

c.pCO sistema

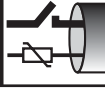
Programmable Controller

CAREL



(ENG) User manual

**→ LEGGI E CONSERVA
QUESTE ISTRUZIONI ←**
**READ AND SAVE
THESE INSTRUCTIONS**

  **NO POWER
& SIGNAL
CABLES
TOGETHER**
READ CAREFULLY IN THE TEXT!

Integrated Control Solutions & Energy Savings

WARNINGS



CAREL bases the development of its products on decades of experience in HVAC, on continuous investments in technological innovations to products, procedures and strict quality processes with in-circuit and functional testing on 100% of its products, and on the most innovative production technology available on the market. CAREL and its subsidiaries/affiliates nonetheless cannot guarantee that all the aspects of the product and the software included with the product respond to the requirements of the final application, despite the product being developed according to start-of-the-art techniques.

The customer (manufacturer, developer or installer of the final equipment) accepts all liability and risk relating to:

- correct configuration of the product in order to reach the expected results in relation to the installation;
- specific final equipment (example: installation, programming, uploading application software, product commissioning);
- management of IT security and personal data protection.

Before connecting the product to a private computer network, the customer is responsible for adopting and implementing appropriate measures to prevent risks, including cyber-security risks, taking into consideration the recommendations in chapters 8, 9 and 10 of this manual (for example: user configuration, webserver and FTP server access management, etc.)

CAREL may, based on specific agreements and/or circumstances, act as a consultant for the successful commissioning of the final unit/application, however in no case does it accept liability for the correct operation of the final equipment/system.

Programming and connection to computer networks, including in relation to IT security aspects and personal data protection, must be carried out by expert personnel, under the responsibility of the system's owner.

The product in question is not intended to be a finished product and, in relation to its advanced level of technology, is supplied in "commissioning mode", i.e. is not intended to be sold directly to end users or be installed on the production line or in any case outside of a secure development environment. It therefore requires setup/configuration/programming/commissioning to be able to operate in the best possible way for the specific application. Failure to carry out the checks specified in the manual may make the product vulnerable and consequently exposed to the risk of potential IT attacks; CAREL accepts no liability in such cases.

Only qualified personnel may install or carry out technical service on the product. The customer must only use the product in the manner described in the documentation relating to the product.

In addition to observing any further warnings described in this manual, the following warnings must be heeded for all CAREL products:

- Prevent the electronic circuits from getting wet. Rain, humidity and all types of liquids or condensate contain corrosive minerals that may damage the electronic circuits. In any case, the product should be used or stored in environments that comply with the temperature and humidity limits specified in the manual.
- Do not install the device in particularly hot environments. Too high temperatures may reduce the life of electronic devices, damage them and deform or melt the plastic parts. In any case, the product should be used or stored in environments that comply with the temperature and humidity limits specified in the manual.
- Do not attempt to open the device in any way other than described in the manual.
- Do not drop, hit or shake the device, as the internal circuits and mechanisms may be irreparably damaged.
- Do not use corrosive chemicals, solvents or aggressive detergents to clean the device.
- Do not use the product for applications other than those specified in the technical manual.

All the above suggestions also apply to controllers, serial boards and any other accessories in the CAREL product portfolio.

CAREL adopts a policy of continual development. Consequently, CAREL reserves the right to make changes and improvements to any product described in this document without prior warning.

The technical specifications shown in the manual may be changed without prior warning.

The liability of CAREL in relation to its products is specified in the CAREL general contract conditions, available on the website www.carel.com and/or by specific agreements with customers; specifically, to the extent where allowed by applicable

legislation, in no case will CAREL, its employees or subsidiaries/affiliates be liable for any lost earnings or sales, losses of data and information, costs of replacement goods or services, damage to things or people, downtime or any direct, indirect, incidental, actual, punitive, exemplary, special or consequential damage of any kind whatsoever, whether contractual, extra-contractual or due to negligence, or any other liabilities deriving from the installation, use or impossibility to use the product, even if CAREL or its subsidiaries/affiliates are warned of the possibility of such damage.

DISPOSAL



Fig. 1

Fig. 2

Please read and keep.

With reference to European Union directive 2012/19/EU issued on 4 July 2012 and related national legislation, please note that:

1. Waste Electrical and Electronic Equipment (WEEE) cannot be disposed of as municipal waste but must be collected separately so as to allow subsequent recycling, treatment or disposal, as required by law;
2. users are required to take Electrical and Electronic Equipment (EEE) at end-of-life, complete with all essential components, to the WEEE collection centres identified by local authorities. The directive also provides for the possibility to return the equipment to the distributor or retailer at end-of-life if purchasing equivalent new equipment, on a one-to-one basis, or one-to-zero for equipment less than 25 cm on their longest side;
3. the equipment may contain hazardous substances: the improper use or incorrect disposal of such may have negative effects on human health and on the environment;



4. the symbol (crossed-out wheeled bin ) is shown on the product or on the packaging, indicates that the equipment must be disposed of separately at end-of-life;



5. if at end-of-life the EEE contains a battery , this must be removed following the instructions provided in the user manual before disposing of the equipment. Used batteries must be taken to appropriate waste collection centres as required by local regulations;
6. in the event of illegal disposal of electrical and electronic waste, the penalties are specified by local waste disposal legislation.

Warranty on materials: 2 years (from production date, excluding consumables).

Approval: the quality and safety of CAREL INDUSTRIES Hq products are guaranteed by the ISO 9001 certified design and production system.



NO POWER & SIGNAL CABLES TOGETHER

READ CAREFULLY IN THE TEXT!

IMPORTANT: separate as much as possible the probe and digital input cables from cables to inductive loads and power cables, so as to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel cables) and signal cables in the same conduits

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1. INTRODUCTION

c.pCO is a programmable microprocessor electronic controller operating equipped with a multitasking operating system, compatible with the c.pCO system family of programmable controllers, user terminals, gateways and communication and remote management devices. These devices constitute a powerful controller system that can be easily interfaced with the most common building management systems (BMS) on the market. It has been developed by CAREL to manage multiple applications in the air conditioning, refrigeration and HVAC/R sectors in general. The controller features considerable flexibility, allowing specific products to be created upon customer request. Compared to the pCO system, the range comprises a new compact-sized controller, the c.pCO mini (4 DIN module and panel version), equipped with 10 universal inputs/outputs and available with built-in driver for unipolar electronic expansion valves, in addition to the c.pCO Small, Medium, Large, and ExtraLarge models. The number of inputs/outputs can be increased by connecting c.pCOe expansion cards. The Medium size controller versions come with one or two built-in electronic expansion valve drivers. The Ultracap module (accessory) can be used for emergency power supply to the valve driver so as to completely close the valves in the event of a mains power failure. c.pCO can be connected via Ethernet LAN to other c.pCO family controllers. Each controller in the LAN can exchange digital or analogue variables with the other controllers, as defined by the application program. c.pCO can be connected via a pLAN network (pCO Local Area Network) to the pGN range terminals.

Each FieldBus serial port, either built into the controller or installable via an optional card, can be connected to field devices such as valve and damper actuators, as well as external drivers (for example electronic expansion valve drivers, EVD Evolution).

Each BMS serial port, either built into the controller or installable via an optional card, provides connection to standard bus systems at a field level, automation level and management level, such as KNX®, LON®, BACnet™, etc.

The real-time operating system (OS) manages priority to ensure the application program cycle time, 32-bit data and floating point numbers, multi-master and multi-protocol Ethernet networking.

Main features:

- optimisation of the memory occupied by the operating system and the application program, boot time, the application program loading time and cycle time;
- optimisation of system response time: the controller runs multiple processes in parallel, each managed with a different priority level;
- process independence: each process, whether a protocol, USB port management, data or alarm log (datalogger), data exchange with the tERA cloud service, operates independently from the others;
- debugging during execution (on target);
- native management of the TCP/IP multitasking protocol.

Local connectivity:

- built-in web server, fully customisable, supports standard HTML and Javascript. pages created with the most common website development tools can be copied into the 90 MB memory. Dynamic methods (CGI, Common Gateway Interface) available to read and write application program variables. Other innovative features: possibility to display the contents of the pGD family terminals on the browser page, to view graphs of data stored by the datalogger and to plot data from probes and energy meters in real time (variable trends);
- file server (FTP): in the LAN network, the public storage space on the c.pCO can be accessed via the FTP protocol. FTP clients can thus be connected to upload updates, web pages and documents to the controller. ".csv" (comma separated value) files can also be exported and downloaded from the datalogger.
- Creation of users/passwords with different access privileges, associated with both web servers and FTP servers;
- management of multiple simultaneous instances of Modbus TCP/IP Main and Secondary protocol;
- BACnet™ protocol management with B-BC profile (MSTP or TCP/IP, license purchased separately).

Remote connectivity:

- embedded connectivity to the Carel tERA cloud service: the controller, when connected to a normal router, establishes a secure connection with the tERA server, after having registered and configured the controller. Remote management services on the control variables, alarm notifications, data analysis and reporting can be activated. Connections to tERA are encrypted via standard SSL (Secure Socket Layer).
- A built-in firewall on the controller ensures remote access only via a secure connection (connection to the tERA cloud for c.suite based products or via VPN encryption). Any changes to the default firewall configuration may impair product security.
- No other types of remote connection to the controller are possible.

Built-in USB peripheral: used to update the controller, and save web pages, documentation, and applications to the flash memory. Can also be used to download logs from the controller.

- c.pCO Small-Extralarge: the USB host and device ports are managed directly by the operating system. USB host port (top): updates (operating system/application program) can be uploaded to the controller using a USB flash drive. USB device port (bottom): the c.pCO can be connected to a personal computer, making its memory becomes visible as a removable disk, and at the same time establishing a communication channel with the c.suite or STone software for programming and online debugging.
- c.pCO mini: the 2 USB ports are physically integrated into a single micro USB port; this solution offers the same performance as the two ports available on the larger models.

Other features:

- possibility to connect up to 3 terminals to the same controller (both semi-graphic terminals such as the PGN or touchscreen terminals such as the pGDx);
- external or built-in terminal, equipped with display and keypad with LED-backlit buttons, useful for uploading software and commissioning;
- universal inputs/outputs configurable in the application program to connect active and passive probes, digital inputs, analogue and PWM outputs. This increases the possibility of configuring the inputs/outputs, without needing to upgrade to a larger size controller;
- possibility to use the c.suite or STone software development environment, installable on a personal computer, to create and customise the application program, for simulation, supervision and configuration of the Ethernet network;
- wide range of models that differ in terms of:
 - size (Mini, Small, Medium, Large and Extralarge), to ensure maximum flexibility based on the application;
 - digital outputs (24/230 V relay) and SSR (solid state relay);
 - NO or NC relay outputs;
 - built-in optically-isolated/non optically-isolated serial ports;
 - optional built-in display;
 - various types of connectors (spring, screw, etc.).

1.1 Models and options

c.suite

Development environment designed as a set of independent modules, one for each stage of HVAC/R software development, c.suite allows a team of professionals with different skills to work together on the same project, increasing the efficiency of everyone involved through flow- and team-based development. All the software modules cooperate via centralised data exchange, with optional version control (SVN).

Development environment:

- c.strategy: environment where expert algorithm programmers prepare the heart of the application program. Programming environment features:
 - total independence of the programming logic from the hardware and devices connected to the network;
 - Availability of languages compliant with IEC 61131: ST (Structured Text), FBD (Function Block Diagram), SFC (Sequential Function Chart), LD (Ladder diagram), also used simultaneously;
 - management of 32-bit data types, floating point, arrays and native structures;
 - debugging on target via USB or Ethernet port.
- c.mask: dedicated environment for developers of the user interface.
- c.design: definition of configurations, such as controller type and size, inputs/outputs, client/server protocols, default parameter values, data logger, network address and user management, connection to tERA cloud services.

Command line tools:

- c.factory: used to program the controller by loading the application program and the desired unit configuration during assembly.

STone

Development environment designed to manage every stage of HVAC/R software development, STone allows a team of professionals to work together on the same project, increasing the efficiency of everyone involved through flow- and team-based development. STone can be used to manage source files and features through version control software (e.g. GIT).

Development environment:

- STone: environment for developing the application program and the user interface for semi-graphic displays, defining configurations, inputs/outputs, client/server protocols, default parameter values, data logger, network address management and users. Programming environment features:
 - total independence of the programming logic from the hardware and devices connected to the network;
 - IEC 61131 compliant ST (structured text) language available;
 - management of 32- and 64-bit data types, floating point, arrays and native structures;
 - debugging on target via USB or Ethernet port.
 - Availability of a complete test suite: Unit testing, automatic tests and non-regression tests

Command line tools:

- Sparkly;
 - program the controller by loading the application program
 - write individual parameters and/or parameter configurations

All the aspects related to strengthening controller cybersecurity and the protection of personal data are the customer's responsibility (manufacturer, designer or installer of the final equipment).

Model identification

The development tool used to program the controllers - 1tool, c.suite or STone - can be identified as shown below.

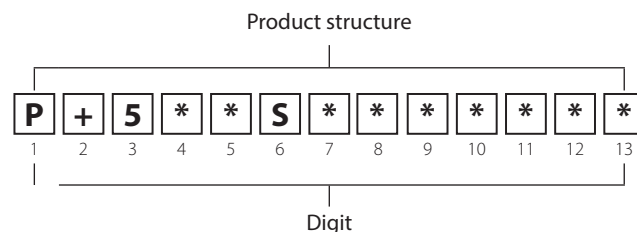
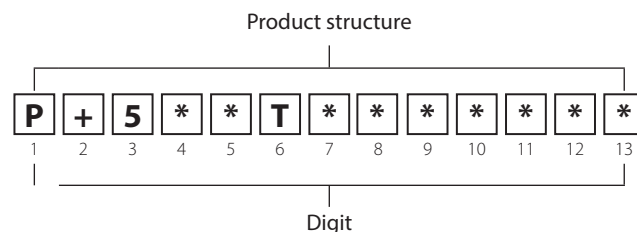
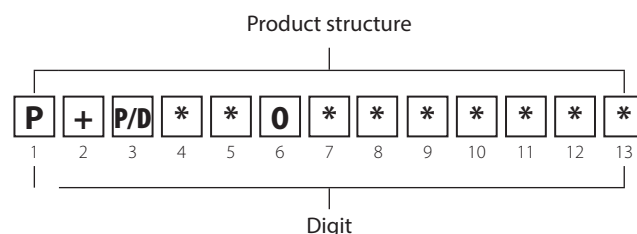
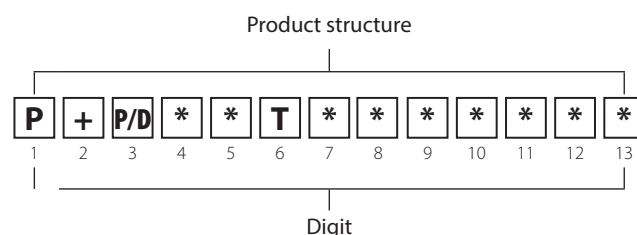
Identification code on the product label.

On c.pCO, if digit 6 of the part number is:

- S = c.suite operating system
- T = STone operating system

On c.pCO mini, if digit 6 of the part number is:

- 0 = c.suite operating system
- T = STone operating system

c.pCO controller with c.suite operating system**c.pCO controller with STone operating system****c.pCO mini controller with c.suite operating system****c.pCO mini controller with STone operating system****Built-in 7-segment display (on models where available).**

At power on, the controller will show a different letter for a few seconds, depending on the operating system installed:

- "C" -> c.suite operating system
- "S" -> STone operating system

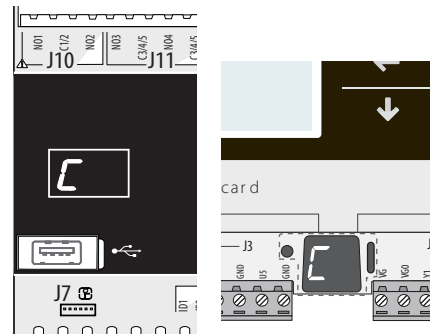
c.pCO c.suite

Fig. 1.a

c.pCO STone

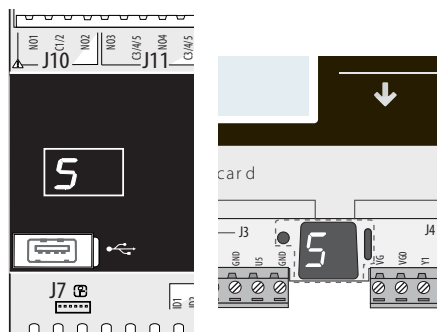


Fig. 1.b



Caution: the two operating systems are not compatible. Therefore, specific controllers need to be used depending on the development tool.

1.2 Applications

The same controller, running the dedicated application program, can be used to manage different units:

- chillers and heat pumps;
- roof-top units;
- air conditioners;
- small/medium air handling units (on request);
- refrigerated cabinets (on request and to specification);
- cold rooms (on request and to specification);
- aging rooms;
- compressor racks;
- universal activation devices.



Notice: from version 4.5 of the c.suite operating system, the following screens have been modified: Application statistics and Memory info. See KSA under Sw&Support -> c.suite.

1.3 Functional diagram

The following figure shows the general diagram of the possible connections to the c.pCO controller. Specifically, on a generic air handling unit, the damper and valve actuators are field devices that communicate via Fieldbus 1 (ref. C). The serial probes send the measured values, the humidifier control board and the fans send and receive the set point from the controller via Fieldbus 2 (ref. E). The built-in terminal and the remote terminal, which communicates via pLAN (ref. A), are used for installing the application program and for commissioning the system. The pGDx touchscreen terminal, with intuitive and direct operation, can be used to set the on and off time bands, the main parameters, manage other advanced functions provided by the application program, and display any alarms that are activated during normal operation. This communicates with the controller via the Ethernet port (ref. D). The same network can be used to connect another c.pCO controller, communicate with a BACnet™ supervisor and/or with the tERA remote connectivity cloud service. Finally, connection to other supervisory systems (KNX®, LON®, etc.) is available on installing the BMS1 expansion card (ref. B).

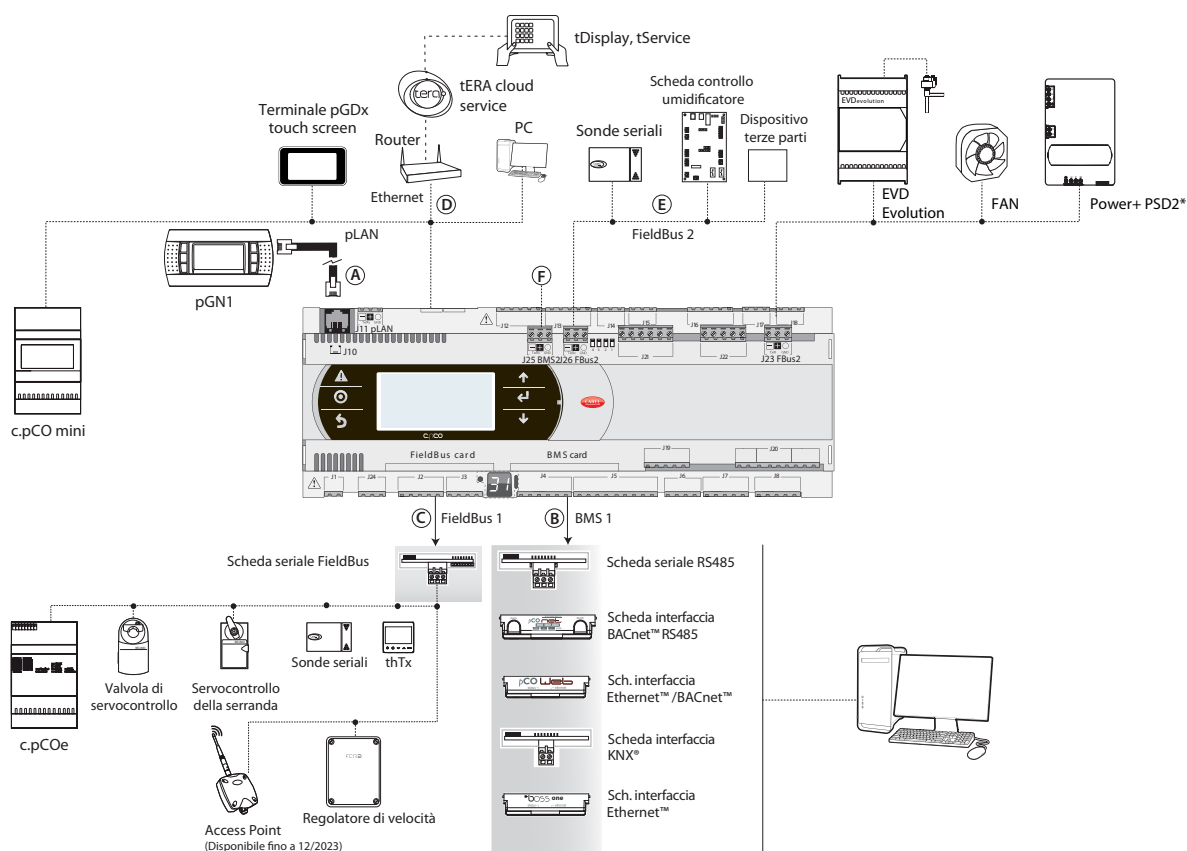


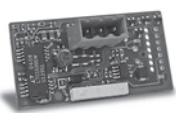
Fig. 1.c

Ref.	Serial port/connectors	Connection
A	pLAN/J10, J11	up to 3 terminals (semi-graphic terminals such as the PGN or touchscreen terminals such as the pGDx)
B	BMS 1 Serial Card	a building automation system, once the corresponding BMS card has been installed (see par. 1.3)
C	FieldBus 1 Serial Card	field bus sensors, actuators, etc., once the corresponding card has been installed (see par. 1.4)
D	Ethernet	pGDx terminals, c.pCO controllers, router->tERA
E	FieldBus 2 / J26 (and J23 on Large, Extralarge models)	field bus sensors, actuators, etc. (built-in)
F	BMS 2 / J25	other devices (built-in)

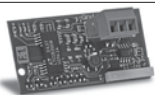
1.4 Terminals

	P/N	Description	Notes
	PG[R/B]04* (Technical leaflet +050001895)	pGDx 4.3" user terminal	The pGDx 4.3 inch graphic terminal is part of the touch screen family, designed to make the user interface with the c.pCO sistema controllers simple and intuitive. The electronic technology used and the 65,000 colour display enable management of high quality images and advanced features to ensure a high aesthetic standard. The touch screen display guarantees simple human-unit interaction, making it easier to browse between the various screens.
	PG[R/B]07* (Technical leaflet +050001950)	pGDx 7" user terminal	The pGDx 7 inch graphic terminal is part of the touch screen family, designed to make the user interface with the pCO sistema controllers simple and intuitive. The electronic technology used and the 16 million colour display enable management of high quality images and advanced features to ensure a high aesthetic standard. The touch screen display guarantees simple human-unit interaction, making it easier to browse between the various screens.
	PGNE000* (Technical leaflet +050001425)	pGN graphic terminal	This provides complete graphic management through icons (defined during application software development) and the management of international fonts in two sizes: 5x7 and 11x15 pixels. The application software resides on the c.pCO controller only, and the terminal does not require any additional software during use. Installation accessories: • telephone connection cable P/N S90CONN00*; • connection cable for c.pCO mini P/N S90CONN050; • TCONN6J000 splitter board (technical leaflet +050002895).
	PLD**GFP00 (Technical leaflet +050001840)	pLDPRO graphic terminal	This provides complete graphic management through icons (defined during application software development) and the management of international fonts in two sizes: 6x8 and 12x16 pixels and buzzer. The application software resides on the c.pCO controller only, and the terminal does not require any additional software during use. It is compatible with graphic interfaces developed for the pGN graphic terminal. Installation accessories: • telephone connection cable P/N S90CONN00*; • connection cable for c.pCO mini P/N S90CONN050; • TCONN6J000 splitter board (technical leaflet +050002895).
	AT* (Technical leaflet +05000161E/ +05000171E)	th-TUNE, panel- or wall-mounted terminal	This allows the user to set the temperature and humidity in a residential environment. th-Tune is compatible with the main recessed wall boxes in different markets (Italy, USA, Germany, China).
	TD* (Technical leaflet +050001291E/ +050000445)	thTx, thermostat for temperature and humidity control	Thermostat for controlling temperature and humidity in homes and commercial buildings, equipped with a simple and intuitive user interface. It features its own logic, but can also be completely controlled via the Modbus® communication protocol, allowing complete remote management of system settings, fan operation, and operating modes.

1.5 BMS port expansion cards (c.pCO Small-Extralarge)

	P/N	Description	Notes
	PCOS004850 (Technical leaflet +050003237)	BMS RS485 serial card	This is used to interface directly with an RS485 network, with a maximum baud rate of 19200. The card guarantees opto-isolation of the controller from the RS485 serial network.
	PCO1000WD0 (Technical leaflet +050003243)	Ethernet - pCOWeb interface card	It allows the controller to interface to networks that use HVAC protocols based on the physical Ethernet standard, such as BACnet IP, Modbus TCP/IP and SNMP. It also has an internal web server for managing the HTML pages relating to the application, meaning a browser can be used to access the controller's information (network variables and parameters), as well as a logger function.
	PCO1000BD0 (Technical leaflet +050000935)	BACnet MS/TP - pConet interface card	This is used to connect the controller to a BACnet MS/TP network (Main/Secondary Token Pass) The RS485 connection is optically-isolated from the controller.
	PCO1000F0 (Technical leaflet +050004045)	LonWorks® interface card	This is used to connect to a LonWorks® TP/FT 10 network. The program resides on the flash memory housed on the socket, and can be programmed directly via the LonWorks® network, using network installation and maintenance tools such as LonMaker™. Information on the card programming procedures is available in the manual +030221960. NO LONGER AVAILABLE FROM 31/10/2023
	PCOS00KXN0 (Technical leaflet +030220326)	KNX® interface card	This is used to connect to a network operating in accordance with the KNX® standard via the controller's BMS port
	PCOG000WE0/ PCOD000WE0 (Technical leaflet +050003246)	Ethernet - boss one interface card	This differs from pCOWeb, with the introduction of numerous features that cover the same applications yet with much high levels of IT security, usability and flexibility. It is available in two versions, called "gateway" and "supervisor". The "gateway" version has been created to mainly allow integration of the unit into a local BMS that communicates via Modbus, BACnet and SNMP protocols. The "supervisor" version is intended for applications that, in addition to the field protocols, require supervisory features, such as managing log files, sending emails or instant messages for alarms, and communicating with the outside world (Internet) to CAREL cloud systems or third-party systems via XML or MQTT protocol.

1.6 FieldBus port expansion cards (c.pCO Small-Extralarge)

	P/N	Description	Notes
	PCO100FD10 (Technical leaflet +050003270)	RS485 serial card	This is used to connect via an electrically isolated interface to an RS485 network. The function implemented is main (i.e. supervisor), and therefore other secondary controllers or devices can be connected. A maximum of 64 devices can be connected.
	PCO100TLN0 (Technical leaflet +050003270)	tLAN-Fieldbus card	This is used to connect to devices that communicate via the CAREL proprietary tLAN protocol (2 wires), to receive information or send commands. Up to five devices can be connected, both I/O expansions and drivers for the management of electronic valves. Alternatively, it can be used to connect the PLD/PST LED display.
	PCO100MPB0 (Technical leaflet +050003270)	Belimo card	This is used to connect the controller to up to 8 servo controls that communicate via the MP-BUS® protocol, to receive information or send commands.

1.7 Accessories and expansions

	P/N	Description	Notes
	PCOS00UC20 (Technical leaflet +05000411E)	Ultracap module for c.pCO built-in driver	This module guarantees temporary power supply to the valve driver only in the event of a power failure, for sufficient time to immediately close the connected electronic valve or valves (one or two). It also avoids the need to install a solenoid valve in the refrigeration circuit, or a backup battery kit.
	EVD0000UC0 (Technical leaflet +05000421E)	External Ultracap module	DIN rail mounted, this can be connected as an alternative to the PCOS00UC20 Ultracap module. It can also be used in applications with electronic expansion valve drivers not built into the controller (e.g. c.pCO Small - EVD Evolution - external Ultracap module). If used with c.pCO mini, the module guarantees temporary power supply to the controller in the event of a power failure, for a sufficient time to immediately close the valve (see technical leaflet +05000581E)
	EVD0000E* (Technical leaflet +050004150)	Electronic expansion valve driver	The bipolar stepper motor electronic expansion valve driver manages refrigerant expansion in a refrigerant circuit. The version with RS485 Modbus/Carel serial port is required with the c.pCO controller family. Alternatively, the driver can operate in stand-alone mode.
	CPY* (manual +040000030)	CAREL KUE humidifier card.	This is used to manage an immersed electrode humidifier and share the main parameters via the Carel / Modbus RS485 serial line. It features: - all the inputs and outputs needed to completely and autonomously control the humidifier; - three LEDs to indicate: alarms (red), steam production (yellow), 24 Vac power supply (green); - connection to the CPY terminal (P/N CPYTERM*) or to the supervisor network using the Modbus® RTU or CAREL proprietary protocol.
	PCOUMI2000 (Technical leaflet +050003210)	Interface for OEM series humidifiers	This is used to control the key parameters of CAREL OEM humidifiers directly from the c.pCO controller. The values acquired by the sensors (high level, feed water conductivity, current sensor) are converted into signals compatible with the inputs available on the controller.
	PCOE* (Technical leaflet +050003265)	pCOe expansion card	I/O expansion card that offers users a good combination of inputs and outputs, both digital and analogue.
	UXP* (Technical leaflet +050003271)	pCOe DI expansion card	I/O expansion card that provides extra digital inputs in a single solution. The expansion features both voltage-free and fast contact digital inputs.
	P+E* (Technical leaflet +05000591E)	c.pCOe expansion card Basic or Enhanced version	This is used to increase the number of inputs/outputs and relays on the controller. The Enhanced version has an additional built-in driver for managing a CAREL unipolar electronic expansion valve.
	emeter1/ emeter3 (Technical leaflet +0500046ML/ +0500047ML)	Single-phase/three-phase energy meter	Single-phase/three-phase energy meter with LCD display for parameter values; especially suitable for measuring active energy and cost allocation. Equipped with RS485 port (Modbus RTU protocol).
	FCR3 (Technical leaflet +050004065)	Three-phase speed controller	The FCR series devices are electronic three-phase voltage regulators that use the phase cutting principle to regulate the effective output voltage to the load, based on the input signal. These can drive asynchronous electric fan motors.

	P/N	Description	Notes
	WS01AB2M2* (Technical leaflet +0500030ML)	Access point	The access point is an electronic device that is part of the rTM SE (Remote Temperature Monitoring) system. It enables communication between devices using the Modbus® protocol (c.pCO system, PlantVisor) and wireless sensors (WS01*) or other routers (WS01*). Available until 12/2023.
	DPW*, DPP*, DPD* (Technical leaflet +050001235, +050001245)	Serial probes	The DP* series temperature and humidity probes for rooms, equipment rooms and ducts are designed for the residential and light industrial HVAC/R market. The range includes models with 0-10 V output and with RS485 serial output (Carel or Modbus).

2. STRUCTURE

2.1 c.pCO structure

The controllers include, on the models where featured, a display and keypad comprising six buttons that, when pressed alone or combined with other buttons, activate the following operations:

- upload application program (UPLOAD);
- commissioning.

During operation, the terminal can be used to:

- set the basic operating parameters;
- display the measured values, active functions, activated alarms.

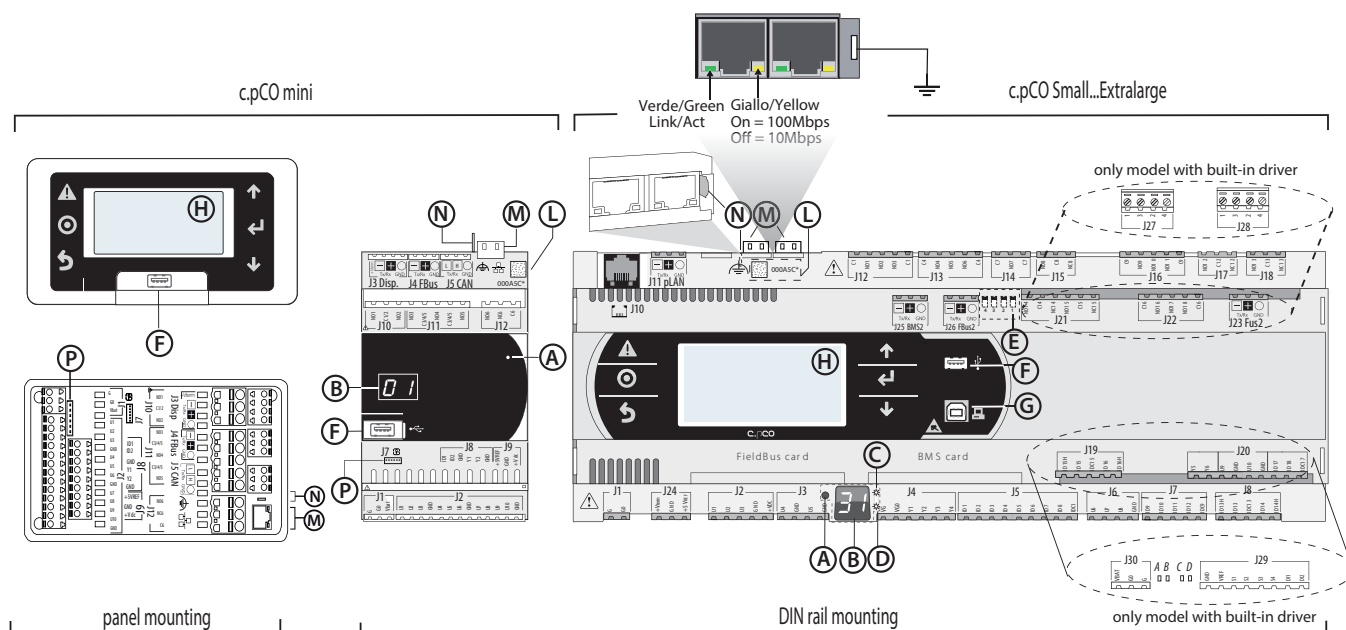


Fig. 2.a

Key:

A	pLAN address selection button	G	USB Device port (secondary)
B	pLAN address display	H	Main display
C	Power LED	L	MAC address label
D	Overload LED	M	Ethernet port
E	FieldBus/BMS dipswitches on port J26	N	Ethernet port spade connectors
F	USB Host port (main)	P	Unipolar valve connector

Each controller has a series of connectors for the inputs/outputs (see chap. 5) and the secondary display with button and LED for setting the pLAN address.

Keypad

Button	Description	Backlit	Functions
	Alarm	Red/White	pressed together with Enter accesses the screens managed by the operating system.
	Prg	White/Yellow	-
	Esc	White	return to higher level
	UP	White	increase value.
	Enter	White	Confirm value
	DOWN	White	decrease value.
	pLAN address selection	-	short press: the pLAN address is displayed brighter repeated press: increase address value release: after a few seconds, the display lighting is dimmed and the pLAN address is saved



Notice: once the application program has been installed, the functions of the buttons depend on the application program and do not necessarily correspond to the above description.

Display (c.pCO Small-Extralarge)

There are two displays:

- the main display on the built-in terminal (if provided);
- the secondary display that shows the controller's pLAN address.

Display (c.pCO mini)

This is a built-in display (if featured), or a secondary display that shows the controller's pLAN address.

LED (c.pCO Small-Extralarge)

There are six LEDs:

- 1 yellow LED that indicates power is connected;
- 1 red LED that indicates an overload on the +VDC TERMINAL (J2-5);
- 4 LEDs to display valve status (only for c.pCO built-in driver models). The LEDs flash if the valve is moving and are when if the valve is fully open or closed.

LED	Colour	Description
A	yellow	valve A closing (connector J27)
B	green	valve A opening (connector J27)
C	yellow	valve B closing (connector J28)
D	green	valve B opening (connector J28)

Dipswitches (c.pCO Small-Extralarge)

There are four dipswitches for configuring port J26 as FieldBus or BMS (see par. "Port J26 configuration").

USB ports

c.pCO Small-Extralarge

There are two USB ports, accessible after opening the cover, for loading the application program and the operating system, saving the logs, etc.:

- USB "host" port for connecting a USB flash drive;
- USB "device" port for direct connection to a computer.

c.pCO mini

The c.pCO mini models contain a single micro USB port, for loading the application program and the operating system, saving the logs, etc.

- The same USB port functions as both a "host" USB port for connecting a USB flash drive, and as a "device" port for direct connection to a computer.

MacAddress label

Label with QR code containing the MAC address that uniquely identifies the controller's Ethernet network card

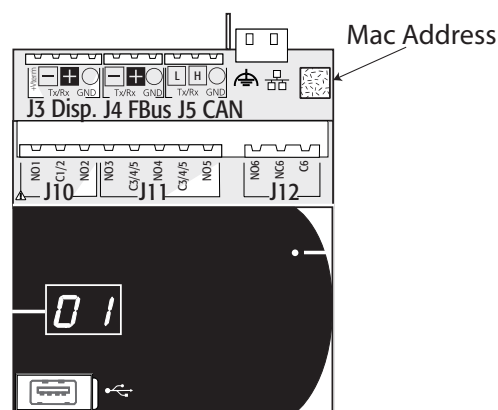


Fig. 2.b

3. COMMUNICATION PORTS

3.1 Serial ports

c.pCO Small-Extralarge

The controllers have five serial ports:

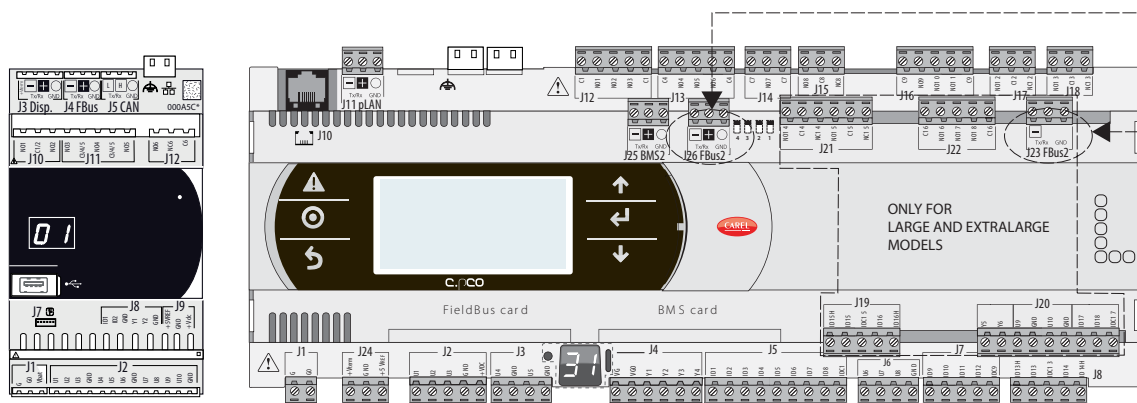
- one terminal port on connector J10-J11 (pLAN)
- one built-in BMS port on connector J25 (BMS2)
- one built-in FieldBus port on connector J26 (FBus2).
- one BMS port to be used with a c.pCO family BMS expansion card (BMS1)
- one FieldBus port to be used with c.pCO family FieldBus expansion card (FBus1)

On the Large and Extralarge version c.pCO cards, connector J23 is labelled FBus2, as for connector J26. In terms of application program management, in fact, this is the same serial line; different addresses need to be used for the devices connected to the two connectors. From an electrical point of view, the ports are independent (an electrical fault on port J26 does not affect port J23). See the "Technical specifications" table (chap. 12).

c.pCO mini

The controllers have:

- one terminal port on connector J3 (Disp.)
- one built-in BMS port on connector J6 (BMS, only on the c.pCO mini Enhanced model)
- one built-in FieldBus port on connector J4 (FBus, on the c.pCO mini Enhanced, Smart and High End models).



(*) To use the serial port as a BMS, the correct communication protocol also needs to be set in the application program in the c.suite or STone programming environment.

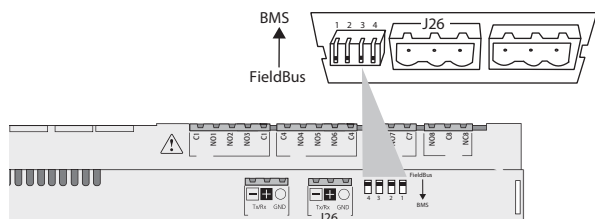


Fig. 3.b

3.2 Ethernet ports

The c.pCO Small-Extralarge controllers have one or two 10/100 Mbps/s Ethernet ports. The two ports are connected internally by a switch that enables automatic routing of passing traffic not addressed to the controller. In the event of a failure on the intermediate node that causes a power outage, the network is disconnected. The ports feature the auto crossover function (Auto-MDIX). The c.pCO mini High End controller has a 10/100Mbps/s Ethernet port.

3.3 Network connection between controllers

A multi-master or main/secondary network of c.pCO controllers can be created using the Ethernet ports and serial ports:

Connection via Ethernet port

The built-in Ethernet ports on the c.pCO can be used to create multi-master and multi-protocol networks, with transmission speeds of up to 100 Mbps. The controllers can be interconnected using an external switch (see figure below). For c.pCO Small-Extralarge models, the two Ethernet ports are connected by an internal hub-switch so as to create a daisy-chain network of multiple devices without the need for external switches (see Figure 3.c). The bypass relays ensure the Ethernet connection and data transmission are kept active even in the event of a power failure on one module in the chain.

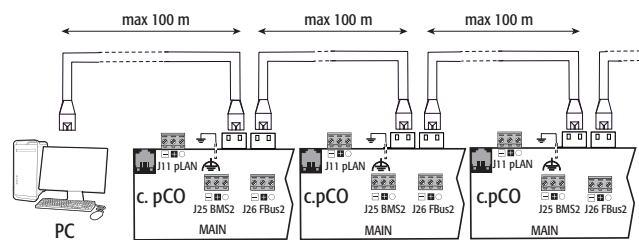
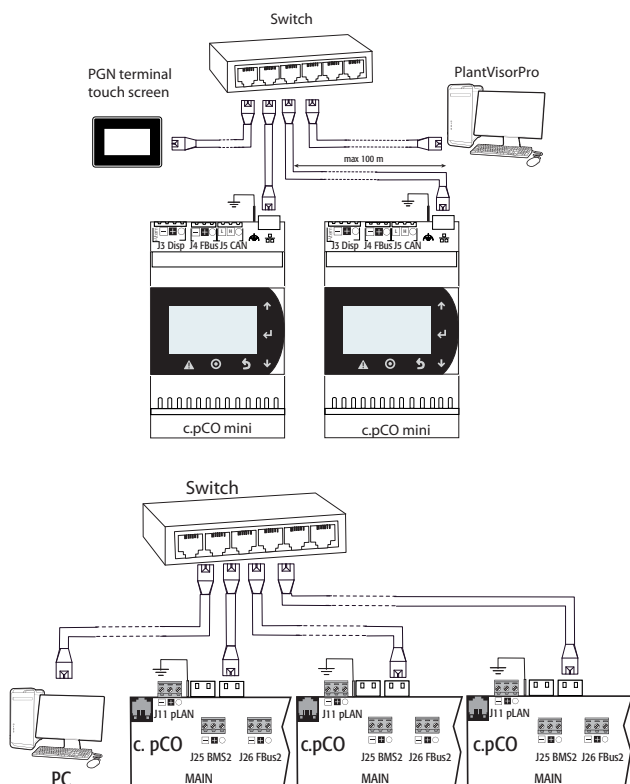


Fig. 3.c

Connection via serial ports:

A main/secondary network can be created between different c.pCO controllers using the RS485 serial ports. The network comprises:

- one c.pCO (main) controller that communicates via Fieldbus RS485 serial using the Carel Main or Modbus Main protocol.
- one or more c.pCO (secondary) controllers connected to the point-to-point network via BMS RS485 serial using the Carel Secondary or Modbus Secondary protocol.

MAIN - SECONDARY network

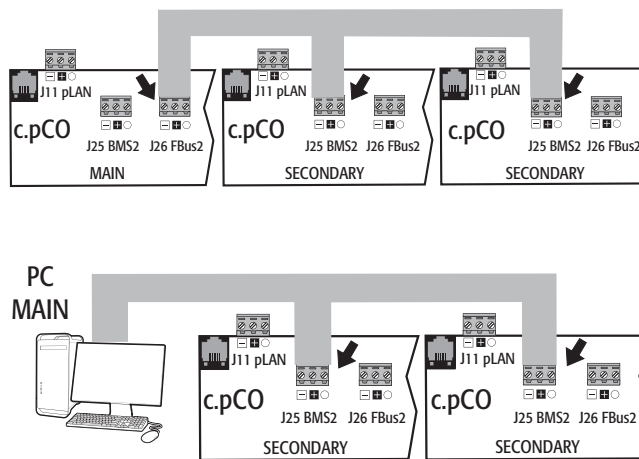


Fig. 3.d



Important warnings:

1. A serial port with main (FBus) hardware powers the network, with an appropriate impedance, with the correct polarisation voltage needed for operation of all connected devices: the main itself and its secondary devices; serial ports with secondary (BMS) hardware, on the other hand, do not have this polarisation voltage, which is why it is always recommended to connect a device with main (FBus) hardware to the network to ensure it is correctly polarised;
2. It is not possible to connect more than two main (FBus) hardware devices to the same network, as the total polarisation impedance of the network would be too low, and therefore unable to supply sufficient voltage for the RS485 network;
3. It is recommended to connect serial probes or other field devices to the optically-isolated FieldBus serial port or to serial port TWO – FieldBus, to take advantage of the filtering properties of optical isolation.

Special cases

- In the event of a network comprising only devices with main HW, a maximum of two devices can be connected. The maximum permitted network length is 1000 m. Terminating resistors (120 Ω , 1/4 W) must be fitted on the first and last device in the network if the length exceeds 100 m;
- connect the computer to a network with at most one device with main HW or at most 207 devices with secondary HW.

4. INSTALLATION

4.1 Assembly and dimensions

All models in the c.pCO family can be installed on a DIN rail, with the exception of the c.pCO mini panel version.

DIN rail mounting: c.pCO mini, c.pCO Small-Extralarge

The following figure shows the dimensions of the c.pCO controllers for each size.

Fixing:

- place the controller on the DIN rail and apply light pressure. The rear tabs snap into place when the device is correctly fitted.

Removal:

- Use a screwdriver as a lever in the hole to lift and release the tabs. The tabs are held in the locked position by return springs.

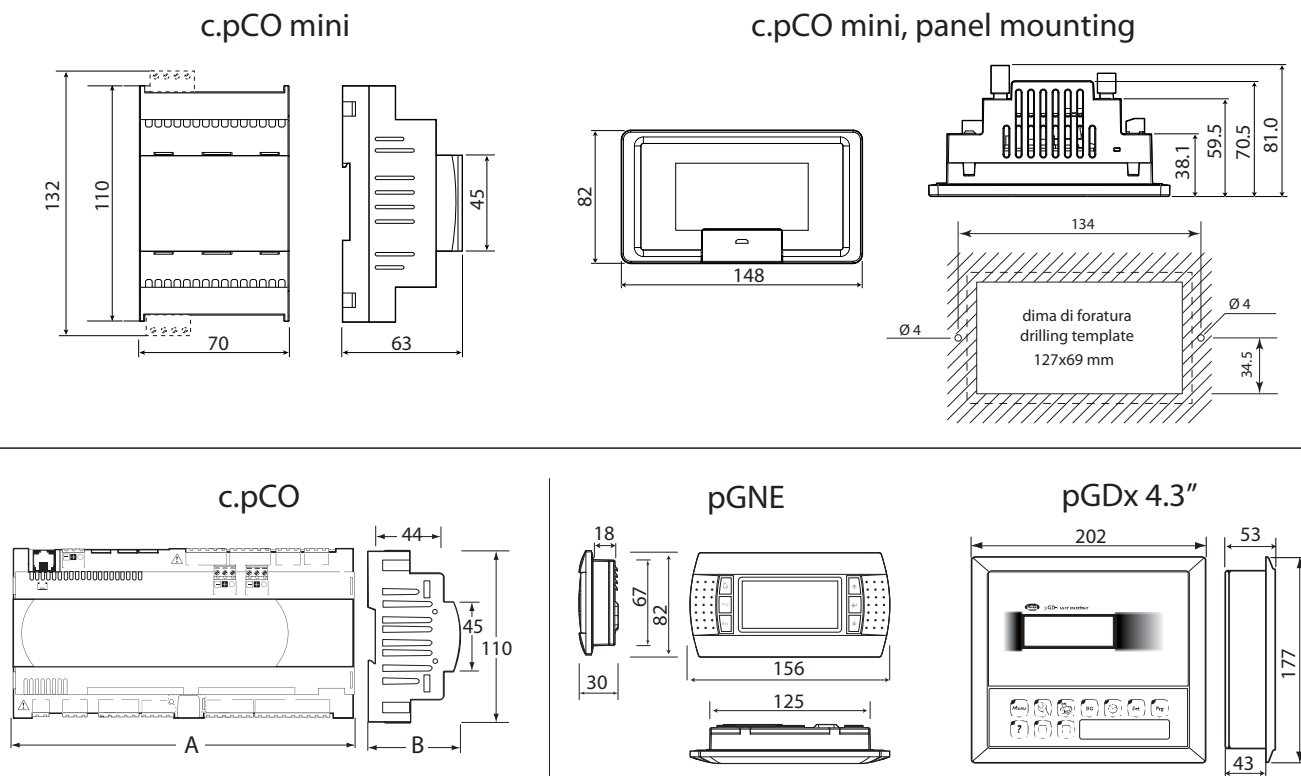


Fig. 4.a

Dimensions (mm)

	Small	Medium	Built-in driver	Large	Extralarge
A	227.5	315	315	315	315
B	60	60	60	60	60
B - with built-in USB port/terminal	70	70	70	70	70
B - with ULTRACAP module	-	-	75	-	-

Tab. 4.a

Panel mounting: c.pCO mini for panel mounting

Procedure:

1. insert the sealing gasket, with the smooth side facing the terminal;
2. insert the terminal into the opening;
3. tighten the screws;
4. apply the frame, applying uniform pressure first on the four corners (points D) and then on the midpoints of the frame (points E), until it clicks into place each time.

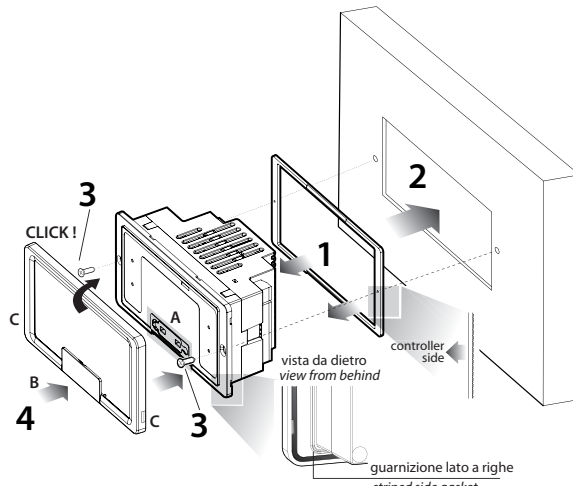
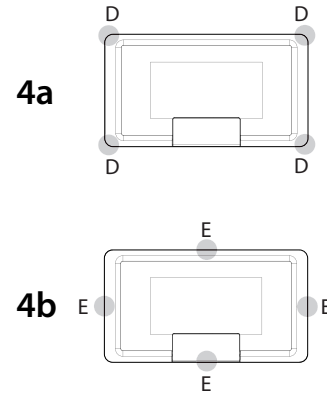


Fig. 4.b



Notice:

- for correct assembly, follow the instructions shown in the following drawing.
- Important: during assembly, make sure that the top frame is perfectly attached on all four sides.
- If needing to remove the frame, use a screwdriver to lever it out in opening C.
- To access the USB port, open the cover B and lift the rubber cap A using the tab.
- Before closing the cover B, make sure that the rubber cap A has been fully inserted (it must be flush with the outer plastic surface).
- It is recommended to laser cut the sheet metal panelling.
- Notice: the thickness of the sheet metal (or material) used to make the electrical panel must be adequate to ensure safe and stable mounting of the terminal.
- the tension exerted by the screws must not cause the sheet metal to deform, so as to guarantee the IP protection rating reported in the specifications. This protection rating is guaranteed under the following conditions: maximum deviation of the drilling rectangle from the flat surface ≤ 0.3 mm, maximum roughness of the surface where the gasket is applied ≤ 120 μ m.

4.2 Installation

Environmental conditions

Avoid installing the controller and terminal in environments with the following conditions:

- exposure to direct sunlight and the elements in general;
- temperature and humidity outside of the values allowed for operation of the product (see Chap. 12 "Technical specifications");
- wide and rapid fluctuations in ambient temperature;
- strong magnetic and/or radio frequency interference (thus avoid installation near transmitting antennae);
- strong vibrations or knocks;
- in the presence of explosives or flammable gas mixtures;
- exposure to aggressive and polluting atmospheres (e.g.: sulphur and ammonia gases, saline mist, smoke) which may cause corrosion and/or oxidation;
- exposure to dust (formation of corrosive patina with possible oxidation and reduction of insulation);
- exposure to water.

Positioning the controller inside the panel

The controller must be installed inside an electrical panel and must not be accessible, to avoid impact. The position in the electrical panel must be chosen so as to guarantee correct physical separation from the power components (solenoids, contactors, actuators, inverters, ...) and the connected cables. The ideal solution is to house these two circuits in two separate cabinets. Proximity to such devices/cables may create random malfunctions that are not immediately evident. The structure of the panel must allow the correct flow of cooling air.



Caution:

- It is recommended to protect the communication cables against unauthorised access, so as to prevent any "man in the middle" attacks;
- for safety reasons, the equipment must be housed inside an electrical panel so that the only accessible parts are the display and the keypad on the built-in terminal;
- the controller must be installed in such a way as to simplify operations on the disconnection devices;
- when wiring, separate as much as possible the probe, digital input and serial line cables from the power device cables (contactors, circuit breakers and the like) to avoid possible electromagnetic disturbance;
- never run power cables (including the electrical cables) and probe signal cables in the same conduits;
- for the control signals, it is recommended to use shielded cables with twisted wires. If the controller cables have to cross over the power cables, the intersections must be as near as possible to 90 degrees, always avoiding running the controller cables parallel to the power cables;
- reduce the path of probe cables as much as possible, and avoid spiral paths that enclose power devices;
- in the event of any malfunctions, do not attempt to repair the device, rather contact a CAREL service centre.
- to avoid tampering, it is recommended to place the equipment inside an electrical panel or locked container. The keys should be kept by qualified personnel and their use must be recorded on a specific traceability form.

Electrical installation

Caution: before carrying out any maintenance, disconnect the controller from the power supply by moving the main system switch to "off".

Provide a power disconnect device in compliance with current regulations. Use cable ends suitable for the corresponding terminals. Loosen each screw and insert the cable ends, then tighten the screws. There is no limit to the number of wires that can be inserted into a single terminal. The maximum torque for tightening the terminal screws is 0.6 Nm. For the maximum length of the connections of the analogue/digital inputs and the analogue outputs, see the table of technical specifications (see chap. 12.). For environments with strong disturbance, it is recommended to use shielded cables with the shield connected to the earth in the electrical panel. When the operation is completed, slightly tug the cables to check they are sufficiently tight.

Notice:

- fix the cables connected to the controller using cable ties, placed around 3 cm from the connectors;
- if the power supply transformer secondary is earthed, make sure that the earth wire is connected to the wire that runs to the controller and is connected to terminal G0. Follow this instruction for all devices connected to controller via the serial network.

Caution:

- a power supply voltage other than that specified may seriously damage the system;
- the fuse must be located near the controller;
- installation and maintenance/inspection of the controller are operations reserved exclusively for qualified technical personnel, in compliance with current national and local regulations;
- all of the extra low voltage connections (24 Vac or 28-36 Vdc analogue and digital inputs, analogue outputs, serial bus connections, power supplies) must have reinforced or double insulation from the mains network;
- avoid touching or nearly touching the electronic components fitted on the boards to avoid electrostatic discharges (extremely damaging) from the operator to the components;
- do not exert excessive force with the screwdriver on the connectors to avoid damaging the controller;
- when handling CAREL products, the use of an antistatic bracelet or electrostatic dissipating footwear is recommended;
- if the device is used in a way not specified by the manufacturer, the protection provided may be compromised;
- only install optional cards and connectors supplied by Carel.

4.3 Preliminary operations

Serial card assembly

If the Fieldbus and BMS serial ports built into the c.pCO are not sufficient for the required application, it is possible to add a FieldBus serial port and a BMS serial port, available as accessories (see chap.1).

Installation:

- locate the FieldBus or BMS serial port;
- using a screwdriver, remove the corresponding cover; using wire cutters, detach the pre-perforated plastic part to make an opening;
- fully insert the optional card into the slot, ensuring it makes good contact;
- close the cover by aligning the serial card connector with the opening;
- complete the required wiring.

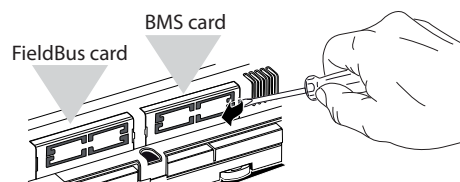


Fig. 4.c

Notice: see the technical leaflets for details on the cards to be installed.

c.pCOe expansion card assembly

See technical leaflet +05000591E.

Ultracap module assembly

See technical leaflets +05000421E and +05000411E.

4.4 Electrical connections

Ethernet network

Connections:

- use CAT-5 STP shielded cables;
- always make the earth connection using the male spade connector near the Ethernet connectors;
- the maximum length of an Ethernet connection is 100 m between devices;

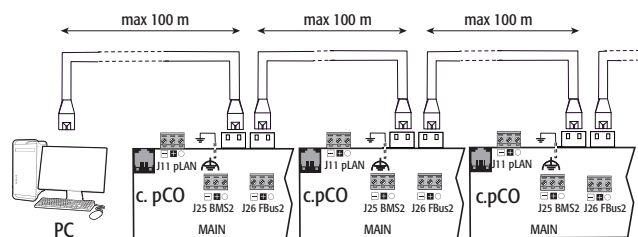


Fig. 4.d

RS485 network

To improve the controller's immunity to electromagnetic disturbance, the serial connection cable must be a shielded twisted pair, two-core or three-core depending on the insulation of the serial port.

The following rule applies:

- if the serial port is (functionally) isolated from the power supply, a third connection wire is required in the serial cable, as a common reference for the controllers. If the serial port is not optically-isolated and the common reference is already available, the third wire is not used.

For the RS485 network, use a twisted pair cable with the specifications shown in the table.

Main device	HW	Lmax (m)	Wire/wire capacity (pF/m)	Resistance on first and last device	Max no. secondary devices on bus	Data rate (bit/s)
c.pCO mini						
FBUS	RS485	2/500 (not shielded/ shielded AWG 24)	< 90	120 Ω	64	19200
PC			< 90	120 Ω	207	38400
c.pCO Small-Extralarge						
FBUS	RS485	1000	< 90	120 Ω	64	19200
PC		1000	< 90	120 Ω	207	38400



Notice: for main/secondary networks the maximum allowed length is 1000 m; 120 Ω, 1/4 W terminating resistors on the first and last devices in the network must be used when the length exceeds 100 m.

Not optically-isolated serial port

c.pCO mini: Fieldbus (J4) and BMS (J6) ports

c.pCO Small-Extralarge: serial zero - pLAN (J11), FieldBus 2 (J23 and J26), not optically-isolated BMS2 (in the models with built-in ports without optical isolation).

Case 1: multiple boards connected in a main/secondary network powered by the same transformer. The length of the network is <100m, terminating resistors are not needed (for example multiple cards connected inside the same electrical panel).

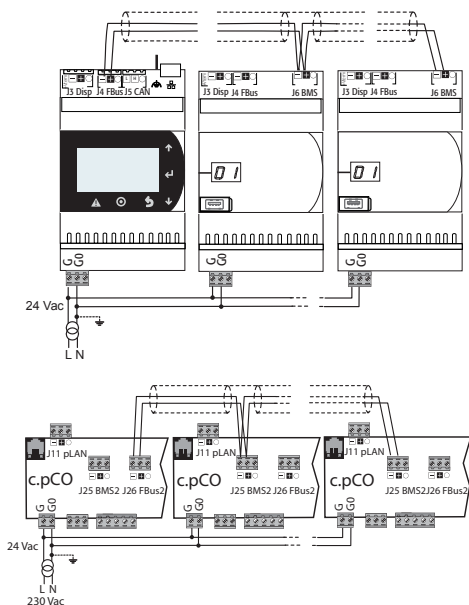


Fig. 4.e

For details on earthing the shield, see the corresponding paragraph.

Case 2: multiple boards connected in a main/secondary network powered by different transformers (with G0 not earthed); this is a typical application of multiple boards that are installed in different electrical panels. If the length of the network exceeds 100 m, the 120 Ω $\frac{1}{4}$ W terminating resistor is required.

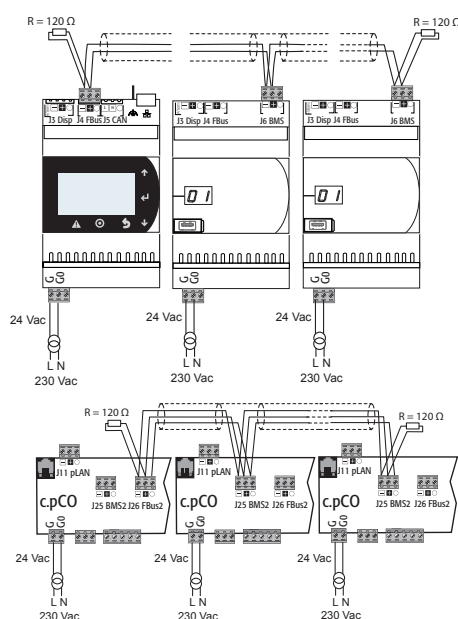


Fig. 4.f



Notice: the diagrams in cases 1 and 2 also apply to the pLAN port, with the connection cable connected to the J11 terminals. However, if the pLAN port is configured to communicate in "Display Protocol" (PGD1 and pGDx displays) the 120 Ω terminating resistor should never be installed if case 2 applies).



Caution: any earth connections must be made only at one point on the earth line (same earth pole, for all controllers).

For details on earthing the shield, see the corresponding paragraph.

Optically-isolated serial port

This is the case of serial one – BMS1, serial two - FieldBus 1 and built-in serial ports three and four on models with optical isolation. Regardless of the type of power supply or earthing, use a shielded three-wire cable, connected as shown in the figure. If the network exceeds 100 m, a terminating resistor is required.

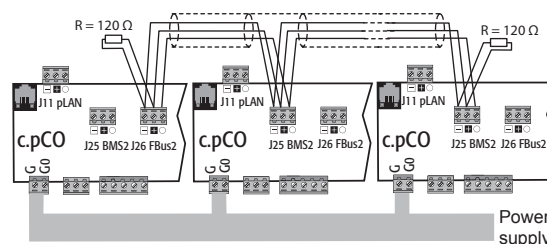


Fig. 4.g

For details on earthing the shield, see the corresponding paragraph.

Method for earthing the shield

The serial cable shield must be earthed in different ways, depending on its length, as shown in the figures (A=FBUS terminal, B=BMS terminal).

Case 1: distance between controllers less than 0.3 m: earth only one end of the cable.

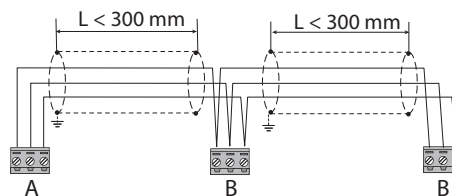


Fig. 4.h

Case 2: distance between controllers greater than 0.3 m: Two possibilities.

- earth only one end with a bridge between the shields.

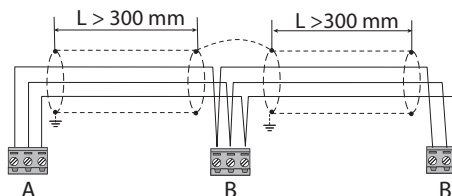


Fig. 4.i

- earth both ends (without a bridge between the shields).

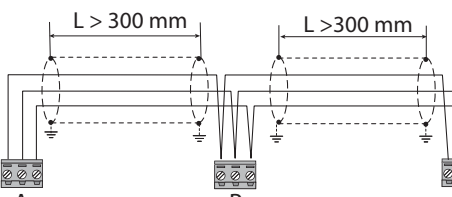


Fig. 4.j

4.5 Terminal connection

c.pCO mini

Use the accessory cable P/N S90CONN050, as shown in the figure. The maximum distance allowed without shielding is 2 metres; from 2 to 50 m a shielded cable must be used.

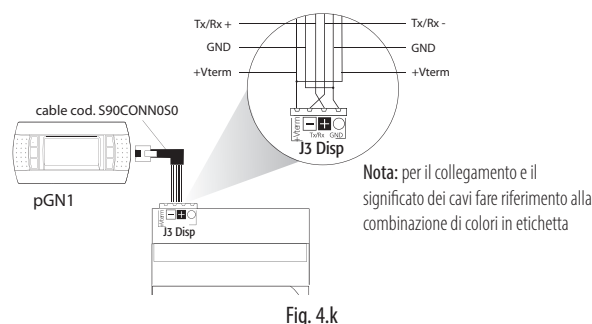


Fig. 4.k

c.pCO Small-Extralarge

The controller and the terminal are connected in a pLAN network.

1: Terminal to c.pCO controller connection

When connecting the controller to the terminal, the following constraints must be taken into account:

1. the total length of the pLAN network must not exceed 500 m. Therefore, if a remote terminal is used, the length of the terminal cable is included in the calculation of the total length;
2. unshielded telephone cable can be used for a maximum length of 50 m. Beyond this length, use a three-wire shielded cable (see the table below);
3. over 200 m, the terminal must be powered separately;
4. it is possible to connect a maximum of three terminals (semi-graphic terminals such as the PGN or touchscreen terminals such as the pGDx) to the same c.pCO controller. The terminals must be the same type (e.g. all pGN1). One terminal is powered by the controller, the other two must be powered externally;
5. Except for PGN0/PGN1/PGNE, the other terminals must be powered with a separate power supply.



Caution:

- in domestic environments, the standard (EN55014) specifies that the connection cable between the controller and the terminal must be shielded, with the shield earthed at both ends;
- In industrial environments, for lengths > 10 m, the connection cable between the controller and the terminal must be shielded, with the shield earthed.

Case A: One terminal

A.1: distance $L < 50$ m.

The typical connection of one terminal (e.g. PGN1) is made using a 6-wire telephone cable, supplied by CAREL as an accessory (P/N S90CONN00*). The telephone connector ensures both data transmission and power supply to the terminal.

Connection:

- plug the connector into terminal J10 until it clicks into place.

To remove the connector:

- press lightly on the plastic catch on the connector and remove it.

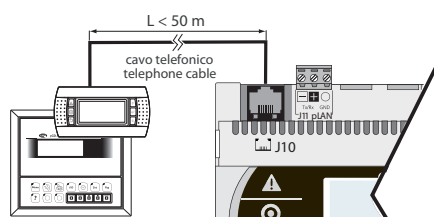


Fig. 4.l

A.2: distance $50 < L < 200$ m.

Over 50 m, two TCONN6J000 cards must be used, connected with a shielded four-wire cable, as shown in the figure. The terminal power is taken from the controller.

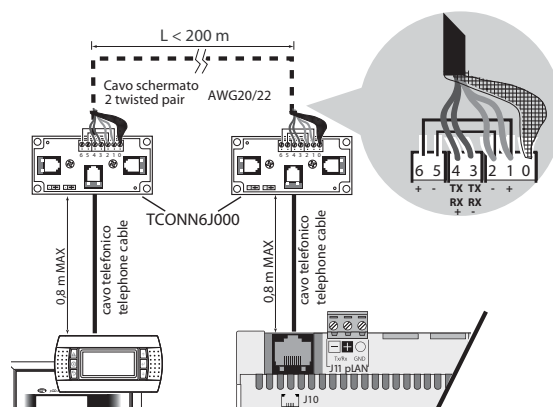


Fig. 4.m



Notice: see technical leaflet +050002895 for the location of the TCONN6J000 card jumpers.

A.3: distance $200 < L < 500$ m.

The terminal must be powered by an external power supply. Connect a shielded three-wire cable to pLAN connector J11. Power the TCONN6J000 card separately as shown in the figure.

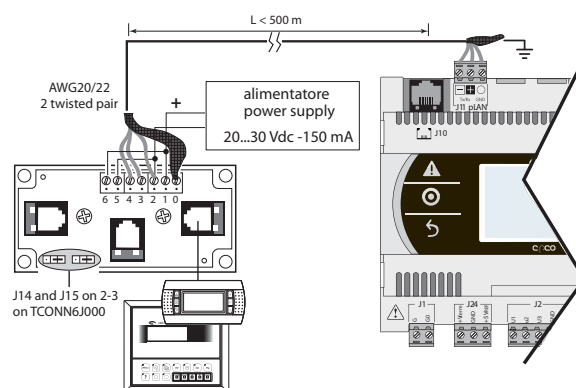


Fig. 4.n



Notice: to achieve the maximum network length, use a bus arrangement, with branches no longer than 5 m.

Case B: Two terminals

Only the Small model allows direct connection of two terminals. Other models require a separate power supply for the second terminal. Use the previously-described configuration A.1, A.2 or A.3 for Medium / Large /Extralarge controllers.

B.1: distance $L < 50$ m.

Use 1 TCONN6J000 card connected as shown in the figure.

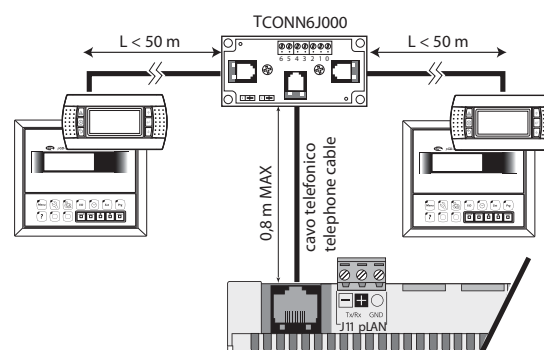


Fig. 4.o

B.2 distance $50 < L < 200$ m.

Use 3 TCONN6J000 cards connected as shown in the figure.

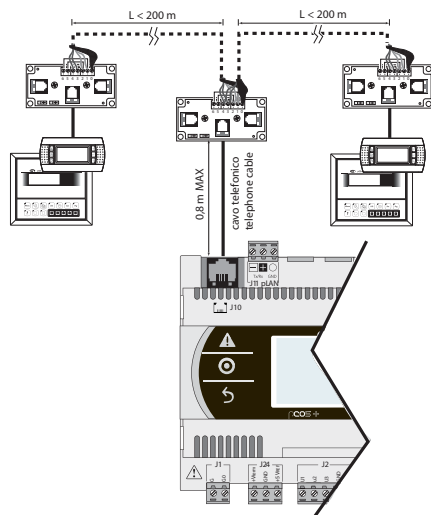


Fig. 4.p

B.3 distance $200 < L < 500$ m.

If one of the terminals is connected at a distance > 200 m, connect it according to the diagram shown in point A.3. Connect the other terminal according to diagram A.1 or A.2. If both terminals are close to each other at distances > 200 m, connect them according to the following diagram:

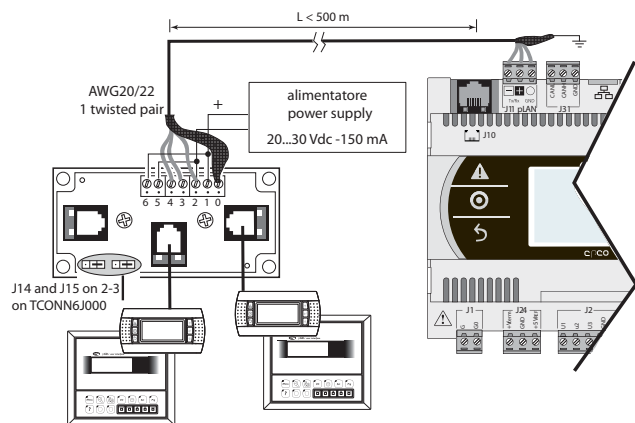


Fig. 4.q

Case C: Three terminals.

See case B for the first two terminals. For the third, use a connection according to A.1, A.2 or A.3.



Caution:

- the 24 Vdc present at +Vterm (J24) can only be used as an alternative to connector J10 to power an external terminal, with a maximum power consumption of 1.5 W;
- if using a star layout, and the cable is more than 5 m long, connect the terminal only to the first or last c.pCO on the network (to avoid branches).

The following table therefore applies.

	cable type	MAX distance terminal-controller (m)	power supply	use card TCONN6J000
1	telephone	50	taken from the controller (150 mA)	NO
2	shielded AWG24	200	taken from the controller (150 mA)	YES
3	shielded AWG20/22	500	separate	YES

2: Shared terminal connection in pLAN network

In order to share a terminal between several c.pCO controllers, these can be connected in a pLAN network, with the terminal connected to one of the controllers (see the figure below). The previous considerations regarding the maximum length allowed between terminal and controller still apply.

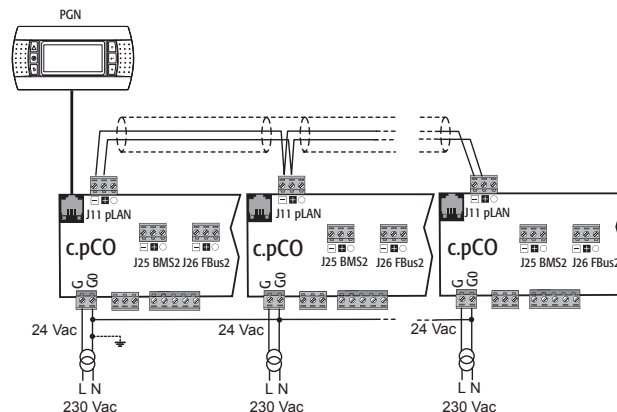


Fig. 4.r

A single terminal can be shared so as to display the information relating to each controller in sequence (see "Private and shared terminal").

4.6 Input/output labelling

The c.pCO controllers come in different sizes, with inputs, outputs and power supplies to active probes suitable for various applications. The following specifications depend on the model:

- maximum number and type of inputs/outputs;
- built-in expansion valve driver;
- type of interfaces

Label	Signal type
U...	Universal inputs/outputs, configurable via software as: Analogue inputs: - NTC, PTC, PT500, PT1000 sensors - PT100 sensors 0-1 Vdc or 0-10 Vdc signals 0/4-20 mA signals 0-5 V signals for ratiometric probes Digital inputs (not optically-isolated): - voltage-free contacts (not optically-isolated) - fast digital inputs Analogue outputs (not optically-isolated): 0-10 Vdc signals - PWM signals
Y...	0-10 Vdc analogue outputs, PWM outputs
ID...	24 Vac/24 Vdc digital input
ID...H	230 Vac digital input
NO...	Relay output, normally-open contact
NC...	Relay output, normally-closed contact
C...	Relay output, common
Tx/Rx, GND	Serial port
	Ethernet port
	Functional earth

Tab. 4.b

4.7 I/O table

		c.pCO controllers												c.pCOe I/O expansion card										
		mini (Basic)	mini (smart Enhanced)	mini (smart High End)	mini (Enhanced)	mini (High End)	Small	Medium	Large	Extra Large	Built-in driver	Label	In/Out	Type	Basic - c.pCOe	Enhanced - c.pCOe	Label	In/Out	Type					
Inputs/ outputs universal	NTC input		10				5	8	10	8	8	U	In	Universal I/O	10	U	In	Universal I/O						
	PTC input		10				5	8	10	8	8	U	In	Universal I/O	10	U	In	Universal I/O						
	PT500 input		10				5	8	10	8	8	U	In	Universal I/O	10	U	In	Universal I/O						
	PT1000 input		10				5	8	10	8	8	U	In	Universal I/O	10	U	In	Universal I/O						
	PT100 input		max 5				max 2	max 3	max 4	max 3	max 3	U	In	Universal I/O	max 5	U	In	Universal I/O						
	0-1 Vdc/0-10 Vdc input (power from controller)		0				max tot 5	max 5	max 6	max 6	max 6	U	In	Universal I/O	0	U	In	Universal I/O						
	0-1 Vdc/0-10 Vdc input (powered externally)		10 (Note¹)				max tot 5	max 5	8	max tot 10	max tot 8	max 8	U	In	Universal I/O	10 (Note¹)	U	In	Universal I/O					
	0-20 mA/4-20 mA input (power from controller)	max tot 4	max 2 (Note²)				max tot 4	max 4	max 6	max 6	max 6	max tot 7	max 6	U	In	Universal I/O	max tot 4 max 2 (Note²)	U	In	Universal I/O				
	0-20/4-20 mA input (external power)	max tot 4	max 4				max tot 4	max 4	max 7	max 9	max 7	max 7	U	In	Universal I/O	max tot 4 max 4	U	In	Universal I/O					
	0-5 V input for ratio. probe (+5Vref)		max 2				max 5	max 6	max 6	max 6	max 6	U	In	Universal I/O	2	U	In	Universal I/O						
	Digital inputs with voltage-free contacts		10				5	8	10	8	8	U	In	Universal I/O	10	U	-	Universal I/O						
	Fast digital inputs		max 2				max 2	max 4	max 6	max 4	max 4	U	In	Universal I/O	max 2	U	-	Universal I/O						
	0-10 Vdc output, not optically-isolated		max 5				5	8	10	8	8	U	Out	Universal I/O	max 5	U	-	Universal I/O						
	PWM output, not optically-isolated		10				5	8	10	8	8	U	Out	Universal I/O	10	U	-	Universal I/O						
Digital inputs		max tot 10				max tot 5	max tot 8	max tot 10	max tot 8	max tot 8				max tot 10										
	24 Vac/Vdc input, optically-isolated		0				8	12	14	12	12	ID	In	Digital input	0	ID	In	Digital input						
	24 Vac/Vdc or 230 Vac (50/60 Hz) input		0				-	2	4	2	2	ID	In	Digital input	0	ID	In	Digital input						
	Voltage-free contacts		0	2			-	-	-	-	-	ID	In	Digital input	0	ID	In	Digital input						
		max tot 0		max tot 2			max tot 8	max tot 14	max tot 18	max tot 14	max tot 14				max tot 0									
Analogue outputs	0-10 Vdc output, optically-isolated		0			4	4	6	4	4	Y	Out	Analogue output	0	Y	Out	Analogue output							
	0-10 Vdc output, not optically-isolated		0	2			0	0	0	0	0	Y1, Y2	Out	Analogue output	0	Y1, Y2	Out	Analogue output						
	PWM output, optically-isolated		0				2	2	2	2	2	Y3, Y4	Out	Analogue output	-	-	-	-						
	PWM output, not optically-isolated		0	2			0	0	0	0	0	Y1, Y2	Out	Analogue output	0	Y1, Y2	Out	Analogue output						
	Unipolar stepper motor output		0	1			0	0	0	0	0	J7	Out	Analogue output	0	1	J7	Out	Analogue output					
	Bipolar stepper motor output		0				0	0	0	0	1/2	1-3-2-4	Out	Analogue output	0	-	-	-						
			max tot 0		max tot 2			max tot 4	max tot 4	max tot 6	max tot 4	max tot 6			max tot 0	max tot 1								
Digital outputs	NO/NC relay output		1				1	3	5	3	3	NO/NC	Out	Digital output	1	NO/NC	Out	Digital output						
	NO relay output		5				7	10	13	26	10	NO	Out	Digital output	5	NO	Out	Digital output						
	24 V SSR output		2				1	2	3/4	2	2	NO	Out	Digital output	2	NO	Out	Digital output						
	230 V SSR output		2				1	2	3/4	2	2	NO	Out	Digital output	2	NO	Out	Digital output						
			max tot 6				max tot 8	max tot 13	max tot 18	max tot 29	max tot 13				max tot 6									
		16	20	25	39	52	55	39													16	17	Total	I/Os

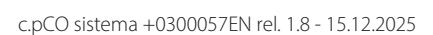


Note 1: CAREL probes P/N DP**Q and DP***2 can only be used with an external power supply and not powered by c.pCO mini.

Note 2: except for CAREL probes P/N DP**Q and DP***2.

	c.pCO controllers											c.pCOe I/O expansion card					
	mini (Basic)	mini (smart Enhanced)	mini (smart High End)	mini (Enhanced)	mini (High End)	Small	Medium	Large	Extra Large	Built-in driver	Label	In/Out	Type	Basic/Enhanced - c.pCOe	Label	In/Out	Type
Terminal power supply	0					1	1	1	1	1	J10			0	---		Telephone jack (pLAN) J10
	1					0	0	0	0	0	J3 Disp			0			J3 Disp, display port
	1					1	1	1	1	1	+Vterm			0			Additional terminal power supply
Probe power supply	1					1	1	1	1	1	+VDC			1			Power supply to active probes
	1					1	1	1	1	1	+5 VREF			1			Ratiometric probe power supply
Analogue output power supply	0					1	1	1	1	1	VG, VG0			0			
Built-in Fieldbus ports	0	1			1	1	1	2	2	1	J23/ J26, J4 (Mini)			0			
Accessory Fieldbus ports	0					1	1	1	1	1	Fbus card			0			
Built-in BMS ports	0	1	0	1	0	1	1	1	1	1	J25, J6 (Mini)			1			
Accessory BMS ports	0					1	1	1	1	1	BMS card			0			
USB host port	1					1	1	1	1	1				0			
Secondary USB port						1	1	1	1	1							
Ethernet	0	0	1	0	1	1/2	1/2	1/2	2	1/2				0			

c.pCO mini - DIN version



Factory setting:
 address = not configured
 extension = no offset
 Baud Rate = 19.2 K
 protocol = Modbus

Basic version

Enhanced version

The diagram illustrates the wiring and configuration of the C.P.C.O.e Basic version and Enhanced version modules. The modules are shown in a rack, with the Basic version on the left and the Enhanced version on the right. The modules are connected to a power supply (J1) and a communication bus (J2). The Enhanced version includes a built-in driver (J7) and a J6 BMS connector. The diagram also shows the factory settings for the modules, including address, extension, baud rate, and protocol.

Wiring details:

- Power Supply (J1):**
 - Basic version: G, GA, V+, U1, U2, U3, GND, U4, U5, U6, GND, U7, U8, U9, U10, GND.
 - Enhanced version: G, GA, V+, U1, U2, U3, GND, U4, U5, U6, GND, U7, U8, U9, U10, GND.
- Communication Bus (J2):**
 - Basic version: G, GA, V+, U1, U2, U3, GND, U4, U5, U6, GND, U7, U8, U9, U10, GND.
 - Enhanced version: G, GA, V+, U1, U2, U3, GND, U4, U5, U6, GND, U7, U8, U9, U10, GND.
- Enhanced version specific:**
 - J6 BMS:** Twilio, GND.
 - J7:** Built-in driver.

Configuration details:

- Address:** ON/OFF switches for Address, Ext., Baud, and Prot.
- Ext. Baud Prot:** ON/OFF switches for Extension, Baud Rate, and Protocol.
- Factory settings:**
 - Address: not configured
 - Extension: no offset
 - Baud Rate: 19.2 K
 - Protocol: Modbus

See the figures on the previous pages relating to the c.pCO mini/c.pCOe.

(*) Voltage A: 24 Vac +10%/-15% 50/60 Hz, from 28 to 36 Vdc $\pm$ 10%

[illegible]

Tab. 4.c

SMALL



Ref.	Description
12	Reserved
13	Ethernet port 1
14	Ethernet port 2
15	Relay digital outputs
16	BMS2 connector
17	FieldBus2 connector
18	Dipswitches for FieldBus/ BMS selection
25	USB Host port (main)
26	USB Device port (secondary)
27	Spade connector for Ethernet port earth
28	Built-in display and keypad

4.10 c.pCO Large and Extralarge: connection terminals

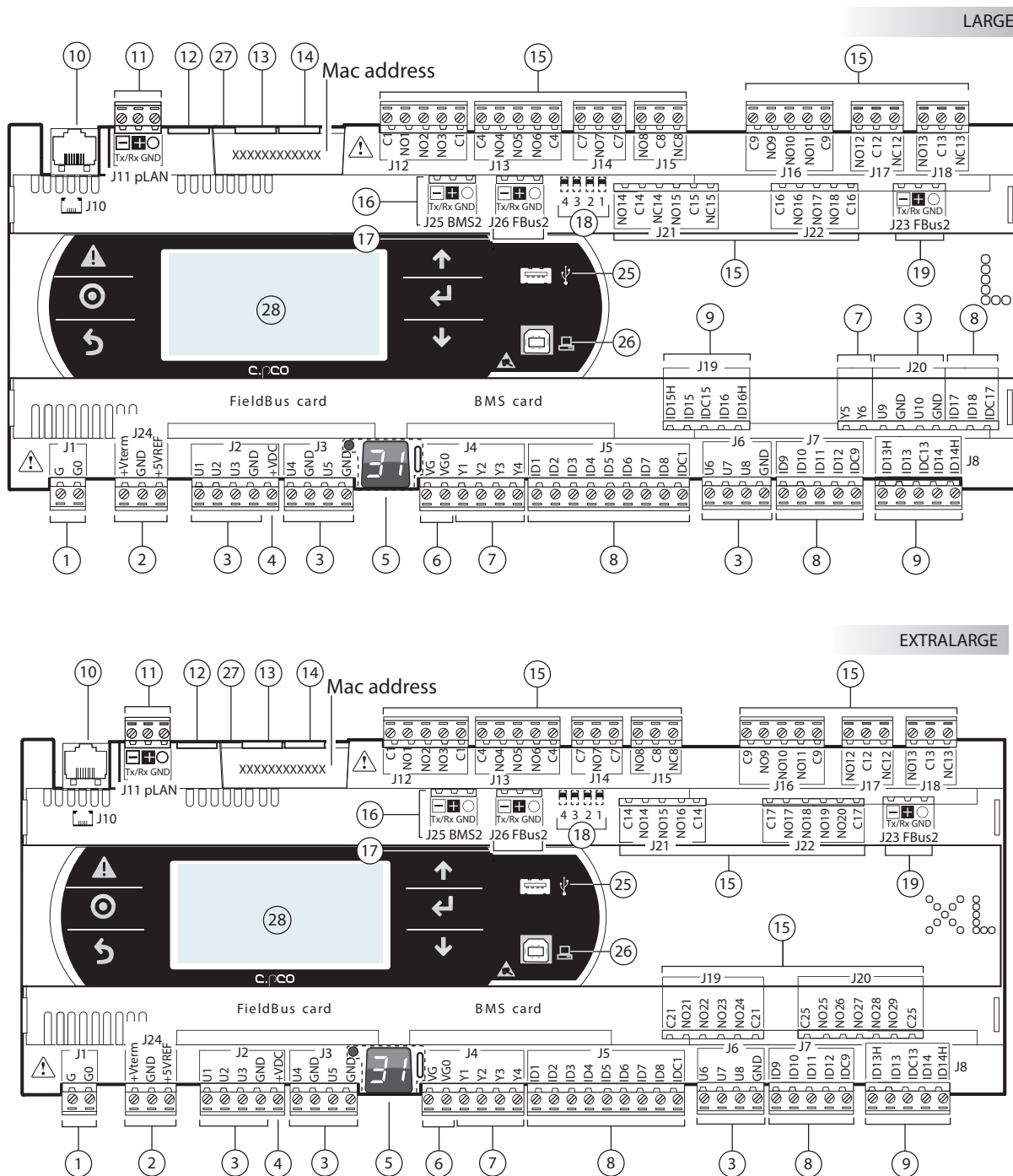


Fig. 4.t

Key:

Ref.	Description
1	Power supply connector [G(+), G0(-)]
2	+Vterm: power supply to additional terminal +5 VREF power supply for ratiometric probes
3	Universal inputs/outputs
4	+Vdc: power supply to active probes
5	pLAN address setting button, secondary display, LED
6	VG: power at voltage A (*) for optically-isolated analogue output VG0: power at 0 Vac/Vdc for optically-isolated analogue output
7	Analogue outputs
8	ID: digital inputs with voltage A (*)
9	ID.: digital inputs with voltage A (**) IDH.: digital inputs with voltage B (**)
10	pLAN telephone connector for terminal/application program download
11	Plug-in pLAN connector
12	Reserved

(*) Voltage A: 24 Vac or 28-36 Vdc; (**) Voltage B: 230 Vac - 50/60 Hz

Ref.	Description
13	Ethernet port 1
14	Ethernet port 2
15	Relay digital outputs
16	BMS2 connector
17	FieldBus2 connector
18	Dipswitches for FieldBus/ BMS selection
19	FieldBus2 connector
25	USB Host port (main)
26	USB Device port (secondary)
27	Spade connector for Ethernet port earth
28	Built-in display and keypad

4.11 c.pCO built-in driver: connection terminals

c.pCO comes in two models, with one or two built-in electronic expansion valve drivers.

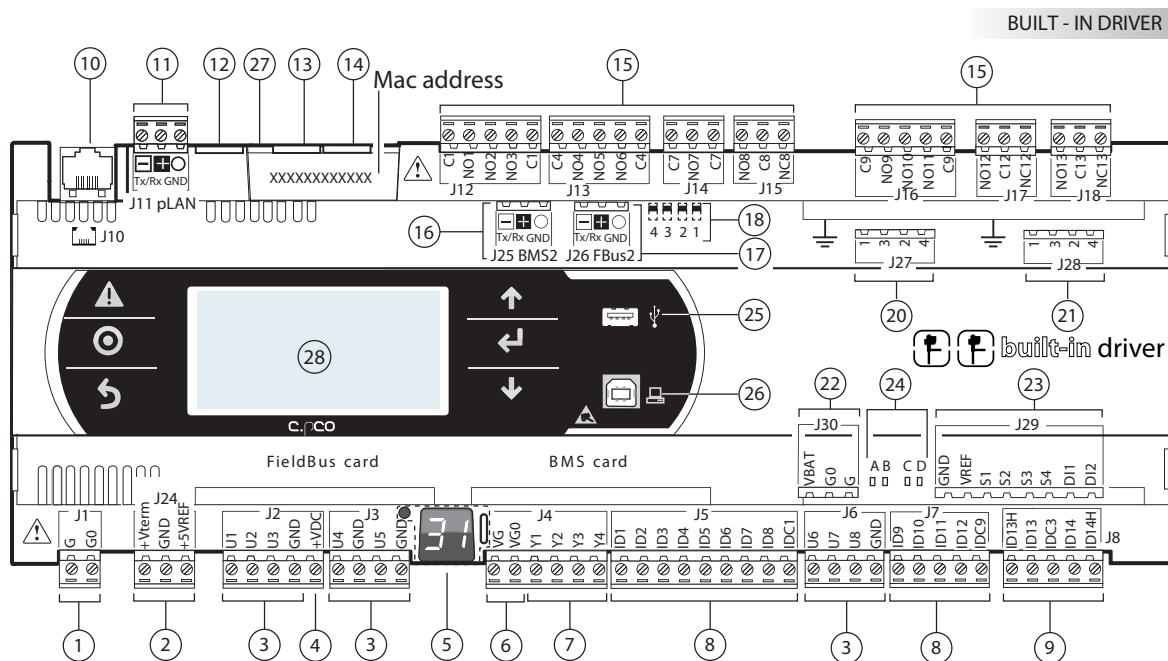


Fig. 4.u

Key:

Ref.	Description	Ref.	Description
1	Power supply connector [G(+), G0(-)]	15	Relay digital outputs
2	+Vterm: power to additional terminal +5 VREF power supply for ratiometric probes	16	BMS2 connector
3	Universal inputs/outputs	17	FieldBus2 connector
4	+Vdc: power supply to active probes	18	Dipswitches for FieldBus/ BMS selection
5	pLAN address setting button, secondary display, LED	20	Electronic valve A connector
6	VG: power at voltage A (*) for optically-isolated analogue output VG0: power at 0 Vac/Vdc for optically-isolated analogue output	21	Electronic valve B connector
7	Analogue outputs	22	Connector for external Ultracap module (accessory)
8	ID: digital inputs with voltage A (*)	23	Valve driver analogue and digital inputs
9	ID.: digital inputs with voltage A (*) IDH.: digital inputs with voltage B (**)	24	Valve status indicator LED
10	pLAN telephone connector for terminal	25	USB Host port (main)
11	Plug-in pLAN connector	26	USB Device port (secondary)
12	Reserved	27	Spade connector for Ethernet port earth
13	Ethernet port 1	28	Built-in display and keypad
14	Ethernet port 2		

(*) Voltage A: 24 Vac or 28-36 Vdc; (**) Voltage B: 230 Vac - 50/60 Hz

Description of c.pCO Small-Extralarge terminals

Ref.	Term.	Label	Description
1	J1-1	G	Power supply at voltage A(*)
	J1-2	G0	Power reference
2	J24-1	+Vterm	Power supply to additional terminal
	J24-2	GND	Common for power supply
3	J24-3	+5 VREF	Power supply to 0-5 V ratiometric probes
	J2-1	U1	Universal input/output 1
3	J2-2	U2	Universal input/output 2
	J2-3	U3	Universal input/output 3
3	J2-4	GND	Common for universal inputs/outputs 1, 2, 3
	J3-1	U4	Universal input/output 4
3	J3-2	GND	Common for universal input/output 4
	J3-3	U5	Universal input/output 5
3	J3-4	GND	Common for universal input/output 5
3	J6-1	U6	Universal input/output 6
	J6-2	U7	Universal input/output 7
3	J6-3	U8	Universal input/output 8
	J6-4	GND	Common for universal inputs/outputs 6, 7, 8
3	J20-3	U9	Universal input/output 9
	J20-4	GND	Common for universal input/output 9
3	J20-5	U10	Universal input/output 10
	J20-6	GND	Common for universal input/output 10
4	J2-5	+VDC	Power supply to active probes
5	pLAN address selection button, secondary display, signal LED		

Ref.	Term.	Label	Description
6	J4-1	VG	Power supply for optically-isolated analogue output at voltage A(*)
	J4-2	VG0	Power supply for optically-isolated analogue output at 0 Vac/Vdc
7	J4-3	Y1	Analogue output 1, 0-10 V
	J4-4	Y2	Analogue output 2, 0-10 V
7	J4-5	Y3	Analogue output 3, 0-10 V
	J4-6	Y4	Analogue output 4, 0-10 V
7	J20-1	Y5	Analogue output 5, 0-10 V
	J20-2	Y6	Analogue output 6, 0-10 V
8	J5-1	ID1	Digital input 1 at voltage A(*)
	J5-2	ID2	Digital input 2 at voltage A(*)
8	J5-3	ID3	Digital input 3 at voltage A(*)
	J5-4	ID4	Digital input 4 at voltage A(*)
8	J5-5	ID5	Digital input 5 at voltage A(*)
	J5-6	ID6	Digital input 6 at voltage A(*)
8	J5-7	ID7	Digital input 7 at voltage A(*)
	J5-8	ID8	Digital input 8 at voltage A(*)
8	J5-9	IDC1	Common for digital inputs 1 to 8 (negative pole if group is DC powered)
	J7-1	ID9	Digital input 9 at voltage A(*)
8	J7-2	ID10	Digital input 10 at voltage A(*)
	J7-3	ID11	Digital input 11 at voltage A(*)
8	J7-4	ID12	Digital input 12 at voltage A(*)
	J7-5	IDC9	Common for digital inputs 9 to 12 (negative pole if group is DC powered)

Ref.	Term.	Label	Description
8	J20-7◆	ID17	Digital input 17 at voltage A(*)
	J20-8◆	ID18	Digital input 18 at voltage A(*)
	J20-9◆	IDC17	Common for digital inputs 17 and 18 (negative pole if group is DC powered)
9	J8-1	ID13H	Digital input 13 at voltage B(**)
	J8-2	ID13	Digital input 13 at voltage A(*)
	J8-3	IDC13	Common for digital inputs 13 and 14 (negative pole if group is DC powered)
	J8-4	ID14	Digital input 14 at voltage A(*)
	J8-5	ID14H	Digital input 14 at voltage B(**)
9	J19-1◆	ID15H	Digital input 15 at voltage B(**)
	J19-2◆	ID15	Digital input 15 at voltage A(*)
	J19-3◆	IDC15	Common for digital inputs 15 and 16 (negative pole if group is DC powered)
10	J19-4◆	ID16	Digital input 16 at voltage A(*)
	J19-5◆	ID16H	Digital input 16 at voltage B(**)
	J10	-	pLAN telephone cable connector
11	J11-1	Tx-/Rx-	pLAN port RS485 Tx-/Rx-
	J11-2	Tx+/Rx+	pLAN port RS485 Tx+/Rx+
	J11-3	GND	pLAN port RS485 GND
12	-	-	Reserved
13	-	-	Ethernet port 1
14	-	-	Ethernet port 2
15	J12-1	C1	Common for relay 1, 2, 3
	J12-2	NO1	Relay 1, normally open contact
	J12-3	NO2	Relay 2, normally open contact
	J12-4	NO3	Relay 3, normally open contact
	J12-5	C1	Common for relay 1, 2, 3
	J13-1	C4	Common for relay 4, 5, 6
	J13-2	NO4	Relay 4, normally open contact
	J13-3	NO5	Relay 5, normally open contact
	J13-4	NO6	Relay 6, normally open contact
	J13-5	C4	Common for relay 4, 5, 6
	J14-1	C7	Common for relay 7
	J14-2	NO7	Relay 7, normally open contact
	J14-3	C7	Common for relay 7
	J15-1	NO8	Relay 8, normally open contact
	J15-2	C8	Common for relay 8
	J15-3	NC8	Relay 8, normally closed contact
	J16-1	C9	Common for relay 9, 10, 11
	J16-2	NO9	Relay 9, normally open contact
	J16-3	NO10	Relay 10, normally open contact
	J16-4	NO11	Relay 11, normally open contact
	J16-5	C9	Common for relay 9, 10, 11
	J17-1	NO12	Relay 12, normally open contact
	J17-2	C12	Common for relay 12
	J17-3	NC12	Relay 12, normally closed contact
	J18-1	NO13	Relay 13, normally open contact
	J18-2	C13	Common for relay 13
	J18-3	NC13	Relay 13, normally closed contact
	J21-1◆	NO14	Relay 14, normally open contact
	J21-2◆	C14	Common for relay 14
	J21-3◆	NC14	Relay 14, normally closed contact
	J21-4◆	NO15	Relay 15, normally open contact
	J21-5◆	C15	Common for relay 15
	J21-6◆	NC15	Relay 15, normally closed contact
	J22-1◆	C16	Common for relay 16, 17, 18
	J22-2◆	NO16	Relay 16, normally open contact
	J22-3◆	NO17	Relay 17, normally open contact
	J22-4◆	NO18	Relay 18, normally closed contact
	J22-5◆	C16	Common for relay 16, 17, 18
	J21-1◆◆	C14	Common for relay 14, 15, 16
	J21-2◆◆	NO14	Relay 14, normally open contact
	J21-3◆◆	NO15	Relay 15, normally open contact
	J21-4◆◆	NO16	Relay 16, normally open contact
	J21-5◆◆	C14	Common for relay 14, 15, 16

Ref.	Term.	Label	Description
15	J22-1◆◆	C17	Common for relay 17, 18, 19, 20
	J22-2◆◆	NO17	Relay 17, normally open contact
	J22-3◆◆	NO18	Relay 18, normally open contact
	J22-4◆◆	NO19	Relay 19, normally open contact
	J22-5◆◆	NO20	Relay 20, normally open contact
	J22-6◆◆	C17	Common for relay 17, 18, 19, 20
	J19-1◆◆	C21	Common for relay 21, 22, 23, 24
	J19-2◆◆	NO21	Relay 21, normally open contact
	J19-3◆◆	NO22	Relay 22, normally open contact
	J19-4◆◆	NO23	Relay 23, normally open contact
	J19-5◆◆	NO24	Relay 24, normally open contact
	J19-6◆◆	C21	Common for relay 21, 22, 23, 24
	J20-1◆◆	C25	Common for relay 25, 26, 27, 28, 29
	J20-2◆◆	NO25	Relay 25, normally open contact
	J20-3◆◆	NO26	Relay 26, normally open contact
	J20-4◆◆	NO27	Relay 27, normally open contact
	J20-5◆◆	NO28	Relay 28, normally open contact
	J20-6◆◆	NO29	Relay 29, normally open contact
	J20-7◆◆	C25	Common for relay 25, 26, 27, 28, 29
16	J25-1	Tx-/Rx-	BMS2 port RS485 Tx-/Rx-
	J25-2	Tx+/Rx+	BMS2 port RS485 Tx+/Rx+
	J25-3	GND	BMS2 port RS485 GND
17	J26-1	Tx-/Rx-	Fieldbus 2 port RS485 Tx-/Rx-
	J26-2	Tx+/Rx+	Fieldbus 2 port RS485 Tx+/Rx+
18	Port J26 configuration dipswitches		
19	J23-1	Tx-/Rx-	Fieldbus 2 port RS485 Tx-/Rx-
	J23-2	Tx+/Rx+	Fieldbus 2 port RS485 Tx+/Rx+
	J23-3	GND	Fieldbus 2 port RS485 network GND
For built-in driver models only:			
20	J27-1	1	Electronic expansion valve 1 command (see par. "Electronic valve connection").
	J27-2	3	
	J27-3	2	
	J27-4	4	
21	J28-1	1	Electronic expansion valve 2 command (see par. "Electronic valve connection").
	J28-2	3	
	J28-3	2	
	J28-4	4	
22	J30-1	VBAT	Power from external Ultracap module
	J30-2	G0	
	J30-3	G	
23	J29-1	GND	Common for probe power supply
	J29-2	VREF	Driver probe power supply
	J29-3	S1	Probe 1
	J29-4	S2	Probe 2
	J29-5	S3	Probe 3
	J29-6	S4	Probe 4
	J29-7	DI1	Digital input 1
24	J29-8	DI2	Digital input 2
	A, B	Valve A status indicator LED	
	C, D	Valve B status indicator LED	
Tab. 4.d			

(*) : voltage A: 24 Vac or 28-36 Vdc;

(**) : voltage B: 230 Vac - 50/60 Hz

◆: Large model; ◆◆: Extralarge model.

5. INPUT/OUTPUT CONNECTIONS

5.1 Power supply

The following figure shows the power supply connection diagram. Use a class II safety transformer with protection against short circuits and overload. See the technical specifications table for the transformer size according to the model (see chap. 12).

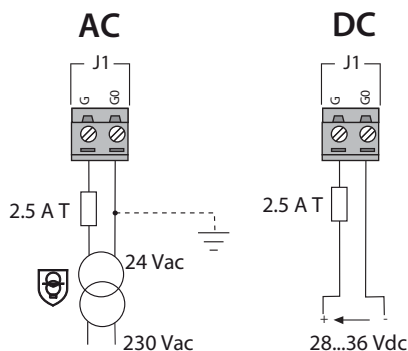


Fig. 5.a



Caution:

- power the c.pCO built-in driver only with AC voltage, with the transformer secondary earthed;
- if the Ethernet connection is used, the transformer secondary must be connected to earth;
- a power supply voltage other than that specified may seriously damage the controller;
- If the transformer secondary is earthed, check that the earth wire is connected to terminal G0. Follow this instruction for all devices connected to c.pCO via the serial network.
- if powering multiple c.pCO controllers connected to a pLAN network, make sure that the G and G0 references are respected (the G0 reference must be maintained for all controllers);
- it is recommended to separate the power supply to the controller and the terminal (or multiple controllers and terminals) from the power supply to the other electrical devices (contactors and other electromechanical components) inside the electrical panel.



Notice:

- the c.pCO Small-Extralarge controllers have a yellow LED power signal;
- for controllers connected to a pLAN network, both in the same electrical panel or different electrical panels, see the diagrams in par. 4.4.

5.2 Universal inputs/outputs

The universal inputs/outputs are marked with the letter U ... and can be configured in the application program as:

- passive temperature probes: NTC, PTC, PT100, PT500, PT1000;
- active pressure/temperature/humidity probes;
- ratiometric pressure probes;
- 0-20 mA or 4-20 mA current inputs;
- 0-1 Vdc or 0-10 Vdc voltage inputs;
- fast, voltage-free digital inputs;
- 0-10 Vdc analogue outputs.
- PWM outputs.



Caution:

- universal inputs/outputs must be preconfigured for the required signals in the application program;
- universal inputs/outputs cannot be used as digital outputs.

Maximum number of analogue inputs that can be connected

The maximum number of analogue inputs that can be connected to the universal inputs/outputs depends on the type.

Maximum number of inputs that can be connected to the universal inputs/outputs				
Signal type	c.pCO mini - c.pCOe	Small	Medium/ Built-in driver/ Extralarge	Large
- NTC/PTC/PT500/PT1000 probes	10	5	8	10
- PT100 probes	max 5	2	3 (2 on U1-U5, 1 on U6-U8)	4 (2 on U1-U5, 1 on U6-U8, 1 on U9-U10)
- 0-1 Vdc/0-10 Vdc signals from probes powered by the controller	0	5	6	max 6
- 0-1 Vdc/0-10 Vdc signals powered externally	10	max tot 5	max tot 8	max tot 10
- 0-20 mA /4-20 mA inputs from probes powered by the controller	2	4	6: (max 4 on U1-U5, 3 on U6-U8)	6: (max 4 on U1-U5, 3 on U6-U8, 2 on U9-U10)
- 0-20 mA inputs /4-20 mA inputs from externally powered probes	max tot 4	4	max tot 7	max tot 9
- 0-5 V signals from ratiometric probes powered by the controller	max 2	max 5	max 6	max 6

Tab. 5.a



Notice: the table specifies the maximum number of inputs that can be connected. For example, on the Small controller, a maximum of five 0-1 Vdc inputs from probes powered by the controller and a maximum of five 0-1 Vdc inputs from externally-powered probes can be connected. The total number of inputs of both types however cannot exceed five.



Caution: there is a known limitation to the possible configurations, i.e. the following arrangement of probes/functions causes the probe alarm to fail:

- U8 = NTC, U9 = NTC, U10 = 0-10 V analogue input
- U6 = 0-10V, U7 = 0-10V, U8 = NTC

Remote control of analogue inputs

The cable sizes for the remote control of the analogue inputs are shown in the following table.

Input type	Cross-section (mm ²)
NTC	0.5
PT1000	0.75
I (current)	0.25
V (current)	0.25

Tab. 5.b



Caution: separate as much as possible (at least 3 cm) the probe and digital input cables from cables to loads and power cables, so as to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel cables) and probe signal cables in the same conduits.

NTC, PTC temperature probe connection

See the table at the beginning of the paragraph for the maximum number of probes that can be connected. For the operating range, see the technical specifications table (see chap. 12).

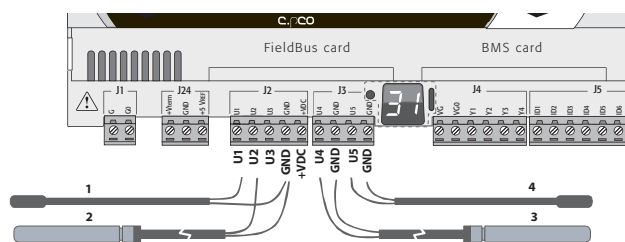


Fig. 5.b

Key

Controller terminals	NTC probe			
	1	2	3	4
GND	Wire 1			
U1	Wire 2			
GND		Wire 1		
U2		Wire 2		
GND			Wire 1	
U4			Wire 2	
GND				Wire 1
U5				Wire 2

PT500/PT1000 temperature probe connection

See the table at the beginning of the paragraph for the maximum number of probes that can be connected. For the operating range, see the technical specifications table (see chap. 12).



Caution:

- to ensure a correct probe measurement, each wire must be connected to a single terminal;
- The two probe wires have no polarity.

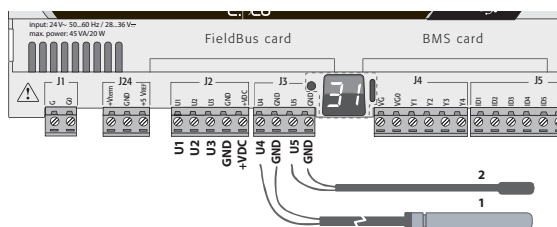


Fig. 5.c

Key

Controller terminals	PT500/PT1000 probe	
	1	2
GND	Wire 1	
U4	Wire 2	
GND		Wire 1
U5		Wire 2

PT100 temperature probe connection

See the table at the beginning of the paragraph for the maximum number of probes that can be connected. For the operating range, see the technical specifications table (see chap. 12).

The probe has three wires, one of which goes to GND and the other two to separate, adjacent universal inputs on the same connector (e.g. U1, U2, GND, or U4, U5, GND).

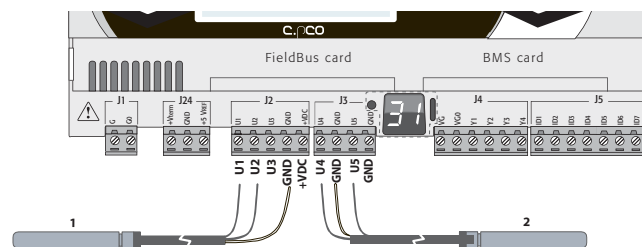


Fig. 5.d

Key

Controller terminals	PT100 probe	
	1	2
U1	Wire 1 (red)	
U2	Wire 2 (red)	
GND	Wire 3 (white)	
U4		Wire 1 (red)
U5		Wire 2 (red)
GND		Wire 3 (white)

Active temperature and humidity probe connection

See the table at the beginning of the paragraph for the maximum number of probes that can be connected. This depends on the type of power supply. The distinction is made between probes powered by the controller (+VDC terminal) and probes powered externally, as well as between active probes with voltage or current output signals. For the operating range, see the probe data sheets. All CAREL DP* series active temperature and humidity probes configured for 0-1 V or 4-20 mA signals can be connected to the controller.



Notice: the c.pCO mini models do not allow 0-1 Vdc or 0-10 Vdc signals from probes powered by the controller as inputs.



Caution: for temperature probes, use the 4-20 mA or NTC configuration, as the 0-1 Vdc signal is limited to the narrow range of 0 to 1 V and therefore is not always compatible with the standard 10 mV/°C signal for CAREL probes (for negative temperatures and temperatures above 100 °C, a probe alarm may be generated).

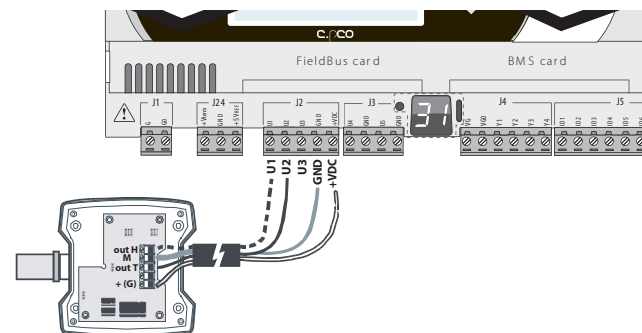


Fig. 5.e

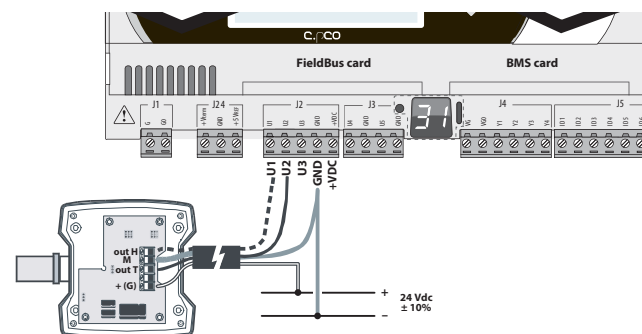


Fig. 5.f

Key

Controller terminals	Probe terminals	Description
GND	M	Reference
+VDC	+(G)	Probe power supply
U1	outH	Humidity probe output
U2	outT	Temperature probe output

Pressure probe with current signal connection

See the table at the beginning of the paragraph for the maximum number of probes that can be connected. For the operating range, see the probe data sheets. All CAREL SPK* series active pressure probes or any pressure probe available on the market with a 0-20 mA or 4-20 mA signal can be connected to the controller.

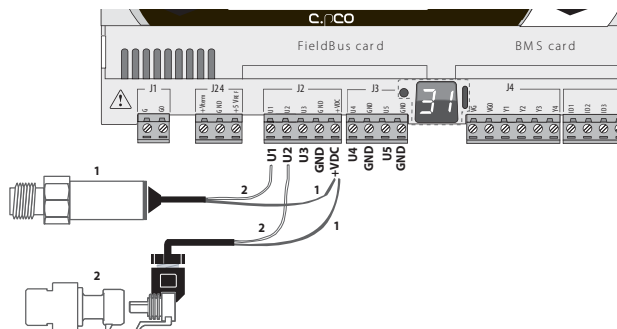


Fig. 5.g

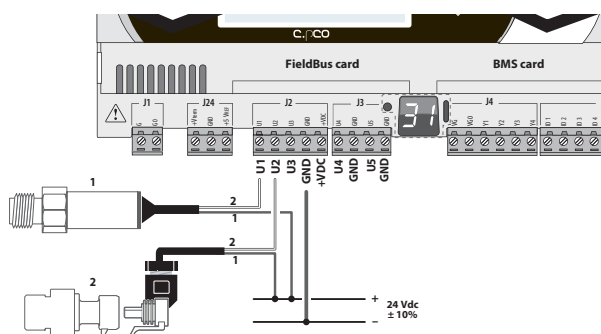


Fig. 5.h

Key						
Pressure probe with current signal						
Controller terminals						
1						2
+VDC	Wire 1	power supply	brown	Wire 1	power	brown
U1	Wire 2	Signal	white	-		
U2				Wire 2	Signal	white

0-5 V ratiometric pressure probe connection

See the table at the beginning of the paragraph for the maximum number of probes that can be connected. For the operating range, see the probe data sheets. All CAREL SPKT series active pressure probes or any pressure probe on the market with a 0-5 V ratiometric signal can be connected to the controller.



Caution:

- the ratiometric probes are powered by the controller via the +5 V_{REF} terminal;
- ratiometric probes cannot be powered externally.

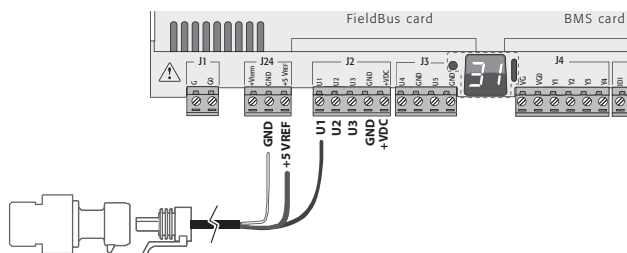


Fig. 5.i

Key		
Controller terminals	Description	Wire colour
+5 Vref	Power supply	black
GND	Power reference	green
U1	Signal	white

Active probes with 0-10 V output connection

See the table at the beginning of the paragraph for the maximum number of probes that can be connected. For the operating range, see the probe data sheets.

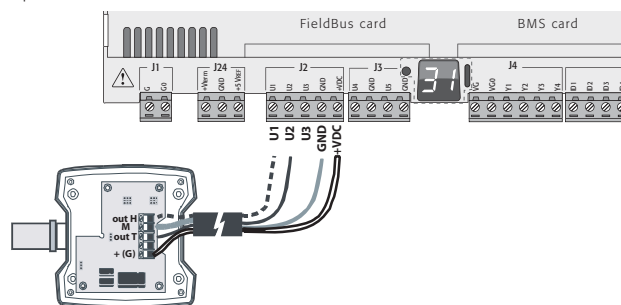


Fig. 5.j

Key

Controller terminals	0 to 10 V active probes
GND	Reference
+VDC	Power supply
U1	Signal 1
U2	Signal 2

Max. number of digital inputs that can be connected

The controller allows the universal inputs/outputs to be configured as voltage-free, non-optically isolated digital inputs. In any case, the inputs must be connected to a voltage-free contact.

Maximum number of digital inputs that can be connected to the universal inputs/outputs

Signal type		c.pCO			
		mini	Small	Medium/ Built-in driver/ Extralarge	Large
Digital inputs (not optically-isolated)	- voltage-free contacts	10	5	8	10
	- fast digital inputs	max 2	max 2	4 (max 2 on U1-U5, max 2 on U6-U8)	6 (max 2 on U1-U5, max 2 on U6-U8, 2 on U9-U10)

Tab. 5.c



Caution: the maximum current allowed by the digital input is 10 mA. Therefore, the external contact must be rated for at least 10 mA.

ON/OFF input connection

There are no specific constraints on the maximum number of inputs that can be connected. For the operating range, see the technical specifications table (see chap. 12).

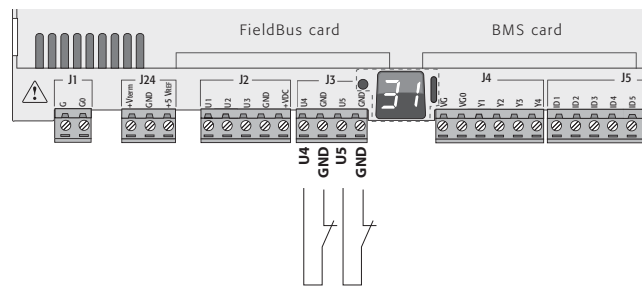


Fig. 5.k

Key

Controller terminals	Description
U4	Digital input 1
GND	
U5	Digital input 2
GND	

Fast digital input connection



Caution: The wires for the fast digital inputs/counters must be shielded to avoid causing electromagnetic disturbance to the probe cables.

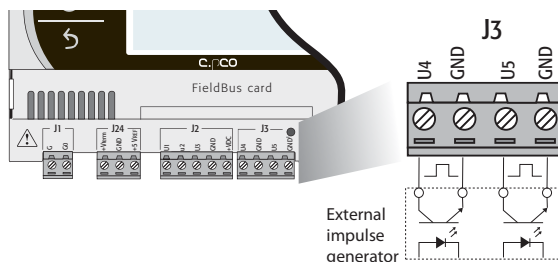


Fig. 5.1

The fast digital input can be used as a frequency counter. The count occurs on the rising edge of the pulse. The pulse generator device will have an optically-isolated transistor digital output that will be connected to the input as shown in the figure. For the characteristics of the input signal, see the technical specifications table (see chap. 12).



 **Notice:** the application program makes the frequency values available through specific variables. If configuring the inputs as counters, the application program decides when to reset the counter.

Example:

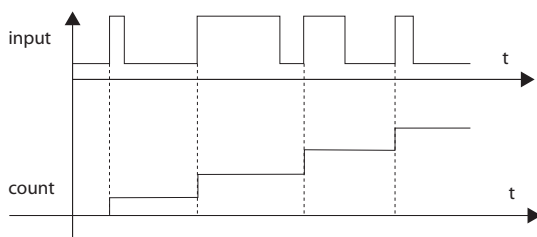


Fig. 5.m



 **Notice:** for fans with a tachometer output and high resistance in series, the pulse reading may depend on the current. The current value is configurable in the I/O Editor function in c.design.

Non optically-isolated analogue output connection

There are no specific constraints on the number of inputs that can be connected. For the characteristics of the output signal, see the technical specifications table (see chap. 12).

Example: analogue/PWM output connection diagram.

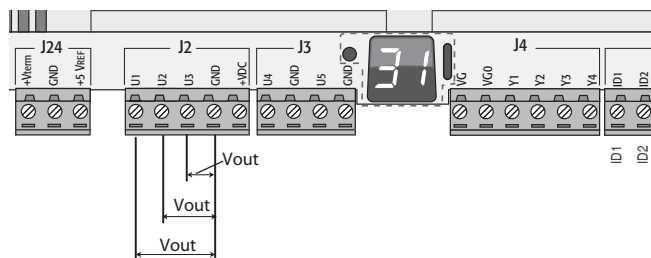


Fig. 5.n

Key	Description
Controller terminals	
U1	Analogue output 1
GND	
U2	Analogue output 2
GND	
U3	Analogue output 3
GND	



Notice: analogue outputs cannot be connected in parallel.

5.3 Digital inputs

The controller features digital inputs for connecting safety devices, alarms, device states and remote enabling signals. See the technical specifications table for the maximum cable length (see chap. 12).

c.pCO mini

The digital inputs are not optically-isolated and have voltage-free contacts. The following figure shows how to connect the digital inputs:

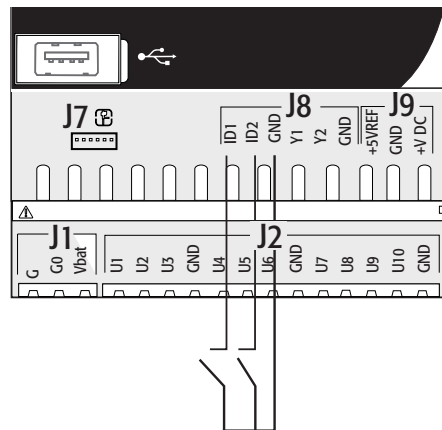


Fig. 5.0

c.pCO Small-Extralarge

These inputs are all optically-isolated from the other terminals and can operate at 24 Vac (+10/-15%) or 28-36 Vdc (-20/+10%) (indicated as ID*) and some at 230 Vac (indicated as IDH*), see the figure below as a reference.



Notice:

- if the control voltage is taken in parallel with a coil, install a dedicated RC filter in parallel (typical specifications 100 Ω , 0.5 μF , 630 V);
- if connected to the digital inputs of security systems (alarms), the presence of voltage across the contact must be considered the normal operating condition, while no (zero) voltage must be considered an alarm condition. This will also ensure that any interruption (or disconnection) of the input is signalled;
- do not connect neutral in place of an open digital input;
- make sure to always interrupt the phase.



Caution:

- separate as much as possible (at least 3 cm) the probe and digital input cables from cables to loads and power cables, so as to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel cables) and probe signal cables in the same conduits.

Digital inputs powered at 24 Vac (c.pCO Small-Extralarge only)

The digital inputs (ID...) can be controlled at 24 Vac.



Notice:

- the digital inputs have only functional isolation from the rest of the controller;
- to maintain optical isolation of the digital inputs, use a separate power supply for each;
- the digital inputs can be powered at a voltage different from that of the controller.

Cable sizes

For remote digital inputs (length < 50 m), use cables with a cross section of 0.25 (mm²).

Caution: if the controller is installed in an industrial environment (standard EN 61000-6-2), the length of the connections must be less than 30 m. Do not exceed this length so as to avoid measurement errors;
Example connection diagram: (LARGE model):

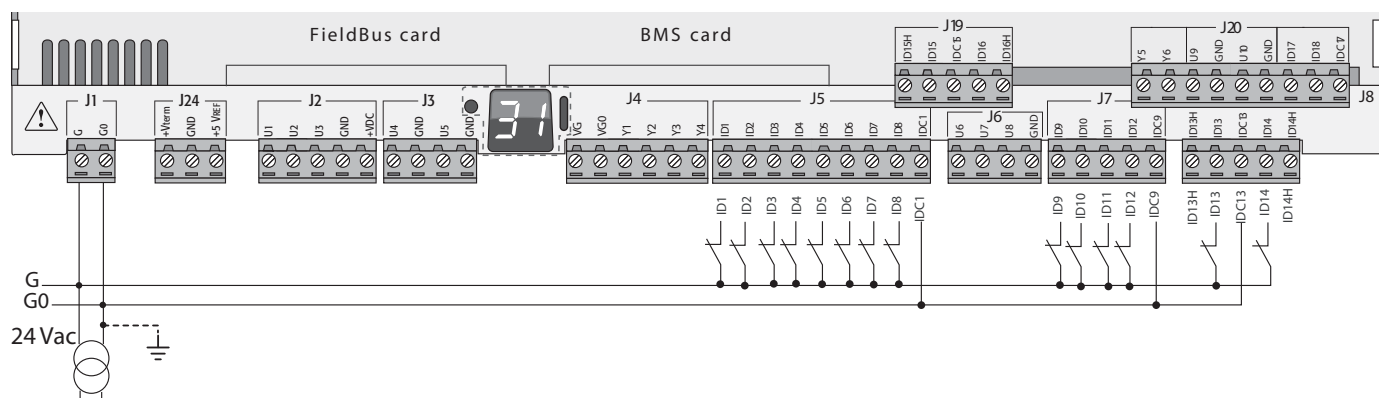


Fig. 5.p

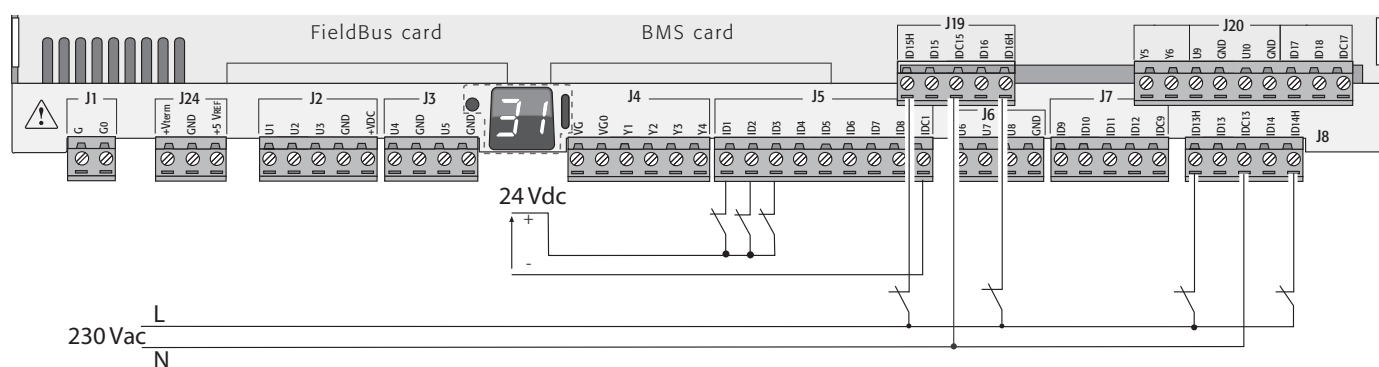


Fig. 5.q

Digital inputs powered at 24 Vdc

The digital inputs (ID...) can be controlled at 24 Vdc.

Example connection diagram: (LARGE model):

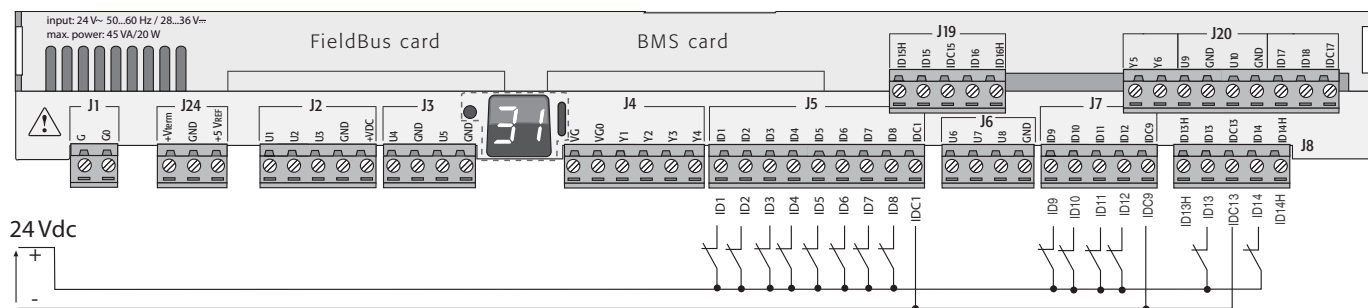


Fig. 5.r

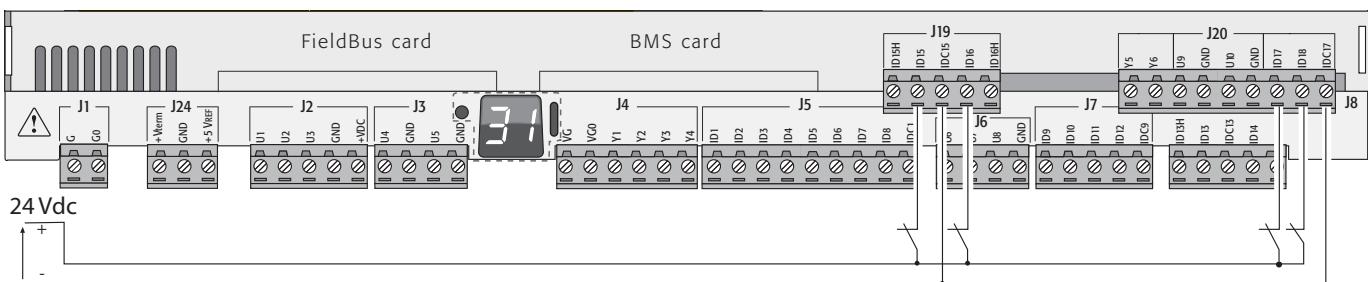


Fig. 5.s

In the Medium and Extralarge models there is only one group (J8), in the Large version there are two groups of inputs that can be powered at 230 Vac, on terminals J8 and J19. Each group has two digital inputs powered at 230 Vac, marked as ID*H, and two inputs powered at 24 Vac/Vdc, marked as ID*. The two groups of 230 Vac inputs have double insulation between them and from the controller: the digital inputs can be 24 Vac/dc in one group and 230 Vac in the other. In each group, the two inputs have the same common pole. Insulation is functional. **In each group, the digital inputs must be powered at the same voltage (24 Vac, 28-36 Vdc or 230 Vac) to avoid dangerous short circuits and/or energising lower voltage circuits at 230 Vac.**



- the uncertainty range of the activation threshold is from 43 to 90 Vac;
- the voltage must be 230 Vac (+10/-15%), 50/60 Hz.

5.4 Analogue outputs

34

c.pCO Small-Extralarge: optically-isolated 0-10 V analogue outputs

The controller features optically-isolated 0-10 V analogue outputs to be powered externally, at the same supply voltage as the controller, 24 Vac or 28-36 Vdc, at terminals VG, VG0. The following figure shows the connection diagram; the 0 V of the power supply is also the voltage reference for the outputs. See the technical specifications table (output current, output impedance, etc., see chap. 12).



Notice:

- other outputs of the same type can be connected in parallel to a 0-10 Vdc analogue output or an external voltage. The resulting voltage will be the higher value. Correct operation is not guaranteed if actuators with voltage inputs are connected.
- if optical isolation is not required, the analogue outputs can be powered at VG-VG0 with the same voltage available at G-G0: connect G0 to VG0 and G to VG.

Example connection diagram (LARGE model):

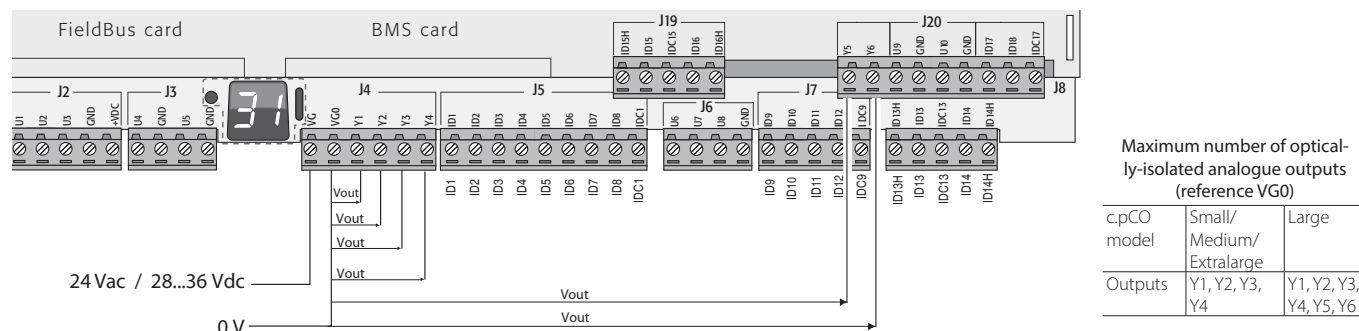


Fig. 5.w

5.5 Ultracap module connection

The Ultracap module can be connected to power the controllers in the event of a power failure:

1. c.pCO mini: the module guarantees temporary power supply **to the controller and the driver** for the time required to close the electronic valve (40 s for forced closing of the valve, 60 s without forced closing of the valve). NB: with Vdc power supply, forced closing of the electronic expansion valve in the event of a power failure is not managed.

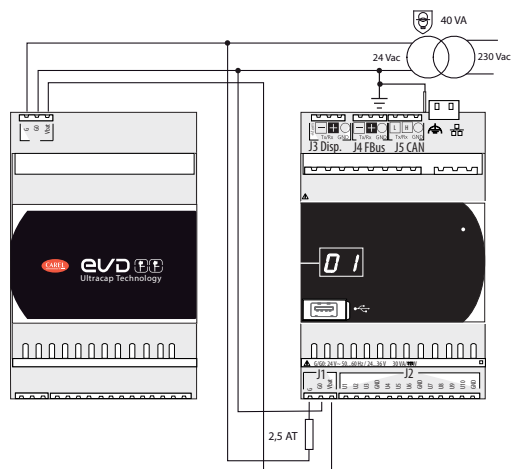


Fig. 5.x

2. c.pCO controller with built-in driver: the module guarantees temporary power supply **to the driver** for the time required to close the electronic valves.

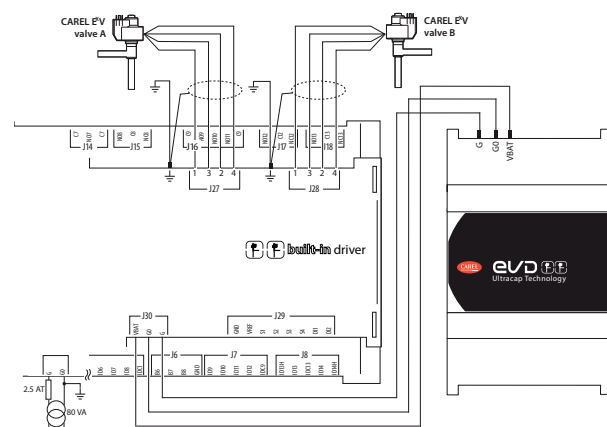


Fig. 5.y

5.6 Electronic valve connection

c.pCO mini: unipolar electronic valve

The controller includes the driver for managing a unipolar electronic expansion valve.

Notice: to manage the valve, the control algorithm requires two probes (one pressure probe and one temperature probe);

Connection example using ratiometric probes (for pressure) and NTC probes (for temperature).

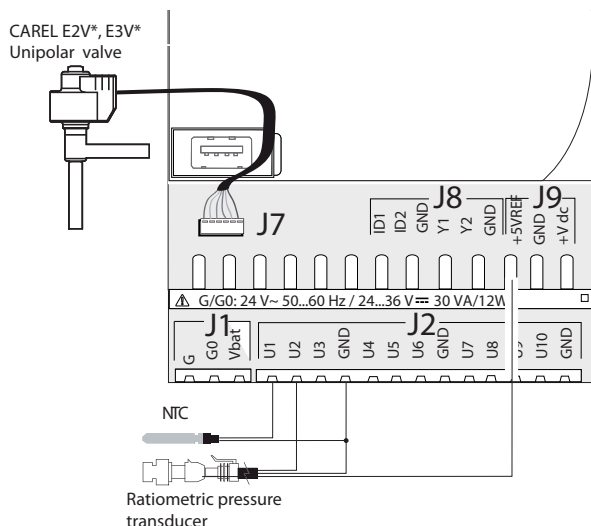


Fig. 5.z

c.pCO (Medium with built-in driver): bipolar electronic valve

The controller with built-in driver can manage one or two bipolar electronic expansion valves, depending on the model.

Example connection diagram (the colour of the wires refers to the standard CAREL valve cable P/N E2VCAB5*00):

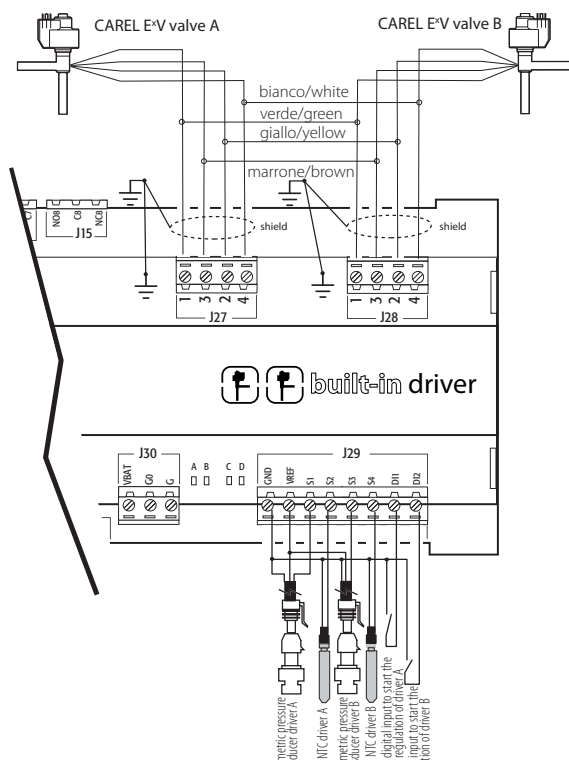


Fig. 5.aa



Notice:

- connect the valve cable shield to the spade connector and earth;
- For valve and refrigerant compatibility, see the technical specifications table (see chap. 12) and the EVD Evolution driver manual.

The controller with built-in valve driver can be fitted with the Ultracap module (accessory, P/N PCOS00UC20); this is made using special capacitors, called ultracapacitors, which ensure closing of the electronic valve in the event of a power failure. The module only powers the driver and not the controller it is mounted on.



Caution: the c.pCO built-in driver with PCOS00UC20 module (or external Ultracap module EVD0000UC0 or battery EVBAT00400) must be powered at 24 Vac to ensure emergency closing of the valve in the event of a power failure. If the power supply is DC, the controller does not manage valve closing in the event of a power failure.



Notice:

- the built-in driver replicates all the hardware and logic functions of the “EVD Evolution” stand-alone driver when there is one valve, and the “EVD Evolution TWIN” when there are two valves, i.e. it independently drives one or two electronic expansion valves with bipolar stepper motor. The only difference compared to EVD Evolution is the absence of the output relays. For details on the valve control logic, configuration and installation, please see the EVD Evolution manual (+ 0300005EN for the single driver, +0300006EN for the dual driver);
- in the same way as EVD Evolution, for c.pCO the built-in driver is also available in the CAREL and “Universal” versions. The “Universal” models can control not only CAREL electronic expansion valves, but also valves made by different manufacturers (see the technical specifications table, chap. 12), while the CAREL models only control CAREL valves.

Serial communication and programming

Communication between c.pCO Medium and the built-in driver is managed internally using the FBus2 serial port. The FBus2 serial port (J26) is however electrically isolated from the driver's serial line: this ensures that in the event of external faults on the line connected to FBus2, the built-in driver can continue to function independently and correctly. The driver can only be configured using the c.pCO application program created using the c.suite or STone development environments; no external displays are available for the driver.

The development environment includes a module for managing the EVD Evolution driver. When managing the built-in driver, the module should be used as if it were an external driver connected to the FBus2 port.

At an application software level, the valve driver must be connected to FBus2. For this reason, any other devices that are physically connected to FBus2 (J26) must have the same communication protocol (CAREL Standard Main or Modbus® Main), the same baud rate, stop bits and parity. Note that the address of the built-in driver is 198 (the default value on EVD Evolution), so the address of any other devices connected to J26 must not be 198. The communication frame is selected in the c.suite or STone development environment.

External EVD Evolution drivers can be connected to the FieldBus 1 serial port (optional card) without any constraints in terms of the address.

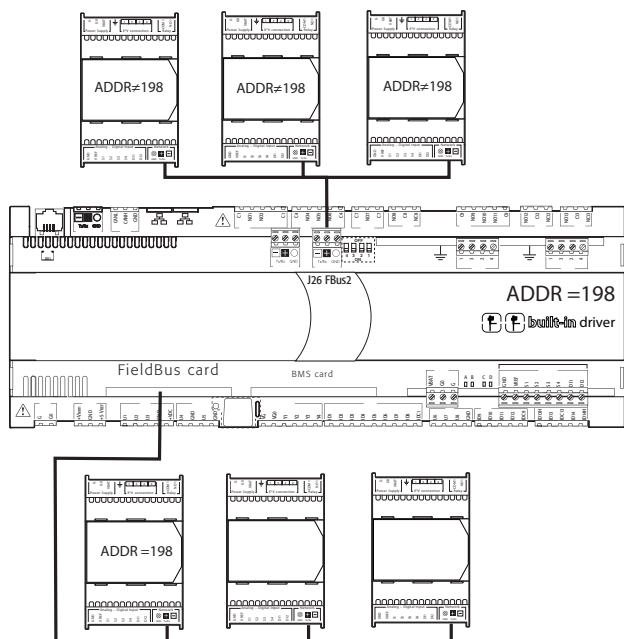


Fig. 5.ab



Caution: to ensure the nominal data exchange performance between the drivers and the controller, if there are devices connected to the FBus2 port (terminal J26) using the Modbus® protocol, during development of the application program it is recommended to evaluate the total number of variables exchanged over the entire serial line.

5.7 Digital outputs

Electromechanical relay digital outputs

The controller provides digital outputs with electromechanical relays; for easier assembly, the common terminals for some relays have been grouped together. Some relays are equipped with changeover contacts.

Relay with changeover contacts

No. of outputs	c.pCO model			
	mini - c.pCOe	Small	Medium / Extralarge	Large
	6	8	8, 12, 13	8, 12, 13

The following tables apply in relation to the type of insulation. Also see the table of technical specifications in chap. 12.

c.pCO mini - c.pCOe

Type of insulation	
Between relays in group 1 and 2	basic insulation
Between relays in group 3 (R6) and in group 1 and 2	reinforced insulation



Notice:

- there is basic insulation between groups 1 and 2, and therefore these must have the same voltage (generally 24 Vac or 110/230 Vac);
- between relays in groups 1 and 2 and in group 3 there is reinforced insulation, therefore group 3 can have a different voltage.

c.pCO Small-Extralarge

Type of insulation	
Between relays in same group	functional insulation
Between groups of relays	reinforced insulation
Between relays and the rest of the controller	reinforced insulation



Notice:

- within a group, the relays have functional insulation from each other and therefore must have the same voltage (generally 24 Vac or 110/230 Vac);
- between groups of relays there is reinforced insulation, therefore the groups can have different voltages.

Example connection diagram (LARGE model):

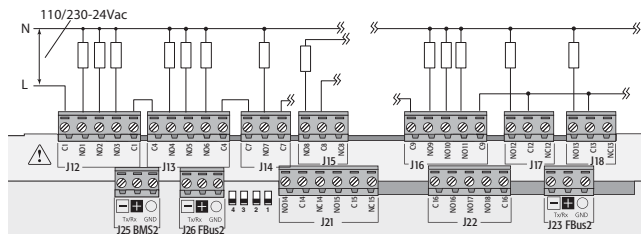


Fig. 5.ac

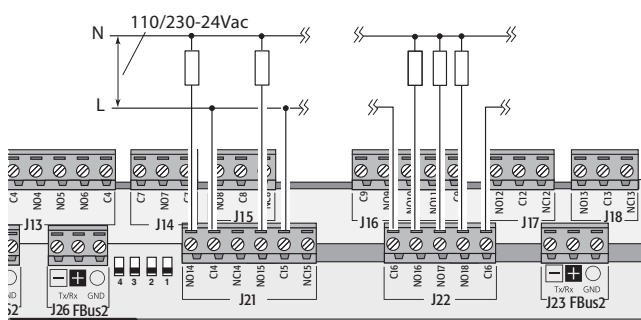


Fig. 5.ad



Caution: the current running through the common terminals must not exceed the rated current of a single terminal (8 A).

Remote control of digital outputs

The cable sizes based on the current are shown in the following table.

Cross-section (mm²)/AWG	Current (A)
0.5/20	2
1.5/15	6
2.5/14	8



Notice: if needing to control different relay outputs at very close consecutive intervals (e.g. motor star/delta starting), in the order of hundreds of ms, the relays in the same group must be selected as defined in the following table.

c.pCO mini - c.pCOe

relay groups for sequential commands (~ 100 ms)		
1	2	3
Re-lays 1, 2	3, 4, 5	6

c.pCO Small-Extralarge

relay groups for sequential commands (~ 100 ms)					
1	2	3	4 - c.pCO Large	4 - c.pCO ExtraLarge	5
Re-lays 1, 2, 3, 4	5, 6, 7, 8	9, 10, 11, 12, 13	14, 15, 16, 17, 18	14, 15, 16, 17, 18, 19, 20, 21	22, 23, 24, 25, 26, 27, 28, 29



Caution: selecting relays from different groups may lead to switching delays.

5.8 Solid state relay (SSR) digital outputs

c.pCO also comes in versions with solid state relays (SSR) for controlling devices that require a high number of operations that would not be supported by electromechanical versions. These outputs are dedicated to resistive or inductive loads, powered up to:

- 36 Vac/Vdc SELV (models with 24 V SSR - P+5*****1-6****) max load current up to 1 A.
- 230 Vac (models with 110/230 V SSR P+5*****AF****) max load current up to 70 mA.

Example 1: connection diagram

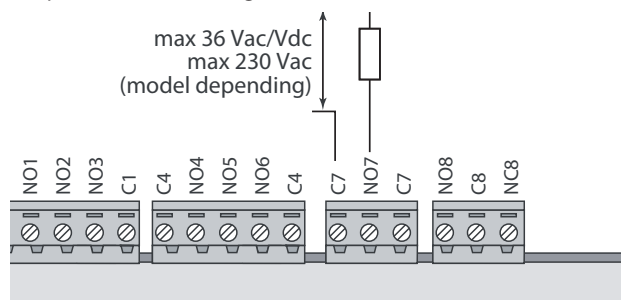


Fig. 5.ae

Example 2: connection diagram for resistive or inductive load with load current > 1 A (24 V model) or >70 mA (230 V model)

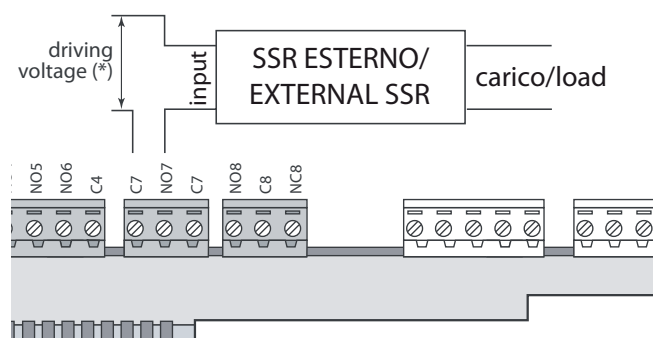


Fig. 5.af

(*) dedicated power supply or the same power supply as the controller: not shared with the power supply of other external loads (e.g. contactors, coils), in accordance with the control voltage of the external SSR used.



Notice: the built-in SSR relay load and all other terminals in the group must be powered at the same voltage due to the lack of reinforced insulation inside the group.

5.9 c.pCO mini connection diagram

MINI

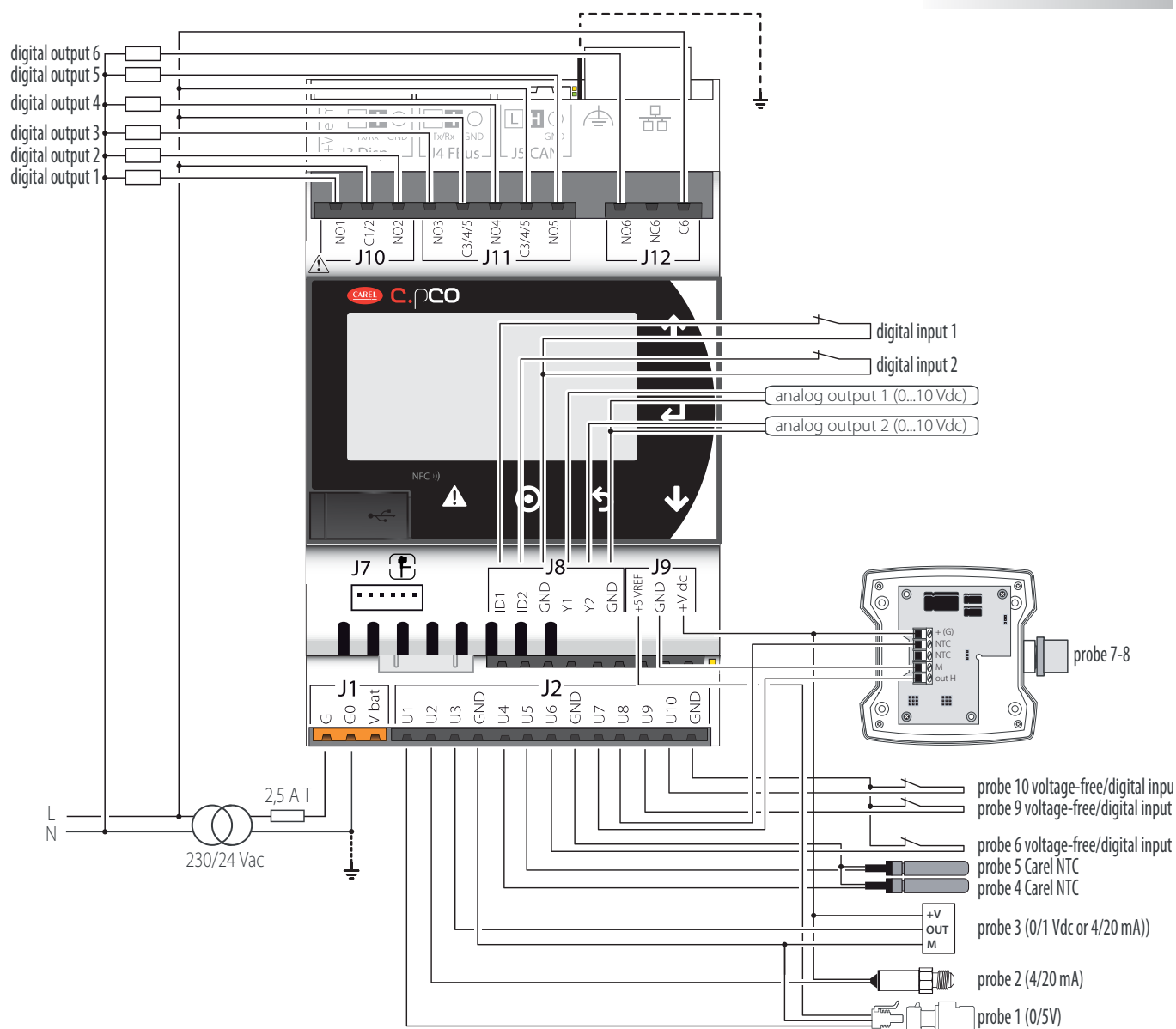


Fig. 5.ag

5.10c.pCO general connection diagram

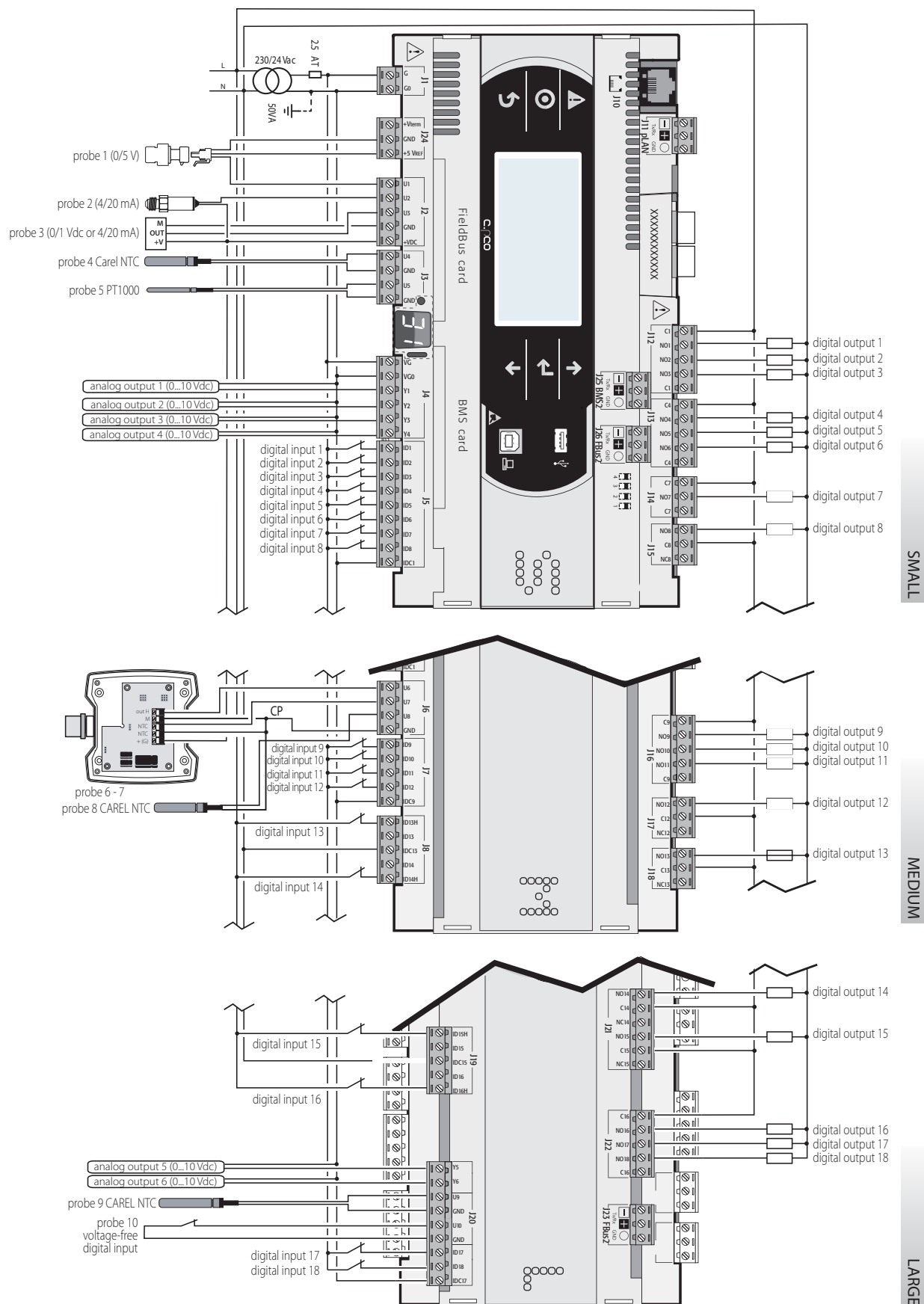


Fig. 5.ah

6. COMMISSIONING

6.1 Power on

When switched on, the controller begins a test in which the segments on the secondary display light up in sequence.

6.2 Private and shared terminal

The c.pCO controllers can be connected to each other in a pLAN local network (see the figure below) in order to share one or more terminals. Shared terminals cannot simultaneously display variables (temperature, humidity, pressure, I/O, alarms) from different controllers. The terminal does not need to be connected to the controller in normal operation; it can also be used only for setting the main parameters. If one or more terminals is disconnected or malfunctioning, the application program continues to function correctly on each controller. Typically, the application program monitors the status of the network and the terminals, and takes action in the event of malfunctions. The figure below shows a possible pLAN network connection diagram.

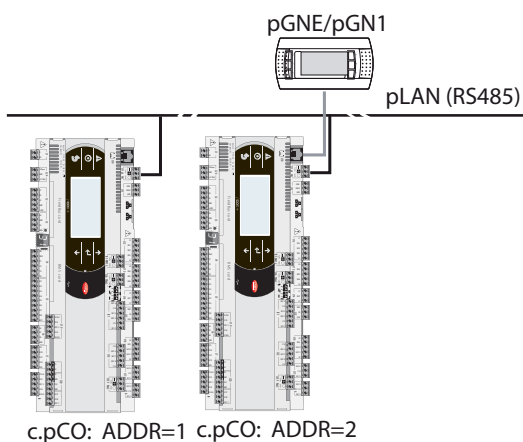


Fig. 6.a

All terminals and controllers must communicate on the network at the same baud rate. This is adapted automatically.

A maximum of 32 units can be connected in the network, including:

- c.pCO controllers, which execute the control program;
- terminals.

Each device in the pLAN network is identified by a unique address, which is a number between 1 and 32. The latter (32) can only be assigned to a terminal. Programs for different applications (e.g. chillers, air conditioners, compressor racks, ...) cannot be automatically integrated into the same local network: these must be configured considering the system architecture using the Carel development tool. Each controller connected to the network can simultaneously manage up to three terminals connected to the pLAN network (either semi-graphic terminals such as the PGN or touchscreen terminals such as the pGDx). The values are displayed simultaneously and not independently, i.e. as if the keypads and displays were connected in parallel: for this reason, the controller cannot simultaneously manage different types of terminals.

A terminal associated with a specific controller is called:

- private ("Pr"), if it only displays the output of that controller;
- shared ("Sh") if, automatically or via keypad, it can be switched between multiple controllers.

Each c.pCO constantly refreshes the display of private terminals; shared terminals will only be refreshed by the c.pCO that is currently being displayed.

From a logical point of view, the following applies:

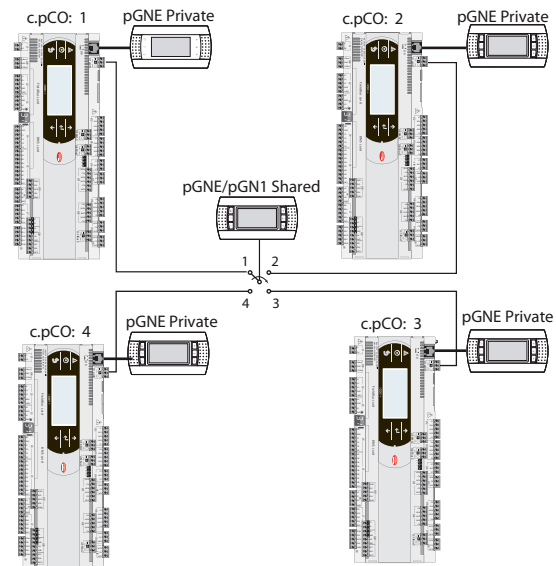


Fig. 6.b

In this example the shared terminal is associated with four controllers but, at this moment, only controller number 1 can be displayed and can receive input from the keypad. The terminal switched between controllers as follows:

1. by a system menu command;
2. in cyclical succession (1->2->3->4->1...), by pressing a button defined in the application program; it can also occur automatically if specified in the program: for example, a c.pCO can request control of the shared terminal to display alarms or, vice versa, hand over control to the next c.pCO after a pre-set time has elapsed (cyclical rotation).

The data relating to the number and type of terminals are established during the initial network configuration phase, and are saved in the permanent memory of each individual c.pCO controller. The configuration details are described subsequently. For details on the type of cables to use and the electrical connections, see "Installation".

6.3 Controller pLAN address setting

The controller's factory pre-set pLAN address is 1.

There are two ways to set the controller's address:

1. button A (see pLAN address setting - Procedure 1) located next to the seven-segment display. To activate the button, use the tip of a screwdriver ($\varnothing < 3$ mm) for example;
2. from the system menu (see chapter 7).

Display pLAN address

The pLAN address is permanently displayed in the pLAN address display.

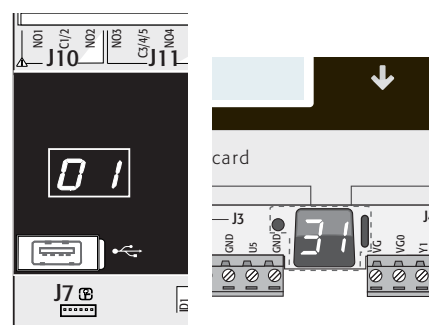


Fig. 6.c

pLAN address setting

Procedure 1 - button

- press button A for 5s: the pLAN address is displayed more brightly;
- press repeatedly: the value of the address increases
- release the button: after a few seconds the display dims and the pLAN address is saved to memory

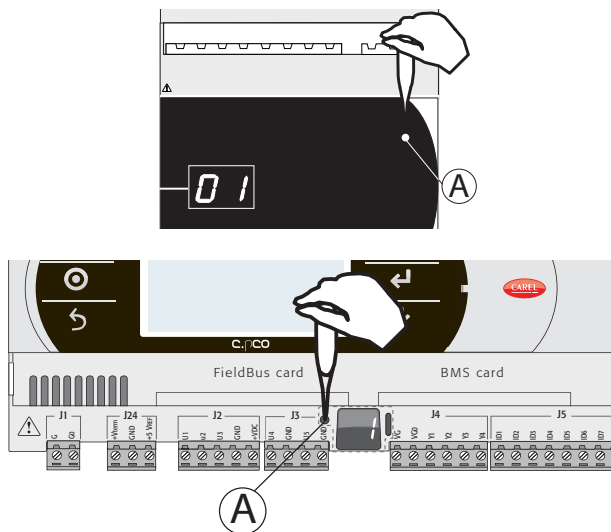
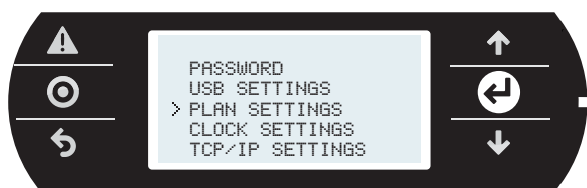


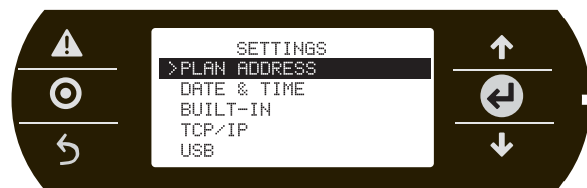
Fig. 6.d

Procedure 2 - system menu

1. press Alarm (⚠) and Enter (↵) together for 3s and enter the system menu. Select settings;
- 2.a c.suite-based controller: select pLAN settings and press Enter (↵);



- 2.b STone-based controller: select pLAN address and press Enter (↵);



3. Use with UP (↑), DOWN (↓) to set the controller's pLAN address and confirm by pressing Enter (↵).

6.4 Terminal address setting and controller-terminal connection

After having set the controller's address (see previous paragraph), to establish the connection between controller and terminal, first set the terminal address. If an external terminal with address 32 (factory setting) is connected to the controller, communication is established (if the built-in terminal is present, the external terminal replicates the same display).

To configure multiple terminals, private and/or shared, different addresses need to be assigned to the terminals and the controller needs to be configured appropriately:

1. To set the terminal address, press UP (↑), DOWN (↓) and Enter (↵) for 3s. A new screen will be shown. Change the terminal address (in the range 1 to 32) and confirm by pressing Enter (↵).
2. The screen with the list of configured terminals will be shown. Set the terminals to private (Priv) or shared (Shared) based on the application and confirm to exit. After a few seconds the connection will be established.
3. To add a second terminal, repeat the previous steps.

6.5 Share terminals in a pLAN network

Once connected to the network (pLAN), the c.pCO controllers can share the same pGN terminal. The shared terminal can be used, for example, to install an operating system and/or update the application program. Connect the controllers and terminals to the network (Figure 6.e). Set the pLAN address of each controller using the button provided (see paragraph 6.3), and of each terminal by following the appropriate procedure. The figure below refers to three c.pCO controllers in a pLAN network with three pGN displays, each with its own address.

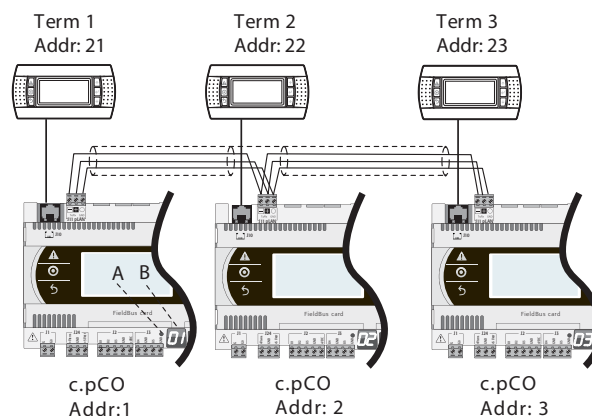
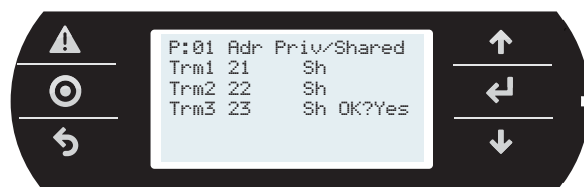


Fig. 6.e

1. To set the address of each terminal (Term1, Term2, Term3) see paragraph 6.4.
2. Enter the address of the three terminals and set them as "shared". This operation must be repeated on all three terminals (see par. 6.4).

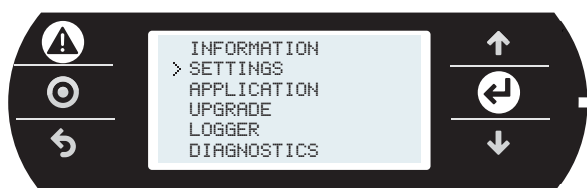


Acquire/release commands

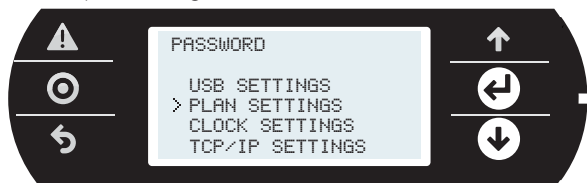
This paragraph only applies to c.suite-based controllers. On STone-based controllers, there is no acquire/release screen from the system menu: the operation can be performed from the application software.

The commands are used to acquire/release a terminal to/from a controller. Procedure:

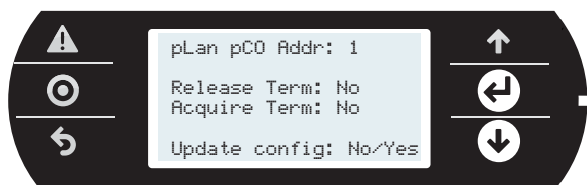
1. Press Alarm (▲) and Enter (↵) together to enter the system menu. Then select "Settings"



2. Select pLAN settings



3. The following screen is shown, where the acquire/release commands can be sent.



Key

pLAN pCO addr.	Address of the c.pCO controller that the terminal is currently connected to
Release terminal	Release command
Acquire terminal	Acquire command
Update configuration	Confirm update

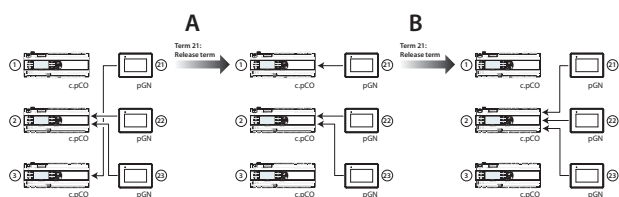
Command virtualisation

Whenever a pGD terminal is connected to a c.pCO controller, the pGD terminal displays its user interface. The command is sent from the terminal, however it is the controller that releases or acquires the terminal.

Example 1

A: the release command on terminal 21 causes c.pCO 3 to release terminal 21, which is then assigned to c.pCO 1;

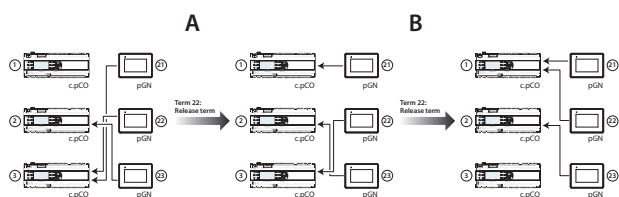
B: the release command on terminal 21 causes c.pCO 1 to release terminal 21, which is then assigned to c.pCO 2.



Example 2

A: the release command on terminal 22 causes c.pCO 3 to release terminal 21, which is then assigned to c.pCO 1;

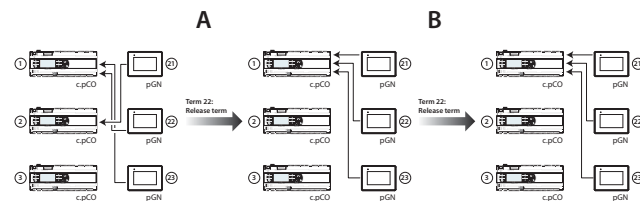
B: the release command on terminal 22 causes c.pCO 3 to release terminal 22, which is then assigned to c.pCO 1.



Example 3

A: the acquire command on terminal 22 causes c.pCO 1 to acquire terminal 21, which is therefore assigned to c.pCO 1;

B: The acquire command on terminal 22 has no effect, because the c.pCO 1 has already acquired all the terminals



6.6 Upload/update software

The c.pCO family controller application program can be uploaded/updated as follows:

- Update from computer via command line tool (via USB or Ethernet connection)
- Update via USB pen drive
- Update with file transfer via FTP
- Update via tERA cloud service (c.suite-based products only)

Update from computer via command line tool

On all c.pCO family controllers, the application program can be uploaded using the command line tool, with direct connection to the controller via USB cable or Ethernet network. For c.suite-based controllers, the c.factory software is part of the "c.suite" software, or can be installed separately, after being downloaded from <http://ksa.carel.com> in the "Software & Support" -> "c.Suite" section. For STone-based controllers, the Sparkly software can be installed separately, after being downloaded from <http://ksa.carel.com> in the "Software & Support" -> "STone" section. To upload the application program, follow the procedures available in the development tool "help".



Caution:

- it is recommended to install the latest available security patch on the PC to ensure the highest protection against cyber threats;
- it is recommended to install and keep updated antivirus/anti-malware software on the PC;
- when reading or configuring the device via PC, it is recommended not to interact with unknown or untrusted files.

It is recommended to securely format USB flash drives and take appropriate PC security measures (see above) before loading any software required for updates.

Update via Ethernet connection:

Appropriately configure the computer and the c.pCO controller so that they are the same LAN (see paragraph 9.2).

1. Open the command line tool (c.factory or Sparkly) and select the application file compiled using the development tool. Follow the procedure described in the development tool "help".
2. Select the files to be uploaded to the controller and set the connection type as "Ethernet connection".
3. Once updated, the c.pCO controller automatically restarts using the new application program (or new configuration).



Note: if the c.pCO controller contains an application program that is protected by a password or digital signature other than the one used to sign the new application, a window will open prompting for the previous password. If the correct password is entered, the new application program can be uploaded.

Update via USB connection

Connect the computer and the c.pCO controller via USB cable using the USB device port.

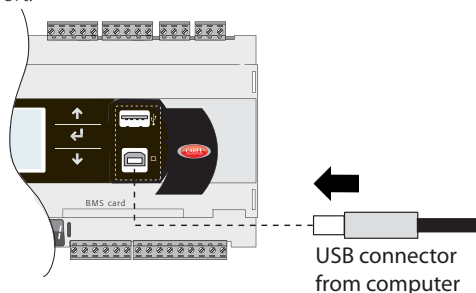


Fig. 6.f

1. Open the command line tool (c.factory or Sparkly) and select the application file compiled using the development tool. Follow the procedure described in the development tool "help".
2. Select the files to be uploaded to the controller and set the connection type as "USB connection".
3. Once updated, the c.pCO controller automatically restarts using the new application program (or new configuration).

Notice: if the c.pCO controller contains an application program that is protected by a password or digital signature other than the one used to sign the new application, a window will open prompting for the previous password. If the correct password is entered, the new application program can be uploaded.

Caution: before updating the c.pCO controller via USB connection, check under the System Menu that the USB Device port is enabled (Settings --> USB Settings --> CDC connection/Serial port).

Update via USB pen drive

All c.pCO family models are equipped with a USB host port that a USB mass storage device can be connected to (typically a USB pen drive or portable hard disk), used to load the application software on the c.pCO programmable controller. To update the controller, first create the .ap1 application file using the command line tool and load it onto the USB flash drive.

See the development tool "help".

Plug the flash drive into the USB Host port and enter the system menu. On the next screen select UPGRADE and the desired application program and confirm by pressing enter.

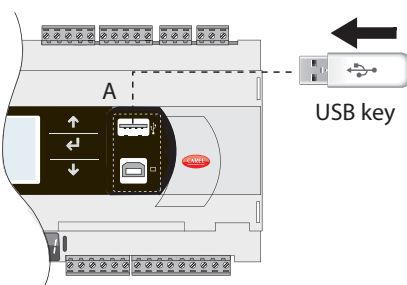


Fig. 6.g

- Caution:**
- before updating the c.pCO controller via USB connection, check in the system menu that the USB Host port is enabled (Settings --> USB Settings --> Pen drive).
 - Use only FAT formatted pen drives.
 - Do not use the controller's two USB ports at the same time.
 - Do not use mass storage devices with a current draw higher than 500 mA.

Update with file transfer via FTP

The c.pCO family controllers equipped with an Ethernet port include an FTP server that provides access to the public partition of the file system. It is thus possible to read, modify, create and remove files and folders. It is also possible to transfer an .ap1 file via FTP and thus, for example, update the image of the operating system or application program. A client program is used to transfer files with the FTP protocol, such as "FileZilla". To protect the contents of the public file system from unauthorised access, different users can be created, granting each user different access profiles based on the corresponding service and adapted to the individual folder (see chapter 9). To update the application program via FTP, follow the procedures available in the development tool "help".

Update via tERA cloud service (c.suite-based controllers only)

The c.pCO controller family can establish a secure remote connection to the Carel cloud services platform called tERA. All c.pCOs with Ethernet are natively integrated into the tERA cloud platform and can access the associated services. Each c.pCO is uniquely identified by the tERA cloud using the MAC address. IT IS possible to create a custom tERA portal based on the customer's specifications. For more information on tERA services, contact your local Carel sales network. The activation/registration procedure and configuration of tERA services are described in: "tERA quick start guide" (manual +030222140), downloadable from www.carel.com.

6.7 c.pCOe expansion card: installation and configuration

c.pCOe is an I/O expansion module compatible with the c.pCO and pCO sistema platforms. The module is equipped with:

- 10 universal inputs/outputs that can be configured by the application program to connect active and passive probes, digital inputs, analogue and PWM outputs.
- 6 relay digital outputs divided into three groups (see paragraph 5.7)
- Power terminals for ratiometric probes and active probes
- Built-in BMS serial
- Dipswitches for configuring the communication protocol and serial address
- Built-in driver for managing a CAREL unipolar expansion valve (Enhanced version only)

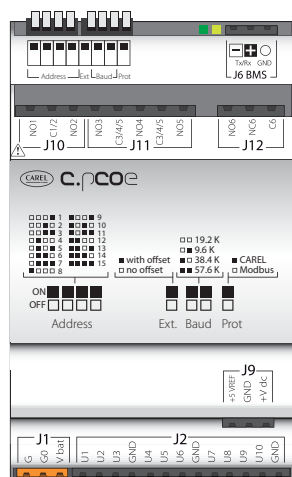
Caution: The c.pCOe is an advanced product that has internal memories to ensure an optimal functioning. So, it is therefore necessary to have maximum attention writing frequency of the device configuration parameters in the application software. It to preserve their integrity. The maximum recommended number of writings is 1,000.

Unipolar valve output (Enhanced version only)

Number of valves	1
Maximum power	8 W
Type of control	unipolar
Valve connector	6-pin, fixed sequence
Power supply	13 Vdc $\pm 5\%$
Maximum current	0.35 A for each winding
Min. winding resistance	40 Ω
Maximum length of connection cable	Residential/industrial environment = 2 m without shielded cable. 6 m without shielded cable earthed at both ends (E2VCABS3U0, E2VCABS6U0) Domestic environment = 2 m without shielded cable

Tab. 6.d

Basic



Enhanced

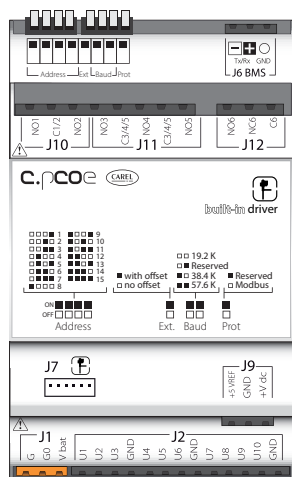


Fig. 6.h

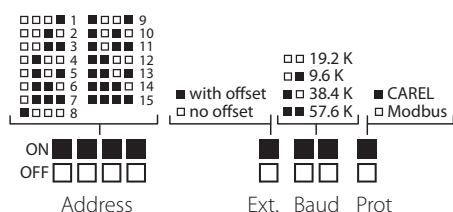


Fig. 6.i

Notice: the green LED indicates the communication status on the BMS port. If there is communication at the BMS port (online status) the green LED flashes, if there is no communication (offline status) the LED remains on steady.

Caution: the product must be powered via terminals G and G0. The Vbat terminal is used solely for connection to the Ultracap module as a backup power supply in the event of power failures.

The dipswitches can be used to set the expansion card address (from 1 to 15), the protocol (Modbus or Carel - supported only on the Basic model) and the baud rate. The serial connection can also be used to modify the line's electrical configuration and assign a serial address between 16 and 247 (207 for Carel protocol).

Baud rate and communication protocol configuration

The card's factory configuration is 19.2 Kbps baud rate and Modbus protocol. The "Baud" and "Prot" dipswitches (see Fig. 6.i.) can be used to set the baud rate and communication protocol of the expansion card. The dipswitches must be set with the unit switched off.

Caution: if the baud rate and protocol dipswitch settings are changed when the unit is on, it will need to be restarted for the new settings to take effect.

Address and serial communication mode configuration

To assign the card a serial address between 1 and 15, set the dipswitches as shown in Figure 6.i. The "Ext" dipswitch must be set to "OFF" (no offset). The dipswitches must be set when the unit is off.



Caution: If the baud rate and protocol dipswitch settings are changed when the unit is on, it will need to be restarted for the new settings to take effect.

To assign the card a serial address from 16 to 247 and to configure serial communication, an offset must be added to the "Address" setting and the variable relating to the serial transmission parameters must also be set, as follows:

E.g.: (address setting N=87, serial communication 8, Even, 1):

1. Set the "Address" group dipswitches and the "Ext." dipswitch to OFF.
2. Restart the unit. The c.pCOe board goes into "Set Mode". **Caution:** enabling this mode resets both the address offset and serial communication settings. In this mode, the card will take serial address 207 and an 8-bit electrical configuration, no parity control and 2 stop bits (8bit, None, 2). The yellow LED will flash. For the 8-bit, None, 1 configuration, a dedicated part number is available (P+E**1*****).
3. To configure the communication parameters, set the "Serial configuration" variable via serial (see Tab. 6.a and 6.b). In this example, the variable is set to 5 (configuration 8, Even, 1).
4. To set the serial address, configure the offset via serial using the "Address extension" variable (the offset must be greater than 14, see Tab. 6.a). In this example, it can be set to 86.
5. Set the "Ext" dipswitch to ON. Set the "Address" group dipswitches to a value greater than 0. In this example, the value is set to 1.
6. Restart the unit. After restarting, the expansion card is configured with serial address equal to the sum of the "Address extension" variable and the value set in the "Address" group (in this example $86 + 1 = 87$). After restarting, the expansion card is configured with serial communication 8, Even, 1.

Variable	Carel Address (Integer)	Min Value Carel	Max Value Carel	Modbus Address (Holding Register)	Min Value Modbus	Max Value Modbus
Address Extension	14	15	192	14	15	232
Serial Configuration	17	0	5	17	0	5

Tab. 6.e



Caution:

- if using the Carel protocol, the maximum offset is 192.
- Prohibited configurations:
 - It is not permitted to set the "Ext" dipswitch to ON with an offset of 0 ("Address Extension" variable = 0). In this case, the board will signal a configuration error with the yellow LED flashing. The green LED remains on steady, indicating the board is offline.
 - It is not permitted to set the "Ext" dipswitch to ON with an offset value other than 0 and the "Address" group dipswitches to 0 (all set OFF). In this case, the board will signal a configuration error with the yellow LED flashing. The green LED remains on steady, indicating the board is offline.

Serial Configuration

Value	Configuration
0	8, none, 2
1	8, none, 1
2	8, odd, 2
3	8, odd, 1
4	8, even, 2
5	8, even, 1

In order to avoid tampering with the Autorun USB system, it is recommended to protect the card with a password. This will prevent the potential creation of actions that can be executed by an unknown operator. Alternatively, the USB function can be disabled if needed.

7. SYSTEM MENU

To access the system menu, see the information available in the development tool "help".

8. PROTECTION

The c.pCO controller implements protection methods aimed at preventing certain sensitive operations being accessed by unauthorised personnel, such as software updates, access to system menu screens, cloning of proprietary application programs, etc. Depending on the development environment, the following can be set on the c.pCO controller:

- system menu password;
- controller protection password;
- digital signature.

8.1 Characteristics of the protection methods

	Controller protection password		Digital signature	
	c.suite	STone	c.suite	STone
Purpose	Prevent software from being uploaded by unauthorised personnel. Avoid software cloning.		Prevent software from being uploaded by unauthorised personnel. Avoid software cloning.	
Protect the c.pCO	Reversible		Irreversible	Reversible (only if in possession of the Device Certificate and Application Certificate as it is protected by asymmetric key encryption)
Generation	c.suite	STone	c.suite (c.design)	STone
Activation	Function included in the standard license		Can be activated with optional additional license.	
Number of signatures that can be generated	Multiple passwords can be generated.		Multiple signatures can be generated.	
Application of the protection	The application program is protected by password before being uploaded to the c.pCO		The c.pCO is signed by uploading the digital signature via command line tool. The application program that is subsequently loaded via USB flash drive or command line tool must be protected with the same digital signature.	

Tab. 8.a

8.2 Password protection

Password protection can be set in the development tool. A password can be set for each configuration. On c.suite-based controllers, the protection password has no effect when using a digital signature. To ensure confidentiality and prevent possibly dangerous changes to the parameter settings, it is recommended to protect access with a sufficiently complex password, which can be changed if necessary. To improve security, it is recommended to enable temporary access prevention after repeated incorrect password attempts (e.g. 5 attempts). It is also recommended to profile access rights based on the user's role, for example:

- operator: read-only access only to the required data, preventing access to sensitive data and functions;
- configurator: access to device functions, access to sensitive data and function settings;
- administrator: access to all device functions.

8.3 Digital signature generation

The digital signature protection system, if enabled by optional license, protects the programmable controller against from being overwritten with unauthorised software. The controller is signed, either via password defined in the development tool (c.suite) or via certificates (STone). Once a controller has been signed with a specific digital signature, it can only be used with application programs created with the same digital signature. For STone-based controllers, the digital signature can be modified or removed if in possession of a Device Certificate and Application Certificate, as these are protected by asymmetric key encryption. To sign a c.pCO using a digital signature, follow the procedures available in the development tool "help".

Upload the digital signature

The digital signature can be uploaded onto the controller via USB flash drive (c.suite-based models only) or command line tool.

To upload via USB:

- Plug the USB flash drive into the host USB port.
- Press Alarm and Enter together to enter the system menu;
- select "Upgrade" and confirm by pressing Enter; the controller is now indelibly signed by digital signature. The controller can only be used with application programs created with the same digital signature (see paragraph 8.4).

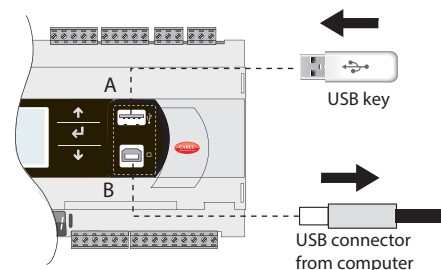


Fig. 8.a



Notice: to permanently activate the digital signature, power the controller off and on again.



Caution: the digital signature procedure is irreversible.

8.4 Load application program on a controller with digital signature

A c.pCO controller signed with a digital signature can only operate with an application program signed with the same signature. To generate an application program signed with a digital signature, follow the procedure described in the previous paragraph, and then install the application program as described in paragraph 6.6.

If the digital signature of the application program being loaded onto the c.pCO does not match the digital signature on the controller, when the latter loads the application program via the command line tool:

- c.suite-based controllers -> the password request screen is shown; the password is the one used to generate the digital signature currently on the c.pCO. On entering the correct password, the application program is uploaded successfully;
- STone-based controllers -> the default application is loaded.



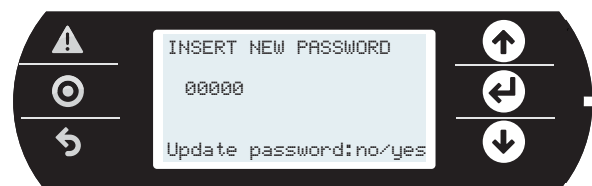
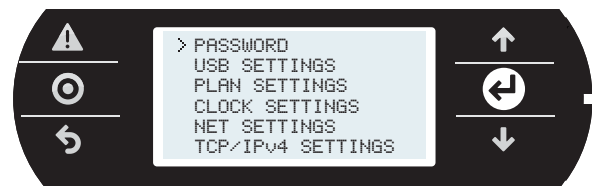
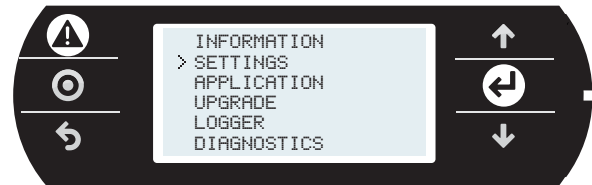
Notice: On c.suite-based controllers, if both the protection password and digital signature have been set on c.pCO, the latter has priority.

8.5 System menu password

The system menu password prevents access to the entire system menu, except for the information menu item.

Procedure for c.suite-based controllers:

1. Press Alarm and Enter together or 3s to enter the system menu;
2. Select Settings --> Password
3. Press Enter; set a value > 000000 using UP/DOWN.
4. Confirm the update.



Notice: for STone-based controllers, the procedure may differ, depending on the application software installed (users need to customise the system menu library, by adding the function).

9. ACCESS MANAGEMENT FOR IP SERVICES

The c.pCO controllers have a built-in web server and FTP server:

- web server: this provides access to files (HTML pages, images, Javascript code, etc.) saved in the /HTTP/ folder of the file system public partition. These pages can display dynamic content generated by CGI (Common Gateway Interface) requests, managed by the controller's firmware, in order to read/write application variables, create logs and custom web pages; these pages are accessed via a browser in a LAN on entering the IP address or host name of the c.pCO controller;
- FTP server: provides access to the public partition of the file system, to read, modify, create and remove files and folders, including web pages. It is also possible to transfer an .ap1 file via FTP and update the controller's operating system or application program. Access is via a file transfer client program using the FTP protocol, such as "Filezilla".

To protect the contents of the public file system against unauthorised access, the system administrator can create different users, granting each user different access profiles based on the corresponding service and adapted to the individual folder.

Access is configured in two steps:

1. create users in the development tools;
2. create authorisation files in the file system public folders that need to be protected.

9.1 Account management

By default, c.pCO comes without any configured users, so the entire public file system is accessible from the "anonymous" account in read/write mode, and access via web does not require authentication. This simplifies the initial installation of application programs and web pages (if performed via FTP/HTTP protocol). Users can then be created, restricting access to the public file system. The users who can access IP services can be created in the development tools. The procedures are described in the development tool "help".

9.2 Computer - c.pCO connection

There are two ways to connect the c.pCO controller to a computer via Ethernet:

1. direct computer-c.pCO connection
2. connection to a LAN network with DHCP server

Direct computer-c.pCO connection

Connect one end of the network cable to the computer's Ethernet port and the other end to any of the Ethernet ports on the c.pCO; the LEDs will come on to indicate a successful connection. The c.pCO Ethernet ports are auto-crossing (Auto MDI-X), so there is no need to use a crossover cable. After connecting via Ethernet cable, configure the IP addresses of the computer and the c.pCO so that they are in the same subnet.

Configuration example:

Computer:

IP address: 192.168.0.2

Subnet mask: 255.255.255.0

c.pCO controller:

1. press Alarm and Enter together for 3s to enter the system menu;
2. Select Settings --> TCP/IPv4 settings or TCP/IP, and enter an address in the same subnet as set on the PC
3. Select update configuration --> Yes

Connection to a LAN network equipped with DHCP server

To connect the c.pCO controller to the LAN network, follow the procedures described in the development tool "help".

10. WEB SERVER

The c.pCO family controllers include a web Server that can be completely customised by the user. The c.pCO web server supports both HTML and JavaScript. Custom web pages can be uploaded to the public file system, in the /HTTP/ folder. The c.pCO implements CGI (Common Gateway Interface) functions that can be used to dynamically read and/or write application variables and generate dynamic content. For more information about the web server, see the KSA website.

10.1 c.pCO connection to cloud tERA

The c.pCO controllers family can establish a remote secure connection to the Carel cloud server platform called tERA. Every c.pCO with built-in Ethernet interface is natively integrated into tERa cloud platform and can access to linked services. Every c.pCO is uniquely identified by the tERA cloud using its MAC address. It is possible to create a customized private portal according to the customers specifications. For further information on tERA services available, contact your local Carel sales network.



Fig. 10.a

c.pCO registration:

Activation and registration procedure and settings of the tERA services are described in the "tERA Quick start Guide" (document +030222141), that can be download from www.carel.com.

Following data are requested in order to register a c.pCO in tERA server:

- MAC address of the c.pCO
- c.pCO Hardware unique ID
- tERA password

Above data are reported in the c.pCO System menu at the following path: INFORMATION --> pCO INFO --> second page (see figure below).

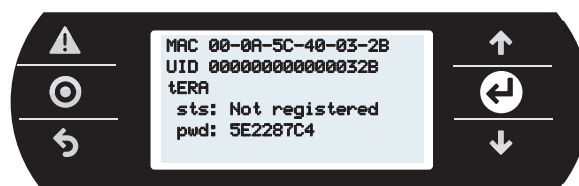


Fig. 10.b

c.pCO Update from tERA

From tERA portal, it is possible to update the application program and the Operating System of the c.pCO by remote. The controller should be already registered in the tERA portal.

Procedure is described in "tERA Quick start Guide" (document +030222141), that can be download from www.carel.com.

11. EXAMPLES

Below are some examples illustrating possible configurations based on the type of application. Below are some diagrams illustrating which devices can be connected to the c.pCO and the accessory cards required, according to the type of application.

Air handling unit

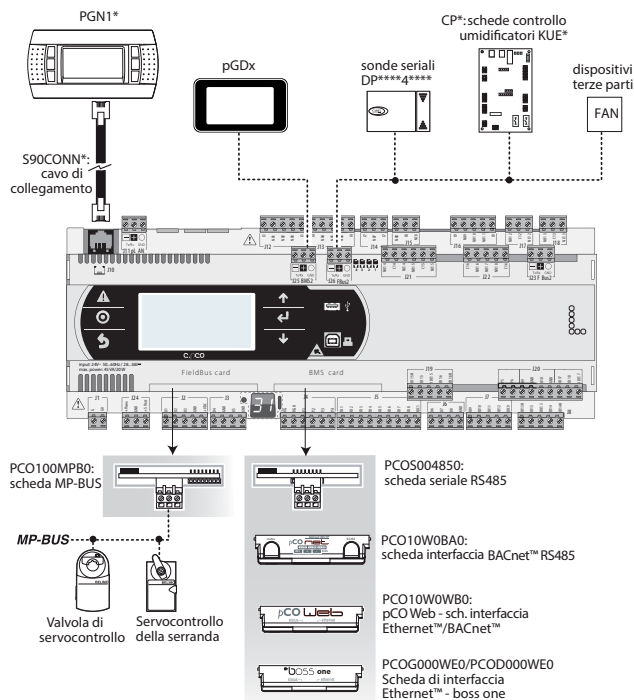


Fig. 11.a

Roof top

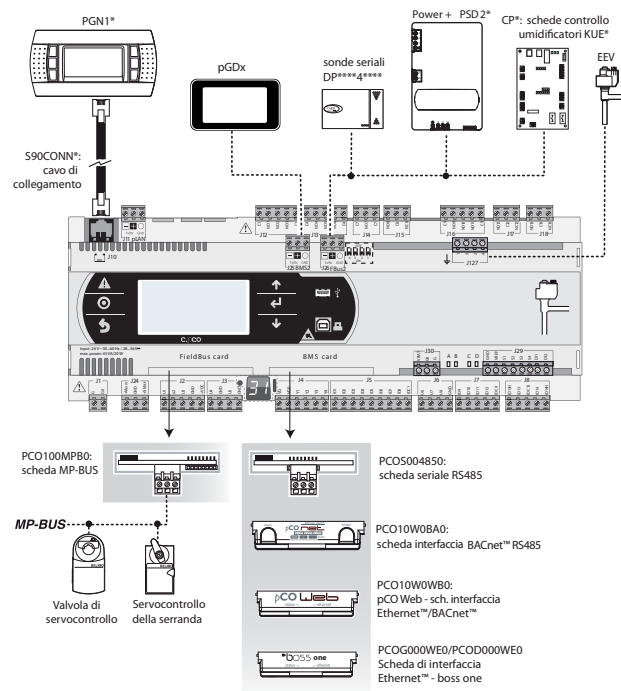


Fig. 11.b

Heat pump

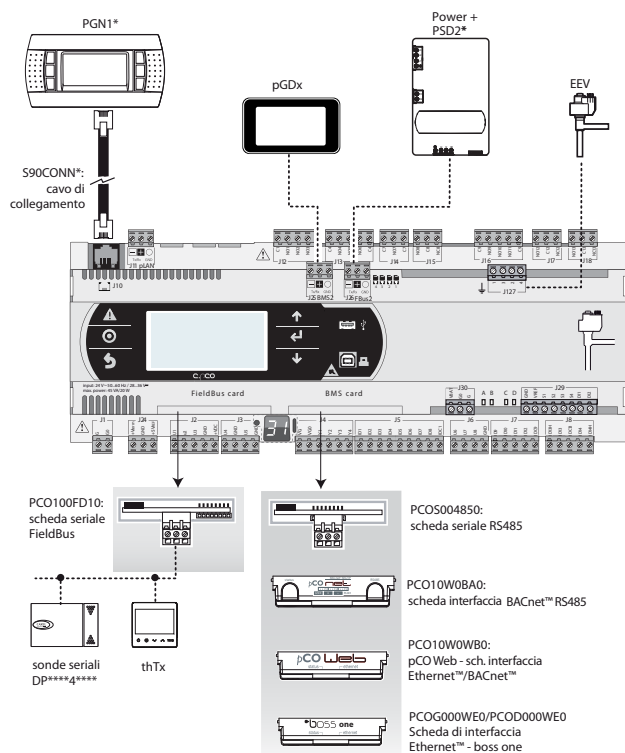


Fig. 11.c

Close control units (CCU)

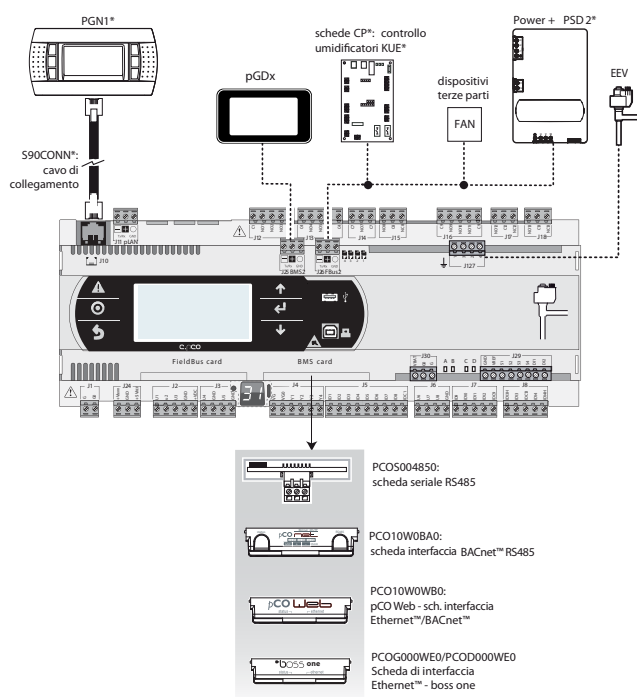


Fig. 11.d

Chiller - screw compressor

To create two refrigerant circuits, there are two possibilities

Case 1: 2 c.pCO Medium and c.pCO with built-in electronic expansion valve driver.

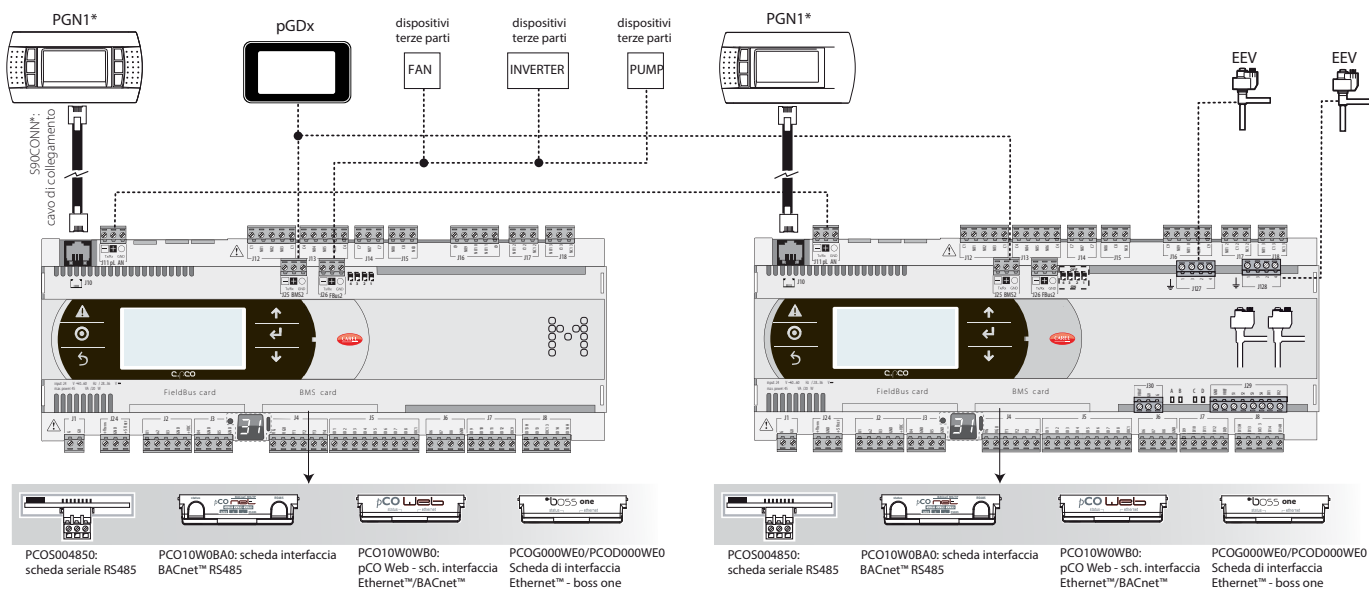


Fig. 11.e

Case 2: 1 c.pCO Large with external twin EVD Evolution driver.

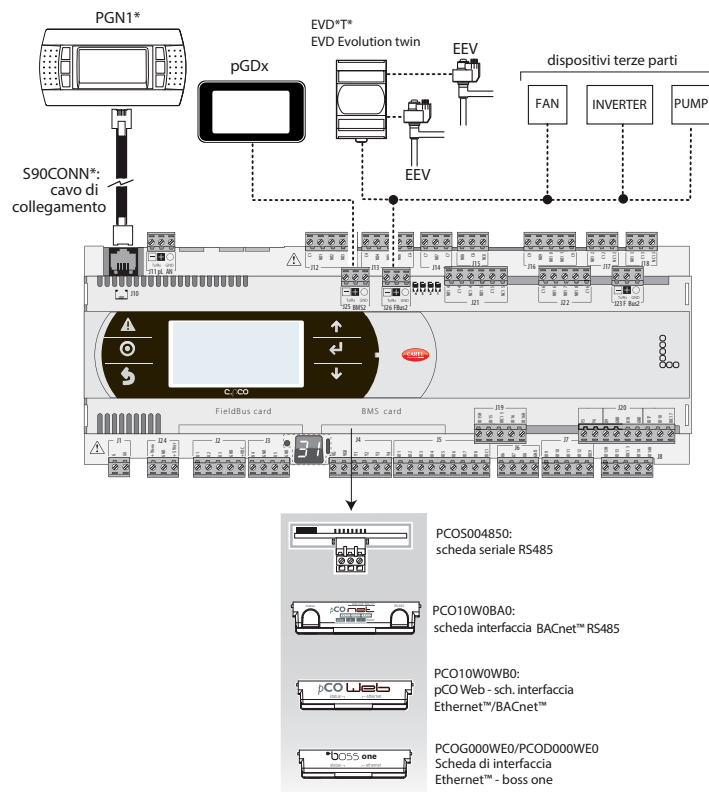


Fig. 11.f

Chiller - scroll compressor

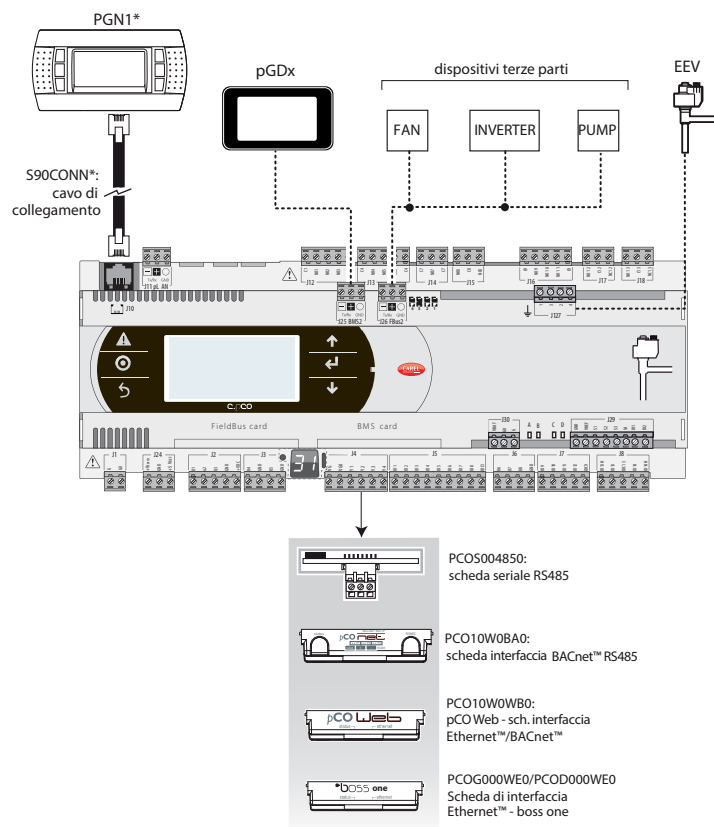


Fig. 11.g

11.2 Devices that can be connected to the c.pCO

Device	serial zero - pLAN or display port			serial one - BMS1				serial two - FBus 1	serial three - BMS 2		serial four - FBus 2		USB Main (Host)	USB Secondary (Device)	Ethernet
	connector J11	connector J10	connector J3 Disp.	PCOS004850	PCO1000F0	PCO10W0WB0	PCO10W0BA0	PCOS00KXN0	PCO100FD10	connector J25	connector J6 BMS	connector J26 (and J23 on L and XL)	connector J4 FBus		
pGN1 terminal		x	x												
pLDPRO terminal		x	x												
EVD Evolution									x			x	x		
CAREL Secondary devices (485)									x			x	x		
pCOexp 485									x			x	x		
c.pCOe									x			x	x		
PlantVisorPRO	x		x	x					x	x	x	x	x		
PlantWatchPRO	x		x	x					x	x	x	x	x		
PCGate	x		x	x					x	x	x	x	x		
WebGate (**)	x		x	x					x	x	x	x	x		
GATEWAY**0 (**)	x		x	x					x	x	x	x	x		
LON - Echelon FTT10 (**)					x										
BACnet MS/TP (RS485) (*)							x								x
KNX®								x							
HTTP client						x									x
BACnet/Ethernet						x									
BACnet/IP						x									x
SNMP v1, SNMP v2C						x									
Modbus TCP/IP						x									x
Modbus supervisor (RTU)	x		x	x						x	x				
Modbus Secondary devices									x			x	x		
Power +									x			x	x		
Pendrive (USB)														x	
PC mass storage															
th - Tune/thTx terminal									x			x	x		
pGDx	x	x (***)	x	x						x	x	x	x		

Tab. 11.a

(*) The BACnet/MSTP protocol is available on BMS2/FBus2/Ethernet, if the additional license is activated on the controller (the protocol is active on one port at a time).

(**) No longer available from 31/10/2023

(***) Possible with specific model of pGDx 4.3"

12. TECHNICAL SPECIFICATIONS

12.1 c.pCO technical specifications

Physical specifications

Dimensions	MINI	panel	147.3 x 81.3 x 70.5 mm
		4 DIN modules	70 x 110 x 63 mm
	SMALL	13 DIN modules	110 x 227.5 x 60 mm
	MEDIUM, LARGE, EXTRALARGE	18 DIN modules	110 x 315 x 60 mm
	BUILT-IN DRIVER	18 DIN modules	110 x 315 x 75 mm
Plastic container	Mounting	DIN rail in accordance with DIN 43880 IEC EN 50022/ panel	
	Material	technopolymer	
	Flammability	V2 (UL94) and 850 °C (IEC 60695)	
	Ball pressure test temperature	125 °C	
	Creep current resistance	≥ 250 V	
Built-in terminal	Colour	RAL 9016 white	
	pGD1 (132x64 pixels) with backlit keypad		

Other specifications

Control type	Control device, programmable electronic controller for air conditioning, heating and refrigeration applications and for HVAC/R in general		
Operating conditions	c.pCO: P+5**SE***0** (no built-in term.): -40T70 °C, 90% rH non-condensing(*)		
	c.pCO mini: P+D*****0** (no built-in terminal): -40T70 °C, 90% rH non-cond.		
	c.pCO: P+5**SE***E** (with built-in term.): -20T60 °C, 90% rH non-condensing		
	c.pCO mini: P+(D,P)*****E** (with built-in term.): -20T60 °C, 90% rH non-cond.		
	(*) with Ultracap module fitted: -40T60°C		
Storage conditions	c.pCO: P+5**SE***0** (no built-in terminal): -40T70 °C, 90% rH non-condensing		
	c.pCO mini: P+(D)*****0** (no built-in terminal): -40T70 °C, 90% rH non-cond.		
	c.pCO: P+5**SE***E** (with built-in terminal): -30T70 °C, 90% rH non-cond.		
	c.pCO mini: P+(D,P)*****E** (with built-in terminal): -30T70 °C, 90% rH non-cond.		
	c.pCO: IP20 front panel only		
Ingress protection	c.pCO mini: P+P***** (panel): IP 65; P+D***** (DIN): IP 40		
Pollution degree	2		
Class of protection against electric shock	c.pCO: to be incorporated into Class I and/or II equipment in the versions without valve driver, Class I in the versions with valve driver		
PTI of insulation materials	c.pCO mini: o be incorporated into Class I and/or II equipment (Basic/Enhanced) - Class I (High-End)		
Period of electrical stress across insulating parts	PCB: PTI 250V; insulation material: PTI 175		
Type of action	long		
Type of disconnection or micro-switching	1C; 1Y for SSR versions		
Heat and fire resistance category	microswitching		
Rated impulse voltage	Category D (UL94-V2)		
	c.pCO: 2500V		

Electrical specifications

Power supply

MINI, SMALL, MEDIUM, LARGE, EXTRALARGE: use a dedicated 50 VA class 2 safety transformer.

BUILT-IN DRIVER: use a dedicated 100 VA class 2 safety transformer.

	Vac	P (Vac)	Vdc	P (Vdc)
MINI		30 VA (40 VA with Ultracap module)	28 to 36 Vdc +10% to -15% to be protected by an external 2.5 AT fuse	12 W
SMALL	24 Vac (+ 10/-15%), 50/60 Hz to be protected by an external 2.5 A (T) fuse	45 VA	28-36 Vdc (-20/+10%) to be protected by an external 2.5 A (T) fuse	30 W
MEDIUM				
LARGE				
EXTRALARGE				
BUILT-IN DRIVER (built-in valve driver)		90 VA	Not allowed	



Caution: for controllers: with built-in drivers, AC power supply and transformer secondary earthing (G0 to earth) are mandatory; if the Ethernet connection is used, the transformer secondary must be earthed (G0 to earth).

Terminal block	with removable male/female connectors
Cable sizes	min 0.5 mm ² - max 2.5 mm ²
CPU	32 bit, 100 MHz
Clock with battery	standard, precision: c.pCO/c.pCO mini: 100/ 50 ppm
Buzzer	enabled from software only with built-in terminal
Battery	c.pCO: lithium "button" type CR2430 3 Vdc (dimensions 24x3 mm)
	c.pCO mini: lithium "button" type BR/CR2032 3 Vdc (dimensions 20x3.2 mm)
Software class and structure (IEC 60730)	Class A
Surge immunity category (IEC EN 61000-4-5)	c.pCO/ c.pCO mini: Category III/II
Device not intended to be hand-held when powered	

c.suite-based

Non-volatile memory (NAND FLASH)	128 MB of which 96 MB available as file storage
Data memory (RAM)	16 MB
Retain memory (EEPROM)	• c.pCO: 31,7 kB; • c.pCO mini: 15,4 kB; • c.pCO mini SMART: 31,7 kB Maximum writings: 1 Million

STone-based

Non-volatile memory (NAND FLASH)	128 MB of which • 98 MB available as file storage; • 31,7 kB available as retain memory
Data memory (RAM)	16 MB
Settings memory (EEPROM)	31,7 kB Maximum writings: 1 Million



Warning: the operating system issues a warning when the write frequency is too high. The development system includes libraries that enable handling this warning at the application level. It is recommended to use this feature to preserve memory integrity. For more details, refer to the development environment's online help.

Universal inputs/outputs U...

Analogue inputs, Lmax = 30 m (maximum number)

	MINI	SMALL	MEDIUM / BUILT-IN DRIVER / EXTRALARGE	LARGE
maximum number	10	5	8	10
CAREL NTC (-50T90°C; R/T 10 kΩ±1% at 25°C); NTC HT (0T150°C); PTC (600Ω-2200Ω); PT500 (-100T300°C); PT1000 (-100T400°C) probes	10	5	8	10
PT100 probes (-100T400°C);	5	2	3 (2 on U1-U5, 1 on U6-U8)	4 (2 on U1-U5, 1 on U6-U8, 1 on U9-U10)
0-1 Vdc/0-10 Vdc signals from probes powered by the controller (*)	-	5	6	6
0-1 Vdc/0-10 Vdc signals powered externally (*)	10	5	8	10
0-20 mA/4-20 mA inputs from probes powered by the controller (*)	2	4	6 (max 4 on U1-U5, 3 on U6-U8)	6 (max 4 on U1-U5, 3 on U6-U8, 2 on U9-U10)
0-20 mA/4-20 mA inputs powered externally (*)	4	4	7 (max 4 on U1-U5, 3 on U6-U8)	9 (max 4 on U1-U5, 3 on U6-U8, 2 on U9-U10)
0-5 V signals from ratiometric probes powered by the controller (*)	2	5	6	6
Input precision: ± 0.3 % f.s.				
Time constant for each input: 0.5 s				
Classification of measuring circuits (IEC 61010-1): category I				
Universal I/O: PWM 0-10V, 10 mA				

Digital inputs (not optically-isolated)

	MINI	SMALL	MEDIUM / BUILT-IN DRIVER / EXTRALARGE	LARGE
Lmax	30 m	30 m	30 m	30 m
voltage-free contacts	10	5	8	10
fast digital inputs - type: voltage-free contact; max current: 10 mA; max frequency 2 kHz and resolution ±1 Hz	max 2	max 2	4 (max 2 on U1-U5, max 2 on U6-U8)	6 (max 2 on U1-U5, max 2 on U6-U8, 2 on U9-U10)



Caution:

- provide adequate current protection measures (input current < 100 mA) for externally-powered active probes (0-1 V, 0-10 V, 0-20 mA, 4-20 mA)
- ratiometric probes can only be powered by the controller;
- At power on, the universal inputs/outputs are shorted to GND for approximately 500 ms until the configuration stage is completed.

Analogue outputs (not optically-isolated)

	MINI	SMALL	MEDIUM / BUILT-IN DRIVER / EXTRALARGE	LARGE
0-10 Vdc (*) (maximum current 2 mA)	5	5	8	10
PWM (0/3.3 Vdc output, maximum current 2 mA, frequency: 2 kHz asynchronous, 100 Hz asynchronous) PWM output duty cycle selectable by application program: operating range: 0% - 10% to 90% - 100% (values in the range 1-9% - 91-99% are not supported)	10	5	8	10

Power supply to probes and terminals

+Vdc	c.pCO: to power active probes, the 24/21 Vdc ± 10% available at the +VDC terminal (J2) can be used. The maximum current that can be delivered is 150 mA, protected against short circuits. c.pCO mini: 12 Vdc ± 8%; maximum current 50 mA, protected against short circuits
+5Vref	c.pCO: to power the 0-5 V ratiometric probes, use the 5 Vdc (± 5%) available at the +5VREF terminal (J24). The maximum current that can be delivered is 60 mA c.pCO mini: +5VREF = 5 Vdc ± 3%; maximum current 50 mA, protected against short circuits
Vterm	c.pCO: 24 Vdc ± 10% - Used to power an external terminal as an alternative to the one connected to J10, Pmax = 1.5 W. Caution: if the length exceeds 10 m, use a shielded cable with the shield earthed. In any case, the maximum length is 30 m. c.pCO mini: 24-36 Vdc ± 5% depending on the power supply voltage; max available current: 100 mA (pGN1, pLDPRO, tHTUNE CAREL), protected against short circuits. Max. connection cable length: 10 m

Digital inputs ID... IDH

Type	c.pCO Small-Extralarge: optically-isolated; c.pCO mini not optically-isolated
Lmax	30 m, (c.pCO mini 10 m)

		Volt-free contacts	No. of opto-isolated 24 Vac or 24 Vdc inputs	No. of opto-isolated 24 Vac/Vdc or 230 Vac - 50/60 Hz inputs
Maximum number	MINI (Enhanced/HighEnd only)	2	0	0
	SMALL	0	8	0
	MEDIUM/ BUILT-IN DRIVER/EXTRALARGE	0	12	2
	LARGE	0	14	4
Minimum digital input pulse detection time		Normally open (open-closed-open): 200 ms; Normally closed (closed-open-closed): 400 ms		
Input power supply		c.pCO Small-Extralarge - External; c.pCO mini - Internal IDH...: 230 Vac (+10/-15%) 50/60 Hz ID...: 24 Vac (+10/-15%) 50/60 Hz or 28-36 Vdc (+10/-20%)		
Measurement circuit classification (IEC EN 61010-1)		Category I: 24 Vac/Vdc (J5, J7, J20); Category III: 230 Vac (J8, J19)		
Current draw of 24 Vac/Vdc digital inputs		5 mA		
Current draw of 230 Vac digital inputs		5 mA		



Caution:

c.pCO SMALL, MEDIUM, BUILT-IN DRIVER, LARGE, EXTRALARGE:

- separate as much as possible the probe and digital input cables from cables to inductive loads and power cables, so as to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel cables) and signal cables in the same conduits;
- the two 230 Vac or 24 Vac/Vdc inputs on terminals J8 (ID13, ID14) or J19 (ID15, ID16) have the same common pole and therefore both must have the same voltage (230 Vac or 24 Vac/Vdc). The insulation between the two inputs is functional; there is reinforced insulation between the inputs and the rest of the controller;
- ID1-ID8, ID9-ID12, ID17, ID18 have functional insulation from the rest of the controller;
- for inputs with direct current voltage (24 Vdc), either the + or - can be connected to the common terminal;
- the external contact for digital inputs must be rated to at least 5 mA.

c.pCO mini

- separate as much as possible the probe and digital input cables from cables to inductive loads and power cables, so as to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel cables) and signal cables in the same conduits;
- the external contact for digital inputs must be rated to at least 5 mA.

Analogue outputs Y...

	MINI	SMALL	MEDIUM / BUILT-IN DRIVER / EXTRALARGE	LARGE
Type	0-10 V, not optically-isolated, on Y1, Y2	optically-isolated 0-10 V on Y1-Y6		
Lmax	10m	30 m		
Maximum number	2: Y1, Y2	4: Y1-Y4, 0-10 V		6: Y1-Y6, 0-10 V
Power supply	Internal	external: 24 Vac (+10/-15%) or 28-36 Vdc on VG(+), VG0(-) (*)		
Precision	Y1, Y2 $\pm$ 3% full scale	Y1-Y6: $\pm$ 2% full scale		
Resolution	8 bits	8 bits		
Stabilisation time	Y1, Y2: from 1 s (slew rate 10 V/s) to 20 s (slew rate 0.5 V/s) selec. via SW	Y1-Y6: from 1 s (slew rate 10 V/s) to 20 s (slew rate 0.5 V/s) selectable via SW		
Maximum load	1 k Ω (10 mA)	1 k Ω (10 mA)		



Caution:

c.pCO SMALL, MEDIUM, BUILT-IN DRIVER, LARGE, EXTRALARGE

- for lengths > 10 m, a shielded cable is required, with the shield connected to earth;
- other outputs of the same type can be connected in parallel to a 0-10 Vdc analogue output or an external voltage. The resulting voltage will be the higher value. Correct operation is not guaranteed if actuators with voltage inputs are connected;
- power analogue outputs VG-VG0 at the same voltage supplied at G-G0: connect G to VG and G0 to VG0. This applies to both AC and DC power supplies.

c.pCO mini

- for lengths > 10 m, a shielded cable is required, with the shield connected to earth;
- other outputs of the same type can be connected in parallel to a 0-10 Vdc analogue output or an external voltage. The resulting voltage will be the higher value. Correct operation is not guaranteed if actuators with voltage inputs are connected.

Digital outputs NO..., NC...

c.pCO mini

Type	Relays		
Lmax	less than 30 m		
Maximum number	6		
Isolation distance	The outputs can be divided into groups: between group 1 and 2 there is a basic insulation. Group 3 has reinforced insulation compared to the first 2 groups and a different power supply voltage can be applied.		
Make-up of the groups	Group		
	1	2	3
	1 to 2	3, 4, 5	6
	Type C relay	Type C relay	Type D relay
Number of changeover contacts	1 (relay 6)		
Switchable power	Type C relay		
	Approval	NO EN 60730-1:	2(1) A (75000 cycles)
		UL 508:	5 A resistive 250 Vac, 30,000 cycles; Definite purpose, 1FLA, 6LRA, 250 Vac, 30,000 cycles; Pilot duty C300, 250 Vac, 30,000 cycles.
	Type D relay		
	Approval	NO EN 60730-1:	1(1) A (100000 cycles), maximum switching voltage: 250 Vac
		UL 508:	1 A resistive, 1 A FLA, 6A LRA, 250 Vac, 30,000 cycles; Pilot duty D300, 250 Vac, 30,000 cycles.
	R2 (output NO2), R5 (output NO5) with SSR: switchable power 15 VA 110/230 Vac or 15 VA 24 Vac depending on the model purchased		
	Operating voltage	SSR 24 V model 24 Vac/Vdc SELV	SSR 110/230V model 230 Vac
	Load current (MAX)	1 A	70 mA
	Pulse load current (MAX)	1.2 A	150 mA

c.pCO SMALL, MEDIUM, BUILT-IN DRIVER, LARGE, EXTRALARGE

Type	Relays											
Maximum number	8: SMALL; 13: MEDIUM/ BUILT-IN DRIVER; 18: LARGE; 29: EXTRALARGE											
Isolation distance	The relay outputs have different characteristics depending on the model of controller. The outputs can be divided into groups. Relays in the same group (single cell in the table) have functional isolation from each other and therefore must have the same voltage. There is reinforced insulation between groups (different cells in the table) so the relays can have different voltages. In any case, there is reinforced insulation between each digital output terminal and the rest of the controller.											
Relay with same insulation	Group											
	Model	1	2	3	4	5	6	7	8	9	10	11
	SMALL	1 to 3	4 to 6	7	8	-	-	-	-	-	-	-
	Relay type	Type A	Type A	Type A	Type A	-	-	-	-	-	-	-
	MEDIUM/ BUILT-IN DRIVER	1 to 3	4 to 6	7	8	9 to 11	12	13	-	-	-	-
	Relay type	Type A	Type A	Type A	Type A	Type A	Type A	Type A	-	-	-	-
	LARGE NO	1 to 3	4 to 6	7	8	9 to 11	12	13	14 to 15	16 to 18	-	-
	Relay type	Type A	Type A	Type A	Type A	Type A	Type A	Type A	Type A	Type A	-	-
	EXTRALARGE	1 to 3	4 to 6	7	8	9 to 11	12	13	14 to 16	17 to 20	21 to 24	25 to 29
	Relay type	Type A	Type A	Type A	Type A	Type A	Type A	Type A	Class B	Class B	Class B	Class B
Number of changeover contacts	1: SMALL (relay 8); 3: MEDIUM and EXTRALARGE (relays 8, 12, 13); 5: LARGE NO (relays 8, 12, 13, 14 and 15)											

Notice: the output relays have different characteristics according to the model of c.pCO

SSR outputs (on models where fea- tured)	Switchable power	Type A relay	Rated data	SPDT, 2000 VA, 250 Vac, 8 A resistive	
			Approval	UL 508	2 A resistive, 250 Vac, 30,000 cycles; Pilot duty C300, 240 Vac, 30,000 cycles.
				EN 60730-1 2(2) A, 250 Vac, 100,000 cycles	
		Type B relay	Relay rating data	SPST, 1250 VA, 250 Vac, 5A resistive	
			Approval	UL 508	1A resistive, 250 Vac, 30,000 cycles; Pilot duty C300, 240 Vac, 30,000 cycles.
				EN 60730-1 1(1), 250 Vac, 100,000 cycles	
	Maximum number		1: SMALL (output 7); 2: MEDIUM and EXTRALARGE (outputs 7 and 12); 3 or 4: LARGE 3 SSR (outputs 7, 12, 14) LARGE 4 SSR (outputs 7, 8, 12, 13)		
			SSR 24 V model SSR 110/230V model		
	Operating voltage		24 Vac/Vdc SELV 230 Vac		
	Load current (MAX)		1 A 70 mA		
Pulse load current (MAX)		1.2 A 150 mA			



Caution:

- If the load requires higher currents, use an external SSR relay. To power external loads, use the same power supply as the c.pCO (supplied to terminals G-G0), which must be dedicated and not shared with that of other devices (contactors, coils, etc.);
- the digital output groups have two common pole terminals to facilitate wiring;
- pay attention to the current running through the common terminals; this must not exceed the nominal current of a single terminal, i.e. 8 A.

(*) class 2

Serial ports (use AWG 20-22 twisted pair shielded cable for +/-)

Serial	Type/connectors	Specifications
Serial 0	pLAN/J10, J11	- Integrated on main board - HW driver: asynchronous half duplex RS485 pLAN - Not optically-isolated - Connectors: 6-way telephone jack + 3-pin plug-in p. 5.08 - Maximum length: 500 m - Max data rate: 38400 bits/s - Maximum number of connectable devices: 32
Serial ONE	BMS 1 Serial Card	- Not integrated on main board - HW driver: not present - Can be used with all pCO family optional BMS cards
Serial TWO	FieldBus 1 Serial Card	- Not integrated on main board - HW driver: not present - Can be used with all pCO family optional FieldBus cards
Serial THREE	BMS 2 / J25	- Integrated on main board - HW driver: asynchronous half duplex RS485 Secondary. - Optically-isolated/not optically-isolated serial(*) 3-pin plug-in connector p. 5.08 - Maximum length: 1000 m - Max data rate: 115200 bits/s - Maximum number of connectable devices: 16
Serial FOUR	Fieldbus 2 / J26 (and J23 on Large and Extralarge versions)	- Integrated on main board - HW driver: asynchronous half duplex RS485 main/secondary (**) - J23: not optically-isolated - J26: optically-isolated/not optically-isolated 3-pin plug-in connector p. 5.08 - J23 and J26 are both managed by the same protocol as serial 4, with the advantage of being electrically independent

(*): both models are available; (**): configurable port J26: see par. 3.2.



Notice: in industrial/residential environments, a shielded cable with the shield earthed is required for distances > 10 m. In domestic environments (EN 55014), regardless of the cable length, on the versions without valve driver, the connection cable between the controller and the terminal and the serial cable must be shielded and earthed at both ends.

Ethernet	RJ45 connector	cpCO mini High End	1 Ethernet port, 10/100 Mbps
		cpCO Small-Extralarge	1 or 2 Ethernet ports, 10/100 Mbps (100-BASE TX), both equivalent

c.pCO mini: Model with electronic expansion valve driver

Number of valves:	1
Maximum power for each valve	8 W
Type of control	Unipolar
Valve connector	6-pin fixed sequence (JST connector)
Power supply	12 Vac
Maximum current	0.35 A for each winding
Minimum winding resistance	40 Ω +/- 10%
Max connection cable length	Residential/industrial environments = 2 m with cable built-in into the stator, 6 m using shielded cable earthed at both ends (E2VCABS3U0, E2VCABS6U0)
Valve compatibility	CAREL: Unipolar valves - E2V* and E3V*, stators - E2VSTA*3**, E3VSTA*3**

c.pCO: Model with electronic expansion valve driver

Valve compatibility	CAREL: E*V**** - 1 or 2 bipolar valves depending on the model chosen. For further information, see the "EEV System Guide" (+030220810) available on the www.carel.com website		
	ALCO: EX4; EX5; EX6; EX7; EX8 330 Hz (recommended by CAREL); EX8 500 Hz (to ALCO specifications)		
	SPORLAN: SEI 0.5-11; SER 1.5-20; SEI 30; SEI 50; SEH 100; SEH175		
	ETS 12.5-25B; ETS 50B; ETS 100B; ETS 250; ETS 400; CCM 10-20-30-40; CCMT 2-4-8-16-24-30-42; Colibri		
	SPORLAN: SER(I) G, J, K Ejectors: E2J17AS1N0; E2J23AT1N0; E3J26AT2N0; E3J33AU2N0; E3J39AV3N0; E6J50AV3N0		
Motor connection	CAREL 4-wire shielded cable P/N E2VCABS*00, or 4-wire shielded cable AWG22 Lmax =10 m, or 4-wire shielded cable AWG14 Lmax 50 m		
Connection of digital inputs	Digital inputs activated using voltage-free contact or transistor to GND. Closing current 5 mA; maximum length < 10m		
Probes	Maximum length 10 m or less than 30 m with shielded cable		
	S1	ratiometric pressure probe (0-5 V)	resolution 0.1% fs measurement error: 2% fs maximum; 1% typical
		electronic pressure probe (4-20 mA)	resolution 0.5 % fs measurement error: 8% fs maximum; 7% typical
		combined ratiometric pressure probe (0-5 V)	resolution 0.1% fs measurement error: 2 % fs maximum; 1 % typical
		4-20 mA input (max. 24 mA)	resolution 0.5 % fs measurement error: 8 % fs maximum; 7 % typical
	S2	NTC low temperature	10 kΩ at 25 °C, -50T90 °C meas. error: 1°C in the range -50T50 °C; 3°C in the range +50T90 °C
		NTC high temperature	50 kΩ at 25 °C, -40T150 °C meas. error: 1.5 °C in range -20T115 °C; 4 °C in range outside -20T115 °C
		Combined NTC	10 kΩ at 25 °C, -40T120 °C measurement error: 1°C in the range -40T50 °C; 3°C in the range +50T90 °C
		0-10 V input (max 12 V)	resolution 0.1% fs measurement error: 9% fs maximum; 8% typical
	S3	ratiometric pressure probe (0-5 V)	resolution 0.1% fs measurement error: 2% fs maximum; 1% typical
		electronic pressure probe (4-20 mA)	resolution 0.5 % fs measurement error: 8% fs maximum; 7% typical
		combined ratiometric pressure probe (0-5 V)	resolution 0.1% fs measurement error: 2 % fs maximum; 1 % typical
		4-20 mA input (max. 24 mA)	resolution 0.5 % fs measurement error: 8 % fs maximum; 7 % typical
	S4	NTC low temperature	10 kΩ at 25 °C, -50T105 °C; 3°C in the range 50T90 °C
		NTC high temperature	10 kΩ at 25 °C, -40T150 °C meas. error: 1.5 °C in range -20T115 °C; 4 °C in range outside -20T115 °C
		Combined NTC	10 kΩ at 25 °C, -40T120 °C measurement error 1°C in the range -40T50°C; 3°C in the range +50T90°C
Power to active probes (VREF)	programmable output: +5 Vdc ±2% or 12 Vdc ±10%, I _{max} = 50 mA		
Emergency power supply	Optional Ultracap module (PCOS00UC20 or EVD0000UC0). If the controller is constantly subjected to temperatures near the upper limit of 60°C, it is recommended to use the external module P/N EVD0000UC0, where possible installed in the coolest point of the panel. The PCOS00UC20 and EVD0000UC0 modules can be connected simultaneously to the same controller, doubling the energy available to close the valves. Caution: the module only powers the valve driver, not the controller.		

12.2 Standards compliance

Electrical safety	EN 60730-1, EN 60730-2-9, EN 61010-1, UL60730
Electromagnetic compatibility	Versions without valve driver: EN 61000-6-1, EN 61000-6-2, EN 61000-6-2/EC, EN 61000-6-2/IS1, EN 61000-6-3, EN 61000-6-4; EN 55014-1, EN 55014-2, EN 55014-2/EC, EN 55014-2/A1, EN 55014-2/IS1, EN 55014-2/A2 Versions with valve driver with or without Ultracap module: EN 61000-6-1, EN 61000-6-2, EN 61000-6-2/EC, EN 61000-6-2/IS1, EN61000-6-3, EN 61000-6-4
Compatibility with flammable refrigerant gases	The c.pCO, c.pCO mini controllers are: - compliant with IEC 60335-2-40:2018 when using A2L refrigerants (e.g. R32); in particular, electrical components that could be a source of ignition during normal operation comply with Annex JJ and the maximum surface temperature of all components does not exceed the values specified in Annex BB for A2L refrigerants, reduced by 100K, during normal operation. - classified as UL Category Control Number (CCN) LZGH2/8, in accordance with UL 60335-2-40 (ed. 4, revision date 15 December 2022; Annex JJ only) and CSA C22.2 No. 60335-2-40 (ed. 4, revision date 15 December 2022; Annex JJ only) when using A2L refrigerants.

12.3 c.pCO connectors

c.pCO

Part number	Description	Classification
P+**CON**	Carel standard	Type
P+**C****	Customisation	
P+*****Q**	With screws	Terminal type
P+*****1**	Spring	
P+*****S0	Small	Size
P+*****M0	Medium	
P+*****L0	Large	
P+*****Z0	Extralarge NO	
P+*****20	Medium 2 drivers	

c.pCO mini

Part number	Description	Classification
P+**CON**	Carel standard	Type
P+**C****	Customisation	
P+*****Q**	With screws	Terminal type
P+*****1**	Spring	
P+*****B0	Basic	Version
P+*****E0	Enhanced/High End	
P+*****S0	Smart	

Electrical specifications of the plug-in connectors used

Connector type	Pitch 5.08
Cable cross-section	0.25 mm ² - 2.5 mm ² (AWG: 24 to 12)
Stripped length	7 mm
Screw thread	M3
Tightening torque	0.5 - 0.6 Nm

AWG and wire cross-section cross-reference

AWG	Cross-section (mm ²)	MAX current
20	0.5	2
15	1.5	6
14	2.5	8

13. APPENDIX

13.1 Document revisions

Manual version release	Date	Changes
1.7	27/06/2024	- information added on STone-based controllers (par. 1.1, 6,7,8,9,10); - updated list of connectable devices (par. 1.4, 1.5, 1.6, 1.7); - network connection between controllers - bypass relay (par. 3.3); - insertion - Note: pLAN port configured to communicate in "Display Protocol" (Par. 4.4); - c.pCO mini Smart models added and updated specifications (par. 4.8); - notes added on configuration limitations (par. 5.2); - updated remote analogue input table (par. 5.2); "useful cycle duration" removed (par. 12.1); - updated data relating to the PWM output for c.pCO mini (par. 12.1); - update digital output approvals to UL 508 (Par. 12.1); - update memory data and maximum number of writes (Par. 12.1); - updated valve compatibility data (par. 12.1); - update statement regarding compatibility with flammable refrigerant gases (par. 12.2); - connector table added (par. 12.3); - items "Aging characteristics" and "No. of automatic operating cycles" removed (par. 12.1); - typos corrected.
1.8	21/10/2025	- paragraph on SSR features updated (par. 5.8, 12.1) - info on c.pCOe 8-bit, None, 1 configuration updated (par. 6.7) - introduction to tEra connection (par. 10.1) - compatibility with flammable refrigerants updated (par. 12.2)

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