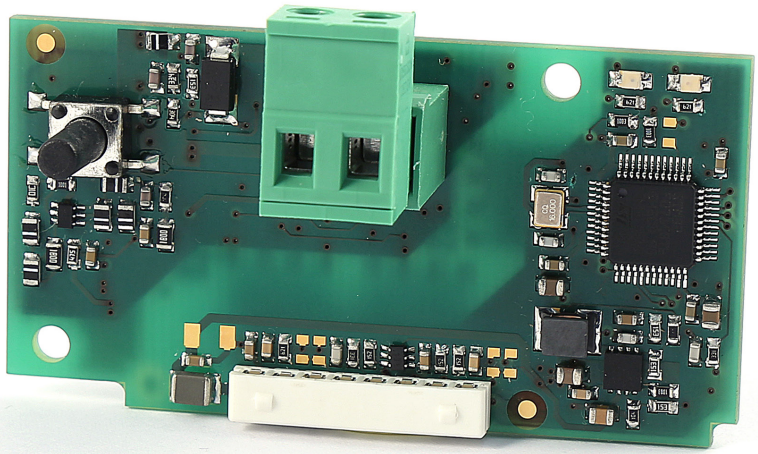
Scheda seriale KNX / KNX serial card

Lo standard tecnologico KNX rappresenta ormai una realtà diffusa nel settore dell'automazione e controllo di edifici ad uso terziario e residenziale.

The KNX technological standard is now widely used in building automation and control for commercial and residential applications

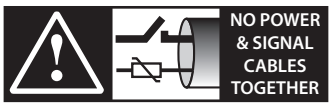


ITA Manuale d'uso

ENG User manual

LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS



READ CAREFULLY IN THE TEXT!

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 the configuration of the product in order to reach the expected results in relation to the specific final installation and/or equipment.
CAREL may, based on specific agreements, acts as a consultant for the positive commissioning of the final unit/application, however in no case does it accept liability for the correct operation of the final equipment/system.

The CAREL product is a state-of-the-art product, whose operation is specified in the technical documentation supplied with the product or can be downloaded, even prior to purchase, from the website www.carel.com.
Each CAREL product, in relation to its advanced level of technology, requires setup/configuration/programming/commissioning to be able to operate in the best possible way for the specific application. The failure to complete such operations, which are required/indicated in the user manual, may cause the final product to malfunction; 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 of the above suggestions likewise apply to the controllers, serial cards, programming keys or any other accessory 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



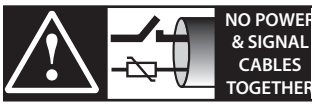
INFORMATION FOR USERS ON THE CORRECT HANDLING OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)

In reference to European Union directive 2002/96/EC issued on 27 January 2003 and related national legislation, please note that:

- WEEE cannot be disposed of as municipal waste and such waste must be collected and disposed of separately;
- the public or private waste collection systems defined by local legislation must be used. In addition, the equipment can be returned to the distributor at the end of its working life when buying new equipment;
- 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;
- the symbol (crossed-out wheeled bin) shown on the product or on the packaging and on the instruction sheet indicates that the equipment has been introduced onto the market after 13 August 2005 and that it must be disposed of separately;
- 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 S.P.A. products are guaranteed by the ISO 9001 certified design and production system.



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

1.1 KNX

The KNX technological standard is now widely used in building automation and control for commercial and residential applications.
The technological convergence of EIB with two other standards used on the European market, BatiBus and EHS, led to the establishment of the KNX protocol, in which EIB essentially represents the reference basis.

The protocol KNX is approved as:
- European standard: CENELEC EN 50090 and CEN EN 13321-1 and 13321-2.
- International standard: ISO/IEC 14543-3
- Chinese standard: GB/Z 20965

The KNX serial card is a KNX-certified product.
For information and technical support regarding this package, please contact us by email at konnex@carel.com.

1.2 Description

The KNX card is part of the range of optional cards for pCO, c.pCO and e-drofan controllers. The card, equipped with an ARM Cortex-M0 processor, acts as a gateway between a network operating according to the KNX/EIB protocol and the Modbus RTU protocol, supported directly by the firmware on pCO controller, the operating system on the c.pCO controller and the firmware on the e-drofan controller.
To configure and install the card, the following are required: ETS5 professional program, Device Configuration Apps tool (DCA) (downloadable from KNX) and the product database (available at ksa.carel.com or the online catalogue).

1.3 Part numbers

PCOS00KXN0 model for pCO BMS port, "Serial card" socket and e-drofan.

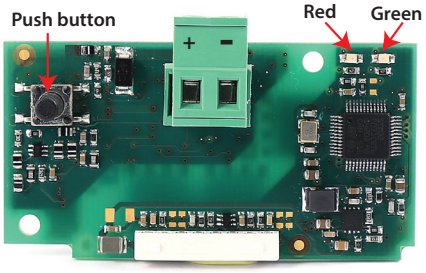


Fig. 1.a

2. INSTALLATION

2.1 pCO and c.pCO

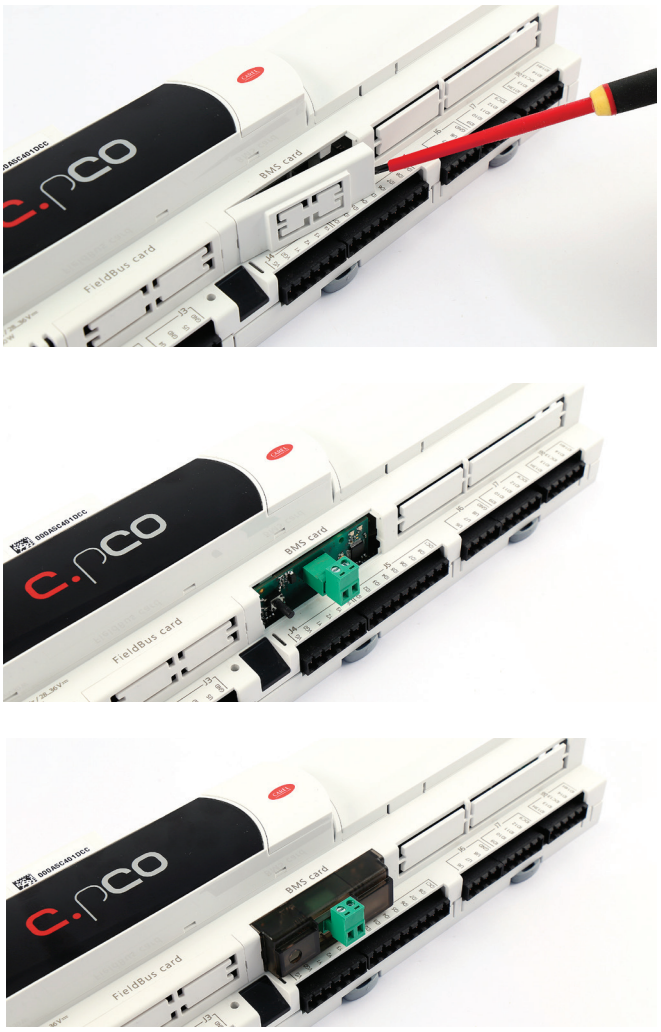


Fig. 2.a

With reference to Fig. 2.a, the card is installed on the controller when powered off, with following procedure:

1. Use a screwdriver to remove the "BMS card/serial card" cover, depending on the model of the pCO (see Fig. 2.a);
2. Insert the optional card in the corresponding slot, making sure that the card is fitted correctly and in contact with the two supports on the case of the pCO. Warning! The card and the connectors may be hard to install due to the space available and the two plastic supports; the card should be inserted obliquely, and then rotated until the connectors are aligned.
3. Fit the special cover (ordered separately, P/N PCOS00SKX0) lining up the connector on the serial card with the hole provided on the cover (see Fig. 2.a).

2.2 e-drofan

With reference to Fig 2.b-A/B, the optional card is installed on the e-drofan controller when powered off, inserting it correctly in the corresponding slot. (Fig. 2.b, points A, B). Fit and tighten the plastic support (to be ordered separately, P/N PCOS00S030) as shown in Figure 2.b, points C and D.

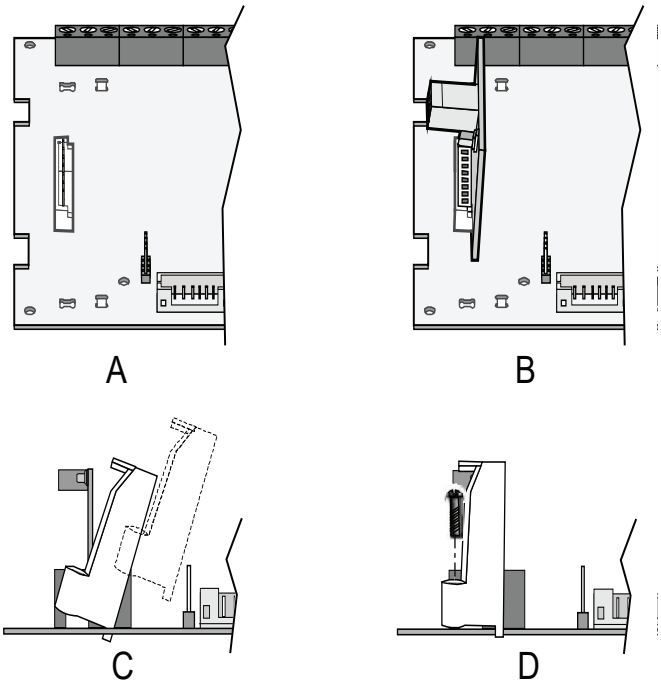


Fig. 2.b

3. COMMUNICATION SPECIFICATIONS

3.1 KNX communication

The mode supported by the Carel Konnex card is TP1 9.6 kbits/s System mode.

Operation of a KNX network requires a specific bus power supply that supplies the bus 29 volts DC. The network is configured using a personal computer (Windows OS) running the ETS5 program, and an interface between the USB/Ethernet port and the KNX bus.

3.1.1 KNX datapoint

In the KNX standard, information is transferred between devices via data structures called "datapoints"; the term "datapoint" can be considered a synonym of shared variable. The connection is created by assigning the "group address" to each datapoint, independently of the device address.
To "share" a set of variables between multiple devices, these must have the same group address and be the same type (bit, byte, word, etc.…). This mode is called System mode and in fact creates "free binding" between the variables on the various devices.
Multicast data transmission is used: the node that has a certain output datapoint (transmission flag activated) sends the network a packet that will be received at the same time by all the devices with an input datapoint of the same type, with the same group address as the sender.

Example of communication between datapoints:

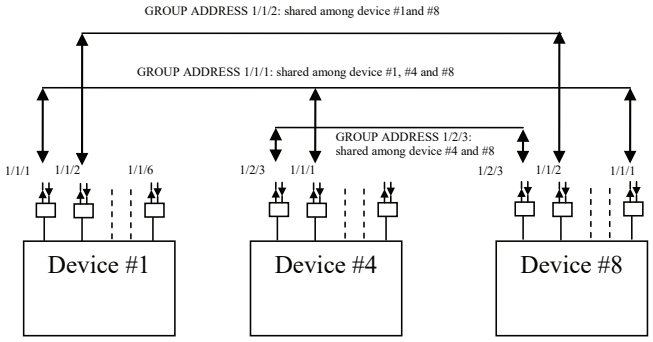


Fig. 3.a

3.1.2 Device addresses

In a KNX network, each device must have a unique address. The addresses are assigned to the devices over the network connection using the ETS software.
ETS5 is used to define, even before connecting to the bus, the layout of the entire system, adding all the devices that make it up. The ETS software automatically assigns an address to each device, however where necessary these can be changed manually. The values of the addresses are saved in a project file. During the first stage of installation, when connecting the personal computer to the bus, the actual device addresses need to be set. This operation is performed by activating the "download address" procedure for each device and then pressing the button on the controller being configured. In this way, each device is identified and configuration can continue.

3.2 Modbus communication

The card acts as a Modbus RTU master in relation to the pCO, using the following function codes:

- 01 Read coil status
- 02 Read discrete inputs
- 03 Read holding registers
- 04 Read input registers
- 05 Force single coil
- 06 Preset single register.

The controller address and baud rate can be configured using the ETS software. For the e-drofan controller the address must be set to 1 and the baud rate must be 9600 baud. For the other controllers, the address and baud rate must be set in line with the chosen configuration.

4. USING ETS5

The ETS5® program is the software solution for designing and setting up a KNX system. ETS5® is a software tool that is independent of individual manufacturers and is marketed by KNX International (www.knx.org). ETS5® can be used to design, commission and run diagnostics on KNX systems installed with KNX devices made by different manufacturers.
For information on how to the use ETS5, see the dedicated manual available at www.knx.org.

5. USING THE CAREL DCA

The Carel DCA (Device Configuration Apps) tool can be downloaded from www.knx.org. This is used to configure the Modbus-KNX gateway based on the user's specific requirements.
The DCA tool, downloaded from www.knx.org, can be installed from the ETS opening page, clicking Apps N active (where N represents the number of active apps) and then clicking the '+' button.
Correct installation of the DCA tool can be verified by checking that DcaCarel is displayed and selected, as shown in Fig. 5.a.

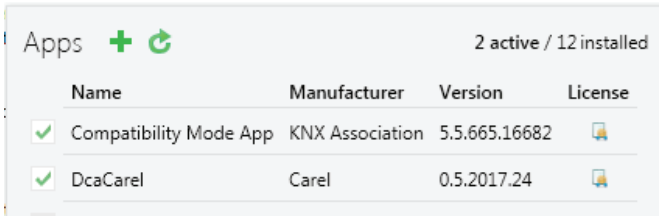


Fig. 5.a

Once the DCA tool has been correctly installed, the file in knxprod format must be used to add the new device to the project:

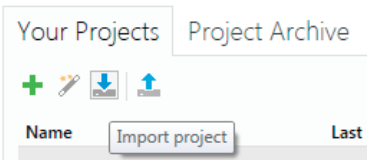


Fig. 5.b

Then, selecting the Devices panel and importing the device, a DCA tab is provided, used to continue the steps for defining the project by completing the fields in the "General Settings", "Datapoints Settings" and, optionally, "String Tables" tabs.

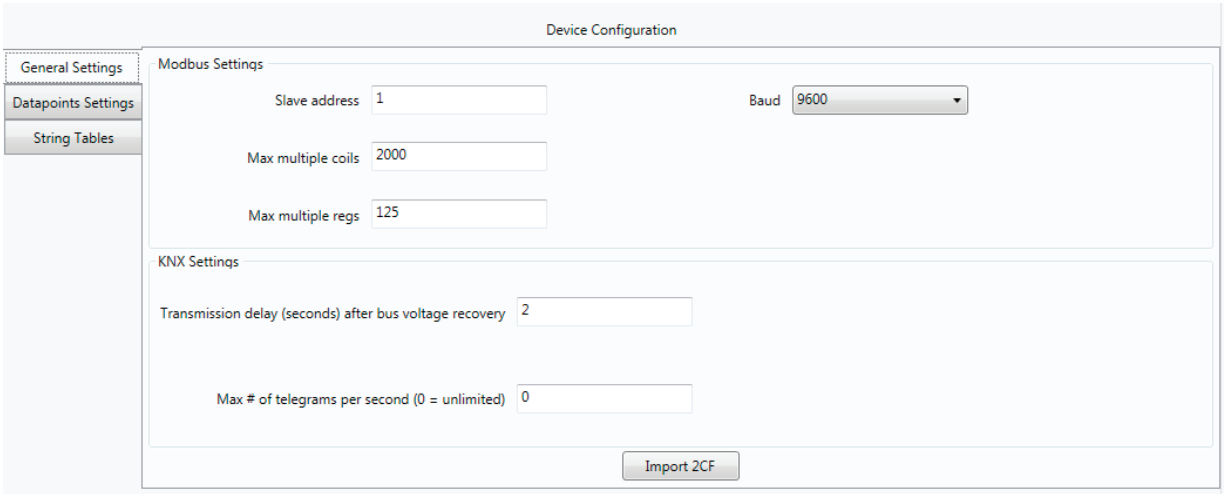


Fig. 5.c

5.1 "General Settings" menu

The "General Settings" menu is used to set the Modbus communication parameters between the card and the corresponding controller, i.e. the communication address (in the range 1-247, default 1) and baud rate (default 9600bps). The maximum number of consecutive coils read with an individual Read Coils (0x01) or Read Discrete Inputs (0x02) command, and the maximum number of consecutive registers read with an individual Read Holding Registers (0x03) or Read Input Registers (0x04) command can also be set. When these parameters are set to 1, multiple readings are disabled. For the e-drofan, the limit to these parameters is implicit in the controller's firmware and should be set manually: max multiple regs must be 1, max multiple coils can be ignored, given that e-drofan does not manage coils. The same menu can be used to set some KNX communication parameters:

- the time interval expected by the KNX card from the moment it detects a connection to the KNX bus until the moment it starts sending packets to the bus (default 2s)
- the maximum number of packets that the card can send per second (the default is 0, indicating no limits).

Once the communication parameters have been set, the 2cf file corresponding to the controller (or the application on the controller) needs to be imported. For the pCO family controllers, the 2cf file is self-compiled, for the c.pCO family controllers it can be exported from c.design, while for e-drofan it can be downloaded from ksa.carel.com.

When importing a 2cf file for a pCO family controller, the DCA requires the name of the parameter database that the application has been developed for:

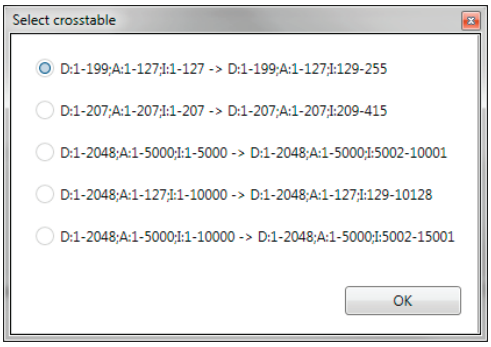


Fig. 5.d

The selected database is shown in the "General Settings" menu. For the other controllers this option does not need to be selected. The 2cf file and the selected reference database cannot be modified when configuring the project; indeed if importing a new 2cf, a pop-up message will prompt for confirmation before proceeding, warning that all configurations previously made to the project will be deleted.
The 2cf file is imported together with the 2ct file (if present in the same directory as the 2cf). This file contains descriptions of the variables translated into different languages. If there are multiple languages in the 2ct file, the same language as the DCA is selected; if this is not available, the English version is selected, and if this too is not available, the first available version is selected.

5.2 "Datapoints Settings" menu

The "Datapoints Settings" menu is used to associate the Modbus parameter in the 2cf file with the required KNX datapoints.
To add a datapoint, simply click "Add": a selection window will be displayed, containing all the Modbus parameters defined in the 2cf file (with the corresponding translations, if available, in the Description column). The filter function can be used to refine the search by variable name. Once the desired parameter has been identified and selected, click OK to add it to the Datapoints Settings menu.

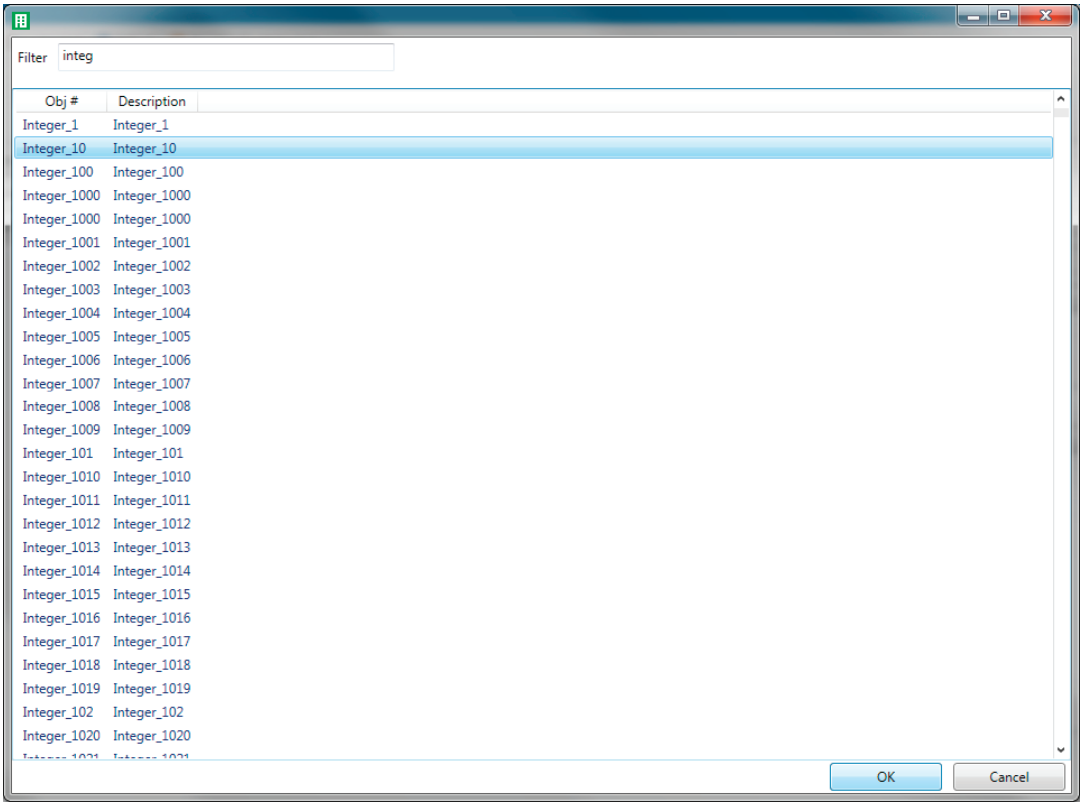


Fig. 5.e

The selected parameter can then be configured by suitably setting the fields in the "Modbus Datapoint", "Value Conversion" and "KNX Datapoint" sub-menus.

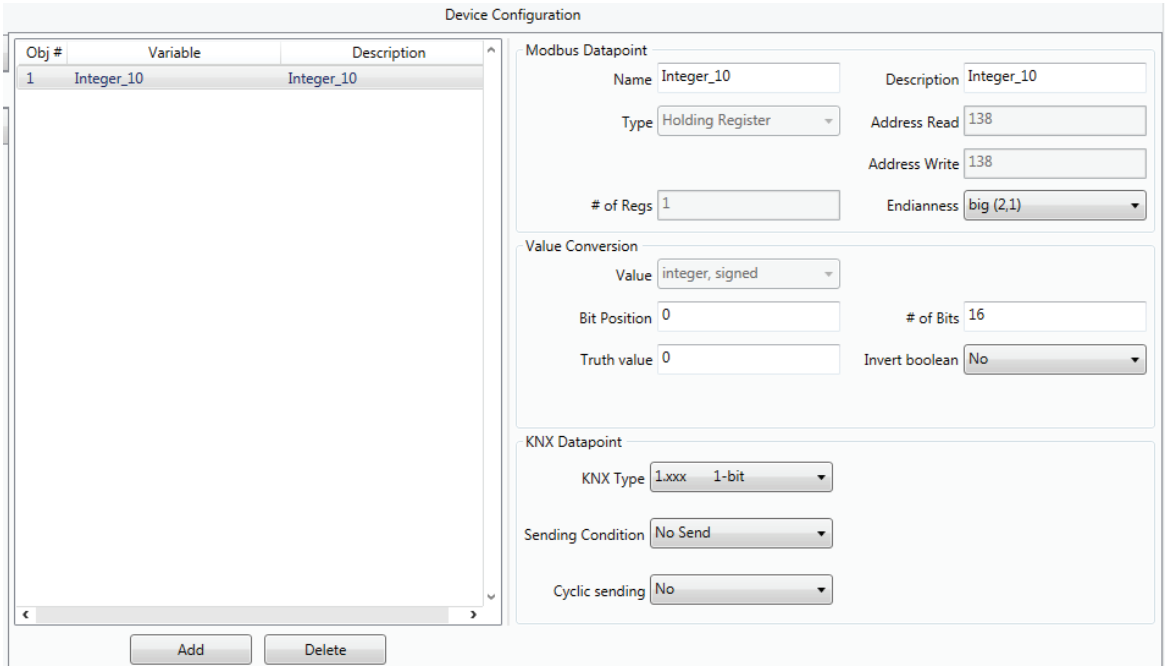


Fig. 5.f

5.2.1 Modbus Datapoint

For each variable that has been added, the "Modbus Datapoint" sub-menu shows certain data that cannot be modified: Modbus type (holding register, coil, input register, input), read/write address, and the number of consecutive registers making up the parameter. In the same sub-menu, the endianness field can be set so as to specify the order of bytes in the Modbus parameter. The options are big or little endianness for 16-bit data, there are four options (big, little, big swapped, little swapped) for 32-bit data, while no options can be selected for 1- or 8-bit data.
The default value for this field is big endian.

5.2.2 Value Conversion

The "Value Conversion" sub-menu shows the type (non-modifiable) of value represented by the Modbus parameter (Boolean, signed integer, unsigned integer, floating), while the remaining fields specify:

- Bit Position: position of the least significant bit in the Modbus register (values between 0 and number of bits in the register – 1)
- # of Bits: number of bits in the Modbus register

The # of Bits field shows the initial size of the Modbus parameter, this must be decreased if setting the Bit Position parameter to a value other than 0. The sum of the Bit Position parameter and the new # of Bits setting must coincide with the initial value.

The other fields in the "Value Conversion" sub-menu depend on the type of datapoint selected subsequently. If the selected KNX datapoint is type 1.xxx, the "Value Conversion" sub-menu shows the following fields:

- Truth value: when reading Modbus parameter X, the KNX datapoint Y will be: Y = (X == truth value). The default for the truth value is 1.
- Invert boolean: when set to No, no other changes are made to Y, otherwise when set to Yes, Y is inverted. The default is No.

In all other cases, the following fields can be set:

- A, B: allow linear conversion on the data. With the value of the Modbus register being X, the converted value Y = A * X + B. Vice-versa, if reading from KNX, the Modbus value is determined using the rule X = (Y - B) / A. The default values of A and B are 1 and 0 respectively (no transformation).
- Rounding: method for rounding off the result of linear conversion. The method adopted by default is the nearest whole number. Other methods available are: up, down, towards 0, away from 0.

5.2.3 KNX Datapoint

The "KNX Datapoint" sub-menu is used to associate the type of KNX datapoint, choosing from the available options in the KNX Type drop-down menu.
The transmission mode can also be selected, from one of the following three options:

- No send, the datapoint is not never sent independently over the KNX bus,
- On change, the datapoint is sent again over the KNX bus whenever it changes, irrespective of the extent of the change
- On difference, the datapoint is sent again over the KNX bus whenever it changes by absolute value more than a certain amount, selectable in the Sending Difference field (default 1).

Cyclical transmission mode can also be selected for a datapoint, specifying the period in seconds, in the Interval field (default 1s).

Special attention must be paid when needing to define a 16.xxx character string datapoint. In this case, the mapping table associated with the datapoint also needs to be specified (choice between 1 of the 8 available). The mapping table is defined in the "String Tables" menu.

5.3 "String Tables" menu

The "String Tables" menu is used to define the mapping tables for type 16.xxx KNX parameters (character strings). The fields in this menu therefore depend on whether there is a type 16.xxx datapoint: if there are no datapoints of this type, proceed with the next step. For each of the tables referred to in the "Datapoint Settings" menu, the number of items in the table needs to be specified, and for each item in the table the datapoint value needs to be mapped to the required string.

Once all of the datapoints have been configured, these are available in the ETS Devices menu; the datapoints can then be associated with the corresponding group addresses, following the standard procedure in ETS5. Subsequently, the individual address can be assigned to the card and the configuration for the corresponding device can be downloaded.

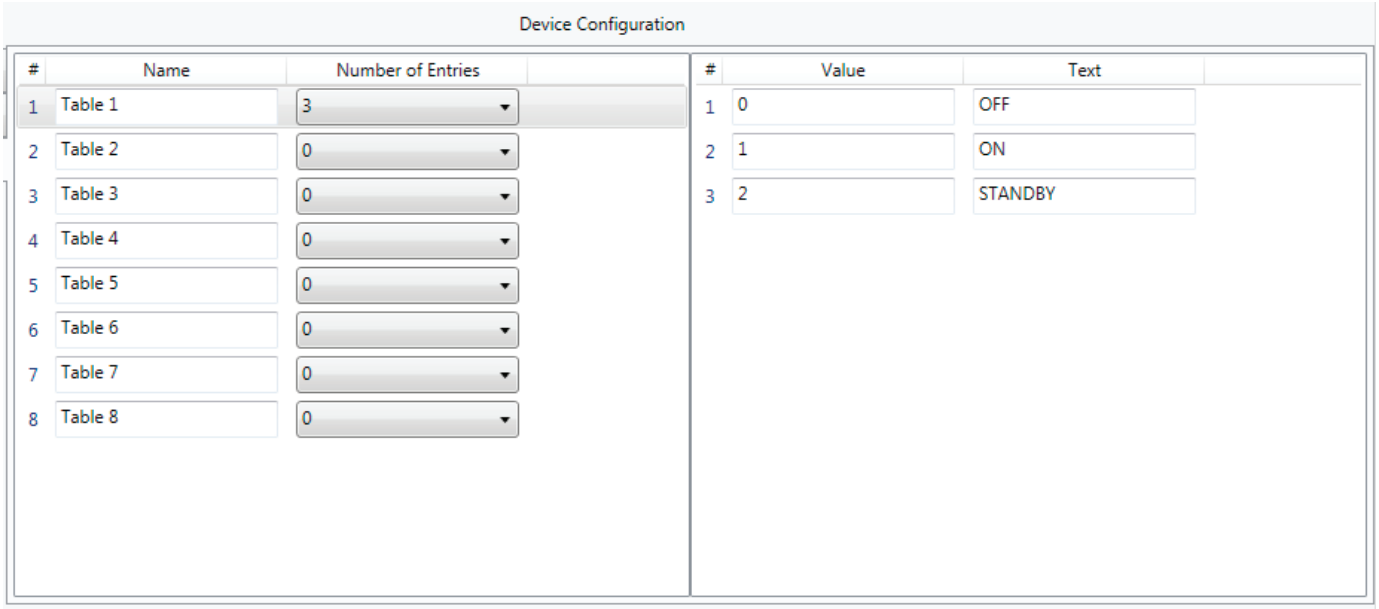


Fig. 5.g

5.4 Assigning an individual address

The addresses of the individual Carel KNX cards are assigned using the standard procedure.
Make sure that:

- there is a connection to the BUS
- the BUS is powered
- the Carel card is connected to the KNX line
- the controller is powered on.

Use the mouse to select the device being configured, clicking the right button to display the Download menu. Click the Download Individual Address button to start the configuration procedure (Fig. 5.h). ETS then requires the button on the card to be pressed before proceeding with the operation. The green LED on the card will switch off to confirm that the operation has been completed. If the card's address has already been configured, the message 'The individual address is already in use by another device' is shown.

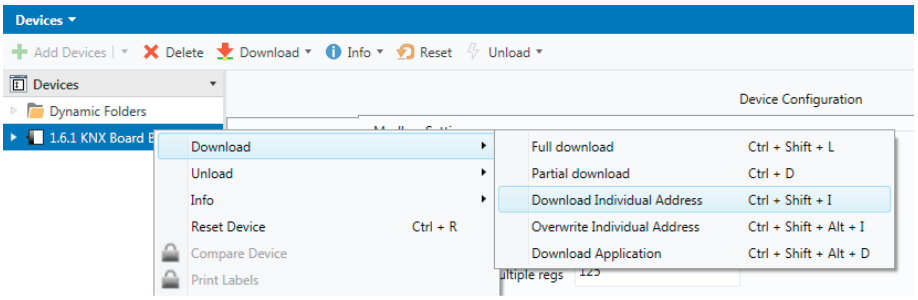


Fig. 5.h

5.5 Download the configuration

Make sure that:

- there is a connection to the BUS
- the BUS is powered
- the Carel card is connected to the KNX line
- the controller is powered on
- the individual address has been assigned

Use the mouse to select the device being configured, clicking the right button to display the Download menu. Click the Partial Download button to start downloading the configuration (Fig. 5.i).

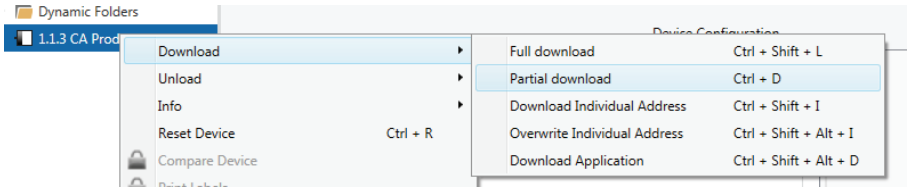


Fig. 5.i

6. CONTROLLER SETTINGS

The Carel KNX card, as already described, acts as gateway between the KNX bus and the Carel device. The Modbus protocol is used, and consequently the pCO/c.pCO or e-drofan controller must be configured to work as a slave using this protocol on the BMS port. The index of the variable to write in the table must therefore be consistent with the application loaded on the pCO controller or with supervisor list on the e-drofan controller. To do this, the .2cf file is used, which contains all the information relating to the Modbus parameter database.
The configuration procedure for the pCO, c.pCO family and e-drofan controllers is described below.

6.1 pCO application settings

In order to use the KNX card with the pCO, the application must allow the Modbus Slave protocol to be configured on the BMS serial port. The application must also allow at least all of the required KNX variables (datapoints) to be exported to the supervisor (Modbus).
The Modbus Slave protocol can be configured using the COM_PROTOCOL_BMS and BMS_EXTENSION system variables. Different combinations of these settings will create a parameter register of varying size, as shown in Table. 6.a.

	Offset	Crosstable
BMS_EXTENSION = 0 COM_PROTOCOL_BMS = 3	128	D:1-199;A:1-127;I:1-127 ->D:1-199;A:1-127;I:129-255
BMS_EXTENSION = 1 COM_PROTOCOL_BMS = 3	208	D:1-207;A:1-207;I:1-207 ->D:1-207;A:1-207;I:209-415
COM_PROTOCOL_BMS = 30	5001	D:1-2048;A:1-5000;I:1-5000 ->D:1-2048;A:1-5000;I:5002-10001
BMS_EXTENSION = 0 COM_PROTOCOL_BMS = 33	128	D:1-2048;A:1-127;I:1-10000 ->D:1-2048;A:1-127;I:129-10128
BMS_EXTENSION = 1 COM_PROTOCOL_BMS = 33	5001	D:1-2048;A:1-5000;I:1-10000 ->D:1-2048;A:1-5000;I:5002-15001

Tab. 6.a

In addition, the address of the Modbus variables is obtained from the index of the supervisor atoms entered in the pCO application, as follows:

Digital variables
Coil address = Atom index for digital variables

Analogue variables
Register address = Atom index for analogue variables

Integer variables
Register address = Atom index for integer variables + offset (see Table 6.a).

To complete the configuration, the BMS_ADDRESS variable also needs to be set with the BMS serial address (in the range 1-247), as well as the serial line baud rate, using the COM_BAUDRATE_BMS system variable, according to the following map:

COM_BAUDRATE_BMS	0	1	2	3	4
Baud rate [bps]	1200	2400	4800	9600	19200

The .2cf file for the pCO family controllers is generated when compiling the application in 1tool, and is automatically saved to the directory containing the application binary files.

6.2 c.pCO application settings

The Modbus Slave protocol configuration for the c.pCO family controllers is managed directly using the c.design tool. In this case, the register addresses do not require an offset and are exactly the same as specified in the Protocol Editor.
The BMS address and baud rate can also be configured directly in c.design.

The 2cf file can be exported in the line configuration window, as shown in Fig. 6.a.

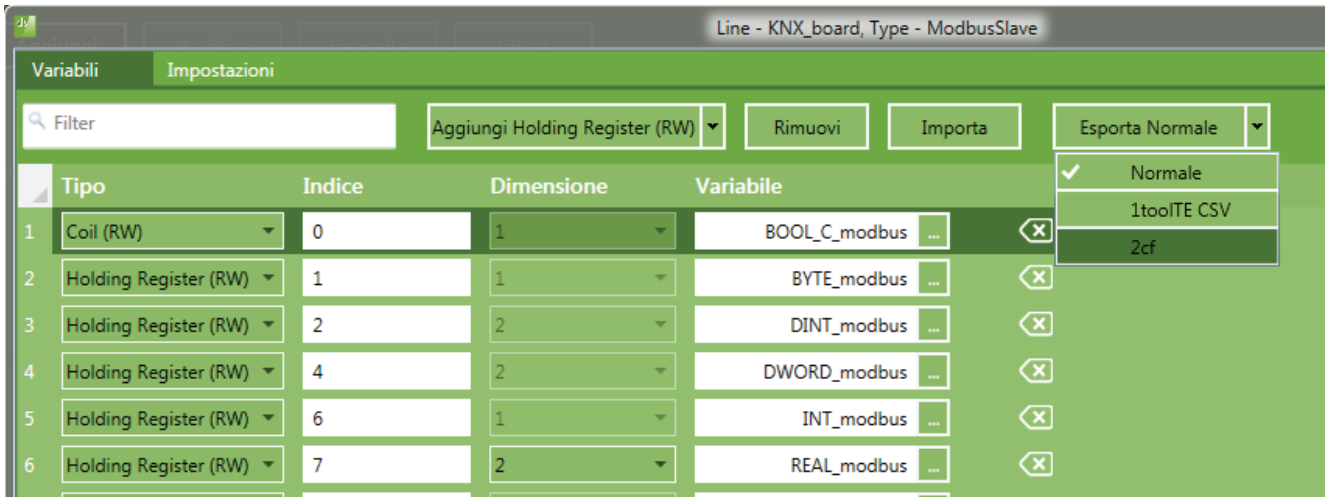


Fig. 6.a

6.1 e-drofan controller settings

For the Modbus addresses, see the parameter table shown in the e-drofan manual.

For correct communication with the KNX card, the e-drofan controller must be set as follows:

Baud rate	fixed 9600 Baud
Address	P69=1
Modbus protocol	P54=1

Tab. 6.b

7. ALARMS AND SIGNALS

LED		Meaning	Error/solution
Red	On steady	No Modbus communication between KNX card and pCO	Configuration: • Incorrect pCO or e-drofan address • Incorrect pCO baud rate • Incorrect pCO or e-drofan protocol
	Flashing	Modbus communication error between KNX card and pCO / e-drofan	Modbus exception: • the card has been configured with a wrong Modbus or addresses not supported
Green	On steady	The button has been pressed for assignment of the address and the card is awaiting the corresponding procedure from ETS	
	Flashing fast	• The configuration has not been loaded • One short fast flash indicates reception of the address after pressing the button	Download the configuration from ETS
	Flashing slowly	Configuration in progress: ETS is downloading the configuration	
Green + Red	Both on steady	No power supply to KNX Bus	Check: KNX bus power supply, electrical connections and polarity of the connections to terminals + and - on the connector.
	Flashing alternately	Card FW being updated	

Tab. 7.a

8. TECHNICAL SPECIFICATIONS

8.1 Technical specifications

Power supply	12 - 33 V from control board
Power input:	max 200 mW
BUS power supply	21-32V, current draw: 5 mA
BUS	TP1 9600 baud
Maximum number of datapoints	250
Screw terminals	Wire cross-section min. 0.2 mm max. 1.5 mm2 - 30 – 12 AWG
Insulation	TP bus optically isolated from the controller's ground
Ingress protection	IP00
Operating conditions	-20T60 °C, humidity <85% RH non-condensing
Storage conditions	-20T80 °C, humidity <85% RH non-condensing
Pollution degree	2
Cat. of resistance to heat and fire	Same as the pCO
PTI of insulating material	PTI ≥ 175
Software class and structure	A
Period of stress across the insulating parts	Long
Protection against electric shock	the device guarantees insulation between SELV and the power supply to the controller

Tab. 8.a

To guarantee the correct operation of the card, avoid fitting pCO3 devices with built-in displays in electrical panels with metal front panels.

Maximum distance

Each line can reach 1,000 m, including all the branches; multiple lines can be connected together using a "Line coupler". Two KNX/EIB devices connected to the same line can be installed a maximum distance of 700 m apart, while each device must not be more than 350 m from the line power supply.

A maximum of 64 devices can be connected to each segment in the line, multiple segments can be connected together using couplers to reach the maximum of 255 devices in each line. Each line can have a maximum of 3 couplers.

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