Vorläufige Prototypenbestätigung / *Preliminary prototype confirmation*

Nr. / *No.*:

968/GI 2208.00/25

Netzintegration von Erzeugungseinheiten und -anlagen

Grid integration of power generating units and systems

Antragsteller / *Applicant*	Solax Power Network Technology(Zhejiang)Co.,Ltd No.278,Shizhu Road,Chengnan Sub-district,Tonglu Country,Hangzhou,Zhejiang,P.R. China
Zertifizierstelle / *Certification Body*	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln, Deutschland / *Germany*
Produkttyp / *Product type*	Umrichter für Speicher / Energieerzeugungseinheit (EZE) Typ 2 *Inverter for Energy Storage System / Power Generating Unit (PGU) Type 2*
Modell / *Model*	**X3-TRENE-79.9K, X3-TRENE-99.9K, X3-TRENE-100K, X3-TRENE-124.9K, X3-TRENE-125K**
Beschreibung / *Description*	Die EZE kann innerhalb ihrer Betriebsbereiche Leistung und Blindleistung bereitstellen / beziehen. Darüber hinaus bietet sie eine dynamische Blindstromeinspeisung bei Netzfehlern mit eingebauter Schutzfunktion. / *The PGU can supply/receive power and reactive power within its operating ranges. It also provides dynamic reactive current feed-in during grid fault with equipped protective function.*
Normen / *Standards*	VDE-AR-N 4110:2023-09, VDE-AR-N 4120:2018-11, FGW TR 8 / *TG8*, Rev.9 (2019-02-01)
Erklärung / *Declaration*	Die TÜV Rheinland Industrie Service GmbH bestätigt, dass es sich bei der genannten Energieerzeugungseinheit (EZE) Typ-2 nach sowie gemäß FGW TR 8, um einen Prototypen handelt, der in der Lage ist die technischen Anforderungen der Normen zu erfüllen. Es wird davon ausgegangen, dass die Anforderungen der FGW TR8 im Rahmen einer Zertifizierung erfüllt werden. / *TÜV Rheinland Industrie Service GmbH confirms that the mentioned Power Generating Unit (PGU Type-2) is a prototype according to as well as according to FGW TG 8, which is able to meet the technical requirements of the standards. It is assumed that the requirements of FGW TG8 are fulfilled within the scope of a certification.*
Inbetriebnahme der ersten EZE / *Commissioning of the first PGU*	--
Datum / *Date*	2025-03-17
Gültig bis / *Valid until*	2025-03-17 Die Details zur Gültigkeit im Kapitel 1.3 sind entsprechend zu beachten. / *The details on validity in chapter 1.3 must be observed accordingly.*

Diese Prototypenbestätigung darf nicht auszugsweise verwendet werden.

This prototype confirmation may not be used in extracts.

Köln, 2025-03-17
TÜV Rheinland Industrie Service GmbH
Am Grauen Stein, D-51105 Köln

M. Sc. Armin Kerperin
Certifier

M. Sc. Sandipkumar Prajapati
Assessor

1. Aufgabenstellung / *Task*

Im Rahmen dieser Prototypenbestätigung wird auf Grundlage herstellerspezifischer Dokumente überprüft, ob die genannte Energieerzeugungseinheit (EZE) die Anforderungen gemäß [N1] bis [N3] erfüllen kann.

As part of this prototype confirmation, it is checked on the basis of manufacturer-specific documents whether the named power generating unit (EZE Type-2) can meet the requirements according to [N1] to [N3].

1.1. Normen und Technische Richtlinien / *Standards and technical guidelines*

[N1] Technical Guideline for the connection of customer systems to the medium-voltage network and their operation (TAR medium voltage / VDE-AR-N 4110: 2023-09)

[N2] Technical Guideline for the connection of customer systems to the high-voltage network and their operation (TAR high voltage / VDE-AR-N 4120: 2018-11)

[N3] Technical guideline for generating units and systems part 8 revision 09 of the Fördergesellschaft Windenergie und andere Erneuerbare Energien e.V. (FGW TG8 Rev. 9)

1.2. Für die Bestätigung verwendete Dokumente / *Documents supplied for confirmation*

Für die Bewertung der EZE wurden u. a. Informationen aus den folgenden herstellerspezifischen Dokumenten entnommen.

For the evaluation of the PGU, e.g. Information taken from the following manufacturer-specific documents.

[D1] Solax Power Network Technology(Zhejiang)Co.,Ltd
Declaration of VDE-AR-N 4110 & 4120
Dated: 2025-01-07

[D2] Solax Power Network Technology(Zhejiang)Co.,Ltd
Application for Certification
Dated: 2025-01-15

[D3] Solax Power Network Technology(Zhejiang)Co.,Ltd
User Manual
Dated: 2024-01-30

1.3. Gültigkeit der Prototypenbestätigung / *Validity of prototype confirmation*

Die Gültigkeit der ausgestellten Prototypenbestätigung beschränkt sich gemäß VDE-AR-N 4110 [N1] auf zwei Jahre nach Inbetriebsetzung des ersten Prototypen. Da zurzeit noch keine EZE von diesem Typ in Betrieb genommen worden ist, handelt es sich um eine vorläufige Prototypenbestätigung. Diese Prototypenbestätigung ist nach Inbetriebnahme des ersten Prototypen entsprechend zu revidieren und die Gültigkeit ist auf zwei Jahre nach Inbetriebsetzung der der ersten EZE dieses Prototypen zu beschränken.

The validity of the prototype confirmation issued is limited to two years after commissioning of the first prototype in accordance with VDE-AR-N 4110 [N1]. Since. Since no PGU of this type has currently been commissioned, this is a provisional prototype confirmation. This prototype confirmation must be revised accordingly after commissioning of the first prototype and the validity must be limited to two years after commissioning of the first PGU of this prototype.

2. Prototypenregelung nach FGW TR 8 / *Prototype regulation according to FGW TG 8*

In diesem Abschnitt wird überprüft, ob es sich bei der EZE gemäß FGW TR 8 [N3] um einen Prototyp handelt. Nach [N3] ist ein Prototyp das erste Betriebsmittel eines Typs, welches wesentliche technische Weiterentwicklungen oder Neuerungen aufweist, sowie alle weiteren Betriebsmittel dieses Typs, die innerhalb von zwei Jahren nach Inbetriebsetzung des ersten Betriebsmittels dieses Typs in Betrieb gesetzt wurden. Die Regelung und Fristen von Betriebsmittelprototypen in einer EZE können den Netzanschlussregeln (NAR) entnommen werden.

In this section, it is checked whether the mentioned PGU is a prototype according to FGW TG 8 [N3]. According to [N3], the definition of the prototype is the first item of equipment of this type that has significant technical developments or innovations, as well as all other items of equipment of this type that were put into operation within two years after the first item of equipment of this type was in service. The rules and deadlines for equipment prototypes of PGU can be found in the grid connection guideline (NAR).

Gemäß [N1] gilt: Für Erzeugungsanlagen (EZA) mit EZE gleichen Prototyps müssen das Anlagenzertifikat und die Konformitätserklärung binnen eines Jahres, nachdem für den ersten Prototyp ein Einheitenzertifikat vorliegt, nachgereicht werden. Für Komponenten innerhalb der Erzeugungsanlage, für die ein Komponentenzertifikat erforderlich ist, kann die Prototypenregelung entsprechend angewendet werden.

According to [N1] the following applies: for power generating systems (PGS) with PGU of the same prototype, the plant certificate and the declaration of conformity must be submitted within one year after a unit certificate is available for the first prototype. The prototype regulation can be applied accordingly for components within the generating plant for which a component certificate is required.

Bewertung / *Assessment:*

FGW TR8 / TG8 (Revision 9)	**Bewertung/Assessment**
2.11 Betriebsmittel Prototypen / *Prototype*	
Herstellererklärung zur teilweisen oder vollständigen Konformität zu einer oder mehreren NAR. */ Manufacturer's declaration of partial or full conformity to one or more NAR.*	☒ Berücksichtigt */ Included* (Anhang 1 / *Annex 1*)
Herstellererklärung, dass es sich um eine wesentliche technische Weiterentwicklung bzw. Neuerung handelt. / *Manufacturer's declaration that it is a major technical development or innovation.*	☒ Berücksichtigt */ Included* (Anhang 1 / *Annex 1*)
Aufzeigen von Unterschieden zu ggf. vorhandenen und bereits zertifizierten Betriebsmitteln. / *Identification of differences to any existing and already certified equipment.*	☒ Berücksichtigt */ Included* (Anhang 1 / *Annex 1*)
Herstellererklärung, dass weitere technische Daten den Anforderungen der jeweiligen NAR entsprechen. / *Manufacturer's declaration that further technical data meet the requirements of the respective NAR.*	☒ Berücksichtigt */ Included* (Anhang 1 / *Annex 1*)

3. Prototypenregelung gemäß VDE-AR-N 4110/ *Prototype regulation according to VDE-AR-N 4110*

Nach [N3] muss die Zertifizierungsstelle in der Prototypenbestätigung nachvollziehbar ausweisen, dass der Prototyp grundsätzlich in der Lage ist, die Anforderungen der jeweiligen NAR an die elektrischen Eigenschaften und Funktionen der Betriebsmittel zu erfüllen.

According to [N3], the certification body must clearly state in the prototype confirmation that the prototype is basically able to meet the requirements of the respective NAR for the electrical properties and functions of the equipment.

Die Vorgaben der NAR an den Prüfumfang für die Prototypenbestätigung sind zu berücksichtigen (sofern vorhanden). Im Folgenden wird dazu die Übereinstimmung der elektrischen Eigenschaften des EZE- mit den Anforderungen nach [N1] überprüft.

The specifications of the NAR for the scope of testing for the prototype confirmation must be taken into account (if available). In the following, the compliance of the electrical properties of the PGU with the requirements of [N1] is checked.

Bewertung / Assessment:

Art der Betriebsmittel ***Type***	EZE / *PGU*		Komponenten / *Components*		
	PV	Speicher / *Storage System*	EZA-Regler / *PGU Controller*	Kompensations-einrichtung / *Compensation equipment*	Schutzein-richtungen / *Protective devices*
	☐	☒	☐	☐	☐
Anmerkung ***Annotation***	Die folgenden Punkte 1), 2) und 4) sind anzuwenden. *The following items 1), 2) and 4) are applied.*		Die folgenden Punkte 1), 2), 3) und 4) sind anzuwenden. *The following items 1), 2), 3) and 4) are applied.*		

Anforderungen an Prototypen gemäß VDE-AR-N 4110 Requirements for Prototypes according to VDE-AR-N 4110		
Nr.	Anforderungen / *Requirements*	Bewertung / *Evaluation*
1)	Der Prototyp weist wesentliche technische Weiterentwicklungen oder Neuerungen auf. / *The prototype shows significant technical developments or innovations.*	☒ Zutreffend/ *Applied*
2)	Der Prototyp ist grundsätzlich in der Lage die Anforderungen dieser VDE-Richtlinie an die elektrischen Eigenschaften zu erfüllen. / *The prototype is basically able to meet the requirements of this VDE guideline for the electrical properties.*	☒ Zutreffend/ *Applied*
3)	Für Komponenten innerhalb der Erzeugungsanlage, für die ein Komponentenzertifikat erforderlich ist, kann die Prototypenregelung entsprechend angewandt werden. *For components within the power generating plant, for which a component certificate is required, the prototype regulation can be applied in analogy.*	☒ Zutreffend/ *Not applicable*
4)	Anforderungen an die Angaben der Datenblätter und darauf basierende Plausibilitätsprüfung (PP) / *Requirements for the information in the data sheets and the plausibility check (PP) based on them*	

	a) Herstellererklärung, dass die Erzeugungseinheit so konstruiert wurde, dass die Anforderungen der VDE erfüllt werden können. / *Manufacturer's declaration that the generating unit was constructed in such a way that the requirements of the VDE can be met.*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)* ☐ Entfällt / *Not applicable*	
	b) Schematisches Übersichtsbild der Erzeugungseinheit mit allen wesentlichen Komponenten / *Schematic overview of the generating unit with all essential components*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)* ☐ Entfällt / *Not applicable*	
	c) Elektrische Daten (Nenn- und Bemessungsgrößen) / *Electrical data (nominal and rated values)*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)* ☐ Entfällt (keine Anforderungen an EZA-Regler)/ *Not applicable for PGU controllers*	
	d) Schutzfunktionen mit Einstellbereichen / *Protection functions with setting ranges* Entkupplungsschutz / *Decoupling protection* Eigenschutz / *Self-protection*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)* ☐ Entfällt (keine Anforderungen an EZA-Regler) / *Not applicable for PGU controllers*	
	e) Betriebsbereich der Erzeugungseinheit: / *Operating range of the generating unit* Grenzen im quasistationären Betrieb / *Limits in quasi-steady state operation* Blindleistungsstellbereich / *Reactive power adjustment range* FRT-Grenzkurve (U/t-Diagramm) / *FRT limit curve (U/t diagram)*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)* ☐ Entfällt (keine Anforderungen an EZA-Regler) *Not applicable for PGU controllers*	
	f) Wirkleistungsregelung: / *Active power control* Leistungs-Frequenz-Verhalten; / *Power frequency regulation* Wirkleistungsgradient / *Active power ramping*	☒ Enthalten *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1):* ☐ Entfällt / *Not applicable*	
	g) Blindleistungsregelung / *Reactive power control regulated by* *- Fixed Q* *- Fixed cos φ* *- Voltage-dependent reactive power Q(U)* *- Active power Dependent reactive power Q(P)*	☒ Enthalten *Included* ☐ Entfällt für EZA-Regler / *Not applicable*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)*: ☐ Entfällt (keine Anforderung an EZA-Regler) / *Not applicable*	
	h) Spannungsstützung bei Netzfehlern durch Blindstromeinspeisung bei dynamischer Netzstützung / *Dynamic reactive current feed-in functionality*	☒ Enthalten *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)* ☐ Entfällt / *Not applicable*	

Votum des Fachauditors / Conclusion

Die TÜV Rheinland Industrie Service GmbH bestätigt, dass es sich bei der genannten EZE nach [N1] sowie gemäß [N3], um einen Prototypen handelt, der in der Lage ist die technischen Anforderungen der Normen zu erfüllen. Es wird davon ausgegangen, dass die Anforderungen von [N3] im Rahmen einer Zertifizierung erfüllt werden.

TÜV Rheinland Industrie Service GmbH confirms that the mentioned PGU according to [N1] as well as according to [N3], is a prototype that is able to meet the technical requirements of the standards. It is assumed that the requirements of [N3] are met within the framework of a certification.

Die Bewertung ergab keine Beanstandungen.
The evaluation did not result in any objections.

Anhang / Annex
Anhang 1 / Annex 1:
Manufacturer's Declaration

Declaration of VDE-AR-N 4110&4120

SolaX Power Network Technology (Zhejiang) Co., Ltd.

X3-TRENE-79.9-125K Series

Version: V1.0

We confirm that the parameters listed and the information in the parameter list correspond to the actual parameters present in the control system and adjustable on the generating units.

Signature: _____

Date: 2025.01.07

Declaration of VDE-AR-N 4110&4120

1. Company Information

License Holder:	SolaX Power Network Technology (Zhejiang) Co., Ltd.
Address:	No.278, Shizhu Road, Chengnan Sub-district, Tonglu County, Hangzhou, Zhejiang, P.R. China
Product Type:	X3-TRENE-79.9K, X3-TRENE-99.9K, X3-TRENE-100K, X3-TRENE-124.9K, X3-TRENE-125K

2. Product Datasheet:

Product Type:	X3-TRENE-79.9K	X3-TRENE-99.9K	X3-TRENE-100K	X3-TRENE-124.9K	X3-TRENE-125K
d.c. Battery voltage range:	650 ~ 936V				
d.c. Max. charge / discharge current	129.3A	161.7A	161.8A	202.1A	202.3A
a.c.Rated Output Voltage:	3 / N / PE, 230 / 400 V 3 / N / PE, 220 / 380 V				
a.c.Rated Output Frequency:	50 / 60Hz				
a.c.Rated.Output Current:	115.8A	144.8A	145.0A	181.1A	181.2A
a.c.Max.Output Current:	127.4A	159.3A	159.5A	199.2A	199.3A
a.c.Rated Output Power:	79.9kW	99.9kW	100kW	124.9kW	125kW
Max.Apparent Power:	79.9kVA	99.9 kVA	110k kVA	124.9k kVA	125k kVA
Adjustable Power Factor Range:	1 (0.8 Leading ~ 0.8 Lagging)				
Enclosure:	IP66				
Temperature Range:	-35~60℃ (>45℃ Derating)				
Overvoltage category	III(MAINS), II(DC)				
Protective Class:	I				
Topology	Non-isolated				
Firmware:	Master:1.00 Manager:1.00				
Note(s): Voltage measure accuracy: ±0.01p.u. Frequency measure accuracy: ±0.01 Hz					

Declaration of VDE-AR-N 4110&4120

3. Rating Label:

SMART PCS
POWER CONVERSION SYSTEM
Model: X3-TRENE-79.9K PCS SN:

DC INPUT / OUTPUT	
Battery voltage range	650 - 936 d.c. V
Max. charge / discharge current	129.3 d.c. A
AC INPUT / OUTPUT	
Nominal AC voltage	3 / N / PE, 230 / 400 a.c. V 3 / N / PE, 220 / 380 a.c. V
Nominal AC frequency	50 / 60 Hz
Rated output current	115.8 a.c. A @230 V 121.1 a.c. A @220 V
Max. output continuous current	127.4 a.c. A @230 V 133.2 a.c. A @220 V
Rated output power	79.9 kW
Max. output apparent power	79.9 kVA
Adjustable power factor range	1 (0.8 Leading - 0.8 Lagging)
OTHERS	
Operating ambient temperature range	-35 ℃ ~ +60 ℃ (>45℃ Derating)
Ingress protection	IP66
Protective class	I
Overvoltage category	III(MAINS), II(DC)
Topology	Non-isolated
Safety	IEC 62477
Grid monitoring	EN 50549, VDE 4105, G99, CEI 0-21, IEC 61727, PEA/MEA, NRS-097-2-1, RD 1699, TOR

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
X	X	☐	☐	☐	X	☐	☐	☐

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320301360401

SMART PCS
POWER CONVERSION SYSTEM
Model: X3-TRENE-99.9K PCS SN:

DC INPUT / OUTPUT	
Battery voltage range	650 - 936 d.c. V
Max. charge / discharge current	161.7 d.c. A
AC INPUT / OUTPUT	
Nominal AC voltage	3 / N / PE, 230 / 400 a.c. V 3 / N / PE, 220 / 380 a.c. V
Nominal AC frequency	50 / 60 Hz
Rated output current	144.8 a.c. A @230 V 151.4 a.c. A @220 V
Max. output continuous current	159.3 a.c. A @230 V 166.5 a.c. A @220 V
Rated output power	99.9 kW
Max. output apparent power	99.9 kVA
Adjustable power factor range	1 (0.8 Leading - 0.8 Lagging)
OTHERS	
Operating ambient temperature range	-35 ℃ ~ +60 ℃ (>45℃ Derating)
Ingress protection	IP66
Protective class	I
Overvoltage category	III(MAINS), II(DC)
Topology	Non-isolated
Safety	IEC 62477
Grid monitoring	EN 50549, VDE 4105, G99, CEI 0-21, IEC 61727, PEA/MEA, NRS-097-2-1, RD 1699, TOR

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
X	X	☐	☐	☐	X	☐	☐	☐

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Declaration of VDE-AR-N 4110&4120

SMART PCS
POWER CONVERSION SYSTEM

Model: X3-TRENE-100K PCS SN:

DC INPUT / OUTPUT	
Battery voltage range	650 - 936 d.c. V
Max. charge / discharge current	161.8 d.c. A
AC INPUT / OUTPUT	
Nominal AC voltage	3 / N / PE, 230 / 400 a.c. V 3 / N / PE, 220 / 380 a.c. V
Nominal AC frequency	50 / 60 Hz
Rated output current	145 a.c. A @230 V 151.6 a.c. A @220 V
Max. output continuous current	159.5 a.c. A @230 V 166.7 a.c. A @220 V
Rated output power	100 kW
Max. output apparent power	110 kVA
Adjustable power factor range	1 (0.8 Leading - 0.8 Lagging)
OTHERS	
Operating ambient temperature range	-35 ℃ ~ +60 ℃ (>45℃ Derating)
Ingress protection	IP66
Protective class	I
Overvoltage category	III(MAINS), II(DC)
Topology	Non-isolated
Safety	IEC 62477
Grid monitoring	EN 50549, VDE 4105, G99, CEI 0-21, IEC 61727, PEA/MEA, NRS-097-2-1, RD 1699, TOR

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
☒	☒	☐	☐	☐	☒	☐	☐	☐

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SMART PCS
POWER CONVERSION SYSTEM

Model: X3-TRENE-124.9K PCS SN:

DC INPUT / OUTPUT	
Battery voltage range	650 - 936 d.c. V
Max. charge / discharge current	202.1 d.c. A
AC INPUT / OUTPUT	
Nominal AC voltage	3 / N / PE, 230 / 400 a.c. V 3 / N / PE, 220 / 380 a.c. V
Nominal AC frequency	50 / 60 Hz
Rated output current	181.1 a.c. A @230 V 189.3 a.c. A @220 V
Max. output continuous current	199.2 a.c. A @230 V 208.2 a.c. A @220 V
Rated output power	124.9 kW
Max. output apparent power	124.9 kVA
Adjustable power factor range	1 (0.8 Leading - 0.8 Lagging)
OTHERS	
Operating ambient temperature range	-35 ℃ ~ +60 ℃ (>45℃ Derating)
Ingress protection	IP66
Protective class	I
Overvoltage category	III(MAINS), II(DC)
Topology	Non-isolated
Safety	IEC 62477
Grid monitoring	EN 50549, VDE 4105, G99, CEI 0-21, IEC 61727, PEA/MEA, NRS-097-2-1, RD 1699, TOR

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
☒	☒	☐	☐	☐	☒	☐	☐	☐

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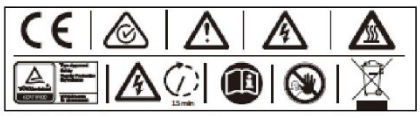
Declaration of VDE-AR-N 4110&4120

SMART PCS
POWER CONVERSION SYSTEM

Model: X3-TRENE-125K PCS SN:

DC INPUT / OUTPUT	
Battery voltage range	650 - 936 d.c. V
Max. charge / discharge current	202.3 d.c. A
AC INPUT / OUTPUT	
Nominal AC voltage	3 / N / PE, 230 / 400 a.c. V 3 / N / PE, 220 / 380 a.c. V
Nominal AC frequency	50 / 60 Hz
Rated output current	181.2 a.c. A @230 V 189.4 a.c. A @220 V
Max. output continuous current	199.3 a.c. A @230 V 208.4 a.c. A @220 V
Rated output power	125 kW
Max. output apparent power	125 kVA
Adjustable power factor range	1 (0.8 Leading- 0.8 Lagging)
OTHERS	
Operating ambient temperature range	-35 ℃ ~ +60 ℃ (>45℃ Derating)
Ingress protection	IP66
Protective class	I
Overvoltage category	II(MAINS), II(DC)
Topology	Non-isolated
Safety	IEC 62477
Grid monitoring	EN 50549, VDE 4105, G99, CEI 0-21, IEC 61727, PEA/MEA, NRS-097-2-1, RD 1699, TOR

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
☒	☒	☐	☐	☐	☒	☐	☐	☐



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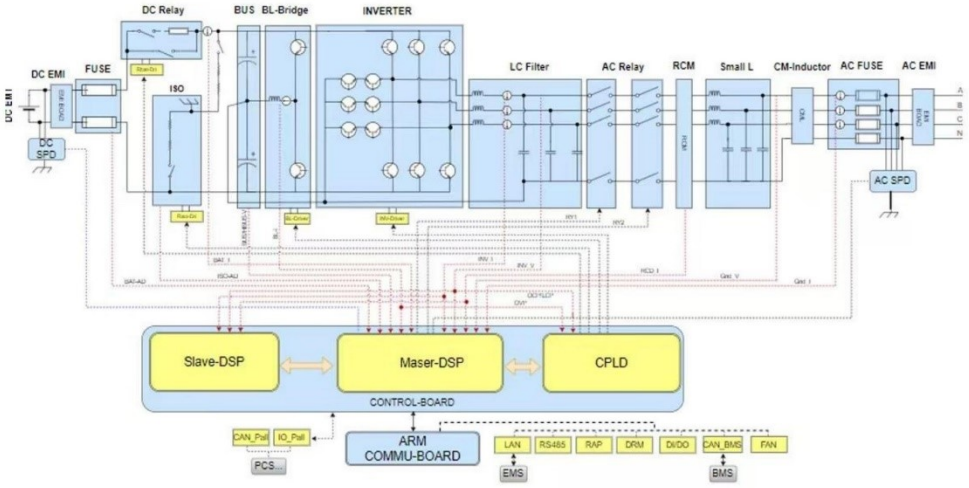
4. Product description:

The PCE under test (EUT) is Power Conversion System which used in AC coupled energy storage systems such as grid-connected energy storage and microgrid energy storage, connecting the battery pack and the power grid (or load), and is a device to realize the two-way conversion of electric energy.

The PCE series under test is three-phase Power Conversion System, the rating of 79.9kW-125kW. All types of models in the hardware are exactly the same, through the software to achieve different power segment model distinction.

The PCS has been designed with the requirements of VDE-AR-N 4110 and 4120 for the power generating unit.The prototype is an essential technical advancement or innovation. After a long time of technical accumulation and precipitation of the development of the product, the safety and reliability of the product absolutely meet the standards and regulatory requirements. This product has not been certified and has not been commissioned in Germany.

The block diagrams of products are as below:



Block Diagram

Primary energy supply: Battery source

Type of modulation in inverter: SVPWM(Space Vector Pulse Width Modulation)

Pulse frequency: 16.2KHz

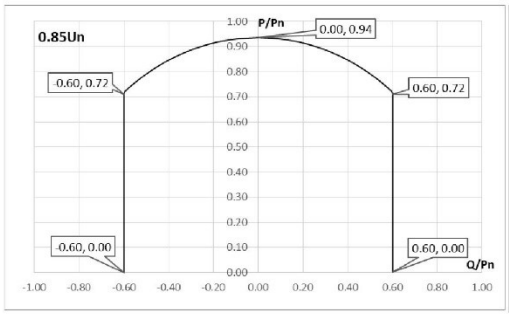
Phase to Phase voltage is used for protection detetion.

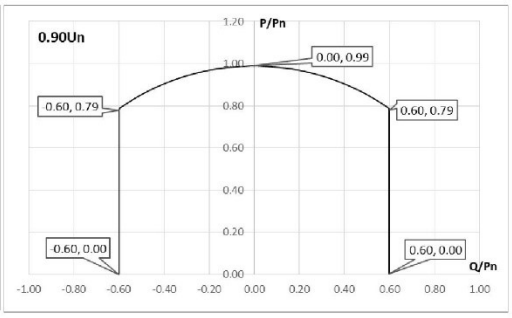
P.u. value is related to rated current =145.0A(For model X3-TRENE-100K)

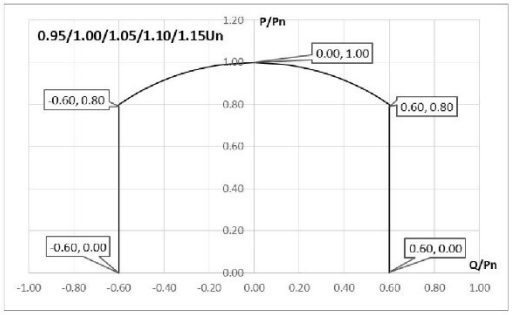
Declaration of VDE-AR-N 4110&4120

5. PQ diagram:

X3-TRENE-79.9K(Discharge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--

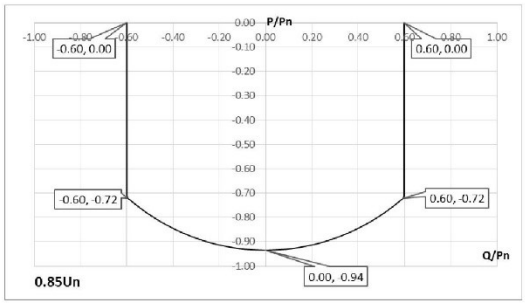






Declaration of VDE-AR-N 4110&4120

X3-TRENE-79.9K(Charge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
-0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
-1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
-1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--



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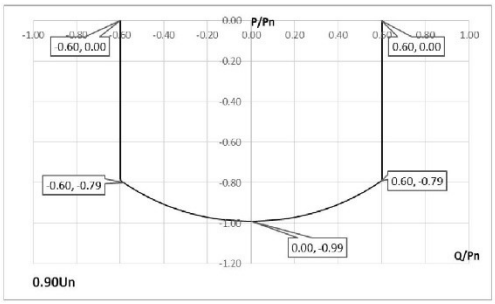

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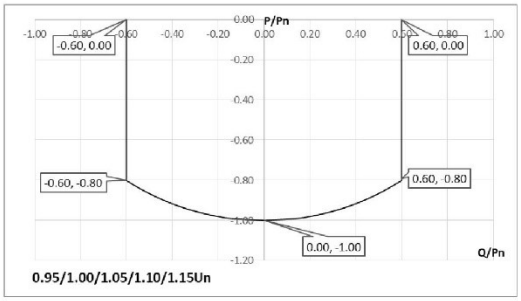

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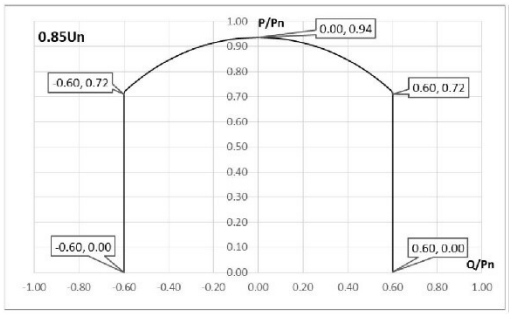
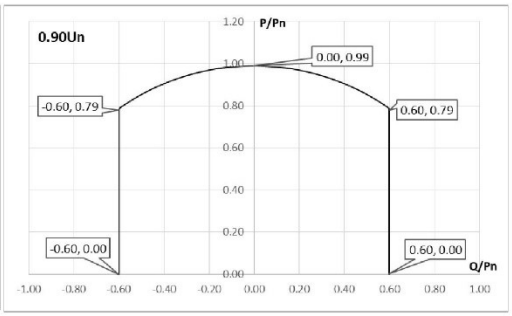
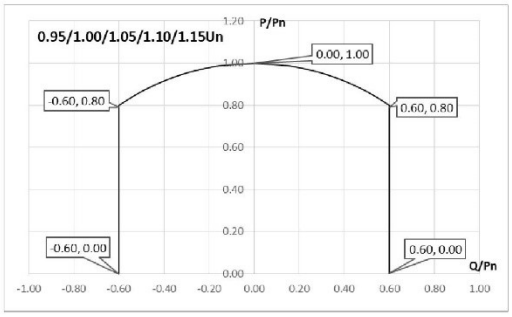
Declaration of VDE-AR-N 4110&4120

X3-TRENE-99.9K(Discharge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--

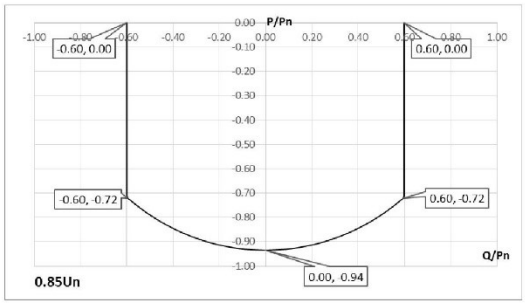






Declaration of VDE-AR-N 4110&4120

X3-TRENE-99.9K(Charge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
-0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
-1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
-1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--



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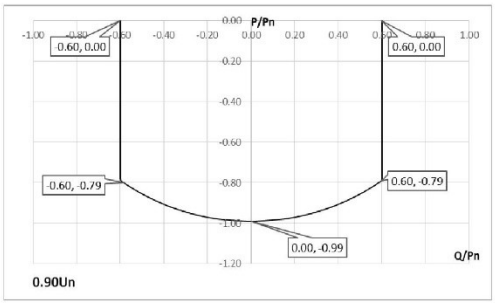

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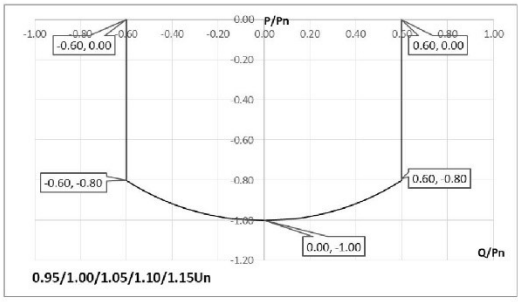
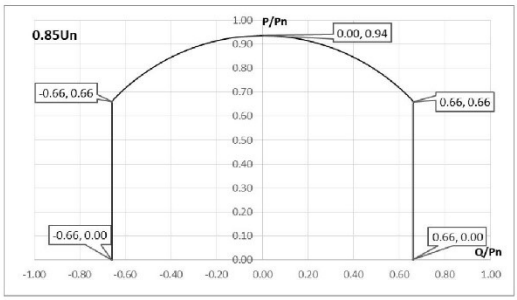
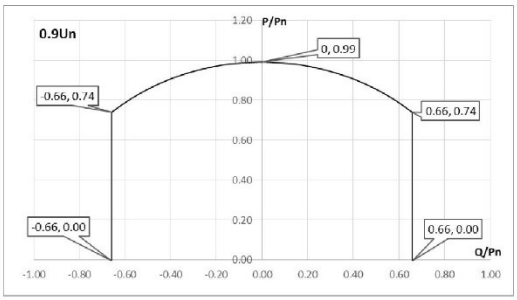


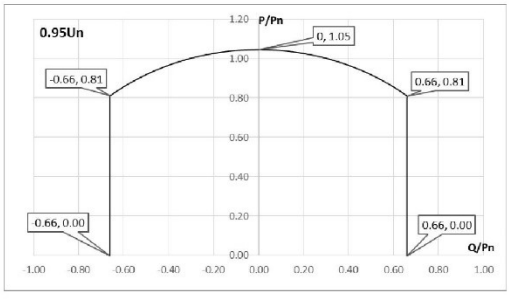
0.95/1.00/1.05/1.10/1.15Un

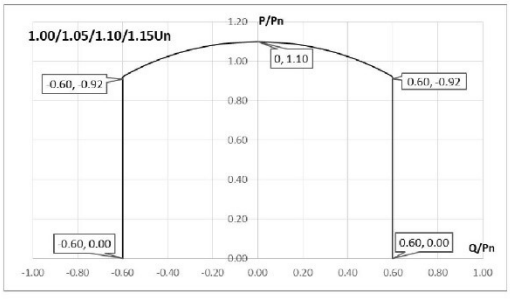
Declaration of VDE-AR-N 4110&4120

X3-TRENE-100K(Discharge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
0.1	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
0.2	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
0.3	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
0.4	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
0.5	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
0.6	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
0.7	Underexcited	-0.62	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.62	0.66	0.66	0.66	0.66	0.66	0.66
0.8	Underexcited	-0.48	-0.58	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.48	0.58	0.66	0.66	0.66	0.66	0.66
0.9	Underexcited	-0.26	-0.41	-0.53	-0.63	-0.63	-0.63	-0.63
	Overexcited	0.26	0.41	0.53	0.63	0.63	0.63	0.63
1.0	Underexcited	--	--	-0.31	-0.46	-0.46	-0.46	-0.46
	Overexcited	--	--	0.31	0.46	0.46	0.46	0.46
1.1	Underexcited	--	--	--	0.00	0.00	0.00	0.00
	Overexcited	--	--	--	0.00	0.00	0.00	0.00



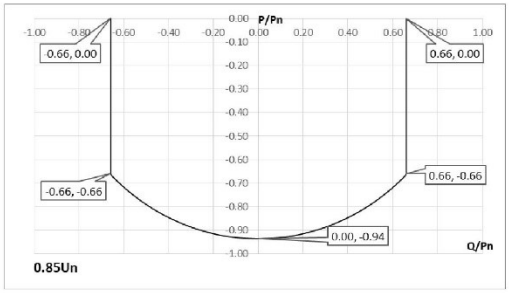


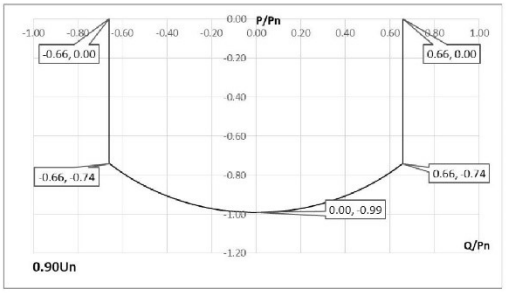


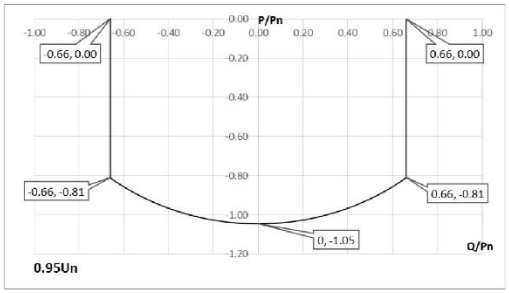


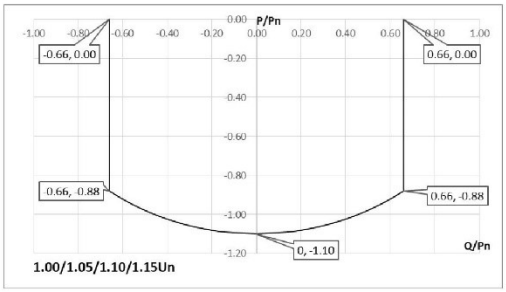
Declaration of VDE-AR-N 4110&4120

X3-TRENE-100K(Charge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
-0.1	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
-0.2	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
-0.3	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
-0.4	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
-0.5	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
-0.6	Underexcited	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.66	0.66	0.66	0.66	0.66	0.66	0.66
-0.7	Underexcited	-0.62	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.62	0.66	0.66	0.66	0.66	0.66	0.66
-0.8	Underexcited	-0.48	-0.58	-0.66	-0.66	-0.66	-0.66	-0.66
	Overexcited	0.48	0.58	0.66	0.66	0.66	0.66	0.66
-0.9	Underexcited	-0.26	-0.41	-0.53	-0.63	-0.63	-0.63	-0.63
	Overexcited	0.26	0.41	0.53	0.63	0.63	0.63	0.63
-1.0	Underexcited	--	--	-0.31	-0.46	-0.46	-0.46	-0.46
	Overexcited	--	--	0.31	0.46	0.46	0.46	0.46
-1.1	Underexcited	--	--	--	0.00	0.00	0.00	0.00
	Overexcited	--	--	--	0.00	0.00	0.00	0.00



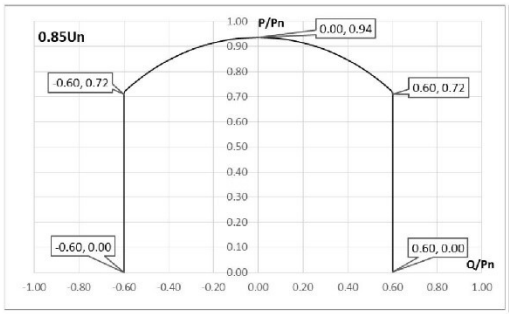


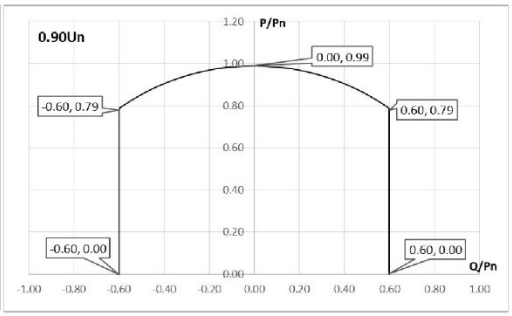


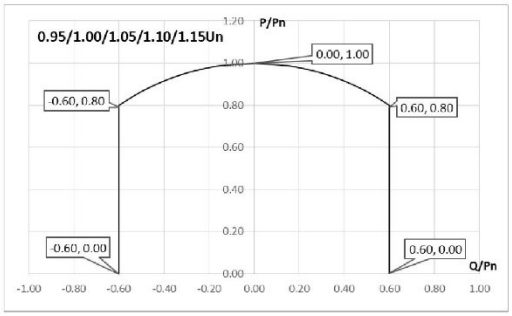


Declaration of VDE-AR-N 4110&4120

X3-TRENE-124.9K(Discharge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--

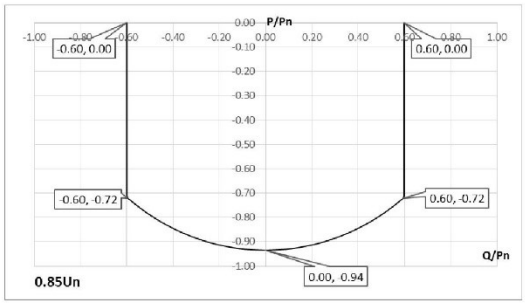






Declaration of VDE-AR-N 4110&4120

X3-TRENE-124.9K(Charge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
-0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
-1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
-1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--



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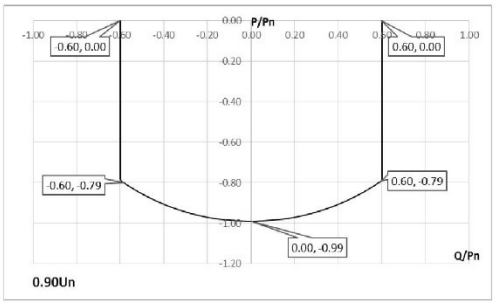

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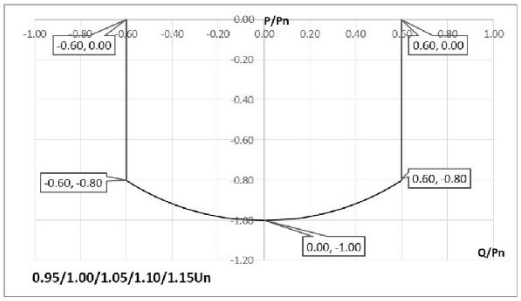
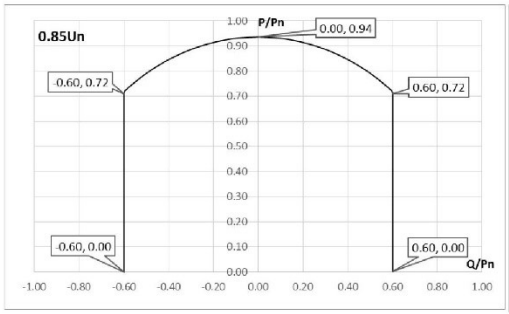
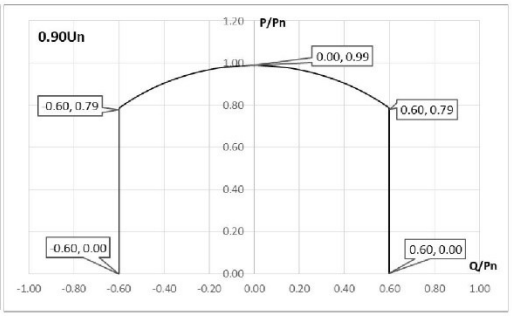


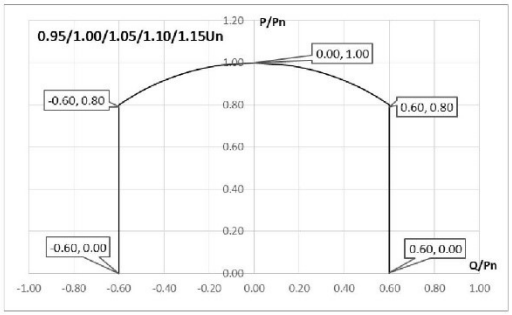
0.95/1.00/1.05/1.10/1.15Un

Declaration of VDE-AR-N 4110&4120

X3-TRENE-125K(Discharge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--

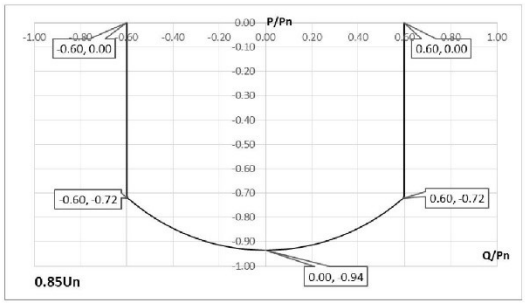


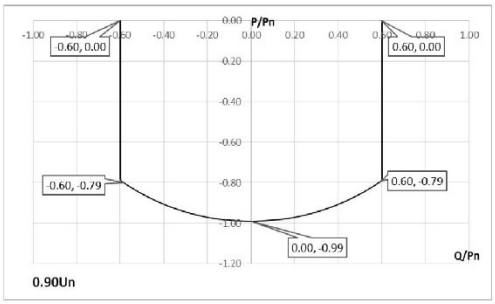


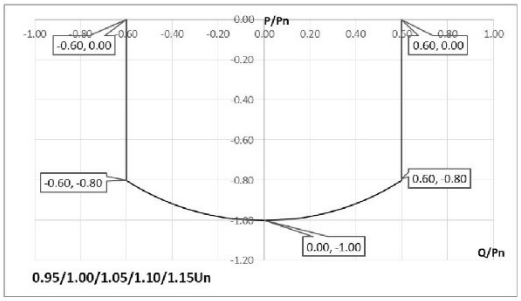


Declaration of VDE-AR-N 4110&4120

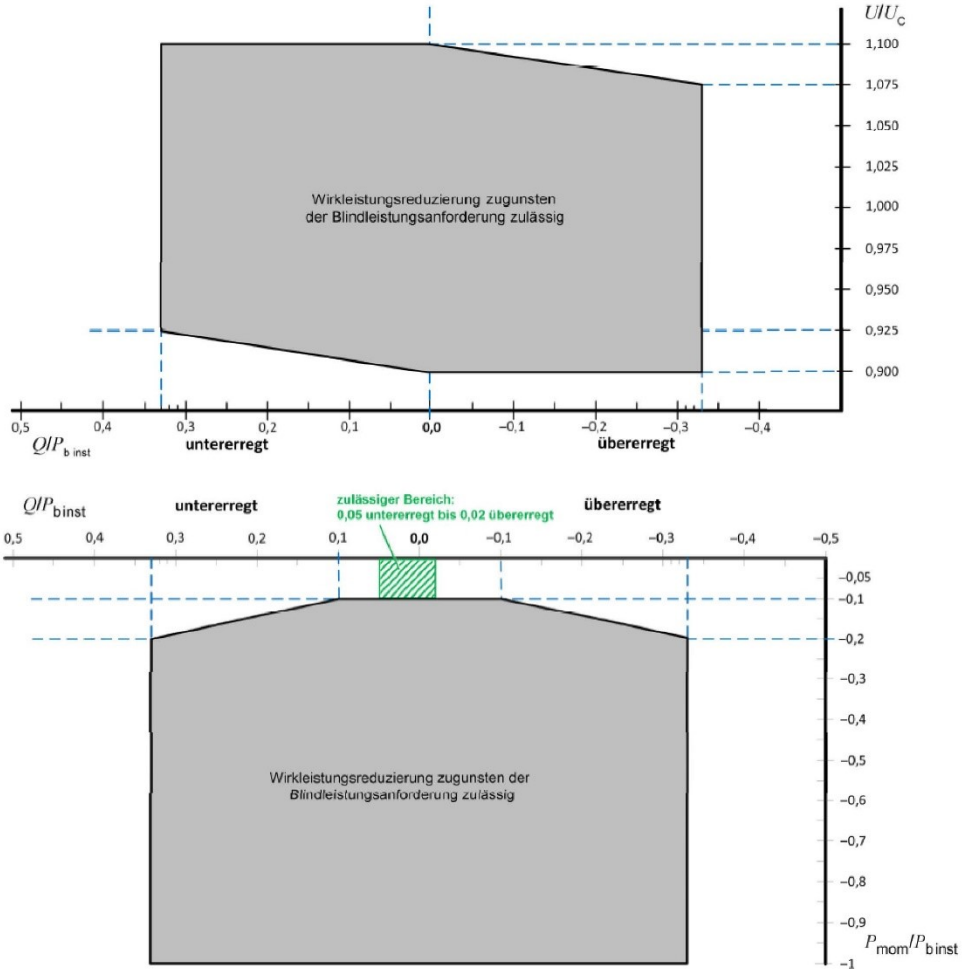
X3-TRENE-125K(Charge mode)								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.1	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.2	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.3	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.4	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.5	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.6	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.7	Underexcited	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.60	0.60	0.60	0.60	0.60	0.60	0.60
-0.8	Underexcited	-0.48	-0.58	-0.60	-0.60	-0.60	-0.60	-0.60
	Overexcited	0.48	0.58	0.60	0.60	0.60	0.60	0.60
-0.9	Underexcited	-0.25	-0.41	-0.44	-0.44	-0.44	-0.44	-0.44
	Overexcited	0.25	0.41	0.44	0.44	0.44	0.44	0.44
-1.0	Underexcited	--	--	0.00	0.00	0.00	0.00	0.00
	Overexcited	--	--	0.00	0.00	0.00	0.00	0.00
-1.1	Underexcited	--	--	--	--	--	--	--
	Overexcited	--	--	--	--	--	--	--





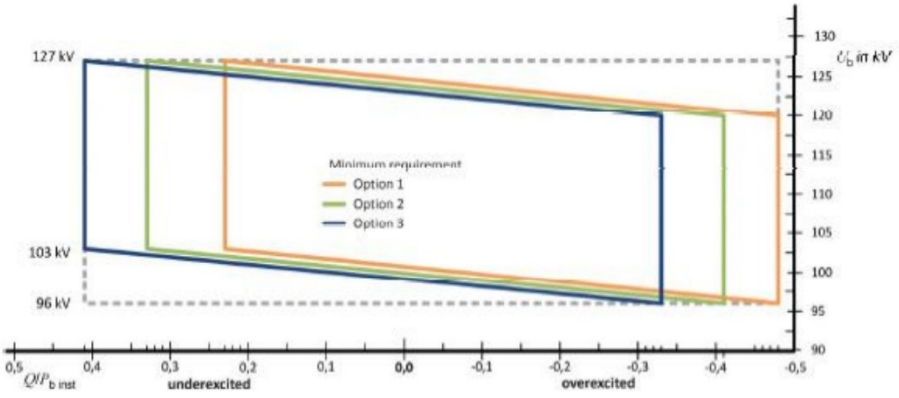


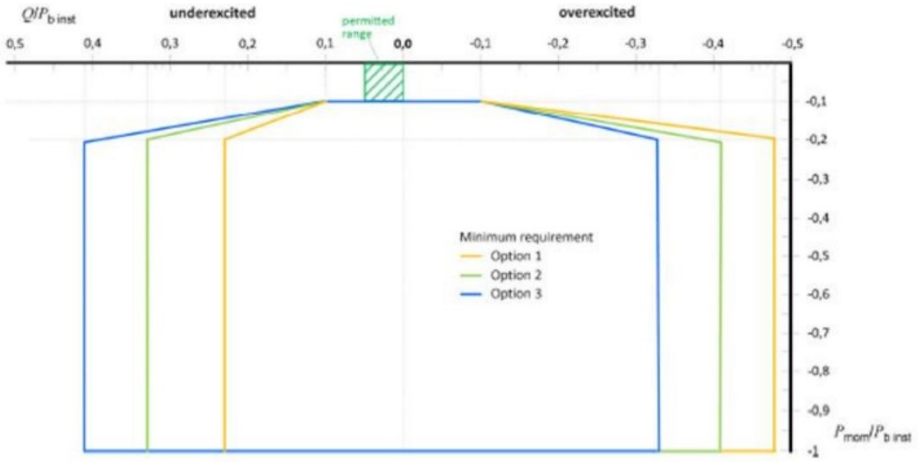
Every set point value specified by the grid operator can be achieved within the required reactive power range from VDE-AR-N 4110.



Declaration of VDE-AR-N 4110&4120

Every set point value specified by the grid operator can be achieved within the required reactive power range from VDE-AR-N 4120.





6. Methods for reactive power control

The reactive power is always prioritised over active power.

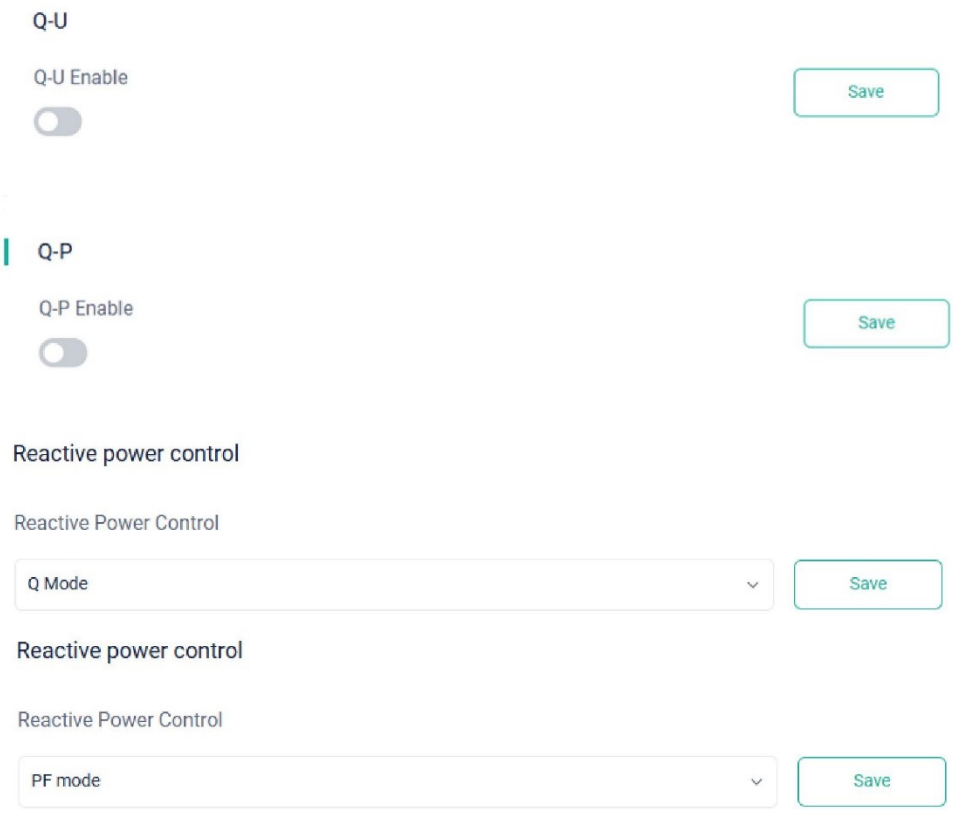
The P-Q relation in normal operation always follow the equation:

S=min(U*I, min(Smax, U*Imax))

P=sqrt(S^2-Q^2)

Reactive power control			
Parameter	Setting range	Setting step	Default value
Reactive power control	-Q-U mode -Q-P mode -Q mode -PF mode	--	Disable reactive power:0%Pn
Remark: For this function, the curve can be turned off directly under WEB UI. The parameters can be set on the PGS controller to meet the requirements of reactive power control.			

WEB UI setting for Reactive power control:



Declaration of VDE-AR-N 4110&4120

a. Q-U mode

Q-U mode (Reactive power-voltage character curve)			
Parameter	Setting range	Setting step	Default value
Q-U Voltage 1 Q-U Voltage 2 Q-U Voltage 3 Q-U Voltage 4 (Voltage value settings)	Q-U Voltage 1: 0V…300V Q-U Voltage 2: 0V…300V Q-U Voltage 3: 0V…300V Q-U Voltage 4: 0V…300V	0.1V	VDE4110 Q-U Voltage1: 220.8V Q-U Voltage2: 230V Q-U Voltage3: 230V Q-U Voltage4: 239.2V VDE4120 Q-U Voltage1: 227.7V Q-U Voltage2: 239.2V Q-U Voltage3: 239.2V Q-U Voltage4: 250.7V
Q-U Reactive Power 1 Q-U Reactive Power 2 Q-U Reactive Power 3 Q-U Reactive Power 4 (Reactive power value settings)	Q1: -200%Pn…200%Pn Q2: -200%Pn…200%Pn Q3: -200%Pn…200%Pn Q4: -200%Pn…200%Pn	0.01%Pn	Q1: Qmax Q2: 0 Q3: 0 Q4: -Qmax Note: Qmax=66%Pn(for X3-TRENE-100K) Qmax=60%Pn(for other models)
Q-U Power Entry Conditions Q-U Power Exit Conditions (The 4110 QU function is not affected)	-200%Pn…200%Pn	0.01%Pn	Entry Conditions: -130%Pn Exit Conditions: -140%Pn
Q-U Power factor Min (The 4110QU function is not affected)	0…1	0.001	0.400
Q-U power setting times - 3Tau (Reactive power response time)	0s···100s	0.01s	VDE4110 10s VDE4110 5s
Q-U Dead Zone voltage	0-300V	0.1V	0.0V
Remark: For this function, the curve can be turned off directly under WEB UI.			

Curve setting in test:

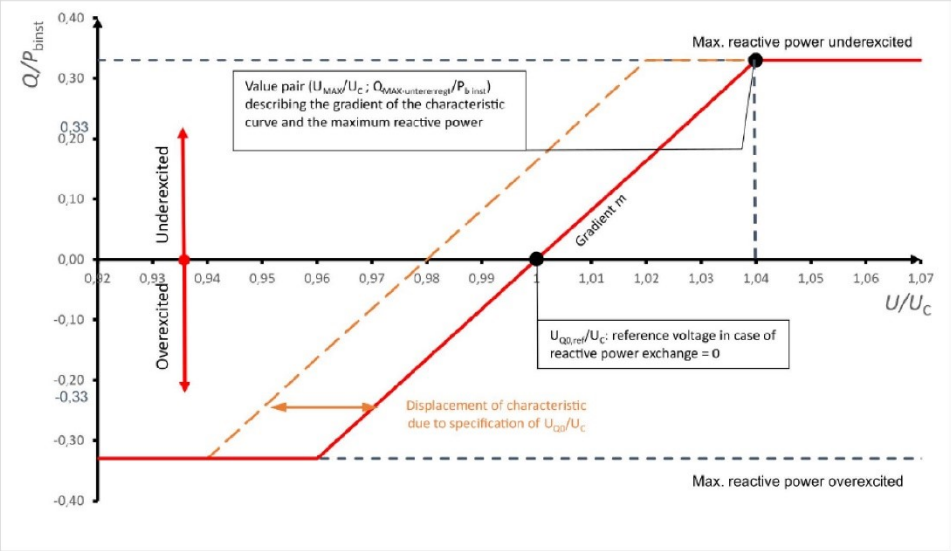


Figure 6–7: Reactive power-voltage characteristic Q(U)
(Source: VDE-AR-N 4110 [4] Picture 8: Load sign convention)

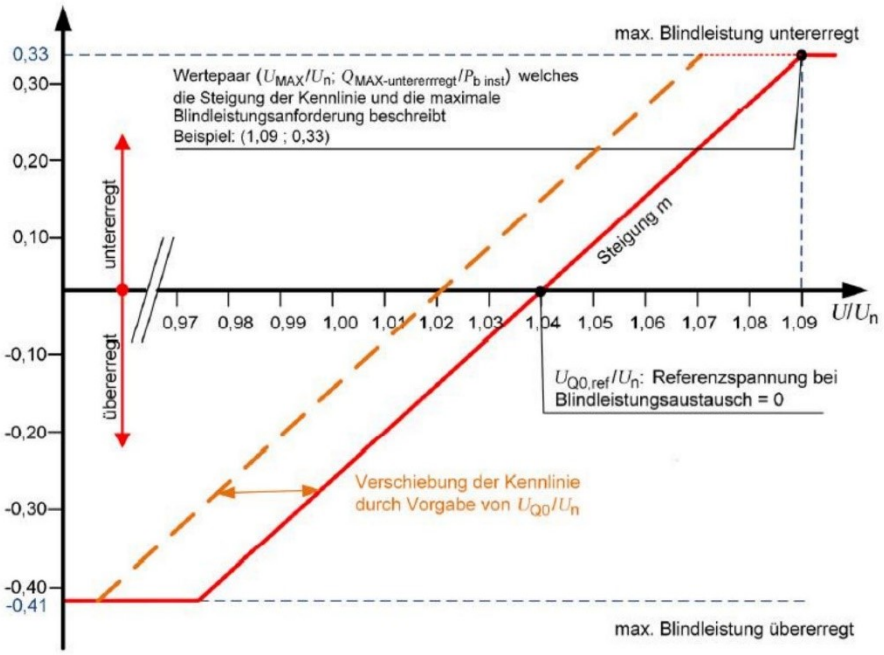


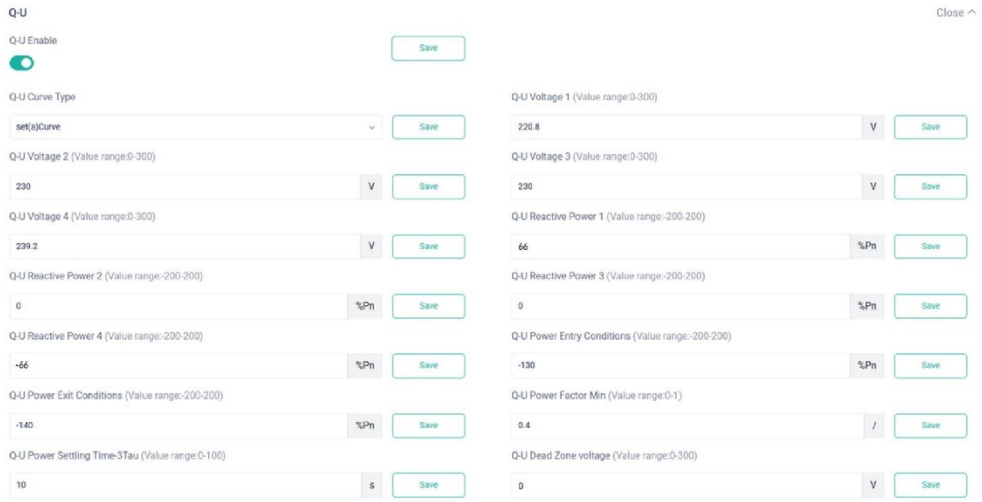
Bild 7 – Beispiel für eine $Q(U)$-Kennlinie für Variante 2

Declaration of VDE-AR-N 4110&4120

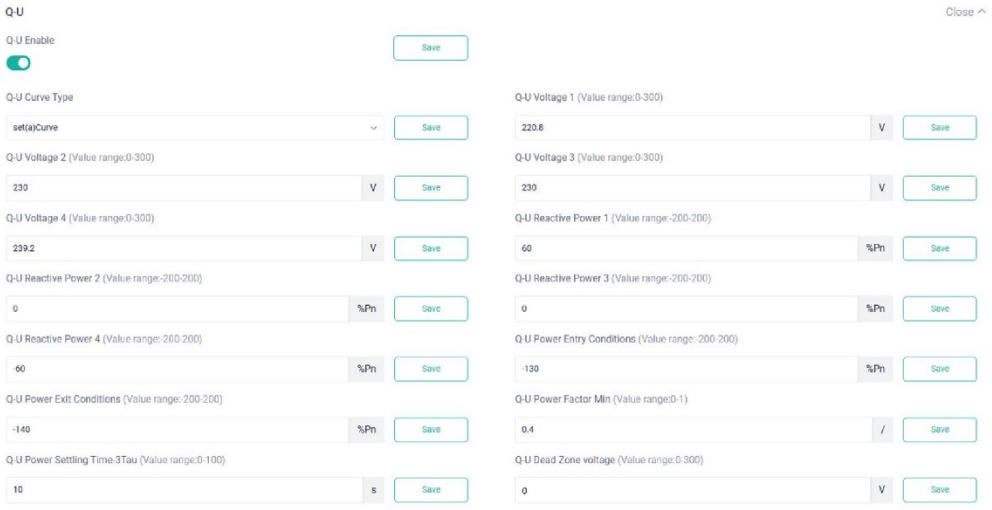
WEB UI setting for Q-U mode:

VDE4110 :

(for model X3-TRENE-100K)



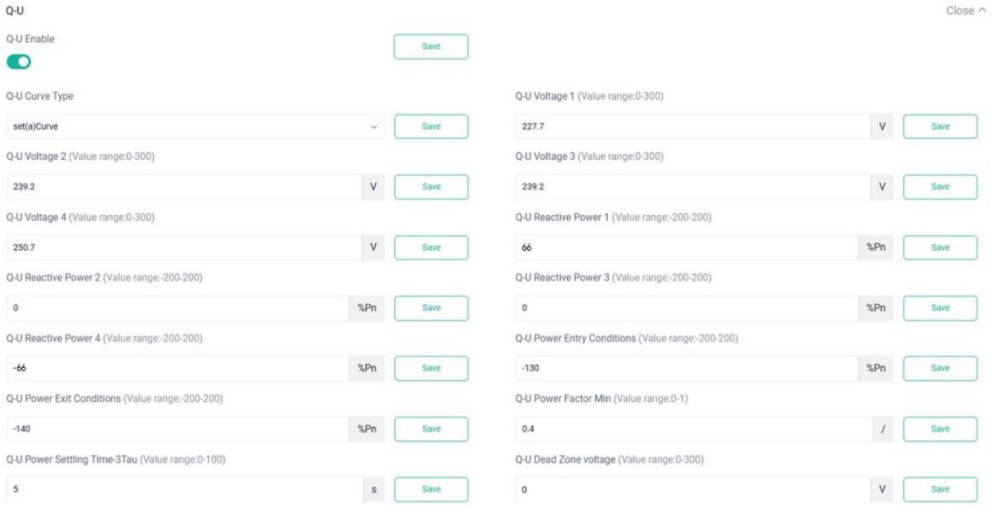
(for other models)



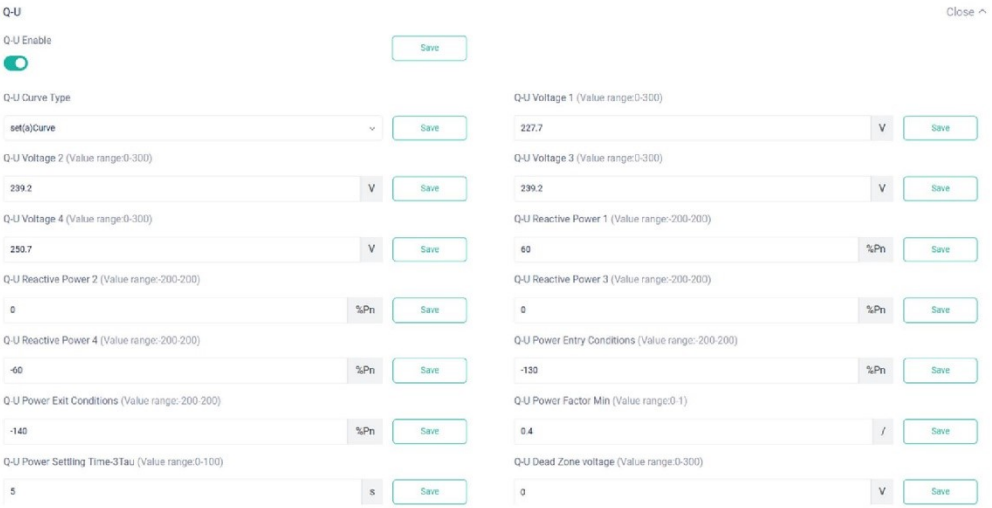
Declaration of VDE-AR-N 4110&4120

VDE4120 :

(for model X3-TRENE-100K)



(for other models)



b. Q-P mode

Q-P mode (Character curve Q(P))			
Parameter	Setting range	Setting step	Default value
Q-P Reactive Power 1 Q-P Reactive Power 2 Q-P Reactive Power 3 Q-P Reactive Power 4 Q-P Reactive Power 5 (Reactive power value settings)	Q1: -200%Pn…200%Pn Q2: -200%Pn…200%Pn Q3: -200%Pn…200%Pn Q4: -200%Pn…200%Pn Q5: -200%Pn…200%Pn	0.1%Pn	Q1: 0 Q2: 0 Q3: -5%Pn Q4: -33%Pn Q5: -33%Pn
Q-P Active Power 1 Q-P Active Power 2 Q-P Active Power 3 Q-P Active Power 4 Q-P Active Power 5 (Active power value settings)	P1: -200%Pn…200%Pn P2: -200%Pn…200%Pn P3: -200%Pn…200%Pn P4: -200%Pn…200%Pn P5: -200%Pn…200%Pn	0.1%Pn	P1: 0 P2: 50%Pn P3: 60% Pn P4: 90% Pn P5: 100% Pn
Q-P PF Min Value 1 Q-P PF Min Value 2 （The 4110QP function is not affected）	0…1	0.001	Value 1:0.001 Value 2:0.001
Q-P Voltage Entry Conditions Q-P Voltage Exit Conditions (The 4110QP function is not affected)	0V…300V	0.1V	Entry Conditions: 2.0V Exit Conditions: 1.0V
Q-P Power Setting Time-3Tau (Reactive power value settings)	0s…100s	1s	VDE 4110: 10s VDE 4120: 5s
Remark: For this function, the curve can be turned off directly under WEB UI.			

Curve setting in test:

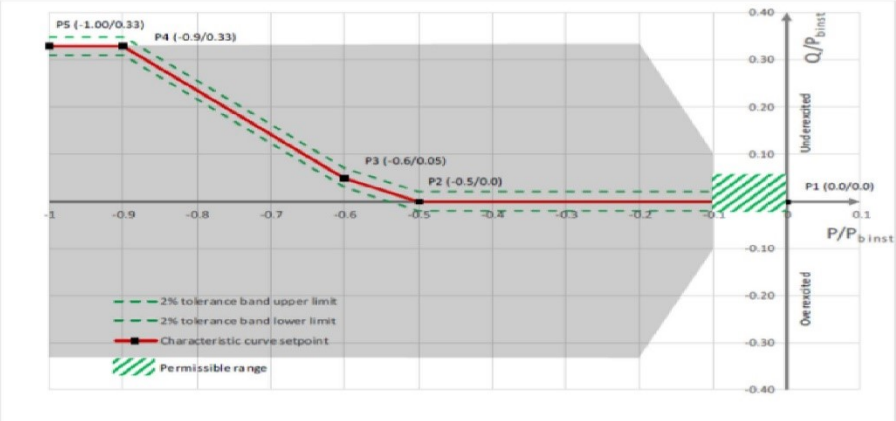
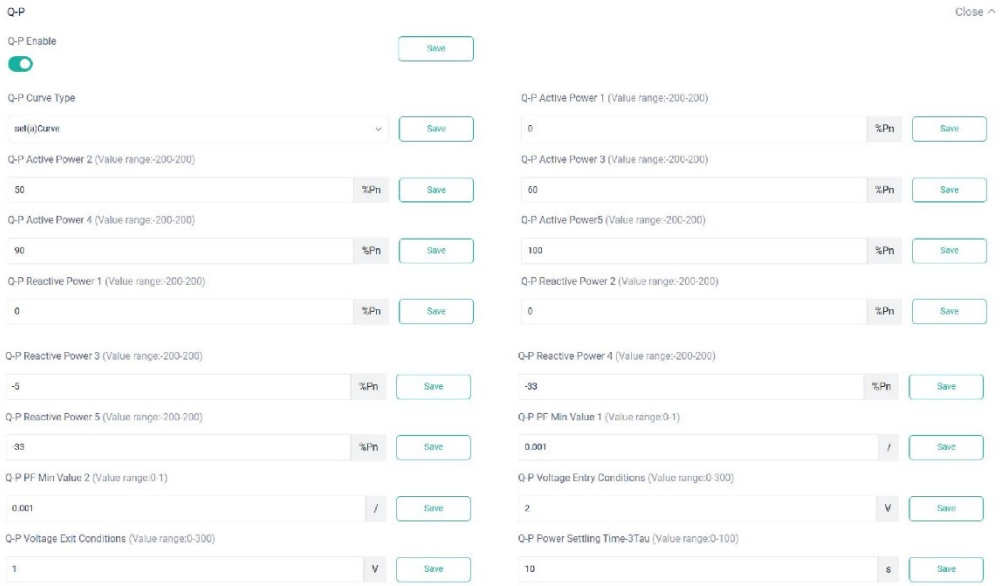


Figure 6–9: Reactive power characteristic curve as a function of the active power Q(P) (source: VDE-AR-N 4110 [4] Picture 9: Load sign convention)

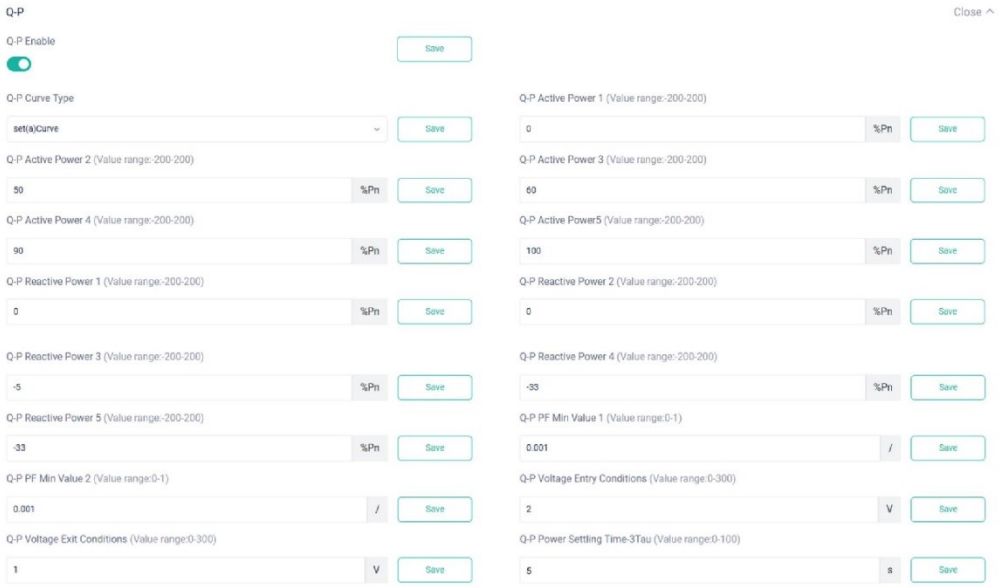
Declaration of VDE-AR-N 4110&4120

WEB UI setting for Q-P mode:

VDE 4110:



VDE4120:



c. Q mode

Q mode (Fixed Q)			
Parameter	Setting range	Setting step	Default value
Reactive power Q Reactive power in ConstPower Mode (Reactive power value settings)	-66%Pn···66%Pn	0.1%Pn	Q=0Kvar
Fixed Reactive Power Adjustment Time-3Tau (Reactive power value settings)	6s···650s	1s	10s
Remark: For this function, the curve can be turned off directly under WEB UI.			

WEB UI setting for Q mode:

If communication with plant controller or network operator interrupted over 1min, the reactive power maintain the last set-point received.

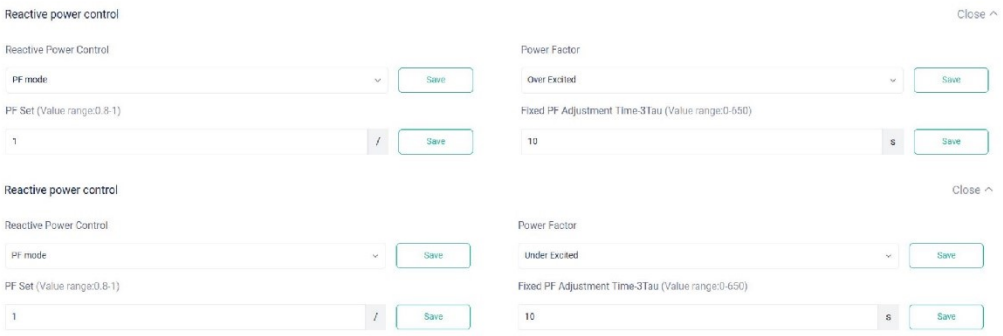
Reactive power strategy:

The reactive power is prioritized over active power. Active power can be reduced in favor of reactive power provision. In favor of reactive power provision, the active power can be reduced when limitation of apparent power(Smax) or current(Imax) reached. The reduction of power is automatically, and can not be parameterized manually.

d. PF mode

PF mode (Fixed cosφ)			
Parameter	Setting range	Setting step	Default value
Over-Excited			
Power factor value settings	0.80oe…1oe	0.001	1
Fixed PF Adjustment Time-3Tau (Reactive power value settings)	6s…60s	1s	10s
Under-Excited			
Power factor value settings	0.80ue…1ue	0.001	1
Fixed PF Adjustment Time-3Tau (Reactive power value settings)	6s…60s	1s	10s
Remark: For this function, the curve can be turned off directly under WEB UI.			

WEB UI setting for PF mode:



If communication with plant controller or network operator interrupted over 1min, the reactive power maintain the last set-point received.

Reactive power strategy:

The reactive power is prioritized over active power. Active power can be reduced in favor of reactive power provision.

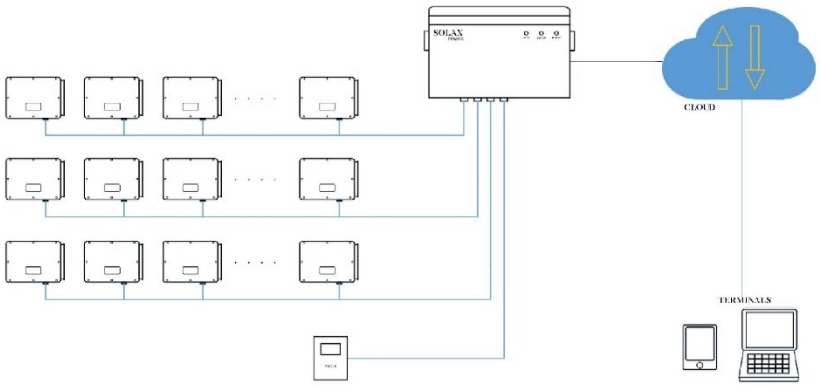
7. Network security management

Network security management			
Parameter	Setting range	Setting step	Default value
Active power in ConstPower Mode (Active power value settings) Note: The model X3-TRENE-100K is overloaded, but the others are not.	-95.9...95.9kW(for model X3-TRENE-79.9K) -119.9...119.9kW(for model X3-TRENE-99.9K) -120.0...120.0kW(for model X3-TRENE-100K) -149.9...149.9kW(for model X3-TRENE-124.9K) -150.0...150.0kW(for model X3-TRENE-125K)	0.1kW	79.9kW(for model X3-TRENE-79.9K) 99.9kW(for model X3-TRENE-99.9K) 110kW(for model X3-TRENE-100K) 124.9kW(for model X3-TRENE-124.9K) 125kW(for model X3-TRENE-125K)
AC Active Power Ramp-up Mode Enable	Disable/Enable	--	Enable
AC Active Power Ramp-up Percentage (Active power gradient)	0.1%Pn/min...100%Pn/min	0.1%Pn/min	30%Pn/min

Interface: RJ45

Communication way:RS485

There is single interface for network security management integrated in each unit and only one command from network or third party can be responded a time.



It has the function of permanently reducing the Active power.

The active power setting has two instructions, one of which is permanently valid by directly storing 'eeprom'; Or the meter control zero output, then storaging 'eeprom', permanently valid.

The power scheduling sampling is parsed using standard Modbus. The following data can be read using function code '0x03' and written using single write '0x06' and multiple write '0x10'.

The specific format is as follows:

Read the current power set value (HEX format): 01 03 23 03 xx xx CRC16(xx xx: indicates the percentage of the current power).

Set the current power value (HEX format): 01 06 23 03 xx xx CRC16(xx xx: indicates the percentage of the current power).

Example: Set the operating power of the equipment to 100% of the rated power, the instructions are as follows:

01 06 23 03 03 E8 72 F0

01: modbus communication address;

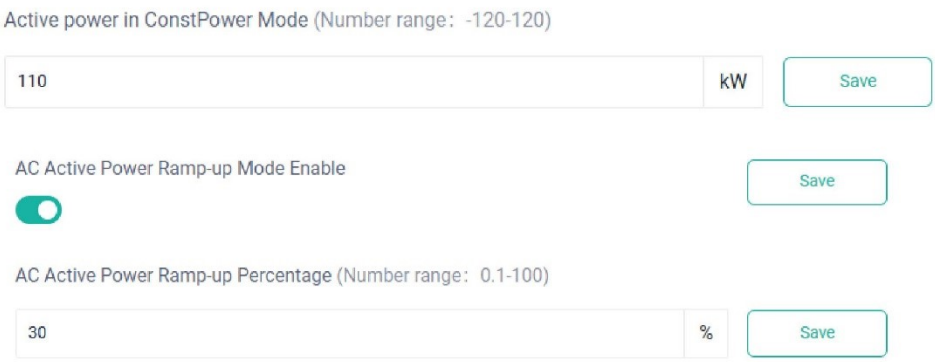
06: function code;

23 03: Register address;

03 E8: Rated power 100%;

Store EEPROM with address 0x2303; Do not store EEPROM with address 0x2304;

WEB UI setting for Active power mode:



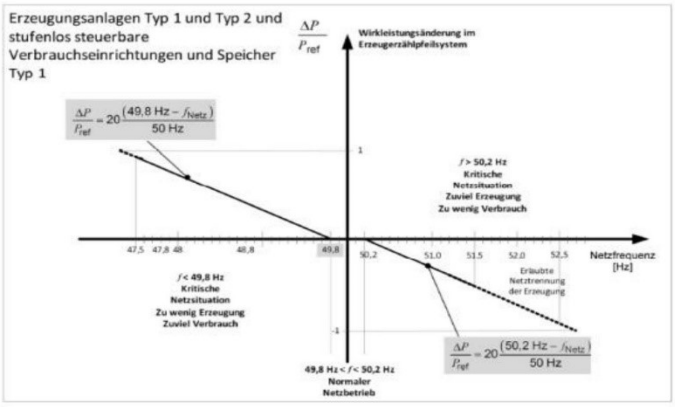
8. Active power output dependent on grid frequency

RoCoF complied with:

±2.0Hz/s for a moving average window 0.5s or

±1.5Hz/s for a moving average window 1s or

±1.25Hz/s for a moving average window 2s P(f) curve:



Over frequency curve start point: 50.2Hz – 50.5Hz adjustable Over frequency curve droop: 2% - 12% adjustable.
Under frequency curve start point: 49.5Hz – 49.8Hz adjustable Under frequency curve droop: 2% - 12% adjustable
While frequency step or shift exceeded the dead-band of P(f) curve, the unit output decrease or increase according to the droop of curve. There is no power change when frequency located within the dead-band (50±200mHz default). In the case of frequency above 51.5Hz the unit is able to remain connected to grid for another 5s without any power increase.

Even if the mains frequency has regained the tolerance band of 50,0 Hz ± 200 mHz after the frequency deviation, a critical network condition shall still be assumed. The transition from “critical network condition” to “normal operation” is time-limited by a maximum change of the set-point active power, starting from Pmom. This set-point active power change (except for the supply of control energy) shall be limited to a maximum gradient of 10 % Pb inst/min. Only when the mains frequency has been within the tolerance band of 50,0 Hz ± 200 mHz for an uninterrupted period of 10 min, the normal network operation is considered to be restored and this requirement is no longer valid.

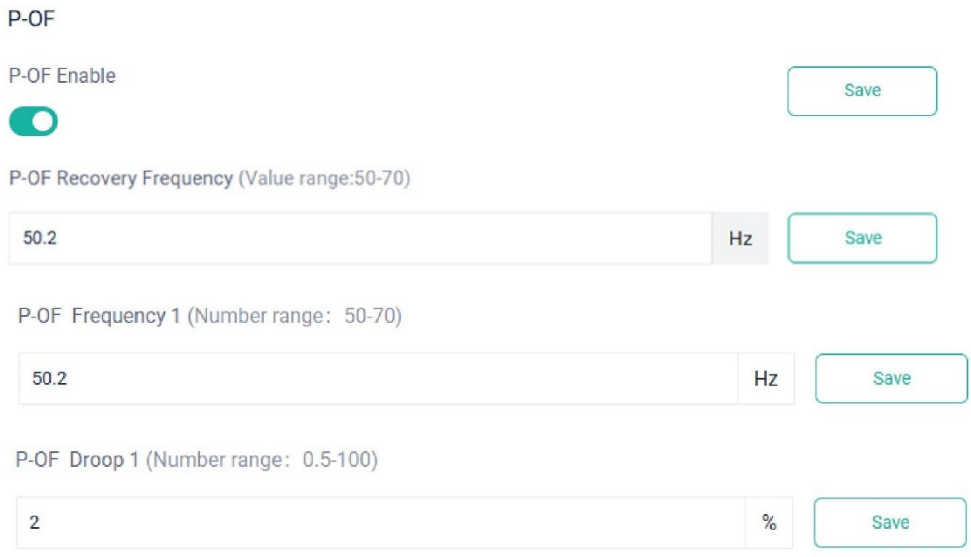
The following requirements complied:

1) Initial time delay Tv < 2 s
2) Accuracy of frequency measurement ≤ 10 mHz
3) Accuracy of fast frequency measurement < 50 mHz
4) Sample time < 200 ms

Declaration of VDE-AR-N 4110&4120

P-OF/P-UF(Active power output dependent on grid frequency)			
Parameter	Setting range	Setting step	Default value
OF exit frequency P-OF Recovery Frequency (Exit curve value)	50Hz···70Hz	0.01Hz	50.2Hz
OF threshold P-OF Frequency 1 (Enter curve value)	50Hz···70Hz	0.01Hz	50.2Hz
OF droop P-OF Droop 1 (Active power gradient)	0.5%...100%	0.1%	2%
OF Initial time delay P-OF Enter Delay Time (Enter delay time)	0s...1000s	1s	0s
OF exit recovery slope P-OF Power Ramp Up Uint Time (power recovery slope)	0s...3000s	1s	600s (Pn/600s=10%Pn/min)
UF exit frequency P-UF Recovery Frequency (Exit curve value)	40Hz...60Hz	0.01Hz	49.8Hz
UF threshold P-UF Frequency 1 (Enter curve value)	40Hz...60Hz	0.01Hz	49.8Hz
UF droop P-UF Droop 1 (Active power gradient)	0.5%...100%	0.1%	2%
UF Initial time delay P-UF Enter Delay Time (Enter delay time)	0s...1000s	1s	0s
UF exit recovery slope P-UF Power Ramp Up Uint Time (power recovery slope)	0s...3000s	1s	600s (Pn/600s=10%Pn/min)

WEI UI settings for Active power output dependent on grid frequency



Declaration of VDE-AR-N 4110&4120

P-OF Entry Delay Time (Value range:0-1000)

0 s Save

P-OF Power Ramp Up Uint Time (Value range:0-3000)

600 s Save

P-UF

P-UF Enable

Save

P-UF Recovery Frequency (Value range:40-60)

49.8 Hz Save

P-UF Frequency 1 (Number range: 40-60)

49.8 Hz Save

P-UF Droop 1 (Number range: 0.5-100)

2 % Save

P-UF Entry Delay Time (Value range:0-1000)

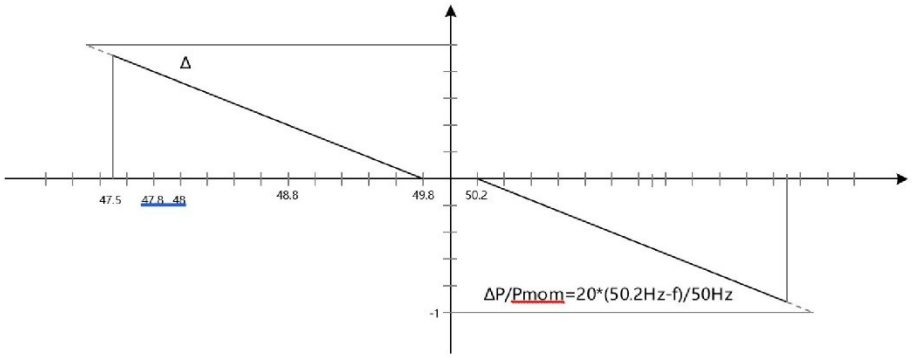
0 s Save

P-UF Power Ramp Up Uint Time (Value range:0-3000)

600 s Save

9. Capability of primary control energy supply

For all VDE-AR-N 4110 and 4120, P(f)-diagram is default according to Figure below.



Note: Here P_{mom} is the active power freeze at that moment when the frequency to 50.2Hz. Pn is normial active power. The default gradient for over-frequency and under-frequency is 40%Pref/Hz (slope=5%), while it can be adjustable from 16.67%Pref/Hz(s=12%) to 100%Pref/Hz(s=2%).

The functionality for primary control energy supply (FSM) shall be implemented by PGS controller. The inverter's control is able to give the priority to FSM even when there is a change in the active power output for other reasons. The inverter can supply FSM in range between min. technical power and 100% rated power with exception that a power restriction with higher priority such as derating on max. power is set. The inverter is able to supply FSM continuously. Fluctuating may occur in correspondence to max. possible available power depends on the natural conditions like solar radiation.

Primary Control Energy Supply			
Parameter	Setting range	Setting step	Default value
Primary Control Energy Supply Enable	--	--	Disable
Over-frequency Enter Frequency	50Hz···60Hz	0.01Hz	50.2Hz
Over-frequency Slope	2%···12%	0.1%	5%
Under-frequency Enter Frequency	40Hz···60Hz	0.01Hz	49.8Hz
Over-frequency Slope	2%···12%	0.1%	5%

Note: This feature comes from within the software, or can be from the external measuring device.

WEI UI settings for Primary Control Energy Supply

Declaration of VDE-AR-N 4110&4120

10.Quasi-steady-state operation:

During quasi-steady-state operation, the power generating plants shall be able to operate linked to the distribution network in compliance with the minimum time requirements given in Figure 4 over the full frequency range of 47,5 Hz to 51,5 Hz and for voltages in the range of 85 % Uc to 115 % Uc (r.m.s. values of the phase-to-phase voltage) at the network connection point.

Minimum time requirements given in standard:

Following P-f diagram per VDE-AR-N 4110: 2023 complied:

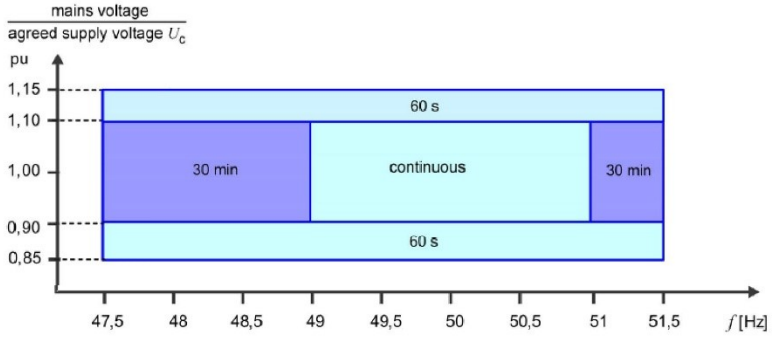
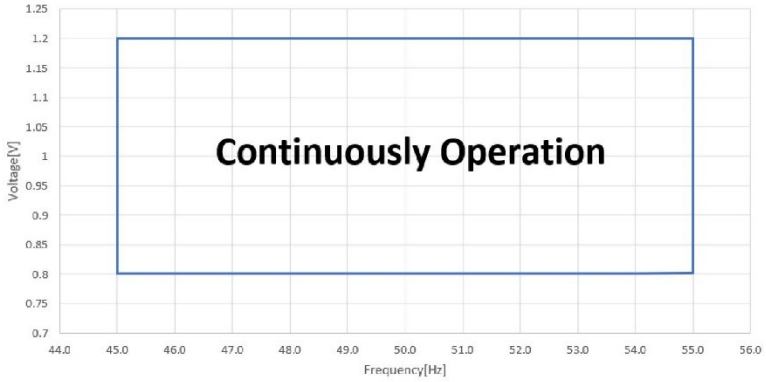


Figure 4 – Requirements for the quasi-steady-state operation of power generating plants

Actual capability of inverter:

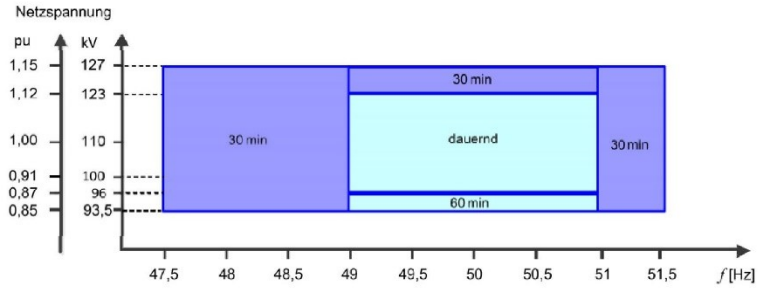


Continuously operation range:45 - 55Hz, 0.80-1.20Un(When the internal protection and FVRT functions are disabled)

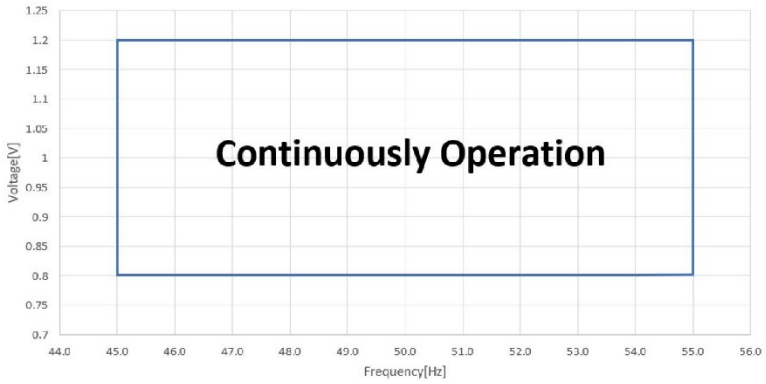
Remark:When the internal protection and FVRT functions are disabled, the machine cannot be operated outside the range,and the machine will shut down When hardware detects overvoltage.

Declaration of VDE-AR-N 4110&4120

Following P-f diagram per VDE-AR-N 4120: 2018 complied:



Actual capability of inverter:



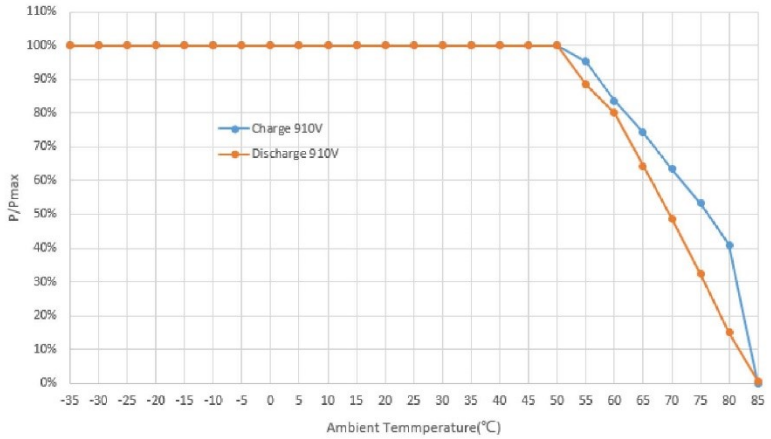
Continuously operation range:45 - 55Hz, 0.80-1.20Un(When the internal protection and FVRT functions are disabled)

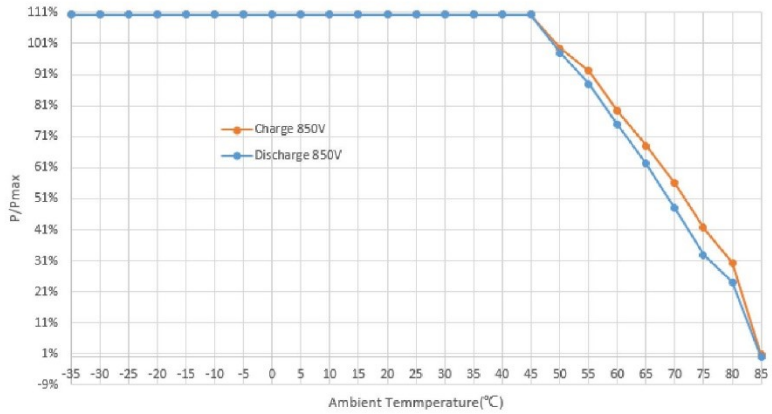
Remark:When the internal protection and FVRT functions are disabled, the machine cannot be operated outside the range,and the machine will shut down When hardware detects overvoltage.

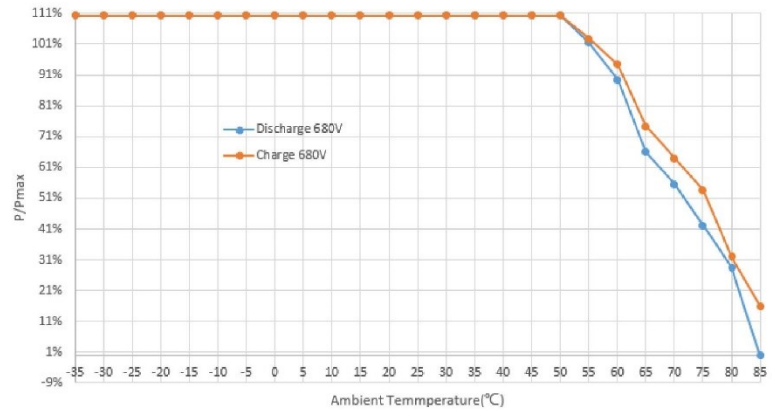
Declaration of VDE-AR-N 4110&4120

11. Active power dependent on ambient temperature

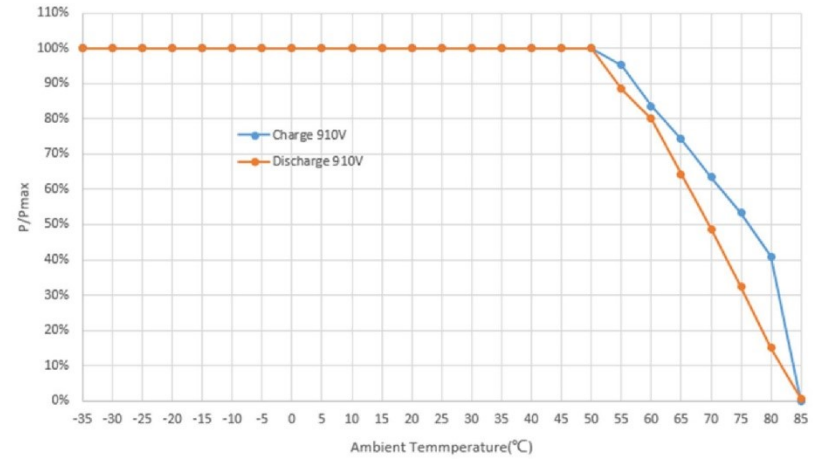
For model X3-TRENE-100K:

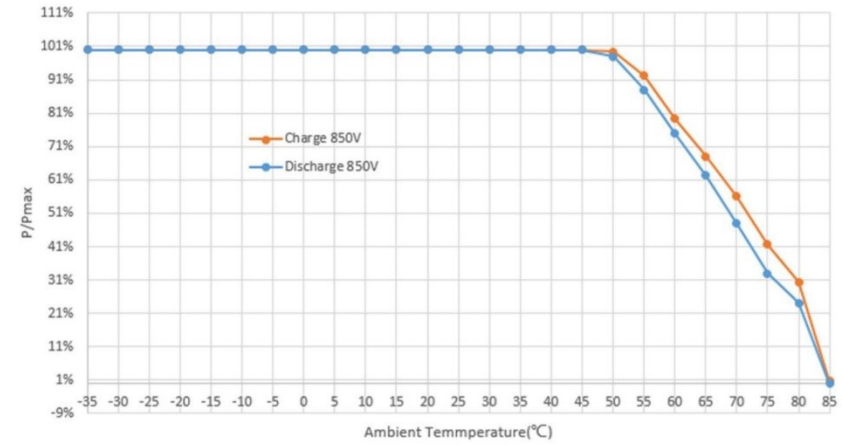


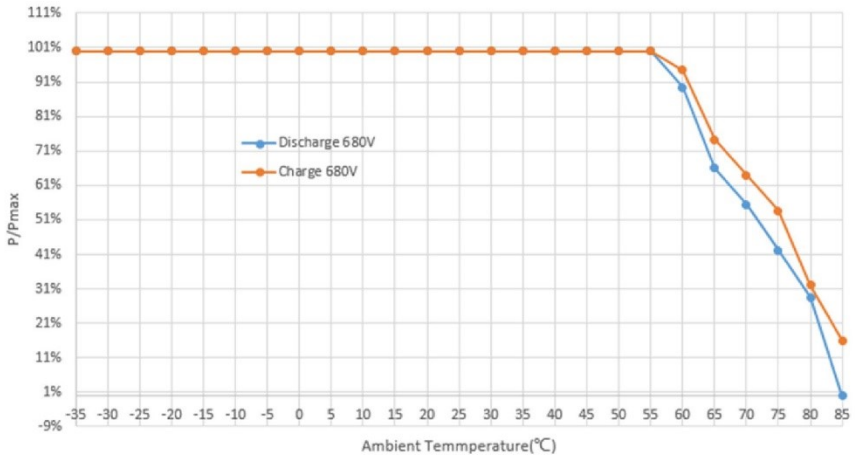




For models X3-TRENE-79.9K, X3-TRENE-99.9K, X3-TRENE-124.9K and X3-TRENE-125K:







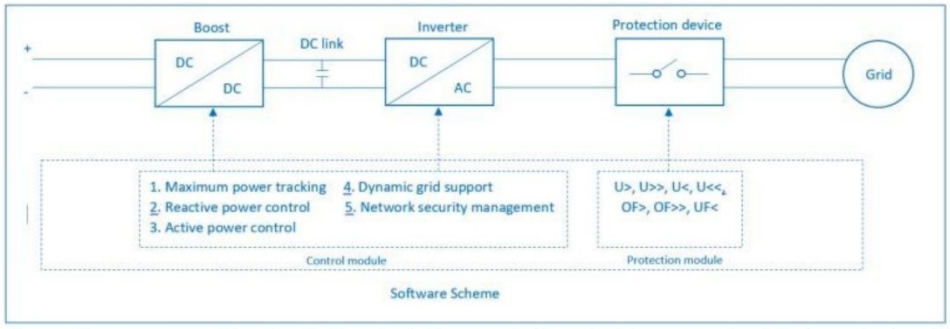
12. Interface protection function

Interface protection settings:			
Parameter	Setting range	Setting step	Default value
OV1 protection value *Vol Protect Max1* (Over voltage protection value level 1)	220V…308V	0.1V	253V
OV1 *protection time* *Vol Protect Time Max1* (Over voltage protection time)	0.01s…650s	0.01s	0.1s
OV2 protection value *Vol Protect Max2* (Over voltage protection value level 2)	220V…308V	0.1V	287.5V
OV2 protection time *Vol Protect Time Max2* (Over voltage protection time)	0.01s…650s	0.01s	0.1s
UV1 protection value *Vol Protect Min1* (Under voltage protection value level 1)	22V…220V	0.1V	184V
UV1 protection time *Vol Protect Time Min1* (Under voltage protection time)	0.01s…650s	0.01s	1s
UV2 protection value *Vol Protect Min2* (Under voltage protection value level 2)	22V…220V	0.1V	103.5V
UV2 protection time *Vol Protect Time Min2* (Under voltage protection time)	0.01s…650s	0.01s	0.3s
OF1 protection value *Freq Protect Max1* (Over frequency protection value level 1)	50.0Hz…55.0Hz	0.01Hz	51.5Hz
OF1 protection time *Freq Protect Time Max1* (Over frequency protection time)	0.01s…650s	0.01s	0.1s
OF2 protection value *Freq Protect Max2* (Over frequency protection value level 2)	50.0Hz…55.0Hz	0.01Hz	52.5Hz
OF2 protection time *Freq Protect Time Max2* (Over frequency protection time)	0.01s…650s	0.01s	0.1s
UF1 protection value *Freq Protect Min1* (Under frequency protection value level 2)	45.0Hz…50.0Hz	0.01Hz	47.5Hz
UF1 protection time *Freq Protect Time Min1* (Under frequency protection time)	0.01s…650s	0.01s	0.1s

Declaration of VDE-AR-N 4110&4120

All the settings values are readable through WEB UI.

The integrated protection functions are implemented in separate software modules and they operate independent from control functions as the software block diagram below:



The auxiliary power supply of protection device be supply from dc side, as a network independent auxiliary power can supply to the protection device over 5s. The protection device would be tripped immediately as long as the auxiliary power supply failed.

WEI UI setting for Interface protection settings:

Vol Protect Max1 (Number range: 220-308)

253 V Save

Vol Protect Max2 (Number range: 220-308)

287.5 V Save

Vol Protect Min1 (Number range: 22-220)

184 V Save

Vol Protect Min2 (Number range: 22-220)

103.5 V Save

Vol Protect Time Max1 (Number range: 0.01-650)

0.1 s Save

Vol Protect Time Max2 (Number range: 0.01-650)

0.1 s Save

Declaration of VDE-AR-N 4110&4120

Vol Protect Time Min1 (Number range: 0.01-650)

1 s Save

Vol Protect Time Min2 (Number range: 0.01-650)

0.3 s Save

Interface Frequency protection settings:

Freq Protect Max1 (Number range: 50-55)

51.5 Hz Save

Freq Protect Max2 (Number range: 50-55)

52.5 Hz Save

Freq Protect Min1 (Number range: 45-50)

47.5 Hz Save

Freq Protect Time Max1 (Number range: 0.01-650)

0.1 s Save

Freq Protect Time Max2 (Number range: 0.01-650)

0.1 s Save

Freq Protect Time Min1 (Number range: 0.01-650)

0.1 s Save

13. Connection and reconnection conditions

It shall be set out in the unit certificate that the requirements for connection and reconnection of the power generating unit given in 10.4 can be complied with. Based on a manufacturer declaration or on measurements carried out on the power generating unit or on the control unit relevant for analysis of the connection conditions, it shall be verified that connection is possible for 47.5 Hz ± 0.1 Hz and 50.2 Hz ± 0.1 Hz for VDE-AR-N 4110 and 47.5 Hz ± 0.1 Hz and 51.0Hz ± 0.1 Hz for VDE-AR-N 4120 as well as at 90 % Un ± 2 % Un and 110 % Un ± 2 % Un. The verification of connection can be carried out at simulated mains frequency and mains voltage.

After the inverter was disconnected from the network by opening the coupling switch (galvanic isolation) at the power generating unit due to the tripping of decoupling protection equipment (overfrequency, underfrequency, voltage reduction, voltage rise), regardless of command from PGS controller, automatic connection or reconnection of inverter will be implemented if the voltage at the network connection point is at least 95 % Uc and if the frequency is between 49.9 Hz and 50.1 Hz for a settable period. The time period shall be adjustable from undelayed operation up to 60 mins. The default value is 5 mins. Per requirement of VDE 4120, the PGU cannot reconnect without a release command, thus, an external grid protection device in PGU is necessary.

The gradient of power recovery could be set between 0.1%Pn/min – 100.0%Pn/min.

Automatic reconnection of the power generating units may only be made after the mains voltage and frequency have been stable within the aforementioned voltage and frequency limits for a settable period of time. This time period shall be adjustable from undelayed operation up to 10 min. Unless otherwise specified by the network operator, a default value of 5 min shall be set.

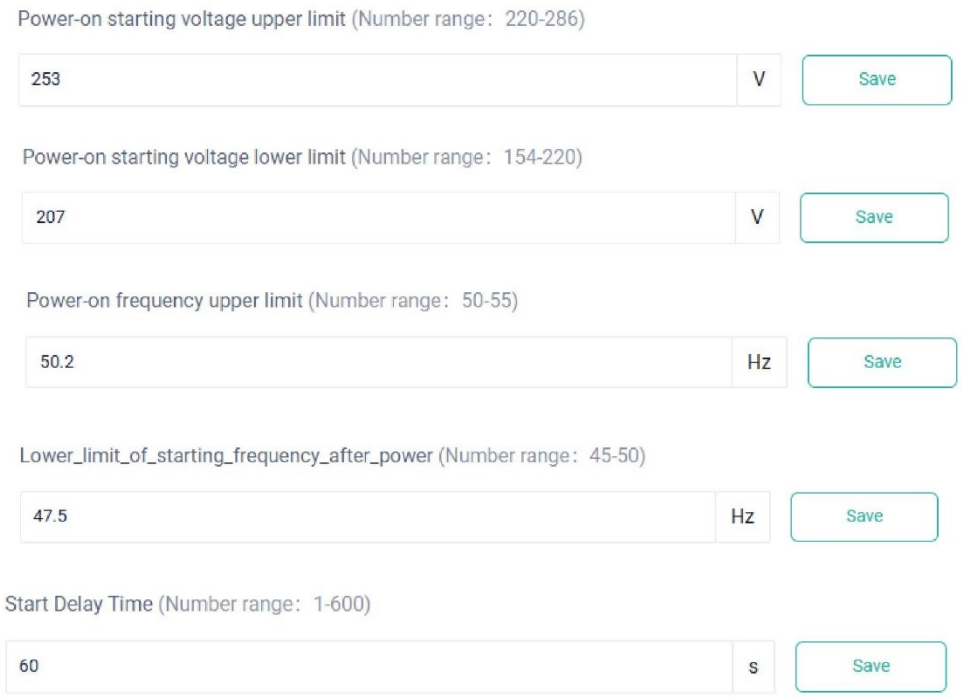
Parameter Protected Settings(Connection condition settings)			
Parameter	Setting range	Setting step	Default value
Power-on starting voltage upper limit(V) (Connection upper voltage value)	220…286V	0.1V	253V
Power-on starting voltage lower limit(V)) (Connection lower voltage value)	154…220V	0.1V	207V
Power-on frequency upper limit(Hz) (Connection upper frequency value)	50…55Hz	0.01Hz	VDE4110 : 50.2Hz VDE4120 : 51Hz
Lower limit of starting frequency after power-on(Hz) (Connection lower frequency value)	45…50Hz	0.01Hz	47.5Hz
Start Delay Time(S) (Delay time to connect)	1...600S	1s	60s
Startup power Rising Slop (%) (Power gradient to connect)	0.1%Pn/min...100%Pn/min	0.1%Pn/min	30%Pn/min

Declaration of VDE-AR-N 4110&4120

Reconnection condition settings:			
Parameter	Setting range	Setting step	Default value
Voltage range Reconnect Vol Max(V) (Reconnection voltage value)	220…286V	0.1V	250.7V
Reconnect Vol Min(V) (Reconnection voltage value)	22…220V	0.1V	218.5V
Freq Reconnect Max(Hz) (Reconnection frequency value)	50…55Hz	0.01Hz	50.1Hz
Freq Reconnect Min(Hz) (Reconnection frequency value)	45…50Hz	0.01Hz	49.9Hz
Reconnection Time(s) (Reconnection time)	1...650S	1s	300S
Reconnection Active Power Rise Rate (%) (Power gradient to reconnect)	0%Pn/min...60000%Pn/min	0.1%Pn/min	30%Pn/min

WEI UI settings for Parameter Protected Settings:

VDE4110:



Declaration of VDE-AR-N 4110&4120

Startup power Limit Enable

Save

Startup power Rising_Slop (Number range: 0.1-100)

30 %

Save

VDE4120:

Power-on starting voltage upper limit (Number range: 220-286)

253 V

Save

Power-on starting voltage lower limit (Number range: 154-220)

207 V

Save

Power-on frequency upper limit (Number range: 50-55)

51 Hz

Save

Lower_limit_of_starting_frequency_after_power (Number range: 45-50)

47.5 Hz

Save

Start Delay Time (Number range: 1-600)

60 s

Save

Startup power Limit Enable

Save

Startup power Rising_Slop (Number range: 0.1-100)

30 %

Save

Declaration of VDE-AR-N 4110&4120

Reconnecton condition settings:

Reconnect Vol Max (Number range: 220-308)

250.7 V Save

Reconnect Vol Min (Number range: 22-220)

218.5 V Save

Freq Reconnect Max (Number range: 50-55)

50.1 Hz Save

Freq Reconnect Min (Number range: 45-50)

49.9 Hz Save

Reconnection Time (Number range: 1-650)

300 s Save

Reconnect Power Limit Function

Save

Reconnection Active Power Rise Rate (Number range: 0-6000)

30 % Save

Declaration of VDE-AR-N 4110&4120

14. Interface Switch Information

Mfg.	Type	Parameter
SONG CHUAN PRECISION CO., LTD.	420A-1AH-F-C M01 12VDC (AC-Relay)	Relay 1000VAC 270A 1formA 12VDC GAP=3.6mm -40C° ~ +85C°

the interface switch complied with:

- Three-pole galvanic separation.
- The switch is designed as specified by the manufacturer. The switching capacity of the coupling switch may sustain the max. output current of inverter
- The coupling switch is designed to be triggered without delay.
- The sum of time elements of the protection and switching equipment does not exceed 100 ms.

15. Dynamic Grid Support

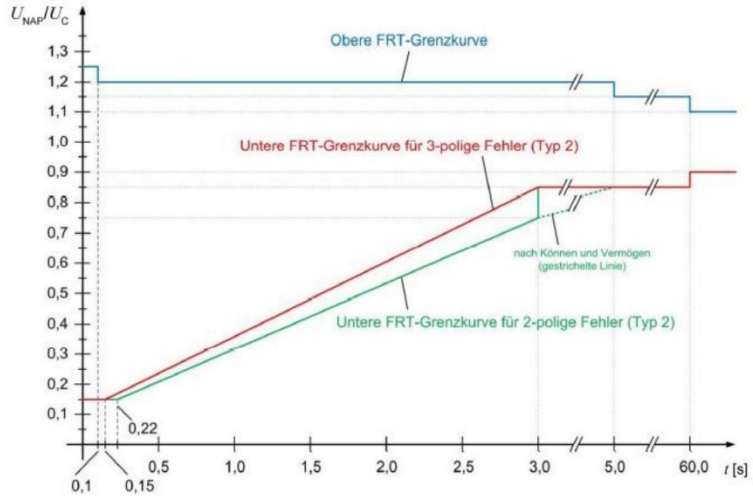
The occurrence of the following two events is defined as the onset of the fault whichever comes first:

• occurrence of an abrupt voltage change (tolerance band of at least 5 %); or

• voltages > 1.1 Un or < 0.9 Un.

The inverter is able to keep connecting on the grid in case grid voltage change within the limit curve below, even the step change of voltage exceeded 15%Un.

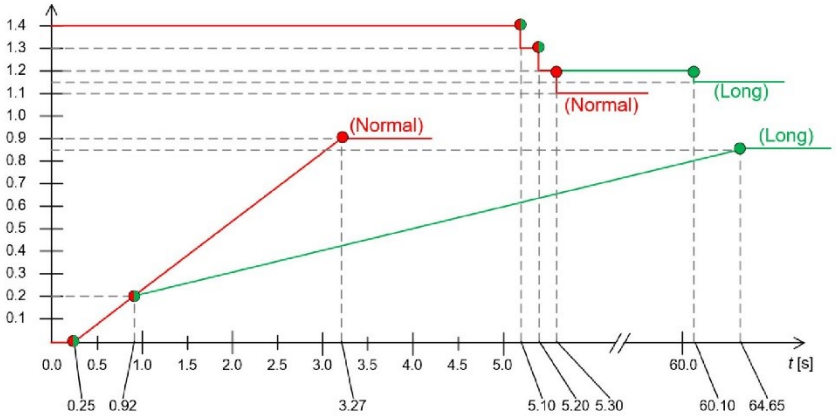
VDE-AR-N 4110:2023-09:



Legende

U_{NAP} Effektivwert der aktuellen Spannung am Netzanschlusspunkt

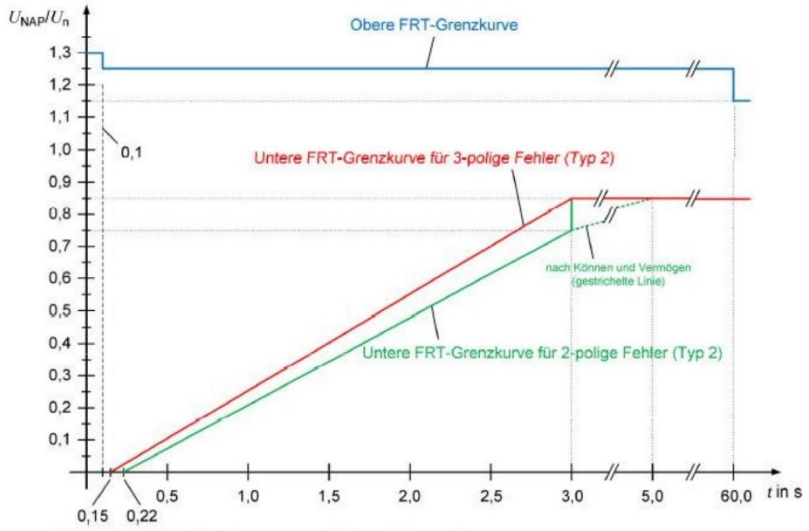
Actual capability according to the WEI UI settings:



Remark：LVRT (HVRT) includes three coordinates.The red coordinates represents normal mode and the green coordinates represents long mode.The only difference between the two modes is the time of the last coordinate.And for lower FRT limit curve for 3-pole faults (type 2) and 2-pole fault (type 2),its ability is the same.

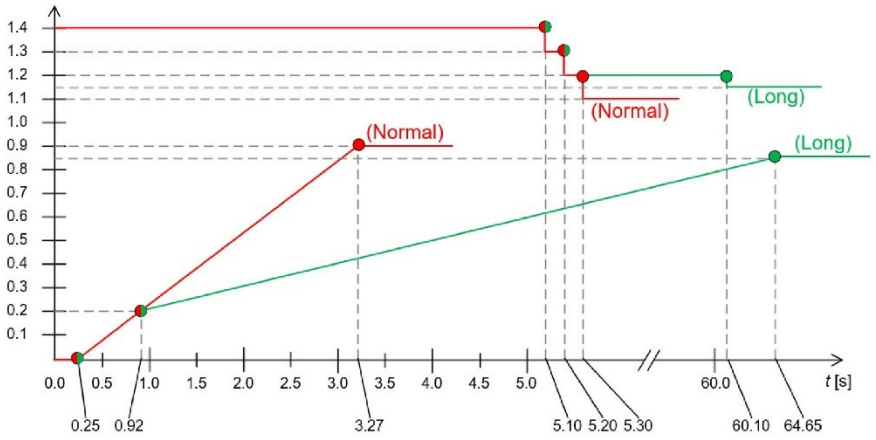
Declaration of VDE-AR-N 4110&4120

VDE-AR-N 4120:2018-11:



U_{NAP} = Effektivwert der aktuellen Spannung am Netzanschlusspunkt

Actual capability according to the WEI UI settings:



Remark：LVRT (HVRT) includes three coordinates.The red coordinates represents normal mode and the green coordinates represents long mode.The only difference between the two modes is the time of the last coordinate. And for lower FRT limit curve for 3-pole faults (type 2) and 2-pole fault (type 2),its ability is the same.

During the voltage fault, the inverter may:

a) cease feeding any current to grid or
b) feed the reactive current of both positive and negative sequence components according to the ΔU-ΔI relationship below:

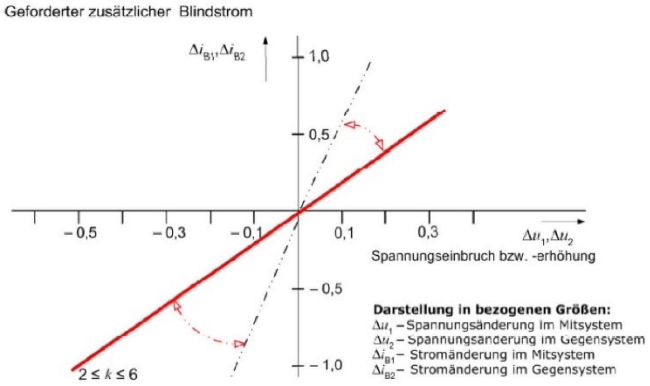


Bild 15 – Prinzip der Spannungsstützung bei Netzfehlern

Response the reactive current fulfill:
a) Rising Time: $T_{rising\_90\ \%} \leqslant 30$ ms;

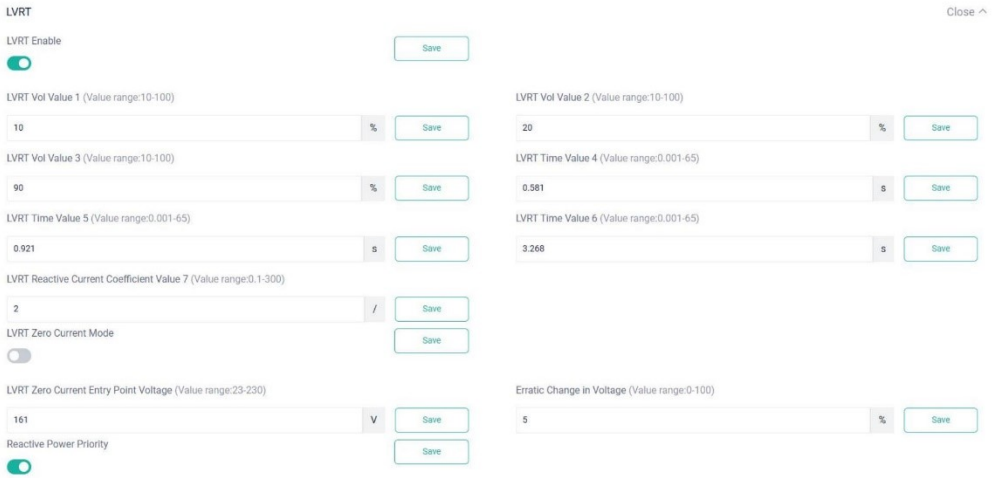
b) Setting Time: $T_{setting} \leqslant 60$ ms.

Dynamic network support			
Parameter	Setting range	Setting step	Default value
LVRT			
Operation Mode LVRT Zero Current Mode; Reactive Power Priority	Enable / Disable	--	LVRT Zero Current Mode:Disable Reactive Power Priority::Enable
LVRT Reactive Current Coefficient Value7 (Reactive power coefficient)	0.1 …300	0.1	2
Entry threshold LVRT Vol Value 1 LVRT Vol Value 2 LVRT Vol Value 3 (Voltage value range)	10…100%Un	0.1%Un	LVRT Vol Value 1: 10%Un LVRT Vol Value 2:20%Un LVRT Vol Value 3:90%Un
Entry threshold LVRT Time Value 4 LVRT Time Value 5 LVRT Time Value 6 (Voltage time range)	0.0001…65s	0.001s	LVRT Time Value4:0.581s LVRT Time Value5:0.921s LVRT Time Value6:3.268s
Operation Mode LVRT Zero Current Mode	Enable / Disable	--	Disable
LVRT Zero Current Entry Point Voltage (Enter mode value)	23…230V	0.1V	161V

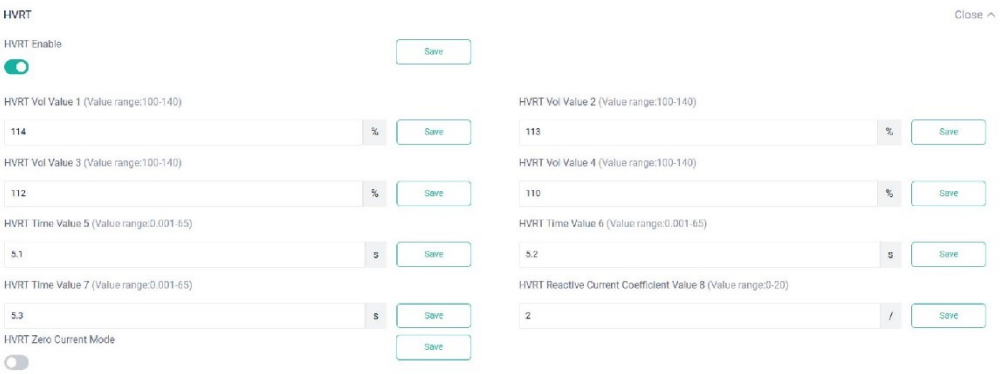
Declaration of VDE-AR-N 4110&4120

Erratic Change in Voltage	0%-100%	1%	5%
HVRT			
Operation Mode HVRT Zero Current Mode; Reactive Power Priority	Enable / Disable	--	HVRT Zero Current Mode:Disable Reactive Power Priority::Enable
HVRT Reactive Current Coefficient Value8 (Reactive power coefficient)	0.1 …20	0.1	2
Entry threshold HVRT Vol Value 1 HVRT Vol Value 2 HVRT Vol Value 3 HVRT Vol Value 4 (Voltage value range) (note: HVRT Vol Value 4 is not affected)	100…140%Un	0.1%Un	HVRT Vol Value 1: 114%Un HVRT Vol Value 2: 113%Un HVRT Vol Value 3: 112%Un HVRT Vol Value 4: 110%Un
Entry threshold HVRT Time Value 5 HVRT Time Value 6 HVRT Time Value 7 (Voltage time range)	0.0001…65s	0.001s	HVRT Time Value 5 :5.1s HVRT Time Value 6 :5.2s HVRT Time Value 7 :5.3s
Erratic Change in Voltage	0%-100%	1%	5%

WEI UI settings for FVRT/HVRT:



Declaration of VDE-AR-N 4110&4120



16.Multiple faults

Per control strategy of inverter, the PV input power reduced meanwhile in case the power output is blocked during voltage dips. Thus, the primary available energy is able to completely dissipate during the fault.

For instance, in multiple faults test procedure below under PEmax power condition, the dissipated energy can be estimated by PEmax*(0.16s+0.6s+1.05s+0.16s+1.05s)= PEmax*3.02s

Event	Times according to VDE-AR-N 4110 [4]/ VDE-AR-N 4120 [3] in s	Alternative sequence times in s
Drop	0.14 – 0.16	0.14 – 0.16
Break	0.30 – 2	0.30 – 2
Drop	0.55 – 0.6	0.95 – 1.05
Break	20 – 30	20 – 30
Drop	0.95 – 1.05	0.14 – 0.16
Break	20 – 30	0.30 – 2
Drop	0.14 – 0.16	0.95 – 1.05
Break	0.30 – 2	20 – 30
Drop	0.95 – 1.05	0.14 – 0.16
Break	-	0.30 – 2
Drop	-	0.95 – 1.05

Table 4-81: Multiple faults

After multiple faults, the product can continue to enter multiple faults even after 30 minutes.

17. Configuration summary

Grid code selection:			
Parameter	Setting range	Setting step	Default value
VDE 4110/ VDE 4120	--	--	VDE 4110/4120
Interface protection settings:			
Parameter	Setting range	Setting step	Default value
OV1 protection value *Vol Protect Max1* (Over voltage protection value level 1)	220V…308V	0.1V	253V
OV1 *protection time* *Vol Protect Time Max1* (Over voltage protection time)	0.01s…650s	0.01s	0.1s
OV2 protection value *Vol Protect Max2* (Over voltage protection value level 2)	220V…308V	0.1V	287.5V
OV2 protection time *Vol Protect Time Max2* (Over voltage protection time)	0.01s…650s	0.01s	0.1s
UV1 protection value *Vol Protect Min1* (Under voltage protection value level 1)	22V…220V	0.1V	184V
UV1 protection time *Vol Protect Time Min1* (Under voltage protection time)	0.01s…650s	0.01s	1s
UV2 protection value *Vol Protect Min2* (Under voltage protection value level 2)	22V…220V	0.1V	103.5V
UV2 protection time *Vol Protect Time Min2* (Under voltage protection time)	0.01s…650s	0.01s	0.3s
OF1 protection value *Freq Protect Max1* (Over frequency protection value level 1)	50.0Hz…55.0Hz	0.01Hz	51.5Hz
OF1 protection time *Freq Protect Time Max1* (Over frequency protection time)	0.01s…650s	0.01s	0.1s
OF2 protection value *Freq Protect Max2* (Over frequency protection value level 2)	50.0Hz…55.0Hz	0.01Hz	52.5Hz
OF2 protection time *Freq Protect Time Max2* (Over frequency protection time)	0.01s…650s	0.01s	0.1s
UF1 protection value *Freq Protect Min1* (Under frequency protection value level 2)	45.0Hz…50.0Hz	0.01Hz	47.5Hz

Declaration of VDE-AR-N 4110&4120

UF1 protection time *Freq Protect Time Min1* (Under frequency protection time)	0.01s…650s	0.01s	0.1s
Self-protection settings:			
Parameter	Setting range	Setting step	Default value
OV protection value	--	--	1.40Un
OV protection time	--	--	50ms
Parameter Protected Settings(Connection condition settings)			
Parameter	Setting range	Setting step	Default value
Power-on starting voltage upper limit(V) (Connection upper voltage value)	220…286V	0.1V	253V
Power-on starting voltage lower limit(V)) (Connection lower voltage value)	154…220V	0.1V	207V
Power-on frequency upper limit(Hz) (Connection upper frequency value)	50…55Hz	0.01Hz	VDE4110 : 50.2Hz VDE4120 : 51Hz
Lower limit of starting frequency after power-on(Hz) (Connection lower frequency value)	45…50Hz	0.01Hz	47.5Hz
Start Delay Time(S) (Delay time to connect)	1...600S	1s	60s
Startup power Rising Slop (%) (Power gradient to connect)	0.1%Pn/min...100%Pn/min	0.1%Pn/min	30%Pn/min
Reconnection condition settings:			
Parameter	Setting range	Setting step	Default value
Voltage range Reconnect Vol Max(V) (Reconnection voltage value)	220…286V	0.1V	250.7V
Reconnect Vol Min(V) (Reconnection voltage value)	22…220V	0.1V	218.5V
Freq Reconnect Max(Hz) (Reconnection frequency value)	50…55Hz	0.01Hz	50.1Hz
Freq Reconnect Min(Hz) (Reconnection frequency value)	45…50Hz	0.01Hz	49.9Hz
Reconnection Time(s) (Reconnection time)	1...650S	1s	300S
Reconnection Active Power Rise Rate (%) (Power gradient to reconnect)	0%Pn/min...60000%Pn/min	0.1%Pn/min	30%Pn/min
Q-U mode (Reactive power-voltage character curve)			
Parameter	Setting range	Setting step	Default value

Declaration of VDE-AR-N 4110&4120

Q-U Voltage 1 Q-U Voltage 2 Q-U Voltage 3 Q-U Voltage 4 (Voltage value settings)	Q-U Voltage 1: 0V…300V Q-U Voltage 2: 0V…300V Q-U Voltage 3: 0V…300V Q-U Voltage 4: 0V…300V	0.1V	VDE4110 Q-U Voltage1: 220.8V Q-U Voltage2: 230V Q-U Voltage3: 230V Q-U Voltage4: 239.2V VDE4120 Q-U Voltage1: 227.7V Q-U Voltage2: 239.2V Q-U Voltage3: 239.2V Q-U Voltage4: 250.7V
Q-U Reactive Power 1 Q-U Reactive Power 2 Q-U Reactive Power 3 Q-U Reactive Power 4 (Reactive power value settings)	Q1: -200%Pn…200%Pn Q2: -200%Pn…200%Pn Q3: -200%Pn…200%Pn Q4: -200%Pn…200%Pn	0.01%Pn	Q1: Qmax Q2: 0 Q3: 0 Q4: -Qmax Note: Qmax=66%Pn(for X3-TRENE-100K) Qmax=60%Pn(for other models)
Q-U Power Entry Conditions Q-U Power Exit Conditions (The 4110 QU function is not affected)	-200%Pn…200%Pn	0.01%Pn	Entry Conditions: -130%Pn Exit Conditions: -140%Pn
Q-U Power factor Min (The 4110QU function is not affected)	0…1	0.001	0.400
Q-U power setting times - 3Tau (Reactive power response time)	0s···100s	0.01s	VDE4110 10s VDE4110 5s
Q-U Dead Zone voltage	0-300V	0.1V	0.0V
Q-P mode (Character curve Q(P))			
Parameter	Setting range	Setting step	Default value
Q-P Reactive Power 1 Q-P Reactive Power 2 Q-P Reactive Power 3 Q-P Reactive Power 4 Q-P Reactive Power 5 (Reactive power value settings)	Q1: -200%Pn…200%Pn Q2: -200%Pn…200%Pn Q3: -200%Pn…200%Pn Q4: -200%Pn…200%Pn Q5: -200%Pn…200%Pn	0.1%Pn	Q1: 0 Q2: 0 Q3: -5%Pn Q4: -33%Pn Q5: -33%Pn
Q-P Active Power 1 Q-P Active Power 2 Q-P Active Power 3 Q-P Active Power 4 Q-P Active Power 5 (Active power value settings)	P1: -200%Pn…200%Pn P2: -200%Pn…200%Pn P3: -200%Pn…200%Pn P4: -200%Pn…200%Pn P5: -200%Pn…200%Pn	0.1%Pn	P1: 0 P2: 50%Pn P3: 60% Pn P4: 90% Pn P5: 100% Pn
Q-P PF Min Value 1 Q-P PF Min Value 2 （The 4110QP function is not affected）	0…1	0.001	Value 1:0.001 Value 2:0.001
Q-P Voltage Entry Conditions	0V…300V	0.1V	Entry Conditions: 2.0V Exit Conditions: 1.0V

Declaration of VDE-AR-N 4110&4120

Q-P Voltage Exit Conditions (The 4110QP function is not affected)			
Q-P Power Setting Time-3Tau (Reactive power value settings)	0s…100s	1s	VDE 4110: 10s VDE 4120: 5s
Q mode (Fixed Q)			
Parameter	Setting range	Setting step	Default value
Reactive power Q Reactive power in ConstPower Mode (Reactive power value settings)	-66%Pn…66%Pn	0.1%Pn	Q=0Kvar
Fixed Reactive Power Adjustment Time-3Tau (Reactive power value settings)	6s…650s	1s	10s
PF mode (Fixed cosφ)			
Parameter	Setting range	Setting step	Default value
Over-Excited			
Power factor value settings	0.80oe…1oe	0.001	1
Fixed PF Adjustment Time-3Tau (Reactive power value settings)	6s…60s	1s	10s
Under-Excited			
Power factor value settings	0.80ue…1ue	0.001	1
Fixed PF Adjustment Time-3Tau (Reactive power value settings)	6s…60s	1s	10s
Network security management			
Parameter	Setting range	Setting step	Default value
Active power in ConstPower Mode (Active power value settings) Note: The model X3-TRENE-100K is overloaded, but the others are not.	-95.9...95.9kW(for model X3-TRENE-79.9K) -119.9...119.9kW(for model X3-TRENE-99.9K) -120.0...120.0kW(for model X3-TRENE-100K) -149.9...149.9kW(for model X3-TRENE-124.9K) -150.0...150.0kW(for model X3-TRENE-125K)	0.1kW	79.9kW(for model X3-TRENE-79.9K) 99.9kW(for model X3-TRENE-99.9K) 110kW(for model X3-TRENE-100K) 124.9kW(for model X3-TRENE-124.9K) 125kW(for model X3-TRENE-125K)
AC Active Power Ramp-up Mode Enable	Disable/Enable	--	Enable
AC Active Power Ramp-up Percentage (Active power gradient)	0.1%Pn/min...100%Pn/min	0.1%Pn/min	30%Pn/min
P-OF/P-UF(Active power output dependent on grid frequency)			
Parameter	Setting range	Setting step	Default value
OF exit frequency P-OF Recovery Frequency	50Hz…70Hz	0.01Hz	50.2Hz

Declaration of VDE-AR-N 4110&4120

(Exit curve value)			
OF threshold P-OF Frequency 1 (Enter curve value)	50Hz···70Hz	0.01Hz	50.2Hz
OF droop P-OF Droop 1 (Active power gradient)	0.5%...100%	0.1%	2%
OF Initial time delay P-OF Enter Delay Time (Enter delay time)	0s...1000s	1s	0s
OF exit recovery slope P-OF Power Ramp Up Uint Time (power recovery slope)	0s...3000s	1s	600s (Pn/600s=10%Pn/min)
UF exit frequency P-UF Recovery Frequency (Exit curve value)	40Hz...60Hz	0.01Hz	49.8Hz
UF threshold P-UF Frequency 1 (Enter curve value)	40Hz...60Hz	0.01Hz	49.8Hz
UF droop P-UF Droop 1 (Active power gradient)	0.5%...100%	0.1%	2%
UF Initial time delay P-UF Enter Delay Time (Enter delay time)	0s...1000s	1s	0s
UF exit recovery slope P-UF Power Ramp Up Uint Time (power recovery slope)	0s...3000s	1s	600s (Pn/600s=10%Pn/min)
Primary Control Energy Supply			
Parameter	Setting range	Setting step	Default value
Primary Control Energy Supply Enable	--	--	Disable
Over-frequency Enter Frequency	50Hz···60Hz	0.01Hz	50.2Hz
Over-frequency Slope	2%···12%	0.1%	5%
Under-frequency Enter Frequency	40Hz···60Hz	0.01Hz	49.8Hz
Over-frequency Slope	2%···12%	0.1%	5%
Dynamic network support			
Parameter	Setting range	Setting step	Default value
LVRT			
Operation Mode LVRT Zero Current Mode; Reactive Power Priority	Enable / Disable	--	LVRT Zero Current Mode:Disable Reactive Power Priority::Enable
LVRT Reactive Current Coefficient Value7 (Reactive power coefficient)	0.1 …300	0.1	2
Entry threshold LVRT Vol Value 1 LVRT Vol Value 2	10…100%Un	0.1%Un	LVRT Vol Value 1: 10%Un LVRT Vol Value 2:20%Un LVRT Vol Value 3:90%Un

Declaration of VDE-AR-N 4110&4120

LVRT Vol Value 3 (Voltage value range)			
Entry threshold LVRT Time Value 4 LVRT Time Value 5 LVRT Time Value 6 (Voltage time range)	0.0001…65s	0.001s	LVRT Time Value4:0.581s LVRT Time Value5:0.921s LVRT Time Value6:3.268s
Operation Mode LVRT Zero Current Mode	Enable / Disable	--	Disable
LVRT Zero Current Entry Point Voltage (Enter mode value)	23…230V	0.1V	161V
Erratic Change in Voltage	0%-100%	1%	5%
HVRT			
Operation Mode HVRT Zero Current Mode; Reactive Power Priority	Enable / Disable	--	HVRT Zero Current Mode:Disable Reactive Power Priority::Enable
HVRT Reactive Current Coefficient Value8 (Reactive power coefficient)	0.1 …20	0.1	2
Entry threshold HVRT Vol Value 1 HVRT Vol Value 2 HVRT Vol Value 3 HVRT Vol Value 4 (Voltage value range) (note: HVRT Vol Value 4 is not affected)	100…140%Un	0.1%Un	HVRT Vol Value 1: 114%Un HVRT Vol Value 2: 113%Un HVRT Vol Value 3: 112%Un HVRT Vol Value 4: 110%Un
Entry threshold HVRT Time Value 5 HVRT Time Value 6 HVRT Time Value 7 (Voltage time range)	0.0001…65s	0.001s	HVRT Time Value 5 :5.1s HVRT Time Value 6 :5.2s HVRT Time Value 7 :5.3s
Erratic Change in Voltage	0%-100%	1%	5%

Automatic shutdown			
Parameter	Setting range	Setting step	Default value
Automatic shutdown in com loss condition *ComLost_ShutDown* (The product will shut down when lose communicating signal)	Enable / Disable	--	Disable

Declaration of VDE-AR-N 4110&4120

18. Short-circuited current of PGU

Type of power generating Unit	Information	Symbol	Value
PGU with full-scale converters (For all models)	RMS value of the source current for three-phase fault	I_{skPF}	1.00In
	RMS value of the source current for two-phase fault	$I_{(1)sk2PF}$	1.00In
	RMS value of the source current for single-phase fault	$I_{(1)sk1PF}$	1.00In
	Negative-sequence short-circuit impedance for integer k-factors	$Z_{(2)PF}$	0.50

- End -