webdyn

Flexitron group

Application note

Power regulation using the WebdynSunPM

Introduction

This application note describes how to configure and parameter the WebdynSunPM product in the specific case of power regulation on a photovoltaic production site. The purpose is to explain how the power regulation script designed by Webdyn's design office works. The use of the "ActivePowerRegulation-Vx_xx" power regulation script requires a paying licence. To purchase a licence, contact the Webdyn sales department (https://www.webdyn.com/contact).

Expression of needs

A regulated injection site is one of which renewable energy production is essentially for local use. The amount of energy injected into the public Grid must be kept to a minimum or controlled around a required value, and mainly used by local electric installations.

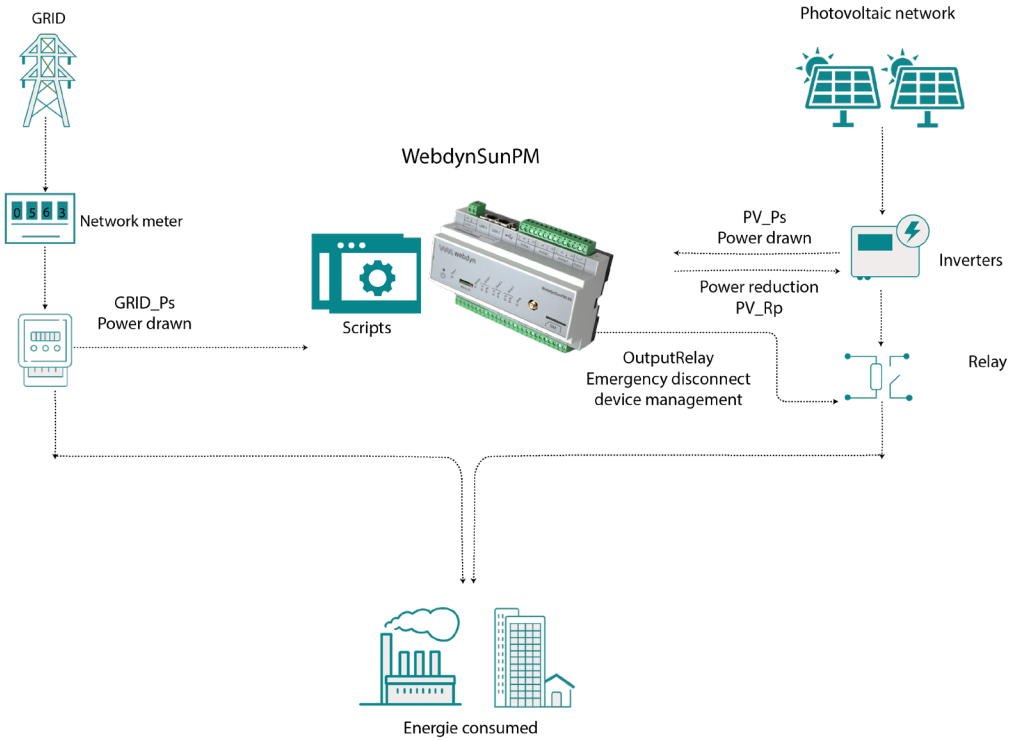
The objective is therefore to be able to reduce photovoltaic production depending on the energy consumption of an industrial site.

Synopsis

The WebdynSunPM product is used to control photovoltaic production depending on the site's actual electricity consumption.

Production control is local using an LUA scenario that:

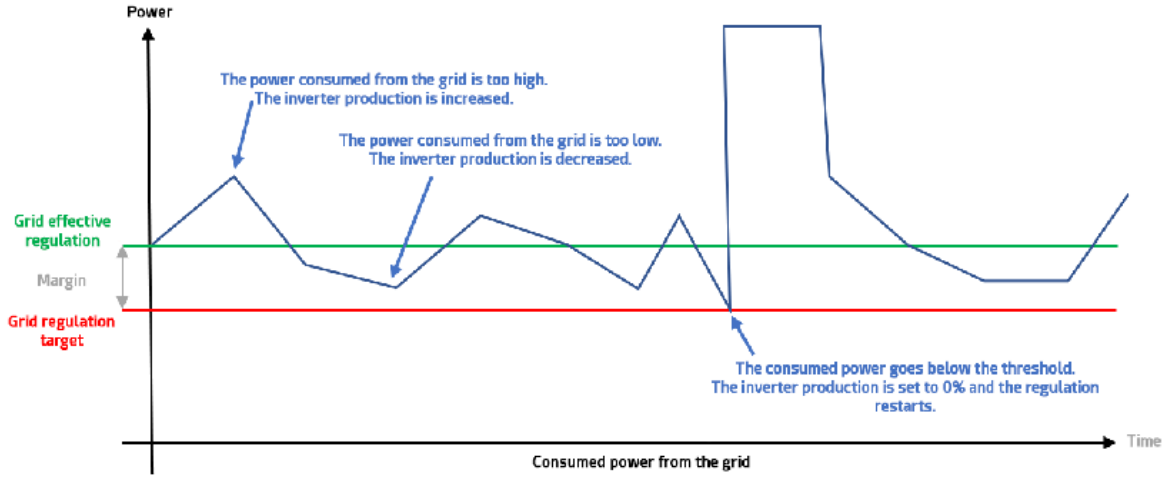
- Analyses site consumption read from an electric meter.
- Analyses energy production by querying the power inverters.
- Reduces or increases this energy production depending on actual site consumption.



Power regulation management

The WebdynSunPM script sends active power set points in a dynamic control loop, and adapts the photovoltaic plant's power limitation to the required power drawn from the GRID to meet the customer site's energy needs.

The script takes into account the GRID energy meter and regulates the photovoltaic according to the mode chosen in the "Grid regulation type" parameter. If the chosen setting is consumption, then the script will respect zero injection. If the chosen setting is injection, the script will regulate around a required value. The target value for the power drawn from the GRID can be configured using the "Grid regulation target" parameter.



If the power consumed minus the photovoltaic production is higher than the "Grid regulation target" threshold with its predefined "Grid effective regulation" margin on the GRID, the photovoltaic production is considered to be insufficient: the inverter production is increased accordingly. If the power consumed minus the photovoltaic production is lower than the "Grid regulation target" with its "Grid effective regulation" margin predefined on the GRID, the photovoltaic production is considered to be too high: the inverter production is reduced accordingly. The "Grid regulation target" parameter acts as a safety threshold below which the power drawn from the GRID measured by the energy meter must not fall. When the power drawn from the GRID drops below this threshold, the photovoltaic regulation switches to 0% (the inverters stop producing) and the regulation starts again from the new read values. The inverter regulation time depends on the "Regulation speed" parameter value.

For unbalanced phases on three-phase equipment, if the "Phase control" parameter is set to "Min of the 3 phases" mode, then the WebdynSunPM script takes into account the power of the lowest phase.

For single-phase installations, the "Phase control" parameter of the script must be set to "Single phase or sum of the 3 phases".

Specific operation

When the script starts, a transient phase occurs during the inverter regulation time, this time depends on the "Regulation speed" parameter. The regulation always starts by setting the inverters to 0%.

Restarting or updating the WebdynSunPM causes the inverters to stop and then restart.

If communication with a device (inverter or energy meter) is lost, or if the script stops, the script triggers the operation selected in the "On error" parameter. When the fault disappears, the script restarts the regulation.

Prerequisite

The regulation is carried out by a scenario which is a LUA script built into the WebdynSunPM from version 4.3.1 onwards (a manual import of the script is possible). To be able to use, understand and/or parameter the regulation script, it is essential to:

- Have a WebdynSunPM with an "ActiveControl" license which is marketed by the Webdyn sales department (https://www.webdyn.com/contact).
- Have an operational installation including an energy meter on the GRID, inverters, and a configured WebdynSunPM concentrator,
- Have the WebdynSunPM user manual to hand.

Photovoltaic production regulation is achieved by coupling the inverters using a LUA scenario.

This proprietary ".luaw" script specifically designed by Webdyn which includes the purchase of a Webdyn licence is available. In that case, please contact the Webdyn sales department, which will be able to advise or to request the script in a specific version: contact@webdyn.com

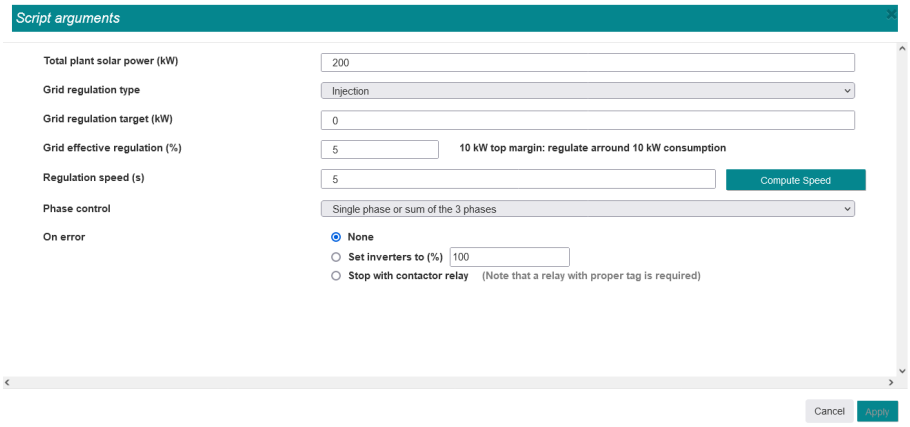
Lua script explanation

The script must be configured according to your site and your equipment. You can configure the script using the web interface or using the remote server (see section 3.1.2.1.4: "File " _scl.ini" " and section 4.1.6: " "SCRIPT" scripts" in the WebdynSunPM manual).

Script log files are available on the concentrator. It may be useful to use them to monitor the photovoltaic production regulation evolution. (See section 4.1.8.2: “script log” in the WebdynSunPM manual).

Script configuration depending on the installation

The script configuration can be accessed remotely using the "<uid>_scl.ini" file (See WebdynSunPM manual in section 3.1.2.1.4: “File “<uid>_scl.ini” “) using the web interface “Settings” button, and a specific window is reserved for it:



The script parameters are the following:

Script parameter name in the web interface	Parameter name in the "<uid>_scl.ini" file	Description	Type	Default value
Total plant solar power	solarRatedPowerKW	Maximum solar plant power in kW	Positive integer	200
Grid regulation type	gridRegulationType	Regulation type: • injection: The regulation target value (gridRegulationTargetKW) is a (positive) injection value: see below. • consumption: The regulation target value (gridRegulationTargetKW) is a (positive) consumption value: see below.	List: • injection • consumption	injection
Grid regulation target	gridRegulationTargetKW	Regulation target value in kW, the operation of this value depends on the type of regulation (gridRegulationType) • injection: The regulation target value (gridRegulationTargetKW) represents the maximum value that can be injected. • consumption: The regulation target value (gridRegulationTargetKW) is the minimum value that is authorised for consumption.	Positive integer	0
Grid effective regulation	gridEffectiveRegulationPercent	in % of the installed solar power, this value is used to calculate the regulation operating point. This information indicates which margin is calculated in relation to the target (top margin) and what the actual value of the regulation is.	Positive integer	5
Regulation speed	regulationSpeedS	Time of each step of the regulation management in seconds	Positive integer	5

Phase control	phaseControl	Regulation management can be carried out in 2 ways: • Single phase or sum of the 3 phases (sum): On all the phases in three-phase or on one phase in single-phase. • Min of the 3 phases (min): On the weakest phase (only possible for a three-phase installation)	List: • sum • min	sum
On error	errorAction	In the event of an equipment error or script stoppage, 3 scenarios can be selected: • none: Current regulation • Set inverters to (setTo): Percentage control relative to a value indicated in the "setToPercent" parameter • Stop with contactor relay (stop): Relay opening (set the relay using the "RelayOutput" tag)	List: • none • setTo • stop	none
	setToPercent	Percentage of the required power in the event of an error. (Only if the "errorAction" parameter is in "setTo" mode)	Positive integer	100

On the web interface, the "Compute speed" button can be used to best adapt the script regulation speed relative to the equipment entered on the WebdynSunPM. The concentrator will take into account the polling time for each declared equipment and multiply it by two for safety reasons, the determined value will then be entered in the "Regulation speed" parameter. Make sure all equipment is declared and operational before pressing the button.

“<uid_sc.ini>” file example:

```
SCRIPT_Args[0]={"solarRatedPowerKW":200,"gridRegulationType":"injection","gridRegulationTargetKW":0,"gridEffectiveRegulatio
nPercent":5,"regulationSpeedS":5,"phaseControl":"sum","errorAction":"none","setToPercent":100}
SCRIPT_Enable[0]=0
SCRIPT_File[0]=ActivePowerRegulation-V1_02.luaw
```

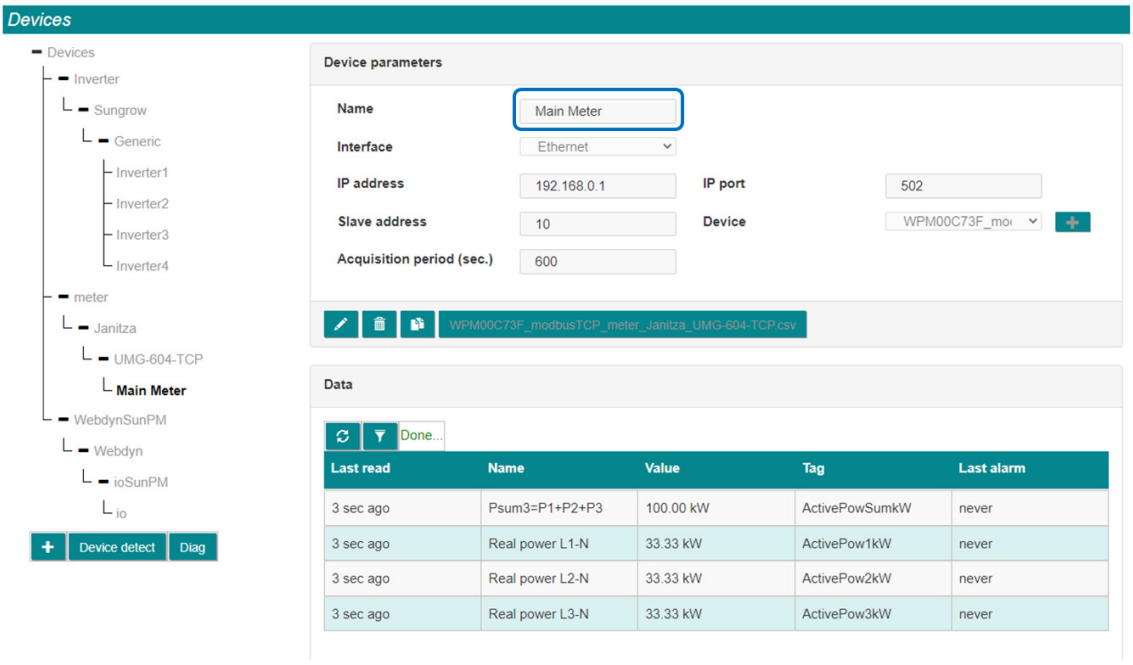
1) Configuring the electricity GRID energy meter

The electricity GRID Meter equipment connected to the concentrator must be identified in the concentrator acquisition file to be able to retrieve its data. Set the Meter Name field (“Name” field, column 3) of the device to "Main Meter".

When adding the equipment to the concentrator, simply select the "Device" equipment to obtain the equipment definition file that will be automatically generated by the WebdynSunPM.

Example of equipment configuration taken from an acquisition file (DAQ):

```
index;interface;name;address;acqPeriod(s);timeout(ms);serialNumber;parameters;manufacturer;model;defFile
IO;;io;;10;;;;WebdynSunPM;ioSunPM;WPM00C75B_IO.csv
1;SERIAL2;Inverter1;1;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
2;SERIAL2;Inverter2;2;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
3;SERIAL2;Inverter3;3;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
4;SERIAL2;Inverter4;4;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
5;192.168.0.1:502;Main Meter;10;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
```



Which, depending on the user's profile, may be correct or not. TITAN-based devices can return a personalized response for each ALIAS. Let's continue with the example, imagine that we want to receive the following responses:

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Variables "ActivePow1kW", "ActivePow2kW", "ActivePow3kW" and "ActivePowSumkW":

In the definition file (DEF) for the Meter device connected to the concentrator, the power variables must be identified and the following tags assigned to them using the device manufacturer's manual:

- Active power of phase L1 in kW: tag "ActivePow1kW" (Only for three-phase installations)
- Active power of phase L2 in kW: tag "ActivePow2kW" (Only for three-phase installations)
- Active power of phase L3 in kW: tag "ActivePow3kW" (Only for three-phase installations)
- Active power of the 3 phases in kW: tag "ActivePowSumkW"

The "Tag" fields are available in column 7 of the device.

Example of power tags taken from a Meter definition file (DEF) for a three-phased installation:

```
modbusTCP;meter;Janitza;UMG-604-TCP
1;4;19020;F32;;Real power L1-N;ActivePow1kW;0.001000;0.000000;kW;4
2;4;19022;F32;;Real power L2-N;ActivePow2kW;0.001000;0.000000;kW;4
3;4;19024;F32;;Real power L3-N;ActivePow3kW;0.001000;0.000000;kW;4
4;4;19026;F32;;Psum3=P1+P2+P3;ActivePowSumkW;0.001000;0.000000;kW;4
```

Example of power tags taken from a Meter definition file (DEF) for a single phase installation:

```
modbusTCP;meter;Janitza;UMG-604-TCP
1;4;19026;F32;;Real power L;ActivePowSumkW;0.001000;0.000000;kW;4
```

2) Inverter configuration

This step is normally already completed when the inverter is Modbus and uses a definition file automatically generated by WebdynSunPM.

In each definition file (DEF) for inverters connected to the concentrator, the following tags must be entered:

"Inverter" tag:

In the inverter definition file header, the category name must be entered, which must be identical for all the inverters. The category in the header ("Category" field in column 2) for the device must be called "Inverter".

“cmdPwrPercent” tag:

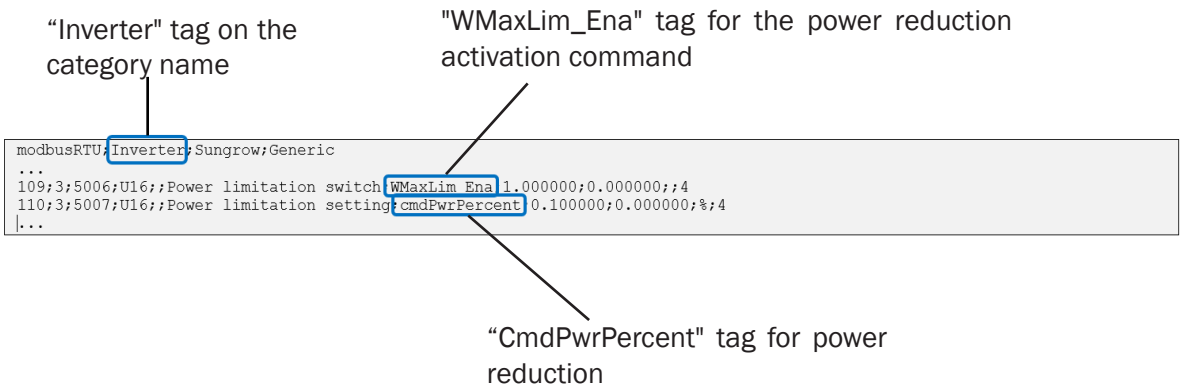
The power reduction variable must be identified In the inverter definition file. The power reduction variable tag (“Tag” field in column 7) for the device must be called “cmdPwrPercent”. This tag must be identical for all the inverters. If that is not the case, they must be modified so that they are all identical.

"WMaxLim_Ena” tag optional:

The control variable for activating the power change must be identified in the inverter definition file. The power change activation command variable tag (“Tag” field in column 7) for the device must be called “WMaxLim_Ena”.

This tag must be identical for all the inverters. If that is not the case, they must be modified so that they are all identical.

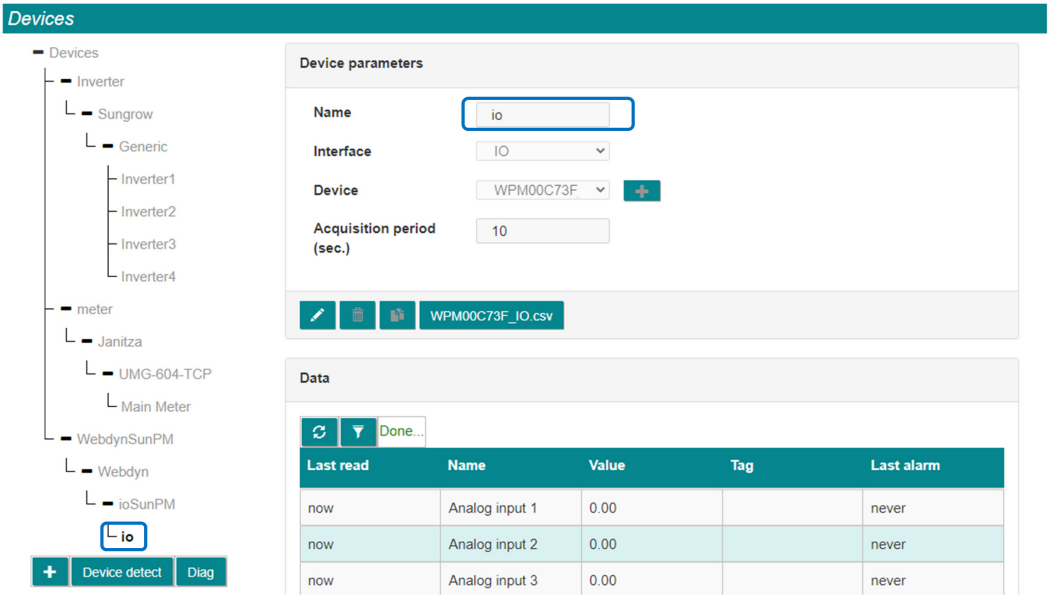
Example of inverter category and tags taken from an inverter definition file (DEF)



3) Relay output configuration (only if the "onError" parameter is "stop" (Stop with contactor relay))

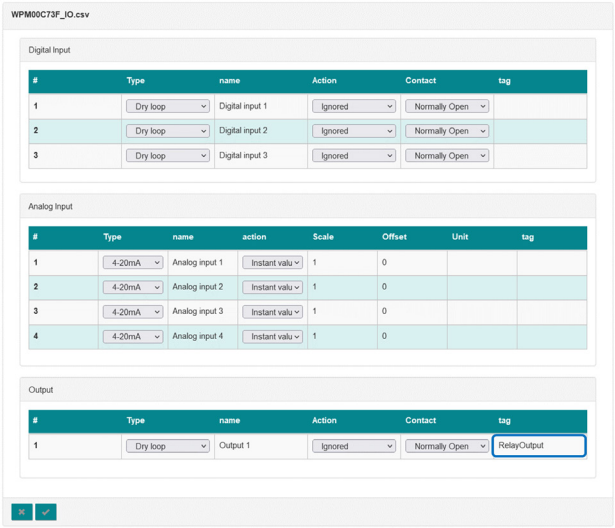
This step is normally already complete if you haven’t changed the WebdynSunPM default configuration.

A tag must be added to the internal relay which is part of the WebdynSunPM’s default "ioSunPM" device. To edit the “ioSunPM” device, first select the device to edit:



Check that the device name is "io". If not, the device will need to be edited to change its name.

Then click the device definition file:



Add the "RelayOutput" tag to the "Output 1" output and validate the modification.

Example of a WebDynSunPM input and output definition file (DEF):

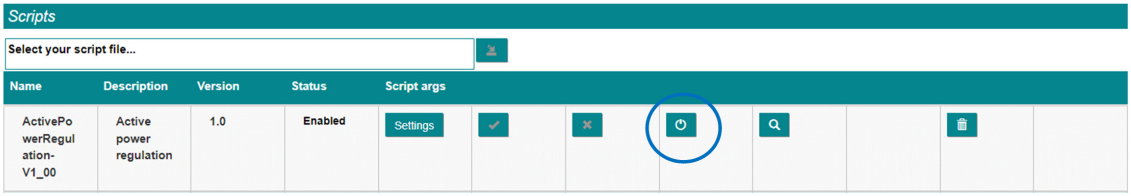
“io” device name

```
io;WebdynSunPM;Webdyn;ioSunPM
1;2;1;1;;Digital input 1;;1.000000;0.000000;;0
2;2;2;1;;Digital input 2;;1.000000;0.000000;;0
3;2;3;1;;Digital input 3;;1.000000;0.000000;;0
4;1;1;1;;Analog input 1;;1.000000;0.000000;;4
5;1;2;1;;Analog input 2;;1.000000;0.000000;;4
6;1;3;1;;Analog input 3;;1.000000;0.000000;;4
7;1;4;1;;Analog input 4;;1.000000;0.000000;;4
8;3;1;;;Output 1;RelayOutput;1.000000;0.000000;;0
```

"RelayOutput" tag to control the WebdynSunPM output relay "Output1"

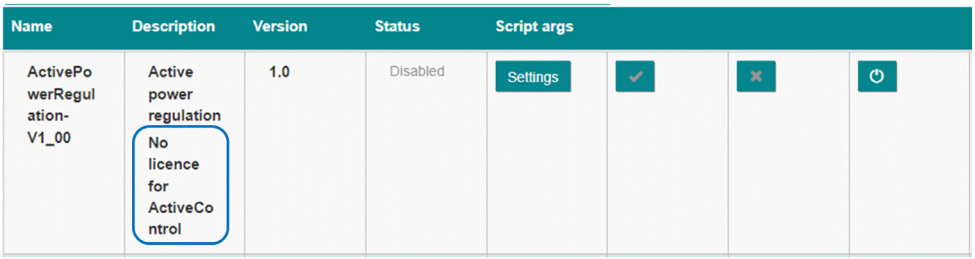
4) Activate the script

A specific button is used to enable and disable:



When the script is disabled, its status is greyed out and displays "Disabled". When the script is enabled, its status is black and displays "Enabled".

If the script remains "Disabled", an error message is displayed in the script description.



If a "No licence for ActiveControl" error message is displayed, the licence must be added to be able to enable the script. See importing a licence in the WebdynSunPM manual, section 3.1.2.1.5: "File "<uid>_licence.ini"" or section 3.2.3.1.1: "Import a script or a licence".

Webdyn cannot be held liable for any possible damage caused by the use of a script.

5) Script log

The study of the script logs makes it possible to follow and understand the inverter regulation assessment.

Example of photovoltaic regulation:

```
2023-01-13 17:07:49 [ActiveControl-V1_00.lua 648] tune;Main Meter:OK;state:running;
gridMeterEffectiveRegulationKW:10.00;gridMeterRegulationTargetKW:0.00;meterValue:100;invPwr:100;loop:2.0
```

Description of the log values:

- tune: indicates that the regulation is active
- Main Meter:OK: indicates that the GRID energy meter is present
- state:running: indicates that regulation is in progress
- gridMeterEffectiveRegulationKW:100.00: regulation target power
- gridMeterRegulationTargetKW:10.00: regulation threshold
- meterValue: 100: total current power of the main source, here the GRID
- invPwr: 100: actual percentage of photovoltaic power
- loop:5.0: time in seconds of the regulation management

Example of a photovoltaic regulation problem:

```
2023-01-13 17:07:49 [ActiveControl-V1_00.lua 648] set;Main Meter:OK;state:error;
gridMeterEffectiveRegulationKW:10.00;gridMeterRegulationTargetKW:0.00;meterValue:0;invPwr:0;loop:2.0
```

Description of the log values:

- set: indicates that there is a problem with the regulation and that the inverter is set to the "setTo" setpoint
- Main Meter:OK: indicates that the GRID energy meter is present
- state:error: indicates that the regulation is in error
- gridMeterEffectiveRegulationKW:100.00: regulation target power
- gridMeterRegulationTargetKW:10.00: regulation threshold
- meterValue: 0: total current power of the main source, here the GRID
- invPwr: 0: actual percentage of photovoltaic power
- loop:5.0: time in seconds of the regulation management

This can be interpreted as an inverter polling problem.