EQUIPMENT CERTIFICATE

Certificate No.:	Issued:	Valid until:	GCC class
TC-GCC-DNVGL-SE-0124-08049-0	2021-12-03	Unlimited	TC_I

Issued for:

PV Inverters MIN[2500-6000]TL-[XE/XH/XA] (PPM Type A)

With specifications and software version as listed in Annex 2

Issued to:

Shenzhen Growatt New Energy CO., Ltd.

4-13/F,Building A,Sino-German(Europe) Industrial Park,Hangcheng Ave,Bao'an District,Shenzhen,China postcode：518101

According to:

DNVGL-SE-0124, 2016-03: Certification of Grid Code Compliance

PTPiREE, 2021-04: Conditions and procedures for using certificates in the process of connecting power generating modules to power networks

32016R0631, 2016-04: Requirements for Generators (NC RfG)

PSE, 2018-12: Requirements of general application resulting from Commission Regulation (EU) 2016/631 of 14 April 2016

detailed in Annex 1

Based on the document:

CR-GCC-DNVGL-SE-0124-08049-A072-0 Network Code Requirements for a PGU of Type A - Poland, Certification Report, dated 2021-12-03

Further assessment information, including scope and conditions, is found in Annex 1. Description of the PV inverters and type tests performed is found in Annex 2 and Annex 3 respectively.

Hamburg, 2021-12-03

For DNV Renewables Certification

Bente Vestergaard
Director and Service Line Leader Type and Component Certification

DAkkS Deutsche Akkreditierungsstelle D-ZE-11053-01-00

By DAkkS according DIN EN IEC/ISO 17065 accredited Certification Body for products. The accreditation is valid for the fields of certification listed in the certificate.

Hamburg, 2021-12-03

For DNV Renewables Certification

i.A. L Ulvgård

Liselotte Ulvgård
Project Manager

EQUIPMENT CERTIFICATE – ANNEX 1

Conditions, assessment criteria and scope of assessment

Provided that the conditions listed in section 1 are considered at project level, the PV inverters as further specified in Annex 2 comply with the requirements within scope of this certification, as specified in section 3.

1 Conditions

- Changes of the system design, hardware or the software of the certified PV inverters are to be approved by DNV
- Inverter settings must finally be agreed and checked at project level to ensure grid code compliance, based on the requirements of relevant System Operator (SO). For the functionalities within scope of this certification, more information about the settings assessed is found in Control Settings in section 4.2 as well as the corresponding assessment sections 5.1-5.4 of the certification report CR-GCC-DNVGL-SE-0124-08049-A072-0.
- The capability of remote control has been shown on unit level but must finally be ensured at project level, considering any further requirements of relevant System Operator (SO) and the full communication network. For the functionalities within scope of this certification, this concerns remote cessation of active power and remote blocking and control of LFSM-O, as further describes in section 5.3 and 5.4 of the certification report CR-GCC-DNVGL-SE-0124-08049-A072-0.

2 Assessment criteria and normative references for this certificate:

/A/ Service Specification DNVGL-SE-0124: Certification of Grid Code Compliance, DNV GL, March 2016

/B/ Conditions and procedures for using certificates in the process of connecting power generating modules to power networks, Warunki i procedury wykorzystania certyfikatów w procesie przyłączenia modułów wytwarzania energii do sieci elektroenergetycznych, version 1.2, PTPiREE, dated 2021-04-28, (in the following: PTPiREE 2021-04)

/C/ Requirements of general application resulting from Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (NC RfG) – as approved by the decision of the President of the Energy Regulatory Office DRE.WOSE.7128.550.2.2018.ZJ dated January 2nd 2019, Wymogi ogólnego stosowania wynikające z Rozporządzenia Komisji (UE) 2016/631 z dnia 14 kwietnia 2016 r. ustanawiającego kodeks sieci dotyczący wymogów w zakresie przyłączenia jednostek wytwórczych do sieci (NC RfG), PSE S.A., dated 2018-12-18 zatwierdzone Decyzją Prezesa Urzędu Regulacji Energetyki DRE.WOSE.7128.550.2.2018.ZJ z dnia 2 stycznia 2019 r, (in the following: PSE 2018-12)

/D/ Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators, published in the Official Journal of the European Union L112/1, The European Comission, 27/04/2016. Document 32016R0631, (in the following: NC RfG)

3 Scope of assessment and results

The following functionalities have been assessed based on the rules for the use of equipment certificates for Power Park Modules (PPMs), as specified in chapter 7 and 9 of the PTPiREE 2021-04 /B/. The functions denoted “Not Applicable” in the table of chapter 7 has not been included.

Capability	NC RfG /D/	PSE 2018-12 /C/	Type A	Assessment result (*)
Frequency range	13.1 (a)	13.1 (a)(i)	x	Compliant
Rate of Change of Frequency (RoCoF) withstand capability, df/dt	13.1 (b)	13.1 (b)	x	Compliant
Remote cessation of active power	13.6	13.6	x	Compliant
Limited Frequency Sensitive Mode – Over Frequency (LFSM-O)	13.2	13.2 (a), (b), (f)	x	Compliant

(*) Please note also the corresponding conditions for compliance, as stated in section 1

EQUIPMENT CERTIFICATE – ANNEX 2

Schematic description and technical data of the generating units

1 Schematic description of the generating unit

The Growatt solar inverter family MIN[2500-6000]TL-[XE/XH/XA], consisting of: MIN 2500TL-XE, MIN 3000TL-XE, MIN 3600TL-XE, MIN 4200TL-XE, MIN 4600TL-XE, MIN 5000TL-XE, MIN 6000TL-XE, MIN 2500TL-XH, MIN 3000TL-XH, MIN 3600TL-XH, MIN 4200TL-XH, MIN 4600TL-XH, MIN 5000TL-XH, MIN 6000TL-XH, MIN 2500TL-XA, MIN 3000TL-XA, MIN 3600TL-XA, MIN 4200TL-XA, MIN 4600TL-XA, MIN 5000TL-XA, MIN 6000TL-XA convert electrical energy generated by photovoltaic modules (DC) and/or a battery into single phase alternating current (AC). The MIN TL -XE series consists of pure PV inverters, while the MIN TL -XH series have hybrid inverters, and the MIN TL XA series have pure battery inverters.

All inverter variants run at 280 V rated output voltage with a rated active power output of 2,5 kW to 6 kW. The different output power variants are achieved through derating via software. The hardware and software are the same in all variant except some modifications for battery connection on the input side of the battery and hybrid version. For this, there is an additional DC input for r battery in MIN TL-XH and MIN TL -XA series, which is not present in MIN TL-XE series. Meanwhile the MIN TL -XA series lacks the PV-input, since it's a pure battery inverter. There is no further difference in the hardware or firmware used, as stated by the manufacturer /6/.

The MIN TL -XH and MIN TL -XA series, which can be connected to a battery storage system, can operate in so called "charging mode" where they can charge the battery from the grid. Grid code capabilities when operating in this mode had not taken into consideration during assessment, since this is not covered by Polish regulations /C/ or NC RfG /D/

The electrical data of the generating unit is summarized in the following section.

2 Technical data of main components

Technical data of the main components of the MIN[2500-6000]TL-[XE/XH/XA] is given below, as provided in Manufacturer Information /6/.

2.1 General Specifications

Generating Unit	**MIN 2500TL-XE MIN 2500TL-XH MIN 2500TL-XA**	**MIN 3000TL-XE MIN 3000TL-XH MIN 3000TL-XA**	**MIN 3600TL-XE MIN 3600TL-XH MIN 3600TL-XA**	**MIN 4200TL-XE MIN 4200TL-XH MIN 4200TL-XA**
No. of phases	1	1	1	1
Rated apparent power	2500VA	3000VA	3600VA	4200VA
Rated active power	2500W	3000W	3600W	4200W
Rated AC-voltage	230Vac	230Vac	230Vac	230Vac
Rated frequency	50Hz	50Hz	50Hz	50Hz

Generating Unit	**MIN 4600TL-XE MIN 4600TL-XH MIN 4600TL-XA**	**MIN 5000TL-XE MIN 5000TL-XH MIN 5000TL-XA**	**MIN 6000TL-XE MIN 6000TL-XH MIN 6000TL-XA**
No. of phases	1	1	1
Rated apparent power	4600VA	5000VA	6000VA
Rated active power	4600W	5000W	6000W
Rated AC-voltage	230Vac	230Vac	230Vac
Rated frequency	50Hz	50Hz	50Hz

2.2 DC Input

Generating unit: **- PV inverters**	**MIN 2500TL-XE,** **MIN 3000TL-XE**	**MIN 3600TL-XE, MIN 4200TL-XE,** **MIN 4600TL-XE, MIN 5000TL-XE, MIN 6000TL-XE**
PV input:		
Min. MPPT voltage	70Vdc	70Vdc
Max. MPPT voltage	500Vdc	550Vdc
Max. DC input voltage	500Vdc	550Vdc
Max. DC input current	13,5A	13,5A
Generating unit: **- Hybrid inverters**	**MIN 2500TL-XH,** **MIN 3000TL-XH**	**MIN 3600TL-XH, MIN 4200TL-XH,** **MIN 4600TL-XH, MIN 5000TL-XH, MIN 6000TL-XH**
PV input:		
Min. MPPT voltage	70Vdc	70Vdc
Max. MPPT voltage	500Vdc	550Vdc
Max. DC input voltage	500Vdc	550Vdc
Max. DC input current	13,5A	13,5A
Battery input:		
Min. input/output voltage	360 Vdc	360 Vdc
Max. input/output voltage	500Vdc	550Vdc
Max. DC input current	17 A	17A
Generating unit: **- Battery inverters**	**MIN 2500TL-XA,** **MIN 3000TL-XA,**	**MIN 3600TL-XA, MIN 4200TL-XA,** **MIN 4600TL-XA, MIN 5000TL-XA, MIN 6000TL-XA**
Battery input:		
Min. input/output voltage	360 Vdc	360 Vdc
Max. input/output voltage	500Vdc	550Vdc
Max. DC input current	17 A	17A

2.3 Software Version

Firmware version	AL1.0
Software version	AL1.0

2.4 Unit transformer

The transformer is not part of the generating unit and consequently has not been part of the assessment.

2.6 Grid Protection

The protection is not part of certification scope

2.7 Control settings

The control interface allows for the selection of different parameter sets via Shinebus application or OLED screen interface. Shinebus allows to select the parameter set by setting the “S” bit in “Mode” field to 23 (Representing Poland). OLED interface allows to change the parameter set by setting the “Country/Area” or “Panstwo” (if Polish language is used) parameter to “Poland”. The parameter set provides default settings based on specific grid codes and national requirements. For this certification report the parameter set called “Poland” in the interface or “S23” in Shinebus app was assessed for the functionalities within scope of this certification.

EQUIPMENT CERTIFICATE – ANNEX 2

It should be noted that compliance can be achieved also with other parameter sets and control settings, but that changes to control settings will affect the inverter control behaviour which can thus affect compliance. It should be noted the final settings must be agreed on project level in agreement with relevant system operator.

Protection settings has not been part of the assessment. Since these could intervene with and affect the compliance of the assessed functionalities, this must be further assessed at project level.

EQUIPMENT CERTIFICATE – ANNEX 3

Type tests

1 Type tests

Tests were performed between 2021-07-12 and 2021-07-14 in the Growatt lab, Suzhou (P.R. China).

The tests were performed according to a tailor made test plan issued by DNV Renewable Certification, since there is no standard test guideline for Polish requirements. The test plan was based on the Polish Network Code requirements as presented in Section 2 Annex 1.

All tests were performed under ISO-17025 accreditation and they were performed on the MIN 6000TL-XH and MIN 6000TL-XE units. Full scope of tests, as described in the test plan was performed on MIN 6000TL-XH, which is hybrid type inverter, while LFSM-O tests were repeated on MIN 6000TL-XE.

The results used for assessment are documented in the measurement report(s) as specified below:

Scope	Reference
Frequency range	3.1.1 and 3.1.2 of /1/
Rate of Change of Frequency (RoCoF) withstand capability, df/dt	3.2 of /1/
Remote cessation of active power	3.3 of /1/
Limited Frequency Sensitive Mode – over frequency (LFSM-O)	3.4 and 3.5 of /1/

Test report(s)	Document number	Content
/1/	*10298225-TR-01-A*	Measurement of power control characteristics of PV inverters of the type MIN 6000TL-XH and MIN 6000TL-XE according to FGW TG3 Rev. 25 and Polish Grid Code

The tests results have been assessed against the requirements of PSE 2018-12 /C/ and NC RfG /D/. Further details are described in the corresponding certification report CR-GCC-DNVGL-SE-0124-08049-A072-0.