SOLON Allegro

Stand alone sinewave inverter

08/12, 10/24 and 10/48

Instructions for installation and operation

SOLON Inverters AG
CH-8730 Uznach
Schweiz

www.solon.com

Don't leave the planet to the stupid

About this Manual

Congratulations on your purchase of a SOLON Allegro sinewave inverter. You've become the owner of the finest engineered, highest quality sinewave inverter. We have dedicated our product's, our services and ourselves to the satisfaction of every customer.

This manual for installation and operation contains important information's about this unit. Please familiarise yourself with all the information's contained in these instructions before installing and operating this unit. This will help you to acquaint yourself properly with this unit and make full use of its advanced technical features under all operating conditions.

Should you encounter problems while installing or running this unit, please contact the dealer you purchased the unit from or a dealer authorised by SOLON Inverters.

Improper assembly, installation and maintenance may impair the safety and function of this unit. For this reason make sure that you understand all the information's in this manual before beginning the assembly and installation procedure.

SOLON Inverters AG, CH-8730 Uznach/SG

Safety Symbols

Safety symbols mark passages in the text, which you absolutely need to read and consider.

- Consider these warnings.
- Behave in such cases particularly carefully.
- Inform other users about these dangers.

Warning of dangerous electrical voltage

Ignoring this warning can lead to heavy bodily injury or to death.

Warning of a danger

Ignoring this warning can lead to heavy bodily injury or to damage.

Warning of hot surface

Ignoring this warning can lead to burns or to damage.

Precautions

Safety Instructions

- In principle the general regulations for security and accident prevention are valid for operating and handling the inverter.
- The equipment was built and examined in accordance with the safety regulations for electrical devices. In order to guarantee a safe handling, the safety instruction must be considered, which are contained in this manual.
- For any works on equipment and electrical connections the national and regional regulations are valid concerning grounding, protective ground and lightning protection.
- **Any Work on equipment and electrical connections may be carried out only by electrical specialists.** An electrical specialist has the necessary technical training and knowledge to avoid dangers by electricity.

Warning! In this unit potential differences of up to 1000V occur during operation and can result in death or serious bodily injury.
Use extreme caution while operating and always observe precautions as:
The unit must be connected by a professional electrician only.

Safe handling of this inverter is only ensured by correct installation and mounting according to regional valid regulations. Carefully follow the lightning protection regulations!

Only specially trained maintenance and service personnel are permitted to test and repair this unit. This personnel further must be familiar with this manual and all domestic regulations.

No AC-generator or power supply is allowed to connect to this unit. Connecting mains power, AC-Generator or an other inverter to AC-output will damage the unit immediately. Excess voltage applied to the inputs and outputs may result in destruction of the unit.
Charging the battery with a dynamo while the inverter is connected to the battery, the inverter may be damaged. Please ask your dealer if you have any questions.
Take care of regulations for lightning protection.
The unit is tested by the manufacturer and it is not allowed to change anything! Without a written permission of SOLON Inverters AG you will loose warranty if you repair the unit. Please refer to the warranty information's.
Any work performed on this unit, its installation and electrical connection must be carried out in compliance with national electric codes and local regulations, which may deviate from those contained herein. Refer to responsible authorities for relevant information's.

Operate the device only when all factory-supplied covers are available and in place. Temperatures at the enclosure of the device may be as high as 80 degrees C during operation. Obstruction of the ventilation of the unit may result in overheating and thus in failure of the unit. Always keep the unit and the ventilation slots clean. Do not cover up or place any item on ventilation holes or cooling components.
Please note the permissible ambient conditions for operating the unit.

Automatic restart of the unit may occur after fault clearance.

Please note that also under standby operation, 230V test voltage pulses are present at the inverter AC-output. The inverter is still ready to run. To be sure that the unit is completely switched off you have to switch the main circuit breaker in OFF-position or disconnect the battery.

Warning! Inbuilt, large electrolytic capacitors will hold DC-voltage for extended periods.

Do not use any measuring equipment damaged or defective.

Contact with energised parts can result in serious or fatal injury. Please note that, even under excessively light load or in stand by operation, high voltage can be present at the AC-output.

Limitation of liability

Since neither the observance of these instructions for installation and operation, nor the conditions and methods of installation, operation, utilisation and maintenance of the unit can be supervised by SOLON Inverters, we don't assume any responsibility or liability for loss, damage or costs arising from using this unit or in any way connected with faulty installation, improper operation or incorrect utilisation and maintenance.
Furthermore we don't assume any responsibility for infringement of patent rights or violations of the rights of third parties arising from the utilisation of this unit.
We reserve the right to make product changes, change technical specifications or these instructions without prior notice.
Important: Please be informed that units without CE-declaration can only be used on your own liability in Europe countries. If you have an unit without CE please contact your local dealer.
WARNING! Unauthorised repairs and operation of this device for any use other than that for which it was intended will result in loss of warranty. If you have problems with the unit SOLON Inverters will provide you with the authorisation necessary to return or repair a unit.

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Environmental protection

Recycling raw materials instead of waste disposal. This unit is built from valuable materials and is easy to recycle. The unit, accessories and packaging should be sorted for environment-friendly recycling. Please keep packaging for retransport the inverter later. To prevent damage during transport we have to use and bill you a new packaging if we receive the unit not with original packaging. Thank you.

Maintenance and Spare parts

This unit is maintenance-free.
Proper functioning of the unit and electrical connections must be inspected at regular intervals - we recommend once a year - by trained electrical specialists. The routine inspection should include the entire electrical system.

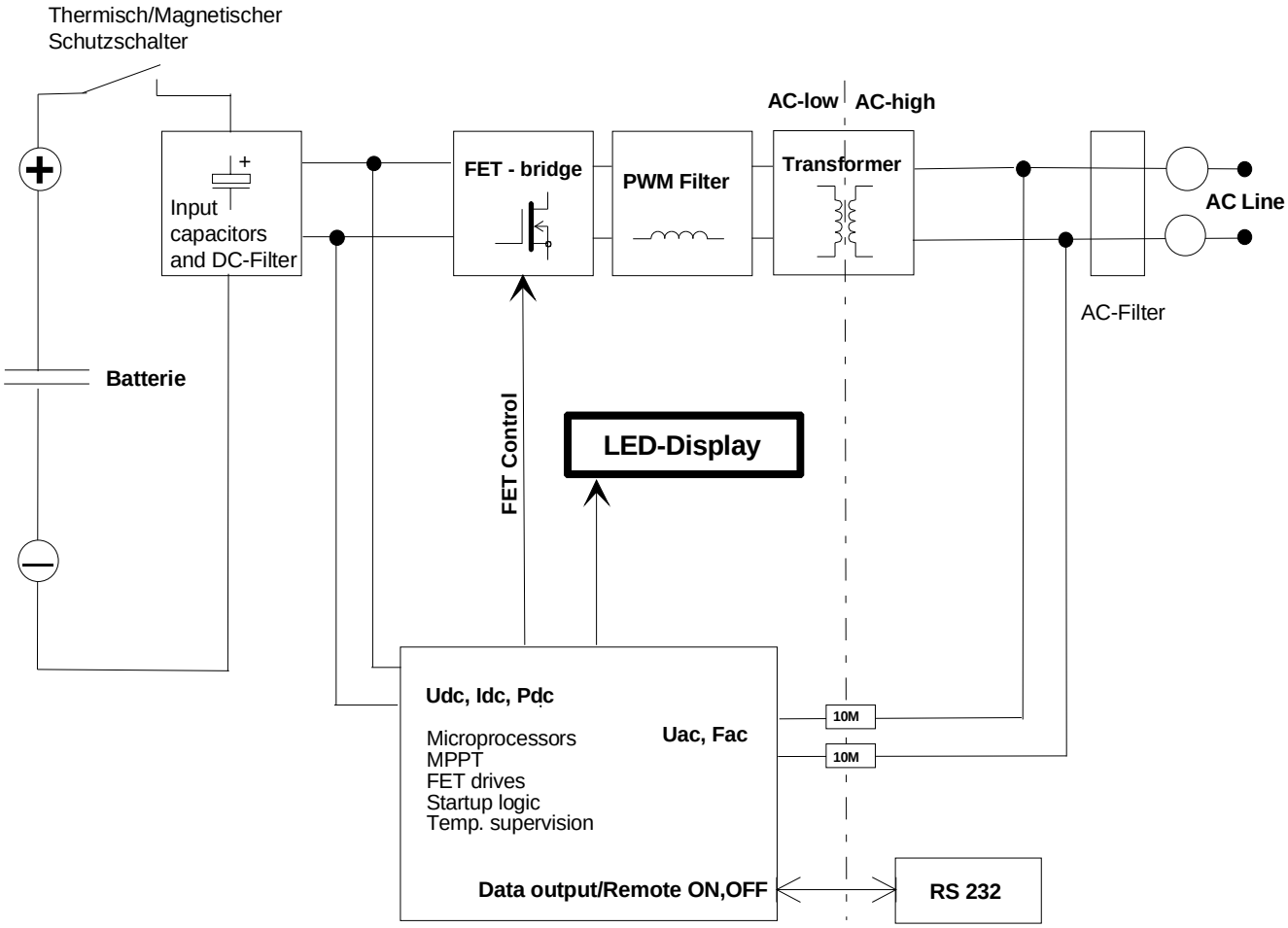
Should malfunctions of the unit occur despite these inspections, the unit must be returned to the manufacturer for repair. Original spare parts are only available from SOLON Inverters. SOLON Inverters will provide you with the authorisation necessary to return a unit for repair. Before you call please prepare you for the following questions: Type of unit, DC-voltage, manufacturing date, date of purchase, kind of fault, connected loads.

Unpacking the unit

Please check if the unit has no visible damage. If the unit is damaged you must inform your dealer within 3 days after receiving the unit.

Function, technology

This inverter is designed to convert DC-battery voltage (direct voltage) to 230V AC (sinusoidal alternating voltage). Voltage controlled, the inverter provides a stabilised, crystal-accurate alternating 230V/50Hz voltage (different voltages and frequencies refer to the indication label). With a sine-wave inverter almost any type of electric consumer may be connected as for example energy saving lights, fluorescent tubes, computers, Radio- and HIFI-equipment and other household appliances, freezers, pumps, motors etc.
Due to a high degree built-in safety, excellent dynamic response, a surge-proof and overload-proof output, it is very simple to operate a broad range of applications.
The "heart" of the inverter is a very powerful RISC-microprocessor of the latest generation. This microprocessor is responsible for the real time computing of the output sine-wave shape, for the process control of the output voltage, for the supervision of the battery (dynamic) and the inverter temperature.
The power stage features modern Power MOS-FET transistors. These transistors are the key to the high partial-load efficiency and superb overload capability. The power transistors are protected by independent intelligent protection circuits. The inverter is further more protected against DC-over voltage (static) and short circuit on AC-output.
The battery input side is equipped with a thermal/magnetic circuit breaker to protect of your system.
The superb toroidal transformer has very low magnetic losses, high efficiency and a very low RFI-radiation level. The transformer design provides a high efficiency over a wide operating range. No electrical connection between DC-input and AC-output due to the transformer. It complies with the following guidelines: IEC 742, EN60742, VDE 0551 TI, SEMLO 9742.
The whole control electronics are manufactured in SMD technology to ensure a high standard of quality and reliability.



General information

Always check the power draw of your appliances. Electrical equipment as motors, pumps, compressors etc. need more power while starting up. Start up power draw can be much higher than Pnom. For this applications the inverter is able to supply up to 300% surge power for a short time. Be careful if you use pumps. Power declaration on pumps is normally not the electrical input power of the pump! The inverter switches off automatically if surge power is too high.

If ambient temperature is higher than 20° C, Pnom and overload capability of the inverter will be reduced.

Due to reduced cooling capacity, Pnom of the inverter is reduced if operation altitude is above 900m ASL. Reduction of Pnom is approx. 1,5% per every additional 100m more altitude.

Example: If a 1000VA inverter is installed as high as 2500m ASL maximal Pnom will be at 780VA only! If you use more power, overheating and associated premature disconnection of the inverter must be anticipated.

If you use the inverter under above conditions we recommend to use a well over dimensioned inverter.

Installation

Safety Instructions

- Be sure the points demanded under "safety regulations" are obeyed.
- Install the unit in a dry place. The unit is not designed for outdoor use.
- Adequate ventilation. Keep min. 10cm distance to other objects (except mounting side). Do not cover heat sink!

The selection of a safe location for installing the inverter depends on the following criteria:

- ♦ Check indication label for correct DC-Voltage and AC-Voltage.
- ♦ The inverter can be used in any position.
- ♦ Protection from unauthorised access in particular of children's.
- ♦ Dry, dust free surroundings (max. 95% humidity, not condensing).
- ♦ Short distance between battery and inverter. Use a grounded metal pipe to reduce RFI emission and to prevent surroundings of fire. The inverter should not be mounted in the same room as the batteries are (gas of the batteries during charging).
- ♦ Adequate ventilation. Keep min. 10cm distance to other objects (except mounting side)
- ♦ Battery capacity must be at least 200Ah. Using a smaller battery may reduce performance of the unit.
- ♦ If other DC-units are installed at the same battery, contact your dealer for more information's.
- ♦ Protection of inverter and battery from the effects of water.
- ♦ Temperature range –25°C to +50 degrees C.
- ♦ Only specially trained maintenance and service personnel are permitted to test this unit. This personnel further must be familiar with this manual and all domestic regulations before installing this unit.

Connecting the inverter

Safety Instructions

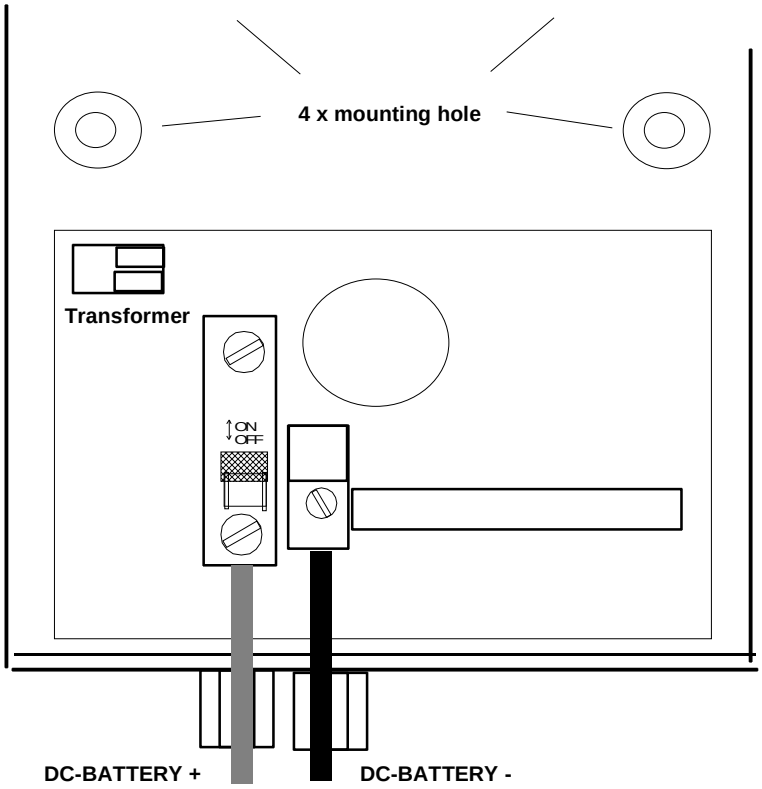
- Be sure the points demanded under "safety regulations" are obeyed.
- Check whether the intended solar generator voltage corresponds properly with the type-label on the unit itself
- Any electrical connections must be carried out by an electrical specialist.
- The large input capacitors may still be charged even if DC-cables are disconnected and DC-switches are in OFF position!

The DC-circuit breaker must be turned to OFF-Position. **Note:** Inbuilt, large capacitors will hold DC-Voltage for extended periods. They still can have DC-Voltage even when the switch is in off position and the DC-Cables are disconnected from the battery!

First make AC-Connections. Connect your load with enclosed connector to the inverters AC-Output. An additional AC-Circuit breaker (size refer to datasheet) has to be installed. We recommend to install a earth leakage protector for protection of personnel. Please observe domestic regulations when making connections!
To connect the Battery to the inverter use a wire with minimum cross section of 25mm2. An additional DC-breaker must be installed direct at the battery. Before connecting the cables to

the battery make sure that the polarity is correct! Applying of wrong polarity may damage the inverter.

NOTE: Please exercise extreme care when connecting the unit to a battery. Otherwise the inverter or the battery could be damaged!



Take care of correct grounding of the inverter and your equipment that is connected to the inverter! We recommend to use an earth cable with minimum cross section of 10mm^2 to ground the inverter. This will help to protect your unit in case of lightning. Be sure to meet all regulations about lightning protection!
Check again to make sure all cables are securely connected. Switch on the DC-Circuit breaker. The inverter is now ready to operate.

Information's for operation

Security advices

- Be sure that all demands written in the topic "safety regulations" are kept.
- If DC voltage is out of range longer then 5 sec., the inverter switches off automatically, LED indication "LOW BATERY" flashes red.
  Caution: As soon as DC voltage is back in tolerance the inverter switches automatically on again.

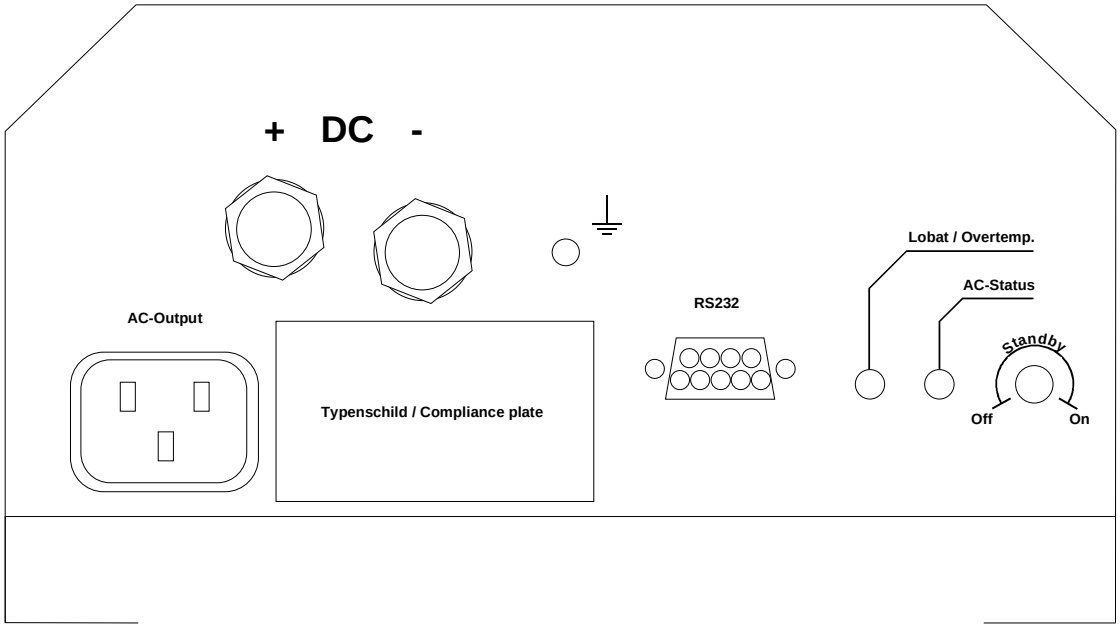
- If AC voltage is out of range, LED indication "AC-OUTPUT" turns to red. The inverter switches off automatically and indication "AC-OUTPUT" flashes red. Caution: After approx. 20 sec. the inverter tries to switch on automatically again.
- Each time a fault occurs, the inverter restarts automatically after 20 seconds or if the parameters (for example temperature) are back in normal conditions after a fault. Time before the unit starts again can be from a few seconds to a few hours! Always switch off the unit if you work at your system or electric consumer.
- For any manipulations and works on the electrical facility or AC-load, always cut off the inverter from the battery (turn DC-switch rsp. circuit breaker to OFF position).

- Inverter heat sink may be very hot, do not touch surface to reduce the risk of burns.

Protect your inverter from rain. The unit is not designed to be used outdoor.

The DC-input breaker should be in „ON"-position all the time. In case of an error it will switch of automatically. If the inverter is switched off (by turning the potentiometer fully counter clockwise) it still needs app. 25mA from the battery. The inverter is electronically short circuit protected at the AC-Output.
DC input of the inverter is monitored for over voltage and under voltage. The upper limit is static. If DC-Voltage is too high the inverter will switch off. Automatic restart follows after DC-Voltage is in the normal range.
The lower limit is dynamic (cut off voltage is lower if a big load is in use). This allows an optimal use of the battery capacity and protects your battery during small load operation.
Important: If the inverter has switched off automatically it still needs very little power from the battery!
Important: Always before you switch on the circuit breaker you must switch off the load.
The fan is controlled by temperature and power needed. It is helping to reduce problems of overheating.

Status LED-display



LED LOBAT:	Battery voltage low. The inverter switches off automatically if DC-Voltage is out of range for more than 5 seconds (LED continuous red). **Warning!** The inverter restarts automatically if DC-Voltage is in permitted range.
LED OVERTEMP:	Over-temperature. Overheating as a result of insufficient cooling or extended overload. The inverter switches off automatically after 5 seconds (LED flashing red). **Warning!** The inverter restarts automatically if temperature is in permitted range.
LED AC-Status:	During normal operation this LED emits a green light. Inverter ON - Output = 230V AC/50Hz (or as on compliance plate). During standby this LED blinks green. **Hint:** This LED blinks orange before the inverter switches to standby if the load is to small. Use this information to adjust the standby level to your load. If AC-Output transcends tolerance (for ex. because of short circuit at the AC-Output) this LED emits a red light. **Warning!** The inverter restarts automatically after 20 seconds.
STDBY-ADJUST:	With this potentiometer placed next to the LED's you can adjust standby level in a range from app. 2 - 40W (app.100 steps). Turn the potentiometer completely counter clockwise: The inverter is always OFF. Turning the potentiometer clockwise: The standby level (for sleep mode) will increase from app. 2W to 40W. Fully clockwise – the inverter is ON all the times. Note: If the inverter is in remote control mode this potentiometer is disabled (see RS232).

Important: Each time a fault occurs the inverter restarts automatically after 20 seconds or if the parameters (for example temperature) are back in normal conditions after a fault. Time before the unit starts again can be from a few seconds to a few hours! Always switch off the unit if you work at your system or electric consumer.

Additional information about standby/sleep mode

This specially designed standby circuit (energy saving circuit) recognises automatically if power is needed at the AC-Output.
If no power is needed and after a delay of 10 seconds the unit switches into standby/sleep mode. In this operation mode power draw of the unit is less than 2W. Every 800ms the inverter checks the AC-Output by emulating a true sine-wave voltage. If power draw exceeds the adjusted sensitivity level the inverter switches on immediately. If no more power is needed the inverter switches back to standby mode after a delay of 10 seconds.
If you use a small, not compensated load it may occur that the inverter is switching on and off all the time. If this occurs you should compensate the load or switch an additional load to the AC-output.

Note: A lot of electrical equipment needs power even if they are switched off. Especially units as portable radios, TV- and video equipment, plug in power supplies etc. may have still such a high power draw that the inverter recognises a load and is not able to switch into standby/sleep mode. The sense level is adjustable on the potentiometer next to the LED's. You can adjust sensitivity level from app. 4W to 40W. Sensitivity level may slightly change depending on DC-Voltage of the battery and temperature of the inverter (app. +/- 1W).

RS232 Interface

Connect a computer or palmtop to the RS232 interface by using a 9pin RS232 cable. Start up a terminal program (Procomm, Hyperterminal etc., setting 4800Baud, 8N1) and you can readout the most important parameters of the inverter during operation. Also you can remote control the inverter via computer/modem.
You will see on your screen the following information:

*0 ASP ALLEGRO V1.1 1000/24, 230V/50Hz	Type of unit, software version
*1 Vbatt = 24.7 Vdc	Actual battery voltage
*2 Vout = 227 Vac	Actual AC-Output voltage
*3 Pac = 930 W	Actual AC-Power
*4 Tint = 35 Cels	Inverter temperature
*5 Sby Level=99	Standby Level
*6 Remote enabled	Status of remote function
*7 YOUR COMMAND:++	Command line
*8 (00-99,++,--),<ENTER>	(Possible commands, confirm by pressing Enter)
*9 Legend:	Description of commands
*A 00=Continuous	Continuous operation
*B 01-98=Sby Level	Standby Level value
*C 99=Off	Inverter OFF
*D ++=Remote enable (On)	Enable remote function
*E --=Remote disable (Off)	Disable remote function

If you switch on the inverter the first time (or power-up after DC-Voltage interrupt) the remote function is disabled. You can enable the remote function by entering ++ <ENTER> via RS232 (direct or via modem from remote location).
If the remote function is enabled the potentiometer at the front panel is disabled! The read out of all operating information's are always available.

Example
(Confirm commands by pressing ENTER-button)

Command	++	Inverter is now ready for remote control
Command	00	Inverter is in continuous operation
Command	50	Standby-Level app. at 20Watts
Command	99	Inverter OFF
Command	--	Remote control of the inverter is no longer possible. The potentiometer on the inverter is enabled again.

Fault clearance

Security advices

- Be sure that all demands written in the topic "safety regulations" are kept.
- Before any manipulations and works on the electrical facility or load, always cut off the inverter from the battery (turn DC-switch rsp. circuit breaker to OFF position).
    - Please note when opening inverter housing:
    - Inside the inverter dangerous electrical tensions are accessible.
    - Do not disconnect ground wire connection to the housing cover.
- Repair works and service on the inverter unit may be only carried out by the manufacturer or an official SOLON Inverters service partner.

AC-Output LED is flashing red an green	refer to point LED -Display
The unit is noisy and switches off	The load is to big, battery is to Small
It is not possible to set DC-Circuit breaker in ON-Position	wrong polarity at DC-input, wrong installation
DC-Circuit breaker switches to OFF-Position	Overload operation for long time, reduce load
No function	Check wiring, check DC-Voltage

Before you call the help desk or your dealer please visit FAQ section on our home page: www.solon.com. Thank you!

Technical data

SOLON Allegro	08/12	10/24	10/48
Inverter			
Rated Voltage UDC_{IN}	12V	24V	48V
Input Voltage Range	10.5 ... 16.0V DC	21.0 ... 32.0V DC	42.0 ...64.0V DC
Dynamic Low Voltage Cut Off (depending on load)	10.5 ... 9.0V DC	21.0 ... 18.0V DC	42.0 ... 36.0V DC
Rated current IDC_{IN}	78A	50A	25A
Current IDC_{IN} max.	250A	160A	80A
Rated Power P_{10} (10 min at T_A=20ºC)[1)]	1100VA	1600VA	1600VA
Rated Power P_{30} (30 min at T_A=20ºC) [1)]	950VA	1450VA	1450VA
Continuous Power P_D[1)]	850VA	1100VA	1100VA
Rated Output Voltage UAC_{OUT}	230V AC, ± 2% (short circuit proof)		
Output Frequency	50Hz, ± 0.5% (true sinewave)		
Rated Output Current IAC_{OUT}	3.5A	4.2A	4.2A
Short Circuit Current IAC_K (max. 0.5s)	8A	11A	11A
Allowable CosPhi	0.3 ... 1		
Efficiency Factor max.	94%	94%	94%
Adjustable Standby Level (logarithmic)	2 ... 40W		
Consumption Standby/OFF	ca. 0.5W (Test impulse every 800ms) / 0W		
Consumption 230V AC OK	8W	10W	10W
Reset after Short Circuit	every 60s		
Reset after Overload	every 60s		
Reset after Overtemperature	automatically after reaching semiconductor temp. +45ºC		
Reset after Battery failure	automatically after reaching UDC_{IN}		

General data			
Ambient Temperature range	-25ºC ... +50ºC (max. 95% rH, not condensing)		
DC- Breaker / fuse	80A	80A	32A
Remote control ON / OFF	via RS-232		
Status indication	LED	LED	LED
Alarm contact (insulated Relay contact)	no	no	no
Toroidal Transformer (galvanically isolated)	EN61558 (IEC61558)		
Temperature and Load controlled fan	ON 55ºC / OFF 45ºC, P_D >80%		
RS-232 Interface	yes, 9-Pin, female		
Dimensions (L x W x H)	360 x 210 x 120 mm		
IP Protection	IP20		
Standards	CE		
Included in delivery	connector for non-heating apparatus		
Weight	10 kg	11 kg	11 kg
Warranty	2 years		

[1)] This values correspond to rated battery voltage.