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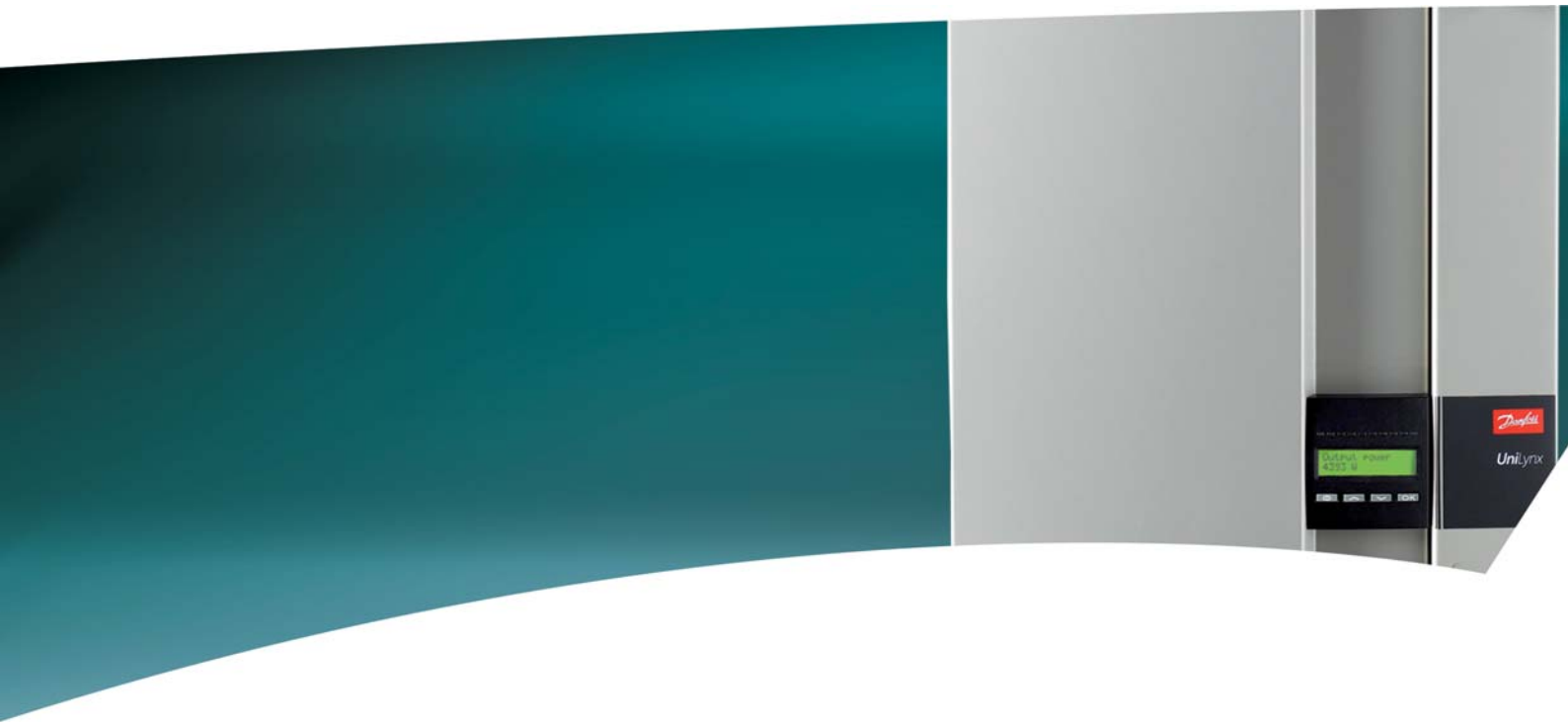

UniLynx Indoor
User Manual

ULX 1800i • ULX 3000i • ULX 3600i • ULX 5400i

SOLAR INVERTERS

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1. Introduction

1.1. Introduction

This manual describes Danfoss photovoltaic inverters. These products are among the most technologically advanced and efficient inverters on the market and are designed to supply the owner with reliable solar energy for many years.

Illustration 1.1: ULX Indoor Range

CE	CE marking - This certifies the conformity of the equipment with the regulations which apply in accordance with the directives 2004/108/EC and 2006/95/EC.

2. Function Description

2.1. Definition of Operation Modes

The inverter has four modes:

Standby mode:
In standby mode, the inverter is ready to switch into connecting mode. As decision variable the input voltage of the PV generator is used. If the input voltage exceeds a preset nominal value, the inverter shifts from "standby" to "connecting", or continues into the operation mode "OFF" if the PV voltage drops.

Connecting mode:
After performing the system tests, which check whether all connection conditions are met, the inverter goes from standby mode to connecting mode. During the specified cut-in time, the inverter continues testing the system values and connects the inverter to the grid if the system tests are okay. The minimum cut-in time is specified by the supplier and authorities and can vary from region to region.

Grid mode:
In this mode, the inverter is connected to the grid and supplies power to the grid. The inverter is only uncoupled from the grid in case of abnormal grid conditions or when PV power is not available.
PV configuration mode
Having completed the connecting mode the PV module wiring is automatically tested to detect whether any of the DC inputs are wired in parallel string configuration. If so, the DC modules are automatically run in parallel string configuration mode (Master/Slave).
Derating temperature
If the display shows (DRT. TEMP), the inverter is derating due to high temperatures.
Derating grid
If the display shows (DRT GRID), the inverter is derating due to high voltage on the grid.

Off:
If there is no PV power available, the inverter waits ten minutes (specified value) before it disengages. In this mode, the power supply to all processors is switched off to conserve energy. This is the normal night mode.

2.1.1. Grid Surveillance

In order to safeguard the people working on AC power lines and the inverter, the inverter shuts down in the event of abnormal grid conditions or failures. The inverter continuously monitors grid voltage and frequency by means of an internal control circuit. Subsequently, the inverter will reconnect as soon as the grid is within limits.

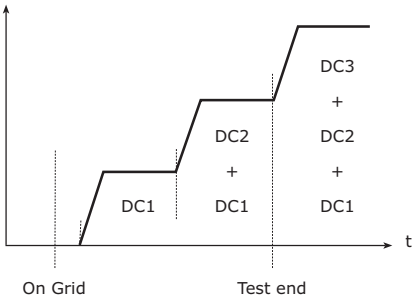
2.1.2. PV Configuration

Upon connecting to grid an automatic test of the PV module wiring is performed by the inverter. This test is made in order to determine the wiring configuration of the modules. It is established whether the modules are connected in individual string configuration or in parallel string configuration and the inverter is automatically configured accordingly.

The test works by activating the input one by one. The test takes 1-2 minutes and the inverter continues to produce energy meanwhile. In menu B the result of the test can be read in the display menu called PV configuration.
Upon test completion the display will automatically show the PV configuration detected; however, only if the buttons on the display have not been used in the past 3 minutes.

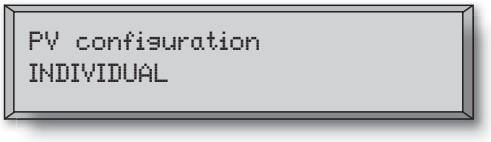
For ULX 5400i, 2 out of 3 DC modules must be powered for the test to run. If not enough PV power is available to power 2 modules, the test is postponed until sufficient PV power is available for the second DC module to run.

Notice that the inverter continues to produce energy in the meantime.



The display readout shows the status of the test. The first line shows that this concerns the PV configuration and the second line shows which status the test is in or which configuration it has detected.

Illustration 2.1: PV configuration test



The status field may show the following:

Display Text	Description
IDLE	PV configuration test has not yet been run. Shown before the inverter connects to grid.
OFF	PV configuration test is disabled. Applicable to ULX 1800i and to inverters where the test is otherwise disabled.
WAITING	The PV configuration test is ready to run, but only solar radiation for one PV input is available. (Applicable to ULX 5400i). The inverter can only determine the configuration of all three modules, when two are running.
PV-AUTODETECTING	The PV configuration test is running. No result yet.
INDIVIDUAL	The PV modules are connected in individual string configuration
PARALLEL 1-2*	The PV configuration has ended, concluding that inputs 1 and 2 are connected in parallel string configuration.
PARALLEL 1-3*	The PV configuration has ended, concluding that inputs 1 and 3 are connected in parallel string configuration.
PARALLEL 2-3*	The PV configuration has ended, concluding that inputs 2 and 3 are connected in parallel string configuration.
PARALLEL 1-2-3	The PV configuration has ended, concluding that inputs 1, 2 and 3 are connected in parallel string configuration.

Table 2.1: PV Configuration Test Status Field Text

*) The "PARALLEL 1-2" is only allowed for the ULX 3000i / 3600i inverter. The "PARALLEL 1-2", "PARALLEL 1-3", and "PARALLEL 2-3" is not allowed for the ULX 5400i inverter.

2.1.3. LEDs

The green LED indicators show the production in percentage of the nominal inverter power rating. The leftmost green LED is always lit when the inverter is connected to the grid. While connecting to grid both the red LED and the leftmost green LED will be on. When the inverter is off grid, the red LED to the left is lit to indicate that the inverter is in standby mode. No green LEDs are lit. If no LED's are on the inverter is off. If the inverter is forced into standby mode because of an event in the inverter or the peripheral connections, e.g. disconnection from the grid, the red LED starts flashing.

For a description of events, please refer to the section on *Troubleshooting*.

2.1.4. Display

Through the integrated display on the inverter front, the user has access to all information about the PV system and the inverter. When the inverter is in OFF mode (at night), the inverter can be activated by pressing the left button (ESC).

Illustration 2.2: Display

⏎	ESC	Goes one step backwards/up in the menu structure
▲	Up	Scrolls back to the previous menu display
▼	Down	Scrolls forward to the next menu display
OK	Enter	New menu level or changing of settings

The parameters shown in the display refer to internally measured voltages and currents. The parameters shown may deviate.

The display information is organised in a menu structure divided into two sections: A and B

Section A: Contains information about the inverter and PV system performance.
Section B: Displays all measurement values and user settings.

2.1.5. Overview Menu Section A

The table below gives an overview of the menu structure. The values shown are only intended as examples of display texts. The display text (shown in the first column Display Functions) is divided between 2 lines, with 16 characters available per line. The line division is illustrated with the symbol |.

Menu Structure A

Display Functions	**Description**
Output power | 0 W	Current output power in watt.
Inverter name |	Use Service Tool to enter inverter name. If the inverter name is undefined this menu is skipped.
Total production | 22.991 kWh	Total energy production in kWh since first inverter start-up.
Total operating time | 00028h 57m 02s	Total operating time (time with power on) displayed in hours, minutes and seconds.
Production today | 19637 Wh	Energy production today in Wh.
Go to menu B	Jumps to menu level B when OK is pressed.

Table 2.2: Overview Menu Structure A

2.1.6. Overview Menu Section B

The table below gives an overview of the menu structure. The two menu levels are clearly indicated by an arrow followed by a submenu. The values shown are only intended as examples of display texts.

The display text (shown in the first column Display Functions) is divided between 2 lines, with 16 characters available per line. The line division is illustrated with the symbol |.

Menu Structure B

Display Functions		**Description**
Operation mode | STANDBY		Displays present inverter operation mode. See operation mode definitions in chapter 2.
PV configuration | IDLE		Shows the status of the automatic PV configuration test and the results found.
Event: Mod. | ENS FL. CH DCAC		If the inverter is not connected to the grid because of a failure, the red LED starts flashing, and the reason for the failure is shown here.
Language | ENGLISH		View and choose display language. Does not affect any other settings.
Grid voltage | 0 V		Displays the present grid AC voltage.
Grid current | 0.00 A		Displays the present current flow to the grid.
Grid frequency | 0.00 Hz		Displays the present grid frequency.
Grid impedance | 0.0 ohm		Displays the present grid impedance.
PV voltage | Press OK to view		Press OK to access submenu for recorded values.
↳	**Submenu**	
	PV voltage no. 1 | 303.0 V	Present voltage at PV input 1 (upper position in inverter).
	PV voltage no. 2 | 303.0 V	Present voltage at PV input 2 (second position in inverter)*.
	PV voltage no. 3 | 303.0 V	Present voltage at PV input 3 (third position in inverter)*.
PV current | PRESS OK to view		Press OK to access submenu for recorded values.
↳	**Submenu**	
	PV current no. 1 | 0.0 A	Present current at PV input 1 (upper position in inverter).
	PV current no. 2 | 0.0 A	Present current at PV input 2 (second position in inverter)*.
	PV current no. 3 | 0.0 A	Present current at PV input 3 (third position in inverter)*.
Maximum values | Press OK to view		Press OK to access submenu for recorded values.
↳	**Submenu**	
	AC out: 1844 W | 8.356 A 263 V	Maximum values recorded at AC output since last resetting of max. value memory.
	DC1 in: 2220 W** | 8.004 A 509 V	Maximum values recorded at DC1 input since last resetting of max. value memory.
	DC2 in: 2220 W** | 8.004 A 509 V	Maximum values recorded at DC2* input since last resetting of max. value memory.
	DC3 in: 2220 W** | 8.004 A 509 V	Maximum values recorded at DC3* input since last resetting of max. value memory.

Table 2.3: Overview Menu Structure B

*) The PV2 and PV3 menus are only displayed in inverters equipped with two or three inputs.

Menu Structure B- Continued

Display Functions		**Description**
Maximum values | Press OK to view		Press OK to access submenu for recorded values.
↳	**Submenu**	
	AC out: 1844 W | 8.356 A 263 V	Maximum values recorded at AC output since last resetting of max. value memory.
	DC1 in: 2220 W** | 8.004 A 509 V	Maximum values recorded at DC1 input since last resetting of max. value memory.
	DC2 in: 2220 W** | 8.004 A 509 V	Maximum values recorded at DC2* input since last resetting of max. value memory.
	DC3 in: 2220 W** | 8.004 A 509 V	Maximum values recorded at DC3* input since last resetting of max. value memory.
Total drt. Temp. - Press OK to view		Total Derating Temperature. Shows the total amount of time the inverter has derated due to high temperature.
↳	**Submenu**	
	DC1 derate temp. | 3h 35m	DC1 Derating Temperature. Shows the amount of time the inverter has derated due to high temperature.
	DC2 derate temp. | 3h 35m	DC2* Derating Temperature. Shows the amount of time the inverter has derated due to high temperature.
	DC3 derate temp. | 3h 35m	DC3* Derating Temperature. Shows the amount of time the inverter has derated due to high temperature.
Total drt. Grid | 0h 00 min		Total Derating Grid. Shows the amount of time the inverter has derated due to unstable grid conditions.
Power-down time | 00600 seconds		Time before inverter goes into 'OFF' mode when no solar power is available.
Code numbers | PRESS OK to view		Press OK to access submenu for recorded values.
↳	**Submenu**	
	Inverter code no. |	Indicates inverter product code.
	AC code number | C0070105602	Indicates AC module product code.
	DC1 code number | C0070105402	Indicates DC1 module product code.
	DC2 code number | C0070105402	Indicates DC2* module product code.
	DC3 code number | C0070105402	Indicates DC3* module product code.
Serial numbers | Press OK to view		Press OK to go to submenu for recorded values.
↳	**Submenu**	
	Inverter SN: |	Indicates inverter serial number.
	AC SN: | 117500C0408	Indicates AC module serial number.
	DC1 SN: | 642800C0808	Indicates DC1 module serial number.
	DC2 SN: | 642800C0808	Indicates DC2* module serial number.
	DC3 SN: | 642800C0808	Indicates DC3* module serial number.

Table 2.4: Overview Menu Structure B

*) The DC2 and DC3 menus are only displayed in inverters equipped with two or three inputs.
**) The maximum values for PV power may reach more than 2000 W in inverters where the inputs are connected in parallel. This is normal.

In menu section A the display will continue to show the menu point last chosen by the user.

In menu B the display automatically switches to menu A when there has been no keyboard activity for 3 minutes.

If the inverter is off grid and no keys have been pressed for a certain number of seconds, the display will automatically switch to the operation mode display.

If the inverter is on grid and there has been no keyboard activity for 3 minutes, the display automatically switches to the display Production today. When the PV configuration test initiates and terminates the display temporarily changes to menu B to show the state of the PV configuration test.

If the inverter is disconnected from the grid because of a failure, the red LED will start flashing, and the display automatically switches to menu B, where the event is shown.

If an earthing fault occurs, the display will indicate this by a flash of the lit green LEDs. The display will change to "current event", if it has not been operated in the past 10 minutes. The inverter will continue to produce energy. In case an earth fault occurs, this does not indicate an inverter error and technical assistance must be called to check the PV panel connection.
Only applicable if earth fault detection is enabled. By default, earth fault detection is enabled for the following countries: Austria, France and Spain.

3. Troubleshooting

3.1. Troubleshooting

Note:
Remember that only trained and authorised personnel familiar with electrical systems and safety issues may work on inverters and electrical installations.

In the following, the term 'Event' describes all events that prevent the inverter from operating properly.
An event may occur anywhere in the installation (grid, PV module, cable and connections, inverter) at any time. Not all events indicate an inverter error.

If the PV system does not supply power to the grid as expected, please go through the following checklist:

1. Check that the grid is connected properly to the inverter and that the grid is ready for operation.
2. Check that there is sufficient solar radiation to generate power.
3. Check for shading and loose cables/connections in the PV system.
4. Check the installation of the PV modules if the voltages of the PV modules is not within the expected values.
5. Check the event in menu B. If the red LED is flashing, this indicates a failure.
6. If the above-mentioned points are OK, wait 15 minutes to find out whether there is a permanent failure.
7. If the PV system still does not supply any power to the grid, please check the voltage, current and power of the PV module as well as voltage, current and power of the grid in menu B.
8. If the voltage values of the grid do not lie within the threshold values, please contact your public utility for technical assistance.

3.1.1. Inverter Event Messages

The red LED will start flashing in case of an inverter event. Please check the event in menu B.

The event text is a short text describing the event. If the inverter reports an event ID number to the display instead of a text, no event text has been predefined for that particular event ID number. This could be the case if the display software is older than the inverter software. Module designation identifies the module that caused the event (DC1, DC2, DC3 or AC).

Event text	Description	Fault origin	Action in the event of a permanent failure
U 3.3	Internal power supply outside limits	Inverter	Service inverter
U 5.0	Internal power supply outside limits	Inverter	Service inverter
U 15.0	Internal power supply outside limits	Inverter	Service inverter
U PV	Input voltage from PV string too high	PV system	Request technical service from PV system supplier
U-SNUBBER	Snubber voltage too high	Inverter	Service inverter
U DC-BUS	DC bus voltage too high	Inverter	Service inverter
U-GRID	AC grid voltage outside the threshold values (higher or lower than setting)	AC grid	In case of repeated occurrence: Request technical service from utility
F-GRID	Grid frequency outside limits (outside settings)	AC grid	In case of repeated occurrence: Request technical service from utility
IPM CURRENT	The DC content in the AC current is too high	Inverter	Service inverter
ENS	ENS error	AC grid	In case of repeated occurrence: Request technical service from utility
ENS RAM	ENS memory error	Inverter	Service inverter
ENS FL. CHKSM	Flash memory error after self-test	Inverter	Service inverter
ENS EP. CHKSM	EPROM memory error after self-test	Inverter	Service inverter
HW TRIP	Hardware trip – current too high	Inverter	Service inverter
TEMP HIGH	Temperature in integrated power module too high	Environment	Check whether inverter is covered. Check inverter for free air flow through heat sink. Clean heat sink. Check that ambient temperature is within limits.
EPRM PAR. LIM	Validity check of grid voltage and frequency settings. Settings too far away from actual grid voltage and frequency values.	Inverter	Request service to check inverter settings
ENS COM ERR	Error in communication with ENS board	Inverter	Service inverter
ENS impedance	Grid impedance step higher than limit	AC grid	In case of repeated occurrence: Request technical service from utility
PV—CONFIG—ERR	Error detected by PV configuration test	PV system	Check the cabling of the PV panels. Two DC inputs are wired in parallel string configuration, one is not
Not recorded in the event log - red LED does not flash			
Event text	**Description**	**Fault origin**	**Action in the event of a permanent failure**
EARTHFAULT	Current event shown in grid mode	PV system	Earth fault, check PV system for earthing to avoid damage to PV panels. Request technical service from the PV system supplier or installer.

Table 3.1: Inverter Event Log

A "permanent failure" is defined by an event having been present for more than 15 minutes.

4. Maintenance

4.1. Maintenance

4.1.1. Maintenance

Normally, the ULX indoor inverters need no maintenance or calibration. It should be ensured, however, that the cooling is not obstructed and that the inverter is kept dry at all times.

To ensure the functionality of the DC-switch, all switches should be switched on and off (by turning the switch to on and off positions ten times) once a year, to clean the contacts.

If it becomes wet, wipe it dry immediately. Liquids may contain substances that corrode the electronics.

4.1.2. Cleaning the Cabinet

Clean inverter and integrated display with a soft cloth. Do not use aggressive chemicals, cleaning solvents or strong detergents to clean the inverter.

4.1.3. Cleaning the Heatsink

In order to secure proper function and long inverter life, it is essential that the free air circulation around the heat sink at the back of the inverter is not obstructed.
If the free air circulation is obstructed, e.g. by dust, this has to be removed. Clean the heatsink by means of a soft cloth or a brush. Do not use aggressive chemicals, cleaning solvents or strong detergents to clean the inverter.

The heatsink can reach a temperature of more than 70 °C during operation. Touching components of this temperature may result in serious injuries!

Note:
Do not cover the inverter.

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Rev. date 2010-03-24 Lit. No. L004100292-05_02