



Modbus

Manuale d'uso

User manual

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**READ AND SAVE
THESE INSTRUCTIONS**

CAREL
Technology & Evolution

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Introduction

Carel pCO² peripherals can now be directly interfaced to systems that communicate using the standard Modbus protocol, a protocol that is very widely used by almost all BMS manufacturers.

1. General description of the Modbus protocol

The Modicon Modbus Protocol used in the Carel pCO² (BIOS version 2.15 or higher) follows the details described in the document:

**Modicon Modbus Protocol
Reference Guide
March 1992, PI-MBUS-300 Rev. D**

The Modbus protocol used is RTU type, with synchronicity based on the time between the characters.

The configuration is multipoint for RS485, or point-point for RS232.

The pCO² can be identified by the Modbus supervisor by assigning a unique address in the Modbus network, which can be set using the system variable IDENT. This is also the address sent in the Modbus package.

The meaning of the pCO² variables and whether they can be read or modified depends on the application software used by the pCO² itself.

1.1 Method of transmission

The pCO² and the Modbus supervisor can communicate across a serial network using the RS232 or RS485 standard.

1.1.1 RS232 communication standard

For communication using the RS232 standard, the pCO² must be connected to the supervisor using the RS232 expansion board, Carel code **PCO200MDM0**. The maximum baud rate is 19200.

For the technical specifications and the meanings of the connections, as well as the installation of the expansion board, please refer to the instructions on the sheet enclosed inside the packaging of the board itself.

1.1.2 RS485 communication standard

For communication using the RS485 standard, the pCO² must be connected to the supervisor using the RS485 expansion board, Carel code **PCO2004850**.

The PCO2004850 board guarantees the optical isolation of the controller from the RS485 serial network. The maximum baud rate is 19200.

For the technical specifications and the meanings of the connections, as well as the installation of the expansion board, please refer to the instructions on the sheet enclosed inside the packaging of the board itself.

1.1.3 Communication parameters

The protocol used in the pCO² allows it to be connected to a Modbus supervisor in RTU mode (Remote Terminal Unit), with 8 bit encoding and error handling using a 16 bit CRC.

The transfer of the packages between the peripheral and supervisor (frame communication) follows the RTU mode (frame interval \geq approx. 3.5 T, T being the communication time for one datum).

The data communication is asynchronous serial, 8 data bits, 2 stop bits and no parity (in total 11 bits/datum), across a RS485 or RS232 serial line.

The communication speed can vary from 1200 baud up to the default value, set at 19200 baud, using the system variable INIT_BAUD_SPV as per the following table.

INIT_BAUD_SPV	BAUD-RATE
0	1200
1	2400
2	4800
3	9600
4	19200

Table. 1.1.3.1

1.2 Representation of the data

The pCO² Modbus works by registers, where a register is considered as 16 bits.

Each digital datum is encoded using a single bit ('0' for OFF and '1' for ON). All the digital variables are assigned to consecutive register bits, each having the lower address variable assigned to the lower bit and the higher address to the higher bit.

An analogue value with one fixed decimal point is multiplied by 10 and represented by a 16 bit register in binary notation with two's complement, with the higher value part on the higher address byte and the lower on the lower address byte.

Example: the value 10.0 is represented as 0064H.

WARNING: the Carel analogue and integer variables are managed by the Modbus protocol as WORD variables (registers).

1.3 Description of the commands used

The following commands are used in the pCO²:

Function Code	Command	Action	NOTES
01	Read Output Status	Read digital variables	acquires the current status of a group of digital variables
02	Read Input Status	Read digital variables	acquires the current status of a group of digital variables
03	Read Output Registers	Read analogue or/and integer variables	acquires the current value of one or more analogue variables
04	Read Input Registers	Read analogue or/and integer variables	acquires the current value of one or more analogue variables
05	Force Single Coil	Write digital variable	forces the individual digital variable to the ON or OFF value
06	Force Single Registers	Write analogue or integer variable	forces an analogue variable to a specific value
15	Force Multiple Coils	Multiple write of digital variables	forces a consecutive series of digital variables to defined ON or OFF states
16	Preset Multiple Registers	Multiple write of analogue or/and integer variables	forces a consecutive series of analogue variables to specific values

Table. 1.3.1

Note that there is no distinction between input variables (read only) and output variables (read/write). In this way the knowledge and management of the database is entrusted to the supervisor. Also note that given the general structure of the system, the pCO² responds to more than one Modbus command in the same way.

The possibility of a **Timeout** occurring in the response of the pCO² to the master must be handled appropriately.

When writing the variables (functions 5, 6, 15, 16), the supervisor must check, using the successive read (functions 1, 2, 3, 4), that the value set by the peripherals is the same as that in the command. The application software must therefore allow the values of the variables in question to be sent in order to be able to check the effective write of such variables (Atoms R*IN/R*OUT).

1.4 Maximum database

The maximum number of variables transmittable from a Carel pCO² to a Modbus supervisor is:

Variable type	Maximum number
digital	200
analogic	128
integer	128

Tab. 1.4.1

Concerning the Modbus they are:

Variable type	Maximum number
digital	200
WORD register	256

Tab. 1.4.2

WARNINGS.

The analog and integer variables are managed by the Modbus protocol in the same manner as WORD register. The analog, integer and digital variables with address 0 are not handled by Carel peripherals.

1.5 Construction of a Modbus database from a Carel database

The construction of a database that can be used by a Modbus supervisor which handles a Carel pCO² peripheral is performed as follows.

- the Carel digital variables are transferred with their addresses to the Modbus database, and are read, as seen previously, using commands 1 or 2.
- the Carel analogue variables are transferred with their addresses to the Modbus database, and are read, as seen previously, using commands 3 or 4.
- the Carel integer variables are encoded with the analogue variables and are then transferred, with their addresses summed to the offset 128 (dec.), to the Modbus database, and are also read, as seen previously, using commands 3 or 4.

Type of Carel variable	Carel Address	Type of Modbus variable	Modbus Address
Digital	1	Coil	1
Digital	2	Coil	2
Digital
Digital	198	Coil	198
Digital	199	Coil	199
Analogue	1	Register	1
Analogue	2	Register	2
Analogue
Analogue	126	Register	126
Analogue	127	Register	127
Integer	1	Register	129
Integer	2	Register	130
Integer
Integer	126	Register	254
Integer	127	Register	255

Table.1.5.1

WARNINGS.

Modbus Address refers to the address received in the frame sent by the master.

The meaning, index and network availability of the variables depends on the application program installed on the pCO².

1.6 Error codes

The error messages returned by the pCO² conform to the Modbus specifications, which envisage the resending of the function code with the higher value bit set to 1 and with the following byte indicating the type of error.

The following commands are used in the pCO² program:

ERROR CODE	DESCRIPTION
01	Illegal Function
02	Illegal Data Address
03	Illegal Data Value

Table. 1.6.1

The pCO² sends the message **ILLEGAL FUNCTION**:

- if the master attempts to perform commands with codes other than those envisaged;
- if the master attempts to perform a multiple reading of registers (analogue or integer variables) greater than 127 in number;

The pCO² sends the message **ILLEGAL DATA ADDRESS**:

- if the master attempts to read a coil (digital variable) with a Carel address greater than 255;
- if the master attempts to perform a multiple write of registers (analogue or integer variables) greater than 127 in number;

The pCO² sends the message **ILLEGAL DATA VALUE**:

- if the master attempts to activate a coil (digital variable) with a value other than 0xFF00, or alternatively to deactivate it with a value other than 0.

The write of an individual register does not involve any possible error messages, whether this doesn't correspond to an analogue or integer variable present in the pCO².

The pCO² sends the register variables not present in the pCO², if requested by the supervisor, with the value 0.

If the frame sent by the master has a wrong CRC, no error message is sent by the pCO².

2. pCO² settings

1. The EasyTools development system, version June 2000 or higher is required.
The latest version is available in the Carel TopUser area of the Carel WEB site.
2. BIOS version 2.15 or higher.
The latest version is available in the Carel TopUser area, and is included in the EasyTools package.
3. If the communication standard to the Modbus network is RS232, then the RS232 serial board for pCO² is required (Carel code PCO200MDM0);
4. If the communication standard to the Modbus network is RS485, then the RS485 serial board for pCO² is required (Carel code PCO2004850).
5. In the application program must be available a menu mask from which the user can set the following system variables, as described in table:

System variable	Value	Meaning
<i>SERIAL1_PROTOCOL</i>	3	activates the Modbus protocol in the pCO ²
<i>IDENT</i>	<i>n</i>	sets the address 'n' for the pCO ² in the Modbus network
<i>INIT_BAUD_SPV</i>		sets the baudrate of the Modbus network:
	0	1200
	1	2400
	2	4800
	3	9600
	4	19200

Table. 2.1

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