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ENERGY FLOW MANAGEMENT USING THE FOUR DIGITAL OUTPUTS OF FRONIUS GEN24 & GEN24 PLUS INVERTERS

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Business Unit Solar Energy

CONTENTS

1 INTRODUCTION

Photovoltaic systems are generally equipped with controllable loads to increase the degree of self-consumption and autonomy. High self-consumption means consuming as much of the energy produced as possible at source, while autonomy means drawing as little energy as possible from the grid, i.e. being as self-sufficient as possible.

To achieve these goals, a Fronius Smart Meter is installed on the household connection. This device measures how much power is fed into the grid and how much is drawn from the grid.
If more power is generated by the PV system than is consumed in the household, this results in a PV surplus. If more power is required than is generated by the PV system, electricity is drawn from the grid.

With Fronius Ohmpilot and the Fronius battery storage solutions, Fronius offers products that can be tailored specifically to the system to help increase self-consumption levels and/or provide a greater degree of autonomy. These solutions enable the system to extract heat from the surplus energy to heat hot water, for example, and allow the sur[Plus] energy obtained during the day to be stored so it can be used at night. And that’s not all, loads can now be controlled using four digital outputs in such a way that they use PV energy as a matter of course.

2 CABLING

2.1 Circuit diagram

The circuit diagram shown overleaf is a typical example featuring an external relay and manual switching, e.g. to manually activate a pool pump for backwashing purposes. Relays with integrated Auto-On-Off switching can also be used.

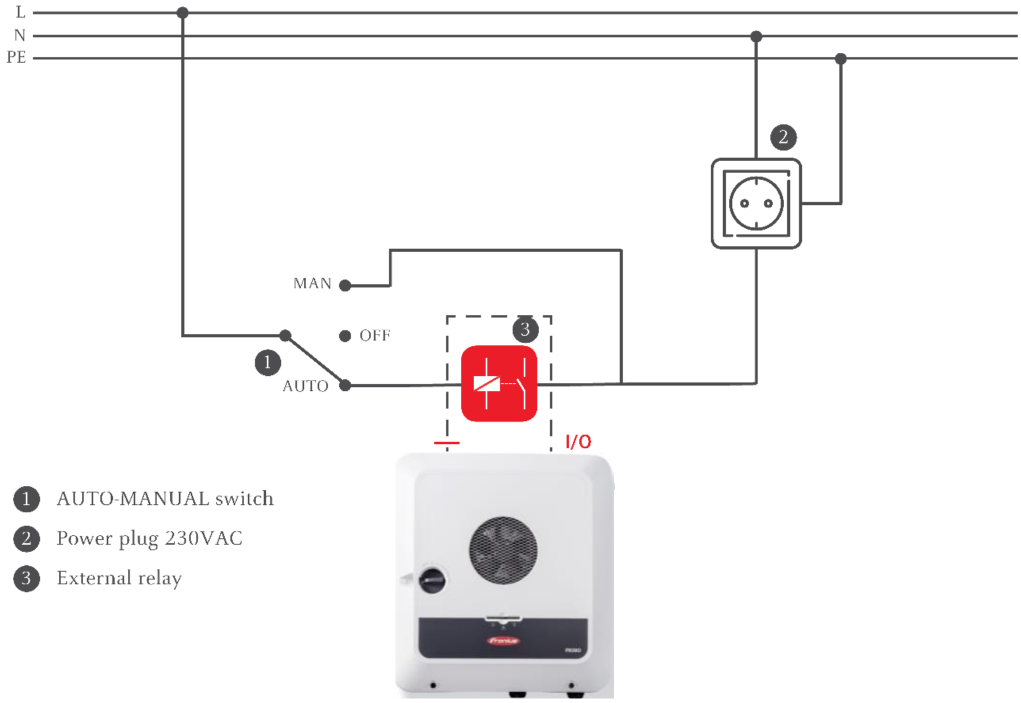


Figure 1 – Typical circuit diagram

2.2 Examples of relay types

Refer to the technical specifications when choosing the relay (coil power max. 3.2 W, coil voltage, switching voltage and switching current). Examples of suitable relays are shown below:

Figure 2 - FINDER relay 48.31.7.012.0050 4C series – 10A, 12VDC + DIN rail mounting; series 48

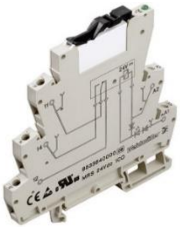
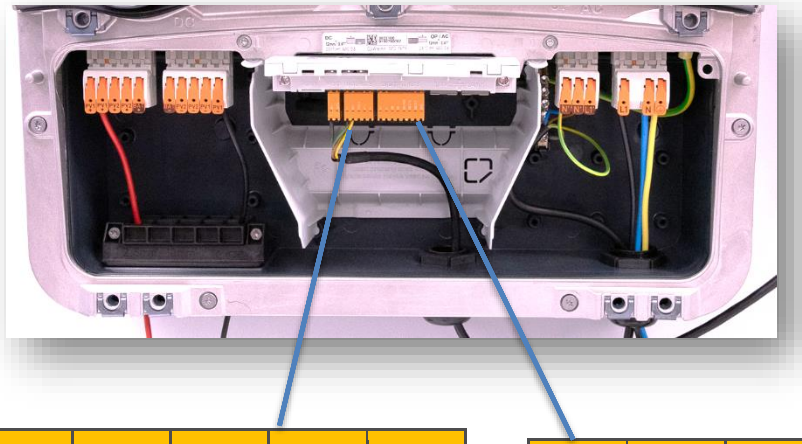


Figure 3 - Weidmüller relay 6A -MRS 12 VDC 1CO 1 changeover contact

Figure 4 - FINDER 12 V DC Relay 19.91.9.012.4000

2.3 GEN24 [Plus] inverter interface

The Fronius GEN24 [Plus] inverters offer some additional functions, such as a Modbus RTU (RS 485) interface to a Fronius Smart Meter (M-, M+, Gnd). More information about the installation and commissioning of the Smart Meter can be found at https://www.fronius.com/en/solar-energy/installers-partners/service-support/tech-support/how-to-install/installation-guide-gen24-plus



V+	M0+	SHIELD	M1+	V+
GND	M0-	SHIELD	M1-	GND

V+	V+	IO0	IO2	IO4/RG0	IN6/1/5	IN8/3/7	IN10
GND	GND	IO1	IO3	IO5/CL0	IN7/2/6	IN9/4/8	IN11

Figure 5 – 10-pole plug with 2 Modbus RTU, 16-pole plug with the digital I/Os (IO 0 to IO 3)

3 CONNECTING: USING THE WEB INTERFACE

1. Put your finger on the area between the 2 LED's to activate the Wi-Fi Access Point of the inverter.

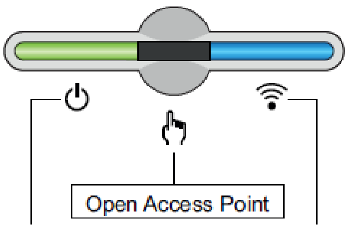


Figure 6 - Activating the Access Point on the inverter

2. Connect your end device to the Wi-Fi Access Point
   a. Search for the "FRONIUS_xxx.xxxxx" network on the end device
   b. Establish a connection to this network
   c. Enter the password: 12345678
   d. Enter 192.168.250.181 (IP address of the WLAN connection) from the browser on the end device. If using a LAN, enter 169.254.0.180.

For further information relating to establishing a connection, see the Operating Instructions of the Fronius inverter.

4 ACTIVATING THE DIGITAL OUTPUTS

Loads can be controlled on the basis of the PV surplus or the amount of PV energy produced by activating four digital outputs on the inverter. Loads such as pool pumps, fountains, electric vehicle charging points, air-conditioning systems, etc. can be controlled using a series-connected relay. The first step is to activate the digital outputs that are going to be used to control the loads. This can be done from GEN24 [Plus] web interface.

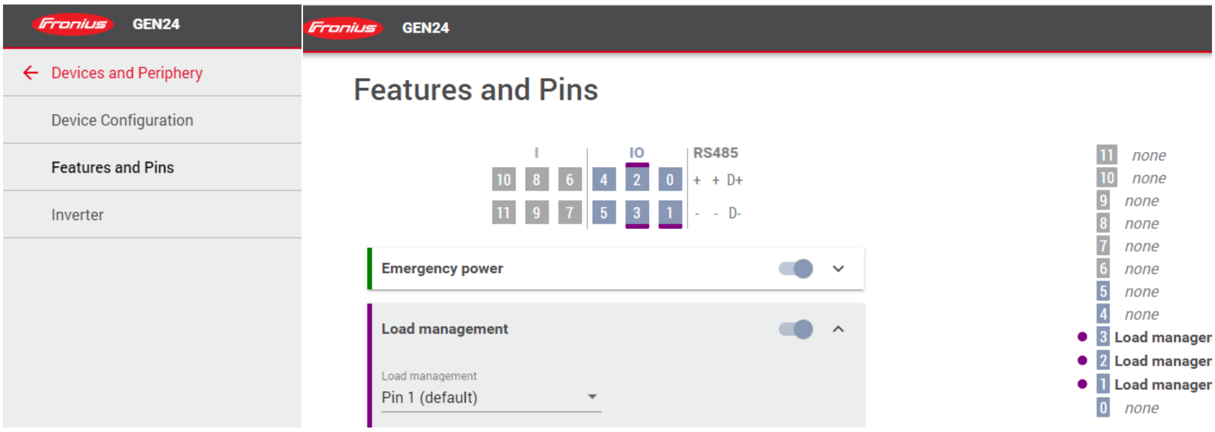


Figure 7 - Activating digital outputs for load management

5 CONFIGURING THE DIGITAL OUTPUTS

The second step involves configuring each output in turn.

5.1 Control

The output can be controlled on the basis of the surplus at the grid feed-in point or the amount of PV energy produced. The former option can only be selected when a Fronius Smart Meter has been connected and activated to the inverter.

5.2 Thresholds

Thresholds must be defined so the inverter knows at what power level the output is to be activated or deactivated. Note that in the case of the activation threshold, the power of the connected load will be taken into account if control “on the basis of surplus power” was selected. A hysteresis should also be specified to prevent the load switching too often whenever small changes occur at the feed-in point.

A pool pump rated at 1000 W might operate with an activation threshold of 1200 W and a deactivation threshold of 0 W, giving a hysteresis value of 200 W.

5.3 Durations

Selecting a minimum duration prevents switching occurring too frequently in situations where solar radiation or surplus energy levels are constantly changing, as excessive switching reduces the service life of the load. Specifying a minimum duration ensures that once the load is activated, it will remain on for that long, even if the relevant parameter falls below the deactivation value.

The maximum duration limits the amount of time the load is on every day. For example, there is not much point in operating a pool pump for more than eight hours a day, even if there is still some surplus energy available at the end of the day. The individual durations for each load are added up across the day.

The target duration guarantees that the load will have been running for at least the defined duration by a specific time. Taking the example of the pool pump again, the pump should run for at least four hours a day in order to maintain water quality. We recommend setting the point at which the target duration will be reached some time before sunset to ensure that at least some of the surplus energy can be used to drive the pump. If the time is set for 6 pm, and the pump has only been running on this particular day for two hours, then the output will be activated at 4 pm.

5.4 Prioritisation

Priorities have to be defined for the battery, Fronius Ohmpilot and load management IOs. Note that the load management IOs are prioritised according to their activation thresholds, meaning that the load management IO with the lowest power value switches first. If two load management IOs have the same activation threshold, the one higher up the list will switch first.

5.5 Status

Hovering the cursor over the status causes the reason for the present status to be displayed.

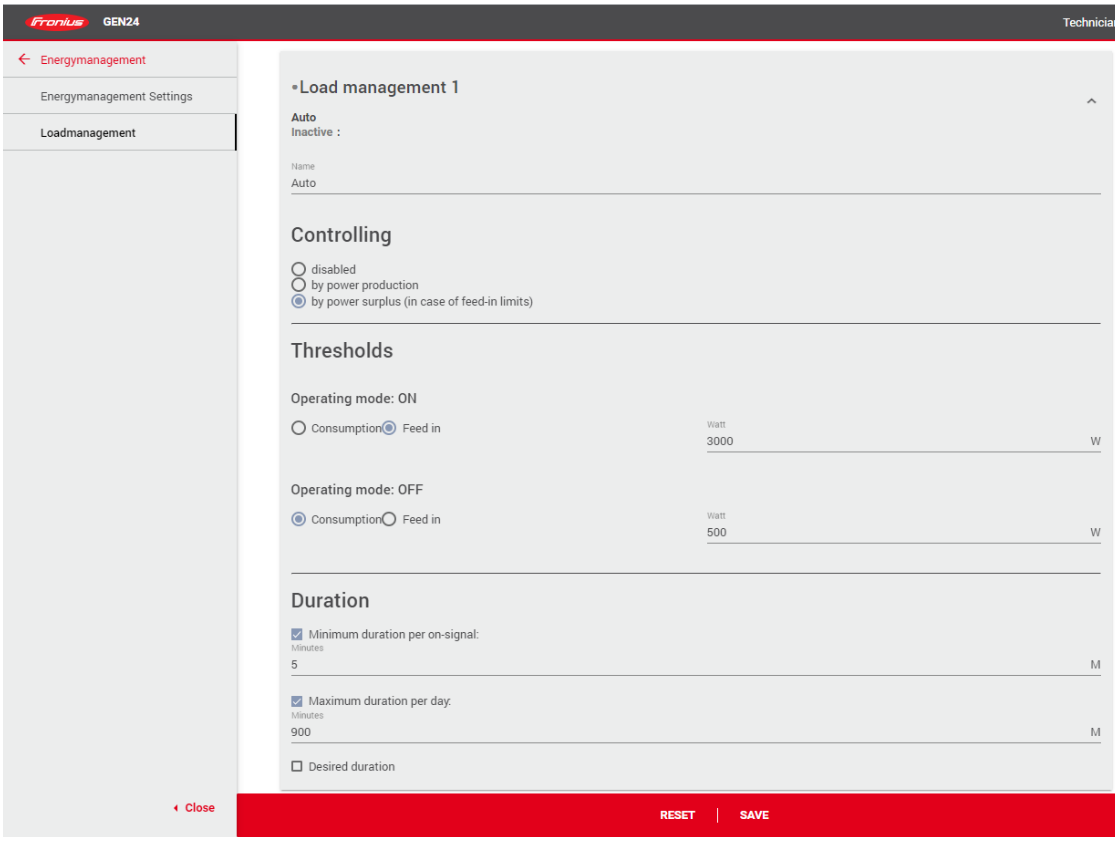


Figure 8 - Configuring one load management output

6 APPLICATION EXAMPLES

6.1 Battery, Fronius Ohmpilot and pool pump

A pool pump connected to load management IO1 via a contactor must be activated before any energy can be stored in the battery, which is intended to be used primarily during the night. The heating rod has the lowest priority, as the minimum water temperature is provided from the central heating system and is regulated by Fronius Ohmpilot.

Prioritisation:

1 … Load management IO1 with 1000 W pool pump, maximum duration per day = 4 hours

2 … Battery

4 … Fronius Ohmpilot with 6 kW heating rod

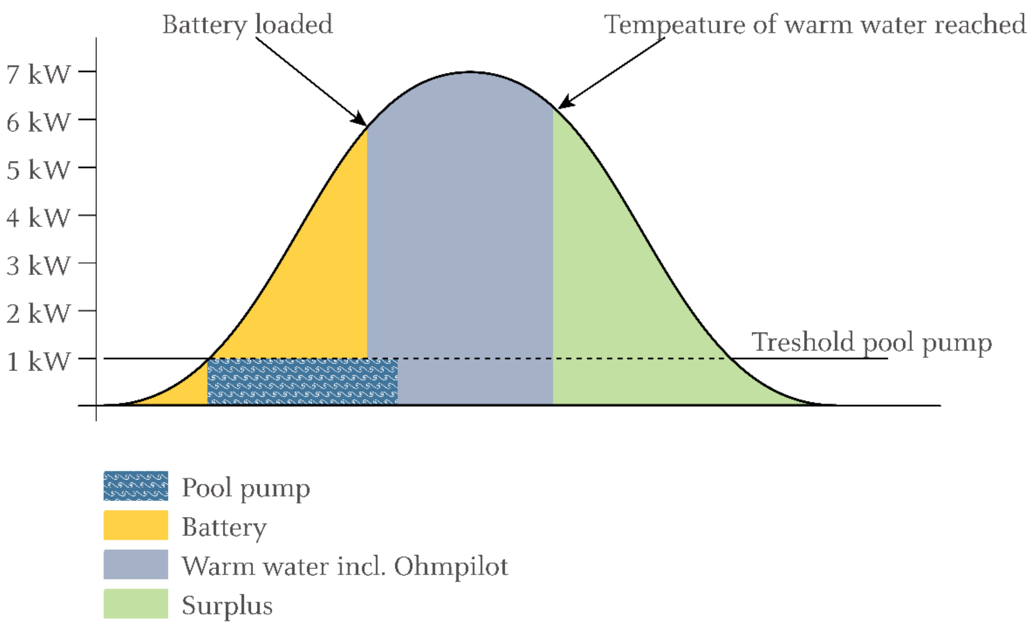


Figure 12 - Power distribution

6.2 Fronius Ohmpilot, pool pump, electric vehicle

The pool pump and wallbox are connected via load management IO1 and IO2. Load management IOs are allocated the highest priority. The lower power threshold means that the pool pump is activated before the wallbox.

Prioritisation:

1 … Load management IO1 with 1000 W pool pump, maximum duration per day = 4 hours

2 … Load management IO2 wallbox with 3000 W activation threshold and -1000 W deactivation threshold

3 … Battery

4 … Fronius Ohmpilot with 9 kW heating rod

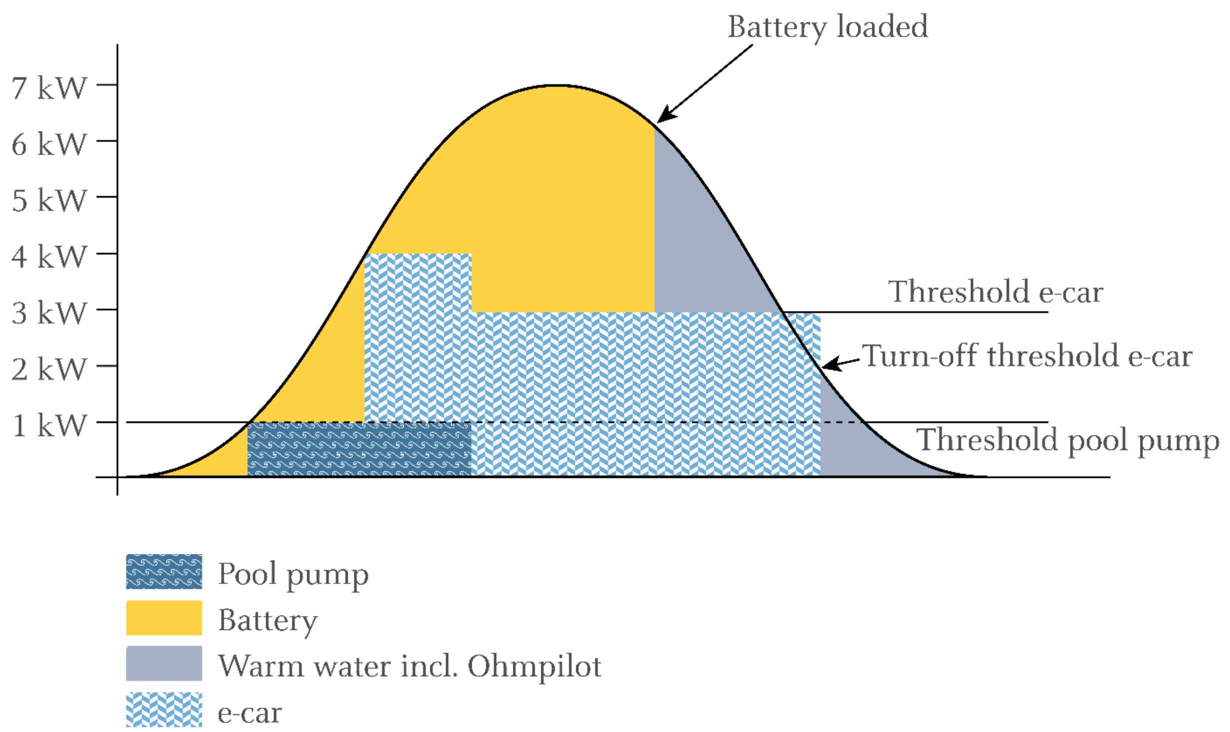


Figure 13 - Power distribution

7 FURTHER INFORMATION

Visit www.fronius.com for additional information on this subject.

Refer to “Fronius Energy Profiling” for a visualisation of the individual loads in Fronius Solar.web.
The Fronius Ohmpilot is the ideal solution for heating hot water or when generating warmth of any sort from your own electricity, as it can consume this PV surplus up to 9 kW.

For loads that are mainly active during the night, the Fronius battery storage solutions is the recommended approach, as surplus energy is temporarily stored in a battery.

Other White Papers: “E-Mobility solutions - Intelligently charging an electric car at home with PV energy”
“Heat pump control with Fronius energy management”