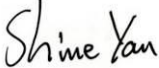





<p>TEST REPORT</p> <p>Engineering Recommendation G98/1-6</p> <p>Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks on or after 27 April 2019</p>	
Report	
Report Number.....	: 6136782.50
Date of issue.....	: 2022-08-10
Total number of pages.....	: 69 pages
Testing Laboratory	: DEKRA Testing and Certification (Suzhou) Co., Ltd.
Address	: No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
Applicant's name	: Afore New Energy Technology (Shanghai) Co., Ltd.
Address	: Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China
Test specification:	
Standard.....	: Engineering Recommendation G98 Issue 1 – Amendment 6: 2021
Test procedure	: Type test
Non-standard test method.....	: N/A
Test Report Form No.	: G98/1-6_V1.0
Test Report Form(s) Originator	: DEKRA Testing and Certification (Suzhou) Co., Ltd.
Master TRF	: Dated 2022-06
Test item description	: On-Grid PV Inverter
Trade Mark	: 
Manufacturer	: Afore New Energy Technology (Shanghai) Co., Ltd. Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China
Model/Type reference	: BNT003KTL, BNT004KTL, BNT005KTL, BNT006KTL, BNT008KTL, BNT010KTL

Ratings	Operating temperature range: - 25°C to + 60°C Protective class: I Ingress protection rating: IP65 Power factor range (adjustable): 0.8 leading...0.8 lagging
	BNT003KTL: PV input: Max. 1100 Vdc, MPPT voltage range: 150-1000 Vdc, max 15*2 A, Isc PV: 25*2 A AC Output: 3P+N+PE/ 3P+PE, 230/ 400 Vac, 50/ 60 Hz, Nominal 3000 VA, rated 4.4 A, max 5.3 A
	BNT004KTL: PV input: Max. 1100 Vdc, MPPT voltage range: 150-1000 Vdc, max 15*2 A, Isc PV: 25*2 A AC Output: 3P+N+PE/ 3P+PE, 230/ 400 Vac, 50/ 60 Hz, Nominal 4000 VA, rated 5.8 A, max 7.0 A
	BNT005KTL: PV input: Max. 1100 Vdc, MPPT voltage range: 150-1000 Vdc, max 15*2 A, Isc PV: 25*2 A AC Output: 3P+N+PE/ 3P+PE, 230/ 400 Vac, 50/ 60 Hz, Nominal 5000 VA, rated 7.3 A, max 8.5 A
	BNT006KTL: PV input: Max. 1100 Vdc, MPPT voltage range: 150-1000 Vdc, max 15*2 A, Isc PV: 25*2 A AC Output: 3P+N+PE/ 3P+PE, 230/ 400 Vac, 50/ 60 Hz, Nominal 6000 VA, rated 8.7 A, max 10.5 A
	BNT008KTL: PV input: Max. 1100 Vdc, MPPT voltage range: 150-1000 Vdc, max 15*2 A, Isc PV: 25*2 A AC Output: 3P+N+PE/ 3P+PE, 230/ 400 Vac, 50/ 60 Hz, Nominal 8000 VA, rated 11.6 A, max 13.5 A
	BNT010KTL: PV input: Max. 1100 Vdc, MPPT voltage range: 150-1000 Vdc, max 15*2 A, Isc PV: 25*2 A AC Output: 3P+N+PE/ 3P+PE, 230/ 400 Vac, 50/ 60 Hz, Nominal 10000 VA, rated 14.5 A, max 17.0 A

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	Testing Laboratory:	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Testing location/ address		No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
Tested by (name, function, signature)		Shine Yan (ENG) 
Approved by (name, function, signature) ..		Jason Guo (REW) 
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/ address		
Tested by (name, function, signature)		
Approved by (name, function, signature) ..		
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/ address		
Tested by (name + signature)		
Witnessed by (name, function, signature) ..		
Approved by (name, function, signature) ..		
<input type="checkbox"/>	Testing procedure: CTF Stage 3:	
<input type="checkbox"/>	Testing procedure: CTF Stage 4:	
Testing location/ address		
Tested by (name, function, signature)		
Witnessed by (name, function, signature) ..		
Approved by (name, function, signature) ..		
Supervised by (name, function, signature) :		

List of Attachments (including a total number of pages in each attachment): Appendix 1: Type Verification Test Report (38 pages) Appendix 2: Photo Documentation (7 pages)	
Summary of testing:	
Tests performed (name of test and test clause): Full applicable clauses test according to standards: Engineering Recommendation G98 Issue 1 – Amendment 6: 2021	Testing location: DEKRA Testing and Certification (Suzhou) Co., Ltd. No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China

Copy of marking plate:

Afore | NEW ENERGY

Mode: 003 004 005 006 008 010
BNTxxxKTL

Pdc Max (W)	5100	6000	7500	9000	12000	15000
Voc PV Max (V)	1100					
Vdc MPPT (V)	150-1000					
Idc Max (A)	15 x 2					
Isc PV Max (A)	25 x 2					
Pac Nom (W)	3000	4000	5000	6000	8000	10000
Iac Max (A)	5.3	7	8.5	10.5	13.5	17
Vac Nom (V)	3P+N+PE / 3P+PE 230/400					

Mode: 012 013 015 017 020 025
BNTxxxKTL

Pdc Max (W)	18000	19500	22500	25500	30000	37500
Voc PV Max (V)	1100					
Vdc MPPT (V)	150-1000					
Idc Max (A)	15 x 2	15 x 2	20+32	32 x 2	32 x 2	32 x 2
Isc PV Max (A)	25 x 2	30+48	48 x 2			
Pac Nom (W)	12000	13000	15000	17000	20000	25000
Iac Max (A)	21.5	22	27	30	32	40
Vac Nom (V)	3P+N+PE / 3P+PE 230/400					
Fac Nom (Hz)	50/60					
Power Factor	1 (-0.8~+0.8 adjustable)					
Protective Class	I					
Operating temperature range	-25 ~ +60 °C (Derating 45 °C)					
IP Degree	IP65					

S/N T06021-04

⚡ ⚠ ⚡ CE ⚡ 5 min RoHS

T +86-21-54326236 F +86-21-54326136 Afore New Energy Technology (Shanghai) Co., Ltd.
 W www.aforeenergy.com E info@aforeenergy.com Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China. 201112

Remark:

As Great Britain public Low Voltage Distribution Networks grid code G98 required, only 230 Vac / 50Hz output setting was verified in this test report. And this report only for the generator which is no greater than 16 A per phase.

Warning Label:

WARNING



Hot surfaces

To reduce the risk of burns. Do not touch.



Risk of electric shock

Both AC and DC voltage sources are terminated inside this equipment. Each circuit must be individually disconnected before servicing and when the photovoltaic array is exposed to light, it supplies a DC voltage to this equipment.



Risk of electric shock from energy stored in capacitor. Do not remove cover until 5 minutes after disconnecting all sources of supply.



Risk of electric shock, do not remove cover. No user serviceable parts inside. Refer servicing to qualified service personnel.



Check user manual before service

Refer to the operation instruction.



NO warranty for disassembled inverter

Warranty doesn't provide for the inverter disassembled by non-authorized staff.

	WARNING:	POWER FED FROM MORE THAN ONE SOURCE
For continued protection against risk of fire, replace only with same type and ratings of fuse.		



Electronic Materials

Please scan the QR code below with your mobile phone to obtain relevant electronic information.

MONITORING APP



e USER MANUAL



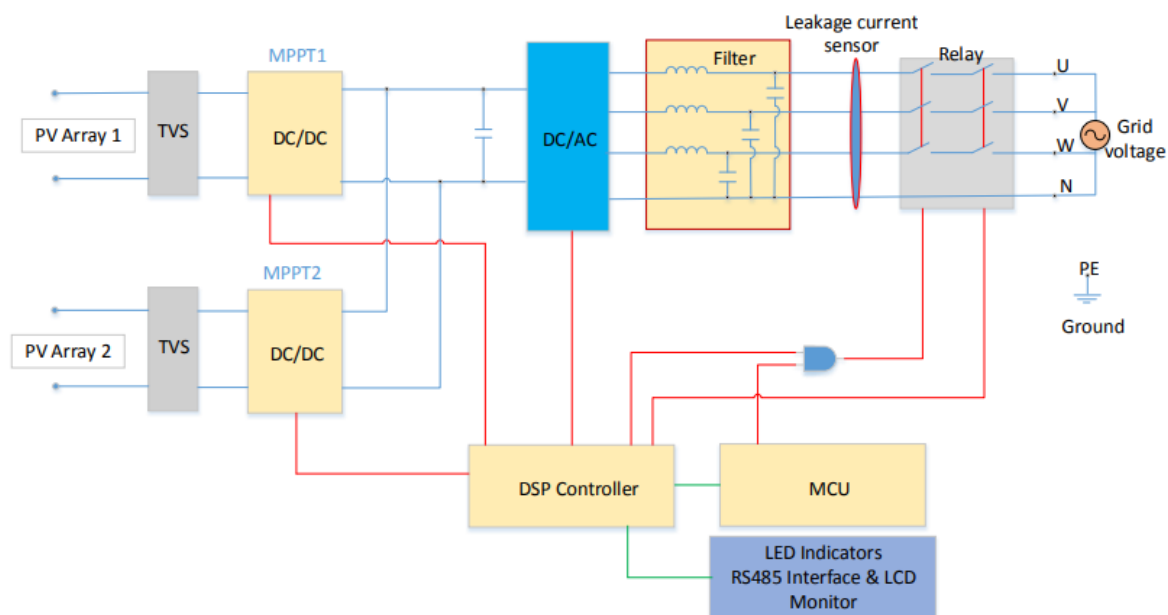
7140-0056/V0.01

Test item particulars:			
Equipment mobility	: movable <u>fixed</u>	hand-held transportable	stationary for building-in
Connection to the mains	: pluggable equipment <u>permanent connection</u>		direct plug-in for building-in
Environmental category	: <u>outdoor</u>	indoor unconditional	indoor conditional
Over voltage category Mains.....	: OVC I	OVC II	<u>OVC III</u> OVC IV
Over voltage category PV	: OVC I	<u>OVC II</u>	OVC III OVC IV
Mains supply tolerance (%).....	: -80% / +119%		
Tested for power systems	: TN		
IT testing, phase-phase voltage (V).....	: N/A		
Class of equipment.....	: <u>Class I</u> Not classified	Class II	Class III
Mass of equipment (kg)	: 16 kg		
Pollution degree	: Outside PD3; Inside PD2		
IP protection class	: IP65		
Possible test case verdicts:			
- test case does not apply to the test object	: N/A		
- test object does meet the requirement.....	: P (Pass)		
- test object does not meet the requirement	: F (Fail)		
- test object does not evaluate according to manufacturer requirements	: N/E		
- this clause is information reference for installation....	: Info.		
Testing:			
Date of receipt of test item	: 2022-06-23 (samples provided by applicant)		
Date (s) of performance of tests	: 2022-06-24 to 2022-07-28		
General remarks:			
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.			
The information provided by the customer in this report may affect the validity of the results, the test lab is not responsible for it.			
This report is not used for social proof function in China market.			
"(see Enclosure #)" refers to additional information appended to the report.			
"(See appended table)" refers to a table appended to the report.			
Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.			
Name and address of factory (ies):			
Afore New Energy Technology (Shanghai) Co., Ltd.			
Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China			

General product information:

The products are three-phase On-Grid PV Inverter which converts DC voltage into AC voltage.

The unit is providing EMC filtering at the input and output towards mains. The output was switched off redundant by the high-power switching bridge and relays in series. This assures that the opening of the output circuit will also operate in case of one error.

Block Diagram:**Description of the electrical circuit and functional safety (redundancy control):**

The internal control is redundant built. It consists out of two Microcontroller DSP, the master DSP can control the relays, measures voltage, frequency, AC current with injected DC, insulation resistance and residual current. The slave DSP can control the relay, measures the voltage and frequency. Both microcontrollers communicate with each other.

The voltage and frequency measurement were performed with resistors in serial that were connected directly to line and neutral. Both controllers get these signals and analyse the data.

The unit provides relays in series in line and neutral. The relays are test before each start up. In addition, the power bridge can be stopped by both DSP.

The product operating temperature range: -25°C to $+60^{\circ}\text{C}$

Model difference:

All the models are classified as one family because they are identical in hardware and similar in software. The models of BNT008KTL and BNT010KTL both have an external fan, but models from BNT003KTL to BNT006KTL do not have a fan.

The product was tested on:

If no special state, the tests were performed on model BNT010KTL also applicable for all other models stated in this report.

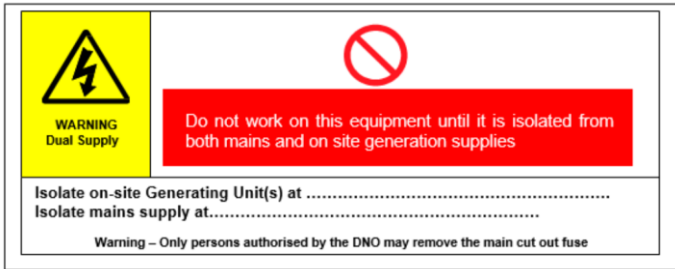
Hardware version: V06

Software version: V06

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
5	CONNECTION PROCEDURE		-
5.1	Single Premises Connection Procedure		-
5.1.1	In most instances the installation of Micro-generating Plant, the aggregate Registered Capacity of which is no greater than 16 A per phase, connected in parallel with the public Low Voltage Distribution Network, will have negligible impact on the operation of the public Low Voltage Distribution Network; as such there will be no need for the DNO to carry out detailed network studies to assess the impact of the connection. As required by the ESQCR Certificate of Exemption (2008) the Installer shall provide the DNO with all necessary information on the installation no later than 28 days after the Micro-generating Plant has been commissioned; the format and content shall be as shown in Appendix 3 Form B Installation Document.		Info.
5.1.2	This procedure will not apply where an Installer plans (within the next 28 days) or has already installed (in the previous 28 days) other Micro-generating Plants in a Close Geographic Region; in this case the procedure in 5.2 shall be followed. Failure to comply with this requirement may lead to the disconnection of the Micro-generating Plant under ESQCR (26) or failure of the Micro-generating Plant to operate as intended.		Info.
5.2	Multiple Premises Connection Procedure		-
5.2.1	In the case of projects where the proposal is to install single or multiple Micro-generators in a number of Customer Installations in a Close Geographic Region, the Installer shall discuss the installation project with the local DNO at the earliest opportunity. The DNO will need to assess the impact that these connections may have on the Distribution Network and specify conditions for connection. The initial application will need to be in a format similar to that shown in Appendix 3 Form A. Connection of the Micro-generator is only allowed after the application for connection has been approved by the DNO and any DNO works facilitating the connection have been completed. Confirmation of the commissioning of each Micro-generator will need to be made no later than 28 days after commissioning; the format and content shall be as shown in Appendix 3 Form B Installation Document.		Info.
5.2.2	Upon receipt of a multiple premises connection application the DNO's response will be in accordance with the electricity generation standards set by the Authority for applications for connection to the Distribution Network.		Info.
5.3	General		Info.

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
5.3.1	<p>It is the responsibility of the Installer to ensure that the relevant information as specified in this section and in section 6 is forwarded to the local DNO as appropriate. The pro formas in Appendix 3 are designed to:</p> <ul style="list-style-type: none"> a) simplify the connection procedure for both DNO and Micro-generator Installer; b) provide the DNO with all the information required to assess the potential impact of the Micro-generator connection on the operation of the Distribution Network; c) inform the DNO that the Micro-generator installation complies with the requirements of this EREC G98; and d) allow the DNO to accurately record the location of all Micro-generators connected to the Distribution Network. 		Info.
6	CERTIFICATION REQUIREMENTS		P
6.1	Type Test Certification		P
6.1.1	Type Tested certification is the responsibility of the Manufacturer. The Manufacturer shall make available upon request a Type Test Verification Report confirming that the Micro-generator has been tested to satisfy the requirements of this EREC G98. The report shall detail the type and model of Micro-generator tested, the test conditions and results recorded. All of these details shall be included in a Type Test Verification Report. The required verification report and declaration are shown in Appendix 3 Form C. It is intended that Manufacturers of Micro-generators will use the requirements of this EREC G98 to develop type verification certification for each of their Micro-generator models.		P
6.1.2	Manufacturers of a Fully Type Tested Micro-generator should allocate a Manufacturer's reference number with the required details of the Micro-generator with the Energy Networks Association Type Test Verification Report Register.		P
6.2	Compliance		P
6.2.1	Compliance with the requirements detailed in this EREC G98 will ensure that the Micro-generator(s) is considered to be approved for connection to the DNO's Distribution Network.		P
6.2.2	The Micro-generator(s) shall conform to all relevant European Directives and should be labelled with a CE marking.		P
6.3	Family approach to Type Testing		P

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
6.3.1	A family approach to type testing is acceptable, whereby Micro-generators that are the same model and produced by the same Manufacturer but vary in electrical output can be considered to be Fully Type Tested once one Micro-generator in the family has been shown to be compliant. ⁴ The approach is permissible in the following range of Micro-generator electrical output:		P
	<ul style="list-style-type: none"> • For synchronous Micro-generators: <ul style="list-style-type: none"> o Lower limit: $1/\sqrt{10}$ (0.3162) times the tested Micro-generator nameplate rating (W) o Upper limit: $\sqrt{10}$ (3.162) times the tested Micro-generator nameplate rating (W) 		N/A
	<ul style="list-style-type: none"> • For all other Micro-generators: <ul style="list-style-type: none"> o Lower limit: $1/\sqrt{10}$ (0.3162) times the tested Micro-generator nameplate rating (W) o Upper limit: 2 times the tested Micro-generator nameplate rating (W) 		P
6.3.2	All absolute values (e.g. operating range tests) from the tested Micro-generator shall be transferred directly in the compliance forms of an assumed compliant Microgenerator of the same family. All relative results related to design Active Power or current (e.g. power quality fluctuation and flicker) from the tested Micro-generator shall be transferred to the compliance form of a Micro-generator in the same family according to the ratio of the respective nameplate rating (W) of the tested Microgenerator and the assumed compliant Micro-generator. For the avoidance of doubt, the Manufacturer shall register each Micro-generator in the family on the Energy Networks Association Type Test register.		P
6.3.3	It is the responsibility of the Manufacturer to provide technical justification that the results are transferable. For example, the Micro-generators have the same control systems.		P
7	OPERATION AND SAFETY		P
7.1	Operational Requirements		P
7.1.1	Compliance with this EREC G98 in respect of the design, installation, operation and maintenance of a Micro-generating Plant, will ensure that the Customer is discharging their legal obligations under ESQCR 22(1)(a) and the EU Network Code on Requirements for Grid Connection of Generators.		P
7.2	Installation Wiring and Isolation		Info.

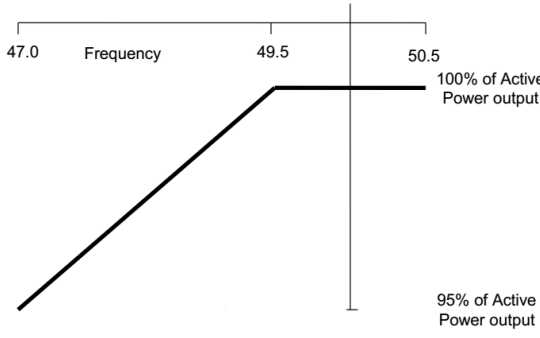
G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.1	The installation that connects the Micro-generating Plant to the Connection Point shall comply with the requirements of BS 7671. All wiring between the Connection Point and the Micro-generator(s) shall be protected by a suitably rated protective device and shall be of suitable size and type for the rating of the Micro-generator. The Micro-generator(s) shall be connected via an accessible isolation switch that is capable of isolating all phases and neutral. The isolation switch shall be capable of being secured in the 'off' (isolated) position.	Must be taken under consideration for the installation.	Info.
7.3	Labelling		Info.
7.3.1	<p>The Installer shall provide labelling at the Connection Point with the DNO's Distribution Network (cut-out), meter position, consumer unit and at all points of isolation between the Connection Point and the Micro-generating Plant within the Customer's premises to indicate the presence of a Micro-generating Plant. The labelling should be sufficiently robust and if necessary fixed in place to ensure that it remains legible and secure for the lifetime of the installation. Warning labels of the form shown in Figure 1 shall be used. It should be noted that the warning label does not imply a right on the Customer, Installer or maintainer to operate (remove / replace) the DNO's cut-out fuse and a note to this effect should be included on the warning label.</p> <div data-bbox="292 1144 970 1411" style="border: 1px solid black; padding: 5px; margin: 10px 0;">  <p style="text-align: center;">Isolate on-site Generating Unit(s) at</p> <p style="text-align: center;">Isolate mains supply at.....</p> <p style="text-align: center; font-size: small;">Warning - Only persons authorised by the DNO may remove the main cut out fuse</p> </div> <p style="text-align: center;">Figure 1 – Example of a Warning Label</p>	Must be taken under consideration for the installation.	Info.
7.3.2	In addition to the warning label, this EREC G98 requires the following, up to date, information to be displayed at the Connection Point with the DNO's Distribution Network.		Info.
	a) A circuit diagram relevant to the installation showing the circuit wiring, including all protective devices, between the Micro-generator and the DNO's fused cut-out. This diagram should also show by whom all apparatus is owned and maintained; and	Must be taken under consideration for the installation.	Info.
	b) A summary of the Interface Protection settings incorporated within the Micro-generator.	Must be taken under consideration for the installation.	Info.

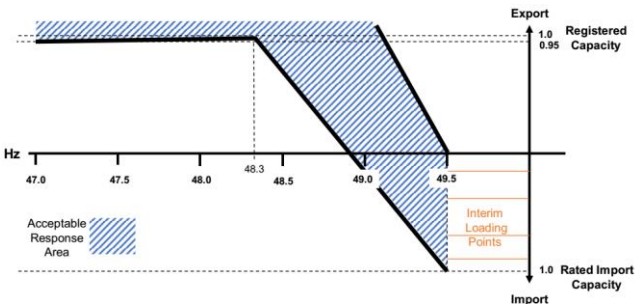
G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
7.3.3	<p>Figure 2 shows an outline example of the type of circuit diagram that will need to be displayed. Figure 2 is non-prescriptive and is for illustrative purposes only.</p> <p style="text-align: center;">Figure 2 – Example of the type of circuit diagram</p>		Info.
7.3.4	<p>The Installer shall advise the Customer that it is the Customer's responsibility to ensure that this safety information is kept up to date. The installation operating instructions shall contain the Manufacturer's contact details eg name, telephone number and web address.</p>	Must be taken under consideration for the installation.	Info.
7.4	Maintenance & Routine Testing		N/A
7.4.1	<p>Periodic testing of the Micro-generator is recommended at intervals prescribed by the Manufacturer. This information shall be included in the installation and user instructions. The method of testing and/or servicing should be included in the servicing instructions.</p>	Must be taken under consideration after the installation.	N/A
7.5	Phase Unbalance		N/A
7.5.1	<p>There is no requirement to balance phases on installations below or equal to 16 A per phase.</p>		N/A
7.5.2	<p>For multiple installations of Micro-generators (eg new housing developments), balancing the Micro-generators evenly against the load on the three phases will need to be considered by the DNO. The DNO will advise the Installer of any phase balancing requirements.</p>	Three phase inverter up to 16 A.	N/A
7.6	Voltage Management Units		P

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.1	If a Voltage Management Unit is installed in a Customer's Installation between the Connection Point and the Micro-generator, it may result in the voltage at the Micro-generator side of the Voltage Management Unit remaining within the limits of the protection settings defined in Table 2 while the voltage at the Connection Point side of the unit might be outside the limits of the protection settings. This would negate the effect of the protection settings. Therefore, this connection arrangement is not acceptable and all Micro-generators connected to the DNO's LV Distribution Network under this EREC G98 shall be made on the Connection Point side of any Voltage Management Unit installed in a Customers' Installation.		P
7.7	Earthing		P
7.7.1	There shall be no direct connection between the Micro-generator current carrying conductors and earth with the following exception: For a Micro-generator that is connected via an Inverter (eg a PV array or fuel cell) it is permissible to connect one pole of the DC side of the Inverter to the DNO's earth terminal if the insulation between the AC and the DC sides of the Inverter meets the requirements for at least simple separation. The requirements for simple separation are those given in Section 5.3.3 of BS EN 60664-1 for basic insulation. In such cases the Installer shall take all reasonable precautions to ensure that the Micro-generating Plant will not impair the integrity of the DNO's Distribution Network and will not suffer unacceptable damage for all credible operating conditions, including faults on the DNO's Distribution Network.		P
7.7.2	Earthing of all exposed conductive parts shall comply with the requirements of BS 7671.		P
8	COMMISSIONING, NOTIFICATION AND DECOMMISSIONING		Info.
8.1	General		Info.
8.1.1	The installation shall be carried out by Installers who are competent and have sufficient skills and training (complete with recognised and approved qualifications relating to the fuels used and general electrical installations) to apply safe methods of work to install a Micro-generator in compliance with this EREC G98.	Must be taken under consideration for the installation.	Info.
	Notwithstanding the requirements of this EREC G98, the installation will be carried out to no lower a standard than that required in the Manufacturer's installation instructions.		Info.
8.2	Commissioning		Info.
8.2.1	No parameter relating to the electrical connection and subject to type verification certification shall be modified unless previously agreed in writing between the DNO and the Customer or their agent. Customer access to such parameters shall be prevented.		Info.

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
8.2.2	As part of the on-site commissioning tests the Installer shall carry out a functional check of the loss of mains protection, for example by removing the supply to the Micro-generator during operation and checking that the Interface Protection operates to disconnect the Micro-generator from the DNO's Distribution Network. For three phase installations this test can be achieved by opening a three phase circuit breaker or isolator and confirming that the Micro-generator has shut down. Testing for the loss of a single phase is covered in the type testing of Inverters, see section 10.2.		Info.
8.3	Notification of Commissioning		Info.
8.3.1	In accordance with ESQCR and the HSE Certificate of Exemption (2008) (see Appendix 4) the Installer shall ensure that the DNO is advised of the intention to use the Micro-generator in parallel with the Distribution Network no later than 28 days (inclusive of the day of commissioning) after commissioning the Micro-generator. Notification that the Micro-generator has been commissioned is achieved by completing an Installation Document as per Appendix 3 Form B (Installation Document), which also includes the relevant details on the Micro-generator installation required by the DNO.		Info.
8.3.2	The Installer shall supply separate Installation Documents for each premises in which Micro-generators are installed under EREC G98. Documentation may be submitted via an agent acting on behalf of the Installer and may be submitted electronically.		Info.
8.4	Notification of Changes		Info.
8.4.1	If a Micro-generator requires modification the Manufacturer must re-submit the Type Test Verification Report prior to the modification being made and the Micro-generator being recommissioned.		Info.
8.4.2	The DNO shall be notified of any operational incidents or failures of a Micro-generator that affect its compliance with this EREC G98, without undue delay, after the occurrence of those incidents.		Info.
8.4.3	The DNO shall have the right to request that the Customer arrange to have compliance tests undertaken after any failure, modification or replacement of any equipment that may have an impact on the Micro-generator's compliance with this EREC G98.		Info.

G98/1-6															
Clause	Requirement - Test	Result - Remark	Verdict												
8.4.4	Where an existing Micro-generator installed under EREC G83 is substantially modified (eg a significant piece of equipment, such as an inverter, is replaced) then it will be necessary for that Micro-generator to be modified to be compliant with this EREC G98. Modifications to an existing Micro-generator which complies with the requirements of EREC G83 that are not considered to be substantial do not change the compliance requirements of that Micro-generator, ie it can remain compliant with EREC G83.		Info.												
8.5	Notification of Decommissioning		Info.												
8.5.1	The Customer shall notify the DNO about the permanent decommissioning of a Micro-generator by providing the information as detailed under Appendix 3 Form D. Documentation may be submitted by an agent acting on behalf of the Customer and may be submitted electronically.		Info.												
9	GENERAL TECHNICAL REQUIREMENTS		P												
9.1	Frequency withstand		P												
9.1.1	The Micro-generator shall be capable of remaining connected to the Distribution Network and operating within the frequency ranges and time periods specified in Table 1 unless disconnection was triggered by rate-of-change-of-frequency-type loss of mains protection.		P												
	Table 1 – Minimum time periods for which a Micro-generator has to be capable of operating within different frequency ranges without disconnecting from the Distribution Network	See appended table.	P												
	<table border="1"> <tbody> <tr> <td>47.0 Hz – 47.5 Hz</td> <td>20 seconds</td> </tr> <tr> <td>47.5 Hz – 48.5 Hz</td> <td>90 minutes</td> </tr> <tr> <td>48.5 Hz -49.0 Hz</td> <td>90 minutes</td> </tr> <tr> <td>49.0 Hz – 51.0 Hz</td> <td>Unlimited</td> </tr> <tr> <td>51.0 Hz – 51.5 Hz</td> <td>90 minutes</td> </tr> <tr> <td>51.5 Hz – 52.0 Hz</td> <td>15 minutes</td> </tr> </tbody> </table>	47.0 Hz – 47.5 Hz	20 seconds	47.5 Hz – 48.5 Hz	90 minutes	48.5 Hz -49.0 Hz	90 minutes	49.0 Hz – 51.0 Hz	Unlimited	51.0 Hz – 51.5 Hz	90 minutes	51.5 Hz – 52.0 Hz	15 minutes		
47.0 Hz – 47.5 Hz	20 seconds														
47.5 Hz – 48.5 Hz	90 minutes														
48.5 Hz -49.0 Hz	90 minutes														
49.0 Hz – 51.0 Hz	Unlimited														
51.0 Hz – 51.5 Hz	90 minutes														
51.5 Hz – 52.0 Hz	15 minutes														
9.2	Rate of Change of Frequency		P												
9.2.1	With regard to the rate of change of frequency withstand capability, a Micro-generator shall be capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1.0 Hzs ⁻¹ measured over 500 ms.	See appended table.	P												
9.3	Limited Frequency Sensitive Mode – Overfrequency		P												

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Clause	Requirement - Test	Result - Remark	Verdict
9.3.1	With regard to the Limited Frequency Sensitive Mode — Overfrequency (LFSMO), the Micro-generator shall be capable of reducing its Active Power output when the frequency rises above 50.4 Hz. The Droop shall be 10%. No intentional delay should be programmed to ensure that the initial delay is as short as possible with a maximum of 2 s.	See appended table.	P
9.3.2	The Micro-generator will continue to reduce power with rising frequency with a Droop of 10% until 52.0 Hz, at which point the Micro-generator should disconnect.		P
9.3.3	If the reduction in Active Power output is such that the Micro-generator reaches its minimum stable operating level, it shall continue to operate stably at this level.		P
9.3.4	Steady state operation below a Micro-generator's minimum stable operating level is not expected but if system frequency would cause operation below its minimum stable operating level then the Micro-generator shall be able to deliver an output of not less than the minimum stable operating level.		P
9.4	Active Power Output		P
9.4.1	The Micro-generator shall be capable of maintaining constant output at its Registered Capacity regardless of changes in frequency, except where the output follows the changes defined in the context of paragraphs 9.3.1 and 9.4.2.		P
9.4.2	<p>The Micro-generator shall be capable of maintaining constant Active Power output at its Registered Capacity regardless of changes in frequency in the range 49.5 – 50.4 Hz. Below 49.5 Hz, the Active Power output should not drop by more than prorata with frequency, ie the maximum permitted requirement is 100% power at 49.5 Hz falling linearly to 95% power at 47.0 Hz as illustrated in Figure 3.</p>  <p style="text-align: center;">Figure 3 – Change in Active Power output with falling frequency</p>	See appended table.	P

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Clause	Requirement - Test	Result - Remark	Verdict
9.4.3	<p>This paragraph describes an optional performance characteristic as discussed in the foreword. A Micro-generating Plant that incorporates an Electricity Storage device can support the Total System by being arranged to automatically respond to falling frequency in line with the characteristic of Figure 4.</p>  <p>Figure 4 Change in Active Power of Electricity Storage with falling frequency (not to scale)</p>	Not Electricity Storage device.	N/A
	<p>The required characteristics are:</p> <ol style="list-style-type: none"> When the frequency falls to 49.5 Hz the automatic response shall start; The frequency response characteristic shall be within the shaded area of Figure 4; If the Electricity Storage device is not capable of moving from an import level to an appropriate export level within 20 s of the frequency falling to 49.2 Hz, then it shall cease to import; and If the Electricity Storage device has not achieved at least zero Active Power import when the frequency has reached 48.9 Hz it shall cease to import immediately. 		N/A
9.4.4	<p>The Micro-generator shall be equipped with a logic interface (input port) in order to cease Active Power output within 5 s following an instruction being received from the DNO at the input port. By default the logic interface will take the form of a simple binary output that can be operated by a simple switch or contactor. When the switch is closed the Micro-generator can operate normally. When the switch is opened the Micro-generator will reduce its Active Power to zero within 5 s. The signal from the Micro-generator that is being switched can be either AC (maximum value 240 V) or DC (maximum value 110 V). The DNO may specify any additional requirements particularly regarding remote operation of this facility.</p>		P
9.5	Power Factor		P
9.5.1	<p>The power factor capability of the Micro-generator shall conform to EN 50549-1. When operating at Registered Capacity the Micro-generator shall operate at a power factor within the range 0.95 lagging to 0.95 leading relative to the voltage waveform unless otherwise agreed with the DNO eg for power factor improvement.</p>	See appended table.	P

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Clause	Requirement - Test	Result - Remark	Verdict
9.6	Automatic Connection		P
9.6.1	Micro-generators shall conform to EN 50549-1 in respect of connection and starting to generate electric power. Connection, reconnection and starting to generate electrical power is only allowed after the voltage and frequency at the Connection Point is within the limits of the Interface Protection settings for a minimum of 20 s.		P
9.7	Cyber Security		N/E
9.7.1	Every Micro-generator and any associated equipment must be designed and operated appropriately to ensure cyber security. The Manufacturer or Installer shall consider all cyber security risks applicable to the Micro-Generator both in terms of the communication between any home energy management system etc and also in terms of interaction with any system of the Manufacturer for product management.		N/E
9.7.2	The Manufacturer or Installer shall provide information describing the high level cyber security approach, as well as the specific cyber security requirements complied with. The statement will make appropriate reference to the Micro-generator's compliance with		N/E
	<ul style="list-style-type: none"> ETSI EN 303 645; 		N/E
	<ul style="list-style-type: none"> relevant aspects of PAS 1879 "Energy smart appliances – Demand side response operation – Code of practice; 		N/E
	<ul style="list-style-type: none"> relevant aspects of "Distributed Energy Resources – Cyber Security Connection Guidance" published by BEIS and the ENA; 		N/E
	<ul style="list-style-type: none"> Any other relevant standard that has been incorporated in the design of the Micro-Generator. 		N/E
10	INTERFACE PROTECTION		P
10.1	General		P
10.1.1	The Micro-generator shall conform to the Interface Protection settings set out below (Table 2). Means shall be provided to protect the settings from unpermitted interference (eg via a password or seal).	Interface protection settings protected via a password.	P
10.1.2	The DNO is responsible under the Distribution Code for ensuring, by design, that the voltage and frequency at the Connection Point remains within statutory limits. The Interface Protection settings have been chosen to allow for voltage rise or drop within the Customer's Installation and to allow the Micro-generator to continue to operate outside of the statutory frequency range as required by the EU Network Code on Requirements for Grid Connection of Generators.		P

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Clause	Requirement - Test	Result - Remark	Verdict																								
10.1.3	<p>Interface Protection shall be installed which disconnects the Micro-generator from the DNO's Distribution Network when any parameter is outside of the settings shown in Table 2.</p> <p style="text-align: center;">Table 2 – Interface Protection settings</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Protection Function</th> <th>Trip Setting</th> <th>Time Delay Setting</th> </tr> </thead> <tbody> <tr> <td>U/V</td> <td>$V_{\phi-n}^{\dagger} - 20\% = 184 \text{ V}$</td> <td>2.5 s</td> </tr> <tr> <td>O/V stage 1</td> <td>$V_{\phi-n}^{\dagger} + 14\% = 262.2 \text{ V}$</td> <td>1.0 s</td> </tr> <tr> <td>O/V stage 2</td> <td>$V_{\phi-n}^{\dagger} + 19\% = 273.7 \text{ V}^3$</td> <td>0.5 s</td> </tr> <tr> <td>U/F stage 1</td> <td>47.5 Hz</td> <td>20 s</td> </tr> <tr> <td>U/F stage 2</td> <td>47 Hz</td> <td>0.5 s</td> </tr> <tr> <td>O/F</td> <td>52 Hz</td> <td>0.5 s</td> </tr> <tr> <td>LoM (RoCoF)</td> <td>1.0 Hzs^{-1}</td> <td></td> </tr> </tbody> </table> <p>† A value of 230 V phase to neutral</p>	Protection Function	Trip Setting	Time Delay Setting	U/V	$V_{\phi-n}^{\dagger} - 20\% = 184 \text{ V}$	2.5 s	O/V stage 1	$V_{\phi-n}^{\dagger} + 14\% = 262.2 \text{ V}$	1.0 s	O/V stage 2	$V_{\phi-n}^{\dagger} + 19\% = 273.7 \text{ V}^3$	0.5 s	U/F stage 1	47.5 Hz	20 s	U/F stage 2	47 Hz	0.5 s	O/F	52 Hz	0.5 s	LoM (RoCoF)	1.0 Hzs^{-1}		See appended table.	P
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O/F	52 Hz	0.5 s																									
LoM (RoCoF)	1.0 Hzs^{-1}																										
10.1.4	The total disconnection time for voltage and frequency protection, including the operating time of the disconnection device, shall be the time delay setting with a tolerance of, -0s + 0.5 s.		P																								
10.1.5	For the avoidance of doubt, where the Distribution Network voltage or frequency exceed the trip settings in Table 2, for less than the time delay setting, the Micro-generator should not disconnect from the Distribution Network.		P																								
10.1.6	Fully Type Tested Micro-generators shall have protection settings set during manufacture.		P																								
10.1.7	The Manufacturer shall establish a secure way of displaying the Interface Protection setting information in one of the following ways:		P																								
	<ul style="list-style-type: none"> • A display on a screen; • A display on a PC which can communicate with the Micro-generator and confirm that it is the correct Micro-generator by means of a serial number permanently fixed to the Micro-generator and visible on the PC screen at the same time as the settings; or • Display of all Interface Protection settings and nominal voltage and current outputs, alongside the serial number of the Micro-generator, permanently fixed to the Micro-generator. 		P																								
10.1.8	The provision of loose documents, documents attached to the Micro-generator by cable ties etc, or provision of data on adhesive paper based products which are not likely to survive due to fading, or failure of the adhesive, for at least 20 years is not acceptable.		P																								
10.1.9	In response to a protection operation the Micro-generator shall be automatically disconnected from the DNO's Distribution Network. This disconnection must be achieved preferably by the separation of mechanical contacts or alternatively by the operation of a suitably rated solid state switching device.		P																								

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Clause	Requirement - Test	Result - Remark	Verdict
10.1.10	The Interface Protection shall function correctly, ie operate within the required tolerance range as given in paragraph 10.1.4, across the expected range of ambient operating temperatures and other environmental factors.		P
10.1.11	Where a common protection system is used to provide the protection function for multiple Micro-generators the complete installation cannot be considered to comprise Fully Type Tested Micro-generators if the protection and connections are made up on site and so cannot be factory tested or Fully Type Tested. In accordance with Annex A1 or Annex A2 if the units or Micro-generators are specifically designed with plugs and sockets to be interconnected on site, then provided the assembly passes the function tests required in Appendix 3 Form C, the Micro-generator(s) can retain Fully Type Tested status.		N/A
10.1.12	Once the Micro-generator has been installed and commissioned the protection settings shall only be altered following written agreement between the DNO and the Customer or their agent.	Interface protection settings protected via a password and can't be change by user.	Info.
10.2	Loss of Mains Protection		P
10.2.1	Loss of mains protection shall be incorporated and tested as defined in the compliance type testing annex of this EREC G98. Active methods which use impedance measuring techniques by drawing current pulses from or injecting AC currents into the DNO's Distribution Network are not considered to be suitable. For Micro-generators which generate on more than one phase, the loss of mains protection should be able to detect the loss of a single phase of the supply network. This should be tested during type testing and recorded in the Type Test Verification Report as per Appendix 3 Form C.	See appended table.	P
10.3	Frequency Drift and Step Change Stability Test		P
10.3.1	Under normal operation of the Distribution Network, the frequency changes over time due to continuous unbalance of load and generation or can experience a step change due to the loss of a Distribution Network component which does not cause a loss of supply.		P
10.3.2	In order to ensure that such phenomena do not cause unnecessary tripping of Micro-generators, stability type tests shall be carried out.		P
10.3.3	The Rate of Change of Frequency (RoCoF) and Vector Shift values required for these tests are marginally less than the corresponding protection settings for RoCoF in Table 2 and vector shifts of up to 50°. Both stability tests shall be carried out in all cases.	See appended table.	P

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Clause	Requirement - Test	Result - Remark	Verdict
10.3.4	<p>The stability tests are to be carried out as per the table in Appendix 3 Form C of this document and the Micro-generator should remain connected during each and every test. The tests shall check that the Micro-generator remains stable and connected during the following scenarios:</p> <ul style="list-style-type: none"> • RoCoF: 0.95 Hzs-1 from 49.0 Hz to 51.0 Hz on both rising and falling frequency; and • Vector shift: 50° plus from 49.5 Hz and 50° minus from 50.5 Hz. 	See appended table.	P
11	QUALITY OF SUPPLY		P
11.1	<p>The connection and operation of a Micro-generator in parallel with a DNO's Distribution Network shall not impair the quality of supply provided by the DNO to any Customers. In this respect the Micro-generator shall comply with:</p> <ul style="list-style-type: none"> • EN 61000-3-2 Class A for harmonics; and • EN 61000-3-3 for voltage fluctuation and flicker with a d_{max} value of 4%. 	See appended table.	P
11.2	DC injection		P
11.2.1	The upper limit for DC injection is 0.25% of AC current rating per phase.	See appended table.	P
11.3	Electromagnetic Compatibility (EMC)		P
11.3.1	<p>All equipment shall conform to the generic EMC standards: BS EN61000-6-3: Electromagnetic Compatibility, Generic Emission Standard; and BS EN61000-6-1: Electromagnetic Compatibility, Generic Immunity Standard</p>	Refer to report number 210901907SHA-001 from Intertek	P
11.4	Short Circuit Current Contribution		P
11.4.1	Directly Coupled Micro-generators		N/A
	The Manufacturer shall establish the maximum short circuit current contribution from the Micro-generator and the conditions under which this exists. This shall be determined in accordance with Annex A.2.3.4.		N/A
	The Manufacturer shall establish the maximum short circuit current contribution from the Micro-generator and the conditions under which this exists. This shall be determined in accordance with Annex A.2.3.4.		N/A
11.4.2	Inverter Connected Micro-generators		P
	DNOs need to understand the contribution that Inverters make to system fault levels in order to determine that they can continue to safely operate their Distribution Networks without exceeding design fault levels for switchgear and other circuit components.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	As the output from an Inverter reduces to zero when a short circuit is applied to its terminals, a short circuit test does not represent the worst case scenario; in most cases the voltage will not collapse to zero for a Distribution Network fault.		P
	To address this issue a test, which ensures that at least 10% of nominal voltage remains and which allows the Micro-generator to feed into a load with an X to R ratio of 2.5, is specified as detailed in Annex A1.3.5.		P
APPENDIX 1	EMERGING TECHNOLOGIES AND OTHER EXCEPTIONS		N/A
APPENDIX 2	CONNECTION PROCEDURE FLOW CHART		Info.
APPENDIX 3	MICRO-GENERATOR DOCUMENTATION		P
APPENDIX 4	RELAXATION OF COMMISSIONING NOTIFICATION TIMESCALES FOR MICRO-GENERATOR: HSE CERTIFICATE OF EXEMPTION (AUGUST 2008)		N/A

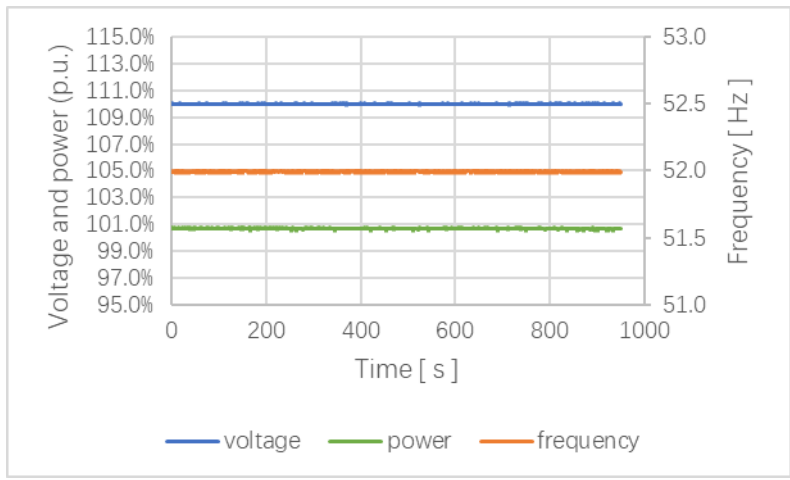
G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

Appendix 1: Type Verification Test Report

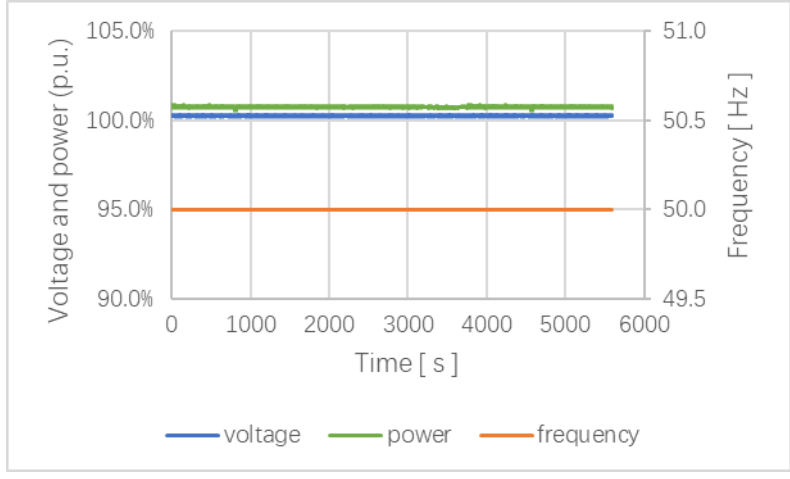
Form C: Type Test Verification Report																																	
1. Operating Range:	P																																
<p>This test should be carried out as specified in A.1.2.10.</p> <p>Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement "Pass", "No disconnection occurs", etc. Graphical evidence is preferred.</p>																																	
<p>Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47.0 Hz, Power Factor = 1, Period of test 20 s</p>	<table border="1"> <caption>Test 1 Data</caption> <thead> <tr> <th>Time [s]</th> <th>Voltage [p.u.]</th> <th>Power [p.u.]</th> <th>Frequency [Hz]</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>85.0</td> <td>100.0</td> <td>47.0</td> </tr> <tr> <td>5</td> <td>85.0</td> <td>100.0</td> <td>47.0</td> </tr> <tr> <td>10</td> <td>85.0</td> <td>100.0</td> <td>47.0</td> </tr> <tr> <td>15</td> <td>85.0</td> <td>100.0</td> <td>47.0</td> </tr> <tr> <td>20</td> <td>85.0</td> <td>100.0</td> <td>47.0</td> </tr> <tr> <td>25</td> <td>85.0</td> <td>100.0</td> <td>47.0</td> </tr> <tr> <td>30</td> <td>85.0</td> <td>100.0</td> <td>47.0</td> </tr> </tbody> </table>	Time [s]	Voltage [p.u.]	Power [p.u.]	Frequency [Hz]	0	85.0	100.0	47.0	5	85.0	100.0	47.0	10	85.0	100.0	47.0	15	85.0	100.0	47.0	20	85.0	100.0	47.0	25	85.0	100.0	47.0	30	85.0	100.0	47.0
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<p>Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, Power Factor = 1, Period of test 90 minutes</p>	<table border="1"> <caption>Test 2 Data</caption> <thead> <tr> <th>Time [s]</th> <th>Voltage [p.u.]</th> <th>Power [p.u.]</th> <th>Frequency [Hz]</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>85.0</td> <td>100.0</td> <td>47.5</td> </tr> <tr> <td>1000</td> <td>85.0</td> <td>100.0</td> <td>47.5</td> </tr> <tr> <td>2000</td> <td>85.0</td> <td>100.0</td> <td>47.5</td> </tr> <tr> <td>3000</td> <td>85.0</td> <td>100.0</td> <td>47.5</td> </tr> <tr> <td>4000</td> <td>85.0</td> <td>100.0</td> <td>47.5</td> </tr> <tr> <td>5000</td> <td>85.0</td> <td>100.0</td> <td>47.5</td> </tr> <tr> <td>6000</td> <td>85.0</td> <td>100.0</td> <td>47.5</td> </tr> </tbody> </table>	Time [s]	Voltage [p.u.]	Power [p.u.]	Frequency [Hz]	0	85.0	100.0	47.5	1000	85.0	100.0	47.5	2000	85.0	100.0	47.5	3000	85.0	100.0	47.5	4000	85.0	100.0	47.5	5000	85.0	100.0	47.5	6000	85.0	100.0	47.5
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<p>Test 3 Voltage = 110% of nominal (253 V), Frequency = 51.5 Hz, Power Factor = 1, Period of test 90 minutes</p>	<table border="1"> <caption>Test 3 Data</caption> <thead> <tr> <th>Time [s]</th> <th>Voltage [p.u.]</th> <th>Power [p.u.]</th> <th>Frequency [Hz]</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>110.0</td> <td>100.0</td> <td>51.5</td> </tr> <tr> <td>1000</td> <td>110.0</td> <td>100.0</td> <td>51.5</td> </tr> <tr> <td>2000</td> <td>110.0</td> <td>100.0</td> <td>51.5</td> </tr> <tr> <td>3000</td> <td>110.0</td> <td>100.0</td> <td>51.5</td> </tr> <tr> <td>4000</td> <td>110.0</td> <td>100.0</td> <td>51.5</td> </tr> <tr> <td>5000</td> <td>110.0</td> <td>100.0</td> <td>51.5</td> </tr> <tr> <td>6000</td> <td>110.0</td> <td>100.0</td> <td>51.5</td> </tr> </tbody> </table>	Time [s]	Voltage [p.u.]	Power [p.u.]	Frequency [Hz]	0	110.0	100.0	51.5	1000	110.0	100.0	51.5	2000	110.0	100.0	51.5	3000	110.0	100.0	51.5	4000	110.0	100.0	51.5	5000	110.0	100.0	51.5	6000	110.0	100.0	51.5
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Clause	Requirement - Test	Result - Remark	Verdict

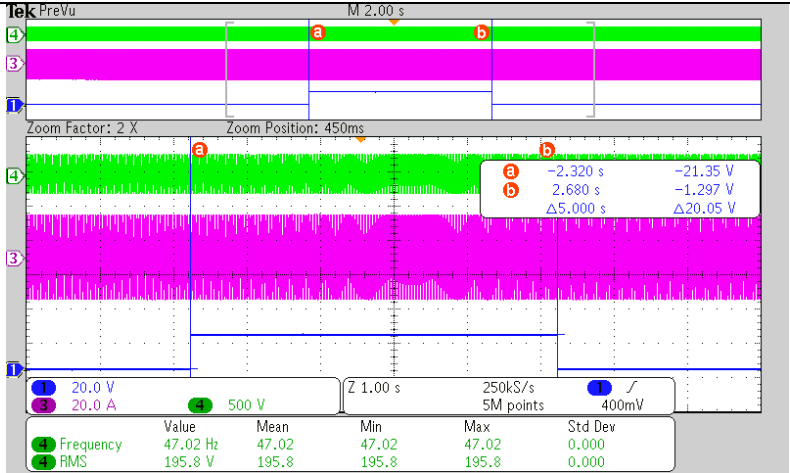
Test 4
 Voltage = 110% of nominal (253 V),
 Frequency = 52.0 Hz,
 Power Factor = 1,
 Period of test 15 minutes



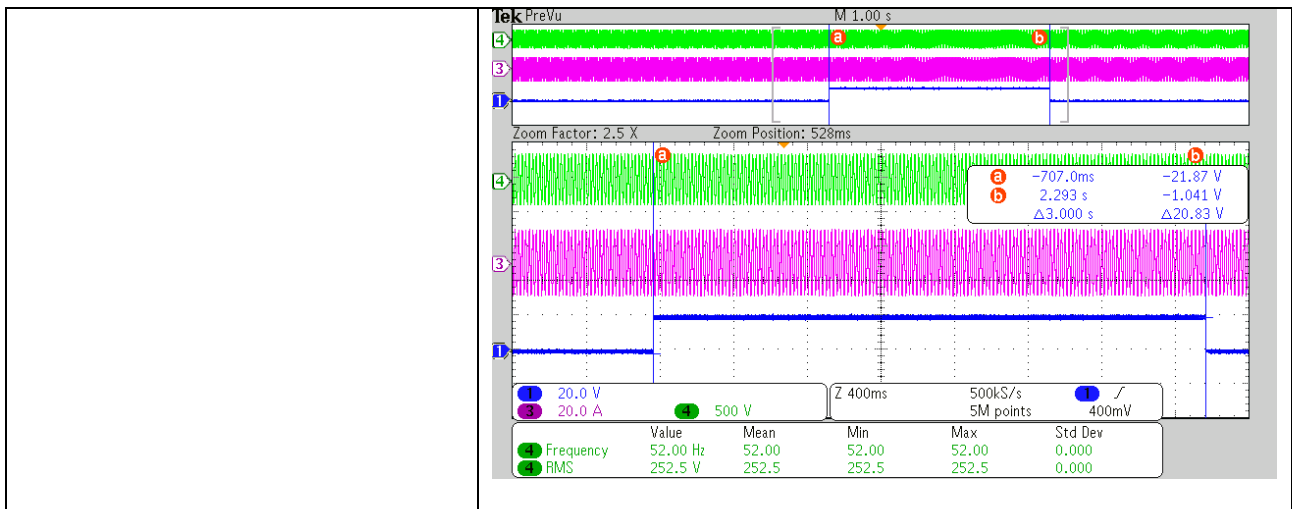
Test 5
 Voltage = 100% of nominal (230 V),
 Frequency = 50.0 Hz,
 Power Factor = 1,
 Period of test = 90 minutes



Test 6 RoCoF withstand
 Confirm that the **Micro-Generating Plant** is capable of staying connected to the **Distribution Network** and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms.



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Clause	Requirement - Test	Result - Remark	Verdict



Model: BNT010KTL **P**

Test 1:				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (seconds)
195.61	47.00	9889.91	0.9994	20
Test 2:				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
195.62	47.50	9886.80	0.9994	90
Test 3:				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.04	51.50	10070.87	0.9979	90
Test 4:				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.08	52.00	10069.46	0.9979	15
Test 5:				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
230.56	50.00	10075.42	0.9989	90
Test 6:				
Measured Voltage (V)	Ramp range	Test frequency ramp	Test Duration	Confirm no trip
195.5	47.0 Hz to 52.0 Hz	+1 Hzs ⁻¹	5.0s	No trip
253.0	52.0 Hz to 49.0 Hz	-1 Hzs ⁻¹	3.0s	No trip

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Clause	Requirement - Test			Result - Remark		Verdict
2. Power Quality – Harmonics:						P
These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of Registered Capacity . The test requirements are specified in Annex A1 A.1.3.1 (Inverter connected) or Annex A2 A.2.3.1 (Synchronous).						
Model: BNT003KTL						
L1						
Micro-generator tested to BS EN 61000-3-2						
Micro-generator rating per phase (rpp)				1	kW	
For 3-phase Micro-generators , tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.				three phase PV inverter		
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps		
2	0.018	0.132	0.026	0.096	1.080	
3	0.070	0.514	0.028	0.103	2.300	
4	0.011	0.077	0.011	0.042	0.430	
5	0.140	1.027	0.120	0.442	1.140	
6	0.008	0.060	0.008	0.030	0.300	
7	0.064	0.474	0.052	0.192	0.770	
8	0.010	0.074	0.006	0.024	0.230	
9	0.028	0.202	0.009	0.033	0.400	
10	0.010	0.074	0.007	0.026	0.184	
11	0.149	0.275	0.024	0.086	0.330	
12	0.013	0.093	0.005	0.020	0.153	
13	0.057	0.140	0.037	0.136	0.210	
14	0.005	0.039	0.006	0.024	0.131	
15	0.019	0.144	0.005	0.020	0.150	
16	0.006	0.047	0.005	0.019	0.115	
17	0.020	0.048	0.032	0.059	0.132	
18	0.007	0.048	0.005	0.019	0.102	
19	0.006	0.043	0.038	0.024	0.118	
20	0.005	0.035	0.006	0.021	0.092	
21	0.011	0.081	0.010	0.038	0.107	0.160

G98/1-6						
Clause	Requirement - Test				Result - Remark	Verdict
22	0.007	0.051	0.006	0.021	0.084	
23	0.035	0.085	0.039	0.024	0.098	0.147
24	0.006	0.043	0.007	0.024	0.077	
25	0.040	0.060	0.024	0.088	0.090	0.135
26	0.004	0.032	0.006	0.021	0.071	
27	0.008	0.058	0.011	0.041	0.083	0.124
28	0.004	0.032	0.005	0.018	0.066	
29	0.018	0.027	0.023	0.028	0.078	0.117
30	0.005	0.038	0.007	0.025	0.061	
31	0.010	0.040	0.022	0.021	0.073	0.109
32	0.005	0.036	0.005	0.018	0.058	
33	0.004	0.031	0.008	0.029	0.068	0.102
34	0.005	0.035	0.004	0.015	0.054	
35	0.013	0.049	0.011	0.007	0.064	0.096
36	0.005	0.038	0.005	0.018	0.051	
37	0.021	0.039	0.016	0.020	0.061	0.091
38	0.003	0.024	0.004	0.015	0.048	
39	0.009	0.018	0.006	0.024	0.058	0.087
40	0.003	0.025	0.004	0.016	0.046	
<p>Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.</p>						

G98/1-6						
Clause	Requirement - Test			Result - Remark		Verdict
Model: BNT003KTL						
L2						
Micro-generator tested to BS EN 61000-3-2						
Micro-generator rating per phase (rpp)				1	kW	
For 3-phase Micro-generators , tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.				three phase PV inverter		
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps		
2	0.018	0.132	0.025	0.090	1.080	
3	0.079	0.581	0.043	0.159	2.300	
4	0.010	0.078	0.012	0.046	0.430	
5	0.152	1.120	0.172	0.633	1.140	
6	0.010	0.071	0.009	0.032	0.300	
7	0.081	0.598	0.100	0.367	0.770	
8	0.008	0.060	0.007	0.024	0.230	
9	0.035	0.262	0.025	0.093	0.400	
10	0.010	0.069	0.008	0.030	0.184	
11	0.151	0.139	0.046	0.171	0.330	
12	0.009	0.063	0.006	0.022	0.153	
13	0.082	0.077	0.046	0.169	0.210	
14	0.007	0.049	0.007	0.026	0.131	
15	0.011	0.082	0.021	0.079	0.150	
16	0.005	0.036	0.006	0.021	0.115	
17	0.018	0.035	0.040	0.048	0.132	
18	0.005	0.039	0.006	0.023	0.102	
19	0.007	0.054	0.034	0.042	0.118	
20	0.005	0.038	0.007	0.025	0.092	
21	0.005	0.034	0.009	0.032	0.107	0.160
22	0.006	0.042	0.005	0.020	0.084	
23	0.033	0.049	0.036	0.044	0.098	0.147
24	0.005	0.040	0.006	0.023	0.077	
25	0.032	0.047	0.023	0.083	0.090	0.135
26	0.007	0.049	0.007	0.025	0.071	

G98/1-6							
Clause	Requirement - Test				Result - Remark		Verdict
27	0.006	0.040	0.008	0.031	0.083	0.124	
28	0.004	0.032	0.006	0.023	0.066		
29	0.021	0.031	0.028	0.026	0.078	0.117	
30	0.005	0.033	0.005	0.020	0.061		
31	0.012	0.018	0.020	0.019	0.073	0.109	
32	0.004	0.032	0.005	0.020	0.058		
33	0.007	0.053	0.008	0.028	0.068	0.102	
34	0.006	0.047	0.008	0.030	0.054		
35	0.018	0.034	0.018	0.022	0.064	0.096	
36	0.005	0.038	0.007	0.027	0.051		
37	0.014	0.026	0.015	0.056	0.061	0.091	
38	0.005	0.040	0.009	0.034	0.048		
39	0.007	0.053	0.007	0.025	0.058	0.087	
40	0.006	0.042	0.007	0.024	0.046		

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

G98/1-6						
Clause	Requirement - Test			Result - Remark		Verdict
Model: BNT003KTL						
L3						
Micro-generator tested to BS EN 61000-3-2						
Micro-generator rating per phase (rpp)				1	kW	
For 3-phase Micro-generators , tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.				three phase PV inverter		
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps		
2	0.016	0.121	0.031	0.113	1.080	
3	0.035	0.258	0.033	0.121	2.300	
4	0.011	0.078	0.013	0.047	0.430	
5	0.082	0.595	0.102	0.376	1.140	
6	0.009	0.066	0.010	0.038	0.300	
7	0.042	0.310	0.063	0.229	0.770	
8	0.009	0.067	0.006	0.023	0.230	
9	0.018	0.130	0.024	0.090	0.400	
10	0.009	0.066	0.007	0.024	0.184	
11	0.130	0.121	0.041	0.149	0.330	
12	0.009	0.064	0.006	0.021	0.153	
13	0.084	0.105	0.033	0.123	0.210	
14	0.006	0.046	0.006	0.021	0.131	
15	0.022	0.054	0.018	0.067	0.150	
16	0.006	0.043	0.006	0.021	0.115	
17	0.020	0.048	0.028	0.101	0.132	
18	0.006	0.046	0.005	0.019	0.102	
19	0.005	0.035	0.037	0.027	0.118	
20	0.005	0.040	0.005	0.020	0.092	
21	0.009	0.068	0.007	0.027	0.107	0.160
22	0.007	0.049	0.006	0.023	0.084	
23	0.025	0.038	0.028	0.021	0.098	0.147
24	0.005	0.040	0.005	0.020	0.077	
25	0.045	0.034	0.027	0.020	0.090	0.135
26	0.007	0.053	0.006	0.022	0.071	

G98/1-6						
Clause	Requirement - Test			Result - Remark		Verdict
27	0.005	0.037	0.005	0.020	0.083	0.124
28	0.005	0.035	0.007	0.027	0.066	
29	0.021	0.030	0.019	0.068	0.078	0.117
30	0.004	0.031	0.006	0.021	0.061	
31	0.011	0.029	0.028	0.021	0.073	0.109
32	0.005	0.036	0.006	0.020	0.058	
33	0.005	0.040	0.005	0.018	0.068	0.102
34	0.007	0.052	0.008	0.028	0.054	
35	0.009	0.035	0.014	0.053	0.064	0.096
36	0.005	0.038	0.006	0.021	0.051	
37	0.021	0.040	0.019	0.037	0.061	0.091
38	0.006	0.040	0.010	0.036	0.048	
39	0.004	0.031	0.005	0.018	0.058	0.087
40	0.005	0.036	0.005	0.019	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

G98/1-6						
Clause	Requirement - Test			Result - Remark		Verdict
Model: BNT010KTL						
L1						
Micro-generator tested to BS EN 61000-3-2						
Micro-generator rating per phase (rpp)				3.33	kW	
For 3-phase Micro-generators , tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.				three phase PV inverter		
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps		
2	0.045	0.099	0.096	0.106	1.080	
3	0.036	0.079	0.024	0.026	2.300	
4	0.013	0.029	0.013	0.014	0.430	
5	0.096	0.212	0.091	0.100	1.140	
6	0.008	0.018	0.009	0.010	0.300	
7	0.073	0.161	0.059	0.065	0.770	
8	0.007	0.015	0.007	0.008	0.230	
9	0.019	0.042	0.014	0.015	0.400	
10	0.007	0.015	0.006	0.007	0.184	
11	0.091	0.201	0.078	0.086	0.330	
12	0.005	0.011	0.005	0.006	0.153	
13	0.070	0.155	0.075	0.083	0.210	
14	0.006	0.013	0.004	0.004	0.131	
15	0.015	0.033	0.010	0.011	0.150	
16	0.007	0.015	0.006	0.007	0.115	
17	0.047	0.104	0.053	0.059	0.132	
18	0.004	0.009	0.005	0.006	0.102	
19	0.040	0.088	0.056	0.062	0.118	
20	0.005	0.011	0.006	0.007	0.092	
21	0.009	0.020	0.008	0.009	0.107	0.160
22	0.005	0.011	0.004	0.004	0.084	
23	0.018	0.040	0.026	0.029	0.098	0.147
24	0.005	0.011	0.004	0.004	0.077	
25	0.012	0.026	0.041	0.045	0.090	0.135
26	0.004	0.009	0.007	0.008	0.071	

G98/1-6						
Clause	Requirement - Test				Result - Remark	Verdict
27	0.004	0.009	0.010	0.011	0.083	0.124
28	0.004	0.009	0.004	0.004	0.066	
29	0.014	0.031	0.016	0.018	0.078	0.117
30	0.007	0.015	0.005	0.006	0.061	
31	0.015	0.033	0.027	0.030	0.073	0.109
32	0.004	0.009	0.007	0.008	0.058	
33	0.006	0.013	0.012	0.013	0.068	0.102
34	0.004	0.009	0.006	0.007	0.054	
35	0.009	0.020	0.020	0.022	0.064	0.096
36	0.004	0.009	0.006	0.007	0.051	
37	0.017	0.038	0.020	0.022	0.061	0.091
38	0.004	0.009	0.006	0.007	0.048	
39	0.006	0.013	0.013	0.014	0.058	0.087
40	0.003	0.007	0.006	0.007	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

G98/1-6						
Clause	Requirement - Test			Result - Remark		Verdict
Model: BNT010KTL						
L2						
Micro-generator tested to BS EN 61000-3-2						
Micro-generator rating per phase (rpp)				3.33	kW	
For 3-phase Micro-generators , tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.				three phase PV inverter		
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps		
2	0.036	0.079	0.091	0.100	1.080	
3	0.068	0.150	0.028	0.031	2.300	
4	0.011	0.024	0.013	0.014	0.430	
5	0.123	0.272	0.126	0.139	1.140	
6	0.009	0.020	0.029	0.032	0.300	
7	0.111	0.245	0.112	0.124	0.770	
8	0.007	0.015	0.008	0.009	0.230	
9	0.021	0.046	0.008	0.009	0.400	
10	0.007	0.015	0.008	0.009	0.184	
11	0.096	0.212	0.085	0.094	0.330	
12	0.009	0.020	0.016	0.018	0.153	
13	0.075	0.166	0.067	0.074	0.210	
14	0.006	0.013	0.006	0.007	0.131	
15	0.014	0.031	0.013	0.014	0.150	
16	0.007	0.015	0.006	0.007	0.115	
17	0.052	0.115	0.055	0.061	0.132	
18	0.007	0.015	0.010	0.011	0.102	
19	0.040	0.088	0.059	0.065	0.118	
20	0.005	0.011	0.008	0.009	0.092	
21	0.006	0.013	0.011	0.012	0.107	0.160
22	0.006	0.013	0.005	0.006	0.084	
23	0.024	0.053	0.026	0.029	0.098	0.147
24	0.005	0.011	0.006	0.007	0.077	
25	0.019	0.042	0.041	0.045	0.090	0.135
26	0.006	0.013	0.012	0.013	0.071	

G98/1-6						
Clause	Requirement - Test				Result - Remark	Verdict
27	0.005	0.011	0.009	0.010	0.083	0.124
28	0.004	0.009	0.005	0.006	0.066	
29	0.012	0.026	0.018	0.020	0.078	0.117
30	0.006	0.013	0.006	0.007	0.061	
31	0.012	0.026	0.028	0.031	0.073	0.109
32	0.005	0.011	0.009	0.010	0.058	
33	0.005	0.011	0.008	0.009	0.068	0.102
34	0.006	0.013	0.008	0.009	0.054	
35	0.014	0.031	0.018	0.020	0.064	0.096
36	0.005	0.011	0.006	0.007	0.051	
37	0.010	0.022	0.021	0.023	0.061	0.091
38	0.006	0.013	0.007	0.008	0.048	
39	0.006	0.013	0.010	0.011	0.058	0.087
40	0.005	0.011	0.006	0.007	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

G98/1-6						
Clause	Requirement - Test			Result - Remark		Verdict
Model: BNT010KTL						
L3						
Micro-generator tested to BS EN 61000-3-2						
Micro-generator rating per phase (rpp)				3.33	kW	
For 3-phase Micro-generators , tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.				three phase PV inverter		
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps		
2	0.051	0.113	0.056	0.062	1.080	
3	0.052	0.115	0.034	0.038	2.300	
4	0.011	0.024	0.010	0.011	0.430	
5	0.082	0.181	0.091	0.100	1.140	
6	0.008	0.018	0.025	0.028	0.300	
7	0.058	0.128	0.064	0.071	0.770	
8	0.008	0.018	0.007	0.008	0.230	
9	0.012	0.026	0.011	0.012	0.400	
10	0.007	0.015	0.006	0.007	0.184	
11	0.073	0.161	0.071	0.078	0.330	
12	0.008	0.018	0.014	0.015	0.153	
13	0.077	0.170	0.060	0.066	0.210	
14	0.005	0.011	0.007	0.008	0.131	
15	0.020	0.044	0.018	0.020	0.150	
16	0.009	0.020	0.007	0.008	0.115	
17	0.032	0.071	0.051	0.056	0.132	
18	0.005	0.011	0.007	0.008	0.102	
19	0.051	0.113	0.056	0.062	0.118	
20	0.004	0.009	0.005	0.006	0.092	
21	0.008	0.018	0.009	0.010	0.107	0.160
22	0.004	0.009	0.005	0.006	0.084	
23	0.019	0.042	0.017	0.019	0.098	0.147
24	0.005	0.011	0.008	0.009	0.077	
25	0.018	0.040	0.037	0.041	0.090	0.135
26	0.006	0.013	0.005	0.006	0.071	

G98/1-6						
Clause	Requirement - Test				Result - Remark	Verdict
27	0.004	0.009	0.009	0.010	0.083	0.124
28	0.004	0.009	0.006	0.007	0.066	
29	0.009	0.020	0.011	0.012	0.078	0.117
30	0.005	0.011	0.008	0.009	0.061	
31	0.012	0.026	0.035	0.039	0.073	0.109
32	0.004	0.009	0.004	0.004	0.058	
33	0.005	0.011	0.008	0.009	0.068	0.102
34	0.008	0.018	0.007	0.008	0.054	
35	0.010	0.022	0.019	0.021	0.064	0.096
36	0.006	0.013	0.006	0.007	0.051	
37	0.016	0.035	0.026	0.029	0.061	0.091
38	0.007	0.015	0.007	0.008	0.048	
39	0.005	0.011	0.006	0.007	0.058	0.087
40	0.005	0.011	0.006	0.007	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

G98/1-6								
Clause	Requirement - Test						Result - Remark	Verdict
3. Power Quality – Voltage fluctuations and Flicker:								P
<p>These tests should be undertaken in accordance with EREC G98 Annex A1 A.1.3.3 (Inverter connected) or Annex A2 A.2.3.3 (Synchronous).</p> <p>The standard test impedance is 0.4 Ω for a single phase Micro-generating Plant (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase Micro-generating Plant (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the Power Factor of the generation output is 0.98 or above):</p> <p>d max normalised value = (Standard impedance / Measured impedance) x Measured value.</p> <p>Where the Power Factor of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the standard impedance.</p> <p>The stopping test should be a trip from full load operation.</p> <p>The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.</p> <p>The test date and location must be declared.</p>								
Model:	BNT010KTL							
L1								
	Starting			Stopping			Running	
	d(max)	d(c)	d(t)	d(max)	d(c)	d(t)	P _{st}	P _{lt} 2 hours
Measured Values at test impedance	0.20	0.04	0	0.20	0.05	0	0.14	0.11
Normalised to standard impedance	0.20	0.04	0	0.20	0.05	0	0.14	0.11
Normalised to required maximum impedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65
Test Impedance	R	0.4	Ω	XI	0.25	Ω		
Standard Impedance	R	0.24 * 0.4 ^	Ω	XI	0.15 * 0.25 ^	Ω		
Maximum Impedance	R	N/A #	Ω	XI	N/A #	Ω		
<p>*Applies to three phase and split single phase Micro-generators. Delete as appropriate.</p> <p>^ Applies to single phase Micro-generators and Micro-generators using two phases on a three phase system. Delete as appropriate.</p>								

G98/1-6								
Clause	Requirement - Test						Result - Remark	Verdict
Model:	BNT010KTL							
L2								
	Starting			Stopping			Running	
	d(max)	d(c)	d(t)	d(max)	d(c)	d(t)	P _{st}	P _{It} 2 hours
Measured Values at test impedance	0.26	0.06	0	0.28	0.06	0	0.12	0.10
Normalised to standard impedance	0.26	0.06	0	0.28	0.06	0	0.12	0.10
Normalised to required maximum impedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65
Test Impedance	R	0.4	Ω	XI	0.25	Ω		
Standard Impedance	R	0.24 * 0.4 ^	Ω	XI	0.15 * 0.25 ^	Ω		
Maximum Impedance	R	N/A #	Ω	XI	N/A #	Ω		
<p>*Applies to three phase and split single phase Micro-generators. Delete as appropriate.</p> <p>^ Applies to single phase Micro-generators and Micro-generators using two phases on a three phase system. Delete as appropriate.</p>								

G98/1-6								
Clause	Requirement - Test						Result - Remark	Verdict
Model:	BNT010KTL							
L3								
	Starting			Stopping			Running	
	d(max)	d(c)	d(t)	d(max)	d(c)	d(t)	P _{st}	P _{It} 2 hours
Measured Values at test impedance	0.26	0.06	0	0.28	0.06	0	0.12	0.10
Normalised to standard impedance	0.26	0.06	0	0.28	0.06	0	0.12	0.10
Normalised to required maximum impedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65
Test Impedance	R	0.4	Ω	XI	0.25	Ω		
Standard Impedance	R	0.24 * 0.4 ^	Ω	XI	0.15 * 0.25 ^	Ω		
Maximum Impedance	R	N/A #	Ω	XI	N/A #	Ω		
<p>*Applies to three phase and split single phase Micro-generators. Delete as appropriate.</p> <p>^ Applies to single phase Micro-generators and Micro-generators using two phases on a three phase system. Delete as appropriate.</p>								

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

4. Power quality – DC injection:	P
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This test should be carried out in accordance with A 1.3.4 as applicable.
 The % DC injection (“as % of rated AC current” below) is calculated as follows:
 % DC injection = Recorded DC value in Amps / base current
 where the base current is the **Registered Capacity (W) / 230 V**. The % DC injection should not be greater than 0.25%.

Model: BNT03KTL

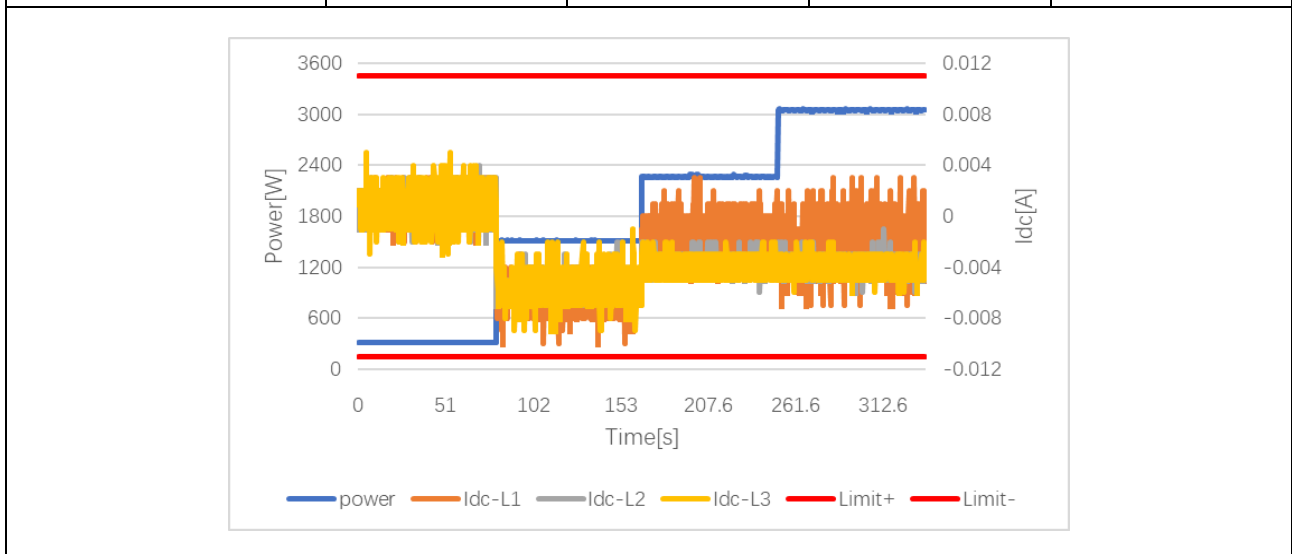
L1				
Test power level	10%	50%	75%	100%
Recorded DC injection value in Amps	0.005	-0.01	-0.008	-0.007
as % of rated AC current	0.12%	-0.23%	-0.18%	-0.16%
Limit	0.25%	0.25%	0.25%	0.25%

Model: BNT03KTL

L2				
Test power level	10%	50%	75%	100%
Recorded DC injection value in Amps	0.006	-0.008	-0.006	-0.006
as % of rated AC current	0.14%	-0.18%	-0.14%	-0.14%
Limit	0.25%	0.25%	0.25%	0.25%

Model: BNT03KTL

L3				
Test power level	10%	50%	75%	100%
Recorded DC injection value in Amps	0.007	-0.009	-0.008	-0.006
as % of rated AC current	0.16%	-0.21%	-0.18%	-0.14%
Limit	0.25%	0.25%	0.25%	0.25%

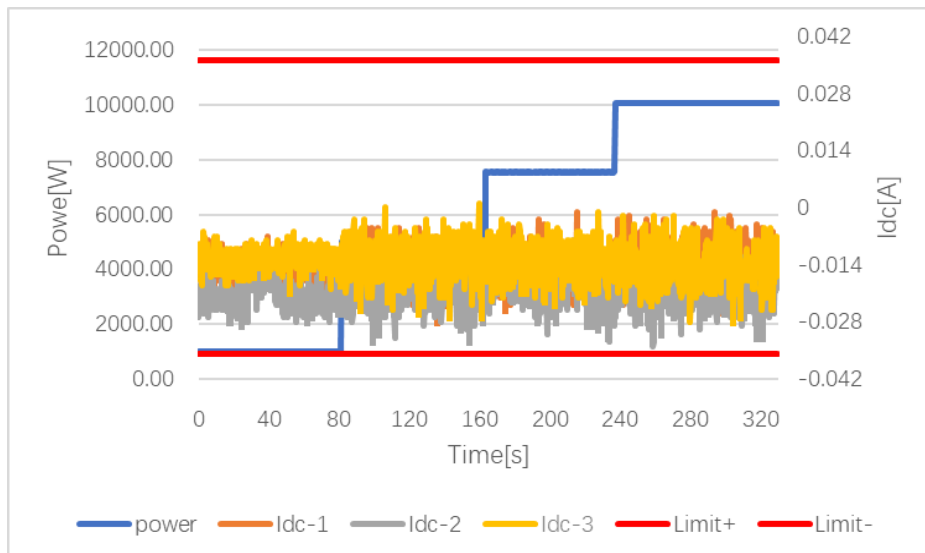


G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

Model: BNT010KTL				
L1				
Test power level	10%	50%	75%	100%
Recorded DC injection value in Amps	-0.022	-0.028	-0.028	-0.026
as % of rated AC current	-0.15%	-0.19%	-0.19%	-0.18%
Limit	0.25%	0.25%	0.25%	0.25%

Model: BNT010KTL				
L2				
Test power level	10%	50%	75%	100%
Recorded DC injection value in Amps	-0.029	-0.033	-0.033	-0.034
as % of rated AC current	-0.20%	-0.23%	-0.23%	-0.23%
Limit	0.25%	0.25%	0.25%	0.25%

Model: BNT010KTL				
L3				
Test power level	10%	50%	75%	100%
Recorded DC injection value in Amps	-0.021	-0.027	-0.024	-0.028
as % of rated AC current	-0.14%	-0.19%	-0.17%	-0.19%
Limit	0.25%	0.25%	0.25%	0.25%



G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
5. Power Factor:			P
This test shall be carried out in accordance with A.1.3.2 and A.2.3.2 at three voltage levels and at Registered Capacity and the measured Power Factor must be greater than 0.95 to pass. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.			
Model: BNT010KTL			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9999	0.9999	0.9999
Power Factor Limit	>0.95	>0.95	>0.95
Model: BNT003KTL			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9990	0.9990	0.9990
Power Factor Limit	>0.95	>0.95	>0.95

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

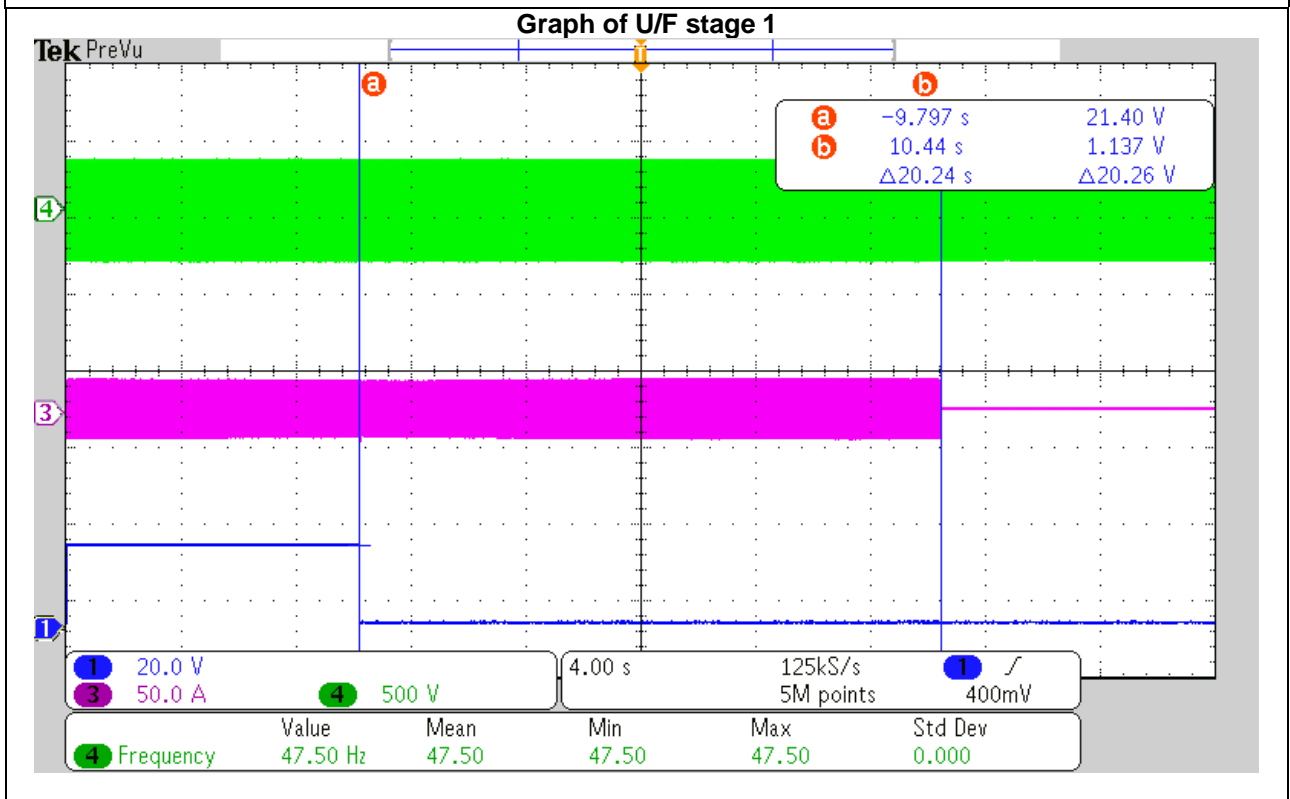
6. Protection – Frequency tests:	P
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These tests should be carried out in accordance with Annex A1 A.1.2.3 (**Inverter** connected) or Annex A2 A.2.2.3 (Synchronous). For trip tests, frequency and time delay should be stated. For “no trip tests”, “no trip” can be stated.

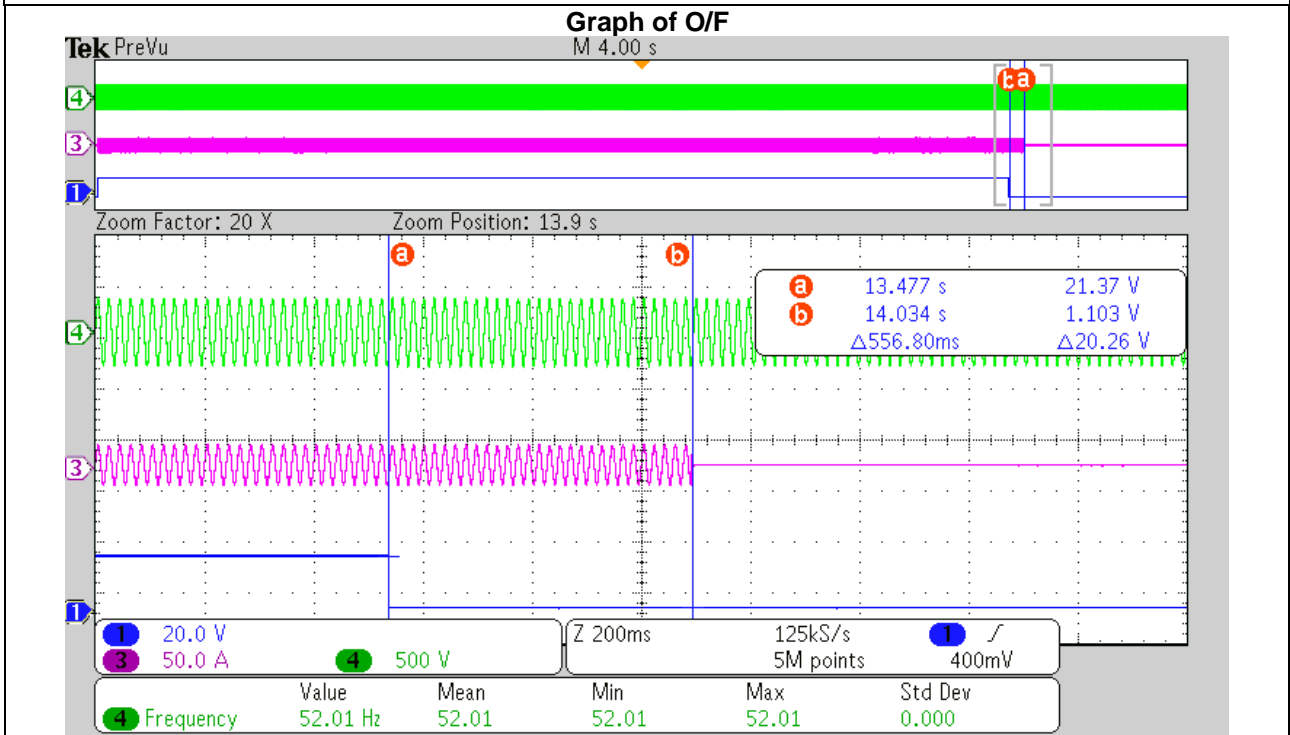
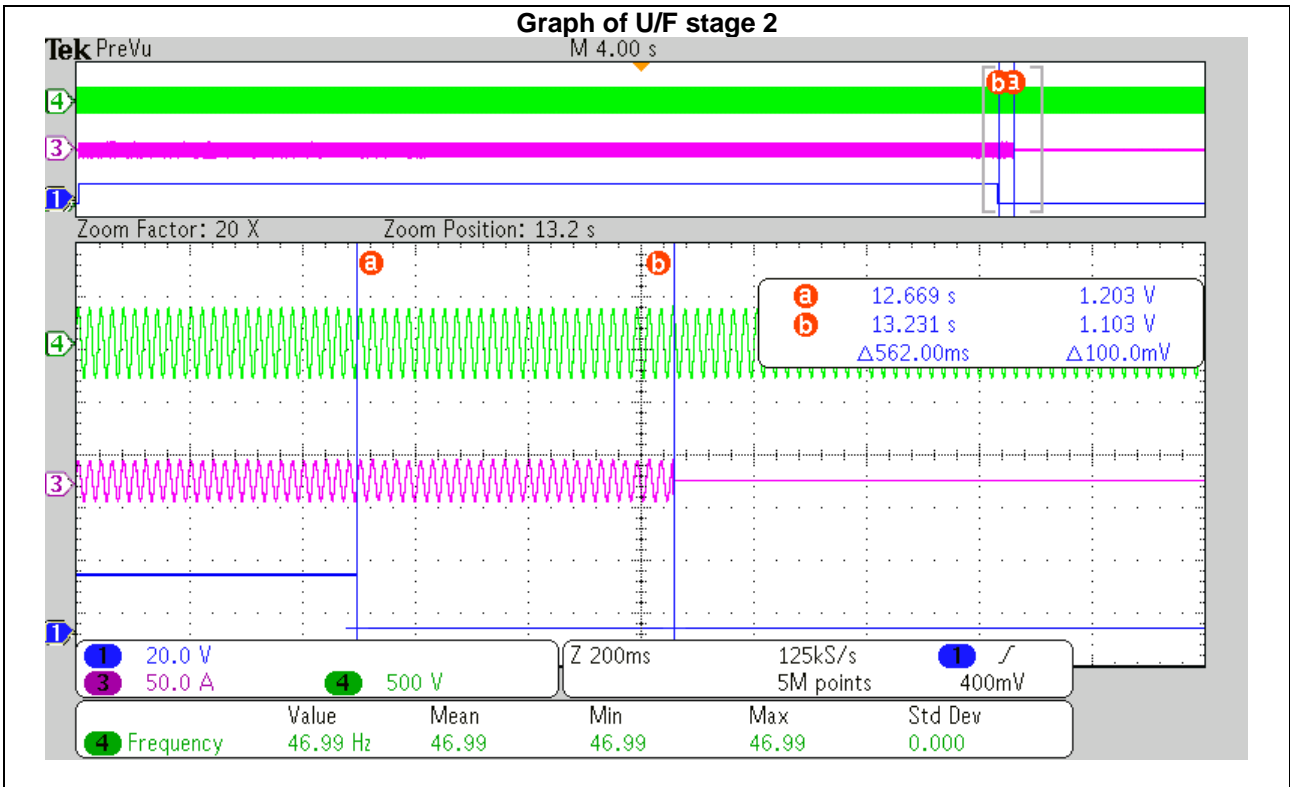
Model: BNT010KTL

Function	Setting		Trip test		“No trip tests”	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.5	20.24s	47.7 Hz 30 s	No trip
U/F stage 2	47.0 Hz	0.5 s	46.99	0.562s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52.0 Hz	0.5 s	52.01	0.557s	51.8 Hz 120.0 s	No trip
					52.2 Hz 0.45 s	No trip

Note: For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The “No trip tests” need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.



G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict



Channel 1 represents trip signal
 Channel 3 represents output current of EUT
 Channel 4 represents output voltage of EUT

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

7. Protection – Voltage tests:	P
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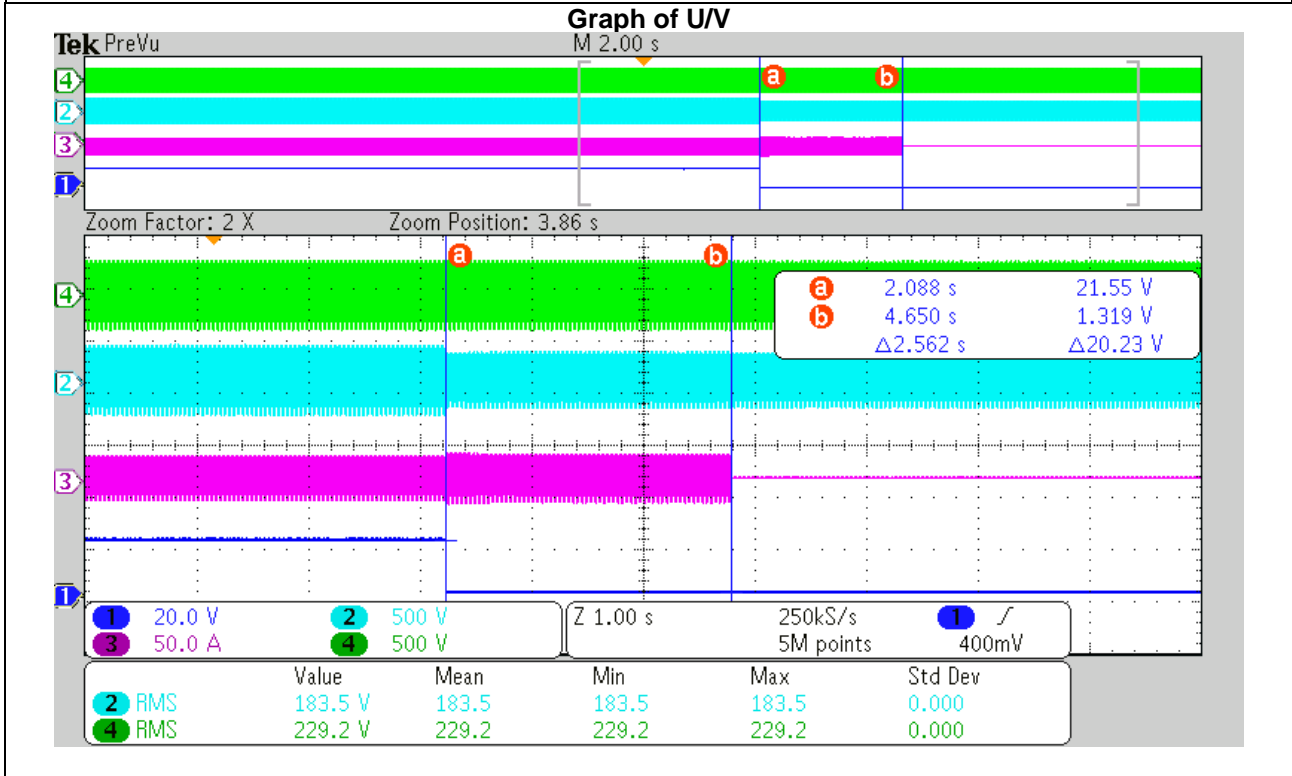
These tests should be carried out in accordance with Annex A1 A.1.2.2 (**Inverter** connected) or Annex A2 A.2.2.2 (Synchronous). For trip tests, voltage and time delay should be stated. For “no trip tests”, “no trip” can be stated.

Model: BNT010KTL

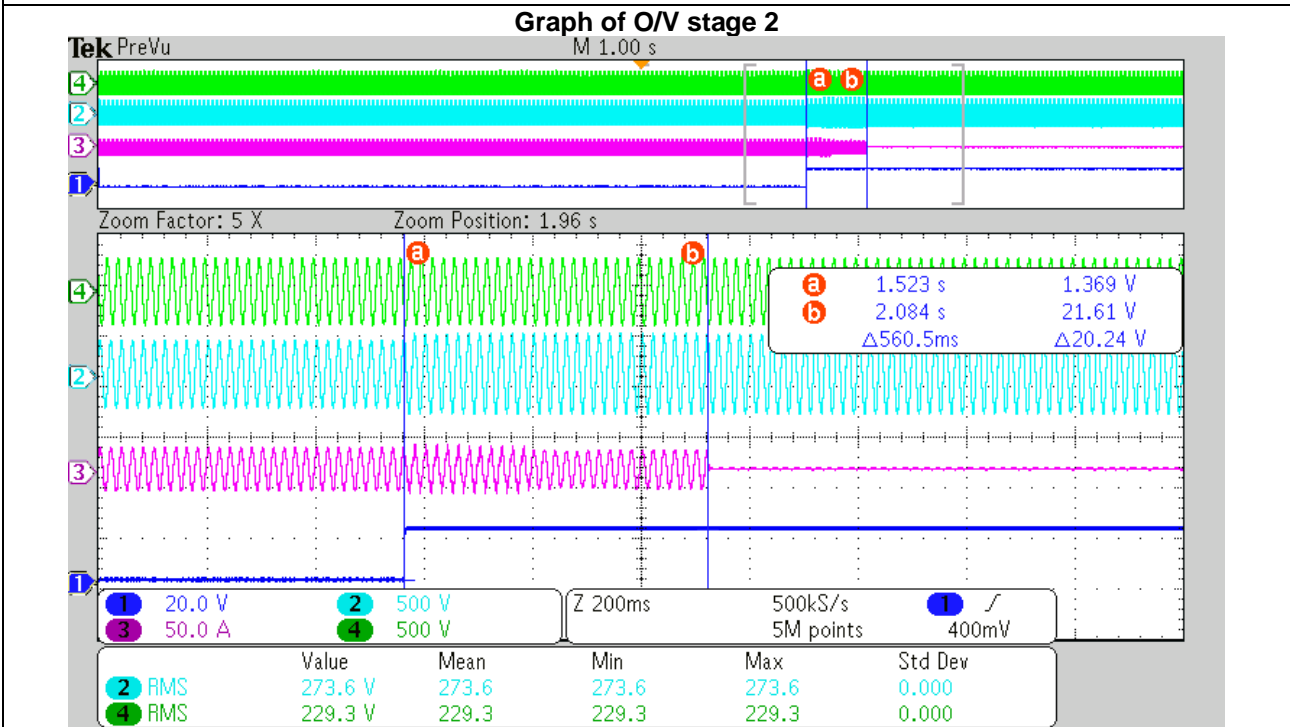
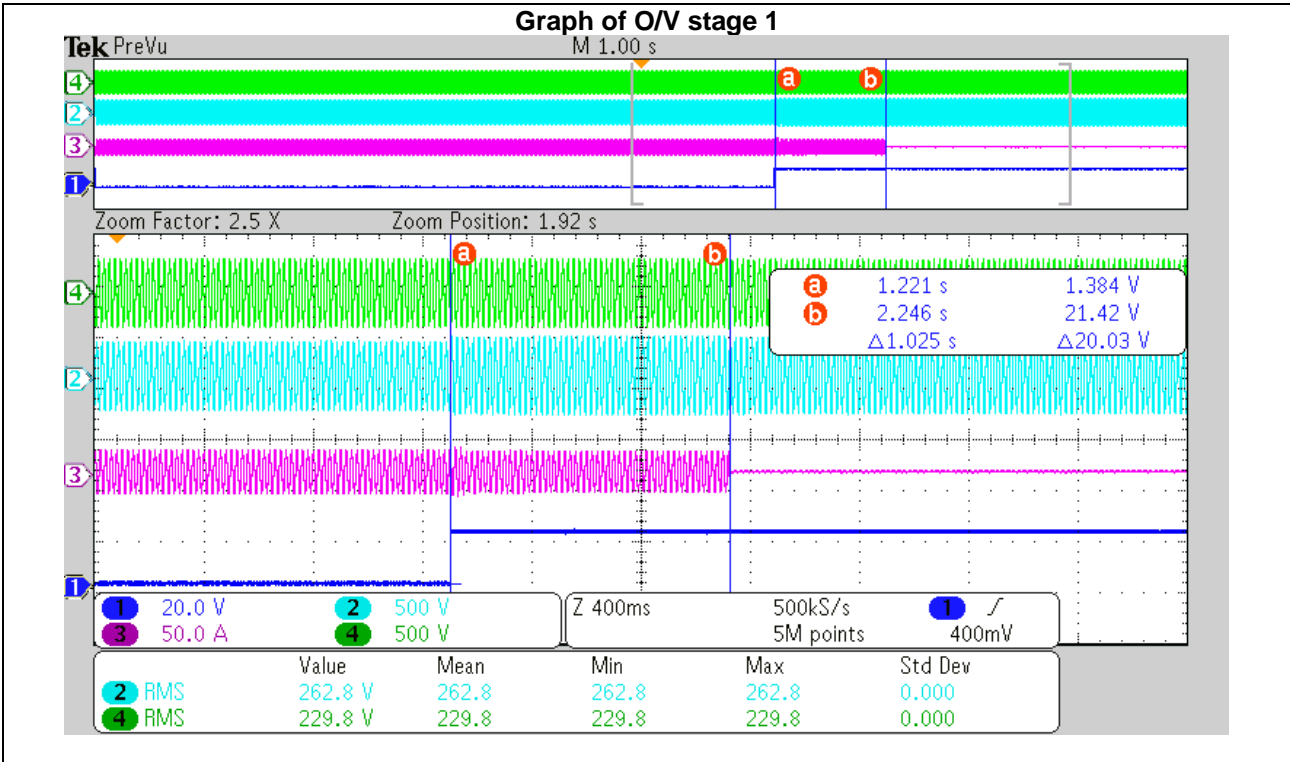
L1

Function	Setting		Trip test		“No trip tests”	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	183.5	2.562	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage 1	1.14 pu (262.2 V)	1.0 s	262.8	1.025	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	273.6	0.561	269.7 V 0.95 s	No trip
					277.7 V 0.45 s	No trip

Note: For Voltage tests the Voltage required to trip is the setting ± 3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ± 4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.



G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

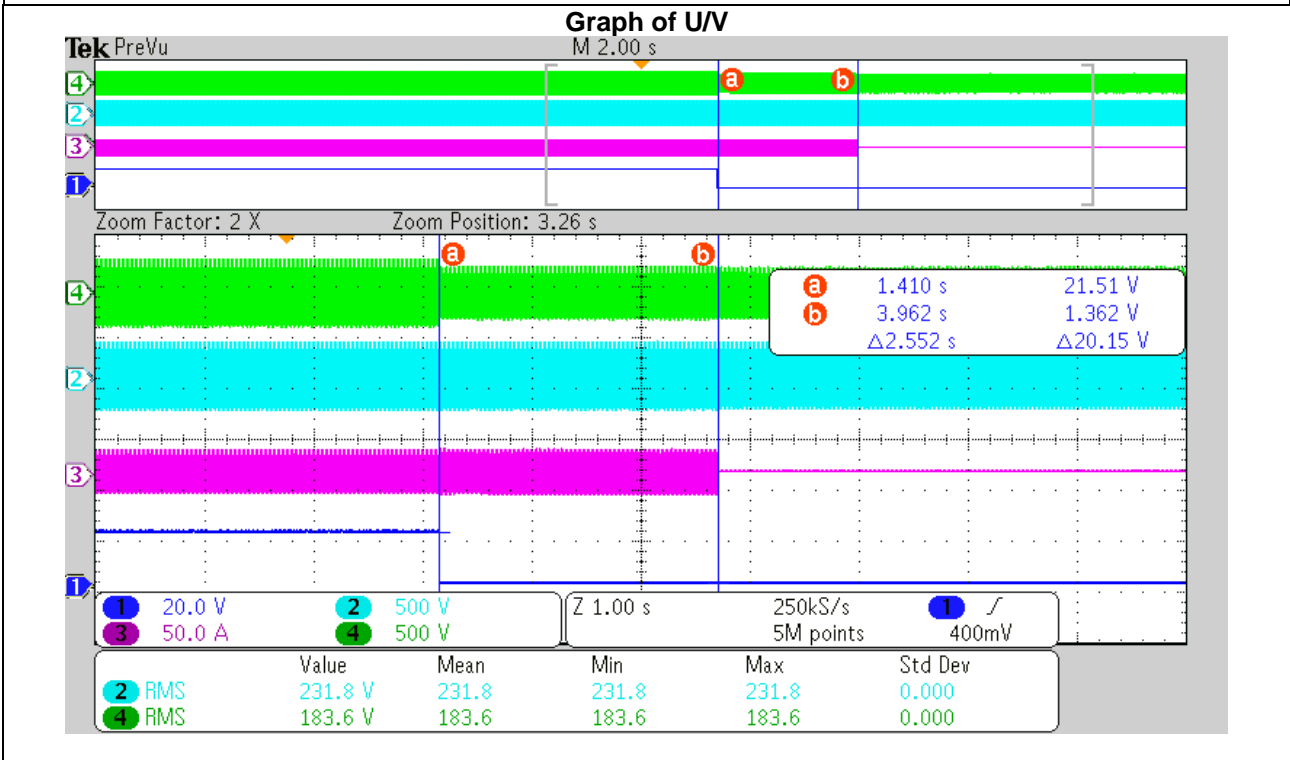


Channel 1 represents trip signal
 Channel 2 represents L1 output voltage of EUT
 Channel 3 represents L1 output current of EUT
 Channel 4 represents L2 output voltage of EUT

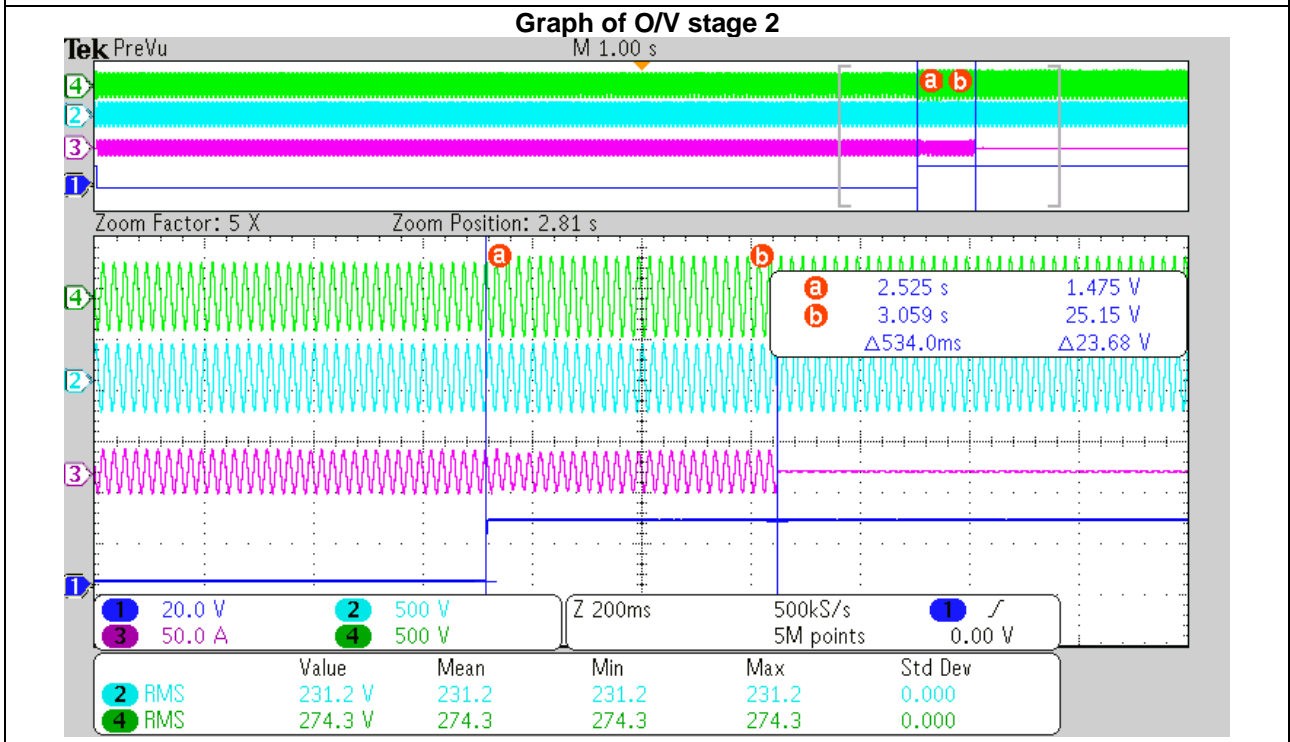
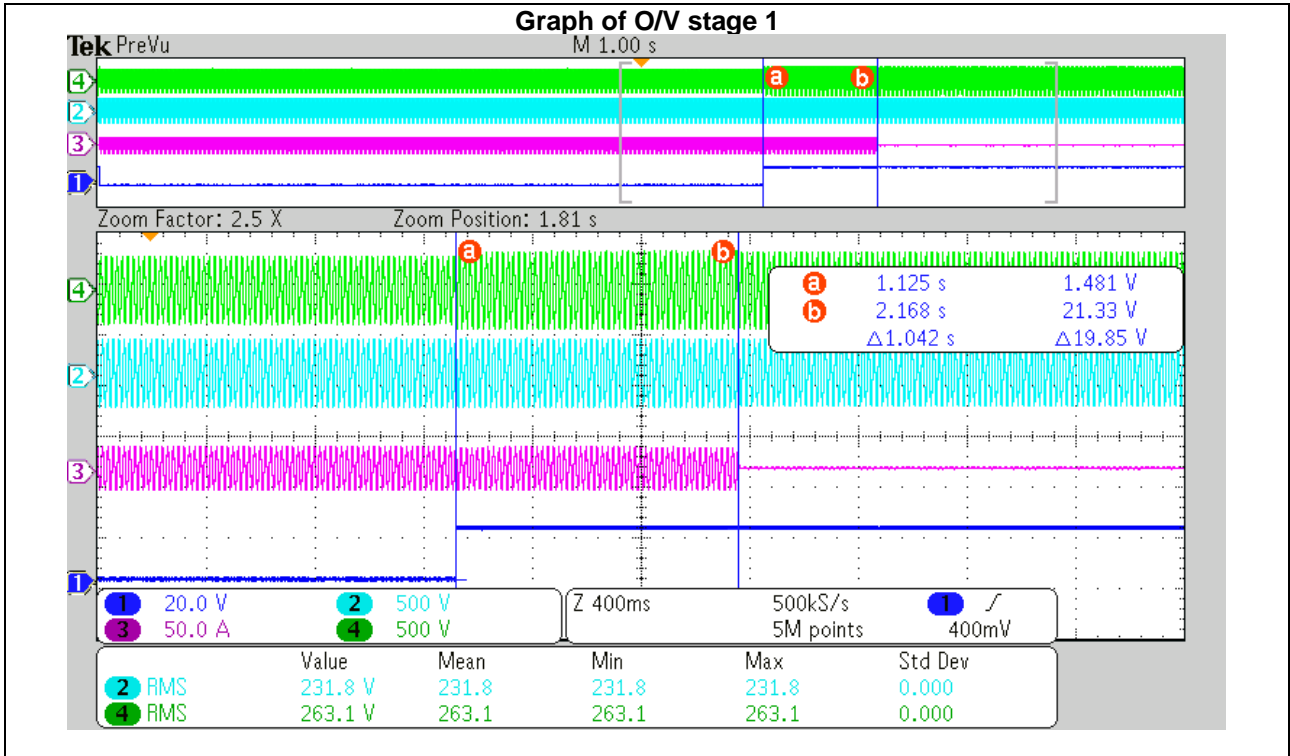
G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

Model: BNT010KTL						
L2						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	183.6	2.552	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage 1	1.14 pu (262.2 V)	1.0 s	263.1	1.042	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274.3	0.534	269.7 V 0.95 s	No trip
					277.7 V 0.45 s	No trip

Note: For Voltage tests the Voltage required to trip is the setting ± 3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ± 4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.



G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

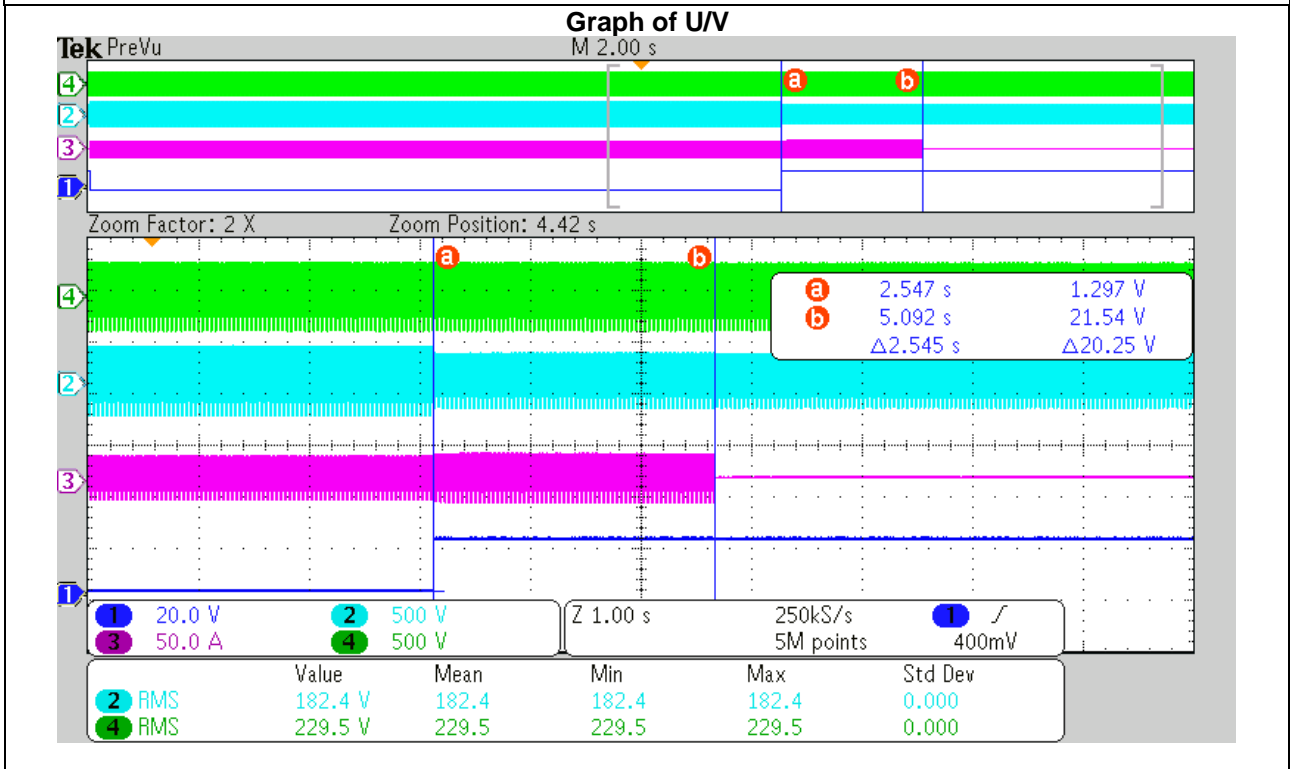


Channel 1 represents trip signal
 Channel 2 represents L1 output voltage of EUT
 Channel 3 represents L2 output current of EUT
 Channel 4 represents L2 output voltage of EUT

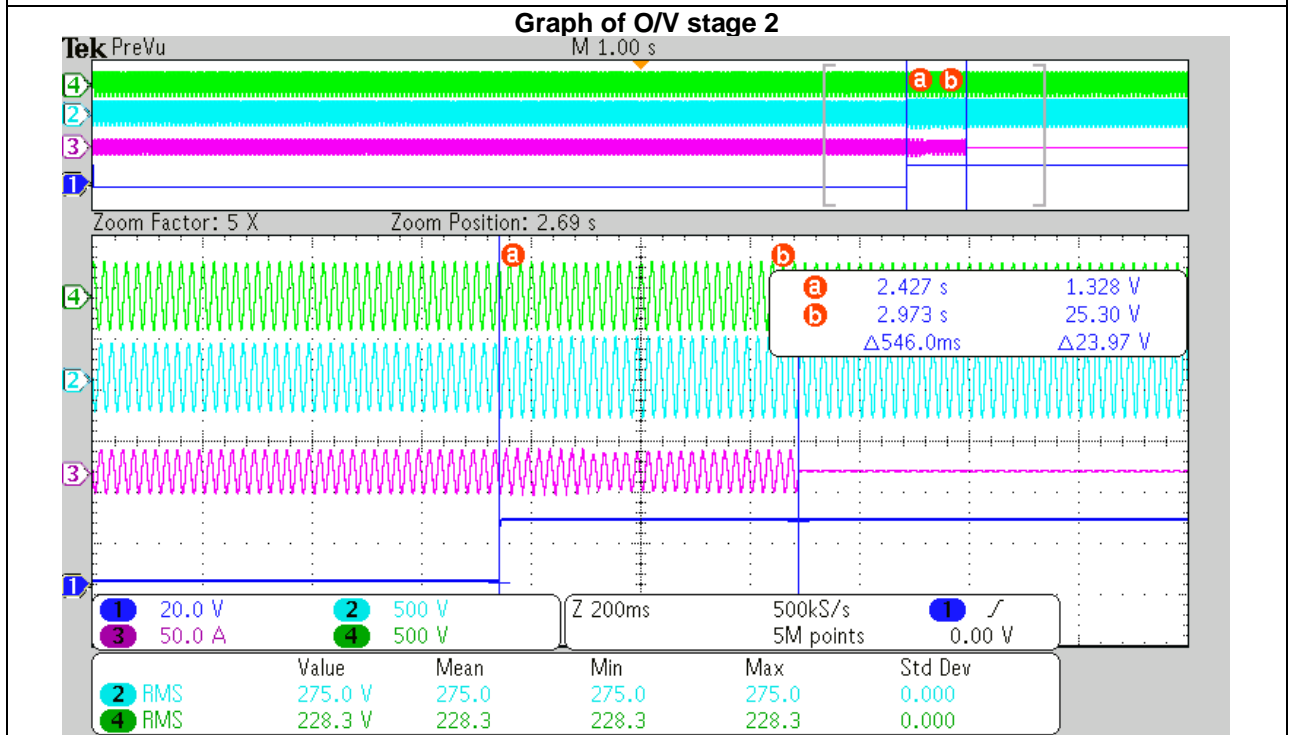
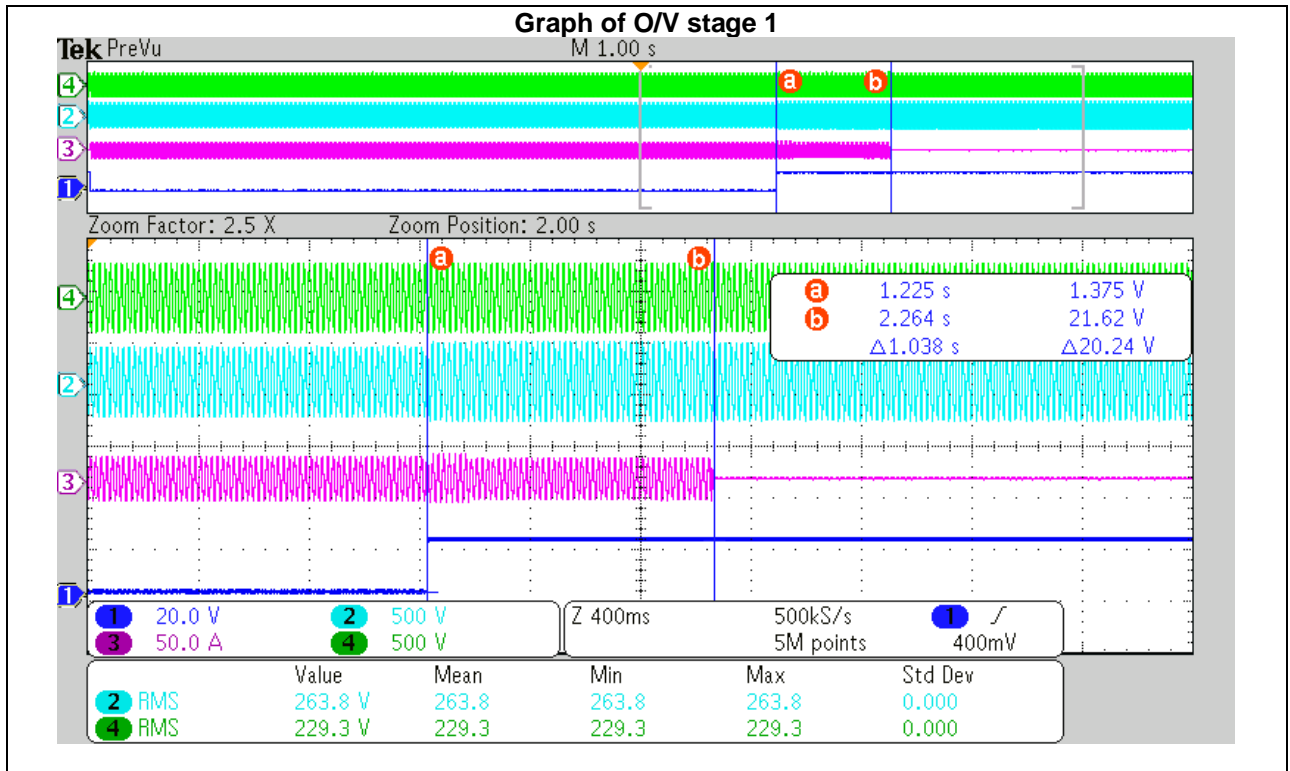
G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

Model: BNT010KTL						
L3						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	182.4	2.545	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage 1	1.14 pu (262.2 V)	1.0 s	263.8	1.038	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	275.0	0.546	269.7 V 0.95 s	No trip
					277.7 V 0.45 s	No trip

Note: For Voltage tests the Voltage required to trip is the setting ± 3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ± 4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.



G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict



Channel 1 represents trip signal
 Channel 2 represents L3 output voltage of EUT
 Channel 3 represents L3 output current of EUT
 Channel 4 represents L2 output voltage of EUT

G98/1-6									
Clause	Requirement - Test					Result - Remark			Verdict
8. Protection – Loss of Mains test:									P
For PV Inverters shall be tested in accordance with BS EN 62116. Other Micro-generators should be tested in accordance with A.2.2.4 at 10%, 55% and 100% of rated power.									
For test condition A, EUT output = 100 % P _n , test condition B, EUT output = 50 % to 66 % P _n , and test condition C, EUT output = 25 % to 33 % P _n .									
Model: BNT010KTL									
For Inverters tested to BS EN 62116 the following sub set of tests should be recorded in the following table.									
Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10			
Trip time. Limit is 0.5s	0.171s	0.176s	0.184s	0.174s	0.176s	0.178s			
No.	P _{EUT} ^{a)} (% of EUT rating)	Reactive load (% of Q _L)	P _{AC} ^{b)} (% of nominal)	Q _{AC} ^{c)} (% of nominal)	Run-on time (ms)	P _{EUT} (W)	Actual Q _f	V _{DC} ^{d)}	Remarks ^{e)}
1	100	100	0	0	204	10000	0.99	698	Test A at BL
2	66	66	0	0	200	6600	1.00	515	Test B at BL
3	33	33	0	0	559	3300	0.98	296	Test C at BL
4	100	100	-5	-5	188	10000	1.01	698	Test A at IB
5	100	100	-5	0	184	10000	1.04	698	Test A at IB
6	100	100	-5	+5	180	10000	1.07	698	Test A at IB
7	100	100	0	-5	184	10000	0.96	698	Test A at IB
8	100	100	0	+5	170	10000	1.01	698	Test A at IB
9	100	100	+5	-5	172	10000	0.92	698	Test A at IB
10	100	100	+5	0	178	10000	0.94	698	Test A at IB
11	100	100	+5	+5	196	10000	0.96	698	Test A at IB
12	66	66	0	-5	176	6600	0.97	515	Test B at IB
13	66	66	0	-4	180	6600	0.98	515	Test B at IB
14	66	66	0	-3	184	6600	0.98	515	Test B at IB
15	66	66	0	-2	192	6600	0.99	515	Test B at IB
16	66	66	0	-1	196	6600	0.99	515	Test B at IB
17	66	66	0	+1	196	6600	1.00	515	Test B at IB
18	66	66	0	+2	186	6600	1.01	515	Test B

G98/1-6									
Clause	Requirement - Test					Result - Remark			Verdict
									at IB
19	66	66	0	+3	184	6600	1.01	515	Test B at IB
20	66	66	0	+4	182	6600	1.02	515	Test B at IB
21	66	66	0	+5	176	6600	1.02	515	Test B at IB
22	33	33	0	-5	171	3300	0.96	296	Test B at IB
23	33	33	0	-4	192	3300	0.96	296	Test C at IB
24	33	33	0	-3	202	3300	0.97	296	Test C at IB
25	33	33	0	-2	230	3300	0.97	296	Test C at IB
26	33	33	0	-1	280	3300	0.98	296	Test C at IB
27	33	33	0	+1	243	3300	0.99	296	Test C at IB
28	33	33	0	+2	210	3300	0.99	296	Test C at IB
29	33	33	0	+3	201	3300	1.00	296	Test C at IB
30	33	33	0	+4	181	3300	1.01	296	Test C at IB
31	33	33	0	+5	174	3300	1.01	296	Test C at IB

Note:

^{a)}PEUT: EUT output power.

^{b)}P_{ac}: Active power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

^{c)}Q_{ac}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

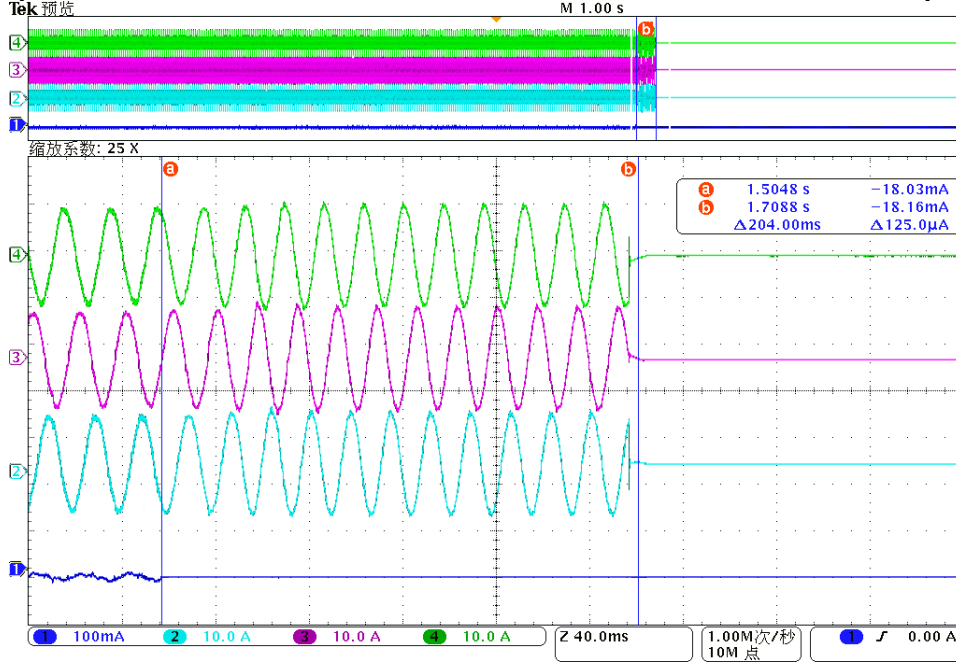
^{d)}For test condition A, > 75 % of rated input voltage range used, for test condition B, 50 % of rated input voltage range, ±10 % used, for test condition C, < 20 % of rated input voltage range used. Based on EUT rated input operating range. For example, if range is between X volts and Y volts, 75 % of range = $X + 0,75 \times (Y - X)$. Y shall not exceed $0,8 \times$ EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

^{e)}BL: Balance condition, IB: Imbalance condition.

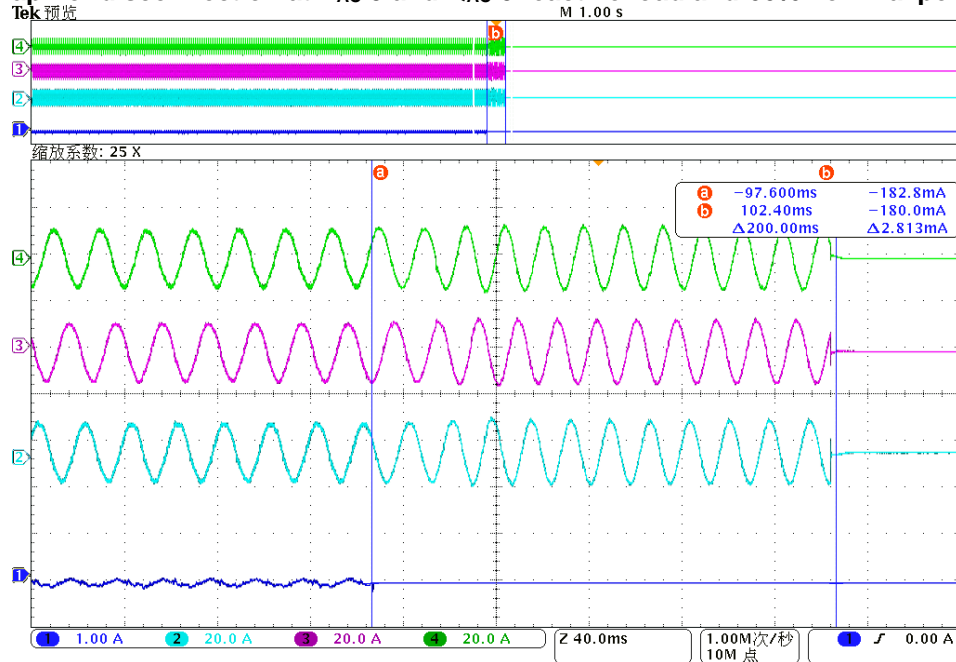
If the device requires additional shut down time (beyond 0.5 s but less than 1 s) then this should be stated on this form.

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

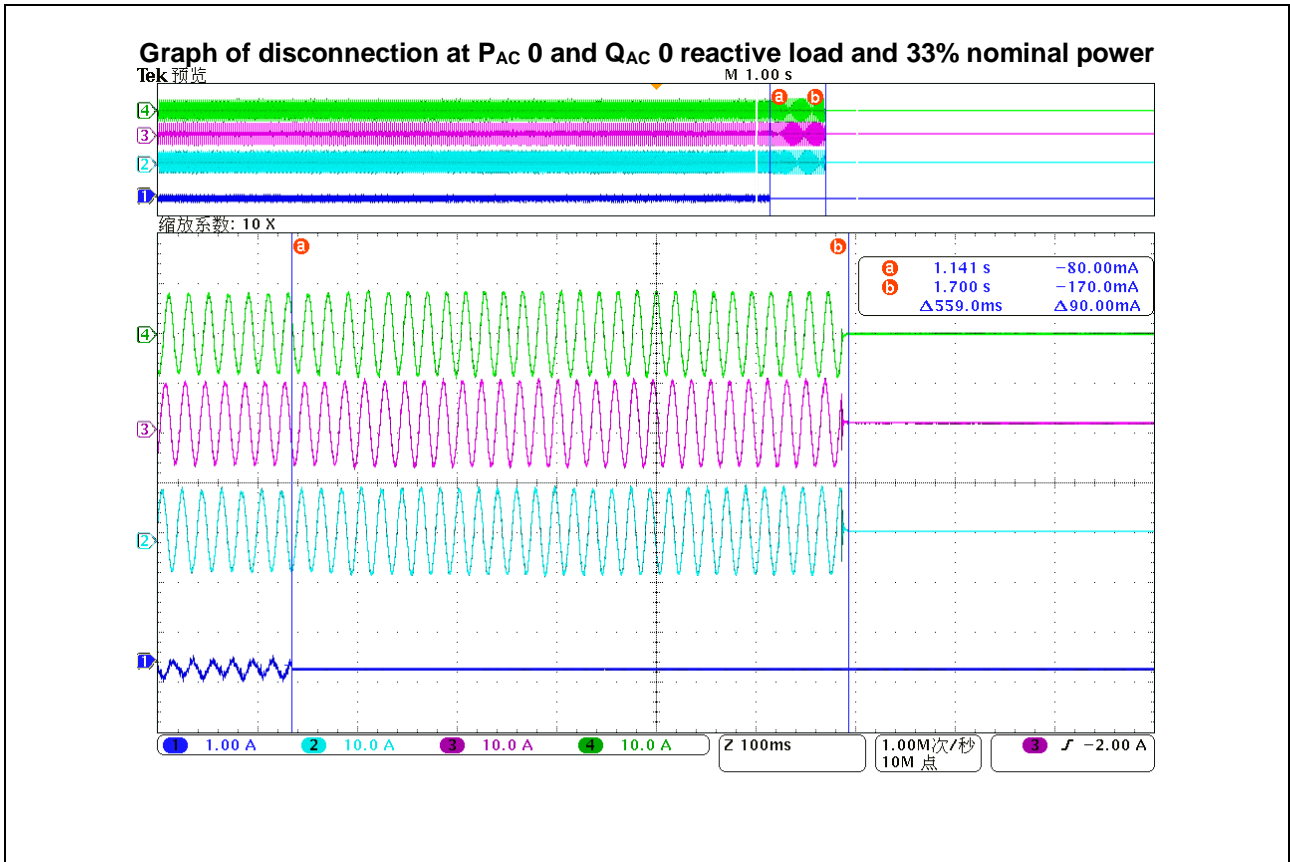
Graph of disconnection at P_{AC} 0 and Q_{AC} 0 reactive load and 100% nominal power



Graph of disconnection at P_{AC} 0 and Q_{AC} 0 reactive load and 66% nominal power



G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

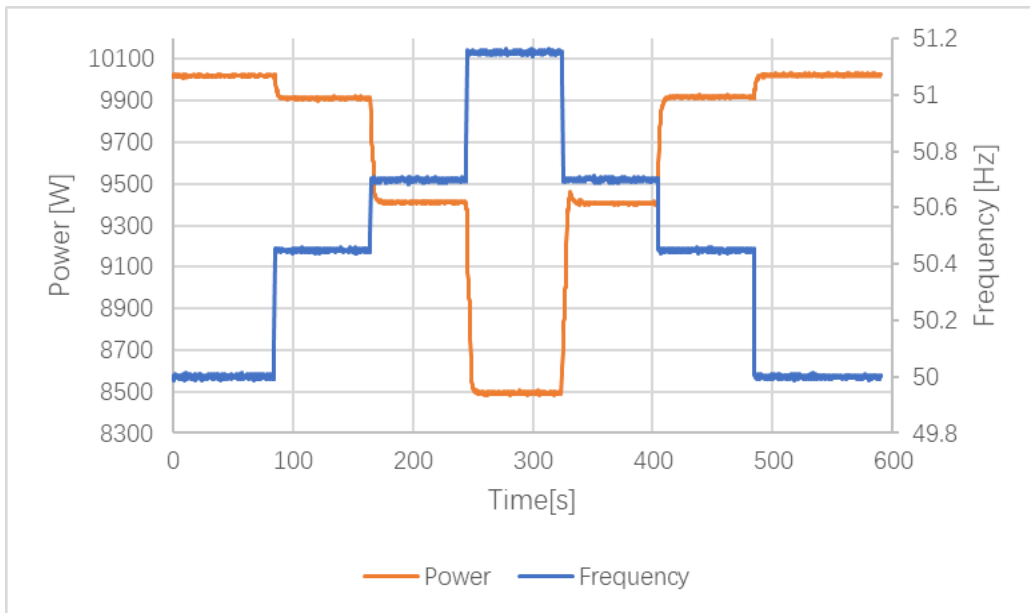


G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
8. Protection – Frequency change, Vector Shift Stability test:			P
This test should be carried out in accordance with EREC G98 Annex A1 A.1.2.6 (Inverter connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the Micro-generating Plant does not trip under positive / negative vector shift.			
Model: BNT010KTL			
	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.0 Hz	+50 degrees	No trip
Negative Vector Shift	50.0 Hz	-50 degrees	No trip
8. Protection – Frequency change, RoCoF Stability test:			P
The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 (Inverter connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the Micro-generating Plant does not trip for the duration of the ramp up and ramp down test.			
Model: BNT010KTL			
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs ⁻¹	2.1 s	No trip
51.0 Hz to 49.0 Hz	-0.95 Hzs ⁻¹	2.1 s	No trip

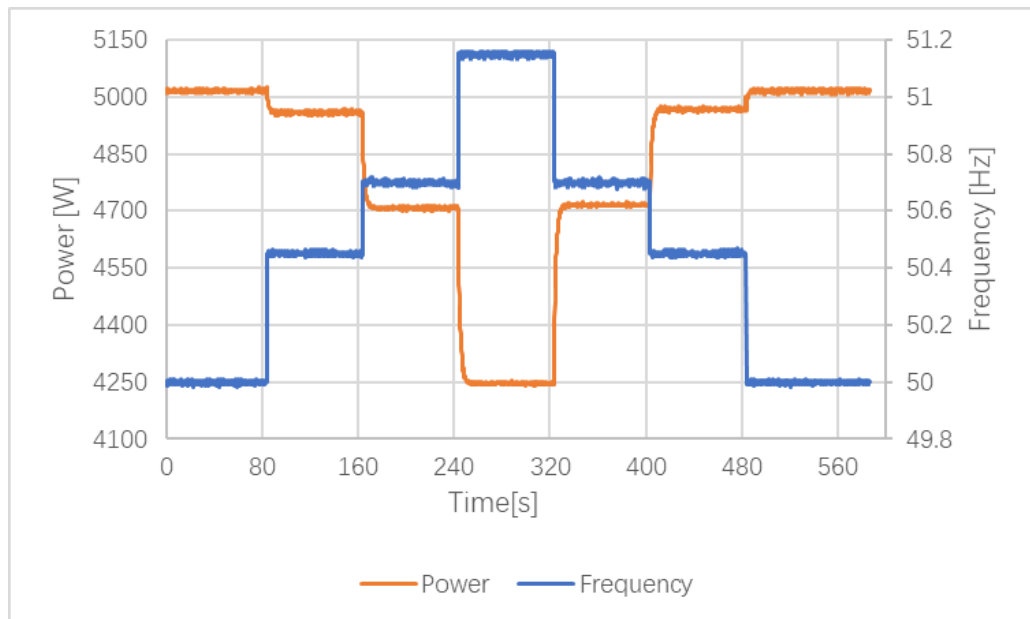
G98/1-6					
Clause	Requirement - Test	Result - Remark			Verdict
9. Limited Frequency Sensitive Mode – Over frequency test:					P
This test should be carried out in accordance with A.1.2.9. The test should be carried out using the specific threshold frequency of 50.4 Hz and Droop of 10%. The measurement tolerances are contained in A.1.2.9.					
Model: BNT010KTL					
Alternatively, simulation results should be noted below:					
Test sequence at Registered Capacity >80%	Measured Active Power Output (W)	Frequency (Hz)	Calculated droop (%)	Primary Power Source	Active Power Gradient
Step a) 50.00 Hz ±0.01 Hz	10020.65	50.00	-	Photovoltaic array simulator	-
Step b) 50.45 Hz ±0.05 Hz	9912.67	50.45	9.28		-
Step c) 50.70 Hz ±0.10 Hz	9413.90	50.70	9.91		-
Step d) 51.15 Hz ±0.05 Hz	8507.02	51.15	9.93		-
Step e) 50.70 Hz ±0.10 Hz	9386.02	50.70	9.47		-
Step f) 50.45 Hz ±0.05 Hz	9911.54	50.45	9.18		-
Step g) 50.00 Hz ±0.01 Hz	10023.75	50.00	-		-
Test sequence at Registered Capacity 40-60%	Measured Active Power Output (W)	Frequency (Hz)	Calculated droop (%)	Primary Power Source	Active Power Gradient
Step a) 50.00 Hz ±0.01 Hz	5015.77	50.00	-	Photovoltaic array simulator	-
Step b) 50.45 Hz ±0.05 Hz	4960.08	50.45	9.01		-
Step c) 50.70 Hz ±0.10 Hz	4711.95	50.70	9.91		-
Step d) 51.15 Hz ±0.05 Hz	4254.49	51.15	9.88		-
Step e) 50.70 Hz ±0.10 Hz	4708.92	50.70	9.81		-
Step f) 50.45 Hz ±0.05 Hz	4963.61	50.45	9.62		-
Step g) 50.00 Hz ±0.01 Hz	5016.41	50.00	-		-
<p>The frequency at each step should be maintained for at least one minute and the Active Power reduction in the form of a gradient determined and assessed for compliance with paragraph 11.2.3. The Droop should be determined from the measurements between 50.4 Hz and 51.15 Hz. The allowed tolerance for the frequency measurement shall be ± 0.05 Hz. The allowed tolerance for Active Power output measurement shall be ±10% of the required change in Active Power.</p> <p>The resulting overall tolerance range for a nominal 10% Droop is +2.8% and – 1.5%, ie a Droop less than 12.8% and greater than 8.5%.</p>					

G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

Diagram



Diagram



G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict

10. Power output with falling frequency test (For PV Inverter):	P
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This test should be carried out in accordance with A.1.2.7.

Model: BNT010KTL

Test sequence	Measured Active Power Output (W)	Frequency (Hz)	Primary power source
Test a) 50 Hz ± 0.01 Hz	10030.59	50.00	Photovoltaic array simulator
Test b) Point between 49.5 Hz and 49.6 Hz	10029.18	49.55	Photovoltaic array simulator
Test c) Point between 47.5 Hz and 47.6 Hz	10026.53	47.55	Photovoltaic array simulator

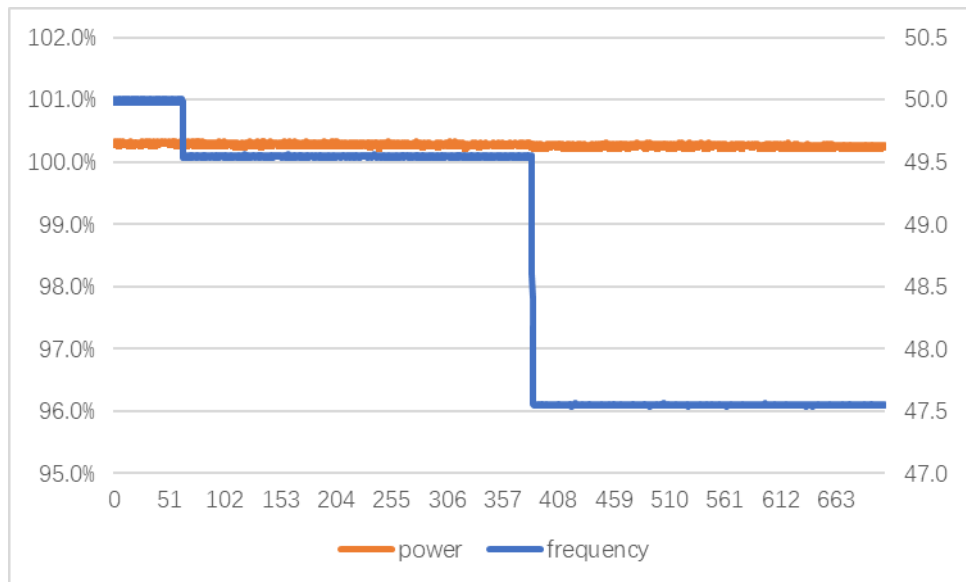
NOTE:
The operating point in Test (b) and (c) shall be maintained for at least 5 minutes

The test is regarded as passed if:

- the Micro-generator does not disconnect from the network at the operating points a) to c) when the network frequency is changed and
- the Micro-generator does not reduce output energy at point b) and
- the power reduction at point c) is less than or equal to the allowed power reduction according to paragraph 9.4.2 (Figure 3).

The following data shall be documented:

- variation of the network frequency with time;
- the measured Active Power with time.



G98/1-6					
Clause	Requirement - Test	Result - Remark			Verdict
12. Re-connection timer					P
Model: BNT010KTL					
Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 2. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the Micro-generating Plant does not reconnect at the voltage and frequency settings below; a statement of "no reconnection" can be made.					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
60s	60.54s	At 1.16 pu (266.2 V)	At 0.78 pu (180.0 V)	At 47.4 Hz	At 52.1 Hz
Confirmation that the Micro-generator does not re-connect.		No Reconnection	No Reconnection	No Reconnection	No Reconnection

13. Fault level contribution:					P
These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 (Inverter connected) and Annex A2 A.2.3.4 (Synchronous). Please complete each entry, even if the fault contribution is zero.					
Model: BNT010KTL					
For machines with electro-magnetic output			For Inverter output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	N/A	20ms	17.41V	18.78A
Initial Value of aperiodic current	A	N/A	100ms	17.57V	16.72A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	-	-
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	-	-
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	165.6ms	In seconds
For rotating machines and linear piston machines the test should produce a 0 s – 2 s plot of the short circuit current as seen at the Micro-generator terminals.					
* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.					

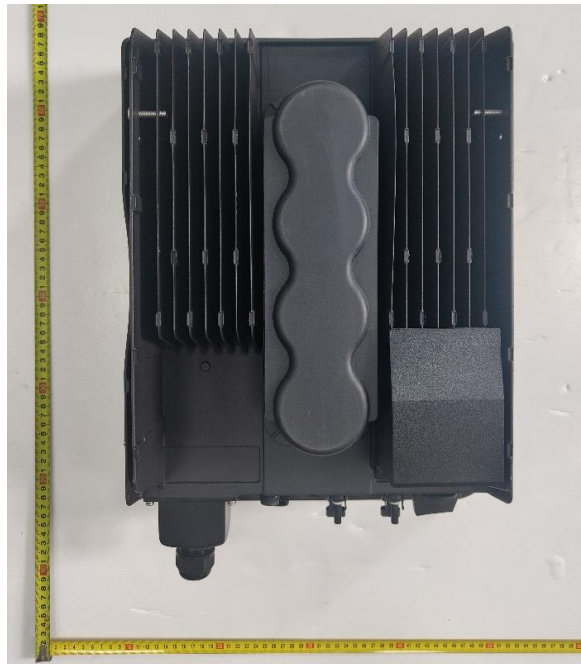
G98/1-6			
Clause	Requirement - Test	Result - Remark	Verdict
14. Logic interface (input port)			
	Confirm that an input port is provided and can be used to reduce the Active Power output to zero		Yes
	Provide high level description of logic interface, e.g. details in 9.4.3 such as AC or DC signal (the additional comments box below can be used)		Yes
15. Self-Monitoring solid state switching: No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (Inverter connected).			
	It has been verified that in the event of the solid state switching device failing to disconnect the Micro-generator , the voltage on the output side of the switching device is reduced to a value below 50 V within 0.5 s.		N/A
16. Cyber security			
	Confirm that the Manufacturer or Installer of the Micro-generator has provided a statement describing how the Micro-generator has been designed to comply with cyber security requirements, as detailed in 9.7.		N/E
Additional comments.			

Appendix 2: Photo documentation

Enclosure Front View



Enclosure Rear View



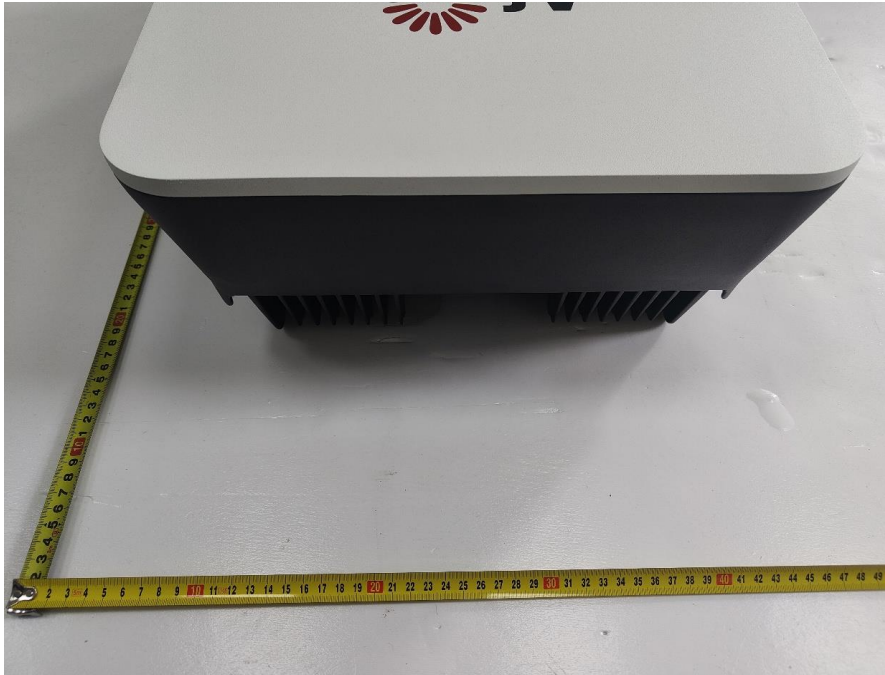
Enclosure Left Side View



Enclosure Right Side View



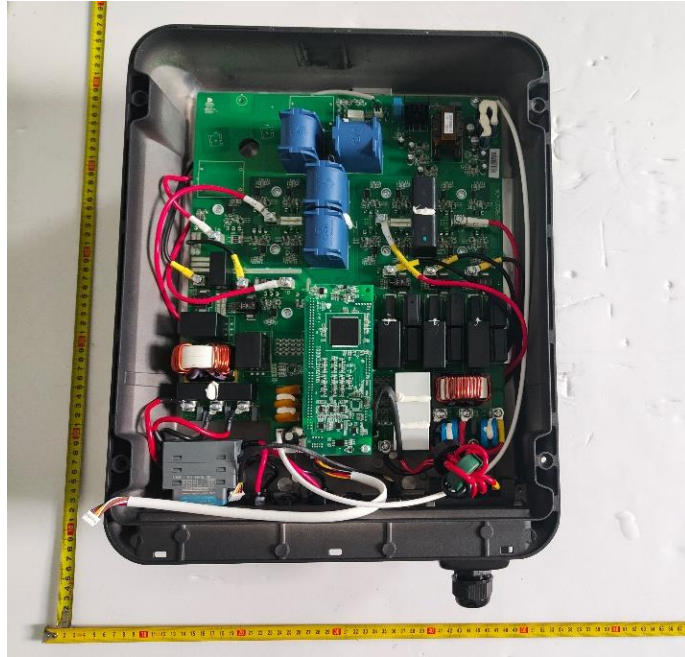
Enclosure Top Side View



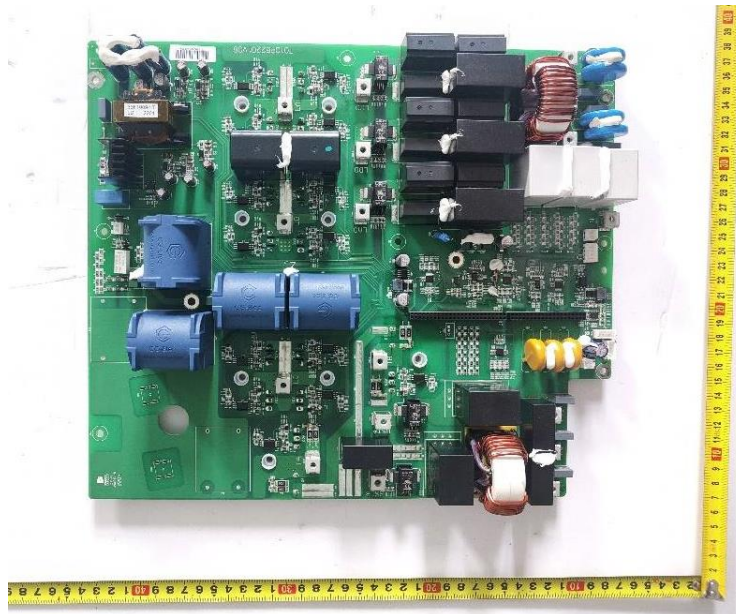
Enclosure Bottom Side View



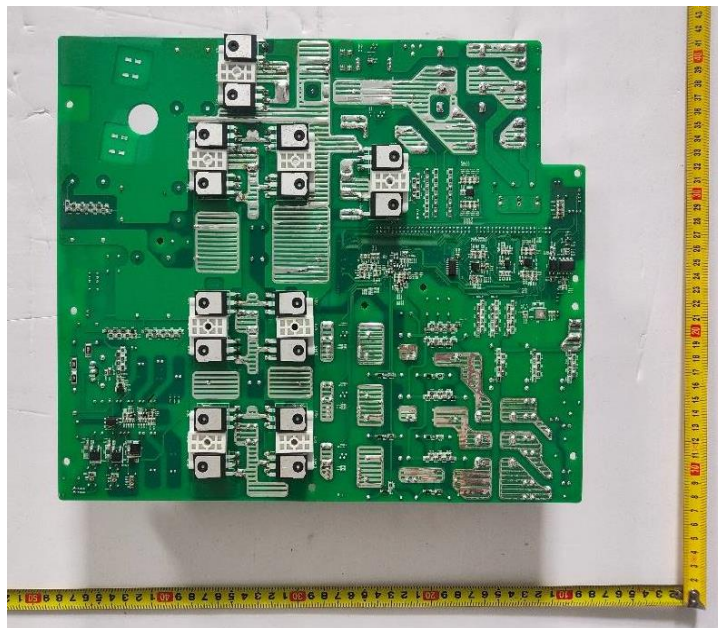
Internal View for BNT010KTL



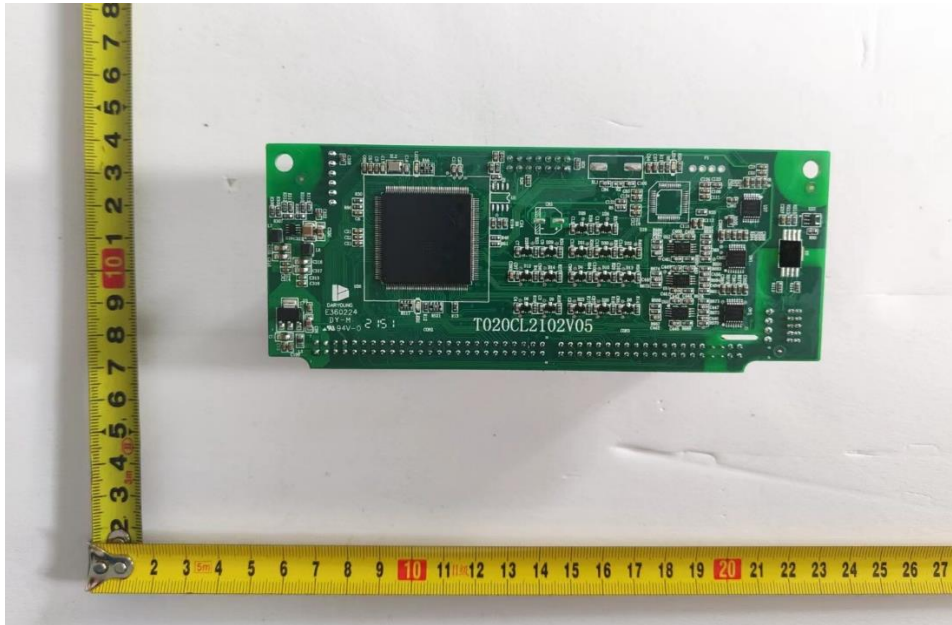
Main Board – Component Side (BNT010KTL)



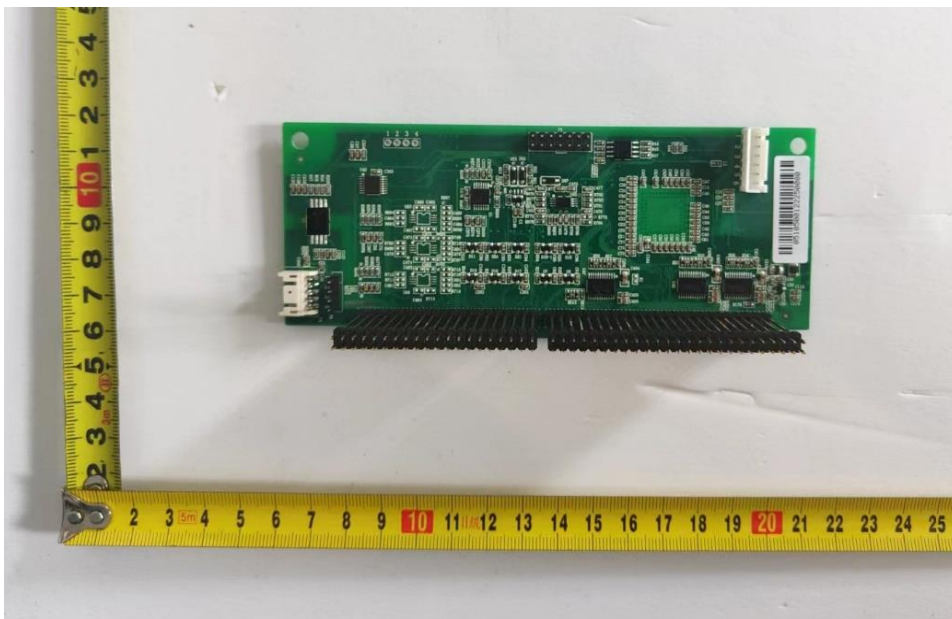
Main Board – Solder Side (BNT010KTL)



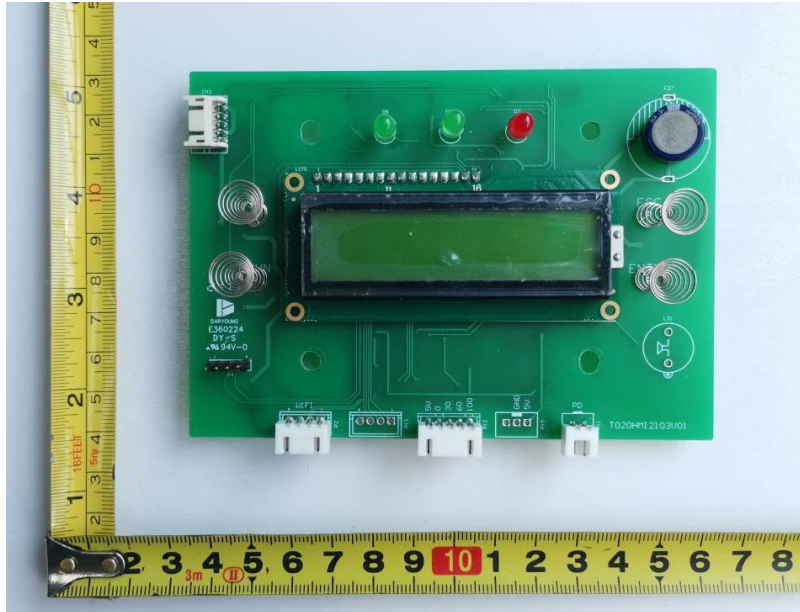
Control Board – Component Side



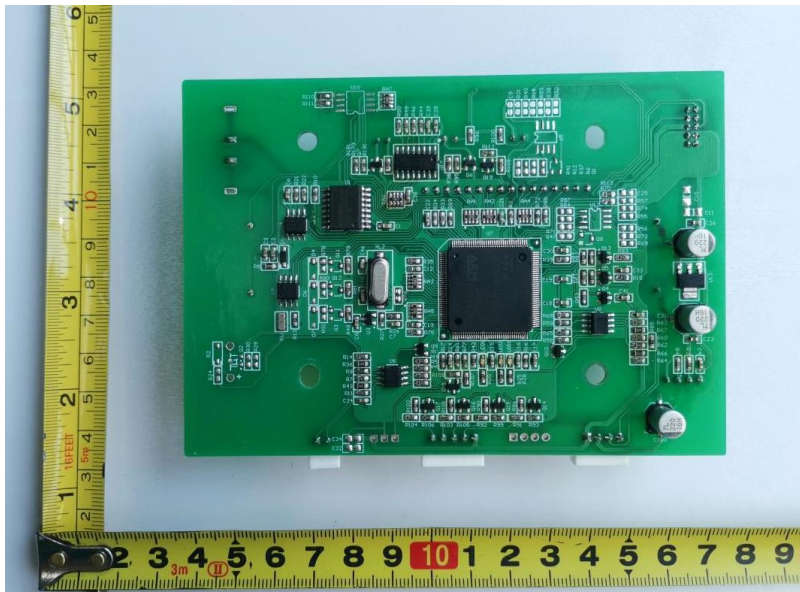
Control Board – Solder Side



LCD Display Board – Component Side



LCD Display Board – Solder Side



--- End of test report---