TEST REPORT

Applicant	:	Shenzhen Longsheng Energy Technology Co., Ltd
Address	:	1410, Huiyi Building, No. 9 Zhongxin Road, Taoyuan Community, Dalang.Street, Longhua District, Shenzhen, Guangdong, 518109, China
Manufacturer	:	Shenzhen Longsheng Energy Technology Co., Ltd
Address	:	1410, Huiyi Building, No. 9 Zhongxin Road, Taoyuan Community, Dalang.Street, Longhua District, Shenzhen, Guangdong, 518109, China
Product Name	:	PV Microinverter
Trade Mark	:	LIONSHEE
Model No.	:	LS-800
Ratings	:	See the copy of marking plate on page 6
Standard	:	VDE-AR-N 4105:2018 (Test Requirement: DIN VDE V 0124-100:2020) Generators connected to the low-voltage distribution network -Technical requirements for the connection to and parallel operation with low-voltage distribution networks
Date of Receiver	:	July 01, 2023
Date of Test	:	July 01, 2023 to August 10, 2023
Date of Issue	:	November 14, 2023
Test Report Form No	:	NTCS-EN 50549-1-E
Test Result	:	Pass*

This Test Report is Issued Under the Authority of :

Compiled by	Approved by
Smile Tian	Jason
Smile Tian / Engineer	Jason Tong / Manager

*Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of Shenzhen Nore Testing Center Co., Ltd. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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Revision History of This Test Report

Report Number	Description	Issued Date
SZNTC23111006SV00	Initial Issue	2023-11-14
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Summary of testing:

The product has been tested according to standard listed below:

☒ VDE-AR-N 4105:2018 (Test Requirement: DIN VDE V 0124-100:2020)

☐ Others

General remarks:

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

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

The tests results presented in this report relate only to the object tested.

This report shall not be reproduced except in full without the written approval of the testing laboratory.

List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attachments to this report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Test item particulars..... :	
Equipment mobility..... :	☐ movable ☐ hand-held ☐ stationary ☒ fixed ☐ transportable ☐ for building-in
Connection to the mains..... :	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
Enviromental category..... :	☒ outdoor ☐ indoor unconditional ☐ indoor conditional
Over voltage category Mains..... :	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
Over voltage category PV..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%)..... :	±10 %
Tested for power systems..... :	TN system
IT testing, phase-phase voltage (V)..... :	N/A
Class of equipment..... :	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg)..... :	1.8kg
Pollution degree..... :	PD2
Operation ambient temperature..... :	65℃
IP protection class..... :	IP67
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A (Not Applicable)
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)

General product information:

1. The unit is isolated (transformerless) Hybrid Solar Inverter with UPS function, and the storage battery can be charged by PV or Mains. It intends to be connected into LV Distribution Utility. The unit is defined as type A generator according to Regulation (EU) 2016/631 (NC RfG).

2. In order to protect the system, user and installer, external DC/AC circuit breaker shall be equipped, for PV input/Utility Output port at the end-use application.

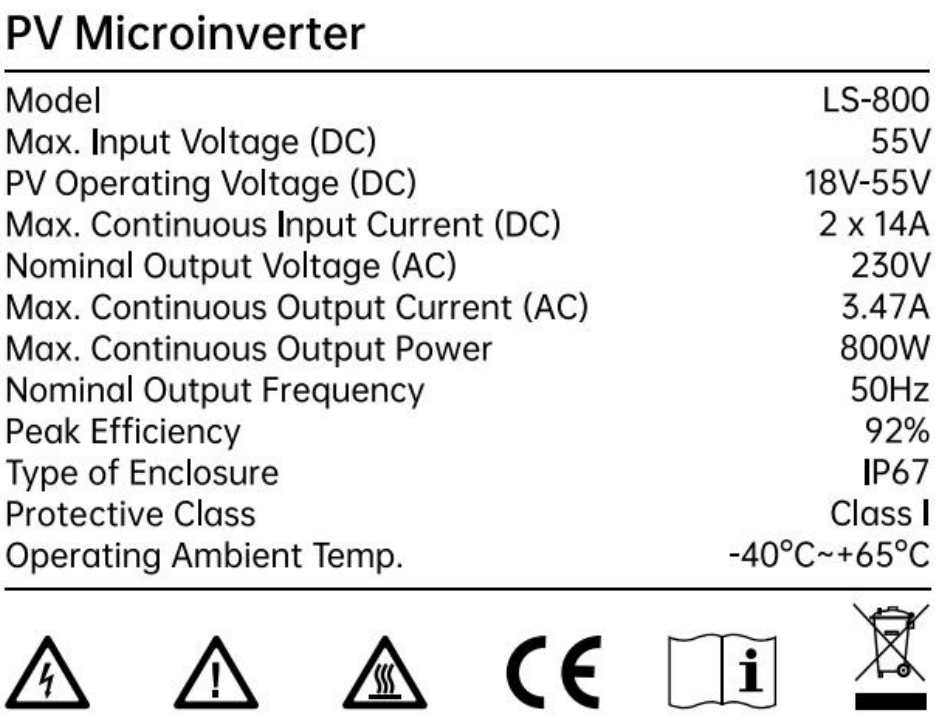
3. Low voltage electrical installations shall comply with national and local regulation. Only qualified electricians are allowed to install and maintain the system.

4. Version Number: Software versioning: KS-01 Hardware version number : 0900302

Remark: This report updates the applicant, manufacturer, product name, model, and nameplate based on SZNTC23061025SV01.

Copy of marking plate:

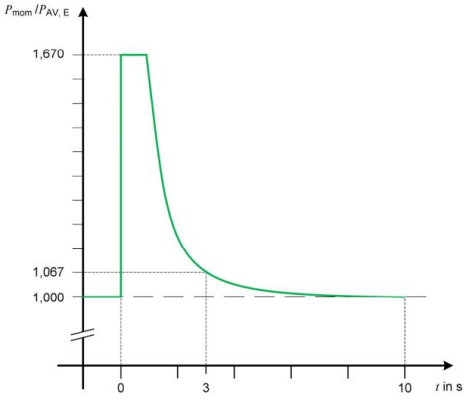
1. Rating labels



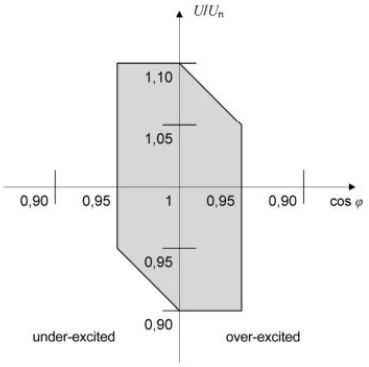
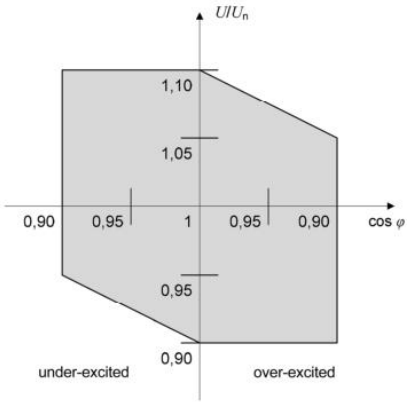
Note: - Symbol CE (hight at least 5.0mm) and symbol (hight at least 7.0mm)

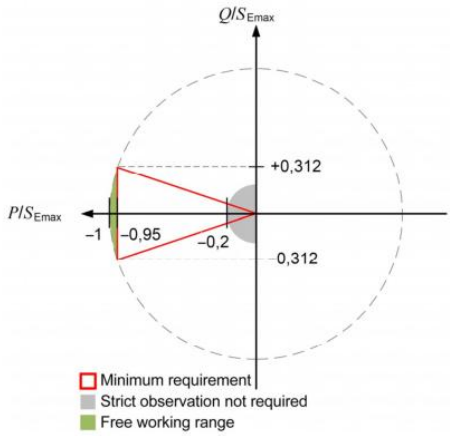
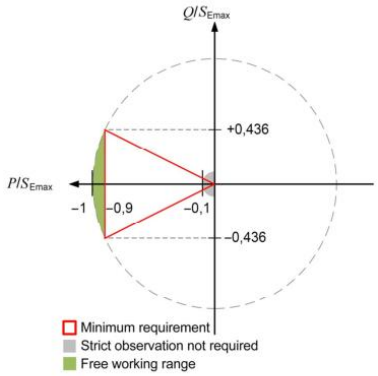
-The warnings & cautions could be provided in the instruction manual

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict

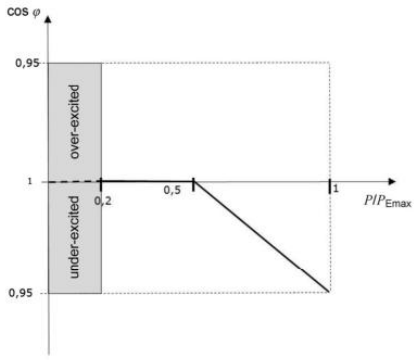
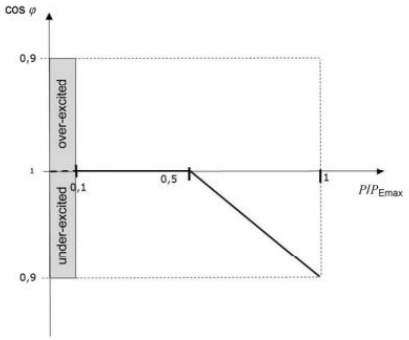
5	Grid connection		P
5.1	Principles for determining the grid connection point	Determined in final installation	N/A
5.2	Rating of network equipment	Refer to the marking label of the PGU	P
5.3	Permissible voltage change	See appendix table for PGU test	P
	For the undisturbed operation of the network, the level of slow voltage change caused by all power generation systems and storage units with a network connection point in a low-voltage network shall at none of the PCCs in this network exceed a value of 3 % as compared with the voltage without power generation systems and storage units:	Verified on system level with grid impedence	N/A
5.4	Network interactions	Evaluated according to DIN VDE V 0124-100:2020.	P
	For power generation systems and storage units, the permissible limits for network interactions are also described in VDE-AR- N 4100, 5.4. For the connection evaluation of power generation systems and storage units, the connection owner provides the completed forms E.2 to E.5 to the network operator.		P
5.5	Connection criteria		P
5.5.1	General		P
5.5.2	$P^{AV, E}$ monitoring (feed-in limitation)	Should be evaluated in field installation	N/A
	The measurement of the feed-in limit described in this subsection must be carried out at the central meter panel according to VDE-AR-N 4100, 7.2		N/A
	If exceeding the $P^{AV, E}$, the power of generation system and/or energy storage must be reduced within blue curve with specified time response according to Fig-1.  **Figure 1 – Active power limit curve for power generation systems**		N/A

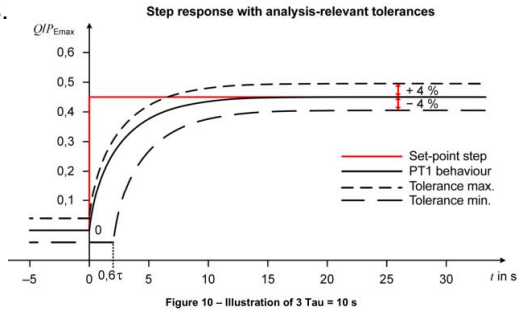
VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
5.5.3	Power generation system ready for connection		N/A
5.6	Three-phase inverter system	Single Phase Inverter	N/A
	For three-phase power generation systems feeding into the network via inverters, the power feed-in into the three line conductors shall be three-phase balanced. The inverter circuit shall preferably be set up as a three phase current unit. The positive sequence system of the terminal voltages, even if they are unbalanced, is to be used as the reference quantity for the currents.		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
	In the frequency range of 47,5 Hz to 51,5 Hz, power generation systems shall be capable of network parallel operation in compliance with the time-related minimum requirements given in Table 1. **Table 1 – Frequency/time ranges for the proper operation of power generation systems** **Frequency range** / **Operating period** 47,5 Hz to 49,0 Hz / ≥ 30 min 49,0 Hz to 51,0 Hz / unlimited 51,0 Hz to 51,5 Hz / ≥ 30 min		P
	Power generation units shall be able to ride through rapid frequency changes without disconnection from the network. This requirement applies provided the following		P
	averaged rates of change of frequency (RoCoF) are not exceeded: +/- 2.0Hz/s for moving time solt of 0.5s; +/- 1.5Hz/s for moving time solt of 1s or +/-1.25Hz/s for moving time solt of 2s		
5.7.2	Steady-state voltage stability/reactive power supply		P
5.7.2.1	General boundary conditions		P
	Steady-state voltage stability means the reactive power supply provided by a power generation system and/or a storage unit when energy is supplied for the purpose of voltage stability in the distribution network. The steady-state voltage stability is intended to keep slow (steady-state) voltage changes in the distribution network within acceptable limits.		P

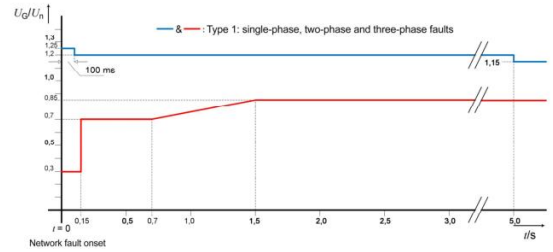
VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	In case of three-phase feed-in, the reactive power supply associated with all three methods described in 5.7.2.4 a) to c) refers to the positive sequence system components of the current and voltage fundamental component. In a passive sign convention system (see A.8), this means the operation of the power generation system in Quadrant II (under-excited) or Quadrant III (over-excited).	Single Phase Inverter	N/A
	If a storage unit consumes energy from the network, the reactive power exchange at the network connection point shall comply with the contractual agreements regarding the network connection for customer installations for consumption (see VDE-AR- N 4100).	Solar inverter considered as type 2 generation unit and doesn't consume energy from the network by design.	N/A
5.7.2.2	Reactive power supply at S^{Emax}  **Figure 2 – Requirements for power generation units regarding the reactive power supply at the generator terminals ($\sum S_{Emax} \leq 4{,}6$ kVA)**  **Figure 3 – Requirements for power generation units regarding the reactive power supply at the generator terminals ($\sum S_{Emax} > 4{,}6$ kVA)**	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.4.2. See appended table	P
	For type 2 system with only converter, the output displacement factor should cover the area described in Fig-2 or Fig-3	0.9 leading to 0.9 lagging	P
5.7.2.3	Reactive power supply smaller than P^{Emax}	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.4.2. See appended table	P

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	In addition to the requirements for reactive power supply at the operating point P^{Emax} of the power generation unit ($P^{mom} = P^{Emax}$), requirements also apply to operation with an instantaneous active power P^{mom} smaller than P^{Emax}.		P
	The minimum reactive power control area shoul cover the red triangle P/Q diagram in Fig-5 or Fig-6. In the free operation area, a	See appendix table for PGU test	P
	reduction of active power to facilitate reactive power is permitted.  **Figure 5 – P/Q diagram for type 2 $\sum S_{Emax} \leq 4{,}6$ kVA and type 1, stirling generator, fuel cell $\sum S_{Emax} > 4{,}6$ kVA at the generator terminals in the passive sign convention system**  **Figure 6 – P/Q diagram for type 2 (inverters only) $\sum S_{Emax} > 4{,}6$ kVA at the generator terminals in the passive sign convention system**		
	The maximal deviation between setting value and actual value of the controlled reactive power should be 4.0% of S^{Emax}. In range of $0<P^{mom}/S^{Emax}<0.2$(or 0.1), the reactive power should be less than 10% of S^{Emax}.		P
5.7.2.4	Method for reactive power supply		P

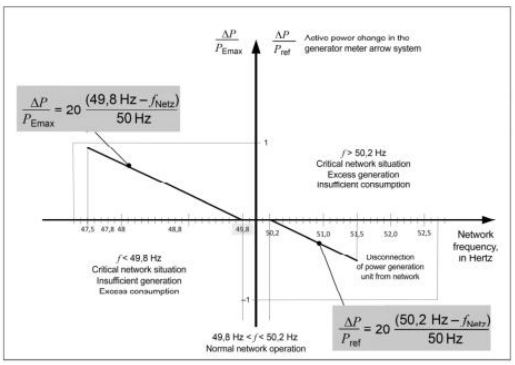
VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	The static voltage supporting with reactive power control should not influence dynamic grid supporting. The generation system		P
	should control the reactive power within range described in Fig-5 or Fig-6 using one of below process of controlling reactive power. The selection of process is informed during plan of grid connection		P
	a) reactive power voltage characteristic curve *Q*(*U*);	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.4.8.3. See appended table	P
	The reference voltage U^{Q0} is 400V/1,732. The arithmetic mean of the r.m.s. values (optionally of the positive sequence system) of the three measured line-to-neutral voltages at the generator terminals of the power generation unit is the target value for the reactive power to be fed in on all line conductors. Voltage measurement shall not exceed a maximum measurement error of 1% in relation to the nominal value.		P
	The Q(U) control is only applicable to 3 phase generation unit and the requirement is performed on generation unit terminals		P
	b) displacement factor/active power characteristic curve cos φ (*P*);	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.4.8.3. See appended table	P

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	The displacement power factor is dependent on the actual active power output according to Fig-8 and Fig-9  **Figure 8 – Characteristic curve for type 2 $\sum S_{Emax} \leq 4{,}6$ kVA and type 1, stirling generator, fuel cell $\sum S_{Emax} > 4{,}6$ kVA**  **Figure 9 – Standard characteristic curve for type 2 (inverters only) $\sum S_{Emax} > 4{,}6$ kVA**		
	c) fixed displacement factor cos φ.	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.4.8.2. See appended table	P
	For this purpose, the target value is defined with a minimum increment of Δ cos φ = 0,01. The maximum permissible error tolerance of the reactive power feed-in is calculated using the error tolerance given in 5.7.2.3 of ± 4 % in relation to PEmax.		P
5.7.2.5	Requirements for reactive power methods of type 2 systems (inverters only) and type 1 systems	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.4.8.2. See appended table	P

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	The control process of reactive power (process a, b and c) during setting value adjustment should follow PT-1 process of Fig-10. The PT-1 proecess 3 Tau should be settable between 6s and 60s for Type 2 system with default setting as 10s.  Figure 10 – Illustration of 3 Tau = 10 s		P
5.7.2.6	Special aspects regarding the extension of power generation systems	Determined in final installation	N/A
5.7.3	Dynamic network stability	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.8. See appended table	P
5.7.3.1	General		P
	A grid fault start if the voltage at generation unit terminals is under 0.85 Un or over 1.15Un.		P
	The grid fault ends when one of below two things happen in earlier: The voltage of generation unit recover to range -15% Un to +10% Un or 5s after the start of the fault		P
	Power generation units in the “energy supply” mode and storage units in the “energy consumption and supply” modes shall contribute to the dynamic network stability.		P
	During grid fault, the generation unit and energy storage should fulfil below requirements in both balanced and unbalanced grid fault:		P
	- No disconnection from the grid		P
	- Overvoltage up to 1.2Un for period of 5s		P
	- Type 2 unit and energy storage should not feed-in active or reactive current into grid during fault.		P
	- Generation unit and energy storage should endure multiple grid faults followed		P

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	The FRT-Limit-Curve according to Fig-12 is applicable to 1-, 2- and 3-phases fault  Key & FRT curve for single-phase, two-phase and three-phase network faults U_G r.m.s. value of the actual voltage at the generator terminals **Figure 11 – Fault Ride-Through (FRT) limit curve for the voltage curve at the generator terminals for a type 1 power generation unit**		**P**
5.7.3.2	Dynamic grid supporting for Type 1 unit		N/A
5.7.3.3	Dynamic grid supporting for Type 2 unit and energy storage	See appendix table for PGU test	P
	The output current at all terminals should be limited less than 20% of rated current in 60ms and 10% of rated current in 100ms Behavior after end of fault: Active current should recover back to normal value before fault within 1s after end of fault		P
5.7.4	Active power output	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.4.3. See appended table	P
5.7.4.1	During active power remote control required by grid security management, the change should fulfil power gradient requirement. The adjustment of power gradient direct on generation unit or energy storage is sufficient to fulfil the requirement: Not faster than 0.66% PAmax/s; Not slower than 0.33% PAmax/s. For generation system not slower than 4% PAmax/minute		P
	The generation system and energy storage should have a logic interface to receive active power order within 5s after sending by grid operator.		P
5.7.4.2	Network security management		P
5.7.4.2.1	Generation system and energy storage		P
	For PV system less than 30kWp, the certified technical control limited to 70% of installed module power of grid connection point or PV system is equipped with remote active power control for limitation	PGU can meet this application	P
	For PV system large than 30kWp and less than 100kWp, it should be equipped with remote active power control for limitation		N/A
	For PV system large than 100kWp, it should be equipped with remote active power control for limitation and report feed-in power in real time.		N/A

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	For Energy storage used in EEG or KWK-G system, if the P^{Amax}>100kW, it should be equipped with remote active power control for limitation and report feed-in power in real time.	Less than 100kW	N/A
5.7.4.2.2	Implementation of network security management	System solution	P
	The generation system and energy storage should control its active power without grid disconnection to 100%/60%/30%/0% of P^{Amax}.		P
5.7.4.3	Active power adjustment during over and under frequency	See appendix table for PGU test	P
	If the network frequency falls out of tolerance band of +/-200mHz from rated frequency of 50.0Hz, all generation unit and energy storage connected to the grid shall support grid stability by frequency regulation.		P
	The accuracy of frequency measurement must be <10mHz.		P
	For DC-coupled energy storage unit, type-2 unit is regarded.		P
	During frequency change, the active power output should fulfil Fig-14 and/or Fig-15		P
5.7.4.4	Voltage-dependent active power reduction is not required in this technical requirement		N/A



Key

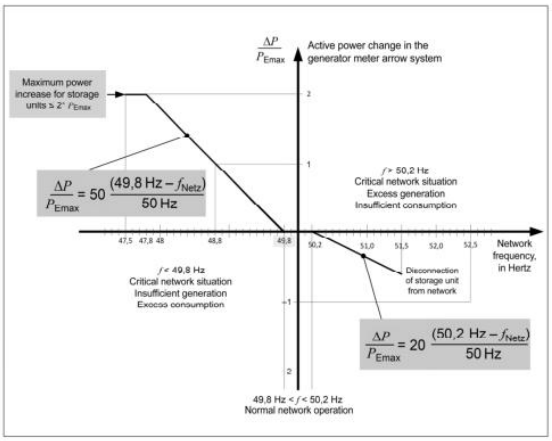
P_{Emax} highest active power of a power generation unit (10 min mean value)

P_{ref} equals P_{Emax} for type 1 power generation units or P_{mom} for type 2 power generation units at the moment when 50,2 Hz is exceeded.

ΔP power change

f network frequency

Figure 14 – Active power adjustment for type 1 and type 2 power generation units at over-frequency and under-frequency with a static value of 5 % and frequency limit values of 49,8 Hz and 50,2 Hz for starting the adjustment

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	 **Figure 15 – Active power adjustment for storage units at an over-frequency with a static value of 5 % and an under-frequency with a static value of 2 % and frequency limit values of 49,8 Hz and 50,2 Hz for starting the adjustment**		
5.7.5	Short circuit contribution		P
6	Construction of the power generation system/network and system protection (NS protection)		P
6.1	General requirements		P
6.2	Central NS protection		N/A
6.3	Integrated NS protection	The PGU include integratedinterface switch and NS protection, is type-tested against EN 62109-1 and -2, Report No.:**SZNTC2306018SV00**	P
6.4	Interface switch		P
6.4.1	The disconnection switch is used for NS protection can be used as switch device in single generation unit (integrated interface switch)		P
	The interface switch must be designed and rated for the conditional short-circuit current and taking into account the protective devices required by 6.5. The switching ability of the interface switch is to be measured according to the higher value from the rated current of the upstream fuse and maximum initial short-circuit current contribution of the generation plant. The function control of the interface switch is to be realized according to a) or b) or (c):		P
	a) Using a interface switch, that switch-on with control voltage and can automatic switch-off without voltage supply. The switch on-off state can be monitored		N/A
	b) Minimum once daily check of on-off switch with the NS protection and monitoring of normal functions of interface switch		N/A
	c) Using integrated interface switch and integrated NS protection for PV and ESS inverter according to DIN EN 62109		P

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	If a defect is detected, the generation system should not feed-in grid and not reconnect to grid		P
	The interface switch should switch all line conductors. In TT system, all pole disconnection should be realized. In this condition, the interface switch as grid disconnection device during islanding operation, it should comply with VDE-AR-E 2510-2		P
6.4.2	Central interface switch		N/A
6.4.3	Integrated interface switch		P
6.5	Protective devices and protection settings		P
6.5.1	General		P
	The specification given in 6.5.2 do not refer to the short-circuit protection, overload protection, electric shock protection and all- phase separator. The protection function may have to be extended by the connection owner if applicable		P
	The protection function shall be implemented as follows: Voltage drop protection U< Rise-in-voltage protection U> Rise-in-voltage protection U>> Frequency decrease protection f< Frequency increase protection f> Islanding detection.	See appendix table for PGU test	P
	Voltage protection devices should utilize the r.m.s value of 50Hz.		P
	The rise-in voltage protection U> shall be designed as 10 minute mean value as required in DIN EN 50160 (power quality). The formation of a new 10 minute mean value shall be at least every 3s.		P
	For PGS up to 30kVA, the voltage protection shall be measured between line and neutral		N/A
	For PGS more than 30kVA, the voltage protection shall be measured between line and neutral. The line to line voltage shall be determined or measured.		N/A
	Frequency protection may be designed as single-phase equipment		P
	The setting value of protection function and the last five dated failure report shall be readable at the NS protection. Interruption of supply shall not lead to loss of any failure report. Read-out shall be possible for central protection without any additional aid. For integrated NS protection read-out may use a data interface.		P
6.5.2	The protection function setting should follow Table 2	See appendix table for PGU test	P

VDE-AR-N 4105:2018, and Draft E DIN VDE V 0124-100 (VDE V 0124100):2019			
Clause	Requirement – Test	Result - Remark	Verdict
	The rise-in-voltage protection U> can be 1.1 to 1.15 Un, if used for up to 30kVA with only integrated NS protection, 1.1Un setting shall not be changed.		P
	The tolerance of the setting value and trip value of voltage shall be maximum +/-1% and frequency +/-0.1%		P
6.5.3	Islanding detection	Evaluated according to DIN VDE V 0124-100:2020 Cl.5.5.10. See appended table	P
	The testing method is according to DIN EN 62116. Detection of an isolated network and disconnection of PGS shall be within 2s.		P
6.6	Other requirements for generation system		N/A
6.6.1	Ability to provide primary control power is not required in the technical requirement. If this function is included, reference to VDE- AR-N 4120, 10.5.3		N/A
6.6.2	Ability to provide secondary control and minute reserve is not required in the technical requirement. If this function is included, reference to VDE-AR-N 4120, 10.5.4		N/A
7	Metering for billing purpose		N/A
8	Operation of the system		P
8.1	General		P
8.2	Special aspects of the management of the network operator's network		N/A
8.3	Connection conditions and synchronization		P
8.4	Special aspects regarding the planning, installation and operation of power generation systems and storage units each with *P*Amax ≥ 135 kW		N/A
9	Verification of electrical properties		P
Annex A	Explanation (informative)		N/A
Annex B	Measurement concepts (informative)		N/A
Annex C	Examples of meter panel configurations (informative)		N/A
Annex D	Example of connection assessment of generation plants – connection of a 20 kW photovoltaic plant (informative)		N/A
Annex E	Form (Normative)		P

5.2.2	**TABLE: Rapid voltage change**							P
Nominal current of PGU I_n (A)			3		The k_{imax} value:			0.917
Test frequency (Hz)			50Hz		--			--
Switching action		Ia (A)			U(V)			ki
A	--	L1	L2	L3	L1	L2	L3	--
	#1	1.38	--	--	230.06	--	--	0.43
	#2	1.58	--	--	230.11	--	--	0.50
	#3	1.38	--	--	230.10	--	--	0.43
B	--	L1	L2	L3	L1	L2	L3	--
	#1	0.680	--	--	230.1	--	--	0.216
	#2	0.680	--	--	230.2	--	--	0.216
	#3	0.680	--	--	230.1	--	--	0.216
C	--	L1	L2	L3	L1	L2	L3	--
	#1	2.52	--	--	230.1	--	--	0.800
	#2	2.88	--	--	230.15	--	--	0.917
	#3	2.87	--	--	230.12	--	--	0.914
D	--	L1	L2	L3	L1	L2	L3	--
	#1	1.02	--	--	230.01	--	--	0.324
	#2	1.06	--	--	230.2	--	--	0.337
	#3	1.06	--	--	230.1	--	--	0.337

Supplementary information:

A. Connection without provisions (regarding the primary energy carrier)
B. Most adverse case when switching between generator levels
C. Connection at nominal conditions (of the primary energy carrier)
D. Disconnection at rated power
Choose the applicable case for the tested EZE.
Each case shall be measured for three times.

5.2.3	**TABLE: Flicker**					P
Simulated network voltage (V)		L1 (P-N)	230.00V	Network impedance	L1	0.15+j0.15Ω
		L2(P-N)	--		L2	--
		L3(P-N)	--		L3	--
		--	--		N	--
EZE operating current (A)		L1	3.014	EZE operating power (VA)	L1	700
		L2	--		L2	--
		L3	--		L3	--
Simulated network frequency (Hz)		50		Short circuit power Sk (VA)	721	
Plt (Maximum measured Pst)		L1	3.012	EZE nominal apparent power Sn(VA)	700	
		L2	--			
		L3	--			

Test items	$d_{(t)\ -\ 500ms}$ [%]	d_c [%]	d_{max} [%]
Limit value	3.3	3.3	4
L1	0	0.187	0.399
L2	--	--	--

L3	--	--	--

Pst	#1	#2	#3	#4	#5	#6
L1	0.084	0.12	0.129	0.136	0.08	0.08
L2	--	--	--	--	--	--
L3	--	--	--	--	--	--
Pst	#7	#8	#9	#10	#11	#12
L1	0.08	0.081	0.082	0.13	0.125	0.129
L2	--	--	--	--	--	--
L3	--	--	--	--	--	--

Supplementary information:
The table is only applied to EZE with nominal current less than 75A.
- PGU operating mode: reactive power Q=0

5.2.4&5.2.6	TABLE: Harmonics and inter-harmonics& Feed-in of direct currents	P

Phase L-N

Harmon. Nr.	P/PEmax											Limit
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	(%)
	Ih/Iref(%)											
0	--	--	--	--	--	--	--	--	--	--	--	0.5% IR
1	0.1011	0.3336	0.6370	0.9087	1.2147	1.5421	1.8496	2.1465	2.4514	2.7396	3.0289	-
2	0.0036	0.0119	0.0256	0.0667	0.0541	0.0565	0.0677	0.0772	0.0906	0.0990	0.1370	8
3	0.0078	0.0260	0.0408	0.0996	0.1544	0.2405	0.3054	0.3437	0.3759	0.3659	0.3460	21.6
4	0.0071	0.0071	0.0196	0.0322	0.0415	0.0468	0.0546	0.0627	0.0688	0.0770	0.0875	4
5	0.0154	0.0514	0.0596	0.0425	0.0368	0.0220	0.0223	0.0513	0.0762	0.1324	0.1841	10.7
6	0.0034	0.0080	0.0038	0.0175	0.0166	0.0260	0.0297	0.0285	0.0313	0.0315	0.0408	2.67
7	0.0155	0.0350	0.0635	0.0584	0.0586	0.0747	0.0765	0.0810	0.0835	0.1560	0.2362	7.2
8	0.0047	0.0091	0.0056	0.0132	0.0104	0.0138	0.0154	0.0172	0.0170	0.0094	0.0131	2
9	0.0064	0.0147	0.0423	0.0505	0.0542	0.0759	0.0820	0.0782	0.0784	0.1235	0.1761	3.8
10	0.0017	0.0056	0.0142	0.0098	0.0103	0.0013	0.0015	0.0082	0.0089	0.0127	0.0203	1.6
11	0.0068	0.0193	0.0199	0.0409	0.0534	0.0660	0.0690	0.0801	0.0831	0.1046	0.1391	3.1
12	0.0058	0.0026	0.0126	0.0108	0.0120	0.0045	0.0028	0.0022	0.0035	0.0204	0.0361	1.33
13	0.0073	0.0109	0.0091	0.0196	0.0368	0.0511	0.0572	0.0523	0.0554	0.0620	0.0876	2
14	0.0050	0.0032	0.0068	0.0132	0.0180	0.0137	0.0118	0.0093	0.0047	0.0188	0.0371	-
15	0.0041	0.0069	0.0206	0.0068	0.0215	0.0353	0.0448	0.0458	0.0448	0.0463	0.0491	-
16	0.0003	0.0010	0.0064	0.0142	0.0158	0.0124	0.0128	0.0158	0.0088	0.0161	0.0266	-
17	0.0034	0.0012	0.0190	0.0139	0.0056	0.0110	0.0191	0.0169	0.0247	0.0292	0.0423	-

18	0.0023	0.0011	0.0108	0.0076	0.0131	0.0148	0.0145	0.0194	0.0143	0.0168	0.0221	-
19	0.0023	0.0011	0.0116	0.0188	0.0135	0.0088	0.0105	0.0137	0.0148	0.0173	0.0522	-
20	0.0013	0.0009	0.0073	0.0094	0.0115	0.0104	0.0099	0.0086	0.0092	0.0089	0.0239	-
21	0.0058	0.0027	0.0081	0.0192	0.0174	0.0222	0.0195	0.0185	0.0195	0.0192	0.0621	-
22	0.0034	0.0014	0.0040	0.0127	0.0068	0.0056	0.0070	0.0099	0.0147	0.0083	0.0247	-
23	0.0052	0.0006	0.0117	0.0129	0.0158	0.0285	0.0287	0.0307	0.0306	0.0266	0.0562	-
24	0.0014	0.0014	0.0074	0.0116	0.0072	0.0066	0.0044	0.0070	0.0095	0.0129	0.0285	-
25	0.0052	0.0007	0.0125	0.0074	0.0115	0.0299	0.0342	0.0356	0.0390	0.0355	0.0423	-
26	0.0005	0.0016	0.0099	0.0114	0.0081	0.0115	0.0061	0.0068	0.0075	0.0125	0.0375	-
27	0.0045	0.0017	0.0073	0.0091	0.0081	0.0246	0.0317	0.0399	0.0380	0.0372	0.0273	-
28	0.0024	0.0012	0.0071	0.0101	0.0075	0.0141	0.0105	0.0067	0.0048	0.0132	0.0311	-
29	0.0035	0.0015	0.0072	0.0127	0.0061	0.0185	0.0262	0.0272	0.0322	0.0285	0.0169	-
30	0.0032	0.0008	0.0040	0.0064	0.0073	0.0167	0.0147	0.0038	0.0029	0.0198	0.0242	-
31	0.0044	0.0013	0.0053	0.0088	0.0071	0.0139	0.0200	0.0257	0.0213	0.0188	0.0241	-
32	0.0004	0.0013	0.0072	0.0091	0.0054	0.0128	0.0109	0.0080	0.0050	0.0169	0.0204	-
33	0.0033	0.0010	0.0070	0.0061	0.0068	0.0134	0.0152	0.0102	0.0152	0.0055	0.0337	-
34	0.0012	0.0005	0.0097	0.0125	0.0037	0.0102	0.0121	0.0107	0.0073	0.0152	0.0215	-
35	0.0002	0.0005	0.0043	0.0038	0.0056	0.0105	0.0118	0.0067	0.0075	0.0050	0.0304	-
36	0.0012	0.0008	0.0086	0.0098	0.0039	0.0071	0.0079	0.0051	0.0062	0.0136	0.0244	-
37	0.0042	0.0005	0.0048	0.0041	0.0030	0.0069	0.0097	0.0122	0.0107	0.0120	0.0241	-
38	0.0002	0.0005	0.0055	0.0060	0.0052	0.0059	0.0055	0.0030	0.0064	0.0105	0.0283	-
39	0.0042	0.0007	0.0014	0.0022	0.0022	0.0022	0.0044	0.0022	0.0099	0.0120	0.0148	-
40	0.0023	0.0010	0.0084	0.0080	0.0040	0.0070	0.0075	0.0006	0.0037	0.0110	0.0251	-
THD	0.1064	0.3421	0.6489	0.9245	1.2326	1.5709	1.8849	2.1842	2.4908	2.7821	3.0826	23
PWHD	--	--	--	--	--	--	--	--	--	--	--	23
Supplementary information: N/A												

5.4.2 & 5.4.8.2	**TABLE: Measurement of reactive and active power range**	P
	$S_{Emax600}$ (VA)	$P_{Emax600}$(W)
	720	710
5.4.2	Reactive and active power range, For S_{Emax}>4.6kVA Cosφ =0.90, other 0.95 (or max. under and over for manufacturer declares), test 10min	

Test voltage	Cosφ setting	P_{600} [W]	Q_{600} [Var]	S_{600} [VA]	Cosφ 600	U [V]
0.90 Un	1.000	708.6	-54.8	710.7	0.997	210.0
1.00 Un	1.000	718.0	-55.6	720.1	0.997	230.0
1.09 Un	1.000	728.2	-56.4	730.4	0.997	251.7
0.90 Un	0.90 un	640.0	-279.0	698.2	0.900	205.0
1.00 Un	0.90 un	641.0	-279.4	699.2	0.900	229.0
1.09 Un	0.90 un	649.5	-285.8	709.6	0.898	247.7
0.90 Un	0.90 ov	635.0	279.4	693.8	0.898	209.0
1.00 Un	0.90 ov	642.0	282.5	701.4	0.898	233.0
1.05 Un	0.90 ov	654.5	286.6	714.5	0.899	250.7

5.4.8.2 Checking reactive power / displacement factor setting accuracy

Case a) Tested at Nominal voltage 0.90 Un, test 1min

P/S_{Emax} (%)	50			100		
Cosφ setting	0.90un	0.95un	0.98un	0.90un	0.95un	0.98un
Cosφ 60	0.901	0.95	0.981	0.9	0.953	0.982
P_{60} (W)	320	323.02	337.16	640	640.04	666.32
Q_{60} (Var)	147.05	110.3	74.05	292.1	210.6	138.1
S_{60} (VA)	352.2	341.3	345.2	698.2	673.8	680.5
U 60 [V]	248.5	247.4	248.4	205	206	205.7
Percentage of Q deviation (%P_{Emax})	1.39%	0.30%	0.34%	3.06%	2.00%	0.73%
Tolerance with 4% S_{Emax}	Yes	Yes	Yes	Yes	Yes	Yes
P/S_{Emax} (%)	50			100		
Cosφ setting	0.90ov	0.95ov	0.98ov	0.90ov	0.95ov	0.98ov
Cosφ 60	0.901	0.947	0.98	0.898	0.949	0.977
P_{60} (W)	324.5	339.5	361.8	635	681	709.6
Q_{60} (Var)	142.7	112.55	70.7	279.4	235.1	149.4
S_{60} (VA)	354.5	357.7	368.6	693.8	720.4	725.2
U 60 [V]	247.4	247	248.3	209	210	209.9
Percentage of Q deviation (%P_{Emax})	2.00%	0.02%	0.13%	1.85%	1.45%	0.86%
Tolerance with 4% S_{Emax}	Yes	Yes	Yes	Yes	Yes	Yes

Case b): Tested at Nominal voltage 1.0Un, test 1min

P/S_{Emax} (%)	50			100		
Cosφ setting	0.90un	0.95un	0.98un	0.90un	0.95un	0.98un
Cosφ 60	0.9	0.95	0.977	0.9	0.947	0.979
P_{60} (W)	316.5	336.5	358.3	641	679	708.6
Q_{60} (Var)	164.4	117.9	71.15	320.8	221.8	138.3
S_{60} (VA)	356.7	356.6	365.3	716.8	714.3	722

U_{60} [V]	247.9	247.5	247.9	229	229.8	229.1
Percentage of Q deviation (%P_{Emax})	1.05%	0.77%	0.07%	0.98%	0.43%	0.70%
Tolerance with 4% S_{Emax}	Yes	Yes	Yes	Yes	Yes	Yes
P/S_{Emax} (%)	50			100		
Cosφ setting	0.90ov	0.95ov	0.98ov	0.90ov	0.95ov	0.98ov
Cosφ $_{60}$	0.901	0.955	0.98	0.898	0.952	0.977
P_{60} (W)	320	349	344.8	642	684	699.6
Q_{60} (Var)	166.25	116.05	70.2	334.5	232.1	148.4
S_{60} (VA)	360.6	367.8	351.9	723.9	722.3	715.2
U_{60} [V]	248.2	247.6	247.8	233	232.2	232.2
Percentage of Q deviation (%P_{Emax})	1.31%	0.51%	0.20%	2.91%	1.03%	0.72%
Tolerance with 4% S_{Emax}	Yes	Yes	Yes	Yes	Yes	Yes
Case c): Tested at Nominal voltage 1.1Un, test 1min						
P/S_{Emax} (%)	50			100		
Cosφ setting	0.90un	0.95un	0.98un	0.90un	0.95un	0.98un
Cosφ $_{60}$	0.896	0.95	0.985	0.898	0.951	0.983
P_{60} (W)	323.75	356.6	370.94	649.5	715.2	743.88
Q_{60} (Var)	167.75	111.55	74.2	331.5	235.1	152.4
S_{60} (VA)	364.6	373.6	378.3	729.2	752.8	759.3
U_{60} [V]	246.8	246.9	248.2	247.7	247.7	247.5
Percentage of Q deviation (%P_{Emax})	1.53%	0.12%	0.36%	2.49%	1.45%	1.28%
Tolerance with 4% S_{Emax}	Yes	Yes	Yes	Yes	Yes	Yes
P/S_{Emax} (%)	50			100		
Cosφ setting	0.90ov	0.95ov	0.98ov	0.90ov	0.95ov	0.98ov
Cosφ $_{60}$	0.9	0.954	0.982	0.899	0.952	0.983
P_{60} (W)	322.25	362.1	367.44	654.5	722.2	738.88
Q_{60} (Var)	164.75	114.05	66.2	331.5	242.1	144.4
S_{60} (VA)	361.9	379.6	373.4	733.7	761.7	752.9
U_{60} [V]	248.7	247.9	248.5	250.7	250.3	251
Percentage of Q deviation (%P_{Emax})	1.10%	0.23%	0.77%	2.49%	2.43%	0.16%
Tolerance with 4% S_{Emax}	Yes	Yes	Yes	Yes	Yes	Yes
Supplementary information: N/A						

5.4.3	**TABLE: Reduction of active power by setpoint specification**							P		
P/Pn (%)	100	90	80	70	60	50	40	30	20	10
Setting value(W)	700	630	560	490	420	350	280	210	140	70
Measured value(W)	701	618	550	483	418	352	284	215	146	73
Deviation(%Pn)	0.14%	-1.91%	-1.73%	-1.47%	-0.44%	0.59%	1.48%	2.57%	4.52%	4.28%
Supplementary information: N/A										

5.4.3.4 Measurement of the power gradient	P
Maximum active power gradient (0.66% Pn inst (or P controllable) per second)	

Sample test from 100% P_n to 5% P_n, settling time [s], (see the graphic below):	152	
Sample test from 5% P_n to 100% P_n, settling time [s], (see the graphic below):	150	
Sample test from 100% P_n to 5% P_n Gradient [%/s], (see the graphic below):	0.63	
Sample test from 5% P_n to 100% P_n Gradient [%/s], (see the graphic below):	0.63	
Minimum active power gradient(0.33% Pn inst (or P controllable) per second)		
Sample test from 100% P_n to 5% P_n, settling time [s], (see the graphic below):	306	
Sample test from 5% P_n to 100% P_n, settling time [s], (see the graphic below):	307	
Sample test from 100% P_n to 5% P_n Gradient [%/s], (see the graphic below):	0.31	
Sample test from 5% P_n to 100% P_n Gradient [%/s], (see the graphic below):	0.31	
During the active power regulation, the PGU disconnect from the grid or not?	Yes/No	
	Disconnection power level	No
Supplementary information: N/A		

5.4.4	**TABLE: Active power feed-in from EZE at overfrequency**	P

Test 1: generation unit (PV and ESS), over-frequency regulation, with active power reduction frequency start point=50.2Hz, gradient s=5% (40 % P_{ref}/Hz)

TYPE 2 inverter DC input power is set to 100% of maximum active output power till the end of the test. The active power value shall not be deviated from the required value calculated from the feature curve (a gradient of 40% of P_M per hertz) for more than 10% P_{Emax}.

P_M = 700W, 10% P_{Emax}= 70 W.

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve P_{shall} (W)	Deviation of $P_{measure}$ and P_{shall} (W)	Deviation within 10% P_{Emax} (Yes/No)
a)	50	702	100% PM	2	Yes
b)	50.25	683	98% P_M	-3	Yes
c)	50.7	563	80% P_M	3	Yes
d)	51.4	580	52% P_M	216	No
e)	50.7	565	80% P_M	5	Yes
f)	50.25	684	98% P_M	-2	Yes
g)	50	700	100% P_M	0	Yes
h)	51.65	Protection	Protection	--	--
i)	50.15	No reconnection	Maintain 147 s	--	--

j)	50	See below table	100% PM (waiting for 60s, then power rise up with gradient of <10 P_{Emax}/min)	--	--

Test sequence	Frequency (Hz)	Time after step bac from 50.00 Hz t (min)	Measured active output power P_{10} (W)	Arised active power ΔP during next 0,5 minute (W)	Gradient of arising active power ΔP/t (W/1 min.)	Gradient of arising active power ΔP/ P_{Π}/t (%/1 min.)	Limit within 10% of P_{Π}/min (Yes/No)
6	50	0.0 min	17	--	--	--	--
6	50	0.0 min	The time that the active power start increases after the frequency change to 50.00Hz (s)				17
7	50	0.5 min	42	--	--	--	--
8	50	1.0 min	68	26	--	--	--
9	50	1.5 min	90	22	48	6.86%	Yes
10	50	2.0 min	115	25	47	6.71%	Yes
11	50	2.5 min	140	25	50	7.14%	Yes
12	50	3.0 min	167	27	52	7.43%	Yes
13	50	3.5 min	189	22	49	7.00%	Yes
14	50	4.0 min	219	30	52	7.43%	Yes
15	50	4.5 min	243	24	54	7.71%	Yes
16	50	5.0 min	271	28	52	7.43%	Yes
17	50	5.5 min	300	29	57	8.14%	Yes
18	50	6.0 min	322	22	51	7.29%	Yes
19	50	6.5 min	343	21	43	6.14%	Yes
20	50	7.0 min	371	28	49	7.00%	Yes
21	50	7.5 min	395	24	52	7.43%	Yes
22	50	8.0 min	415	20	44	6.29%	Yes
23	50	8.5 min	443	28	48	6.86%	Yes
24	50	9.0 min	469	26	54	7.71%	Yes
25	50	9.5 min	496	27	53	7.57%	Yes
26	50	10.0 min	521	25	52	7.43%	Yes
27	50	10.5 min	548	27	52	7.43%	Yes
28	50	11.0 min	569	21	48	6.86%	Yes
29	50	11.5 min	594	25	46	6.57%	Yes
30	50	12.0 min	620	26	51	7.29%	Yes
31	50	12.5 min	645	25	51	7.29%	Yes
32	50	13.0 min	669	24	49	7.00%	Yes
33	50	13.5 min	699	30	54	7.71%	Yes
34	50	14.0 min	702	29	59	8.43%	Yes
35	50	14.5 min	698	--	--	--	--

Max. and Mean active power gradient after returning from an overfrequency	
Max. active power gradient	8.14%
Mean active power gradient	6.14%
Defined active power gradient	10% P_{Emax}/min

Test 2: generation unit (PV and ESS), over-frequency regulation, with active power reduction frequency start point=50.5Hz, gradient s=12% (16.67 % P_{ref}/Hz)

inverter DC input power is set to 60% of maximum active output power till the end of the test. The active power value shall not be deviated from the required value calculated from the feature curve (a gradient of 16.7% of P_M per hertz) for more than 10% P_{Emax}., once the frequency rise above 50.5Hz, the DC input power shall immediately be set to a point to support 100% active output power.

P_M =___700W___, 10% P_{Emax}=____70W_____..

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve P_{shall} (W)	Deviation of $P_{measure}$ and P_{shall} (W)	Deviation within 10% P_{Emax} (Yes/No)
a)	50	419	60%	-1	Yes
b)	50.4	427	60%	7	Yes
c)	50.7	405	58%	-1	Yes
d)	51.4	354	51%	-3	Yes
e)	50.7	404	58%	-2	Yes
f)	50.4	427-698 (Detail refer to the following table)	Go back to 60% first and then from 60% rise to 100% (power rise up with gradient of <10 PEmax/min)	--	Yes
g)	50	699	100%	6	Yes

Test sequence	Frequency (Hz)	Time after step bac from 50.00 Hz t (min)	Measured active output power P_{10} (W)	Arised active power ΔP during next 0,5 minute (W)	Gradient of arising active power ΔP/t (W/1 min.)	Gradient of arising active power ΔP/ P_n/t (%/1 min.)	Limit within 10% of P_{Emax}/min (Yes/No)
2	50.4	0.0 min	427	--	--	--	--
3	50.4	0.5 min	448	21	--	--	--
4	50.4	1.0 min	475	27	48	6.86%	Yes
5	50.4	1.5 min	501	26	53	7.57%	Yes
6	50.4	2.0 min	525	24	50	7.14%	Yes
7	50.4	2.5 min	550	25	49	7.00%	Yes
8	50.4	3.0 min	572	22	47	6.71%	Yes
9	50.4	3.5 min	598	26	48	6.86%	Yes
10	50.4	4.0 min	625	27	53	7.57%	Yes
11	50.4	4.5 min	645	20	47	6.71%	Yes
12	50.4	5.0 min	672	27	47	6.71%	Yes
13	50.4	5.5 min	699	27	54	7.71%	Yes
14	50.4	6.0 min	696	-3	24	3.43%	Yes
15	50.4	6.5 min	698	--	--	--	--

Supplementary information: N/A

5.4.8.3	**TABLE: Testing of the displacement factor/active power characteristic cos φ (P)**	P

1)Test steps for guided EZE accuracy (characteristic)

Maximal active power P_{Emax} with the tested displacement factor (W)	700VA*0.9=630 W

Trip #1
During the test, the active power gradient setting at 0.5% Pn/s
Response of the reactive power set 3-Tau=10s

Percentage of output active power P/PEmax (%)	Measured active power P (W)	Measured apparent power S (VA)	Measured displacement factor cosφ	Measured reactive power Q(Var)	Displacement factor as to feature curve	Deviation of displacement reactive power
20%	140.133	140.837	0.995	14.066	1	14.066
100%	705.685	714.967	0.899	-343.775	0.900	-4.822
20%	141.292	142.002	0.995	14.182	1	14.182

Trip #2-
the active power gradient setting at 100% Pn/s
Response of the reactive power set 3-Tau=10s

Percentage of output active power P/PEmax (%)	Measured active power P (W)	Measured apparent power S (VA)	Measured displacement factor cosφ	Measured reactive power Q(Var)	Displacement factor as to feature curve	Deviation of displacement reactive power
20%	141.466	141.725	0.994	8.562	1	8.56185
100%	711.858	721.833	0.899	-346.782	0.900	-4.822
20%	140.533	140.79	0.994	8.505	1	8.5052

Supplementary information: N/A

5.5.2 and 5.5.6.3	**TABLE: Fault condition tests**	**P**
Ambient temperature T_{amb} (°C)..... :	25°C, if not specified	—

Component No.	Condition	Supply voltage (V)	Test time	Fuse no.	Fuse current (A)	Observation
RY1 pin 3-4	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards
RY1 pin 5-6	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards
C40	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, FG1 and FG2 is damaged, no hazards
U3 pin 18-10	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, U3 and U6 is damaged, no hazards
U6 pin 16-15	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards
Q20 pin D-S	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards

Q19 pin D-S	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards
TX4 pin 4-5	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards
D17	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards
REC pin 1-2	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, no damaged, no hazards
Q7 pin D-S	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, Q7 damaged, no hazards.
Q7 pin D-G	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, Q7 damaged, no hazards.
Q7 pin G-S	S/C	PV Input:55VDC	10min	FG1, FG2	--	Unit shutdown immediately, Q7 damaged, no hazards.

Supplementary information:

1) SC: Short-circuited, OC–Open Circuit. OL=Overload
2) The test result shown all safeguards remained effective and didn't lead to a single fault condition during abnormal operating condition; In addition all safeguards complied with applicable requirements in this standard after restoration of normal operating conditions.
3) The test result showed no Class 1 or 2 energy source become Class 3 level during and after single fault condition.
4) Tested with model: KS-800, the tested results of LS-800can representative KS-600.

5.5.4 & 5.5.7.4	**TABLE: Integrated NA Protection and Protective devices and settings**				P	
Test step	Size	Apply to	Jump height △U, △f	Step length △t	Measured value	Limit
1	U>>	L-N	< 1.15 V	>400ms	287.3	287.5±2.3 V
2	U>>	L-N	>9.2 V	>400 ms	135	100-200ms
3.1	U>	L-N	27.6 V	> 600.2 s	533	450-550 s
3.2	U>	L-N	18.4 V	>400 ms	No disconnection	No disconnection
4	U<	L-N	< 1.15 V	> 600.2 s	183	184±2.3 V
5	U<	L-N	> 9.2 V	>3.2 s	3027ms	3.0-3.1s
6	U<<	L-N	<1.15 V	>3.2 s	104.3	103±2.3 V
7	U<<	L-N	> 9.2 V	>500 ms	338	300-400ms
8	f>	f	< 25 mHz	> 400 ms	51.11Hz	51.5±0.05Hz
9	f>	f	> 0.2 Hz	> 400 ms	141ms	100-200ms
10	f<	f	< 25 mHz	> 400 ms	47.48Hz	47.5±0.05Hz
11	f<	f	> 0.2 Hz	> 400 ms	189ms	100-200ms
Supplementary information:						

5.5.7.2	**TABLE: Voltage monitoring (integrated protection and interface switch)-setting check**			P	
Description	Parameter name	Setting value in pu	Setting value L-N	Set value L-L	Check match (yes or not)
Excitation threshold U>>	AU>>	1,25	287.5 V	--	Yes
Delay time U>>	tU>>	–	100 ms	--	Yes
Excitation threshold U>	AU>	1,10	253 V	--	Yes

Delay time U>[a]	tU>	–	100 ms	--	Yes
Excitation threshold U<	AU<	0,8	184 V	--	Yes
Delay time U<.	tU<	–	3 s	--	Yes
Excitation threshold U<<	AU<<	0,45	103.5 V	--	Yes
Delay time U<<	tU<<	–	300 ms	--	Yes
Excitation threshold f>	Af>	1,03	51,5 Hz	--	Yes
Delay time f>	Tf>	–	100 ms	--	Yes
Excitation threshold f<	Af<	0,95	47,5 Hz	--	Yes
Delay time f<	Tf<	–	100 ms	--	Yes
Supplementary information: N/A					

5.5.10	**TABLE: Islanding detection**								P / F / N/A
No.	P_{EUT} (% of EUT rating)	Reactive load (% of normial)	P_{AC}	Q_{AC}	Run-on time(ms)	P_{EUT} (W)	Actual $Q_{f\ (Var)}$ (L1)	V_{DC}	Which load is selected to be adjusted (C or L)
Test condition A									
1.	100	100	0	0	1350	698	1.00	50	
2.	100	100	-5	-5	677	665	1.01	50	/
3.	100	100	-5	0	1740	665	1.02	50	/
4.	100	100	-5	5	320	666	1.00	50	/
5.	100	100	0	-5	741	701	0.97	50	/
6.	100	100	0	5	688	701	1.01	50	/
7.	100	100	5	-5	741	736	0.92	50	/
8.	100	100	5	0	1500	735	0.95	50	/
9.	100	100	5	5	1600	735	0.98	50	/
10.	100	100	-10	10	1050	630	0.98	50	/
11.	100	100	-5	10	1850	665	1.01	50	/
12.	100	100	0	10	592	700	1.02	50	/
13.	100	100	10	10	267	730	0.982	50	/
14.	100	100	10	5	320	730	0.99	50	/
15.	100	100	10	0	1750	730	0.975	50	/
16.	100	100	10	-5	1560	730	0.987	50	/
17.	100	100	10	-10	1530	730	0.786	50	/
18.	100	100	5	-10	1620	735	1.011	50	/
19.	100	100	0	-10	1700	701	1.012	50	/
20.	100	100	-5	-10	1710	665	1.023	50	/
21.	100	100	-10	-10	1660	630	1.022	50	/
22.	100	100	-10	-5	709	630	1.011	50	/
23.	100	100	-10	0	448	630	1.012	50	/
24.	100	100	-10	5	1750	630	1.011	50	/
Test condition B									
25.	66	66	0	0	861.3	459	1.01	35	/
26.	66	66	0	-5	1580	460	1.012	35	L
27.	66	66	0	-4	223	460	1.011	35	L
28.	66	66	0	-3	1690	460	1.01	35	L
29.	66	66	0	-2	1080	460	1.02	35	L
30.	66	66	0	-1	330	460	1.01	35	L
31.	66	66	0	1	1590	460	0.975	35	L

32.	66	66	0	2	1660	460	0.978	35	L
33.	66	66	0	3	874	459	0.987	35	L
34.	66	66	0	4	1730	460	0.985	35	L
35.	66	66	0	5	874	460	0.817	35	L
Test condition C									
36.	33	33	0	0	1830	232	0.70	25	/
37.	33	33	0	-5	335	232	0.80	25	L
38.	33	33	0	-4	954	232	0.80	25	L
39.	33	33	0	-3	1600	233	0.79	25	L
40.	33	33	0	-2	1550	232	0.79	25	L
41.	33	33	0	-1	1050	232	0.79	25	L
42.	33	33	0	1	511	232	0.79	25	L
43.	33	33	0	2	735	232	0.79	25	L
44.	33	33	0	3	868	232	0.78	25	L
45.	33	33	0	4	1600	232	0.78	25	L
46.	33	33	0	5	1840	232	0.78	25	L

Remark:

For test condition A:

If any of the recorded run-on times are longer than the one recorded for the rated balance condition, then the non-shaded parameter combinations also require testing.

For test condition B and C:

If run-on times are still increasing at the 95 % or 105 % points, additional 1 % increments is taken until run-on times begin decreasing

Qeut is added to Qc when calculating the Qf for realizing the resonant result

5.6	**TABLE: Connection conditions and synchronization**	P
Test procedure	a) f=47.45Hz, no reconnection allowed	Yes
	b) f=47.55Hz, reconnection allowed	Yes
	c) f=50.15Hz, no reconnection allowed	Yes
	d) f=50.05Hz, reconnection allowed	Yes
	e) U=84% Un, no reconnection allowed	Yes
	f) U=86% Un, reconnection allowed	Yes
	g) U=111% Un, no reconnection allowed	Yes
	h) U=109% Un, reconnection allowed	Yes
Supplementary information: N/A		

5.8	**Proof of dynamic grid support**		P
Test procedure			
	Test number	Ratio of fault voltage to rated voltage (U/Un)	Fault duration (ms)
	1	0,15 … 0,25	0,15pu ≥ 150 0,25pu ≥ 500
	2	0,50 … 0,60	0,5pu ≥ 1500 0,6pu ≥ 2000
	3	0.70 … 0.85	≥ 3000
	4	0,85 … 0,90	≥ 60000
	5	1,20 … 1,25	≥ 100
	6	1,15 … 1,20	≥ 5000
	7	1,10 … 1,15	≥ 60000

Test number definition

Test	Voltage during fault	Phase fault type	Fault duration (ms)	Load	Cosφ setting	Test Number
1	0.15-0.25	1 phase	At 0.15pu> 150 At 0.25pu> 200	Full load	1	1.1
				Partial load		1.2
		1 phase D1		Full load		1.3
				Partial load		1.4
		1 phase D2		Full load		1.5
2	0.50-0.60	1 phase	at 0.50pu ≥1500 at 0.60pu ≥2000	Full load	maximum over-excited	2.1
				Partial load	maximum over-excited	2.2
		1 phase D1		Full load	maximum over-excited	2.3
				Partial load	maximum over-excited	2.4
3	0.50-0.60	1 phase	at 0.50pu ≥1500	Full load	maximum under-excited	3.1
				Partial load	maximum under-excited	3.2
		1 phase D1		Full load	maximum over-excited	3.3
				Partial load	maximum over-excited	3.4
4	0.85-0.90	1 phase	> 60000	Full load	1	4.1
				Partial load		4.2
		1 phase D1		Full load		4.3
				Partial load		4.4
5	1.20 to 1.25	1 phase	> 100	Full load	1	5.1
				Partial load		5.2
		1 phase D1		Full load		5.3
				Partial load		5.4
		1 phase D2		Full load		5.5

6	1.15 to 1.20	1 phase	> 5000	Full load	1	6.1
				Partial load		6.2
		1 phase D1		Full load		6.3
				Partial load		6.4
7	1.10-1.15	1 phase	> 60000	Full load	1	7.1
				Partial load		7.2
		1 phase D1		Full load		7.3
				Partial load		7.4

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	1.1
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	9:33:45
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-72279
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-72109
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	170
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	0.129
				t1-10s to t1	[p.u.]	1.003
Before t1	8	Voltage	L-N	t1-10s to t1	[p.u.]	1.003
	9	Current	L-N	t1-10s to t1	[p.u.]	1.001
	10		Pos. seq.	t1-10s to t1	[p.u.]	1.001
	11	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.1
	12		Pos. seq.	t1-1s to t1	[p.u.]	0.1
	13	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.995
	14	Active power	Total	t1-10s to t1	[p.u.]	0.995
	15		Pos. seq.	t1-10s to t1	[p.u.]	0.995
	16	Reactive power	Total	t1-10s to t1	[p.u.]	0.1
	17		Pos. seq.	t1-10s to t1	[p.u.]	0.1
t1 to t2	18	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.129
	19		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.129
	20	Momentary Current	L-N	t1+60ms	[p.u.]	0.067
	21		L-N	t1+100ms	[p.u.]	0.07

	22	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.07
	23	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.006
	24		Pos	t1+100ms to t2-20ms	[p.u.]	0.006
After t2	25	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1.004
	26	Active power	Total	t2+3s to t2+10s	[p.u.]	1.004
	27		Pos	t2+3s to t2+10s	[p.u.]	1
	28	Active power recover time	Total	-	[ms]	310
	29	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.098
	30		Pos	t2+3s to t2+10s	[p.u.]	0.098
	31	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	1.2
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	10:02:11
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-71983
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-71813
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	170
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	0.128
				t1-10s to t1	[p.u.]	0.999
	8	Voltage drop depth or voltage increase determined from no load test	Pos. seq.	t1+100ms to t2 and t1-10s to t1	[p.u.]	0.875
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	0.999
	10	Current	L-N	t1-10s to t1	[p.u.]	0.195
	11		Pos. seq.	t1-10s to t1	[p.u.]	0.195
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.098
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.098
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.196
	15	Active power	Total	t1-10s to t1	[p.u.]	0.198
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.198
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.002
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.002

t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.128
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.128
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.065
	22		L-N	t1+100ms	[p.u.]	0.071
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.071
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.011
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.011
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	0.997
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.197
	28		Pos	t2+3s to t2+10s	[p.u.]	0.199
	29	Active power recover time	Total	-	[ms]	117
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.002
	31		Pos	t2+3s to t2+10s	[p.u.]	0.002
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	2.1
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	10:13:15
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-73366
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-71666
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	1700
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	0.497
				t1-10s to t1	[p.u.]	1.003
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	0.484
				t1-10s to t1	[p.u.]	1.002
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	1.003
	10	Current	L-N	t1-10s to t1	[p.u.]	1.008
	11		Pos. seq.	t1-10s to t1	[p.u.]	1.008
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0
	13		Pos. seq.	t1-1s to t1	[p.u.]	0

	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.997
	15	Active power	Total	t1-10s to t1	[p.u.]	1
	16		Pos. seq.	t1-10s to t1	[p.u.]	1
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0
	18		Pos. seq.	t1-10s to t1	[p.u.]	0
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.497
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.497
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.065
	22		L-N	t1+100ms	[p.u.]	0.072
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.072
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.004
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.004
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	0.997
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	1.004
	28		Pos	t2+3s to t2+10s	[p.u.]	1.001
	29	Active power recover time	Total	-	[ms]	364
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.005
	31		Pos	t2+3s to t2+10s	[p.u.]	0.005
	32	Reactive power recover time	Total	-	[ms]	9040

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	2.2
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	10:42:21
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-70724
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-69024
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	1700
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	0.502
				t1-10s to t1	[p.u.]	1
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	0.498
				t1-10s to t1		0.999

Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	1
	10	Current	L-N	t1-10s to t1	[p.u.]	0.233
	11		Pos. seq.	t1-10s to t1	[p.u.]	0.233
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.002
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.002
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.2
	15	Active power	Total	t1-10s to t1	[p.u.]	0.198
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.198
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.002
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.002
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.502
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.502
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.066
	22		L-N	t1+100ms	[p.u.]	0.069
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.069
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.006
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.006
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1.004
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.204
	28		Pos	t2+3s to t2+10s	[p.u.]	0.202
	29	Active power recover time	Total	-	[ms]	103
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.002
	31		Pos	t2+3s to t2+10s	[p.u.]	0.002
	32	Reactive power recover time	Total	-	[ms]	7006

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	3.1
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	11:23:14
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-72558
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-70858
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	1700
	7	Voltage drop depth or voltage increase	L-N	t1+100ms to t2	[p.u.]	0.515

		determined from no load test		t1-10s to t1	[p.u.]	1.002
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	0.507
				t1-10s to t1	[p.u.]	0.997
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	1.002
	10	Current	L-N	t1-10s to t1	[p.u.]	1
	11		Pos. seq.	t1-10s to t1	[p.u.]	1
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.1
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.1
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.995
	15	Active power	Total	t1-10s to t1	[p.u.]	0.995
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.995
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.1
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.1
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.515
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.515
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.074
	22		L-N	t1+100ms	[p.u.]	0.066
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.074
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.01
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.01
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1.005
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	1.004
	28		Pos	t2+3s to t2+10s	[p.u.]	0.996
	29	Active power recover time	Total	-	[ms]	304
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.098
	31		Pos	t2+3s to t2+10s	[p.u.]	0.098
	32	Reactive power recover time	Total	-	[ms]	8980
	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	3.2
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	11:32:21
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-72400

	5	Fault clearance(t2)	Fault Phase	-	[ms]	-70700
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	1700
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	0.497
				t1-10s to t1	[p.u.]	1
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	0.496
				t1-10s to t1		0.998
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	1
	10	Current	L-N	t1-10s to t1	[p.u.]	0.202
	11		Pos. seq.	t1-10s to t1	[p.u.]	0.202
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.002
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.002
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.198
	15	Active power	Total	t1-10s to t1	[p.u.]	0.197
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.197
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.002
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.002
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.497
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.497
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.07
	22		L-N	t1+100ms	[p.u.]	0.072
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.072
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.009
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.009
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1.003
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.202
	28		Pos	t2+3s to t2+10s	[p.u.]	0.196
	29	Active power recover time	Total	-	[ms]	112
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.002
	31		Pos	t2+3s to t2+10s	[p.u.]	0.002
	32	Reactive power recover time	Total	-	[ms]	7004

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	4.1
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3

	2	Time （start of time）	-	-	[hh:mm:ss.f]	13:39:14
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-92612
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-32612
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	60000
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	0.857
				t1-10s to t1	[p.u.]	0.996
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	0.851
				t1-10s to t1	[p.u.]	0.997
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	0.996
	10	Current	L-N	t1-10s to t1	[p.u.]	1.006
	11		Pos. seq.	t1-10s to t1	[p.u.]	1.006
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.045
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.045
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.998
	15	Active power	Total	t1-10s to t1	[p.u.]	0.999
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.999
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.045
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.045
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.857
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.857
	21	Momentary Current	L-N	t1+60ms	[p.u.]	1.005
	22		L-N	t1+100ms	[p.u.]	1.002
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	1.005
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.007
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.007
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1.005
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	1.002
	28		Pos	t2+3s to t2+10s	[p.u.]	0.995
	29	Active power recover time	Total	-	[ms]	--
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.046
	31		Pos	t2+3s to t2+10s	[p.u.]	0.046
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	4.2
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	13:52:11
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-93312
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-33312
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	60000
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	0.849
				t1-10s to t1	[p.u.]	1.003
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	0.854
				t1-10s to t1		0.998
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	1.003
	10	Current	L-N	t1-10s to t1	[p.u.]	0.203
	11		Pos. seq.	t1-10s to t1	[p.u.]	0.203
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.002
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.002
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.2
	15	Active power	Total	t1-10s to t1	[p.u.]	0.196
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.196
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.002
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.002
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	0.849
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	0.849
	21	Momentary Current	L-N	t1+60ms	[p.u.]	1
	22		L-N	t1+100ms	[p.u.]	1.003
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	1.003
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.012
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.012
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	0.999
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.203
	28		Pos	t2+3s to t2+10s	[p.u.]	0.196
	29	Active power recover time	Total	-	[ms]	--

	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.002
	31		Pos	t2+3s to t2+10s	[p.u.]	0.002
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	5.1
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	14:02:18
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-71032
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-70922
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	110
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	1.261
				t1-10s to t1	[p.u.]	0.998
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	1.253
				t1-10s to t1	[p.u.]	1.002
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	0.998
	10	Current	L-N	t1-10s to t1	[p.u.]	1.008
	11		Pos. seq.	t1-10s to t1	[p.u.]	1.008
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.045
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.045
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.996
	15	Active power	Total	t1-10s to t1	[p.u.]	0.999
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.999
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.045
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.045
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	1.261
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	1.261
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.047
	22		L-N	t1+100ms	[p.u.]	0.054
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.054
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.052
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.052
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1

	27	Active power	Total	t2+3s to t2+10s	[p.u.]	1.003
	28		Pos	t2+3s to t2+10s	[p.u.]	0.995
	29	Active power recover time	Total	-	[ms]	372
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.04
	31		Pos	t2+3s to t2+10s	[p.u.]	0.04
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	5.2
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	14:22:11
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-71185
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-71075
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	110
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	1.255
				t1-10s to t1	[p.u.]	1.003
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	1.245
				t1-10s to t1		0.999
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	1.003
	10	Current	L-N	t1-10s to t1	[p.u.]	0.237
	11		Pos. seq.	t1-10s to t1	[p.u.]	0.237
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.002
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.002
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.198
	15	Active power	Total	t1-10s to t1	[p.u.]	0.199
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.199
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.002
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.002
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	1.255
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	1.255
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.051
	22		L-N	t1+100ms	[p.u.]	0.055
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.055

	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.007
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.007
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	0.998
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.197
	28		Pos	t2+3s to t2+10s	[p.u.]	0.205
	29	Active power recover time	Total	-	[ms]	71
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.002
	31		Pos	t2+3s to t2+10s	[p.u.]	0.002
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	6.1
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	14:56:18
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-70746
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-65746
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	5000
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	1.184
				t1-10s to t1	[p.u.]	0.997
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	1.181
				t1-10s to t1	[p.u.]	0.995
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	0.997
	10	Current	L-N	t1-10s to t1	[p.u.]	1.005
	11		Pos. seq.	t1-10s to t1	[p.u.]	1.005
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.063
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.063
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.997
	15	Active power	Total	t1-10s to t1	[p.u.]	0.998
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.998
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.063
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.063
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	1.184
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	1.184

	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.049
	22		L-N	t1+100ms	[p.u.]	0.054
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.054
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.05
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.05
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1.004
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.997
	28		Pos	t2+3s to t2+10s	[p.u.]	1.002
	29	Active power recover time	Total	-	[ms]	327
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.063
	31		Pos	t2+3s to t2+10s	[p.u.]	0.063
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	6.2
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	15:12:15
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-71810
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-66810
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	5000
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	1.203
				t1-10s to t1	[p.u.]	0.997
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	1.197
				t1-10s to t1		1.003
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	0.997
	10	Current	L-N	t1-10s to t1	[p.u.]	0.235
	11		Pos. seq.	t1-10s to t1	[p.u.]	0.235
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.002
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.002
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.196
	15	Active power	Total	t1-10s to t1	[p.u.]	0.2
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.2

	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.002
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.002
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	1.203
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	1.203
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.055
	22		L-N	t1+100ms	[p.u.]	0.054
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.055
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.068
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.068
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	0.998
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.202
	28		Pos	t2+3s to t2+10s	[p.u.]	0.197
	29	Active power recover time	Total	-	[ms]	67
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.002
	31		Pos	t2+3s to t2+10s	[p.u.]	0.002
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	7.1
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	16:16:15
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-103219
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-43219
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	60000
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	1.159
				t1-10s to t1	[p.u.]	0.997
	8	Voltage drop depth or voltage increase determined from test	Pos. seq.	t1+100ms to t2	[p.u.]	1.167
				t1-10s to t1	[p.u.]	1.005
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	0.997
	10	Current	L-N	t1-10s to t1	[p.u.]	1.004
	11		Pos. seq.	t1-10s to t1	[p.u.]	1.004

	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.077
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.077
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.995
	15	Active power	Total	t1-10s to t1	[p.u.]	0.997
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.997
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.077
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.077
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	1.159
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	1.159
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.811
	22		L-N	t1+100ms	[p.u.]	0.812
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.812
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.978
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.978
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	0.997
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.995
	28		Pos	t2+3s to t2+10s	[p.u.]	1
	29	Active power recover time	Total	-	[ms]	--
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.079
	31		Pos	t2+3s to t2+10s	[p.u.]	0.079
	32	Reactive power recover time	Total	-	[ms]	--

	No.	Parameter	Phase reference	Reference time	Unit	Value
General information	0	Test Number	-	-	-	7.2
	1	Date	-	-	[dd.mm.yyyy]	2023/8/3
	2	Time （start of time）	-	-	[hh:mm:ss.f]	15:12:15
	3	Fault type (affected phases)	-	-	-	1 phase
	4	Fault occurrence(t1)	Fault Phase	-	[ms]	-102436
	5	Fault clearance(t2)	Fault Phase	-	[ms]	-42436
	6	Fault duration determined from no load test	Fault Phase	-	[ms]	60000
	7	Voltage drop depth or voltage increase determined from no load test	L-N	t1+100ms to t2	[p.u.]	1.152
				t1-10s to t1	[p.u.]	0.995
	8	Voltage drop depth or voltage increase	Pos. seq.	t1+100ms to t2	[p.u.]	1.145

		determined from test		t1-10s to t1		1
Before t1	9	Voltage	L-N	t1-10s to t1	[p.u.]	0.995
	10	Current	L-N	t1-10s to t1	[p.u.]	0.204
	11		Pos. seq.	t1-10s to t1	[p.u.]	0.204
	12	Reactive current	Pos. seq.	t1-10s to t1	[p.u.]	0.002
	13		Pos. seq.	t1-1s to t1	[p.u.]	0.002
	14	Active current	Pos. seq.	t1-1s to t1	[p.u.]	0.204
	15	Active power	Total	t1-10s to t1	[p.u.]	0.196
	16		Pos. seq.	t1-10s to t1	[p.u.]	0.196
	17	Reactive power	Total	t1-10s to t1	[p.u.]	0.002
	18		Pos. seq.	t1-10s to t1	[p.u.]	0.002
t1 to t2	19	Voltage	L-N	t1+100ms to t2-20ms	[p.u.]	1.152
	20		Pos. seq.	t1+100ms to t2-20ms	[p.u.]	1.152
	21	Momentary Current	L-N	t1+60ms	[p.u.]	0.171
	22		L-N	t1+100ms	[p.u.]	0.166
	23	Max current after t1+100ms during fault	L-N	t1+100ms to t2-20ms	[p.u.]	0.171
	24	Active power	Total	t1+100ms to t2-20ms	[p.u.]	0.188
	25		Pos	t1+100ms to t2-20ms	[p.u.]	0.188
After t2	26	Voltage	L-N	t2+3s to t2+10s	[p.u.]	1.005
	27	Active power	Total	t2+3s to t2+10s	[p.u.]	0.205
	28		Pos	t2+3s to t2+10s	[p.u.]	0.195
	29	Active power recover time	Total	-	[ms]	--
	30	Reactive power	Total	t2+3s to t2+10s	[p.u.]	0.002
	31		Pos	t2+3s to t2+10s	[p.u.]	0.002
	32	Reactive power recover time	Total	-	[ms]	--

Photo Documentation

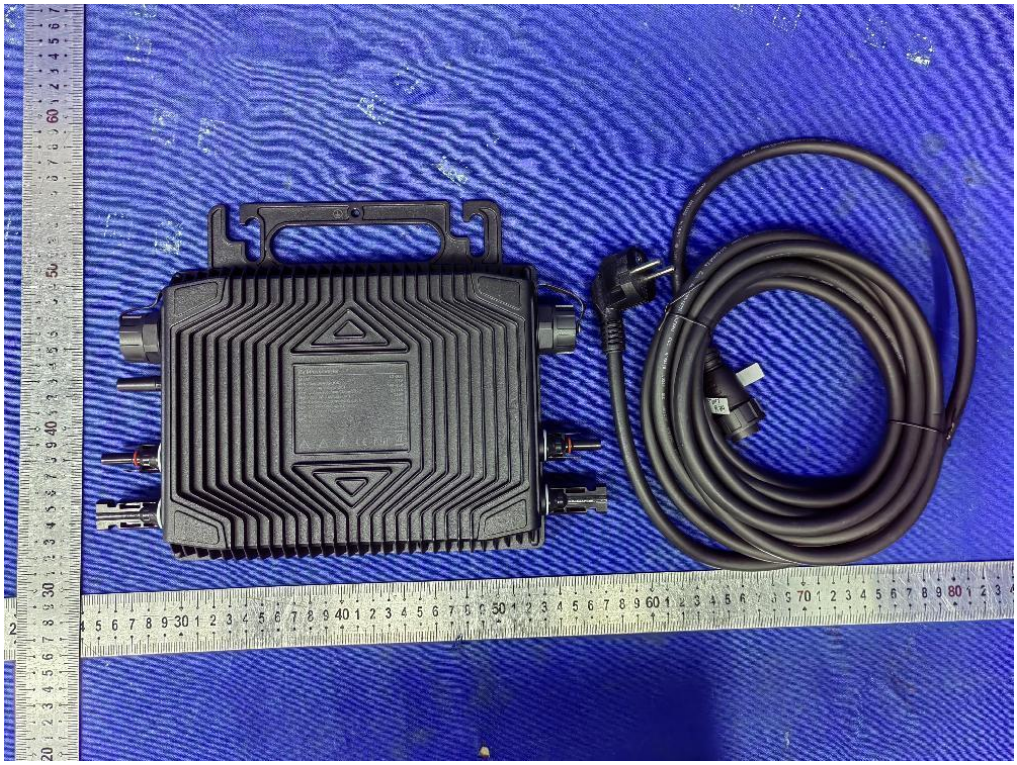


Fig.1---Over View 1

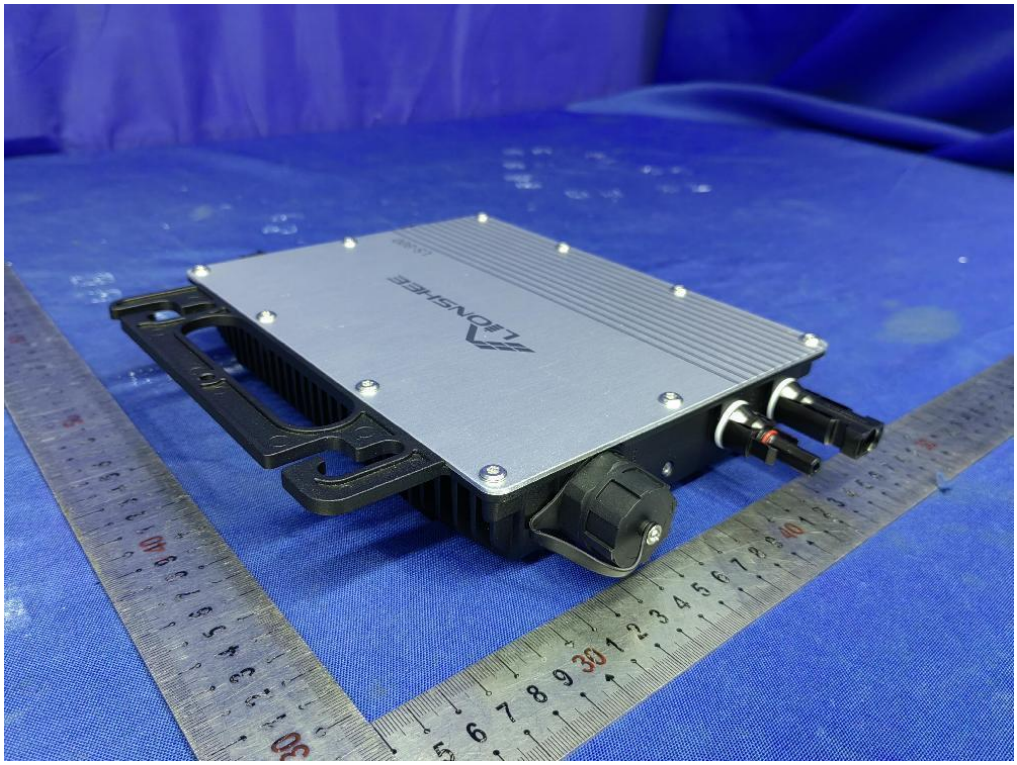


Fig.2---Over View 2

Photo Documentation

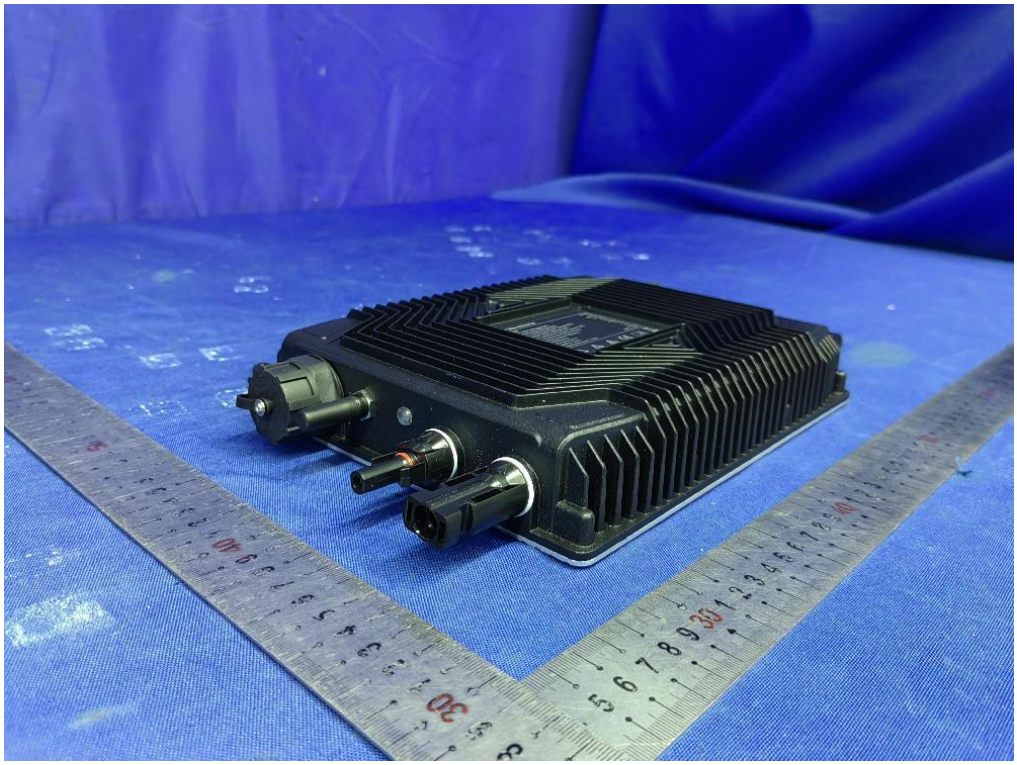


Fig.3---Over View 3

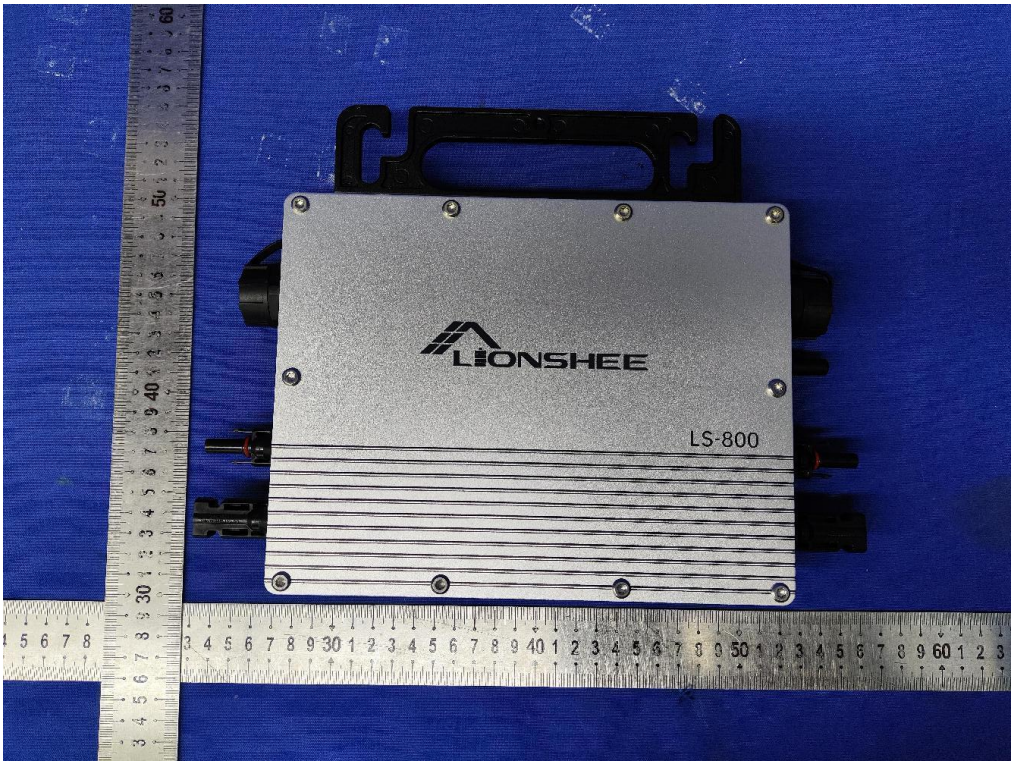


Fig.4---Over View 4

Photo Documentation

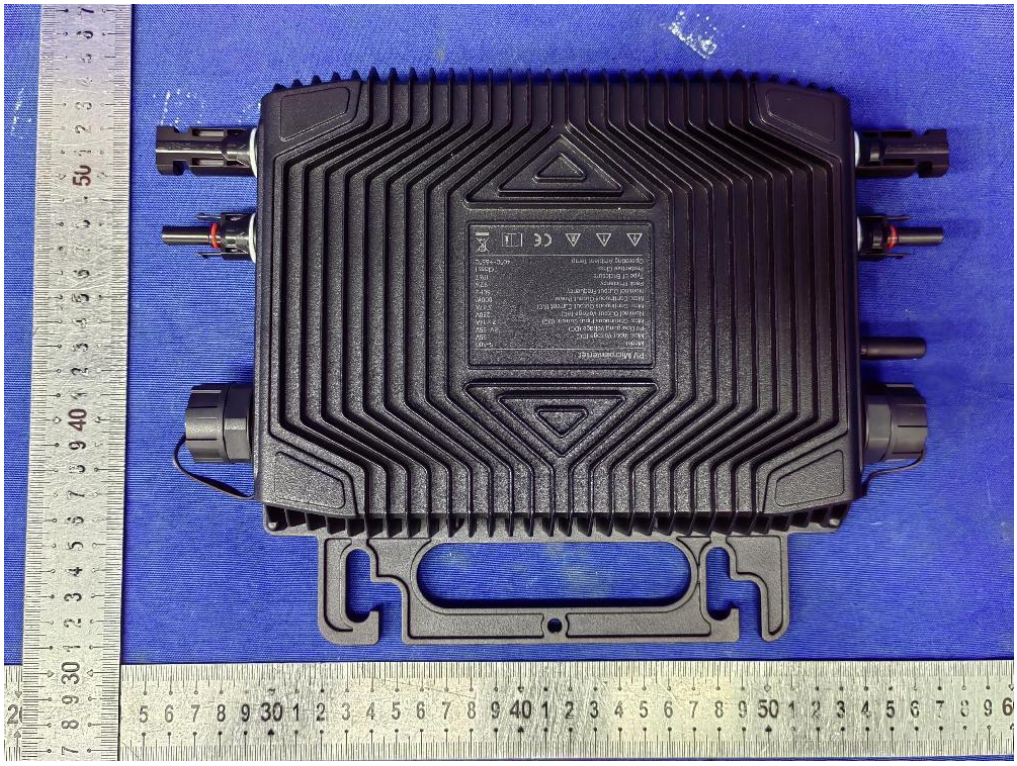


Fig.5---Over View 5

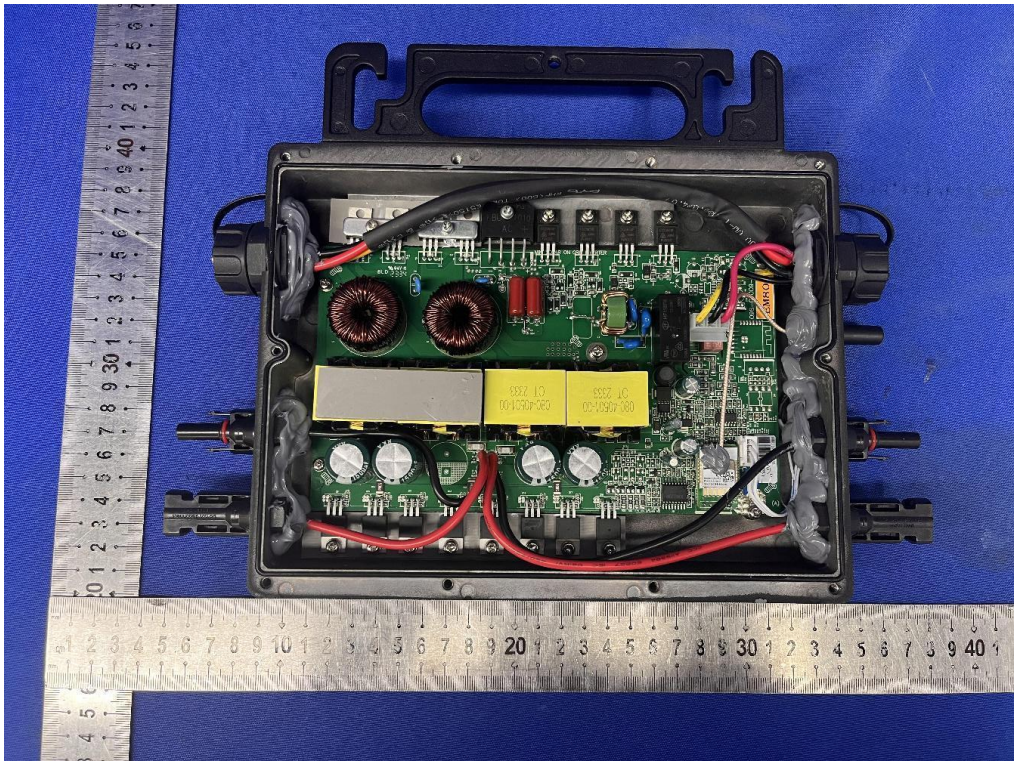


Fig.6---Inside View 1

Photo Documentation

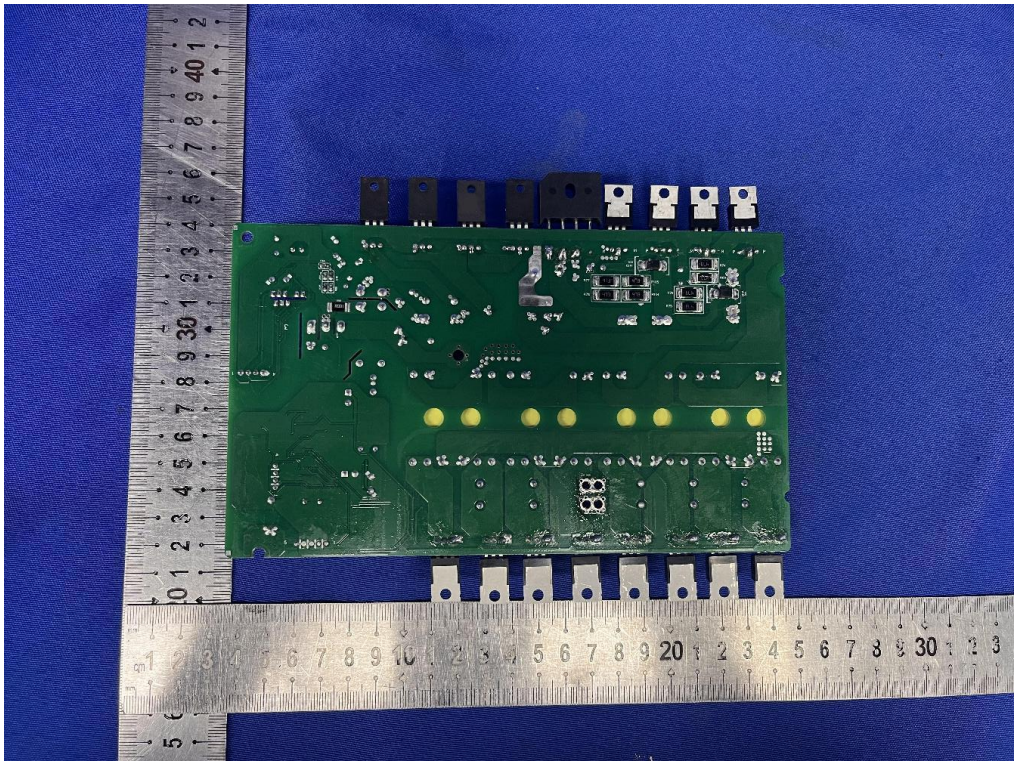


Fig.7---Inside View 2

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