FREE Smart - SKP SKW

Logic controller

02/2015

USER MANUAL

9MA10251.00

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Eliwell nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.
If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Eliwell software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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ABOUT THE BOOK

How to use this manual

This manual uses the following conventions to highlight certain parts of the text:

	**Note**	Indicates further information on the subject concerned that the user should take into account.
	**Tip**	A suggestion that could help the user to understand and make better use of the information provided
*, **, ***, (°), (°°), [1], (^), (§)		Provides further specifications on an explanation provided previously
Fig. 1, 1 - Fig. 1, etc.		Provides references to figures, details in figures, parts of the text. Figures are referred to using an abbreviation in bold (E.g. "**Fig.**") and a number identifying the reference (E.g. **Fig. 1**). For components inside figures, the references are given using a letter or number (E.g. **1 - Fig. 1**). References to parts of the text are given using the number and title of the relative chapters, sub-chapters, paragraphs and page number.

Document Scope

This document describes the **FREE Smart** Logic controller**s** and accessories including installation and wiring information.

Validity Note

This document is valid for **FREE Studio**.

Related Documents

Title of Documentation	Reference Document Code
User Guide FREE Evolution - FREE Panel	9MA10252 (EN)
User Guide XVD	9MA10254 (EN)
User Guide FREE Studio	9MA10255 (EN)
FREE Studio software HelpOnLine Manual	9MA10256 (EN)
FREE Smart 22 I/O Instruction Sheet	9IS54406
FREE Smart 14 I/O Instruction Sheet	9IS54407
FREE SKP 22 Instruction Sheet	9IS54409
FREE SKW22(L) Instruction Sheet	9IS54410

You can download these technical publications and other technical information from our website at:
www.eliwell.com

SAFETY INFORMATION

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to inform of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards.
Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **results in** death or serious injury**.**

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.
No responsibility is assumed by Eliwell for any consequences arising out of the use of this material.
A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Permitted use

This product is used to control HVAC applications.

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 also suitable for use in household and commercial refrigeration appliances and/or similar equipment and has been tested for safety aspects in accordance with the harmonized European reference standards.

Prohibited use

Any use other than that expressed above under Permitted use is strictly prohibited.

The relay contacts supplied are of an electromechanical type and subject to wear. Functional safety protection devices, specified in international or local standards, must be installed externally to this device.

Liability and residual risks

Eliwell liability is limited to the proper and professional use of this product under the guidelines contained in the present and other supporting documents, and does not extend to damages caused by (but not limited to):

- 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.

Disposal

The appliance (or the product) must be disposed of separately in compliance with the local standards in force on waste disposal.

Product Related Information

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices, prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires.
- Always use a properly rated voltage sensing device to confirm the power is removed.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

This equipment has been designed to operate outside of any hazardous location.
Only install this equipment in zones known to be free of hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.(1)
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) For additional information, refer to NEMA ICS 1.1 (latest edition), “Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control” and to NEMA ICS 7.1 (latest edition), “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems” or their equivalent governing your particular location.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Eliwell for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

CHAPTER 1
Introduction

1.1. General description

The **FREE Smart** Logic controller family is the compact option in the **Eliwell** platform of programmable controllers and LCD displays, and is ideal for use in a variety of HVAC/R and other applications.

In this manual, the photos are intended to show the **FREE Smart** and are for indication purposes only. The dimensions shown in the figures are not to scale.

The **FREE Smart** offer is made of:

- **Controller**
- **Expansion** (**controller**)
- **Display**

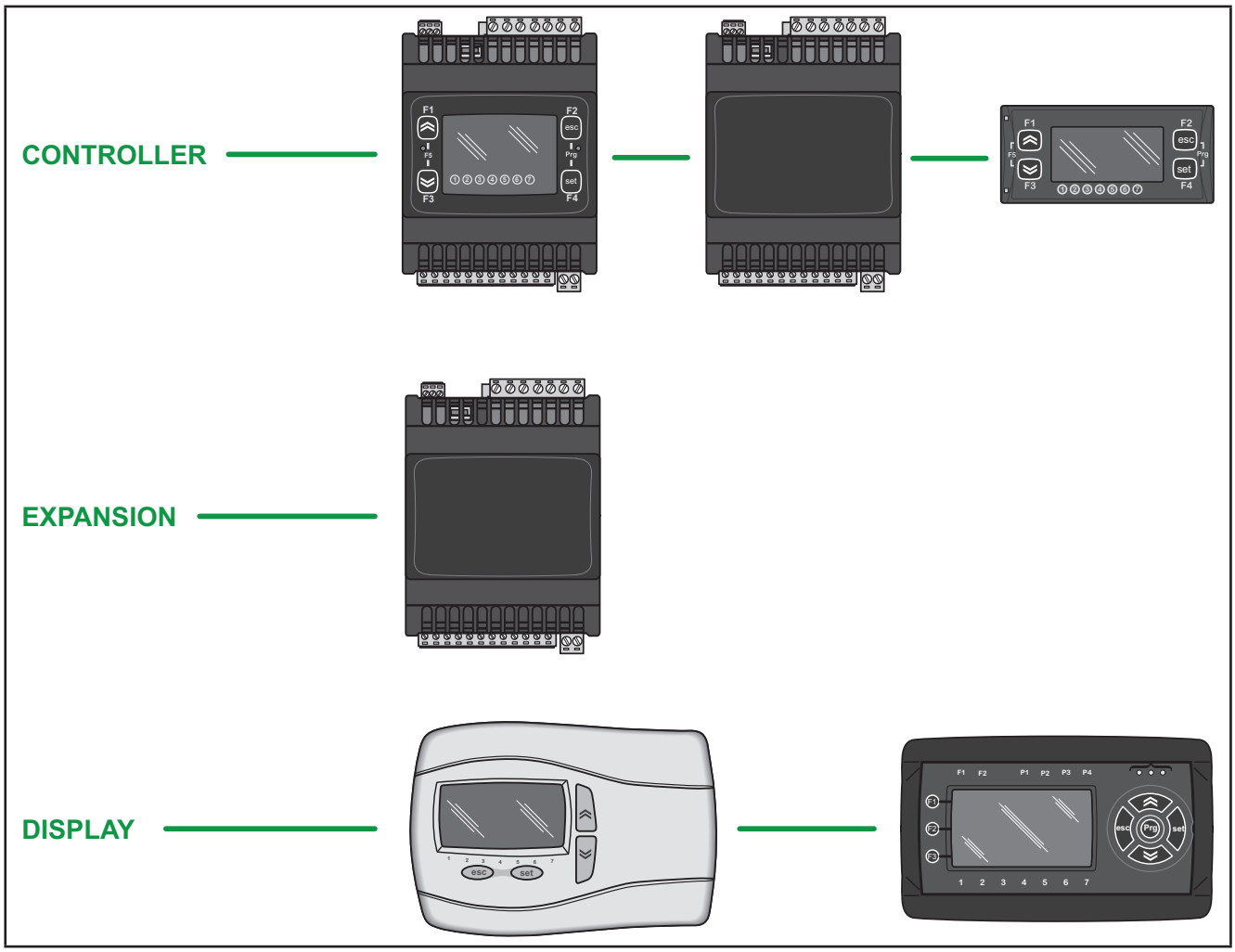


Fig. 1. FREE Smart

There are various hardware references with varying numbers of analog and digital inputs/outputs and, for displays, with varying dimensions, mounting and display type.

The **FREE Smart** come in a DIN rail-mounted version which significantly reduces wiring times, or in a format for panel / wall mounting.

The **Controller** references has the option of downloading parameter maps and applications via the **MFK 100**. In association with the **Controller** references 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 the **FREE Smart** modules via PC or **MFK 100**, helping to provide confidentiality with appropriate security. Ratiometric pressure sensors, external modules (e.g. fan modules) and displays can also be connected with no need for any further serial interfaces.	The **Display** references are an exact reproduction of what can be seen on the controller and the large, double display makes it even easier to configure and control applications. The **Display** references are equipped with an on-board ambient temperature sensor.

1.1.1. Specifications

SMP (22 I/Os) mounting has 2 references, giving you 6 digital inputs, up to 5 relay outputs, a TRIAC output, 2 PWM analog outputs, 3 configurable 0…10V/0…20mA/4…20mA analog outputs and an Open Collector digital output for an external relay.
The 32x74mm format ensures versatility and ease of installation.

SMC-SMD5500/C(/S) / SME5500 (22 I/Os) comes in a variety of references, giving you 6 digital inputs, up to 5 relay outputs, up to 2 TRIAC outputs, up to 2 PWM analog outputs, up to 3 configurable 0…10V/0… 20mA/4… 20mA analog outputs and up to 2 Open Collector digital outputs for an external relay.

The 4DIN format provides maximum flexibility and easy installation.

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

SMC-SMD4500/C(/S) / SME4500 (14 I/Os) have removable connectors both for the low voltage inputs and the relay outputs.
Has different references, giving you up to 2 digital inputs, 4 relay outputs, up to 2 PWM Open Collector analog outputs, up to 2 x 0…10V analog outputs, one configurable 20mA/4…20mA output or, as an alternative one 0…10V output on dedicated references.

The 4DIN format provides maximum flexibility and easy installation.

100-240V~ power supply

1.1.2. Main functions of hardware

- Parameter settings via keyboard or PC
- **MFK 100** to download or upload parameter maps
- Configurable NTC, 0…20mA ,4...20mA, 0...1V, 0...5V, 0...10V inputs or digital input configurable from parameters
- 3 x Pt1000 inputs for **SMD-SMC4500/C(/S)** references
- **Display** references (up to 100m cable) with direct connection without serial interface:
  - o Easy-to-use
  - o Easy programming
  - o Memory saving during programming and clock that doesn't need to be reset after a power failure
  - o Large, easy-to-read double display (showing current time and ambient temperature for example)
  - o Temperature can be easily configured manually
  - o Mode changeover
  - o Modern, pleasant design

CHAPTER 2
Mechanical installation

2.1. Before Starting

Read and understand this chapter before beginning the installation of your system. The use and application of the information contained herein require expertise in the design and programming of automated control systems. Only you, the user, machine builder or integrator, can be aware of all the conditions and factors present during installation and setup, operation, and maintenance of the machine or process, and can therefore determine the automation and associated equipment and the related safeties and interlocks which can be effectively and properly used. When selecting automation and control equipment, and any other related equipment or software, for a particular application, you must also consider any applicable local, regional or national standards and/or regulations. Pay particular attention in conforming to any safety information, different electrical requirements, and normative standards that would apply to your machine or process in the use of this equipment.

The use and application of the information contained herein require expertise in the design and programming of automated control systems. Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during installation and setup, operation, and maintenance of the machine or process, and can therefore determine the automation and associated equipment and the related safeties and interlocks which can be effectively and properly used. When selecting automation and control equipment, and any other related equipment or software, for a particular application, the user or integrator must also consider any applicable local, regional or national standards and/or regulations.

⚠ WARNING

REGULATORY INCOMPATIBILITY

Be sure that all equipment applied and systems designed comply with all applicable local, regional and national regulations and standards.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

2.2. Disconnecting Power

All options and modules should be assembled and installed before installing the control system on a mounting rail, into a panel door or onto a mounting surface. Remove the control system from its mounting rail, mounting plate or panel before disassembling the equipment.

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices, prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires.
- Always use a properly rated voltage sensing device to confirm the power is removed.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

2.3. Programming Considerations

The products described in this manual have been designed and tested using Eliwell programming, configuration and maintenance software products.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Eliwell for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

2.4. Operating Environment

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Install and operate this equipment according to the conditions described in the General Specifications.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

2.5. Installation Considerations

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use appropriate safety interlocks where personnel and/or equipment hazards exist.
- Install and operate this equipment in an enclosure, or other locations that are appropriate for its rated environment.
- Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment.
- Do not use this equipment in safety-critical machine functions.
- Do not disassemble, repair, or modify this equipment.
- Do not connect any wiring to reserved, unused connections, or to connections designated as Not Connected (N.C.).
- Do not mount devices in extremely damp and/or dirt-laden areas

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: JDYX2 or JDYX8 fuse types are UL-recognized and CSA approved.

For mechanical dimensions, see **4.6. Mechanical dimensions on pag. 55**.

The **FREE Smart** controllers are intended for DIN rail mounting, panel mounting or wall mounting.

Care must be taken to avoid damage from electrostatic sources when handling this equipment. In particular exposed connectors and, in some cases, exposed printed circuit boards are exceptionally vulnerable to electrostatic discharge.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION DUE TO ELECTROSTATIC DISCHARGE DAMAGE

- Keep equipment in the protective conductive packaging until you are ready to install the equipment.
- Only install equipment in approved enclosures and / or locations that prevent casual access and provide electrostatic discharge protection as defined by IEC 1000-4-2.
- Use a conductive wrist strap or equivalent field force protective device attached to an earth ground when handling sensitive equipment.
- Always discharge yourself by touching a grounded surface or approved antistatic mat before handling the equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

2.6. SMP / SKP 10 installation

The instrument is intended for panel mounting (refer to **Fig. 2 on pag. 18**, **Fig. 3 on pag. 18**, **Fig. 5 on pag. 18** and **Fig. 6 on pag. 19**).

1. Drill a 29x71 mm hole.
2. Insert the instrument.
3. Secure it with the special brackets provided.

The TTL serial is on the left side of the device.

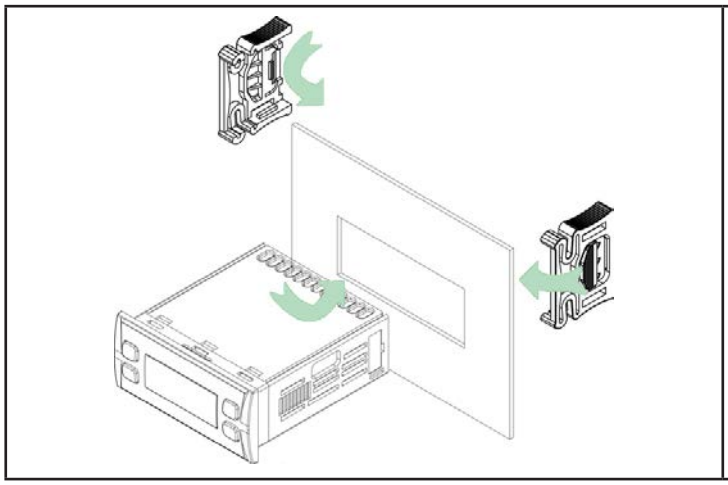


Fig. 2. Example of installation

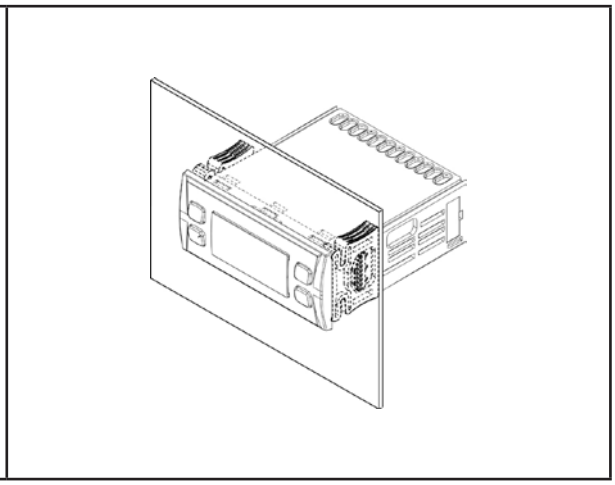


Fig. 3. Panel mounted

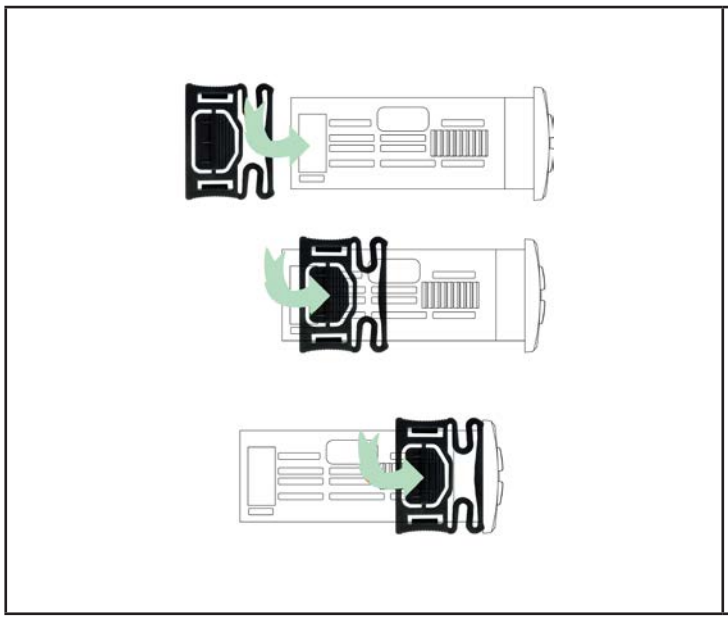


Fig. 4. Example of panel mounting - side view

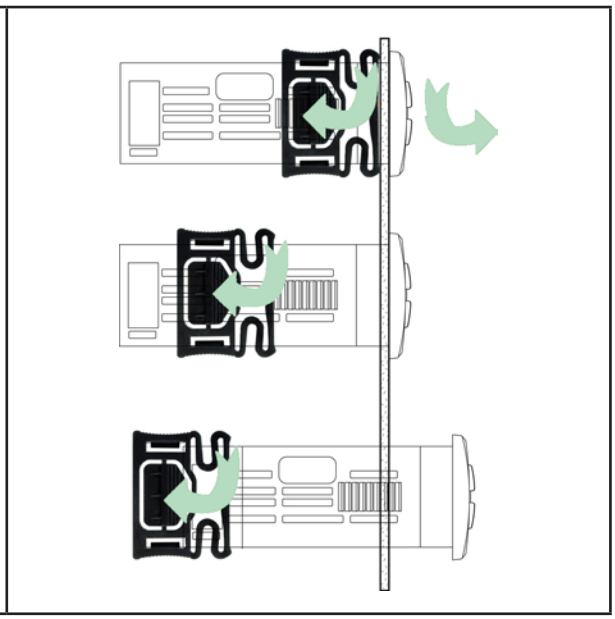


Fig. 5. Removing the device from the panel – side view

2.7. SMD / SMC / SME installation

The instrument is intended for 4DIN rail mounting (refer to **Fig. 6 on pag. 19**, **Fig. 7 on pag. 19, Fig. 8 on pag. 20** and **Fig. 9 on pag. 20**).
For DIN rail installation, follow the steps described below:

1. Move the two spring docking devices to their standby position (use a screwdriver to press against the relative compartments).
2. Then install the device on the DIN rail.
3. Pressing on the "spring docking devices" to put them into the locked position.

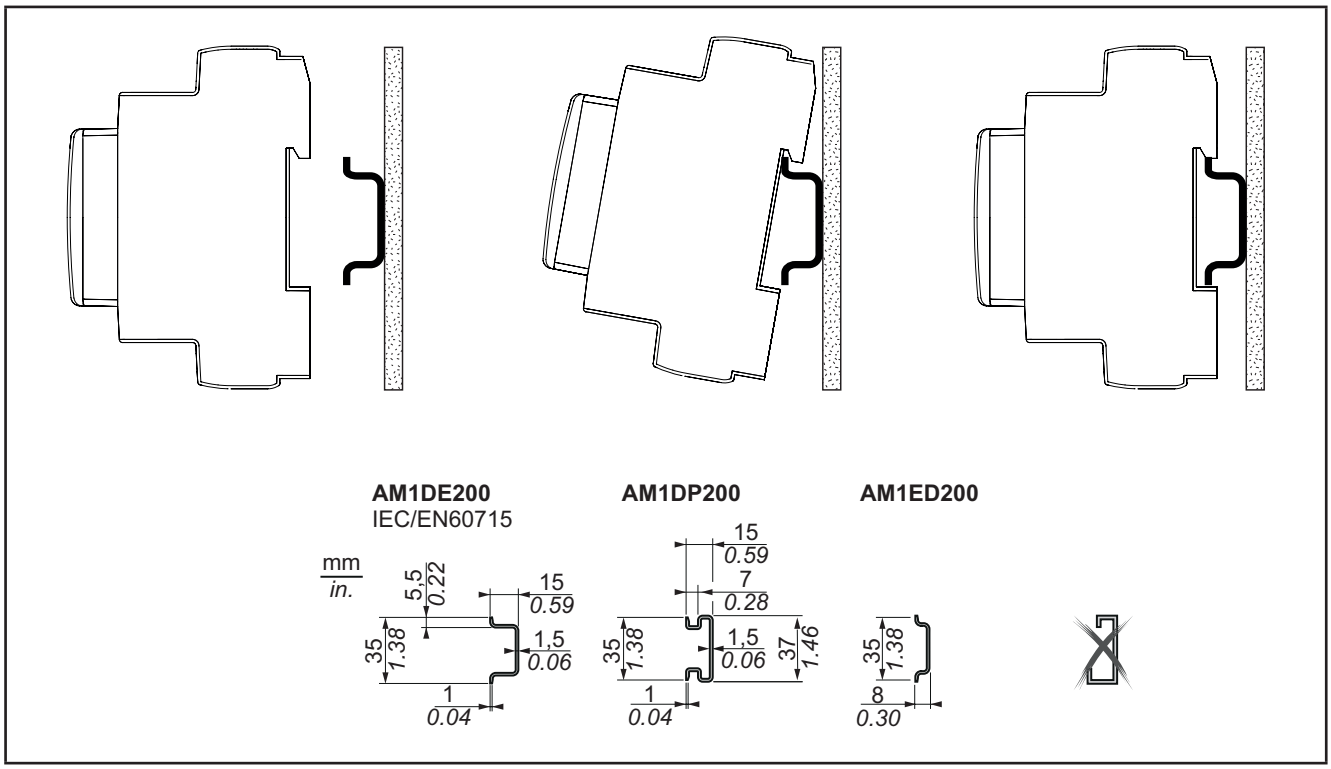


Fig. 6. Installation on DIN rail – side view

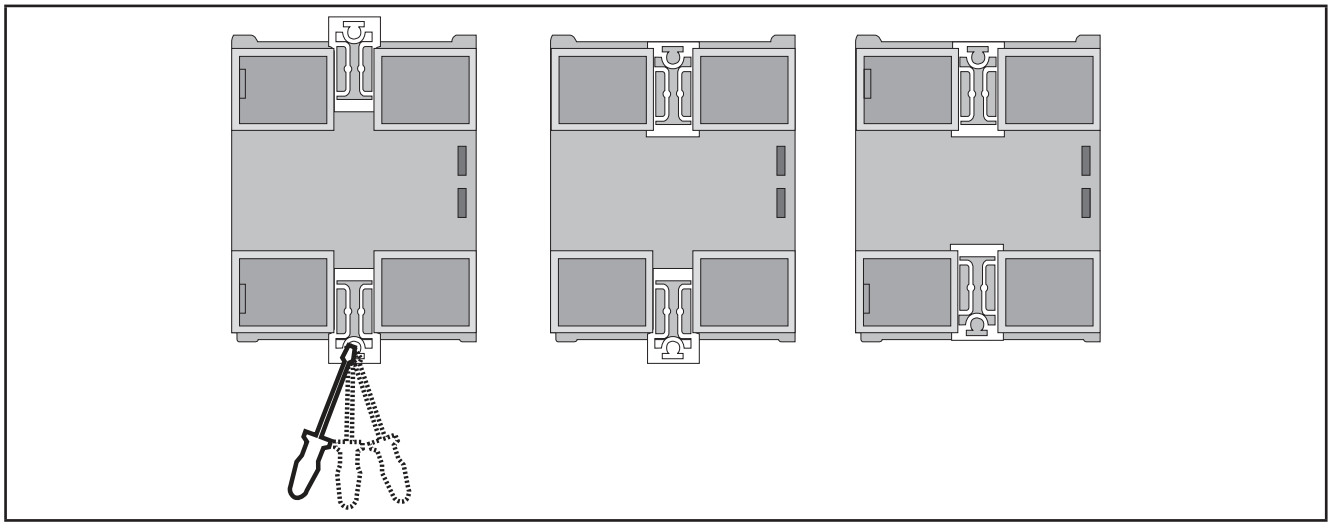


Fig. 7. Installation on DIN rail – rear view

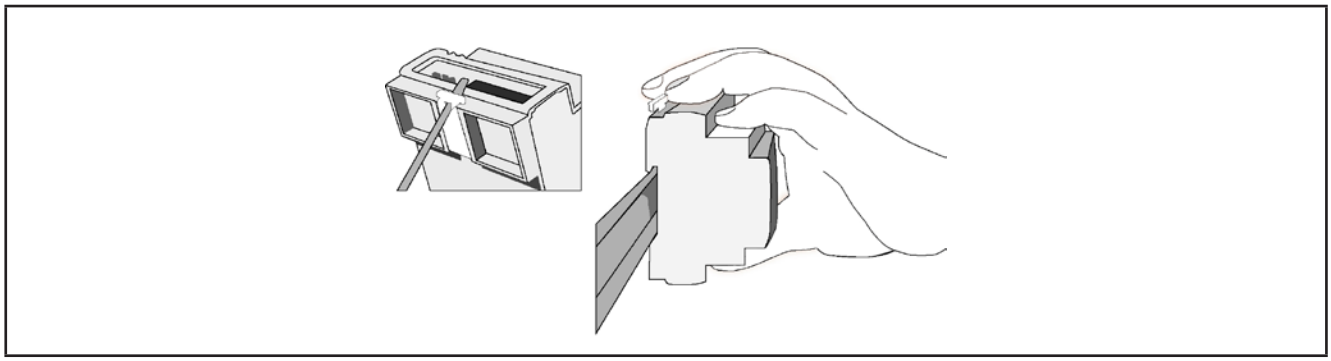


Fig. 8. Installation on DIN rail – ¾ view

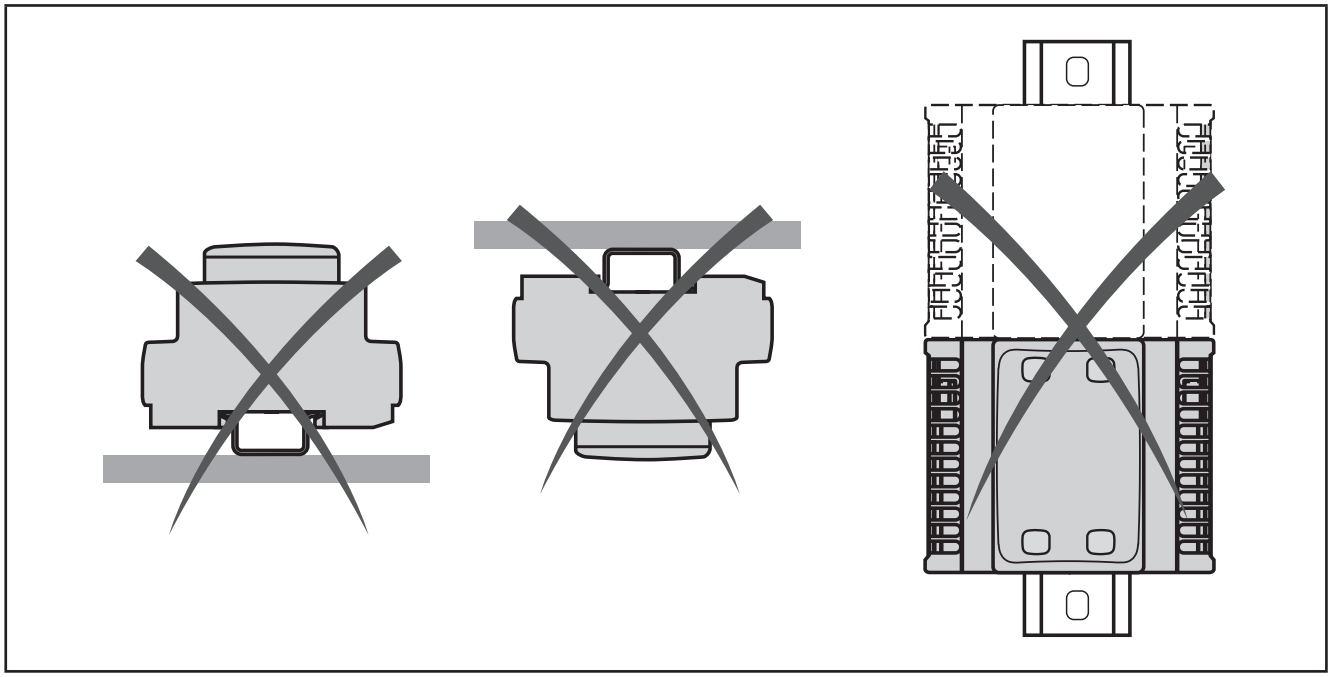


Fig. 9. Mounting

The **FREE Smart** logic controller has been designed as an IP20 product and must be installed in an enclosure. Clearances must be respected when installing the product.
There are 3 types of clearances between:

- The **FREE Smart** controller and all sides of the cabinet (including the panel door).
- The **FREE Smart** controller terminal blocks and the wiring ducts. This distance reduces electromagnetic interference between the controller and the wiring ducts.
- The **FREE Smart** controller and other heat generating devices installed in the same cabinet.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Place devices dissipating the most heat at the top of the cabinet and ensure adequate ventilation.
- Avoid placing this equipment next to or above devices that might cause overheating.
- Install the equipment in a location providing the minimum clearances from all adjacent structures and equipment as directed in this document.
- Install all equipment in accordance with the specifications in the related documentation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

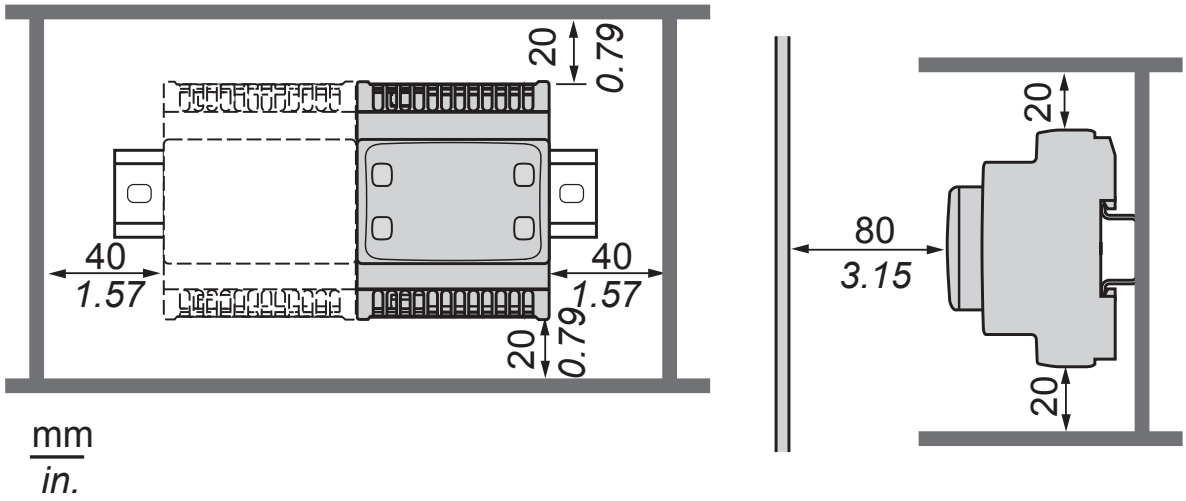


Fig. 10. Clearances

2.8. SKW 22(L) installation

The instrument is intended for wall mounting.

1. Open the front panel of the appliance.
2. Separating it from the bottom.
3. Levering it with a screwdriver or similar tool (see **Fig. 11 on pag. 22**).
4. Remove the front panel.
5. Drill two appropriately spaced 4mm holes in the wall where the device is to be mounted (see **Fig. 12 on pag. 22**, point B).
6. The cables must pass through the hole in the centre of the device's back panel (see **Fig. 12 on pag. 22**, point A).
7. Position the back of the device on the wall with the two screws.
8. After having made the connections, close the front panel of the keypad by pressing it with your fingers (see **Fig. 13 on pag. 23**).

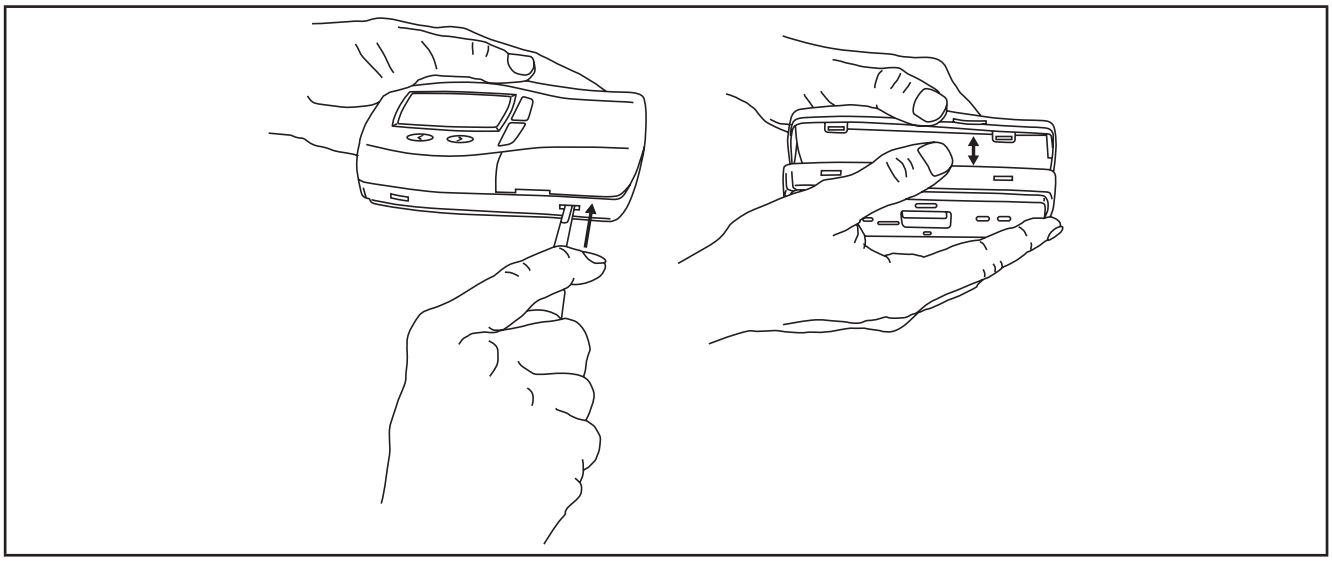


Fig. 11. Opening

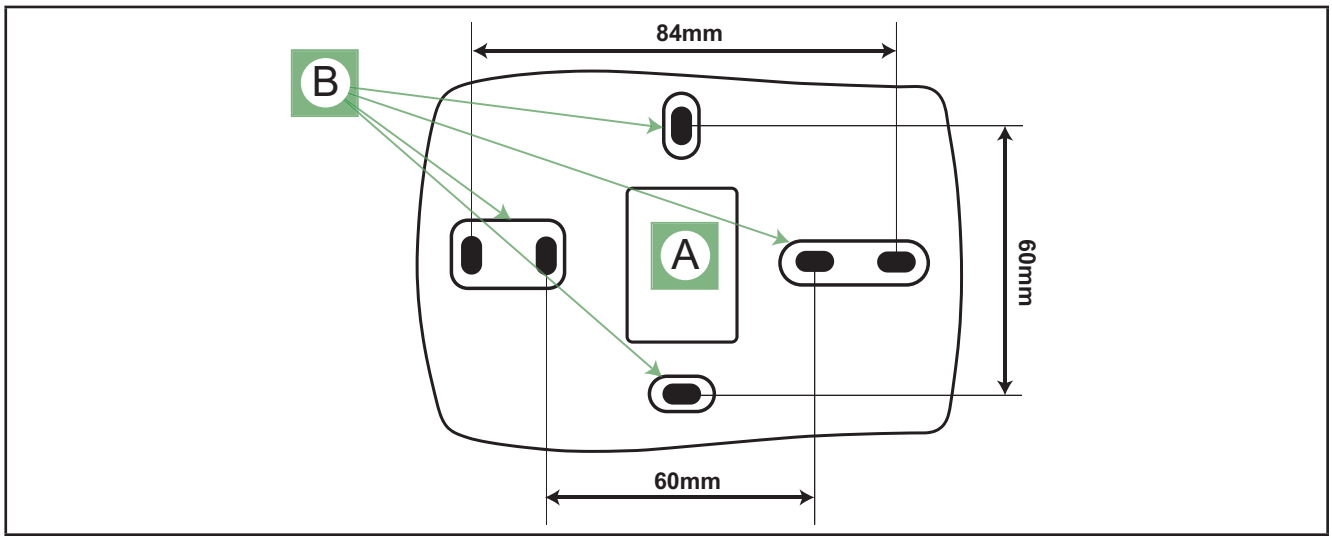


Fig. 12. Holes

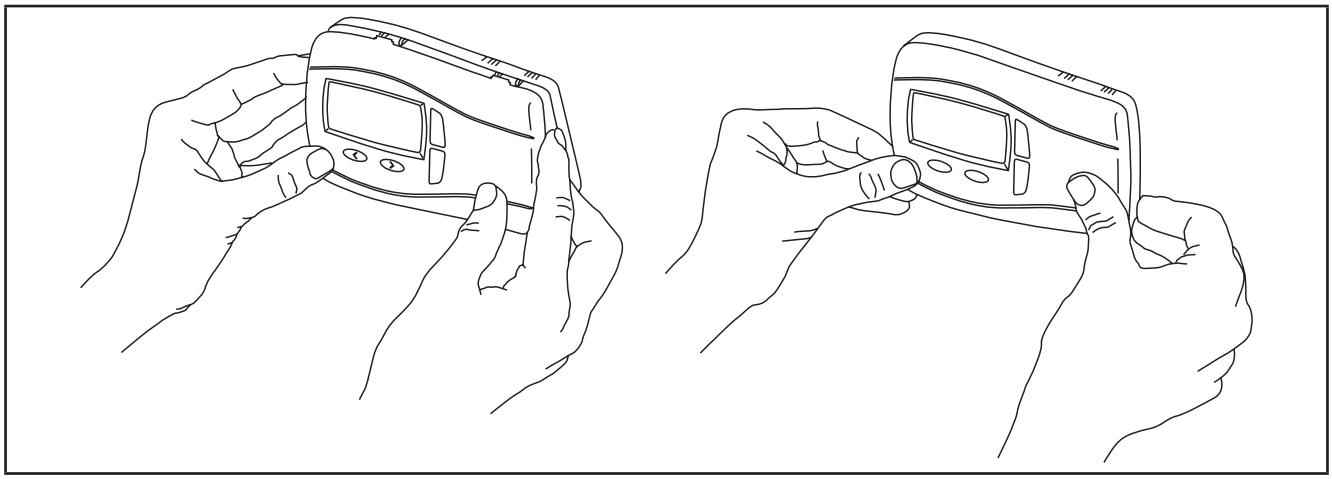


Fig. 13. Closing

2.9. SKP 22 installation

2.9.1. Panel mounting

The display is intended for panel mounting; refer to **Fig. 14 on pag. 23**.

1. Make a 138x68mm hole.
2. Remove the front panel.
3. Make 4 holes in the panel that the controller is to be mounted on or two holes of diam. 2.7 mm at the specified spacing.
4. Insert the device, fixing it with the screws.
5. Press the front of the display to close.

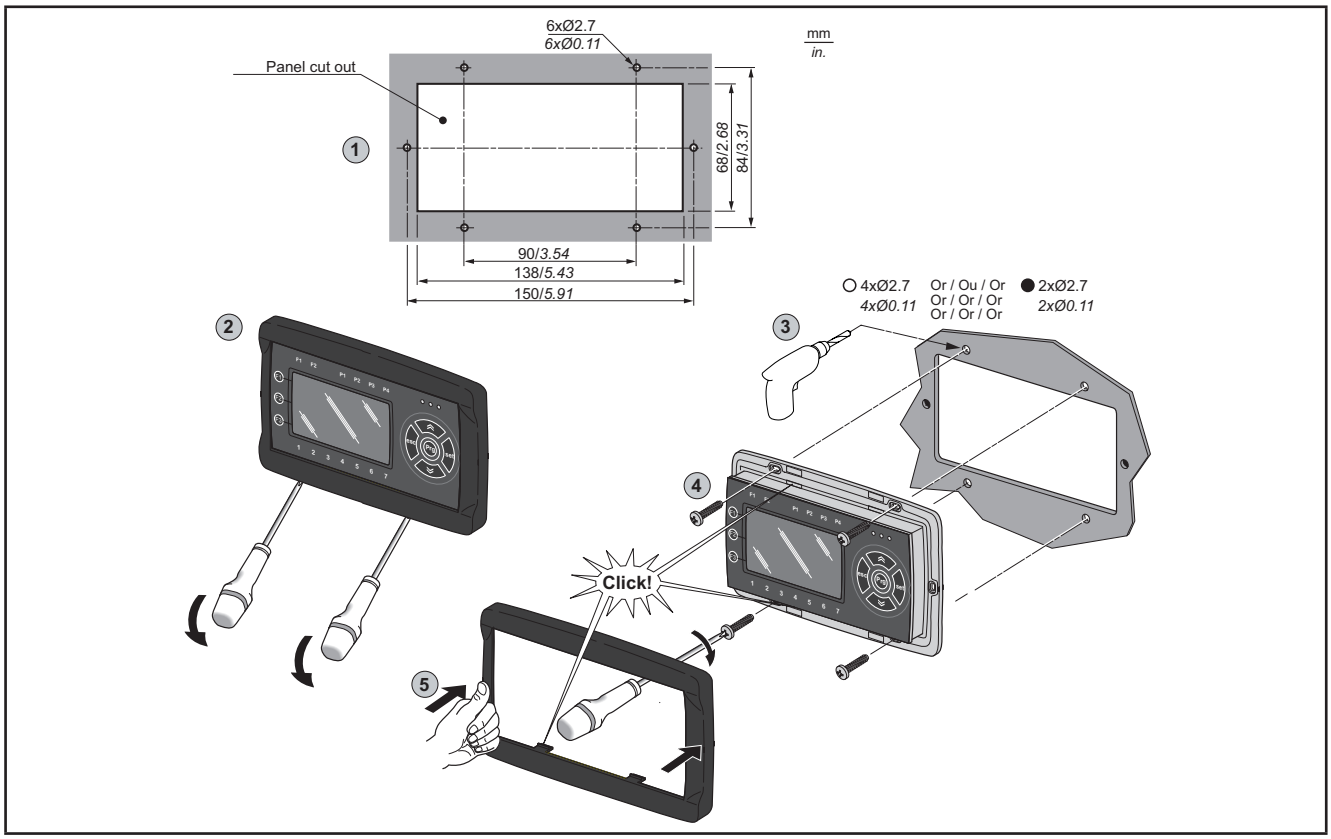


Fig. 14. Assembling the SKP 22

2.9.2. Accessories for Wall mounting

Contact the **Eliwell** Sales Department for wall-mounting accessories.
For wall mounting, refer to **Fig. 15 on pag. 24**.

1. Make 4 holes of diameter 4.2mm in the wall at the specified spacing, to fix the backplate. Alternatively use the two side slots, one at the bottom and one at the top, under the corresponding break-open removable doors, preventing the opening of holes in walls with recessed-wall wiring.
2. Make all the necessary connections.
3. Insert the **SKP 22** (without front) onto the backplate, which serves as a panel, following the instructions for panel mounting (see **2.9.1. Panel mounting on pag. 23**).

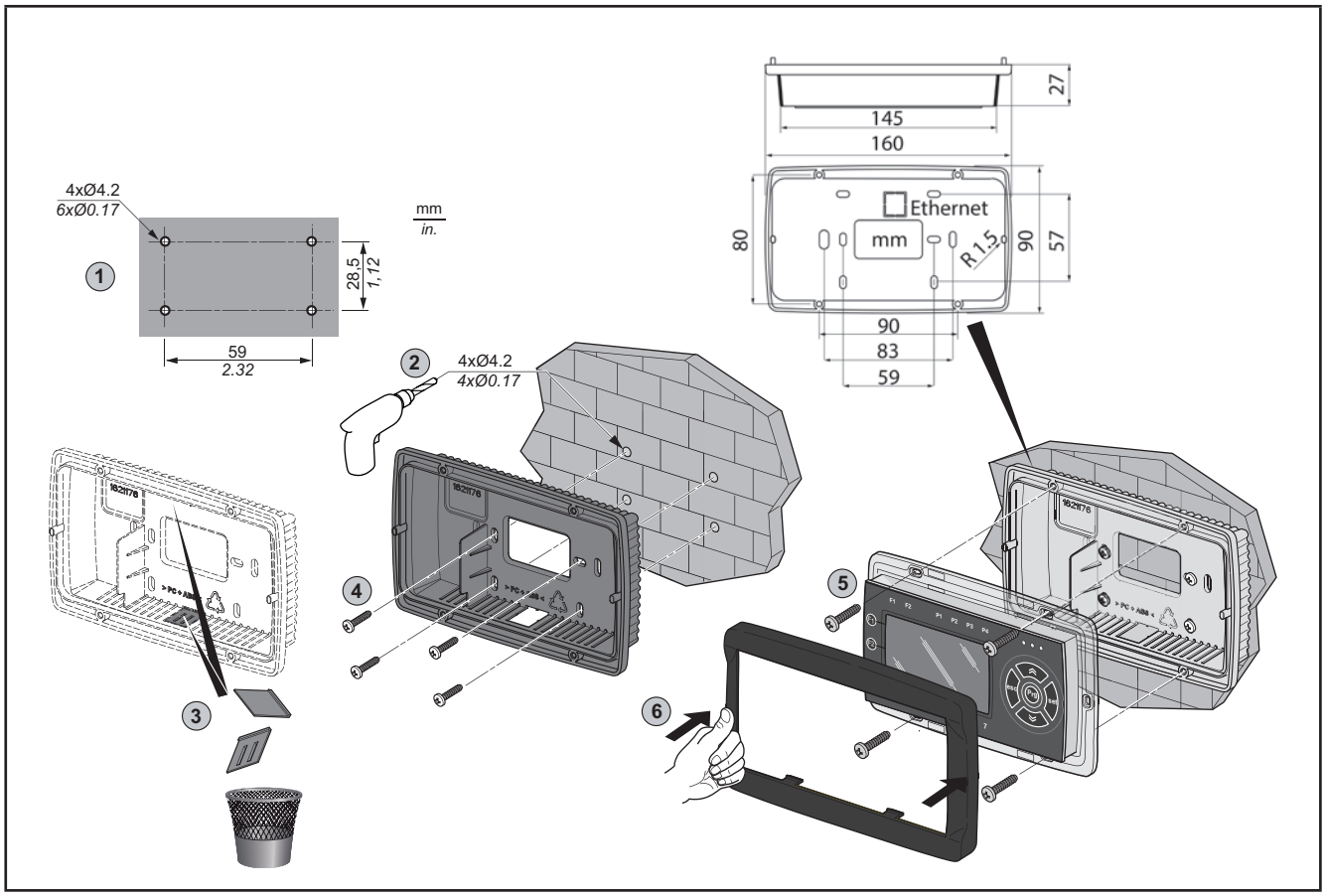


Fig. 15. Accessories for Wall mounting

Code	Description
EVA00WMRC0000	White backplate kit for wall mounting
EVA00WMRC0001	Black backplate kit for wall mounting

CHAPTER 3
Electrical connections

3.1. Wiring Best Practices

The following information describes the wiring guidelines and associated best practices to be respected when using the **FREE Smart** logic controllers.

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices, prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires.
- Always use a properly rated voltage sensing device to confirm the power is removed.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.(1)
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) For additional information, refer to NEMA ICS 1.1 (latest edition), “Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control” and to NEMA ICS 7.1 (latest edition), “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems” or their equivalent governing your particular location.

3.1.1. Wiring Guidelines

The following rules must be applied when wiring a **FREE Smart** controllers:

- I/O and communication wiring must be kept separate from the power wiring. Route these two types of wiring in separate cable ducting.
- Verify that the operating conditions and environment are within the specification values.
- Use proper wire sizes to meet voltage and current requirements.
- Use copper conductors (required).
- Use twisted pair, shielded cables for analog, and/or fast I/O.
- Use twisted pair, shielded cables for networks, and fieldbus.

Use shielded, properly grounded cables for all analog and high-speed inputs or outputs and communication connections. If you do not use shielded cable for these connections, electromagnetic interference can cause signal degradation. Degraded signals can cause the controller or attached modules and equipment to perform in an unintended manner.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use shielded cables for all fast I/O, analog I/O and communication signals.
- Ground cable shields for all analog I/O, fast I/O and communication signals at a single point [1].
- Route communication and I/O cables separately from power cables.
- Make connections as short as possible and do not wind them around electrically connected parts.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

NOTE: Surface temperatures may exceed 60 °C. Route primary wiring (wires connected to power mains) separately and apart from secondary wiring (extra low voltage wiring coming from intervening power sources). If that is not possible, double insulation is required such as conduit or cable gains.

3.1.2. Rules for Screw Terminal Block

The following table presents the cable types and wire sizes for a **5.08** or **5.00 pitch** screw terminal block:

mm / in. 7 / 0.28								
mm²	0.2…2.5	0.2…2.5	0.25…2.5	0.25…2.5	2 x 0.2…1	2 x 0.2…1.5	2 x 0.25…1	2 x 0.5...1.5
AWG	*24…14*	*24…14*	*22...14*	*22...14*	*2 x 24…18*	*2 x 24…16*	*2 x 22…18*	*2 x 20...16*

Ø 3,5 mm (*0.14 in.*)	C	N•m	0.5...0.6
		lb-in	*4.42...5.31*

Fig. 16. Pitch 5.08 mm (0.20 in.) or 5.00 mm (0.197 in.)

The following table presents the cable types and wire sizes for a **3.81** or **3.50 pitch** screw terminal block:

mm / in. 9 / 0.35								
mm²	0.14…1.5	0.14…1.5	0.25…1.5	0.25…0.5	2 x 0.08…0.5	2 x 0.08…0.75	2 x 0.25…0.34	2 x 0.5
AWG	*26…16*	*26…16*	*22...16*	*22...20*	*2 x 28…20*	*2 x 28…20*	*2 x 24…22*	*2 x 20*

Ø 2,5 mm (*0.1 in.*)	C	N•m	0.22...0.25
		lb-in	*1.95...2.21*

Fig. 17. Pitch 3.81 mm (0.15 in.) or 3.50 mm (0.14 in.)

The use of copper conductors is required.

⚠ ⚠ DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

- Tighten connections in conformance with the torque specifications.
- Do not insert more than one wire per connector of the terminal block without the cable ends specified in the tables found in the Rules for Screw Terminal Block information.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

FIRE HAZARD

- Use only the recommended wire sizes for the current capacity of the I/O channels and power supplies.
- For relay output wiring of 2 A, use conductors of at least 0.5 mm^2 (AWG 20) with a temperature rating of at least 80 °C (176 °F).
- For relay output wiring of 3 A, use conductors of at least 1.5 mm^2 (AWG 16) with a temperature rating of at least 80 °C (176 °F).
- For common conductors of relay output wiring of 8 A, or relay output wiring greater than 3 A, use conductors of at least 2.0 mm^2 (AWG 12) with a temperature rating of at least 80 °C (176 °F).

Failure to follow these instructions will result in death or serious injury.

3.1.3. Protecting Outputs from Inductive Load Damage

Depending on the load, a protection circuit may be needed for the outputs on the controllers and certain modules. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

⚠ CAUTION

OUTPUT CIRCUIT DAMAGE DUE TO INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk od inductive direct current load damage

Failure to follow these instructions can result in injury or equipment damage.

If your controller or module contains relay outputs, these types of outputs can support up to 240 Vac. Inductive damage to these types of outputs can result in welded contacts and loss of control. Each inductive load must include a protection device such as a peak limiter, RC circuit or flyback diode. Capacitive loads are not supported by these relays.

⚠ WARNING

RELAY OUTPUTS WELDED CLOSED

- Always protect relay outputs from inductive alternating current load damage using an appropriate external protective circuit or device.
- Do not connect relay outputs to capacitive loads.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Protective circuit A: this protection circuit can be used for both AC and DC load power circuits.

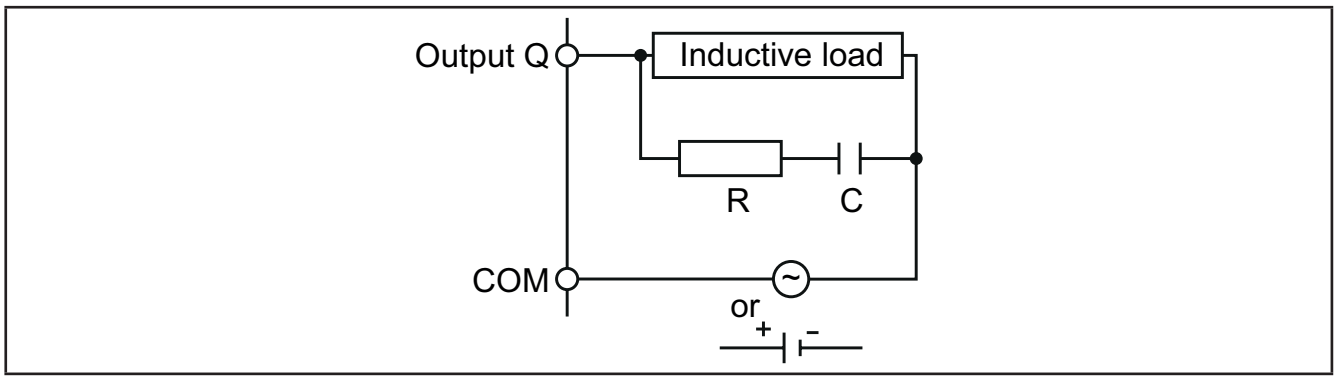


Fig. 18. Protective circuit A

C Value from 0.1 to 1 µF
R Resistor of approximately the same resistance value as the load

Protective circuit B: this protection circuit can be used for DC load power circuits.

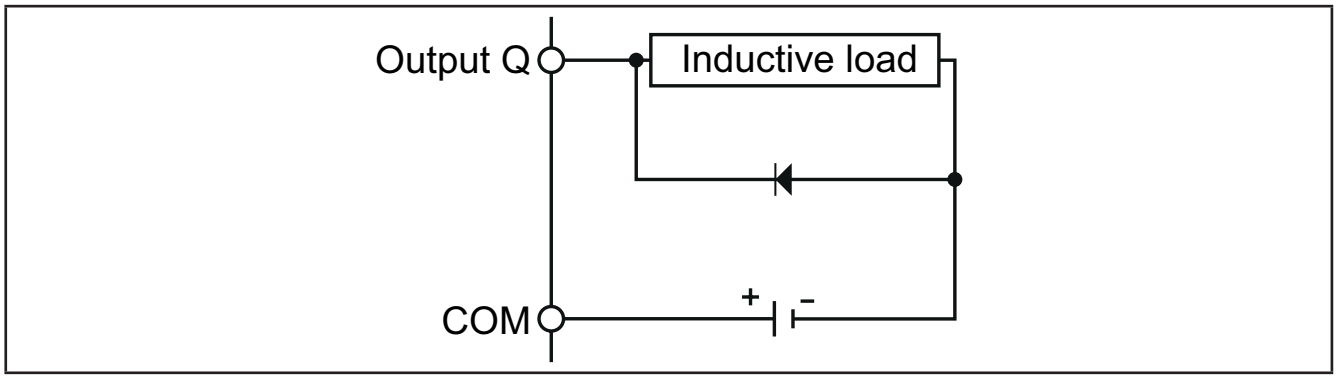


Fig. 19. Protective circuit B

Use a diode with the following ratings:
- Reverse withstand voltage: power voltage of the load circuit x 10.
- Forward current: more than the load current.

Protective circuit C: this protection circuit can be used for both AC and DC load power circuits.

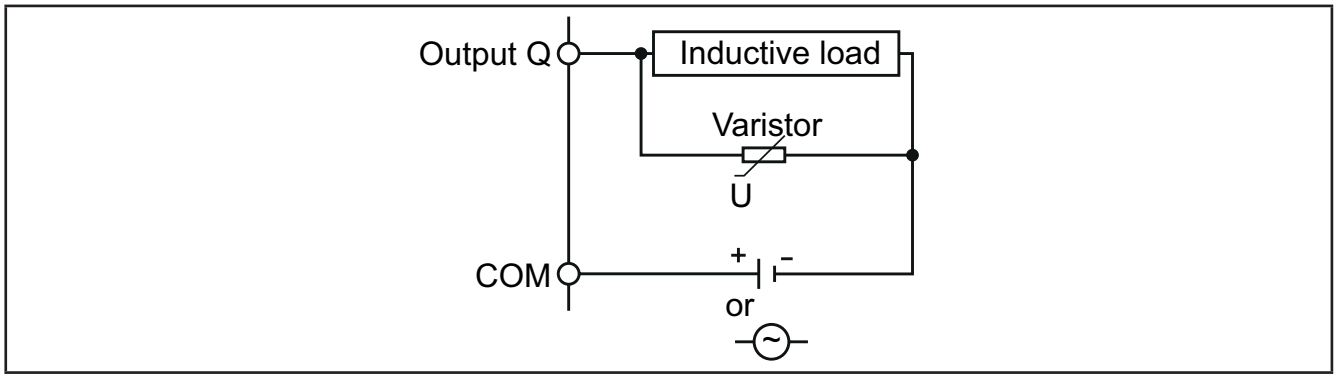


Fig. 20. Protective circuit C

In applications where the inductive load is switched on and off frequently and/or rapidly, ensure that the continuous energy rating (J) of the varistor exceeds the peak load energy by 20 % or more.

NOTE: Place protection devices as close to the load as possible.

3.1.4. Special handling considerations

Care must be taken to avoid damage from electrostatic sources when handling this equipment. In particular exposed connectors and, in some cases, exposed printed circuit boards are exceptionally vulnerable to electrostatic discharge.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION DUE TO ELECTROSTATIC DISCHARGE DAMAGE

- Keep equipment in the protective conductive packaging until you are ready to install the equipment.
- Only install equipment in approved enclosures and / or locations that prevent casual access and provide electrostatic discharge protection as defined by IEC 1000-4-2.
- Use a conductive wrist strap or equivalent field force protective device attached to an earth ground when handling sensitive equipment.
- Always discharge yourself by touching a grounded surface or approved antistatic mat before handling the equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

3.1.5. Analog Inputs-Probes

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

NOTE: Probes which have a specific connection polarity, which must be observed.

NOTICE

INOPERABLE EQUIPMENT

Verify all wiring connections before applying power.

Failure to follow these instructions can result in equipment damage.

NOTE: Apply power to all externally powered devices after applying power to the **FREE Smart** controllers.

NOTE: Signal leads (probes, digital inputs, communication and the electronic supply) must be routed separately from power cables.

3.1.6. Serial connections

TTL

Use a 5-wire TTL cable up to 30cm in length.

NOTE: SMC-SMD-SMP4500-5500/C/S / **SMD3600/C/S 2T**: the TTL and RS485 serials cannot be used at the same time.

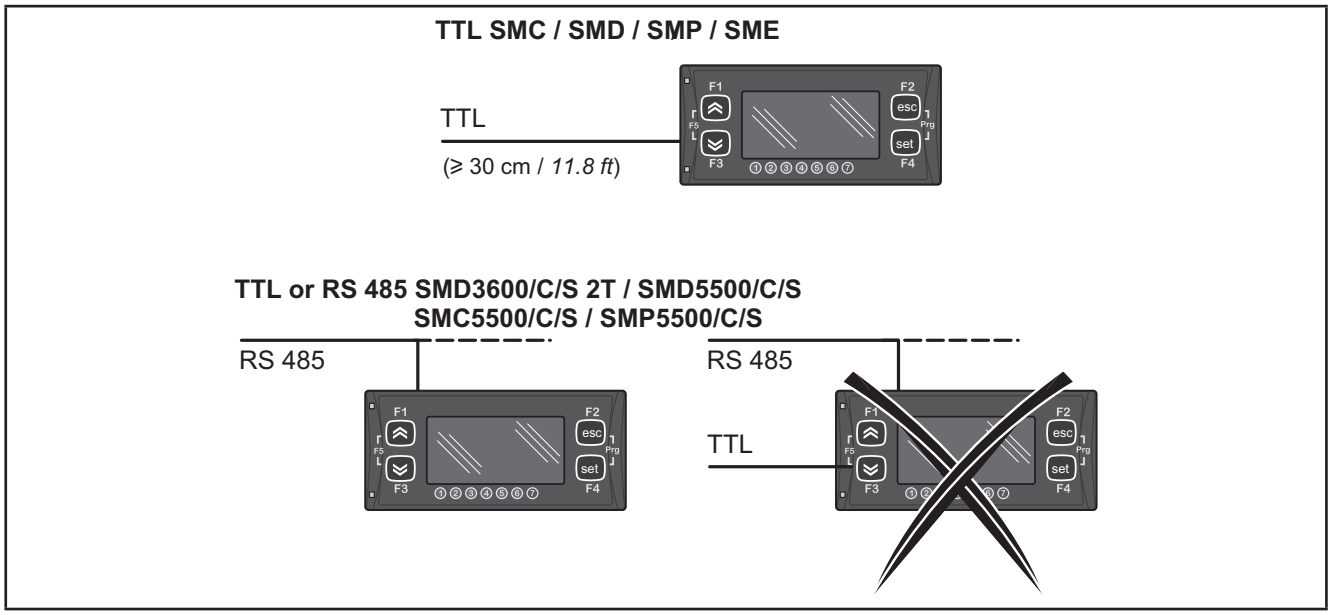


Fig. 21. Serial connection: TTL / RS485

LAN

3-wire LAN 3 powered serial available on the **Display** to connect to the LAN network.

Max. distance of 100m between the first and last element in the network.

3.2. Wiring diagrams

Miswiring irreversibly damages the **FREE Smart** logic controller**s**.

NOTICE
INOPERABLE EQUIPMENT Verify all wiring connections before applying power. **Failure to follow these instructions can result in equipment damage.**

3.2.1. SMD4500/C(/S) / SMC4500/C/S / SME4500 references

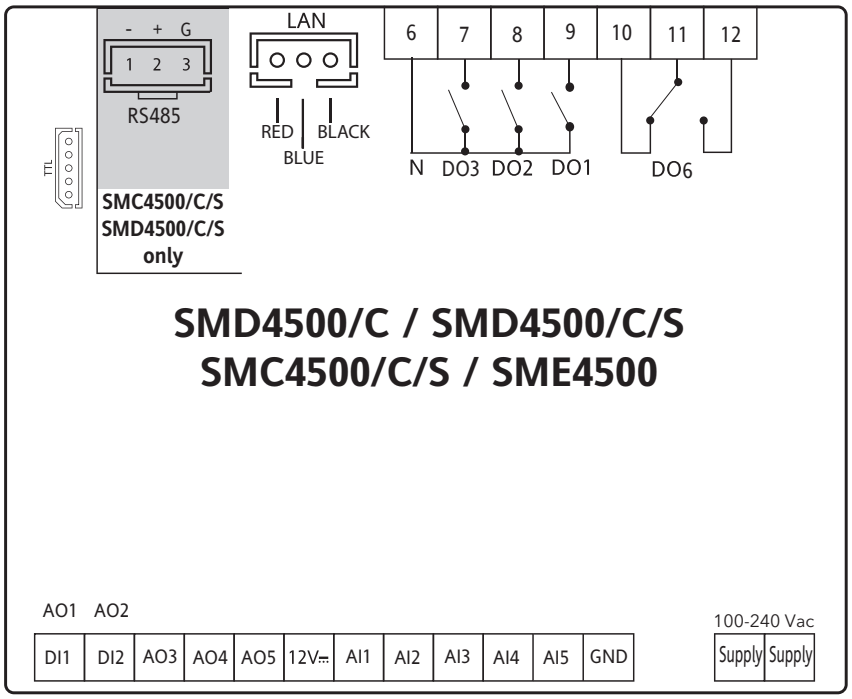


Fig. 22. SMD4500/C(/S) / SMC4500/C/S / SME4500 - 100-240V~ references

4 x 2A 230 Vac high voltage digital outputs	[DO1, DO2, DO3, DO6]
5 analog outputs	2 PWM Open Collector analog output [AO1, AO2]
	3 low voltage (SELV (§)) analog output • 2 x 0-10V output [AO3-4] • 1 x 0-10Voutput [AO5] or 4…20mA/0…20mA alternative on dedicated reference
2 no-voltage digital inputs (°)	[DI1, DI2]
5 analog inputs	• 3 NTC* / Pt1000(^) / Digital Input*** [AI1, AI2, AI5] • 2 NTC / voltage, current** / Digital input*** [AI3, AI4]

(^) Pt1000 available on **SMC-SMD4500/C(/S) only.** 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
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

POWER SUPPLY	100-240V~
12V⎓	12Vdc auxiliary supply
N	Neutral
LAN	Connection to **SKP 10** / **SME** (max 100m)
TTL	TTL serial to connect a **MFK 100**
RTC	RTC as standard
RS485	**SMC-SMD4500/C/S** integrated RS485 serial to connect to supervisor

3.2.2. SMC-SMD-SMP5500/C(/S) / SME5500 reference

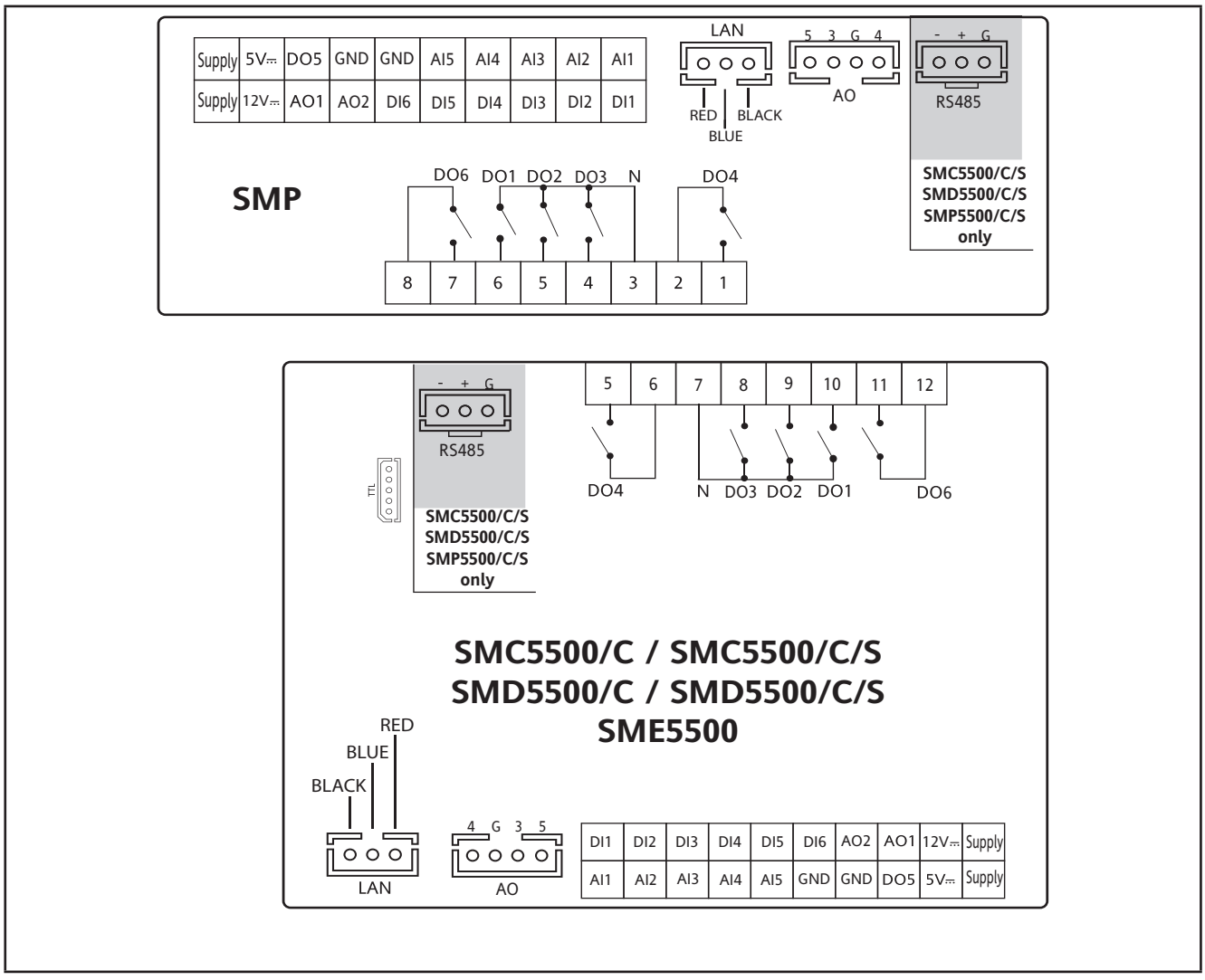


Fig. 23. SMC-SMD-SMP5500/C(/S) / SME5500 reference

5 x 2A 230Vac high voltage digital outputs	[DO1, DO2, DO3, DO4, DO6]
5 analog outputs	2 PPM/PWM Open Collector analog output [AO1, AO2]
	3 low voltage (SELV (§)) analog output
2 x 0-10V outputs	[AO3-4]
1 output	1 x 0-10Voutput [AO5] or 4…20mA/0…20mA alternative on dedicated reference
6 configurable, no-voltage digital inputs (°)	[DI1…DI6]
5 analog inputs	3 NTC* / Digital input*** [AI1, AI2, AI5]
	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
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

POWER SUPPLY	12-24V~ / 24V⎓
5V⎓	5Vdc 20mA max. auxiliary supply
12V⎓	12Vdc auxiliary supply
N	Neutral
LAN	Connection to **SKP 10** / **SME** (max 100m)
TTL	TTL serial to connect a **MFK 100**
RTC	RTC as standard
RS485	**SMC-SMD-SMP4500-5500/C/S / SMD3600/C/S 2T** integrated RS485 serial to connect to supervisor

3.2.3. SMD3600/C/S 2T reference

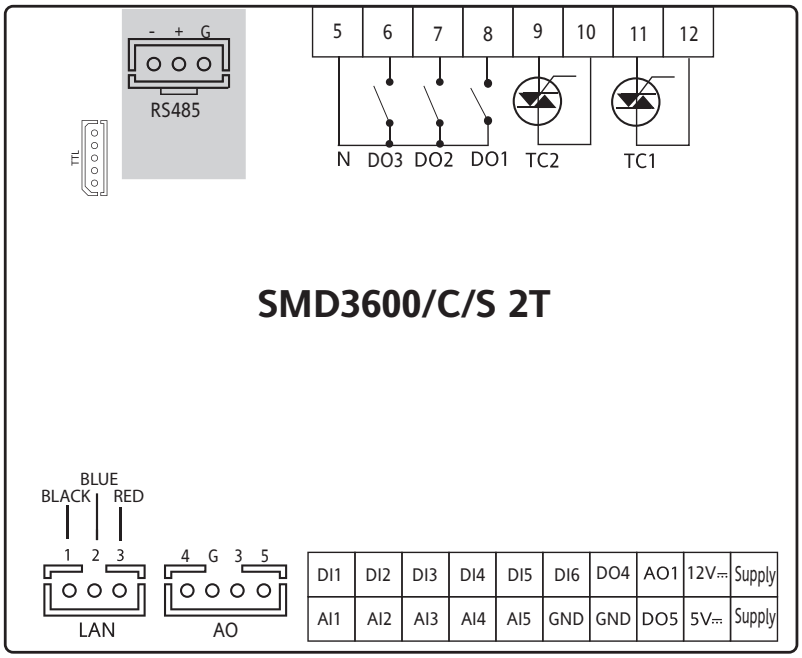


Fig. 24. SMD3600/C/S 2T reference

3 x 2A 230Vac high voltage digital outputs	[DO1, DO2, DO3]
6 analog outputs	2 x3A 230Vac high voltage analog output [TC1 TC2]
	1 PPM/PWM Open Collector analog output [AO1]
	3 low voltage (SELV (§)) analog output
2 x 0-10V outputs	[AO3-4]
1 output	0-10V output [AO5] or 4…20mA/0…20mA alternative on dedicated reference
6 digital inputs	[DI1…DI6]
5 analog inputs	[AI1…AI5]
3 NTC* / Digital inputs***	[AI1, AI2, AI5]
2 NTC / voltage, current** / Digital inputs***	[AI3, AI4]
2 low voltage (SELV (§)) Open Collector outputs	[DO4, DO5]

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

POWER SUPPLY	12-24V~ / 24V⎓
5V⎓	5Vdc 20mA max. auxiliary supply
12V⎓	12Vdc auxiliary supply
N	Neutral
LAN	**SKP 10** / **SME** (max 100m)
TTL	TTL serial to connect a **MFK 100**
RTC	RTC as standard
RS485	**SMC-SMD-SMP4500-5500/C/S / SMD3600/C/S 2T** integrated RS485 serial to connect to supervisor

SMD3600/C/S 2T

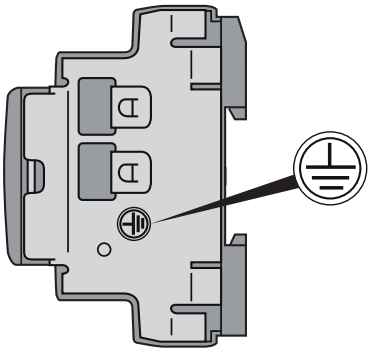


Fig. 25. SMD3600/C/S 2T ground

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK

The grounding connection on the side of the device must be used to provide a protective ground at all times.

Failure to follow these instructions will result in death or serious injury.

3.2.4. SME3200 reference

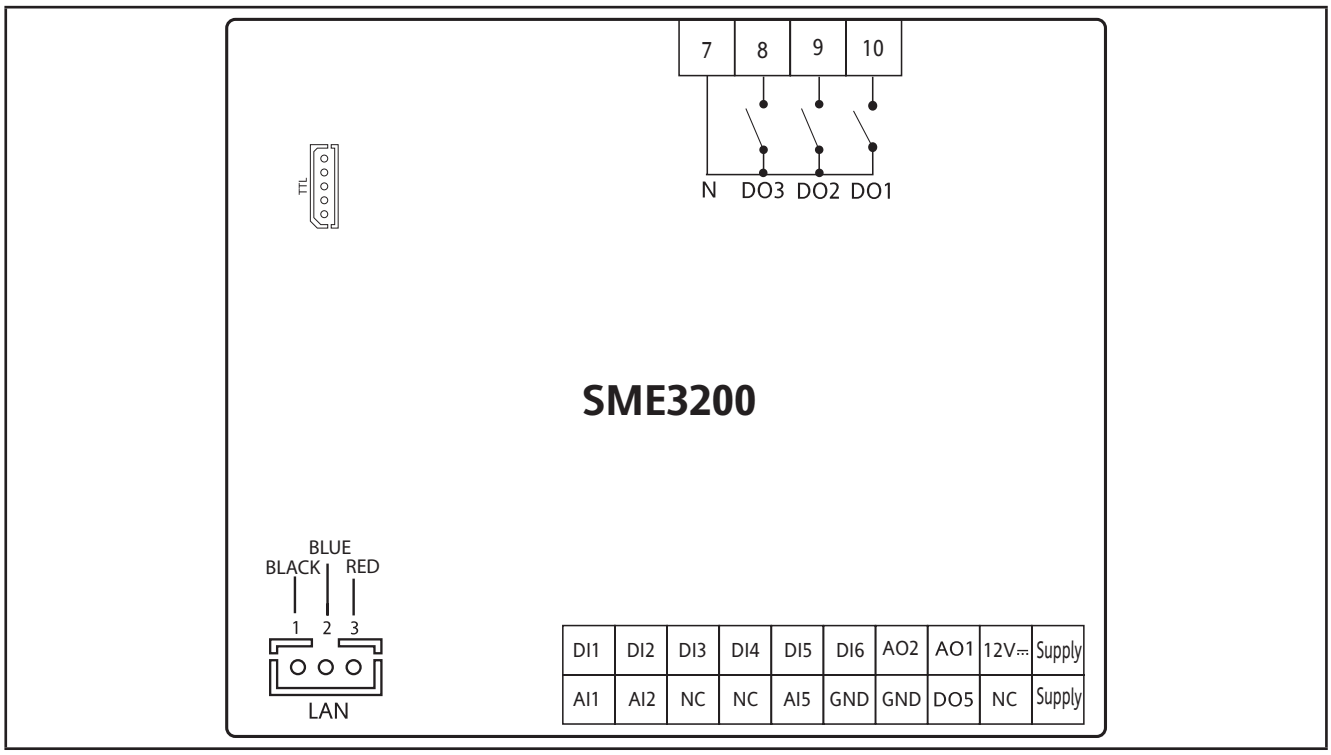


Fig. 26. SME3200 reference

6 digital inputs	[DI1…DI6]
3 x 2A 230Vac high voltage digital outputs	[DO1, DO2, DO3]
2 PPM/PWM Open Collector analog outputs	[AO1, AO2]
3 analog 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
***no voltage digital input
(°) closing current for 0.5mA ground
(§) SELV: (SAFETY EXTRA LOW VOLTAGE)

POWER SUPPLY	12-24V~ / 24V⎓
12V⎓	12Vdc auxiliary supply
N	Neutral
LAN	**SKP 10** / **SMC-SMD-SMP5500/C(/S)** / **SMD3600/C/S 2T** connection (max 100m)
TTL	TTL serial to connect a **MFK 100**

3.2.5. Example of low voltage/low current input/output connection

Example of current/voltage input connection

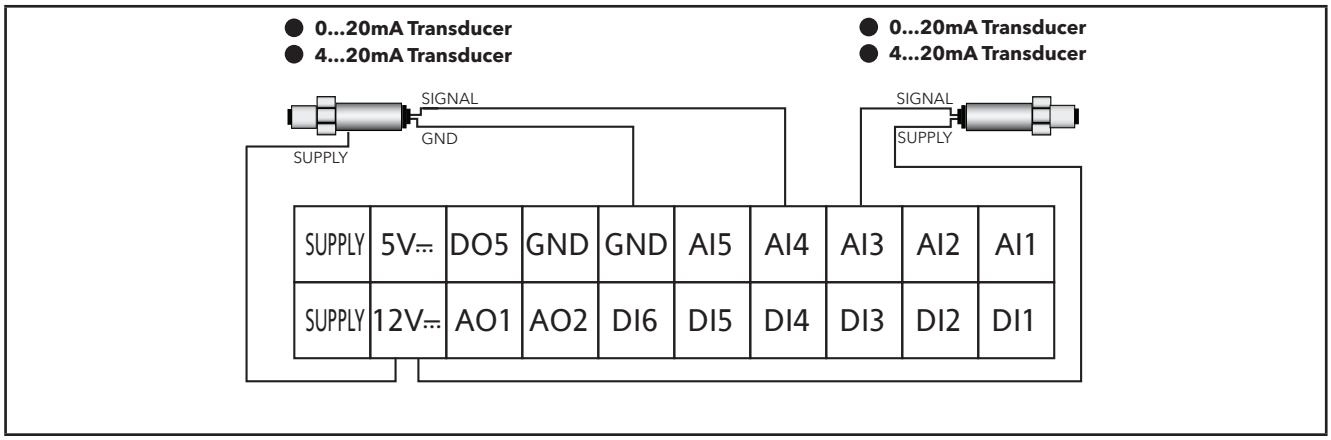


Fig. 27. Current input connection

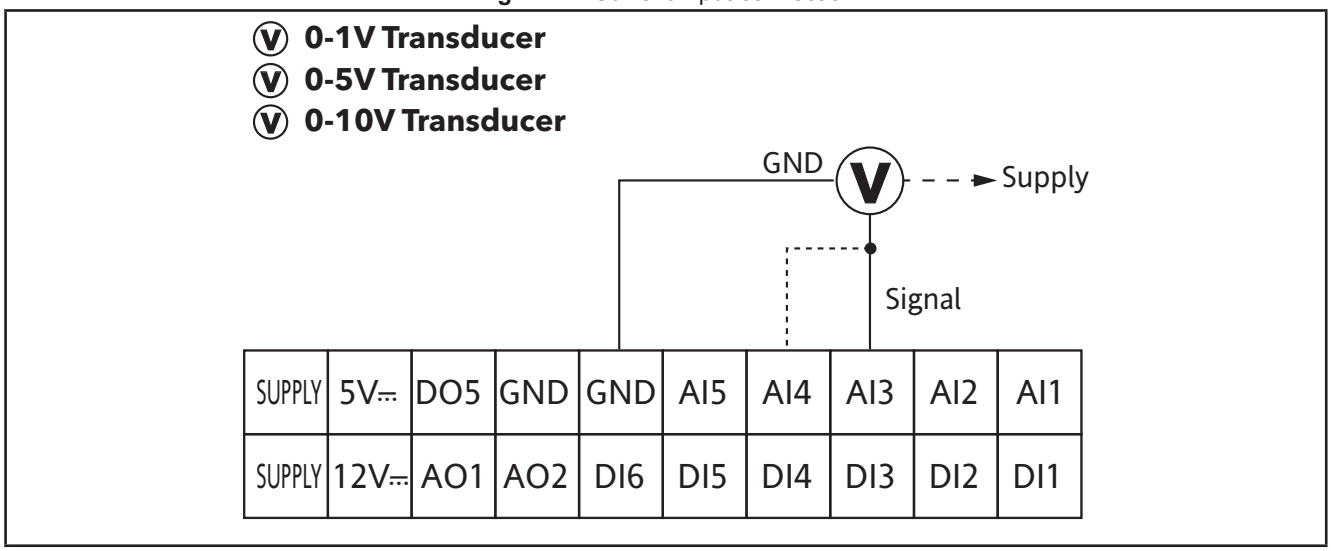


Fig. 28. Voltage input connection

In **Fig. 28 on pag. 37**, transducer Supply: from the **FREE Smart** (5V or 12V) or external supply depending on reference.
For further information, refer to transducer technical data sheet.

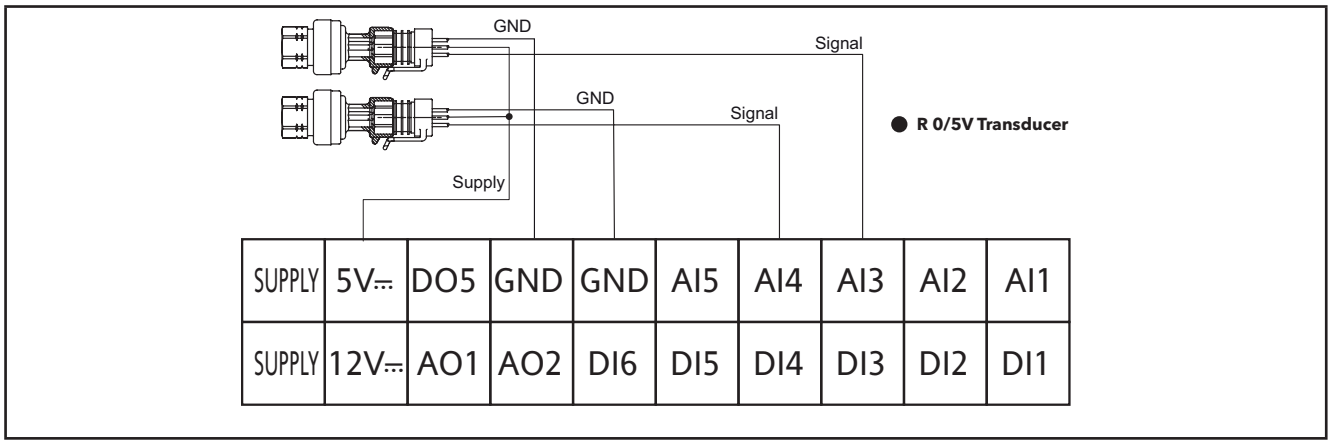


Fig. 29. 0-5V ratiometric voltage input connection

Example of Pt1000 input connection (SMD-SMC4500/C(/S) only)

Pt1000 available on **SMC-SMD4500/C(/S) only.**
If 1 Pt1000 is set -> all three AI1/AI2/AI5 are configured as Pt1000.

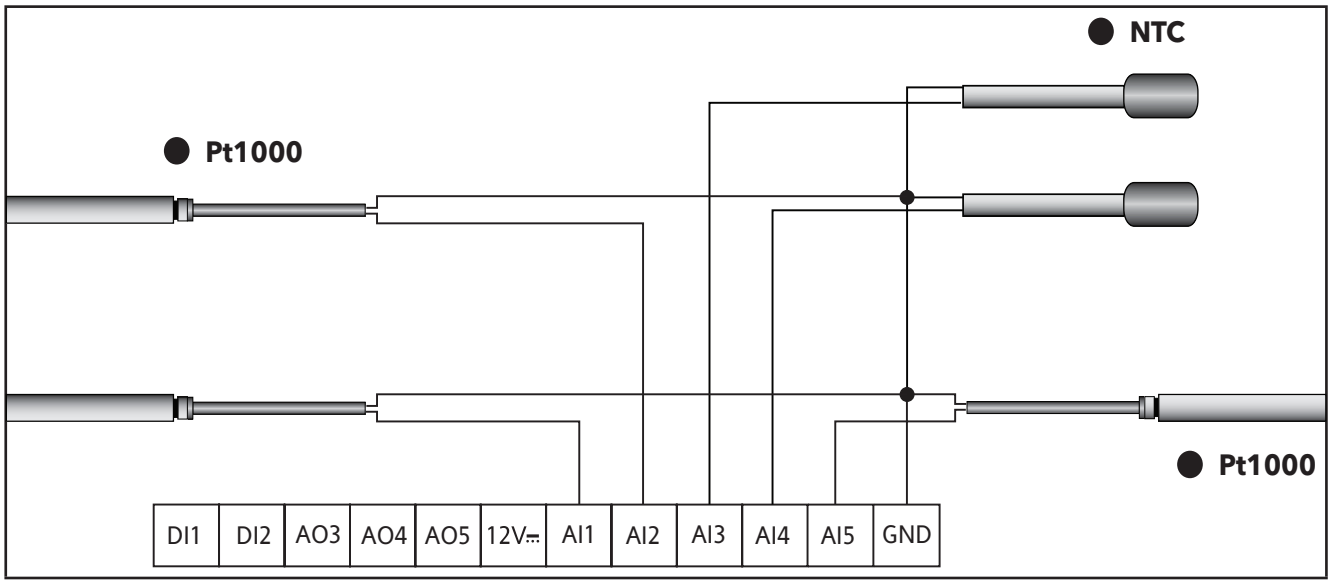


Fig. 30. Pt1000 input connection

Example of NTC/DI input connection

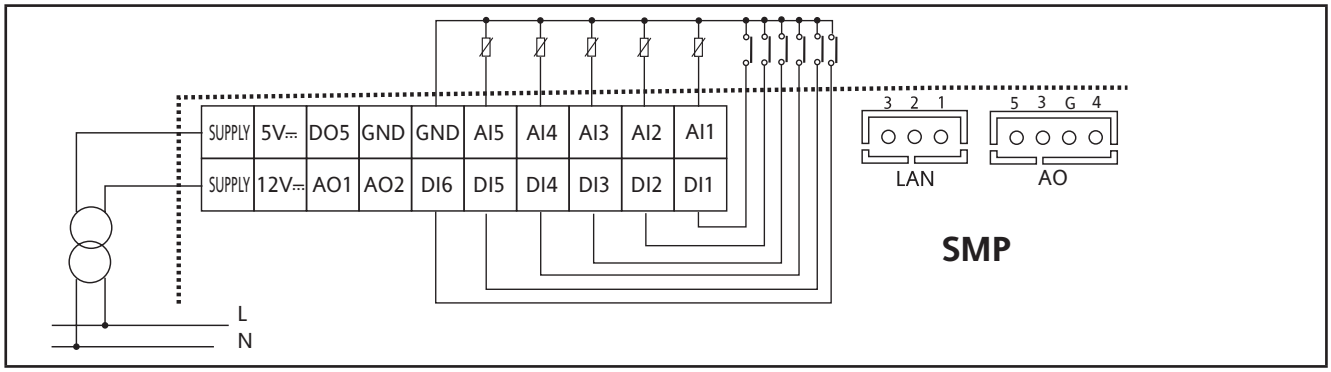


Fig. 31. SMP - Example of low voltage input / output connection

SMD / SMC / SME Identical Example.

Analog outputs AO: see **7.4. Analog outputs on pag. 77**.
Digital output DO5: see **7.3. Digital outputs on pag. 76**.
LAN: see **SKP 10** / **SME** connection.

Example of AO1 / AO2 connection

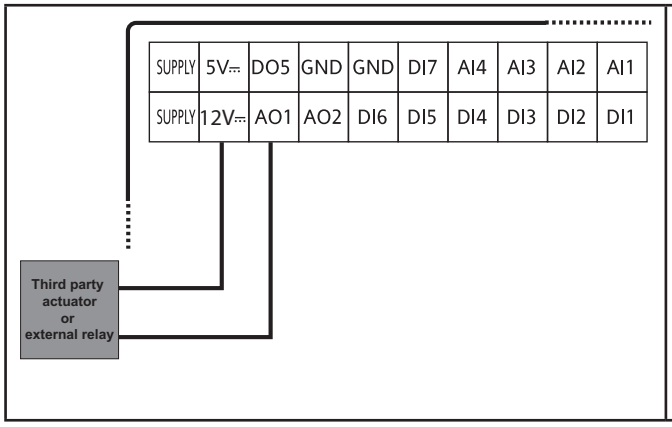


Fig. 32. Example of SMP connection (AO1) with 1 fan module or an external relay

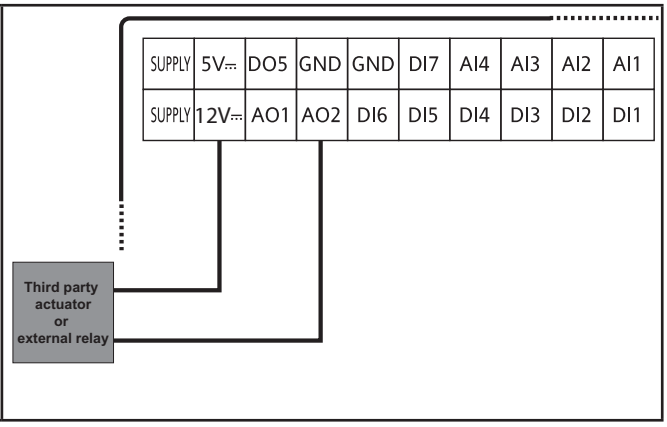
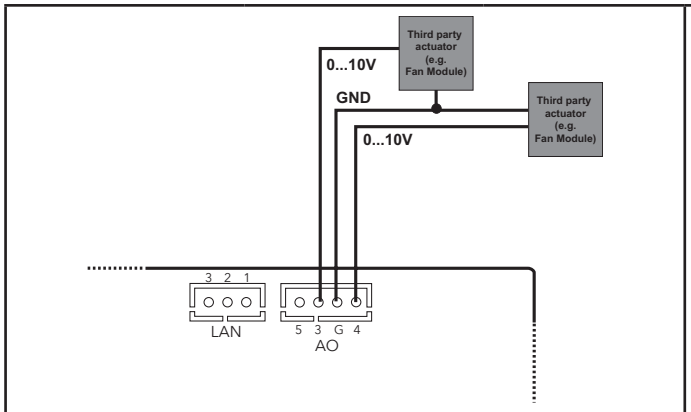


Fig. 33. Example of SMP connection (AO2) with 1 fan module or an external relay

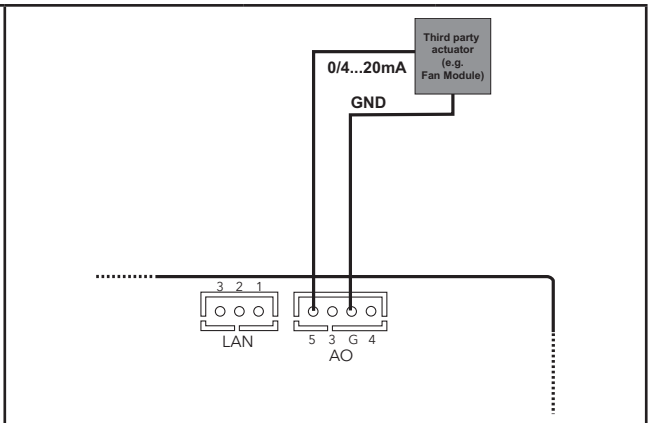
SMD / SMC / SME Identical Example.

Example of AO3-AO4 / AO5 connection



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

Fig. 34. Example of SMP connection (AO3-AO4) with 1 0-10V fan module



Analog output	Terminal no	Description
AO5	5	0-10V output or 4…20mA/ 0…20mA alternative on dedicated reference
AO5	G	GND

Fig. 35. Example of SMP connection (AO5) with 1 0…20mA / 4…20mA fan module

SMD / SMC / SME Identical Example.

Example of AO3 - AO4/AO5 connection - SMD-SMC4500/C(/S) / SME4500 references

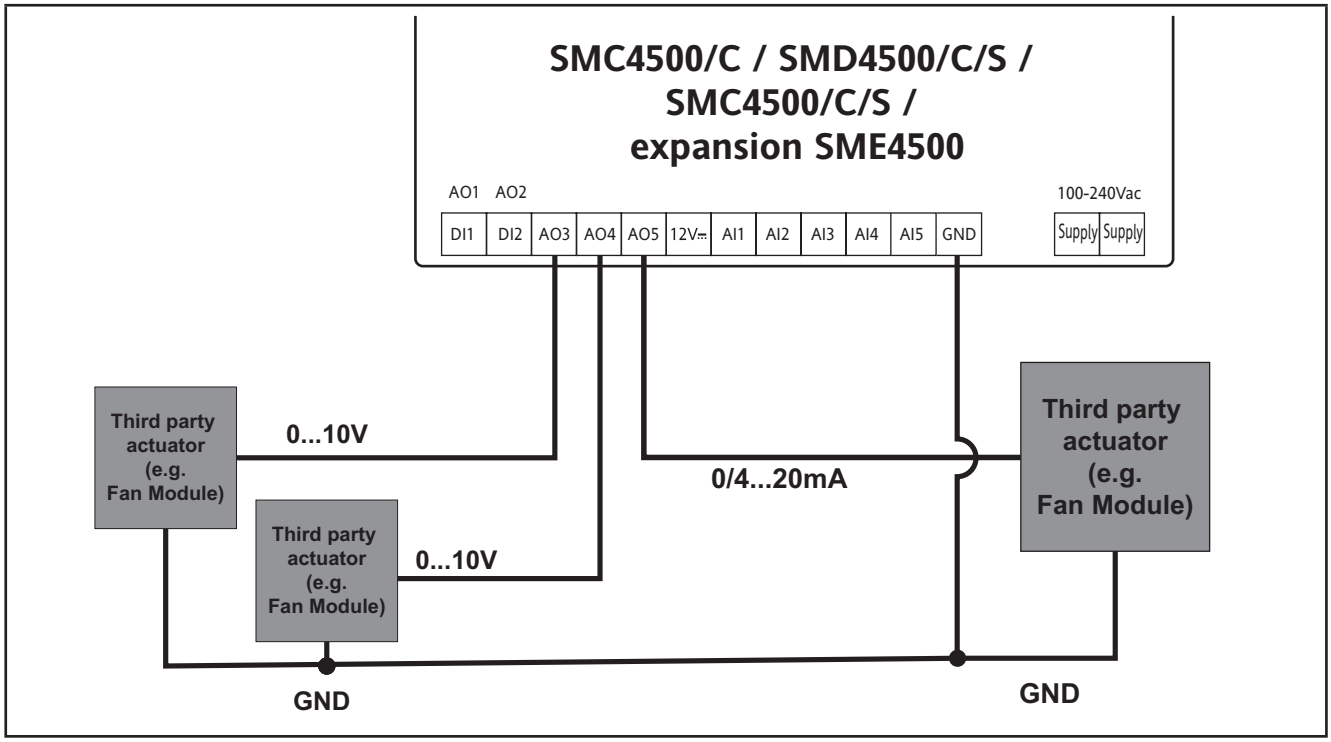


Fig. 36. Example of (AO) connection with 0…20mA / 4…20mA / 0-10V Fan Speed modules

Example of DO5 connection

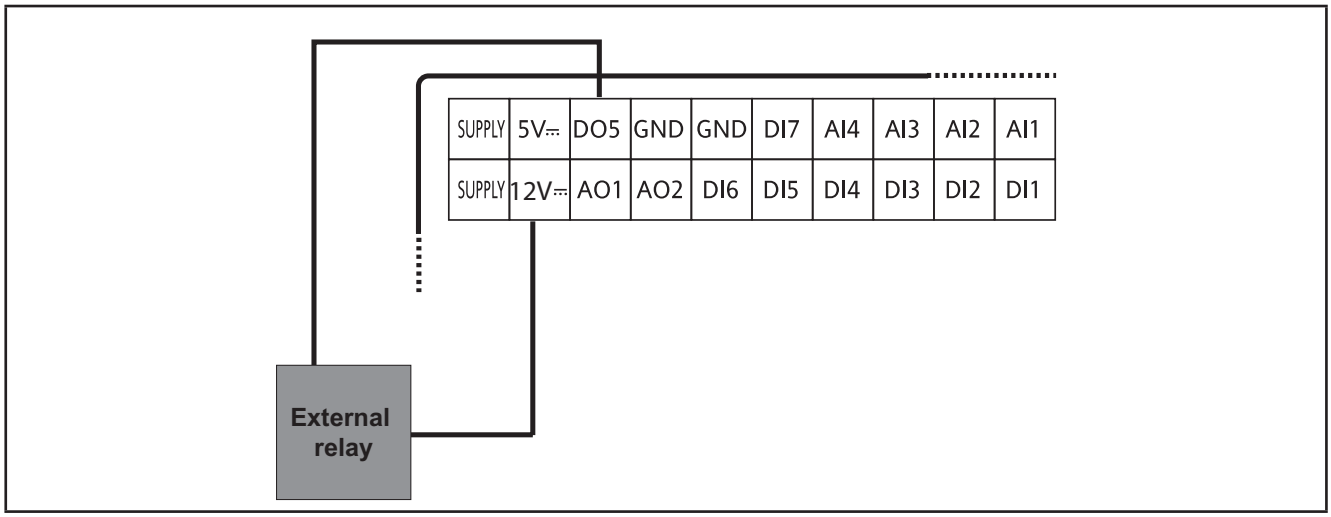


Fig. 37. Example of SMP connection with an external relay

SMD / SMC / SME Identical Example.

3.2.6. Example of high voltage outputs connection

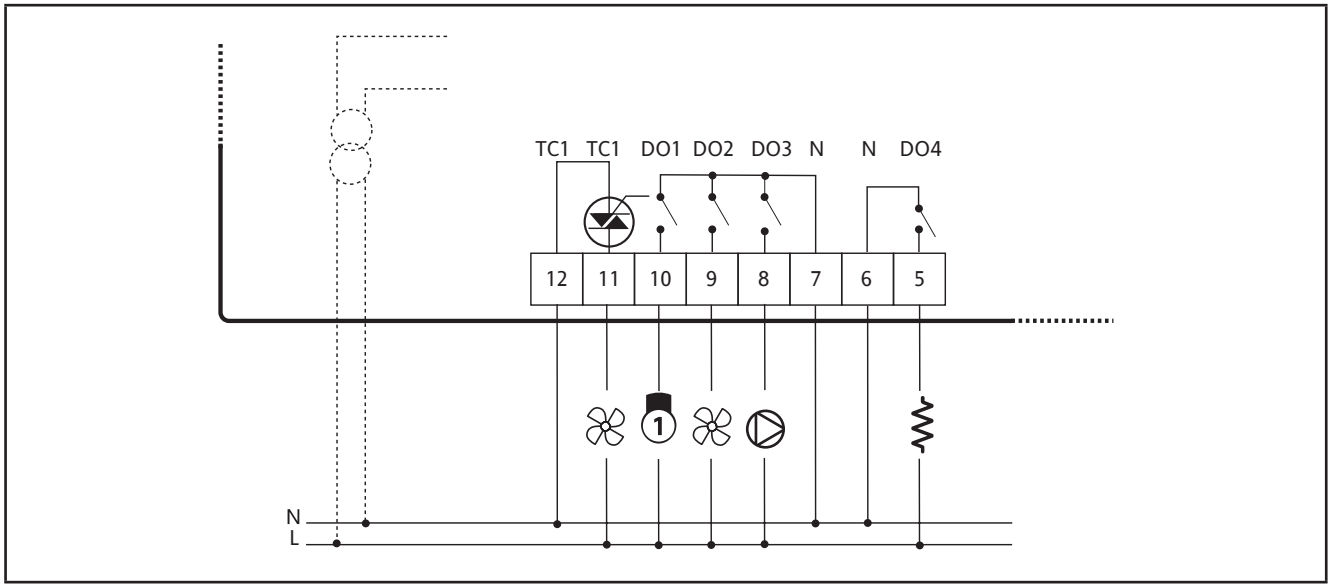


Fig. 38. Example of reference with TRIAC: example of connection of high voltage outputs

3.2.7. SKW 22(L), wall-mounted LCD display

To connect the display to a power supply, use:

- Screw connector
- JST 3-way connector

for connection to the **FREE Smart**.

The connector is inside the front keypad which is accessed by removing the cover (use a screwdriver or similar) as shown in **Fig. 11 on pag. 22.**
The cables must pass through the hole in the centre of the device's back panel (see **Fig. 12 on pag. 22**, point A).

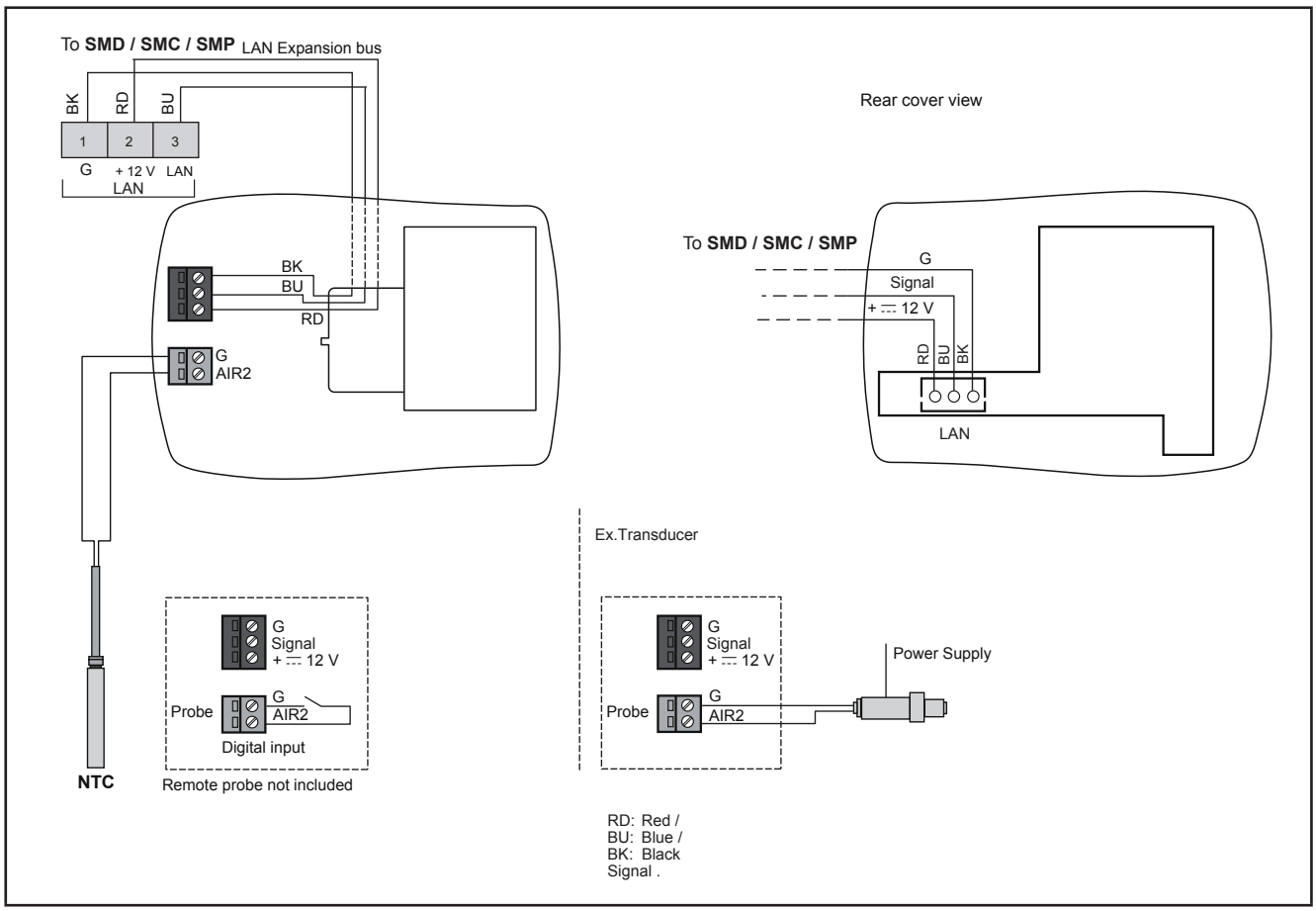


Fig. 39. SKW 22(L)

SMD / SMC / SMP	SKW 22(L)	Description
AIR1		NTC on-board analog input
1	G / BK	GND / black
2	Signal / BU	Signal / blue
3	+12Vdc / red	12V power supply from **Controller** (the transducer can be powered from the +12Vdc terminal)
AIR2	AIR2	Probe AIR2 remote analog input configurable as NTC* / 4...20mA / DI

* SEMITEC 103AT (10Kohm / 25°C) type

3.2.8. SKP 22, panel-mounted LCD display

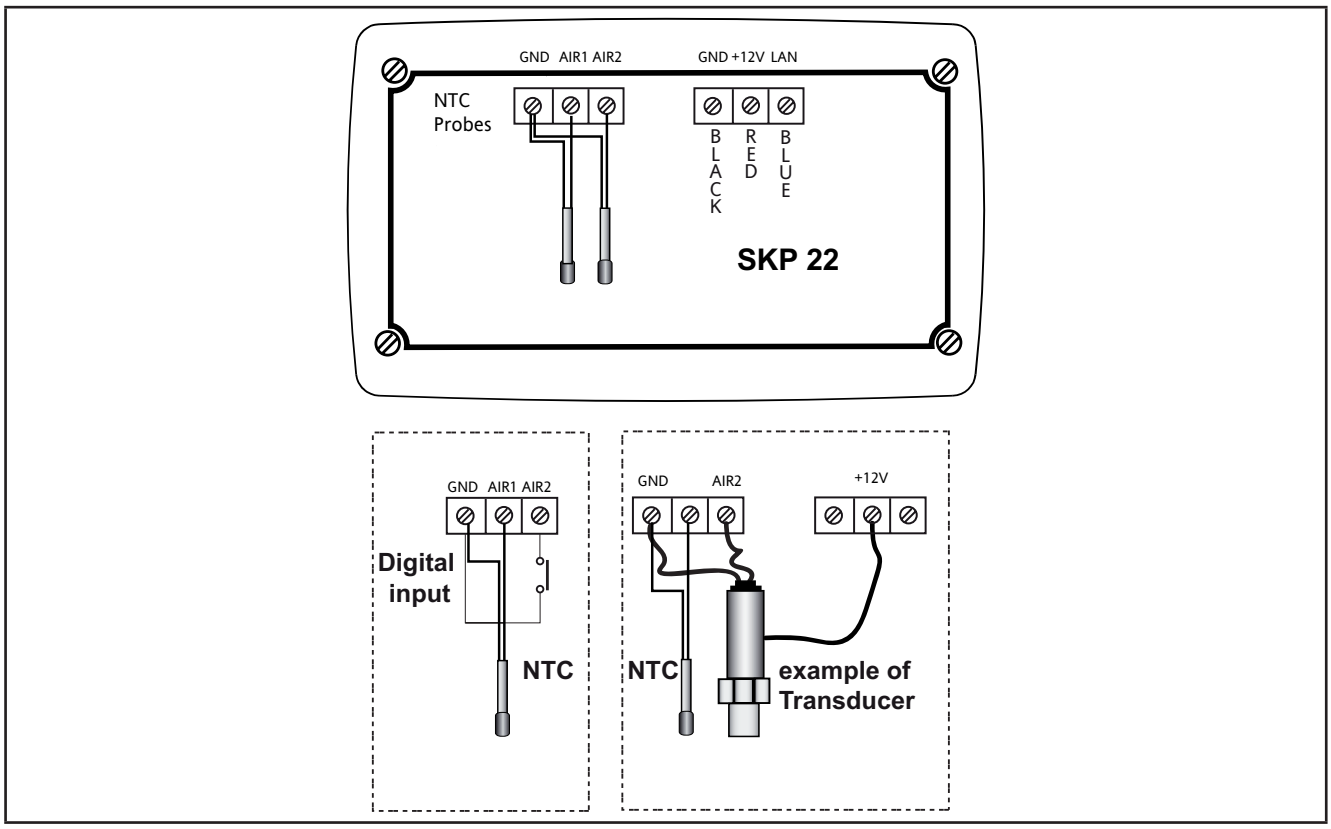


Fig. 40. SKP 22

	SKP 22	Description
AIR1	AIR1	NTC/DI on-board analog input
AIR2	Remote Probe	Remote analog 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 **Controller** (the transducer can be powered from the +12Vdc terminal)

* SEMITEC 103AT (10Kohm / 25°C) type

3.3. Examples of network connection

NOTE: Max distance for LAN cable is 100 m.

3.3.1. Example of SMP / SME connection

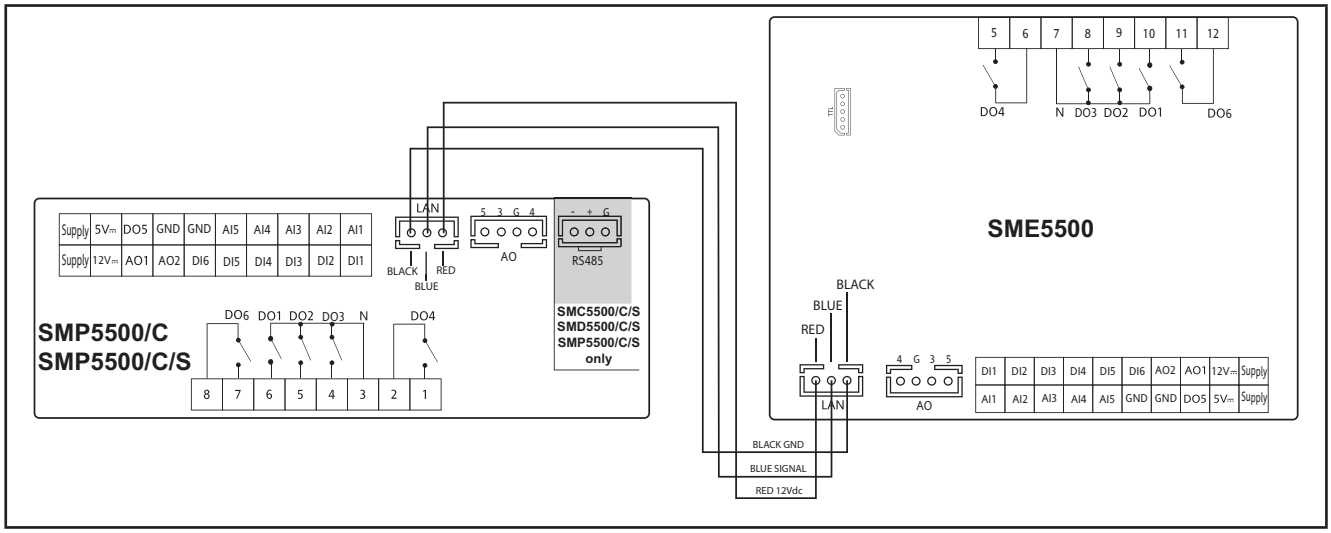


Fig. 41. SMP / SME connection

3.3.2. Example of SMC / SMD / SME connection

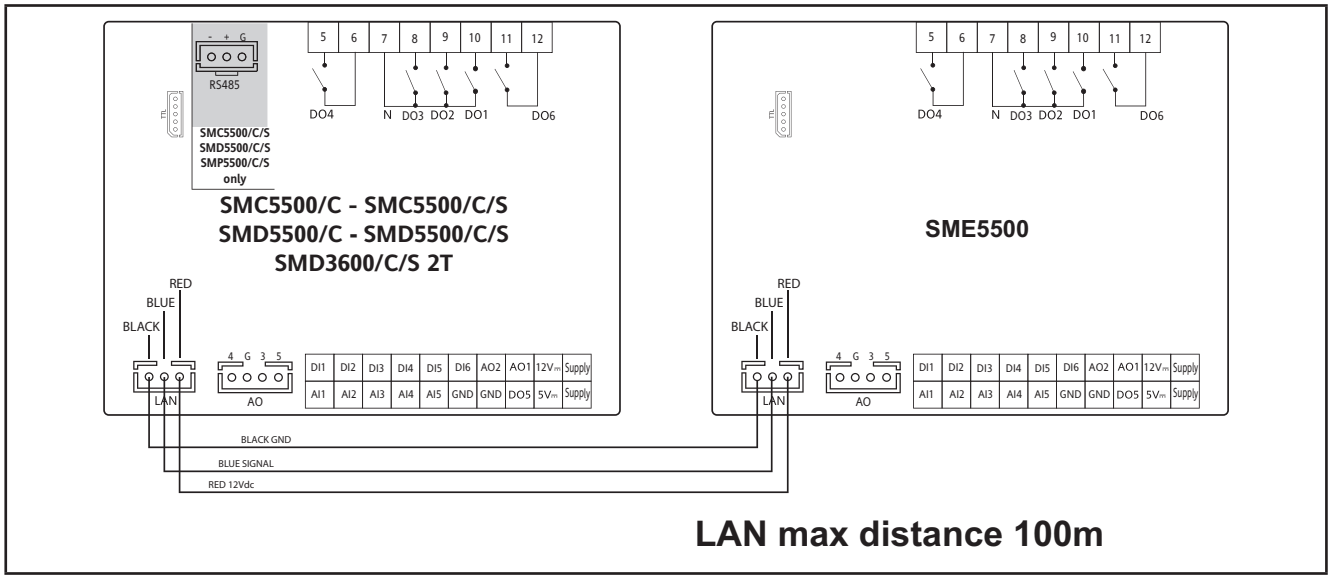
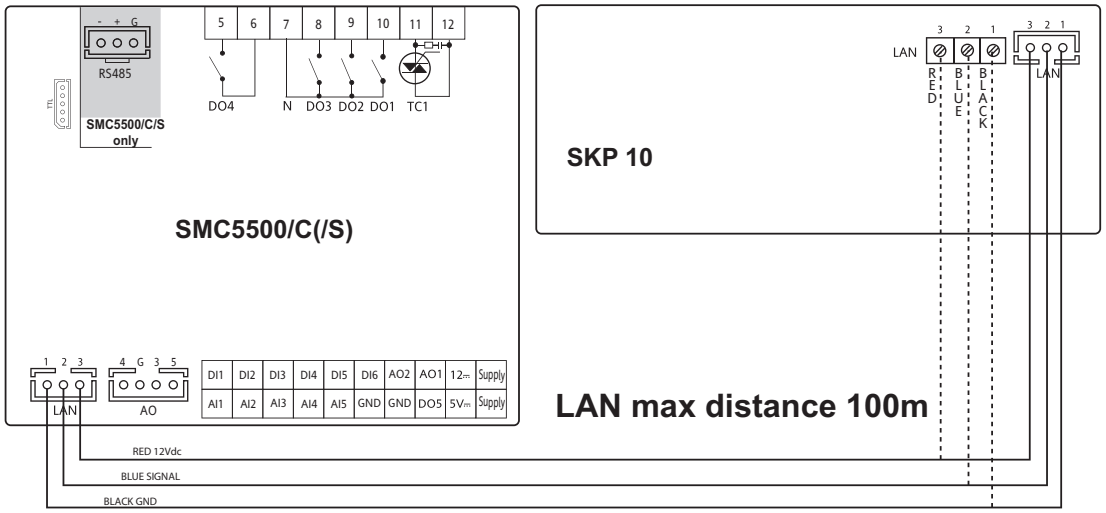


Fig. 42. SMC / SMD / SME connection

3.3.3. Example of 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

Fig. 43. SMC / SKP 10 connection

3.3.4. Example of SMC / SME / SKP 10 / SKW 22(L) network connection

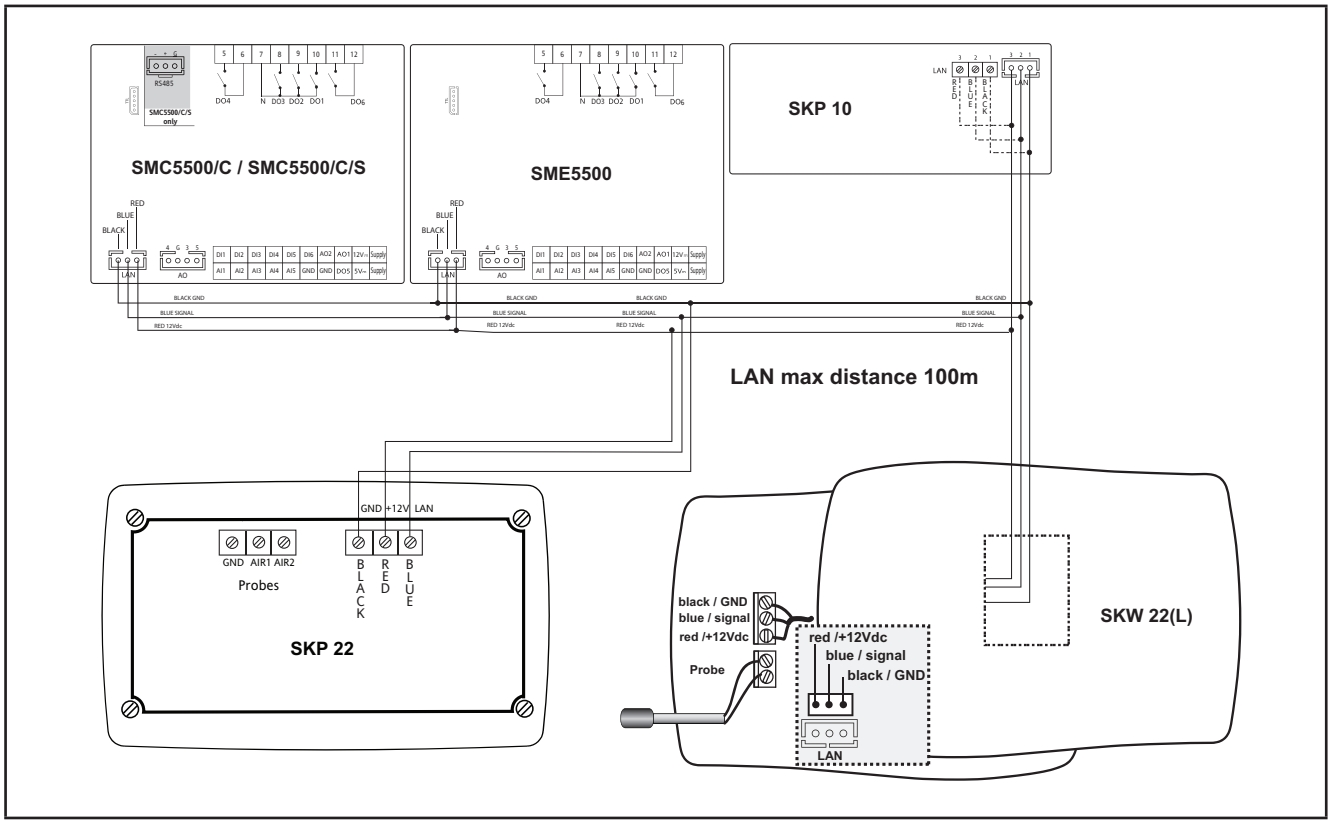


Fig. 44. SMC / SME / SKP 10 / SKW 22(L) connection

NOTE: Only 1 **Display** module (**SKW 22(L)**) can be connected at time.

CHAPTER 4
Technical data

All **FREE Smart** logic controller system components meet European Community (CE) requirements for open equipment. You must install them in an enclosure or other location designed for the specific environmental conditions and to minimize the possibility of unintended contact with hazardous voltages. Use metal enclosures to improve the electromagnetic immunity of your **FREE Smart** system. This equipment meets CE requirements as indicated in the table below.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified within this chapter.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Applying incorrect current or voltage levels on analog inputs and outputs could damage the electronic circuitry. Further, connecting a current input device to an analog input configure for voltage, and vice-versa, will likewise damage the electronic circuitry.

NOTICE

INOPERABLE EQUIPMENT

- Do not apply voltages above 11 Vdc to the analog inputs of the controller or Input/Output expansion module when analog input is configured as 0-10V input.
- Do not apply current above 30 mA to the analog inputs of the controller or Input/Output expansion module when analog input is configured as 0-20 mA or 4-20 mA input.
- Do not mismatch applied signal with analog input configuration.

Failure to follow these instructions can result in equipment damage.

4.1. General specifications

4.1.1. Controller and Expansion modules

	Standard	Min.	Max.
Supply voltage **SMC4500/C/S / SME4500**	100-240V~		
Supply voltage **SME3200 / SME5500**	12-24V~ / 24V⎓		
Supply voltage NOT INSULATED **SMC-SMD-SMP5500/C(/S)**	12-24V~ / 24V⎓		
Supply voltage NOT INSULATED **SMD3600/C/S 2T**	12-24V~		
Power supply frequency	50Hz/60Hz	---	---
Power draw **SME4500 / SMC-SMD4500/C(/S) / SMD3600/C/S 2T**	6 VA	---	---
Power draw **SME3200 / SMC5500/C**	4VA / 3W	---	---
Power draw **SMC5500/C/S / SMP-SMD5500/C(/S) / SME5500**	6VA / 4W	---	---
Insulation class	II	---	---
Ambient operating temperature	25°C	-20°C	55°C
Ambient operating humidity (non-condensing)	30%	10%	90%
Ambient storage temperature	25°C	-40°C	85°C
Ambient storage humidity (non-condensing)	30%	10%	90%

Classification	
The product 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

4.1.2. Display modules

	SKW 22	SKW 22L	SKP 22
Supply voltage	12V from base		
Power consumption	1W max	2W max	1W max
Front protection	IP40		
Insulation class	II		
Ambient operating temperature	-5…+60°C		
Ambient operating humidity (non-condensing)	10…90%RH		
Ambient storage temperature	-20…85°C		
Ambient storage humidity (non-condensing)	10…90%RH		

Classification	
The product complies with the following harmonized regulations	EN 60730-2-6 / EN 60730-2-9 / EN 60730-1
Use	In terms of design: as an automatic electronic temperature controller for built-in or stand-alone installation In terms of connection: as a device with flexible, external and disconnectable cable.
Mounting	wall (**SKW 22(L)**), panel / wall (**SKP 22**)
Type of action	1.B
Pollution class	2 (normal)
Over voltage category	II
Fire resistance category	D
Software class and structure	A
Material class	IIIa
Ball test temperature	90°C

	SKW 22	SKW 22L	SKP 22
Display	LCD	Backlit LCD	LCD 128x64 pixel LED
Casing	White ABS plastic		PC+ABS UL94 V-0 resin plastic casing, polycarbonate glass
Mounting	Wall		Panel mounting with 138x68mm template

4.2. I/O Features

4.2.1. Controller and Expansion modules

		Controller modules			Expansion modules		
Type and Label	**Description**	**SMC4500/C/S**	**SMD3600/C/S 2T**	**SMC5500/C(/S) SMD5500/C(/S) SMP5500/C(/S)**	**SME4500**	**SME3200**	**SME5500**
Digital inputs DI1 DI2	2 no-voltage digital inputs Closing current for ground: 0.5mA Note. For **SMD-SMC4500/C(/S) / SME4500** references, also available as an analog output (OC: PWM)	✓	✓	✓	✓	✓	✓
Digital inputs DI3 DI4 DI5 DI6	4 no-voltage digital inputs Closing current for ground: 0.5mA		✓	✓		✓	✓
High voltage digital outputs DO1 DO2 DO3 DO4*	3 x 2A 250V~ relays; For **SMD3600/C/S 2T**, DO4 is available as an Open Collector (OC) output.	**DO1 DO2 DO3**	***OC**	✓	**DO1 DO2 DO3**	**DO1 DO2 DO3**	✓
DO6	1 x 2A 250V~ relays; Relay output lifetime at nominal rating: 100,000 cycles	✓		✓	✓		✓
TC1 + TC2 (= AO2)	3A TRIAC, max 250V Resolution: 1% Remote control switches downstream from the TRIAC are NOT permitted		✓				

	Controller modules	Expansion modules

Type and Label	Description	SMC4500/C/S	SMD3600/C/S 2T	SMC5500/C(/S) SMD5500/C(/S) SMP5500/C(/S)	SME4500	SME3200	SME5500
PWM/PPM OC low voltage (SELV) analog 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 340Ω @12Vcc)	OC: PWM	**AO2 = TC2 (TRIAC)**	✓	OC: PWM	✓	✓
Low voltage (SELV) analog outputs AO3 AO4	0-10V max 28mA*** @10V outputs (min. 360 Ω load resistance) 2% full scale accuracy Resolution: 1%	✓	✓	✓	✓		✓
AO5	1 x 4..20mA / 0…20mA output on dedicated reference 2% full scale accuracy Resolution: 1% • 0/4…20mA output, max load (max load resistance **350Ω**)***	✓	✓	✓	✓		✓
AO5	1 x 0…10V output 2% full scale accuracy Resolution: 1%	✓			✓		
Analog inputs AI1 AI2 AI5 AI3 AI4	See tables (**Analog Inputs**)						
Open Collector low voltage (SELV) digital output DO4*, DO5	2 x Open Collector outputs ** Max. current 35mA** @12VDC		✓				
DO5	1 x Open Collector output ** Max. current 35mA** @12VDC			✓		✓	✓

*On **SMD3600/C/S 2T**, DO4 is an open collector, TC2 equals AO2 (TC2=AO2) - see **CHAPTER 7 Configuration physical I/O (Folder PAR/CL...CR) on pag. 74**.

** 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.

SMD3600/C/S 2T / SMC-SMD-SMP5500/C(/S) Analog Inputs

	NTC (103AT) 10kΩ @25°C	Current 0-20 mA 4-20 mA	Voltage 0-10 V	Voltage 0-5 V	Voltage 0-1 V	DI
AI1	✓	-	-	-	-	✓
AI2	✓	-	-	-	-	✓
AI3	✓	✓	✓	✓	✓	✓
AI4	✓	✓	✓	✓	✓	✓
AI5	✓	-	-	-	-	✓
Range	-50…+100°C (-58..212°F)	-	-	-	-	-
Accuracy	1% f.s.	1% f.s.	1% f.s.	1% f.s.	2% f.s.	
Resolution	0.1°C	0,1	0,1	0,1	0,1	
Input impedance	10kΩ	100 Ω	21K Ω	110K Ω	110K Ω	

SMD-SMC4500/C(/S) / SME4500 Analog Inputs

	NTC (103AT) 10kΩ @25°C	**Pt1000 SMD4500/C(/S) / SMC4500/C/S only**	Current 0-20 mA 4-20 mA	Voltage 0-10 V	Voltage 0-5 V	Voltage 0-1 V	DI
AI1	✓	**Pt1000**	-	-	-	-	✓
AI2	✓	**Pt1000**	-	-	-	-	✓
AI3	✓	**-**	✓	✓	✓	✓	✓
AI4	✓	**-**	✓	✓	✓	✓	✓
AI5	✓	**Pt1000**	✓	✓	✓	✓	✓
Range	-50…+100°C (-58..212°F)	-50…+400°C (-58...752°F)	-	-	-	-	-
Accuracy	1% f.s.	1% f.s.	1% f.s.	1% f.s.	1% f.s.	2% f.s.	
Resolution	0.1°C	0.1°C	0,1	0,1	0,1	0,1	
Input impedance	10kΩ	2kΩ	100 Ω	21K Ω	110K Ω	110K Ω	

DI:clean contact digital input

Probes NOT included – contact Eliwell Sales Department for Accessories

4.2.2. Display modules

SKW 22(L)	SKP 22
1 on-board configurable 103AT NTC*	1 remote configurable 103AT NTC*
1 remote configurable NTC*/4...20mA**/DI	1 remote configurable NTC*/4...20mA**/DI

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

- Measurement range: -50...100°C
- Max. resolution: 0.1°C
- Accuracy: 0.8°C [0...35°C]; 0.8...3°C [-5...0°C, 35...60°C]

User interface specifications

	SKW 22(L)	SKP 22
Keys	4 keys on the front panel of the device	8 keys on the front panel of the device
Icons	26 icons on the display, 13 on the front panel	26 icons on the display, 13 on the front panel
Double display to show temperatures / menu / folders / parameters. 4 digits. 2 and a half digits + sign.		

4.3. Serials

	Label	Description	References
Serials	**TTL**	1 TTL serial to connect Programming stick (**MFK 100**) or Personal Computer via interface module	**All references**
	RS485	RS485 opto-isolated serial	**SMC-SMD-SMP4500-5500/C/S / SMD3600/C/S 2T**

4.4. Power supply

The **SMD-SMC4500/C(/S) / SME4500** require a nominal voltage of 120-240 Vac.
All **SMC-SMD-SMP5500/C(/S) / SME5500** logic controller references **except SMD-SMC4500/C(/S) / SME4500** require power supplies with a nominal minimal voltage of 12 Vac.

The power supplies for the references **except SMD-SMC4500/C(/S) / SME4500** must be rated Safety Extra Low Voltage (SELV) according to IEC 61140. These sources of power are isolated between the electrical input and output circuits of the power supply as well as simple separation from ground (earth), PELV and other SELV systems.

⚠ ⚠ DANGER

GROUND LOOP CAUSING ELECTRIC SHOCK AND/OR INOPERABLE EQUIPMENT

- Do not connect the 0 V power supply/transformer connection supplying this equipment to any external ground (earth) connection.
- Do not connect any 0 V or ground (earth) of the sensors and actuators connected to this equipment to any external ground connection.
- If necessary, use separate power supplies/transformers to power sensors or actuators isolated from this equipment.

Failure to follow these instructions will result in death or serious injury.

In all cases, if the specified voltage range is not maintained, the products may not function as intended. Use appropriate safety interlocks and voltage monitoring circuits.

⚠ WARNING

POTENTIAL OF OVERHEATING AND FIRE

- Do not connect the equipment directly to line voltage for the references **except SMD-SMC4500/C(/S) / SME4500**
- Use only isolating SELV power supplies / transformers to supply power to this equipment for all references **except SMD-SMC4500/C(/S) / SME4500**.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The equipment must be connected to a suitable power supply/transformers with the following features:

Power supply frequency	50/60Hz
Power	6VA min. (**SMC-SMD-SMP4500-5500/C/S / SMD3600/C/S 2T**), 5VA (all other references)

References	Description	Power Supply
SMD5500/C	FREE Smart Display 22 I/Os	12/24 Vac / 24Vdc
SMC5500/C	FREE Smart Blind 22 I/Os	
SMP5500/C	FREE Smart Flush mounting 22 I/Os	
SMP5500/C/S	FREE Smart Flush mounting 22 I/Os, Modbus	
SMD5500/C/S	FREE Smart Display 22 I/Os, Modbus	
SMC5500/C/S	FREE Smart Blind 22 I/Os, Modbus	
SME5500	FREE Smart Expansion 22 I/Os	
SMD3600/C/S 2T	FREE Smart Display 22 I/Os, Modbus, 2 SSR	12/24 Vac
SME3200	FREE Smart Expansion 15 I/Os	
SMD4500/C	FREE Smart Display 14 I/Os	100-240 Vac
SMD4500/C/S	FREE Smart Display 14 I/Os, Modbus	
SMC4500/C/S	FREE Smart Blind 14 I/Os, Modbus	
SME4500	FREE Smart Expansion 14 I/Os	

4.5. Mechanical specifications

	Description	All references except for SMD-SMC4500/C(/S) /SME4500	SMD-SMC4500/C(/S) / SME4500
	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 **SMC-SMD-SMP5500/C/S / SMD-SMC4500/C/S / SMD3600/C/S 2T**	1 x 3-way connector To be used with **COLV000035100**	**All references /S**	-
	1 x 3-way low voltage male connector For use in combination with the supplied female connector	-	**All references /S**
	Container		
	PC+ABS plastic resin with V0 flammability rating	**All references**	**All references**

4.6. Mechanical dimensions

	Length (L) mm	Depth (d) mm	Height (H) mm	Notes
SMP front panel **SKP 10**	74 74	80 30	32 32	(+0.2mm)
SMD / SMC front panel (cover) **SME**	70	//	45	(+0.2mm)
SMP dimensions	86	76 connectors excluded	26	
SMD / SMC dimensions **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)
SKW 22(L)	137	31.3	96.5	
SKP 22	160	10	96	

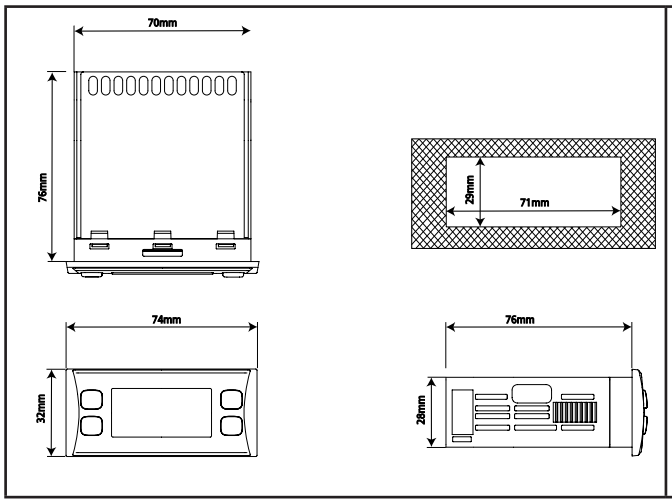


Fig. 45. SMP

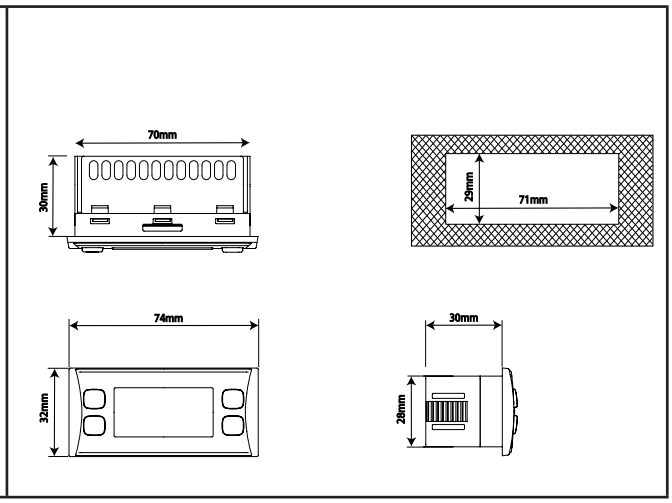


Fig. 46. SKP 10

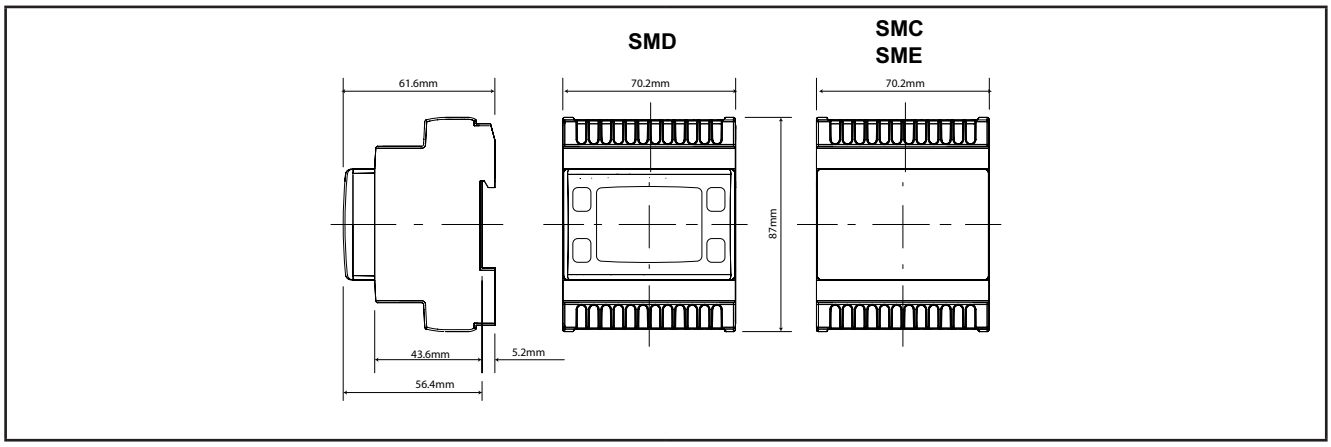


Fig. 47. SMD / SMC / SME

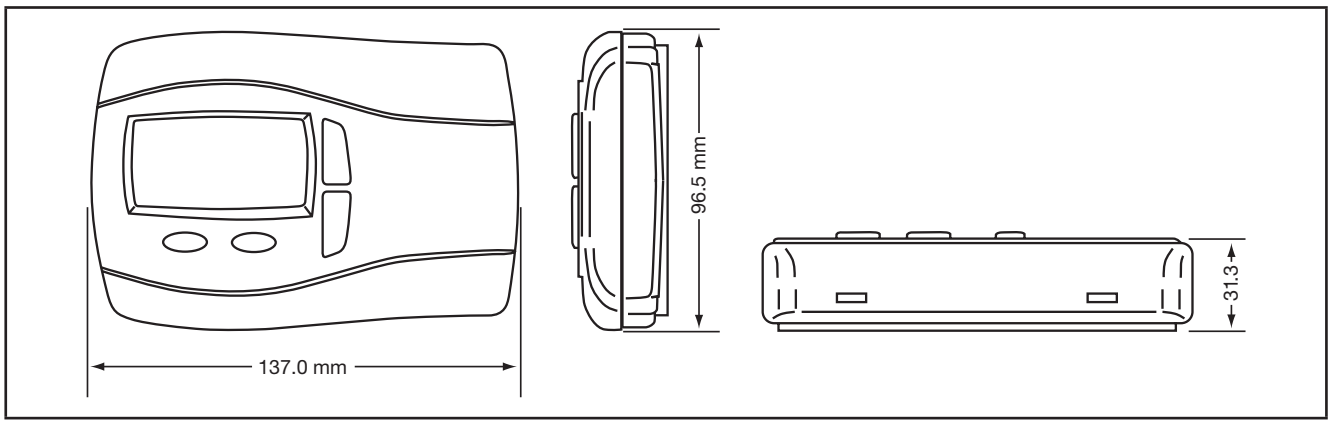


Fig. 48. SKW 22(L)

For **SKP 22** see **on pag. 22**.

CHAPTER 5
SMD / SMP / SKP 10 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.

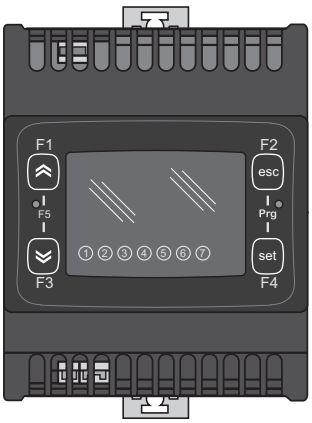


Fig. 49. SMD

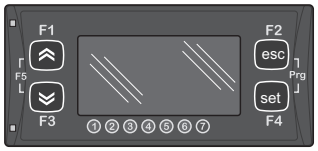


Fig. 50. SMP / SKP 10

The **SMC** module does not have a display. To operate the device, use the **SMP** / **SKP 10** or **SKW 22(L) - SKP 22**. The **SME** expansion module does not have a display.

5.1. Keys

Refer to references **SMP** / **SMD** / **SKP 10**.

Key	Press once (press and release)	Key [depending on the application; press for Ui26 seconds]
UP	• Increase a value • Go to next label	**F1**
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** user interface. Navigation for **SMD** and **SKP 10** 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 **9MA10255** - User Guide **FREE Studio** for details
Prg	**[F2+F4]**	(Open programming menu)

5.2. LEDs and Display

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

- States and Operating Modes
- Values and Units of Measure
- Utilities

5.2.1. Display

The display shows the value/resource set for the "main display".

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

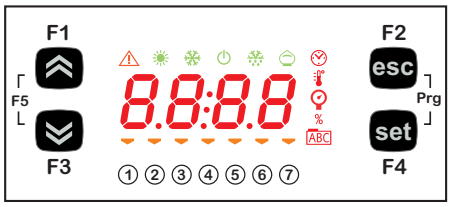
5.2.2. LEDs

LED states and Operating Modes	Icons	Description	Colour
 The 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)	
	%	RH% or % of analog output	
	ABC	Menu (ABC)	

LED utilities	Icons	Description	Colour
		Utility	Amber

5.3. First power on



When the **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 **5.1. Keys on pag. 57**).
Access to each individual menu is explained below (or in the sections indicated). There are 2 menus:

"States" menu	see **5.4.1. "States" menu on pag. 60**
"Programming" Menu	see **5.4.2. Programming menu on pag. 64**

There are 3 folders/submenus in the Programming Menu:

Parameters Menu (PAr folder)	see **Parameters (folder PAr) on pag. 64**
Functions Menu (Fnc folder)	see **5.4.3. Functions (Par/FnC folder) on pag. 65**
PASS Password	see **5.4.4. Entering a password (Par/PASS folder) on pag. 65**

BIOS menu

The **FREE Smart** has a BIOS menu to control the “State” menu and the “Programming” menu.

- If the target is ‘empty’, e.g. there is no IEC application on the device, the **FREE Smart** will display the message FrEE.
- Otherwise (the **FREE Smart** is loaded with an IEC application) the developer's default message displays, or PLC if no default has been set.

BIOS menu

Press the **UP** and **DOWN** keys (F1+F3) together to access to the BIOS menu.

See **9MA10255** - User Guide **FREE Studio** for details

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 reference (e.g dOL6 is only present on **SMP** / **SMD** / **SMC**).

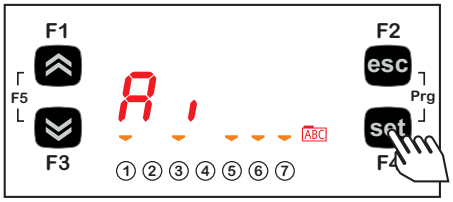
Label							Description	Change
Ai	AIL1	AiL2	AIL3	AIL4	AIL5		CONTROLLER analog inputs	//
Ai	AIE1	AiE2	AIE3	AIE4	AIE5		EXPANSION analog inputs(§)	//
Ai	Air1	Air2					DISPLAY analog inputs	//
di	diL1	diL2	diL3	diL4	diL5	diL6	CONTROLLER digital inputs	//
di	diE1	diLE2	diE3	diE4	diE5	diE6	EXPANSION (§) digital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

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

Inputs/Outputs display (AiL, diL, tCL1/AOL, dOL)

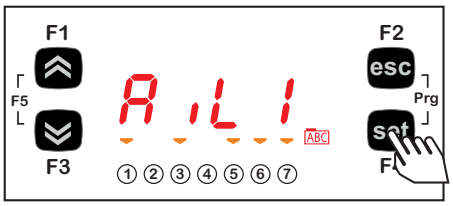
Inputs/Outputs display

To display inputs/outputs, press the **set** key from the main display.

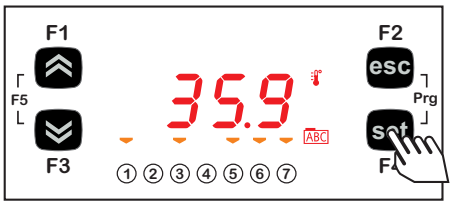


Example of view for Analog Inputs. The same procedure applies to all other I/Os***
Pressing the **set** key once will open a list of the various folders.
The label Ai will appear on the display.

(Use the **UP** and **DOWN** keys to scroll the other labels until you find the label required).



Press the **set** key to view the label for the first analog input (AiL1 in this case).



Press the **set** key again to view the value of AiL1. Note that the °F icon lights up to indicate that the value shown is in degrees centigrade.

Press the **esc** key to go back to the main display.

***For digital inputs/analog inputs configured as digital, the value will be:

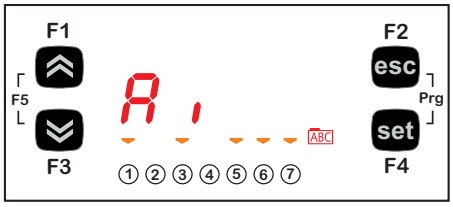
Value	Input	For digital input this in equivalent to	For analog inputs configured as digital this is equivalent to
0	not active	input open	input shortcircuited to ground
1	active	input shortcircuited to ground	input open

Setting the clock (CL)

The **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.

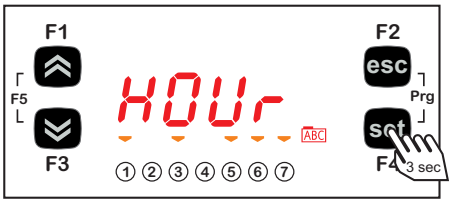
Setting the clock

To change the clock on your machine, press the **set** key from the main display.



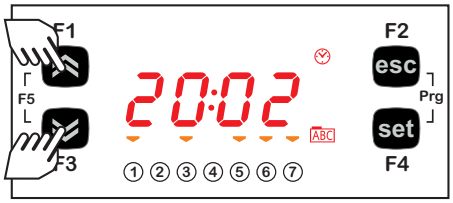
Pressing the **set** key once will open a list of the various folders.
Use the **UP** and **DOWN** keys to find the CL folder.

Press the **set** key to open the CL menu.



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.



To set the time, date and year, use the **UP** and **DOWN** keys to enter the required value.

Press **set**.

Press the **esc** key to exit the set clock menu and go back to the main display.

5.4.2. Programming menu

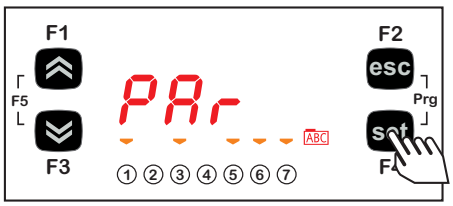
Parameters	Parameter	CL	Cr	CF	Ui
Functions	FnC				
Password	PASS				

Parameters (folder PAr)

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).

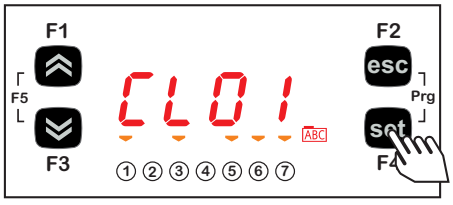
Modifying a parameter

Press the **esc** and **set** keys together to open the parameters menu. This will open the PAr menu.



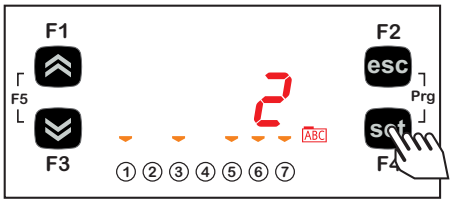
The PAr parameters menu contains all device parameter folders. Press the **set** key to view all folders.

The first folder the controller shows is the CL configuration folder. Simply press the **set** key again to modify individual CL parameters.

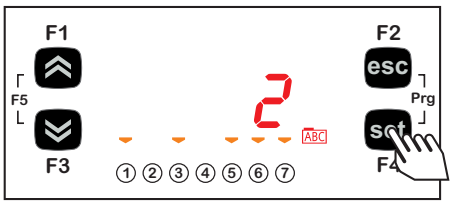


The CL00 parameter will be shown on the device (factory default settings).

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.

Note: 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)

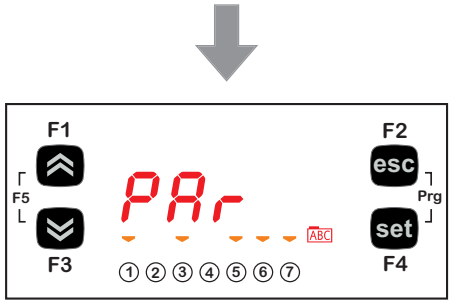
See **CHAPTER 9 Functions (Folder FnC) on pag. 92.**

5.4.4. Entering a password (Par/PASS folder)

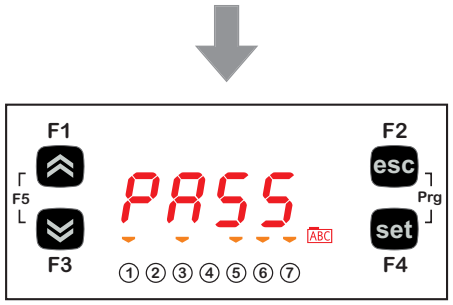
To view parameters visible for the given password, open folder PASS (press **esc** and **set** together [**esc**+**set**] from the main display and search the folder using the **UP**/**DOWN** keys) and set the PASS value.

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 **5.4.2. Programming menu on pag. 64**).

CHAPTER 6
SKP 22 / SKW 22(L) User interface (Folder PAR/UI)

The front panel of the **Display** serves as user interface and is used to perform all operations required to use the **FREE Smart** logic controllers.

6.1. Keys

The displays are the same and are interchangeable (see **Fig. 53 on pag. 69**).

Display	Keys
SKW 22(L)	4 keys on the front cover of the controller
SKP 22	8 keys on the front cover of the controller

Each key has (see **Fig. 53 on pag. 69**).

Action / function related to a key	How the action / function is shown in this chapter
A direct action	Shown on the key itself (e.g. **UP**)
An “associated” function	Shown in square brackets (e.g. [**UP**])
A combined action using 2 keys	Shown in square brackets (e.g. [**UP+DOWN**])

6.1.1. SKW 22(L) Keys

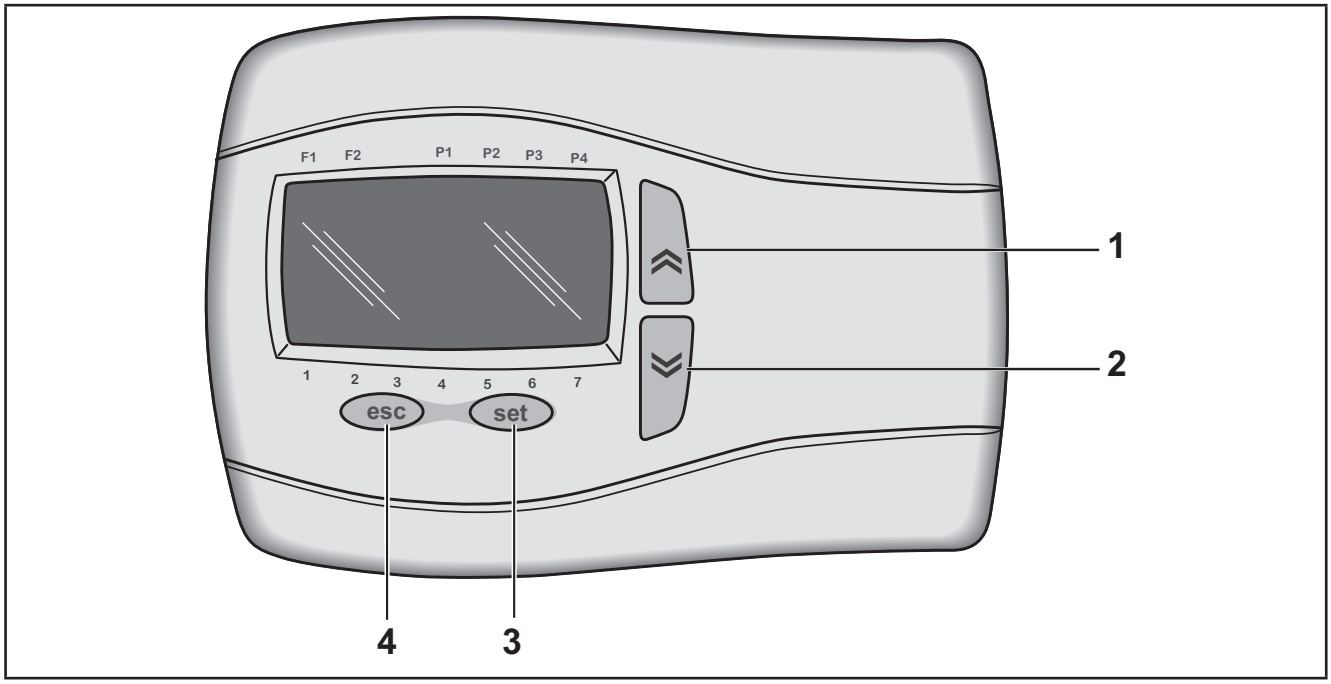


Fig. 51. SKW 22(L) Keys

No.	Key	Press once (press and release)	Long press (press and hold for about 3 seconds)
1	⌃⌃ **UP**	• Increase a value. • Go to next label.	Configurable
2	**DOWN** ⌄⌄	• Decrease a value. • Go to previous label.	Configurable
3	**set**	• Confirm value / exit and save new settings. • Move to next level (open folder, subfolder, parameter, value). • Open State Menu.	Configurable
4	**esc**	• Exit without saving new settings. • Go back to previous level.	Configurable
[1+2]	[UP + DOWN]	/	Configurable
[3+4]	[set+esc]	/	Configurable

6.1.2. SKP 22 Keys

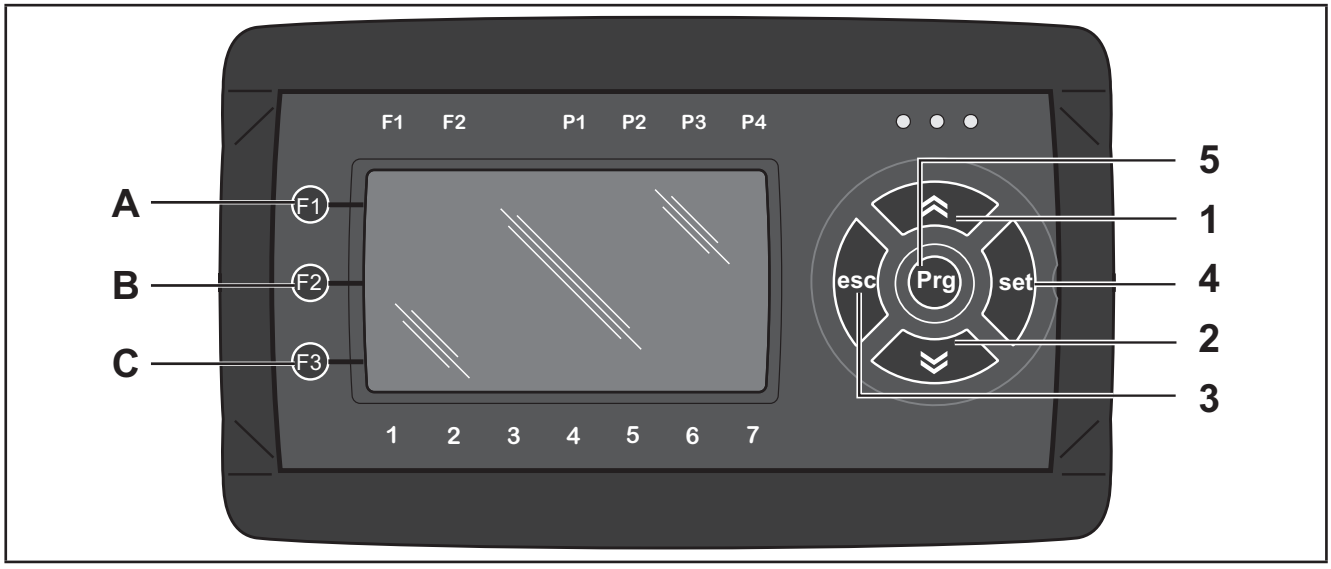


Fig. 52. SKP 22 Keys

To maintain consistency with **SKW 22(L)**, the same numbers have been used.

No.	Key	Press once (press and release)	Long press (press and hold for about 3 seconds)	Note
1	**UP**	• Increase a value. • Go to next label.	**See also F1**	/
2	**DOWN**	• Decrease a value. • Go to previous label.	**See also F3**	/
3	**esc**	• Confirm value / exit and save new settings. • Move to next level (open folder, subfolder, parameter, value). • Open State Menu. • Open Edit Mode.	Configurable	/
4	**set**	• Exit menu page / go back to previous menu. • Move cursor to left in Edit Mode (press and hold). • Exit Edit Mode without saving.	**See also F2**	/
5	**Prg**	• Open Programming menu.	/	/
[A+C]	**[F1+F3]**	/		/
A	**F1**	/		See **UP** key (press and hold)
B	**F2**	/		See **esc** key (press and hold)
C	**F3**	/		See **DOWN** key (press and hold)

6.1.3. Keys: equivalence between SKP 22 and SKW 22(L)

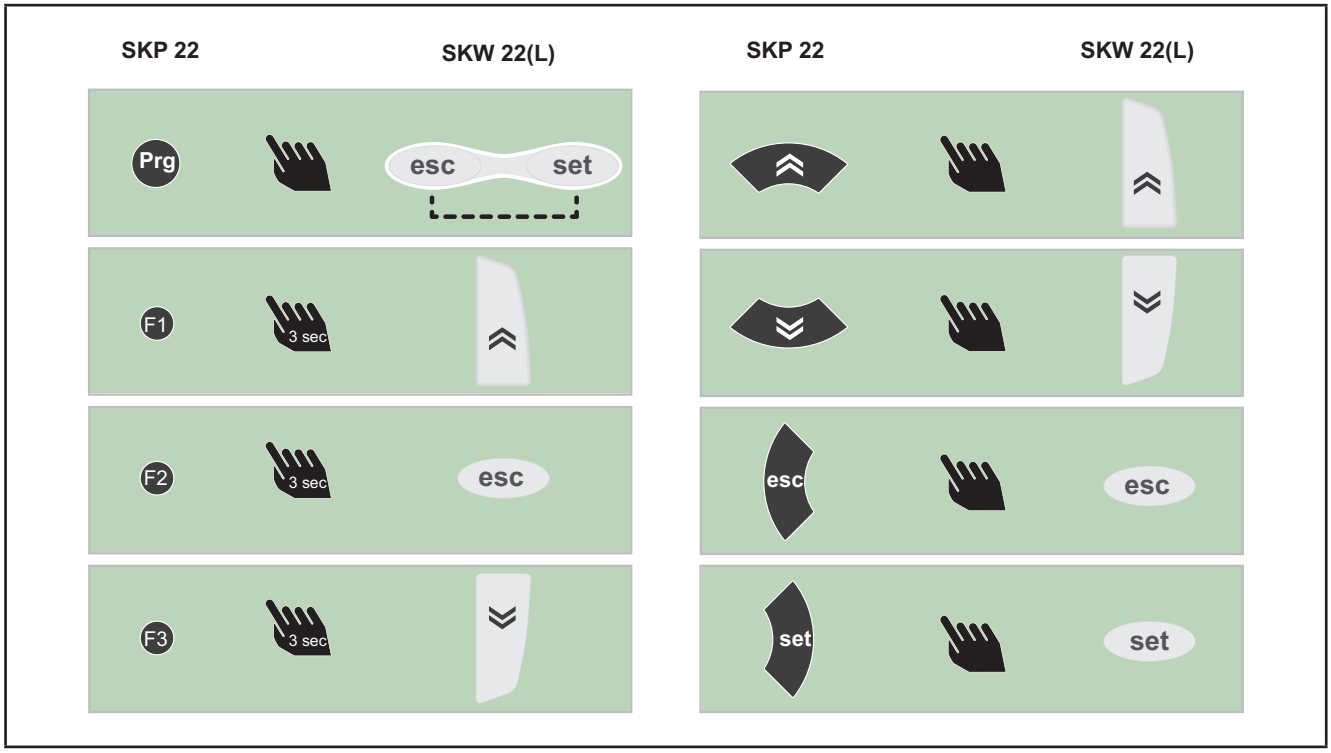


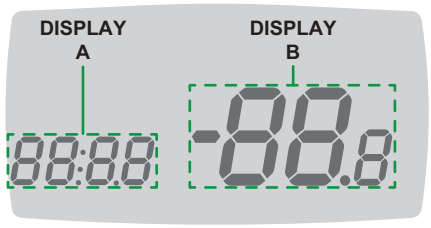
Fig. 53. SKP 22 vs SKW 22(L)

6.2. Icons and double display

The 13 icons on the front panel indicate associated/combined functions (6 icons) + default utilities (7 icons).

6.2.1. Double LCD

Which we will refer to as follows:

Display	Display A	Display B
	4-figure read-out	Read-out with 2 and a half digits and +/- sign

The double display has 26 icons:

- States and operating modes - 9 icons
  - o Browse menu / manual defrost – 2 icons
- Values and units of measure - 4 icons
- Utilities - 7 icons
- Fans - 4 icons

Read-outs can have up to

- **Display A**: 4 digits or
- **Display B**: 2 and a half digits and +/- sign

Note:

- Icons are all grey in colour.
- Some icons are NOT used – are shown on a grey background.

6.2.2. ICONS: no decimal point.

Values are always shown in tenths of a degree/bar.

6.2.3. ICONS: States and Operating Modes

Display B shows the value/resource set for the “main display”.

If there is an alarm:

- **Display A** shows the alarm code Exx. (when more than one alarm occurs at the same time, the one with the lowest number will be shown first).
- **Display B** shows “- - -” if the alarm is a probe alarm referring to the value set for the main display.

Icons	Name	Permanently ON	Flashing
⚠	Alarm	Configurable	Configurable
	Economy	Configurable	Configurable
	Not used	/	/
	Clock (RTC)	Configurable	Configurable
	Standby	Configurable	Configurable
	Heating	Configurable	Configurable
	Cooling	Configurable	Configurable
	Not used	/	/
AUTO	Not used	/	/

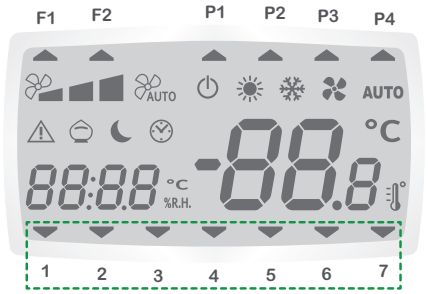
Icons ▲ are associated with menu navigation and manual defrost. The factory settings of the controller are listed in the table:

Icons	Name	
▲	ICON 1 (first from top on the left)	Configurable
▲	ICON 2	Configurable

6.2.4. ICONS: Values and Units of Measure

	Icons	
	°C	Not used
	%R.H.	Not used
	°C	Degrees centigrade
		Not used

6.2.5. ICONS: Utilities

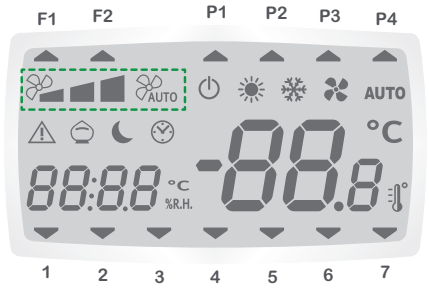
	Icons	Name	Permanently ON	Flashing
		ICON 1-7	Configurable	Configurable

ICONS Utilities: default configuration

The icons associated to utilities are all configurable. The factory settings of the controller are listed in the table:

Icon	Name	LED	
	ICON 1 (first from bottom left)	LED 11	Programmable indicators
	ICON 2	LED 12	
	ICON 3	LED 13	
	ICON 4	LED 14	
	ICON 5	LED 15	
	ICON 6	LED 16	
	ICON 7	LED 17	

6.2.6. ICONS: fans



Icons	
	Not used
AUTO	Not used

CHAPTER 7
Configuration physical I/O (Folder PAR/CL...CR)

From time to time, new input modules, output modules or other devices are made available that are not documented in the following information. For information on new devices, contact your local Eliwell representative.

NOTICE

INOPERABLE EQUIPMENT

Update the controller firmware to the latest version every time you install a newly released Input/Output expansion module or other device to this equipment.

Failure to follow these instructions can result in equipment damage.

NOTE: For more information on how to update the controller firmware, contact your local Eliwell representative.

Applying incorrect current or voltage levels on analog inputs and outputs could damage the electronic circuitry. Further, connecting a current input device to an analog input configure for voltage, and vice-versa, will likewise damage the electronic circuitry.

NOTICE

INOPERABLE EQUIPMENT

- Do not apply voltages above 11 Vdc to the analog inputs of the controller or Input/Output expansion module when analog input is configured as 0-10V input.
- Do not apply current above 30 mA to the analog inputs of the controller or Input/Output expansion module when analog input is configured as 0-20 mA or 4-20 mA input.
- Do not mismatch applied signal with analog input configuration.

Failure to follow these instructions can result in equipment damage.

7.1. Analog Inputs

The analog 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).

7.1.1. SME expansion Analog Inputs

The analog 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).

7.1.2. SKW 22(L) / SKP 22 display Analog Inputs

The analog 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.

	Par	Description	0	1*	2	3	4	5	6	7	8
Controller	CL00	Type of analog input AiL1	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	Pt1000 **SMD-SMC4500/C(/S)** only
	CL01	Type of analog input AiL2	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	Pt1000 **SMD-SMC4500/C(/S)** only
	CL02	Type of analog 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 **SMD-SMC4500/C(/S)** only
	CL03	Type of analog 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 analog input AiL5	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	
Expansion	CE00	Type of analog input AiE1	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	
	CE01	Type of analog input AiE2	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	
	CE02	Type of analog 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 analog 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 analog input AiE5	Probe not configured	Probe configured as no voltage digital input	NTC sensor	//	//	//	//	//	
Display	Cr00	Type of analog input Air1	Probe not configured	//	NTC sensor	//	//	//	//	//	
	Cr01	Type of analog input Air2	Probe not configured	Probe configured as no voltage digital input	NTC sensor	4…20 mA	//	//	//	0-20 mA	

// indicates that value is not present. *See **7.2. Digital Inputs on pag. 76**.

	Analog input AI	Parameter	range	Description
Controller	AiL3	**CL10**	CL11…999.9	Analog input AiL3 full scale value
	AiL3	**CL11**	-999.9…CL10	Analog input AiL3 start of scale value
	AiL4	**CL12**	CL13…999.9	Analog input AiL4 full scale value
	AiL4	**CL13**	-999.9…CL12	Analog input AiL4 start of scale value
Expansion	AiE3	**CE10**	CE11…999.9	Analog input AiE3 fullscale value
	AiE3	**CE11**	-999.9…CE10	Analog input AE3 start of scale value
	AiE4	**CE12**	CE13…999.9	Analog input AiE4 fullscale value
	AiE4	**CE13**	-999.9…CE12	Analog input AiE4 start of scale value
Display	Air2	**Cr10**	CR11…999.9	Analog input Air2 fullscale value
	Air2	**Cr11**	-999.9…Cr10	Analog input Air2 start of scale value

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

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

7.2. Digital Inputs

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

7.3. Digital outputs

See **CHAPTER 3 Electrical connections on pag. 25** 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, relay(s).
- The low voltage (SELV), open collector output(s).

The digital outputs are identified as DO1,...DO6.

7.4. Analog outputs

See **CHAPTER 3 Electrical connections on pag. 25** for the number and type of analog outputs used and for information on the symbols used on labels supplied with the device.
There are 6 analog outputs: high voltage output(s) and low (SELV) voltage one(s), the exact number depending on the following references and with the following characteristics:

Table A2 – Analog Outputs and References

		High voltage	SELV			Controller references		Expansion references	
Output	Label on display	SMD3600/C/S 2T	Open Collector PWM/ PPM	0-10 V	0..20 mA 4..20 mA	SMD3600/C/S 2T	SMD5500/C(/S) SMP5500/C(/S) SMC5500/C(/S)	SME3200	SME5500
TC1	TCL1	3A 230V				●			
TC2	TCL2	3A 230V				●			
AO1	AOL1		●			●	●		
AO2	AOL2		●				●		
AO3	AOL3			●		●	●		
AO4	AOL4			●		●	●		
AO5	AOL5			●	●	●	●		
TC1	TCE1	3A 230V						●	
TC2	TCE2	3A 230V							
AO1	AOE1		●					●	●
AO2	AOE2		●					●	●
AO3	AOE3			●					●
AO4	AOE4			●					●
AO5	AOE5				●				●

Triac Analog 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.

The TRIAC TC1 output (TC1, TC2 ~ **SMD3600/C/S 2T**), when partialized, suppresses the half-wave at the zero-crossing.

> **⚠ WARNING**
>
> **UNINTENDED EQUIPMENT OPERATION**
> Do not install contactors or other interposing relays downstream from Triac outputs.
> **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

The output can be configured as described in table “Table B - Analog Outputs”.

Configuration of low voltage (SELV) analog output

AO1	AO2	AO3-AO4	AO5
always available. Configurable as: PWM/PPM (via fans) or On/Off	always available. Configurable as: PWM/PPM (via fans) 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 analog outputs can be configured as digital or proportional.

Table B – Analog Outputs

Analog output TC1 - AO1 AO2				
Output	**Parameter**	**Description**	**Values**	**Notes**
TC1 Only reference SMD3600/C/S 2T	**CL73 CE73**	Analog output TCL1 phase shift Analog output TCE1 phase shift	0…90	Phase shift values to pilot Triac with cut- off in the event of inductive loads.
	CL76 CE76	Analog output TCL1 pulse time Analog 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=**SMC-SMD-SMP5500/ C(/S)** references	
			1= not used	See CL73 – CL76
TCE1	**CE70**	Enable TRIAC TCE1 output	0= **SME5500** reference	
			1= not used	See CE73 – CE76
AO1	**CL71 CE71**	Enable AOL1 analog output Enable AOE1 analog output	0= Output configured as digital	
	CL71	Enable AOL1 analog output	0= Output configured as digital	
			2 = REAL PWM	=2 only for **CL71**
	CL74 CE74	Analog output AOL1 phase shift Analog output AOE1 phase shift	0…90	Active if **CL71=1 / CE71=1**
AO2 *	**CL77 CE77**	Analog output AOL1 pulse time Analog output AOE1 pulse time	5…40 units (347…2776 µs)	Active if **CL71=1 / CE71=1** (1 unit = 69.4 µs).
	CL72 CE72	Enable AOL2 analog output Enable AOE2 analog output	0= Output configured as digital	
	CL72	Enable AOL2 analog output	0= Output configured as digital	
			2 = REAL PWM	=2 only for **CL72**
	CL75 CE75	Analog output AOL2 phase shift Analog output AOE2 phase shift	0…90	Active if **CL72=1 /CE72=1**
	CL78 CE78	Analog output AOL2 pulse time Analog output AOE2 pulse time	5…40 units (347…2776 µs)	Active if **CL72=1 /CE72=1** (1 unit = 69.4 µs).

*In **SMD3600/C/S 2T** reference AO2 is used as TRIAC (TC2).

SELV analog output AO3-4-5		
Parameter	**Description**	**Values**
CL60	Type of analog output AOL5	0=0-20mA Current analog output on dedicated reference 1=4-20mA Current analog output on dedicated reference 2=0-10V Voltage analog output
CE60	Type of analog output AOE5	0=0-20mA Current analog output 1=4-20mA Current analog output

The following can be piloted:

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

CHAPTER 8
Parameters (PAR)

Parameters are used to configure every aspect of the **FREE Smart** logic controllers.

They can be modified with:

- The **MFK 100**.
- Keys on **SMP** / **SMD** front panel or **SKP 10** / **SKW 22(L)** / **SKP 22** display.
- Personal computer and **FREE Studio** software.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

You must power cycle the device after any BIOS parameter modifications.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

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	**Controller** I/O configuration
CE	**C**onfiguration **E**xpansion	**Expansion** I/O configuration
Cr	**C**onfigu**r**ation display	**Display** I/O configuration
CF	**C**on**f**iguration	Configuration
UI	**U**ser **i**nterface	User interface

Visibility and value of Parameters

There are various hardware references with varying numbers of inputs/outputs.
Depending on the reference, 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** F**REE Studio** or other communication softwares) **or by programming key**.
The visibility levels are:

Value	Level of visibility	Need to password entry
3	Parameters or folders **always visible**	These ones are always visible even without a password: in this case, the following procedure is not necessary.
2	**Manufacturer level** These parameters or folders can only be viewed by entering the manufacturer's password (see parameter Ui28) (all parameters declared as always visible, parameters visible at the installer level and manufacturer's level will be visible)	These ones (password-protected) will be visible only if the correct password is entered (installer or manufacturer) via the following procedure (next table).
1	**Installation level** These parameters or folders can only be viewed by entering the installer's password (see parameter Ui27) (all parameters declared as always visible and parameters visible at the installer level will be visible)	
0	Parameters or folders **NOT visible**	

Refer also to the following table:

	hardware	TCL1 TCE1	TCL2 TCE2	DOL6 DOE6
The **FREE Smart Reference**	**SMD3600/C/S 2T**	**CL73-CL76** **CE73-CE76**	**CL75-CL78 (AOL2)** **CE75-CE78 (AOE2)**	
	SMC-SMD-SMP5500/C(/S)	//	//	//
	SMD-SMC4500/C(/S) / SME4500	//	//	//

When not indicated otherwise, the parameter is always visible and modifiable, unless customised settings have configured via serial.

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.

8.1. Parameters / visibility table, folder visibility table and client table

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

Parameter table	It contains all device configuration parameters stored in the non-volatile memory of the instrument, including visibility information	See **8.1.1. BIOS Parameters / visibility table on pag. 81**
Folders table	It lists the visibility of all parameter folders	See **8.1.2. Folder visibility table on pag. 88**.
Client table	It includes all I/O and alarm status resources available in the volatile memory of the instrument	See **8.1.3. Client table on pag. 89**

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.
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).
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** software is 50.0 • The value read from the register is 500 --> 500/10 = 50.0
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 (see **5.4.4. Entering a password (Par/PASS folder) on pag. 65**) • U.M. num
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
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 reference of the instrument. In this table, the hardware reference can be presumed to be **SMP** with 4 relays + TRIAC + 2 AO1 AO2 Open Collector PWM/PPM analog outputs + 1 low voltage analog output AO3.
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)

8.1.1. 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 analog input AiL1** • 0= Probe not configured • 1= DI • 2 = NTC • 3…7 = NOT USED 8= Pt1000 (**SMD-SMC4500/C(/S)** References only)	0 ... 8	0	num
CL	CL01	**53305**	WORD			**53586**	2	RW	**Type of analog input AiL2** See CL00	0 ... 8	0	num
CL	CL02	**53306**	WORD			**53587**	2	RW	**Type of analog 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 analog input AiL4** See CL02	0 ... 7	0	num
CL	CL04	**53308**	WORD			**53589**	2	RW	**Type of analog input AiL5** See CL00	0 ... 8	0	num
CL	CL10	**15649**	WORD	Y	-1	**53590**	1	RW	**Analog input AiL3 full scale value**	CL11 ... 9999	500	°C/Bar
CL	CL11	**15655**	WORD	Y	-1	**53591**	1	RW	**Analog input AiL3 start of scale value**	-9999 ... CL10	0.0	°C/Bar
CL	CL12	**15650**	WORD	Y	-1	**53592**	1	RW	**Analog input AiL4 full scale value**	CL13 ... 9999	500	°C/Bar
CL	CL13	**15656**	WORD	Y	-1	**53593**	1	RW	**Analog input AiL4 start of scale value**	-9999 ... CL12	0	°C/Bar
CL	CL20	**53334**	WORD	Y	-1	**53594**	1	RW	**Analog input AiL1 differential**	-120 ... 120	0	°C
CL	CL21	**53335**	WORD	Y	-1	**53595**	1	RW	**Analog input AiL2 differential**	-120 ... 120	0	°C
CL	CL22	**53336**	WORD	Y	-1	**53596**	1	RW	**Analog input AiL3 differential**	-120 ... 120	0	°C/Bar
CL	CL23	**53337**	WORD	Y	-1	**53597**	1	RW	**Analog input AiL4 differential**	-120 ... 120	0	°C/Bar
CL	CL24	**53338**	WORD	Y	-1	**53598**	1	RW	**Analog input AiL5 differential**	-120 ... 120	0	°C
CL	CL60	**53344**	WORD			**53599**	2	RW	**Type of analog output AOL5** • 0 = 4-20mA on dedicated references only • 1 = 0-20mA on dedicated references only • 2 = 0-10V	0 ... 2	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	CL70	**53346**	WORD			**53600**	0	RW	**Enable TRIAC output TCL1** • 0 = **SMC-SMD-SMP5500/C(/S)** reference • 1 = not used • 2 = REAL PWM	0 ... 2	0	num
CL	CL71	**53347**	WORD			**53601**	2	RW	**Enable analog output AOL1** • 0 = Output configured as digital • 1 = not used • 2 = REAL PWM	0 ... 2	0	num
CL	CL72	**53348**	WORD			**53602**	2	RW	**Enable analog output AOL2** • 0 = Output configured as digital • 1 = output configured as Triac – see CL75 – CL78 • 2 = REAL PWM	0 ... 2	0	num
CL	CL73	**53349**	WORD			**53603**	0	RW	**Analog output TCL1 phase shift**	0 ... 90	27	Deg
CL	CL74	**53350**	WORD			**53604**	2	RW	**Analog output AOL1 phase shift**	0 ... 90	27	Deg
CL	CL75	**53351**	WORD			**53605**	2	RW	**Analog output AOL2 phase shift**	0 ... 90	27	Deg
CL	CL76	**53352**	WORD			**53606**	0	RW	**Analog output TCL1 pulse time**	5 ... 40	10	num (1 unit = 69.4 µsec)
CL	CL77	**53353**	WORD			**53607**	2	RW	**Analog output AOL1 pulse time**	5 ... 40	10	num (1 unit = 69.4 µsec)
CL	CL78	**53354**	WORD			**53608**	2	RW	**Analog output AOL2 pulse time**	5 ... 40	10	num (1 unit = 69.4 µsec)
CE	CE00	**53792**	WORD			**53615**	2	RW	**Type of analog input AIE1** • 0= Probe not configured • 1= DI • 2 = NTC	0 ... 2	0	num
CE	CE01	**53793**	WORD			**53616**	2	RW	**Type of analog input AIE2** See CE00	0 ... 2	0	num

FOLDER	LABEL	VAL PAR ADDRESS	DATA SIZE	CPL	EXP	VIS PAR ADDRESS	VIS PAR VALUE	R/W	DESCRIPTION	RANGE	DEFAULT	U.M.
CE	CE02	**53794**	WORD			**53617**	2	RW	**Type of analog 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 analog input AIE4** See CE02	0 ... 7	0	num
CE	CE04	**53796**	WORD			**53619**	2	RW	**Type of analog input AIE5** See CE00	0 ... 2	0	num
CE	CE10	**15893**	WORD	Y	-1	**53620**	1	RW	**Analog input AIE3 fullscale value**	CE11 ... 9999	500	°C/Bar
CE	CE11	**15899**	WORD	Y	-1	**53621**	1	RW	**Analog input AIE3 start of scale value**	-9999 ... CE10	0	°C/Bar
CE	CE12	**15894**	WORD	Y	-1	**53622**	1	RW	**Analog input AIE4 fullscale value**	CE13 ... 9999	500	°C/Bar
CE	CE13	**15900**	WORD	Y	-1	**53623**	1	RW	**Analog input AIE4 start of scale value**	-9999 ... CE12	0	°C/Bar
CE	CE20	**53822**	WORD	Y	-1	**53624**	1	RW	**Analog input AIE1 differential**	-120 ... 120	0	°C
CE	CE21	**53823**	WORD	Y	-1	**53625**	1	RW	**Analog input AIE2 differential**	-120 ... 120	0	°C
CE	CE22	**53824**	WORD	Y	-1	**53626**	1	RW	**Analog input AIE3 differential**	-120 ... 120	0	°C/Bar
CE	CE23	**53825**	WORD	Y	-1	**53627**	1	RW	**Analog input AIE4 differential**	-120 ... 120	0	°C/Bar
CE	CE24	**53826**	WORD	Y	-1	**53628**	1	RW	**Analog input AIE5 differential**	-120 ... 120	0	°C
CE	CE60	**53832**	WORD			**53629**	2	RW	**Type of analog output AOE5** • 0 = 0-20mA • 1 = 4-20mA	0 ... 1	0	num
CE	CE70	**53834**	WORD			**53630**	0	RW	**Enable analog output TCE1** • 0 = **SME5500** reference • 1 = not used	0 ... 1	1	num
CE	CE71	**53835**	WORD			**53631**	2	RW	**Enable analog output AOE1** • 0 = Output configured as digital • 1 = output configured as Triac – see CE74 – CE77	0 ... 1	0	num
CE	CE72	**53836**	WORD			**53632**	2	RW	**Enable analog output AOE2** • 0 = Output configured as digital • 1 = output configured as Triac – see CE75 – CE78	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.
CE	CE73	**53837**	WORD			**53633**	0	RW	**Analog output TCE1 phase shift**	0 ... 90	27	Deg
CE	CE74	**53838**	WORD			**53634**	2	RW	**Analog output AOE1 phase shift**	0 ... 90	27	Deg
CE	CE75	**53839**	WORD			**53635**	2	RW	**Analog output AOE2 phase shift**	0 ... 90	27	Deg
CE	CE76	**53840**	WORD			**53636**	0	RW	**Analog output TCE1 pulse time**	5 ... 40	10	69 µsec
CE	CE77	**53841**	WORD			**53637**	2	RW	**Analog output AOE1 pulse time**	5 ... 40	10	69 µsec
CE	CE78	**53842**	WORD			**53638**	2	RW	**Analog output AOE2 pulse time**	5 ... 40	10	69 µsec
Cr	Cr00	**53760**	WORD			**53609**	2	RW	**Type of local analog 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 analog input AIR2** • 0= Probe not configured • 1= DI • 2 = NTC • 3 = 4..20mA • 4…6 = Not used • 7 = 0..20mA	0 ... 7	0	num
Cr	Cr10	**15874**	WORD	Y	-1	**53611**	1	RW	**Local analog input AIR2 full-scale value**	Cr11 ... 9999	0	num
Cr	Cr11	**15876**	WORD	Y	-1	**53612**	1	RW	**Local analog input AIR2 start of scale value**	-9999 ... Cr10	0	num
Cr	Cr20	**53770**	WORD	Y	-1	**53613**	1	RW	**Local analog input AIR1 differential**	-12.0 ... 12.0	0.0	°C
Cr	Cr21	**53771**	WORD	Y	-1	**53614**	1	RW	**Local analog 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. **COM1 = TTL/RS485 (SMC-SMD-SMP4500-5500/C/S / SMD3600/C/S 2T only): cannot be used simultaneously**	0 ... 1	1	num

FOLDER	LABEL	VAL PAR ADDRESS	DATA SIZE	CPL	EXP	VIS PAR ADDRESS	VIS PAR VALUE	R/W	DESCRIPTION	RANGE	DEFAULT	U.M.
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 (RS485: not supported) • 6=57600 baud (RS485: not supported) • 7=115200 baud (RS485: not supported)	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 can assign these parameters values that e.g. identify the type and/or reference of the system, and its configuration etc.	0 ... 999	0	num
CF	CF61	**15640**	WORD			**53647**	3	RW	**Client code 2** See CF60	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.
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

8.1.2. 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

8.1.3. Client table

CONTENTS	FOLDER	LABEL	ADDRESS	R/W	DESCRIPTION	DATA SIZE	CPL	RANGE	DEFAULT	EXP	U.M.
1	AI	LocalAInput[0]	8336	R	Analog input AIL1	WORD	Y	-500 ... 999	0	-1	°C
2	AI	LocalAInput[1]	8337	R	Analog input AIL2	WORD	Y	-500 ... 999	0	-1	°C
3	AI	LocalAInput[2]	8338	R	Analog input AIL3	WORD	Y	-500 ... 999	0	-1	°C/Bar
4	AI	LocalAInput[3]	8339	R	Analog input AIL4	WORD	Y	-500 ... 999	0	-1	°C/Bar
5	AI	LocalAInput[4]	8340	R	Analog 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	Analog output TCL1	WORD	Y	0 ... 100	0		num
22	AO	Analog.Out AOL1	8449	R	Analog output AOL1	WORD	Y	0 ... 100	0		num
23	AO	Analog.Out AOL2	8450	R	Analog output AOL2	WORD	Y	0 ... 100	0		num
24	AO	Analog.Out ALO3	8451	R	Analog output AOL3	WORD	Y	0 ... 999	0	-1	num
25	AO	Analog.Out AOL4	8452	R	Analog output AOL4	WORD	Y	0 ... 999	0	-1	num

CONTENTS	FOLDER	LABEL	ADDRESS	R/W	DESCRIPTION	DATA SIZE	CPL	RANGE	DEFAULT	EXP	U.M.
26	AO	Analog.Out AOL5	8453	R	Analog output AOL5	WORD	Y	0 ... 999	0	-1	num
27	AI	ExtAInput[0]	8352	R	Analog input AIE1	WORD	Y	-500 ... 999	0	-1	°C
28	AI	ExtAInput[1]	8353	R	Analog input AIE2	WORD	Y	-500 ... 999	0	-1	°C
29	AI	ExtAInput[2]	8354	R	Analog input AIE3	WORD	Y	-500 ... 999	0	-1	°C/Bar
30	AI	ExtAInput[3]	8355	R	Analog input AIE4	WORD	Y	-500 ... 999	0	-1	°C/Bar
31	AI	ExtAInput[4]	8356	R	Analog 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	Analog output TCE1	WORD	Y	0 ... 100	0		num
48	AO	Analog.Out AOE1	8465	R	Analog output AOE1	WORD	Y	0 ... 100	0		num
49	AO	Analog.Out AOE2	8466	R	Analog output AOE2	WORD	Y	0 ... 100	0		num
50	AO	Analog.Out AOE3	8467	R	Analog output AOE3	WORD	Y	0 ... 999	0	-1	num

CONTENTS	FOLDER	LABEL	ADDRESS	R/W	DESCRIPTION	DATA SIZE	CPL	RANGE	DEFAULT	EXP	U.M.
51	AO	Analog.Out AOE4	8468	R	Analog output AOE4	WORD	Y	0 ... 999	0	-1	num
52	AO	Analog.Out AOE5	8469	R	Analog output AOE5	WORD	Y	0 ... 999	0	-1	num
53	AI	RemAInput[0]	8432	R	Analog input AIr1	WORD	Y	-500 ... 999	0	-1	°C
54	AI	RemAInput[1]	8433	R	Analog input AIr2	WORD	Y	-500 ... 999	0	-1	°C/Bar
55	alarm	Er45	NA	R	Clock error alarm	WORD		0 ... 1	0		flag
56	alarm	Er46	NA	R	Time loss alarm	WORD		0 ... 1	0		flag

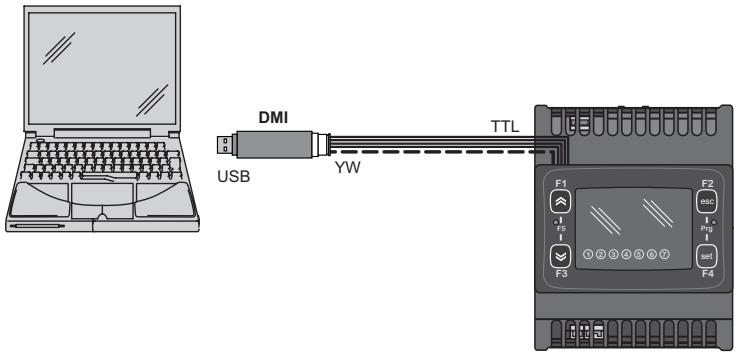
NA not accessible.

CHAPTER 9
Functions (Folder FnC)

The **MFK 100** is an accessory that can be connected to the **FREE Smart** logic controller (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 100
To connect **MFK 100** to the **FREE Smart** the **YELLOW** cable is used.



MFK 100 → FREE Smart	MFK 100 ← FREE Smart
Parameters	Parameters
BIOS	-
IEC	-

Fig. 54. Connections between MFK 100 and the FREE Smart

NOTE: in "Direct", **FREE Smart** must not be connected to earth. If a ground (earth) connection exists for the PC as well as the **FREE Smart** a ground loop condition could develop and render either PC or the **FREE Smart** inoperable.

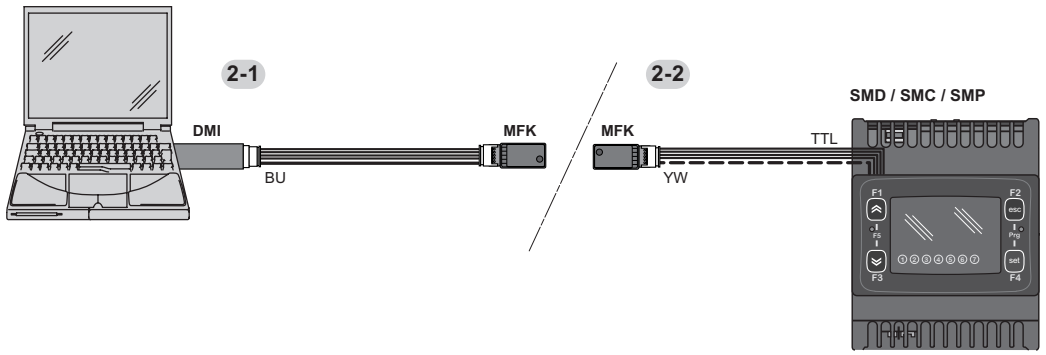
NOTICE

INOPERABLE EQUIPMENT

Disconect any ground connection of the **FREE Smart** before conecting a PC.

Failure to follow these instructions can result in equipment damage.

To connect **MFK 100** to **DMI 100-3** the **BLU** cable is used.



DMI 100-3+PC → MFK 100	DMI 100-3+PC ← MFK 100
BIOS	-
IEC	-

Fig. 55. Connections between MFK 100 and DMI 100-3 + PC

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Connect the programming cable to the PC first, then to the programming port of the controller.
- Disconnect the programming cable from the controller before disconnecting it from the PC.

Failure to follow these instructions can result in death, serious injury, or equipment damage

CHAPTER 10
FREE Studio

10.1. 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 the **FREE Smart** logic controllers via PC or **MFK 100** with the utmost confidentiality, thanks to the appropriate security safeguards.

10.2. Components

All basic components and accessories are described below.

10.2.1. FREE Studio software component

The **FREE Studio** software application has a graphic interface. **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.

10.2.2. DM Interface (DMI) component

DMI 100-3 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 **MFK 100** component.

NOTICE

INOPERABLE EQUIPMENT

Supply the **FREE Smart** logic controllers only with **DMI 100-3** programming cable when downloading BIOS parameters and applications.

Failure to follow these instructions can result in equipment damage.

10.2.3. MFK 100 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.

10.2.4. Connection cables

Yellow cable, see **9IS54406** for advice on use.
Blue cable, see **9IS54406** for advice on use.
USB-A/A 2m extension lead.

CHAPTER 11
Monitoring

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

11.1. 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.

NOTE: The Modbus standard used by **Eliwell** uses RTU coding for data transmission.

11.1.1. 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.**

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

- The instrument's keypad.
- **MFK 100**.
- By sending data via the Modbus protocol straight to individual instruments, or via broadcast, using the address 0 (broadcast).

For connection diagram when using Modbus see **Fig. 21 on pag. 30**.

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 reference 8762 cable)

11.1.2. Modbus commands available and data areas

The commands implemented are:

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

The length restrictions are:

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

For variables, see **8.1.3. Client table on pag. 89**.

11.2. Configuration of device address

The Device Number in a ModBus message is defined by the parameter **CF30** (see **8.1.1. BIOS Parameters / visibility table on pag. 81**).
The address 0 is used for broadcast messages that all slaves recognize.

Slaves do not reply to broadcast messages.

11.2.1. Configuration of parameter addresses

The list of addresses is given in **CHAPTER 8 Parameters (PAR) on pag. 79** under the section Parameters Table / ADDRESS column visibility (parameters addresses) and VIS PAR ADDRESS (addresses visibility parameters).

11.2.2. Configuration of variable / state addresses

The list of addresses is given in **CHAPTER 8 Parameters (PAR) on pag. 79**, under the section Client Table ADDRESS column.

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