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Communication protocol specifications

For SIEMENS S7 & SAIA controllers – Standard chambers

Fetch/Write

Vers. 2.05.08 – 31 Aug 2018

Date	Author	Version	Note
Sept 2012	wgs	2.04 / b	Original
17 Sept 2013	wgs	2.05	Examples added
18 Sept 2013	wgs	2.05.01	Bug fix in the name representation of command bytes
28 July 2015	wgs	2.05.02	Some paragraph review
27 November 2015	wgs	2.05.03	Some paragraph review
09 March 2017	wgs	2.05.04	Some paragraph review
02 May 2017	wgs	2.05.05	Some paragraph review
13 Oct 2017	Fulvio	2.05.06	Alarms review and update
30 Mar 2018	wgs	2.05.07	Addresses review
31 Aug 2018	wgs	2.05.08	Addresses review

INTRODUCTION

The present document contains information on the FETCH/WRITE protocol for performing data exchange between a PC and the controller SIEMENS or SAIA of the ATT chambers. You can find here a short description of the query and answer syntax for the read function and the write function.

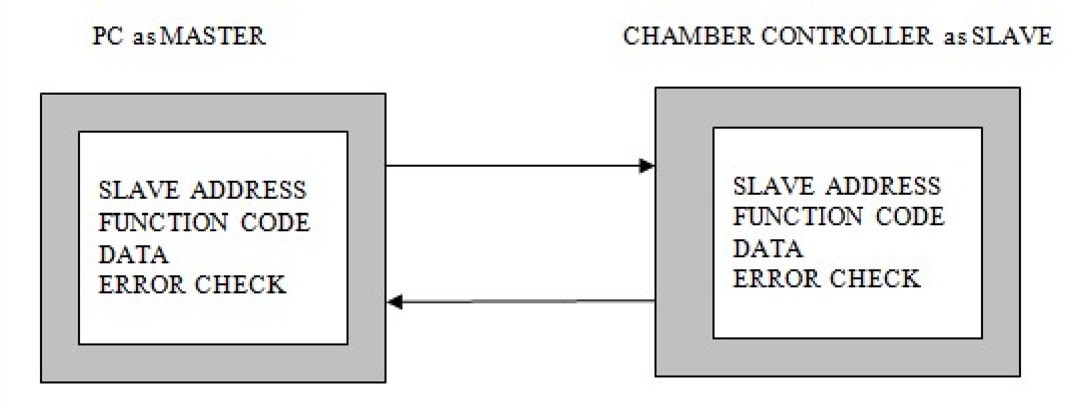
Moreover, a short example of code has been included as a guideline for the development of a complete program.

A communication protocol defines media, data formats and rules that are common to two or more systems that must exchange information by means of a physical communication line.

Moreover is described here how the devices (master and salve) connected to the line interact between them to start and close the communication, and the way to identify error conditions during the data transmission.

Practically the protocol allows a data exchange between Master device and a Slave device according to the following situation:

Fig. 1 – Master and Slave

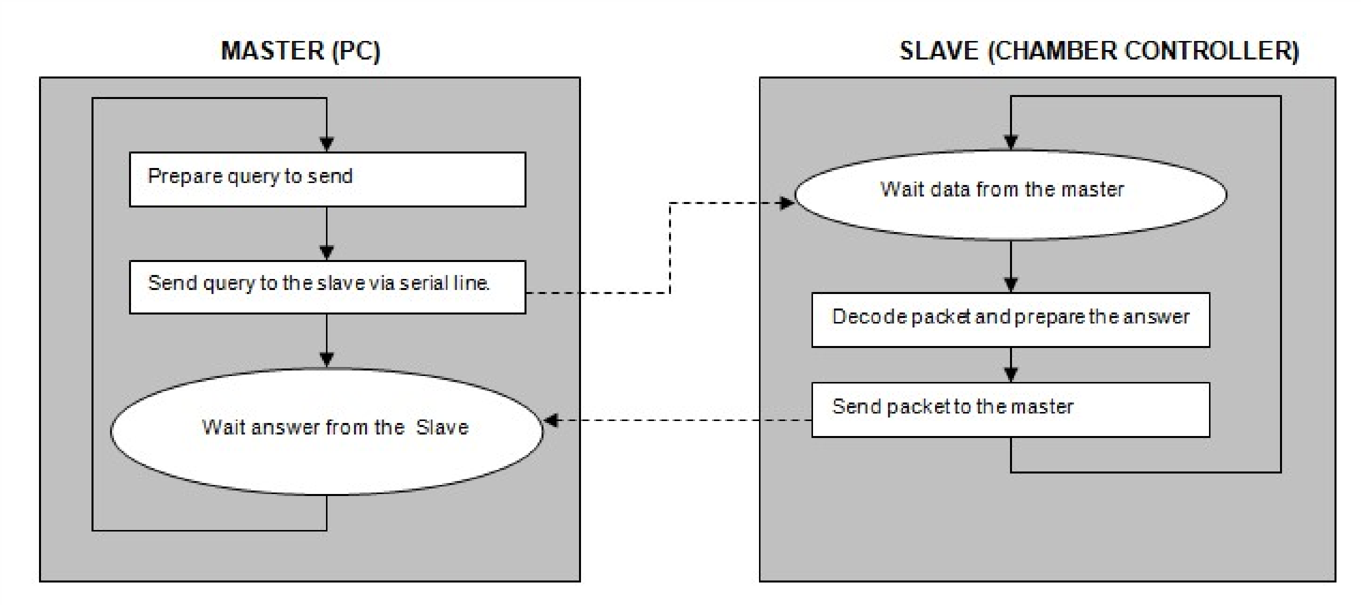


In this architecture, PC always acts as Master while the chamber controller is always the Slave device.
The Master device is the only one that can start the communication.

The communication consists essentially in a **query** made by the Master device (normally a PC) that is directly followed by an **answer** coming from the Slave device (the Siemens/SAIA chamber controller).

The communication task, either is a query or an answer, consists in preparing a data packet which includes the identification code of the requested function, the length of the query/answer, the data itself and error check information. This data packet is then transmitted to the device on the other end of the serial communication line.

Fig. 2 – Communication overview



PROTOCOLLO FETCH/WRITE

Notes below come directly from the Siemens documentation available on-line. They are reported here for your convenience

Linking to Other Systems with FETCH/WRITE

a) Structure of WRITE Frames

The meaning and values of parameters shown without values in the following table can be found in the section "Parameter Values".

WRITE request frame

0	System ID	="S"
1		="5"
2	Length of header	=16d.
3	ID OP code	=01
4	Length OP code	=03
5	OP code	=03
6	ORG field	=03
7	Length ORG field	=08
8	ORG ID	
9	DBNR	
A	Start address	High Byte
B		Low Byte
C	Length	High Byte
D		Low Byte
E	Empty field	=FFh.
F	Length empty field	=02
	Data up to 64 K	

WRITE acknowledgment frame

0	System ID	="S"
1		="5"
2	Length of header	=16d.
3	ID OP code	=01
4	Length OP code	=03
5	OP code	=04
6	Ack field	=0Fh
7	Length ack field	=03
8	Error field	=No
9	Empty field	=FFh
A	Length empty field	=07
B	free	
C		
D		
E		
F		

a) Structure of FETCH Frames

The meaning and values of parameters shown without values in the following table can be found in the section "Parameter Values".

FETCH request frame

0	System ID	="S"
1		="5"
2	Length of header	=16d.
3	ID OP code	=01
4	Length OP code	=03
5	OP code	=05
6	ORG field	=03
7	Length ORG field	=08
8	ORG ID	
9	DBNR	
A	Start address	High Byte
B		Low Byte
C	Length	High Byte
D		Low Byte
E	Empty field	=FFh.
F	Length empty field	=02

FETCH response frame

0	System ID	="S"
1		="5"
2	Length of header	=16d.
3	ID OP code	=01
4	Length OP code	=03
5	OP code	=06
6	Ack field	=0Fh
7	Length ack field	=03
8	Error field	=No
9	Empty field	=FFh
A	Length empty field	=07
B	free	
C		
D		
E		
F		
	Data up to 64 K but only if Error no. =0	

Parameter Values

S7 Address Area	DB	M	I	Q
ORG ID	01_H Source/dest. data from/to data block in main memory	02_H Source/dest. data from/to flag area	03_H Source/dest. data from/to process image of the inputs (PII)	04_H Source/dest. data from/to process image of the outputs (PIQ)
DBNR	DB, from which the source data are taken or to which the dest data are transferred	irrelevant	irrelevant	irrelevant
permitted range	1...255			
Start address	DW number, from which the data are taken or written to	Flag byte no., from which the data are taken or written to	Input byte no., from which the data are taken or written to	Output byte no., from which the data are taken or written to
permitted range	0...2047	0...255	0...127	0...127
Length	Length of the source/dest. data field in words	Length of the source/dest. data field in bytes	Length of the source/dest. data field in bytes	Length of the source/dest. data field in bytes
permitted range	1...2048	1...256	1...128	1...128

S7 Address Area	PI/PQ	C	T
ORG ID	05_H Source/dest. data from/to in I/O modules. With source data input modules, with dest data output modules	06_H Source/dest data from/to counter cells	07_H Source/dest data from/to timer cells
DBNR	irrelevant	irrelevant	irrelevant
Start address	I/O byte no., from which the data are taken or written to	Number of the counter cell from which the data are taken or written to	Number of the timer cell from which the data are taken or written to
permitted range	0...127 digital I/Os 128...255 analog I/Os	0...255	0...255
Length	Length of the source/dest. data field in bytes	Length of the source/dest. data field in words (counter cell = 1 word)	Length of the source/dest. data field in words (counter cell = 1 word)
permitted range	1...256	1	1

CODE SNIPPETS

Some code snippets on how to populate the header for reading and writing operations. The developer has to write a scheduler so to have the read queries normally active. A write request will be fired as soon as a specific event raises (ex: the user presses a button to transfer new setpoints to the chamber).

In the next section, an example on how to format a data packet for writing commands and setpoints to the chamber will be given.

PART 1 – HOW TO WRITE DATA TO THE CHAMBER

WRITE OPERATION – COMMANDS NAD CHANNEL ENABLE FLAGS

Write commands (Run, Alarm reset etc.) are allocated into DB62 starting at address 1000.
We have to transfer 2 bytes (1 word) starting at the above address (1000).
The result in the memory of PLC, at address 1000, must be:
[Byte 0] => Channel flags CH0=T, CH1=RH, others (depending on the chamber)
[Byte 1] => Commands (run, Prgm, AlarmReset etc.

In the example below we have 1000.0 = 1 (that is, RUN = 1, see items [017]) and 1001.0 = 1, 1001.1 = 1 which means (see memory layout) temperature channel ON,
rel.humidity ON.

```
[000] = 83     <= Fixed, start header section ('S')
[001] = 53     <= Fixed,                      ('5')
[002] = 16     <= Fixed, header length, 16 bytes
[003] = 1      <= Fixed, OP code
[004] = 3      <= Fixed, OP code lenght
[005] = 3      <= Fixed, OP code
[006] = 3      <= Fixed, ORG field
[007] = 8      <= Fixed, length ORG field
[008] = 1      <= Use DB
[009] = 62     <= Number of DB, (a special case using DB15 instead of DB62)
[010] = 3      <= addr 1000=3E8 that is 3 in one byte, E8 (=232)) in the other
[011] = 232
[012] = 0
[013] = 1      <= 1 word, that is 2 bytes
[014] = 255
[015] = 2      <= End header packet
[016] = 3      <= Channel flags: CH0=on, CH1=ON: we are controlling T and RH
[017] = 1      <= Commands byte: Bit0=Run=ON, others OFF
```

Note that the same philosophy can be used for writing relays new status: just take into account that the address to be used is 1001 and relays are mapped into 2 words (see memory map layout).

WRITE OPERATION - SETPOINTS AND SLOPES

Details: channels starting at address 524 (byte addres, that is teh real PLC address)
We write 6 channels, evenn is only 2 channels are really used in the example.
Specifically:

Channel 0: Set=25 Celsius degree, Slope=0
Channel 1: Set=28 Celsius degree, Slope=0
Other channels forced to 0

Float representation refers to the IEEE754 standard, see the link at the bottom of this document.

```
[000] = 83      <= Fixed, start header section ('S')
[001] = 53      <  Fixed                       ('5')
[002] = 16      <= Fixed, header lenght, 16 bytes
[003] = 1       <  Fixed, OP code
[004] = 3       <  Fixed, OP code lenght
[005] = 3       <  Fixed, OP code
[006] = 3       <  Fixed ORG field
[007] = 8       <  Fixed, lenght ORG field
[008] = 1       <  Use DB
[009] = 62      <  Number of DB, in effect DB62
[010] = 3       <  Addr. 1008, that is 3F0 Hex => 3 and F0 (240) in bytes 10
and 11
[011] = 240
[012] = 0
[013] = 24      <= 24 word, that is 48 bytes
[014] = 255
[015] = 2       <= End header packet
[016] = 65      <= Set channel 0: 25 Celsius degree, 4 bytes, float
[017] = 200     <
[018] = 0       <
[019] = 0       <
[020] = 0       <= Slope channel 0, 4 bytes, float, Celsius degree/minute
[021] = 0       <
[022] = 0       <
[023] = 0       <
[024] = 65      <= Set channel 1: 28 Celsius degree, 4 bytes, float
[025] = 224     <
[026] = 0       <
[027] = 0       <
[028] = 0       <= Slope channel 1, 4 bytes, float, Celsius degree/minute
[029] = 0       <
[030] = 0       <
[031] = 0       <---------------
[032] = 0
[033] = 0
[034] = 0
[035] = 0
[036] = 0
[037] = 0
[038] = 0
```

```
[039] = 0
[040] = 0
[041] = 0
[042] = 0
[043] = 0
[044] = 0
[045] = 0
[046] = 0
[047] = 0
[048] = 0
[049] = 0
[050] = 0
[051] = 0
[052] = 0
[053] = 0
[054] = 0
[055] = 0
[056] = 0
[057] = 0
[058] = 0
[059] = 0
[060] = 0
[061] = 0
[062] = 0
[063] = 0
```

For converting a 4 byte hexadecimal packet into a floating number and viceversa, see the link below or others for the same purpose.

http://babbage.cs.qc.cuny.edu/IEEE-754.old/Decimal.html

SAIA MEMORY LAYOUT VERS. 2.0

It's very important that writing operations are correct from the format point of view and from the addresses point of view.

Wrong data or wrong addresses for data can create problems in the functionality of the chamber.

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In the following section the memory layout of the chamber controller version 2.00 is shown

In this version the entire area available to the user is divided in two different sections, the first of them dedicated only for reading and the second one for writing.

Please, note that the SAIA controller provides a wide range of facilities (temperature inputs, analog inputs, contacts, regulators and so on) and only a sub-set of these could be really used to control the chamber.

Please, always refers to the memory layout to have the detailed description of what available in your system.

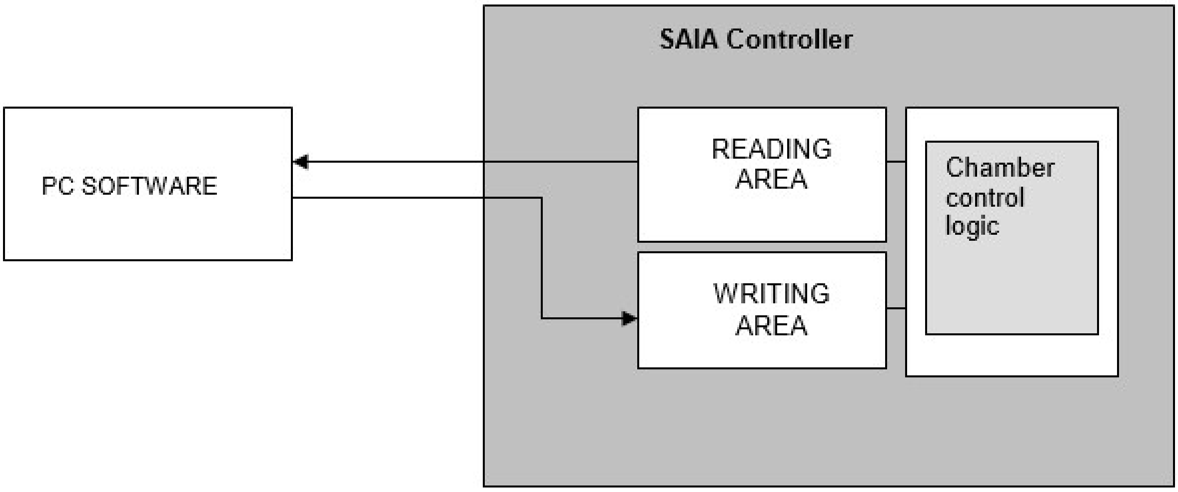
The PC software normally reads the **reading area** in order to know the status (measures, activations, alarms) of the chamber.

When a new status for the chamber is required (for example, the user wants to change the temperature set for the chamber from 35 to 75 Celsius degree), the PC software makes a query to the SIEMENS S7, writing data into the **writing area.** When done, the PC software simply turn back to its normal task: reading from the chamber.

According to the data sent by the PC, chamber controller will try to act in order to satisfy the user requests, if possible.

A logic layout is shown below (the picture refers to SAIA controller, but it is the same for Siemens. In effect all notes are common to both):

Fig. 7 System logic layout



CHAMBER CONTROL AT A GLANCE

From logical point of view a chamber can be seen as:

Measure channels

Analogic channels, temperature and humidity channels and so on.

In effect each channel is related to a specific parameter to acquire.

Controlled channels

Temperature and rel. humidity are controlled channels, for example.

The user defines a setpoint and the internal (PLC) PID try to reach (and maintain) the required setpoint.

Note that it is necessary also to enable the channel to work. In other words, you need to give the regulator the setpoint and the “enable” command (a bit in a specific word inside the memory layout, as you will see later).

Activations

Rele' are available to the user

Alarms

ON/OFF signals coming from chambers. they identifies specific conditions or events.

All these information are the matter to work with, even if a very little subset is strictly necessary to make the system working. It depends on the user requirements to decide how many data to acquire.
The entire set of data as described above is available in a specific PLC memory area, as described into the documentation.

RUNNING A TEST

A test is defined by T setpoint and slope, RH setpoint and slope (if RH control is required), activation status (ON or OFF) for the channels, activation status for the contacts.
All these data have to be sent to the Write Area of the mplc, according to the PLC memory layout.
The chamber will work with the sent parameters until the user will change them.
To stop a test, simply make the same operations as before, forcing to zero all the values and the contact status.

READING AREA

The information in this area allows the user to know the general status of the system.
According to the application to be developed only a part of these information could be necessary.
Gray backgorund (where present) identifies items not used in this system.
A skeleton of a conversion C function is showed for each table. Please note that the type "int" represents 4 bytes while "short int" is 2 bytes and float is 4 bytes.

SYSTEM MEASURES

MEASURE INDEX	MEASURE ADDRESS (in bytes)	MEANING	NOTES
0	0	Dry bulb temperature/PT100 suction	
1	4	Wet bulb/PT100 discharge	
2	8	PT100-User n.0	
3	12	PT100-User n.1	
4	16	PT100-User n.2	
5	20	PT100-User n.3	
6	24	Low stage suction presuure	
7	28	Low stage discharge pressure	
8	32	High stage suction pressure	
9	36	High stage discharge pressure	
10	40	User analog input 0	
11	44	User analog input 1	
12	48	User analog input 2	
13	52	User analog input 3	
14	56	User analog input 4	
15	60	User analog input 5/Capacitive probe	
16	64	Chamber Temperature	

17	68	Relative humidity	
18	72	Absolute Humidity	
19	76	Not used	
20	80	Not used	
21	84	Not used	
22	88	Not used	
23	92	Not used	
24	96	Not used	
25	100	Not used	
26	104	CHannel 0 Measure	
27	108	CHannel 1 Measure	
28	112	Not used	
29	116	Not used	
30	120	Not used	
31	124	Not used	

Use this function to decode floating point value coming from Siemens S7 into C floating point

```
float conv_float_s7_pc(char * plc_real)
{
	char tmp[4];

	tmp[0] = * (plc_real + 3);
	tmp[1] = * (plc_real + 2);
	tmp[2] = * (plc_real + 1);
	tmp[3] = * (plc_real + 0);

	return (* (float *) tmp) ;
}
```

USER AND REAL SETTINGS

It is important to well understand the logic operations in sending a new data configuration (we intend a new group of data the chamber has to use, for example new temperature settings, new RUN/STOP status and so on). In effect, this operation can be seen as composed of 2 different stages:

1. **the user prepares the new set of data and send it to the controller (user settings)**
2. **the controller acts properly to work with the new set (if possible) (real settings)**

From the above description you can understand that the final result of the entire operation can or cannot be the same as requested by the user depending on the chamber and controller status. For example, suppose that an alarm is present in the system, so the chamber is in alarm condition. If the user send a new set of data in order to change the status of the RUN bit (the user wants the chamber running), no action will take place, because of the alarm.
In other words, we have a "user setting" group of data in which the RUN bit is in ON status, while the same bit in the "real settings" will be in OFF status.

ACTIVATIONS AND LOGICAL STATUS (USER SETTINGS)

INDEX	USER SETTINGS ADDRESS	REAL SETTINGS ADDRESS	MEANING	NOTES
0	138.0	146.0	Enable channel n. 0	TEMPERATURE
1	138.1	146.1	Enable channel n. 1	HUMIDITY
2	138.2	146.2	Enable channel n. 2	RESERVED. KEEP AT 0
3	138.3	146.3	Enable channel n. 3	RESERVED. KEEP AT 0
4	138.4	146.4	Enable channel n. 4	RESERVED. KEEP AT 0
5	138.5	146.5	Enable channel n. 5	RESERVED. KEEP AT 0
6	138.6	146.6	Enable channel n. 6	RESERVED. KEEP AT 0
7	138.7	146.7	Enable channel n. 7	RESERVED. KEEP AT 0
8	139.0	147.0	Run	
9	139.1	147.1	Alarm reset	
10	139.2	147.2	Program (1) – manual (0) mode	RESERVED. KEEP AT 0
11	139.3	147.3	Local(1) – Remote (0) mode	RESERVED. KEEP AT 0
12	139.4	147.4	Pause	RESERVED. KEEP AT 0

13	139.5	147.5	Freeze	RESERVED. KEEP AT 0
14	139.6	147.6	Not used	RESERVED. KEEP AT 0
15	139.7	147.7	Not used	RESERVED. KEEP AT 0
INDEX	USER SETTINGS ADDRESS	REAL SETTINGS ADDRESS	MEANING	NOTES
16	140.0	148.0	Dedicated contact n. 09	-
17	140.1	148.1	Dedicated contact n. 10	-
18	140.2	148.2	Dedicated contact n. 11	-
19	140.3	148.3	Dedicated contact n. 12	-
20	140.4	148.4	Dedicated contact n. 13	-
21	140.5	148.5	Dedicated contact n. 14	-
22	140.6	148.6	Dedicated contact n. 15	-
23	140.7	148.7	Dedicated contact n. 16	-
24	141.0	149.0	Dedicated contact n. 01	Dehumidification
25	141.1	149.1	Dedicated contact n. 02	Vibration system
26	141.2	149.2	Dedicated contact n. 03	Device under test
27	141.3	149.3	Dedicated contact n. 04	UV Lamp
28	141.4	149.4	Dedicated contact n. 05	Water recharge
29	141.5	149.5	Dedicated contact n. 06	LN2 AUX
30	141.6	149.6	Dedicated contact n. 07	LN2
31	141.7	149.7	Dedicated contact n. 08	Dry air
32	142.0	150.0	Auxiliary contact n. 09	
33	142.1	150.1	Auxiliary contact n. 10	
34	142.2	150.2	Auxiliary contact n. 11	

35	142.3	150.3	Auxiliary contact n. 12	
36	142.4	150.4	Auxiliary contact n. 13	
37	142.5	150.5	Auxiliary contact n. 14	
38	142.6	150.6	Auxiliary contact n. 15	
39	142.7	150.7	Auxiliary contact n. 16	
40	143.0	151.0	Auxiliary contact n. 01	Auxiliary relais 1
41	143.1	151.1	Auxiliary contact n. 02	Auxiliary relais 2
42	143.2	151.2	Auxiliary contact n. 03	Auxiliary relais 3
43	143.3	151.3	Auxiliary contact n. 04	Auxiliary relais 4
44	143.4	151.4	Auxiliary contact n. 05	Auxiliary relais 5
45	143.5	151.5	Auxiliary contact n. 06	Auxiliary relais 6
46	143.6	151.6	Auxiliary contact n. 07	Auxiliary relais 7
47	143.7	151.7	Auxiliary contact n. 08	Auxiliary relais 8
VACUUM CHAMBERS ONLY				
48	144.0	152.0	Vacuum command n. 09	
49	144.1	152.1	Vacuum command n. 10	
50	144.2	152.2	Vacuum command n. 11	
51	144.3	152.3	Vacuum command n. 12	
52	144.4	152.4	Vacuum command n. 13	
53	144.5	152.5	Vacuum command n. 14	
54	144.6	152.6	Vacuum command n. 15	
55	144.7	152.7	Vacuum command n. 16	
56	145.0	153.0	Vacuum command n. 01	
57	145.1	153.1	Vacuum command n. 02	
58	145.2	153.2	Vacuum command n. 03	

59	**145.3**	**153.3**	**Vacuum command n. 04**	
60	**145.4**	**153.4**	**Vacuum command n. 05**	
61	**145.5**	**153.5**	**Vacuum command n. 06**	
62	**145.6**	**153.6**	**Vacuum command n. 07**	
63	**145.7**	**153.7**	**Vacuum command n. 08**	

The following function can be used to decode data coming from Siemens S7

```
short int conv_word_mplc_to_word_pc(unsigned char * buf)

{
        return ((short int) ((* (buf + 0)) << 8) + ((* (buf + 1)) << 0));
}
```

After decoding, each bit of the word will have the meaning previously described.

ALARMS AND MESSAGES

The following messages list is general: **_some of them could not be used in your chamber_**. Note that messages are associated to bits, so the term “128.3” means “bit number 3 (counting from 0) at address 128”.

INDEX	PLC ADDRESS	MEANING	NOTES
0	128.0	Safety temperature switch	
1	128.1	Overload cutout	
2	128.2	Thermal cutout	
3	128.3	Power fail	
4	128.4	Emergency switch	
5	128.5	Door open	
6	128.6	Max temperature	
7	128.7	Adjustable max temperature	
8	129.0	Adjustable min temperature	
9	129.1	Pt100 dry bulb sensor fail	
10	129.2	TC dut sensor fail	
11	129.3	Pt100 wet bulb sensor fail	
12	129.4	Salt solution min level	
13	129.5	Water lack	
14	129.6	Steam generator max temperature	
15	129.7	Low stage compressor min oil pressure	
16	130.0	Low stage compressor overload cutout	
17	130.1	Low stage compressor thermal cutout	
18	130.2	Low stage fan compressor overload cutout	
19	130.3	Max low stage pressure	

20	130.4	Min low stage pressure	
21	130.5	Max low stage discharge temperature	
22	130.6	High stage compressor min oil pressure	
23	130.7	High stage compressor overload cutout	
24	131.0	High stage compressor thermal cutout	
25	131.1	High stage fan compressor overload cutout	
26	131.2	High stage max pressure	
27	131.3	High stage min pressure	
28	131.4	Max high stage discharge temperature	
29	131.5	Intermediate fluid overtemperature	
30	131.6	Intermediate fluid undertemperature	
31	131.7	Max intermediate fluid level	
32	132.0	Min intermediate fluid level	
33	132.1	Intermediate fluid overpressure	
34	132.2	Intermediate fluid underpressure	
35	132.3	Intermediate fluid pump overload cutout	
36	132.4	Intermediate fluid pump thermal cutout	
37	132.5	Condenser fan overload cutout	
38	132.6	Water lack pre-alarm	
39	132.7	Min condenser water flow	
40	133.0	Min compressed air pressure	
41	133.1	Min differential pressure	
42	133.2	Min liquid nytrogen pressure	
43	133.3	Smoke detector	
44	133.4	Max CO concentration	
45	133.5	Min oxygen concentration	

46	133.6	Inverter fail	
47	133.7	Vacuum pump overload cutout	
48	134.0	Vacuum pump thermal cutout	
49	134.1	Vacuum pump warmup	
50	134.2	Ventilation lack	
51	134.3	Air filter	
52	134.4	Low stage compressor start-up failure	
53	134.5	High stage compressor start-up failure	
54	134.6	Movement timeout	
55	134.7	Defrosting in progress	
56	135.0	Defrosting timeout	
57	135.1	Capacitive probe temperature out of range	
58	135.2	Acceleration critical deviation	
59	135.3	Oxygen min. concentration (Non critical)	
60	135.4	Hardware alarm (WinSmartkit)	
61	135.5		
62	135.6		
63	135.7		
64	136.0		
65	136.1		
66	136.2		
67	136.3		
68	136.4		
69	136.5		
70	136.6		
71	136.7		

72	**137.0**		
73	**137.1**		
74	**137.2**		
75	**137.3**		
76	**137.4**	**Remote mode control**	
77	**137.5**	**Abort test in program mode**	
78	**137.6**	**End test**	
79	**137.7**	**Critical alarm**	

The decode operation on data coming from Siemens S7 can be accomplished by the following function:

```
short int conv_word_mplc_to_word_pc(unsigned char * buf)

{
        return ((short int) ((* (buf + 0)) << 8) + ((* (buf + 1)) << 0));
}
```

After decoding, each bit of the word will have the meaning previously described.

SETPOINTS READING

The values reported here are the setpoint values currently used by the regulators inside the chamber controller. Note that the final setpoint equals the current setpoint only in case of maintenances or slopes at max. speed. They will be different in case of controlled slopes (gradient different from 0).

As previously stated, in the standard chambers channel 0 is the Temperature regulator, while channel 1 is the Rel. Humidity regulator.
Note: the word “gradient” is used in the meaning of “slope”, even if the real physical meaning is different

Please, note that all the values are floating point.

CHANNEL INDEX	ADDRESS	MEANING	NOTES
0	154	User final setpoint	TEMPERATURE
0	158	Current user setpoint	TEMPERATURE
0	162	Gradient	TEMPERATURE
1	166	User final setpoint	RELATIVE HUMIDITY
1	170	Current user setpoint	RELATIVE HUMIDITY
1	174	Gradient	RELATIVE HUMIDITY
2	178	User final setpoint	NOT USED
2	182	Current user setpoint	NOT USED
2	186	Gradient	NOT USED
3	190	User final setpoint	NOT USED
3	194	Current user setpoint	NOT USED
3	198	Gradient	NOT USED
4	101-102	User final setpoint	NOT USED
4	103-104	Current user setpoint	NOT USED

4	**105-106**	**Gradient**	**NOT USED**
5	**107-108**	**User final setpoint**	**NOT USED**
5	**109-110**	**Current user setpoint**	**NOT USED**
5	**111-112**	**Gradient**	**NOT USED**
6	**113-114**	**User final setpoint**	**NOT USED**
6	**115-116**	**Current user setpoint**	**NOT USED**
6	**117-118**	**Gradient**	**NOT USED**
7	**119-120**	**User final setpoint**	**NOT USED**
7	**121-122**	**Current user setpoint**	**NOT USED**
7	**123-124**	**Gradient**	**NOT USED**

How to decode a floating point value coming from Siemens SIMATIC S7 into C

floating point variable:

```
float conv_float_s7_pc(char * plc_real)
{
	char tmp[4];
	tmp[0] = * (plc_real + 3);
	tmp[1] = * (plc_real + 2);
	tmp[2] = * (plc_real + 1);
	tmp[3] = * (plc_real + 0);
	return (* (float *) tmp) ;
}
```

TEST PROGRAM STATUS

All information on the test cycle status currently running are reported in this section.

	ADDRESS	MEANING	NOTES
	250	Total segment number	
	252	First segment	
	254	Current segment	
	256	Current segment duration (seconds)	
	260	Current segment elapsed time (seconds)	
	264	Current segment remaining time (seconds)	
	268	Test program elapsed time (seconds)	
	272	RESERVED	
CONTACT NUMBER	ADDRESS	DEDICATED CONTACTS	NOTES
1	274.0	Dedicated contact n. 09	-
2	274.1	Dedicated contact n. 10	-
3	274.2	Dedicated contact n. 11	-
4	274.3	Dedicated contact n. 12	-
5	274.4	Dedicated contact n. 13	-
6	274.5	Dedicated contact n. 14	-
7	274.6	Dedicated contact n. 15	-
8	274.7	Dedicated contact n. 16	-
9	275.0	Dedicated contact n. 01	Dehumidification
10	274.1	Dedicated contact n. 02	Vibration system
11	275.2	Dedicated contact n. 03	Device under test
12	275.3	Dedicated contact n. 04	UV Lamp
13	275.4	Dedicated contact n. 05	Water recharge

14	275.5	Dedicated contact n. 06	LN2 AUX
15	275.6	Dedicated contact n. 07	LN2
16	275.7	Dedicated contact n. 08	Dry air
CONTACT NUMBER	ADDRESS	AUXILIARY CONTACTS	NOTES
1	276.0	Auxiliary conatct n. 09	
2	276.1	Auxiliary conatct n. 10	
3	276.2	Auxiliary conatct n. 11	
4	276.3	Auxiliary conatct n. 12	
5	276.4	Auxiliary conatct n. 13	
6	276.5	Auxiliary conatct n. 14	
7	276.6	Auxiliary conatct n. 15	
8	276.7	Auxiliary conatct n. 16	
9	277.0	Auxiliary conatct n. 01	
10	277.1	Auxiliary conatct n. 02	
11	277.2	Auxiliary conatct n. 03	
12	277.3	Auxiliary conatct n. 04	
13	277.4	Auxiliary conatct n. 05	
14	277.5	Auxiliary conatct n. 06	
15	277.6	Auxiliary conatct n. 07	
16	277.7	Auxiliary conatct n. 08	

The decode operation on data coming from Siemens S7 can be accomplished by the function reported below. After decoding, each bit of the word will have the meaning previously described.

```
short int conv_word_mplc_to_word_pc(unsigned char * buf)
{
        return ((short int) ((* (buf + 0)) << 8) + ((* (buf + 1)) << 0));
}
```

Converting the time representation from Siemens S7 (double word) into PC representation

```
int conv_dword_s5s7_pc(char * plc_dword)
{
	char tmp[4];

	tmp[0] = * (plc_dword + 3);
	tmp[1] = * (plc_dword + 2);
	tmp[2] = * (plc_dword + 1);
	tmp[3] = * (plc_dword + 0);

	return(* (int *) tmp);
}
```

WRITING AREA

This is the “control” area wherein the user must write the new operative configuration he wants for the system. The term “new operative configuration” means the desired status of the relays, setpoints, gradients and channels in order to obtain a certain behaviour from the chamber.

The setpoint and gradient values of the various channels are represented as floating point values. So, for instance, if you want to set the value of 75.0 degrees with gradient of 1.5 Celsius degrees/minute, it will be necessary to write 75 and 1.5 in the correspondent locations.
As already stated, channel 0 refers to the temperature channel.
Gray background identifies items not used for the current system.

ADDRESS (in word)	MEANING	NOTES
1000.0	Enable Channel 0	TEMPERATURE
1000.1	Enable Channel 1	REL.HUMIDITY
1000.2	Enable Channel 2	NOT USED, KEEP AT 0
1000.3	Enable Channel 3	NOT USED, KEEP AT 0
1000.4	Enable Channel 4	NOT USED, KEEP AT 0
1000.5	Enable Channel 5	NOT USED, KEEP AT 0
1000.6	Enable Channel 6	NOT USED, KEEP AT 0
1000.7	Enable Channel 7	NOT USED, KEEP AT 0
1001.0	Run	
1001.1	Alarm reset	
1001.2	Program(1) - Manual(0) mode	
1001.3	Local(1) - Remote(0) mode	Reserved, keep at 0
1001.4	Pause (reserved)	Reserved, keep at 0
1001.5	Freeze (reserved)	Reserved, keep at 0
1001.6	Not used	Reserved, keep at 0
1001.7	Not used	Reserved, keep at 0

1002.0	Dedicated contact n. 09	-
1002.1	Dedicated contact n. 10	-
1002.2	Dedicated contact n. 11	-
1002.3	Dedicated contact n. 12	-
1002.4	Dedicated contact n. 13	-
1002.5	Dedicated contact n. 14	-
1002.6	Dedicated contact n. 15	-
1002.7	Dedicated contact n. 16	-
1003.0	Dedicated contact n. 01	Dehumidification
1003.1	Dedicated contact n. 02	Vibration system
1003.2	Dedicated contact n. 03	Device under test
1003.3	Dedicated contact n. 04	UV Lamp
1003.4	Dedicated contact n. 05	Water recharge
1003.5	Dedicated contact n. 06	LN2 AUX
1003.6	Dedicated contact n. 07	LN2
1003.7	Dedicated contact n. 08	Dry air
1004.0	Auxiliary contact n. 09	
1004.1	Auxiliary contact n. 10	
1004.2	Auxiliary contact n. 11	
1004.3	Auxiliary contact n. 12	
1004.4	Auxiliary contact n. 13	
1004.5	Auxiliary contact n. 14	
1004.6	Auxiliary contact n. 15	
1004.7	Auxiliary contact n. 16	

1005.0	Auxiliary contact n. 01	
1005.1	Auxiliary contact n. 02	
1005.2	Auxiliary contact n. 03	
1005.3	Auxiliary contact n. 04	
1005.4	Auxiliary contact n. 05	
1005.5	Auxiliary contact n. 06	
1005.6	Auxiliary contact n. 07	
1005.7	Auxiliary contact n. 08	
VACUUM CHAMBERS ONLY		
ADDRESS	MEANING	NOTES
1006.0	Vacuum command n. 09	
1006.1	Vacuum command n. 10	
1006.2	Vacuum command n. 11	
1006.3	Vacuum command n. 12	
1006.4	Vacuum command n. 13	
1006.5	Vacuum command n. 14	
1006.6	Vacuum command n. 15	
1006.7	Vacuum command n. 16	
1007.0	Vacuum command n. 01	
1007.1	Vacuum command n. 02	
1007.2	Vacuum command n. 03	
1007.3	Vacuum command n. 04	
1007.4	Vacuum command n. 05	
1007.5	Vacuum command n. 06	
1007.6	Vacuum command n. 07	
1007.7	Vacuum command n. 08	

CHANNEL NUMBER	ADDRESS	MEANING	NOTES
0	1008	User final setpoinrt	TEMPERATURE
0	1012	Gradient	TEMPERATURE
1	1016	User final setpoinrt	RELATIVE HUMIDITY
1	1020	Gradient	RELATIVE HUMIDITY
2	1024	User final setpoinrt	NOT USED
2	1028	Gradient	NOT USED
3	1032	User final setpoinrt	NOT USED
3	1036	Gradient	NOT USED
4	1040	User final setpoinrt	NOT USED
4	1044	Gradient	NOT USED
5	1048	User final setpoinrt	NOT USED
5	1052	Gradient	NOT USED
6	1056	User final setpoinrt	NOT USED
6	1060	Gradient	NOT USED
7	1064	User final setpoinrt	NOT USED
7	1068	Gradient	NOT USED

The setpoint and slope values can be done via the following functions

```
void conv_float_pc_s7(float pc_real, char * plc_real)
{
        plc_real[0] = * ((char *) &pc_real + 3);
        plc_real[1] = * ((char *) &pc_real + 2);
        plc_real[2] = * ((char *) &pc_real + 1);
        plc_real[3] = * ((char *) &pc_real + 0);
}
```

This function can be used to write words at address 500 up to 502.

```
short int conv_word_mplc_to_word_pc(unsigned char * buf)

{

        return ((short int) ((* (buf + 0)) << 8) + ((* (buf + 1)) << 0));

}
```

NOTES

- The ALARM RESET operation is made setting to 1 the corresponding bit. The SIEMENS S7 will provide in automatic mode to force it to 0 after few seconds.

- The bit **LOCAL/REMOTE** bit is reserved and not used at the moment. It must be forced to 0. Same for all the bits not used for the specific application.

- In order to work, a regulator needs both the setpoint value and the enable bit in ON status (bit 500.8 and following). For instance, the temperature controller (Channel 0) will be in stand-by and will not execute any regulation in case that the enabling bit (bit 500.8) is equal to 0.