Heliocentris

# Nexa® 1200

Instruction Manual

Nexa® 1200, Instruction Manual
Version 2.1
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# Content

# 1 About This Document

If only the masculine or feminine form is used in parts of this manual, this is only used for readability and simplicity. Persons of the respective other gender are always included.

The operating manual is intended to help you use the product. It is structured as follows.

**Safety Instructions** In the safety chapter you will find information on the safe handling of the product. It is essential that you read and understand this chapter.

**Components** This chapter includes background information about the product and its supplied components.

**Getting Started** This chapter describes the scope of delivery and the necessary steps for initial startup of the product – from choosing a suitable installation location to connecting all required components. It is supplemented by the laminated assembly instructions.

**Operation** The chapter provides instruction for the Operation of the product.

**Software** The chapter describes the software and provides instructions for the software-supported use of the product.

**Decommissioning** In the chapter Decommissioning the necessary steps for the disassembly product and the conditions for its packaging, storage and transport are described.

**Troubleshooting** This chapter answers FAQ and deals with possible problems and their respective solutions.

**Maintenance, Service** This chapter describes all necessary measures arising in the product life cycle, such as the maintenance, cleaning, service, warranty and disposal.

**Integration** In this chapter Integration information is provided about the possibilities of integrating the product into different applications.

**Technical Data** An overview of important Technical Data and the abbreviations used in this manual is provided at the end of the operating manual.

**Index** The index at the end of the manual can be used for fast orientation in the manual.

## 1.1 Notices and Symbols

### 1.1.1 Symbols

The following symbols and labels are used in this manual:

| Symbol or label | Meaning |
|---|---|
| ➔ | Instruction |
| ✓ | Aids or prerequisites that are required prior to an |

| | |
|---|---|
| | action |
| 1. | Instructions in a specific sequence |
| ⇨ | Result of an action |
| ●, - | List |
| SWITCH | Refers to a switch, key, button or icon |
| Reference to page x | Reference to further information |

Table 1-1 Symbols in the instruction manual

### 1.1.2 Warnings

The following warnings are used:

| | |
|---|---|
| **DANGER** | ➔ Warns of danger of death. |
| **WARNING** | Warns of dangers of serious injury. |
| **CAUTION** | Warns of dangers of injury. |
| **NOTICE** | Warns of property damage to the product. |

### 1.1.3 Tips

| | |
|---|---|
| **TIP** | Useful tips are marked this way: |

## 1.2 Accompanying Documents

The following documents are supplied with the product in addition to the instruction manual:

- CD-ROM with:
  - *Electronic version of the manual*
  - *Software Nexa® 1200 RCS*
- Drivers for CAN-USB converter

# 2 Safety Instructions

In this chapter you will find information on the safe handling of the product. It is essential that you read and understand this chapter.

## 2.1 General Information on Safety & Responsibility

**WARNING**

**Danger of injury due to improper use!**

Improper use of the product can result in serious injuries.

- ➔ Ensure that the manual is accessible at all times.
- ➔ Make sure you have read and understood this manual in its entirety.
- ➔ Comply with all safety instructions and warnings.
- ➔ Store the manual and other documentation in a safe place and pass them on to future owners of the product.
- ➔ Comply with all local regulations.
- ➔ Use only product components.
- ➔ Exception: if other aids are specified in the manual.

**DANGER**

**Danger of death due to unauthorized modifications!**

Conversions and modifications to the product can result in general hazards (danger due to escaping hydrogen, danger of injury due to heavy parts, danger of death due to electric shock).

- ➔ Do not make conversions and modifications to the product or its individual components.
- ➔ Do not remove components (exception: air filter cartridge).

## 2.2 Approved Use

The product has been designed for:

- Analysis and test purposes
- Experimentation purposes
- Demonstration purposes

- Training purposes
- Research purposes
- R&D projects

The product is not intended for any other purpose; any other use is not approved.

The product may only be operated under supervision (for individual cases of exception, see Requirements for the Owner/Operator on page 9).

The use of the hydrogen supply, which is available as an accessory, is subject to special safety regulations and is intended only in combination with the product for the purposes listed above.

## 2.3 Non-approved Use

Do **not** use this product for:

- Generation of electricity and heat for other purposes than those stated above
- Operation beyond the technical specifications
- Operation beyond the approved operating environment
- Feeding generated energy into the power grid
- Unsupervised operation
- Operation in potentially explosive areas
- Installation in mobile applications
- If an inverter is used, do not feed the current into the electric power grid.
- Installation of the unit in a position other than horizontal.

Components or products delivered by or purchased from Heliocentris are not approved for use in aeronautics or aerospace applications (including models).

## 2.4 Hazards During Approved Use

For proper handling of all chemical or hazardous substances, it is necessary to exercise appropriate care; also make sure you have read and understood the relevant safety data sheets.

Hydrogen

Hydrogen itself is not a hazardous substance – its properties, however, can make it hazardous in interaction with other substances.

**DANGER**

**Danger of injury due to explosion!**

Escaping hydrogen can ignite and burn the skin.

Escaping hydrogen can reduce the oxygen content and cause breathing difficulty.

- ➔ Do not inhale hydrogen.
- ➔ The lab must be equipped with a suitable ventilation system for the use of hydrogen.
- ➔ The lab must be equipped for hydrogen monitoring.
- ➔ Avoid heat in the vicinity of the system and the hydrogen source.
- ➔ No smoking, no naked flames.
- ➔ Comply with local safety regulations.
- ➔ Comply with regulations for handling of compressed hydrogen cylinders.
- ➔ In the case of escaping gas, keep away and keep inflammable materials away.
- ➔ Prevent electrostatic charges.
- ➔ Ensure proper installation of the hydrogen supply.
- ➔ Check the hydrogen lines and connectors regularly for leak tightness.
- ➔ Comply with local safety regulations.

Electricity

The unit poses no special electrical hazards as long as the following instructions are observed:

**NOTICE**

**Damage due to electricity!**

Excess voltage, short circuits and polarity reversal damage the unit.

- ➔ Use only the supply voltage specified on the rating plate.
- ➔ Do not short-circuit inputs and outputs.
- ➔ Do not reverse the polarity of inputs and outputs.
- ➔ Never use the system if any part of it has been immersed in water.

## 2.5 General Information on Operation

### 2.5.1 Requirements for the Owner/Operator

The owner/operator must ensure that the unit is accessible only to the persons defined in this manual (see Requirements for the User page 10).

The safety instructions and warnings listed in this instruction manual must be observed. The owner/operator is responsible for compliance with local safety regulations.

Furthermore, the owner/operator is responsible for:

- Proper installation of the hydrogen supply by a specialized company
- Regular checking of the hydrogen lines and connectors for leak tightness
- Unauthorized persons must be prevented, using corresponding measures, from installing, operating or maintaining the system. Installation, commissioning, shutdown and maintenance of the hydrogen supply and filling the metal hydride canisters must be carried out by appropriately qualified personnel.
- Replacement and cleaning of filters if used under dirty operating conditions and/or impaired ventilation

The operator of the system must take sufficient precautions to prevent hydrogen being able to accumulate in enclosed or non-ventilated areas (e.g. installation of an exhaust air system and hydrogen warning system, etc.).

Unmanned operation of the system is possible if the overall design is integrated in a safety concept which conforms to local regulations. The overall design and the safety concept must be approved by the safety officer.

### 2.5.2 Requirements for the Location / Installation Location

The unit must be operated in a lab which complies with the local regulations.

**NOTICE**

**Damage due to reactive gases and substances!**

The membrane of the fuel cell contains a catalyst which reacts with reactive gases and can ignite them.

➔ Operate the fuel cell only in rooms which contain no reactive gases and fluids.

➔ Ventilate the room sufficiently.

### 2.5.3 Requirements for the User

The product is intended as a laboratory system for use by trained qualified personnel in education and research. Its design does not correspond to that of a "consumer-oriented" product whose proper use is generally known and which is protected against operation errors or improper use. The product may be used by the following persons under the following conditions:

- Persons who can demonstrate proof of training in chemistry, physics, electronics, electrical engineering or comparable qualifications and who are familiar with the local regulations for safe handling of hydrogen and who have experience in working with hydrogen.

➔ Personnel must be familiar with and comply with the local applicable accident prevention and safety regulations.

There is an obligation of supervision during all training

- The fuel cell system must only be used by persons undergoing training when under the supervision of the instructor.
- The instructor must ensure proper handling and is obliged to point out possible dangers.

# 3 Components

Nexa® 1200 is a complete fuel cell unit which, with an output voltage between 20…36 $V_{DC}$ and a maximum output current of 65 A, delivers a power output of 1200 W.

The Nexa® 1200 (also referred to as the unit) includes an air-cooled PEM fuel cell stack and the necessary peripheral components. It can be directly integrated in an application in various installation positions.

The unit converts the chemical energy of the hydrogen into electrical and thermal energy and water. The unit can be supplied with hydrogen by means of the lab supply with a downstream pressure reducer, an electrolyzer or metal hydride canisters. The cooling air flowing through the unit provides the oxygen required for the chemical reaction.

The unit can be controlled via the Nexa® 1200 Remote Control Software (RCS).

## 3.1 Nexa® 1200

The plastic housing holds all the necessary components for the unit. Essentially, the unit consists of a PEM fuel cell stack (also referred to as the stack) and all important secondary components for operation of the unit, including the hydrogen components, air filter, controller, valves and sensors.

On the front there is a control panel with 3 LEDs and one button. The LEDs serve to indicate operating modes; the button is used to switch the unit on and off and to reset errors.


Fig. 3-1 Nexa® 1200 front side

On the back there is a connection panel (1) with the connections for communication, control of external components and configuration of the unit.

Below the connection panel are the power outputs and the hydrogen supply (2).

Fig. 3-2 Nexa® 1200 back side

**Stack**

The stack in the Nexa® 1200 is the FCgen™-1020ACS stack from Ballard Power Systems. It is an air-cooled PEM stack with 36 fuel cells and a power output of 1200°W.

**Air supply**

A fan provides the necessary reaction and cooling air through the housing to the stack. The housing not only holds the components, but also functions to guide the air.

**Hydrogen component**

The necessary hydrogen is conditioned by means of a hydrogen component to a pressure level that is adapted to the stack and supplied to the stack as flammable gas.

Controller

The controller regulates the operation of the stack, carries out the procedure for startup and shutdown, provides warnings and error messages and ensures safe operation at all times.

Via the CAN interface the controller provides the process data for monitoring and analysis to the PC and/or the Heliocentris control and visualization unit Overall System Controller (OSC).

### 3.1.1 Safety Concept

The unit can be used in an application as a standalone system or together with other modules. The unit features a 2-stage safety concept which is designed for both options.

- The unit features a fast shut-down function as part of a safety chain. External monitoring devices (such as a hydrogen sensor or oxygen sensor) can be integrated in this safety chain.
- In case a critical situation occurs (e.g. hydrogen leakage) the connected monitors open the safety chain and therefore switch the Nexa® 1200 to an intrinsically safe state.
- This safety chain operates independent of the unit's internal software controller and therefore ensures fast shutdown of the hydrogen supply.
- The 2nd stage of the safety device operates parallel to the first and uses the firmware to monitor the internal components to ensure compliance with specified threshold values.
- In case the threshold values are exceeded the unit switches to an error mode and can no longer be operated until the fault is eliminated.

### 3.1.2 Protection Concept

The Nexa® 1200 protects the stack and / or its operating environment against:

- overheating
- overvoltage
- overpressure
- overcurrent
- increased hydrogen concentration

## 3.2 Nexa® 1200 Startup Kit

In order to start, the unit needs an external power supply; for operation, a hydrogen supply, an external hydrogen valve and a load relay are also necessary.

The Nexa® 1200 Startup Kit consists of a connection and communication set and includes an external hydrogen valve, a load relay and the connecting lines.

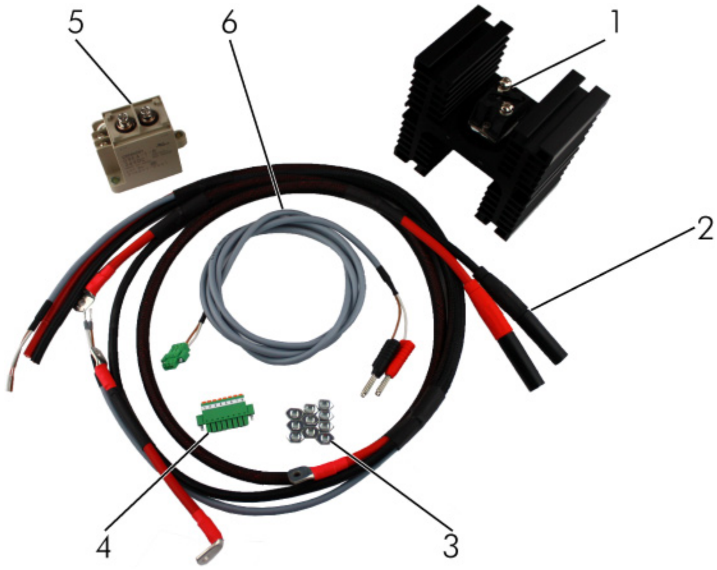



Fig. 3-3 Startup Kit connecting set

1 Heat sink with reverse current diode

2 Pre-assembled power supply cable for battery, load and load relay

3 Sliding blocks

4 Plug for the SAFETY CHAIN connection)

5 Load relay

6 Plug connector for connecting the external power supply

Fig. 3-4 Startup Kit connecting set: external hydrogen valve

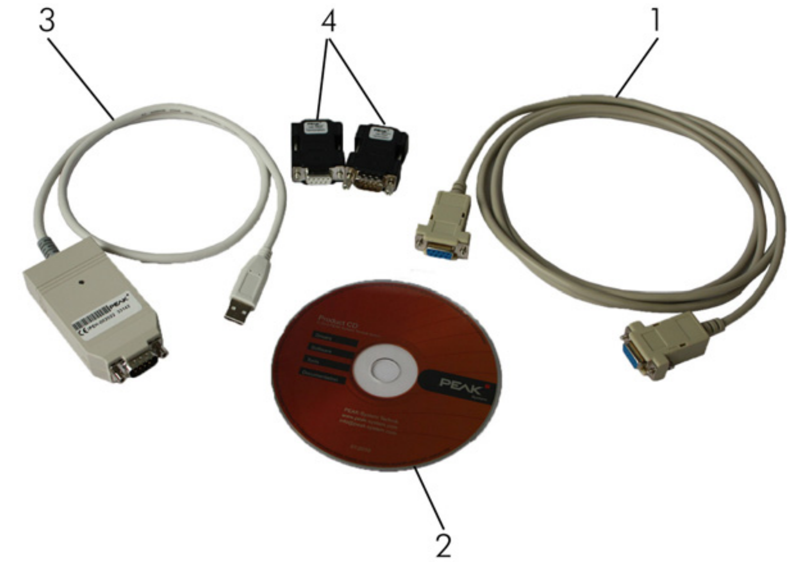



Fig. 3-5 Startup Kit communications set

| | |
|---|---|
| 1 CAN cable | 2 Driver CD |
| 3 CAN-USB converter | 4 Resistors |

### 3.2.1 External Power Supply

For the external power supply, either an AC adapter or a battery with a voltage of 9...36°VDC can be used.

A 3-pin plug connector for connecting the external power supply is included in the Startup Kit.

### 3.2.2 External Hydrogen Valve

The external hydrogen valve is an additional protective device between the hydrogen supply and the unit. It separates the unit from the hydrogen supply.

### 3.2.3 Load Connection

An external load can be connected to the unit.

A load relay prevents tapping of current if the unit is not in a suitable operating mode.

The reverse current diode mounted on a heat sink protects the unit against reverse current from the load to the unit.

During use of the reverse current diode, the heat sink enlarges the heat-emitting surface of this heat-producing component, therefore preventing the possibility of damage from overheating.

The load relay, a 6-pin plug connector, a heat sink with reverse current diode and power cable are included in the Startup Kit.

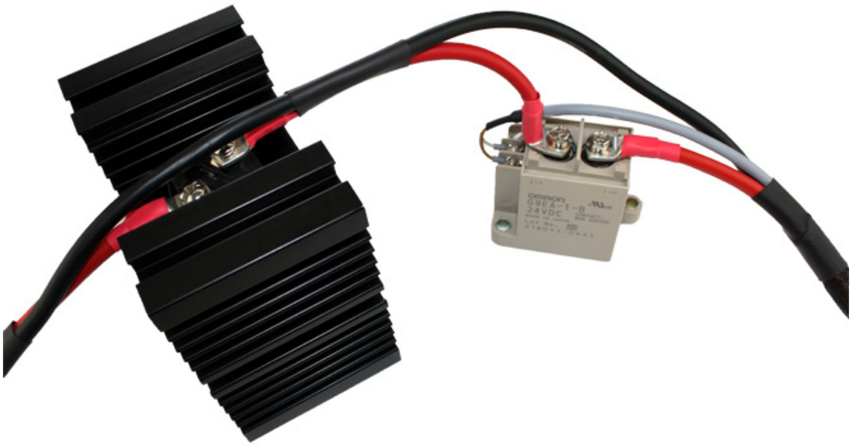


Fig. 3-6 Heat sink with mounted reverse current diode and connected load relay

### 3.2.4 Communication

For connecting a PC or the OSC, the Startup Kit also includes a CAN-USB converter, CAN cable and 2 terminating resistors.

Fig. 3-7 CAN-USB converter, 2 terminating resistors and CAN cable

### 3.2.5 Nexa® 1200 Remote Control Software

The Nexa® 1200 RCS (also referred to as the software) is used for communication between the Nexa® 1200 and the PC. The software is primarily used for visualization of the measured data. It also makes it possible to operate the unit via the PC.

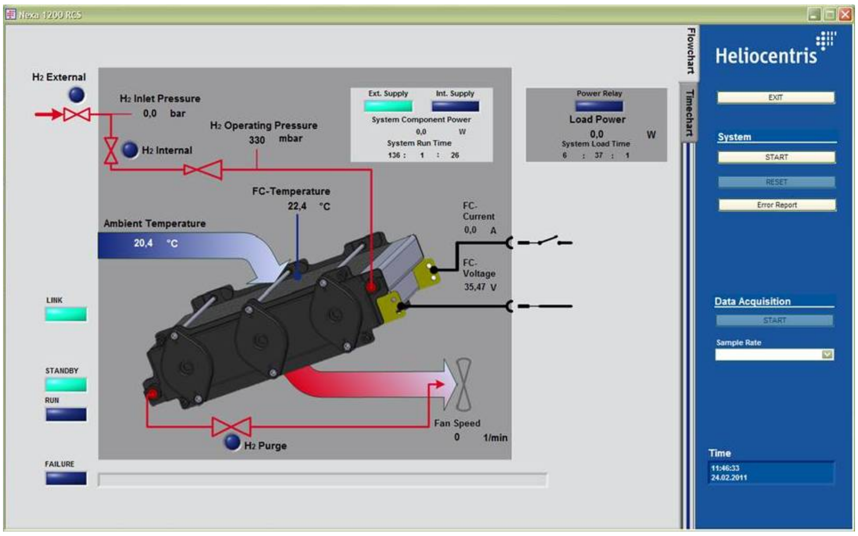



Fig. 3-8 Nexa® 1200 RCS

Communication with the Nexa® 1200 and the PC takes place via a CAN interface.

The software allows measuring of all relevant operating parameters, e. g. stack voltage and stack current.

# 4 Getting Started

This chapter describes the scope of delivery and the necessary steps for initial startup of the Nexa® 1200 from choosing a suitable installation location to connecting all required components.

## 4.1 Scope of Delivery

| **Illustration** | **Designation** |
|---|---|
|  | Nexa® 1200 |
|  | Nexa® 1200 Startup Kit connection set<br>• 2-pin plug connector for connecting the external power supply<br>• Load relay<br>• Reverse current diode on heat sink<br>• Pre-assembled power supply cable for battery, load and load relay<br>• 8-pin plug for the *SAFETY CHAIN* connection<br>• 10 sliding blocks<br>• Pre-assembled solenoid valve with hydrogen hose and 6-pin plug connector for the connection of the solenoid valve and load relay |
|  | Nexa® 1200 Startup Kit communication set<br>• CAN-USB converter<br>• CAN cable<br>• 2 CAN terminating resistors)<br>• CD-ROM Nexa® 1200 RCS<br>• CD-ROM PEAK System |

Table 4-1 Scope of delivery

## 4.2 Additional Supplemental Components

The following components are also recommended for connecting the unit – they are not included in the scope of delivery, but can be purchased from Heliocentris.

- Connecting set for hydrogen supply
- HydroKnowz™ hydrogen sensor

## 4.3 Installation Location

The unit must be operated in a lab which complies with the local regulations (see Requirements for the Location / Installation Location on page 10).

The installation location must also meet the following requirements:

- Hydrogen monitoring
- Frost-free
- Precautions against electrostatic charge have been taken
- Non-flammable or difficult to ignite surface (at least FV-1 according to IEC 60707 or better)
- Stable, level surface
- The unit may be operated at a maximum angle of inclination of 10 ° relative to the mounting plane
- Clean
- To prevent overheating of the unit, a minimum clearance of 20 cm must be maintained from walls or other equipment
- To ensure unobstructed air circulation the clearance at the air outlet must be at least 30 cm
- Do not install the unit in cabinets or facilities without sufficient ventilation
- Power connections must be present
- The back side must be accessible for making connections

## 4.4 Unpacking and Installation

The following section describes what to watch out for when unpacking and setting up the unit.

**CAUTION**

**Danger of injury due to heavy weight of the unit!**

If the unit falls, this can result in injuries from crushing. Material damage can also occur.

➔ Wear safety shoes.

➔ Have 2 persons unpack and set up the unit.

✓ Suitable installation location

✓ 2 persons

1. Grasp unit on profile side to lift it out of the packaging.
2. Check the unit for obvious transport damage to the packaging and to the product itself. In the event of damage, inform the shipping company and Heliocentris or your supplier about the damage immediately.
   – *If possible, document the damage with a camera.*
3. Compare the delivered items with the information in this instruction manual immediately after unpacking.
   – *(see page 21).*


Fig. 4-1 Set up the Nexa® 1200 horizontally

4. Set up unit at selected installation location.
   – *The unit must be set up horizontally*

**TIP** Store packaging material for future storage or dispatch of the unit.

## 4.5 System Design

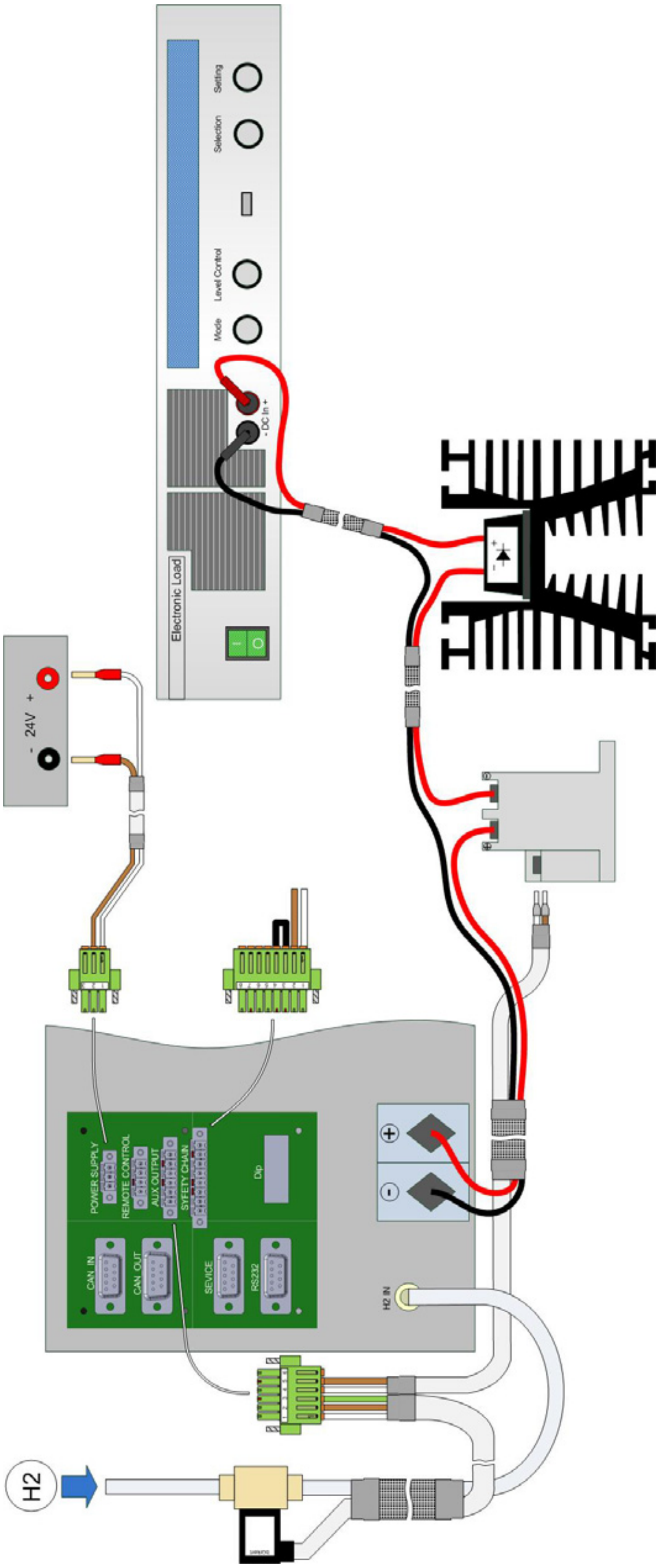


Fig. 4-2 Assembly instructions for the Nexa® 1200

### 4.5.1 How to Establish Electrical Connections and Communication

To get the unit ready for operation, connections must still be established for the electrical system, communication, safety devices and the hydrogen supply:

Connections and plugs are coded to prevent incorrect connection.

**NOTICE**

**Damage due to defective cables!**

Defective cables can cause a short circuit, resulting in damage to the unit.

➔ Check cables for intactness before use and reject defective cables.

## 4.6 How to Connect an External Load

An external load can be connected to the unit. For this purpose, the electronic loads (EL 2400 or EL 1500) of Heliocentris are suitable:

While the black (-) power cable is connected directly to the load, the red (+) power cable is routed through the load relay and the reverse current diode.

**NOTICE**

**Damage due to short circuits!**

Voltage can be present at the power output. If it is short-circuited this can damage the stack.

➔ Do not short-circuit the power output.

**NOTICE**

**Damage due to reverse current!**

Reverse current from the load to the unit can damage the fuel cell system.

➔ Install a reverse current diode between the unit's power outputs and the power inputs of the connected load.

Power output of the unit


Fig. 4-3

The power outputs are below the connection panel on the back of the unit. The power outputs are designed as screw terminals.

Proceed as follows to connect an external load to the unit:

- ✓ Pre-assembled power supply cable for battery, load and load relay
- ✓ The external load is switched off
- ✓ The device is off-circuit
- ✓ Flat-tip screwdriver

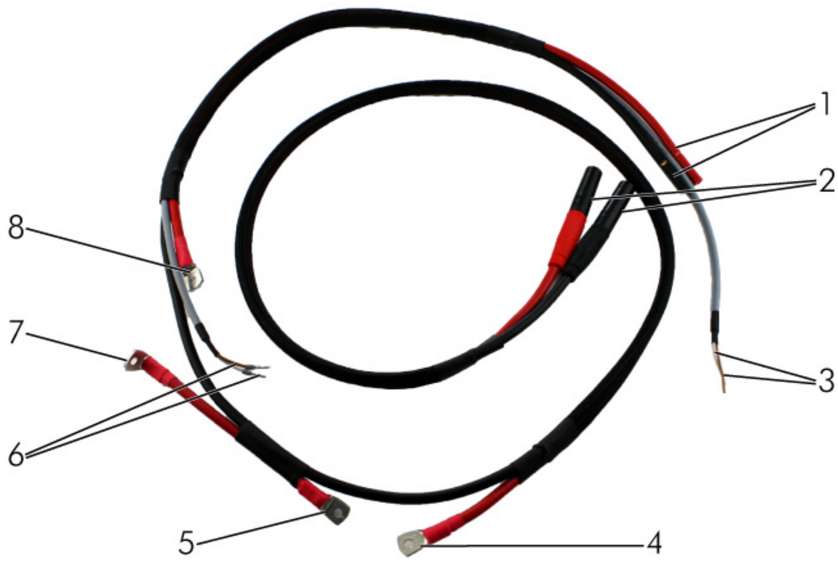



Fig. 4-4 Pre-assembled power cable

1. Loosen locking screws (1, Fig. 4-3) to open the power outputs (2, Fig. 4-3).
2. Insert the exposed end of the black power cable (1, Fig. 4-4) into the negative power output (-).
3. Insert the exposed end of red power cable (1, Fig. 4-4) into the positive power output (+).
4. Tighten the locking screws hand-tight.
5. Insert the black lab plug (2, Fig. 4-4) into the negative power input (-) of the load.

   ⇨ *The power cables are now connected to the power output.*

### 4.6.1 How to Connect the Load Relay

A load relay serves to switch off the load. It is connected between the unit's positive power output and the load. The load relay can be positioned anywhere near the unit.

Connect the load relay as follows:

- ✓ Load relay
- ✓ The pre-assembled power cable is connected to the load output of the unit

- ✓ Pre-assembled solenoid valve
- ✓ Philips-head screwdriver

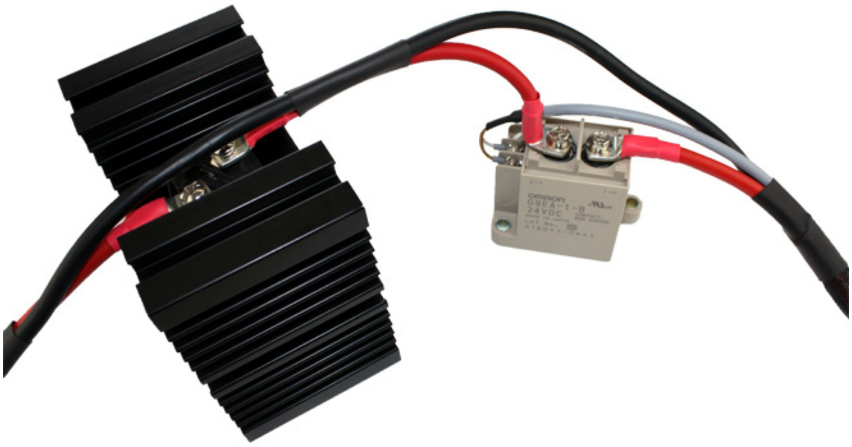


Fig. 4-5 Connect the load relay as follows

1. Connect the positive power cable coming from the unit (8, Fig. 4-4) to positive contact 1 (+) of the load relay.
2. Connect the angled side of the positive power cable (7, Fig. 4-4) to negative contact 2 (-) of the load relay.

   ⇨ *The power cable is connected to the load relay.*

Control of the load relay

For the control, the load relay is connected to the unit through the control of the solenoid valve by a two-wire cable.

Fig. 4-6

1. Plug the two wire cable (3, Fig. 4-4) to the fourth and fifth terminal of the solenoid valve plug connector (Fig. 4-6).
   - *Press the orange holding spring of the 5th terminal back towards the rear.*
   - *Insert the negative lead (brown) of the 2-wire cable.*
   - *Release orange holding spring.*
   - *Repeat steps with the positive lead (white) and the 4th terminal.*

Fig. 4-7

2. Loosen the screws of the contacts on the side of the load relay (Fig. 4-7).
3. Insert the white lead of the two-wire cable (6, Fig. 4-4) in Contact 8.
4. Insert the brown lead in Contact 7.
5. Tighten screw hand-tight.

   ⇨ *Electrical connection to load relay is now established*

### 4.6.2 How to Connect the Reverse Current Diode

Without the use of a reverse current diode, the unit is not protected against reverse current from the load to the unit. The installation of the reverse current diode with a heat sink is absolutely necessary.

The heat sink enlarges the heat-emitting surface of the reverse current diode, therefore preventing the possibility of damage from overheating. The heat sink can be positioned anywhere near the unit as long as it can dissipate the heat efficiently.

NOTICE ! Damage from reverse current! Install a reverse current diode between the unit's power outputs and the power inputs of the connected load.

Connect the diode to the unit as follows:

- ✓ Heat sink with reverse current diode
- ✓ The pre-assembled power cable is connected to the load relay.

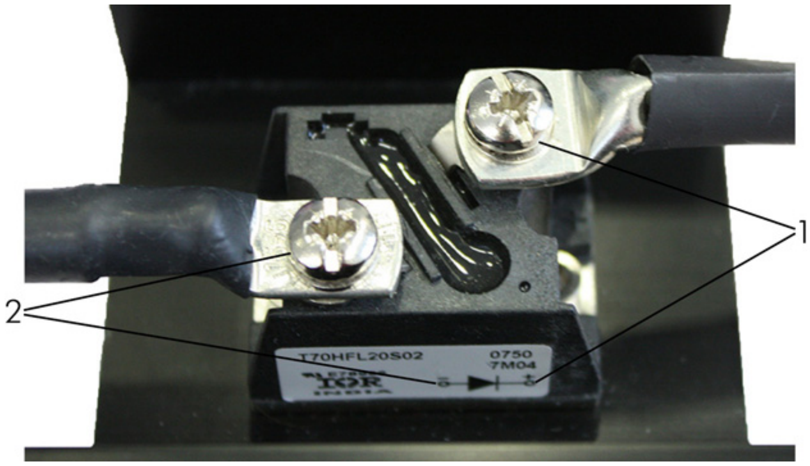



Fig. 4-8 Reverse current diode on heat sink

1 Positive contact
2 Negative contact

1. Loosen screw of negative contact (2) on the reverse current diode.
2. Place cable lug of the positive power cable (5, Fig. 4-4) coming from the load relay on the contact.
3. Tighten screw on contact hand-tight.
4. Loosen screw of positive contact (1) on the reverse current diode.
5. Place cable lug of the positive power cable (4, Fig. 4-4) to the load on the contact.
6. Tighten screw on contact.

   ⇨ *Reverse current diode is now connected.*

## 4.7 How to Install Safety Devices

### 4.7.1 How to Install the Safety Chain

**WARNING**

**Danger of injury due to hydrogen!**

Escaping hydrogen can ignite and cause severe burns to the body.

Escaping hydrogen can be hot and burn the skin.

Escaping hydrogen can reduce the oxygen concentration and cause respiratory difficulties.

➔ A safety chain must be installed.

The safety chain is based on a current loop. This allows every participant in the safety chain to detect or create an interruption. An interruption in the safety chain switches the system to an intrinsically safe state.

The following actions take place as soon as the safety chain is interrupted:

- All hydrogen valves of the unit are closed
- The connected load relay is disconnected
- The unit cannot be started

The electronic components of the safety chain can be integrated in an existing current loop, but they also have their own power source.

*NEXA® 1200* as a central safety controller

If the *NEXA® 1200* serves as the center of the safety equipment, various external monitoring devices (e.g. hydrogen and oxygen sensors) with potential-free switch output (relay contact) are integrated in the chain.

**How to connect the external $H_2$ sensor (not included in the scope of delivery)**

NOTICE ! If no external sensor / relay contact is used, a cable bridge must be used instead of the relay contact.

Connect the hydrogen sensor to the unit as follows:

- ✓ HydroKnowz™ hydrogen sensor
- ✓ Cable bridge
- ✓ Two-wire safety chain lead (0.5mm$^2$, flexible)
- ✓ Small flat-head screwdriver for holding spring

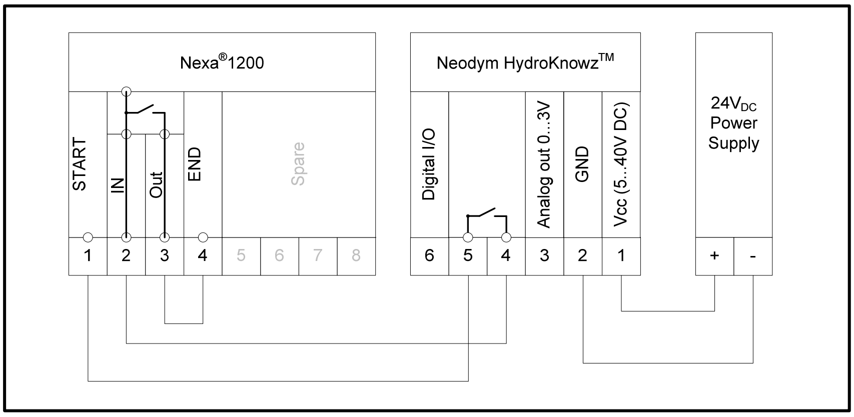



Fig. 4-9 Hydrogen sensor connection diagram

1. Plug cable bridge into the 3rd and 4th terminal in the SAFETY CHAIN connection on the Nexa® 1200.
2. Connect the 1st and 2nd terminal of the SAFETY CHAIN connection to the 5th and 4th contact of the hydrogen sensor.

   ⇨ *The hydrogen sensor is now connected*

For the allocation of the contacts, see Chapter Allocation of Plugs and Jacks on the Connection Panel page 78.

### 4.7.2 How to Connect the Equipotential Bonding Conductor

The equipotential bonding conductor eliminates electrical potential differences (voltages) between the devices of the system, the ground and conductive parts of third-party equipment. Connect the equipotential bonding conductor as follows:

- ✓ Equipotential bonding cable (not included in delivery)
- ✓ 10 mm open-end wrench (not included in delivery)

Fig. 4-10 Equipotential bonding

1. Loosen nut.
2. Place equipotential bonding cable on thread.
3. Tighten nut.
4. Fasten the other end of the equipotential bonding cable to a further Heliocentris product (e.g. a further Nexa® 1200 or Nexa® DC 1200) or to the rack system.

   ⇨ *Equipotential bonding is established.*

## 4.8 How to Connect the Hydrogen Supply

Hydrogen gas with a minimum purity of 4.0 (=99.99 %) is necessary for operation of the stack. The permissible hydrogen inlet pressure is 1…15 bar.

The unit can be supplied with hydrogen by means of all options, e.g. lab supply, metal hydride canister or electrolyzer which fulfill the above conditions.

**CAUTION**

**Danger of injury due to gas jet!**

The compressed hydrogen cylinder is pressurized. If the gas jet is directed at human beings, this can result in injuries.

➔ Do not direct the gas jet at human beings.

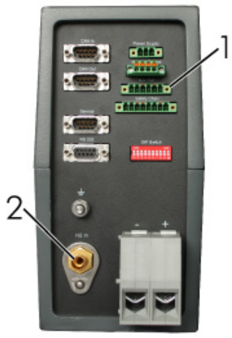



Fig. 4-11

The connection for the hydrogen supply is located on the back of the unit, to the left of the power connections.

The hydrogen valve is pre-assembled. It is equipped with a connecting cable and a hydrogen connection.

The load relay cables are already connected to the cables of the solenoid valve by means of a plug connector (see Control of the load relay on page 27). This plug connector is connected to the AUX OUT (1, Fig. 4-11) connection.

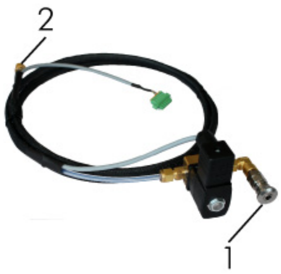



Fig. 4-12

Solenoid valve to Nexa® 1200

Connect the hydrogen supply as follows:

- ✓ Hydrogen Supply
- ✓ Solenoid valve
- ✓ Hydrogen connection set (not included in scope of delivery), with quick coupling and consisting of
  - *Pressure reducer*
  - *Hydrogen hose*
- ✓ Hydrogen connecting set must be connected to hydrogen supply (see documentation for hydrogen connection set)
- ✓ Main valve of the hydrogen supply is closed

1. Push back the union nut on the hydrogen hose (Fig. 4-12, 2).
2. Insert the hydrogen hose in *$H_2$ IN* (Fig. 4-11, 2) as far as it will go.
3. Push the coupling ring forward.
4. Tighten hand-tight.
5. Tighten ⅛ to ¼ of a turn with the open-end wrench.

Solenoid valve to hydrogen connection set

6. Insert quick coupling plug of the pressure reducer from the hydrogen connection set into the quick coupling of the solenoid valve (Fig. 4-12, 1) until it locks into place.

⇨ *The hydrogen supply is now connected.*

Set pressure

➔ Set the hydrogen inlet pressure.

➔ The recommended hydrogen inlet pressure for optimal operation is between 3 and 8 bar.

Electrical connection of solenoid valve

Connect the solenoid valve as follows:

1. Insert plug connector (Fig. 4-12) in the AUX OUT (Fig. 4-11, 1) connection.
2. Tighten the locking screws hand-tight.

   ⇨ *The electrical connection of the solenoid valve and load relay is established.*

## 4.9 How to Connect the External Power Supply

**NOTICE**

**Damage due to incorrect connection!**

Connection of the external power supply to a different jack than *POWER SUPPLY* will short-circuit the unit.

➔ Connect the external power supply only to *POWER SUPPLY*.

AC adapter

Connect an AC adapter as the external power supply as follows:

✓ Power supply unit (12…36 $V_{DC}$)

✓ Power cable with plug connector


Fig. 4-13 Connect external power supply

1 Connection for power supply    2 Pre-assembled power supply cable

The startup kit includes a pre-assembled power supply cable with a plug connector in which the leads are already inserted into the terminal.

1. Connect an AC adapter with the power supply cable to the power supply.
2. Set the voltage (12…36 $V_{DC}$) at the power supply unit
3. Insert plug connector of the power supply cable (2) into the connection for the external power supply (POWER SUPPLY, 1).
4. Tighten the locking screws hand-tight.

NOTICE! Incorrect polarity can damage the unit! Check for correct polarity of the connection: + = red, - = black.

5. Insert lab plug of the power supply cable into the AC adapter.

   ⇨ *The external power supply with the AC adapter is now established.*

For the allocation of the contacts, see Chapter Allocation of Plugs and Jacks on the Connection Panel on page 78.

Battery

It is possible to provide the power supply with a battery (9...36 VDC). The battery cannot be charged by means of the unit.

## 4.10 How to Perform a Leak Test

For safe operation of the unit, it must be assembled so that there are absolutely no leaks.

The leak test should be conducted every time the hydrogen supply is connected.

- ✓ The unit is assembled
- ✓ Electrical connections are established
- ✓ Hydrogen supply is connected
- ✓ Set for $H_2$ leak monitoring (not included in the scope of delivery)

1. Remove contacts of the solenoid valve from the terminal (contact 1, 2 and 3 on AUX OUT) connection.
   - *Press the orange holding spring of the terminal toward the back.*
   - *Remove the lead.*
   - *Release orange holding spring.*
2. Connect solenoid valve cable to external power supply (AC adapter). The polarity of this connection is not important.
3. Switch on AC adapter with 0.4 A and 24 V to open solenoid valve.

   ⇨ *Opening the solenoid valve generates a clicking sound.*
4. Open valve from hydrogen supply (e.g. gas cylinder valve on the compressed gas cylinder).
5. Set the hydrogen inlet pressure.
6. Read the pressure.
7. Close the valve.
8. Wait 5 minutes.
9. Check the hydrogen primary pressure.
10. If the hydrogen primary pressure has not changed, the installation is leak proof.
11. If the hydrogen primary pressure has dropped, there is a leak in the installation.
12. Use the hand-held sensor and the leak test liquid to find the leak.

- *See the included operating manual for the personal gas warning unit and the instructions printed on the cylinder.*

Leak found:

13. Seal connection.
14. Repeat steps 1–7.

Leak eliminated

15. Switch off AC adapter.
16. Disconnect solenoid valve cable from the AC adapter.
17. Connect solenoid valve to unit
    - *Press the orange holding spring of the 2nd terminal of the plug connector back towards the rear.*
    - *Insert the negative lead (brown) of the 2-wire cable.*
    - *Release orange holding spring.*
    - *Repeat the preceding steps with the positive lead (white) and the 1st terminal.*

## 4.11 How to Establish Communication

**NOTICE**

**Damage due to incorrect interface cable!**

Incorrect interface cables can damage the unit.

➔ Use only connecting elements provided by Heliocentris.

The following data interfaces are connected to the unit.

- *CAN IN* (1): to PC
- *CAN OUT* (2): to a further Heliocentris product, e. g. Nexa® 1200 or Nexa® DC 1200

A CAN interface (3) is provided for service purposes.

The following data interfaces can optionally be connected to the unit:

- *RS232* (4)

The *RS232* interface can be enabled by Heliocentris if needed.

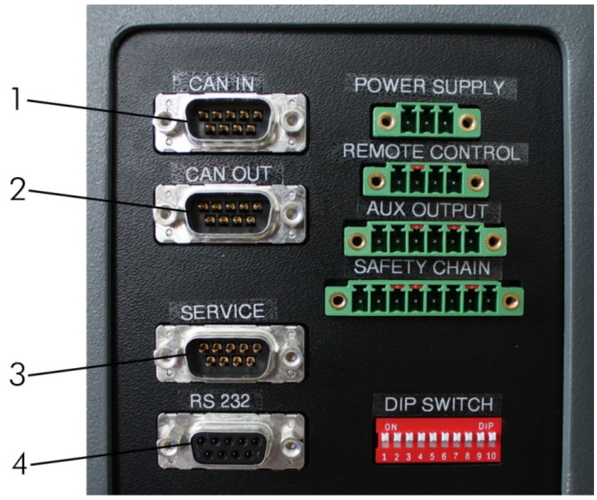



Fig. 4-14 Data interfaces

1 *CAN IN* (PC)

2 *CAN OUT* (connection for further unit)

3 *SERVICE* (CAN)

4 *RS232*

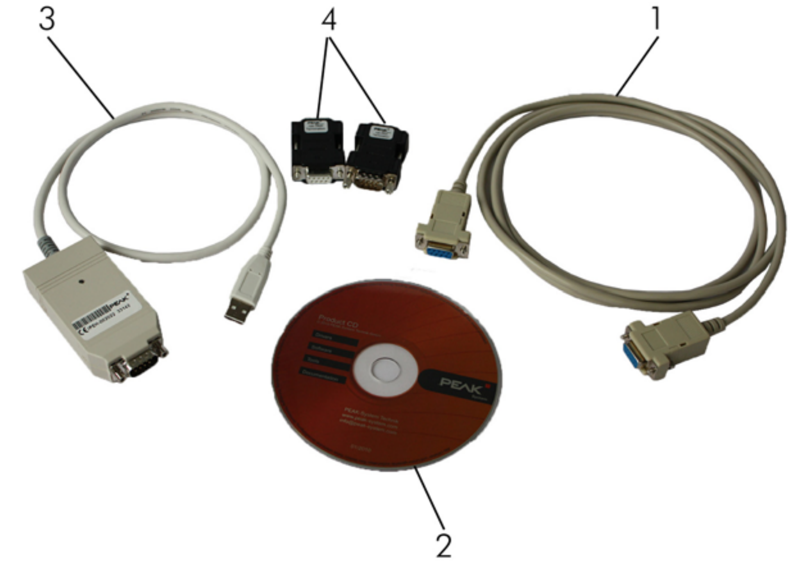



Fig. 4-15 Components for connection of PC and terminal connection of CAN-Bus

1 CAN cable

2 Driver CD

3 CAN-USB converter

4 Resistors

Fig. 4-16 Assembly instructions for establishing communication

### 4.11.1 How to Connect the Data Interface to the PC and Connect the CAN Bus to Terminals

Connect a PC as follows:

- ✓ PC or OSC (not included in delivery)
- ✓ CAN-USB converter
- ✓ CAN cable
- ✓ Terminating resistor
- ✓ Small flat-head screwdriver

PC connection

1. Insert jack of CAN cable in *CAN IN* of the unit.
2. Insert terminating resistor in jack of CAN cable.
3. Insert CAN-USB converter in terminating resistor.
4. Tighten all locking screws hand-tight.
5. Insert USB plug of the CAN-USB converter into the USB port of the PC.

   ⇨ *The unit is now connected to the PC.*

CAN-Bus terminal connection

The CAN-Bus must have a terminal connection if the unit is the last or only Heliocentris product connected to the bus. Establish the terminal connection as follows:

- ✓ Terminating resistor

1. Insert the terminating resistor into *CAN OUT*.
2. Tighten the locking screws hand-tight.

   ⇨ *The terminating resistor is now connected.*

### 4.11.2 How to Install the Software and Hardware Drivers

How to install the software and the hardware driver:

- ✓ System requirements

(see PC Requirements on page 83)

- ✓ CD-Rom Nexa® Integration System
- ✓ Sufficient rights for installation of the software
  - – *Contact the administrator, if necessary*

1. Switch on PC and monitor.
2. Insert the CD-Rom Nexa® Integration System

The folder on the CD for the software installation is named *SOFTWARE*.

3. Open *SOFTWARE* folder.
4. Open *NEXA® 1200 RCS INSTALLER* folder.
5. Follow the instructions of the setup program for the Nexa® 1200 RCS.

   ⇨ *The program Nexa® 1200 RCS is installed.*

Install the PCAN-USB Driver

6. Follow the instructions of the setup program from the PCAN USB (software) driver.

   ⇨ *The PCAN USB (software) driver is installed.*

7. Restart the PC

8. Open >*ALL PROGRAMS* > *NEXA INSTALLER RC04* in the Windows Start menu.

9. Follow the instructions of the setup program from the PCAN USB (hardware) driver.

10. Select the following options:

    – *PCAN-USB Driver*
    – *PCAN View Bus CAN Bus Monitor*

11. Follow the further instructions of the setup program from the PCAN USB (hardware) driver.

    ⇨ *The PCAN USB (hardware) driver is installed.*

12. Open > *CONTROL PANEL* in the Windows start menu.

13. Open *PCAN* folder.

    ⇨ *The* PROPERTIES *dialog opens.*

14. Mark the *USB* checkbox and confirm with *ADOPT* and *OK*.

15. Close the dialog window and the > *CONTROL PANEL*.

    ⇨ *The communication between the unit and the PC can now be established.*

# 5 Operation

The unit can be controlled via the Nexa® RCS software, buttons on the unit or remote control.

To start the unit and the software and to establish communication between the unit and the software, proceed as follows:

- Start unit
- Start software

The order is not important.

## 5.1 How to Start the Nexa® 1200

Proceed as follows to put the system into operation:

✓ The unit is mounted
  – *(see Unpacking and Installation on page 22)*

✓ Hydrogen supply is connected
  – *(see How to Connect the Hydrogen Supply on page 31)*

✓ Interfaces are connected
  – *(see How to Establish Communication page 34)*

✓ Hydrogen connection has been checked for leaks
  – *(see How to Perform a Leak Test on page 33)*

✓ Power supply (AC adapter or battery) is connected and switched on.

Start unit

Start the unit as follows:

➔ Press button.

Fig. 5-1 Button

Or (if software is already running)

➔ Click the START button in the SYSTEM area.

⇨ *The unit is now switched on. The flush valve opens and flushes the unit. The fast blinking CAN-USB converter indicates the transfer of data to the PC.*

Initialization

The unit conducts the initialization, starting with the system test. The communication is initialized by the system.

Standby

After successful initialization and completion of the system test, the system automatically switches to *STANDBY MODE* and also switches to internal power supply.

**TIP**

If the unit continues to operate and communicate in the event of a faulty stack, for example as a result of insufficient hydrogen, it is recommended to leave the external power supply switched on while the unit is in operation. This maintains external communication when the unit switches to *ERROR MODE*.

### 5.1.1 Information for the Commissioning:

The system can reach 50…60 % of the full capacity right after startup. To regenerate the system, a longer warm-up period may be necessary, depending on the past operation. The information provided here is based on experience; diverging values do not necessarily mean that the unit is defective.

The warm-up period depends on the temperature and the relative humidity during the storage period, the load and the characteristics of the BOP. The table below shows the foreseeable warm-up times with constant current load operation (65 A) and a minimum excess of oxygen of 20.

| Effect temperature | 80 % stack power | 100 % stack power |
|---|---|---|
| 20 | 0:20 | 1:35 |
| 0 | 1:00 | 2:51 |

Table 5-1 Foreseeable warm-up time of the Nexa® 1200 until the specified power is reached (minutes:seconds)

## 5.2 How to Start the Software

✓ PC and monitor are switched on

Start the software

Start the software as follows:

➔ In the Windows start menu, open > *PROGRAMS* > *NEXA® 1200 RCS*.

⇨ *The software starts.*

## 5.3 Operating Modes

The unit is in different modes during the course of operation.

| Designation | Description | Supply |
|---|---|---|
| *OFF* | The unit is not switched on and there is no external power supply present. Communication is not possible. The LEDs are off.<br>If the unit was switched from *RUN* or *ERROR* to *OFF*, | Without |

| Designation | Description | Supply |
|---|---|---|
| | the minimum quantity of hydrogen still remaining in the stack diffuses after a maximum period of 30 minutes. | |
| *STANDBY* | The unit is ready for operation. The start signal (button on the unit or Start button in software) switches the unit to *RUN* . The green LEDs blink in alternation. | External |
| *RUN* | Power can be tapped. The external load relay is actuated and closed. The unit is in normal operating mode. The green LEDs light up continuously.<br>Depending on the power output the fuel cell is flushed regularly in this operating mode; this is accompanied by an audible noise. | Internal |
| *ERROR* | The unit switches to an intrinsically safe state due to incorrect parameters. Red LED signals error. | External |

Table 5-2 User-related operating modes of the unit

### 5.3.1 Processes

Certain processes take place during the transition from one mode to the next:

| Designation | Description | Mode transition |
|---|---|---|
| Initializing | External power supply is established. The controller of the unit conducts the initialization. The communication is initialized and started by the system. Outputs controlled by the controller are set to defined values.<br>The system controller analyzes the sensor signals and initializes the variables required for operation.<br>This process is displayed in the software. | *OFF* → *STANDBY* |
| Fuel cell startup | The system controller starts the stack. This includes startup of the air and hydrogen supply. From this point onward all operating parameters, the operating pressure, fuel cell voltage, fuel cell current and temperatures are controlled constantly. As long as all operating parameters are within the defined ranges, the unit is remains switched to internal power supply.<br>As long as all operating parameters in internal power supply state are within the defined ranges, the unit is in *RUN* mode. | *STANDBY* → *RUN* |
| Fuel cell shutdown | The external input valve is closed, thus interrupting the hydrogen supply. If necessary, the stack is cooled to the defined temperature. The internal power supply is switched off. If a power supply is (still or again) present, the unit switches to *STANDBY*; otherwise it automatically switches to *OFF*. | *RUN* → *STANDBY* → *OFF* |

Table 5-3 Processes which take place during the transition from one mode to the next

## 5.3.2 LED Display of the Mode or Process

The LEDs on the front of the unit indicate the operating mode or current process of the unit.

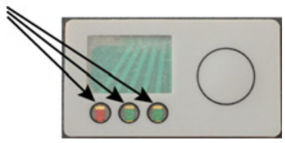


Fig. 5-2 LED display

| LED (from left to right) | | | Operating mode or process |
|---|---|---|---|
| Red | Green | Green | |
| o | o | o | Initializing (after application of an external power supply) |
| - | (o) | o | Standby, Fuel cell startup, Fuel cell shutdown |
| - | o | o | Run |
| o | - | o | Error |
| (o) | - | o | Critical error, e.g. in the safety chain |
| - | - | - | Unit has no external power supply |

Table 5-4 LED display of the mode or process

1 o LED lights up

2 (o) LED blinks

3 - LED off

## 5.3.3 Communication Status

The communication status is indicated at the CAN-USB converter.

Fig. 5-3 Status display at CAN-USB converter

| Status display | Meaning |
|---|---|
| Blinking fast | Data is being sent to PC |
| Blinking slow | Error in communication |
| No signal | No communication |

Table 5-5 Communication status

## 5.4 How to Reset an Error

The operating parameters are displayed in the software flow chart. If the parameters are not within the specified values, the unit switches to *ERROR* mode. Warnings and error messages (2) are displayed in the field next to the *FAILURE* button.

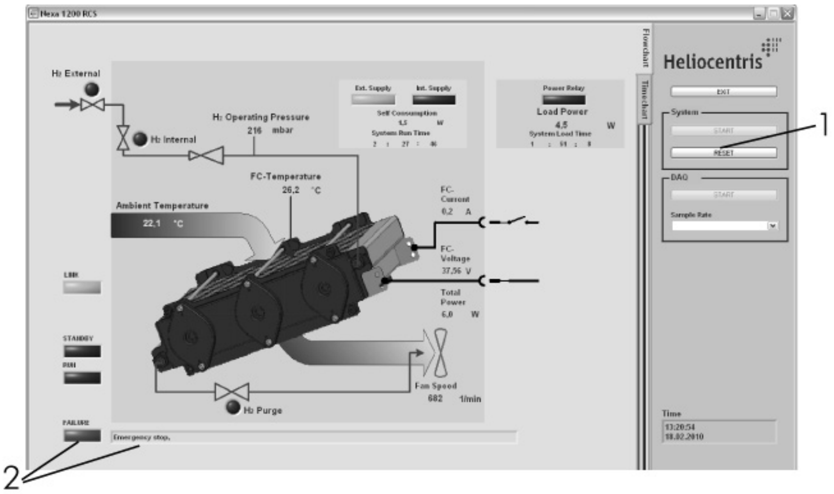



Fig. 5-4 Error

Troubleshooting

In case of shutdown due to an error, the unit is in a locked operating mode. After eliminating the cause of the error, the user must reset the error in order for the unit to operate.

**Reset error**

After eliminating the error, it has to be reset. Reset an error as follows:

In the software

- ➔ Click *RESET* (1) button in *SYSTEM* area.
- ➔ Click the *START* button in the *SYSTEM* area.
- ⇨ *This switches the unit to the* STANDBY *mode after an error.*

Or

On the unit

- ➔ Press button.
- ⇨ *The unit can now be started again.*
- ➔ Press button one time briefly.
- ⇨ *This switches the unit to the* STANDBY *mode after an error.*

If the error is not completely eliminated, the unit will switch back to *ERROR* mode during the initialization.

## 5.5 How to Enable Power Output

If the system is in *STANDBY* mode and the operating mode status display (*OFF*) in the software is blinking, the power output can be enabled. It is recommended to first connect the load and set it to 0.

Proceed as follows to enable the power output:

- ✓ Power cables are connected
- ✓ Load relay is connected
- ✓ Reverse current diode is connected
- ✓ System is in *STANDBY MODE*

Unit

1. Press button.

Fig. 5-5 Button

Or

Software

1. Click the *START* button in the *SYSTEM* area.
2. Switch on load.

   ⇨ *Load relay closes and power can be tapped.*

**TIP** If the software is closed, the most recently set power parameter is kept; in other words the loads draws power from the battery. Switch off the load manually.

## 5.6 How to Maintain the Hydrogen Supply

**TIP** Insufficient hydrogen supply results in shutdown of the unit and therefore shutdown of the load. Make sure that sufficient hydrogen is available at all times. The hydrogen inlet pressure during operation must be at least 1 bar. The recommended hydrogen inlet pressure is 3...12 bar.

If the pressure of the hydrogen supply is less than 1 bar, the hydrogen supply must be replaced. To do so, the unit must first be shut down.

- See How to Shut Down the Nexa® 1200 page 51.

# 6 Software

The function of the software is to switch the to the various operating modes and to visualize all relevant operating parameters. The operating parameters, e.g. stack voltage and stack current, can be saved.

## 6.1 Software Views

The software is divided into 2 views: Flowchart and Timechart.

The status display, navigation bar and control area are maintained in each view.

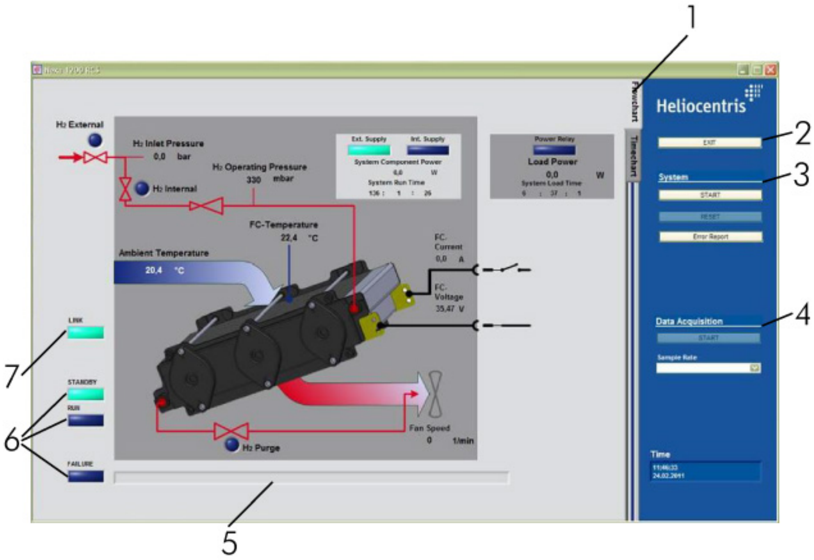



Fig. 6-1 Flowchart Software View

| | |
|---|---|
| 1 Navigation bar | 2 *EXIT* button |
| 3 System controller | 4 Data acquisition |
| 5 Error and warning messages | 6 Status display of unit |
| 7 Status display of communication | |

**Current operating status**

Four display fields at the left of the display (6, 7) show the operating mode and the communication status of the unit. The current operating mode and the existing communication with the unit are displayed in green.

**Navigation**

The vertical navigation bar (1) is located between the view and the control area. The respective view can be activated by clicking on the corresponding tab.

- *FLOWCHART*: Flowchart View
- *TIMECHART*: Timechart View

***EXIT***

At the top of the control area you will find the *EXIT* button (2) which interrupts the connection to the unit and shuts down the software.

*SYSTEM* — Beneath the *EXIT* button, in the *SYSTEM* area, you will find the buttons for controlling the unit.

*START / STOP* — Click the *START* button to start the unit.

During operation, the text on the button changes to *STOP*. Click the *STOP* button to switch the unit to *STANDBY* mode.

*RESET* — Click the *RESET* button to reset existing error and warning messages.

*ERROR REQUEST* — When the *ERROR REQUEST* button is clicked, a service file is created, which can be sent to Heliocentris Service for error remedy. This file is saved in the directory *C:\DOCUMENTS AND SETTINGS\USER\USER DATA\NEXA 1200\ERROR REPORT*.

*DATA ACQUISITION* — Beneath the *SYSTEM* area you will find the area for recording the data.

For further information on recording data, see How to Record Data on page 49.

*TIME* — The current time and date are displayed in the control area the bottom of the display.

## 6.1.1 Flowchart view

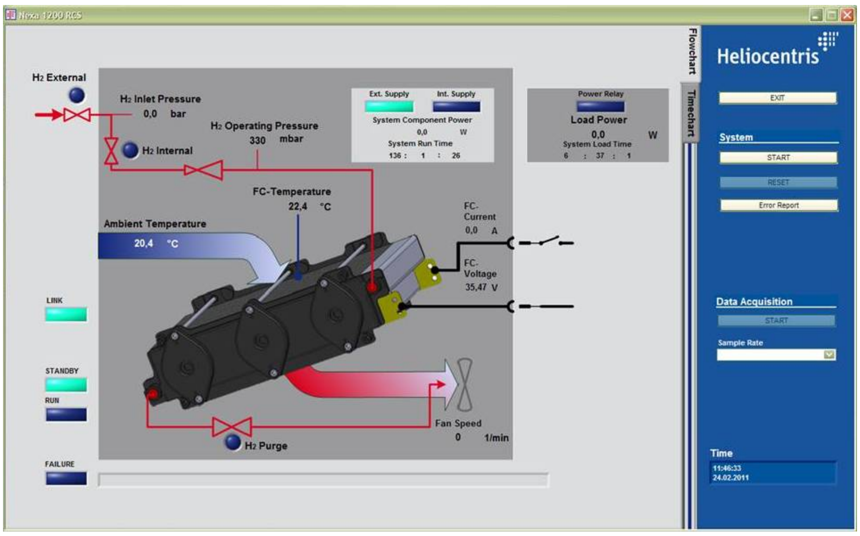



Fig. 6-2 Flowchart with displayed parameters

The flowchart view is the default view on startup. It visualizes the stack with all interfaces and the system limits.

The flowchart view shows the individual values of the operating parameters and other information.

| Area | Displayed parameters | Definition | Units / states |
|---|---|---|---|
| Hydrogen Supply | $H_2$ *INTERNAL* | Internal hydrogen valve | Green (active), blue (inactive) |
| | $H_2$ *EXTERNAL* | External Hydrogen Valve | |
| | $H_2$ *INLET PRESSURE* | Inlet pressure | bar |
| | $H_2$ *OPERATING PRESSURE* | Operating pressure | mbar |
| Air supply / cool- | *AMBIENT TEMPERATURE* | Ambient temperature | °C |

| Area | Displayed parameters | Definition | Units / states |
|---|---|---|---|
| ing | *FC TEMPERATURE* | Fuel cell temperature | °C |
| | *FAN SPEED* | Fan speed | 1/min |
| Exhaust air | *$H_2$ PURGE* | Flush valve | Green (active), blue (inactive) |
| Power | *FC CURRENT* | Total power output | A |
| | *FC-VOLTAGE* | | V |
| Hydrogen supply and consumption | *EXT. SUPPLY* | Power supply, external / internal | Green (active), blue (inactive) |
| | *INT. SUPPLY* | | |
| | *SELF COMPONENT POWER* | Self consumption | W |
| Operating hours | *SYSTEM RUN TIME* | Hours of operation starting with initial startup | hh : mm : ss |
| External load | *POWER RELAY* | Load relay | Green (open), blue (closed) |
| | *LOAD POWER* | Load power | W |
| | *SYSTEM LOAD TIME* | Runtime with closed load relay starting with initial startup | hh : mm : ss |
| Mode | *LINK* | Communication status | Green (active), blue (inactive) |
| | *STANDBY* | Operating mode | |
| | *RUN* | | |
| | *FAILURE* | | |

Table 6-1 Operating parameters displayed in the flow chart

### 6.1.2 Timechart view

The vertical navigation bar is located between the view and the control area. Click the *TIMECHART* tab to activate the timechart view.

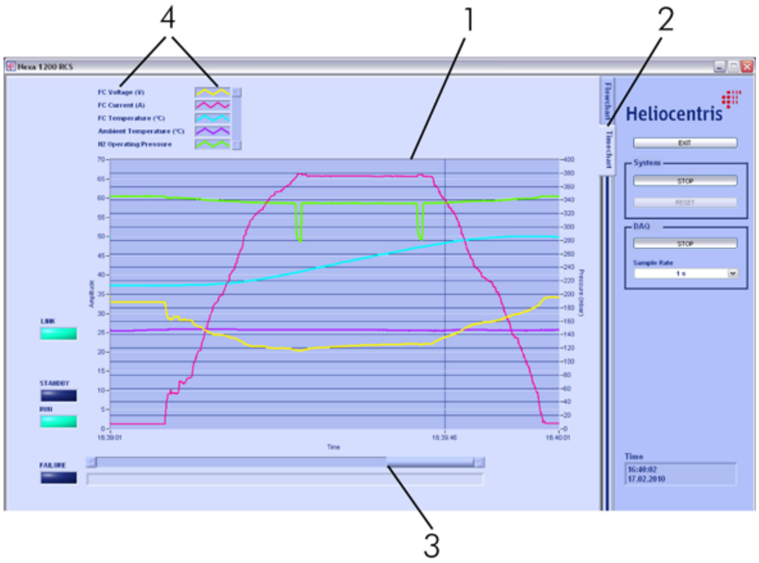



Fig. 6-3 Timechart view

1 Time history of the individual parameters

2 *TIMECHART* tab

3 History of the time chart

4 Displayed parameters with respective display mode

This view visualizes the measured values and system data in the form of graphs. Data is displayed in time curves.

The following parameters are displayed:

- Fuel cell voltage (*FC VOLTAGE*)
- Fuel cell current (*FC CURRENT*)
- Fuel cell temperature (*FC TEMPERATURE*)
- Ambient temperature (*AMBIENT TEMPERATURE*)
- Operating pressure (*H2 OPERATING PRESSURE*)

Display history of the time chart:

➔ Push the horizontal slider (3) beneath the chart in the direction of the desired time interval.

## 6.2 How to Install the Software

Installation of the software is described in How to Install the Software and Hardware Drivers (see page 36).

## 6.3 How to Start the Software

The procedure for starting the software and establishing communication with the unit is described in How to Start the Software, page 40.

## 6.4 How to Record Data

Activate the recording of the data in the *DAQ* operating area as follows:

1. Click the drop-down field *Sample Rate*.
2. Set the desired time interval for performing the recording (e.g. 30 s: a measurement is recorded every 30 seconds).
   - *The following values can be selected: 1 s, 10 s, 30 s, 1 min, 5 min, 10 min*

   ⇨ *The* Start *button is no longer grayed out.*
3. Click the *Start* button.

   ⇨ *The data recording begins. During recording of data, the text on the button changes to* Stop.

Proceed as follows to stop the recording:

1. Click the *Stop* button.

   ⇨ *The data recording stops. A dialog opens.*

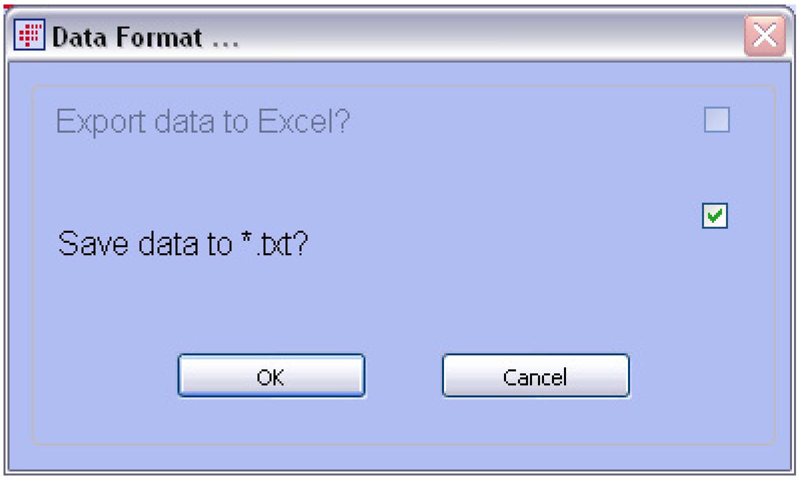



Fig. 6-4 Data format…dialog

2. Select the checkbox of the desired output format:
   - *Output as a text file is the default*

   or

   - *Deactivate check box for text output*
   - *Select Excel file checkbox*
3. Confirm with *OK*.

   ⇨ *Another window opens and prompts for the corresponding path and filename.*

**TIP** Use unique filenames so that you can classify the data at any time.

4. Enter the desired path and filename and save using the *Save* button.

⇨ *The recorded data is saved.*

## 6.5 How to Uninstall the Software

To uninstall the software, use the integrated software management functions in the Windows operating system.

1. In *START* > *CONTROL PANEL* open the *SOFTWARE* folder.

   ⇨ *The* SOFTWARE *dialog opens with a list of the installed software.*

2. Select *NEXA® 1200 RCS* .
3. Click the *REMOVE* button.

# 7 Decommissioning

## 7.1 How to Shut Down the Nexa® 1200

The following steps must be performed to shut down the unit:

- Switch off the unit
- Disconnect unit from the power supply
- Shut down the hydrogen supply

### 7.1.1 How to Switch off the Nexa® 1200

Proceed as follows to switch off the unit:

1. Switch off all consumers and loads.

   ➔ Unit: Use the button to switch off the unit.

   ⇨ *LED signals* SHUTDOWN: *middle LED blinks, right LED lights up green.*

Or

   ➔ Software: Use the *STOP* button to switch off the unit.

   ⇨ RUN *button blinks yellow.*

2. Close the software by pressing the *EXIT* button.
3. Shutdown the PC and switch off.

### 7.1.2 How to Disconnect the Nexa® 1200 from the Power Supply

✓ The unit is switched off

➔ Disconnect the power supply, i.e. physically disconnect the AC adapter from the power grid or disconnect the battery.

⇨ *The unit is now disconnected.*
⇨ *LED signals* OFF: *all LEDs are off.*

### 7.1.3 How to Shut Down the Hydrogen Supply

✓ The unit is switched off
✓ All LEDs are off
➔ Close main valve of the hydrogen supply

➔ If operating unit with a compressed hydrogen cylinder / metal hydride canister, store properly.

– *See documentation for hydrogen supply*

⇨ *The hydrogen supply has been shut down*

## 7.2 Storage and Transportation of the Nexa® 1200

The following steps must be performed if the unit is to be stored or transported:

- Switch off unit
  – *(see How to Switch off the Nexa® 1200 page 51)*
- Disconnect unit from the power supply
  – *(see How to Disconnect the Nexa® 1200 from the Power Supply page 51)*
- Shut down the hydrogen supply
  – *(see How to Shut Down the Hydrogen Supply page 51)*
- Remove the hydrogen connections
- Shut down the external load
- Disconnect electrical contacts
- Disconnect data interfaces
- Pack components

### 7.2.1 How to Disassemble the Hydrogen Supply

✓ Open-end wrench
✓ Flat-tip screwdriver
✓ All LEDs are off

1. Loosen locking screws with flat-tip screwdriver.
2. Disconnect plug of the solenoid valve from the AUX OUT connection.

   ⇨ *The electrical connection of the load relay is now disconnected.*
3. Unscrew the coupling ring on the hydrogen connection of the unit.
4. Pull out the hydrogen hose.

⚠ CAUTION! The solenoid valve becomes hot during operation! Do not touch.

5. Push back the release ring on the quick coupling of the solenoid valve.
6. Pull out the quick coupling plug.

   ⇨ *The hydrogen supply has been shut down.*

⇨ *As soon as the solenoid valve has cooled and the contacts on the load relay have been disconnected, the solenoid valve can be packed.*

### 7.2.2 How to Shut Down the External Load

After switching off the power supply, a residual amount of hydrogen is still present in the stack. This causes the unit to remain in operation for a maximum duration of 1 minute, which also means that voltage is present at the unit's power output. Therefore, do not disconnect the power connection from the unit until the LEDs reliably indicate OFF mode, i.e. when all LEDs are off.

✓ Flat-head screwdriver
✓ Philips-head screwdriver

1. Loosen the locking screws on the top end of the power output.
2. Pull out the power cable.
3. Tighten the locking screws hand-tight.

Remove load relay

4. Loosen screws for the contacts on the load relay.
5. Remove the cable lugs of the positive power cable.
6. Remove the contacts of the load relay cable.
7. Tighten screws on contacts hand-tight.

⇨ *Load relay is now disconnected.*

Remove reverse current diode

8. Loosen screws for the contacts on the reverse current diode.
9. Remove the cable lugs of the positive power cable.
10. Tighten screws on contacts.

⇨ *Reverse current diode has now been disconnected.*

Disconnect communication

➔ Disconnect the RS232 cable from the Electronic Load and the PC connection.

### 7.2.3 How to Disconnect Electrical Contacts

The following electrical contacts must be disconnected:

- Power supply cable
- Equipotential bonding conductor

✓ 10 mm open-end wrench
✓ Flat-tip screwdriver

Power supply cable to adapter or battery

1. Loosen locking screws.
2. Pull out the plug from the POWER SUPPLY connection.
3. Pull out the lab plug from the adapter or disconnect from the battery.

⇨ *External power supply is now disconnected.*

Equipotential bonding conductor

4. Loosen nut with open-end wrench.
5. Disconnect equipotential bonding cable from the threads.
6. Tighten nut.
   ⇨ *Equipotential bonding is now disconnected.*

The following electrical contacts must optionally be disconnected:

- Monitoring device for the safety chain
- Load relay
- Remote control

✓ Small flat-head screwdriver

Monitoring device

1. Loosen locking screws of the SAFETY CHAIN connection with flat-head screwdriver.
2. Press the orange holding spring back towards the rear with the flat-head screwdriver.
3. Pull out the lead.
4. Release orange holding spring

Load relay

The load relay cable can remain in the plug connector of the solenoid valve for future use or it can be disconnected. Proceed as follows to disconnect the load relay contacts from the terminal:

5. Repeat steps 2 - 4 on contact 4 and 5 on the plug connector of the solenoid valve.
   ⇨ *The solenoid valve and load relay have now been shut down and can be packed.*

Remote control

6. Repeat steps 2 - 4 on the REMOTE CONTROL connection
   ⇨ *The remote control and monitoring device have now been shut down and can be packed.*

### 7.2.4 How to Disconnect Data Interfaces

✓ Small flat-head screwdriver

✓ Additional unit, peripheral devices and their power supply have been shut down

PC

1. Loosen locking screw of CAN cable.
2. Unplug the CAN cable.
3. Pull out the CAN-USB converter connection.
4. Pull out USB plug from the USB port of the PC.
   ⇨ *The data interface to the PC has been disconnected; the CAN-USB converter can be packed. The terminating resistor in* CAN IN *does not have to be disconnected.*

Additional unit

If no additional unit is connected, the *CAN OUT* is connected to a terminating resistor. This terminating resistor does not have to be disconnected.

Disconnect an additional unit from the data interface as follows:

1. Loosen locking screws from *CAN OUT* with a flat-head screwdriver.
2. Pull out the cable.

   ⇨ *The additional unit has now been shut down and can be packed.*

Peripheral devices

1. Loosen locking screws of the RS232 connection with flat-head screwdriver.
2. Pull out the cable.

   ⇨ *The peripheral device has now been shut down and can be packed.*

### 7.2.5 How to Pack and Store the Nexa® 1200

**CAUTION**

**Danger of injury due to falling!**

The package is heavy and can cause injuries if it falls.

➔ Two people are needed to carry it.

Pack the unit in the original packaging material.

The unit should be stored in the temperature range from 3…30 °C.

Storage at higher temperatures increases power losses during storage (see Power Losses during Storage). If the unit is stored at higher temperatures and for a longer period of time than specified in the Table 7-1, special start-up procedures are required (see Troubleshooting starting on page 57).

| Temperature range | Maximum storage duration |
|---|---|
| 3…30 °C | 2 years |
| 30…50 °C | 1 month |
| 50…70 °C | 3 days |

Table 7-1 Time limit for storage at higher temperatures

### 7.2.6 Power Losses during Storage

Storage of the Nexa® over a longer period of time results in a reversible loss of power. Losses increase with the duration of the storage time and the level of the storage temperature to up to 70 mV per cell.

### 7.2.7 Transporting the Nexa® 1200

The unit can be transported as needed. During transport, the unit should not be exposed to freezing temperatures or excessive heat for extended periods. A temperature range of -40…+70 °C is possible for a short time.

The position of the unit during transport is not important. When packing the single components, they must be sufficiently padded to protect them against impact and fast acceleration.

# 8 Troubleshooting

## 8.1 FAQ

1. Where is the firmware version of the Nexa® 1200 firmware?

   ➩ *Open the PCAN View USB program and view the messages of the Nexa® 1200.*

   ➩ *In ID 010 you can read the version in the last 4 bytes.*

2. How do I open PCAN View USB?


   ➔ Press the Windows START button.

   ➔ Open ALL PROGRAMS > PCAN > PCAN VIEW USB.

   ➔ Confirm the pre-set selection in the *PCAN VIEW* dialog with *OK*.

   ➔ Check of the following CAN message and log of the value – this must be *01 00 06*.

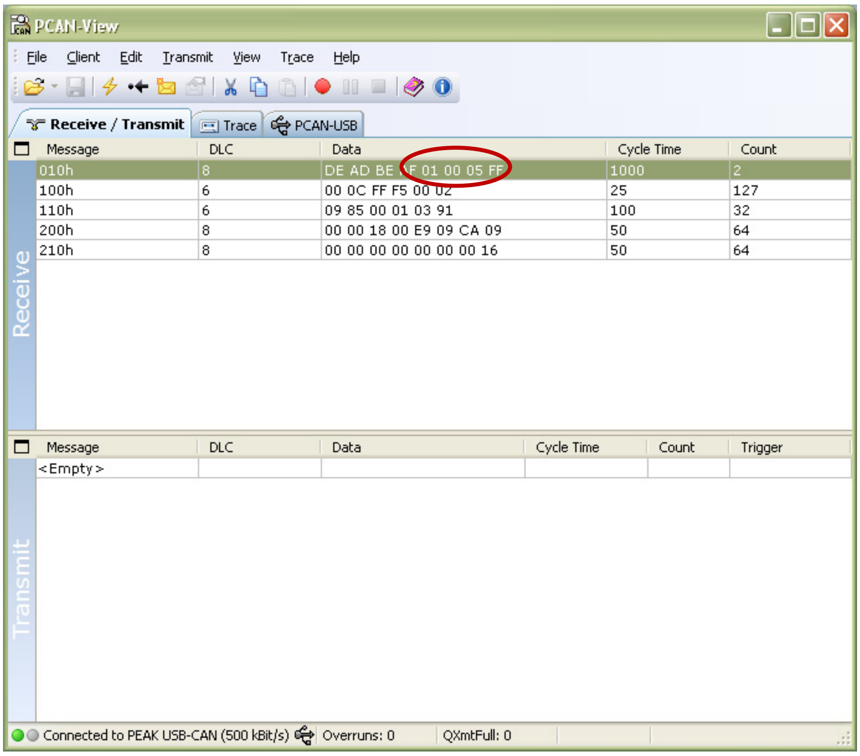



Fig. 8-1 PCAN View

3. How do I know if the firmware update has been properly executed?

   ➩ *Check the firmware version after the update through the PCAN USB Monitor*

⇨ *During the firmware upload the LEDs of the Nexa® 1200 are out and only illuminate once you press the* START *button in the upload software.*

4. What must I take into consideration or think about for the operation of the fuel cell?

   ⇨ *Since the fuel cell involves an electrochemical energy conversion based on hydrogen and oxygen, the characteristic of a fuel cell is essentially based on the electrochemistry which takes place. The fuel cell can experience a reversible loss of power due to storage and appearances of aging. After extended periods of shutdown, depending on the environmental temperature, it may take from several minutes to hours (depending on the load current) until the fuel cell reaches the characteristics specified in the data sheet.*

   ⇨ *Irreversible power losses can result due to contamination of the environmental air, such as sulfur compounds.*

5. How do I check whether the CAN communication is functional?

   ⇨ *For this purpose, you can connect the PCAN USB adapter directly to the terminator of the CAN network and test the CAN Traffic using the PCAN USB monitor software.*

   ⇨ *Check the ID addresses of the Nexa® 1200 with the PCAN USB monitor software. With proper communication, the messages received must lie in the 100 and 200 range.*

   ⇨ *Check the wiring of the communications and whether the CAN is properly connected to the terminating resistors.*

   ⇨ *Check whether it uses a correct null modem cable incl. terminating resistors or CAN cable. Do not use a RS232 cable.*

6. How can you tell that the Nexa® 1200 is in standby mode?

   ⇨ *The right green LED illuminates.*

7. How can you tell that the Nexa® 1200 is started?

   ⇨ *The middle LED blinks while the right LED permanently lights up green.*

8. How can you tell that the Nexa® 1200 is in operation?

   ⇨ *The LEDS on the front side both illuminate green. In standby mode only the right LED; errors are signaled by a red LED.*

   ⇨ *On the Hybrid Extension Kit the* NEXA RUN *LED illuminates (only with integration of the Nexa® DC1200)*

   ⇨ *Measure the output voltage at the cage terminal of the Nexa® 1200*

9. How can you tell that the Nexa® 1200 has just shut down?

   ⇨ *The right LED blinks while the middle LED permanently lights up green.*

10. Is it possible to save characteristics during operation of the system within the system without external software for later viewing?

    ⇨ *No. The internal memory is not intended for this purpose.*

11. Can an error memory be read out for Heliocentris Service?

   ➩ *Yes. For this purpose, see Software Views on page 46.*

12. How can I provide the supply voltage to an external $H_2$ sensor from the unit.

   ➩ *Connect the supply voltage of the external $H_2$ sensor to the Nexa® 1200 supply voltage.*

NOTICE ! The sensor must be designed for the supply voltage.

   ➩ *With the use of the Hybrid Extension Kit, you can tap the supply voltage at the Hybrid Extension Kit. In the 24 V version this voltage corresponds to the battery voltage. In the 48 V version the voltage is fixed at 24 V.*

## 8.2 Behavior in the Event of an Error

With supply through a battery (hybridization) or in operation with an external mains adapter, a controlled overall system shut-off always takes place in the event of an error of the Nexa® Integration System.

Restart after an error

➔ Press and hold the System Start button until the green System Run LED illuminates.

With an additional external voltage supply errors which lead to a shut-off can be viewed and acknowledged with the Nexa® 1200 RCS or Nexa® DC1200 Control Software.

## 8.3 Errors and Troubleshooting

| **Error / Error message** | **Possible cause** | **Solution** |
|---|---|---|
| After the firmware update the LEDs on the front side do not light up. | You have to press Start after the update | Press Start |
| | | Carry out the update again. If this is still not successful, contact Heliocentris Service |
| No communication with Nexa® 1200 PC software RCS | The PCAN – USB dongle is connect to the wrong USB port | Connect the PCAN – USB dongle to the same USB port at which it was installed |
| | If the PCAN USB dongle is active and receives messages, the blink frequency of the red LED increases significantly. Blink frequency approx. 1 Hz. | |
| | CAN hardware driver not installed after the RCS installation. | Install the CAN hardware driver: The PCAN hardware driver can be found under All Programs → Nexa Installer RC04 → PEAKOemDrv (see p. 37 for further details) |

| Error / Error message | Possible cause | Solution |
|---|---|---|
| | Incorrect ID address of the Nexa® 1200 | Check the ID addresses of the Nexa® 1200 with the PCAN USB monitor software. They must always end with 0 so that they are recognized by the RCS. In the case of IDs ending with a 1 or 7 the DIP switches on the rear connection panel are in the wrong position. Set all DIP switches to the upward position and then disconnect the supply voltage. It is necessary to restart the controller in order to adopt the changes. Check the IDs in the PCAN USB monitor after all old messages have been deleted with the RESET button and only the most current messages are displayed. |
| | Incorrect wiring of the communications or CAN Bus not terminated. | Check the assembly and complete wiring on the basis of the assembly instructions |
| | Use of an incorrect null modem cable, CAN cable or an RS232 cable. | Check whether a correct null modem cable incl. terminating resistors or a CAN cable is connected. Use of an RS232 cable is not permitted. |
| FAILURE illuminates on the RCS software, but no error is displayed | The safety electronics reacted faster to the triggering event than the software can react. There is a safety-relevant error present in the safety chain. The cause for this can only have been a short pulse (for example, how it can be called by turn-on current pulse). Due to the extremely fast triggering characteristics of the electronics hardware, this error was detected, but not registered by the software due to the inactivity of the firmware. | Reset by pressing RESET |
| The Nexa® 1200 is currently in RUN mode, but not load can be tapped at the connected lines. | Incorrect installation direction of the reverse current diode | Check the assembly and complete wiring on the basis of the assembly instructions |
| | The load relay does not function | |
| | The Nexa® is not in RUN mode. No voltage can be measured at the cage terminals. There is a hardware error. | Measure the output voltage at the cage terminals. If not, check whether both green LEDs on the front side illuminate. If this is not the case, contact Heliocentris Service. |
| The Nexa® 1200 remains in standby mode with the error and the unit cannot be started. EMERGENCY STOP error message. | | Configure the system's Emergency STOP chain according to the instruction manual (see 29). |
| | | Check the external Emergency STOP chain |
| The Nexa® 1200 has a reproducible error on start or start purge | Too low hydrogen inlet pressure | Check whether sufficient hydrogen is present (recommended inlet pressure range 2... 12 bar) |
| System repeatedly goes into error status due to excessive inlet pressure > 15 bar. | Excessive inlet pressure > 15 bar | Reduce inlet pressure to the recommended pressure range of 2... 12 bar |

| Error / Error message | Possible cause | Solution |
|---|---|---|
| The Nexa® 1200 appears to go into error status on start purge | The power supply unit has too little power | Check whether the external power supply unit can provide at least 110 W. The use of the Nexa® 1200 power supply available from Heliocentris is recommended. |
| The Nexa® 1200 goes into error status during the operation by the purge | Too low hydrogen inlet pressure | Check whether sufficient hydrogen is present (recommended inlet pressure range 2... 12 bar) |
| | Metal hydride storage canisters cool down due to a high desorption rate and the pressure in the canisters falls below the minimum inlet pressure of the Nexa® 1200 | Check the temperature of the metal hydride canisters and whether their outlet valves may possible be icy |
| The valve fittings of the metal hydride canisters cool down drastically during operation | Due to repeated rinsing processes in short intervals (for example in a high power range of approx. 65 A every 30 seconds) the desorption rates of the metal hydride alloys lead to a lowering of the temperature (endothermic reaction) of the metal hydride, which can cause the icing of the outlet valves. | Reduce the power or supplement the metal hydride canisters with additional canisters in order to prepare the hydrogen necessary for the rinsing processes. Volumetric flows of up to 140 Nl/min can arise during a rinsing process. |
| The Nexa® 1200 repeatedly goes into error status due to an excessive stack temperature | Output too high | For this purpose, reduce the load current and/or the power removed from the unit.<br>• Maximum stack temperature: 65 °C<br>• Maximum supply air temperature: 35 °C<br>• Maximum stack current limited to 60 A in the range of 0…25 °C supply temperature<br>• Maximum stack current decreases by 1 A/°C starting at a supply air temperature of 25 °C<br>• In other words, the maximum stack current at 35 °C is 45 A |
| | Dirty filter | Check the filter of the system for visible soiling and replace if necessary (see p. 63). |
| | Blocked air outlet | The clearance at the air outlet must be 30 cm |
| The Nexa® 1200 repeatedly goes into error status due to too high stack current | Output too high | For this purpose, reduce the load current and/or the power removed from the unit.<br>• Maximum stack current limited to 60 A in the range of 0…25 °C supply temperature (useable at load output are 60 A @ 25 °C)<br>• Maximum stack current decreases by 1 A/°C starting at a supply air temperature of 25 °C<br>• In other words, the maximum stack current at 35 °C is 45 A (useable at load output are 60 A @ 25 °C) |
| The Nexa® 1200 repeatedly goes into error status due to too low stack voltage | Output too high | |
| | Possibly the system reached End of Life. The reasons therefore may be different. | Contact Heliocentris Service. |

| Error / Error message | Possible cause | Solution |
|---|---|---|
| The hydrogen sensor continuously reports an excessive hydrogen concentration by a acoustic signals | Blocked air outlet | The clearance at the air outlet must be 30 cm |
| | Leak of the hydrogen supply | Contact Heliocentris Service. |
| The hydrogen sensor is connected, but does not react | There is a hardware error. | Contact Heliocentris Service. |
| The LEDs of the Nexa® 1200 do not illuminate; operation using the software is possible | There is a hardware error. | Contact Heliocentris Service. |
| Nexa® 1200 goes into error status during a start with too low current | A voltage is present at the load output of the unit | Check the assembly and complete wiring on the basis of the assembly instructions |
| | Too high ext. voltage at the output terminals of the unit | Observe switching from external to internal supply voltage. If a negative output can be detected after the switch, there is a defect of the internal fuse of the electronics. Contact Heliocentris Service. |
| Nexa® 1200 repeatedly switches to error status during shutdown (SYSTEM VOLTAGE TOO LOW or SYSTEM CURRENT TOO LOW). The error can be reset, but recurs reproducibly | Problem with internal electronics | Check whether the error occurs together with switching of the external load relay or solenoid valve.<br>Contact Heliocentris Service |
| Nexa® 1200 switches to error status during switching of external relay or valves (EMERGENCY STOP) | The cutoff current peaks of the relays or valves created by Lenz's law cause unwanted emergency stop errors through the unit's supply voltage. | Connect recovery diodes to the coils |

# 9 Maintenance, Service and Disposal

## 9.1 Maintenance

To ensure maximum performance of the unit and to prevent loss of efficiency, proceed as follows:

➔ Operate the unit regularly, at least once every month for half an hour at ca. 200 W.

**CAUTION**

**Danger of injury due to igniting hydrogen!**

As the result of damaged hydrogen hoses or leaky connections, hydrogen can escape and ignite.

➔ Close hydrogen supply

➔ Disconnect unit from power supply. Replace damaged hoses.

**NOTICE**

**Damage from short circuits!**

Short circuit due to damaged cables.

➔ Disconnect unit from power supply or battery. Replace damaged cables.

Inspect the condition of hoses and cables regularly and check connections for leaks and to make sure they are tightly connected:

Leaks

➔ Check hydrogen supply for leaks

– *(see How to Perform a Leak Test on page 33)*

### 9.1.1 How to Replace the Air filter

Occasion

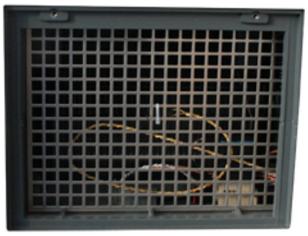
A sufficient amount of reaction air required by the fuel cell cannot be supplied if the air filter is dirty.

Interval

Visually inspect the air filter regularly for dirt. In the event of a visible accumulation of dirt and each year, no later than after 1000 operating hours, it must be replaced. For this purpose, contact Heliocentris.

Implementation

The replacement can be carried out at any time. The system does not have to be shut down for this.

Replace the air filter as follows:

- ✓ Air filter for replacement
- ✓ Open-ended wrench / socket wrench

1. Loosen the two screws of the air filter cover on the fuel cell module.
   - – *Keep the screws available for re-use.*
2. Remove the fan cover.
3. Remove the filter.
   - ⇨ *The fuel cell stack is behind a protective grating. The temperature sensor protrudes out through the grating.*
4. Place the new air filter in front of the protective grating, making sure that the temperature sensor fits between the fins of the air filter.
5. Slide the air filter cover into the guide with the slot from below.
6. Fold the air filter cover upward and screw in place.

### 9.1.2 How to Replace the Internal $H_2$ Sensor

The $H_2$ has a two-year function guarantee After this time it should be replaced for safety purposes in the case of regular operation or after extended periods of shutdown.

How to replace the $H_2$ sensor:

Fig. 9-1

- ✓ $H_2$ sensor
- ✓ The unit is switched off
  - – *(see How to Switch off the Nexa® 1200 page 51)*
- ✓ The device is de-energized
  - – *(see How to Disconnect the Nexa® 1200 from the Power Supply page 51)*
- ✓ Open-end wrench
- ✓ Allen key

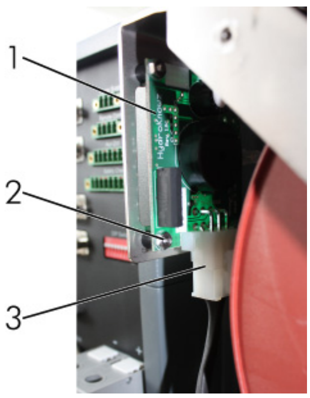



Fig. 9-2

1. Loosen the four screws of the fan cover (Fig. 9-1) on the rear side of the unit.
2. Remove the fan cover.
   - ⇨ *The $H_2$ sensor (1) is located to the left of the fan, screwed onto the fan mount.*
3. Pull out the plug of the $H_2$ sensor (3).
4. Loosen the four screws (2)of the $H_2$ sensor on the fan mount.
   - – *The screws are ready for re-use.*
5. Screw on the $H_2$ sensor for replacement on the fan mount.
6. Insert the plug in the $H_2$ sensor.
7. Re-mount and fasten the fan cover

⇨ *The $H_2$ sensor has been replaced.*

## 9.2 Cleaning

✓ Moist cloth

1. Disconnect unit from the power supply.
2. Clean the case with a slightly moist cloth.

## 9.3 Service

If you experience problems with the unit, then please contact the manufacturer:

Heliocentris Academia International GmbH

Rudower Chaussee 30

12489 Berlin

Germany

Fon +49 (0)30 – 340601-600

Email: service@heliocentrisacademia.com

An employee from Heliocentris Customer Service will contact you and explain all further steps. If you return the unit for repair or replacement, you must ship the unit sufficiently secured and packaged.

Heliocentris is not responsible for damage which has been caused by improper packaging and / or improper shipment. You must bear the costs yourself for the shipment of units with expired warranty.

## 9.4 Disposal

### Unit

The unit is not registered for use in private households. Therefore, it may not be disposed of at the local recycling centers. Return the unit to Heliocentris for disposal.

### Packaging material

➔ Store packaging material for future storage of the unit.

➔ Dispose of packaging material that is no longer needed in accordance with the local laws and regulations.

## 9.5 Warranty

For the Nexa® 1200 incl. startup kit (article number 1911) Heliocentris provides a warranty of 1 year.

The warranty only covers defects which are present at the time of the handover of the product from the seller to the purchaser.

A warranty for specific characteristics (e.g. power and service life of the fuel cell) is not made.

With proper operation a minimum service life of 1500 hours can be expected, which is guaranteed by Heliocentris.

Warranty claims against Heliocentris cannot be made if:

- The customer has caused the damage by improper use or incorrect operation
- Unauthorized repairs or manipulations have been made to the product
- The customer has neglected his duty of supervision and has caused damage to third parties

The supplier is liable for damage caused during the delivery to the customer and provides replacement in the case of damage.

In the case of complaints and return of the product, the risk is borne by the customer who must provide proper and secure packaging.

# 10 Integration

## 10.1 How to Install the Nexa® in a Rack System

The unit can be integrated in a 19" rack system with a depth of 600 mm. In a 19" rack system, the unit is always installed horizontally.

The following components are also available for connecting the unit – they are not included in the scope of delivery, but can be purchased from Heliocentris.

- 19" mounting bracket
- 90° angled exhaust housing.
- For installation on the fan cover; conducts exhaust air to the rear

The unit can be mounted in a 19" rack system as in the following example:

- ✓ 19" rack system with a depth of 600 mm (not included in the scope of delivery)
- ✓ At least 4 sliding blocks
- ✓ M5 screws (not included in delivery)
- ✓ Wrench (not included in delivery)

Fig. 10-1 Insert sliding block in profile

1. Mount shelf / rails in rack system at the desired height.
   – *See mounting instructions of the rack system manufacturer.*
2. Insert sliding block with the rounded side facing downward into the profile of the unit.
3. Insert at least one sliding block on each corner.
4. Insert the unit in the rack system.

5. Tighten screws in the sliding block through the hole in the shelf / rail.

   ⇨ *The unit is now mounted.*

## 10.2 How to Connect an Additional Unit via CAN

An additional Heliocentris product, e. g. Nexa® 1200 or Nexa® DC 1200 can be connected to the CAN OUT interface. Connect an additional unit as follows:

- ✓ CAN cable
- ✓ The unit is switched off
- ✓ Small flat-head screwdriver
- ✓ Terminating resistor removed from *CAN OUT*

1. Insert the SUB-D jack of the CAN cable in CAN OUT (2 in Fig. 4-15).
2. Tighten the locking screws hand-tight.

   ⇨ *The additional unit is now connected*

CAN-Bus terminal connection

The CAN-Bus must have a terminal connection if the unit is the last Heliocentris product connected to the bus. Establish the terminal connection as follows:

- ✓ Terminating resistor

1. Insert the terminating resistor into *CAN OUT*.
2. Tighten the locking screws hand-tight.

   ⇨ *The terminating resistor is now connected.*

## 10.3 Consideration of Internal Frequencies

**NOTICE**

**Damage due to resonances in the Nexa® 1200!**

Integration of the unit in a setup where shocks and vibrations are likely to occur can cause resonances which will damage the unit.

➔ In case the unit is integrated in such a setup, take measures to prevent resonances.

Resonances are always found in the same frequency ranges, regardless of the point of measurement. The most critical range to evaluate is between 25 Hz and 60 Hz. Smaller fluctuations also occur in the ranges 300 Hz…360 Hz, 1225 Hz…1280 Hz and 1790 Hz…1820 Hz.

In order to isolate vibrations of the unit, the Konus 20 vibration damper made by STS Schwingungstechnik Schuster GmbH is used.

## 10.4 How to Change the Configuration of the Nexa® 1200

On the connection panel on the back of the unit there are DIP switches (1). The DIP switches can be used to change the configuration of the unit.

The basic setting for all DIP switches is ON.

When operating several units in one CAN Bus, they can be assigned different IDs by means of the DIP switch. 8 different IDs can be assigned.

**TIP** The supplied Nexa® 1200 RCS software is functional only for ID 0


Fig. 10-2 DIP switches on connection panel

For the allocation of the DIP switches, see Chapter Table 10-10 Allocation of the DIP switches page 80.

## 10.5 How to Check the Hydrogen Supply

The unit features an integrated leak and function test. This test is automatically conducted each time an external supply voltage is applied. The solenoid valve with the pre-configured hose length included in the connecting set is absolutely necessary, since it also functions as a redundant safety valve.

NOTICE! When integrating the unit, the length of the hydrogen hose from the unit to the solenoid valve must not exceed 2 m, since otherwise the integrated leak and function test cannot be conducted.

## 10.6 Protocol Definition of CAN Interface

This chapter contains the protocol definition of the CAN interface for the communication of the fuel cell system Nexa® 1200 with an external control unit.

The communication of the device is carried out through a CAN bus (Controller Area Network) without an advanced implementation of protocol, i.e. the useful information is directly embedded within the OSI-Layer 2 (data back-up layer). In order to denote the content of the messages an 11 bit identifier (base frame format) is used. The bus works with a speed of 500 kBaud.

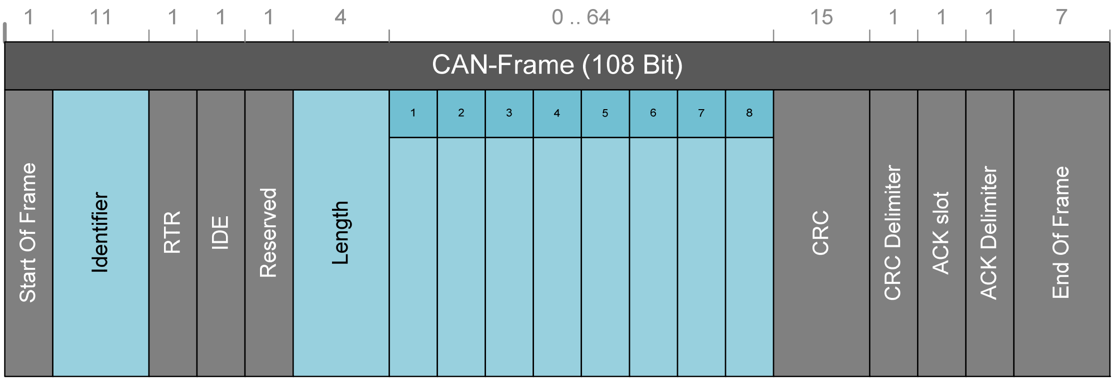



Fig. 10-3 CAN frame

Fig. 10-3 displays the content of a CAN message (frame) with the inscription of the corresponding identifier and its length. Tables 10-1 and 10-2 display which identifier is used for communication with the Nexa® 1200 fuel cell system and show its length (byte) and its transfer rate(T). An exact description of the message contents can be found in chapters 10.6.1 and 10.6.2.

| Identifier | Length | T | Content |
|---|---|---|---|
| 0x010 | 8 | 1s | Version number of the firmware |
| 0x100 | 6 | 25ms | Stack voltage and stack current<br>Self consumption of the system |
| 0x110 | 4 | 100ms | Stack temperature, H2 concentration in exhaust air and warnflags |
| 0x120 | variable | ACK | Response to 0x520 dependent on the parameter code in the 1. byte |
| 0x200 | 6 | 50ms | System pressure, system voltage, ambient temperature, mode |
| 0x210 | 6 | 50ms | Valve positions and fan rotation speed, fan control point and inlet pressure |
| 0x300 | 7 | - | Error flags (in the case of an error will only be transmitted once) |
| 0x330 | 8 | ACK / 25ms | Response to request 0x550. After a request several messages are sent in intervals of 25 ms in order to transmit the entire error memory that can be sent for |

| Identifier | Length | T | Content |
|---|---|---|---|
| | | | troubleshooting to the Heliocentris Service |

Table 10-1 CAN message transferred from fuel cell system to external control

| Identifier | Length | T | Content |
|---|---|---|---|
| 0x500 | 2 | acycl. | System commands for control of the Nexa®1200 (Start, Stop, Error Reset) |
| 0x520 | 8 | acycl. | Command for reading the stack operating time |
| 0x550 | 4 | acycl. | Request to dispatch the error log, which can be sent to Heliocentris Service for debugging. |

Table 10-2 CAN message transferred from external control to fuel cell system

The following specified CAN IDs are reserved for further Heliocentris' components in the Controller and must not be used for integration by the integrator.

| Identifier | Length | T | Content |
|---|---|---|---|
| 0x130 | 1 to 8 | ACK | answer to request 0x560 |
| 0x220 | 1 to 8 | ACK | answer to request 0x530 |
| 0x240 | 1 to 8 | ACK | answer to request 0x540 |
| 0x310 | 1 to 8 | ACK | answer to request 0x500 |
| 0x320 | 1 to 8 | ACK | answer to request 0x510 |
| 0x700 | 1 to 8 | - | variable content: debug information |

Table 10-3 Reserved CAN messages transferred from the fuel cell system to external control

| Identifier | Length | T | Content |
|---|---|---|---|
| 0x510 | 8 | acycl. | reserved |
| 0x530 | 8 | acycl. | reserved |
| 0x540 | 8 | acycl. | reserved |
| 0x550 | 8 | acycl. | reserved |
| 0x560 | 8 | acycl. | reserved |

Table 10-4 Reserved CAN identifiers transferred from the external control to the fuel cell system

### 10.6.1 Message Definition of Incoming Messages

Description of CAN messages (request) which are sent from an external control unit to the Nexa® 1200 fuel cell system .

### Identifier 0x500

The CAN message ID 0x500 transfers system commands to the control unit of the Nexa® 1200 (Start, Stop, Error Reset).

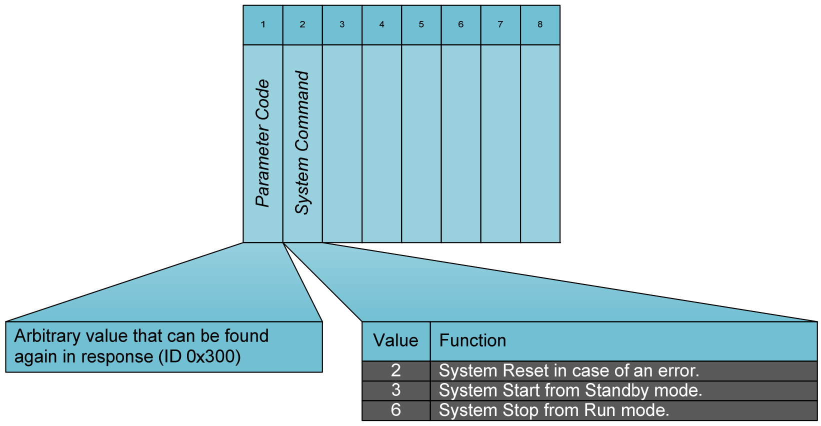



Fig. 10-4 Description of the frame 0x500

### Identifier 0x520

The stack operating time in the format hours, minutes, seconds is requested by the external control unit with CAN message ID 0x520 (Request); Nexa® 1200 responds to this message with CAN message ID 0x120.

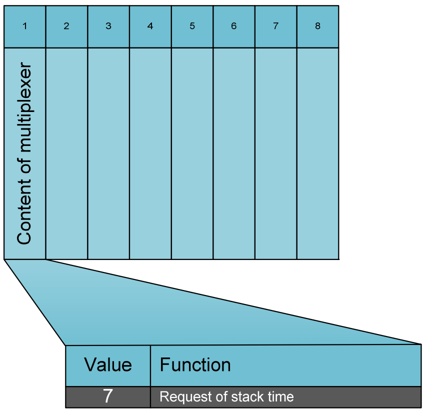



Fig. 10-5 Description of the frame 0x520

Length and content of this message are variable and depend on Byte0 multiplexer of the request (0x520). The multiplexer from 0x520 can be found again in Byte0 of the response. Values between 1…7 are valid, whereas exclusively value 7 is allowed to be used for the Integrator.

### Identifier 0x550

With the help of the Identifier 0x550, the external control unit requests the error log of the Nexa® 1200. It is possible that several controlling units request for the error log, or that during an existing transfer a new request is generated. In order to guarantee the allocation of the transferred data in accordance with a request, each request is furnished with a randomly generated request ID, which can then be found again in the corresponding response sequence. The request ID can thereby be displayed on a range of values between 1…255. Request IDs of the value 0 is ignored.

| Byte 1 | Byte 2 | Byte 3 | Byte 4 | Byte 5 |
|---|---|---|---|---|
| Request-ID | Command HB | Command LB | Frame # | Sequence # |
| ID, which can be found again in the response. Values between 1…255 are permitted. The message with the request ID "0" will be ignored | Commands 0 .. 3<br>0 request initialization (Command to dispatch a error frame.)<br>1 Resend all (break off the dispatch sequence with the stated request ID and start from the beginning.)<br>2 Resend frame (renewed dispatch of frames from byte 4 with the request-ID from byte 1)<br>3 Resend sequence (renewed dispatch of the sequence number from byte 5 of the frame out of byte 4 with the request from byte 1) | | # 0..N<br>States the frame that has to be sent by a frame-resend-command. | # 0..N<br>States the sequence number that has to be send by a resend-sequence-command. |

Table 10-5 Description of the data structure of frame 0x550

**TIP** Up to version V1.0.5 of the operational software of the fuel cell system the parallel processing of several connections is not yet supported.

## 10.6.2 Message Definition of Outgoing Messages

Description of messages sent from a fuel cell system to an external control unit.

### Identifier 0x100

The Frame with the identifier 0x100 is sent cyclically every 25ms. It transfers stack voltage, stack current and self consumption.

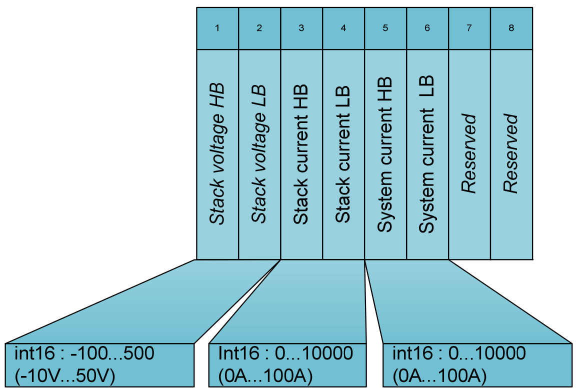



Fig. 10-6 Description of the frame 0x100

### Identifier 0x110

The Frame with the identifier 0x110 is sent cyclically every 100 ms. It transfers stack temperature, $H_2$ concentration and warning flags.

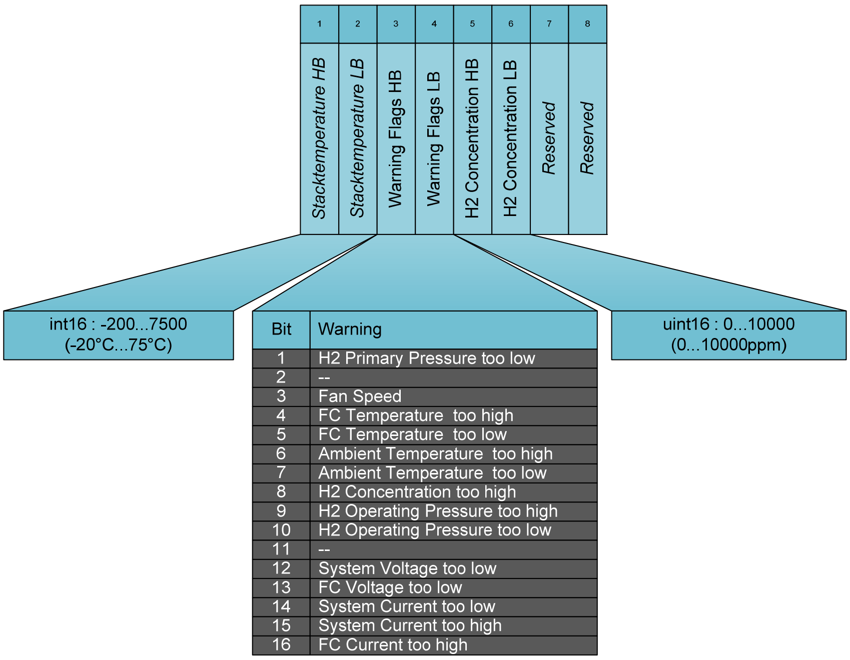



Fig. 10-7 Description of the frame 0x110

### Identifier 0x120

The frame with the identifier 0x120 is sent on request the ID 0x520.

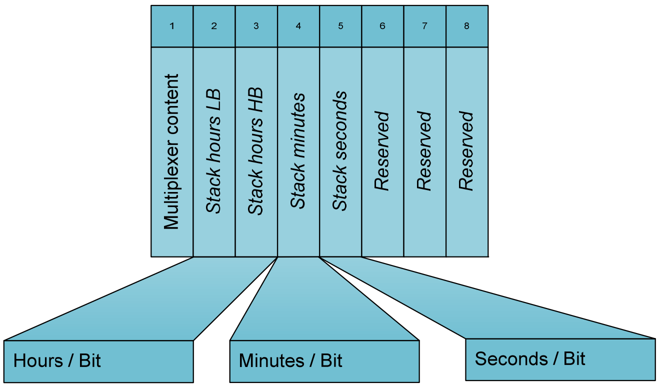



Fig. 10-8 Description of the content of frame 0x120

The message with the ID 0x120 will always be sent in response to the message 0x520. Length and content of this message is variable and dependent on Byte0 multiplexer of the request (0x520). The multiplexer from 0x520 can also be found in the Byte0 of the response. Valid are values between 1…7, where as the integrator can only use the value 7.

| Byte0 Multiplexer | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **Byte 1** | reserved | | | | | | Stack hours (HB) |
| **Byte 2** | reserved | | | | | | Stack hours (LB) |
| **Byte 3** | reserved | | | | | | Stack minutes |
| **Byte 4** | reserved | | | | | | Stack seconds |
| **Byte 5** | reserved | | | | | | - |
| **Byte 6** | reserved | | | | | | - |
| **Byte 7** | reserved | | | | | | - |

Table 10-6 Description of the content of frame 0x120

## Identifier 0x200

The frame with the identifier 0x200 is sent cyclically every 50 ms. It transfers data about system pressure, system voltage, ambient temperature, and current mode.

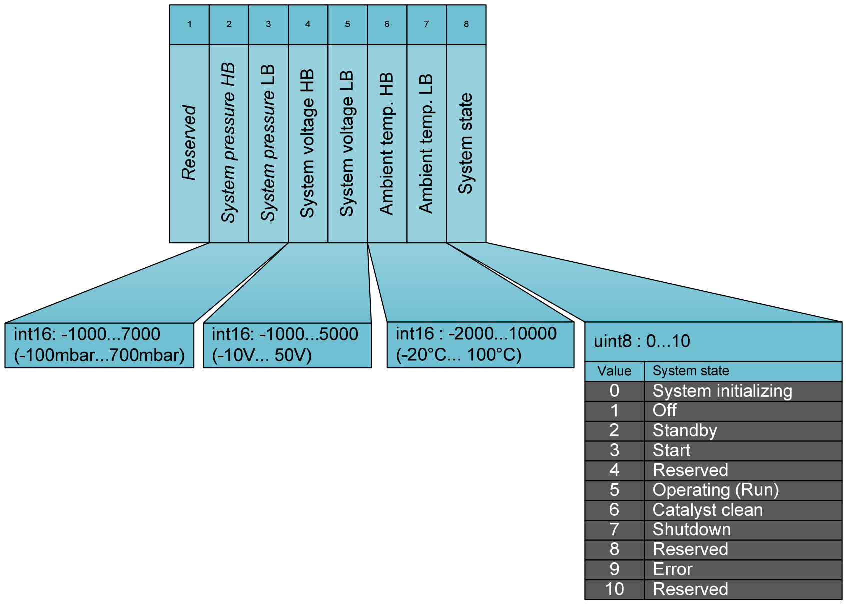
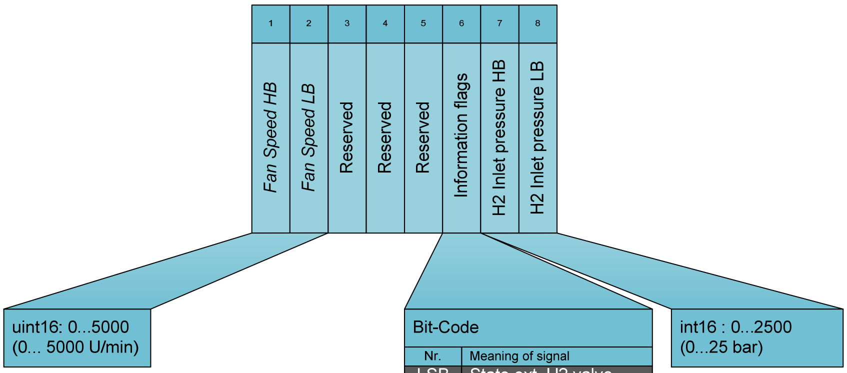



Fig. 10-9 Description of the frame 0x200

## Identifier 0x210

The frame with the identifier 0x210 is sent cyclically every 50 ms. It transfers data about valve positions, fan rotation speed, fan control point and inlet pressure.

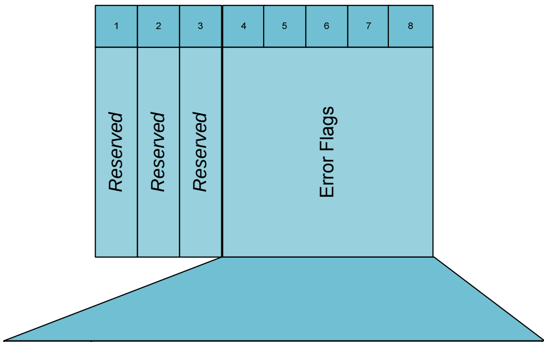



| Nr. | Meaning of signal |
|---|---|
| LSB | State ext. H2 valve |
| 1 | State int. H2 valve |
| 2 | State purge valve |
| 3 | Reserved |
| 4 | State power relay |
| 5 | Reserved |
| 6 | State int./ext. supply |
| MSB | State start button |

Fig. 10-10 Description of the Frame 0x210

### Identifier 0x300

The frame with the identifier 0x300 contains the error messages and is sent once an error appears.




| Bit | Error |
|---|---|
| 1 | FC-Current too high |
| 2 | FC-Current too low |
| 3 | System Current too high |
| 4 | System Current too low |
| 5 | FC-Voltage too high |
| 6 | FC-Voltage too low |
| 7 | System Voltage too high |
| 8 | System Voltage too low |
| 9 | - |
| 10 | - |
| 11 | - |
| 12 | Operating Pressure too high |
| 13 | Operating Pressure too low |
| 14 | Primary Pressure too high |
| 15 | Primary Pressure too low |
| 16 | H2 Concentration too high |
| 17 | H2 Sensor failed |
| 18 | Ambient Temperature exceded |
| 19 | Ambient Temperature passed lower limit |
| 20 | FC-Temperature exceded |
| 21 | FC-Temperature passed lower limit |
| 22 | Fan Speed |
| 23 | - |
| 24 | Emergency_Stop Sensorwerte |
| 25 | Emergency_Stop Overcurrent Safety Chain |
| 26 | Emergency_Stop external cut off |
| 27 | Emergency_Stop |
| 28...40 | - |

Fig. 10-11 Description of the frame 0x300

### Identifier 0x330

The frame with the identifier 0x330 is sent after a request (0x550) every 25ms, until the entire error log is transmitted.

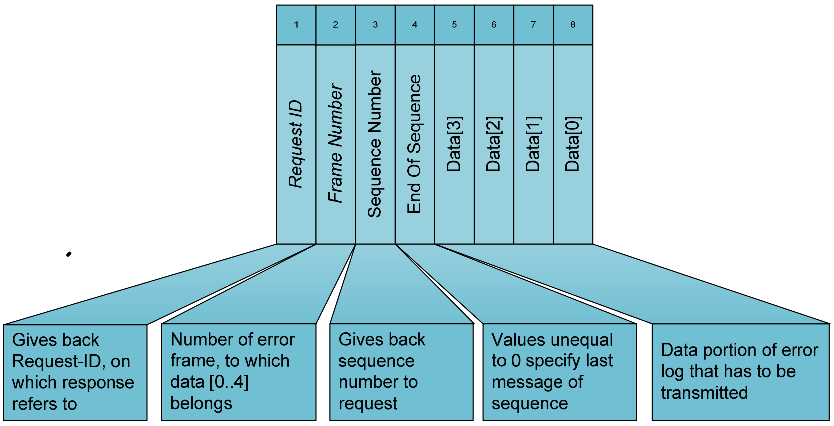



Fig. 10-12 Description of the Frame 0x330

The portion of data that begins with Data[0], is written linearly into memory. The process of writing ends when the *END OF SEQUENCE* Byte is unequal to 0. Fig. 10-13 gives an overview of how received data should be organized in the memory.

<table>
<tr><td colspan="17">Request ID</td></tr>
<tr><td colspan="8">Frame Number [0]</td><td rowspan="3">..</td><td colspan="8">Frame Number [N]</td></tr>
<tr><td colspan="4">Sequenz Number [0]</td><td colspan="4">Sequenz Number [1]</td><td colspan="4">Sequenz Number [N-1]</td><td colspan="4">Sequenz Number [N]</td></tr>
<tr><td>Data [0]</td><td>Data [1]</td><td>Data [2]</td><td>Data [3]</td><td>Data [0]</td><td>Data [1]</td><td>Data [2]</td><td>Data [3]</td><td>Data [0]</td><td>Data [1]</td><td>Data [2]</td><td>Data [3]</td><td>Data [0]</td><td>Data [1]</td><td>Data [2]</td><td>Data [3]</td></tr>
</table>

Fig. 10-13 Description of how the received data of the Error Log are organized in the memory

The enumeration of the *SEQUENCE NUMBER* begins in each frame at 0. In order to identify a certain data package, a *FRAME NUMBER* and *SEQUENCE NUMBER* are needed.

The received error protocol contains the following data and can be used in the following way. When an error appears (change in the error-state) all the information relevant to the system is secured in the form of an error frame in a non-volatile buffer memory. These error-frames will be placed in a non-blocking ring buffer memory in the Nexa® 1200.

- System time
- Stack operating time
- System parameters currently measured in case of an error
- SE (security electronics) error flags
- History of the system parameters of up to 5 seconds before the error had occured
- Storage of the error protocol in case of Controler voltage loss

- Storage and continuation of the error protocol after a firmware update

**Information Structure Error Frame**

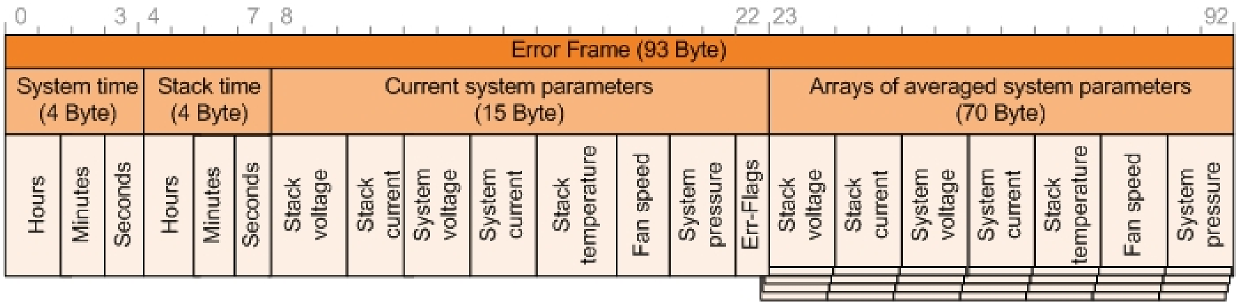



Fig. 10-14 Data structure of the error frame

How the error in the field *ERR-FLAG* has to be stored, can be gathered from the following table.

| Bit | Error-Flag | Description |
|---|---|---|
| 0 | SE-Error 1 | Emergency_stop sensorvalues |
| 1 | SE-Error 2 | Emergency_stop overcurrent Safety Chain |
| 2 | SE-Error 3 | Emergency_stop external cut off |
| 3 | SE-Error 4 | Emergency_stop actors |
| 4 | Timeout-Error | Keep-Alive-Timeout from the DC/DC converter |
| 5 | Leakage-Error | Error during leakage test |
| 6 | H2-ConcMax-Error | Maximum permitted $H_2$ concentration in the exhaust air channel exceeded |
| 7 | - | Reserved is always 0 |

Table 10-7 Error assignment in the field *ERR-FLAG* within an error frame

## 10.7 Allocation of Plugs and Jacks on the Connection Panel

### Plugs

| Plug | Pin | Signal | Specification |
|---|---|---|---|
| CAN IN | 2 | CAN_L | CAN |
| | 7 | CAN_H | CAN |
| | 1, 3-6, 8-9 | NC. | NC. |
| | Housing | Shield | Shield |
| CAN OUT | 2 | CAN_L | CAN |
| | 7 | CAN_H | CAN |
| | 1, 3-6, 8-9 | NC. | NC. |
| | Housing | Shield | Shield |
| Service | 2 | CAN_L | CAN |

| Plug | Pin | Signal | Specification |
|---|---|---|---|
| | 7 | CAN_H | CAN |
| | 1, 3-6, 8-9 | NC. | NC. |
| | Housing | Shield | Shield |

Table 10-8 Allocation of plugs CAN IN and CAN OUT

### Jacks

| Jack | Contact | Signal | Specification | Color of the line |
|---|---|---|---|---|
| RS232 | 2 | TxD | RS232 | |
| | 3 | RxD | RS232 | |
| | 5 | GND | RS232 | |
| | 1, 4, 6-9 | NC. | NC. | |
| | Housing | Shield | Shield | |
| Power Supply | 1 | VDC IN + | I / 9…36 $V_{DC}$ | White |
| | 2 | VDC IN - | I / GND | Brown |
| | 3 | Shield | Shield | Green |
| Remote Control | 1 | S1 / S2 | O / V+ | White |
| | 2 | | | |
| | 3 | S2 (Start / Stop) | I / V+ | White |
| | 4 | Shield | Shield | Green |
| Aux output | 1 | Valve + | O / V+ PWM | White |
| | 2 | Valve - | O / V- | Brown |
| | 3 | Shield | Shield | Green |
| | 4 | Relay + | O / V+ | White |
| | 5 | Relay - | O / V- | Brown |
| | 6 | Shield | Shield | Green |
| Safety chain | 1 | Output current of safety chain | O / CSC max. 20 mA | |
| | 2 | Safety chain input | I / CSCIN | |
| | 3 | Safety chain output | O / CSCOUT | |
| | 4 | Safety chain end / ground | I / CSCGND | Green |
| | 5-8 | NC. | NC. | |

Table 10-9 Allocation of jacks

### Switches

| DIP switch | Signal |
|---|---|
| 1 | NC |
| 2 | Address 1 (Address bit 0) |
| 3 | Address 2 (Address bit 1) |
| 4 | Address 3 (Address bit 2) |
| 5-8 | NC. |

| DIP switch | Signal |
|---|---|
| 9 | NC |
| 10 | NC |

Table 10-10 Allocation of the DIP switches

## 10.8 Data for the System Integration

| Designation | Specification |
|---|---|
| Current ramp | 1 A / Sec |

Table 10-11 Notes for the System Integration

# 11 Technical Data

## 11.1 Complete System

| **Designation** | **Definition** | **Specification** |
|---|---|---|
| Physical data | Dimensions (H x W x D) | 220 x 400 x 550 mm |
| | Weight | ca. 22 kg |
| | Protection type | IP22 |
| Power output | Output voltage | 20…36 $V_{DC}$ |
| | Rated current | 60 $A_{DC}$ max. |
| | Rated output | 1200 W @ 5…25 °C |
| | Rated output | 1000 W @ 35 □ |
| Fuel | | $H_2$, hydrogen gas |
| | Minimum purity | 4.0 (= 99,99 %) |
| | Permissible inlet pressure | 1…15 bar |
| | Hydrogen consumption at 1200 W | 15 NL/min |
| Electrical supply | Min. input power | 110 $W_{DC}$ |
| | Power supply | 12…36 $V_{DC}$ |
| Oxidant | Oxygen | Atmospheric oxygen |
| | Volume flow rate | Max 335 $m^3$/h |
| | Oxygen concentration | Min 18% |
| | Ambient pressure | 700…1100 mbar |
| | Temperature | 5…35 °C |
| | Vaporous water content in exhaust gas at rated output | 550 g/h |
| Operating environment | Operating location | Inside of labs, dry |
| | Ambient temperature | 5…35 °C |
| | Relative humidity | 0…95 % , non-condensing |
| Storage | Ambient temperature | 3…30 °C |
| Transport | Ambient temperature | -40…+70 °C |
| German Electrical Electronic Equipment Act (ElektroG) | Law over the placing on the market, recycling and the environmentally-compatible disposal of electrical and electronic devices. | RoHS (Restriction of the use of certain Hazardous Substances) |
| | | WEEE Waste Electrical and Electronic Equipment) |

Table 11-1 Typical values with a unit which has been in operation for some time

<table>
<tr><th colspan="2">Parameter</th><th colspan="2">Specification</th><th>Comment</th></tr>
<tr><td rowspan="4">Communications protocol</td><td rowspan="4"></td><td>Baud rate</td><td>500 kBaud</td><td></td></tr>
<tr><td>Identifier</td><td>11 bit</td><td></td></tr>
<tr><td>Protocol</td><td>Helio-centris</td><td></td></tr>
<tr><td>Recom-mended converter</td><td>PEAK CAN USB</td><td>Required in combi-nation with Nexa® 1200 RCS</td></tr>
<tr><td rowspan="4">Data interface</td><td>CAN IN</td><td colspan="2">SUB D9 Male</td><td rowspan="2">If the unit is the last unit in the CAN bus, the CAN OUT connection must be terminally con-nected with 120 Ohm.</td></tr>
<tr><td>CAN OUT</td><td colspan="2">SUB D9 Male</td></tr>
<tr><td>Service</td><td colspan="2">SUB D9 Male</td><td>Only for Heliocen-tris Service</td></tr>
<tr><td>RS 232</td><td colspan="2">SUB D9 Female</td><td>Reserved for com-munication to peri-pheral devices,</td></tr>
</table>

Table 11-2 Specification for communication

## 11.2 Startup Kit

| Designation | Property | Specification |
|---|---|---|
| Connection of external power supply | | 3-pin 4mm plug con-nector |
| Connection of load relay and solenoid valve | | 6-pin plug connector |
| Reverse current diode with heat sink | Reverse voltage | 200 V |
| | Max. flow current | 70 A |
| Power cable | | 16 $mm^2$ lead, 6 mm safety plug (red / black) / 4 AWG, stripped length 24 mm |
| CAN-USB converter, CAN cable and 2 terminating resistors | | SUB-D extension 9-pin Bu/Bu 1.8m |
| | | CAN-USB opto-decoupled |
| | | CAN-Term |
| Load relay | Type | Relay Omron |
| | Coil voltage | 24 $V_{DC}$ |
| | Power consumption | < 6 W |
| | Control logic | NO, currentless open |

| Designation | Property | Specification |
|---|---|---|
| External hydrogen valve | Nominal diameter | 1.5 mm |
| | Pressure | 0…25 bar |
| | Connection | Parker quick coupling Q4 |
| | Coil voltage | 24 V |
| | Power consumption | < 8 W |
| | Control logic | NC, currentless closed |
| Hydrogen hose | Hose length | 2 m |
| | Hose diameter | 6 mm |
| Sliding blocks | | |

Table 11-3 Specification of startup kit components

## 11.3 Standards and Guidelines

The Nexa® 1200 complies with the following guidelines and standards:

Guidelines: EMC Directive 2004/108/EG

Product standards: EN 61326: 2006-10

Electrical measuring, control, regulating and lab devices - EMC requirements

Basic standards: Standards on Electromagnetic Compatibility (EMC):

- EN 61000-4-2: 2009-12
- EN 61000-4-3: 2008-06
- EN 61000-4-4: 2010-11
- EN 61000-4-5: 2007-06
- EN 61000-4-6: 2009-12
- EN 61000-4-7: 2009-12
- EN 61000-4-8: 2010-11
- EN 61000-4-11: 2005-02

The Nexa® 1200 is based on the following standards:

- IEC 62282-2: 2008-03

Fuel cell technologies - Part 2: Fuel cell modules

## 11.4 PC Requirements

| Designation | Specification |
|---|---|
| Operating system | Windows 2000, Windows XP, Vista |
| Processor | > Intel® Core™ 2, 2 GHz |

| Designation | Specification |
|---|---|
| Ports | 1 free USB port |
| RAM | >1 GB |
| Hard disk space for installation | >1 GB |
| Monitor resolution | 1280 x 1024 pixels |

Table 11-4 PC hardware requirements

## 11.5 Abbreviations

| Abbreviation | Definition |
|---|---|
| ACK | Acknowledgement: Signal which indicates the reception or the process of data or commands |
| AWG | American Wire Gauge |
| BOP | Balance of Plant: Entirety of the mechanical and electrical components (humidifying, compressors, condensers, electrical drives, etc.) of the fuel cell system |
| CAN | Controller Area Network |
| DIP | DIP switches are small Dual Inline Package (DIP) switches for configuring and changing parameters |
| HB | High byte |
| ID | Identifier (also Identification) |
| LB | Low byte |
| NC. | Not connected |
| NO | Normally Open |
| LED | Light Emitting Diode |
| OSC | Overall System Controller: control and visualization device from Heliocentris |
| PEM fuel cell | Polymer Electrolyte Membrane fuel cell |
| RCS | Remote Control Software |
| SUB D | D shaped subminiature |
| UEG | Lower explosion limit |

Table 11-5 Abbreviations

# Index

## N



## P



## R



## S



## T



## U



## V



## W

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