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| **A2-1 Compliance Verification Report –Tests for Type A Synchronous Power Generating Modules up to and including 50 kW – test record** | |
| **1. Operating Range:** Two tests should be carried with the **Power Generating Module** operating at **Registered** **Capacity** and connected to a suitable test supply, grid simulation set or load bank. The power supplied by the primary source shall be kept stable within ± 5 % of the apparent power value set for the entire duration of each test sequence.  Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time.  The **Interface Protection** shall be disabled during the tests. | |
| Test 1  Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz**, Power Factor** = 1, Period of test 20 s |  |
| Test 2  Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, **Power Factor** = 1, Period of test 90 minutes |  |
| Test 3  Voltage = 110% of nominal (253 V), Frequency = 51.5 Hz, **Power Factor** = 1, Period of test 90 minutes |  |
| Test 4  Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, **Power Factor** = 1, Period of test 15 minutes |  |

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| **2. Power Quality – Harmonics**: The test requirements are specified in A.7.2.5. These tests should be carried out as specified in BS EN 61000-3-12. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 610000-3-12 for three phase equipment.  **Power Generating Modules** with emissions close to the limits laid down in BS EN 61000-3-12 may require the installation of a transformer between 2 and 4 times the rating of the **Power Generating Module** in order to accept the connection to a **Distribution Network.** | | | | | | | | |
| **Power Generating Module** tested to BS EN 61000-3-12 | | | | | | | | |
| **Power Generating Module** rating per phase (rpp) | | |  | | | kVA | Harmonic % = Measured Value (A) x 23/rating per phase (kVA) | |
| Harmonic | At 45-55% of **Registered Capacity** | | | 100% of **Registered Capacity** | | | Limit in BS EN 61000-3-12 | |
|  | Measured Value (A) | % | | Measured Value (A) | % | | 1 phase | 3 phase |
| 2 |  |  | |  |  | | 8% | 8% |
| 3 |  |  | |  |  | | 21.6% | Not stated |
| 4 |  |  | |  |  | | 4% | 4% |
| 5 |  |  | |  |  | | 10.7% | 10.7% |
| 6 |  |  | |  |  | | 2.67% | 2.67% |
| 7 |  |  | |  |  | | 7.2% | 7.2% |
| 8 |  |  | |  |  | | 2% | 2% |
| 9 |  |  | |  |  | | 3.8% | Not stated |
| 10 |  |  | |  |  | | 1.6% | 1.6% |
| 11 |  |  | |  |  | | 3.1% | 3.1% |
| 12 |  |  | |  |  | | 1.33% | 1.33% |
| 13 |  |  | |  |  | | 2% | 2% |
| THD[[1]](#footnote-1) |  |  | |  |  | | 23% | 13% |
| PWHD[[2]](#footnote-2) |  |  | |  |  | | 23% | 22% |

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| **3. Power Quality – Voltage fluctuations and Flicker**: These tests should be undertaken in accordance with Annex A.7.2.5.3. Results should be normalised to a standard source impedance, or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable maximum impedance. | | | | | | | | | | | | | |
|  | | 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 | |  |  |  | |  | |  |  | | |  |  |
| Normalised to standard impedance | |  |  |  | |  | |  |  | | |  |  |
| Normalised to required maximum impedance | |  |  |  | |  | |  |  | | |  |  |
| 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 |  | | Ω | | X | | |  | Ω | | |
| Standard Impedance | | R | 0.24 \*  0.4 ^ | | Ω | | X | | | 0.15 \*  0.25 ^ | Ω | | |
| Maximum Impedance | | R |  | | Ω | | X | | |  | Ω | | |
| \* Applies to three phase and split single phase **Power Generating Modules.**  ^ Applies to single phase **Power Generating Module** and **Power Generating Modules** using two phases on a three phase system.  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 x 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.  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 comply with 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. | | | | | | | | | | | | | |
| Test start date | | |  | | | | Test end date | | | | |  | |
| Test location | | |  | | | | | | | | | | |
| **4. Power Factor**: The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity**. Voltage to be maintained within ±1.5% of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.2.5.2. | | | | | | | | | | | | | |
| Voltage | | | 0.94 pu (216.2 V) | | | | 1.0 pu (230 V) | | | | | 1.1 pu (253 V) | |
| Measured value | | |  | | | |  | | | | |  | |
| **Power Factor** Limit | | | >0.95 | | | | >0.95 | | | | | >0.95 | |
| **5. Protection – Frequency tests:** These tests should be carried out in accordance with Annex A.7.2.2.3**.** | | | | | | | | | | | | | |
| 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 | |  | |  | | | 47.7 Hz 30 s | |  | |
|  |  | |  | |  | |  | | | 47.3 Hz 19.5 s | |  | |
| U/F stage 2 | 47 Hz | | 0.5 s | |  | |  | | | 46.8 Hz 0.45 s | |  | |
| O/F | 52 Hz | | 0.5 s | |  | |  | | | 51.8 Hz 120 s | |  | |
|  |  | |  | |  | |  | | | 52.2 Hz 0.45 s | |  | |
|  | | | | | | | | | | | | | |

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| **6. Protection – Voltage tests:** These tests should be carried out in accordance with Annex A.7.2.2.2. | | | | | | | | | | | | | | | | |
| 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 | |  | | |  | | | 188 V 5.00 s | | |  | | |
|  |  | |  | |  | | |  | | | 180 V 2.45 s | | |  | | |
| O/V stage 1 | 1.14 pu (262.2 V) | | 1.0 s | |  | | |  | | | 258.2 V 5.0 s | | |  | | |
|  |  | |  | |  | | |  | | | 269.7 V 0.95s | | |  | | |
| O/V stage 2 | 1.19 pu (273.7 V) | | 0.5 s | |  | | |  | | | 277.7 V 0.45s | | |  | | |
|  | | | | | | | | | | | | | | | | |
| **7. Protection – Loss of Mains test:** The tests are to be carried out at three output power levels ±5%. These tests should be carried out in accordance with Annex A.7.2.2.4. | | | | | | | | | | | | | | | | |
| To be carried out at three output power levels with a tolerance of ± 5% in Test Power levels. | | | | | | | | | | | | | | | | |
| Test Power (% of **Registered Capacity)** | | 10% | | 55% | | | 100% | | 10% | | | 55% | | | | 100% |
| Balancing load on islanded network | | 95% of Test Power | | 95% of Test Power | | | 95% of Test Power | | 105% of Test Power | | | 105% of Test Power | | | | 105% of Test Power |
| Trip time.  Limit is 0.5 s | |  | |  | | |  | |  | | |  | | | |  |
| For Multi phase **Power Generating Modules** confirm that the device shuts down correctly after the removal of a single fuse as well as operation of all phases. | | | | | | | | | | | | | | | | |
| Test Power (% of **Registered Capacity)** | | 10% | | 55% | | | 100% | | 10% | | | 55% | | | | 100% |
| Balancing load on islanded network | | 95% of Test Power | | 95% of Test Power | | | 95% of Test Power | | 105% of Test Power | | | 105% of Test Power | | | | 105% of Test Power |
| Trip time. Ph1 fuse removed | |  | |  | | |  | |  | | |  | | | |  |
| Test Power (% of **Registered Capacity)** | | 10% | | 55% | | | 100% | | 10% | | | 55% | | | | 100% |
| Balancing load on islanded network | | 95% of Test Power | | 95% of Test Power | | | 95% of Test Power | | 105% of Test Power | | | 105% of Test Power | | | | 105% of Test Power |
| Trip time.  Ph2 fuse removed | |  | |  | | |  | |  | | |  | | | |  |
| Test Power (% of **Registered Capacity)** | | 10% | | 55% | | | 100% | | 10% | | | 55% | | | | 100% |
| Balancing load on islanded network | | 95% of Test Power | | 95% of Test Power | | | 95% of Test Power | | 105% of Test Power | | | 105% of Test Power | | | | 105% of Test Power |
| Trip time.  Ph3 fuse removed | |  | |  | | |  | |  | | |  | | | |  |
| Note 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. | | | | | | | | | | | | | | | | |
| Indicate additional shut down time included in above results. | | | | | | | | | | | | ms | | | | |
| **Loss of Mains Protection, Vector Shift Stability test.** This test should be carried out in accordance with Annex A.7.2.2.6. | | | | | | | | | | | | | | | | |
|  | | | Start Frequency | | | Change | | | | Confirm no trip | | | | | | |
| Positive Vector Shift | | | 49.5 Hz | | | +50 degrees | | | |  | | | | | | |
| Negative Vector Shift | | | 50.5 Hz | | | - 50 degrees | | | |  | | | | | | |
| **Loss of Mains Protection, RoCoF Stability test:** This test should be carried out in accordance with Annex A.7.2.2.6. | | | | | | | | | | | | | | | | |
| Ramp range | | | Test frequency ramp: | | | | | | | Test Duration | | | Confirm no trip | | | |
| 49.0Hz to 51.0Hz | | | +0.95 Hzs-1 | | | | | | | 2.1 s | | |  | | | |
| 51.0Hz to 49.0Hz | | | -0.95 Hzs-1 | | | | | | | 2.1 s | | |  | | | |
| **8. Limited Frequency Sensitive Mode – Over frequency test:** The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%.  This test should be carried out in accordance with Annex A.7.2.4 . | | | | | | | | | | | | | | | | |
| **Active Power** response to rising frequency/time plots are attached | | | | | | | | | | | | | | | **Y/N** | |

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| **9. Power output with falling frequency test** | | | | | | | | |
| Tests should prove that the **Power Generating Module** does not reduce output power as the frequency falls. These tests should be carried out in accordance with Annex A.7.2.3. | | | | | | | | |
| Test sequence | | Measured **Active Power** Output | Acceptable **Active Power** | | | Primary power source (if applicable) | | |
| 49.5 Hz for 5 minutes | |  | 100% **Registered Capacity** | | |  | | |
| 49.5 Hz for 5 minutes | |  | 99% **Registered Capacity** | | |  | | |
| 48.0 Hz for 5 minutes | |  | 97% **Registered Capacity** | | |  | | |
| 47.6 Hz for 5 minutes | |  | 96.2% **Registered Capacity** | | |  | | |
| 47.1 Hz for 20 s | |  | 95% **Registered Capacity** | | |  | | |
| **11. Protection – Re-connection timer**. | | | | | | | | |
| 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 10.1. | | | | | | | | |
| 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. | | | | | | |
|  |  | At 1.16 pu (266.2 V) | | At 0.85 pu (196.1 V) | At 47.4 Hz | | At 52.1 Hz | |
| Confirmation that the **Power Generating Module** does not re-connect. | |  | |  |  | |  | |
| **12. Fault level contribution**: **Manufacturers’** **Information** in respect of the fault level contribution shall be provided. | | | | | | | | |
| **13. Wiring functional tests:** If required by para 15.2.1, | | | | | | | | |
| Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning) | | | | | | | | Yes / NA |
| **14. Logic interface (input port)** | | | | | | | | |
| Confirm that an input port is provided and can be used to shut down the module. | | | | | | | | Yes / NA |

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| Additional comments |
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1. THD = Total Harmonic Distortion [↑](#footnote-ref-1)
2. PWHD = Partial Weighted Harmonic Distortion [↑](#footnote-ref-2)