ePowerControl

PV/Diesel/Grid/Battery storage integration Controller

User Manual

Product installation instructions

ePowerControl ES/ES+.

Version 1.0_Mars 2026

Index

1. General information

1.1. About this manual

This User Manual provides all essential information required to install, configure, and operate the **ePowerControl ES/ES+** by Elum Energy. It covers product details, safety precautions, installation guidelines, and configuration steps.

The manual is structured to guide users through each phase of deployment, from wiring devices and configuring communication, to commissioning and advanced functionalities.

Intended audience:

- EPC contractors involved in new PV, Battery Energy Storage Systems (BESS), or hybrid PV/Genset/Battery installations.
- EPC contractors working on PV/Battery integration into existing genset-based power systems.
- System integrators and engineers working on microgrids, hybrid plants, or battery integration into existing generation assets.
- Professionals responsible for the design, commissioning, and maintenance of hybrid or storage-based power systems.

To improve readability and emphasize critical information, this manual uses the following symbols:

Warning
Indicates a potentially hazardous situation that could lead to serious injury or death. This symbol is used to highlight precautionary measures and safety guidelines that must be followed.

Notes
Provides **general information** or useful tips to help the user during installation, configuration, or operation.

Before installing the **ePoweControl**, carefully read this manual to **prevent personal injury and avoid equipment damage**.

1.2. Glossary

APN address	A gateway that connects a GSM, GPRS, 3G, or 4G mobile network to another computer network.
AWG (12 wires)	American wire gauge : A standard unit for measuring the diameter of electrical wires.
CT	Current Transducers: A device that detects electric current in a wire and generates a proportional signal.
DHCP mode	Dynamic Host Configuration Protocol : A network protocol that automatically assigns IP addresses to devices.
DIN rail	A standardized metal rail used for mounting industrial control equipment inside enclosures or racks.
EMS	Energy Management System A system designed to monitor and/or control, and optimize energy usage in industrial and commercial environments.
EPC	Engineering, Procurement & Commissioning : A company responsible for the design, procurement, and installation of power systems.
I/O module	Input/Output module : A device that manages input and output signals between control systems and external devices.
ICMP	Internet Control Message Protocol : A network protocol used for diagnostic and error reporting in IP networks (e.g., Ping command).
LAN ports	Local Area Network : Physical connections for networking devices within a local network.
Local NEC rules	National Electrical Code : A standard for the safe installation of electrical wiring in various regions.
Modbus RTU	Communication protocol to connect a supervisory computer with a remote terminal unit (RTU)
Modbus TCP	Communication protocol to connect a supervisory computer with a remote terminal unit through Ethernet with a transmission control protocol (TCP)
OCPP	Open Charge Point Protocol for communication between electric vehicle charging stations and a central management system
RS-485	Standard electrical characteristics of drivers and receivers in serial communications systems
SCADA	Supervisory control and data acquisition
SNMP	Simple Network Management Protocol (SNMP) is an Internet Standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior.
UDP ports	Ports for User Datagram Protocol

UPS	Uninterruptible Power Supply : A backup power system used to ensure continuous operation of the controller, preventing data loss or system shutdowns during power outages.
PF (Power Factor)	Ratio of active power (kW) to apparent power (kVA) in electrical systems. It indicates the efficiency of power usage.

1.3. Legal information

Elum SAS, headquartered at 9 rue d'Enghien - 75010 Paris, is registered with the Paris Trade and Companies Registry under number 817 860 083. The company specializes in the integration and distribution of monitoring and control panels for photovoltaic and hybrid energy systems, marketed under the brands "ePowerLog" and "ePowerControl".

Elum ensures that its controllers and dataloggers comply with French quality standards, are designed and assembled in France, and meet all necessary technical and quality requirements.

Elum reserves the right to modify the content of this document as needed. In the event of any discrepancy between translated versions, the English version shall take precedence.

1.4. Safety warnings

The ePoweControl products are electrical devices and should only be installed and operated by qualified personnel who are aware of the associated safety risks.

Installation of meters
Voltage-carrying parts. Risk of heart attack, burns and other injuries. Disconnect the power supply and charge the device before installing the analyzer. Protect the terminals with covers. The energy analyser must be installed by qualified/approved personnel.

Dangerous voltage
Do not touch the terminals for voltage and current measurement. Always connect grounding terminals. Do not disconnect the controller CT terminals. Be careful to protect the unit from electrostatic discharges during the installation.

Internet access
A **stable internet connection** is required for the proper **commissioning and operation** of the **ePoweControl**.

Monitoring and control features
Elum can only guarantee the monitoring and control of the site according to its product features once all of the equipment to be monitored have correctly been configured and connected to the controller.

Reverse Power Protection (for the ePowerControl SD, HFS, ES, MC and PPC)
The ePowerControl is NOT an electrical protection. It does not replace an adequate protection of diesel generators against power reversal, nor a properly configured/installed protection relay, nor a properly configured/installed genset controller integrating the reverse current protection functionality. If necessary, please install protection relays against reverse power.

1.5. Scope of supply

The **ePowerControl ES** is a ready-to-use solution that consists of a Central Computing Unit (CCU) and, depending on the project, optional expansion modules.

- The Central Unit is responsible for executing advanced control algorithms and enabling remote communication with the Elum cloud via the Internet.
- The firmware is pre-installed and optimized to ensure seamless operation upon installation.
- Any additional options purchased by the client are already integrated into the base station before delivery.

For detailed specifications and technical information regarding the **Central Computing Unit**, please refer to the **ePowerControl datasheet**.

1.5.1. About the ePowerControl ES/ES+

The **ePowerControl ES** is an **Energy Management System (EMS)** developed by Elum Energy to control and optimize hybrid power plants.

It manages and coordinates multiple energy sources and loads, including:

- **Grid** (utility connection)
- **Load** (site consumption)
- **PV (Photovoltaic)** generation
- **BESS (Battery Energy Storage System)**
- **Gensets (Diesel Generators)**

The ePowerControl ES/ES+ operates on a **deterministic, rule-based logic**, meaning that actions are triggered based on predefined conditions and parameters. This ensures:

- **Reliable and predictable operation** (no random or uncertain behavior).
- **Flexible control strategies**, where specific rules can be set to automatically start, stop, charge, or discharge devices according to the site's needs.

The **ePowerControl ES+** version includes additional capabilities and enhanced computing resources for larger or more complex installations.

The ePowerControl ES/ES+ integrates both:

- **EMS logic** (optimization and dispatch of energy resources)
- **PPC logic** (grid compliance and centralized plant control)

This dual functionality enables the controller to optimize internal energy flows while ensuring compliance with grid requirements and supervisory commands.

1.5.2. Monitoring and Control

The **ePowerControl ES/ES+** can be used both for **controlling devices** and for **monitoring only**.

1. When a device is **EMS Compliant**, it is fully integrated into the EMS. This means it appears in the Control page, can be actively managed by the system, and its data is monitored and exported either to the Elum platform or to third-party systems through the Modbus Gateway.

2. When a device is set as **Monitoring Only**, it is not controlled by the EMS and does not appear in the Control or Overview pages. However, its data are still collected and can be exported to the Elum platform or third-party systems if listed in the Elum data model.

1.5.3. Modbus Gateway

The **ePowerControl ES/ES+** includes a **Modbus Gateway** that enables third-party platforms (e.g., SCADA systems) to access data from the EMS.

1. Supported protocols: **Modbus TCP**
2. Exposed data include:
    - Standard device measurements (e.g., PV, BESS, gensets, meters).
    - EMS controller values and commands (depending on configuration).

1.5.4. Additional Equipment (Optional)

Additional external equipment, such as **power meters, current transformers (CTs), I/O modules, antennas, UPS (ASI), and weather sensors**, may be included in the purchase order. These items will be delivered under the same terms as the controller.

- Some components may already be **pre-installed within the ePowerControl ES/ES+ cabinet**, ensuring seamless operation upon installation.
- Others will require installation on-site by the client or the commissioning team.

Optional accessories can include:

- **Power meters**.
- **Current transformers (CTs)** for accurate measurement.
- **I/O modules** for breaker, relay, or sensor integration.
- **Antennas** (cellular, Wi-Fi, GPS) for connectivity.
- **Uninterruptible Power Supply (UPS)** to maintain operation during outages.
- **Weather sensors** (irradiance, pyranometer, temperature, wind).
- **Mounting accessories or cabinets** for secure integration.

For further details on optional accessories and configurations, please refer to the **Options** section of this manual.

1.5.3. Monitoring Platform - ePowerMonitor

Upon purchase of a subscription to the **ePowerMonitor** platform, and once all hardware components are installed, the internet connection is configured, and commissioning tests are successfully completed, Elum will provide the client with **access credentials** (User ID and Password).

This access enables:

- **Remote monitoring** of plant performance.

- **Visualization of data** from all connected devices.
- **Alarm notifications** and event tracking.
- **Basic remote control features**, depending on the system configuration.

The ePowerMonitor platform is available online and provides operators, EPCs, and asset managers with a centralized view of their energy systems.

2. Commissioning overview

2.1. Before proceeding to the commissioning

Before initiating the commissioning process, Elum will provide the following essential documents:

- User Manual
- Datasheet

The ePoweControl is delivered with pre-installed Elum firmware, ensuring that it is ready for installation. The installation team must follow the step-by-step instructions provided in this manual to complete the autonomous commissioning of the controller.
The entire system configuration can be performed on-site, and all necessary setup details are included within this document.

Equipment first integration by Elum
For the integration of new equipment by Elum, the Operations team must be notified at least 15 days prior to deployment. Failure to do so may result in limited availability of Elum engineers for assistance, and their full support cannot be guaranteed.

PV injection precaution
During the deployment process, PV injection must remain shut down. Elum cannot be held responsible for any damage caused by uncontrolled PV injection during the commissioning process. It is the responsibility of the installation team to ensure that proper precautions are taken before proceeding.

2.2. Deployment steps

Step 1	Read the User Manual
Step 2	Plan the communication architecture
Step 3	Wire the slave devices
Step 4	Connect and configure all non-Elum equipment: - PV inverters - Generator controller (*with a protection relay if necessary*) - Power meters - Other equipment (sensors, Electric Vehicle Charging Stations, etc.)
Step 5	Wire and install the ePowerControl
Step 6	Configure the ePoweControl online with Elum Configuration: - ePoweControl password and Internet access - Communication ports and devices according to your Communication Architecture Plan (test and correct)
Step 7	Start the Data acquisition
Step 8	(Optional) access to ePowerMonitor

2.3. Step 2: Communication Architecture Plan

2.3.1. Objectives

Before commissioning, a clear communication plan must be established to prevent any network-related issues. The design of the network should take into account wiring limitations, communication protocol compatibility, and the configuration requirements of each device to ensure seamless integration.

2.3.2. RS485 Constraints: Configuring Slave ID Addresses

To ensure stable communication via RS485 (Modbus RTU), the following rules must be followed:

Each **device** must have a **unique Slave ID** to avoid address conflicts.

All devices connected to the **same serial port** must use the **same communication protocol** and have matching parameters, including **baud rate, parity, byte size, and stop bits**.

The **Modbus RTU protocol** allows up to **32 devices** to be connected to a single serial communication port.

Limits
The **maximum cable length** for RS485 communication must not exceed **1000 meters** to ensure signal integrity.

2.3.3. Ethernet Constraints: Configuring IP Addresses

For proper Ethernet communication, the following guidelines must be observed:

- Each **device** must have a **unique IP address** within the network.
- All devices must be **within the same subnet** as the **Elum Explorer** to allow seamless data exchange.
- The **subnet range 192.168.4.XX** is **reserved** for LAN port **2 for ePowerControl ES,** LAN port 4 **for ePowerControl ES+** and **must not be used** for other devices.

All devices should be configured with the **Subnet Mask: 255.255.255.0** to maintain proper network segmentation and communication stability.

Limits
The **maximum Ethernet cable length** must not exceed **100 meters** to prevent signal degradation and ensure reliable communication

2.3.4. Example

Table 1: Communication Architecture Plan Example

Device	Slave Reference	Protocol	Slave IP address	Slave ID	Baud rate	Byte Size	Parity	Stop Bit
Inverter n°1	*SMA STP 25000 TL*	*Modbus TCP*	*192.168.3. 200*	-	-	-	-	-
Inverter n°2	*SMA STP 25000 TL*	*Modbus TCP*	*192.168.3. 201*	-	-	-	-	-
Inverter n°3	*SMA STP 25000 TL*	*Modbus TCP*	*192.168.3. 202*	-	-	-	-	-
Inverter n°3	*SMA STP 25000 TL*	*Modbus TCP*	*192.168.3. 203*	-	-	-	-	-
Grid Meter	*EM330-DIN. AV5.3.H.S1.X, Carlo Gavazzi*	*Modbus RTU*	-	*2*	*9600*	*8*	*No*	*1*
Load Meter	*EM330-DIN. AV5.3.H.S1.X, Carlo Gavazzi*	*Modbus RTU*	-	*1*	*9600*	*8*	*No*	*1*

2.4. Step 3: Wire the slave devices

2.4.1. Connecting RS485 Devices

To enable the ePoweControl to monitor external devices via RS485, a physical connection must be established. The ePoweControl functions as the master of the communication bus, while all connected equipment act as slaves. Each slave device must be properly configured to ensure seamless communication using the Modbus RTU/TCP protocol.

2.4.2. Central Computing Unit serial ports

2.4.2.1. ePowerControl ES

RS485-compatible devices can be connected to Serial Port 1 or Serial Port 2 on the ePowerControl ES/ES+ Central Computing Unit using shielded twisted pair connectors. If an RS485 Extension Module is provided by Elum, its serial ports 1 or 2 can also be used for device connections.

For specific wiring and configuration details related to third-party hardware, please refer to the manufacturer's documentation to ensure compatibility and correct setup.

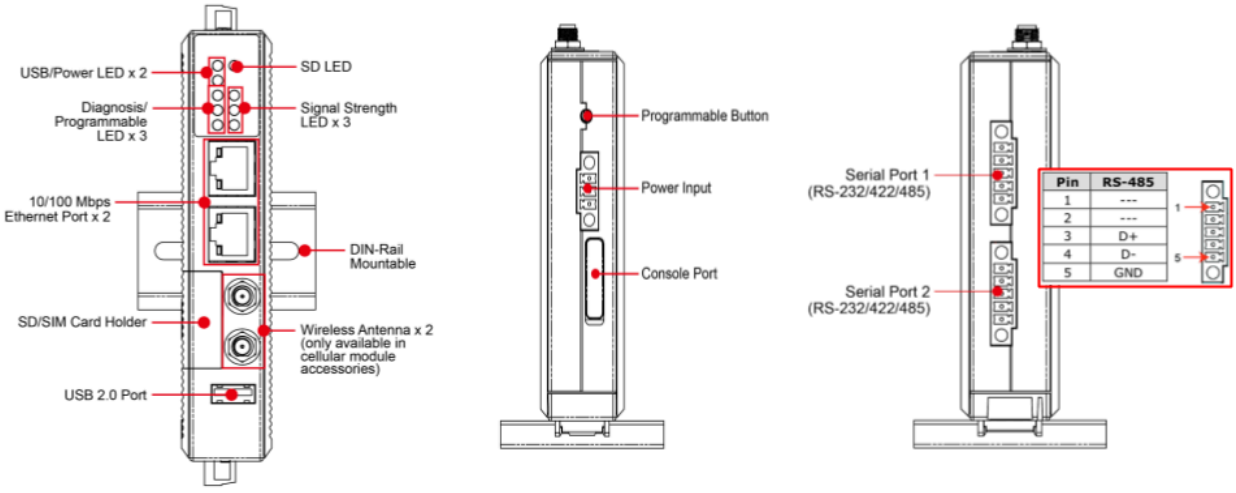


Fig. 1: Front, Top, and Bottom Views of the Central Computing Unit

The table below provides the pin configuration for the UC-8100 (ePowerControl ES) communication ports, used to connect RS485-compatible devices to the ePowerControl Central Computing Unit. Proper wiring and adherence to these pin assignments are crucial to ensure stable data transmission and device monitoring

Pin	RS-485
1	---
2	---
3	D+
4	D-
5	GND

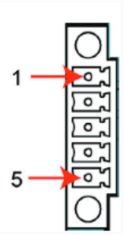
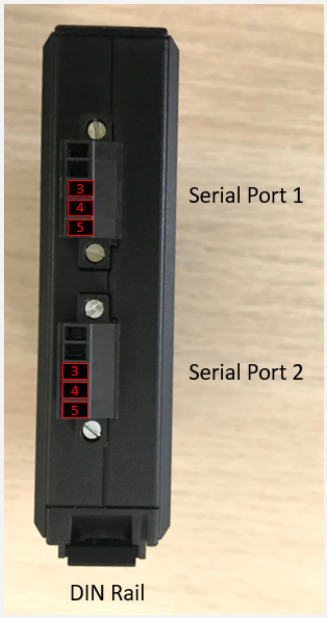
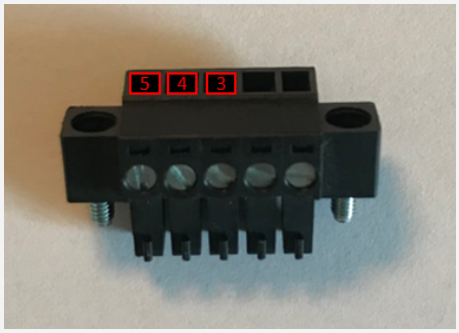


Fig. 2: Pin association of the central computing unit serial ports for RS485 wiring

For correct RS485 wiring, ensure that Pin 3 (Data B+) and Pin 4 (Data A-) are connected using a shielded twisted pair cable to prevent interference. Pin 5 (GND) should also be connected to maintain signal integrity.





If additional RS485 expansion modules are used, follow the same pin configuration for serial communication. For third-party devices, refer to their respective technical documentation to verify compatibility with the UC-8100 (ePowerControl ES) communication ports.

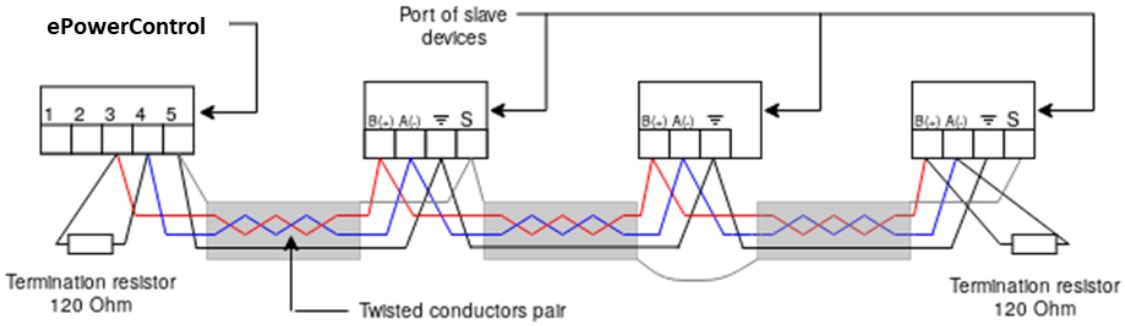


Fig. 3: Daisy-chain wiring for RS-485 serial communication

2.4.2.2. ePowerControl ES+

Compatible RS485 devices can be connected to any of the four serial ports available on the ePowerControl ES+ Central Computing Unit. This connection must be made using two shielded twisted pair connectors to ensure proper data transmission and minimize electromagnetic interference.
If an RS485 Extension has been provided by Elum, any available serial port on the extension can also be used for connecting RS485 devices.
For detailed configuration and installation guidelines specific to third-party hardware, please refer to the manufacturer's documentation.

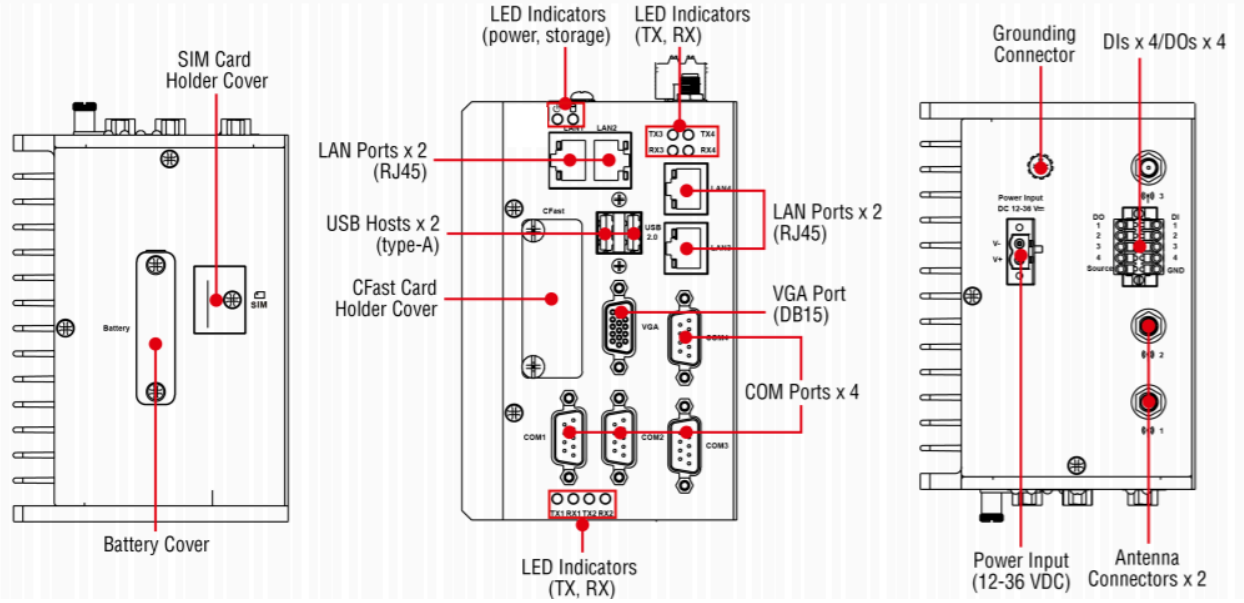
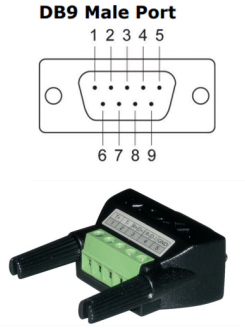


Fig. 4: Front, top and bottom views of the Central Computing Unit

Table 2 provides the pin assignments for COM ports.

Table 2: Pin of the Central Computing Unit serial ports association forRS485 wiring



Pin	RS-485 (4-wire)	RS-485 (2-wire)
1	TxDA(-)	–
2	TxDB(+)	–
3	RxDB(+)	DataB(+)
4	RxDA(-)	DataA(-)
5	GND	GND
6	–	–
7	–	–
8	–	–

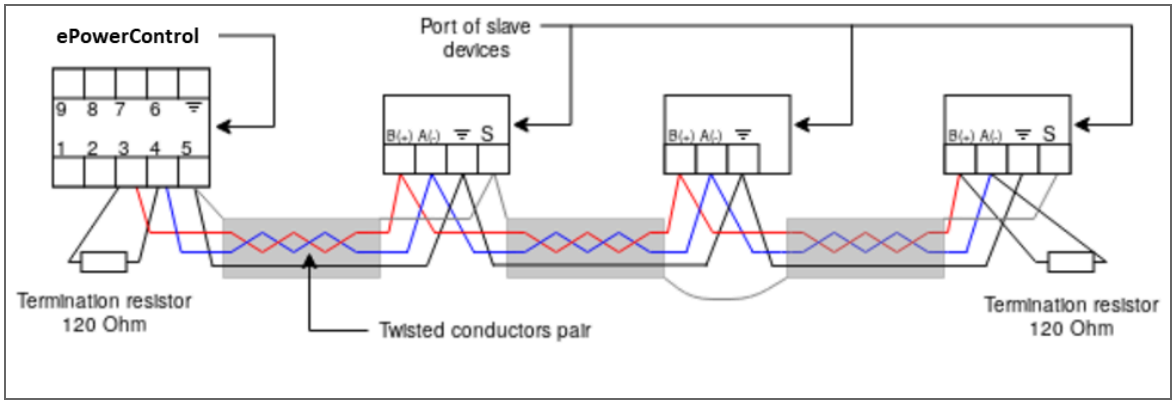


Fig. 5: Daisy-chain for RS-485 serial communication

2.4.3. RS-485 Wiring Guidelines

Proper wiring of the RS-485 serial line is essential for ensuring reliable data transmission between the ePoweControl and connected devices. Follow these guidelines to minimize interference and maintain stable communication:

- **Daisy chaining connections**

1. Pin 3 (DataB +) of the serial port should be connected in a daisy-chain with all DataB (+) ports of the connected devices
2. Pin 4 (DataA -) of the serial port should be connected in a daisy-chain with all DataA (-) ports of the connected devices.
3. Pin 5 (GND) should be connected in a daisy-chain with all GND ports of the connected devices.

- **Cable selection & Organization**

1. Use twisted-pair cables for DataB (+) and DataA (-) to reduce electromagnetic interference
2. To simplify wiring and avoid errors, maintain a consistent color scheme (e.g., red for DataB (+), blue for DataA (-), and black for GND).

2.4.4. Termination of data wires

To prevent signal reflections and data errors, termination resistors must be installed:

- A 120 Ohm resistor should be placed at each end of the RS-485 communication line, connecting DataB (+) and DataA (-).
- The resistance value must be compatible with the impedance of the communication cable used.

2.4.5. Shielding

- It is recommended to use shielded RS-485 cables to protect against external electrical noise.

- The shielding should be continuous along the entire RS-485 communication line and must be connected to the GND (Pin 5) at the controller.
- To prevent ground loops, the shield should only be connected at a single point, preferably at the controller side.

2.4.6. RS-485 connection limitations

- The total cable length between the controller and the farthest external device must not exceed 1 km for proper signal integrity.
- The use of unshielded cables should be minimized to prevent communication interference.

Failure to adhere to the **RS-485 wiring guidelines**, including the use of **termination resistors**, **proper grounding**, and **adequate shielding** can lead to **unstable communication**, **reduced performance**, and even **potential equipment damage**.

To maintain signal integrity, **shield continuity must be ensured** throughout the entire communication line. This requires **dedicated third-party hardware** for shield connections, with the shield being **grounded at a single point** to **prevent ground loops**

For **RS-485 lines exceeding 100 meters**, the installation of a **120 Ohm termination resistor** is strongly recommended. This resistor should be placed **between pin 3 and pin 4** on the **RS-485 port of the Central Computing Unit**, ensuring stable data transmission over long distances.

2.4.7. Connecting Ethernet Devices

To enable the ePoweControl to monitor Ethernet-based equipment, a physical Ethernet connection must be established. The ePowerControl ES/ES+ acts as the master of the communication network, while all connected devices function as slaves. The controller communicates via Modbus TCP/IP.

2.4.8. Central Computing Unit LAN ports

To connect power units, sensors, or other Ethernet-compatible devices, use an Ethernet-male to Ethernet-male cable and connect it to the LAN ports on the ePoweControl module.

- If an Ethernet switch is not used, devices communicating via Modbus TCP should be directly connected to LAN port 1 on the ePowerControl ES (see Figure 4) or on LAN port 1, 2, 3 on the ePowerControl ES+ (see Figure 5).

- If an Ethernet switch is used, all Modbus TCP devices should be connected to any of the available ports on the switch. One of the Ethernet switch ports must then be connected to the ePoweControl, ensuring seamless data transmission

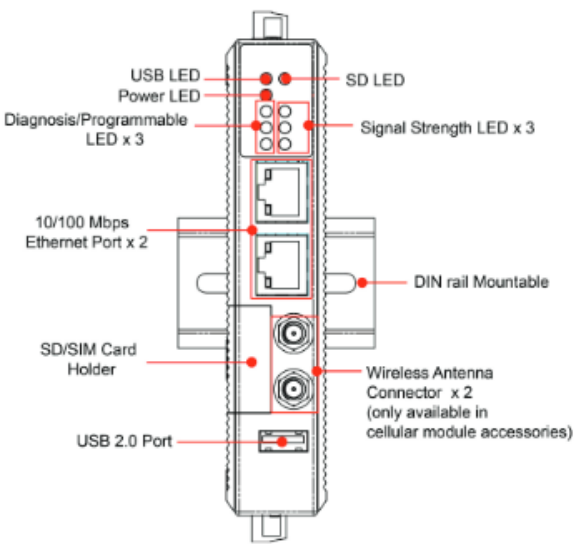


Fig. 4: Front view of the Central Computing Unit

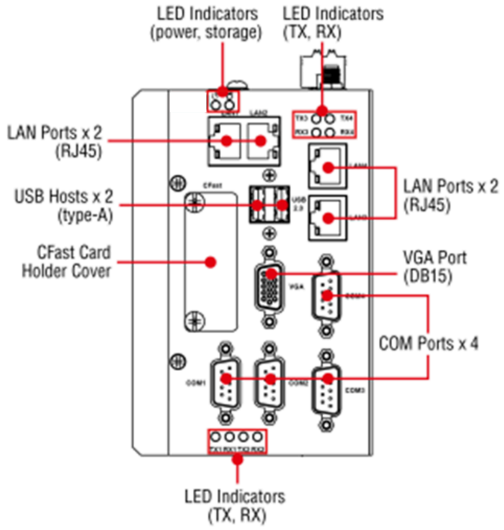


Fig. 5: Front view of the Central Computing Unit

The two 10/100 Mbps Ethernet ports of the Central Computing Unit and the switches provided by Elum use RJ45 connectors.

Pin	Signal
1	ETx+
2	ETx-
3	ERx+
6	ERx-

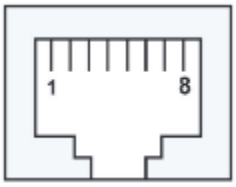


Fig. 6: Pin description of the LAN ports of the Central Computing Unit

2.4.9. Wiring

The wiring of the Ethernet line should be done by connecting each of the Slaves to the ePoweControl using an RJ45 cable

2.4.10. Wiring an AC Meter | 5A provided by Elum

2.4.10.1. Materials required

The installation and wiring of an AC Meter | 5A provided by Elum require the following components:

- **Circuit protection:** For each phase, use the smallest available breakers or rated fuse taps according to local NEC regulations. Typically, a 15A circuit breaker or a single multipole breaker is used, depending on the number of phases.
- **Wiring:** Use black, red, and white stranded AWG 12 wire, ensuring a thermal resistance of at least 75°C. The wire length should be determined based on the installation location. For three-phase installations, an additional blue wire is required. The insulation rating of the wire must be greater than the maximum voltage inside the panel.
- **Other materials:**
    - Electrical tape for insulation.
    - Conduit and couplings as needed.
    - Mounting and wire organization hardware to ensure a neat and secure installation.
    - Outdoor-rated enclosure (if the meter is installed outside) to protect against environmental conditions.

2.4.10.2. Safety warnings

To ensure a **safe and proper installation**, always follow the **wiring diagrams** and **CT selection guidelines** provided in this manual.

To **reduce the risk of electric shock** and prevent damage to the equipment:

- **Do not connect** the device to a circuit that operates at **more than 277 Vrms to neutral**.
- **Always disconnect** circuits from the **building's power distribution system** before installing or servicing the **power meter or attached current transformers (CTs)**.
- **Only use authorized 5A CTs** with this device to maintain accurate measurement and ensure safe operation.

2.4.10.3. Device overview

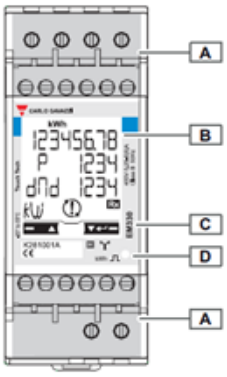
The power meter should be installed near the low-voltage distribution panel, ensuring easy access to connections for the grid, load, and genset (refer to the application overview for guidance). A 10A circuit breaker must be installed for each phase, positioned close to the meter and within easy reach of the operator. These breakers must be clearly labeled as the disconnecting devices for the power meter to allow quick identification and access.

Since the power meter is a listed device, it must be housed inside a suitable enclosure that meets the environmental requirements of the installation site:

- For indoor installations, a standard electrical cabinet is sufficient.
- For outdoor installations, a weatherproof, outdoor-rated enclosure is required to protect against moisture, dust, and direct sunlight.

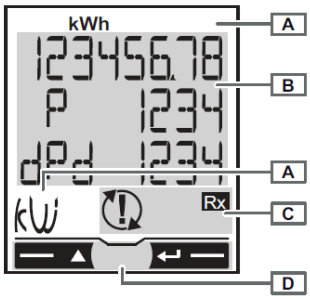
When selecting the installation location, ensure that the power meter is not exposed to direct sunlight or extreme environmental conditions.

2.4.10.4. Installation location



Area	Description
A	Current and communication connection terminals
B	Backlit LCD display with sensitive touch screen areas
C	Model, feature summary and serial number
D	LED: • blinking red: pulse weight proportionate to the TA and TV ratio result, • orange on: total active power negative. Control only run if the imported and exported energies are measured separately (**Measure** = b).

Fig. 6: View of the EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi



Area	Description
A	Unit of measure area
B	Specific section information area
C	Signal area: • : incorrect voltage connections • : incorrect current connections • Rx: version S1 only. Modbus command correctly received. • Tx: version S1 only. Modbus command correctly sent to master.
D	Command area

Fig. 7: View of the EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi LCD screen

2.4.10.5. Installation steps

1. Place the required breaker(s) in the power distribution panel, ensuring access to all phases of the system.
2. Open the breakers to ensure there is no power on the breaker contacts before proceeding with the installation.
3. Securely mount the power meter inside a suitable enclosure near the power distribution panel.
4. Ensure the enclosure is appropriate for the installation environment (e.g., outdoor-rated enclosures for external installations).
5. Wiring the Power Meter and CTs :
    a. Follow the wiring diagram corresponding to the site's system layout to properly connect the power meter.
    b. For a three-phase system with a 4-wire unbalanced load, connect the three current transformers (CTs) as specified in the installation diagram.
    c. Ensure the stickers on the CTs are correctly oriented toward the measured current flow direction to avoid incorrect readings.
    d. If the CT wires need to be adjusted in length, ensure they are securely connected without compromising signal integrity.

The main voltage must not exceed 400V, and the CTs must always have 5A secondary current.

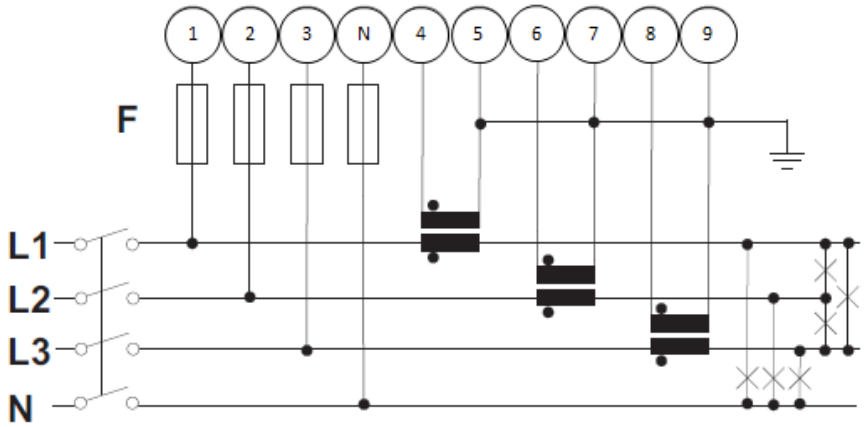


Fig. 8: Example of the EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi connection diagram for a three-phase system of the system, 4 wires, unbalanced load and three current transformers (CT) and three voltage transformers (VT)

6. Wire the power supply of the power meter as per the installation diagram provided.

*The power supply should be **65-400V AC, 50Hz**.*

*The **auxiliary power supply** on the meter ensures it remains powered **regardless of whether the plant is running on the grid or gensets**. Power meters responsible for **monitoring the grid, load, or gensets** should **never be turned off**, as this could trigger a **fail-safe mode in the ePowerControl**, leading to **curtailed PV production**.*

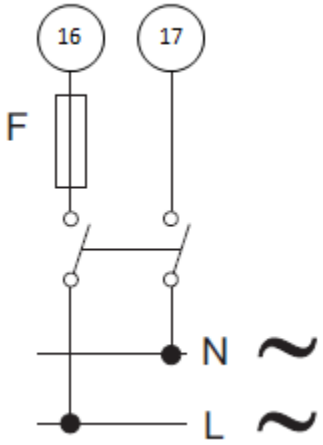


Fig. 9: Connecting the power supply to the EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi

7. Close the newly installed breakers to energize the power meter. Within a few seconds, the screen should illuminate, displaying the measurement page to confirm proper operation.
8. Once the power meter is successfully powered on, you can continue with the configuration and parameter setup to align with the system's operational requirements.

*After powering up the **EM330-DIN.AV5.3.H.S1.X** power meter, it is essential to **configure its parameters** correctly to ensure **accurate measurements** and proper system integration. Below are the **critical settings** that must be adjusted:*

***SYStEM**, System type : To be set according to the site design*

***Ct rAtIo**, Current transformer ratio : To be set according to the CTs used*

with the power meter. You can obtain this ratio by dividing the primary current by the secondary current. As an example, when using 200 A to 5 A CTs, the ratio should be set to 40.

***Vt rAtIo**, Voltage transformer ratio : To be set according to the VTs used with the power meter. You can obtain this ratio by dividing the primary voltage by the secondary voltage. As an example, when the power meter when using no VTs, the ratio should be set to 1.*

***MEASurE**, Measurement type : To be set to "b"*

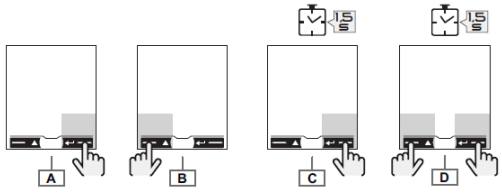
***AddrESS**, Modbus address : To be set according to your ID plan*

The result of the ratio between the current and voltage transformers must be under 1054.

It is critical that the measurement type was correctly set up to "b" for the zero export control feature. If the power meter was not correctly set up, Elum cannot guarantee any reliability on the zero export feature and will not be taken responsible if some energy is exported to the grid.

Instructions to use the power meter and navigate through the different menus.

Measurement pages displayed by default when turned on. Pages are characterized by the reference unit of measure. The initial measurement page set is displayed after 120 s of disuse.



Commands

Navigation

Operation	Command
View the next page	**A**
View the previous page	**B**
Open the programming section	**C**
Exit the programming section	**C** (page **End**)
Open the information section	**D**
Exit the information section	**D**

Parameter settings

Operation	Command
Increase a parameter value	**A**
View the next value option	**A**
Decrease a parameter value	**B**
View the previous value option	**B**
Confirm a value	**C**
Open the parameter settings page	**C**

Parameters description

Page	Code	Description	Values
PASS	**P1**	Enter current password	Current password. 0000 default password.
nPASS	**P2**	Change password	Four digits (0000–9999)
SYStEM	**P3**	System type	**3Pn**: three phase system, 4-wire/ **3P**: three-phase system, 3-wire/ **2P**: two-phase system, 3-wire
Ct rAtIo	**P4**	Current transformer ratio (TA)	1–1000 *
Vt rAtIo	**P5**	Voltage transformer ratio (TV)	1–1000 *
		*NOTE *: the result of the ratio between the current and voltage transformers must be under 1054 for **AV5** analyzers and under 3148 for **AV6**.*	
MEASurE	**P6**	Measurement type	**A** : *easy connection* , measures total energy without considering the direction/ **b** : separately measures imported and exported energy
InStALL	**P7**	Connection check	**On**: enabled/ **Off**: disabled
P int	**P8**	Average power calculation interval (minutes)	1–30
MOdE	**P9**	Display mode	**Full** : complete mode/ **Easy** : reduced mode. Measurements not displayed are still sent via serial port.
tArIFF	**P10**	Tariff management	**On**: enabled/ **Off**: disabled
HoME	**P11**	Measurement page displayed when turned on and after 120 seconds of disuse	For full display mode (**Mode** = Full): 0–19 For reduced display mode (**Mode** = Easy): 0–3, 6, 7, 10/11, 18 To learn the page code *see "**Measurement (Fig. 16)**" on page 7.*
rESET	**P17**	Enable energy tariff, maximum requested power and partial active and reactive energy reset (the latter only sent via serial port)	**No**: cancel reset/ **Yes**: enable reset
End	**P18**	Return to the initial measurement page	–

AddrESS	**P14**	Modbus address	1–247
bAUd	**P15**	Baud rate (kbps)	**9.6/ 19.2/ 38.4/ 57.6/ 115.2**
PArITY	**P16**	Parity	**Even/ No**
STOP bit	**P16–2**	Only if no parity. Stop bit.	**1/ 2**

9. Proceed to the communication wiring of the power meter as described below. Connect the power meter to one of the serial ports of the Central Computing Unit using a shielded twisted-pair RS485 connector and a Cat 5 cable.

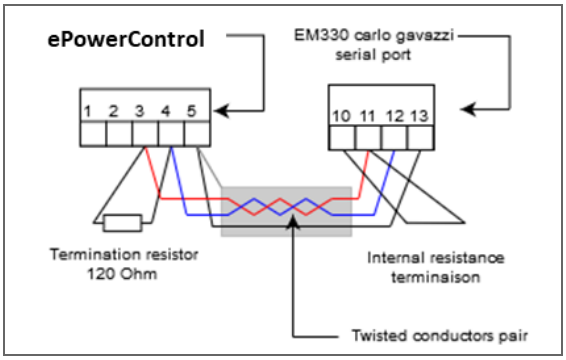


Fig. 10: RS 485 Wiring diagram for connecting a single EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi to the ePoweControl

Additional RS485 power meters should be connected in parallel, with the serial output terminated only on the last device by connecting terminals B+ and T.

For connections over 1000 meters or networks with more than 160 devices, a signal repeater must be used.

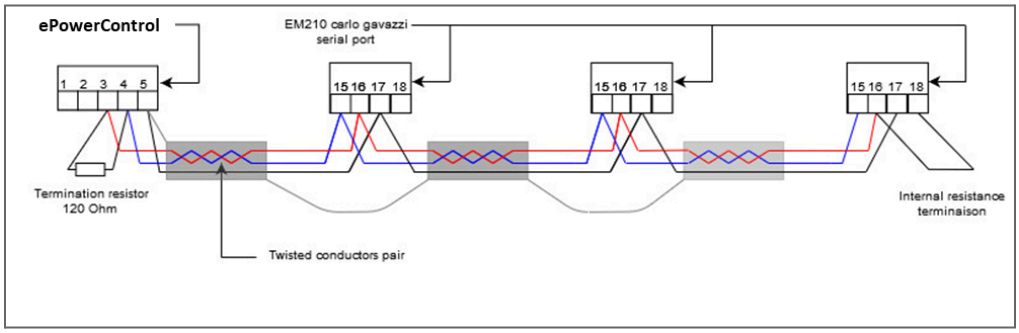


Fig. 11: RS485 wiring diagram for connecting multiple EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi in parallel

The continuity of the shielding must be ensured throughout the communication cable, and the ground must be connected at a single point. The total length of the cable must not exceed 1000m.

10. Label the newly installed breakers as "Power Meter Disconnect" so they can be easily identified if the device needs to be power-cycled or turned off.

2.4.11. Wiring an AC Meter | 333mV provided by Elum

2.4.11.1. Materials required

- **Circuit protection:** For each phase, use the smallest available breakers or rated fuse taps according to local NEC regulations. Typically, a 15A circuit breaker or a single multipole breaker is used, depending on the number of phases.
- **Wiring:** Use black, red, and white stranded AWG 12 wire, ensuring a thermal resistance of at least 75°C. The wire length should be determined based on the installation location. For three-phase installations, an additional blue wire is required. The insulation rating of the wire must be greater than the maximum voltage inside the panel.
- **Other materials:**
    - Electrical tape for insulation.
    - Conduit and couplings as needed.
    - Mounting and wire organization hardware to ensure a neat and secure installation.
    - Outdoor-rated enclosure (if the meter is installed outside) to protect against environmental conditions.

2.4.11.2. Safety Warnings

To ensure a **safe and proper installation**, always follow the **wiring diagrams** and **CT selection guidelines** provided in this manual.

To **reduce the risk of electric shock** and prevent damage to the equipment:

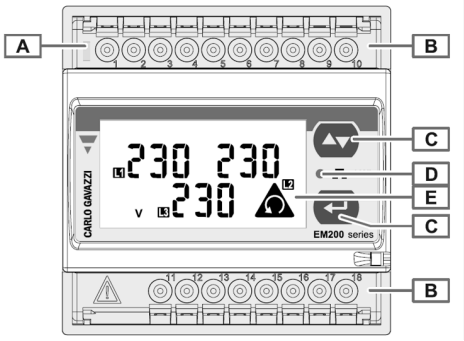
- **Do not connect** the device to a circuit that operates at **more than 277 Vrms to neutral**.
- **Always disconnect** circuits from the **building's power distribution system** before installing or servicing the **power meter or attached current transformers (CTs)**.
- **Only use authorized 5A CTs** with this device to maintain accurate measurement and ensure safe operation.

2.4.11.3. Installation location

The power meter should be installed near the low-voltage distribution to ensure easy access to the grid, load, and genset connections (see application overview). A 10A circuit breaker per phase must be installed close to the device and within easy reach of the operator. These breakers must be clearly labeled as the disconnecting device for the power meter.

As a listed device, the power meter must be housed in a suitable enclosure rated for its installation environment. For outdoor installations, a weather-resistant, outdoor-rated enclosure is required to protect against environmental conditions. The installation location should be shielded from direct sunlight and harsh elements to ensure long-term reliability and accuracy.

2.4.11.4. Device overview



Product

Area	Description
A	Green LED: • steadily on: instrument powered. • blinking: instrument powered and serial communication under way.
B	Terminals for current, voltage and communication connections
C	Control buttons
D	Red LED: • blinking: pulses proportional to the measured energy (pulse weight: see *Features*).
E	Non-backlit LCD display

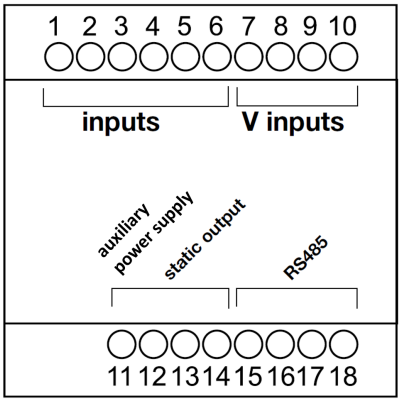


Fig. 12: View of the EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi

Display

Area	Description
A	Measuring unit area
B	Indication area:
	Incorrect phase sequence.
	Displayed line voltages .
	Displayed system values.

Fig. 13: View of the EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi LCD screen

2.4.11.5. Installation steps

1. First, install the breaker(s) in the power distribution panel, ensuring they provide access to all phases.

2. Before proceeding, open the breakers to ensure no power is present on the breaker contacts.

3. Next, mount the power meter inside a suitable enclosure near the power distribution panel, ensuring easy access for wiring and maintenance.

4. Proceed with the wiring of the power meter and CTs, following the wiring diagram corresponding to the site system layout. For a three-phase system with a 4-wire unbalanced load, connect the three current transformers (CTs) as specified. Ensure that the CT stickers are correctly oriented toward the measured current flow. If CT wires need to be shortened or extended, make sure they are properly connected to maintain signal integrity.

*The **main voltage** must not exceed **400V**, and the **CTs** must always have a **333mV output**.*

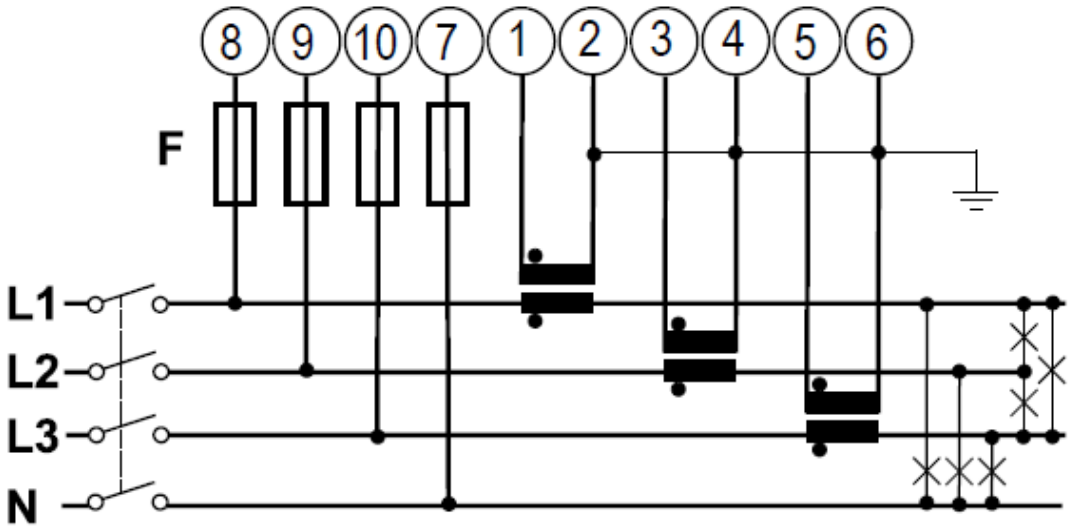


Fig. 14: Example of the EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi connection diagram for a three-phase system of the system, 4 wires, unbalanced load and three current transformers (CT) and three voltage transformers (VT)

5. Proceed with the power supply wiring of the power meter as specified. The power supply should be 65-400V AC, 50Hz.

The power supply should be 65-400 V AC, 50 Hz

*The **auxiliary power supply** ensures that the meter remains powered, whether the plant is running on the **grid or gensets**. Power meters monitoring the **grid, load, or gensets** must always remain powered. If any of these meters **turns off unexpectedly**, the **ePowerControl** will enter **fail-safe mode**, causing a **curtailment of PV production**.*

Fig. 15: Connecting the power supply to the EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi

6. Once the wiring is complete, close the newly installed breakers. Within a few seconds, the power meter should turn on, and its screen will display the measurement page.

7. At this point, you can proceed with the parameter setup of the power meter.

When installing a EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi the critical parameters to be set are listed below:

***SYStEM**, System type: To be set according to the site design.*

***SEnSOr** , CT type: To be set according to the CTs used with the power meter. As an example, when installing the power meter with Rogowski coil CTs, the type should be set to roG*

***Ct Prin**, Current transformer maximum current input: To be set according to the CTs used with the power meter. As an example, when installing the power meter with Rogowski coil 4000A, the type should be set to 4,00k.*

***Vt rAtIo**, Voltage transformer ratio: To be set according to the VTs used with the power meter. You can obtain this ratio by dividing the primary voltage by the secondary voltage. As an example, when installing the power meter using no VTs, the ratio should be set to 1.*

***APPLiC**, Measurement application: To be set to “E”.*

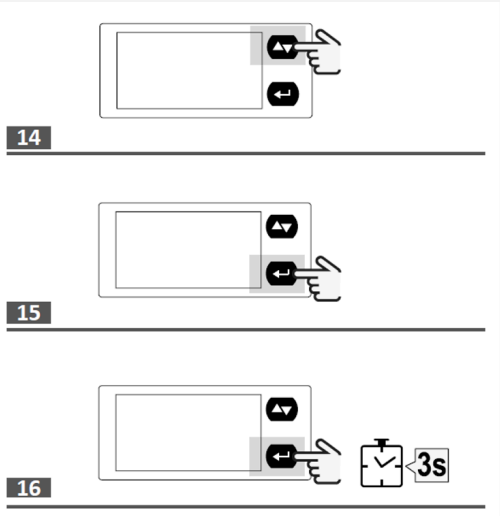
***AddrESS**, Modbus address: To be set according to your ID plan.*

*The **combined ratio of the current and voltage transformers must not exceed 1054**.*

*It is essential to set the **measurement application** to **"E"** for the **zero export control** feature. If this setting is incorrect, **Elum cannot guarantee the reliability of zero export control** and will not be responsible for any unintended energy export to the grid.*

*For instructions on **using the power meter** and **navigating through its menus**, refer to the manufacturer's guidelines.*

*When powered on, the **default measurement pages** will be displayed, each showing a **reference unit of measure**. If no interaction occurs, the **initial measurement page** will automatically reappear after **120 seconds of inactivity**.*



Controls (Fig. 14 – Fig. 16)

Navigation

Operation	Control
Display the next measurements page	**Fig. 14**
Open the Information menu	**Fig. 15**
Display the next information page	**Fig. 15**
Exit the information menu	**Fig. 14**
Enter the parameters menu	**Fig. 16**
Exit the parameters menu (the information menu will be displayed)	**Fig. 16** (page **End**)

Parameter setting

Operation	Control
Access the page to set a parameter	**Fig. 15**
Switch from increase mode (**C** icon) to decrease mode (**-C** icon)	**Fig. 15**
Increase the value of a parameter/display the next option (**C** icon)	**Fig. 14**
Decrease the value of a parameter/display the previous option (**-C** icon)	**Fig. 14**
Confirm a value	**Fig. 16**
NOTE: hold it pressed for at least 2.5 s.	

6. To establish communication, connect the power meter to one of the serial ports of the Central Computing Unit (CCU) using a shielded twisted-pair RS485 connector and a Cat 5 cable.

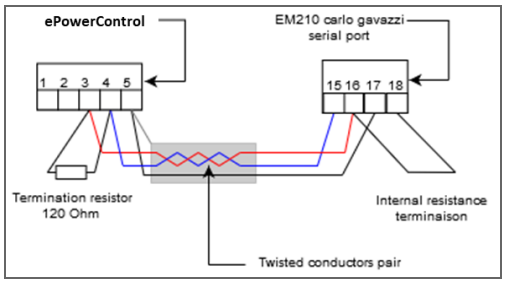


Fig. 16: RS485 wiring diagram for connecting a single EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi

Additional RS485 power meters must be connected in parallel (daisy-chained). The serial output should only be terminated on the last device in the network by connecting terminals B+ and T.

The total cable length must not exceed 1000 meters to ensure reliable communication.

*The **shielding continuity** must be maintained throughout the entire **communication cable**, with the **ground connected at a single point** to prevent interference.*

To facilitate maintenance, label the newly installed breakers as "power meter Disconnect" so you can easily locate them if the device needs to be power-cycled or turned off.

2.5. Step 4: Configuring non-Elum equipment

2.5.1. Configuring Solar Inverters

Some solar inverters may require RS485 control features to be activated. To configure a specific inverter, please refer to the manufacturer's instructions.

The ePowerControl must communicate with solar inverters to collect data for monitoring purposes. To achieve this, the controller interacts with the inverters to:

- Collect active power output measurements
- Communicate maximum power output setpoints
- Retrieve additional measurement data useful for monitoring operations

Table 3 lists the main accessed variables (non-exhaustive).

Table 3: Solar inverter variable accessed

Elum Name	Description	Max Access
W	Total active power	Read Only
WphA	Active power phase A	Read Only
WphB	Active power phase B	Read Only
WphC	Active power phase C	Read Only
VAR	Total reactive power	Read Only
VARphA	Reactive power phase A	Read Only
VARphB	Reactive power phase B	Read Only
VARphC	Reactive power phase C	Read Only
VA	Total apparent power	Read Only
VAphA	Apparent power phase A	Read Only
VAphB	Apparent power phase B	Read Only
VAphC	Apparent power phase C	Read Only
Hz	Frequency	Read Only
AphA	Current phase A	Read Only
AphB	Current phase B	Read Only
AphC	Current phase C	Read Only
PhVphA	Line voltage phase A	Read Only
PhVphB	Line voltage phase B	Read Only
PhVphC	Line voltage phase C	Read Only
Status	Solar inverter status	Read Only
Operating Mode	Solar inverter operating modes	Read Only
Alarm	Solar inverter alarms	Read Only
WSet	Solar inverter maximum active power setpoint	Read / Write

Table 4: Requirement for solar inverter

RS1	Each inverter must allow Modbus RTU or TCP communication
RS2	Each inverter must allow active power setpoint communication via Modbus RTU or TCP

2.5.2. Configuring Genset Controllers

To enable remote communication or activate reverse power protection on a genset controller, follow the manufacturer's instructions.

The ePowerControl must communicate with the genset or its controller to ensure safe operation and collect monitoring data. To perform this task, the controller gathers:

- Active power output measurements
- Additional accessible data needed for site monitoring

Table 5 lists the main accessed variables (non-exhaustive).

Table 5: Genset or genset controller variable accessed

Elum Name	Description	Max Access
W	Total active power	Read Only
WphA	Active power phase A	Read Only
WphB	Active power phase B	Read Only
WphC	Active power phase C	Read Only
VAR	Total reactive power	Read Only
VARphA	Reactive power phase A	Read Only
VARphB	Reactive power phase B	Read Only
VARphC	Reactive power phase C	Read Only
VA	Total apparent power	Read Only
VAphA	Apparent power phase A	Read Only
VAphB	Apparent power phase B	Read Only
VAphC	Apparent power phase C	Read Only

Hz	Frequency	Read Only
AphA	Current phase A	Read Only
AphB	Current phase B	Read Only
AphC	Current phase C	Read Only
PhVphA	Line voltage phase A	Read Only
PhVphB	Line voltage phase B	Read Only
PhVphC	Line voltage phase C	Read Only
Status	Genset status	Read Only
Operating Mode	Genset operating modes	Read Only
Alarm	Genset alarms	Read Only
WSet	Gensets active power setpoint	Read / Write

Table 6: Requirement for genset or genset controller

RS1	The genset or the controller must allow Modbus RTU or TCP communication

2.5.3. Configuring Grid and Load Sensors

The ePowerControl requires data from the Point of Connection (POC) between the site and the external power grid, as well as from the load. This information is gathered through sensors capable of measuring the necessary electrical parameters.

The ePowerControl communicates with the installed power meters to collect:

- Active power measurements
- Relevant data for system monitoring

The power meters provided by Elum are pre-configured to meet these requirements and are used by default.

To set up remote communication on a third-party power meter, refer to:

- The manufacturer’s instructions
- The Device Connection & Configuration Specific Instructions provided by Elum

Table 7 lists the main accessed variables (non-exhaustive).

Table 7: Grid sensor variable accessed

Elum Name	Description	Max Access
W	Total active power	Read Only
WphA	Active power phase A	Read Only
WphB	Active power phase B	Read Only
WphC	Active power phase C	Read Only
VAR	Total reactive power	Read Only
VARphA	Reactive power phase A	Read Only
VARphB	Reactive power phase B	Read Only
VARphC	Reactive power phase C	Read Only
VA	Total apparent power	Read Only
VAphA	Apparent power phase A	Read Only
VAphB	Apparent power phase B	Read Only
VAphC	Apparent power phase C	Read Only
Hz	Frequency	Read Only
AphA	Current phase A	Read Only
AphB	Current phase B	Read Only
AphC	Current phase C	Read Only
PhVphA	Line voltage phase A	Read Only
PhVphB	Line voltage phase B	Read Only
PhVphC	Line voltage phase C	Read Only

Table 8: Requirement for grid sensor

RS1	The sensor must allow Modbus RTU or TCP communication

2.6. Step 5: Installing the ePowerControl

2.6.1. Installation

Installation location
*The **ePowerControl** is designed for **indoor installations**. If an **outdoor installation** is required, a **special housing** must be specified when placing the order.*

Internet access
*A **stable internet connection** is required for the **autonomous deployment** of the **ePowerControl** and for **maintenance interventions** by **Elum engineers**. The enclosure should be installed in a location with **at least edge-level reception** if using a **wireless connection**, or with a **stable local network connection** if using a **wired connection**.*

2.6.2. Instructions for ePowerControl delivered in a pre-installed casing

To wall mount the ePowerControl enclosure, follow these steps:

1. Remove the mounting plate by unscrewing the four nuts securing it inside the enclosure.
2. Mount the Base Station to the wall using the appropriate screws and wall plugs.
3. Reattach the mounting plate inside the enclosure.

2.6.3. Instructions for ePowerControl delivered in a pre-installed casing

If delivered as a kit, all ePowerControl components must be installed on a DIN rail. To prevent the Central Computing Unit from overheating, ensure a 15 cm cooling space on each side of the unit.

2.6.4. Power Supply

To power the electrical enclosure, use the screw terminal block. The allowed voltage range is 100 to 240V AC, with a maximum current draw of 1.30A.

Power source

*The **power source** supplying the **controller** must be taken from the **load side** to ensure it remains powered in both **"On-grid"***

(Grid-connected mode) *and* ***"Off-grid" (Genset-connected mode)"*** *operations.*

If a ***UPS*** *is used, its* ***power source*** *must also follow this same rule to guarantee continuous operation of the* ***controller*** *under all conditions.*

UPS
For ePowerControl SD, HFS and MC, the use of an UPS is mandatory.

2.6.4.1. Instructions for connecting the power supply to ePowerControl when in Elum casing

1. The power connectors are pre-wired to a single screw terminal block on the left side of the DIN rail.

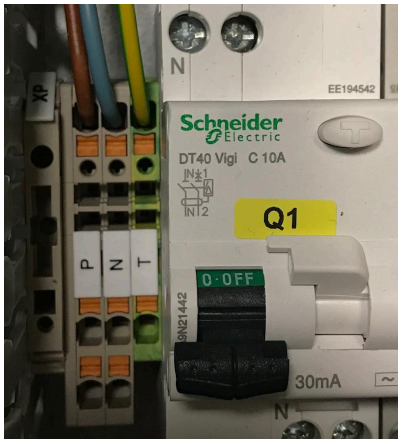


Fig. 20: Overview of the terminal block and circuit breaker

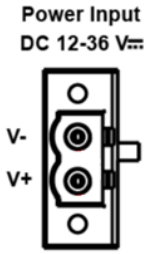
2. Connect the phase wire to the red/brown wire.
3. Connect the neutral wire to the blue wire.
4. Connect the ground wire to the green/yellow wire.
5. If a UPS is included with the ePowerControl, connect the battery red/black wire to the transformer.
6. Engage the circuit breaker to supply power.
7. Verify that the Power LED on the Central Computing Unit is on, confirming proper power connection.

2.6.4.2. Instructions for connecting the power supply to ePowerControl when in kit

Table 9: ePowerControl Power Supply Parameters

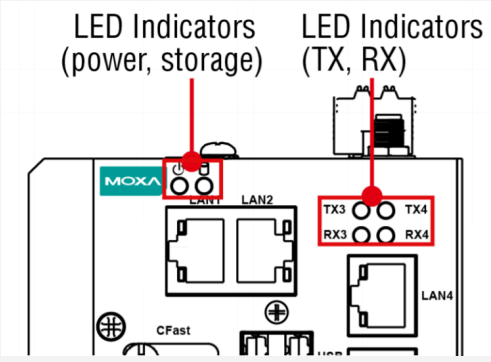
Input voltage	12 to 24 VDC
Input Current	480 mA @ 12 VDC 225 mA @24 VDC
Power Consumption	5,4 W

1. To power the Central Computing Unit (CCU), connect the "terminal block to power jack converter" (included in the package) to the DC
terminal block located on the top panel of the unit.
Then, connect the power adapter. The system will take approximately 30 seconds to boot up.



2. Proper grounding and wire routing help reduce electromagnetic interference (EMI) and ensure stable operation. The shielded ground contact (also known as protected ground) is the top contact of the 3-pin power terminal block connector. Connect the shielded ground wire to a properly grounded metal surface to enhance protection and minimize interference.

*When the **ePowerControl** is turned on, **all LEDs** will illuminate for **1 second**, then turn **off for 60 seconds** while the **Internet connection and system services** initialize.*



The central processing unit within the ePowerControl controller is equipped with multiple LED indicators that offer a quick overview of the system's status. Their meanings are detailed in the table below.

LED Name	Status	Function
Power	Green	Power is on and computer is function normally.
	Off	Power is off.
Storage 1 (CFast)	Yellow	Blinking: Data is being transmitted.
	Off	No data transmission.
Storage 2 (SD) (MC-1111 and MC-1121 Series only)	Yellow	Blinking: Data is being transmitted.
	Off	No data transmission.
LAN 1/2/3/4 (LAN 3/4 is available only on the MC-1121 and MC-1122 Series)	Green	100 Mbps Ethernet link. Blinking: Data is being transmitted.
	Yellow	1000 Mbps Ethernet link. Blinking: Data is being transmitted.
	Off	10 Mbps Ethernet link or LAN is not connected.
Tx 1/2/3/4	Green	Blinking: Data is being transmitted.
	Off	Not connected.
Rx 1/2/3/4	Yellow	Blinking: Data is being transmitted.
	Off	Not connected.

2.7. Step 6: Setting up ePowerControl in eConf

2.7.1. Before proceeding to the commissioning

2.7.1.1. Required Materials

To configure internet access, you will need:

- A **computer** with an **Ethernet port**
- An **Ethernet cable**
- If your computer **does not have a LAN port**, use a **USB-to-Ethernet** or **Type-C-to-Ethernet adapter**.

2.7.1.2. Prerequisites

Before commissioning your system, Elum may require a firmware update to ensure access to the latest version of eConf with the most recent communication drivers. Keeping the drivers updated is essential for reliable communication tests and for conducting wiring reviews and ePowerControl configuration autonomously.

2.7.2. Accessing eConf

2. To access the eConf interface, connect your laptop to LAN 4 of the Central Computing Unit (CCU).

Ensure that the CCU is powered on (check the Power LED).

3. Then, open a web browser and enter 192.168.4.127 in the URL bar to access the configuration settings.

*To access eConf local web page, ensure that your computer's **Ethernet port is configured in DHCP mode**..*

2.7.3. Configuring your password

On the login page, set an access password, which will be required each time you connect to the ePowerControl and access the configuration platform "eConf". Once the password is set, click "Begin Setup" to proceed..

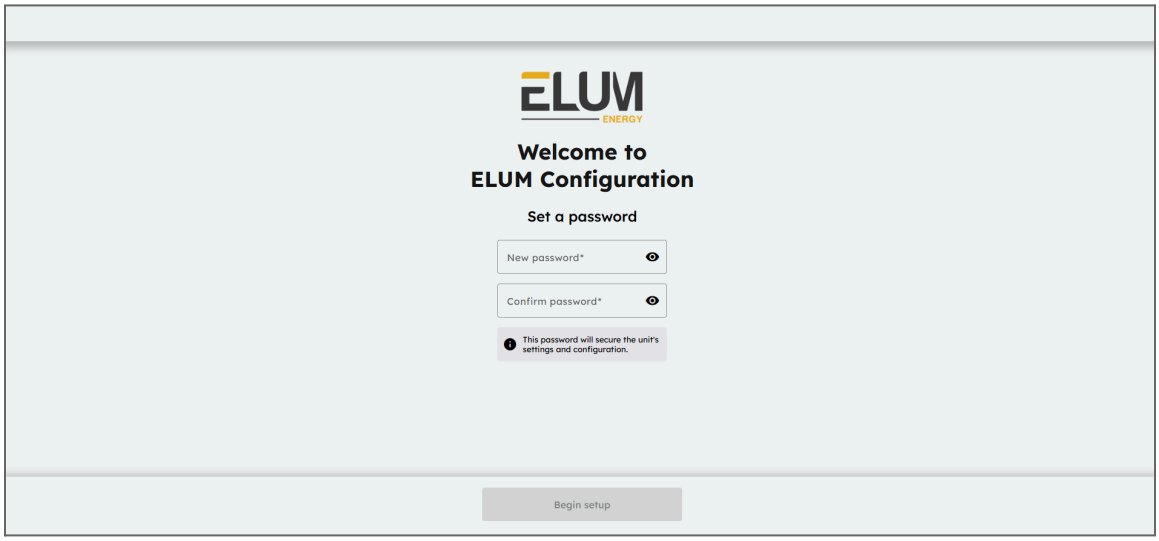


Fig. 21: Password configuration panel in eConf

2.7.4. Checking and installing Software Updates

After setting up the password, the system will automatically check for available software updates and display them. However, you can also manually check for updates by clicking on "Check for updates".

If an update is available, it will appear in the "Available updates" section. To proceed with the update, click the "Install" button. The update process will then begin, ensuring your system runs the most recent version of ExplorerOS.

It is recommended to install the latest available update to ensure optimal performance and compatibility.

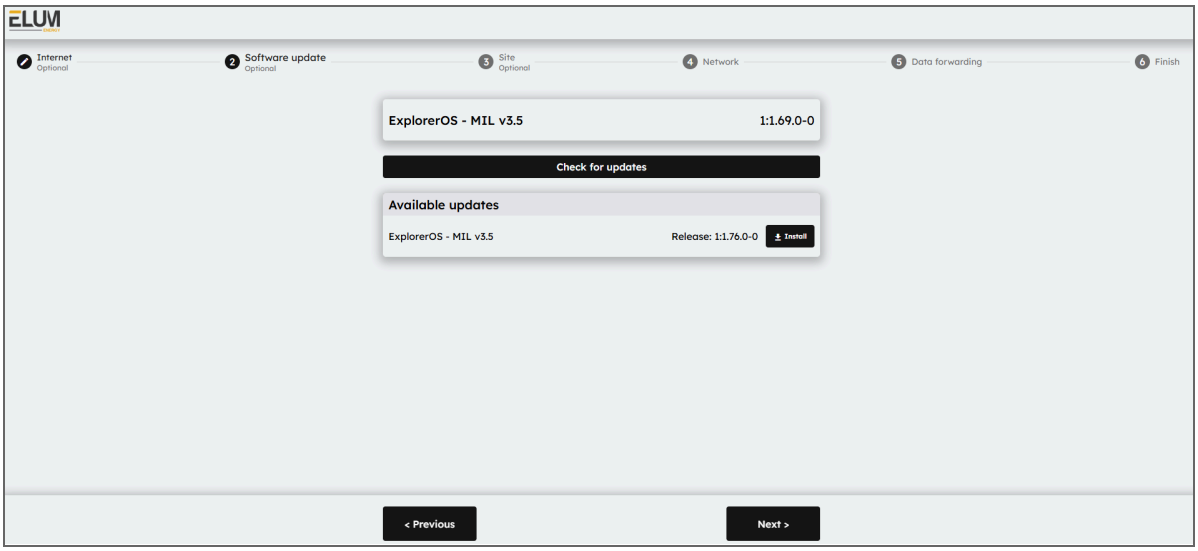


Fig. 22: Explorer update panel in eConf

2.7.5. Configuring site settings (optional)

Enter the name and GPS coordinates of the site associated with the ePowercontrol controller..

*The information provided in this panel will be used to **configure the ePowerMonitor dashboard**. Access to **ePowerMonitor** requires a **subscription** to the platform.*

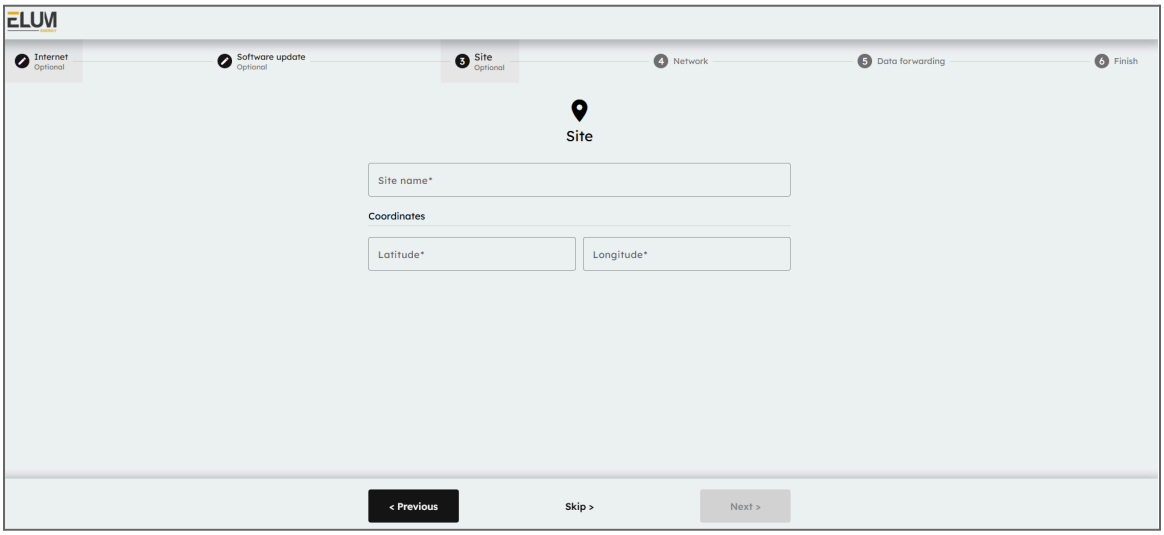


Fig. 23: Site setting panel

2.7.6. Configuring internet access (optional)

After setting up the site settings, you will need to configure the network settings for internet access and device communication.

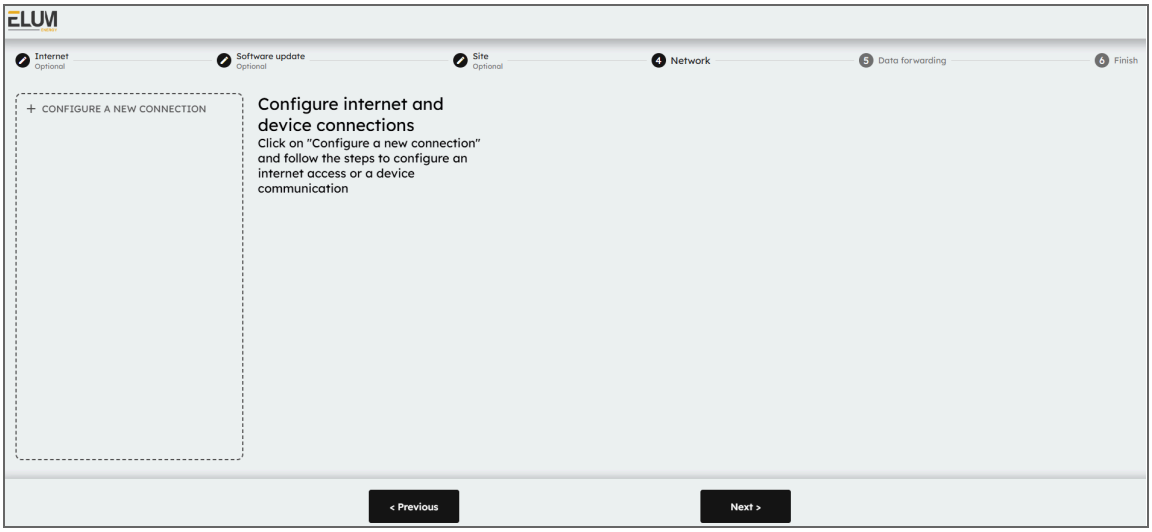


Fig. 24: eConf Network panel

2.7.6.1. Configuring a wired internet connection

*The **LAN connection** that allows the **ePowerControl** to access the internet via a **wired connection** must always be made through **LAN port 4** of the **Central Computing Unit (CCU)**. If additional **LAN ports** are needed, a **network switch** can be connected to **LAN port 1, 2 or 3.***

*To properly configure the **internet connection**, coordination with the **IT team** is essential. The following **outgoing IPv4 network accesses** must be allowed for the* controller *to communicate with the **Elum backend servers**:*

- ***ICMP (Ping Protocol)***
- ***TCP Ports:** 53, 80, 443, 4505, 4506*
- ***UDP Ports:** 53, 123, 1195*

*Additionally, before installation, request the **network configuration details** that should be applied to the **ePowerControl** to ensure proper connectivity.*

No optional module is required to establish a wired internet connection between the ePowerControl and the internet.

1. Click on "+ Configure a new connection" and select "Internet access", then choose "Wired Access - LAN1".

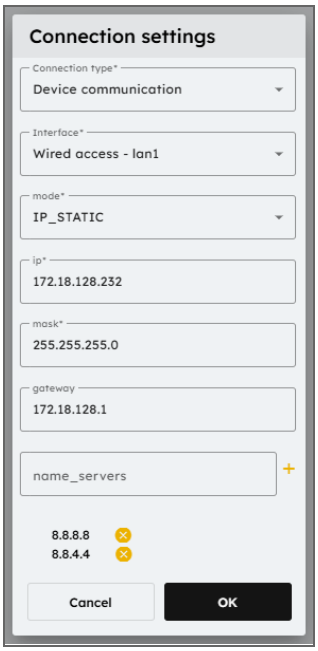


Fig. 25: Internet access configuration through wired connection

2. Enter the appropriate connection parameters based on your network settings and press OK.
3. Click the "Test" button to verify the connection. 

2.7.6.2. Configuring a cellular internet connection

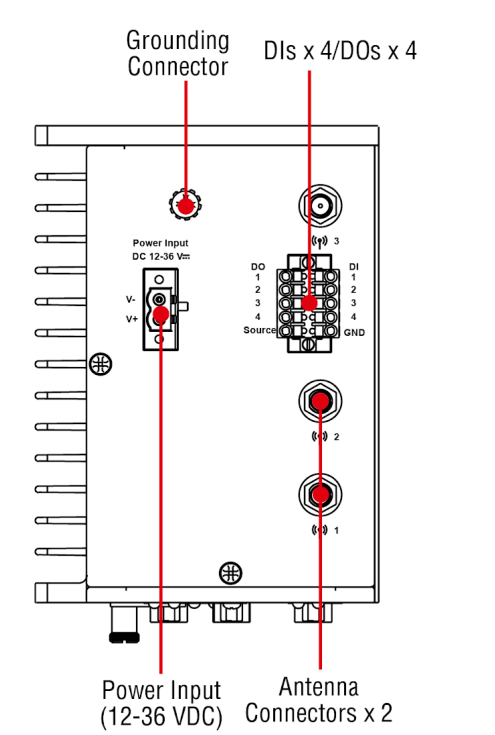
*The **GSM/3G module** is **pre-installed** in the **Central Computing Unit (CCU)**. However, you will need a **SIM card** with a valid **data subscription** to enable connectivity*

*The **ePowerControl must be turned off** before **inserting or removing** the SIM card.*
*If you need to **change the SIM card**, an **empty start** (powering on without a SIM card before inserting the new one) must be performed.*

For these steps, the Central Computing Unit must NOT be powered on.

1. Connect the two wireless antennas to the dedicated connectors on the front panel of the CCU.

The antenna connectors are located on the front Panel of the Central Computing Unit



2. Insert the SIM card into the SIM card slot

To access the SIM card slot, use a screwdriver to open the cover.

*Insert the SIM card directly into the slot **until you hear a "click"**, indicating it is securely in place.*

3. Power ON the Central Computing Unit (CCU).

*Upon startup, **all LEDs will turn ON for 1 second, then turn OFF for 60 seconds** while the system initializes.*

4. Wait approximately 1 minute for the startup process to complete.

5. In the Network Configuration Panel, click "+ Configure a new connection" and select "Internet access", then choose "3G Access - Built-in".

6. Enter the appropriate connection parameters for your network and press OK.
7. Test the connection by clicking the “Test” button. 

Fig. 26: Internet access configuration through 3G access

To obtain your **SIM card PIN number**, **APN address**, and **required credentials**, please refer to the **documentation provided by your service provider**. These details are necessary to configure the **GSM/3G connection** on the **ePowerControl**.

2.7.7. Configuring ports and devices

Once the wiring and internet configuration is complete, you can proceed with setting up communication between the ePowerControl and connected devices.

From eConf you have to configure each connection corresponding to each of the ports of the Central Computing Unit which are used.

1. Click “+ Configure a new connection” and select “Device communication”, then choose the appropriate interface.

Fig. 27: Connection settings when adding a device (1/2)

Only **unused interfaces** will be available in the **drop-down list**. If a port has already been configured, you can **edit its settings** directly.

2. Apply the correct connection settings based on the device requirements.

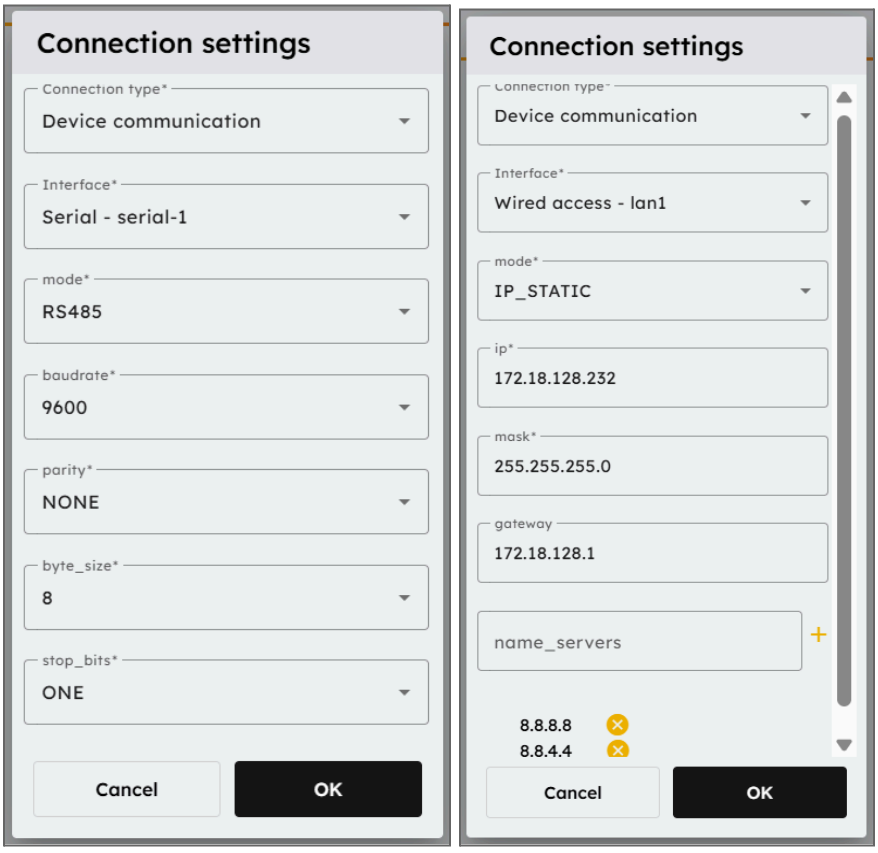


Fig. 28: Connection settings when adding a device (2/2)

3. Once the connection is configured, add each device one by one by clicking “+ Add device”.
4. Apply the correct parameters for each device to ensure proper communication.

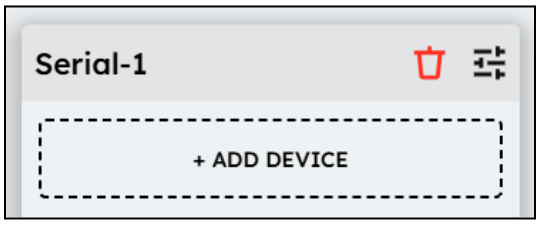


Fig. 29: Associating a device to a communication port (1/2)

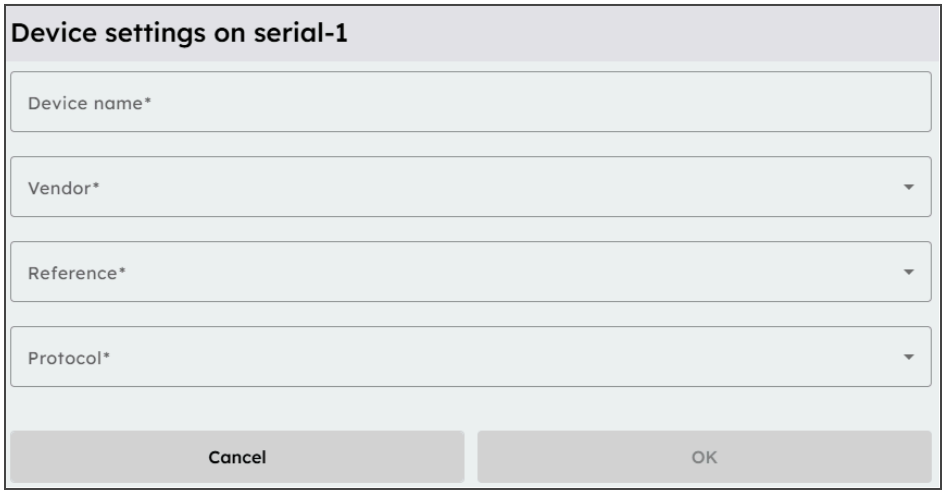


Fig. 30: Associating a device to a communication port (2/2)

Communication parameters

Modbus RTU:

- **Slave ID** : Unique identifier for the device.
- **Response Timeout** (default: **0.5s**) : Maximum waiting time before receiving the **first byte** of the response.
- **Byte Timeout** (default: **0.1s**) : Maximum waiting time between subsequent bytes in the response.

Modbus TCP:

- **IP Address** : The device’s network address.
- **Port** (default: **502**) : The communication port used for Modbus TCP.
- **Slave ID** : Unique identifier for the device.
- **Response Timeout** (default: **0.5s**) : Maximum waiting time before receiving the **first byte** of the response.
- **Byte Timeout** (default: **0.1s**) : Maximum waiting time between subsequent bytes in the response

SNMP:

- **IP Address** : The device's network address.
- **Community** : The SNMP community string for authentication.
- **Port** (default: **161**) : The communication port for SNMP.
- **Transport** (default: **UDP**) : The protocol used for SNMP communication.
- **Timeout** (default: **0.5s**) : Maximum waiting time before receiving a response.

5. To test all devices linked to a specific connection port on the Central Computing Unit (CCU), click on "Test" in the connection settings.

Fig. 31: Serial connection daisy-chaining test

To test a single device independently, click on the three dots next to the device name, then select "Test".

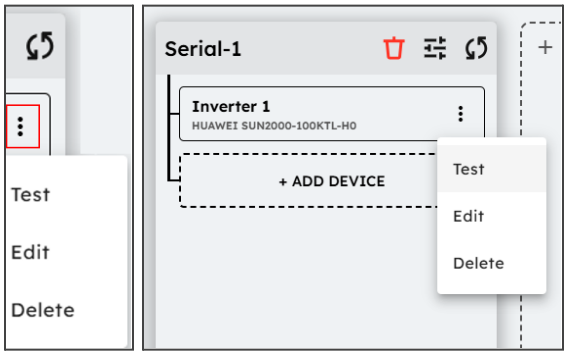


Fig. 32: Testing the connection with a single device associated with a communication port. (1/2)

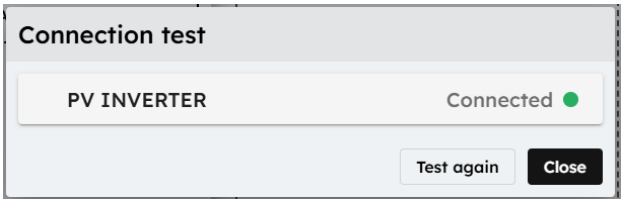


Fig. 33: Testing the connection with a single device associated with a communication port. (2/2)

When you run a connection test from the eConf interface, the ePowerControl sends a read request to the connected equipment.

- If the test is successful, the device status will be displayed as “Connected”.
- If the test fails, the device status will be shown as “Disconnected”.

Driver error
If the test returns a **“Driver error”**, it means the device is **“Connected”**, but the driver needs to be **updated remotely** by **Elum**. In this case, please notify the **Elum Deployment Team** for assistance.

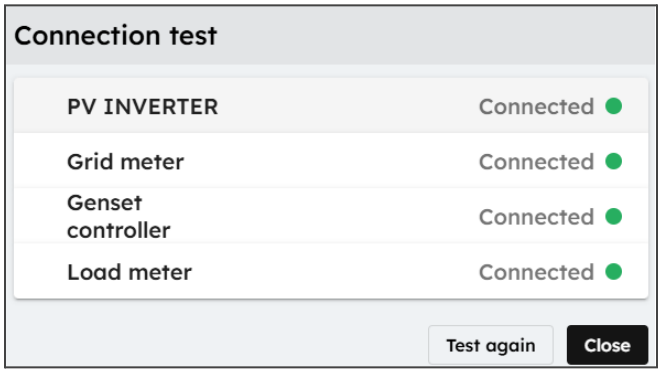


Fig. 34: Devices status during the connection test.

6. Once all ports and devices have been correctly configured and all connection tests have been successful, click “Continue” to proceed.

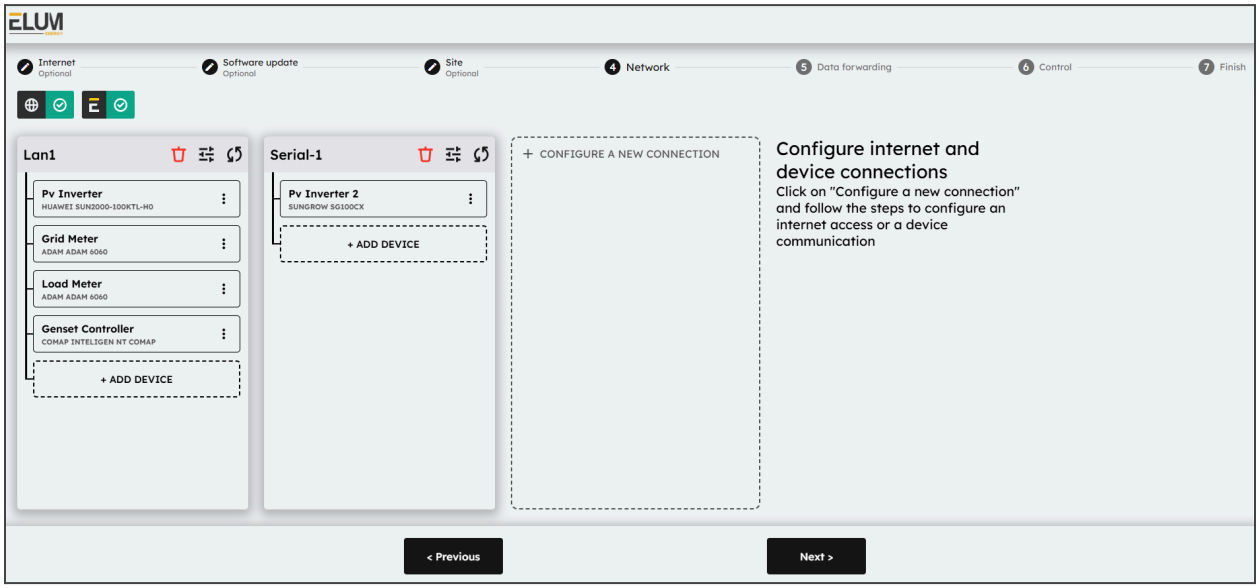


Fig. 35: Network panel

*It is essential to **only start data acquisition** once **functional communication** has been established with all **necessary and useful equipment** on-site. If any equipment is still marked as **"Disconnected"** in **eConf** after commissioning, Elum **cannot be held responsible** for any **malfunction of the monitoring and control system**.*

2.7.8. Configuring data forwarding (optional)

Elum offers an optional data export feature, allowing data to be forwarded to third-party platforms or USB devices. If you do not need to export data to any platform other than ePowerMonitor or to a USB device, click "Skip" to move to the next configuration section.

Available Data Export options:

- **FTP Push to Energysoft :** Exports data to the Energysoft monitoring platform using the S4E PowerAPI data format.
- **FTP Push to Other Servers :** Sends data to any internal or external server supporting the FTP protocol, using the Elum Energy data format.
- **Meteocontrol Export :** Enables data export to the Meteocontrol platform. The serial number of the controller must be registered on the Meteocontrol interface for data export to be enabled. Users can configure:
- **USB Export :** Saves data directly to a USB device for local storage.
- **QOS Energy:** Exports data from the Elum Data Model to the QOS Energy monitoring platform through a secure FTP connection, in compliance with QOS Energy's data integration requirements.

For more details about the Elum Data Export feature and supported data formats, contact Elum support at support@elum-energy.com.

*If needed, all **export methods** can be **activated simultaneously**.*

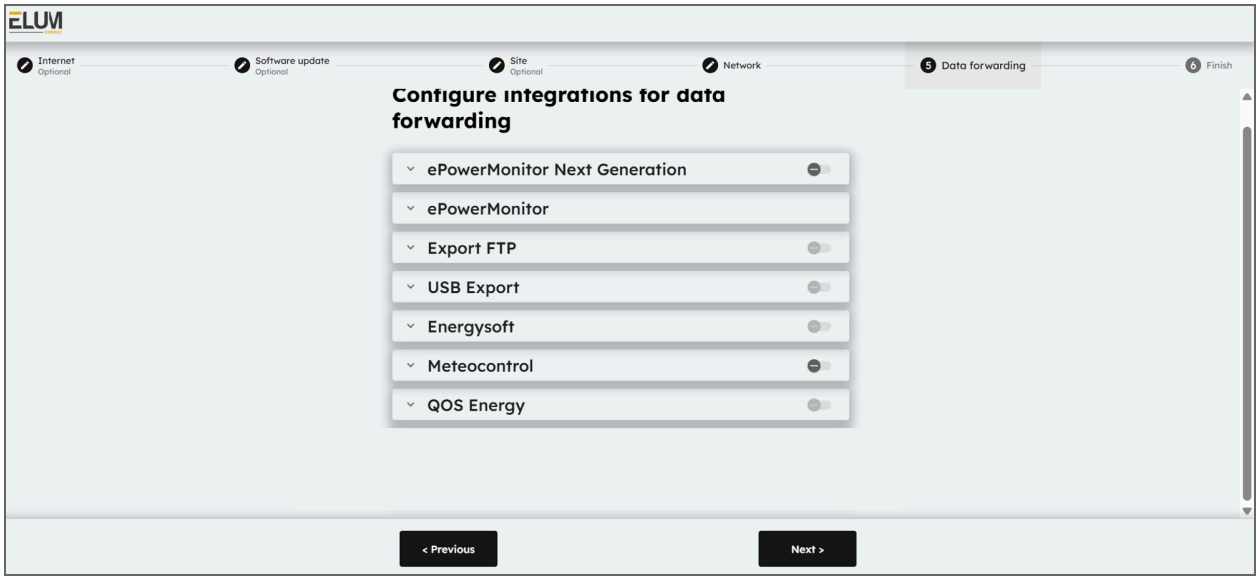


Fig 36: Data forwarding configuration panel

Start by selecting an export method from the available options. Once chosen, you will be prompted to enter additional details required to configure the data forwarding settings.

2.7.8.1. Export FTP

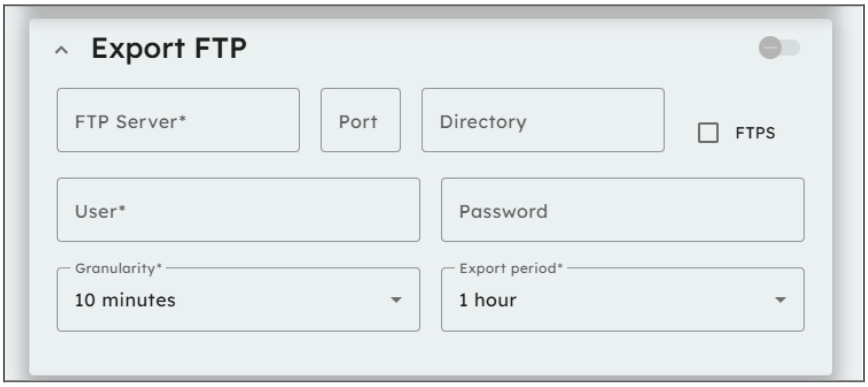


Fig. 37: FTP export configuration

- Enter the FTP server details, including the server address, port, and directory, where you want to forward your data.

- Provide your user credentials (Username and Password) to authenticate access to the specified FTP server.

- Set the data granularity, which determines how frequently data points are recorded before being forwarded. This can range from 5 minutes to 1 day.

- Specify the export period, which defines how often the collected data is sent to the FTP server. This setting is independent of granularity and can range from 10 minutes to 1 day.

- Enable FTPS (via the checkbox) if you require a secure connection using FTP over SSL/TLS to enhance data encryption and security during transmission.

2.7.8.2. Energysoft

The Energysoft export method operates using the FTP protocol, similar to Elum's standard FTP push service, with the only difference being the export file format. Therefore, the same FTP forwarding settings apply to both methods.

For further information see previous section Export FTP.

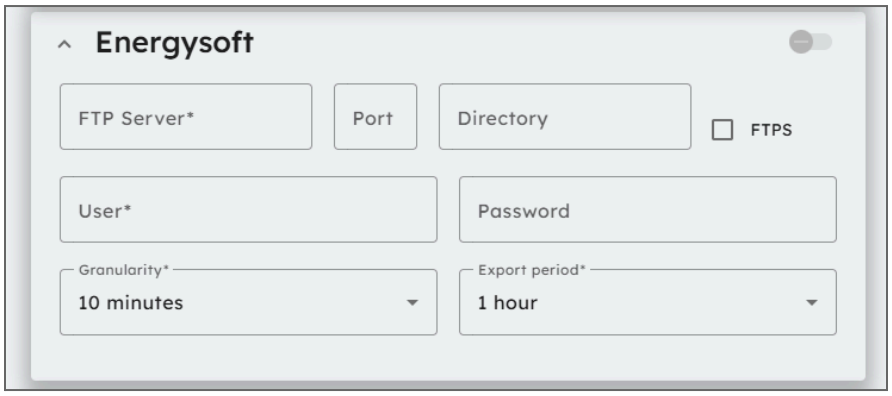


Fig. 38: Energysoft export configuration

2.7.8.3. Meteocontrol Export

The Meteocontrol export option enables the ePowerControl to forward data to the Meteocontrol platform for monitoring and analysis. To activate this feature, the serial number displayed on the (eConf must be registered on the Meteocontrol interface.
Configuration parameters :

- **Serial number:** The unique identifier generated by eConf, which must be registered in the Meteocontrol platform to activate data export.
- **Granularity:** Defines how often data is collected before being forwarded. This can be set between 5 minutes and 1 hour.
- **Export period:** Determines how often the collected data is sent to Meteocontrol, with options ranging from 10 minutes to 1 day.

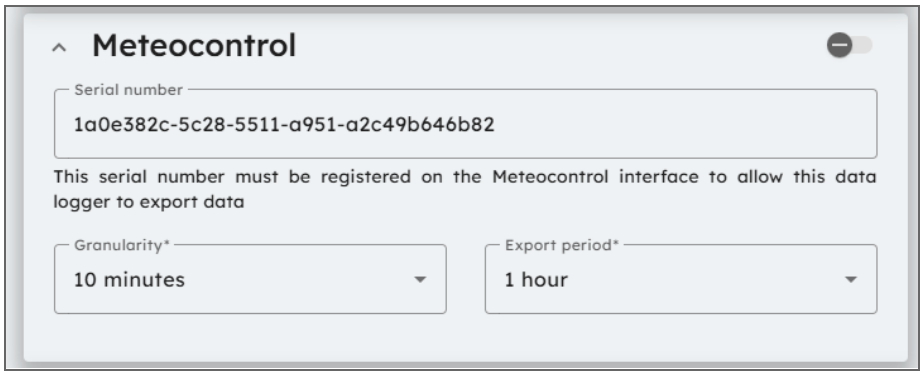


Fig. 39: Meteocontrol export configuration

2.7.8.4. Meteocontrol Export USB Export

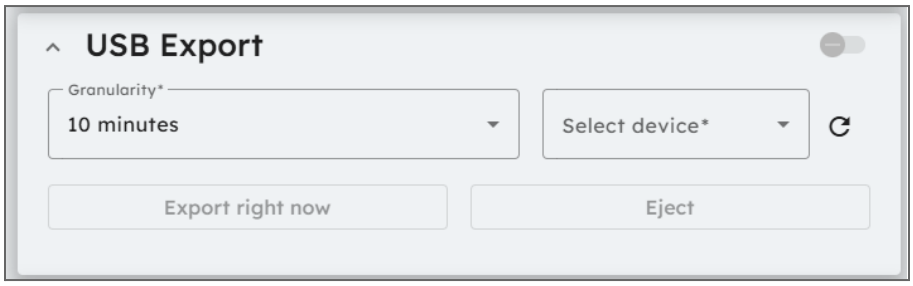


Fig. 40: USB export configuration

When a USB device is plugged into the Elum Explorer USB port, it will appear in the device selection list within the USB export configuration panel. Select the USB device where you want to forward your data.

Configuration parameters :

- Granularity: Defines how often data is collected before being saved to the USB device..
- Export Period: The export period is fixed at 24 hours, with all data being exported once per day at 00:00 UTC.

Manual data export & Ejecting USB device

- By clicking “Export right now”, the data from the current export period will be immediately saved to the USB device.
- It is highly recommended to use “Export right now” just before ejecting your USB device to ensure all collected data is saved.
- To safely remove your USB device, click “Eject” before physically unplugging it.

- Failure to eject the USB device properly may result in data loss or permanent damage to the USB storage.

*To prevent **damage to your USB device** and **avoid irreversible data loss**, always **eject the USB device** before physically removing it from the **Elum Explorer USB port**.*

2.7.9. Control panel overview

The Control panel in eConf allows you to configure and input power-related data for the different components of your power system. It is where you set up the grid meters, genset meters, and I/O modules, ensuring proper monitoring and control of the installation.

Depending on the model of ePowerControl and the application type (PV + Grid, PV + Genset, or PV + Genset + Grid), different sub-tabs may be displayed for configuration.

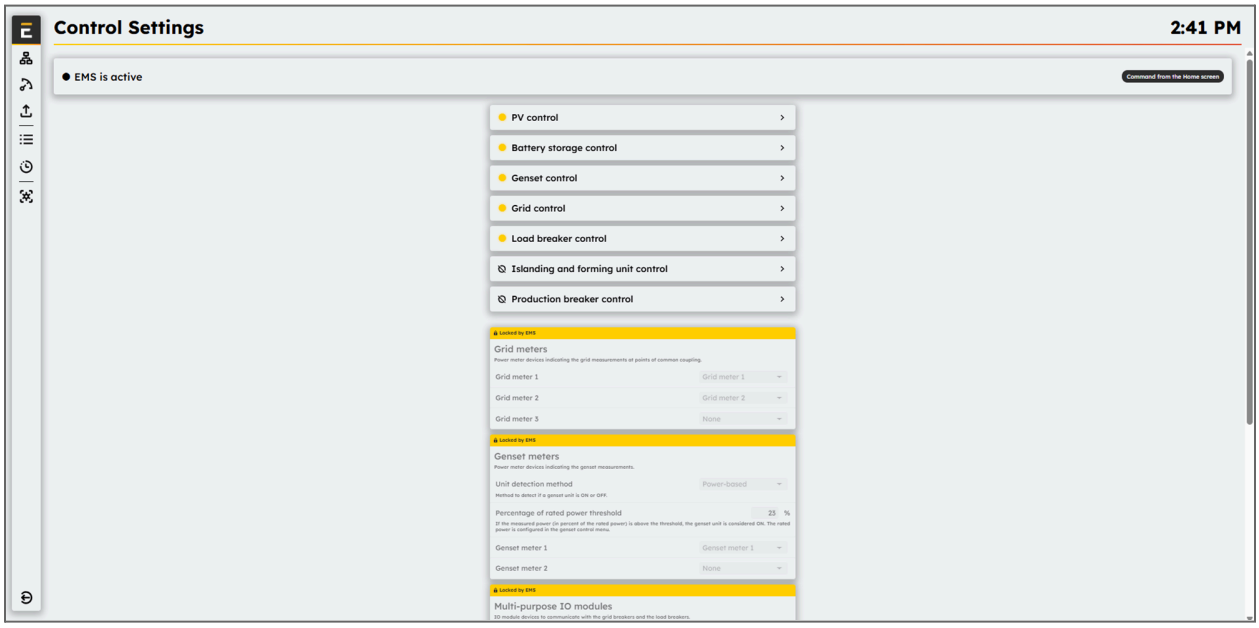


Fig. 41: Control panel overview

Available control sub-tabs

Activating a control toggle (e.g., PV Control, Genset Control) enables configuration and management of the corresponding subsystem.

1. **PV control :** Configure the photovoltaic system settings, including power limitations and inverter parameters.

2. **Genset control :** Set up genset parameters, including startup thresholds and control strategies.
3. **Grid control :**Configure grid interaction settings, including grid meters and connection rules.
4. **Load breaker control :** Manage load breakers used to disconnect non-priority loads based on predefined site conditions..
5. **Production breaker control :**Manage production breakers used to disconnect external or uncontrolled generation sources from the site when required..

Main configuration sections

- **Grid meters :** Set up power meters that measure the grid's power flow at the point of common coupling.
- **Genset meters :** Configure genset power meters used when no genset controller is available.
- **Multi-purpose I/O modules :** Configure I/O modules that allow communication with grid breakers, load breakers and production breakers.

This Control panel is essential for defining power control strategies and ensuring seamless communication between system components.

2.7.9.1. PV Control configuration

The **PV Control** tab in eConf allows you to activate or deactivate PV control and configure how the EMS computes and dispatches power setpoints to the inverters. When activated, the EMS determines both active and reactive power setpoints according to system requirements and control strategies.

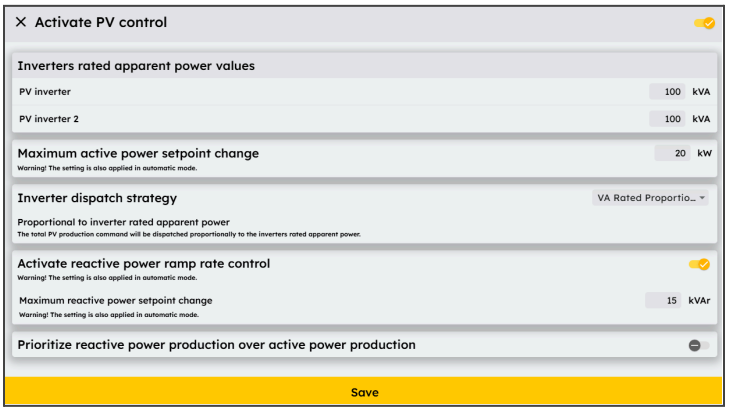


Fig. 42: PV control panel overview

In this tab, you can:

- Define the rated apparent power (kVA) of the connected inverters, ensuring the system adheres to configured power limits.
- Configure active and reactive power ramp rates, ensuring smooth power variations.
- Select a dispatch strategy for optimal inverter power distribution.

a) Maximum active power setpoint change

This setting controls the ramp rate for how quickly the PV inverters adjust their power output. It ensures gradual changes, preventing sudden power fluctuations that could impact grid stability.

b) PV Dispatch strategies

To optimize PV performance, the EMS offers two dispatch strategies:

- *VA Rated Proportional Dispatch :* The PV plant's total power is distributed based on each inverter’s nominal power.
- *Optimized Dispatch :* Power commands are based on actual inverter output, ensuring more accurate and dynamic power adjustments.

c) Activate reactive power ramp rate control

- This setting determines whether reactive power setpoints should change gradually or instantly.
- By default, it is disabled (False).
- When activated (True), it enables the maximum reactive power setpoint change field, allowing you to set a maximum allowable change rate for reactive power adjustments.

d) Prioritize reactive power production over active power production

This setting determines whether the PV system prioritizes reactive power before active power.

- When activated (True):
    - The system will first fulfill reactive power requirements.
    - Active power output may be reduced depending on remaining capacity.
- When deactivated (False - Default):
    - The system prioritizes active power production.
    - Reactive power is adjusted only after fulfilling active power needs

2.7.9.2. Genset Control configuration

The Genset Control tab in eConf allows you to activate or deactivate genset control and configure the operational settings for connected gensets. The ePowerControl can automatically manage genset operation based on the selected mode:

- *Following mode (Direct Control)*: The EMS sends setpoints directly to the genset controller via Modbus.
- *Forming mode (Indirect Control):* The EMS does not directly control the genset but instead monitors its power output and adjusts PV system setpoints to influence genset production.

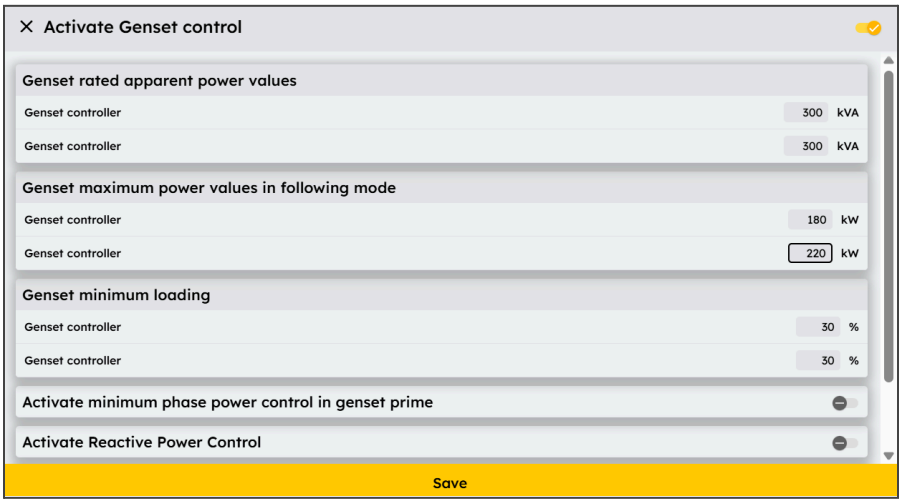


Fig. 43: Genset control panel overview

In this tab, you can define genset power parameters, set power limits, activate reactive power control, and configure automatic genset start/stop functions.

a) Rated Apparent Power
   - Define the rated apparent power (kVA) of each genset.
   - The maximum power value in following mode must always be less than or equal to the rated apparent power.

b) Genset minimum loading
   - Ensures that the genset does not operate below a defined minimum power level.
   - If necessary, the EMS will curtail PV production to maintain this threshold.
   - For multiple gensets:

    - If the total setpoint is below the sum of minimum loadings, power is distributed proportionally to ensure each genset meets its minimum threshold.
    - If the total setpoint exceeds the sum of minimum loadings, power is first allocated to ensure all gensets reach their minimum before distributing remaining power.
- In forming mode, the EMS adjusts other controllable devices to maintain gensets above their minimum loading percentage.

c) Activate minimum phase power control in genset prime

This function ensures that in Genset Prime mode, the PV system adjusts its output to keep the lowest phase's active power above a defined threshold.

- If the power in any genset phase falls below the set minimum, the EMS will adjust the PV inverters or other controllable devices to boost the genset's power output.
- This helps maintain balance across all three phases, preventing uneven load distribution that could cause instability.
- Ideally, the active power should be evenly distributed among the three phases of a genset system.

d) Activate reactive power control

The Genset reactive power control function ensures a stable and efficient power factor by coordinating the production of reactive power between PV inverters and gensets.

- If the genset alone cannot maintain the desired power factor, the PV inverters provide additional reactive power support.
- Reactive power calculation:
    - The EMS continuously monitors the genset's power factor and the reactive power produced by the genset.
- Reactive power setpoint dispatch:
    - The EMS calculates the necessary reactive power to meet the target power factor.
    - The calculated value is sent to PV inverters, which adjust their reactive power output accordingly.
- Maintaining the genset power factor: The EMS balances reactive power by adjusting PV inverter output when needed:
    - ***Defined Range:*** Ensures that the genset's power factor remains within a pre-defined range (either inductive or capacitive).

- ***Fixed Target:*** The EMS maintains a specific power factor value by adjusting reactive power dynamically.

e) Automatic genset Start/stop

This function automates genset activation and deactivation in a grid-connected system for peak shaving and import limit control.

Key Parameters:

- Margin before target:
  - Defines a power margin to trigger peak shaving before reaching the limit.
  - Ensures that gensets activate early to avoid exceeding import limits.

- Start delay:
  - Sets a time delay before starting gensets.
  - Prevents gensets from activating due to temporary power surges.

- Stop delay:
  - Sets a time delay before stopping gensets.
  - Ensures gensets are not turned off too quickly due to short-term power drops.

f) Genset Commitment Strategy

When multiple gensets are available, this function determines how many gensets should start based on real-time power demand. The three available strategies are:

- ***Start All:*** Activates all configured gensets simultaneously to meet power demand.
- ***Start One:*** Starts only the genset with the least total engine runtime.
- ***Adaptive***: Dynamically adjusts the number of active gensets based on power demand.

2.7.9.3. Grid Control configuration

The Grid Control Panel allows you to configure power exchange settings between the site and the local grid. It ensures compliance with grid regulations, optimizes energy flows, and provides control over both active and reactive power. Below are the key functionalities available in this section:

a) Activate active power export control

The Export Control function manages how much active power the PV inverters and BESS can export to the grid, ensuring that power levels at the Point of Common Coupling (PCC) stay within defined limits. This prevents the site from exceeding the permitted export threshold.

- Minimum active power at PCC
    - ***Positive value :*** The EMS ensures the site imports at least the defined power from the grid (no export allowed).
    - ***Negative value :*** The EMS allows exporting power up to the specified limit while still allowing grid imports.

This feature ensures grid stability by managing power flow between the site and the grid, and it is applicable in Grid Prime Configuration.

- Sensing method for the Grid Meter

Determines how the system calculates active power reference for export control. Two methods are available:

    - ***Sum of all phases :*** Uses the total active power from all three phases combined.
    - ***3x Lowest Phase :*** Dynamically identifies the lowest phase power and multiplies it by three. This helps maintain phase balance in asymmetrical grid conditions.

b) Peak Shaving

Peak shaving prevents the grid from importing excessive power due to load surges or drops in PV production. It achieves this by automatically adjusting genset production or PV curtailment.

- Activate peak shaving with genset
    - Enables automatic genset production adjustment to limit grid import.
    - Requires activation of automatic genset start/stop in Genset Control settings.
- Peak shaving target
    - Defines the maximum active power import limit at different times of the day.
    - Configurable via a daily schedule with up to two-day categories and ten time slots per category.
- Sensing method for the grid meter : Determines how the system calculates the active power reference for peak shaving:

- ○ ***Sum of all phases :*** Uses the total active power from all three phases combined.
- ○ ***3x Highest Phase :*** Uses three times the highest phase power, ensuring phase balance in asymmetrical conditions

c) Activate reactive power control

This feature automatically adjusts reactive power to keep the grid power factor within a defined range or at a target value. It does this by sending reactive power setpoints to the PV inverters.

- ***Controlled units:*** The system identifies which units (e.g., PV inverters) will be responsible for reactive power regulation.
- ***Maximum absolute value of reactive power petpoint for PV:*** Defines the upper limit for how much reactive power PV inverters can absorb or inject into the grid
- ***Reactive power control strategies :*** Two strategies are available:
  - ○ Power factor range maintains the power factor within a predefined range by setting:
    - ■ Minimum capacitive power factor : Defines the lowest allowable leading (capacitive) power factor.
    - ■ Minimum inductive power factor: Defines the lowest allowable lagging (inductive) power factor.
  - ○ Power Factor Target: Keeps the power factor at PCC fixed to a specific value.

2.7.9.4. Grid Meters

This tab enables you to define and configure grid meters that provide power measurements at the Point of Common Coupling (PCC). These meters must first be added and configured in the Network tab of eConf before being assigned here.

2.7.9.5. Genset Meters

This tab allows you to configure genset meters, which measure power when running on genset power. These meters also determine the operational status (ON/OFF) of the genset.

- Genset ON/OFF Detection Methods

The EMS can determine if a genset is running using two different detection methods:

- ○ ***Frequency-based detection*** : If the measured frequency exceeds the configured threshold, the genset is considered ON.

- ***Power-based detection*** : If the measured power (as a percentage of the rated genset power) exceeds a defined limit, the genset is considered ON. The rated power is configured in the Genset Control tab.

2.7.9.6. Multi-Purpose IO Modules

This tab enables you to configure how breakers are controlled using multi-purpose IO modules (MPIOs). The setup is done in the Network tab of eConf.

Each MPIO module can control up to three breakers, with a total of five MPIO units available, allowing for control of up to 15 breakers.

- Types of breakers
  - ***Production Breaker :*** Controls power production sources.
  - ***Load Breaker:*** Controls power consumption loads.

- Breaker control types: The EMS can open or close breakers based on specific conditions:
  - ***Load power (Grid Prime/Genset Prime) :*** Opens/closes a breaker based on load levels.
  - ***Grid import (Grid Prime) :*** Controls breakers based on grid import limits.
  - ***Genset loading (Genset Prime) :*** Ensures proper genset loading by controlling breaker status.

2.7.10. Starting the EMS

1. Confirm that you want to complete the setup by clicking on "Finish Setup".

The data entered during the setup process can be modified later through the eConf configuration platform.

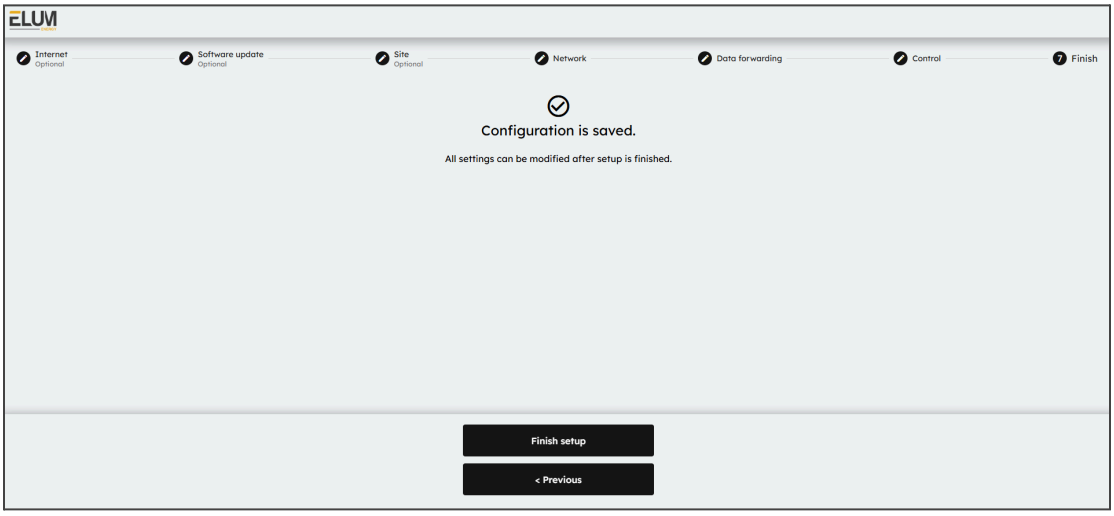


Fig. 44: Completing the setup and accessing the eConf homepage.

2. Once you click on the "Finish Setup" button, you will be redirected to the Overview page of the eConf configuration platform.

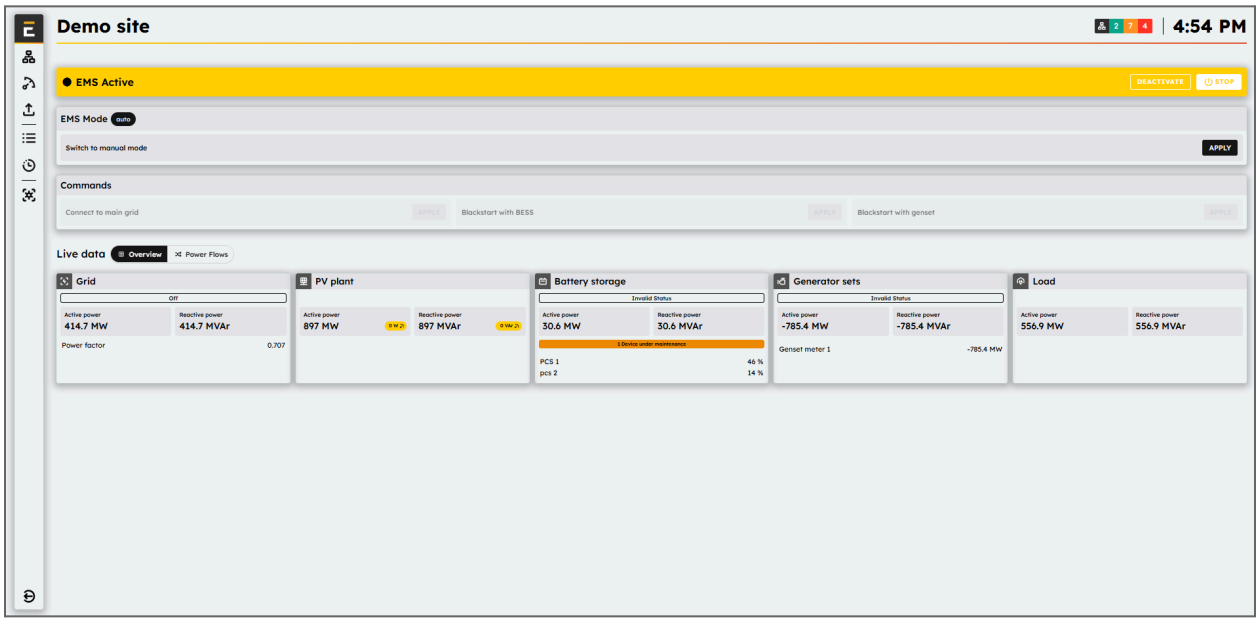


Fig. 45: eConf Homapage overview

Load meter

The **load power meter** can be useful for the **installer** to perform **consistency checks**, but it is **not a mandatory component** for the **proper functioning** of the **ePowerControl**.

If no **load meter** is installed, the **Load Meter field** can be left **blank**.

However, if a **load indicator** is detected by the **control panel**, it will be **integrated into the EMS control loop** as a **critical device** and will be considered when **triggering the safety mode**.

2.8. Step 7: Functional tests

2.8.1. Test environment configuration

To perform the functional tests, ensure that your computer remains connected to the controller and that you are logged into eConf interface.

2.8.1.1. EMS status

Before proceeding with the functional tests, ensure that:

- Data acquisition has already been launched.
- The EMS control status is displayed as “ON”, indicating that the EMS is actively computing and dispatching production.

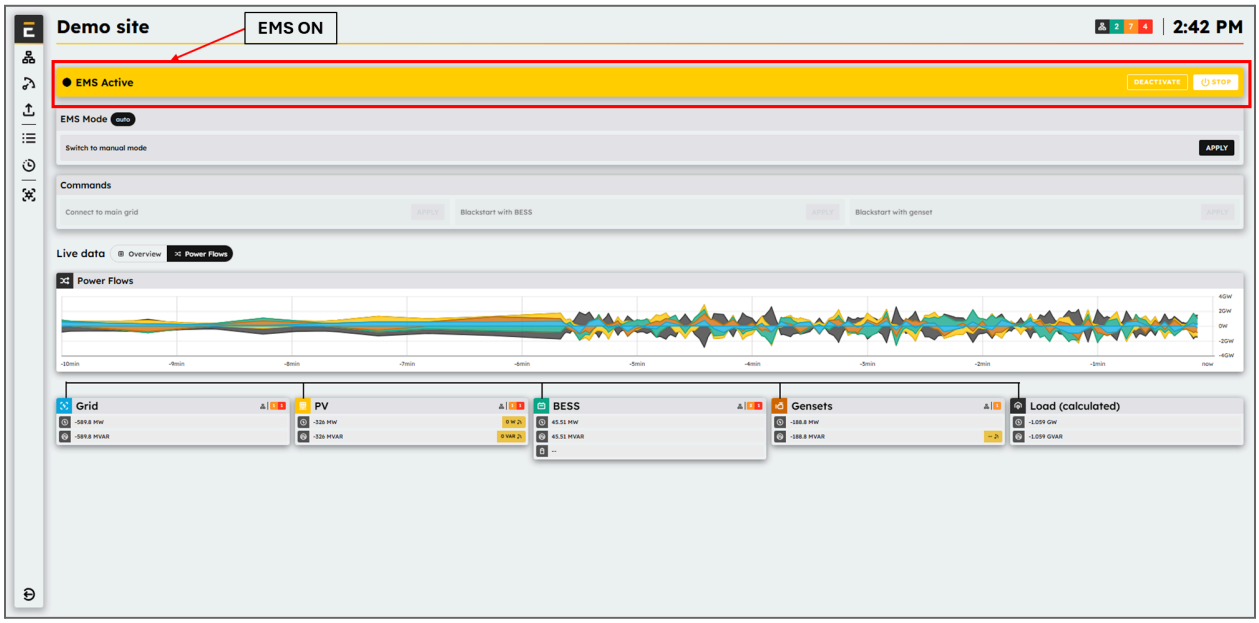


Fig. 46: Overview of the eConf homepage (EMS ON).

2.8.1.2. PV injection

During the entire deployment process, PV injection must remain shut down. This requirement also applies to the functional tests configuration, meaning PV injection should stay off initially.

2.8.1.3. Devices connection status

By this stage of commissioning, all equipment to be monitored and controlled by the Elum controller should be properly connected. You can verify the connection status of each device through eConf Devices panel.

2.8.1.4. Consistency check up

In the Overview and Devices panels of eConf, real-time data is displayed and automatically refreshed. You must perform a consistency check, particularly to validate the correct configuration of power meters.

Power meters consistency check

Proper **power meter installation** depends on the **correct positioning and wiring** of **Current Transformers (CTs)** and **Voltage Transformers (VTs)**. Ensure the following:

- **CTs and VTs** must be installed on the **correct bus bar/wires**, matching the **exact measurement point of interest**.
- **CTs must be installed in the correct direction** to ensure accurate readings.
- **Grid power consumption** should always be displayed as a **positive value**.
- **Load power consumption** should always be displayed as a **positive value**.
- **Genset(s) power production** should always be displayed as a **positive value**.
- **CTs and VTs must correspond phase by phase**, a phase swap will affect the **power factor (cos φ) measurement**, leading to incorrect readings.

2.8.2. Test procedures

The test procedures vary depending on the EMS application being used. Please follow the specific instructions for the EMS application selected in eConf Control panel.

Each step of the procedure must be strictly followed according to the instructions provided in this section.

If, at any point during the test procedure, the outcome differs from the expected result described, contact the Elum Deployment Team at support@elum-energy.com for assistance.

2.8.2.1. On-Grid (PV + Grid application) & Islanded (PV + Genset)

Follow the steps below carefully. Proceed to the next step only when your test results match the expected outcome described in this user manual.

1. Go to the Overview page in eConf.

Normally, the EMS should be running, and its status should be displayed as "EMS ACTIVE".

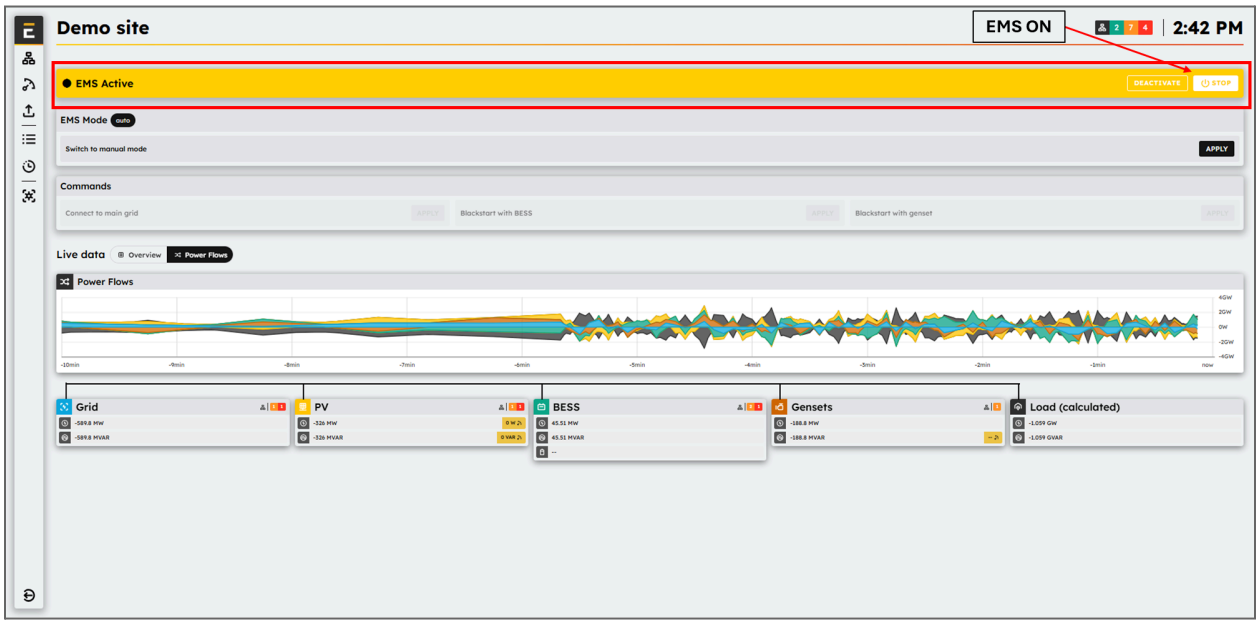


Fig. 47: Stopping the EMS from the homepage in eConf.

2. Click on "Stop" to shut down the EMS from the Overview page in eConf.

Expected outcome: The EMS control status should first display “EMS FORCE STOPPING”, and then change to “EMS OFF”, confirming that the EMS has been successfully shut down.

When the **EMS is stopped**:

- All **control features** of the EMS are **disabled**.
- **PV inverters** are **curtailed** to their **minimum AC power output level**.
- **Datalogging functions** remain **active**, allowing continuous data collection.

3. Step 1: Turn on PV injection for one of the inverters.

Expected outcome: The AC power output of the inverter must remain below 1% of its nominal output power.

4. Step 2: If you have multiple PV inverter brands and models, turn off all inverters and restart this step for each brand and reference individually.

Expected outcome: For each brand and model, the AC power output must remain below 1% of the nominal power.

5. Step 3: Turn on all PV inverters simultaneously.

Expected outcome: The AC power output of each inverter must still remain below 1% of its nominal output power.

6. Step 4: Start the EMS and activate PV injection by clicking on the appropriate control button in eConf.

- *Expected outcome 1:* The EMS control status should first display “EMS STARTING” for a few seconds, then switch to “EMS ON”, indicating that the Energy Management System is fully operational.

Fig. 48 : EMS status transitioning from "Starting" to "Active".

- *Expected outcome 2:* PV injection should begin slowly, increasing power output gradually.

2.8.2.2. Backup (PV + Genset + Grid)

Please find below the testing procedure, you must only move from one step to the following when your test results have been those described in this User Manual

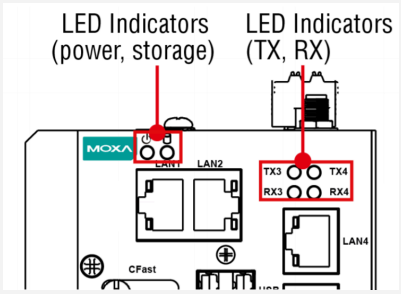
- Ensure that the EMS is ON, and both grid control and genset control are activated and correctly configured with the necessary parameters.
- Manually simulate a grid failure by opening the grid breaker.

- ePowerControl must remain powered during the transition from "On grid, Grid connected" to "Off grid, Genset connected" configuration.
- This outcome also serves as a valid test for verifying UPS functionality.

Additional Consideration:

- Since Elum controllers are always provided with a UPS, this test helps confirm its operation.
- If you do not connect UPS, this step is critical for ensuring that the system remains powered during grid failure.

You can verify if the ePowerControl is turned on by checking the Power LED on the front panel of the Central Computing Unit.



Expected outcome 1: Grid, Load, and Genset power meters must remain powered after the gensets have started.

Expected Outcome 2: Genset power meter readings must be consistent with the Load power meter readings (i.e., their values should be equal).

Expected Outcome 3: Grid power meter readings must be consistent and show null values, confirming that the site is no longer drawing power from the grid.

1. Go to the Overview page in eConf.

Normally, the EMS should be running, and its status should be displayed as "EMS ACTIVE".

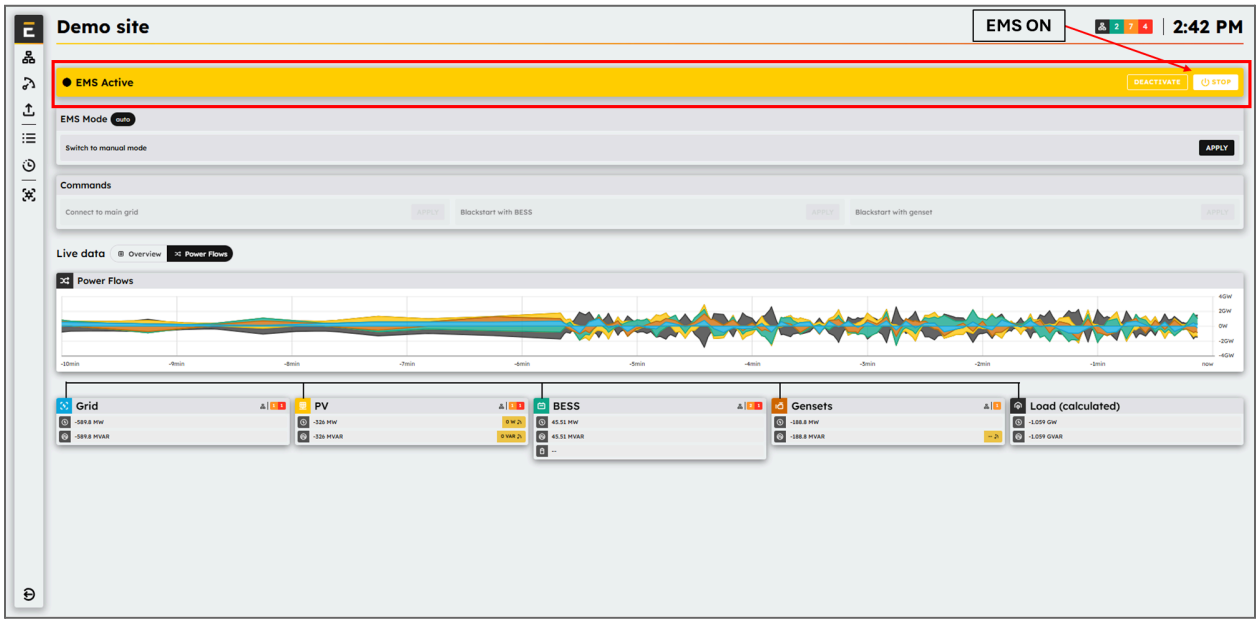


Fig. 49: Stopping the EMS from the homepage in eConf.nf

1. Click on "Stop" to shut down the EMS from the Overview page in eConf.

Expected outcome: The EMS control status should first display “EMS FORCE STOPPING”, and then change to “EMS OFF”, confirming that the EMS has been successfully shut down.

When the EMS is stopped, its control features are disabled, and the PV inverters are limited to their minimum AC power output, while datalogging remains active.

2. Start PV injection of one of the inverters.

Expected outcome: The AC power output of the inverter must remain below 1% of the PV inverter nominal output power.

3. If you have different brands and references of PV inverters, turn off all the inverters again and start over at this step 3 until you have tested independently all of the PV inverters brands and references.

Expected outcome: The AC power output of the inverter must remain below 1% of the PV inverter nominal output power, for each brand and reference of PV inverter.

4. Turn on all the PV inverters one by one.

Expected outcome: The AC power output of each inverter must remain below 1% of the PV inverter nominal output power.

5. Start the EMS and activate PV injection by clicking on the appropriate control button in eConf.

Expected outcome 1: The EMS control status should first display “EMS STARTING” for a few seconds, then switch to “EMS ON”, indicating that the Energy Management System is fully operational.

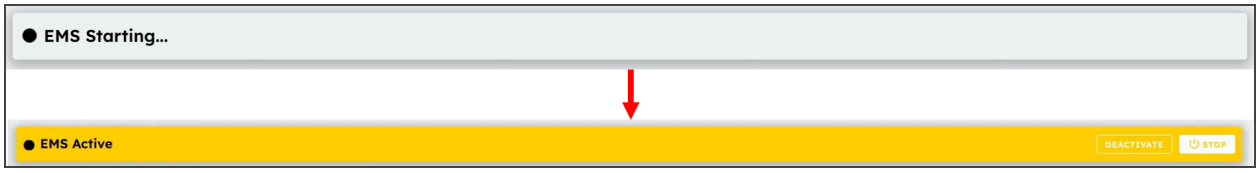


Fig. 50 : EMS status transitioning from "Starting" to "Active".

- *Expected outcome 2:* PV injection should begin slowly, increasing power output gradually.

6. Manually transition the power plant from “Off grid, Genset connected” to “On grid, Grid connected” by closing the grid breaker.

Expected Outcome 1: ePowerControl must remain powered during the transition from “Off grid, Genset connected” to “On grid, Grid connected” configuration.

Expected Outcome 2: Grid, Load, and Genset power meters must be powered once the system has switched back to “On grid, Grid connected” configuration.

2.8.2.3. Verification of zero export control and reactive power regulation

If the system is configured with multiple grid injection points, the zero export control must be verified for each point. This ensures that no power is injected into the grid at any monitored location.

a) Zero Export Test for Multi-Point Injection

- Verify the configuration of multiple grid monitoring points in eConf.
- Start the EMS and allow it to regulate power based on zero export settings.
- Check the real-time grid power measurements at each injection point.

Expected Outcome: The site should not inject active power into the grid at any monitored injection point.

- If active power injection is detected at any point, contact Elum Support for assistance.

b) Reactive power control test

The controller can regulate the grid power factor by controlling reactive power. This test ensures that the system correctly adjusts reactive power to maintain the target power factor.

Configure the desired grid power factor target in the Grid Control tab.
Start the EMS and allow it to regulate the system.
Monitor the power factor at the PCC using the grid meter.

Expected Outcome: The measured power factor should stay within the defined range or match the set target.

If the power factor deviates from the expected value, verify the reactive power settings and contact Elum Support if the issue persists.

b) Genset minimum loading test

This test ensures that the genset never operates below its defined minimum loading threshold, as running under this limit can cause inefficiencies, increased fuel consumption, and potential mechanical wear.

The Genset Minimum Loading function is designed to keep the genset running at a safe and efficient power level, preventing it from operating under an inadequate load.

- Verify the genset minimum loading threshold configured in the Genset Control tab (e.g., 30% of the genset's nominal power).
- Start the genset and allow it to stabilize.
- Monitor the genset's active power output in real time.
- Observe its operation under different load conditions:
    - If the genset power is below the minimum loading threshold, corrective measures should be applied according to the system configuration.
    - If the genset power is at or above the minimum loading threshold, normal operation should continue.

Expected outcomes:

- The genset should never operate below its configured minimum loading value.
- If the load decreases below the threshold, the system should take corrective actions based on the defined configuration.
- The genset maintains stable operation without running underloaded

2.9. Test Conclusion

Once all test procedures have been rigorously followed and each step has resulted in the expected outcomes described in this document, the EMS can be considered fully commissioned.

All results and comments should be documented in the Test Matrix for record-keeping.

2.9.1. On-Grid (PV + Grid application) & Islanded (PV + Genset) test matrix

Table 10: Test Conclusion for On-Grid (PV + Grid) & Islanded (PV + Genset) Applications

	Steps	**Expected outcome**
1	Accessing eConf Overview	Ensure the EMS is running and its status is displayed as "EMS ACTIVE."
	Stopping the EMS	Click "Stop" in eConf. EMS control status should first display “EMS FORCE STOPPING” and then change to “EMS OFF,” confirming shutdown.
2	Testing PV Injection for Individual Inverters	Turn on PV injection for one inverter at a time. The inverter’s AC power output must remain below 1% of its nominal output power.
3	Testing Multiple PV Inverter Brands and Models	If different inverter brands or models are used, turn off all inverters and restart the test for each brand separately. The AC power output must remain below 1% of the nominal power. r.
4	Testing All PV Inverters Together	Turn on all PV inverters simultaneously. The AC power output of each inverter must still remain below 1% of its nominal output power.
5	Starting the EMS and Enabling PV Injection	Click the appropriate control button in eConf to start the EMS and activate PV injection. The EMS control status should first display “EMS STARTING” and then switch to “EMS ON.” PV injection should gradually ramp up, increasing power output smoothly.
		Expected outcome 2: PV injection should begin slowly, increasing power output gradually.

2.9.2. Backup (PV + Genset + Grid) test matrix

Table 11: Test Conclusion for Backup (PV + Genset + Grid) Application

	Steps	**Expected outcome**
1	Ensure that the EMS is ON, and both grid control and genset control are activated and correctly configured.	The system is ready for testing with all required parameters set.
2	Manually simulate a grid failure by opening the grid breaker.	ePowerControl must remain powered during the transition from 'On grid, Grid connected' to 'Off grid, Genset connected'. This also serves as a valid test for verifying UPS functionality.
3	Go to the Overview page in eConf.	EMS should be running, and its status should be displayed as 'EMS ACTIVE'.
4	Click on 'Stop' to shut down the EMS from the Overview page in eConf.	The EMS control status should first display 'EMS FORCE STOPPING' and then change to 'EMS OFF', confirming that the EMS has been successfully shut down.
5	Start PV injection of one of the inverters.	The AC power output of the inverter must remain below 1% of its nominal output power.
6	If you have multiple PV inverter brands and models, turn off all inverters and restart this step for each brand and reference individually.	For each brand and model, the AC power output must remain below 1% of the nominal power.
7	Turn on all the PV inverters one by one.	The AC power output of each inverter must still remain below 1% of its nominal output power.
8	Start the EMS and activate PV injection by clicking on the appropriate control button in eConf.	EMS control status should first display 'EMS STARTING' for a few seconds, then switch to 'EMS ON'. PV injection should begin slowly, increasing power output gradually.
9	Manually transition the power plant from 'Off grid, Genset connected' to 'On grid, Grid connected' by closing the grid breaker.	ePowerControl must remain powered during the transition. Grid, Load, and Genset power meters must be powered once the system has switched back to 'On grid, Grid connected' configuration.

2.9.3. Zero Export and Reactive Power Test Matrix

Table 12: Test Conclusion for Zero Export and Reactive Power Regulation

	Steps	**Expected outcome**
1	Verify the configuration of multiple grid monitoring points in eConf.	All grid injection points should be correctly configured and monitored.
2	Start the EMS and allow it to regulate power based on zero export settings.	No active power should be injected into the grid at any monitored injection point.
3	Check the real-time grid power measurements at each injection point.	If active power injection is detected, the user must contact Elum Support.
4	Configure the desired grid power factor target in the Grid Control tab.	The power factor settings should match the intended target values.
5	Start the EMS and allow it to regulate the system.	The EMS should adjust reactive power to maintain the set power factor.
6	Monitor the power factor at the PCC using the grid meter.	The measured power factor should stay within the defined range or match the set target. If deviations occur, verify the reactive power settings or contact Elum Support.

3. eConf navigation after the commissioning

3.1. Accessing eConf

After deploying the ePowerControl, the eConf interface remains accessible at any time for further adjustments or diagnostics.

To access the interface:

1. Connect your laptop to LAN 2 (ePowerControl ES) or LAN 4 (ePowerCon of the Central Computing Unit (CCU).
2. Open a web browser and enter 192.168.4.127 in the URL bar.

3.2. User interface : eConf

3.2.1. General information

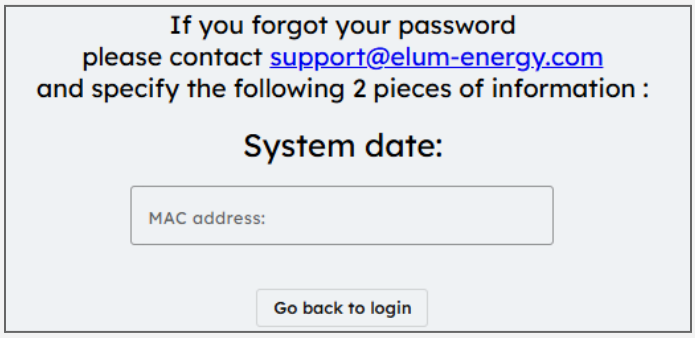
The main purposes of eConf are:

- To configure the site : Set up network parameters, connected devices, and system settings.
- To define the control rules : Establish operational rules for managing site behavior.
- To monitor the logs : Track system logs, events, setpoints, and errors.
- To monitor the behavior of the site : Observe real-time data and performance of all connected devices

Forgot password?

If the User password is forgotten, Elum can generate a backup password upon request.

This backup password will be valid for 24 hours and can be used to log in and set a new password from the Password panel in eConf interface.



3.2.2. Supported language

The eConf interface supports the following languages:

- English
- French

The language selection is automatically determined by the browser's language settings.

In solutions that include a screen, it may not always be possible to change the browser's language. If this issue occurs, please **contact Elum Support** for guidance and assistance.

3.2.3. Overview

The **Live Data Overview Panel** provides a real-time summary of your power plant's status. It displays essential information on power generation, consumption, and control operations, helping operators monitor system performance at a glance.

Once configuration is complete and the EMS is activated, the system automatically redirects the user to this page.

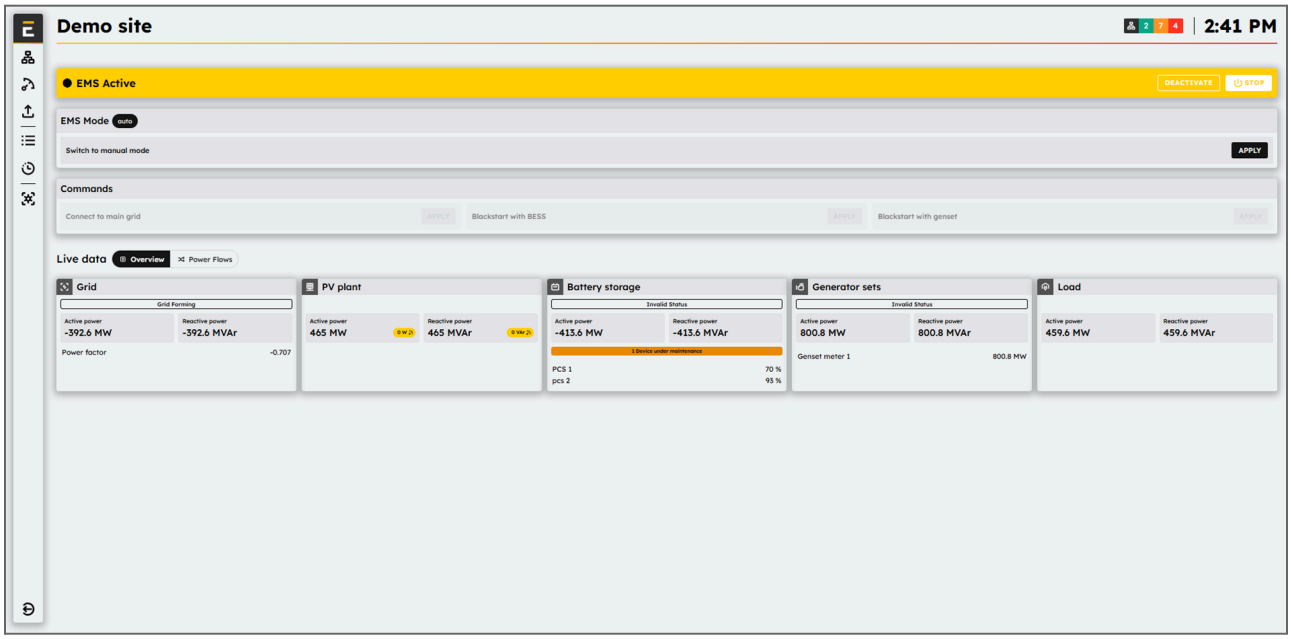


Fig. 51 : eConf Live Data Overview panel.

3.2.3.1. Main Overview panel

This central section of the interface includes:

- *Control Actions:* Located at the top-right, operators can:
    - Start, Stop, or Force Stop the EMS.
    - Deactivate automatic control when necessary.

  These actions allow manual intervention during critical operations.
- *Current EMS Mode*: Displays whether the EMS is running in Auto or Manual mode. You can switch between modes using the “Switch to manual mode” button and applying changes.
- *Current EMS State:* Indicates the real-time operational status of the EMS.
- *Power Monitoring Summary:* Shows active and reactive power metrics for each connected unit:
    - Grid: Power import/export and power factor.
    - PV Plant: Current solar generation values.
    - Battery Storage**:** Charge/discharge power and State of Charge (SOC)
    - Generator Sets: On/Off status and output data.
    - Load: Total Estimated total site consumption (active and reactive power), calculated by the EMS based on the measured values of all other assets .
- Current EMS Setpoints: Highlighted in yellow circles, these indicate active control targets applied by the EMS to maintain optimal system performance.
- Active Components Counter: Displayed in the top-right corner next to the clock, showing the total number of components in the system and their current status.

3.2.3.2. Power flow view

The **Power Flows** view provides an intuitive and real-time visualization of energy flows within the power plant. It is designed to help you monitor the dynamic interactions between generation, storage, consumption, and grid exchange.

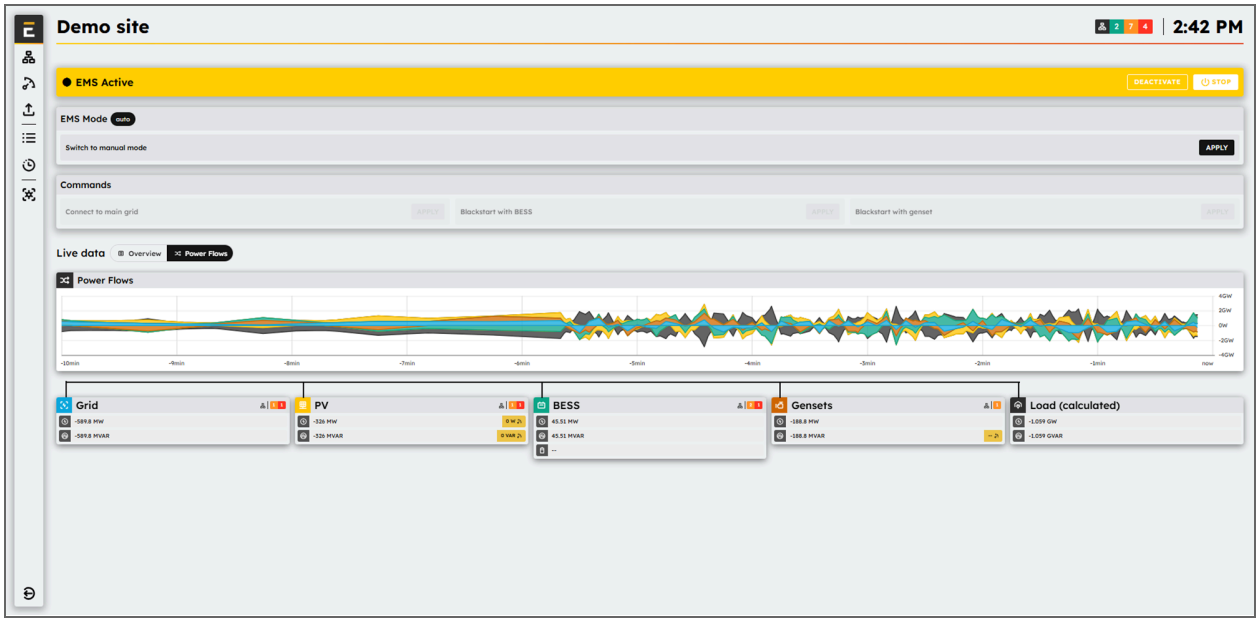


Fig. 52 : eConf Live Data Power Flow Graph panel.

The **Power Flow graph** (Timeline graph) shows active power (kW) values for each major component of the power plant over the last 10 minutes:

- *Stacked color bands:* Each band represents a component:
  - PV (yellow)
  - Grid (blue)
  - Gensets (orange)
  - Load (dark gray/black)
  - Battery (green)
- *Positive values:* Represent energy generation or export.
- *Negative values:* Represent energy consumption or import.
- *Tooltip on hover:* Displays the exact active power values of all components at a specific timestamp.

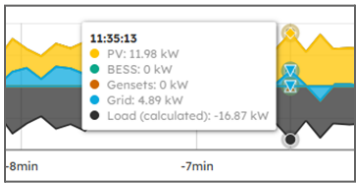


Fig. 53 : Power Flow Graph tooltip : Component values at selected timestamp.

Reactive power is **not displayed in the timeline graph** but is shown in the component list below the graph:

- For each component (PV, Grid, BESS, Gensets, Load), both active and reactive power are displayed in real time.
- Yellow highlighted values: Represent EMS control setpoints applied to the system.
- Status squares (🟩🟧🟥): Indicate the communication and operational status of each component:
    - Green (🟩): Connected devices with no active alarms
    - Orange (🟧): Connected devices with at least one active alarm
    - Red (🟥): Disconnected devices

The Power Flow graph is **not available on embedded 7-inch screens**. It can only be viewed through the **web interface** version of eConf.

For **long-term data visualization and historical analysis**, Elum Energy also provides dedicated solutions such as **ePowerMonitor** and **ePowerSCADA**, offering advanced dashboards and detailed performance tracking.

3.2.4. Left side menu

The vertical menu on the left provides access to all major functionalities of the (EMS), You can navigate through eConf interface using this left-side menu, which provides access to different configuration panels :

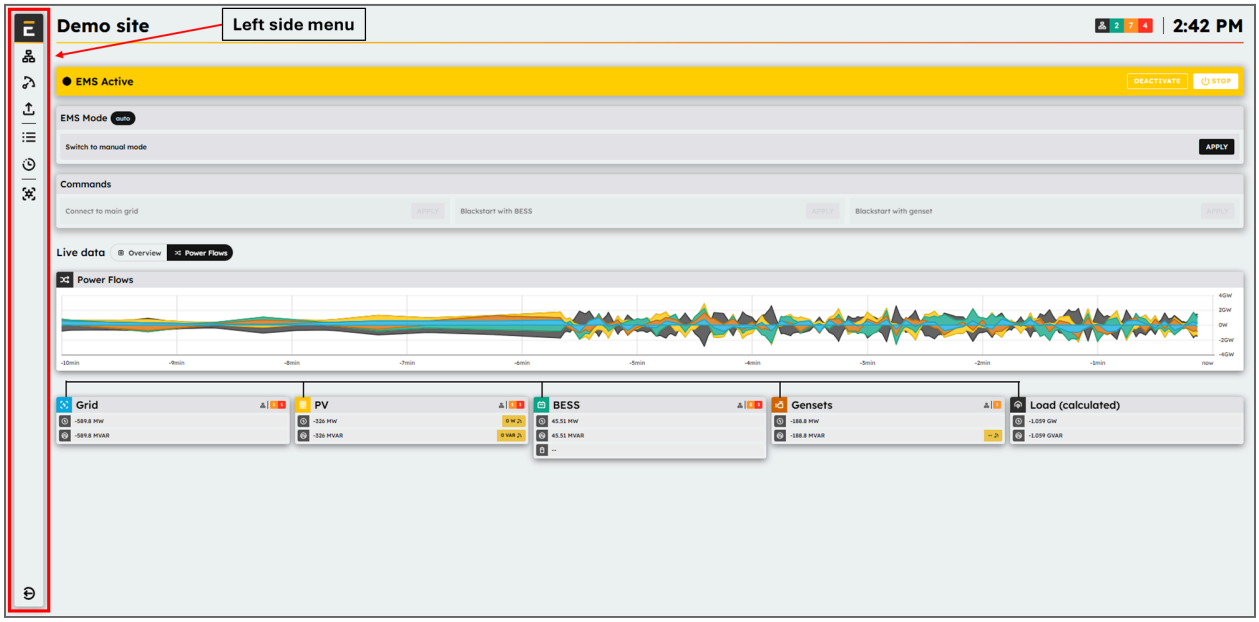


Fig. 54 : eConf left side manu : Navigation panel.

- **Elum Logo :** Clicking on the logo will return you to the homepage of the interface.
- **“Network” panel** : Used to configure LAN connections, serial connections for devices, and internet connectivity.
- **“Control” panel** : Allows navigation through different control and monitoring options.
- **“Data Forwarding” panel** : Provides access to data export options, enabling configuration for exporting data to third-party platforms or USB storage.
- **“All Devices” panel** : Displays the status of all devices connected to the ePowerControl and provides access to individual device data acquisition.
- **“Logs History” panel** : Allows access to the history of logs, setpoints, and errors for system diagnostics and analysis.
- **“System Settings” panel** : Enables modification of various system settings and parameters.

A User can log out at any time by clicking on the logout button located in the bottom left corner of the eConf interface.

3.2.5. Network panel

The **"Network"** panel provides access to network settings, allowing users to configure and manage network interfaces.

Within the network menu, users can:

- Create or configure network interfaces (Serial or LAN)
- Add devices to a configured interface

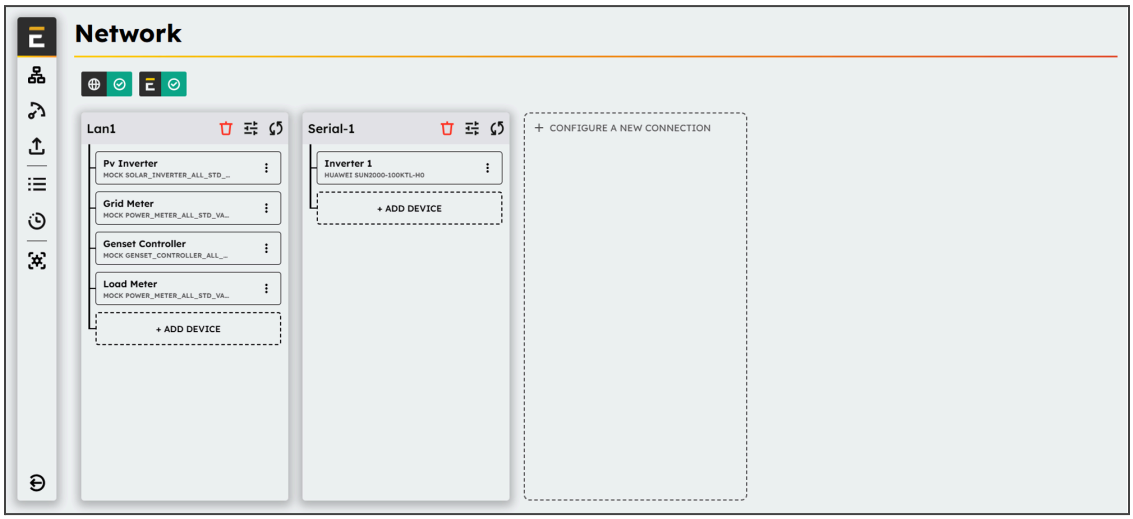


Fig. 55: eConf Network page

3.2.6. Control Panel

For more details on configuring and using the different control parameters (PV, Genset, Grid, Breakers, etc.), please refer to the section Control Configuration.

3.2.7. Data Forwarding

Data forwarding manages all specific data exchange methods between the EMS and third-party solutions that do not use the Modbus gateway for data transfer. The Data Forwarding panel allows you to modify the data forwarding settings that were initially configured during commissioning.

Available data forwarding interfaces

- ePowerMonitor
- ePowerMonitor Next Gen
- Export FTP
- Export USB
- Energysoft
- QOS Energy
- Meteocontrol

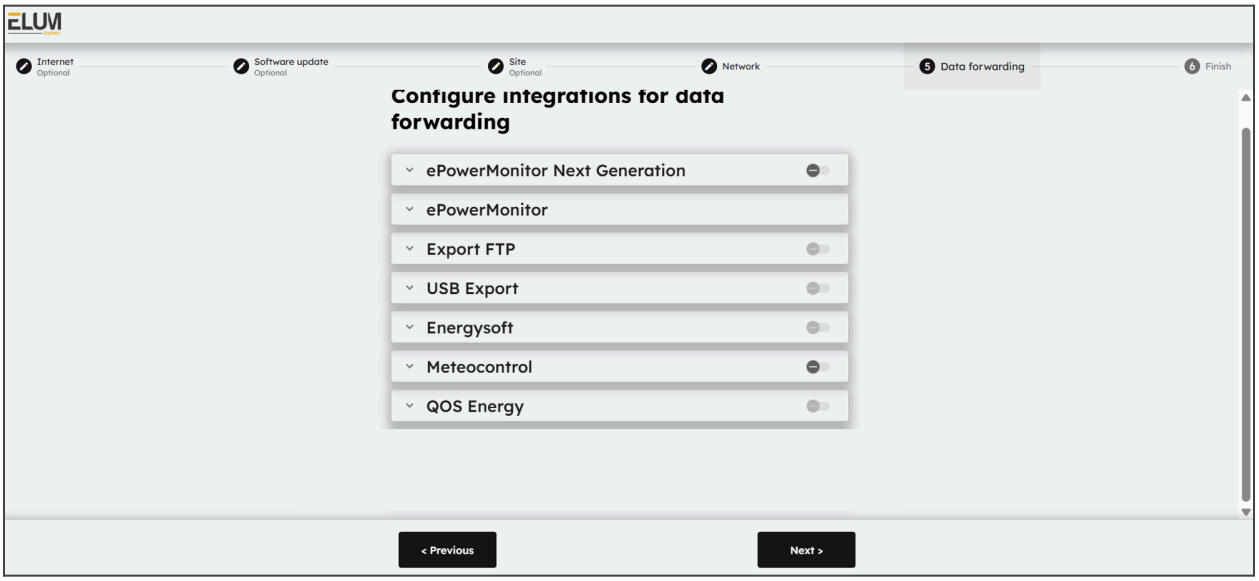


Fig. 56: eConf Data forwarding page

In eConf, the Data Forwarding page allows you to configure connections with different interfaces. All mandatory settings are displayed, and once they are completed, data forwarding can be activated. Some advanced parameters can be modified in a configuration file.

Table 13: Data Forwarding Interface Options and Descriptions

Interface	Description
ePowerMonitor	Sends all data from the Elum Data Model to the Elum asset management platform: ePowerMonitor. *Activated upon subscription to ePowerMonitor.*
FTP	Allows sending data from the EMS to an FTP server. All data from the Elum Data Model is transferred.
USB	Enables exporting data from the EMS to a local USB key. All data from the Elum Data Model is transferred.
Energysoft	Sends available data from the Elum Data Model to the Energysoft platform.
QOS Energy	Sends available data from the Elum Data Model to the QOS Energy platform.
Meteocontrol	Sends available data from the Elum Data Model to the Meteocontrol platform.

3.2.8. Devices

The Devices panel displays a list of all equipment connected to the ePowerControl, along with their current connection status.

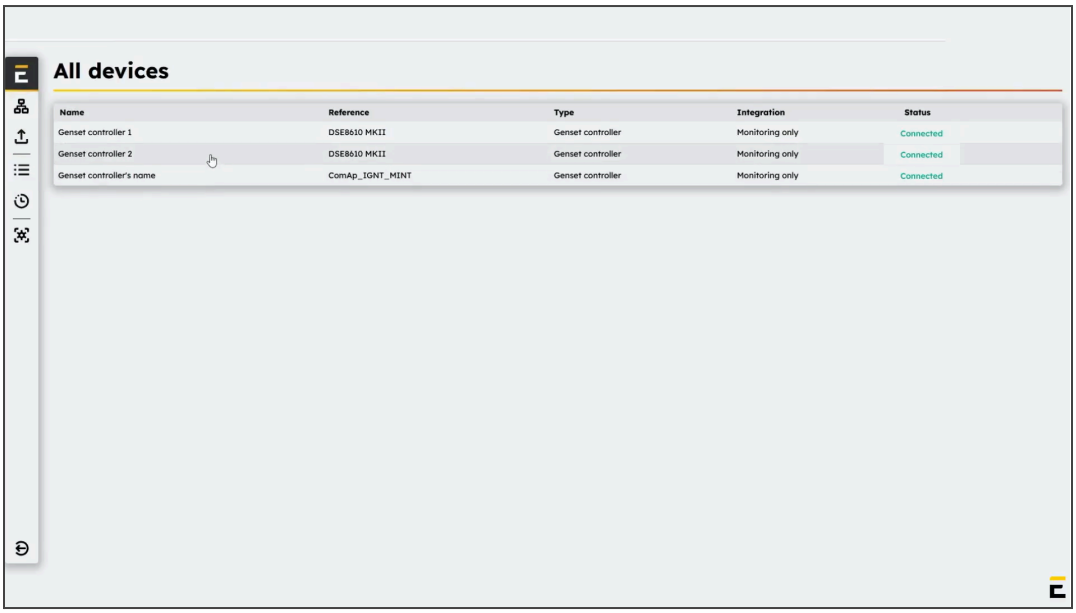


Fig. 57: eConf Devices page

By selecting a device in the “All Devices” panel, you can view its detailed live data to monitor its real-time performance and status.

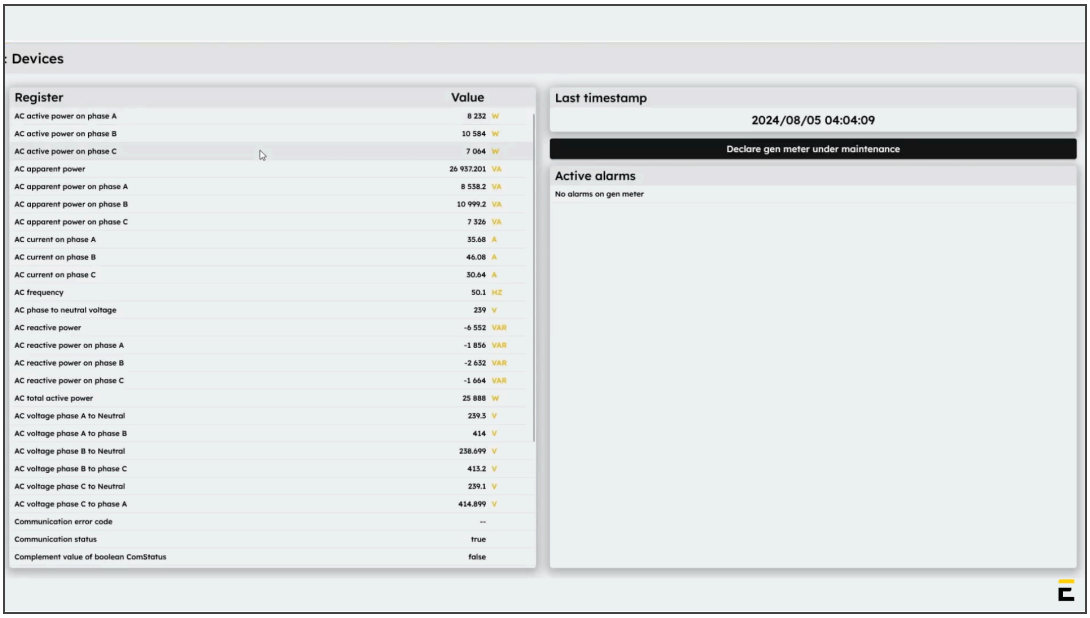


Fig. 58 : :eConf Device registers panel

The live data panel displays all accessible read and write registers for the selected device.

On the right side of the device page, users can manually declare a device under maintenance by clicking the “Declare [device name] under maintenance” button.
This applies not only to meters (grid, genset, or BESS) but also to any device displayed in the list.

When a device is declared under maintenance, it is excluded from control calculations, while its data remains visible and exportable.

Some registers can be edited by clicking on the edit icon. When modifying a register, you will be prompted to enter a new value for the specific device and confirm your choice.

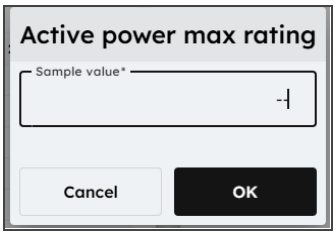


Fig. 59:: Register edition from Device panel

3.2.9. Logs

The Logs History panel provides access to timestamped logs of EMS events, enabling system diagnostics and analysis.

Available Log categories :

- Communication Errors : View a list of communication failures between devices.
- Device Errors : Check any device-related malfunctions detected by the system.
- Setpoints : Monitor the setpoints sent by the EMS to the plant for control operations.

Filtering and exporting Logs :

You can:

- Select a start and stop date to filter logs for a specific time range.
- Export the log data in CSV format for further analysis.

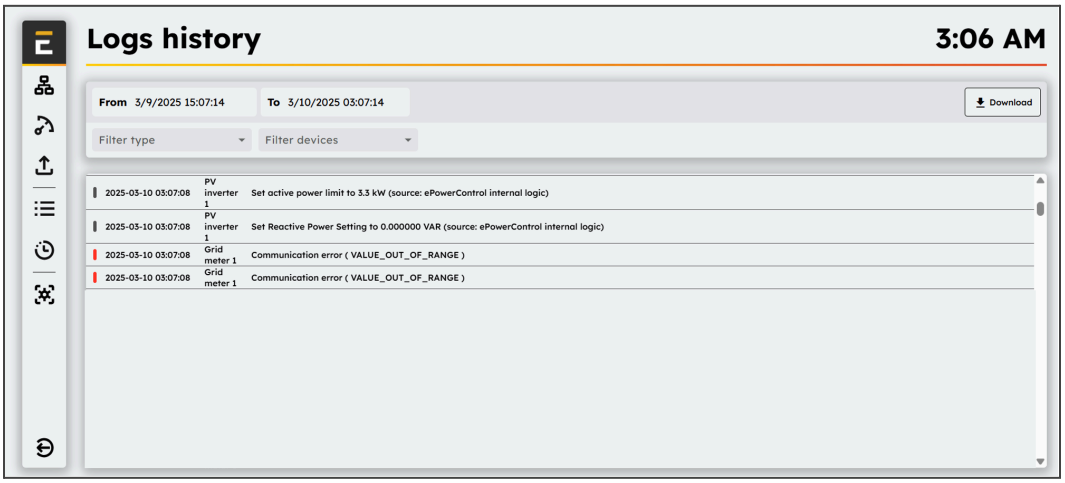


Fig. 60: Log history page

3.2.10. System settings

The System Settings panel allows you to access and configure essential system parameters.

Available settings:

1. **Site :** Enter the site name and its location details.
2. **Date and Time :** Define and adjust the date, time, and time zone settings.
3. **Firmware :** Check the installed firmware version and update if necessary.
4. **Password :** Change the login password for accessing eConf.
5. **Advanced settings :** Access additional system configurations, including logging options and factory reset.

Fig. 61: System setting page

3.2.10.1. Version

The “Firmware” panel shows the version of the Elum firmware packages installed on your ePowerControl.

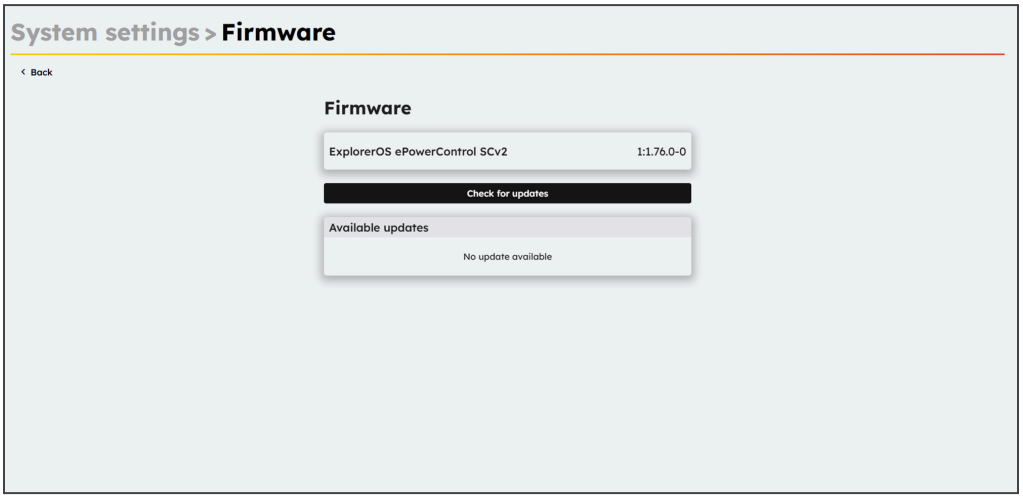


Fig. 62: eConf firmware page

3.2.10.2. Date

The “System settings” panel allows you to access and configure the Date & Time settings, including the Timezone.

If the Explorer is connected to the internet, the controller or datalogger automatically synchronizes its time with Elum’s cloud server.

Alternatively, users can configure synchronization with a specific NTP server or a local GPS clock, depending on site requirements.

The date and time settings on the controller are crucial for accurate timestamping of monitored values.

Timestamps are recorded in UTC, meaning the time zone setting does not affect them. The timestamp assigned to the data corresponds to the midpoint of the reading operation. For example, if the reading starts at 12:35:30 and takes 3 seconds to complete, all variables will be assigned the timestamp 12:35:31.5.

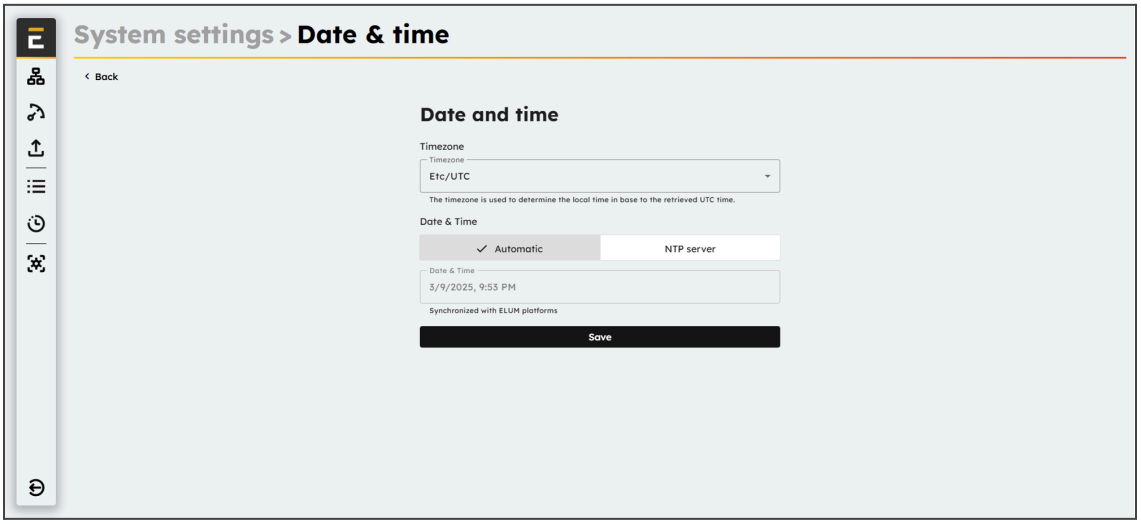


Fig. 63: eConf Date & time tab

3.2.10.3. Password

The Password panel allows you to set a new password for accessing the system.

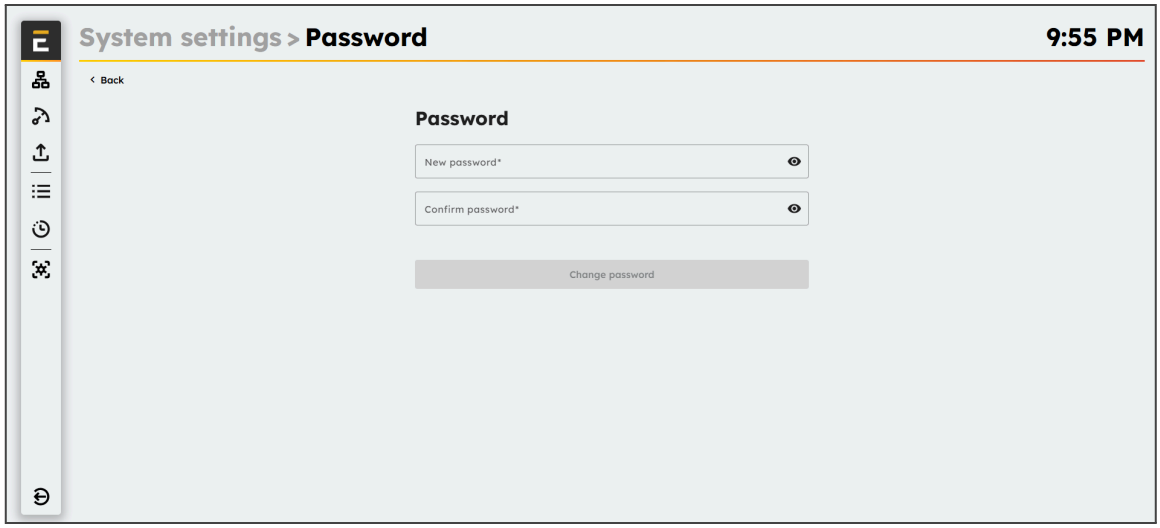


Fig. 64: eConf password modification tab

3.2.10.4. Site

The Site panel allows you to modify the site settings, with new settings overwriting the previous ones.

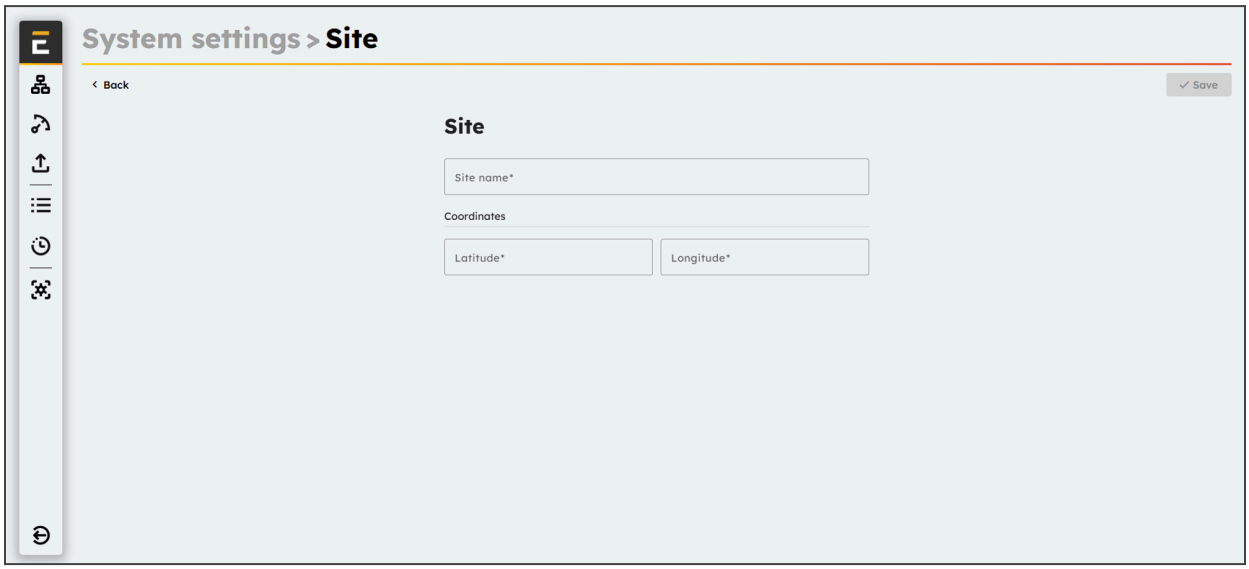


Fig. 65: Site panel information and coordinate tab

3.2.10.5. Advanced

The Advanced panel allows an Advanced User to reset the ePowerControl configuration to factory settings.

⚠	*This action will **permanently delete all personal data**, and **restoration will not be possible**.*

The Advanced panel also provides access to the Modbus Gateway interface of the Elum Controller. To access it, click on "Elum Technician Tools", then select "Modbus Gateway".

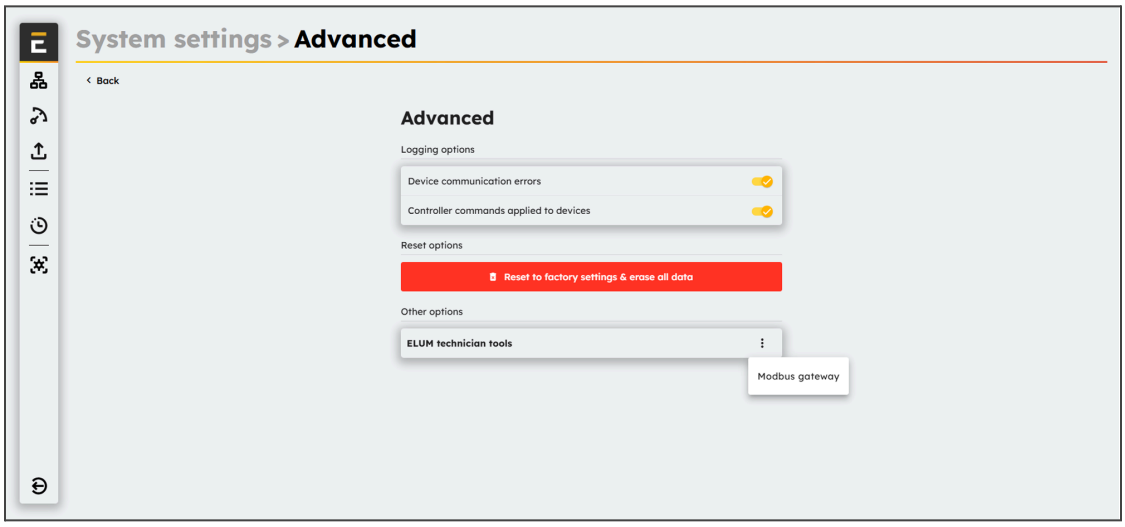


Fig. 66: Advanced setting tab

From this menu, you can select the LAN port of the Elum Explorer to be exposed for external Modbus masters to send queries. Additionally, you can configure the slave ID for each device connected to the Elum Explorer.

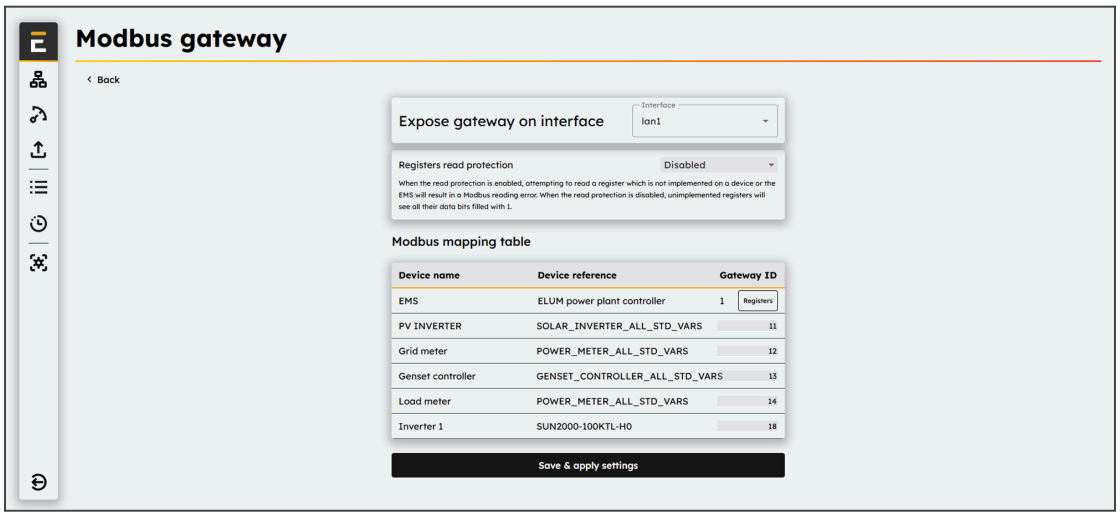


Fig. 67: Advanced settings - modbus gateway tab.

For more details about the Elum Modbus Gateway interface, please refer to Appendix D: Modbus Gateway.

Please note that this option is only available when ordering your Elum Explorer. If you wish to subscribe to this additional feature after purchase, please contact the Elum sales team at sales@elum-energy.com .

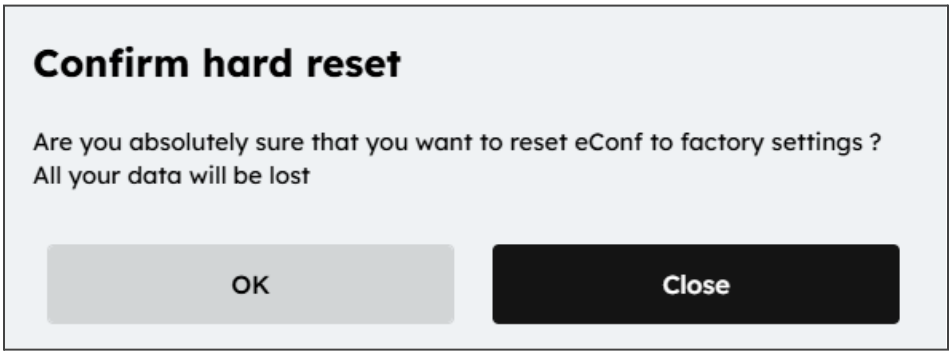


Fig. 68: Hard reset confirmation tab.

4. Control and Operating Modes

4.1. PPC Control

In addition to its EMS functions, the **ePowerControl ES/ES+** can also act as a **Plant Power Controller (PPC)**, centralizing the control of all generation and storage units in the plant. In this role, the controller defines the **operating configuration of the site** and applies the appropriate control strategies.

The solution offers two different ways of controlling the plant:

- **Automatic Control:** In this mode, the EMS automatically calculates and sends setpoints to the power units in the network. The setpoints follow the configured control logics (e.g., zero export, load following, time-of-use, genset optimization) as well as any external commands received from higher-level systems.
- **Direct Control :** In this mode, the user can manually send commands to the connected devices through the ES control interface. This allows for immediate operator actions, such as starting or stopping units, adjusting power output, or changing operating conditions.

This dual approach provides both flexibility for operators who need manual control and reliability for automated plant operation.

4.1.1. Automatic Control (Standard mode)

By default, the ePowerControl ES/ES+ operates in **Automatic Mode**, dynamically adjusting device setpoints in real time according to predefined rules and external commands.

Automatic Control can run under four predefined **plant configurations**:

- **Grid Prime**: the utility grid acts as the grid-forming reference.
- **BESS Prime**: the battery storage system is grid-forming.
- **Genset Prime**: the gensets are grid-forming.
- **Deadbus**: no reference available, all sources remain disconnected.

“Invalid Mode” is not a valid operating state.

Configurations are **predefined operating states of the plant**. Each configuration determines which single unit (grid, battery, or genset)acts as the forming unit and provides the voltage and frequency reference for the plant, as well as which functions can be activated.

A single plant or microgrid may operate under different configurations during its lifetime, depending on site conditions and available sources.

Table 14: Summary of Plant Configurations

Configurations	Grid	PV	BESS	Gensets
Genset Prime	Disconnected	Grid Following	Grid Following	Grid Forming
Grid Prime	Grid Forming	Grid Following	Grid Following	Grid Following
BESS Prime	Disconnected	Grid Following	Grid Forming	Grid Following
Deadbus	Disconnected	Disconnected	Disconnected	Disconnected

4.1.2. Direct Control

In **Direct Control**, the operator can manually send commands directly to the devices via eConf:

- This way of control should be used when the EMS is deactivated.

- Commands are issued from the **Device Page on eConf** by writing the desired setpoints values into the register.
- The command is applied once and immediately executed by the device.
- Useful when the EMS is temporarily deactivated or for testing purposes.

For Direct Control, it is also possible for a third-party system (such as a SCADA) to send commands directly to the devices via the Modbus Gateway of the ePowerControl ES:

- This way of control can be used when the EMS is activated.
- The list of registers that can be called depends on the selected devices.

This gives the operator full manual flexibility when required.

4.1.3. Maintenance mode

Devices can be placed in **Maintenance Mode**, which excludes them from EMS control calculations but keeps them monitored.

- Defined per device, from the **Device Page on eConf or Modbus Gateway**.
- The number of devices under maintenance is visible in the **Overview**.
- Data from devices in maintenance remain exported.

Use cases:

- Device unavailable due to local operations.
- The operator wants to temporarily adapt the control strategy.

4.2. Modes and transitions

The **ePowerControl ES/ES+** continuously monitors the plant to determine its current operating mode. Four possible operational states can be detected:

- **Grid Prime**
- **Genset Prime**
- **BESS Prime**
- **Deadbus**

In addition, an **Invalid** error state may occur if the plant configuration does not match any valid operating condition.

Each operational state corresponds to a predefined plant configuration. Depending on the detected state, specific control functions become available.

4.2.1. Grid Prime

In this configuration, the utility grid is the grid-forming reference.

Typical functions available:

- PV Maximization
- Export Control
- Peak Shaving
- Grid Reactive Power Control

Table 15: Asset roles in Grid Prime Configuration

Configuration	Grid	PV	Gensets	BESS
Grid Prime	Grid Forming	Disconnected/Grid Following	Disconnected / Grid Following	Disconnected / Grid Following

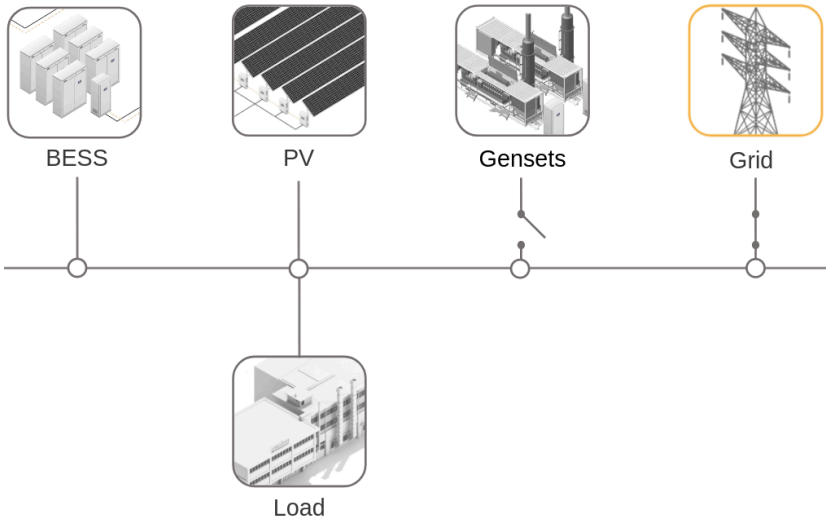


Figure 1: Example scheme representing grid forming configuration

4.2.2. Genset Prime

In this configuration, the gensets are grid-forming.

Typical functions available:

- PV Maximization
- Genset Minimum Loading
- Genset Reactive Power Control
- SoC Equalization
- SoC Target

Table 16: Asset roles in Genset Prime Configuration

Configuration	Grid	PV	Gensets	BESS
Genset Prime	Disconnected	Disconnected/ Grid Following	Grid Forming	Disconnected / Grid Following

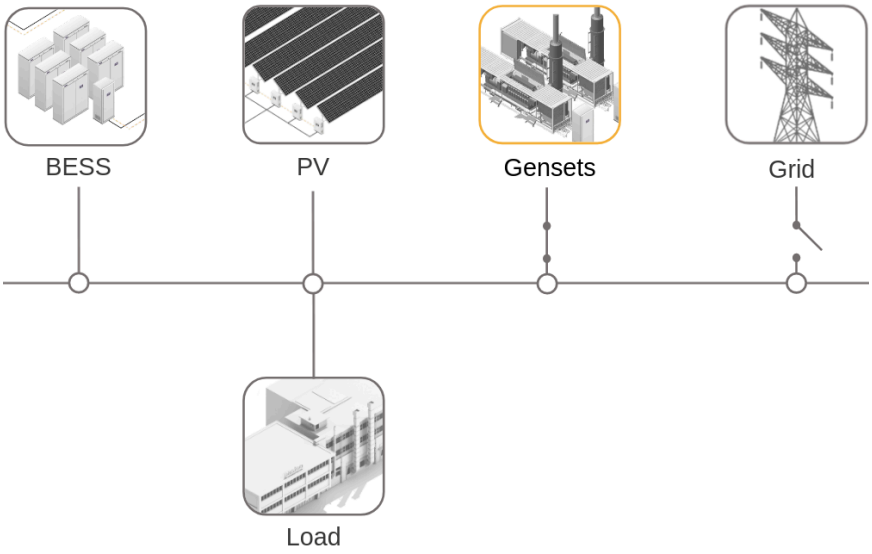


Figure 2: Example scheme representing genset prime configuration

4.2.3. BESS Prime

In this configuration, the battery system is grid-forming.

Typical functions available:

- PV Maximization
- Genset Minimum Loading
- Genset Reactive Power Control
- Automatic Start/Stop of Gensets

Table 17: Asset roles in BESS Prime Configuration

Configuration	Grid	PV	Gensets	BESS
BESS Prime	Disconnected	Disconnected/ Grid Following	Disconnected / Grid Following	Grid Forming

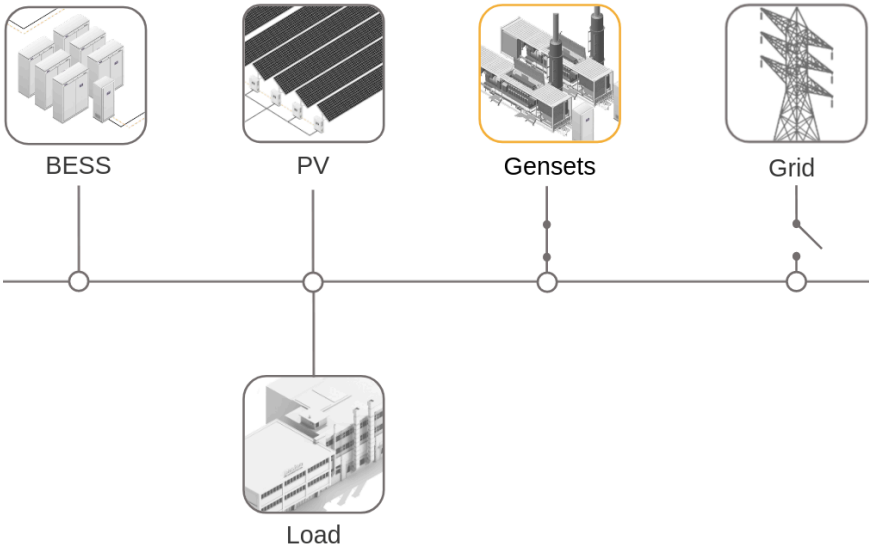


Figure 3: Example scheme representing BESS prime configuration

4.2.4. Deadbus

This state occurs when no unit is grid-forming. To ensure system safety, the EMS performs the following actions:

- Ramp down the PV production.
- Stop the gensets.
- Stop the BESS.
- Opens the islanding breaker.

Once safe, the EMS can transition to another plant mode automatically or manually.

4.2.5. Invalid

The **Invalid** mode is entered when the EMS cannot match the system state with a valid configuration (Grid Prime, Genset Prime, BESS Prime, Deadbus). In this case, the EMS applies protective actions, such as:

- Reducing genset to minimum, then stopping it.
- Stopping the BESS.
- Opening the islanding breaker.
- Curtailing PV generation to a minimum.

4.3. Mode detections

The **ePowerControl ES** continuously analyzes system measurements to determine which unit is currently **forming the grid**. Based on this analysis, the EMS

automatically detects and updates the current **plant mode** (Grid Prime, Genset Prime, BESS Prime, Deadbus, or Invalid).

Mode detection relies on the status of the following units:

- **Grid**
- **Genset(s)**
- **BESS**

Each of these can be in one of the following states:

- **Forming Unit :** the source is creating and stabilizing the grid reference.
- **Following :** the source synchronizes with an existing grid.
- **Off :** the source is not active.

The EMS determines the forming unit by analyzing frequency, breaker position, and power flow data.

4.3.1. Grid Detection

The grid is considered Forming when its measured frequency exceeds a predefined threshold (Default : 40Hz) and the grid breaker (if available) is closed.

4.3.2. Genset Detection

The EMS can detect gensets as Forming Units using one of two methods:

- **Frequency-based method:** when the genset frequency exceeds the configured threshold.
- **Power-based method:** when the genset's active power output exceeds a defined threshold.

Detection can be performed using either:

- The **genset controller**, or
- The associated **genset meter**, depending on the device configuration.

The appropriate detection method is automatically selected according to the configured device type in the Elum device knowledge base.

4.3.3. BESS Detection

The EMS identifies the BESS as a forming unit based on information provided by the PCS (Power Conversion System).

The detection logic depends on the specific PCS device and its available status signals.

4.3.4. Deadbus Condition

If none of the units (Grid, Genset, or BESS) are forming the grid, and the controller is not in an invalid state, the EMS declares the Deadbus state.

4.3.5. Coexistence Parameters

In normal operation, **only one source should be grid-forming at a time**, either the **Grid**, the **BESS**, or the **Genset**.

However, during transitions (for example, when switching from Grid Prime to BESS Prime), it is possible that two units temporarily act as grid-forming at the same time.

The controller behavior in this case depends on a configuration setting that defines whether such coexistence is allowed:

- If **coexistence is allowed**, the EMS interprets the situation as part of a **normal transition** (for example, moving from grid to battery operation).
- If **coexistence is not allowed**, the EMS considers the situation **invalid** and switches the system to *Invalid Mode* for safety, stopping or curtailing affected units.

Table 18: Summary of Mode Detection logic

Grid forming	BESS Forming	Genset Forming	Detected Mode
✅	❌	❌	**Grid Prime :** The grid provides the main reference.
❌	✅	❌	**BESS Prime :** The battery system is grid-forming.
❌	❌	✅	**Genset Prime :** The gensets are grid-forming.
❌	❌	❌	**Deadbus :** No forming unit detected, plant stopped for safety.
✅	✅	❌	**BESS Prime** *(if allowed)* or **Invalid** *(if not allowed)*
✅	❌	✅	**Genset Prime** *(if allowed)* or **Invalid** *(if not allowed)*

✅	✅	✅	**Invalid :** multiple sources forming simultaneously.
❌	✅	✅	**Invalid :** conflicting forming units detected

4.4. Transitions

A **transition** is the change from one plant mode to another; for example, from **Grid Prime** to **BESS Prime**, **Genset Prime**, or **Deadbus**.

The **ePowerControl ES/ES+** automatically detects these mode changes based on real-time measurements and device statuses. Transitions can also be **managed directly by the EMS**, depending on the configured control strategy.

Even when the EMS is temporarily off, the controller can still interpret the current state of the plant (e.g., detecting *Genset Prime* mode through the genset meter).

4.5. Islanding Control

The **Islanding Control** feature enables the EMS to **manage transitions between grid-connected and islanded operation**.
This includes:

- Switching between **Grid Prime**, **BESS Prime**, and **Genset Prime** modes.
- Automatically handling the **reconnection to the grid** after a disconnection event.

This function ensures that the system continues to operate safely and smoothly during power source changes.

Every transition between forming units involves a **temporary blackout**, which is required to resynchronize the system safely and avoid damage to connected equipment.

4.6. Control information

4.6.1. General information

The **ePowerControl ES/ES+** supervises and controls PV inverters, BESS, gensets, grid interface and breakers. Measurements and setpoints follow the **generator**

convention for **PV, Grid, BESS, Genset**; **Load** is shown using the **receptor convention** in eConf *Overview* for easier reading.

4.6.2. Summary of main control functions

Table 19: Main Control functions and Mode Applicability

Function	Applicable Modes	What it does
PV Maximization	BESS Prime, Grid Prime, Genset Prime	Maximizes PV while respecting constraints (e.g., genset min loading).
Export Control	Grid Prime	Limits export/import at PCC to meet grid requirements.
Peak Shaving	Grid Prime	Caps grid import using BESS and/or genset support.
PV Ramp Rate	Grid/BESS/Genset Prime	Limits PV active/reactive ramps to protect the network.
Grid VAR Control	Grid Prime	Keeps grid PF within range or meets PF/Volt-VAR targets.
BESS Ramp/ToU/SoC Target/Equalizer	See sections	Shapes BESS behavior (ramp limits, schedules, targets, equalization).
Genset Min Loading / VAR / Dispatch	See sections	Protects gensets, manages PF and power sharing.
Breaker Control	Grid/Genset Prime	Opens/closes per load/SoC/grid import/genset loading rules.
Blackstart & Reconnection	BESS/Genset	Restarts plant after blackout and reconnects to grid.

4.6.3. Control Loop & Rate Limits

The EMS updates device setpoints at a fixed interval (default: 5 seconds).
This interval can be adjusted to meet project requirements (down to approximately 100 ms), with the support and validation of the Customer Success team.

4.7. Control Logic

4.7.1. Overview

The EMS optimizes the operation of all plant assets according to the configured control objectives and constraints. It manages PV, BESS, gensets, grid exchange, power factor/voltage, ramp rates, and safety limits. The control strategy automatically adapts to the active plant mode.

4.7.2. Feature Map & Mode Applicability

Table 7: Control Feature Applicability by Plant Mode *(The following list is non-exhaustive)*

Feature	Grid Prime	Genset Prime	BESS Prime
PV Maximization	✅	✅	✅
PV Ramp-Rate	✅	✅	✅
Grid Export Control	✅	–-	–
Peak Shaving (Grid)	✅	–	–
Genset Min Loading	✅	✅	✅
Genset VAR Control	–	✅	–
Genset Automatic start/stop	✅	✅	
Grid VAR / Volt-VAR	✅	–	–
BESS ToU	✅	–	–
BESS SoC Equalizer	✅	✅	✅
BESS SoC Target	✅	✅	✅
BESS Power assist	✅	✅	✅
Voltage-based BESS Charge Limit	✅	✅	✅
Breaker Control (rules)	✅	✅	✅

(✅ *= available, – = not available.)*

Each feature below explicitly lists its **Applicable Modes** (some features only work in certain modes).

How to read each feature

- **Applicable Modes :** the modes where this feature is available.
- **Settings :** operator-facing options you can configure (technical references appear in the tables).
- **Outputs :** which setpoints the EMS writes (e.g., PV max active power, BESS active/reactive power, genset active power) and the **update rate** (per control loop).

4.7.3. PV Control

PV Control covers all features that directly command PV inverters. The EMS computes PV **active** and (if enabled) **reactive** power setpoints each control loop and dispatches them to the inverters. PV reactive power setpoints are calculated **only** when **Grid Reactive Power Control** (Grid Prime) or **Genset Reactive Power Control** (Genset Prime) is enabled.

Capabilities:

- **Curtail PV production** according to active site rules (e.g., Export Control, Peak Shaving, Genset Minimum Loading, ramp limits).
- **Handle PV reactive power** when reactive-power control is enabled (Grid VAR Control in Grid Prime or Genset VAR Control in Genset Prime).

Notes
PV reactive setpoints are produced only when a reactive-power control function is active.

4.7.3.1. PV Maximization

The PV Maximization function adjusts active power setpoints of PV inverters, and when required BESS and gensets, to maximize the utilization of available solar production while respecting plant operational constraints and system limits.

- **Applicable Modes:** Grid Prime Configuration, Genset Prime Configuration, BESS Prime Configuration
- **Controlled Setpoints:**

Base settings

The following setting for PV inverters is mandatory for PV Control and is used by multiple PV control functions.

Table 20: PV Control: Base Setting

Name	Description	Unit
Inverter Nominal Power	Nominal apparent power of each PV inverter, **declared in eConf**. Must match the inverter's maximum configurable apparent power. **Required per inverter** and used by **all PV control functions**.	kVA

4.7.3.2. PV Ramp-Rate Control

Limits the step change of PV **active** and (optionally) **reactive** power setpoints between control loops to avoid rapid variations of setpoints that could destabilize the network.

Rapid variations caused by meteorological conditions (e.g., cloud transients) are not mitigated by this function.

The ramp is applied to the difference between the latest measured value and the commanded setpoint (conceptually: *next setpoint = current measured value ± ramp limit*). Reactive-power ramp limiting can be enabled or disabled.

- **Applicable Modes:**
  - Grid Prime
  - BESS Prime
  - Genset Prime

Table 21: PV Ramp-Rate Control: Function Settings

Name	Description	Unit
Maximum PV active power setpoint ramp	Max step change of the **total PV active-power command** per control loop (relative to the latest measured PV power).	kW
Activate PV reactive power setpoint ramp	Enable/disable application of the reactive-power ramp (default: False).	None
Maximum PV reactive power setpoint ramp	Max step change of the total PV reactive-power command per control loop (relative to the latest measured reactive power); applies only when reactive-power control is active.	kVAr

Ramp values apply per control-loop interval. The ramp is enforced on the aggregated PV command and then distributed to inverters by the PV Dispatch logic.

4.7.3.3. Reactive power prioritization

Defines whether reactive power (Q) or active power (P) has priority when the inverter approaches its apparent-power limit. Using the last measured active and reactive power and the inverter's nominal apparent power, the controller calculates the remaining apparent power and limits the lower-priority component so the apparent-power rating is respected.

- **P priority:** Q command is limited to what remains after the last measured P.
- **Q priority:** P command is limited to what remains after the last measured Q.

Ramp values apply per control-loop interval. The ramp is enforced on the aggregated PV command and then distributed to inverters by the PV Dispatch logic.

Applicability: Active only when PV reactive-power control is enabled: Grid VAR Control (Grid Prime), Genset VAR Control (Genset Prime) or BESS Prime.

Table 22: PV Control: Base Setting

Name	Description	Unit
Prioritize reactive power over active power	Choose which power takes priority when the inverter is close to its maximum. **True:** keep reactive power, reduce active power first. **False (default):** keep active power, reduce reactive power first.	kVA

4.7.3.4. PV Dispatch

The **Inverter Dispatch Strategy** defines how the EMS distributes the total PV active and (if enabled) reactive power setpoints among all declared PV inverters. A configuration setting allows selecting the dispatch method.

Two strategies are available:

- **VA-rated proportional dispatch :** The total PV command is distributed proportionally to each inverter's nominal apparent power (kVA).

- **Optimized dispatch :** The total PV command is distributed so that inverters capable of producing more (based on measured output and available DC resource) receive a higher share of the command.

Applicable Modes:

- Grid Prime
- BESS Prime
- Genset Prime

Table 23: Parameter (Optimized dispatch)

Name	Description	Unit
Minimum active power command increase *(optimized dispatch only)*	The smallest step by which an individual inverter's active power command is allowed to increase when adjustments are made in optimized dispatch.	% Of inverter nominal apparent power (Default = 2%)

4.7.4. BESS Control

4.7.4.1. Scope

The BESS subsystem consists of a BMS (Battery Management System) and a PCS (Power Conversion System). The ePowerControl ES/ES+ controls power via the PCS. State of Charge (SoC) is read from the PCS or BMS.

4.7.4.2. Observations & Prerequisites

- **SoC source:** If both PCS and BMS provide State of Charge, the ePowerControl ES/ES+ uses th**e PCS** value.
- **Device linkage:** In the ePowerControl ES/ES+ data model, a BMS is not automatically associated with a specific PCS. However, when the number of BMS units matches the number of PCS units, a virtual one-to-one association can be configured (Expert - Battery Bank Layout).
- **Only BMS (no PCS): Not supported** for BESS control; a PCS is required.
- **Only PCS (no BMS):** Supported **if the PCS exposes SoC** in its driver/Modbus table.
- **Multiple PCS:** The controller can control **several PCS** per site as configured.

4.7.4.3. Operating Approaches

- **Direct control / Following mode:** The controller sends active and reactive power setpoints directly to the PCS.
- **Indirect control / Forming mode:** The controller does not write setpoints to the PCS; instead, it adjusts PV/genset commands so the BESS naturally charges or discharges to meet plant targets.

The ePowerControl ES/ES+ can change the BESS state, it turns the BESS ON in following mode and OFF when required. This behavior does not apply to PV inverters; their on/off state is not commanded by the controller.

4.7.4.4. Base settings

These parameters (declared in **eConf**) are required for BESS control and are reused by multiple functions and controllers. The ePowerControl ES/ES+ charges/discharges the BESS to absorb PV surplus or supply load within these power and SoC limits.

Table 24: BESS General Settings

Name	Description	Unit
BESS rated apparent power (per PCS)	kVA rating used for dispatch and limit checks (one value per PCS).	kVA
Maximum charging power (per PCS)	Upper bound for PCS charging command.	kW
Maximum discharging power (per PCS)	Upper bound for PCS discharging command.	kW
BESS rated capacity (per PCS)	Maximum energy capacity, used by SoC Equalization.	kWh
Maximum SoC	Do not charge above this state of charge.	%
Minimum SoC	Do not discharge below this state of charge.	%
Expert settings		
SoC tolerance	Margin around thresholds/targets to avoid chatter (**default: 1%**).	%

4.7.4.5. BESS Ramp Control

Limits how fast the commanded BESS power changes between control loops to avoid abrupt variations. The active-power ramp is always applied; the reactive-power ramp is optional.

To effectively disable active-power ramp limiting, set the maximum active-power change to a value higher than the total rated power of all PCS units. Since the ramp is applied to the aggregated BESS command (across all PCS), using a sufficiently large value prevents ramp restriction from taking effect

Applicable Modes:

- Grid Prime
- Genset Prime

Table 25: BESS Ramp rate parameters

Name	**Description**	**Unit**
Maximum active-power change per loop	The smallest step by which an individual inverter's active power command is allowed to increase when adjustments are made in optimized dispatch.	% Of inverter nominal apparent power (Default = 2%)
Reactive-power ramp enable	Enables/disables application of the reactive-power ramp (default: **False**).	None
Maximum reactive-power change per loop	Upper bound on the step change of the total BESS reactive-power command at each control loop.	kVAr

4.7.4.6. BESS Time-of-Use (ToU)

Defines day-based schedules that allow/forbid BESS charging from or discharging to the grid. If charging or discharging is not allowed, the EMS calculates the sum of relevant meters (power meter, inverter, etc.) to ensure the BESS does not cause grid import or export. This means the load can still import from the grid and PV can still inject into the grid (if allowed by other settings). The BESS, however, will not charge from or discharge to the grid during restricted periods. The BESS can still supply the load internally, and PV surplus can still be stored in the BESS when permitted.

Applicable Modes:

- Grid Prime

Scheduling:

- **Number of profiles**: 2 (based on weekdays)
- **Assignment:** Date & time settings
- **Number of time slots per profile:** 10
- **Granularity:** Minute via eConf, second via Modbus

Table 26: BESS ToU parameters

Name	Description	Unit
Activate BESS control - Time of Use management	Activate Time of Use management for the BESS (default = False).	–
Time Slot to allow charge	Beginning of the timeslot (category 1 or 2) to allow **charge from the grid** (in seconds from midnight).	Min
Allow charge from the grid	Allow BESS charge from the grid for the timeslot of a category (0 = not allowed, 1 = allowed).	None
Time Slot to allow discharge	Beginning of the timeslot (category 1 or 2) to allow **discharge to the grid** (in seconds from midnight).	Min
Allow discharge to the grid	Allow BESS discharge to the grid for the timeslot of a category (0 = not allowed, 1 = allowed).	None

4.7.4.7. BESS SoC Equalizer

When multiple BESS are configured, the SoC Equalizer adjusts power dispatch to reduce differences in State of Charge (SoC) between batteries. Dispatch is proportional to PCS rated power, helping avoid large SoC gaps.

Applicable Modes:

- Grid Prime
- Genset Prime

Table 27: Function Settings - SoC Equalization

Name	Description	Unit
Activate SoC Equalization	Enable SoC equalization for the BESS (default: **False**).	–None

4.7.4.8. BESS SoC Target

Defines daily profiles with **State of Charge (SoC) targets**. During each timeslot, the EMS charges or discharges the BESS to reach the configured target. If no target is set, the EMS may discharge when no other constraints prevent it (e.g., PV Optimization, Genset Minimum Loading).

Scheduling:

- **Number of profiles**: 2 (based on weekdays)
- **Assignment:** Date & time settings
- **Number of time slots per profile:** 10
- **Granularity:** Minute via eConf, second via Modbus

Table 28: Function Settings - SoC Target

Name	Description	Unit
Activate SoC Target	Enable SoC equalization for the BESS (default: **False**).	None
SoC target value	Target SoC for the selected timeslot (per profile)	%
SoC target start	Start time of each SoC target slot (seconds from midnight)	Min

SoC Target operates alongside other limits (SoC min/max, ramps, export rules). The most restrictive constraint applies.

4.7.4.9. BESS Voltage-Based Charging Power Limits

Defines a maximum BESS charging power vs. DC battery voltage curve. The limit is expressed as a percentage of the BESS maximum charging power. You can

configure up to 10 points to form a piece-wise profile (e.g., a fixed limit up to a threshold, then a linear derating as voltage rises).

Behavior by mode

- BESS Prime: ES also limits PV/Genset production so the BESS charging power does not exceed the voltage-based limit.
- Grid Prime / Genset Prime: ES directly limits the BESS charge command to stay within the voltage-based limit.

This constraint has the **same priority** as the standard BESS charge/discharge power limits.

If **no DC voltage** is available from PCS or BMS and the feature is enabled, ePowerControl **logs a warning** and **no voltage-based limit** is applied.

Applicable Modes:

- Grid Prime
- BESS Prime
- Genset Prime

Table 29: Function Settings - BESS Voltage-Based Charging Power Limits

Name	Description	Unit
Activate voltage-based charging power limits	Enable/disable the voltage-based charge limit.	None
DC voltage threshold(s)	Voltage point(s) where a limit segment starts. Up to 10 points.	V
% of BESS max charging power	Allowed charge power at/after each voltage point. Up to 10 values.	%

4.7.4.10. Reactive Power Prioritization

Defines whether reactive power (Q) or active power (P) has priority when the BESS (PCS) approaches its apparent-power rating in following (direct control) mode.

Using the last measured active and reactive power and the PCS nominal apparent power, the controller calculates the remaining apparent power. The lower-priority component is then limited to ensure the apparent-power rating is not exceeded.

- **P priority (default):** The reactive-power command is limited based on the remaining apparent power after the active-power command.
- **Q priority:** The active-power command is limited based on the remaining apparent power after the reactive-power command.

This setting applies only in following (direct control) mode.

Table 30: Function Setting - BESS VAR Priority

Name	Description	Unit
Prioritize reactive power over active power	Enable priority for **reactive power** over **active power**. Values: **True** = reactive power prioritized; **False (default)** = active power prioritized. *(Applies only in following mode.)*	–None

4.7.4.11. BESS - Genset Loading Control

In Genset Prime, this function gives the genset controller or plant operator additional time to **start or stop generators** by having the BESS buffer sudden changes caused by **load fluctuations** or **PV variability**. When fast changes occur, the BESS temporarily compensates so engines can be added or removed safely.

- **Scenario 1 - High loading (PV Drop or Load increase) :**

If PV power drops suddenly -or the load steps up- the demand is instantly transferred to the genset plant. Before the genset controller or plant operator can start additional generators (which can take minutes), existing units may risk overload. In this case, the BESS discharges long enough to keep loading in check until new generators are online, reducing overload risk and fuel spikes.

- **Scenario 2 - Low loading (PV rise or load decrease) :**

If the load falls or PV rises, the loading of the running generators drops immediately while PV ramps down. To avoid under-loading and allow time to stop unnecessary generators, the BESS charges (acts as a load), improving operating efficiency and protecting the genset fleet.

Table 20: Function Setting - BESS VAR Priority

Name	Description	Unit
High Loading threshold	Above this value, BESS **discharges** to hold genset loading below the limit until more generators start.	%

Low Loading threshold	Above this value, BESS **discharges** to hold genset loading below the limit until more generators start.	%

Set Low and High thresholds respectively below and above the genset controller's own stop/start triggers.

4.7.4.12. BESS - Self-Consumption Prioritization (Grid Prime)

When the grid is the forming unit, The ePowerControl ES/ES+ can either export PV surplus to the grid or store it in the BESS. By default, surplus is exported. Enabling this option prioritizes charging the BESS instead of exporting whenever storage capacity is available.

Applicable Modes:

- Grid Prime

Table 31 : Function Setting - Self-Consumption

Name	**Description**	**Unit**
Prioritize self-consumption over grid export	Prevent export when surplus can be stored by the BESS. **Enabled:** prioritize BESS charging · **Disabled (default):** allow export	None

4.7.4.13. Virtual Synchronous Generator (VSG)

Virtual Synchronous Generator (VSG) functionality enables a PCS control behavior that emulates the dynamic response of a synchronous generator.

A PCS can operate in different control modes:

- **Following mode:** The PCS follows an existing voltage and frequency reference (grid or forming unit). The EMS sends active power (P) and reactive power (Q) setpoints, and the PCS injects power accordingly.
- **Forming mode:** The PCS establishes and regulates voltage (V) and frequency (F), acting as the reference source for the plant during islanded operation.
- **VSG mode:** VSG is not a separate plant mode, but an advanced control behavior that can be applied depending on the PCS design. It improves dynamic response by emulating synchronous machine characteristics.

Depending on the implementation, it may operate in a forming or following context.

VSG can improve transition stability between plant modes (e.g., during grid loss or reconnection), but it does not inherently guarantee a seamless transition. Actual behavior depends on PCS capabilities and configuration.

Prerequisites

- The feature must be **enabled in the ePowerControl ES/ES+** and the **PCS must support VSG** (vendor/firmware dependent).
- Configure VSG **per PCS**. Use this feature **only** with VSG-compliant PCS.

Applicable Modes:

- Grid Prime
- BESS Prime
- Genset Prime

Table 32 : Function Setting - Self-Consumption

Name	**Description**	**State**
Grid Prime VSG activation	Enable VSG when the plant is in **Grid Prime**.	Enabled / Disabled.
BESS Prime VSG activation	Enable VSG when the plant is in **BESS Prime**.	Enabled / Disabled
Genset Prime VSG activation	Enable VSG when the plant is in **Genset Prime**.	Enabled / Disabled
Production feedback for VSG	In **BESS Prime**, adjust the PCS active-power setpoint to follow **net load** while in VSG. *(This parameter is required only for PCS that rely on measured production feedback in VSG operation.)*	Enabled / Disabled

Enabling VSG in multiple modes (e.g., BESS Prime and Grid Prime) may improve transition behavior between operating modes, depending on PCS capabilities and configuration.

4.7.5. Genset Control

4.7.5.1. Indirect Genset Status Detection (via Genset Meter)

When a direct ON/OFF signal isn't available, ES can infer each genset's status from a **genset meter** using one of two methods:

- **Frequency-based**: the genset is ON if measured frequency ≥ a threshold.
- **Power-based**: the genset is ON if measured active power ≥ a percentage of its rated power.

Multiple genset meters can be assigned for status detection.

Table 33: Function Setting - Indirect Genset Status Detection

Name	Description	Unit
Unit detection method	Select how ON/OFF is detected: ● **Frequency-based**, ● **Power-based**.	None
Unit detection frequency absolute threshold	Frequency above which the genset is considered **ON** (used with Frequency-based).	Hz
Unit detection power threshold	Percentage of rated power above which the genset is considered **ON** (used with Power-based).	%

4.7.5.2. Observations & Prerequisites

Sites may include **multiple gensets**: some with controllers (directly controllable), others only metered. The ePowerControl ES/ES+ handles both cases.

Requirements

- **Direct control (following mode):** a genset **controller with Modbus** command capability and **authorization** to control the genset.
- **Indirect control (forming mode):** a **genset meter or controller** providing status/loading measurements.

The ePowerControl ES/ES+ can **change the genset controller state** (start/stop) in following mode. This behavior **does not apply to PV inverters**; their on/off state is not commanded by the controller.

4.7.5.3. Operating Approaches

- **Direct control (following mode).** The ePowerControl ES/ES+ sends **active-power setpoints** to the genset controller and can start/stop units as permitted.
- **Indirect control (forming mode).** The ePowerControl ES/ES+ does **not** write setpoints to the genset. Instead, it adjusts **PV and/or BESS** commands so the genset naturally follows the load and plant targets.

The controller does not directly command the genset reactive power. Reactive power regulation is handled either by the genset controller itself or indirectly through PV/BESS reactive power control at plant level.

4.7.5.4. Base settings

These parameters are declared in eConf, required by genset control, and reused by multiple functions (ramp, dispatch, minimum loading). Values are per genset.

Table 34 : Function Setting - Self-Consumption

Name	Description	Unit
Genset rated apparent power (per genset)	kVA rating used for dispatch and limit checks.	kVA
Genset maximum active power in following mode (per genset)	Upper bound for commanded active power when the genset is in following (direct control) mode.	kW
Genset minimum loading (per genset)	Minimum allowed loading for a running genset; used by ES to keep loading above this level.	%

“per genset” means one value must be provided for each genset device configured in eConf.

4.7.5.5. Genset Ramp Control

Limits how fast **genset active-power commands** change between control loops to avoid abrupt variations.

Applicable Modes:

- Grid Prime
- BESS Prime

Table 35 : Function Setting - Genset ramp control

Name	Description	Unit
Maximum active-power change per loop	Upper bound on the step change of genset active-power command each control loop.	kW

4.7.5.6. Genset Minimum Loading

Maintains each running genset **above its configured minimum loading**. The ePowerControl ES/ES+ will **curtail PV** and/or **command BESS** charging/discharging as needed.

Requirements

- Genset loading must be measurable (via genset controller or meter). With multiple gensets, the minimum loading is applied **per genset**.

Applicable Modes:

- Grid Prime
- BESS Prime
- Genset Prime

4.7.5.7. Genset Reactive Power Control

Commands **reactive power** from PV and/or BESS so that the **genset power factor** stays within a configured **range** or meets a **target** while the gensets are forming the local grid.

Applicable Modes:

- Genset Prime

Table 36 : Function Setting - Genset Reactive Power Control

Name	Description	Unit
Genset Reactive Power	Enable/disable the Genset Reactive	None

Control Activation	Power Control function.	
PV activation for Genset Reactive Power Control	Allow PV to participate in genset reactive power control (inactive if no PV unit configured).	None
Maximum absolute value of reactive power setpoint for PV	Absolute limit for PV reactive power magnitude (both inductive/capacitive).	kVAr
BESS activation for Genset Reactive Power Control	Allow BESS to participate in genset reactive power control (inactive if no BESS unit configured).	None
Maximum absolute value of reactive power setpoint for BESS	Allow BESS to participate in genset reactive power control (inactive if no BESS unit configured).	kVAr
Lead unit	Choose which unit acts **first** to supply reactive power: **PV** or **BESS**.	None
Genset reactive power control strategy	Choose **Power Factor within a Range** or **Power Factor equal to a Target**.	None
Inductive Genset Minimum Power Factor	Inductive-side PF limit (used with the “range” strategy).	None
Capacitive Genset Minimum Power Factor	Capacitive-side PF limit (used with the “range” strategy).	None
Genset Power Factor Target Value	Absolute PF target (used with the “target” strategy).	None
Genset Power Factor Target Type	Target **side** for the “target” strategy: **Inductive** or **Capacitive**.	None

4.7.5.8. Genset Dispatch

Distributes the **total genset active-power command** across the configured genset controllers so that no unit **exceeds its maximum power in following mode** and no running unit **drops below its Minimum Loading**.

Applicable Modes:

- Grid Prime
- BESS Prime

Table 37: Genset Dispatch - Controlled Setpoints

	Applicability	Edit Frequency
Genset Active Power Setpoint	All Generator Controllers declared in the ePower Control ES configuration interface	Each control loop

4.7.5.9. Automatic Start/Stop - Grid Following

Automatically manages the starting and stopping of gensets when the system operates alongside a grid-forming unit (Grid Prime or BESS Prime). The function adjusts the number of running gensets to support system objectives while minimizing unnecessary runtime.

Typical use: Peak-shaving to avoid exceeding an import limit. Requires at least one genset controller with control authorization.

This function operates only in **Following modes**, where another unit establishes voltage and frequency. In Genset Prime mode, the PPC starts ALL gensets (no commitment logic).

Applicable Modes:

- Grid Prime
- BESS Prime

Operating Principle (Grid-following):

When peak-shaving is enabled, gensets are started and stopped according to the measured active power at the Point of Common Coupling (PCC). A genset is started when grid import approaches the configured limit (taking into account the defined margin). It is stopped once the grid import remains below the threshold for a configured duration.

Peak-shaving can be performed by gensets when grid import exceeds a limit minus a margin.

Coordination with other Controls:

Peak-shaving parameters are defined under Grid Control. Automatic genset start/stop must also be enabled in Genset Control. Only one unit type (BESS or gensets) performs peak-shaving at a given time.

Table 38: Function Setting - peak-shaving control

Name	Description	Unit
Automatic genset start/stop for peak shaving	Upper bound on the step change of genset active-power command each control loop.	None
Margin before target	Power margin used to trigger peak-shaving before the limit, and to release it after dropping back below the limit.	kW
Timer of peak-shaving start genset	Minimum time the grid power must stay above the threshold before starting gensets.	min
Timer of peak-shaving stop genset	Minimum time the grid power must stay below the threshold before stopping gensets.	min

Peak-shaving parameters are defined under Grid Control; you must also enable automatic genset start/stop here in Genset Control.

Table 39: Commitment strategy (when multiple gensets are available)

Name	Description	Unit
Genset commitment strategy	How many gensets to run: **Start all**, **Start one** (lowest cumulative runtime), or **Adaptive** (number on depends on required capacity).	None
Minimum genset runtime	The **shortest time a genset must stay ON after it is started** before the automatic logic is allowed to stop it. *(Prevents rapid start/stop cycling.)*	min
Target capacity computation horizon	Time window the Adaptive strategy uses to average recent **load** and **PV** when deciding **how many gensets to keep ON**	min

4.7.5.10. Minimum phase power control (Genset Prime)

In **Genset Prime**, keeps the **lowest genset phase active power** above a configured threshold by adjusting other devices (e.g., curtailing PV) so genset output remains within limits.

Applicable Modes:

- Genset Prime

Table 40: Function Setting - Minimum phase power control

Name	Description	Unit
Minimum phase power control in genset prime	Enable/disable enforcement of a minimum per-phase active power in Genset Prime.	None
Minimum allowed genset phase power	Threshold for the **lowest** genset phase. If a phase reaches this value, the ePowerControl ES/ES+ controls other devices to increase genset production.	kW

4.7.6. Grid Control

All Grid Control functions operate only in **Grid Prime.**

4.7.6.1. Export Control

Maintains the active power at the Point of Common Coupling (PCC) in line with the configured limit by capping PV output and commanding BESS as needed. This prevents unwanted export or enforces a minimum import at the grid connection point.

The EMS enforces this parameter by limiting PV output and commanding the BESS. The configured **Minimum Active Power at PCC** defines grid exchange:

- **Positive value (>0):** Enforces a minimum import equal to the set value; export not permitted.
- **Zero (0):** Zero export; import permitted.
- **Negative value (<0):** Export permitted up to the absolute value; import permitted.

Active power at the PCC is expressed from the site perspective:

- **Positive** values indicate power **imported** from the grid.
- **Negative** values indicate power **exported** to the grid.

Table 41: Function Setting - Indirect Genset Status Detection

Name	Description	Unit
Export Control Activation	Enables/Disables Export Control.	None
Minimum Active Power At PCC	Import/export target at PCC. Positive = minimum import; zero = zero-export; negative = maximum export.	W
Export Control Phase Strategy	Reference used to assess PCC power: **Sum of phases**, or **Lowest phase multiplied by 3** (dynamic).	None

The *Phase Strategy* defines how the EMS evaluates three-phase active power when applying a control function.

- **Sum of phases:** The EMS calculates total power as the sum of the three phase powers (P1 + P2 + P3). This represents the actual total power exchanged in the system and is typically used for balanced installations.
- **Lowest phase multiplied by 3 (dynamic):** The EMS identifies the phase with the lowest active power and multiplies it by three. This provides a conservative estimation of total power and is useful in systems with phase imbalance to ensure that control limits are respected on all phases.

4.7.6.2. Peak shaving

Limits grid **import** at the Point of Common Coupling (PCC) by commanding gensets or BESS so the measured grid active power does not exceed the configured **Maximum Active Power at PCC**.

Applicable Modes:

- Grid Prime

Table 42: Function Setting - Indirect Genset Status Detection

Name	Description	Unit
Genset Peak Shaving	Enables peak shaving using gensets	None

Activation	(mutually exclusive with BESS Peak Shaving).	
Maximum Active Power at PCC	Import cap at PCC. Supports up to **2 day categories** with **10 time slots** each.	kW
Peak Shaving Phase Strategy	Phase reference method: **Sum of phases** or **Highest phase × 3**	None
BESS Peak Shaving Activation	Enables peak shaving using BESS (mutually exclusive with Genset Peak Shaving).	None
Allow gensets as backup for peak shaving	When BESS SoC falls below its minimum, allow gensets to assist peak shaving. Requires **Automatic Genset Start/Stop** to be enabled.	None
Activate SoC Reserve	Enables a scheduled SoC reserve to prepare BESS for upcoming peak periods.	None
SoC reserve value	Reserved BESS SoC per time slot and category (used when SoC Reserve is active).	%

Mutual exclusivity: Do not enable Genset Peak Shaving and BESS Peak Shaving at the same time.

Dependency (genset-based): Genset peak shaving requires **Automatic Genset Start/Stop** to be configured (see *Genset Control* section).

Configure peak shaving **only** on sites that have a contractual or technical import limit at the PCC.

The *Phase Strategy* defines how the EMS evaluates three-phase active power when applying a control function.

- **Sum of phases:** The EMS calculates total power as the sum of the three phase powers (P1 + P2 + P3). This represents the actual total power exchanged in the system and is typically used for balanced installations.
- **Lowest phase multiplied by 3 (dynamic):** The EMS identifies the phase with the lowest active power and multiplies it by three. This provides a conservative estimation of total power and is useful in systems with phase imbalance to ensure that control limits are respected on all phases.

4.7.6.3. Grid Reactive Power Control

Keeps the site within the required **power factor** or **voltage** limits at the point of common coupling (PCC). The controller automatically sends **reactive-power (kVAr)** commands to PV inverters and/or the BESS.

Configurable strategies:

- **Power-factor range:** keep PF within a minimum/maximum band.
- **Power-factor target:** hold a single PF target.
- **Volt-VAR (Q=f(U)):** adjust reactive power as a function of measured voltage.

A **leading unit** (PV or BESS) can be designated; the secondary unit assists only when the leader reaches its limit.

All commands respect device capabilities and configured kVAr limits. Update rate is every control loop.

Applicable Modes:

- Grid Prime

Table 43: Function Setting - Grid Reactive Power Control

Name	**Description**	**Unit**
Grid Reactive Power Control Activation	Enable/disable grid VAR control.	None
PV activation for grid Reactive Power Control	Allow PV to participate in grid VAR control.	None
Maximum absolute value of reactive power setpoint for PV	Limit for PV reactive power magnitude.	kVAr
BESS activation for grid Reactive Power Control	Allow BESS to participate in grid VAR control.	None
Maximum absolute value of reactive power setpoint for BESS	Limit for BESS reactive power magnitude.	kVAr
Leading control unit	Select the primary device for VAR control; the secondary contributes once the primary reaches its limit. Accepted values: **1 = PV**, **2 = BESS**	None

Grid reactive power control strategy	Control mode. Accepted values: **1 = Power Factor within Range**, **2 = Power Factor Target**, **3 = Q=f(U) (Volt-VAR)**.	%
Power Factor Range		
Inductive Grid Minimum Power Factor	Lower (inductive) limit when using PF Range.	None
Capacitive Grid Minimum Power Factor	Lower (capacitive) limit when using PF Range.	None
Power Factor Target		
Grid Power Factor Target Value	Absolute PF target when using PF Target.	None
Grid Power Factor Target Type	PF target type. Either Inductive, or Capacitive.	None
Q = f(U)		
Voltage target	Nominal phase-to-phase voltage at PCC (Q=f(U)).	kV
Maximum allowed capacitive reactive power	Capacitive VAR cap at PCC (negative values are capacitive).	kVAr
Maximum allowed inductive reactive power	Inductive VAR cap at PCC (positive values are inductive).	kVAr
Negative voltage variation: start of constant capacitive zone	Voltage deviation (% of nominal) where the constant capacitive region begins (Q=f(U)).	None
Negative voltage variation: start of linear capacitive zone	Voltage deviation (% of nominal) where the linear capacitive region begins (Q=f(U)).	None
Positive voltage variation: start of linear inductive zone	Voltage deviation (% of nominal) where the linear inductive region begins (Q=f(U))	None
Positive voltage variation: start of constant inductive zone	Voltage deviation (% of nominal) where the constant inductive region begins (Q=f(U))	None

4.7.7. Blackstart

Automatically restores the plant after a blackout by starting a forming unit (BESS or genset) and re-establishing voltage and frequency. When both options are enabled, preference is given to the BESS to maximize renewable usage.

4.7.7.1. Blackstart operating sequence

- **Blackout detection:** Loss of all forming sources is detected and the plant state is set to **Deadbus**.
- **Islanding :** The controller isolates the site from the grid by opening the grid breaker.
- **Forming-unit start**
    - If **BESS Blackstart** is enabled and SoC is above the configured threshold, all BESS PCS are started as the forming unit and the plant enters **BESS Prime**.
    - Otherwise, if **Genset Blackstart** is enabled, all gensets are started as the forming unit and the plant enters **Genset Prime**.
    - When both options are enabled, **BESS is prioritized** to favor renewable operation.

- **Stabilization :**Voltage and frequency are established by the forming unit; other assets are ramped according to their configured limits.
- **Optional role transfer (SoC-based) :** If enabled, the controller automatically transfers the grid-forming role between BESS and gensets based on battery state of charge (SoC).
    - BESS Prime → Genset Prime: Triggered when the BESS SoC falls below the configured minimum threshold, ensuring continuity of supply while protecting the battery from deep discharge.
    - Genset Prime → BESS Prime: Triggered when the BESS SoC rises above the configured upper threshold, allowing the system to resume battery-based grid-forming operation.

Each transfer is executed automatically by the controller and includes a brief Deadbus state to safely switch the grid-forming reference.

4.7.7.2. Blackstart with BESS

When enabled, a blackout that brings the plant to Deadbus triggers an automatic islanding sequence (grid breaker opened), then all BESS PCS are started as the forming unit, provided the State of Charge (SoC) meets the configured threshold.

Table 44: Function Setting - Blackstart with BESS

Name	Description	Unit
BESS as forming unit	Enables BESS to be used as the forming source during blackstart. On blackout: island the plant, then start all BESS PCS/controllers as the forming unit if SoC ≥ threshold.	None
Minimum SoC for BESS Prime	SoC threshold below which BESS is not used (or no longer used) as the forming unit.	%
Automatic transition to Genset Prime based on SoC	When enabled and SoC falls below the threshold, stop BESS, enter Deadbus, then start gensets as the forming unit.	None

If both **“Blackstart with BESS”** and **“Blackstart with Genset”** are enabled, the **BESS is prioritized** for the blackstart. The genset blackstart is triggered only if the BESS SoC is below the required threshold.

4.7.7.3. Blackstart with Genset

When enabled, a blackout that brings the plant to Deadbus triggers an automatic sequence in which all gensets are started as the forming unit.

Table 45: Function Setting - Blackstart with Genset

Name	Description	Unit
Genset as forming unit	Enables gensets to be used as the forming source during blackstart. On blackout, start all gensets as the forming unit.	None

If both **“Blackstart with BESS”** and **“Blackstart with Genset”** are enabled, the **BESS is prioritized** for the blackstart. The genset blackstart is triggered only if the BESS SoC is below the required threshold.

4.7.8. Automatic grid reconnection

When a blackout happens, Automatically returns the plant to Grid Prime when the utility grid is available and stable.

Prerequisite:

- At least one **grid meter** (grid stability detection).

- At least one **grid breaker** (to close and reconnect to the grid).

Table 46: Function Setting - Indirect Genset Status Detection

Name	Description
Activate automatic grid reconnection	Enables automatic reconnection to the main grid when available: stops the current forming unit and closes the grid breaker.

When grid power is back and stable, the EMS starts the reconnection sequence.
Sequence depends on the current plant state.

4.7.8.1. Reconnection to the Grid (Return from Islanded Operation)

When the utility grid becomes available again, the controller reconnects the plant to the grid and restores Grid Prime operation.

The transition sequence depends on the device currently providing grid-forming capability.

- **Case 1 : Plant Islanded in BESS Prime**

The BESS is the grid-forming unit.

If VSG is enabled in both BESS Prime and Grid Prime

Sequence

1. The BESS Stop grid-forming operation and de-energize the bus
2. A dead bus condition occurs
3. The grid breakers closes onto the dead bus
4. The utility grid establishes voltage and frequency reference
5. The plant enters **Grid Prime mode**
6. EMS resumes normal control of all assets

No Deadbus state occurs.

- **Case 2 : Plant Islanded in Genset Prime**

1. One or more gensets are providing grid-forming capability.
2. Because gensets cannot synchronize directly to a live grid in this configuration, a controlled shutdown is required.

Sequence

1. All assets ramp down power output
2. Gensets stop
3. The microgrid enters a brief Deadbus state
4. The controller performs the standard startup sequence from Deadbus.
5. The grid breaker closes
6. The plant enters Grid Prime mode
7. EMS resumes normal control

These transitions include a short interruption of supply.

Table 47: VSG options (per PCS)

Name	Description
VSG in BESS Prime	Run PCS in VSG mode while in **BESS Prime** (enables seamless transfer)
VSG in Grid Prime	Run PCS in VSG mode while in **Grid Prime**

4.7.9. Breaker control

Open and close breakers based on plant conditions.

1. **Breaker types**

- **Grid breaker**:Main plant breaker between the utility grid and the plant network. When open, the plant is isolated from the grid. Multiple grid breakers may exist on a site. In ePowerControl ES/ES+, the grid breaker also **defines the plant mode** (Grid Prime or otherwise).
- **Production breaker**: Connects/disconnects a downstream power source that is **not** directly controlled by the EMS.
- **Load breaker** : Connects/disconnects a downstream load.

Each breaker type supports a specific set of control functions.
Grid breakers are used only for islanding and grid reconnection, while production and load breakers support rule-based automatic control.
Table 40 lists the control bases available for each breaker type.

2. **Integration**

All breakers are declared via an I/O module. Up to 15 breakers per EMS are supported.

3. Control scope

Control logic depends on the breaker type. The **grid breaker** is operated for islanding and reconnection to switch between modes (see *Islanding & Grid Reconnection*). **Production** and **load** breakers follow the rule-based controls described in the next load sections.

Table 48: Breaker Control Rule summary

Control basis	**Description**	**Applies to**	**Available in modes**
Load power	Opens the breaker when load power is above the high threshold; closes when it falls below the low threshold (hysteresis*).	Load breaker	Grid Prime, BESS Prime, Genset Prime
BESS State of Charge (SoC)	Opens the breaker when SoC is below the low threshold; closes when SoC rises above the high threshold (hysteresis*). Uses the **lowest** SoC when multiple BESS are present.	Load breaker	Grid Prime, BESS Prime, Genset Prime
Grid import	Closes the breaker when grid **import** is above the high threshold; opens when import falls below the low threshold (hysteresis*). *Import only.*	Production breaker	Grid Prime
Genset loading	Closes the breaker when genset loading is above the high threshold; opens when it falls below the low threshold (hysteresis). With multiple gensets, uses the **lowest** loading for comparison.	Production breaker	Genset Prime

These rule-based controls are commonly used for load shedding, production management, or system protection depending on the selected control basis.

“*Hysteresis” means two thresholds are used to avoid chattering: a higher value to open/close and a lower value to return.

All breakers are declared via the I/O module; up to 15 breakers per EMS.

4.7.9.1. Control based on load power (Load breakers)

Table 49: Function Setting - Control based on load power

Name	Description	Unit
Activate control based on load active power	Enables deferrable-load breaker control based on measured load power.	None
Maximum load power - deferrable load	Above this threshold, the deferrable load is disconnected (breaker opens). Must be higher than the minimum threshold.	kW
Minimum load power - deferrable load	At or below this threshold, the deferrable load is reconnected (breaker closes). Must be lower than the maximum threshold.	kW

Applicable in Grid Prime, BESS Prime, and Genset Prime.

4.7.9.2. Control based on BESS State of Charge (Load breakers)

Table 50: Function Setting - Control based on BESS State of Charge

Name	Description	Unit
Activate control based on SoC	Enables load-breaker control based on BESS SoC.	None
Maximum state of charge - deferrable load	SoC at or above which a **closing** signal is sent to the load breaker. With multiple BESS, the **lowest** SoC is used.	%
Minimum state of charge - deferrable load	SoC at or below which an **opening** signal is sent to the load breaker. With multiple BESS, the **lowest** SoC is used.	%

Applicable in Grid Prime, BESS Prime, and Genset Prime.

4.7.9.3. Control based on grid import (Production breakers)

Table 51: Function Setting - Control based on grid import

Name	Description	Unit
Activate control based on grid import	Enables production-breaker control based on grid **import** power.	None
High grid import threshold	At or above this import level, the production breaker **closes**. Should exceed (low threshold + downstream production capacity).	kW
Low grid import threshold	At or below this import level, the production breaker **opens**. Should be below (high threshold − downstream production capacity).	kW

Applicable in Grid Prime only. Import direction only

4.7.9.4. Control based on genset loading (Production breakers)

Table 52: Function Setting - Control based on genset loading

Name	Description	Unit
Activate control based on genset loading	Enables production-breaker control based on genset loading.	–
High genset loading threshold	At or above this loading, the production breaker **closes**. Should exceed (low threshold + downstream production capacity). (Loading % can be converted to kW using apparent power.)	%
Low genset loading threshold	At or below this loading, the production breaker **opens**. Should be below (high threshold − downstream production capacity). (Loading % can be converted to kW using apparent power.)	%

⚠	Applicable in Genset Prime only

⚠	**Interaction rule (production breaker):** Grid-import and genset-loading controls are never active in the same plant mode; therefore no priority rule is required. The breaker acts on whichever condition is configured for the current mode.

4.7.10. Failsafe Mode

A failsafe state is entered when communication is lost with one or more devices, or when the plant configuration is invalid, preventing normal control. Depending on the current operating state (Grid Prime, BESS Prime, Genset Prime, Deadbus) and the condition detected, the EMS transitions to the corresponding failsafe state.

Table 53: Transition triggers (to failsafe)

Name	Description
Grid meter comms loss	At least one grid meter is configured **and** any grid meter loses communication for **> 1 minute**.
BESS comms loss	At least one PCS is configured **and** any PCS loses communication for **> 1 minute**.
Genset comms loss	At least one genset is configured **and** any genset device (genset meter or genset controller) loses communication for **> 1 minute**.
Invalid plant state	None of the state conditions for **Grid Prime**, **BESS Prime**, **Genset Prime**, or **Deadbus** is satisfied
Peak-shaving comms error	Communication lost with **either** a grid meter **or** a genset device (≥ 1 minute) while peak shaving with genset is applicable.
Auto start/stop comms error	Communication is lost **simultaneously** with BESS (PCS) **and** genset devices (≥ 1 minute) in contexts that rely on automatic genset start/stop.

⚠	Devices marked **Under Maintenance** are excluded from failsafe evaluation.

	Communication loss or invalid data from such devices **does not trigger** a failsafe transition. Other devices continue to be monitored normally and can still trigger failsafe if their own conditions are met.

Failsafe Behavior

When a failsafe condition is detected, the EMS suspends normal optimization and dispatch functions and applies a predefined safe operating strategy to maintain plant stability. The exact behavior depends on the current operating mode and the condition that triggered failsafe.
Typical actions include:

- Maintaining operation of available grid-forming sources
- Preventing automatic mode transitions
- Freezing or limiting setpoints to controlled assets
- Disabling non-essential functions (e.g., peak shaving, auto start/stop)
- Maintaining supply to loads whenever possible
- Triggering alarms to indicate degraded operation

Normal control resumes automatically once the triggering condition is cleared and communication is restored.

4.7.11. Run & Stop the EMS (Automatic Mode)

4.7.11.1. Operating state

The Operating state indicates the current status of the EMS control engine and determines whether the controller is actively computing and sending setpoints to the connected assets (PV, BESS, gensets, etc.).
Depending on the selected state, the EMS may initialize its control logic, execute the control loop, stop gradually, or remain inactive.

- **Off** : EMS does not write any setpoints.
- **Starting** : initialization before taking control.
- **On** : EMS computes and writes setpoints each control loop.
- **Stopping** : EMS ramps power down to zero using a controlled deceleration.
- **Force stopping** : emergency stop available **only** while Stopping: immediately commands zero setpoints at the next control loop.

4.7.11.2. Start (enter Automatic mode)

Sequence : In eConf:

1. Open the Overview page
2. Click Start EMS

Effect:

- Current device setpoints are **not modified**.
- EMS **stops writing** new setpoints.
- EMS state becomes **Off**; connected devices continue with their last valid setpoints.

4.7.11.3. Deactivate (turn EMS off without changing current outputs)

Sequence : In eConf

1. Open the Overview page
2. Click Stop EMS

Effect while **Stopping**:

- Commands PV active/reactive power to **0** with a ramp.
- Ramps genset power toward **0**.
- Default ramp duration: **60 s** (configurable).
- After ramp-down completes, **gensets are turned off**, and EMS exits to **Off**.

4.7.11.4. Stop (ramped shutdown)

Sequence : In eConf

3. Open the Overview page
4. Click “Stop “

Effect while **Stopping**:

- Commands PV active/reactive power to **0** with a ramp.
- Ramps genset power toward **0**.
- Default ramp duration: **60 s** (configurable).
- After ramp-down completes, **gensets are turned off**, and EMS exits to **Off**.

4.7.11.5. Force stop (emergency)

- Available only during Stopping.
- Immediately commands 0 setpoints at the next control loop (no ramp).
- Faster than the normal Stop sequence

4.7.11.6. Reboot behavior

The EMS may automatically reboot in cases such as controller restart, loss of internet with reboot script active, database or filesystem issues, or kernel issues on Ethernet/serial adapters.

- If Automatic mode was **On** before the reboot, it **automatically resumes** after the reboot (the act_ems state is persistent).

5. Options and accessories

5.1. Cabinets

	**Metal Casing | S** IP50 Casing	- Dimension : 300*300*150 - Weight : 10,5 kg - Wireways - Power supply 24V
	**Metal Casing | M** IP50 Casing	- Dimension : 500*400*250 - Weight : 12,5 kg - Wireways - Power supply 24V
	**Metal Casing | L** IP50 Casing	- Dimension : 600*600*300 - Weight : 28 kg - Wireways - Power supply 24V - Screen mounting option
	**ePowerMonitor | SCADA** HMI supervision screen 115-AP01, Arcdis	- 15-inch industrial grade touchscreen - Fully autonomous - no internet required

5.2. Antennas

	**Cellular kit | No casing** Antennas + modem 4G/LTE Antenna VT4GLTE-R-1, Techship	- Pair of plastic 4G/LTE Antennas - SMA connector - Modem for 3G/4G connection access - Does not include the 3G card
	**Cellular kit | Casing** Antennas + modem CELLULAR/LTE MIMO 2J602 4Ba, Techship	- Single plastic 4G/LTE Antennas - SMA connector - Modem for 3G/4G connection access - Does not include the 3G card
	**Cellular kit | Container** IP65 antennas + modem 3G/4G LTE Multiband Antennas LP70x, Techship	- Pair of plastic 4G/LTE Antennas IP65 - Operating conditions -40°C to 85°C - SMA connector - Modem for 3G/4G connection access - Does not include the 3G card

5.3. Meters

	**AC Meter | 5A** EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi	- AC power measurements - Active/Reactive power, cos phi, current, voltage - Frequency - RS485 | Modbus RTU communication - Compatible with 5A CTs
	**AC Meter | 333mV** EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi	- AC power measurements - Active/Reactive power, cos phi, current, voltage - Frequency - RS485 | Modbus RTU communication - Compatible with 333 mV CTs
	**AC Meter | 5A | LV & MV** WM20.AV5.3.H, Carlo Gavazzi	- Advanced modular AC power analyzer - Active/Reactive power, cos phi, current, voltage - Frequency - RS485 | Modbus RTU communication - Compatible with 5A CTs + LV/MV Applications

	**CT | 200 A** Current transformer CTD-6S.200.5A.XXX	- Input current up to 200 A - 5A output - Split core
	**CT | 1000 A** Current transformer CTD-6S.1000.5A.XXX	- Input current up to 1000 A - 5A output - Split core
	**CT | 4000 A** Current transformer ROG4K1002M4003X02, Carlo Gavazzi	- Input current up to 4000 A - 333 mV output - Split core rope

5.4. UPS

	**UPS | S** SPUBC24120 with SPUBAT241A2, Carlo Gavazzi	- Output voltage 24 V - Nominal current 5A - 1.2 Ah battery
	**UPS | M** SPUBC24120 with SPUBAT243A2, Carlo Gavazzi	- Output voltage 24 V - Nominal current 5A - 3.2 Ah battery
	**UPS | L** SPUBC24120 with SPUBAT2412A, Carlo Gavazzi	- Output voltage 24 V - Nominal current 5A - 12 Ah battery

5.5. Connectivity

	**I/O Module | Analog** 6017, ADAM	- 8 channel differential Analog input - Ethernet | Modbus TCP/IP communication
	**RS485 Extension** Nport 5230A, Moxa	- 1 Ethernet port - 2 RS485 ports
	**Switch** EDS 205, Moxa	- 5 Ethernet ports

5.6. Weather Sensors

	**Pyranometer** SMP 10, Kipp & Zonen	- Pyranometer < 1 % (-20 ...50 °C) otherwise < 2 % (-40 ... 70 °C) - Ambient temperature +/- 0.1 °C - Operating range -40 to 80 °C - RS485 | Modbus RTU communication
	**Irradiance sensor** Si-RS485TC-T-Tm-MB, INGENIEURBÜRO	- Irradiance sensor +/- 5% - Module temperature +/- 1 °C - Operating range -20°C to 70 °C - RS485 | Modbus RTU communication
	**Temperature sensor** Ta-ext-RS485-MB, INGENIEURBÜRO	- Ambient temperature sensor +/- 1 °C - Operating range -40°C to 90 °C - RS485 | Modbus RTU communication

Weather station
WS500, Lufft

- Temperature ±0.2 °C (-20...50 °C) otherwise ±0.5 °C (>-30 °C)
- Operating range -50 to 60 °C
- Relative humidity ±2 % RH
  Operating range 0 to 100 % RH
- Air pressure ±0.5 hPa (0...40 °C)
  Operating range 300 to 1200 hPa
- Wind direction < 3°
  Operating range 0 to 359.9 °
- Wind speed ±0.3 m/s
  Operating range 0 to 75 m/s
- RS485 | Modbus RTU communication

Remote temperature sensor
WT1, Lufft

- Additional module for the weather station
- Module temperature sensor +/- 0.1 °C
- Operating range -40°C to 125 °C
- Communication through weather station WS500

6. Appendices

6.1. Appendix A: New equipment driver integration by Elum

6.1.1. Objectives

Elum Explorers can communicate with a wide range of devices, provided they are compatible in terms of communication protocol and communication ports.

Table 14: Elum Explorers Communication Compatibility Requirements

Communication Port	Communication Protocol
RS485	Modbus RTU
Ethernet	Modbus TCP
Ethernet	SNMP v2

6.1.2. Device Integration Process

The integration process depends on the device to be integrated. Please follow instructions according to the equipment classification which new driver will be integrated by Elum.

Table 15: Critical Device Classification Criteria

Critical when commissioning ePowerControl	Critical when commissioning ePowerControl
N/A	Any device of the following type: - PV Inverter - Genset controller - Load Power Meter - Grid Power Meter - Genset Power Meter

For integrating a new equipment driver into the system, you must schedule a dedicated date and time with the **Elum Deployment Team**. This appointment must be booked **at least 10 days prior** to the commissioning of the **Elum Explorer** to ensure smooth integration and avoid delays in deployment.

a. Non-critical device

To ensure a smooth integration of new devices with the **Elum Explorer**, follow the steps below:

1. You must send the required device documentation to Elum at least 10 days prior to the Explorer shipping date. The following documents will be requested for a new device integration:
    - Datasheet
    - User Manual
    - Communication Protocol Technical Specification, which includes:
        - Modbus Register Map (for devices communicating via Modbus RTU or Modbus TCP)
        - Management Information Base (MIB) file (for devices communicating via SNMP v2)

2. Driver preparation and pre-embedding :
    - The Elum Deployment Team will prepare and pre-embed the required driver(s) in your Elum Explorer before shipping.
    - The Explorer will be shipped with:
        - All pre-integrated drivers for already supported devices.
        - Your project-specific drivers, ensuring compatibility with your system.

When shipping your **Elum Explorer**, Elum ensures that it includes:

- **All pre-integrated device drivers** that are already supported by Elum.
- **Project-specific drivers** tailored to your system requirements.

Once the **Elum Explorer** has been shipped, **no additional equipment drivers** will be added. Ensure all necessary drivers are requested and integrated **before shipping** to avoid delays in commissioning.

3. Proceed with the commissioning of your Elum Explorer by setting up communication and testing the new device following the same procedure as for other connected devices.
    - Once the commissioning is complete, the Elum Deployment Team will conduct:
    - QA analysis to verify the integration.

- Consistency check to ensure the new driver functions correctly within the system.

At the end of the commissioning process, the **device must appear as "Connected"** in the **Overview Panel** of the eConf interface.

If real-time monitored values appear **inconsistent**, please contact the **Elum Deployment Team** at **support@elum-energy.com** for assistance.

Once the commissioning is completed, the **Elum Deployment Team operates autonomously**, meaning that if a **driver update is required**, it can be performed **remotely** without requiring the presence of technical teams on-site.

b. Critical device

1. To ensure seamless integration of new devices with the Elum Explorer, the required device manufacturer documentation must be sent to Elum at least 10 days before the Explorer shipping date.

The following documents must be provided to Elum for integration:

- Datasheet – Technical specifications of the device.
- User Manual – Instructions for installation and operation.
- Communication Protocol Technical Specification –
  - Modbus Register Map (for devices using Modbus RTU or Modbus TCP).
  - Management Information Base (MIB) File (for devices using SNMP v2).

2. The Elum Deployment Team will develop and pre-embed the required driver(s) into the Explorer before shipping.
   - All previously integrated drivers, along with project-specific drivers, will be included in the shipped Explorer.

When shipping your **Elum Explorer**, Elum ensures that it includes:

- **All pre-integrated device drivers** that are already supported by Elum.
- **Project-specific drivers** tailored to your system requirements.

	Once the **Elum Explorer** has been shipped, **no additional equipment drivers** will be added. Ensure all necessary drivers are requested and integrated **before shipping** to avoid delays in commissioning.

3. Coordinate with the Elum Deployment Team to book a date and time for the new equipment driver integration, ensuring this is done at least 10 days before the commissioning of your Explorer.

4. Proceed with the Explorer commissioning up to Step 6: Configuring the ePowerControl on eConf. The communication setup and testing for the new device must follow the same process as other connected devices.

5. Once the setup is complete, reach out to Elum Deployment Team, which will independently conduct additional communication tests on the driver.
6. Some adjustments in the device configuration may be required, so remain on-site until testing is finalized. You will be notified once these tests are successfully completed.

	During this phase, **eConf might be temporarily unavailable** while tests are being performed.

7. Proceed to the Step 7: Functional tests.

6.2. Appendix B: New equipment driver integration by Elum

Table 16: Ten mistakes to avoid

Diagnosis	Mistake	How to fix it
• Communication with the device cannot be established. • Communication with the device is intermittent	Neglected RS485 wiring	Connecting RS485 Devices • Review Central Computing Unit pin and serial port identification. • Verify wiring against Elum and RS485 standard guidelines. • Ensure correct data wire termination on the last device (B+ and T terminals). • Ensure shielding continuity throughout the entire cable run. Shielding must be grounded at one point only to prevent ground loops.

	Modbus communication not enabled on slave device	• Check device Modbus settings: baud rate, parity, stop bits, and Modbus ID. • Refer to the Device Connection & Configuration Specific Instructions. • Ensure that Modbus RTU or TCP is enabled in the device menu.
Device monitoring works, but control fails.	Dynamic power control not enabled on inverter	• Enable dynamic power control in the inverter settings. • Ensure Modbus write permissions are enabled for active/reactive power setpoints. • Refer to the Device Connection & Configuration Specific Instructions.
The Elum Controller reboots when switching from On grid - Grid connected to Off grid - Genset connected mode and vice versa.	UPS wiring issue	Power Supply • The controller power source must come from the load side so it stays powered in both grid and genset modes. • If using a UPS, its power source must follow the same rule. • For ePowerControl SD, HFS, and MC, UPS is mandatory for system stability. For ePowerControl SD, HFS and MC the use of an UPS is mandatory.

Breaker control fails.
Wrong breaker operation.
	Reverse power protection configuration issue	Refer to the *Device Connection & Configuration Specific Instructions* and third party documentation.
		
		Safety warnings
		
		• Check breaker control logic in eConf → Control Panel.
		• Refer to the Device Connection & Configuration Specific Instructions.
		• **Important:** The ePowerControl is NOT a protection device! It does not replace:
		  ○ Reverse power relays
		  ○ Proper genset controller settings
		  ○ Protection relays.
		• Install a reverse power relay if needed.

Power meter turns off when switching between **On grid - Grid connected** and **Off grid - Genset connected** modes.	Power meters power supply wiring issue	AC Meter | 5A provided by Elum AC Meter | 333mV provided by Elum ● Ensure auxiliary power supply is properly connected and powered at all times. ● If power is lost, the system triggers fail-safe mode and curtails PV production. ● If using ePowerControl SD, HFS, or MC, ensure the power meters are UPS-backed.
Power meter monitoring values appear **incorrect or inconsistent**.	Incorrect power meter VT/CT ratio	AC Meter | 5A provided by Elum When installing a EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi: Ct rAtIo, Current transformer ratio: You can obtain this ratio by dividing the primary current by the secondary current. As an example, when using 200 A to 5 A CTs, the ratio should be set to 40. Vt rAtIo, Voltage transformer ratio:You can obtain this ratio by dividing the primary voltage by the secondary voltage. As an example, when installing the power meter using no VTs, the ratio should be set to 1. AC Meter | 333mV provided by Elum When installing a EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi: SEnSOr , CT type: As an example, when installing the power meter with Rogowski coil CTs, the type should be set to roG Ct Prin, Current transformer maximum current input: As an example, when installing the power meter with

		Rogowski coil 4000A, the type should be set to 4,00k. Vt rAtIo, Voltage transformer ratio: You can obtain this ratio by dividing the primary voltage by the secondary voltage. As an example, when installing the power meter using no VTs, the ratio should be set to 1.
Power factor (Cos φ) is incorrect, but power meter readings seem fine.	Incorrect power meters VT/CT wiring	AC Meter | 5A provided by Elum AC Meter | 333mV provided by Elum ● Check CT and VT wiring order. ● Ensure phases match correctly. ● If phases are swapped, power factor and reactive power readings will be incorrect.
Power meter values have **wrong signs** (positive instead of negative).	Negative power monitoring not enabled on grid meter	AC Meter | 5A provided by Elum When installing a EM330-DIN.AV5.3.H.S1.X, Carlo Gavazzi: MEASurE, Measurement type: To be set to “b” AC Meter | 333mV provided by Elum When installing a EM210-72D.MV5.3.X.OS.X, Carlo Gavazzi: APPLiC, Measurement application: To be set to “E”.
No internet access (wired or cellular).	Local internet network misconfiguration or invalid SIM card contract	Configuring a wired internet connection Configuring a cellular internet connection Appendix C: Internet Speed Test **For wired internet connections:**

		● Ensure the following IPv4 outgoing accesses are allowed: ○ ICMP ○ TCP ports: 53, 80, 443, 4505, 4506 ○ UDP ports: 53, 123, 1195. **For cellular internet connections:** ● Insert a valid data-enabled SIM card. ● -Always turn off ePowerControl before inserting/removing the SIM card. ● -If replacing the SIM card, perform an empty start before reconfiguring the network. ● If issues persist, refer to Appendix C: Internet Speed Test. ● Check SIM card contract: Some SIM cards require activation for IoT usage.

6.3. Appendix C: Internet Speed Test

6.3.1. Internet Speed Test Requirements for Elum Explorers

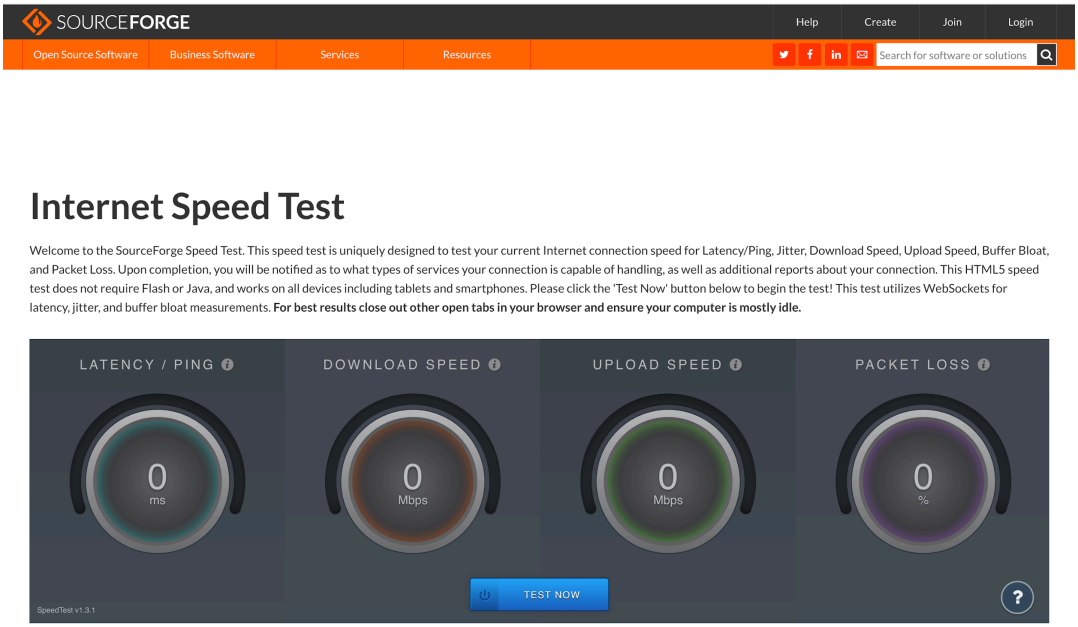
Function of the internet access point	Max packet loss	Minimum upload rate	Minimum download rate	ePowerLog	ePowerControl ES
Firmware update	10%	any	50 ko/s	X	X
Data upload to Archive	10%	200 ko/s	-	X (ePowerMonitor)	X (ePowerMonitor)
Remote Commissioning or remote Assistance using SSH session	10%	25 ko/s	25 ko/s	X (unstable version)	
FTP push to remote server	10%	50 ko/s	-	X (FTP)	X (FTP)
Remote assistance using eConf	10%	200 ko/s	-	X	X

6.3.2. Test protocol to be performed

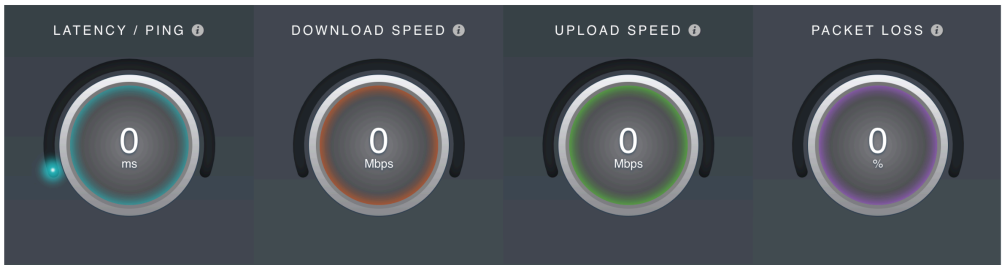
Prerequisite: disable your internet browser adblock if you have one active

- **At precise Elum controller future location,** access from your mobile / computer to the following website: https://sourceforge.net/speedtest/

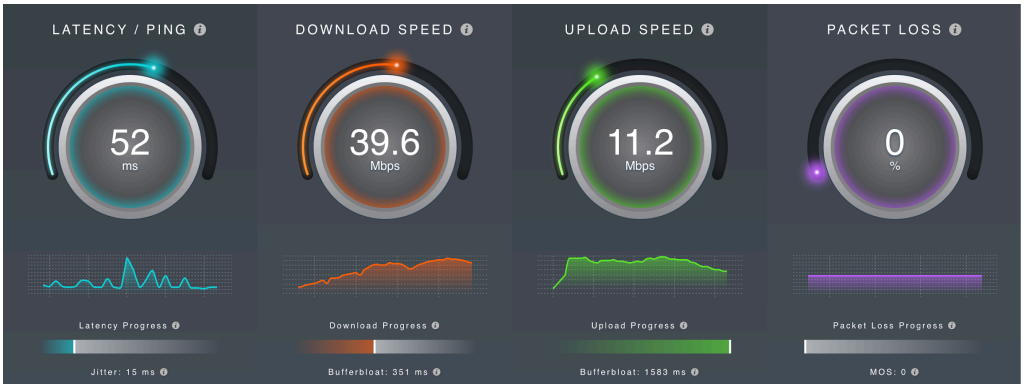
- Click on the button Test now:



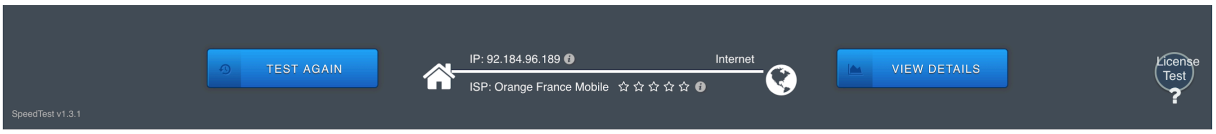
- Wait for the test launch:



- Check that the test is going to the end and **take this as a screenshot (N1)**:

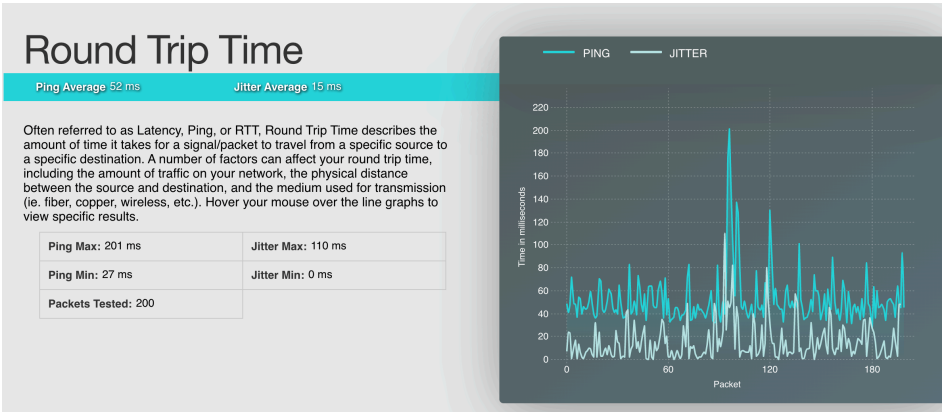


- Once the test is complete, scroll down and click on the “view details” button:

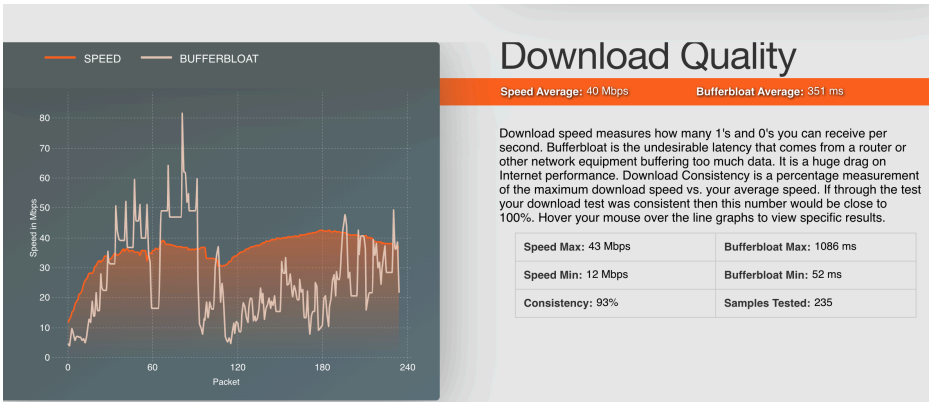


- Take the **following 4 screenshots (N2/N3/4/N5) and send them to us**:

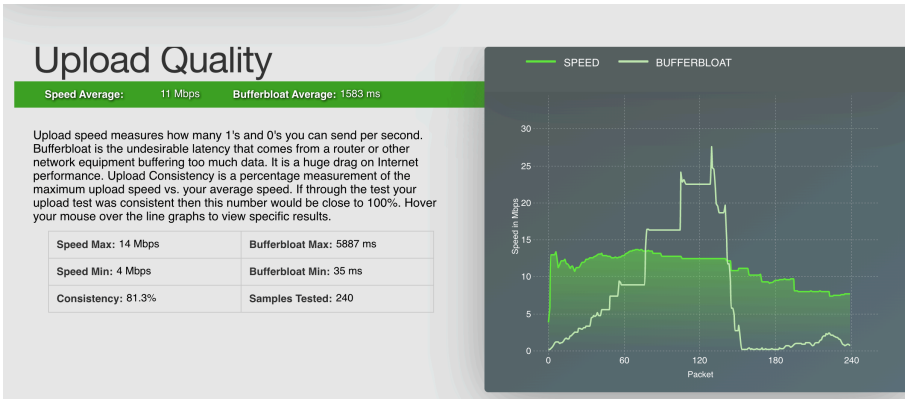
- **N2: Round Trip Time**



- **N3: Download Quality**



- **N4: Upload Quality**



- **N5: Internet Quality**