iE 150 and ASC 150

4189341367B

Modbus client

User manual

Improve Tomorrow

1. General information

1.1 Modbus client

Controllers

Throughout this document, *Controller* refers the controllers listed below.

Controller	Controller types	Software version
iE 150	Battery, Solar	1.31 or later
ASC 150	Storage, Solar	1.30 or later
ASC-4	Battery, Solar	4.29 or later

Battery/Storage

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

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

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

Solar

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

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

NOTE The controller also includes a Modbus server. This is described in the **iE 150 Battery Solar Modbus server tables**, **ASC 150 Modbus server User manual** and **ASC 150 Modbus server tables**.

1.2 Disclaimer

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

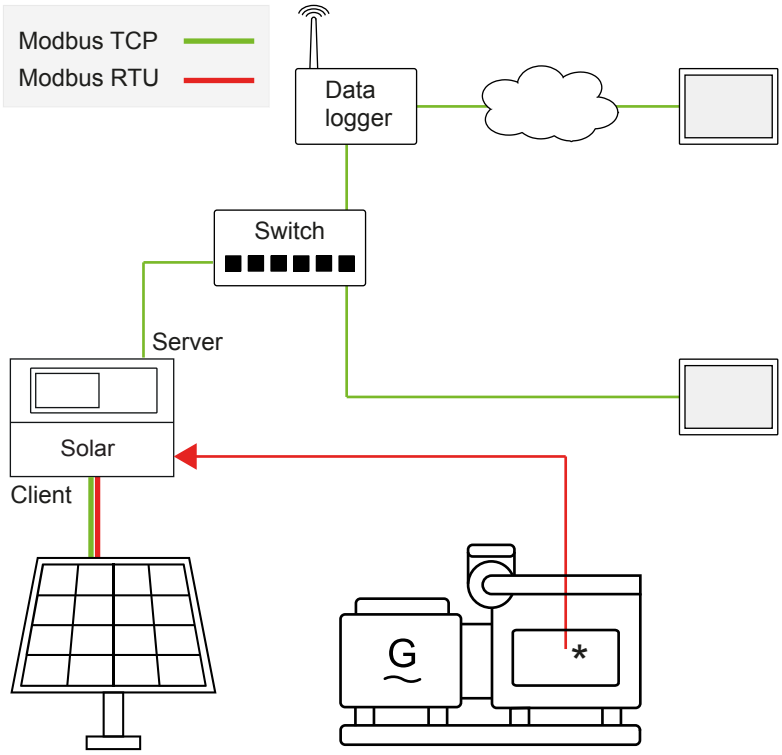
The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English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

2. Hardware information

2.1 Communication

2.1.1 Solar controller communication

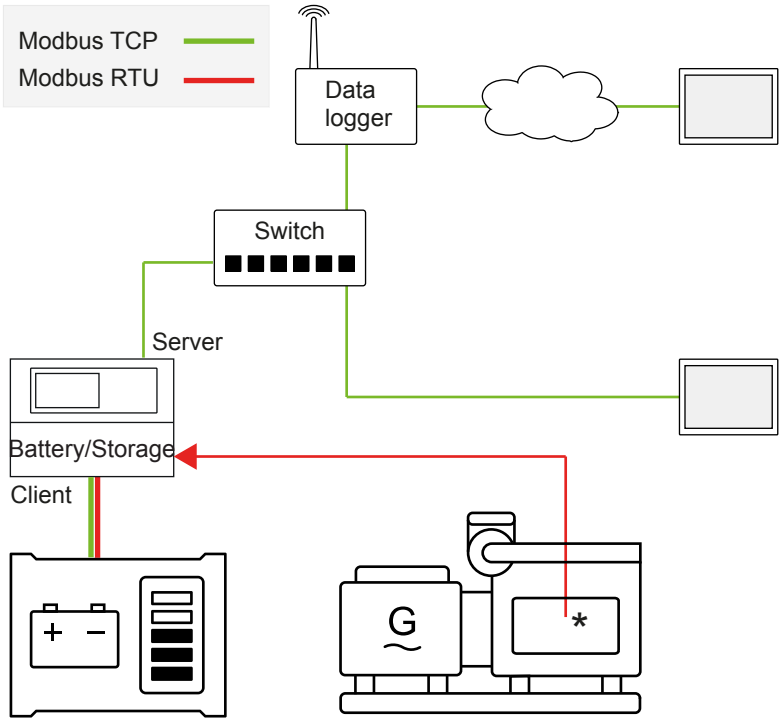
Example of Solar controller communication for a single controller application



The controller can communicate over Modbus as the client and/or server device. The controller can communicate with the PV system using Modbus TCP or Modbus RTU. The controller reads from power meters or genset controllers using Modbus RTU.

2.1.2 Battery/Storage controller communication

Example of Battery/Storage controller communication for a single controller application



The controller can communicate over Modbus as the client and/or server device. The controller can communicate with the ESS using Modbus TCP and/or Modbus RTU. * The controller reads from power meters or genset controllers using Modbus RTU.

2.2 Terminals for Modbus RTU client

The controller includes two RS-485 ports that can be used for a Modbus RTU client.

Terminal	Function	Description
33	DATA + (A)	Port 1 Modbus RTU (RS-485)
34	DATA (GND)	
35	DATA - (B)	
36	DATA + (A)	Port 2 Modbus RTU (RS-485)
37	DATA (GND)	
38	DATA - (B)	

More information
See **Modbus RS-485** in the **Installation instructions** for wiring recommendations and requirements.

These are the RS-485 hardware settings:

- 9600, 19200, 38400 or 115200 bps
- 8 data bits
- None parity
- 1 stop bit
- No flow control

2.3 Wiring

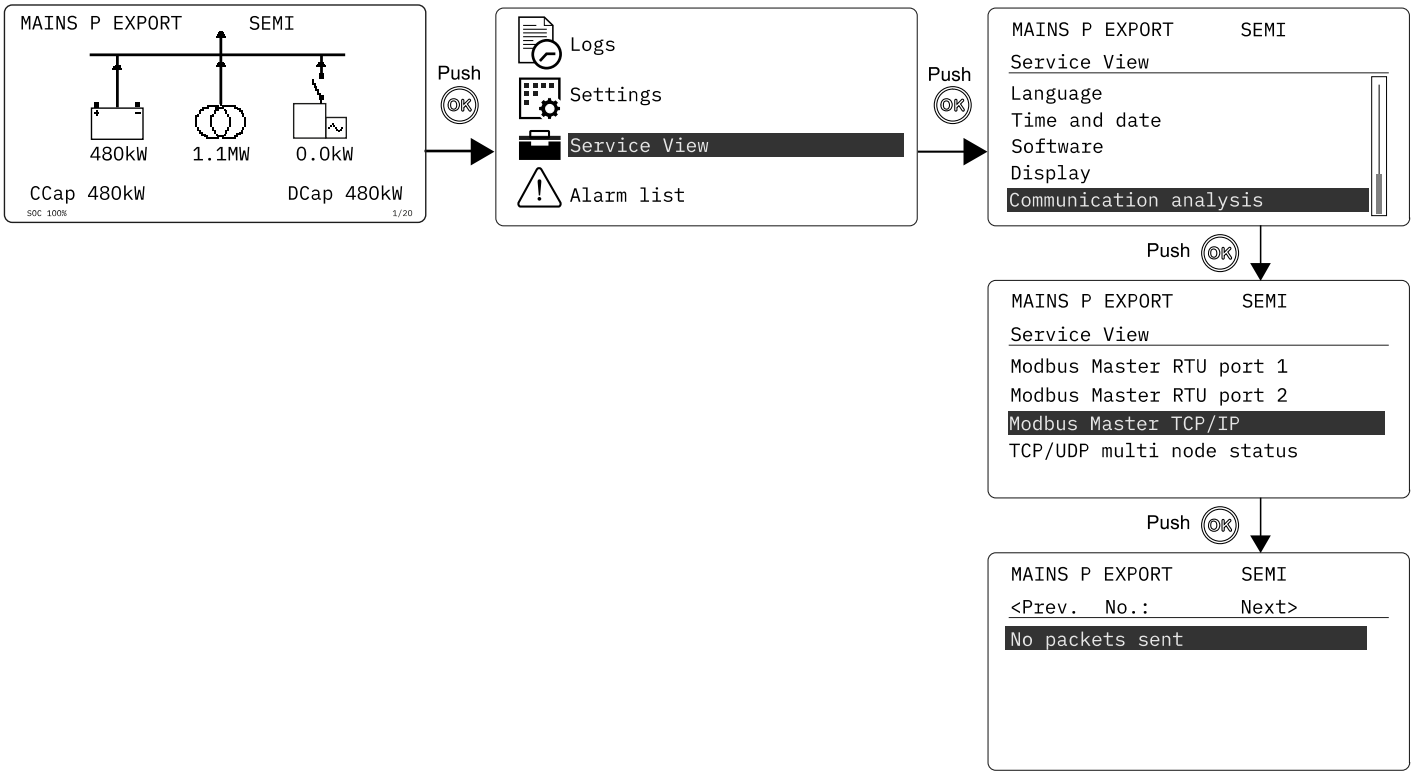
More information
See the **Installation instructions** for wiring information.

3. Modbus client monitoring

3.1 Modbus monitoring

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

Monitoring communication (example for a Battery controller)



3.2 Modbus troubleshooting

In `Service View > Communication analysis` you can see:

- Modbus Master RTU port 1
- Modbus Master RTU port 2
- Modbus Master TCP/IP
- TCP/UDP multi mode status

For each selection, you can see configuration and operating details. For example, for Modbus Master TCP/IP you can see:

- Details for each connected device (use <Prev. and Next> to navigate)
- IDs, Rx and Tx info, IP address, connected (true or false), and so on.

The Battery/Storage controller controls the ESS with communication to a battery management system (BMS), a battery control unit (BCU), or a power conversion system (PCS).

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.

Text	Reason
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.
TCP CONNECTION ERROR	The TCP/UDP socket could not be connected to the Modbus server. The Modbus server TCP/IP interface may be off. The IP address may be wrong. You may have selected TCP or UDP incorrectly.
TIMED OUT	No response.

4. Solar: Inverter monitoring

4.1 Supported inverters

The Modbus client can monitor up to 32 inverters (nodes). See the **iE 150 ASC 150 and ASC-4 Solar Modbus client tables** for the data that can be monitored for each inverter protocol.

In the Modbus server, 70 registers are reserved for each inverter. The **iE 150 Battery Solar Modbus server tables** and the **ASC 150 Modbus server tables** only list the addresses for the first inverter (input register (04), addresses 47000 to 47069). The other inverters follow consecutively. Additional inverter monitoring data is in the input register (04), 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 Monitoring must be enabled for the controller to monitor the inverters. For RTU, select enable in *RTU PV monitoring* (parameter 7565). For TCP/IP, in the utility software, under *Ethernet setting (TCP/IP), PV - Modbus TCP/IP*, select the *Monitoring* check box(es).

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

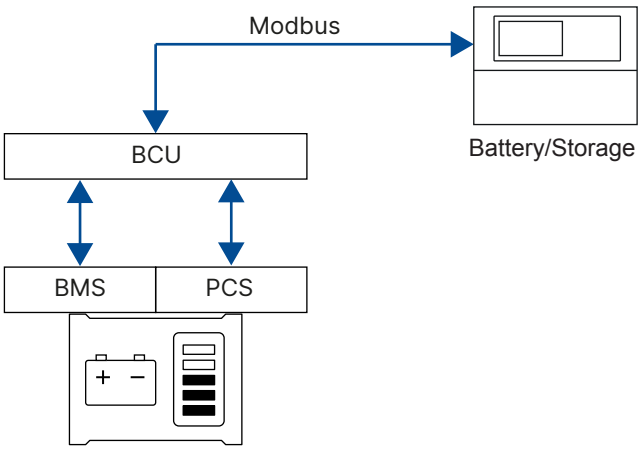
5. Storage: DEIF Generic protocols

5.1 Setting up the connection

The following drawings show the connection configurations when the Battery/Storage controller is using the **DEIF Generic** Modbus client protocol.

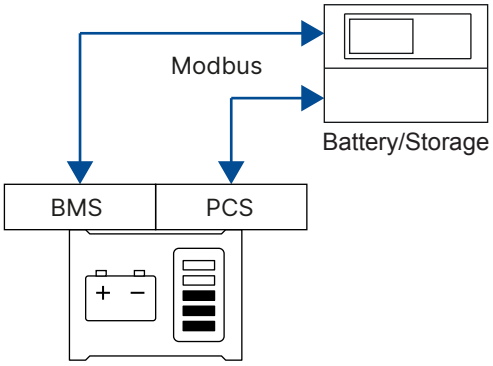
ESS = Energy storage system
BCU = Battery control unit
BMS = Battery management system
PCS = Power conversion system.

Connection to the BCU



Select **DEIF Generic** in *ESS protocol* (parameter 7561) and select **OFF** in *BMS protocol* (parameter 7682).

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 7682) 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 150 Storage Designer's handbook** for more communication parameters.

5.2 Battery/Storage Modbus client tables

More information
See the **iE 150 Battery ASC 150 Storage ASC-4 Battery Modbus client tables** for the *DEIF Generic* protocols Modbus addresses. See the **ASC 150 Storage 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.

5.2.1 DEIF Generic Offset

Parameter 7960 allows the user to select between higher (offset 30000) and lower (offset 1000) Modbus address spaces for the ESS protocol DEIF Generic.

5.3 BCU PCS DEIF Generic

5.3.1 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 controller 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 controller 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 controller 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 controller 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 controller transmits the frequency and voltage offsets. These are added to the nominal frequency and voltage, which correspond to the frequency at 0 kW and voltage at 0 kvar.

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

5.3.2 P set point

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

5.3.3 Q set point

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

5.3.4 Frequency set point

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

5.3.5 Voltage set point

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

5.3.6 Heart beat

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

5.3.7 Phase rotation

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

5.3.8 Custom input to ESS

You can use M-Logic in the controller 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.

5.3.9 Acknowledge alarms

When an active ESS or BMS alarm has been acknowledged either automatically or by an operator, the controller sends information to external system.

5.3.10 Ground relay

This function is only relevant for iE 150 Battery and ASC 150 Storage in a greenfield installation, with ground relay activated.

More information
See the **ASC 150 Storage Designer's handbook** for more details.

5.3.11 Frequency slope

If the BCU/PCS supports droop, for power control in V/f mode (grid forming), the controller 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 *parameters*, the controller uses the frequency droop slope in parameter 2803. For *BESS comm. reading*, the controller reads the frequency droop slope from the ESS.

5.3.12 Voltage slope

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

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

5.3.13 AC measurements

The controller can use parameters ESS power meas. (7021) and BB/ESS V/f meas. (7022) to read the power, voltage and frequency measurements from external systems.

5.3.14 Alarms

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

5.3.15 ESS status

Display	Status	Description
ESS NOT READY	Stopped/Fault	ESS is either not running or has stopped due to a fault.
ESS STARTING UP	Standby	ESS is either in a standby state or is starting up.
ESS NOT READY	Wait	ESS is waiting and not ready to receive a start/stop signal.

NOTE See **Designer's handbook** for more information on **P/Q, V/f and Droop**.

5.3.16 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*).

5.3.17 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**.

5.3.18 Custom outputs from ESS

The PCS/BCU can activate/deactivate events in M-Logic in the controller. 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.

5.4 BCU BMS DEIF Generic

5.4.1 Maximum charge

The controller 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.

5.4.2 Maximum discharge

The controller 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.

5.4.3 State of charge

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

5.4.4 State of health

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

5.4.5 DC battery measurements

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

5.4.6 Alarms

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

5.4.7 Custom output from BMS

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