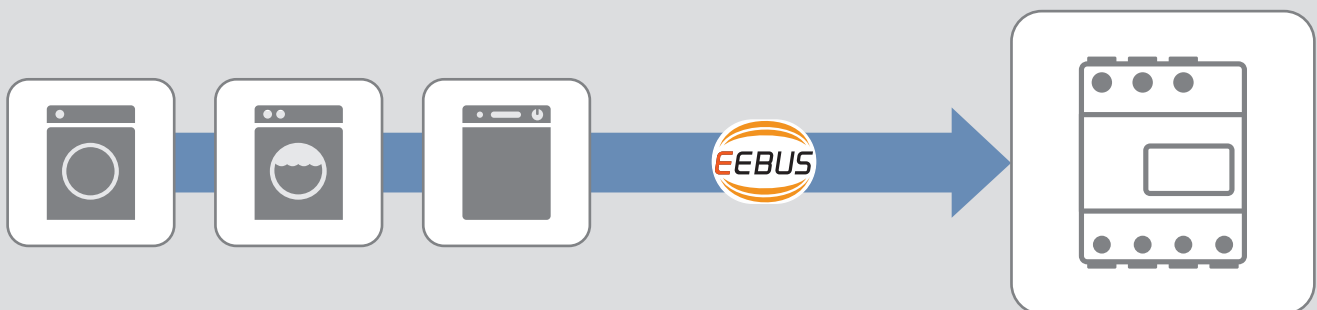


Technical Information

SMA SMART HOME

Home Appliance Energy Management using EEBus



1 Application

1.1 New Applications based on the EEBus Standard

Users of PV systems for self-consumption, who operate SMA inverters together with Sunny Home Manager as part of the SMA Smart Home, can now easily incorporate selected home appliances from Bosch/Siemens into their energy management systems.

This is made possible due to the fact that the new EEBus communication standard has been integrated into Sunny Home Manager and home appliance controllers. This standard enables automatic data exchange, ensuring efficient use of energy.

The EEBus standard will soon be introduced as a standard across Europe. Particularly in Germany, large manufacturers of home appliances, heating systems and eMobility devices are in the process of implementing the standard in various devices and applications based on EEBus data communication.

This pairing of Sunny Home Manager with Bosch/Siemens home appliances is the first time that the standard production models of two device types have had the ability to be paired using the EEBus standard. Additional device types from a variety of manufacturers and with expanded application scenario options are expected to be added in the foreseeable future.

1.2 Advantages of Pairing using EEBus in Energy Management

Easy Installation

Both Sunny Home Manager and home appliances are connected to the local network (router). This means that no other components are required to establish a connection between devices.

Automatic Configuration

The devices communicate over a standard communication protocol, making it incredibly easy to initiate a connection (see Section 3 "Connecting Sunny Home Manager to Home Appliances", page 6). The devices automatically exchange all information required for ensuring efficient energy management.

Convenient Operation

Once the home appliances are ready for operation (such as loading a washing machine with laundry), the appliance can be configured and started easily using the Home Connect app from Bosch/Siemens. Sunny Home Manager receives all of the information automatically so it can configure the controller according to its optimization procedures without any further input from the user.

Cost Savings and Greater Independence

Paired operation of the devices automatically ensures that the home appliances use inexpensive electricity. This ensures the home appliances use the largest possible portion of self-generated PV electricity. If electric utility companies offer inexpensive electricity at specific times, the system automatically utilizes these opportunities to ensure the optimal reduction in costs.

1.3 Compatible Home Appliances from Bosch/Siemens (as of July 2016)

The following devices from Bosch/Siemens are equipped with a communication module, which supports a connection to Sunny Home Manager (in firmware version 1.13 or later):

Dishwasher (sold in Europe)

| Series | Dishwasher VIB identification number | Series | Dishwasher VIB identification number |
|------------|-----------------------------------------|------------|-----------------------------------------|
| Bosch Ser6 | SBE68TX06E | Bosch Ser8 | SBA88TD16E |
| | SBI68TS06E | | SBV88TX36E |
| | SBV68TX06E | | SMA88TD16E |
| | SME68TX06E | | SMI88TS16D |
| | SMI68TS06E | | SMI88TS36E |
| | SMS68TI06E | | SMS88TI36E |
| | SMS68TW06E | | SMU88TS06S |
| | SMS68TW16E | | SMU88TS16D |
| | SMU67MS06S | | SMU88TS36E |
| | SMU67MW06S | | SMU88TW06S |
| | SMU68TS06E | | SMV88TX16D |
| | SMV68TX06E | | SMV88TX36E |

| Series | Dishwasher VIB identification number | Series | Dishwasher VIB identification number |
|---------------|-----------------------------------------|---------------|-----------------------------------------|
| Siemens IQ500 | SN258I06TE | Siemens IQ700 | SN278I36TE |
| | SN258W06TE | | SN478S16TD |
| | SN558S06ME | | SN478S36TE |
| | SN558S06TE | | SN578S16TD |
| | SN658X06TE | | SN578S36TE |
| | SN758X06TE | | SN678X16TD |
| | SN778D16TE | | SN678X36TE |
| | SN858D06PE | | SN878D26PE |
| | SX558S06TE | | SX678X36TE |
| | SX658X06TE | | SX878D26PE |
| | SX758X06TE | | |
| | SX858D06PE | | |

Washing machine/clothes dryer (sold in Germany and Austria)

| Series | Washing machine VIB identification number | Clothes dryer VIB identification number |
|-------------------------|----------------------------------------------|--------------------------------------------|
| Bosch Home Professional | WAYH87W0 | WTYH7701 |
| Siemens IQ800 | WM4YH7W0 | WT7YH701 |

1.4 Availability

After IFA 2016 (starting in mid-September), compatible home appliances from Bosch/Siemens will gradually be put on the market. All models presented at the trade show should be available by the start of 2017.

Starting in August 2016, Sunny Home Manager will be outfitted with the compatible 1.13 version of the firmware through an automatic firmware update. Automatic updates must be activated in Sunny Home Manager in order for this to occur.

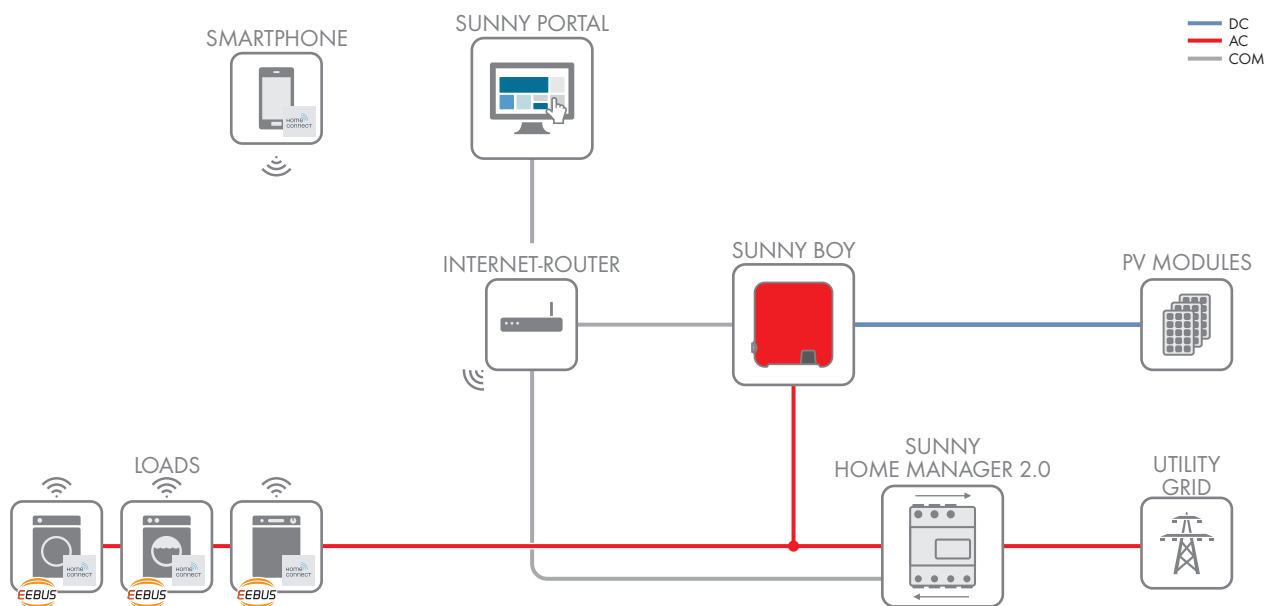


Figure 1: Sunny Home Manager and home appliances in a local network with EEBus and Home Connect

2 Connecting Devices in a Local Network

Both Sunny Home Manager and home appliances compatible with EEBus have a connection to the local household router. Typically, the Internet connection can be used to provide operating interfaces or remote access for the controller or monitoring/service.

Connecting the devices to the router also allows the devices to link together on the local network. This connection uses EEBus to exchange data between Sunny Home Manager and the home appliance.

2.1 Sunny Home Manager and SMA Energy Meter

Requirements:

- Sunny Home Manager and SMA Energy Meter have been correctly connected and put into operation (see manual under www.SMA-Solar.com).
- The PV system has been fully set up in Sunny Portal and correctly displays the system status, energy flows, etc.
- The **EEBus Support** option under **Configuration > Device Overview > Sunny Home Manager > Properties** in Sunny Home Manager is activated (deactivated by default).

The screenshot shows the 'Device: Home Manager 140' configuration page. The 'Device Characteristics' section includes the following fields:

| | |
|------------------------|-----------------------------------------------------------------------------------------------------------------|
| Device Class: | Sunny Home Manager |
| Device Type: | HOME MANAGER-000 |
| Product Group: | Sunny Home Manager |
| Serial Number: | 157000140 |
| Manufacturer: | SMA Solar Technology AG |
| Device Name: | Home Manager 140 |
| Description: | |
| Data Request Interval: | <input checked="" type="radio"/> automatic <input type="radio"/> hourly <input type="radio"/> daily |
| Time Zone: | (UTC+01:00) Amsterdam, Berlin, Bern, Niestetal, Rome, Stockho |
| PV System Password: | |
| Repeat Password: | |
| Automatic updates: | <input checked="" type="checkbox"/> Sunny Home Manager <input checked="" type="checkbox"/> PV system devices |
| EEBus Support: | <input checked="" type="checkbox"/> Active |
| SEMP/Miele Support: | <input checked="" type="checkbox"/> Active |

Figure 2: EEBus Support in Sunny Home Manager

2.2 Home Appliance

Bosch/Siemens home appliances are typically connected to the local router over a wireless LAN using an integrated "COM" module.

The following preparatory steps have been taken using the Home Connect app or the control console for the home appliance:

- The wireless LAN is switched on.
- The home appliance has been connected to the Home Connect app.

Refer to the manual from the respective manufacturer for more information on operating the home appliances.

3 Connecting Sunny Home Manager to Home Appliances

After the home appliance has been connected to the Home Connect app, the energy management system can be connected. This connection process is known as "pairing".

1. Select [**Connect energy management**] on the home appliance. Depending on the specific home appliance, the proper connection to the energy management system is selected in a menu item in the appliance control console (see manufacturer's manual).
2. Within 2 minutes after selecting [**Connect energy management**] on the home appliance, briefly disconnect Sunny Home Manager from the power, then reconnect it.
 - Sunny Home Manager restarts and then connects to the home appliance.
3. Select [**Refresh devices**] in Sunny Portal.
 - All new home appliances are displayed in Sunny Portal.
 - The "pairing" of the the two devices has been successfully completed. The new home appliance is displayed as a **smart appliance** in the list and can be identified by its serial number. Serial numbers are created using the following pattern: "Manufacturer - Type - MAC address".

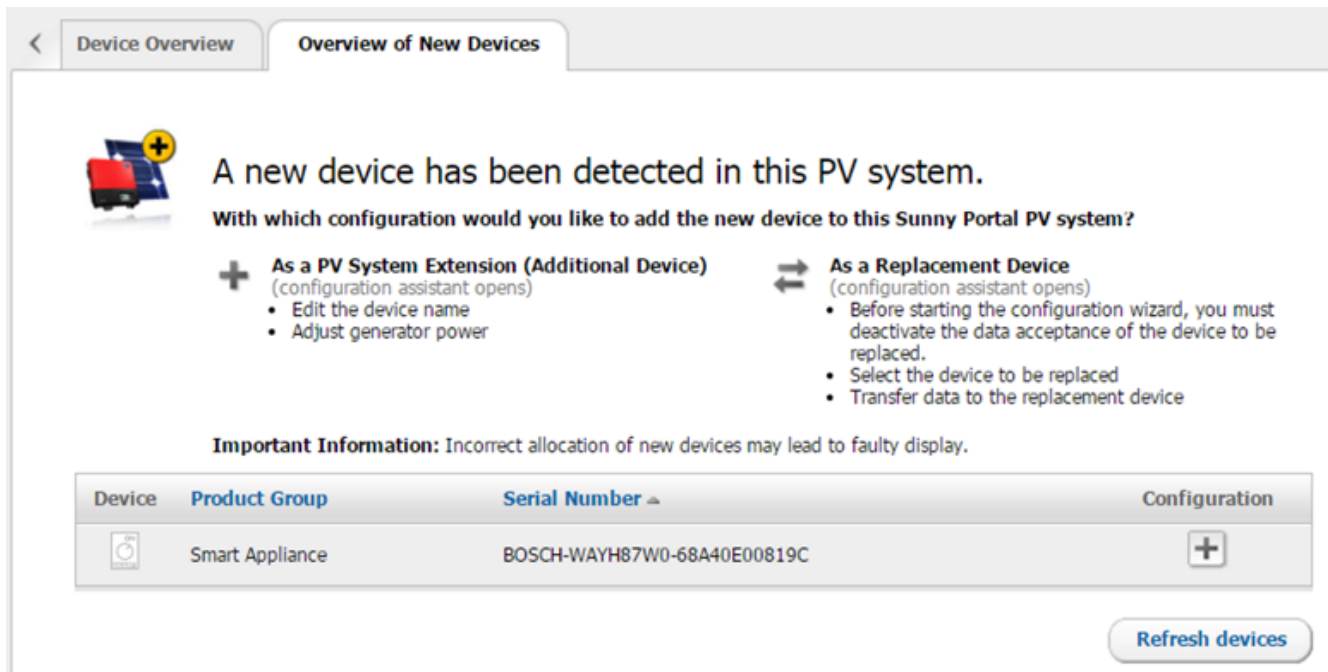


Figure 3: Washing machine as a new device in Sunny Portal

i Remove devices from the Overview of all new devices

The overview can list devices that do not exist anymore in the household or that exist but should not be added to the system. To remove devices from the overview, proceed as follows:

- Add a device to the system, see (see Section 4, page 7).
- Select the button [**Delete**] in the characteristics of the devices.

4 Adding Home Appliances to Sunny Portal

1. Press the **+** button to add the new home appliance to the Sunny Portal system. Please note that it will take a moment to add the new device to the Sunny Portal system.

2. Assign a device name. Please note that the device name must not exceed 24 characters. It is highly recommended that you use the recommended device name (device designation + part of the serial number).

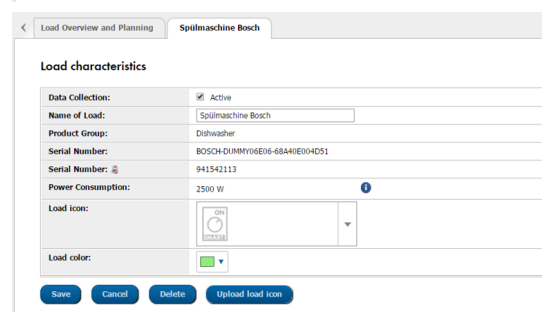
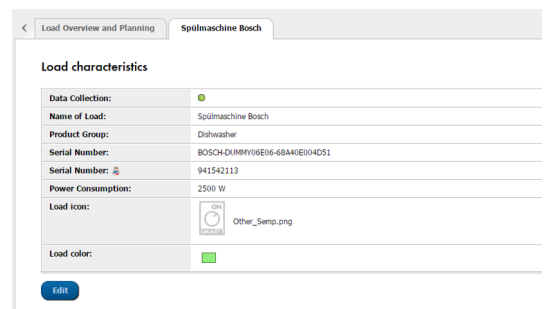
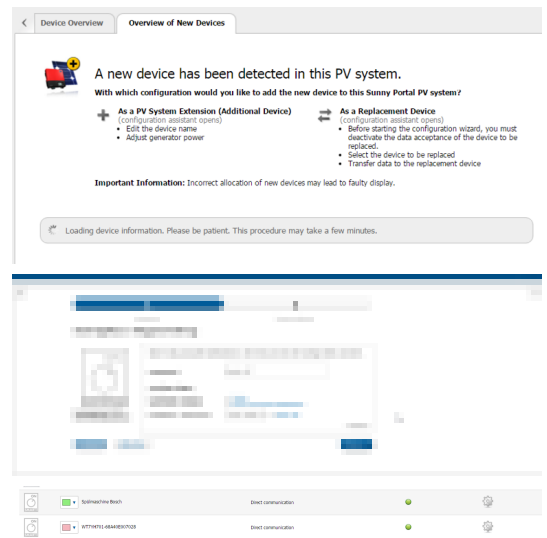
- ☑ The new home appliance is displayed on the **Configuration > Load Overview and Planning** page in Sunny Portal and automatically removed from the list of new devices. The entry **Direct communication** indicates that a home appliance is being controlled over a data connection. Either EEBus or SMA's proprietary SEMP protocol can be used as the data communication protocol.

3. Press the **⚙** button to open the **Load characteristics** page for the home appliance.
4. Press the **Edit** button to edit the load properties. The following load properties can be edited:

- **Data Collection:** Ensure that the **Active** option is enabled. The **Active** option is enabled by default.
- **Name of Load:** Here you can assign any load name.
- **Load icon:** Select [**Upload load icon**] to configure your own load icon. An load icon is set by default.
- **Load color:** Here you can select the color of the curves in the energy diagrams (load balancing and controller).

5. Press the [**Save**] button to apply the entries.

6. To delete the load from the PV system, select the [**Delete**] button. This removes all data collected on the home appliance.



5 Operation as Part of Energy Management

Typically, the following steps are required to operate home appliances as part of energy management. Refer to the manual from the respective manufacturer for more information on operating the home appliances.

1. Load the home appliance with laundry or dishes and fill it with a laundry or dish detergent.
2. The user initiates operation of the home appliance. If Sunny Home Manager is to control operation, control must be transferred to the energy management system. The following methods can be used to select operating modes for Bosch/Siemens home appliances:
 - Using the Home Connect app on a smartphone (this requires approving remote start-up using the Home Connect app beforehand in the device control console menu).
 - Using the buttons and display on the home appliance's control console.

Bosch/Siemens home appliances (such as dishwashers) generally include the following operating modes:

- No control by Sunny Home Manager
 - Immediate start: The dishwasher starts immediately and uses solar and/or grid electricity, depending on availability
 - Delayed start (pre-selected start time): The user specifies that the dishwasher should not start immediately but instead wait for a certain period of time, such as two hours. The dishwashing process will then end two hours later than with an immediate start.
- Control by Sunny Home Manager
 - Flexible start: The user specifies the latest possible time for the dishwasher to finish the rinse cycle and gives control of the cycle to Sunny Home Manager. Sunny Home Manager uses its energy planning function to determine when the dishwasher should start. Thus, it also ensures that during the cycle, the dishwasher maximizes its use of inexpensive, locally generated solar energy. PV self-consumption increases, lowering the energy costs for the user. Meanwhile, less power is fed into the utility grid, thereby relieving the strain on the distribution grids.

After the operating mode has been selected, all required information is automatically transferred to Sunny Home Manager over the EEBus data connection. If "Flexible Start" is selected, it takes over control of the home appliance to achieve the described energy cost optimization.

Sunny Home Manager does not require any operating steps from the user. Control of the home appliance is fully automated.

Generally, the available operating information is displayed for all operating modes in Sunny Portal. The precise information displayed depends on the respective home appliance and the degree of implementation of the EEBus standard. For both SMA Solar Technology AG and Bosch/Siemens, this is the initial implementation of the EEBus standard, so there are still some limitations (see Section 7 "Troubleshooting", page 10).

Refer to the manual from the respective manufacturer for more information on operating the home appliances.

6 Control Sequence in Energy Management

When the "Flexible Start" operating mode is selected on the home appliance using the Sunny Home Manager controller, the following control sequence starts:

| Device | Action |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Home appliance | Transferring selected data to Sunny Home Manager over EEBus |
| Sunny Home Manager | Assessment of the following: <ul style="list-style-type: none"> • The PV yield forecast • The learned load characteristics of the home • The electricity rate of the electric utility company |
| Sunny Home Manager | Drafting an initial plan for cost-optimized operation based on the following device data: <ul style="list-style-type: none"> • Pmax specification of the home appliance (e.g. 2 kW) • Reported operating time (e.g. 90 minutes for a rinsing cycle) • Reported ending time of the time window (the latest time the rinsing cycle can end) |
| Sunny Home Manager | Assessing the changes: <ul style="list-style-type: none"> • In the PV yield forecast • In the home's load at present <p>If any conditions have changed, a new schedule for obtaining cost optimization is made.</p> |

Case study A

| Device | Action |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sunny Home Manager | When the start time for the present schedule is reached: <ul style="list-style-type: none"> • Start command sent to the home appliance over EEBus |
| Home appliance | The home appliance starts operating and continues to operate without interruption until completion: <ul style="list-style-type: none"> • Use of cost-optimized energy |

Case study B

| Device | Action |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sunny Home Manager | If no cost-optimized schedule could be found: <ul style="list-style-type: none"> • A start command is sent to the home appliance at the latest possible start time (end time - operating time) |
| Home appliance | The home appliance starts operating and continues to operate without interruption until completion: <ul style="list-style-type: none"> • The energy that is available at present is used |

The user can also directly start the home appliance manually at any time. In such cases, Sunny Home Manager gives up the control and clears the currently drafted schedule.

7 Troubleshooting

7.1 Responsibility for Service Support

Potential problem areas are listed below together with the respective responsibility area as it relates to service support. Please contact the service point in charge of the problem area in question.

| Problem area | Service point |
|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Connection between home appliance and Home Connect app | Bosch/Siemens |
| Connection between home appliance and Sunny Home Manager | Bosch/Siemens SMA Solar Technology AG |
| Home Connect app: Expected messages are not in the app | Bosch/Siemens |
| Control console of the home appliance: Expected messages are not on the device display | Bosch/Siemens |
| Compatibility of Bosch/Siemens home appliances with EEBus | Bosch/Siemens |
| Problems with devices from SMA Solar Technology AG and questions about energy management (inverter from a third-party company, etc.) | SMA Solar Technology AG |
| Inquiries regarding SMA systems and retrofitting options | SMA Solar Technology AG |
| Sunny Portal (registration in Sunny Portal, problems adding a home appliance, display in Sunny Portal, etc.) | SMA Solar Technology AG |

7.2 Special Notes on the Current Implementation of the EEBus Pairing

The pairing with Bosch/Siemens home appliances implemented in Sunny Home Manager firmware version 1.13 is the very first practical implementation of the EEBus standard in a series product. Sunny Home Manager and Bosch/Siemens home appliances do not yet feature all functions necessary for comprehensive energy management. In specific cases, it may include restrictions described in the following paragraphs.

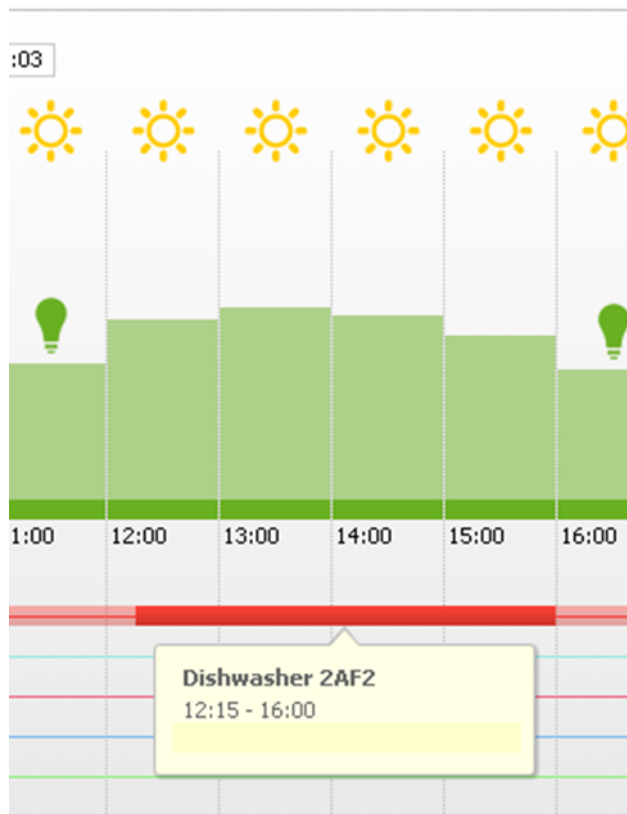
The functional scope will be expanded gradually in future firmware updates for SMA devices and Bosch/Siemens home appliances.

| Problem | Explanation |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial operation after adding a home appliance to the Sunny Home Manager system: Though a delayed start was set via the Home Connect app or control console of the home appliance, the appliance starts immediately. | The current implementation of the pairing between the home appliance and Sunny Home Manager requires an initial synchronization run. After this run, Sunny Home Manager correctly notes the time delay in the home appliance's control system. |

| Problem | Explanation |
|---------|-------------|
|---------|-------------|

| | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>After starting a device run controlled by Sunny Home Manager, a device start time is displayed in the Home Connect app that corresponds to the latest possible start time. But Sunny Home Manager actually starts the home appliance at another time.</p> | <p>In the Home Connect app, the latest possible theoretical time is displayed by default. Scheduling in Sunny Home Manager is actually more precise. It determines a cost-optimized switch-on time. The switch-on time that Sunny Home Manager uses depends on the weather forecast and the consumption situation in the home at present. Because the conditions can be changing constantly, the planned switch-on time also changes.</p> <p>The current Sunny Home Manager schedule can be viewed in the Sunny Home Manager system, on the Current status and forecast page in Sunny Portal.</p> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Example:



The dishwasher is currently scheduled to start at 12:15 pm. The weather is sunny and no clouds are expected. Nevertheless, an electric stove may be used for cooking in the middle of the day, resulting in a lack of sufficient PV power. In this case, the dishwasher operation would be rescheduled accordingly.

Due to the latest end time for the rinsing cycle (as defined by the user), the dishwasher still starts on time automatically when there is not sufficient PV power so it can complete the cycle by the defined end time.

| | |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>No performance data is displayed for paired home appliances in Sunny Portal. (only 0 W or 0 Wh and no energy mix information)</p> | <p>In the current implementation of the pairing between a home appliance and Sunny Home Manager, no performance data is transferred from the home appliance to Sunny Home Manager. As a result, no information can be displayed.</p> <p>An additional radio-controlled socket can be used to measure the power consumption of a home appliance using a separate channel and display this value in Sunny Portal.</p> |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Problem | Explanation |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Though a much later end time for washing machine operation was selected in the Home Connect app, operation is completed earlier. This applies to the operation of home appliances with and without control by Sunny Home Manager.</p> | <p>To prevent odors from forming, this system also ensures that laundry does not remain in the washing machine for more than 6 hours after the end of the cycle. As such, a special function of the home appliance controller allows for automatic adjustment of the end time. Sunny Home Manager operates according to the information it receives from the home appliance over the data connection.</p> |
| <p>Though a washing cycle with low power requirements has been selected, Sunny Home Manager does not start the home appliance until substantially more PV power is available.</p> | <p>In the current implementation of the pairing between a home appliance and Sunny Home Manager, Sunny Home Manager receives the highest reported consumption requirements from the home appliance. If a 60°C wash cycle with a power consumption of 2 kW has been selected once for a washing machine, this same power consumption value is used for subsequent cycles. This continues to apply even if the selected cycle requires substantially less power (e.g. 500 W for a pure spin cycle).</p> |
| <p>Why are dishwasher cycles no longer scheduled by Sunny Home Manager?</p> | <p>Settings for "Flexible Start" may be lost after a power outage or if WiFi is switched off for the Bosch/Siemens home appliance. As a result, the dishwasher starts at the scheduled, delayed start time.</p> |
| <p>Even after a home appliance paired over EEBus is deleted from the Sunny Portal system and is no longer available in the network, it is still displayed in the new device list.</p> | <p>Unfortunately, in the current implementation of the pairing between a home appliance and Sunny Home Manager, a home appliance paired over EEBus cannot be completely deleted from the Sunny Portal system. This issue will be rectified in a future update.</p> |

