

# ATTESTATION OF CONFORMITY

Issued to: EcoFlow Inc.  
RM 401, Plant #1, Runheng Industrial Zone, Fuyuan Road, Zhancheng Community,  
Fuhai Street, Bao'an District, Shenzhen City, Guangdong Province, China

For the product: EcoFlow PowerOcean Plus Hybrid Inverter

Trade name: 

Type/Model: EF HD-P3-29K9-S1, EF HD-P3-25K0-S1, EF HD-P3-20K0-S1, EF HD-P3-15K0-S1

Ratings: See annex

Manufactured by: EcoFlow Inc.  
RM 401, Plant #1, Runheng Industrial Zone, Fuyuan Road, Zhancheng Community,  
Fuhai Street, Bao'an District, Shenzhen City, Guangdong Province, China

Subject: Complete evaluation of electrical system of the appliances

Requirements: G99/1-9:2022

This Attestation is granted on account of an examination by DEKRA, the results of which are laid down in a test file / test report no 4929472.50.

The examination has been carried out on one single specimen or several specimens of the product, submitted by the manufacturer. The Attestation does not include an assessment of the manufacturer's production. Conformity of this production with the specimen tested by DEKRA is not the responsibility of DEKRA.

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Arnhem, 20 November 2025

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# Annex

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| Model list and rating (Inverter): |                                                        |                                           |                  |                  |                  |
|-----------------------------------|--------------------------------------------------------|-------------------------------------------|------------------|------------------|------------------|
| Model                             |                                                        | EF HD-P3-29K9-S1                          | EF HD-P3-25K0-S1 | EF HD-P3-20K0-S1 | EF HD-P3-15K0-S1 |
| PV Input                          | V <sub>MAX PV</sub> [V <sub>DC</sub> ]                 | 1000                                      |                  |                  |                  |
|                                   | I <sub>SC PV</sub> [A <sub>DC</sub> ]                  | PV1 19/19, PV2&3 24/24                    |                  |                  |                  |
|                                   | MPPT Voltage Range V <sub>MPP</sub> [V <sub>DC</sub> ] | 200-850                                   |                  |                  |                  |
|                                   | Max. Input Current I <sub>MAX</sub> [A <sub>DC</sub> ] | PV1 16/16, PV2&3 16/16                    |                  |                  |                  |
|                                   | MPPT Full Power Voltage Range [V <sub>DC</sub> ]       | 200-850                                   |                  |                  |                  |
|                                   | Number of MPPT                                         | 3                                         |                  |                  |                  |
|                                   | String per MPPT                                        | PV1 2, PV2/3 1/1                          |                  |                  |                  |
|                                   | Overvoltage Category (OVC)                             | II                                        |                  |                  |                  |
| Battery                           | Rated input voltage [V <sub>DC</sub> ]                 | 800                                       |                  |                  |                  |
|                                   | Input voltage range [V <sub>DC</sub> ]                 | 750~960                                   |                  |                  |                  |
|                                   | Max. charge/ Discharge current [A <sub>DC</sub> ]      | 40.0                                      | 33.3             | 26.6             | 20.0             |
|                                   | Max. charge/ Discharge Power [kW]                      | 29.9                                      | 25.0             | 20.0             | 15.0             |
|                                   | Battery Type                                           | Li-ion                                    |                  |                  |                  |
| AC Input (Side Grid)              | Rated Output Voltage [V <sub>AC</sub> ]                | 230/400,3L/N/PE                           |                  |                  |                  |
|                                   | Rated Output Frequency [Hz]                            | 50                                        |                  |                  |                  |
|                                   | Max. Input Current [A <sub>AC</sub> ]                  | 63.0                                      |                  |                  |                  |
|                                   | Power Factor cosφ [λ]                                  | -0.8 leading to +0.8 lagging (adjustable) |                  |                  |                  |
|                                   | Overvoltage Category (OVC)                             | III                                       |                  |                  |                  |
| AC output (Grid Side)             | Rated Output Voltage [V <sub>AC</sub> ]                | 230/400, 3L/N/PE                          |                  |                  |                  |
|                                   | Rated Output Frequency [Hz]                            | 50                                        |                  |                  |                  |
|                                   | Rated Output Power [kW]                                | 29.9                                      | 25               | 20               | 15               |
|                                   | Max. Apparent power [kVA]                              | 29.9                                      | 25               | 20               | 15               |
|                                   | Max. Output Current [A <sub>AC</sub> ]                 | 43.3                                      | 36.2             | 29               | 21.7             |
|                                   | Overvoltage Category (OVC)                             | III                                       |                  |                  |                  |
| AC Output (Back-up)               | Rated Output Voltage [V <sub>AC</sub> ]                | 230/400, 3L/N/PE                          |                  |                  |                  |
|                                   | Rated Output Frequency [Hz]                            | 50                                        |                  |                  |                  |
|                                   | Rated Output Current [A <sub>AC</sub> ]                | 43.3                                      | 36.2             | 29.0             | 21.7             |
|                                   | Rated Output Power [kW]                                | 29.9                                      | 25               | 20               | 15               |
|                                   | Max. Apparent power [kVA]                              | 35.88@1s                                  | 30.0@1s          | 24.0@1s          | 18.0@1s          |
|                                   | Max. Output Current (off-grid) [A <sub>AC</sub> ]      | 52.0@1s                                   | 43.4@1s          | 34.8@1s          | 26.0@1s          |
|                                   | Overvoltage Category (OVC)                             | III                                       |                  |                  |                  |
| General                           | Type of inverter                                       | Non-Isolated                              |                  |                  |                  |
|                                   | Type of NS Protection                                  | Integrated                                |                  |                  |                  |
|                                   | Protective Class                                       | Class I                                   |                  |                  |                  |
|                                   | Enclosure Protection (IP)                              | IP65                                      |                  |                  |                  |
|                                   | Operating Temperature Range [°C]                       | -20°C to +50°C (45°C with derating)       |                  |                  |                  |
|                                   | Pollution degree                                       | PD2(internal), PD3(outside)               |                  |                  |                  |
|                                   | Altitude [m]                                           | 3000                                      |                  |                  |                  |
|                                   | Size (W*H*D) [mm]                                      | 636*235*498 (without trim cover)          |                  |                  |                  |
|                                   | Weight [kg]                                            | 41                                        |                  |                  |                  |

# Annex

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| Appendix 1: A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                     |                       |                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------|-----------------------|---------------------|
| <b>1. Operating Range:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                     |                       | <b>P</b>            |
| <p>Two tests should be carried with the <b>Power Generating Module</b> operating at <b>Registered Capacity</b> and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within <math>\pm 5\%</math> of the apparent power value set for the entire duration of each test sequence.</p> <p>Frequency, voltage and <b>Active Power</b> measurements at the output terminals of the <b>Power Generating Module</b> shall be recorded every second. The tests will verify that the <b>Power Generating Module</b> can operate within the required ranges for the specified period of time.</p> <p>The <b>Interface Protection</b> shall be disabled during the tests.</p> <p>In case of a PV <b>Power Park Module</b> the PV primary source may be replaced by a DC source.</p> <p>In case of a full converter <b>Power Park Module</b> (eg wind) the primary source and the prime mover <b>Inverter</b>/rectifier may be replaced by a DC source.</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>Note that the value of voltage stated in brackets assumes a <b>LV</b> connection. This should be adjusted for <b>HV</b> as required.</p> |                         |                     |                       |                     |
| Model: KLD-MS60KW-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                     |                       | <b>P</b>            |
| <b>Test 1:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                     |                       |                     |
| Measured Voltage (V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Measured Frequency (Hz) | Measured Power (KW) | Measured Power factor | Test Time (seconds) |
| 195.86                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 47.00                   | 28.88               | 0.998                 | 20                  |
| <b>Test 2:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                     |                       |                     |
| Measured Voltage (V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Measured Frequency (Hz) | Measured Power (KW) | Measured Power factor | Test Time (Minutes) |
| 195.49                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 47.49                   | 28.78               | 0.998                 | 90                  |
| <b>Test 3:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                     |                       |                     |
| Measured Voltage (V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Measured Frequency (Hz) | Measured Power (KW) | Measured Power factor | Test Time (Minutes) |
| 253.28                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 51.49                   | 28.98               | 0.997                 | 90                  |
| <b>Test 4:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                     |                       |                     |
| Measured Voltage (V)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Measured Frequency (Hz) | Measured Power (KW) | Measured Power factor | Test Time (Minutes) |

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|                         |                            |                        |                          |                        |
|-------------------------|----------------------------|------------------------|--------------------------|------------------------|
| 253.73                  | 51.99                      | 29.98                  | 0.995                    | 15                     |
| <b>Test 5:</b>          |                            |                        |                          |                        |
| Measured Voltage<br>(V) | Measured<br>Frequency (Hz) | Measured Power<br>(KW) | Measured Power<br>factor | Test Time<br>(Minutes) |
| 230.22                  | 49.99                      | 29.84                  | 0.997                    | 90                     |
| <b>Test 6:</b>          |                            |                        |                          |                        |
| Measured Voltage<br>(V) | Ramp range                 | Test frequency<br>ramp | Test Duration            | Confirm no trip        |
| 230.29                  | 50 Hz → 47.50 Hz           | -1 Hzs <sup>-1</sup>   | 2.50 s                   | No trip                |
| 230.25                  | 47.50 Hz → 50 Hz           | +1 Hzs <sup>-1</sup>   | 2.50 s                   | No trip                |
| 230.29                  | 50 Hz → 52.00 Hz           | +1 Hzs <sup>-1</sup>   | 2.00 s                   | No trip                |
| 230.30                  | 52.00 Hz → 50 Hz           | -1 Hzs <sup>-1</sup>   | 2.00 s                   | No trip                |

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| <b>2. Power Quality – Harmonics:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |       |       |                          |       |       | <b>P</b>                  |                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------|-------|--------------------------|-------|-------|---------------------------|----------------------------------------------------------------------|
| <p>For <b>Power Generating Modules</b> of <b>Registered Capacity</b> of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5. These tests should be carried out as specified in BS EN 61000-3-12, and measurements for the 2<sup>nd</sup> – 13<sup>th</sup> harmonics should be provided. 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 61000-3-12 for three phase equipment. For three phase <b>Power Generating Modules</b>, measurements for all phases should be provided.</p> <p>For <b>Power Generating Modules</b> of <b>Registered Capacity</b> of greater than 75 A per phase (ie 50 kW) the installation must be designed in accordance with EREC G5.</p> <p>The rating of the <b>Power Generating Module</b> (per phase) should be provided below, and the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWHd) should be provided at the bottom of this section.</p> |                                         |       |       |                          |       |       |                           |                                                                      |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                         |       |       |                          |       |       |                           |                                                                      |
| <b>Power Generating Module</b> tested to BS EN 61000-3-12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                         |       |       |                          |       |       |                           |                                                                      |
| <b>Power Generating Module</b> rating per phase (rpp)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                         |       |       | 9.97                     |       | kVA   |                           | Harmonic % =<br>Measured Value (A) x<br>23/rating per phase<br>(kVA) |
| Single or three phase measurements (for single phase measurements, only complete L1 columns below)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                         |       |       | Three-phase PV inverter  |       |       |                           |                                                                      |
| Harmonic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | At 45-55% of <b>Registered Capacity</b> |       |       |                          |       |       | Limit in BS EN 61000-3-12 |                                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Measured Value (MV) in Amps             |       |       | Measured Value (MV) in % |       |       |                           |                                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | L1                                      | L2    | L3    | L1                       | L2    | L3    | 1 phase                   | 3 phase                                                              |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1.470                                   | 1.677 | 1.599 | 3.380                    | 3.858 | 3.679 | 8%                        | 8%                                                                   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.221                                   | 0.397 | 0.379 | 0.508                    | 0.912 | 0.872 | 21.6%                     | Not stated                                                           |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.282                                   | 0.166 | 0.269 | 0.648                    | 0.381 | 0.619 | 4%                        | 4%                                                                   |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.170                                   | 0.438 | 0.278 | 0.392                    | 1.008 | 0.640 | 10.7%                     | 10.7%                                                                |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.199                                   | 0.168 | 0.107 | 0.458                    | 0.387 | 0.247 | 2.67%                     | 2.67%                                                                |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.158                                   | 0.253 | 0.280 | 0.364                    | 0.582 | 0.644 | 7.2%                      | 7.2%                                                                 |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.341                                   | 0.309 | 0.191 | 0.783                    | 0.710 | 0.438 | 2%                        | 2%                                                                   |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.070                                   | 0.079 | 0.116 | 0.160                    | 0.183 | 0.267 | 3.8%                      | Not stated                                                           |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.237                                   | 0.210 | 0.130 | 0.545                    | 0.482 | 0.299 | 1.6%                      | 1.6%                                                                 |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.265                                   | 0.305 | 0.290 | 0.611                    | 0.702 | 0.666 | 3.1%                      | 3.1%                                                                 |
| 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.082                                   | 0.104 | 0.113 | 0.187                    | 0.240 | 0.260 | 1.33%                     | 1.33%                                                                |

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|          |                                       |       |       |                          |       |       |                           |            |
|----------|---------------------------------------|-------|-------|--------------------------|-------|-------|---------------------------|------------|
| 13       | 0.168                                 | 0.169 | 0.223 | 0.387                    | 0.389 | 0.514 | 2%                        | 2%         |
| THD      | -                                     | -     | -     | 3.825                    | 4.407 | 4.145 | 23%                       | 13%        |
| PWHD     | -                                     | -     | -     | 0.735                    | 0.766 | 0.698 | 23%                       | 22%        |
|          |                                       |       |       |                          |       |       |                           |            |
| Harmonic | At 100% of <b>Registered Capacity</b> |       |       |                          |       |       | Limit in BS EN 61000-3-12 |            |
|          | Measured Value (MV) in Amps           |       |       | Measured Value (MV) in % |       |       |                           |            |
|          | L1                                    | L2    | L3    | L1                       | L2    | L3    | 1 phase                   | 3 phase    |
| 2        | 1.647                                 | 1.821 | 1.669 | 3.789                    | 4.188 | 3.838 | 8%                        | 8%         |
| 3        | 0.301                                 | 0.554 | 0.537 | 0.693                    | 1.275 | 1.235 | 21.6%                     | Not stated |
| 4        | 0.298                                 | 0.216 | 0.288 | 0.685                    | 0.497 | 0.662 | 4%                        | 4%         |
| 5        | 0.175                                 | 0.545 | 0.346 | 0.402                    | 1.253 | 0.796 | 10.7%                     | 10.7%      |
| 6        | 0.179                                 | 0.130 | 0.082 | 0.413                    | 0.298 | 0.189 | 2.67%                     | 2.67%      |
| 7        | 0.248                                 | 0.356 | 0.284 | 0.571                    | 0.820 | 0.653 | 7.2%                      | 7.2%       |
| 8        | 0.263                                 | 0.241 | 0.108 | 0.604                    | 0.554 | 0.249 | 2%                        | 2%         |
| 9        | 0.111                                 | 0.093 | 0.136 | 0.255                    | 0.215 | 0.313 | 3.8%                      | Not stated |
| 10       | 0.173                                 | 0.221 | 0.063 | 0.398                    | 0.508 | 0.144 | 1.6%                      | 1.6%       |
| 11       | 0.581                                 | 0.675 | 0.628 | 1.336                    | 1.552 | 1.444 | 3.1%                      | 3.1%       |
| 12       | 0.119                                 | 0.113 | 0.130 | 0.274                    | 0.259 | 0.298 | 1.33%                     | 1.33%      |
| 13       | 0.433                                 | 0.440 | 0.479 | 0.996                    | 1.012 | 1.101 | 2%                        | 2%         |
| THD      | -                                     | -     | -     | 4.581                    | 5.244 | 4.797 | 23%                       | 13%        |
| PWHD     | -                                     | -     | -     | 1.259                    | 1.283 | 1.287 | 23%                       | 22%        |

THD = Total Harmonic Distortion

PWHD = Partial Weighted Harmonic Distortion

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| 3. Power Quality – Voltage fluctuations and Flicker:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                  |      |      |          |       |      |                 | P                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------|------|----------|-------|------|-----------------|-------------------------|
| <p>For <b>Power Generating Modules</b> of <b>Registered Capacity</b> of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. 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.</p> <p>For <b>Power Generating Modules</b> of <b>Registered Capacity</b> of greater than 75 A per phase (ie 50 kW) the installation must be designed in accordance with EREC P28.</p> <p>The standard test impedance is 0.4 <math>\Omega</math> for a single phase <b>Power Generating Module</b> (and for a two phase unit in a three phase system) and 0.24 <math>\Omega</math> for a three phase <b>Power Generating Module</b> (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 <b>Power Factor</b> 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 <b>Power Factor</b> 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:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | EF HD-P3-29K9-S1 |      |      |          |       |      |                 |                         |
| <b>L1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |      |      |          |       |      |                 |                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Starting         |      |      | Stopping |       |      | Running         |                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | d(max)           | d(c) | d(t) | d(max)   | d(c)  | d(t) | P <sub>st</sub> | P <sub>lt</sub> 2 hours |
| Measured Values at test impedance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.250            | 0    | 0    | 0.637    | 0.286 | 0    | 0.025           | 0.022                   |
| Normalised to standard impedance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.250            | 0    | 0    | 0.637    | 0.286 | 0    | 0.025           | 0.022                   |
| 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                    |

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|                                          |          |                 |      |          |       |                  |                 |                         |
|------------------------------------------|----------|-----------------|------|----------|-------|------------------|-----------------|-------------------------|
| Test Impedance                           | R        | 0.4             |      | Ω        | XI    | 0.25             |                 | Ω                       |
| Standard Impedance                       | R        | 0.24 *<br>0.4 ^ |      | Ω        | XI    | 0.15 *<br>0.25 ^ |                 | Ω                       |
| Maximum Impedance                        | R        | N/A #           |      | Ω        | XI    | N/A #            |                 | Ω                       |
| L2                                       |          |                 |      |          |       |                  |                 |                         |
|                                          | Starting |                 |      | Stopping |       |                  | Running         |                         |
|                                          | d(max)   | d(c)            | d(t) | d(max)   | d(c)  | d(t)             | P <sub>st</sub> | P <sub>lt</sub> 2 hours |
| Measured Values at test impedance        | 0.351    | 0               | 0    | 0.482    | 0.523 | 0                | 0.024           | 0.022                   |
| Normalised to standard impedance         | 0.351    | 0               | 0    | 0.482    | 0.523 | 0                | 0.024           | 0.022                   |
| 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 *<br>0.4 ^ |      | Ω        | XI    | 0.15 *<br>0.25 ^ |                 | Ω                       |
| Maximum Impedance                        | R        | N/A #           |      | Ω        | XI    | N/A #            |                 | Ω                       |
| L3                                       |          |                 |      |          |       |                  |                 |                         |
|                                          | Starting |                 |      | Stopping |       |                  | Running         |                         |
|                                          | d(max)   | d(c)            | d(t) | d(max)   | d(c)  | d(t)             | P <sub>st</sub> | P <sub>lt</sub> 2 hours |
| Measured Values at test impedance        | 0.270    | 0               | 0    | 0.934    | 0.033 | 0                | 0.026           | 0.023                   |
| Normalised to standard impedance         | 0.270    | 0               | 0    | 0.934    | 0.033 | 0                | 0.026           | 0.023                   |
| 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 *          |      | Ω        | XI    | 0.15 *           |                 | Ω                       |

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|                                                                                                                                                                                                                                                              |   |       |          |    |        |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------|----------|----|--------|----------|
|                                                                                                                                                                                                                                                              |   | 0.4 ^ |          |    | 0.25 ^ |          |
| Maximum Impedance                                                                                                                                                                                                                                            | R | N/A # | $\Omega$ | XI | N/A #  | $\Omega$ |
| <p>* Applies to three phase and split single phase <b>Power Generating Modules</b>.</p> <p>^ Applies to single phase <b>Power Generating Module</b> and <b>Power Generating Modules</b> using two phases on a three phase system. Delete as appropriate.</p> |   |       |          |    |        |          |

| 4. Power quality – DC injection:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |        |        | P |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|---|
| <p>The tests should be carried out on a single <b>Generating Unit</b>. Tests are to be carried out at three defined power levels <math>\pm 5\%</math>. At 230 V a 50 kW three phase <b>Inverter</b> has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.</p> <p>The % DC injection ("as % of rated AC current" below) is calculated as follows:</p> <p>% DC injection = Recorded DC value in Amps / Base current</p> <p>where the base current is the <b>Registered Capacity</b> (W) / Vphase. The % DC injection should not be greater than 0.25%.</p> |        |        |        |   |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |        |        |   |
| <b>L1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |        |        |   |
| Test power level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 10%    | 55%    | 100%   |   |
| Recorded DC injection value in Amps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.013  | 0.047  | 0.041  |   |
| as % of rated AC current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.029% | 0.109% | 0.095% |   |
| Limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.25%  | 0.25%  | 0.25%  |   |
| <b>L2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |        |        |   |
| Test power level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 10%    | 55%    | 100%   |   |
| Recorded DC injection value in Amps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.035  | 0.047  | 0.045  |   |
| as % of rated AC current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.081% | 0.108% | 0.103% |   |
| Limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.25%  | 0.25%  | 0.25%  |   |
| <b>L3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |        |        |   |
| Test power level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 10%    | 55%    | 100%   |   |
| Recorded DC injection value in Amps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.052  | 0.066  | 0.039  |   |
| as % of rated AC current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.119% | 0.152% | 0.091% |   |
| Limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.25%  | 0.25%  | 0.25%  |   |

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| 5. Power quality – Power Factor:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |              |                | P |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------|----------------|---|
| <p>The tests should be carried out on a single <b>Power Generating Module</b>. Tests are to be carried out at three voltage levels and at <b>Registered Capacity</b> and the measured <b>Power Factor</b> must be greater than 0.95 to pass. Voltage to be maintained within <math>\pm 1.5\%</math> of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2</p> <p>Note that the value of voltage stated in brackets assumes a <b>LV</b> connection. This should be adjusted for <b>HV</b> as required.</p> |                   |              |                |   |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |              |                |   |
| Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.94 pu (216.2 V) | 1 pu (230 V) | 1.1 pu (253 V) |   |
| Measured value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0.9978            | 0.9971       | 0.9975         |   |
| Power Factor Limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | >0.95             | >0.95        | >0.95          |   |

| 6. Protection – Frequency tests:                                                                                                                                                                                                                                                                                                                                                                                                   |           |            |           |            |                    | P               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|-----------|------------|--------------------|-----------------|
| <p>These tests should be carried out in accordance with the Annex A.7.1.2.3. For trip tests, frequency and time delay should be stated. For “no trip tests”, “no trip” can be stated.</p>                                                                                                                                                                                                                                          |           |            |           |            |                    |                 |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                                                                                                                                                                                                                                            |           |            |           |            |                    |                 |
| 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       | 47.50 Hz  | 20.054 s   | 47.7 Hz<br>30 s    | No trip         |
| U/F stage 2                                                                                                                                                                                                                                                                                                                                                                                                                        | 47.0 Hz   | 0.5 s      | 46.99 Hz  | 0.536 s    | 47.2 Hz<br>19.5 s  | No trip         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |            |           |            | 46.8 Hz<br>0.45 s  | No trip         |
| O/F                                                                                                                                                                                                                                                                                                                                                                                                                                | 52.0 Hz   | 0.5 s      | 52.04 Hz  | 0.541 s    | 51.8 Hz<br>120.0 s | No trip         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |            |           |            | 52.2 Hz<br>0.45 s  | No trip         |
| <p>Note: For frequency trip tests the frequency required to trip is the setting <math>\pm 0.1</math> Hz. In order to measure the time delay a larger deviation than the minimum required to operate the protection can be used. The “No trip tests” need to be carried out at the setting <math>\pm 0.2</math> Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p> |           |            |           |            |                    |                 |

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| 7. Protection – Voltage tests:                                                                                                                                                                                                                                                                                                                          |                      |            |           |            |                  | P               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------|-----------|------------|------------------|-----------------|
| <p>These tests should be carried out in accordance with Annex A.7.1.2.2. For trip tests, voltage and time delay should be stated. For “no trip tests”, “no trip” can be stated.</p> <p>Note that the value of voltage stated below assumes a <b>LV</b> connection This should be adjusted for <b>HV</b> taking account of the VT ratio as required.</p> |                      |            |           |            |                  |                 |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                                                                                                                                                                 |                      |            |           |            |                  |                 |
| L1                                                                                                                                                                                                                                                                                                                                                      |                      |            |           |            |                  |                 |
| Function                                                                                                                                                                                                                                                                                                                                                | Setting              |            | Trip test |            | “No trip tests”  |                 |
|                                                                                                                                                                                                                                                                                                                                                         | Voltage              | Time delay | Voltage   | Time delay | Voltage / time   | Confirm no trip |
| U/V                                                                                                                                                                                                                                                                                                                                                     | 0.8 pu<br>(184 V)    | 2.5 s      | 184.0 V   | 2.546 s    | 188 V / 5.0 s    | No trip         |
|                                                                                                                                                                                                                                                                                                                                                         |                      |            |           |            | 180 V / 2.45 s   | No trip         |
| O/V stage 1                                                                                                                                                                                                                                                                                                                                             | 1.14 pu<br>(262.2 V) | 1.0 s      | 263.2 V   | 1.045 s    | 258.2 V / 5.0 s  | No trip         |
| O/V stage 2                                                                                                                                                                                                                                                                                                                                             | 1.19 pu<br>(273.7 V) | 0.5 s      | 274.5 V   | 0.535 s    | 269.7 V / 0.95 s | No trip         |
|                                                                                                                                                                                                                                                                                                                                                         |                      |            |           |            | 277.7 V / 0.45 s | No trip         |
| L2                                                                                                                                                                                                                                                                                                                                                      |                      |            |           |            |                  |                 |
| Function                                                                                                                                                                                                                                                                                                                                                | Setting              |            | Trip test |            | “No trip tests”  |                 |
|                                                                                                                                                                                                                                                                                                                                                         | Voltage              | Time delay | Voltage   | Time delay | Voltage / time   | Confirm no trip |
| U/V                                                                                                                                                                                                                                                                                                                                                     | 0.8 pu<br>(184 V)    | 2.5 s      | 184.1 V   | 2.531 s    | 188 V / 5.0 s    | No trip         |
|                                                                                                                                                                                                                                                                                                                                                         |                      |            |           |            | 180 V / 2.45 s   | No trip         |
| O/V stage 1                                                                                                                                                                                                                                                                                                                                             | 1.14 pu<br>(262.2 V) | 1.0 s      | 263.9 V   | 1.031 s    | 258.2 V / 5.0 s  | No trip         |
| O/V stage 2                                                                                                                                                                                                                                                                                                                                             | 1.19 pu<br>(273.7 V) | 0.5 s      | 275.4 V   | 0.546 s    | 269.7 V / 0.95 s | No trip         |
|                                                                                                                                                                                                                                                                                                                                                         |                      |            |           |            | 277.7 V / 0.45 s | No trip         |
| L3                                                                                                                                                                                                                                                                                                                                                      |                      |            |           |            |                  |                 |
| Function                                                                                                                                                                                                                                                                                                                                                | Setting              |            | Trip test |            | “No trip tests”  |                 |
|                                                                                                                                                                                                                                                                                                                                                         | Voltage              | Time delay | Voltage   | Time delay | Voltage / time   | Confirm no trip |

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|             |                      |       |         |         |                  |         |
|-------------|----------------------|-------|---------|---------|------------------|---------|
| U/V         | 0.8 pu<br>(184 V)    | 2.5 s | 184.2 V | 2.549 s | 188 V / 5.0 s    | No trip |
|             |                      |       |         |         | 180 V / 2.45 s   | No trip |
| O/V stage 1 | 1.14 pu<br>(262.2 V) | 1.0 s | 263.0 V | 1.046 s | 258.2 V / 5.0 s  | No trip |
| O/V stage 2 | 1.19 pu<br>(273.7 V) | 0.5 s | 274.4 V | 0.544 s | 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  $\pm 3.45$  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  $\pm 4$  V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

| 8. Protection – Loss of Mains test:                                                                                                                          |                         |                         |                         |                         |                         | P                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------------------|
| These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.                                                                           |                         |                         |                         |                         |                         |                          |
| 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: EF HD-P3-29K9-S1                                                                                                                                      |                         |                         |                         |                         |                         |                          |
| The following sub set of tests should be recorded in the following table.                                                                                    |                         |                         |                         |                         |                         |                          |
| Test Power and imbalance                                                                                                                                     | 33%<br>-5% Q<br>Test 22 | 66%<br>-5% Q<br>Test 12 | 100%<br>-5% P<br>Test 5 | 33%<br>+5% Q<br>Test 31 | 66%<br>+5% Q<br>Test 21 | 100%<br>+5% P<br>Test 10 |
| Trip time.<br>Limit is 0.5s                                                                                                                                  | 0.179 s                 | 0.188 s                 | 0.229 s                 | 0.143 s                 | 0.141 s                 | 0.342 s                  |

| 8. Loss of Mains Protection, Vector Shift Stability test:                                                                                                                                  |                 |  |              | P               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--|--------------|-----------------|
| This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the <b>Power Generating Module</b> does not trip under positive / negative vector shift. |                 |  |              |                 |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                    |                 |  |              |                 |
| Vector Shift                                                                                                                                                                               | Start Frequency |  | Change       | Confirm no trip |
| Positive                                                                                                                                                                                   | 49.5 Hz         |  | +50 degrees  | No trip         |
| Negative                                                                                                                                                                                   | 50.5 Hz         |  | - 50 degrees | No trip         |

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| 8. Loss of Mains Protection, RoCoF Stability test:                                                                                                                                                     |                         |               |                 | P |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------|-----------------|---|
| This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the <b>Power Generating Module</b> does not trip for the duration of the ramp up and ramp down test. |                         |               |                 |   |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                |                         |               |                 |   |
| Ramp range                                                                                                                                                                                             | Test frequency ramp:    | Test Duration | Confirm no trip |   |
| 49.0 Hz to 51.0 Hz                                                                                                                                                                                     | +0.95 Hzs <sup>-1</sup> | 2.1 s         | No trip         |   |
| 51.0 Hz to 49.0 Hz                                                                                                                                                                                     | -1.95 Hzs <sup>-1</sup> | 1.1 s         | No trip         |   |

| 9. Limited Frequency Sensitive Mode – Over frequency test:                                                                                                                                                            |                                                |                   |                         |                                    |                                 | P   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------|-------------------------|------------------------------------|---------------------------------|-----|
| The test should be carried out using the specific threshold frequency of 50.4 Hz and <b>Droop</b> of 10%. This test should be carried out in accordance with A.7.1.3, which also contains the measurement tolerances. |                                                |                   |                         |                                    |                                 |     |
| <b>Active Power</b> response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4                                                                 |                                                |                   |                         |                                    |                                 | N/A |
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                               |                                                |                   |                         |                                    |                                 |     |
| Alternatively, simulation results should be noted below:                                                                                                                                                              |                                                |                   |                         |                                    |                                 |     |
| Test sequence at<br><b>Registered Capacity</b> >80%                                                                                                                                                                   | Measured<br><b>Active Power</b><br>Output (KW) | Frequency<br>(Hz) | Calculated<br>droop (%) | Primary<br>Power<br>Source         | <b>Active Power</b><br>Gradient |     |
| Step a) 50.00 Hz ±0.01 Hz                                                                                                                                                                                             | 29.85                                          | 50.00             | -                       | Photovoltaic<br>array<br>simulator | -                               |     |
| Step b) 50.45 Hz ±0.05 Hz                                                                                                                                                                                             | 29.60                                          | 50.45             | 10.80                   |                                    | -                               |     |
| Step c) 50.70 Hz ±0.10 Hz                                                                                                                                                                                             | 28.09                                          | 50.70             | 9.93                    |                                    | -                               |     |
| Step d) 51.15 Hz ±0.05 Hz                                                                                                                                                                                             | 25.38                                          | 51.15             | 10.81                   |                                    | -                               |     |
| Step e) 50.70 Hz ±0.10 Hz                                                                                                                                                                                             | 28.07                                          | 50.70             | 8.78                    |                                    | -                               |     |
| Step f) 50.45 Hz ±0.05 Hz                                                                                                                                                                                             | 29.56                                          | 50.45             | 10.75                   |                                    | -                               |     |
| Step g) 50.00 Hz ±0.01 Hz                                                                                                                                                                                             | 29.84                                          | 50.00             | -                       |                                    | -                               |     |
| Test sequence at<br><b>Registered Capacity</b> 40-60%                                                                                                                                                                 | Measured<br><b>Active Power</b><br>Output (kW) | Frequency<br>(Hz) | Calculated<br>droop (%) | Primary<br>Power<br>Source         | <b>Active Power</b><br>Gradient |     |
| Step a) 50.00 Hz ±0.01 Hz                                                                                                                                                                                             | 14.85                                          | 50.00             | -                       | Photovoltaic<br>array<br>simulator | -                               |     |
| Step b) 50.45 Hz ±0.05 Hz                                                                                                                                                                                             | 14.64                                          | 50.45             | 9.48                    |                                    | -                               |     |
| Step c) 50.70 Hz ±0.10 Hz                                                                                                                                                                                             | 13.16                                          | 50.70             | 10.00                   |                                    | -                               |     |

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|                                |       |       |       |  |   |
|--------------------------------|-------|-------|-------|--|---|
| Step d) 51.15 Hz $\pm$ 0.05 Hz | 10.49 | 51.15 | 10.05 |  | - |
| Step e) 50.70 Hz $\pm$ 0.10 Hz | 13.15 | 50.70 | 9.98  |  | - |
| Step f) 50.45 Hz $\pm$ 0.05 Hz | 14.64 | 50.45 | 9.58  |  | - |
| Step g) 50.00 Hz $\pm$ 0.01 Hz | 14.86 | 50.00 | -     |  | - |

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  $\pm$  0.05 Hz. The allowed tolerance for Active Power output measurement shall be  $\pm$ 10% of the required change in Active Power.

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%**.

| 10. Protection – Re-connection timer                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                                                                                                              |                                                                                                |                 | P               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------|-----------------|
| Model: EF HD-P3-29K9-S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |                                                                                                              |                                                                                                |                 |                 |
| 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. 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 <b>Power Generating Module</b> 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. |                                                                                                |                 |                 |
| 60 s                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 109.7 s        | At 1.16 pu (266.2 V <b>LV</b> connection, 127.6 V <b>HV</b> connection assuming 110 V ph-ph VT)              | At 0.78 pu (180.0 V <b>LV</b> connection, 85.8 V <b>HV</b> connection assuming 110 V ph-ph VT) | At 47.4 Hz      | At 52.1 Hz      |
| Confirmation that the <b>Power Generating Module</b> does not re-connect.                                                                                                                                                                                                                                                                                                                                                                                                                        |                | No reconnection                                                                                              | No reconnection                                                                                | No reconnection | No reconnection |

| 11. Fault level contribution:                                                                                                                                |       |      | P |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|---|
| These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5. Please complete each entry, even if the contribution to the fault level is zero. |       |      |   |
| Model: EF HD-P3-29K9-S1                                                                                                                                      |       |      |   |
| For Inverter output L1                                                                                                                                       |       |      |   |
| Time after fault                                                                                                                                             | Volts | Amps |   |

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|                        |       |            |
|------------------------|-------|------------|
| 20ms                   | 92.8  | 0.02       |
| 100ms                  | 62.0  | 0          |
| 250ms                  | 1.8   | 0.01       |
| 500ms                  | 0.7   | 0.02       |
| Time to trip           | 0.010 | In seconds |
| For Inverter output L2 |       |            |
| Time after fault       | Volts | Amps       |
| 20ms                   | 92.4  | 0.03       |
| 100ms                  | 50.3  | 0.02       |
| 250ms                  | 1.3   | 0.02       |
| 500ms                  | 0.9   | 0.01       |
| Time to trip           | 0.009 | In seconds |
| For Inverter output L3 |       |            |
| Time after fault       | Volts | Amps       |
| 20ms                   | 307.5 | 0.02       |
| 100ms                  | 326.7 | 0.01       |
| 250ms                  | 46.7  | 0.02       |
| 500ms                  | 25.2  | 0.01       |
| Time to trip           | 0.006 | In seconds |

## 12. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.6.

It has been verified that in the event of the solid state switching device failing to disconnect the **Power Park Module**, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.

Yes

## 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)

N/A

## 14. Logic interface (input port).

Confirm that an input port is provided and can be used to shut down the module.

Yes

Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used)

N/A

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|                      |
|----------------------|
| Additional comments. |
| N/A                  |

| 15. Cyber security                                                                                                                  |     |
|-------------------------------------------------------------------------------------------------------------------------------------|-----|
| Confirm that the <b>Power Generating Module</b> has been designed to comply with cyber security requirements, as detailed in 9.1.7. | Yes |

---

End