Test Report issued under the responsibility of:





REPORT VDE-AR-N 4105:2018-11

Generators connected to the low-voltage distribution network – Technical requirements for the connection to and parallel operation with low-voltage distribution networks in junction with

DIN VDE V 0124-100 :2020-06

Report Reference No	· 240415256G7U-001
Date of issue	
Total number of pages	-
Testing Laboratory	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Address	Room101/301/401/102/202/302/402/502/602/702/802, No. 7-2, Caipin Road, Huangpu District, Guangzhou, Guangdong, China
Testing location/ address:	Same as above
Tested by (name +	Allen Feng
signature):	Engineer
Approved by (+ signature):	Gaison Li
	Reviewer
Applicant's name:	Zendure USA Inc.
Address:	1765 E BAYSHORE RD # 201 EAST PALO ALTO, CA 94303-5501 USA
Test specification:	
Standard:	VDE-AR-N 4105:2018-11
	DIN VDE V 0124-100 :2020-06
Test procedure:	Type approval
Non-standard test method	N/A
Test Report Form No	VDE-AR-N 4105d
Test Report Form(s) Originator.:	Intertek Guangzhou
Master TRF:	Dated 2020-06
	tole or in part for non-commercial purposes as long as Intertek is acknowledged as copyright takes no responsibility for and will not assume liability for damages resulting from the material due to its placement and context.
Test item description::	Hybrid Inverter
Trade Mark:	ZENDURE SuperCharged+-
Manufacturer:	ZENDURE TECHNOLOGY CO., LIMITED
Address	RM 517, NEW CITY ENTRE, 2 LEI YUE MUN ROAD, KWUN TONG, KOWLOON, HK, CHINA
Model/Type reference:	ZDHYP2000



Page 2 of 159

Ratings	Model	ZDHYP2000
	PV input	15 – 55 Vdc
	voltage Range	15 – 55 Vdc
	MPPT voltage Range	16 -48 Vdc
	Max.input	2*20.5 A
	current	2 20.3 A
	PV lsc	2*30A
	Nominal output voltage	230 Vac
	Nominal output Frequency	50 Hz
	Max. output current	5.5 A
	Max. output power	1200 W
	Max. apparent power	1200 VA
	Power factor range	0.8leading~0.8lagging
	Safety level	Class I
	Ingress Protection	IP 65
	Operation Ambient Temperature	-25℃ - +60℃
	Software version	V2



Page 3 of 159

Summary of tes	ting:		
Tests performed clause):	d (name of test and test	Testing location: Intertek Testing Services Shenzhen Ltd. Guangzhou	
VDE4105 (VDE0124) Test Description		Branch Room101/301/401/102/202/302/402/502/602/702/802	
, , , , , , , , , , , , , , , , , , ,	Rapid voltage changes	No. 7-2, Caipin Road, Huangpu District, Guangzhou, Guangdong, China	
5.4.4.3 (5.2.4)	Harmonics and inter- harmonics		
5.4.4.8 (5.2.6)	DC current feeding to network		
5.7.2.2.2 (5.4.2)	Measurement of active- and reactive power ranges		
5.7.2.3 (5.4.8.1)	2.3 Reactive power provision		
5.7.2.4 (5.4.8.2, 5.4.8.3)	Method of reactive power provision		
5.7.3 (5.8)	Dynamic Network support	1	
5.7.4.2 (5.4.3)	Network security management		
5.7.4.3 (5.4.4 & 5.4.5 & 5.4.6 & 5.4.7)	Active power adjustment when over- and under	when over- and under	
6.4 (5.5.1 & 5.5.2 & 5.5.3 & 5.5.4 & 5.5.5 & 5.5.6)	Interface switch (Functional safety)		
6.5.2 (5.5.7 & 5.5.8 & 5.5.9)	Protective function		
6.5.3 (5.5.10)	Islanding detection		
8.3 (5.6)	Connection conditions and synchronisation		



Page 4 of 159

Report no. 240415256GZU-001

Copy of marking plate:			
Supercharged Hyper 2000 Hybrid Inverter Model: ZDHYP2000 PV1, PV2, PV3, PV4 Rated Input: 15V-55V, 550W Max Number of MPPTs: 2 MPPT1(PV1 + PV2) Rated Input: 16V-48V == 20.5A, 900W Max MPPT2(PV3 + PV4) Rated Input: 16V-48V == 20.5A, 900W Max Battery Charge: 54VDC Max, 1600W Max Battery Discharge 54VDC Max, 1600W Max a c.Input, Output Nominal Power: 220/230/240V, 50Hz, 5.5A, 1200W M Power Factor(AC Input): >0.99 Power Factor(AC Output): 0.8 leading0.8 lagging Operating Temperature Range: -25°C to + 60°C IP Rating: IP65 Zendure DE GmbH ZENDURE TECHNOO Protective Closs: I		SN SN E Rohs	
Note: 1. The above markings are the minimum requirements requir production samples, the additional markings which do not			

2. Label is attached on the side surface of enclosure and visible after installation.

Page 5 of 159

Test item particulars				
Temperature range:	emperature range25°C to +65°C			
AC Overvoltage category:			🛛 OVC III	
DC Overvoltage category:		🛛 OVC II		
IP protection class:	IP65			
Possible test case verdicts:				
- test case does not apply to the test object :	- 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)			
Testing:				
Date of receipt of test item:	15 Apr 202	24		
Date (s) of performance of tests:	26 Apr 202	24 – 20 May	2024	



Page 6 of 159

General remarks:

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

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

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

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

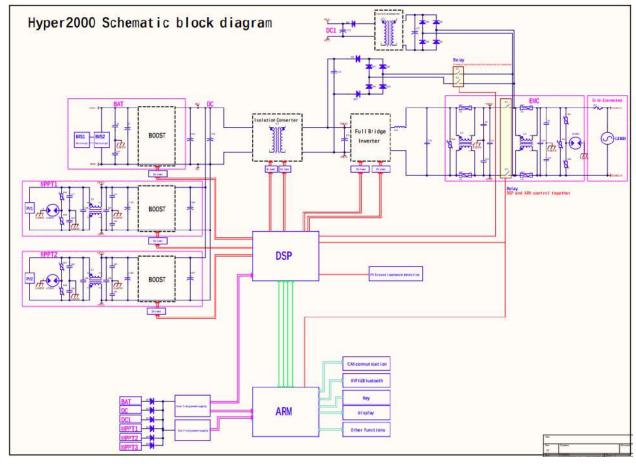
Page 7 of 159

General product information:

The unit is bidirectional which applies to the PV system with battery storage. Energy produced by the PV system is used to optimize self-consumption. Excess energy is used to charge the batteries, and then fed into the public grid when the PV energy is adequate.

When PV energy output is insufficient to support connected loads, the system automatically draws energy from the batteries if battery capacity is sufficient. If the battery capacity is insufficient to meet own consumption requirements, electricity will be drawn from the public grid.

The topology diagram as following:



The product was tested on:

The Software version: V2

The Hardware version: 19.12.00019 Hyper2000-PI-V1.2-20240421

Factory information:

Astec Énergy Products (Dongguan)Company Limited Address: Building 1, No. 215, Yuehai Avenue, Xiegang, Dongguan City, Guangdong Province, P.R. China Page 8 of 159

Report no. 240415256GZU-001

	VDE-AR-N 4105:2018-11			
Clause	Requirement - Test		Result - Remark	Verdict

4	General framework conditions		N/A
4.1	Provisions and regulations	This report is only evaluated and tested for PGU; The PGS incorporated with the PGU shall further consider this clause and sub-clause.	N/A
4.2	Application procedure and relevant document for connection	Shall consider in final PGS	N/A
4.3	Commissioning of the power generation system and/or the storage unit	Shall consider in final PGS	N/A

5	Network connection		Р
5.1	Principles for determination of the network connection point	Shall consider in final PGS	N/A
	Power generation systems and storage units shall be connected at a suitable point of the network, i. e. the network connection point. Based on the documents listed in 4.2, the network operator determines the suitable		
	network connection point which will ensure safe network operation while also taking into account the power		
	generation system and the storage unit and at which the requested power can be drawn and transmitted. The essential aspect for a network connection evaluation is always the behaviour of the power generation system and the storage unit at the		
	network connection point or at the PCC. This is intended to ensure that the power generation system or storage unit is operated without adverse interactions and impairment of the supply of other customers. Annex D shows an example of the connection evaluation of power generation systems		
5.2	Rating of the network equipment	Shall consider in final PGS	N/A
	 Due to their operating mode, power generation systems and storage units may cause higher loading of lines, transformers and other network equipment. Therefore, the network operator verifies the transmission capacity of the network equipment with regard to the connected power generation systems and storage units in accordance with the relevant rating regulations. For calculation purposes, the maximum apparent power of the sum of all power generation systems and 		
	storage units $\sum S_{Amax}$ and usually the load factor $m = 1$ shall be used. This does not apply to buried cables for the connection of photovoltaic systems where a load factor $m = 0.7$ shall be used.		

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Page 9 of 159

Report no. 240415256GZU-001

	VE	E-AR-N 4105:2018-11		
Clause	Requirement - Test	Result	- Remark	Verdict
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5.3	Permissible voltage change	Shall consider in final PGS	N/A
	For undisturbed operation of the network, the amount of the voltage change caused by all power generation systems with a network connection point in a low- voltage network shall at none of the PCCs in this network may a value of 3 % as compared with the voltage without power generation systems. Deviations from the value of $\Delta u_a \le 3$ % are permissible as specified by the network operator (e. g. when using a controllable local network transformer). When calculating the voltage change, the displacement factor shall be taken into account which is provided by the network operator for the maximum apparent connection power of the power generation system SAmax.		
5.4	Network interactions		N/A
	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.		
5.5	Connection criteria		Р
5.5.1	General	Shall be considered full feed-in	Р
	When connecting a power generation system or a storage unit, the technical connection conditions of the network operator shall be observed.	or excess feed-in that in accordance with VDE-AR-N 4100 in the power system	

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Page 10 of 159

VDE-AR-N 4105:2018-11				
Clause	Requirement - Test	Result - Remark	Verdict	
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5.5.2	 PAV, E monitoring (feed-in limitation) PAV, E monitoring allows a connection power PAV, E deviating from the installed power to be agreed with the network operator and to be set. The feed-in limit described in this sub-clause shall be measured at the central meter panel in accordance with VDE-AR-N 4100, 7.2. PAV, E monitoring can be an independent equipment mounted at the central meter panel in accordance with VDE-AR-N 4100 or in a suitable circuit distributor or may also be part of a power generation unit or a storage unit or a charging unit for electric vehicles. When PAV, E is exceeded, the power of the power generation system and/or the storage unit causing the event shall be reduced. PAV, E monitoring is to be used for monitoring the agreed active connection power PAV, E of power generation systems and/or storage units if thefeed-in power at the network connection point PAV, E agreed with the network operator is smaller than the sum of the installed maximum active connection power of all power generation systems and/or storage units at that network connection point. 		N/A	
5.5.3	Power generation systems ready for connection In addition to the requirements specified in this VDE application guide, DIN VDE V 0100-551-1 (VDE V 0100-551-1) applies to power generation systems ready for connection. Provided a connection-ready power generation system is connected via an existing specific energy socket (e. g. complying with VDE V 0628-1 (VDE V 0628-1)) and a bidirectional meter is mounted at the central meter panel, the signature and the details of the system installer on the commissioning protocol E.8 may be omitted. A site map is not required in this case. This only applies up to a value SAmax ≤ 600 VA per network user installation Three-phase inverter systems For three-phase power generation systems feeding into the network via inverters, the power feed-in into the inverter circuit shall preferably be set up as a three phase current unit. The positive sequence		N/A N/A	
5.7	system of the terminal voltages, even if they are unbalanced, is to be used as the reference quantity for the currents. Behaviour of the power generation system at the n	letwork	P	

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Page 11 of 159

Report no. 240415256GZU-001

VDE-AR-N 4105:2018-11

	VDE-AR-N 4103.2016-11			
Clause	Requirement - Test	Result - Remark	Verdict	

5.7.1	General	(See appended table)	Р
	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 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. Power generation units shall be able to ride through rapid frequency changes without disconnection from the network. This requirement applies provided the following averaged rates of change of frequency (RoCoF) are not exceeded: $- \pm 2,0$ Hz/s for a moving time slot of 0,5 s; or $- \pm 1,5$ Hz/s for a moving time slot of 2 s. In case of rapid frequency changes, frequency measurements shall not take more than 200 ms. The minimum accuracy of frequency measurements is \pm 50 mHz.	The unit is verified with ROCOF (2.0Hz/s) without disconnection.	
5.7.2	Steady-state voltage stability/reactive power supply	у	Р

Page 12 of 159

	VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict	
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5.7.2.1	General boundary conditionsSteady-state voltage stability means the reactivepower supply provided by a power generation systemand/ora storage unit when energy is supplied for thepurpose of voltage stability in the distribution network.Thesteady-state voltage stability is intended to keep slow(steady-state) voltage changes in the distributionnetwork within acceptable limits.In case of three-phase feed-in, the reactive powersupply associated with all three methods described in5.7.2.4 a) to c) refers to the positive sequencesystem components of the current and voltagefundamentalcomponent. In a passive sign convention system (seeA.8), this means the operation of the powergenerationsystem in Quadrant II (under-excited) or Quadrant III(over-excited).If a storage unit consumes energy from the network,the reactive power exchange at the networkconnectionpoint shall comply with the contractual agreementsregarding the network connection for customerinstallations for consumption (see VDE-AR-N 4100).It shall be possible to approach each set-pointresulting from the applied control method accordingto therequired reactive power range given in 5.7		Ρ	
5.7.2.2	Reactive power supply at ΣS_{Emax}		Р	
5.7.2.2.1	General		Р	
	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 $U_{\rm h} \pm 10$ %.			
5.7.2.2.2	Type 2 systems – inverters only At the generator terminals, each power generation unit to be connected shall meet the requirements		Р	
	according to Figure 2 and Figure 3.			

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Page 13 of 159

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.2.2.3	Type 2 systems – Asynchronous generators (directly connected to the network and	Inverter	N/A
	principally not able to control any reactive power)		
	For power generation units with generators that are directly connected to the network and principally not able to control any reactive power and therefore use constant capacities, a constant displacement factor $\cos \phi = 0.95$ under-excited with an accuracy of ± 0.02 at nominal voltage and rated power shall be observed.		
5.7.2.2.4	Type 1 systems and type 2 systems – stirling generators and fuel cells		N/A
	For power generation systems with a rated apparent power of Σ SEmax \leq 4,6 kVA , the network operator does not give any specifications. The value of cos ϕ lies within a range of cos $\phi = 0.95$ under-excited to 0,95over-excited. At its generator terminals, each power generation unit to be connected in systems Σ SEmax > 4,6 kVA shall meet the requirements according to Figure 4.		
5.7.2.3	Reactive power supply smaller than <i>P</i> Emax	(See appended table)	Р
5.7.2.5	In addition to the requirements for reactive power supply at the operating point P_{Emax} of the power generation unit ($P_{\text{mom}} = P_{\text{Emax}}$), requirements also apply to operation with an instantaneous active power P_{mom} smaller than P_{Emax} . The minimum requirement for the reactive power supply in partial load operating mode at the generator terminals is indicated as a red triangle on the P/Q		
	diagram. Within the ranges given in Figure 5 or Figure 6, the maximum residual deviation between the set-point and the actual value of the reactive power at the generator terminals shall not exceed $\pm 4,0$ % in relation to <i>P</i> Emax. Within the range of $0 \le P$ mom/ <i>P</i> Emax < 0,2 (or 0,1, respectively), the power generation unit shall not exceed the reactive power value at the generator terminals of 10 % of the active power value <i>P</i> Emax (reactive power supply and consumption respectively). Where a minimum technical power for a power generation unit has been agreed, the same conditions apply as for the range $0 \le P$ mom/ <i>P</i> Emax < 0,2 (or 0,1, respectively) between 0 and the minimum technical power.		

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Report no. 240415256GZU-001

VDE-AR-N 4105:2018-11

Page 14 of 159

	VDE-AR-N 4105.2016-11			
Clause	Requirement - Test	Result - Remark	Verdict	

5.7.2.4	Methods for reactive power supply	Method b and c are used for	Р
	The reactive power supply for steady-state voltage stability shall not impair the dynamic network stability.	reactive power supply PGU S _{Emax} ≤4.6 kVA characteristic curve provided	
	The reactive power to be provided by the power generation system is limited to the range given in Figure 5 or Figure 6, respectively. In the context of network connection planning, the network operator prescribes to the connection owner one of the following methods for reactive power supply at the generator terminals of the power generation unit: a) reactive power voltage characteristic curve $Q(U)$; or b) displacement factor/active power characteristic curve $\cos \phi$ (<i>P</i>); or c) fixed displacement factor $\cos \phi$. The $Q(U)$ rule applies only to three-phase power generation units connected to the three-phase current system. Here, too, the reactive power requirements are implemented at the generator terminals of the power	by the network operator within cosφ= 0.95under-excited to 0.95 over-excited.	
	generation units.		
	Re: a) reactive power voltage characteristic curve $Q(U)$ The objective of this method is the reactive power exchange between power generation unit and network depending on the actual voltage at the generator terminals of the power generation unit ($Q = f(U)$). The reference voltage U_{Q0} is 400 V / 3. 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.		N/A
	Re: b) Displacement factor/active power characteristic curve cos ϕ (<i>P</i>) The objective of this method is the reactive power supply by the power generation unit depending on the	(See appended table)	Р
	actual active power output ($Q = f(P_{mom})$).		

Page 15 of 159

Report no. 240415256GZU-001

	VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict	
	Re: c) Displacement factor cos ϕ The objective of displacement factor control is the power feed-in by the power generation unit at a constant active power/apparent power ratio (cos ϕ = const). Thereby, the use of the reactive power control range given in Figure 5 and Figure 6 is restricted. For this purpose, the target value is defined with a minimum increment of $\Delta \cos \phi = 0,01$. 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 <i>P</i> Emax. The network operator predefines a displacement factor set-point.	(See appended table)	P	
5.7.2.5	Requirements for reactive power methods of type 2 systems (inverters only) and type 1 systems 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.		Ρ	
	The control behaviour of the reactive power (methods a), b) and c)) with respect to set-point offsets corresponds to the PT-1 behaviour shown in Figure 10. Method a) deals with a closed control circuit under consideration of the network impedance. Each reactive power value resulting from the control behavior predefined by the network operator shall be adjustable within a range of 6 s to 60 s (from 10 s to 60 s for type 1) when being provided by the power generation unit. The time specified by the network operator corresponds to 3 Tau of a PT-1 behaviour or to the time until reaching 95 % of the set-point. If no actual value is predefined by the network operator for this purpose, the applicable value is 10 s for 3 Tau or 95 % of the set-point, respectively. The envelop delay time includes the determination of the network voltage or the active and reactive powers.		Ρ	
5.7.2.6	Special aspects regarding the extension of power generation systems The requirements specified in 5.7.2.4 shall also be met by the newly added power generation units at their generator terminals. The reactive power supply by the added power generation units in accordance with 5.7.2.2 shall be determined based on the sum of the rated apparent powers of the existing power generation system and the newly added power generation units.		Ρ	

Page 16 of 159

Report no. 240415256GZU-001

VDE-AR-N 4105:2018-11

Clause Requirement - Test

Result - Remark

Verdict

5.7.3	Dynamic network stability		Р
5.7.3.1	General	(See appended table)	Р
5.7.3.2	Dynamic network stability for type 1 units		N/A
	Transient stability – Reaction to network faults		
	Regarding the power generation unit remaining connected to the network, the following applies to type 1 units: Throughout the operating range of the power generation unit, voltage drops caused by single- phase, two phase or three-phase network faults and the subsequent voltage transient phenomena shall not cause the power generation unit to become unstable or to disconnect from the network if the voltage assumes values within the limit curves shown in Figure 11 (red for the under-voltage limit curve, blue for the over-voltage limit curve).		
5.7.3.3	Dynamic network stability for type 2 units and storage units		Р
	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.		
	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.		Ρ
	If the voltage at the generator terminals falls below < 0,8 <i>U</i> n or exceeds > 1,15 <i>U</i> n (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).		Ρ

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Page 17 of 159

	VDE-AR-N 4105:2018-11		
Clause	Requirement - Test	Result - Remark	Verdict
	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 <i>I</i> ^{<i>t</i>} within 60 ms and 10 % of <i>I</i> ^{<i>t</i>} within 100 ms upon a voltage drop below 0,8 <i>U</i> ⁿ or a voltage rise above 1,15 <i>U</i> ⁿ .		Ρ
	Behaviour after the end of a fault		Р
	If, after the end of a fault, the network voltage resumes a value within the voltage band from -15 % <i>U</i> n to +10 % <i>U</i> n 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 <i>U</i> n, 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.		
5.7.4	Active power output	·	Р
5.7.4.1	General 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 following power gradients shall be observed for increasing/reducing the active power output of power generation systems (minimum technical power or 5 % <i>P</i> Amax ↔ 100 % <i>P</i> Amax) as well as the energy supply and consumption by storage units (5 % <i>P</i> Amax ↔ 100 % <i>P</i> Amax): – at a maximum rate of 0,66 % <i>P</i> Amax per s; – at a minimum rate of 0,33 % <i>P</i> Amax per s. Power generation systems may react more slowly in case of set-points specified by third parties and of power increases. For this purpose, a minimum rate of 4 % <i>P</i> Amax per minute should be observed.	The active power can be remote-controlled on the Phone and Server through WiFi module.	Ρ

Page 18 of 159

	VDE-AR-N 4105:2018-11		
Clause	Requirement - Test	Result - Remark	Verdict
	Other technically induced power gradients (e. g. for hydro power generation systems with level control depending on network demands) are permissible upon approval by the network operator. The power increase or reduction of the customer installation shall be realised in a uniform process, i. e. with a behaviour as linear as possible. The specification of set-points by third parties shall be realised on the level of the individual customer installation or by the sum of all systems accessed by a third party (e. g. by uniform distribution of the active powers to be connected or disconnected over a total period of \ge 2,5 min).		N/A
	The power generation system or storage unit shall be provided with a logical interface (inlet port) which, irrespective of the power gradients listed above, allows to terminate the active power output within 5 s upon reception of a corresponding signal from the network operator. Additionally, the interface may be used for network security management.		Ρ
5.7.4.2	Network security management		Р

Page 19 of 159

Report no. 240415256GZU-001

	VDE-AR-N 4105:2018-1	1	
Clause	Requirement - Test	Result - Remark	Verdic
5.7.4.2.1	Types of power generation systems and storage unitsIf not specified otherwise by legislation, the requirements described below apply.	The active power can be remote-controlled on the Phone and Server through WiFi module.	P
	Photovoltaic systems PV systems shall contribute to the avoidance of network overload. For this purpose, PV system power is divided into three power groups: For PV systems up to and including 30 kWp, the system operator may chose between two options: a) by means of a corresponding inverter design or a certified technical control, the active power feed-in of the PV system shall be permanently limited to a maximum value of 70 % of the installed module power at the network connection point with the power gradients given in 5.7.4.1; or b) the PV system shall be provided with a technical means for remote-controlled reduction of the feedin power by the network operator. PV systems > 30 kWp up to and including 100 kWp shall be provided with a technical means enabling the remote-controlled reduction of the feed-in power by the network operator. PV systems > 100 kWp shall be provided with a technical means enabling the remote-controlled reduction of the actual feed-in power. If the installed total power increases to > 100 kWp due to the installation of a further PV system on the same plot or building within a period of 12 months, legal provisions require implementation of the feed-in management for systems > 100 kWp while providing the actual feed-in power increases to power. 		
	Cogeneration of power and heat (CHP) systems, wind, biogas, hydroelectric power as well as landfill and sewage gas systems Those PV systems with <i>P</i> Amax > 100 kW shall be provided with a technical means enabling the remote-		N/A

feed-in power.

controlled reduction of the feed-in power by the network operator and for the provision of the actual

Page 20 of 159

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
	Storage units buffering EEG or KWKG systems Those storage units with <i>P</i> Amax > 100 kW shall be provided with a technical means enabling the remote controlled reduction of the feed-in power by the network operator and for the provision of the actual feed-in power. These requirements do not apply if the feeding into the network of the network operator by a storage unit is prevented by technical control means. This shall be demonstrated by means of a manufacturer's declaration.		N/A
	Any EEG and KWKG systems with an intelligent measurement system If an intelligent measurement system is present, the network operator may demand the metering point operator to transmit network state data (i. e. also the actual feed-in power).		N/A
	Any power generation systems and storage units other than those indicated above All power generation systems and storage units shall be provided with technical means enabling the remote-controlled reduction of the feed-in power by the network operator and for the provision of the actual feed-in power.		P
5.7.4.2.2		(See appended table)	P

Page 21 of 159

Report no. 240415256GZU-001

VDE-AR-N 4105:2018-11

Clause	Requirement - Test	Result - Remark	Verdict

5.7.4.2.3	Active power adjustment at over-frequency and under-frequency A network frequency outside the tolerance band of \pm 200 mHz around the nominal network frequency of 50,0 Hz indicates the presence of a critical system state in the integrated network where any power generation units and storage units shall contribute to the network frequency support. The accuracy of the frequency measurement in the steady state shall be $\leq \pm 10$ mHz. The requirements given in 5.7.4.3 do not apply to storage units in standby mode. Additionally, DC coupled storage units shall behave as type 2 units. In case of over-frequency , an excess of generated power is opposed by a deficit of consumed power. Therefore, all power generation units and storage units shall be able to adjust the active power working point at an over-frequency up to a maximum of 51,5 Hz (see Figure 14 and Figure 15). Power generation units shall enable the frequency for starting this frequency-dependent active power feed- in to be set to a value between 50,2 Hz and 50,5 Hz. Unless specified otherwise by the network operator, this start frequency shall be set to 50,2 Hz. The static value of the frequency-dependent active power feed- in shall be adjustable within a range of 2 % to 12 %. This corresponds to a power gradient within a range of 16.67 % of <i>Pret</i> per Hertz (s = 12 %) to	(See appended table) The starting frequency can be set from 50.2 to 50.5Hz, And, power gradient 2%-12% adjustable Default 50.2 and power gradient 5% setting.	Ρ
	Therefore, all power generation units and storage units shall be able to adjust the active power working point at an over-frequency up to a maximum of 51,5 Hz (see Figure 14 and Figure 15). Power generation units shall enable the frequency for starting this frequency-dependent active power feed- in to be set to a value between 50,2 Hz and 50,5 Hz. Unless specified otherwise by the network operator, this start frequency shall be set to 50,2 Hz. The static value of the frequency-dependent active power feed- in shall be adjustable within a range of 2 % to 12 %.		
	of <i>P</i> _{ref} per Hertz ($s = 5$ %) shall be set (see Figure 14). For storage units, the generated active power with a gradient of 40 % of <i>P</i> _{Emax} per Hertz ($s = 5$ %) shall be reduced or increased (see Figure 15). Consequently, the power generation unit or the storage unit will constantly move up and down along the frequency characteristic within the frequency range of 50,2 Hz (unless specified otherwise for power generation units by the network operator) to 51,5 Hz with regard to its maximum possible active power feed-in ("operation along the characteristic").		

Page 22 of 159

Report no. 240415256GZU-001

V/DE_AP_N /105:2018-11

VDE-AR-N 4105:2018-11			
Clause	Requirement - Test	Result - Remark	Verdict
	· · · · · · · · · · · · · · · · · · ·		
		PV inverter units, a gradient of 40 % <i>P</i> Emax per Hertz (s =	Ρ

 units shall increase the instantaneous generated active power <i>P</i>mom with a gradient of 40 % <i>P</i>Emax per Hertz (s = 5 %) to its technically possible maximum value. For storage units, a gradient of 100 % <i>P</i>Emax per Hertz (s = 2 %) applies. The maximum value is determined by the actual primary energy supply as well as the actually usable storage power. Power reductions for the protection of operating equipment are permitted even at under-frequency. For CHP systems, power reductions resulting from a heat-lead operating mode or a power drop due to the rotational speed are also permitted. Storage units dedicated to other purposes (e. g. gas storage units in biogas systems, DC buffer storage elements for self-consumption etc.) should be activated for this purpose. System-integrated storage units with an energy level below <i>P</i>n x 30 s (e. g. smoothing chokes, indirect capacitors etc.) may be neglected for this application. Consequently, power generation units and storage units will constantly move up and down along the frequency characteristic also within the frequency range of 49,8 Hz to 47,5 Hz or 47,8 Hz with regard to their maximum possible active power feed-in ("operation along the characteristic"). At an under-frequency within the range of 49,8 Hz to 47,5 Hz, all storage units in charging power according to the characteristic curve shown in Figure 15 to its technically possible minimum value ("operation along the characteristic curve shown in Figure 15. In this case, system stability is of higher priority than a potential restraint for feeding storage energy into the network of the network operator based on technical/financial requirements. At network fequencies f < 47,5 Hz, power generation units and storage units and storage units with a potential restraint for feeding storage energy into the network of the network operator based on technical/financial requirements. 	40 % <i>P</i> Emax per Hertz (s = 5 %) applies (See appended table)	
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Page 23 of 159

	VDE-AR-N 4105:2018-1	1	
Clause	Requirement - Test	Result - Remark	Verdict
	Requirements for the control times for power generation units and storage unitsThe initial time delay <i>T</i> ∨ of the frequency-dependent adjustment of the active power output at over- frequency and under-frequency is part of the transient period and shall preferably be ≤ 2 s. In case of a time delay > 2 s, the operator of the power generation system shall justify that delay by submitting technical proof to the transmission network operator. For type 2 power generation units and storage units, the necessary initial time delays <i>T</i> ∨ for reaching the required transient periods are significantly shorter than 2 s. For the time curve of the frequency-dependent active power adjustment, the following conditions regarding the initial time delay <i>T</i> ∨ and the transient period <i>T</i> an_90 % shall be observed: – After <i>T</i> ∨ + 0,1 × (<i>T</i> an_90 % – <i>T</i> ∨) has elapsed, a value of at least 9 % of the required power adjustment Δ <i>P</i> has been reached. – After the transient period <i>T</i> an_90 % has elapsed, a value of 90 % of the power adjustment Δ <i>P</i> has been reached.		P
	During the control process ("operation along the characteristic"), the power generation unit and the storage unit shall respond as quickly as possible to sudden network frequency changes within a frequency range of 50,2 Hz to 51,5 Hz (subject to capability as declared by the manufacturer) with a transient period of 8 s for $\Delta P \le 45$ % of <i>P</i> Emax and ΔP for power changes beyond that in case of type 1 units and type 2 units with rotating machinery and 2 s in case of all other type 2 power generation units and 1 s in case of storage units. The settling period shall not exceed 30 s for type 1 units and type 2 units with rotating machinery or 20 s for all other type 2 power generation units and for storage units. After settling, the supplied active power should deviate by $\le \pm 10$ % <i>P</i> Emax from the set-point. The same requirements shall be applied to the active power increase at an under-frequency between 49,8 Hz and 47,5 Hz.		P

Page 24 of 159

Report no. 240415256GZU-001

VDE-AR-N 4105:2018-11

	VDE-AR-N 4105.2018-1	1	
Clause	Requirement - Test	Result - Remark	Verdict

Conditional requirements based on technical restrictions	N/A
As an alternative to active power reduction at over-	
frequency, non-controllable power generation units	
may disconnect from the network within the	
frequency range of 50,2 Hz to 51,5 Hz; in that case,	
uniform	
distribution of the disconnection frequency in	
maximum increments of 0,1 Hz shall be ensured for	
each system type by the manufacturer.	
Power generation units of limited variability, e. g. only	
within the range of 70 % to 100 % <i>P</i> Emax, can be	
curtailed within that range in accordance with the	
characteristic curve. Outside the controllable range,	
disconnection is then carried out according to the	
uniformly distributed shut-down limit curve.	
For power generation units with combustion engines	
or gas turbines, active power reduction occurs with a	
power gradient of at least 66 % PEmax per minute	
(equals 1,11 % <i>P</i> Emax per second). Thus, the	
transient period of 8 s can be observed up to a power	
reduction of 8,88 % PEmax. In case of a greater	
change of frequency, the transient period is	
accordingly higher.	
Linear generators, such as stirling machines up to a	
maximum apparent power of SAmax ≤ 4,6 kVA, are	
exempt from the active power feed-in at over/under-	
frequency. They may remain connected to the	
network within a frequency range between 50,2 Hz	
and their maximum upper frequency limit and may	
disconnect from	
the network if this value is exceeded or, at the latest,	
when a frequency of 51,5 Hz is reached or exceeded.	
At an under-frequency between 49,8 Hz and their	
maximum lower frequency limit, linear generators	
should remain connected to the network but shall	
disconnect from it at the latest when a frequency of	
47,5 Hz is reached or exceeded.	

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Page 25 of 159

VDE-AR-N 4105:2018-11 Result - Remark Verdict Clause Requirement - Test End of critical network state and return to normal Ρ operation Even if the network frequency has resumed a value within the tolerance band of 50,0 Hz \pm 200 mHz after a frequency deviation, a critical network state has still to be assumed initially. The time for transition from the critical network state to normal operation is limited by a maximum change of the active power set-point based on Pmom. This change of the active power set-point (except for providing the operating reserve) shall be limited to a maximum gradient of 10 % of the active power PEmax per minute (under consideration of 5.7.1). Only after the network frequency has been within the tolerance band of 50.0 Hz \pm 200 mHz for 10 min continuously. the normal operation of the network is deemed to be restored whereupon this requirement does no longer apply. Voltage-dependent active power reduction 5.7.4.4 N/A In order to avoid disconnection of the power generation system due to over-voltage protection U >, it is permissible to reduce the active power feedin as a function of the voltage of (a) power generation unit(s). Implementation is then chosen by the system manufacturer. This is not considered an active power reduction in the context of feed-in management in compliance with EEG. Surges or oscillations of the active power feed-in are not permitted for that purpose. Short-circuit contribution 5.7.5 Ρ 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 *I*kA 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.

Page 26 of 159

	VDE-AR-N 4105:2018-1	1	
Clause	Requirement - Test	Result - Remark	Verdict
6	Construction of the power generation system/networ protection)	k and system protection (NS	Р
6.1	General requirements 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 point Σ SAmax , the following conditions apply to the NS protection:		P
6.2	Central NS protection	Integrated NS protection	N/A
	The central NS protection shall be accommodated, installed and connected as an independent equipment at the central meter panel in a suitable circuit distributor in accordance with VDE-AR-N 4100, Clause 8, Paragraph 1, and not in the upper connection compartment according to VDE-AR-N 4100, 7.2, Paragraph 11. Examples of the arrangement of the central NS protection and hence the connection of power generation systems to meter panels are shown in Annex C. For central NS protection, it is additionally required to carry out a trigger test for checking the tripping circuit "NS protection – interface switch". For this purpose, the central NS protection is provided with a means for tripping the interface switch (e. g. by means of a test button) for testing purposes. Activation shall be visualised at the interface switch.		
6.3	Integrated NS protection		Р
	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). In this case, the means for testing the tripping circuit "NS protection – interface switch" by the system installer is not required. The integrated NS protection acts on an integrated interface switch (see 6.4.3).		
6.4	Interface switch	The PSU include integrated interface switch and is type tested in the report	Р

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Page 27 of 159

Report no. 240415256GZU-001

VDE-AR-N 4105:2018-11

Clause Requirement - Test Result - Remark Verdict	VDL-A(-1) + 103.2010-11			
	Clause	Requirement - Test	Result -	Remark Verdict

6.4.1	General	Integrated interface switch has	Р
	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. As interface switches, the switching devices of the individual power generation units (integrated interface switch) can be used. The integrated interface switches can also be used in combination with the central NS protection. In any	been type tested in compliance with DIN EN 62109	
	case, central NS protection from Σ SAmax>30 kVA (sum of the maximum apparent powers of all power		
	generation systems and storage units connected to the same network connection point; for exceptions, see 6.1) shall be directly connected to the central meter panel. Where a signal is routed to a spatially separate switching device, it shall be ensured that the required disconnection periods given in Table 2 are observed and lead to the disconnection of the power generation system. During commissioning of the power generation		
	system, a tripping test of the interface switch shall be conducted.		
	The interface switch shall be designed for the rated conditional short-circuit current and under consideration of the protective devices required according to 6.5 and it shall enable instantaneous tripping. The switching capacity of the interface switch shall be rated according to the rated current of the upstream fuse or the maximum initial short-circuit AC current contribution of the power generation system, whichever is the higher. 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 with DIN EN 62109 (VDE 0126-14). When a defect of the interface switch is detected, the 		
	power generation system shall neither feed in nor reconnect.		

Page 28 of 159

Report no. 240415256GZU-001

	VDE-AR-N 4105:2018-1	1	
Clause	Requirement - Test	Result - Remark	Verdict
6.4.2	Central interface switch		N/A
	The central interface switch shall be a galvanic break device (e. g. mechanical contactor, protective motor switch, mechanical circuit breaker). For a power generation system required to contribute to the dynamic network stability, an interface switch enabling compliance with the requirements specified in 5.7.3 (no malfunction at under-voltage in the context of the FRT requirements) shall be used. The interface switch shall be installed in the distribution field of or directly at the central meter panel in a circuit distributor. Examples of the arrangement of interface switches and hence the connection of power generation systems to meter panels are shown in Annex C.		
6.4.3	Integrated interface switch For the construction of the interface switch, the requirements specified in 6.1 shall be considered. The interface switch (e. g. power relay, mechanical contactor, mechanical circuit-breaker, etc.) ensures	Integrated power relay in the PGU. Each live conductor is constructed with two relays	P
	galvanic breaking.		
	For power generation systems with inverters, the interface switch shall be provided on the inverter's network side.		
6.5	Protective devices and protection settings		Р
6.5.1	General 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.		P
6.5.2	Protective functions	(See appended table)	Р
	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 P_n > 50 kW shall also be designed such as to be adjustable in the NS protection (see Table 2, Footnote d). Any other 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.		

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Page 29 of 159

VDE-AR-N	4105:2018-11	
Requirement - Test	Result - Remark	Verdict

9	Verification of electrical properties	P
8.4	Special aspects regarding the planning, installation and operation of power generation systems and storage units each with PAmax \ge 135 kW	N/A
	units with invertersPower generation units with inverters (such as photovoltaic systems) and storage units with inverters shall only be connected with $k_{imax} \le 1,2.$	
8.3.4	Connection of power generation units and storage	Р
8.3.3	Connection of asynchronous generators	N/A
8.3.2	Connection of synchronous generators	N/A
8.3.1	General(See appended table)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 % Uh to 110 % Uh 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 PAV, 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 PAmax per minute. Non-controllable power generation systems and storage units can connect after 1 min to 10 min (random generator) or later.	P
8.3	Connection conditions and synchronisation	P
8.2	Special aspects of the management of the network operator's network	N/A
8.1	General	Р
8	Operation of the system	Р
7	Metering for billing purposes	N/A
6.6	Further requirements for power generation systems Shall be considered in PGS	N/A
6.5.3	Islanding detection (See appended table)	P

Report no. 240415256GZU-001

VDE-AR-N 4105:2018-11							
Clause	Requirement - Test		Result - Remark	Verdict			
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Page 30 of 159

Annex A: Explanations (informative)

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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)

	Annex E: Forms (mandatory)	Р
E.1	Application procedure	N/A
E.2	Data sheet for power generation systems	N/A
E.3	Data sheet for storage units	N/A
E.4	Unit certificate	Р
E.5	Test report "Network interactions" for power generation units with an input current > 75 A	N/A
E.6	Certificate of the network and system protection	Р
E.7	Requirements for the test report for the NS protection	Р
E.8	Commissioning protocol for power generation systems and/or storage units	N/A
E.9	Type approval procedure	N/A

Page 31 of 159

Report no. 240415256GZU-001

Appended Table - Testing Result

5.2.2	.2.2 TABLE: Rapid voltage change						
Operation	type: Switc	hing on at any power le	evel (without default to primary	energy source)			
Condition		Test 1: cosφ=1	Test 2: cosφ=0.90over- excited	Test 3: cosφ= excited	0.90under-		
Ki		0.073	0.061	0.0)65		
Kimax Lim	it	<1.2					
Operation	type: start-	up at Pn (reference cor	ndition) with circuit breaker rec	losing			
Condition		Test 1: cosφ=1	Test 2: cosφ=0.90over- excited	Test 3: cosφ= excited	0.90under-		
Ki		0.067	0.069	0.067			
Kimax Lim	it	<1.2		I			
Operation	type: shut-o	down (breaking operation	on at nominal power)				
Condition		Test 1: cosφ=1	Test 2: cosφ=0.90over- excited	Test 3: cosφ=0.90und excited			
Ki		0.581	0.694	0.7	724		
Kimax Lim	it	<1.2	- ·				
generator	ratio of the current, the	current is to be consid	ing during a switching operatio lered as an r.m.s. value over a ult of section 5.2.3 based on D	period	3		
Switching	actions				Ki		
Marking c	peration wi	thout default (to primary	/ energy carrier)	(0.073		
Worst cas	e at switch	over of generator section	ons	(0.069		
Marking c	peration at	reference conditions (o	f primary energy carrier)	(0.069		
Breaking	operation a	t nominal power		(0.724		
1		all switching operations			0.724		

Page 32 of 159

	IAC	BLE: Flick	ker						Р	
	pedanc		0.24 Ω +0 .′	15j						
Model:	ZDHYP	2000								
	_			Pst				CΨk		
		L	.1	L2	L3		L1	L2	L3	
	1	0.0)78				1.56			
	2	0.0)78				1.56			
(3	0.0)78				1.56			
	4	0.0	78				1.56			
Ę	5	0.0)78			-	1.56			
	6	0.0)78			-	1.56			
7	7	0.0)78			-	1.56			
8	8	0.0)78				1.56			
ę	9	0.0)78			1	1.56			
1	0	0.0)78			1	1.56			
1	1	0.0)77				1.54			
1	2	0.0)77			1	1.54			
					Calculatio	n				
	L1	0.078								
	L2									
Plt	L3									
grea	atest									
ascer c Note:	atest tained ^{Ψk}	1.56								
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 N变模式	星程溢出 UT U2 U3 U4 U5 U TT 12 13 14 15 1	6 U7	宿放 线路递波器 平均 频率递波器				CH: 1 2 3 4 5 6 7	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 N变模式	U1 U2 U3 U4 U5 U I1 I2 I3 I4 I5 I 次数	6 U7	平均 频率滤波器 12	■ 2/12 完成	ł		4 5 6 7 单元 1 U1 300 V	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 N变模式	U1 U2 U3 U4 U5 U 11 12 13 14 15 1	6 U7	平均 频率滤波器 12		à		4 5 6 7 _{単元1}	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 内变模式 内变波动 单元 电压集	UTU2U3U4U5U TI2I3H4U5T 次数 周期间隔 2 程300	6 <u>07</u> 5 17 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	平均 妖率滤波器 12	2/12 完成 0:00s/10:00s 判断	通过		4 5 6 7 単元1 UI 300V H 100 mA Syne Sire UI 軟分:重量 単元2 U2 300V	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 刃变模式 刃变波动 单元 里 电压 野 「 Freq	UTU2U3U4U5U TTU2T3H4U5U 次数 周期间隔 2 2 2 2 2 2 2 2 2 2 300 ¹ (U2)233. (U2)50.0	6 07 6 17 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	平均 频率滤波器 12 00	2/12 完成 0:00s/10:00s			4 5 6 7 単元1 U1 300V H 100 mA Syne Sine U1 転分 重量 単元 2 U2 300V 12 100 mA Syne Sine U1	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 内变模式 内空波动 单元 年 电元 耳 Un	UTU2U3U4U5U TTU2T3H4U5U 次数 周期间隔 2 2 2 2 2 2 2 2 2 2 2 3 0 0 (U2) 50.0	6 07 6 17 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	平均 频率滤波器 12 00 单元2 全部	2/12 完成 0:00s/10:00s 判断	通过		4 5 6 7 単元 1 UI 3001V HI 100 mA Syne Stree U1 取分:重量 単元 2 U2 3000 V 12 100 mA Syne Stree U1 時分:重量 単元 3	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 刃变模式 刃变波动 单元 里 电压 野 「 Freq	11 U2 U3 U4 U5 U 11 U2 U3 U4 U5 U 清明市局 22 22 24 (U2) 233: (U2) 50.0 0.10	V/50Hz 373V 00Hz %	平均 频率滤波器 12 00 单元2 全部 (単元1.2.6)	2/12 完成 0:00s/10:00s 判断 判断	通过 通过 Ptt 0.65		4 5 6 7 単元1 U1 3001V 11 100 mA Syne Srcs U1 戦分:重量 単元2 U2 300 V 12 100 mA Syne Srcs U1 時分:重量 単元 3 U3 300 V 13 10 mA	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 不变模式 不变模式 如空波动 単元 単 中元 単 一 東 い Freq Dmin 限定信 No. 1	11 02 03 04 05 0 11 12 13 4 15 1 次数 高則同隔 2 2 2 2 2 2 2 2 2 2 2 3 0 0 10 0 10 12 13 14 15 15 15 15 15 15 15 15 15 15	6 07 172 ■ 173 3 V/50Hz 373∨ 00Hz % dmax(%) 4.00 0.000 運过	平均 频率滤波器 12 00 单元2 全部 (单元1,2,6) d(t)[ms] 500 3,30% 0.0 演过	2/12 完成 0:00s/10:00s 判断 判断 <u>Pst</u> 1.00 0.078 演过	通过 通过 Ptt		4 5 6 7 単元1 U1 300V H 100 mA Syne Sine U1 気分 重量 単元2	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 N变模式 N变波动 单元 电压压 Un Freq Dmin 限定值 No. 1 2 3	11 02 03 04 05 0 11 12 13 14 15 1 次数 周期可隔 2 2 2 2 2 2 2 3 3 0 0 0 0 0 0 0 1 1 2 1 3 3 5 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	6 07 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0	平均 频率滤波器 算元2 全部 (単元1.2.6) d(t)[ms] 500 3.30% 0.0 通过 0.0 通过 0.0 通过	2/12 完局 0:00s/10:00s 判断 判断 <u>Pst</u> 1.00 0.078 通过 0.078 通过 0.078 通过	通过 通过 Ptt 0.65		4 5 6 7 単元 1 UI 3001V H 100 mA Syne Src UI 取分: 重量 単元 2 UZ 3001V 12 100 mA Syne Src UI 取分: 重量 U3 300 V 引 10 mA Syne Src UI 取分: 重量 単元 3 U3 300 V 引 10 mA Syne Src UI 取分: 重量 単元 4 00 x 4 00 x 1 00 x 1 0 0 0 0 0 0 0 0 0 0 0 0 0	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 内变模式 内变波动 单元 电压 Un Freq Dmin 限定信 No. 1 2 3 4	UTU2U3U4U5U 「1213日 「213日日 「213日日 「1213日日	6 07 5 00 Hz 5 00 Hz 5 00 4 .00 5 00 6 00 5 0 5 0 5 0 5 0 5 0 5 0 5 0	平均 妖率滤波器 12 00 单元2 全部 (单元1.2.5) d(t)[ms] 500 3.30% 0.0 通过 0.0 通过 0.0 通过 0.0 通过	2/12 完成 D:00s/10:00s 判断 判断 <u>Pst</u> 1.00 0.078 通过 0.078 通过 0.078 通过	通过 通过 Ptt 0.65		4 5 6 7 単元 1 UI 3001V H 100 mA Syne Stre U1 取分:重量 単元 2 U2 300 V 12 100 mA Syne Stre U1 取分:重量 単元 3 U3 300 V 基元 3 U3 300 V 単元 3 U3 300 V 単元 4 U4 60 V I4 20 mA Syne Stre U4	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 不变模式 不变模式 不变读动 単元 単元 里 Un Freq Dmin 限定值 No. 1 2 3 4 5 6	11 02 03 04 05 0 11 12 13 4 15 1 次数 周囲目隔 2 2 2 2 2 2 2 2 3 3 0 0 0 0 0 1 0 2 3 3 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	6 U7 172 172 V/50Hz 373V 00Hz % dmax(%) 4.00 0.000 通过 0.000 通过	平均 坂率減減器 12 00 単元2 全部 (単元1,2.6) d(t)[ms] 500 3.30% 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过	2/12 完成 0:00s/10:00s 判断 判断 判断 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过	通过 通过 Ptt 0.65		4 5 6 7 単元 1 UI 300 V H 100 mA Syne Sire U1 気分:重量 単元 2 U2 300 V 12 100 mA Syne Sire U1 気分:重量 単元 3 U3 300 V 13 10 mA Syne Sire U1 気分:重量 単元 4 U4 60 V 14 20 mA Syne Sire U4 気分:重量	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 지变機式 지变波动 単元 电元 Un Freq Dmin 限定位 No. 1 2 3 4 5 6 7	ID 2 03 04 05 0 ID 12 13 4 15 1 /次数 周期市局 2 2 2 2 2 2 2 3 0.00 0.10 0.000 通貨市局 0.00 0.10 0.10 0.10 0.00 0.10 0.00 0.10 0.00 0.10 0.00 0.10 0.00 0.10 0.00 0.10 0.00 0.10 0.00 0.10 0.00 0.10 0.00 0.	V/50Hz 373V 00Hz % dmax[%] 4.00 0.000 通过	平均 妖率減減器 12 00 単元2 全部 (単元1.2.6) d(t)[ms] 500 3.30% 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过 0.0 通过	2/12 完成 0:00s/10:00s 判断 判断 判断 1.00 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过 0.078 通过	通过 通过 Ptt 0.65		4 5 6 7 単元1 UI 300V H 100 mA Syne Stre U1 気分 重量 単元2 U2 300V 12 100 mA Syne Stre U1 気分 重量 単元3 U3 300 V 13 10 mA Syne Stre U1 気分 重量 単元4 U4 60 V 14 20 mA Syne Stre U4 長分 重量 単元 5 U5 60 V 15 20 mA	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 内变模式 内变波动 单元 甲 Un Freq Dmin 限定信 No. 1 2 3 4 5 6 7 8 9	UTU2U3U4U5U 下12U3U4U5U 周期间隔 2 2 2 2 2 2 2 2 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0	(ジロ) ((junt) (junt) ((junt) ((junt) (junt) ((junt)	平均 妖率滤波器 単元2 全部 (単元1.2.6) d(t)[ms] 500 3.30% 0.0 通过 0.0 通过	2/12 完局 2:00s/10:00s 判断 判断 判断 1:00 0.078 通过 0.078 通过	通过 通过 Ptt 0.65		4 5 6 7 単元 1 U1 3001V 11 100 mA Sync Src U1 電元 2 型元 2 U2 3001V 12 100 mA Sync Src U1 電元 3 U3 3001V 3 3001V 3 3001V 当元 3 U3 400 mA Sync Src U1 転分:重量 単元 4 U4 601V 4 20 mA Sync Src U4 転分:重量 単元 5 単元 5 U5 60 V	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 内变模式 内变波动 单元 年 Un Freq Dmin 限定值 No. 1 2 3 4 5 6 7 8	UTU2U3U4U5U 下12U3U4U5U 周囲可隔 2 2 2 2 2 2 2 2 3 3 0 0 0 0 0 0 0 0 0 0 0 0 0		平均 坂率減送器 単元2 全部 (単元1,2,6)	2/12 完局 0:00s/10:00s 判断 判断 判断 1.00 0.078 通过 0.078 通过	通过 通过 Ptt 0.65		4 5 6 7 単元1 UI 300V H 100 mA Syne Stre U1 家分: 主量 単元2 U2 300V 12 100 mA Syne Stre U1 家分: 主量 単元3 U3 300V H 60V H 20 mA Syne Stre U5 長分: 主量 単元5 U5 60V H 20 mA Syne Stre U5 長分: 主雪	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 N变模式 内变波动 単元 中 Freq Dmin 限定值 No. 1 2 3 4 5 6 7 8 9 10 11 12	ID 2 03 04 05 0 ID 12 03 04 05 0 ID 12 03 14 15 1	V/50Hz 373V 00Hz % dmax[%] 4.00 0.000 通过	平均 妖率減減器 12 00 単元2 全部 (単元1.2.6) d(t)[ms] 500 3.30% 0.0 通过 0.0 通过	2/12 完成 2:000s/10:00s 判断 判断 判断 1.00 0.078 通过 0.078 通过 0.077 通过 0.077 通过 0.077 通过 0.077 通过	通过 通过 0.65 N:12		4 5 6 7 単元1 UI 300 V H 100 mA Syne Sire U1 駅分:重量 単元2 U2 300 V 12 100 mA Syne Sire U1 駅分:重量 単元3 U3 300 V 13 10 mA Syne Sire U1 限分:重量 単元4 U4 60 V H 20 mA Syne Sire U4 影から Sire U4 Syne Sire U5 展分:重量	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 入变模式 入变波动 単元 电元 Un Freq Dmin 版定值 No. 1 2 3 4 5 6 7 8 9 10 11	TO 2 03 04 05 0 TO 2 03 0 TO 2 TO 2 0 TO 2 TO 2 0 TO 2	Kore Control Co	平均 坂率減減器 算元2 全部 (単元1,2.6)	2/12 完成 0:00s/10:00s 判断 判断 判断 1.00 0.078 通过 0.078 通过	通过 通过 Ptt 0.65		4 5 6 7 単元1 UI 300V H 100 mA Syne Sine UI 零分:重量 単元2 000V 12 100 mA Syne Sine UI 零分:重量 単元3 00V 13 10 mA Syne Sine UI 零分:重量 単元4 U3 60V 14 20 mA Syne Sine U4 長分:重量 単元5 U5 60V 15 20 mA Syne Sine U5 長分:重量 単元6 U5 000V 15 20 mA	
ascer c Note: 1) Sk,f	tained _{Ψk} ic/Sn = 2	20 N变模式 内变波动 単元 中 Freq Dmin 限定值 No. 1 2 3 4 5 6 7 8 9 10 11 12	ID 2 03 04 05 0 ID 12 03 04 05 0 ID 12 03 14 15 1	V/50Hz 373V 00Hz % dmax[%] 4.00 0.000 通过	平均 妖率減減器 12 00 単元2 全部 (単元1.2.6) d(t)[ms] 500 3.30% 0.0 通过 0.0 通过	2/12 完成 2:000s/10:00s 判断 判断 判断 1.00 0.078 通过 0.078 通过 0.077 通过 0.077 通过 0.077 通过 0.077 通过	通过 通过 0.65 N:12		4 5 6 7 単元1 UI 300 V HI 100 mA Sync Strc U1 駅分:重量 単元2 U2 300 V I2 100 mA Sync Strc U1 駅分:重量 単元3 U3 300 V I3 10 mA Sync Strc U1 限分:重量 単元4 U4 60 V I4 20 mA Sync Strc: U4 限分:重量 単元5 U5 60 V I5 70 CmA Sync Strc U5 70 C	



Page 33 of 159

5.2.4 TABLE: Harmonics and inter-harmonics (according to DIN EN 61000-3-2) Model: ZDHYP2000									Ρ		
Active power P/Pn[%]	10	20	30	40	50	60	70	80	90	100	Limit
Harmonic number	[A]	[A]									
2	0.0088	0.0120	0.0154	0.0188	0.0220	0.0257	0.0294	0.0324	0.0366	0.0399	1.080
3	0.0654	0.0580	0.0514	0.0465	0.0469	0.0537	0.0620	0.0733	0.0887	0.1092	2.3
4	0.0035	0.0039	0.0039	0.0040	0.0040	0.0039	0.0038	0.0040	0.0038	0.0036	0.43
5	0.0175	0.0202	0.0264	0.0307	0.0335	0.0360	0.0382	0.0399	0.0415	0.0408	1.14
6	0.0039	0.0038	0.0039	0.0040	0.0040	0.0039	0.0039	0.0038	0.0038	0.0036	0.3
7	0.0083	0.0061	0.0080	0.0105	0.0127	0.0140	0.0157	0.0174	0.0193	0.0200	0.77
8	0.0040	0.0041	0.0041	0.0040	0.0041	0.0039	0.0040	0.0039	0.0037	0.0038	0.23
9	0.0048	0.0048	0.0049	0.0051	0.0058	0.0058	0.0069	0.0081	0.0091	0.0108	0.4
10	0.0041	0.0042	0.0039	0.0041	0.0042	0.0042	0.0041	0.0041	0.0039	0.0037	0.184
11	0.0042	0.0045	0.0042	0.0044	0.0046	0.0041	0.0044	0.0050	0.0055	0.0063	0.33
12	0.0043	0.0043	0.0042	0.0042	0.0042	0.0041	0.0040	0.0041	0.0041	0.0038	0.153
13	0.0045	0.0046	0.0042	0.0044	0.0044	0.0040	0.0041	0.0043	0.0049	0.0052	0.21
14	0.0041	0.0043	0.0043	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0043	0.131
15	0.0043	0.0045	0.0045	0.0046	0.0047	0.0043	0.0045	0.0046	0.0050	0.0052	0.15
16	0.0053	0.0044	0.0045	0.0045	0.0044	0.0044	0.0045	0.0043	0.0042	0.0043	0.115
17	0.0047	0.0046	0.0047	0.0046	0.0048	0.0044	0.0046	0.0047	0.0050	0.0052	0.132
18	0.0044	0.0059	0.0043	0.0045	0.0045	0.0045	0.0045	0.0045	0.0044	0.0043	0.102
19	0.0043	0.0045	0.0064	0.0048	0.0051	0.0046	0.0049	0.0051	0.0053	0.0053	0.118
20	0.0045	0.0047	0.0045	0.0048	0.0047	0.0047	0.0046	0.0046	0.0045	0.0043	0.092
21	0.0044	0.0048	0.0050	0.0062	0.0053	0.0046	0.0048	0.0049	0.0049	0.0047	0.107
22	0.0047	0.0046	0.0048	0.0047	0.0046	0.0047	0.0046	0.0045	0.0044	0.0044	0.084
23	0.0045	0.0047	0.0048	0.0050	0.0062	0.0045	0.0047	0.0048	0.0049	0.0049	0.098
24	0.0044	0.0047	0.0046	0.0047	0.0058	0.0048	0.0046	0.0046	0.0045	0.0045	0.077
25	0.0044	0.0047	0.0049	0.0052	0.0055	0.0048	0.0048	0.0049	0.0048	0.0049	0.09
26	0.0048	0.0047	0.0050	0.0048	0.0050	0.0059	0.0047	0.0046	0.0044	0.0046	0.071
27	0.0046	0.0048	0.0049	0.0051	0.0051	0.0056	0.0044	0.0043	0.0043	0.0042	0.083
28	0.0044	0.0046	0.0045	0.0045	0.0045	0.0044	0.0051	0.0044	0.0046	0.0048	0.066
29	0.0042	0.0043	0.0044	0.0046	0.0047	0.0042	0.0051	0.0042	0.0042	0.0044	0.078
30	0.0042	0.0043	0.0046	0.0046	0.0046	0.0047	0.0055	0.0048	0.0047	0.0047	0.061
31	0.0041	0.0042	0.0043	0.0045	0.0045	0.0041	0.0044	0.0041	0.0043	0.0042	0.073
32	0.0047	0.0049	0.0049	0.0048	0.0049	0.0049	0.0048	0.0048	0.0048	0.0046	0.058
33	0.0039	0.0041	0.0042	0.0043	0.0042	0.0041	0.0041	0.0048	0.0041	0.0040	0.068
34	0.0043	0.0046	0.0044	0.0045	0.0045	0.0047	0.0046	0.0056	0.0049	0.0047	0.054
35	0.0039	0.0040	0.0041	0.0042	0.0042	0.0041	0.0041	0.0049	0.0042	0.0041	0.064
36	0.0042	0.0043	0.0046	0.0048	0.0051	0.0051	0.0052	0.0058	0.0051	0.0049	0.051
37	0.0039	0.0041	0.0042	0.0043	0.0045	0.0043	0.0044	0.0046	0.0047	0.0047	0.061
38	0.0048	0.0054	0.0054	0.0056	0.0055	0.0054	0.0056	0.0054	0.0052	0.0054	0.048

Page 34 of 159

39	0.0042	0.0047	0.0050	0.0052	0.0054	0.0048	0.0048	0.0049	0.0054	0.0049	0.058
40	0.0055	0.0055	0.0055	0.0054	0.0052	0.0051	0.0051	0.0052	0.0061	0.0055	0.046
41	0.0045	0.0047	0.0049	0.0050	0.0051	0.0046	0.0046	0.0045	0.0054	0.0046	
42	0.0051	0.0051	0.0051	0.0052	0.0054	0.0055	0.0056	0.0058	0.0067	0.0063	
43	0.0045	0.0047	0.0049	0.0051	0.0053	0.0048	0.0050	0.0051	0.0061	0.0057	
44	0.0050	0.0053	0.0055	0.0060	0.0062	0.0063	0.0063	0.0063	0.0063	0.0061	
45	0.0051	0.0056	0.0060	0.0066	0.0069	0.0063	0.0066	0.0068	0.0072	0.0073	
46	0.0064	0.0067	0.0069	0.0070	0.0066	0.0062	0.0059	0.0057	0.0055	0.0053	
47	0.0061	0.0066	0.0069	0.0073	0.0074	0.0063	0.0063	0.0064	0.0065	0.0064	
48	0.0064	0.0063	0.0060	0.0055	0.0052	0.0049	0.0046	0.0047	0.0048	0.0053	
49	0.0064	0.0063	0.0063	0.0063	0.0060	0.0050	0.0051	0.0051	0.0051	0.0057	
50	0.0044	0.0043	0.0042	0.0042	0.0042	0.0042	0.0042	0.0043	0.0045	0.0053	

Page 35 of 159

5.2.6	6 TABLE: DC Injection										
Model: ZDH	Model: ZDHYP2000										
Rated outpu	Rated output current: 5.22A										
Power F	Power P/Pn 100%										
		Meas	urement			Li	mitation				
Phas	se L1	Phas	se L2	Phas	se L3						
0.0213A	0.408%					0.5%					
Power P/F	Pn [%]	60%									
		Measurement					mitation				
Phas	se L1	Phas	se L2	Phas	se L3						
0.0012A	0.022%						0.5%				
Power P/F	Pn [%]										
		Meas	urement	Li	mitation						
Phas	se L1	Phas	se L2	Phas	se L3						
0.0164A	0.315%						0.5%				

Total Quality. Assured.

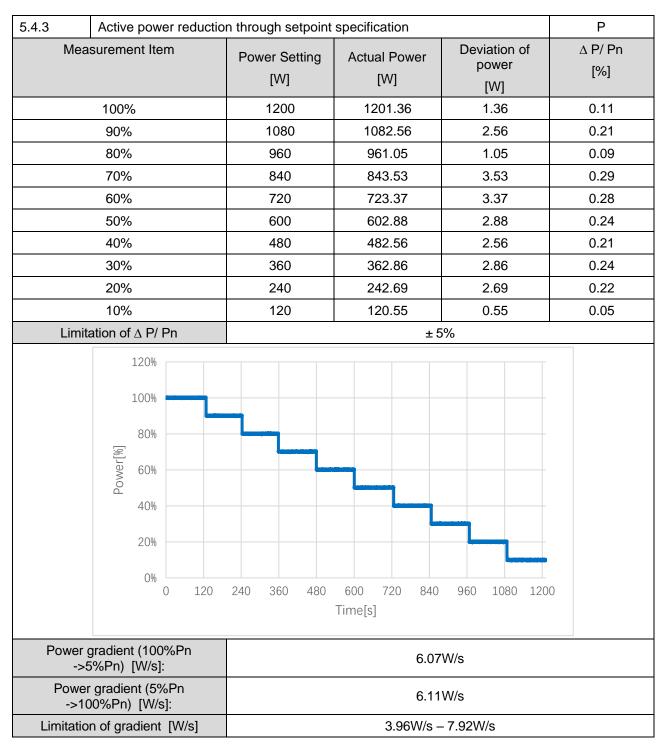
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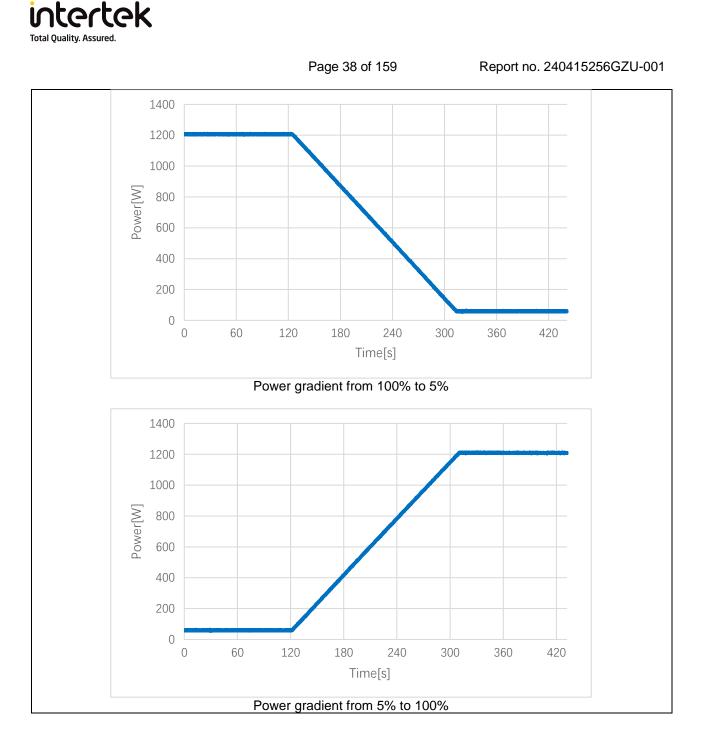
Page 36 of 159

5.4.2	-	TABLE: Mea	asurement of	surement of active- and reactive power ranges							
Model: ZDHYP2000											
	Test co	ondition		Measurement							
No.	Cosφ	U / Un	U [V]	 [A]	PEmax600 *) [W]	Semax600 *) [VA]	Q [Var]	Cos _φ			
a1		90%	207.18	5.82	1204.70	1205.82	51.83	0.9999			
a3	1.00	100%	230.18	5.18	1191.83	1193.06	54.07	0.9999			
a5		109%	250.86	4.75	1190.37	1191.73	56.71	0.9999			
b1		95%	219.31	5.71	1187.27	1252.36	-398.5	2 0.9501			
b3	max.	ed 100%	230.77	5.42	1186.31	1251.63	-399.0	6 0.9503			
B5		109%	251.41	4.96	1180.66	1246.29	-399.1	1 0.9509			
c1		90%	207.89	6.16	1218.72	1281.35	395.69	9 0.9508			
c3	max.	d 100%	230.80	5.54	1216.10	1279.21	396.84	4 0.9507			
c4		105%	242.27	5.27	1213.08	1276.26	396.58	8 0.9500			
	PEmax600 [[W]	1218.72								
SEmax600 [VA] 1281.35											

itertek

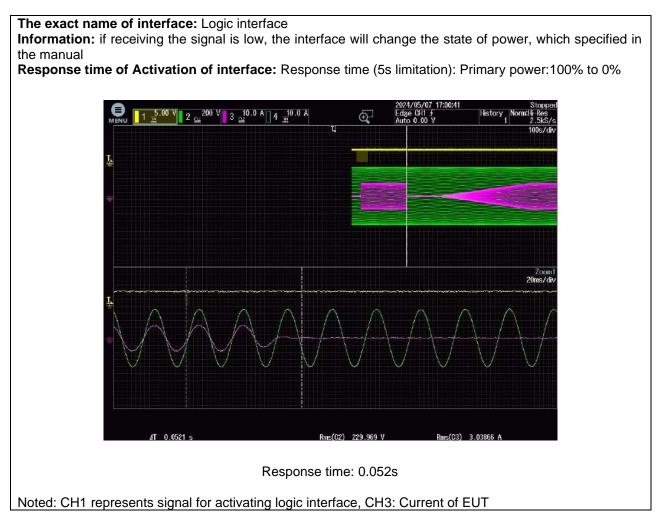
Page 37 of 159







Page 39 of 159



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Page 40 of 159

5.4.4	Active powe	er supply at	overfrequenc	у				Р
Test 1	40%P	Emax (W)		480	109	%P _{Emax} (W)		120
Setting parameters of the EZE:	of (Hz)	Expected Active power	output between Power measured		Tolerance Limit [%]		Time	
P = 100% PEmax Start of power reduction at 50.2 Hz s = 5% (40% Pref / Hz)		output [P/ PEmax] [%]	(W)	P and Expected [△P/ PEmax] [%]		The initial time delay TV <2s	The response times <i>T</i> an_90 % <2s	The settling times <20s
a) 50Hz ± 0.01Hz	50.00	100	1213.82	1.15	< ± 5%			
b)50.25Hz ± 0.01Hz	50.25	98	1190.77	1.23	< ± 10%	0.1	0.1	0.3
c)50.70Hz ± 0.01Hz	50.70	80	972.12	1.01	< ± 10%		0.1	0.2
d)51.40Hz ± 0.01Hz	51.40	52	633.82	0.82	< ± 10%		0.1	0.3
e)50.70Hz ± 0.01Hz	50.70	80	970.52	0.88	< ± 10%		0.5	0.9
f)50.25Hz ± 0.01Hz	50.25	98	1185.19	0.77	< ± 10%		0.2	0.5
g)50Hz ± 0.01Hz	50.00	100	1195.68	-0.36	< ± 10%		0.2	0.6
h)51.65Hz± 0.01Hz	51.65	0	0	Disconnection Time[ms]:100, Limitation[n			imitation[ms	s]: 200
i)50.15Hz± 0.01Hz	50.15	0	0	0 Reconnection: Yes/ No, Limitation: reconnection is allowed.				: No
j)50.00Hz± 0.01Hz	50.00	100	1210.67	0.67 Reconnection time: 117.1s Maximal Rising Gradient [%/min]:9.56 Limitation [%/min]: 10%				%,

Page 41 of 159

Test 2	16.67	%P _{Emax} (W)		200	10%	P _{Emax} (W	/) 1	20
Setting	f (Hz)	Expected	Measured	Tolerance	Tolerance	Time		
parameters of the EZE:		Active	output	between	Limit			
P = 60% PEmax		power output	Power (W)	measured P and	[%]			
(The reduction		[P/	(~~)	Expected		The	The	The
of the primary		PEmax]		[△P/		initial	response	settling
energy supply to		[%]		PEmax]		time	times	times
limit the active				[%]		delay	Tan_90 %	<20s
power output, or						TV	<2s	
the limiting						<2s		
setting of the								
active power								
output must be removed from								
measuring point								
C)								
Start of power								
reduction at								
50.5 Hz								
s= 12%								
(16.67% P / Hz)								
a)50Hz ±	50.00	60	727.75	0.65	< ± 5%			
0.01Hz			_					
b)50.40Hz ±	50,40	60	729.99	0.83	< ± 10%			
0.01Hz								
c)50.70Hz ± 0.01Hz	50.70	58	707.66	0.97	< ± 10%	0.1	0.1	0.3
d)51.40Hz ±								
0.01Hz	51.40	51	626.61	1.22	< ± 10%		0.1	0.2
e)50.70Hz ±	F0 70	50	700.05	0.00	400/		0. f	
0.01Hz	50.70	58	706.35	0.86	< ± 10%		0.1	0.3
f)50.40Hz ±	50.40	60-100	Maximal B	Rising Gradie	nt [%//min]: 0	16 Limi	tation [0/ /mi	nl· 100/
0.01Hz	50.40	00-100		Sing Graule	in [/0/11111]. 9	. 10, LIIII	auon [70/11]	iij. 10%
g)50Hz ±	50.00	100						
0.01Hz	30.00	100						

Page 42 of 159 Report no. 240415256GZU-001 1400 52.0 1200 51.5 1000 51.0 Frequency[Hz] 800 Power[W] 50.5 600 400 50.0 200 49.5 0 49.0 -200 250 500 0 750 1000 1250 1500 1750 2000 Time[s] Power — Frequency Test 1 P&F curve 1220 50.3 50.2 1210 Frequency[Hz] Momentary 1200 June 1200 J 50.1 50 49.9 1180 1170 49.8 128.5 130.5 132.5 126.5 134.5 136.5 Time[s] Power Frequency Response time

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Response time

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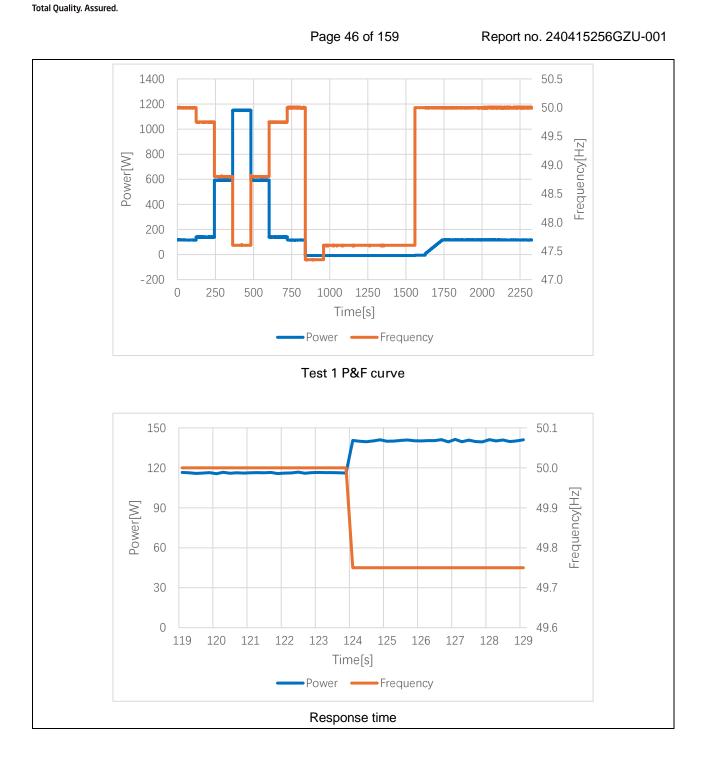
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Page 44 of 159

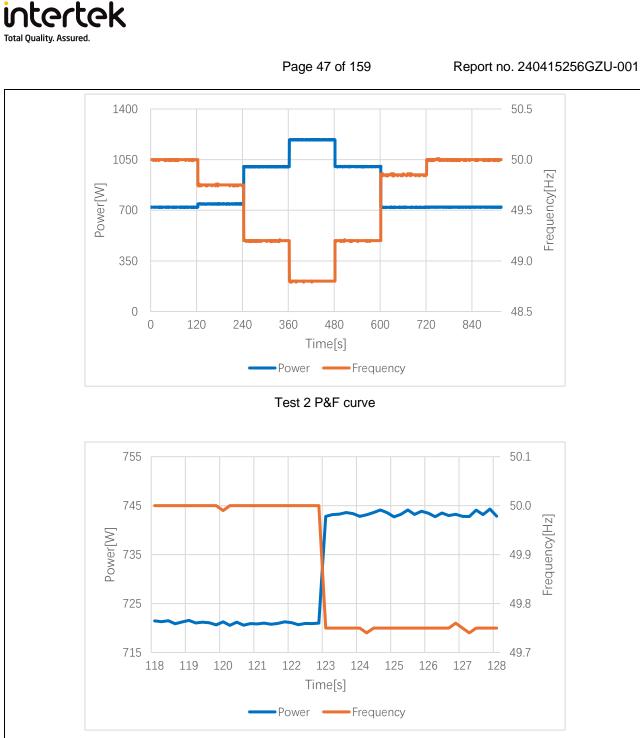
5.4.6	Active pow	/er supply a	t underfrequ	uency				Р
Test 1	40%P	Emax (W)		480	10%	6PEmax (W)		120
Setting	f (Hz)	Expected Active power	Measured output Power	Tolerance between measured	Tolerance Limit [%]		Time	
the EZE:P=10% Start of powe reduction at 49.8 Hz	é er	output [P/ PEmax] [%]	(W)	P and Expected [△P/ PEmax] [%]		The initial time delay TV <2s	The response times <i>T</i> an_90 % <2s	The settling times <20s
a) 50Hz ± 0.01Hz	50.00	10.00	116.81	-0.27	< ± 5%			
b)49.75Hz ± 0.01Hz	49.75	12.00	140.53	-0.29	< ± 10%	0.1	0.1	0.3
c)48.80Hz ± 0.01Hz	48.80	50.00	592.88	-0.59	< ± 10%		0.1	0.2
d)47.60Hz ± 0.01Hz	47.60	98.00	1149.52	-2.21	< ± 10%	-	0.1	0.2
e)48.80Hz ± 0.01Hz	48.80	50.00	592.65	-0.61	< ± 10%		0.1	0.3
f)49.75Hz ± 0.01Hz	49.75	12.00	140.31	-0.31	< ± 10%		0.1	0.2
g)50Hz ± 0.01Hz	50.00	10.00	116.23	-0.31	< ± 10%		0.1	0.2
h)47.35Hz± 0.01Hz	47.35	0	0	Disconnect	tion Time[ms]]:100ms, L	imitation[m	s]: _200_
i)47.60Hz± 0.01Hz	47.60	0	0	0 Reconnection: Yes/ No, Limitati reconnection is allowed.				n: No
j)50.00Hz± 0.01Hz	50.00	10	120.19	Max	imal Rising G	ction time: Gradient [% n [%/min]:	/min]: 5.34	%,

Page 45 of 159

Test 2	40%	P _{Emax} (W)		480	10%	PEmax (W))	20
Setting parameters of the EZE:	f (Hz)	Expected Active power	Measured output Power	Tolerance between measured	Tolerance Limit [%]		Time	
P = 60% PEmax (The reduction of the primary energy supply to limit the active power output, or the limiting setting of the active power output must be removed from measuring point c) Start of power reduction at 49.8 Hz		output [P/ PEmax] [%]	(W)	P and Expected [△P/ PEmax] [%]		The initial time delay TV <2s	The response times <i>T</i> an_90 % <2s	The settling times <20s
a)50Hz ± 0.01Hz	50.00	60.00	721.25	0.10	< ± 5%			
b)49.75Hz ± 0.01Hz	49.75	62.00	742.82	-0.10	< ± 10%	0.1	0.1	0.2
c)49.20Hz ± 0.01Hz	49.20	84.00	1002.33	-0.47	< ± 10%		0.1	0.2
d)48.80Hz ± 0.01Hz	48.80	100.00	1186.35	-1.14	< ± 10%		0.1	0.3
e)49.20Hz ± 0.01Hz	49.20	84.00	1001.98	-0.50	< ± 10%		0.1	0.2
f)49.85Hz ± 0.01Hz	49.85	60.00	720.63	0.05	< ± 10%		0.1	0.2
g)50Hz ± 0.01Hz	50.00	60.00	721.99	0.17	< ± 10%			



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Response time

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Page 48 of 159

5.4.8.2	TABLE:	TABLE: Reactive power / displacement factor setting accuracy Test condition Measurement										
No.	Test cor											
	Cos_{ϕ}	Power	U [V]	P [W]	Q [Var]	S [VA]	cos φ	∆ Q / P _{Emax}	Limit ∆ Q / P _{Emax}			
⊠∑s	Emax < 4.0	6kVA										
C)			207.15	600.74	-196.53	632.07	0.9504	0.04	≤ ±4%			
	0.95	50%PEmax	230.15	597.46	-196.07	628.81	0.9501	0.08	≤ ±4%			
			253.15	595.00	-196.96	626.76	0.9493	0.01	≤ ±4%			
	under- excited		207.58	1186.29	-398.56	1251.45	0.9479	-0.37	≤ ±4%			
		SEmax	230.53	1182.71	-398.69	1248.11	0.9476	-0.38	≤±4%			
			253.49	1177.86	-399.37	1243.73	0.9470	-0.43	≤ ±4%			
			207.16	604.48	-120.99	616.47	0.9806	0.07	≤ ±4%			
		50%PEmax	230.15	601.43	-120.89	613.46	0.9804	0.08	≤±4%			
	0.98		253.15	597.96	-122.09	610.30	0.9798	-0.02	≤ ±4%			
	under- excited		207.58	1192.85	-244.13	1217.57	0.9796	-0.03	≤±4%			
		SEmax	230.53	1189.82	-240.55	1213.89	0.9801	0.26	≤ ±4%			
			253.49	1185.00	-240.93	1209.25	0.9799	0.22	≤ ±4%			
d)			207.16	614.28	195.94	644.77	0.9527	-0.09	≤ ±4%			
					50% PEmax	230.16	611.19	197.83	642.41	0.9514	0.07	≤ ±4%
	0.95		253.15	608.18	199.10	639.94	0.9504	0.17	≤ ±4%			
	over- excited		207.60	1215.45	400.68	1279.79	0.9497	0.55	≤ ±4%			
		SEmax	230.55	1211.95	401.18	1276.62	0.9493	0.59	≤ ±4%			
			253.51	1206.98	401.79	1272.10	0.9488	0.64	≤ ±4%			
			207.16	612.84	120.90	624.65	0.9811	-0.08	≤ ±4%			
		50% P _{Emax}	230.15	610.10	123.17	622.41	0.9802	0.11	≤ ±4%			
	0.98 over-		253.15	606.51	124.67	619.19	0.9795	0.24	≤ ±4%			
	excited		207.59	1209.97	242.05	1233.94	0.9805	-0.13	≤ ±4%			
		SEmax	230.54	1206.43	242.67	1230.60	0.9803	-0.08	≤ ±4%			
			253.50	1201.62	243.46	1226.04	0.9800	-0.02	≤ ±4%			

Page 49 of 159 Report no. 240415256GZU-001 120% 100% 80% P/Sn[%] 60% ۲ Ó 40% 20% 0% -40% -30% -20% -10% 0% 10% 20% 30% 40% Q/Sn[%]

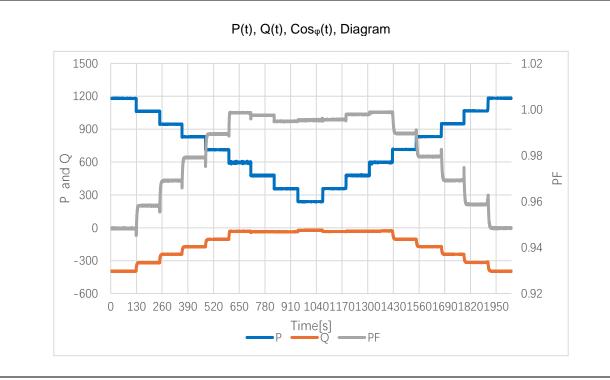
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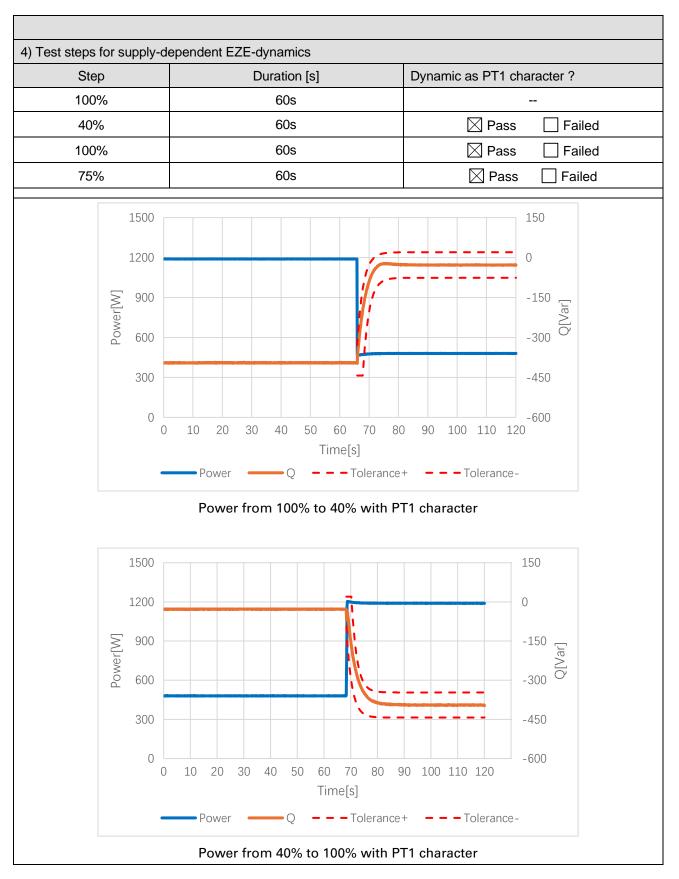
Page 50 of 159

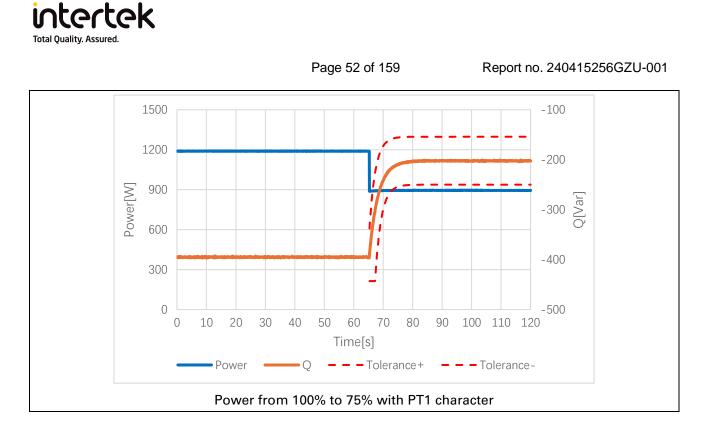
5.4.8.3	TABLE: Tes Cos _φ (P)	ting the displa	cement factor	/ active pow	er characterist	tic curve	Р				
3) Test steps for supply-dependent EZE accuracy (characteristic curve)											
Step	Pdc[W]	P[W]	Q[Var]	Cosφ	Qdesired	Δ Q / P _{Emax}	Limitation				
100%	1250.51	1179.70	-393.94	0.95	-394.10	0.01	± 4%				
90%	1125.67	1063.06	-317.45	0.96	-315.00	-0.20	± 4%				
80%	1001.92	946.11	-241.47	0.97	-240.50	-0.08	± 4%				
70%	878.68	828.87	-171.93	0.98	-170.57	-0.11	± 4%				
60%	756.99	712.44	-105.77	0.99	-102.55	-0.27	± 4%				
50%	637.32	593.00	-32.32	1.00	0.0	-2.69	± 4%				
40%	515.76	477.69	-34.25	1.00	0.0	-2.85	± 4%				
30%	390.75	356.81	-36.39	1.00	0.0	-3.03	± 4%				
20%	267.78	239.02	-23.55	1.00	0.0	-1.96	± 4%				
30%	392.21	358.65	-33.82	1.00	0.0	-2.82	± 4%				
40%	514.82	481.45	-31.80	1.00	0.0	-2.65	± 4%				
50%	638.85	598.73	-28.76	1.00	0.0	-2.40	± 4%				
60%	758.53	714.24	-104.62	0.99	-102.55	-0.17	± 4%				
70%	881.80	831.99	-170.88	0.98	-170.57	-0.03	± 4%				
80%	1004.98	949.42	-241.06	0.97	-240.50	-0.05	± 4%				
90%	1128.34	1065.78	-316.23	0.96	-315.00	-0.10	± 4%				
100%	1251.49	1181.25	-394.89	0.95	-394.10	-0.07	± 4%				



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Page 51 of 159





Page 53 of 159

Report no. 240415256GZU-001

5.5. 5.5.		LE: Interface	e switch (Function	al safety)			Р
	ntegrated interfa	ace switch						
\boxtimes	Complied with D	IN EN 62109	-2					
			ONG CHUAN PR				I-1AH-F-C.	
			ch for integrated N	•	ction:1	.5ms		
The	max. initial shor	t-circuited cu	Irrent of PGU Ik":	17A				
No.	component No	o. fault	test voltage (V)	test time	fuse No.	fuse current (A)	res	
1.	PV input	Reverse before start up	45Vdc	10min			Reversed before Inverter could ne after fault removinverter normal No damage, No	ot operate, /ed, the operation.
2.	AC output	SC	45Vdc	10min			After applying th unit shutdown ir the breaker on t opened. F1 damage, No	ne fault, the nmediately, he wall
3.	AC output	Reverse before start up	45Vdc	10min			Reversed before Inverter could tie No damage, No	e start up, the e to grid. hazard.
4.	Realy1, Pin 2-4	SC	45Vdc	10min			The fault was an operation. After EUT disconnect immediately. No damaged, N	the fault, ed from grid
5.	Realy2, Pin 2-4	SC	45Vdc	10min			The fault was a operation. After EUT disconnect immediately. No damaged, N	the fault, ed from grid
6.	Realy1, Pin1-2	SC	45Vdc	10min			It applied during operation.Aftert No hazard, No o Can resettable.	he fault, damage.
7.	Relay2, Pin1-2	SC	45Vdc	10min			It applied during operation.Aftert hazard. No dam resettable.	he fault, No age. Can
8.	R 324	SC	45Vdc	10min			It applied during operation. After No hazard, No o Can resettable.	the fault, damage.
9.	T5, Pin3-4	SC	45Vdc	10min			After applying th unit shutdown in No damage, No	nmediately. hazard.
10.	T2, Pin3-4	SC	45Vdc	10min			After applying th unit shutdown in No damage, No	nmediately. hazard.
11.	Fuse	SC	45Vdc	10min			After applying th unit shutdown ir F1 damaged, N	nmediately.

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Page 54 of 159

					1		After applying the fault, the
12.	U4, Pin15-14	SC	45Vdc	10min			unit shutdown immediately.
12.	04, FII115-14	30	45700	TOTINT			No damage, No hazard.
40	LIAE Dint 4	80	45\/do	10min			After applying the fault, the unit shutdown immediately.
13.	U15, Pin1-4	SC	45Vdc	10min			
							No damage, No hazard.
	Dat		45141	40			After applying the fault, the
14.	R94	S-C	45Vdc	10min			unit shutdown immediately.
							No damage, No hazard.
	5446						After applying the fault, the
15.	R110	S-C	45Vdc	10min			unit shutdown immediately.
							No damage, No hazard.
							After applying the fault, the
16.	R126	S-C	45Vdc	10min			unit shutdown after three
10.	11120	00	10140				seconds.
							No damage, No hazard.
							After applying the fault, the
17.	R142	S-C	45Vdc	10min			unit shutdown after five
17.	11142	3-0	43700	TOTINT			seconds.
							No damage, No hazard.
							After applying the fault,
18.	R174	S-C	45Vdc	10min			the unit normal operation.
							No damage, No hazard
							After applying the fault, the
19.	R191	S-C	45Vdc	10min			unit shutdown immediately.
							No damage, No hazard.
							After applying the fault, the
20.	R212	S-C	45Vdc	10min			unit shutdown immediately.
_0.							No damage, No hazard.
							After applying the fault, the
21.	Filter capacitor,	S-C	45Vdc	10min			unit shutdown immediately.
21.	C185	00	10140				C185 damaged, No hazard
							After applying the fault, the
							unit shutdown immediately.
22.	Q17, PinG-D	S-C	45Vdc	10min			C184, C185 damaged, No
							hazard
							After applying the fault, the
23	Q17, PinS-D	S-C	45Vdc	10min			unit shutdown immediately.
20.		00	40 V 00				No damage, No hazard.
							After applying the fault, the
24.	Filter capacitor,	S-C	45Vdc	10min			unit normal operation.
27.	C423	00	40 0 00				No damage, No hazard
							After applying the fault, the
25.	Triode Q41,	S-C	45Vdc	10min			unit normal operation.
20.	Pin1-3	3-0	45700	TOTINT			No damage, No hazard
							After applying the fault, the
26.	Triode Q41,	S-C	45Vdc	10min			unit normal operation.
20.	Pin2-3	3-0	45700	TOTINT			
							No damage, No hazard
~7	Filter capacitor,	<u> </u>	45)/de	10			After applying the fault, the
27.	C460	S-C	45Vdc	10min			unit normal operation.
						+	No damage, No hazard
~~	Filter capacitor,			40			After applying the fault, the
28.	C473	S-C	45Vdc	10min			unit normal operation.
	-						No damage, No hazard
	Filter capacitor,		(.				After applying the fault, the
29.	C431	S-C	45Vdc	10min			unit normal operation.
		1			1		No damage, No hazard

Page 55 of 159

							After applying the fault, the
20	GDT2	S-C	45\/do	10min			After applying the fault, the
30.	GDTZ	3-0	45Vdc	10min			unit normal operation.
							No damage, No hazard
	Diode Q21						After applying the fault, the
31.	Pin2-6	S-C	45Vdc	10min			unit normal operation.
	1 1112 0						No damage, No hazard
	Diode Q21						After applying the fault, the
32.	Pin4-6	S-C	45Vdc	10min			unit normal operation.
	F1114-0						No damage, No hazard
	Descent						After applying the fault, the
33.	Resonant	S-C	45Vdc	10min			unit shutdown immediately.
	capacitor C91						No damage, No hazard.
							After applying the fault, the
34.	Q7, PinS-D	S-C	45Vdc	10min			unit shutdown immediately.
54.		00	40 0 00				No damage, No hazard.
							After applying the fault, the
25		S-C	45\/do	10min			
35.	Q7, PinG-D	3-0	45Vdc	10min			unit shutdown immediately.
		-					Q7 damaged, No hazard.
							After applying the fault, the
36.	Q8, PinG-D	S-C	45Vdc	10min			unit shutdown immediately.
							Q8 damaged, No hazard.
							After applying the fault, the
37.	Q8, PinS-D	S-C	45Vdc	10min			unit shutdown immediately.
							Q8 damaged, No hazard.
							After applying the fault, the
38.	AC Relay K2B,	S-C	45Vdc	10min			unit normal operation.
	Pin2-4						No damage, No hazard.
							After applying the fault, the
39.	Q2, Pin1-9	S-C	45Vdc	10min			unit shutdown immediately.
00.	Q2, 1 III 0	00	10140				Q3, Q4 damaged, No hazard
							After applying the fault, the
40	O2 Dine 0	S-C	45Vdc	10min			unit shutdown immediately.
40.	Q2, Pin6-9	3-0	45 V 00	TOMIN			
							Q3, Q4 damaged, No hazard
	Filter capacitor,			10			After applying the fault, the
41.	C49	S-C	45Vdc	10min			unit shutdown immediately.
							No damage, No hazard.
	Filter capacitor,						After applying the fault, the
42.	C59	S-C	45Vdc	10min			unit shutdown immediately.
	000						No damage, No hazard.
							After applying the fault, the
43.	Q3, pinG-D	S-C	45Vdc	10min			unit shutdown immediately.
							Q3 damaged, No hazard.
							After applying the fault, the
44.	Q3, PinS-D	S-C	45Vdc	10min			unit shutdown immediately.
							Q3 damaged, No hazard.
							After applying the fault, the
45.	Filter capacitor,	S-C	45Vdc	10min			unit normal operation.
-5.	C14	00	40 0 00	TOTINT			No damage, No hazard.
							After applying the fault, the
10	POF	O-C	45Vdc	10			
46.	R95	0-0	45 V 00	10min			Inverter could not tie to grid.
		+					No damage, No hazard.
-	D 444		4514			1	After applying the fault, the
47.	R111	O-C	45Vdc	10min			Inverter could not tie to grid.
							No damage, No hazard.
							After applying the fault, the
48.	R127	O-C	45Vdc	10min			Inverter could not tie to grid.
	1			1	1	1	No damage, No hazard.

Page 56 of 159

Report no. 240415256GZU-001

						After applying the fault, the
49.	R143	0-C	45Vdc	10min	 	Inverter could not tie to grid.
						No damage, No hazard.
						After applying the fault, the
50.	R175	0-C	45Vdc	10min	 	unit normal operation.
						No damage, No hazard
	_					After applying the fault, the
51.	R192	0-C	45Vdc	10min	 	Inverter could not tie to grid.
						No damage, No hazard.
						After applying the fault, the
52.	R213	0-C	45Vdc	10min	 	Inverter could not tie to grid.
						No damage, No hazard.
						After applying the fault, the
53.	TP70	0-C	45Vdc	10min	 	unit normal operation.
						No damage, No hazard
						After applying the fault, the
54.	R7	O-C	45Vdc	10min	 	Inverter could not tie to grid.
						No damage, No hazard.
	Triode Q1,					After applying the fault, the
55.	Pin 2-3	0-C	45Vdc	10min	 	Inverter could not tie to grid.
	1 111 2-5					No damage, No hazard.
Sup	plement:					

s-c: short-circuited, o-c: open-circuited, o-l: overload

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Page 57 of 159

5.5.7.2 &5.5.7.4	TABLE		Р				
OV Stage 2	Set	Measured	Limitation	Test cond	dition		
No.	value	L1-N					
4	1.25Un	287.47	+/-1%Un	1.2, UL1-N applying ra			
1	100ms	120	≤200ms	<282.9 V, and ramp to voltage length is <1.15			
	1.25Un	287.84	+/-1%Un	time is >400ms			
2	100ms	140	≤200ms	2.2, UL1-N applying Le <282.9 V, and jump to			
0	1.25Un	287.42	+/-1%Un	voltage length is >9.2 \			
3	100ms	142	≤200ms	is >400ms			
	1.25Un	287.42	+/-1%Un				
4	100ms	139	≤200ms				
F	1.25Un	287.42	+/-1%Un				
5	100ms	119	≤200ms				

OV Stage 1 No.		Trip time [s]	Limitation [s]	Test condition
1	Set value 1.10Un	485.2	450-550	3.1 Operation under nominal voltage for 10min, then jumped from Un to 1.12Un.
2	100ms	No disconnect	No disconnect	3.2 Operation under nominal voltage for 10min, then jumped from Un to 1.08Un.
3		281.2	225 - 375	3.3 Operation under 1.06 voltage for 10min, then jumped from 1.06Un to 1.14Un.

UV Stage 2	Set value	Measured	Limitation				
No.		L1-N	[ms]	Test condition			
	0.45Un	104.10	+/-1%Un	6.2, UL1-N applying ramp test, start			
1	300ms	341	300-400ms	of >108.1 V, and ramp to <98.9V, step voltage length is <1.15 V, and step			

Page 58 of 159

UV Stage 2	Set value	Measured	Limitation	The second second			
No.		L1-N	[ms]	Test condition			
	0.45Un	103.59	+/-1%Un	time is >500ms			
2	300ms	322	300-400ms	7.2, UL1-N applying Jump test, start of >108.1 V, and jump to <98.9V, step			
	0.45Un	103.92	+/-1%Un	voltage length is >9.2 V, and step time is >500ms			
3	300ms	322	300-400ms				
	0.45Un	103.67	+/-1%Un				
4	300ms	340	300-400ms				
	0.45Un	103.87	+/-1%Un				
5	300ms	323	300-400ms				

UV Stage 1	Set value	Measured	Limitation [ms]	Test condition					
No.		L1-N							
	0.8Un	184.37	+/-1%Un	4.2, UL1-N applying ramp test,					
1	3s	3.05	3-3.1s	start of >188.6 V, and ramp to <179.4V, step voltage length is					
	0.8Un	184.05	+/-1%Un	<1.15 V, and step time is >3.2s					
2	3s	3.05	3-3.1s	5.2, UL1-N applying Jump test, start of >200.1 V, and jump to					
	0.8Un	184.11	+/-1%Un	<179.4V, step voltage length is >9.2 V, and step time is >3.2s					
3	3s	3.05	3-3.1s						
	0.8Un	184.39	+/-1%Un						
4	3s	3.05	3-3.1s						
	0.8Un	184.13	+/-1%Un						
5	3s	3.03	3-3.1s						

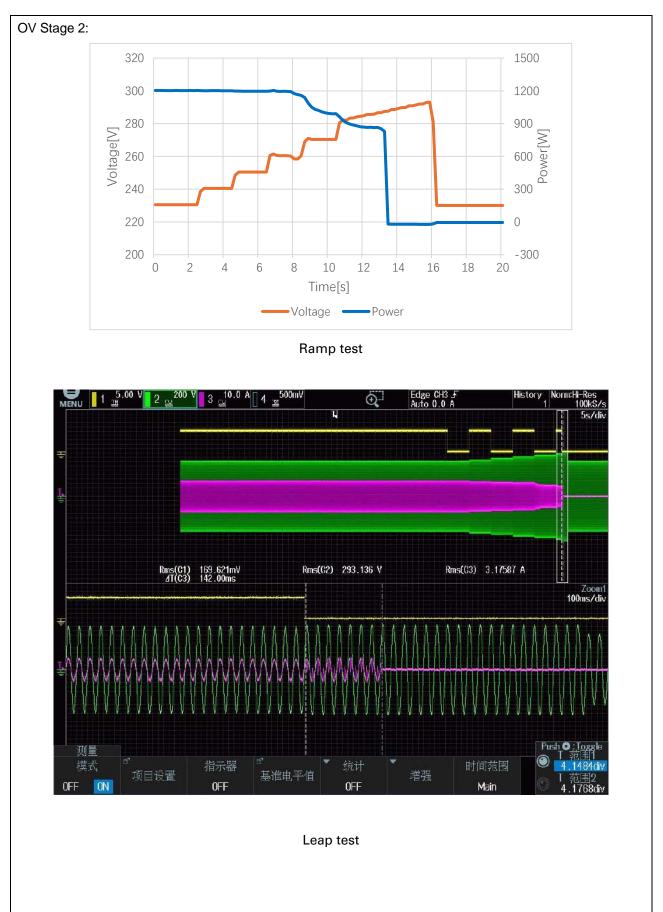
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Page 59 of 159

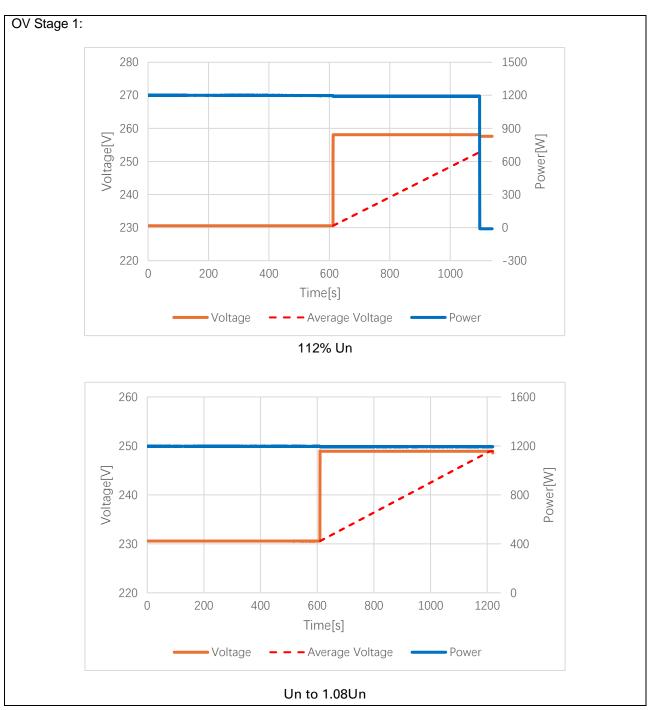
OF	Set		Ν	leasure	ed			Remark
No.	value		Т	rip valu	e		Limitation	8.1, applying ramp test, start of <pre><51.4Hz, and ramp to >51.6Hz, step</pre>
1	51.5Hz	51.50	51.50	51.49	51.50	51.49	+/-0.05Hz	frequency length is <0.025 Hz, and step time is >400ms
2	100ms	130	173	132	156	114	≤200	9.1, applying Jump test, start of <51.4Hz, and jump to >51.6Hz, step frequency length is >0.2Hz, and step time is >400ms
UF	Set		Ν	leasure	ed		Limitation	Remark
No.	value		Т	rip valu	e		[ms]	10.1, applying ramp test, start
1	47.5Hz	47.48	47.48	47.48	47.48	47.48	+/-0.05Hz	of >47.6Hz, and ramp to <47.4Hz, step frequency length is <0.025 Hz, and step time is >400ms
2	100ms	176	133	174	196	175	≤200	10.2, applying Jump test, start of >47.6Hz, and jump to <47.4Hz, step frequency length is >0.2Hz, and step time is >400ms

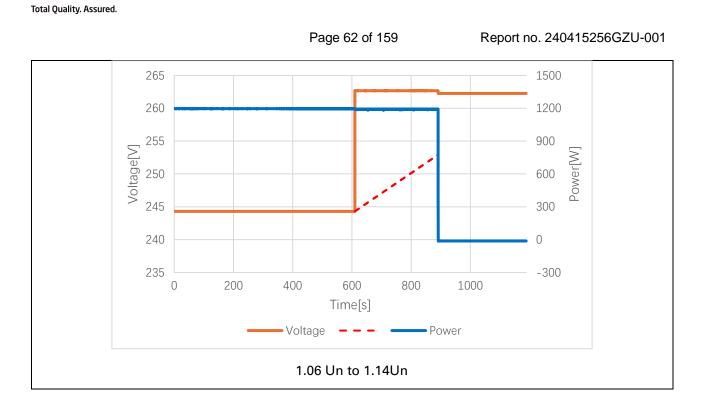


Page 60 of 159



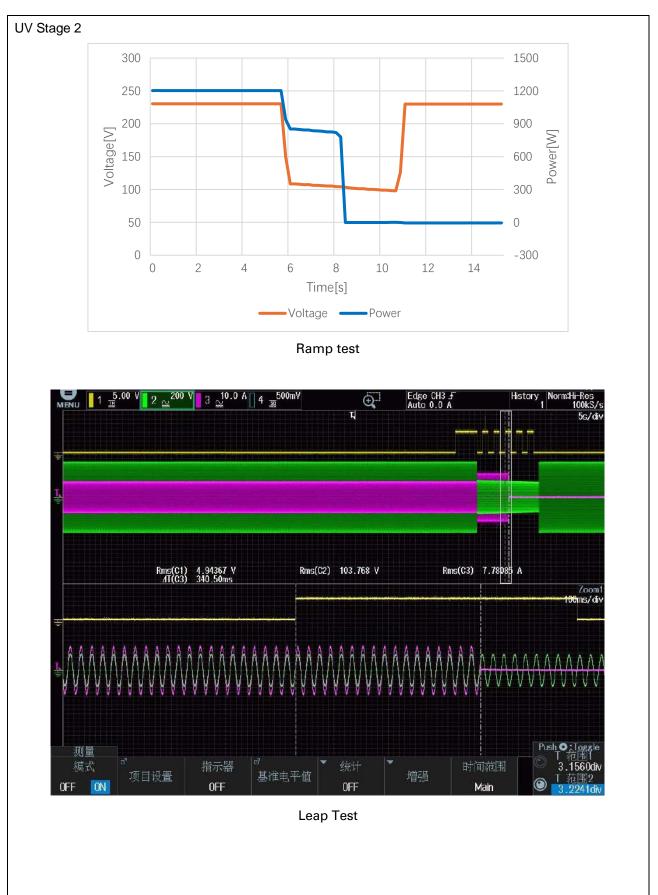
Page 61 of 159

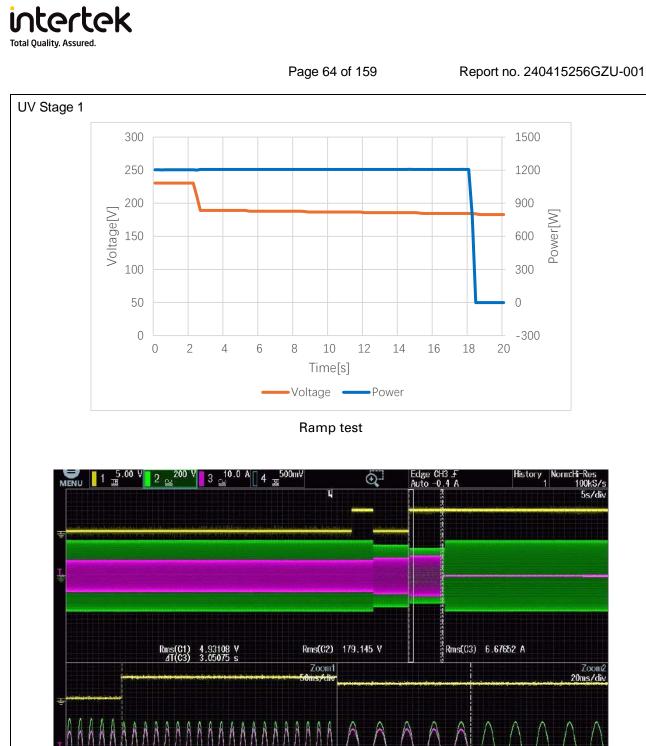




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Page 63 of 159





940

Main

测量模式

OFF ON

指示器

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基准电平值

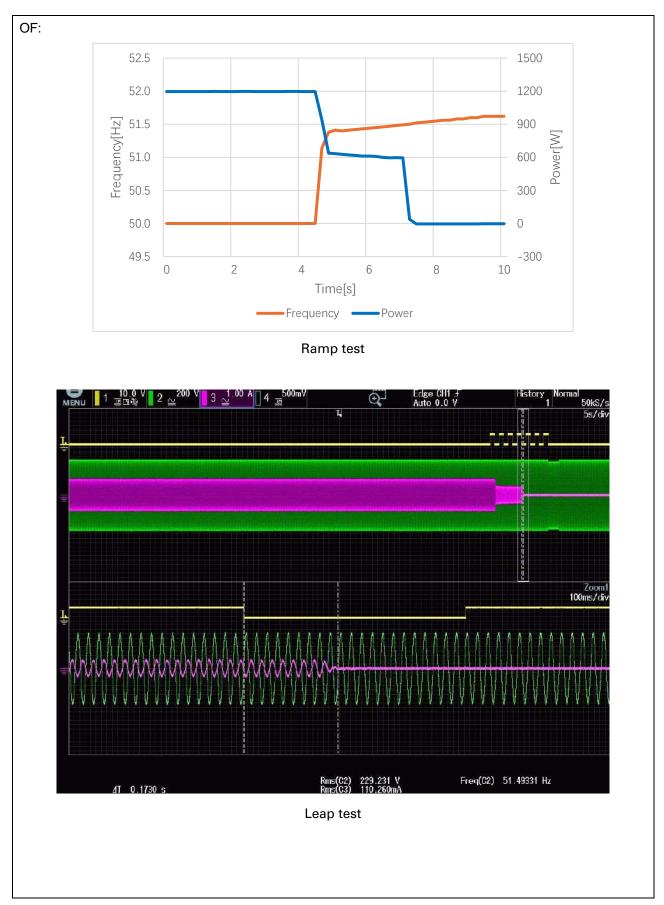
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Leap test

项目设置

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Page 65 of 159



Page 66 of 159

Report no. 240415256GZU-001



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Page 67 of 159

5.5.8	3, 5.5.9	TABLE: Indication / protection of NS protection		Р			
1.	The last	5 fault indication can be read	Pass Dailed	·			
	Fault 1:		Error message display				
	Fault 2:		Error message display				
	Fault 3:		Error message display				
	Fault 4:		Error message display				
	Fault 5:		Error message display				
2.	Fault ind 3s	ication can be read after a supply interruption \leq	🛛 Pass 🗌 Failed				
	Fault 1:		Error message display				
	Fault 2:		Error message display				
	Fault 3:		Error message display				
	Fault 4:		Error message display				
	Fault 5:		Error message display				
3.		ection settings can be read on PGU or data	Pass Dailed				
	Interface	equipment	Interface equipment: remote monitor				
4.	The NS	protection settings shall be protected.	Pass Dailed				
			Protection type: Integrated NS protection				
5.	If all prot	ection settings are fixed	Pass Dailed				

Page 68 of 159

Report no. 240415256GZU-001

5.5.10 Island detection									Ρ	,		
No.	PEUT ¹⁾ (% of EUT rating)	Reactive load (% of QL in 6.1.d)1)	PAC ²⁾ (% of nominal)	QAC ³⁾ (% of nominal)	Run on time (ms)	PEUT (KW)	Actual Qf	VDC	Re	ema	rks ⁴⁾	,
1	100	100	0	0	198	1.20	1.01	40	Test	Α	at	BL
2	66	66	0	0	166	0.79	1.03	30	Test	В	at	BL
3	33	33	0	0	157	0.40	1.01	20	Test	С	at	BL
4	100	100	-5	-5	158	1.20	1.03	40	Test	Α	at	ΙB
5	100	100	-5	0	156	1.20	1.06	40	Test	Α	at	IB
6	100	100	-5	5	239	1.20	1.08	40	Test	Α	at	IB
7	100	100	0	-5	157	1.20	0.98	40	Test	Α	at	IB
8	100	100	0	5	219	1.20	1.03	40	Test	Α	at	ΙB
9	100	100	5	-5	157	1.20	0.94	40	Test	Α	at	IB
10	100	100	5	0	155	1.20	0.96	40	Test	Α	at	IB
11	100	100	5	5	217	1.20	0.98	40	Test	Α	at	ΙB
12	66	66	0	-5	164	0.79	1.00	30	Test	В	at	ΙB
13	66	66	0	-4	167	0.79	1.01	30	Test	В	at	ΙB
14	66	66	0	-3	166	0.79	1.01	30	Test	В	at	ΙB
15	66	66	0	-2	165	0.79	1.02	30	Test	В	at	ΙB
16	66	66	0	-1	165	0.79	1.02	30	Test	В	at	IB
17	66	66	0	1	166	0.79	1.03	30	Test	В	at	IB
18	66	66	0	2	165	0.79	1.04	30	Test	В	at	IB
19	66	66	0	3	164	0.79	1.04	30	Test	В	at	IB
20	66	66	0	4	163	0.79	1.04	30	Test	В	at	IB
21	66	66	0	5	164	0.79	1.05	30	Test	В	at	ΙB
22	66	66	0	6	152	0.79	1.05	30	Test	В	at	IB
23	33	33	0	-5	145	0.40	0.98	20	Test	С	at	ΙB
24	33	33	0	-4	146	0.40	0.98	20	Test	С	at	IB
25	33	33	0	-3	160	0.40	0.99	20	Test	С	at	ΙB
26	33	33	0	-2	145	0.40	1.00	20	Test	С	at	ΙB
27	33	33	0	-1	158	0.40	1.00	20	Test	С	at	IB
28	33	33	0	1	159	0.40	1.01	20	Test	С	at	IB
29	33	33	0	2	160	0.40	1.02	20	Test	С	at	IB
30	33	33	0	3	143	0.40	1.02	20	Test	С	at	IB
31	33	33	0	4	145	0.40	1.02	20	Test	С	at	IB
32	33	33	0	5	144	0.40	1.03	20	Test	С	at	IB
33	100	100	-10	-10	158	1.20	1.03	40	Test		at	
34	100	100	-10	-5	158	1.20	1.06	40	Test		at	
35	100	100	-10	0	199	1.20	1.09	40	Test	Α	at	IB
36	100	100	-10	5	240	1.20	1.11	40	Test	Α	at	
37	100	100	-10	10	200	1.20	1,14	40	Test			IB
38	100	100	-5	-10	158	1.20	1.00	40	Test			IB
39	100	100	-5	10	201	1.20	1.11	40	Test			

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Page 69 of 159

Report no. 240415256GZU-001

40	100	100	10	-10	156	1.20	0.87	40	Test	А	at	IB
41	100	100	10	-5	156	1.20	0.89	40	Test	А	at	IB
42	100	100	10	0	198	1.20	0.92	40	Test	А	at	IB
43	100	100	10	5	218	1.20	0.94	40	Test	А	at	IB
44	100	100	10	10	222	1.20	0.96	40	Test	А	at	IB
45	100	100	0	-10	158	1.20	0.95	40	Test	А	at	IB
46	100	100	0	10	208	1.20	1.05	40	Test	А	at	IB
47	100	100	5	-10	157	1.20	0.91	40	Test	А	at	IB
48	100	100	5	10	214	1.20	1.00	40	Test	А	at	IB

Remark:

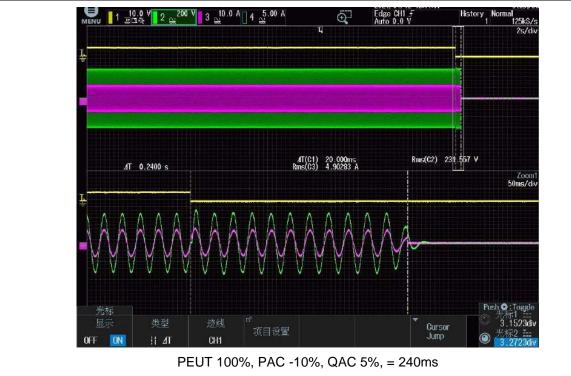
¹⁾ PEUT: EUT output power

²⁾ PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0% test condition value.

³⁾ QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0% test condition value.

⁴⁾ BL: Balance condition, IB: Imbalance condition.

⁵⁾ *Note: test condition A (100%): If any of the recorded run-on times are longer than the one recorded for the rated balance condition, i.e. test procedure 6.1 f), then the non-shaded parameter combinations (no.33~48) also require testing.



intertek Total Quality. Assured. Page 70 of 159 Edge CH1 F Auto 0.0 V MENU 1 10.0 V 2 200 V 3 10.0 A 4 5.00 A Ð ⊿T 0.1672 s Rms(C2) 229.391 V

> 3 10.0 A 4 5.00 A Edge CH1 5 Auto 0.0 V Histo 1 10.0 2 _2²⁰⁰ V 0 125kS/ T. 2s/di Rms(C3) 1.74289 A ⊿T 0.1600 s Rms(C2) 229.212 V Zoom1 50ms/div Togg .8091div Cursor Jump ă CH1

> > PEUT 33%, PAC 0%, QAC 2%, = 160ms

Rms(C3) 3.43726 A Zoom 50ms/di Push, 👥 Cursor Jump 3123di OFF ON || ⊿T CH1 PEUT 66%, PAC 0%, QAC -4%, = 167ms

Report no. 240415256GZU-001

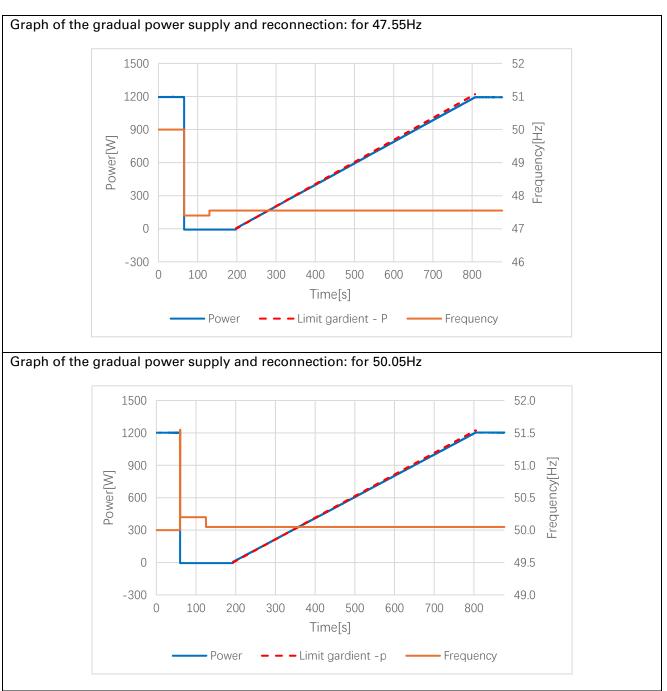
mal 125kS/s 2s/div

Page 71 of 159

5.6	Connection con		Р						
DC input:		AC output:		Rated Outp	Rated Output Power				
	40Vdc	230Vac;	50Hz		1.2kW				
IVIE	easure Item	Reconnec	tion?		Measurem	ent			
				Voltage [%Un]	Frequency [Hz]	Reconnection Time (>60s)			
f _{ist} <47.45H	lz		🛛 No	100	47.40	Cannot reconnection			
f _{ist} ≥ 47.55	Ηz	🛛 Yes	🗌 No	100	47.55	67.8			
f _{ist} > 50.15h	Hz	☐ Yes	🛛 No	100	50.20	Cannot reconnection			
f _{ist} ≤ 50.05	Ηz	🛛 Yes	🗌 No	100	50.05	67.6			
U _{ist} < 84%	Un		🛛 No	83.93	50.00	Cannot reconnection			
U _{ist} ≥ 86% U _n		🛛 Yes	🗌 No	86.11	50.00	67.6			
U _{ist} > 111% U _n		🗌 Yes	🛛 No	111.36	50.00	Cannot reconnection			
U _{ist} ≤ 109%	b Un	🛛 Yes	🗌 No	108.73	50.00	67.8			

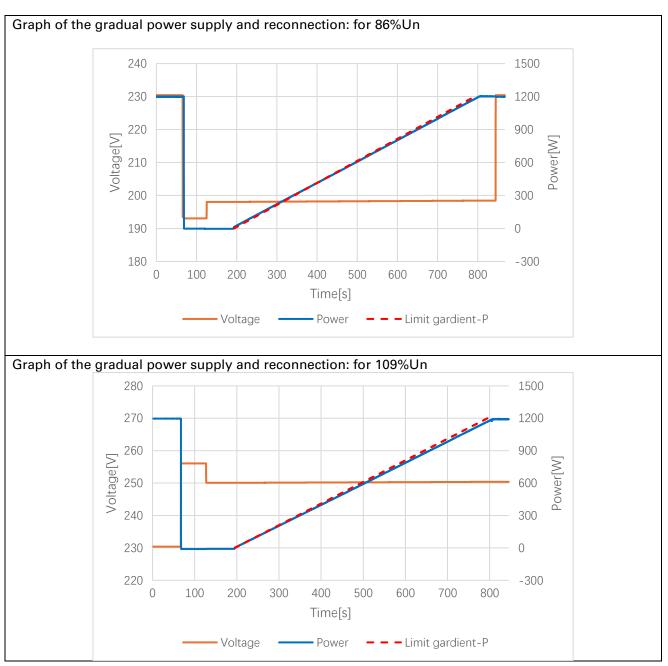


Page 72 of 159

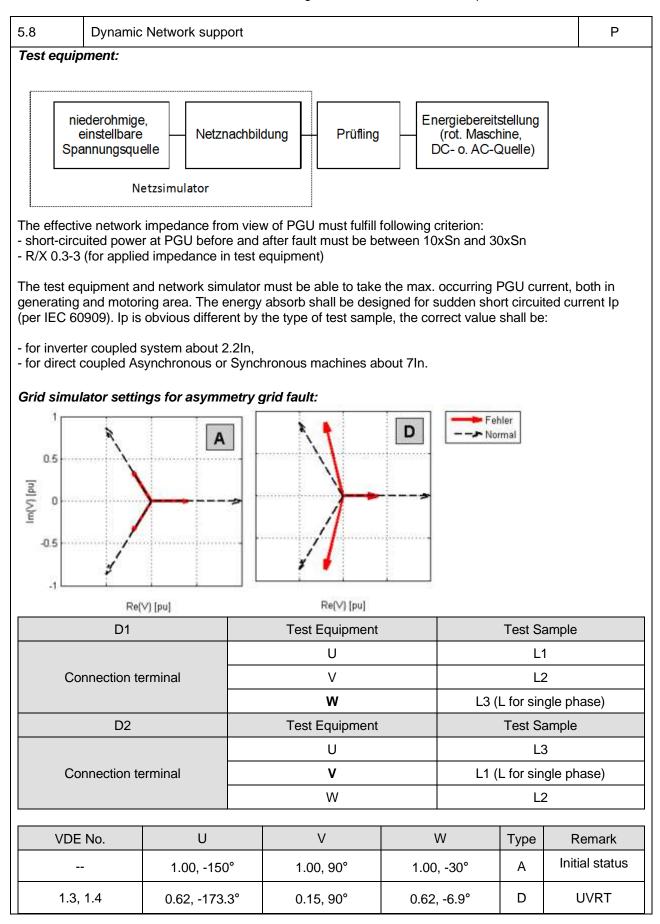




Page 73 of 159



Page 74 of 159



Page 75 of 159

Report no. 240415256GZU-001

2.3, 2.4, 3.3, 3.4	0.76, -161.1°	0.50, 90°	0.76, -19.1°	D	
4.3, 4.4	0.93, -152.8°	0.85, 89.9°	0.93, -27.4°	D	
5.3, 5.4	1.08, -144.5°	1.25, 89.1°	1.06, -36.3°	D	
6.3, 6.4	1.06, -145.5°	1.20, 89.3°	1.05, -35.1°	D	OVRT
7.3, 7.4	1.04, -146.6°	1.15, 89.4°	1.04, -33.9°	D	

Diagram:

For each test the following diagrams shall be figured since t1-1s (one second before fault entry) till t2+6s (six seconds after fault clear), zoomed if needed:

Empty load tests:

- line to line voltages and line to neutral voltages (signal)

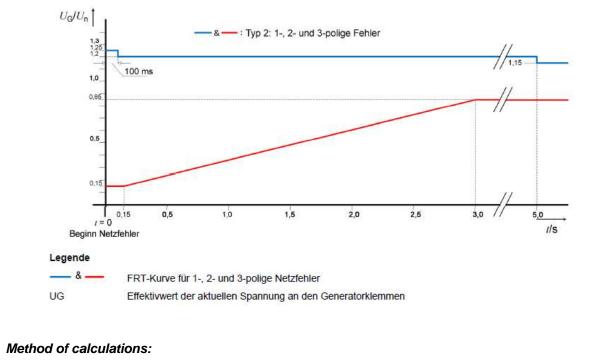
- full period-RMS value of line to neutral voltages with updated rate of 1/ms.

Tests with sample:

- line to line voltage and line to neutral voltage (signal)

- line currents (signal)
- full period-RMS value of line to neutral voltage with updated rate of 1/ms
- full period-RMS value of line currents with updated rate of 1/ms (active and reactive part additionally)
- active power and reactive power in pos. sequence with updated rate of 1/ms
- voltage and current in pos. sequence with updated rate of 1/ms

Test condition:





Page 76 of 159

Notes on calculations:	Used formula	Remarks
General remarks: The average grid frequency over the measured interval is calculated from zero-crossings of the sine function. Only 10 cycles before the dip are used for this calculation. RMS-Calculations are performed with a moving window, which is determined by $T = 1/f$ and must remain constant. The number of samples N per calculation window is determined by the sampling rate f_s . N has to be even and an integer number nearest to the product T^*f_s .	$\underline{U}_{1} = \frac{\sqrt{2}}{N} \cdot \sum_{n=0}^{N} u(n) \cdot e^{-j(\frac{2\pi n}{N})}$ $\underline{I}_{1} = \frac{\sqrt{2}}{N} \cdot \sum_{n=0}^{N} i(n) \cdot e^{-j(\frac{2\pi n}{N})}$	 Calculated for each phase A,B,C N: Amount of samples per window n: number of sample
Performed Calculation	$\underline{U}^{+} = \frac{1}{3} \cdot (\underline{U}_{1A} + \underline{U}_{1B} \cdot e^{+j\frac{2\pi}{3}} + \underline{U}_{1C} \cdot e^{-j\frac{2\pi}{3}})$ $\underline{I}^{+} = \frac{1}{3} \cdot (\underline{I}_{1A} + \underline{I}_{1B} \cdot e^{+j\frac{2\pi}{3}} + \underline{I}_{1C} \cdot e^{-j\frac{2\pi}{3}})$	
Complex values for the fundamental harmonic	$P = 3 \cdot U^+ \cdot I^+ \cdot \cos(\varphi)$ $Q = 3 \cdot U^+ \cdot I^+ \cdot \sin(\varphi)$	Phase-angle : Angular difference between current and voltage $\varphi = (\varphi_U - \varphi_I)$
Positive sequence component of the voltage and current	$I_r = I^+ \cdot \sin(\varphi)$ $I_{tot} = I^+$	
Power:	$U_{rms} = \sqrt{\frac{1}{N} \cdot \sum_{n=0}^{N} (u(n) - \overline{u})^2}$ $\overline{u} = \frac{1}{N} \cdot \sum_{n=0}^{N} u(n)$	- Calculated for each phase A,B,C or L1, L2, L3

Page 77 of 159

Report no. 240415256GZU-001

Verificatio	on of c	lynamic networ	k support					Р	
		ed power at rminal [VA]			Z	iκ		·	
NS pr	otectio	on settings			See table 5	5.5 for detail.			
	No.	Parameter	Phase ref.	Time ref.	unit		Result		
	0	Test number				1.1	2.1	3.1	
	1	Date			dd.mm.yyyy	15-Apr-	2024 to 10-Ma	ay-2024	
	2	Time (start of test)			hh:mm:ss.f		See graph		
	3	Fault type (phase)				A	А	А	
	4	Setting voltage depth	Line to line		p.u.	0.15	0.5	0.5	
General	5	Setting dip duration			ms	150 1500		1500	
Info.	6	Point of fault entry	Total		ms		20ms		
	7	Point of fault clearance	Total		ms				
	8	Fault duration in empty load test	Total		ms	150.0	1569.0	1571.8	
	9	Voltage	Total	t1+100ms	p.u.	0.15	0.5	0.5	
	10	depth/height in empty load test	Positive sequence	to t2 and t1-10s to t1	p.u.	0.15	0.5	0.5	
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.				
	13	Active	Total	41.40a.4a		0.992	0.956	0.933	
Before dip <t1< td=""><td>14</td><td>power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td></t1<>	14	power	Positive sequence	t1-10s to t1	p.u.				
	15	Reactive	Total	t1 10c to		0.033	0.318	-0.307	
	16	power	Positive sequence	t1-10s to t1	p.u.				
	17	Cos _φ		t1-10s to t1		0.9999	0.9501	0.9504	
During dip t1 to	18	Voltage	Line to neutral	t1+100ms to t2- 20ms	p.u.	0.15	0.5	0.5	

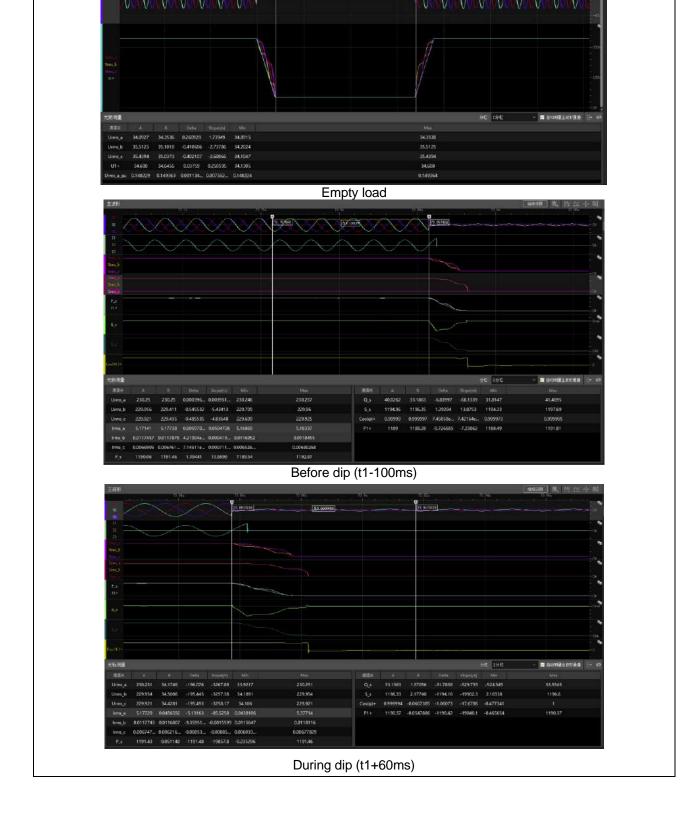
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Page 78 of 159

								1
t2	19		Phase 1			0.009	0.019	0.019
	20	Line current	Phase 2	t1+60ms	p.u.			
	21		Phase 3					
	22		Phase 1			0.009	0.020	0.019
	23	Line current	Phase 2	t1+100ms	p.u.			
	24		Phase 3					
	25	Active power	Total	t1+100ms		0.001	0.001	0.001
	26		Positive sequence	to t2- 20ms	p.u.			
	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00
	28	Active	Positive sequence.	t2+3s to	p.u			
	29	power	Total	t2+10s	·	0.993	0.962	0.934
	39	Active power rising time	Positive sequence		S	0.550	0.496	0.563
After dip	31	Reactive	Positive sequence	t2+3s to t2+10s	p.u.			
> t2	32	power	Total	12+105		0.034	0.302	-0.303
	33	Reactive power rising time	Positive sequence		S	0.011	9.157	9.814
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No		Yes	

TRF No. VDE-AR-N 4105d



Page 79 of 159

30 1800

71.169170

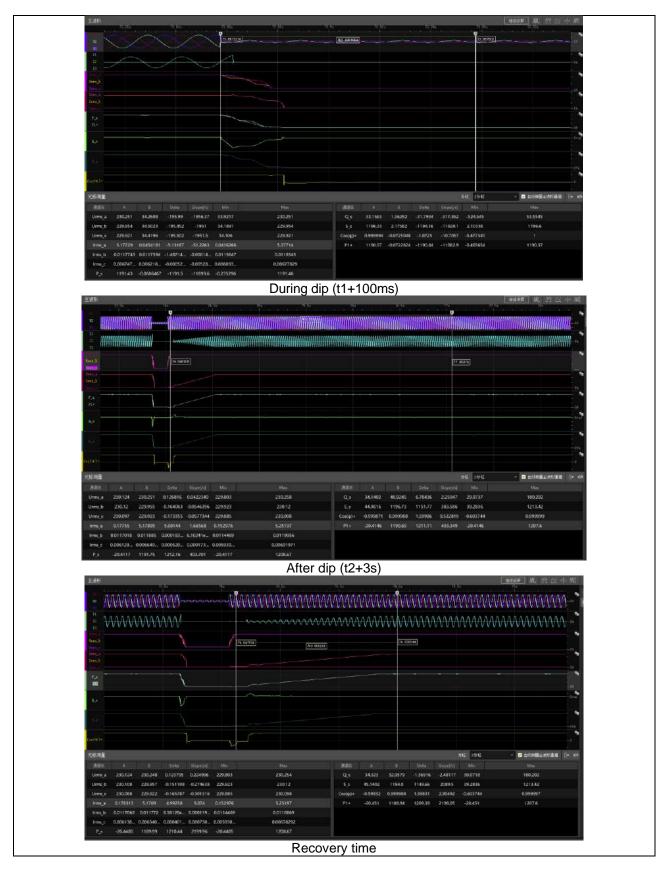
Report no. 240415256GZU-001

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Graph of Test number 1.1_0.15Un

Page 80 of 159

Report no. 240415256GZU-001



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Page 82 of 159

Report no. 240415256GZU-001

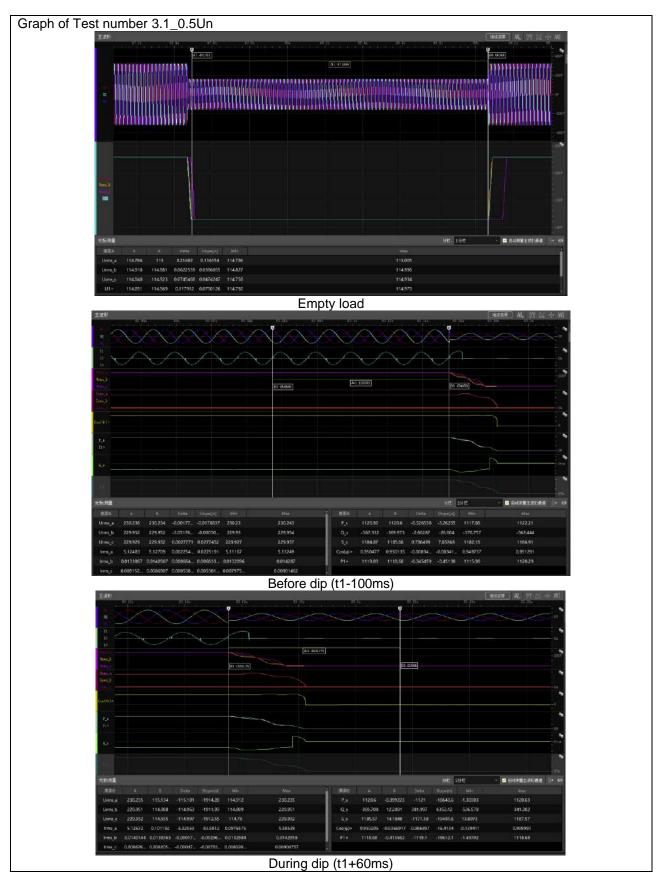
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9.4			
光标测量		96 295	- B BUMBINIA - 40-
1520 A A Deba Stopel/d Umoja 230255 114.023 -115.425 -1151.41		30377 4 5 0459 Min Min P_4 114931 -0.431656 -1149.74 -11468 -1.35797	Max 1150,65
Umrs_b 229.97 114.99 -114.90 -1146.96 Umrs_c 229.918 114.932 -114.966 -1147.02		P1+ 1149.03 -0.379302 -1149.41 -11465.7 -1.42582 Q_5 380.083 9.09667 -370.906 -3700.69 8.50832	1149.03 473.14/
Irms_a 5,25571 0.102305 -5.15341 -51.4066 Irms_b 0.0137374 0.0141177 0.000380 0.003753.	. 0.0134136 0.0147803	5,4 1215.3 14,3949 -1200.9 11979.3 13,6566 Ceel@)+ 0,950662 -0,0336145 -0,984277 -9,81842 -0,140097	1215.3. 0.099344
Imme_c 0.000627 0.000908 0.000201 0.002810.	. 0.00336 000943272 During dip	(t1+100ms)	
14P			mm 是 是 是 是 是 是 是 是 是 是 是 是 是 是 是 是 是 是
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Linns_s 230.174 230.26 0.0866378 0.028922 Linns_b 230.051 229.562 -0.000623 -0.029517	74 229.956 230.067	P_s -9.79463 118446 119426 397.767 -9.79463 P1+ -9.67075 1183.91 1193.59 397.544 -9.67875	1208,94 1207.93
Umma_c 2206.025 229.918 -0.107776 -0.035697 Imma_a 0.155912 3.24377 5.06986 1.69526	0.147352 5.25273	Q_1 25.9129 295.903 206.99 66.9413 -126.566 5_5 40.5943 1212.89 1172.29 390.451 39.1094	236346 121409
hms_b 0.0138045 0.0144636 0.000658 0.000219. hms_c 0.00959 0.003047 0.000586 0.000196.	0.0081482 0.00975264	Coely)+ -0294585 0.961755 1.27634 0.425106 -0.256834	₹.
王 刘书	After dip		·
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大和深識 西古 A B Delta Stoce(A)	New 1	対応 3分世 通信さ A E Deta Sape(A) Mia	
manae n province Umm_e 250:174 200.267 0.00936127 0.16854 Umm_b 230.051 229.56 -0.0994236 -0.108211	229.967 230.273	P_6 -3.75463 1200.62 1210.41 2437.83 -9.79463 P1+ -3.67875 1199.63 1209.31 2435.61 -9.67875	1200-94 1207-93
Uma_c 230.025 229.923 0.102476 0.206.99 irms_s 0.153912 5.21734 5.06342 10.1979	15 229.917 230.057	Q.s 28.9129 43.0491 14.1362 28.4709 -126.586 S.s 40.5943 120669 1166.1 2348.57 39.1094	124,225 1214,09
Irms,5 020138049 0.0140455 0.000240 0.000484. Irms_c 0.0096559 0.00090557 0.000396 0.000798.		Cos(\$)+ -0.294585 0.999901 1.29449 2.60715 -0.296804	1
	Recover	y time-P	

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Page 83 of 159



Page 84 of 159



Page 85 of 159

Report no. 240415256GZU-001



intertek

Page 86 of 159



Page 87 of 159

Report no. 240415256GZU-001

Verificatio	on of c	lynamic networ	k support						Р			
		ed power at rminal [VA]			2	4K						
NS pr	otectio	on settings	See table 5.5 for detail.									
	No.	Parameter	Phase ref.	Time ref.	unit		Res	sult				
	0	Test number				4.1	5.1	6.1	7.1			
	1	Date			dd.mm.yyyy	15-A	pr-2024 to	10-May-2	2024			
	2	Time (start of test)			hh:mm:ss.f		See g	raph				
	3	Fault type (phase)				А	А	А	А			
	4	Setting voltage depth	Line to line		p.u.	0.85	1.25	1.20	1.15			
General	5	Setting dip duration			ms	60000	100	5000	60000			
Info.	6	Point of fault entry	Total		ms	20ms						
	7 Point of fault clearance		Total		ms		20r	ns				
	8	Fault duration in empty load test	Total		ms	60980	100.0	5079.4	60079			
	9	Voltage	Total	t1+100ms	p.u.	0.85	1.25	1.20	1.15			
	10	depth/height in empty load test	Positive sequence	to t2 and t1-10s to t1	p.u.	0.85	1.25	1.20	1.15			
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00			
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.							
	13	Active	Total	11 10a ta		0.998	0.998	0.994	0.994			
Before dip <t1< td=""><td>14</td><td>power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td><td></td></t1<>	14	power	Positive sequence	t1-10s to t1	p.u.							
	15	Popetivo	Total	t1-10s to		0.028	0.032	0.033	0.034			
	16	Reactive power	Positive sequence	t1-105 to	p.u.							
	17	Cos _φ		t1-10s to t1		0.9999	0.9999	0.9999	0.9999			
During dip t1 to	18	Voltage	Line to neutral	t1+100ms to t2- 20ms	p.u.	0.85	1.25	1.20	1.15			

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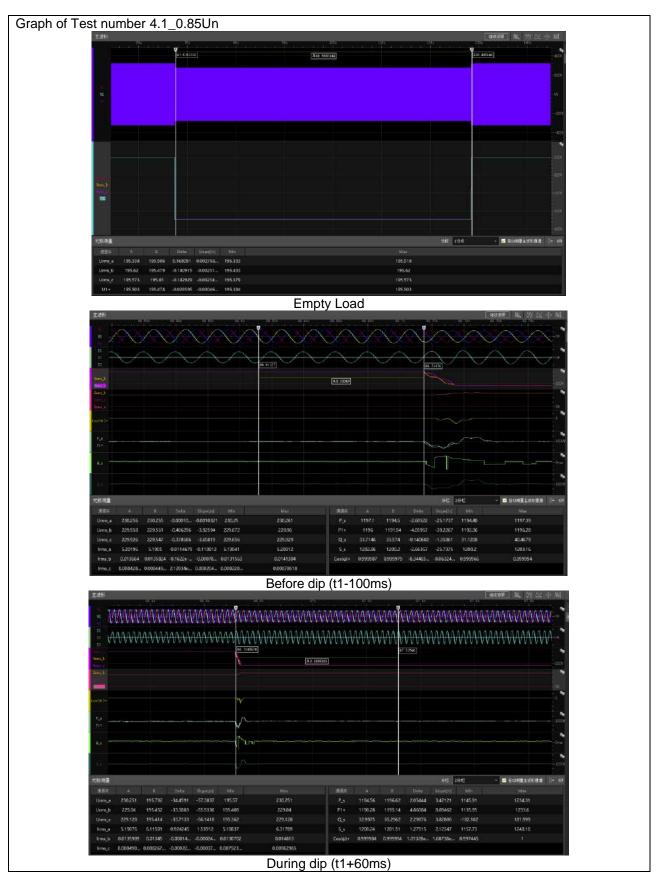
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Page 88 of 159

t2	19		Phase 1			1.172	0.034	0.033	0.857
	20	Line current	Phase 2	t1+60ms	p.u.				
	20 Line cu 21 22		Phase 3						
	22		Phase 1			1.175	0.034	0.033	0.855
	23	Line current	Phase 2	t1+100ms	p.u.				
	24		Phase 3						
	25	A	Total	t1+100ms		1.000	0.001	0.001	0.985
	26	Active power	Positive sequence	to t2- 20ms	p.u.				
	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u				
	29	power	Total	12+105	•	0.995	1.013	0.998	0.996
	39	Active power rising time	Positive sequence		S	0.016	0.492	0.499	0.012
After dip	31	Reactive	Positive sequence	t2+3s to t2+10s	p.u.				
> t2	32	power	Total	12+105		0.033	0.032	0.040	0.028
	33	Reactive power rising time	Positive sequence		S	0.013	0.012	0.015	0.010
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No		Ye	S	

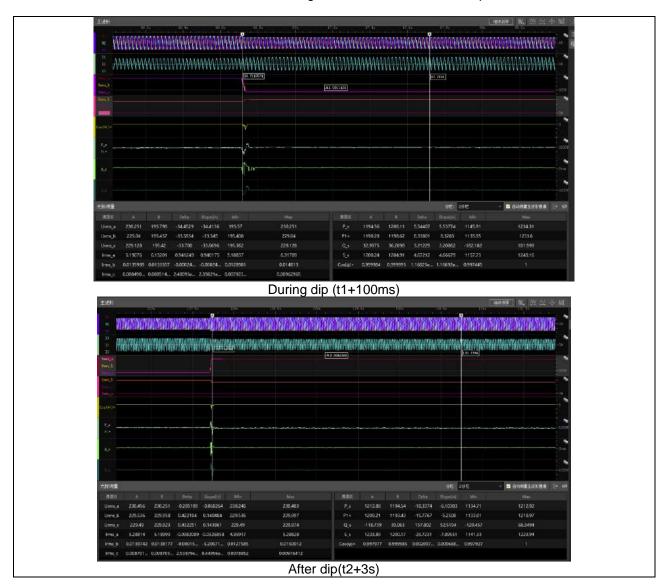
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Page 89 of 159



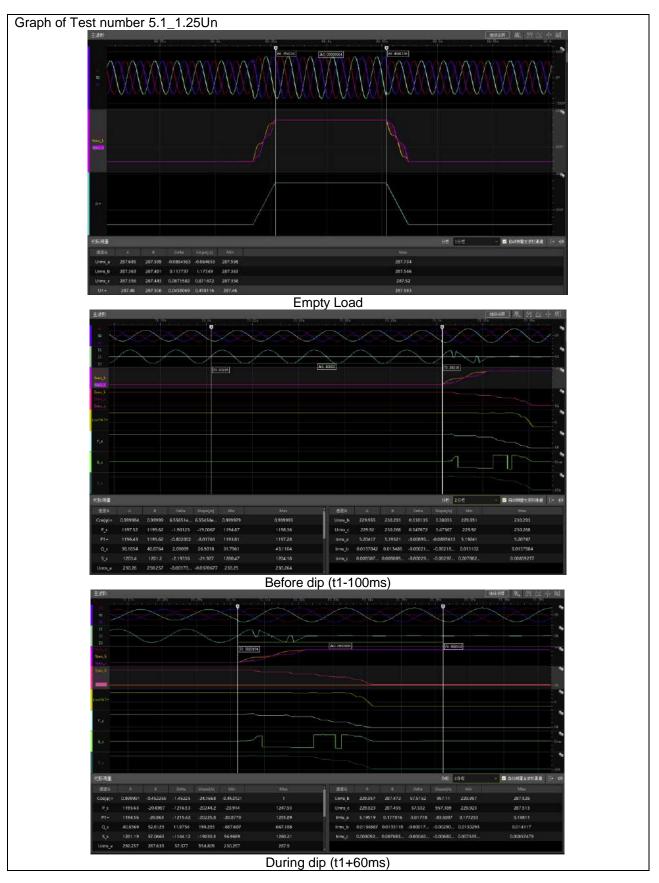
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Page 90 of 159









Page 92 of 159

Report no. 240415256GZU-001



intertek

intertek

Page 93 of 159



Page 94 of 159

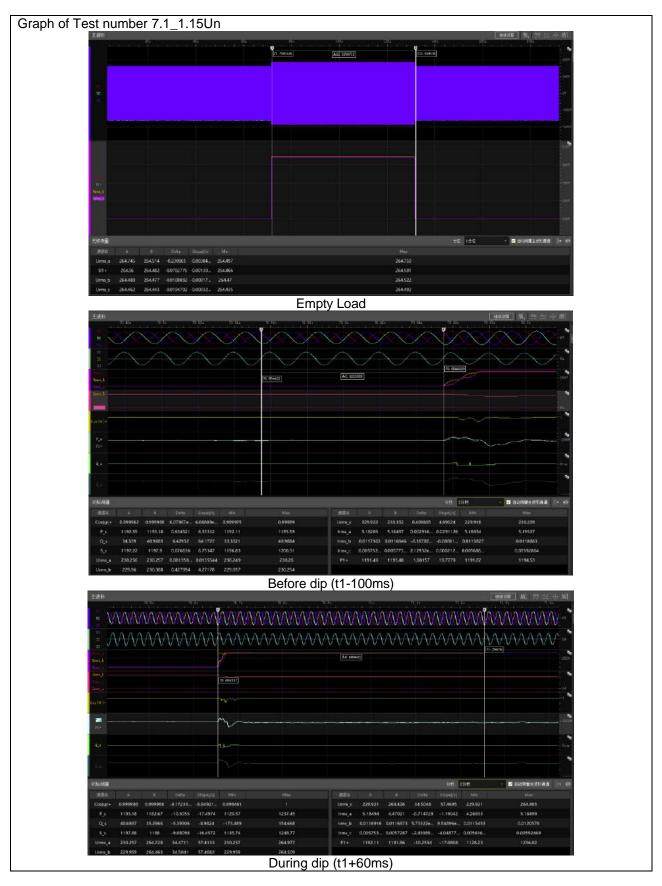
Report no. 240415256GZU-001

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光标测量					1				分世: 2分世		~ 🗌 自动	则里主波形通道	
通道名 Cos(ψ)+	A 0.999969	B -0.383954	Delta -1.38392	Slope[/s] -13.8199	Min -0.403961	Max 1	通道名 Urms_b	A 229.96	B 275.984	Delta 46.0237	Slope[/s] 459.594	Min 229.96	Маж 276.01
P_s	1192.67	-16.5968	-1209.27	-12075.8	-18.0606	1244.0	Urms_c	229.92	275.956	46.0363	459.72	229.92	276
P1+ Q_s	1191.65 38.6577	-16.542 45.4796	-1208.19 6.82183	-12065 68.123	-18.0769 -584.343	1252.6 576.38	Irms_a	5.18299 0.0133792	0.170412	-5.01258 -2.44938	-50.0557 -2.44595	0.169715	5.1892 0.01462
S_s	1198.47	52.9877	-1145,48	-11438.8	52,8055	1262.4	Irms_b Irms_c		0.008071	-0.00039			
Urms_a	230,261	276.201	45.9393	458.751	230.261	276.47	•						
					During	_	(t1+10	00ms)					
主波形		745	14.5±		755	75,6		76 :	16.5.		■ 「 「 「 」 「 」 「 」 「 」 「 」 「 」 「 」 「 」 「 」 「 」 「 」 」 「 」 」 」 「 」 」 」 「 」 」 」 」 」 「 」 」 」 」 」 」 」 」 」 」 」 」 」	L M A n,6s	∻ MI
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光标测量 通道名		в					通道名		分祖: 2分祖 8		✓ ■自助! Slope[/s]	N量主波形通道 Min	[→ Ø Max
Cos(ψ)+	-0.134959		1.13494	0.377451	-0.170193	1	Urms_b	230.25	229.96	-0.290482	-0.0966069		230.2
P_s P1+	-4.78681 -4.75254	1195.62 1194.61	1200.41 1199.36	399.226 398.877	-10.732 -10.7659	1214.4 1213.4	Urms_c	230.21 0.157145	229.92 5.19481	-0.289993 5.03766	-0.0964445 1.6754	0.15689	230.2
Q_s	40.9546	40.3647	-0.589806	-0.196155	29.6184	178.23	lrms_a lrms_b	0.0139607		0.000137		0.012882	0.01506
S_s	41.2754	1201.46	1160.18	385.847	41.1175	1220.5	lrms_c	0.008470	0.008990	0.000519	0.000172	0.0079928	0.00974
Urms_a	229.794	230.258	0.463913	0.154286	229.794	230.26	•						•
					Aft	er dip	o(t2+3	BS)		_			1. aut
主波形		73.8s		74.5		74.2c		74.4s		74.65		N, M 🗠	~~ //I
122 MM	KANA KA	VAVAVAV	VAAVAV					MAMAA					
12 					$\sim\sim\sim\sim\sim\sim$	ww	www	www	www	MW	www	MMM	Af-1A
Urns_b Arms_r				\									
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Cos(Φ)+						A 0.499	11						- 0
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0_5													- 000
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and the second second				Slope[/s]	Min	Мах	通道名	A	8 B		Slope[/s]	Min #325120606	Max
光标测量 通道名		0.999995	1.13482	2.27368	-0.170193		Urms_b	229.921	229.961		0.0802821		229.98
速道名 Cos(ψ)+	-0.134822	1.000		2399.57	-10.732	1214.4	Urms_c	229.867	229,921	0.0544891	0.109173	229.865	229.93
通道名	-0.134822 -4.79894 -4.76204	1192.85 1191.85	1197.65 1196.61	2397.48	-10.7659	1213.4	Irms_a	0.157727	5.18588	5.02815	10.0742	0.157532	5.277
進道名 Cos(ψ)+ P_s P1+ Q_s	-4.79894 -4.76204 41.1265	1191.85 47.8848	1196.61 6.75828	2397.48 13.5407	-10.7659 29.7035	178.23	Irms_b	0.0140719	0.0141859	0.000114	0.000228.	0.0131762	0.0148
透道系 Cos(ψ)+ P_s P1+	-4.79894 -4.76204	1191.85	1196.61	2397.48	-10.7659				0.0141859	0.000114		0.0131762	0.0148

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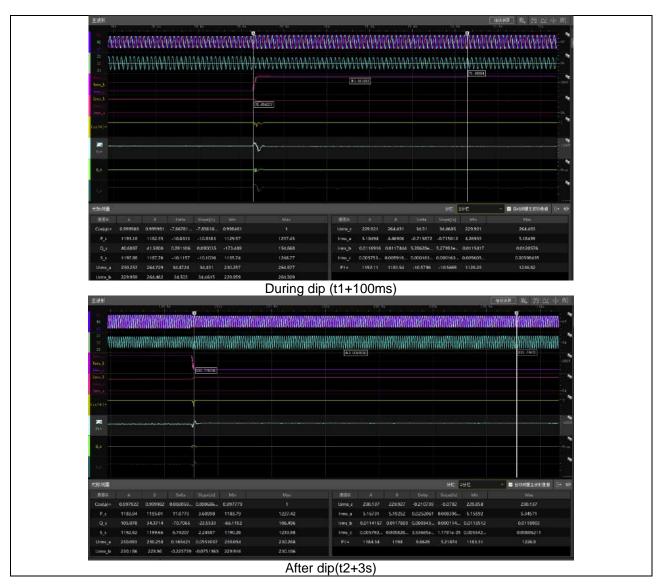


Page 95 of 159





Page 96 of 159



Page 97 of 159

Report no. 240415256GZU-001

Verificatio	on of c	lynamic networ	k support					Р			
		ed power at rminal [VA]	4К								
NS pr	otectio	on settings			See table 5	5.5 for detail.					
	No.	Parameter	Phase ref.	Time ref.	unit		Result				
	0	Test number				1.2	2.2	3.2			
	1	Date			dd.mm.yyyy	15-Apr-2	2024 to 10-M	ay-2024			
	2	Time (start of test)			hh:mm:ss.f		See graph				
	3	Fault type (phase)				А	А	А			
	4	Setting voltage depth	Line to line		p.u.	0.15	0.5	0.5			
General	5	Setting dip duration			ms	150	1500	1500			
Info.	6	Point of fault entry	Total		ms						
	7	Point of fault clearance	Total		ms		20ms				
	8	Fault duration in empty load test	Total		ms	150.0	1569.0	1571.8			
	9	Voltage	Total	t1+100ms	p.u.	0.15	0.5	0.5			
	10	depth/height in empty load test	Positive sequence	to t2 and t1-10s to t1	p.u.	0.15	0.5	0.5			
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00			
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.						
	13	A ethice	Total			0.497	0.511	0.496			
Before dip <t1< td=""><td>14</td><td>Active power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td></t1<>	14	Active power	Positive sequence	t1-10s to t1	p.u.						
	15	Desetive	Total	14 40- 1-		0.020	0.334	-0.331			
	16	Reactive power	Positive sequence	t1-10s to t1	p.u.						
	17	Cos _φ		t1-10s to t1		0.9999	0.9521	0.9479			
During dip t1 to	18	Voltage	Line to neutral	t1+100ms to t2- 20ms	p.u.	0.15	0.50	0.50			

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Page 98 of 159

t2	19		Phase 1			0.008	0.021	0.022
	20	Line current	Phase 2	t1+60ms	p.u.			
	21		Phase 3					
	22		Phase 1			0.009	0.022	0.022
	23	Line current	Phase 2	t1+100ms	p.u.			
	24		Phase 3					
	25	Asting	Total	t1+100ms		0.001	0.001	0.001
	26	Active power	Positive sequence	to t2- 20ms	p.u.			
	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00
	28	Active	Positive sequence.	t2+3s to	p.u			
	29	power	Total	t2+10s	·	0.498	0.501	0.500
	39	Active power rising time	Positive sequence		S	0.311	0.272	0.302
After dip	31	Reactive	Positive sequence	t2+3s to t2+10s	p.u.			
> t2	32	power	Total	12+105		0.020	0.322	-0.322
	33	Reactive power rising time	Positive sequence		S	0.008	9.452	9.619
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No		Yes	

Page 99 of 159

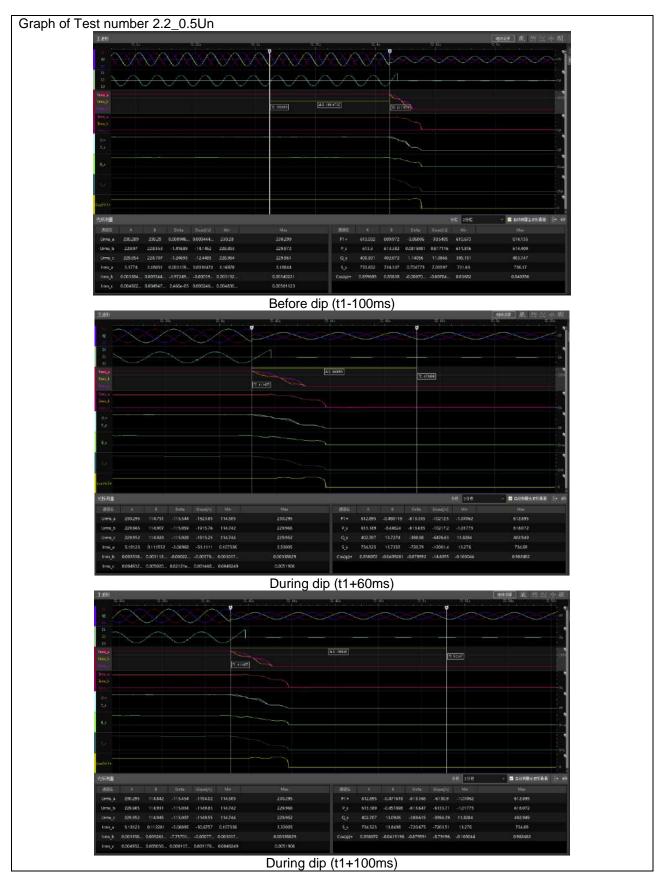


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Page 100 of 159

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	125279 -0.216838 34.1934	35,2931		0678593 -27.1652	-101.009 -0.351107	21.0978
and the second se	26638 -0.177575 34.1041 10076 -10.0044 0.0424687	35.2279		.15974 46.8105 .46719 -51.146	912,049 -45,8508 -540,95 2,08422	31.1825 51.6132
Irmi_b 0.012199 0.0120222 -0.00	00170.00117 0.0118485			0626597 -0.933033		0.99999
Ima_c 0.006521 0.0065071.351	7de9.04874 0.006288	0.00662613				
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02711 A 8 U4 Urms_a 230.153 250.117 0.01 Ums_1 230.076 229.961 -0.13	116571 -0.055247 229.817 14197 -0.366943 229.921	230 133 230.076	P.s -20.0177 1 P1+ -20.0139	594,311 614,349 594,02 614,054	1974.06 -20.0177 1973.11 -20.0559	614,188 613,908
23032 A 8 99 Urres, a 230.153 220.117 0.00 Urres, b 230.076 229.561 -0.15 Urres, c 230.087 229.427 -0.16	16571 0.055247 229.817	230.185	P.s -20.0377 1 P1+ -20.0339 Q.s 33.4326	\$94,311 614.349	1974.06 -20.0877	614.155
332/2 A 6 144 Uniting, a 230.715 250.717 0.07 Uniting, i 230.076 229.661 -0.13 Uniting, i 230.087 229.662 -0.16 Uniting, i 230.087 239.57 -0.14 Uniting, i 0.071.6238 0.072.173 0.002	14571 - 0.055267 - 225.817 14197 - 0.366963 - 225.821 60492 - 0.515701 - 229.888 1123 - 7.74791 - 0.152893 0293 0.000945 0.0117271	230.188 230.076 230.087 2.67394 0.0123399	P.s -20.0377 1 P1+ -20.0339 Q.s 33.4326	994.311 614.349 594.02 614.054 22.3548 -11.0378 599.269 555.045	1974.06 -20.0877 1973.11 -20.0839 -85.4672 22.5731	614788 613.908 163.319
332/2 A 6 144 Uniting, a 230.715 250.717 0.07 Uniting, i 230.076 229.661 -0.13 Uniting, i 230.087 229.662 -0.16 Uniting, i 230.087 239.57 -0.14 Uniting, i 0.071.6238 0.072.173 0.002	116571 0.053267 229,817 14197 -0.366943 229,821 60492 -0.515701 229,888 11123 7,74791 0.152893	230.753 230.076 230.687 2.67334	P.5 -20.0377 1 P1+ -20.0339 Q.6 33.4326 2 5.5 44.2235 5	994.311 614.349 594.02 614.054 22.3548 -11.0378 599.269 555.045	1974.06 -20.0877 1973.11 -20.0889 -35.4672 22.5781 1763.5 39.3308	614.185 613.505 163.319 619.593

Page 101 of 159



Page 102 of 159

Report no. 240415256GZU-001



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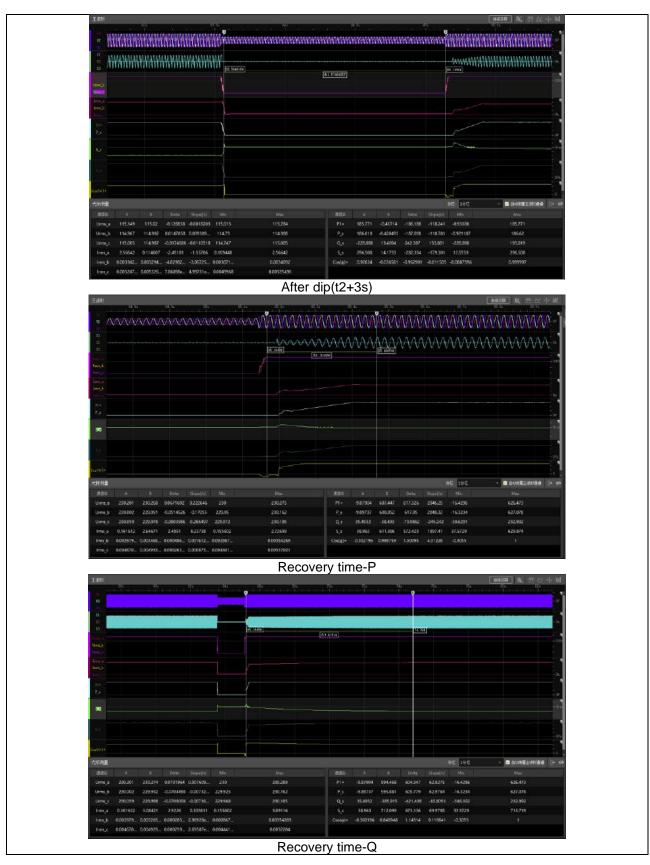
Page 103 of 159

Report no. 240415256GZU-001



intertek

Report no. 240415256GZU-001



Page 104 of 159

Page 105 of 159

Report no. 240415256GZU-001

Verificatio	on of c	lynamic networ	k support						Р
		ed power at rminal [VA]			2	4K			
NS pr	otectio	on settings			See table 5	5.5 for deta	ail.		
	No.	Parameter	Phase ref.	Time ref.	unit		Re	sult	
	0	Test number				4.2	5.2	6.2	7.2
	1	Date			dd.mm.yyyy	15-A	Apr-2024 to	o 10-May-2	2024
	2	Time (start of test)			hh:mm:ss.f		See	graph	
	3	Fault type (phase)				А	А	А	А
	4	Setting voltage depth	Line to line		p.u.	0.85	1.25	1.20	1.15
General	5	Setting dip duration			ms	60000 100 5000			60000
Info.	6	Point of fault entry	Total		ms	20ms			
	7	Point of fault clearance	Total		ms	20ms			
	8	Fault duration in empty load test	Total		ms	60980	100.0	5079.4	60079
	9	Voltage	Total	t1+100ms	p.u.	0.85	1.25	1.20	1.15
	10	depth/height in empty load test	Positive sequence	to t2 and t1-10s to t1	p.u.	0.85	1.25	1.20	1.15
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.				
	13	A otivio	Total	14 40-1-		0.498	0.496	0.496	0.497
Before dip <t1< td=""><td>14</td><td>Active power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td><td></td></t1<>	14	Active power	Positive sequence	t1-10s to t1	p.u.				
	15	Poncting	Total	t1-10s to		0.017	0.021	0.023	0.020
	16	Reactive power	Positive sequence	t1-105 to t1	p.u.				
	17	Cos _φ		t1-10s to t1		0.9998	0.9998	0.9998	0.9998
During dip t1 to	18	Voltage	Line to neutral	t1+100ms to t2- 20ms	p.u.	0.85	1.25	1.20	1.15

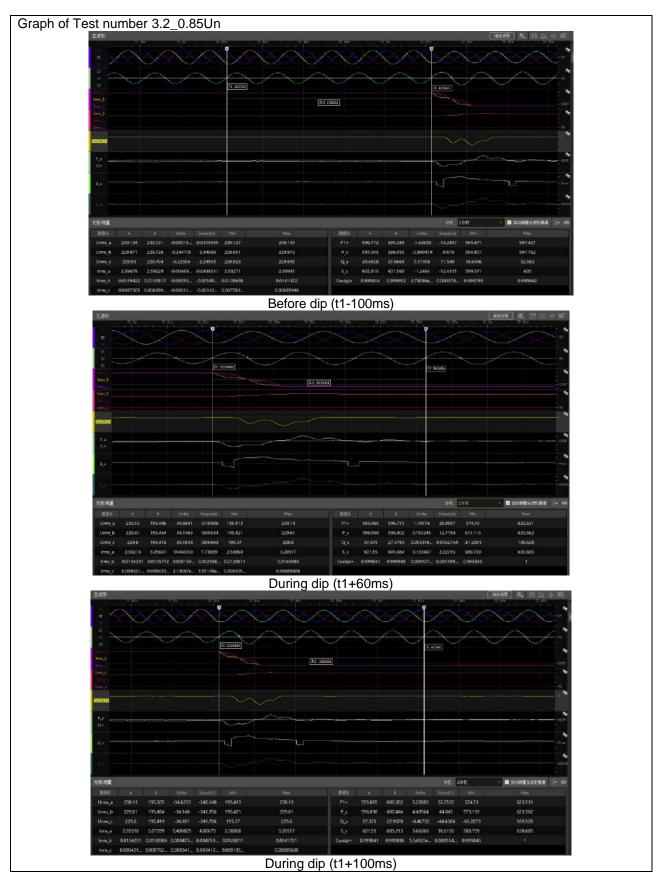
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Page 106 of 159

						1			
t2	19	Line current	Phase 1	t1+60ms	p.u.	0.587	0.034	0.033	0.426
	20		Phase 2						
	21		Phase 3						
	22	Line current	Phase 1	t1+100ms	p.u.	0.588	0.034	0.033	0.424
	23		Phase 2						
	24		Phase 3						
	25	Active power	Total	t1+100ms to t2- 20ms	p.u.	0.500	0.001	0.001	0.486
	26		Positive sequence						
After dip > t2	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active power	Positive sequence.	t2+3s to t2+10s	p.u				
	29		Total			0.496	0.496	0.496	0.497
	39	Active power rising time	Positive sequence		S	0.011	0.271	0.241	0.021
	31	Reactive power	Positive sequence	t2+3s to t2+10s	p.u.				
	32		Total			0.018	0.018	0.017	0.020
	33	Reactive power rising time	Positive sequence		S	0.009	0.008	0.009	0.011
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No	Yes			

Page 107 of 159

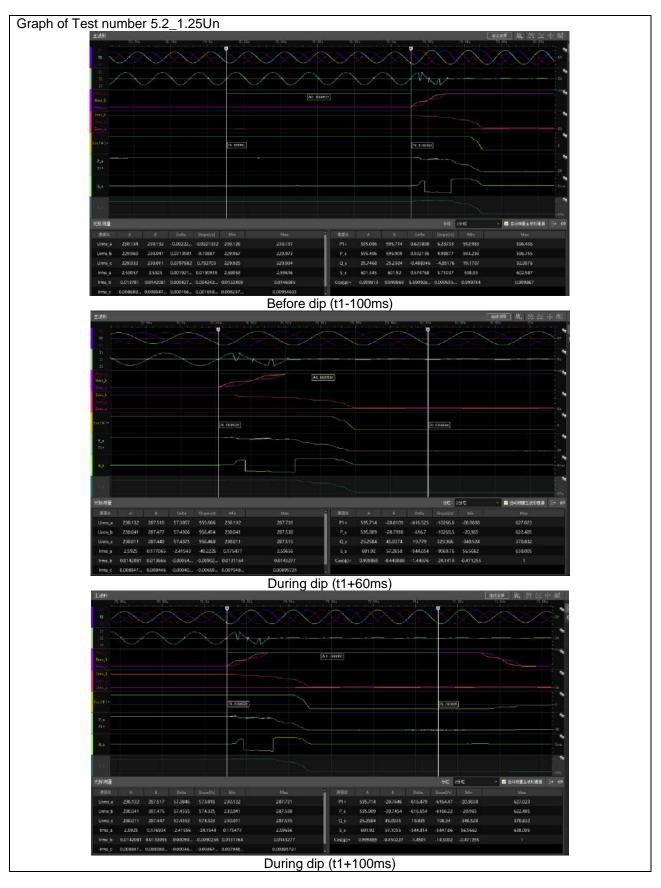


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Page 108 of 159



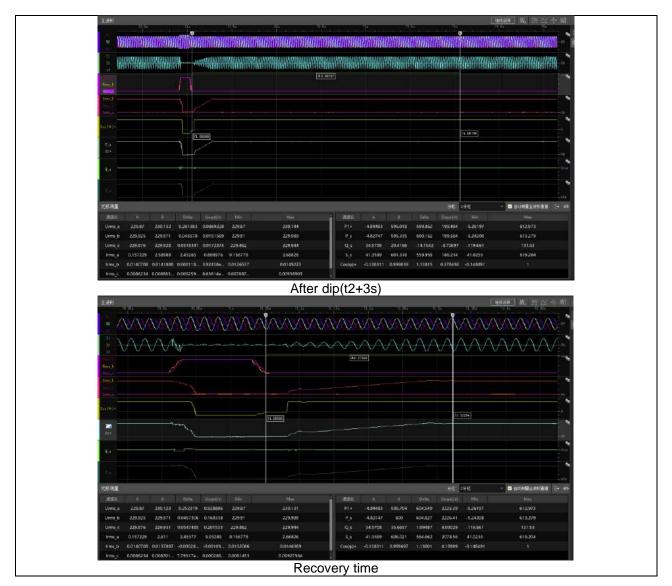
Page 109 of 159



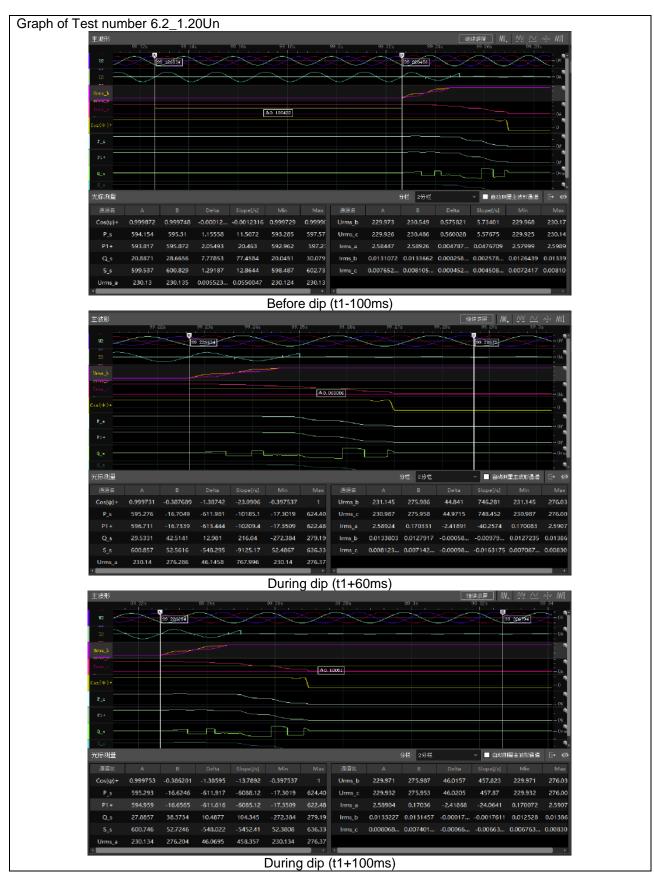
Page 110 of 159

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Page 111 of 159



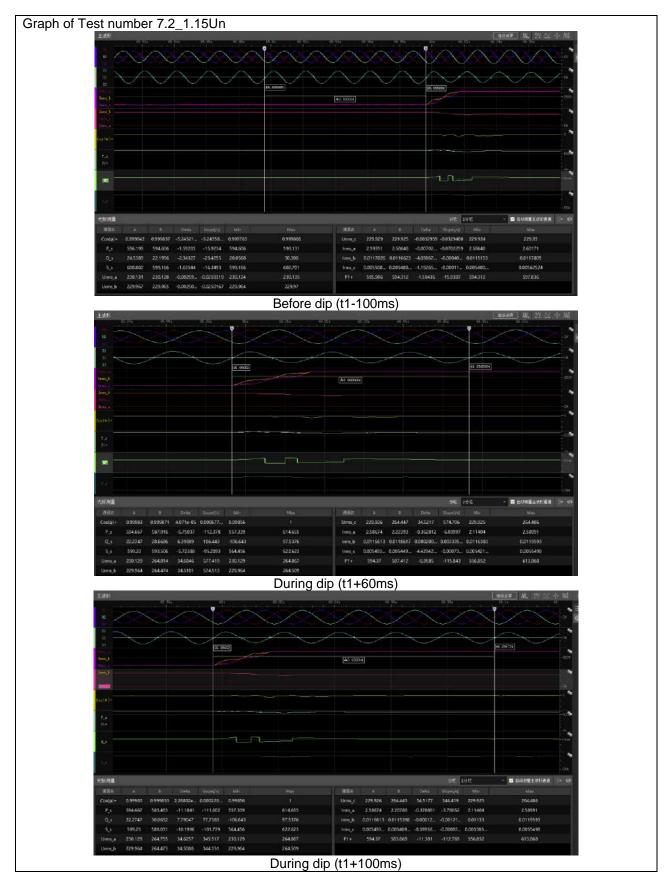
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光标测量							No.	_	ઝ년: 2 9 년		1	里主波形通道	
通道名 Cos(ψ)+	A -0.139227	B 0.999808	Delta 1.13903	Slope[/s] 0.379497	Min -0.148055	Max 1	通道名 Urms b	A 230.944	B 229.968	Delta -0.975571	Slope[/s]	Min 229.922	Max 230.94
P_s	-4.8645	595.61	600.474	200.063	-5.27775	613.14	Urms_c	230.992	229.900	-1.06483	-0.354776	229.866	230.94
P1+	-4.91453	595.269	600.183	199.966	-5.31826	612.83	irms_a	0.156999	2.59048	2.43349	0.810776	0.156572	2.6677
Q_s	40.445	20.8727	-19.5723	-6.52101	-124.677	134.54	lrms_b	0.0129394	0.0131519	0.000212	7.08027e	0.012018	0.01401
S_s	40.7723	600.943	560.171	186.635	40.6664	618.54	lrms_c	0.007385	0.007677	0.000292	9.75366e	0.0069845	0.00836
Urms_a	229.799	230.132	0.333069	0.11097	229.796	230.14							
					Aft	er dip	(12+3)	s)					
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12 12 12 12 12 12 12 12 12 12 12 12 12 1	A -0.139227 -4.0645	8 0.999745 612.811			Min -0.148055 -5.27775	Max 1 613.14	通道名 Urms_b		_	Delta -0.973062 -1.0663	Slope[/s]		- 04 - 04 - 04 - 04 - 04 - 04 - 04 - 04
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12 12 13 14 14 14 14 14 14 14 14 14 14	-0.139227 -4.8645 -4.91453	0.999745 612.811 612.499	Delta 1.13897 617.675 617.413	Slope[/s] 4.71646 2557.78 2556.7	-0.148055 -5.27775 -5.31826	1 613.14 612.83	通道名 Urms_b Urms_c Irms_a	A 230.944 230.992 0.156999 0.0129394	B 229.97 229.925 2.66672	-0.973862 -1.0668 2.50972 5.54165e	Slope[/s] -4.03274 -4.41761 10.3927 0.000229	NIP 1248/848 Min 229.922 229.866 0.156572 0.0125300	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
22 22 20 20 20 20 20 20 20 20 20 20 20 2	-0.139227 -4.8645 -4.91453 40.445	0.999745 612.811 612.499 27.5182	Delta 1.13897 617.675 617.413 -12.9269	Slope[/s] 4.71646 2557.78 2556.7 -53.5299	-0.148055 -5.27775 -5.31826 -124.677	1 613.14 612.83 134.54	通道名 Urms_b Urms_c Irms_a Irms_b	A 230.944 230.992 0.156999 0.0129394	B 229.97 229.925 2.66672 0.0129948	-0.973862 -1.0668 2.50972 5.54165e	Slope[/s] -4.03274 -4.41761 10.3927 0.000229	NIP 1248/848 Min 229.922 229.866 0.156572 0.0125300	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

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Page 113 of 159

Report no. 240415256GZU-001



intertek

Page 114 of 159



Page 115 of 159

Report no. 240415256GZU-001

Verificatio	on of c	lynamic networ	k support						Р
		ed power at rminal [VA]			4	4K			
NS pr	otectio	on settings			See table s	5.5 for det	ail.		
	No.	Parameter	Phase ref.	Time ref.	unit		R	esult	
	0	Test number				1.3	2.3	3.3	4.3
	1	Date			dd.mm.yyyy	15-/	Apr-2024	to 10-Ma	y-2024
	2	Time (start of test)			hh:mm:ss.f		See	graph	
	3	Fault type (phase)				D1	D1	D1	D1
	4	Setting voltage depth	Line to line		p.u.	0.15	0.50	0.50	0.85
	5	Setting dip duration			ms	150	1500	1500	60000
General Info.	6	Point of fault entry	Total		ms		2	0ms	
	7	Point of fault clearance	Total		ms		2	0ms	
	8	Fault duration in empty load test	Total		ms	150.0	1579.4	1579.4	60080
	9	Voltage depth/height in empty	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.620	0.760	0.760	0.930
	10	load test	Positive sequence		p.u.				
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.				
	13	Active	Total	t1 10c to		0.999	0.956	0.932	0.994
Before dip <t1< td=""><td>14</td><td>power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td><td></td></t1<>	14	power	Positive sequence	t1-10s to t1	p.u.				
	15	Reactive	Total	t1_10c to		0.031	0.317	0.308	0.021
	16	power	Positive sequence	t1-10s to t1	p.u.				
	17	Cos _φ		t1-10s to t1		0.9999	0.9500	0.9506	0.9999
During	18	Voltage	Phase 1	t1+100ms	p.u.				

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Page 116 of 159

P . 14 1				1- 10					
dip t1 to t2			Phase 2	to t2- 20ms					
			Phase 3			0.620	0.760	0.760	0.930
	19		Phase 1						
	20	Line current	Phase 2	t1+60ms	p.u.				
	21		Phase 3			0.023	0.027	0.027	1.070
	22		Phase 1						
	23	Line current	Phase 2	t1+100ms	p.u.				
	24		Phase 3			0.024	0.027	0.027	1.071
	25	Asting	Total	t1+100ms		0.001	0.001	0.001	0.997
	26	Active power	Positive sequence	to t2- 20ms	p.u.				
	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active	Positive sequence.	t2+3s to t2+10s	p.u				
	29	power	Total	t2+105	•	0.999	0.957	0.937	0.995
	39	Active power rising time	Positive sequence		S	0.530	0.486	0.506	0.006
After dip	31	Reactive	Positive sequence	t2+3s to t2+10s	p.u.				
> t2	32	power	Total	12+105		0.030	0.309	-0.301	0.031
	33	Reactive power rising time	Positive sequence		S	0.013	9.428	9.476	0.015
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No			Yes	

Page 117 of 159

Report no. 240415256GZU-001



intertek

Page 118 of 159

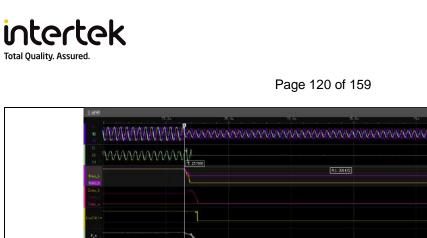
Report no. 240415256GZU-001

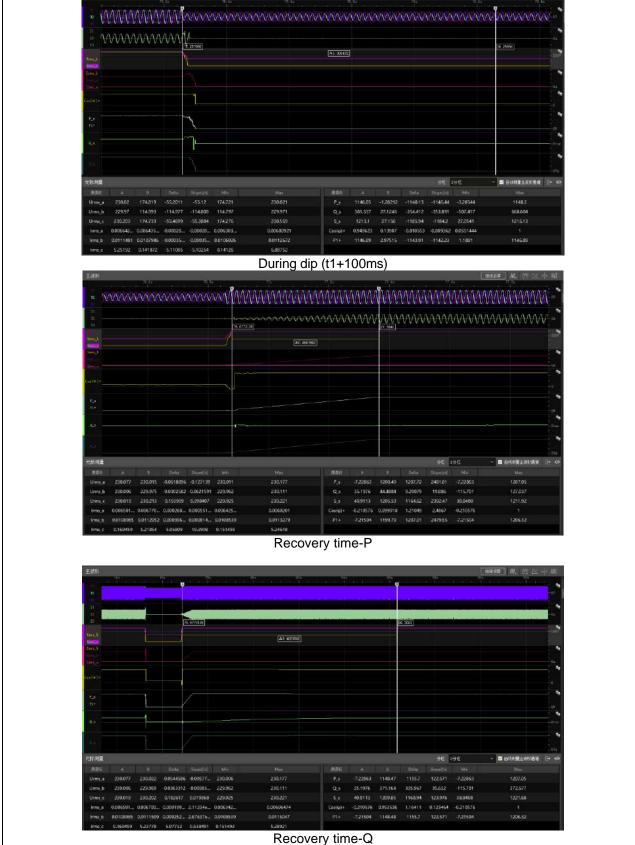


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Page 119 of 159

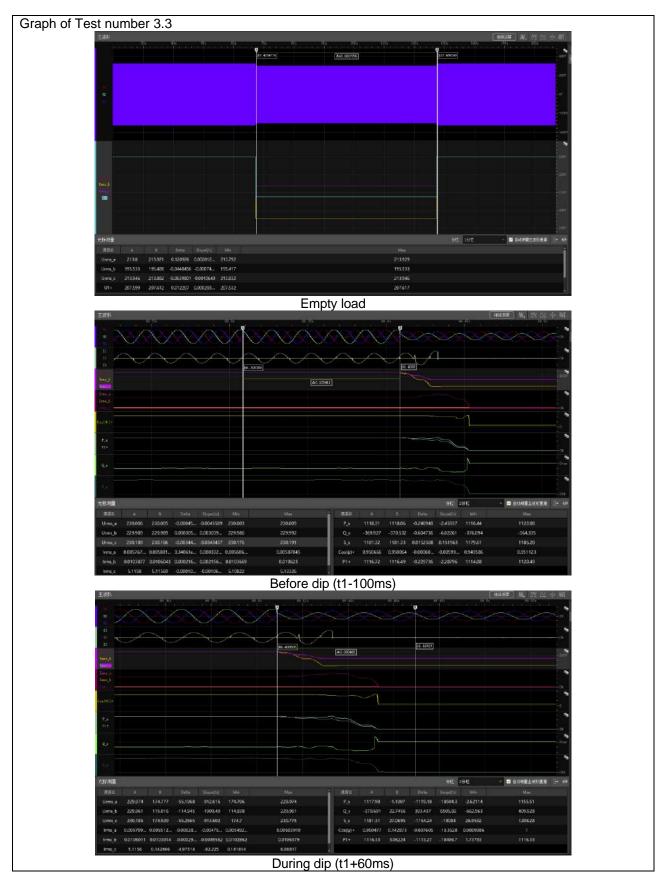






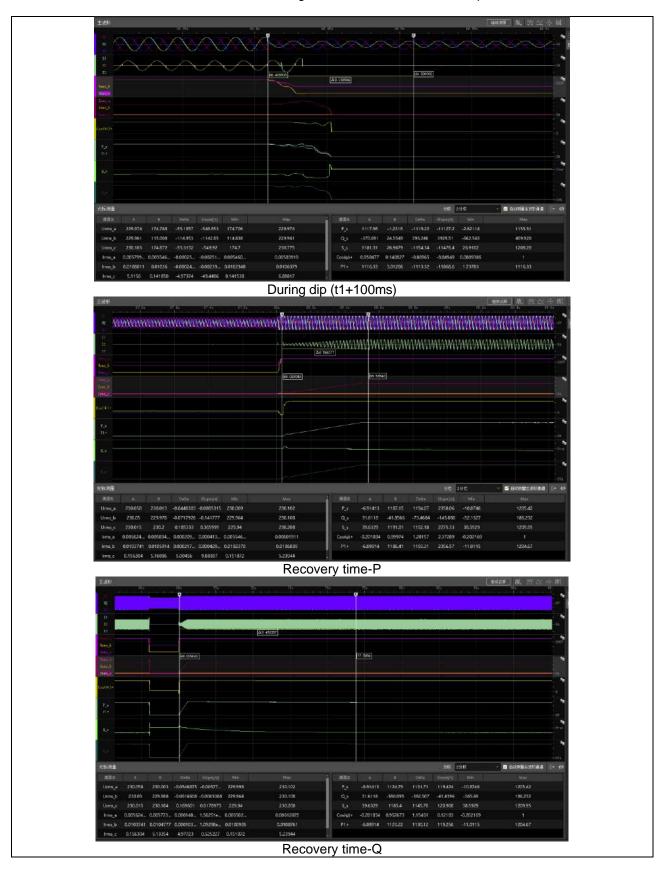


Page 121 of 159



Page 122 of 159

Report no. 240415256GZU-001



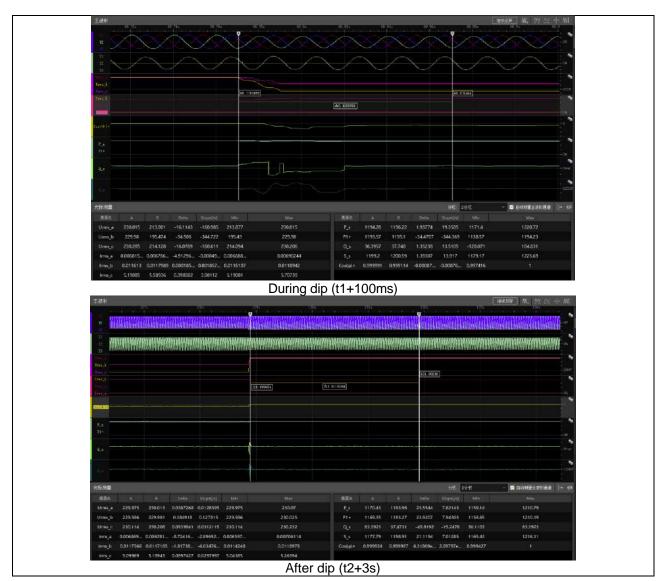
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Page 123 of 159



Page 124 of 159

Report no. 240415256GZU-001



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Page 125 of 159

Verificatio	on of c	lynamic networ	k support						Р
		ed power at rminal [VA]			2	4K			
NS pr	otectio	on settings			See table 5	5.5 for deta	ail.		
	No.	Parameter	Phase ref.	Time ref.	unit		Re	sult	
	0	Test number				5.3	6.3	7.3	1.4
	1	Date			dd.mm.yyyy	15-A	Apr-2024 to	o 10-May-2	2024
	2	Time (start of test)			hh:mm:ss.f		See (graph	
	3	Fault type (phase)				D1	D1	D1	D1
	4	Setting voltage depth	Line to line		p.u.	1.25	1.20	1.15	0.15
	5	Setting dip duration			ms	100	5000	60000	150
General Info.	6	Point of fault entry	Total		ms		20	ms	
	7	Point of fault clearance	Total		ms		20	ms	
	8	Fault duration in empty load test	Total		ms	100.0	5079.1	60081	1500.0
	9	Voltage depth/height in empty	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.060	1.050	1.040	0.620
	10	load test	Positive sequence		p.u.				
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.				
	13	A stirrs	Total			1.001	1.002	0.994	0.498
Before dip <t1< td=""><td>14</td><td>Active power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td><td></td></t1<>	14	Active power	Positive sequence	t1-10s to t1	p.u.				
	15	Depative	Total	14 40- 1		0.032	0.028	0.031	0.021
	16	Reactive power	Positive sequence	t1-10s to t1	p.u.				
	17	Cos _φ		t1-10s to t1		0.9999	0.9999	0.9999	0.9999

Page 126 of 159

	18		Phase 1	t1+100ms					
		Voltage	Phase 2	to t2- 20ms	p.u.				
		Vonago	Phase 3	20115	p.a.	1.060	1.050	1.040	0.620
	19		Phase 1						
	20	Line current	Phase 2	t1+60ms	p.u.				
During	20		Phase 3		p.u.	0.941	0.961	0.953	0.023
dip t1 to t2	22		Phase 1						
	23	Line current	Phase 2	t1+100ms	p.u.				
	23		Phase 3	11+100113	p.u.	0.942	0.950	0.954	0.023
	24		Total	t1+100ms		1.000	0.999	0.993	0.023
	25	Active	Positive	to t2-	p.u.	1.000	0.999	0.995	0.001
	20	power	sequence	20ms	P				
	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active	Positive sequence.	t2+3s to	p.u				
	29	power	Total	t2+10s	•	1.000	1.001	0.972	0.497
	39	Active power rising time	Positive sequence		S	0.011	0.013	0.028	0.269
After dip	31	Reactive	Positive sequence	t2+3s to	p.u.				
> t2	32	power	Total	t2+10s	·	0.029	0.030	0.030	0.021
	33	Reactive power rising time	Positive sequence		S	0.013	0.012	0.013	0.010
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No		Ye	98	

Page 127 of 159



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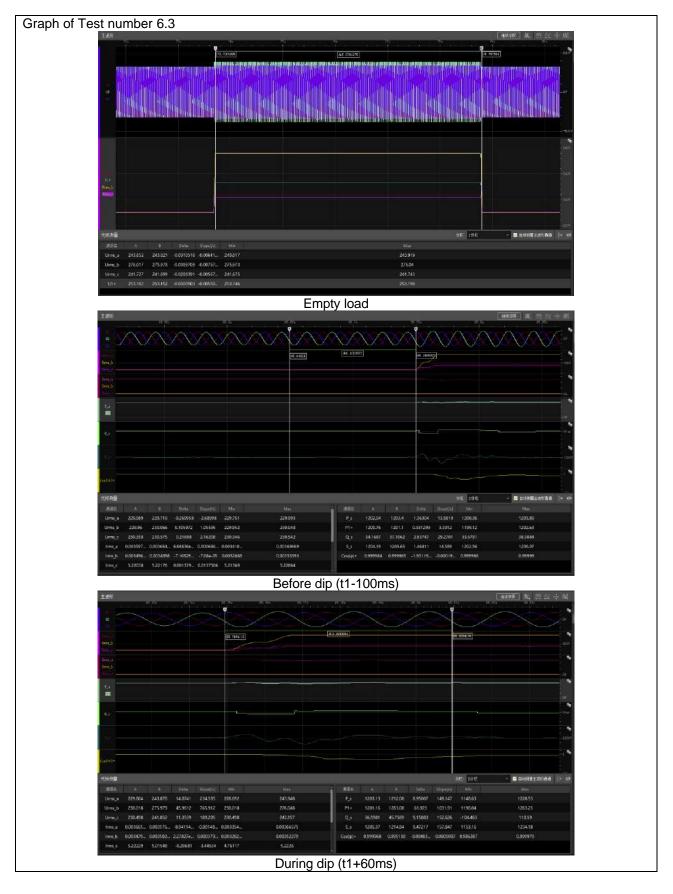
Page 128 of 159

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Т&к	Merry				Wrat in	D	Ourin		ever.	n Alfa	Y Y					e waa	× ~ ₩
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138 R	Merry				Wrat in	D	Ourin		ever.	n Alfa	Y Y					e waa	
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Page 129 of 159

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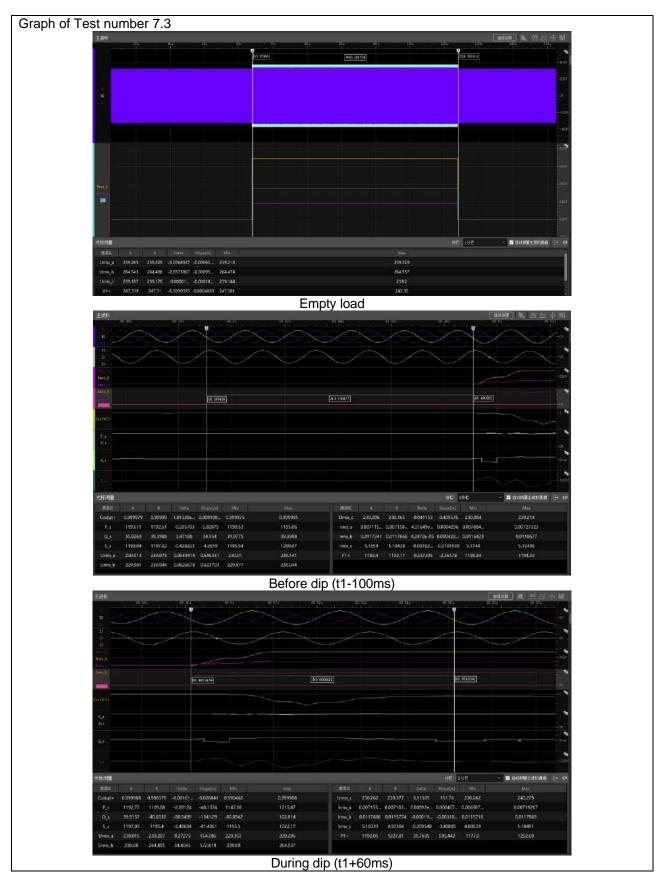
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Page 130 of 159

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Page 131 of 159



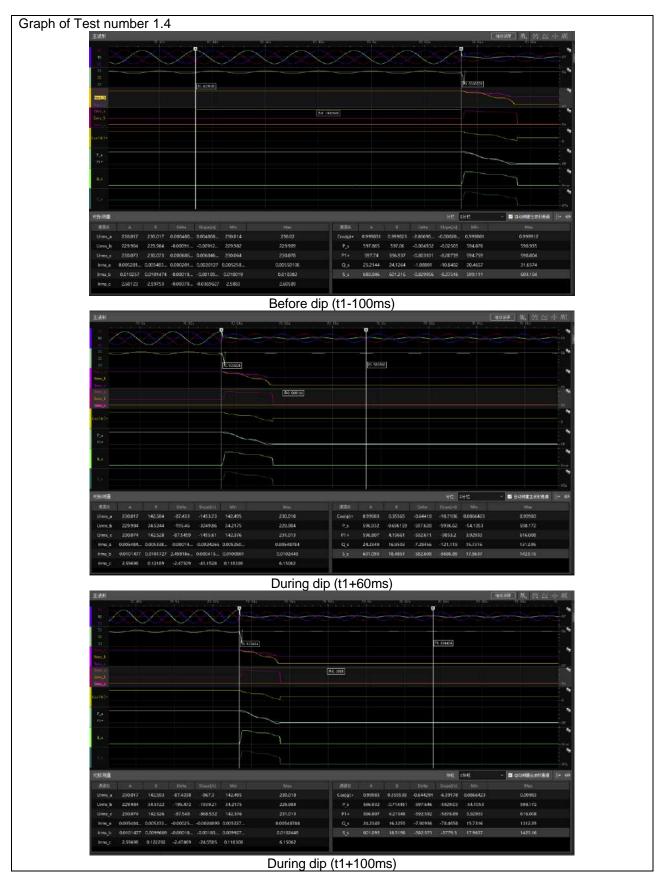
Page 132 of 159

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Page 133 of 159



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Page 135 of 159

Report no. 240415256GZU-001

Verificatio	on of c	lynamic networ	k support						Р
		ed power at rminal [VA]			2	4K			
NS pr	otectio	on settings			See table 5	5.5 for deta	ail.		
	No.	Parameter	Phase ref.	Time ref.	unit		Re	sult	
	0	Test number				2.4	3.4	4.4	5.4
	1	Date			dd.mm.yyyy	15-A	Apr-2024 to	o 10-May-2	2024
	2	Time (start of test)			hh:mm:ss.f		See	graph	
	3	Fault type (phase)				D1	D1	D1	D1
	4	Setting voltage depth	Line to line		p.u.	0.50	0.50	0.85	1.25
	5	Setting dip duration			ms	1500	1500	60000	100
General Info.	6	Point of fault entry	Total		ms		20	ms	
	7	Point of fault clearance	Total		ms		20	ms	
	8	Fault duration in empty load test	Total		ms	1579.4	1579.4	60080	100.0
	9	Voltage depth/height in empty	Total	t1+100ms to t2 and t1-10s to t1	p.u.	0.760	0.760	0.930	1.060
	10	load test	Positive sequence		p.u.				
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.				
	13	Active	Total	t1 10c to		0.511	0.491	0.497	0.498
Before dip <t1< td=""><td>14</td><td>power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td><td></td></t1<>	14	power	Positive sequence	t1-10s to t1	p.u.				
	15	Reactive	Total	t1 10c to		0.332	-0.335	0.021	0.022
	16	power	Positive sequence	t1-10s to t1	p.u.				
	17	Cos _φ		t1-10s to t1		0.8396	0.8293	0.9998	0.9998
During	18	Voltage	Phase 1	t1+100ms	p.u.				

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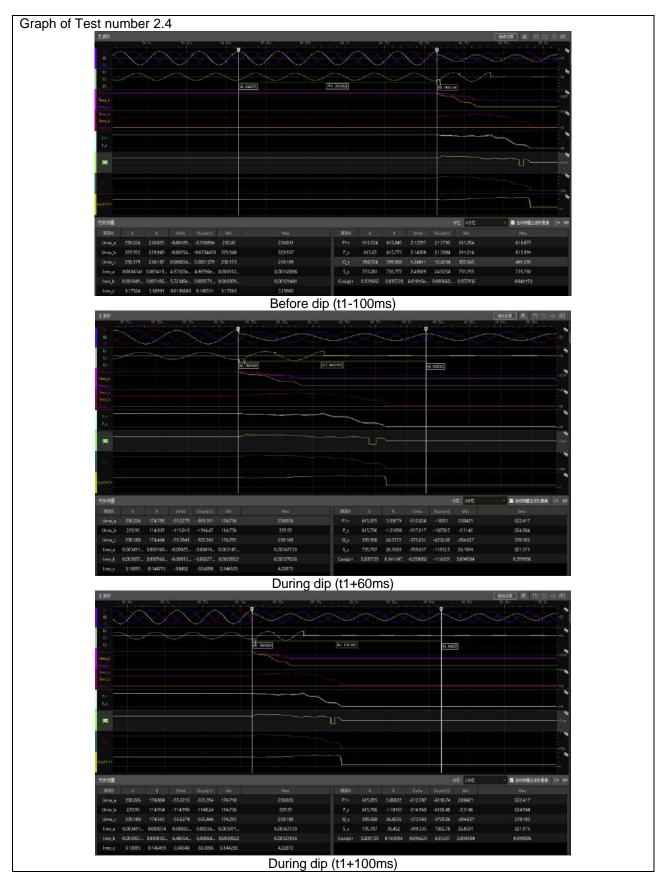
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Page 136 of 159

dip t1 to			Phase 2	to t2- 20ms					
t2			Phase 3	Zums		0.760	0.760	0.930	1.060
	19		Phase 1						
	20	Line current	Phase 2	t1+60ms	p.u.				
	21		Phase 3			0.028	0.028	0.535	0.468
	22		Phase 1						
	23	Line current	Phase 2	t1+100ms	p.u.				
	24		Phase 3			0.028	0.028	0.537	0.467
	25	Active	Total	t1+100ms to t2-		0.001	0.001	0.499	0.493
	26	power	Positive sequence	20ms	p.u.				
	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active	Positive sequence.	t2+3s to t2+10s	p.u				
	29	power	Total	12+105		0.511	0.494	0.497	0.449
	39	Active power rising time	Positive sequence	-	S	0.303	0.359	0.011	0.012
After dip	31	Reactive	Positive sequence	t2+3s to t2+10s	p.u.				
> t2	32	power	Total	12+105	•	0.321	-0.326	0.023	0.022
	33	Reactive power rising time	Positive sequence	-	S	9.567	9.784	0.011	0.010
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No		Ye	es	

Page 137 of 159



Page 138 of 159 Report no. 240415256GZU-001 90 290
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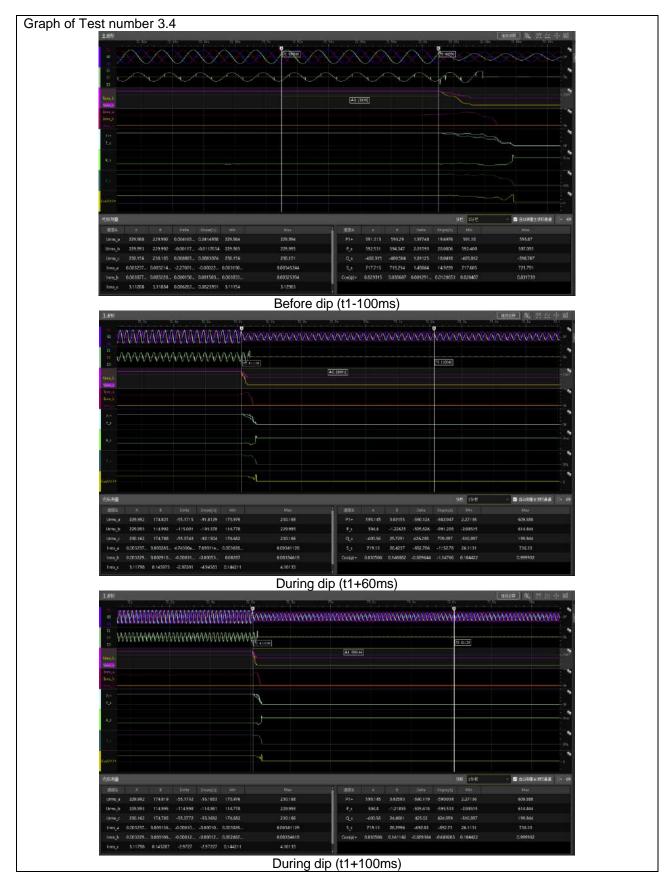
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Page 139 of 159

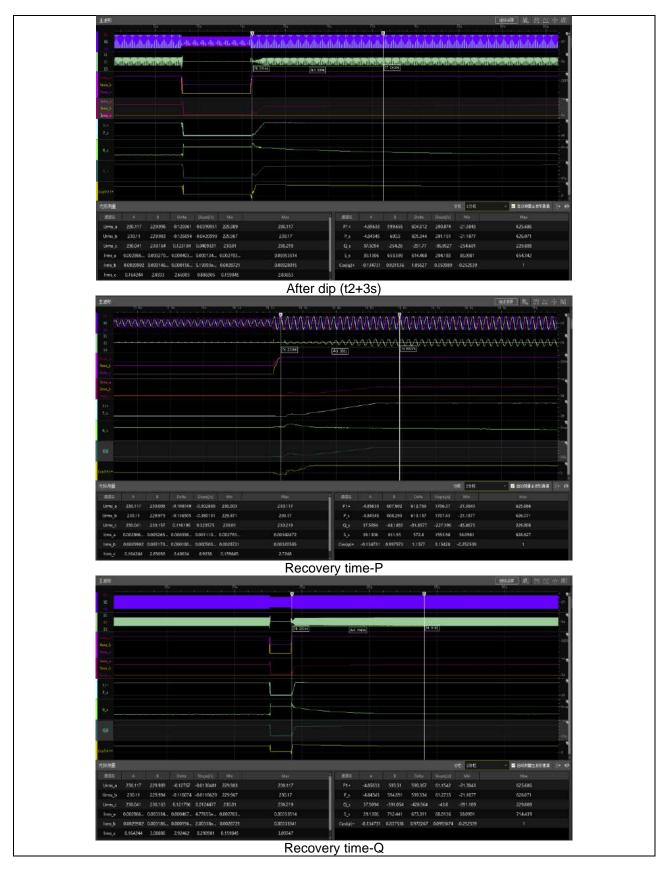
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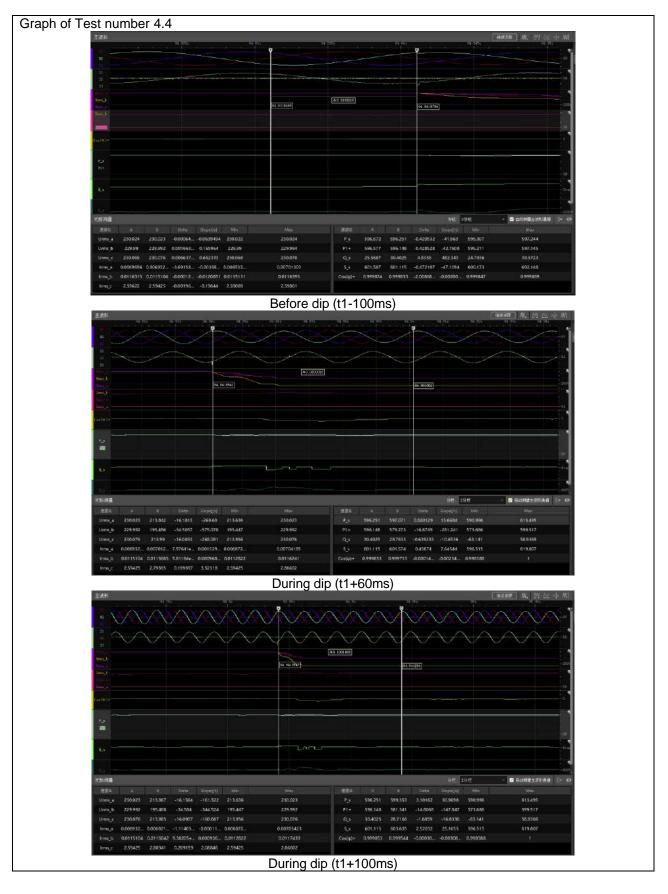
Page 140 of 159

Report no. 240415256GZU-001



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Page 141 of 159

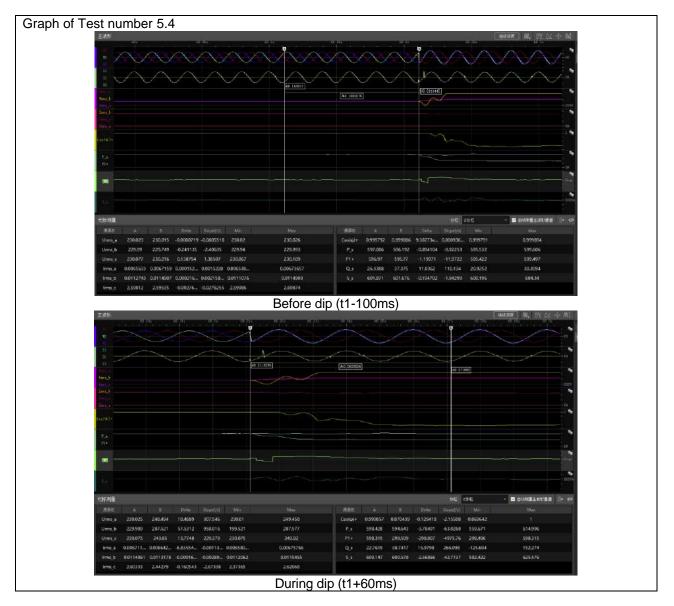


Page 142 of 159

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irms_b			0.000137			0.01380		Cos(ψ)+	0.99906	0.999851	0.000791_	0.000263	0.99892	0.9999	
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Page 143 of 159

Report no. 240415256GZU-001



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Page 144 of 159

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Page 145 of 159

Report no. 240415256GZU-001

Verificatio	erification of dynamic network support								Р		
		ed power at rminal [VA]	4К								
NS pr	otectio	on settings	See table 5.5 for detail.								
	No.	Parameter	Phase ref.	Time ref.	unit		Re	sult			
	0	Test number				6.4	7.4	1.5	5.5		
	1	Date			dd.mm.yyyy	15-A	pr-2024 to	o 10-May-2	2024		
	2	Time (start of test)			hh:mm:ss.f		See (graph			
	3	Fault type (phase)				D1	D1	D2	D2		
	4	Setting voltage depth	Line to line		p.u.	1.20	1.15	0.15	1.25		
	5	Setting dip duration			ms	5000	60000	150	100		
General Info.	6	Point of fault entry	Total	Total ms							
	7	Point of fault clearance	Total		ms	ms 20ms					
	8	Fault duration in empty load test	Total		ms	5079.1	60081	150.0	100.0		
	9	Voltage depth/height in empty	Total	t1+100ms to t2 and t1-10s to t1	p.u.	1.050	1.040	0.15	1.25		
	10	load test	Positive sequence		p.u.						
	11	Voltage	Line to neutral	t1-10s to t1	p.u.	1.00	1.00	1.00	1.00		
	12	Current	Positive sequence	t1-500ms to t1- 100ms	p.u.						
	13	Active	Total	+1 40+ +-		0.497	0.495	0.994	1.002		
Before dip <t1< td=""><td>14</td><td>Active power</td><td>Positive sequence</td><td>t1-10s to t1</td><td>p.u.</td><td></td><td></td><td></td><td></td></t1<>	14	Active power	Positive sequence	t1-10s to t1	p.u.						
	15	Reactive	Total			0.018	0.021	0.032	0.030		
	16	power	Positive sequence	t1-10s to t1	p.u.						
	17	Cos _φ		t1-10s to t1		0.9998	0.9998	0.9999	0.9999		
During	18	Voltage	Phase 1	t1+100ms	p.u.						

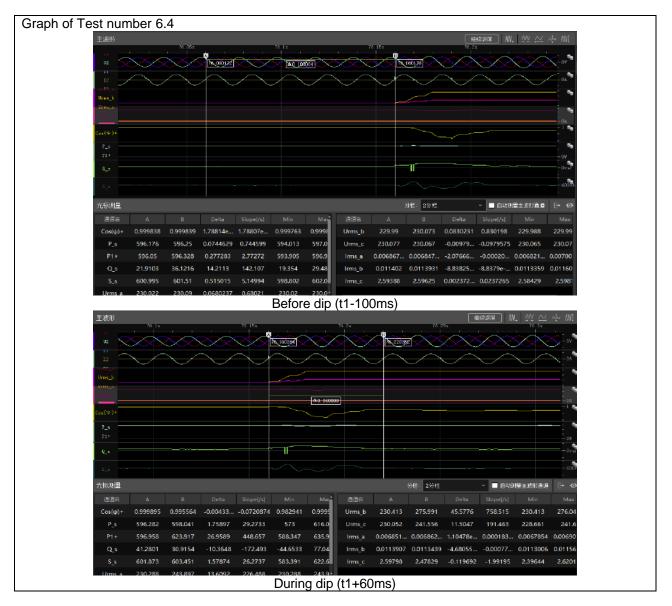
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Page 146 of 159

1				1 10				1	
dip t1 to t2			Phase 2	to t2- 20ms				0.150	1.250
			Phase 3			1.050	1.040		
	19		Phase 1						
	20	Line current	Phase 2	t1+60ms	p.u.			0.023	0.034
	21		Phase 3			0.475	0.478		
	22		Phase 1						
	23	Line current	Phase 2	t1+100ms	p.u.			0.024	0.034
	24		Phase 3			0.472	0.478		
	25	A	Total	t1+100ms		0.494	0.497	0.001	0.001
	26	Active power	Positive sequence	to t2- 20ms	p.u.				
	27	Voltage	Line to neutral	t2+3s to t2+10s	p.u.	1.00	1.00	1.00	1.00
	28	Active	Positive sequence.	t2+3s to	p.u				
	29	power	Total	t2+10s	•	0.479	0.494	0.994	1.001
	39	Active power rising time	Positive sequence		S	0.011	0.012	0.620	0.569
After dip	31	Reactive	Positive sequence	t2+3s to t2+10s	p.u.				
> t2	32	power	Total	12+105		0.022	0.020	0.031	0.030
	33 Reactive power rising time	power rising	Positive sequence		S	0.008	0.009	0.011	0.009
	34	PGU does not disconnect from grid till 60s after fault		t2 to t2+60s	Yes / No		Ye	es	

Page 147 of 159



Page 148 of 159

Report no. 240415256GZU-001

Number Number Number 1		76.1s			76.153			18.25		76. 2	5s 		76.3s	
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Page 149 of 159

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Page 150 of 159

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53	600.762	601,943	1,18164	11.8058	500,272	514.035	lems c	2.59332	2,49592	-0.0975985	-0.973113	2.40525	2.59435
Urms_a	230,174	239.281		90.9916	229.499			595,987	614.731	18.7447		584.904	
Ums_b	230.167	264.497	34.3305	342.998	250.167	264.549							
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Total Quality. Assured.

Page 151 of 159



Page 152 of 159

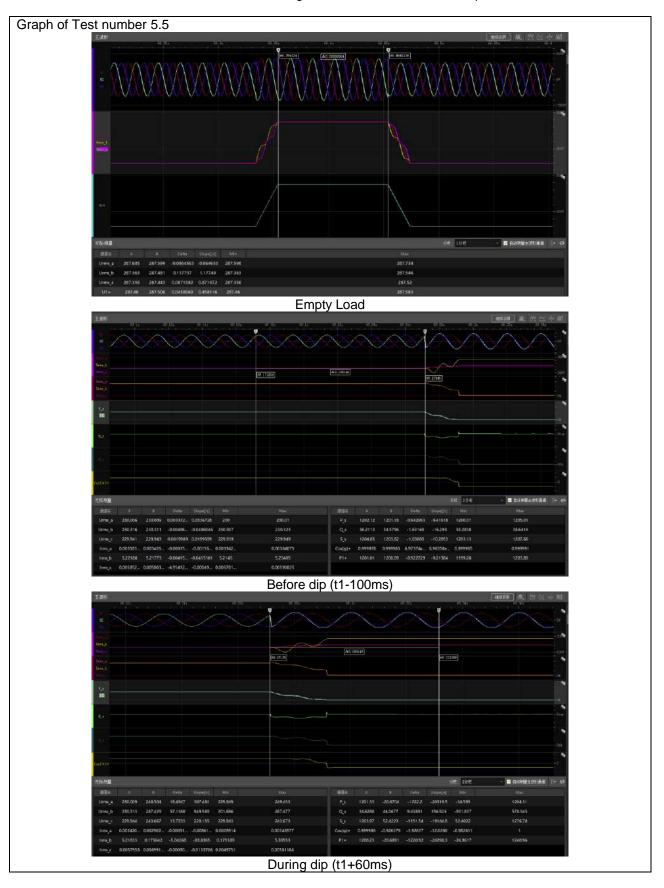
Report no. 240415256GZU-001



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Total Quality, Assured.

Page 153 of 159



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Total Quality, Assured.

Page 154 of 159





Page 155 of 159

Report no. 240415256GZU-001

E.7 Requirements for the test report for the NS protection

E.7 Requirements for the tes	•										
Extract of the test report for NS	•	0	,	für den NA-Sc	hutz)						
NS protection as integrated NS	•				,						
Manufacturer: (Hersteller)	Hersteller) RM 517, NEW CITY ENTRE, 2 LETYUE MUN ROAD, KWUN TONG, KOWLOON, HK, CHINA										
Type of NS Protection: (Typ NA-Schutz)	Typ NA-Schutz)										
Software Version:	V2										
Measurement Period: (Messzeitraum)	•	24 – 20 May 20									
		ng generators, eneratoren, Bre	fuel cells ennstoffzellen)		Inverter(s) (Umrichter)						
	generato di (direkt od		0 kW coupled verters iter gekoppelte ongeneratoren	asynchronou (direkt geł	upled synchro is generators w kW koppelte Synch generatoren m kW)	vith <i>P</i> n > 50 vron- und					
Protective function (Schutzfunktion)	Set value (Einste Ilwert)	Tripping value (Auslösewe rt)	Tripping time NS protection * (Auslösezeit NA-Schutz*)	Set value (Einstellwer t)	Tripping value (Auslösewe rt)	Tripping time NS protection * (Auslösez eit NA- Schutz*)					
Rise-in-voltage protection (Spannungssteigerungsschu tz) U>>				1,25 * Un	1.251* Un	142.0ms					
Rise-in-voltage protection (Spannungssteigerungsschu tz) U>				1,10 * Un	1.101* Un	485.2s					
Voltage drop protection (Spannungsrückgangsschutz) U <				0,8 * Un	0.801* Un	3.05s					
Voltage drop protection (Spannungsrückgangsschutz) U <<				0,45* Un	0.452* Un	341.0ms					
Frequency decrease protection (Frequenzrückgangsschutz) f <				47,5 Hz	47.48Hz	196ms					
Frequency increase protection (Frequenzsteigerungsschutz) f >				51,5 Hz	51.50Hz	173ms					

Page 156 of 159

* The tripping time includes the period from the limit value v switch.	iolation U/f until the tripping signal to the interface									
/hen planning the power generation system, the response time of the interface switch shall be added to the										
	naximum time value obtained as indicated above.									
The disconnection time (sum of tripping time of the NS prot	ection plus response time of the interface switch)									
shall not exceed 200 ms.										
* Die Auslösezeit umfasst den Zeitraum von der Grenzwert	verletzung U/I bis zum Auslosesignal an den									
Kuppelschalter.	. Kunneleskeltere zum häcketen ehen ermittelten									
Bei der Planung der Erzeugungsanlage ist die Eigenzeit de Zeitwert zu addieren.	s Ruppeischalters zum nochsten oben ermittelten									
Die Abschaltzeit (Summe der Auslösezeit NA-Schutz zzgl.	Figenzeit des Kunnelschalters) darf 200 ms nicht									
überschreiten.	Ligenzen des Ruppeischaners) dan 200 ms ment									
	->									
For integrated NS protection (Bei integriertem NA-Schutz	2)									
Assigned to power generation unit of type	ZDHYP2000									
zugeordnet zu Erzeugungseinheit Typ										
Type integrated interface switch	SONG CHUAN PRECISION CO., LTD.									
Typ integrierter Kuppelschalter	215H-1AH-F-C.									
Response time of interface switch for integrated NS										
protection	15ms									
Eigenzeit des Kuppelschalters bei integriertem NA-Schutz										
Verification of the entire functional chain "integrated NS pro	tection – interface switch" has resulted in successful									
disconnection.										
Die Überprüfung der Gesamtwirkungskette "integrierter NA	-Schutz – Kuppelschalter" führte zu einer									
erfolgreichen Abschaltung.										



Page 157 of 159

Report no. 240415256GZU-001

Appendix 1: photos



Overview

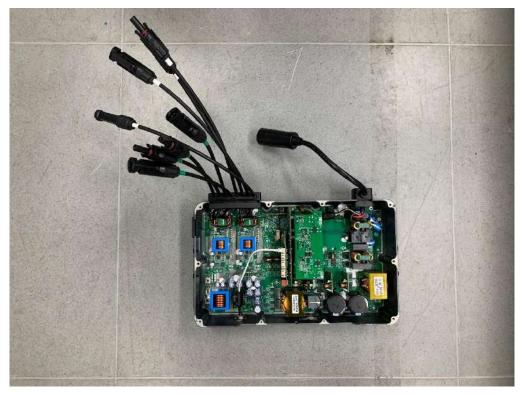


Bottom view

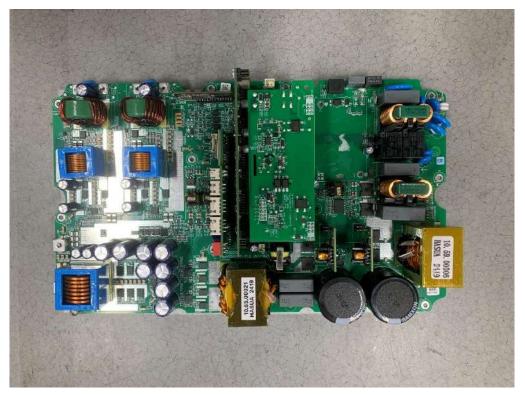


Page 158 of 159

Report no. 240415256GZU-001



Internal view

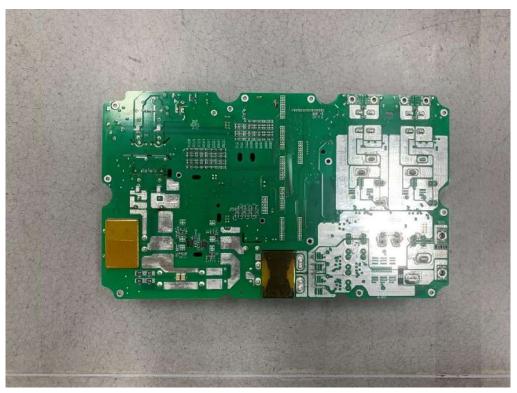


Power board view (Components side)



Page 159 of 159

Report no. 240415256GZU-001



Power board view (Soldered side)

Appendix 2: Equipment

Asset	Description	Manufacturer	Model	Cal Date	Cal Due
SA200-16	Precision Power Analyzer	YOKOGAWA	WT3000	21 Aug 2023	20 Aug 2024
SA200-02	RLC load	Qunling	ACLT-4830H	/	/
SA200-52	AC power source	Chroma	61860	/	/
SA050-33	Scope Corder	YOKOGAWA	DL 850E	05 Jan 2024	04 Jan 2025

(End of Report)