Operating Manual

Intelligent Transmitter for Simatic S7-300 PLC

CARBO 1001

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About the contents

The operating manual CARBO 1001 documents structure, measuring technique, function, and installation of the device as well as error diagnostics.
The instructions address all users (owners) and operators of the CARBO. It must be accessible to these persons and must be read through carefully before using the device.

TABLE OF CONTENTS

1. INTRODUCTION

The CARBO 1001 device is designed for using as an intelligent transducer in industrial plants (hardening furnaces, heat treatment plants). Different type of sensors can be accepted. It includes complex mathematic calculation for finding value of C concentration, and/or others measurement results, depend on configuration. There is an actual value correction facility.

The Carbo 1001 module can be used with SIMATIC S7-300 type of CPU. Inside system with one CPU, up to three Carbo1001 modules can be attached. Carbo 1001 is based on CP340 RS232C communication module and additional measurement board included inside housing, which measures necessary signals (4 analog inputs, electrical isolation of all channels, 16 bits).

Based on current configuration (see 2.6) there are few different transducer functions of Carbo 1001:

- C-level computer on an L-probe, an O_2-probe or a CO_2-analyser.
- Transducer L-probe voltage $\rightarrow$ O_2-probe voltage.
- Computer for the quotients CO content and CO_2 content (CO/CO2 level) from L-probe voltage or O_2 probe voltage or CO_2 analyser and the process temperature.
- Percentage of O_2 concentration is calculated as float point measurement result (in big dynamic range of result, from 10^{-28}% to 0.21% of O_2),
- Dew Point calculation.

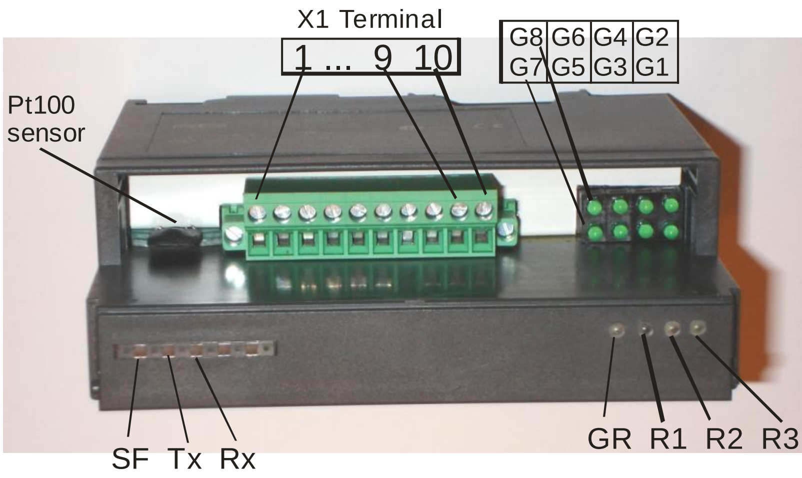
The determination of the C level from the residual oxygen and carbon monoxide content of a furnace atmosphere and the process temperature in connection with a conventional controller enable a low-cost system for controlling carbon atmospheres in heat treatment plants.

Another function of the device is the conversion of the L-probe voltage into the equivalent probe voltage of a conventional zirconium dioxide probe (O_2 probe) whereby the much more robust and lower cost L probe can be adapted to existing control systems.

Device calculate and present all possible output results according to current inputs and configuration: temperature inside furnace, mV of O_2 probe, contest of CO_2, C level, CO/CO_2 ratio, Dew point in [^{O}C], and concentration of O_2 as float point result.

Automatic two point correction mechanism is provided for next outputs: L-probe voltage to O_2-probe voltage, C level, Dew Point and O2%.

2. INPUTS AND FUNCTIONS



2.1 Pin assignments of X1 terminal

1. Thermoelement+
2. Thermoelement-
3. CO anly+
4. CO anly -
5. O2/CO2 probe+
6. O2/CO2 probe-
7. Readiness Signal of Carbo1001 result, max 20mA, NPN-, emitter
8. Readiness Signal of Carbo1001 result, max 20mA, NPN+, collector
9. Supply +24V
10. Supply 0V

2.2 Inputs and Ranges

There are three analog input signals:

1. Probe input (X1.5 and X1.6), with three possible sources:

- L probe, range -20mV...1300mV
- O_2 probe, range 0mV...1300mV
- CO_2 analyzer, range 0mV...1300mV

2. CO analyzer input (X1.3 and X1.4), with range 0mV...1000mV, accept content of CO.

3. Thermoelement (X1.1 and X1.2), type S (PtRh-Pt) or K (NiCr-Ni), with range 0mV...13mV or 0mV...50mV, with cold junction compensation by Pt100 sensor in device.

4. Readiness output of Carbo1001 result (X1.7 and X1.8), NPN transistor max 20mA. Switch-on when all inputs are in proper range, and result is ready.

2.3 Scope of functions

1) C-level computer:

When used as a C-level computer, the C-level is calculated in furnace atmospheres from the voltage signal of an L-probe or O_2-probe or a CO_2-analyser as well as the process temperature.

The CO-content of the furnace atmosphere can be permanently set as a parameter value. It can also be fed optionally into the CARBO as an analog signal of a CO-analyser.

The result signal can be influenced by two correction values. Since the CARBO has been calibrated in the laboratory under ideal conditions, but the specific on-site conditions usually deviate from these as a rule, an arithmetic correction of the measured values must be made to adapt them to the respective conditions, and to avoid false results. These correction data are determined typically from foil tests performed by Carbo 1001.

Analog input signals:

- **Probe input:** One of all possible sources
  - L-probe
  - O_2-probe
  - CO_2-analyser
- **Thermoelement input:** Thermoelement Type S or K.
- **CO analyzer input:** CO-content, optional.

2) O_2 concentration:

Concentration of O_2 as float point result is calculated based on probe voltage input. If O_2 probe is used, then process temperature is required. Output result is real (float point) number due to big dynamic range: from 10^{-28}% to 0.21% of O_2). This float point result can be also influenced for arithmetic adaptation of the measured values to the specific conditions of the respective plant with two correction values, which are entered via included PLC program.

Analog input signals:

- **Probe input:** One of possible sources
  - L-probe
  - O_2-probe
- **Thermoelement input:** Thermoelement Type S or K.
-

3) Dew Point:

Dew Point in [^{O}C] is calculated based on inputs and concentration of H_2, which is entered as constant. The result signal can be influenced by two correction values.

Analog input signals:

- **Probe input:** One of possible sources
  - L-probe
  - O_2-probe
- **Thermoelement input:** Thermoelement Type S or K.

4) L-probe - O_2 probe computer:

When used as an L-probe-O_2-probe computer, the voltage signal of an L-probe is converted into an equivalent voltage signal of a conventional zirconium dioxide probe.

The result signal (O_2-probe voltage) can be influenced for arithmetic adaptation of the measured values to the specific conditions of the respective plant with two correction values, which are entered via included PLC program.

Analog input signals:

- **Probe input:** L-probe voltage.
- **Thermoelement input:** Thermoelement Type S or K.

All variants:

Digital outputs: (open collector output for 24 V=)

- Standby signal, becomes inactive under each of the following conditions:
  - device switched off or not ready for operation
  - signal overflow
  - serious internal error occurred

2.4 The Function of LED

There are three groups of LEDs on Carbo1001:

Square LEDs on front side of housing - display current status of communication between PLC and Carbo1001:

SF - red LED, light when there is error of CP340 communication module inside Step7.
Tx - green LED, light on message from PLC to Carbo1001
Rx - green LED, light on message from Carbo1001 to PLC
When there is no power supply for Carbo1001, then only Tx blinks. When Carbo1001 answer on message, then both Tx and Rx blinks rapidly.

Four Round LEDs on front side of housing - display current status of measurement:

GR - overall status:

flash slow GREEN when all is ok.
flash RED slow for error which is not critical

flash RED rapid for critical error

R1 - temperature measurement:

flash slow RED for Pt100 sensor error (cold side thermoelement temperature), then default value of 30^0C is used.

light RED for thermoelement error

R2 - light RED for CO probe error. Then Fix value of CO is used.

R3 - light RED on O2 probe error.

Error status Remarks:

- If GR is only RED LED, then calculation error is present. Error causes are temperature <750^0C, or calculated C level greater then 1.8%.

- IF GR is flash RED slow, then error is not critical, so some measurement results are present.

- If GR flash rapid RED, then there is no valid measurement result.

Eight GREEN LEDs near to connector - present current setting of Carbo1001 (parameter CONFIG at address 1):

G8, G7 - CO Analyzer selector

0,0 - CO Analyzer 0..1V to 0..60% CO

0,1 - CO Analyzer 4-20mA (0.2..1V) to 0..60% CO

1,0 - CO Analyzer, 0..1V to user define range of % CO

1,1 - CO fix value, input is not used

G6 - Termoelement selection

0 - PtRh-Pt Thermoelement, S type

1 - NiCr-Ni Thermoelement, K type

G5, G4, G3 - Probe selection:

0,0,0 - L probe, -20mV to 1300mV

0,0,1 - O2 probe, -20 to 1300mV

0,1,0 - CO2 Analyzer 0.15mA..1.05mA (150mV-1050mV) to 0.03..3.000%,log scale.

0,1,1 - CO2 Analyzer 4-20mA (260mV-1300mV) to 0..0.5% lin.

1,0,0 - CO2 Analyzer 0-1300mV to 0..20% lin.

1,0,1 - CO2 Analyzer, 0-1000mV to user define range of % CO2

G2, G1 - main function of device,

0,0 - C level computer

0,1 – O2%

1,0 – Dew Point

1,1 - L probe to O2 probe computer

2.5 Table of measurement results

The measurement results and configuration parameters for each particular zone can be read and set via PLC program and functions calls, explained in chapter six. Here, the tables of that measurement results and configurations are exposed to explain functionality and correction techniques inside device.

All measurement results are integer type except status and errors, where lower byte can be interpreted bit by bit, as exposed. Depend on configuration, some measurement results have invalid values (0x8000 = -32768). At number 18 and 19 are status and error byte for Carbo device.

Version number of Module firmware is at address 22.

Address	Name		Comments
1	SOND_SPG_RM		Probe voltage [0.1mV]
2	LS_SPG		L-probes voltage [0.1mV]
3	O2_SPG		O2-probes voltage [0.1mV]
4	O2_SPG_cor		O2-probes voltage, corrects [0.1mV]
5	TMPK		Temperature [^{O}C]
6	TMP_V		Cold junction temperature [^{O}C]
7	CO		CO content [0.1%CO]
8	CO2		CO2 content [0.001%CO2]
9	C_PEG		C level [0.01%C]
10	C_PEG_cor		C level, corrects [0.01%C]
11	C0X_PEG		CO/CO2 level [0.1]
12	Dew_Point		Dew Point [0.01 ^{O}C]
13	Dew_Point_cor		Dew Point [0.01 ^{O}C]
14:15	O2f		O2 concentration as real number (use 4 bytes=2 INT)
16:17	O2f_cor		Corrected O2 concentration as real number
18	STATUS	bit pos 0	Thermocoupler Type K=True, S=false
18		1	-reserve-
18		2	-reserve-
18		3	CO value = CO fixed value
18		4	-reserve-
18		5	-reserve-
18		6	-reserve-
18		7	new Correction Data
19	ERRORS:	0	error inside device
19		1	error of ambient temperature sensor
19		2	error of Thermocoupler input channel
19		3	error or CO-Analyser input channel

19		4	error ...reserve...
19		5	error in calculation (range of output values)
19		6	error in Parameter internal memory
19		7	inadmissible configuration
20	FOILSTAT		Status of foiltest correction: 0-non, 1-run, 2-finish, 3-abort undoc,4-forgottn,8-nonstable,16-calcerr
21	Moduletype		For Carbo1001E should be equal to 2 if INP module exist
22	Version		Firmware version number x.xx

2.6 Table of Configuration Parameters

The CARBO is calibrated at the factory before delivery. However, the function of device, and the correction data, whose adjust transducer to real furnace parameters, should be set.

Configuration parameters are stored in Carbo1001 inside EEPROM, so retain setting after power-off. By function FC309 (see chapter 6.2), and input code 'W' one can permanently change the value of parameter. By the same function and code 'R', parameter can be read. Actual value in the table is example for C measurement configuration.

Address	Name	Actual value	Comments
1.	CONFIG	w#16#0	Main Configuration word
2.	K1	-80	L-probe offset K1 [0.1mV]
3.	K2	0	L-probe offset K2
4.	TempOfset	0	Temperature offset ['C]
5.	COfix	200	CO fix value [0.1%CO]
6.	COmin	10	minimum CO-analyser value [0.1%CO]
7.	H2fix	400	H2 fix value, used for Dew Point [0.1%H2]
8.	CO2min	0	CO2 min value for user range of CO2 analyser in [0.001%]
9.	CO2max	20000	CO2 max value for user range of CO2 analyser in [0.001%]
10.	COmin	0	CO min value for user range of CO analyser in [0.1%]
11.	COmax	600	CO max value for user range of CO analyser in [0.1%]
12.	CorA_O2spg_TMP	-32768	Temperature for O2 correction, first point
13.	CorA_O2spg	-32768	Calculated O2, first point
14.	CorA_O2spg_cor	-32768	Corrected O2, first point
15.	CorB_O2spg_TMP	-32768	Temperature for O2 correction, second point
16.	CorB_O2spg	-32768	Calculated O2, second point
17.	CorB_O2spg_cor	-32768	Corrected O2, second point
18.	CorA_C_TMP	-32768	Temperature for C correction, first point
19.	CorA_C	-32768	Calculated C, first point
20.	CorA_C_cor	-32768	Corrected C, first point

21.	CorB_C_TMP	-32768	Temperature for C correction, second point
22.	CorB_C	-32768	Calculated C, second point
23.	CorB_C_cor	-32768	Corrected C, second point
24.	CorA_DewP	-32768	Calculated DewPoint, first point
25.	CorA_DewP_cor	-32768	Corrected DewPoint, first point
26.	CorB_DewP	-32768	Calculated DewPoint, second point
27.	CorB_DewP_cor	-32768	Corrected DewPoint, second point
28,29	CorA_O2%f	-32768	Calculated O2% float, first point
30,31	CorA_O2%f_cor	-32768	Corrected O2% float, first point
32,33	CorB_O2%f	-32768	Calculated O2% float, second point
34,35	CorB_O2%f_cor	-32768	Corrected O2% float, second point
36	Foli_TMP	-32768	Internal
37	Foil_calcC	-32768	Internal
38	Foil_C	-32768	Internal

User should set parameter from 1 to 7. If L-probe is used, then parameters 2 and 3 are important. If there is temperature measurement error, parameter 4 should be set. If Dew point measurement result is required then H2 fix value (7) must be defined. Parameters from 8 to 11 is required if specific range of CO and/or CO2 input analyzer are used and set in parameter 1.

After that, correction of any results of interest can be performed using particular 'C' command (see chapter 6.2). Correction parameters can be changed via 'W' command also, but with skills and recognition of parameters function.

2.7 Explanation of configuration parameters

1) Main Configuration parameter (**CONFIG**) at address 1 defines the type of inputs, and the main result which correspond to calculation error indication. For the Carbo 1001E, this configuration parameter is byte type, and completely correspond to LED diagnostic on CPU board, when configuration is selected (see 2.2.1).

Function of bits inside configuration - CONFIG byte:

b7, b6 - CO Analyzer selector

0,0 - CO Analyzer 0..1V to 0..60% CO

0,1 - CO Analyzer 4-20mA (0.2..1V) to 0..60% CO

1,0 - CO Analyzer, 0..1V to user define range of % CO

1,1 - CO fix value, input is not used

b5 - Thermoelement selection

0 - PtRh-Pt Thermoelement, S type

1 - NiCr-Ni Thermoelement, K type

b4, b3, b2 - Probe selection:

0,0,0 - L probe, -20mV to 1300mV

0,0,1 - O2 probe, -20 to 1300mV

0,1,0 - CO2 Analyzer 0.15mA..1.05mA (150mV-1050mV) to 0.03..3.000%,log scale.

0,1,1 - CO2 Analyzer 4-20mA (260mV-1300mV) to 0..0.5% lin.

1,0,0 - CO2 Analyzer 0-1300mV to 0..20% lin.

1,0,1 - CO2 Analyzer, 0-1000mV to user define range of % CO2

b1, b0 - main results for calculation error indication

0,0 - C level computer

0,1 – O2%

1,0 – Dew Point

1,1 - L probe to O2 probe computer

Example: CONFIG = W#16#00C0 = 192, defines that C level computer will be based on fix CO value, S type thermoelement and L probe.

2) Probe K parameters:

The **K1** is stored at address=2. This value is a probe-specific parameter which must be re-entered when the L-probe is changed.

The **K2** is stored at address=3. This value is a probe-specific parameter which must be re-entered when the L-probe is changed.

3) Temperature measurement correction:

Parameter **TempOfset** (address 4) temperature offset correction is used to optionally correct thermocouple temperature measurement by adding entered value to final temperature measurement results. Before that final correction, linearization and cold junction compensation is performed, depending on selected thermocouple type.

4) COfix value [0.1% CO] is integer value at address 5. If there is no CO-analyzer connected to the input, this fix value is used to calculate main measurement results (C value) of transducer. If there is some error of CO input, this value is used also, and not-critical error is reported via R2 status LED. Default value is 200, i.e. 20.0% of CO. In the Main configuration word, user can select force using of fix CO value instead of using measured value. **COmin** parameter (address 6) is used to define lower limit of valid CO value. Both parameters as all others are also settable for each particular zone.

5) H2fix value [0.1% H2] is integer value at address 7. Concentration of H2 is used only for Dew Point calculation.

6) CO2min and **CO2max** (address 8 and 9), integer number with [0.001% CO2] resolution are used if user defined range of CO2 analyzer is selected in CONFIG parameter. 0-1000mV of input voltage is transferred to **CO2min-CO2max** range of CO2% concentration.

7) COmin and **COmax** (address 10 and 11), integer number with [0.1% CO] resolution are used if user defined range of CO analyzer is selected in CONFIG parameter. 0-1000mV of input voltage is transferred to **COmin-COmax** range of CO% concentration.

When used as an L-probe-O_2-probe computer, the voltage signal of an L-probe is converted into an equivalent voltage signal of a conventional zirconium dioxide probe.

8) Correction of measurement results

Two point correction mechanism is provided for next measurement results: 1) L-probe voltage to O_2-probe voltage (after correction results are **O2_SPG_cor** in measurement list), 2) C level (**C_PEG_cor**), 3) Dew Point (**DewPoint_cor**) and 5) O2% (**O2f_cor**).

For O_2 probe voltage, and C level measurement results, temperature dependent corrections are implemented. For all corrections it is possible to use particular ‘C’ command to enter right value of measurement (see chapter 6.2), where device itself chooses right correction point (CORRA or CORRB) to change, and sets temperature, measured and correction values. Another possibility is to change temperature, calculated and corrected value in parameter list directly.

The following rules must be observed when manually overwriting those data:

- The data must be within the value range (working area) - **There is no plausibility check!**

- Particular correction point can be deleted by overwriting parameters with invalid value (8000hex = -32768dec).

- If only one valid correction set is to be entered, this must be at CORRA whilst CORRB is invalid.

For temperature dependent correction:

- If both sets are occupied, the set with the lowest temperature must be at CORRA.
- The difference between the temperatures of both correction sets must be more than 30 degrees.

Those rules are observed automatically by the program when entering a correction set by ‘C’ command, see chapter 6.

Both correction points for one measurement results, or for all results, can be erased simultaneously via ‘C’ commands, also.

"L-probe voltage to O_2 voltage transducer" correction parameters (integer parameters at addresses from 12 to 17). Device calculates mV of conventional O2 as **O2_SPG**

measurement result. Corrected value (**O2_SPG_cor** measurement result) is calculated based on two optional correction points, at two different temperatures. Correction can be set by entering known C level values (perform one command, adr=5, see chapter 6.2). Both correction points can be erased by one command, adr=6.

C level correction parameters (integer parameters at addresses from 18 to 23). Device calculates C% level as **C_PEG** measurement result. Corrected value (**C_PEG_cor** measurement result) is calculated based on two optional correction points, at two different temperatures. Correction can be set by entering known C level values (perform one command, adr=11, see chapter 6.2), or by performing foil test explained in next chapter. Both correction points can be erased by one command, adr=12.

Dew Point correction parameters (integer parameters at addresses from 24 to 27). Device calculates Dew Point as **Dew_Point** measurement result. Corrected value (**Dew_Point_cor** measurement result) is calculated based on two optional correction points. Correction can be set by entering known Dew Point values (perform one command, adr=7, see chapter 6.2). Both correction points can be erased by one command, adr=8.

O2% correction parameters (float point parameters – each occupy two integer places in list of paramteres at addresses from 28:29 to 34:35). Device calculates concentration of O2 as float point **O2f** measurement result. Corrected value (**O2f _cor** measurement result) is calculated based on two optional float point correction points. Correction can be set by entering known O2f values (perform one command, adr=9, see chapter 6.2). Both correction points can be erased by one command, adr=10.

2.8 Foil test

Instead of directly changing C-level measurement correction parameters, device and delivered PLC software provide automatic performing of foil test. Foil test can be start, stop or cancel for more than one zone independently from each other.

For one particular zone, user should start foil test via FC309 or FB317, perform one command, adr=14. please see chapter 6.2 and 6.4.2. During foil test, device check integrity of measurement results and device status in order to reject false correction. After successful start of foil test, user can watch on foilstat value (measurement results table, address 17). During execution of foil test, foilstat has value 1.

At the beginning and during foil test next checking is performed:

- Foiltest must run more then 60 sec, if not foilstat=8.
- Temperature must be >750^{O}C, and C>0,1%. Opposite foilstat=8.
- If calculated C values are changed for more than 0.2%, then foilstat=8, also.

- If there is any error in Carbo calculation so there is no valid C value (any input or calculation results are out of measurement span of device), then foilstat=16.

- Foil test is considered forgotten, when didn't stop for 30 minutes (foilstat=4)

Foil test must be stopped in 30 minutes. (perform one command, adr=15) If test has finished well, foilstat will be =2. The results of foil test are temporary written inside configuration parameters. After that, user can enter real value of C level which was stable during foil test, using function FC309, address=13, or FB317. User can erase performed foil test instead, using FC309, address=16.

The results of entering correct C value will be new correction point (CORRA or CORRB). After successful correction, foilstat becomes zero again.

3. INSTALATION AND OPERATION INSIDE STEP 7

3.1 Software and hardware requirements

Software requirements:

1. An installed version of STEP 7 Basis V4.02 or higher.

Hardware requirements:

1. S7-300 mounting rack (DIN rail).
2. Power supply from PS-300 series.
3. CPU 31x module from SIMATIC S7-300 series.
4. Memory card with 64KB, or more, is recommended.
5. MPI-USB or MPI-RS232 adapter for connection with PC, (e.g. PG 740).
6. Standard PC.

3.2. Instalation

Before using Carbo1001 in your control application you will need to perform the following operations in the given order:

1. Mounting the Carbo1001.
2. Library installation.
3. Configuring the Carbo1001.
4. Creating a user program for the Carbo1001, or adding it in existing application.

3.3 Mounting the Carbo1001

The following section describes the rules that you must observe when positioning the Carbo1001 in the rack.

For mounting and demounting the Carbo1001 you require a 4.5mm cylindrical screwdriver.

To insert the Carbo1001 in a rack, proceed as follows:

1. Switch off the CPU by POWER OFF power supply unit.

2. The Carbo1001 is accompanied by an extension bus. Plug this onto the backplane connector of the module to the left of the Carbo1001.

3. If more modules are to be mounted to the right, plug the expansion bus of the next module onto the right backplane connector of the Carbo1001.

4. Mount the Carbo1001 on the rail and tilt it downward.

5. Screw the Carbo1001 tight.

6. Connect 24V power supply to Carbo 1001 from power supply unit (PS-300 series).

7. Connect all necessary probes.

3.4 Library installation

In order to be able to work with the Carbo1001 library you need to have installed Point-to-Point Communication (**CP PtP Param**) package which comes with CP340 module. It contains all necessary driver files and library to work with CP340 module. If you don't have installed **CP PtP Param** package follow this instruction:

- The CP configuration software can only be installed once STEP 7 has been completely installed.
- Before starting the Setup program, close all other applications (such as STEP 7, MS Word, etc.).
- Insert CD in the drive and start the Setup program in the Setup folder. The files are then copied to the PC/programming device and the appropriate entries are made in the MS Windows files. Important information on handling will be displayed during the Setup process.
- The drive on which you install the software for the CP configuration is automatically determined with the installed version of STEP 7.
- In order to remove the program use the functions in the Control Panel > Add/Remove Programs function. STEP7 cannot be removed unless all the option packages have been removed.

Next install Carbo1001 library as described below:

- Copy "CarboLib1001_ver2" folder from installation CD to folder \Siemens\Step7\S7LIBS\
- Copy Example project "Carbo1001_ver2" from installation CD to folder \Siemens\Step7\S7Proj\

4. EXAMPLE PROJECT "Carbo1001_ver2_twoCP340"

There are two approach of software start-up of Carbo 1001:

1) To use example project "Carbo1001_ver2_twoCP340", and then you can adjust hardware configuration from used CPU312C to actually used CPU.

2) To create new project and then to insert CP340 module to hardware configuration of project following instruction in next chapter, and all required block from library "CarboLib1001_ver2".

Example project is easier way for starting up. It explains standard functions for operating the Carbo 1001 modules. There is example program based on two Carbo1001 modules. Inside the example project CPU312C is used, CP340-RS232C module is installed in slot 4 and 5, and configured as Carbo1001 requires. If this setting is not ok, please see hardware configuration of CP340 in next chapter. If you use one Carbo1001 module, please disable/delete part of OB1 which calls second module, and change the address of module to zero, defined in calling of FC300.

Instruction:

Open the project using the STEP 7 SIMATIC Manager by calling the menu command **File > Open > Project**.

Check that the hardware for the example is fully set up and programming device is connected. Transfer the complete code to the user memory. After the overall reset of the CPU (operation mode STOP), use the operating mode switch to change from STOP to RUN mode. User just needs to switch button Monitor ON/OFF for observed block in order to see actual values of measurement results.

Cyclic execution of Program

Example program is present in appendix A.1. The cyclic program execution is defined in the organization block OB1. The main function block is FC300 "Carbo main". It is placed in one network and executed cyclic. First three input parameters for FC300 call defines the addresses of attached Carbo modules. If there is only one module, then only first address is non zero. The last parameter is PREV_CYCLE, which takes value of OB1_PREV_CYCLE temp parameter for OB1 process as time reference. Inside FC300 is functionality of transferring measurements results and configuration parameter for Carbo1001 device. Please see chapter 6.1.

Carbo1001 modules are used via function block FB317, with instanced data blocks DB307 and DB308 (for two modules). Changing variables (programmaticaly, or by debugger) inside that data blocks, user can start particular commands, or can choose automatical transfer of all measurement results.

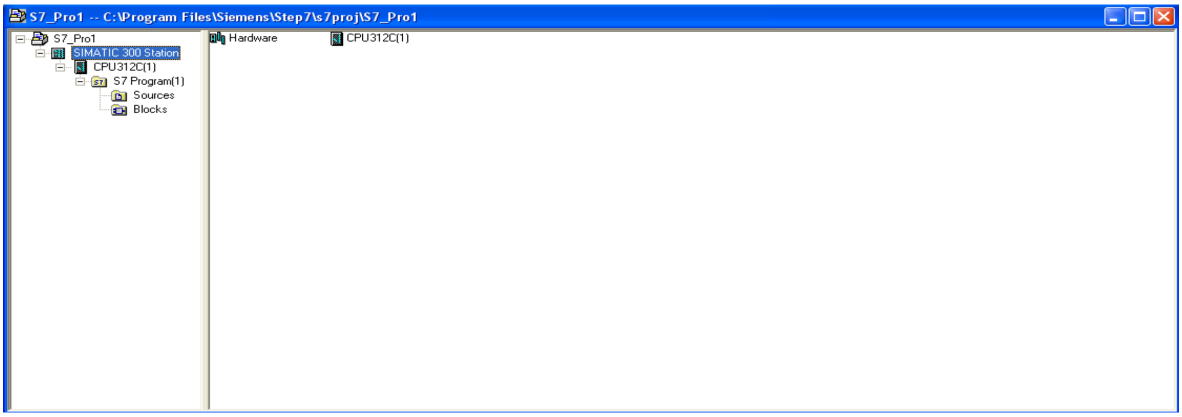
In the example, disabled part of code with function FC315, "GetMain value", which obtains main measuremetn results automatically, can be seen. Depend on configuration, main measurement results can be for example C value in [0.01%]. Each new measurement result and correctness of the result is used to drive digital output A124.3 i A124.1. Measurement value of C is transfered to CVAL variable inside OB1, and used to compare with defined constant value.

5. ADDING CARBO1001 TO THE PROJECT

Setting described in this chapter is required if you use Library instead to modify example program.

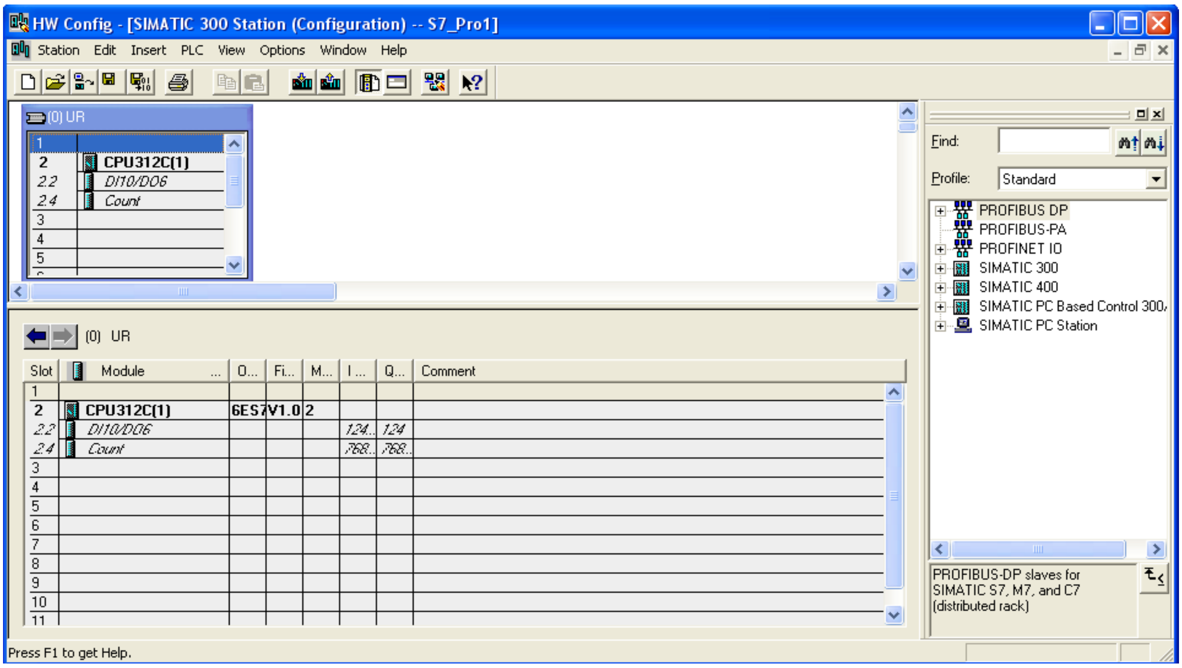
5.1 Configuring the Carbo1001 module inside STEP7 programming environment

Once you have mounted the Carbo1001 module you must inform the programmable controller that it is there. Before you can enter the Carbo1001 in the configuration table of the STEP7 software, you must have created a project and a terminal with STEP7. Then, follow steps bellow:

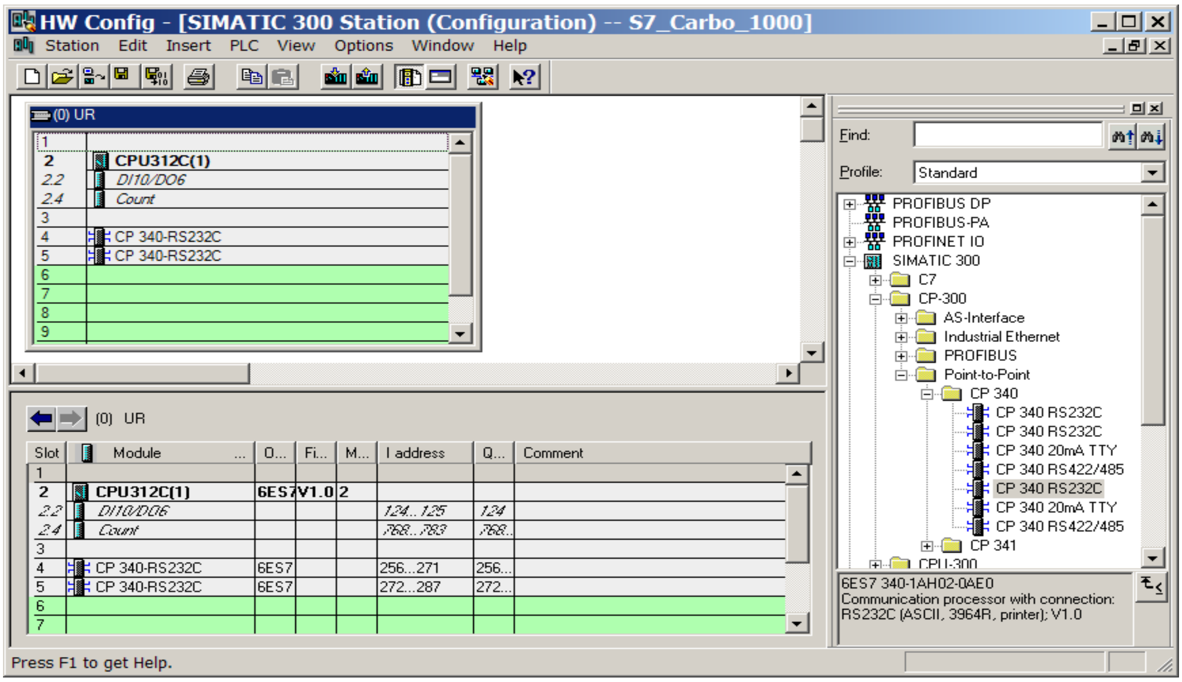


Click **SIMATIC 300 Station** folder in your project. All the hardware-related project data are stored here. Open the **SIMATIC 300 Station** folder and double-click the **Hardware** symbol.

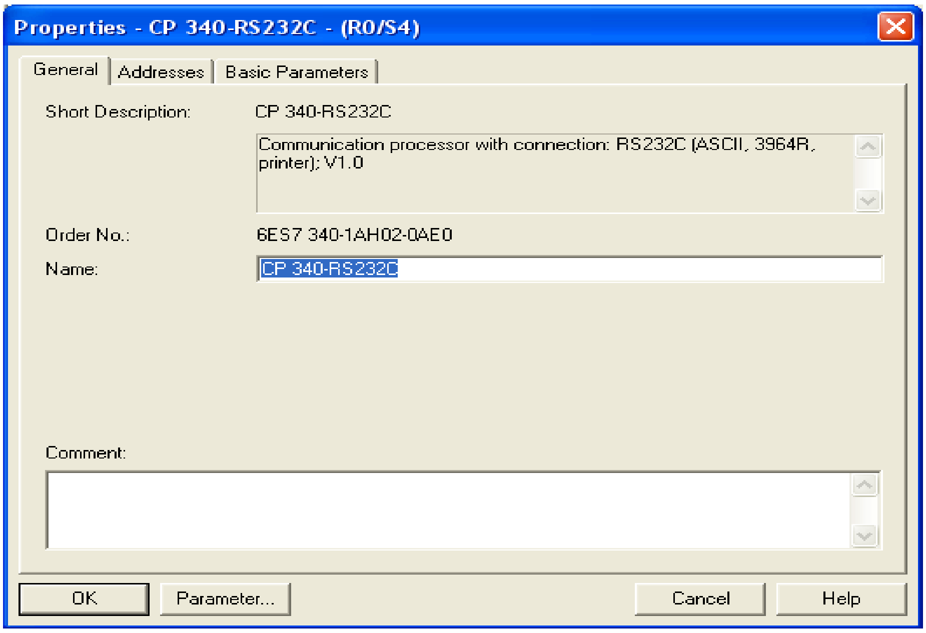
The "**HW Config**" window opens. The CPU you selected on creating the project is displayed.



Navigate in the catalogue until you reach the **CP 340 RS232C** module and drag and drop this onto one of allowable slots (green fields). Repeat adding CP340 for each used Carbo module.



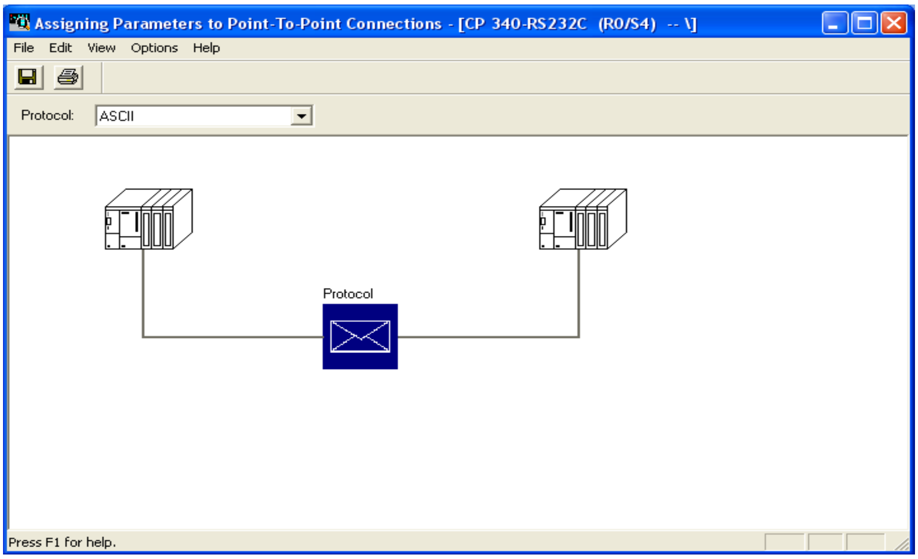
Double-click to **CP 340 RS232C** modules field to open properties.



In addresses tab one can define input and output address of the module. Carbo 1001 program and Library use the same addresses for both start fields of the one particular module. If more than one Carbo module is installed, then all modules have the same properties according communication protocol, but in the address tab of properties window, addresses of each existing module must be different. When FC300 - Carbo_main function (please see chapter 6.1) is called, one must define actual addresses of all used modules. The address must be set to zero, if module is not used. Next table present default address during configuration of CP340 modules.

Module number:	Input/output start addresses:
1	256
2	272
3	288

Click on **Parameter** button.



Choose **ASCII** type of communication form **Protocol** drop menu and click on Protocol box (blue) to set communication parameters.

Choose value for **Speed** and **Character Frame**:

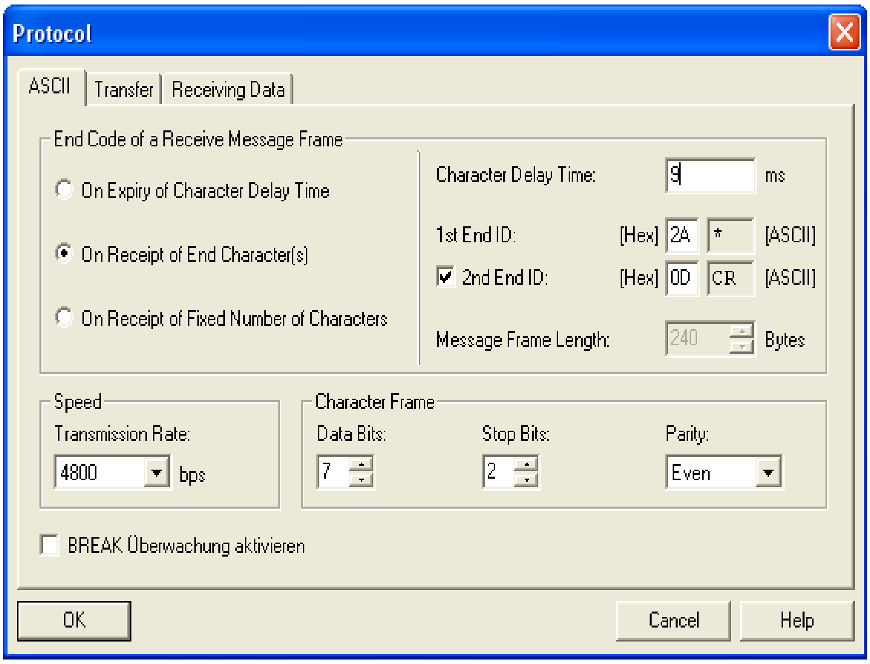
- Transmission Rate: **9600**
- Data Bits: **7**
- Stop Bits: **2**
- Parity: **Even**

For **End Code of a Receive Message Frame** choose On **Receipt of End Character(s).**

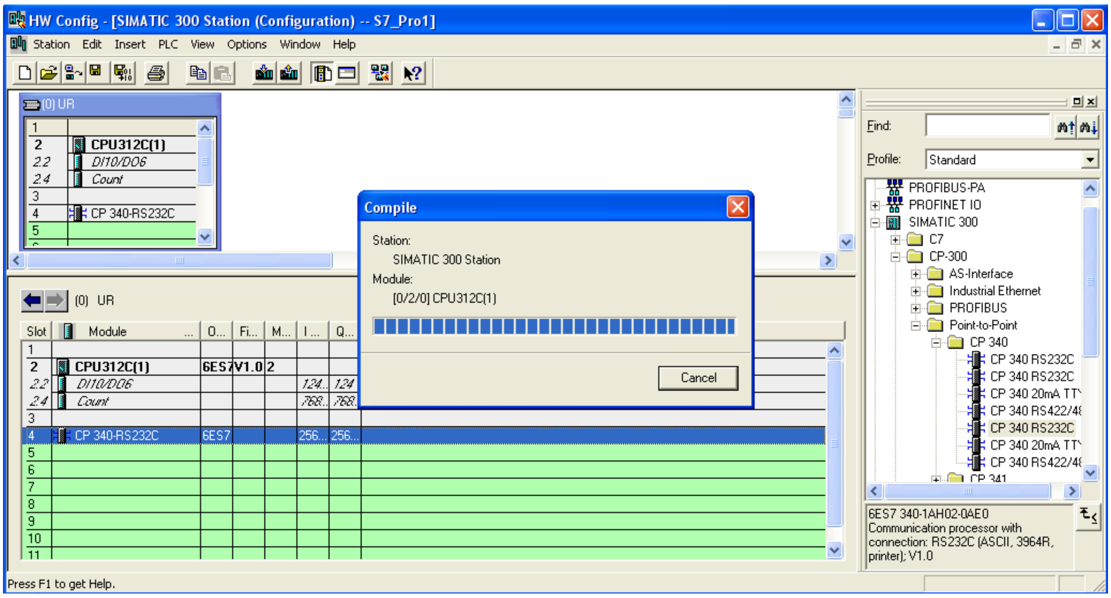
Character Delay Time set to 9 ms.

- 1st End ID: [Hex] **2A**

- 2nd End ID: [Hex] **0D**



Then click on **OK** button.



Click on **Save and Compile** icon to confirm setup.

5.2 Open Library CarboLib1001_ver2

It is important to say that user needs to copy all DBs, FBs and FCs from library CarboLib to opened project. Then it is easy to call all relevant functions in user program and watch results in appropriate DBs.

To copy all DBs, FBs and FCs from library CarboLib to user program you need to open library "CarboLib" in SIMATIC manager, select all blocks and click on right button of mouse and choose **Copy** command. Then go to your project and in block section where OB1 block is, and paste blocks with click on right button mouse and use **Paste** command.

After that, functionality of Carbo device is reached if at least FC300 "Carbo main" function is cyclic called, for example inside OB1 block, see chapter 6.

6. CARBO1001 FUNCTIONS AND DATA BLOCKS INSIDE STEP7

Communication between the CPU and the Carbo1001 takes place via cyclic execution of FC300 (for example in OB1). There are few different approaches of using Carbo software:

1) Low level approach is to use only FC309 function with different parameters to reach all functionality of Carbo device (chapter 6.2)

2) Another approach is to use function block “CarboMenu” - FB317, and instanced data blocks per each zone (DB307 and DB308 in example, please see chapter 6.4). This is procedure, which cyclic obtain all measurement results and perform other command on user request, or change parameters, as some kind of terminal program. Here, user should only read and write variables from instanced data blocks DB307 and DB308.

3) If parameters and correction are set, one can use only function "GetMeasurement" - FC315 to obtain one particular measurement results, and the pulse when each new measurement results arrived. This approach requires less memory than 2).

At one time, only one function of FC309, FC315 or FB317 can be used for one particular zone of Carbo1001E, but FC300 is required once for all zones together. Functions from FC301 to FC307 are not called directly. Please see appendix A.2 for all function block and overall required program resources.

6.1 Function FC300, Symbolic name "Carbo_main".

This is main loop function, which automatic sends and receives all required message between PLC and all Carbo 1001 device. It calls timer and CP340 send/receive functions, and must be used in cyclic program one for all installed Carbo modules. Input variable PREV_CYCLE CYCLE takes value of OB1_PREV_CYCLE temp parameter for OB1 process. Input variable adr1..adr3 is address of Carbo 1001 modules attached into the system.

The same Simatic software is used for this Carbo1001E type of device, and for Carbo1001 devices. Only different is in calling FC300:

1) Carbo1001: it is possible to attach up to three Carbo1001 devices to system, and each must have different address (adr2 is different from adr1, etc).
2) Carbo1001E: it is possible to attach only one Carbo1001E device with one ore more input modules, so only adr1 is used, and must not be zero.

Input/output parameters:

Name	Type	Data type	Description
adr1	INPUT	INT	Address of used module, default is 256
adr2	INPUT	INT	Address of second used module, default is 272
adr3	INPUT	INT	Address of third used module, default is 288
Carbo1001E	INPUT	BOOL	True for Carbo1001E, **false for Carbo1001**
PREV_CYCLE	INPUT	INT	OB1_PREV_CYCLE, must be used for timer

6.2 Function FC309, symbol name "OneCommand"

Implement one command for communication with particular zone (module) Carbo1001. If there is more than one zone, then one can use only one FC309 for each particular zone in parallel.

Depend of the input code, there are next actions:

'M' - read one measurement results defined by address. Please see chapter 2.5 for the table of enumerated all possible measurement results.

'R' - read one configuration parameter defined by address. Please see chapter 2.6 for the list of parameters.

'W' - write one configuration parameter defined by address.

'C' - perform one command. Code of command is in address variable, with meaning:

Address=1, execute **software reset** of Carbo 1001 device - make influence on all zones, no matter on which is performed. In general, there is no need to manually reset device. Resetting is performed very quickly, only some pause in LED working can discover that this command is executed.

Address=2, then EnterVal contain new **Cofix** value. This value is used when it is defined so in configuration, but also when CO input value is not correct (see 2.7).

Address=3, then EnterVal contain new **H2fix** value. This value is used for DewPoint caculation.

Address=4, **clear all correction points** for all measurement results whose are corrected.

Address=5, then EnterVal contain new **O2 mV correction value**. Function performs adding new correction point for L mV to O2 mV conversion (see 2.7).

Address=6, **clear both correction points for O2 mV.**

Address=7, then EnterVal contain new **Dew Point correction value**. Function performs adding new correction point for Dew Point measurement result (see 2.7).

Address=8, **clear both correction points for Dew Point.**

Address=9, then EnterVal contain upper part of **O2% float point correction value as integer number**. After this device excepted second part of this float point number through command with address 109.

Address=109, then EnterVal contain lower part of **O2% float point correction value as integer number**. This command must be after one with address=9, when first part of this float point number is received.

Address=10, **clear both correction points for O2% float point calculation.**

Address=11, then EnterVal contain new **C level correction value**. Function performs adding new correction point for C level correction measurement result (see 2.7).

Address=12, **clear both correction points for C level measurement.**

Address=13, then EnterVal contain **real C value after foil test**. Function performs adding new correction point for C measurement, if Foil test is performed already (see 2.8).

Address=14, execute **start of Foil test** for particular zone, then status of foil test can be seen with 'M' command and address 14 - Foilstat.

Address=15, execute **stop of Foil test** of that zone, then status of foil test can be seen with 'M' command and address 14 - Foilstat.

Address=16, **clear** results of last performed **Foil Test**. When new corrected value of C is not entered jet, but user want to omit last foil test and to perform new one, then last and not used results of foil test must be erased first. That data are cleared when correction is executed, also.

'S' - read one particular char form LOGO strings. There are 4 strings with 16 chars with zero end char, so address can be from 0 to 68.

Input/output parameters:

Name	Type	Data type	Description
zone	INPUT	INT	zone number, from 1 to 5
start	INPUT	BOOL	Start change on rising edge of this signal
Code	INPUT	CHAR	What to do: 'M', 'R', 'W', 'C', 'S'
Address	INPUT	INT	Address of variable
EnterVal	INPUT	INT	Input Value for addressed variable or command
Outcode	OUTPUT	CHAR	Received code of command
Outaddress	OUTPUT	INT	Received address
OutVal	OUTPUT	INT	Read variable if any
finish	OUTPUT	BOOL	Become true when command is finished
status	OUTPUT	INT	Status of finished command, 0-not finished, 1-good, >1 for error

Each command return "status" variable with one of the next value:

0 - Command is successful

2 - there is no answer

3 - bad command

4 - bad address of command

5 - bad value

7 - bad zone number

8 - impossible correction or foil test

9 - command for CPU module is not allowed

15 - error during reading EEPROM

6.3 Function FC315, symbol name "GetMeasurement"

Function returns INT value of the selected measurement result for selected zone. Communication starts itself as soon as last transfer is finished. "gotnew" signal pulse on each new value.

Input/output parameters:

Name	Type	Data type	Description
zoneNumber	INPUT	INT	zone number, from 1 to 5
MeasNumber	INPUT	INT	From 1 to 21, select one result according to list of measurement results
OutVal	OUTPUT	INT	integer value of main measurement result
gotnew	OUTPUT	BOOL	pulse when new measurements are obtained
good	OUTPUT	BOOL	status of the measurement results

6.4 Function block FB317 symbolic name "CarboMenu"

This Function block can be included in cyclic part of the main PLC program, for example in OB1. For each particular zone, separate calling of FB317, with its own instanced DB should be used. In example program, DB307 is instanced for using with zone module number 1, and DB308 for second zone. The purpose of FB317 is to get all measurement, and to enable calling of command function by editing static variable in instanced data block (chapter 6.4.1). It is convenient for testing and adjusting of device, even without additional Human Interface program, i.e. using only Step7 development environment.

"Request_code" variable at address 84 defines next action. When code is zero, i.e. there is no special request, then cyclic transfers of all measurement variables from device to instanced data block are performed. When one enter some different form zero to the "Request_code" next action is performed, and code is immediate change back to zero to prevent multiple execution of the same action. There are all possible actions, depend of "Request_code" variable:

0 - cyclic transfer of measurement results. After all measurement results are transferred, "Cycle_completed" flag is pulsed.

1 - perform one 'C' command, please see chapter 6.2 for detailed explanation. Before entering value '1' to "Request_code" variable, one should enter code of command to "Addressinp" variable (possible codes are 1-Cofix, 2-O2corr, 3-Foil C, 4-ClrFoil, 5-clear

corr points, 6-Reset, 7-StartFoil, 8-StopFoil, 9-H2fix), and required value to "Valinp", if command expect input values (for changing Cofix value, O2corr and Foil correction of C measurement value).

2 - write one parameter. Only one parameter will be transferred to EEPROM memory, based on ordinal number of parameters in "Addressinp", and value to send in correspond parameter variable. For example for changing main configuration word - "PAR.CONFIG", one should enter "addressinp":=1; and then "Request_code":=2. After that, current value from "PAR.CONFIG" location (address 32.0), will be transferred to EEPROM memory.

3 - write ALL parameters. When "Request_code":=3, all current value of parameters variable in instanced data block for that zone will be transferred to the EEPROM of device.

4 - read ALL parameters for one zone. It is convenience to read all parameters first, then to change few of them, and after that to write all back with "3" to the "Request_code".

When one particular request is finished, "Request_completed" variable becomes true. If request is reading or writing parameters, then "RW_good" variable becomes false, if there is some error during that transfer.

Input parameter:

Name	Type	Data type	Description
zoneNumber	INPUT	INT	zone number, from 1 to 5

6.4.1 Instanced data block for function block FB317

Address in DB	Addres in Measure or Parametar list	Name	Type	Initial value	Comment
0.0		zoneNumbers	INT	0	Carbo1000 zone, i.e. module, from 1 TO 5
2.0			INT	0	Not used
4.0	1	MES.SOND_SPG	INT	-32768	Probe voltage [0.1mV]
6.0	2	MES.LS_SPG	INT	-32768	L-probes voltage [0.1mV]
8.0	3	MES.O2_SPG	INT	-32768	O2-probes voltage [0.1mV]
10.0	4	MES.O2_SPG_cor	INT	-32768	O2-probes voltage, corrects [0.1mV]
12.0	5	MES.TMPK	INT	-32768	Temperature [^{O}C]
14.0	6	MES.TMP_V	INT	-32768	Cold junction temperature [^{O}C]
16.0	7	MES.CO	INT	-32768	CO content [0.1%CO]
18.0	8	MES.CO2	INT	-32768	CO2 content [0.001%CO2]
20.0	9	MES.C_PEG	INT	-32768	C level [0.01%C]
22.0	10	MES.C_PEG_cor	INT	-32768	C level, corrects [0.01%C]
24.0	11	MES.C0X_PEG	INT	-32768	CO/CO2 level [0.1]
26.0	12	MES.DewPoint	INT	-32768	DewPoint [0,01^{O}C]

28.0	13	MES.DewPoint_cor	INT	-32768	DewPoint corrected [0,01^{O}C]
30.0	14, 15	MES.O2f	Float	0.0e+0	O2[%], float point result
34.0	16, 17	MES.O2f_cor	Float	0.0e+0	O2[%] corrected, float point result
38.0	18	MES.STATUS	WORD	w#16#0	Status of device
40.0	19	MES.ERRORS	WORD	w#16#0	Error status of device
42.0	20	MES.FOILSTAT	INT	0	Status of foil testing: 0-non, 1-run, 2-finish, 3-abort undoc,4-forgottn, 8-nonstable,16-calcerr
44.0	21	MES.MODULETYPE	INT	0	For Carbo input module must be =2, if no, there is no correct module!
46.0	22	MES.Version	INT	0	Version of Module firmware
48.0			INT	0	Not used
50.0			INT	0	Not used
52.0	28.	PAR.CONFIG	WORD	w#16#0	Main Configuration word
54.0	29.	PAR.K1	INT	-32768	L-probe offset K1
56.0	30.	PAR.K2	INT	-32768	L-probe offset K2
58.0	31.	PAR.TempOfset	INT	-32768	Temperature offset ['C]
60.0	32.	PAR. COfix	INT	-32768	CO fix value [0.1%CO]
62.0	33.	PAR. COmin	INT	-32768	minimum CO-analyser value [0.1%CO]
64.0	34.	PAR. H2fix	INT	-32768	H2 fix value, used for Dew Point [0.1%H2]
66.0	35.	PAR. CO2min	INT	-32768	CO2 min value for user range of CO2 analyser in [0.001%]
68.0	36.	PAR. CO2max	INT	-32768	CO2 max value for user range of CO2 analyser in [0.001%]
70.0	37.	PAR. COmin	INT	-32768	CO min value for user range of CO analyser in [0.1%]
72.0	38.	PAR. COmax	INT	-32768	CO max value for user range of CO analyser in [0.1%]
74.0	39.	PAR.CorA_O2spg_TMP	INT	-32768	Temperature for O2 correction, first point
76.0	40.	PAR.CorA_O2spg	INT	-32768	Calculated O2, first point
78.0	41.	PAR.CorA_O2spg_cor	INT	-32768	Corrected O2, first point
80.0	42.	PAR.CorB_O2spg_TMP	INT	-32768	Temperature for O2 correction, second point
82.0	43.	PAR.CorB_O2spg	INT	-32768	Calculated O2, second point
84.0	44.	PAR.CorB_O2spg_cor	INT	-32768	Corrected O2, second point
86.0	45.	PAR.CorA_C_TMP	INT	-32768	Temperature for C correction, first point
88.0	46.	PAR.CorA_C	INT	-32768	Calculated C, first point
90.0	47.	PAR.CorA_C_cor	INT	-32768	Corrected C, first point
92.0	48.	PAR.CorB_C_TMP	INT	-32768	Temperature for C correction, second point
94.0	49.	PAR.CorB_C	INT	-32768	Calculated C, second point
96.0	50.	PAR.CorB_C_cor	INT	-32768	Corrected C, second point
98.0	51.	PAR.CorA_DewP	INT	-32768	Calculated DewPoint, first point
100.0	52.	PAR.CorA_DewP_cor	INT	-32768	Corrected DewPoint, first point
102.0	53.	PAR.CorB_DewP	INT	-32768	Calculated DewPoint, second point
104.0	54.	PAR.CorB_DewP_cor	INT	-32768	Corrected DewPoint, second point
106.0	28,29	PAR.CorA_O2%f	Float	-32768	Calculated O2% float, first point
110.0	30,31	PAR.CorA_O2%f_cor	Float	-32768	Corrected O2% float, first point
114.0	32,33	PAR.CorB_O2%f	Float	-32768	Calculated O2% float, second point
118.0	34,35	PAR.CorB_O2%f_cor	Float	-32768	Corrected O2% float, second point
122.0	36	PAR.Foli_TMP	INT	-32768	Internal

124.0	37	PAR.Foil_calcC	INT	-32768	Internal
126.0	38	PAR.Foil_C	INT	-32768	Internal
128.0			INT	0	Not used
130.0			INT	0	Not used
132.0			INT	0	Not used
134.0			INT	0	Not used
136.0		Cycle_completed	BOOL	False	Pulse at each complete loop of reading all measurements
136.1		Request_completed	BOOL	False	true when finish requesting
136.2		RW_good	BOOL	False	become false, when some read/write of param. is not ok.
138.0		**Request_code**	**INT**	**4**	**request : 0-automeas,1-one command,2-write one par, 3-write ALL par,4-read ALL par**
140.0		**Addressinp**	**INT**	**0**	**for command: 1-Reset device, 2-Cofix, 3-H2fix, 4-clear All corr points, 5-O2corr, 6-Clear O2corr, 7-DewPointcorr, 8-Clear DewPointcorr, 9-O2% Float point corr, 10- Clear O2% Float point corr, 11-C% corr, 12-Clear C% corr, 13-Foil C%, 14-StartFoil, 15-StopFoil, 16-Clear Foil,**
142.0		**Valinp**	**INT**	**0**	**input value for command, for example Foil C correct. value**
144.0		**Valinpf**	**Float**	**0**	**Float input value for O2% Correction command**
148.0		valout	INT	0	output variable, when some is reading
150.0		Statusout	INT	0	status of the last command
152.0		addressout	INT	0	out address data of the last command
154.0		ccount	INT	0	Internal
156.0		parcount	INT	0	Internal
158.0		command_State	INT	0	Internal
160.0		command_executed	INT	0	Internal

6.4.2 Execution of foil test via function block FB317

1) Please start foil test with: addressinp=14, and then Request_code=1. After that, please monitor "MES.FOILSTAT" measurement value on DB address 42. During regular foil test, this value should be =1, (Foilstat: 0-non, 1-run, 2-finish, 3-abort undoc, 4-forgottn, 8-nonstable, 16-calcerr). One can also monitor main measurement value, or level of C on address 2.

2) In next 30 minutest foil test should be stopped by: addressinp=15, and then Request_code=1.

3) If foil test is regular finished, then MES.FOILSTAT=2. After that, one can enter corrected C value by addressinp=3, Valinp=corrected_carbo_value, and after that Request_code=1. Immediately, new correction becomes active.

If foil test which should be ignored before performing new one, please erase it via addressinp=4 command. If correction performed already, but it is not good, one can erase both correction point by, addressinp=5 and Request_code=1.

APPENDIX

A.1. STL source code of OB1 block of example project "Carbo1001_ver2_twoCP340"

Name	Data type	Address	Comment
TEMP		0.0	
OB1_EV_CLASS	Byte	0.0	Bits 0-3 = 1 (Coming evant), Bits 4-7 = 1 (Evant class 1)
OB1_SCAN_1	Byte	1.0	1 (Cold restart scan 1 of OB1), 3 (Scan 2-n of OB1)
OB1_PRIORITY	Byte	2.0	Priority of OB Execution
OB1_OB_NUMBR	Byte	3.0	1 (Organization block 1, OB1)
OB1_RESERVED_1	Byte	4.0	Reserved for system
OB1_RESERVED_2	Byte	5.0	Reserved for system
OB1_PREV_CYCLE	Int	6.0	Cycle time of previous OB1 scan (milliseconds)
OB1_MIN_CYCLE	Int	8.0	Minimum cycle time of OB1 (milliseconds)
OB1_MAX_CYCLE	Int	10.0	Maximum cycle time of OB1 (milliseconds)
OB1_DATE_TIME	Date_And_Time	12.0	Date and time OB1 started
Cval	Int	20.0	

Block: OB1 "Main Program Sweep (Cycle)"
Example of calling CARBO1001 main procedure and some user actions

Network: 1
Calling of the main procedure of CARBO1001, must exist in OB1 !!!

```
CALL "Carbo main"
adr1     :=256
adr2     :=272
adr3     :=0
carbo1001E:=FALSE
PREV_CYCLE :=#OB1_PREV_CYCLE
```

Network: 2
Call menu procedure by editing static variable in data blok. Convinian for testing via Step7 upload of data blok to PLC cycle measurement of all variable, or one particular variable can be choosen

```
CALL "CarboMenu" , DB307
```

```
zoneNumber:=1
```

Network: 3
Call menu procedure by editing static variable in data blok. Convinian for testing via Step7 upload of data blok to PLC cycle measurement of all variable, or one particular variable can be choosen

```
CALL "CarboMenu" , DB308
zoneNumber:=2
```

Network: 4
Reading of Corrected C value, gotnew pulse on each complete cycle of measurements to LED. Overall status is also obtained and sent to LED

```
// CALL "GetMeasurement"
// zoneNumber:=1
// MeasNumber:=9
// gotnew :=Q124.3
// good :=Q124.1
// OutVal :=#Cval
```

Network: 5
Example: comparation of C meas. result with fixed value in order to control some. LED is driven

```
// L 18          // comparasion with 0.18% of C
// L #Cval
// >I            // compare 18>Cval
// = Q 125.5     // output result to LED
```

A.2. List of all blocks used in library CarboLib and example project

Object name	**Symbolic name**	**Size in the work memory**	**Type**	**Obligation use**	**Optional use**
OB1	Cycle Execution	188	Org. block		for example
FB2	P_RCV	1888	FB	●	
FB3	P_SEND	1590	FB	●	
FB317	CarboMenu	1322	FB		●
FC300	Carbo Main	1274	FC	●	
FC301	Make_string_command	690	FC	●	
FC302	Analyse_command	848	FC	●	
FC303	BYTE_TO_HEXA1	90	FC	●	
FC304	XORSTRING	194	FC	●	
FC305	readHEXAbyte	258	FC	●	
FC306	BYTE_TO_HEXA2	98	FC	●	
FC307	nibble_TO_HEXA	112	FC	●	
FC308	adr_CP340	136	FC	●	
FC309	OneCommand	344	FC	●	
FC315	GetMeasurement	274	FC		●
UDT300		---	Data type	●	
DB300		168	Data Block	●	
DB301		108	Instance DB	●	
DB302		104	Instance DB	●	
DB307		196	Instance DB		for example
DB308		196	Instance DB		for example
SFB52	RDREC	---	System FB	●	
SFB53	WRREC	---	System FB	●	
SFC24	TEST_DB	---	System FC	●	
SFC64	TIME_TCK	---	System FC	●	

A.3. Table of used symbols

Symbol	Address	Comments
Cycle Execution	OB 1	Example program
UDTcarboMain	UDT 300	Definition of data for working with Carbo
DBcarbo	DB 300	Main data block for working with all three Carbo modules
DBcomm1R	DB 301	Used from CP340 for receiving, first Carbo module
DBcomm1T	DB 302	Used from CP340 for transmiting, first Carbo module
P_RCV	FB 2	Receive Data from CP340
P_SEND	FB 3	Send Data to CP340
CarboMenu	FB 317	optional used for callcommands by editing static variable in data blok
Carbo_main	FC 300	Perform cycle execution of Carbo1001E communication
Make_string_command	FC 301	Prepare command for sending from CP340 to Carbo1001E
Analyze_command	FC 302	Analyze of receiving command
BYTE_TO_HEXA1	FC 303	Convert byte to first char of HEXA ASCII string
XORSTRING	FC 304	calculate XOR of string
readHEXAbyte	FC 305	Convert two HEXa ASCII CHARS to one byte from receive array of chars
BYTE_TO_HEXA2	FC 306	Convert byte to first char of HEXA ASCII string
nibble_TO_HEXA	FC 307	convert nibble to HEXA char
adr_CP340	FC 308	define current addres to work with CP340
OneCommand	FC 309	change either CO fix value, O2 correction, or enter Foil C value
GetMeasurement	FC 315	get one measurement result, according to inputaddress
RDREC	SFB 52	Read a Process Data Record
WRREC	SFB 53	Write a Process Data Record
TEST_DB	SFC 24	Test Data Block
TIME_TCK	SFC 64	Read the System Time

A.4. Technical Data

Housing:

– Siemens Simatic S7 compatible housing for Simatic Rail mounting

Dimensions:

– 40 x 125 x 120 mm (BxHxT)

Weight:

– ca. 0.4 kg

Degree of protection:

– IP 20 according to DIN 40050

Climate:

– storage: -10..+70 °C
– operation: 0..+50 °C
– 5..95 % relative humidity, no condensation

Auxiliary voltage:

– 24 Vdc ± 10 %

Power consumption:

– approx. 3 VA

Fuse:

– 1 × 0.375 A, slow-blow

Connections:

– Lines: 10pin adapter plug with screw terminals