DEIF

-power in control

C E

INSTALLATION INSTRUCTIONS

Automatic Load Controller, ALC-4

- Mounting
- Board slot positions
- Terminal strip overview
- I/O lists
- Wiring

1. General information

2. General product information

3. Mounting

4. Hardware

5. Wirings

6. Technical information

1. General information

1.1 Warnings, legal information and safety

1.1.1 Warnings and notes

Throughout this document, a number of warnings and notes with helpful user information will be presented. To ensure that these are noticed, they will be highlighted as follows in order to separate them from the general text.

Warnings

⚠ **Warnings indicate a potentially dangerous situation, which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.**

Notes

ⓘ **Notes provide general information, which will be helpful for the reader to bear in mind.**

1.1.2 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.

⚠ **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.

1.1.3 Safety issues

Installing and operating the Multi-line 2 unit may imply work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

⚠ **Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.**

1.1.4 Electrostatic discharge awareness

Sufficient care must be taken to protect the terminal against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

1.1.5 Factory settings

The Multi-line 2 unit is delivered from factory with certain factory settings. These are based on average values and are not necessarily the correct settings for matching the system in question. Precautions must be taken to check the settings before running the system.

1.2 About the installation instructions

1.2.1 General purpose

These Installation Instructions mainly include general product and hardware information, mounting instructions, terminal strip descriptions, I/O lists and wiring descriptions.

The general purpose of this document is to give the user important information to be used in the installation of the unit.

⚠️ **Make sure to read this document before starting to work with the Multi-line 2 unit and the genset to be controlled. Failure to do this could result in human injury or damage to the equipment.**

1.2.2 Intended users

These Installation Instructions are mainly intended for the person responsible for the design and installation. In most cases, this would be a panel builder designer. Naturally, other users might also find useful information in the document.

1.2.3 Contents and overall structure

This document is divided into chapters, and in order to make the structure simple and easy to use, each chapter will begin from the top of a new page.

2. General product information

2.1 ALC-4 product information

2.1.1 Introduction
The ALC is part of the DEIF Multi-line 2 product family. Multi-line 2 is a complete range of multi-function generator protection and control products integrating all the functions you need into one compact and attractive solution.

The concept of the ALC is to offer a cost-effective solution to plant designers who need a flexible load controller as part of their power management system. Being part of the Multi-line product family, the standard functions can be supplemented with a variety of optional functions.

2.1.2 Type of product
The Automatic Load Controller is a micro-processor based control unit containing all necessary functions for controlling and prioritising load groups.
It contains all necessary 3-phase measuring circuits, and all values and alarms are presented on the LCD display.

2.1.3 Options
The Multi-line 2 product range consists of different basic versions, which can be supplemented with the flexible options needed to provide the optimum solution. The options cover for instance various outputs, power management, serial communication, additional operator display and so on.

2.2 Standard functions

2.2.1 Display
- Prepared for remote mounting
- Push-buttons for breaker operations
- Push-button for changing running mode
- Status texts

2.2.2 M-Logic
- Simple logic configuration tool
- Selectable input events
- Selectable output commands

3. Mounting

3.1 ALC mounting and dimensions

3.1.1 Mounting of the unit

The unit is designed for mounting inside the panel. The display can be installed on the panel door and connected to the main unit with a display cable.

3.1.2 Unit dimensions

115 (4.528)

165 (6.486)

144 (5.669)

15 (0.59)

115 (4.528)

215(8.465)

230 (9.055)

119(4.689)

115 (4.528)

Display or AOP

220 (8.661)

20.0 (0.787)
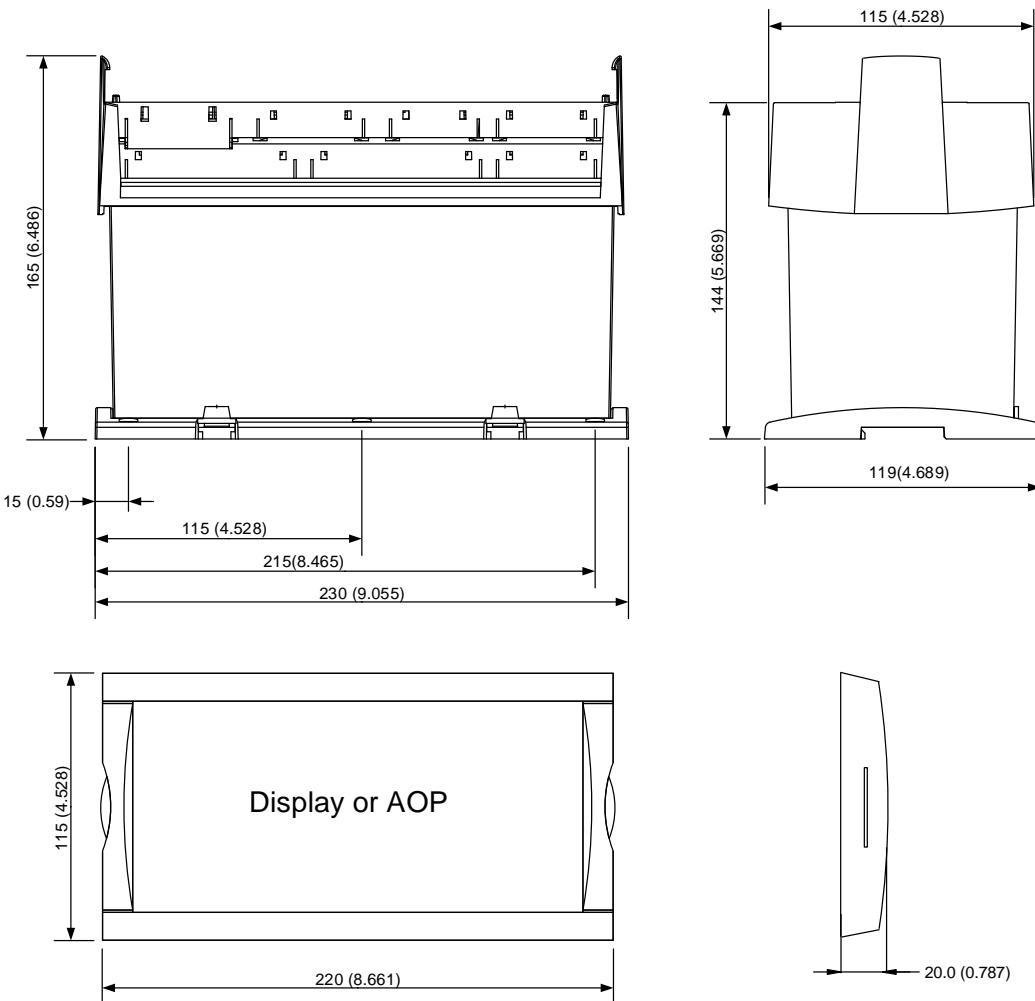
ⓘ **Dimensions are given in mm (inches).**

3.1.3 Panel cutout

In order to ensure optimum mounting, the panel door must be cut out according to the panel cut-out illustration.
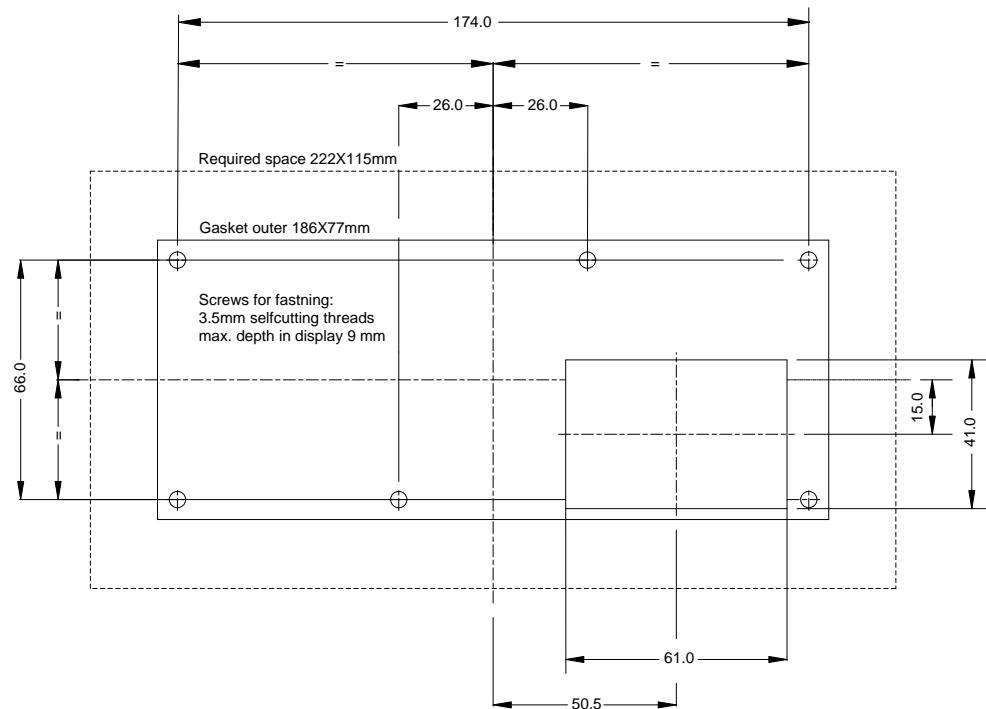
ⓘ **Dimensions are given in mm.**

3.1.4 Drilling template in mm (inches)
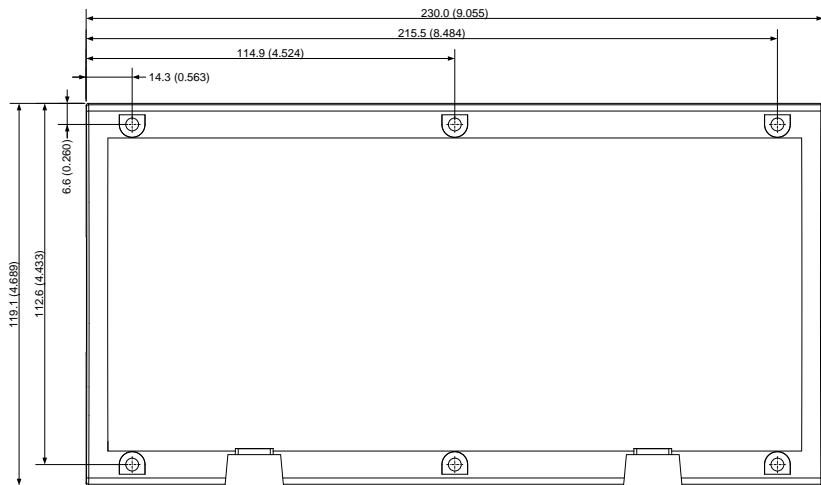
3.1.5 Mounting instructions
The unit can be mounted in two different ways:

1. Directly mounted on a DIN rail.
2. Fastened with screws to the rear side of the cabinet. Six screw holes are available for this mounting method.

ⓘ **DEIF recommends using the screw hole fastening.**

3.1.6 Mounting of gasket (option L1)
It is important that the gasket is mounted correctly; otherwise the IP65 tightness will not be obtained.
Mount the gasket as shown in the illustration below.
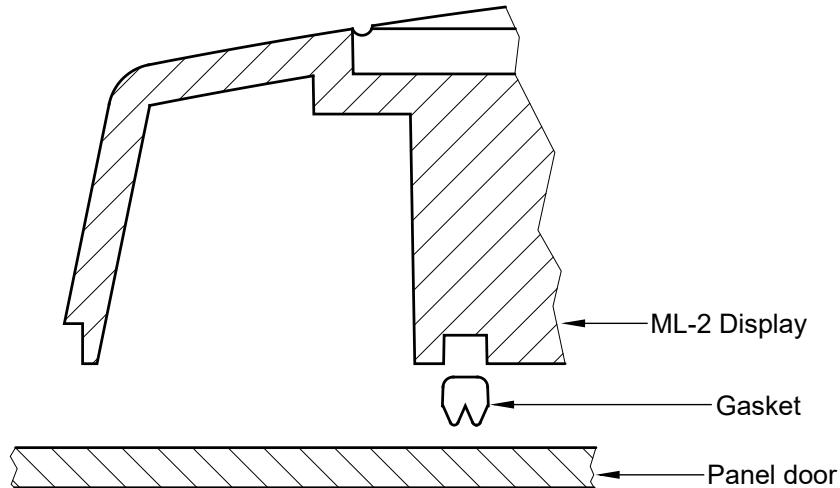
Furthermore, it is necessary to use all six screw holes to ensure IP65 tightness.

3.1.7 Tightening torques

Controller unit: 1.5 Nm for the six M4 screws (countersunk screws are not to be used)
Plug connections (terminals):   0.5 Nm, 4.4 lb-in

AOP-1 and AOP-2 (see diagram below)
Panel door mounting: 0.7 Nm, 6.2 lb-in
Sub-D screw: 0.2 Nm, 1.8 lb-in
DC-DC converter terminals: 0.5 Nm, 4.4 lb-in
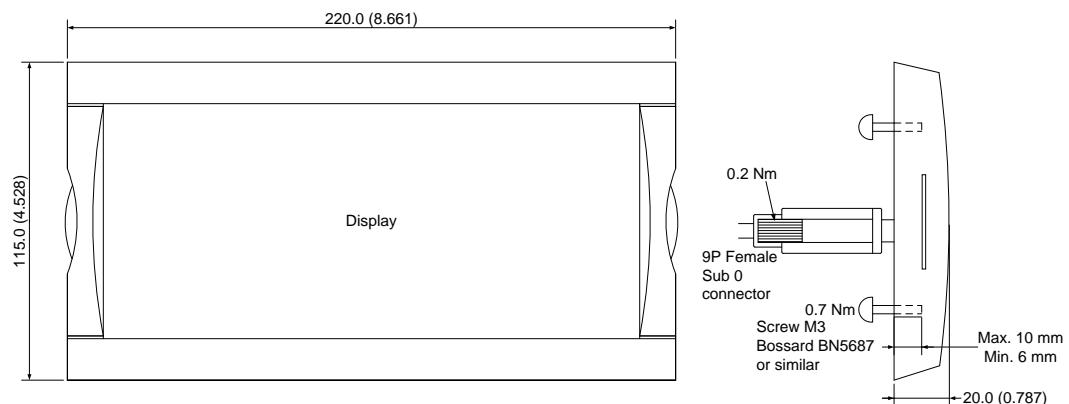
4. Hardware

4.1 Board slot positions

The unit housing is divided into board slot positions. This means that the unit consists of a number of printed circuit boards (PCB) mounted in numbered slots. The green terminal blocks are then mounted in the PCBs. Some of these board slots are standard and some are intended for options. The board slot positions are arranged as illustrated below.

Slot type	Option	Slot #1	Slot #3	Slot #5	Slot #7
Terminals		1-28	37-64	73-89	98-125
Power supply	Standard	X			
AC measurements	Standard			X	
Power management	Standard				X
I/O extension	M12		X		

Slot type	Option	Slot #2	Slot #4	Slot #6	Slot #8
Terminals		29-34	65-72	90-97	126-133
Serial communication	H2	X			
I/O extension cards	M13.2/M14.2	X			
I/O extension cards	M14.4		X		
I/O extension cards	M13.6/M14.6/M15.6/M16.6			X	
I/O extension cards	M13.8/M14.8/M15.8/M16.8				X

ⓘ **Only hardware options, which will affect the hardware of the unit, are represented in the table. The software options will be seen through the PC utility software. The software options that are not represented in the above table can be found in the data sheet.**

4.1.1 Unit top side overview

An overview of the terminals is presented below. The slot positions are as follows:
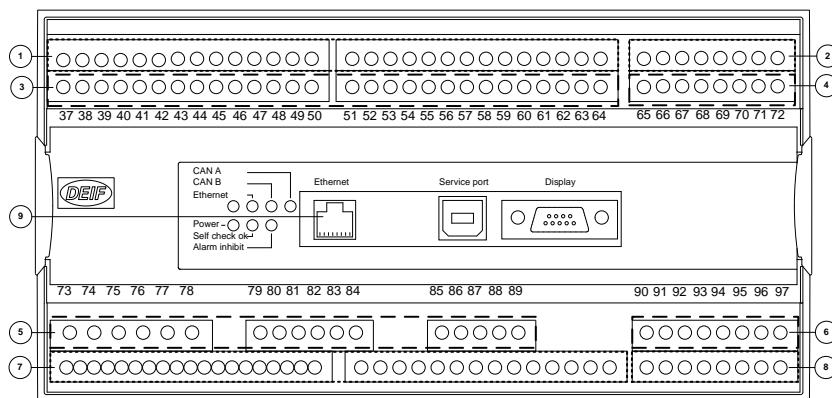
(1): The numbers in the drawing above refer to the slot numbers indicated in the table below.

No.	Slot
1	#1, terminal 1-28, power supply (standard)
2	#2, terminal 29-36, communication and I/O extensions
3	#3, terminal 37-64, in-/outputs
4	#4, terminal 65-72, in-/outputs
5	#5, terminal 73-89, AC measuring (standard)
6	#6, terminal 90-97, in-/outputs
7	#7, terminal 98-125, in-/outputs/power management (standard)
8	#8, terminal 126-133, in-/outputs.
9	LED I/F

4.1.2 Terminal strip overviews
ALC Standard unit

	36		97	
	35		96	
	34	Reserved for options	95	
	33	*See data sheet*	94	
	32		93	
	31		92	
	30		91	
	29	Slot #2	90	

Common for 23-27	28	Slot #1 Slot #5		
Configurable	27			
Configurable	26			
Configurable	25			
Configurable	24			
Configurable	23			
Common for 20/21	22			
kVArh pulse / Relay 20	21			
kWh pulse / Relay 20	20			
	19			
Configurable	18	Relay 17		
	17		89	L3
	16		88	Neutral
Configurable	15	Relay 14	87	L2 BUSBAR VOLTAGE
	14		86	
	13		85	L1
Configurable	12	Relay 11	84	Neutral
	11		83	L3
	10		82	
Configurable	9	Relay 08	81	L2 *Not used*
	8		80	
	7		79	L1
Alarm horn / configurable	6	Relay 05	78	
	5		77	
Status relay	4	Status relay	76	*Not used*
	3		75	
DC power supply (-)	2		74	
8-36 VDC (+)	1		73	

	72			133	
	71			132	
	70			131	
	69	Reserved for options *See data sheet*	Reserved for options *See data sheet*	130	
	68			129	
	67			128	
	66			127	
	65	Slot #4	Slot #8	126	
Configurable	64	Relay 63 Slot #3	Slot #7	B3	CAN L
	63			B2	GND / CANBUS Interface B
Configurable	62	Relay 61		B1	CAN H
	61			A3	CAN L
Configurable	60	Relay 59		A2	GND / CANBUS Interface A
	59			A1	CAN H
Configurable	58	Relay 57		124	Not used
	57			123	
Common for 43-55	56			122	Not used
Configurable	55			121	
Configurable	54			120	Not used
Configurable	53			119	Not used
Configurable	52			118	Not used
Configurable	51			117	Configurable
Configurable	50			116	Configurable
Configurable	49			115	Configurable
Configurable	48			114	Configurable
Configurable	47			113	Configurable
Configurable	46			112	Configurable
Configurable	45			111	Common for 112-117
Configurable	44			110	C
Configurable	43			109	B / Multi input 108
Not used	42			108	A
Not used	41			107	C
Not used	40			106	B / Multi input 105
Not used	39			105	A
Not used	38			104	C
Not used	37			103	B / Multi input 102
				102	A
				101	Not used
				100	
			uP / Communication I/F to main uP	99	(-) Common for 118
				98	(+) 8-36 V DC

The hardware shown in slot #3 is option M12. For a detailed description of this option, please refer to the option manual.

4.1.3 Input/output lists

In the I/O lists, the following terms will be used in connection with the relay outputs:

NO means Normally Open
NC means Normally Closed
NE means Normally Energised
ND means Normally Deenergised
Com. means common terminal

4.1.4 Slot #1, power supply PCB

Term.	Function	Technical data	Description
1	+12/24 V DC	12/24 V DC +/-30%	Power supply
2	0 V DC		
3	NO	Status relay 24 V DC/1 A	Normally open relay, processor/power supply status supervision
4	Com.		
5	NO	Relay 05 250 V AC/8 A	Central alarm HORN/configurable
6	Com.		
7	NC		
8	NO	Relay 08 250V AC/8 A	configurable
9	Com.		
10	NC		
11	NO	Relay 11 250 V AC/8 A	configurable
12	Com.		
13	NC		
14	NO	Relay 14 250 V AC/8 A	configurable
15	Com.		
16	NC		
17	NO	Relay 17 250 V AC/8 A	configurable
18	Com.		
19	NC		
20	Open collector 1	Transistor output/Relay 20	Pulse output 1, kWh counter/configurable
21	Open collector 2	Transistor output/Relay 21	Pulse output 2, kvarh counter/configurable
22	Com.	Common	Common terminal for terminals 20 and 21
23	Digital input 23	Optocoupler	Configurable
24	Digital input 24	Optocoupler	configurable
25	Digital input 25	Optocoupler	configurable
26	Digital input 26	Optocoupler	configurable
27	Digital input 27	Optocoupler	configurable
28	Com.	Common	Common for terminals 23 to 27

4.1.5 Slot #2, serial communication (option H2)

Term.	Function	Description
29	DATA + (A)	Modbus RTU, RS-485
30	GND	
31	DATA - (B)	
32	Not used	
33	DATA + (A)	
34	Not used	
35	DATA - (B)	
36	Not used	

The serial communication line should be terminated between DATA + and DATA - with a resistor equal to the cable impedance. The terminals 29/33 and 31/35 are internally connected.

ⓘ **Never connect the GND terminal 30 to earth. Only connect it to a third wire in the communication cable!**

4.1.6 Slot #2, 7 digital inputs (option M13.2)

Term.	Function	Technical data	Description
29	Binary input 29	Optocoupler	Configurable
30	Binary input 30	Optocoupler	Configurable
31	Binary input 31	Optocoupler	Configurable
32	Binary input 32	Optocoupler	Configurable
33	Binary input 33	Optocoupler	Configurable
34	Binary input 34	Optocoupler	Configurable
35	Binary input 35	Optocoupler	Configurable
36	Com.	Optocoupler	Common for terminals 29-35

4.1.7 Slot #2, relay outputs (option M14.2)

Term.	Function	Technical data	Description
29	NE/ND	Relay 29 250 V AC/5 A	Configurable
30	Com.		
31	NE/ND	Relay 31 250 V AC/5 A	Configurable
32	Com.		
33	NE/ND	Relay 33 250 V AC/5 A	Configurable
34	Com.		
35	NE/ND	Relay 35 250 V AC/5 A	Configurable
36	Com.		

4.1.8 Slot #3, 13 binary inputs and 4 relay outputs (option M12)

Term.	Function	Technical data	Description
37			
38			
39		**Not used**	
40			
41			
42			
43	Binary input	Optocoupler	Configurable
44	Binary input	Optocoupler	Configurable
45	Binary input	Optocoupler	Configurable
46	Binary input	Optocoupler	Configurable
47	Binary input	Optocoupler	Configurable
48	Binary input	Optocoupler	Configurable
49	Binary input	Optocoupler	Configurable
50	Binary input	Optocoupler	Configurable
51	Binary input	Optocoupler	Configurable
52	Binary input	Optocoupler	Configurable
53	Binary input	Optocoupler	Configurable
54	Binary input	Optocoupler	Configurable
55	Binary input	Optocoupler	Configurable
56	Com.	Common	Common for terminals 43 to 55
57	NE/ND	Relay 57	Configurable
58	Com.	250 V AC/5 A	
59	NE/ND	Relay 59	Configurable
60	Com.	250 V AC/5 A	
61	NE/ND	Relay 61	Configurable
62	Com.	250 V AC/5 A	
63	NE/ND	Relay 63	Configurable
64	Com.	250 V AC/5 A	

4.1.9 Slot #4, relay outputs (option M14.4)

Term.	Function	Technical data	Description
65	NE/ND	Relay 65	Configurable
66	Com.	250 V AC/5 A	
67	NE/ND	Relay 67	Configurable
68	Com.	250 V AC/5 A	
69	Not used	Relay 69	Configurable
70	Com.	250 V AC/5 A	
71	Not used	Relay 71	Configurable
72	Com.	250 V AC/5 A	

4.1.10 Slot #5, AC measuring - ALC

Term.	Function	Technical data	Description
73	I L1, s1	Bus A current L1	x/1 A or x/5 A input
74	I L1, s2		
75	I L2, s1	Bus A current L2	x/1 A or x/5 A input
76	I L2, s2		
77	I L3, s1	Bus A current L3	x/1 A or x/5 A input
78	I L3, s2		
79		**Not used**	
80			
81			
82			
83			
84			
85	U L1	Bus voltage L1	Max. 690 V AC phase-phase value
86		Not used	
87	U L2	Bus voltage L2	Max. 690 V AC phase-phase value
88	U$_{NEUTRAL}$	Bus voltage neutral	
89	U L3	Bus voltage L3	Max. 690 V AC phase-phase value

4.1.11 Slot #6, 7 digital inputs (option M13.6)

Term.	Function	Technical data	Description
90	Com.	Common	Common for terminals 90-97
91	Binary input 91	Optocoupler	Configurable
92	Binary input 92	Optocoupler	Configurable
93	Binary input 93	Optocoupler	Configurable
94	Binary input 94	Optocoupler	Configurable
95	Binary input 95	Optocoupler	Configurable
96	Binary input 96	Optocoupler	Configurable
97	Binary input 97	Optocoupler	Configurable

4.1.12 Slot #6, 4 relay outputs (option M14.6)

Term.	Function	Technical data	Description
90	NE/ND	Relay 90 250 V AC 5 A	Configurable
91	Com.		
92	NE/ND	Relay 92 250 V AC 5 A	Configurable
93	Com.		
94	NE/ND	Relay 94 250 V AC 5 A	Configurable
95	Com.		
96	NE/ND	Relay 96 250 V AC 5 A	Configurable
97	Com.		

4.1.13 Slot #6, 4 analogue inputs (option M15.6)

Term.	Function	Technical data	Description
90	Analogue input 91 -	Common	Configurable
91	Analogue input 91 +	4-20 mA in	
92	Analogue input 93 -	Common	Configurable
93	Analogue input 93 +	4-20 mA in	
94	Analogue input 95 -	Common	Configurable
95	Analogue input 95 +	4-20 mA in	
96	Analogue input 97 -	Common	Configurable
97	Analogue input 97 +	4-20 mA in	

4.1.14 Slot #6, 4 multi-inputs (option M16.6)

Term.	Function	Technical data	Description
90	Multi-input 91	Common	Configurable: 4-20 mA/0-5 V/Pt100
91	Multi-input 91	Analogue in	
92	Multi-input 93	Common	Configurable: 4-20 mA/0-5 V/Pt100
93	Multi-input 93	Analogue in	
94	Multi-input 95	Common	Configurable: 4-20 mA/0-5 V/Pt100
95	Multi-input 95	Analogue in	
96	Multi-input 97	Common	Configurable: 4-20 mA/0-5 V/Pt100
97	Multi-input 97	Analogue in	

4.1.15 Slot #7, engine interface card (std.) ALC

Term.	Function	Technical data	Description
98	+12/24 V DC	12/24 V DC +/-30 %	DC power supply
99	0 V DC		
100		**Not used**	
101			
102	A	0(4)-20 mA Digital Pt100 Pt1000 RMI 0-40 V DC	Multi-input 1
103	B		
104	C		
105	A		Multi-input 2
106	B		
107	C		
108	A		Multi-input 3
109	B		
110	C		
111	Com.	Common	Common for terminals 112-117
112	Digital input 112	Optocoupler	Configurable
113	Digital input 113	Optocoupler	Configurable
114	Digital input 114	Optocoupler	Configurable
115	Digital input 115	Optocoupler	Configurable
116	Digital input 116	Optocoupler	Configurable
117	Digital input 117	Optocoupler	Configurable
118	Digital input 118	Optocoupler	Emergency stop and common for 119 and 120
119	NO	Relay 24 V DC/5 A	Not used
120	NO	Relay 24 V DC/5 A	Not used
121	Com.	Relay 250 V AC/5 A	Not used
122	NO		
123	Com.	Relay 24 V DC/5 A	Not used
124	NO		
A1	CAN-H		CAN bus interface A (option G4 or G5)
A2	GND		
A3	CAN-L		
B1	CAN-H		CAN bus interface B (option G4 or G5)
B2	GND		
B3	CAN-L		

4.1.16 Slot #8, 7 digital inputs (option M13.8)

Term.	Function	Technical data	Description
126	Com.	Common	Common for terminals 127-133
127	Digital input 127	Optocoupler	Configurable
128	Digital input 128	Optocoupler	Configurable
129	Digital input 129	Optocoupler	Configurable
130	Digital input 130	Optocoupler	Configurable
131	Digital input 131	Optocoupler	Configurable
132	Digital input 132	Optocoupler	Configurable
133	Digital input 133	Optocoupler	Configurable

4.1.17 Slot #8, 4 relay outputs (option M14.8)

Term.	Function	Technical data	Description
126	NE/ND	Relay 126 250 V AC/5 A	Configurable
127	Com.		
128	NE/ND	Relay 128 250 V AC/5 A	Configurable
129	Com.		
130	NE/ND	Relay 130 250 V AC/5 A	Configurable
131	Com.		
132	NE/ND	Relay 132 250 V AC/5 A	Configurable
133	Com.		

4.1.18 Slot #8, 4 analogue inputs (option M15.8)

Term.	Function	Technical data	Description
126	Analogue input 127 -	Common	Configurable
127	Analogue input 127 +	4-20 mA in	
128	Analogue input 129 -	Common	Configurable
129	Analogue input 129 +	4-20 mA in	
130	Analogue input 131 -	Common	Configurable
131	Analogue input 131 +	4-20 mA in	
132	Analogue input 133 -	Common	Configurable
133	Analogue input 133 +	4-20 mA in	

4.1.19 Slot #8, 4 multi-inputs (option M16.8)

Term.	Function	Technical data	Description
126	Multi-input 127	Common	Configurable: 4-20 mA/0-5 V/Pt100
127	Multi-input 127	Analogue in	
128	Multi-input 129	Common	Configurable: 4-20 mA/0-5 V/Pt100
129	Multi-input 129	Analogue in	
130	Multi-input 131	Common	Configurable: 4-20 mA/0-5 V/Pt100
131	Multi-input 131	Analogue in	
132	Multi-input 133	Common	Configurable: 4-20 mA/0-5 V/Pt100
133	Multi-input 133	Analogue in	

5. Wirings

5.1 AC connections

The Multi-line 2 unit can be wired up in 1-phase, 2-phase or 3-phase configuration.

⚠ **Contact the switchboard manufacturer for accurate information about required wiring for the specific application.**

5.1.1 Neutral line (N)

When three-phase distribution systems are used, the neutral line (N) is only necessary if it is a three-phase + neutral system. If the distribution system is a three-phase system without neutral, then leave terminal 84 empty.

5.1.2 Current transformer grounding

The current transformer ground connection can be made on s1 or s2 connection, whichever is preferred.

5.1.3 Fuses

If the cables are protected with fuses, then use 2 A, slow blow.

5.1.4 ALC 3-phase

TO
LOADGROUPS

L1   L2   L3   N

ALC

89	U_{L3}	
88	N	BUSBAR
87	U_{L2}	VOLTAGE
85	U_{L1}	

26

27

14

15

17

18

84 N

83 U_{L3}

81 U_{L2}

79 U_{L1}

77

78 I3

75

76 I2

73

74 I1

TO BUSBAR
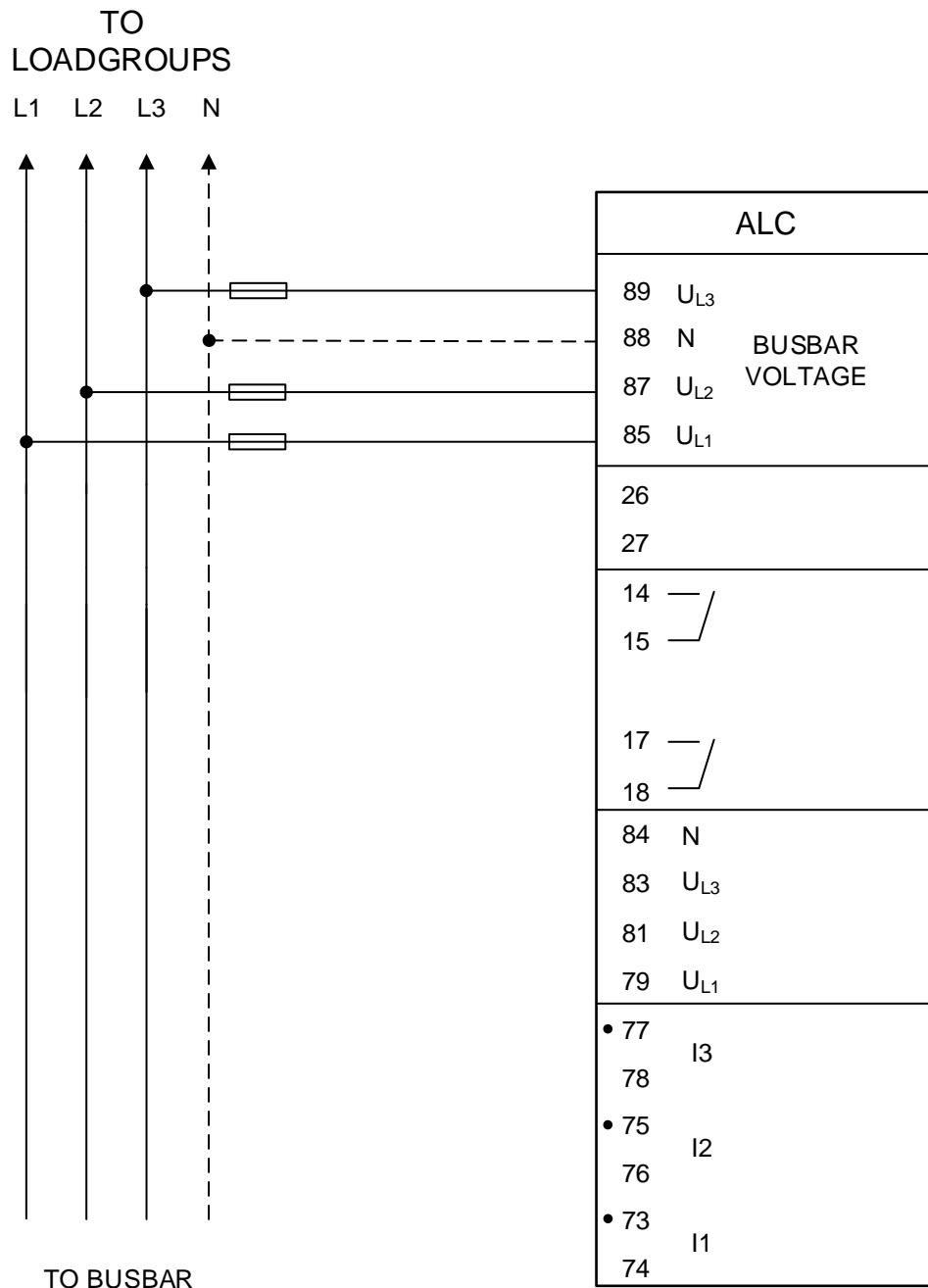
5.2 DC connections

5.2.1 Digital inputs

Battery positive to input:

12/24V DC

Switch

23

Multi-line 2

28 (COM.)
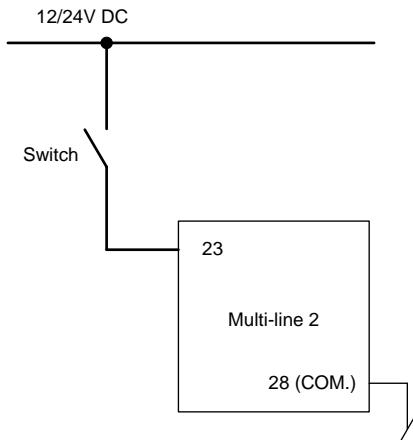
Battery negative to input:

12/24V DC

23

Multi-line 2

28 (COM.)

Switch

Emergency stop:

12/24V DC

118

Multi-line 2

99 (COM.) —— 0V DC
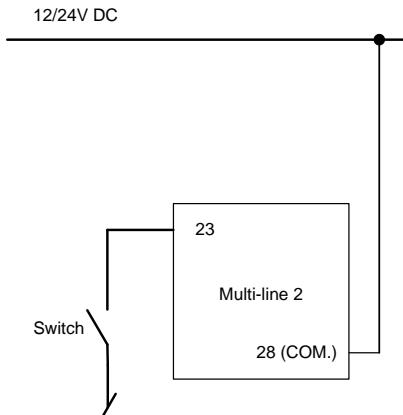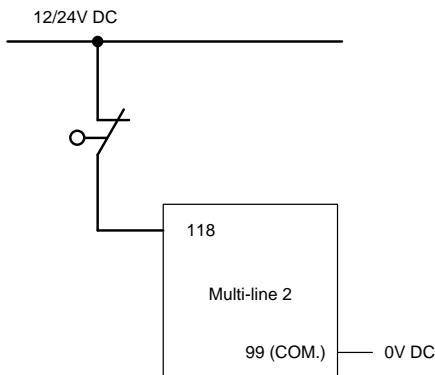
5.2.2 Analogue inputs (option M15.X)
4-20 mA
Active transducer

4-20 mA
transducer

Multi-line 2

+12/24V DC —— + +
0V DC —— - -

Measurement

91

Analogue input 91

90 (Common)
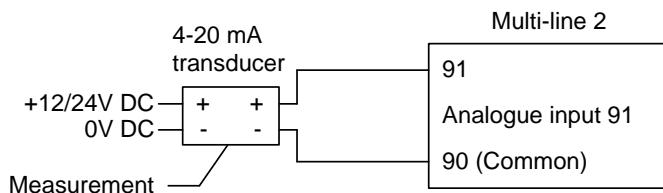
Passive transducer
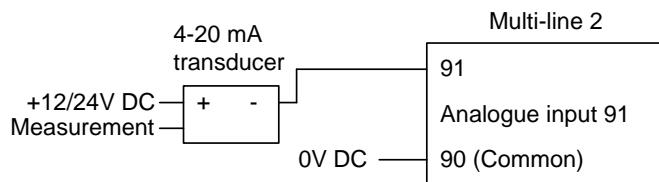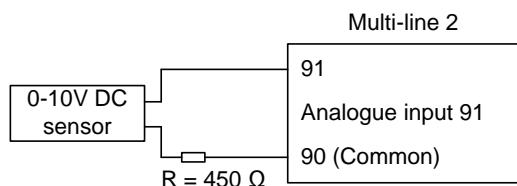
V DC sensor

5.2.3 Multi-inputs (option M16.X)

4-20 mA

Active transducer
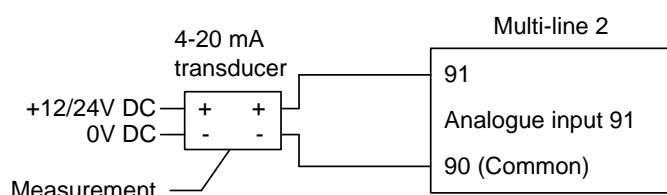
Passive transducer
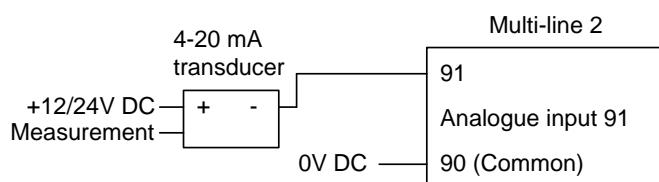
V DC sensor
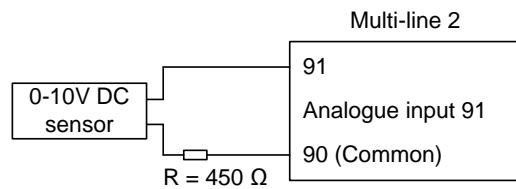
0-5V DC
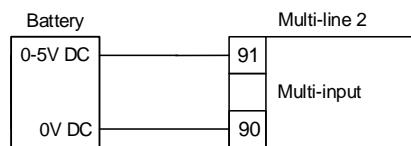
Pt100
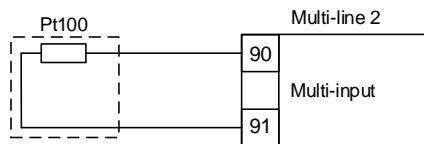
5.2.4 Multi-inputs (102, 105, 108)
0(4)-20 mA
The multi-inputs are placed in slot #7, the terminal numbers for the individual multi-inputs can be seen in the "Input/output list".

Active transducer
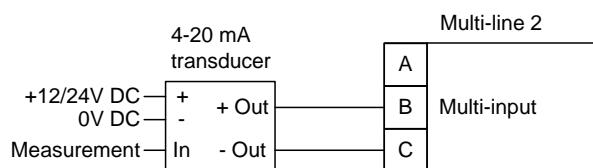
Passive transducer
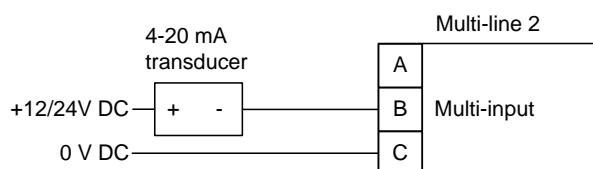
ⓘ **If the passive sensor has its own battery supply, the voltage must not exceed 30 V DC.**

Digital inputs
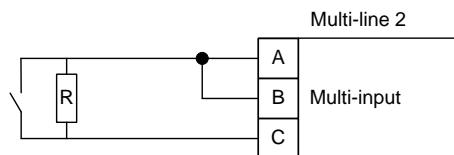
ⓘ **The resistor is only mounted if wire fail supervision is required. The value of the resistor should be 270 Ω +/-10 %.**

Pt100/Pt1000

2-wire
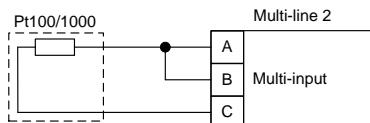
3-wire
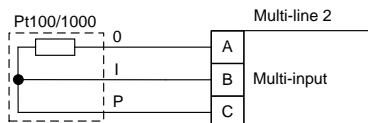
RMI

1-wire
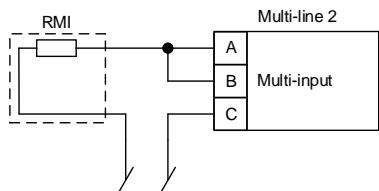
2-wire
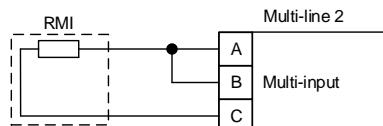
0-40V DC
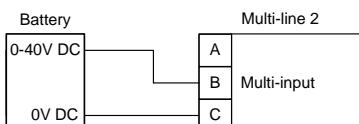
5.2.5 Transistor outputs (open collector outputs)

The open collector outputs can be used as kWh and kvarh counter outputs or as relay outputs. The outputs are low power outputs. For that reason, one of the following circuits must be applied.

External counter:

+12/24 VDC

0,5 μF
100 V

External
counter

20 kWh

Multi-line 2

22 (Com. For 20/21)

0 VDC

Relay outputs:

+12/24 VDC

A1

Relay

A2

20 (Relay 20)

Multi-line 2

22 (Common)

0 VDC

Connection to PLC:

+12/24 VDC

4,7 kΩ

PLC

Input (positive)

20 kWh

Multi-line 2

22 (Com. For 20/21)

0 VDC
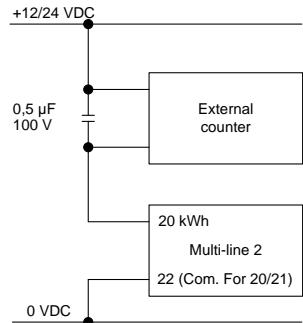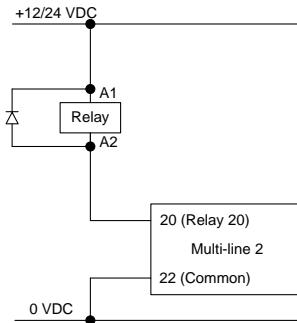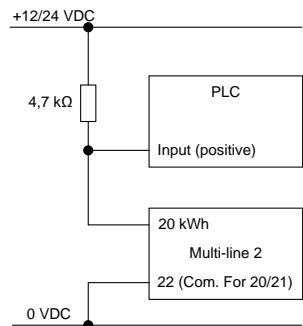
(i) **Remember to mount the free wheel diode.**

(i) **Maximum load on the open collector outputs is 10 mA at 24 V DC.**

5.3 Communication

## 5.3.1 CAN bus (Option G5)

Examples with three ML-2 units connected, for example two AGC units and one ALC unit.
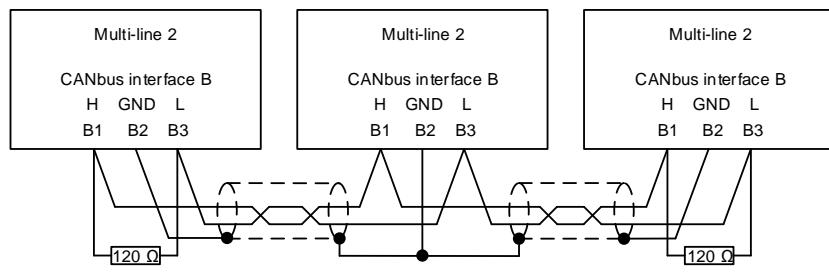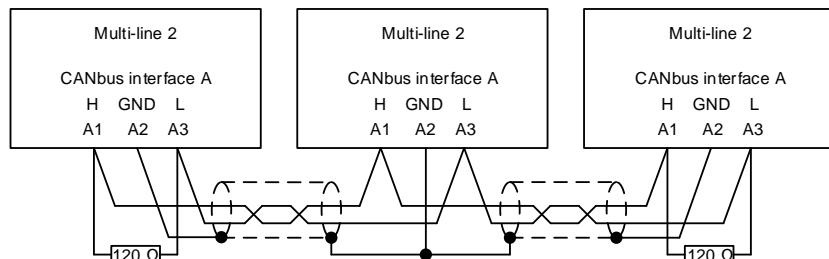
(i) **Connect shield to earth at one end only. Shield ends must be insulated with tape or insulation tubing.**

(i) **Use shielded twisted cable.**

(i) **End resistor R = 120 Ohm.**

5.3.2 Modbus (option H2)

Connection with 2-wire screened cable (recommended):
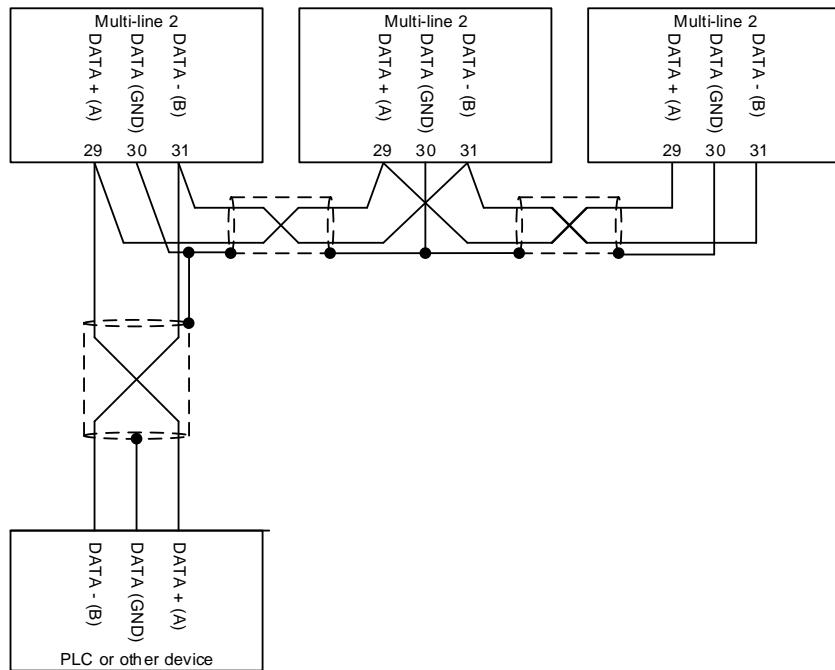
ⓘ **Connect shield to ground at one end only. Shield ends must be insulated with tape or insulation tubing.**

ⓘ **Use shielded twisted cable.**

Connection with 3-wire shielded cable:

ℹ **Connect shield to ground at one end only. Shield ends must be insulated with tape or insulation tubing.**

ℹ **Use shielded twisted cable.**

⚠ **This solution is only feasible if the COM line is insulated. Check PLC/other device before connecting.**

⚠ **A non-insulated COM line may result in damage to the equipment.**

Normally, the Modbus does not need bias resistors (end terminators). These are only needed in case of very long lines and/or many nodes (>32) on the Modbus network. If bias resistors are needed, the calculation should be based on the following data:

ℹ
- A line internal pull-up bias resistor:	**22 kΩ**
- B line internal pull-down bias resistor:	**22 kΩ**
- Receiver input sensitivity:	**+/-200 mV**
- Receiver input impedance:	**12 kΩ**

ℹ **Cable: Belden 3105A or equivalent. 22 AWG (0.6 mm^2) twisted pair, shielded, <40 mΩ/m, min. 95 % shield coverage.**

5.3.3 Display cable (option J)

A standard computer extension cable can be used (9-pole SUB-D male/female plugs) or a cable can be tailored.
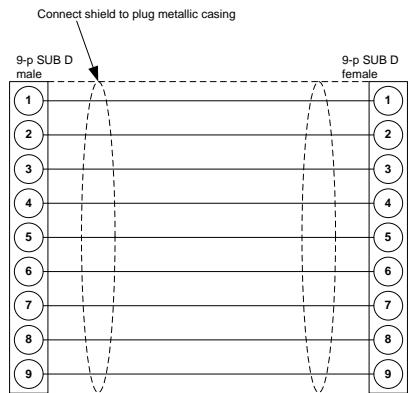
Wires min. 0.22 mm^2, max. cable length 6 m.

Cable types: Belden 9540, BICC H8146, Brand Rex BE57540 or equivalent.

No use of tools or brute force when tightening finger-screws on display cable.

6. Technical information

6.1 Technical information, ALC

6.1.1 Technical specifications

Accuracy	**Class 1.0** **-25 to 15 to 30 to 70 °C** **Temperature coefficient: ±0.2 % of full scale per 10°C**
Operating temperature	-25 to 70 °C (-13 to 158 °F) -25 to 60 °C (-13 to 140 °F) if Modbus TCP/IP (option N) is available in the controller (UL/cUL Listed: Max. surrounding air temperature: 55 °C/131 °F)
Storage temperature	-40 to 70 °C (-40 to 158 °F)
Climate	97 % RH to IEC 60068-2-30
Operating altitude	0 to 4000 m above sea level Derating 2001 to 4000 m above sea level: Max. 480 V AC phase-phase 3W4 measuring voltage Max. 690 V AC phase-phase 3W3 measuring voltage
Measuring voltage	100 to 690 V AC ±20 % (UL/cUL Listed: 600 V AC phase-phase) Consumption: Max. 0.25 VA/phase
Measuring frequency	30 to 70 Hz
Aux. supply	Terminals 1 and 2: 12/24 V DC (8 to 36 V continuously, 6 V 1 sec). Max. 11 W consumption Battery voltage measurement accuracy: ±0.8 V within 8 to 32 V DC, ±0.5 V within 8 to 32 V DC @ 20 °C Terminals 98 and 99: 12/24 V DC (8 to 36 V continuously, 6 V 1 sec). Max. 5 W consumption The aux. supply inputs are to be protected by a 2 A slow blow fuse. (UL/cUL Listed: AWG 24)
Binary inputs	Optocoupler, bi-directional ON: 8 to 36 V DC Impedance: 4.7 kΩ OFF: <2 V DC
Analogue inputs	-10 to +10 V DC: Not galvanically separated. Impedance: 100 kΩ (G3) 0(4) to 20 mA: Impedance 50 Ω. Not galvanically separated (M15.X)
Multi-inputs	0(4) to 20 mA: 0 to 20 mA, ±1 %. Not galvanically separated Binary: Max. resistance for ON detection: 100 Ω. Not galvanically separated Pt100/1000: -40 to 250 °C, ±1 %. Not galvanically separated. To IEC/EN60751. V DC: 0 to 40 V DC, ±1 %. Not galvanically separated
Relay outputs	Electrical rating: 250 V AC/30 V DC, 5 A. (UL/cUL Listed: 250 V AC/24 V DC, 2 A resistive load) Thermal rating @ 50 °C: 2 A: Continuously. 4 A: ton = 5 sec, toff = 15 sec(Unit status output: 1 A)
Open collector outputs	Supply: 8 to 36 V DC, max. 10 mA (terminal 20, 21, 22 (com))

Accuracy	**Class 1.0** **-25 to 15 to 30 to 70 °C** **Temperature coefficient: ±0.2 % of full scale per 10°C**
Galvanic separation	Between AC voltage and other I/Os: 3250 V, 50 Hz, 1 min Between analogue outputs and other I/Os: 550 V, 50 Hz, 1 min Between binary input groups and other I/Os: 550 V, 50 Hz, 1 min
Mounting Tightening torque	DIN rail mount or base mount with six M4 screws 1.5 Nm for the six M4 screws (countersunk screws are not to be used)
Safety	To EN 61010-1, installation category (over-voltage category) III, 600 V, pollution degree 2 To UL 508 and CSA 22.2 no. 14-05, over-voltage category III, 600 V, pollution degree 2
EMC/CE	To EN 61000-6-2, EN 61000-6-4, IEC 60255-26
Vibration	3 to 13.2 Hz: 2 mmpp. 13.2 to 100 Hz: 0.7 g. To IEC 60068-2-6 & IACS UR E10 10 to 60 Hz: 0.15 mmpp. 60 to 150 Hz: 1 g. To IEC 60255-21-1 Response (class 2) 10 to 150 Hz: 2 g. To IEC 60255-21-1 Endurance (class 2)
Shock (base mount)	10 g, 11 ms, half sine. To IEC 60255-21-2 Response (class 2) 30 g, 11 ms, half sine. To IEC 60255-21-2 Endurance (class 2) 50 g, 11 ms, half sine. To IEC 60068-2-27
Bump	20 g, 16 ms, half sine. To IEC 60255-21-2 (class 2)
Material	All plastic materials are self-extinguishing according to UL94 (V1)
Plug connections	AC voltage: 0.2 to 2.5 mm2stranded wire. (UL/cUL Listed: AWG 20) Relays: (UL/cUL Listed: AWG 22) Terminals 98-116: 0.2 to 1.5 mm2stranded wire. (UL/cUL Listed: AWG 24) Other: 0.2 to 2.5 mm2 stranded wire. (UL/cUL Listed: AWG 24) Tightening torque: 0.5 Nm (5-7 lb-in) Display: 9-pole Sub-D female Tightening torque: 0.2 Nm Service port: USB A-B
Protection	Unit: IP20. Display: IP40 (IP54 with gasket: Option L). (UL/cUL Listed: Type Complete Device, Open Type). To IEC/EN 60529
Approvals	UL/cUL Listed to UL508 Applies to VDE-AR-N 4105

Accuracy	**Class 1.0** **-25 to <u>15 to 30</u> to 70 °C** **Temperature coefficient: ±0.2 % of full scale per 10°C**
UL markings	Wiring: Use 60/75 °C copper conductors only Mounting: For use on a flat surface of type 1 enclosure Installation: To be installed in accordance with the NEC (US) or the CEC (Canada) **AOP-2:** Maximum ambient temperature: 60 °C Wiring: Use 60/75 °C copper conductors only Mounting: For use on a flat surface of type 3 (IP54) enclosure. Main disconnect must be provided by installer Installation: To be installed in accordance with the NEC (US) or the CEC (Canada) **DC/DC converter for AOP-2:** Wire size: AWG 22-14 Tightening torque: 0.5 Nm (4.4 lb-in) Panel door mounting: 0.7 Nm Sub-D screw: 0.2 Nm
Weight	Base unit: 1.6 kg (3.5 lbs) Option J1/J4/J6/J7: 0.2 kg (0.4 lbs) Option J2: 0.4 kg (0.9 lbs) Option J8: 0.3 kg (0.58 lbs) Display: 0.4 kg (0.9 lbs)