

ENERGY MANAGEMENT

# EMS System Overview

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Operational modes, time-slot configuration, input settings, and export and generator management.

ARQ CONTROLS · INDUSTRIAL ENERGY CONTROL

MODBUS

## System overview

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The ARQ Controls EMS manages energy across three modes: Peak, Valley, and Flat. Up to ten time slots, each with a start time, end time, and mode, automate switching throughout the day to optimize consumption and cost.

## Operational modes: 1. Peak

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**Objective.** Reduce grid consumption during peak-price periods by prioritizing battery discharge and optimizing PV usage.

### Battery discharge

- Discharges to cover loads until the Peak SOC is reached.
- After Peak SOC, discharges only for peak shaving until the Discharge Stop SOC.
- At the Discharge Stop SOC, the battery ceases all discharging.

### Charging & export

- Grid does not charge the battery in Peak mode. PV charges the battery from excess after loads, until the PV Charge SOC.
- Once the PV Charge SOC is reached, PV export begins if enabled. If export is disabled, PV is limited to match load after the PV Charge Stop SOC, so no excess is produced.
- The system always imports at least the Minimum Grid Import value, even with export disabled.
- PV output ramps up or down per the PV Ramp Rate, set as a percentage of Max PV Capacity.

## Operational modes: 2. Valley

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**Objective.** Maximize the use of cheaper grid power to cover loads and charge the battery.

- Charges the battery from both grid power and excess PV, until the Grid Charge Stop SOC and PV Charge Stop SOC.
- Battery export is disabled, focusing on charging.
- The battery still discharges to keep grid consumption below the Peak Shaving Limit.
- If enabled, surplus PV after charging can export to the grid, up to the Max PV Export Power.
- Minimum Grid Import is maintained to prevent feedback. PV ramps gradually per the PV Ramp Rate.

## Operational modes: 3. Flat

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**Objective.** Charge the battery using only excess PV power, and discharge only for peak shaving.

- Charges the battery from excess PV until the PV Charge Stop SOC. Grid power is not used for charging.
- The battery discharges only for peak shaving, stopping entirely at the Discharge Stop SOC.
- If enabled, surplus PV after charging can export to the grid, up to the Max PV Export Power.
- Minimum Grid Import is adhered to, so at least the minimum grid power is always maintained to prevent feedback.
- PV output ramps up or down per the PV Ramp Rate, set as a percentage of Max PV Capacity.

## Time-slot configuration

Up to ten time slots automate switching between modes. Each slot is defined by a start time, end time, and a selected mode, so the system adjusts dynamically throughout the day.

| TIME SLOT    | START TIME | END TIME | SELECTED MODE |
|--------------|------------|----------|---------------|
| Time slot 1  | 06:00      | 09:00    | Peak          |
| Time slot 2  | 09:00      | 12:00    | Valley        |
| Time slot 3  | 12:00      | 16:00    | Flat          |
| Time slot 4  | 16:00      | 20:00    | Peak          |
| Time slot 5  | 20:00      | 23:00    | Valley        |
| Time slot 6  | 23:00      | 06:00    | Flat          |
| ...          | ...        | ...      | ...           |
| Time slot 10 | Custom     | Custom   | Custom        |

### Notes

- **Flexible scheduling.** Full customization lets the EMS adapt to varying energy pricing and consumption patterns throughout the day.
- **Mode automation.** Each slot defines which mode the system operates in, with automatic changes at the configured intervals.

## Export & generator management

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### PV export

Enable PV Export allows the system to export excess PV power to the grid, up to the Max PV Export Power. If disabled, no PV power is exported.

### Battery export

Enable Battery Export allows the system to export battery power to the grid, up to the Max Battery Export Power. If disabled, no battery power is exported.

### Generator management

- **Enable PV on generator.** Lets PV run alongside the generator, contributing to loads and charging the battery. If disabled, PV is curtailed when the generator is active.
- **Min generator power.** Keeps the generator at a minimum output. If loads are too low, the battery charges to absorb the excess and keep the generator running efficiently.
- **Max generator power.** Prevents the generator from exceeding its maximum output by discharging the battery to reduce its load.

## System operation

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The EMS automatically adjusts energy flow according to the selected mode, the user-defined input settings, and the configured time slots. It dynamically balances grid consumption, PV production, battery usage, and generator management to optimize performance, reduce costs, and prevent equipment overload.

## Input settings

| #  | SETTING                  | DESCRIPTION                                                                                       |
|----|--------------------------|---------------------------------------------------------------------------------------------------|
| 1  | Max PV Export Power      | Maximum power that can be exported to the grid from the PV system.                                |
| 2  | Max Battery Export Power | Maximum power that can be exported to the grid from the battery.                                  |
| 3  | Min Generator Power      | Minimum generator output. The battery charges to ensure this minimum is met.                      |
| 4  | Max Generator Power      | Maximum allowable generator output. The battery discharges to prevent the generator exceeding it. |
| 5  | Grid Charge Stop SOC     | SOC at which grid charging stops.                                                                 |
| 6  | PV Charge Stop SOC       | SOC at which PV charging stops.                                                                   |
| 7  | Peak SOC                 | SOC at which Peak mode stops discharging for loads and switches to peak shaving only.             |
| 8  | Discharge Stop SOC       | SOC at which all battery discharging stops.                                                       |
| 9  | Minimum Grid Import      | Ensures a small amount of power is always imported to prevent feedback.                           |
| 10 | Peak Shaving Limit       | Maximum grid consumption allowed before the battery discharges to shave the peak.                 |
| 11 | Max PV Capacity          | Total PV capacity used for ramp-rate calculations.                                                |
| 12 | PV Ramp Rate             | Percentage of Max PV Capacity used for ramping PV output up or down.                              |

## Input booleans

- **Enable PV Export.** Allows PV export to the grid.
- **Enable Battery Export.** Allows battery export to the grid.
- **Enable PV on Generator.** Allows PV to operate alongside the generator.

## Quick comparison: operating modes

The three scheduled modes compared across the main control behaviors. Two further modes, Off-Grid and Generator, extend the same logic for islanded and generator-backed operation.

| BEHAVIOR          | PEAK                                                   | VALLEY                                                    | FLAT                                               |
|-------------------|--------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------|
| Objective         | Minimize grid use at peak times via battery discharge. | Use cheaper grid power to cover loads and charge battery. | Charge from excess PV, discharge only for shaving. |
| Battery discharge | Covers loads to Peak SOC, then shaving only.           | Shaving only, above the Peak Shaving Limit.               | Shaving only, to the Discharge Stop SOC.           |
| Battery charging  | PV only, to PV Charge SOC. No grid charging.           | Grid plus PV, to the stop SOC.                            | Excess PV only. No grid charging.                  |
| PV export         | Excess PV after PV Charge SOC, if enabled.             | Excess PV after battery charging, if enabled.             | Excess PV after charging, if enabled.              |
| Min grid import   | Always maintained.                                     | Always maintained.                                        | Always maintained.                                 |
| Peak shaving      | Above the Peak Shaving Limit.                          | Above the Peak Shaving Limit.                             | Above the Peak Shaving Limit.                      |
| Grid usage        | Loads only.                                            | Loads and battery charging.                               | Loads only, not charging.                          |
| Control focus     | Cut grid use, maximize battery discharge at peak.      | Charge battery with cheap grid, cover loads.              | Charge from PV, reduce peak demand.                |

## User interface & software

The platform spans a client interface for plant owners and an installer interface for commissioning and device-level control. The screens below are to be supplied as current, clean captures.

**FIGURE: POWER DATA, CENTRAL PLANT VIEW**

Client interface, all-plants overview.

**FIGURE: ENERGY DATA, PRODUCTION VS ACTUALS**

Production against actual yield.

**FIGURE: DESIGN DATA UPLOAD & DAILY PV YIELDS**

Scheduled reporting and yield tracking.

**FIGURE: CUSTOM REPORTS**

Report builder output.

**FIGURE: INSTALLER INTERFACE, LIVE DATA**

Real-time commissioning view.

**FIGURE: INVERTER SETTINGS & DEVICE MONITORING**

Per-device configuration.

**FIGURE: DETAILED HISTORY & EMS GRANULAR CONTROL**

Historical trends and control.

**FIGURE: CONSOLIDATED PLANT DATA SET**

Unified plant data export.

**FIGURE: DETAILED FAULT REPORTING**

Fault detection and logs.

**FIGURE: GRID-TIED INVERTERS & BATTERY POWER CONTROL**

Grid-tied dispatch.

**FIGURE: SMART EV CHARGER CONTROL**

EV charge management.

**FIGURE: WATER-HEATER TEMPERATURE MONITORING**

Controllable-load monitoring.

## Supported brands

The ARQ Controls EMS supports the following inverter and meter brands via RS485 / Modbus TCP.

|                      |              |           |
|----------------------|--------------|-----------|
| ARB                  | Fanox        | SigEnergy |
| AccuRev              | Fronius      | Sineng    |
| Acrel                | GoodWe       | SMA       |
| Atess                | Huawei       | SmartGen  |
| Canadian Solar       | IES          | Socomec   |
| Carlo Gavazzi        | Kaco         | SolarEdge |
| Delta                | Lovato       | Solis     |
| Deep Sea Electronics | Maxwell      | Sungrow   |
| Eastron              | Megarevo     | Sunsynk   |
| easYgen              | MeteoControl |           |
| Efacec               | Schneider    |           |

Optional protocol packs: **DNP3**, **IEC 60870-5-104**, **BACnet**, **MQTT bridge**. More brands added regularly.

FOR FURTHER ENQUIRIES

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