TEST REPORT

CEI 0-21:2022-03

Reference technical rules for the connection of active and passive users to the LV electrical Utilities

Report Number.....	4905773.50
Date of issue	2023-06-28
Total number of pages	78 pages
Testing Laboratory	DEKRA Testing and Certification (Shanghai) Ltd., Guangzhou Branch
Address.....	Block 5. No.3, Qiyun Road, Huangpu District, Guangzhou, Guangdong, China
Applicant.....	EcoFlow Inc.
Applicant Address	Plant A202, Founder Technology Industrial Park, Shiyan Sub-district, Bao'an District Shenzhen, Guangdong 518000 China
Standard	CEI 0-21:2022-03
Test Report Form No.	CEI 0-21_V2.1 (modified)
Test Report Form(s) Originator..	DEKRA Suzhou
Test item description.....	Microinverter
Model/Type reference.....	EFWN511, EFWN511B
Trade Mark.....	
Manufacturer	Same as applicant
Manufacturer Address.....	Same as applicant
Prepared by	Ray Ye (Project Manager)
Verified and approved by.....	Among Chen (Technical Expert)

Summary of testing

Tests performed:

The following scope of assessment according to the standard: CEI 0-21:2022-03

Clause	Test	Result
A.3	Adjustable ranges of the interface protection system (SPI)	P
A.4.3.1 & A.4.3.2	Test procedure for maximum/minimum frequency functions (81.S2, 47.5~51.5 Hz)	P
A.4.3.1 & A.4.3.2	Test procedure for maximum/minimum frequency functions (81.S1, 49.8~50.2 Hz)	P
A.4.3.1 & A.4.3.2	Test procedure for maximum/minimum voltage functions (27.S2~59.S2, 0.15~1.15 Vn)	P
A.4.3.1 & A.4.3.2	Test procedure for maximum/minimum voltage functions (27.S1, 0.85 Vn)	P
A.4.3.1 & A.4.3.2	Measuring the rise-in voltage protection as a running 10-minute mean value (59.S1, 1.1 Vn)	P
A.4.3.3.1	Insensitivity to harmonics of the frequency relay (47.5Hz, 51.5Hz)	P
A.4.3.3.2	Remote trip signal	P
A.4.3.3.3	Communication signal	P
A.4.3.4	Verification of insensitivity to the frequency derivative	P
A.4.4	Self -test	P
A.4.5	Single fault tolerance	N/E
A.4.6	EMC compatibility tests	N/E
A.4.7	Climatic compatibility tests	P
A.4.8	Insulation tests	P
A.4.9	Tests for the overload capacity of measuring circuits	N/A
A.4.10	Compliance of equipment	P
A.4.11	Automatic mechanism to prevent current imbalance during production	P
B.1 (a)	Harmonic current	P
B.1 (c)	Voltage fluctuation and flicker	P
B.1.1	Conditions of connection, reconnection and gradual power supply	P
B.1.2.1	Verification of construction requirements: reactive power capability	P
B.1.2.2.1	Inverter in systems with total capacity (up to 11.08 kW)	P
B.1.2.2.2	Inverter in systems with total capacity (greater than 11.08 kW)	N/A
B.1.2.3.1	Procedures for performing tests and recording results (hypothesis of adjustment by Q) (greater than 11.08 kW)	N/A
B.1.2.4	Response time to an assigned step level change (greater than 11.08 kW)	N/A
B.1.2.5.1	Verification of compliance with the methods of application of the standard characteristic curve, cosφ = f(P)	P
B.1.2.6.1	Verification of compliance with the methods of application of the standard characteristic curve, Q = f(V) (greater than 11.08 kW)	N/A
B.1.3.1	Automatic limitation of the active power for voltage values close to 110% of the	P

	rated voltage P(U)	
B.1.3.2	Adjusting active power in the presence of transients on the transmission network	P
B.1.3.3.1	Reduction of active power in the presence of under-frequency transients on transmission network	P
B.1.3.4	Limitation of the active power by an external control from the distributor	P
B.1.4.1	Verification of the emission of continuous component	N/A
B.1.4.2	Verification of the protections against the induction of a continuous component	N/A
B.1.5	Verification of insensitivity to voltage dips (UVRT capability, greater than 11.08 kW)	N/A
B.1.6.1	Verification of insensitivity to automatic reclosing in phase discrepancy (simulation network)	P

Note:
- test case does not apply to the test object: N/A
- test object was not evaluated for the requirement: N/E
- test object does meet the requirement: P (Pass)

Performed tests:

All tests were performed under ISO/IEC 17025 accreditation on model EFWN511.

Date (s) of performance of tests: 2023-03-21 to 2023-06-27

Testing location:

EcoFlow Inc.

Plant A202, Founder Technology Industrial Park, Shiyan Sub-district, Bao'an District, Shenzhen, Guangdong, China

Conclusion:

The equipment under test complies with the following documents:

CEI 0-21:2022-03: Reference technical rules for the connection of active and passive users to the LV electrical Utilities

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.
The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
The measurement result is considered in conformance with the requirement if it is within the prescribed limit. It is not necessary to account the uncertainty associated with the measurement result.
This report is only for reference and is not used for legal proof function in China market.
The information provided by the customer in this report may affect the validity of the results, the test lab is not responsible for it.

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

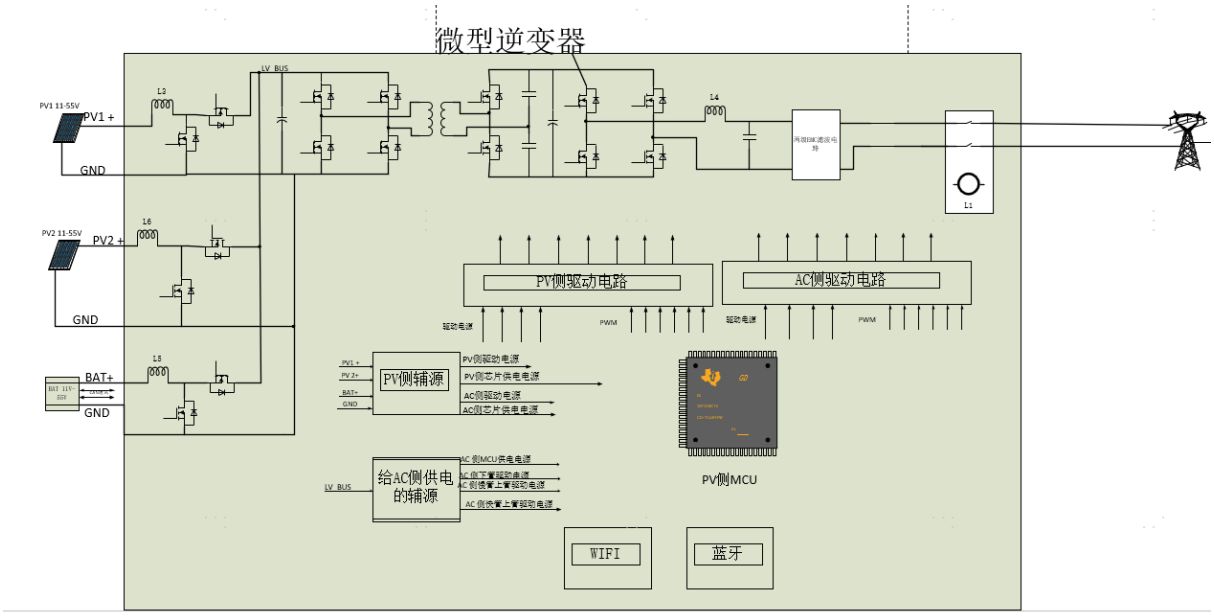
Product information

General:

The product is single-phase utility-interactive PV inverter, which converts DC power from the photovoltaic (PV) arrays as well as batteries to AC power. The battery port is able to be charged by the energy from PV port. The PCE does not provide galvanic separation between the PV input and battery circuit, but provides galvanic isolation from the AC output circuit.

The PV input combiner with 2 string MPPT tracers, which combines in one PV input terminal. AC output direct connected to grid and protective earthing are provided by dedicated earthing terminals. After the control system receives the abnormal signal from the relevant protective detection circuit, the redundant relays will operate to disconnect the PV inverter active lines from grid automatically.

Block diagram:



Model difference:

The model EFWN511B is identical with EFWN511 in hardware except the output power derated by software. Refer to the electrical rating.

Hardware & Software version

Hardware version	V4.0
Software version	V1.0

Factory:

Dongguan Streamax Electronics Co., Ltd.

101 Room, No.20 Building Leaguer Zijing Intelligent Manufacture Center, NO.105 Qingbin East Road, Qingxi Town, Dongguan City, Guangdong Province, China

Copy of marking plate:

EFWN511

EFWN511B

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.

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

Specification of equipment under test:	
Classification of installation and use	☐ movable ☐ hand-held ☐ stationary ☒ fixed ☐ transportable ☐ for building-in
Supply connection	☒ pluggable equipment ☐ direct plug-in ☐ permanent connection ☐ for building-in
Environmental category	☒ outdoor ☐ indoor unconditional ☐ indoor conditional
Over voltage category Mains	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
Over voltage category PV	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%)	-15% to 10%
Tested for power systems	TN
IT testing, phase-phase voltage (V)	N/A
Protective class	☒ Class I ☐ Class II ☐ Class III
Mass of equipment (kg)	Approximately 3 kg
Pollution degree	Outside PD3; Inside PD2
Operating temperature range	- 40 °C to 50 °C
IP protection class	IP67
Power factor range	0.8 leading…0.8 lagging (adjustable)
Electrical rating	EFWN511 PV input: max 55 Vdc, MPPT voltage range 11-55 Vdc, max 13 A / 13 A, Isc PV 14 A / 14 A Battery: voltage range 30-58 Vdc, max current 13 A AC Output: L/N/PE, 220/230/240 Vac, 50 Hz, max 800 W, max 3.7 A EFWN511B PV input: max 55 Vdc, MPPT voltage range 11-55 Vdc, max 13 A / 13 A, Isc PV 14 A / 14 A Battery: voltage range 30-58 Vdc, max current 13 A AC Output: L/N/PE, 220/230/240 Vac, 50 Hz, max 600 W, max 2.8 A

Test setup:

The tests were performed using a PV simulator as a simulation of the PV module and a grid simulator as a simulation of the power grid and the transmission network. A simplified diagram of the test setup is given below. The measurement data were measured at POC at LV level.

Clause	Requirement + Test	Result - Remark	Verdict
A.3	Adjustment ranges for the SPI		P
A.3.1	Phase (or phase-to-phase) undervoltage protection [27]		P
	Minimum voltage threshold 27.S1: Threshold (0.2 ~ 1) Un r adjustable by steps of 0.05 Un Intervention time (0.05 ~ 5) s adjustable in steps of 0.05 s		P
	Minimum voltage threshold 27.S2: Threshold (0.05 ~ 1) Un adjustable by steps of 0.05 Un Intervention time (0.05 ~ 5) s adjustable in steps of 0.05 s		P
A.3.2	Maximum (or concatenated) phase voltage protection [59]		P
	Maximum voltage threshold 59.S1: Threshold (1 ~ 1.20) Un adjustable by steps of 0.01 Un Intervention time $\leqslant$ 3 s		P
	The overvoltage protection (59.S1) must be implemented as protection based on the calculation of the average value of 10 min according to the provisions of the EN 61000-4-30 standard. At the latest every 3 s, a new average value of the previous 10 min must be created, to be compared with the setting value for protection 59.S1 in Table 13.		P
	Maximum voltage threshold 59.S2: Threshold (1.0 ~ 1.30) Un adjustable by steps of 0.01 Un Intervention time (0.05 ~ 1) s adjustable in steps of 0.05 s		P
A.3.3	Minimum frequency protection [81<]		P
	Threshold 81<.S1: Threshold (47.0 ~ 50.0) Hz adjustable with step of 0.1 Hz Intervention time (0.05 ~ 5) s adjustable with step of 0.05 s		P
	Threshold 81<.S2: Threshold (47.0 ~ 50.0) Hz adjustable with step of 0.1 Hz Intervention time (0.05 ~ 5) s adjustable with step of 0.05 s		P
A.3.4	Maximum frequency protection [81>]		P
	Threshold 81>.S1: Threshold (50.0 ~ 52.0) Hz adjustable with step of 0.1 Hz Intervention time (0.05 ~ 5) s adjustable with step of 0.05 s		P
	Threshold 81>.S2: Threshold (50.0 ~ 52.0) Hz adjustable with step of 0.1 Hz Intervention time (0.05 ~ 5) s adjustable with step of 0.05 s		P
A.4.3	Functional tests on the interface protection system (SPI)		P
A.4.3.1	Test procedure for maximum voltage and frequency functions	See appended table	P
A.4.3.2	Test procedure for minimum voltage and frequency functions	See appended table	P
A.4.3.3	Additional requirements for functional tests	See appended table	P
A.4.3.3.1	Insensitivity to harmonics of the frequency relay	See appended table	P

A.4.3.3.2	Remote trip signal	See appended table	P
A.4.3.3.3	Communication signal	See appended table	P
A.4.3.4	Verification of insensitivity to the frequency derivative	See appended table	P
A.4.4	Self -test		P
	If the interface protection functions are integrated in the inverter, at least one self-test system must be provided which checks the maximum/minimum frequency and maximum/minimum voltage functions provided in the interface protection system (SPI).	See appended table	P
A.4.5	Single fault tolerance	See Enclosure #GZES221102245201 and #GZES221102245202	N/E
A.4.6	EMC compatibility tests	See Enclosure #18220WC30056802E	N/E
A.4.7	Climatic compatibility tests	See appended table	P
A.4.8	Insulation tests	See Enclosure #GZES221102245201	P
A.4.9	Tests for the overload capacity of measuring circuits	Internal SPI circuit for voltage protection.	N/A
A.4.10	Compliance of equipment		P
	The declaration of conformity must contain the results of all tests specified in A.4. In particular, all results related to the checking of tripping thresholds, falling times and falling ratios in all specified conditions must be provided.		P
	The tests were performed at a third-party laboratory accredited according to the CEI UNI EN ISO / IEC 17025 standard, or.		N/A
	at the manufacturer's laboratories, or non-accredited external laboratories under the supervision of a certification body accredited according to the CEI UNI EN ISO / IEC 17065 standard.		P
	It is also necessary to provide evidence that the production of the device takes place under a quality system (according to ISO 9001, see Annex 1 ISO 9001 certificate).		P
A.4.11	Automatic mechanism to prevent current imbalance during production	Single-phase equipment	N/A
B.1 (a)	Harmonic current	See appended table	P
B.1 (c)	Voltage fluctuation and flicker	See appended table	P
B.1.1	Conditions of connection, reconnection and gradual power supply		P
B.1.1.1	Checking of connection and reconnection conditions	See appended table	P
B.1.1.2	Checking gradual supply of active power	See appended table	P
B.1.2	Reactive power exchange		P
B.1.2.1	Checking construction standards: Reactive power capability		P

	As established in 8.4.4.2, static converters set up for continuous operation in parallel with the distributor network must be able to operate with a power factor different from 1.		P
	The converter must be set so that it can, respectively, absorb (induction) and supply (resistance) the maximum reactive power available at each level of active power supplied according to its capability.		P
	At this point the DC source must be regulated so that the converter can supply active power in sequence included in the 10 intervals [0-10]%; [10-20]%; [90-100]% of nominal power (1-min average values calculated on the basis of the values measured at the fundamental frequency in a 200-ms window).		P
	For each of the 10 levels of active power at least 3 values for inductive reactive power and 3 for capacitive power shall be reported as 1-min average values calculated based on measurements at the fundamental frequency of a 200-ms window.		P
	In addition to measurements of reactive power limit values, the measured values should be recorded by setting the reactive power supplied to 0 (cos φ= 1).		P
B.1.2.2	Methods of carrying out and recording the test	See appended table	P
B.1.2.2.1	Inverter in systems with total capacity (up to 11.08 kW)	See appended table	P
B.1.2.2.2	Inverter in systems with total capacity (greater than 11.08 kW)	Rating capacity 800 W	N/A
B.1.2.3	Exchange of reactive power according to an assigned level (greater than 11.08 kW)	Rating capacity 800 W	N/A
B.1.2.3.1	Procedures for performing tests and recording results (hypothesis of adjustment by Q) (greater than 11.08 kW)	Rating capacity 800 W	N/A
B.1.2.4	Response time to an assigned step level change (greater than 11.08 kW)	Rating capacity 800 W	N/A
B.1.2.5	Automatic supply of reactive power according to a characteristic curve, cos φ = f(P)		P
B.1.2.5.1	Verification of compliance with the methods of application of the standard characteristic curve, cosφ = f(P)	See appended table	P
B.1.2.6	Automatic exchange of reactive power according to a characteristic curve, Q = f(V)		N/A
B.1.2.6.1	Verification of compliance with the methods of application of the standard characteristic curve, Q = f(V) (greater than 11.08 kW)	Rating capacity 800 W	N/A
B.1.3	Limitation of active power		P
B.1.3.1	Automatic limitation of the active power for voltage values close to 110% of the rated voltage P(U)	See appended table	P
B.1.3.2	Adjusting active power in the presence of transients on the transmission network	See appended table	P
B.1.3.3	Verification of the operating range in voltage and frequency	See appended table	P
B.1.3.3.1	Reduction of active power in the presence of under-frequency transients on transmission network	See appended table	P

B.1.3.4	Limitation of the active power by an external control from the distributor	See appended table	P
B.1.4	Output of DC component in the output current		N/A
B.1.4.1	Verification of the emission of continuous component	Isolated equipment	N/A
B.1.4.2	Verification of the protections against the induction of a continuous component	Isolated equipment	N/A
B.1.5	Verification of insensitivity to voltage dips (UVRT capability, greater than 11.08 kW)	Rating capacity 800 W	N/A
B.1.6	Checking the insensitivity to automatic reclosing during phase accordance		P
B.1.6.1	Test on the simulation network	See appended table	P
B.1.6.2	Test on the distribution network by means of a coupling transformer	By simulation network	N/A
B.1.6.3	Distribution network test, frequency drift simulation	By simulation network	N/A
B.1.6.4	Extension of results		P

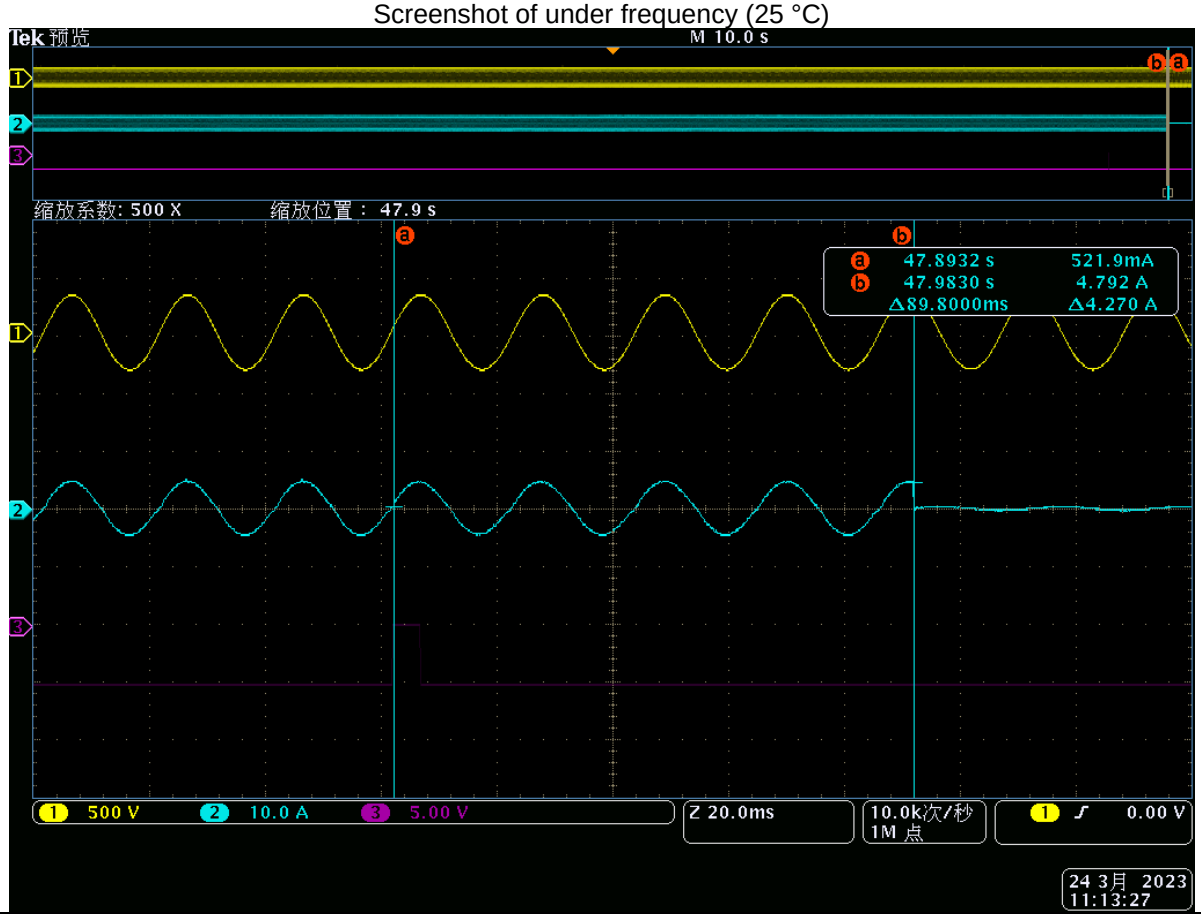
A.4.3.1 & A.4.3.2	TABLE: Test procedure for maximum/minimum frequency functions (81.S2, 47.5~51.5 Hz)						P
Model: EFWN511							
	Under frequency: 81<.S2			**Over frequency: 81>.S2**			
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps			
D) STEP for trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold			
Ambient condition 25 °C							
Tripping threshold limit [Hz]:	47.50 (47.48–47.52)			51.50 (51.48–51.52)			
Measurement accuracy of the tripping value [Hz]:	47.493	47.490	47.492	51.503	51.510	51.513	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	89.8	80.6	92.0	94.8	104.4	103.6	
Ambient condition -10 °C							
Tripping threshold limit [Hz]:	47.50 (47.48–47.52)			51.50 (51.48–51.52)			
Measurement accuracy of the tripping value [Hz]:	47.502	47.490	--	51.515	51.504	--	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	98.0	110.2	--	101.8	93.4	--	
Ambient condition 50 °C							
Tripping threshold limit [Hz]:	47.50 (47.48–47.52)			51.50 (51.48–51.52)			
Measurement accuracy of the tripping value [Hz]:	47.494	--	--	51.505	--	--	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	113.8	--	--	105.4	--	--	

Test:
To measure the disconnection time a step of 1%f_n is taken from the nominal frequency for underfrequency and overfrequency.

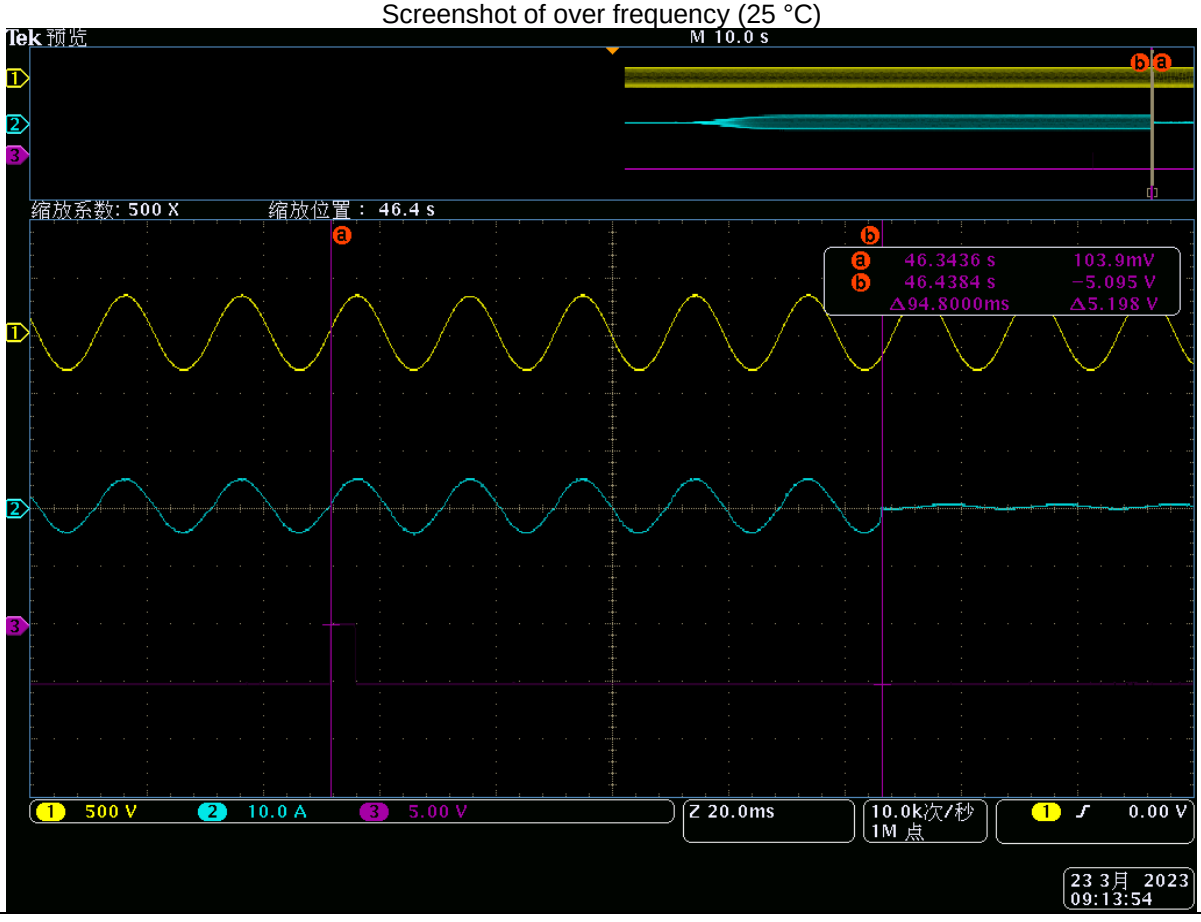
Assessment criterion:
For frequencies of between 47.5 Hz and 51.5 Hz (±0,1% f_n) automatic disconnection from the network as a result of a deviation in frequency is not permitted.
Limit values:
Frequency decrease protection f<47.5 Hz, 100 ms
Frequency increase protection f<51.5 Hz, 100 ms
For each repetition of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20 mHz
Trip times: 1%±20 ms

Note:
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

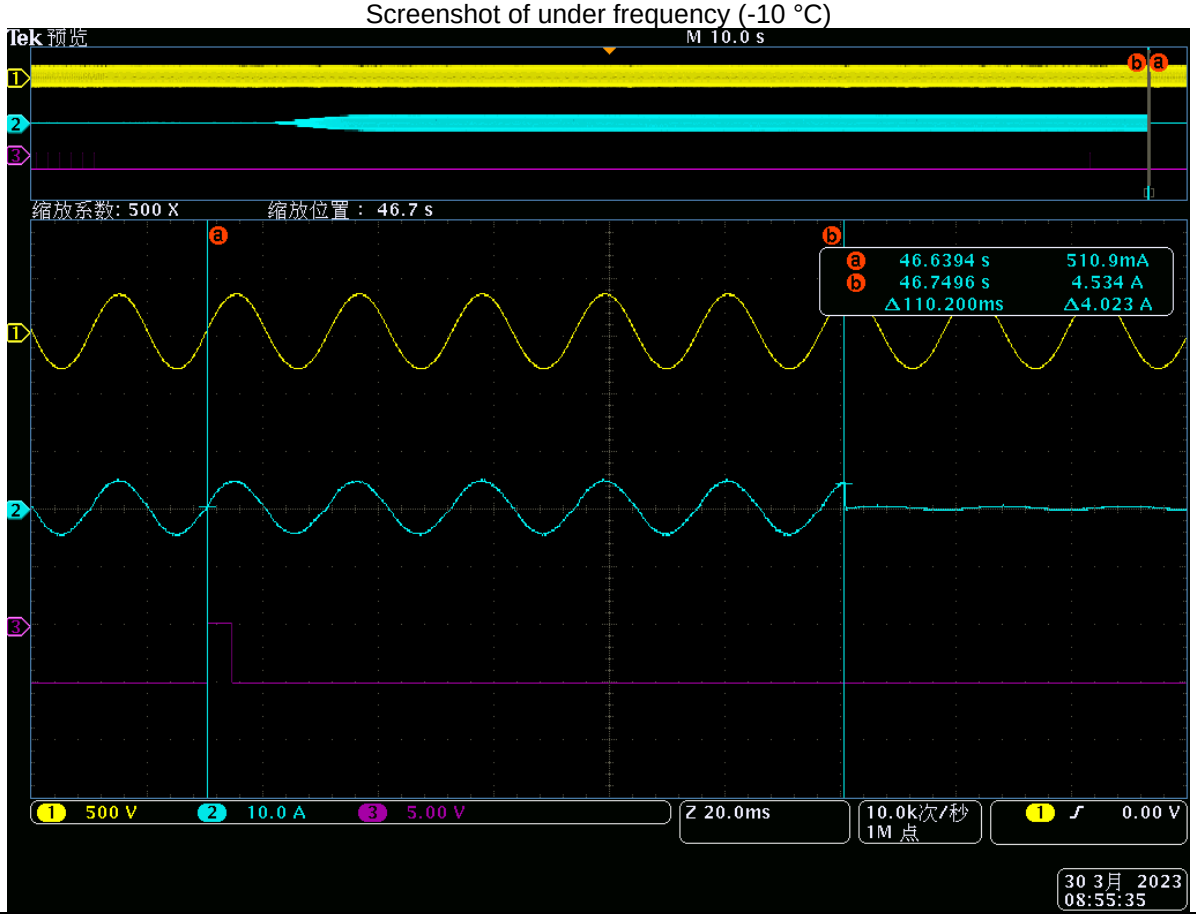
Screenshot of under frequency (25 °C)



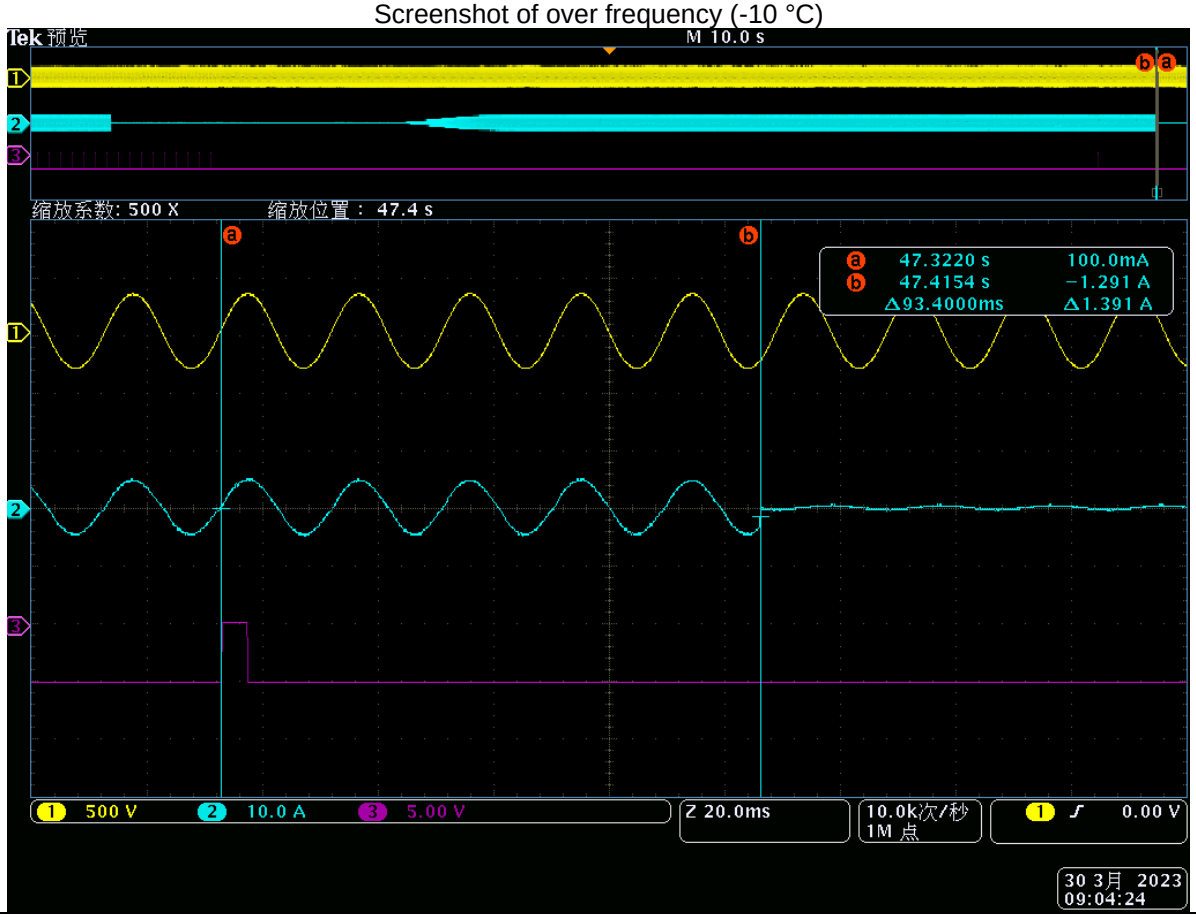
Screenshot of over frequency (25 °C)



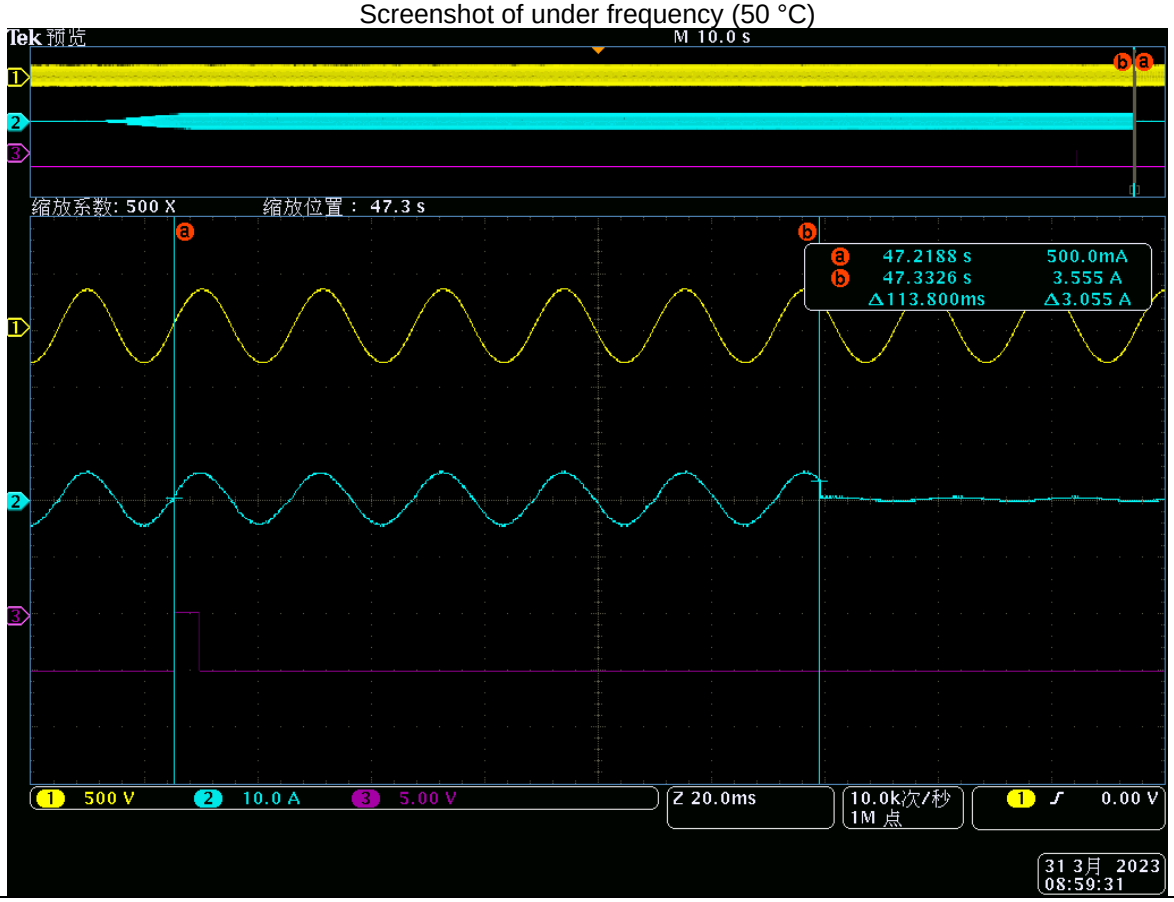
Screenshot of under frequency (-10 °C)



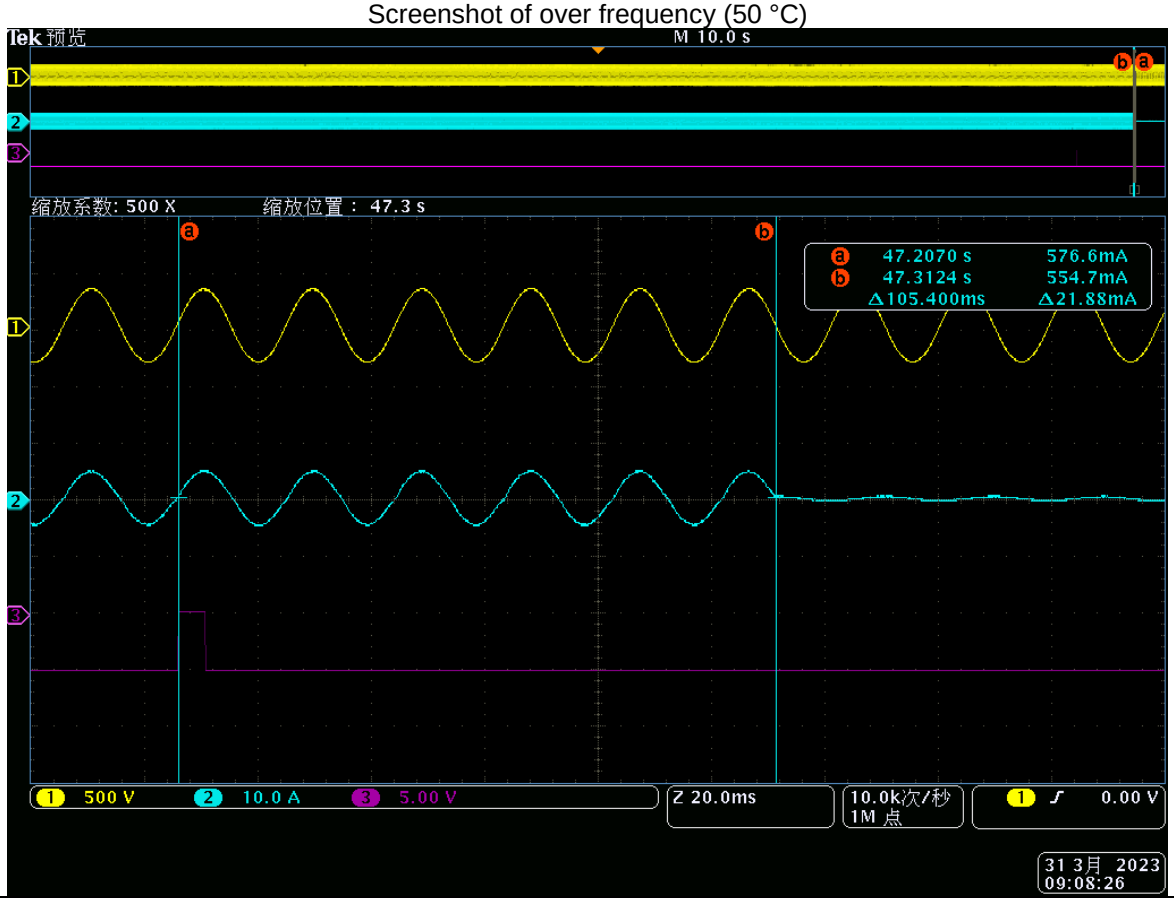
Screenshot of over frequency (-10 °C)



Screenshot of under frequency (50 °C)



Screenshot of over frequency (50 °C)



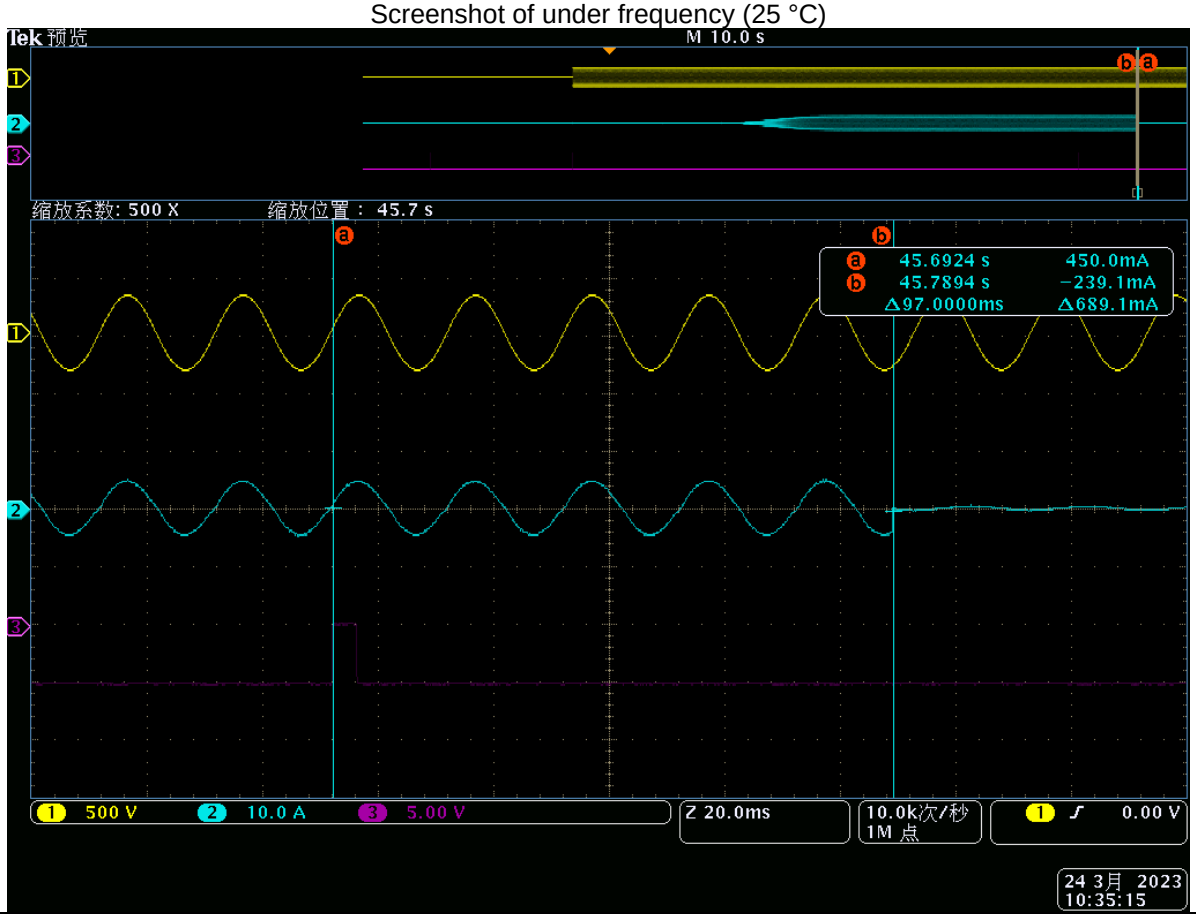
A.4.3.1 & A.4.3.2	TABLE: Test procedure for maximum/minimum frequency functions (81.S1, 49.8~50.2 Hz)						P
Model: EFWN511							
	Under frequency: 81<.S1			**Over frequency: 81>.S1**			
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps			
D) STEP for trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold			
Ambient condition 25 °C							
Tripping threshold limit [Hz]:	49.80 (49.78–49.82)			50.20 (50.18–50.22)			
Measurement accuracy of the tripping value [Hz]:	49.793	49.792	49.792	50.203	50.202	50.211	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	97.0	100.4	110.8	107.2	113.2	100.0	
Ambient condition -10 °C							
Tripping threshold limit [Hz]:	49.80 (49.78–49.82)			50.20 (50.18–50.22)			
Measurement accuracy of the tripping value [Hz]:	49.792	49.793	--	50.203	50.204	--	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	109.8	105.6	--	108.8	109.0	--	
Ambient condition 50 °C							
Tripping threshold limit [Hz]:	49.80 (49.78–49.82)			50.20 (50.18–50.22)			
Measurement accuracy of the tripping value [Hz]:	49.793	--	--	50.204	--	--	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	97.0	--	--	106.6	--	--	

Test:
To measure the disconnection time a step of 1%fn is taken from the nominal frequency for underfrequency and overfrequency.

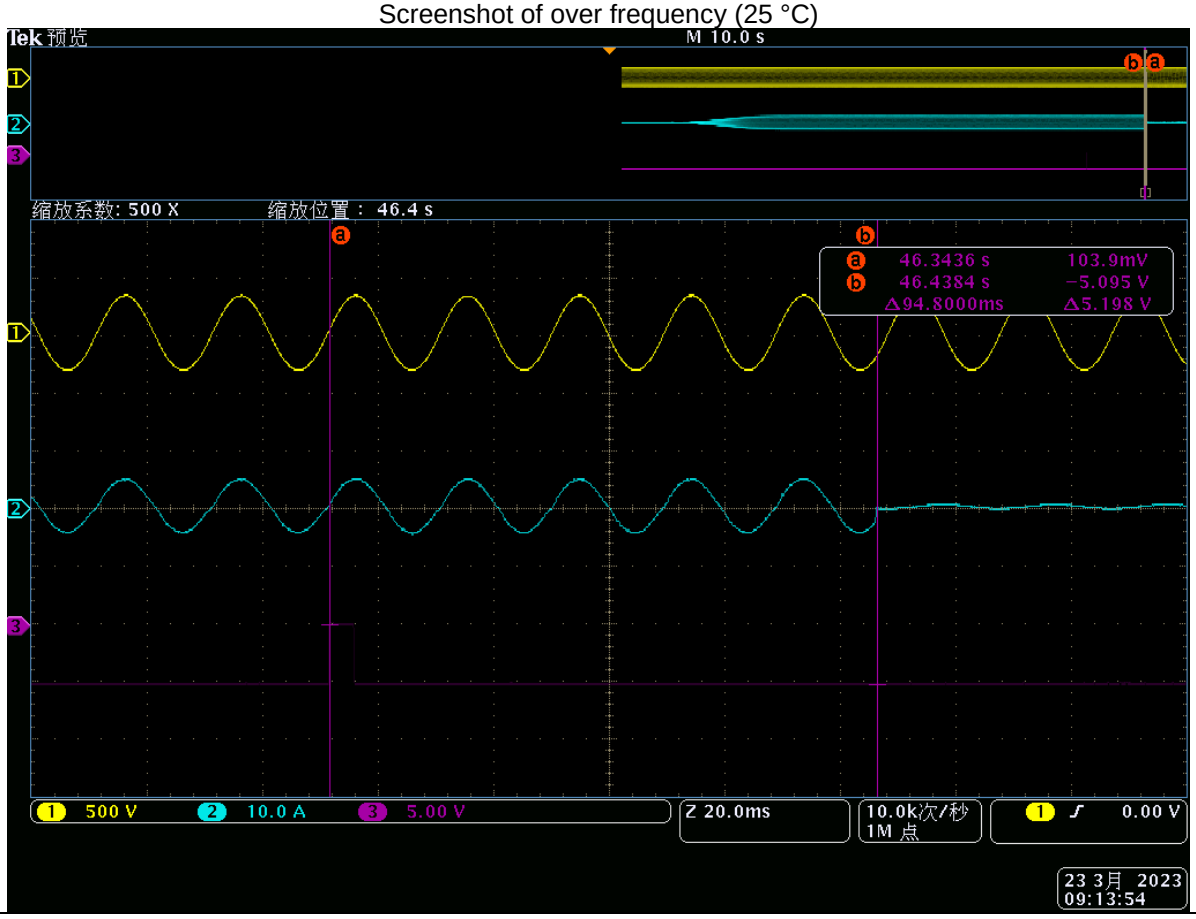
Assessment criterion:
For frequencies of between 47.5 Hz and 51.5 Hz (±0,1% f_n) automatic disconnection from the network as a result of a deviation in frequency is not permitted.
Limit values:
Frequency decrease protection f<47.5 Hz, 100 ms
Frequency increase protection f<51.5 Hz, 100 ms
For each repetition of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20 mHz
Trip times: 1%±20 ms

Note:
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

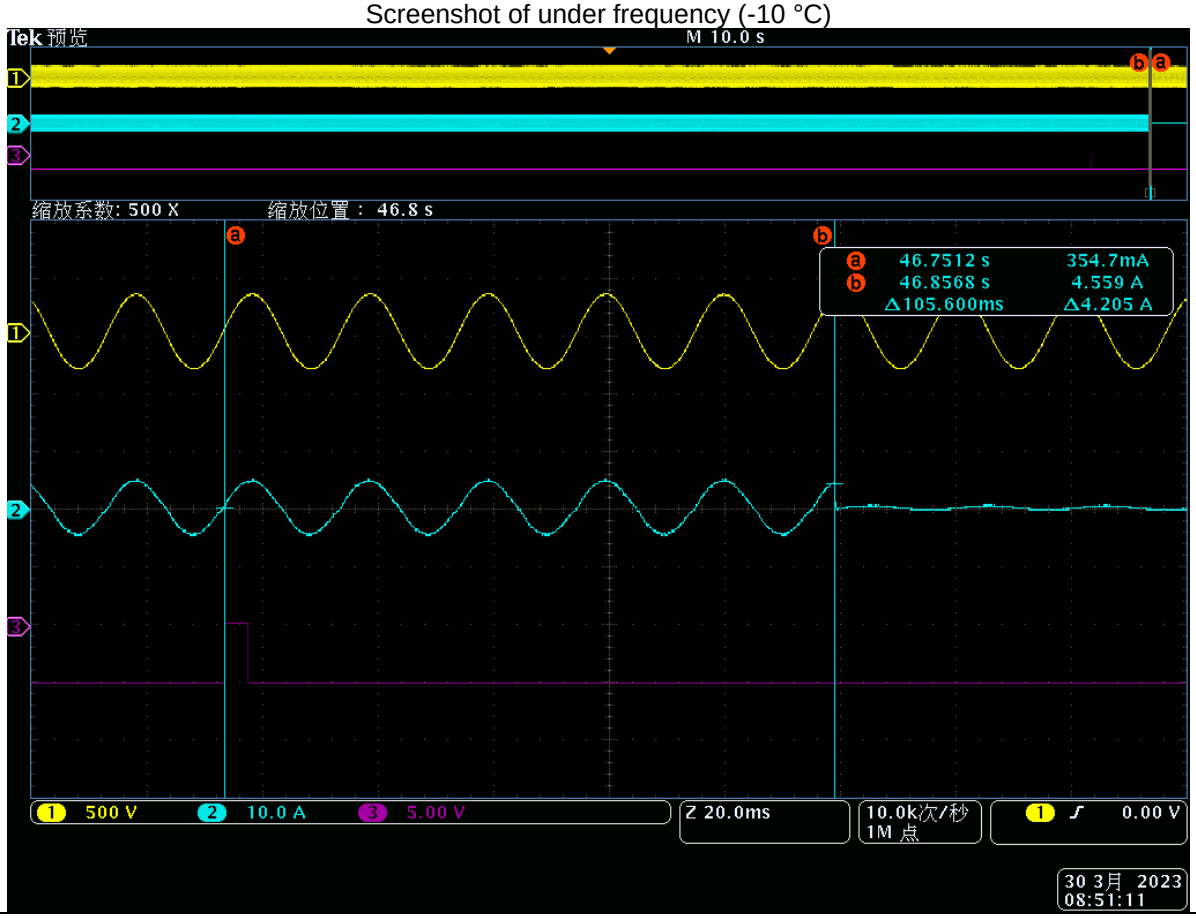
Screenshot of under frequency (25 °C)



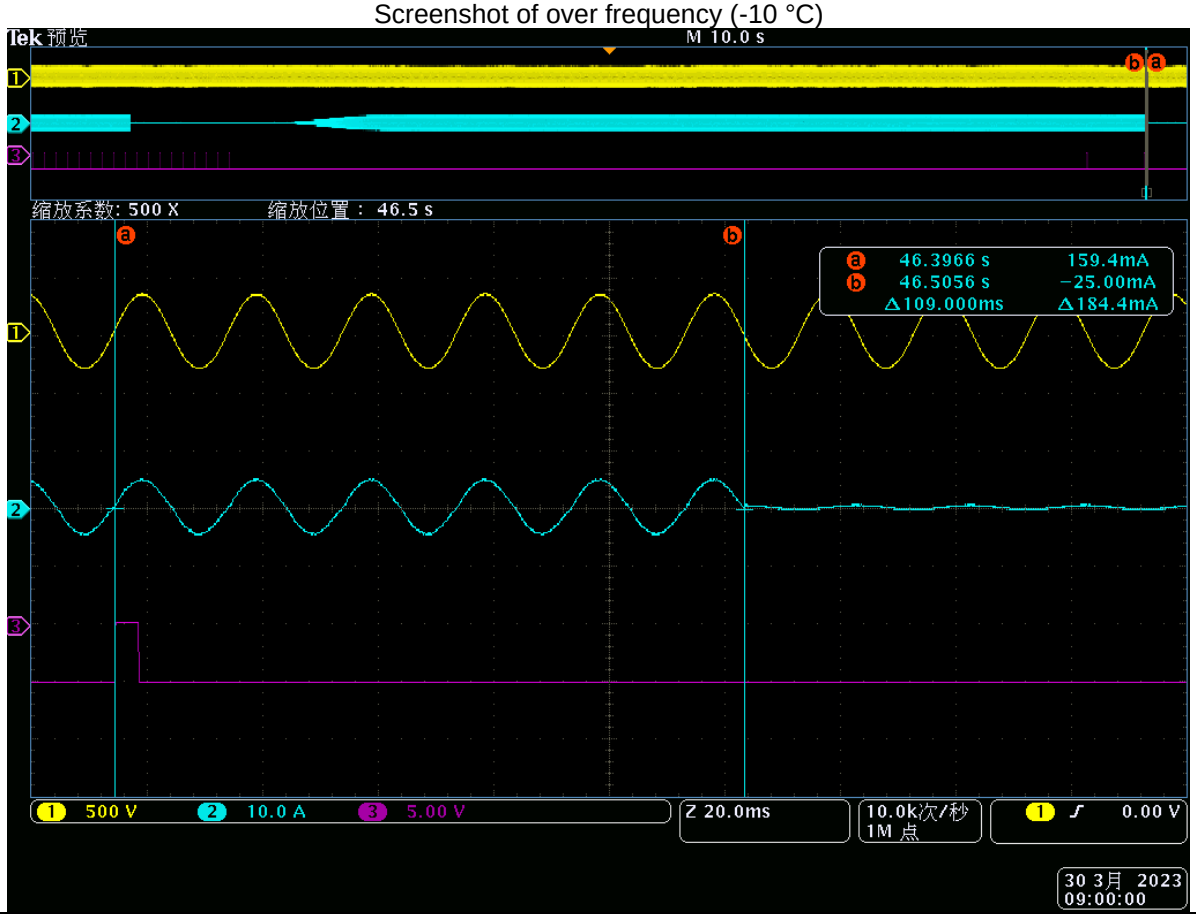
Screenshot of over frequency (25 °C)



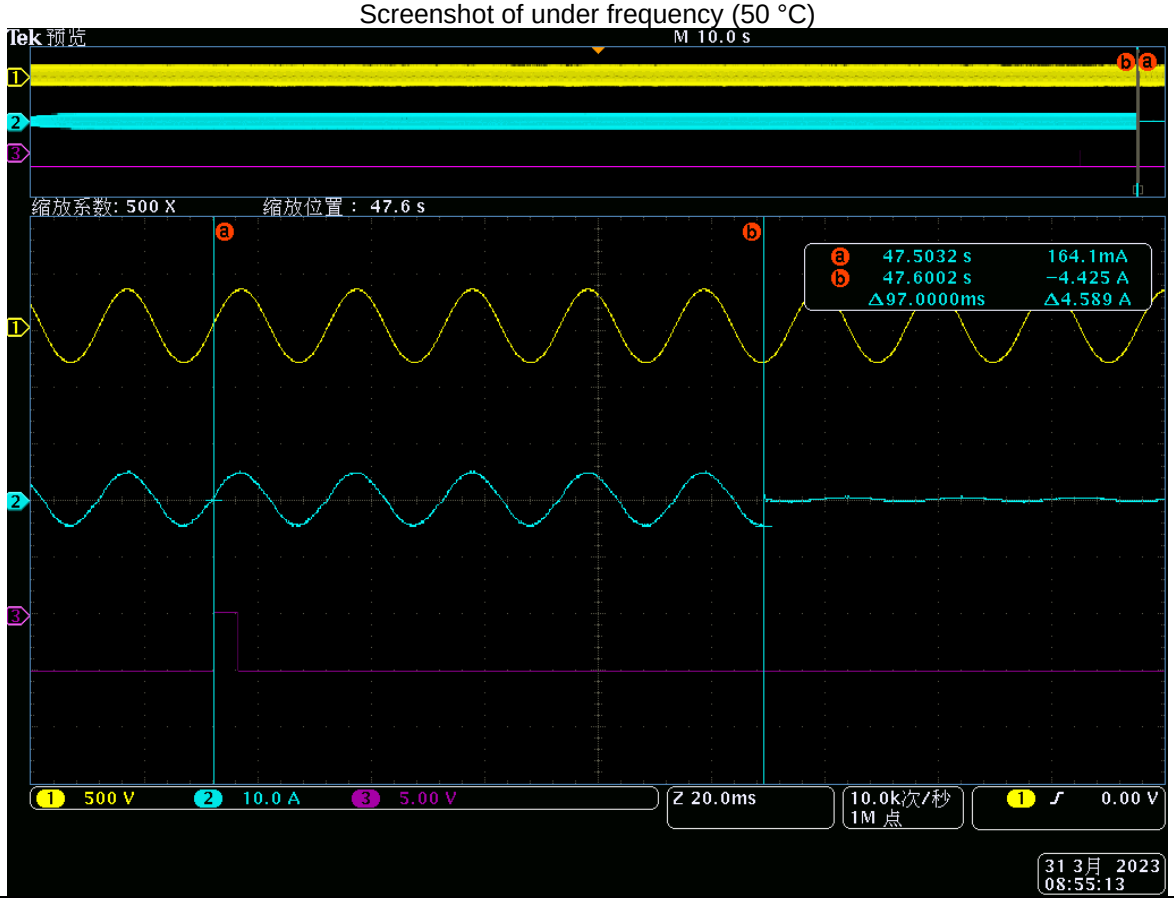
Screenshot of under frequency (-10 °C)



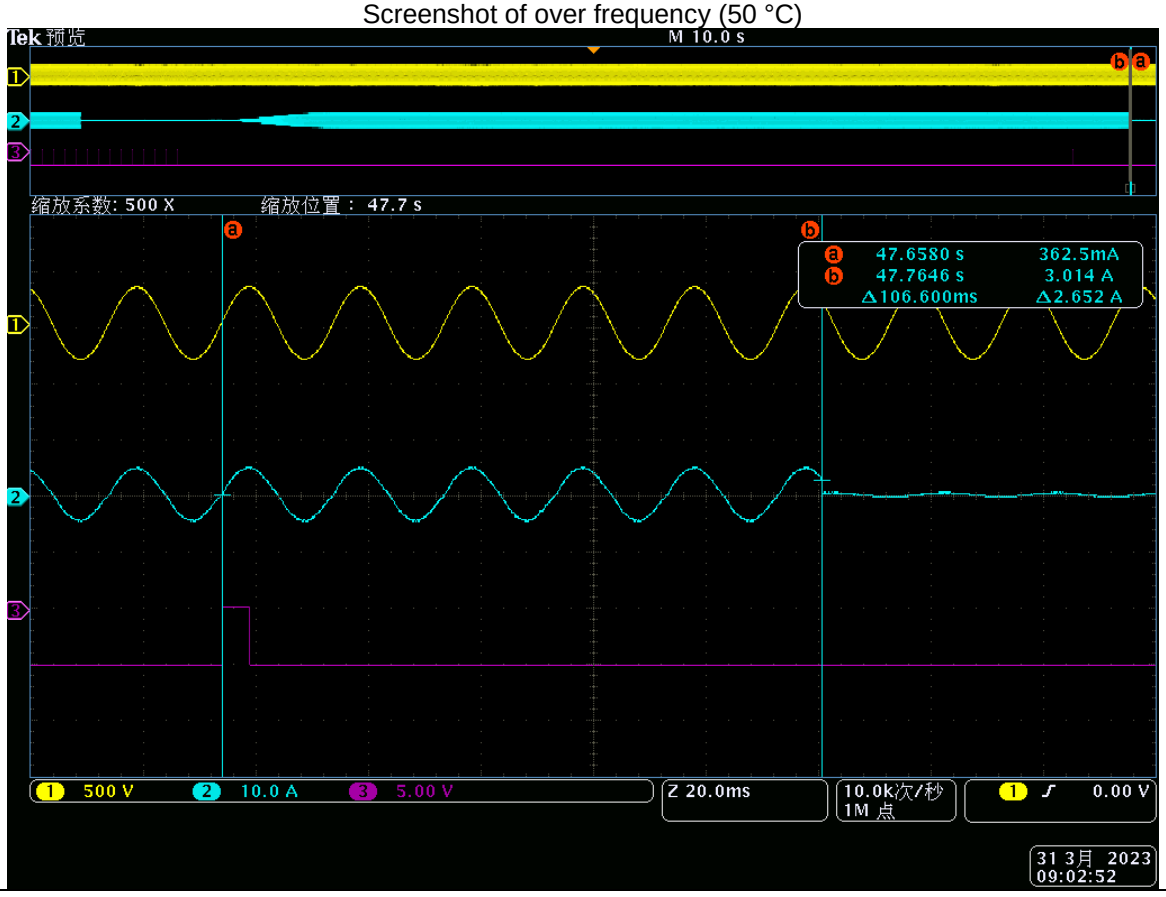
Screenshot of over frequency (-10 °C)



Screenshot of under frequency (50 °C)



Screenshot of over frequency (50 °C)



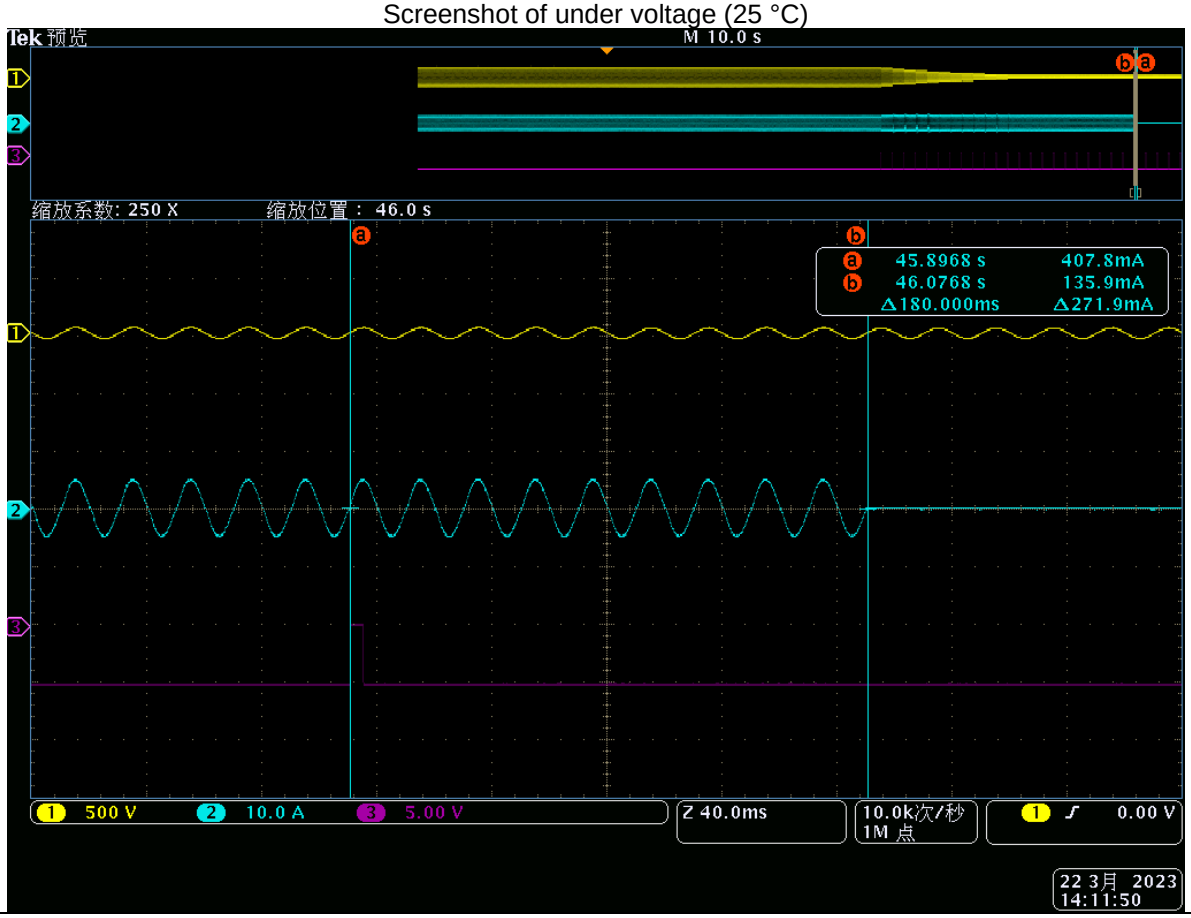
A.4.3.1 & A.4.3.2	TABLE: Test procedure for maximum/minimum voltage functions (27.S2~59.S2, 0.15~1.15 Vn)						P
Model: EFWN511			Phase: single				
	Under voltage: 27.S2			**Over voltage: 59.S2**			
A) STEPS for trip value [V to V]:	1.1 threshold -> decrease by max 5V steps			0.9 threshold -> increase by max 5V steps			
D) STEP for trip time [V to V]:	1.1 threshold -> 0.9 threshold			0.9 threshold -> 1.01 threshold			
Ambient condition 25 °C							
Tripping threshold limit [V]:	34.5 (32.2–36.8)			264.5 (262.2–266.8)			
Measurement accuracy of the tripping value [V]:	34.0	33.8	33.4	263.6	264.0	263.8	
Trip time limit [ms]:	200 (174–226)			200 (174–226)			
Measurement the trip time [ms]:	180.0	184.8	185.6	213.6	203.2	194.8	
Ambient condition -10 °C							
Tripping threshold limit [V]:	34.5 (32.2–36.8)			264.5 (262.2–266.8)			
Measurement accuracy of the tripping value [V]:	33.58	33.08	--	263.58	264.35	--	
Trip time limit [ms]:	200 (174–226)			200 (174–226)			
Measurement the trip time [ms]:	205.0	189.2	--	217.4	217.9	--	
Ambient condition 50 °C							
Tripping threshold limit [V]:	34.5 (32.2–36.8)			264.5 (262.2–266.8)			
Measurement accuracy of the tripping value [V]:	33.72	--	--	264.55	--	--	
Trip time limit [ms]:	200 (174–226)			200 (174–226)			
Measurement the trip time [ms]:	204.6	--	--	210.0	--	--	

Test:
To measure the disconnection time a step of 15%U_n for undervoltage and of 115%U_n for overvoltage.
The voltages should be measured per phase conductor, in which current is fed between the line conductor and the neutral conductor.

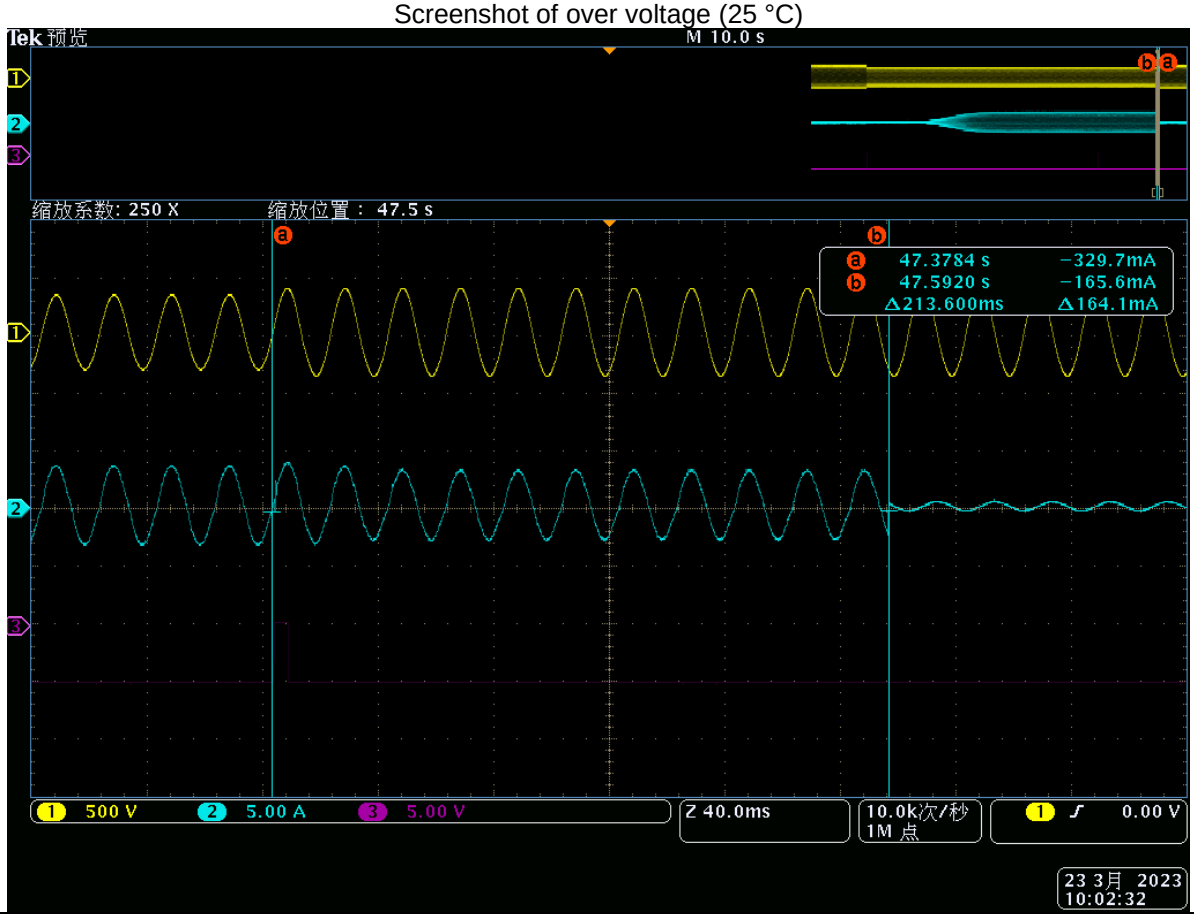
Assessment criterion:
Limit values:
Voltage drop protection 27.S2 / 0.15 U_n / 200 ms
Rise-in voltage protection 59.S2 / 1.15 U_n / 200 ms
The setting value and the trip value of the frequency may not vary by more than ≤5%V_n and 3%±20ms.
For each repetition of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20mHz
Trip times: 1%±20ms

Note:
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

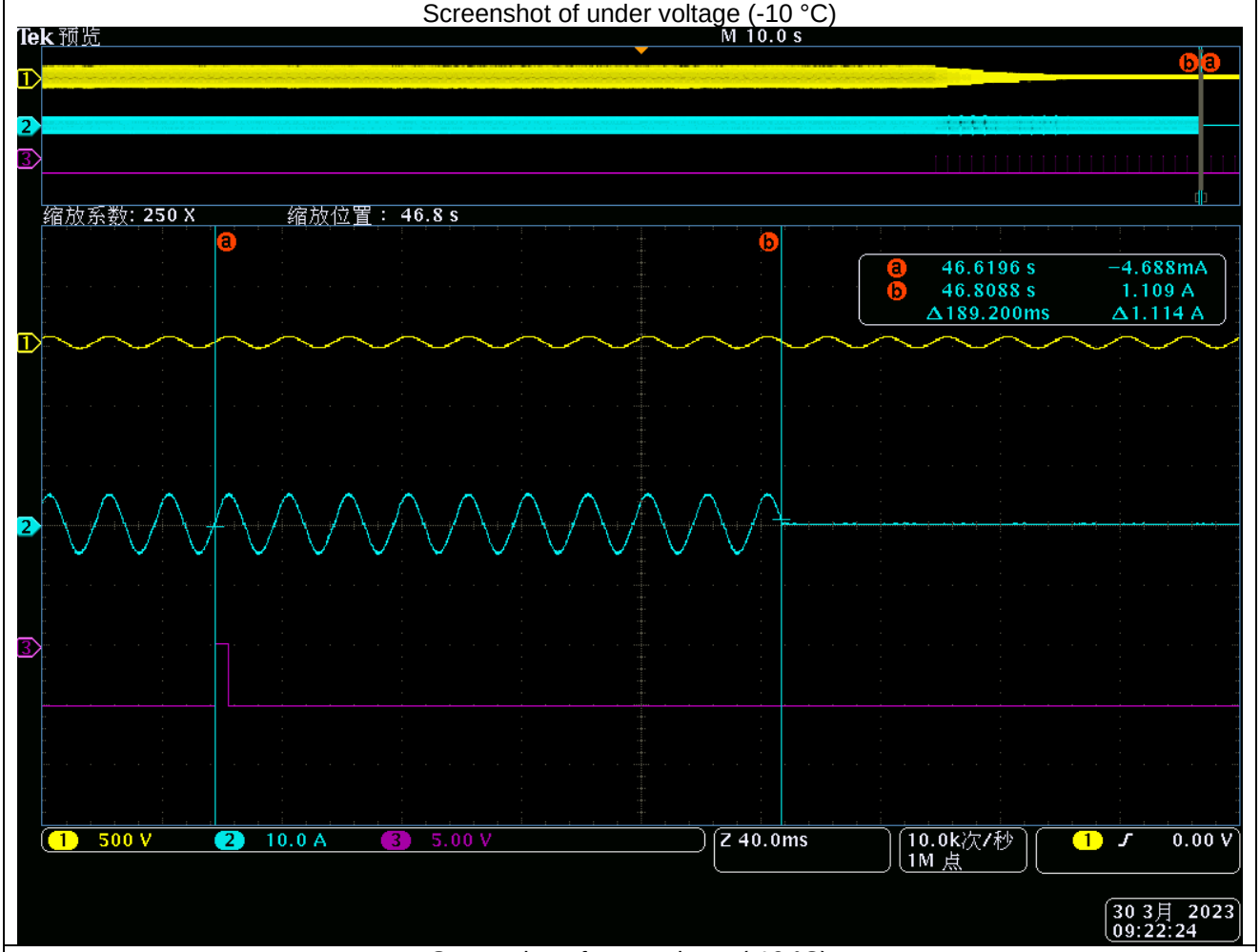
Screenshot of under voltage (25 °C)



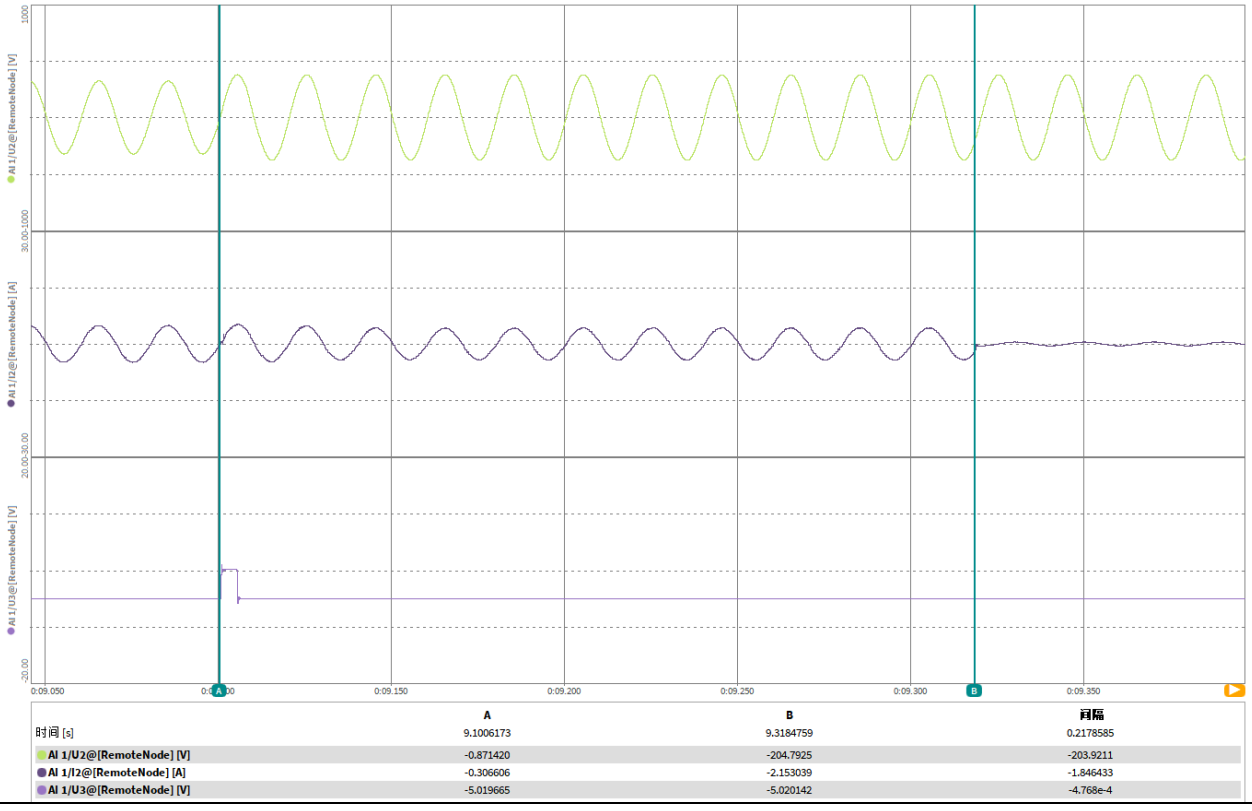
Screenshot of over voltage (25 °C)



Screenshot of under voltage (-10 °C)

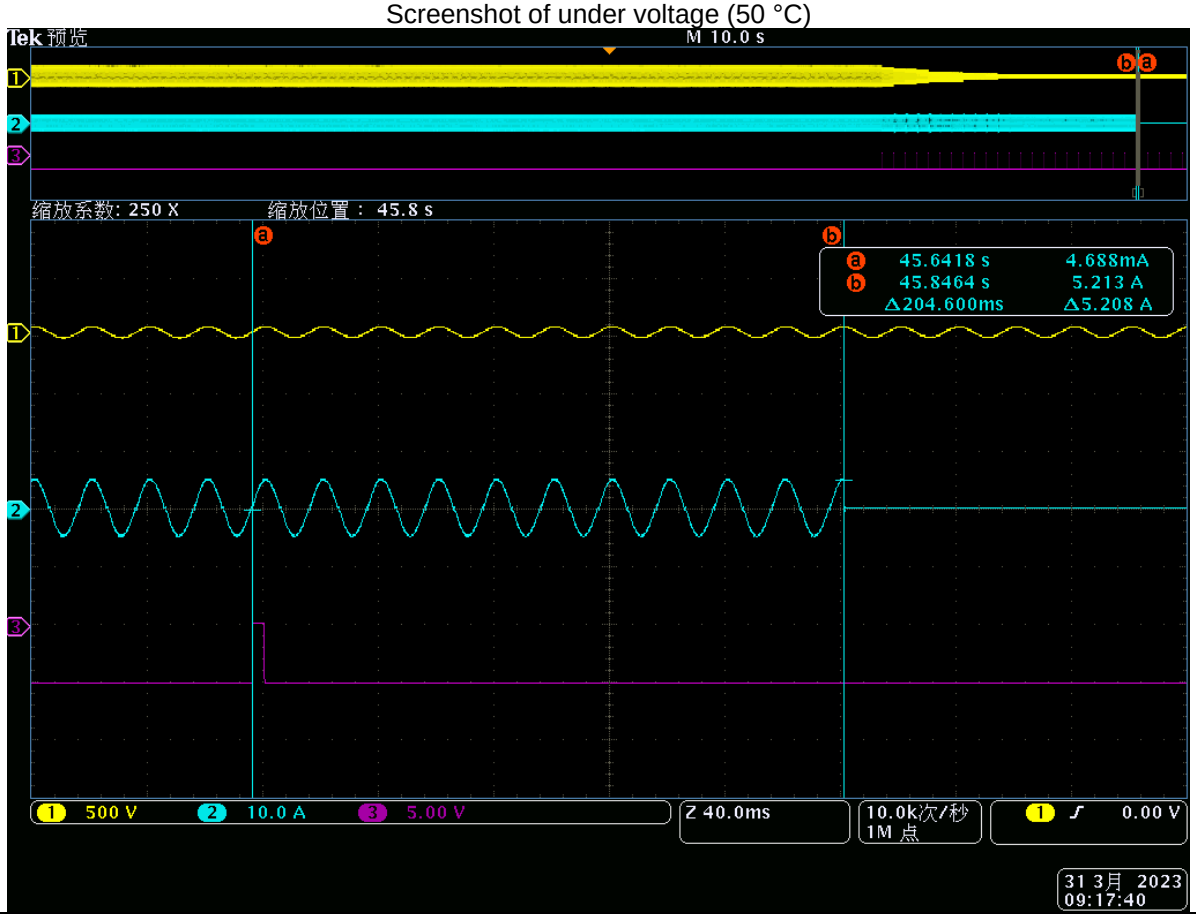


Screenshot of over voltage (-10 °C)

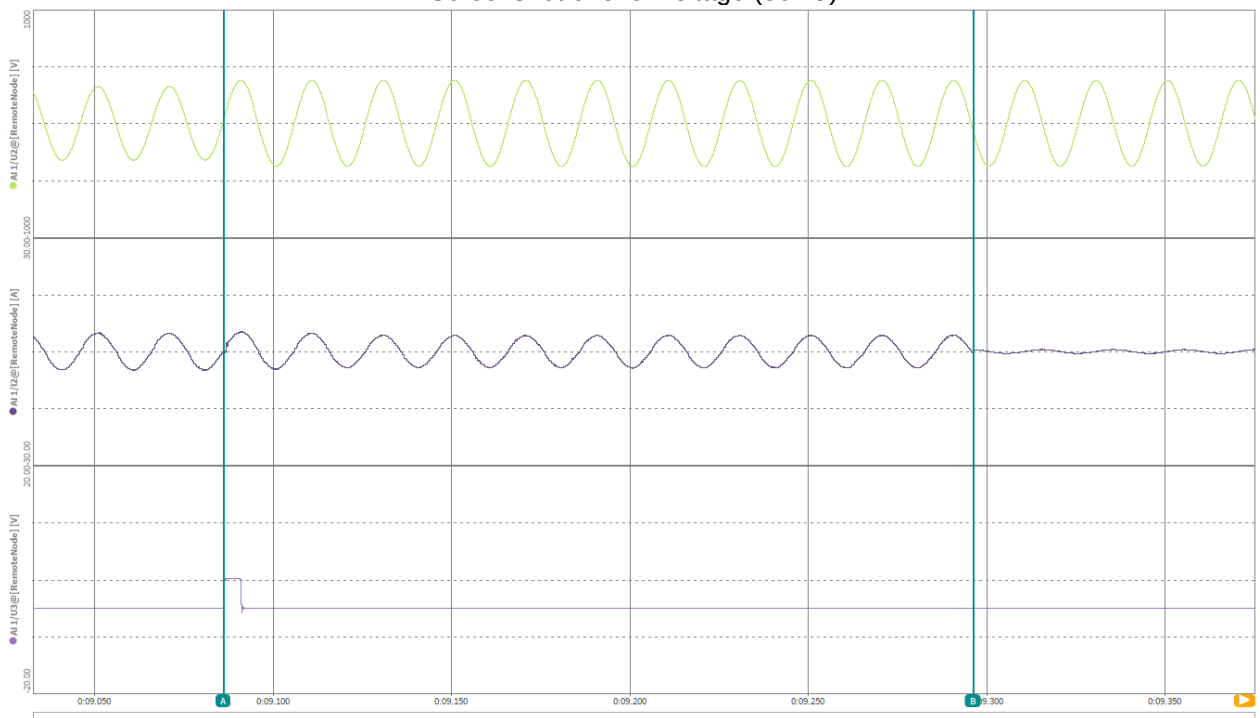


时间 [s]	A 9.1006173	B 9.3184759	间隔 0.2178585
AI 1/U2@[RemoteNode] [V]	-0.871420	-204.7925	-203.9211
AI 1/I2@[RemoteNode] [A]	-0.306606	-2.153039	-1.846433
AI 1/U3@[RemoteNode] [V]	-5.019665	-5.020142	-4.768e-4

Screenshot of under voltage (50 °C)



Screenshot of over voltage (50 °C)



	A	B	间隔
时间 [s]	9.0863033	9.2962879	0.2099845
AI 1/U2@[RemoteNode] [V]	17.30681	-58.89678	-76.20359
AI 1/I2@[RemoteNode] [A]	0.260949	0.504732	0.243783
AI 1/U3@[RemoteNode] [V]	-4.915715	-5.019665	-0.103951

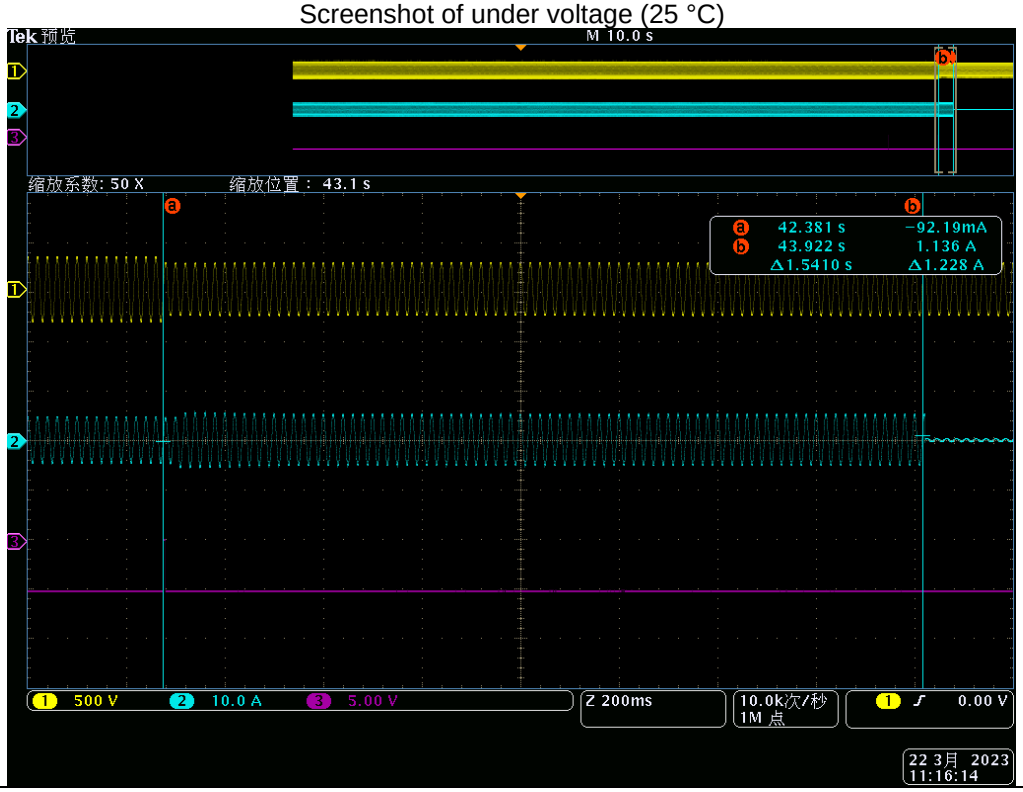
A.4.3.1 & A.4.3.2	TABLE: Test procedure for maximum/minimum voltage functions (27.S1, 0.85 Vn)								P
Model: EFWN511				Phase: single					
	Under voltage: 27.S1								
A) STEPS for trip value [V to V]:	1.1 threshold -> decrease by max 5V steps								
D) STEP for trip time [V to V]:	1.1 threshold -> 0.9 threshold								
Ambient condition	**25 °C**			**-10 °C**			**50 °C**		
Tripping threshold limit [V]:	195.5 (193.2–197.8)								
Measurement accuracy of the tripping value [V]:	195.2	195.1	195.2	194.95	194.64	--	194.85	--	--
Trip time limit [ms]:	1500 (1435–1565)								
Measurement the trip time [ms]:	1541	1542	1540	1522	1537	--	1521	--	--

Test:
To measure the disconnection time a step of 85%U_n for undervoltage.
The voltages should be measured per phase conductor, in which current is fed between the line conductor and the neutral conductor.

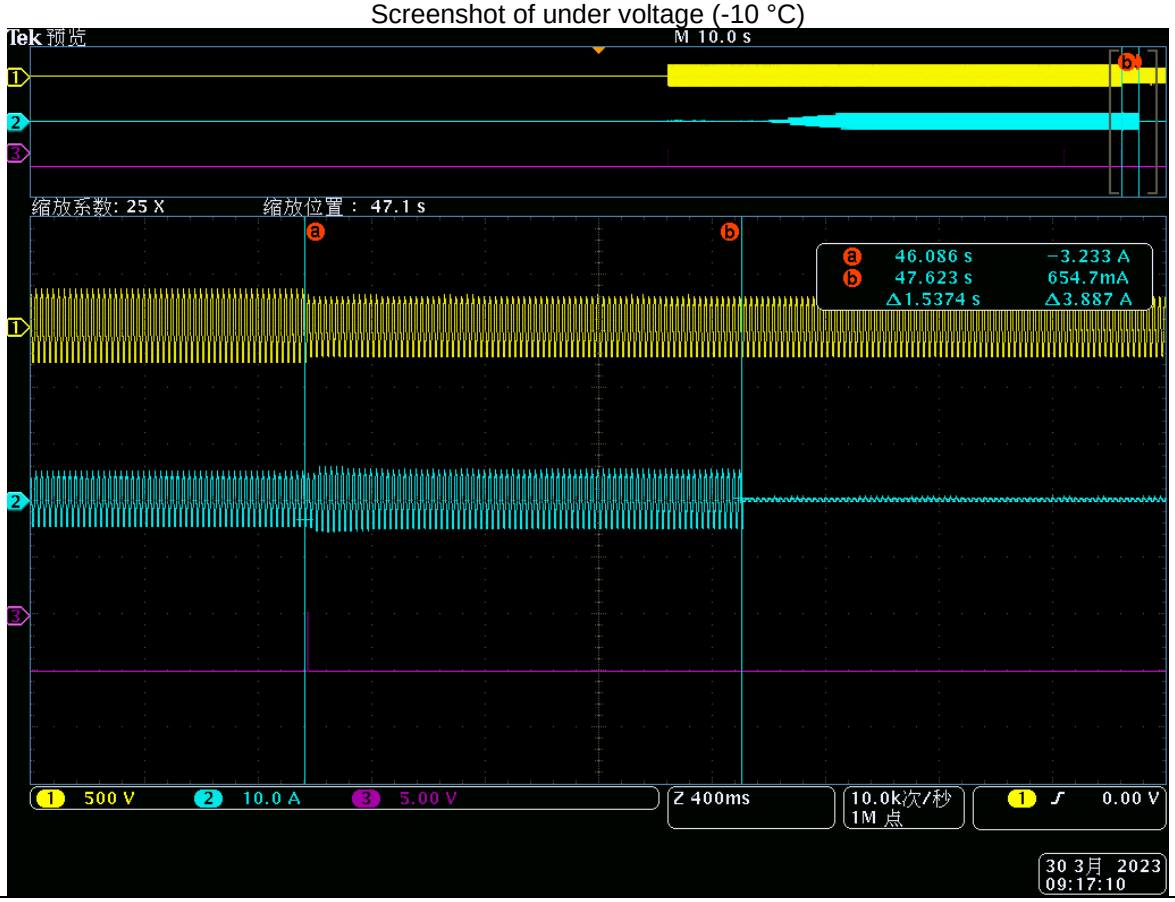
Assessment criterion:
Limit values:
Voltage drop protection 27.S1 / 0.85 U_n / 1500 ms
The setting value and the trip value of the frequency may not vary by more than ≤5%V_n and 3%±20ms.
For each repetition of the tests, the max tolerances of the values are:
Voltage: 2%
Frequency: ±20mHz
Trip times: 1%±20ms

Note:
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

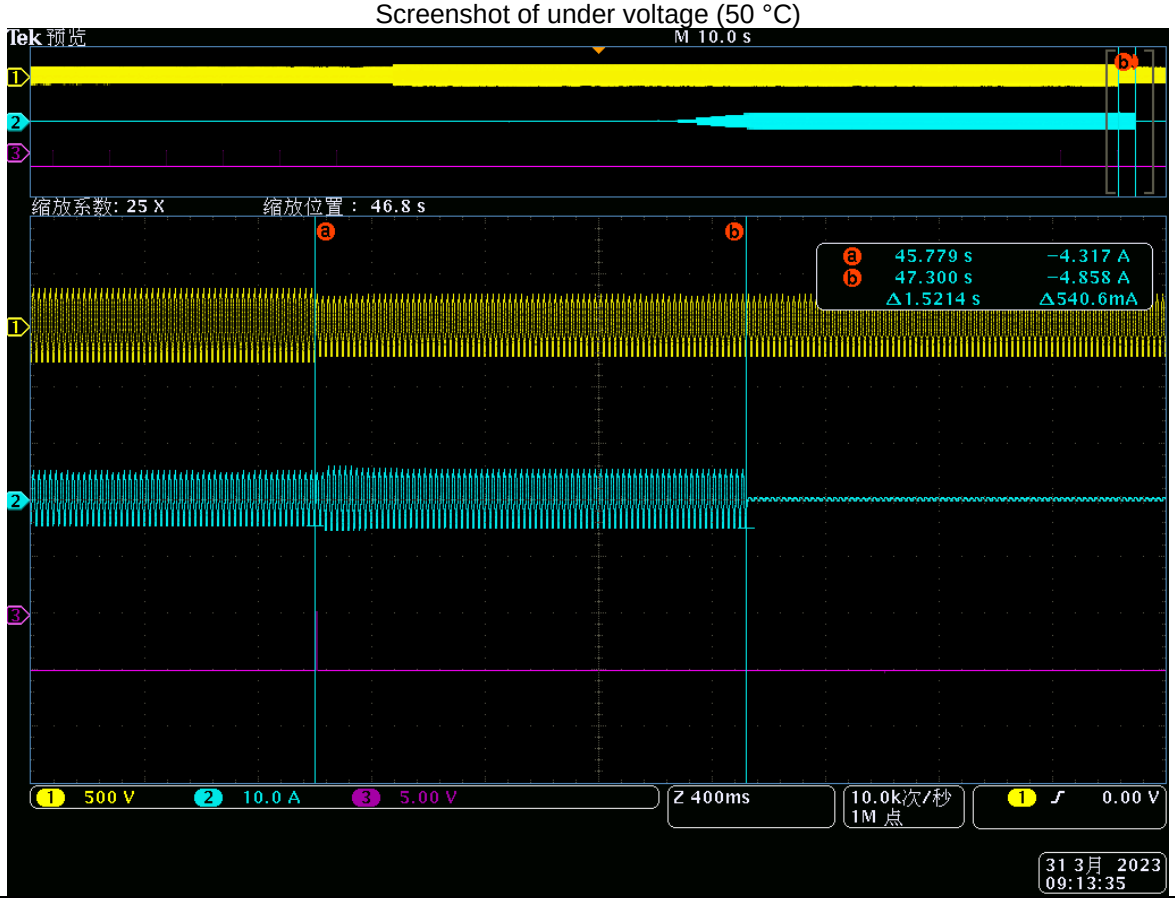
Screenshot of under voltage (25 °C)



Screenshot of under voltage (-10 °C)

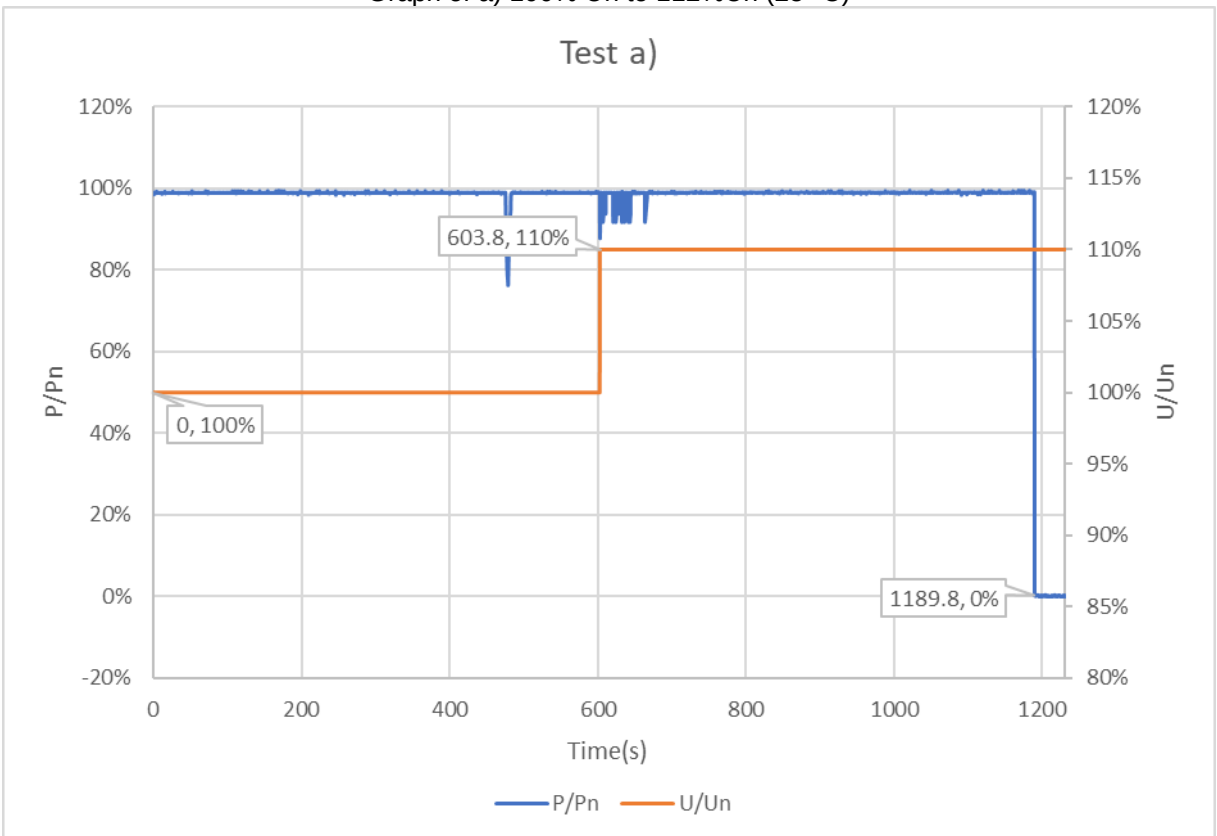


Screenshot of under voltage (50 °C)

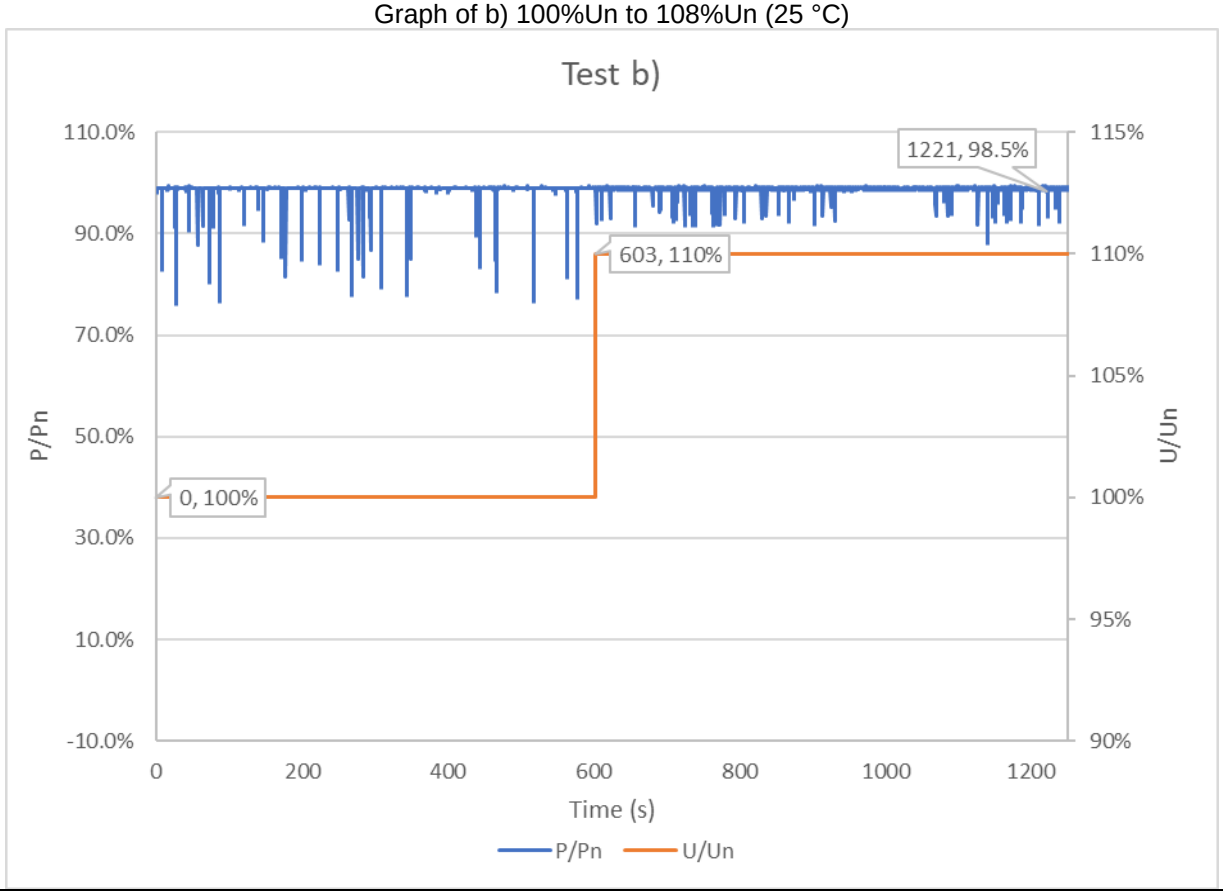


A.4.3.1 & A.4.3.2	TABLE: Measuring the rise-in voltage protection as a running 10-minute mean value (59.S1, 1.10 Vn)		P
Model: EFWN511			
Test:		Disconnection time:	Limit:
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% U_n. Disconnection must take place within 600 s.		
	Phase A	586.0	≤ 600 s
	Phase B	--	
	Phase C	--	
b)	The voltage is set to 100% U_n for 600 s and then to 108% U_n for 600 s. No disconnection should take place.		
	Phase A	No disconnection	Disconnection should not take place.
	Phase B	--	
	Phase C	--	
c)	The voltage is set to 106 % U_n and held for 600 s. Thereafter the voltage is set to 114 % U_n. Disconnection must take place within 300 s or about 50 % of the disconnection time measured in point a).*		
	Phase A	255.8	The disconnection time should be about 50 % of the value measured in a). *
	Phase B	--	
	Phase C	--	
Note: *If the setting value is set to 600 s, then disconnection time can be in the range between 225 s and 375 s. The tests were performed on EFWN511 and are also applicable for all other models stated in this report.			

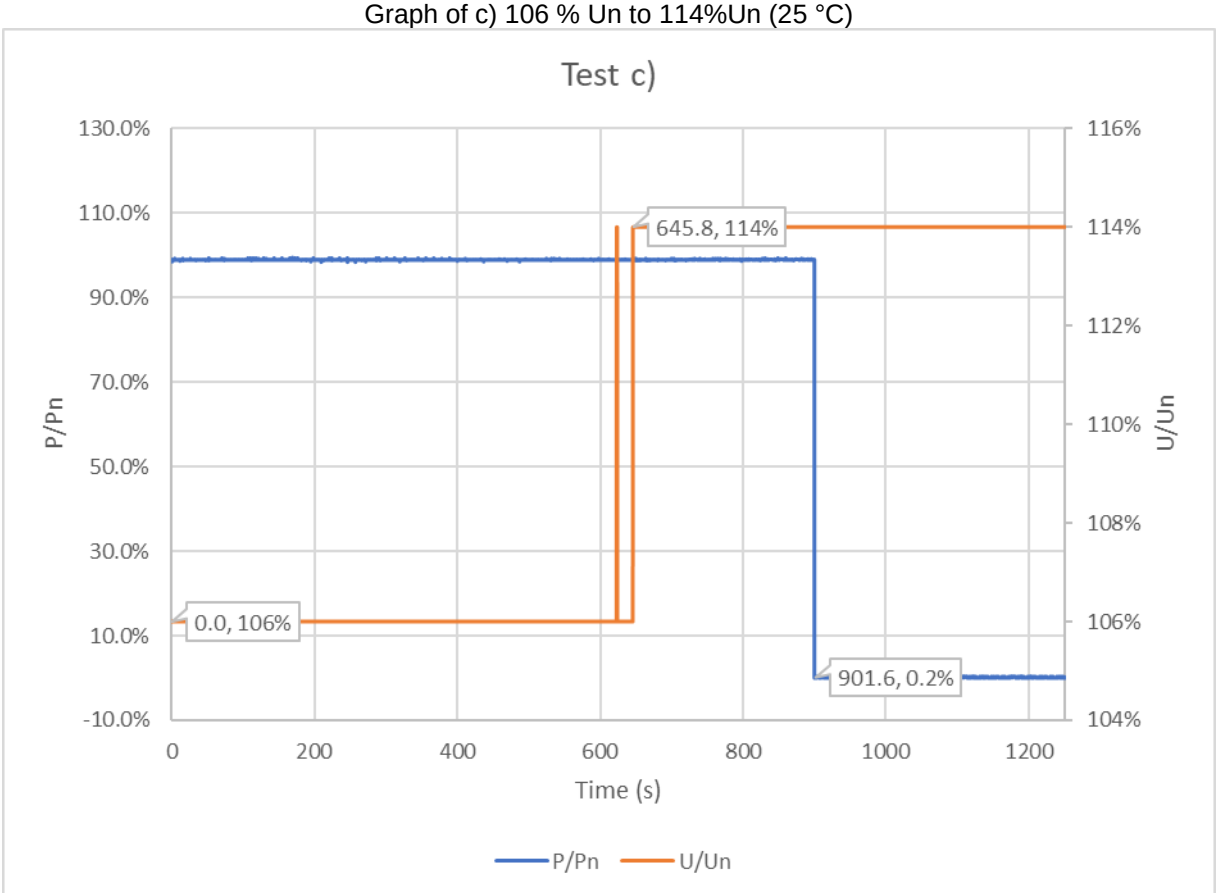
Graph of a) 100% Un to 112%Un (25 °C)



Graph of b) 100%Un to 108%Un (25 °C)

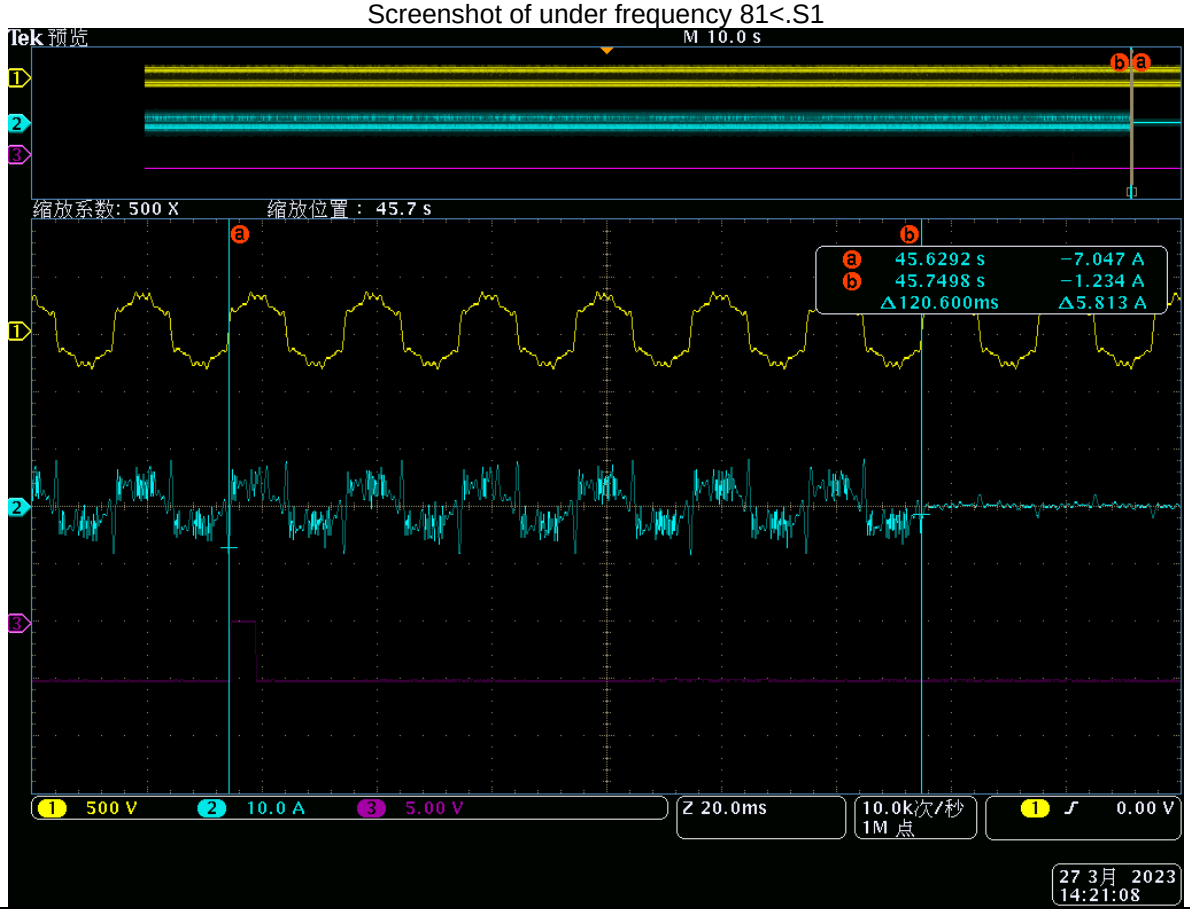


Graph of c) 106 % Un to 114%Un (25 °C)

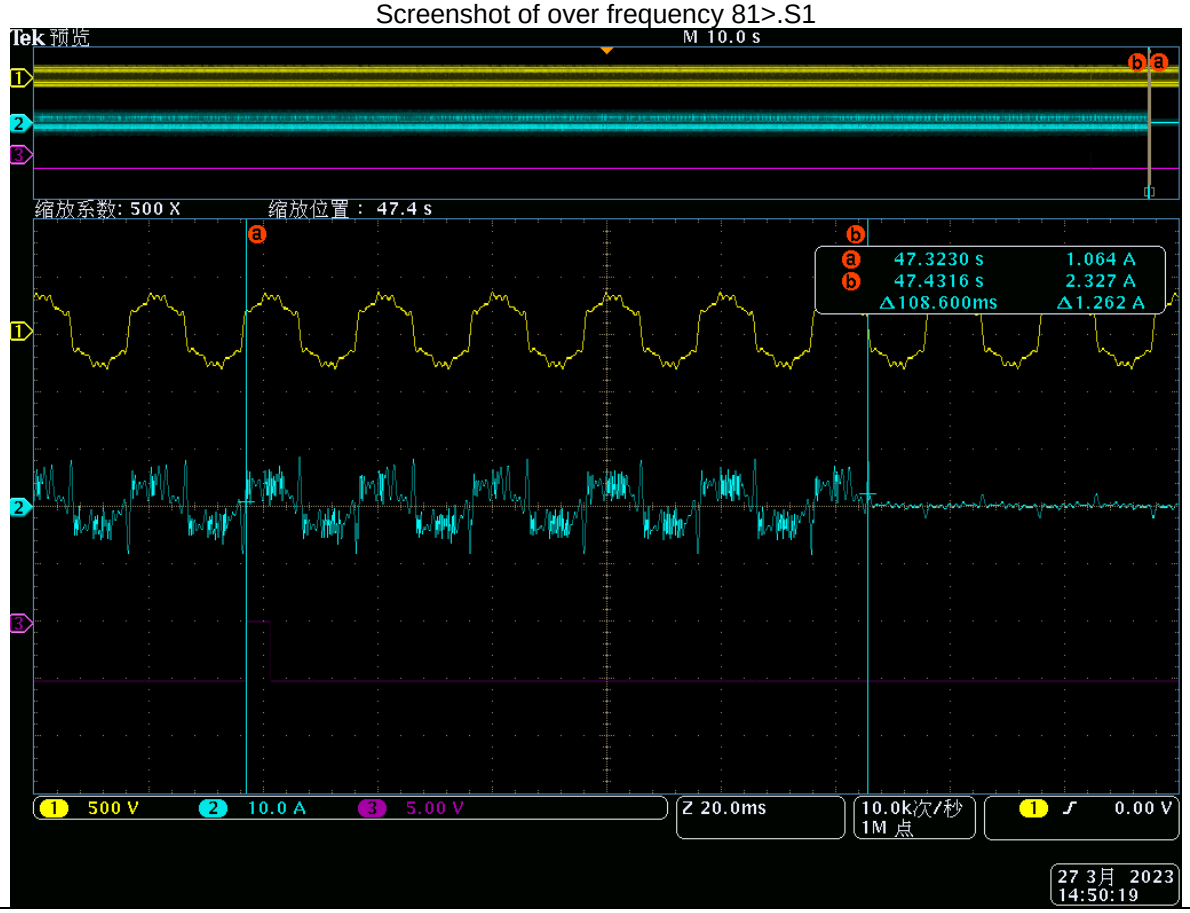


A.4.3.3.1	TABLE: Insensitivity to harmonics of the frequency relay (47.5Hz, 51.5Hz)						P
Model: EFWN511							
	Under frequency: 81<.S1			**Over frequency: 81>.S1**			
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps			
D) STEP trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold			
Tripping threshold limit [Hz]:	49.80 (49.78–49.82)			50.20 (50.18–50.22)			
Measurement accuracy of the tripping value [Hz]:	49.790	--	--	50.205	--	--	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	120.6	--	--	108.6	--	--	
	Under frequency: 81<.S2			**Over frequency: 81>.S2**			
A) STEPS for trip value [Hz to Hz]:	1.01 threshold -> decrease by max 10mHz steps			0.99 threshold -> increase by max 10mHz steps			
D) STEP trip time [Hz to Hz]:	1.01 threshold -> 0.99 threshold			0.99 threshold -> 1.01 threshold			
Tripping threshold limit [Hz]:	47.50 (47.48–47.52)			51.50 (51.48–51.52)			
Measurement accuracy of the tripping value [Hz]:	47.491	--	--	51.504	--	--	
Trip time limit [ms]:	100 (77–123)			100 (77–123)			
Measurement the trip time [ms]:	117.2	--	--	106.6	--	--	
Test: The harmonics, which voltage waveform distorted as required by *Table 17 – Harmonics for the insensitivity of the frequency protection function*, were applied at the a.c. terminals in order to check the trip time and trip values of the protections.							
Note: The setting value and the trip value of the frequency may not vary by more than **±20mHz** and **3%±20ms**. Differences between the test values: **±20mHz** and **1%±20ms.** The tests were performed on EFWN511 and are also applicable for all other models stated in this report.							

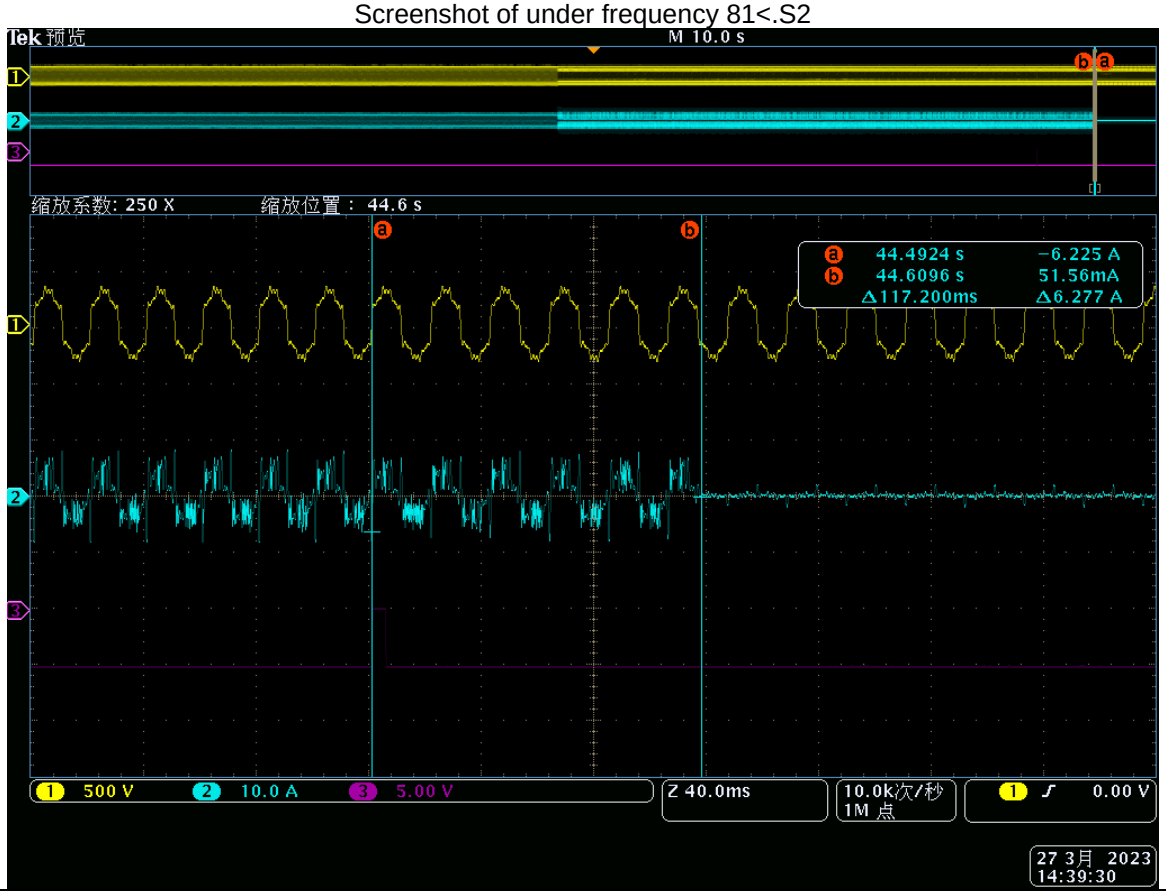
Screenshot of under frequency 81<.S1



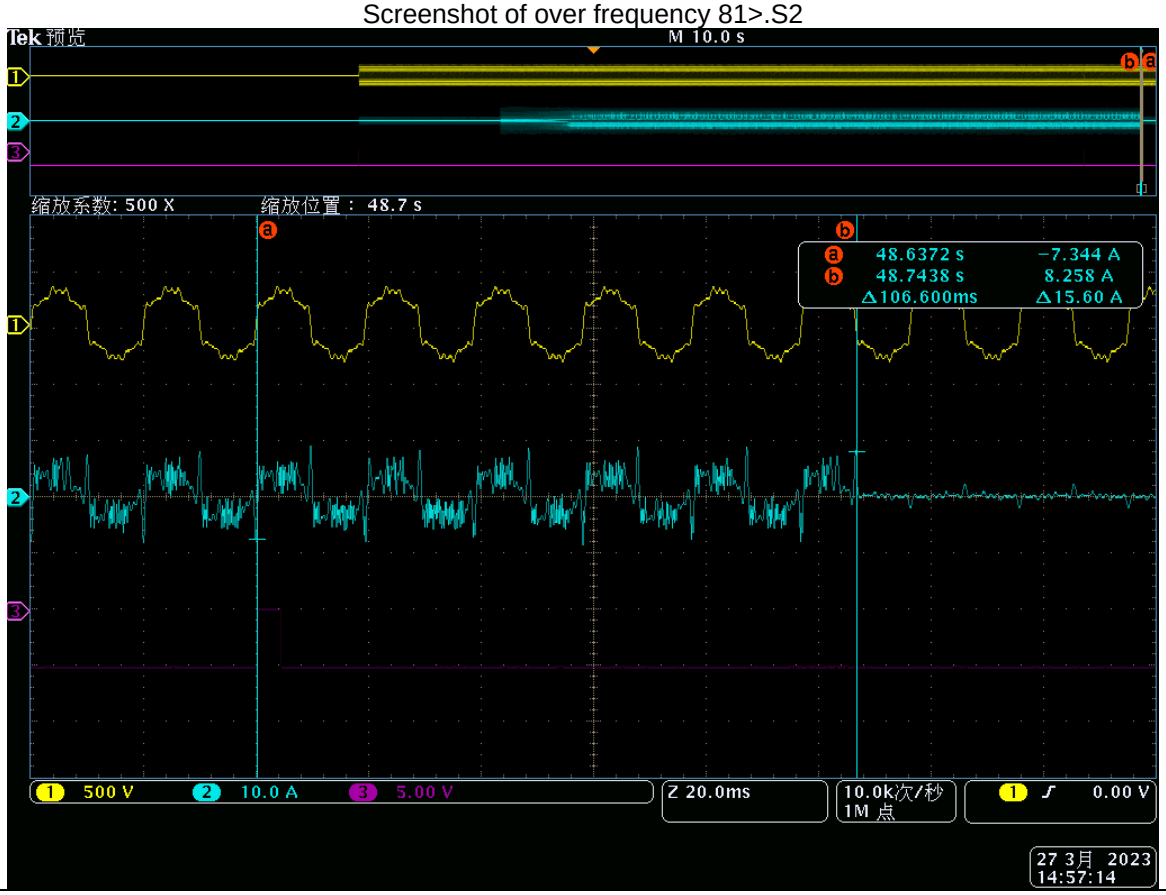
Screenshot of over frequency 81>.S1



Screenshot of under frequency 81<.S2



Screenshot of over frequency 81>.S2

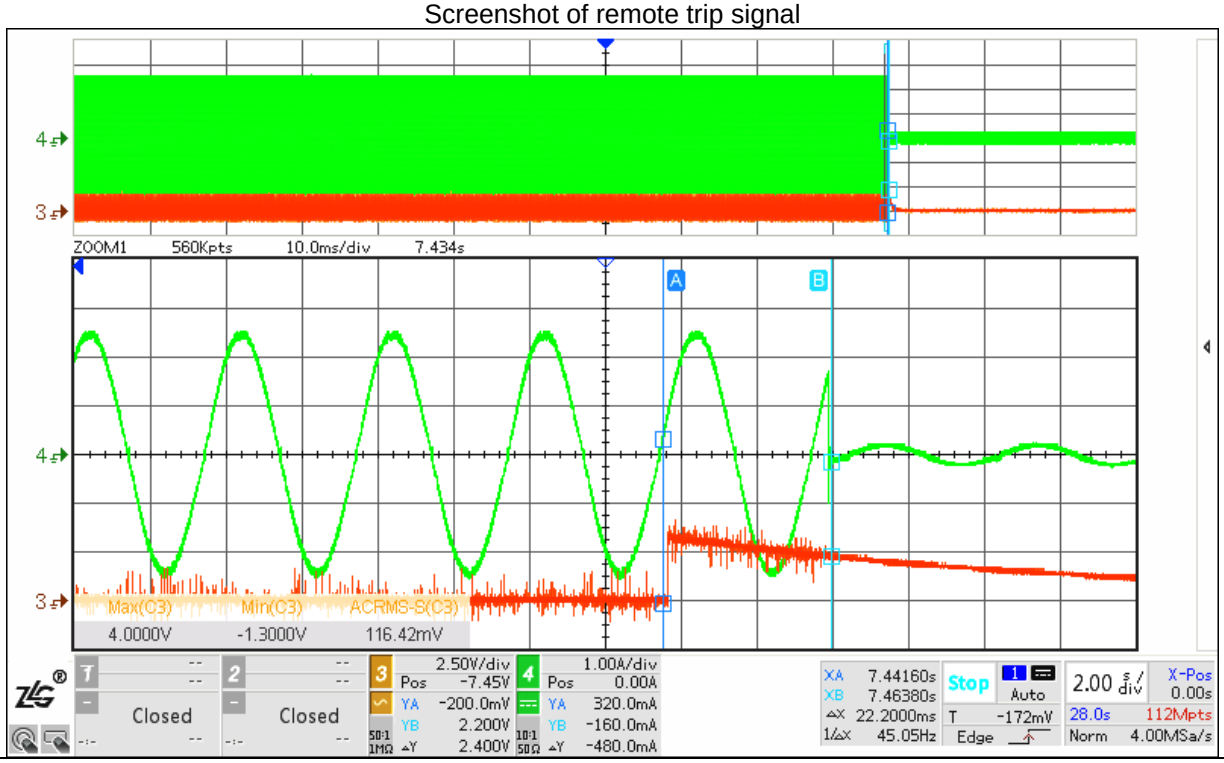


A.4.3.3.2	TABLE: Remote trip signal	P
Model: EFWN511		
Test:	Remote tripping signal for the external disconnection	
Limit [ms]:	50	
Reaction time of the tripping value [ms]:	22.2	

Note:
The protection interface has to have a maximum delay of the remote tripping signal from receiving to transmitting to the DDI of 50ms.

The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

Screenshot of remote trip signal



A.4.3.3.3	TABLE: Communication Signal			P
Model: EFWN511				
Test at standard conditions	Threshold value	Input signal value	SPI trip	Result
External signal ON	Set: 47.50 Hz	47.49 Hz	Yes	Pass
External signal OFF	Set: 49.80 Hz	49.79 Hz	Yes	Pass
External signal ON	Set: 51.50 Hz	51.51 Hz	Yes	Pass
External signal OFF	Set: 50.20 Hz	51.21 Hz	Yes	Pass

Test:
It is checked that the selection of frequency protections is performed with an external signal via USB.

Note:
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

A.4.3.4	TABLE: Verification of insensitivity to the frequency derivative	P

Model: EFWN511

No.	Test	Trip
1)	Positive slope (47.57 Hz to 51.44 Hz)	☐ Yes ☒ No
2)	Negative slope (51.44 Hz to 47.57 Hz)	☐ Yes ☒ No
3)	Positive slope (47.57 Hz to 51.44 Hz)	☐ Yes ☒ No
4)	Negative slope (51.44 Hz to 47.57 Hz)	☐ Yes ☒ No
5)	Positive slope (47.57 Hz to 51.44 Hz)	☐ Yes ☒ No
6)	Negative slope (51.44 Hz to 47.57 Hz)	☐ Yes ☒ No
7)	Positive slope (47.57 Hz to 51.44 Hz)	☐ Yes ☒ No
8)	Negative slope (51.44 Hz to 47.57 Hz)	☐ Yes ☒ No
9)	Positive slope (47.57 Hz to 51.44 Hz)	☐ Yes ☒ No
10)	Negative slope (51.44 Hz to 47.57 Hz)	☐ Yes ☒ No

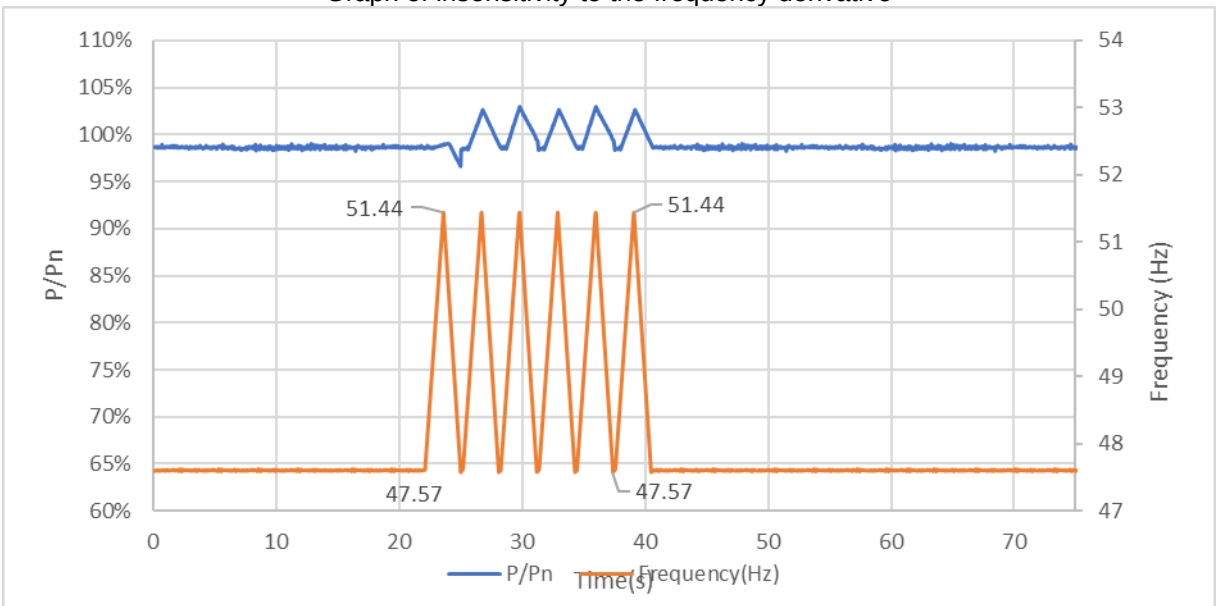
Test:
Frequency protection settings as following:
81>: tripping threshold 51.5 Hz, tripping time 0.15 s
81<: intervention threshold 47.5 Hz, tripping time 0.15 s
Test procedure as following:

1) Working at 100%Un and 47.550Hz;
2) Increase the frequency with ramp steps having an amplitude equal to 12.5 mHz and duration 5 ms, until reaching the frequency value of 51.450 Hz (*) ;
3) Decrease the frequency with ramp steps having an amplitude equal to 12.5 mHz and duration 5 ms, until reaching the frequency value of 47.550Hz (*) ;
4) repeat the tests described in points 2 and 3 above for four times, for a total of 5 positive and negative ramps.

The test is considered to be passed in the absence of minimum and maximum frequency protection trips.
If the SPI is integrated in the inverter, in addition to the absence of minimum and maximum frequency protection trips, it must also be verified that the inverter continues to operate.
(*) These ramp settings produce a frequency derivative of 12.5 mHz / 5 ms = 2.5 Hz / s

Note:
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

Graph of insensitivity to the frequency derivative



A.4.4	TABLE: Self -test	P
No.	Item	Result
1)	for each frequency and voltage protection function, the tripping threshold varies linearly upward or downward with a slope of ≤ 0.05 Hz/s or ≤ 0.05 Vn/s respectively for the frequency and voltage protection;	Pass
2)	This will determine, at a certain point in the test, whether the threshold and the actual value of the controlled parameter (frequency or voltage) coincide, and thus whether the protection was triggered and the interface device subsequently opened.	Pass
3)	For each test, the person conducting the test must be able to view the quantity and trip time values, in addition to the current value of the voltage and frequency detected by the converter.	Pass
4)	The tests must measure the: • accuracy of tripping thresholds; • accuracy of trip times.	Pass
5)	After each test, the inverter must exit the test mode, reset the normally used settings and automatically reconnect to the network when the conditions are appropriate.	Pass
6)	Any user must be able to activate the procedure and it must be clearly described in the converter user manual.	Pass
Note: The tests were performed on EFWN511 and are also applicable for all other models stated in this report.		

A.4.7	TABLE: Climatic compatibility tests		P
Model: EFWN511			
Equipment not powered			
Temperature	Relative humidity	Standards	Test time
70°C ± 2°C	--	EN 60068-2-2	16h
40°C ± 2°C	93% ± 3%	EN 60068-2-78	4 days
-10°C ± 2°C	--	EN 60068-2-1	16h
-10°C -> +70°C ± 2°C	--	EN 60068-2-14	3h @ -10°C, 3h @ +70°C
Equipment powered			
Temperature	Relative humidity	Standards	Test time
50°C ± 2°C	--	EN 60068-2-2	16h
40°C ± 2°C	93% ± 3%	EN 60068-2-78	4 days
-10°C ± 2°C	--	EN 60068-2-1	16h
-10°C -> +50°C ± 2°C	--	EN 60068-2-14	3h @ -10°C, 3h @ +50°C
Note: During and at the end of the test the sample does not have any damage. For the verification of the following during the climatic tests, see TABLE A.4.3.1 & A.4.3.2. The tests were performed on EFWN511 and are also applicable for all other models stated in this report.			

A.4.9	Tests for the overload capacity of measuring circuits	N/A
Model: EFWN511		
Voltage	Test time	Result:
≥130%U_N	1 min	
≥150%U_N	1s	
Note: The unit is not allowed to be damaged while testing. The measurement circuit must show after the test the same values like before the test.		

A.4.11	Automatic mechanism to prevent current imbalance during production	N/A
Model:		
Test 1		
Imbalance of power:	Test time:	Limit:
<10kW		max. 30 min
Test 2		
Imbalance of power:	Test time:	Limit:
>10kW		max. 1 min
Note: Test 1 must only be performed, if the system can produce an inbalance less than 10kW. Test 1 and Test 2 must be performed, if the system can produce an inbalance more than 10kW.		

B.1 (a)	TABLE: Harmonic current									P
Model: EFWN511										
Ambient condition 25 °C										
Order no.	**Current Magnitude (A)**									**Current Limits (A)**
	Output 100%Pn			**Output 66%Pn**			**Output 33%Pn**			
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
1	--	--	--	--	--	--	--	--	--	--
2	0.175	--	--	0.116	--	--	0.059	--	--	1.080
3	0.080	--	--	0.054	--	--	0.030	--	--	2.300
4	0.056	--	--	0.040	--	--	0.023	--	--	0.430
5	0.041	--	--	0.027	--	--	0.014	--	--	1.140
6	0.041	--	--	0.029	--	--	0.015	--	--	0.300
7	0.030	--	--	0.020	--	--	0.010	--	--	0.770
8	0.028	--	--	0.019	--	--	0.009	--	--	0.230
9	0.022	--	--	0.015	--	--	0.008	--	--	0.400
10	0.021	--	--	0.013	--	--	0.007	--	--	0.184
11	0.020	--	--	0.013	--	--	0.006	--	--	0.330
12	0.017	--	--	0.011	--	--	0.006	--	--	0.153
13	0.016	--	--	0.011	--	--	0.007	--	--	0.210
14	0.014	--	--	0.010	--	--	0.005	--	--	0.131
15	0.014	--	--	0.009	--	--	0.005	--	--	0.150
16	0.013	--	--	0.009	--	--	0.005	--	--	0.115
17	0.012	--	--	0.008	--	--	0.005	--	--	0.132
18	0.011	--	--	0.008	--	--	0.004	--	--	0.102
19	0.011	--	--	0.007	--	--	0.004	--	--	0.118
20	0.011	--	--	0.008	--	--	0.005	--	--	0.092
21	0.010	--	--	0.007	--	--	0.004	--	--	0.107
22	0.010	--	--	0.007	--	--	0.004	--	--	0.084
23	0.009	--	--	0.006	--	--	0.003	--	--	0.098
24	0.010	--	--	0.007	--	--	0.004	--	--	0.077
25	0.008	--	--	0.006	--	--	0.003	--	--	0.090
26	0.008	--	--	0.006	--	--	0.003	--	--	0.071
27	0.008	--	--	0.005	--	--	0.003	--	--	0.083
28	0.008	--	--	0.005	--	--	0.003	--	--	0.066
29	0.007	--	--	0.005	--	--	0.003	--	--	0.078
30	0.007	--	--	0.005	--	--	0.003	--	--	0.061
31	0.007	--	--	0.005	--	--	0.003	--	--	0.073
32	0.007	--	--	0.004	--	--	0.002	--	--	0.058
33	0.006	--	--	0.004	--	--	0.002	--	--	0.068
34	0.006	--	--	0.004	--	--	0.002	--	--	0.054
35	0.006	--	--	0.004	--	--	0.002	--	--	0.064
36	0.006	--	--	0.004	--	--	0.002	--	--	0.051
37	0.006	--	--	0.004	--	--	0.002	--	--	0.061
38	0.005	--	--	0.004	--	--	0.002	--	--	0.048
39	0.005	--	--	0.004	--	--	0.002	--	--	0.058
40	0.005	--	--	0.004	--	--	0.002	--	--	0.046

Note:
Each phase output current ≤ 16A, it shall be complied with EN 61000-3-2.
The tests were performed on both EFWN511 and EFWN511B.

B.1 (a)	TABLE: Harmonic current	P

Model: EFWN511

Ambient condition -10 °C

Order no.	Current Magnitude (A)									Current Limits (A)
	Output 100%Pn			Output 66%Pn			Output 33%Pn			
	L1	L2	L3	L1	L2	L3	L1	L2	L3	
1	--	--	--	--	--	--	--	--	--	--
2	0.117	--	--	0.077	--	--	0.039	--	--	1.080
3	0.053	--	--	0.036	--	--	0.020	--	--	2.300
4	0.037	--	--	0.027	--	--	0.016	--	--	0.430
5	0.027	--	--	0.018	--	--	0.009	--	--	1.140
6	0.027	--	--	0.019	--	--	0.010	--	--	0.300
7	0.020	--	--	0.013	--	--	0.007	--	--	0.770
8	0.018	--	--	0.013	--	--	0.006	--	--	0.230
9	0.015	--	--	0.010	--	--	0.005	--	--	0.400
10	0.014	--	--	0.009	--	--	0.004	--	--	0.184
11	0.014	--	--	0.008	--	--	0.004	--	--	0.330
12	0.011	--	--	0.008	--	--	0.004	--	--	0.153
13	0.011	--	--	0.007	--	--	0.005	--	--	0.210
14	0.010	--	--	0.006	--	--	0.003	--	--	0.131
15	0.009	--	--	0.006	--	--	0.004	--	--	0.150
16	0.008	--	--	0.006	--	--	0.003	--	--	0.115
17	0.008	--	--	0.006	--	--	0.003	--	--	0.132
18	0.008	--	--	0.005	--	--	0.003	--	--	0.102
19	0.007	--	--	0.005	--	--	0.003	--	--	0.118
20	0.007	--	--	0.005	--	--	0.003	--	--	0.092
21	0.006	--	--	0.005	--	--	0.002	--	--	0.107
22	0.007	--	--	0.005	--	--	0.003	--	--	0.084
23	0.006	--	--	0.004	--	--	0.002	--	--	0.098
24	0.006	--	--	0.005	--	--	0.003	--	--	0.077
25	0.006	--	--	0.004	--	--	0.002	--	--	0.090
26	0.005	--	--	0.004	--	--	0.002	--	--	0.071
27	0.005	--	--	0.004	--	--	0.002	--	--	0.083
28	0.005	--	--	0.003	--	--	0.002	--	--	0.066
29	0.005	--	--	0.004	--	--	0.002	--	--	0.078
30	0.005	--	--	0.003	--	--	0.002	--	--	0.061
31	0.005	--	--	0.003	--	--	0.002	--	--	0.073
32	0.004	--	--	0.003	--	--	0.002	--	--	0.058
33	0.004	--	--	0.003	--	--	0.002	--	--	0.068
34	0.004	--	--	0.003	--	--	0.002	--	--	0.054
35	0.004	--	--	0.003	--	--	0.002	--	--	0.064
36	0.004	--	--	0.003	--	--	0.001	--	--	0.051
37	0.004	--	--	0.003	--	--	0.001	--	--	0.061
38	0.004	--	--	0.003	--	--	0.001	--	--	0.048
39	0.003	--	--	0.002	--	--	0.001	--	--	0.058
40	0.003	--	--	0.002	--	--	0.001	--	--	0.046

Note:
Each phase output current ≤ 16A, it shall be complied with EN 61000-3-2.
The tests were performed on both EFWN511 and EFWN511B.

B.1 (a)	TABLE: Harmonic current									P
Model: EFWN511										
Ambient condition 50 °C										
Order no.	**Current Magnitude (A)**									**Current Limits (A)**
	Output 100%Pn			**Output 66%Pn**			**Output 33%Pn**			
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
1	--	--	--	--	--	--	--	--	--	--
2	0.175	--	--	0.116	--	--	0.059	--	--	1.080
3	0.080	--	--	0.054	--	--	0.030	--	--	2.300
4	0.056	--	--	0.040	--	--	0.023	--	--	0.430
5	0.041	--	--	0.028	--	--	0.014	--	--	1.140
6	0.041	--	--	0.028	--	--	0.015	--	--	0.300
7	0.030	--	--	0.020	--	--	0.010	--	--	0.770
8	0.028	--	--	0.019	--	--	0.009	--	--	0.230
9	0.023	--	--	0.015	--	--	0.008	--	--	0.400
10	0.021	--	--	0.013	--	--	0.007	--	--	0.184
11	0.021	--	--	0.012	--	--	0.006	--	--	0.330
12	0.017	--	--	0.011	--	--	0.006	--	--	0.153
13	0.016	--	--	0.011	--	--	0.007	--	--	0.210
14	0.014	--	--	0.010	--	--	0.005	--	--	0.131
15	0.014	--	--	0.009	--	--	0.005	--	--	0.150
16	0.013	--	--	0.009	--	--	0.005	--	--	0.115
17	0.012	--	--	0.009	--	--	0.005	--	--	0.132
18	0.011	--	--	0.008	--	--	0.005	--	--	0.102
19	0.011	--	--	0.007	--	--	0.004	--	--	0.118
20	0.011	--	--	0.007	--	--	0.005	--	--	0.092
21	0.010	--	--	0.006	--	--	0.004	--	--	0.107
22	0.010	--	--	0.007	--	--	0.004	--	--	0.084
23	0.009	--	--	0.006	--	--	0.003	--	--	0.098
24	0.009	--	--	0.007	--	--	0.004	--	--	0.077
25	0.009	--	--	0.006	--	--	0.003	--	--	0.090
26	0.008	--	--	0.006	--	--	0.003	--	--	0.071
27	0.008	--	--	0.006	--	--	0.003	--	--	0.083
28	0.007	--	--	0.005	--	--	0.003	--	--	0.066
29	0.008	--	--	0.005	--	--	0.003	--	--	0.078
30	0.007	--	--	0.005	--	--	0.003	--	--	0.061
31	0.007	--	--	0.005	--	--	0.003	--	--	0.073
32	0.006	--	--	0.005	--	--	0.002	--	--	0.058
33	0.006	--	--	0.004	--	--	0.002	--	--	0.068
34	0.006	--	--	0.004	--	--	0.002	--	--	0.054
35	0.006	--	--	0.004	--	--	0.002	--	--	0.064
36	0.006	--	--	0.004	--	--	0.002	--	--	0.051
37	0.006	--	--	0.004	--	--	0.002	--	--	0.061
38	0.005	--	--	0.004	--	--	0.002	--	--	0.048
39	0.005	--	--	0.004	--	--	0.002	--	--	0.058
40	0.005	--	--	0.004	--	--	0.002	--	--	0.046

Note:
Each phase output current ≤ 16A, it shall be complied with EN 61000-3-2.
The tests were performed on both EFWN511 and EFWN511B.

B.1 (a)	TABLE: Harmonic current	P

Model: EFWN511B

Ambient condition 25 °C

Order no.	Current Magnitude (A)									Current Limits (A)
	Output 100%Pn			Output 66%Pn			Output 33%Pn			
	L1	L2	L3	L1	L2	L3	L1	L2	L3	
1	--	--	--	--	--	--	--	--	--	--
2	0.021	--	--	0.018	--	--	0.018	--	--	1.080
3	0.081	--	--	0.064	--	--	0.045	--	--	2.300
4	0.005	--	--	0.005	--	--	0.006	--	--	0.430
5	0.043	--	--	0.029	--	--	0.014	--	--	1.140
6	0.005	--	--	0.005	--	--	0.004	--	--	0.300
7	0.022	--	--	0.008	--	--	0.008	--	--	0.770
8	0.004	--	--	0.003	--	--	0.004	--	--	0.230
9	0.010	--	--	0.006	--	--	0.009	--	--	0.400
10	0.004	--	--	0.004	--	--	0.003	--	--	0.184
11	0.005	--	--	0.004	--	--	0.009	--	--	0.330
12	0.004	--	--	0.004	--	--	0.004	--	--	0.153
13	0.006	--	--	0.009	--	--	0.009	--	--	0.210
14	0.004	--	--	0.004	--	--	0.003	--	--	0.131
15	0.006	--	--	0.008	--	--	0.007	--	--	0.150
16	0.003	--	--	0.004	--	--	0.004	--	--	0.115
17	0.007	--	--	0.008	--	--	0.007	--	--	0.132
18	0.004	--	--	0.004	--	--	0.004	--	--	0.102
19	0.006	--	--	0.006	--	--	0.005	--	--	0.118
20	0.004	--	--	0.003	--	--	0.003	--	--	0.092
21	0.008	--	--	0.007	--	--	0.005	--	--	0.107
22	0.003	--	--	0.003	--	--	0.003	--	--	0.084
23	0.007	--	--	0.006	--	--	0.007	--	--	0.098
24	0.004	--	--	0.003	--	--	0.004	--	--	0.077
25	0.005	--	--	0.005	--	--	0.007	--	--	0.090
26	0.004	--	--	0.004	--	--	0.003	--	--	0.071
27	0.005	--	--	0.006	--	--	0.006	--	--	0.083
28	0.005	--	--	0.004	--	--	0.004	--	--	0.066
29	0.006	--	--	0.005	--	--	0.007	--	--	0.078
30	0.005	--	--	0.006	--	--	0.005	--	--	0.061
31	0.007	--	--	0.006	--	--	0.006	--	--	0.073
32	0.005	--	--	0.005	--	--	0.004	--	--	0.058
33	0.006	--	--	0.007	--	--	0.006	--	--	0.068
34	0.005	--	--	0.005	--	--	0.005	--	--	0.054
35	0.006	--	--	0.007	--	--	0.008	--	--	0.064
36	0.007	--	--	0.005	--	--	0.006	--	--	0.051
37	0.007	--	--	0.006	--	--	0.007	--	--	0.061
38	0.006	--	--	0.006	--	--	0.005	--	--	0.048
39	0.007	--	--	0.007	--	--	0.008	--	--	0.058
40	0.006	--	--	0.005	--	--	0.005	--	--	0.046

Note:
Each phase output current ≤ 16A, it shall be complied with EN 61000-3-2.
The tests were performed on both EFWN511 and EFWN511B.

B.1 (a)	TABLE: Harmonic current									P
Model: EFWN511B										
Ambient condition -10 °C										
Order no.	**Current Magnitude (A)**									**Current Limits (A)**
	Output 100%Pn			**Output 66%Pn**			**Output 33%Pn**			
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
1	--	--	--	--	--	--	--	--	--	--
2	0.019	--	--	0.019	--	--	0.018	--	--	1.080
3	0.080	--	--	0.063	--	--	0.043	--	--	2.300
4	0.005	--	--	0.005	--	--	0.006	--	--	0.430
5	0.042	--	--	0.029	--	--	0.013	--	--	1.140
6	0.004	--	--	0.004	--	--	0.005	--	--	0.300
7	0.022	--	--	0.007	--	--	0.008	--	--	0.770
8	0.003	--	--	0.003	--	--	0.004	--	--	0.230
9	0.009	--	--	0.006	--	--	0.008	--	--	0.400
10	0.003	--	--	0.003	--	--	0.003	--	--	0.184
11	0.005	--	--	0.004	--	--	0.009	--	--	0.330
12	0.005	--	--	0.004	--	--	0.004	--	--	0.153
13	0.005	--	--	0.007	--	--	0.008	--	--	0.210
14	0.004	--	--	0.003	--	--	0.003	--	--	0.131
15	0.006	--	--	0.008	--	--	0.007	--	--	0.150
16	0.003	--	--	0.003	--	--	0.003	--	--	0.115
17	0.008	--	--	0.007	--	--	0.007	--	--	0.132
18	0.003	--	--	0.003	--	--	0.004	--	--	0.102
19	0.005	--	--	0.005	--	--	0.005	--	--	0.118
20	0.003	--	--	0.003	--	--	0.003	--	--	0.092
21	0.007	--	--	0.006	--	--	0.005	--	--	0.107
22	0.003	--	--	0.002	--	--	0.003	--	--	0.084
23	0.006	--	--	0.006	--	--	0.007	--	--	0.098
24	0.004	--	--	0.003	--	--	0.003	--	--	0.077
25	0.006	--	--	0.006	--	--	0.006	--	--	0.090
26	0.003	--	--	0.004	--	--	0.003	--	--	0.071
27	0.005	--	--	0.005	--	--	0.006	--	--	0.083
28	0.004	--	--	0.004	--	--	0.004	--	--	0.066
29	0.005	--	--	0.005	--	--	0.006	--	--	0.078
30	0.005	--	--	0.004	--	--	0.004	--	--	0.061
31	0.006	--	--	0.004	--	--	0.006	--	--	0.073
32	0.005	--	--	0.005	--	--	0.005	--	--	0.058
33	0.005	--	--	0.006	--	--	0.006	--	--	0.068
34	0.004	--	--	0.005	--	--	0.004	--	--	0.054
35	0.008	--	--	0.007	--	--	0.007	--	--	0.064
36	0.006	--	--	0.005	--	--	0.005	--	--	0.051
37	0.007	--	--	0.007	--	--	0.008	--	--	0.061
38	0.004	--	--	0.005	--	--	0.005	--	--	0.048
39	0.006	--	--	0.007	--	--	0.006	--	--	0.058
40	0.004	--	--	0.005	--	--	0.005	--	--	0.046

Note:
Each phase output current ≤ 16A, it shall be complied with EN 61000-3-2.
The tests were performed on both EFWN511 and EFWN511B.

B.1 (a)	TABLE: Harmonic current	P

Model: EFWN511B

Ambient condition 50 °C

Order no.	Current Magnitude (A)									Current Limits (A)
	Output 100%Pn			Output 66%Pn			Output 33%Pn			
	L1	L2	L3	L1	L2	L3	L1	L2	L3	
1	--	--	--	--	--	--	--	--	--	--
2	0.019	--	--	0.019	--	--	0.018	--	--	1.080
3	0.081	--	--	0.063	--	--	0.043	--	--	2.300
4	0.005	--	--	0.005	--	--	0.006	--	--	0.430
5	0.043	--	--	0.029	--	--	0.014	--	--	1.140
6	0.005	--	--	0.005	--	--	0.004	--	--	0.300
7	0.021	--	--	0.007	--	--	0.008	--	--	0.770
8	0.003	--	--	0.003	--	--	0.003	--	--	0.230
9	0.008	--	--	0.007	--	--	0.008	--	--	0.400
10	0.003	--	--	0.003	--	--	0.003	--	--	0.184
11	0.005	--	--	0.004	--	--	0.009	--	--	0.330
12	0.003	--	--	0.003	--	--	0.003	--	--	0.153
13	0.006	--	--	0.007	--	--	0.008	--	--	0.210
14	0.003	--	--	0.003	--	--	0.004	--	--	0.131
15	0.007	--	--	0.008	--	--	0.007	--	--	0.150
16	0.003	--	--	0.003	--	--	0.003	--	--	0.115
17	0.007	--	--	0.007	--	--	0.006	--	--	0.132
18	0.003	--	--	0.003	--	--	0.003	--	--	0.102
19	0.005	--	--	0.006	--	--	0.005	--	--	0.118
20	0.003	--	--	0.003	--	--	0.003	--	--	0.092
21	0.008	--	--	0.006	--	--	0.006	--	--	0.107
22	0.002	--	--	0.003	--	--	0.003	--	--	0.084
23	0.006	--	--	0.005	--	--	0.006	--	--	0.098
24	0.004	--	--	0.003	--	--	0.003	--	--	0.077
25	0.004	--	--	0.005	--	--	0.006	--	--	0.090
26	0.004	--	--	0.004	--	--	0.003	--	--	0.071
27	0.004	--	--	0.005	--	--	0.006	--	--	0.083
28	0.004	--	--	0.003	--	--	0.003	--	--	0.066
29	0.005	--	--	0.006	--	--	0.006	--	--	0.078
30	0.005	--	--	0.004	--	--	0.004	--	--	0.061
31	0.007	--	--	0.005	--	--	0.006	--	--	0.073
32	0.005	--	--	0.006	--	--	0.004	--	--	0.058
33	0.005	--	--	0.006	--	--	0.006	--	--	0.068
34	0.004	--	--	0.006	--	--	0.005	--	--	0.054
35	0.006	--	--	0.006	--	--	0.007	--	--	0.064
36	0.005	--	--	0.005	--	--	0.005	--	--	0.051
37	0.006	--	--	0.007	--	--	0.007	--	--	0.061
38	0.005	--	--	0.005	--	--	0.005	--	--	0.048
39	0.006	--	--	0.006	--	--	0.007	--	--	0.058
40	0.006	--	--	0.005	--	--	0.004	--	--	0.046

Note:
Each phase output current ≤ 16A, it shall be complied with EN 61000-3-2.
The tests were performed on both EFWN511 and EFWN511B.

B.1 (c)	TABLE: Voltage fluctuation and flicker									P
Model: EFWN511										
Ambient condition 25 °C										
Output	**100%Pn**			**66%Pn**			**33%Pn**			**Limit**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
P_{st}	0.172	--	--	0.173	--	--	0.171	--	--	≤ 1.0
P_{lt}	0.167	--	--	0.169	--	--	0.166	--	--	≤ 0.65
d(t) (ms)	0	--	--	0	--	--	0	--	--	500
d_c (%)	0.324	--	--	0.325	--	--	0.316	--	--	≤ 3.3
d_{max} (%)	0.573	--	--	0.583	--	--	0.604	--	--	≤ 4.0
Ambient condition -10 °C										
Output	**100%Pn**			**66%Pn**			**33%Pn**			**Limit**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
P_{st}	0.174	--	--	0.174	--	--	0.142	--	--	≤ 1.0
P_{lt}	0.170	--	--	0.167	--	--	0.138	--	--	≤ 0.65
d(t) (ms)	0	--	--	0	--	--	0	--	--	500
d_c (%)	0.314	--	--	0.313	--	--	0.210	--	--	≤ 3.3
d_{max} (%)	0.551	--	--	0.548	--	--	0.449	--	--	≤ 4.0
Ambient condition 50 °C										
Output	**100%Pn**			**66%Pn**			**33%Pn**			**Limit**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
P_{st}	0.170	--	--	0.168	--	--	0.167	--	--	≤ 1.0
P_{lt}	0.165	--	--	0.164	--	--	0.162	--	--	≤ 0.65
d(t) (ms)	0	--	--	0	--	--	0	--	--	500
d_c (%)	0.315	--	--	0.318	--	--	0.306	--	--	≤ 3.3
d_{max} (%)	0.590	--	--	0.571	--	--	0.500	--	--	≤ 4.0
Model: EFWN511B										
Ambient condition 25 °C										
Output	**100%Pn**			**66%Pn**			**33%Pn**			**Limit**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
P_{st}	0.0287	--	--	0.0282	--	--	0.0234	--	--	≤ 1.0
P_{lt}	0.0287	--	--	0.0282	--	--	0.0234	--	--	≤ 0.65
d(t) (ms)	0	--	--	0	--	--	0	--	--	500
d_c (%)	0.0365	--	--	0.0467	--	--	0.0598	--	--	≤ 3.3
d_{max} (%)	0.5659	--	--	0.5489	--	--	0.5304	--	--	≤ 4.0
Ambient condition -10 °C										
Output	**100%Pn**			**66%Pn**			**33%Pn**			**Limit**
	L1	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	
P_{st}	0.0287	--	--	0.0282	--	--	0.0234	--	--	≤ 1.0
P_{lt}	0.0287	--	--	0.0282	--	--	0.0234	--	--	≤ 0.65
d(t) (ms)	0	--	--	0	--	--	0	--	--	500
d_c (%)	0.0567	--	--	0.0494	--	--	0.0449	--	--	≤ 3.3
d_{max} (%)	0.5643	--	--	0.5343	--	--	0.5342	--	--	≤ 4.0

Ambient condition 50 °C										
Output	100%Pn			66%Pn			33%Pn			Limit
	L1	L2	L3	L1	L2	L3	L1	L2	L3	
P_{st}	0.0287	--	--	0.0284	--	--	0.0244	--	--	≤ 1.0
P_{lt}	0.0287	--	--	0.0284	--	--	0.0244	--	--	≤ 0.65
d(t) (ms)	0	--	--	0	--	--	0	--	--	500
d_c (%)	0.0617	--	--	0.0487	--	--	0.0252	--	--	≤ 3.3
d_{max} (%)	0.5658	--	--	0.5548	--	--	0.5379	--	--	≤ 4.0
Note: Each phase output current ≤ 16A, it shall be complied with EN 61000-3-3. The tests were performed on both EFWN511 and EFWN511B.										

Screenshot of 100%Pn at 25 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12
No. 1	0.319	Pass	0.573	Pass	0.0	Pass	0.168	Pass	
2	0.309	Pass	0.545	Pass	0.0	Pass	0.164	Pass	
3	0.324	Pass	0.547	Pass	0.0	Pass	0.170	Pass	
4	0.309	Pass	0.458	Pass	0.0	Pass	0.159	Pass	
5	0.311	Pass	0.452	Pass	0.0	Pass	0.164	Pass	
6	0.310	Pass	0.449	Pass	0.0	Pass	0.164	Pass	
7	0.302	Pass	0.479	Pass	0.0	Pass	0.165	Pass	
8	0.208	Pass	0.451	Pass	0.0	Pass	0.169	Pass	
9	0.211	Pass	0.443	Pass	0.0	Pass	0.169	Pass	
10	0.208	Pass	0.426	Pass	0.0	Pass	0.172	Pass	
11	0.209	Pass	0.425	Pass	0.0	Pass	0.166	Pass	
12	0.294	Pass	0.561	Pass	0.0	Pass	0.168	Pass	
Result		Pass		Pass		Pass		Pass	0.167 Pass

Screenshot of 66%Pn at 25 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12
No. 1	0.310	Pass	0.497	Pass	0.0	Pass	0.171	Pass	
2	0.312	Pass	0.485	Pass	0.0	Pass	0.168	Pass	
3	0.303	Pass	0.498	Pass	0.0	Pass	0.171	Pass	
4	0.318	Pass	0.509	Pass	0.0	Pass	0.170	Pass	
5	0.310	Pass	0.526	Pass	0.0	Pass	0.165	Pass	
6	0.295	Pass	0.530	Pass	0.0	Pass	0.172	Pass	
7	0.207	Pass	0.485	Pass	0.0	Pass	0.173	Pass	
8	0.314	Pass	0.581	Pass	0.0	Pass	0.164	Pass	
9	0.311	Pass	0.566	Pass	0.0	Pass	0.167	Pass	
10	0.309	Pass	0.583	Pass	0.0	Pass	0.167	Pass	
11	0.311	Pass	0.580	Pass	0.0	Pass	0.171	Pass	
12	0.325	Pass	0.580	Pass	0.0	Pass	0.168	Pass	
Result		Pass		Pass		Pass		Pass	0.169 Pass

Screenshot of 33%Pn at 25 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12
No. 1	0.310	Pass	0.592	Pass	0.0	Pass	0.164	Pass	
2	0.316	Pass	0.604	Pass	0.0	Pass	0.168	Pass	
3	0.316	Pass	0.564	Pass	0.0	Pass	0.171	Pass	
4	0.310	Pass	0.564	Pass	0.0	Pass	0.167	Pass	
5	0.210	Pass	0.449	Pass	0.0	Pass	0.164	Pass	
6	0.217	Pass	0.454	Pass	0.0	Pass	0.167	Pass	
7	0.209	Pass	0.442	Pass	0.0	Pass	0.161	Pass	
8	0.311	Pass	0.431	Pass	0.0	Pass	0.165	Pass	
9	0.298	Pass	0.463	Pass	0.0	Pass	0.165	Pass	
10	0.300	Pass	0.454	Pass	0.0	Pass	0.162	Pass	
11	0.213	Pass	0.440	Pass	0.0	Pass	0.169	Pass	
12	0.208	Pass	0.452	Pass	0.0	Pass	0.164	Pass	
Result		Pass		Pass		Pass		Pass	0.166 Pass

Screenshot of 100%Pn at -10 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.213	Pass	0.441	Pass	0.0	Pass	0.172	Pass		
2	0.289	Pass	0.503	Pass	0.0	Pass	0.168	Pass		
3	0.293	Pass	0.535	Pass	0.0	Pass	0.170	Pass		
4	0.289	Pass	0.497	Pass	0.0	Pass	0.167	Pass		
5	0.297	Pass	0.537	Pass	0.0	Pass	0.168	Pass		
6	0.297	Pass	0.551	Pass	0.0	Pass	0.167	Pass		
7	0.298	Pass	0.530	Pass	0.0	Pass	0.171	Pass		
8	0.309	Pass	0.499	Pass	0.0	Pass	0.169	Pass		
9	0.305	Pass	0.525	Pass	0.0	Pass	0.172	Pass		
10	0.307	Pass	0.455	Pass	0.0	Pass	0.170	Pass		
11	0.314	Pass	0.470	Pass	0.0	Pass	0.174	Pass		
12	0.304	Pass	0.477	Pass	0.0	Pass	0.168	Pass		
Result		Pass		Pass		Pass		Pass	0.170	Pass

Screenshot of 66%Pn at -10 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.206	Pass	0.431	Pass	0.0	Pass	0.170	Pass		
2	0.205	Pass	0.445	Pass	0.0	Pass	0.160	Pass		
3	0.210	Pass	0.429	Pass	0.0	Pass	0.166	Pass		
4	0.208	Pass	0.434	Pass	0.0	Pass	0.165	Pass		
5	0.306	Pass	0.548	Pass	0.0	Pass	0.164	Pass		
6	0.298	Pass	0.500	Pass	0.0	Pass	0.160	Pass		
7	0.290	Pass	0.508	Pass	0.0	Pass	0.171	Pass		
8	0.295	Pass	0.512	Pass	0.0	Pass	0.168	Pass		
9	0.307	Pass	0.509	Pass	0.0	Pass	0.169	Pass		
10	0.302	Pass	0.506	Pass	0.0	Pass	0.174	Pass		
11	0.304	Pass	0.527	Pass	0.0	Pass	0.169	Pass		
12	0.313	Pass	0.460	Pass	0.0	Pass	0.165	Pass		
Result		Pass		Pass		Pass		Pass	0.167	Pass

Screenshot of 33%Pn at -10 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.209	Pass	0.413	Pass	0.0	Pass	0.141	Pass		
2	0.200	Pass	0.401	Pass	0.0	Pass	0.142	Pass		
3	0.207	Pass	0.358	Pass	0.0	Pass	0.139	Pass		
4	0.210	Pass	0.367	Pass	0.0	Pass	0.138	Pass		
5	0.207	Pass	0.360	Pass	0.0	Pass	0.139	Pass		
6	0.202	Pass	0.369	Pass	0.0	Pass	0.137	Pass		
7	0.185	Pass	0.427	Pass	0.0	Pass	0.140	Pass		
8	0.110	Pass	0.424	Pass	0.0	Pass	0.135	Pass		
9	0.200	Pass	0.449	Pass	0.0	Pass	0.133	Pass		
10	0.208	Pass	0.425	Pass	0.0	Pass	0.137	Pass		
11	0.205	Pass	0.427	Pass	0.0	Pass	0.133	Pass		
12	0.204	Pass	0.426	Pass	0.0	Pass	0.139	Pass		
Result		Pass		Pass		Pass		Pass	0.138	Pass

Screenshot of 100%Pn at 50 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.309	Pass	0.484	Pass	0.0	Pass	0.167	Pass		
2	0.303	Pass	0.505	Pass	0.0	Pass	0.164	Pass		
3	0.300	Pass	0.500	Pass	0.0	Pass	0.170	Pass		
4	0.301	Pass	0.523	Pass	0.0	Pass	0.170	Pass		
5	0.203	Pass	0.477	Pass	0.0	Pass	0.165	Pass		
6	0.315	Pass	0.506	Pass	0.0	Pass	0.167	Pass		
7	0.216	Pass	0.495	Pass	0.0	Pass	0.163	Pass		
8	0.213	Pass	0.488	Pass	0.0	Pass	0.161	Pass		
9	0.285	Pass	0.535	Pass	0.0	Pass	0.159	Pass		
10	0.304	Pass	0.565	Pass	0.0	Pass	0.165	Pass		
11	0.309	Pass	0.590	Pass	0.0	Pass	0.164	Pass		
12	0.312	Pass	0.578	Pass	0.0	Pass	0.163	Pass		
Result		Pass		Pass		Pass		Pass	0.165	Pass

Screenshot of 66%Pn at 50 °C

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.306	Pass	0.483	Pass	0.0	Pass	0.167	Pass		
2	0.305	Pass	0.521	Pass	0.0	Pass	0.162	Pass		
3	0.292	Pass	0.496	Pass	0.0	Pass	0.168	Pass		
4	0.309	Pass	0.514	Pass	0.0	Pass	0.163	Pass		
5	0.285	Pass	0.484	Pass	0.0	Pass	0.165	Pass		
6	0.305	Pass	0.547	Pass	0.0	Pass	0.166	Pass		
7	0.215	Pass	0.481	Pass	0.0	Pass	0.165	Pass		
8	0.209	Pass	0.484	Pass	0.0	Pass	0.164	Pass		
9	0.318	Pass	0.569	Pass	0.0	Pass	0.159	Pass		
10	0.307	Pass	0.566	Pass	0.0	Pass	0.166	Pass		
11	0.312	Pass	0.571	Pass	0.0	Pass	0.163	Pass		
12	0.314	Pass	0.556	Pass	0.0	Pass	0.160	Pass		
Result		Pass		Pass		Pass		Pass	0.164	Pass

Screenshot of 33%Pn at 50 °C

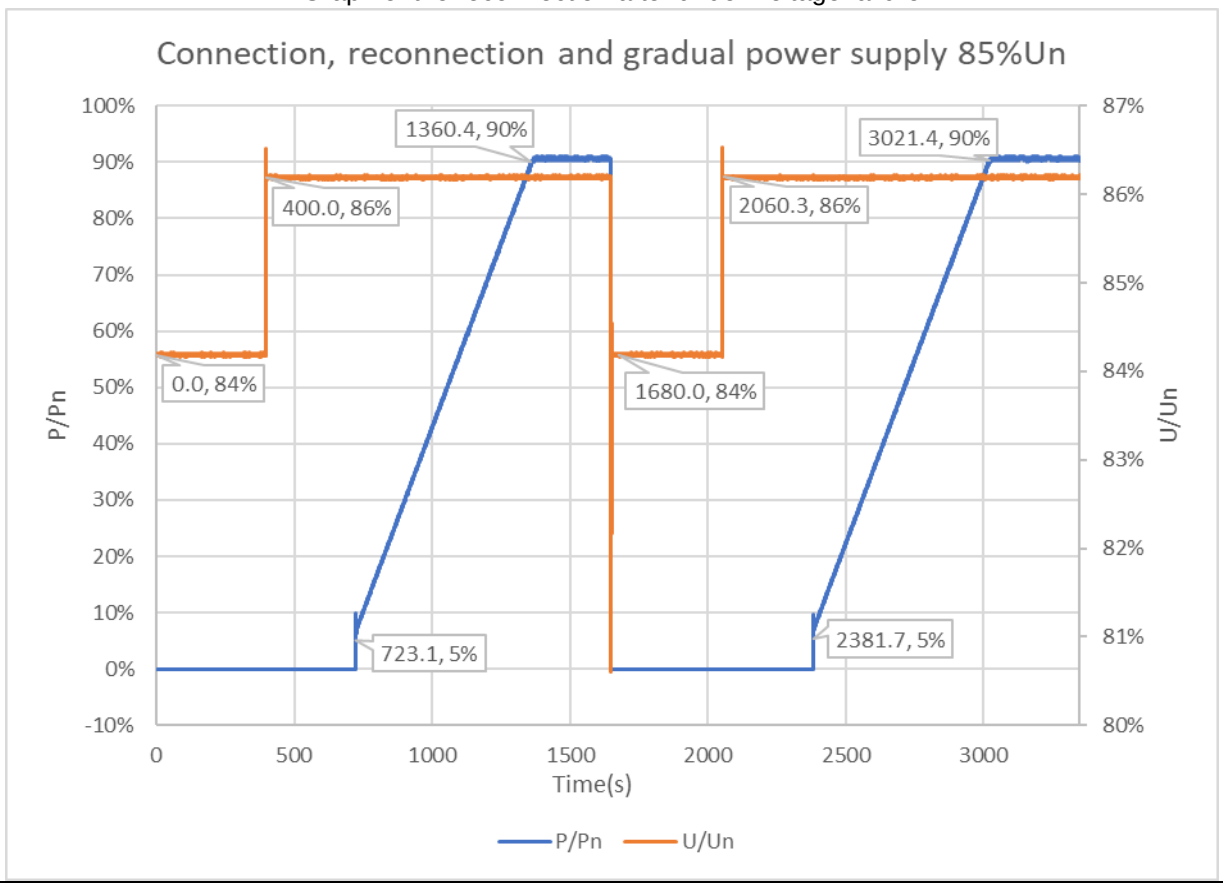
	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.205	Pass	0.454	Pass	0.0	Pass	0.167	Pass		
2	0.214	Pass	0.461	Pass	0.0	Pass	0.162	Pass		
3	0.210	Pass	0.428	Pass	0.0	Pass	0.163	Pass		
4	0.216	Pass	0.447	Pass	0.0	Pass	0.158	Pass		
5	0.204	Pass	0.442	Pass	0.0	Pass	0.164	Pass		
6	0.208	Pass	0.398	Pass	0.0	Pass	0.155	Pass		
7	0.297	Pass	0.495	Pass	0.0	Pass	0.162	Pass		
8	0.218	Pass	0.433	Pass	0.0	Pass	0.163	Pass		
9	0.301	Pass	0.500	Pass	0.0	Pass	0.160	Pass		
10	0.299	Pass	0.497	Pass	0.0	Pass	0.165	Pass		
11	0.298	Pass	0.460	Pass	0.0	Pass	0.161	Pass		
12	0.306	Pass	0.489	Pass	0.0	Pass	0.162	Pass		
Result		Pass		Pass		Pass		Pass	0.162	Pass

B.1.1.1 & B.1.1.2	TABLE: Conditions of connection, reconnection and gradual power supply of active power	P

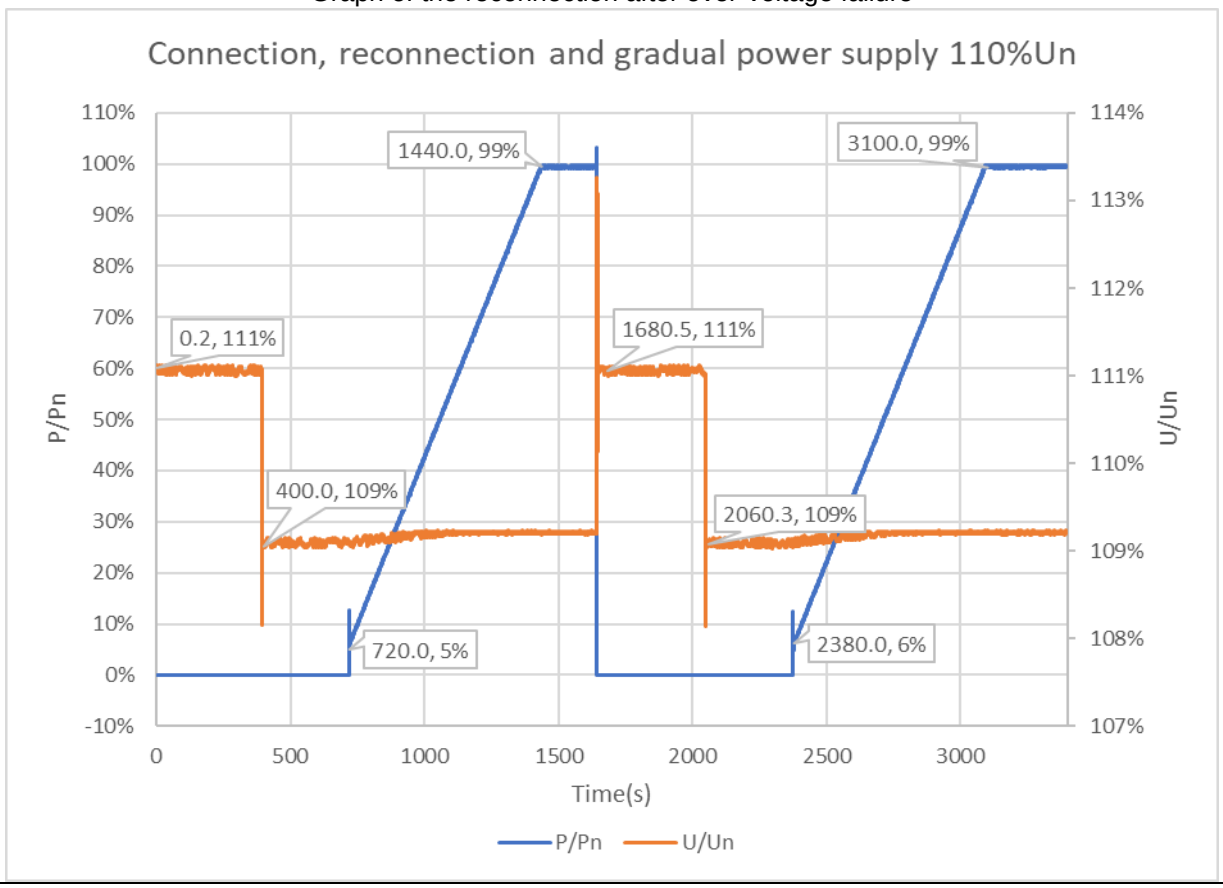
Model: EFWN511		
Voltage conditions		
a) Out of voltage range	84% U_n for 30s	111% U_n for 30s
Connection:	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	85% U_n < U <110% U_n	
Voltage limit	86% U_n	109% U_n
Reconnection time [s]	326.0	326.1
Limit:	> 30s	
Gradient:	8.03	7.89
Limit:	20%Pn/min	
c) In voltage range after voltage failure	85% U_n < U <110% U_n	
Voltage limit	86% U_n	109% U_n
Reconnection time [s]	329.6	328.5
Limit:	> 300s	
Gradient:	8.13	7.78
Limit:	20%Pn/min	
Frequency conditions		
d) Out of frequency range	49.88 ± 0.01	50.12 ± 0.01
Connection:	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	49.90 Hz < f < 50.10 Hz	
Frequency limit [Hz]	49.91	50.09
Reconnection time [s]	333.0	333.6
Limit:	> 30s	
Gradient:	7.87	8.00
Limit:	20%Pn/min	
f) In frequency range after frequency failure	49.90 Hz < f < 50.10 Hz	
Frequency limit [Hz]	49.91	50.09
Reconnection time [s]	613.7	328.7
Limit:	> 300s	
Gradient:	8.01	8.00
Limit:	20%Pn/min	

Note:
Test condition b) and c): voltage within the limits of 85% to 110%
Test condition e) and f): frequency within the limits of 49.90Hz to 50.10Hz
For gradient, it should be recorded for at least 300s until the inverter has the full output power.
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

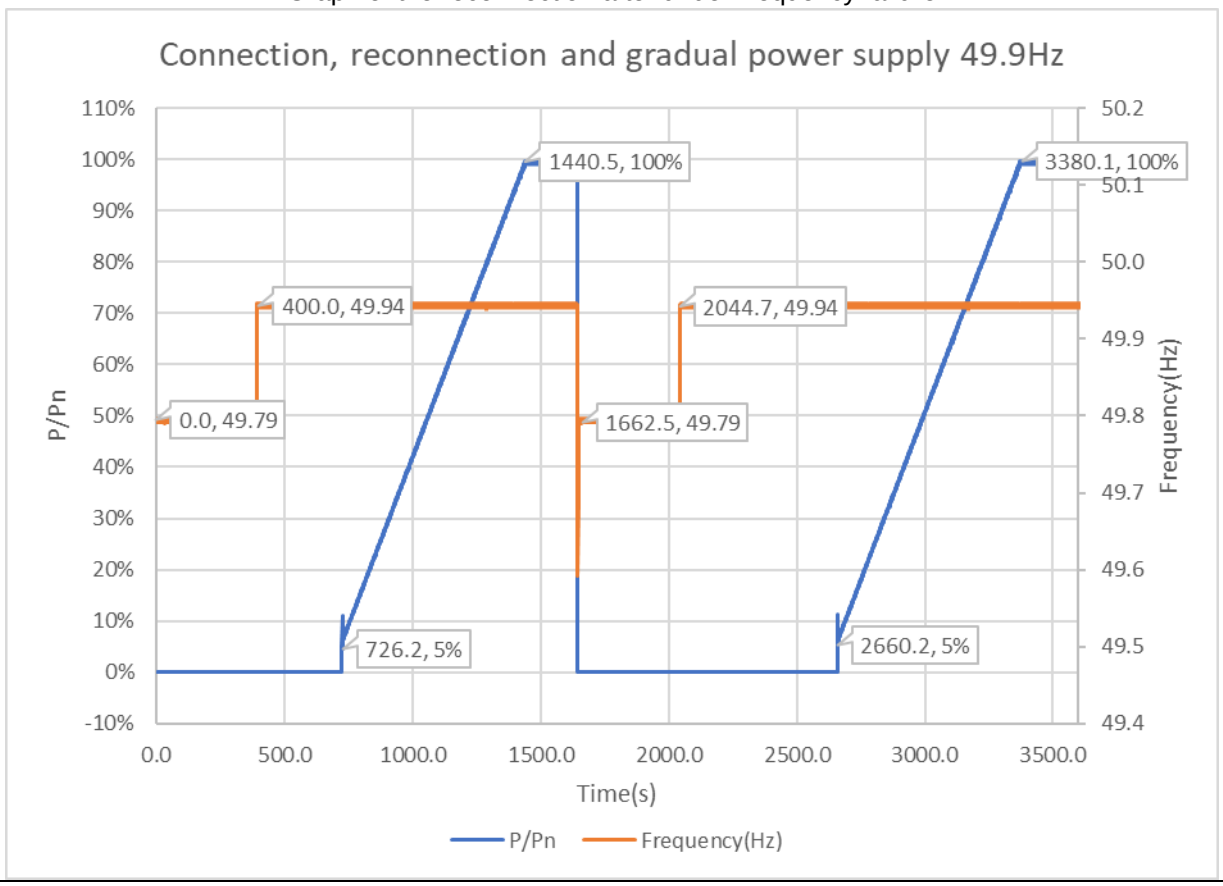
Graph of the reconnection after under-voltage failure



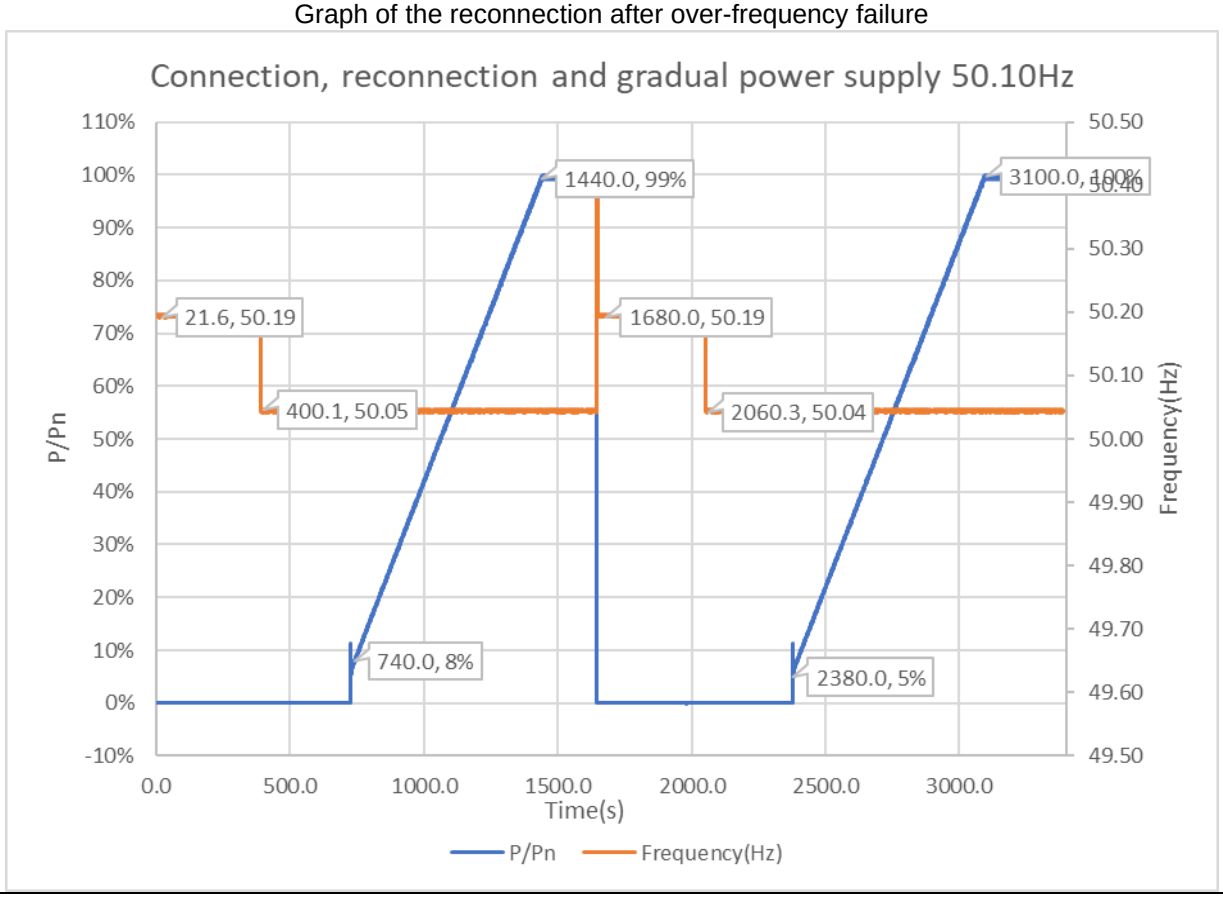
Graph of the reconnection after over-voltage failure



Graph of the reconnection after under-frequency failure



Graph of the reconnection after over-frequency failure

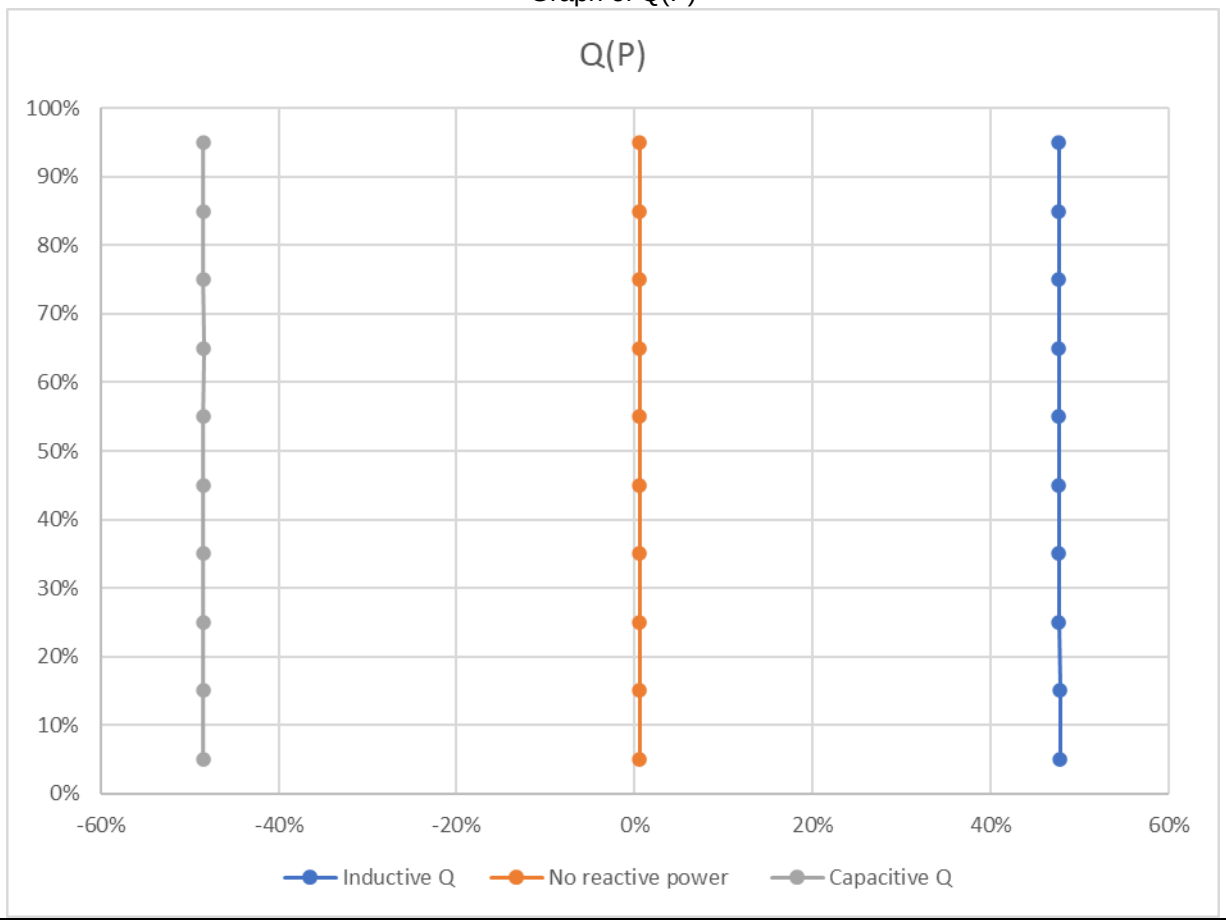


B.1.2.2.2	TABLE: Inverter in systems with total capacity (greater than 11.08 kW)	P
Model	**EFWN511**	

Inductive supply reactive power Q = 48.43% Pn						
Test power P/Pn	Target Q/Pn	Measured P/Pn	Measured Q/Pn	Deviation Δ Q/Pn	Power factor cos φ	Limit Δ Q/Pn
0% - 10%	48.43%	4.9%	47.8%	-0.6%	0.103	± 2.5%
10% - 20%	48.43%	14.9%	47.8%	-0.6%	0.298	
20% - 30%	48.43%	24.8%	47.7%	-0.7%	0.462	
30% - 40%	48.43%	34.8%	47.7%	-0.7%	0.589	
40% - 50%	48.43%	44.8%	47.7%	-0.7%	0.684	
50% - 60%	48.43%	54.7%	47.7%	-0.7%	0.754	
60% - 70%	48.43%	64.7%	47.7%	-0.7%	0.805	
70% - 80%	48.43%	74.6%	47.7%	-0.7%	0.843	
80% - 90%	48.43%	84.6%	47.7%	-0.7%	0.871	
90% - 100%	48.43%	86.6%*	47.7%	-0.7%	0.876	
Capacitive supply reactive power Q = - 48.43% Pn						
Test power P/Pn	Target Q/Pn	Measured P/Pn	Measured Q/Pn	Deviation Δ Q/Pn	Power factor cos φ	Limit Δ Q/Pn
0% - 10%	48.43%	5.0%	-48.5%	-0.1%	0.103	± 2.5%
10% - 20%	48.43%	15.0%	-48.5%	-0.1%	0.295	
20% - 30%	- 48.43%	25.0%	-48.5%	-0.1%	0.457	
30% - 40%	- 48.43%	34.9%	-48.5%	-0.1%	0.584	
40% - 50%	- 48.43%	44.9%	-48.5%	-0.1%	0.679	
50% - 60%	- 48.43%	54.8%	-48.5%	-0.1%	0.749	
60% - 70%	- 48.43%	64.8%	-48.4%	0.0%	0.800	
70% - 80%	- 48.43%	74.7%	-48.5%	-0.1%	0.838	
80% - 90%	- 48.43%	84.7%	-48.5%	-0.1%	0.867	
90% - 100%	- 48.43%	87.9%*	-48.5%	-0.1%	0.875	
No reactive power supply cos φ = 1						
Test power P/Pn	Target Q/Pn	Measured P/Pn	Measured Q/Pn	Deviation Δ Q/Pn	Power factor cos φ	Limit Δ Q/Pn
0% - 10%	0	5.0%	+0.6%	+0.6%	0.943	± 2.5%
10% - 20%	0	15.0%	+0.6%	+0.6%	0.993	
20% - 30%	0	25.0%	+0.6%	+0.6%	0.997	
30% - 40%	0	35.0%	+0.6%	+0.6%	0.998	
40% - 50%	0	45.0%	+0.6%	+0.6%	0.998	
50% - 60%	0	55.0%	+0.6%	+0.6%	0.999	
60% - 70%	0	65.0%	+0.6%	+0.6%	0.999	
70% - 80%	0	75.0%	+0.6%	+0.6%	0.999	
80% - 90%	0	85.0%	+0.6%	+0.6%	0.999	
90% - 100%	0	94.9%	+0.6%	+0.6%	0.999	

Note:
When operating above the apparent power threshold S_{min} equal to 10 % of the maximum apparent power S_{max} or the minimum regulating level of the generating plant, whichever is the higher value, the reactive power capability shall be provided with an accuracy of ± 2 % S_{max}. Up to this apparent power threshold S_{min}, deviations above 2 % are permissible.
* The inverter can't output the desired active power due to current limitation, so don't consider the deviation value.
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

Graph of Q(P)



B.1.2.3.1	TABLE: Procedures for performing tests and recording results (hypothesis of adjustment by Q) (greater than 11.08 kW)	N/A

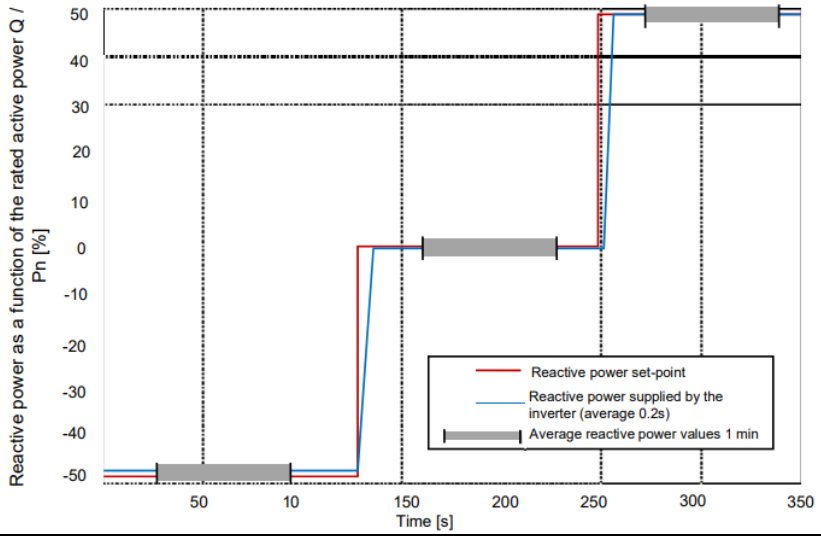
Model: EFWN511

	Reactive power set point Q/Pn [%]	Measured reactive power Q/Pn [%]	Deviation compared to set- point ΔQ/Pn [%]
- Q_{min}	-48.43		
0	0		
+ Q_{max}	+48.43		
Limit	$\Delta Q \leq \pm 2{,}5\%\ P_n$		

Test:
DC source should be set to 50% output power
Starting with Qmin≤ -0,4843 P_n to Q=0 and then to Qmax≥ 0,4843 P_n, in doing so each point must be kept for at least 3 minute.

The total tolerance is $\Delta Q \leq \pm 2{,}5\%$ of P_n or $\Delta\cos\varphi \leq \pm 0.01$

The tests covered by this paragraph are only mandatory for inverters used in systems with power greater than 11.08 kW, but at the request of the manufacturer they can be carried out and documented even for smaller converters.



B.1.2.4	TABLE: Response time to an assigned step level change (greater 11.08 kW)	N/A

Model: EFWN511

Test result : 50% P_n

	Reactive power set point Q/Pn [%]	Measured reactive power Q/Pn [%]	Deviation compared to setpoint $\Delta Q/P_n$ [%]
0	0		
$-Q_{min}$	-48.43		
$+Q_{max}$	+48.43		
0	0		
Response time [s]	Q=0 to $-Q_{min}$	$-Q_{min}$ to $+Q_{max}$	$+Q_{max}$ to Q=0
	1.2	1.8	1.0

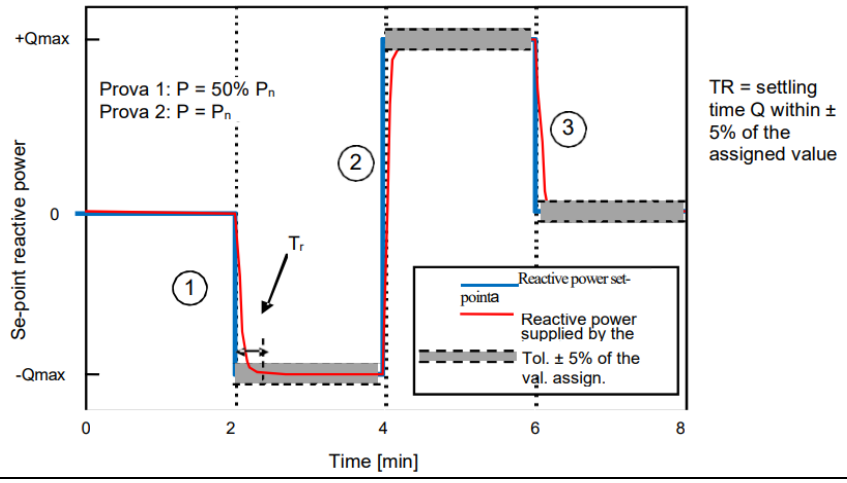
Test result : 100% P_n

	Reactive power set point Q/Pn [%]	Measured reactive power Q/Pn [%]	Deviation compared to setpoint $\Delta Q/P_n$ [%]
0	0		
$-Q_{min}$	-48.43		
$+Q_{max}$	+48.43		
0	0		
Response time [s]	Q=0 to $-Q_{min}$	$-Q_{min}$ to $+Q_{max}$	$+Q_{max}$ to Q=0
	1.2	1.8	1.0
Limit	$\Delta Q \leq \pm 5\%$ of P_n Max response time 10s		

Test:
DC source should be set to 50%(test1) and 100%(test2) output power
Starting with Q=0 then Qmin≤ -0,4843 P_n to to Qmax≥ 0,4843 P_n, and then back to Q=0 in doing so each point must be kept for at least 2 minute.

The total tolerance is $\Delta Q \leq \pm 5{,}0\%$ of P_n or $\Delta\cos\varphi \leq \pm 0.01$
The maximum response time is 10s.

As for the requirements of the previous paragraph, also in this case the tests are required to inverters used in plants with a total power greater than 11.08 kW, which must also be able to implement a centralized control strategy via remote control signal, issued by the Distributor. However, the manufacturer has the right to voluntarily carry out tests even for smaller inverters.



B.1.2.5.1	TABLE: Verification of compliance with the methods of application of the standard characteristic curve, cosφ = f(P)	P

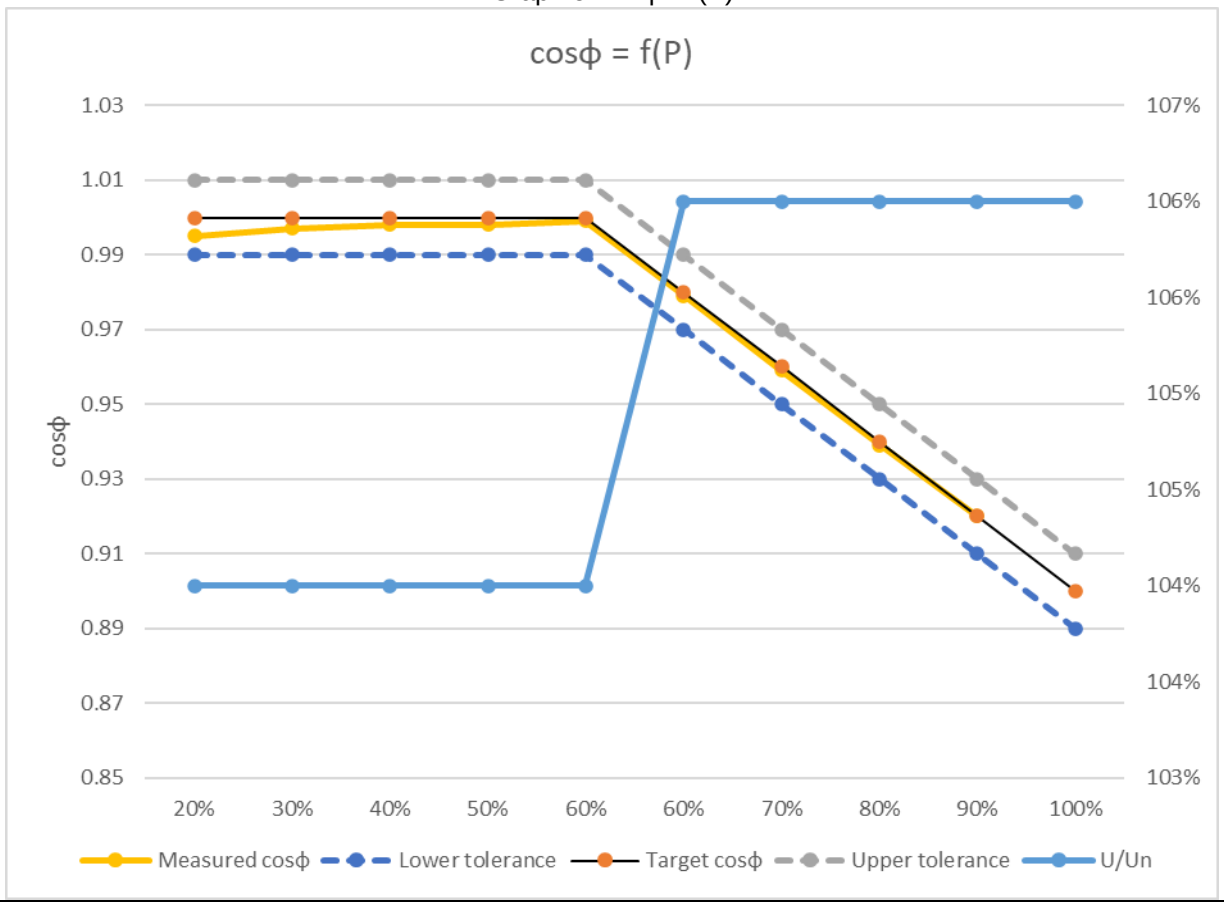
Model: EFWN511

cosφ = f(P)

Condition P/Pn	Condition U/Un	Target cosφ	Measured P/Pn	Measured Q/Pn	Measured cosφ	Deviation Δ cosφ	Limit Δ cosφ
20%	104%	1.000	20.1%	0.2%	0.995	-0.005	± 0.01
30%	104%	1.000	30.2%	0.2%	0.997	-0.003	
40%	104%	1.000	40.2%	0.2%	0.998	-0.002	
50%	104%	1.000	50.3%	0.2%	0.998	-0.002	
60%	104%	1.000	60.4%	0.2%	0.999	-0.001	
60%	106%	0.980	60.4%	-12.1%	0.979	-0.001	
70%	106%	0.960	70.7%	-20.4%	0.959	-0.001	
80%	106%	0.940	80.6%	-29.1%	0.939	-0.001	
90%	106%	0.920	90.7%	-38.5%	0.920	0	
100%	106%	0.900	90.7%*	-38.5%	0.920	--	

Note:
The lock-in value is adjustable between V_n and $1.1V_n$ and the lock-out value between V_n and $0.9V_n$ in 0.01V steps.
* The inverter can't output the desired active power due to current limitation, so don't consider the deviation value.
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

Graph of cosφ = f(P)



B.1.2.6.1	TABLE: Verification of compliance with the methods of application of the standard characteristic curve, Q = f(V) (greater than 11.08 kW)	N/A

Model: EFWN511

Q_{min} reactive power in accordance to standard characteristic curve Q = f(V)

Condition P/Pn	Condition U/Un	Target Q	Measured P/Pn	Measured U/Un	Measured Q/Pn	Δ Q/Pn [≤±2.5%]
< 20%	1.07	≈0(<±2.5%Pn)				
< 20%	1.09	≈0(<±2.5%Pn)				
< 20%->30%	1.09	-0.5 Q_{min} (within 10s)				
40%	1.09	-0.5 Q_{min}				
50%	1.09	-0.5 Q_{min}				
60%	1.09	-0.5 Q_{min}				
70%	1.09	-0.5 Q_{min}				
80%	1.09	-0.5 Q_{min}				
90%	1.09	-0.5 Q_{min}				
100%	1.09	-0.5 Q_{min}				
100%	1.10	- Q_{min}				
100%->10%	1.10	- Q_{min}				
10%- ≤5%	1.10	≈0(<±2.5%Pn)				

Q_{max} reactive power in accordance to standard characteristic curve Q = f(V)

Condition P/Pn	Condition U/Un	Target Q	Measured P/Pn	Measured U/Un	Measured Q/Pn	Δ Q/Pn [≤±2.5%]
< 20%	0.93	≈0 (<±2.5%Pn)				
< 20%	0.91	≈0 (<±2.5%Pn)				
< 20%->30%	0.91	-0.5 Q_{max} (within 10s)				
40%	0.91	-0.5 Q_{max}				
50%	0.91	-0.5 Q_{max}				
60%	0.91	-0.5 Q_{max}				
70%	0.91	-0.5 Q_{max}				
80%	0.91	-0.5 Q_{max}				
90%	0.91	-0.5 Q_{max}				
100%	0.91	-0.5 Q_{max}				
100%	0.90	- Q_{max}				
100%->10%	0.90	- Q_{max}				
10%- ≤5%	0.90	≈0(<±2.5%Pn)				

Note:
The lock-in value is adjustable between Vn and 1.1Vn and the lock-out value between Vn and 0.9Vn in 0.01V steps.
The inverter voltage on the AC side of the (inverter) is rated to 380V line to line.
In reference to the circular characteristic, the inverter reduces the active output power to maintain the reactive output power.
The under-voltage measurement effects the active output power in reference to reactive output power since the reactive output power has always priority. Therefore inverter must lower the active output power.

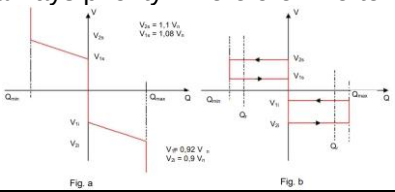


Fig. a Fig. b

B.1.3.1	TABLE: Automatic limitation of the active power for voltage values close to 110% of the rated voltage P(U)	P

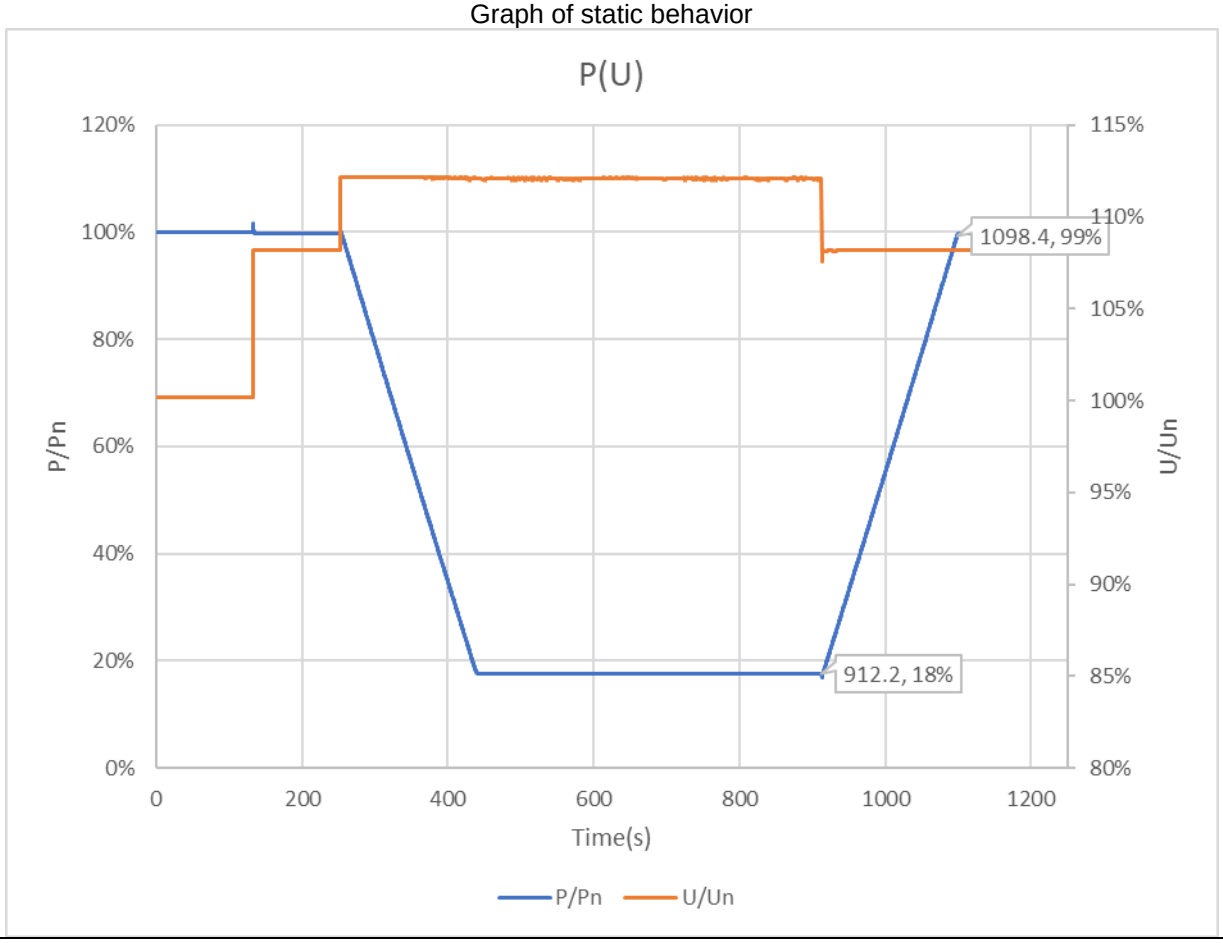
Model: EFWN511

Test sequence for the static behavior (Threshold set: 110% Un)

Test voltage U/Un	Target P/Pn	Measured U/Un	Measured P/Pn	Deviation ΔP / Pn	Limitation
100	100%	100.2%	100.0%	0%	± 10%
108	100%	108.2%	99.8%	-0.2%	
112	20%	112.1%	17.6%	-2.4%	
108	100%	108.2%	99.8%	-0.2%	
Reduced time measurement					
From 100%Pn to 20%Pn		3.1 min			≤ 5 min

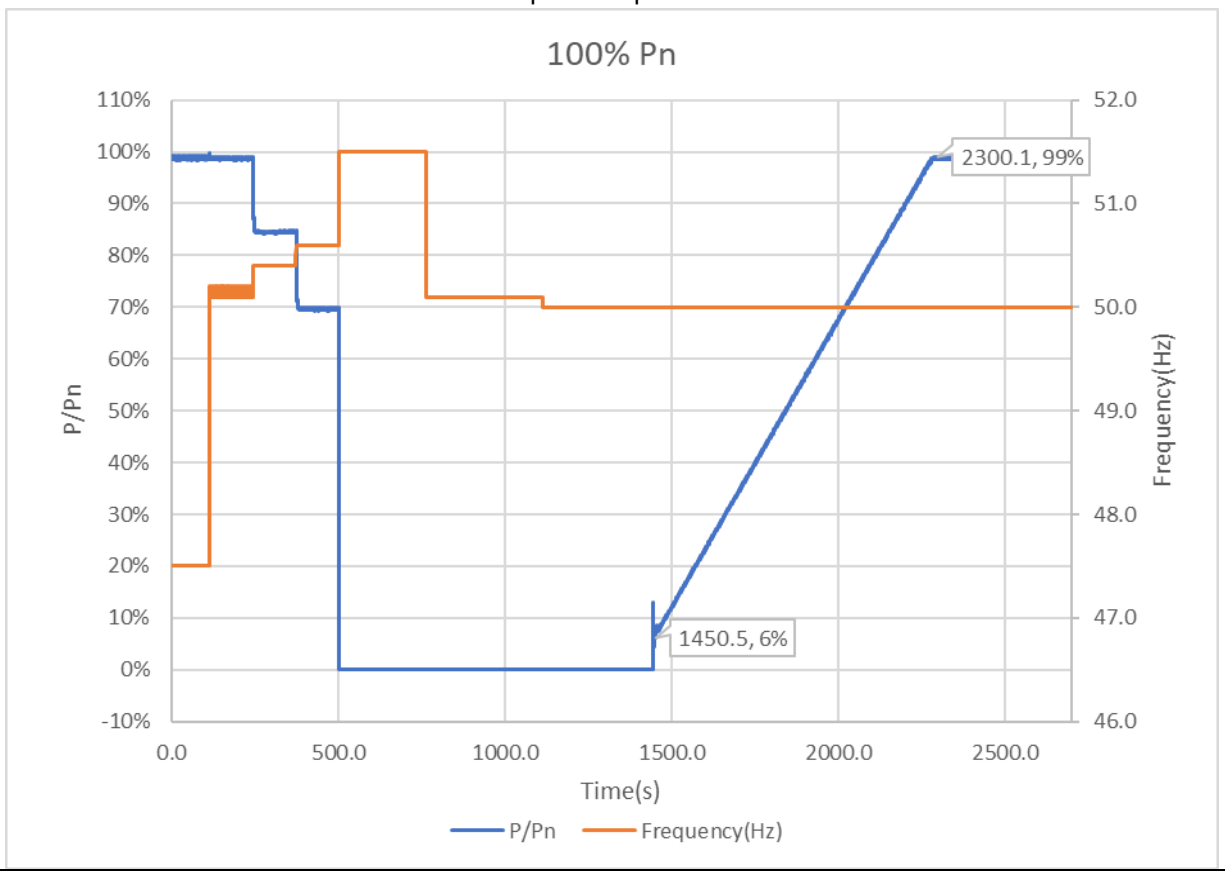
Notes:
The tests were performed on EFWN511 and are also applicable for all other models stated in this report.

Graph of static behavior

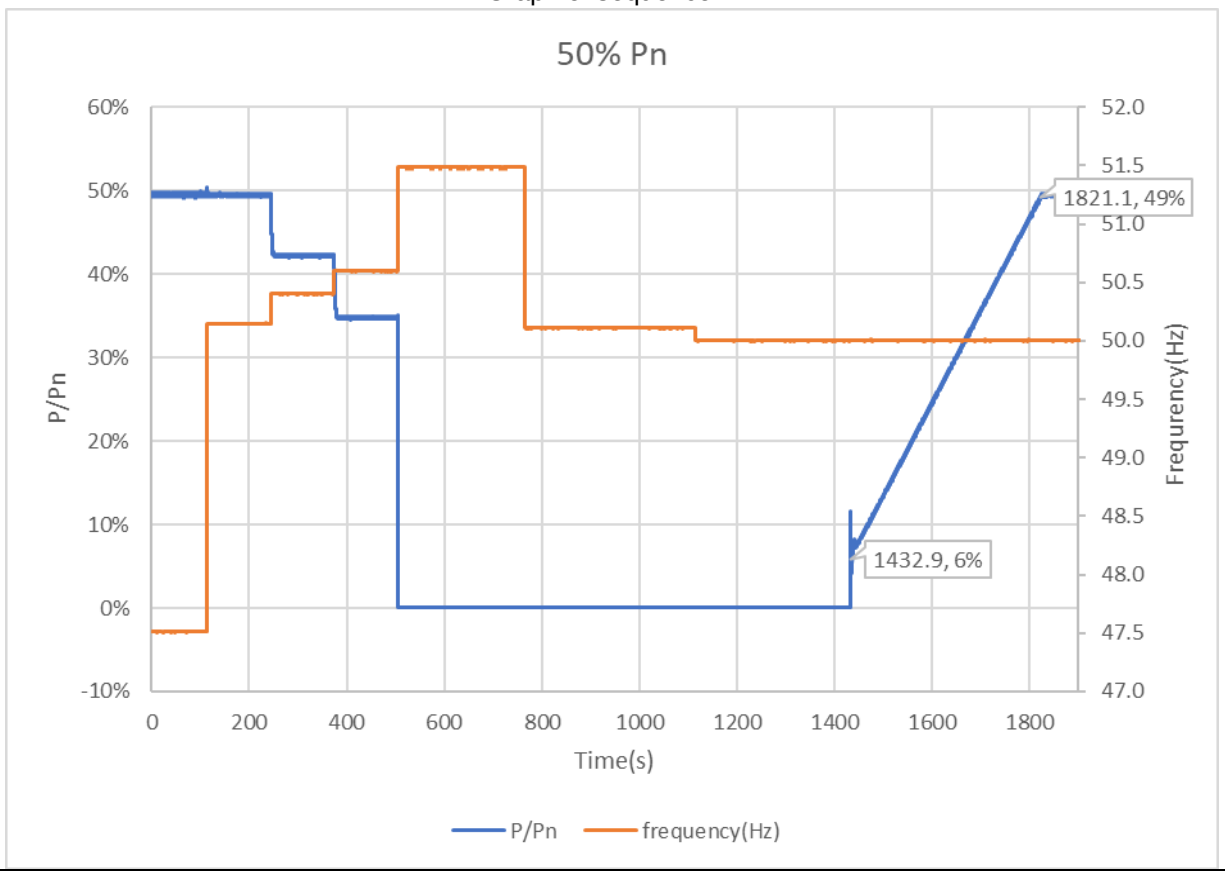


B.1.3.2	TABLE: Adjusting active power in the presence of transients on the transmission network							P
Model: EFWN511								
Measurement sequence A								
Power output:		100% P_n						
Starting frequency f_1:		50.2 Hz						
Deactivation threshold f_{stop}:		50.0 Hz (Activated)						
Droop:		2.6% (76.9% P_{ref} / Hz), P_{ref} = P_{max}						
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/P_n	f (Hz)	P/P_n	$T_{sr\_95\%}$ (s)	$T_{settling}$ (s)	T_d (s)	$\Delta P/P_n$	
a) 47.51	100%	47.51	98.90%	--	--	--	-1.10%	± 2.5%
b) 50.15	98%	50.15	98.79%	--	--	--	-1.21%	
c) 50.40	84.6%	50.40	84.51%	--	--	--	-0.09%	
d) 50.60	69.2%	50.60	69.64%	--	--	--	0.44%	
e) 51.49	0.8%	51.49	0.02%	--	--	--	-0.78%	
f) 50.11	0.8%	50.11	0.02%	--	--	--	-0.78%	
g) 50.00	0.8%	50.00	0.02%	--	--	--	-0.78%	
h) 50.00	100%	50.00	98.85%	--	849.6	--	-1.15%	
Test condition		Measurement					Limit	
g) 50.00 to h) 50.00		Max. power gradient (%P_n/min):			6.78		≤20% P_n/min	
Measurement sequence B								
Power output:		50% P_n						
Starting frequency f_1:		50.2 Hz						
Deactivation threshold f_{stop}:		50.0 Hz (Activated)						
Droop:		5.2% (38.4% P_{ref} / Hz), P_{ref} = P_{max}						
Test condition		Measurement						Limit $\Delta P/P_n$
f (Hz)	Target P/P_n	f (Hz)	P/P_n	$T_{sr\_95\%}$ (s)	$T_{settling}$ (s)	T_d (s)	$\Delta P/P_n$	
a) 47.51	50%	47.51	49.60%	--	--	--	-0.40%	± 2.5%
b) 50.15	98%	50.15	49.53%	--	--	--	-0.47%	
c) 50.40	42.3%	50.40	42.22%	--	--	--	-0.08%	
d) 50.60	34.6%	50.60	34.80%	--	--	--	0.20%	
e) 51.49	0.4%	51.49	0.02%	--	--	--	-0.38%	
f) 50.11	0.4%	50.11	0.02%	--	--	--	-0.38%	
g) 50.00	0.4%	50.00	0.02%	--	--	--	-0.38%	
h) 50.00	50%	50.00	49.48%	--	388.2	--	-0.52%	
Test condition		Measurement					Limit	
g) 50.00 to h) 50.00		Max. power gradient (%P_n/min):			6.97		≤20% P_n/min	
Note: The tests were performed on EFWN511 and are also applicable for all other models stated in this report.								

Graph of sequence A

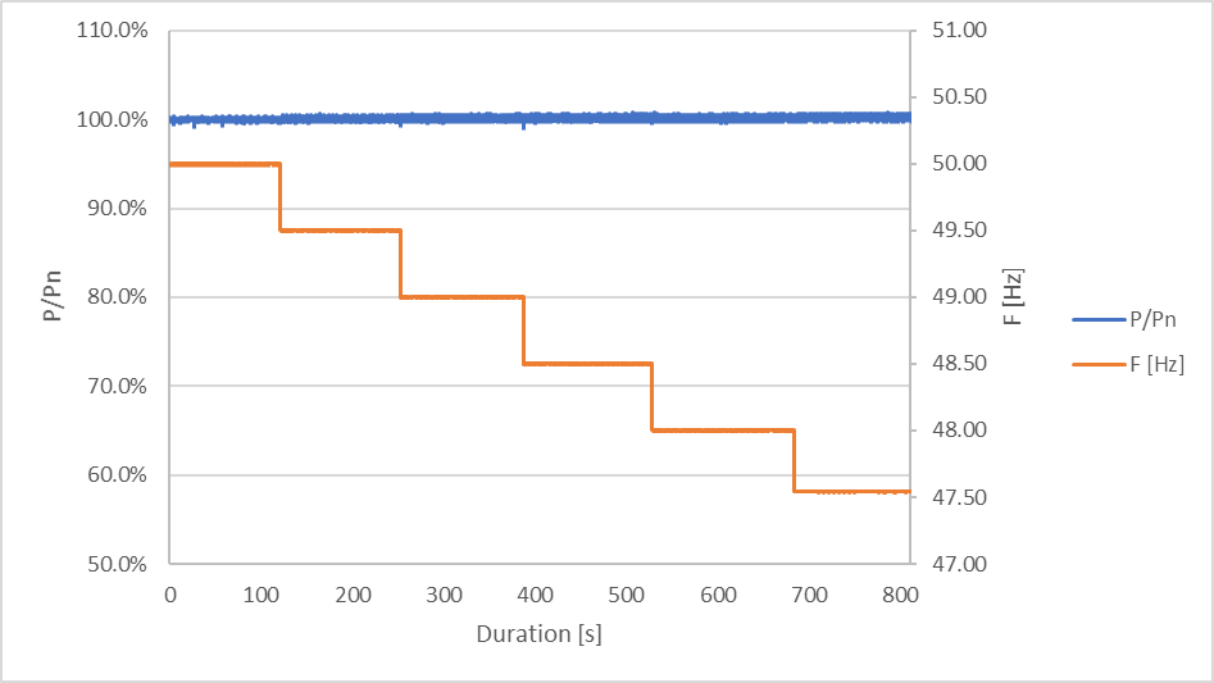


Graph of sequence B



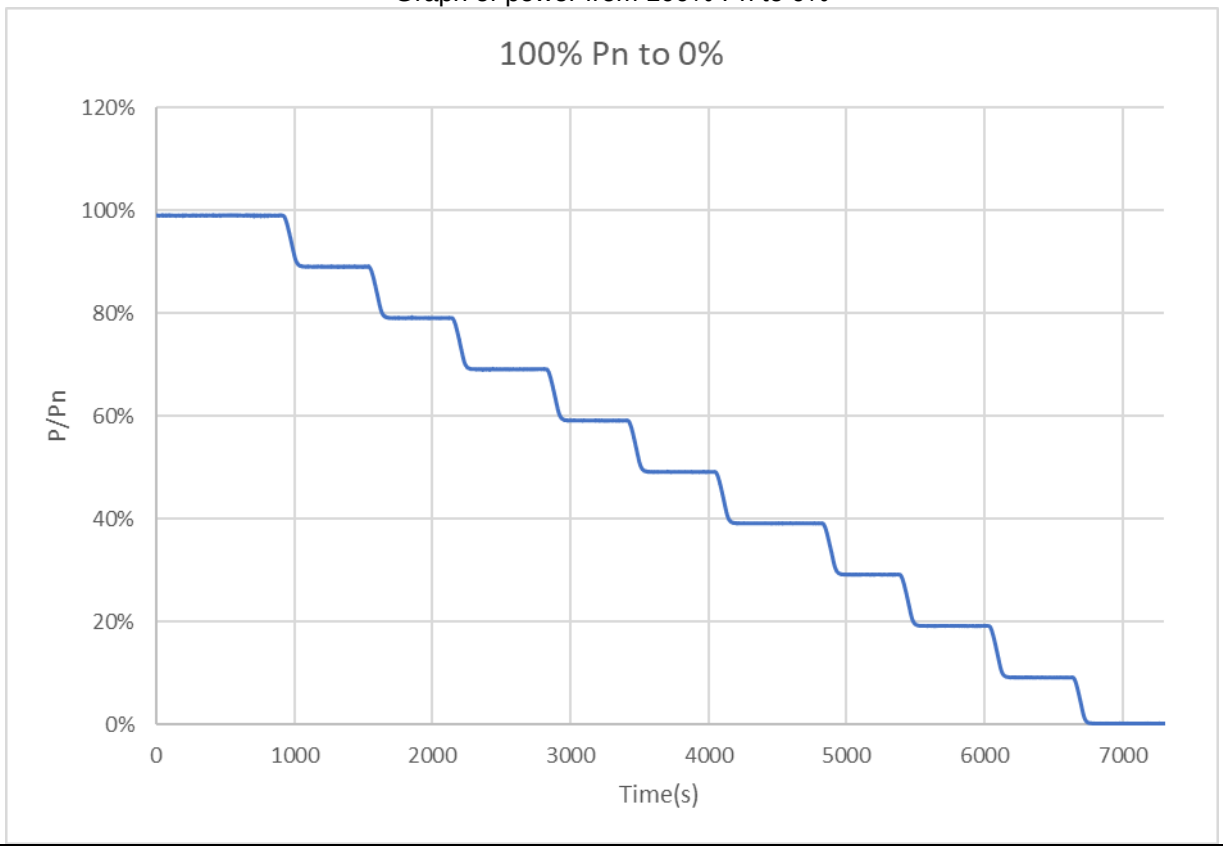
B.1.3.3.1	TABLE: Reduction of active power in the presence of under-frequency transients on transmission network			P
Model: EFWN511				
Output voltage	230 Vac			
Test sequence	Frequency [Hz]	Measured output P/Pn	ΔP/Pn per 1 Hz	Reduction rate of stringent limits
Test a)	50.0	100.0%	0%	0
Test b)	49.5	100.1%	0.1%	0
Test c)	49.0	100.0%	0%	0
Test d)	48.5	100.0%	0%	-1%
Test e)	48.5	100.0%	0%	-2%
Test f)	47.5	100.0%	0%	-3%
Note:				

Graph of frequency and power from step 50.0Hz to 47.5Hz



B.1.3.4	TABLE: Limitation of active power by external control from the distributor		P
Model: EFWN511			
Target P/Pn	Measured output P/Pn	Accuracy ΔP/Pn	Limit $\Delta P/P_n$
100%	99.1%	-0.9%	± 2.5%
90%	89.1%	-0.9%	
80%	79.1%	-0.9%	
70%	69.2%	-0.8%	
60%	59.2%	-0.8%	
50%	49.2%	-0.8%	
40%	39.2%	-0.8%	
30%	29.2%	-0.8%	
20%	19.2%	-0.8%	
10%	9.2%	-0.8%	
0%	0.3%	0.3%	
Note:			

Graph of power from 100% Pn to 0%



B.1.4.1	TABLE: Verification of the emission of continuous component		N/A
Model: EFWN511			
Phase A			
Power Level	(33 ± 5)%	(66 ± 5)%	(100 ± 5)%
Ambient condition 25 °C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Ambient condition -10 °C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Ambient condition 50°C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Phase B			
Power Level	(33 ± 5)%	(66 ± 5)%	(100 ± 5)%
Ambient condition 25 °C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Ambient condition -10 °C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			

Ambient condition 50°C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Phase C			
Power Level	(33 ± 5)%	(66 ± 5)%	(100 ± 5)%
Ambient condition 25 °C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Ambient condition -10 °C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Ambient condition 50°C			
Power (W)			
Voltage (V)			
Current (A)			
PF			
Cosφ			
DC Component (A)			
DC Component (% In)			
Note: Isolated Equipment			

Graph of power 100%/66%/33% at 25 °C
Graph of power 100%/66%/33% at -10 °C
Graph of power 100%/66%/33% at 50 °C

B.1.4.2	TABLE: Verification of the protections against the induction of a continuous component			N/A
Model: EFWN511				
Actual Power	Limits	Measurement: (mA)	Limiting value: (mA)	Disconnection time: (ms)
I_{dc} = 0,5% of I_{nom}				
100%	+0.5%I_{nom} /1s		181	
66%	+0.5%I_{nom} /1s		181	
33%	+0.5%I_{nom} /1s		181	
100%	-0.5%I_{nom} /1s		181	
66%	-0.5%I_{nom} /1s		181	
33%	-0.5%I_{nom} /1s		181	
I_{dc} = 1A				
100%	+1A Idc/200ms		1000	
66%	+1A Idc/200ms		1000	
33%	+1A Idc/200ms		1000	
100%	-1A Idc/200ms		1000	
66%	-1A Idc/200ms		1000	
33%	-1A Idc/200ms		1000	
Note: Isolated Equipment				

Screenshot of power 100% at +0.5%I_{nom}
Screenshot of power 100% at -0.5%I_{nom}
Screenshot of power 100% at +1A Idc
Screenshot of power 100% at -1A Idc

B.1.5	TABLE: Verification of insensitivity to voltage dips (UVRT capability, greater than 11.08 kW)	N/A

Model: EFWN511

Requirement of LVRT test:

Table 24 - Test sequences to verify immunity to temporary voltage dips. The amplitude, duration and shape relate to no-load test conditions

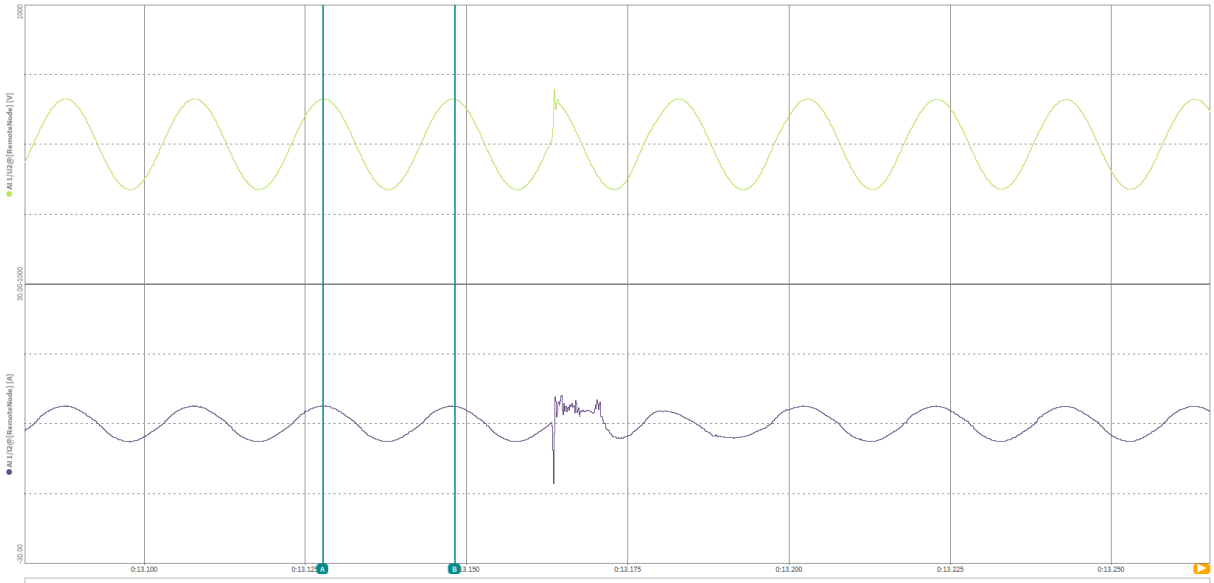
List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Drop duration limit [ms]	Power re-supply time after restoring network [ms]	Form (*)
1s – three-phase symmetrical fault	0.10 ± 0.05 (V_1/Vn)	200 ± 20	400	
1a – two-phase asymmetric failure	0.10 ± 0.05 (V_1/Vn)	200 ± 20	400	
2s – three-phase symmetrical fault	0.25 ± 0.05 (V_2/Vn)	400 ± 20	400	
2a – two-phase asymmetric failure	0.25 ± 0.05 (V_2/Vn)	400 ± 20	400	
3s – three-phase asymmetrical fault	0.50 ± 0.05 (V_3/Vn)	850 ± 20	400	
3a – two-phase asymmetric failure	0.50 ± 0.05 (V_3/Vn)	850 ± 20	400	
4s – three-phase asymmetrical fault	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	400	
4a – two-phase asymmetric failure	0.75 ± 0.05 (V_4/Vn)	1300 ± 20	400	
5 – LV two-phase asymmetrical fault	0.10 ± 0.05 (V_5/Vn)	200 ± 20	400	
6 – LV two-phase asymmetrical fault	0.50 ± 0.05 (V_6/Vn)	850 ± 20	400	

Test No.	V/V_{nom}	Phase-to-earth voltages			Phase angles		
		$U_1/U_{1,nom}$	$U_2/U_{2,nom}$	$U_3/U_{3,nom}$	φ_{U1}	φ_{U2}	φ_{U3}
1s	0.10 ± 0.05	0.10 ± 0.05	0.10 ± 0.05	0.10 ± 0.05	0°	-120°	120°
1a	0.10 ± 0.05	0.87 ± 0.05	0.87 ± 0.05	0.10 ± 0.05	27°	-147°	120°
2s	0.25 ± 0.05	0.25 ± 0.05	0.25 ± 0.05	0.25 ± 0.05	0°	-120°	120°
2a	0.25 ± 0.05	0.88 ± 0.05	0.88 ± 0.05	0.25 ± 0.05	22°	-142°	120°
3s	0.50 ± 0.05	0.50 ± 0.05	0.50 ± 0.05	0.50 ± 0.05	0°	-120°	120°
3a	0.50 ± 0.05	0.90 ± 0.05	0.90 ± 0.05	0.50 ± 0,05	14°	-134°	120°
4s	0.75 ± 0.05	0.75 ± 0.05	0.75 ± 0.05	0.75 ± 0.05	0°	-120°	120°
4a	0.75 ± 0.05	0.94 ± 0.05	0.94 ± 0.05	0.75 ± 0.05	7°	-127°	120°
5	0.10 ± 0.05	1	0.10 ± 0.05	0.10 ± 0.05	0°	-120°	120°
6	0.50 ± 0.05	1	0.50 ± 0.05	0.50 ± 0.05	0°	-120°	120°
normal condition	1	1	1	1	0°	-120°	120°

Graph of LVRT test:				
List of tests	**Residual amplitude of phase-to-phase voltage V/V_{nom}**	**Drop duration limit [ms]**	**Measured drop duration [ms]**	**Duration of restoring network [ms]**
1s – three-phase symmetrical fault (P = 0.1 – 0.3)	0.10 ± 0.05 (V_1/Vn)	200 +20		
1s – three-phase symmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200 +20		
1a – two-phase asymmetrical fault (P = 0.1 – 0.3)	0.10 ± 0.05 (V_1/Vn)	200 +20		
1a – two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_1/Vn)	200 +20		
2s – three-phase symmetrical fault (P = 0.1 – 0.3)	0.25 ± 0.05 (V_2/Vn)	400 +20		
2s – three-phase symmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400 +20		
2a – three-phase symmetrical fault (P = 0.1 – 0.3)	0.25 ± 0.05 (V_2/Vn)	400 +20		
2a – three-phase symmetrical fault (P > 0.9)	0.25 ± 0.05 (V_2/Vn)	400 +20		
3s – three-phase symmetrical fault (P = 0.1 – 0.3)	0.50 ± 0.05 (V_3/Vn)	850 ± 20		
3s – three-phase symmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850 ± 20		
3a – two-phase asymmetrical fault (P = 0.1 – 0.3)	0.50 ± 0.05 (V_3/Vn)	850 ± 20		
3a – two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_3/Vn)	850 ± 20		
4s – three-phase symmetrical fault (P = 0.1 – 0.3)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20		
4s – three-phase symmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20		
4a – two-phase asymmetrical fault (P = 0.1 – 0.3)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20		
4a – two-phase asymmetrical fault (P > 0.9)	0.75 ± 0.05 (V_4/Vn)	1300 ± 20		
5 – LV two-phase asymmetrical fault (P = 0.1 – 0.3)	0.10 ± 0.05 (V_5/Vn)	200 +20		
5 – LV two-phase asymmetrical fault (P > 0.9)	0.10 ± 0.05 (V_5/Vn)	200 +20		
6 – LV two-phase asymmetrical fault (P = 0.1 – 0.3)	0.50 ± 0.05 (V_6/Vn)	850+20		
6 – LV two-phase asymmetrical fault (P > 0.9)	0.50 ± 0.05 (V_6/Vn)	850 +20		
Note: (*) Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms The interface protection shall be disabled or adjusted to avoid spurious tripping during testing. The test conditions are performed as worst-case conditions. The inverter feeds maximal active and reactive power during the complete test.				

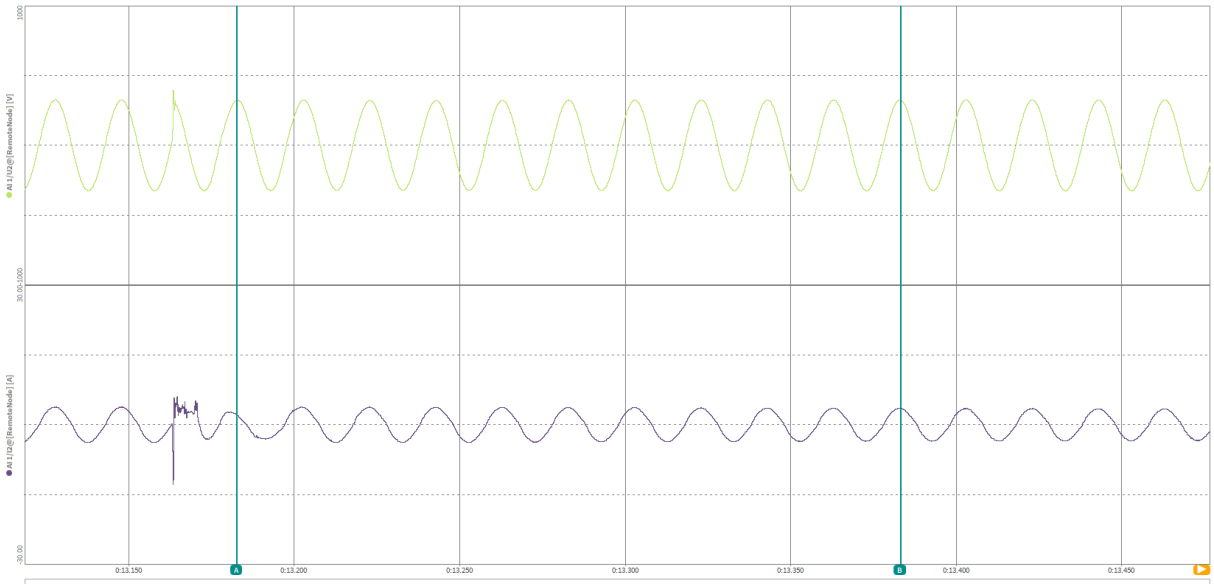
B.1.6.1	TABLE: Verification of insensitivity to automatic reclosing in phase discrepancy (simulation network)					P
Model: EFWN511						
Test 1 - phase shift angle of 90°						
Power	Phase shift angle	Current 20 ms before phase shift		Current 200ms after phase shift		Result
100% Pn	90°	Phase A	3.84 A	Phase A	3.56 A	Normal situation
		Phase B	--	Phase B	--	Normal situation
		Phase C	--	Phase C	--	Normal situation
		Phase A/B/C	--	Phase A/B/C	--	Normal situation
Test 2 - phase shift angle of 180°						
Power	Phase shift angle	Current 20 ms before phase shift		Current 200ms after phase shift		Result
100% Pn	180°	Phase A	3.85 A	Phase A	3.56 A	Normal situation
		Phase B	--	Phase B	--	Normal situation
		Phase C	--	Phase C	--	Normal situation
		Phase A/B/C	--	Phase A/B/C	--	Normal situation
Note: The tests were performed on EFWN511 and are also applicable for all other models stated in this report.						

Screenshot of current 20 ms before the setoff for 90º



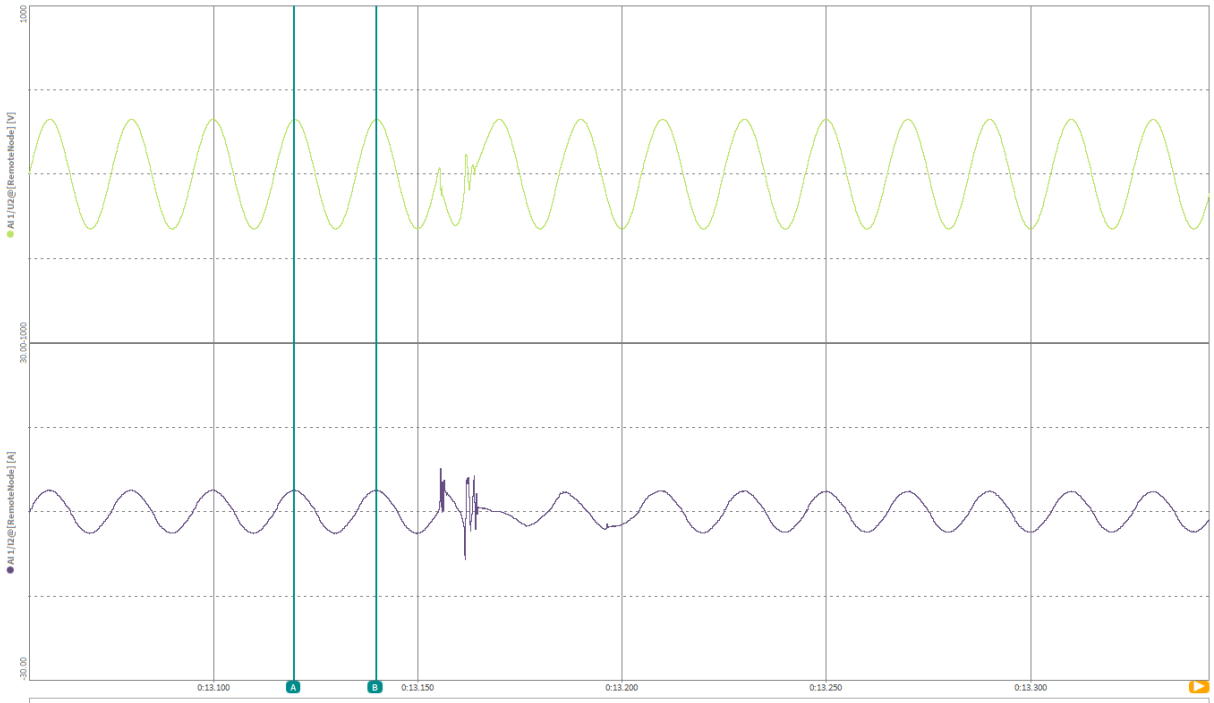
	A	B	间隔
时间 [s]	0:13.1277814	0:13.1482197	0.0204384
AI 1/U2@[RemoteNode] [V]	324.9171	324.6751	-0.241995
AI 1/I2@[RemoteNode] [A]	3.836241	3.845911	9.670e-3

Screenshot of current 200 ms after the setoff for 90º



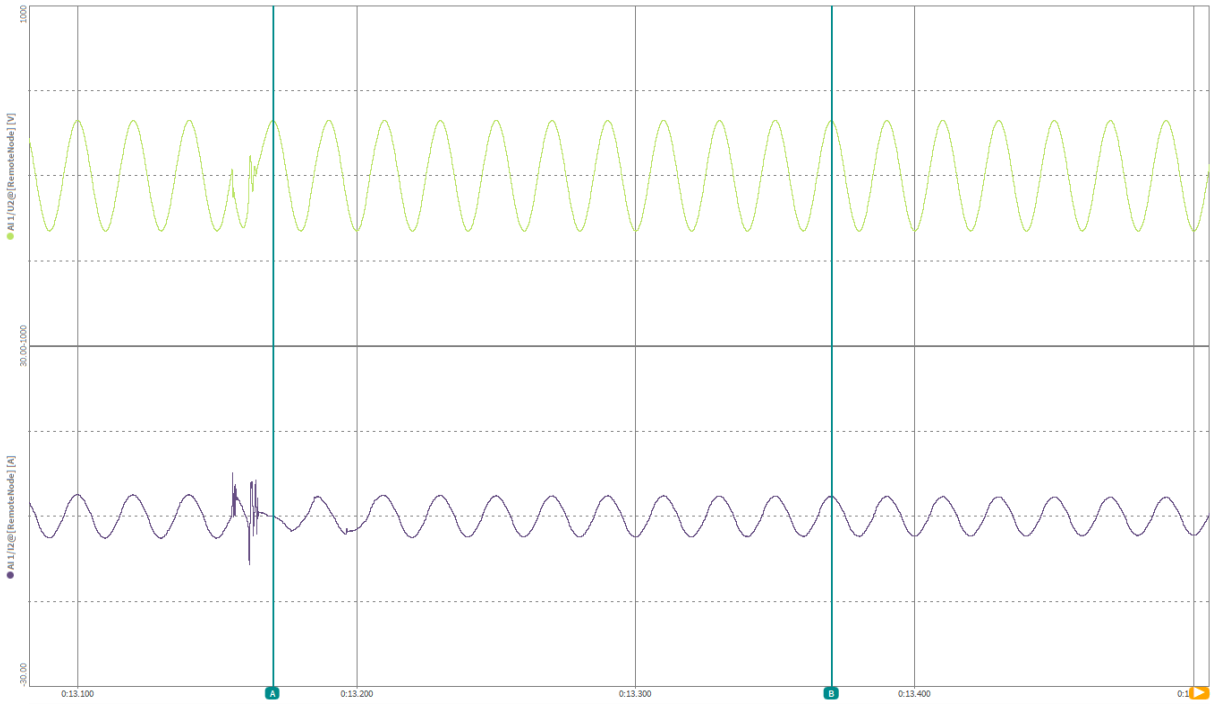
	A	B	间隔
时间 [s]	0:13.1827023	0:13.3831130	0.2004107
AI 1/U2@[RemoteNode] [V]	324.9111	325.8689	0.957727
AI 1/I2@[RemoteNode] [A]	2.180643	3.558159	1.377516

Screenshot of current 20 ms before the setoff for 180º



	A	B	间隔
时间 [s]	0:13.1196718	0:13.1397090	0.0200373
AI 1/U2@[RemoteNode] [V]	324.1415	324.8494	0.707865
AI 1/I2@[RemoteNode] [A]	3.849135	3.892403	0.043268

Screenshot of current 200 ms after the setoff for 180º



	A	B	间隔
时间 [s]	0:13.1700307	0:13.3703071	0.2002764
AI 1/U2@[RemoteNode] [V]	326.1213	324.4231	-1.698256
AI 1/I2@[RemoteNode] [A]	0.028267	3.565102	3.536835

Appendix 1: ISO 9001 certificate

Certificate CN17/30219

The management system of

Dongguan Streamax Electronics Co., Ltd.

Unified Social Credit Code: 91441900MA560UJB4C
Business Registration Address: Room 101, No.20 Building, Leaguer Zijing Intelligent Manufacture Center, NO.105, Qingbin East Road, Qingxi Town, Dongguan City, Guangdong Province, P. R. China
Business Operation Address: No.20 Building Leaguer Zijing Intelligent Manufacture Center, NO.105 Qingbin East Road, Qingxi Town, Dongguan City, Guangdong Province,P.R.China

has been assessed and certified as meeting the requirements of
ISO 9001:2015

For the following activities

Design and manufacture of cameras and DVR (digital video recorder) for electronic security equipment;
Design and manufacture of vehicle video terminals and satellite positioning system terminals;
Design and system integration of vehicle satellite positioning system terminals and video monitoring systems;
Manufacture of inverter

This certificate is valid from 13 April 2023 until 10 September 2024 and remains valid subject to satisfactory surveillance audits.
Issue 7. Certified since 03 January 2017
Certified activities performed by additional sites are listed on subsequent pages.

Authorised by
Jonathan Hall
Global Head - Certification Services

SGS United Kingdom Ltd
Rossmore Business Park, Ellesmere Port, Cheshire, CH65 3EN, UK
t +44 (0)151 350-6666 - www.sgs.com

The certification information can be verified on the web site of Certification and Accreditation Administration of the People's Republic of China
www.cnca.gov.cn

Page 1 of 2

Appendix 2: Datasheet of the relay

SONG CHUAN

507

Features

- ☐ High rating miniature PCB Relay.
- ☐ AC & DC coil are both available.
- ☐ UL/CUL and VDE approved.
- ☐ 17A 277VAC SPDT.
- ☐ Low profile 15.7mm and high insulation system class F.
- ☐ High CTI 250 material & New Glow Wire Approved. (E version)
- ☐ Special version for inrush rating application is available. (507 IR type)
- ☐ Complies with RoHS-Directive 2011/65/EU.
- ☐ Optional for halogen free version.

Type List

◆ Standard type

Terminal style	Contact form	Insulation system	Designation (provided with)		
			Flux tight	Sealed type	Sealed type washable
PCB terminal	1A (SPNO)	F	507-1AH-F-C	507-1AH-F-V	507-1AH-F-S
	1C (SPDT)	F	507-1CH-F-C	507-1CH-F-V	507-1CH-F-S

◆ High sensitivity type (N) / Ultra-sensitivity type (N1)

PCB terminal	1A (SPNO)	F	507N-1AH-F-C	507N-1AH-F-V	507N-1AH-F-S
			507N1-1AH-F-C	507N1-1AH-F-V	507N1-1AH-F-S
	1C (SPDT)	F	507N-1CH-F-C	507N-1CH-F-V	507N-1CH-F-S
			507N1-1CH-F-C	507N1-1CH-F-V	507N1-1CH-F-S

◆ High power type

PCB terminal	1A (SPNO)	F	507H-1AH-F-C	507H-1AH-F-V	507H-1AH-F-S
	1C (SPDT)	F	507H-1CH-F-C	507H-1CH-F-V	507H-1CH-F-S

◆ High power type、High sensitivity type (N)

PCB terminal	1A (SPNO)	F	507HN-1AH-F-C	507HN-1AH-F-V	507HN-1AH-F-S
	1C (SPDT)	F	507HN-1CH-F-C	507HN-1CH-F-V	507HN-1CH-F-S

Note：507A Special footprint 5.0mm pinning version can be selected.

Ordering Information

507 ☐ ☐ - 1A H - ☐ - C ☐ ☐

1 2 3 4 5 6 7 8 9

1. 507 -- Basic series designation

2. Blank -- Standard type
   (1P - Terminal pitch 3.5mm)
   (2P - Terminal pitch 5.0mm)
   A -- Standard type and special terminal pitch
   (1P - Terminal pitch 5.0mm)
   H -- High power type (only for 1P type)

3. Blank -- Standard type(DC: 0.53 W) (AC: 0.75 VA)
   N -- High sensitivity type (0.40 W)
   N1 -- Ultra-sensitivity type (0.25 W)(only for 1P type)

4. 1A -- Single pole normally open
   1C -- Single pole double throw
   2A -- Double pole normally open
   2C -- Double pole double throw

5. C -- Contact material AgNi
   CA -- Contact material AgNi+Au
   H -- Contact material AgSnO
   HA -- Contact material AgSnO+Au

6. Blank -- Standard type
   F -- Class F

SONG CHUAN

507

7. C -- Flux tight
V -- Sealed type
S -- Sealed type washable

8. Blank -- Standard type

E -- CTI 250V
IR -- 507 Inrush type(only for H, 1A/1C type)

9. ☐ -- Coil voltage (please refer to the coil rating data for the availability)

Contact Rating

Type	1P			2P
	507、507N	507N1	507H、507HN	507、507N
Rated load (resistive)	12A 240VAC	10A 240VAC	16A 240VAC	8A 240VAC
Max. switching current	12A	10A	17A	8A
Max. switching voltage	277VAC	277VAC	277VAC	277VAC
Max. switching capacity	2880VA	2400VA	4080VA	1920VA

◆ Inrush type

Tungsten Lamp	NO:1500W 240VAC 30,000 ops. (Inrush 110A)
Halogen Lamp	NO:1500W 240VAC 30,000 ops. (Inrush 110A)

Coil Rating (DC)

◆ Standard Type

Rated voltage (V)	Rated current ±10% at 23°C (mA)	Coil resistance ±10% at 23°C (Ω)	Max. continuous voltage at 85°C	Pick up voltage(Max.) at 23°C	Drop out voltage(Min.) at 23°C	Power consumption at rated voltage
3	176	17	150 % of rated voltage	75 % of rated voltage	10 % of rated voltage	approx. 0.53W
5	106	47				
6	88	68				
9	59	153				
12	44	272				
15	35	425				
18	29	611				
24	22	1,087				
36	15	2,445				
48	11	4,347				

◆ High sensitivity type (N)

Rated voltage (V)	Rated current ±10% at 23°C (mA)	Coil resistance ±10% at 23°C (Ω)	Max. continuous voltage at 85°C	Pick up voltage(Max.) at 23°C	Drop out voltage(Min.) at 23°C	Power consumption at rated voltage
3	133	22.5	150 % of rated voltage	70 % of rated voltage	10 % of rated voltage	approx. 0.40W
5	80	62				
6	67	90				
9	44	203				
12	33	360				
18	23	771				
24	17	1,440				
36	11	3,240				
48	9	5,520				

SONG CHUAN 507

◆ Ultra-sensitivity type (N1)

Rated voltage (V)	Rated current ±10% at 23°C (mA)	Coil resistance ±10% at 23°C (Ω)	Max. continuous voltage at 85°C	Pick up voltage(Max.) at 23°C	Drop out voltage(Min.) at 23°C	Power consumption at rated voltage
3	83	36	150 % of rated voltage	75 % of rated voltage	10 % of rated voltage	approx. 0.25W
5	50	100				
6	42	144				
9	28	324				
12	21	576				
18	14	1,296				
24	10	2,304				
36	7	5,184				

Coil Rating (AC) [only for 507、507H]

Rated voltage (V)	Rated current ±10% at 23°C (mA)	Coil resistance ±10% at 23°C (Ω)	Max. continuous voltage at 70°C	Pick up voltage(Max.) at 23°C	Drop out voltage(Min.) at 23°C	Power consumption at rated voltage
6	125	23.4	150 % of rated voltage	80 % of rated voltage	15 % of rated voltage	approx. 0.75VA
12	62.5	100				
24	31.2	368				
42	17.8	1,188				
48	15.6	1,540				
100/110	7.45	6,880				
110/120	6.8	8,360				
200/220	3.75	26,700				
220/240	3.4	33,000				

Specification

Contact material	AgNi / AgSnO alloy	
Contact resistance (1)	100mΩ Max. (1A(100mA for Au-plating contact)/6VDC by 4 pipes mΩ meter)	
Operate time (1)	20ms Max.	
Release time (1)	10ms Max.	
Insulation resistance (1)	1000MΩ Min. (DC 500V)	
Dielectric strength (1)	Between open contact	: AC 1000V, 50/60Hz 1 min.
	Between contact and coil	: AC 5000V, 50/60Hz 1 min.
	Between contact circuits	: AC 3000V, 50/60Hz 1 min. (for 2P DC type) : AC 2500V, 50/60Hz 1 min. (for 2P AC type)
Surge voltage withstand (1)	Between contact and coil	: 10KV (1.2X50) μS
Vibration resistance	Operating extremes	10～55Hz , amplitude 1.5 mm
	Damage limits	10～55Hz , amplitude 1.5 mm
Shock resistance	Operating extremes	10G
	Damage limits	100G
Life expectancy	Mechanical	30,000,000 operations (for DC type) (frequency 72,000 operations /hr)
		10,000,000 operations (for 1P AC type) 5,000,000 operations (for 2P AC type) (frequency 18,000 operations /hr)

SONG CHUAN

507

Life expectancy	Electrical	100,000 operations (frequency 360 operations /hr)
Operating ambient temperature	DC coil	-40～+85°C (no freezing) (2)
	AC coil	-40～+70°C (no freezing)
Weight	Approx. 10 g	

Note：(1) Initial value. Operate and release time excluding contact bounce.
(2) Special version of high temperature 105°C can be selected.

Safety Approval

Certified	UL / CUL	VDE
File No.	E88991	40006746

Safety Approval Rating (VDE)

◆ DC coil

507H、507HN	507、507N 、507N1	507、507N
	1P	2P
17A 250VAC T105	12A 250VAC T105	12A 250VAC T85 10A 250VAC T105

◆ AC coil

507H	507
17A 250VAC T85	1P: 12A 250VAC T85 2P: 10A 250VAC T85

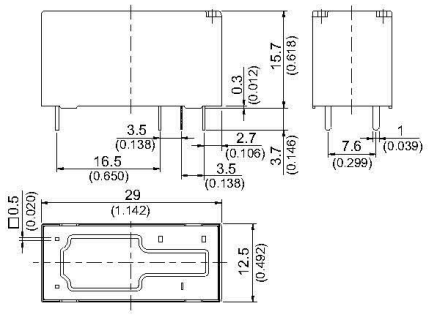
Safety Approval Rating (UL/CUL)

507 (1P)		507 (2P)	507N1
AgNi contact	AgSnO contact		
NO/NC: 17A 277VAC NO: 10FLA 250VAC 12A 30VDC 1HP 480VAC NC: 1/2HP 120/240/480VAC	NO/NC: 17A 277VAC 10FLA 250VAC 1HP 120/240/480VAC NO: TV-8 (for IR type) NC: 12A 30VDC 1/2HP 120/240/480VAC	NO/NC: 12A 277VAC NO: 1/2HP 120/240VAC TV-5 (AgSnO contact only) NC: 1/3HP 120/240VAC	17A 277VAC 12A 30VDC

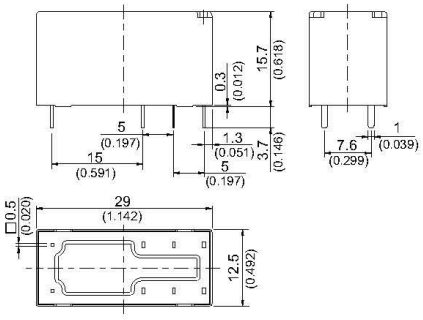
Note：If there is cleaning process and sealed type is selected, the vent-hole should be removed after the process.

Outline Dimensions

◆ 507 1P

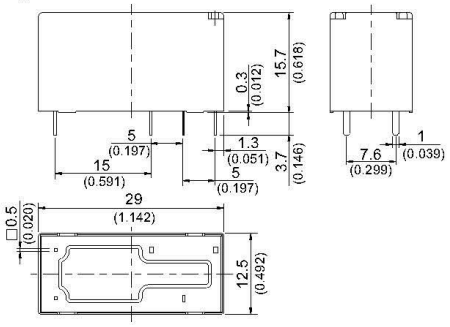


◆ 507H 1P

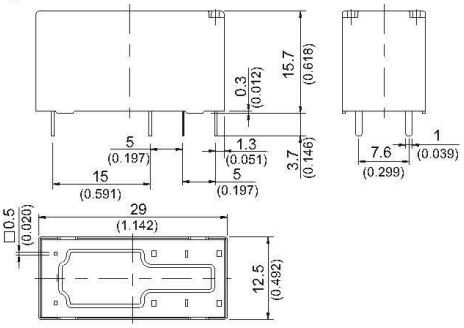


SONG CHUAN 507

◆ 507A 1P



◆ 507 2P



Wiring Diagram

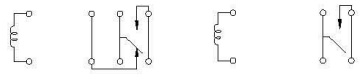
BOTTOM VIEW

◆ 507 1P

1C 1A

◆ 507H 1P

1C 1A

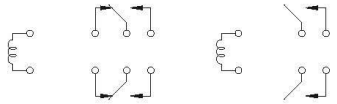


◆ 507A 1P

1C 1A

◆ 507 2P

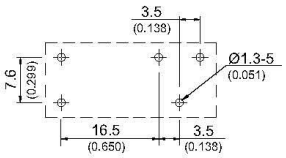
2C 2A



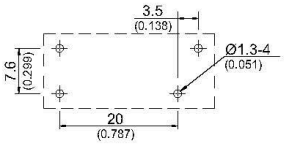
PC Board Layout

BOTTOM VIEW

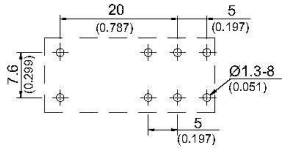
◆ 507 1P 1C



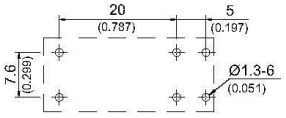
1A



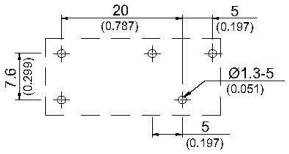
◆ 507H 1P 1C



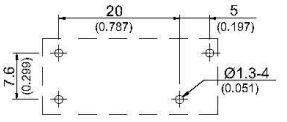
1A



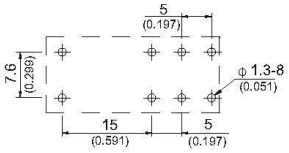
◆ 507A 1P 1C



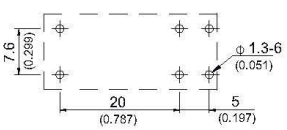
1A



◆ 507 2P 2C



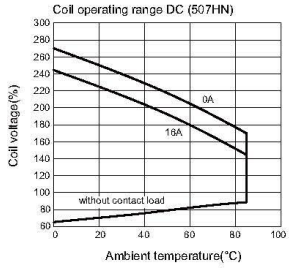
2A

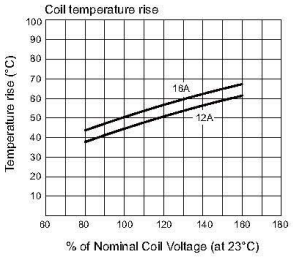


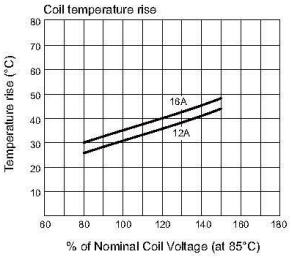
SONG CHUAN

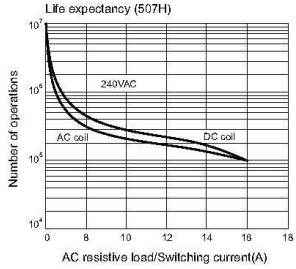
507

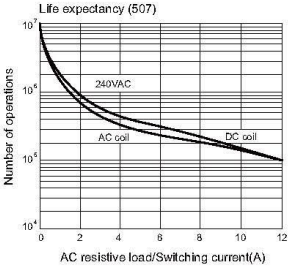
Engineering Data

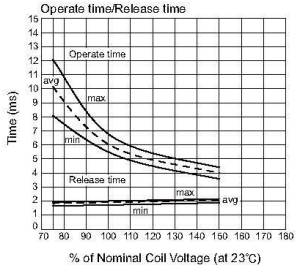




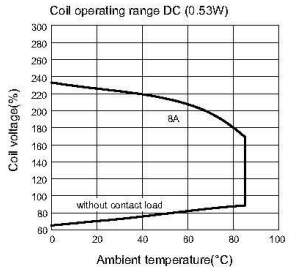


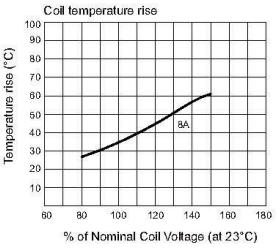


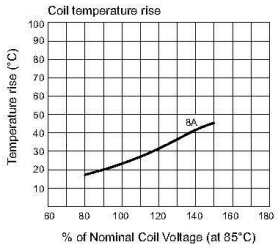


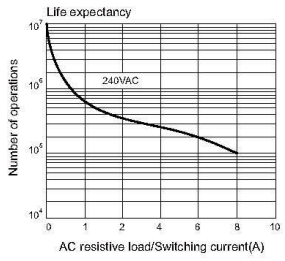


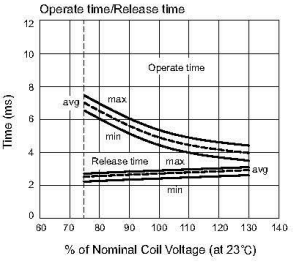
◆ 507 2P

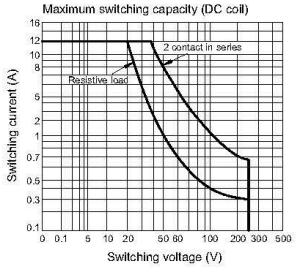


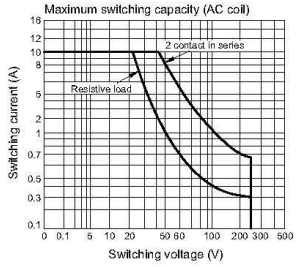






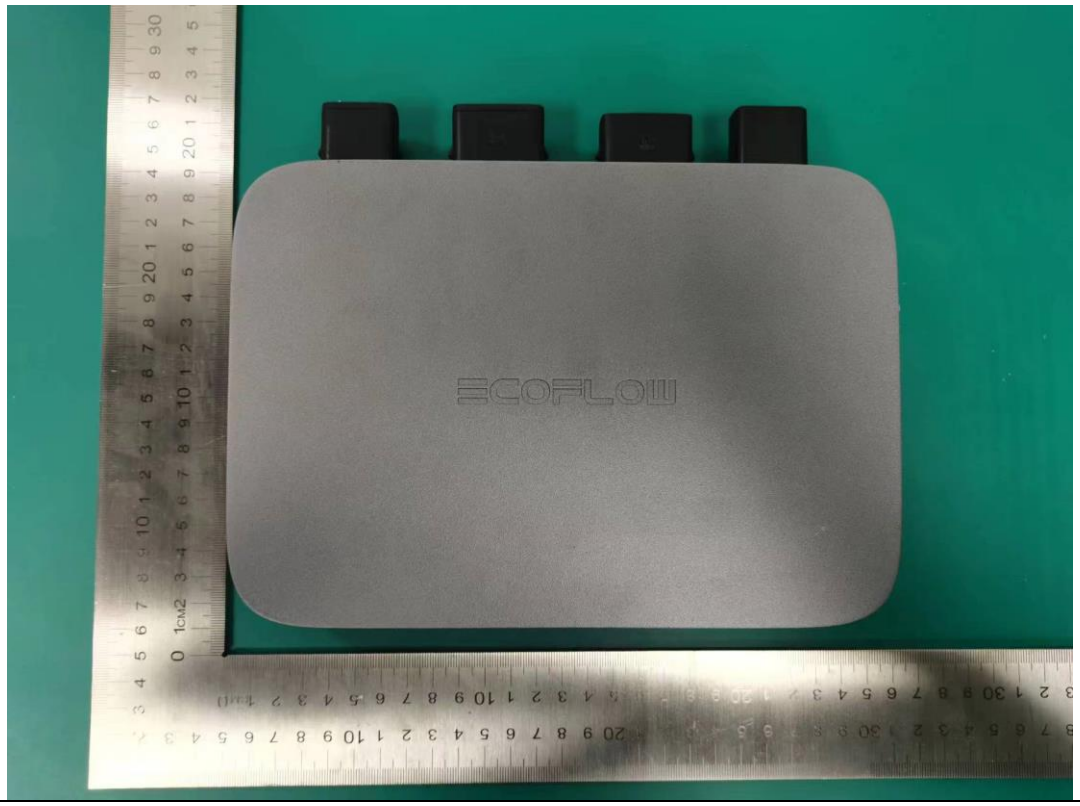




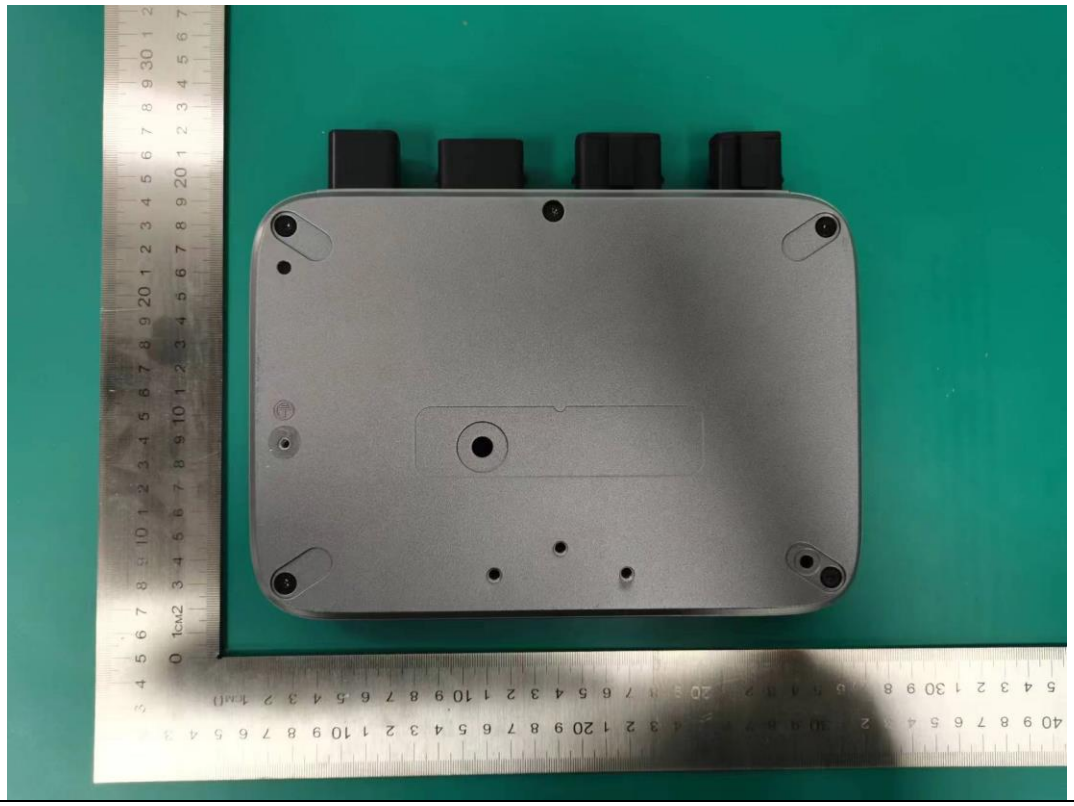


Appendix 3: Pictures

Enclosure – Front View

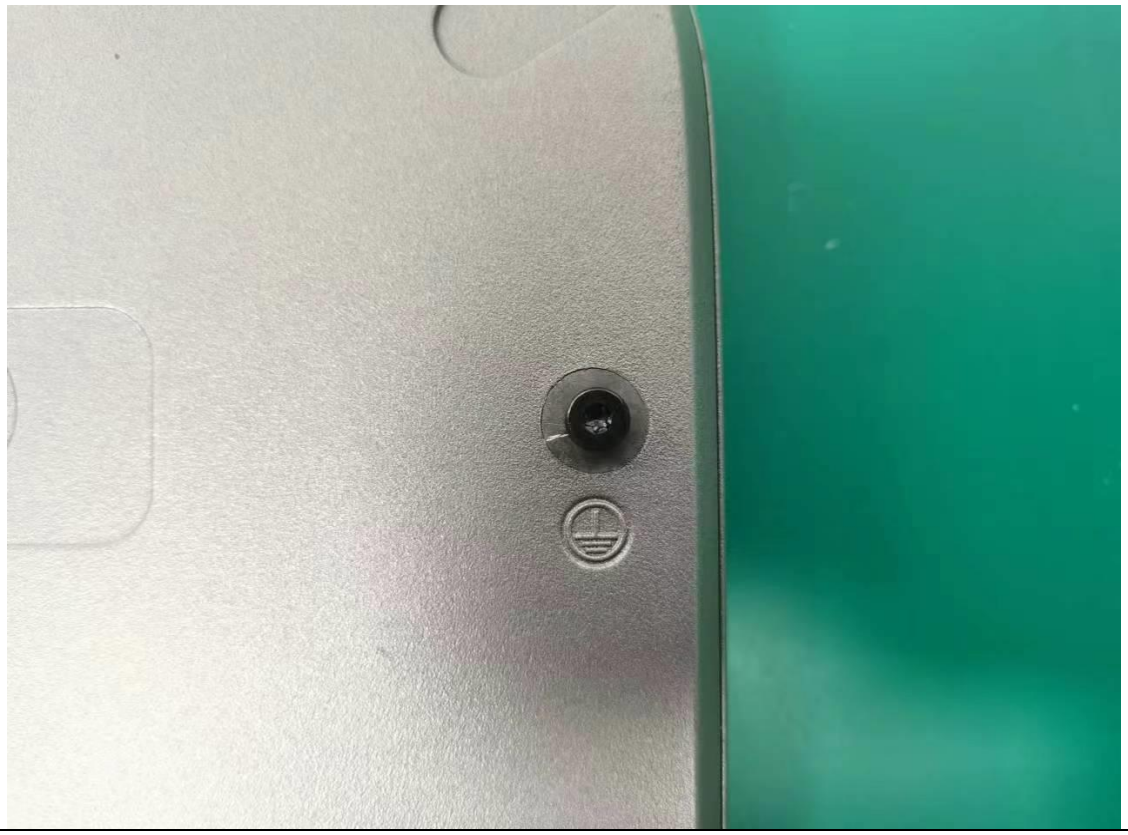


Enclosure – Rear View

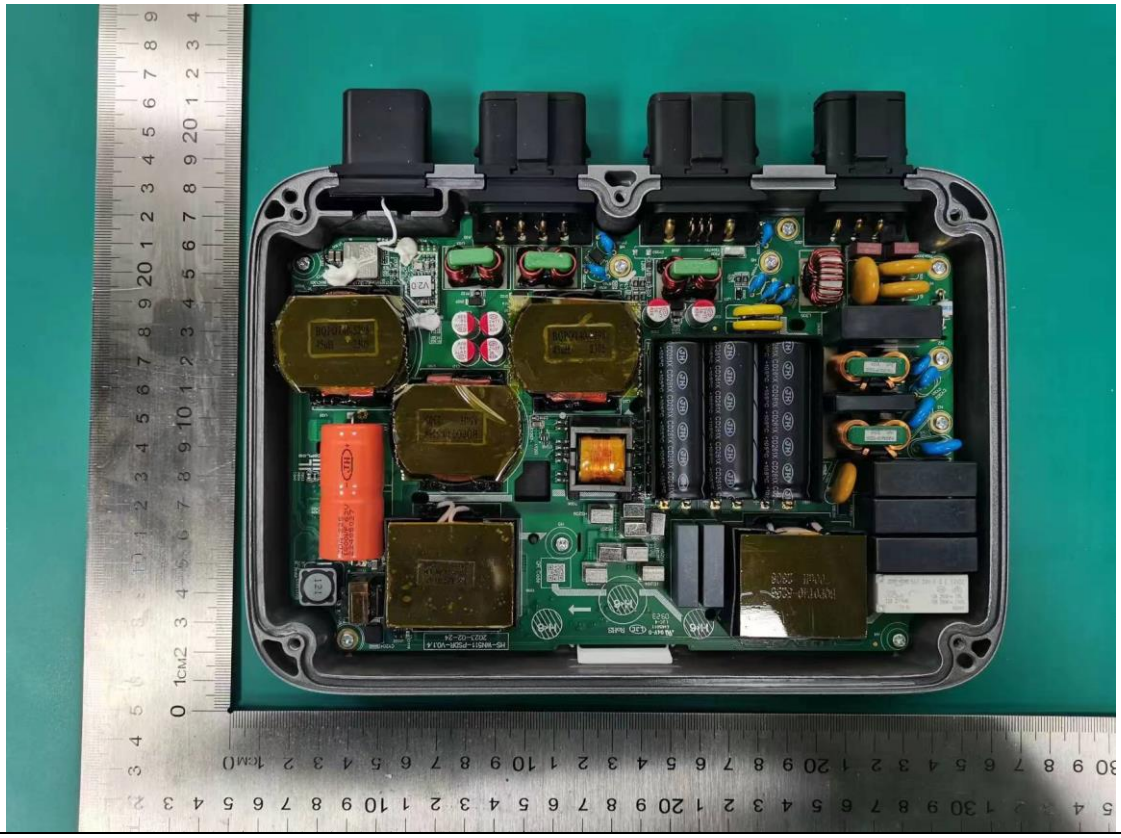


Connectors

Protective earthing terminal

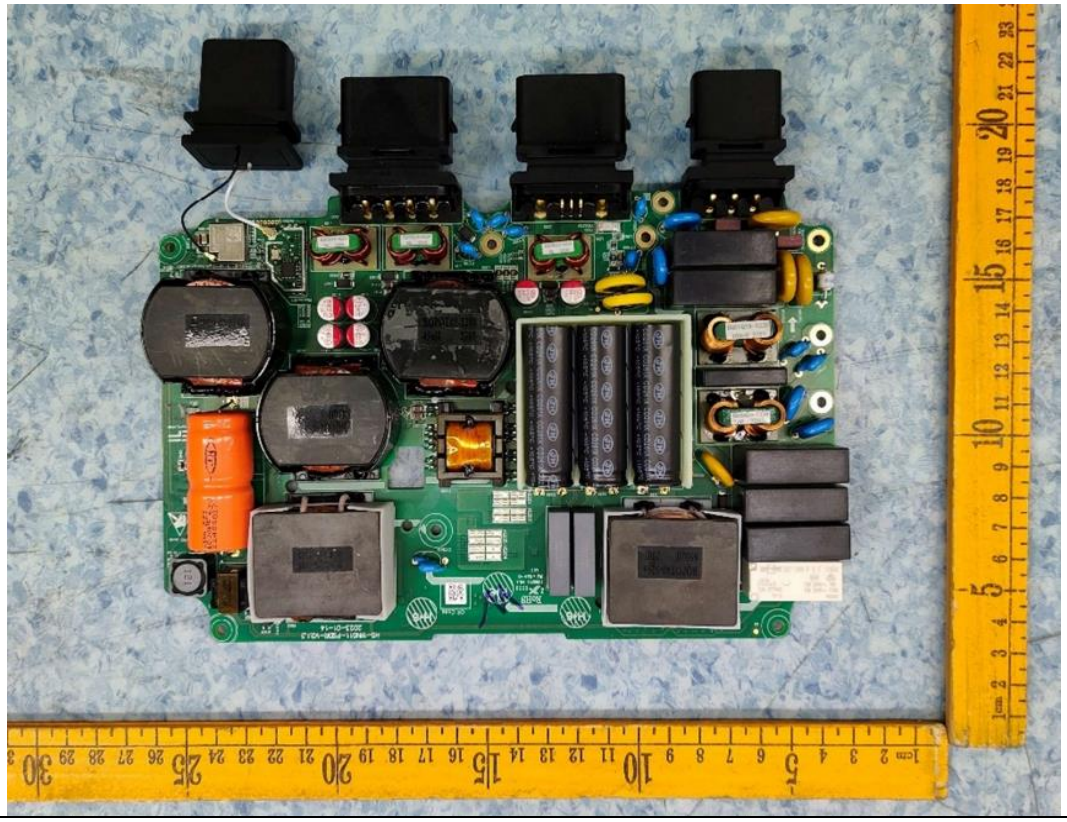


Internal view of inverter

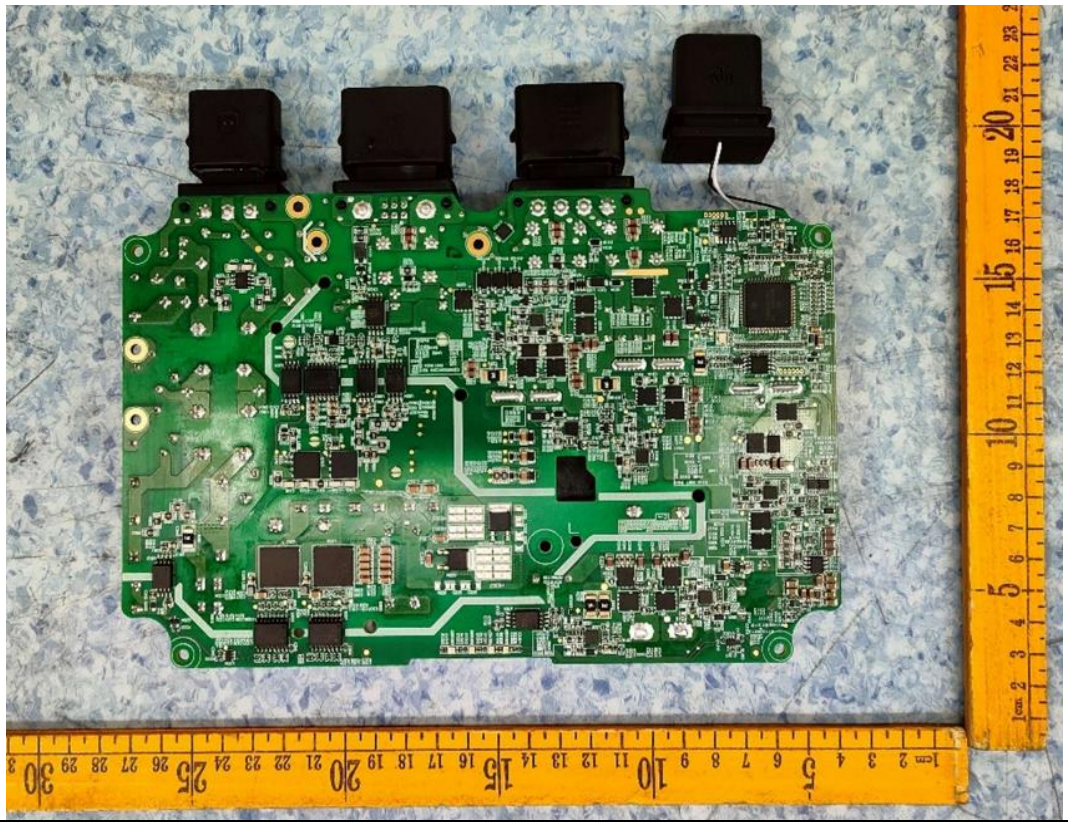


Internal view of inverter (potting)

PCB- Front side



PCB-Rear side



Appendix 4: Test equipment list

Equipment Name	Equipment Number	Manufacturer	Type/Model	Last Cal Date
PV Simulator	EC-7B-LO-PVS-001	CHROMA	62020H-150S	2022/07/31
Grid Simulator	EC-7B-6-PVSR-20211203-002	CHROMA	61815	2022/07/31
RLC Load	EC-7B-ROAD-20211-001	YIMAISI	IMAS5331	2022/07/31
Power analyzer	EC-01-PA-20221115-001	ZLG	PA5000H	2022/08/06
Digital oscilloscope	EC-7B-6-OS-20210419-024	ZLG	ZDS3024Plus	2022/07/30
Digital oscilloscope	EC-7B-OS-20210715-047	Tektronix	C061054	2022/07/31
Multimeter	EC-7B-20-MM-005	FLUKE	17B	2022/07/30
Current Probe	EC-7B-6-CP-20210726-026	CYBERTEK	CP8150A	2022/07/30
Voltage Probe	EC-7B-6-VP-20210726-026	CYBERTEK	P1300	2022/07/30
Temperature / Humidity Chamber	100020200392	YOKOGAWA	GP20	2023/1/6
DC Power supply	EC-7B-6-PVS-20210531-003	CHROMA	62150H-600S	2022/07/31

--- End of test report---