free smart

Programmable controller
Installation manual

EN

Controls

CONTENTS

1 INTRODUCTION

To allow quick, easy reference, the manual has been designed with the following features:

References

***References* column:**
A column to the left of the text contains *references* to subjects discussed in the text to help you locate the information you need quickly and easily.

Cross references

Cross references:
All words in *italics* are listed in the analytical index along with the page number where they are dealt with in more detail.
In the "online" (computer) manual, the words in italics are "hyperlinks" (i.e. mouse-clickable links), connecting up the different parts of the manual and making it "navigable".

Highlighting icons:

Some text passages are marked by icons in the *references* column, which have the following meanings:

Important! :	**Information that the user must be aware of to prevent any damage to the system or hazards for people, devices, data, etc. Users MUST read and take note of these sections**.
Note / highlight:	Further information on the topic in question that the user should be aware of.
Tip:	A suggestion that could help the user to understand and make better use of the information provided.

1.1 General description

FREE Smart is the compact option in the Eliwell platform of programmable controllers, and is ideal for use in a variety of HVAC/R and other applications.

FREE Smart has the same I/O's and variety of *models* as the Flex *range*, which can be combined with Energy Flex *expansions*.

The *models* come in a DIN rail-mounted version which significantly reduces wiring times, or in the regular Eliwell 32x74 format for panel mounting.

FREE Smart also has the same Modbus RTU serial communication standard interface as the Flex *range* and the option of downloading parameter maps and applications via the Multi Function Key.

In association with FREE Smart hardware, the *FREE Studio* development tool is also provided to quickly and reliably program and customize new programmes for any application.
The use of several different programming languages in accordance with IEC61131-3 regulations (programming standard for industrial control), makes it possible to develop new algorithms or entire programmes totally unassisted, which can then be uploaded to Free Smart modules via PC or Multi Function Key, guaranteeing the utmost confidentiality with appropriate security.

Ratiometric pressure sensors, external modules (e.g. fan modules) and *terminals* can also be connected with no need for any further serial interfaces.

1.1.1 Specifications:

FREE Smart SMD4500 – SMC4500 / SME4500 Expansion have disconnectable connectors for both low voltage inputs and relay outputs.
Various *models* are available giving up to 2 *digital inputs*, 4 relay outputs, up to 2 Open Collector PWM *analogue outputs*, up to 2 x 0..10V *analogue outputs*, one configurable 0...20mA/4...20mA output or, alternatively, one 0...10V output on dedicated *models*.
The 4DIN format guarantees maximum flexibility and easy installation.
Power supply 100-240V~

FREE Smart SMP has 2 *models* based on which it is possible to have 6 *digital inputs*, 5 relay outputs, one *TRIAC* output, 2 Open Collector PPM/PWM *analogue outputs*, 3 configurable *analogue outputs* 0...10V/0...20mA/4...20mA and one open collector digital output for external relay.
The standard Eliwell 32x74mm format ensures versatility and ease of installation.

FREE Smart SMD – SMC / SE *Expansions* come in a variety of *models*, giving you 6 *digital inputs*, up to 5 relay outputs, up to 2 *TRIAC* outputs, up to 2 Open Collector PPM/PWM *analogue outputs*, up to 3 configurable 0...10V/0...20mA/4...20mA *analogue outputs* and up to 2 Open Collector *digital outputs* for an external relay.
The 4DIN format guarantees maximum flexibility and easy installation.

It runs on 12-24V~ or 12-24V~/24V⎓ power supplies.

1.1.2 Main functions of hardware:

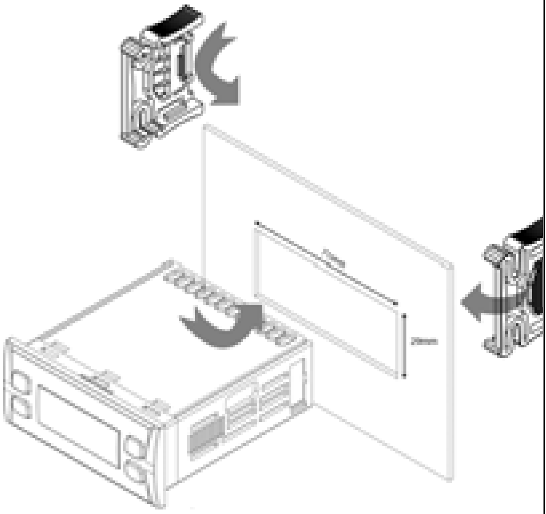
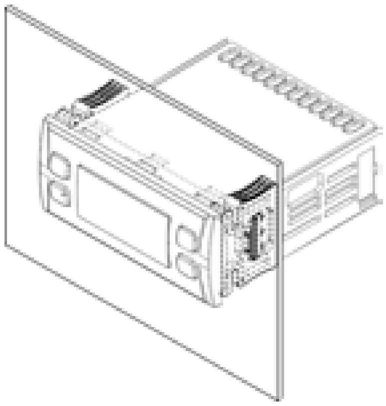
- Parameter settings via keyboard or PC
- Multi Function Key (MFK) to download or upload parameter maps
- Terminal (up to 100m cable) with direct connection without serial interface
- Configurable NTC, 0…20mA ,4…20mA, 0…1V, 0…5V, 0…10V inputs or digital input configurable from parameters
- 3 x Pt1000 inputs for 4500 *models*

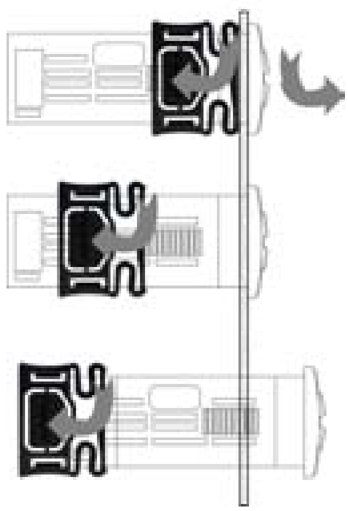
1.2 Models and Features

-->See Appendix A - *Models and Accessories*, and *Technical Data* section

2 MECHANICAL INSTALLATION

Smart SMP ● SKP 10
The instrument is intended for panel mounting (see diagram).
Drill a 29x71 mm hole and insert the instrument; secure it with the special brackets provided.
Do not mount the instrument in damp and/or dirty areas; it is suitable for use in places with ordinary or normal levels of pollution.
Keep the area around the instrument cooling slots adequately ventilated.
The *TTL* serial is on the left side of the device.

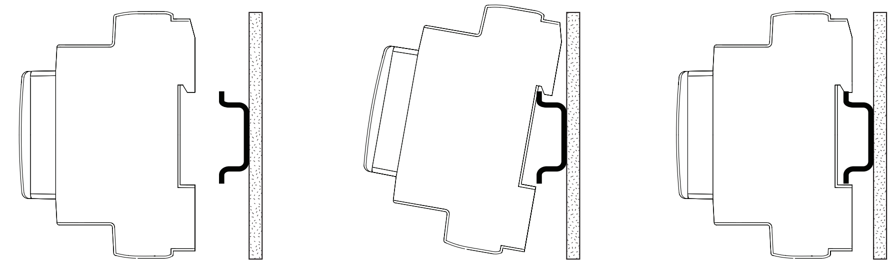
Example of installation of SMP ● SKP 10 *range* panel	**SMP ● SKP 10 ranges panel-mounted**
	
The images refer to Smart SMP	

SMP ● SKP 10 ranges Example of panel mounting - side view	**SMP ● SKP 10 ranges Removing the device from the panel – side view**
	

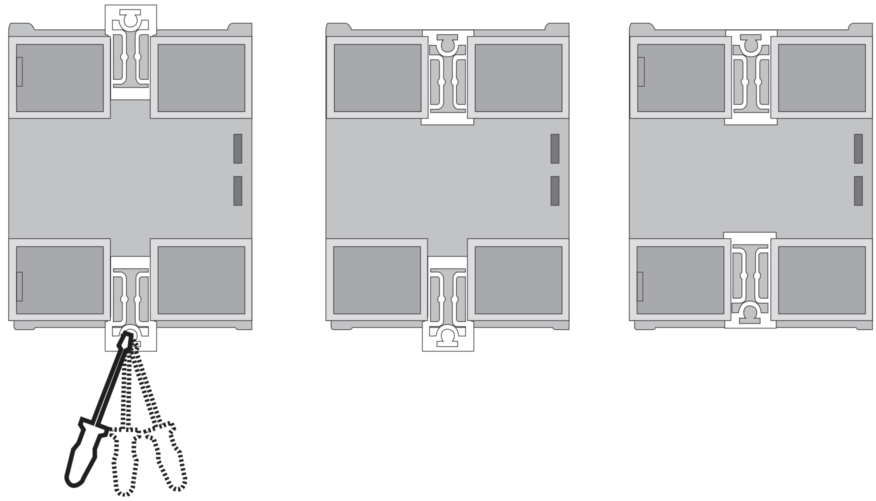
SMD – SMC – SE SME ranges
The instrument is intended for 4DIN rail mounting.
For GUIDA DIN installation, follow the steps described below:

- Move the two spring docking devices to their standby position (use a screwdriver to press against the relative compartments).
- Then install the device on the DIN RAIL, pressing on the "spring docking devices" to put them into the locked position.

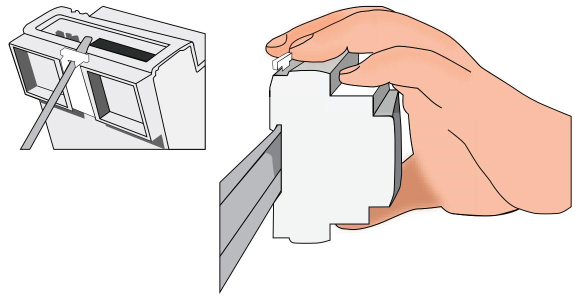
SMD – SMC – SE/SME
Installation on DIN rail – side view



SMD – SMC – SE/SME
Installation on DIN rail – rear view

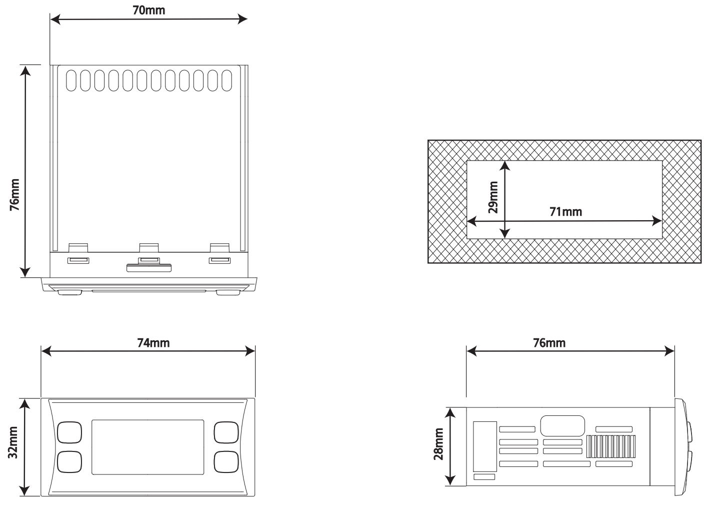


SMD – SMC – SE/SME
Installation on DIN rail – ¾ view

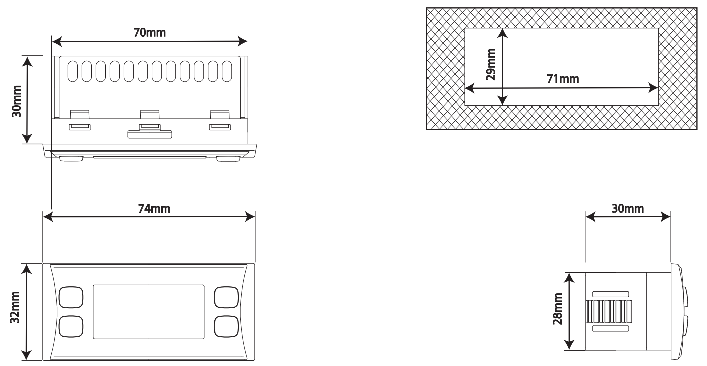


2.1 Mechanical dimensions

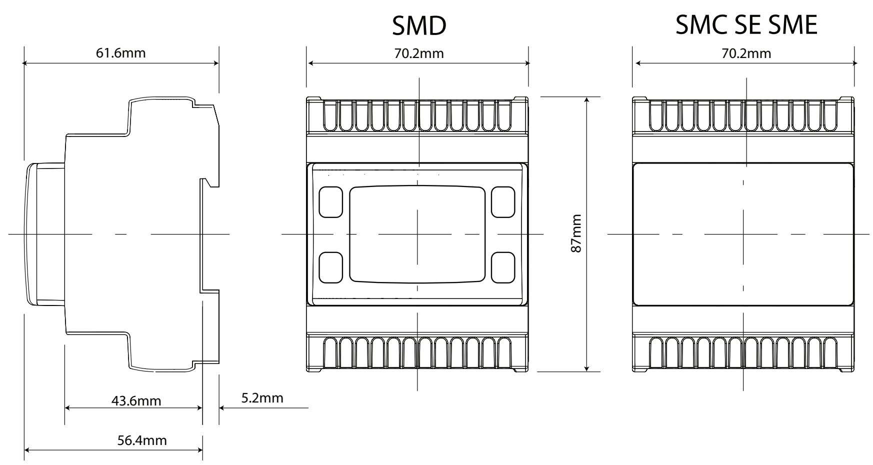
SMP



SKP 10



SMD/SMC – SE6xx - SME4500



3 ELECTRICAL CONNECTIONS

3.1 General warnings

Before doing anything, make sure the device is connected to a suitable external *transformer*. The following rules must be followed when connecting cards to each other and to the application:

- **Loads that exceed the maximum limits set forth in this manual/product *label* must not be applied to outputs.**
- **When connecting loads, follow connection diagrams carefully.**
- **To avoid electric pairings, wire all low SELV (*) utilities separately from high voltage ones.**

IMPORTANT!
Make sure the machine is switched off before working on the *electrical connections*. All operations must be carried out by qualified personnel. To ensure proper connections, comply with the following:

- Power supplies other than those specified can seriously damage the system.
- Use cables of suitable section for the *terminals* used.
- Separate the cables of probes and *digital inputs* from inductive loads and high voltage connections to prevent any electromagnetic interference. Do not place the probe cables near other electrical equipment (switches, meters, etc.)
- Make connections as short as possible and do not wind them around electrically connected parts.
- To avoid causing static discharges, do not touch the electronic *components* on the boards.
- Eliwell supplies the high voltage cables to connect the device to loads - see *Accessories* chapter
- Eliwell supplies the signal cables to connect the power supply, probes, *digital inputs*, etc - see *Accessories* Chapter.
- The device must be connected to a suitable *transformer* that complies with the specifications provided in the Specifications chapter.

3.1.1 Power supply - High voltage inputs (relay)

Do not exceed the maximum permitted current; for higher loads, use a contactor with sufficient power capacity.
Important!
Make sure that the power supply is of the correct voltage for the device.

3.1.2 TRIAC

The *TRIAC* TC1 output (TC1, TC2 ~ **36xx *models***), when partialized, suppresses the half-wave at the zero-crossing.

3.1.3 Analogue Inputs-Probes

Temperature probes

Probes have no connection polarity and can be extended using a normal bipolar cable (note that the extension of the probes influences the instrument's EMC electromagnetic compatibility: take great care with the wiring).

Important!

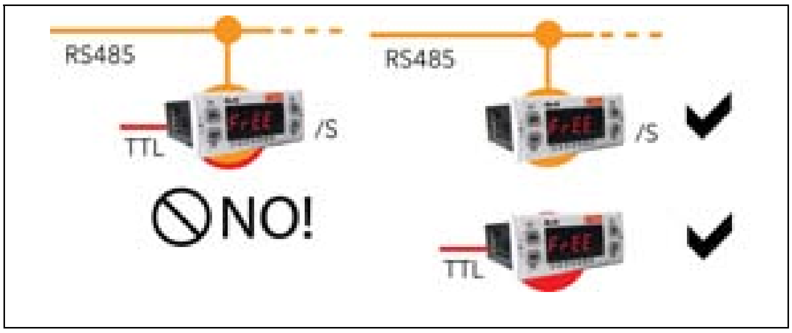
Pressure probes

Pressure probes have a specific insertion polarity which must be observed.
Signal cables (temperature/*pressure probes*, *digital inputs*, *TTL* serial) must be wired separately from high voltage cables.
Eliwell-supplied probes are recommended. Contact Eliwell sales department for item availability.

3.1.4 Serial connections

TTL

Use a 5-wire *TTL* cable up to 30cm in length.
An Eliwell-supplied *TTL* cable is recommended. Contact Eliwell sales department for item availability.
/S *models* : the *TTL* and RS485 *serials* cannot be used at the same time.

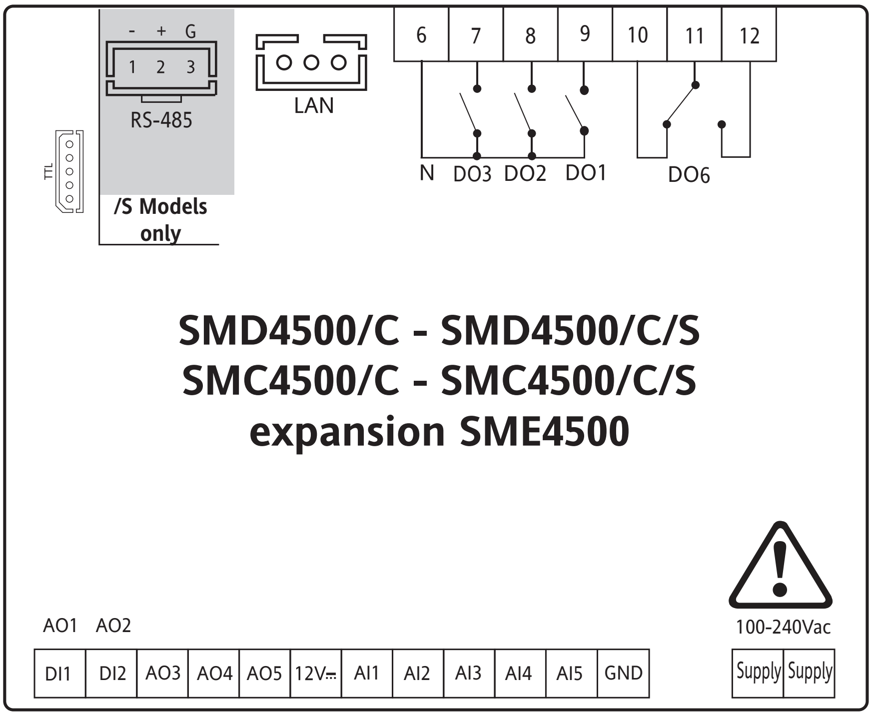


LAN

LAN
3-wire *LAN* 3 powered serial available on the terminal board to connect to the *LAN* network.
Max. distance of 100m between the first and last element in the network.

3.2 Wiring diagrams

45xx 100-240V~ *models*



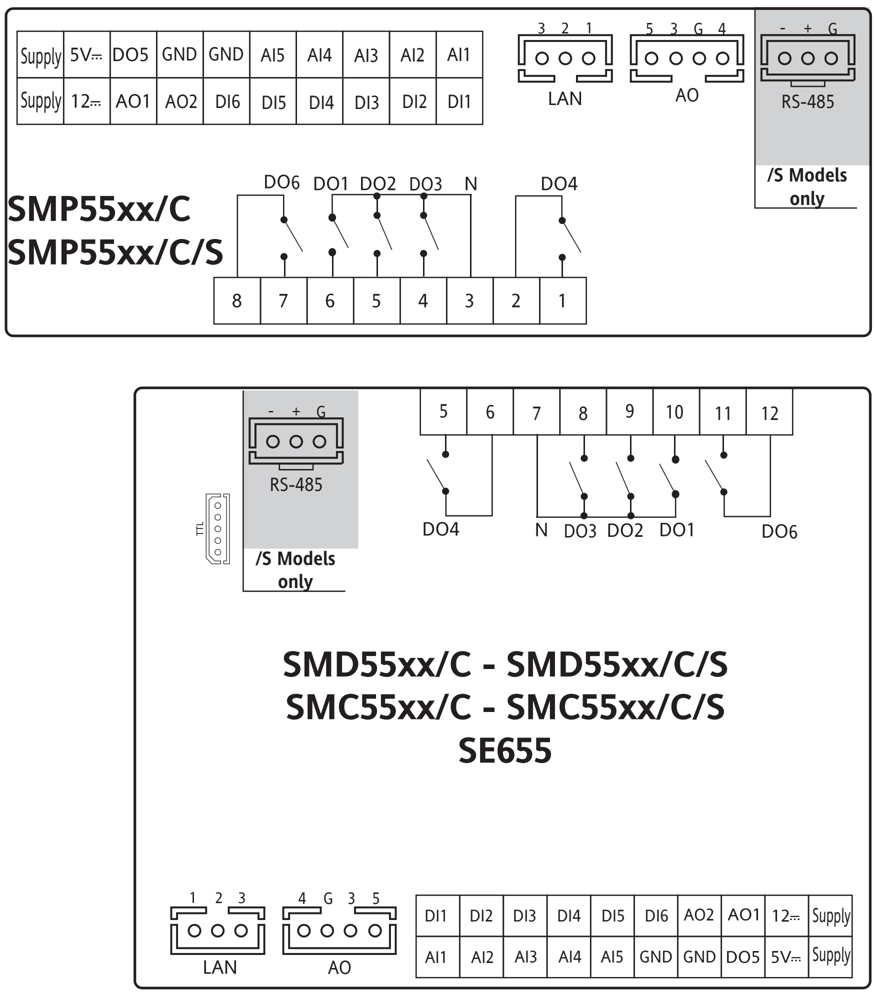
- **4** x 2A 230Vac high voltage *digital outputs* ● [DO1, DO2, DO3, DO6]
- **5** *analogue outputs*:
  - 2 PWM Open Collector *analogue outputs* [AO1, AO2]
  - 3 low voltage (SELV (§)) *analogue outputs*
    - 2 x 0-10V outputs [AO3-4]
    - 1 x 4...20mA/0...20mA output [AO5] or 0-10V alternative on dedicated model

- 2 no-voltage *digital inputs* (°) [DI1...DI2]
- 5 *analogue inputs*
  - 3 NTC* / Pt1000(^) / *Digital Inputs**** [AI1, AI2, AI5]
  - 2 NTC / voltage, current** / Digital Input*** [AI3, AI4]

(^) If 1 Pt1000 is set → all three are configured as Pt1000
*SEMITEC 103AT type (10KΩ / 25°C)
**0...20mA / 4...20mA current or 0...5V / 0...10V / 0...1V voltage input
or no voltage digital input
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

• POWER SUPPLY	100-24V~
• 12 ⎓	12Vdc auxiliary supply
• N	Neutral
• *LAN*	Connection to terminal (KEYBoard) / SE6xx (max 100m)
• *TTL*	*TTL* serial to connect a Multi Function Key
• /C	RTC
• RS-485	**/S** integrated RS-485 serial to connect to supervisor

55xx *models*



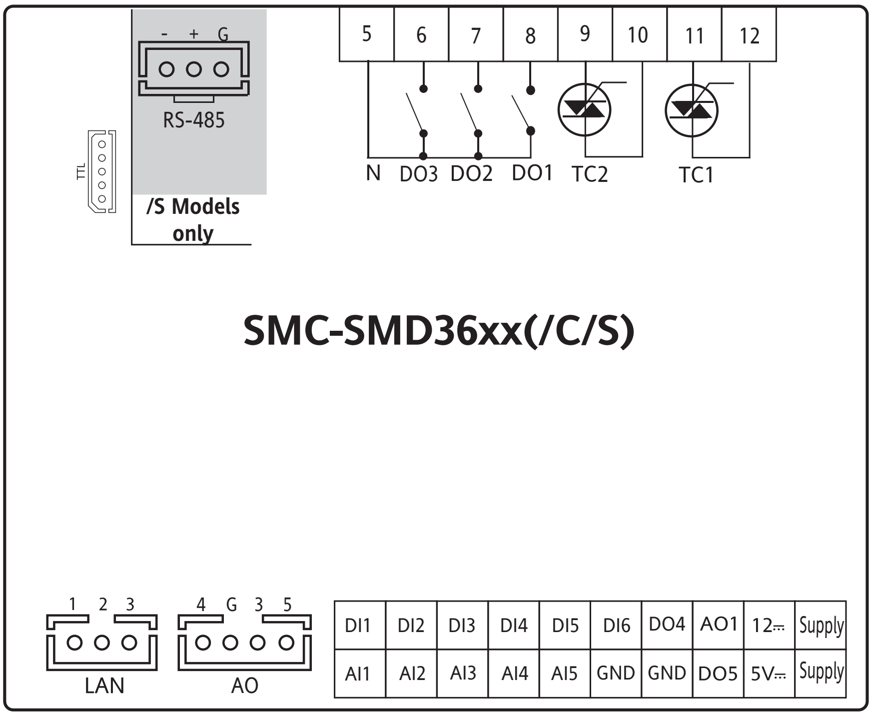
- **5** x 2A 230Vac high voltage *digital outputs* ● [DO1, DO2, DO3, DO4, DO6]
- **5** *analogue outputs*:
  - o 2 PPM/PWM Open Collector *analogue outputs* [AO1, AO2]
  - o 3 low voltage (SELV (§)) *analogue outputs*
    - 2 x 0-10V outputs [AO3-4]
    - 1 output [AO5] 4…20mA/0…20mA

- 6 configurable, no-voltage *digital inputs* (°) [DI1…DI6]
- 5 *analogue inputs*
  - o 3 NTC* / Digital Input*** [AI1, AI2, AI5]
  - o 2 NTC / voltage, current** / Digital Input*** [AI3, AI4]
- 1 low voltage (SELV (§)) PWM Open Collector output [DO5]

*SEMITEC 103AT type (10KΩ / 25°C)
**0…20mA / 4…20mA current or 0…5V / 0…10V / 0…1V voltage input
or no voltage digital input
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

• SUPPLY	12-24V~ / 24V⎓
• 5 ⎓	5Vdc 20mA max. auxiliary supply
• 12 ⎓	12Vdc auxiliary supply
• N	Neutral
• *LAN*	Connection to terminal (KEYBoard) / SE6xx (max 100m)
• *TTL*	*TTL* serial to connect a Multi Function Key
• /C	RTC
• RS-485	**/S** integrated RS-485 serial to connect to supervisor

36xx ***models***



- **3** x 2A 230Vac high voltage *digital outputs* [DO1, DO2, DO3]
- **6** *analogue outputs*:
  - o 2 x3A 230Vac high voltage *analogue outputs* [TC1 TC2]
  - o 1 PPM/PWM Open Collector analogue output [AO1]
  - o 3 low voltage (SELV (§)) *analogue outputs*
    - 2 x 0-10V outputs [AO3-4]
    - 1 output [AO5] 4…20mA/0…20mA

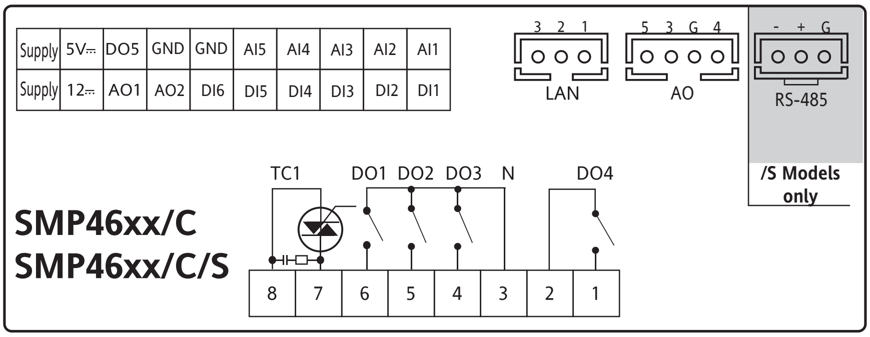
- 6 *digital inputs* [DI1…DI6]
- 5 *analogue inputs* [AI1…AI5]
  - o 3 NTC* / Digital Input*** [AI1, AI2, AI5]
  - o 2 NTC / voltage, current** / Digital Input*** [AI3, AI4]
- 2 low voltage (SELV (§)) Open Collector outputs [DO5]

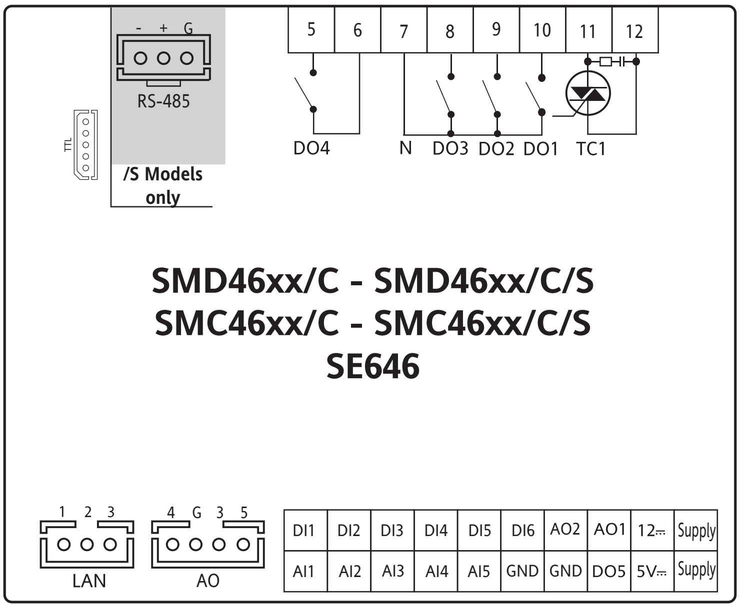
*SEMITEC 103AT type (10KΩ / 25°C)
**0…20mA / 4…20mA current or 0…5V / 0…10V / 0…1V voltage input
or no voltage digital input
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

• SUPPLY	12-24V~
• 5 ⎓	5Vdc 20mA max. auxiliary supply
• 12 ⎓	12Vdc auxiliary supply
• N	Neutral
• *LAN*	Terminal (KEYBoard) / SE6xx connection (max 100m)
• *TTL*	*TTL* serial to connect a Multi Function Key
• /C	RTC
• RS-485	**/S** integrated RS-485 serial to connect to supervisor

(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

46xx *models*



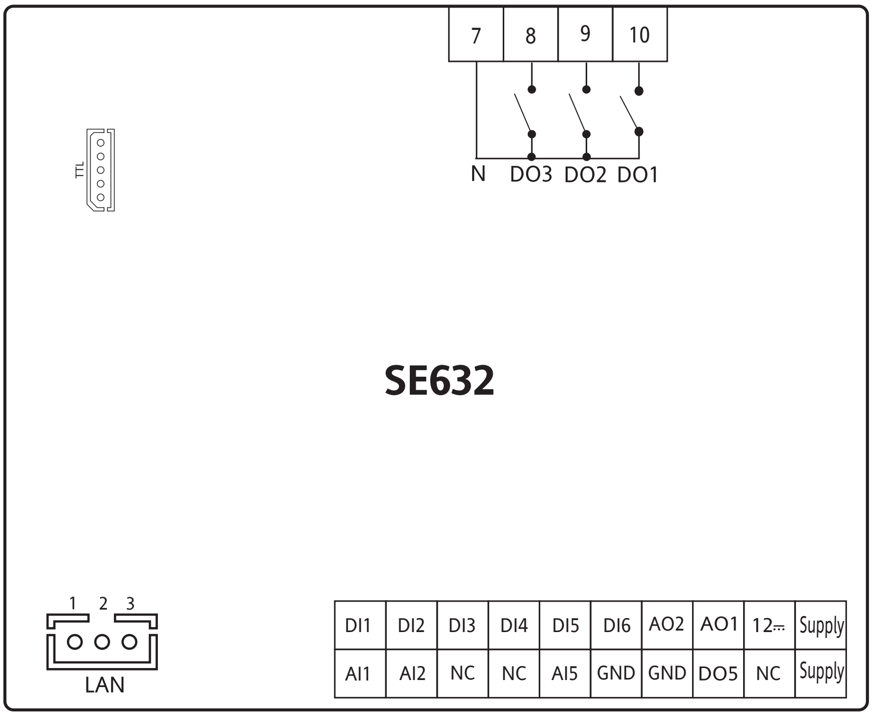


- **4** x 2A 230Vac high voltage *digital outputs* ● [DO1, DO2, DO3, DO4]
- **6** *analogue outputs*:
  - o 1 high voltage [TC1] 2A 230Vac analogue output
  - o 2 PPM/PWM Open Collector *analogue outputs* [AO1, AO2]
  - o 3 low voltage (SELV (§)) *analogue outputs*
    - 2 x 0-10V outputs [AO3-4]
    - 1 output [AO5] 4…20mA/0…20mA
- 6 *digital inputs* [DI1…DI6]
- 5 *analogue inputs* [AI1…AI5]
  - o 3 NTC* / Digital Input*** [AI1, AI2, AI5]
  - o 2 NTC / voltage, current** / Digital Input*** [AI3, AI4]
- 1 low voltage (SELV (§)) PWM Open Collector output [DO5]

*SEMITEC 103AT type (10KΩ / 25°C)
**0…20mA / 4…20mA current or 0…5V / 0…10V / 0…1V voltage input
or no voltage digital input
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

• SUPPLY	12-24V~
• 5 ⎓	5Vdc 20mA max. auxiliary supply
• 12 ⎓	12Vdc auxiliary supply
• N	Neutral
• *LAN*	Terminal (KEYBoard) / SE6xx connection (max 100m)
• *TTL*	*TTL* serial to connect a Multi Function Key
• /C	RTC
• RS-485	**/S** integrated RS-485 serial to connect to supervisor

SE632 model



- **6** *digital inputs* [DI1…DI6]
- **3** x 2A 230Vac high voltage *digital outputs* ● [DO1, DO2, DO3]
- **2** PPM/PWM Open Collector *analogue outputs* [AO1, AO2]

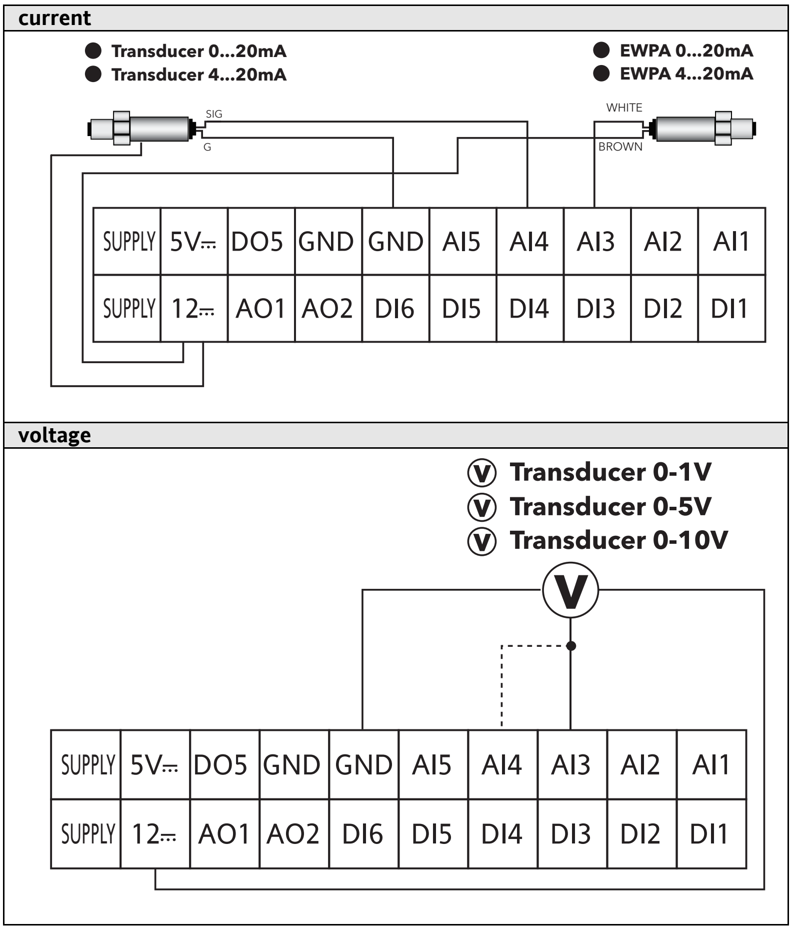
- 3 *analogue inputs* [AI1, AI2, AI5]
- 1 low voltage (SELV (§)) PWM Open Collector output [DO5]

*SEMITEC 103AT type (10KΩ / 25°C)
**0…20mA / 4…20mA current or 0…5V / 0…10V / 0…1V voltage input
or no voltage digital input
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

SUPPLY	12-24V~
5 ⎓	5Vdc 20mA max. auxiliary supply
12 ⎓	12Vdc auxiliary supply
N	Neutral
LAN	Terminal (KEYBoard) / SMP/SMD/SMC6xx connection
TTL	*TTL* serial to connect a Multi Function Key

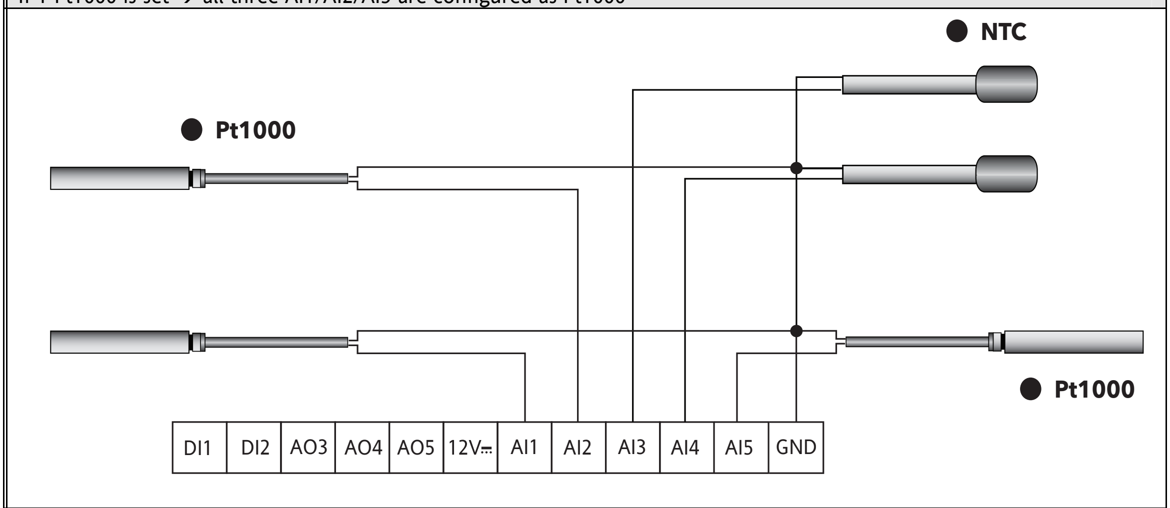
3.2.1 Example of low voltage input/output connection

Example of current/voltage input connection



Example of Pt1000 input connection (4500 only)

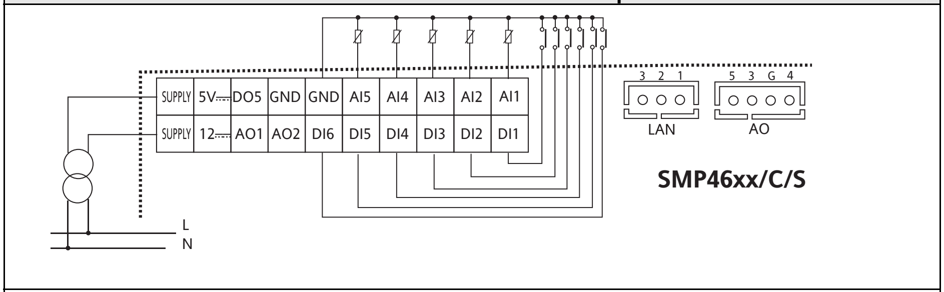
If 1 Pt1000 is set → all three AI1/AI2/AI5 are configured as Pt1000



3.2.2 Example of NTC/DI input connection

SMP - *Example of low voltage input/output connection*

SMD/SMC SE 6xx Identical Example



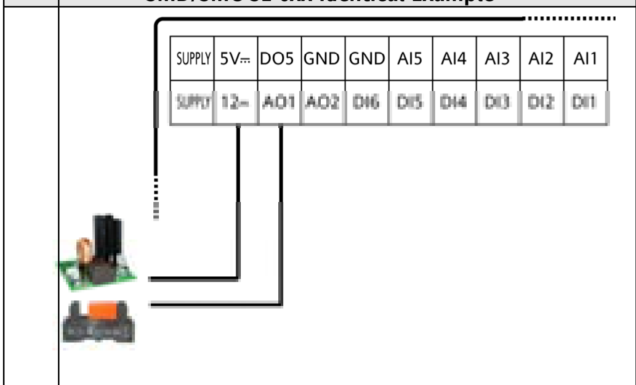
Analogue outputs **AO see System Configuration chapter (*folder* Par/CF) paragraph Configuration of *analogue outputs***

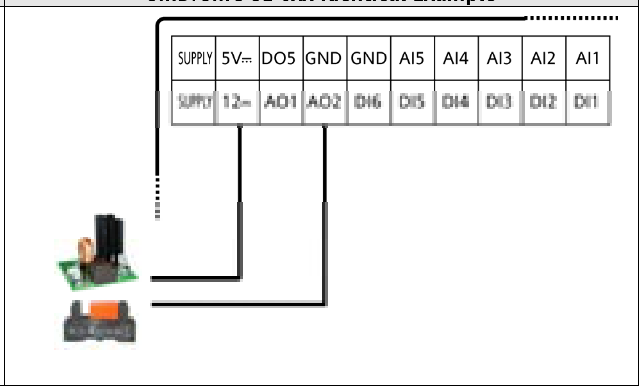
Digital output D05 see Digital Output Configuration

LAN**: see terminal/SE6xx connection**

3.2.2.1 Example of AO1 / AO2 connection

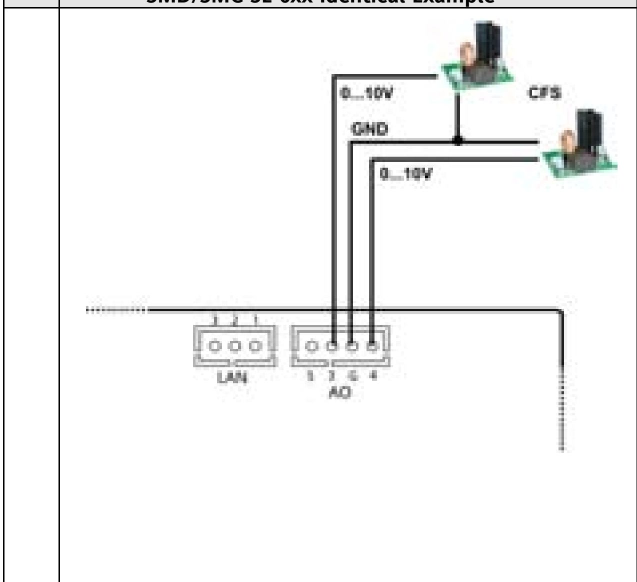
Example of SMP connection (AO1) with 1 CFS OPEN COLLECTOR PPM/PWM or EXP211 fan module	Example of SMP connection (AO2) with 1 CFS OPEN COLLECTOR PPM/PWM or EXP211 fan module
SMD/SMC SE 6xx Identical Example	SMD/SMC SE 6xx Identical Example

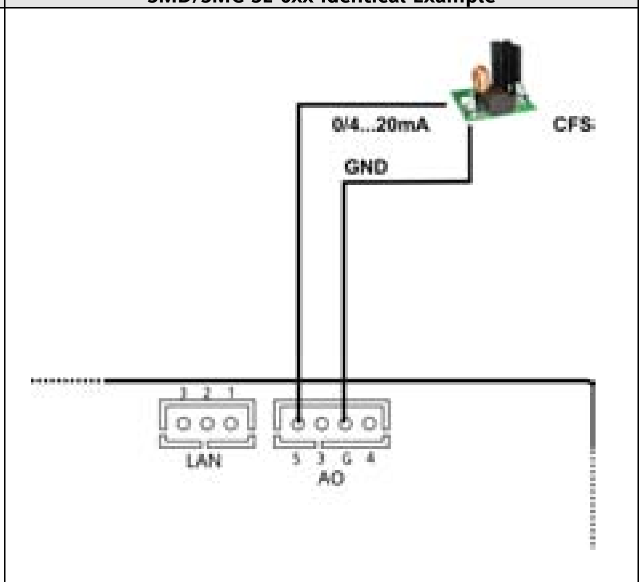




3.2.2.2 Example of AO3 - AO4/A05 connection

Example of SMP connection (AO3-A04)) with 1 CFS 0-10V fan module	Example of SMP (AO5) connection with 1 CFS 0...20mA / 4...20mA fan module
SMD/SMC SE 6xx Identical Example	SMD/SMC SE 6xx Identical Example





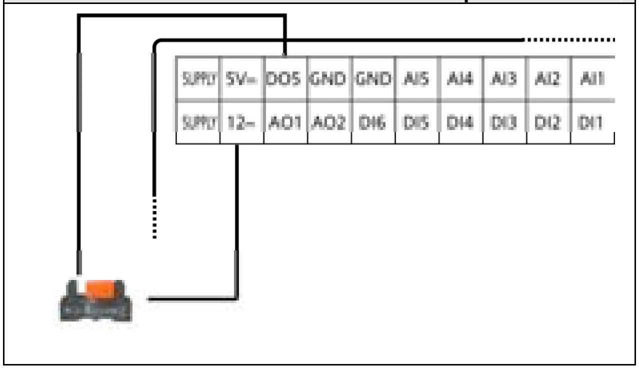
Analogue output	Terminal no	Description
AO3	3	0..10V
AO3	G	GND
AO4	4	0..10V
AO4	G	GND

Analogue output	Terminal no	Description
AO5	5	0...20mA / 4...20mA
AO5	G	GND

3.2.2.3 Example of DO5 connection

Example of SMP connection with *EXP* 211

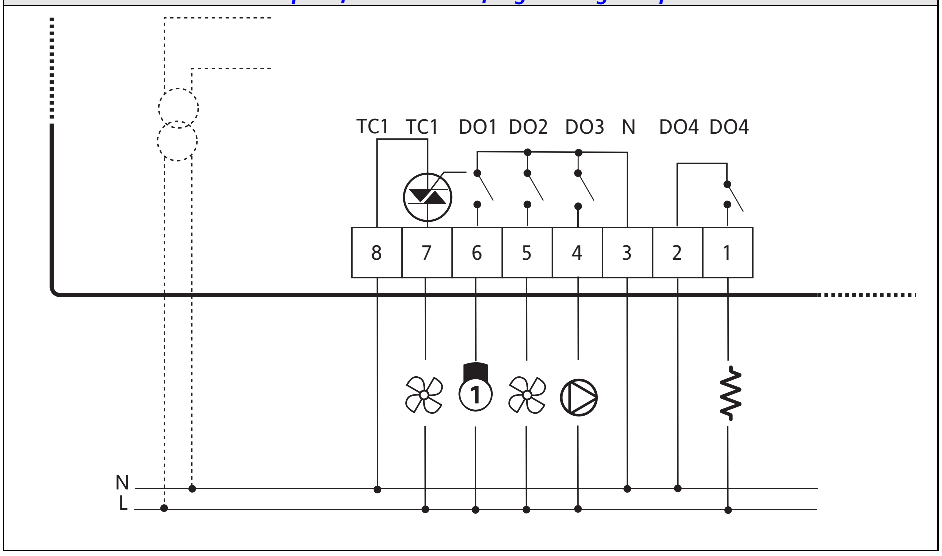
SMD/SMC SE 6xx Identical Example



3.2.3 Example of connection of high voltage outputs

Example of model with *TRIAC*

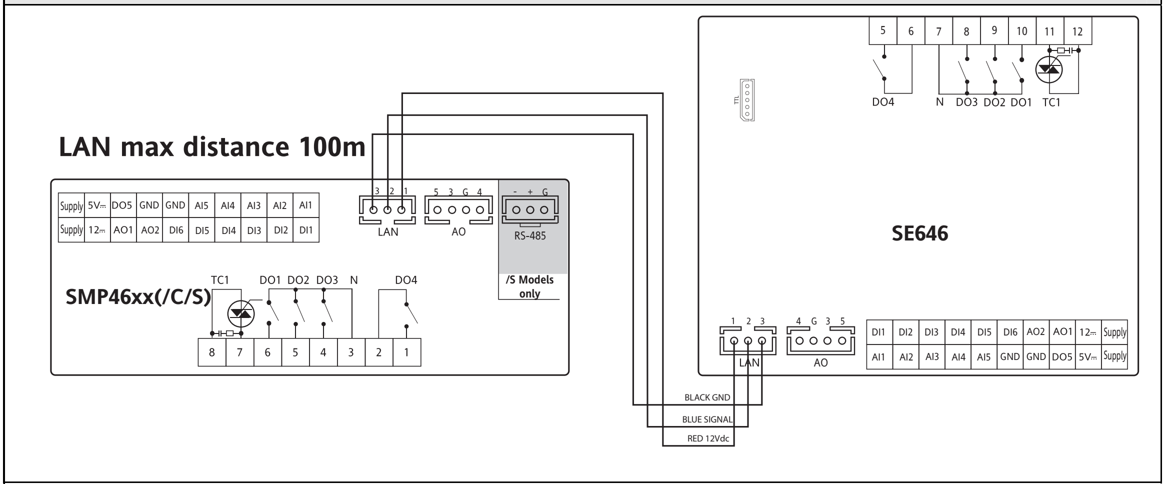
Example of connection of high voltage outputs



3.3 Network connection examples

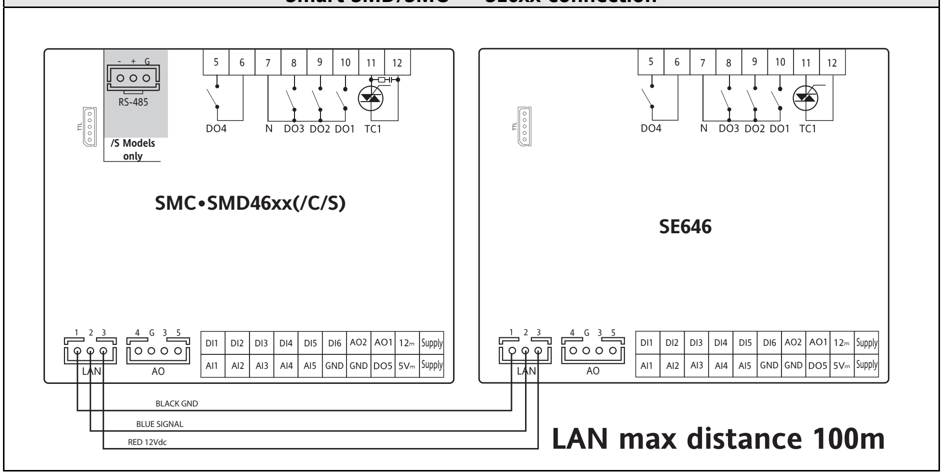
3.3.1 Example of Smart SMP–> SE6xx connection

Smart SMP –> SE6xx connection



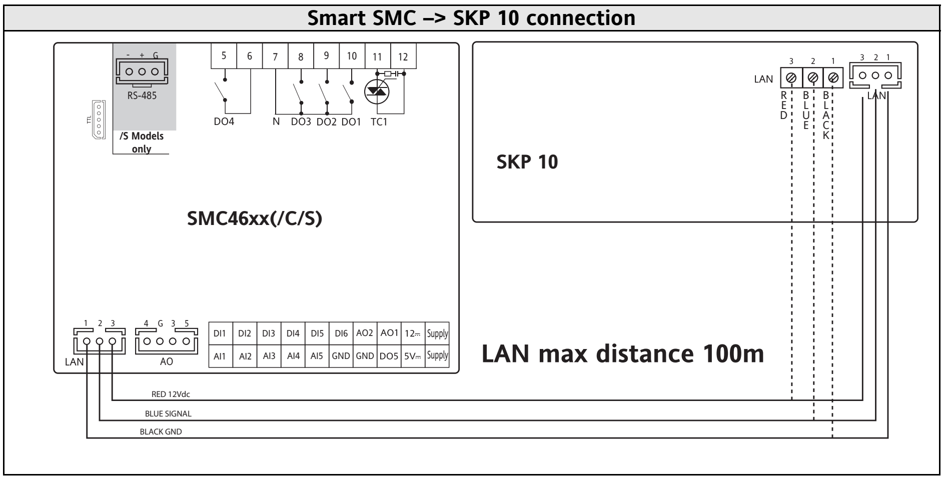
3.3.2 Example of SMD/SMC –> SE6xx connection

Smart SMD/SMC –> SE6xx connection



3.3.3 Example of SMC – SKP 10 connection

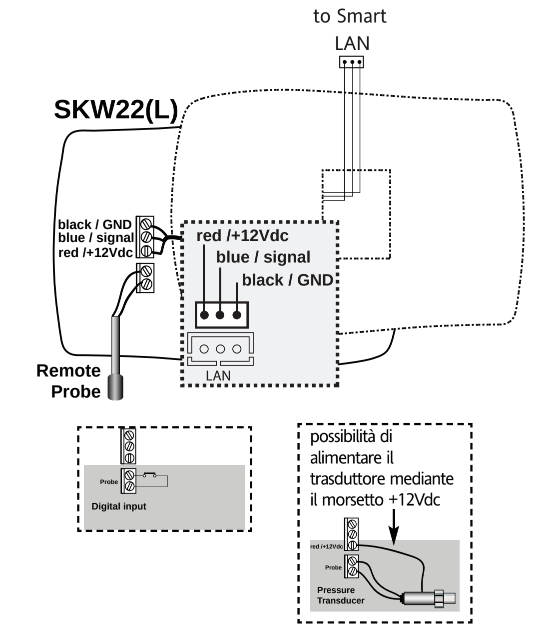
Smart SMC –> SKP 10 connection



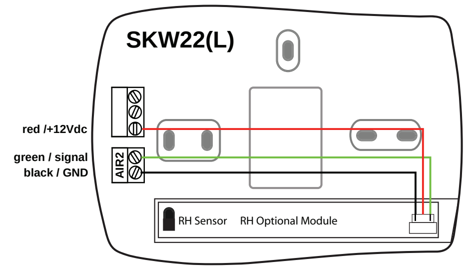
SMC terminal	SKP 10 terminal	Description
1	1 BLACK	GND / black
2	2 BLUE	Signal / blue
3	3 RED	12V~ power supply from base module

3.3.4 SKW22(L), wall-mounted LCD terminal

SKW22(L)	Optional RH module Part number KP100000 can be ordered from the Sales Department NOT included



PROBE NOT INCLUDED
SONDE NON INCLUSE

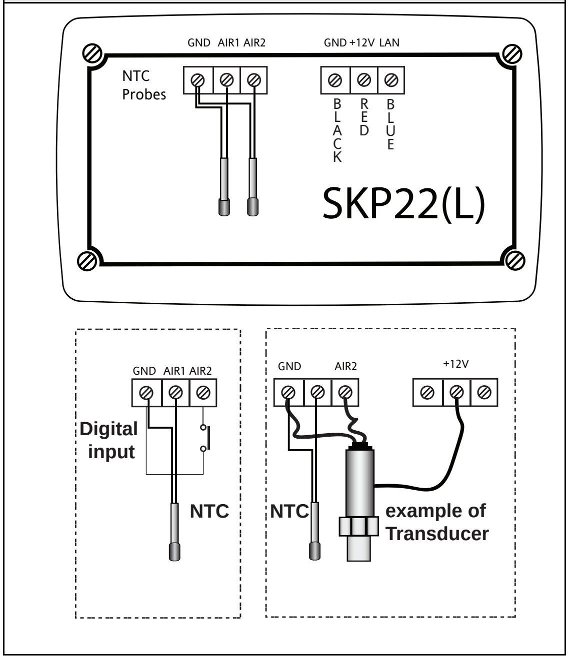


Smart	SKW22(L)	description
AIR1		NTC integrated analogue input
1	GND / black	GND / black
2	Signal / Blue	Signal / blue
3	+12Vdc /red**	12V~ power supply from Smart
AIR2	Remote Probe	Probe AIR2 remote analogue input configurable as NTC*/ 4...20mA / DI

*** SEMITEC 103AT (10Kohm / 25°C) type**
****the transducer can be powered from the +12Vdc terminal**

3.3.5 SKW22(L), panel-mounted LCD terminal

SKP22(L)

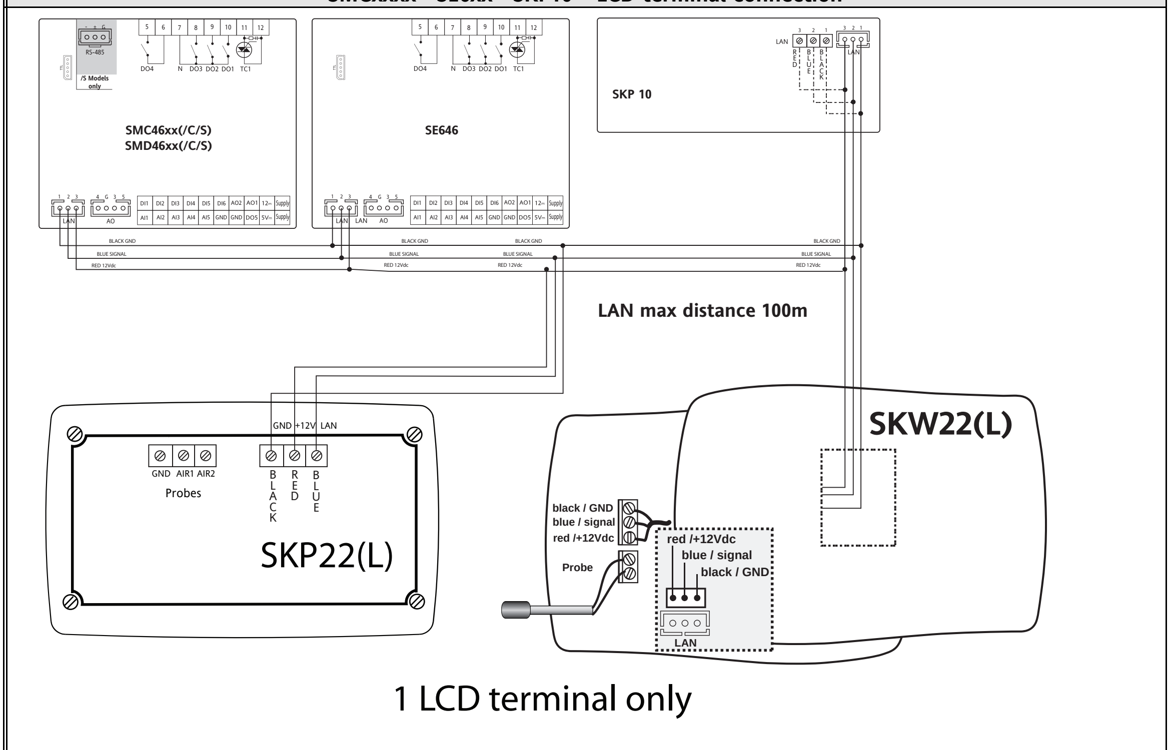


Smart	SKP22(L)	description
AIR1	AIR1	NTC/DI integrated analogue input
AIR2	Remote Probe	Remote analogue input configurable as NTC*/ 4...20mA / DI
	GND	Ground
1	GND / black	GND / black
2	Signal / Blue	Signal / blue
3	+12Vdc /red**	12V~ power supply from Smart

*** SEMITEC 103AT (10Kohm / 25°C) type**
****the transducer can be powered from the +12Vdc**

3.3.6 Example of SMC – SE6xx – SKP 10 – LCD terminal connection

SMCxxxx - SE6xx - SKP10 – LCD terminal connection



4 TECHNICAL DATA

4.1 General specifications

	Standard	Min.	Max.
Supply voltage **45xx** ***Models***	100-240V~		
Supply voltage NOT INSULATED **55xx** ***Models***	12-24V~ /24V⎓		
Supply voltage NOT INSULATED **36xx** ***Models***	12-24V~		
Power supply frequency	50Hz/60Hz	---	---
Power draw **SMD SMC4500**	5W	---	---
Power draw **SMP SMD SMC**	6VA / 4W	---	---
Power draw **SME4500**	4.3 W	---	---
Power draw: **SE6xx**	5VA /3.5W	---	---
Insulation class	2	---	---
Ambient operating temperature	25°C	-20°C	55°C
Ambient operating humidity (non-condensing)	30%	10%	90%
Storage temperature	25°C	-40°C	85°C
Ambient storage humidity (non-condensing)	30%	10%	90%

Classification	
The product complies with the following European Community Directives	Directive 2006/95/EC Directive 89/108/EC
And complies with the following harmonized regulations	EN 60730-2-6 / EN 60730-2-9
Use	operating (not safety) device for incorporation
Mounting	panel or on DIN Omega bar support
Type of action	1.C 1.Y
Pollution class	2
Over voltage category	II
Nominal pulse voltage	2500V
Digital outputs	refer to the *label* on the device
Fire resistance category	D
Software class	A

4.2 I/O features

		Smart				**Expansion modules**			
Type and *Label*	**Description**	**45xx**	**36xx**	**46xx**	**55xx**	**4500**	**632**	**646**	**655**
Digital inputs **DI1 DI2**	2 no-voltage *digital inputs* Closing current for ground: 0.5mA Note. For 4500 *models*, also available as an analogue output **(OC: PWM)**	x	x	x	x	x	x	x	x
Digital inputs **DI3 DI4** **DI5 DI6**	4 no-voltage *digital inputs* Closing current for ground: 0.5mA		x	x	x		x	x	x
High voltage *digital outputs* **DO1 DO2 DO3** **DO4***	3 x 2A 250V~ relays; For 36xx *models*, D04 is available as an Open Collector **(OC)** output.	**DO1** **DO2** **DO3**	***OC**	x	x	**DO1** **DO2** **DO3**	**DO1** **DO2** **DO3**	x	x
DO6	1 x 2A 250V~ relays; **Relay output lifetime at nominal rating: 100,000 cycles**	x			x	x			x
High voltage analogue output **TC1**	1 2A *TRIAC*, max 250V~ Resolution: 1% **Remote control switches downstream from the *TRIAC* are NOT permitted**			x				x	
TC1 + **TC2 (= AO2)**	3A *TRIAC*, max 250V Resolution: 1% **Remote control switches downstream from the *TRIAC* are NOT permitted**		x						

		Smart				Expansion modules			
Type and *Label*	**Description**	**45xx**	**36xx**	**46xx**	**55xx**	**4500**	**632**	**646**	**655**
PWM/PPM OC low voltage (SELV) *analogue outputs* **AO1** **AO2**	**Open Collector PWM/PPM outputs** Accuracy: 2% Nominal *range* 0...16.9V⎓ (12V~ rectified) Closing at 12V⎓ ** Max. current **35mA**** (min. load 340Ohm @12Vcc)	OC: **PWM**	**AO2 = TC2 (*TRIAC*)**	**x**	**x**	OC: **PWM**	**x**	**x**	**x**
Low voltage (SELV) *analogue outputs* **AO3 AO4**	0-10V max **28mA***** @10V outputs (min. **360** Ohm load resistance) 2% full scale accuracy Resolution: 1%	**x**	**x**	**x**	**x**	**x**		**x**	**x**
AO5	1 x 4..20mA / 0...20mA output 2% full scale accuracy Resolution: 1% • 0/4...20mA output, max load (max load resistance **350Ohm**)***	**x**	**x**	**x**	**x**	**x**		**x**	**x**
AO5	1 x 0...10V output on dedicated model 2% full scale accuracy Resolution: 1%	**x**				**x**			
Analogue inputs **AI1 AI2** **AI5**	3 configurable inputs: Pt1000 temperature, measurement *range* -50°C ÷ 400°C; Accuracy: 1% full scale Resolution: 0.1	**x**							
Analogue inputs **AI1 AI2** **AI5**	3 configurable inputs: a) NTC temperature 103AT 10kΩ, measurement *range* -50°C ÷ 99.9°C; b) no voltage digital input Accuracy: 1% full scale Resolution: 0.1	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Analogue inputs **AI3 AI4**	2 configurable inputs: a) NTC temperature 103AT 10kΩ, measurement *range* -50°C ÷ 99.9°C. b) 0...20mA/4...20 mA current input/0-10V/0-5V/0-1V voltage input measurement *range* -50.0 ÷ +99.9; c) no voltage digital input Accuracy: • 0-10V 1% full scale • 0-5V: 1% full scale • 0-1V: 2% full scale • 0...20mA /4...20mA: 1% full scale Resolution: 0.1 Input impedance (b): • 0-10V 21KOhm • 0-5V: 110KOhm • 0-1V: 110KOhm • 0...20mA / 4...20mA: 100Ohm		**x**	**x**	**x**	**x**		**x**	**x**
Open Collector low voltage (SELV) digital output **DO4*, DO5**	2 x **Open Collector** outputs ** Max. current **35mA**** @12VDC		**x**						
DO5	1 x **Open Collector** output ** Max. current **35mA**** @12VDC			**x**	**x**		**x**	**x**	**x**

*On SMD/SMC36xx *models*, DO4 is an open collector, **TC2 equals AO2 (TC2=AO2) - see chapter entitled Physical I/O Configuration (PAr/CL..Cr *folder*)**

** Outputs AO1, AO2 and DO5 (typically connected to the device's auxiliary 12V⎓ output) cannot deliver more than **70mA** in total. Any other loads connected to the same 12V⎓ auxiliary output must also be taken into account.

If the **SKP 10** keypad is connected to the device, the current becomes **55mA**.

***Outputs AO3, AO4 and AO5 cannot deliver more than 40mA total.

4.3 Mechanical specifications

	Description	**All *models* except for 4500**	**4500 *models***
	***Terminals* and connectors**		
High voltage	1 x 8-way high voltage male connector For use in combination with the supplied female connector	✓	-
	1 x 2-way high voltage male connector For use in combination with the supplied female connector	-	✓
	1 x 7-way high voltage male connector For use in combination with the supplied female connector	-	✓
Low voltage	1 x 20-way snap-on low voltage connector To be used with COLV0000E0100	✓	-
	1 x 12-way low voltage male connector For use in combination with the supplied female connector	-	✓
	1 x 4-way connector To be used with COLV000042100	✓	-
terminal	1 x 3-way *LAN* connector and terminal To be used with COLV000033200	✓	✓
RS485 serial /S *models*	1 x 3-way connector To be used with COLV000035100	**/S *models***	-
	1 x 3-way low voltage male connector For use in combination with the supplied female connector	-	**/S *models***
	Container		
	PC+ABS plastic resin with V0 flammability rating	**All *models***	**All *models***

4.4 Serials

Type	***Label***	**Description**	***Models***
Serials	***TTL***	1 *TTL* serial to connect CopyCard (MFK) or Personal Computer via interface module	**All *models***
	RS-485	RS-485 opto-isolated serial	**/S *models***

4.5 Transformer

<u>All *models* except 4500</u>
FREE Smart must be connected to a suitable current *transformer* with the following features:

- Primary voltage: Depending on requirements of the individual device and/or country of installation.
- Secondary voltage: 12V~
- Power supply frequency: 50/60Hz
- Power: 6VA min. (/S *models*), 5VA (all other *models*)

4.6 Mechanical dimensions

	Length (L) mm	**Depth (d) mm**	**Height (H) mm**	**Notes**
SMP front panel SKP 10	76.4	//	35	(+0.2mm)
SMD SMC front panel (cover) SE6xx SME	70	//	45	(+0.2mm)
SMP dimensions	86	76 connectors excluded	26	
SMD SMC dimensions SE6xx SME	70.2	61.6 56.4 from Din bar to cover	87	4DIN
Hole for panel-mounting SMP SKP 10	71	//	29	(+0.2mm /-0.1mm)

4.7 Permitted use

For safety reasons, the device must be installed and used in accordance with the instructions provided. In particular, parts carrying dangerous voltages must not be accessible under normal conditions.
The device must be adequately protected from water and dust with regard to the application, and must only be accessible using tools (with the exception of the front panel).
The device is suitable for use in household refrigeration appliances and/or similar equipment and has been tested for safety aspects in accordance with harmonized European reference standards.

4.8 Improper Use

Any use other than that expressly permitted is prohibited.

The relay contacts supplied are of the functional type and are subject to fault (since they are electronically controlled they are prone to short-circuiting or remaining open). Any protection devices specified in product standards or suggested by common sense for obvious safety requirements must be installed externally to the device.

Eliwell is not liable for damage caused by:
- Unspecified installation/use and, in particular, in contravention of the safety requirements of established legislation or specified in this document;
- Use on equipment which does not provide adequate protection against electrocution, water and dust in the actual installation conditions;
- Use on equipment in which dangerous *components* can be accessed without the use of specific tools;
- Installation/use on equipment which does not comply with established legislation and standards.

4.9 Disclaimer

This document is the exclusive property of **Eliwell Controls srl** and may not be reproduced or circulated unless expressly authorized by **Eliwell Controls srl** itself.
Every care has been taken in preparing this document; however, **Eliwell Controls srl** cannot accept liability for any damage resulting from its use.

5 USER INTERFACE (FOLDER PAR/UI)

The front panel of the device functions as the user interface and is used to perform all operations relating to the device.

	SMP	SMD	SMD4500
			

SKP 10 terminal	
	Note: The SMC module does not have a *display*. To operate the device, use the **SKP 10** or **SKW22(L) – SKP22(L)** terminal. The SExx / SME expansion module does not have a *display*.

5.1 Keys

Refer to *models* SMP/SMD and SKP 10.

Key	Press once (press and release)	Key [depending on the application; press for Ui26 seconds]
▲UP **(UP)**	• Increase a value • Go to next *label*	**F1**
▼DOWN **(DOWN)**	• Decrease a value • Go to previous *label*	**F3**
Esc(ape) **Exit** (Without saving new settings)	• Exit without saving new settings • Go back to previous level	**F2**
Set Confirm (and save new settings)	• Confirm value / exit and save new settings • Move to next level (open *folder*, subfolder, parameter, value) • Open state Menu	**F4**

The following indications refer to the SMP FREE Smart user interface. Navigation for SMD and SKP10 is the same.

5.1.1 Description of keys – combined action

Symbol (function when *keys* are pressed together)	Combined pressing Single press (press and release)	(Associated Function)
F5	**[F1+F3]**	[Lets you switch from the BIOS menu in the main *display* to the main *display* of the PLC menu (if present)] See *FREE Studio* Quick Start for details
Prg	**[F2+F4]**	(Open *programming menu*)

5.2 LEDs and Display

The *display* has 18 icons (*LEDs*) split into 3 categories:

1. States and Operating Modes
2. Values and Units of Measure
3. Utilities

5.2.1 Display

Values of up to 4 figures or 3 figures plus a sign can be displayed.

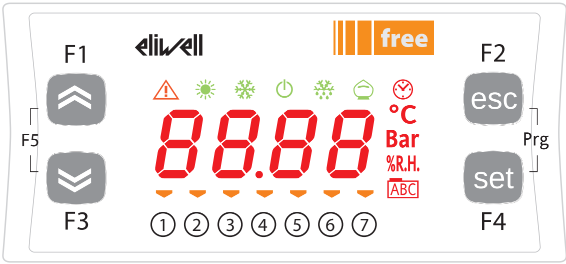
5.2.2 LEDs

LED states and Operating Modes	Icons	Description	Colour
 The *display* shows the value/resource set for the "main *display*". The Alarm icon lights up if there is an alarm.		Alarm	Red
		Heating	Green
		Cooling	
		Standby	
		Defrost	
		Economy	

LED Unit of measure	Icons	Description	Colour
		Clock (RTC)	Red
		Degrees centigrade	
		Pressure (Bar)	
		Relative humidity transducer RH	
		Menu (ABC)	

LED utilities	Icons	Description	Colour
		Utility	Amber

5.3 First switch on



When FREE Smart is powered on for the first time, a lamp test is carried out to check its state and operation.

The Lamp Test lasts for a few seconds. During this short time, all *LEDs* and digits flash at the same time.

5.4 Access to folders - menu structure

Access to folders is organised into menus.
Access is determined by the *keys* on the front panel (see relative sections).
Access to each individual menu is explained below (or in the sections indicated). There are 2 menus:

- *"States" menu* → see "States Menu' section;
- "Programming" Menu → see '*Programming Menu*' section.

There are 3 folders/submenus in the *Programming Menu*:

- Parameters Menu (PAr *folder*) → see Parameters chapter.
- Functions Menu (Fnc *folder*) → see Functions chapter.
- PASS Password

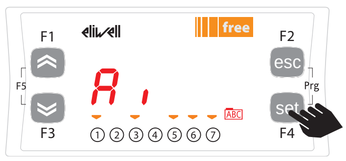
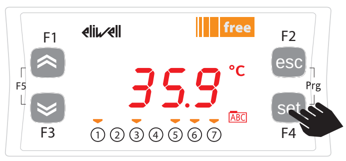
5.4.1 "States" menu

From the states menu you can view values for each resource.
The resources may be present / not present depending on the model (e.g dOL6 is only present on Smart SMP/SMD/SMCxxxx).

Label							**Description**	**Change**
Ai	AIL1	AiL2	AIL3	AIL4	AIL5		LOCAL *analogue inputs*	//
Ai	AIE1	AiE2	AIE3	AIE4	AIE5		EXTENDED *analogue inputs*(§)	//
Ai	Air1	Air2					TERMINAL *analogue inputs*	//
di	diL1	diL2	diL3	diL4	diL5	diL6	LOCAL *digital inputs*	//
di	diE1	diLE2	diE3	diE4	diE5	diE6	EXTENDED(§) *digital inputs*	//
AO	tCL1	AOL1	AOL2	AOL3	AOL4	AOL5	LOCAL *analogue outputs*	//
AO	tCE1	AOE1	AOE2	AOE3	AOE4	AOE5	EXTENDED(§) *analogue outputs*	//
dO	dOL1	dOL2	dOL3	dOL4	dOL5	dOL6	LOCAL *digital outputs*	//
dO	dOE1	dOE2	dOE3	dOE4	dOE5	dOE6	EXTENDED(§) *digital outputs*	//
CL	HOUr	dAtE	YEAr				Clock	YES
AL	Er45	Er46					Alarms	//

(§) Only if SE6xx expansion module is present.
As you will be able to see from the table, the time can be modified and viewed:

5.4.1.1 Display Inputs/Outputs (AiL, diL, tCL1/AOL, dOL)

<table>
<tr><th colspan="3">Inputs/Outputs display</th></tr>
<tr><td>
▶</td><td>
▶</td><td>
■</td></tr>
<tr><td>Example of view for Analogue Inputs. The same procedure applies to all other I/Os***

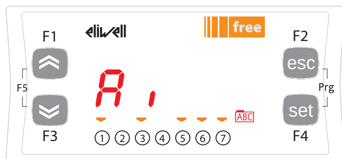
The label Ai will appear on the display.

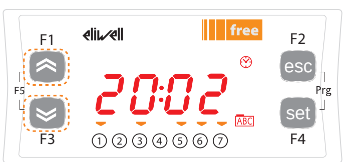
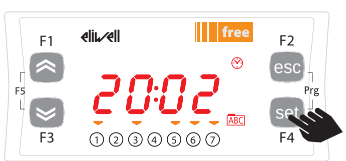
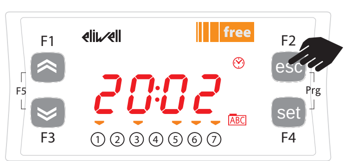
(Use the UP and DOWN keys to scroll the other labels until you find the label required).</td><td>Press the set key to view the label for the first analogue input (AiL1 in this case).</td><td>Press the set key again to view the value of AiL1. Note that the °C icon lights up to indicate that the value shown is in degrees centigrade.

Press the esc key to go back to the main display.</td></tr>
<tr><td colspan="3">***For digital inputs/analogue inputs configured as digital, the value will be:
- 0 = Input not active (for digital inputs this is equivalent to input open, for analogue inputs configured as digital this is equivalent to input shortcircuited to ground).
- 1 = Active input (for digital inputs this is equivalent to input shortcircuited to ground, for analogue inputs configured as digital it is equivalent to input open).</td></tr>
</table>

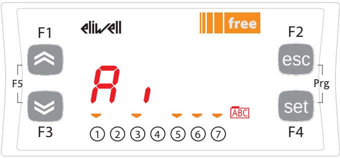
5.4.1.2 Setting the clock (CL)

FREE Smart has a clock (RTC) to run the alarm history just like a programmable chronothermostat.
Instructions are provided below on how to set the time: the same procedure applies to change the date and year.

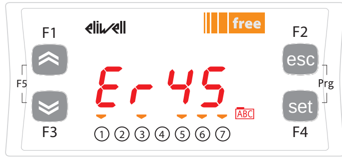
<table>
<tr><th colspan="3">Setting clock</th></tr>
<tr><td>
▶</td><td>
▶</td><td>
▶</td></tr>
<tr><td>To change the clock on your machine, press the set key from the main display.</td><td>Pressing the set key once will open a list of the various folders.
Use the "UP" and "DOWN" keys to find the CL folder.</td><td>Press the set key to open the CL menu.</td></tr>
<tr><td>
▶</td><td>
▶</td><td>
▶</td></tr>
<tr><td colspan="3">On entering this menu, you will see HOUr. Use the "UP" and "DOWN" keys to select the time, date or year.

Once you have decided what you want to set, press the [set]** key to open the modification menu for the variable selected.
**press and hold for about 3 seconds.</td></tr>
<tr><td>
▶</td><td>
▶</td><td>
■</td></tr>
<tr><td>To set the time, date and year, use the "UP" and "DOWN" keys to enter the required value, then</td><td>Press set.</td><td>Press the Esc key to exit the set clock menu and go back to the main display.</td></tr>
</table>

5.4.1.3 Alarm Display (AL)

<table>
<tr><th colspan="3">Alarm display</th></tr>
<tr><td colspan="3">Press the set key from the main display</td></tr>
<tr>
<td>

▶</td>
<td>

▶</td>
<td>

■</td>
</tr>
<tr>
<td>The label Ai will appear on the display. Use the UP and DOWN keys to browse the other labels until you find the AL label.</td>
<td>Press the set key to view the label of the first active alarm (if it exists).</td>
<td>In this case, the first alarm is Er01. Use the UP and DOWN keys to scroll any other alarms.

Note: the menu is not cyclical.
For example, if the active alarms are Er45 and Er46, the display will show:
Er45 ->Er46<Er45

Note: -> UP, <-DOWN

Press the esc key to go back to the main display.</td>
</tr>
</table>

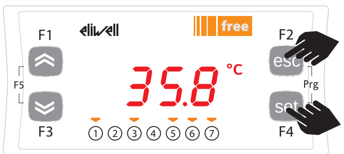
5.4.2 Programming menu

Parameters	Parameter	CL	Cr	CF	Ui	Parameters
Functions	FnC					Functions
Password	PASS					Password

5.4.2.4 Parameters (folder PAr)

Modifying a parameter

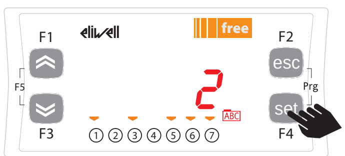
Instructions are provided below on how to change a machine parameter. By way of example, let's look at the CL configuration parameters *folder*, parameter CL01 (*folder* PAr/CL/CL01).

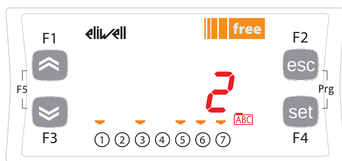
<table>
<tr><th colspan="3">Modifying a parameter -1</th></tr>
<tr>
<td>

▶</td>
<td>

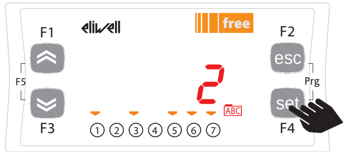
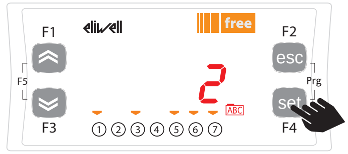
▶</td>
<td>

▶</td>
</tr>
<tr>
<td>Press the esc and set keys together to open the parameters menu. This will open the PAr menu.</td>
<td>The PAr parameters menu contains all device parameter folders. Press the set key to view all folders.</td>
<td>The first folder the controller shows is the CL configuration folder. Simply press the set key again to modify individual CL parameters.</td>
</tr>
<tr>
<td>

▶</td>
<td>

▶</td>
<td>

▼</td>
</tr>
<tr><td colspan="3">--> continued on page next</td></tr>
</table>

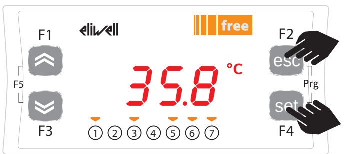
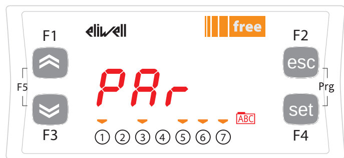
Modifying a parameter -2		
 ▶	 ▶	 ■
The CL00 parameter will be shown on the device (factory *default* settings). Press the "up" key to scroll through the various parameters or move to the next parameter (CL01 in this case) or the "down" key to go back to the previous parameter	Press the set key to view the value of the parameter (CL01 in this case).	For parameter CL01, the value shown will be 2. Press the "up" and "down" *keys* to modify this value. Press the set key once you have entered the required value. ** Press the esc key to exit this *display* and go back to the previous level. **N.B. pressing the set key will confirm the value entered; Pressing the esc key will take you back to the previous level without saving the value entered.

5.4.3 Functions (Par/FnC folder)

See Functions chapter (*folder* FnC)

5.4.4 Entering a password (Par/PASS folder)

To view parameters visible for the given password, open *folder* PASS (press esc and set together [esc+set] from the main *display* and search the *folder* using the up/down *keys*) and set the PASS value.

Setting password		
 ▶	 ▶	 ■
Press the esc and set *keys* together from the main *display* to enter the PASS *folder*. [esc+set]	Pressing the two *keys* will open the menu containing the list of folders. Use the "up" and "down" *keys* to scroll the list until you find the PASS *folder*.	Press the set key to open the PASS *folder*. Enter the password (installation or manufacturer) from here, press the set key and exit. Now open and view parameters to change a value (see parameters chapter).

6 CONFIGURATION PHYSICAL I/O (FOLDER PAR/CL..CR)

6.1 Analogue inputs

Free Smart analogue inputs

The *analogue inputs* referred to below as AiL1…AiL5 are 5 in total.
Using the parameters, a physical resource (probe, digital input, voltage/current signal) can be "physically" configured for each type of input:

- 3 inputs can be configured as *temperature probes*, an NTC type probe, or as *digital inputs*.
- 2 inputs (AiL3 and AiL4) can be configured as *temperature probes*, an NTC type probe, as *digital inputs* or current/voltage input (signal 0-20mA / 4-20mA / 0-10V, 0-5V, 0-1V).

6.1.1 SE6xx SME expansion analogue inputs

SE6xx analogue inputs

The *analogue inputs* referred to below as AiE1…AiE5 are 5 in total.
Using the parameters, a physical resource (probe, digital input, voltage/current signal) can be "physically" configured for each type of input:

- 3 inputs can be configured as *temperature probes*, an NTC type probe, or as *digital inputs*.
- 2 inputs (AiE3 and AiE4) can be configured as *temperature probes*, an NTC type probe, as *digital inputs* or current/voltage input (signal 0-20mA / 4-20mA / 0-10V, 0-5V, 0-1V).

6.1.2 SKW SKP terminal analogue inputs

SKW SKP analogue inputs

The *analogue inputs* referred to below as AIR1…AIR2 are 2 in total.
Using the parameters, a physical resource (probe, digital input, voltage/current signal) can be "physically" configured for each type of input:

- 1 input configurable as NTC type temperature probe.
- 1 input configurable as NTC type temperature probe, digital input or current input (0-20mA/4-20mA signal).

Inputs can be "physically" configured as specified in the table below.

Analogue inputs: table

	Par	Description	0	1*	2	3	4	5	6	7	8
Smart	**CL00**	Type of analogue input AiL1	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	//
	CL01	Type of analogue input AiL2	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	Pt1000 4500 *models* only
	CL02	Type of analogue input AiL3	Probe not configured	Probe configured as no voltage digital input	NTC sensor	4-20 mA	0-10 V	0-5 V	0-1 V	0-20 mA	Pt1000 4500 *models* only
	CL03	Type of analogue input AiL4	Probe not configured	Probe configured as no voltage digital input	NTC sensor	4-20 mA	0-10 V	0-5 V	0-1 V	0-20 mA	//
	CL04	Type of analogue input AiL5	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	Pt1000 4500 *models* only
SE SME	**CE00**	Type of analogue input AiE1	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	//
	CE01	Type of analogue input AiE2	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	//
	CE02	Type of analogue input AiE3	Probe not configured	Probe configured as no voltage digital input	NTC sensor	4-20 mA	0-10 V	0-5 V	0-1 V	0-20 mA	//
	CE03	Type of analogue input AiE4	Probe not configured	Probe configured as no voltage digital input	NTC sensor	4-20 mA	0-10 V	0-5 V	0-1 V	0-20 mA	//
	CE04	Type of analogue input AiE5	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	//
SKW22 SKP22	**Cr00**	Type of analogue input Air1	Probe not configured	//	NTC sensor	//	//	//	//	//	//
	Cr01	Type of analogue input Air2	Probe not configured	Probe configured as no voltage digital input	NTC sensor	4…20mA	//	//	//	0-20 mA	//
Note: // indicates that value is not present ***See Configuration of *Digital Inputs***											

	Analogue input AI	Parameter	*range*	Description
Smart	AiL3	**CL10**	CL11...99.9	Analogue input AiL3 full scale value
	AiL3	**CL11**	-50.0...CL10	Analogue input AiL3 start of scale value
	AiL4	**CL12**	CL13...99.9	Analogue input AiL4 full scale value
	AiL4	**CL13**	-50.0...CL12	Analogue input AiL4 start of scale value
SE SME	AiE3	**CE10**	CE11...99.9	Analogue input AiE3 fullscale value
	AiE3	**CE11**	-50.0...CE10	Analogue input AE3 start of scale value
	AiE4	**CE12**	CE13...99.9	Analogue input AiE4 fullscale value
	AiE4	**CE13**	-50.0...CE12	Analogue input AiE4 start of scale value
SKW22 SKP22	Air2	**Cr10**	CR11...99.9	Analogue input Air2 fullscale value
	Air2	**Cr11**	-50.0...Cr10	Analogue input Air2 start of scale value

The values read by *analogue inputs* can be calibrated using parameters CL20...CL24 / CR20...CR21

	Parameter	Description	Measurement Unit	*Range*
Smart	**CL20**	Analogue input AiL1 differential	°C	-12.0..12.0
	CL21	Analogue input AiL2 differential	°C	-12.0..12.0
	CL22	Analogue input AiL3 differential	°C / Bar	-12.0..12.0
	CL23	Analogue input AiL4 differential	°C / Bar	-12.0..12.0
	CL24	Analogue input AiL5 differential	°C	-12.0..12.0
Expansion SE SME	**CE20**	Analogue input AiE1 differential	°C	-12.0..12.0
	CE21	Analogue input AiE2 differential	°C	-12.0..12.0
	CE22	Analogue input AiE3 differential	°C / Bar	-12.0..12.0
	CE23	Analogue input AiE4 differential	°C / Bar	-12.0..12.0
	CE24	Analogue input AiE5 differential	°C	-12.0..12.0
SKW	**Cr20**	Analogue input Air1 differential	°C	-12.0..12.0
	Cr21	Analogue input Air2 differential	°C / Bar	-12.0..12.0

6.2 Digital Inputs

Digital Inputs

The no voltage *digital inputs* referred to below as DI1...DI6 are 6 in total.

6.3 Digital outputs

Digital outputs

See the chapter on Electric Connections for the number and capacity of relays/open collectors and for information on the symbols used on labels supplied with the device.

- High voltage outputs (relays) are identified as DO1, DO2, DO3, DO4 and DO6.
- The low voltage (SELV), open collector output is called DO5.

6.4 Analogue outputs

Analogue outputs

See the chapter on Electric Connections for the number and type of *analogue outputs* used and for information on the symbols used on labels supplied with the device.
There are 6 *analogue outputs*. 1 high voltage one and 5 low (SELV) voltage ones, the exact number depending on the following *models* and with the following characteristics:

Table A2 – *Analogue Outputs* and *Models*

		High voltage		SELV			Smart *models*			Expansion *models*			
Output	*Label* on *display*	36xx free Smart *models*	46xx free Smart *models*	Open Collector PWM/PPM	0-10V	0...20mA 4...20mA	36xx	46xx	55xx	632	636	646	655
TC1	TCL1	3A 230V	2A 230V				●	●					
TC2	TCL2	3A 230V					●						
AO1	AOL1			●			●	●	●				
AO2	AOL2			●				●	●				
AO3	AOL3				●		●	●	●				
AO4	AOL4				●		●	●	●				
AO5	AOL5					●	●	●	●				
TC1	TCE1	3A 230V	2A 230V							●	●	●	
TC2	TCE2	3A 230V									●		
AO1	AOE1			●						●	●	●	●
AO2	AOE2			●						●		●	●
AO3	AOE3				●						●	●	●
AO4	AOE4				●						●	●	●
AO5	AOE5					●					●	●	●

Triac Analogue Outputs (TC1, TC2)

One *TRIAC* output is a high voltage one and is generally used to pilot fans or water pumps.
The output can be configured for proportional operation (constant speed variation) or as ON/OFF.
Remote control switches downstream from the *Triac* are NOT permitted

The output can be configured as described in table "*Analogue Output TC1 - AO1 AO2*: table".
Configuration of low voltage (SELV) analogue output

AO1	AO2	AO3-AO4	AO5
always available. Configurable as: PWM/PPM (via CFS modules) or On/Off)	always available. Configurable as: PWM/PPM (via CFS modules) or On/Off)	low voltage (SELV) output to pilot external modules (e.g. to control fans).	low voltage (SELV) output to pilot external modules to run fans. It can be used to pilot 4-20mA fans or 0-20mA fans (via parameter CL60/CE60)

To configure, see the table below. All *analogue outputs* can be configured as digital or proportional.
Table B – *Analogue Outputs*

Analogue output TC1 - AO1 AO2

Output	Parameter	Description	Values	Notes
TC1 Only *models* 36x 46x SE636 SE646	**CL73 CE73**	Analogue output TCL1 phase shift Analogue output TCE1 phase shift	0…90	Phase shift values to pilot *Triac* with cut-off in the event of inductive loads.
	CL76 CE76	Analogue output TCL1 pulse time Analogue output TCE1 pulse time	5…40 units (347…2776 µs)	Pulse length to pilot *Triac* (1 unit = 69.4 µs).
TCL1	**CL70**	Enable *TRIAC* TCL1 output	0= 55x *models*	
			1= 46x *models*	See CL73 – CL76
TCE1	**CE70**	Enable *TRIAC* TCE1 output	0= SE655 *models*	
			1= SE636/SE646 *models*	See CE73 – CE76
AO1	**CL71 CE71**	Enable AOL1 analogue output Enable AOE1 analogue output	0= Output configured as digital	If=0 see parameter **CL96 /CE96**
			1= Output configured as *Triac*	(for pulse pilot) If =1 see parameters CL74 – CL77 – CL80 CE74 – CE77 – CE80
	CL74 CE74	Analogue output AOL1 phase shift Analogue output AOE1 phase shift	0…90	Active if **CL71=1** / **CE71=1**
	CL77 CE77	Analogue output AOL1 pulse time Analogue output AOE1 pulse time	5…40 units (347…2776 µs)	Active if **CL71=1** / **CE71=1** (1 unit = 69.4 µs).
AO2 *	**CL72 CE72**	Enable AOL2 analogue output Enable AOE2 analogue output	0= Output configured as digital	If=0 see parameter **CL97 / CE97**
			1= Output configured as *Triac*	(for pulse pilot) If =1 see parameters CL75 – CL78 – CL81 CE75 – CE78 – CE81
	CL75 CE75	Analogue output AOL2 phase shift Analogue output AOE2 phase shift	0…90	Active if **CL72=1** **/CE72=1**
	CL78 CE78	Analogue output AOL2 pulse time Analogue output AOE2 pulse time	5…40 units (347…2776 µs)	Active if **CL72=1** **/CE72=1** (1 unit = 69.4 µs).

* In 36xx Smart – SE636 *models* AO2 is used as *TRIAC* (TC2).

SELV analogue output AO3-4-5

Parameter	Description	Values
CL60 CE60	Type of analogue output AOL5 Type of analogue output AOE5	0=4-20mA Current analogue output 1=0-20mA Current analogue output 2=0-10V on dedicated model

The following can be piloted:

- Loads with output modulation or
- Loads with on/off type switching using
  - the *Triac* as switch (TC1 AO1 AO2).
  - the output as switch 0-10V (AO3-4).
  - the output as switch 0/4…20mA (AO5).

7 PARAMETERS (PAR)

Parameters are used to configure every aspect of free Smart;

They can be modified with:

- The Multi Function key (MFK).
- *Keys* on SMP/SMD front panel or SKP 10/SKW22(L)/SKP22(L) terminal.
- Personal computer and *free Studio* software.

THE DEVICE MUST BE TURNED OFF AND SWITCHED ON AGAIN AFTER BIOS PARAMETERS MODIFICATION

The following sections analyse each parameter, divided into categories (folders), in detail.

Each *folder* is designated with 2 figures (example: CF, UI, etc).

Folder label	**Acronym meaning (*label*)**	**Parameters of:**
CL	**C**onfiguration **L**ocal	Local I/O configuration
CE	**C**onfiguration **E**xpansion	Configuration I/O Expansion
Cr	**C**onfigu**r**ation terminal	Terminal I/O configuration
CF	**C**on**f**iguration	Configuration
UI	**U**ser **i**nterface	User interface

Visibility and value of Parameters
Free Smart is a family of programmable controllers.
There are various hardware *models* (see *Models*) with varying numbers of inputs/outputs.
Depending on the model, some configuration parameters may not be visible and/or of any significance given that the associated resource is not present.

Levels of visibility
Four levels of visibility can be set by assigning suitable values to each parameter and *folder*, by **serial, software** (*free Studio* or other communication softwares) **or by programming key.**
The visibility levels are:

- Value 3 = parameter or *folder* always visible.
- Value 2 = **manufacturer level;** These parameters can only be seen by entering the manufacturer's password (see parameter Ui28) (all parameters specified as always visible, parameters that are visible at the installation level, and manufacturer level parameters will be visible).
- Value 1 = **installation level**; these parameters can only be viewed by entering the installation password (see parameter Ui27) (all parameters specified as always visible and parameters that are visible at the installation level will be visible).
- Value 0 = parameter or *folder* NOT visible.

1. Parameters and/or folders with visibility level <>3 (i.e. password protected) will only be visible if the correct password is entered (installer or manufacturer) following the procedure outlined below:
2. Parameters and/or folders with visibility level =3 are always visible and no password is required; in this case, the procedure below is not required.

Refer also to the following table:

	hardware	**TCL1** **TCE1**	**TCL2** **TCE2**	**DOL6** **DOE6**
Smart Model	**36xx**	**CL73-CL76** **CE73-CE76**	**CL75-CL78 (AOL2)** **CE75-CE78** **(AOE2)**	
	46xx/C **46xx/C/S**	**CL73-CL76** **CE73-CE76**		//
	55xx/C **55xx/C/S**	//	//	//
	4500	//	//	//

When not indicated otherwise, the parameter is always visible and modifiable, unless customised settings have configured via serial.
Note: parameters and *folder* visibility can both be controlled (See *Folder* table).
If *folder* visibility is modified, the new setting will apply to all parameters in the *folder*.

7.1 Parameters / visibility table, folder visibility table and client table

The **tables below** list all information required to read, write and decode all accessible resources in the device.
There are three tables:

- The **parameter table** contains all device configuration parameters stored in the non-volatile memory of the instrument, including visibility information.
- The **folders** table lists the visibility of all parameter folders.
- The *client table* includes all I/O and alarm status resources available in the volatile memory of the instrument.

Description of columns:

FOLDER This indicates the *label* of the *folder* containing the parameter in question.

LABEL **This indicates the *label* used to *display* the parameters in the device menu.**

VAL PAR ADDRESS Indicates the address of the modbus register containing the resource you wish to access.

VIS PAR ADDRESS Same as above. In this case, the parameter visibility value is in the MODBUS register address.
By *default*, all parameters have

- *Data size* WORD
- *Range* 0...3**
- *U.M.* num

**** See** Setting Password (*folder* Par/PASS) paragraph, User Interface chapter.

VIS PAR VALUE Indicates parameter / *folder* visibility

- **0 = Never visible.** Not visible from device
- **1 = Level 1 – see Ui27**
- **2 = Level 2 – see Ui28**
- **3 = Always visible**.

R/W Indicates if resources are read/write, read-only or write-only:

R	Read-only resource
W	Write-only resource
RW	Read / write resource

DATA SIZE Indicates the size of the data in bits. The dimension is always in WORD = 16 bit.

CPL When the field indicates "Y", the value read by the register requires conversion, because the value represents a number with a sign. In the other cases the value is always positive or null.
To carry out conversion, proceed as follows:

- If the value in the register is between 0 and 32.767, the result is the value itself (zero and positive values).
- If the value in the register is between 32.768 and 65.535, the result is the value of the register – 65.536 (negative values).

RANGE Describes the interval of values that can be assigned to the parameter. It can be correlated with other instrument parameters (indicated with the parameter *label*).
NOTE: If the actual value is outside the limits specified for the parameter itself (for example, because other parameters defining the limits in question have been varied), instead of the actual value the value of the limit not respected is displayed.

DEFAULT Indicates the factory setting for the standard model of the instrument. In this table, the hardware model can be presumed to be **SMP/SMD/SMC46xx/C** with 4 relays + *TRIAC* + 2 A01 AO2 Open Collector PWM/PPM *analogue outputs* + 1 low voltage analogue output A03.

EXP If = -1 the value read from the register is divided by 10 (value/10) to convert it to the values given in the *RANGE* and *DEFAULT* column and the unit of measure specified in the ***U.M.*** **column.**,
Example: parameter CL04 = 50.0. Column *EXP* = -1:

- The value read by the device /*free Studio* is 50.0
- The value read from the register is 500 --> 500/10 = 50.0

U.M. Measurement unit for values converted according to the rules indicated in the *CPL* and *EXP* columns.
Measurement unit listed shall be considered as an example – it could depends on the application developed (i.e. parameters with *U.M.* °C/bar could have *U.M.* %RH)

7.1.1 BIOS Parameters / visibility table

(See next page).

FOLDER	LABEL	VAL PAR AdDRESS	DATA SIZE	CPL	EXP	VIS PAR ADDRESS	VIS PAR VALUE	R/W	DESCRIPTION	RANGE	DEFAULT	U.M.
CL	CL00	**53304**	WORD			**53585**	2	RW	**Type of analogue input AiL1** • 0= Probe not configured • 1= DI • 2 = NTC • 3…7 = NOT USED • 8= Pt1000 (4500 *Models* only)	0 … 8	0	num
CL	CL01	**53305**	WORD			**53586**	2	RW	**Type of analogue input AiL2** See CL00	0 … 8	0	num
CL	CL02	**53306**	WORD			**53587**	2	RW	**Type of analogue input AiL3** • 0= Probe not configured • 1= DI • 2 = NTC • 3=4..20mA • 4=0-10V • 5=0-5V • 6=0-1V • 7= 0..20mA	0 … 7	0	num
CL	CL03	**53307**	WORD			**53588**	2	RW	**Type of analogue input AiL4** See CL02	0 … 7	0	num
CL	CL04	**53308**	WORD			**53589**	2	RW	**Type of analogue input AiL5** See CL00	0 … 8	0	num
CL	CL10	**15649**	WORD	Y	-1	**53590**	1	RW	**Analogue input AiL3 full scale value**	CL11 … 999	500	°C/Bar
CL	CL11	**15655**	WORD	Y	-1	**53591**	1	RW	**Analogue input AiL3 start of scale value**	-500 … CL10	0.0	°C/Bar
CL	CL12	**15650**	WORD	Y	-1	**53592**	1	RW	**Analogue input AiL4 full scale value**	CL13 … 999	500	°C/Bar
CL	CL13	**15656**	WORD	Y	-1	**53593**	1	RW	**Analogue input AiL4 start of scale value**	-500 … CL12	0	°C/Bar
CL	CL20	**53334**	WORD	Y	-1	**53594**	1	RW	**Analogue input AiL1 differential**	-120 … 120	0	°C
CL	CL21	**53335**	WORD	Y	-1	**53595**	1	RW	**Analogue input AiL2 differential**	-120 … 120	0	°C
CL	CL22	**53336**	WORD	Y	-1	**53596**	1	RW	**Analogue input AiL3 differential**	-120 … 120	0	°C/Bar
CL	CL23	**53337**	WORD	Y	-1	**53597**	1	RW	**Analogue input AiL4 differential**	-120 … 120	0	°C/Bar
CL	CL24	**53338**	WORD	Y	-1	**53598**	1	RW	**Analogue input AiL5 differential**	-120 … 120	0	°C
CL	CL60	**53344**	WORD			**53599**	2	RW	**Type of analogue output AOL5** • 0 = 4-20mA • 1 = 0-20mA • 2 = 0-10V on dedicated model	0 … 2	0	num
CL	CL70	**53346**	WORD			**53600**	0	RW	**Enable *TRIAC* output TCL1** • 0 = 55xx *models* • 1 = 46xx – *models* see CL73 – CL76	0 … 1	0	num

FOLDER	LABEL	VAL PAR AdDRESS	DATA SIZE	CPL	EXP	VIS PAR ADDRESS	VIS PAR VALUE	R/W	DESCRIPTION	RANGE	DEFAULT	U.M.
CL	CL71	**53347**	WORD			**53601**	2	RW	**Enable analogue output AOL1** • 0 = Output configured as digital • 1 = 46xx – *models* see CL74 – CL77	0 ... 1	0	num
CL	CL72	**53348**	WORD			**53602**	2	RW	**Enable analogue output AOL2** • 0 = Output configured as digital • 1 = output configured as *Triac* – see CL75 – CL78	0 ... 1	0	num
CL	CL73	**53349**	WORD			**53603**	0	RW	**Analogue output TCL1 phase shift**	0 ... 90	27	Deg
CL	CL74	**53350**	WORD			**53604**	2	RW	**Analogue output AOL1 phase shift**	0 ... 90	27	Deg
CL	CL75	**53351**	WORD			**53605**	2	RW	**Analogue output AOL2 phase shift**	0 ... 90	27	Deg
CL	CL76	**53352**	WORD			**53606**	0	RW	**Analogue output TCL1 pulse time**	5 ... 40	10	num (1 unit = 69.4 µsec)
CL	CL77	**53353**	WORD			**53607**	2	RW	**Analogue output AOL1 pulse time**	5 ... 40	10	num (1 unit = 69.4 µsec)
CL	CL78	**53354**	WORD			**53608**	2	RW	**Analogue output AOL2 pulse time**	5 ... 40	10	num (1 unit = 69.4 µsec)
CE	CE00	**53792**	WORD			**53615**	2	RW	**Type of analogue input AIE1** • 0= Probe not configured • 1= DI • 2 = NTC	0 ... 2	0	num
CE	CE01	**53793**	WORD			**53616**	2	RW	**Type of analogue input AIE2** See CE00	0 ... 2	0	num
CE	CE02	**53794**	WORD			**53617**	2	RW	**Type of analogue input AIE3** • 0 = Probe not configured • 1 = DI • 2 = NTC • 3 = 4..20mA • 4 = 0-10V • 5 = 0-5V • 6 = 0-1V • 7 = 0..20mA	0 ... 7	0	num
CE	CE03	**53795**	WORD			**53618**	2	RW	**Type of analogue input AIE4** See CE02	0 ... 7	0	num
CE	CE04	**53796**	WORD			**53619**	2	RW	**Type of analogue input AIE5** See CE00	0 ... 2	0	num
CE	CE10	**15893**	WORD	Y	-1	**53620**	1	RW	**Analogue input AIE3 fullscale value**	CE11 ... 999	500	°C/Bar
CE	CE11	**15899**	WORD	Y	-1	**53621**	1	RW	**Analogue input AIE3 start of scale value**	-500 ... CE10	0	°C/Bar

FOLDER	LABEL	VAL PAR AdDRESS	DATA SIZE	CPL	EXP	VIS PAR ADDRESS	VIS PAR VALUE	R/W	DESCRIPTION	RANGE	DEFAULT	U.M.
CE	CE12	**15894**	WORD	Y	-1	**53622**	1	RW	**Analogue input AIE4 fullscale value**	CE13 ... 999	500	°C/Bar
CE	CE13	**15900**	WORD	Y	-1	**53623**	1	RW	**Analogue input AIE4 start of scale value**	-500 ... CE12	0	°C/Bar
CE	CE20	**53822**	WORD	Y	-1	**53624**	1	RW	**Analogue input AIE1 differential**	-120 ... 120	0	°C
CE	CE21	**53823**	WORD	Y	-1	**53625**	1	RW	**Analogue input AIE2 differential**	-120 ... 120	0	°C
CE	CE22	**53824**	WORD	Y	-1	**53626**	1	RW	**Analogue input AIE3 differential**	-120 ... 120	0	°C/Bar
CE	CE23	**53825**	WORD	Y	-1	**53627**	1	RW	**Analogue input AIE4 differential**	-120 ... 120	0	°C/Bar
CE	CE24	**53826**	WORD	Y	-1	**53628**	1	RW	**Analogue input AIE5 differential**	-120 ... 120	0	°C
CE	CE60	**53832**	WORD			**53629**	2	RW	**Type of analogue output AOE5** • 0 = 4-20mA • 1 = 0-20mA	0 ... 1	0	num
CE	CE70	**53834**	WORD			**53630**	0	RW	**Enable analogue output TCE1** • 0 = SE655xx *models* • 1 = SE646xx – *models* see CE73 – CE76	0 ... 1	1	num
CE	CE71	**53835**	WORD			**53631**	2	RW	**Enable analogue output AOE1** • 0 = Output configured as digital – see CE96 • 1 = output configured as *Triac* – see CE74 – CE77	0 ... 1	0	num
CE	CE72	**53836**	WORD			**53632**	2	RW	**Enable analogue output AOE2** • 0 = Output configured as digital – see CE97 • 1 = output configured as *Triac* – see CE75 – CE78	0 ... 1	0	num
CE	CE73	**53837**	WORD			**53633**	0	RW	**Analogue output TCE1 phase shift**	0 ... 90	27	Deg
CE	CE74	**53838**	WORD			**53634**	2	RW	**Analogue output AOE1 phase shift**	0 ... 90	27	Deg
CE	CE75	**53839**	WORD			**53635**	2	RW	**Analogue output AOE2 phase shift**	0 ... 90	27	Deg
CE	CE76	**53840**	WORD			**53636**	0	RW	**Analogue output TCE1 pulse time**	5 ... 40	10	69 µsec
CE	CE77	**53841**	WORD			**53637**	2	RW	**Analogue output AOE1 pulse time**	5 ... 40	10	69 µsec
CE	CE78	**53842**	WORD			**53638**	2	RW	**Analogue output AOE2 pulse time**	5 ... 40	10	69 µsec
Cr	Cr00	**53760**	WORD			**53609**	2	RW	**Type of local analogue input Air1** • 0= Probe not configured • 1 = Not used • 2 = NTC	0 ... 2	0	num
Cr	Cr01	**53761**	WORD			**53610**	2	RW	**Type of local analogue input AIR2** • 0= Probe not configured • 1= DI • 2 = NTC • 3 = 4..20mA • 4...6 = Not used • 7 = 0..20mA	0 ... 7	0	num

FOLDER	LABEL	VAL PAR AdDRESS	DATA SIZE	CPL	EXP	VIS PAR ADDRESS	VIS PAR VALUE	R/W	DESCRIPTION	RANGE	DEFAULT	U.M.
Cr	Cr10	**15874**	WORD	Y	-1	**53611**	1	RW	**Local analogue input AIR2 fullscale value**	Cr11 ... 999	0	num
Cr	Cr11	**15876**	WORD	Y	-1	**53612**	1	RW	**Local analogue input AIR2 start of scale value**	-999 ... Cr10	0	num
Cr	Cr20	**53770**	WORD	Y	-1	**53613**	1	RW	**Local analogue input AIR1 differential**	-12.0 ... 12.0	0.0	°C
Cr	Cr21	**53771**	WORD	Y	-1	**53614**	1	RW	**Local analogue input AIR2 differential**	-12.0 ... 12.0	0.0	°C/Bar
CF	CF01	**53265**	WORD			**53639**	2	RW	**Select COM1 protocol** Select COM1 (*TTL*) communication channel protocol: 0 = Eliwell; 1 = Modbus Note: • If CF01=0 parameters CF20/CF21 should be configured. • If CF01=1 parameters CF30/CF31/CF32 should be configured.	0 ... 1	1	num
CF	CF20	**53272**	WORD			**53640**	1	RW	**Eliwell protocol controller address** CF20= device index in family (values from 0 to 14) CF21 = device family (values valid from 0 to 14) The pair of values CF20 and CF21 represent the device's network address and is indicated as "FF.DD" (where FF=CF21 and DD=CF20).	0 ... 14	0	num
CF	CF21	**53273**	WORD			**53641**	1	RW	**Eliwell protocol controller family** See CF21	0 ... 14	0	num
CF	CF30	**53274**	WORD			**53642**	3	RW	**Modbus protocol controller address** Note: 0 (zero) is not included.	1 ... 255	1	num
CF	CF31	**53275**	WORD			**53643**	3	RW	**Modbus protocol Baudrate** • 0=not used • 1= not used • 2=not used • 3=9600 baud • 4=19200 baud • 5=38400 baud • 6=57600 baud • 7=115200 baud	0 ... 7	3	num
CF	CF32	**53276**	WORD			**53644**	3	RW	**Modbus protocol parity** • 1= EVEN • 2= NONE • 3= ODD	1 ... 3	1	num
CF	CF43	//	//	//	//	//	//	//	Firmware screen (Mask)	0 ... 999	412	num
CF	CF44	//	//	//	//	//	//	//	firmware release	0 ... 999	//	num
CF	CF50	**53456**	WORD			**53645**	0	RW	**RTC present** 0= RTC not present; 1 = RTC present	0 ... 1	0	num
CF	CF60	**15639**	WORD			**53646**	3	RW	**Client code 1** Parameter for exclusive use of the customer/user. The client	0 ... 999	0	num

FOLDER	LABEL	VAL PAR AdDRESS	DATA SIZE	CPL	EXP	VIS PAR ADDRESS	VIS PAR VALUE	R/W	DESCRIPTION	RANGE	DEFAULT	U.M.
									can assign these parameters values that e.g. identify the type and/or model of the system, and its configuration etc.			
CF	CF61	**15640**	WORD			**53647**	3	RW	**Client code 2** See CF60	0 ... 999	0	num
UI	UI26	**15715**	WORD			**53648**	2	RW	**Key hold time to enable function**	0 ... 999	350	4ms
UI	UI27	**15744**	WORD			**53649**	1	RW	**Installation password** When enabled (value other than zero), constitutes the password for access to parameters.	0 ... 255	1	num
UI	UI28	**15745**	WORD			**53650**	2	RW	**Manufacturer password** When enabled (value other than zero), constitutes the password for access to parameters.	0 ... 255	2	num

7.1.2 Folder visibility table

LABEL	ADDRESS	R/W	DESCRIPTION	DATA SIZE	RANGE	VIS. PAR VALUE	U.M.
_VisCarStati_Ai	**53520**	RW	Ai *folder* visibility	WORD	0 ... 3	3	num
_VisCarStati_di	**53521**	RW	Visibility of *folder*	WORD	0 ... 3	3	num
_VisCarStati_AO	**53522**	RW	AO *folder* visibility	WORD	0 ... 3	3	num
_VisCarStati_dO	**53523**	RW	dO *folder* visibility	WORD	0 ... 3	3	num
_VisCarProgPar	**53525**	RW	PAr *folder* visibility	WORD	0 ... 3	3	num
_VisCarFnC	**53526**	RW	FnC *folder* visibility	WORD	0 ... 3	3	num
_VisCarProgPASS	**53527**	RW	PASS *folder* visibility	WORD	0 ... 3	3	num
_VisCarPrCL	**53578**	RW	Par\CL *folder* visibility	WORD	0 ... 3	1	num
_VisCarPrCr	**53579**	RW	Par\Cr *folder* visibility	WORD	0 ... 3	1	num
_VisCarPrCE	**53580**	RW	Par\CE *folder* visibility	WORD	0 ... 3	1	num
_VisCarPrCF	**53581**	RW	Par\CF *folder* visibility	WORD	0 ... 3	3	num
_VisCarPrUi	**53582**	RW	Par\Ui *folder* visibility	WORD	0 ... 3	1	num
_VisCarCC	**53584**	RW	FnC\CC *folder* visibility	WORD	0 ... 3	3	num
_VisCarCC\UL	**53651**	RW	FnC\CC\UL *folder* visibility	WORD	0 ... 3	3	num
_VisCarCC\dL	**53652**	RW	FnC\CC\dL *folder* visibility	WORD	0 ... 3	3	num
_VisCarCC\Fr	**53653**	RW	FnC\CC\Fr *folder* visibility	WORD	0 ... 3	3	num

7.1.3 Client Table

CONTENTS	FOLDER	LABEL	ADDRESS	R/W	DESCRIPTION	DATA SIZE	CPL	RANGE	DEFAULT	EXP	U.M.
1	AI	LocalAInput[0]	8336	R	Analogue input AIL1	WORD	Y	-500 ... 999	0	-1	°C
2	AI	LocalAInput[1]	8337	R	Analogue input AIL2	WORD	Y	-500 ... 999	0	-1	°C
3	AI	LocalAInput[2]	8338	R	Analogue input AIL3	WORD	Y	-500 ... 999	0	-1	°C/Bar
4	AI	LocalAInput[3]	8339	R	Analogue input AIL4	WORD	Y	-500 ... 999	0	-1	°C/Bar
5	AI	LocalAInput[4]	8340	R	Analogue input AIL5	WORD	Y	-500 ... 999	0	-1	°C
6	DI	LocalDigInput DIL1	8192	R	Digital input DIL1 status	WORD		0 ... 1	0		num
7	DI	LocalDigInput DIL2	8193	R	Digital input DIL2 status	WORD		0 ... 1	0		num
8	DI	LocalDigInput DIL3	8194	R	Digital input DIL3 status	WORD		0 ... 1	0		num
9	DI	LocalDigInput DIL4	8195	R	Digital input DIL4 status	WORD		0 ... 1	0		num
10	DI	LocalDigInput DIL5	8196	R	Digital input DIL5 status	WORD		0 ... 1	0		num
11	DI	LocalDigInput DIL6	8197	R	Digital input DIL6 status	WORD		0 ... 1	0		num
13	DO	LocalDigOutput DOL1	8528	R	Digital output DOL1	WORD		0 ... 1	0		num
14	DO	LocalDigOutput DOL2	8529	R	Digital output DOL2	WORD		0 ... 1	0		num
15	DO	LocalDigOutput DOL3	8530	R	Digital output DOL3	WORD		0 ... 1	0		num
16	DO	LocalDigOutput DOL4	8531	R	Digital output DOL4	WORD		0 ... 1	0		num
17	DO	LocalDigOutput DOL5	8532	R	Digital output DOL5	WORD		0 ... 1	0		num
18	DO	LocalDigOutput DOL6	8533	R	Digital output DOL6	WORD		0 ... 1	0		num
19	AO	LocalDigOutput AOL1	8449	R	Digital output AOL1	WORD		0 ... 1	0		num
20	AO	LocalDigOutput AOL2	8450	R	Digital output AOL2	WORD		0 ... 1	0		num
21	AO	Analog.Out TC1	8448	R	Analogue output TCL1	WORD	Y	0 ... 100	0		num
22	AO	Analog.Out AOL1	8449	R	Analogue output AOL1	WORD	Y	0 ... 100	0		num
23	AO	Analog.Out AOL2	8450	R	Analogue output AOL2	WORD	Y	0 ... 100	0		num
24	AO	Analog.Out ALO3	8451	R	Analogue output AOL3	WORD	Y	0 ... 999	0	-1	num
25	AO	Analog.Out AOL4	8452	R	Analogue output AOL4	WORD	Y	0 ... 999	0	-1	num
26	AO	Analog.Out AOL5	8453	R	Analogue output AOL5	WORD	Y	0 ... 999	0	-1	num
27	AI	ExtAInput[0]	8352	R	Analogue input AIE1	WORD	Y	-500 ... 999	0	-1	°C
28	AI	ExtAInput[1]	8353	R	Analogue input AIE2	WORD	Y	-500 ... 999	0	-1	°C

CONTENTS	*FOLDER*	*LABEL*	ADDRESS	*R/W*	DESCRIPTION	*DATA SIZE*	*CPL*	*RANGE*	*DEFAULT*	*EXP*	*U.M.*
29	AI	ExtAInput[2]	8354	R	Analogue input AIE3	WORD	Y	-500 ... 999	0	-1	°C/Bar
30	AI	ExtAInput[3]	8355	R	Analogue input AIE4	WORD	Y	-500 ... 999	0	-1	°C/Bar
31	AI	ExtAInput[4]	8356	R	Analogue input AIE5	WORD	Y	-500 ... 999	0	-1	°C
32	DI	ExtDigInput DIL1	8224	R	Digital input DIE1 status	WORD		0 ... 1	0		num
33	DI	ExtDigInput DIL2	8225	R	Digital input DIE2 status	WORD		0 ... 1	0		num
34	DI	ExtDigInput DIL3	8226	R	Digital input DIE3 status	WORD		0 ... 1	0		num
35	DI	ExtDigInput DIL4	8227	R	Digital input DIE4 status	WORD		0 ... 1	0		num
36	DI	ExtDigInput DIL5	8228	R	Digital input DIE5 status	WORD		0 ... 1	0		num
37	DI	ExtDigInput DIL6	8229	R	Digital input DIE6 status	WORD		0 ... 1	0		num
39	DO	ExtDigOutput DOL1	8544	R	Digital output DOE1	WORD		0 ... 1	0		num
40	DO	ExtDigOutput DOL2	8545	R	Digital output DOE2	WORD		0 ... 1	0		num
41	DO	ExtDigOutput DOL3	8546	R	Digital output DOE3	WORD		0 ... 1	0		num
42	DO	ExtDigOutput DOL4	8547	R	Digital output DOE4	WORD		0 ... 1	0		num
43	DO	ExtDigOutput DOL5	8548	R	Digital output DOE5	WORD		0 ... 1	0		num
44	DO	ExtDigOutput DOL6	8549	R	Digital output DOE6	WORD		0 ... 1	0		num
45	AO	ExtDigOutput AOE1	8465	R	Digital output AOE1	WORD		0 ... 1	0		num
46	AO	ExtDigOutput AOE2	8466	R	Digital output AOE2	WORD		0 ... 1	0		num
47	AO	Analog.Out TCE1	8464	R	Analogue output TCE1	WORD	Y	0 ... 100	0		num
48	AO	Analog.Out AOE1	8465	R	Analogue output AOE1	WORD	Y	0 ... 100	0		num
49	AO	Analog.Out AOE2	8466	R	Analogue output AOE2	WORD	Y	0 ... 100	0		num
50	AO	Analog.Out AOE3	8467	R	Analogue output AOE3	WORD	Y	0 ... 999	0	-1	num
51	AO	Analog.Out AOE4	8468	R	Analogue output AOE4	WORD	Y	0 ... 999	0	-1	num
52	AO	Analog.Out AOE5	8469	R	Analogue output AOE5	WORD	Y	0 ... 999	0	-1	num
53	AI	RemAInput[0]	8432	R	Analogue input AIr1	WORD	Y	-500 ... 999	0	-1	°C
54	AI	RemAInput[1]	8433	R	Analogue input AIr2	WORD	Y	-500 ... 999	0	-1	°C/Bar
55	alarm	Er45	NA	R	Clock faulty alarm	WORD		0 ... 1	0		flag
56	alarm	Er46	NA	R	Time loss alarm	WORD		0 ... 1	0		flag

Note: NA not accessible

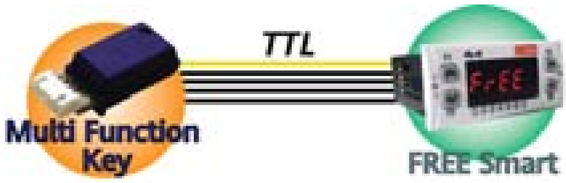
8 FUNCTIONS (FOLDER FNC)

For a full description of MFK functioning, please refer to the relevant **Application Notes MFK cod.9IS24233 EN-IT**

The Multi Function Key (abbreviation MFK) is an accessory that can be connected to the FREE Smart (target) serial port to make a quick programming of :

- Target's parameters (upload and download of a parameter map to/from one or more target/s of the same type)
- Target's BIOS
- *FREE Studio*'s IEC applications

Connection of MFK
To connect MFK to FREE the **YELLOW** cable is used.



MFK➔FREE Smart	MFK🡐FREE Smart
Parameters	Parameters
BIOS	-
IEC	-

To connect MFK to DMI the **BLU** cable is used.

DMI+PC ➔MFK	DMI+PC🡐MFK
BIOS	-
IEC	-

9 FREE STUDIO

9.1 General description

The *FREE Studio* development tool makes it possible to quickly and accurately create and customize new programs for all types of application. It is especially recommended for applications in the HVAC/R sector.
The use of several different programming languages, in accordance with IEC61131-3 (industrial control programming standard) means new algorithms or entire programs can be developed independently, downloadable in free smart modules via PC or multi-function key with the utmost confidentiality, thanks to the appropriate security safeguards.

9.2 Components

All basic *components* and *accessories* are described below.

9.2.1 FREE Studio software component

The *Free Studio* software application has a graphic interface and its functions will be illustrated in this manual. *FREE Studio* consists of two applications

- *FREE Studio* Application, the software developer part, to create and manage libraries, applications and diagnostics.
- *FREE Studio* Device, the dedicated user part, to manage previously developed applications, upload/download applications, and modify device parameters from a serial port.

9.2.2 DM Interface (DMI) component

USB/*TTL* DMI 100-3 MANUFACTURER hardware interface, to be used in association with the software package, allows:

- The use of the software itself.
- Connection to device/s for controlling it/them.
- Connection to *Multi Function Key component*.

PLEASE NOTE: supply FREE Smart ONLY through DMI when downloading BIOS parameters and application in the FREE Smart device

9.2.3 Multi Function Key Component

This is a memory support, which allows you to:

- Update the device's parameter values.
- Updating the device's firmware.
- Download the parameter values from the device.

9.2.4 Connection cables

- Yellow cable, see 9IS42020 DMI – *FREE Studio* instructions for advice on use.
- Blue cable, see 9IS42020 DMI – *FREE Studio* instructions for advice on use.
- USB-A/A 2m extension lead.

10 MONITORING

The *TTL* serial - referred to also as COM1 – can be used to configure the device, parameters, states, and variables using the Modbus protocol.

Study the following tables:

Parameter.	Description	value	
		0	**1**
CF01	**Select COM1 (*TTL*) protocol**	Eliwell	Modbus

If CF01=0, the following parameters should be configured:

Parameter.	Description	*Range*
CF20	**Eliwell protocol controller address**	**0...14**
CF21	**Eliwell protocol controller family**	

Parameter.	Description	*Range*
CF30	**Modbus protocol controller address**	**1...255**
Parameter.	**Description**	**Values**
CF31	**Modbus protocol Baudrate**	• 0= not used • 1= not used • 2= not used • 3=9600 baud • 4=19200 baud • 5=38400 baud • 6=57600 baud • 7=115200 baud

10.1 Configuration with Modbus RTU

Modbus is a client/server protocol for communication between network-connected devices.
Modbus devices communicate using a master-slave technique in which a single device (the master) can send messages. All other devices in the network (slaves) respond by returning the data required to the master or executing the action indicated in the message received. A slave is defined as a device connected to a network that processes information and sends the results to a master using the Modbus protocol.
The master can send messages to individual slaves or to the entire network (broadcast) whilst slaves can only reply to messages received individually from the master.
The Modbus standard used by Eliwell uses RTU coding for data transmission.

10.1.1 Data format (RTU)

The data coding model used defines the structure of messages sent to the network and the way in which the information is decoded. The type of coding selected is generally based on specific parameters (baud rate, parity, etc)*** and some devices only support specific code *models*. However, the same model must be used for all devices connected to a Modbus network.
The protocol used the RTU binary method with the following bytes:
8 bits for data, even parity bit (not configurable), 1 stop bit.

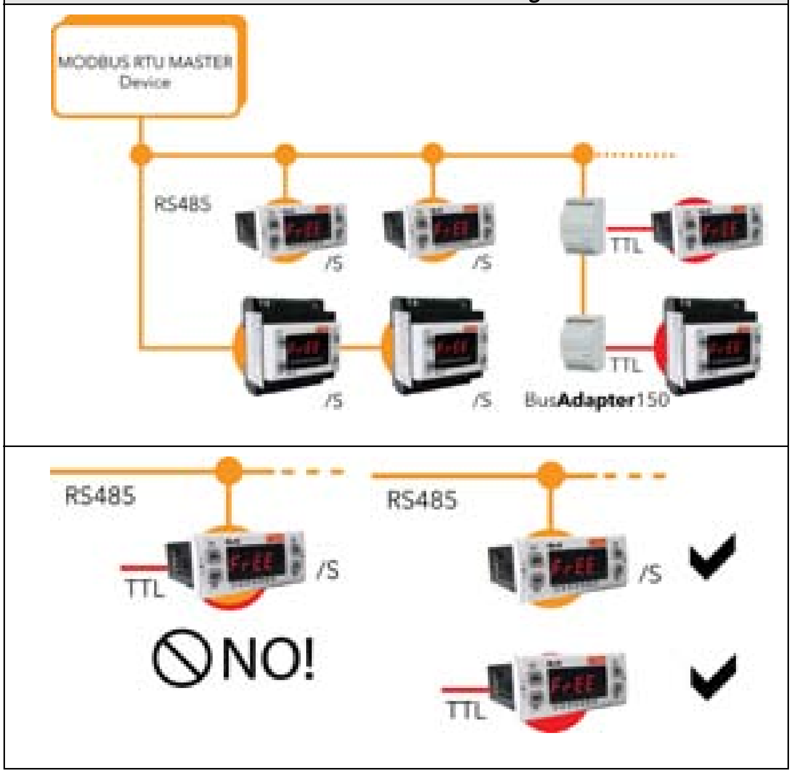
***configured with parameters **CF30, CF31 – see table at start of paragraph.**

The device is fully configurable via parameter settings.
They can be modified with:

- The instrument's keypad.
- Multi Function key.
- By sending data via the Modbus protocol straight to individual instruments, or via broadcast, using the address 0 (broadcast).

The connection diagram when using Modbus is shown below.

ModBus - device connection diagram



Device / Bus Adapter connection	5-wire *TTL* cable (30cm) in length (other measurements/lengths available)
Bus Adapter	BA150
Bus Adapter / Interface connection	RS485 cable shielded and twisted (example: Belden model 8762 cable)

10.1.2 Modbus commands available and data areas

The commands implemented are:

Modbus command	Description of command
3	Read multiple registers on Client side
16	Write multiple registers on Client side
43	Read device ID
	DESCRIPTION Manufacturer ID Model ID Version ID

Length restrictions

Maximum length in bytes of messages sent to device	30 BYTES
Maximum length in bytes of messages received by device	30 BYTES

Variables:
See Parameters chapter (PAr), *Client table*.

10.2 Configuration of device address

The Device Number in a ModBus message is defined by the parameter **CF30 – see table at beginning of this section.**
The address 0 is used for broadcast messages that all slaves recognize. Slaves do not reply to broadcast messages.

10.2.1 Configuration of parameter addresses

The list of addresses is given in the Parameters chapter under the section headed "Parameters Table / ADDRESS column visibility (parameters addresses) and *VIS PAR ADDRESS* (addresses visibility parameters).

10.2.2 Configuration of variable / state addresses

The list of addresses is given in the Parameters chapter, under the section headed *Client Table* ADDRESS column.

11 MODELS AND ACCESSORIES

11.1 Models

11.1.1 Smart models

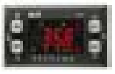
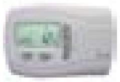
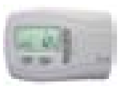
Model	Digital outputs (*)	*TRIAC* Outputs	O.C. : PWM Outputs (**)	Analogue outputs (**)	*Digital inputs* (§)	Analogue Inputs (**)	O.C. Outputs
SMx4500	**4**	**-**	**2 O.C. : PPM**	**3**	**2**	5	-
SMx3600	**3**	**2**	**1**	**3**	**6**	5	2
SMx4600	**4**	**1**	**2**	**3**	**6**	5	1
SMx5500	**5**	**-**	**2**	**3**	**2(§§)**	5	1

11.1.2 Expansions

Model	*Digital outputs*	Analogue Output	*Analogue outputs* O.C.: PWM/PPM	*Analogue outputs* (**)	Digital Inputs	Analogue Inputs	Digital Output O.C.
SE632	**3**	-	**2**	-	**6**	3	1
SE646	**4**	**1**	**2**	**3**	**6**	5	1
SE655	**5**	-	**2**	**3**	**6**	5	1
SME4500	**5**	-	**2 O.C.: PPM**	**3**	**2(§§)**	5	-

TTL **supplied as standard**
(*) high voltage
(**) low voltage (SELV: SAFETY EXTRA LOW VOLTAGE)
(§) no voltage
(§§) DI alternatively to O.C.:PPM
SELV: SAFETY EXTRA LOW VOLTAGE
O.C. Open Collector
PWM Pulse Width Modulation
PPM Pulse Position Modulation
/C indicates the presence of the RTC - Real Time Clock
/S RS485 Serial on board
For details about 4600 *models* availability, contact the Eliwell Sales Department.

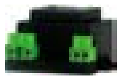
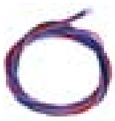
11.1.3 Terminals

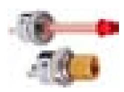
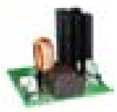
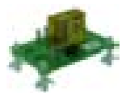
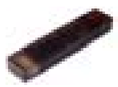
Model	Code	Mounting	Dimensions	*Display*	*Analogue Inputs* Safe voltage (SELV)	Power supply
SKP10		**panel**	**74x32x30mm**	**LED / 4 digit**	-	From base
SKW22		**wall**	**137x96.5x31.3mm**	**LCD**	1 onboard NTC 1 V/I configurable input	12V~ from base
SKW22L		**wall**	**137x96.5x31.3mm**	**LCD backlit**	1 onboard NTC 1 configurable V/I input	12V~ from base
SKP22		**panel (°)**	**160x96x10mm**	**LCD**	1 input NTC 1 input NTC/DI/4...20mA configurable	from base
SKP22L		**panel (°)**	**160x96x10mm**	**LCD backlit**		from base

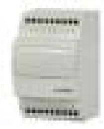
(°) Contact the Eliwell Sales Office for wall-mounting *accessories*.

11.2 Accessories

Note: the photos are intended to show the *accessories* and are for indication purposes only. The dimensions shown in the figures are not to scale.

	Name	Code	Description	Documentation / Notes
Converters		SAR0RA00X701	USB/485 MINI KIT Converter + USB cable	**/S *models***
Transformer		TF411205	230V~/12V 6VA (protected) (*) *transformer*	
		TF411210	230V~/12V 11VA (protected) *transformer*	
Multi Function key		MFK100T000000	Programming key to upload/download parameters and applications	
EXP11 expansion		MW320100	230V 10A expansion module with base fitted to DIN rail	
Cables		COLV0000E0100	Cables (connector + 1m cables) to connect inputs and outputs safe voltage inputs and outputs (SELV).	4500 *models* excluded
		COLV0000035100	RS-485 serial port wiring	
		COLV000042100	Smart – AO3-4-5 CABLES (connector + 1m cables)	
EMC filter		FT111201	LC filter, network filter, recommended for applications with fan speed modulation.	
Temperature probes	 (1) (2)	SN691150	NTC 103AT 1.5m probe, (plastic cap, 2-wire cable);	
		SN9DAE11502C6	Sonda Pt1000 6X20 1.5mt IP68	**4500 *models* only**
		SN9DED11502C6	Sonda Pt1000 5X20 1.5mt IP68	**4500 *models* only**
		SN8DED11502C0	NTC103AT 1,5mt IP 68 5x20 -50+110°C	**Cable Double insulation**
		SN8DED13002C0	NTC103AT 3,0mt IP 68 5x20 -50+110°C	
		SN8DAE11502C0	NTC103AT 1,5mt IP 68 6x20 -50+110°C	
		SN8DAE13002C0	NTC103AT 3,0mt IP 68 6x20 -50+110°C	
Ratiometric transducers		TD400010	EWPA 010 R 0/5V 0/10BAR ratiometric transducer Female connector	**Include 2mt cable packard IP67**
		TD400030	EWPA 030 R 0/5V 0/30BAR ratiometric transducer Female connector	
		TD400050	EWPA 050 R 0/5V 0/50BAR ratiometric tranducer Female connector	

	Name	Code	Description	Documentation / Notes
Pressure transducers		(1)	Male TD220050° TD240050* TD220007° TD240007* Female TD320050° TD340050* TD320007° TD340007*	**EWPA050** **4...20mA/0..50bar** **IP54° / IP67*** **EWPA007** **4...20mA/-0.5...7bar** **IP54° / IP67*** **Instruction sheet** **9IS64173** EWPA EN-IT-ES-DE-FR-RU
Pressure switches		(1)	HR *range* (automatic reset) - minimum 100,000 ON/OFF cycles available	
		(1)	HL *range* (manual reset) - minimum 6,000 ON/OFF cycles	
		(1)	HC *range* (automatic reset) - minimum 250,000 ON/OFF cycles	
Fan modules		For codes **See instruction sheet** **(1)**	**CFS FAN MODULES** Single-phase speed regulators for currents of 2A to 9A	**Instruction sheet** **8FI40014** CFS - Fan Speed Modules GB-I-E-D-F
		MW991300	**CF-REL FAN MODULE** 6A 230V relay	**Instruction sheet** **8FI40014** CFS - Fan Speed Modules GB-I-E-D-F
		MW991012	**CFS05 TANDEM FAN MODULE** *TRIAC* 5+5A 230V	**Instruction sheet** **8FI40016** CFS05 - Fan Speed Module GB-I-E-D-F
		Contact Eliwell Sales Department	THREE-PHASE FAN REGULATOR Contact Eliwell Sales Department	Contact Eliwell Sales Department
Interface modules		DM1003002000	DM100-3 Manufacturer	

	Name	Code	Description	Documentation / Notes
Connectivity		BA11250N3700	**Bus Adapter 130** ***TTL*** RS485 *TTL*/RS-485 communication interface 12 V aux. output for power supply to device. *TTL* cable, L = 1 m (2)	**Instruction sheet 9IS43084** BusAdapter 130-150-350 GB-I-E-D-F
		BA10000R3700	**Bus Adapter 150** ***TTL*** RS485 *TTL*/RS-485 communication interface *TTL* cable, L = 1 m (2)	
		BARF0TS00NH00 (1)	RadioAdapter *TTL*/WIRELESS 802.15.4	**Instruction sheet 8FI40023** RadioAdapter GB-I-E-D-F **Manual 9MAX0010** RadioAdapter GB-I-E-D-F
		WA0ET00X700	WebAdapter	**Instruction sheet 9IS44065** WebAdapter GB-I-E-D-F-RUS **manual 8MA00202** WebAdapter **X = 0 IT; 1 EN; 2 FR; 3 ES; 5 DE; A RU**
		WA0WF00X700	WebAdapter Wi-Fi	
Software Tools		Contact Eliwell Sales Department	Studio	Contact Eliwell Sales Department
Demo Case		VAL00031K	Demo case Smart	

(1) Various items available. Contact the Sales Department.
(2) Various lengths can be requested.

GENERAL NOTES:

- COHV and COLV cabling are not required if they are made by the manufacturer.
- Connection of terminal via 3-way cables with no optional modules.
- Eliwell can also supply a variety of different NTC probes depending on the cable type (PVC or silicon) and length.

12 ANALITIC INDEX

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