



Installation Manual

MSK GEN1

Revision V1.2

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Date May 5, 2026

Grazian Eller



Important Notice – Prototype System (Research and Development Use Only)

The MSK GEN1 (Methanol Power Converter) is provided as a prototype system within the scope of research and development activities. At the time of delivery, the MSK GEN1 is not CE-marked and has not yet undergone a formal conformity assessment according to applicable EU harmonization legislation. The system is therefore not released as a commercially available product. The prototype is supplied exclusively for evaluation, testing, and development purposes in cooperation with the customer. It is not intended for permanent commercial operation, resale, or unrestricted use.

Operation of the MSK GEN1 prototype is limited to:

- defined project scopes
- trained and instructed personnel
- use cases agreed between the manufacturer and the customer

All operation described in this manual refers to the prototype configuration as delivered and may change as part of ongoing system development and validation. Once the conformity assessment process has been completed, including risk assessment, technical documentation, and issuance of an EU Declaration of Conformity, the system will be updated accordingly. Only then will a CE marking be affixed and the system released for regular market use.

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Until that time:

- The system shall be treated as a prototype
- Modifications and operating conditions are subject to project-specific agreements
- The manufacturer retains control over restricted system areas and safety-critical components

This manual documents the current functional state of the MSK GEN1 prototype and supports its safe and intended use within the defined research and development context.

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1 About This Installation Manual

1.1 Purpose of This Installation Manual

This Installation and Service Manual provides the technical information required for the proper installation, electrical integration, and technical support of the MSK GEN1 system. It is intended for qualified personnel and supports the planning, implementation, and evaluation of installation-related activities within defined projects.

The document primarily describes the mechanical and electrical requirements for the installation site, different operating and connection concepts, the role of external grid supply, and relevant service aspects. It serves as a technical reference and guidance document for project partners and does not replace detailed execution planning or the independent professional assessment by the executing contractor.

This manual is not intended for end users. Information regarding operation, normal use, and user-level routine actions is provided exclusively in the MSK GEN1 User Manual.

1.2 Target Audience and User Role

This manual is intended for persons involved in the installation, electrical integration, or technical support of the MSK GEN1. This includes, in particular, qualified electricians, installation contractors, project partners, and service and maintenance personnel of the manufacturer or explicitly authorized service providers.

Users of this manual act in a professionally responsible role. They are responsible for the planning, execution, and verification of all work in compliance with applicable laws, standards, and recognized rules of engineering practice. This document assumes appropriate technical qualification and deliberately does not include simplified instructions for untrained personnel.

1.3 System Status and Application Context

The MSK GEN1 is a prototype system used within research, development, and pilot projects. At the time of delivery, the system does not carry CE marking and has not undergone formal conformity assessment under applicable EU harmonization legislation. It is not a series-released product.

Use of the system is therefore limited to clearly defined project scopes, agreed applications, and trained professional personnel. All information contained in this manual refers to the current prototype status and reflects the state of technical development at the time of documentation. Changes to system architecture, interfaces, or functional scope may occur as part of ongoing development.

1.4 Manufacturer, Responsibilities, and Liabilities

The manufacturer of the MSK GEN1 system is Gumpert Automobile GmbH, Carl-Hahn-Strasse 5, 85053 Ingolstadt, Germany (Contact: info@gumpert.de).

The manufacturer is responsible for system integration, the overall system concept, safety-relevant functions, and the provision of system-related documentation.

Responsibility for installation and electrical connection of the system within a building lies with the executing contractor. The contractor is obligated to perform installation in accordance with applicable national regulations, standards, and generally accepted engineering practices. Gumpert Automobile GmbH assumes no responsibility for damage or malfunctions resulting from improper installation, deviation from the specified boundary conditions, or unauthorized modifications to the system.

Service and maintenance work on the MSK GEN1 shall be performed by Gumpert Automobile GmbH or by partners explicitly authorized by the manufacturer, unless otherwise contractually agreed.

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1.5 Intended Use from an Installation Perspective

From an installation and technical perspective, the MSK GEN1 is designed for stationary installation at a fixed location. Mechanical mounting, electrical integration, and connection to the building infrastructure must be carried out within the boundary conditions defined in this manual.

The intended use exclusively includes installation, connection, and operation of the system in accordance with the specified operating modes and interfaces. Deviating forms of use, mobile applications, independent modifications, or changes to electrical protection and switching concepts are not part of the intended use.

1.6 Scope and Limitations

This manual covers installation, electrical integration, and service- and maintenance-related topics from a technical and informational standpoint. It describes requirements, concepts, and system relationships but does not provide detailed work instructions for maintenance or service interventions.

In particular, this document does not include step-by-step instructions for:

- Electrical or mechanical work performed by end users
- Interventions in safety-critical components
- Independent maintenance measures outside the manufacturer's service concept

The practical execution of service and maintenance activities is exclusively the responsibility of the manufacturer or authorized technical partners.

1.7 Validity of This Manual

This Installation and Service Manual applies to the MSK GEN1 in the prototype configuration supplied at the time of delivery. The manufacturer reserves the right to revise or replace this document as part of ongoing system development.

For installation, operation, service, and maintenance, the latest valid version of this manual shall always be used. Earlier versions become invalid upon publication of a new revision.

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2 Safety Instructions

2.1 General Safety Instructions

This section contains essential safety-related information that must be strictly observed during installation, electrical integration, commissioning, and all technical work on the MSK GEN1 system. Improper installation or use of the system outside its intended purpose may result in severe personal injury and property damage.

The MSK GEN1 is a technically complex prototype system that combines electrical, thermal, chemical, and electrochemical processes within a closed enclosure. Even though the system operates largely automatically during normal operation, increased hazard potential exists in particular during installation, grid connection, and service activities. Activation of the Emergency Stop results in an uncontrolled shutdown and does not replace the defined shutdown or re-energization procedures.






All work must be carried out exclusively in accordance with this Installation Manual and the applicable national regulations. In particular, relevant electrical, occupational safety, and fire protection regulations must be observed. Deviations from the procedures described or unauthorized modifications to the system are strictly prohibited.

2.2 Safety Symbols, Signal Words, and Hazard Levels

This Installation Manual uses standardized safety symbols and signal words to indicate hazards and risks. The signal words indicate the severity of the potential hazard.

- **Caution** indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury or property damage
- **Warning** indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death
- **Danger** indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death

In addition to signal words, the following safety symbols are used. These symbols may appear both in this documentation and directly on the system and must always be observed.

	Flammable Material (GHS02)	The system uses methanol as fuel. Methanol is highly flammable and must not come into contact with ignition sources, open flames, or sparks. During installation and work on the system, adequate ventilation and a non-explosive environment must be ensured.
	Toxic Material (GHS06)	Methanol is toxic and may cause severe health damage if swallowed, inhaled, or absorbed through the skin. Direct contact must be avoided. Appropriate personal protective equipment must be worn when handling methanol-containing components.
	Health Hazard (GHS08)	Long-term or repeated exposure to methanol or exhaust gas components may cause serious health damage. Work must only be performed in well-ventilated environments.
	Electrical Hazard (ISO 7010)	The system contains electrical components operating at 48 V DC and 230 V / 400 V AC. Dangerous voltages may be present even when the system appears to be switched off. Prior to any work, all relevant circuits must be properly de-energized and secured against reconnection.
	Hot Surface (ISO 7010)	During operation and shortly after shutdown, system components may reach very high temperatures. Contact may result in severe burns.

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2.3 Personnel Qualification

Installation, electrical connection, commissioning, and all technical work on the MSK GEN1 may only be performed by qualified personnel. For all electrical work, the use of certified electricians in accordance with applicable national regulations is mandatory.

Personnel must be familiar with the typical hazards of electrical power supply systems, three-phase grids, protective measures, and work on stationary energy systems. In addition, it is required that personnel have fully read and understood this Installation Manual.

Work performed by unqualified persons or end users is strictly prohibited.

2.4 Electrical Hazards and User Role Delineation

The MSK GEN1 contains electrical systems with different voltage and power levels. In addition to the internal 48 V DC system, installation and grid connection involve 230 V and 400 V AC supplies. Despite the comparatively low DC nominal voltage, significant hazards may exist due to high currents.

Before commencing any work, all relevant circuits must be professionally de-energized, disconnected on all poles, and secured against unintentional re-energization. Capacitors, inverters, and battery systems may carry residual voltage even after external power supplies have been disconnected.

Damaged cables, connectors, or enclosures must not be placed into operation. In case of signs of moisture, water ingress, or corrosion, the system must be taken out of service and the manufacturer must be informed.

2.5 Fuel and Media Safety (Methanol and Process Water)

The MSK GEN1 uses methanol as fuel for the reformer system. Methanol is highly flammable and toxic. Smoking, open flames, and sparks are strictly prohibited when handling methanol-containing components.

Opening, modifying, or disconnecting methanol-carrying lines, tanks, or components is exclusively reserved for the manufacturer or authorized service personnel. During installation and service work, care must be taken to avoid damage to all media-carrying components.

Process water is used in demineralized quality. Contamination or the introduction of unsuitable fluids may cause damage to the system.

2.6 Hydrogen and Reformer Gas Safety

During operation, the system internally generates hydrogen-containing reformer gas. Hydrogen is an extremely flammable gas with very low ignition energy. Although no hydrogen is stored, hazardous situations may occur in the event of faults or leaks. Ventilation openings must not be blocked or covered during installation or operation. Work in poorly ventilated or enclosed spaces is not permitted. Gas detection and safety devices of the system must not be manipulated or disabled.

2.7 Thermal Hazards

The system contains components that reach high temperatures during operation, in particular the reformer, fuel cell stacks, exhaust system, and heat transfer circuits. Components may remain hot for an extended period after shutdown.

During installation and service work, no interaction with operating or still-hot components is permitted. Adequate cooling time must be observed. Warning labels on the system must be strictly followed.

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2.8 Fire Protection and Ventilation

Due to the combination of electrical energy, flammable media, and elevated operating temperatures, special fire protection measures must be observed. The installation site must be free of easily flammable materials and must provide sufficient natural or mechanical ventilation.

A suitable fire extinguisher for electrical and chemical fires must be available in the vicinity of the system in accordance with local regulations. Installation in potentially explosive atmospheres is not permitted.

2.9 Battery Safety

The system contains an internal high-energy-density battery system. Batteries may present serious hazards if damaged, short-circuited, or overheated.

Mechanical damage to battery modules must be strictly avoided. Batteries must not be opened, modified, or disconnected. Abnormal conditions such as odor, excessive heat, unusual noises, or visible damage require immediate shutdown of the system and contact with the manufacturer.

2.10 Personal Protective Equipment (PPE)

During installation, electrical connection, and service work, appropriate personal protective equipment must be worn. This includes, in particular, insulating protective gloves, eye protection, and additional protective measures as required by the specific task.

The selection and use of PPE is the responsibility of the executing personnel and must comply with applicable occupational safety regulations.

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3 System Overview and System Components (Installation Perspective)

3.1 Purpose of This Section

This section provides a fundamental understanding of the system architecture, energy design, and operating logic of the MSK GEN1 from an installation and electrical integration perspective. It serves as the technical foundation for all subsequent sections, in particular for the description of operating options and the electrical connection and switching concepts.

A correct understanding of the system logic is a prerequisite for proper installation, selection of the appropriate operating mode, and correct integration into a building's electrical infrastructure.

3.2 General System Architecture

The MSK GEN1 is a stationary hybrid energy supply system that integrates the following main components into a single overall unit:

- A reformer-based methanol HT-PEM fuel cell system
- An internal battery storage system (48 V)
- Three inverters for supplying 230 V / 400 V AC power
- An integrated photovoltaic module
- All required protection, control, and monitoring devices

The system is mechanically and functionally divided into two separate zones, each with different functions, risk profiles, and access restrictions.

3.3 Zone and Component Overview

3.3.1 Zone 1 – Fuel Cell and Media System

Zone 1 contains all components related to energy generation from methanol. This includes, in particular, the reformer, the fuel cell stack, the media-carrying system for methanol and process water, as well as the associated thermal, ventilation, and safety-related assemblies.

From an installation perspective, Zone 1 is not an active work area. Its relevance is limited exclusively to:

- Mechanical placement
- Unobstructed ventilation
- Compliance with environmental conditions
- Access restrictions

No electrical grid connection is made in this zone.

3.3.2 Zone 2 – Battery System, Inverters, and Electrical Interfaces

Zone 2 contains all components relevant for electrical integration. These include:

- The 48 V battery system
- The inverters
- Internal protection and switching devices
- The electrical cabinet with terminals and selector switches
- External AC interfaces to the building installation

All grid-related and installation-side electrical functions are implemented in Zone 2. From the perspective of qualified electrical personnel, this is the central zone for connection, configuration, and system integration.



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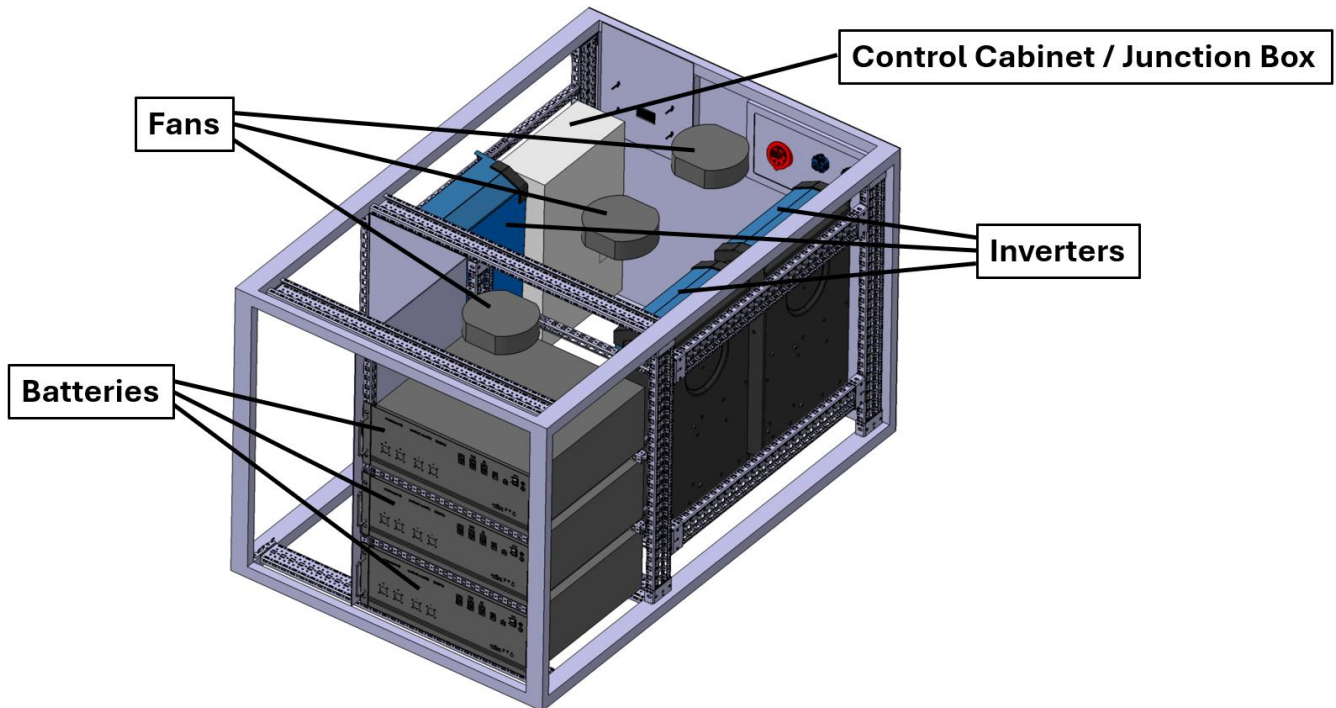
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3.4 Energy Architecture and Control Logic

3.4.1 Core Principle: Battery-Buffered Backup Power System

To avoid unnecessary start cycles of the fuel cell, the MSK GEN1 is designed as a battery-buffered backup power system. This means:

- In the event of a power outage, immediate backup power supply is provided by the batteries
- The fuel cell is started or stopped solely based on the battery state of charge, independent of the grid status

In other words, from the outside the system behaves like a stationary battery storage unit that is automatically recharged by the fuel cell when required.

3.4.2 Fuel Cell Start and Stop Criteria

The state of charge (SOC) of the three internal battery units is continuously monitored:

- When battery SOC falls below 50 %, the fuel cell automatically starts from standby mode
- The fuel cell runs through a controlled startup and warm-up process and then transitions into operating mode
- Once the batteries reach a SOC of 95 %, the fuel cell is shut down in a controlled manner and returns to standby mode

This logic applies regardless of the cause of battery discharge, including:

- Backup power operation
- Increased winter energy demand (e.g. heating functions)
- Low solar power availability

3.4.3 Fuel Cell Power Modulation Based on Battery State of Charge

The electrical output power of the fuel cell in the MSK GEN1 is not constant but is dynamically adjusted based on the state of charge (SOC) of the internal batteries. This control strategy is part of the internal energy management system and ensures

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All electrical loads as well as all internal standby and heating loads are supplied entirely by the battery system. The photovoltaic module supports battery charging, particularly under sufficient solar irradiation.

Since no external energy source is available, battery SOC inevitably decreases, resulting in more frequent fuel cell starts to recharge the batteries. While this operating mode is technically feasible, it is associated with increased fuel cell wear, particularly during winter operation.

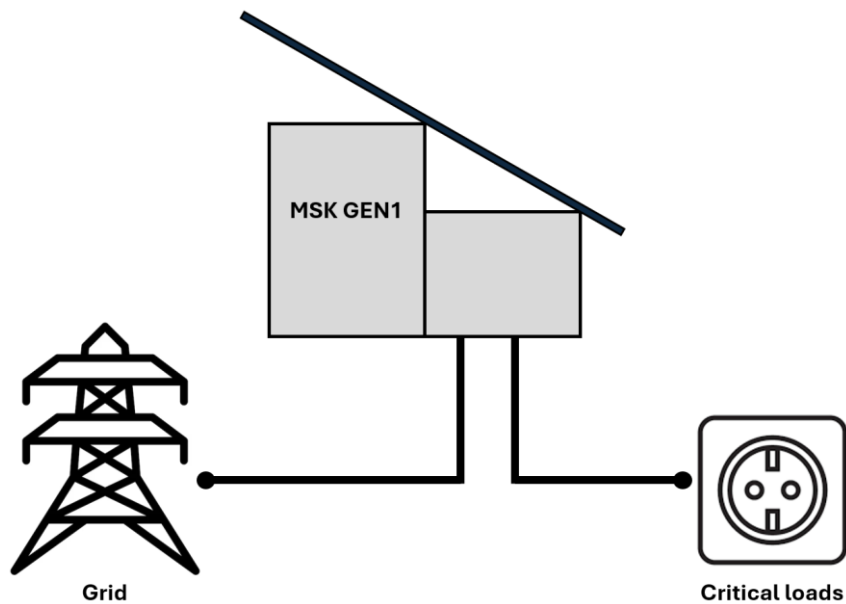
3.6.2 Option 2 – Backup Operation via 32-A Connection

In this option, the MSK GEN1 is connected to a defined sub-network of the building via a 32-A three-phase connection. This sub-network is monitored by the MSK GEN1.

- With grid power present, the system remains in standby mode
- In the event of a grid failure, the batteries immediately assume supply
- The resulting battery SOC decrease subsequently triggers automatic startup of the fuel cell
- After grid restoration, the system recharges the batteries and shuts down the fuel cell once the target SOC is reached

The fuel cell is not started externally.

It responds exclusively and indirectly to grid events via the battery state of charge.



3.6.3 Option 3 – Full Building Integration

In full building integration, the MSK GEN1 is integrated into the entire electrical system of the building. Switching between grid and backup operation is performed via an external transfer switch, which is electrically controlled by the MSK GEN1.

Key aspects:

- The MSK GEN1 is not externally triggered or started
- The system detects grid events via a dedicated grid-sensing line and actively controls the transfer process
- The fuel cell continues to follow the battery-based SOC logic exclusively

This operating option requires additional coordination between the manufacturer, the electrical contractor, and the building installation.

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3.7 Role of the Photovoltaic Module

The integrated photovoltaic module follows a simple and robust control strategy. It charges the batteries whenever solar energy is available. Once the batteries reach their maximum state of charge, the module automatically disconnects from the system. When SOC decreases again, the connection is re-established.

The photovoltaic module operates fully independently of:

- Grid status
- Fuel cell operating state
- Selected operating option

3.8 Thermal Management and Battery Temperature Control

Independent of the fuel cell frost protection system, the MSK GEN1 features a dedicated thermal management system for batteries, inverters, and additional electronic components. This system operates fully automatically and is active both in standby mode and during operation.

To prevent overheating, fans are installed in the upper section of the system enclosure. These fans are temperature-controlled and begin active ventilation at an internal air temperature of approximately 25 °C. The objective is reliable removal of waste heat generated by the batteries and power electronics. This ventilation concept is used both during summer operation at elevated ambient temperatures and during high-load operation, regardless of whether the fuel cell is active or the system is in standby mode.

For low-temperature conditions, the battery system is additionally equipped with integrated heating mats. When battery temperature falls below approximately 5 °C, these heating mats are automatically activated to maintain the batteries within their permissible temperature range. Heating remains active until a temperature of 10 °C is reached, after which it is switched off. Battery temperature control serves to protect the cells and ensures reliable operation even at low ambient temperatures. The described ventilation and heating concept operates fully autonomously and does not require user intervention. Correct operation requires that the system is in standby mode and electrically powered, and not in a fully de-energized state.

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4 Mechanical Installation

4.1 Purpose and Scope

This section describes the mechanical requirements for installation and placement of the MSK GEN1 system. It is intended for qualified personnel responsible for planning, preparation, and execution of the physical installation. Only mechanical and environmental aspects are addressed, including foundation, installation site, system orientation, ventilation, and permissible ambient conditions. Electrical connections and operational aspects are covered separately in subsequent sections.

4.2 Requirements for the Installation Site

The MSK GEN1 is designed as a stationary system for permanent outdoor installation. The installation site must be selected in such a way that safe operation is ensured throughout the entire service life of the system. The system must be installed as a freestanding unit, naturally ventilated, and protected from continuous critical environmental influences. Installation in enclosed spaces, shafts, or areas with restricted air circulation is not permitted. The installation site must also be permanently protected against standing water, flooding, or soil erosion. Safe access must be available at all times for installation, future inspections, and service activities. The footprint of the system is shown below in mm:



4.3 Foundation and Load-Bearing Capacity

The MSK GEN1 has a high overall weight in operational condition. For mechanical installation, a foundation must therefore be provided with a minimum load-bearing capacity of 1,000 kg to ensure sufficient static safety reserves. The foundation must be permanently level and torsion-resistant. Significant settling, inclination, or distortion must be avoided.

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4.4 Placement, Orientation, and Accessibility

During installation, it must be ensured that all ventilation and exhaust openings remain completely unobstructed. Structural elements such as walls, fences, or other technical installations must not impede or redirect airflow. Subsequent enclosures, claddings, or shielding are not permitted unless explicitly approved by the manufacturer.

From a safety and service perspective, all designated external doors and access points must be freely operable without restriction. Adequate clearance must be provided around the system to allow safe inspection, maintenance, and service operations.

4.5 Orientation of the Integrated Photovoltaic Module

The MSK GEN1 is equipped with an integrated photovoltaic module designed to support battery charging. To ensure optimal performance, the system must be oriented such that the module receives the maximum possible number of sunlight hours per day. Please note that shading from buildings, trees, poles, or similar obstructions will significantly reduce module output.

4.6 Ambient Conditions

4.6.1 Ambient Temperature

The MSK GEN1 is designed for operation within an ambient temperature range of -10 °C to +40 °C. When selecting the installation site, particular attention must be paid to ensuring freeze protection during standby operation. Complete de-energization under frost conditions may result in damage to system components.

4.6.2 Installation Altitude

The fuel cell system used in the MSK GEN1 is approved for operation up to an altitude of 2,000 m above mean sea level. Above 1,000 m above mean sea level, reduced performance must be expected. A power derating of 5 % per additional 1,000 m altitude increase applies. This reduction affects only the maximum available electrical output and must be taken into account during installation-side load planning.

4.6.3 Air Humidity

The permissible operating range for relative air humidity is between 0 % and 95 % RH. The installation site must ensure that the system is not permanently exposed to condensing moisture, standing water, or extreme humidity. Adequate natural ventilation is mandatory to prevent moisture accumulation.

4.7 Ventilation and Heat Dissipation

The MSK GEN1 is equipped with an actively controlled ventilation and thermal management system. This system is safety- and function-critical and requires unrestricted air intake and exhaust.

During mechanical installation, it must be ensured that airflow is not impeded by structural obstacles and that waste heat can be freely dissipated into the environment. Operation in environments with heavy dust exposure, aggressive atmospheres, or corrosive gases is not permitted.

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4.8 Protection Against Animals (Martens and Small Animal Protection)

During mechanical installation of the MSK GEN1, it must be ensured that animals cannot gain access to the interior of the system. In particular, martens as well as other small animals may be attracted by the heat emitted by the system (e.g. battery heating, fuel cell operation).

Martens pose a significant safety risk, as they may bite through cables and insulation. This can result in electrical short circuits, system malfunctions, or hazardous situations for personnel. The intrusion of other animals may likewise lead to mechanical damage, functional impairment, or hygienic issues.

Special attention must be paid to the openings in the bottom section of the MSK GEN1 in Zone 2. This area contains the cable entry points for grid and building connections. Although a factory-installed cover plate with cable openings is provided, these openings may still be sufficiently large to allow martens to enter if not properly sealed during installation.

As part of the mechanical installation, it is therefore mandatory to ensure that:

- All cable entries in the bottom area are designed and executed such that no openings remain that allow animals to enter
- Any remaining gaps or openings are sealed using form-stable and temperature-resistant measures (e.g. appropriate cable glands, sealing elements, or protective meshes)

This requirement applies in particular to the first delivered prototype units of the MSK GEN1.

The manufacturer will address and further optimize this aspect in future system generations as part of ongoing development.

Until then, responsibility for adequate protection of the cable entry openings during installation lies with the executing qualified personnel.



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5 Electrical Installation and Building Connection

5.1 Purpose and Context of This Section

This section describes the electrical integration of the MSK GEN1 for different operating options and serves as the central reference for all grid- and installation-related aspects. It is intended exclusively for licensed electricians and qualified technical personnel.

The described concepts and connection variants are based on the current prototype status of the system. They serve as technical guidance and do not replace the obligation to implement the installation in compliance with applicable national codes, regulations, and utility connection requirements.

5.2 Fundamental Electrical Concept

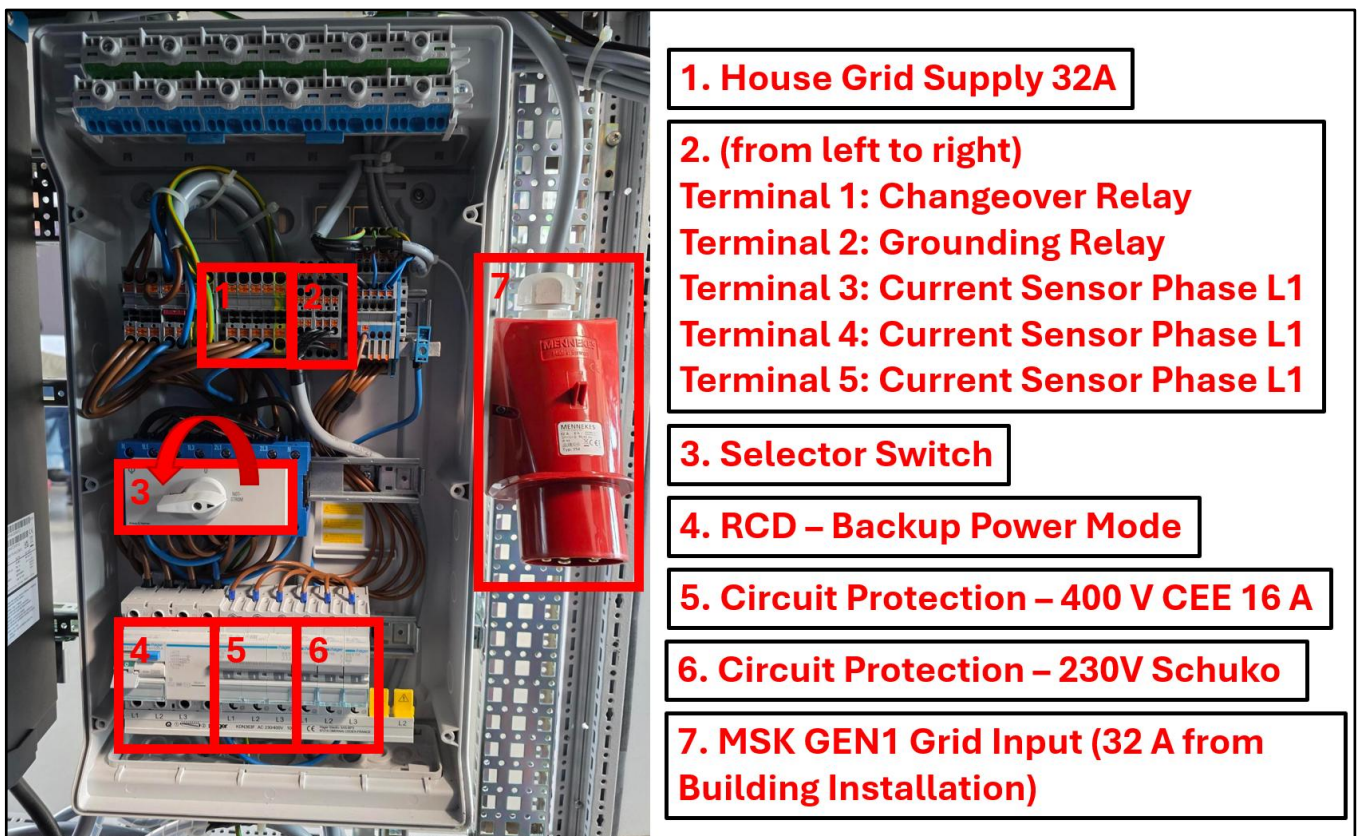
The MSK GEN1 is electrically designed as a self-contained, battery-led energy system. All internal energy flows are implemented via a central DC link. Conversion to 230 V and 400 V AC is performed by integrated inverters (one per phase).

The system serves as a backup power supply and does not operate in parallel with the public grid. Backup power is initially provided by the batteries. As described in Section 3, the fuel cell is started or stopped based solely on battery state of charge.

5.3 Electrical Interfaces

All electrical interfaces to the building installation are located in the white electrical cabinet in Zone 2. This cabinet may only be opened and serviced by qualified electricians.

The main connection points and control elements are shown in the overview below. For further details, refer to Appendix B.



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5.4 Grid Connection

Electrical connection must be implemented according to the selected operating mode (see Section 3).

5.4.1 Operating Mode 1 – Standalone Operation

In standalone operation, the MSK GEN1 functions as an autonomous backup power system and supplies electrical energy via the integrated outlets.

The selector switch (3) must be set to the position “NOT-STROM” (backup power).

Residual current devices and circuit breakers for the outlets are located in the lower section of the control cabinet. These protective devices must not be removed or bypassed.

As described in Section 3, the MSK GEN1 must remain in standby mode at low ambient temperatures to prevent frost damage. This requires electrical energy, which the system can generally generate itself. However, since this leads to frequent fuel cell start-stop cycles, it is strongly recommended to additionally supply the MSK GEN1 via the 32 A connector (7) during winter operation.

If only single-phase power is available, the supplied adapter may optionally be used. In this case, the maximum permissible current for this connection must be configured on the “Shore Power” settings page.

The use of adapters to standard household outlets (Schuko) is strictly prohibited. Such adapters pose a risk of incorrect phase assignment, which can lead to severe malfunctions or damage to the inverters and represents a significant safety hazard.

5.4.2 Operating Mode 2 – Backup Operation via 32 A Connection

In this operating mode, a sub-circuit (maximum 32 A) is routed through the MSK GEN1 and automatically supplied with backup power in the event of a grid outage (see illustration in Section 3.6.2).

Important note: Although up to 32 A can be routed through the system, the short-term and especially the continuous power available during backup operation is lower.

Grid supply from the building main distribution is connected via the integrated 32 A plug (7) and must be protected on-site with a maximum of 32 A. The line to the building circuit to be backed up is connected to output terminal (1) in the control cabinet. The selector switch (3) must be set to “NETZ” (grid).

In this mode, no protective devices such as circuit breakers or residual current devices are active within the MSK GEN1. These must be provided on the building side at an appropriate location and in accordance with regulations.

5.4.3 Operating Mode 3 – Full Building Integration

In this operating mode, the MSK GEN1 is integrated into the building’s electrical distribution via an external transfer switch. In the event of a grid failure, the MSK GEN1 automatically disconnects the downstream circuit from the grid via the transfer switch and supplies it with backup power. This configuration removes the 32 A limitation on the protected circuit.

Important note: Short-term and continuous backup power output is significantly lower than the maximum power rating of the supplied building circuit.

In this mode, the 32 A connector (7) is used solely for grid detection and may be connected using a reduced conductor size and protective rating. As in Mode 2, the backup circuit is connected to output terminal (1). The selector switch (3) must be set to “NETZ” (grid).

In addition to Mode 2, current sensors must be installed on each phase. The corresponding terminals, as well as the control terminals for the external transfer switch, are pre-wired in the control cabinet (2).

As in Mode 2, no internal circuit breakers or residual current devices are active within the MSK GEN1. These must be provided on the building side.

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If this operating mode is desired, prior technical coordination with the manufacturer (Gumpert Automobile GmbH) is mandatory, as minor adaptations to the MSK GEN1 are required (e.g. removal of a bridge for external current measurement, firmware update).

5.5 Grounding and Protective Measures

In standalone operation (Option 1), a local grounding system at the installation site is mandatory. A grounding rod or equivalent grounding device must be installed. Without a defined ground reference, electric shock hazards may occur in the event of faults or damage.

In grid-connected operating modes (Options 2 and 3), grounding is provided via the existing building installation. Additional grounding of the MSK GEN1 is not strictly required but may optionally be implemented if compatible with the overall grounding concept of the building.

5.6 Responsibility of the Executing Electrician

The executing electrician is responsible for selecting the appropriate operating mode, ensuring correct electrical connection, and integrating the system in compliance with applicable local codes and standards. The MSK GEN1 provides the required interfaces but does not replace proper engineering design, verification, or approval of the building electrical installation.

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6 Initial Commissioning, Re-Energization, and Return to Standby Mode

6.1 Purpose of This Section and Scope

This section describes the initial commissioning and re-energization of the MSK GEN1 from a fully de-energized state. It is intended exclusively for licensed electricians or explicitly authorized technical personnel.

The procedures described herein are particularly relevant in the following situations:

- Initial commissioning after installation
- After transport or extended storage
- After a complete shutdown (full de-energization)
- After an emergency stop event

End users are not permitted to perform the activities described in this section. An incorrect sequence or improper operation may result in malfunctions, system faults, or damage to battery and fuel cell components.

6.2 Applicable Use Cases

The procedure described in this section applies when the system is in a fully de-energized state. This condition exists when:

- All relevant main circuit breakers (MCBs) are switched OFF
- The battery system is deactivated
- No internal standby power supply is active

The transition from the de-energized state to standby mode is a safety- and system-critical process and must be carried out in a controlled manner and strictly in the sequence described below.

6.3 Preconditions for Re-Energization

Before starting the re-energization process, the following conditions must be met:

- All system enclosures are closed and mechanically undamaged
- Mechanical and electrical installation has been fully completed
- All external connections have been correctly installed
- No visible damage or leaks are present
- The installation site complies with the requirements defined in Section 4

Only after these conditions are fulfilled may system activation begin.

6.4 Re-Energization of the System (OFF → Standby)

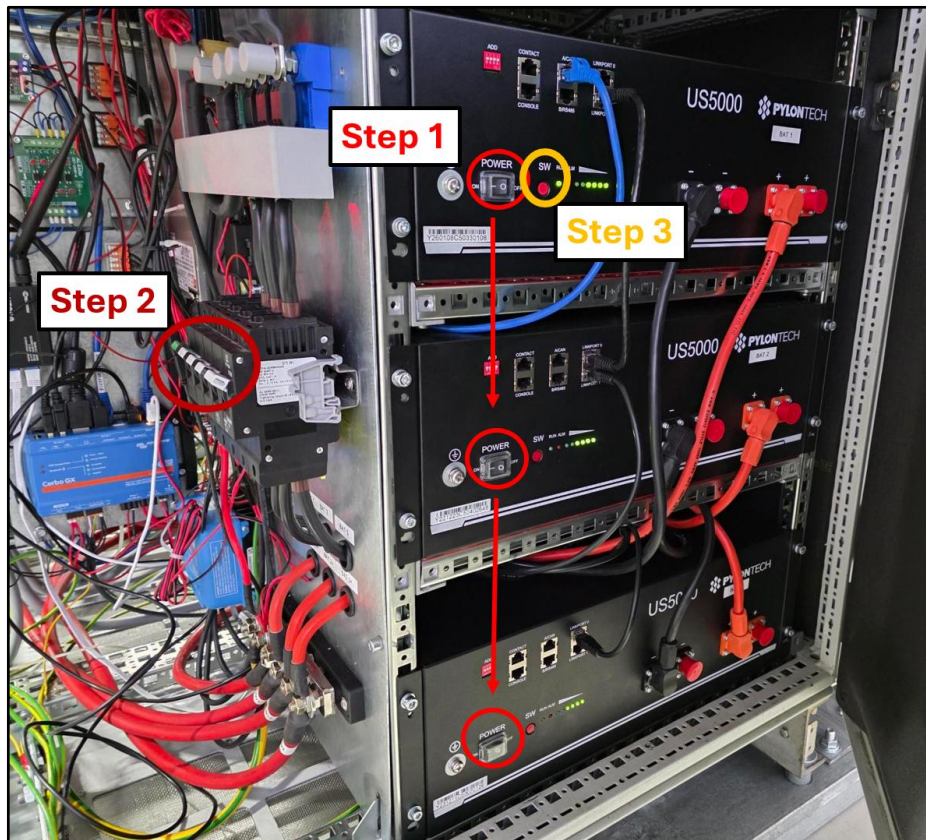
Re-energization must be carried out in a strictly defined sequence, which must be followed without deviation:



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6.4.1 Activation of the Battery Units

The individual battery units must be activated first.

Activation is performed manually at the battery modules and must be carried out in the following order:

- Battery 1 (uppermost unit)
- Battery 2 (middle unit)
- Battery 3 (lowermost unit)

On each battery unit, the corresponding I/O switch must be set to the ON position.

6.4.2 Switching ON the Main MCBs (Zone 2)

In the next step, DC-side power is restored.

Important: Ensure that all MCBs in Zone 1 are in the OFF position.

Then, switch the main MCB for the battery system in Zone 2 to the ON position.

This step makes the internal DC system generally capable of being energized. At this point, however, the battery system itself has not yet been started.

6.4.3 Initialization and Synchronization of the Battery System

If sufficient solar irradiation is available, the batteries are automatically started by the solar charge controller. If this is not the case, manual startup is required.



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To manually start the batteries, press and hold the round red SW pushbutton on Battery 1 (uppermost battery) for approximately 5 seconds.

After a short delay, the status LEDs of all three battery units begin flashing green.

This state indicates that:

- The battery system is active
- All battery units are correctly synchronized
- The internal DC supply is stable

⚠ Important note:

The next step must not be performed until all three battery units display the correct LED status. If this condition is not met, the process must be interrupted and the cause investigated.

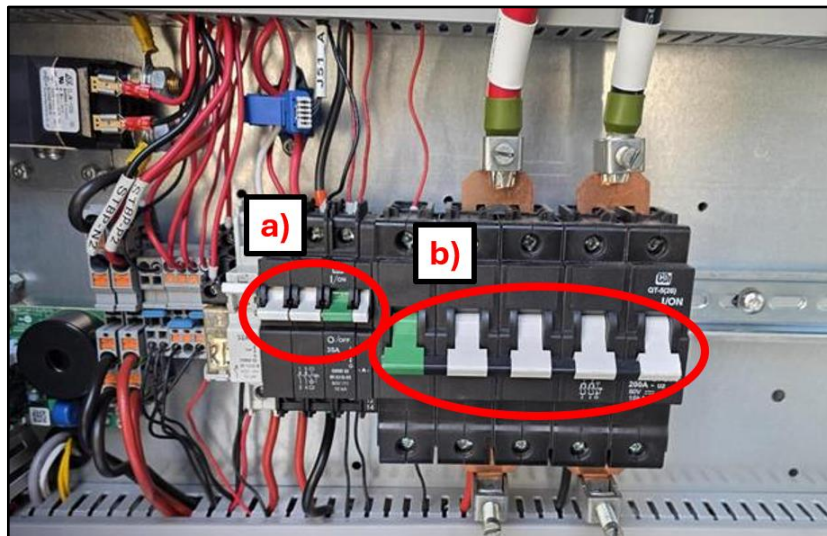
6.4.4 Activation of the Fuel Cell System (Zone 1)

Only after successful battery initialization may the fuel cell system be activated.

In Zone 1, switch on the fuel cell MCBs in the following order:

- a) First, the MCB group for the Balance of Plant (BoP)
- b) Then, the MCB group for the fuel cell stack

After switching on these MCBs, the system automatically begins its internal initialization process. Immediate power generation by the fuel cell does not necessarily occur at this stage, as system behavior depends on the battery state of charge.



6.4.5 Entering Standby Mode

After completion of initialization, the MSK GEN1 automatically transitions to standby mode.

The current system status can be checked via the external control and display panel.

In standby mode:

- The system is fully electrically active
- Internal monitoring is operational
- The MSK GEN1 is ready for automatic operation according to the control logic described in Section 3

No further operator actions are required at this point, provided that no manual start is intended.

To draw electrical power from the MSK GEN1 regardless of the selected operating mode, the AC output must be enabled via the control panel.

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6.5 Typical Errors and Important Notes

The most common errors during re-energization are caused by:

- Incorrect activation order of the battery units
- Incomplete battery synchronization
- Premature switching on of the fuel cell MCBs

Strict adherence to the described sequence is mandatory to avoid fault conditions or unnecessary system startups.

6.6 Return to Fully De-Energized State (Standby → OFF)

If the system must be fully shut down in a controlled manner, the reverse process must be applied. Returning the MSK GEN1 to a fully de-energized state (OFF / de-energized) is not a normal operating condition and is intended only for specific situations, such as:

- Prior to transport or storage
- Before extensive service or maintenance work
- Upon project-specific instruction from the manufacturer

This procedure may be carried out exclusively by licensed electricians or authorized technical personnel and must be performed strictly in the sequence described below.

6.6.1 Preconditions Before Shutdown

Before initiating complete de-energization, ensure that:

- The system is in standby mode
- No active power delivery is taking place
- The AC output has been disabled via the control panel
- No automatic system start is imminent

An emergency stop does not replace this procedure and does not constitute a controlled transition to the OFF state.

6.6.2 Deactivation of the Fuel Cell System (Zone 1)

First, electrically disconnect the fuel cell system.

In Zone 1, switch off the fuel cell MCBs in reverse order of activation:

- First, the MCB group for the fuel cell stack
- Then, the MCB group for the BoP

After switching off these MCBs, the fuel cell system is fully de-energized and no internal processes remain active.

6.6.3 Deactivation of the Battery System

After deactivating the fuel cell system, the battery system must be shut down in a controlled manner.

On Battery 1 (uppermost battery), press and hold the round red SW pushbutton for approximately 5 seconds until the status LEDs of the battery units turn off.

This step terminates the active readiness of the battery system.

Then switch the I/O switches of the three battery units to the OFF position in the following order:

- Battery 1 (uppermost unit)

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- Battery 2 (middle unit)
- Battery 3 (lowermost unit)

6.6.4 Switching OFF the Main MCB (Zone 2)

As the final step, switch the main MCB for the battery system in Zone 2 to the OFF position.

This fully de-energizes the internal DC system.

After this step, the MSK GEN1 is completely in the OFF state. No internal monitoring, heating, or ventilation functions remain active.

6.6.5 Important Note on the OFF State

In the fully de-energized state, all protective and convenience functions are disabled, including:

- Battery temperature control
- Internal fans
- Standby monitoring
- Frost protection functions

The OFF state is therefore not intended for continuous operation.

In the event of frost risk or unfavorable environmental conditions, damage to media- or temperature-sensitive components may occur in this state. Responsibility for maintaining suitable environmental conditions during de-energization lies with the operator or the executing technical personnel.

6.6.6 Restarting the System

Restarting the system from the OFF state must be performed exclusively in accordance with Section 6.4. Deviations from the defined sequence are not permitted.

6.7 Safety Notice Regarding State Transitions

Transitions between the states de-energized, standby, and operation directly affect the electrical and electrochemical systems of the MSK GEN1.

These state transitions are safety-critical and may only be performed by qualified technical personnel.

End users are neither trained nor authorized to perform these actions.

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7 Service and Maintenance – Overview

7.1 Purpose and Context of This Section

This section provides a purely informational overview of service and maintenance activities related to the MSK GEN1. It is intentionally separated from the preceding installation sections and serves solely to inform operators, project partners, and other interested parties.

The components described herein are not accessible to end users, installation contractors, or third-party service providers. Access to relevant sensors, filters, and maintenance points is reserved exclusively for Gumpert Automobile GmbH. This section does not contain instructions or procedural descriptions for performing maintenance work.

7.2 Fundamental Service Concept

The MSK GEN1 is designed as a prototype system with a manufacturer-centered service and maintenance concept. All preventive maintenance measures, inspections, and media replacements are carried out by Gumpert Automobile GmbH or explicitly authorized partners only.

Maintenance intervals are based on both operating hours and calendar time, depending on the respective component and its aging or load characteristics.

7.3 Overview of Maintenance-Relevant Components

Process Water Quality Sensor

The quality sensor monitors the purity of the demineralized process water used. Deviations in water quality can lead to long-term damage to the reformer system or the fuel cell stack.

Recommended inspection interval:

After 2,000 operating hours

Methanol Leakage Sensor

The leakage sensor monitors the methanol tank and adjacent areas. It detects methanol leaks at an early stage and is a safety-critical element of the system.

Recommended inspection interval:

After 2,000 operating hours

Water Filter

The water strainer removes contaminants from the process water and protects sensitive components within the media system.

Recommended inspection / service interval:

After 2,000 operating hours

Coolant (Water-Glycol Mixture)

The water-glycol mixture provides thermal coupling and temperature stabilization for central electronic system components.

Recommended replacement interval:

After 2,000 operating hours

Cathode Air Flushing / Pre-Ventilation Filter

This maintenance step ensures flushing and ventilation of the cathode compressor system to maintain a clean air path.

Recommended maintenance interval:

After 500 operating hours

Cathode Air Filter

The cathode air filter protects the fuel cell stack from dust, particles, and contaminants present in ambient air.

Recommended maintenance / replacement interval:

After 2,000 operating hours

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Heat Transfer Oil

The heat transfer oil is used for controlled heating and cooling of the fuel cell stack and is essential for startup, operation, and shutdown processes.

Recommended replacement interval:

After 2,000 operating hours

7.4 Important Note on Accessibility

All sensors, filters, and media listed above are located in restricted-access areas of the MSK GEN1. The required keys as well as the necessary service expertise are held exclusively by Gumpert Automobile GmbH.

Unauthorized access is neither intended nor possible.

7.5 Note on Prototype Status

The specified maintenance intervals are provided for orientation purposes only and are based on the current development and operational experience of the prototype system. As part of ongoing system development, validation, and potential series production, maintenance cycles and procedures may be subject to change.



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Appendix A – List of Abbreviations

Abbreviation	Description
A	Ampere
AC	Alternating
ATS	Automatic Transfer Switch
BoP	Balance of Plant (auxiliary equipment of the fuel cell system)
W × H × D	Width × Height × Depth
CE	Conformité Européenne (EU conformity marking)
CEE	IEC 60309 industrial connector (CEE plug)
DC	Direct Current
EU	European Union
FC	Fuel Cell
RCD / FI	Residual Current Device
GX	Victron GX device platform
HT-PEM	High Temperature Proton Exchange Membrane
IEC	International Electrotechnical Commission
IMPCA	International Methanol Producers and Consumers Association
ISO	International Organization for Standardization
I/O	On/Off switch
kg	Kilogram
kW	Kilowatt
l	Liter
MCB	Main Circuit Breaker
mm	Millimeter
MPPT	Maximum Power Point Tracking
MSK	Methanol Power Converter (Methanol-Strom-Konverter)
AMSL	Above Mean Sea Level
PE	Protective Earth
PPE	Personal Protective Equipment
PV	Photovoltaic
RH	Relative Humidity
SOC	State of Charge (battery state of charge)
SW	Switch / Pushbutton



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UI	User Interface
UPS	Uninterruptible Power Supply
URL	Uniform Resource Locator
V	Volt
VRM	Victron Remote Management
W	Watt
°C	Degrees Celsius
%	Percent

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Appendix B – Electrical Schematics

Figure B-1: AC Distribution of the MSK GEN1

This figure illustrates the internal AC distribution of the MSK GEN1.

Shown are the three-phase AC input, the internal residual current device (RCD), the downstream circuit protection devices, and the distribution to the internal AC outputs.

In addition, the internal outlet circuits (CEE 16 A as well as single-phase Schuko outlets assigned per phase) and the outgoing feeder to the customer’s building distribution or sub-distribution are depicted.

Figure B-2: Inverter Integration and Phase Assignment

This figure shows the electrical integration of the three inverters into the AC system of the MSK GEN1.

Depicted are the 48 V DC supply to the inverters, the assignment of each inverter to phases L1, L2, and L3, and their connection to the three-phase AC output.

Also shown are the interfaces for customer-side components such as an external transfer switch, grounding relay, and current sensors, where applicable in the respective operating mode.

The schematics shown are provided for overview and conceptual understanding of the internal electrical structure only. They do not replace proper electrical planning, verification, or execution in accordance with applicable electrical codes, standards, and regulations.



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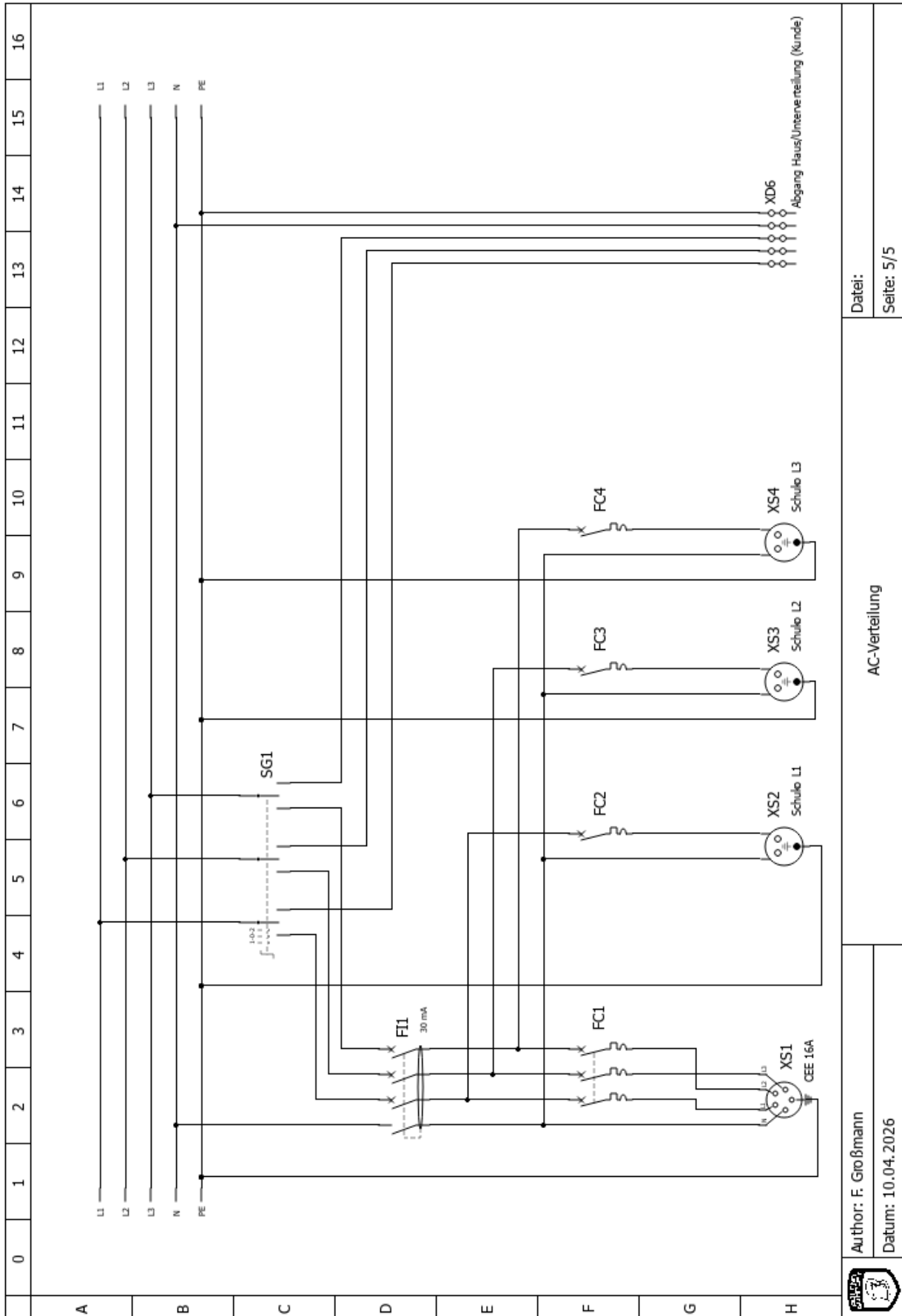


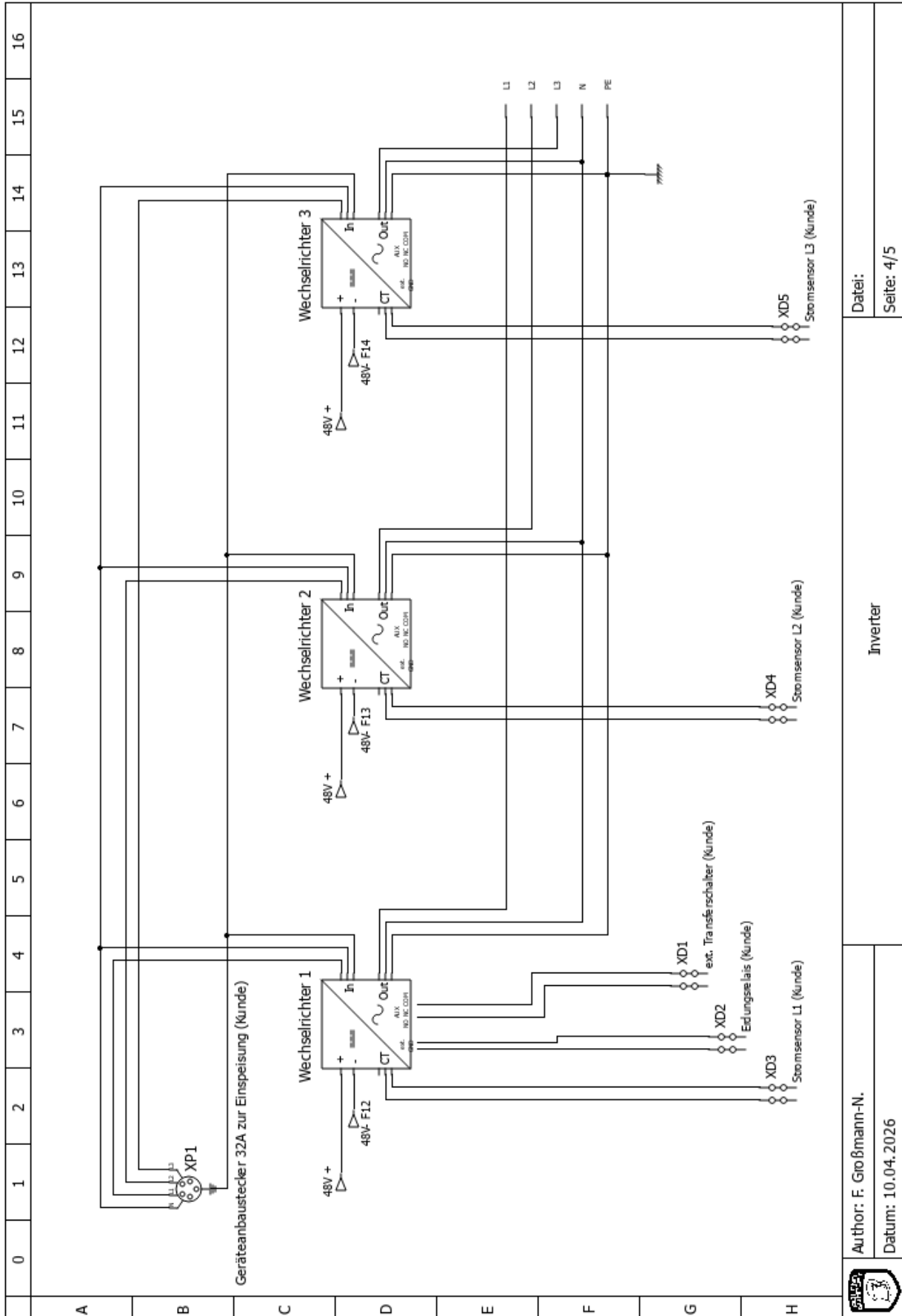
Figure B-1



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Author: F. Großmann-N.

Date: 10.04.2026



Inverter

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Figure B-2