

## Compatibility of inverters to thinfilm and special module technologies

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Due to the growing number of new module technologies (e.g. thin-film technology), it is becoming increasingly important to take special module and inverter features into account during the planning phase for a solar system. This document provides information on known restrictions and suitable combinations. On the last page you will find a list of combinations that have been approved by module manufacturers.

### Inverters from Sunways AG

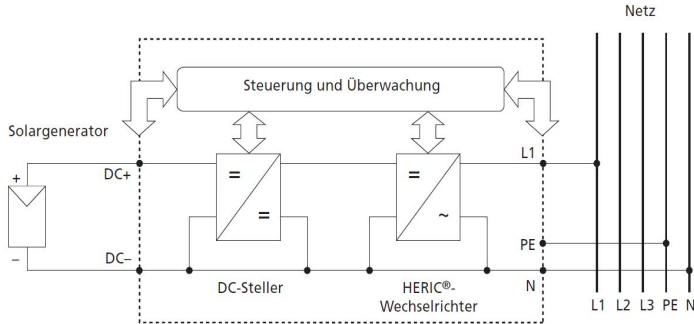
A key factor for deciding whether certain solar modules may be operated with a particular inverter is the voltage curve between the solar generator poles and the earth potential. This voltage curve is determined by the inverter circuitry. The following section contains a description of the individual inverter topologies including block diagrams and solar generator voltage curves.



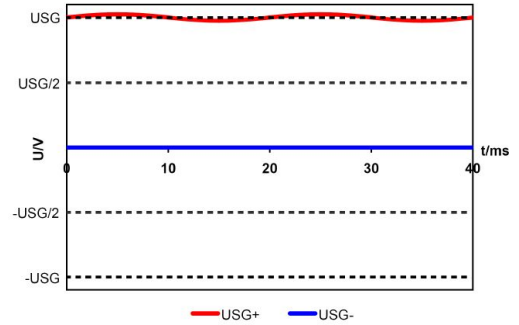
### AT series

Consisting of a DC actuator with downstream HERIC inverter. The negative pole of the solar generator is connected to mains N. Single-phase feed, single-phase mains monitoring.

#### block diagram



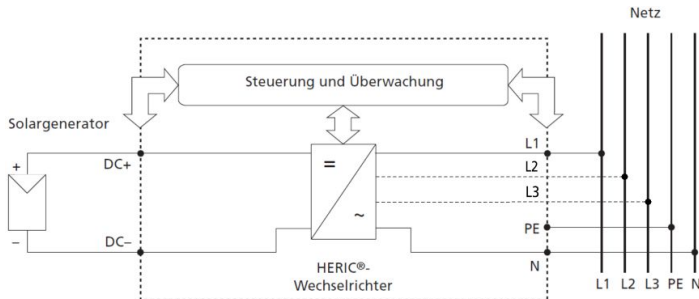
#### Voltage curve



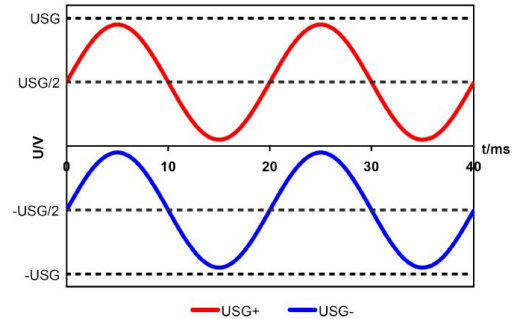
### NT-series

Consisting of a direct feed HERIC inverter. The Solar Inverters NT 2500, NT 3700, NT 4200 and NT 5000 have a single-phase feed-in and monitoring. The Solar Inverters NT 10000, NT 11000 and NT 12 000 consist of three independently controlled inverters, with each power unit feeding to a separate phase. The grid voltage monitoring of these devices is three-phase.

#### block diagram



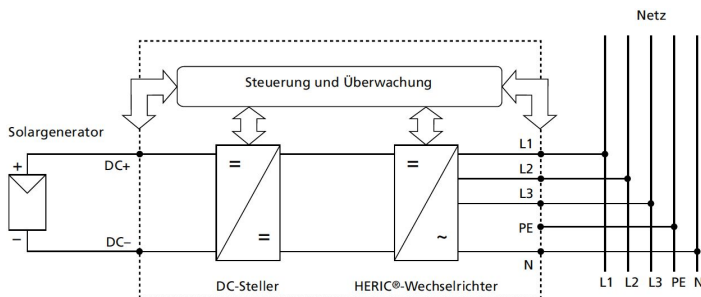
#### Voltage curve



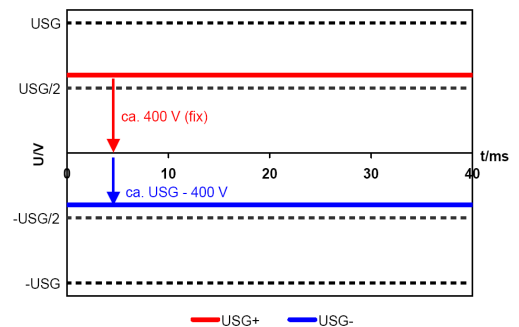
### PT-series

Consisting of a DC actuator with downstream HERIC inverter. The positive pole of the solar generator is always fixed at approx. 400 V. The voltage of the negative pole depends on the solar generator voltage (system voltage). Three-phase, symmetric feed, three-phase mains monitoring.

#### Block diagram



#### Voltage curve



## Compatibility of inverter to solar module

If you are planning a PV system please ask your module manufacturer for the required solar generator voltage curve. Then determine the possible applications based on the following information.

This section describes the different module technologies and the associated inverter requirements. A distinction can be made between five basic cases:

- 1.) Conventional silicon-based solar modules generally have no special inverter requirements. In this case any Sunways solar inverters can be used.
- 2.) In some thin-film or silicon modules the output may be reduced when negative voltages are present on the solar generator. Depending on the module technology, this degradation can be permanent or reversible. Modules of this type require earthing of the negative solar generator pole, as is the case in the AT series.
- 3.) With Sunpower cell technology reversible power degradation may occur as a result of positive solar generator voltages. Modules with this cell type require earthing of the positive solar generator pole. In this case a positively earthed transformer unit should be used. Sunways AG currently does not offer a suitable inverter for this configuration.
- 4.) Certain solar modules generate high leakage currents in the presence of alternating voltage on the generator side, which may lead to the inverter shutting down. These leakage currents are primarily caused by metallic back panels and alternating voltage on the solar generator. In this case the AT series can be used.
- 5.) If the module manufacturer insists on an inverter with galvanic isolation (transformer), please ask for the underlying voltage curve specified by the manufacturer for the module. In addition, the module manufacturer should specify which solar generator pole should be earthed where required.

Solar module manufacturer requirement	Suitable Sunways inverter technology
1.) No requirement	AT series, NT series, PT series
2.) No negative voltages on solar generator	AT series
3.) No positive voltages on solar generator	None
4.) No alternating voltage on solar generator	AT series, PT series
5.) Only transformer unit	Possibly AT series*

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\* Ask the module manufacturer for the allowed voltage levels at the solar generator

## Approval list

Sunways AG is currently in discussions with several module manufacturers with a view of obtaining general approvals for use of the AT, NT or PT series with the respective modules.

Please note that any module/inverter combination must be approved by the module manufacturer.

### Combinations approved by module manufacturers:

Company	Solar modules	Approved	Additional information
Auria Solar	C-Series F-Series M-Series	AT-series	At the current, all modules are confined to operate only with negative grounding. Auria announced to introduce a new module technology in Q2/2012 which will not require any grounding.
Avancis	Powermax	AT series	See Installation Manual Mat. No. 1000257 (Nov. 2009)
Bosch Solar	CIS – Thin film modules	AT-series NT-series PT-series	Approved with CIS thin film technology. Attention: Not approved for the application with micromorph module technology!
Calyxo	CX-42-60	AT series	With single approval from module manufacturer
Calyxo	CX-3	AT-Serie NT-Serie PT-Serie	Approval available
CNPV Solar Power	CNPV-250M, CNPV-205M	AT-series NT-series PT-series	Mono- and polycrystalline solar modules
EGing	P60-C	AT-series NT-series PT-series	
ecoTec	DS30V	AT-series	
Evergreen Solar	ES-xxx-RL-T ES-xxx-SL-K xxx=170...195)	AT-series	See Evergreen Solar Application Guide, Edition 1, October 2007
Evergreen Solar	ES-xxx-RL-TU ES-xxx-SL-KU xxx=170...195)	AT-series NT-series PT-series	Additional identification on the "U" rating plate is required. See document "Evergreen introduces polarisation-free modules", January 2008
First Solar	FS-260 ... FS-277	AT-series NT-series PT-series	NT 8000 / NT 10000: approval list PD-5-429 Rev 1.1 Other Inverters: Project-specific approvals are granted via SDAs submitted by the First Solar customer. <a href="http://www.firstsolar.com/de/systems.php">http://www.firstsolar.com/de/systems.php</a>
GS Solar	GS 50	AT-series NT-series PT-series	
Inventux	X79-a...X94-a X105... X130	AT-series	With single approval from module manufacturer
Masdar PV	Amorph (a-Si) / micromorph module technology	AT-series	Approved for the application of the AT series in combination with thin film modules. For further information please have a look at the data sheet of the module manufacturer.

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Jürgen Frei

Company	Solar modules	Approved	Additional information
Nexpower	NH-100 Series	AT-series	
Q-Cells	Q.SMART, Q.SMART UF, Q.SMART UF L	AT-series NT-series PT-series	Please look into the Q.SMART installation manual, which can be found on-line at <a href="http://www.q-cells.com">www.q-cells.com</a> . Here you can find details on country-specific grounding requirements. Only in those countries which Q.SMART modules DO NOT require functional grounding are customers free to use Sunways NT- and PT-series inverters. AT-series inverters can be used anywhere.
Solar Frontier	SF130L ... SF150L	AT-series NT-series PT-series	See letter from Solar Frontier. Plants up to 125 kW power to limit leakage current to 300 mA, otherwise external RCD is required. Please comply with local regulations!
Sunpower	E18 E19 E20	AT-Serie NT-Serie PT-Serie	Those back contact modules can be used with all our solar inverters without any constraints
Sun Well	WD-A-CC-087, WD-E-CC-125, WD-A-GE-065	AT Serie	All modules require grounding of the negative pole. This is only feasible by using the Sunways AT Inverter series
Schott Solar	ASI TM series	AT-series	See Schott Solar approval list of 18 March 2009
Sharp	NA-Serie	AT-series	Sharp Datenblatt NA-Serie Versionskennzeichnung: SolarNA_142_RD0509
Sun Earth	TDB und TPB Modules	AT-Series NT-Series PT-Series	Mono- and multicrystalline modules can be operated with all Sunways Solar Inverters.
Sungen	S series a-Si thin film modules	AT-series	Approved for the application of the AT-series in combination with amorph (a-Si) thin film solar modules. For further information please have a look into the data sheet of the module manufacturer.
Sulfurcell	SCG-HV-F SCG-LV-F SCG-HV-L SCG-LV-L SCG-HV-RI	AT series	See User Information of the relevant module: SP-09001 Rev. 1 SP-09003 Rev. 1 SP-09004 Rev 0

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Company	Solar modules	Approved	Additional information
Uni-Solar	PVL-68 PVL-124 PVL-136	AT series	Earthing of the DC side is not allowed. Assembly system, substrates and conductive material near the PV generator must be earthed. The DC cables must not form loops. Please note the initial module values for DC voltage (+11%), DC current (+4%) and DC power (+15%). See document "Operation of Sunways Transformer-less Inverters with United Solar Ovonic PV Modules and Laminates" of 12 June 2008

If you are a module manufacturer and require additional information please contact Mr. Andre Vollmer (+49 (0)7531 996 77-471 christian.buchholz@sunways.de). If you are a planner or system owner, our Technical Hotline will be happy to answer any questions you may have on +49 (0)7531 996 77-577.

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