Technical Information



SUNNY CENTRAL and SUNNY CENTRAL STORAGE with Solbank 3.0 Lithium-Ion Battery System

e-Storage Solbank 3.0 wit Modbus TCP interface

Battery interface documentation / system documentation

1 SMA implementation

1.1 General Information

With the implementation, the behavior of the battery is transferred to a simplified battery image in the SMA inverter.

1.2 Implementation into Sunny Central Storage

Information required in the inverter:

Signal	Explanation
Bat.BmsStt	Operating state of the battery as an image on a simplified state machine The operating state controls how the inverter is allowed to behave in relation to the battery: • The inverter is only allowed to connect to the battery when the battery is in **Operation** status. • A connect command can only be sent to the battery if the battery is in **Ready** status. • The inverter must disconnect immediately only if the battery is in **Error** status.
Bat.SOCConn	State of charge of the connected battery The inverter can limit the allowed operating range based on the state of charge. The state of charge is also required for the superordinate system controller to ensure optimum power and energy distribution within the system.
Bat.SOH	State of health of the battery The state of health is required for the superordinate system controller to ensure optimum power and energy distribution within the system.
Bat.WarnBits	The battery is signaling a warning, but can continue to be operated as normal. The warning is also reported by the inverter to the superordinate system controller as warning **9347**.
Bat.ErrBits	Battery reports an error and no longer allows operation. The error is also reported by the inverter to the superordinate system controller as error **9307**. The inverter cannot be operated as long as the battery error persists.
Bat.DcAmpDynMin	Currently permitted charging current The power in the direction of charging is limited or reduced to this value. For control reasons, this limit may be exceeded for a short period of time. If the current operating point is limited by this value, the derating status **DrtStt** = **Bat.DcAmp** is signaled.
Bat.DcAmpDynMax	Currently permitted discharging current The power in the direction of discharging is limited or reduced to this value. For control reasons, this limit may be exceeded for a short period of time. If the current operating point is limited by this value, the derating status **DrtStt** = **Bat.DcAmp** is signaled.
Bat.DcAmpOpMin	Disconnection current in direction of charging If this current value is exceeded for more than 50 ms (can be parameterized via **BatCtl.DcAmpOpLimTm**), the inverter is disconnected with error **6607**. The error causes an operation inhibition and must be reset by activating the parameter **ErrClr**.

Signal	Explanation
Bat.DcAmpOpMax	Disconnection current in direction of discharging If this current value is exceeded for more than 50 ms (can be parameterized via **BatCtl.DcAmpOpLimTm**), the inverter is disconnected with error **6608**. The error causes an operation inhibition and must be reset by activating the parameter **ErrClr**.
Bat.DcVolDynMax	Currently permitted charging voltage The power in the direction of charging is limited or reduced by this value. The inverter then switches to a constant voltage charging process. For control reasons, this limit may be exceeded for a short period of time. If the current operating point is limited by this value, the derating status **DrtStt** = **Bat.DcVol** is signaled.
Bat.DcVolDynMin	Currently permitted discharge voltage The power in the direction of discharging is limited or reduced by this value. The inverter then switches to a constant voltage discharging process. For control reasons, this limit may be undershot for a short period of time. If the current operating point is limited by this value, the derating status **DrtStt** = **Bat.DcVol** is signaled.
Bat.DcVolOpMax	Disconnection voltage direction of charging If this voltage value is exceeded for more than 50 ms (can be parameterized via **BatCtl.DcVolOpLimTm**), the inverter is disconnected with error **6610**. The error causes an operation inhibition and must be reset by activating the parameter **ErrClr**.
Bat.DcVolOpMin	Disconnection voltage direction of discharging If this voltage value is undershot for more than 50 ms (can be parameterized via **BatCtl.DcVolOpLimTm**), the inverter is disconnected with error **6609**. The error causes an operation inhibition and must be reset by activating the parameter **ErrClr**.
Bat.NoStrgTot	Number of racks installed
Bat.NoStrgConn	Number of racks connected
Bat.WhInRmg	Available capacity in direction of charging This is signal is sent to the higher-level system management as information for the scheduling of available energies.
Bat.WhOutRmg	Available capacity in direction of discharging This is signal is sent to the higher-level system management as information for the scheduling of available energies.
Bat.RisIn	Internal resistance of the battery in operation This signal is used as a basis for estimating the effect of battery voltage limits on the achievable power before the voltage limits are reached.

Optional information in the inverter:

- Battery current
- Battery voltage
- Battery temperatures
- Battery cell voltages

1.3 Implementation into Sunny Central with DC coupling

Information required in the inverter:

Signal	Explanation
Bat.Stt	Operating state of the battery as an image on a simplified state machine The operating state controls how the inverter is allowed to behave in relation to the battery: • The inverter is only allowed to connect to the battery when the battery is in **Operation** status. • A connect command can only be sent to the battery if the battery is in **Ready** status. • The inverter must disconnect immediately only if the battery is in **Error** status.
Bat.SOC	State of charge of the connected battery The inverter can limit the allowed operating range for the DC-DC Converter based on the state of charge. The state of charge is needed to ensure optimal power and energy distribution within the system and between different DC coupled batteries.
Bat.SOH	State of health of the battery The state of health is needed to ensure optimal power and energy distribution within the system and between different DC coupled batteries.
Bat.NomCap	Nominal capacity of active batteries The nominal capacity is needed to ensure optimal power and energy distribution within the system and between different DC coupled batteries.
Bat.Amp	Battery current Measured value of the battery's current DC current at its system limit (optional signal)
Bat.Vol	Battery voltage Measured value of the battery's current DC voltage at its system limit (optional signal)
Bat.AmpDynMax	Currently permitted discharging current The power in the direction of discharging is limited or reduced to this value. For control reasons, this limit may be exceeded for a short period of time. The limit is applied to the **Port 1 Max Discharge Current Limit** parameter of the associated DC-DC Converters. Based on the allowed current, an estimation is also made about the available power of the respective DC-DC Converters in the direction of discharging.
Bat.AmpDynMin	Currently permitted charging current The power in the direction of charging is limited or reduced to this value. For control reasons, this limit may be exceeded for a short period of time. The limit is applied to the **Port 1 Max Charge Current Limit** parameter of the associated DC-DC Converters. Based on the allowed current, an estimation is also made about the available power of the respective DC-DC Converters in the direction of charging.
Bat.VolDynMax	Currently permitted charging voltage The power in the direction of charging is limited or reduced by this value. The DC-DC Converter then switches to a constant voltage charging process. For control reasons, this limit may be exceeded for a short period of time. The limit is applied to the **Port 1 High Voltage Limit** parameter of the associated DC-DC Converters.

Signal	Explanation
Bat.VolDynMin	Currently permitted discharge voltage The power in the direction of discharging is limited or reduced by this value. The DC-DC Converter then switches to a constant voltage discharging process. For control reasons, this limit may be undershot for a short period of time. The limit is applied to the **Port 1 Low Voltage Limit** parameter of the associated DC-DC Converters.
Bat.AmpOpMax	Disconnection current in direction of discharging The current value is applied to the **Port 1 Discharge Over Current Level** parameter of the associated DC-DC Converter. If this current value is exceeded for more than 500 ms, the DC-DC Converter is disconnected with the **Port 1 Discharge Overcurrent Trip** error.
Bat.AmpOpMin	Disconnection current in direction of charging The current value is applied to the **Port 1 Charge Over Current Level** parameter of the associated DC-DC Converter. If this current value is exceeded for more than 500 ms, the DC-DC Converter is disconnected with the **Port 1 Charge Overcurrent Trip** error.
Bat.VolOpMax	Disconnection voltage in direction of charging The voltage value is applied to the **Port 1 Timed Over Voltage Level** parameter of the associated DC-DC Converters. If this voltage value is exceeded for more than 100 ms, the DC-DC Converter is disconnected with the **Port 1 Timed Over Voltage** error.
Bat.VolOpMin	Disconnection voltage in direction of discharging The voltage value is applied to the **Port 1 Timed Under Voltage Level** parameter of the associated DC-DC Converters. If this voltage value is undershot for more than 100 ms, the DC-DC Converter is disconnected with the **Port 1 Timed Under Voltage** error.

2 Implementation for Solbank 3.0 Battery Systems

2.1 System requirements

The following requirements must be met for correct integration of the mentioned batteries with the SMA product:

- The Sunny Central Storage or Sunny Central with DC coupling must have a firmware version ≥ 10.01.xx.R.
- For firmware version 10.02.xx.R and later, the final profile and library are automatically loaded in the firmware.
- Implementation after completion of the integration tests includes the following files: main profile CSI_Solbank_3.bap in version 1011, library Libunified_bat.so in version 2011 and CSI_Solbank_3_Rackinfo.c#.bap in version 1010
- The battery used for integration must have a Modbus TCP interface corresponding to the document "Solbank 3.0 CSI BMS Modbus communication protocol-To EMS&BCI-V2.4-2025.3.3.xlsx" or a compatible interface.
- During the integration work, the battery was tested with the following software versions. These software versions are also considered the minimum requirement for system operation.
- ESMU version: 0.50P_US_SJ202509700_0304_0023
- BMU version: C-3-6.0.1.4.-GB1.2-20241660-01.08-00

2.2 Version overview

Implementation of the battery integration can be revised as needed, which leads to differences in the versions.

Version	Description	Included from FW package	References
CSI_Solbank_3.bap in version 1011, library Libunified_bat.so in version 2011, CSI_Solbank_3_Rackinfo.c#.bap in Version 1010	Version from integration tests in 03/2025	-	KODI-6708
CSI_Solbank_3.bap in version 1012, library Libunified_bat.so in version 2012, CSI_Solbank_3_Rackinfo.c#.bap in Version 1010	Additional option for changing the UnitID from the WebUI	10.02.xx.R	KODI-6860

3 Parameter Settings

3.1 Parameterization of Modbus configuration

These parameters can be viewed and modified on the user interface, in the section **External devices**.

UniqueID	Parameter	Recommended setting	Comments
#n.a.	Polling ratio	1	-
#n.a.	Polling time	1000 ms	-
#n.a.	Dev.Port	502	-
#n.a.	Dev.Prop	Readback_Param, Write Multiple	Holding registers are also read back after writing. Holding registers are written using function code 16 (0x10)
#n.a.	Dev.UnitID	100	Changes the Modbus TCP UnitID for the client connection to the BMS
#n.a.	Bat.VolDynMax-Man	1497.6 V	These voltage limits have been adapted to the default values of Solbank 3.0.
#n.a.	Bat.VolDynMin-Man	1164.8 V	-
#n.a.	Bat.VolOpMax-Man	1500 V	-
#n.a.	Bat.VolOpMinMan	1149 V	-
#n.a.	Bat.AmpDynMax-Man	4900 A	Parameters for possible manual limitation of the permitted operating range.
#n.a.	Bat.AmpDynMin-Man	-4900 A	-
#n.a.	Bat.AmpOpMax-Man	4900 A	-
#n.a.	Bat.AmpOpMin-Man	-4900 V	-
#n.a.	DcAmpDynMin factor	1.00	See Section 6.1 for further explanations
#n.a.	DcAmpDynMax factor	1.00	-
#n.a.	DcAmpOpMin offset	100 A	-
#n.a.	DcAmpOpMax offset	100 A	-
#n.a.	DcAmpOpMin Factor	0.05	-
#n.a.	DcAmpOpMax Factor	0.05	-

UniqueID	Parameter	Recommended setting	Comments
#n.a.	Clock Sync	Off	See Section 6.7 for further explanations
#n.a.	Shutdown Delay Time	30 s	See Section 6.6 Delayed battery disconnection
#n.a.	Shutdown Delay	Off	-
#n.a.	Split-Busbar-Handling	project-dependent	-
#n.a.	Split-Busbar Expected Imbalance	50 A	-
#n.a.	Split-Busbar Cross-Fuse Limit	300 A	See Section 6.2 Current limitation for split DC busbar with cross-fuse
#n.a.	Split-Busbar Input 1 Sol-banks	project-dependent	-
#n.a.	Split-Busbar Input 2 Sol-banks	project-dependent	-
#n.a.	Split-Busbar Input 3 Sol-banks	project-dependent	-
#n.a.	Installed Solbanks	project-dependent	Number of installed containers per inverter or DC-DC Converter in increments of half containers (0.5; 1; 1.5.....) (project-dependent)
#n.a.	Racks/Solbank	12	Number of installed racks per complete Solbank
#n.a.	kWh/Rack	418kWh	Nominal energy per rack Solbank 3.0 = 418 kWh
#n.a.	Ah/Rack	314 Ah	Nominal capacity per rack Solbank 3.0 = 314 Ah

3.2 Required parameterization

3.2.1 Required parameterization in terms of Sunny Central Storage

UniqueID	Parameter	Recommended setting	Comments
#3969	Bsc.BatPrf	CSI Solbank 3.0	Selection of the correct communication profile when used with the Sunny Central Storage Corresponds to entry #36
#3921	Bsc.BatEna	On	Activation of battery communication.
#n.a.	Dev.Adr	IP address of the corresponding BMS of the Master-Solbank 3.0 Container	-

Check Section 6 for further explanations to determine whether this results in an additional necessary parameter adjustment. The Dev.Adr parameters can be viewed and modified via the user interface, in the section **External devices**.

3.2.2 Recommended parameterization in terms of Sunny Central Storage

UniqueID	Parameter	Recommended setting	Comments
#7708	BatCtl.DcAmpOpLimTm	400 ms	Tripping time for evaluation of the current limits **Bat.DcAmpOpMax** and **Bat.DcAmpOpMin**. The battery limit values can be abruptly reduced to 0. The default value of 50 ms can then lead to unwanted error triggers.
#6120	TmpExlLim	55 °C	To prevent the battery from operating at temperatures above 55 °C, the inverter should disconnect at 55 °C. This also disconnects the battery.
#6590	DiagAutoAcknEna	Disable	At the explicit request of Canadian Solar, any automatisms for resetting errors are undesirable. This ensures that the battery is only connected and disconnected on explicit command. Each error therefore requires **ErrClr** to be set in order to restore the inverter's operational readiness.
#8689	BatCtl.ComFlb.BatTmLim	20 s	Duration until a battery communication error is detected. Warning **ErrNo = 9308** is reported
#7298	BatCtl.ComFlb.FlbTmLim	20 s	Duration for which a battery communication error is tolerated, then disconnect with error **ErrNo = 6136** Total time of #8689 and #7298 must be less than 60 seconds

3.2.3 Required parameterization in terms of Sunny Central with DC coupling

UniqueID	Parameter	Recommended setting	Comments
#3600	Dcs.Bat.Prf.01	CSI Solbank 3	Selection of the correct communication profile when used with the DC-DC Converter 1.
#3602	Dcs.Bat.Prf.02	CSI Solbank 3	Selection of the correct communication profile when used with the DC-DC Converter 2.
#3604	Dcs.Bat.Prf.03	CSI Solbank 3	Selection of the correct communication profile when used with the DC-DC Converter 3.
#3606	Dcs.Bat.Prf.04	CSI Solbank 3	Selection of the correct communication profile when used with the DC-DC Converter 4.
#3608	Dcs.Bat.Prf.05	CSI Solbank 3	Selection of the correct communication profile when used with the DC-DC Converter 5.
#3610	Dcs.Bat.Prf.06	CSI Solbank 3	Selection of the correct communication profile when used with the DC-DC Converter 6.
#n.a.	Dev.Adr	IP address of the corresponding BMS of the Solbank 3 Container	Must be configured individually for each battery.

Check Section 6 for further explanations to determine whether this results in an additional necessary parameter adjustment. The Dev.Adr parameters can be viewed and modified via the user interface, in the section **External devices**.

3.2.4 Recommended parameterization in terms of Sunny Central with DC coupling

UniqueID	Parameter	Recommended setting	Comments
#8273	Dcs.ComTmLim	40 s	Tripping time for evaluation of communication errors to the DC-DC Converter or to the battery. After the time has elapsed, the DC-DC Converter stops automatically or is stopped. The setting must be less than 60 seconds.

4 Signal assignment

4.1 Signal assignment based on the documentation and designation of the battery manufacturer

For better traceability, a table with the manufacturer-specific signals and the respective use by the SMA implementation can be provided. The table contains information on the signals used, their use by SMA and the possibility of retrieving these signals from the inverter.

4.2 Signal assignment based on the required signals for the Sunny Central Storage

The signal mapping is based directly on the implementation and describes the relationships starting from the required SMA signals. The BMS signals are designated directly in accordance with the documentation provided by the battery manufacturer.

The following describes how the information required in the inverter is generated from the available signals.

UniqueID	Instantaneous value	Explanation	Signal generation
#3841	Bat.BmsStt	Operating state of the battery as an image on a simplified state machine	Derived from the signal System Status **Bat.BmsStt** = **Ready**, if **System Status** = **Off** or **System Status** = (**Ready, Maintain, Discharge, Charge, Ban_Charge, Ban_Discharge** or **Ban_Charge_and_Discharge**) and **Online Racks** = **0**; **Bat.BmsStt** = **Operation**, if **System Status** = (**Ready, Maintain, Discharge, Charge, Ban_Charge, Ban_Discharge** or **Ban_Charge_and_Discharge**) and **Online Racks** > **0**; **Bat.BmsStt** = **Error**, if **System Status** = **Fault**; **Bat.BmsStt** = **Init**, if **System Status** = **Init**; Otherwise, **Bat.BmsStt** = **Unknown**
#3842	Bat.SocConn	State of charge of the connected battery	**Bat.SocConn** corresponds **System SOC**; except **System SOC** >100%, then 0%
#3814	Bat.SocTot	State of charge of the installed battery	**Bat.SocTot** corresponds to **System SOC**; except **System SOC** >100%, then 0%
#3816	Bat.SOH	State of health of the battery	**Bat.SOH** corresponds to **System SOH**
#7345	Bat.WarnBits	The battery is signaling a warning but can continue to be operated.	**Bat.WarnBits** is set as soon as a value other than 0 is reported in either **System Level Alarm 1 Summary** or **System Level Alarm 2 Summary**.
#7343	Bat.ErrBits	Battery reports an error and no longer allows operation.	**Bat.ErrBits** is set as soon as a value other than 0 is reported in either **System Level Alarm 3 Summary** or **System Status** = **Fault**.

UniqueID	Instantaneous value	Explanation	Signal generation
#3847	Bat.DcAmpDynMin	Currently permitted charging current	**Bat.DcAmpDynMin** expects a negative value and corresponds to the maximum of **DcAmpDynMin Factor * system max charge power limit / System voltage** and **Bat.AmpDynMinMan**.
#3846	Bat.DcAmpDynMax	Currently permitted discharging current	**Bat.DcAmpDynMax** expects a positive value and corresponds to the minimum of **DcAmpDynMax Factor * system max discharge power limit / system voltage** and **Bat.AmpDynMaxMan**.
#3853	Bat.DcAmpOpMin	Disconnection current in direction of charging	**Bat.DcAmpOpMin** expects a negative value and corresponds to the maximum of **(DCAmpOpMin Offset + (1+ DCAmpOpMin Factor)*System DC Charge power limit/System Total Voltage)** and **Bat.AmpOpMinMan**.
#3852	Bat.DcAmpOpMax	Disconnection current in direction of discharging	**Bat.DcAmpOpMax** expects a positive value and corresponds to the minimum of **(DCAmpOpMax Offset + (1+ DCAmpOpMax Factor)*System DC Discharge power limit/System Total Voltage)** and **Bat.AmpOpMaxMan**.
#3848	Bat.DcVolDynMax	Currently permitted charging voltage	**Bat.DcVolDynMax** corresponds to **Bat.VolDynMaxMan**
#3849	Bat.DcVolDynMin	Currently permitted discharge voltage	**Bat.DcVolDynMin** corresponds to **Bat.VolDynMinMan**
#3854	Bat.DcVolOpMax	Disconnection voltage direction of charging	**Bat.DcVolOpMax** corresponds to **Bat.VolOpMaxMan**
#3855	Bat.DcVolOpMin	Disconnection voltage direction of discharging	**Bat.DcVolOpMin** corresponds to **Bat.VolOpMinMan**
#3827	Bat.NoStrgTot	Number of racks installed	**Bat.NoStrgTot** corresponds to the parameters **Installed Solbanks * Racks/Solbank**
#3826	Bat.NoStrgConn	Number of racks connected	**Bat.NoStrgConn** corresponds to the signal **Number of Online Racks**
#3828	Bat.NomCapTot	Total capacity of battery in Ah	**Bat.NomCapTot** corresponds to the parameter **Ah/Rack*Bat.NoStrgTot**
#3845	Bat.NomCapConn	Capacity of the connected battery in Ah	**Bat.NomCapConn** corresponds to the parameter **Ah/Rack*Bat.NoStrgConn**
#3836	Bat.WhInRmg	Available energy in direction of charging	**Bat.WhInRmg** corresponds to **(100-system SoC)/100*Bat.NoStrgConn*kWh/Rack**
#3834	Bat.AhInRmg	Available capacity in direction of charging	**Bat.AhInRmg** corresponds to **(100-system SoC)/100*Bat.NoStrgConn*Ah/Rack**

UniqueID	Instantaneous value	Explanation	Signal generation
#3837	Bat.WhOutRmg	Available energy in direction of discharging	**Bat.WhOutRmg** corresponds to **system SoC/ 100 * Bat.NoStrgConn * kWh/Rack**
#3835	Bat.AhOutRmg	Available capacity in direction of discharging	**Bat.AhOutRmg** corresponds to **System SoC/ 100*Bat.NoStrgConn*Ah/Rack**
#3843	Bat.DcVolConn	Current voltage of the connected racks	**Bat.DcVolConn** corresponds to **system voltage**
#3818	Bat.DcVolTot	Current battery voltage	**Bat.DcVolTot** corresponds to **system voltage**
#3844	Bat.DcAmp	Current flow through the battery	**Bat.DcAmp** corresponds to **system current**
#3895	Bat.WInAval	Available charging power of battery	**Bat.WInAval** corresponds to **system max charge power limit**
#3896	Bat.WOutAval	Available discharge capacity of the battery	**Bat.WOutAval** corresponds to **system max discharge power limit**
#3800	Bat.CellVolMax	Maximum cell voltage of the battery	**Bat.CellVolMax** corresponds to **maximum cell voltage**
#3801	Bat.CellVolMin	Minimum cell voltage of the battery	**Bat.CellVolMin** corresponds to **minimum cell voltage**
#3821	Bat.TmpMin	Battery: lowest temperature	**Bat.TmpMin** corresponds to **Minimum cell temperature**
#3822	Bat.TmpMax	Battery: highest temperature	**Bat.TmpMax** corresponds to **Maximum cell temperature**

4.3 Signal assignment based on the required signals for the Sunny Central with DC coupling

The signal mapping is based directly on the implementation and describes the relationships starting from the required SMA signals.

The following describes how the information required in the inverter is generated from the available signals.

There is **no UniqueID** for these signals.

Instantaneous value	Explanation	Signal generation
Bat.Stt	Operating state of the battery as an image on a simplified state machine	Derived from the signal System Status **Bat.Stt** = **Ready**, if **System Status** = **Off** or **System Status** = **(Ready, Maintain, Discharge, Charge, Ban_Charge, Ban_Discharge or Ban_Charge_and_Discharge)** and **Online Racks** = **0**; **Bat.Stt** = **Connected**, if **System Status** = **(Ready, Maintain, Discharge, Charge, Ban_Charge, Ban_Discharge oder Ban_Charge_and_Discharge)** and **Online Racks** > **0**; **Bat.Stt** = **Fault**, if **System Status** = **Fault**; **Bat.Stt** = **Init**, if **System Status** = **Init**; Ansonsten **Bat.Stt** = **Init**
Bat.SOC	State of charge of the connected battery	**Bat.SOC** corresponds to **System SOC**; except **System SOC** >100%, then 0%
Bat.SOH	State of health of the battery	**Bat.SOH** corresponds to **System SOH**
Bat.AmpDynMin	Currently permitted charging current	**Bat.AmpDynMin** expects a negative value and corresponds to the maximum **DcAmpDynMin Factor * system max charge power limit/System voltage** and **Bat.AmpDynMinMan**.
Bat.AmpDynMax	Currently permitted discharging current	**Bat.AmpDynMax** expects a positive value and corresponds to the minimum of **DcAmpDynMax Factor * system max discharge power limit /system voltage** and **Bat.AmpDynMaxMan**.
Bat.AmpOpMin	Disconnection current in direction of charging	**Bat.AmpOpMin** expects a negative value and corresponds to the maximum of **DcAmpOpMin Offset + (1+ DcAmpOpMin Factor)* (system max charge power limit/system voltage)** and **Bat.AmpOpMinMan**.
Bat.AmpOpMax	Disconnection current in direction of discharging	**Bat.AmpOpMax** expects a positive value and corresponds to the minimum of **DcAmpOpMax Offset + (1+ DcAmpOpMax Factor)*(system max discharge power limit/system voltage)** and **Bat.AmpOpMaxMan**.
Bat.VolDynMax	Currently permitted charging voltage	**Bat.VolDynMax** corresponds to **Bat.VolDynMaxMan**.
Bat.VolDynMin	Currently permitted discharge voltage	**Bat.VolDynMin** corresponds to **Bat.VolDynMinMan**
Bat.VolOpMax	Disconnection voltage in direction of charging	**Bat.VolOpMax** corresponds to **Bat.VolOpMaxMan**
Bat.VolOpMin	Disconnection voltage in direction of discharging	**Bat.VolOpMin** corresponds to **Bat.VolOpMinMan**

Instantaneous value	Explanation	Signal generation
Bat.NomCap	Nominal capacity of the connected battery	**Bat.NomCap** corresponds to **Ah/Rack * Number of Online Racks**
Bat.Vol	Current battery voltage	**Bat.Vol** corresponds to **system voltage**
Bat.Amp	Current presently flowing through the battery	**Bat.Amp** corresponds to **system current**

Each signal is present once per battery interface, i.e. up to six times in an inverter with 6 DC-DC Converters.

4.4 Write access to the battery interface

The following are additional implemented functionalities for the integration of the battery interface, where signals are written in the direction of the battery:

Signal	Explanation
Year/Month/Date/Hour/ Minute/Second	The date and time registers will be read and will be set to the current time of the inverter when the time is more than 2 seconds away from the inverter's time. The function is only active if the **ClockSync** parameter is set to the **On** status. See Section 4.4 for further explanations.
BCI Heartbeat enable	If it is read in, unless it is read to state 1, a 1 is written.
BCI Heartbeat	Written with an increasing number between 0 and 255 with each communication cycle
System power on	Is written once with the current value of the **Solbanks with communication** register if the battery is to be connected, the battery status corresponds to the conditions of **Bat.BmsStt = Ready**, and the **OnOffCmdSet** marker has the **OffCmdSet** status. This ensures that the command is only set once. As soon as the **OnOffCmdSet** marker has the **OnCmdSet** status, no further connect command is written. The marker is reset to **OffCmdSet** after a System Power Off command was set or the **ErrClr** parameter is activated in the inverter while the battery is disconnected. If the associated inverter or DC-DC Converter is to be started, the battery is connected first; the connection process is not initiated until **Bat.BmsStt= Operation** / **Bat.Stt = Connected**.
System power off	Is written once with the current value of the **Solbanks with communication** register if the battery is to be disconnected, the battery is still in one of the statuses **System Status = Ready/Maintain/Charge/Discharge/Ban_Charge/Ban_Discharge/Ban_Charge_and_Discharge**, and the **OnOffCmdSet** marker has the **OnCmdSet** status. The signal is possibly written with a delay if the Delayed Battery Disconnection function is activated, as explained in Section 6.3.
System Fault Reset	Is set to 1 if a battery error or a battery warning is reported and the resetting of an error is requested in the inverter.

Signal	Explanation
Enable Maintenance Mode	Is not written automatically, can only be written by manual intervention on the user interface. However, according to the manufacturer, these registers have no function in the current BMS version.
Maintenance Rack Masks	
Maintenance Start	
Master level minimal rack number	Is not written automatically, can only be written by manual intervention on the user interface. Operation with selected racks is required, as explained in Section 6.5.
Set Master level operating rack mask (1-64)	
Master operating rack mask set enable	
Aux contactor control	Is not written automatically, can only be written by manual intervention on the user interface. According to the manufacturer, this makes it possible to connect or disconnect the AC contactor.
Chiller Silent Mode control	Is not written automatically, can only be written by manual intervention on the user interface. According to the manufacturer, this makes it possible to reduce the maximum volume of the air conditioner. Options are: • Disconnected (100% maximum fan speed) • Silent Mode 1 (60% maximum fan speed) • Silent Mode 2 (70% maximum fan speed) • Silent Mode 3 (80% maximum fan speed)

5 Information on the operating behavior

5.1 Resetting battery errors

A battery error can be reset fully integrated via the inverter error reset function, if the conditions that triggered the error are no longer present. A battery error in the Sunny Central Storage also automatically causes the inverter to disconnect.

In the Sunny Central with DC coupling, a battery error only results in a warning, since the inverter and the other batteries can continue to operate independently.

5.2 Controlling the battery via the inverter

Activating the direct battery integration links the triggering of the battery and the inverter. This automatically integrates the status of the battery into the state machine of the inverter.

The inverter's operating manual explains the general operation of the inverter.

The most relevant sections for operation in connection with the battery and the Sunny Central Storage are in particular:

- **Setting the operating mode**
  - Selection of the signal source
  - Differences between the operating modes
- **Static and dynamic DC limits of the battery**
- **State of charge limit of the battery**

5.3 Manual Control or Remote Control

The Sunny Central Storage and the connected battery system can be written to either be remote control via a Modbus TCP interface or via manual option buttons on the user interface. This is determined by the parameter **Bsc.SrcSel** and is explained in the operating manual of Sunny Central Storage in the Section “Setting the operating mode”.

6 Special functions

6.1 Screening factors for charge and discharge current

Particularly in DC-coupled battery systems with unbalanced battery racks, uneven current distribution to the connected racks can occur. Unequal current distribution can lead to an overload of individual racks without exceeding the total current limits and without any adjustment of the limits at system level. To prevent this overload or to compensate for asymmetries, the total current limits can be reduced temporarily or generally by a screening factor before they are applied in the SMA system.

Use	Parameters	Setting	Explanation
Charging current	DcAmpDynMin factor	Default: 1.000 (100 %)	Full utilization of the permitted current of the Solbank 3.0-BMS
		0.950 (95%)	The battery inverter or DC-DC Converter is assigned a maximum of 95% of the charging current permitted by the Solbank 3.0-BMS as the current limit.
Discharge current	DcAmpDynMax factor	Default: 1.000 (100 %)	Full utilization of the permitted current of the Solbank 3.0-BMS
		0.950 (95%)	The battery inverter or DC-DC Converter is assigned a maximum of 95% of the discharge current permitted by the Solbank 3.0-BMS as the current limit.

6.2 Split DC busbar

6.2.1 Current limitation for split DC busbar with cross-fuse

This function is only available for the Sunny Central Storage UP with the option “Split DC buses."

It must be deactivated via the **Split Busbar Handling** = **Off** parameter if the "Split DC busbar" option is not installed. The function can only calculate the possible load on the cross-fuses correctly if all stacks of the inverter are active.

In order to allow a very high level of battery capacity to be connected to the Sunny Central Storage UP, the option “Split DC buses” divides the DC connection area, which is usually bundled, into various sections that are coupled to each other only by cross-fuses with substantially lower ampacity. In order to avoid overloading the cross-fuses when using this option, the current distribution across the various connection areas must be uniform.

Current distribution is mostly characterized by distributing active battery racks across the various connection areas. When the Split Busbar Handling = On function is activated, the inverter evaluates the status information for the various inputs Input 1 to 3 and calculates the permitted total current for the inverter on this basis.

To enable the inverter to assign the different racks to different inputs, the parameters **Split-Busbar Input 1 Solbanks**, **Split-Busbar Input 2 Solbanks**, **Split-Busbar Input 3 Solbanks** must first be used to specify which input is connected to which Solbanks. Since Solbank 3 can be divided into two halves and operated separately, configuration is also done in increments of half containers.

Of key importance here is the correlation that the Solbanks connected to the same input of the SCS are also configured for a common input during configuration. It does not matter to which of the inputs they are connected or configured.

6.2.2 Examples with split DC busbar

Example of configuration with 1.5 Solbank containers and inverter with 3 stacks and "Split DC busbar"

- Split-Busbar Handling = On
- Split-Busbar Input 1 Solbank = Solbank 1.1
- Split-Busbar Input 2 Solbank = Solbank 1.2

- Split-Busbar Input 3 Solbank = Solbank 2.1
- Installed Solbanks = 1.5 Solbanks

Example of configuration with 3 Solbanks containers and inverter with 3 stacks and "Split DC busbar"

- Split-Busbar Handling = On
- Split-Busbar Input 1 Solbank = Solbank 1.1 and Solbank 1.2
- Split-Busbar Input 2 Solbank = Solbank 2.1 and Solbank 2.2
- Split-Busbar Input 3 Solbank = Solbank 3.1 and Solbank 3.2
- Installed Solbanks = 3.0 Solbanks

In the rare case that an inverter with only 2 stacks and split busbar is used, two inputs with identical configuration must be assigned in the parameterization.

Example of configuration with 2 Solbanks containers and inverter with 2 stacks and "Split DC busbar"

- Split-Busbar Handling = On
- Split-Busbar Input 1 Solbank = Solbank 1.1 and Solbank 1.2
- Split-Busbar Input 2 Solbank = Solbank 2.1 and Solbank 2.2
- Split-Busbar Input 3 Solbank = Solbank 2.1 and Solbank 2.2
- Installed Solbanks = 2.0 Solbanks

6.2.3 Example with common DC busbar or DC-DC Converter

Example of configuration with 2 Solbank containers and inverter with “common DC busbar”

- Split Busbar Handling = Off
- Split-Busbar Input 1 Solbank = Not connected
- Split-Busbar Input 2 Solbank = Not connected
- Split-Busbar Input 3 Solbank = Not connected
- Installed Solbanks = 2 Solbanks

Example of the configuration with 1 Solbank container and DC-DC Converter

- Split Busbar Handling = Off
- Split-Busbar Input 1 Solbank = Not connected
- Split-Busbar Input 2 Solbank = Not connected
- Split-Busbar Input 3 Solbank = Not connected
- Installed Solbanks = 1 Solbanks

6.2.4 How the function works

Based on the above configuration and the feedback from the BMS about the connected racks (Racks connected status (1-32) and Racks connected status (33-64)), the function module now evaluates how the connected racks are distributed to the various inputs. Status information is output on the spot values of the Modbus profile for this purpose. The **Split busbar Inp # Racks Online** signals are used to indicate how many racks are currently connected for each input. The maximum total current calculated from the currently connected constellation of racks, which is still permitted for the cross-fuses, is calculated via the **Split-Busbar I Max 1 to 3** signal. As soon as the value of **Split-Busbar I Max 1 to 3** becomes smaller than the currents currently permitted on the battery side, this leads to an additional limitation of the DC current limits **Bat.DcAmpDynMin** or **Bat.DcAmpDynMax** in order to limit the total power of the inverter to the permitted load of the cross-fuses.

The **Split-Busbar Expected Imbalance** parameter maps possible asymmetries in the DC currents through the 3 DC switches of the inverter and thus reduces the assumed load capacity of the fuses.

The **Split-Busbar Cross-Fuse Limit** parameter covers the permitted continuous load of the cross-fuses, taking temperature-related restrictions into account. The default value of 300 A corresponds to the permitted continuous load of the factory-installed fuses with 500 A nominal current.

6.3 Delayed battery disconnection

In accordance with a customer requirement, a function was created that delays the disconnection of the battery component via the **System Power Off** command if a Disconnect command was sent to the system. As a result, the battery racks first remain connected, and the DC voltage from the batteries continues to be supplied to the inverter or DC-DC converter.

The following parameters are available for parameterizing the function

Parameters	Setting	Explanation
Shutdown Delay Time	Standard: 30 s Setting range 0 s to 500 s	Delay between the internal system request to disconnect the battery and the actual writing of the command to the BMS.
Shutdown Delay	Off	Disconnection delay is not used
	On	Disconnection delay is used unless a special case applies.

This delay of the batteries is only bypassed and an immediate disconnect command is written in the event of critical errors or when there are indications that manual intervention is required on-site.

The following reasons bypass the delay and an immediate disconnect command is written:

Parameters	Setting	Explanation
Critical errors	The following error numbers are classified as critical errors: 3501: Insulation error 6495: Device error, insulation measuring device 7801: Surge arrester triggered 9025: Triggering of the fast stop next to the switch cabinet door 9031: Opening the DC/AC circuit breaker next to the switch cabinet door	Safety-critical errors or errors that indicate the need for manual intervention and safety measures on-site.
Disconnection via key switch	When the key switch is turned to **Stop**	Manual intervention on-site

This function for delaying the disconnect command to the battery is particularly useful in situations where the system is only switched off for a very short time and needs to be connected again shortly afterwards. In this case, it is not necessary to disconnect the battery completely and there is no need to connect it again, which would result in a loss of time. If, for example, a delay time of 60 seconds has been set, but the system is already prompted to connect again after 50 seconds, no disconnect command is sent and the battery remains permanently connected. An example of this could be necessary changes to the operating mode in the event of a grid failure. Due to the delay, the battery remains connected and the system is ready for a black start more quickly.

6.4 Time synchronization via Modbus

The inverter can use the **Year/Month/Date/Hour/Minute/Second** registers to report the current time to the BMS via Modbus and thus ensure time synchronization between the inverter and the BMS.

To implement this function, the date and time registers will be read and set to the current time of the inverter when the time is more than 2 seconds away from the inverter's time.

This function is only active if the **ClockSync** parameter is set to the **On** status. Due to the low accuracy of this time synchronization via Modbus TCP, other methods of time synchronization are preferable, if they are available in the system network. Both the inverter and the BMS support the use of NTP time servers. If an NTP server is available, it should be configured in the inverter and also in the BMS. In this case, the **Clocksync** parameter should be set to the **Off** status, as it is by default.

The status of the NTP configuration of the BMS can also be viewed in Section 6.6 Detailed information about racks. If **Solbank NTP Status = "success and waiting"** is displayed here, NTP time synchronization in the BMS has been set up successfully and is effective.

6.5 Operation with selected racks

For maintenance purposes or for the targeted equalization of battery voltages and states of charge, it is possible to operate only specific racks as part of the Solbank 3.0 battery system.

The registers required for this can be written manually via the user interface of the inverter. These registers can be used to configure the BMS in the disconnected status (**System status = off**) so that only the specified racks are included in subsequent operation.

Parameters	Setting	Explanation
Master level minimal rack number	Standard: 6	Parameters for the minimum number of racks in operation per Solbank half (6 racks). May need to be adjusted to enable partial operation.
Set Master level operating rack mask (1-64)	Standard: 1 for each installed rack	Bit mask for activating and deactivating individual racks. Example for 1.5 Solbanks / 18 racks: • Set Master level operating rack mask (49-64): 0000 0000 0000 0000 • Set Master level operating rack mask (33-48): 0000 0000 0000 0000 • Set Master level operating rack mask (17-32): 0000 0000 0000 0011 • Set Master level operating rack mask (1-16): 1111 1111 1111 1111
	Example: only racks 1-3 should be used	• Set Master level operating rack mask (49-64): 0000 0000 0000 0000 • Set Master level operating rack mask (33-48): 0000 0000 0000 0000 • Set Master level operating rack mask (17-32): 0000 0000 0000 0000 • Set Master level operating rack mask (1-16): 000 0000 0000 0111
Master operating rack mask set enable	No operation	-
	Set rack mask	Parameters for applying the previously parameterized bit masks to activate/deactivate the individual racks

During the integration tests, the following procedure was tested and evaluated for functionality:

1. System consisting of inverter and battery is in stop mode, check whether the system **status = off**.

2. Adjustment of the minimum number of racks in operation per Solbank half in accordance with the desired partial operation. For example **Master level minimum rack number = 1**
3. Configuration of bit masks for activating and deactivating the individual racks
4. Command to trigger the application of the bit masks **Master operating rack mask set enable = Set rack mask**.
5. After a few seconds, check that the registers for displaying the current configuration mask (**Current Master Level operating rack mask (xx-xx)**) correspond to the desired status. If there are deviations from the desired status, repeat steps 3 and 4.
6. Operate the system using the usual methods: for example, charging or discharging until the desired operating target, such as equalizing the states of charge, is reached. During operation, the registers **Rack connected status (33-64)** and **Rack connected status (1-32)** can be used to determine which racks are currently actually included in the operation.
7. Restore the original configuration to enable full operation of the installed system. To do this, repeat steps 1 to 5 and activate the bits for all installed racks.

6.6 Detailed information about racks

6.6.1 Detailed information about racks

In addition to the central communication profile for operational management, the **Installed Solbanks** and **Racks/ Solbank** parameters can also be used to create and use a communication profile for retrieving detailed rack information. For this purpose, one or multiple additional communication profiles with the keyword "Rack information" are generated based on the set number of Solbanks and racks, which are then also displayed under External devices.

In these additional communication profiles, data points are also retrieved and visualized with significantly slower sampling, which are not required for normal operation but, in the event of an error, can provide important information for understanding the error.

The data points are retrieved directly and unmodified from the battery manufacturer's BMS and are converted into readable signals as per the documentation. See the battery manufacturer's documentation for an explanation and background of the signals.

For Solbank 3.0, this function can also be used to retrieve and display the following data points for each container.

6.6.2 Rack information of half containers

The possibility to operate battery containers in two separate halves offers several options for assigning which half is assigned to the current inverter. In order to display the rack information reliably for all assigned racks, the rack information for all racks is retrieved for each container involved. In the example of a combination of 1 inverter with 1.5 battery containers and thus 18 battery racks (12 racks/containers * 1.5 = 18), the rack information for both containers is retrieved in full, i.e. for 24 racks. This means that 12 racks are displayed for Container 2, but only 6 racks are assigned to the current inverter.

6.6.3 Status information about the configuration

- Solbank HW version
- Solbank serial number 1
- Solbank serial number 2
- Solbank serial number 3
- Solbank serial number 4
- Solbank serial number 5
- Solbank serial number 6
- Solbank charge/discharge rate
- Solbank controller software version 1

- Solbank controller software version 2
- Solbank controller software version 3
- Solbank controller software version 4
- Solbank controller software version 5
- Solbank controller software version 6
- Solbank controller software version 7
- Solbank controller software version 8
- Solbank controller software version 9
- Solbank controller software version 10
- Solbank NTP enable
- Solbank NTP Server IP 1
- Solbank NTP Server IP 2
- Solbank NTP Server IP 3
- Solbank NTP Server IP 4
- Solbank NTP Server Port
- Solbank NTP Operation Start
- Solbank NTP status
- Solbank Master Mode Enable
- Solbank Master Number
- Solbank Slave Number
- Solbank Slave Number in Master 1
- Solbank Slave 1 IP in Master 1 1
- Solbank Slave 1 IP in Master 1 2
- Solbank Slave 1 IP in Master 1 3
- Solbank Slave 1 IP in Master 1 4
- Solbank Slave 1 DeviceID in Master 1
- Solbank Slave 2 IP in Master 1 1
- Solbank Slave 2 IP in Master 1 2
- Solbank Slave 2 IP in Master 1 3
- Solbank Slave 2 IP in Master 1 4
- Solbank Slave 2 DeviceID in Master 1
- Solbank Slave 3 IP in Master 1 1
- Solbank Slave 3 IP in Master 1 2
- Solbank Slave 3 IP in Master 1 3
- Solbank Slave 3 IP in Master 1 4
- Solbank Slave 3 DeviceID in Master 1
- Solbank Slave 4 IP in Master 1 1
- Solbank Slave 4 IP in Master 1 2
- Solbank Slave 4 IP in Master 1 3
- Solbank Slave 4 IP in Master 1 4
- Solbank Slave 4 DeviceID in Master 1

6.6.4 Discrete status registers for current error messages

- Summary of total voltage undervoltage level 1 alarms for each rack in Solbank
- Summary of total voltage undervoltage level 2 alarms for each rack in Solbank
- Summary of total voltage undervoltage level 3 alarms for each rack in Solbank
- Summary of total voltage overvoltage level 1 alarms for each rack in Solbank
- Summary of total voltage overvoltage level 2 alarms for each rack in Solbank
- Summary of total voltage overvoltage level 3 alarms for each rack in Solbank
- Summary of overcurrent level 1 alarms for each rack in Solbank
- Summary of overcurrent level 2 alarms for each rack in Solbank
- Summary of overcurrent level 3 alarms for each rack in Solbank
- Summary of low insulation resistance alarm level 1 alarms for each rack in Solbank
- Summary of low insulation resistance alarm level 2 alarms for each rack in Solbank
- Summary of low insulation resistance alarm level 3 alarms for each rack in Solbank
- Summary of module under-temperature level 1 alarms for each rack in Solbank
- Summary of module under-temperature level 2 alarms for each rack in Solbank
- Summary of module under-temperature level 3 alarms for each rack in Solbank
- Summary of module over-temperature level 1 alarms for each rack in Solbank
- Summary of module over-temperature level 2 alarms for each rack in Solbank
- Summary of module over-temperature level 3 alarms for each rack in Solbank
- Summary of single cell overvoltage level 1 alarms for each rack in Solbank
- Summary of single cell overvoltage level 2 alarms for each rack in Solbank
- Summary of single cell overvoltage level 3 alarms for each rack in Solbank
- Summary of single cell undervoltage level 1 alarms for each rack in Solbank
- Summary of single cell undervoltage level 2 alarms for each rack in Solbank
- Summary of single cell undervoltage level 3 alarms for each rack in Solbank
- Summary of single cell voltage difference level 1 alarms for each rack in Solbank
- Summary of single cell voltage difference level 2 alarms for each rack in Solbank
- Summary of single cell voltage difference level 3 alarms for each rack in Solbank
- Summary of single cell under-temperature level 1 alarms for each rack in Solbank
- Summary of single cell under-temperature level 2 alarms for each rack in Solbank
- Summary of single cell under-temperature level 3 alarms for each rack in Solbank
- Summary of single cell over-temperature level 1 alarms for each rack in Solbank
- Summary of single cell over-temperature level 2 alarms for each rack in Solbank
- Summary of single cell over-temperature level 3 alarms for each rack in Solbank
- Summary of single cell temperature difference level 1 alarms for each rack in Solbank
- Summary of single cell temperature difference level 2 alarms for each rack in Solbank
- Summary of single cell temperature difference level 3 alarms for each rack in Solbank
- Summary of low SOC level 1 alarms for each rack in Solbank
- Summary of low SOC level 2 alarms for each rack in Solbank
- Summary of low SOC level 3 alarms for each rack in Solbank
- Summary of high SOC level 1 alarms for each rack in Solbank

- Summary of high SOC level 2 alarms for each rack in Solbank
- Summary of high SOC level 3 alarms for each rack in Solbank
- Summary of low SOH level 1 alarms for each rack in Solbank
- Summary of low SOH level 2 alarms for each rack in Solbank
- Summary of low SOH level 3 alarms for each rack in Solbank
- Summary of high SOH level 1 alarms for each rack in Solbank
- Summary of high SOH level 2 alarms for each rack in Solbank
- Summary of high SOH level 3 alarms for each rack in Solbank
- Summary of lost BCM alarms for each rack in Solbank
- Summary of lost BMU alarms for each rack in Solbank
- Abnormal total voltage across the Racks in the Solbank (differential voltage greater than 15V)
- Abnormal contactor disconnection in Solbank
- Abnormal contactor closure in Solbank
- Solbank charging prohibition
- Solbank discharging prohibition
- Solbank alarm summary
- Solbank fault summary
- Water sensor alarms
- Fire safety system level 1 alarm
- Combustible Gas System level 1 alarm
- Reserved 61
- Summary of over-temperature level 1 alarms for high voltage box terminals in each Rack in Solbank
- Summary of over-temperature level 2 alarms for high voltage box terminals in each Rack in Solbank
- Summary of over-temperature level 3 alarms for high voltage box terminals in each Rack in Solbank
- Summary of module overvoltage level 1 alarms for high voltage box terminals in each Rack in Solbank
- Summary of module overvoltage level 2 alarms for high voltage box terminals in each Rack in Solbank
- Summary of module overvoltage level 3 alarms for high voltage box terminals in each Rack in Solbank
- Summary of module undervoltage level 1 alarms for high voltage box terminals in each Rack in Solbank
- Summary of module undervoltage level 2 alarms for high voltage box terminals in each Rack in Solbank
- Summary of module undervoltage level 3 alarms for high voltage box terminals in each Rack in Solbank
- Voltage collection fault in Solbank
- Temperature collection in Solbank
- Local emergency stop fault
- Combustible Gas System level 2 alarm
- Fire safety system level 2 alarm
- Remote emergency stop fault
- Door sensor status
- Surge protector faults
- AC surge protector faults
- Positive Fuse disconnection faults in the current collector
- Negative Fuse disconnection faults in the current collector

- fire safety system fault
- gas system fault
- Reserved 84
- Reserved 85
- Reserved 86
- Reserved 87
- Level 2/3 fault input dry contact alarms
- current unbalance alarms
- Level 2 alarm for uneven temperature difference between Rack
- Level 3 alarm for uneven temperature difference between Rack
- Air cooling AC communication status alarm (if installed)
- 1# Liquid Cooling Chiller communication status alarms
- #1 Dehumidity AC communication status alarms (if installed)
- #2 Dehumidity AC communication status alarms (if installed)
- #3 Dehumidity AC communication status alarms (if installed)
- UPS communication status alarms
- Meter communication status alarms
- Temperature and humidity meter communication status alarms
- IO expansion port communication status alarms
- H2 gas controller 1 (5#) communication status alarm
- H2 gas controller 1 (6#) communication status alarm
- Solbank over current limit fault
- Master communication failure
- Pack poles over temperature level 1 alarm
- Pack poles over temperature level 2 alarm
- Pack poles over temperature level 3 alarm

6.6.5 Overview information on the entire Solbank

- Solbank Reserved 1
- Solbank total voltage
- Solbank total current
- Solbank SOC
- Solbank SOH
- Solbank max cell voltage
- Max cell voltage rack number
- Max cell voltage cell number
- Solbank min cell voltage
- Min cell voltage rack number
- Min cell voltage cell number
- Solbank max cell temperature
- Max cell temperature rack number
- Max cell temperature sensor number

- Solbank min cell temperature
- Min cell temperature rack number
- Min cell temperature sensor number
- Solbank cumulative charge energy
- Solbank cumulative discharge energy
- Solbank current cycle charge energy
- Solbank current cycle discharge energy
- Solbank available charge capacity
- Solbank available discharge capacity
- Solbank remaining time to full discharge
- Solbank remaining time to full charge
- Solbank max discharge power limit
- Solbank max charge power limit
- Solbank max discharge current limit
- Solbank max charge current limit
- Solbank daily discharge times
- Solbank daily charge times
- Solbank daily discharge energy
- Solbank daily charge energy
- Solbank average cell temperature
- Solbank current status
- Solbank charging and discharging status
- Solbank insulation resistance
- Solbank power
- Solbank SOC calibration warning
- Solbank usable capacity

6.6.6 Detailed information for each individual rack

- Rack #1 current status
- Rack #1 max charge power limit
- Rack #1 max discharge power limit
- Rack #1 max charge voltage
- Rack #1 max discharge voltage
- Rack #1 max charge current limit
- Rack #1 max discharge current limit
- Rack #1 DI1 (positive contactor status)
- Rack #1 DI2 (positive fuse status)
- Rack #1 DI3 (negative contactor status)
- Rack #1 DI4 (negative fuse status)
- Rack #1 DI5 (Reserved)
- Rack #1 DI6 (High Voltage box disconnect switch status)
- Rack #1 DI7 (Reserved)

- Rack #1 DI8 (Reserved)
- Rack #1 total voltage
- Rack #1 current
- Rack #1 power
- Rack #1 SOC
- Rack #1 SOH
- Rack #1 insulation resistance
- Rack #1 average cell voltage
- Rack #1 average cell temperature
- Rack #1 max single voltage
- Rack #1 max single voltage cell number
- Rack #1 min single voltage
- Rack #1 min single voltage cell number
- Rack #1 max single temperature
- Rack #1 max single temperature sensor number
- Rack #1 min single temperature
- Rack #1 min single temperature sensor number
- Rack #1 max cell SOC
- Rack #1 max cell SOC cell number
- Rack #1 min cell SOC
- Rack #1 min cell SOC cell number
- Rack #1 max cell SOH
- Rack #1 max cell SOH sensor number
- Rack #1 min single SOH
- Rack #1 min single SOH sensor number
- Rack #1 cumulative charge energy
- Rack #1 cumulative discharge energy
- Rack #1 current cycle charge energy
- Rack #1 current cycle discharge energy
- Rack #1 available charge capacity
- Rack #1 available discharge capacity
- Rack #1 SOC calibration warning
- Rack #1 usable capacity

7 Instructions on commissioning the system

7.1 Instructions on commissioning the system

The combination of Sunny Central Storage and Solbank 3.0 battery systems has undergone a joint certification process in accordance with UL 9540. To improve joint commissioning and system reliability, various measures were defined during certification, which are explained below.

The certification in accordance with UL 9540 (UL 9540:2023 and UL 9540:2025) applies to the combination of the following product variants:

Sunny Central Storage

- SCS 3450 UP-US 600V 3320A
- SCS 3600 UP-US 630V 3320A
- SCS 3800 UP-US 660V 3320A
- SCS 3950 UP-US 690V 3320A
- SCS 3450 UP-XT-US 4000kVA 600V 3850A
- SCS 3600 UP-XT-US 4200kVA 630V 3850A
- SCS 3800 UP-XT-US 4400kVA 660V 3850A
- SCS 3950 UP-XT-US 4600kVA 690V 3850A
- SCS 2300 UP-XT-US 2667kVA 600V 2566A
- SCS 2400 UP-XT-US 2800kVA 630V 2566A
- SCS 2530 UP-XT-US 2933kVA 660V 2566A
- SCS 2630 UP-XT-US 3067kVA 690V 2566A

Solbank 3.0

- CSI-Solbank-S-5016-2h-NA
- CSI-Solbank-S-5016-4h-NA

7.2 Connections between the system components

Sunny Central Storage and the Solbank 3.0 battery can be connected to each other using various interfaces, which are described in the following table and graphic.

Interface Sunny Central Storage	Interface Solbank 3.0	Requirements and instructions for Sunny Central Storage	Requirements and instructions for Solbank 3.0
DC connection	DC line connection	Operating manual, section Installation/DC connection	Installation manual, section Solbank 3.0 series system wiring / Solbank 3.0 series DC cable installation procedure
External Fast-Stop Function	Interconnecting Dry Contact	Operating manual, section Installation/Cables for communication, control and monitoring/Cables for external fast-stop function	Installation manual, section Solbank 3.0 series system wiring / Auxiliary power cable, signal wires and communication cable installation procedure

Interface Sunny Central Storage	Interface Solbank 3.0	Requirements and instructions for Sunny Central Storage	Requirements and instructions for Solbank 3.0
Status of the fast-stop switch	External F-stop signal input	Operating manual, section Installation/Cables for communication, control and monitoring/Cables for the status of the fast-stop switch	Installation manual, section Solbank 3.0 series system wiring / Auxiliary power cable, signal wires and communication cable installation procedure
Communication	Communication	Operating manual, section Installation/Cables for communication, control and monitoring/Cables for communication via Ethernet	Installation manual, section Solbank 3.0 series system wiring / Auxiliary power cable, signal wires and communication cable installation procedure

If the specified requirements of both sides, such as maximum distances, minimum cross-section, voltage specifications, and insulation requirements, are not identical, the system installation must meet the more restrictive/higher requirement.

Depending on the system configuration, the following schematic graphics show the necessary connections between the components mentioned above. Connections and interfaces to other external components such as energy self-sufficiency, AC power connection, external monitoring, or control systems remain valid but are not shown in the following graphics.

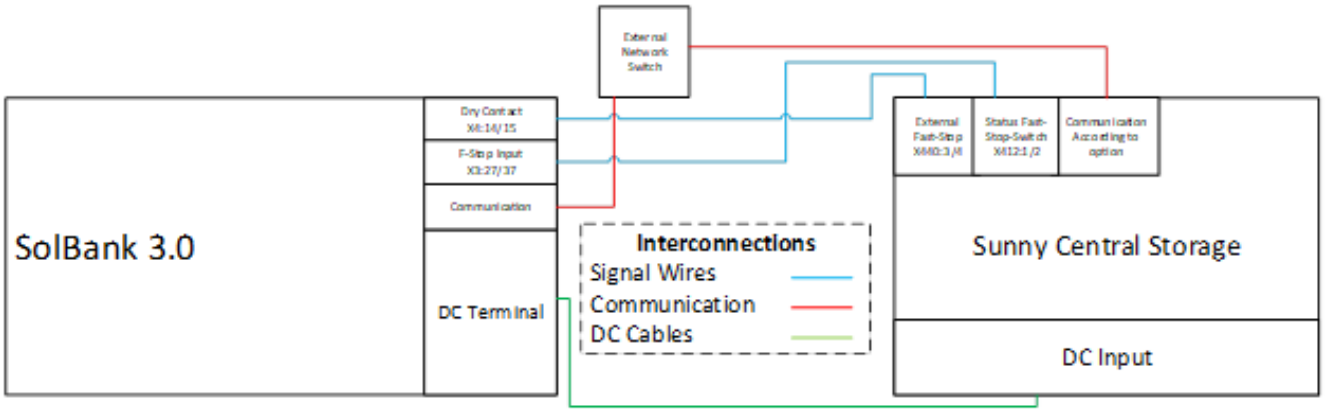


Figure 1: System connection for Solbank 3.0 and 1 Sunny Central Storage

Figure 2 and Figure 3 show an additional box for the signal connection, which is required to provide fast-stop inputs and outputs in accordance with the specific system. The fast-stop inputs must be connected to the various sources (dry contact and status of the fast-stop switch) and accumulate their signals to form a common status. As soon as one of these inputs is active, the entire fast stop must become active. The external signal connection box provides individual fast-stop outputs to each system component and connects their respective inputs (external fast-stop function and external F-stop signal input), whereas all these inputs are interrupted as soon as the fast stop is active.

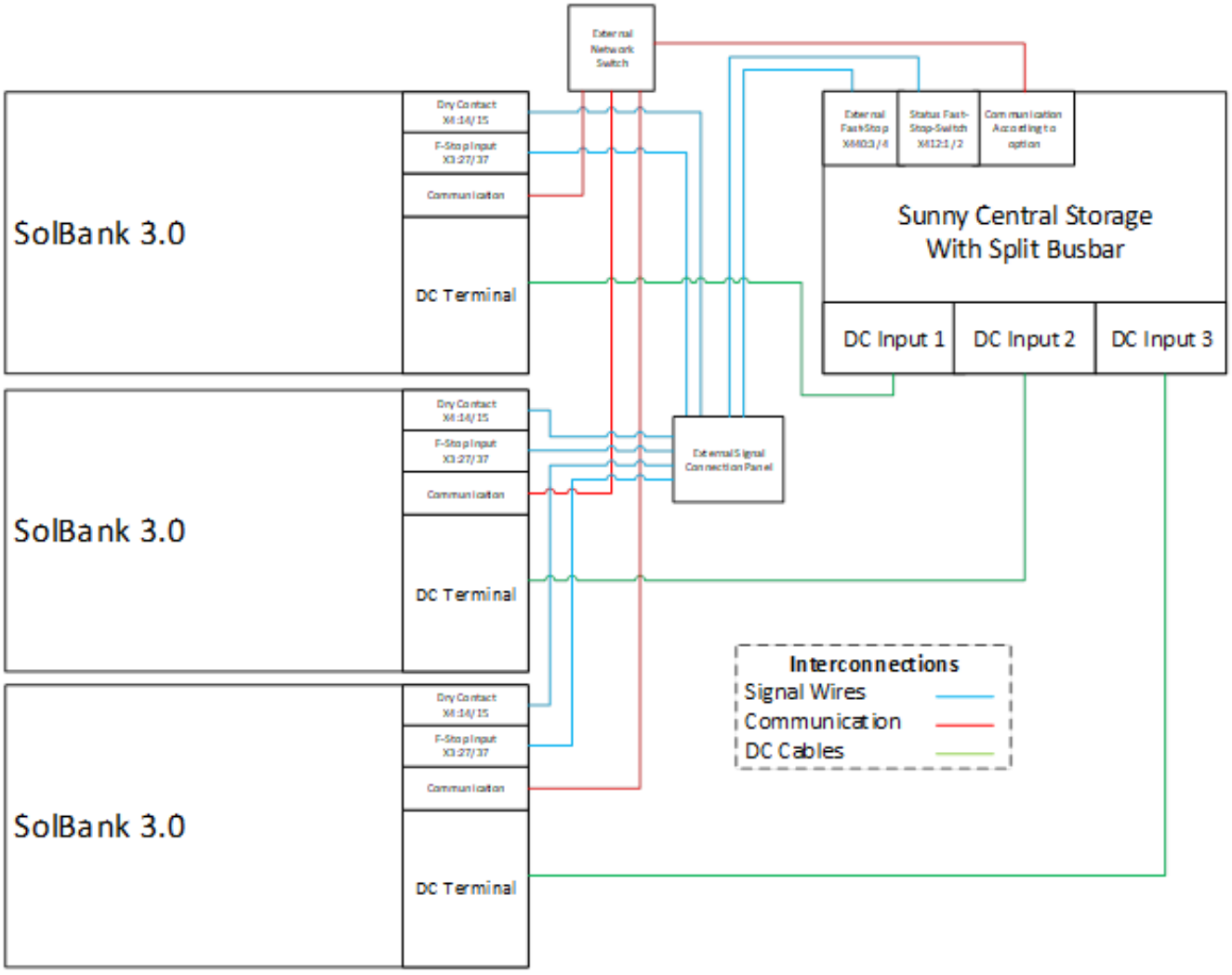


Figure 2: System connection for 3 Solbank 3.0 units and 1 Sunny Central Storage in parallel

Figure 3 describes a possible system in which 1.5 Solbank 3.0 batteries are used with an inverter. This means that a total of 3 battery containers are connected to 2 Sunny Central Storage units.

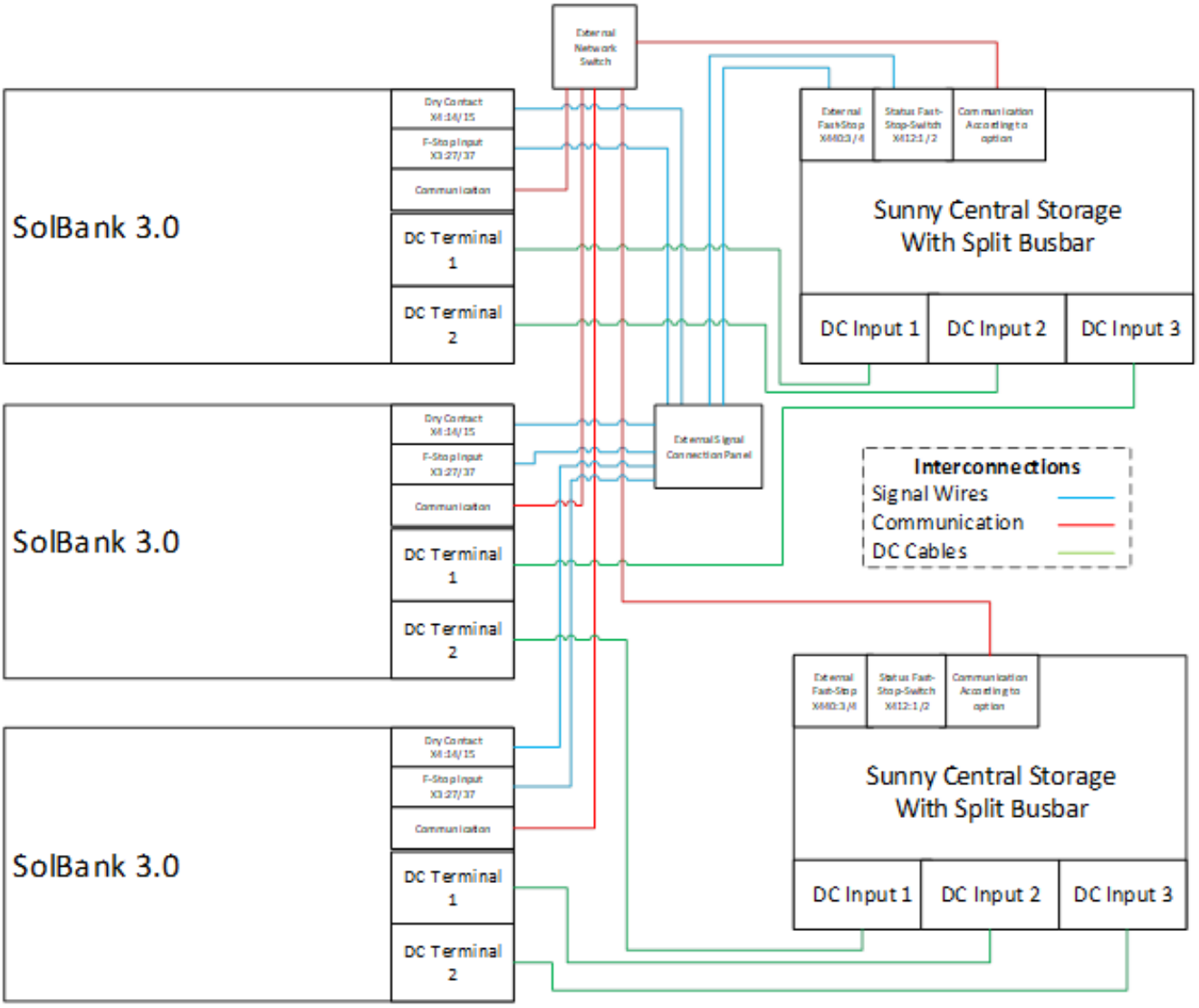


Figure 3: System connection for 3 Solbank 3.0 units and 2 Sunny Central Storage units

7.3 Restrictions of the system

The system can consist of any combination of one of the above Sunny Central Storage variants with up to 3 units of the Solbank 3.0 battery container.

This allows the system to achieve the following maximum specifications.

Maximum system combination	Maximum nominal power	Maximum nominal energy	Maximum expected short-circuit current
Sunny Central Storage with 3 Solbank 3.0 units	4600 kW	14400kWh	330.36 kA

The system may only be installed in closed electrical operating areas.

The system is designed for humid and coastal environments. The system is designed for seismically active environments in accordance with High Level (IEEE 693 standard) and Zone 4 (GR-63-Core standard) conditions.

Remote software updates for the common system are not permitted if they change critical or monitoring software sections as defined by UL 1998.

7.4 System test of the fast-stop chains

To protect the components involved as effectively as possible, they must be connected via a common wired fast-stop chain. In particular, in configurations with multiple battery containers per Sunny Central Storage, additional connection components are required to create this fast-stop chain, which makes the cabling more complex.

To ensure that each component can successfully trigger and receive a fast stop, it is necessary to test this fast-stop chain during system commissioning. To do this, a fast stop must be triggered from each component involved and it must be verified that each connected component receives it as expected. It is not necessary for the system to be in charging or discharging mode, but the components must be fully powered and free of faults.

Take the following triggering components into account:

- Fast-stop button on the outside of each battery container that is part of the system
- Possible connection component (ESC cabinet) with its own fast-stop button
- Fast-stop button next to the key switch of the inverter

Take the following receiving components into account:

- Each battery container that is part of the system
- Inverter

The test of all triggering components and receiving components should normally be carried out by at least 2 people. Take the following into account:

- Each triggering component must be tested individually. The last fast stop must be successfully reset before the next component can be tested.
- All fast-stop buttons are self-locking, which means that they must first be reset before the reported error states can be reset and the next triggering component can be tested.
- In the battery container, triggering the fast-stop chain disconnects the circuit breaker that supplies power to the air conditioner. This must be connected again before the next test.
- Open doors on the battery container are a separate Level 2 error. These must be closed again before the next triggering component is tested.
- At each receiving component, it must be confirmed that each tested fast-stop activation is reported.
- Each battery container provides feedback on the error state.
  - The main profile of the Master container reports at least 1 active fault under **Level 3 Alarm Summary**.
  - The rack information profiles of all containers involved report at least 1 active fault under **Remote emergency stop fault**. By default, this information is only retrieved once every 10 seconds, so there may be a delay before it becomes available.
- In the event of a fast stop, the inverter goes into error mode and must report at least one of the following 2 error numbers.
  - Error 9026 confirms receipt of the wired fast-stop signal if another component triggered the fast stop.
  - Error 9025 indicates that the fast-stop button on the inverter itself was pressed.
- In each case tested, the inverter must display error number 9307, which confirms that the assigned battery has switched to an error state.

7.5 Verification of the battery and inverter assignment

Inverters and battery containers are assigned via the configuration of IP addresses and system configurations in the BMS. Incorrect IP addresses or incorrect configurations in the Master BMS can cause faulty operating states or overload individual components even though communication appears to be functioning properly.

To confirm that the system configuration and IP address assignment are correct, it is important to take special care during commissioning. Simple tests performed during system commissioning make it possible to confirm that the system has been configured and set up correctly.

The following procedure must be carried out to verify that the system has been set up correctly:

- The inverters and associated batteries must undergo a system test one after the other, not simultaneously. Only sequential execution ensures that the inverter and battery are assigned correctly and that different systems in the same state do not simulate an apparently functioning assignment.
- The system consisting of the inverter and battery must be completely set up and parameterized in accordance with the documentation provided.

The inverter is in the Stop state and the batteries are disconnected. When using manual control (**Bsc.SrcSel** = **Manual Control**), this can be achieved by using the parameter **Bsc.ScsOpCmdMan** = **Stop**.

- The instantaneous value **OpStt** corresponds to the **Stop** status.
- In this status, there must be no DC voltage applied to the inverter. The instantaneous value **DcMs.Vol** corresponds approximately to **0 V**.
- The battery status **Bat.BmsStt** corresponds to the **Ready** status.

Connect the batteries via the parameter **Bsc.ScsOpCmdMan** = **Battery Standby**.

- After a few seconds, the inverter measures an applied DC voltage that corresponds to the expected battery voltage. The instantaneous value **DcMs.Vol** corresponds approximately to **Bat.DcVolConn**.
- The battery was able to connect all configured racks and reports them as connected. The instantaneous value **Bat.NoStrgConn** corresponds to **Bat.NoStrgTot**.
- The battery is in the expected operating state. Instantaneous value **Bat.BmsStt** = **Operation**

Connect the inverter via the parameter **Bsc.ScsOpCmdMan** = **Power Control**.

- After a successful start-up, the inverter is now in operation. The instantaneous value **OpStt** corresponds to the **GridFeed** status.

Power flow between the battery and inverter via an active power setpoint corresponding to a permitted power flow on the system side, e.g. **Bsc.WSptMan = 500 kW**.

- After a few seconds, e.g. after corresponding ramps of the active power flow, the inverter reaches the specified setpoint. The instantaneous value **InvMs.TotW** corresponds approximately to **Bsc.WSptMan**.
- The measured DC current in the inverter corresponds to the measured DC current of the battery. The instantaneous value **DcMs.TotAmp** corresponds to the instantaneous value **Bat.DcAmp**, except for a few amps.
- The rack information shows the expected number of racks in operation (**Bat.NoStrgConn**) and each of the racks in operation shows the current flow based on the total power flow.
  - The current measurements of the individual racks are normally only retrieved every 10 seconds. It may therefore take a few seconds until all racks display the correct current.
  - Use the rack information to check that each connected rack is also participating in the current flow. Particularly during initial commissioning, slight differences in the state of charge of the battery containers may result in significant differences in the current contribution of the individual racks. During initial commissioning, it is important that all connected racks participate in the current flow and that any change in the power flow also causes a corresponding change in the individual current flow.
  - Take into account the information in Section 6.6.2 Rack information for half containers. Not all racks within the displayed rack information are necessarily assigned to the inverter that is currently in operation. Within the container, which is divided into two inverters, only one half, i.e. either half 1 (racks 1 to 6) or half 2 (racks 7 to 12), is assigned to the current inverter. It is essential that within the entire rack information, the expected number of racks can be recognized as connected.
  - Under **External devices > CSI Solbank 3 #x rack info > Instantaneous value**, the instantaneous values displayed can be filtered using keywords.
  - The instantaneous value **Rack #x current status** indicates whether the respective rack is connected and participating in the current flow, e.g. **Rack #x current status** corresponds to **Discharge**.

  - The instantaneous value **Rack #x current** indicates which current flow the respective rack is currently measuring.
- If the power specification changes, e.g. from Bsc.WSptMan = 800 kW, the current contribution of all connected racks changes. The instantaneous value **Rack #x current** shows a corresponding change in the current contribution of all connected racks.

Disconnect the system from the inverter and battery via the parameter **Bsc.ScsOpCmdMan = Stop**

- When the system is stopped, the inverters and batteries disconnect and there is no longer any DC voltage on the common DC bus. In accordance with the function described in Section 6.3 Delayed battery disconnection, the battery disconnection may be delayed. The instantaneous value OpStt corresponds to the Stop status.
- In this status, there must be no DC voltage applied to the inverter. The instantaneous value **DcMs.Vol** corresponds approximately to 0 V.
- The battery status **Bat.BmsStt** corresponds to the **Ready** status.

7.6 Verification of insulation resistances

To ensure that the configuration in the inverter is correct and that the battery is correctly configured for use with the inverter, the insulation resistance reported by the inverter should be evaluated for joint operation.

For the system in operation consisting of an inverter and battery, an insulation resistance (instantaneous value **PvGnd.RisIso**) in the range between 300 kOhm and 1000 kOhm is expected when connected (**OpStt = Gridfeed**, **Bat.BmsStt = Connected**).

If the insulation resistance is greater than 1000 kOhm, it is possible that the insulation monitoring in the inverter is not configured correctly or that the connection cables on the insulation monitoring device have been disconnected. The parameter **PvGnd.Mod** must be configured with the **Bender** option.

If the insulation resistance is less than 300 kOhm, it is possible that the battery is equipped with an incorrect software version and that parts of the battery's own insulation monitoring remain connected during normal operation, which impairs the insulation. In particular, the BMU version should be checked in accordance with Section 2.1.

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