

Certificate

UK-G59 issue 3


This Type Test sheet shall be used to record the results of the type testing of Generating unit between 16A per phase and 17kW per phase maximum output at 230V(17kW limit single phase, 34kW limit split phase, 50kW limit 3 phase)
It include the Generating Units supplier declaration of compliance with the requirements of Engineering Recommendation G59/3

| | | | |
|------------------------------|--|----------|--|
| Type Tested reference number | Eversol TLC10K | | |
| Generating Unit technology | Photovoltaic Inverter | | |
| System Supplier name | Jiangsu Zeversolar New Energy CO., LTD. | | |
| Address | No. 198 Xiangyang Road, Suzhou, 215011 China | | |
| Tel | +86 512 6937 0998 | Fax | +86 512 6937 0630 |
| E:mail | service.china@zeversolar.com | Web site | www.zeversolar.com |

| | | |
|-------------------------|-------------------|--|
| Maximum export capacity | Connection Option | |
| | N/A | kW single phase, single, split or three phase system |
| | 10.0 | kW three phase (Eversol TLC10K) |
| | N/A | kW two phases in three phase system |
| | N/A | kW two phases split phase system |

System supplier declaration.

I certify on behalf of the company named above as a supplier of a Generating unit, that all products supplied by the company with the above Type Test 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.

| | | | |
|--------|---|--------------|---|
| Signed |  | On behalf of | Jiangsu Zeversolar New Energy CO., LTD. |
|--------|---|--------------|---|

The result of the G59/3 tests are summarized in this certificate.

Zeversolar declares that the units installed in UK market and set for G59/3 operations are characterized by the following features:

- The internal specification and parameters are set to be compliant with: Engineering Recommendation G59 issue 3, September 2013
- These parameters can't be changed by user, an installer or by any person other than Zeversolar (password protected)

POWER QUALITY

Harmonic current emissions as per BS EN 61000-3-2

These tests should be carried out as specified in BS EN61000-3-2. The test should be undertaken with a fixed source of energy at two power level a) between 45 and 55% and b) at 100% of maximum export capacity. The result need to comply with the limits of table 1 of BS EN 61000-3-2.

The Generating Units meeting the requirement of BS EN 61000-3-2 will need no further assessment with regards to harmonics according to G59/3.

| SSEG rating per phase (rpp) | | 3.33 | KW | |
|-----------------------------|-----------------------------|-----------------------------|----------------------------------|---|
| Harmonic | At 45-55% of rated output | 100% of rated output | | |
| | Measured Value (MV) in Amps | Measured Value (MV) in Amps | Limit in BS EN 61000-3-2 in Amps | Higher limit for odd harmonics 21 and above |
| 2 | 0.052 | 0.026 | 1.080 | |
| 3 | 0.020 | 0.022 | 2.300 | |
| 4 | 0.011 | 0.015 | 0.430 | |
| 5 | 0.100 | 0.119 | 1.140 | |
| 6 | 0.014 | 0.009 | 0.300 | |
| 7 | 0.049 | 0.095 | 0.770 | |
| 8 | 0.051 | 0.020 | 0.230 | |
| 9 | 0.012 | 0.012 | 0.400 | |
| 10 | 0.048 | 0.019 | 0.184 | |
| 11 | 0.036 | 0.074 | 0.330 | |
| 12 | 0.011 | 0.009 | 0.153 | |
| 13 | 0.031 | 0.074 | 0.210 | |
| 14 | 0.015 | 0.014 | 0.131 | |
| 15 | 0.009 | 0.010 | 0.150 | |
| 16 | 0.011 | 0.017 | 0.115 | |
| 17 | 0.024 | 0.062 | 0.132 | |
| 18 | 0.008 | 0.010 | 0.102 | |
| 19 | 0.029 | 0.064 | 0.118 | |
| 20 | 0.008 | 0.012 | 0.092 | |
| 21 | 0.010 | 0.009 | 0.107 | 0.160 |
| 22 | 0.010 | 0.009 | 0.084 | |
| 23 | 0.031 | 0.050 | 0.098 | 0.147 |
| 24 | 0.011 | 0.009 | 0.077 | |
| 25 | 0.034 | 0.049 | 0.090 | 0.135 |
| 26 | 0.010 | 0.007 | 0.071 | |
| 27 | 0.008 | 0.010 | 0.083 | 0.124 |
| 28 | 0.009 | 0.011 | 0.066 | |
| 29 | 0.021 | 0.03 | 0.078 | 0.117 |
| 30 | 0.008 | 0.009 | 0.061 | |
| 31 | 0.024 | 0.023 | 0.073 | 0.109 |
| 32 | 0.010 | 0.008 | 0.058 | |

| | | | | |
|----|-------|-------|-------|-------|
| 33 | 0.010 | 0.010 | 0.068 | 0.102 |
| 34 | 0.011 | 0.011 | 0.054 | |
| 35 | 0.028 | 0.008 | 0.064 | 0.096 |
| 36 | 0.009 | 0.009 | 0.051 | |
| 37 | 0.033 | 0.013 | 0.061 | 0.091 |
| 38 | 0.009 | 0.010 | 0.048 | |
| 39 | 0.012 | 0.008 | 0.058 | 0.087 |
| 40 | 0.008 | 0.011 | 0.046 | |

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

Voltage Fluctuations and Flicker as per BS EN 61000-3-3

The Generating Units meeting the requirement of BS EN 61000-3-3 can be stated as an alternative and there is no need to specify the maximum supply impedance according to G59/3.

| | Starting | | | Stopping | | | Running | |
|--|--------------------------------------|--------|---------------|---------------|-------|---------------|------------|-------------|
| | dmax | dc | d(t) | dmax | dc | d(t) | Pst | Plt 2 hours |
| Measured Values | 1.03% | 0.51% | 1.10% | 0.81% | 0.84% | 0.82% | 0.248 | 0.222 |
| Normalised to standard impedance and 3.68kW for multiple units | 1.14 % | 0.57 % | 1.22 % | 0.90 % | 0.93% | 0.91 % | 0.278 | 0.249 |
| Limits set under BS EN 61000-3-2 | 4% | 3.3% | 3.3% 500ms | 4% | 3.3% | 3.3% 500ms | 1.0 | 0.65 |
| Test start date | 2014.06.03 | | | Test end date | | | 2014.06.03 | |
| Test location | Audix Technology (Wujiang) Co., Ltd. | | | | | | | |

| | DC injection | | | Power factor * | | |
|--------------------------|--------------|--------|--------|----------------|-------|-------|
| | 10% | 55% | 100% | 216.2 V | 230 V | 253 V |
| Recorded value in Amps | 28.2mA | 32.5mA | 31.3mA | 0.995 | 0.997 | 0.998 |
| as % of rated AC current | 0.19% | 0.22% | 0.22% | - | - | - |
| Limit | 0.25% | 0.25% | 0.25% | >0.95 | >0.95 | >0.95 |

* Measured at three voltage levels and at full output. The voltage was maintained within $\pm 1.5\%$ of the stated level during the test.

PROTECTION

| Frequency tests | | | | | | |
|-----------------|-----------|------------|-----------|------------|-----------------|-----------------|
| Function | Setting | | Trip test | | "No trip tests" | |
| | Frequency | Time delay | Frequency | Time delay | Frequency/time | Confirm no trip |
| O/F Stage 1 | 51.5 Hz | 90.0s | 51.52Hz | 90.01s | 51.3Hz/95s | No trip |
| O/F Stage 2 | 52.0 Hz | 0.5s | 52.01Hz | 0.51s | 51.8Hz/89.98s | No trip |

| | | | | | | |
|-------------|--------|------|---------|--------|---------------|---------|
| | | | | | 52.2Hz/0.48s | No trip |
| U/F Stage 1 | 47.5Hz | 20s | 47.50Hz | 20.03s | 47.7Hz/25s | No trip |
| U/F Stage 2 | 47.0Hz | 0.5s | 47.01Hz | 0.53s | 47.2Hz/19.98s | No trip |
| | | | | | 46.8Hz/0.48s | No trip |

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

Voltage tests

| Function | Setting | | Trip test | | "No trip tests" | |
|-------------------|---------|------------|-----------|------------|-----------------|-----------------|
| | Voltage | Time delay | Voltage | Time delay | Voltage/time | Confirm no trip |
| O/V Stage 1 L1 | 262.2V | 1.0s | 262.7V | 1.02s | 258.2V/2.0s | No trip |
| O/V Stage 1 L2 | 262.2V | 1.0s | 261.8V | 1.03s | 258.2V/2.0s | No trip |
| O/V Stage 1 L3 | 262.2V | 1.0s | 263.1V | 1.02s | 258.2V/2.0s | No trip |
| O/V Stage 2 L1 | 273.7V | 0.5s | 274.8V | 0.52s | 269.7V/0.98s | No trip |
| O/V Stage 2 L2 | 273.7V | 0.5s | 274.1V | 0.52s | 269.7V/0.98s | No trip |
| O/V Stage 2 L3 | 273.7V | 0.5s | 275.1V | 0.53s | 269.7V/0.98s | No trip |
| L1 | | | | | 277.7V/0.48s | No trip |
| L2 | | | | | 277.7V/0.48s | No trip |
| L3 | | | | | 277.7V/0.48s | No trip |
| U/V Stage 1 L1 | 200.1V | 2.5s | 199.5V | 2.52s | 204.1V/3.5s | No trip |
| U/V Stage 1 L2 | 200.1V | 2.5s | 198.9V | 2.51s | 204.1V/3.5s | No trip |
| U/V Stage 1 L3 | 200.1V | 2.5s | 200.0V | 2.52s | 204.1V/3.5s | No trip |
| U/V Stage 2 L1 | 184.0V | 0.5s | 184.3V | 0.51s | 188V/2.48s | No trip |
| U/V Stage 2 L2 | 184.0V | 0.5s | 182.8V | 0.50s | 188V/2.48s | No trip |
| U/V Stage 2 L3 | 184.0V | 0.5s | 183.8V | 0.51s | 188V/2.48s | No trip |
| L1 | | | | | 180V/0.48s | No trip |
| L2 | | | | | 180V/0.48s | No trip |
| L3 | | | | | 180V/0.48s | No trip |

Note. For Voltage tests the Voltage required to trip is the setting ± 3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting

±4V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Loss of Mains test

Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.

| | | | | | | |
|------------------------------------|------------------|------------------|-----------------|------------------|------------------|------------------|
| Test Power | 33% | 66% | 100% | 33% | 66% | 100% |
| Balancing load on islanded network | 33% | 66% | 100% | 33% | 66% | 100% |
| | -5% Q Test 22 | -5% Q Test 12 | -5% P Test 5 | +5% Q Test 31 | +5% Q Test 21 | +5% P Test 10 |
| Trip time. Limit is 0.5 seconds | 0.38s | 0.44s | 0.37s | 0.40s | 0.35s | 0.28s |

Single phase test for multi phase Generating units. Confirm that when generating in parallel with a network operating at around 50Hz with no network disturbance, that the removal of a single phase connection to the Generating Unit, with the remaining phases connected causes a disconnection of the generating unit within a maximum of 1s.

| | | | | | |
|-------------|--------------|-------------|--------------|-------------|--------------|
| | Confirm Trip | | Confirm Trip | | Confirm Trip |
| Ph1 removed | 0.43s | Ph2 removed | 0.38s | Ph3 removed | 0.41s |

Frequency change, Stability test

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

Re-connection timer

Test should prove that the reconnection sequence starts after a minimum delay of 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1.

| | | | | | |
|--|----------------|--|--------------|--------------|--------------|
| Time delay setting | Measured delay | Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 10.5.7.1. | | | |
| 30s | 30s | At 266.2V | At 196.1V | At 47.4Hz | At 51.6Hz |
| Confirmation that the SSEG does not reconnect. | | No reconnect | No reconnect | No reconnect | No reconnect |

FAULT LEVEL CONTRIBUTION

| For machines with electro-magnetic output | | | For Inverter output | | |
|--|--------|-------|---------------------|-------|--------|
| Parameter | Symbol | Value | Time after fault | Volts | Amps |
| Peak Short Circuit current | i_p | - | 20ms | 126V | 7.737A |
| Initial Value of aperiodic current | A | - | 100ms | 66V | 4.057A |
| Initial symmetrical short-circuit current* | I_k | - | 250ms | 45V | 2.810A |

| | | | | | |
|--|----------|---|--------------|-------|------------|
| Decaying (aperiodic) component of short circuit current* | i_{DC} | - | 500ms | 29V | 2.249A |
| Reactance/Resistance Ratio of source* | X/R | - | Time to trip | 0.008 | In seconds |

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

*Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

SELF-MONITORING SOLID STATE SWITCHING

Not applicable as electro-mechanical relays are used.