



PROTOTYPE DECLARATION / Prototypenbescheinigung

Product prototype certificate number

No. 2621/0110-PTCER

For the company: / Für das Unternehmen

Shenzhen SOFARSOLAR Co., Ltd.

No.1699 Xiyou Rd., New & High Technology Industrial Development
Zone, Hefei 230088, P. R. China.



Has provided to E&E Product Certification Body of SGS the technical documentation indicated in both articles no. 12 of standards /

Hat der E & E-Produktzertifizierungsstelle von SGS die technischen Dokumente für beide Artikel-Nr. 12 des Standards überliefert:

- **VDE-AR-N 4110: 2018.** Technical requirements for the connection and operation of customer installations to the medium voltage network (TAR medium voltage) /
VDE-AR-N 4110: 2018. Technische Voraussetzungen für den Anschluss und Betrieb von Kundenanlagen an das Mittelspannungsnetz (TAR-Mittelspannung).

For the product / Für das Produkt: **Type 2 Energy storage inverter / Energiespeicher-Wechselrichter Typ 2**

Models / Modelle:		HYD	HYD	HYD	HYD	HYD	HYD
Technical Data / Technische Daten:		5KTL-3PH	6KTL-3PH	8KTL-3PH	10KTL-3PH	15KTL-3PH	20KTL-3PH
DC	Max. input voltage / Max.-Eingangsspannung:	1000 V	1000 V	1000 V	1000 V	1000 V	1000 V
	MPP Voltage Range / MPP-Spannungsbereich:	360-850 V	360-850 V	360-850 V	450-850 V	450-850 V	450-850 V
	N° of MPP inputs / Anzahl MPP-Eingänge:	2	2	2	2	2	2
	Max. input current / Max.-Eingangsstrom:	12.5 A	12.5 A	12.5 A	25 x 2 A	25 x 2 A	25 x 2 A
AC	AC output power/ AC-Ausgangsleistung:	5000 W	6000 W	8000 W	10000 W	15000 W	20000W
	Max. AC output current / Max. AC-Ausgangsstrom:	8 A	10 A	13 A	16 A	24 A	32 A
	Nominal Grid Voltage / Nominale Netzspannung:	3P+N+PE/ 3P+PE 230/400 V	3P+N+PE/ 3P+PE 230/400 V	3P+N+PE/ 3P+PE 230/400 V	3P+N+PE / 3P+PE 230/400 V	3P+N+PE / 3P+PE 230/400 V	3P+N+PE / 3P+PE 230/400 V
	AC voltage range / Wechselspannungsbereich:	195.5 - 264.5 V	195.5 - 264.5 V	195.5 - 264.5 V	195.5 - 264.5 V	195.5 - 264.5 V	195.5 - 264.5 V
	Nominal Grid Frequency / Nominale Netzfrequenz:	50 Hz / 45- 55 Hz, 60 Hz / 55- 65 Hz	50 Hz / 45- 55 Hz, 60 Hz / 55- 65 Hz	50 Hz / 45- 55 Hz, 60 Hz / 55- 65 Hz	50 Hz / 45-55 Hz, 60 Hz / 55-65 Hz	50 Hz / 45-55 Hz, 60 Hz / 55-65 Hz	50 Hz / 45-55 Hz, 60 Hz / 55-65 Hz

We confirm that the above mentioned ESS inverters are considered as Prototypes in accordance with the VDE-AR-N 4110 and the standard FGW TR 8 / *Hiermit bestätigen wir, dass es sich bei der genannten EZE nach VDE-AR-N 4110, und FGW TR 8 um einen Prototyp handelt*

- **FGW TR8. Certification of the Electrical Characteristics of Power Generating Units, Systems and Storage Systems as well as for their Components to the Grid. Revision 9.**

FGW TR8. Zertifizierung der elektrischen Eigenschaften von Erzeugungseinheiten und -anlagen, Speicher sowie für deren Komponenten am Stromnetz. Revision 9.

Test reports and certificates will be issued when the testing process is finished and evaluated with positive result.

Testberichte und Zertifikate werden nach Abschluss des Testprozesses ausgestellt und mit positivem Ergebnis bewertet.

Restrictions or deviations / *Einschränkungen und Abweichungen:*

A connecting terminal plate has to be installed separately if necessary / *Eine Prüfklemmleiste ist bei Bedarf separat nachzurüsten.*

Brussels, 19th of April 2021


Calogero Lana
Certification Manager /
Zertifizierungsmanager

Annex 1 / Anhang 1

This certificate confirms that the mentioned generation unit is a prototype according to FGW TR 8. For this purpose, the PGU is described below and the main technical developments or innovations are presented: /

Diese Bescheinigung bestätigt, dass es sich bei der genannten Erzeugungseinheit nach FGW TR 8 um einen Prototypen handelt. Dazu wird im Folgenden die EZE beschrieben und die wesentlichen technischen Weiterentwicklungen oder Neuerungen dargestellt:

Description of the generating unit / Beschreibung der Erzeugungseinheit:

The Energy storage inverter (Storage-PGU) enables the supply of direct current stored in external batteries into the public alternating current grid using power electronics. /

Der Energiespeicher-Wechselrichter (Storage-PGU) ermöglicht die Einspeisung von Gleichstrom, der in externen Batterien gespeichert ist, in das öffentliche Wechselstromnetz mittels Leistungselektronik.

Treatment according to FGW TR 8, 2.3.2.2 / Behandlung nach FGW TR 8, 2.3.2.2:

The mentioned PGU is a non-wind generation unit. The plant certificate must be issued two years after the commissioning of the first PGU at the latest. /

Bei der genannten EZE handelt es sich um eine Nicht-Wind-Erzeugungseinheit. Spätestens zwei Jahre nach der Inbetriebnahme der ersten EZE muss das Anlagenzertifikat erstellt werden.

The PGU is operated in an PGS (generation plant), which consists of an PGU with PGU certificate and prototypes (case 2). Manufacturer's data must be compiled and provided for certification of the plant. The final plant certificate is issued when the PGU certificate is available for the generation unit in question. /

Die EZE wird in einer EZA (Erzeugungsanlage) betrieben, welche aus EZE mit EZE-Zertifikat und Prototypen besteht (Fall 2). Herstellerangaben müssen erstellt und für die Zertifizierung der Anlage zur Verfügung gestellt werden. Das endgültige Anlagenzertifikat wird erstellt, wenn das EZE-Zertifikat für die genannte Erzeugungseinheit vorliegt.

0 1 2 3 4 5

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Annex 2 / Anhang 2

This certificate confirms that the mentioned generation unit is a prototype according to FGW TR 8. For this purpose, the PGU is described below and the main technical developments or innovations are presented: /

Diese Bescheinigung bestätigt, dass die genannte Erzeugungseinheit (EZE) in der Lage ist, die Anforderungen an die elektrischen Eigenschaften der Erzeugungseinheit nach VDE-AR-N 4110 zu erfüllen. Dazu wird im Folgenden die Übereinstimmung der elektrischen Eigenschaften der EZE mit den Anforderungen nach VDE-ARN 4110 nachgewiesen:

VDE-AR-N 4110	Comment and reference / Kommentar und Bewertung
<p>12 Regulation for prototypes / Prototypen-Regelung</p>	
<p>A prototype is the first power generating unit of a type presenting substantial technological developments or innovations and all other power generating units of this type put into operation within two years after the commissioning of the first power generating unit of this type. / <i>Ein Prototyp ist die erste Erzeugungseinheit eines Typs, der wesentliche technische Weiterentwicklungen oder Neuerungen aufweist, und alle weiteren Erzeugungseinheiten dieses Typs, die innerhalb von zwei Jahren nach der Inbetriebsetzung der ersten Erzeugungseinheit dieses Typs in Betrieb gesetzt werden.</i></p> <p>NOTE 1 This definition corresponds to the term's definition given in SDLWindV. There is no relation to the term "pilot wind turbine" (de: Pilotwindenergieanlage) used in the EEG. / <i>ANMERKUNG 1 Diese Definition entspricht der Begriffsdefinition nach SDLWindV. Es besteht kein Zusammenhang zum Begriff „Pilotwindenergieanlage“ im EEG [6].</i></p> <p>Technological developments and innovations are generally considered to be substantial where components or software versions are changed so that the electrical behaviour of the power generating unit at the network changes significantly and a unit certification of this new type is required. / <i>Wesentliche technische Weiterentwicklungen und Neuerungen liegen in der Regel vor, wenn Komponenten oder Softwareversionen so geändert werden, dass sich das elektrische Verhalten der Erzeugungseinheit am Netz signifikant ändert und eine Einheitenzertifizierung dieses neuen Typs erforderlich wird.</i></p>	<p>Checked / Berücksichtigt:</p> <ul style="list-style-type: none"> - See annex 1 / siehe Anhang 1
<p>For the prototype of a power generating unit the requirements of this VDE application guide apply. For these prototypes, a prototype confirmation, in which the certification body confirms a substantial technological development or innovation based on a manufacturer declaration, is sufficient, instead of the unit certificate, for a period of two years after commissioning of the first power generating unit prototype in Germany. The certification body shall also check and set out reproducibly in the prototype confirmation, whether the prototype is generally capable of meeting the requirements of this VDE application guide for the electrical properties of the power generating unit. This is based on an electrical properties data sheet prepared by the manufacturer of the power generating unit. / <i>Für einen Prototypen einer Erzeugungseinheit gelten die Anforderungen dieser VDE-Anwendungsregel. Innerhalb von zwei Jahren nach der Inbetriebsetzung der ersten Prototypen-Erzeugungseinheit in Deutschland ist für diese Prototypen anstelle des Einheitenzertifikats eine Prototypenbestätigung ausreichend, in der die Zertifizierungsstelle das Vorhandensein einer wesentlichen technischen Weiterentwicklung oder Neuerung auf Basis einer Herstellererklärung bestätigt. Weiterhin ist durch die Zertifizierungsstelle zu prüfen und in der Prototypenbestätigung nachvollziehbar auszuweisen, ob der Prototyp grundsätzlich in der Lage ist, die Anforderungen dieser VDE-Anwendungsregel an die elektrischen Eigenschaften der Erzeugungseinheit zu erfüllen. Dies erfolgt auf Basis eines vom Hersteller der Erzeugungseinheit erstellten Datenblattes der elektrischen Eigenschaften.</i></p> <p>For prototypes commissioned before 2019-04-27, the above-mentioned period starts 2019-04-27. / <i>Für Prototypen die vor dem 27.04.2019 in Betrieb gesetzt werden, beginnt die oben genannte Frist am 27.04.2019.</i></p>	<p>Checked / Berücksichtigt</p>

VDE-AR-N 4110	Comment and reference / Kommentar und Bewertung
<p>In order to allow the certification body to carry out the required plausibility test, the data sheet of the power generating unit shall contain at least the following information:/ Damit die geforderte Plausibilitätsprüfung durch die Zertifizierungsstelle erfolgen kann, muss das Datenblatt der Erzeugungseinheit mindestens folgende Angaben enthalten:</p>	<p>Checked / Berücksichtigt After documentation provided by the manufacturer (see annex 3 and Annex 4). / Daten vom Hersteller stehen zur Verfügung (siehe Anhang 3 und Anhang 4).</p>
<p>1. Electrical data (nominal and rated quantities) / Elektrische Daten (Nenn- und Bemessungsgrößen);</p>	<p>Compliant / Erfüllt: - See annex 3 / siehe Anhang 3</p>
<p>2. Schematic overview circuit diagram of the power generating unit with all relevant componentsschematisches / Übersichtsbilcl der Erzeugungseinheit mit allen wesentlichen Komponenten.</p>	<p>Compliant / Erfüllt: - See annex 4 / siehe Anhang 4</p>
<p>3. Operating ranges of the power generating unit / Betriebsbereiche der Erzeugungseinheit:</p> <ul style="list-style-type: none"> • Limits in quasi-static operation / Grenzen im quasistationären Betrieb. • Reactive power adjustment range / Blindleistungsstellbereich. • FRT limit curve (U/t diagram) / FRT-Grenzkurve(U/t-Diagramm). 	<p>Compliant / Erfüllt: - See annex 4 / siehe Anhang 4</p>
<p>4. Protection functions with setting ranges / Schutzfunktionen mit Einstellbereichen:</p> <ul style="list-style-type: none"> • Decoupling protection / Entkupplungsschutz. • Self-protection / Eigenschutz. 	<p>Compliant / Erfüllt: - See annex 4 / siehe Anhang 4</p> <p>Restriction / Einschränkung: A connecting terminal plate has to be installed separately if necessary / Eine Prüfklemmleiste ist bei Bedarf separat nachzurüsten.</p>
<p>5. Active power control / Wirkleistungsregelung:</p> <ul style="list-style-type: none"> • Power/frequency behaviour / Leistungs-Freqbenz-Verhalten. • Active power gradient / Wirkleistungsgradient. 	<p>Compliant / Erfüllt: - See annex 4 / siehe Anhang 4</p>
<p>6. Reactive power control / Blindleistungsregelung.</p>	<p>Compliant / Erfüllt: - See annex 4 / siehe Anhang 4</p>
<p>7. Dynamic reactive current feed-in / Dynamische Blindstromeinspeisung:</p> <ul style="list-style-type: none"> • Basic functionality / Grundsätzliche Funktionsweise. 	<p>Compliant / Erfüllt: - See annex 4 / siehe Anhang 4</p>
<p>8. Declaration of the manufacturer stating that the power generating unit has been designed so that the requirements of this application guide for the power generating unit can be complied with / Erklärung des Herstellers, dass die Erzeugungseinheit so konstruiert wurde, dass die Anforderungen dieser Anwendungsregel an die Erzeugungseinheit erfüllt werden können.</p>	<p>Compliant / Erfüllt: - See annex 4 / siehe Anhang 4</p>
<p>At the latest after expiry of the above-mentioned period, a unit certificate is required. / Spätestens nach Ablauf der oben genannten Frist ist ein Einheitenzertifikat erforderlich.</p> <p>NOTE 2 If the unit certificate is available prior to expiry of the two-year term after commissioning the first power generating unit of this type, it can still be a prototype. / ANMERKUNG 2 Sofern das Einheitenzertifikat vor Ablauf der Frist von zwei Jahren nach der Inbetriebnahme der ersten Erzeugungseinheit.</p>	<p>Compliant / Erfüllt</p>

Annex 3 / Anhang 3

Datasheet of the generating unit / *Datenblatt der Erzeugungseinheit:*

Model	HYD 5KTL- 3PH	HYD 6KTL- 3PH	HYD 8KTL- 3PH	HYD 10KTL- 3PH	HYD 15KTL- 3PH	HYD 20KTL- 3PH
PV Input (DC)						
Max. PV input voltage (Vdc)	1000	1000	1000	1000	1000	1000
Min. PV input voltage / Startup input voltage (Vdc)	200	200	200	200	200	200
Nominal PV input voltage (Vdc)	620	620	620	620	620	620
MPP voltage range (Vdc)	180-960	180-960	180-960	180-960	180-960	180-960
MPP voltage range for nominal power (Vdc)	360-850	360-850	360-850	450-850	450-850	450-850
No. of independent MPP inputs	2	2	2	2	2	2
Max. number of input connector per MPPT	2	2	2	4	4	4
Max. PV input current (A)	12.5	12.5	12.5	25 x 2	25 x 2	25 x 2
Max. DC short-circuit current (A)	15	15	15	30 x 2	30 x 2	30 x 2
Battery Input (DC)						
Bat input voltage range (Vdc)	180-800	180-800	180-800	180-800	180-800	180-800
Bat voltage range for nominal power (Vdc)	200-800	240-800	320-800	200-800	300-800	400-800
No. of independent Bat inputs	1	1	1	2	2	2
Max. Bat input current (A)	25	25	25	25 x 2	25 x 2	25 x 2
Peak discharging current, Duration (A)	35	35	35	35 x 2	35 x 2	35 x 2
Output (AC)						
AC output power (W)	5000	6000	8000	10000	15000	20000
Max. AC output current (A)	8	10	13	16	24	32
Nominal AC output current (A)	7.3	8.7	11.6	14.5	21.7	29
Nominal AC voltage (V)	3P+N+PE/3P+PE, 230/400					
AC voltage range	195.5-264.5					
Nominal grid frequency / Grid frequency range (Hz)	50 Hz / 45-55Hz, 60 Hz / 55-65Hz					
THD	< 3%	< 3%	< 3%	< 3%	< 3%	< 3%
DC current injection	< 0.5% In	< 0.5% In	< 0.5% In	< 0.5%	< 0.5%	< 0.5% In
Power factor at nominal power / Adjustable power factor	1(-0.8 ~ +0.8)	1(-0.8 ~ +0.8)	1(-0.8 ~ +0.8)	1(-0.8 ~ +0.8)	1(-0.8 ~ +0.8)	1(-0.8 ~ +0.8)
Feed-in phases / connection phases	3/4, 3/3					

Efficiency						
Max. efficiency / European efficiency	98.0%/ 97.5%	98.0%/ 97.5%	98.0%/ 97.5%	98.2%/ 97.7%	98.2%/ 97.7%	98.2%/ 97.7%
Protection						
DC reverse connection protection	Yes					
AC short circuit protection	Yes					
Leakage current protection	Yes					
Grid monitoring	Yes					
Ground fault monitoring	Yes					
DC switch	Yes					
AC switch	No					
PV String current monitoring	Yes					
An-ti PID and PID recovery function	No					
Overvoltage protection	Yes					
General Data						
Dimensions (W*H*D, mm)	571.4 x 515 x 264.1					
Weight (kg)	33			37		
Isolation method	Transformerless					
Ingress protection rating	OVC II (AC main), OVC II (PV)					
Night power consumption (W)	< 15					
Operating ambient temperature range (°C)	-30~60°C (up 45°C derating)					
Allowable relative humidity range (non-condensing)	0~100%					
Cooling method	Natural			Forced airflow		
Max. operating altitude (m)	4000					
Display	LCD					
Communication	Bluetooth / RS485 / WIFI / GPRS (optional)					
DC connection type	MC4					
AC connection type	5P Connector					
Compliance	IEC62109-1, IEC62109-2, NB-T32004/IEC62040-1, EN61000-1, EN61000-2, EN61000-3, EN61000-4, EN61000-4-16, EN61000-4-18, EN61000-4-29, AS/NZS 4777, VDE V 0124-100, V0126-1-1, VDE-AR-N 4105, CEI 0-21/CEI 0-16, EN50438/EN50549, G83/G59/G98/G99, UTE C15-712-1, UNE206 007-1					
Grid Support	LVRT, HVRT, active & reactive power control and power ramp rate control					

Annex 4 / Anhang 4

Technical data of the generating unit / Technische Daten der Erzeugungseinheit:

Three Phase Hybrid Inverter

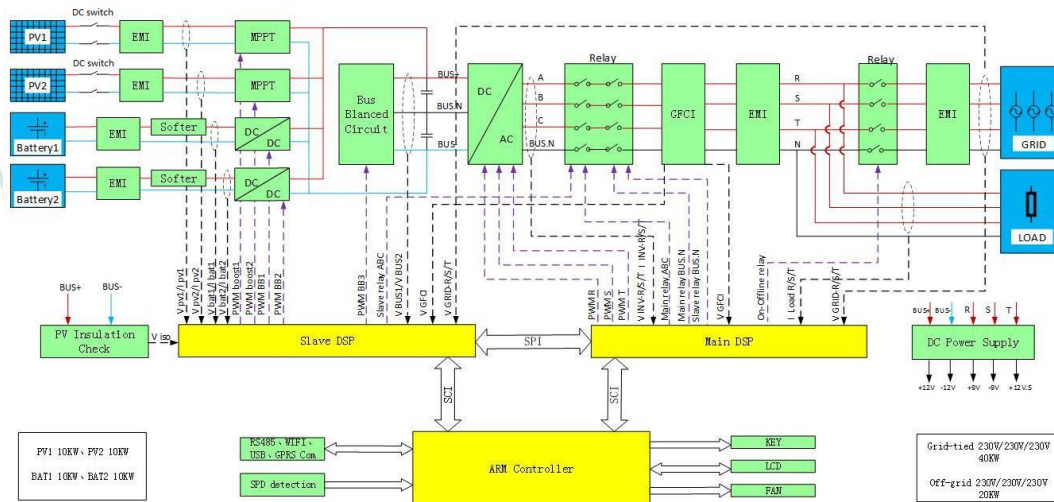


Figure 1

Selection for VDE-AR-N 4110

First start by downloading the safety parameters file (named after the corresponding safety country) on the website and copy the file to a USB flash drive. Then insert the USB flash drive into hybrid inverter HYD xxKTL-3PH. Enter menu "Safety Param." according to Figure 2 below.



Figure 2

Operational areas of MODEL HYD xxKTL-3PH

a) Limits during quasi-stationary operation

For VDE-AR-N 4110, in the entire frequency range from 47.5 Hz to 51.5 Hz and voltages in the range of 85% U_n to 115% U_n at the MODEL HYD xxKTL-3PH Hybrid inverter AC connection terminal, while voltage gradient $<5\% U_c / \text{min}$ and a frequency gradient of $<0.5\% f_n / \text{min}$, for quasi-stationary operation, MODEL HYD xxKTL-3PH Hybrid inverter is able to in parallel operation with grid according to the minimum duration time Figure 3 below.

When voltage changes at the inverter AC terminal in the amount of $\Delta U \leq 10\% U_c$ with voltage gradients of $\geq 5\% U_c / \text{min}$ within the voltage band from 90% U_c to 110% U_c occur, inverter has no reduction for active and reactive power and keep connected to the grid.

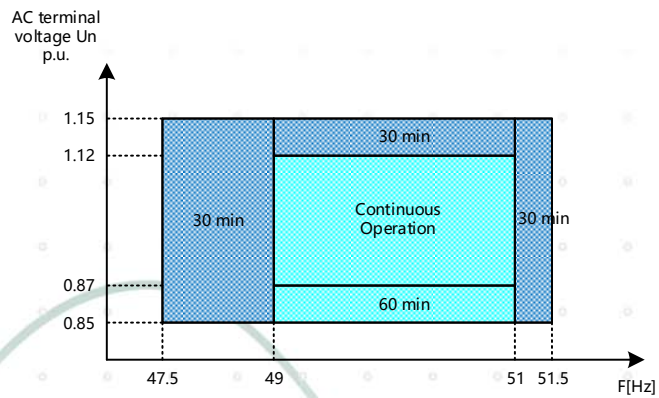


Figure 3 Quasi-stationary operation range for MODEL HYD xxKTL-3PH

b) Reactive power capability

For VDE-AR-N 4110, the reactive power capability of MODEL HYD xxKTL-3PH Hybrid inverter is according to Figure 4 below.

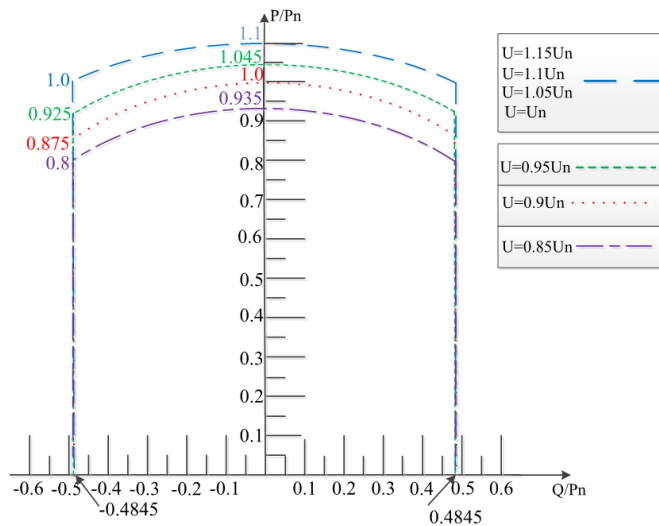


Figure 4 Voltage-dependent PQ diagram for MODEL HYD xxKTL-3PH

c) FRT-limit curve (U(t)-diagram)

For VDE-AR-N 4110, the FRT limit curve of MODEL HYD xxKTL-3PH PV inverter is according to Figure 5 below.

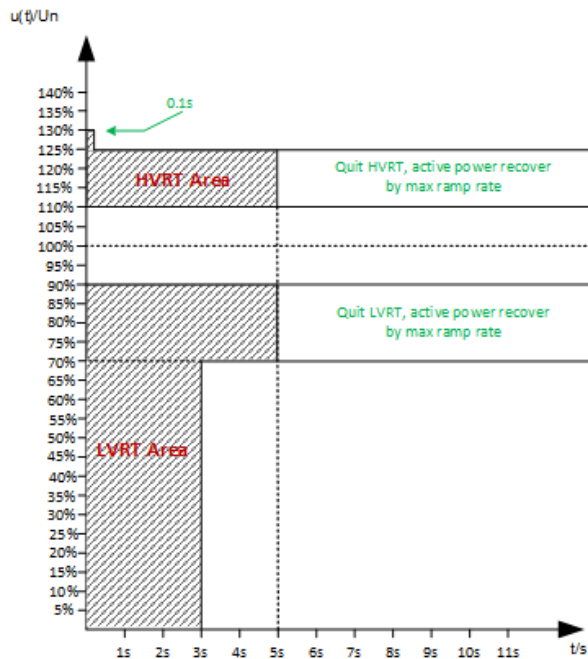


Figure 5 FRT limit curve for MODEL HYD xxKTL-3PH

Note: For the reason of limited dynamic grid support requirement, MODEL HYD xxKTL-3PH provide ZP (Zero Power) mode as well, when select this mode, MODEL HYD xxKTL-3PH will supply no active and reactive power during LVRT for the voltage drop $\leq 70\%U_n$, but for voltage range from $70\% \sim 90\%U_n$, even choose ZP mode, inverter will enter into normal LVRT period with reactive power supplied by K factor.

Protection functions:

a) Grid protection

The default grid protection of MODEL HYD xxKTL-3PH for VDE-AR-N 4110:2018 is according to Table 1 below:

Function	Protection value	Trip time
U>	Default: 287.5V Range: 50.0-6553.5V	Default: 0.10s Range: 0-600s
U>>	Default: 287.5V Range: 50.0-6553.5V	Default: 0.10s Range: 0-600s
U<	Default: 184.0V Range: 50.0-6553.5V	Default: 1.00 s Range: 0-600s
U<<	Default: 103.5V Range: 50.0-6553.5V	Default: 0.30s Range: 0-600s
f>>	Default: 52.5 Hz Range: 50.1-55.0Hz	Default: 0.10s Range: 0-600s
f>	Default: 51.5 Hz Range: 50.1-55.0Hz	Default: 5.00s Range: 0-600s
f<	Default: 47.5 Hz Range: 45.0-49.9Hz	Default: 0.10s Range: 0-600s

Table 1 MODEL HYD xxKTL-3PH default protection setting for VDE-AR-N 4110:2018

Function	Protection value	Trip time
Step for Voltage protection	0.1V	0.01s
Step for Frequency protection	0.01Hz	0.01s

Table 2 MODEL HYD xxKTL-3PH setting step for voltage/frequency protection

The protection functions is independence from other set point.

After the inverter trip for protection, when the voltage recovers to at least 82%Un and frequency is between 47.6~51.4Hz, MODEL HYD xxKTL-3PH has the setting of the delay time of recovery for VDE-AR-N 4110, the setting range is from 0 to 30 mins, default setting is 90s.

Notes: MODEL HYD xxKTL-3PH didn't provide testing terminal for protection test without disconnect the wires, such test terminal would be supplied at the system level on the LV side of MV transformer.

b) Intrinsic ("self") protection

For VDE-AR-N 4110, MODEL HYD xxKTL-3PH is integrated with intrinsic hardware protection only for over voltage, the protection is for hardware protection and is not settable. The protection default setting is 1.87Un for 150us

Active power control

a) Frequency control (P(f)-diagram)

For both VDE-AR-N 4110, P(f)-diagram is default according to the Figure 6 below.

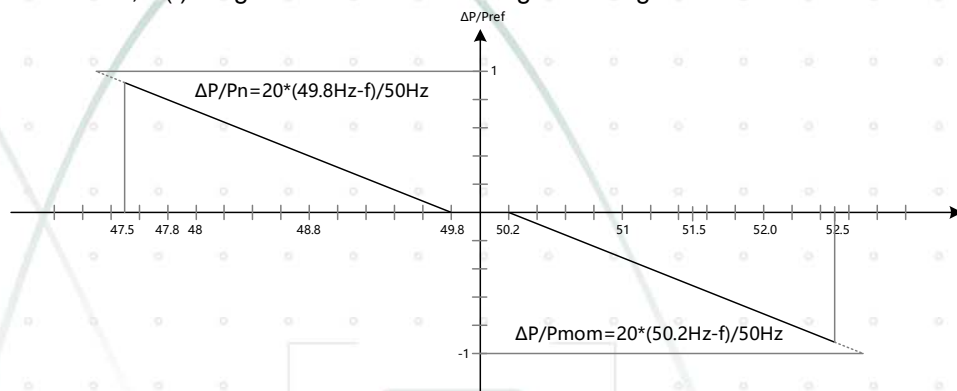


Figure 6 MODEL HYD xxKTL-3PH P(f)-diagram

Note: Here Pmom is the active power freeze at that moment when the frequency to 50.2Hz. Pn is normal 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%).

When doing for TR3 test, due to the requirement by FGW TR3, inverter take higher priority for active power rising during frequency drop from 49.8Hz to 47.5Hz temporary than dispatching command by grid operator set point only for test purpose, but the final inverter will take higher priority for dispatching command set point.

b) Related gradients, dynamics and functions

For VDE-AR-N 4110, the following active power control applied to MODEL HYD xxKTL-3PH.

Normal active power gradients: 0.33%Pn/s~0.66%Pn/s (default is 0.66%Pn/s) for stationary connection and reconnection after grid fault trip.

P(f)-diagram: When frequency returned to rated value (50Hz±0.2Hz) , for the first 10mins, the active power gradients is less than 10%Pn/min, after 10mins quit from abnormal frequency, the active power gradients will back to normal active power gradients: 0.33%Pn/s~0.66%Pn/s.

Dynamic functions: When MODEL HYD xxKTL-3PH enter into FTR, the active power reduced to zero to ensure reactive power, after the FTR end according to Figure 4 limit or 5s whichever is the earlier, the active power will recover by max ramp rate within 200ms

c) Set point

For VDE-AR-N 4110, the active power control set point applied to MODEL HYD xxKTL-3PH is according to Table 3 Overfrequency derating and Underfrequency increment.

Overfrequency Derating		
Function	Default Set Point	Set Range
Frequency-power response (Overfrequency derating)	ON	ON/OFF
Overfrequency Reload Enable	OFF	ON/OFF
Overfrequency Start (0.01Hz step)	50.20Hz	50.10-55.00Hz
Overfrequency Slope	40%Pn/Hz	17-100%Pn/Hz
Overfrequency Reload Start	50.20Hz	50.00-55.00Hz
Overfrequency Reload Delay	0.00s	0-655s
Overfrequency Reload Speed	9%Pn/min	1-6000%Pn/min
Underfrequency Increment		
Function	Default Set Point	Set Range
Frequency-power response (Underfrequency derating)	ON	ON/OFF
Underfrequency Reload Enable	OFF	ON/OFF
Underfrequency Start (0.01Hz step)	49.80Hz	45.00-49.98 Hz
Underfrequency Slope	40%Pn/Hz	17-100%Pn/Hz
Underfrequency Reload Start	50.20Hz	50.00-55.00Hz
Underfrequency Reload Delay	0.00s	0-655s
Underfrequency Reload Speed	9%/min	1-6000%/min

Table 3 Active power set point for MODEL HYD xxKTL-3PH

Reactive power control

a) Related gradients, dynamics and functions

For VDE-AR-N 4110, MODEL HYD xxKTL-3PH reactive power control is following according to Figure 7 below.

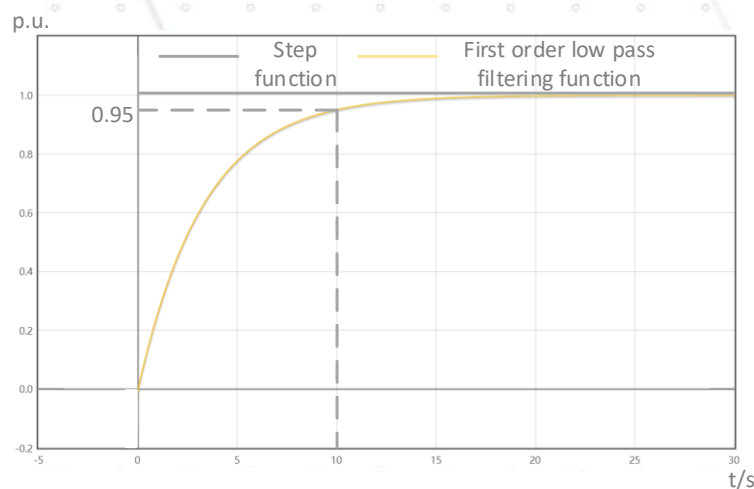


Figure 7 MODEL HYD xxKTL-3PH reactive power control feature

The reactive power is supplied by equation (1):

$$Q = Q_{set} * [1 - e^{-(t/3\tau)}] \quad (1)$$

Here the time constant 3Tau is settable as the time for 95% target value.

For VDE-AR-N 4110, the 3Tau setting range is from 1~60s, the default setting is 10s.

b) Set point

For VDE-AR-N 4110, the reactive power control set point applied to MODEL HYD xxKTL-3PH is according to Table 4.

Function	Default Set Point	Set Range
Reactive mode	OFF	Off/Mode1/2/3/4 ⁽¹⁾
Reactive response period	10	1~600s
Mode 1		
Power factor (0.0001)	1.00	-1 ~ -0.8, +0.8~ +1
Mode 2		
Fixed Reactive Percentage (0.01%)	0%	0~60%Pn
Mode 3		
Reactive Cos1 (0.0001)	1.00	-1 ~ -0.8, +0.8~ +1
Reactive dynamic value1	0	-100~100%Pn
Reactive Cos2 (0.0001)	1.00	-1 ~ -0.8, +0.8~ +1
Reactive dynamic value2	0	-100~100%Pn
Reactive Cos3 (0.0001)	1.00	-1 ~ -0.8, +0.8~ +1
Reactive dynamic value3	0	-100~100%Pn
Reactive Cos4 (0.0001)	1.00	-1 ~ -0.8, +0.8~ +1
Reactive dynamic value4	100	-100~100%Pn
Mode 4		
HighVoltStartValue	104	100~130%
HighVoltEndValue	106	100~130%
LowVoltStartValue	96	0~100%
LowVoltEndValue	94	0~100%
MaxLeadingReactivePower	33	0~60%
MaxLaggingReactivePower	33	0~60%
ReactiveResponseWaitTime	0	0~300s
ReactivePowerOffset	0	-100~100%Qmax

Table 4 Reactive power set point for MODEL HYD xxKTL-3PH

(1) Off The PF is limited to +1.000s and the “Q-Var limits” is limited to 0.0%.

Mode1: The reactive power can be regulated by the parameter PF (Power Factor).

Mode2: The reactive power can be regulated by the parameter Reactive power limit (in %).

Mode3: Q(P) The PF changes with the output power of the inverter.

Mode4: Q(U) The reactive power changes with the grid voltage.

Dynamic reactive current control

c) Basic functions

The reactive current supply during FRT is calculated by both positive sequence and negative sequence component. The additional reactive current ΔI_B of MODEL HYD xxKTL-3PH is proportional to the voltage deviation Δu ($\Delta I_B = k \cdot \Delta u$), where k is the amplification factor. It is defined by the straight line below in Figure 8.

The k factor is settable between 0 to 10 with the step of 0.1, the default MODEL HYD xxKTL-3PH k factor for VDE-AR-N 4110 is 2.

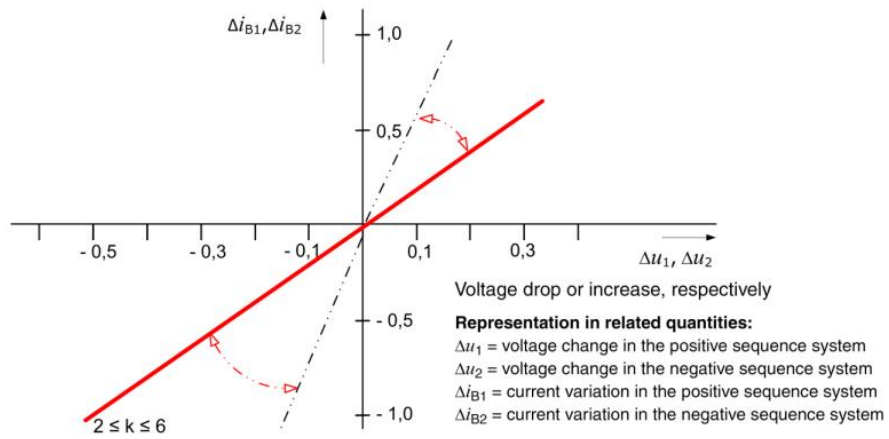


Figure 8 k factor of voltage support in the event of a network fault

0 1 2 3 4 5 6

