TEST REPORT
VDE-AR-N 4105
Power generation systems connected to the low-voltage distribution network

Report Reference No. .....:	210902250SHA-001
Tested by (name + signature) .....:	Billy Chen
Approved by (name + signature) .....:	Sleif Sui
Date of issue.....:	2021-09-29
Contents .....:	27 pages
Testing Laboratory .....:	Intertek Testing Services Shanghai.
Address.....:	Building No.86, 1198 Qinzhou Road (North), Shanghai 200233, China.
Testing location / procedure .....:	TL ☒ SMT ☐ TMP ☐
Testing location / address.....:	Same as above
Applicant's name .....:	Dongguan Kaideng Energy Technology Co., Ltd.
Address.....:	4 th floor, Fuyuan business building, no. 1, Lane 13, xin'an maiyuan Road, Chang 'an town, Dongguan City, Guangdong, China.
Test specification:	
Standard .....:	VDE-AR-N 4105:2018 conjunction with DIN VDE V 0124-100:2020
Test procedure.....:	Type Test
Non-standard test method.....:	N/A
Test Report Form/blank test report	
Test Report Form No. .....:	VDE_4105_TTRF_V1.0
TRF Originator .....:	Intertek Shanghai
Master TRF.....:	2020-06

Test item description .....:	Utility-Interactive Micro Inverter
Trade Mark .....:	KDWVC, CRAFTSTROM
Manufacturer.....:	Same as applicant
Model/Type reference.....:	WVC-350W, WVC-300W, Hedy
Rating……:	See below Specifications table

Specifications table			
Model	KDWVC-350W	KDWVC-300W	Hedy
Input:			
Vmax PV (Vdc)	60	60	100
Isc PV (absolute Max.) (A)	20	15	7
Number MPP trackers	1	1	1
Number input strings	1	1	1
Max. PV input current(A)	14	13.6	6
MPPT voltage range (Vdc)	25 to 60	25 to 60	60 to 100
Output			
Normal Voltage(V)	☒1/N/PE 230Vac ☐3 ϕ /N/PE 230/400Vac		
Frequency (Hz)	☒50 Hz ☐60Hz		
Current (Max. continuous) (A)	1.52	1.3	1.3
Power rating (W)	350	300	300
Power Rating (VA)	350	300	300
Power factor /rated	≥0.99	≥0.99	≥0.99
others			
Protective class	Class I		
Ingress protection (IP)	IP 65		
Temperature (°C)	-40°C to +50°C		
Inverter Isolation	☐Non-isolated ☒High frequency isolated		
Overvoltage category	OVC III (AC Main), OVC II (PV)		
Weight (kg)	0.82		
Dimensions (WxHxD) (mm)	165 x 176 x 38		

Test item particulars..... :	
PGU connect to Grid System	☒ 1/N/PE ☐ 3/PE ☐ 3/N/PE
PGS(kVA)	☐≤3.68 ☒ ≤13.8 ☐ >13.8
Default cos φ- reactive power adjusted	☒ a fixed displacement factor, cos φ=1 ☐ Standard characteristic curve for cos φ (*P*) ☐ non-Standard characteristic curve for cos φ (*P*)
Function of cos φ/Q- reactive power adjusted	☒ Not adjusted ☐ a fixed displacement factor cos φ. ☐ Characteristic curve for cos φ (*P*) ☐ Characteristic curve for Q(U) ☐ Dynamic network supporting (FVRT)
Function of active power adjusted	☒ Active power reduction ☐ Active power output by over-frequency ☐ Active power output by under-frequency ☐ $P_{AV,E}$ monitoring
NS protection	☒ Central NS protection ☐ Integrated NS protection
Voltage –Line to line	☐arithmetically from the three line-to-neutral voltages ☐measured separately ☒N/A
IP protection class .....:	IP65
Remark PGS: Power Generation System, PGU: Power Generation unit.	
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test case does not verify to the test object.....	N/E
- test object does meet the requirement .....:	P(Pass)
- test object does not meet the requirement .....:	F(Fail)
Testing.....:	
Date of receipt of test item.....:	2021-06-12
Date (s) of performance of tests.....:	2021-06-22 to 2021-08-17

General remarks:

The test results presented in this report relate only to the object (single PV inverter unit) tested. The testing voltage is 230Vac single phase. The information about Generating Plant is not considered and tested.

The inverter is high-frequency isolated and without a power relay at AC output. There is a controller in inverter but is not constructed redundantly protection.

NS protection don't consider in the report. NS protection should be considered after the installation.

Installer and relevant persons shall comply with VDE-AR-N4105 and relevant standard and Grid Code in this standard.

"(see Enclosure #)" refers to additional information appended to the report.

"(see appended table)" refers to a table appended to the report.

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

Determination of the test result includes consideration of measurement uncertainty from the test equipment and methods.

Determination of the test conclusion is based on IEC Guide 115 in consideration of measurement uncertainty.

The test results presented in this report relate only to the item tested. See general product information next for details information.

The test does not include the faults inside the CPU and software evaluation as agreed with client.

All the tests are performed on single unit.

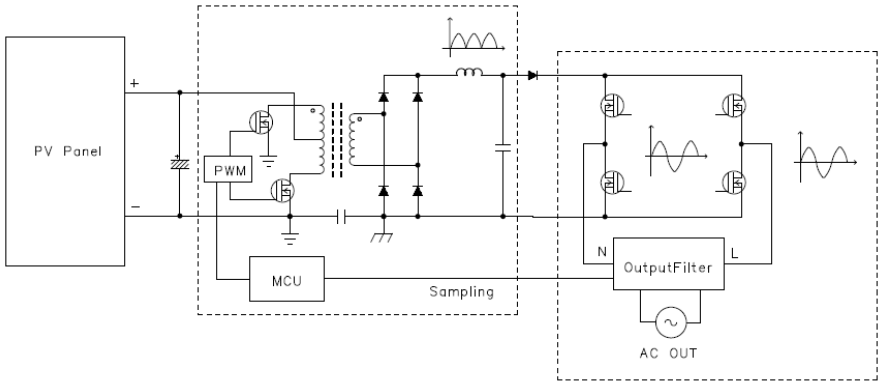
The clause number in first is about VDE-AR-N 4105 The clause number in bracket is about DIN V VDE V 0124-100

General product information:

The Solar converter converts DC power into AC power.

The unit is providing EMC filtering at the output toward mains. The unit provided galvanic insulation from input to output (high frequency transformer isolation).

Block diagram:



The inverter does not have adjustable power factor function.

The model KDWVC-300W is identical to model KDWVC-350W except the power de-rating by software; the model Hedy is identical to model KDWVC-300W except the input voltage range.

The testing performed on typical model KDWVC-350W, is valid for model KDWVC-300W and Hedy.

The software version used for the testing is:

300W and Hedy Firmware version: WVC300R3-55-100-433-c3

350W Firmware version: WVC350R3-55-100-433-c3

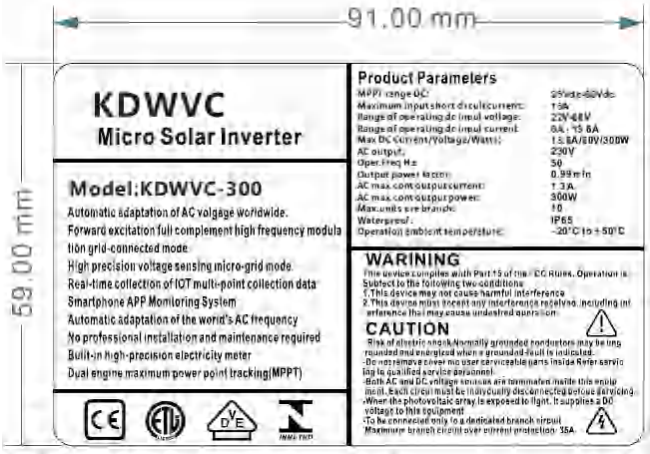
The PV inverter default setting is PGU≤3.68kVA and PGS ≤13.8kVA.

Abbreviations used in the report:

PGU: Power Generation unit. PGS: Power Generation System

In: Rated current of power generation unit.

Copy of marking plate:



VDE-AR-N 4105			
Clause	Requirement - Test	Result - Remark	Verdict
4	General framework conditions		--
4.1	Provisions and regulations	NA for PGU testing	N/A
4.2	Application procedure and connection relevant documents	NA for PGU testing	N/A
4.3	Initial start-up of the power generation system	NA for PGU testing	N/A
5	Network connection		--
5.1	Principles for determination of the network connection point	NA for PGU testing	N/A
5.2	Rating of the network equipment	NA for PGU testing	N/A
5.3	Permissible voltage change	NA for PGU testing	N/A
5.4	Network interactions		N/A
5.5	Connection criteria		--
5.5.1	General		P
	When connecting a power generation system or a storage unit, the technical connection conditions of the network operator shall be observed.	Shall be considered full feed-in that in accordance with VDE-AR-N 4100 in the power system	P
5.5.2	PAV, E monitoring (feed-in limitation)	The independent equipment shall be installed at end use.	N/E
5.5.3	Power generation systems ready for connection		N/A
5.6	Three-phase inverter systems	No Three-phase inverter system will be combined.	N/A
5.7	Behaviour of the power generation system at the network		P
5.7.1	General		P
	For frequencies between 47,5 Hz and 51,5 Hz, automatic disconnection from the network due to a frequency deviation is not permitted. The actual operating principle and the associated exceptions are detailed in 5.7.4.3. Frequency-dependent active power control is implemented in the open-loop control of the power generation units.		P
5.7.2	Steady-state voltage stability/reactive power supply	No such function, the independent equipment shall be installed at end use.	N/E
5.7.2.1	General boundary conditions		N/E
5.7.2.2	Reactive power supply at ΣSEmax		N/E
5.7.2.2.1	General		N/E

VDE-AR-N 4105			
Clause	Requirement - Test	Result - Remark	Verdict
	It is permissible in certain cases described in 5.7.2.2.2 and 5.7.3 to reduce the active power supply to the benefit of the reactive power supply. This is not considered a reduction of the active power supply in thecontext of network security management. Power generation systems shall comply with the reactive power supply irrespective of the number of feed-inphases under normal operating conditions in the voltage tolerance band Un ± 10 %.		N/E
5.7.2.2.2	Type 2 systems – inverters only		N/E
5.7.2.2.3	Type 2 systems – Asynchronous generators (directly connected to the network and principally not able to control any reactive power)	Inverter only	N/A
5.7.2.2.4	Type 1 systems and type 2 systems – stirling generators and fuel cells	Inverter only	N/A
5.7.2.3	Reactive power supply smaller than PEmax	No such function, the independent equipment shall be installed at end use.	N/E
5.7.2.4	Methods for reactive power supply	No such function, the independent equipment shall be installed at end use.	N/E
	a) reactive power voltage characteristic curve Q(U); or		N/E
	b) displacement factor/active power characteristic curve cos ϕ (P); or		N/E
	c) fixed displacement factor cos ϕ.		N/E
	The Q(U) rule applies only to three-phase power generation units connected to the three-phase current system.		N/E
5.7.2.5	Requirements for reactive power methods of type 2 systems (inverters only) and type 1 systems	No such function, the independent equipment shall be installed at end use.	N/E
	In the delivery state, none of the three reactive power methods specified in 5.7.2.4 is set as default. During the commissioning of power generation units, the method specified by the network operator shall be set by the system installer. Without the setting of the method specified by the network operator, power generation units shall not feed in any power.		N/E
5.7.2.6	Special aspects regarding the extension of power generation systems	No such function, the independent equipment shall be installed at end use.	N/E
5.7.3	Dynamic network stability	No such function, the independent equipment shall be installed at end use.	N/E
5.7.3.1	General		N/E

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Clause	Requirement - Test	Result - Remark	Verdict
5.7.3.2	Dynamic network stability for type 1 units Transient stability – Reaction to network faults		N/A
5.7.3.3	Dynamic network stability for type 2 units and storage units	No such function, the independent equipment shall be installed at end use.	N/E
	The following conditions apply to all type 2 power generation units and storage units: As long as the line-neutral-voltages at the generator terminals of the power generation unit or storage unit do not exceed the limit curves shown in Figure 12 (red for the under-voltage limit curve, blue for the over-voltage limit curve), both the power generation unit and the storage unit shall neither become unstable nor disconnect from the network throughout the operating range.		N/E
	For evaluating the curves, the smallest respective value of the line-neutral-voltages at the power generation unit or the storage unit shall be used in case of a voltage drop, and the highest respective value of the line-neutral- voltages at the power generation unit or the storage unit shall be used in case of a voltage rise. As far as the set values for the NS protection given in Table 2 (column “Inverter(s)”) anticipate the requirements given in Figure 12 in certain working points, merely the checking of the set values for NS protection is required for the verification procedure.		N/E
	If the voltage at the generator terminals falls below < 0,8 Un or exceeds > 1,15 Un (onset of fault), type 2 power generation units and storage units shall ride through voltage drops without feeding current into the network of the network operator (limited dynamic network stability).		N/E
	This requirement is deemed to be met, if the current fed in by the power generation unit(s) and/or the storage unit in any line conductor does not exceed 20 % of the rated current Ir within 60 ms and 10 % of Ir within 100 ms upon a voltage drop below 0,8 Un or a voltage rise above 1,15 Un.		N/E
	Behaviour after the end of a fault If, after the end of a fault, the network voltage resumes a value within the voltage band from –15 % Un to +10 % Un and the active current of the power generation unit and/or the storage unit has been reduced during the network fault, it shall, immediately after the end of the fault, be increased to its pre-fault value as quickly as possible. The transient period shall not exceed a maximum of 1 s. The reactive power supply follows 5.7.2.5 in its time-related behaviour. In case of rotating machinery, the transient period shall not exceed a maximum of 6 s. At voltages of 1,15 Un, the power generation units and storage units shall not disconnect from the network for a period of up to 60 s after the onset of the fault. If the tripping of the self-protection of the power generation units and/or the storage unit is imminent, these units can adjust their reactive power behaviour such as to prevent self-protection tripping.		N/E

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Clause	Requirement - Test	Result - Remark	Verdict
5.7.4	Active power output		P
5.7.4.1	General		P
	In cases where set-points are specified by a third party (e. g. direct marketing) and of network security management in accordance with 5.7.4.2, the new set-point shall be approached with the customer installation's power gradients listed below in relation to the network connection point. Implementation of those power gradients directly at the power generation units or storage units is sufficient for meeting the requirement.	The active power can be remote-controlled on the communication interface	P
5.7.4.2	Network security management		P
5.7.4.2.1	Types of power generation systems and storage units	The active power can be remote-controlled on the communication interface	P
	Photovoltaic systems	PGS≤ 30kW	P
	Cogeneration of power and heat (CHP) systems, wind, biogas, hydroelectric power as well as landfill and sewage gas systems		N/A
	Storage units buffering EEG or KWKG systems		N/A
	Any EEG and KWKG systems with an intelligent measurement system		N/A
	Any power generation systems and storage units other than those indicated above		N/A
5.7.4.2.2	Implementation of network security management	No such function, the independent equipment shall be installed at end use.	N/E
5.7.4.2.3	Active power adjustment at over-frequency and under-frequency	No such function, the independent equipment shall be installed at end use.	N/E
5.7.4.4	Voltage-dependent active power reduction	No such function, the independent equipment shall be installed at end use.	N/E

VDE-AR-N 4105			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.5	Short-circuit contribution Due to the operation of a power generation system, the short-circuit current of the low-voltage network is increased by the short-circuit current of the power generation system. Therefore, the short-circuit current of the power generation system to be expected at the network connection point shall be indicated in accordance with 4.2. For the determination of the initial short-circuit AC current contribution IkA of a power generation system, the following roughly estimated values can be assumed: – for synchronous generators: 8 times the rated current; – for asynchronous generators: 6 times the rated current; – for generators and storage units with inverters: the rated current. If the power generation system causes a short-circuit current increase in the network operator's network in excess of the rated value, then connection owner and network operator shall agree upon appropriate measures limiting the short-circuit current from the power generation system accordingly.		P
6	Construction of the power generation system/network and system protection (NS protection)		--
6.1	General requirements		N/A
	The network and system protection (NS protection) is a type-tested protective device with a NS protection certificate (see Form E.6) wherein all protective functions specified in 6.5 are installed. The NS protection acts on the interface switch in accordance with 6.4. Depending on the sum of the maximum apparent powers of all power generation systems and storage units connected to the same network connection pointΣSAmax , the following conditions apply to the NS protection:	Central NS protection shall be used	P
6.2	Central NS protection		P
6.3	Integrated NS protection	Not integrated NS protection	N/A
6.4	Interface switch		N/A
6.4.1	General		N/A
	For the connection of the power generation system to the network operator's low-voltage network or to the remaining customer installation, an interface switch shall be used. The interface switch is controlled by the NS protection and automatically triggers if at least one protective function responds.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	The functional check of the interface switch shall be carried out according to a) or b) or c): a) by using an interface switch which, in its active state, requires a control voltage to be applied continuously and which disconnects automatically when this voltage is no longer applied. The operational connection and disconnection processes shall be monitored; b) by connection and disconnection of the interface switch via the NS protection and monitoring its proper functioning (e. g. break contact of a monitoring contact) at least once daily; c) by using the integrated interface switch and the integrated NS protection for PV and battery inverters in compliance		N/A
6.4.2	Central interface switch	shall be inspected at the end use.	N/E
6.4.3	Integrated interface switch		N/A
	In the case of integrated NS protection, the NS protection can be integrated in the programmable system control of the power generation units (e.g. in the inverter control). If so, then both the test button and the sealing may be omitted, however, password protection is required, if the protective function U > is adjustable. The integrated NS protection acts on an integrated interface switch (see 6.4.3).		N/A
6.5	Protective devices and protection settings	Central NS protection used.	N/A
6.5.1	General		N/A
	The purpose of NS protection is to disconnect the power generation system from the network in the event of inadmissible voltage and frequency values (also refer to DIN VDE 0100-551 (VDE 0100-551)). This is meant to prevent inadvertent feed-in from the power generation system into a partial network separated from the main distribution network.		N/A
6.5.2	Protective functions		N/A
	The NS protection shall be provided with a means for preventing unauthorised access (z. B. sealable, password protection). The rise-in-voltage protection U > shall be designed such as to be adjustable in the NS protection (see Table 2, Footnote b). Additionally, the time delay of the voltage drop protection U < and U << for directly coupled synchronous and asynchronous generators with Pn > 50 kW shall also be designed such as to be adjustable in the NS protection (see Table 2, Footnote d). Any other protective functions listed in 6.5.1 are either to be installed permanently, i. e. not adjustable, in the NS protection or to be provided with an additional separate protection against unauthorised access (e. g. password protection) for preventing modifications.		N/A
6.5.3	Islanding detection	(See appended table)	P
6.6	Further requirements for power generation systems	Shall be considered in PGS	NA

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Clause	Requirement - Test	Result - Remark	Verdict
7	Metering for billing purposes		NA
8	Operation of the system		P
8.1	General		P
8.2	Special aspects of the management of the network operator's network		NA
8.3	Connection conditions and synchronisation		P
8.3.1	General		P
	Power generation systems and storage units shall be connected to the network operator's network only if a suitable device determines that both the mains voltage and the mains frequency are within the tolerance range of 85 % *U*n to 110 % *U*n or 47,5 Hz to 50,1 Hz, respectively, for a period of at least 60 seconds. Additionally, the delay times for the reconnection of a generator and the staggered times applicable when connecting several generators shall be sufficient for safely finishing any control and adjustment processes within the power generation system and/or the storage unit caused by the connection. In case of power generation systems and storage units being reconnected to the network operator's network at the tripping of the NS protective device or the *P*AV, E monitoring, the active power of controllable power generation systems and storage units supplied to the network operator's network shall not exceed the gradient of 10 % of the active power *P*Amax per minute. Non-controllable power generation systems and storage units can connect after 1 min to 10 min (random generator) or later.	(See appended table)	P
8.3.2	Connection of synchronous generators		N/A
8.3.3	Connection of asynchronous generators		N/A
8.3.4	Connection of power generation units and storage units with inverters Power generation units with inverters (such as photovoltaic systems) and storage units with inverters shall only be connected with kimax ≤ 1,2.		P
8.4	Special aspects regarding the planning, installation and operation of power generation systems and storage units each with PAmax ≥ 135 kW		NA
9	Verification of electrical properties		P
	Annex A: Explanations (informative)		---
	Annex B: Connection examples and measurement strategies (informative)		---
	Annex C: Examples of meter panel configurations (informative)		---
	Annex D: Examples for the connection evaluation of power generation systems -Connection of a 20 kW PV system (informative)		---

DIN VDE V 0124-100			
Clause	Requirement - Test	Result - Remark	Verdict
5.2.2	Rapid voltage change (Kimax)		P
5.2.3	Flicker		P
5.2.4	Harmonics and Inter-harmonics (I inter, I higher)		P
5.2.5	Commutation notches		N/A
5.2.6	DC current feeding to network (Idc)		P
5.3.2	Tests of three-phase inverter (Imbalance)		N/A
5.3.3	Symmetry operation with a symmetry device		N/E
5.4.2	Measurement of active- and reactive power ranges (P&Q range)		N/E
5.4.3	Active power reduction through setting provision (P control)		P
5.4.4	Active power output of PGU by over-frequency (LFSM-O)		N/E
5.4.5	Active power output of ESS by over-frequency (LFSM-O)		N/A
5.4.6	Active power output of PGU by under-frequency (LFSM-U)		N/E
5.4.7	Active power output of ESS by under-frequency (LFSM-U)		N/A
5.4.8.2	Tests of reactive power / displacement factor setting accuracy (Fixed cosφ)		N/E
5.4.8.3	Tests of displacement factor- / active power character curve (cosφ(P))		N/E
5.4.8.4	Tests of reactive power-voltage character curve (Q(U))		N/E
5.5.2	NS-protection		N/E
5.5.3	Central NS-protecton		N/E
5.5.4	Integrated NS-protection		N/E
5.5.6	Interface switch (Functional safety)		N/E
5.5.7	Protection devices and protection settings (OV/UV, OF/UF)		N/E
5.5.9	Constructional features of NS protection		N/E
5.5.10	Islanding detection		P
5.6	Connection conditions and synchronization (Reconnection)		P
5.7	Verification of $P_{AV,E}$ monitoring		N/E
5.8	Verification of dynamic network supporting (FVRT)		N/E

Appendix table1

8.3.4 (5.2.2)	TABLE: Rapid voltage change (Kimax)			P
Test Conditions	Measurements			Limit
	U/Un	I/In	Ki	Ki
Starting to 50%Pn	1.00	0.52	0.52	≤ 1.2
Starting to 100% Pn	1.00	1.02	1.02	≤ 1.2
Stopping at 100% Pn	1.00	1.01	1.01	≤ 1.2
Note(s):				

(5.2.3)	TABLE: Flicker			P
Measurement	Plt	0.26		
	Limit	0.65		
	Pst	dc[%]	dmax[%]	d(t)[ms]
	1.0	3.3	4.0	500
1	0.42	1.06	1.12	0
2	0.27	1.02	1.06	0
3	0.22	0.56	0.58	0
4	0.22	0.51	0.58	0
5	0.22	0.52	0.56	0
6	0.22	0.55	0.57	0
7	0.22	0.59	0.61	0
8	0.22	0.56	0.58	0
9	0.22	0.55	0.61	0
10	0.22	0.57	0.62	0
11	0.22	0.53	0.59	0
12	0.22	0.57	0.62	0
Note(s): PGU and ESS with nominal current ≤75A (Per DIN EN 61000-3-3)				

(5.2.4)	TABLE: Harmonics											P
Harmonics												
P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100	Limit
Order No.	I/In [%]											
2	0.00	0.08	0.25	0.47	0.38	0.28	0.20	0.21	0.17	0.23	0.34	--
3	0.01	0.08	0.09	0.09	0.08	0.09	0.17	0.11	0.19	0.20	0.21	--
4	0.00	0.10	0.09	0.03	0.03	0.05	0.14	0.17	0.15	0.16	0.15	--
5	0.01	0.43	0.68	0.84	0.83	0.89	0.90	0.89	0.92	0.99	1.06	--
6	0.00	0.02	0.11	0.08	0.09	0.09	0.11	0.14	0.17	0.20	0.21	--
7	0.00	0.09	0.10	0.24	0.27	0.26	0.28	0.27	0.31	0.38	0.46	--
8	0.00	0.02	0.05	0.03	0.05	0.07	0.07	0.09	0.08	0.07	0.04	--
9	0.00	0.01	0.08	0.06	0.07	0.09	0.09	0.08	0.09	0.10	0.10	--
10	0.00	0.04	0.04	0.05	0.04	0.02	0.09	0.10	0.04	0.04	0.10	--
11	0.00	0.02	0.05	0.06	0.12	0.13	0.14	0.12	0.14	0.15	0.17	--
12	0.00	0.01	0.02	0.02	0.03	0.04	0.03	0.02	0.02	0.02	0.02	--
13	0.00	0.01	0.02	0.01	0.04	0.05	0.06	0.06	0.08	0.10	0.11	--
14	0.00	0.04	0.10	0.12	0.09	0.04	0.06	0.09	0.06	0.06	0.07	--
15	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	--
16	0.00	0.03	0.07	0.07	0.06	0.04	0.02	0.04	0.04	0.04	0.05	--
17	0.00	0.01	0.05	0.02	0.06	0.08	0.06	0.03	0.03	0.05	0.05	--
18	0.00	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	--
19	0.00	0.01	0.03	0.02	0.04	0.05	0.04	0.02	0.01	0.02	0.02	--
20	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.04	0.02	0.02	0.04	--
21	0.00	0.01	0.02	0.01	0.01	0.02	0.03	0.02	0.02	0.02	0.02	--
22	0.00	0.02	0.04	0.03	0.03	0.07	0.12	0.13	0.08	0.05	0.02	--
23	0.00	0.01	0.05	0.02	0.03	0.06	0.08	0.06	0.04	0.05	0.04	--
24	0.00	0.01	0.03	0.02	0.02	0.03	0.02	0.02	0.01	0.01	0.01	--
25	0.00	0.01	0.05	0.01	0.02	0.04	0.04	0.03	0.05	0.06	0.05	--
26	0.00	0.03	0.22	0.24	0.20	0.18	0.16	0.11	0.04	0.04	0.13	--
27	0.00	0.01	0.02	0.02	0.03	0.04	0.04	0.02	0.01	0.02	0.02	--
28	0.01	0.04	0.16	0.16	0.16	0.15	0.15	0.09	0.04	0.03	0.09	--
29	0.00	0.01	0.09	0.06	0.03	0.10	0.13	0.11	0.07	0.08	0.08	--
30	0.01	0.01	0.06	0.05	0.05	0.06	0.04	0.03	0.02	0.03	0.05	--
31	0.00	0.01	0.09	0.07	0.04	0.08	0.12	0.08	0.08	0.08	0.05	--
32	0.00	0.05	0.34	0.25	0.20	0.09	0.08	0.16	0.20	0.24	0.33	--
33	0.00	0.01	0.02	0.02	0.02	0.01	0.03	0.04	0.04	0.04	0.03	--
34	0.00	0.08	0.32	0.27	0.22	0.15	0.08	0.06	0.09	0.14	0.21	--
35	0.00	0.02	0.06	0.05	0.03	0.01	0.02	0.04	0.04	0.03	0.01	--
36	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	--
37	0.00	0.03	0.05	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.01	--
38	0.00	0.18	0.10	0.11	0.10	0.14	0.17	0.18	0.18	0.19	0.20	--
39	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	--
40	0.00	0.08	0.05	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09	--

(5.2.4)	TABLE: Harmonic current limit test (EN 61000-3-2)						P
Model							
Harmonic	L1		--		--		Limits -A
	Magnitude (A)	% of I	Magnitude (A)	% of I	Magnitude (A)	% of I	
02	0.00	--	--	--	--	--	1.08
03	0.00	--	--	--	--	--	2.30
04	0.00	--	--	--	--	--	0.43
05	0.02	--	--	--	--	--	1.14
06	0.00	--	--	--	--	--	0.30
07	0.01	--	--	--	--	--	0.77
08	0.00	--	--	--	--	--	0.23
09	0.00	--	--	--	--	--	0.40
10	0.00	--	--	--	--	--	0.18
11	0.00	--	--	--	--	--	0.33
12	0.00	--	--	--	--	--	0.15
13	0.00	--	--	--	--	--	0.21
14	0.00	--	--	--	--	--	0.13
15	0.00	--	--	--	--	--	0.15
16	0.00	--	--	--	--	--	0.12
17	0.00	--	--	--	--	--	0.13
18	0.00	--	--	--	--	--	0.10
19	0.00	--	--	--	--	--	0.12
20	0.00	--	--	--	--	--	0.09
21	0.00	--	--	--	--	--	0.11
22	0.00	--	--	--	--	--	0.08
23	0.00	--	--	--	--	--	0.10
24	0.00	--	--	--	--	--	0.08
25	0.00	--	--	--	--	--	0.09
26	0.00	--	--	--	--	--	0.07
27	0.00	--	--	--	--	--	0.08
28	0.00	--	--	--	--	--	0.07
29	0.00	--	--	--	--	--	0.08
30	0.00	--	--	--	--	--	0.06
31	0.00	--	--	--	--	--	0.07
32	0.00	--	--	--	--	--	0.06
33	0.00	--	--	--	--	--	0.07
34	0.00	--	--	--	--	--	0.05
35	0.00	--	--	--	--	--	0.06
36	0.00	--	--	--	--	--	0.05
37	0.00	--	--	--	--	--	0.06
38	0.00	--	--	--	--	--	0.05
39	0.00	--	--	--	--	--	0.06
40	0.00	--	--	--	--	--	0.05
THD	--	1.37	--	--	--	--	--

(5.2.6)	TABLE: Direct current injection						P
Power P/Pn [%]	Measured DC output current						Limit [%]
	L1 [A]	L1 [%]	L2 [A]	L2 [%]	L3 [A]	L3 [%]	
100%	0.007	0.46	--	--	--	--	0.5%
66%	0.007	0.46	--	--	--	--	0.5%
33%	0.006	0.39	--	--	--	--	0.5%
Supplementary information: Main voltage 230V							

5.4.3	TABLE: Active power reduction through setting provision (P control)		P
Test Conditions	Measurements		Limit
P/Pn [%]	P/P_{Emax} [%]	$\Delta P/P_{Emax}$ [%]	Δ P/Pn [%]
100	97.29	2.71	≤ 5%
90	89.55	0.45	
80	79.35	0.65	
70	69.48	0.52	
60	60.21	0.21	
50	50.19	0.19	
40	39.90	0.10	
30	30.01	0.01	
20	19.75	0.25	
10	10.20	0.20	
No disconnection occurs			Y/N

5.4.3	TABLE: Active power reduction through setting provision (P control)	N/E
Test Conditions	Measurements	Limit
P/Pn [%]	ΔP/Δt [%Pn/s]	ΔP/Δt [%Pn/s]
100->5		0.33-0.66
5->100		

5.4.3	TABLE: Active power reduction through setting provision (P control)	P
Test Conditions	Measurements	Limit
P/Pn [%]	$T_{response}$ [s]	$T_{response}$ [s]
100->0	1.5	≤ 5
Note(s):		

6.5.2(5.5.7)	TABLE: Protection devices and protection settings (OV/UV)					P
Condition	Setting U/Un [%]	Measurement				Limitation ΔU/Un [%]
		Trip value [V]				
		L123	L1	L2	L3	
U>>	125	--	288	--	--	≤±1.0
U<	80	--	184	--	--	
U<<	45	--	103	--	--	
Condition	Setting U/Un [%]	Measurement				Limitation ΔU/Un [%]
		Trip value [V]				
		L123	L1-L2	L2-L3	L3-L1	
U>>	125	--	--	--	--	≤±1.0
U<	80	--	--	--	--	
U<<	45	--	--	--	--	
Condition	Setting [ms]	Measurement				Limitation [ms]
		Trip time [ms]				
		L123	L1	L2	L3	
U>>	100	--	135	--	--	≤200
U<	3000	--	3010	--	--	3000-3100
U<<	300	--	305	--	--	300-400
Condition	Setting	Measurement				Limitation [ms]
		Trip time [ms]				
		L123	L1-L2	L2-L3	L3-L1	
U>>	100	--	--	--	--	≤200
U<	3000	--	--	--	--	3000-3100
U<<	300	--	--	--	--	300-400
Condition	Setting [s]	Measurement				Limitation [s]
		Trip time [s]				
		L123	L1	L2	L3	
U> 230->257.6	500	--	523	--	--	450-550
U> 230->248.4	No disconnect	--	No disconnect	--	--	No disconnect
U> 244->262.2	300	--	322	--	--	225-375
Note(s): Tests on L-L voltages are applicable to product over 30kVA.						

6.5.2(5.5.7)	TABLE: Protection devices and protection settings (OF/UF)		P
Condition	Setting f [Hz]	Measurement Trip value [Hz]	Limitation Δf/fn [%]
f>	51.5	51.5	≤±0.5
f<	47.5	47.5	
Condition	Setting [ms]	Measurement Trip time [ms]	Limitation [ms]
f>	100	101	≤200
f<	100	60	≤200
Note(s):			

6.5.3 (5.5.10)	TABLE: Islanding detection (per IEC 62116: 2014)					P
Power 100%						
Conditions	P_R [W]	Q_L [Var]	Q_C [Var]	Q_f	Trip time [ms]	Limitation [ms]
P_R: -10% Q_C: +10%	L1: 336	L1: 360	L1: 400	1.130	920	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -10% Q_C: +5%	L1: 335	L1: 359	L1: 393	1.123	882	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -10% Q_C: 0%	L1: 335	L1: 359	L1: 375	1.098	2400	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -10% Q_C: -5%	L1: 335	L1: 360	L1: 359	1.074	922	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -10% Q_C: -10%	L1: 335	L1: 359	L1: 341	1.046	542	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -5% Q_C: +10%	L1: 353	L1: 359	L1: 400	1.075	1300	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -5% Q_C: -10%	L1: 351	L1: 359	L1: 341	0.996	542	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +10%	L1: 368	L1: 359	L1: 393	1.020	2860	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -5% Q_C: +5%	L1: 351	L1: 359	L1: 393	1.069	1022	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -5% Q_C: 0%	L1: 351	L1: 359	L1: 375	1.048	3420	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: -5% Q_C: -5%	L1: 351	L1: 359	L1: 359	1.022	1880	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +5%	L1: 369	L1: 359	L1: 393	1.019	3360	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: 0%	L1: 368	L1: 360	L1: 375	0.998	4660	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: -5%	L1: 368	L1: 359	L1: 358	0.973	4200	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		

P_R: +5% Q_C: +5%	L1: 385	L1: 359	L1: 393	0.975	1600	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +5% Q_C: 0%	L1: 389	L1: 359	L1: 375	0.945	1000	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +5% Q_C: -5%	L1: 385	L1: 359	L1: 359	0.932	1380	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: -10%	L1: 369	L1: 359	L1: 341	0.950	2080	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +5% Q_C: +10%	L1: 386	L1: 359	L1: 400	0.982	902	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +5% Q_C: -10%	L1: 385	L1: 359	L1: 341	0.909	1660	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +10% Q_C: +10%	L1: 403	L1: 359	L1: 400	0.940	862	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +10% Q_C: +5%	L1: 402	L1: 359	L1: 393	0.935	1760	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +10% Q_C: 0%	L1: 402	L1: 359	L1: 375	0.914	2300	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +10% Q_C: -5%	L1: 402	L1: 359	L1: 359	0.893	946	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: +10% Q_C: -10%	L1: 402	L1: 359	L1: 341	0.870	500	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
Power 66%						
Conditions	P_R [W]	Q_L [Var]	Q_C [Var]	Q_f	Trip time [ms]	Limitation [ms]
P_R: 0% Q_C: -5%	L1: 233	L1: 231	L1: 224	0.977	800	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: -4%	L1: 233	L1: 231	L1: 226	0.982	860	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: -3%	L1: 233	L1: 231	L1: 227	0.983	1120	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: -2%	L1: 233	L1: 231	L1: 229	0.987	740	
	L2: --	L2: --	L2: --	--		9000

	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: -1%	L1: 233	L1: 231	L1: 232	0.994	900	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: 0%	L1: 233	L1: 231	L1: 234	0.999	1160	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +1%	L1: 233	L1: 231	L1: 236	1.003	740	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +2%	L1: 233	L1: 231	L1: 236	1.002	660	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +3%	L1: 233	L1: 231	L1: 238	1.006	640	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +4%	L1: 233	L1: 231	L1: 240	1.012	560	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +5%	L1: 233	L1: 231	L1: 242	1.016	540	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
Power 33%						
Conditions	P_R [W]	Q_L [Var]	Q_C [Var]	Q_f	Trip time [ms]	Limitation [ms]
P_R: 0% Q_c: -5%	L1: 121	L1: 118	L1: 116	0.967	500	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_c: -4%	L1: 121	L1: 118	L1: 118	0.975	720	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_c: -3%	L1: 121	L1: 118	L1: 119	0.979	1580	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_c: -2%	L1: 121	L1: 118	L1: 122	0.989	2420	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_c: -1%	L1: 121	L1: 118	L1: 123	0.995	2662	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_c: 0%	L1: 121	L1: 118	L1: 124	0.999	4140	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_c: +1%	L1: 121	L1: 118	L1: 125	1.003	2800	
	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0%	L1: 121	L1: 118	L1: 127	1.008	1800	

Q_C: +2%	L2: --	L2: --	L2: --	--		9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +3%	L1: 121	L1: 118	L1: 128	1.012		
	L2: --	L2: --	L2: --	--	2080	9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +4%	L1: 121	L1: 118	L1: 129	1.016		
	L2: --	L2: --	L2: --	--	800	9000
	L3: --	L3: --	L3: --	--		
P_R: 0% Q_C: +5%	L1: 121	L1: 118	L1: 130	1.017		
	L2: --	L2: --	L2: --	--	640	9000
	L3: --	L3: --	L3: --	--		

8.3(5.6)	TABLE: Connection conditions and synchronization (Reconnection)			P
Condition	Measurement		Limitation	
	Reconnection	Delay time [s]	Reconnection	Delay time [s]
f<47.45Hz	No	--	No	≥60
f≥47.55Hz	Yes	108.5	Yes	≥60
f>50.15Hz	No	--	No	≥60
f≤50.05Hz	Yes	111.3	Yes	≥60
U<0.84Un	No	--	No	≥60
U≥0.86Un	Yes	111.3	Yes	≥60
U>1.11Un	No	--	No	≥60
U≤1.09Un	Yes	111.3	Yes	≥60
Note(s):				

Appendix table 2 -Photos of the product

Overview

Overview -


Internal view-