ALC-4

Option H2

Modbus communication

4189341111C

1. Introduction

1.1 About Modbus communication

This document gives information and examples for using the controller's Modbus tables. In addition, this document explains how to use Modbus to monitor and/or change the parameter and IO configuration.

Option H2 is a hardware option for the controller that support the controller's Modbus slave communication. Option H2 uses Modbus RTU (RS-485) hardware,.

1.1.1 Software version

This document is for ALC-4 software version 4.11 and later.

1.2 Warnings and safety

1.2.1 Symbols for hazard statements

DANGER!

This shows dangerous situations.

If the guidelines are not followed, these situations will result in death, serious personal injury, and equipment damage or destruction.

WARNING

This shows potentially dangerous situations.

If the guidelines are not followed, these situations could result in death, serious personal injury, and equipment damage or destruction.

CAUTION

This shows low level risk situation.

If the guidelines are not followed, these situations could result in minor or moderate injury.

NOTICE

This shows an important notice

Make sure to read this information.

1.2.2 Symbols for general notes

NOTE This shows general information.

More information
This shows where you can find more information.

Example

This shows an example.

How to ...
This shows a link to a video for help and guidance.

1.2.3 Safety during installation and operation

When you install and operate the equipment, you may have to work with dangerous currents and voltages. The installation must only be carried out by authorised personnel who understand the risks involved in working with electrical equipment.

DANGER!

Hazardous live currents and voltages

Do not touch any terminals, especially the AC measurement inputs and the relay terminals, as this could lead to injury or death.

1.2.4 Factory settings

The Multi-line 2 unit is delivered from the factory with default settings. These are not necessarily correct for the engine/generator set. Check all the settings before running the engine/generator set.

1.3 Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the engine/generator controlled by the Multi-line 2 unit, the company responsible for the installation or the operation of the set must be contacted.

NOTE The Multi-line 2 unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

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 Option H2

2.1.1 Terminal description

Option H2 is a hardware option, and therefore a separate PCB is installed in slot #2 in addition to the standard-installed hardware.

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.
NOTE ** Terminals 31 and 35 are internally connected.

2.1.2 Hardware settings

These are the RS-485 hardware settings:

1. 9600 or 19200 bps
2. 8 data bits
3. None parity
4. 1 stop bit
5. No flow control

2.2 Wiring

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

3. Data tables

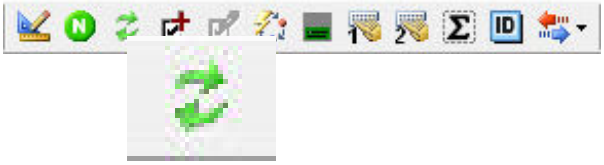
3.1 Configurable area (read only) (function code 04h)

3.1.1 Modbus configurator

The Modbus configurator gives the user the possibility to select which data should be available for the first 500 Modbus addresses with the Modbus function 04.

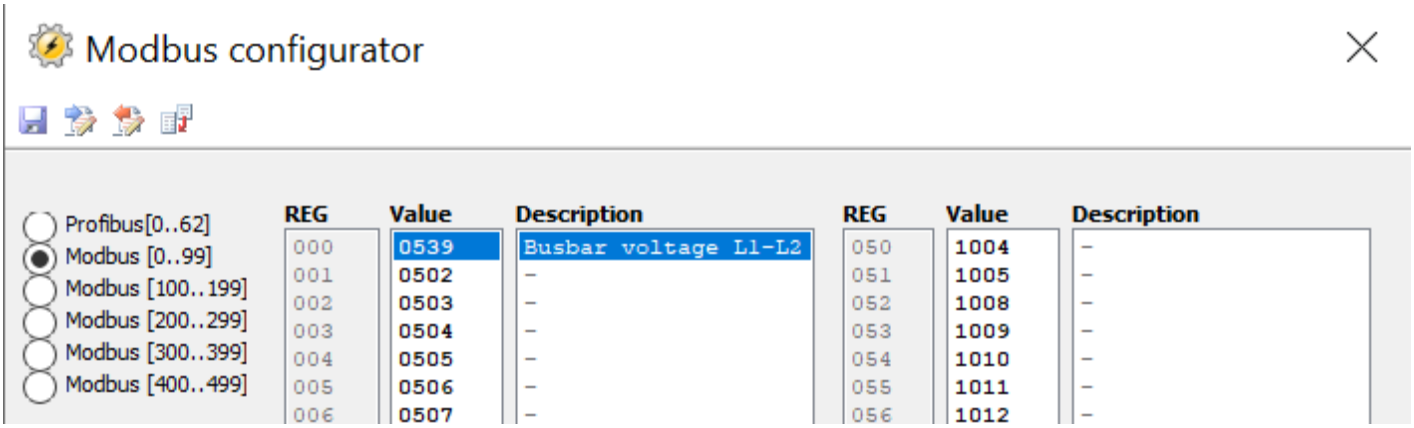
Profibus users often apply this function to select the data they can use. That is why the first address range is called Profibus. This first address range is shared by the Profibus and the Modbus users, as they share the same data.

Open the Modbus configurator from the toolbar in the utility software by clicking the icon shown below.



It is possible to configure the Modbus addresses 0 to 499 to any of the Modbus addresses from 500* to 1999 through the Modbus configurator, as shown below.

NOTE * For the ALC, Modbus addresses 501 to 538 are not used.



The window has four different columns that are described below:

Range: Each Modbus range contains 100 Modbus addresses (63 for the Profibus range). In the screenshot above, the Modbus address range 0 to 99 is selected.

REG: The information in the specific address REG is duplicated from the Modbus address configured in Value. The number changes when another range is selected (0 to 499).

Value: The Modbus address of the information that will be copied to the corresponding REG Modbus address.

Description: Free text for the user to fill in. The text is only saved in the parameter file. In the screenshot, Modbus address 000 duplicates the information of Modbus address 539 which displays the busbar voltage between L1 and L2.

NOTE The popup window has its own dedicated *Read/write* and *Copy description* buttons, which must be used for manual configuration.

Configurable Modbus example

For the screenshot, to check what is assigned to Modbus address 001, look up Modbus address 502 in the **Modbus tables**, under *Input register (04)*.

Modbus address 502 is not used. To assign a different function to Modbus address 001, change the number under *Value*. For example, change the number to 1501. Reading Modbus address 001 from the input register (04) then returns the *Available power*.

3.2 Reference tables

The Modbus tables can be downloaded from www.deif.com/documentation/alc-4/ under **Communication**. The Modbus tables are stored in an .xlsx file that contains:

- Discrete output coil (01; 05; 15): Command flags
- Discrete input contact (02): Digital inputs and outputs
- Holding register (03; 06; 16): Control commands
- Input register (04): A wide range of readable functions, including:
  - Profibus configurable area
  - Modbus configurable area
  - Alarms, measurements, statuses, states, and so on

The number in brackets refers to the Modbus function code (as a decimal value) for the information, and corresponds to the sheet names in the spreadsheet.

3.3 Data scaling

Modbus data is processed as data bytes. This data cannot directly process decimal values. Therefore scaling is defined to convert decimal values to a form that can be sent using Modbus, or to correctly interpret values received from Modbus. Data in the *Holding register* and *Input register* is scaled according to the formula:

$$\text{Actual value} = \text{Value in register} * 10^{-\text{Scaling}}$$

The table below lists parameter types and the scaling values that are normally used for them. Parameter types that are not scaled, are not listed in the table.

Table 3.1 Scaling values normally used by specific parameter types

Parameter type	Scaling
Phase angle	1
DC supply voltage	1
Frequency	2

Scaling example

Nominal frequency 1 is set to 50.00 Hz. Frequency normally has a scaling value of 2.

When nominal frequency 1 is read from the controller using Modbus, the Modbus register returns 5000. The actual value is determined by:

Actual value = Value in register * $10^{-Scaling}$

= 5000 * 10^{-2}

= 50.00

To write a new value of 60.00 Hz to the controller using Modbus, the value that should be written to the register is:

Value in register = Actual value / $10^{-Scaling}$

= 60.00 / 10^{-2}

= 6000

4. Modbus parameter and IO settings

4.1 Introduction

Modbus communication can read parameter data from the controller and write parameter data to the controller. The parameter Modbus addresses are not listed in the Modbus tables. The Modbus address for a parameter is calculated by adding an offset to the first number in the address area. The offset is the parameter *Address* in the Utility Software (USW).

Modbus communication can also read and write alarm data for IOs. The IO Modbus addresses are not listed in the Modbus tables. The IO Modbus addresses are also calculated by adding an offset to the first number in the address area.

This chapter lists the address areas, and gives examples of Modbus address calculations.

NOTE The DEIF controller is the Modbus slave.

4.2 Address areas

4.2.1 Read coil (Function code 01)

Reads the ON/OFF status of discrete output coils. The controller returns **0** (FALSE) when the coil is not activated, and **1** (TRUE) when the coil is activated.

Address area for reading status flags

Data to request	Address area
Enable	2000-3999

4.2.2 Read discrete inputs (Function code 02)

Reads the ON/OFF status of discrete input contacts. The controller returns **0** (FALSE) when the discrete input is not activated, and **1** (TRUE) when the discrete input is activated.

Address areas for reading status flags

Data to request	Address area
Alarm active	4000-5999
Alarm acknowledge	6000-7999
Timer output	8000-9999
Timer running	10000-11999

4.2.3 Read holding registers (Function code 03)

Reads the data value contained in the holding registers. The data can be signed integers (16 or 32 bit) or boolean values. The controller returns the value stored in the holding register. Note that you need the scaling to interpret the value correctly.

Address areas for reading holding registers

Data to request	Address area
Timers used	2000-3999
Values used	4000-5999
Values minimum	6000-7999
Values maximum	8000-9999

Data to request	Address area
Output A	10000-11999
Output B	12000-13999
Fail class used	14000-15999
Enable	16000-17999
Inhibit	18000-19999

4.2.4 Read input registers (Function code 04)

Reads the data value contained in the input registers. The data can be signed integers (16 or 32 bit) or boolean values. The controller returns the value stored in the input register. Note that you need the scaling to interpret the value correctly.

Address areas for reading input registers

Data to request	Address area
Timers minimum	2000-3999
Timers maximum	4000-5999
Output A minimum	6000-7999
Output A maximum	8000-9999
Output B minimum	10000-11999
Output B maximum	12000-13999
Fail class minimum	14000-15999
Fail class maximum	16000-17999
Timers elapsed time	20000-21999

4.2.5 Write single/multiple coils (Function code 05/15)

Change the ON/OFF status of a single or multiple discrete output coils. Write **0** (FALSE) to deactivate the coil, or **1** (TRUE) to activate the coil.

Address areas for writing status flags

Data to request	Address area
Enable	2000-3999
Acknowledge alarm	6000-7999

4.2.6 Write single/multiple holding registers (Function code 06/16)

Change the value of a single or multiple holding registers. The data can be signed integers (16 or 32 bit) or boolean values. When writing values to holding registers, you need to use the correct scaling and data type.

Address area for writing holding registers

Data to request	Address area
Timers used	2000-3999
Values used	4000-4999
Output A	10000-11999
Output B	12000-13999
Fail class used	14000-15999

Data to request	Address area
Enable	16000-17999
Inhibit	18000-19999

4.3 Modbus addresses and examples for parameters

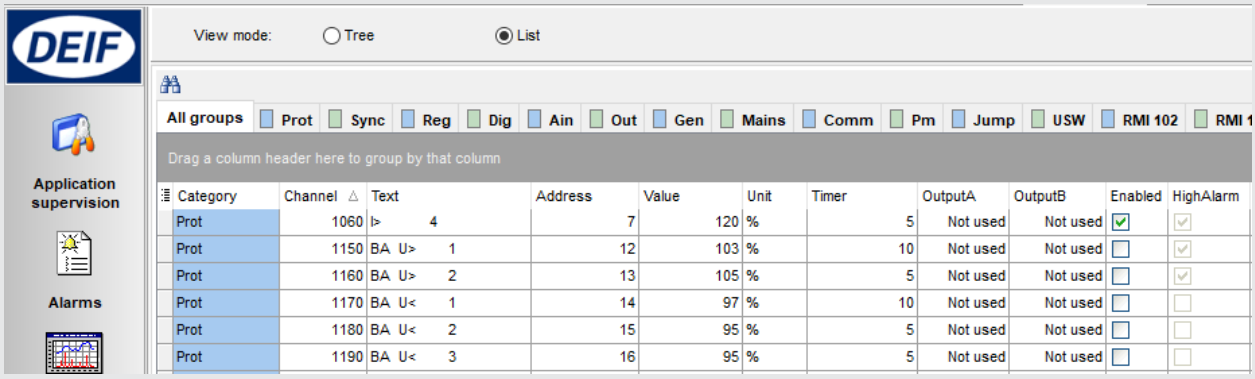
The Modbus address for a parameter is the sum of the **Address** in the Utility Software (USW) and the first value of the address area. To find the address of a specific parameter, go to the **Parameters** tab in the USW, then find the parameter using the parameter's name or parameter number (**Channel** column). The parameter address is located in the **Address** column.

Alarm example

Acknowledge alarm

In this example an over-voltage 1 alarm is active and unacknowledged. First we will check if the alarm is already acknowledged, then acknowledge the alarm using Modbus.

1. The parameter number for the over-voltage 1 alarm is 1150. Find the parameter in the USW in the **Parameters** tab and note the **Address** value for the parameter (12 for over-voltage 1).
   - The parameter numbers are listed in the **Channel** column.



Category	Channel	Text	Address	Value	Unit	Timer	OutputA	OutputB	Enabled	HighAlarm
Prot	1060	I> 4	7	120	%	5	Not used	Not used	☑	☑
Prot	1150	BA U> 1	12	103	%	10	Not used	Not used	☐	☑
Prot	1160	BA U> 2	13	105	%	5	Not used	Not used	☐	☑
Prot	1170	BA U< 1	14	97	%	10	Not used	Not used	☐	☐
Prot	1180	BA U< 2	15	95	%	5	Not used	Not used	☐	☐
Prot	1190	BA U< 3	16	95	%	5	Not used	Not used	☐	☐

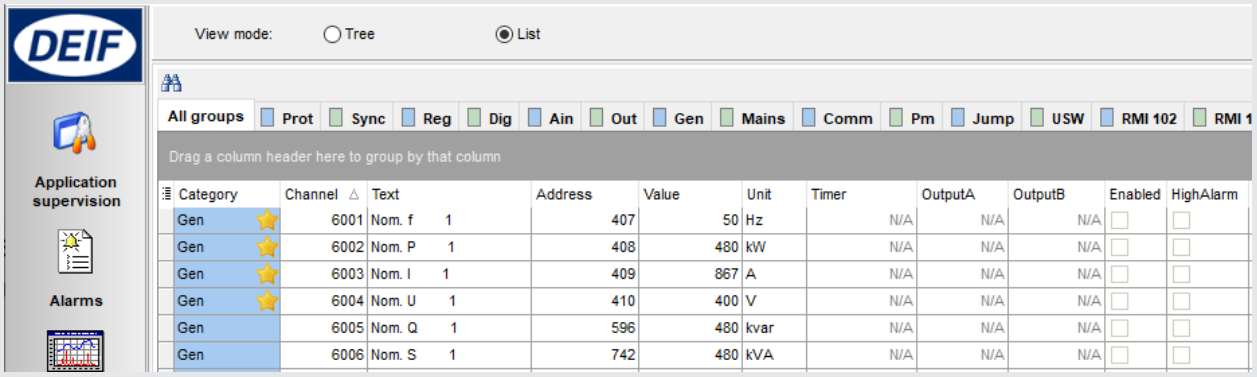
2. To read if the alarm is acknowledged, go to the table in **Address areas > Read discrete input (Function code 02)**. The address area for *Alarm acknowledge* starts at 6000.
3. The Modbus address to read the parameter is: Parameter **Address** + Address area start = 12 + 6000 = 6012.
4. Use function code 02 to read address 6012.
   - For this example when the address is read, the controller returns **0** (FALSE). This means that the alarm is not acknowledged.
5. To acknowledge the alarm, go to the table in **Address areas > Write single/multiple coils (Function code 05/15)**. The address area for *Acknowledge alarm* starts at 6000.
6. The Modbus address to read the parameter is: Parameter **Address** + Address area start = 12 + 6000 = 6012.
7. Use function code 05 to write **1** (TRUE) to address 6012.
   - The alarm is now acknowledged and reading address 6012 using function code 02 returns **1** (TRUE). This means the alarm is acknowledged.

Nominal setting example

Change nominal frequency

In this example nominal frequency 1 is changed from 50 Hz to 60 Hz.

1. The parameter number for the nominal frequency 1 is 6001. Find the parameter in the USW in the **Parameters** tab and note the **Address** value for the parameter (407 for nominal frequency 1).



Category	Channel	Text	Address	Value	Unit	Timer	OutputA	OutputB	Enabled	HighAlarm
Gen	6001	Nom. f 1	407	50	Hz	N/A	N/A	N/A		
Gen	6002	Nom. P 1	408	480	kW	N/A	N/A	N/A		
Gen	6003	Nom. I 1	409	867	A	N/A	N/A	N/A		
Gen	6004	Nom. U 1	410	400	V	N/A	N/A	N/A		
Gen	6005	Nom. Q 1	596	480	kvar	N/A	N/A	N/A		
Gen	6006	Nom. S 1	742	480	kVA	N/A	N/A	N/A		

2. To change the nominal frequency, go to the table in **Address areas > Write single/multiple holding registers (Function code 06/16)**. The address area for *Values used* starts at 4000.
3. The Modbus address to write the new value to is: Parameter **Address** + Address area start = 407 + 4000 = 4407.
4. The nominal frequency has a scaling of 1. See **Data scaling*** for the exponential scaling formula and examples. To write 60 Hz to the address, a value of 600 must be written to the address. Use function code 06 to write 600 to address 4407.
   - Nominal frequency 1 is now 60.0 Hz. To confirm the change use function code 03 to read address 4407. The address returns 600. (The scaling is also 1.)

NOTE * A measurement's scaling in the Modbus tables is not necessarily the same as the scaling for the corresponding parameter. For example, the scaling for the frequency measurement is 2, while the scaling for the nominal frequency parameter is 1.

4.4 Modbus addresses and examples for IOs

Examples

Configure the multi input 102 2nd alarm

1. From the USW, the offset for *Multi input 102 2nd alarm* is **269**.
2. To check whether the alarm is enabled (address area 2000-3999), use function code **01** and Modbus address 2000 + 269 = **2269**.
   - If the controller returns **0**, the alarm is disabled.
   - If the controller returns **1**, the alarm is enabled.
3. To check the fail class (address area 14000-15999), use function code **03** and Modbus address 14000 + 269 = **14269**.
   - The controller returns an integer. For example, if the fail class is *Warning*, the controller returns **1**.
4. To change the fail class to *Shutdown*, use function code **06** and Modbus address **14269** to send the value **4**.
   - To verify that the fail class has changed, use the USW *I/O setup* page, read the I/O setup from the controller.
5. To enable the alarm, use function code **05** and Modbus address **2269** to send the value **1**.
   - To verify that the alarm is enabled, use the USW *I/O setup* page, read the I/O setup from the controller.

Check whether Multi input 108 has a wire failure

1. From the USW, the offset for *Multi input 108 wire fail* is **276**.
2. To check whether the alarm is enabled, use function code **01** and Modbus address **2276**.
3. To see whether the alarm is activated (address area 4000-5999), use function code **02** and Modbus address **4276**.
   - To verify the alarm status, use the USW *Logs* page and read the alarm log from the controller.

Configure the digital input 51 alarm timer (option M12)

1. From the USW, the offset for *Digital input 51* is **205**.
2. To check the configured alarm timer (address area 2000-3999), use function code **03** and Modbus address 2000 + 205 = **2205**.
   - If the controller returns **100**, the delay setting is 10 s (since the scaling is 1).
3. To change the delay setting to 5 s, use function code **06** and Modbus address **2205** to send the value **50**.

Configure the relay output 59 alarm function (option M12)

1. From the USW, the offset for *Relay output 59* is **331**.
2. To check the alarm function (address area 4000 to 5999), use function code **03** and Modbus address 4000 + 331 = **4331**.
   - If the controller returns **0**, the alarm function is *Alarm relay ND*.
3. To change the alarm function to *M-Logic / Limit relay*, use function code **06** and Modbus address **4431** to send the value **4**.