sigmaline specialPAC sP4/8
User Manual

User Manual
M.U.
Code: ISTR_U_sP-SERIES_E_01_--

Ascon Tecnologic srl
Headquarters: viale Indipendenza 56,
27029 Vigevano (PV)
Phone: +39 0381 69871
Fax: +39 0381 698730
Internet Site: www.ascontecnologic.com
E-mail address: info@ascontecnologic.com

Preface

The products described in this manual should be installed, operated and maintained only by qualified application programmers and software engineers who are familiar with EN 61131-3 concepts of PLC programming, automation safety topics, and applicable national standards.

Using this manual

Specifications within the text of this manual are given in the International System of Units (SI), with non SI equivalents in parentheses.

The references to other manuals are pointed out with a number between barckets. The number indicates the position of the manual in the list in: "*Appendix C - Reference documents*".

Fully Capitalized words within the text indicate markings found on the equipment.

Words in **bold** style within the text indicate markings found in the Configuration Tools.

Warnings, Cautions and Notes are used to emphasize critical instructions:

DANGER!
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING!
Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Caution
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Note: Highlights important information about an operating procedure or the equipment.

General Warnings

WARNING!
Ascon Tecnologic S.r.l. and its legal representatives do not assume any responsibility for any damage to people, things or animals deriving from violation, wrong or improper use or in any case not in compliance with the instrument features.

DANGER!
Whenever a failure or a malfunction of the device may cause dangerous situations for persons, thing or animals, please remember that the plant has to be equipped with additional electromechanical devices which will guarantee safety.

Current Documentation on the Internet

Make sure you are always working with the latest version of this document.
Ascon Tecnologic S.r.l. reserves the right to make changes to its products in the name of technological advancement.
New manual revisions, when published, and can be found online at:

http://www.ascontecnologic.com

INDEX

Chapter 1
Technical data

WARNING!
In this manual is described only the **High side** version of the CPU.
The manual that describes the **Low side** version (no longher sold) can be downloaded (free of charge) from:
`www.ascontecnologic.com`
Search sP4 or sP8, in the lower part of the CPU web page click on the "*User manual*" link and select the `ISTR_U_sP-LS_E_01.pdf` file

1-1 General and environmental characteristics

Feature	Description
Power supply	24 Vdc (-15... +25%)
Power consumption	sP4: 10 W max., sP8: 15 W max.
Operating temperature	-20... 50°C (-4... 122°F)
Storage temperature	-40... 70°C (-40... 158°F)
Relative Humidity	5...95 % w/o condensation
Mounting	Omega DIN A rail
Dimensions	sP4: W: 105 H: 110 D: 60 (mm) - 6 DIN module sP8: W: 175 H: 110 D: 60 (mm) - 10 DIN module
Weight	sP4: 200 g; sP8: 350 g.
Protection Degree	IP20
Safety	Compliance to EN 61131-2 Isolation class II (50 Vrms), EN61010-1
Approvals	CE, UL

1-2 Functional characteristics

Feature	Description
Programming languages	IL, ST, FBD, LD, SFC, CFC
Program memory	Max. 0.5 MB internal or on USB key
Dynamic memory	1 MB SRAM
Retentive memory	3.2 kB NVRAM – 16 kB Flash preserved
Data retention (for power failure)	Battery dependant (for NVRAM) 15 years (for Flash)
Min. cycle time	Typical 7 ms
Max. timer resolution	1 ms
Real Time Clock	With rechargeable backup battery
Max. PID number	Unlimited, application or cycle time dependent

1-3 I/O Characteristics

1-3-1 Digital Input Channels (DI1... D8, DI9... DI16)

Feature	Description
Type	Configurable as Digital Input (OFF = 0... 3 V, ON = 5... 30 V)
Compliance	IEC/EN 61131-2 (type 3)
Terminal connectors	X5 (sP4), X5 and X7 (sP8)

1-3-2 Pulse Counter/Frequency/DI (CN1... CN4)

Feature	Description
Type	Configurable as Standard DI, Pulse Counter or Frequency-meter (up to 5 kHz)
Compliance	IEC/EN 61131-2 (type 2)
Terminal connector	X7 (sP4 and sP8)

1-3-3 Specific Relay/SSR Outputs (OP1... OP4, OP6... OP9)

OP1... OP4 and OP6... OP9 are designed to be Digital Outputs only: the type can be selected from the ordering code as Relay, SSR drive, or SSR Relay.

Note: When a mixed confguration is chosen, remember that the outputs must be selected in pairs (OP1/OP2, OP3/OP4, OP6/OP7 and OP8/OP9).

2 A SPST Relay

OP1... OP4, OP6... OP9 as relay outputs with SPST (Single pole, single throw)

Feature	Description
Contact configuration	SPST (Single Pole, Single Throw)
Contact rate	2 A (for resistive loads)
Isolation	3 kV between each channel and main electronics
Output connectors	X3 (sP4), X3 and X14 (sP8)

SSR relay

OP1... OP4, OP6... OP9 as SSR relay

Feature	Description
Rate	0.3 A, 250 Vac or 2 A, 24 Vdc
Special function	Zero Crossing Function (Vac type)
Isolation	2500V between each channel and main electronics
Output connectors	X3 (sP4), X3 and X14 (sP8)

0/12 Vdc for external SSR

OP1... OP4, OP6... OP9 as 0/12 Vdc outputs for SSR drive

Feature	Description
Power output	10 mA, 12 Vdc
Isolation	None
Output connectors	X3 (sP4), X3 and X14 (sP8)

1-3-4 Special Relay outputs (OP5, OP10)

OP5 is a 5 A SPST relay output, while OP10 is a 5 A SPDT relay Output.

OP5 Characteristics

Feature	Description
Contact configuration	SPST (Single Pole, Single Throw)
Contact rate	5 A (for resistive loads)
Isolation	3 kV between each channel and Power Supply and between channel and main electronics
Protection	This output is protected with varistors
Output connector	X2 (sP4 and sP8)

OP10 Characteristics

Feature	Description
Contact configuration	SPDT (Single Pole, Double Throw)
Contact rate	5 A (for resistive loads)
Isolation	3 kV between each channel and Power Supply and between channel and main electronics
Output connector	X13 (sP4 and sP8)

1-3-5 Generic Inputs (IN1... IN4, IN5... IN8)

IN1... IN8 are configurable Inputs.

Feature	Description
Type of input	**IN1 only:** Strain gauge or 0/4... 20 mA, 0/1... 5 V, 0/2... 10 V, Thermocouple (type J, K, L, N, R, S, T), PT100 (2 wires), PT1000, NTC (Semitec 103AT-2), Potentiometer or 5 V Ratiometric
	IN2... IN8: 0/4... 20 mA, 0/1... 5 V, 0/2... 10 V, Thermocouple (type J, K, L, N, R, S, T), PT100 (2 wires), PT1000, NTC (Semitec 103AT-2), Potentiometer or 5 V Ratiometric
Resolution	16 bit
Accuracy	0.5 % of span (linear inputs)/0.5% (Temperature), ±1°C (cold junction)
Input impedance	120 kΩ (V), < 200 Ω (mA)
Input connectors	X8 (sP4), X8 and X18 (sP8)

1-3-6 Generic Output (OT1... OT4, OT5... OT8)

OT1... OT8 are configurable Outputs.

Feature	Description
OT1... OT8	0/1... 5 V, 0/2... 10 V, 0/4... 20 mA, Digital Output
Load	< 500 Ω (mA), > 1 kΩ (V), Digital output: Output voltage:12 V max. supplied current 10 mA
Resolution	14 bit
Accuracy	0.1% full scale
Connectors	X9 (sP4), X9 and X10 (sP8)

1-3-7 Generic Digital Outputs (DO1... DO8, DO9... DO16)

Feature	Description
Output load	The digital output loads must not exceed 0.5 A each
Connectors	X4 (sP4), X5 and X15 (sP8)

WARNING!
Whatever the feeding method is, the max. cumulative current consumption of a block of 8 Outputs (DO1... DO8/DO9... DO16) must be less than 1.6 A.

WARNING!
The **DO** ports (**X4** and **X15**) indicated in this table are those present in the **High side** version of the CPU, the manual that describes the **Low side** version (no longher sold) can be downloaded (free of charge) from
`www.ascontecnologic.com`
(see page 1 for further details)

1-4 Communication ports

1-4-1 COM1 Serial Communications port (X13)

Connect an RS485 terminal (also for setup purposes). Through this port, using the Modbus RTU protocol (master/slave) or serial ASCII the PLC can connect a fieldbus network.

Feature	Description
Isolation	800 V between main electronics (optional)
Connector	X13 (COM1) (sP4 and sP8)

1-4-2 Ethernet Communications port (X9)

Ethernet port (TCP/IP) can be used to configure, program, debug, commission and for Modbus TCP data exchange.

1-4-3 LIN Communications port (X10)

The LIN Port allows to connect the specific digital display through a dedicated cable.

1-5 Other ports

1-5-1 USB port (X11)

USB port (X11) to connect a flash drive (Firmware, system files upload/download or data logging).

1-5-2 LIN port (X9)

The LIN Port allows to connect a the specific digital display through a dedicated cable.

Chapter 2
Hardware description

The system described in this User Manual is mainly composed by:

- Ascon Tecnologic special**PAC sP4/8** CPU which can be equipped by:
  - Up to 4 (8 for sP8) generic inputs: mA, V, thermocouple, PT100, PT1000, NTC, potentiometer, 5 V Ratiometric, Strain gauge (only IN1);
  - Up to 4 (8 for sP8) generic Outputs (mA or V);
  - Up to 8 (16 for sP8) 24 Vdc Digital Inputs;
  - Up to 8 (16 for sP8) High Side Digital Outputs or
    up to 8 (16 for sP8) Low Side (sync) type Digital Outputs (the sync type outputs are no longer sold, but are here mentioned to support the old models);
  - Up to 4 (8 for sP8) SPST-NO relays/SSR/SSR drive Outputs;
  - Up to 4 pulse counts or frequency (0.1... 10 kHz) Inputs;
  - 1 (2 for sP8) high power relay output. OP5 is a 5 A SPST-NO relay, OP10 (sP8 only) is an SPDT 5 A relay.
- **exPAC** remote I/O Modbus expansion modules;
- Infoteam OpenPCS programming tool system.

special**PAC sP4/8** is part of the sigma**line** family and is based on a powerful CPU board powered by an ARM Cortex 32 bit processor with Real Time clock, operating in conjunction with various type of memory which guarantee a very efficient management of all on-board specific I/Os and allows to handle, simultaneously, up to 3 communication ports.

sigma**line exPAC** is a family of flexible analogue and/or digital I/O expansion modules, which can be also connected to the **sP4/8** CPU module through the COM1 communications port (with Modbus).

Infoteam **OpenPCS** is a powerful and useful EN61131-3 compliant programming tool to build flexible PLC applications.

It is a clearly structured and easily operated tool to edit, compile, debug, manage and print PLC applications during all the development phases.

OpenPCS can operates on Windows 7®, Windows 8® and Windows 10® (32 or 64 bit) platforms.

The Ascon Tecnologic **sP4/8** unit based on sigma**line** technology, combines its control capabilities with the functionalities of a PLC. It introduces the "*Modular concept*" which means that you can adapt the system quickly and easily to your requirements: this gives to the sigmaline automation systems an amazing price/performance ratio.

This User Manual handbook introduces you to the sigma**line sP4/8** solution and the Infoteam **OpenPCS** programming tool.

It explains how to install the hardware and software and how to startup the system. Information on maintenance, troubleshooting and services are also included.

2-1 Architecture

From the programmer's point of view, a complete system can be arranged as in "*Figure 2.1 - Programming the sigmaline sP4/8 Control Unit*" below:

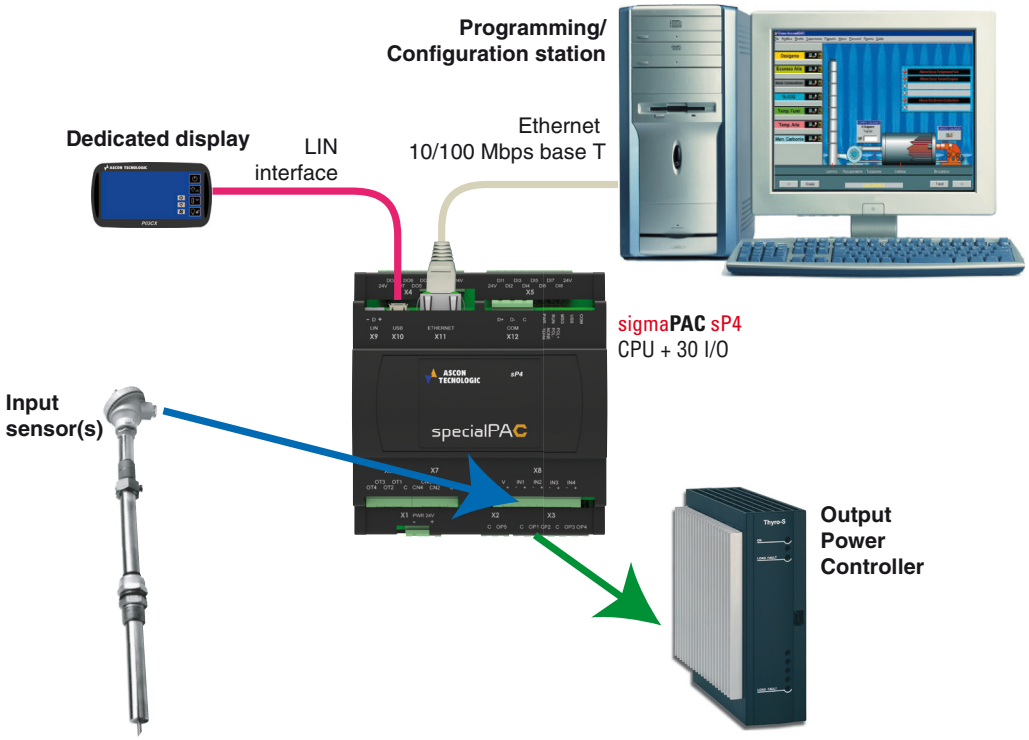


Figure 2.1 - Programming the sigmaline sP4/8 Control Unit

2-1-1 Communication ports

The CPU has 3 communication ports (see "*Chapter 2 - Control Unit Supply, I/O and Communication Ports*"):

- An Ethernet port (TCP/IP) which can be used to perform:
  - CPU configuration using a Telnet client session;
  - Programming, debugging and commissioning;
  - Modbus TCP data exchange;
- An RS485 port (connector X13) to perform:
  - Standard ASCII protocol communication;
  - Modbus RTU master/slave communication data exchange.
- The LIN Port allows to connect a digital display through a dedicated cable:

Pinout of all communication ports is described hereafter and in:
"***sP4/8** Installation Manual*" **[9]**.

2-1-2 USB port

An USB port which can be used to perform data logging, backup/restore function of project files (uploading or downloading configuration and/or programs to/from an external USB mass memory storage), firmware backup/upgrade.

2-1-3 Integrated I/Os

The sigma**line sP4/8** base unit can handle up to 62 I/O signals:

4/8 IN 4 generic inputs as mA, V, thermocouple, PT100, Pt1000, NTC, potentiometer, 5 V ratiometric and strain gauge (only IN1). The sP8 adds up to 4 generic inputs;

4/8 OT 4 generic outputs mA/V/DO/PWM. The sP8 adds up to 4 generic outputs;

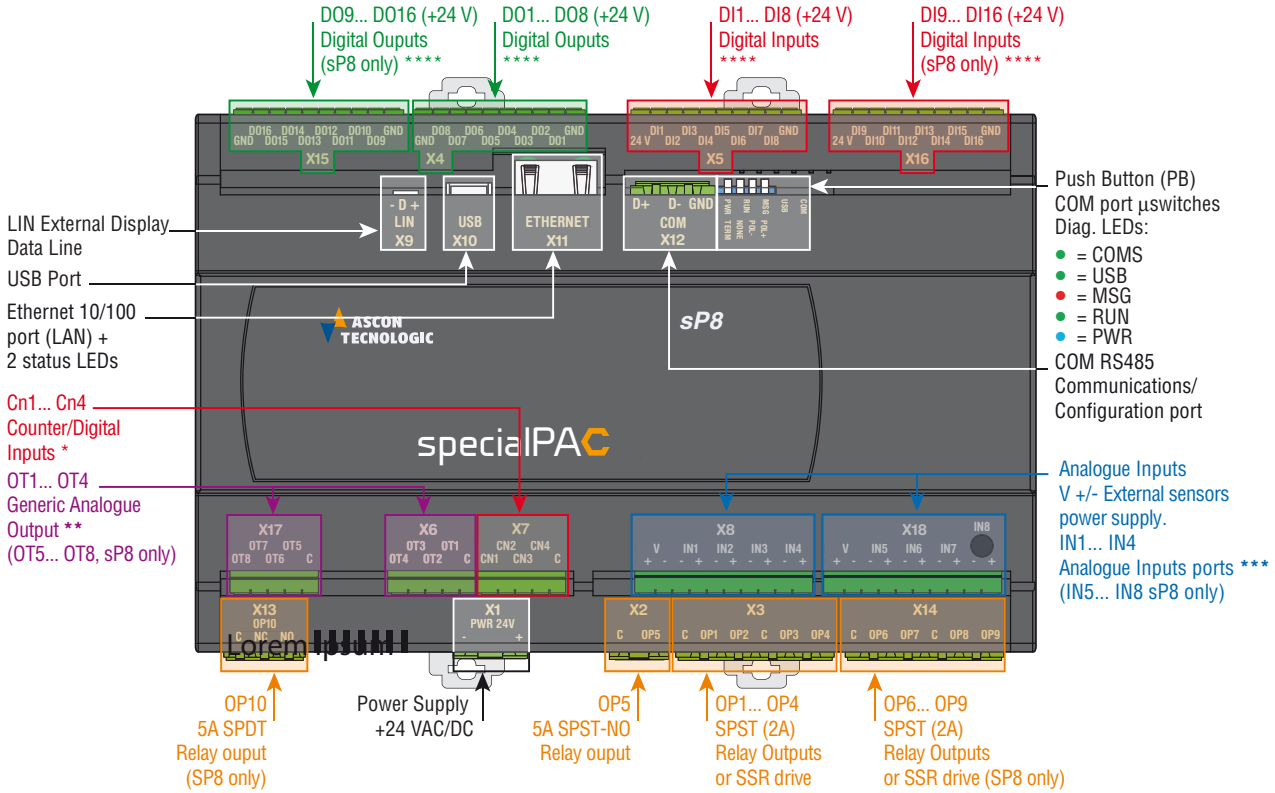
8/16 DI 8 Digital Inputs at 24 Vdc. The sP8 adds up to 8 digital inputs;

4 CN Pulse counter or frequency meter digital input (up to 10 kHz). These 4 Input ports can also be used as 24 V Digital Inputs;

8/16 DO 8 Digital Outputs at 24 Vdc. The sP8 adds up to 8 Digital Outputs;

4/8 OP 8 generic Digital Outputs: SPST relay (2 A) or SSR drive. The sP8 adds up to 4 Digital Outputs;

1/2 OP 1 SPST-NO 5A Relay Output. The sP8 adds an SPDT 5 A Relay Output.



Notes: * These 4 digital inputs can be used as Counter/frequency meters inputs or as standard 24 V Digital Inputs;

** The OT1... OT4 generic Output ports can be used for V, mA, PWM/Frequency or 12 Vdc DO, the OT5... OT8 generic Output ports can only be used for V, mA or 12 Vdc DO;

*** Analogue Input IN1 terminals can be used for DI, mA, TC, Pt100, Pt1000, NTC, Potentiometer, Ratiometric, Voltage and Strain Gauge, all the other Analogue Inputs (IN2... IN4 for sP4, IN2... IN8 for sP8) can be only used for DI, mA, TC, Pt100, Pt1000, NTC, Potentiometer, Ratiometric and Voltage inputs;

**** This Hardware configuration (observe the diagram carefully) is valid for the High Side version only.

Figure 2.2 - Control Unit Supply, I/O and Communication Ports

WARNING!
The **PB** button performs different operations accordingly to system status, but **does not restart** the CPU or the 1131 application.

WARNING!
The **DO** ports (**X4** and **X15**) illustrated in this diagram are those present in the **High side** version of the CPU, the manual that describes the Low side version (no longher sold) can be downloaded (free of charge) from www.ascontecnologic.com.

WARNING!

1) By pressing the **PB** button at the CPU power ON it is possible to **restore the Factory Default parameters**.

2) Immediately after CPU Power ON, if a recognized USB key is present, by pressing the **PB** button will be possible to manage the upload/download of all the files related to the project from/to the USB Key as described in the "*Chapter 6 - USB Mass Storage Device*".

3) While the PLC program is running, if the **PB** button will be pressed, it behaves as a Standard digital input "*Chapter 10 - Digital Inputs Status (D1... D16)*".

2-1-4 Diagnostic LEDs

Accordingly to "*Chapter 2 - Control Unit Supply, I/O and Communication Ports*" the hereafter tables describe in detail LED functions and behaviours (* **Note 1**).

LED	Colour	Action (note 1)	Description
PWR	Blue	ON	Power Supply present
RUN LED while normal CPU or Bootloader operations			
RUN	Green	OFF	PLC Program stopped or not present
		ON	PLC Program running
		Blinking	Telnet Watch Monitor session active
		Flickering	Telnet Configuration session active
		Single flash	Bootloader - Work in progress
		Double flash	Bootloader - Operations result OK
		Triple flash	Bootloader - Operations result KO
MSG LED while normal CPU or Bootloader operations			
MSG	Red	OFF	No Errors - Firmware present
		ON	Firmware not present
		Blinking	Backup battery low
		Flickering	Flash File System error
		Single flash	Checksum error in RETAIN data
		Double flash	Calibration file error
		Triple flash	Configuration error (Reset to Factory Default)
USB LED while normal CPU or Bootloader operations			
USB	White	OFF	Reserved
		ON	USB Host key present
		Blinking	Access to USB key
		Flickering	File transfer active
		Single flash	Wait for PB button to USB files management
		Double flash	Reserved
		Triple flash	Reserved
COMS LED while normal CPU or Bootloader operations			
COMS	Green	OFF	Reserved
		ON	Bootloader - USB host
		Blinking	Bootloader - TFTP with IP as Factory default
		Flickering	Bootloader - TFTP with customer's IP
		Single flash	COM1 data traffic

Table 2.1 Diagnostic LEDs description

Notes: **1.** As the ON/OFF sequence of the LEDs has a specific meaning, it is important that the user recognizes each LED status:

Sequence	Meaning
OFF	The LED is not lit
Steady ON	The LED is lit in a stable way
Blinking	The LED blinks at a frequence of 2.5 Hz (slow)
Flickering	The LED blinks at a frequence of 10 Hz (fast)
Single flash	The LED lits once for at least 200 ms
Double flash	The LED lits twice with pulses of 200 ms each
Triple flash	The LED lits three with pulses of 200 ms each

2. The first time %M variables have been defined as RETAIN (see "*Chapter 5 - Retain Config Menu*"), the system needs to reboot in order to properly create the dedicated files. The error indication will disappear automatically in case of positive result.

WARNING!
While the CPU is writing a new firmware to the internal Flash memory, the RUN and MSG + USB + COMS LEDs will blink to indicate the status and progress of the reserved specific operations.

The CPU formats the internal File System in case of access problems: in this specific case, ALL the LEDs will blink simulating a bargraph filling.

Chapter 3
Installation

3-1 Mechanical installation

The sigma**line** special**PAC sP4/8** CPU and the additional external Modbus I/O expansion units are designed to be installed on standard DIN rails.

3-2 Electrical installation

Refer to: "*Figure 2.2 - Control Unit Supply, I/O and Communication Ports*" and "*sP4/8 Installation Manual*" **[9]** for details.

3-2-1 X1: Mains Supply 24 Vdc Power Supply Connector

This 2 terminals connector brings the Power Supply to the CPU.

3-2-2 X2, X13: OP5 5A STST NO, OP10 5A SPDT Relay Outputs

X2 - 5 A SPST-NO output relay - Terminals Pinout:

This 2 terminals connector is used for OP5 output channel. The connections are:

Label	C	NO
Signal	Common	Normally Open

X13 - 5 A SPDT output relay - Terminals Pinout:

This 3 terminals connector is used for OP10 output channel. The connections are:

Label	C	NC	NO
Signal	Common	Normally Closed	Normally Open

3-2-3 X3, X14 - OP1... OP4, OP6... OP9 Relay/SSR Outputs

The terminals of these 2 connectors are used for the output channels OP1... OP4 connected to X3 connector and OP6... OP9 connected to X14 connector. The outputs can be mixed (relay, SSR or SSR drive) but must be ordered as omogeneous in group of two (e.g.: when OP1 is ordered as SPST-NO relay, OP2 must be the same; if an SSR drive output is required it will be placed in a different output block):

X3, X14 - 0/12 Vdc outputs for SSR Drive - Terminals Pinout

Label	C	OP1/OP2...OP3/OP4	OP6/OP7...OP8/OP9
Signal	**-** (Negative pole)	**+** (Positive pole)	**+** (Positive pole)

X3, X14 - SPST 2A relays/SSR - Terminals Pinout

Label	C	OP1/OP2...OP3/OP4	OP6/OP7...OP8/OP9
Signal	Common	Normally Open	Normally Open

3-2-4 X4, X15: DO1... DO8, DO9... DO16 Digital Outputs

Through these connectors is possible to connect the Digital Outputs High Side **DO1**... **DO16**.

X4 - DO1... DO8 - Terminals Pinout

Label	24 V	DO1	DO2	DO3	DO4	DO5	DO6	DO7	DO8	24 V
Signal	GND	DO1	DO2	DO3	DO4	DO5	DO6	DO7	DO8	GND

X15 - DO9... DO16 - Terminals Pinout

Label	24 V	DO9	DO10	DO11	DO12	DO13	DO14	DO15	DO16	24 V
Signal	GND	DO9	DO10	DO11	DO12	DO13	DO14	DO15	DO16	GND

Note: The current consumption of each output must not exceed 0.5 A and their cumulative current consumption must be less than 1.6 A (whatever the feeding method).

3-2-5 X5, X16: DI1... D8, DI9... DI16: Digital Inputs

Through these connectors is possible to connect the Digital Inputs **DI1**... **DI16**.

X5 - DI1... DI8 - Terminals Pinout

Label	24 V	DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8	24 V
Signal	+24 V	DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8	GND

X16 - DI9... DI16 - Terminals Pinout

Label	24 V	DI9	DI10	DI11	DI12	DI13	DI14	DI15	DI16	24 V
Signal	+24 V	DI9	DI10	DI11	DI12	DI13	DI14	DI15	DI16	GND

3-2-6 X6, X17: OT1... OT4, OT5... OT8 Generic Outputs

Through these connectors is possible to connect the Outputs **OT1**... **OT8**. **OT1... OT4** that can be V, mA, PWM/Frequency or 12 Vdc DO (the output type depends on what was ordered).

X6 - OT1... OT4 - Terminals Pinout

Label	C	OT1	OT2	OT3	OT4
Signal	C	OT1	OT2	OT3	OT4

OT5... OT8 can be V, mA or 12 Vdc DO (the output type depends on what was ordered).

X17 - OT6... OT8 - Terminals Pinout

Label	C	OT5	OT6	OT7	OT8
Signal	C	OT5	OT6	OT7	OT8

Note: The max. Output load is 10 mA. Verify the options ordered for OT1... OT4 Outputs.

3-2-7 X7: CN1... CN4 - Special inputs

Through this connector is possible to connect Special Inputs **CN1... CN4**. These Inputs can be Pulse Counters, Frequency Meters or Digital Inputs (the input type depends on what was ordered).

X7 - CN1... CN4 - Terminals Pinout

Label	C	CN1	CN2	CN3	CN4
Signal	C	CN1	CN2	CN3	CN4

Notes:
1. **Frequency meter:** CN1... CN4 channels can manage up to 10 kHz signals having a duty-cycle of minimum 20 μs;
2. **Impulse counter:** The minimum time of an impluse must be 20 μs.
3. **Standard Digital:** The input circuit is internally closed to the System negative (negative pole of connector X1).
4. Verify the options ordered for CN1... CN4 Inputs.

3-2-8 X8, X18: IN1... IN4, IN5... IN8: Generic Inputs + Auxiliary Power

These connectors are dedicated to the configurable Inputs management and provide also **2 different power supply voltages:**

- +5 Vdc for **Strain Gauge** (at IN1 only) and **Ratiometric signals**;
- +12 Vdc for **Passive transmitters**.

The Voltage level present on the V+/V- terminals depends on what ordered.

AI1... AI4 - Universal Analogue Inputs

Label	V		IN1		IN2		IN3		IN4	
Signal	+	-	+	-	+	-	+	-	+	-

Note: Verify the options ordered for IN1... IN8 Inputs.

3-2-9 X9: LIN

The **X9** connector is used to connect the specific numerical display. The connector has the following pinout:

Label	+	D	-
Signal	External display power supply	Data line	External display power supply

3-2-10 X10: USB

The **X10** connector is dedicated to an USB port to connect an USB mass storage device.

3-2-11 X11: LAN Ethernet 10/100 baseT Connector

The **X11** connector is a standard Ethernet RJ45 type.

3-2-12 X12: COM - RS/485 Serial Communications Port Connector

The **X12** RS485 connector provides the port to connect a fieldbus network using the Modbus protocol (master/slave) or serial ASCII. A dedicated DIP switches bank allows to activate the electrical line polarization (+ and/or -) and/or termination (see the "*Installation Manual*" [**9**] for more information). To select the desired operational mode (RS485) please consult the *"5-1 How to perform the CPU Setup by a Telnet client session" at page 19* for details.

The connector has the following pinout:

Label	D+	D-	GND
Signal	Data **+**	Data **-**	RS485 ground

Chapter 4
Communication Ports Configuration

The **sP4/8** system unit can have up to 3 different communication ports (see *"Figure 2.2 - Control Unit Supply, I/O and Communication Ports" at page 7* for details):

X9 LIN port can be used to connect the specific numerical display;

X11 Ethernet port (TCP/IP) can be used to configure, program, debug, commission and for Modbus TCP data exchange;

X12 Serial Modbus/ASCII communications port.

WARNING!
The maximum data blocks length manageable by the **sP4/8** over a Modbus slave RTU/TCP session is 44 WORD (22 REAL). Pay particular attention when connecting the CPU to a Modbus network in order to verify that the Modbus Master/ Client respects the limits to avoid any possible communication errors or problems (it MUST be equal or less than 44 WORD).

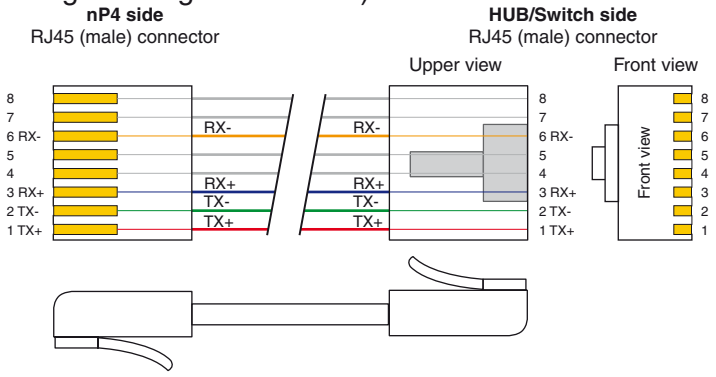
4-1 Ethernet communications port

Setup data can be entered by using a Telnet Client session, establishing the connection through the Ethernet that is always present on the CPU.

4-1-1 Telnet Communications Connection

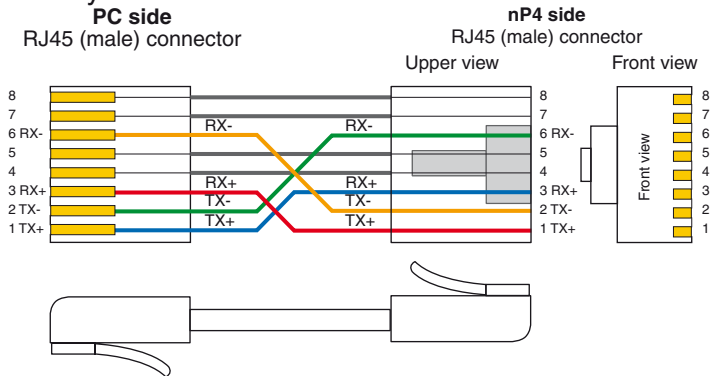
In order to connect the CPU to a Personal Computer using the Ethernet port there are two possibilities:

1. **Through a Switch or a HUB (sP4/8 -> HUB/Switch -> PC).**
   Plug into the Ethernet connector a patch LAN cable (not crossed) to connect the CPU to a switch or HUB (the connection between the HUB is also a straight through connection).



2. Directly to the Personal Computer

Plug into the Ethernet connector a crossed LAN cable to connect the CPU directly to the PC.



WARNING!

Even if many Personal Computers (and Ethernet switches) are able to fully manage a connection by switching the signals to match the type of connection made (patch or crossed), is suggested to use the correct type of cable.

Setting the communications parameters

Once the PC is connected to the CPU, start the Telnet program in order to establish the connection with the **sP4/8** and begin the setup session.

At this point the user must configure the Telnet Client in order to communicate with the CPU as reported in the following table:

IP Address	192.168.5.11 (Factory default)
Port	23

4-2 COM1 serial communications port

4-2-1 Configuring the COM1 Serial communications port

The COM1 serial port is optional: the termination resistance and the line polarization can be configured through a dedicated DIP switch bank, located nearby to the Serial Ports connector. The **X12** RS485 COM connector is located in the upper-central side of the CPU.

Looking at the connector, the 3 terminals are arranged as illustrated.

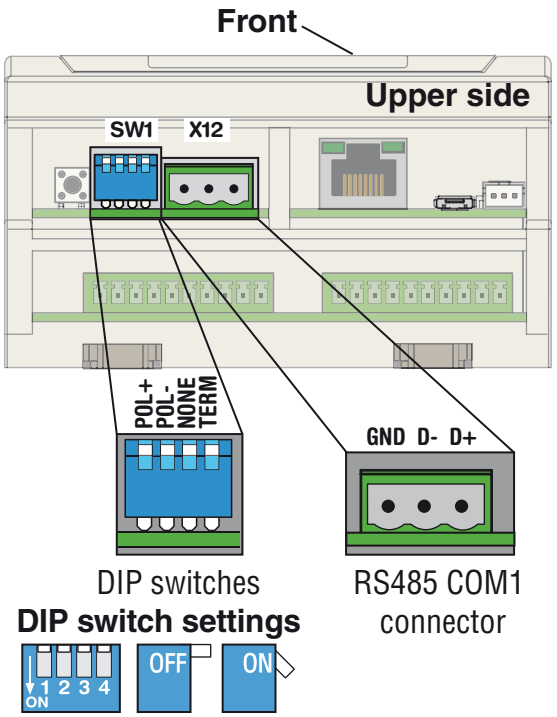


Figure 4.1 - Position of the COM1 serial port configuration DIP switches

The signals present on the COM1 port terminals are (as printed on **sP4/8** case).

Label	Protocol
GND	RS485 Ground
D -	RS485 Data -
D +	RS485 Data +

Some electrical hardware settings related to the COM1 port can be configured using the specific dedicated DIP switches.

The following table explains the possible choices:

Switch	Function	ON	OFF
1	Polarization Line Pull-up (+)	Active	Disabled (Default)
2	Polarization Line Pull-down (-)	Active	Disabled (Default)
3	Reserved	N.A.	N.A.
4	Line Termination (110Ω)	Active	Disabled (Default)

The default communication parameters for the **X12** port are for RS485 are:

Baud Rate: 9600 bps,
Data: 8 bit,
Stop bit: 1,
Parity: none.

The serial port communication parameters can be changed during the CPU Setup Session (see paragraph: *"Serial Setup Menu" at page 25* for details).

4-2-2 Connect the RS485 serial setup terminal

In order to correctly perform the configuration, the user should:

- Prepare a proper communication connection cable;
- Connect the Personal Computer using an USB to RS485 converter;
- Set the correct communications parameters;
- Run the communication Telnet Client program.

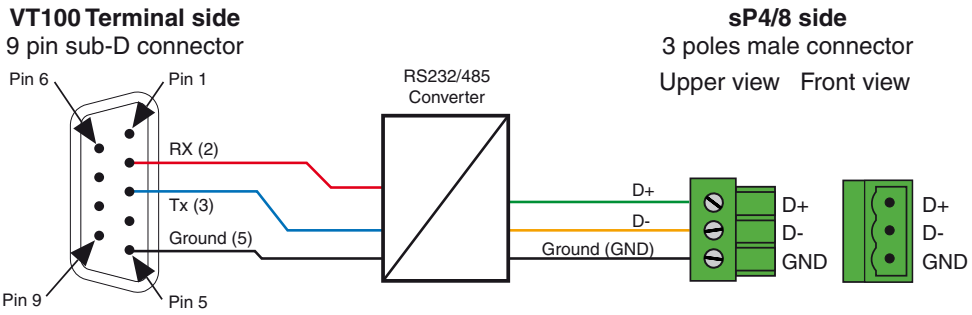


Figure 4.2 - RS485 Serial Communications Connection

Setting the communications parameters

The Telnet client program (HyperTerminal) must be configured accordingly to the communication port desired. If the Personal Computer has no serial ports, the connection can be made through an USB to RS485 adapter: find out the COM number assigned by your OS to it following "*Start\ControlPanel\System\Hardware\Peripherals\Ports (COM and LPT)***".**

Using the COM port number, open a new session of the Telnet client program and set the communication parameters to match the ones of the service port

Baud Rate: 9600 bps,
Data: 8 bit,
Stop bit: 1,
Parity: none.

From the configuration session, it will be possible to change the baud rate, stop bit and parity (see *"Serial Setup Menu" at page 25* for details): if the system communications parameters have been modified, please remember to adjust the PC or VT100 terminal ones in order to match all each other.

WARNING!
The default communication parameters can be set only by using the specific Function Block. See "*Ascon Tecnologic Firmware Function Block Library*" [**3**] for details.

4-3 Wiring the Modbus Ports

Caution
To properly connect over one of the RS485 fieldbus ports (through the **X13** and/or **X4** ports), it is strongly recommended to use cables specifically designed for such type of communications such as the Belden model 9501 or 9841 (or equivalent).

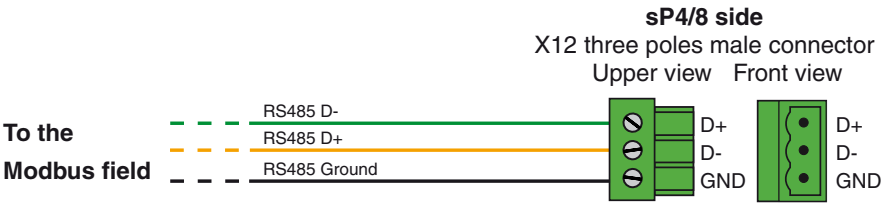


Figure 4.3 - Modbus ports filed connection

Chapter 5
CPU Configuration Session

While boot-up, the system has a time frame window (10 seconds as default) which can be used by the operator to access the configuration session and setup the CPU system module and configure the system I/Os.

Setup data can be entered by using a Telnet Client session, establishing the connection through the Ethernet, the RS485 or the RS232 port.

5-1 How to perform the CPU Setup by a Telnet client session

There are 2 ports available on the CPU to enter the configuration session: the Ethernet LAN port or the **X12** RS485 serial port. Depending on the setup method used, the user must:

- Set the serial or the LAN port (consult the "*sP4/8 Installation Manual*" **[9]** for details);
- Use the proper connection cable;
- Set the correct communications parameters;
- Run the communications program.

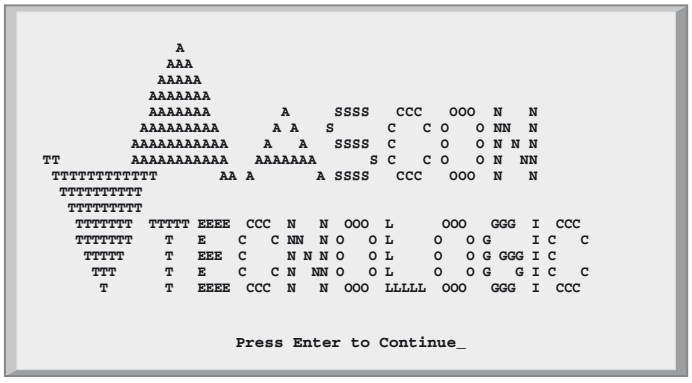
Caution
Chapter 4 describes the connection setup details and COM ports configuration.

Once the Telnet client program has been correctly connected to the **sP4/8** CPU, the user can start to operate the configuration session.

5-1-1 Starting the Configuration Session

Accessing the Main Menu

To open the Configuration session, while the CPU powers ON and the RUN LED starts blinking, establish the connection by pressing the **ENTER** key from the setup terminal window. If there is no activity by the operator until a predefined time (as default, 10 seconds) the system skips the configuration time window and runs the project application (if present). This chapter describes in detail the specific sections of the configuration session and shows the major screenshot used for such type of operations. If the connection has been successfully established, the welcome screen appears as follows:



Now press **ENTER** key again to jump into the Main Menu screen.

Please note that the system has 120 seconds of inactivity timeout. If the user does not perform any operation up to that amount of time, the configuration session will be automatically aborted and the project application will be started (if present).

Both the above described timeouts are part of the setup parameters available from the configuration session: it is not recommended to set these values too small in order to avoid undesired configuration session aborts.

To select an item from a menu or to insert a value for a parameter, the user must type the corresponding selection number and press **ENTER**.

5-2 CPU Main Menu

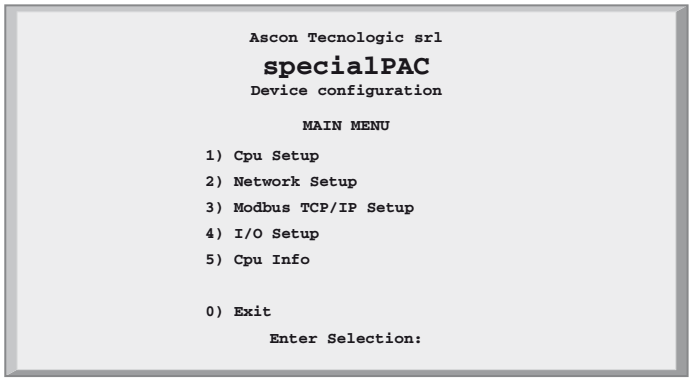


Figure 5.1 - Base Unit configuration Main Menu

Item	Description
CPU Setup	Specific CPU parameters
Network Setup	CPU communication ports settings
ModbusTCP/IP Setup	Modbus TCP/ IP Settings
I/O Setup	Onboard I/O Configuration
CPU Info	Firmware and hardware information
Exit	End the configuration session

5-2-1 CPU Setup Menu

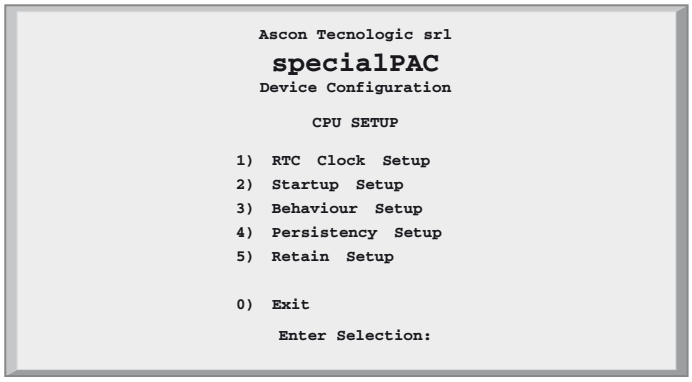


Figure 5.2 - CPU Setup Menu

Item	Description
RTC Clock Setup	Real Time Clock Settings
Startup Setup	Startup Parameters
Behaviour Setup	Device Behaviour Parameters
Persistency Setup	Persistency Parameters
Retain Setup	Retentive Registers Configuration
Exit	Returns to previous menu

RTC Clock Setup Menu

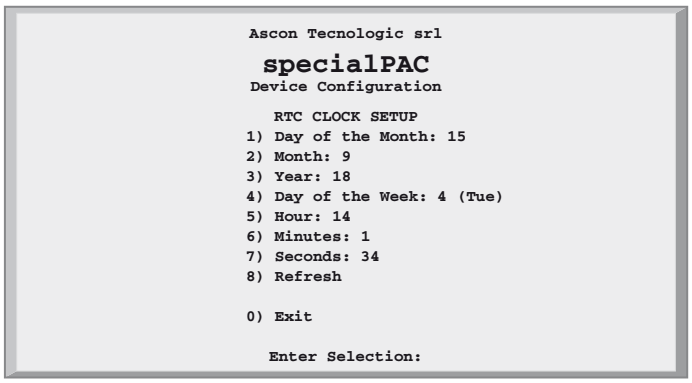


Figure 5.3 - Real Time Clock Setup

Item	Description	Range	Factory Default
Day of the Month	Sets the day of the month number	0... 31	-
Month	Sets the month of the year number	1... 12	-
Year	Sets the last 2 digits of the year	2000... 2100	-
Day of the Week	Sets the day of the week number	1... 7 [Monday = 1]	-
Hour	Sets the Hour value	0... 24	-
Minutes	Sets the Minutes value	0... 59	-
Seconds	Sets the Seconds value	0... 59	-
Refresh	Command refreshing clock values	-	-
Exit	Returns to previous menu	-	-

Note: The Real Time Clock values are not automatically refreshed by the system so, in case, select the "*Refresh*" to update.

Startup Timeout Menu

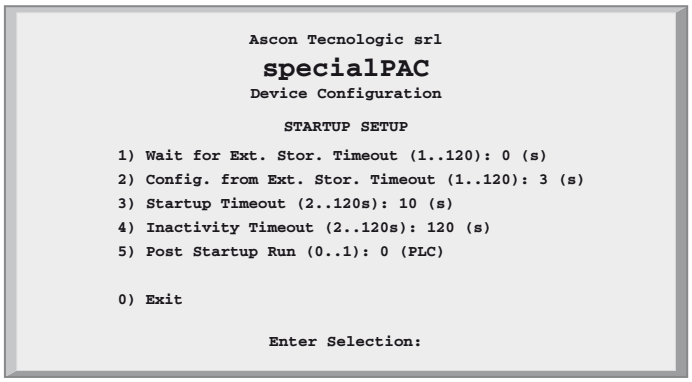


Figure 5.4 - Startup Timeout Menu

Item	Description	Range	Factory Default
Wait for Ext. Stor. Timeout	At timeout end the system reads the esternal storage	1... 120 (s)	0
Config from Ext. Stor. Timeout	At timeout end the system loads the configuration on the esternal storage	1... 120 (s)	10
Startup Timeout	Timeframe window to enter the startup session	1... 120 (s)	10
Inactivity Timeout	Inactivity Timeout	1... 120 (s)	120
Post Startup Run	Operation phase to be executed after the startup session (note)	0 = PLC 1 = I/O Watch	0 (PLC)
Exit	Returns to previous menu	-	-

Note: The I/O Watch window is explained at paragraph *"7-2 I/O Watch Window" at page 38*.

Behaviour Setup

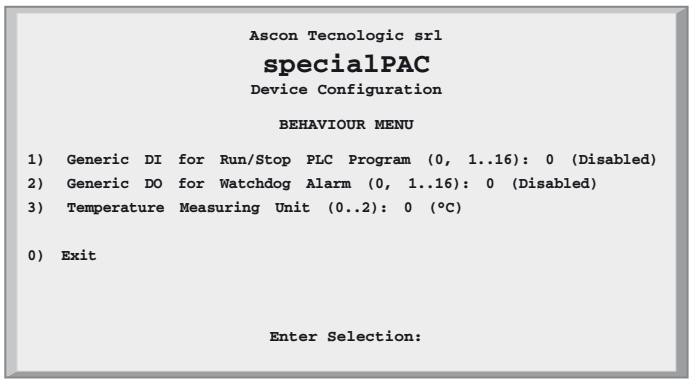


Figure 5.5 - Behaviour Setup Menu

Item	Description	Range	Factory Default
Generic DI for Run/ Stop PLC Program	Digital Input to control a PLC program	0, 1... 16	0 (Disabled)
Generic DO for Watch-dog Alarm	Digital Output activated by Watchdog Alarm	0, 1... 16	0 (Disabled)
Temperature Measur-ing Unit	Temperature measuring scale	0... 3	0 (°C)
Exit	Returns to previous menu	-	-

Persistency Setup Menu

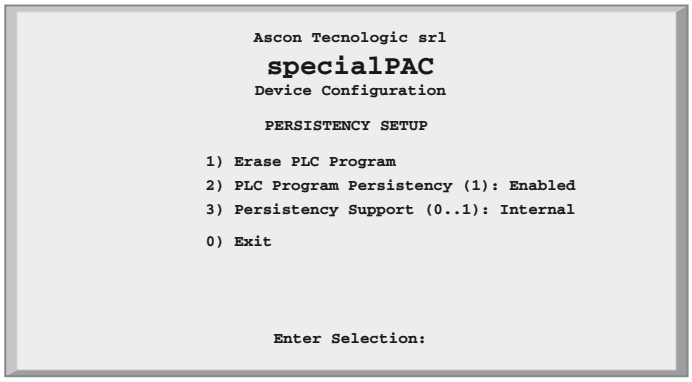


Figure 5.6 - Persistency Setup Menu

Item	Description	Range	Factory Default
Erase PLC Program	Command to erase the PLC program from flash memory	-	-
PLC Program Persistency	Function to save PLC program into flash memory	1= Enabled	Enabled
Persistency Support	Media where to save copy of the PLC program	0/1 [Internal Flash/USB key]	Internal Flash
Exit	Returns to previous menu	-	-

The CPU can save the PLC program into different persistent memory supports. Each time a new program download is executed by the developer, the CPU makes a permanent copy of it into the configured desired media for the next future executions. If needed, the selection of the "*Erase PLC program*" command will delete the PLC program from the media selected location: the overall time needed to perform the operation depends by the project size. Please wait until the "*Persistency setup menu*" screen reappears as confirmation for complete PLC program erasing.

Retain Config

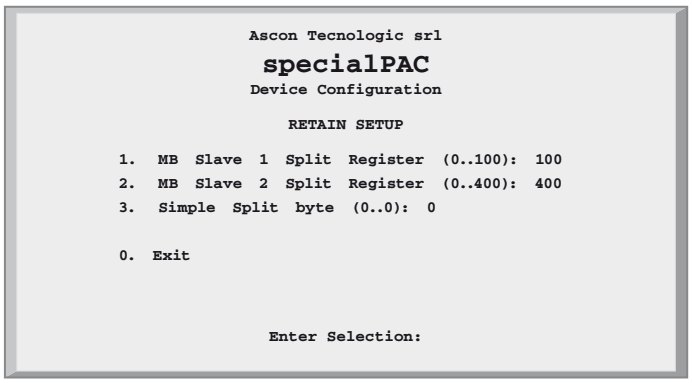


Figure 5.7 - Retain Setup Menu

Item	Description	Range	Factory Default
MB Slave 1 Split register	Amount of Slave 1 Modbus agent retained	0... 100	100
MB Slave 2 Split register	Amount of Slave 2 Modbus agent retained	0... 400	400
Simple Split Byte	Reserved	0... 0	0
Exit	Returns to previous menu	-	-

Standard and Retentive memory management

The IEC 1131 programming tool allows to declare retentive variables using specific files and syntax. These variables are handled by a 16 kB size of NVRAM memory (for security reasons, the memory is duplicated for redundancy and refreshed during runtime operations). Differently, it is possible to declare variables up to 1.6 kB in the % marker memory area.

The percentage memory locations, which can be also enabled to be retained by the above described function, are accessible by declaring the specific direct global variables from the OpenPCS IEC61131 environment programming tool.

In particular, the range available as retentive is:

Modbus Slave 1: %MW1128.0...%MW9320.0 (200)
Modbus Slave 2: %MW10128.0...%MW18320.0 (800)
Marker Area: %MB22000.0...%MB38384.0 (16384 preserved Mem.)

From the Device Configuration session, by the dedicated menu, it is possible to define the amount of registers/Bytes to be retained.

From the main menu select "*CPU setup*" -> "*Retain Config*".

The "*Retain Config*" menu allows to define, for each specific item, the amount of data to be retained.

Note: The process which saves the retentive variables operates in parallel with the one of the PLC application. For this reason the cycle time of the whole project will be effected/delayed ONLY when it is lower than the overall time needed to save ALL the retentive variables defined!

- In case of "**Cold start**" command, the standard retentive variables will be reset or preset to the initialization value whereas the % retentive variables will be reset. In case of retain file corruption error, both the two memory areas are separately reset or initialized.
- In case of "**Warm Start**" command, if the PLC program has not been modified, both the standard and % retentive variables will remain to last previous values. In case of retain file corruption, the % retentive variables will be reset.
- In case of "**Hot start**" command, both the standard and % retentive variables will be unaffected.

It is possible to upload/download both type of retentive memory areas, standard and/or % variables, using a TFTP session. It is possible to perform this operation ONLY in the timeframe window available during the very first boot-up phase of the CPU, before the Device Configuration timeframe session. On how to perform the upload or download the specific retentive memory files, please follow the procedure described at paragraph: *"Chapter 9 CPU Configuration Software (TFTP File Access)" at page 43*.

Publishing I/O configuration data, Battery and Retain Memory status

While PLC program execution is possible to check and verify some specific CPU operational information, in particular:

%M0.0: Battery status (**1** = low, **0** = OK);

%M0.1: Startup retain memory status (**1** = corrupted, **0** = OK);

%M0.2: Preserved memory Startup status;

%M0.3: CPU Production Code status.

The battery status is checked at Power ON and runtime. The remaining bits are updated at startup and the value remains unchanged after a warm or a cold startup.

5-2-2 Network Setup Menu

```
Ascon Tecnologic srl
specialPAC
Device configuration

NETWORK SETUP MENU

1)  Ethernet  Setup
2)  Serial  Setup

0)  Exit

Enter Selection:
```

Figure 5.8 - Network Setup Menu

Item	Description
Ethernet Setup	Ethernet Setup Parameters
Serial Setup	Serial COM1 Setup Parameters
Exit	Returns to previous menu

Ethernet Setup Menu

This menu can be used to configure the COM1 serial port to fulfil the desired operational mode.

```
Ascon Tecnologic srl
specialPAC
Device Configuration

ETHERNET SETUP

MAC  Address:  00:50:C2:47:6F:FF
1)  IP  Address:  172.16.49.37
2)  Subnet  Mask:  255.255.255.224
3)  Gateway  Address:  172.16.49.62
4)  DNS  Server  Address:  172.16.49.62
5)  DHCP  (0..1):  0  (Disabled)
6)  Port:  1200

0)  Exit

Enter Selection:
```

Figure 5.9 - Ethernet Setup Menu

Item	Description	Range	Factory Default
MAC Address	Device MAC Address	-	00:50:c2:47:xx:xx
IP Address	CPU IP Address	0.0.0.0/255.255.255.255	192.168.5.11
Subnet Mask	CPU subnet mask	0.0.0.0/255.255.255.255	255.255.255.0
Gateway Address	Network Gateway Address	0.0.0.0/255.255.255.255	192.168.5.10
DNS Server Address	DNS Server Address	0.0.0.0/255.255.255.255	192.168.5.10
DHCP	DHCP Protocol Status	0/1	0 = Disabled
Port	OpenPCS Port Number	0... 65535	1200
Exit	Returns to previous menu	-	-

Serial Setup Menu

This menu must be used to configure the COM serial port to different values from the default (9600 baud/s, no parity, 1 stop bit) for the COM port.

```
Ascon Tecnologic srl
specialPAC
Device configuration

SERIAL SETUP

HW Configuration: COM Available
   Type : 8 (RS-485)
1) Baudrate (0..7): 2 (9600 bps)
2) Parity (0..2): 0 (No Parity)
3) Stop (1..2): 1 (Bit)

0) Exit

Enter Selection:
```

Figure 5.10 - Serial Setup Menu

Item	Description	Range	Factory Default
Type	COM type	8	8 = RS485
Baudrate	COM baudrate	0... 6 [2400... 115200]	2 = 9600
Parity	COM parity	0... 2 [None/Even/Odd]	0 = None
Stop bit	COM stop bit	1/2	1
Exit	Returns to previous menu	-	-

5-2-3 Modbus TCP/IP Setup

```
Ascon Tecnologic srl
specialPAC
Device Configuration

MODBUS TCP/IP SETUP

1) Messages per cycle (1..50): 10
2) Broken connection timeout (10..5400): 120 (s)
3) Secure Address Setup
4) Priority Address Setup

0) Exit

Enter Selection:
```

Figure 5.11 - Modbus TCP/IP Setup Menu

Item	Description	Range	Factory Default
Messages per Cycle	Max. number of processed messages per cycle	1... 50	10
Broken Connection Timeout	Inactivity Timeout of a TCP/IP connection	10... 5400 (s)	120
Secure Addr. Setup	Secure Address Setup Menu	-	-
Priority Addr. Setup	Priority Address Setup Menu	-	-
Exit	Returns to previous menu	-	-

To verify the connection status after a long period of inactivity, is used the TCP/IP "*keep alive*" protocol. The protocol performs the following sequential steps:

1. At each received message the timeout is reset;
2. If timeout expires, a "*test*" message is sent in order to verify if the connection is still active;
3. If an answer to the "*test*" is received, then the timeout is reset;
4. In case of no answer, the "*test*" will be sent again three times, every 10 s;
5. If even after the fourth "*test*" nothing has been received, the connection will be closed.

5-2-4 Modbus TC/IP Secure Addresses Table Menu

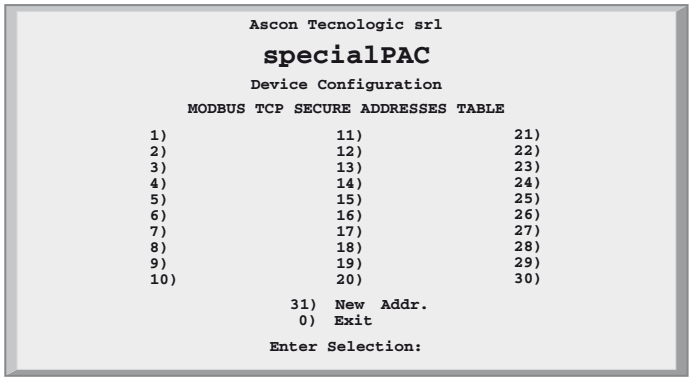


Figure 5.12 - Modbus TCP/IP Secure Addresses Table Menu

If the security function will be enabled (please see the ""*Ascon Tecnologic Firmware Function Block Library*" [**3**]"), the list of addresses present in this menu will indicate the external Modbus TCP/IP Clients allowed to access the CPU Modbus TCP/IP server.

To add a new address, first select "**0**", then enter the new one; it will be inserted in the first free position of the list. To delete an address, simply select the number of the list to be removed.

5-2-5 Modbus TC/IP Priority Addresses Table Menu

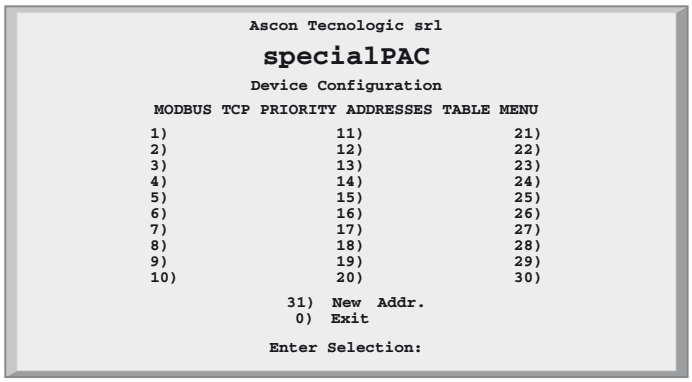


Figure 5.13 - Modbus TCP/IP Secure Addresses Table Menu

The rules to insert a desired value is the same just described above for the "*Secure address table*". The addresses specified in the "*Priority connection table*" are managed in a very particular dedicated way because the Modbus TCP/IP server agent can sustain up to 10 TCP client simultaneous connections at the same time. So, when a new connection request is made, and all 10 available connections are already used, the system will close one of the active connections to satisfy the new request. Addresses not belonging to the "*Priority connection table*" will be closed as first, followed by those which have been inactive longest.

5-2-6 Local I/O Setup Menu

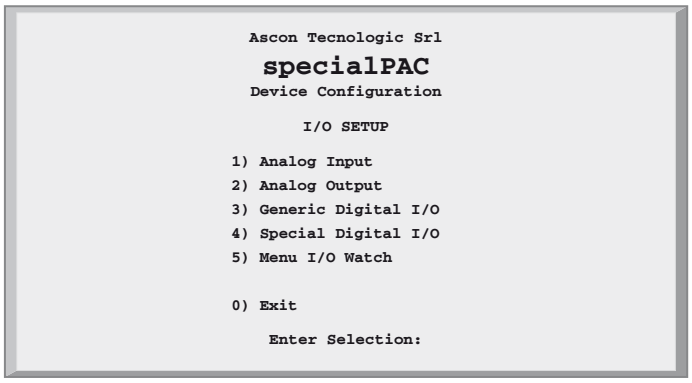


Figure 5.14 - I/O Setup Menu

Item	Description
Analog Input	Inputs configuration (**Digital/Analogue**)
Analog Output	Outputs configuration (**Digital/Analogue**)
Generic Digital I/O	Generic Digital I/O Configuration
Special Digital I/O	Special Digital I/O Configuration
Menu I/O Watch	Recalls the I/O Watch window
Exit	Returns to previous menu

Note: The I/O Watch window is explained at paragraph *"7-2 I/O Watch Window" at page 38*.

Setting the Input Channels

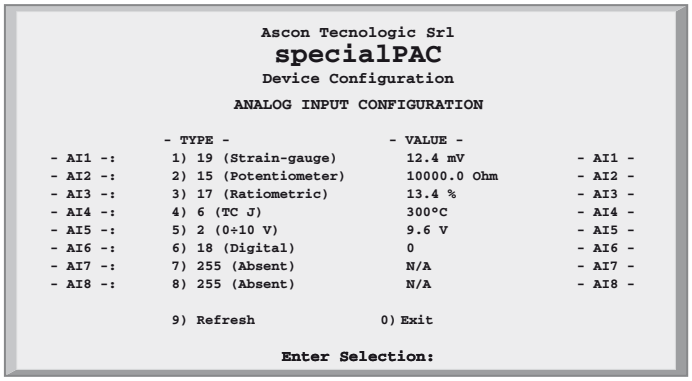


Figure 5.15 - Input Channels Selection Menu

Item	Description
AI1... AI8	Input Channels (from IN1 to IN8) Configuration
Type	Type set for each input
Value	Present Value of the correspondent input
Refresh	Updates the Inputs value
Exit	Returns to previous menu

WARNING!
Is to be noted that, as the system harware is configured at order time, only few Analogue Input type can be configured.
In particular the Termocouple, the Voltage and the Current (mA) Inputs.

To set a specific Input, select it typing the AI number, then press the enter key. The system replies adding the row "***Enter New Value***" below the "***Enter Selection***" row.
The type of input is set by typing the number relating to the desired input type. The table herafter lists all types of inputs and their selection numbers. The input types changeable by the user are those indicated with the label "***Configurable***".

The corresponding configuration choices for all the 8 input channels is as described in the following table.

	Value	Type	Range
Channel Input Type	0	0... 5 Volt (Configurable)	0.0... 5.5 V
	1	1... 5 Volt (Configurable)	0.6... 5.4 V
	2	0... 10 Volt (Configurable)	0.0... 11.0 V
	3	2... 10 Volt (Configurable)	1.2... 10.8 V
	4	0... 20 mA (Configurable)	0.0... 22.0 mA
	5	4... 20 mA (Configurable)	2.4... 21.6 mA
	6	Thermocouple J (Configurable)	-245.25... +1235.5°C
	7	Thermocouple K (Configurable)	-249.3... +1411.3°C
	8	Thermocouple L (Configurable)	-220.0... +620.00°C
	9	Thermocouple N (Configurable)	-32.5... +1332.5°C
	10	Thermocouple R (Configurable)	-40.0... +1640.0°C
	11	Thermocouple S (Configurable)	-44.0... +1804.0°C
	12	Thermocouple T (Configurable)	-215.0... +415.0°C
	13	PT100 (2 wires)(Fixed)	-232.3... +882.7°C
	14	PT1000 (Fixed)	-232.3... +882.7°C
	15	Potentiometer (Fixed)	0... 1000000 Ω
	16	NTC SEMITEC 103AT-2 (Fixed)	-56.5... +141.5°C
	17	Ratiometric 5 V (Fixed)	0.0... 5.5 V
	18	Digital (Fixed)	
	19	Strain gauge (Fixed)	

Setting the Outputs Channels Menu

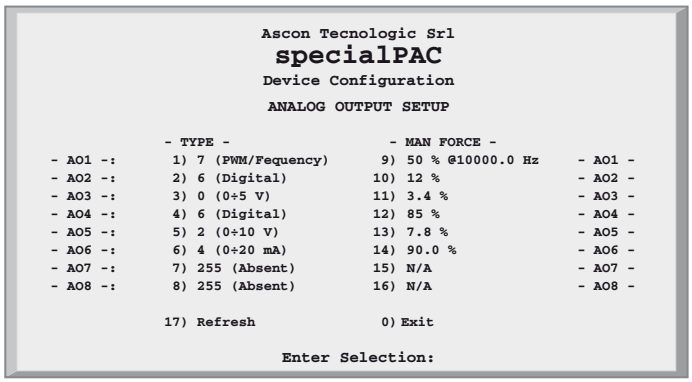


Figure 5.16 - Output Channels Selection Menu

Item	Description
AO1... AO8	Output Channels (from OT1 to OT8) Configuration
Type	Type set for each output
Man force	Output value forced by the user
Refresh	Updates the value of the Outputs
Exit	Returns to previous menu

WARNING!
Is to be noted that, as the system harware is configured at order time, only few Analogue output type can be configured.
In particular the the Voltage and the Current (mA) Outputs.

Setting the output channels

To set a specific Analogue Output, select it typing the AO (or OT) number, then press the enter key. The system shows the same page, but changes the entry from "***Enter selection:***" to "***Enter the new value:***".

The type of output is set by typing the number relating to the desired output type. The table herafter lists all types of outputs and their selection numbers. The output types changeable by the user are those indicated with the label "***Configurable***".

	Value	Type
Channel Output Type	0	0… 5 Volt (Configurable)
	1	1… 5 Volt (Configurable)
	2	0… 10 Volt (Configurable)
	3	2… 10 Volt (Configurable)
	4	0… 20 mA (Configurable)
	5	4… 20 mA (Configurable)
	6	Digital (Fixed)
	7	PWM/Frequency (Fixed)

How to force the outpus value

Using the "*MAN FORCE*" capability, the user can insert the value that each Output must assume. The procedure is the same used to set the output channels, but the selection number of each channel is shifted by 8 (no. 9 is associated to AO1/OT1 and no. 16 to AO8/OT8).

For each Output type, there are specific limits that must be respected. The table below lists them in detail. All the values are expressed as a percentage.

Output Type	Value
0… 5 Volt	0... 110% (0... 5.4 V)
1… 5 Volt	-10... 110% (0.6... 5.4 V)
0… 10 Volt	0... 110% (0... 10.8 V)
2… 10 Volt	-10... 110% (0.12... 5.4 V)
0… 20 mA	0... 110% (0... 21.6 mA)
4… 20 mA	-10... 110% (3.6... 21.6 mA)
Digital	1... 50% = 0 = OFF; 51... 100% = 1 = ON
PWM and Frequency	0.1 Hz... 10 kHz
	Duty cycle: 0.0... 100.0% with the following limits: • 0.1... 500 Hz: 0.1... 100.0%; • 501 Hz... 3 kHz: 1... 100%; • Over 3 kHz: fixed at 50%.

WARNING!

If the value inserted by the user is outside the range, the system replies with the warning message: "***Value not valid!***".

WARNING!

The value forced by the user can be changed for diagnostic purposes, but is reset by exiting the "*Configuration session*" and initializing again the CPU.

Generic Digital I/O

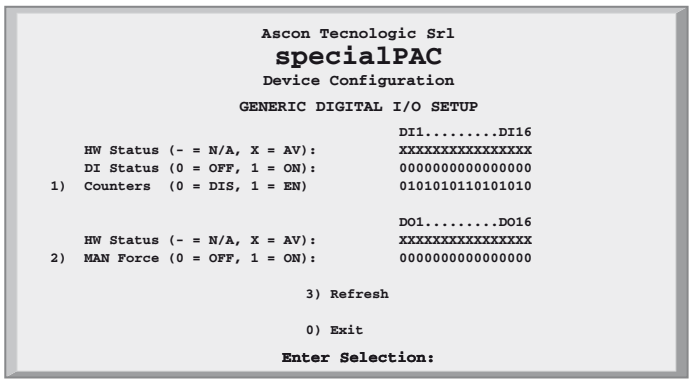


Figure 5.17 - Generic Digital I/O Setup Menu

The generic digital I/O screen shows the availability of a specific I/O channel and the status of each Input or Output channel. Moreover it allows the user to enable/disable a counter for each DI and force the Output status. The 1... 16 inputs and outputs are displayed in the menu as a sequence of 16 characters overhanged by the indication `DI1.....DI16` and `DO1.....DO16`.

Item	Description	Values
HW Status	Shows the availability of the Inputs	- = Not available, X = Available
DI Status	Shows the status of the Inputs	0 = OFF, 1 = ON
Counters	Allows to enable/disable a Counter on each Input channel	0 = Disabled, 1 = Enabled
HW Status	Shows the availability of the Outputs	- = Not available, X = Available
Man force	Allows to force each Output ON/OFF	0 = OFF, 1 = ON
Refresh	Updates the value of the I/O	
Exit	Returns to previous menu	

Special Digital I/O

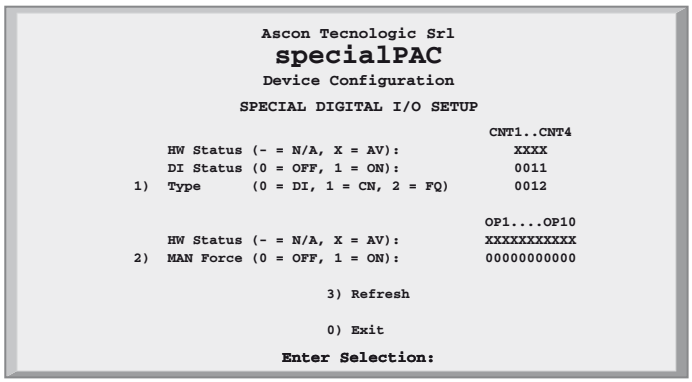


Figure 5.18 - Special Digital I/O Setup Menu

The special digital I/O screen shows the availability of a specific I/O channel and the status of each Counter Input or Relay Output channel. Moreover it allows the user to set the input type and force the Relay Output status. The 4 Counter Inputs are displayed in the menu as a sequence of 4 characters overhanged by the indication `CNT1..CNT4`. The 1... 10 Relay Outputs are displayed in the menu as a sequence of 10 characters overhanged by the indication `OP1.....OP10`).

Item	Description	Values
HW Status	Shows the availability of the Counter Inputs	- = Not available; X = Available
DI Status	Shows the status of the Counter Inputs	0 = OFF; 1 = ON
Type	Allows to set type of Input	0 = DI (Digital Input); 1 = CN (Counter input); 2 = FQ (Frequency input).
HW Status	Shows the availability of the Relay Outputs	- = Not available; X = Available
Man force	Allows to force each Relay Output ON/OFF	0 = OFF; 1 = ON
Refresh	Updates the value of the I/O	
Exit	Returns to previous menu	

5-2-7 CPU Info Menu

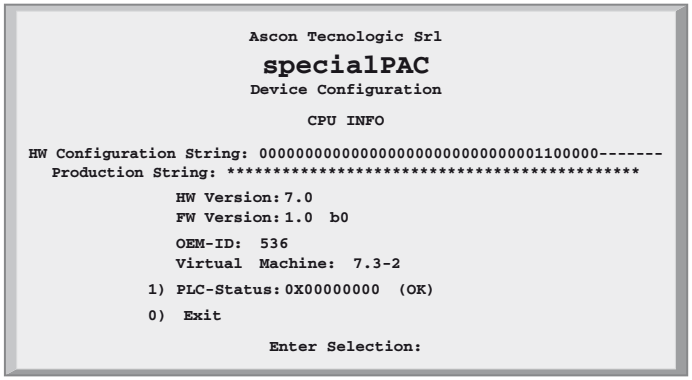


Figure 5.19 - CPU Info

	Status	Message
Production Code (factory reserved information)	OK	The system displays the production code (as shown)
	Error	The system displays the message: **Code Info Error - Invalid File (note)**
HW Version	Revision of the CPU hardware	
FW Version	Revision of the CPU firmware	
OEM-ID	Ascon Tecnologic ID code for the runtime system	
Virtual Machine	Version of the runtime software	
PLC-Status	CPU Status Indication and acknowledge of the errors	
	Errors bit mask (valid also combination of them)	
	bit	Meaning
	0	Configuration file CRC error
	1	Retain Variables file error (only at boot up)
	2	Battery level Low error
	3	Flash Fat file System error (at boot up)
	4	Calibration file CRC error (at boot up)
Exit	Returns to previous menu	

Note: Active errors are acknowledged by entering **1** and then **Return** key while displaying the "*CPU Info*" screen.

Chapter 6
USB Mass Storage Device

6-1 Configuring the CPU with the USB Mass Storage Device

The **sP4/8** CPU is equipped with an USB port type AB which can operate in Host mode and manage an USB Mass Storage Device (**USB key**) to download/upload the CPU firmware or some specific system files. Both processes have their own specific procedure and cannot take place together due to a specific sequence of actions.

6-1-1 Boot-up sequence

The following flowchart illustrates the various steps performed by the CPU while powered up until the timeframe window to access the system configuration session (via a Telnet client such as the Windows Hyperterminal).

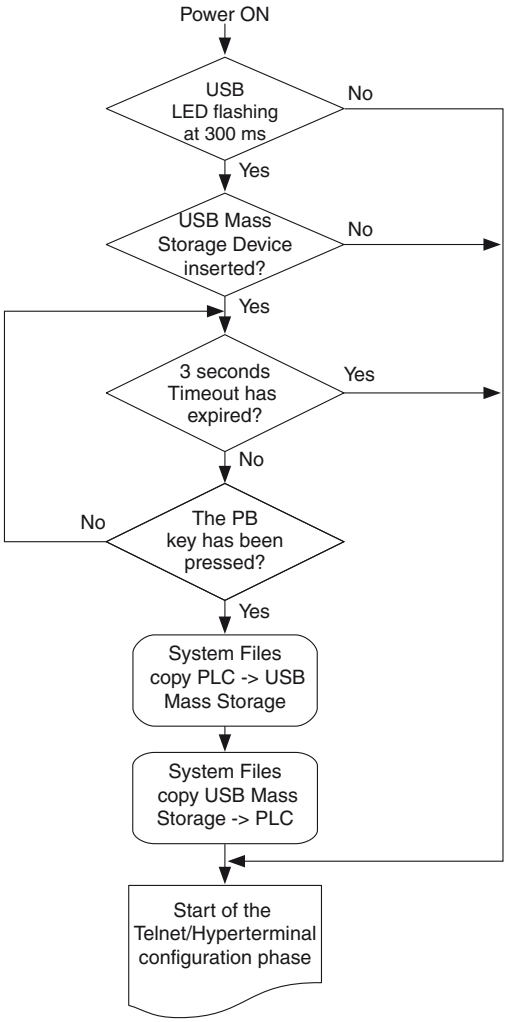


Figure 6.1 - Steps performed by the CPU at power ON

6-1-2 Upload of the files involved within the PLC program operations

After the boot-up phase, if the above described procedure has been properly executed, the CPU copies the internal files on the USB key (if present) as follows.

File location in the PLC	File location in the USB key
/A/restore_file	**0**:sys_sts/apl_rest.bin
/A/sys_file	**0**:sys_sts/sys_conf.bin
/A/errlog_file	**0**:sys_sts/err_log.bin
/fs2/retain	**0**:sys_sts/ret_var.bin
/fs2/preserved	**0**:sys_sts/pres_var.bin

Note: "**0**:" identifies the drive letter assigned to the USB key by the File System.

6-1-3 Download of the files involved within the PLC program operations

Once the files upload process described at paragraph 6.1.2 has ended, the CPU copies then the same files but from the USB key (if present) to the internal Flash memory.

File location in the USB key	File location in the PLC
0:cnfg_sys/apl_rest.bin	/A/restore_file
0:cnfg_sys/sys_conf.bin	/A/sys_file
0:cnfg_sys/ret_var.bin	/fs2/retain
0:cnfg_sys/pres_var.bin	/fs2/preserved

Note: "**0**:" identifies the drive letter assigned to the USB key by the File System.

6-1-4 File system support for the CPU application

Application file executed by the CPU

The program executed by the CPU may reside in the internal Flash file system or in the USB key. The memory support where to save the program can be selected in the "**Persistency Menu**" available from the Setup configuration session.

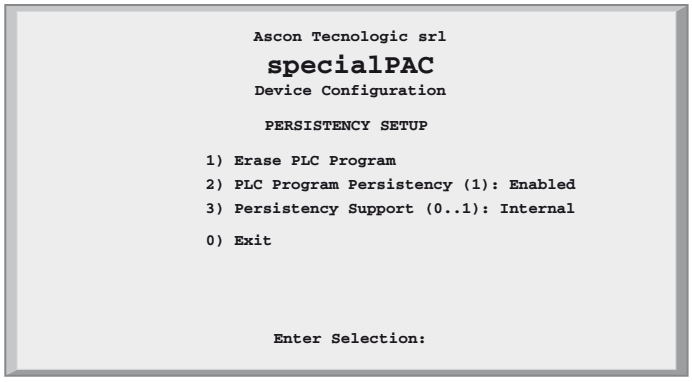


Figure 6.2 - Persistency Setup Menu

Through the "*Persistency Support*" parameter the user can select the area where a persistent copy of the PLC program will be saved.

If the user sets the parameter "*Persistency Support*" to "**0**", the program will be saved in the CPU Internal Flash Memory whilst setting the value to "**1**" it will be saved in the USB Key.

If the user selects to save the PLC application in the USB Key, the path where the program file will be saved is:

0:applic/res_file.bin

If the user selects to save the PLC application in the Internal Flash memory, the path where the program file will be saved is:

/A/restore_file

Application file generated by OpenPCS

The binary application file generated by OpenPCS (standard IEC61131 compliant) which can be downloaded via TFTP to the CPU is located in the "`$GEN$/Resource`" directory of the specific project. The procedure to download it is the following:

- Open a tftp client, set the IP address and port (69) of the device you want to connect;
- Execute a "put" command where the source file name will be:
  `project_root/$GEN$/Resource/Resource.prs`
  while the name of the output file will be:
  `/A/restore_file`
  for the Flash file system, or
  `0:applic/res_file.bin`
  for the USB Key.

Chapter 7
CPU Diagnostic Tests

7-1 Accessing the diagnostic session

Included into the Telnet Configuration session, the **sP4/sP8** unit provides a specific diagnostic interface which allows the user to check and test the on-board I/Os. It can be activated from the "*STARTUP SETUP MENU*", by using the entry "*Post Startup Run*".

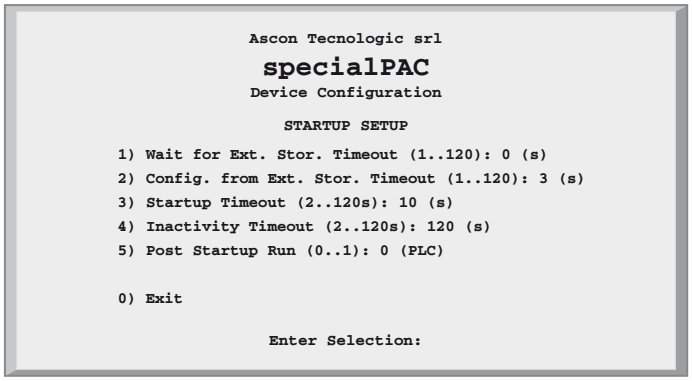


Figure 7.1 - Startup Setup Menu

To run the "*Diagnostic I/O Watch Window*", the value "*Post Startup Menu*" must be set to value "**1**". The table that follows displays the possible values for the "*Post StartUp Run*" entry:

Value	Value displayed	Meaning
0	**PLC**	Exiting the configuration session the system runs the PLC 1131 application
1	**I/O Watch**	Exiting the configuration session the system runs the I/O Watch Window

When the user exits the configuration session, the system restarts running the selected option.

7-2 I/O Watch Window

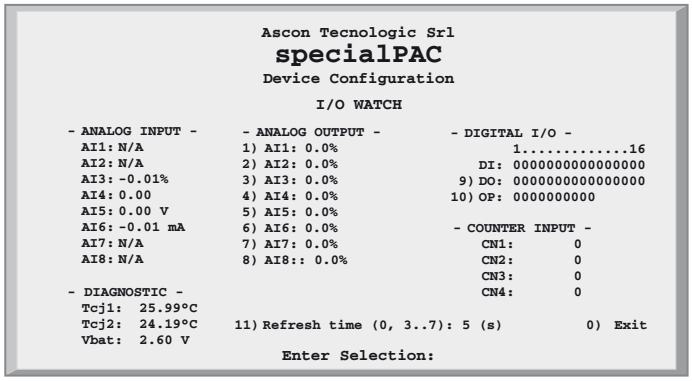


Figure 7.2 - I/O Watch Window

From the "*I/O Watch Window*" the user can:

- Read the analogue input values in engineering format;
- Read the digital input values as bit mask;
- Display/Set the analogue output values as a percentage (-10.0...110.0%);
- Display/Set the digital outputs as bit mask.

The window is updated continuously and allows the user to check the I/O present on-board. The refresh rate can be adjusted accordingly to the following table:

Value	Refresh rate
0	No refresh (static mask)
3... 7	Refresh Time Value (3... 7 seconds)

To set an output value, the user must select the desired specific one (1 for the DOs, 2... 5 for the AOs or 6…9 for relay/SSR drive) and then specify the desired value:

- A percentage (0...100%) for the analogue (without regard for the output type);
- A Boolean value for the digital or OPs.

Examples: **Digital Output Channels**

Digital Output	DO1	DO2	DO3	DO4	DO5	DO6	DO7	DO8
Desired value	0	0	1	0	0	0	1	1
Enter selection	1							
Insert new value	00100011							

Analogue Output Channels

Ch1 Output Type: 0... 10 V
Desired value: 7.00 V
Enter selection: 2
Insert new value: 70.00

Ch2 Output Type: 4... 20 mA
Desired value: 12 mA
Enter selection: 3
Insert new value: 50.00

In order to exit the I/O atch Window mode, reboot the CPU and change the related specific option (see *"Startup Timeout Menu" at page 21*).

Chapter 8
Programming the CPU

8-1 Installing OpenPCS

8-1-1 Hardware and Software Requirements

To properly install and operate with the OpenPCS programming tool version 7.x is required a PC equipped with at least:

- An Intel® Core™ i5 Processor, 2.30 GHz;
- 4 GB RAM;
- 16 GB of free disk space;
- A minimum resolution of 1024 x 768 resolution;
- Windows 7 or 8.1 or 10 (32 or 64 bit).

8-1-2 Installation

The programming tool is provided within the AT Automation Suite. If natively supported by your PC and Internet browser, an HTML main screen interface could be automatically started and from where you can select the software version you want to install. If the auto-start function is disabled or the software comes as standalone package on an USB key or via web, please start the last distributed available OpenPCS programming tool version (e.g. `OpenPCS_Ver_713e.exe` file) available in `X:\SETUP\ folder` (“**x**”: is the letter assigned to the CD-ROM or USB drive by your PC).

At the end of the installation, a popup window will ask if you want to install also an hardware driver. If the drivers have been provided within the AT Automation Suite, please select the desired one to be installed, otherwise select “**Quit**”.

The driver file (`.cab`) typically includes everything needed to fully operate with the OpenPCS programming tool: hardware drivers, libraries, specific documentation, customized functions and the annual licenses related to the AT hardware platforms.

In case of need to enter manually the license codes, please see Licence Editor for how to insert them. If you do not have a hardware driver or a valid active license key, OpenPCS will be 100% functional but with all the restrictions of the “*SIMULATION*” mode.

8-1-3 Starting OpenPCS

Start Windows and from the start-menu choose:

Start → Programs → infoteam OpenPCS 7.x → infoteam OpenPCS 7.x

or double click on the specific desktop icon to open the Framework.

8-1-4 Configuring OpenPCS

In order to work with the Ascon Tecnologic CPU target and the OpenPCS programming tool, you must have first installed `.cab` file. The file `AT_sigmaline_zzzz.cab` includes **ALL** the files inherent the sigma**line** Hardware, drivers, examples and utilities (`zzzz` are digits to identify the year of the software release).

In case of manual or additional cab file installation, from the OpenPCS “*Extras*” menu, select “*tools – Driver install...* ”. Then, from the following popup window

"*Select*" the desired cabinet (e.g. `AT_sigmadue_2012.cab`) and finally "*Install*".

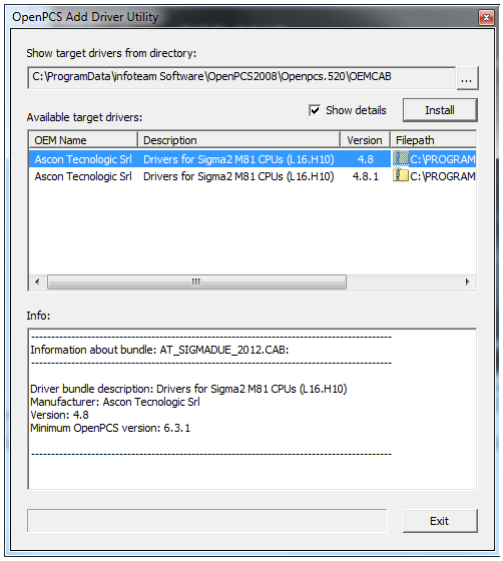


Figure 8.1 - OpenPCS OEM Driver Installation

8-2 OpenPCS Setup

In order to establish the communication between the OpenPCS programming tool and an Ascon Tecnologic target (hardware platform), a connection should be defined. The installation procedure creates itself a connection.

In case of need to modify or create a new one, select the "*Connections...*" item in the "*PLC*" menu then, from the popup window "*Connection Setup*" select "*New*".

Now, from the window "*Edit connection*" it is possible to create the new connection and from the field "*Name*" you can assign a desired name to the connection.

By pushing the "*Select*" button you can pick the driver that manages the communication with the target: for Ascon Tecnologic CPUs is TCP52.

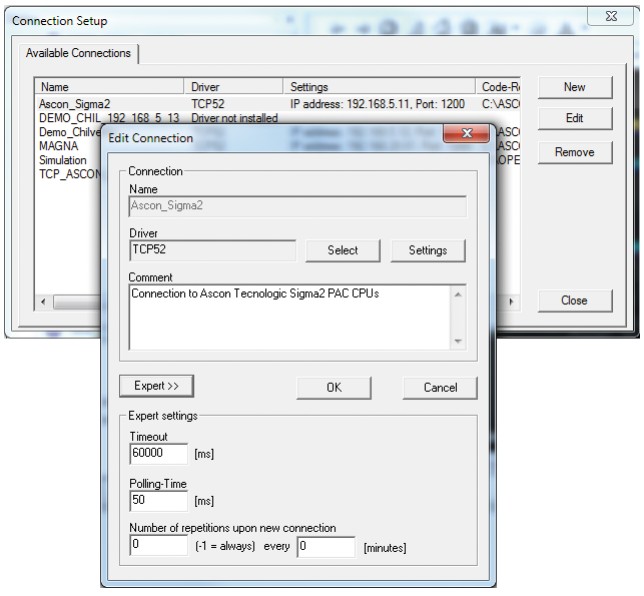


Figure 8.2 - OpenPCS Connection Setup

Now, click “Settings” button to set the communication parameters.

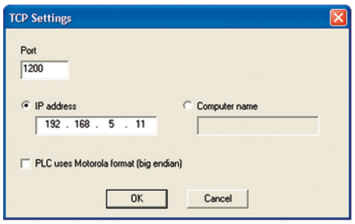


Figure 8.3 - TCP Settings

The Port number and IP address must be the same as those configured from the initial CPU configuration session. See the Ethernet setup menu, items 2 and 7 (see “*Figure 5.3 - Ethernet Setup Menu*” for details).

OpenPCS environment is now ready to communicate with the Ascon Tecnologic target.

The project must be setup in order to use the CPU: select the “*Resource Properties*” item in the PLC menu, select “A*scon…*” in the “*Hardware Module*” field, then select the newly created TCP connection in the “*Network Connection*” field.

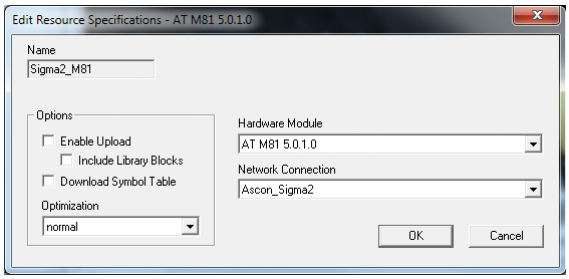


Figure 8.4 - OpenPCS resource Specifications

The “Optimization” option menu allows to select between three compilation choices: two of them, “*Normal*” and “*Speed only*”, are referred to the usage of the NCC (Native Code Compiler) to increase the overall performances of the PLC application whilst the “*Size only*” options can be used to minimize application memory usage.

Please note that in case of NCC usage it is not allowed to insert break points while debugging the projects.

Setup Communications Timeout

There are several conditions that could make necessary to set the Ethernet Port communication timeout to an higher value than default. This timeout verifies the connection status between OpenPCS and the target CPU: for example, in case of need to transfer a big size project, due to the amount of time to perform the operation, it may be necessary to set a longer driver timeout. The default value of 5000 ms can be increased by using the connection “*Expert*” mode option (suggested value = “30000” which means a 30 seconds timeout).

8-2-1 Watchdog Timer

The Ascon Tecnologic **sP4/8** can perform a watchdog control which operates accordingly to 2 specific FBs (*WATCHDOG_SET* and *WATCHDOG_STATUS*).

Conceptually, the Watchdog is a countdown timer which is reset by the CPU every program cycle: if the count reaches value zero, two different operational modes may be set:

- The CPU continues, if possible, the program execution, stores the event and, if enabled, activates the dedicated DO (please see "*5-2-5 Startup Setup Menu*" for details);
- The CPU resets (power cycles) to restart the program;
- The CPU stops the 1131 application and activates the specific configured DO.

Please note that the Watchdog timer is controlled by FBs and it runs independently from the PLC program. Therefore, if the program stops, the timer is still active and behaves as programmed when the counter reaches zero.

Chapter 9
CPU Configuration Software (TFTP File Access)

9-1 TFTP Protocol Access

The sigma**line sP4/8** unit allows the user to access the internal device file system using a TFTP (Trivial File Transfer Protocol) client.

All the Internal Flash Memory files present in the CPU and on the USB Key, can be reached by the TFTP protocol through an Ethernet connection (**port 69**), including the custom ones related to the PLC data logging.

Caution

Working with large files on the USB key will produce an overall decreasing of the CPU performances which would have a significant impact on the whole application cycle time. **For this reason, it is STRONGLY recommended to not exceed 120 MB maximum as data - logging file dimension!**

With TFTP protocol it is possible to upload/download the Firmware, device configuration, IEC61131 program, retained variables and log files to/from the PLC.

For security reasons, the name and the number of the accessible files is limited and fixed. The following table lists the Internal Flash Memory accessible files:

File Name	Description
`/A/restore_file`	IEC61131 program file name
`/A/sys_file`	Configuration file
`/A/errlog_file`	RUNTIME errors file name
`/fs2/retain`	Classic and % retained variable file name
`/fs2/preserved`	Preserved variable file name
`/fs2/stop_prg`	Stops the PLC program (**note 1**)
`/fs2/run_prg`	Starts the PLC program (**1**)
`/fs2/erase_prg`	Erases the PLC program (**1**)
`/fs2/ack_alm`	Acknowledges the retentive variables file error alarm **ONLY** (**2**)
`/fs2/reset`	Reset command file (**3**)

Notes:

1. The TFTP commands do not produce any errors feedback because they do not establish real TFTP data exchange.
2. Because the Acknowledge command cannot be retained, it is not possible to use it for all the other CPU alarm status. To acknowledge those ones you have to use the standard procedure described in *"5-2-7 CPU Info Menu" at page 31*.
3. This TFTP command does not get any feedback answer from the CPU because it resets itself.

Caution
The Reset Command file (`/fs2/reset`) activates the CPU reset command. The access to the `/fs2/reset` file using the TFTP connection causes the instantaneous reset of the CPU.

To connect the unit, the user needs to know the device IP address (see *"Ethernet Setup Menu" at page 24* for details) and the logic port used, which is always **69** for the TFTP activities. The TFTP protocol has only two different services:

- GET (upload);
- PUT (download).

The GET service allows the user to upload a file from a CPU unit whilst the PUT allows files to be downloaded. Using the TFTP client available with Windows (see `C:\Windows\System32\tftp.exe`) the syntax to be used for the commands are:

To GET a file from the **sP4/8**

```
tftp –i <remote host address> get <remote file_name><local file name>
```

To PUT a file into the **sP4/8**

```
tftp –i <remote host address> put <local file name><remote file_name>
```

For example, if the user wants to GET the configuration file from a CPU unit, and store it in a local file named "`configuration.bin`", the command is:

```
tftp -i 192.168.5.11 get /A/sys_file configuration.bin
```

where `192.168.5.11` is the CPU IP address.

If the user wants to PUT the IEC61131 program file into a CPU unit, using the source file "`sigmaline_sPx.prs`", the command will be:

```
tftp -i 192.168.5.11 put sigmaline_sPx.prs /A/restore_file
```

Please note that the application binary file which contains the program compiled with OpenPCS is located in the project folder "`project_root/$GEN$/Resource`" and has always an extension file name "`*.prs`".

9-1-1 IEC61131-3 OpenPCS Runtime Errors log file

In all those situations where an unpredictable internal error locks the CPU, it is very useful to have an historical file which lists and memorizes them, organized by date and time and that can help somehow to understand or identify the source of it. For this reason, it is available into the CPU unit, a file called `/A/errlog_file` that can be uploaded. It is a text file (can be opened by Windows Notepad, for example) and it is organized in rows. The history goes back to maximum 10 events and it is organized as:

```
day of the week  hh:mm:ss   dd-mm-yy   error code
```

Following an example:

```
Wed   16:37:28     23-04-12     2002
Wed   16:37:25     23-04-12     2002
Wed   16:36:36     23-04-12     2001
Thu   11:56:29     22-04-12     2002
```

The table of error managed is the following:

Code	Name	Description
0	kLzsSuccess	PLC is working normal
1	kLzsGeneralError	GENERAL ERROR!
1001	kLzsModeConflict	Local Run/Stop-Switch on PLC set to <STOP>
1002	kLzsNoMem	Out of program memory: program execution not possible
1003	kLzsHardwareError	Hardware error
1004	kLzsInvalidPgm	No valid program
1005	kLzsDwnldError	Download of invalid data
1006	kLzsConfigError	Configuration error/wrong program

Code	Name	Description
1007	kLzsInvalidModCfg	Module configuration error
1008	kLzsInvalidPgmNr	Invalid program number
1009	kLzsInvalidSegNr	Invalid segment number
1010	kLzsInvalidSegType	Invalid segment type
1011	kLzsSegDuplicate	segment already on PLC
1012	kLzsNoWatchTabEntry	No free watch ID available
1013	kLzsUnknownCmd	Invalid command received
1014	kLzsModeErr	Action not valid. Wrong mode
1015	kLzsNetError	General network error
1016	kLzsNetRecSizeError	accepted receipt too small
1017	kLzsProcImgRdWrError	Error reading/writing process image
1018	kLzsTimerTaskError	Timertask error
1019	kLzsIpVerError	Wrong kernal version
1020	kLzsIpExecError	Error calling kernal
1021	kLzsNcExecError	Error calling native code
1022	kLzsNoBkupMem	Out of backup memory (EEPROM/Flash): program will be lost on power down
1023	kLzsIOConfigError	Error in I/O-Configuration
1024	kLzsNoHDMem	Out of user disk space: download of raw file failed
1025	kLzsNotValidInRunState	Invalid action-switch PLC to stop first
1101	kLzsCycleLengthExceeded	RUNTIME ERROR: cycle length exceeded
1102	kLzsRtxBaseTimerLengthExceeded	RUNTIME ERROR: RTX Base Timer length exceeded
1103	kLzsNetErrorLastSession	The previous Online Session was interrupted unexpectedly
1104	kLzsUplErrorNotEnabled	UPLOAD ERROR: Resource does not containupload information
1105	kLzsHistNoFreeEntry	No free hist ID available
1106	kLzsHistInvalidID	Invalid hist ID
1201	kLzsRawFileWriteError	Writing of Raw File failed (disk full write protected etc.)
1202	kLzsRawFileReadError	Reading of Raw File failed (file does not exist, no permission etc.). Try to download again.
1203	kLzsRawFileDeleteError	Deleting of Raw File failed (file is r/o no permission etc.)
1501	kLzsNetInitError	Network configuration error
1502	kLzsNetIoError	Network error in IO-Process communication
1503	kLzsNetInvalidNodeID	Invalid Node Address selected for this PLC
1504	kLzsNetVarCfgError	Invalid configuration for Network Variables (incorrect DCF)
1505	kLzsNetNIOverflow	Network Image overflow (too many network variables defined)
1506	kLzsNetInvalidIpCfg	Invalid IP configuration selected (MAC Addr., IP Addr. or Subnet - Mask)
1507	kLzsNetRemoteNodeCfgError	Remote Node configuration error for details see Error Logfile
1508	kLzsNetErrorInOfflineMode	A network error was occurred during the PLC offline state
1601	kLzsNoBreakpointError	No breakpoint
1602	kLzsMaxBreakpointsError	Maximum number of breakpoints reached
1603	kLzsBreakpointNotFoundError	Breakpoint not found
1604	kLzsDwlTDTError	TDT error
1605	kLzsMoveSegmentError	Error moving segment
1606	kLzsDwlNoLinkerTableError	Linker table error
1607	kLzsDwlAlignmentError	Alignment error
1608	kLzsDwlDSSizeError	DS size error
1609	kLzsDwlReadSegAddrError	Error reading segment address
1610	kLzsDwlResourceReplaceError	Resource replace error
1611	kLzsDwlNoSegTabError	No segment table
1612	kLzsDwlProcDataError	Download procdata error

Code	Name	Description
1613	kLzsDwlNoCopyTableError	No copy table
1614	kLzsHistMaxHistError	Maximum number of history entries reached
1615	kLzsHistSizeError	Historical data size error
1616	kLzsHistMutexError	Historical data mutex error
1617	kLzsHistMaxHistSettingError	LZS_MAXHIST is set too high
1618	kLzsForceTypeError	Unsupported force type
1619	kLzsWatchTypeError	Unsupported watch type
1620	kLzsWatchDeleteError	Error deleting watch entry
1621	kLzsInterpreterError	Interpreter error
1623	kLzsProcImgError	Process image error
1624	kLzsLoginStatusError	Status error on login
1625	kLzsLogoutStatusError	Status error on logout
1626	kLzsWriteSegAddrError	Error writing segment address
1627	kLzsSaveTempSegError	Error saving temporary segment
1628	kLzsNccExecFrmwFnctError	NC firmware execution error
1629	kLzsNccStubError	Undefined stub called in native code
1630	kLzsIStackError	Instance stack overflow
1631	kLzsIStackError2	Instance stack underflow
1632	kLzsPersCRCFailed	CRC Error reading persistence.
1633	kLzsPersVersionMismatch	Version mismatch between target system and persistence
1634	kLzsPersSaveError	Saving persistence failed!
1635	kLzsMaintenanceModeErr	No maintenance mode !
1636	kLzsDwlPISizeMismatchError	Process image size changed
1637	kLzsPatchDirFarByrefError	Error patching Direct Far Byref
1638	kLzsPersCapsMismatch	Capability mismatch between target system and persistence
1639	kLzsEventTaskTwice	Event task exists twice
1700	kLzsRedBackupModeErr	Action not allowed on Backup system
2001	kIpDivisionByZero	RUNTIME ERROR: division by zero
2002	kIpArryIndexInvalid	RUNTIME ERROR: invalid array index
2003	kIpOpcodeInvalid	RUNTIME ERROR: invalid opcode
2004	kIpOpcodeNotSupported	RUNTIME ERROR: opcode not supported
2005	kIpExtensionInvalid	RUNTIME ERROR: invalid extension
2006	kIpTaskCmdInvalid	RUNTIME ERROR: unknown command
2007	kIpPflowNotAvailable	Kernel without power flow
2008	kIpInvalidBitRef	Invalid bit reference
2009	kIpErrorRestoreData	Error restoring data
2010	kIpNoValidArrElementSize	Invalid array element size
2011	kIpInvalidStructSize	Invalid struct size
2012	kIpModuloZero	RUNTIME ERROR: modulo zero result undefined
2013	kIpArrElemNotSupported	Arrays of this type not supported
2014	kIpMemMonitorError	Memory Monitor detected critical error!
3001	kIecGeneralError	FIRMWARE: general error. Group: ID:
3002	kIecFBNotSupported	FIRMWARE: called FB not available. Group: ID:
3003	kIecHardwareError	FIRMWARE: error accessing the hardware. Group: ID:
9002	kLzsOemError02	Not enough space in backup memory: retentive variable will not be saved
9003	kLzsOemError03	Not enough space in persistent memory
9004	kLzsOemError04	Hard fault occurred
9005	kLzsOemError05	Runtime event: watchdog timeout expired

Error 0 and Error 1103 are not saved because they are generated every time the application restarts from a previous error situation. The errors log file is generated in FIFO mode (First In First Out).

Chapter 10
CPU Data Memory Map

A sigma**line sP4/8** CPU is a very flexible unit equipped already with several on-board I/O channels that can be easily accessed by specific dedicated memory map area. The memory areas are divided into different sections:

Central Unit	Digital Input Status
	Analogue Input Value
	I/O Diagnostic Status
	Onboard Temperature Values
	Digital Counters
	Digital Output Status
	Analogue Output Value

10-1 Central Unit Data

10-1-1 Digital & Special Inputs Status (DI1... DI8, DI9... DI16, CN1... CN4)

The 2/4 special Input channels can be configured as Pulse Count or Frequency meter or Digital Input. The status is available from 2 specific WORD, at addresses:

Addr.	Memory type	Data type	Description
320.0	%I	DWORD	xx.0 .. xx.15 = DI Status
324.0	%I	DWORD	xx.0 .. xx.3 = FI/CNT Status
327.7	%I	BOOL	xx.31 CPU Push Button Runtime Status

Note: The information status are mapped as bit mask (xx.0... xx.15) in the specific WORD, both DIs status and PB button (directly as single bit).

In case of Special DIs configured as Fast Pulse Counters, the data are organized in a different way and the accumulated values are mapped on 2 different memory areas for each channels.

The data format used for them is the Unsigned Integer (UINT) 16 bit.

Addr.	Memory type	Data type	Description
200.0	%I	REAL	Frequency Value CNT1 - Eng. Units
204.0	%I	REAL	Frequency Value CNT2 - Eng. Units
208.0	%I	REAL	Frequency Value CNT3 - Eng. Units
212.0	%I	REAL	Frequency Value CNT4 - Eng. Units
220.0	%I	UINT	Counter Value CNT1 - Pulse Counts
222.0	%I	UINT	Counter Value CNT1 - no. of Overflow
224.0	%I	UINT	Counter Value CNT2 - Pulse Counts
226.0	%I	UINT	Counter Value CNT2 - no. of Overflow
228.0	%I	UINT	Counter Value CNT3 - Pulse Counts

Addr.	Memory type	Data type	Description
230.0	%I	UINT	Counter Value CNT3 - no. of Overflow
232.0	%I	UINT	Counter Value CNT4 - Pulse Counts
234.0	%I	UINT	Counter Value CNT4 - no. of Overflow

10-1-2 Generic Inputs (IN1... IN4, IN5... IN8)

The 4/8 generic Inputs can be present on the device. The inputs configuration is performed using the CPU Configuration Session (see "*Chapter 4*" for details) or the AT sigmaPAC Wizard Tools (see "*Appendix B*" for details). The values present in the memory map are already expressed in engineering unit (V, mA, mV, degrees or Ohm), using a REAL 32 bit floating point notation, at the following addresses.

Addr.	Memory type	Data type	Description
140.0	%I	REAL	AI Value Chn_01 - Eng. Units
144.0	%I	REAL	AI Value Chn_02 - Eng. Units
148.0	%I	REAL	AI Value Chn_03 - Eng. Units
152.0	%I	REAL	AI Value Chn_04 - Eng. Units
156.0	%I	REAL	AI Value Chn_05 - Eng. Units
160.0	%I	REAL	AI Value Chn_06 - Eng. Units
164.0	%I	REAL	AI Value Chn_07 - Eng. Units
168.0	%I	REAL	AI Value Chn_08 - Eng. Units

The 8 Generic Inputs configuration meaning is:

Value	Type	Range
0	0... 5 Volt (Configurable)	0.0... 5.5 V
1	1... 5 Volt (Configurable)	0.6... 5.4 V
2	0... 10 Volt (Configurable)	0.0... 11.0 V
3	2... 10 Volt (Configurable)	1.2... 10.8 V
4	0... 20 mA (Configurable)	0.0... 22.0 mA
5	4... 20 mA (Configurable)	2.4... 21.6 mA
6	Thermocouple J (Configurable)	-245.25... +1235.5°C
7	Thermocouple K (Configurable)	-249.3... +1411.3°C
8	Thermocouple L (Configurable)	-220.0... +620.00°C
9	Thermocouple N (Configurable)	-32.5... +1332.5°C
10	Thermocouple R (Configurable)	-40.0... +1640.0°C
11	Thermocouple S (Configurable)	-44.0... +1804.0°C
12	Thermocouple T (Configurable)	-215.0... +415.0°C
13	PT100 (2 wires)(Fixed)	-232.3... +882.7°C
14	PT1000 (Fixed)	-232.3... +882.7°C
15	Potentiometer (Fixed)	0... 1000000 Ω
16	NTC SEMITEC 103AT-2 (Fixed)	-56.5... +141.5°C
17	Ratiometric 5 V (Fixed)	0.0... 5.5 V
18	Digital (Fixed)	
19	Strain gauge (Fixed)	

The raw values of the above described inputs can be found at addresses:

Addr.	Memory type	Data type	Description
20.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_01
24.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_02
28.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_03
32.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_04
36.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_05
40.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_06
44.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_07
48.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_08

10-1-3 Generic I/O Diagnostic Status

For each generic I/O channel, the **sP4/8** unit provides an indication about the operational status of the channel (even if this is not present because optional).
The possible values of this indication are:

Status Value	Description
0	The value is in the range of the signal
1	The value is under range of the signal
2	The value is over range of the signal
4	Channel not Configured
8	No valid measure available

Memory map for the input diagnostic indications:

Addr.	Memory type	Data type	Description
80.0	%I	BYTE	Universal Analogue Input Status Chn_01
81.0	%I	BYTE	Universal Analogue Input Status Chn_02
82.0	%I	BYTE	Universal Analogue Input Status Chn_03
83.0	%I	BYTE	Universal Analogue Input Status Chn_04
84.0	%I	BYTE	Universal Analogue Input Status Chn_05
85.0	%I	BYTE	Universal Analogue Input Status Chn_06
86.0	%I	BYTE	Universal Analogue Input Status Chn_07
87.0	%I	BYTE	Universal Analogue Input Status Chn_08

Memory map for the output diagnostic indications:

Addr.	Memory type	Data type	Description
100.0	%I	BYTE	High level Analogue Output Status Chn_01
101.0	%I	BYTE	High level Analogue Output Status Chn_02
102.0	%I	BYTE	High level Analogue Output Status Chn_03
103.0	%I	BYTE	High level Analogue Output Status Chn_04
104.0	%I	BYTE	High level Analogue Output Status Chn_05
105.0	%I	BYTE	High level Analogue Output Status Chn_06
106.0	%I	BYTE	High level Analogue Output Status Chn_07
107.0	%I	BYTE	High level Analogue Output Status Chn_08

Memory map for the Standard & Special Digital Input diagnostic indications:

Addr.	Memory type	Data type	Description
110.0	%I	BYTE	Digital IOs Overall Status
111.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT1
112.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT2
113.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT3
114.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT4

10-1-4 Internal CJs, Battery Voltage and Temperature Values

The **sP4/8** unit provides an indication about the some generic diagnostic information. The data format used for the value present in the memory map is a REAL 32 bit floating point notation.

Addr.	Memory type	Data type	Description
0.0	%I	REAL	AI1... AI4 Cold Junction Temperature_1 Measure
4.0	%I	REAL	AI5... AI8 Cold Junction Temperature_2 Measure
8.0	%I	REAL	CPU Internal Battery Voltage value
12.0	%I	REAL	CPU Internal Temperature Measure

10-1-5 Digital Software Counters

In the Configuration session (please see *"Startup Timeout Menu" at page 21* for details) it is possible to enable a Counter function for each Digital defined as input. In memory map, there is a section where all Counters value are available.

The data format used for them is the Unsigned Double Integer (UDINT) 32 bit.

Addr.	Memory type	Data type	Description
240.0	%I	UDINT	Digital Input Counter Chn_01
244.0	%I	UDINT	Digital Input Counter Chn_02
248.0	%I	UDINT	Digital Input Counter Chn_03
252.0	%I	UDINT	Digital Input Counter Chn_04
256.0	%I	UDINT	Digital Input Counter Chn_05
260.0	%I	UDINT	Digital Input Counter Chn_06
264.0	%I	UDINT	Digital Input Counter Chn_07
268.0	%I	UDINT	Digital Input Counter Chn_08
272.0	%I	UDINT	Digital Input Counter Chn_09
276.0	%I	UDINT	Digital Input Counter Chn_10
280.0	%I	UDINT	Digital Input Counter Chn_11
284.0	%I	UDINT	Digital Input Counter Chn_12
288.0	%I	UDINT	Digital Input Counter Chn_13
292.0	%I	UDINT	Digital Input Counter Chn_14
296.0	%I	UDINT	Digital Input Counter Chn_15
300.0	%I	UDINT	Digital Input Counter Chn_16

The value of each Counter can be Reset using a specific function block inside the PLC program (see the "*Ascon Tecnologic Firmware Function Block Library*" [**3**] for details).

10-1-6 Generic & Special Digital Outputs Status (DO1... DO16, OP1… OP10)

The commands of all of them can be managed by using 2 dedicated specific WORD, at the following addresses:

Addr.	Memory type	Data type	Description
40.0	%Q	WORD	xx.0 .. xx.10 = RELAY Status
44.0	%Q	WORD	xx.0 .. xx.15 = DO Status

The DO1... DO16 are mapped as complete commands bit mask (xx.0... xx.15) while the OP ones use only some of them (xx.0… xx.9).

10-1-7 Generic Output Value (OT1... OT4, OT5... OT8)

The value for the OT is REAL 32 bit floating point and, for the active channels, the user writes the percentage value at the following addresses:

Addr.	Memory type	Data type	Description
0.0	%Q	REAL	High level Analogue Output Chn_01
4.0	%Q	REAL	High level Analogue Output Chn_02
8.0	%Q	REAL	High level Analogue Output Chn_03
12.0	%Q	REAL	High level Analogue Output Chn_04
16.0	%Q	REAL	High level Analogue Output Chn_05
20.0	%Q	REAL	High level Analogue Output Chn_06
24.0	%Q	REAL	High level Analogue Output Chn_07
28.0	%Q	REAL	High level Analogue Output Chn_08

The 8 Generic Outputs configuration meaning is:

Value	Type
0	0… 5 Volt
1	1… 5 Volt
2	0… 10 Volt
3	2… 10 Volt
4	0… 20 mA
5	4… 20 mA
6	Digital
7	PWM/Frequency

10-1-8 PWM/Frequency Output Value (OT1... OT4)

In case of OTs specific configuration for PWM or Frequency, the value is still a REAL 32 bit floating point and, for the active channels, the user writes the percentage value at the following addresses:

Addr.	Memory type	Data type	Description
60.0	%Q	REAL	PWM Output Chn_01 value
64.0	%Q	REAL	PWM Output Chn_02 value
68.0	%Q	REAL	PWM Output Chn_03 value
72.0	%Q	REAL	PWM Output Chn_04 value

10-2 Battery, Retain Variables, CPU Production code Status

10-2-1 Battery and Retentive Memory Status

Addr.	Memory type	Data type	Description
0.0	%MX	bit	Battery status (0 = Level Low, 1 = OK)
0.1	%MX	bit	Classic Retain Variables Startup Status (0 = KO, 1 = OK)
0.2	%MX	bit	Preserved Variables Startup Status (0 = KO, 1 = OK)
0.3	%MX	bit	CPU Production Code (0 = KO, 1 = OK)

10-2-2 I/O Configuration Information

Digital Channels Configuration Information

Addr.	Memory type	Data type	Description
24.0	%M	DWORD	Digital Channels Mode (0 = Standard, 1 = Counter)

Generic Inputs and Outputs Configuration Information

Addr.	Memory type	Data type	Description
40.0	%M	USINT	Universal Analogue Input Configuration Chn_01
41.0	%M	USINT	Universal Analogue Input Configuration Chn_02
42.0	%M	USINT	Universal Analogue Input Configuration Chn_03
43.0	%M	USINT	Universal Analogue Input Configuration Chn_04
44.0	%M	USINT	Universal Analogue Input Configuration Chn_05
45.0	%M	USINT	Universal Analogue Input Configuration Chn_06
46.0	%M	USINT	Universal Analogue Input Configuration Chn_07
47.0	%M	USINT	Universal Analogue Input Configuration Chn_08
60.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_01
61.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_02
62.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_03
63.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_04
64.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_05
65.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_06
66.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_07
67.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_08
80.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT1
81.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT2
82.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT3
83.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT4
100.0	%M	USINT	Universal Analogue Output Status Chn_01
101.0	%M	USINT	Universal Analogue Output Status Chn_02
102.0	%M	USINT	Universal Analogue Output Status Chn_03
103.0	%M	USINT	Universal Analogue Output Status Chn_04
104.0	%M	USINT	Universal Analogue Output Status Chn_05
105.0	%M	USINT	Universal Analogue Output Status Chn_06
106.0	%M	USINT	Universal Analogue Output Status Chn_07
107.0	%M	USINT	Universal Analogue Output Status Chn_08

Note: The value of the Analogue Input channels (in Engineering Units) con be set as: **0** = °**C**, **1** = **K**, **2** = °**F**.

10-2-3 CPU Ethernet IPs Addresses Management Variables

Ethernet Specific IP Addresses

Addr.	Memory type	Data type	Description
950.0	%M	USINT	CPU Ethernet - IP Address Field_01
951.0	%M	USINT	CPU Ethernet - IP Address Field_02
952.0	%M	USINT	CPU Ethernet - IP Address Field_03
953.0	%M	USINT	CPU Ethernet - IP Address Field_04
954.0	%M	USINT	CPU Ethernet - IP Subnet Field_01
955.0	%M	USINT	CPU Ethernet - IP Subnet Field_02
956.0	%M	USINT	CPU Ethernet - IP Subnet Field_03
957.0	%M	USINT	CPU Ethernet - IP Subnet Field_04
958.0	%M	USINT	CPU Ethernet - IP Gateway Field_01
959.0	%M	USINT	CPU Ethernet - IP Gateway Field_02
960.0	%M	USINT	CPU Ethernet - IP Gateway Field_03
961.0	%M	USINT	CPU Ethernet - IP Gateway Field_04
962.0	%M	USINT	CPU Ethernet - IP DNS Field_01
963.0	%M	USINT	CPU Ethernet - IP DNS Field_02
964.0	%M	USINT	CPU Ethernet - IP DNS Field_03
965.0	%M	USINT	CPU Ethernet - IP DNS Field_04

Ethernet Specific MAC Address

Addr.	Memory type	Data type	Description
966.0	%M	USINT	CPU Ethernet - MAC Address Field_01
967.0	%M	USINT	CPU Ethernet - MAC Address Field_02
968.0	%M	USINT	CPU Ethernet - MAC Address Field_03
969.0	%M	USINT	CPU Ethernet - MAC Address Field_04
970.0	%M	USINT	CPU Ethernet - MAC Address Field_05
971.0	%M	USINT	CPU Ethernet - MAC Address Field_06

10-2-4 CPU Production Code Management Variables

Model Code

Addr.	Memory type	Data type	Description
800.0	%M	BYTE	CPU Model Code - Character_1
807.0	%M	BYTE	CPU Model Code - Character_8

Field Code

Addr.	Memory type	Data type	Description
808.0	%M	BYTE	Field Code “DYL” - DISPLAY
810.0	%M	BYTE	Field Code “SAI” - AI Amount
812.0	%M	BYTE	Field Code “SAO” - AO Amount
814.0	%M	BYTE	Field Code “SCN” - SPECIAL DI Amount
816.0	%M	BYTE	Field Code “SDG” - Digital IO Amount
817.0	%M	BYTE	Field Code “SDG” - Digital IO Amount
819.0	%M	BYTE	Field Code “SOP” - OP RELAY/SSR

Addr.	Memory type	Data type	Description
821.0	%M	BYTE	Field Code “SCM” - COMMs PORT
823.0	%M	BYTE	Field Code “SHW” - HW CONFIGURATION
824.0	%M	BYTE	Field Code “SHW” - HW CONFIGURATION

HW and SW versions

Addr.	Memory type	Size [Bytes]	Data type	Description
826.0	%M	3	BYTE	Field Code “SHW” - HW CONFIGURATION
831.0	%M	4	BYTE	Field Code “SDS” - SW Customization
836.0	%M	1	BYTE	Field Code “SWS” - SW SUBVERSION

Serial Number Code

Addr.	Memory type	Size [Bytes]	Data type	Description
838.0	%M	1	BYTE	Serial Number - Character 1
				...
845.0	%M	1	BYTE	Serial Number - Character_8

HW and FW versions

Addr.	Memory type	Size [Bytes]	Data type	Description
846.0	%M	1	BYTE	HW code Identifier - Main
847.0	%M	1	BYTE	HW code Identifier - Sub
848.0	%M	1	BYTE	FW code Identifier - Main
849.0	%M	1	BYTE	FW code Identifier - Sub

10-3 Complete Memory Map

10-3-1 Input Memory Areas

Addr.	Memory type	Data type	Description
0.0	%I	REAL	AI1..AI4 Cold Junction Temperature_1 Measure
4.0	%I	REAL	AI5..AI8 Cold Junction Temperature_2 Measure
8.0	%I	REAL	CPU Internal Battery Voltage value
12.0	%I	REAL	CPU Internal Temperature Measure
0.0	%I	REAL	AI1..AI4 Cold Junction Temperature_1 Measure
4.0	%I	REAL	AI5..AI8 Cold Junction Temperature_2 Measure
8.0	%I	REAL	CPU Internal Battery Voltage value
12.0	%I	REAL	CPU Internal Temperature Measure
20.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_01
24.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_02
28.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_03
32.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_04
36.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_05
40.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_06
44.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_07
48.0	%I	REAL	Ohm [RTD] / mV [TC] / mA / Volt - Raw AI Chn_08
80.0	%I	BYTE	Universal Analogue Input Status Chn_01
81.0	%I	BYTE	Universal Analogue Input Status Chn_02

Addr.	Memory type	Data type	Description
82.0	%I	BYTE	Universal Analogue Input Status Chn_03
83.0	%I	BYTE	Universal Analogue Input Status Chn_04
84.0	%I	BYTE	Universal Analogue Input Status Chn_05
85.0	%I	BYTE	Universal Analogue Input Status Chn_06
86.0	%I	BYTE	Universal Analogue Input Status Chn_07
87.0	%I	BYTE	Universal Analogue Input Status Chn_08
100.0	%I	BYTE	High level Analogue Output Status Chn_01
101.0	%I	BYTE	High level Analogue Output Status Chn_02
102.0	%I	BYTE	High level Analogue Output Status Chn_03
103.0	%I	BYTE	High level Analogue Output Status Chn_04
104.0	%I	BYTE	High level Analogue Output Status Chn_05
105.0	%I	BYTE	High level Analogue Output Status Chn_06
106.0	%I	BYTE	High level Analogue Output Status Chn_07
107.0	%I	BYTE	High level Analogue Output Status Chn_08
110.0	%I	BYTE	Digital IOs Overall Status
111.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT1
112.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT2
113.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT3
114.0	%I	BYTE	Frequency/Counter Analogue Input Status CNT4
140.0	%I	REAL	AI Value Chn_01 - Eng. Units
144.0	%I	REAL	AI Value Chn_02 - Eng. Units
148.0	%I	REAL	AI Value Chn_03 - Eng. Units
152.0	%I	REAL	AI Value Chn_04 - Eng. Units
156.0	%I	REAL	AI Value Chn_05 - Eng. Units
160.0	%I	REAL	AI Value Chn_06 - Eng. Units
164.0	%I	REAL	AI Value Chn_07 - Eng. Units
168.0	%I	REAL	AI Value Chn_08 - Eng. Units
200.0	%I	REAL	Frequency Value CNT1 - Eng. Units
204.0	%I	REAL	Frequency Value CNT2 - Eng. Units
208.0	%I	REAL	Frequency Value CNT3 - Eng. Units
212.0	%I	REAL	Frequency Value CNT4 - Eng. Units
220.0	%I	UINT	Counter Value CNT1 - Pulse Counts
222.0	%I	UINT	Counter Value CNT1 - no. of Overflow
224.0	%I	UINT	Counter Value CNT2 - Pulse Counts
226.0	%I	UINT	Counter Value CNT2 - no. of Overflow
228.0	%I	UINT	Counter Value CNT3 - Pulse Counts
230.0	%I	UINT	Counter Value CNT3 - no. of Overflow
232.0	%I	UINT	Counter Value CNT4 - Pulse Counts
234.0	%I	UINT	Counter Value CNT4 - no. of Overflow
240.0	%I	UDINT	Digital Input Counter Chn_01
244.0	%I	UDINT	Digital Input Counter Chn_02
248.0	%I	UDINT	Digital Input Counter Chn_03
252.0	%I	UDINT	Digital Input Counter Chn_04
256.0	%I	UDINT	Digital Input Counter Chn_05
260.0	%I	UDINT	Digital Input Counter Chn_06
264.0	%I	UDINT	Digital Input Counter Chn_07
268.0	%I	UDINT	Digital Input Counter Chn_08
272.0	%I	UDINT	Digital Input Counter Chn_09

Addr.	Memory type	Data type	Description
276.0	%I	UDINT	Digital Input Counter Chn_10
280.0	%I	UDINT	Digital Input Counter Chn_11
284.0	%I	UDINT	Digital Input Counter Chn_12
288.0	%I	UDINT	Digital Input Counter Chn_13
292.0	%I	UDINT	Digital Input Counter Chn_14
296.0	%I	UDINT	Digital Input Counter Chn_15
300.0	%I	UDINT	Digital Input Counter Chn_16
340.0	%I	REAL	AI Value Chn_01 - Cold Junction Measure
344.0	%I	REAL	AI Value Chn_02 - Cold Junction Measure
348.0	%I	REAL	AI Value Chn_03 - Cold Junction Measure
352.0	%I	REAL	AI Value Chn_04 - Cold Junction Measure
356.0	%I	REAL	AI Value Chn_05 - Cold Junction Measure
360.0	%I	REAL	AI Value Chn_06 - Cold Junction Measure
364.0	%I	REAL	AI Value Chn_07 - Cold Junction Measure
368.0	%I	REAL	AI Value Chn_08 - Cold Junction Measure

Output Memory Areas

Addr.	Memory type	Data type	Description
0.0	%Q	REAL	High level Analogue Output Chn_01
4.0	%Q	REAL	High level Analogue Output Chn_02
8.0	%Q	REAL	High level Analogue Output Chn_03
12.0	%Q	REAL	High level Analogue Output Chn_04
16.0	%Q	REAL	High level Analogue Output Chn_01
20.0	%Q	REAL	High level Analogue Output Chn_02
24.0	%Q	REAL	High level Analogue Output Chn_03
28.0	%Q	REAL	High level Analogue Output Chn_04
40.0	%Q	WORD	xx.0 .. xx.10 = REALY Sts
44.0	%Q	WORD	xx.0 .. xx.15 = DO Sts
60.0	%Q	REAL	PWM Output Chn_01 value
64.0	%Q	REAL	PWM Output Chn_02 value
68.0	%Q	REAL	PWM Output Chn_03 value
72.0	%Q	REAL	PWM Output Chn_04 value

10-3-2 Marker Memory Areas

Addr.	Memory type	Data type	Description
0.0	%MW	WORD	CPU Cumulative Status
0.0	%MX	BOOL	CPU Battery Status (0 = KO, 1 = OK)
0.1	%MX	BOOL	Std retained Var. Status (0 = KO, 1 = OK)
0.2	%MX	BOOL	% r Preserved Var. Status (0 = KO, 1 = OK)
0.3	%MX	BOOL	CPU Production Code Status (0 = KO, 1 = OK)
20.0	%M	DWORD	Actually not used - Backword compatibility
24.0	%M	DWORD	DI Mode [mask x.0 .. x.15] : 0 = DI, 1 = Cnt
40.0	%M	USINT	Universal Analogue Input Configuration Chn_01
41.0	%M	USINT	Universal Analogue Input Configuration Chn_02
42.0	%M	USINT	Universal Analogue Input Configuration Chn_03

Addr.	Memory type	Data type	Description
43.0	%M	USINT	Universal Analogue Input Configuration Chn_04
44.0	%M	USINT	Universal Analogue Input Configuration Chn_05
45.0	%M	USINT	Universal Analogue Input Configuration Chn_06
46.0	%M	USINT	Universal Analogue Input Configuration Chn_07
47.0	%M	USINT	Universal Analogue Input Configuration Chn_08
60.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_01
61.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_02
62.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_03
63.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_04
64.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_05
65.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_06
66.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_07
67.0	%M	USINT	Universal Analogue Input Eng. Unit Chn_08
80.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT1
81.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT2
82.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT3
83.0	%M	USINT	Standard/Frequency/Counter Input Config. CNT4
100.0	%M	USINT	Universal Analogue Output Status Chn_01
101.0	%M	USINT	Universal Analogue Output Status Chn_02
102.0	%M	USINT	Universal Analogue Output Status Chn_03
103.0	%M	USINT	Universal Analogue Output Status Chn_04
104.0	%M	USINT	Universal Analogue Output Status Chn_05
105.0	%M	USINT	Universal Analogue Output Status Chn_06
106.0	%M	USINT	Universal Analogue Output Status Chn_07
107.0	%M	USINT	Universal Analogue Output Status Chn_08
800.0	%M	BYTE	Model Code - Character_01
801.0	%M	BYTE	Model Code - Character_02
802.0	%M	BYTE	Model Code - Character_03
803.0	%M	BYTE	Model Code - Character_04
804.0	%M	BYTE	Model Code - Character_05
805.0	%M	BYTE	Model Code - Character_06
806.0	%M	BYTE	Model Code - Character_07
807.0	%M	BYTE	Model Code - Character_08
808.0	%M	BYTE	Field Code “DYL” - Display
810.0	%M	BYTE	Field Code “SAI” - AI Amount
812.0	%M	BYTE	Field Code “SAO” - AO Amount
814.0	%M	BYTE	Field Code “SCN” - Special DI Amount
816.0	%M	BYTE	Field Code “SDG” - Digital IO Amount
817.0	%M	BYTE	Field Code “SDG” - Digital IO Amount
819.0	%M	BYTE	Field Code “SOP” - OP Relay/SSR
821.0	%M	BYTE	Field Code “SCM” - COMMs Port
823.0	%M	BYTE	Field Code “SHW” - HW Configuration
824.0	%M	BYTE	Field Code “SHW” - HW Configuration
826.0	%M	BYTE	Field Code “PEC” - Packaging & Case
828.0	%M	BYTE	Field Code “HW” - HW Customization
829.0	%M	BYTE	Field Code “HW” - HW Customization
831.0	%M	BYTE	Field Code “SDS” - SW Customization

Addr.	Memory type	Data type	Description
832.0	%M	BYTE	Field Code “SDS” - SW Customization
833.0	%M	BYTE	Field Code “SDS” - SW Customization
834.0	%M	BYTE	Field Code “SDS” - SW Customization
836.0	%M	BYTE	Field Code “SWS” - SW subversion
838.0	%M	BYTE	Serial Number - Character_01
839.0	%M	BYTE	Serial Number - Character_02
840.0	%M	BYTE	Serial Number - Character_03
841.0	%M	BYTE	Serial Number - Character_04
842.0	%M	BYTE	Serial Number - Character_05
843.0	%M	BYTE	Serial Number - Character_06
844.0	%M	BYTE	Serial Number - Character_07
845.0	%M	BYTE	Serial Number - Character_08
846.0	%M	BYTE	Hardware Code_01 - Identifier
847.0	%M	BYTE	Hardware Code_02 - Identifier
848.0	%M	BYTE	Firmware Code_01 - Identifier
849.0	%M	BYTE	Firmware Code_02 - Identifier
950.0	%M	USINT	CPU Ethernet - IP Address Field_01
951.0	%M	USINT	CPU Ethernet - IP Address Field_02
952.0	%M	USINT	CPU Ethernet - IP Address Field_03
953.0	%M	USINT	CPU Ethernet - IP Address Field_04
954.0	%M	USINT	CPU Ethernet - IP Subnet Field_01
955.0	%M	USINT	CPU Ethernet - IP Subnet Field_02
956.0	%M	USINT	CPU Ethernet - IP Subnet Field_03
957.0	%M	USINT	CPU Ethernet - IP Subnet Field_04
958.0	%M	USINT	CPU Ethernet - IP Gateway Field_01
959.0	%M	USINT	CPU Ethernet - IP Gateway Field_02
960.0	%M	USINT	CPU Ethernet - IP Gateway Field_03
961.0	%M	USINT	CPU Ethernet - IP Gateway Field_04
962.0	%M	USINT	CPU Ethernet - IP DNS Field_01
963.0	%M	USINT	CPU Ethernet - IP DNS Field_02
964.0	%M	USINT	CPU Ethernet - IP DNS Field_03
965.0	%M	USINT	CPU Ethernet - IP DNS Field_04
966.0	%M	USINT	CPU Ethernet - MAC Address Field_01
967.0	%M	USINT	CPU Ethernet - MAC Address Field_02
968.0	%M	USINT	CPU Ethernet - MAC Address Field_03
969.0	%M	USINT	CPU Ethernet - MAC Address Field_04
970.0	%M	USINT	CPU Ethernet - MAC Address Field_05
971.0	%M	USINT	CPU Ethernet - MAC Address Field_06
972.0	%M	BYTE	CPU Infos - Hardware Version Field_01
973.0	%M	BYTE	CPU Infos - Hardware Version Field_02
974.0	%M	BYTE	CPU Infos - Firmware Version Field_01
975.0	%M	BYTE	CPU Infos - Firmware Version Field_01
976.0	%M	BYTE	CPU Infos - OEM Revision Version

Chapter 11
Ascon Tecnologic Function Blocks Libraries

In this chapter are listed and described the libraries part of AT Automation Suite and those FBs which are available only from the CPU device firmware. For every library, we have prepared a complete list of function blocks with a brief description of each one. In case of need, more details are available from the specific documentation.

11-1 AT_Generic_Advanced_Lib

The *AT_Generic_Advanced_Lib* is the library which contains the set of very generic functionalities, in part inherited from the old AC-Station series, useful for generic purposes (see the "*IEC 61131-3 Function Block Library*" [**4**] manual for details).

The table hereafter reported gives the specific list of FBs part of the library.

Function Block name	Description
AVG_ADV_8REAL	Advanced Instantaneous Average calculation
AVG_MOVING	Moving Average calculation
AVG_RUNNING	Running Average calculation
CHAR_08_ARRAY	Analogue Conversion using an 8 points array input
CHAR_16_ARRAY	Analogue Conversion using a 16 points array input
CHARACTERIZER_8	Linear Interpolation with 8 points
CHARACTERIZER_16	Linear Interpolation with 16 points
COMPARATOR	Comparator with hysteresis Function Block
CONV_AD8	From BYTE to 8 bits
CONV_AD16	From WORD to 8 bits
CONV_AD32	From DWORD to 8 bits
CONV_DA8	From bits to BYTE
CONV_DA16	From bits to WORD
CONV_DA32	From bits to DWORD
COUNTER	Rising Edge Counter
DECODER_8	Decoder Function Block
FLIPFLOP_D	D Type FlipFlop Function Block
FLIPFLOP_JK	JK Type FlipFlop Function Block
HOLD_VALUE	Sample & Hold Function Block
INBETWEEN	Middle Selector Function Block
LIMITER_VALUE	Limiter Function Block
MIN_MAX_SELECTOR	Min/Max Selector Function Block
MONOSTABLE_DS	Monostable with Delay
MONOSTABLE_NED	Monostable with Delay on the Negative Edge
MONOSTABLE_PED	Monostable with Delay on the Positive Edge
MONOSTABLE_PUL	Monostable Pulse Generator
MS_MANAGER	USB Mass Storage operations manager
MUX_A8	Analog Multiplexer 8 Input

Function Block name	Description
MUX_A16	Analog Multiplexer 16 Input
MUX_D8	Digital Multiplexer 8 Input
MUX_D16	Digital Multiplexer 16 Input
SAMPLING_TIME	Calculation of Actual, Min and Max CPU cycling time
RESCALE	Rescaling Function Block
POWER_FAIL	Power Fail Condition Monitor
SLOPE_LIMIT	Slope Limiter
TIMER_ADV	Advanced countdown timer function block
TOTALIZER	Totalizer Function Block
TOTALIZER_AVD	Advanced Totalizer Function Block

11-2 AT_Process_Generic_Lib

The *AT_Process_Generic_Lib* is the library which contains the set of generic process FBs.

The table hereafter reported gives the specific list of FBs part of the library.

Function Block name	Description
AI_COND_ADV	Advanced conditioning of an AI value
AI_COND_STD	Standard conditioning of an AI value
ALARM_ABS	Absolute Alarm Function Block
ALARM_ADVANCED	General Alarm Function Block
ALARM_BND	Band Alarm Function Block
ALARM_DEV	Deviation Alarm Function Block
ALARM_RATE	Rate Alarm Function Block
DEW_POINT	Dew Point calculation
F0_CALCULATION	Sterilization time for bacterial load reduction calculation
HR_DRY_WET_BULB	Relative humidity calculation method with dry/wet bulb
MASS FLOW	Compensate Flow calculation
SPx_AI_MNGT_ADV	special**PAC** specific AIs Advanced Management
ZrO2_PROBE	% Carbon Potential calculation
ZrO2_PROBE_CLN	% Carbon potential probe cleaning management

11-3 AT_Process_Control_Lib

The *AT_Process_Control_Lib* is a function block library dedicated to process control and includes advanced function blocks combining basic PID functions coming within the **sP4/8** Firmware, in order to provide a very easy and ready to use solution.

The most advanced function blocks in the library is a complete standard single action PID controller and the equivalent double action, for heat and cool applications.

Advanced auto-tuning function blocks are also included within the library, using different tuning algorithms such as "*Natural Frequency*" or "*Step Response*".

The table hereafter reported gives the specific list of FBs part of the library (see the "*IEC 61131-3 Function Block Library*" [**4**] manual for details).

Function Block name	Description
S2_CONTROLLER_ADV	Advanced Single Action Controller
S2_CONTROLLER	Single Action Controller
S2_EZ_TUNE	Tuning with Modified Step Response Algorithm for Single Action Loops
S2_FILTER	First Order Filter
S2_HC_CONTROLLER_ADV	Advanced Double Action Controller (Heat and Cool)

Function Block name	Description
S2_HC_CONTROLLER	Double Action Controller (Heat and Cool)
S2_HC_EZ_TUNE	Tuning with Modified Step Response Algorithm for Heat and Cool Loops
S2_HC_TFUZZY	Tuning with Fuzzy Logic for Heat and Cool Loops
S2_HC_TNATFREQ	Tuning with Natural Frequency Algorithm for Heat and Cool Loops
S2_HC_TSTEPRESP	Tuning with Step Response Algorithm for Heat and Cool Loops
S2_HCMV	Auto/Man station for output manual value direct access for double action loop
S2_MV	Auto/Man station for output manual value direct access for single action loop
S2_SPLITMV	Auto/Man station for output manual value direct access for double action loop with Split Range
S2_TFUZZY	Tuning with Fuzzy Logic for Single Action Loops
S2_TNATFREQ	Tuning with Natural Frequency Algorithm for Single Action Loops
S2_TSTEPRESP	Tuning with Step Response Algorithm for Single Action Loops

11-4 AT_Communications_Lib

The *AT_Communications_Lib* allows a simplified access to the communication functions of Ascon Tecnologic CPUs (see the "*IEC 61131-3 Function Block Library*" [**4**] manual for details).

The table hereafter reported gives the specific list of FBs part of the library.

Function Block name	Description
COMMS_MNGT_CU02	CU02 Serial Comm Ports Management
COMMS_MNGT_CU02_PB	CU02 Profibus Serial Comm Ports Management
COMMS_MNGT_M81	M81 Serial Comm Ports Management
COMMS_MNGT_MP0x	microPAC MP0x Serial Comm Ports Management
COMMS_MNGT_sPx	special**PAC** specific COMs configuratio
MB_MST_SYNC	Modbus Master: Synchronization of operations
MB_MST_RD_COIL	Modbus Master: Coil reading
MB_MST_WR_COIL	Modbus Master: Coil writing
MB_MST_RD_WORD	Modbus Master: Word reading
MB_MST_WR_WORD	Modbus Master: Word writing
MB_16WORD_TO_ARRAY	Modbus Master: packaging of 16 WORD in an array
MB_ARRAY_TO_16WORD	Modbus Master: un-packaging of an array into 16 WORD
MB_MST_RD8_DINT	Modbus Master: management of 8 DINT read values
MB_MST_RD8_DWORD	Modbus Master: management of 8 DWORD read values
MB_MST_RD8_REAL	Modbus Master: management of 8 REAL read values
MB_MST_RD8_UDINT	Modbus Master: management of 8 UDINT read values
MB_MST_WR8_DINT	Modbus Master: management of 8 DINT write values
MB_MST_WR8_DWORD	Modbus Master: management of 8 DWORD write values
MB_MST_WR8_REAL	Modbus Master: management of 8 REAL write values
MB_MST_WR8_UDINT	Modbus Master: management of 8 UDINT write values
MB_SLV_RD8_DWORD	Modbus Slave: reading of 8 DWORD values

Function Block name	Description
MB_SLV_RD8_REAL	Modbus Slave: reading of 8 REAL values
MB_SLV_RD16_WORD	Modbus Slave: reading of 16 WORD values
MB_SLV_RD32_DIGITAL	Modbus Slave: reading of 32 digital values
MB_SLV_RD_DIGITAL	Modbus Slave: reading a digital value
MB_SLV_RD_DWORD	Modbus Slave: reading a DWORD value
MB_SLV_RD_REAL	Modbus Slave: reading a REAL value
MB_SLV_RD_WORD	Modbus Slave: reading a WORD value
MB_SLV_WR8_DWORD	Modbus Slave: writing of 8 DWORD values
MB_SLV_WR8_REAL	Modbus Slave: writing of 8 REAL values
MB_SLV_WR16_WORD	Modbus Slave: writing of 16 WORD values
MB_SLV_WR32_DIGITAL	Modbus Slave: writing of 32 digital values
MB_SLV_WR_DIGITAL	Modbus Slave: writing a digital value
MB_SLV_WR_DWORD	Modbus Slave: writing a DWORD value
MB_SLV_WR_REAL	Modbus Slave: writing a REAL value
MB_SLV_WR_WORD	Modbus Slave: writing a WORD value
MODEM_CHECK	Modem operational verification
MODEM_CONF	Modem configuration management
MODEM_SMS_SEND	Modem SMS (Short text Message Service) send management
SEND_EMAIL	SMTP server Configuration
SERIAL_PORTS	Set the configuration for the Modbus RTU ports of the CU unit
SYS_OPRS_MNGT	Set communication operational parameters on Modbus RTU and TCP agents
TCP_IP_PORT	Set the configuration for the Modbus TCP port

11-5 AT_Firmware_FBs List

The *AT_Firmware_FBs_Lib* coming within each Ascon Tecnologic CPU is listed in this section.

Keep in mind that, over the past 20 years, Ascon Tecnologic has evolved, improved and fixed his own firmware: for this reason, the list of FBs which follows refers to the very last version of the firmware released within the **sP4/8** hardware platform but can be different when referred to the past ones available on the old CPUs.

For each of the FBs is provided a short description (see the "*AT_Firmware_FBs_Lib*" [*3*] manual for details): for more details please refer to the specific help documentation available in the OpenPCS programming tool.

Function Block name	Description
ASCON_FLATTEN_TO_REAL	Convert the 4 bytes of the input parameters as the flattened equivalent of a real number which is then output-returned
ASCON_REAL_TO_FLATTEN	Convert the REAL variables in their FLATTEN equivalents
CLOSE_Modbus_TCP_SERVER	Disable MBTCP/IP Server
CLOSE_SERIAL_COMM	Close the serial communication port
CONV_ASCII_TO_CHAR	ASCII conversion from binary code to character
CONV_CHAR_TO_ASCII	ASCII conversion from character to binary code
CTD	Counter Down pulses
CTRL_HCMV	Automan Station for heat and cool regulation
CTRL_MV	Automan Station for single action regulation
CTRL_PID	PID algorithm

Function Block name	Description
CTRL_SPLITMV	Automan Station for heat and cool regulation with split range
CTRL_SRV	Servomotors algorithm
CTRL_SRV_POS	Servomotors algorithm close loop (potentiometer)
CTRL_TPO	Time proportional output
CTU	Counter Up pulses
CTUD	Counter Up/Down pulses
DINT_TO_TIME	Conversion between specific Data Type
ENABLE_Modbus_TCP_SERVER	Set and activate the MBTCP/IP Server agent
F_TRIG	Falling edge detection
R_TRIG	Rising edge detection
MB_TCP_CLOSE_CONN	Close one of the 10 active connections
MB_TCP_CONN_STATUS	Show the status of a MBTCP/IP connection
MB_TCP_GET_CONN_BY_ADDR	Return information of a connection identified by the IP address of the client
MB_TCP_GET_CONN_CONFIG	Return configuration data of a specified active connection
MEMCOPY_FROM_M	Copies data from %M memory areas
MEMCOPY_TO_M	Copies data into %M memory areas
MEMCPY_I_TO_M	Copy a specific %I memory into a specific %M memory area
MEMCPY_M_TO_M	Copy a specific %M memory into a specific %M memory area
MEMCPY_M_TO_Q	Copy a specific %M memory into a specific%Qmemory area
MEMCPY_Q_TO_M	Copy a specific %Q memory into a specific %M memory area
Modbus_GET_DIGITAL_SLAVE	Read 16 digital value from a memory area dedicated to a MB slave
Modbus_GET_SLAVE_DATA	Read registers from a memory area dedicated to a MB slave
Modbus_MASTER_EXECUTE	Execute a query in compliance with the MB protocol
Modbus_MASTER_STATUS	Check the status of the MB agent.
Modbus_SET_DIGITAL_SLAVE	Write 16 digital value to a memory area dedicated to a MB slave
Modbus_SET_DWORD_DATA	Write two contiguous registers (4 bytes) to a memory area dedicated to a MB slave
Modbus_SET_WORD_DATA	Write registers to a memory area dedicated to a MB slave
Modbus_SLAVE_SETTINGS	Set the node_id and timeout parameters of the MB slave agent
Modbus_SLAVE_STATUS	Check the status of the MB agent
MS_DATALOG_MNGT	Mass Storage datalogging management
MS_INFO	Mass Storage information
OPEN_SERIAL_COMM	Configure the serial port and set the protocol used on it
PAC_IP_CONFIG	IP Addresses configuration
PRESERVED VARS_SAVE	Preserved Variables Saving command
RAND	Generete random numbers from 0... 65535

Function Block name	Description
RESET_PULSE_COUNTER	Reset the counter value connected to a specific digital input
RTC_SETUP	Set the system clock
RTC_GET_VALUES	Read the system clock
RS	Reset dominant Flip-Flop
RTC_GET_VALUES	Read the system clock
RTC_SETUP	Set the system clock
SEND_EMAIL	Set the configuration for a client SMTP to send e-mail
SERIAL_IO_CONFIG	Configure the ASCII serial port
SERIAL_IO_READ	Read data from the ASCII serial port
SERIAL_IO_READ_BYTE	ASCII serial port Byte reading
SERIAL_IO_WRITE	Write data on the ASCII serial port
SERIAL_IO_WRITE_BYTE	ASCII serial port Byte writing
SR	Set dominant Flip-Flop
TIME_TO_DINT	Conversion between specific Data Type
TIME_TO_LREAL	Conversion between specific Data Type
TIME_TO_REAL	Conversion between specific Data Type
TOF	Delay OFF timer
TON	Delay ON timer
TP	Time pulse generator
WATCHDOG_SET	Configure the system watchdog
WATCHDOG_STATUS	Checking the status of the system watchdog

Appendix A
The Bootloader in the PAC project

WARNING!
In order to protect the data and files present in the system, prior to perform a Firmware update, it is necessary to make a backup of them. Further details about this operation can be found at "*Chapter 6 - USB Mass Storage Device*".

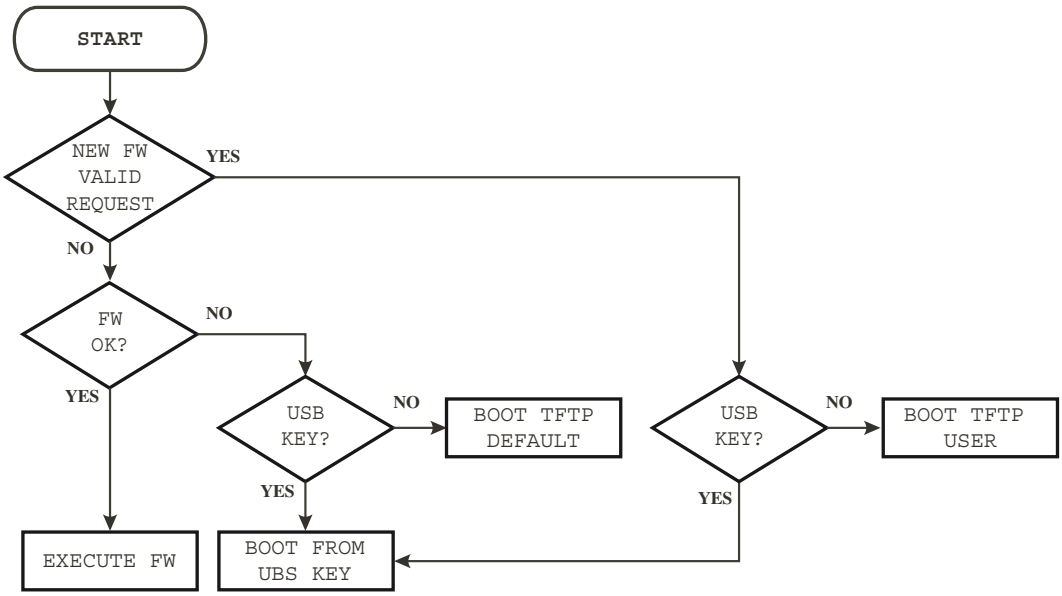
A-1 How to update the CPU Firmware

Inside the CPU runs a program, named **`Bootloader`**, which manages all the activities related to the Firmware update.

The Firmware update process is characterized by 2 different procedures involving some specific files, via the USB (local) or the Ethernet (remote) port.

While the system is normally running, the Bootloader can be activated to get a new Firmware, waits until it recognize it and then reboots.

A-2 Bootloader Startup



A-3 Remote Firmware Update

The remote Firmware update operation needs a TFTP function over the Ethernet port. While the instrument is normally running, the steps to follow are:

1. Start a TFTP client to connect with the CPU (the connection parameters are IP address 192.168.5.11 port 69);
2. Send to the CPU the `/fs2/BOOTGO.TXT` file which contains the **Digital Signature** related to the Firmware file to be downloaded: the CPU will automatically reboot in "**detect mode**", awaiting for a new file;
3. Make a backup of the actual CPU Firmware uploading the file `/FS2/FWUP.HEX` from the CPU;
4. Start to download the `/FS2/FWDOWN.HEX` Firmware file: the process can take up to several minutes;
5. When the Download process has ended, the CPU verifies the quality and the signature of the received Firmware file and then proceeds to update the Flash memory. This phase requires some tens of seconds;
6. Finally Download the file `/FS2/RMTCMD.TXT` that contains the text "**`reset`**" which causes the reboot of the CPU with the new Firmware.

All over the Firmware update operations it is possible to know the status by periodically getting the file `/FS2/ACTSTAT.TXT` which is continuously updated with the code explaining the specific status (see the tables that follow).

WARNING!
In case of any error during the TFTP upgrade operations, the CPU holds pointing out the error condition with a triple flash of the RUN (**green**) and/or the solid ON status of the MSG (**red**) LEDs. To abort the procedure it is necessary to download the file `/FS2/RMTCMD.TXT` that containing the text "**`kill`**": the CPU will reboot automatically, following the *"A-2 Bootloader Startup" at page 65* flow chart.

A-4 Local Firmware Update

Locally, the Firmware update is carried out using an USB memory key.
While the instrument is normally running, the steps to follow are:

1. Format a USB key in FAT32 mode.
2. Create a directory named `FWUPGR` and copy into it the files `BOOTGO.TXT` and `FWDOWN.HEX`;
3. At Power ON, if the Firmware detects a USB key inserted in the specific port, it waits 3 seconds for the operator to press the **PB** button;
4. The CPU copies the actual internal Firmware files (`FWUP.HEX` and `BOOTVER.TXT`) on the USB key into the folder `FWUPGR`.
5. At this point the CPU verifies the signature of the `FWDOWN.HEX` Firmware file and, if it is correct, gets it from the USB key. The process can take a few minutes;
6. When the process has ended the CPU proceeds to update the Flash memory.
7. A double flash of the RUN LED (**green**) indicates to remove the USB key in order to reboot the system with the new Firmware.

All the above described phases are highlighted by specific LEDs indications.

WARNING!
In case of any error during the USB upgrade operations, the CPU holds pointing out the error condition with a triple flash of the RUN (**green**) and/or the solid ON status of the MSG (**red**) LEDs. When this happens, the file `ACTSTAT.TXT` will be anyway created. Restart the procedure from point 2.

A-5 Update Firmware reference Tables

During the Firmware update procedure it is possible to ask to the system the status of the procedure itself. This information is loaded in the file: `ACTSTAT.TXT` which is continuously updated.

The information are:

Status (**XX**)(**YY**)

Where:

Status: **WIP** (Work in Progress) The system is running the update procedure;
OK The update procedure has ended with no errors;
KO The update procedure has ended with errors.

XX Is the phase of the update procedure in execution.

YY Is the error detected during the update procedure.

Phases of the update procedure (**XX** codes):

Code	Phase	Description
00	BOOT_INI_STATUS	Initialize Boot
01	BOOT_CHECK_JUMP_STATUS	Check if jump to a valid application or not
02	BOOT_CHECK_MEDIUM_STATUS	Determines which kind of media has to be used
03	BOOT_INIT_BACKEND_STATUS	Initialize backend medium
04	BOOT_CHECK_UPLOAD_STATUS	Check whether the upload is needed or not
05	BOOT_COPY_FIRMWARE_STATUS	Copy firmware to external memory, convertin it in HEX format
06	BOOT_FWUP_BACKEND_STATUS	Firmware upload using the underlying technology
07	BOOT_WAIT_FW_BACKEND_STATUS	Wait a firmware using the underlying technology
08	BOOT_COMPARE_SIGNATURES_STATUS	Compare file signature with backup RAM signature
09	BOOT_CHECK_SIGNATURE_STATUS	Check firmware signature
10	BOOT_ERASE_FLASH_STATUS	Erase Flash
11	BOOT_PROGRAM_FW_STATUS	Erase and program flash
12	BOOT_WRITE_KEY_STATUS	Write Key to validate the just programmed firmware
13	BOOT_JUMP_STATUS	Jump to the application
14	BOOT_ERR_STATUS	Error Status
15	BOOT_END_STATUS	End status

Error detected during the update procedure (**YY** codes):

Code	Phase	Description
00	BOOT_ERR_OK	No error
01	BOOT_ERR_INIT	Error occurred during bootloader initialization
02	BOOT_ERR_BACKEND_INIT	Something gone wrong while initializing backend infrastructure
03	BOOT_ERR_UPLOAD_COPY	Error occurred while copying firmware to RAM for uploading
04	BOOT_ERR_MSC_HOST_MOUNT	Something gone wrong while mounting the volume (MSC host)
05	BOOT_ERR_MSC_HOST_DISCONNECTED	USB Stick disconnected too early
06	BOOT_ERR_MSC_HOST_UPLOAD	Error occurred while copying firmware on USB stick
07	BOOT_ERR_MSC_HOST_GETVER	Something gone wrong while getting bootloader version (MSC host)
08	BOOT_ERR_MSC_HOST_FOPEN	Something gone wrong while opening download on USB stick

Code	Phase	Description
09	BOOT_ERR_MSC_HOST_DWLOAD	Error occurred while copying firmware from USB stick
10	BOOT_ERR_MSC_HOST_UNKNOWN	Unknown error (MSC host)
11	BOOT_ERR_MSC_DEVICE_MOUNT	Something gone wrong while mounting the volume (MSC device)
12	BOOT_ERR_MSC_DEVICE_GETVER	Something gone wrong while getting boot-loader version (MSC device)
13	BOOT_ERR_MSC_DEVICE_READ	Something gone wrong while reading file (MSC device)
14	BOOT_ERR_MSC_DEVICE_UNKNOWN	Unknown error (MSC device)
15	BOOT_ERR_DWNLD_EMPTY_FW_FILE	Error while downloading FW file or empty file downloaded
16	BOOT_ERR_DIFFERENT_SIGNATURES	File signature and backup RAM signature are different
17	BOOT_ERR_SIGNATURE_NOT_VALID	Signature does not match or it is not valid
18	BOOT_ERR_ERASE_FLASH	Error occurred erasing flash
19	BOOT_ERR_PROGRAM_FW	Error while programming firmware
20	BOOT_ERR_WRITEKEY	Error occurred while writing the validation key
21	BOOT_ERR_ERROR	Error while handling error
22	BOOT_ERR_END	Error while ending operations

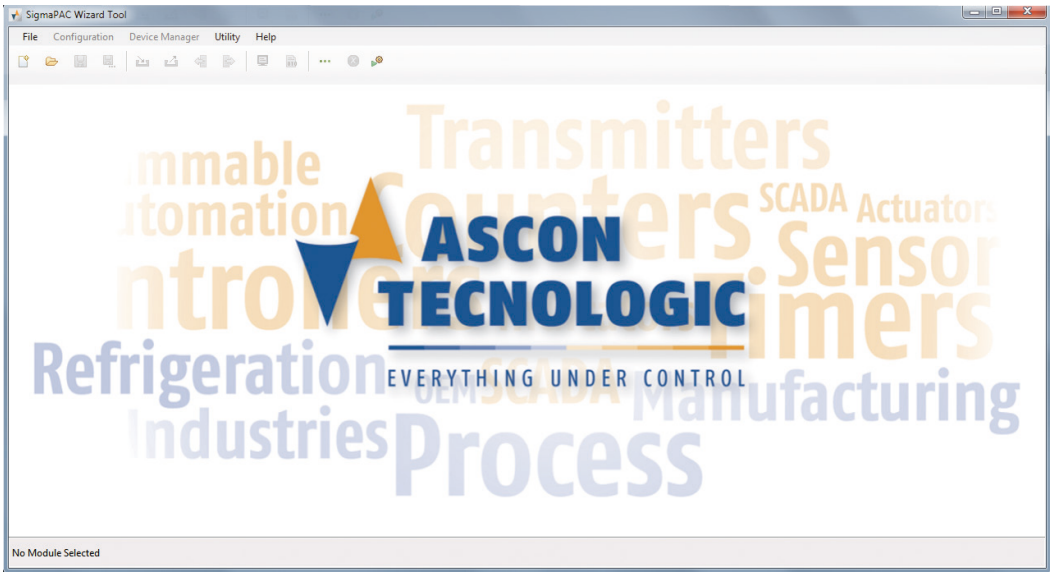
Appendix B
AT SigmaPAC Wizard Tool

The SigmaPAC Wizard Tool is an application expecially designed to perform the offline hardware configuration of any Ascon Tecnologic's programmable CPUs.
Through the same application it is possible to perform some remote commands, manage the diagnostic error tag list, the upload/download of the projects, configuration and/or retentive variables files.

B-1 User Interface

B-1-1 Main Screen

Once the software has been run, the following main screen is displayed.



B-1-2 Program commands

The commands to control the program are grouped in the higher part of the page. They are grouped in drop down menus, but are also dislayed in graphical icon form.

File menu

Menu entry	Icon	Description
New project		Allows to create a new Configuration project
Open		Allow to open an already saved project (note)
Save		Allow to save the current project (note)
Save as		Allow to save the actual progject with a desired name (note)
Exit		Exits the AT Wizard

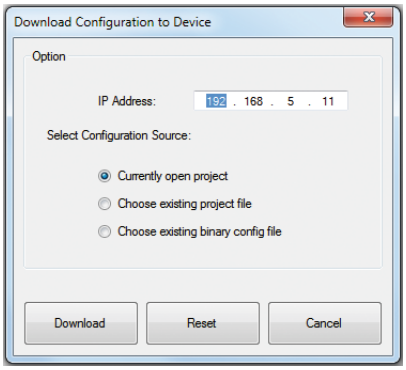
Note: The Configuration file is saved in a proprietary format:
***.swp** = sigmaPAC Wizard Project.

B-1-3 Configuration

Menu entry	Icon	Description
Import Bin (1)		Allow to select/import an already saved CPU binary format Configuration file
Export Bin (1)		Allow to save the current CPU Configuration file in the binary format
Upload Configuration from device		Loads the Configuration from the CPU connected to the PC (requires the IP address)
Download Configuration from device (2)		Tranfers the actual Project to a connected CPU (requires the IP address)

Notes:

1. The Configuration files in binary format (***.bin**) are tipically used to load the Configuration data into a CPU from a memory stick. The binary format is compatible with all the Ascon Tecnologic CPUs.
2. The file selection is made through a specific page.



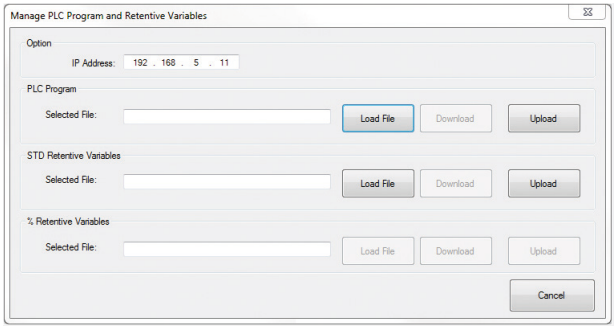
B-1-4 Device manager

Menu entry	Icon	Description
Device Commands (1)		Shows a panel from where the user can ***Start*** or ***Stop*** the CPU, ***Acknowledge*** the alarms, Erase the program file or ***Reset*** the CPU (Power cycle)
PLC Program - Retentive Vars (2)		Shows a popup that allows to manage (upload or download) the program and the retentive data present in the CPU

Notes: **1.**

If needed, the selection of the "*Erase PLC program*" command will delete the PLC program from the media selected location: the overall time needed to perform the operation depends by the project size. Please wait until the "*Persistency setup menu*" screen reappears as confirmation for complete PLC program erasing.

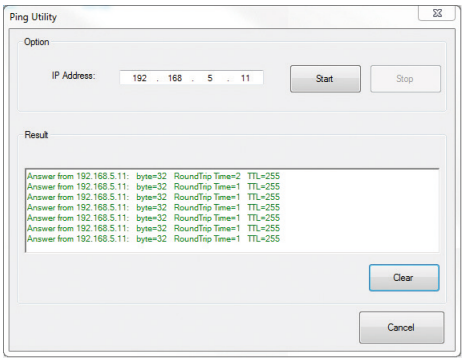
2.



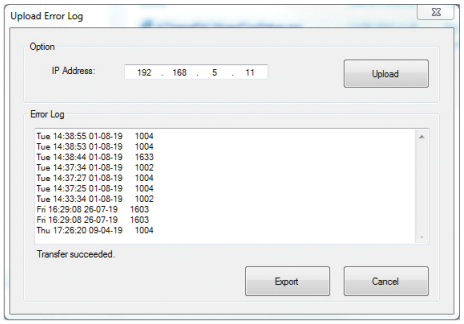
B-1-5 Utility

Menu entry	Icon	Description
TCP Ping Utility		Shows a popup (**1**) from where can be verified the CPU connection through the Ping utility
Upload Error Log		Shows a popup (**2**) which allows to upload the Error Log information from the connected CPU
Run External Tool (3)		Runs a utility which allows to configure the xP4 expansion modules

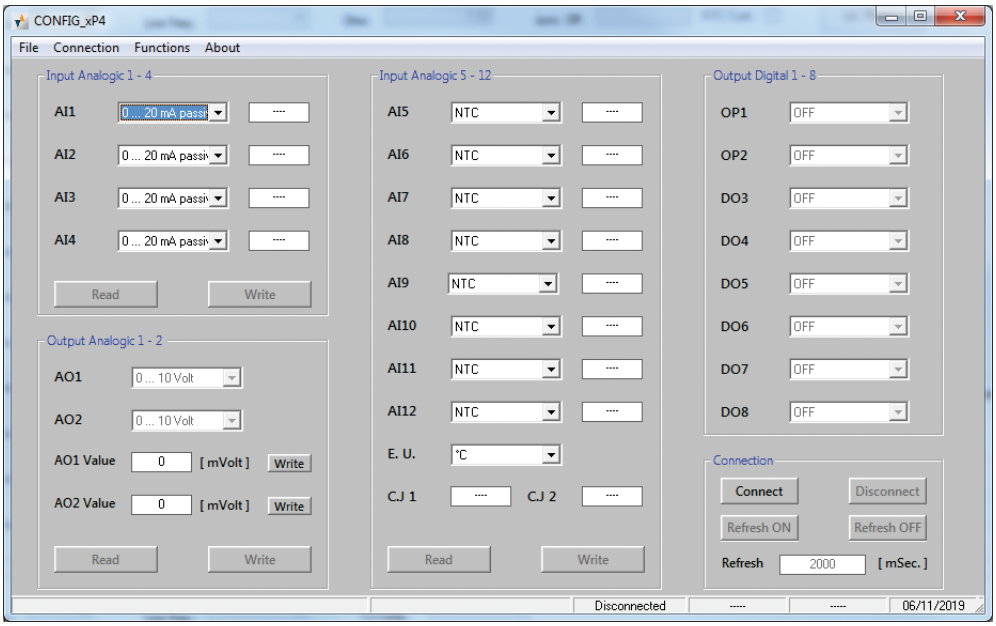
Notes: **1.**



2.



3.



B-2 How to perform the CPU Setup

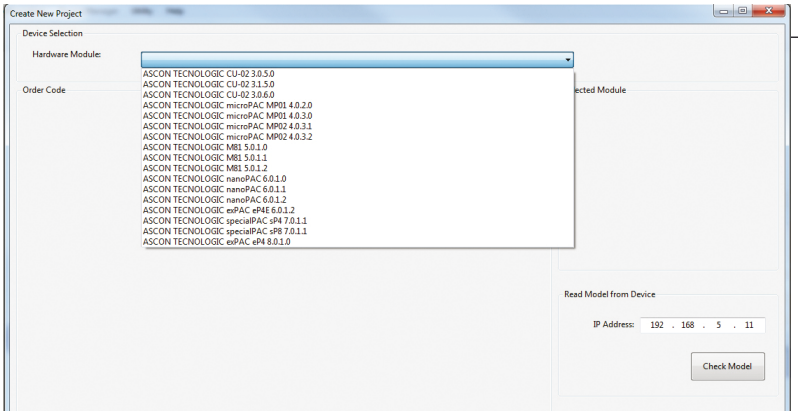
To be able to establish the connection with the CPU, it is necessary to:

- Correctly install the AT Wizard Tool on a PC specifying that the usage is for "*Everyone*" (in order to obtain the Administrator's privileges);
- Know the IP address of the CPU to connect with;
- Properly connect and configure your PC in the same Ethernet subnet (Factory default CPU IP address: 192.168.5.xxx);
- Have PC full Administrator privileges;
- Allow the application to run through the Windows Firewall.

B-2-1 Create a new Configuration project

On the main screen, click on the "*New project*" Icon ( ) to open the "*Create New project*" page.

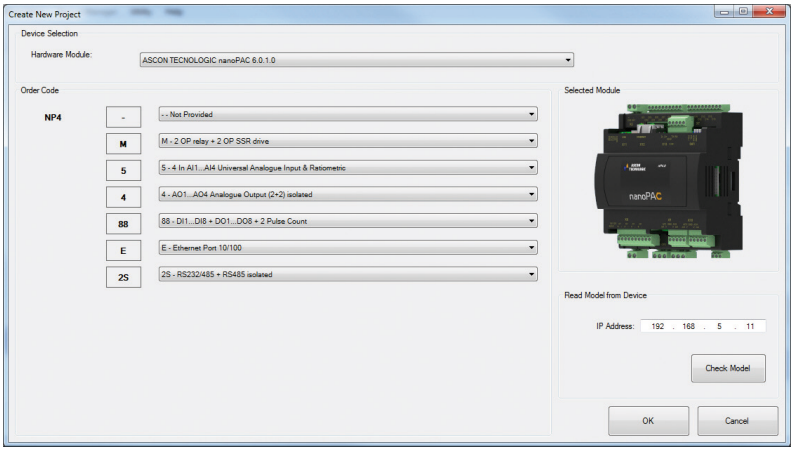
New Configuration project screen



The new configuration screen is a very important page, as helps the user in determining the Hardware configuration of the CPU. It can be used online or offline (in the case the CPU is momentarily not connected to the PC).

Online configuration

This is the easiest way to configure the software, as the CPU is connected to the PC and powered ON, click on the "*Check Model*" button. The Wizard asks to the CPU the order code info and reports them on the screen.



Click on the **OK** button, the Wizard is ready to operate.

Offline configuration

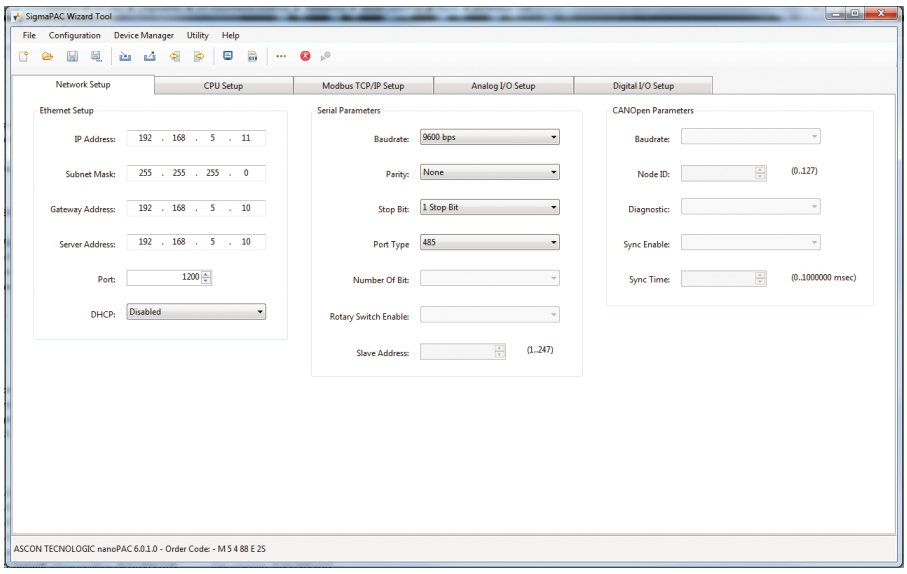
When a CPU is not connected to the PC, the configuration is a little more complex.

- First of all, the user must retrieve the CPU order code available from the back-side plastic box label;
- From the scroll down menu "*Device selection*" > "*Hardware Module*", select the correct CPU model (Ascon Tecnologic SpecialPAC X.X.X.X);

- Once the software has recognized the choice, complete the mask by selecting the specific codes to populate the order code form;
- Completed the list, click on the **OK** button to end the Wizard configuration session.

After the new configuration project has been created and completed, is time to setup the various options available within the CPU. This can be done from the menus displayed, after the CPU has been correctly recognized.

B-3 Network Setup



This page allows to configure the communication ports parameters.

B-3-1 Ethernet Setup Menu

Item	Description	Range	Factory Default
IP Address	CPU IP Address	0.0.0.0/ 255.255.255.255	192.168.5.11
Subnet Mask	CPU subnet mask	0.0.0.0/ 255.255.255.255	255.255.255.0
Gateway Address	Network Gateway Address	0.0.0.0/ 255.255.255.255	192.168.5.10
DNS Server Address	DNS Server Address	0.0.0.0/ 255.255.255.255	192.168.5.10
Port	OpenPCS Port	0... 65535	1200
DHCP	DHCP Protocol Status	Disable/Enable	Disabled

B-3-2 Serial Setup Menu

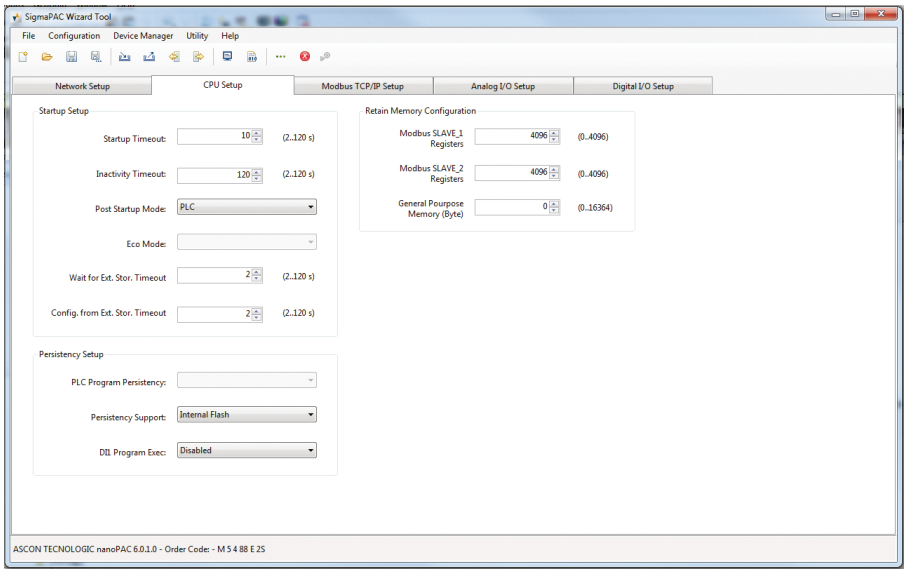
Item	Description	Range	Factory Default
Type	COM1 type	0/1 [RS485/RS232]	RS485
Baudrate	COM1 baudrate	0... 6 [2400... 57600]	9600
Parity	COM1 parity	0... 2 [None/Even/Odd]	None
Stop bit	COM1 stop bit	1/2	1

Note: The COM2 port can be configured from the OpenPCS ambient ***ONLY***.

B-3-3 CanOpen Menu

The CanOpen port is **not present** on the sP4/8 CPU. All the field are greyed because **not active**.

B-4 CPU Setup



B-4-1 Startup Setup Menu

Item	Description	Range	Factory Default
Startup Timeout	Timeframe window to enter the startup session	2... 120 (s)	10
Inactivity Timeout	Inactivity Timeout (please see 3-1-3 for details)	2... 120 (s)	120
Post Startup Run	Operation phase to be executed after the startup session	PLC/I/O Watch	PLC
DO used for watchdog	Enabling DO16 for watchdog management	Disabled/Enabled	Disabled

B-4-2 Persistency Setup Menu

Item	Description	Range	Factory Default
Erase PLC Program	Command to erase the PLC program from flash memory	-	-
PLC Program Persistency	Function to save PLC program into flash memory	Disabled/Enabled	Enabled
Persistency Support	Media where to save copy of the PLC program	Internal Flash/ USB key	Internal Flash
DI Control Program Exec	Reserves D01 for PLC program RUN/STOP function	Disabled/Enabled	Disabled

The CPU can save the PLC program into different persistent memory supports. Each time a program download is executed, the CPU makes a permanent copy of it into the configured desired media for the next future executions.

B-4-3 Retain Config

Item	Description	Range	Factory Default	Time to retain
MB Slave 1 Split register	Amount of Slave 1 Modbus agent retained registers	0... 4096	4096	10 ms
MB Slave 2 Split register	Amount of Slave 2 Modbus agent retained registers	0... 4096	4096	10 ms
Simple Split byte	Amount of generic memory retained bytes	0... 16384	0	15 ms

Standard and Retentive memory

The IEC 1131 programming tool allows to declare retentive variables using specific files and syntax. These variables are handled by a 32 kB size of "*non volatile memory***" (for security reasons, the memory is duplicated for redundancy and refreshed during runtime operations). Differently, it is possible to declare variables up to 32 kB in the % marker memory area (8192 Bytes for each Modbus slave agent).**

In particular, the range available as retentive is:

Modbus Slave 1:	%MW1128.0...	%MW9320.0	(8192)
Modbus Slave 2:	%MW10128.0...	%MW18320.0	(8192)
Marker Area:	%MB22000.0...	%MB38384.0	(16384)

From the CPU setup session, by dedicated entries, it is possible to define the amount of registers/Bytes to be retained.

Note: The process which saves the retentive variables operates in parallel with the PLC application: for this reason the cycle time of the whole project will be effected/delayed ONLY!

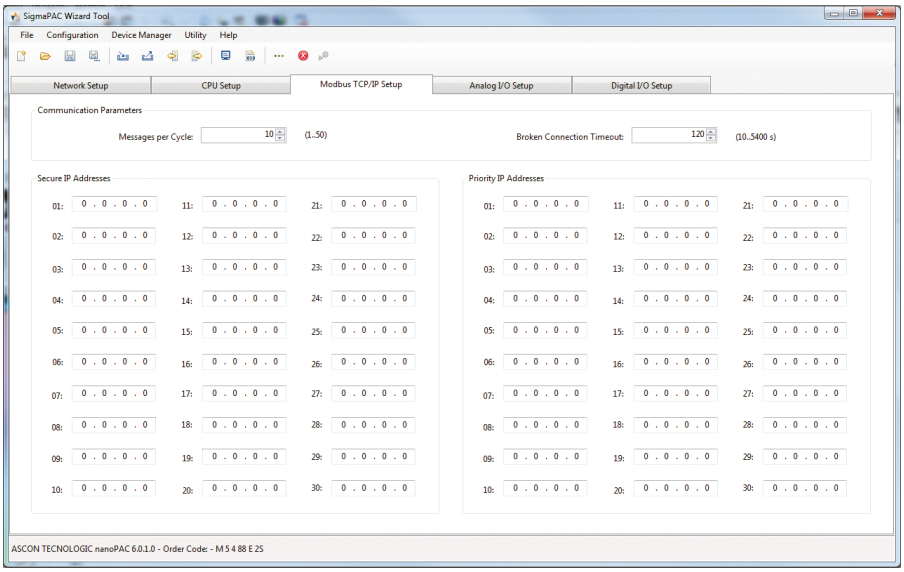
- In case of "*Cold start*" command, the standard retentive variables will be reset or preset to the initialization value whereas the % retentive variables will be reset. In case of retain file corruption error, both the two memory areas are separately reset or initialized.
- In case of "*Warm Start*" command, if the PLC program has not been modified, both the standard and % retentive variables will remain to last previous values. In case of retain file corruption, the % retentive variables will be reset.
- In case of "*Hot start*" command, both the standard and % retentive variables will be unaffected.

It is possible to upload/download thew whole retentive memory areas, standard and % variables (using a TFTP session). It is possible to perform this operation ONLY in the timeframe window available during the CPU boot-up phase, before the Device Configuration timeframe session. On how to perform the upload or download the specific retentive memory files, please refer to the:

"*Device command*" (page 159) or "*sigmaline specialPAC sP4/8 User Manual*" at paragraph: "*Chapter 9 - CPU Configuration Software (TFTP File Access)*".

Note: The CPUs User Manuals can be freely downloaded from the Ascon Tecnologic Internet site.

B-5 Modbus TCP/IP Setup



Item	Description	Range	Factory Default
Messages per Cycle	Max. number of processed messages per cycle	1... 50	10
Broken Connection Timeout	Inactivity Timeout of a TCP/IP connection	10... 5400 (s)	120
Secure Address Setup	Secure IP Address Setup Menu	-	-
Priority Address Setup	Priority IP Address Setup Menu	-	-

To verify the connection status after a long period of inactivity, is used the TCP/IP "*keep alive*" protocol. The protocol performs the following sequential steps:

1. At each received message the timeout is reset;
2. If timeout expires, a "*test*" message is sent in order to verify if the connection is still active;
3. If an answer to the "*test*" is received, then the timeout is reset;
4. In case of no answer, the "*test*" will be sent again three times, every 10 s;
5. If even after the fourth "*test*" nothing has been received, the connection will be closed.

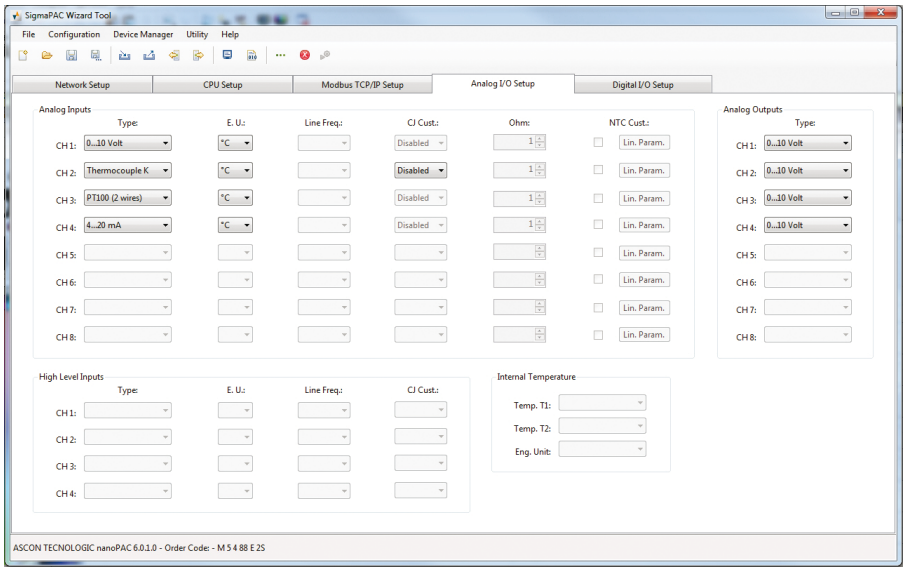
B-5-1 Modbus TC/IP Secure Addresses Table Menu

If the security function will be enabled (please see the "*Ascon Tecnologic Firmware Function Block Library*" [**3**]), the list of addresses present in this menu will indicate the external Modbus TCP/IP Clients allowed to access the CPU Modbus TCP/IP server. To add a new address, enter the new one in the first free position of the list. To delete an address, simply enter the number 0 (zero) in the location to be removed.

B-5-2 Modbus TC/IP Priority Addresses Table Menu

The rules to insert a desired value is the same just described above for the "Secure address table". The addresses specified in the "*Priority connection table*" are managed in a very particular dedicated way because the Modbus TCP/IP server agent can sustain up to 10 TCP client simultaneous connections at the same time. So, when a new connection request is made, and all 10 available connections are already used, the system will close one of the active connections to satisfy the new request. Addresses not belonging to the "*Priority connection table*" will be closed as first, followed by those which have been inactive longest.

B-6 Local Analogue I/O Setup Menu



B-6-1 Setting the AI Channels

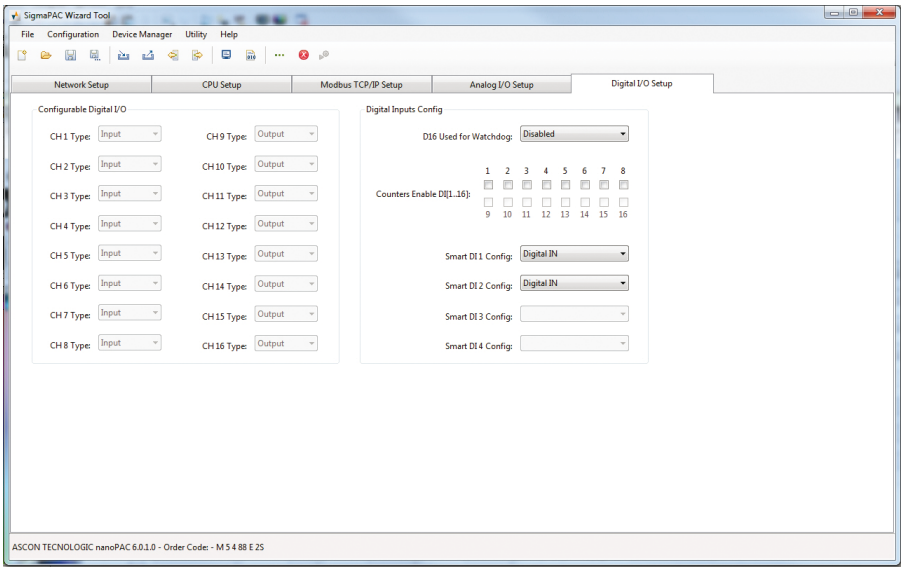
Note: The corresponding configuration choices for all the 4 analogue input channels is as described in the following table.

Analogue Input Type and Range	
Type	**Range**
0... 5 Volt	0.0... 5.5 V
1... 5 Volt	0.6... 5.4 V
0... 10 Volt	0.0... 11.0 V
0... 20 mA	0.0... 22.0 mA
4... 20 mA	2.4... 21.6 mA
Thermocouple J	-245.25... +1235.5°C
Thermocouple K	-249.3... +1411.3°C
Thermocouple L	-220.0... +620.00°C
Thermocouple N	-32.5... +1332.5°C
Thermocouple R	-40.0... +1640.0°C
Thermocouple S	-44.0... +1804.0°C
Thermocouple T	-215.0... +415.0°C
PT100 (2 wires)	-232.3... +882.7°C
PT1000	-232.3... +882.7°C
Potentiometer	0... 1000000 Ω
NTC SEMITEC 103AT-2	-56.5... +141.5°C
Ratiometric 5 V	0.0... 5.5 V

B-6-2 Analogue Output Ch1 - Ch2 or Ch3 - Ch4 Menu

Analogue Output Types
0… 5 Volt
1… 5 Volt
0… 10 Volt
2… 10 Volt
0… 20 mA
4… 20 mA

B-6-3 Local Digital I/O Setup Menu



Note: The channels enabled in the "*Configurable Digital I/O*" part are automatically configured by the Wizard accordingly to the number of I/Os selected during the project creation. Note that the 16 digital I/O can freely be set only when the "***16 Configurable Digital Channels + 2 Pulse Count***" selection has been made.

B-6-4 Configuring the Digital I/Os type

I/O Channel	Digital Input/Output Types	
	Default value	**Selectable values**
Ch1 (D01)	Input	Input/Output
...	...	...
Ch16 (D16)	Input	Input/Output

Note: The Channels can freely be set only when the "***16 Configurable Digital Channels + 2 Pulse Count***" selection has been made.

B-6-5 Digital Input/Output Config

I/O channel	Default value	Selectable values
D01 Used for Watchdog (note)	Disabled	Disabled/Enabled
Counters Enable DI[01... 16]	No (no checkmark)	Yes (checkmark)
Smart DI1 Config	Digital I/O	Digital I/O or Pulse Counter
Smart DI2 Config	Digital I/O	Digital I/O/Pulse Counter

The channel used by the nP04 for the Watchdog is Channel D16 and must be set as "*Output*".

Appendix C
Reference documents

All the documents of the *sigma**line*** products (those with "*Code*" after the title) can be freely downloaded from theAscon Tecnologic website:
`www.ascontecnologic.com`

1. "*Infoteam OpenPCS programming system – User manual*"
2. "*IEC 61131-3: Programming Industrial Automation Systems*" – Karl-Heinz John, Michael Tiegelkamp - Springer
3. "*Ascon Tecnologic Firmware Function Block Library*"
4. "*IEC 61131-3 Function Block Library*"
5. "*Estensioni per gestire porte di comunicazione dell'ambiente OpenPCS*" V1.0 – Maurizio Grassi
6. "*Modbus Messaging on TCP/IP implementation guide*" – *http://www.Modbus.org/docs/*
7. "*Modbus over Serial Line Specification & Implementation guide*" – *http://www.Modbus.org/docs/*
8. "*Modbus Application Protocol Specification*" – *http://www.Modbus.org/docs/*
9. "*sP4/8 Installation manual*" (code: ISTR-MIsP4/8ENG01)
10. "*sP4/8 User manual*" (code: ISTR-MUsP4/8 -ENG01)
11. "*Modbus I/O expansion module Model xP4 - Installation Guide*" (code: ISTR-FIxP4ENG00)
12. "*Modbus I/O expansion module Model xP4 - User Guide*" (code: ISTR-FUxP4ENG00)

Ascon Tecnologic srl
Headquarters: viale Indipendenza 56,
27029 Vigevano (PV)
Phone: +39 0381 69871
Fax: +39 0381 698730
Internet Site: www.ascontecnologic.com
E-mail address: info@ascontecnologic.com