INSTALLATION AND OPERATING MANUAL REMOTE 400 (GEN.2)

Remote 400 LPG/NG

English

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1 INTRODUCTION

1.1 Preface

Thank you for purchasing a fuel cell generator from New enerday GmbH. Our device enables efficient and reliable operation for the generation of power using an SOFC (Solid Oxid Fuel Cell).

1.2 High Temperature Fuel Cell Generator

1.2.1 Operating Principle

In addition to the fuel cell stack, the fuel cell device essentially consists of the housing with high-temperature insulation, starting burner, afterburner, heat exchangers, desulphurization cartridge, reformer, valves, blowers, pumps, sensors, control and voltage converter.
Since both, the reformer and the fuel cell stack are sensitive to sulfur-containing odorants and Hydrogen sulfide, the fuel gas is first passed through a desulfurization cartridge. It passes through a reformer additionally, in which the Natural Gas (CH_4) or Propane (C_3H_8) reacts to form carbon monoxide (CO) and hydrogen (H_2) with the addition of air, before it can be converted into electricity and heat in the fuel cell stack afterwards. This mixture is called reformate:

$$1.\quad 2\,CH_4 + O_2 \rightarrow 2\,CO + 4\,H_2$$
$$2.\quad 2\,C_3H_8 + 3\,O_2 \rightarrow 6\,CO + 8\,H_2$$

The fuel cell contains a membrane that can conduct oxygen ions (O^{2-}) at high temperature. It is a ceramic electrolyte which causes the oxygen deficiency on the anode side and the oxygen excess on the cathode side to be converted into an electron surplus or shortage. This is the basis for direct electrochemical electricity generation.
During the reaction on the anode side and the conduction of the electrons, heat is released which both keeps the stack at operating temperature and is released to the outside. The functional principle of the fuel cell is shown schematically in Figure 1.

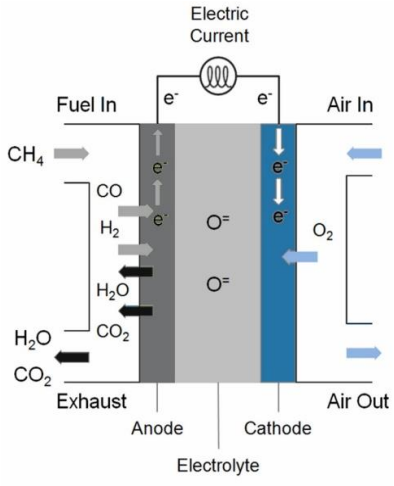


Figure 1: Operation principle of a Fuel Cell

1.2.2 Process Function

In the Remote fuel cell generator, fuel is converted electrochemically into electrical energy and heat. In the case of Sunfire's SOFC (Solid Oxide Fuel Cell), available conventional fuels such as Propane or alternatively Natural Gas can be used. No other operating materials are required.
The heart of the system, the SOFC stack, is installed in a box made of highly porous, ceramic insulation material. In it, electricity is generated from hydrogen-rich gas, the so-called reformate. This reformate is obtained in a catalytic fuel reformer connected upstream of the stack. The direct current generated by the fuel cell is adapted to the battery voltage via a voltage converter and charges the battery and provides power to the connected loads as required. See chapter 5 for further information.

1.2.3 Device Function

The device switches on from standby modus automatically depending on the measured battery voltage. If the battery voltage falls below the limit value U_{Batt_Start}, the unit switches from standby to the start phase (1). During start phase the fuel cell system heats up to operating temperature; the time period depends on the remaining internal temperature and is 5 hours typically. No electricity is generated during this time. Once the operating temperature has been reached, electricity is generated, and the batteries are supplied with the maximum charging power (2). The battery is charged and its voltage increases. If the $U_{Batt\_part\ load}$ threshold is exceeded (3), the unit switches to the efficiency-optimized partial load range and charges with reduced power. If the power drawn is greater than the charging power, the battery voltage drops to the threshold value U_{Batt_Start} (5) and the unit switches back to full-load operation and recharges at maximum power.
If the charge power is always greater than the power consumption, the final charge voltage $U_{charge\ end}$ will be reached (6). The unit reduces the power to the minimum $P_{charge\ end}$ and then returns to standby mode.
The operating states are set automatically depending on the battery voltage. The threshold value U_{Batt_Start} can be adjusted by the user via the IP access. $U_{Batt\_part\ load}$ and $U_{charge\ end}$ can only be adjusted by the Sunfire service.

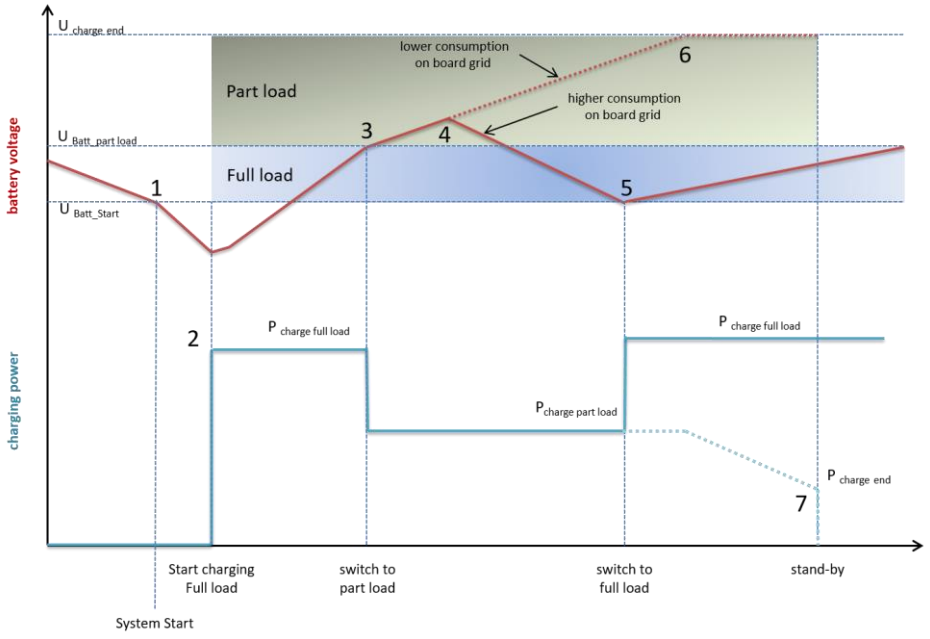


Figure 2: Functional principle of charging in dependance of battery voltage

1.3 Overview of Remote 400

Figure 3 and Figure 4 show the basic structure, connections and maintenance components after removing the front cover.

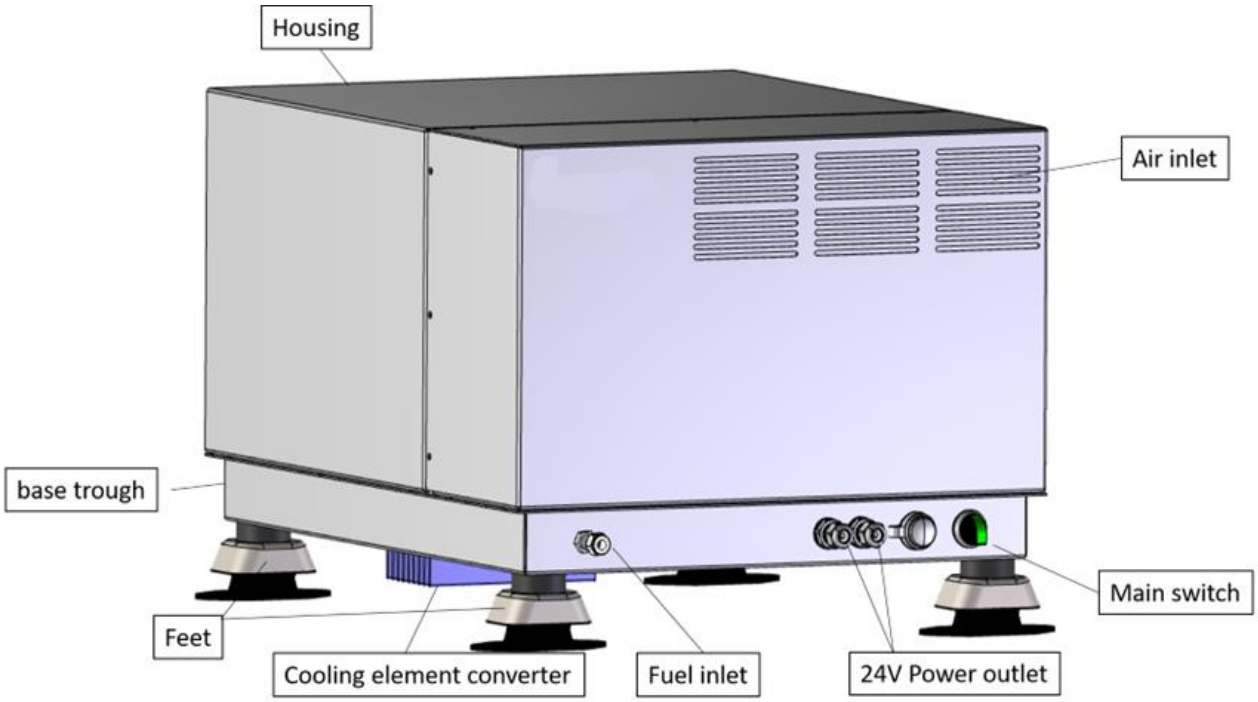


Figure 3: Device connections; delivery with pre-installed battery cables.

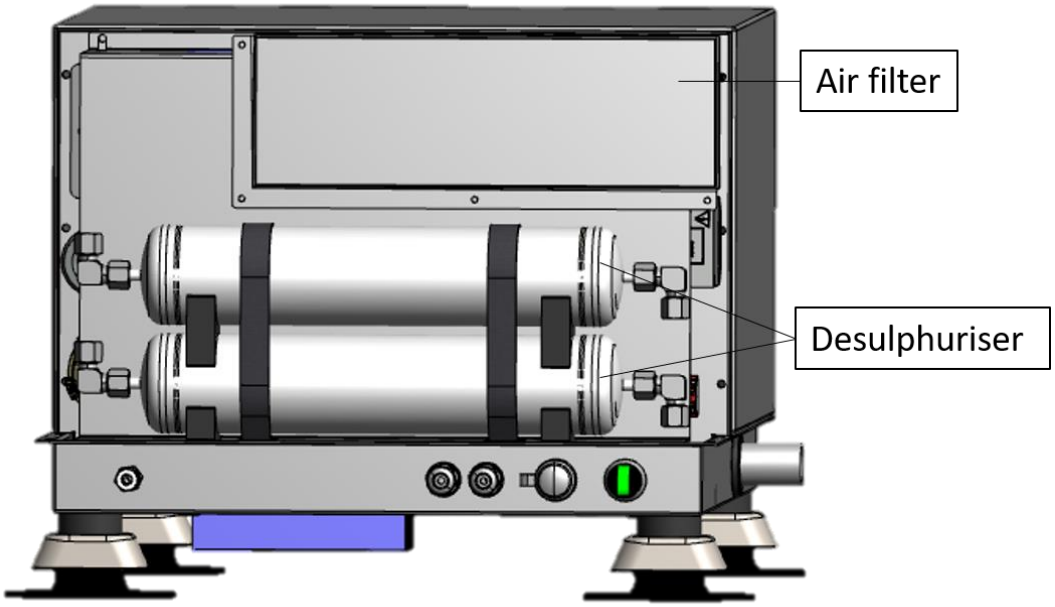


Figure 4: Maintenance components Remote 400 after opening the housing cover; the standard scope of delivery includes a pre-installed desulphurization cartridge, a second one is available optionally.

2 APPLICATION

2.1 Intended Use

The Remote 400 fuel cell unit

- may only be used to generate electrical energy to charge batteries using the specified fuel gases
- may be operated in stationary, permanently installed applications
- for transport system has to be switched off and cooled down for at least 12 hours

2.2 Improper Use

All other applications that are not listed under intended use are not permitted and therefore prohibited. This applies in particular to

- the installation and setup in hazardous areas
- the operation of damaged or defective equipment
- Operation in mobile applications or during transport
- Equipment installed and operated contrary to the rules of this installation and operating manual

Do not use this fuel cell power system if any part has been under water. If it has been, it must be replaced by a new system.

3 HEALTH AND SAFETY

3.1 Storage of Documents

This installation and operating manual and all other applicable documents are part of the product and must be kept carefully and handed over to the operator.

3.2 Legends of Warning Symbols

When installing the device, please note the safety instructions in these instructions! The symbols used in the text are explained below.

DANGER!
High risk - Indicates an immediate danger that can result in property damage, serious injury or even death.

WARNING!
Medium risk - Indicates a possible danger that can result in property damage or serious injury.

ATTENTION!
Low risk - Indicates a possible danger that could result in property damage, minor or moderate injury.

INFORMATION!
No risk - information that is important for the system operator.

3.3 General Safety Instructions

	The installation and operating manual must be read thoroughly before commissioning the device and the instructions given there must be followed!
	The installation and operating manual must be kept accessible near the device.
	It is essential to follow the instructions in the installation and operating manual when installing and operating the device!
	The air and gas supply, the exhaust system, the electrical wiring, and all visible parts must be checked for damage at regular intervals.
	The housing cover may only be opened by trained specialists and only when the appliance is switched off.

	Technical changes to the unit are not permitted. Changes endanger safety and lead to the loss of the operating permission and the warranty becoming void.
	Only use fuel approved for the unit.
	The unit may only be operated in the approved temperature range.
	No flammable liquids or easily flammable materials may be stored near the unit. The device may not be installed and operated in explosive environments and hazardous areas.
	There is a risk of fire and explosion due to fuel escaping in the event of a fault.
	If there is a smell of gas, the following safety instructions must be followed: • Open doors and windows wide, ensure there is a draught, avoid rooms with gas smell! Never switch on light or a fan - danger of sparking! • Avoid open fire, do not smoke, do not use a lighter! • Do not use electric switches, plugs, bells, telephones, mobile phones or other intercoms in the house! • Close gas meter shut-off device or main shut-off device! • Warn other residents of the house, but do not ring the bell, knock instead! • Leave the building! • Notify the gas supply company's on-call service of a telephone connection outside the house! • If there is an audible emission, leave the building immediately, prevent third parties from entering, alert the police and fire brigade from outside the building!
	The unit must be protected against moisture and humidity in accordance with the IP protection class.
	It is not permitted to remove the unit when it is hot.
	Transporting the device while it is hot is not permitted.
	The ventilation slots must be kept free.
	It is essential to keep the heat sink of the converter at the bottom of the device clean and free.
	A sufficient supply of fresh air must be ensured.
	No objects may be placed on or leaned against the unit.
	The exhaust outlet must be kept free.
	Exhaust fumes are hot.
	Installation and maintenance may only be carried out in accordance with the installation and operating manual and by qualified personnel.
	The unit may only be operated in a technically perfect condition.
	Faults must be rectified immediately. The user can remedy simple operating faults (see 6.3) himself after evaluating the fault codes. Device internal faults may only be rectified by authorised service personnel.

	Exhaust gases and escaping gases may contain components that are harmful to health: • Propane • Butane • Carbon dioxide • Carbon monoxide • Hydrogen • Methane • Natural gas • Hot air The gases should therefore never be inhaled directly or permanently.
	When disconnecting the device from the gas supply, increased gas leakage from the pipe system must be expected.
	With a normal gas cylinder change, minimal gas leakage must be expected.
	If cleaning work is carried out in the area of the exhaust gas outlet and the process air supply, the unit must first be shut down and the exhaust pipe and the fresh air supply closed. Before the system is put back into operation, the covers must be removed again.
	The unit must not be operated by children or persons with limited mental or physical abilities or by persons with insufficient knowledge or experience.
	Children must be instructed that it is not permitted to play with the device.
	Damaged power cables must be replaced with equivalent ones by the manufacturer, its service personnel, or other qualified persons to prevent damage.
	Do not use this fuel cell system if it has been under water. A fuel cell flooded with water is very dangerous. Using such a system can lead to a fire or explosion. If the system has been flooded, an inspection must be carried out by qualified personnel.
	The device is used to generate electrical energy for own consumption. Any misuse of the device is prohibited.
	The fuel gas is deodorised inside the fuel cell device. In the gas line after the desulphurisation cartridge, leaks can no longer be perceived in the form of gas odour. Any change due to maintenance or repair in this area must therefore be approved with a gas detector and a leak test!
	No changes may be made to the following equipment: • on the lines for gas, supply air and electricity • at the exhaust pipe • at the enclosure • at structural parts that may have an influence on the operational safety of the device.
	Venting the liquid gas tank when the unit is newly installed (notes for units operated with liquid gas (propane)): Before installing the unit, make sure that the gas tank is vented. The liquid gas supplier is always responsible for the proper venting of the tank. If the tank is poorly vented, ignition problems may occur. In this case, contact the filler of the tank first.

3.4 CE Marking

The CE marking documents that the devices meet the basic requirements of the following directives and standards and may be placed in the EU market:

- EN 62282-3-100:2012 and EN 62282-3-100:2020 - Fuel cell technologies – Part 3-100: Stationary fuel cell power systems - Safety
- Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments (IEC 61000-6-2:2016) Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential environments (IEC CIS/H/400/CDV)
- Household and similar electrical appliances - Safety - Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections (IEC 60335-2-102:2004)

With the CE marking, we as equipment manufacturer confirm that the safety requirements according to the above-mentioned standards have been met and that the serially produced equipment conforms to the tested type.

3.5 CSA Marking

The CSA marking documents that the devices meet the requirements of the following standards and may be placed in the USA and Canada:

- CSA/ANSI FC 1:21
- CSA C22.2 No. 62282-3-100:21 Fuel cell technologies — Part 3-100: Stationary fuel cells power systems — Safety

With the CSA marking, we as equipment manufacturer confirm that the safety requirements according to the above-mentioned standards have been met and that the serially produced equipment conforms to the tested type.

4 PLANNING THE INSTALLATION

4.1 Requirements

The following requirements must be fulfilled for operation of the Remote 400 fuel cell device:

- Installation elevation ≤ 1.500 m / 5,000 ft above sea level
- up to 3.000 m / 10,000 ft on request with 15% power reduction
- Minimum temperature in the installation area ≥ -20 °C / -4 °F, -40 °C / -40 °F on request
- maximum temperature ≤ 55 °C / 131 °F
- Communication via standard broadband internet connection, Ethernet 10/100 MBit
- Installation and fastening horizontally on level and load-bearing surfaces
- An installation environment or room adequate to the IP protection class

4.2 Outer Dimensions

Dimensions: L x W x H = 660 x 540 x 400 mm / 25.98 x 21.26 x 15.75 in

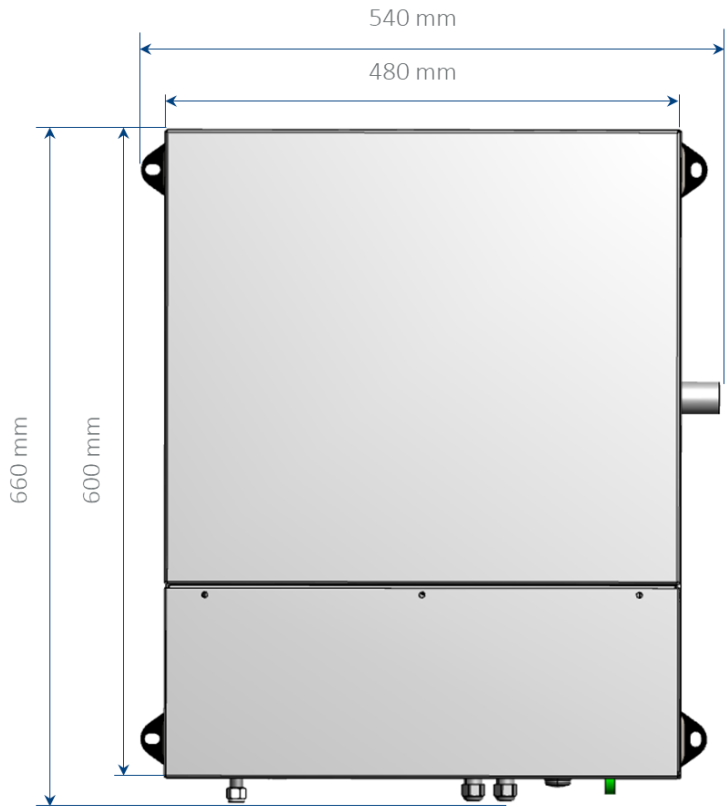


Figure 5: Dimensions of the top view

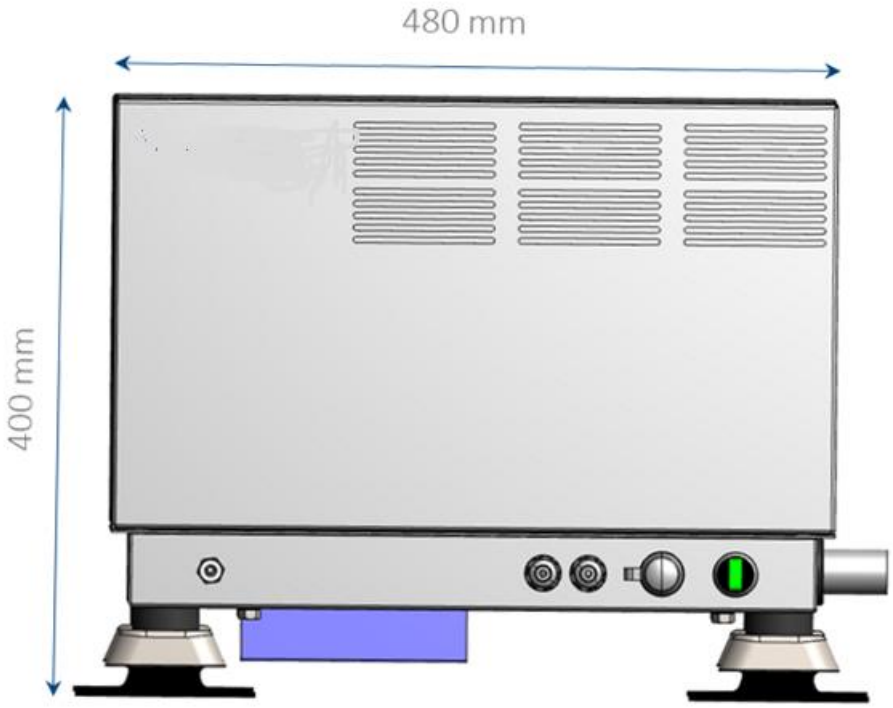


Figure 6: Dimensions of the front view

4.3 Installation Site

The device must be installed in a horizontal position. For maintenance, free access from the front and at least 50 mm / 1,97 in installation space all around is necessary. The fuel cell generator can be installed at public places, but it must be protected against unauthorized use. The distance to flammable material and vegetation must be at least 0.5 m / 19,7 in. The generator must be protected against accidents by cars (Elevation at least 0.5 m / 19,7 in over the surface, protectors for the gas supply). It is not allowed to install the system in rooms with flammable gases or flammable open liquids.

4.4 Surface Temperature

The maximum surface temperature of the device is below 85 °C / 185 °F. Therefore, no special protective measures for flammable building materials are required. Deviating regulations of individual countries must be observed.

4.5 Process Air

To avoid corrosion, the process air must be free of aggressive substances. Halogenated hydrocarbons containing chlorine or fluorine compounds as well as silicone compounds are considered corrosive. These can be contained in solvents, paints, adhesives, propellants, detergents, and household cleaners, for example. The process air must be supplied by a supply pipe, a wall- or a
platform panel breakthrough with a diameter of at least 0.1 m / 3,94 in.

4.6 Required Accessories

For the operation of the Remote 400 are additionally required:

- A battery, VRLA (gel or AGM) 24 V, ≥ 300 Ah recommended, in case of strong load peaks a higher battery capacity adapted to these peaks should be selected
- A gas supply including pressure regulator

Depending on national and local regulations at the installation site, additional components may be required to meet the appropriate installation standards.

For North America:
If no local standards are available, the installer must follow NFPA 853, NFPA 70 and NFPA 54. **It is the installer's responsibility to comply with these standards.** The pressure regulator shall also be an approved type for service and fuel according to UL 252 or UL 144.

5 INSTALLATION

The installation, conversion and adjustment of Remote 400 fuel cell units may only be performed by trained personnel.

5.1 Preparing the Installation

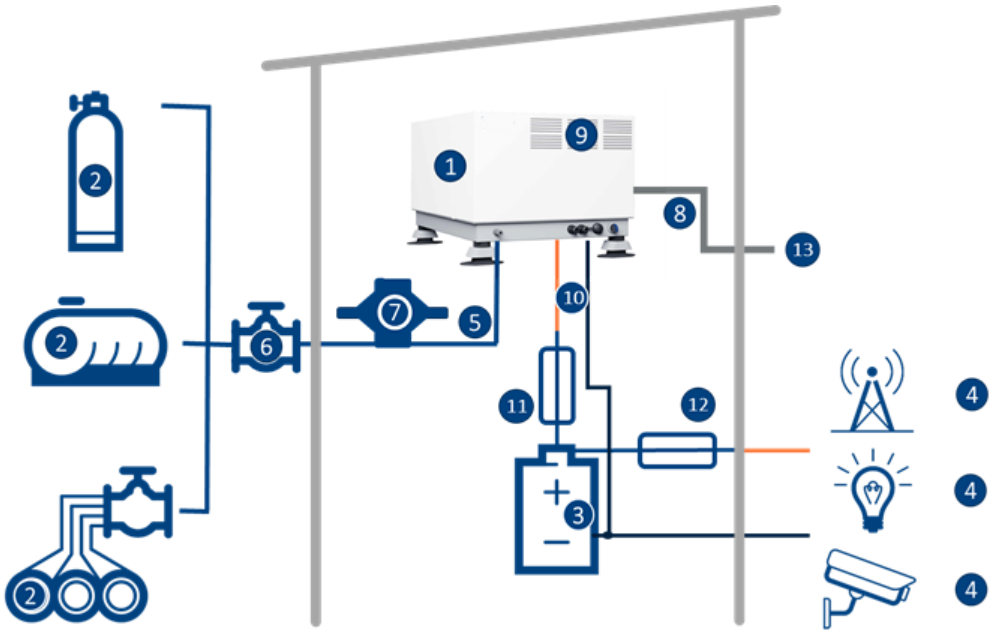
5.1.1 Delivery

Remote 400 must be transported and stored in an upright position within the temperature range of -40 °C / -40°F to 60 °C / 140°F.
The gross weight including packaging and transport pallet is approx. 75 kg (net weight approx. 65 kg). The unit is mounted on a pallet. Tilting up to 45 degrees is permissible but should be avoided if possible.

5.1.2 Scope of Delivery

QUANTITY	ARTICLE
1	Remote 400 fuel cell device
1	Installation and Operating Manual

5.2 Overview of the Installation



1. Fuel Cell Device
2. Fuel Supply / Storage
3. Battery
4. Customer Load
5. Fuel Line
6. Stop Valve
7. Pressure Regulator
8. Exhaust Pipe
9. Process Air Inlet
10. DC Line
11. Battery Fuse 30 A
12. Load Fuse
13. Outdoor

Figure 7: Schematic Installation

5.3 Installation Order

The fuel cell unit must be assembled in the following specified sequence:

1. Making the mechanical fastening
2. Installation and connection of the exhaust pipe
3. Connection of the gas supply
4. Electrical connection
5. Network/data connection

5.4 Mechanical Installation

The fuel cell unit must be securely fastened mechanically. The holes provided on the feet must be used for this purpose. It is recommended to use at least one fastening screw per foot.

5.5 Exhaust Gas Connection

Sunfire offers a venting system. It is standard 1 m / 39.4 in (optionally up to 3 m / 118 in) of a specific high temperature hose, which must be installed in this way, that neither rain nor wind will be let in. It can be bent 2 times 90° with a bend radius of 50 mm / 1.97 in. No other materials are allowed.

- The exhaust outlet must be bent down to avoid rain or wind influences.
- The outlet must be lower than the connection at the Remote 400 to avoid condensate in the exhaust hose.
- Keep the exhaust hose as short as possible.
- Noise adsorber and other devices are not allowed.
- The exhaust outlet has to be at least 0.5 m / 19.69 in away from air inlet
- A wall or side breakthrough with the diameter of at least 50 mm / 1.97 in must be available or installed. The exhaust pipe must be mounted at this breakthrough or at the wall with hose clamps provided by the manufacturer.

The installation, modification and maintenance of the exhaust system may only be carried out by trained specialist personnel under consideration of the points above.

5.6 Gas Supply

The connection to the gas installation may only be carried out by qualified personnel. A shut-off device with a thermal safety shut-off valve must be installed upstream of the device. The use of hose rupture safety devices is additionally recommended in case of hose connections. The maximum gas pressure of Remote 400 is 50 mbar / 0,725 psi. A suitable pressure regulator must be provided by the customer. The gas connection of the unit is an 8 mm / 0,315 in screw connection (compression fitting). Swagelok or Schwer connections are recommended. The connection line can be rigid or with a flexible gas hose line.

The tightness of the connection made must be checked under gas pressure with a gas leakage detector!

Omitting or using an unsuitable gas pressure regulator can lead to the destruction of the unit and gas leakage. Risk of explosion!

5.7 Electrical Connection

The electrical connection may be carried out only by qualified personnel. It consists of two insulated cables, each 1.5 m / 59 in long with a cross-section of 16 mm² / 0,024 in². An electronic overload protection circuit is integrated in the device. On site, a 30 A fuse must be provided close to the battery connection in accordance with the applicable technical regulations.

Risk of injury from electric shocks at live connections, especially if there is no fuse on the battery side of the cable!

5.8 Network Connection

The fuel cell device has an integrated TCP/IP gateway. This should be used in the context of an optimal system monitoring. A reliable, constantly available connection of the device to the Internet is recommended. For this purpose, the device has a network interface (Ethernet). This must be connected to a DSL modem or a router via a network cable. Separate settings may be required in the customer's router, which can be coordinated with NED Service.

The functions of the interface and communication with it are described in a separate manual.

6 OPERATION

6.1 Start of Operation

Before the start of operation, it is essential to check that the exhaust gas outlet and air inlet are free. Any covers must be removed. The system must be connected to the battery and the gas supply. Large quantities of air or inert gases must be avoided in the on-site gas supply system. The gas paths to the unit must be open. The system is in the operating state "Off". After the main switch has been actuated, the system changes to the "Standby" operating state. If the voltage drops below the lower voltage limit U_{Batt_Start} of the battery, the system automatically switches to the operating mode "start phase“.

During initial start-up, there may still be a large amount of air in the supply lines or in the appliance, depending on the length of the gas line. This can cause the unit to malfunction during initial start-up. After every 5 minutes a second and a third attempt is made to start the unit. After a third unsuccessful start attempt, the unit is blocked. The error counter can only be reset by Sunfire Service (remote access).

The error counter is reset to zero only by running through a full operating sequence (see 6.2 Operating states) with start phase and charging operation.

6.2 Operating Statuses

As soon as the unit is connected to the battery to be supplied with power and the gas supply is on, the system is ready to start. The main switch is set to "On". The battery voltage is monitored automatically and the unit starts itself automatically as soon as the voltage falls below the preset threshold value U_{Batt_Start}. The batteries are automatically recharged. The main switch is equipped with a status LED. This can indicate the individual operating states and any error messages.
The following operating states are distinguished and can be recognized by the light signals of the LED in the main switch:

6.2.1 Start Phase

In this phase the system starts and is heated up to operating temperature. A prerequisite for the start sequence is that the temperature at the stack output does not exceed a temperature of 400 °C / 752 °F. If this is the case, the unit waits for the temperature to fall below this

temperature and then starts automatically. It must be ensured that the power supply for the fuel cell system is secured during this time via the connected batteries. The LED in the main switch flashes at long intervals. The batteries will not be charged during this phase.

During this phase, do not disconnect the unit from the battery or operate any main battery switch except in an emergency!

6.2.2 Generation / Charging Mode

In this operating state the batteries are supported by the fuel cell system. The supplied fuel is converted into electrical energy. Charging operation is carried out at full or partial load for optimized efficiency. This ensures that only the energy is generated that is currently required. The switchover is automatic. The LED in the main switch is permanently on.

During this phase, do not disconnect the unit from the battery or operate any main battery switch except in an emergency!

6.2.3 Standby

The main switch is in the "On" position. The LED in the main switch goes on and off continuously and slowly (the LED breathes). The unit is connected to a battery according to the technical specifications and is ready to start. This operating point is reached either by switching the unit on via the main switch while the batteries are still charged or by automatically switching the unit to standby after the batteries have been charged. Automatic monitoring of the battery voltage is active. If the voltage falls below the minimum voltage U_{Batt_Start}, the system is started automatically.

During this phase, do not disconnect the unit from the battery or operate any main battery switch except in an emergency!

6.2.4 Switch Off Phase

The system switches from the respective operating state to the "Off" operating state automatically after the main switch has been actuated. Depending on the operating mode in which the main switch was operated, shutdown may take several minutes. During this time the LED flashes in long intervals. When the system has reached the operating state "Off", the LED does not light up **AND** no operational noises from fans and pumps are noticeable.

During this phase, do not disconnect the unit from the battery or operate any main battery switch except in an emergency!

6.2.5 Off

The main switch is in the off position. The LED in the main switch is not lit. The system cannot start automatically**. At this operating point, maintenance, battery and cylinder changes can be carried out. Before restarting, the device must have cooled down to approx. 400 °C / 752 °F (temperature at stack output). Direct restarting above this temperature is not possible.**

Shutdowns should generally be **avoided** as far as possible, as they accelerate the ageing of the device. Manual shutdowns should only be performed if the maintenance plan requires it. **Excessive manual shutdowns can lead to loss of warranty!**

Overview of the operating states indicated by the LED in the main switch:

LED SIGNAL	OPERATING STATUS OF THE FUEL CELL DEVICE
Off	Off
Breathe slowly	Standby and ready for operation
Flashing slowly	Start phase
Lights	Generation / Charging mode
Flashing slowly	Switch-off phase
Flashing fast	Error, code see following chapter

6.3 Malfunctions in Operation

After switching on, check whether the LED in the main switch is lit; if not, the power supply is interrupted. If the LED flashes quickly, it is an error code:

LED SIGNAL	ERROR	CAUSES
2x fast flashing	Gas supply interrupted	- Main valve of the on-site installation open? - Cylinder valve(s) open? - Gas tank or cylinder all or line disconnected by the supplier?
3x fast flashing	Air supply interrupted or exhaust pipe blocked	- Air filter clogged → Replace - Check and remove blockages or contamination of the exhaust pipe
4x fast flashing	Battery voltage is below 18V or above 32V	- Wrong battery connected→ Replace - Defective battery → Replace

All other error codes are for customer service only. In this case, please contact the service department.

Telephone number: +49 395 351 733-37
This number may be replaced by a local service number when the maintenance contract is concluded.

The NED Service is available at the following times:
Monday-Thursday: 08:00 - 16:00, Friday: 8:00 – 13:00 CET
Closed on Saturdays, Sundays and German national holidays.

7 MAINTENANCE

The fuel cell system is maintenance-free within the first 5,000 operating hours. Depending on the dust load, it is nevertheless recommended to check the air filter regularly and to replace it after 5,000 operating hours at the latest. The equipment with an optional additional desulphurization cartridge extends the replacement interval to a total of 10,000 operating hours. It is only allowed to install original spare parts provided by the manufacturer.

7.1 General Information

The basis for proper functioning and optimum operation of the fuel cell system is compliance with the maintenance schedule. Maintenance of the Remote 400 should only be performed by qualified personnel.

7.2 Maintenance Plan

Regular Maintenance is required

- after 5,000 operating hours with one standard desulphurization cartridge, or
- after 10,000 operating hours with standard **and** optional additional desulphurization cartridge,

but at least every 24 months. In dusty environments, the dust filter may need to be cleaned or replaced more often and as required.

Work to be carried out:

- Replacement of the air filter
- Check for contamination and cleaning, especially the openings and the heat sink of the Voltage converter (underside of device)
- Change desulphurization cartridge(s)
- Check gas connection for leaks with gas leak detector
- Visual inspection of electrical and gas installation for intactness

7.3 Maintenance Procedure

Preparation

1. Set the main switch to the "Off" position and shut down the unit in a controlled manner.
2. Wait until the process is complete: The LED in the main switch is off **AND** the fans and pumps in the unit are also switched off (no noise!)
3. Close the customer's manual main gas valve.
4. Loosen the screws of the front maintenance cover, remove them, and store the screws in a safe place.
5. Pull the front maintenance cover forward. Keep the rear cover closed! This may only be opened by qualified service personnel when it has cooled down completely!

Replace the air filter:

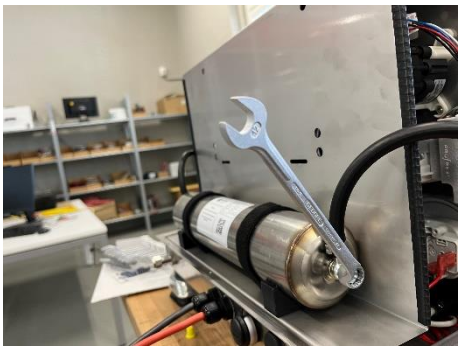

1. Lifting the left rear corner and twist the filter over the left.

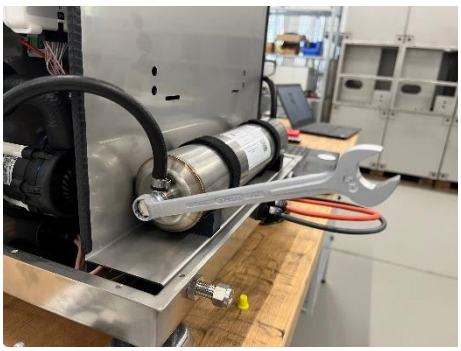

2. Remove the air filter and insert the new filter, beginning at the right side, push it under the right latch

3. Twist the filter and clamp the filter under the left latch.

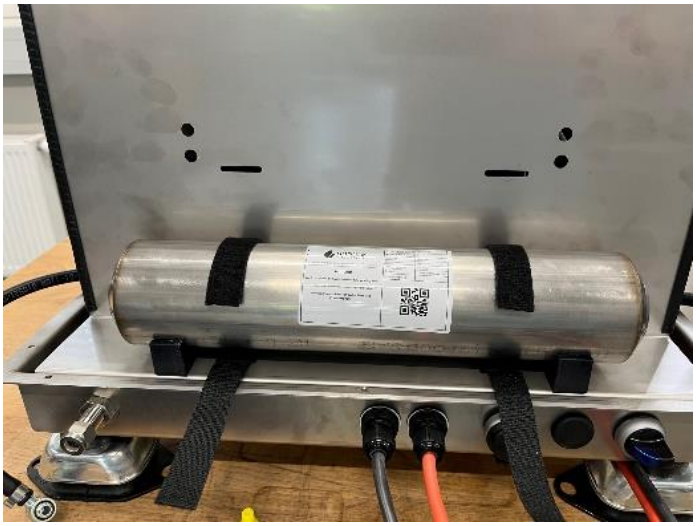
4. Push the filter down.

Replace Desulphurization Cartridge(s) (0,47 in spanner, 0,55 in spanner):





1. Loosen the screws at both sides and loosen the hook-and-loop tapes.



2. Fix the new cartridge(s) with the hook-and-loop tapes, please note that the sticker should be readable to ensure that the cartridge is installed in the right direction, M8 at the right side, M10 at the left side. Fix the screws with new washers and consider maximum torque:
    i. M8 with 10Nm
    ii. M10 with 12Nm
3. Open the manual main gas valve, if installed.

8 TECHNICAL DATA

	Remote 400 LPG/NG
Fuel	Propane (LPG) / Natural Gas (NG)
Electrical power	60 ... 350 W +- 10%
Max. daily electrical output	8,4 kWh/day
Rated voltage Battery voltage	21 V = undervoltage limit ... 27.5 V shutdown / up to 30 V on request
Fuel consumption	Propane: 75 ... 106 g/h / (0.17 ... 0.23 lbs/h)
	Natural gas: 0.094 ... 0.136 Nm³/ h / (3.32 ... 4.80 standard ft3/h)
number of cold start cycles	50 cycles guaranteed / typical >100 cycles
operational altitude	Standard up to 1.500 meter / 5,000 ft, maximum 3.000 meter / 10,000 ft with 15% power reduction
unsupervised operation	up to 10,000 opHrs
lifetime core system typical	>15,000 opHrs (continuous operation, low on-off cycles)
Gas connection	8 mm / 0.039 inches compression fitting
Pressure of gas connection	20 ... 50 mbar / 0.29 ... 0.73 psi
Weight	65 kg / 144 lbs
Dimensions	660 × 540 × 400 mm / 26.0 × 21.3 × 15.7 inches
Ambient temperature for operation	-20 ... +55 °C / -4 ... +131 °F (-40 °C / -40 °F optionally)
Noise emission (without enclosure)	< 49 dB (A) at power mode and < 55 dB (A) during heat-up, in 7 m / 23 ft distance
Thermal output	None
Water / lubricant consumption	None
IP protection category	IP50
Communication	Ethernet TCP / IP (Web based GUI / REST-API)
Essential accessories for operation	Battery VRLA 24 V, > 300 Ah, low pressure regulator, gas line and gas hose
Other products / applications	PowerBox 1200 / PowerTrailer 1200: hybrid systems with photovoltaic, battery bank and 1.2 kW peak power at 230 V AC PowerCabinet 600 (skid wired and ready): outdoor cabinet to supply already existing systems with 600 W / 24V DC peak power – e.g.: SCADA
Qualifications	CE certification for Europe; NRTL certification for North America; ISO 9001:2015 production facilities and quality management system

The specified data are valid for reference conditions:
- standard environmental conditions: T=273.15 K and p=101325 Pa
- Fuel quality:
    a. Natural gas variant: Composition: > 99.0 vol% CH_4 and C_2H_6 (ethane share < 5%)
    b. Propane variant: according to EN51622 with a propane content of > 95%.
- Process air composition: 21% by volume O_2, 79% by volume N_2

The tolerance of the nominal power is ± 5 %. All other electrical, thermal, and fluid parameters are subject to a tolerance of ± 10 % unless otherwise specified.

The efficiency is related to lower heating value, depends on the fuel gas type, and varies with the output power and the degradation of the internal resistance of the fuel cell stacks.

9 DISPOSAL

At end of service life, it is recommended to return as well the desulfurisation cartridges as the Remote device to the manufacturer. New enerday GmbH will arrange for safe and proper disposal.

10 LIABILITY

10.1 Liability Case

The manufacturer is liable for defects caused by material or production faults within the framework of the statutory liability for material defects in accordance with the General Terms and Conditions of Sale and Delivery, which can be accessed at https://sunfire-fuel-cells.de/wp-content/uploads/2022/11/General_Terms_and_Conditions.pdf

In the following cases, this entitlement expires:
- Improper use
- Non-compliance with the installation and operation manual
- Modification without Sunfire's express written consent
- Insufficient maintenance or repair
- Natural wear and tear
- Wear and tear of consumables
- Operation outside the given specifications
- Improper handling
- Improper transportation
- Use of spare parts not approved by the manufacturer
- Use of fuels not approved by the manufacturer
- Defects in peripheral devices (gas cylinders, gas systems, batteries)
- Defects caused by peripheral devices (gas cylinders, gas systems, batteries)

10.2 Extent of Liability

The liability as mentioned above is valid for a maximum of 2 years or 15,000 operating hours with a maximum of 30 cold starts during the life of the core module, whichever occurs first, within the scope of the statutory liability for material defects.

Additionally, the liability for defects is applicable for a range of 31 to 50 cold start cycles but is limited in this case to a maximum of 7,000 operating hours or a 2-year period during the life of the core module, whichever occurs first, within the scope of the statutory liability for material defects. The power of the fuel cell generator may drop to 80 % of nominal power under these preconditions.