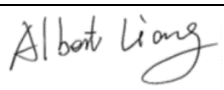
# TEST REPORT
## Engineering Recommendation G98/1-4
**Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks on or after 27 April 2019**

| | |
|---|---|
| **Report** | |
| Report Number. ..... : | 6098057.52 |
| Date of issue..... : | 2021-03-08 |
| Total number of pages ..... : | 55 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 4: 2019 |
| Test procedure..... : | Type test |
| Non-standard test method……..: | N/A |
| **Test Report Form No**. ..... : | G98/1-4_V1.0 |
| Test Report Form(s) Originator ..... : | DEKRA Testing and Certification (Suzhou) Co., Ltd. |
| Master TRF..... : | Dated 2019-07 |
| **Test item description**..... : | Hybrid inverter |
| Trade Mark ..... : | Afore |
| Manufacturer..... : | Afore New Energy Technology (Shanghai) Co., Ltd.<br>Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China |
| Model/Type reference ..... : | AF3K-SL, AF3K-SH, AF3.6K-SL, AF3.6K-SH |

| | |
|---|---|
| Ratings..... | AF3K-SL:<br>PV input: Max. 580 Vdc, MPPT voltage range: 50-550 Vdc, max 20*2 A, Isc PV: 26*2 A<br>AC Output & AC input: 230 Vac, 50 Hz, Nominal 3000 VA, rated 13 A, max 15 A<br>Battery voltage operation range: 40-60 Vdc, Rated voltage: 48 Vdc, Max charge and discharge current: 60 A, Max charge power & discharge power: 3000 W<br>EPS output: 230 Vac, rated power 3000 VA, rated current 13 A<br><br>AF3K-SH:<br>PV input: Max. 580 Vdc, MPPT voltage range: 50-550 Vdc, max 20*2 A, Isc PV: 26*2 A<br>AC Output & AC input: 230 Vac, 50 Hz, Nominal 3000 VA, rated 13 A, max 15A<br>Battery voltage operation range: 85-360 Vdc, Rated voltage: 288 Vdc, Max charge and discharge current: 30 A, Max charge power & discharge power: 6000 W/3000 W<br>EPS output: 230 Vac, rated power 3000 VA, rated current 13 A<br><br>AF3.6K-SL:<br>PV input: Max. 580 Vdc, MPPT voltage range: 50-550 Vdc, max 20*2 A, Isc PV: 26*2 A<br>AC Output & AC input: 230 Vac, 50 Hz, Nominal 3600 VA, rated 16 A, max 18.5 A<br>Battery voltage operation range: 40-60 Vdc, Rated voltage: 48 V, Max charge and discharge current: 66 A, Max charge power & discharge power: 3600 W<br>EPS output: 230 Vac, rated power 3600 VA, rated current 16 A<br><br>AF3.6K-SH:<br>PV input: Max. 580 Vdc, MPPT voltage range: 50-550 Vdc, max 20*2 A, Isc PV: 26*2 A<br>AC Output & AC input: 230 Vac, 50 Hz, Nominal 3600 VA, rated 16 A, max 18.5 A<br>Battery voltage operation range: 85-360 Vdc, Rated voltage: 288 V, Max charge and discharge current: 30 A, Max charge power & discharge power: 7000 W/3600 W<br>EPS output: 230 Vac, rated power 3600 VA, rated current 16 A |

| Responsible Testing Laboratory (as applicable), testing procedure and testing location(s): | | | |
|---|---|---|---|
| ☒ | Testing Laboratory: | DEKRA Testing and Certification (Suzhou) Co., Ltd. | |
| Testing location/ address .....: | | No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China | |
| ☐ | Associated Testing Laboratory: | | |
| Testing location/ address .....: | | | |
| Tested by (name, function, signature) .....: | | Albert Liang |  |
| Approved by (name, function, signature).....: | | Jason Guo |  |
| | | | |
| ~~☐~~ | ~~Testing procedure: TMP/CTF Stage 1:~~ | | |
| ~~Testing location/ address .....:~~ | | | |
| ~~Tested by (name, function, signature) .....:~~ | | | |
| ~~Approved by (name, function, signature).....:~~ | | | |
| | | | |
| ~~☐~~ | ~~Testing procedure: WMT/CTF Stage 2:~~ | | |
| ~~Testing location/ address .....:~~ | | | |
| ~~Tested by (name + signature) .....:~~ | | | |
| ~~Witnessed by (name, function, signature) .....:~~ | | | |
| ~~Approved by (name, function, signature).....:~~ | | | |
| | | | |
| ~~☐~~ | ~~Testing procedure: SMT/CTF Stage 3 or 4:~~ | | |
| ~~Testing location/ address .....:~~ | | | |
| ~~Tested by (name, function, signature) .....:~~ | | | |
| ~~Witnessed by (name, function, signature) .....:~~ | | | |
| ~~Approved by (name, function, signature).....:~~ | | | |
| ~~Supervised by (name, function, signature) .....:~~ | | | |
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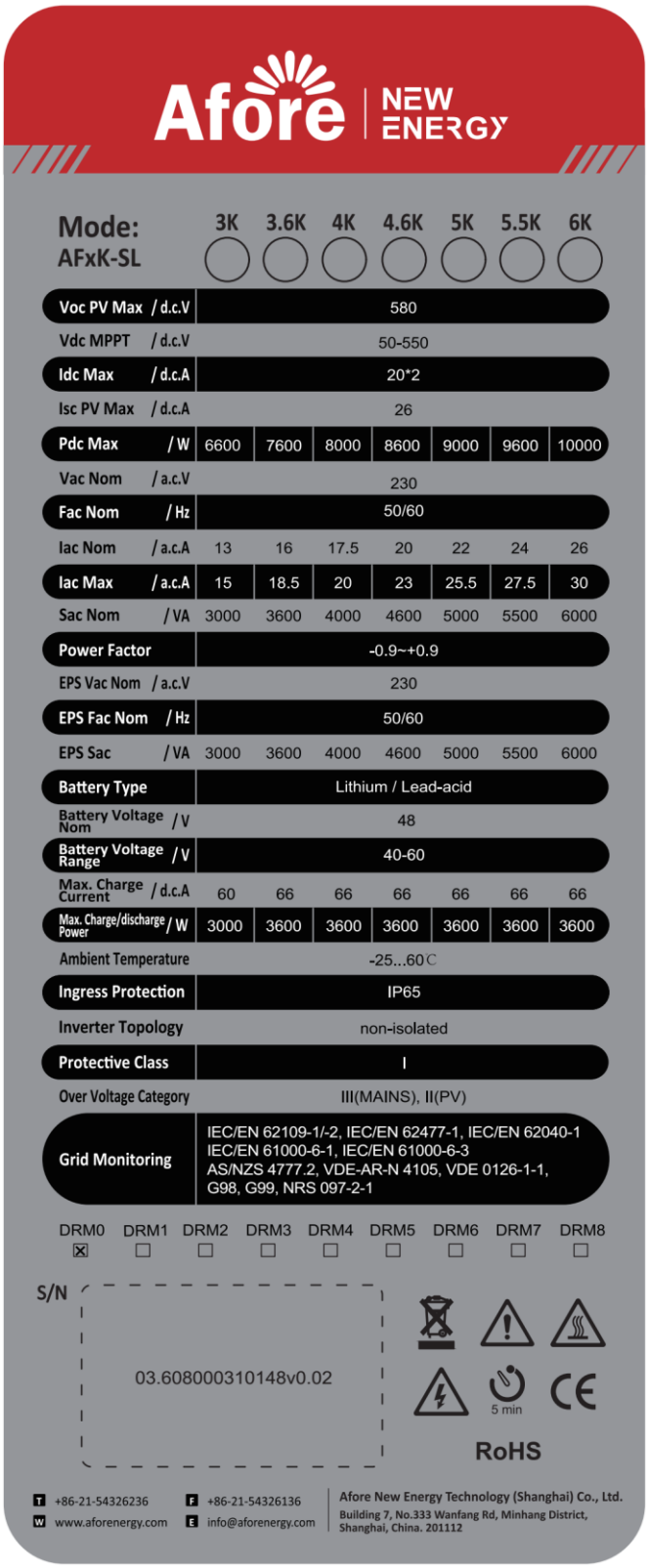
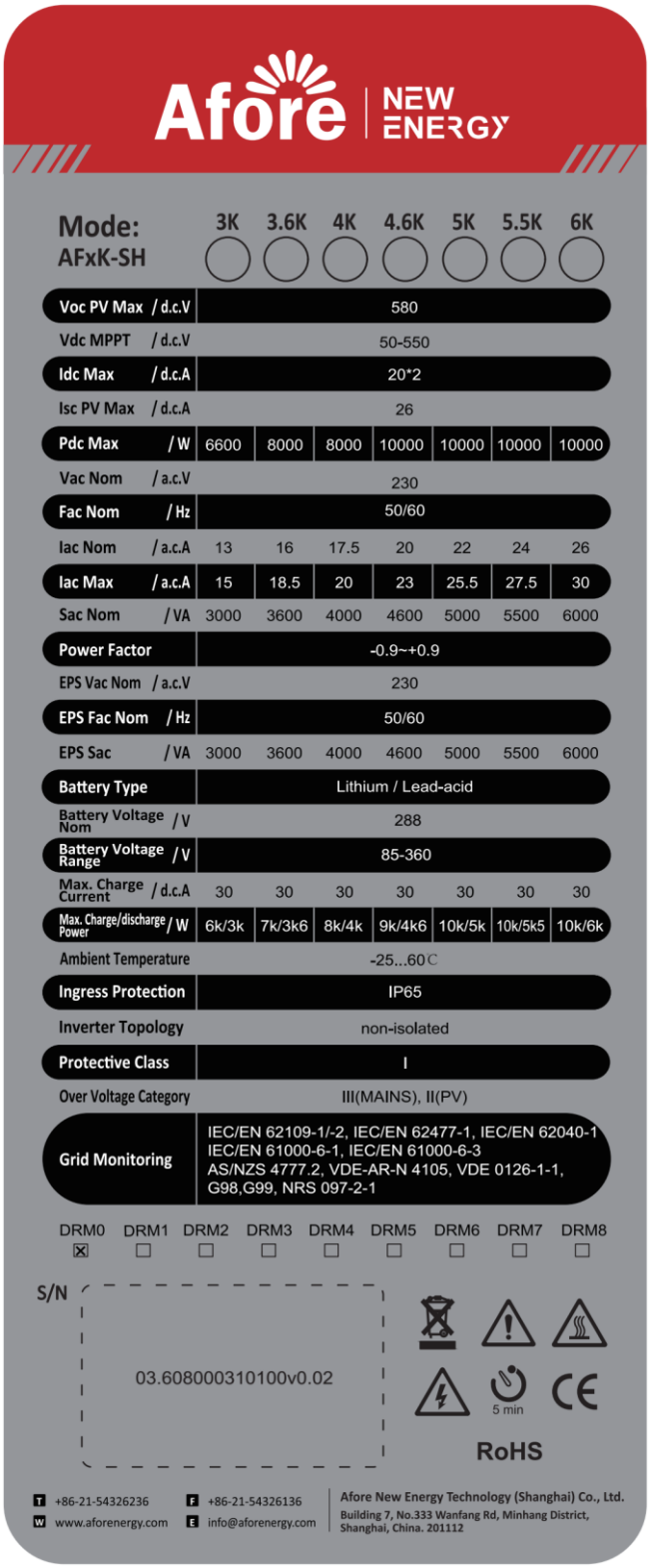
**Copy of marking plate:**






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.

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|---|---|---|---|---|
| **Test item particulars:** | | | | |
| Equipment mobility ..... : | movable<br>fixed | hand-held<br>transportable | stationary<br>for building-in | |
| Connection to the mains ..... : | pluggable equipment<br>permanent connection | | direct plug-in<br>for building-in | |
| Environmental category ..... : | outdoor | indoor unconditional | indoor conditional | |
| Over voltage category Mains ..... : | OVC I | OVC II | OVC III | OVC IV |
| Over voltage category PV ..... : | OVC I | OVC II | OVC III | OVC IV |
| Mains supply tolerance (%) ..... : | -80% / +119% | | | |
| Tested for power systems ..... : | TN | | | |
| IT testing, phase-phase voltage (V) ..... : | N/A | | | |
| Class of equipment ..... : | Class I<br>Not classified | Class II | Class III | |
| Mass of equipment (kg) ..... : | 22 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) | | | |
| - this clause is information reference for installation . : | Info. | | | |
| **Testing:** | | | | |
| Date of receipt of test item ..... : | 2020-04-15 (samples provided by applicant) | | | |
| Date (s) of performance of tests ..... : | 2020-04-25 to 2020-06-29 | | | |

**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 ☐ comma / ☒ point is used as the decimal separator.

**Name and address of factory (ies):**

Afore New Energy Technology (Shanghai) Co., Ltd.

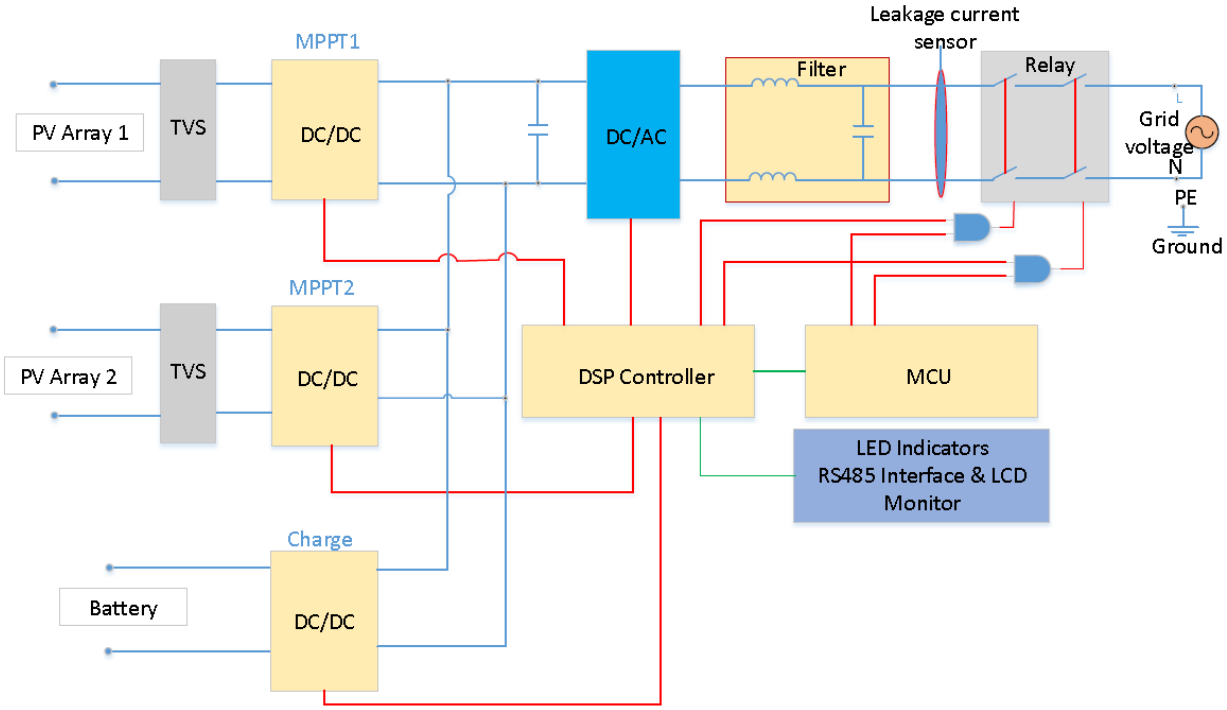
Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China

**General product information:**

The products are single phase hybrid inverter which converts DC voltage (from array and/or storage batteries) into AC voltage, and charge the storage batteries from the power of the PV array or grid.

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 two 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 two relays in series in both 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: -10°C to +50°C

**Model difference:**

In the model name, the suffix SH have below meaning:

“SH” means the product with higher battery voltage.

All the models SL series are classified as one family due to they are identical in software and similar in

hardware except different battery voltage and different electrical ratings.

**The product was tested on:**

If no special state, the tests were performed on model AF3.6K-SL also applicable for all other models stated in this report.

Hardware version:

V03.

Software version:

DSP:1.00

**Amendment 1 report:**

The original report No. 6076147.50 issued by DEKRA Testing and Certification (Suzhou) Co., Ltd. dated on 2020-07-21 was updated and including below modifications which were considered as technical modifications:

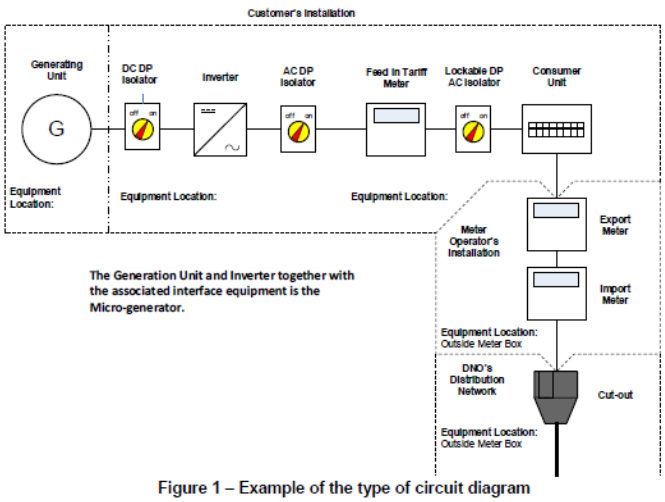
--- The model reference of HNS3000HS, HNS3000-HV, HNS3600HS, HNS3600HS-HV were changed to AF3K-SL, AF3K-SH, AF3.6K-SL, AF3.6K-SH;

---The rating labels in page 4 and page 5 were updated accordingly.

After reviewing and evaluated, no test was considered necessary.

| G98/1-4 | | | |
|---|---|---|---|
| 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. |

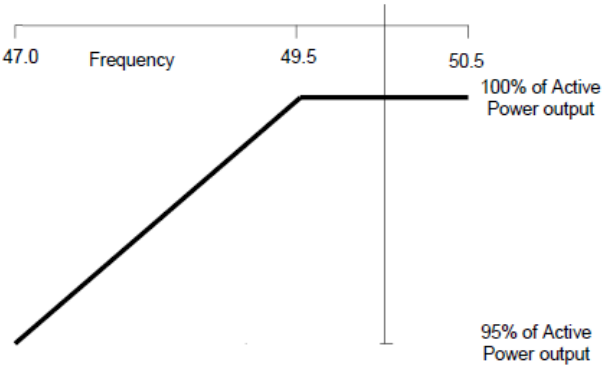
| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 5.3.1 | It is the responsibility of the Installer to ensure that the relevant information as specified in this section and in section 6 is forwarded to the local DNO as appropriate. The pro formas in Appendix 3 are designed to:<br>a) simplify the connection procedure for both DNO and Micro-generator Installer;<br>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;<br>c) inform the DNO that the Micro-generator installation complies with the requirements of this EREC G98; and<br>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 |
| 7 | Operation and Safety | | P |
| 7.1 | Operational Requirements | | P |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 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 | Isolation | | Info. |
| 7.2.1 | 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 | | P |
| 7.3.1 | Labelling shall be placed in accordance with EN 50438. 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 |
| 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. |
| 7.3.3 | Figure 1 shows an outline example of the type of circuit diagram that will need to be displayed. Figure 1 is non-prescriptive and is for illustrative purposes only.<br>  <br><br>Figure 1 – Example of the type of circuit diagram | | Info. |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 7.3.4 | 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. | Must be taken under consideration for the installation. | Info. |
| 7.4 | Maintenance & Routine Testing | | P |
| 7.4.1 | 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 |
| 7.5 | Phase Unbalance | | N/A |
| 7.5.1 | There is no requirement to balance phases on installations below or equal to 16 A per phase. | | N/A |
| 7.5.2 | 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. | Single phase inverter up to 16 A. | N/A |
| 7.6 | Voltage Management Units | | |
| 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. | | |
| 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. |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 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. |
| 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. |
| 8.5 | Notification of Decommissioning | | Info. |

<table>
<tr><td colspan="4">G98/1-4</td></tr>
<tr><td>Clause</td><td>Requirement - Test</td><td>Result - Remark</td><td>Verdict</td></tr>
<tr><td>8.5.1</td><td>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.</td><td></td><td>Info.</td></tr>
<tr><td>9</td><td colspan="2">General Technical Requirements</td><td>P</td></tr>
<tr><td>9.1</td><td colspan="2">Frequency withstand</td><td>P</td></tr>
<tr><td>9.1.1</td><td>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.</td><td></td><td>P</td></tr>
<tr><td></td><td>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
<table>
<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>
</table></td><td>see appended table</td><td>P</td></tr>
<tr><td>9.2</td><td colspan="2">Rate of Change of Frequency</td><td>P</td></tr>
<tr><td>9.2.1</td><td>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.</td><td></td><td>P</td></tr>
<tr><td>9.3</td><td colspan="2">Limited Frequency Sensitive Mode – Overfrequency</td><td>P</td></tr>
<tr><td>9.3.1</td><td>With regard to the Limited Frequency Sensitive Mode — Overfrequency (LFSM-O), the Micro-generator shall be capable of activating the provision of Active Power Frequency Response according to EN 50438. The GB specific standard frequency threshold shall be 50.4 Hz; the Droop setting 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.</td><td>see appended table</td><td>P</td></tr>
<tr><td>9.3.2</td><td>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.</td><td></td><td>P</td></tr>
<tr><td>9.4</td><td colspan="2">Active Power Output</td><td>P</td></tr>
</table>

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 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 | The Micro-generator shall be capable of maintaining constant output at its Registered Capacity regardless of changes in frequency in the range 49.5 – 50.4 Hz. Below 49.5 Hz, the power output should not drop by more than pro-rata 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 2.<br>  <br><br>**Figure 2 – Change in output power with falling frequency** | see appended table | P |
| 9.4.3 | 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 |
| 9.5 | Power Factor | | P |
| 9.5.1 | The power factor capability of the Micro-generator shall conform to EN 50438. 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. | see appended table | P |
| 9.6 | Automatic Connection | | P |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 9.6.1 | Micro-generators shall conform to EN 50438 in respect of connection and starting to generate electric power. This includes automatic reconnection where the minimum observation time shall be as stated in Annex A12 of EN 50438. | | P |
| 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 |
| 10.1.3 | 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.<br>**Table 2 – Interface Protection settings**<br>Protection Function / Trip Setting / Time Delay Setting<br>U/V: Vφ-n† - 20% = 184 V / 2.5 s<br>O/V stage 1: Vφ-n† +14% = 262.2 V / 1.0 s<br>O/V stage 2: Vφ-n†+ 19% = 273.7 V3 / 0.5 s<br>U/F stage 1: 47.5 Hz / 20 s<br>U/F stage 2: 47 Hz / 0.5 s<br>O/F: 52 Hz / 0.5 s<br>LoM (RoCoF): 1.0 Hzs-1 / <br>† A value of 230 V phase to neutral | see appended table | P |
| 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 |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 10.1.7 | The Manufacturer shall establish a secure way of displaying the Interface Protection setting information in one of the following ways: | | P |
| | • A display on a screen;<br><br>• 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<br><br>• 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 |
| 10.1.10 | 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 |
| 10.1.11 | 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. | | Info. |
| 10.2 | Loss of Mains Protection | | P |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 10.2.1 | Loss of mains protection shall be incorporated and tested as defined in the compliance type testing annex of EN 50438. 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 50º. Both stability tests shall be carried out in all cases. | see appended table | P |
| 10.3.4 | 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 |
| | • RoCoF: 0.95 Hzs-1 from 49.0 Hz to 51.0 Hz on both rising and falling frequency; and<br>• Vector shift: 50º plus from 49.5 Hz and 50º minus from 50.5 Hz. | see appended table | P |
| 11 | Quality of Supply | | P |
| 11.1 | The power quality requirements set out in EN 50438 should be met along with the 11.1 requirements described in this section of EREC G98. | | P |
| 11.2 | Micro-generators are likely to be installed in large numbers on LV Distribution 11.2 Networks. They are likely to operate for long periods with no diversity between them, and adjacent Micro-generators are likely to be of the same technology. Therefore, in order to accommodate a high number of Micro-generators on a Distribution Network, procedures are specified in Annex A1 and Annex A2, which need to be applied when testing for harmonic current emissions and flicker. | | P |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |
| 11.3 | The requirements of EN 50438 shall be met for DC injection. | see appended table | P |
| 12 | Short Circuit Current Contribution | | P |
| 12.1 | Directly Coupled Micro-generators | | N/A |
| 12.1.1 | The short-circuit parameters of synchronous Micro-generators shall be determined by means of a short-circuit test in accordance with EN 50438. | | N/A |
| 12.2 | Inverter Connected Micro-generators | | P |
| 12.2.1 | In addition to EN 50438 Manufacturers of Inverters shall take account of the following: | | 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; and<br>• 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 |
| 12.2.2 | 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. | | P |
| Appendix 1 | Emerging Technologies and other Exceptions | | P |
| Appendix 2 | Connection Procedure Flow Chart | | P |
| Appendix 3 | Micro-generator Documentation | | P |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

**Appendix 1: Type Verification Test Report**

**Operating Range:** This test should be carried out as specified in EN 50438 D.3.1.

**Active Power** shall be recorded every second. The tests will verify that the **Micro-generator** can operate within the required ranges for the specified period of time.

The **Interface Protection** shall be disabled during the tests.

In case of a PV **Micro-generator** the PV primary source may be replaced by a **DC** source.

In case of a full converter **Micro-generator** (eg wind) the primary source and the prime mover **Inverter**/rectifier may be replaced by a **DC** source.

In case of a DFIG **Micro-generator** the mechanical drive system may be replaced by a test bench motor.

Test 1
Voltage = 85% of nominal (195.5 V)
Frequency = 47.5 Hz
Power factor = 1
Period of test 90 minutes

Test 2
Voltage = 110% of nominal (253 V).
Frequency = 51.5 Hz
Power factor = 1
Period of test 90 minutes

Test 3
Voltage = 110% of nominal (253 V).
Frequency = 52.0 Hz
Power factor = 1
Period of test 15 minutes

Note:
The tests were performed on model AF3.6K-SL also applicable for all other models stated in this report.

Test 1 **P**

Model: AF3.6K-SL

| Measured Voltage (V) | Measured Frequency (Hz) | Measured Power (W) | Measured Power factor | Test Time (Minutes) |
|---|---|---|---|---|
| 195.49 | 47.50 | 3609.50 | 0.9996 | 90 |

Test 2 **P**

Model: AF3.6K-SL

| Measured Voltage (V) | Measured Frequency (Hz) | Measured Power (W) | Measured Power factor | Test Time (Minutes) |
|---|---|---|---|---|
| 253.11 | 51.50 | 3730.03 | 0.9996 | 90 |

Test 3 **P**

Model: AF3.6K-SL

| Measured Voltage (V) | Measured Frequency (Hz) | Measured Power (W) | Measured Power factor | Test Time (Minutes) |
|---|---|---|---|---|
| 252.98 | 52.00 | 3705.65 | 0.9996 | 15 |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| | |
|---|---|
| **Power Quality – Harmonics:** 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). | **P** |

**Micro-generator** tested to BS EN 61000-3-2

Model: AF3.6K-SL

| **Micro-generator** rating per phase (rpp) | | | 3.6 | kW | | |
|---|---|---|---|---|---|---|
| Harmonic | At 45-55% of **Registered Capacity** | | 100% of **Registered Capacity** | | NV=MV*3.68/rpp | |
| | Measured Value (MV) in Amps | Normalised Value (NV) in Amps | Measured Value (MV) in Amps | Normalised Value (NV) in Amps | Limit in BS EN 61000-3-2 in Amps | Higher limit for odd harmonics 21 and above |
| 2 | 0.032 | 0.033 | 0.040 | 0.041 | 1.080 | |
| 3 | 0.076 | 0.078 | 0.234 | 0.239 | 2.300 | |
| 4 | 0.005 | 0.005 | 0.006 | 0.006 | 0.430 | |
| 5 | 0.030 | 0.031 | 0.093 | 0.095 | 1.140 | |
| 6 | 0.006 | 0.006 | 0.006 | 0.006 | 0.300 | |
| 7 | 0.016 | 0.016 | 0.048 | 0.049 | 0.770 | |
| 8 | 0.006 | 0.006 | 0.007 | 0.007 | 0.230 | |
| 9 | 0.014 | 0.014 | 0.032 | 0.033 | 0.400 | |
| 10 | 0.006 | 0.006 | 0.006 | 0.006 | 0.184 | |
| 11 | 0.008 | 0.008 | 0.017 | 0.017 | 0.330 | |
| 12 | 0.006 | 0.006 | 0.007 | 0.007 | 0.153 | |
| 13 | 0.007 | 0.007 | 0.017 | 0.017 | 0.210 | |
| 14 | 0.006 | 0.006 | 0.006 | 0.006 | 0.131 | |
| 15 | 0.006 | 0.006 | 0.009 | 0.009 | 0.150 | |
| 16 | 0.005 | 0.005 | 0.006 | 0.006 | 0.115 | |
| 17 | 0.006 | 0.006 | 0.008 | 0.008 | 0.132 | |
| 18 | 0.005 | 0.005 | 0.006 | 0.006 | 0.102 | |
| 19 | 0.005 | 0.005 | 0.007 | 0.007 | 0.118 | |
| 20 | 0.005 | 0.005 | 0.006 | 0.006 | 0.092 | |
| 21 | 0.005 | 0.005 | 0.008 | 0.008 | 0.107 | 0.160 |
| 22 | 0.005 | 0.005 | 0.007 | 0.007 | 0.084 | |
| 23 | 0.005 | 0.005 | 0.007 | 0.007 | 0.098 | 0.147 |
| 24 | 0.005 | 0.005 | 0.006 | 0.006 | 0.077 | |
| 25 | 0.005 | 0.005 | 0.007 | 0.007 | 0.090 | 0.135 |
| 26 | 0.005 | 0.005 | 0.007 | 0.007 | 0.071 | |
| 27 | 0.005 | 0.005 | 0.007 | 0.007 | 0.083 | 0.124 |
| 28 | 0.005 | 0.005 | 0.007 | 0.007 | 0.066 | |
| 29 | 0.005 | 0.005 | 0.008 | 0.008 | 0.078 | 0.117 |
| 30 | 0.004 | 0.004 | 0.007 | 0.007 | 0.061 | |
| 31 | 0.004 | 0.004 | 0.007 | 0.007 | 0.073 | 0.109 |
| 32 | 0.004 | 0.004 | 0.007 | 0.007 | 0.058 | |
| 33 | 0.005 | 0.005 | 0.007 | 0.007 | 0.068 | 0.102 |
| 34 | 0.004 | 0.004 | 0.008 | 0.008 | 0.054 | |
| 35 | 0.004 | 0.004 | 0.008 | 0.008 | 0.064 | 0.096 |
| 36 | 0.004 | 0.004 | 0.008 | 0.008 | 0.051 | |
| 37 | 0.004 | 0.004 | 0.008 | 0.008 | 0.061 | 0.091 |
| 38 | 0.004 | 0.004 | 0.008 | 0.008 | 0.048 | |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| | | | | | | |
|---|---|---|---|---|---|---|
| 39 | 0.004 | 0.004 | 0.008 | 0.008 | 0.058 | 0.087 |
| 40 | 0.004 | 0.004 | 0.008 | 0.008 | 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.

| **Power Quality – Harmonics:** 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). | **P** |
|---|---|

**Micro-generator** tested to BS EN 61000-3-2

Model: AF3K-SL

| **Micro-generator** rating per phase (rpp) | | | 3 | kW | NV=MV*3.68/rpp | |
|---|---|---|---|---|---|---|
| Harmonic | At 45-55% of **Registered Capacity** | | 100% of **Registered Capacity** | | | |
| | Measured Value (MV) in Amps | Normalised Value (NV) in Amps | Measured Value (MV) in Amps | Normalised Value (NV) in Amps | Limit in BS EN 61000-3-2 in Amps | Higher limit for odd harmonics 21 and above |
| 2 | 0.021 | 0.021 | 0.041 | 0.042 | 1.080 | |
| 3 | 0.060 | 0.061 | 0.201 | 0.205 | 2.300 | |
| 4 | 0.005 | 0.005 | 0.009 | 0.009 | 0.430 | |
| 5 | 0.022 | 0.022 | 0.079 | 0.081 | 1.140 | |
| 6 | 0.005 | 0.005 | 0.008 | 0.008 | 0.300 | |
| 7 | 0.014 | 0.014 | 0.040 | 0.041 | 0.770 | |
| 8 | 0.004 | 0.004 | 0.009 | 0.009 | 0.230 | |
| 9 | 0.011 | 0.011 | 0.027 | 0.028 | 0.400 | |
| 10 | 0.004 | 0.004 | 0.008 | 0.008 | 0.184 | |
| 11 | 0.006 | 0.006 | 0.016 | 0.016 | 0.330 | |
| 12 | 0.004 | 0.004 | 0.008 | 0.008 | 0.153 | |
| 13 | 0.005 | 0.005 | 0.015 | 0.015 | 0.210 | |
| 14 | 0.004 | 0.004 | 0.008 | 0.008 | 0.131 | |
| 15 | 0.005 | 0.005 | 0.010 | 0.010 | 0.150 | |
| 16 | 0.004 | 0.004 | 0.008 | 0.008 | 0.115 | |
| 17 | 0.004 | 0.004 | 0.009 | 0.009 | 0.132 | |
| 18 | 0.004 | 0.004 | 0.008 | 0.008 | 0.102 | |
| 19 | 0.004 | 0.004 | 0.009 | 0.009 | 0.118 | |
| 20 | 0.004 | 0.004 | 0.009 | 0.009 | 0.092 | |
| 21 | 0.004 | 0.004 | 0.009 | 0.009 | 0.107 | 0.160 |
| 22 | 0.004 | 0.004 | 0.008 | 0.008 | 0.084 | |
| 23 | 0.004 | 0.004 | 0.009 | 0.009 | 0.098 | 0.147 |
| 24 | 0.004 | 0.004 | 0.008 | 0.008 | 0.077 | |
| 25 | 0.004 | 0.004 | 0.008 | 0.008 | 0.090 | 0.135 |
| 26 | 0.004 | 0.004 | 0.008 | 0.008 | 0.071 | |
| 27 | 0.004 | 0.004 | 0.008 | 0.008 | 0.083 | 0.124 |
| 28 | 0.004 | 0.004 | 0.008 | 0.008 | 0.066 | |
| 29 | 0.004 | 0.004 | 0.009 | 0.009 | 0.078 | 0.117 |
| 30 | 0.003 | 0.003 | 0.008 | 0.008 | 0.061 | |
| 31 | 0.003 | 0.003 | 0.008 | 0.008 | 0.073 | 0.109 |

| G98/1-4 | | | | | | |
|---|---|---|---|---|---|---|
| Clause | Requirement - Test | | | | Result - Remark | Verdict |

| | | | | | | |
|---|---|---|---|---|---|---|
| 32 | 0.003 | 0.003 | 0.008 | 0.008 | 0.058 | |
| 33 | 0.003 | 0.003 | 0.008 | 0.008 | 0.068 | 0.102 |
| 34 | 0.003 | 0.003 | 0.008 | 0.008 | 0.054 | |
| 35 | 0.003 | 0.003 | 0.008 | 0.008 | 0.064 | 0.096 |
| 36 | 0.003 | 0.003 | 0.008 | 0.008 | 0.051 | |
| 37 | 0.003 | 0.003 | 0.008 | 0.008 | 0.061 | 0.091 |
| 38 | 0.003 | 0.003 | 0.008 | 0.008 | 0.048 | |
| 39 | 0.003 | 0.003 | 0.008 | 0.008 | 0.058 | 0.087 |
| 40 | 0.002 | 0.002 | 0.009 | 0.009 | 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.
The tests were performed on model AF3.6K-SL and AF3K-SL also applicable for all other models stated in this report.

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Power Quality – Voltage fluctuations and Flicker**: 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 |
|---|---|

Model: AF3.6K-SL

| | 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 | 0.38% | 0.15 | 0 | 0.53% | 0.12 | 0 | 0.18 | 0.15 |
| Normalised to standard impedance | 0.38% | 0.15 | 0 | 0.53% | 0.12 | 0 | 0.18 | 0.15 |
| 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 61000-3-3 | 4% | 3.3% | 3.3% 500ms | 4% | 3.3% | 3.3% 500ms | 1.0 | 0.65 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Impedance | R | 0.24 | Ω | X | 0.15 | Ω |
| Standard Impedance | R | 0.24 *<br>0.4 ^ | Ω | X | 0.15 *<br>0.25 ^ | Ω |
| Maximum Impedance | R | N/A# | Ω | X | N/A# | Ω |

Applies to three phase and split single phase **Micro-generators**.

^ Applies to single phase **Micro-generators** and **Micro-generators** using two phases on a three phase system.

# All the test value and calculated value normalised to standard impedance of $d_{max\ test}$, $d_{c\ test}$, $d_{(t)\ test}$, $P_{st\ test}$ and $P_{lt\ test}$ were complies with the requirements of IEC 61000-3-3 and therefore is not subject to conditional connection, so the manufacturer no need to declare maximum Impedance.

For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the power factor of the generation output is 0.98 or above.

Normalised value = Measured value*reference source resistance/measured source resistance at test point.

Single phase units reference source resistance is 0.4 Ω

Two phase units in a three phase system reference source resistance is 0.4 Ω.

Two phase units in a split phase system reference source resistance is 0.24 Ω.

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

Three phase units reference source resistance is 0.24 Ω.

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.

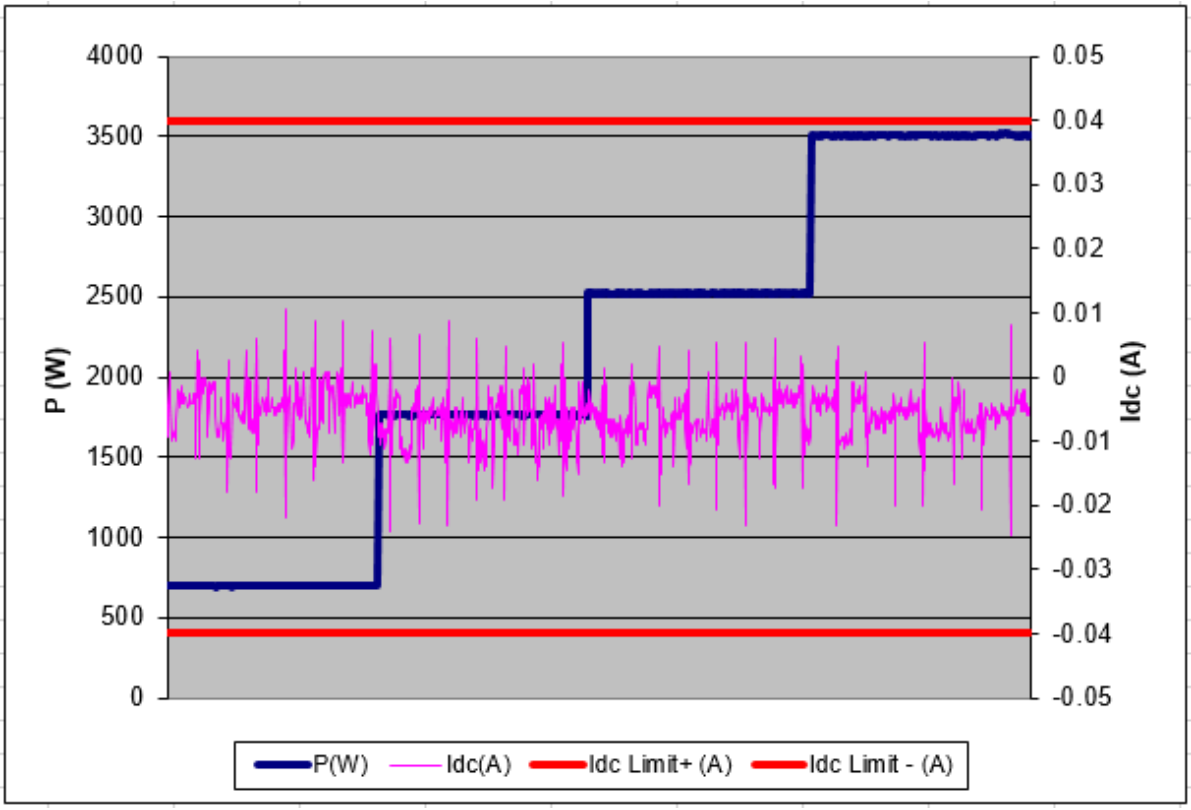
The stopping test should be a trip from full load operation.

The duration of these tests need to conform to the particular requirements set out in the testing notes for the technology under test. Dates and location of the test need to be noted below.

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Power quality – DC injection:** This test should be carried out in accordance with EN 50438 Annex D.3.10 | | | | **P** |
|---|---|---|---|---|
| Model: AF3.6K-SL | | | | |
| Test power level | 20% | 50% | 75% | 100% |
| Recorded value in Amps | 0.022 | 0.024 | 0.023 | 0.025 |
| as % of rated AC current | 0.14% | 0.15% | 0.15% | 0.16% |
| Limit | 0.25% | 0.25% | 0.25% | 0.25% |

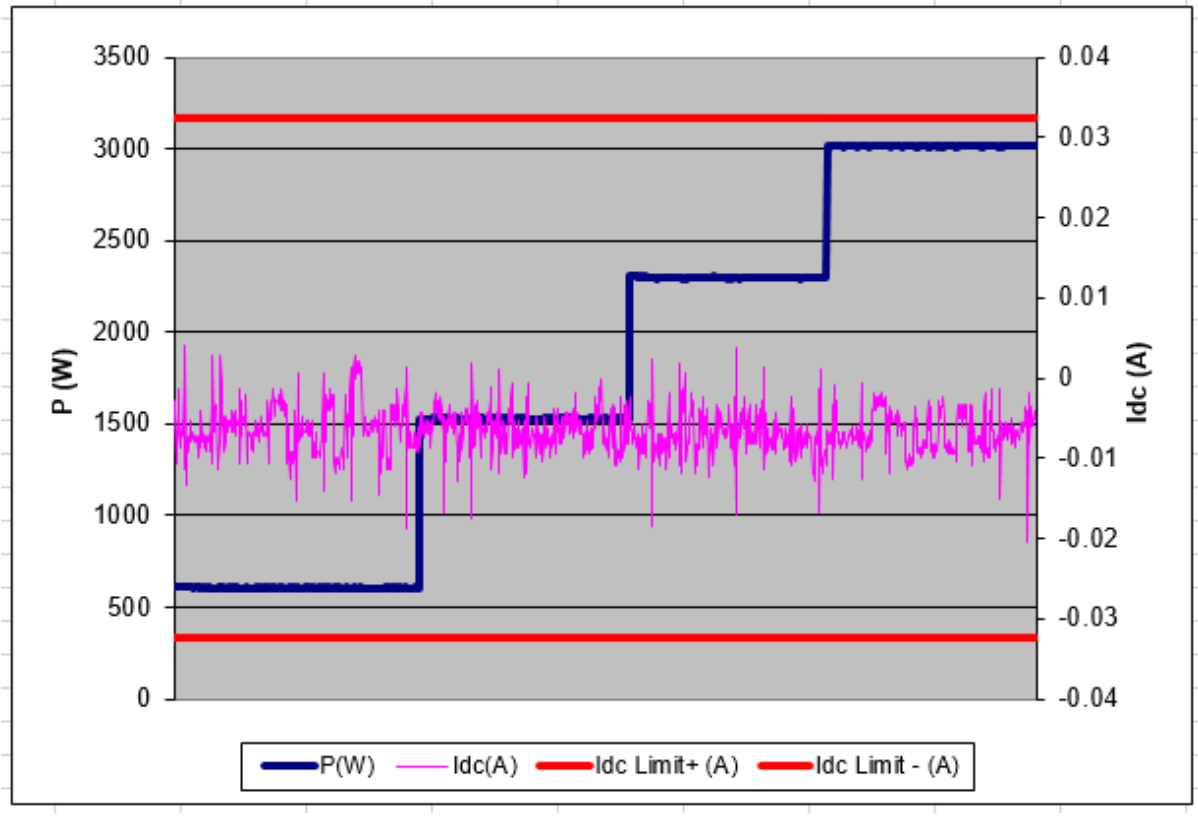
**Diagram of permanent dc-injection (20%/50%75%100%)**



| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Power quality – DC injection:** This test should be carried out in accordance with EN 50438 Annex D.3.10 | | | | **P** |
|---|---|---|---|---|
| Model: AF3K-SL | | | | |
| Test power level | 20% | 50% | 75% | 100% |
| Recorded value in Amps | 0.019 | 0.018 | 0.019 | 0.021 |
| as % of rated AC current | 0.15% | 0.14% | 0.15% | 0.16% |
| Limit | 0.25% | 0.25% | 0.25% | 0.25% |

**Diagram of permanent dc-injection (20%/50%75%100%)**



| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Power Quality – Power factor**: This test shall be carried out in accordance with EN 50538 Annex D.3.4.1 but with nominal voltage -6% and +10%. Voltage to be maintained within ±1.5% of the stated level during the test. | | | **P** |
|---|---|---|---|
| Model: AF3.6K-SL | | | |
| Voltage | 216.2 V | 230 V | 253 V |
| 20% of **Registered Capacity** | 0.9965 | 0.9943 | 0.9890 |
| 50% of **Registered Capacity** | 0.9996 | 0.9994 | 0.9978 |
| 75% of **Registered Capacity** | 0.9997 | 0.9996 | 0.9989 |
| 100% of **Registered Capacity** | 0.9994 | 0.9996 | 0.9989 |
| Limit | >0.95 | >0.95 | >0.95 |

| **Power Quality – Power factor**: This test shall be carried out in accordance with EN 50538 Annex D.3.4.1 but with nominal voltage -6% and +10%. Voltage to be maintained within ±1.5% of the stated level during the test. | | | **P** |
|---|---|---|---|
| Model: AF3K-SL | | | |
| Voltage | 216.2 V | 230 V | 253 V |
| 20% of **Registered Capacity** | 0.9961 | 0.9945 | 0.9889 |
| 50% of **Registered Capacity** | 0.9996 | 0.9994 | 0.9978 |
| 75% of **Registered Capacity** | 0.9997 | 0.9996 | 0.9990 |
| 100% of **Registered Capacity** | 0.9994 | 0.9996 | 0.9990 |
| Limit | >0.95 | >0.95 | >0.95 |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Protection – Frequency tests:** These tests should be carried out in accordance with EN 50438 Annex D.2.4 and the notes in EREC G98 Annex A1 A.1.2.3 (**Inverter** connected) or Annex A2 A.2.2.3 (Synchronous) | | | | | | **P** |
|---|---|---|---|---|---|---|
| Model: AF3.6K-SL | | | | | | |
| 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 | 47.48 Hz | 20.2 s | 47.7 Hz<br>30 s | No trip |
| U/F stage 2 | 47 Hz | 0.5 s | 46.98 Hz | 0.536 s | 47.2 Hz<br>19.5 s | No trip |
| | | | | | 46.8 Hz<br>0.45 s | No trip |
| O/F | 52.0Hz | 0.5 s | 52.02 Hz | 0.546 s | 51.8 Hz<br>120.0 s | No trip |
| | | | | | 52.2 Hz<br>0.45 s | No trip |

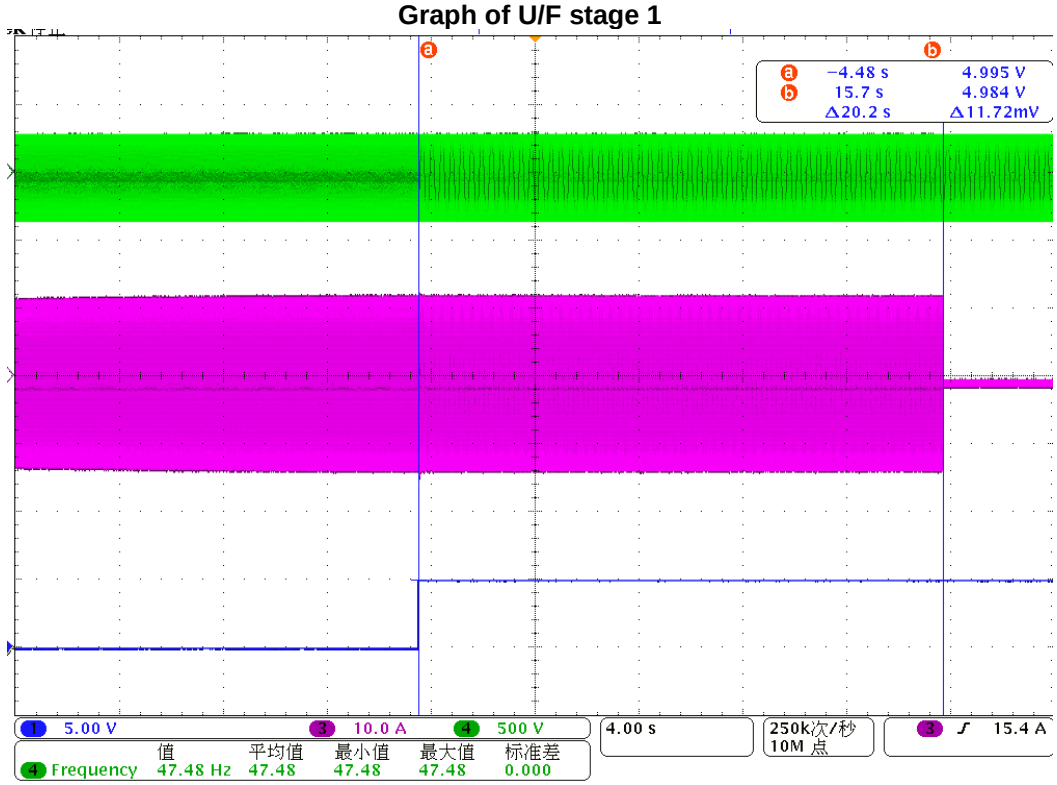
Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The “No trip tests” need to be carried out at the setting ± 0.2 Hz and for the relevant times as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

The Hybrid inverter nominal AC output frequency value is 50Hz.

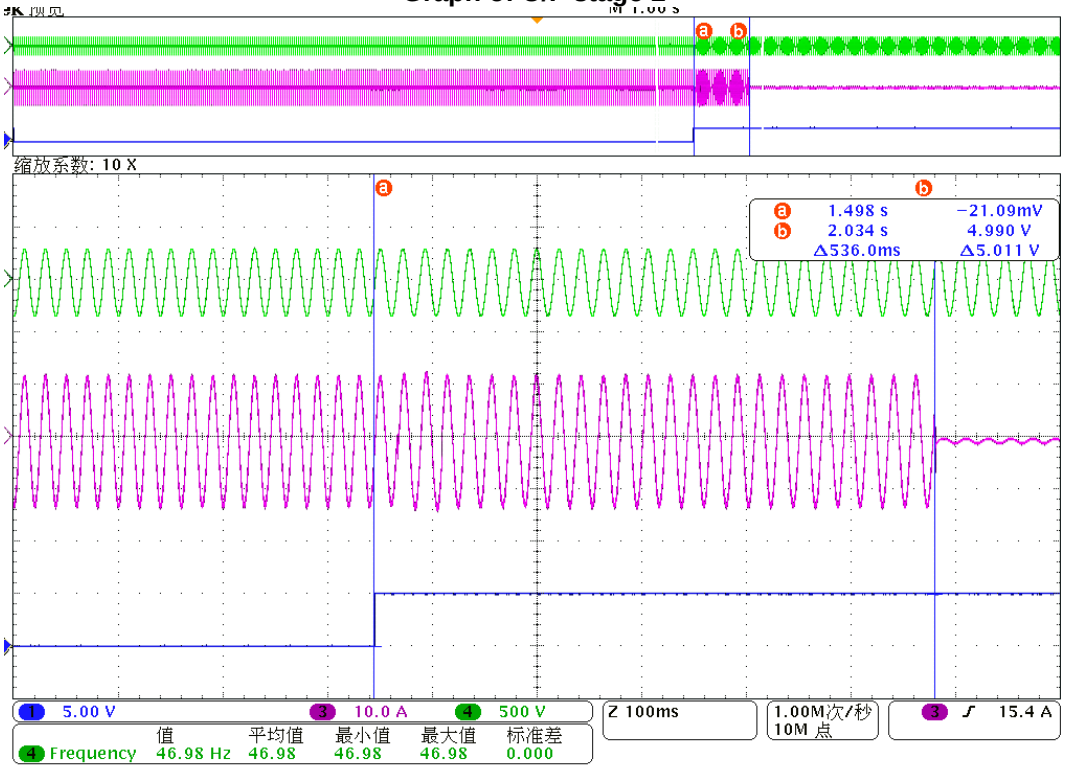
The tests were performed on model AF3.6K-SL also applicable for all other models stated in this report.

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

**Graph of U/F stage 1**




**Graph of U/F stage 2**



| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

**Graph of O/F**

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Protection – Voltage tests:** These tests should be carried out in accordance with EN 50438 Annex D.2.3 and the notes in EREC G98 Annex A1 A.1.2.2 (**Inverter** connected) or Annex A2 A.2.2.2 (Synchronous) | **P** |
|---|---|

Model: AF3.6K-SL

| Function | Setting | | Trip test | | "No trip tests" | |
|---|---|---|---|---|---|---|
| | Voltage | Time delay | Voltage | Time delay | Voltage /time | Confirm no trip |
| U/V | 184.0 V | 2.5 s | 180.8 V | 2.504 s | 188 V<br>5.0 s | No trip |
| | | | | | 180 V<br>2.45 s | No trip |
| O/V stage 1 | 262.2 V | 1.0 s | 265.5 V | 1.048 s | 258.2 V<br>5.0 s | No trip |
| O/V stage 2 | 273.7 V | 0.5 s | 277.1 V | 0.544 s | 269.7 V<br>0.95 s | No trip |
| | | | | | 277.7 V<br>0.45 s | No trip |

Note:

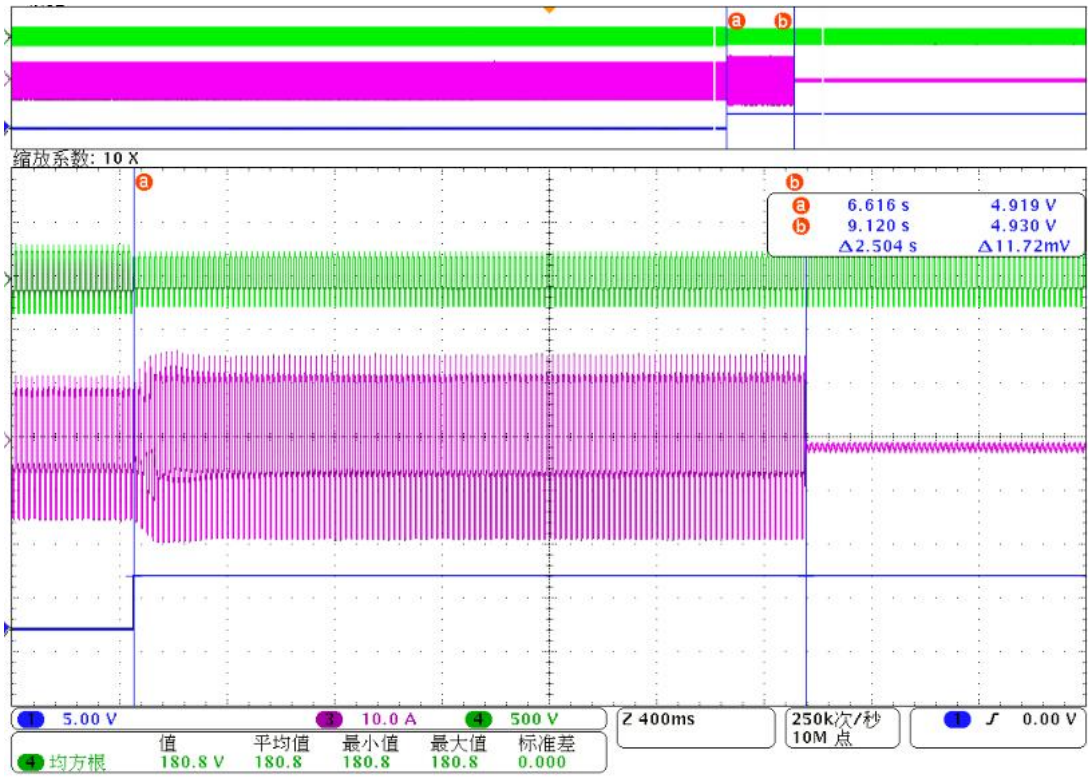
Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to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

The Hybrid inverter nominal AC output voltage value is 230 V phase to neutral.

The tests were performed on model AF3.6K-SL also applicable for all other models stated in this report.

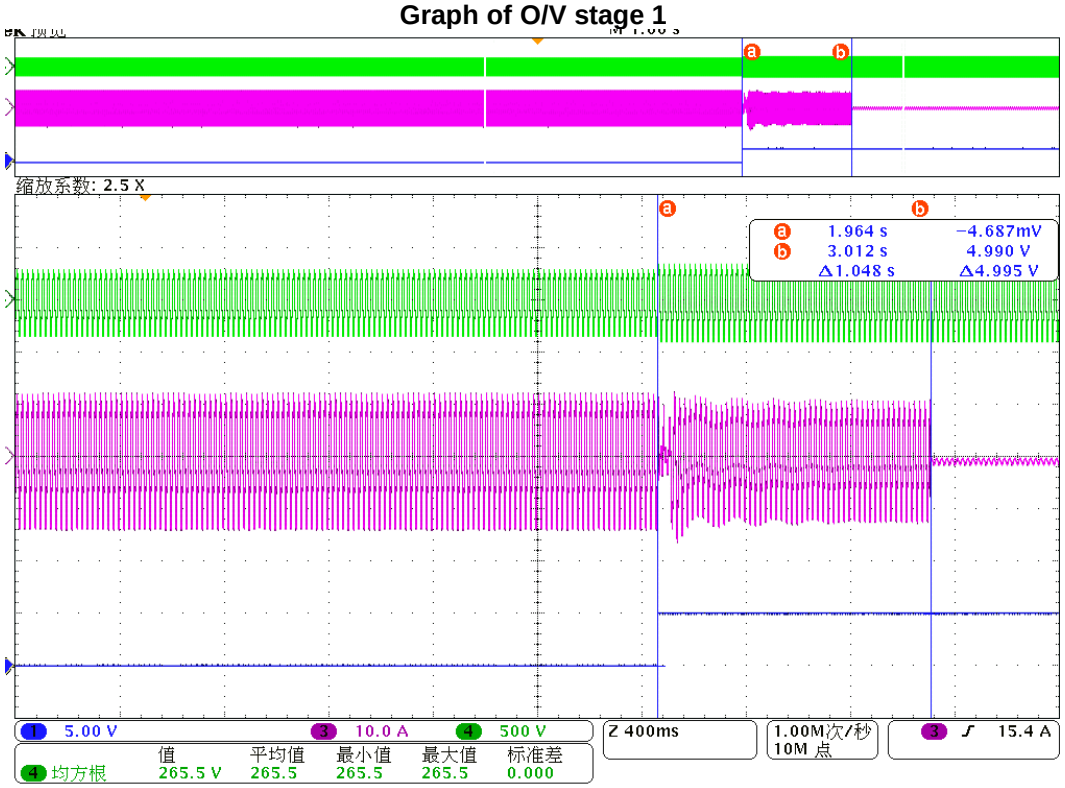
| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

**Graph of U/V**

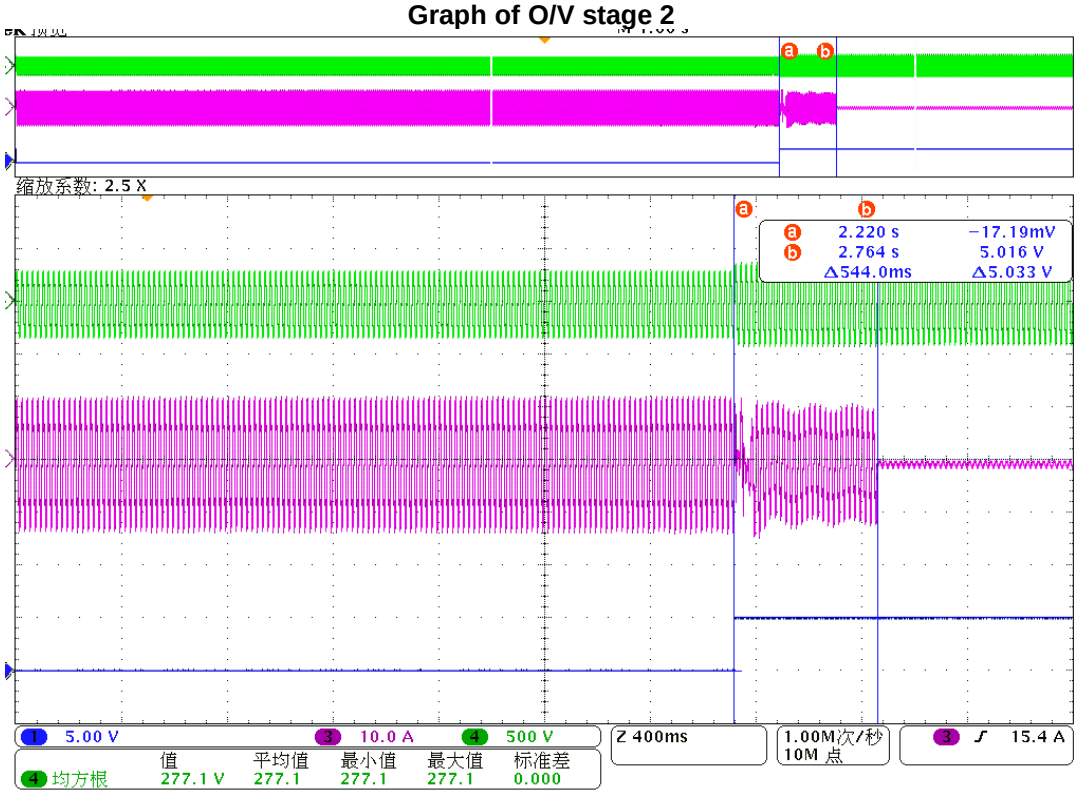


| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

**Graph of O/V stage 1**




**Graph of O/V stage 2**



| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| Protection – Loss of Mains test: For PV Inverters shall be tested in accordance with BS EN 62116. Other Inverters should be tested in accordance with EN 50438 Annex D.2.5 at 10%, 55% and 100% of rated power. | **P** |
|---|---|

The following sub set of tests should be recorded in the following table.

Model: AF3.6K-SL

| Test Power and imbalance | 33% -5% Q | 66% -5% Q | 100% -5% P | 33% +5% Q | 66% +5% Q | 100% +5% P |
|---|---|---|---|---|---|---|
| Trip time. Limit is 0.5s | 90.8 ms | 81.2 ms | 74.8 ms | 81.6 ms | 81.6 ms | 72.8 ms |

Test condition A (EUT output = 100%)

| No | $P_{EUT}$ a) (% of EUT rating) | Reactive load (% of $Q_L$ in 6.1.d) 1) | $P_{ac}$ b) (% of nominal) | $Q_{ac}$ c) (% of nominal) | Run on Time (ms) | $P_{EUT}$ (kW) | Actual $Q_f$ | $V_{DC}$ d) | Remarks e) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 100 | 0 | 0 | 133.4 | 3.6 | 1.00 | 392 | Test A at BL |
| 2 | 100 | 100 | 0 | -5 | 79.4 | 3.6 | 0.97 | 392 | Test A at IB |
| 3 | 100 | 100 | 0 | +5 | 72.0 | 3.6 | 1.02 | 392 | Test A at IB |
| 4 | 100 | 100 | -5 | -5 | 108.0 | 3.6 | 1.03 | 392 | Test A at IB |
| 5 | 100 | 100 | -5 | 0 | 74.8 | 3.6 | 1.05 | 392 | Test A at IB |
| 6 | 100 | 100 | -5 | +5 | 70.4 | 3.6 | 1.08 | 392 | Test A at IB |
| 7 | 100 | 100 | +5 | -5 | 95.2 | 3.6 | 0.96 | 392 | Test A at IB |
| 8 | 100 | 100 | +5 | 0 | 72.8 | 3.6 | 0.94 | 392 | Test A at IB |
| 9 | 100 | 100 | +5 | +5 | 101.2 | 3.6 | 0.98 | 392 | Test A at IB |
| 10 | 100 | 100 | -5 | -10 | 79.6 | 3.6 | 1.00 | 392 | Test A at IB |
| 11 | 100 | 100 | -5 | +10 | 69.2 | 3.6 | 1.10 | 392 | Test A at IB |
| 12 | 100 | 100 | 0 | -10 | 77.6 | 3.6 | 0.95 | 392 | Test A at IB |
| 13 | 100 | 100 | 0 | +10 | 87.2 | 3.6 | 1.05 | 392 | Test A at IB |
| 14 | 100 | 100 | +5 | -10 | 66.4 | 3.6 | 0.9 | 392 | Test A at IB |
| 15 | 100 | 100 | +5 | +10 | 84.4 | 3.6 | 1.00 | 392 | Test A at IB |
| 16 | 100 | 100 | -10 | -10 | 86.0 | 3.6 | 1.05 | 392 | Test A at IB |
| 17 | 100 | 100 | -10 | -5 | 71.6 | 3.6 | 1.08 | 392 | Test A at IB |
| 18 | 100 | 100 | -10 | 0 | 127.6 | 3.6 | 1.11 | 392 | Test A at IB |
| 19 | 100 | 100 | -10 | +5 | 80.0 | 3.6 | 1.14 | 392 | Test A at IB |
| 20 | 100 | 100 | -10 | +10 | 72.4 | 3.6 | 1.17 | 392 | Test A at IB |
| 21 | 100 | 100 | +10 | -10 | 62.0 | 3.6 | 0.86 | 392 | Test A at IB |
| 22 | 100 | 100 | +10 | -5 | 84.0 | 3.6 | 0.89 | 392 | Test A at IB |
| 23 | 100 | 100 | +10 | 0 | 100.8 | 3.6 | 0.91 | 392 | Test A at IB |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 24 | 100 | 100 | +10 | +5 | 86.0 | 3.6 | 0.93 | 392 | Test A at IB |
| 25 | 100 | 100 | +10 | +10 | 82.4 | 3.6 | 0.95 | 392 | Test A at IB |

| Protection – Loss of Mains test: For PV Inverters shall be tested in accordance with BS EN 62116. Other Inverters should be tested in accordance with EN 50438 Annex D.2.5 at 10%, 55% and 100% of rated power. | **P** |
|---|---|

Model: AF3.6K-SL

Test condition B (EUT output = 50 % – 66 %)

| No | $P_{EUT}$ a) (% of EUT rating) | Reactive load (% of $Q_L$ in 6.1.d) 1) | $P_{ac}$ b) (% of nominal) | $Q_{ac}$ c) (% of nominal) | Run on Time (ms) | $P_{EUT}$ (kW) | Actual $Q_f$ | $V_{DC}$ d) | Remarks e) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 66 | 66 | 0 | - 5 | 81.2 | 2.37 | 0.97 | 305 | Test B at IB |
| 2 | 66 | 66 | 0 | - 4 | 91.6 | 2.37 | 0.98 | 305 | Test B at IB |
| 3 | 66 | 66 | 0 | - 3 | 94.0 | 2.37 | 0.98 | 305 | Test B at IB |
| 4 | 66 | 66 | 0 | - 2 | 105.6 | 2.37 | 0.99 | 305 | Test B at IB |
| 5 | 66 | 66 | 0 | - 1 | 112.4 | 2.37 | 0.99 | 305 | Test B at IB |
| 6 | 66 | 66 | 0 | 0 | 133.6 | 2.37 | 1.00 | 305 | Test B at BL |
| 7 | 66 | 66 | 0 | + 1 | 111.2 | 2.37 | 1.00 | 305 | Test B at IB |
| 8 | 66 | 66 | 0 | + 2 | 105.6 | 2.37 | 1.01 | 305 | Test B at IB |
| 9 | 66 | 66 | 0 | + 3 | 108.4 | 2.37 | 1.01 | 305 | Test B at IB |
| 10 | 66 | 66 | 0 | + 4 | 93.2 | 2.37 | 1.02 | 305 | Test B at IB |
| 11 | 66 | 66 | 0 | + 5 | 81.6 | 2.37 | 1.02 | 305 | Test B at IB |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| Protection – Loss of Mains test: For PV Inverters shall be tested in accordance with BS EN 62116. Other Inverters should be tested in accordance with EN 50438 Annex D.2.5 at 10%, 55% and 100% of rated power. | **P** |
|---|---|

Model: AF3.6K-SL

Test condition C (EUT output = 25 % – 33 %)

| No | $P_{EUT}$ a) (% of EUT rating) | Reactive load (% of $Q_L$ in 6.1.d) 1) | $P_{ac}$ b) (% of nominal) | $Q_{ac}$ c) (% of nominal) | Run on Time (ms) | $P_{EUT}$ (kW) | Actual $Q_f$ | $V_{DC}$ d) | Remarks e) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 33 | 33 | 0 | - 5 | 90.8 | 1.2 | 0.97 | 150 | Test C at IB |
| 2 | 33 | 33 | 0 | - 4 | 92.0 | 1.2 | 0.98 | 150 | Test C at IB |
| 3 | 33 | 33 | 0 | - 3 | 109.6 | 1.2 | 0.98 | 150 | Test C at IB |
| 4 | 33 | 33 | 0 | - 2 | 114.0 | 1.2 | 0.99 | 150 | Test C at IB |
| 5 | 33 | 33 | 0 | - 1 | 122.4 | 1.2 | 0.99 | 150 | Test C at IB |
| 6 | 33 | 33 | 0 | 0 | 130.8 | 1.2 | 1.00 | 150 | Test C at BL |
| 7 | 33 | 33 | 0 | + 1 | 123.2 | 1.2 | 1.00 | 150 | Test C at IB |
| 8 | 33 | 33 | 0 | + 2 | 110.8 | 1.2 | 1.01 | 150 | Test C at IB |
| 9 | 33 | 33 | 0 | + 3 | 101.2 | 1.2 | 1.01 | 150 | Test C at IB |
| 10 | 33 | 33 | 0 | + 4 | 95.6 | 1.2 | 1.02 | 150 | Test C at IB |
| 11 | 33 | 33 | 0 | + 5 | 81.6 | 1.2 | 1.02 | 150 | Test C at IB |

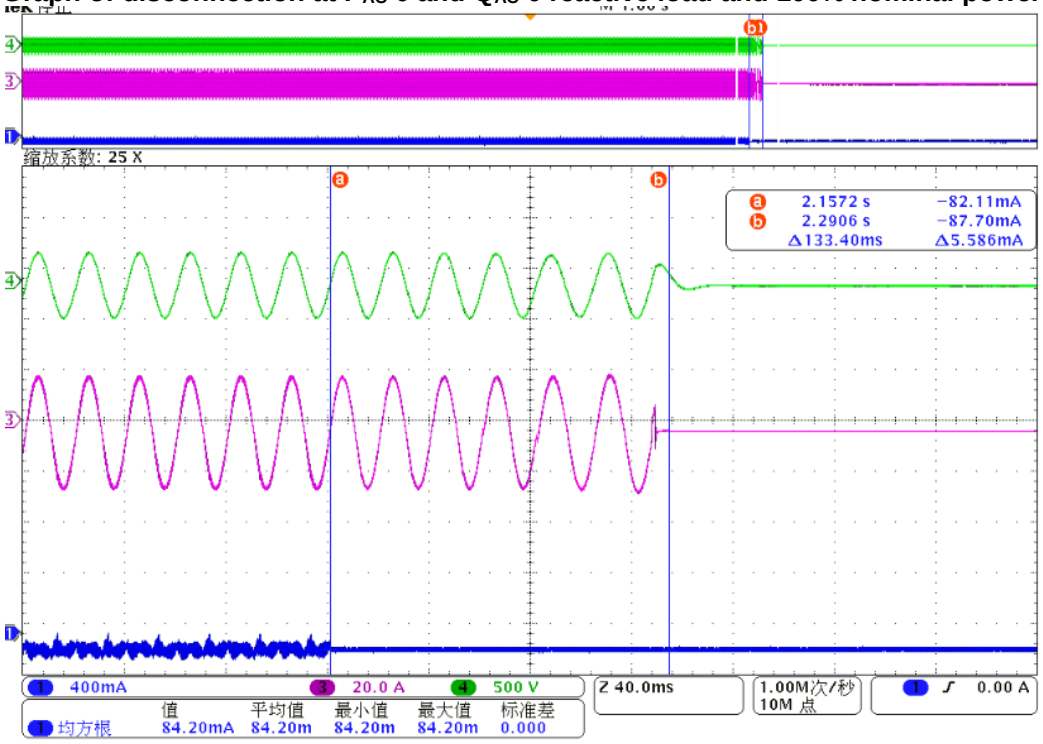
Note:
a) $P_{EUT}$: EUT output power
b) $P_{ac}$: Active power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
c) $Q_{ac}$: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
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 × (Y – X). Y shall not exceed 0,8 × 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.

For technologies which have a substantial shut down time this can be added to the 0.5 s in establishing that the trip occurred in less than 0.5 s maximum. Shut down time could therefore be up to 1.0 s for these technologies.

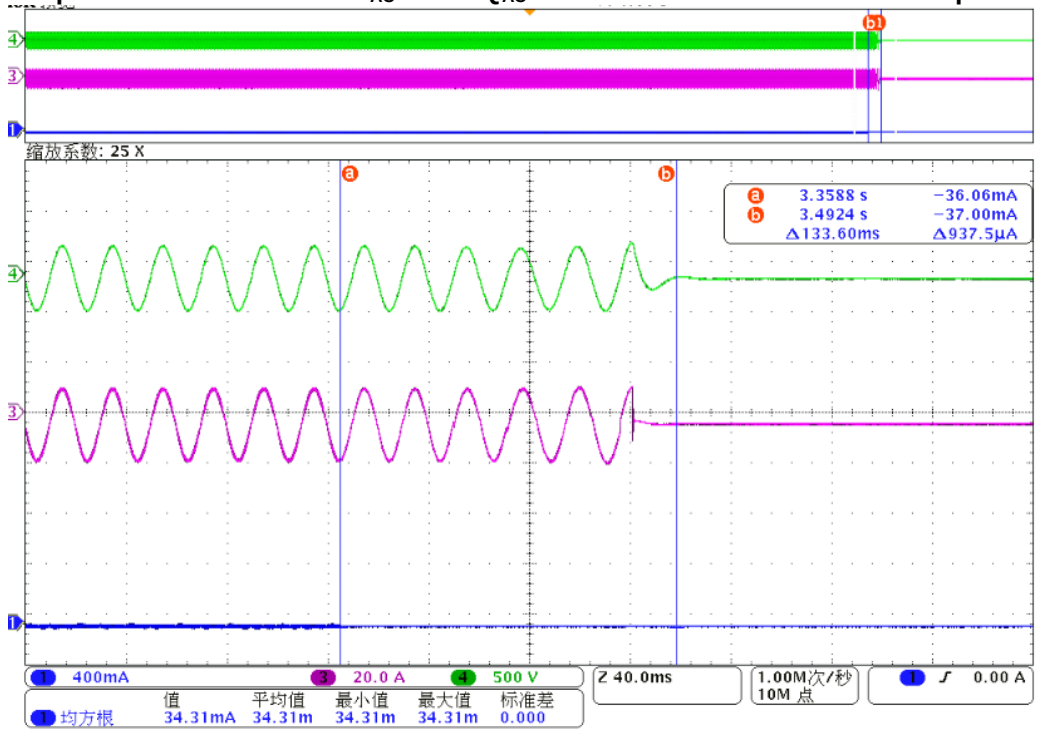
The tests were performed on model AF3.6K-SL also applicable for all other models stated in this report.

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

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

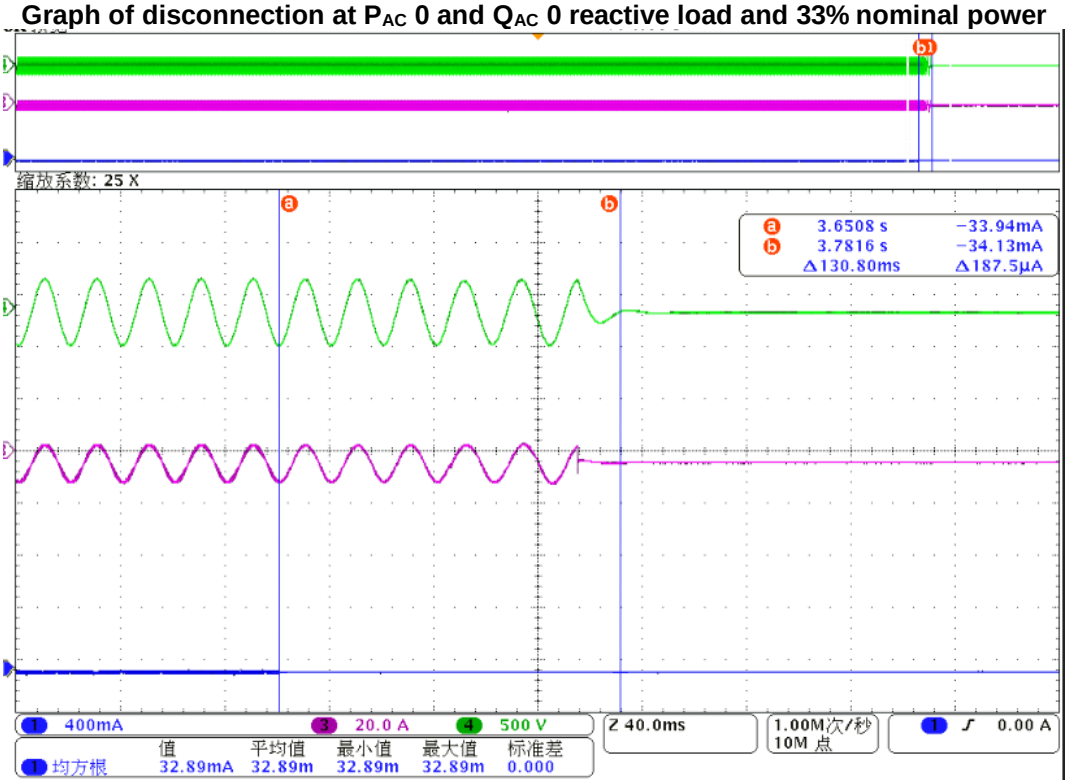



**Graph of disconnection at $P_{AC}$ 0 and $Q_{AC}$ 0 reactive load and 66% nominal power**



| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

**Graph of disconnection at $P_{AC}$ 0 and $Q_{AC}$ 0 reactive load and 33% nominal power**



| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Protection – Frequency change, Vector Shift Stability test:** 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). | | | **P** |
|---|---|---|---|
| Model: AF3.6K-SL | | | |
| Vector Shift | 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 |

| **Protection – Frequency change, RoCoF Stability test:** 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). | | | **P** |
|---|---|---|---|
| Model: AF3.6K-SL | | | |
| 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 |

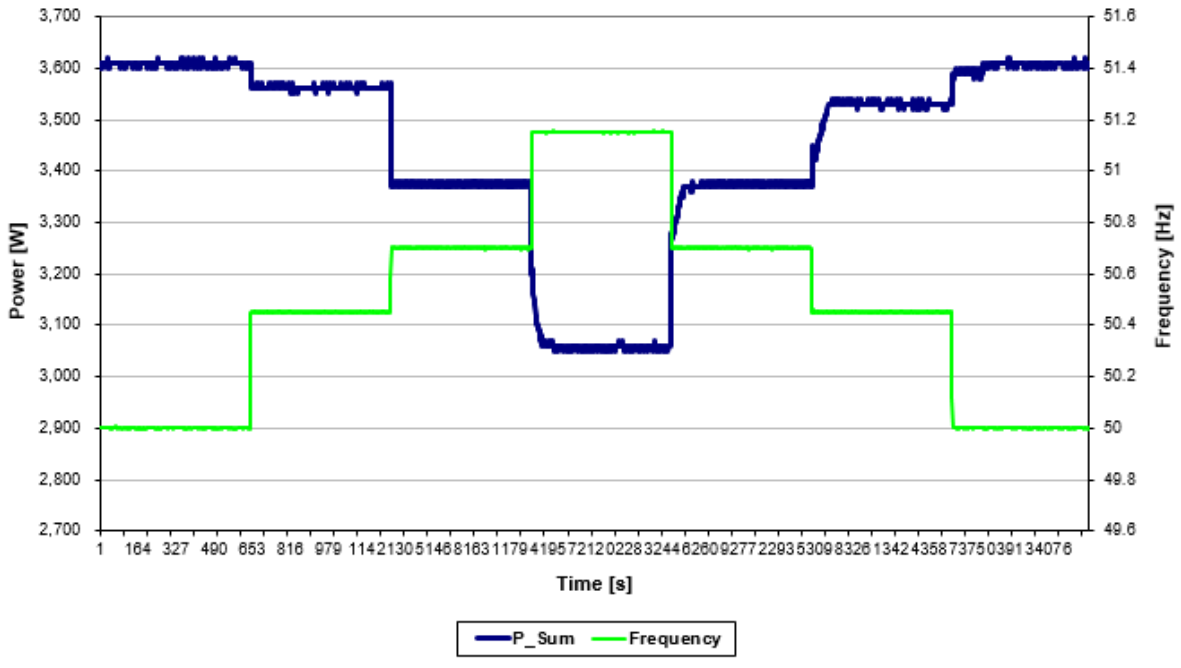
| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| **Limited Frequency Sensitive Mode – Overfrequency test:** This test should be carried out in accordance with EN 50438 Annex D.3.3 Power response to over- frequency. The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%. | **P** |
|---|---|

Model: AF3.6K-SL

| Test sequence at **Registered Capacity** >80% | Measured **Active Power** Output (W) | Frequency (Hz) | Droop (%) | Primary Power Source | **Active Power** Gradient |
|---|---|---|---|---|---|
| Step a) 50.00 Hz ±0.01 Hz | 3609.4 | 50.00 | - | Photovoltaic array simulator | - |
| Step b) 50.45 Hz ±0.05 Hz | 3570.7 | 50.45 | 9.33 | | - |
| Step c) 50.70 Hz ±0.10 Hz | 3373.4 | 50.70 | 9.18 | | - |
| Step d) 51.15 Hz ±0.05 Hz | 3059.6 | 51.15 | 9.85 | | - |
| Step e) 50.70 Hz ±0.10 Hz | 3372.5 | 50.70 | 9.14 | | - |
| Step f) 50.45 Hz ±0.05 Hz | 3571.5 | 50.45 | 9.52 | | - |
| Step g) 50.00 Hz ±0.01 Hz | 3609.3 | 50.00 | - | | 10% |

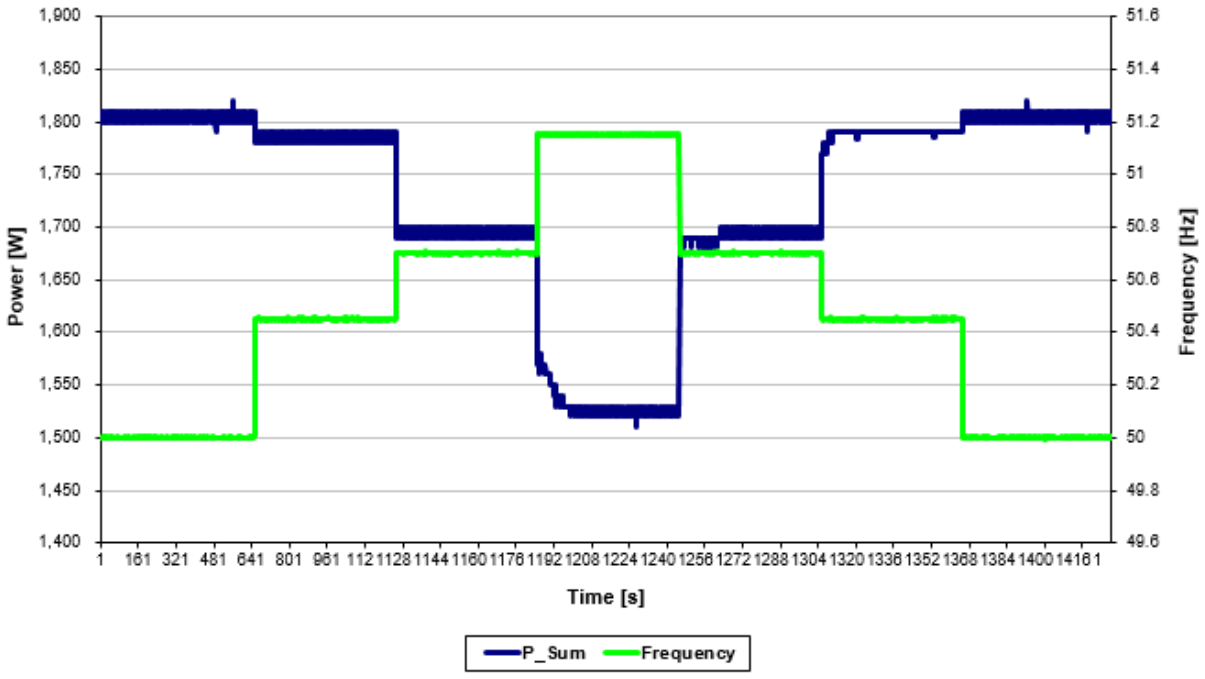
**Diagram**



| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

| Test sequence at **Registered Capacity** 40% - 60% | Measured **Active Power** Output (W) | Frequency (Hz) | $\Delta P_{E60}/P_n$ (%) | Primary Power Source | **Active Power** Gradient |
|---|---|---|---|---|---|
| Step a) 50.00 Hz ±0.01 Hz | 1806.9 | 50.00 | - | Photovoltaic array simulator | - |
| Step b) 50.45 Hz ±0.05 Hz | 1786.9 | 50.45 | 9.04 | | - |
| Step c) 50.70 Hz ±0.10 Hz | 1693.7 | 50.70 | 9.58 | | - |
| Step d) 51.15 Hz ±0.05 Hz | 1533.9 | 51.15 | 9.93 | | - |
| Step e) 50.70 Hz ±0.10 Hz | 1689.9 | 50.70 | 9.27 | | - |
| Step f) 50.45 Hz ±0.05 Hz | 1787.9 | 50.45 | 9.51 | | - |
| Step g) 50.00 Hz ±0.01 Hz | 1807.2 | 50.00 | - | | 10% |

**Diagram**




Steps as defined in EN 50438

Assessment criteria
The test is regarded as passed:
a) For adjustable micro-generators, if:
1) the active power drops between the previously mentioned measuring points b) and f) with the set gradient $P_M$ per Hz with an increase in frequency or increases when the frequency decreases once more;
2) the maximum occurring active power gradient at point j) is less than the configured maximum active power per minute;
3) the active power value of the set value determined by the gradient characteristic curve does not

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

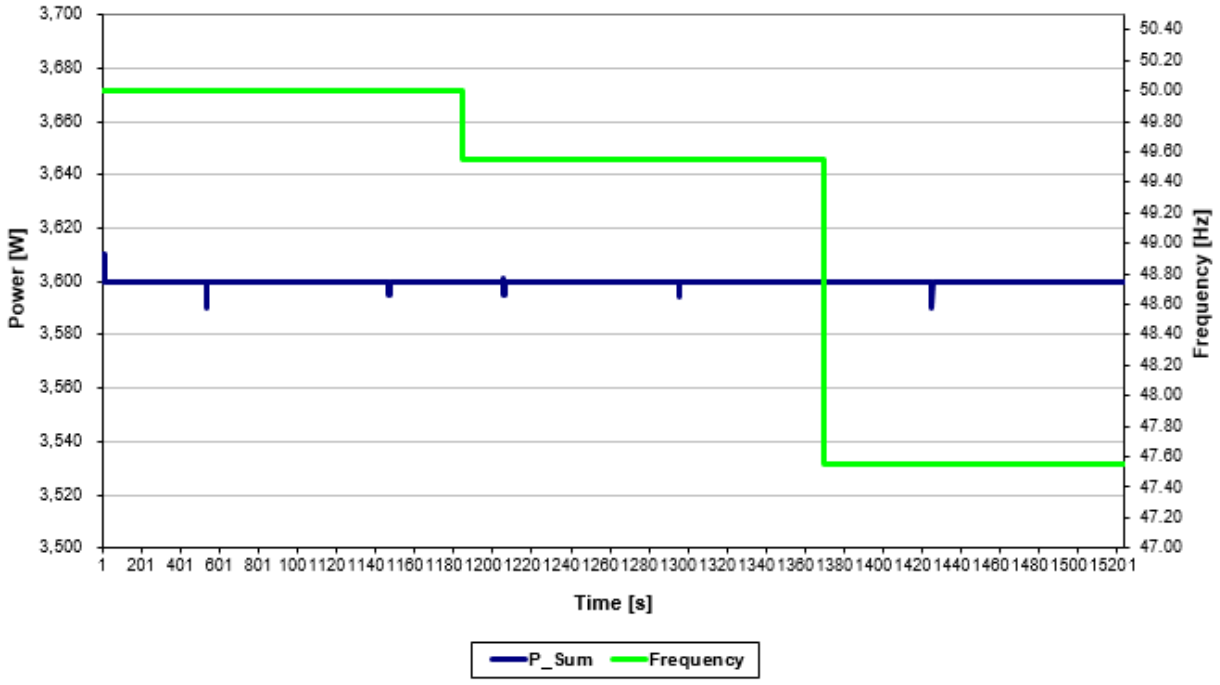
deviate by more than + 10 % nominal power of the micro-generator;
4) the settling time is equal or below 2 s with an intentional delay set to zero.
b) For partly adjustable micro-generators, and non-adjustable micro-generators if:
1) they behave as described in a) inside their control range and
2) outside the control range, the power supplied when leaving the control range remains constant until disconnection. Disconnection shall occur at the latest at $f_{max}$.

| **Power output with falling frequency test:** This test should be carried out in accordance with EN 50438 Annex D.3.2 active power feed-in at under-frequency. | **P** |
|---|---|

Model: AF3.6K-SL

| Test sequence | Measured **Active Power** Output (W) | Frequency (Hz) | Primary power source |
|---|---|---|---|
| Test a) 50 Hz ± 0.01 Hz | 3600.0 | 50.00 | Photovoltaic array simulator |
| Test b) Point between 49.5 Hz and 49.6 Hz | 3599.4 | 49.55 | Photovoltaic array simulator |
| Test c) Point between 47.5 Hz and 47.6 Hz | 3599.8 | 47.55 | Photovoltaic array simulator |

**Diagram**




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

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

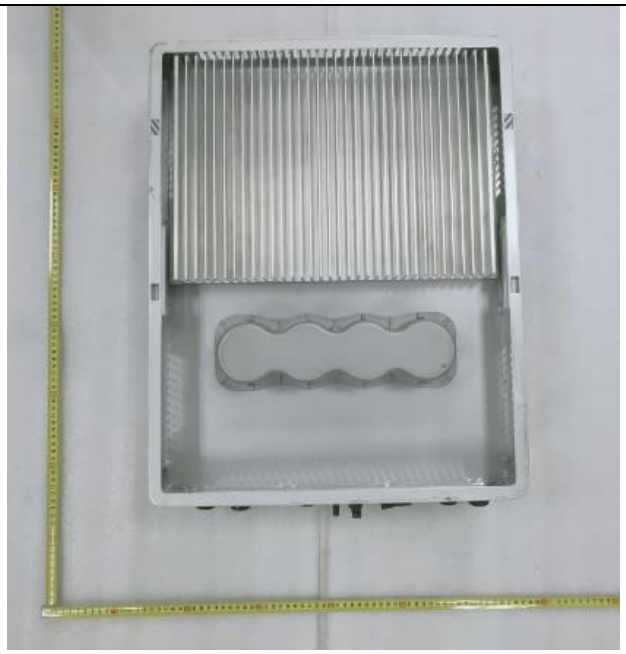
| **Re-connection timer**. | | | | | **P** |
|---|---|---|---|---|---|
| Model: AF3.6K-SL | | | | | |
| Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 2. | | | | | |
| Time delay setting | Measured delay | Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 2. | | | |
| 30 s | 31 s | At 266.2 V | At 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 |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

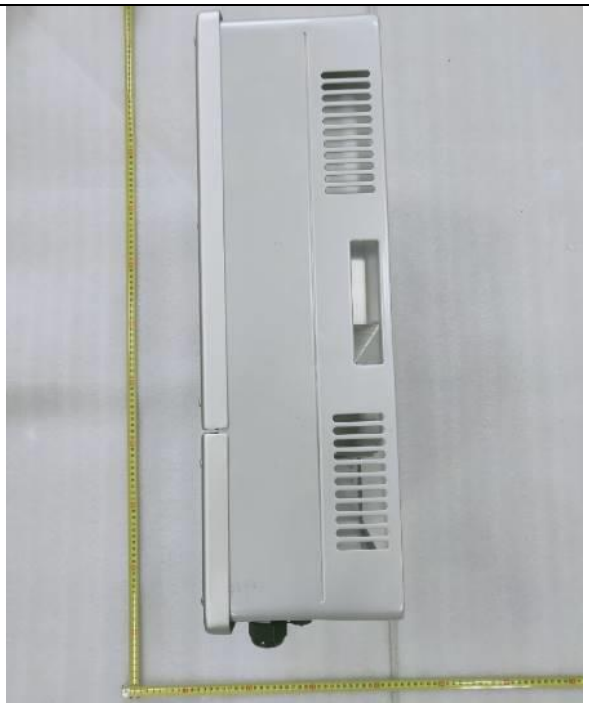
| **Fault level contribution**: These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 (**Inverter** connected) and Annex A2 A.2.3.4 (Synchronous). | | | | | **P** |
|---|---|---|---|---|---|
| Model: AF3.6K-SL | | | | | |
| For machines with electro-magnetic output | | | For **Inverter** output | | |
| Parameter | Symbol | Value | Time after fault | Volts | Amps |
| Peak Short Circuit current | $i_p$ | N/A | 20 ms | 187.7 V | 9.806 A |
| Initial Value of aperiodic current | $A$ | N/A | 100 ms | 0.899 V | 8.758 A |
| Initial symmetrical short-circuit current* | $I_k$ | N/A | 250 ms | 0 | 0 |
| Decaying (aperiodic) component of short circuit current* | $i_{DC}$ | N/A | 500 ms | 0 | 0 |
| Reactance/Resistance Ratio of source* | $X/R$ | N/A | Time to trip | 0.116 | 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.<br><br>* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot | | | | | |
| **Logic Interface.** | | | | | Yes |
| **Self-Monitoring solid state switching:** No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (**Inverter** connected). | | | | | N/A |
| 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 |
| Additional comments | | | | | |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

**Appendix 2: Photo documentation**

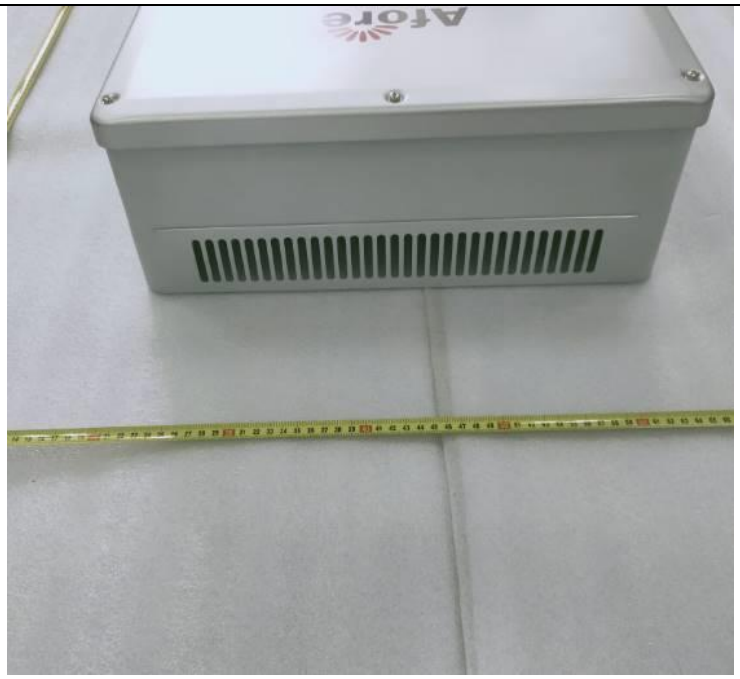
| Enclosure Front View |
|---|
|  |
| Enclosure Rear View |
|  |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

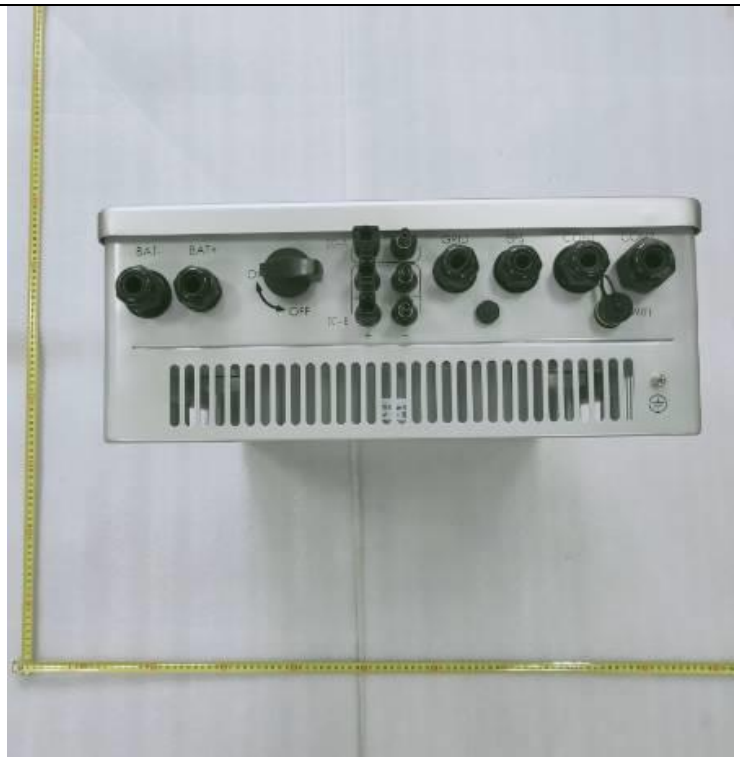
| Enclosure Left Side View |
|---|
|  |
| Enclosure Right Side View |
|  |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

Enclosure Top Side View



Enclosure Bottom Side View



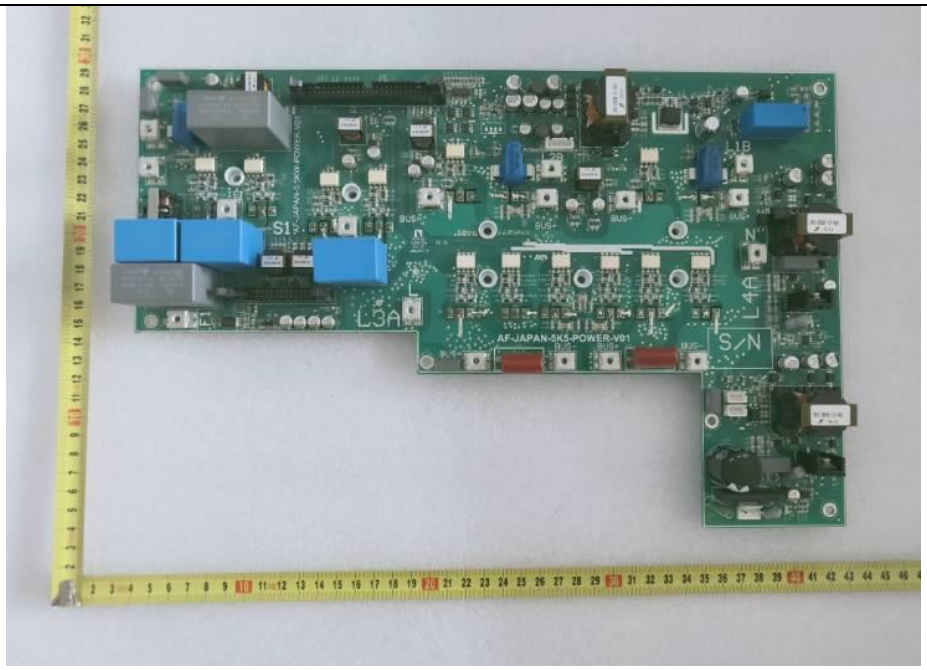
| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

Internal View for AF3.6K-SL

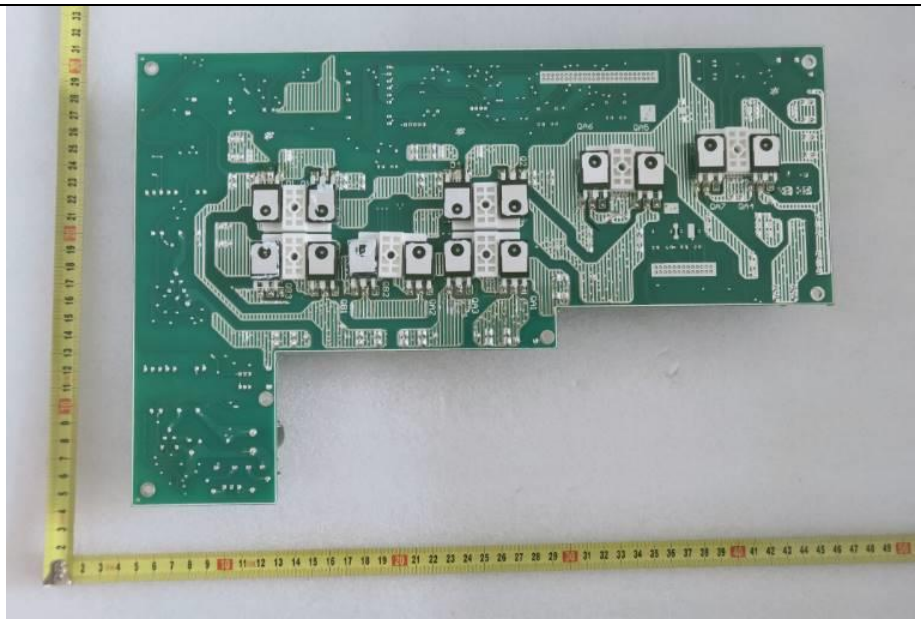
Internal View for AF3.6K-SH

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

Main Board – Component Side (AF3.6K-SL)

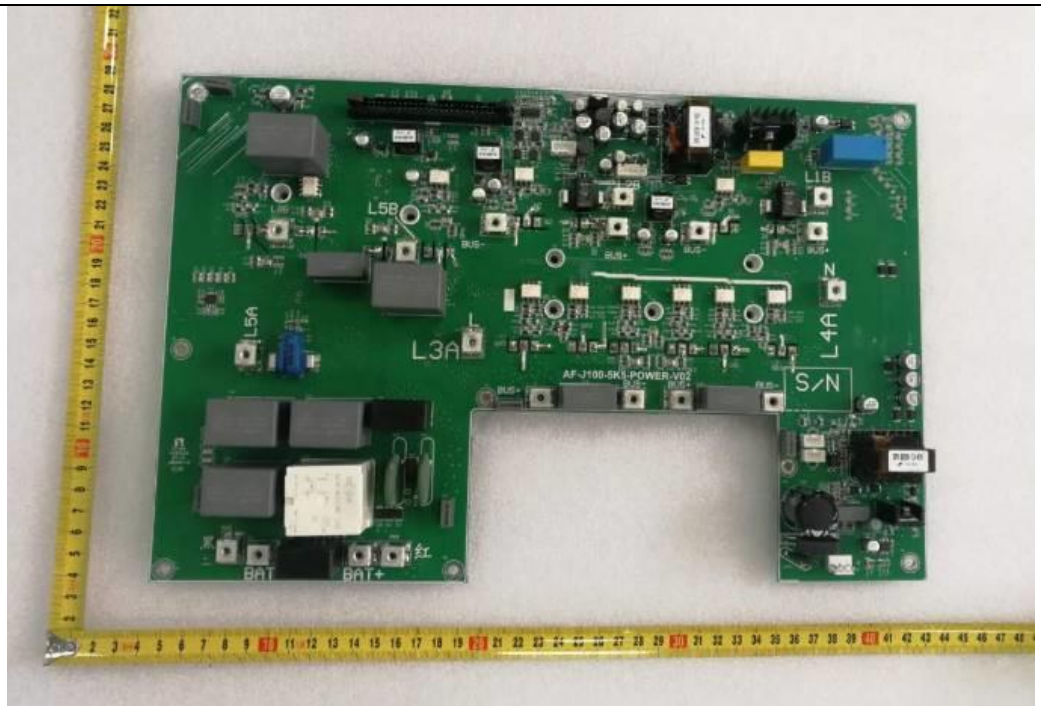



Main Board – Solder Side (AF3.6K-SL)

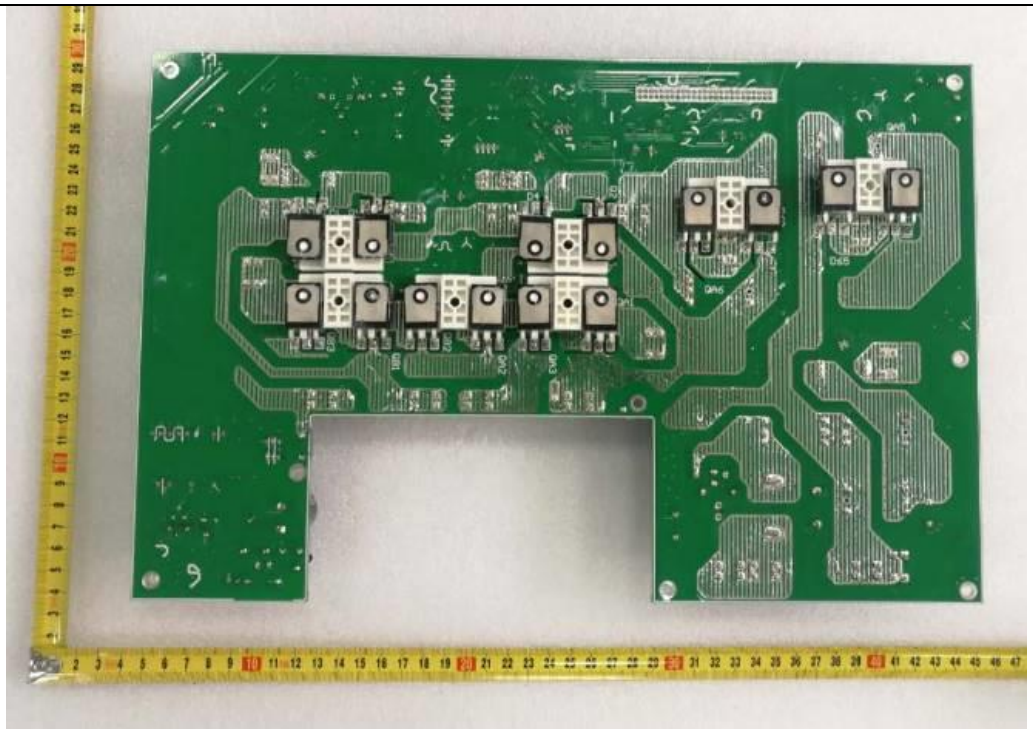


| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

Main Board – Component Side (AF3.6K-SH)

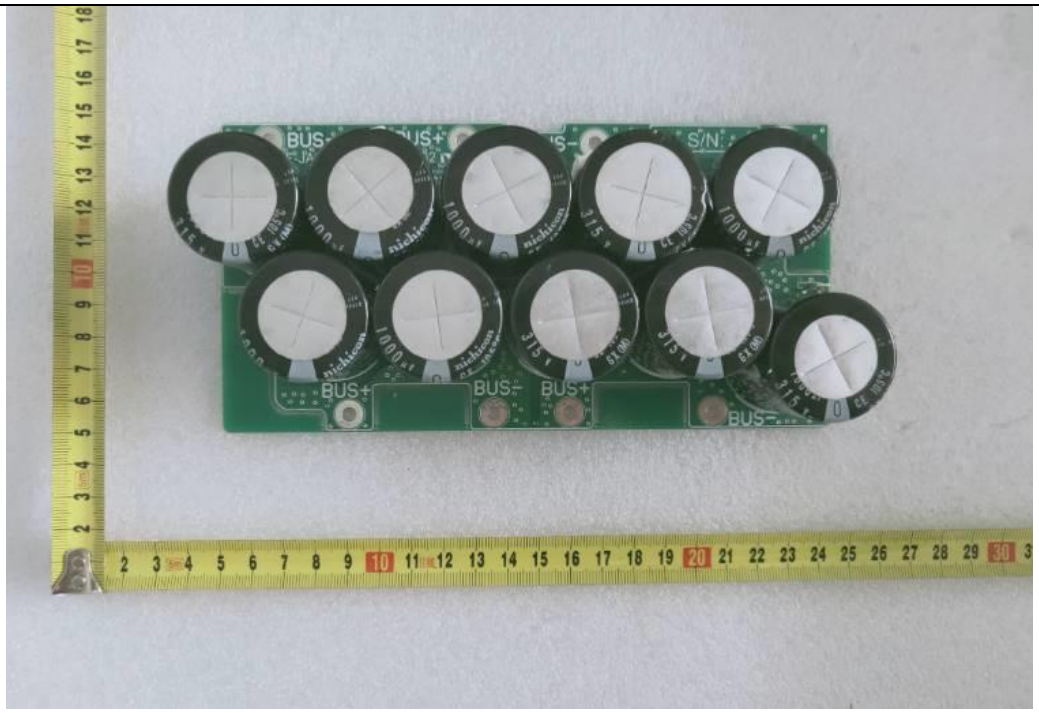



Main Board – Solder Side (AF3.6K-SH)

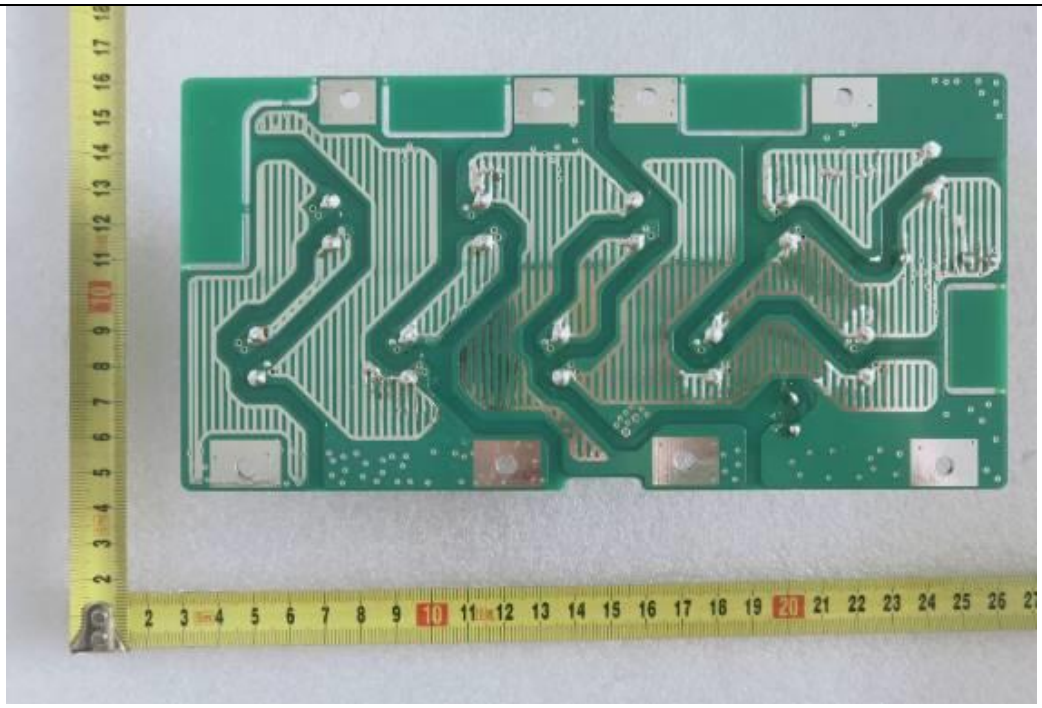


| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

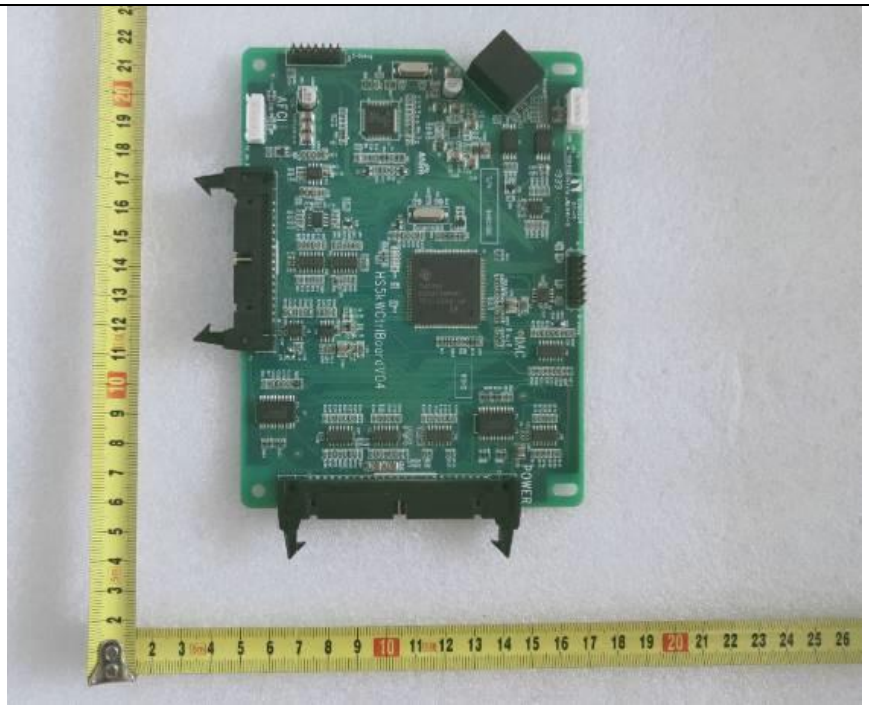
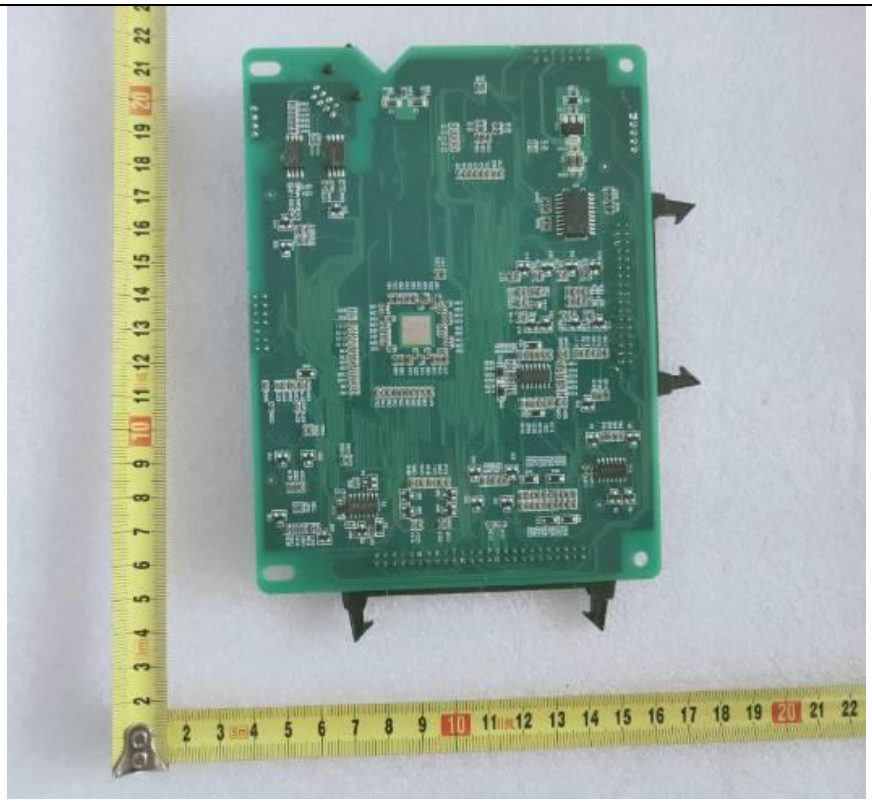
Busbar capacitor Board – Component Side




Busbar capacitor Board – Solder Side

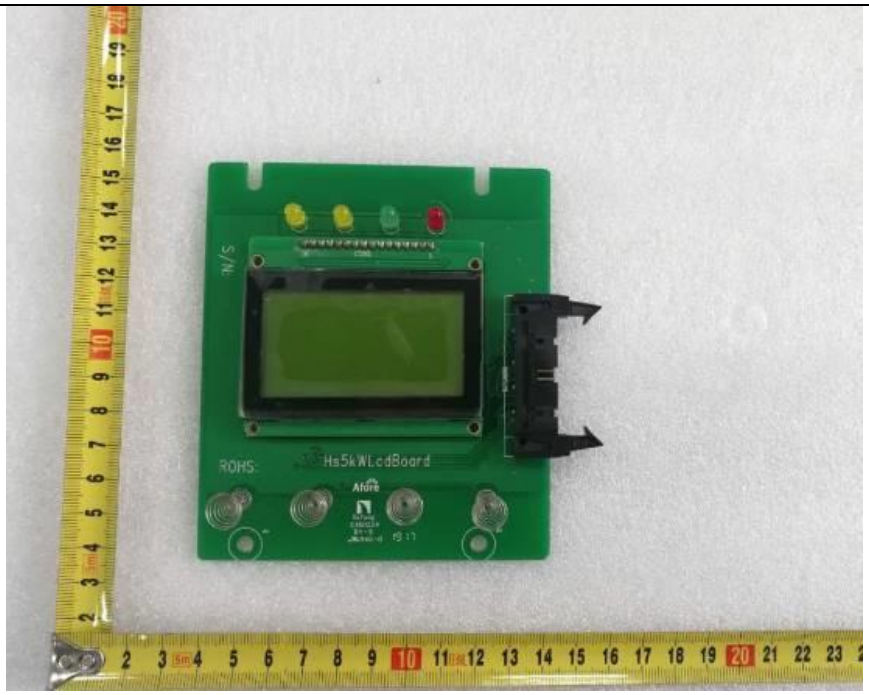


| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

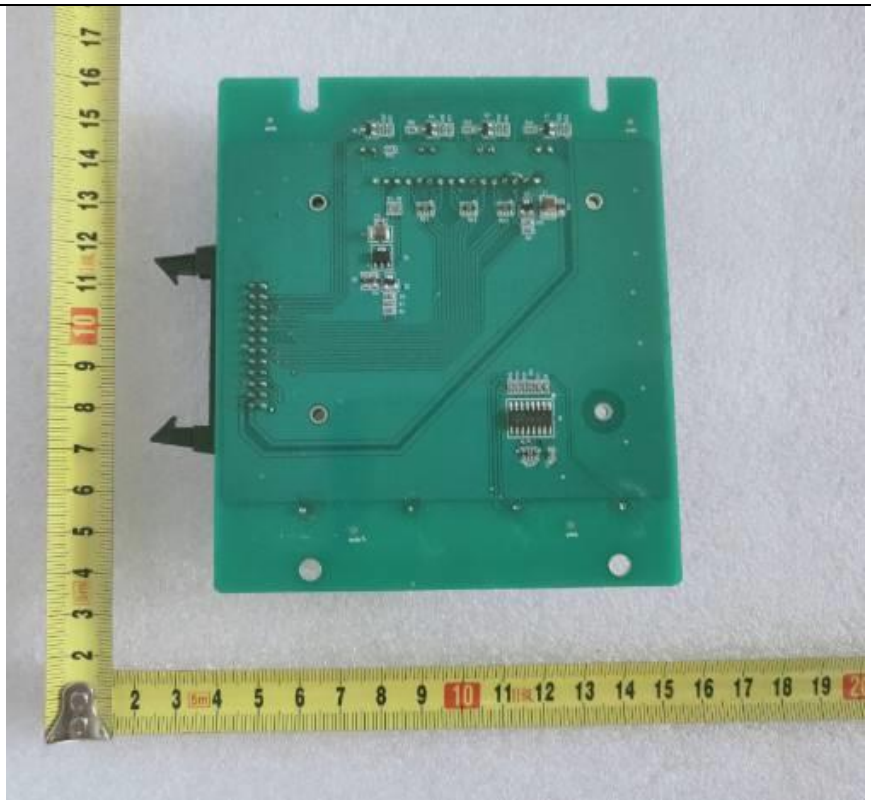
| Control Board – Component Side |
|---|
|  |
| Control Board – Solder Side |
|  |

| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

LCD Display Board – Component Side

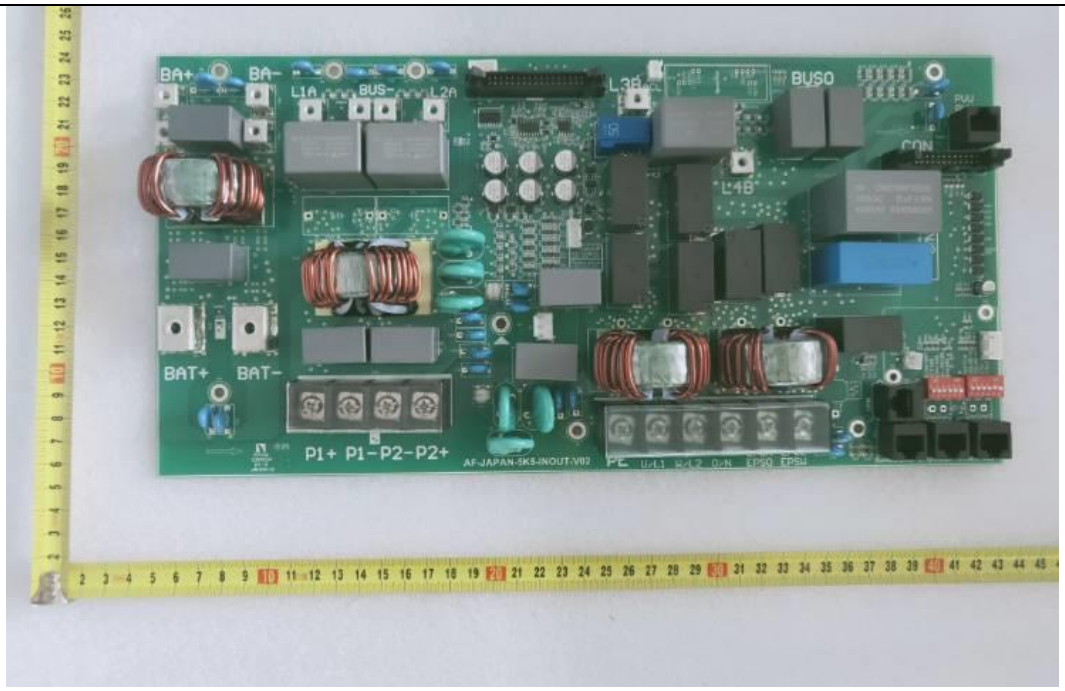



LCD Display Board – Solder Side

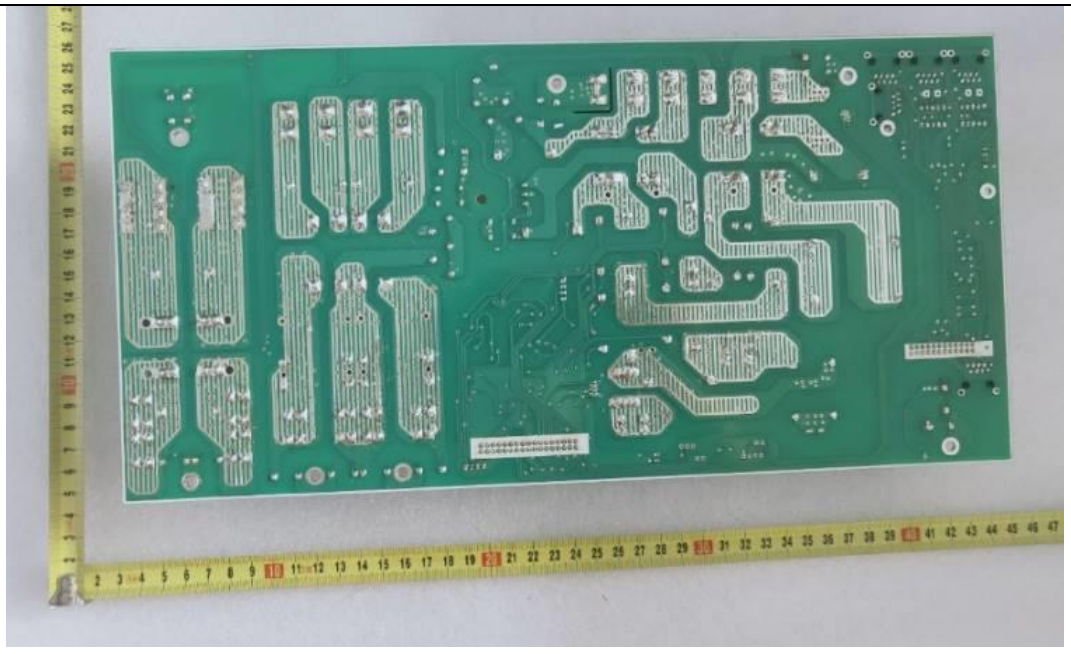


| G98/1-4 | | | |
|---|---|---|---|
| Clause | Requirement - Test | Result - Remark | Verdict |

EMI Board – Component Side




EMI Board – Solder Side



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