

## TYPE TEST SHEET

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 requirements of Engineering Recommendation G59/3

|                                     |   |                 |  |
|-------------------------------------|---|-----------------|--|
| <b>Type Tested reference number</b> | Growatt 4000TL3   |                 |  |
| <b>Generating unit technology</b>   | Photovoltaic inverter   |                 |  |
| <b>System Supplier name</b>         | Shenzhen Growatt New Energy Co., Ltd  |                 |  |
| <b>Address</b>                      | 1st East & 3rd Floor, Jiayu Industrial Zone, Xibianling,Shangwu Village, Shiyan, Baoan District, Shenzhen,P.R.China |                 |  |
| <b>Tel.</b>                         | +86 755 2951 5888   | <b>Fax</b>      | +86 755 2747 2131  |
| <b>E:mail</b>                       | info@ginverter.com  | <b>Web site</b> | <a href="http://www.ginverter.com">www.ginverter.com</a> |

| <b>Maximum export capacity</b> | <b>Connection Option</b> |  |
|--------------------------------|--------------------------|--|
|                                | N/A                      | kW single phase, single, split or three phase system |
|                                | 40                       | kW three phase                                       |
|                                | 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.

|               |                   |                     |                                      |
|---------------|-------------------|---------------------|--------------------------------------|
| <b>Signed</b> | <i>James Wang</i> | <b>On behalf of</b> | Shenzhen Growatt New Energy Co., Ltd |
|---------------|-------------------|---------------------|--------------------------------------|

Note that testing can be done by the manufacturer of an individual component, by an external test house, or by the supplier of the complete system, or any combination of them as appropriate.

Where parts of the testing are carried out by persons or organizations other than the supplier then the supplier shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.

| Power Quality. Harmonics                          |                                    |                      |                                    |                        |  |               |
|---|------------------------------------|----------------------|------------------------------------|------------------------|--|---------------|
| Models: Growatt 40000TL3                          |                                    |                      |                                    |                        | Harmonic %=Measured Value (Amps) × 23/rating per phase (KVA) |               |
| Generating Unit rating per phase(rpp)             |                                    | 40000                | KVA                                |                        |  |               |
| Harmonic  | At45-55% of rated output           | 100% of rated output |                                    | Limit BS EN 61000-3-12 |  |               |
| <b>Average harmonic current results – Phase 1</b> |                                    |                      |                                    |                        |  |               |
|   | <b>Measured Value (MV) in Amps</b> | <b>%</b>             | <b>Measured Value (MV) in Amps</b> | <b>%</b>               | <b>Limit</b>   | <b>Result</b> |
| 1   | 24.341                             | 99.982               | 48.841                             | 99.990                 | -  |               |
| 2   | 0.041                              | 0.167                | 0.043                              | 0.088                  | 8.00%  | PASS          |
| 3   | 0.038                              | 0.157                | 0.057                              | 0.117                  | 21.60%   | PASS          |
| 4   | 0.037                              | 0.154                | 0.045                              | 0.091                  | 4.00%  | PASS          |
| 5   | 0.390                              | 1.604                | 0.558                              | 1.143                  | 10.70%   | PASS          |
| 6   | 0.013                              | 0.054                | 0.023                              | 0.048                  | 2.67%  | PASS          |
| 7   | 0.172                              | 0.705                | 0.300                              | 0.614                  | 7.20%  | PASS          |
| 8   | 0.035                              | 0.142                | 0.047                              | 0.097                  | 2.00%  | PASS          |
| 9   | 0.061                              | 0.250                | 0.052                              | 0.107                  | 3.80%  | PASS          |
| 10  | 0.023                              | 0.094                | 0.043                              | 0.088                  | 1.60%  | PASS          |
| 11  | 0.094                              | 0.385                | 0.210                              | 0.430                  | 3.10%  | PASS          |
| 12  | 0.010                              | 0.041                | 0.024                              | 0.049                  | 1.33%  | PASS          |
| 13  | 0.044                              | 0.181                | 0.092                              | 0.189                  | 2.00%  | PASS          |
| THD ( At 100% rated output )                      |                                    |                      | 1.412%                             |                        | 13%  | PASS          |
| <b>Average harmonic current results – Phase 2</b> |                                    |                      |                                    |                        |  |               |
|   | <b>Measured Value (MV) in Amps</b> | <b>%</b>             | <b>Measured Value (MV) in Amps</b> | <b>%</b>               | <b>Limit</b>   | <b>Result</b> |
| 1   | 24.047                             | 99.982               | 48.779                             | 99.990                 | -  |               |
| 2   | 0.051                              | 0.213                | 0.055                              | 0.113                  | 8.00%  | PASS          |
| 3   | 0.049                              | 0.205                | 0.041                              | 0.084                  | 21.60%   | PASS          |
| 4   | 0.023                              | 0.094                | 0.018                              | 0.036                  | 4.00%  | PASS          |
| 5   | 0.400                              | 1.663                | 0.579                              | 1.187                  | 10.70%   | PASS          |
| 6   | 0.010                              | 0.043                | 0.008                              | 0.016                  | 2.67%  | PASS          |
| 7   | 0.153                              | 0.636                | 0.280                              | 0.575                  | 7.20%  | PASS          |
| 8   | 0.020                              | 0.085                | 0.033                              | 0.068                  | 2.00%  | PASS          |
| 9   | 0.039                              | 0.161                | 0.029                              | 0.059                  | 3.80%  | PASS          |
| 10  | 0.013                              | 0.053                | 0.026                              | 0.054                  | 1.60%  | PASS          |
| 11  | 0.088                              | 0.364                | 0.211                              | 0.433                  | 3.10%  | PASS          |
| 12  | 0.007                              | 0.030                | 0.012                              | 0.025                  | 1.33%  | PASS          |
| 13  | 0.032                              | 0.131                | 0.088                              | 0.180                  | 2.00%  | PASS          |

| THD (At 100% rated output)                        |                             | 1.418% |                             | 13%    | PASS   |        |
|---|-----------------------------|--------|-----------------------------|--------|--------|--------|
| <b>Average harmonic current results – Phase 3</b> |                             |        |                             |        |        |        |
|   | Measured Value (MV) in Amps | %      | Measured Value (MV) in Amps | %      | Limit  | Result |
| 1   | 24.337                      | 99.982 | 49.072                      | 99.990 | -      |        |
| 2   | 0.051                       | 0.208  | 0.036                       | 0.074  | 8.00%  | PASS   |
| 3   | 0.069                       | 0.285  | 0.063                       | 0.129  | 21.60% | PASS   |
| 4   | 0.025                       | 0.102  | 0.030                       | 0.061  | 4.00%  | PASS   |
| 5   | 0.386                       | 1.584  | 0.562                       | 1.145  | 10.70% | PASS   |
| 6   | 0.020                       | 0.083  | 0.025                       | 0.050  | 2.67%  | PASS   |
| 7   | 0.197                       | 0.808  | 0.297                       | 0.606  | 7.20%  | PASS   |
| 8   | 0.018                       | 0.074  | 0.019                       | 0.039  | 2.00%  | PASS   |
| 9   | 0.025                       | 0.101  | 0.035                       | 0.071  | 3.80%  | PASS   |
| 10  | 0.016                       | 0.064  | 0.024                       | 0.049  | 1.60%  | PASS   |
| 11  | 0.091                       | 0.372  | 0.211                       | 0.429  | 3.10%  | PASS   |
| 12  | 0.008                       | 0.034  | 0.022                       | 0.045  | 1.33%  | PASS   |
| 13  | 0.041                       | 0.169  | 0.093                       | 0.190  | 2.00%  | PASS   |
| THD (At 100% rated output)                        |                             | 1.399% |                             | 13%    | PASS   |        |

| Power Quality. Voltage fluctuations and Flicker. |       |                                       |        |               |                                     |
|--|-------|---------------------------------------|--------|---------------|-------------------------------------|
| Models: Growatt 40000TL3                         |       | Measured Values at standard impedance |        |               | Limits set under<br>BS EN 61000-3-2 |
|  |       | L1                                    | L2     | L3            |                                     |
| Starting   | dmax  | 0.286%                                | 0.135% | 0.137%        | 4%                                  |
|  | dc    | 0.030%                                | 0.026% | 0.028%        | 3.30%                               |
|  | d(t)  | 0.000s                                | 0.000s | 0.000s        | 0.5s                                |
| Stopping   | dmax  | 0.286%                                | 0.135% | 0.137%        | 4%                                  |
|  | dc    | 0.030%                                | 0.026% | 0.028%        | 3.30%                               |
|  | d(t)  | 0.000s                                | 0.000s | 0.000s        | 0.5s                                |
| Running  | Pst   | 0.064                                 | 0.277  | 0.149         | 1                                   |
|  | Pit 2 | 0.028                                 | 0.121  | 0.065         | 0.65                                |
| Test start date                                  |       | 1.5.2015                              |        | Test end date |                                     |
|  |       |                                       |        | 1.5.2015      |                                     |
| Test location                                    |       | Growatt R&D Laboratories              |        |               |                                     |

| Power quality. DC injection and Power factor. |    |              |        |          |
|---|----|--------------|--------|----------|
| Test power level                              |    | DC injection |        |          |
|   |    | 10%          | 55%    | 100%     |
| Test Value                                    | L1 | 22mA         | 24.6mA | 24.2mA   |
|   | L2 | 29.6mA       | 28.3mA | 12.7mA   |
|   | L3 | 23.5mA       | 30.8mA | -0.24mA  |
| Limit(0.25% of rated AC current)              |    | 120mA        | 120mA  | 120mA    |
| Test power level                              |    | Power factor |        |          |
|   |    | 460.7Vac     | 480Vac | 497.1Vac |
| Test Value                                    |    | 0.997        | 0.998  | 0.998    |
| 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 stage1                   | 47.53Hz   | 20.09S     | 47.53Hz   | 20.195S    | 47.73Hz/25s     | No Trip         |
| U/F stage2                   | 47Hz      | 638.2ms    | 47.01Hz   | 743.6ms    | 47.2Hz/19.98s   | No Trip         |
|                              |           |            |           |            | 46.8Hz/0.48s    | No Trip         |
| O/F stage1                   | 51.47Hz   | 90.36S     | 51.47Hz   | 90.439S    | 51.27Hz/95s     | No Trip         |
| O/F stage2                   | 52Hz      | 575.7ms    | 52.01Hz   | 665.8ms    | 51.8Hz/89.98s   | No Trip         |
|                              |           |            |           |            | 52.2Hz/0.48s    | No Trip         |

Note. For frequency Trip tests the Frequency required to trip is the setting  $\pm 0.1\text{Hz}$ . 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  $\pm 0.2\text{Hz}$  and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

**Protection. Voltage tests.**

| Function   | Setting |            | Trip test |            | “No trip tests” |                 |
|------------|---------|------------|-----------|------------|-----------------|-----------------|
|            | Voltage | Time delay | Voltage   | Time delay | Voltage/time    | Confirm no trip |
| U/V stage1 | 417.4V  | 2.6S       | 417.24V   | 2.636S     | 421.4V/3.5s     | No Trip         |
| U/V stage2 | 383.8V  | 600ms      | 383.05V   | 620.65ms   | 387.8V/2.48s    | No Trip         |
|            |         |            |           |            | 379.8V/0.48s    | No Trip         |
| O/V stage1 | 546.7V  | 1.1S       | 546.10    | 1.115S     | 542.7V/2.0s     | No Trip         |
| O/V stage2 | 570.9V  | 600ms      | 570.69V   | 623.6ms    | 566.9V/0.98s    | No Trip         |
|            |         |            |           |            | 574.9V/0.48s    | No Trip         |

Note. For Voltage tests the Voltage required to trip is the setting  $\pm 3.45\text{V}$ . 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  $\pm 4\text{V}$  and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

**Protection. Loss of Mains test**

|                          |         |         |        |         |         |         |
|--------------------------|---------|---------|--------|---------|---------|---------|
| Test Power and imbalance | 33%     | 66%     | 100%   | 33%     | 66%     | 100%    |
|                          | -5%Q    | -5%Q    | -5%P   | +5%Q    | +5%Q    | +5%P    |
|                          | Test 22 | Test 12 | Test 5 | Test 31 | Test 21 | Test 10 |
| Trip time. Limit is 0.5s | 0.188s  | 0.140s  | 0.119s | 0.186s  | 0.132s  | 0.168s  |

**Protection. Frequency change, Stability test.**

|                          | Start Frequency | Change      | End Frequency | Confirm no trip |
|--------------------------|-----------------|-------------|---------------|-----------------|
| Positive Vector Shift    | 49.5Hz          | +9degrees   | --            | No trip         |
| Negative Vector Shift    | 50.5Hz          | -9degrees   | --            | No trip         |
| Positive Frequency drift | 49.5Hz          | +0.19Hz/sec | 51.47Hz       | No trip         |
| Negative Frequency drift | 50.5Hz          | -0.19Hz/sec | 47.53Hz       | No trip         |

**Protection. Re-connection timer.**

| 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 |                 |                 |                 |
|---|----------------|---|-----------------|-----------------|-----------------|
| 65s   | 71.8s          | At 550.7V   | At 413.4V       | At 47.43Hz      | At 51.57Hz      |
| Confirmation that the Generating Unit does not re-connect |                | No reconnection   | No reconnection | No reconnection | No reconnection |

| <b>Fault level contribution.</b>   |               |              |                            |              |             |
|--|---------------|--------------|----------------------------|--------------|-------------|
| <b>For machines with electro-magnetic output</b>   |               |              | <b>For Inverter Output</b> |              |             |
| <b>Parameter</b>   | <b>Symbol</b> | <b>Value</b> | <b>Time after fault</b>    | <b>Volts</b> | <b>Amps</b> |
| <b>Peak Short Circuit current</b>  | $i_p$         | --           | 20ms                       | 25.9V        | 1.02        |
| <b>Initial Value of aperiodic current</b>  | A             | --           | 100ms                      | 25.7V        | 0.99        |
| <b>Initial symmetrical short-circuit current</b>   | $I_k$         | --           | 250ms                      | 25.5V        | 0.96        |
| <b>Decaying component of short circuit current</b>   | $i_{DC}$      | --           | 500ms                      | 25.3V        | 0.94        |
| <b>Reactance/Resistance Ratio of source</b>  | X/R           | --           | Time to trip               | 20.8ms       | In seconds  |
| For rotating machines and linear piston machines the test should produce a 0s-2s plot of the sort circuit current as seen as the Generating Unit terminals |               |              |                            |              |             |