


ENA G59/3 TYPE VERIFICATION TEST REPORT



| Type approval and manufacturer/supplier declaration of compliance with the requirements of Engineering Recommendation G59/3. | | | |
|--|---|-----------------|--|
| Generating Unit Type reference number | 7530-2 | | |
| Generating Unit Type | SolarMax 8MT2 | | |
| Generating Unit technology | PV inverter | | |
| System Supplier name | SolarMax Produktions GmbH | | |
| Address | Zur Schönhalde 10, D-89352 Ellzee | | |
| Tel | +49 37 33 50 78 4 0 | Fax | +49 37 33 50 78 4 99 |
| Email | info@solarmax.com | Web site | www.solarmax.com |
| Connection option | | | |
| - | kW single phase, single, split or three phase system | | |
| 8 | kW three phase | | |
| - | kW two phases in three phase system | | |
| - | kW two phases split phase system | | |
| <p>System/supplier declaration.</p> <p>I certify on behalf of the company named above as a manufacturer/supplier of a Generating Unit, that all products manufactured/supplied by the company with the above Type reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of G59/3.</p> | | | |
| Signed | Anton Spengler  | On behalf of | SolarMax Produktions GmbH Zur Schönhalde 10 D-89352 Ellzee +49 37 33 50 78 4 0 +49 37 33 50 78 4 99 |

GENERATING UNIT TESTED TO EN 61000-3-2

| SSEG rating per phase (rpp): 2 kW | | | | | NV=MV*3.68/rpp | |
|-----------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------------|---|
| Harmonic | At 45-55% of rated output | | 100% of rated output | | Limit in BS EN 61000-3-2 in Amps | Higher limit for odd harmonics 21 and above |
| | Measured Value (MV) in Amps | Measured Value (NV) in Amps | Measured Value (MV) in Amps | Measured Value (NV) in Amps | | |
| 2 | 0.030 | 0.041 | 0.028 | 0.039 | 1.080 | |
| 3 | 0.018 | 0.025 | 0.022 | 0.030 | 2.300 | |
| 4 | 0.008 | 0.010 | 0.013 | 0.018 | 0.430 | |
| 5 | 0.044 | 0.061 | 0.190 | 0.262 | 1.140 | |
| 6 | 0.008 | 0.010 | 0.011 | 0.016 | 0.300 | |
| 7 | 0.076 | 0.105 | 0.113 | 0.156 | 0.770 | |
| 8 | 0.008 | 0.011 | 0.016 | 0.021 | 0.230 | |
| 9 | 0.019 | 0.026 | 0.015 | 0.021 | 0.400 | |
| 10 | 0.008 | 0.011 | 0.015 | 0.020 | 0.184 | |
| 11 | 0.049 | 0.068 | 0.075 | 0.103 | 0.330 | |
| 12 | 0.008 | 0.011 | 0.013 | 0.017 | 0.153 | |
| 13 | 0.020 | 0.028 | 0.079 | 0.109 | 0.210 | |
| 14 | 0.009 | 0.012 | 0.016 | 0.021 | 0.131 | |
| 15 | 0.037 | 0.051 | 0.020 | 0.027 | 0.150 | |
| 16 | 0.009 | 0.012 | 0.016 | 0.022 | 0.115 | |
| 17 | 0.044 | 0.061 | 0.044 | 0.061 | 0.132 | |
| 18 | 0.009 | 0.012 | 0.021 | 0.029 | 0.102 | |
| 19 | 0.025 | 0.034 | 0.039 | 0.054 | 0.118 | |
| 20 | 0.009 | 0.012 | 0.015 | 0.021 | 0.092 | |
| 21 | 0.025 | 0.034 | 0.015 | 0.021 | 0.107 | 0.160 |
| 22 | 0.012 | 0.016 | 0.016 | 0.021 | 0.084 | |
| 23 | 0.025 | 0.034 | 0.029 | 0.041 | 0.098 | 0.147 |
| 24 | 0.017 | 0.023 | 0.012 | 0.016 | 0.077 | |
| 25 | 0.015 | 0.021 | 0.035 | 0.048 | 0.090 | 0.135 |

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|-----------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------------|---|
| Harmonic | At 45-55% of rated output | | 100% of rated output | | Limit in BS EN 61000-3-2 in Amps | Higher limit for odd harmonics 21 and above |
| | Measured Value (MV) in Amps | Measured Value (NV) in Amps | Measured Value (MV) in Amps | Measured Value (NV) in Amps | | |
| 26 | 0.007 | 0.009 | 0.011 | 0.016 | 0.071 | |
| 27 | 0.013 | 0.018 | 0.010 | 0.014 | 0.083 | 0.124 |
| 28 | 0.006 | 0.008 | 0.009 | 0.013 | 0.066 | |
| 29 | 0.017 | 0.023 | 0.024 | 0.033 | 0.078 | 0.117 |
| 30 | 0.006 | 0.008 | 0.007 | 0.010 | 0.061 | |
| 31 | 0.013 | 0.017 | 0.022 | 0.030 | 0.073 | 0.109 |
| 32 | 0.006 | 0.008 | 0.009 | 0.013 | 0.058 | |
| 33 | 0.013 | 0.018 | 0.009 | 0.012 | 0.068 | 0.102 |
| 34 | 0.005 | 0.006 | 0.008 | 0.011 | 0.054 | |
| 35 | 0.010 | 0.013 | 0.013 | 0.018 | 0.064 | 0.096 |
| 36 | 0.006 | 0.008 | 0.006 | 0.008 | 0.051 | |
| 37 | 0.009 | 0.012 | 0.010 | 0.014 | 0.061 | 0.091 |
| 38 | 0.005 | 0.007 | 0.006 | 0.008 | 0.048 | |
| 39 | 0.009 | 0.013 | 0.006 | 0.009 | 0.058 | 0.087 |
| 40 | 0.006 | 0.008 | 0.005 | 0.007 | 0.046 | |

POWER QUALITY – VOLTAGE FLUCTUATIONS

| | Starting | | | Stopping | | | Running | |
|--|-----------|-------|-----------|-----------|-------|-----------|----------|------------------|
| | d_{max} | d_c | $d_{(t)}$ | d_{max} | d_c | $d_{(t)}$ | P_{st} | P_{It} 2 hours |
| Measured values at test impedance | 1.40 | 1.34 | 0.00 | 0.89 | 0.83 | 0.00 | 0.03 | 0.03 |
| Normalised to standard impedance | 1.40 | 1.34 | 0.00 | 0.89 | 0.083 | 0.00 | 0.03 | 0.03 |
| Normalised to required maximum impedance | 3.45 | 3.30 | 0.00 | 2.19 | 2.04 | 0.00 | 0.07 | 0.07 |
| Limits set under EN 61000-3-11 | 4.00 | 3.30 | 3.30 | 4.00 | 3.30 | 3.30 | 1.00 | 0.65 |
| | | | | | | | | |
| Test Impedance | R | 0.24 | Ω | XI | 0.15 | Ω | | |
| Standard Impedance | R | 0.24 | Ω | XI | 0.15 | Ω | | |
| Maximum Impedance | R | 0.59 | Ω | XI | 0.37 | Ω | | |

POWER QUALITY – DC INJECTION

| | | | |
|--------------------------|--------|--------|--------|
| Test power level | 10 % | 55 % | 100 % |
| Recorded value | 1 mA | 1 mA | 1 mA |
| as % of rated AC current | 0.0083 | 0.0083 | 0.0083 |
| Limit | 0.25 % | 0.25 % | 0.25 % |

POWER QUALITY – POWER FACTOR

| | 216.2 V | 230 V | 253 V |
|----------------|---------|-------|-------|
| Measured Value | 1.00 | 1.00 | 1.00 |
| Limit | >0.95 | >0.95 | >0.95 |

PROTECTION – FREQUENCY TESTS

| 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 | 47.49 Hz | 20.49 s | 47.7 Hz 25 s | Yes |
| U/F stage 2 | 47 Hz | 0.5 s | 47.00 Hz | 0.99 s | 47.2 Hz 19.98 s | Yes |
| | | | | | 46.8 Hz 0.48 s | Yes |
| O/F stage 1 | 51.5 Hz | 90 s | 51.51 Hz | 90.47 s | 51.3 Hz 95 s | Yes |
| O/F stage 2 | 52 Hz | 0.5 s | 52.01 Hz | 0.98 s | 51.8 Hz 89.98 s | Yes |
| | | | | | 52.2 Hz 0.48 s | Yes |

PROTECTION – VOLTAGE TESTS

| Function | Setting | | Trip test | | "No trip tests" | |
|-------------|---------|------------|-----------|------------|-------------------|-----------------|
| | Voltage | Time delay | Voltage | Time delay | Voltage/time | Confirm no trip |
| U/V stage 1 | 200.1 V | 2.5 s | 198.7 V | 2.98 s | 204.1 V 3.5 s | Yes |
| U/V stage 2 | 184 V | 0.5 s | 182.8 V | 0.99 s | 188 V 2.48 s | Yes |
| | | | | | 180 V 0.48 s | Yes |
| O/V stage 1 | 262.2 V | 1.0 s | 261.7 V | 1.49 s | 258.2 V 2.0 s | Yes |
| O/V stage 2 | 273.7 V | 0.5 s | 273.0 V | 0.97 s | 269.7 V 0.98 s | Yes |
| | | | | | 277.7 V 0.48 s | Yes |

PROTECTION – LOSS OF MAINS TEST

| Test Power | 10 % | 55 % | 100 % | 10 % | 55 % | 100 % |
|------------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Balancing load on islanded network | 95 % of Generating Unit output | 95 % of Generating Unit output | 95 % of Generating Unit output | 105 % of Generating Unit output | 105 % of Generating Unit output | 105 % of Generating Unit output |
| Trip time. Limit is 0.5 seconds | 0.06 s | 0.07 s | 0.08 s | 0.08 s | 0.07 s | 0.10 s |
| Single phase test | Ph1 removed - confirm trip: | Yes | Ph2 removed - confirm trip: | Yes | Ph3 removed - confirm trip: | Yes |

PROTECTION – FREQUENCY CHANGE STABILITY TEST

| | Start Frequency | Change | End Frequency | Confirm no trip |
|--------------------------|-----------------|---------------|---------------|-----------------|
| Positive Vector Shift | 49.5 Hz | +9 degrees | | Yes |
| Negative Vector Shift | 50.5 Hz | - 9 degrees | | Yes |
| Positive Frequency drift | 49.5 Hz | +0.19 Hz/sec | 51.5 Hz | Yes |
| Negative Frequency drift | 50.5 Hz | - 0.19 Hz/sec | 47.5 Hz | Yes |

PROTECTION – RE-CONNECTION TIMER

| Time delay setting | Measured delay | | | | |
|--|----------------|------------|------------|------------|------------|
| 20 s | 30 s | At 266.2 V | At 196.1 V | At 47.4 Hz | At 51.6 Hz |
| Confirmation that the Generating Unit does not re-connect: | | Yes | Yes | Yes | Yes |

FAULT LEVEL CONTRIBUTION

| Time after fault | Volts (Peak) | Amps (Peak) |
|------------------|--------------|-------------|
| 20 ms | 140 | 37.4 |
| 100 ms | 0 | 0 |
| 250 ms | 0 | 0 |
| 500 ms | 0 | 0 |
| Time to trip | 0.05 | In seconds |

SELF MONITORING SOLID STATE SWITCHING

| | Yes/or NA |
|---|-----------|
| It has been verified that in the event of the solid state switching device failing to disconnect the Generating Unit, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 seconds. | NA |