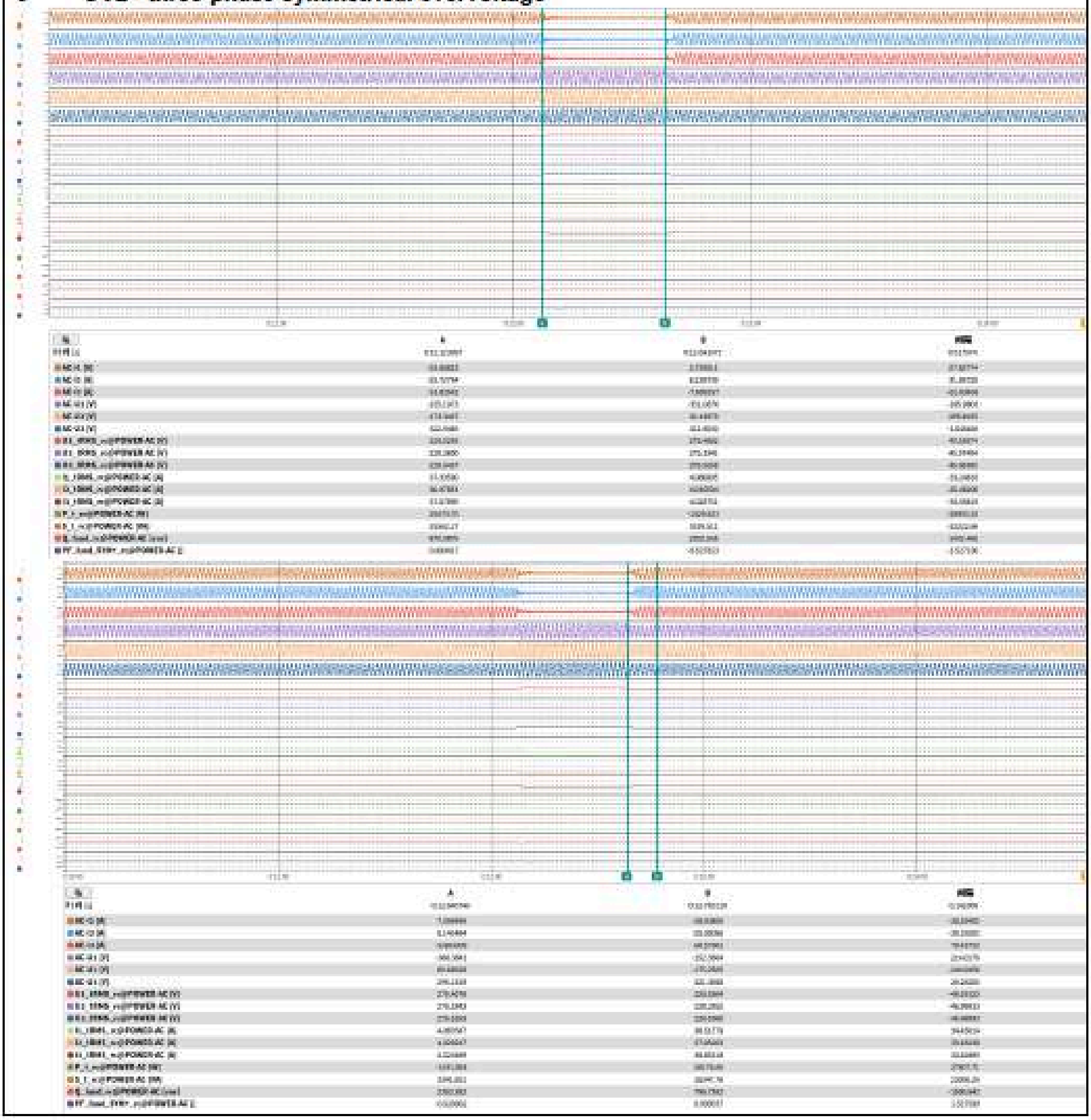


Test 4a -- guasto simmetrico bifase
/ two phases asymmetric failure

5 OV1 - three-phase symmetrical overvoltage



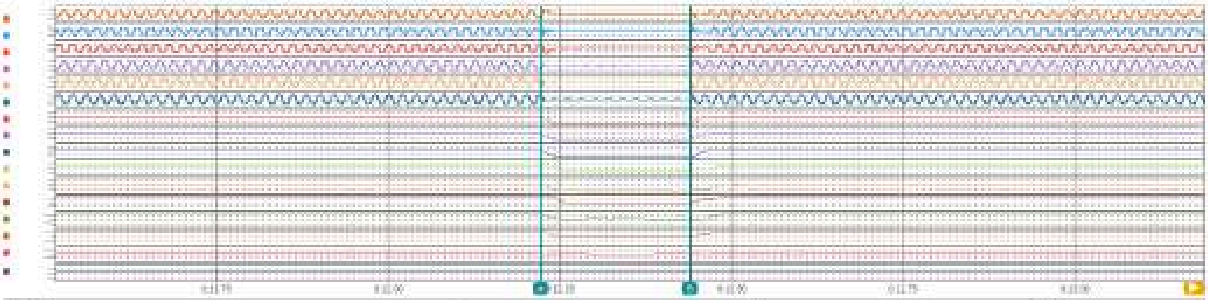
6 OV2 - three-phase symmetrical overvoltage



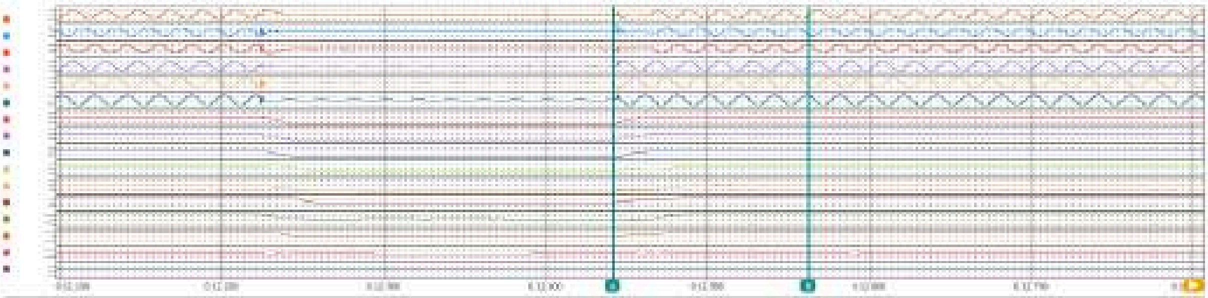
Output power: 125000W							Limit: from > 90% P_{Smax}.		
Test	Residual magnitude [V/Vn]			phase angle [°]			Duration	Recovery time	Recovery time limit
	R	S	T	φ_1	φ_2	φ_3	[ms]	[ms]	[ms]
1s – guasto simmetrico trifase / *three phases symmetric failure*	0.10 ± 0.05	0.10 ± 0.05	0.10 ± 0.05	0°	-120°	120°	200 ± 20	121	400
1a – guasto asimmetrico bifase / *two phases asymmetric failure*	0.87 ± 0.05	0.87 ± 0.05	0.10 ± 0.05	27°	-147°	120°	200 ± 20	181	400
2s – guasto simmetrico trifase / *three phases symmetric failure*	0.25 ± 0.05	0.25 ± 0.05	0.25 ± 0.05	0°	-120°	120°	400 ± 20	174	400
2a – guasto asimmetrico bifase / *two phases asymmetric failure*	0.88 ± 0.05	0.88 ± 0.05	0.25 ± 0.05	22°	-142°	120°	400 ± 20	152	400
3s – guasto simmetrico trifase / *three phases symmetric failure*	0.50 ± 0.05	0.50 ± 0.05	0.50 ± 0.05	0°	-120°	120°	850 ± 20	188	400
3a – guasto asimmetrico bifase / *two phases asymmetric failure*	0.90 ± 0.05	0.90 ± 0.05	0.50 ± 0.05	14°	-134°	120°	850 ± 20	245	400
4s – guasto simmetrico trifase / *three phases symmetric failure*	0.75 ± 0.05	0.75 ± 0.05	0.75 ± 0.05	0°	-120°	120°	1300 ± 20	250	400
4a – guasto simmetrico bifase / *two phases asymmetric failure*	0.94 ± 0.05	0.94 ± 0.05	0.75 ± 0.05	7°	-127°	120°	1300 ± 20	245	400
OV1 - three-phase symmetrical overvoltage	1.25± 0.05	1.25± 0.05	1.25± 0.05	0°	-120°	120	100± 20	257	400
OV2 - three-phase symmetrical overvoltage	1.20± 0.05	1.20± 0.05	1.20± 0.05	0°	-120°	120	500± 20	284	400

Grafici: LVFRT
/ Graphs: LVFRT

Test 1s -- guasto simmetrico trifase
/ three phases symmetric failure



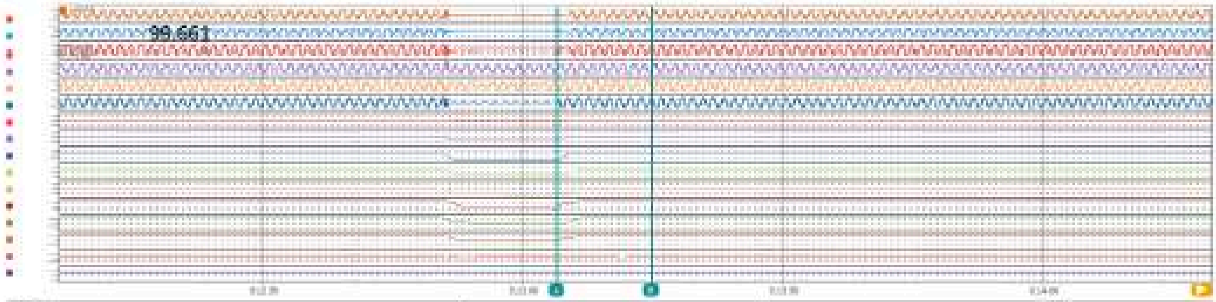
	A	B	[illegible]
[illegible] [s]	0:12.229488	0:12.449590	0.217102
AC-I1 [A]	24.30177	3.602318	-20.69966
AC-I2 [A]	-227.6803	3.231374	230.9116
AC-I3 [A]	207.8200	-4.066088	-211.8887
AC-U1 [V]	30.63944	-25.03753	-51.86780
AC-U2 [V]	-258.5585	-6.898139	268.9535
AC-U3 [V]	266.7447	20.40808	-246.2047
U1_RMS_rc@POWER-AC [V]	229.8866	23.17848	-206.7083
U2_RMS_rc@POWER-AC [V]	226.0204	22.21694	-206.3402
U3_RMS_rc@POWER-AC [V]	229.7390	23.22457	-206.5754
I1_RMS_rc@POWER-AC [A]	181.8160	3.110807	-178.6820
I2_RMS_rc@POWER-AC [A]	178.5020	2.413857	-175.9186
I3_RMS_rc@POWER-AC [A]	182.1777	3.202097	-178.8963
P_t_rc@POWER-AC [W]	124541.6	-23.16486	-124564.8
S_t_rc@POWER-AC [VA]	124555.5	284.0514	-124594.4



	A	B	[illegible]
[illegible] [s]	0:12.441738	0:12.562374	0.120636
AC-I1 [A]	3.879701	-66.14188	-69.02158
AC-I2 [A]	2.909930	-179.8580	-181.7258
AC-I3 [A]	-5.693025	233.2715	238.9240
AC-U1 [V]	-15.20780	-81.32352	-66.23584
AC-U2 [V]	-17.71842	-232.7624	-215.0389
AC-U3 [V]	20.01820	286.0308	276.0018
U1_RMS_rc@POWER-AC [V]	25.17775	220.4479	206.2692
U2_RMS_rc@POWER-AC [V]	23.21660	229.0868	205.7982
U3_RMS_rc@POWER-AC [V]	23.22457	229.5252	206.0088
I1_RMS_rc@POWER-AC [A]	4.142061	182.8271	178.3787
I2_RMS_rc@POWER-AC [A]	2.427385	179.5259	177.0985
I3_RMS_rc@POWER-AC [A]	3.298288	182.4803	178.9606
P_t_rc@POWER-AC [W]	-23.71185	124426.3	124449.7
S_t_rc@POWER-AC [VA]	205.6886	124482.8	124358.4

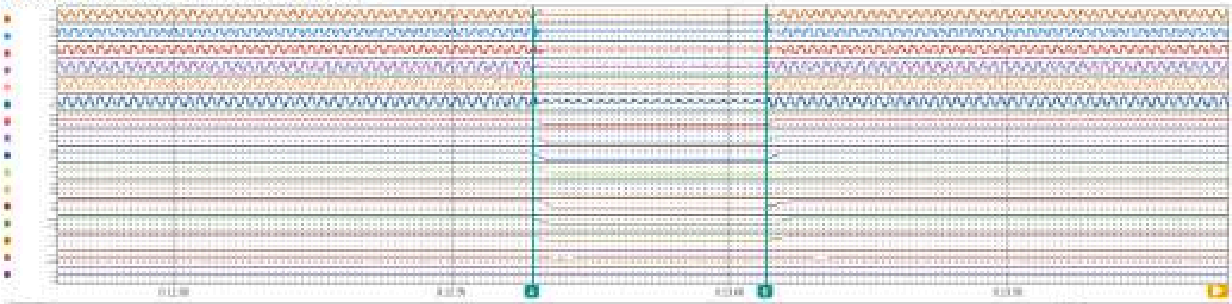
Test 1a -- guasto asimmetrico bifase
/ two phases asymmetric failure

	A	B	时差
时间 (s)	0:12.89819	0:13.09152	0.21143
AC-I1 [A]	161.9798	4.830962	-308.1082
AC-I2 [A]	6.307870	-8.353646	-6.691736
AC-I3 [A]	-152.1455	-2.938487	355.2546
AC-U1 [V]	306.3602	-242.2780	-528.7560
AC-U2 [V]	-271.8025	226.0273	497.8302
AC-U3 [V]	-34.80962	16.41203	31.49264
U1_1RMS_rc@POWER-AC [V]	238.0657	197.4222	-40.65549
U2_1RMS_rc@POWER-AC [V]	218.6353	197.6007	-20.86462
U3_1RMS_rc@POWER-AC [V]	224.5621	23.27768	-201.4742
I1_1RMS_rc@POWER-AC [A]	372.1909	4.818748	-367.1821
I2_1RMS_rc@POWER-AC [A]	154.1170	4.800471	-149.3079
I3_1RMS_rc@POWER-AC [A]	161.7200	2.729598	-178.9932
P_t_rc@POWER-AC [W]	304536.1	-1502.083	-305818.2
S_t_rc@POWER-AC [VA]	319957.1	1925.838	-319032.2



	A	B	时差
时间 (s)	0:13.00369	0:13.28618	0.28124
AC-I1 [A]	3.798876	-95.68134	-99.36831
AC-I2 [A]	-1.116897	-150.6398	-148.5227
AC-I3 [A]	-3.501475	154.9841	258.4555
AC-U1 [V]	-89.03275	-122.5350	-31.90224
AC-U2 [V]	92.03404	-205.8648	-297.3096
AC-U3 [V]	20.21960	318.1741	288.6542
U1_1RMS_rc@POWER-AC [V]	107.4443	213.0776	55.63330
U2_1RMS_rc@POWER-AC [V]	107.6800	230.6396	33.25886
U3_1RMS_rc@POWER-AC [V]	23.27501	229.5208	206.2446
I1_1RMS_rc@POWER-AC [A]	6.821266	181.0366	176.6181
I2_1RMS_rc@POWER-AC [A]	4.622772	177.9655	173.1527
I3_1RMS_rc@POWER-AC [A]	3.734307	181.2097	178.5131
P_t_rc@POWER-AC [W]	-1376.430	124510.5	125896.0
S_t_rc@POWER-AC [VA]	3927.199	124697.7	122544.5

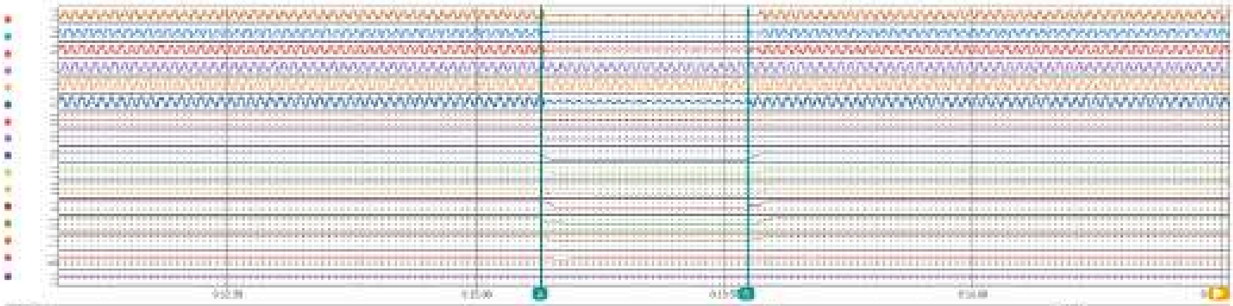
Test 2s -- guasto simmetrico trifase
/ three phases symmetric failure



	A	B	B-A
Ft [s]	-0:12.646379	0:13.068480	0:420,1?
AC-I1 [A]	-178.1966	2.63[illegible]	180.8[illegible]
AC-I2 [A]	-70.17970	5.810308	75.99587
AC-I3 [A]	254.5735	-9.094540	-264.6571
AC-U1 [V]	-317.9952	-70.78923	347.1970
AC-U2 [V]	-308.5302	7.841578	302.7737
AC-U3 [V]	317.3460	67.00828	-249.4586
U1_1RMS_ac@POWER-AC [V]	228.9103	57.01754	-172.8028
U2_1RMS_ac@POWER-AC [V]	228.5533	56.00055	-172.5587
U3_1RMS_ac@POWER-AC [V]	228.6180	57.00094	-172.8089
I1_1RMS_ac@POWER-AC [A]	183.8897	5.889763	-178.0280
I2_1RMS_ac@POWER-AC [A]	178.1645	2.492819	-175.6720
I3_1RMS_ac@POWER-AC [A]	182.1633	3.860960	-178.3038
P_t_ac@POWER-AC [W]	124559.4	-164.3780	-124753.8
S_t_ac@POWER-AC [VA]	124528.5	548.5700	-124079.1

	A	B	B-A
Ft [s]	-0:13.064508	0:13.239027	0:174503
AC-I1 [A]	4.576712	-18.88083	-22.[illegible]
AC-I2 [A]	3.590403	220.0308	223.4885
AC-I3 [A]	-4.795649	-203.8375	-199.1429
AC-U1 [V]	-75.40832	-28.71430	45.68577
AC-U2 [V]	31.21940	290.8941	268.7057
AC-U3 [V]	61.78137	-260.4302	-321.2284
U1_1RMS_ac@POWER-AC [V]	57.01754	232.1319	175.1144
U2_1RMS_ac@POWER-AC [V]	56.00055	231.0263	174.8458
U3_1RMS_ac@POWER-AC [V]	57.00094	232.1561	175.1461
I1_1RMS_ac@POWER-AC [A]	5.889763	179.0[illegible]	175.9[illegible]
I2_1RMS_ac@POWER-AC [A]	2.492810	176.2328	173.7380
I3_1RMS_ac@POWER-AC [A]	3.860960	179.7094	176.[illegible]
P_t_ac@POWER-AC [W]	-164.3780	124170.4	124354.8
S_t_ac@POWER-AC [VA]	548.5700	124028.9	123078.0

Test 2a -- guasto asimmetrico bifase
/ two phases asymmetric failure

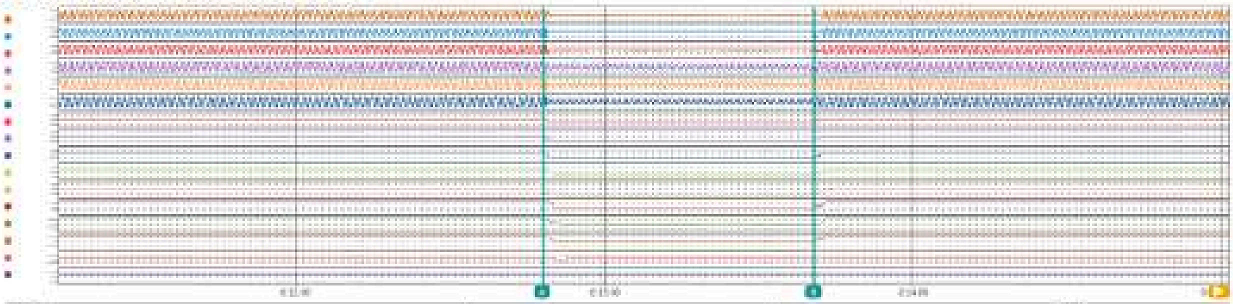


	A	B	[illegible]
t [s]	0:13.159819	0:13.548523	0.415904
AC-I1 [A]	-35.40188	1.840011	32.83682
AC-I2 [A]	-74.38149	4.859759	78.85125
AC-I3 [A]	65.52798	-4.193590	-65.11095
AC-U1 [V]	347.7445	-65.44543	-313.1898
AC-U2 [V]	-252.6758	15.98577	274.5580
AC-U3 [V]	30.20208	78.42518	48.64220
U1_tRMS_rc@POWER-AC [V]	233.5370	201.4964	-31.95150
U2_tRMS_rc@POWER-AC [V]	224.7462	201.2024	-23.20272
U3_tRMS_rc@POWER-AC [V]	227.0005	57.02613	-269.9744
I1_tRMS_rc@POWER-AC [A]	248.8780	4.871188	-178.2280
I2_tRMS_rc@POWER-AC [A]	172.7303	4.341579	-168.5576
I3_tRMS_rc@POWER-AC [A]	181.8339	3.133189	-178.7186
P_t_rc@POWER-AC [W]	117083.2	-1384.003	-118467.2
S_t_rc@POWER-AC [VA]	122329.5	1995.368	-120358.0

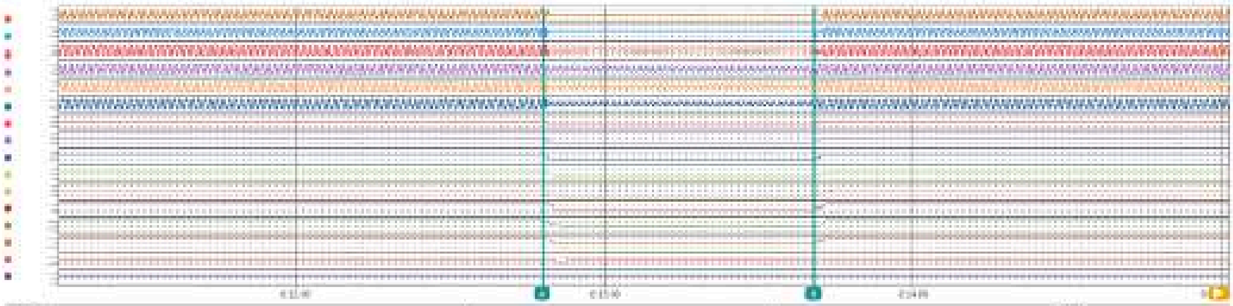
	A	B	[illegible]
t [s]	0:13.543728	0:13.658973	0.152244
AC-I1 [A]	4.003441	186.1791	183.7789
AC-I2 [A]	-0.280404	67.26808	87.46980
AC-I3 [A]	-5.377970	-250.8448	-259.7275
AC-U1 [V]	-253.4047	324.2327	477.6874
AC-U2 [V]	208.5932	94.87838	-113.9149
AC-U3 [V]	44.54200	-320.7481	-364.2012
U1_tRMS_rc@POWER-AC [V]	201.4455	232.9748	31.52027
U2_tRMS_rc@POWER-AC [V]	201.3458	230.8888	30.06280
U3_tRMS_rc@POWER-AC [V]	57.81729	232.5819	175.9381
I1_tRMS_rc@POWER-AC [A]	4.860830	179.0813	175.0280
I2_tRMS_rc@POWER-AC [A]	4.344277	176.5654	172.6511
I3_tRMS_rc@POWER-AC [A]	3.111820	179.2862	176.1038
P_t_rc@POWER-AC [W]	-1582.594	124498.3	125858.6
S_t_rc@POWER-AC [VA]	1991.878	124528.3	122558.4

Test 3s – guasto simmetrico trifase

/ three phases symmetric failure

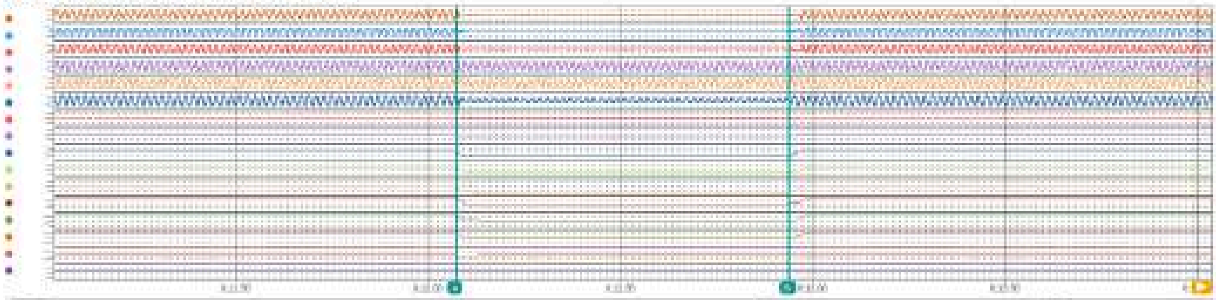


	A	B	Δ
时间 [s]	0:12.801.988	0:13.476118	0.676153
AC-I1 [A]	-107.0181	2.273092	110.2881
AC-I2 [A]	258.0309	-1.550615	-257.5585
AC-I3 [A]	-138.6780	-9.444748	138.4556
AC-U1 [V]	-153.3731	188.7309	302.0081
AC-U2 [V]	321.4121	49.87407	-271.5380
AC-U3 [V]	-177.4557	-160.3780	16.87076
U1_1RMS_rc@POWER-AC [V]	229.9217	114.6908	-115.2309
U2_1RMS_rc@POWER-AC [V]	229.5638	114.6288	-114.9342
U3_1RMS_rc@POWER-AC [V]	229.8823	114.7238	-115.1086
I1_1RMS_rc@POWER-AC [A]	383.8867	6.256718	-377.6230
I2_1RMS_rc@POWER-AC [A]	278.2970	3.624061	-275.2726
I3_1RMS_rc@POWER-AC [A]	382.2460	3.867610	-378.3080
P_1_rc@POWER-AC [W]	124576.5	-732.7330	-125309.1
S_1_rc@POWER-AC [VA]	224654.0	1286.852	-223367.7

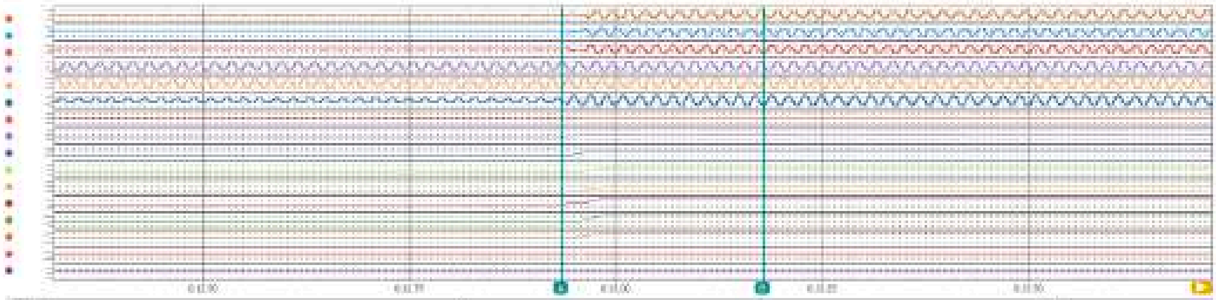


	A	B	Δ
时间 [s]	0:12.801.988	0:13.476118	0.676153
AC-I1 [A]	-107.0181	2.273092	110.2881
AC-I2 [A]	258.0309	-1.550615	-257.5585
AC-I3 [A]	-138.6780	-9.444748	138.4556
AC-U1 [V]	-153.3731	188.7309	302.0081
AC-U2 [V]	321.4121	49.87407	-271.5380
AC-U3 [V]	-177.4557	-160.3780	16.87076
U1_1RMS_rc@POWER-AC [V]	229.9217	114.6908	-115.2309
U2_1RMS_rc@POWER-AC [V]	229.5638	114.6288	-114.9342
U3_1RMS_rc@POWER-AC [V]	229.8823	114.7238	-115.1086
I1_1RMS_rc@POWER-AC [A]	383.8867	6.256718	-377.6230
I2_1RMS_rc@POWER-AC [A]	278.2970	3.624061	-275.2726
I3_1RMS_rc@POWER-AC [A]	382.2460	3.867610	-378.3080
P_1_rc@POWER-AC [W]	124576.5	-732.7330	-125309.1
S_1_rc@POWER-AC [VA]	224654.0	1286.852	-223367.7

Test 3a -- guasto asimmetrico bifase
/ two phases asymmetric failure

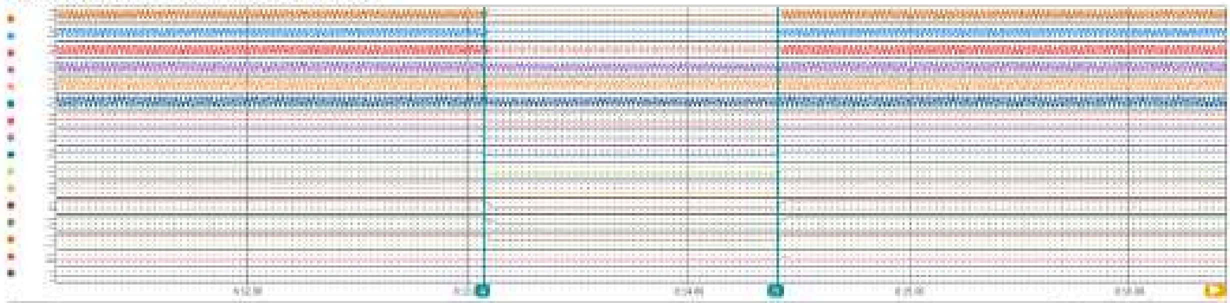


	A	B	Δ
[illegible] (s)	[illegible]	[illegible]	0.469690
AC-I1 [A]	-16.89443	1.026831	17.92324
AC-I2 [A]	78.25503	3.370461	-74.88513
AC-I3 [A]	-44.97204	0.242979	45.21501
AC-U1 [V]	108.6202	273.4883	164.8680
AC-U2 [V]	72.66491	-131.8139	-204.4788
AC-U3 [V]	-107.6061	-95.63880	11.87737
U1_1RMS_rc@POWER-AC [V]	218.1334	196.4664	-21.66699
U2_1RMS_rc@POWER-AC [V]	228.9700	206.2637	-22.70630
U3_1RMS_rc@POWER-AC [V]	228.9947	114.7252	-114.2695
I1_1RMS_rc@POWER-AC [A]	181.6790	4.230382	-177.4486
I2_1RMS_rc@POWER-AC [A]	178.6940	3.845237	-174.8487
I3_1RMS_rc@POWER-AC [A]	182.6238	3.822932	-178.8009
P_t_rc@POWER-AC [W]	124008.4	-1274.788	-125283.1
S_t_rc@POWER-AC [VA]	124757.6	1985.383	-122774.6



	A	B	Δ
[illegible] (s)	[illegible]	[illegible]	0.244600
AC-I1 [A]	-1.999683	185.4047	187.4043
AC-I2 [A]	5.853922	71.02618	65.17226
AC-I3 [A]	0.151439	-250.7187	-250.8702
AC-U1 [V]	167.4486	120.1565	-47.29213
AC-U2 [V]	-286.6724	97.55258	384.2250
AC-U3 [V]	10.60460	-318.8886	-329.4932
U1_1RMS_rc@POWER-AC [V]	208.4453	233.8219	25.3766
U2_1RMS_rc@POWER-AC [V]	206.2626	230.8607	24.59811
U3_1RMS_rc@POWER-AC [V]	114.7251	230.8838	116.1587
I1_1RMS_rc@POWER-AC [A]	4.231780	180.3593	176.1275
I2_1RMS_rc@POWER-AC [A]	3.802938	177.0879	173.2849
I3_1RMS_rc@POWER-AC [A]	3.827831	180.8908	177.0630
P_t_rc@POWER-AC [W]	-1275.515	124520.5	125796.0
S_t_rc@POWER-AC [VA]	3087.079	126078.8	122991.7

Test 4s -- guasto simmetrico trifase
/ three phases symmetric failure

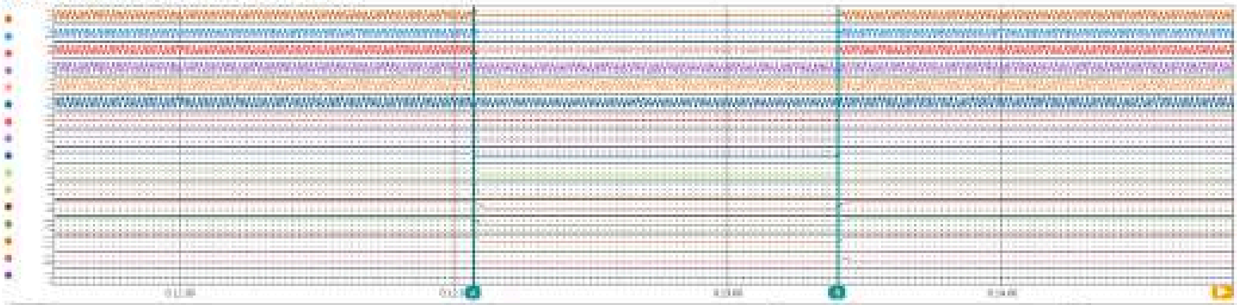


	A	B	B-A
t1 [s]	0:13.869788	0:14.401182	1.055373
AC-I1 [A]	-190.5153	-81.09838	397.1529
AC-I2 [A]	234.4250	18.25218	-216.1735
AC-I3 [A]	-49.81821	51.15329	75.94050
AC-U1 [V]	-258.1130	310.1747	568.2877
AC-U2 [V]	301.1741	-232.3885	-533.6035
AC-U3 [V]	-60.20504	-84.10846	-23.89264
U1_tRMS_rc@POWER-AC [V]	228.9106	177.0980	-51.81286
U2_tRMS_rc@POWER-AC [V]	228.5400	188.2855	-40.25351
U3_tRMS_rc@POWER-AC [V]	229.6184	177.2858	-52.53852
I1_tRMS_rc@POWER-AC [A]	180.0537	12.26307	-168.6087
I2_tRMS_rc@POWER-AC [A]	173.4846	23.77830	-149.7069
I3_tRMS_rc@POWER-AC [A]	182.4829	13.88889	-168.6083
P_t_rc@POWER-AC [W]	122548.7	-9613.985	-138493.7
S_t_rc@POWER-AC [VA]	123807.8	18252.87	-113554.8

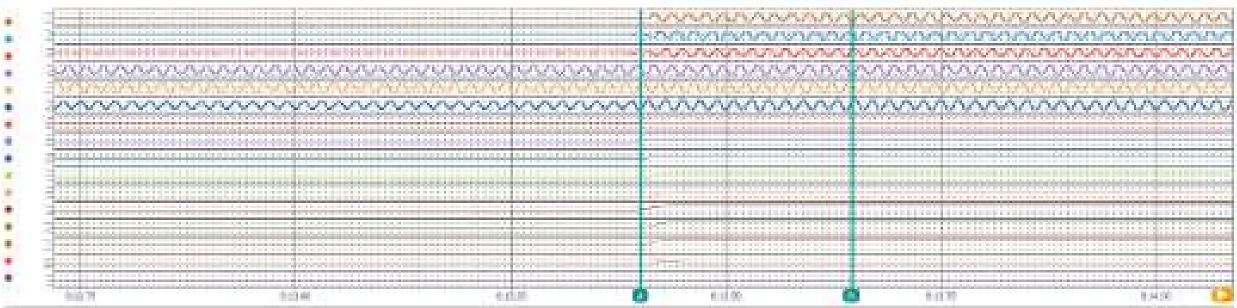
	A	B	B-A
t1 [s]	0:14.395204	0:14.648236	0.240972
AC-I1 [A]	5.208739	136.2990	136.0086
AC-I2 [A]	10.00805	116.5769	106.4786
AC-I3 [A]	-5.498830	-263.3620	259.9032
AC-U1 [V]	-128.9730	172.5991	302.5721
AC-U2 [V]	-116.0770	158.5688	274.5485
AC-U3 [V]	243.6946	207.8673	600.5638
U1_tRMS_rc@POWER-AC [V]	172.0989	253.1806	80.80887
U2_tRMS_rc@POWER-AC [V]	172.0832	230.7588	58.73641
U3_tRMS_rc@POWER-AC [V]	172.1336	231.0812	58.81783
I1_tRMS_rc@POWER-AC [A]	4.181820	180.7943	176.6128
I2_tRMS_rc@POWER-AC [A]	3.947300	172.1465	169.0085
I3_tRMS_rc@POWER-AC [A]	4.131730	181.2841	177.2523
P_t_rc@POWER-AC [W]	-2345.792	123528.9	125874.7
S_t_rc@POWER-AC [VA]	2595.377	123585.4	120990.0

Test 4a -- guasto simmetrico bifase

/ two phases asymmetric failure

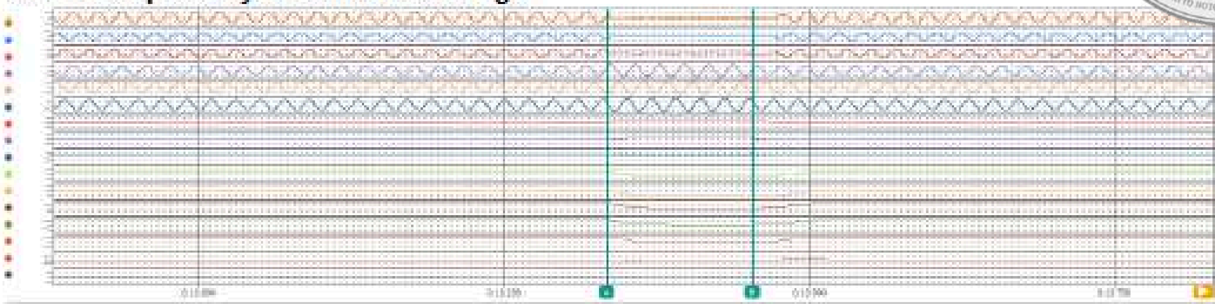


	A	B	[illegible]
时间 [s]	0:12.479698	0:13.401527	1.027691
AC-I1 [A]	152.4461	-9.604109	-118.0961
AC-I2 [A]	-262.5678	-11.33053	251.0373
AC-I3 [A]	127.0103	9.251859	-117.8945
AC-U1 [V]	304.0177	36.89981	-567.1176
AC-U2 [V]	-390.2420	382.0990	852.3230
AC-U3 [V]	93.13274	-286.2794	-369.4122
U1_RMS_rc@POWER-AC [V]	230.4350	222.3006	-8.134527
U2_RMS_rc@POWER-AC [V]	227.8170	220.3666	-7.446267
U3_RMS_rc@POWER-AC [V]	227.8741	196.0283	-30.84571
I1_RMS_rc@POWER-AC [A]	193.7389	18.61658	-171.1880
I2_RMS_rc@POWER-AC [A]	181.1901	14.67811	-166.5020
I3_RMS_rc@POWER-AC [A]	186.2887	23.18903	-166.8981
P_t_rc@POWER-AC [W]	124018.3	-5113.442	-130011.8
S_t_rc@POWER-AC [VA]	129507.3	5585.459	-118846.8

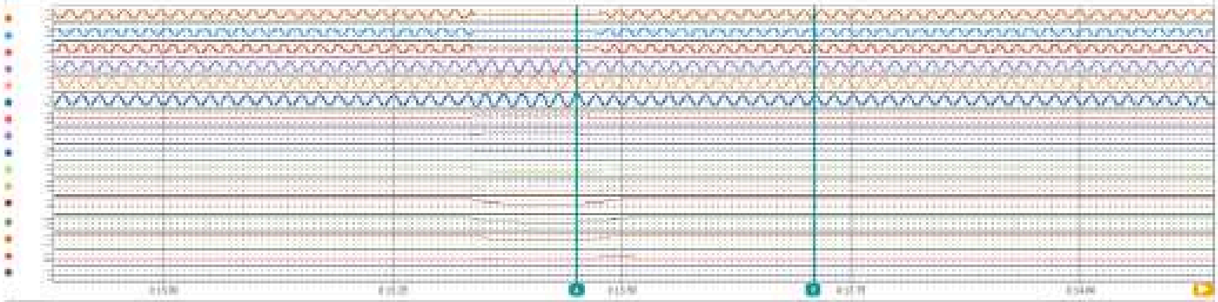


	A	B	[illegible]
时间 [s]	0:13.401877	0:13.698688	0.296532
AC-I1 [A]	0.088837	-297.6933	-297.7934
AC-I2 [A]	-12.45204	115.8716	118.3240
AC-I3 [A]	12.26427	134.6777	122.4134
AC-U1 [V]	-0.864003	-325.6510	-324.7478
AC-U2 [V]	279.9755	146.1845	-133.7786
AC-U3 [V]	103.0376	181.4644	462.5020
U1_RMS_rc@POWER-AC [V]	222.5808	231.4947	8.915099
U2_RMS_rc@POWER-AC [V]	220.3666	230.0847	10.02285
U3_RMS_rc@POWER-AC [V]	196.9283	231.4223	34.46593
I1_RMS_rc@POWER-AC [A]	10.61680	180.0968	170.0281
I2_RMS_rc@POWER-AC [A]	14.67811	176.8705	162.1924
I3_RMS_rc@POWER-AC [A]	23.18903	181.2918	158.0031
P_t_rc@POWER-AC [W]	-5113.442	124440.1	129552.5
S_t_rc@POWER-AC [VA]	5585.459	124058.4	118469.9

OV1 - three-phase symmetrical overvoltage



	A	B	差值
时间 [s]	0:13.3347558	0:13.4638487	0.1290941
AC-I1 [A]	100.5180	26.69610	-73.82937
AC-I2 [A]	-107.3602	-58.46604	48.82130
AC-I3 [A]	79.86210	32.84548	-46.01670
AC-U1 [V]	251.6210	132.6549	-118.9661
AC-U2 [V]	-402.5810	-322.5030	80.05730
AC-U3 [V]	153.0100	193.0963	40.08790
U1_tRMS_rc@POWER-AC [V]	236.1944	186.2844	-50.00083
U2_tRMS_rc@POWER-AC [V]	234.5884	182.3661	-47.97071
U3_tRMS_rc@POWER-AC [V]	232.6000	184.1329	51.44000
I1_tRMS_rc@POWER-AC [A]	181.6910	7.270698	-174.4789
I2_tRMS_rc@POWER-AC [A]	169.5810	15.82758	-153.7530
I3_tRMS_rc@POWER-AC [A]	179.9303	12.09816	-167.8380
P_t_rc@POWER-AC [W]	122094.4	-1719.653	-123814.5
S_t_rc@POWER-AC [VA]	123545.0	18033.48	-113312.2



	A	B	差值
时间 [s]	0:13.4522221	0:13.7093802	0.2571581
AC-I1 [A]	-4.414218	-220.8882	-217.1909
AC-I2 [A]	6.137680	6.727901	-2.469775
AC-I3 [A]	-4.832543	216.6440	221.4771
AC-U1 [V]	-70.76652	-279.5213	-208.7487
AC-U2 [V]	-312.0830	-3.177485	308.8840
AC-U3 [V]	376.0780	281.3633	-94.71540
U1_tRMS_rc@POWER-AC [V]	286.5435	229.9299	-56.61245
U2_tRMS_rc@POWER-AC [V]	286.4631	226.5527	-59.91049
U3_tRMS_rc@POWER-AC [V]	286.6303	229.6567	-56.79330
I1_tRMS_rc@POWER-AC [A]	5.683381	181.0856	176.2270
I2_tRMS_rc@POWER-AC [A]	7.461830	174.5705	167.1089
I3_tRMS_rc@POWER-AC [A]	6.131208	182.2247	176.0936
P_t_rc@POWER-AC [W]	-3371.935	123775.9	127146.9
S_t_rc@POWER-AC [VA]	5581.811	125833.6	119558.6

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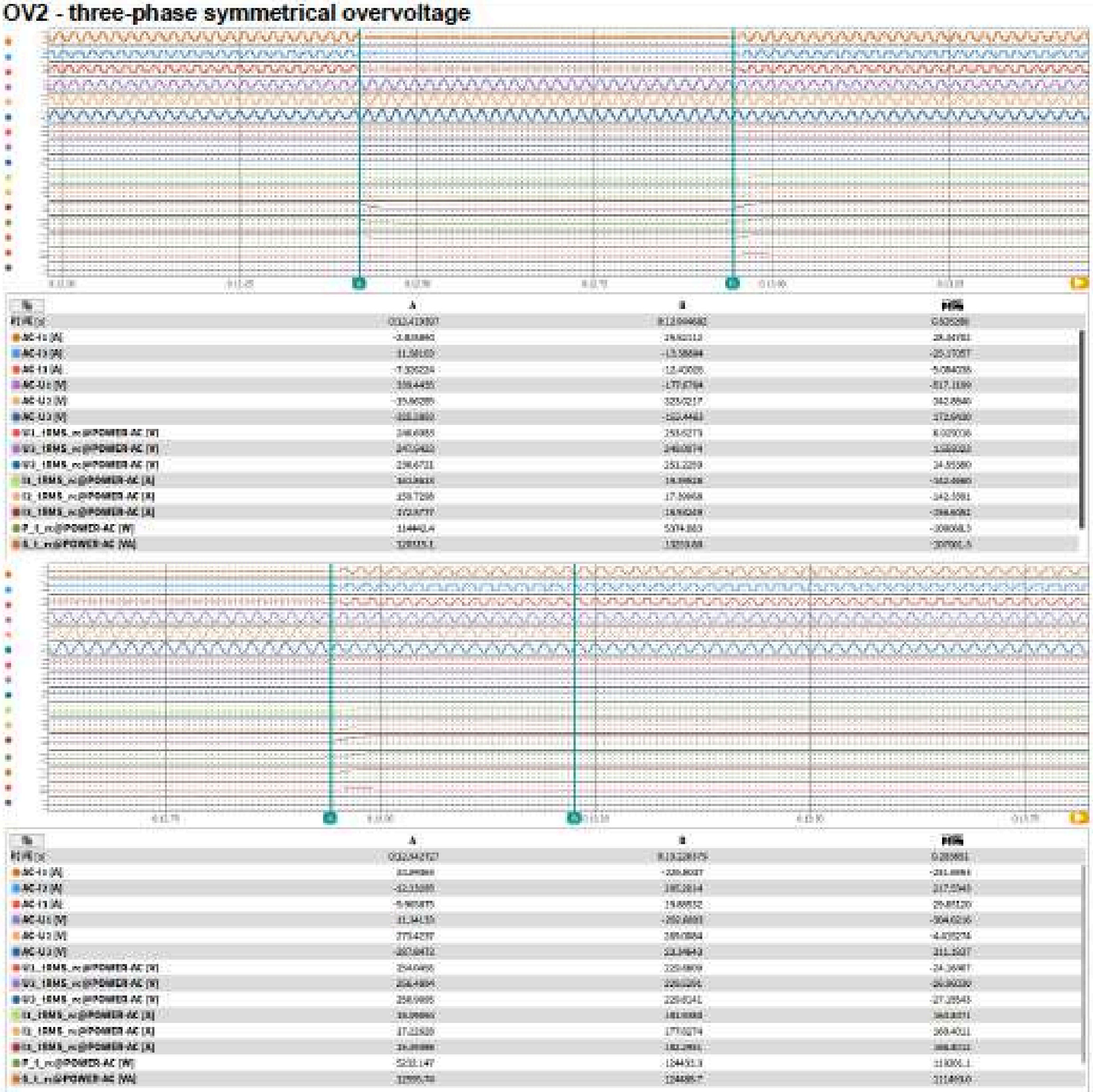
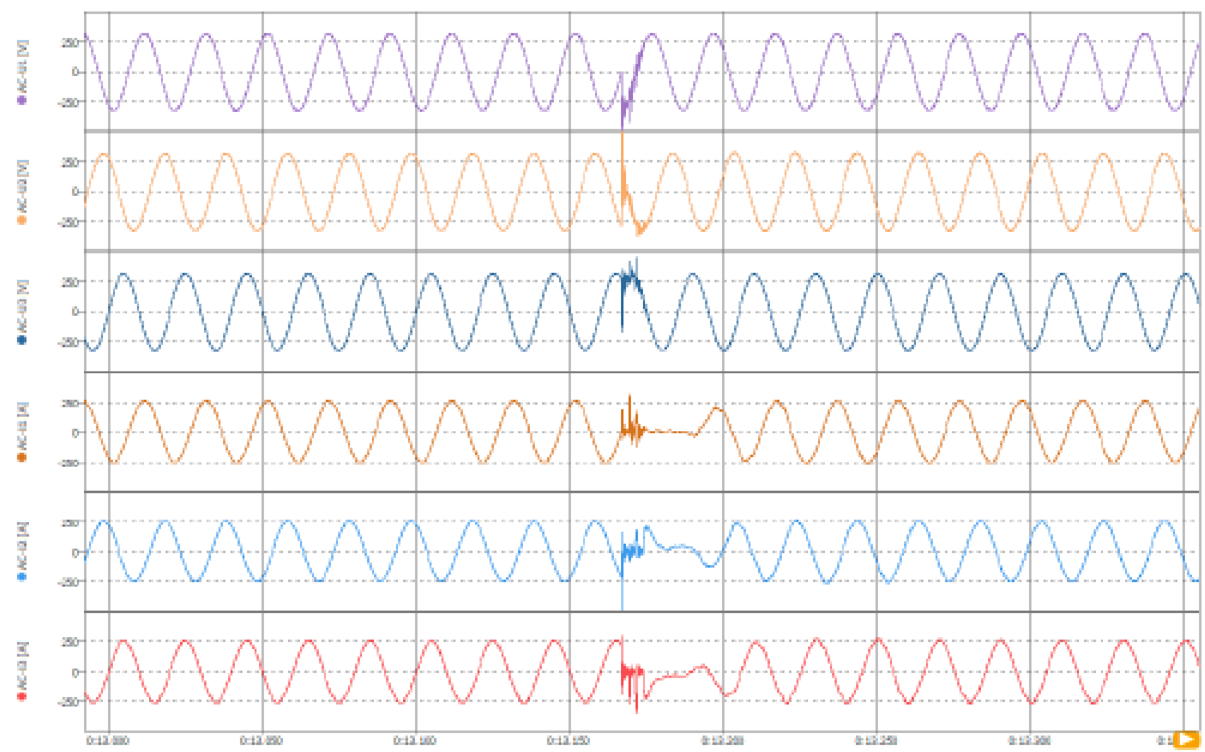
OV2 - three-phase symmetrical overvoltage



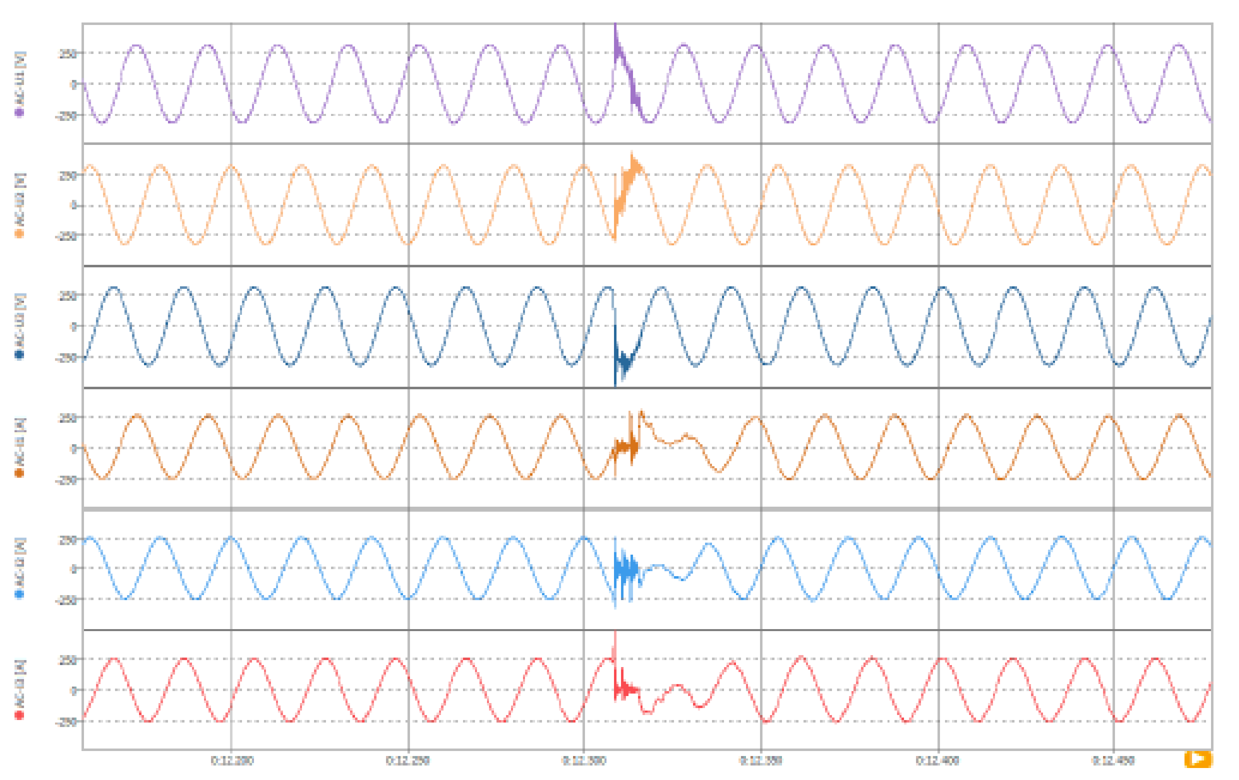
Nbis.9 Verifica della insensibilità alle richiusure automatiche in discordanza di fase */Check of the insensibility to the re-closures when phases are in discordance*	
☒ Nbis.9.1 - Test on simulated grid ☐ Nbs.9.2 - Test on distribution grid through coupler transformer	
Ambient temperature (°C) ....:	25 °C ± 5 °C
Humidity (RH %) ....:	65%
Instrumentation list..:	See table "Measurement equipment and instrumentation"
Supplementary information: none	
Operator ....:	See cover page
Supervisor ....:	See cover page
Test Date...:	See cover page

Test 1a: 0°~ -90° @ 100% of Nominal Power



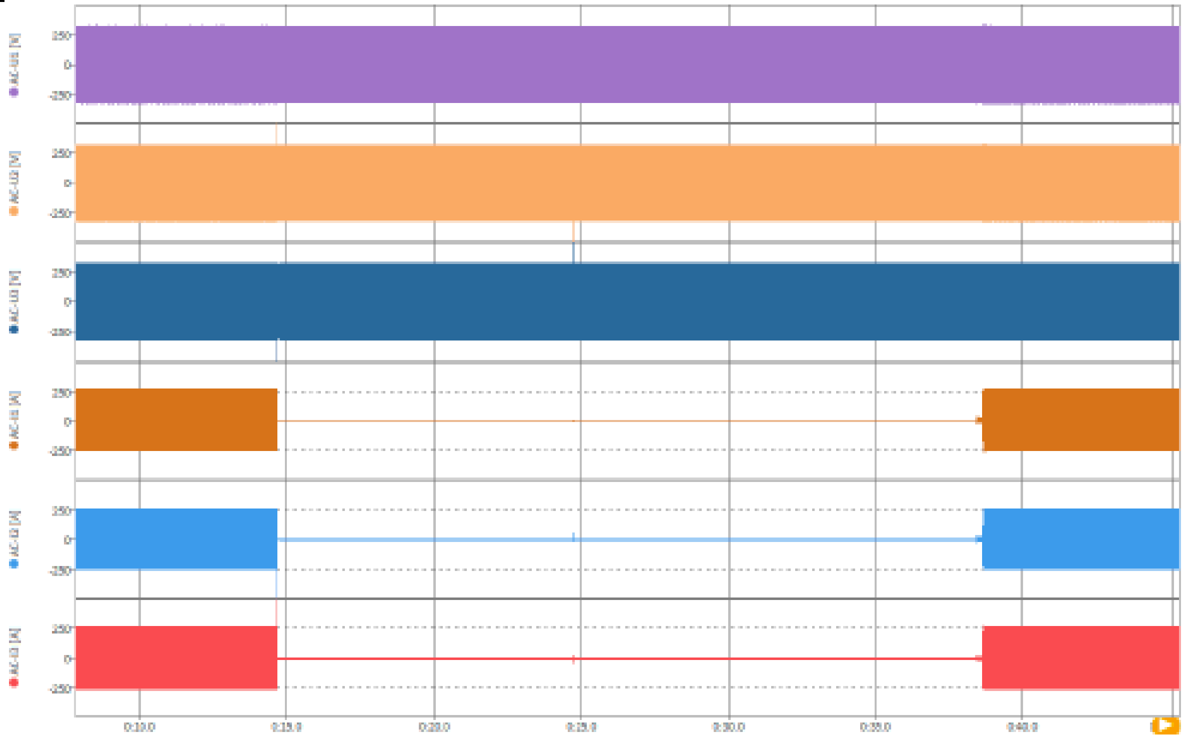
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 1b: 0°~ 90° @ 100% of Nominal Power



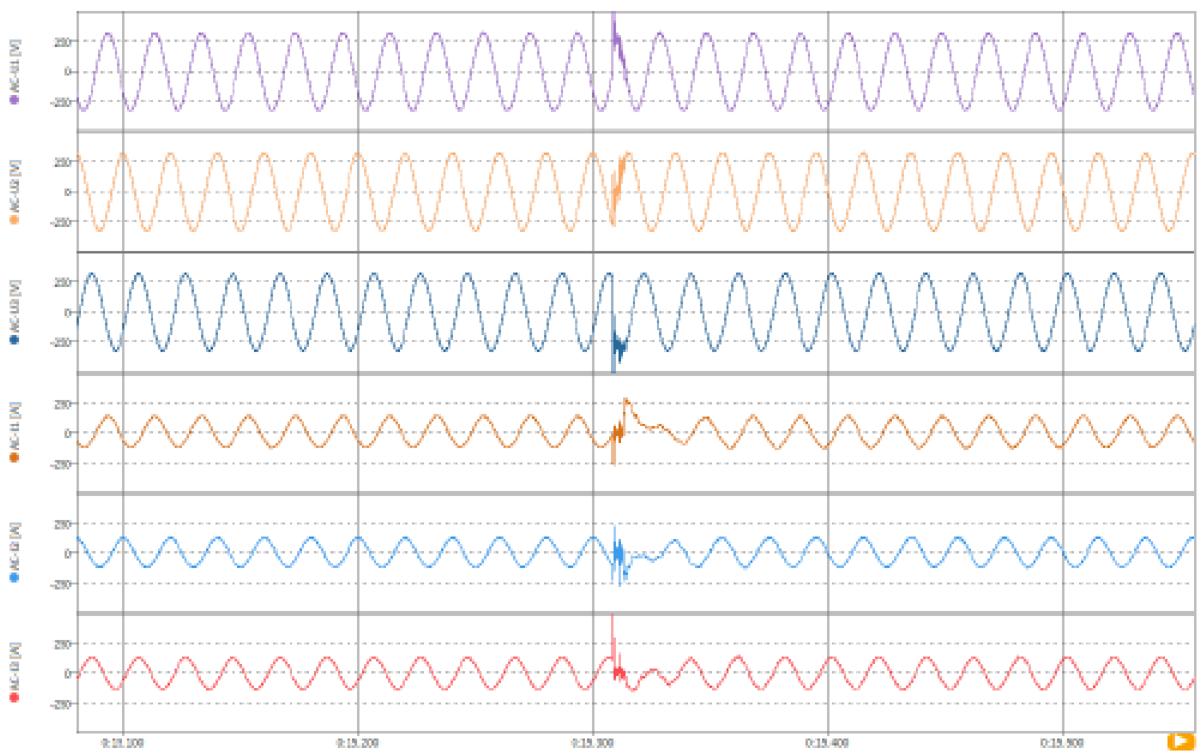
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 1c: 0°~180° @ 100% of Nominal Power



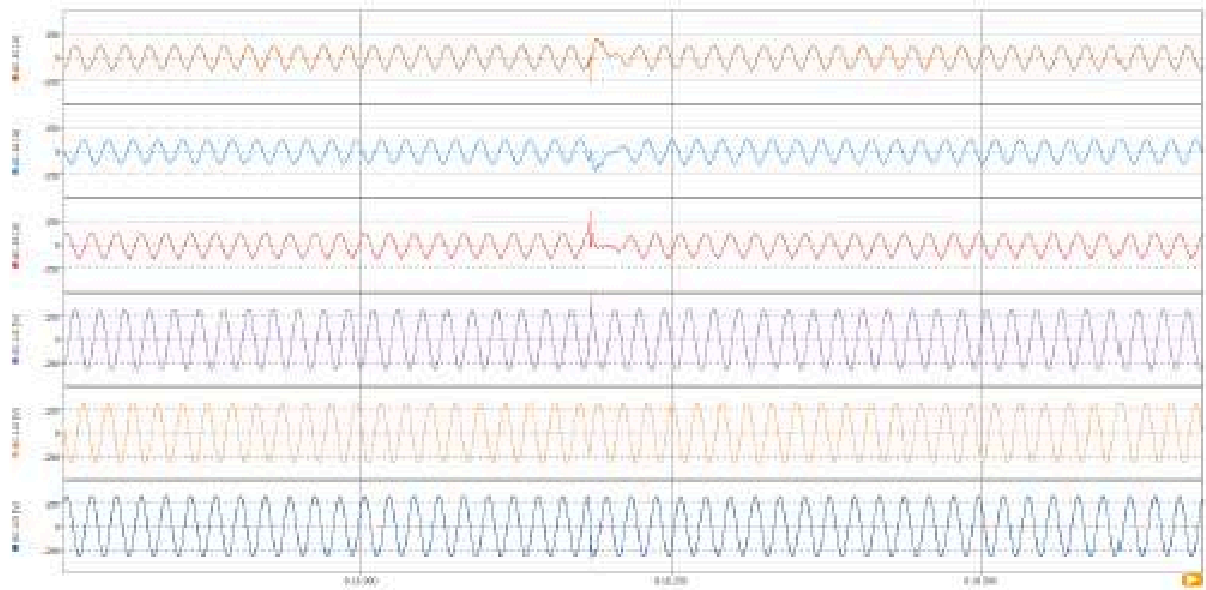
Inverter status: ☒ disconnected to the grid () ☐ not disconnected to the grid
Note: The machine is not damaged and can be connected to the grid normally.

Test 2a: 0°~ 90° @ 50% of Nominal Power



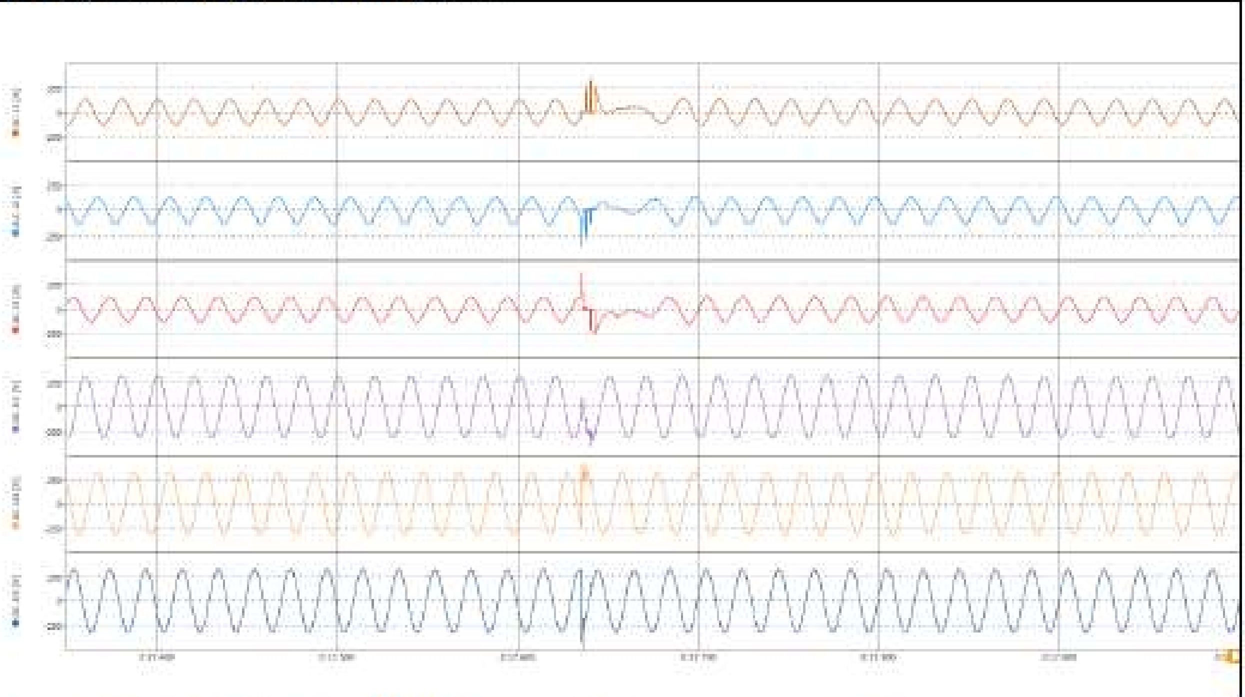
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 2b: 0°~ 90° @ 50% of Nominal Power



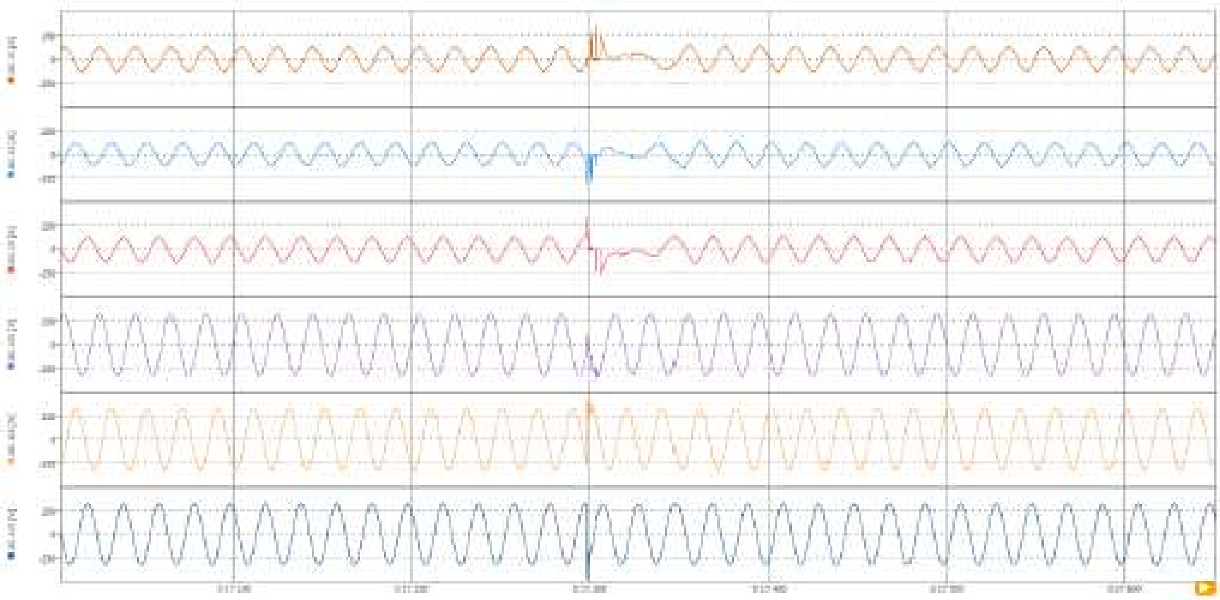
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 2c: 0°~180° @ 50% of Nominal Power



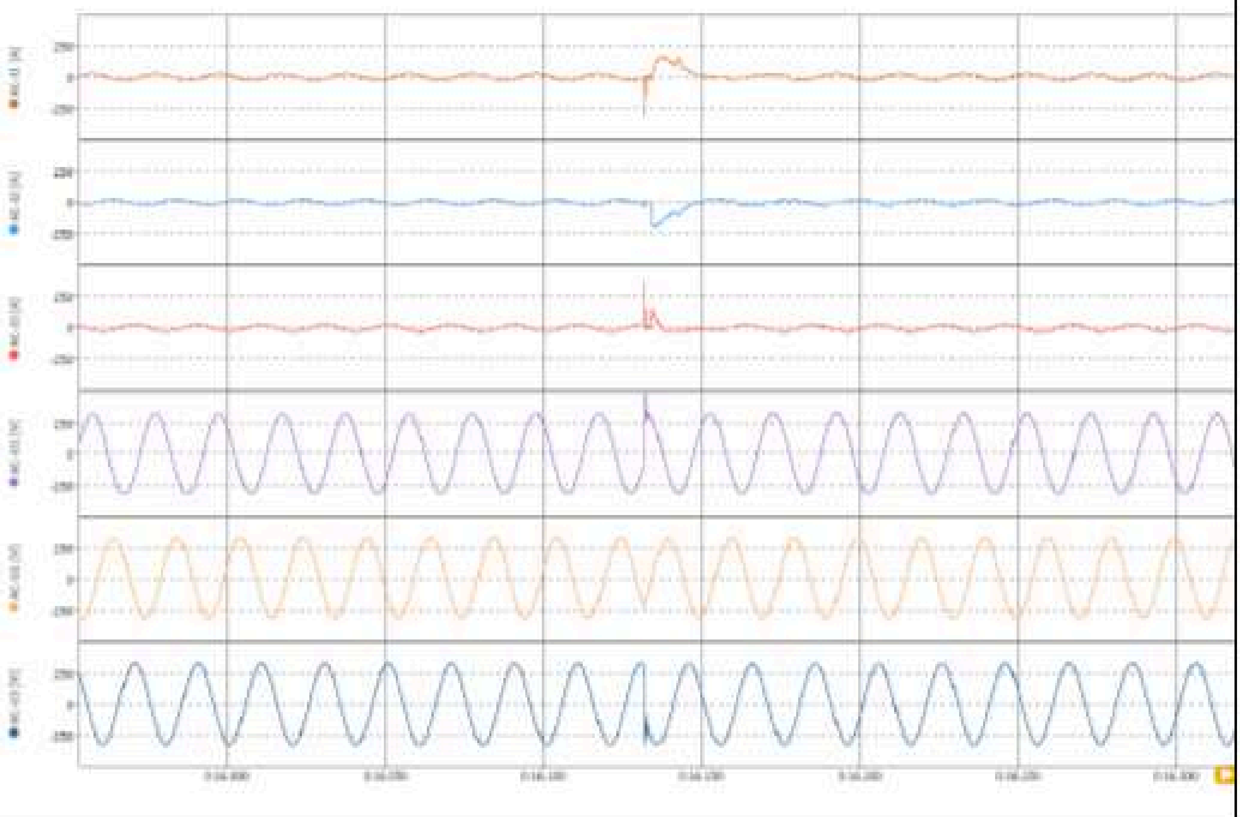
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 2d: 0°~ -180° @ 50% of Nominal Power



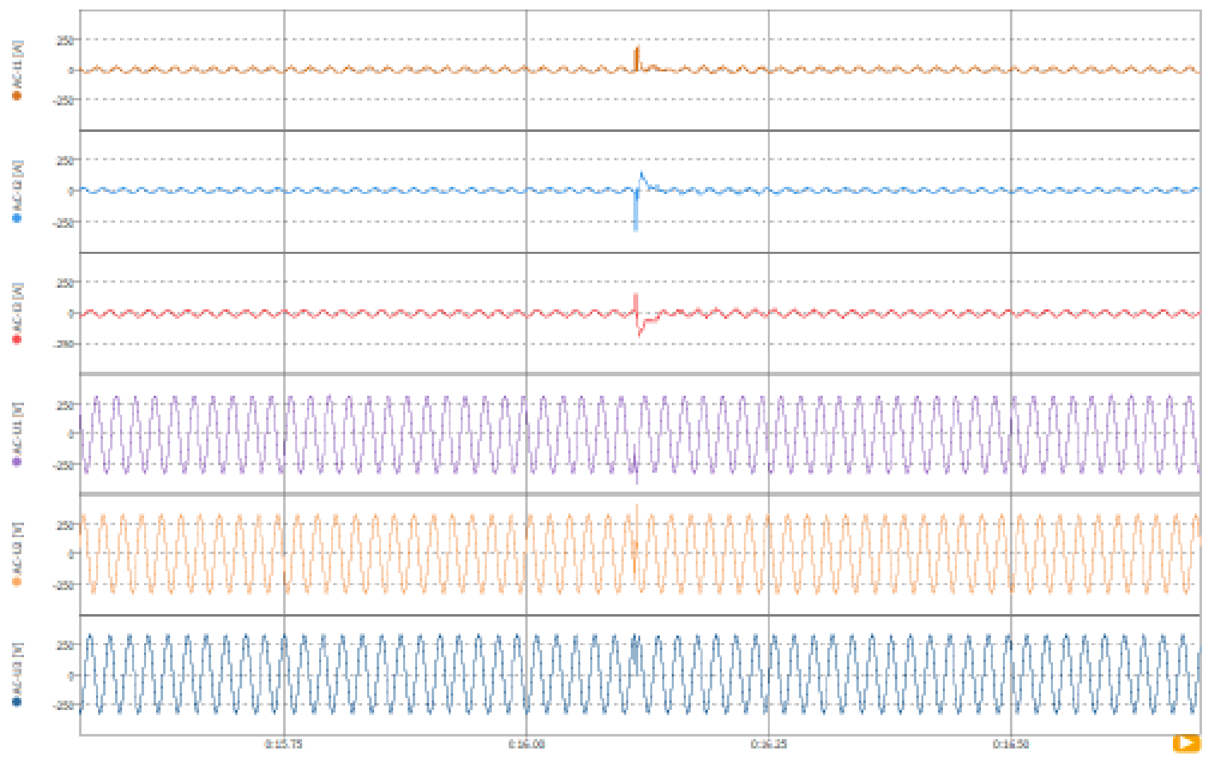
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 3a: 0°~ 90° @ 10% of Nominal Power



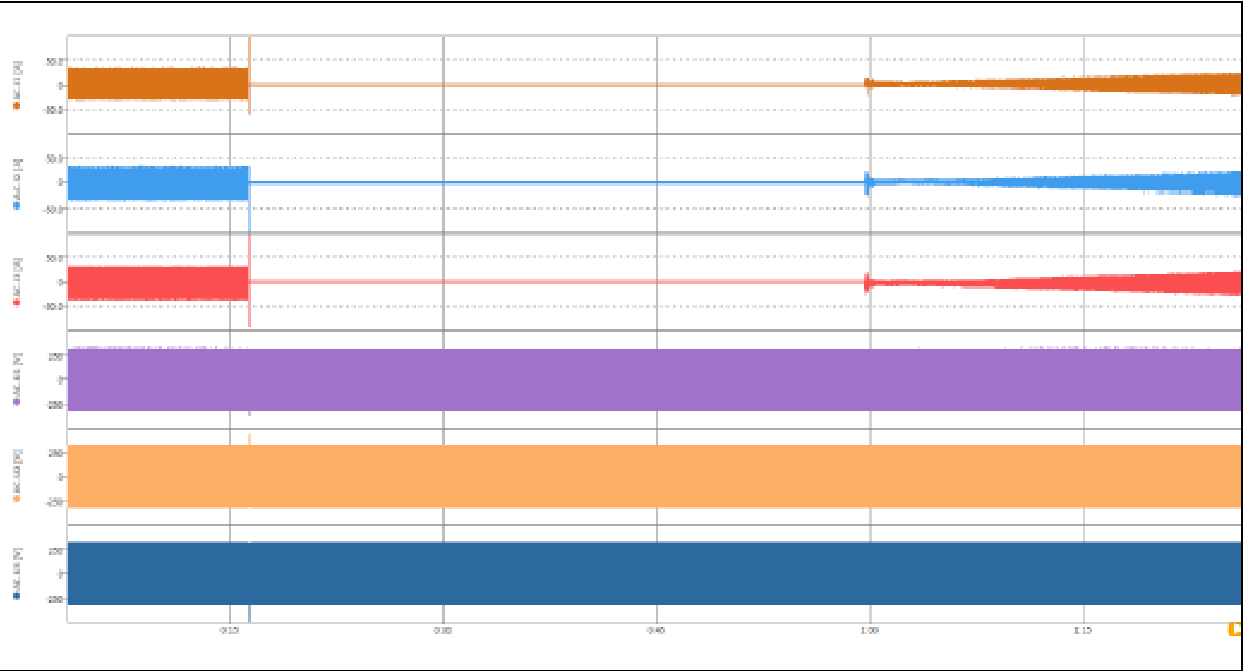
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 3b: 0°~ -90° @ 10% of Nominal Power



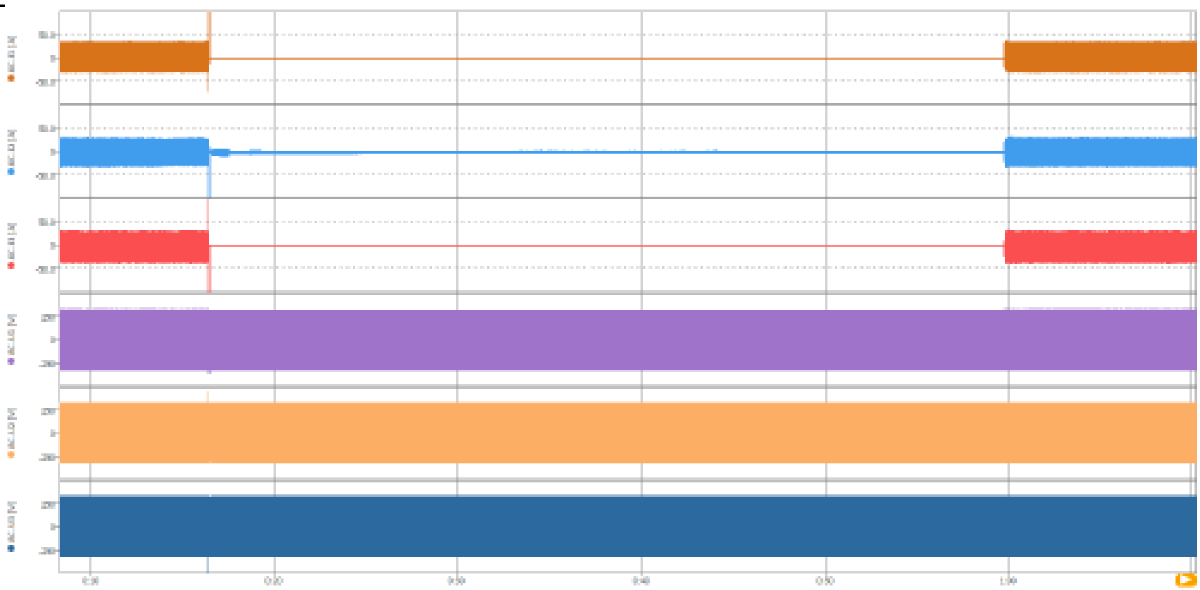
Inverter status: ☐ disconnected to the grid ☒ not disconnected to the grid

Test 3c: 0°~180° @ 10% of Nominal Power



Inverter status: ☒disconnected to the grid () ☐ not disconnected to the grid
Note: The machine is not damaged and can be connected to the grid normally.

Test 3d: 0°~ -180° @ 10% of Nominal Power



Inverter status: ☒ disconnected to the grid () ☐ not disconnected to the grid
Note: The machine is not damaged and can be connected to the grid normally.

Allegato Z – Variante 2 **Regolazioni del sistema di protezione dei gruppi generatori** *Settings of the protection system for groups of generators*	
c) Generatori statici FV / Static PV converters	
Ambient temperature (°C) ....:	25 °C
Humidity (RH %) ....:	35 %
Instrumentation list...:	See table "Measurement equipment and instrumentation"

SETTING:

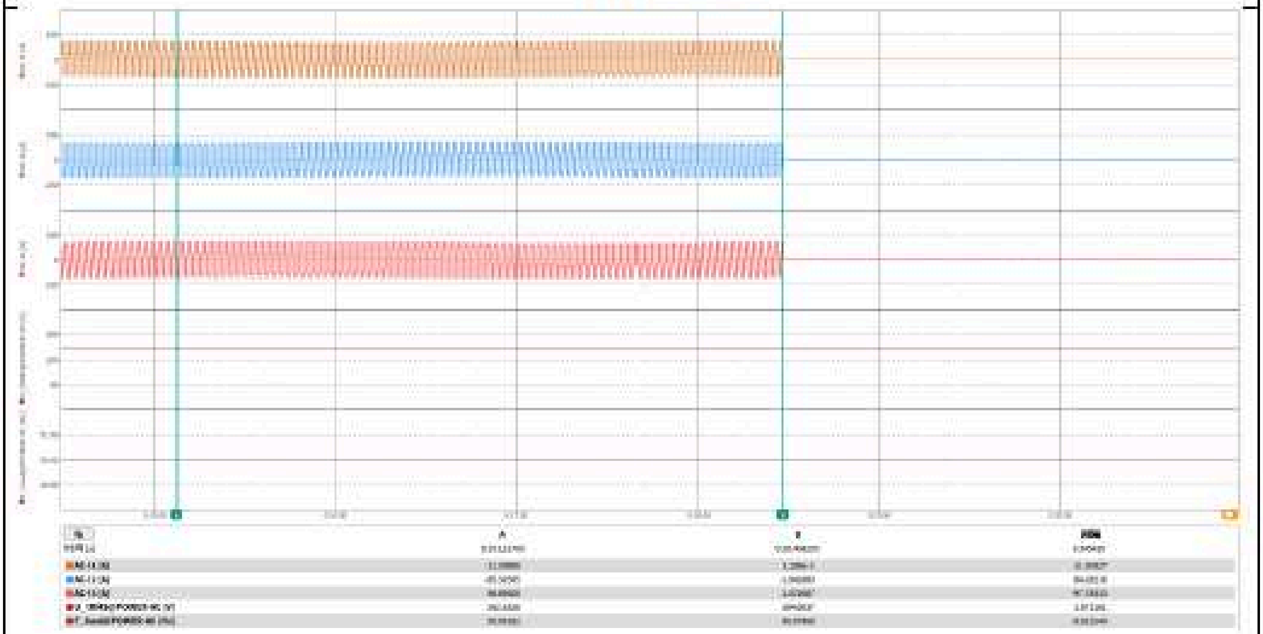
Protezione	Soglia di intervento		Tempo di intervento
Minima tensione 27	S1	≤ 0,85 V_n	≥ 1,5 s
	S2	≤ 0,15 V_n	≥ 0,2 s
Massima tensione 59	S1	≥ 1,15 V_n	≥ 0,5 s
	S2	≥ 1,20 V_n	≥ 0,1 s
Minima frequenza 81<	S1	≤ 47,5 Hz	≥ 4,0 s
	S2	≤ 46,5 Hz	≥ 0,1 s
Massima frequenza 81>	S1	≥ 51,5 Hz	≥ 1,0 s
	S2	≥ 52,5 Hz	≥ 0,1 s

Over Voltage (Ph-N)

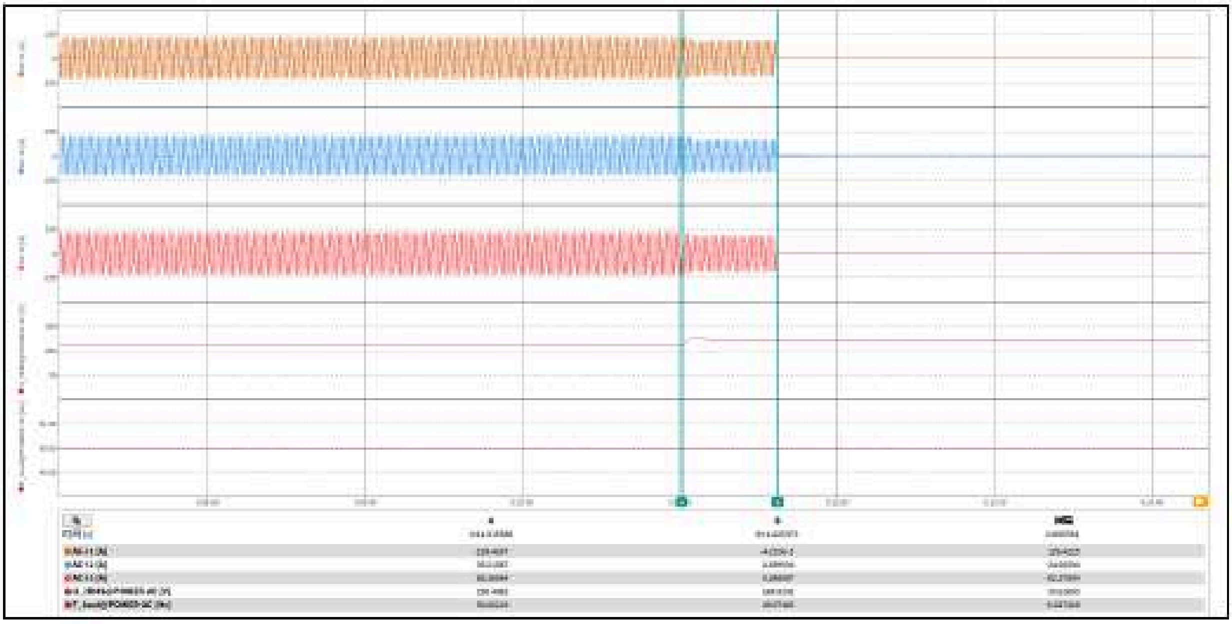
Vϕ-n nom = 230.0 Vac	Limit (At least)		Settings		Results	
OV>>	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]
L1-L2-L3-N	276.0	0.100	276.0	0.100	276.66	0.193
OV>	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]
L1-L2-L3-N	264.5	0.500	264.5	0.500	264.60	0.610

(*) Value due to an Hardware limit of the inverter.

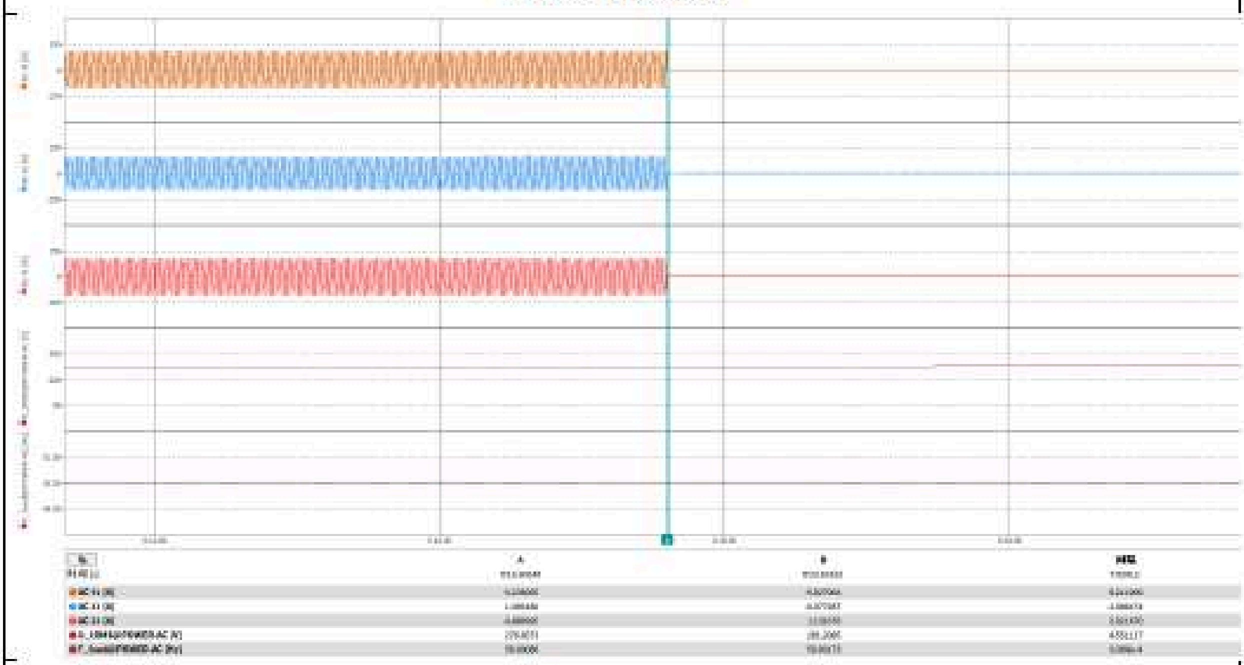
OV> - Threshold



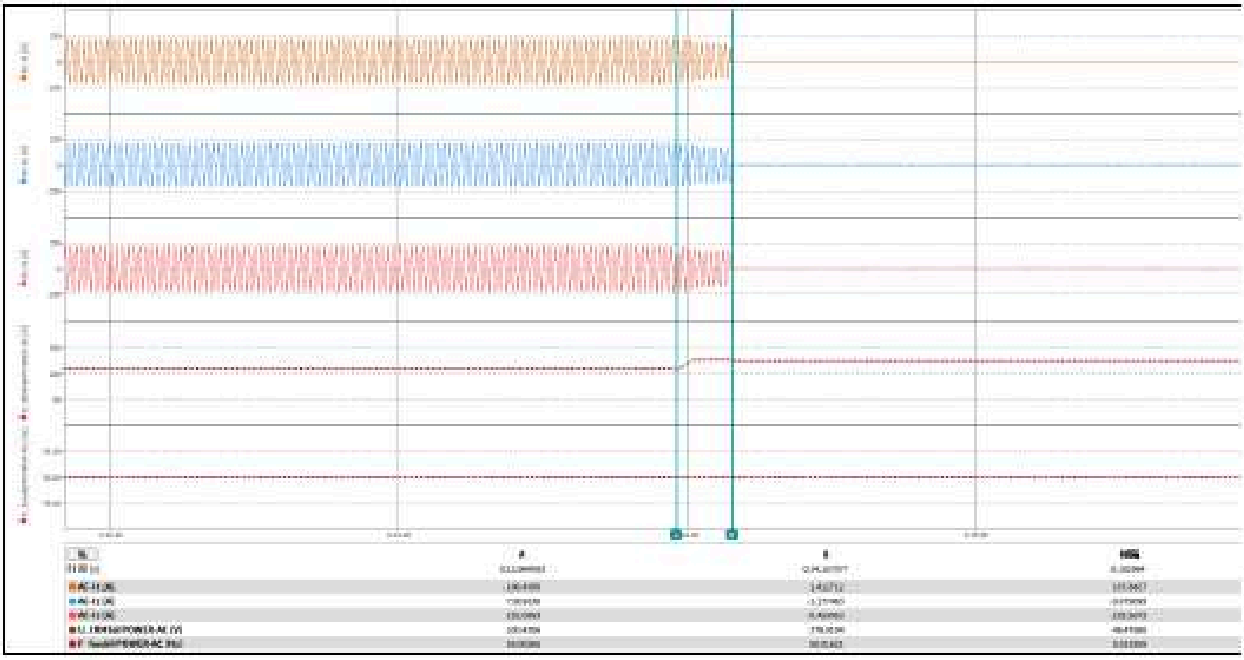
OV> - Trip time



OV>> - Threshold



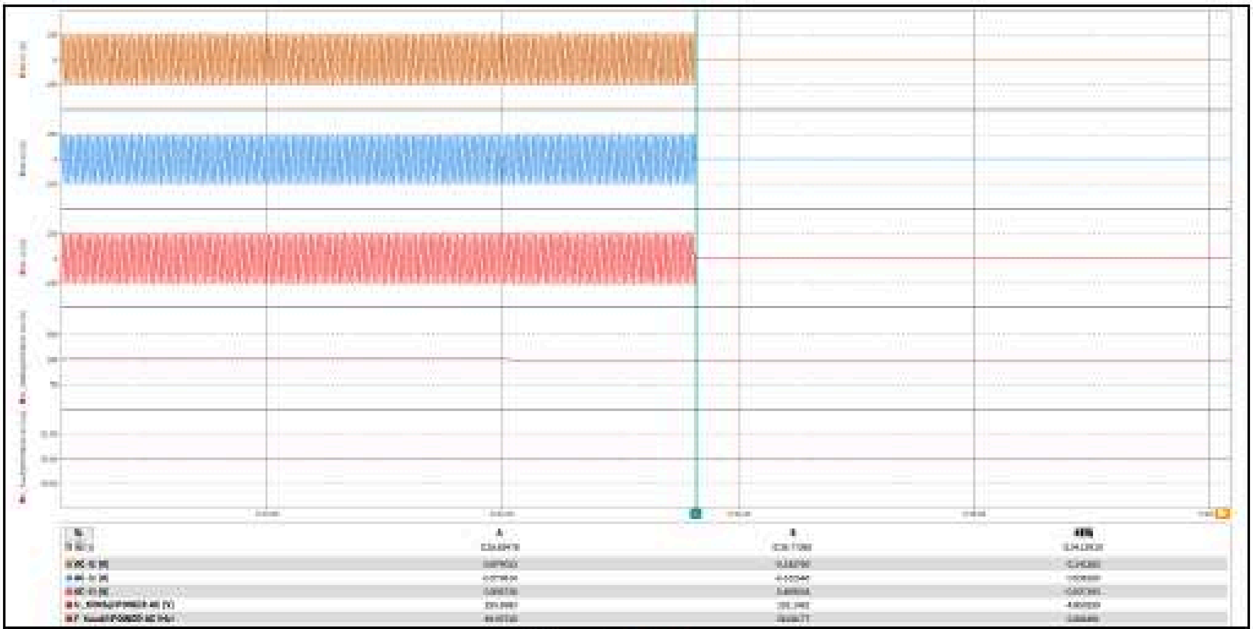
OV>> - Trip time



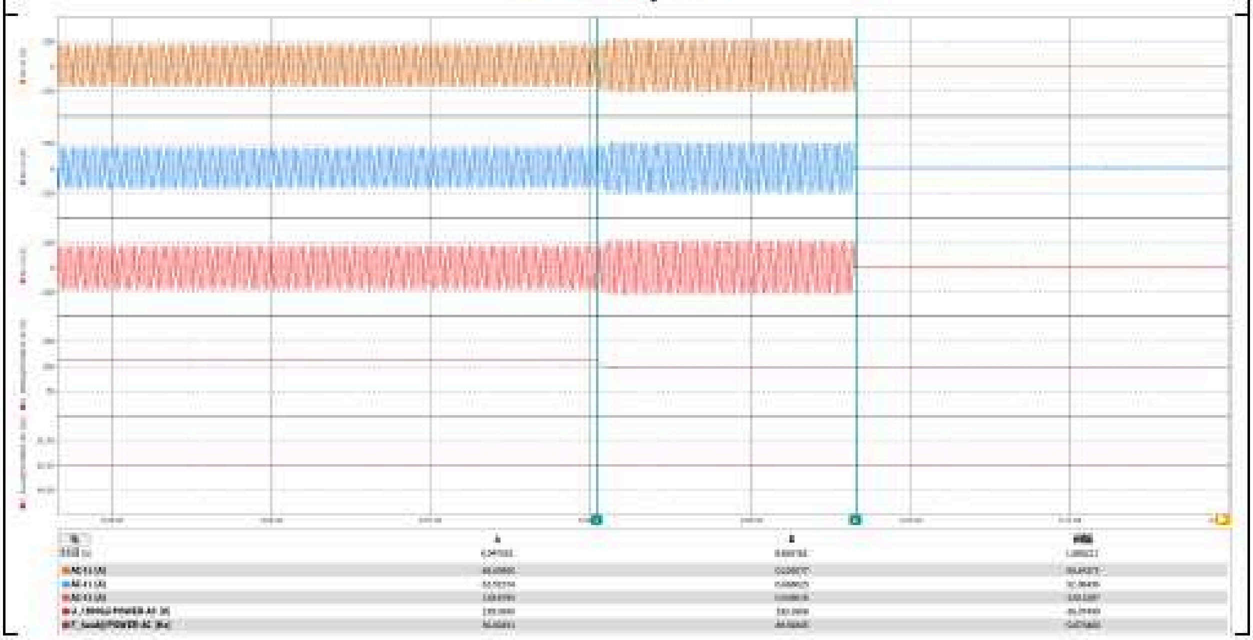
Under Voltage (Ph-N)

Vϕ-n nom = 230.0 Vac	Limit (At least)		Settings		Results	
UV<	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]
L1-L2-L3-N	195.5	1.500	195.5	1.500	196.00	1.608
UV<<	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]	Voltage [Vac]	Time [s]
L1-L2-L3-N	34.6	0.200	34.6	0.200	34.62	0.288

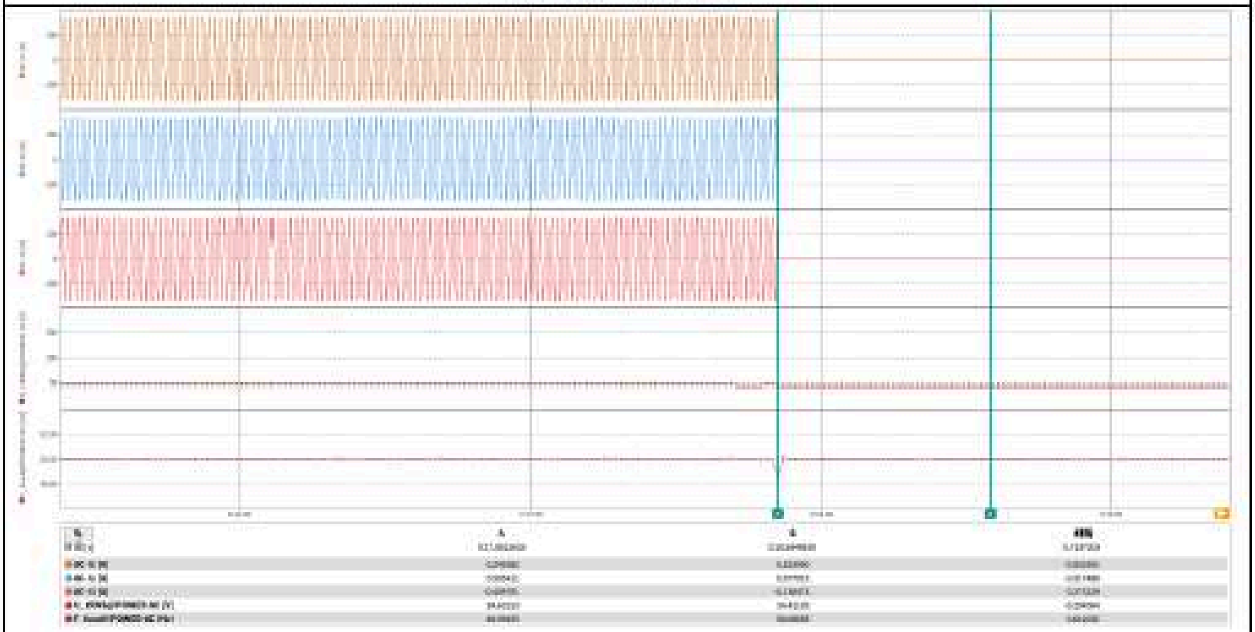
UV< - Threshold



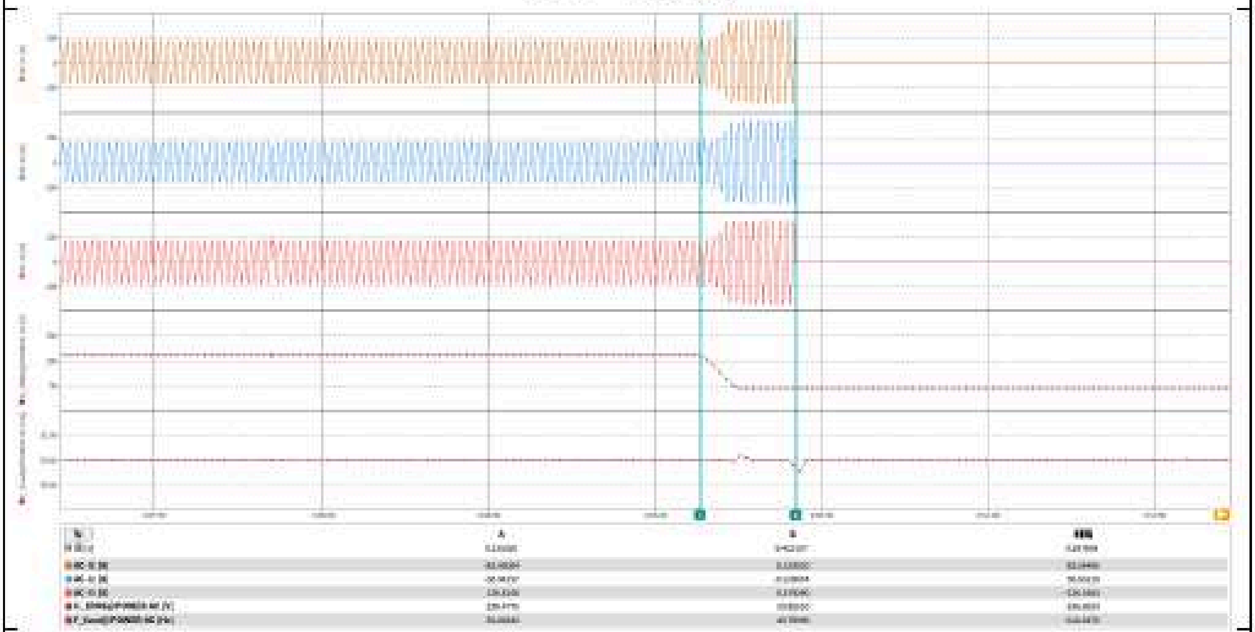
UV< - Trip time



UV<< - Threshold



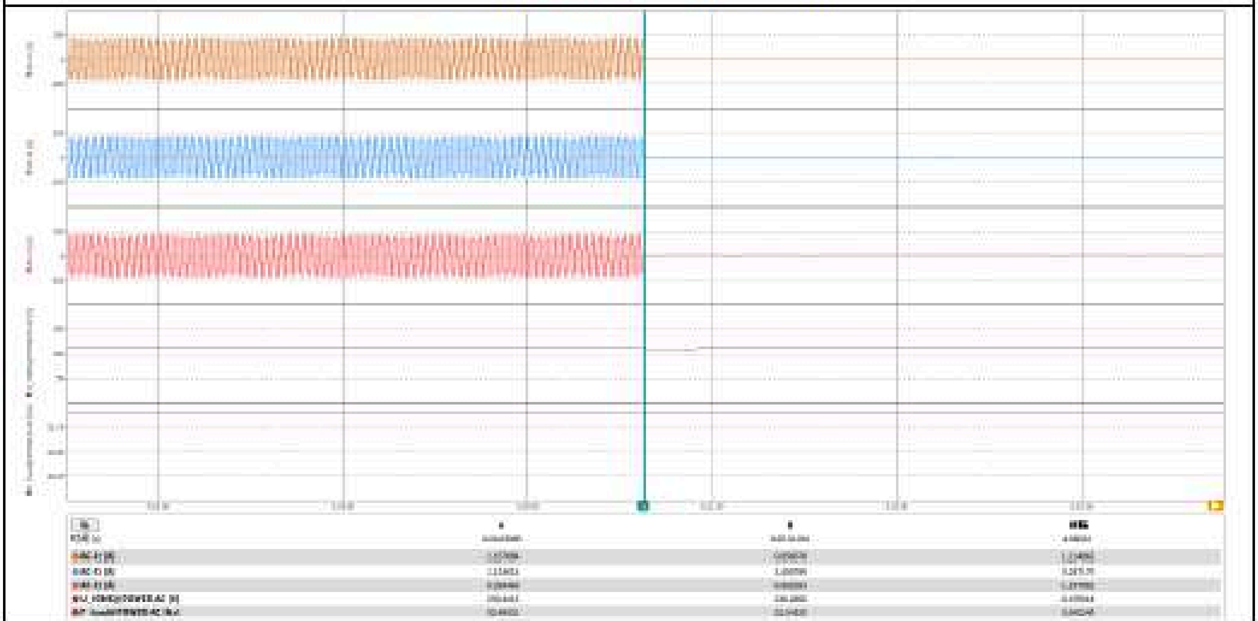
UV<< - Trip time



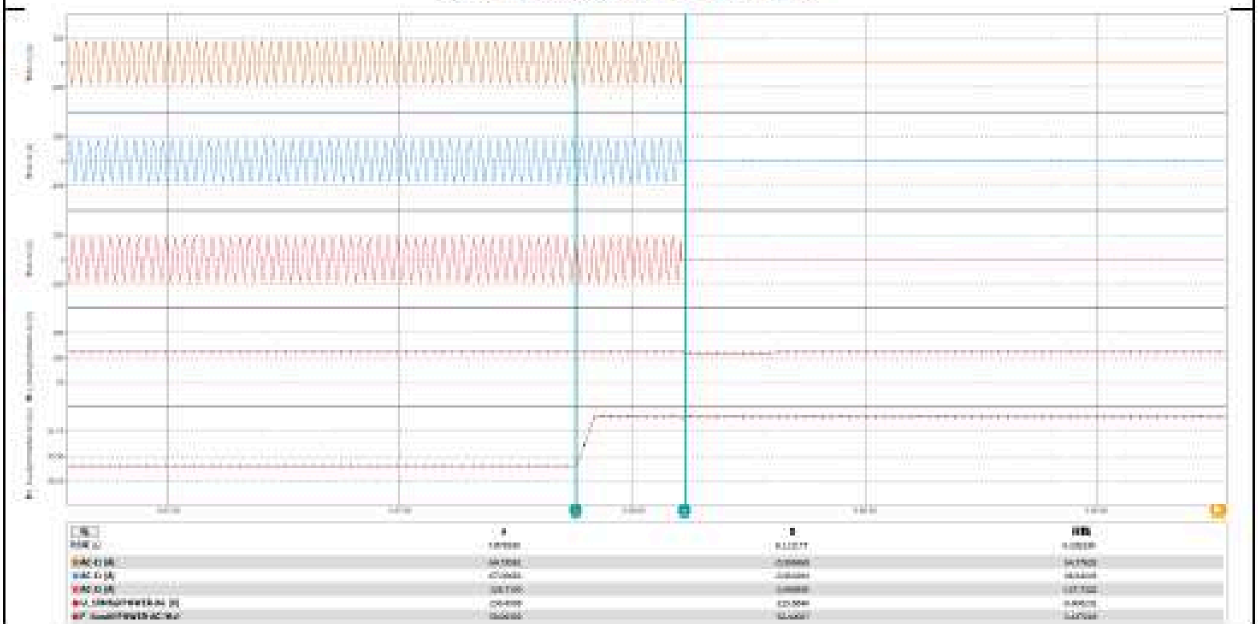
Over Frequency

F nom = 50.00 Hz	Limit (At least)		Settings		Results	
	Frequency [Hz]	Time [s]	Frequency [Hz]	Time [s]	Frequency [Hz]	Time [s]
Over Frequency >>	52.50	0.100	52.50	0.100	52.50	0.235
Over Frequency >	51.50	1.000	51.50	1.000	51.50	1.303

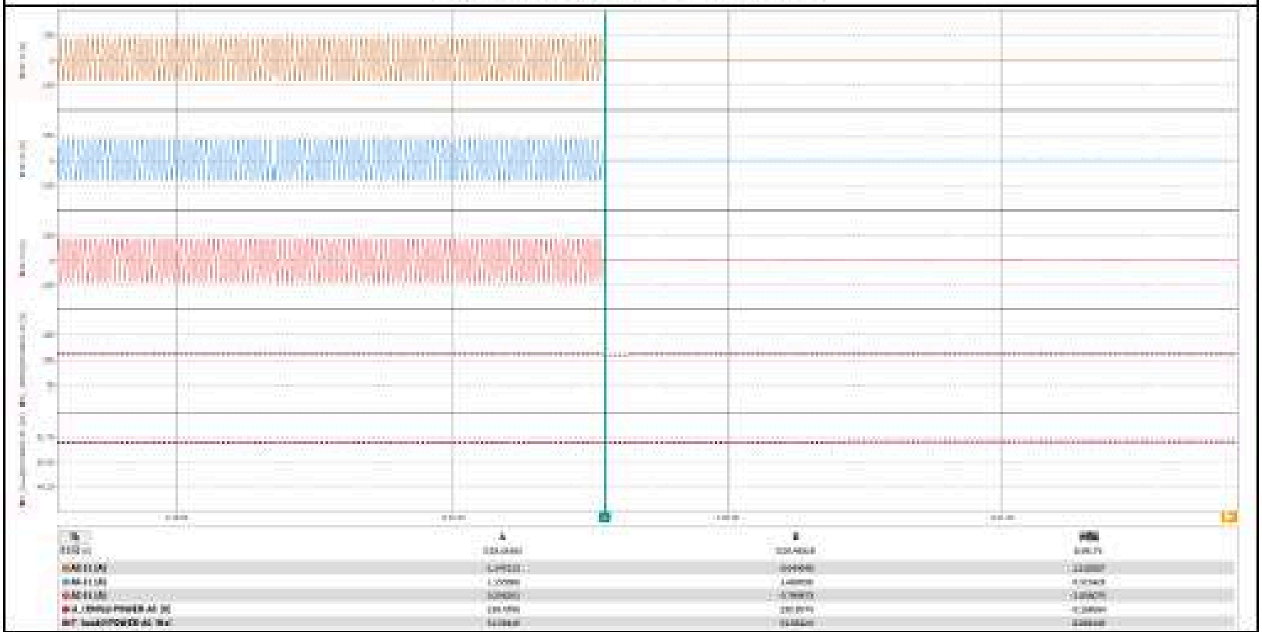
Over Frequency >> - Threshold



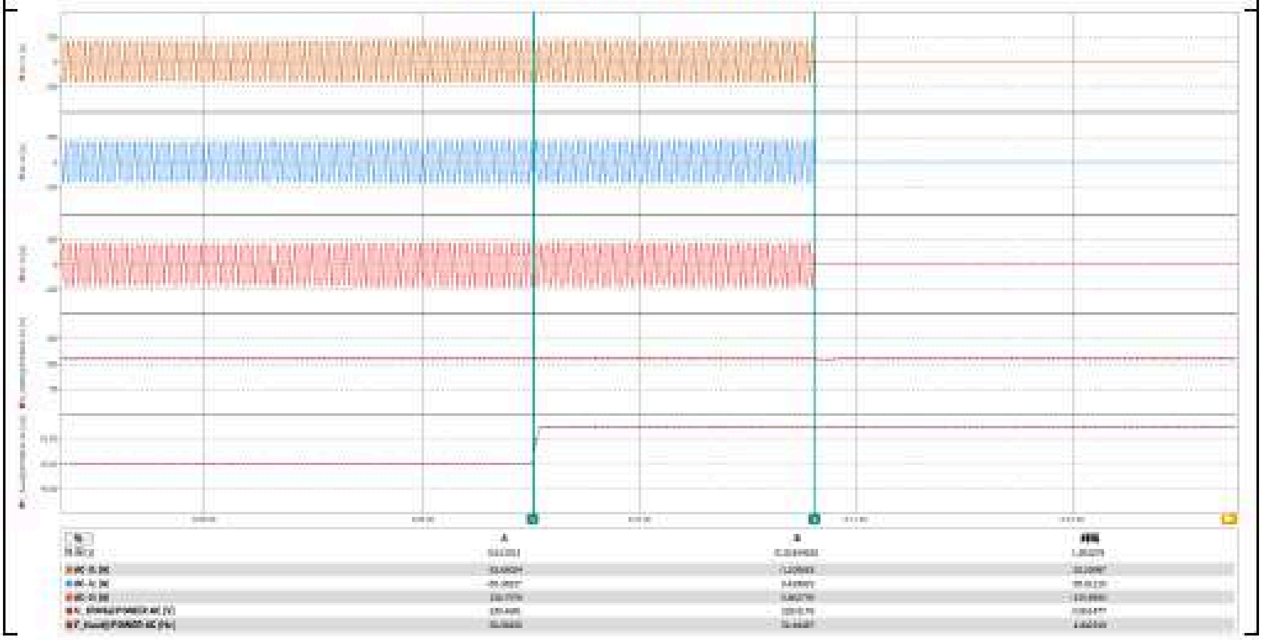
Over Frequency > > - Trip time



Over Frequency > - Threshold



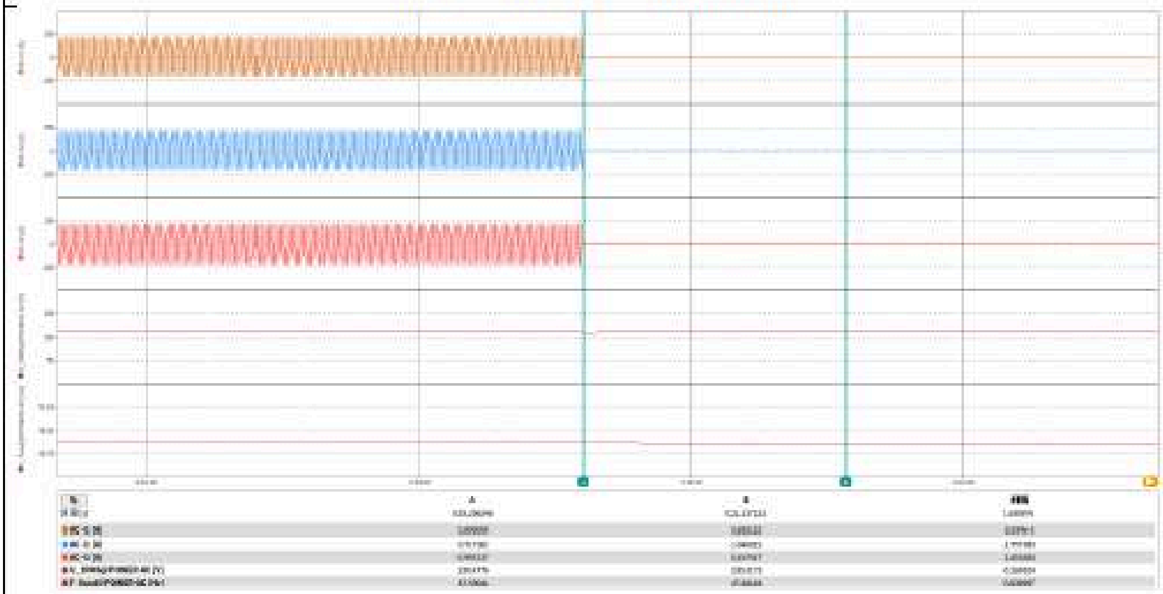
Over Frequency > - Trip time



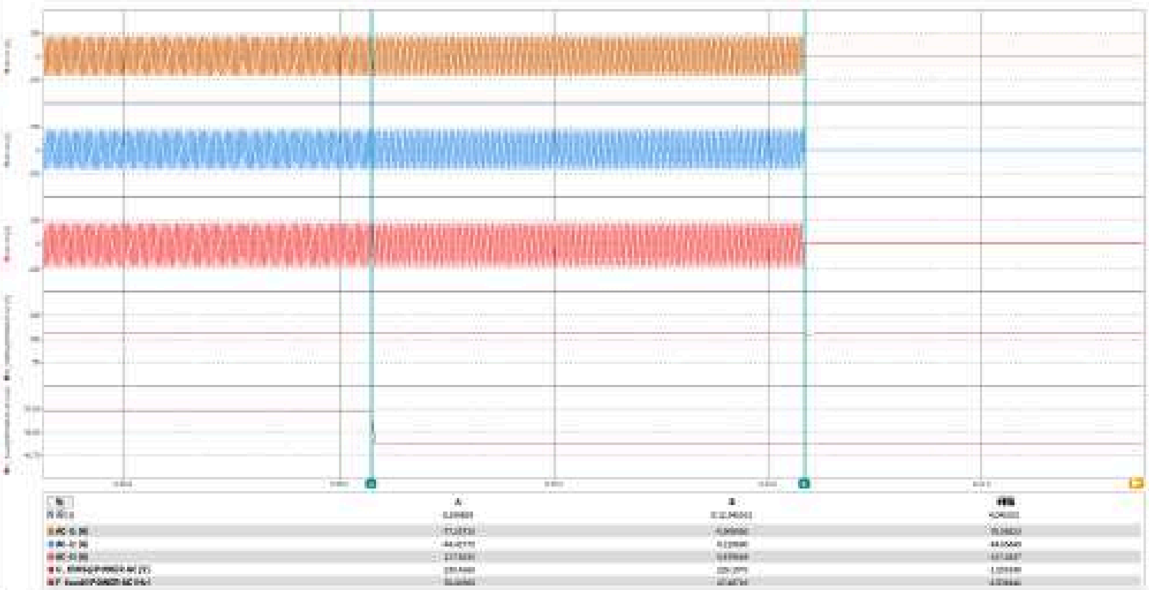
Under Frequency

F nom = 50.00 Hz	Limit (At least)		Settings		Results	
	Frequency [Hz]	Time [s]	Frequency [Hz]	Time [s]	Frequency [Hz]	Time [s]
Under Frequency <	47.50	4.000	47.50	4.000	47.50	4.045
Under Frequency <<	46.50	0.100	46.50	0.100	46.49	0.259

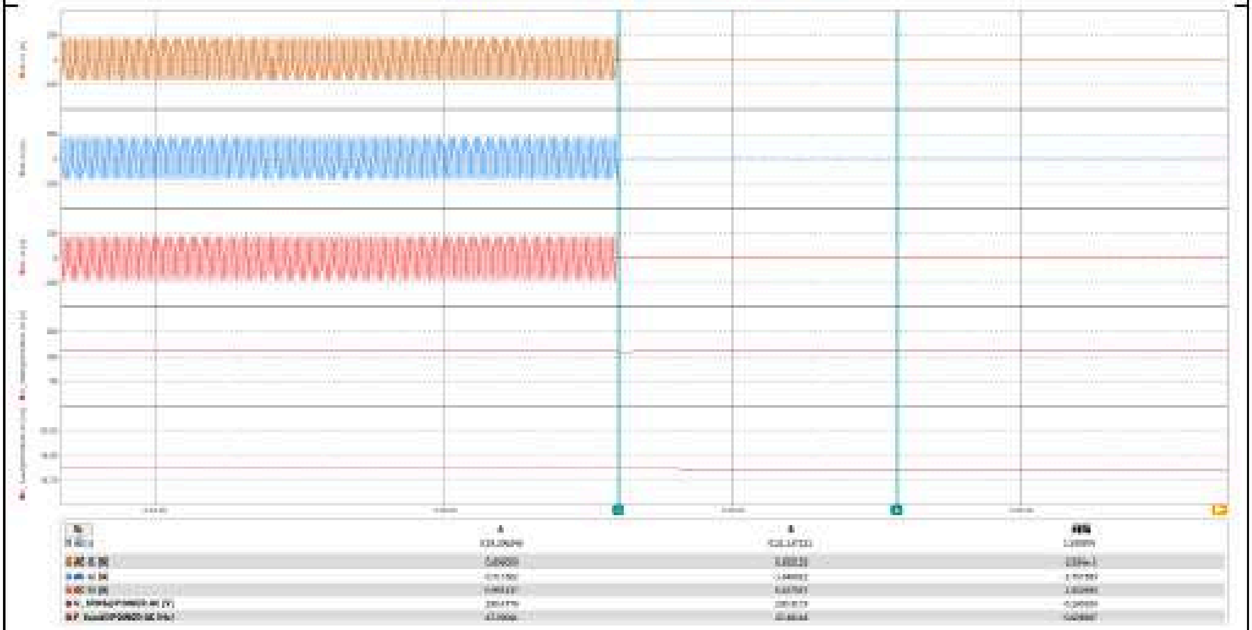
Under Frequency < - Threshold



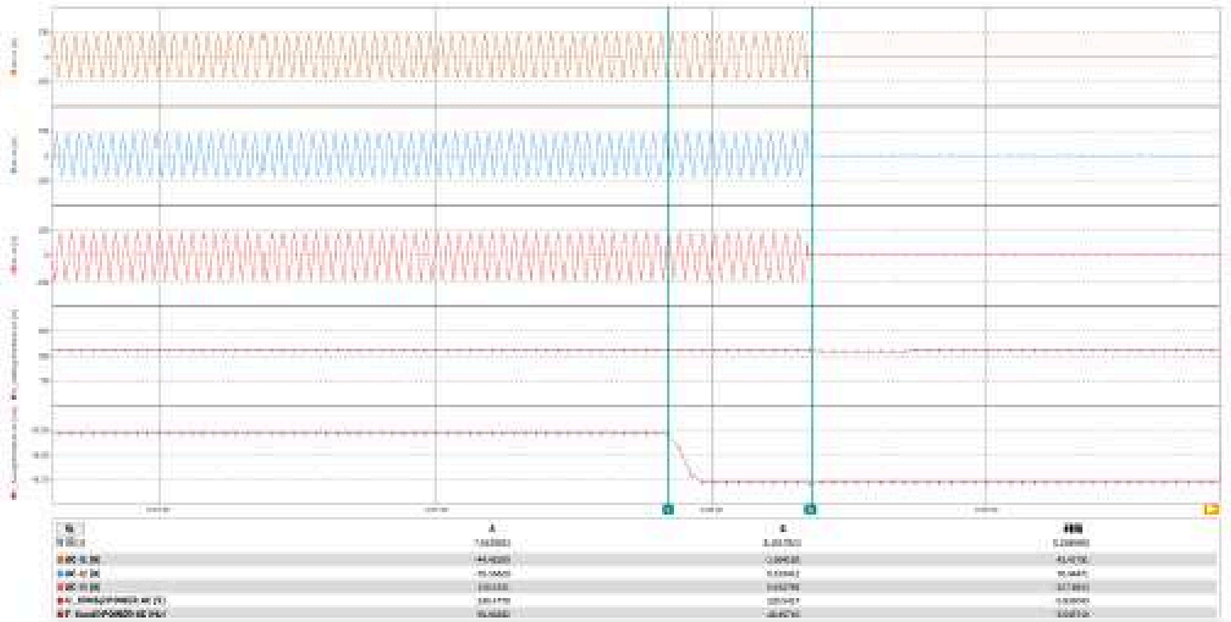
Under Frequency < - Trip time



Under Frequency << - Threshold



Under Frequency << - Trip time



-TEST REPORT END-

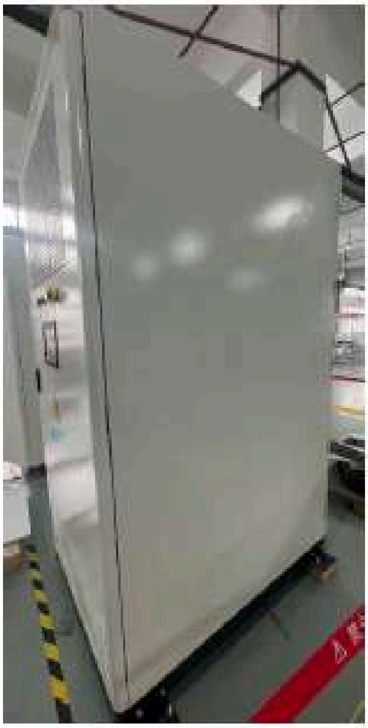
Model: SOLID POWER HV 261

Energy Storage System (Front view)

Energy Storage System (Back view)

Model: SOLID POWER HV 261

Energy Storage System (Left view)



Energy Storage System (Right view)

Model: SOLID POWER HV 261

Energy Storage System (Open view)

Battery Pack

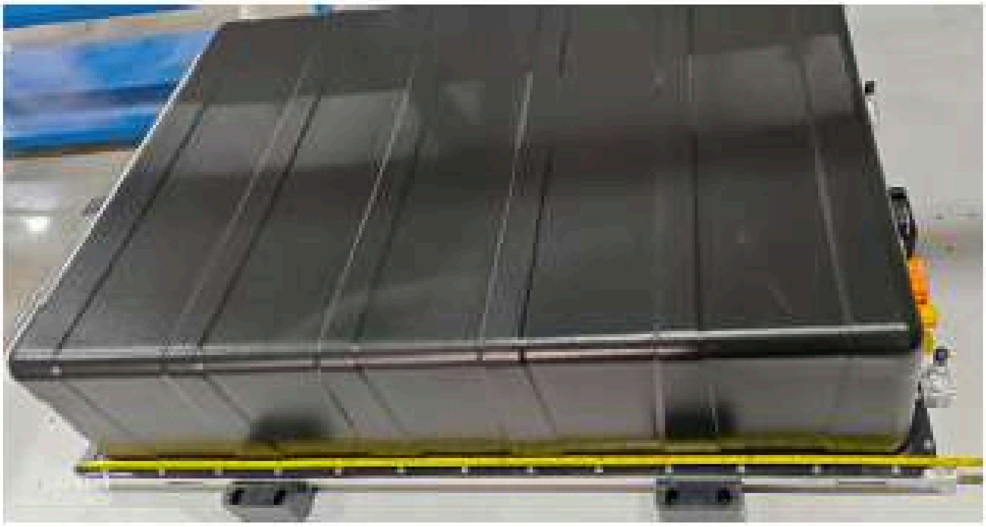
Model: SOLID POWER HV 261

Battery control box

Battery Pack (Top view)

Model: SOLID POWER HV 261

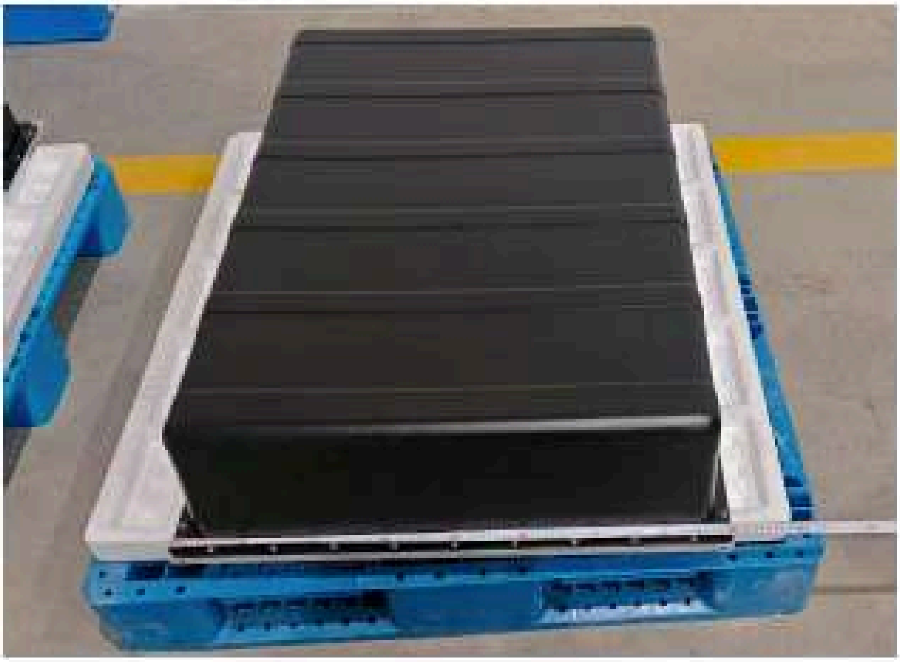
Battery Pack (Right view)



Battery Pack (Left view)

Model: SOLID POWER HV 261

Battery Pack (Front view)



Battery Pack (Back view)

Model: SOLID POWER HV 261

Battery pack (inside view)