

# SolarEdge Inverter Compliance with New German Grid Code

**Dear SolarEdge Customers,**

Beginning Jan. 1 2012 all SolarEdge inverters will support the new German Low Voltage Grid Code VDE-AR-N-4105 (LVGC).

This document details the following:

- Background
- Changes Before Jan. 1 2012
- Compliant Inverters
- Upgrading Older Inverters
- Implementation of LVGC Requirements in SolarEdge Inverters
- System Design Implications

## **Background**

The number of solar installations in Germany is constantly growing, and by the summer of 2011 over 18GW of solar power have been installed. Most of these systems are small to medium sized and therefore connected to the low voltage grid. Since they account for a large portion of the grid power, multiple disconnections of systems can affect grid stability. This has led to the formulation of a new grid code, aimed at increasing the stability of the electric grid in Germany by giving solar installations an active role in grid management.

The new code, VDE-AR-N-4105, which will be mandatory for all inverters connected to the low voltage grid from Jan. 1 2012, replaces VDE-0126-1-1 and includes requirements related to the following points:

1. Phase balancing
2. Frequency-based power reduction
3. Reactive power control
4. Inverter reconnection conditions
5. Output power control

## **Changes Before Jan. 1 2012**

Today, inverters disconnect from the grid at 50,2Hz. However, as an interim solution the utility company may require the inverter to disconnect at a higher frequency, between 50,2-51,5Hz. To change the frequency range of an inverter to be installed prior to Jan. 1 2012 please contact SolarEdge support at [support@solaredge.de](mailto:support@solaredge.de).

## **SolarEdge Technologies**

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**Compliant Inverters**

All inverters delivered by SolarEdge after Jan. 1 2012 will be LVGC compliant. The following table details the available models and the firmware versions which supports LVGC.

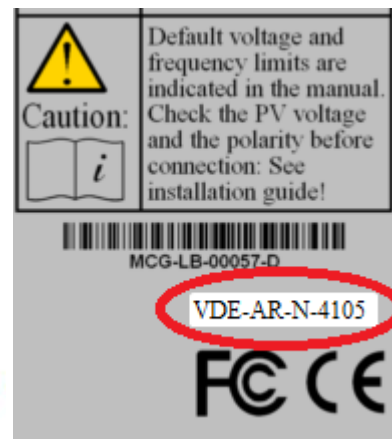
Inverter model	Max. apparent power, $S_{Emax}$	Max AC current (per phase)	Firmware version with LVGC support (higher versions as well)
SE3000	3 kVA	16,5 A	CPU: 2.133 DSP1: 1.210.128 DSP2: 1.034
SE3500	3,5 kVA	19,5 A	
SE4000	4 kVA	22 A	
SE5000	4,6 kVA	25 A	
SE7k*	7 kVA	11,5 A	CPU: 2.133 DSP1: 1.13.58 DSP2: 2.19.54
SE8k*	8 kVA	13 A	
SE9k*	9 kVA	14,5 A	
SE10k*	10 kVA	16 A	
SE12.5k*	12,5 kVA	20 A	

\* These SolarEdge inverters are symmetric 3 phase sources.

Compliant inverters can be identified by their labeling:

1. On the inverter – the inverter ratings label will have an additional label with the code name, as shown below – single phase on the left, three phase on the right:

SE5000-DEU		solar edge			
SE5000-CZE		Photovoltaic Power Inverter			
Electrical Ratings					
DC	Max. Operating Voltage	500V	AC	Nominal Operating Voltage	220/230V <sub>L-N</sub> 380/400V <sub>L-L</sub>
DC	Operating Voltage Range	270-500V	AC	Nominal Operating Frequency	50/60Hz
DC	Max. Input Current	17.5A	AC	Nominal Output Power	4600W
	Operating Temp. Range	-20...+50°C	AC	Max. Output Power	4600W
	Enclosure	IP65	AC	Max. Output Current	25 A RMS
	Safety Standard	IEC 62103	AC	Grid Connection Standard	VDE-AR-N-4105 AS-4777



2. On the inverter box – the inverter box will have the following label:

This inverter is compliant with  
**VDE-AR-N-4105**

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### Upgrading Older Inverters

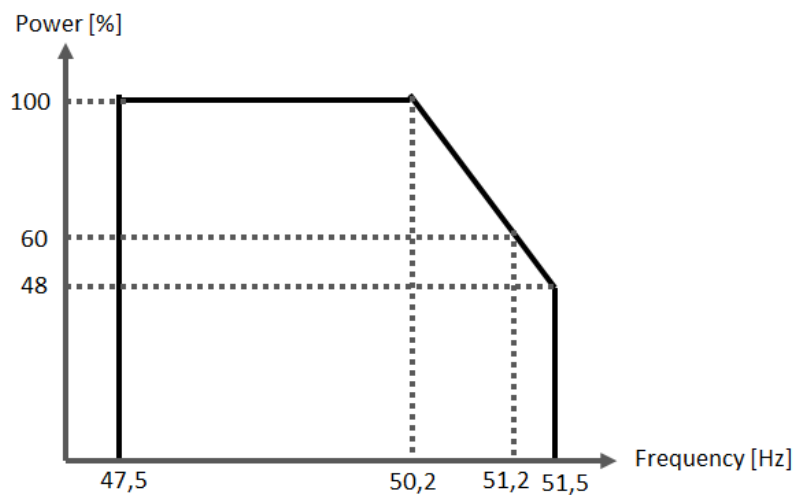
Inverters without the above labels, with firmware versions earlier than those listed in the table above can be upgraded:

- All three phase inverters can be upgraded
- All single phase inverters with DSP2 version 1.027 and above can be upgraded.

For more details please refer to “How to Upgrade an Inverter to LVGC-Compliant FW”, which includes information on identifying the inverter’s firmware version using the inverter LCD, the upgrade configuration steps and the labeling to be placed on the inverter to indicate it is LVGC-compliant.

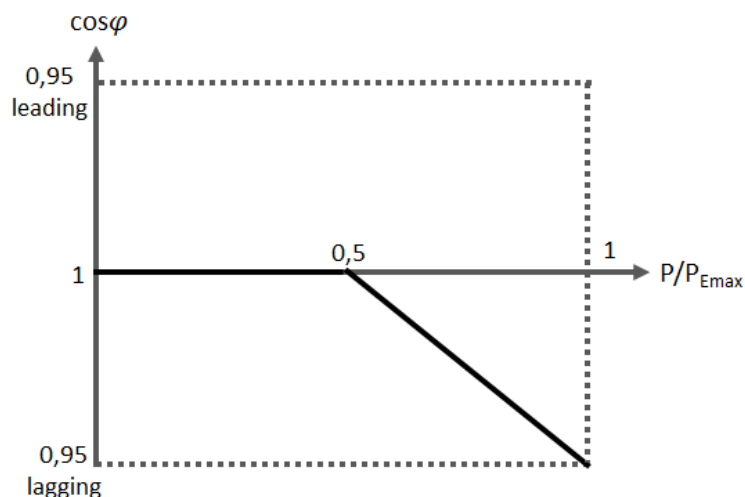
### Implementation of LVGC Requirements in SolarEdge Inverters

1. Phase balancing: All single phase inverters have a max output power of 4,6kVA.
2. Frequency-based power reduction: Inverters will remain active when the frequency is between 47,5-51,5Hz. Above 50,2Hz the inverter will start reducing power at a rate of 40% per Hz, as illustrated in the following graph:



**Figure 1 – frequency-based power reduction**

3. Reactive power: Inverter reactive power will be controlled by a power factor. The inverters will be supplied with the following default power factor graph:



**Figure 2 – default power factor**

This graph may be changed by the installer if the utility requires a different reactive power graph. Please refer to the “LVGC User Guide” for configuration details.

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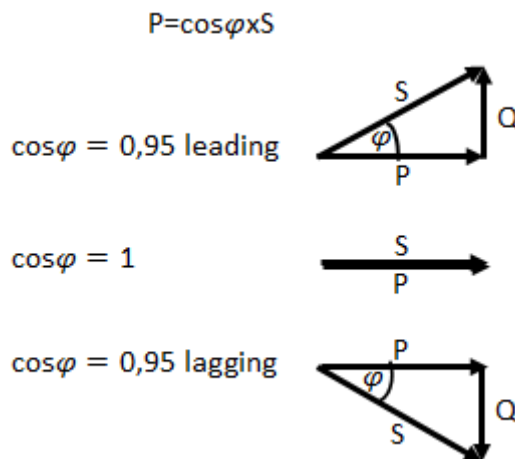
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4. Inverter reconnection conditions:
  - a. In case of inverter disconnection from the grid it will reconnect only if grid voltage is between 85-110% of nominal voltage, and frequency is between 47,5-50,05 Hz, and after no less than 60sec.
  - b. After a grid fault the inverter will start with 10% power increase per minute. After a manual inverter shutdown the inverter will start at full power.
5. Output power control: Output power control, required in any installation greater than 100kVA, can be done via the SolarEdge Power Reduction Interface. For more details please refer to the Power Reduction Interface datasheet ([http://www.solaredge.de/files/pdfs/products/inverters/se\\_power\\_reduction\\_interface\\_datasheet\\_de.pdf](http://www.solaredge.de/files/pdfs/products/inverters/se_power_reduction_interface_datasheet_de.pdf)) and manual ([http://www.solaredge.com/files/pdfs/se\\_power\\_reduction\\_interface\\_manual.pdf](http://www.solaredge.com/files/pdfs/se_power_reduction_interface_manual.pdf)).

### System Design Implications

1. No more than 3 single phase inverters can be connected in one installation.
2. Inverter sizing: the inverter may now operate with a power factor lower than 1, which affects the available active power. The following relations between active power (P, measured in kW), reactive power (Q, measured in VAR) and apparent power (S, measured in VA) exist:



**Figure 3 – P, Q, S relations**

An inverter that formerly had  $\cos\varphi=1$  and therefore  $P=S$ , will now have  $P \leq S$ , and must be sized accordingly.

3. Sizing example: a system using the SE5000-DEU, an inverter with  $S=4,6$ kVA.
  - a. In the past  $\cos\varphi=1$ , and therefore  $P_{max}=4,6$ kW. If a 110% DC/AC oversizing ratio is used, up to 5kWp DC may be installed.
  - b. From Jan. 1 2012, the inverter must be able to operate with  $\cos\varphi=0,95$ ; this is the power factor when the inverter is at maximum power, and using the default setting shown in Figure 2. Therefore  $P_{max}=0,95 \times 4,6$ kVA=4,37kW. If a 110% DC/AC oversizing ratio is used, up to 4,8kWp DC may be installed.

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