CONFIDENTIAL

Technical Description

Onboard Charger
For
Lead Acid Batteries
144V / 156V

Solectria

Contents

Attachements

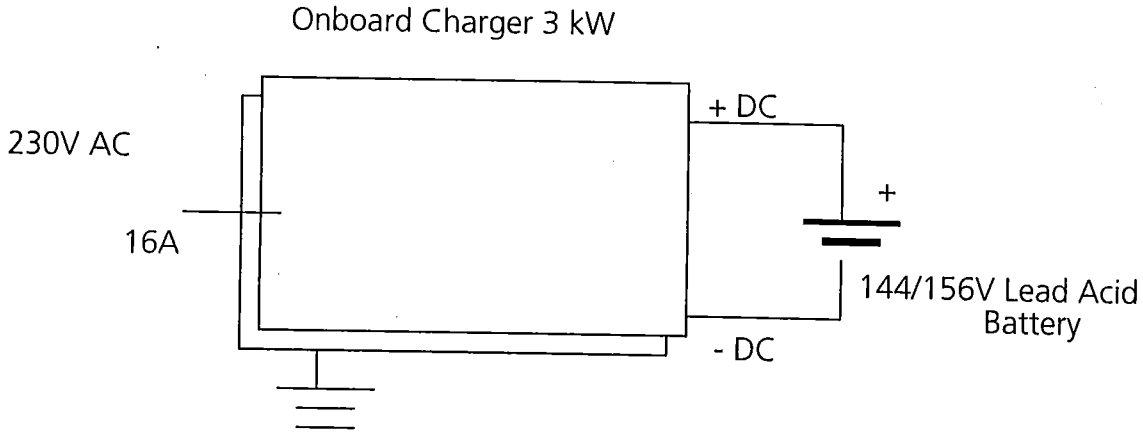
1. Applications

The onboard charger function
is the charging of traction batteries or starter batteries for diesel. It provides a fully isolated output voltage of 144V / 156V lead batteries. The output voltage of the onboard charger could also be grounded; negative and plus pole on mass.

The maximum charging current is regulated at 21A, lower charging currents can be pre-programmed. Parallel connection of three units from a three phase supply is possible.

The input current conforms to the requirements of IEC 555 (PFC).

The unit can be fitted as an onboard charger for vehicles or used as a fixed charging station. Cooling is provided by an attached ventilator unit.
For the use of the onboard charger in trains several tests have been successfully passed.



2. Functional Description

The functional blocks used in the unit are illustrated in picture 1.

2.1 Inverter and Input Rectifier

Power conversion is carried out by a primary combined system with a mains side power factor corrector (PFC). After the input EMC filter a 20A fuse provides mains protection. The incoming mains is rectified and fed directly to the single stage power conversion element, which operates at greater than 90% efficiency. The power stage operates at around 20kHz and is regulated by the control section. Galvanic isolation (Up = 2kVAC/2,85kVDC) between primary and secondary stages is provided by the inverter section transformer. The inverter, the input rectifier and the output rectifier is cooled through a common heatsink via the end mounted fan unit.
The output charging voltage is filtered through H.F. capacitors via a 2 stage LC filter. Caused by the converter topology which is a single stage topology the output current has a 100% ripple with double frequency input voltage. The favourable form factor of 1,17 is sufficient for the requirements of lead batteries.
The output is fused via 30A, 600V fuse.

2.2 Power Control

The following protective systems are implemented:

2.2.1 Overcurrent Protection Primary

When overcurrents (e.g. as a result of a secondary side short circuits) are detected, the inverter is switched off immediately and an error signal is sent to the microprocessor (load control). At the zero crossing of the next half of the input sine wave, the inverter is re-started. After repeated attempts to restart the charger switches off and indicates a fault. Resetting the unit is performed via the retrigger (RTG) input

2.2.2 Secondary Overvoltage

If the output voltage increases beyond the maximum level for a 144/156V lead battery (approx. 200V) the inverter is immediately switched off and indicates an error to the load control (ERR). Resetting the unit is performed via the retrigger (RTG) input.

Temp compensated?

2.2.3 Overtemperature Protection

The maximum output power of the charger is reduced in case that the ambient (inlet air) temperature rises at above 35°C. In the range 35°C and 70°C the power output is derated progressively. At temperature in excess of 70°C the charger turns off and the unit signals an error (ERR) at is control interface. As the unit cools down it will automatically re-start with an output power appropriate to is ambient.

2.3 Charge Control (Characteristic, Interface)

The charger is programmed to realise an I.U.I. characteristic curve. The shape of the curve is held in EPROM which may be readily adapted for other purposes. Both the current (in current mode) or the voltage (in Voltage mode) as well as charge time are determined through the controller software. The battery temperature is measured as essential load parameter and the characteristic curve is appropriate adjusted.
That means all load parameter and characteristic curves are adjustable to special requests of the customer.

The maximum level of the mains input current is also controlled in this way (12A/16A). Signal interfaces could be terminated at the charger.

Following features are included:

Input:
- 110V/230VAC
- 2 x battery temperature sensor NTC 33k at 25°C

Output:
- INTERLOCK – galvanic isolated relay contact (max. 100mA)
- RDY, FLT, L1, L2, Done – LED terminals for state of battery charge
- Battery connection 144V/156VDC

Detailed information under paragraph 4.3.2.3.

All interface signals can be readily changed under software control to meet specialised requirements.

3. Technical Data

Input Voltage Range:	108 –255V AC
Input Frequency:	16 2/3 Hz to 60 Hz
Input Current:	16A 2% at 208V – 255V AC 12A 2% at 108V – 140V AC
Input Power Factor:	PF = 0,98 conform to EN 60 555-2
Maximum Charging Power:	3 kW at input voltage range <208VAC the input current limitation is reduced.
Efficiency:	90%
Nominal Charging Voltage:	312 /336V, isolated (if necessary it could be grounded)
Output Voltage:	144V-195V 1% (characterised for 72 or 78 cell Lead battery)
Output Current:	max. 21A 5% (144V); 20A 5% (156V) at constant current mode, (further unit may be directly paralleled for additional capacity).
Output current form factor:	<1,20
Charging Characteristic curve:	IUI microprocessor controlled (picture 4) U1, U2, and U3 at 25°C battery temperature, Temperature compensation 1) -0,004V/cell/at >30°C 2) -4A/°C at >50°C (detailed information under p.4.2.3.1)
Switch on:	By connection of the mains supply plug
Output Signal:	Relay contact "INTERLOCK"; max. 100mA, 150V AC/DC

Input Signal:	Charge Mode: FLT, RDY, L1, L2, Done (750R/12V) 2 x 2 temperature sensor inputs (NTC 33k at 25°C) Caution: Signals are connected to battery voltage.
Protection:	Input and Output are protected by readily accessible fuses. Internal protection is provided against external short circuits, no load and overtemperature.
Enclosure Protection:	IP 54, without fan, conforms to DIN 40050 (cooler IP 20)
Protection Class:	1
Galvanic Isolation:	Primary/Secondary 2850V DC Primary / Earth 2150V DC Secondary / Earth 1459V DC Secondary / Interface 1450V DC
EMC:	Curve N AC EN 55011
EMV Stability:	conforming IEC 801-2,3,4
Storage Temperature:	-40°C up to 80°C in stationary air
Relative Humidity:	Up to 100% at 40°C (non condensing)
Operating Temperature:	-25°C to +35°C, to 70°C at reduced output power, (-30°C short term operating) appropriate for railway use
Cooling:	forced cooling with fan unit attached (appropriate for railway use)
Dimensions:	440 x 150 x 155
Weight:	approx. 10 kg
Shock and Vibration resistance:	conforming railway standards BN 41 1002 vibration: 1 Hz– 00Hz max 10m/s2 conforming to DIN IEC 68 section 2-6 shock: 50m/s2 to 30m/s conforming DIN IEC 68 section 2-27
Fixing position:	Floor or wall mounting.

4. Installation and Operational Instructions

4.1 Fixing Details

The fixing measurements are detailed in picture 3.
The unit could be mounted in any position, however, we recommend the use of anti-vibration mountings in applications where the unit is exposed to continuous shock and vibration.
The charger enclosure is rated at IP 54 if the unit is not fitted.

4.2 Unit Connection

The unit is rated at 3 kW. Connections are made at appropriate input and output terminals (see picture 2).

4.2.1 Mains Input (230V WS)

AC input connection N, L and PE at 3 x 1,5 mm² Cu lead

4.2.2 Battery Connection

Connect the battery at 2 x 2,5 mm² Cu earth lead
Positive pole battery on the brown lead
Negative pole battery on the blue lead

4.2.3 Connection of the Control Functions

Connect the displays and temperature sensors with 12 x 0,5 mm² Cu connection (see picture 2).

4.2.3.1 Temperature compensation of charging voltage / current

You have to connect an isolated temperature sensor with the yellow; yellow/green and grey/brown lead (NTC 33k at 25°C)

Same T comp rate above and below 30°C?
↑ .2% per °C.
* Temp compensation Above 30°C. Versions 4 Software Also has temp. compensation below 30°C.

Caution! The leads yellow; yellow/green and grey/brown are on battery potential. Do not connect with GND or PE.

Function:

1. Battery temperature –30°C tested with both sensors.
   Signal: - The failure LED turns on at 0.2 Hz = 1 blink per 5 seconds.
   - The charger runs with reduced function as far as the temperature is between –40°C and –30°C. During this phase the charger runs at +49°C and the lead time is limited to 30min.
   - After 10 min and a temperature <-30°C at both sensors the units turns off, the failure LED turns on, the signal current mode turns on 1 Hz.

2. Battery temperature –30°C tested with one sensor
   Battery temperature >-30°C tested with the other sensor
   Signal: -The failure LED is on
   - The signal current mode turns on at 1 Hz "done" LED blinks: 1 blink/second
   - The charger runs like at a battery temperature with +49°C
   - The battery temperature >50C at the warmer sensor shows additional reaction according point 4,5,6.

   The failure LED according point 6 has priority.

3. Battery temperature tested on both sensors between –29°C and +10°C
Signal: - Load voltage according algorithm and battery temperature of +10°C.

4. Battery temperature tested on the warmer sensor between +10°C and +55°C.
Signal: - Compensation of temperature of voltage charge termination at –4 mV/cell/K.

5. Battery temperature tested on the warmer sensor between +50°C and +55°C.
Signal: -additional compensation of temperature of load voltage during the l
phases with –4A/K .

6. Battery temperature >55°C tested on the warmer sensor
Signal: -The units switches off, the failure LED turns on, the status signal current mode turns on 1Hz.

Green

7. Break down of one sensor, input high ohm
Signal: as described under point 2.

8. Break down of both sensors, inputs high ohm
Signal: as described under point 1.

9. Break down of at least one sensor, input common
Signal: as described under point 6.

10. The maximum tolerance at the temperature input sensor, without consideration the tolerance of external temperature sensor, is 30mV.

4.2.3.2 Interface Options

The interface option could be indicated via the leads orange, pink, violet, red and black.

Status	L1 orange	pink	L2 violet	Done red	FLT
phase 1	on		--	--	--
phase 2	--	on	--		--
phase 3	--	--	on		--
phase 4 (default)	x	x	x		2Hz

L3

4.2.3.3 Relay Contact "INTERLOCK"

There is a relay contact at the white and colourless leads.
The relay closes when the unit is switching on and gives a signal "INTERLOCK"
Electrical load of the internal relay contact is max. 100mA, 150V AC/DC.

4.2.3.4 Selection of Charging Voltage and Algorithm 144V/156V

Selection of voltage and algorithm can be achieved by DIL switch at the interface PCB. You find it when opening the onboard charger cover. The choice has to be done before switching on the unit.

Switch OFF 156V (0) → L3 → off
Switch ON 144V (1) → on

4.3. Commissioning the charger

4.3.1. Before powering the charger please check the following

- Is Protection Ground connected?
- Is the battery temperature sensor connected (specified in 4.2.3.1)?
- Check the proper connection of the 144V or 156V lead battery to the charger.
  Notice: The use of lead batteries with a higher nominal voltage of 156V can lead to damage of charger or battery.

4.3.2. Commissioning

A 230VAC, 50/60Hz connection leads to a soft-start charging of the Y-condensators, which will result in by-passing the error-current-line. The AC mains voltage is being measured and AC current limitation is set (12/16A). After about 1 second the unit will start in soft-starting charge mode. The charger will go in bulk charge mode with the maximum current. This maximum charge current can be limited by the maximum AC input current limitation (12/16A) or by the maximum power limitation of 3kW.

When the charge voltage U1 (battery temperature 25°C) has been reached, the charger will change into constant-voltage mode.
Signalisation:
The LED „L1" will turn on.

If the charge current has reached 4A, the charger will change to charge-mode 2 overcharge).
I n this mode the current is limited to 3A and/or maximum charge voltage U2. This mode will be finished after 10% of charge power and/or a maximum of 14Ah.

Signalisation:
LED „L1" will turn off.
LED „L2" will turn on.

After charge-mode 2 the charger will change to charge-mode 3 (float).
The charger will feed the battery at U3 and limit the output current to 10A. This mode is not timed and the unit will stay in this mode until a AC fail or interruption of AC mains supply.
Signalisation:
LED „L2" will turn off.
LED „DONE" will turn on.

In case of overcurrent, overvoltage or a battery temperature above 55°C, the charger turns off. he unit is latched until disconnected from mains.
Signalisation:
The actual signal stays on.
LED „FLT" will turn on.

If the battery is not connected during start of charging, the unit signals a „Battery test failure".
Signalisation:
LED „FLT" will blink (1 Hz).
In case of interruption or short-circuiting of the battery temperature sense wires, please proceed as described under 4.2.3.1.

4.4 Service Instruction

All repairs have to be done at the manufacturer.

5. Safety Instruction

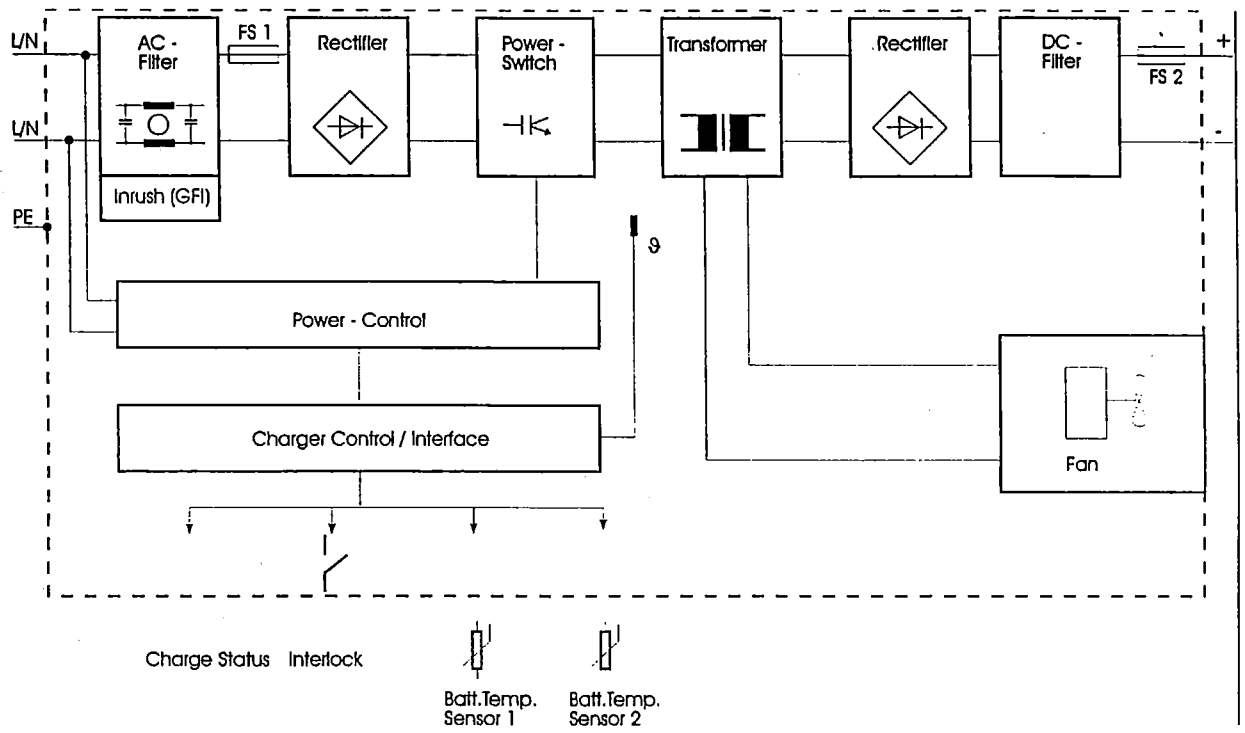
This documentation is provided to allow safe installation and operation of the charger.
Incorrect installation and use may create personal and material hazards to the user.
All stipulations must be done in accordance with the instructions of the manufacturer.
The manufacturer accepts no liability for damage caused by incorrect installation or use, or caused by unauthorised personnel.
The protection class of the setting device is IP 54, Exception: Fan unit

The setting-device delivers high voltages, that can be very dangerous to unauthorized repairs.
All repairs must be done by well trained persons only.
Power up the unit regularly. Description of powering-up the unit are to be find in section 4.

The unit contains electrostatic sensible components. The relevant instructions must always be taken into account.
Before opening the unit, make sure to disconnect AC mains and the battery and short-circuit and ground the DC output. Notice: It will take about a minute until the condensators have been fully discharged.

Notice: It is absolutely important to follow the instructions for installation and operation (section 4. in this manual).

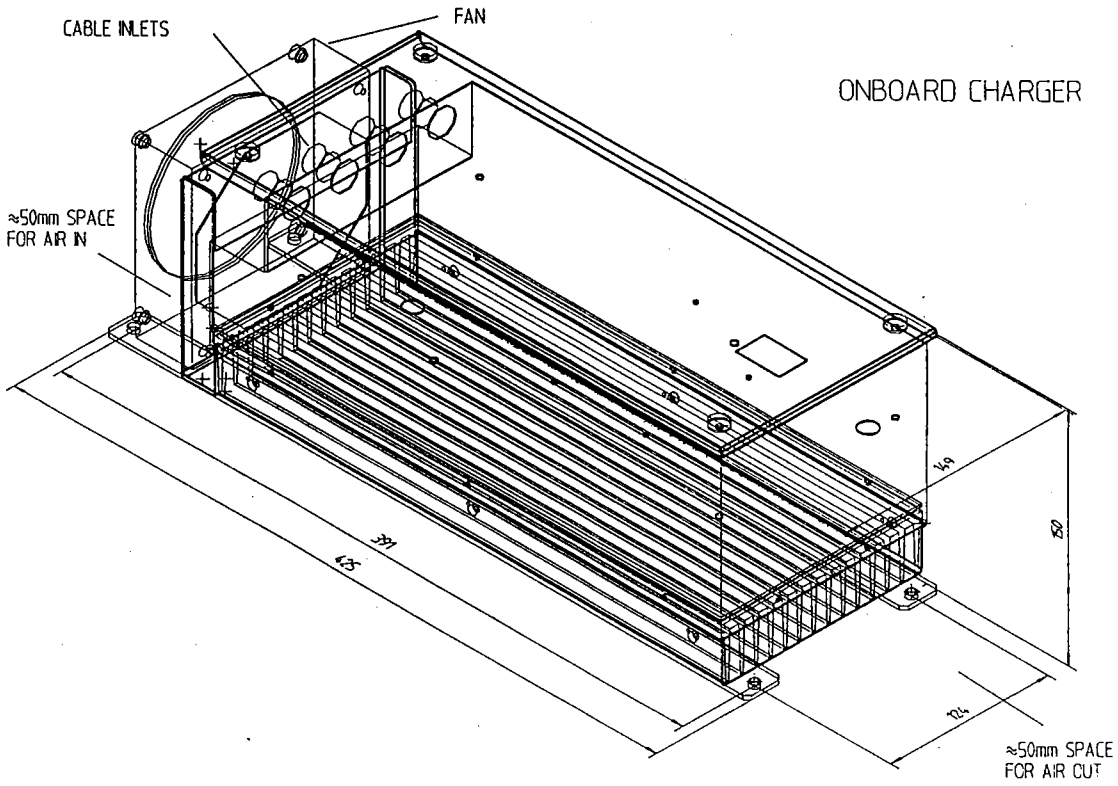
Please notice that the unit will start-up automatically after over temperature condition shut-down, when the unit has cooled off.


L/N
L/N
PE
AC - Filter
Inrush (GFI)
FS 1
Rectifier
Power - Switch
Transformer
Rectifier
DC - Filter
FS 2
+
-
ϑ
Power - Control
Charger Control / Interface
Fan
Charge Status
Interlock
Batt.Temp. Sensor 1
Batt.Temp. Sensor 2

ria

Kabel	Name	Farbe
3 x 1,5 mm^2	AC input	blue
	AC input	brown
	EARTH	yellow/green
2 x 2,5 mm^2	DC output positive	brown
	DC output negative	blue
12 x 0,5 mm^2	LED 1	orange
	LED 2	pink
	n.c.	blue
	DONE	violet
	FAULT	red
	GND	black
	INTERLOCK	white
	INTERLOCK	colourless
	NTC 1	gray
	NTC 1	brown
	NTC 2	yellow
	NTC 2	yellow/green

Kabellänge jeweils 1 Meter


CABLE INLETS
FAN
ONBOARD CHARGER
≈50mm SPACE
FOR AIR IN
149
80
331
425
124
≈50mm SPACE
FOR AIR OUT