

pCO sistema  
programmable controllers

CAREL

pCO



T e c h n o l o g y & E v o l u t i o n

# The complete, flexible and reliable solution



# pCO sistema

pCO sistema is the result of CAREL's years of experience in the design and manufacture of programmable controllers for HVAC/R units.

pCO sistema consists of programmable controllers, user interfaces, software tools for the development of applications, and a series of optional boards to interface to the more commonly-used Building Management Systems and a proprietary supervisory system.

Today, then, not only are the quality and the reliability of the instruments important, but also the degree of external connectability they can offer.

The pCO sistema family controllers come in a number of sizes, according to the number and type of inputs/outputs, the use of the Built-In terminal, and the size of the flash memory available. Everything required to offer the OEMs working in HVAC/R a control system that is powerful yet flexible, and can easily be customised in both aesthetic and functional terms.





**pCO<sup>3</sup>**



DIN rail



EasyTools System



datalogging



pCO local area network



Pt1000



Nand Flash

32 Mb datalogging



time bands and alarm memory



extended temperature range



multi-language



built in graphic



field device control



ratiometric inputs

## The top of the range

pCO<sup>3</sup> represents the most advanced offering by CAREL in the field of programmable controllers. pCO<sup>3</sup> is designed for many air-conditioning and refrigeration applications.

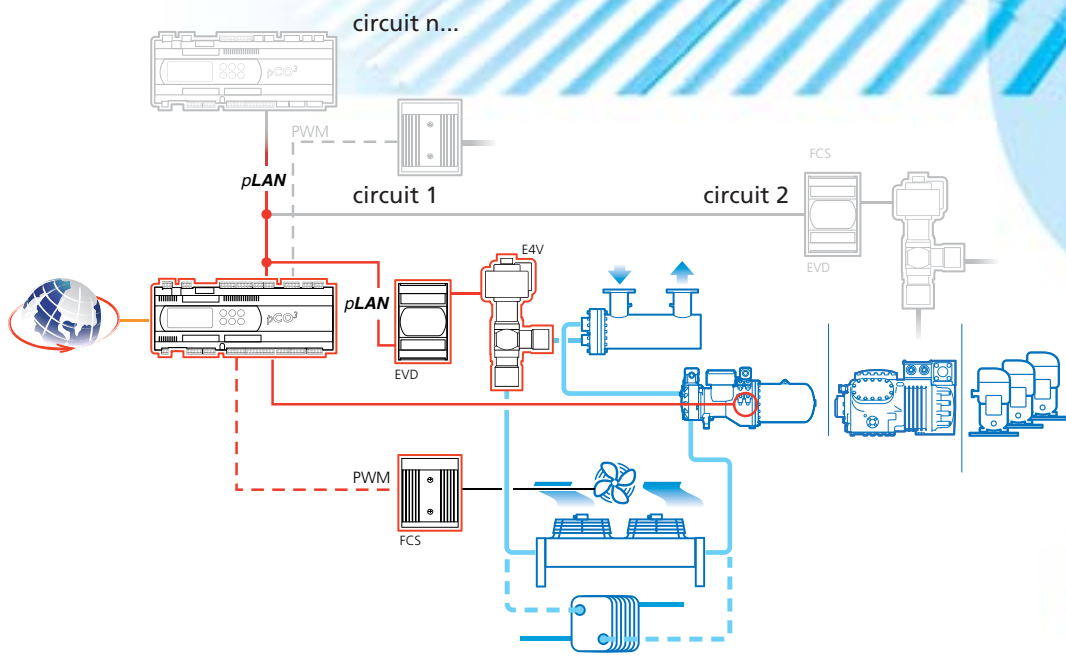
All the boards feature a new quartz, and consequently the calculation power and operation processing speed have been significantly increased. As for all the pCO series controllers, pCO<sup>3</sup> comes in a plastic case that ensures a high index of protection and reduces the risk of electrostatic discharges due to incorrect handling. In addition, assembly is simplified by the DIN rail mounting system, allowing significant saving in wiring and assembly times.

Given the increasing demand for integration, pCO<sup>3</sup> can interface with BMS systems via many of the most commonly-used serial communication standards, using optional boards.

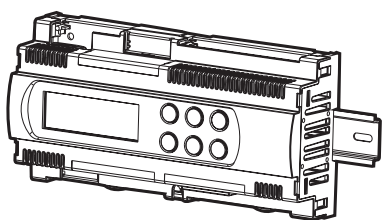
All of these features ensure a level of excellence in responding to the needs of the HVAC/R market.

Based on the experience acquired so far, pCO<sup>3</sup> offers greater safety due to the optical isolation of the serial pLAN, protection of the analogue inputs in the event of incorrect connections, and an extended range of operating temperatures (-25T70 °C). pCO<sup>3</sup> is also synonymous with quality. In fact, as well as CE and UL certification, pCO<sup>3</sup> has VDE certification and compatibility with standards EN50155 and EN13485; pCO<sup>3</sup> can consequently resist shock, vibrations, humidity and an extended range of temperatures.

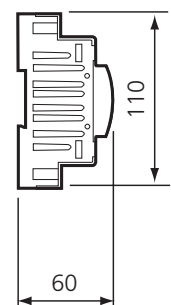
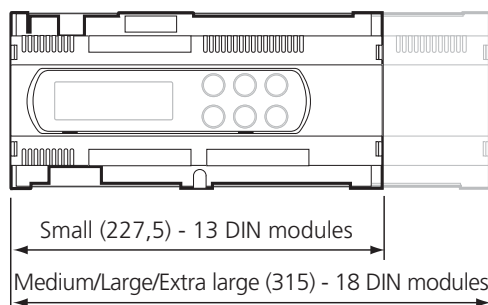
As well as the pLAN and BMS serial ports, pCO<sup>3</sup> offers an additional third port for connection to field devices (valves, I/O expansions, electronic valve drivers...) using optional RS485, tLAN or MP-BUS<sup>®</sup> boards, an analogue or GSM modem using an RS232 board, or the control of fan coils using the CANbus board (e-dronic system).



pCO<sup>3</sup> has been designed for highly complex HVAC/R applications. With its high number of I/O, it can, for example, completely control chillers and heat pumps with semi-hermetic, screw or centrifugal compressors.



DIN rail mounting





## pCO1

### The competitive solution

The pCO<sup>1</sup> series has been designed for the purpose of providing the significant innovations introduced by the pCO<sup>2</sup> to all those applications that require greater competitiveness in terms of price.

The pCO<sup>1</sup> controllers are available in two different sizes, according to the I/O and power requirements: pCO<sup>1</sup> Small, pCO<sup>1</sup> Medium.

Some models feature an SSR to control the devices that require frequent starts and stops.

The pCO<sup>1</sup> inputs can be configured using dipswitches, allowing the characteristics of the inputs to be adapted to the more common market standards (NTC, 0 to 1 Vdc, 0 to 5 Vdc, 0 to 20 mA, 4 to 20 mA, ON/OFF). All the pCO<sup>1</sup> series controllers feature a 16-bit microprocessor, and 2 MB flash memory.

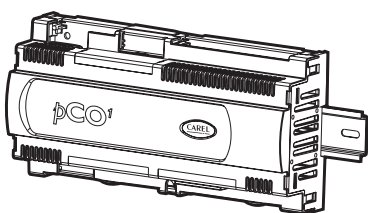
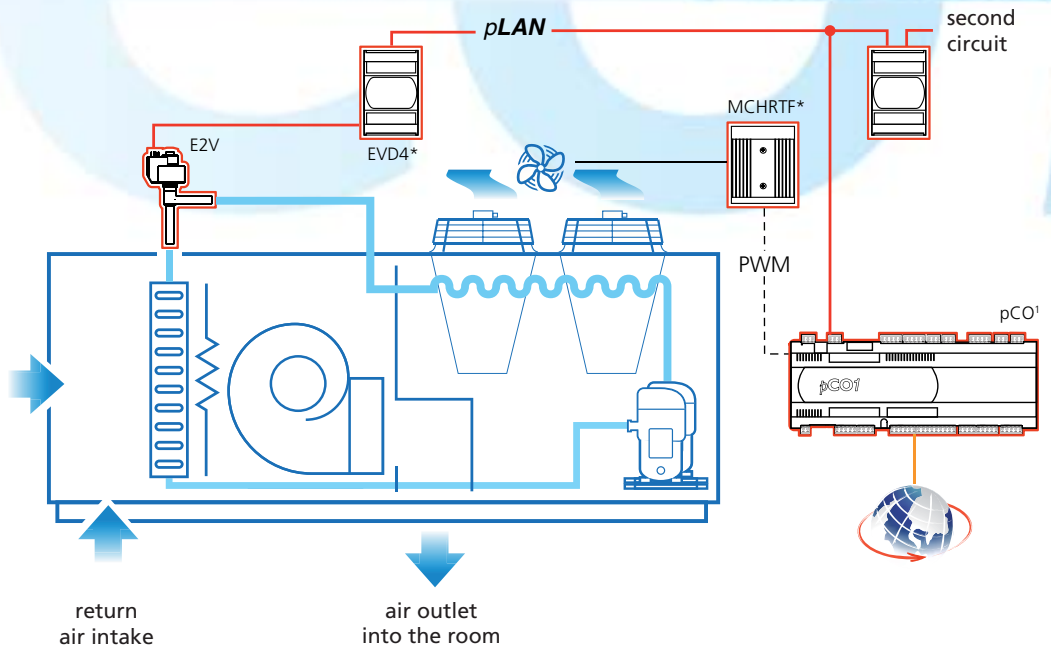
-  DIN rail
-  EasyTools System
-  datalogging
-  pCO local area network
-  time bands and alarm memory
-  multi-language
-  field device control
-  ratiometric inputs

The management of the logged data, using an optional board and real time clock, means that a pCO<sup>1</sup> can manage black box functions. In fact, all the active alarms can be saved, along with the main physical values controlled and the status of the controlled devices.

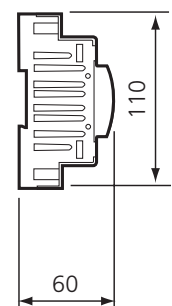
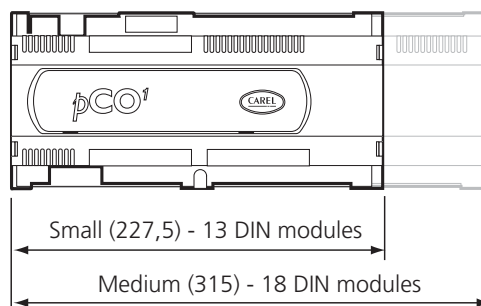
The black box data can then be transferred via the programming key or to a PC via modem.

pCO<sup>1</sup> also offers an additional third port for connection to field devices (valves, I/O expansions, electronic valve drivers...) using optional RS485, tLAN or MP-BUS<sup>®</sup> boards, an analogue or GSM modem using an RS232 board, or the control of fan coils using the CANbus board (e-dronic system).

In roof-top units, for example, pCO<sup>1</sup> can manage the temperature and the humidity of the air-conditioned environment, as well as the freecooling and freeheating functions to optimise the operation of the unit by exploiting the outside temperature conditions.



DIN rail mounting





DIN rail



EasyTools System



datalogging



pCO local area network



Belimo actuators



built in



time bands and alarm memory



extended temperature range



multi-language



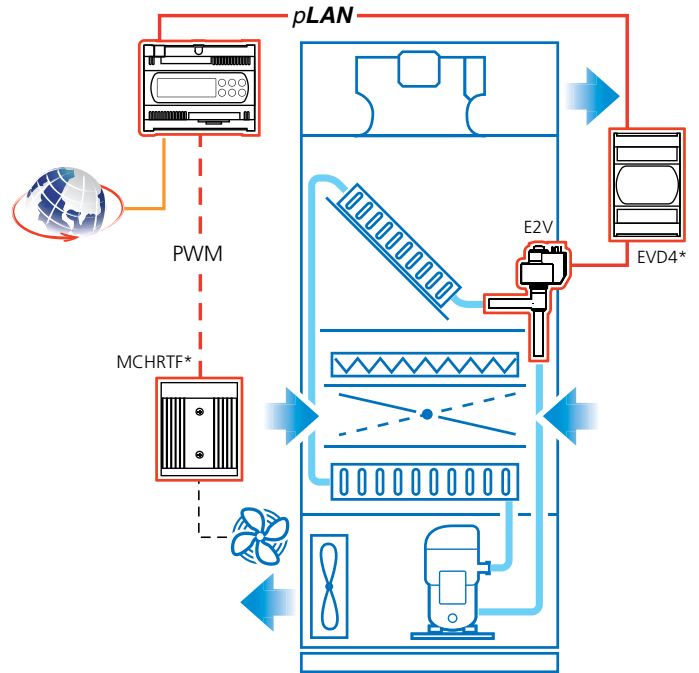
ratiometric inputs



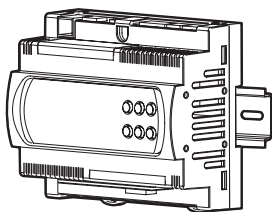
# pCO<sup>XS</sup>

## Compactness and reliability

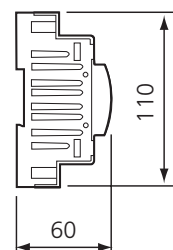
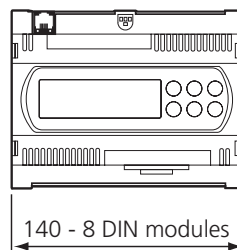
pCO<sup>XS</sup> has been designed to make the potential of the pCO sistema family programmable controllers available to all those applications that until now have been covered only by parametric controllers. Using this controller, the software for single circuit chillers and heat pumps, small roof-top units and precision air-conditioners can be quickly customised based on the specific needs of the individual manufacturer. pCO<sup>XS</sup> is also ideal for the manufacturers of air handling systems. Indeed, a special version is available with the Belimo MP-BUS<sup>®</sup> protocol for easy connection to up to 8 servo controls. This consequently allows the management of large systems for limited costs.



The hardware features of pCO<sup>XS</sup>, such as the wide range DC power supply (22 to 60 Vdc) and voltage-free digital inputs, make it ideal for the shelter management applications.



DIN rail mounting





Model	PCO3*S	PCO3*M	PCO3*L	PCO3*XL ver. NO	PCO3*XL ver. NC	PCO1*S	PCO1*M	PCO1*X	PCOC*
Max. flash memory capacity	4 MB	4 MB	4 MB	4 MB	4 MB	2 MB	2 MB	2 MB	1 MB
Nand Flash	■	■	■	■	■				
Real Time Clock	●	●	●	●	●	■	■	■	■
pLAN	●	●	●	●	●	●	●	●	●
Opto-isolated pLAN	■	■	■	■	■				
tLAN	■	■	■	■	■	■	■	●	■
Pre-set for programming key	●	●	●	●	●	●	●	●	●
pGD <sup>0</sup> built-in display	■	■	■	■	■				
pGD <sup>1</sup> built-in display	■	■	■	■	■				
4x20 built-in display								■	
LED indicators	■	■	■	■	■				
Serial interface for communication with I/O expansion	■	■	●	●	●	■	■	■	
Black box	●	●	●	●	●	■	■	■	
CAREL protocol	●	●	●	●	●	●	●	●	●
Metasys <sup>®</sup> compatible	●	●	●	●	●	●	●	●	●
Modbus <sup>®</sup> RTU protocol	●	●	●	●	●	●	●	●	●
LonWorks <sup>®</sup> protocol	■	■	■	■	■	■	■	■	■
BACnet <sup>™</sup> Ethernet <sup>™</sup> protocol	■	■	■	■	■	■	■	■	■
BACnet <sup>™</sup> MS/TP protocol	■	■	■	■	■	■	■	■	■
HTTP/FTP/SNMP protocol	■	■	■	■	■	■	■	■	■
CANbus protocol	■	■	■	■	■	■	■	■	
MP-BUS <sup>®</sup> Belimo	■	■	■	■	■	■	■	●	
Modem, modem GSM, SMS ready	●	●	●	●	●	●	●	●	●
Max. n. of analogue inputs	5	8	10	8	10	6	8	4	8
PT1000 inputs	2	2	4	2	4				
0 to 10 Vdc inputs	3	6	6	6	6				
0 to 1 Vdc inputs	3	6	6	6	6	4	4	2	4
4 to 20 mA or 0 to 20 mA inputs	3	6	6	6	6	4	4	2	4
NTC inputs	5	8	10	8	10	6	8	4	8
0 to 5 Vdc ratiometric inputs	3	6	6	6	6	4	4	4	
AIN setting by software	●	●	●	●	●			●	
AIN setting by dip-switch						●	●		●
Max. n. of digital inputs	8	14	18	14	14	8	14	6	12
24 Vac/dc inputs	8	14	18	14	14	8	14		12
230 Vac/dc inputs		2	4	2	2	8	2		2
Free contact inputs	2	2	4	2	4	2	2	6	
Max. number of analogue outputs	4	4	6	4	4	4	4	3	2
Uscite 0...10 Vdc	4	4	6	4	4	2	2	2	2
PWM outputs (phase cutting)						2	2	1	
Max. no. of digital outputs	8	13	18	29	27	8	13	5	13
SPST relay outputs	7	10	13	26	24	7	10	4	10
SPDT relay outputs	1	3	5	3	3	1	3	1	3
Max. no. of SSR output	2	4	6	6	6	2	4	2	
Alimentazione 48 Vdc	■	■	■	■	■	■	■	●	■

● standard - ■ opzionale

## User terminals

The pCO sistema currently features 3 series of interfaces: the pGD<sup>0-1</sup> series, the pGD<sup>2-3</sup> series and the pLD series.

The HW structure and modularity of these terminals ensure that the right model is always available, as regards performance, cost and appearance.

The graphic functions provided by the CAREL development tools means that the user interfaces are completely programmable and can be configured so as to best respond to the customer's applications requirements.

## pGD<sup>2</sup> - pGD<sup>3</sup>



pGD<sup>2</sup> and pGD<sup>3</sup> are two terminals with high-tech features, such as the 5.7" touchscreen display with ¼ VGA resolution and the 32-bit microprocessor that manages complex graphic images up to 320x240 pixels in size in up to 256 colours, animated icons, non-proportional fonts in Unicode format, as well as graphs of alarms, temperature values, humidity, pressure, air speed, etc.

The touchscreen function means that the user can easily move around even the most complex layouts, without losing the overall view of the system, and navigate the pages quickly and instinctively. A keypad on the side of the display is always available for applications where the touchscreen is not the preferred solution. pGD<sup>2</sup> and pGD<sup>3</sup> also offer more demanding manufacturers in the HVAC/R market various customisation and differentiation options.



## pAD

pAD (pCO Ambient Display) is the latest member of the pCO sistema family of displays. pAD is an icon-based LCD terminal for wall-mounting in the room. Available in two models (with temperature sensor or temperature and humidity sensors), pAD can be connected to the pLAN or FieldBus RS485 port, depending on the model.

The clock as standard for the management of time bands, and the appealing design make this display ideal for residential or commercial applications.

## pGD<sup>0</sup> - pGD<sup>1</sup>

pGD<sup>0-1</sup> are the basic models in the pCO sistema family of "terminals", designed with graphic LCDs so as to offer greater versatility and customisation options, while maintaining a high aesthetic standard.



When designing this backlit terminal, CAREL focused special attention on the simplicity of programming and the quality of performance: the structure of the pGD allows connection to other keypad modules, which are in turn easily customisable, thus enabling the most complete product differentiation, at affordable costs.

The pGD<sup>0-1</sup> terminals respectively feature 120x32 pixel and 132x64 pixel graphics management, allowing the display of different sized graphic images and the main international alphabets such as Greek, Chinese, Cyrillic and the Scandinavian languages.

pGD<sup>0</sup> is completely compatible with the software developed for the CAREL 4x20 user interfaces. In fact, this display can be connected directly to any pCO sistema series controller without requiring other software tools.

## pLD



For all those applications where the cost and compact dimensions represent important aspects of the application, CAREL offers the pLD terminal (programmable LED display) in the small and large sizes, with 3 and 4 digit display respectively. The use of this terminal does not however

preclude the possibility to connect a graphic terminal. Moreover, the ease of customisation of the pLD and the programmability using the EasyTools environment guarantees a competitive solution.

## BMS connectivity

CAREL, as well as offering its customers high quality and reliable products, has always paid special attention to the requirement of OEMs operating in the HVAC/R sector to interface the pCO sistema controllers with the more commonly-used BMS (Building Management Systems). Today in fact, with the expansion of BMS, the issue of communication between controllers made by different companies is increasingly important. CAREL has consequently developed compatibility with all the protocols that are emerging as the standards in HVAC/R and intelligent management systems, such as: Modbus®, LonWorks®, BACnet™, SNMP.

### pCO Web / pCO Net

This board for pCO sistema series controllers is used to interface the controllers with the emerging protocols (BACnet™ and SNMP) in the HVAC sector, and based on the Ethernet™ and EIA-485 standards.

Connection is therefore possible to the following networks:

- SNMP v1,v2,v3 networks;
- BACnet™ Ethernet, BACnet™ /IP networks, BACnet™ MS/TP networks;
- LAN or Internet.



### LonWorks®

With millions of devices installed all over the world, the LonWorks® system, developed by Echelon®, is one of the dominant solutions in the market of automation and control in industry, offices, homes and transport.

The pCO sistema series controllers are LonWorks® compatible using special serial boards.

The electrical standard supported is FTT10. CAREL is a LonMark® Partner.



### Modbus®

Introduced in the '70s, this has now become one of the most widely used protocols in BMS. The pCO sistema series controllers can communicate directly in the Modbus® protocol.

Type of protocol supported: Modbus® slave, RTU mode; communication standard RS485.



### RS232 board

Using an optional RS232 board, all models in the pCO range can be connected to a PSTN or GSM modem, thus allowing control from a remote station. In addition, the controllers can send and receive SMS messages (GSM modem only) to signal alarms or set the fundamental control parameters.

Alternatively, the optional board can be used to interface the pCO controller to a serial printer.



## FieldBus connectivity

From the viewpoint of communication between controllers made by different companies, CAREL also offers a wide variety of solutions for interfacing the pCO family controllers with field devices such as valves, VFDs, serial sensors, Belimo actuators etc. In this way, the pCO sistema series controllers not only manage the individual units, but the entire air-conditioning/refrigeration installation.

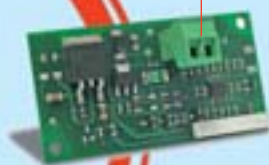


The RS485 serial option on the FieldBus serial interface can be used with the Modbus® Master or CAREL Master protocol. The former is used to interface the pCO controller with a complete series of field devices that communicate via a serial connection using the Modbus® RTU protocol. The CAREL Master protocol, on the other hand, ensures communication with all CAREL devices, such as the  $\mu$ C, ir33 line products, etc.



The CANbus option allows the pCO controllers to be connected to the CAREL fan coil management system (e-drofan), thus ensuring simpler management of the installation and optimising, through synergy between the controllers, comfort and running costs.

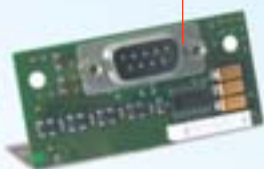
**connectivity**



The MP-BUS® protocol can be used to manage up to 8 Belimo servo controls via a simple two-wire connection cable.



The tLAN option is used to connect pCO controller to CAREL devices, such as I/O expansions (pCO®) or electronic valve drivers. In addition, this option can be used to connect pCO controller to the pLD display.



Models pCO<sup>3</sup> and pCO<sup>1</sup>, using the FieldBus serial interface, and the optional RS232 board, can be connected to a PSTN or GSM modem, thus allowing control from a remote position. In the same way as for the BMS version, in this case too the controller can then send and receive SMS messages or manage a serial printer.

## Programming tools

The EasyTools development environment is a tool for customising the control strategies in the pCO series controllers in a rapid and intuitive manner. The customisation possibilities range from simple modifications to the user interface of standard applications, to the complete development of custom control algorithms. The vast library of functions supplied by CAREL, from simple Boolean functions to very complex functions, allows the user to safely develop even particularly complex algorithms. In addition, the autonomy of the development environment guarantees the privacy of the software created.

CAREL also provides a vast range of standard software applications, designed to respond to the most common control requirements in the refrigeration and air-conditioning sectors.



**EasyTools**  
system

pCO manager is the software used to transfer files to and from the pCO sistema controllers. The tool features two different environments: “Winload” and “smart-key programmer”.

Using Winload, the files developed in EasyTools can be transferred to the pCO controller by connecting it directly to the PC. In addition, the configuration parameters can be loaded and transferred to another device, the data for logging can be set and modified, and the logged data can then be downloaded from the controller’s memory.

The smart-key programmer is used to program the operating mode of the new programming key, and can transfer files from a PC to the programming key and vice-versa.



# Options

pCO sistema, as well as offering a vast range of programmable controllers, displays and serial communication options, also features a series of accessories that help the user develop and configure the air-conditioning or refrigeration unit. These include:

## smartkey



The new smart-key programming key for the programming and service of the pCO sistema family

controllers. smart-key simplifies the transfer of data between the controllers installed and a personal computer, using the ample flash memory (16 MB) to store multiple application programs, Bios and variable logs. The key is compatible with all pCO controllers, with direct connection using the telephone connector. Featuring a microprocessor, the key offers different operating modes (these can be configured using the pCO manager tool) and guarantees a high level of protection by password both in uploading and downloading the software.



The pCO<sup>e</sup> expansion board has been designed to increase the number of I/O on the pCO family controllers. Available in two versions, tLAN and RS485, the latter model is also compatible with the Modbus<sup>®</sup> RTU protocol.



Electronic valve driver. The EVD4\* driver controls the refrigerant superheat by managing the majority of electronic expansion

valves with stepper motors offered on the market. Available in two versions, pLAN and tLAN, for connection to pCO family controllers.



Other optional modules include:

- CONVONOFF0 to convert an analogue control output to an ON/OFF relay output.
- PCO208DI00, pulse divider, allowing the pCO

controllers to manage very fast digital inputs, for example power consumption meters.

- PCOUMI2000, which controls the fundamental values of the CAREL OEM humidifiers (water level and conductivity, current sensor). This consequently eliminates the need for the humidifier controller, with significant cost savings. This interface can be used with all controllers in the pCO range.

## Application examples

### pLAN (pCO local area network)

All the controllers can be connected to pLAN local networks without requiring additional boards, thus allowing the exchange of data and information.

As a result, a control system with distributed intelligence can be developed simply and reliably for optimised management of the installation.

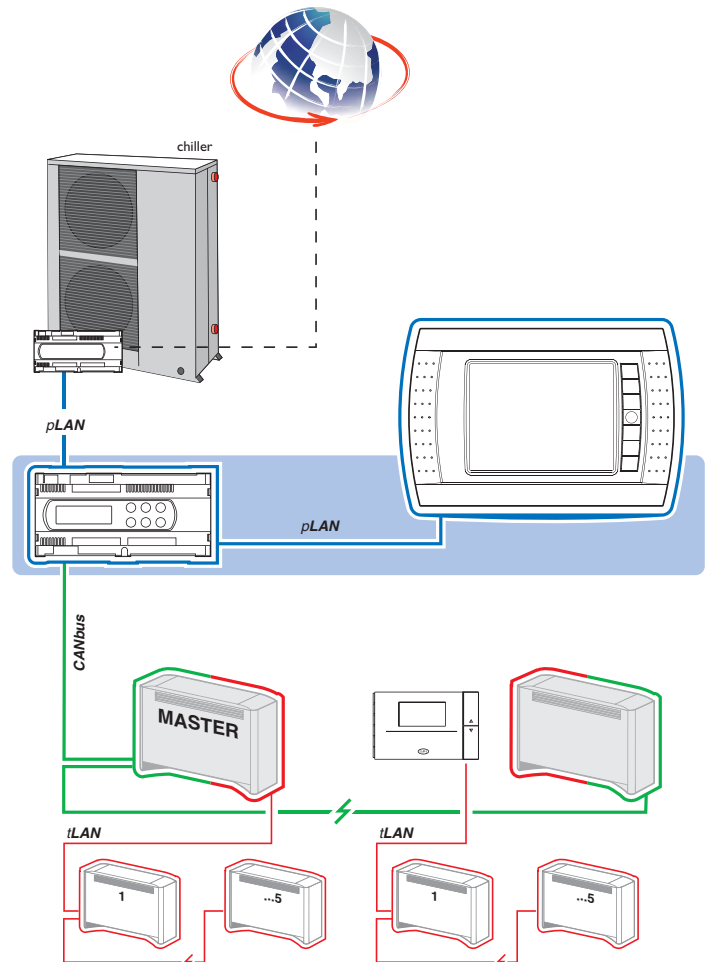
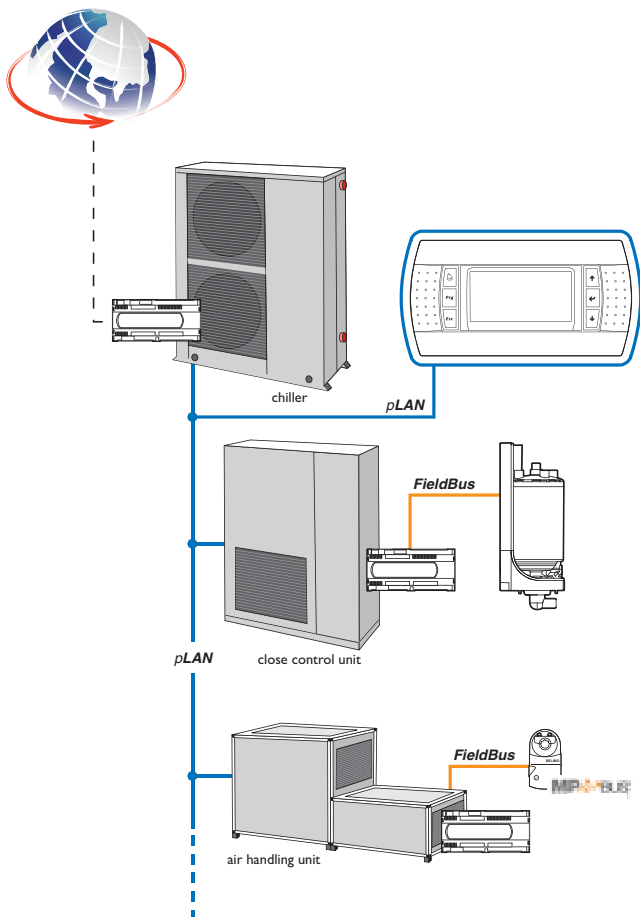
The pLAN network is used to manage the complete system using just one shared pGD terminal.

### Area controller

A first pCO controller manages the chiller/HP, while a second exclusively manages the fan coil (area controller).

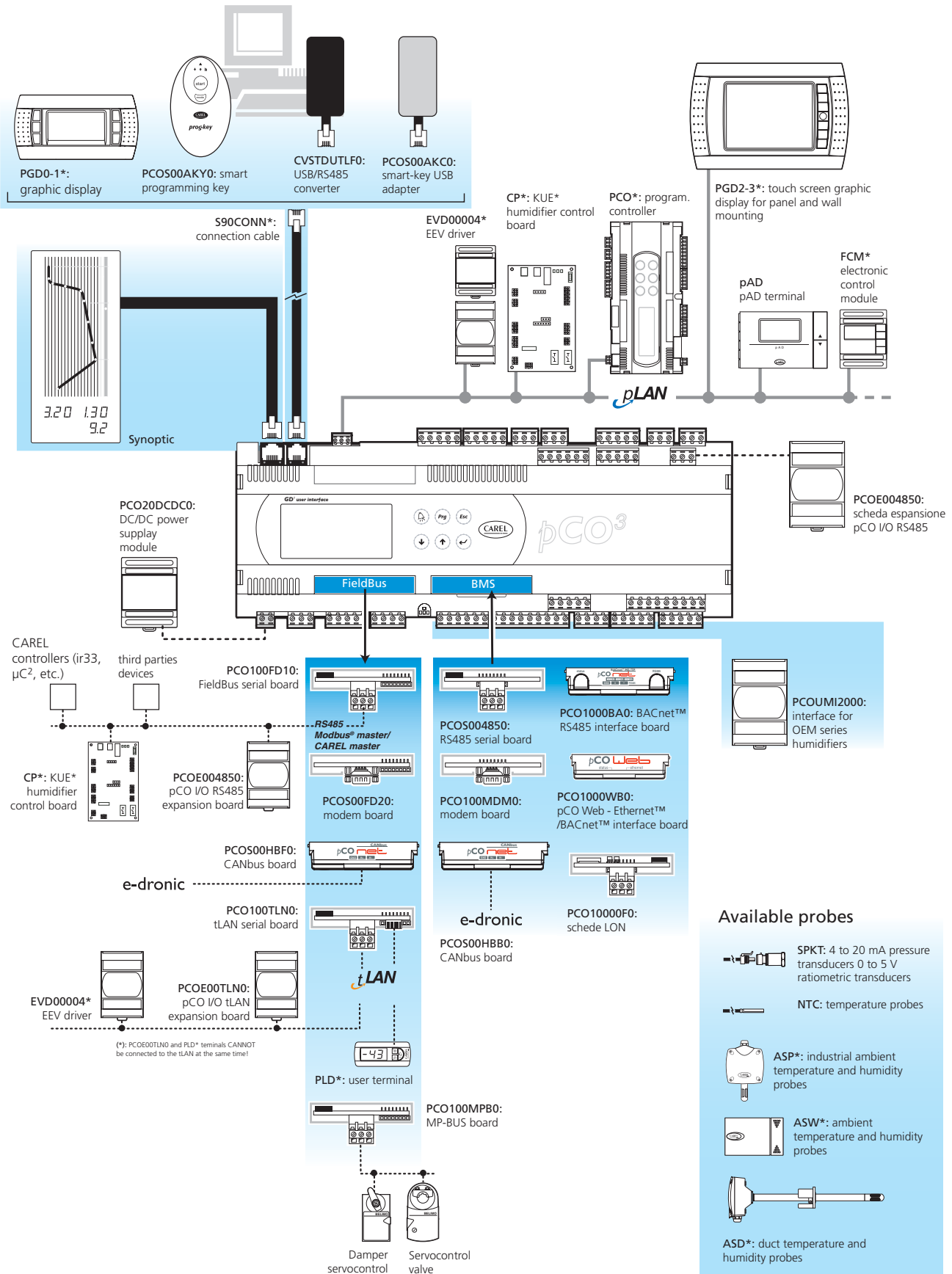
The two controllers exchange data via the pLAN, while the connection to the fan coil is made using the CANbus network.

The area controller can be connected to the pGD<sup>2</sup> or pGD<sup>3</sup> for an intuitive and elegant graphic interface.

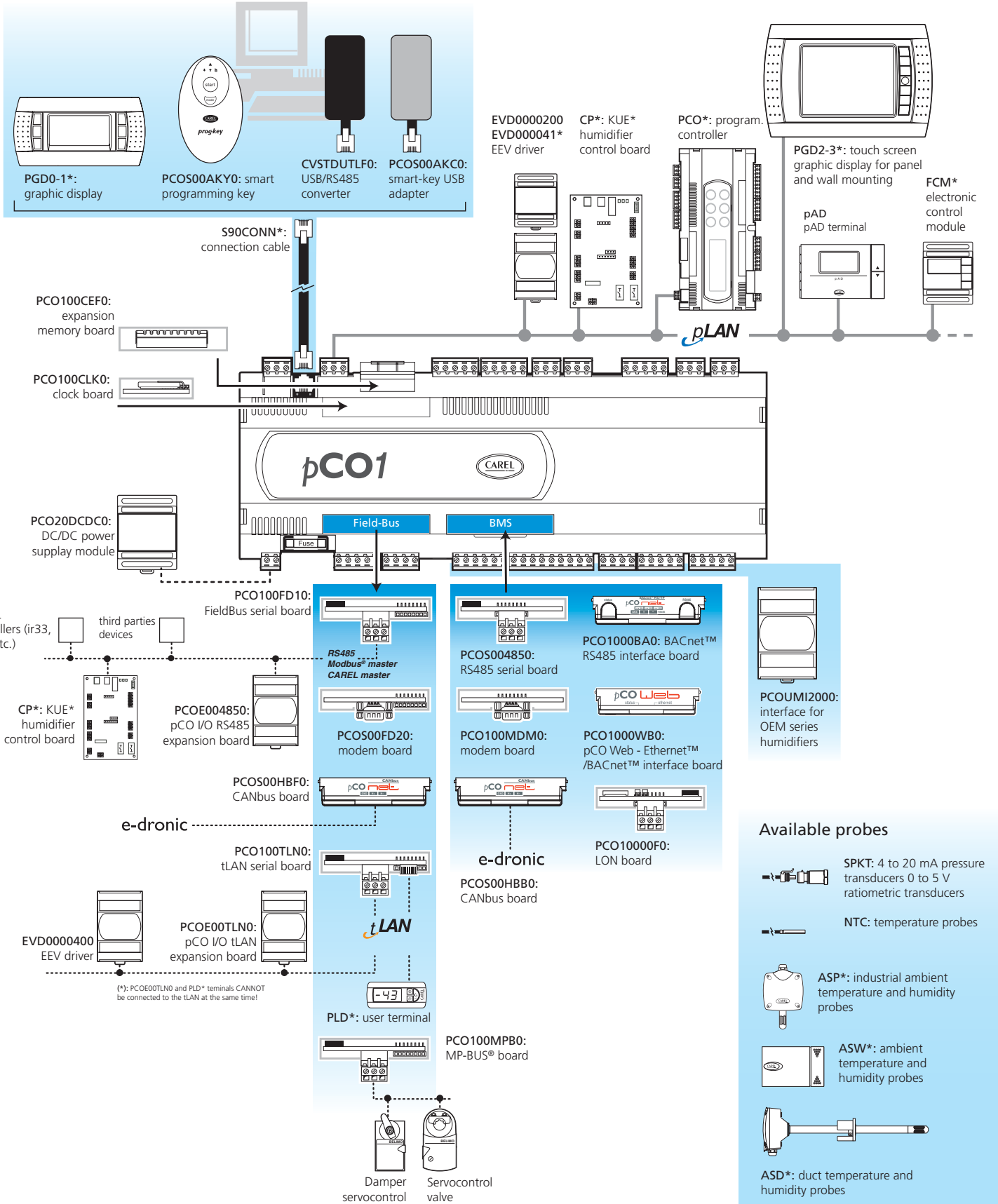




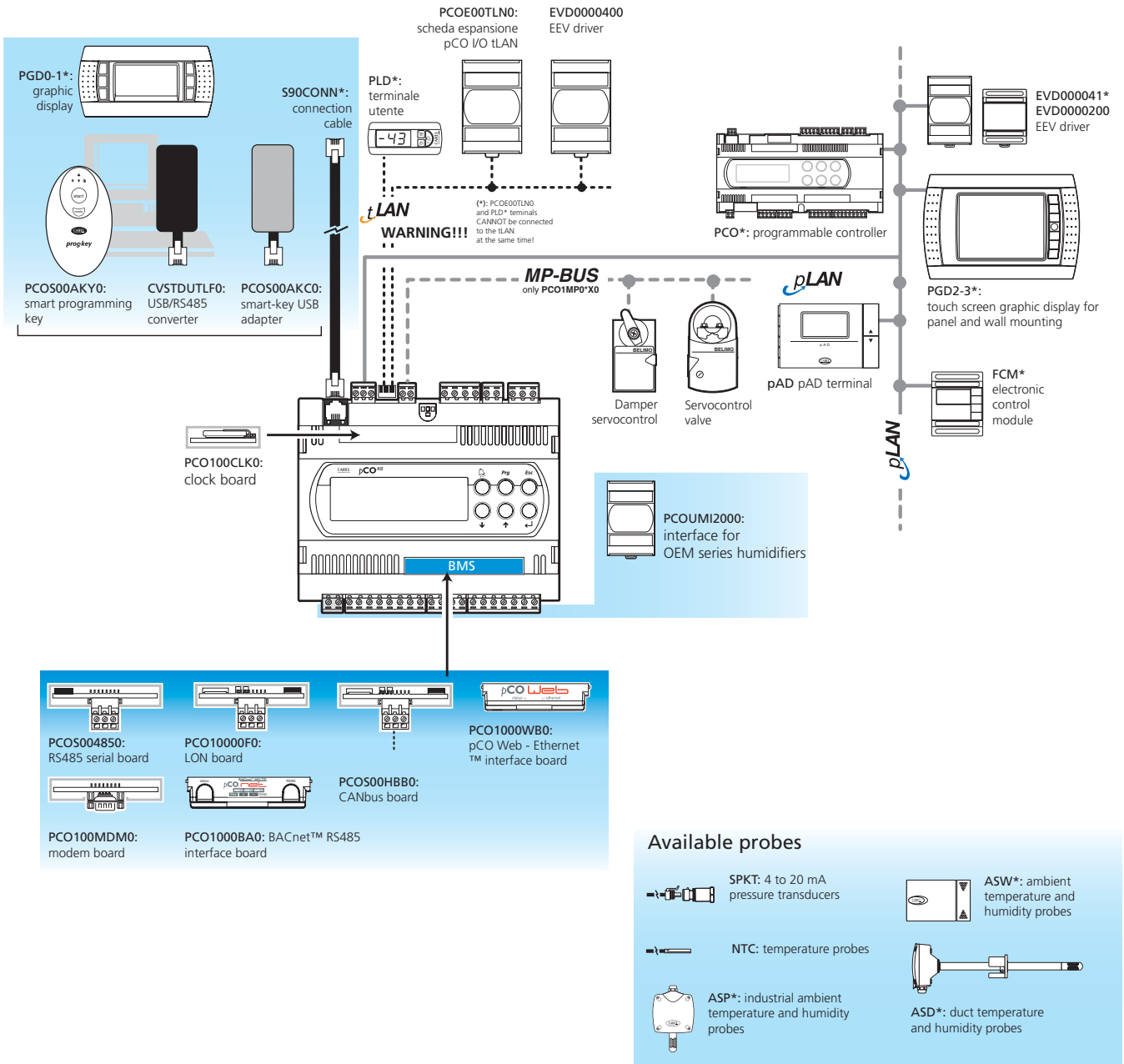
# pCO<sup>3</sup> overview drawing



# pCO<sup>1</sup> overview drawing



# pCO<sup>XS</sup> overview drawing



## Headquarters

### CAREL S.p.A.

Via dell'Industria, 11 - 35020 Brugine - Padova (Italy)  
Tel. (+39) 0499 716611 - Fax (+39) 0499 716600  
carel@carel.com - www.carel.com

## Subsidiaries

### CAREL Australia Pty Ltd

www.carel.com.au  
sales@carel.com.au

### CAREL China Ltd.

www.carelhk.com  
info@carelhk.com

### CAREL Deutschland GmbH

www.carel.de  
info@carel.de

### CAREL Export

www.carel.com  
carelexport@carel.com

### CAREL France Sas

www.carelfrence.fr  
carelfrence@carelfrence.fr

### CAREL Italia

www.carel.it  
carelitalia@carel.com

### CAREL Sud America Ltda.

www.carel.com.br  
carelsudamerica@carel.com.br

### CAREL U.K. Ltd.

www.careluk.co.uk  
careluk@careluk.co.uk

### CAREL USA L.L.C.

www.carelusa.com  
sales@carelusa.com

## Affiliated Companies:

### CAREL Korea Co. Ltd.

www.carel.co.kr  
info@carel.co.kr

### CAREL (Thailand) Co. Ltd.

www.carel.co.th  
info@carel.co.th