ASC-4

Modbus client

USER MANUAL

4189341293B

DEIF Improve Tomorrow

1. General information

1.1 ASC Modbus client

ASC Solar

The ASC Solar controller allows interfacing to inverters and conducting control as a Modbus client. Multiple inverter makes and models are supported. Note, however, that an ASC can only control a system with one type of inverter. That is, the ASC cannot be used with a mix of different inverters.

More information
See the **ASC-4 and ASC 150 Solar Modbus client tables** (an Excel spreadsheet) for the supported data and protocols for an ASC-4 Solar controller.

ASC Battery

The ASC Battery controller allows interfacing to an energy storage system battery control unit, battery management system and/or power conversion system as a Modbus client. The ASC can read operating values, and write control commands.

The ASC Battery controller includes two **DEIF Generic** Modbus client protocols. See Battery: DEIF Generic protocols for more information.

More information
See the **ASC-4 Battery ASC 150 Storage Modbus client tables** (an Excel spreadsheet) for the data schemes for the *DEIF Generic* protocols.

NOTE The ASC also includes a Modbus server. This is described in the **ASC-4 Modbus server User manual** and **ASC-4 Modbus server tables**.

1.2 Software version

This document is based on ASC-4 software version 4.21.

1.3 Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

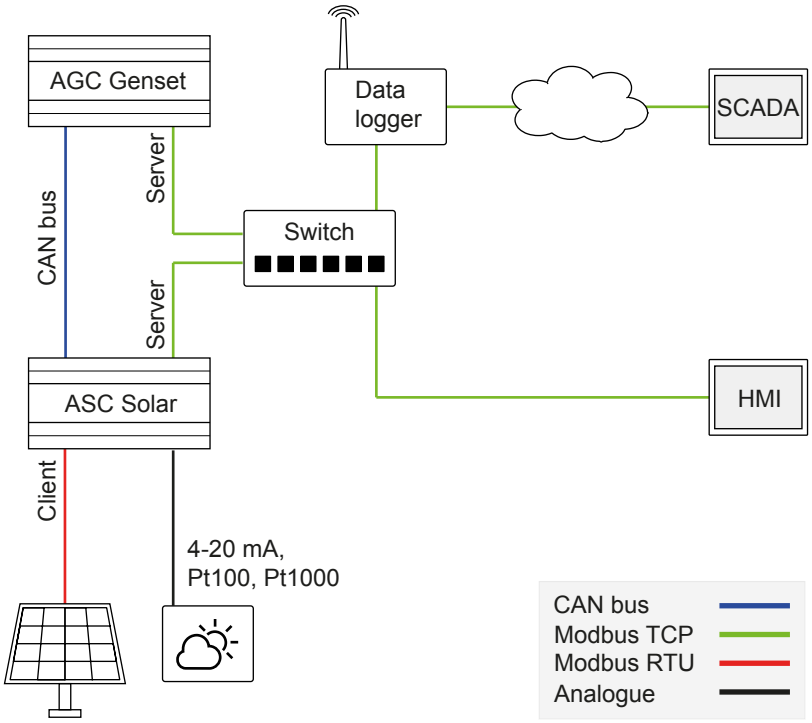
2. Hardware information

2.1 Communication

2.1.1 ASC Solar communication

The ASC can communicate as a Modbus client and/or Modbus server.

Example of ASC Solar communication



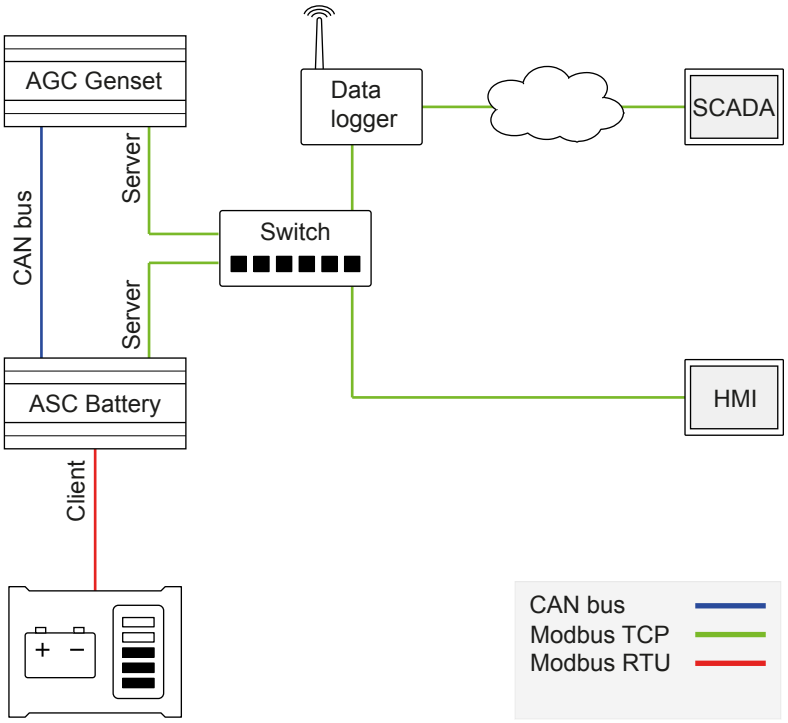
NOTE The ASC can get analogue weather data and/or use a Modbus RTU interface.

NOTE If required, you can use an RTU to TCP/IP converter for the communication between the ASC and the inverters. See the **ASC-4 Commissioning guidelines** for more information.

2.1.2 ASC Battery communication

The ASC can communicate as a Modbus client and/or Modbus server.

Example of ASC Battery communication



NOTE You can use an RTU to TCP/IP converter for the communication between the ASC and the battery. See the **ASC-4 Commissioning guidelines** for more information.

2.2 Terminals for Modbus client

The ASC includes a Modbus RTU client. That is, for an ASC Solar, the ASC is the Modbus client, and the inverters are the Modbus servers. For an ASC Battery, the ASC is the Modbus client, and the BCU, PCS and/or BMS are the Modbus servers. If Modbus TCP/IP interface is required, you can use a Modbus RTU-TCP/IP external converter to connect the ASC.

Option H2 is used for the Modbus client. Option H2 is standard hardware, installed in slot 2.

Terminal	Function	Description
29	DATA + (A)	Modbus RTU (RS-485)
30	DATA GND	
31	DATA - (B)	
32		
33	DATA + (A)	
34		
35	DATA - (B)	
36		

NOTE Terminals 29 and 33 are internally connected. Terminals 31 and 35 are internally connected.

These are the RS-485 hardware settings:

- 9600 or 19200 bps

- 8 data bits
- None parity
- 1 stop bit
- No flow control

2.3 Wiring

More information
See the **Installation instructions** for wiring information.

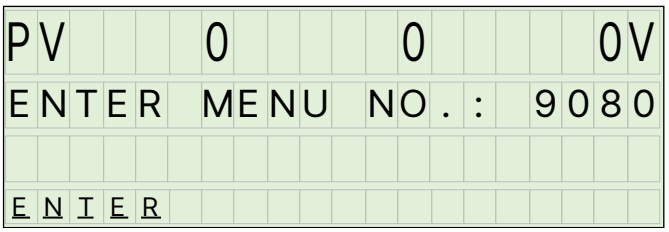
3. Modbus client monitoring

3.1 Modbus monitoring

You can monitor the ASC Modbus client communication from the display unit.

Getting into Modbus monitoring

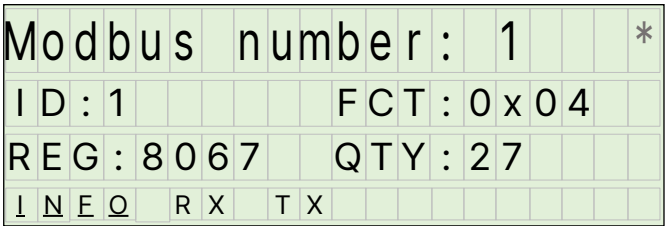
1. On the display unit, press the **JUMP** key, then use the up arrow until menu **9080** is shown.
   - Hint: If you keep holding the arrow, the menu numbers will start to scroll faster.



2. Press **SEL** to enter Modbus monitoring.
3. The Modbus monitoring INFO screen opens.

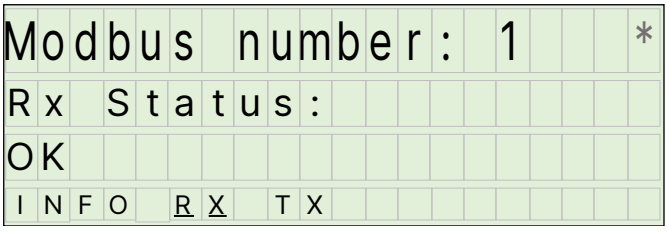
NOTE For a new Modbus connection, this may take up to a minute.

INFO screen



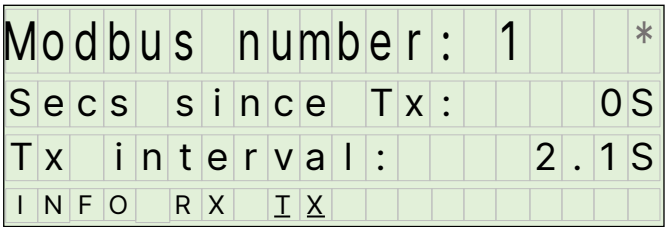
Modbus number	The specific Modbus package. Use the up and down arrows to see the info screens for other Modbus numbers.
Star	Shown when a new transmission has started.
ID	The Modbus server ID.
FCT	The function ID (hexadecimal).
REG	The register start address.
QTY	The number of registers to read/write from the start address.
Bottom row	Use the left and right arrows to navigate to other screens. The screen that is shown is underlined.

RX screen



Modbus number	The specific Modbus package. Use the up and down arrows to see the info screens for other Modbus numbers.
Star	Shown when a new transmission has started.
Rx Status: OK	The ASC Modbus client can receive packages from the external equipment Modbus server.
Bottom row	Use the left and right arrows to navigate to other screens. The screen that is shown is underlined.

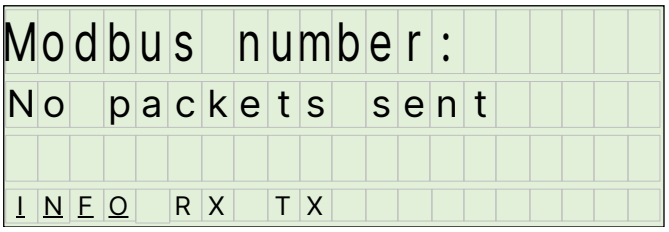
TX screen



Modbus number	The specific Modbus package. Use the up and down arrows to see the info screens for other Modbus numbers.
Star	Shown when a new transmission has started.
Secs since Tx	The time since the last Modbus client transmission.
Tx interval	The interval between the last two Modbus client transmissions.
Bottom row	Use the left and right arrows to navigate to other screens. The screen that is shown is underlined.

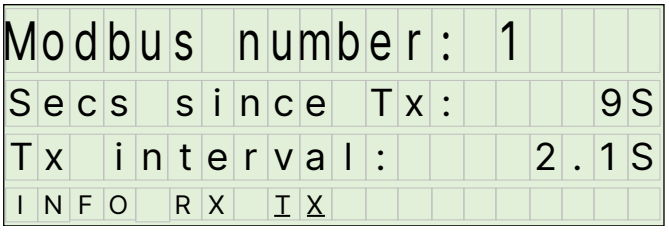
3.2 Modbus troubleshooting

Not configured and/or connected

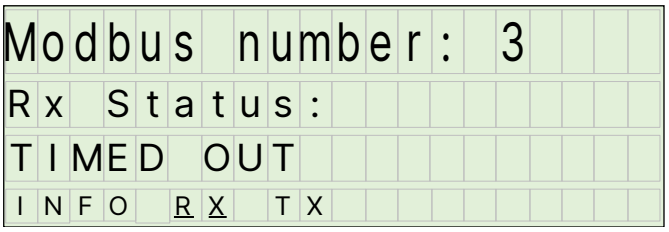


This screen is shown if no protocol is selected, and/or the Modbus server was never connected.

Disconnected



When the Modbus server is disconnected, the time since the last transmission increases. If the time since the last transmission is more than the transmission interval, there is a problem.



The RX screen above shows that the transmission TIMED OUT.

Exception codes and errors

The Rx status can show the following Modbus exception codes and errors.

Text	Reason
ACKNOWLEDGE	The Modbus server has accepted the request and is processing it, but a long time is required. This response is returned to prevent a timeout error in the Modbus client.
BYTESEXPECTED ERROR	The number of bytes received is wrong.
CLIENT CRC ERROR	CRC error in the received telegram.
FUNCTION ID ERROR	Wrong function ID in the received telegram
GATEWAY N/A	The Modbus gateway configuration is wrong.
GATEWAY TGT NORESP	The Modbus server failed to respond.
ILLEGAL DATAADDR	The data address(es) of some or all the required entities are not allowed in the Modbus server.
ILLEGAL FUNCTION	The function code received in the query is not allowed by the Modbus server.
ILLEGAL_DATAVALUE	The value is not accepted by the Modbus server.
NEGATIVE ACK	The Modbus server cannot perform the programming functions.
QUERY ERROR	The Modbus client could not transmit the telegram.
RESP DATA ERROR	The response received did not contain the expected data.
SERVER ADDR ERROR	Wrong Modbus server ID in the received telegram.
SERVER BUSY	The Modbus server is busy processing a long command. The Modbus client should retry later.
SERVER CRC ERROR	The Modbus server detected a CRC error in a received telegram.
SERVER FAILURE	An unrecoverable error occurred while the Modbus server was attempting to perform the requested action.
TIMED OUT	No response.

4. Solar: Inverter monitoring

4.1 Supported inverters

The Modbus client can monitor up to 42 inverters (nodes). See the **ASC-4 and ASC 150 Solar Modbus client tables** for the data that can be monitored for each inverter protocol.

In the ASC-4 Modbus server, 70 registers are reserved for each inverter. The **ASC-4 Modbus server tables** only list the addresses for the first inverter (47000 to 47069). The other inverters follow consecutively. Additional inverter monitoring data is in addresses 49940 to 49961.

In general, data from the inverters supported by the PV protocol (parameter 7561) is supported. However, the available data depends on the inverter make, model and interface.

NOTE *PV monitoring* (parameter 7566) must be enabled for the ASC to monitor the inverters.

4.2 Values for unsupported data

If the inverter does not support the Modbus data, a Modbus value is assigned based on the data type.

Unsupported data type	Modbus value
16-bit signed data	0×8000
32-bit signed data	0×80000000
16-bit unsigned data	0xFFFF
32-bit unsigned data	0xFFFFFFFF
String	Terminated by the NULL-character

5. Solar: SunSpec Modbus server

5.1 SunSpec map

The ASC includes a SunSpec map to provide a standardised Modbus server interface to PV SCADA systems. You can see the data from the inverters in Modbus addresses 50000 to 50280 in the **ASC-4 Modbus server tables**.

Inverter model: St status

The St status is handled as follows:

Status	Value	Details
STARTING	3	If put in operation but still in the start sequence. *Delay regulation* has not expired.
MMPT	4	If in operation, and 3, 5, 6 and/or 7 do not apply.
THROTTLE	5	In operation and power production is throttled.
SHUTTING DOWN	6	In operation but in the stop/shutdown sequence.
FAULT	7	There is a fault that prevents operation.
STANDBY	8	If none of the above apply.

Immediate control model

These functions affect the ASC as follows:

- *Conn* is enabled: Corresponds to sending an auto start signal to the ASC.
- *WMaxLimPct_Ena* is enabled: This only has an effect if the ASC is in fixed power mode.
- *VArPct_Ena* is enabled: This only has an effect if the ASC is in a single PV application or not in power management mode.
- *OutPFSet_Ena* is enabled: This only has an effect if the ASC is in a single PV application or not in power management mode.
- If both *VArPct_Ena* and *OutPFSet_Ena* are enabled: The ASC prioritises *VArPct_Ena*.
- For some SunSpec inverters: The user can control *WMaxLimPct_RvrtTms* in parameter 2810 (*PV fallback tmr*). This sets a fallback timer for the power output. It is useful if the communication between the ASC and the inverter is disconnected.

5.2 Troubleshooting the communication

For inverters using the *SunSpec Generic* protocol, the ASC-4 display unit shows the communication status when the Modbus RTU is connected to the inverter(s).

Status text	Description
SUNSPEC GOT ID: ###	The IDs of the detected Sunspec Modbus server(s) are shown.
SUNSPEC IDENTIFYING	The ASC is trying to detect the Sunspec Modbus server.
SUNSPEC INITIALIZED	There is ASC communication to the Sunspec Modbus server(s).
SUNSPEC N/A RETRY: ##	The Modbus server is not a Sunspec Modbus server. The ASC will try again in ## seconds.
SUNSPEC TIMED OUT	There is no Sunspec Modbus server.

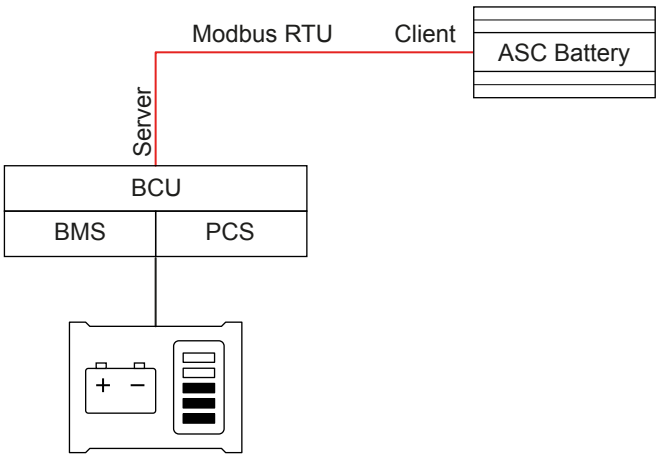
6. Battery: DEIF Generic protocols

6.1 Setting up the connection

The following drawings show the connection configurations when the ASC-4 Battery is using the **DEIF Generic** Modbus client protocol. If required, an RTU to TCP/IP connector can be used (shown by the box with a dashed outline).

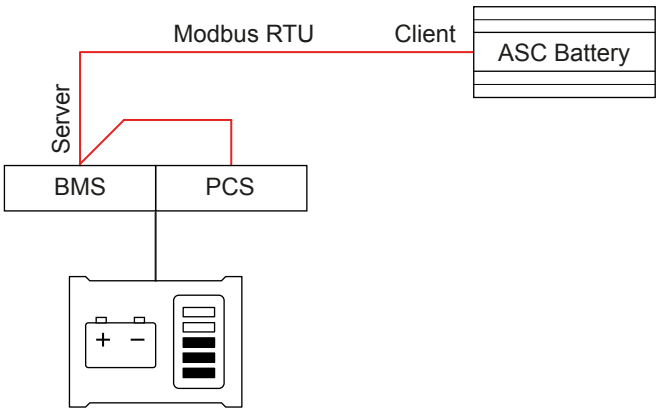
ESS = Energy storage system
BCU = Battery control unit
BMS = Battery management system
PCS = Power conversion system.

ASC connection to the BCU



Select **DEIF Generic** in *ESS protocol* (parameter 7561) and select **OFF** in *BMS protocol* (parameter 7681).

ASC connection to the BMS and PCS



Select **DEIF Generic** in *ESS protocol* (parameter 7561) to control the PCS and select **DEIF Generic** in *BMS protocol* (parameter 7681) to control the BMS.

You can choose different Modbus server IDs for the PCS and BMS control.

You can select another protocol for the PCS or BMS control. See **DEIF Hybrid controller compatibility** for more information.

More information
See the **ASC-4 Battery Designer's handbook** for more communication parameters.

6.2 ASC Battery Modbus client tables

More information
See the **ASC-4 Battery ASC 150 Storage Modbus client tables** for the *DEIF Generic* protocols Modbus addresses.
See the **ASC-4 Battery Designer's handbook** for descriptions of the functions that are included in the Modbus client.

The function names in the Modbus tables are generally self-explanatory. The following sections contain additional information for some functions.

6.3 BCU PCS DEIF Generic

6.3.1 ESS mode

If **multiple register transmission** (function code 16) is selected, then the P, Q, and Droop set points are sent.

If **single register transmission** (function code 06) is selected, the droop set point is only sent if droop is enabled (*Enabled* selected in parameter 2801). The P and Q set points are sent if the P and Q reference parameters are enabled (parameters 2781/2782).

P/Q mode (grid-tie)

When the microgrid is connected to the mains, the ASC calculates the references for active and reactive power and transmits them to the BESS. The references are dynamic and change as the loads in the microgrid change. The references will therefore be transmitted continuously from the ASC at the speed of Modbus.

The BCU or PCS should be able to change to P/Q mode by self-detection, command or breaker feedback.

V/f mode (island/off-grid/grid forming)

If the microgrid is disconnected from the mains, the BESS must change to island operation and do V/f regulation. This shift is normally done by the BCU/PCS, using breaker feedback or its own grid measurements and protection.

Island mode works best in BESS systems that include droop for paralleling with gensets and/or other sources.

It is preferred that the BESS keeps V/f control. The ASC then sends the active and reactive power references (like in P/Q mode). The BCU/PCS then adjusts the frequency and voltage according to the droop curves of the BESS system.

Some BESS cannot do fully automatic droop control. For these, the ASC can operate with its own droop curves, so that the power (as a function of frequency) and reactive power (as a function of voltage) are adjusted.

Droop mode (V/f)

When droop mode is enabled, the ASC transmits the frequency and voltage offsets. These are added to the nominal frequency and voltage, which correspond to the frequency at 0kW and voltage at 0kvar.

More information
See **Battery droop** in **Designer's handbook** for the parameters, offset examples, and droop curve examples.

6.3.2 P set point

If the ESS is connected to a mains, the ESS must use P/Q regulation. The ASC calculates the power (P) set point for the ESS based on the operating conditions. This set point is dynamic. The ASC continuously transmits the power set point (at the speed allowed by the Modbus communication).

6.3.3 Q set point

If the ESS is connected to a mains, the ESS must use P/Q regulation. The ASC calculates the reactive power (Q) set point for the ESS based on the operating conditions. This set point is dynamic. The ASC continuously transmits the reactive power set point (at the speed allowed by the Modbus communication).

6.3.4 Frequency set point

If the ESS is grid-forming, the ESS must use V/f regulation. The ASC calculates the frequency (f) set point for the BCU/PCS based on the operating conditions. This set point is dynamic.

6.3.5 Voltage set point

If the ESS is grid-forming, the ESS must use V/f regulation. The ASC calculates the voltage (V) set point for the BCU/PCS based on the operating conditions. This set point is dynamic.

6.3.6 Heart beat

ASC sends a toggling value on this address. This allows the BCU/PCS to check that communication is okay.

6.3.7 Phase rotation

The ASC sends the phase rotation configured in *Phase rotation* (parameter 2154) to the BCU/PCS.

6.3.8 Custom input to ESS

You can use the ASC M-Logic to activate/deactivate this bit. Use the *Output > Battery > Custom input to ESS* function. The PCS/BCU maker can decide whether and how to use this bit.

6.3.9 Frequency slope

If the BCU/PCS supports droop, for power control in V/f mode (grid forming), the ASC can send the slope for frequency (as a function of P) to the ESS.

The source of the droop slopes can be selected in parameter 2801. For *ASC parameters*, the ASC uses the frequency droop slope in parameter 2803. For *BESS comm. reading*, the ASC reads the frequency droop slope from the ESS.

6.3.10 Voltage slope

If the BCU/PCS supports droop, for power control in V/f mode (grid forming), the ASC can send the slope for voltage (as a function of Q).

The source of the droop slopes can be selected in parameter 2801. For *ASC parameters*, the ASC uses the voltage droop slope in parameter 2804. For *BESS comm. reading*, the ASC reads the voltage droop slope from the BCU/PCS.

6.3.11 Alarms

The ASC can read whether there are warning and/or shutdown alarms on the BESS (BCU, or both PCS and BMS). The ASC does not receive any details of the failure(s). The BESS must respond to these failures.

6.3.12 P/Q set point format

If percentage is used for the P/Q reference set points, the values are percentages of the nominal values in parameters 6002 (*Nom. P*), 6005 (*Nom. Q*) and 6003 (*Nom. I*).

6.3.13 P/Q set point scaling

For *one decimal* scaling, for example, the value **505** corresponds to a P/Q set point of **50.5**.

For *zero decimals* scaling, for example, the value **50** corresponds to a P/Q set point of **50**.

6.3.14 Custom outputs from ESS

The PCS/BCU can activate/deactivate events in the ASC M-Logic. The events are *Events > Event > Custom output [1 to 3] from ESS*. The PCS/BCU maker can decide whether and how to use these bits.

6.4 BCU BMS DEIF Generic

6.4.1 Maximum charge

The ASC needs the maximum charge (active power) to the ESS. This is a dynamic value. It is affected by the state of charge, and other BCU/BMS functions and conditions.

6.4.2 Maximum discharge

The ASC needs the maximum discharge (active power) from the ESS. This is a dynamic value. It is affected by the state of charge, and other BCU/BMS functions and conditions.

6.4.3 State of charge

The ASC needs the state of charge (SOC) from the ESS. SOC is the available energy in the ESS. It is a dynamic value. The ASC uses the SOC to determine the area of operation for the ESS (that is, charge or discharge).

6.4.4 State of health

The ASC only uses the state of health (SOH) from the ESS for display.

6.4.5 DC battery measurements

The ASC can read the DC battery voltage and the DC battery current from the ESS. The ASC only uses these measurements for display.

6.4.6 Alarms

The ASC can read whether there are warning and/or shutdown alarms on the BESS (BCU or BMS). The ASC does not receive any details of the failure(s). The BESS must respond to these failures.

6.4.7 Custom output from BMS

The BCU/BMS can activate/deactivate an event in the ASC M-Logic. The event is *Events > Event > Custom output from BMS*. The BCU/BMS maker can decide whether and how to use this bit.