

Manual: QA EX01PV

Integration of the external **EX01PV SHE** module — analog and digital inputs, analog outputs and five SSR outputs with advanced load power control for photovoltaic installations.

Introduction

QA EX01PV provides complete integration of the external EX01PV SHE module — its inputs, outputs and control of the SSR outputs including the selection of the switching mode and phasing. The application automatically creates child devices for the individual inputs and outputs and communicates directly with downstream QA applications of the SHE family (typically QA DHW Boiler). The application also includes the **Testing** card, which helps to set the correct phase order of the loads for load power control in cooperation with the inverter QA application.

The application cooperates with Mervis SCADA for visualisation and with other QA applications of the Energy Management family — for DHW heating, photovoltaic surplus control, spot prices and more.

Upstream and downstream applications

Upstream applications

Optional:

- **QA DHW Boiler** — controls DHW heating via the SSR outputs and temperature sensors of the EX01PV module (direct child connection).
- **QA DHW Boiler 2 Heating Elements 6SSR** — variant for installations with two heating elements and more SSR outputs.
- **QA Heat Pump** — for older heat pumps without the SG Ready function; passes the heat / do not heat command via a module output.
- **QA Two-Stage Boiler Control** — controls a two-stage boiler via the SSR and analog outputs of the module.
- **QA Heating Circulation Pump Control** — switches the circulation pump via the module outputs.

The application can also work completely standalone — without a supervisory QA application, the inputs and outputs of the module can be controlled directly via the child devices (output type **Write**).

Downstream applications

The module directly controls the connected hardware:

- **SSR relays** — for switching resistive loads (heating coils, electric heating).
- **Temperature sensors** Pt100 / Pt1000 — for temperature measurement.
- **Analog outputs 0–10 V** — for controlling actuators with frequency converters, valves and other hardware.
- **Digital inputs** — typically for the HDO signal or other binary inputs.

Optional:

- **QA HDO** — consumes the HDO signal from the **INPUT DI01** input of the module and distributes it to other QA applications in the SHE ecosystem.

Installation and initial setup of the QA

Installation

Purchase the application in the Smart Home and Energy e-shop (<https://eshop.smarthomeenergy.cz>). After the purchase you receive an e-mail with a link to the activation form, in which you choose one of the two installation methods:

- **Installation via the SHE Installation Application (recommended)** — the activation form provides a link to download the Installation Application. Install it into the unit; it then automatically installs the purchased licences. It provides automatic updates of all SHE applications and easy licence management (requires the "superuser" credentials for the unit). See the separate "Installation Application" manual for details.
- **Standalone installation file** — the activation form provides a link to download an encrypted *.fqax file bound to the entered unit S/N. Install the file manually into the unit according to the unit manufacturer's instructions (logged in as "superuser"). This option does not allow automatic updates.

After a successful installation, the main tile **EX01PV**, the tiles of the **Device settings** and **Testing** cards and the child devices for the enabled inputs and outputs of the module appear on the unit desktop — **Temperature AI1**, **Temperature AI2**, **Output AO1**, **Input DI1** and **Output SSR1** to **Output SSR5**.

Operating prerequisites

- A physically installed **external EX01PV SHE module**.
- A **Modbus TCP / Modbus RTU converter** through which the module is available in the unit network (not supplied with the application).
- For the power and phase order testing function, a compatible **inverter QA application**.
- A correctly designed network topology and carefully chosen reading periods, so that no collisions occur on the Modbus RTU bus.
- A free slot for uploading the application in the controller.

Opening the application control card

To open the application cards in a web browser, move the cursor over the tile (**EX01PV**, **Device settings**, **Testing**) and click the **eye** icon in its top-right corner. The card detail opens.

Warning: Not all cards and tiles are displayed to all users. Each user selects which cards and tiles are displayed on the Display Settings card (sheViewControl application) – levels SHORT, ADVANCED and ADMIN. If you cannot see a described card, check the settings on this card.

User settings

For QA EX01PV, the following tiles and cards are displayed on the unit desktop:

- **EX01PV** — the main information tile with a summary of the current values of all inputs and outputs of the module and the zero-crossing detection state (**ZeroCross Status**).
- **Device settings** — configuration of input and output types, SSR control modes, module parameters and communication.
- **Testing** — card for testing the wiring of the SSR outputs, the power and the phase order in cooperation with the inverter QA application.
- **Temperature AI1, Temperature AI2** — child tiles of the temperature inputs (display the current temperature).
- **Output AO1** — child tile of the 0–10 V analog output.
- **Input DI1** — child tile of the digital input (typically for the HDO signal).
- **Output SSR1 to Output SSR5** — child tiles of the individual SSR outputs (display the current power in % and allow direct control if the output is set to **Write**).

After the installation is complete, first set up the **“Device settings” card** — input and output types, SSR modes and communication parameters. Only then use the **“Testing” card** to verify the correct wiring and phase order. The **EX01PV** card is for information only and requires no further configuration.

“EX01PV” card

The card displays the current values of all inputs and outputs of the module and a summary of the settings.

Input and output values

- **AI1 – AI4** — current values of the analog inputs in the selected units (e.g. temperature in °C, voltage in V, current in mA).
- **AO1 – AO4** — current values of the analog outputs in V.
- **DI** — states of the digital inputs in the format bit1 | bit2 | bit3.
- **Counter1 – Counter3** — counter values of the digital inputs.
- **SSR1 – SSR5** — current power of the individual SSR outputs in the format below limit | above limit.
- **ZeroCross Status** — zero-crossing detection state of phase 1 (**Valid** / error state).

Warning

For correct control of the SSR outputs, a valid zero crossing of phase 1 must be detected (**ZeroCross Status: Valid**). Without valid detection, SSR power control will not work.

Settings summary

The bottom part of the card provides a summary of the active configuration (read-only):

- **Analog Inputs Settings** — selected type for AI1 – AI4 (e.g. Pt1000 °C 2-wire, Voltage 0–10 V, Disabled).
- **SSR Mode/Phase/Min/Max Settings** — mode, phase and limit values for each SSR output (e.g. PWM Distributed ZC | Phase 2 | 0 | 100).
- **PWM Time Window** — period of the pulse-width modulation (e.g. 1000 ms).
- **MWD** — state of data detection on the Modbus bus (Detected / not detected).
- **Modbus Address** and **Modbus Address Set** — currently read and selected address of the module on Modbus RTU.
- **Modbus Speed / Parity** — communication speed and parity of the bus (e.g. 9600 Bd | None).

The individual parameters are configured on the **Device settings** card.

“Device settings” card

The card is used to enable and configure the individual inputs, outputs, SSR outputs, the module and the communication with the Modbus TCP / RTU converter.

Warning

When saving settings, always wait until Run status changes to Running. Do not press SAVE before that. Pressing it repeatedly before the restart is complete may cause configuration errors.

Analog inputs settings

For each analog input **INPUT TYPE AI01** to **INPUT TYPE AI04**, select the correct characteristic according to the connected sensor:

- **Disabled** — the input is not used.
- **Voltage 0–10 V / Voltage 0–2.5 V** — measurement of a voltage signal.
- **Current 0–20 mA** — measurement of a current signal.
- **Resistance 0–1960 Ohm 3-wire / Resistance 0–100 kOhm 2-wire** — resistance measurement.
- **Pt1000 °C 3-wire / Pt1000 °C 2-wire / Pt1000 F 3-wire / Pt1000 F 2-wire** — Pt1000 resistance temperature sensor in °C or °F, 2- or 3-wire connection.
- **Pt100 °C 3-wire / Pt100 °C 2-wire / Pt100 F 3-wire / Pt100 F 2-wire** — Pt100 resistance temperature sensor in °C or °F, 2- or 3-wire connection.

Select the characteristic exactly according to the type of the physically connected sensor — an incorrectly selected type leads to meaningless measured values.

Analog outputs settings

For each analog output **OUTPUT TYPE AO01** to **OUTPUT TYPE AO04**, select the type:

- **Disabled** — the output is not used.
- **Read** — the output is controlled by a supervisory QA application (e.g. QA DHW Boiler). The application only reads the current value.
- **Write** — the output can be controlled directly via the child tile (e.g. manual control of a 0–10 V actuator).

Digital inputs settings

For each digital input **INPUT DI01** to **INPUT DI03**, select:

- **Disabled** — the input is not used.
- **Enabled** — the input is active (typically for integrating the HDO signal or other binary inputs).

SSR outputs settings

For each SSR output **SSR1** to **SSR5**, a separate section with parameters is available:

- **OUTPUT TYPE:**
 - **Disabled** — the output is not used.
 - **Read** — the output is controlled by a supervisory QA application.
 - **Write** — the output can be controlled directly via the child tile.
- **MODE BELOW LIMIT** — SSR control mode for power **up to** the set **MODES LIMIT** threshold.
- **MODES LIMIT** — threshold (in %) between the below-limit mode and the above-limit mode. If you do not require two modes, set it to **Disabled** — the output then uses only the below-limit mode.
- **MODE ABOVE LIMIT** — SSR control mode for power **above** the set threshold.
- **PHASE** — number of the phase to which the SSR output is connected. It must correspond to the actual connection to the grid phase and to the phase on which the inverter measures the power.

Each SSR output can therefore have two control modes — **below limit** and **above limit**. If a compatible SSR relay with instantaneous switching (IO) is available, it is advisable to set the phase control mode for low power (fine regulation without blinking and flicker) and the zero-crossing mode (ZC) for higher power — this minimises interference at high power.

Available modes:

- **Off/On** — simple binary switching.
- **Phase Control IO** — phase control with instantaneous switching during each half-wave (minimises blinking and flicker).
- **PWM Distributed IO / PWM Distributed ZC** — pulse-width modulation with distributed waves (with instantaneous switching IO or at zero ZC).
- **PWM Grouped IO / PWM Grouped ZC** — pulse-width modulation with grouped waves.
- **Phase Control 2F IO** — phase control of a phase-to-phase load using two SSRs.
- **PWM Distributed 2F IO / PWM Distributed 2F ZC / PWM Grouped 2F IO / PWM Grouped 2F ZC** — pulse-width modulation of phase-to-phase loads using two SSRs.
- **PWM Distributed 3F ZC / PWM Distributed 3F ZC Slave / PWM Grouped 3F ZC / PWM Grouped 3F ZC Slave** — pulse-width modulation of three-phase loads using 2 SSRs (Master / Slave variants for mutual synchronisation of the outputs).

Details of the individual modes are given in the EX01PV module documentation.

Warning

For correct function, it is necessary to set both the correct power of the connected load and the phase that corresponds to the phase numbering on the inverter. The installation must have uniform phase labelling and direction of the rotating field.

Module settings

- **Module ID** — internal identifier of the module within the controller for integration and use of several modules in one system.

Reading periods settings

- **READING PERIOD-DIGITAL INPUTS** — interval for reading the state of the digital inputs (e.g. 30 s).
- **READING PERIOD-ANALOG INPUTS** — interval for reading the values of the analog inputs (e.g. 30 s).
- **READING PERIOD-OUTPUTS** — interval for reading the state of the outputs (e.g. 5 min).

Choose the periods carefully with regard to the load on the Modbus RTU bus. The application does not manage the traffic on the bus — with a higher number of devices or intervals that are too short, communication collisions may occur.

Communication settings

- **Unit ID** — address of the EX01PV module on the Modbus RTU bus.
- **BAUD RATE** — transmission speed of the Modbus RTU bus (typically 9600 Bd).
- **PARITY** — parity of the bus (typically None).

IP address settings

- **IP Address** — IP address of the Modbus TCP / RTU converter.
- **MAC Address** — MAC address of the converter.
- **MAC ADDRESS** — selection of the converter from the list of devices found in the network.
- **SEARCH NETWORK** — starts a search for available Modbus TCP converters in the unit network. When the search is complete, the converter can be selected in the **MAC ADDRESS** field.

Saving and status

- **Run status** — operating state of the application. After saving the configuration, it must be **Running**.
- **SAVE** — saves the current configuration to the module and restarts the application. After pressing it, wait until **Run status** changes back to **Running**.

“Testing” card

The card is used to verify the correct wiring of the SSR outputs, to calibrate the power and to verify the correct phase assignment in cooperation with the inverter QA application. Once both applications are connected, the **Inverter Load Phase Power** table gradually displays the current power of the individual phases measured by the inverter.

Procedure for testing the wiring, power and phase order

1. **Switching on the test mode** — press the **TESTING** button on this card and at the same time switch on the test mode in the compatible inverter application. Once connected, rows with the time and the values **R [W]**, **S [W]** and **T [W]** start to appear in the **Inverter Load Phase Power** table.
2. **Checking the ZeroCross state** — verify that **ZeroCross Status** is **Valid**. Without valid detection, SSR control will not work.
3. **Setting the display offset (optional)** — if other loads or PV generation are already contributing to the measured power, press **Set** — the current phase power values are stored as an offset for display and in the following rows you will only see the **change** in power since the button was pressed. Press **Reset** to clear the offset again.
4. **Testing the individual SSR outputs** — using the **SSR1** to **SSR5** sliders (range 0–100), gradually add power to the individual outputs and watch on which phase (**R / S / T**) the power increases in the table. If the power increase corresponds to the phase set for the given SSR output on the **Device settings** card, the wiring is correct. If the power increases on a different phase, correct either the phase number in the SSR output settings or the physical wiring.
5. **Testing the analog output (optional)** — use the **AO1** slider (range 0–10) to verify the function of the 0–10 V analog output.
6. **Ending the test** — press the **TESTING** button again to end the test mode (and do the same in the inverter application).

Card elements

- **ZeroCross Status** — zero-crossing detection state of phase 1.
- **Inverter Load Phase Power** — table with the time and the values **R [W]**, **S [W]** and **T [W]** (single- to three-phase measurement).
- **SSR1 – SSR5** — sliders 0 to 100 for manual control of the individual SSR outputs during the test.
- **AO1** — slider 0 to 10 for manual control of analog output 1.
- **Display offset setting** — the **Offset [W]** row with the current offsets of the individual phases and the **Set / Reset** buttons.
- **TESTING** — button for switching the test mode of the application on / off.

Notes

To evaluate the module's long-term behaviour, archive input and output values and plot the energy consumption of switched loads, we recommend connecting to **Mervis SCADA** (value export, graphs, history). Mervis SCADA allows you to monitor input temperatures, SSR output usage and ZeroCross detection status over time.

For controlling DHW heating via the SSR outputs and temperature sensors of the EX01PV module, we recommend a connection to the **QA DHW Boiler** application (or **QA DHW Boiler 2 Heating Elements 6SSR** for larger installations).