



Solar-Log™
by Solare Datensysteme GmbH

MAXIMIZED SUNPOWER

Technical description of the Solar-Log¹⁰⁰⁰ PM+

Power management for photovoltaic systems of more than 100 kWp

From January 2009 onward, photovoltaic systems in Germany, with outputs of more than 100 kWp, must have the option of being reduced in their supplied effective power by their power companies (§ 6.1 EEG). In practice, this is accomplished by means of ripple control receivers that can signal a 4 stage effective power reduction.

In addition, since 1 July 2010 there have been extended reactive power control regulation requirements. Here, according to the medium voltage guidelines, the network operator can prescribe a $\cos \varphi$ shift factor to operate photovoltaic systems. 3 options are possible here: Setting a fixed value $\cos \varphi$, setting the $\cos \varphi$ in relation to a P/Pn characteristic curve or setting a $\cos \varphi$ that can be controlled by a ripple control receiver.

Since the Solar-Log¹⁰⁰⁰ PM+ performs control tasks as part of its power management, the approval and support of the respective inverter manufacturers are necessary.

➔ Interface



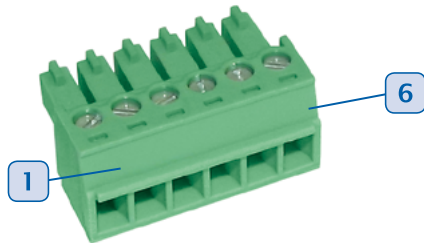
Easy to install

- The Solar-Log¹⁰⁰⁰ PM+ contains the appropriate hardware and software in order to comply with the requirements of grid safety management. Because of the numerous requirements from the power companies, the Solar-Log¹⁰⁰⁰ PM+ restricts itself to the most common connection and configuration options.
- The outputs of the ripple control receiver can be connected via 4 potential-free contacts. If required, by means of another contact, a distinction can be made between the signals of two different ripple control receivers with regard to the requirements for output reduction and reactive power control.
- The Solar-Log¹⁰⁰⁰ PM+ contains an additional interface to which up to two ripple control receivers can be connected.

Power management Output reduction

Hardware installation

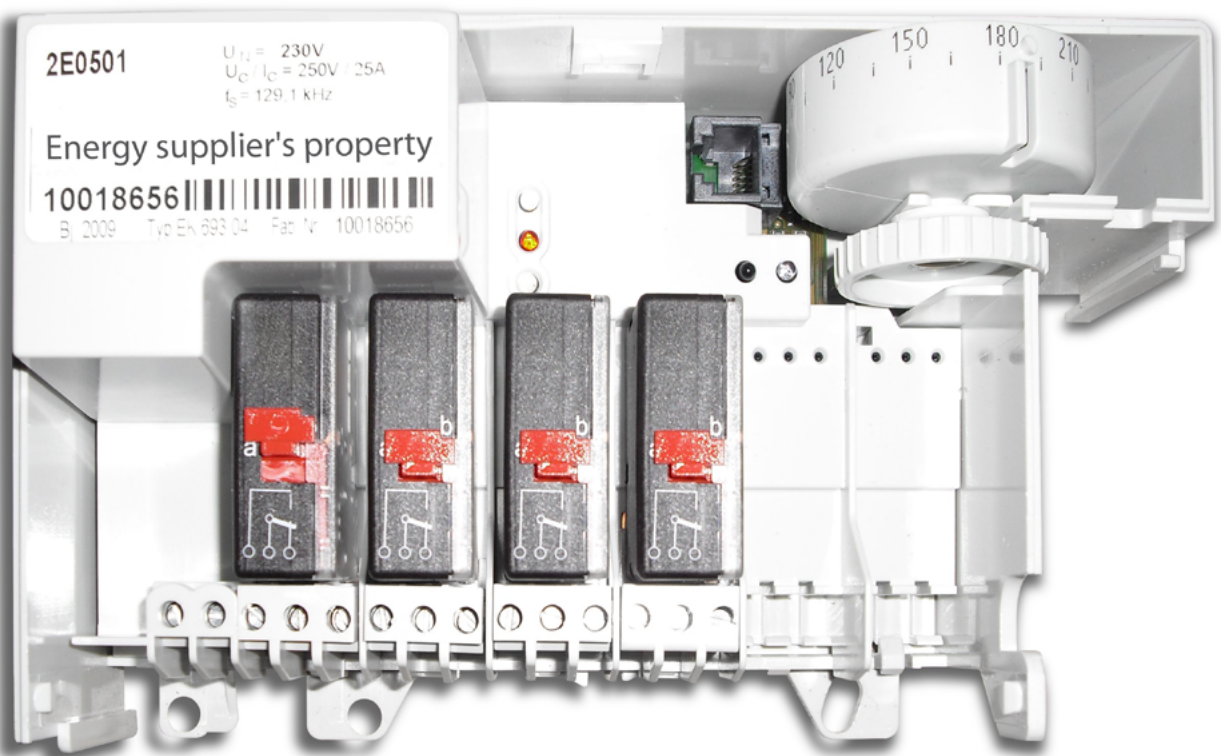
➔ 6 pin plug



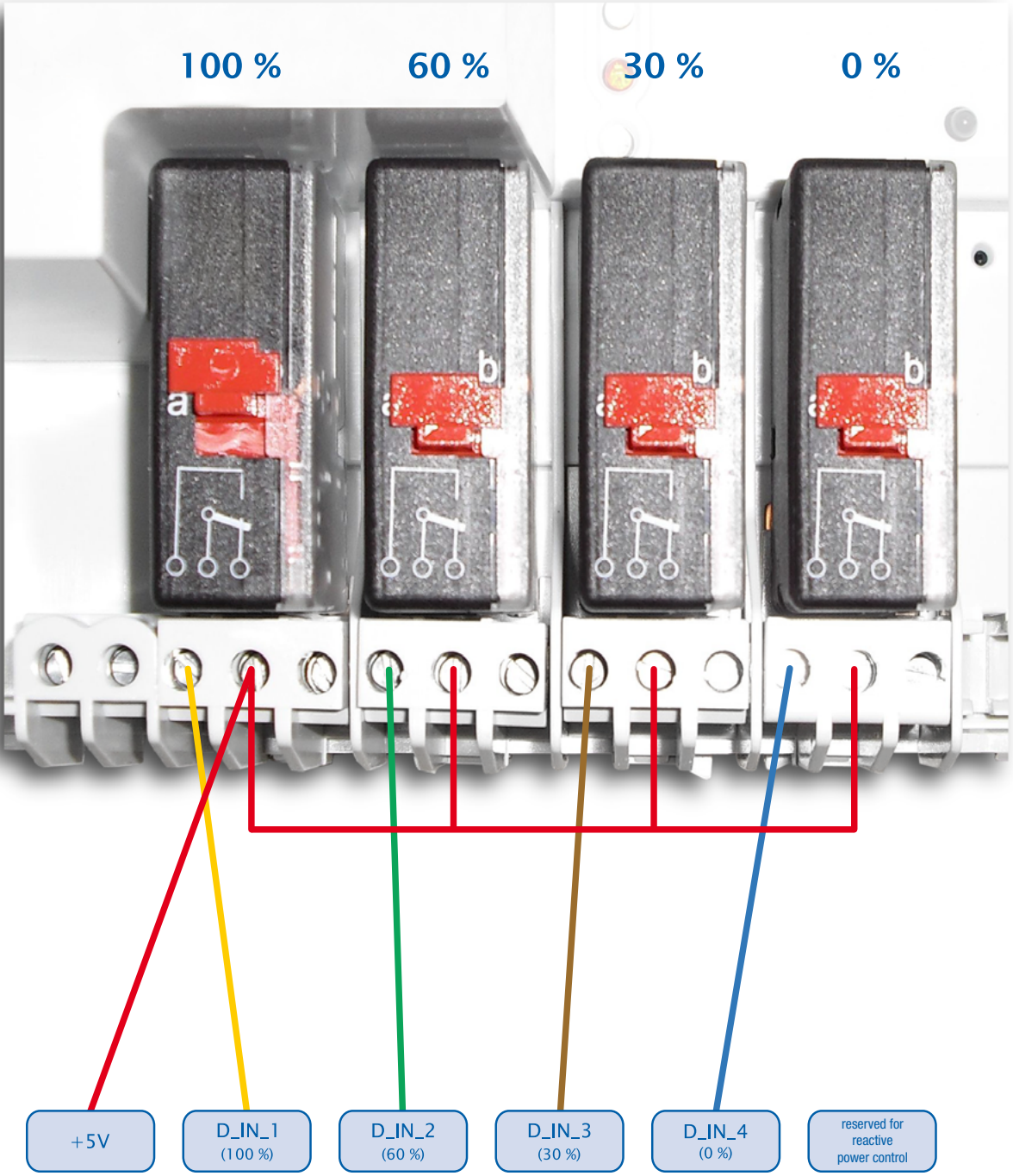
Pin	Allocation	Description
1	+5V	
2	D_IN_1	Level 1 (100%)
3	D_IN_2	Level 2 (60%)
4	D_IN_3	Level 3 (30%)
5	D_IN_4	Level 4 (0%)
6	+5V	reserved for reactive power control

To achieve the greatest flexibility the allocation of the digital inputs for a power reduction can be configured in several way. Therefore, the description above is only one of the possible configurations.

➔ Ripple control receiver (example)



Solar-Log¹⁰⁰⁰ PM+ ripple control receiver wiring



Solar-Log™ 6 pin plug

The feed-in management system is further configured by the Solar-Log™ web interface.

The dialogue box "Config. / Advanced / Feed-in management" is available:

■ Monitoring and logging

Monitoring and logging of the feed-in management system is disabled by default and must be enabled here. After this has been done, the Solar-Log™ logs any change in power, signaled via the digital inputs, into an event log with 200 memory cells. If data export has been enabled, an event log is written on the server within 5 minutes as a "JS" and as a "CSV" file for further analysis.

On the Solar-Log™ itself, a reduction in power is indicated by a flashing P LED, which makes it easy to check if it is working.

■ Adjusting the inverters

Depending on the inverter manufacturer the ripple control receiver signals can be connected directly to the inverters that then reduce the power automatically and independently of the Solar-Log™.

Despite this, it still makes sense to connect the Solar-Log™ to the inverter anyway in order to perform monitoring and logging, because the inverter normally has no logging or Internet connection. In this case, the power reduction setting should therefore be disabled in the Solar-Log™.

➔ Configuration

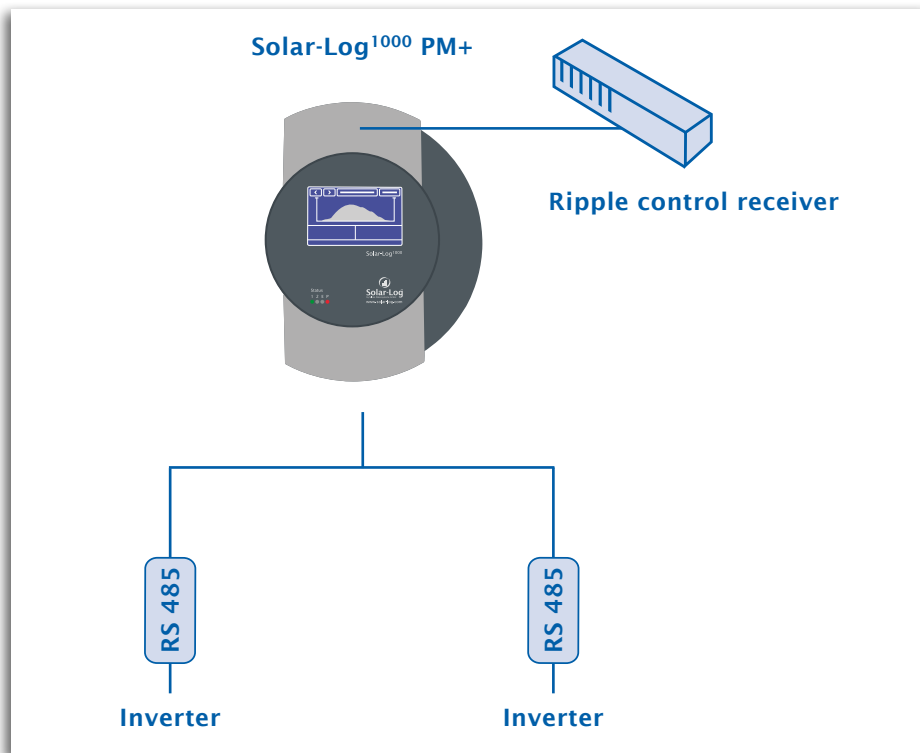
The screenshot shows the 'Configuration // Extended // Power Management' page. The left sidebar has a menu with 'Basic', 'Extended' (containing Internet, E-mail, SMS, Export, Malfunction, and Power Managmt.), and 'Internal'. The main content area is titled 'Configuration // Extended // Power Management' and contains three sections: 'Monitoring and protocolling' with radio buttons for 'Activated' and 'Deactivated' (Deactivated is selected); 'Inverter adjustment' with a note and radio buttons for 'Activated' and 'Deactivated' (Activated is selected); and 'Channel- and level setup' with a table for digital inputs and power levels.

Dry contact	C1	C2	C3	C4	Power in % (max.nominal power)
Digital input	D_IN_1	D_IN_2	D_IN_3	D_IN_4	
Level 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	100
Level 2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	60
Level 3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	30
Level 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0
				Close dry contact at level 4	<input type="checkbox"/>

To prevent big power changes (e.g. full load throw-off), it is possible to specify the max.power change per interval. 1 interval is usually 15 sec.

max. power change % (10-100)

➔ Configuration



■ Channel and power settings

The allocation of the digital inputs for the prescribed power reduction can be entered here. The default settings are the common allocation of power into 100 %, 60 %, 30 % and 0 %. Each power level here is controlled by a single input.

It must be noted that some inverters when reducing to 0% do not reduce completely to 0 watts but supply a certain minimum residual power (e.g. SMA SB versions).

When the power is reduced to 0% (level 4) the Solar-Log™ relay (potential-free output) can also be enabled to trigger any other connections.

As soon as the power is switched to a level other than 4 the relay opens again.

To prevent large fluctuations in power, e.g. from full load to 0%, a corresponding delay in power reduction can be configured. The default is a 30% change at 15 second

intervals.

This means that with a power reduction from 100 % to 0% the actual power is reduced to 0 in about 60 seconds.

If it is to be switched without a delay 100% must be configured.

■ Commissioning/Testing

A power reduction can be simulated very easily by connecting digital 5 V input. Depending on the input connected, the equipment reduces within 60 seconds.

Power management – Reactive power control

Three different shift factors can be set with the Solar-Log¹⁰⁰⁰ PM+:

1. Fixed value $\cos \varphi$.
2. Variable value $\cos \varphi$ using the power currently being fed in (P/P_n characteristic curve).
3. Controlled value $\cos \varphi$ using a ripple control receiver.

Here, up to 4 potential-free contacts are available for signalling.

A preset 5th contact for the $\cos \varphi = 1$ signal does not have to be wired extra separately and is therefore automatically available.

Ripple control receiver software configuration

This is also configured on the feed management side.

1. Fixed value $\cos \varphi$ shift factor

Reactive Power Control

fix Value $\cos(\Phi)$

variable Value $\cos(\Phi)$ over line

controlled Value $\cos(\Phi)$

Cos(Φ) lagging

Here a preset fixed $\cos \varphi$ shift factor can be entered. This shift factor is then set permanently.

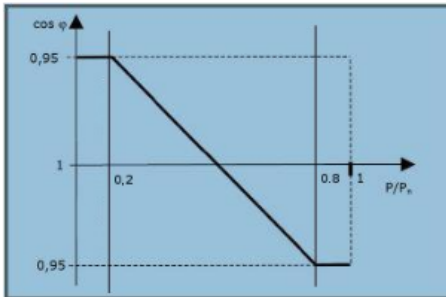
2. Variable value $\cos \varphi$ shift factor via a characteristic curve

Reactive Power Control

fix Value $\cos(\Phi)$

variable Value $\cos(\Phi)$ over line

controlled Value $\cos(\Phi)$



Example above:
From P/P_n 0.20 $\cos(\Phi)$ 0.95
To P/P_n 0.80 $\cos(\Phi)$ 0.95 lagging

From P/P_n $\cos(\Phi)$ lagging

To P/P_n $\cos(\Phi)$ lagging

Here the $\cos \varphi$ shift factor is calculated and set via a characteristic curve depending on the power factor (P/P_n).

3. Fixed value cos φ shift factor

Reactive Power Control

fix Value cos(Phi)
 variable Value cos(Phi) over line
 controlled Value cos(Phi)

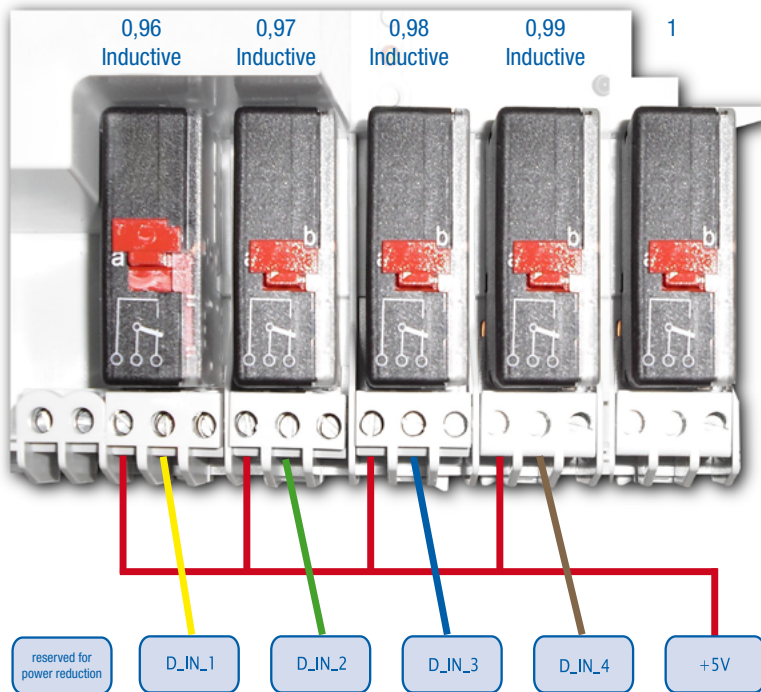
Dry contact	C1	C2	C3	C4	Cos(Phi)	lagging	
Digital input	D_IN_1	D_IN_2	D_IN_3	D_IN_4			
Step 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.00	<input type="checkbox"/>	-
Step 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.99	<input type="checkbox"/>	-
Step 3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.98	<input type="checkbox"/>	-
Step 4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0.97	<input type="checkbox"/>	-
Step 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0.96	<input type="checkbox"/>	-
							+

With this setting the cos φ shift factor is controlled by the ripple control receiver. Here there is the option of up to 16 levels because combination options are also permitted. (e.g. level 6, D_IN_1 and D_IN_2 \Rightarrow cos φ 0.95).

Hardware installation

The ripple control receiver to control the $\cos \varphi$ is wired in the same way as the description on page 3. Some power companies prescribe a ripple control receiver with 5 relay contacts where 1 contact is preset with the shift factor $\cos \varphi = 1$. However, this contact does not have to be wired to the Solar-Log¹⁰⁰⁰ PM+ separately because $\cos \varphi = 1$ is the default setting for unassigned inputs.

5th ripple control receiver

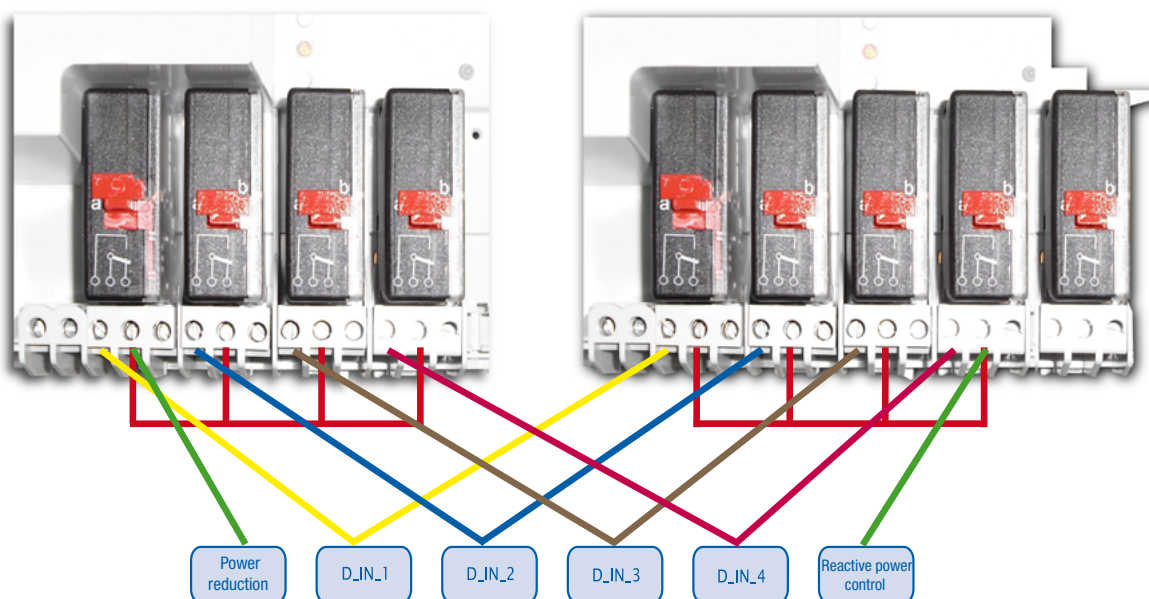


"Two ripple control receivers for power reduction and reactive power control"

Since both ripple control receivers are connected to the same inputs on the Solar-Log™ they are differentiated by the 5 V voltage supply.

Ripple control receiver - Power reduction

Ripple control receiver - Reactive power control



Feed-in management for large systems

In order to provide feed management for large plants, there is the option to operate the Solar-Log¹⁰⁰⁰ PM+ in a network with several Solar-Log¹⁰⁰⁰ units.

Function:

- The ripple control receiver's signals are received by the Solar-Log¹⁰⁰⁰ PM+ (master) and distributed to the connected inverters via the RS 485 bus.
- In addition switching commands from the energy supplier can be forwarded by the Solar-Log¹⁰⁰⁰ PM+ (master) to other Solar-Log¹⁰⁰⁰ units which then, for their part, actuate the connected inverters.
- For this procedure the Solar-Log¹⁰⁰⁰ PM+ (master) is connected to up to 9 Solar-Log¹⁰⁰⁰ (slave) units via the network (RJ45 wiring).

Configuration:

- When configuring the Solar-Log¹⁰⁰⁰ PM+ (master) the IP addresses of the connected Solar-Log¹⁰⁰⁰ units are entered and stored.
- After the Solar-Log¹⁰⁰⁰ (slave) has been restarted, a new menu item, "Feed-in management" appears under "Configuration" ⇒ "Extended".
- This menu item configures the "Feed-in management" of the inverters connected to this Solar-Log¹⁰⁰⁰.

➔ Example

