

User Manual

M.U.

Code: ISTR\_U\_AC3NP\_E\_01\_--



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The products described in this manual should be installed, operated and maintained only by qualified personnel who is familiar with automation safety topics and applicable national standards.

Congratulation for having chosen an Ascon Tecnologic instruments.

This instruction manual is dedicated to the AC<sup>3</sup>nP System.

- Notes:**
1. Be sure this manual would be available to the instrument users.
  2. The manual refers to a family of multifunction programmable systems supplied with high innovative colours graphic display. This effective user interface provides a huge amount of quality information.
  3. The programming tool software for the AC<sup>3</sup>nP Systems, is typically supplied on USB key, but can be also downloaded from Internet. You should keep the original disk in a safe place. The software is licensed to the Company and you can install it on any computer of the licensed Company. It is not allowed to redistribute or resell it. The use of the software is regulated by the licence agreement provided by the Supplier.
  4. When you open the package of an AC<sup>3</sup>nP System, check all the items and verify the correspondance to the packing list below. If an item is missed or damaged, you must contact the nearest Ascon Tecnologic sales office.
    - AC<sup>3</sup>nP System (P04 panel and nP4 CPU);
    - Mounting clamps;
    - Installation manual.

## Using this manual

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

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:



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### **DANGER!**

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

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### **WARNING!**

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

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### **Caution**

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

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

## General Warnings

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### **WARNING!**

Ascon Technologic 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.

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### **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.

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## Current Documentation on the Internet

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Make sure you are always working with the latest version of this document.

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New manual revisions, when published, and can be found online at:

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# Chapter 1

## General information

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### 1-1 Technical specification

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#### 1-1-1 AC<sup>3</sup>nP System Assembly

The AC<sup>3</sup>nP System is composed by a P04 Touch Screen Panel device and an nP4 Control Unit. The system, optionally, can be installed as splitted version where the P04 Panel can be installed remotely from the nP4 Unit.

The data exchange between the two devices is performed through an Ethernet connection.



## 1-1-2 P04 Operator Panel

### Display characteristics

Item	Description
<b>LCD type</b>	TFT display
<b>Screen dimension</b>	4.3"
<b>Screen format</b>	16/9
<b>Touch-screen</b>	Resistive
<b>Resolution</b>	480 x 272
<b>Number of colours</b>	262 k
<b>Back light</b>	LED

### Storage characteristics

Item	Description
<b>RAM</b>	128 MB
<b>Flash</b>	128 MB (Operating System + Program + 16 MB user space)
<b>Memory card</b>	MicroSD (max. capacity 8GB)
<b>USB</b>	2.0 full speed (max. distance <3 m)

### Communication characteristics

Item	Description
<b>Ethernet</b>	10/100 Mb/s (max. distance <30 m)
<b>RS485</b>	Modbus RTU/CAN

### Electrical characteristics

Item	Description
<b>Power Supply</b>	24Vac/DC, ±10%
<b>Current consumption</b>	300mA @ 24Vdc
<b>Internal fuse</b>	Not available

### Mechanical characteristics

Item	Description
<b>Dimensions (H x L x W)</b>	83 x 159 x 28 mm
<b>Cutout</b>	68 x 138 (P04 with front panel mounting adapter) 68 x 127 (panel only)
<b>Weight</b>	200 g

### Environmental characteristics

Item	Description
<b>Operating Temperature</b>	0... 55°C
<b>Storage Temperature</b>	-20... +60°C
<b>Relative Humidity</b>	85% RH
<b>Protection degree</b>	Front panel: IP65, Rear side: IP20
<b>CE standards</b>	EN61151-3, 61000-3-3:1995+A1:2001+A2:2005

## 1-1-3 nP4 CPU

CPU  
specifications

Item	Description
<b>Processor</b>	ARM Cortex M7 32 bit, 216 MHz
<b>Program memory</b>	Max. 4 MB internal or on USB key
<b>Dynamic memory</b>	32 MB RAM
<b>Retentive memory</b>	64 kB redundant - 128 kB MRAM
<b>Memory data retention</b>	15 years (for Flash memory)
<b>Min. cycle time</b>	Typical 7 ms
<b>Real Time Clock</b>	With rechargeable backup battery
<b>Timer resolution</b>	1 ms min.
<b>Communications ports</b>	Ethernet 10/100 Mb base T
	1 RS485 + 1 RS232/485 selectable
<b>Max. PID number</b>	Unlimited, application memory usage dependent

General and  
environmental  
specifications

Item	Description
<b>Power supply</b>	24 Vdc (-15... +25%)
<b>Power consumption</b>	12 W(+5 W with I/O modules)
<b>Mounting</b>	Omega DIN A rail
<b>Dimensions</b>	<b>W:</b> 108 <b>H:</b> 110 <b>D:</b> 60 (mm) - 6 DIN module
<b>Weight</b>	512 g
<b>Protection Degree</b>	IP20
<b>Safety</b>	Compliance to EN 61131-2 Insulation class II (50 Vrms), EN61010-1
<b>Approvals</b>	CE (UL pending)
<b>Operating temperature</b>	-20... 50°C (-4... 122°F)
<b>Storage temperature</b>	-40... 70°C (-40... 158°F)
<b>Relative Humidity</b>	5... 95% with no condensation

Universal  
analogue  
inputs

Item	Description
<b>4 (AI1... AI4) configurable</b>	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
<b>Resolution</b>	16 bit
<b>Accuracy</b>	0.1 % of span (linear inputs)/0.2% (Temperature)
<b>Input impedance</b>	<b>120 kW (V), &lt;200 W (mA)</b>
<b>Cold junction compensation</b>	±1°C/20°C ambient temperature
<b>Insulation</b>	800 V between analogue outputs, power supply, digital I/Os and communication ports (when isolated)
<b>Connector</b>	X8

Analogue  
Outputs

Item	Description
<b>0/2/4 (AO1... AO4) optional configurable</b>	0/1... 5 V, 0/2... 10 V, 0/4... 20 mA
<b>Load</b>	< 500 W (mA), > 1 kW (V)
<b>Resolution</b>	12 bit
<b>Accuracy</b>	<b>0.1% full scale</b>
<b>Insulation</b>	800 V between analogue outputs, power supply, digital I/Os and communication ports (when isolated)
<b>Connector</b>	X9 and X10



*Auxiliary  
Analogue  
Output*

Item	Description	
<b>Power output 1</b>	<b>Ratiometric sensor power supply</b>	+5 V
	<b>Max. Load</b>	30 mA max.
	<b>Output terminal connector</b>	X8
<b>Power output 2</b>	<b>Passive transmitter power supply</b>	<b>+12 Vdc</b>
	<b>Max. Load</b>	80 mA max.
	<b>Output terminal connector</b>	X9

*Digital  
Inputs*

Item	Description
<b>8... 40 with expansions</b>	24 Vdc (On: 5... 30 V, Off: 0... 3 V)
<b>Max. input frequency</b>	80 Hz
<b>Type</b>	Sink
<b>Protection</b>	<b>Reverse polarity and overvoltage</b>
<b>Insulation</b>	800 V between Power supply and logics
<b>Compliance</b>	IEC/EN 61131-2 (type 2)
<b>Terminal connector</b>	X6

*Digital  
Outputs*

Item	Description
<b>8... 40 with expansions</b>	24Vdc, 0.5 A
<b>Type</b>	Source (PNP)
<b>Protection</b>	Overvoltage and short circuit
<b>Insulation</b>	<b>800V between Power supply and logics</b>
<b>Terminal connector</b>	X7

**Note:** The watchdog timer function output, in case, is the D16.

*Pulse  
Counter/  
Frequency  
Meter Digital  
Input*

Item	Description
<b>Type</b>	Configurable as Standard DI, Pulse Counter or Frequency-meter (up to 5 kHz)(note)
<b>Insulation</b>	800 V channels/power supply
	800 V channels/logic components
<b>Compliance</b>	800V between Power supply and logics
<b>Terminal connector</b>	X6

**Note:** The Frequency meter function will be available in a future release.

*Pulse  
Counter/  
Frequency  
Meter Digital  
Input*

OP1 to OP4 are designed to be Digital Outputs only: the type can be selected from the Order code as Relay (code R), SSR drive (code S) or Mixed (code M).

**2 A SPST Relay**

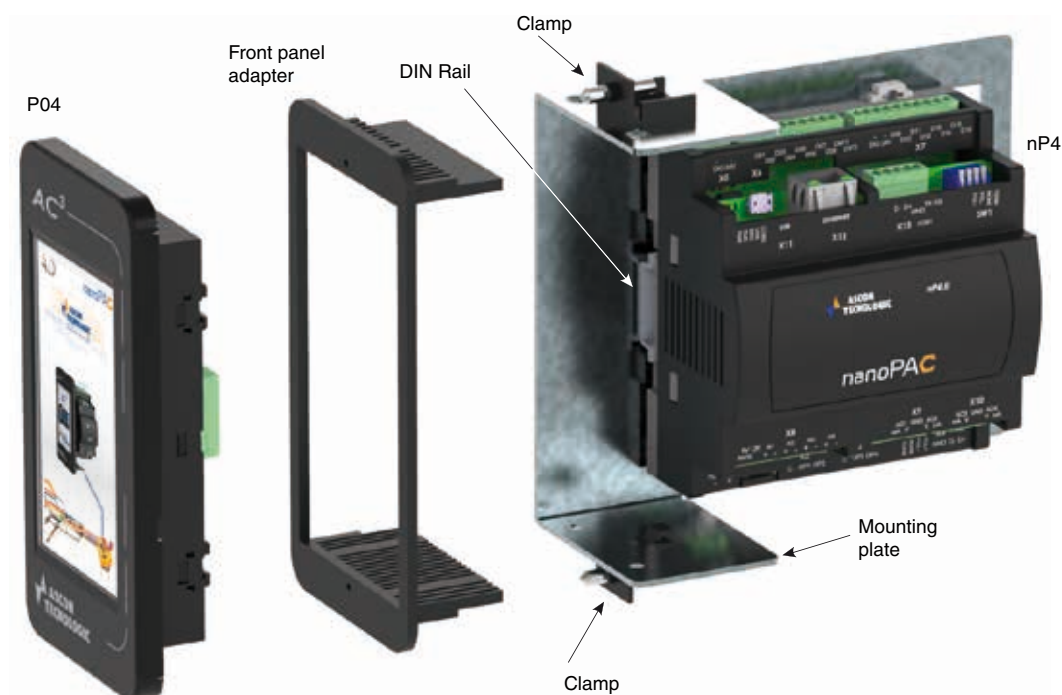
OP1... OP4 as relay outputs with SPST (Single Pole, Single Throw).

Item	Description
<b>Contact configuration</b>	SPST (Single Pole, Single Throw)
<b>Contact rate</b>	2 A (for resistive loads)
<b>Insulation</b>	3 kV between channel and Power Supply and between channel and main electronics
<b>Terminal connectors</b>	X2 and X3

**0/12 Vdc for external SSR**

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

Item	Description
<b>Power output</b>	10 mA, 12 Vdc
<b>Insulation</b>	None
<b>Terminal connectors</b>	X2 and X3

**1-1-4 Installation Kit**

The installation kit is a mandatory item when the AC3nP System is to be installed in place of an AC Station or mounted on Front Panels. It consists of some hardware parts to allow the front panel installation:

- Front panel Adapter;
- 2 Allen screws to install the P04 touch screen display in the front panel adapter;
- Mounting plate with a DIN rail that allows the installation of the nP4;
- 4 conical head Allen screws to assemble the mounting plate to the front panel adapter;
- 2 clamps to fix the structure to the front panel.

*Mechanical characteristics*

Item	Description
<b>Dimensions (H x L x W)</b>	156 x 81 x 215 mm (short plate)
	156 x 81 x 367 mm (long plate)
<b>Cutout</b>	68 x 138 (P04 with front panel mounting adapter)
	68 x 127 (panel only)
<b>Weight</b>	730 g (short plate)
	1200 g (long plate)

## 1-2 Hardware Description

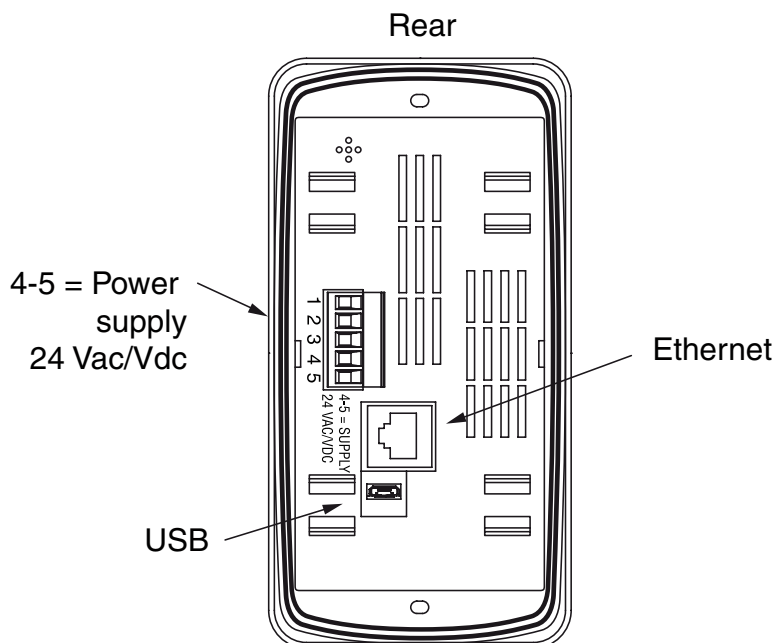
### 1-2-1 P04 Operator Panel

Touch  
Screen  
Panel



The P04 operator panel is operated directly from the Touch Screen Area.

Connections  
and Ports



#### Power Supply connection

The 24 V power supply is to be provided to the operator panel via terminals 4 and 5 of the terminal block. Since the power required can be both alternate and direct current (AC/DC), the polarization of the terminals is not relevant.

#### Ethernet connection

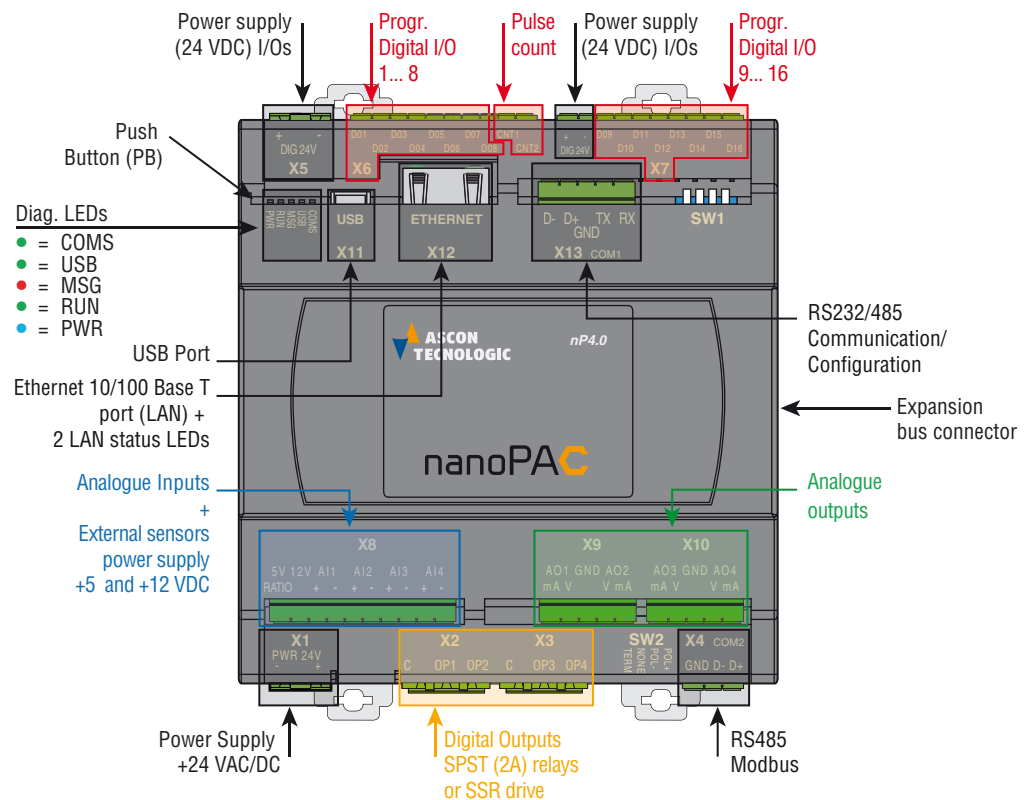
The LAN Ethernet port (TCP/IP) is dedicated to interface the P04 Operator Panel to the nP4 Control Unit.

#### USB port

The USB port can be used to upload a strategy in the P04 Operator Panel.

### 1-3 nP4 CPU

- Integrated I/Os* The AC3nP system base nP4 unit has up to 30 I/O ports:
- 4 AI** Universal analogue inputs configurable as mA, V, thermocouple, PT100, Pt1000, NTC, potentiometer or 5 V ratiometric (connector X8);
  - 0/2/4 AO** High level analogue outputs mA or V (connector X9 and X10);
  - 8 DI** General Purpose Digital Inputs (connector X6);
  - 8 DO** 24 Vdc Digital Outputs (connector X7);
  - 2 Cnt** Standard digital input, pulse counter or frequency meter (up to 5 kHz) (connector X6);
  - 4 OP** General purpose digital outputs: SPST relay (2 A) or SSR drive (connectors X2 and X3).



#### WARNING!

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

### 1-3-1 Diagnostic LEDs

The hereafter tables describe in detail LED functions and behaviours.

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
		Double flash	COM2 data traffic
		Triple flash	COM1 and COM2 data traffic

### 1-4 Electrical Installation

Refer to the previous figure for details.

#### **X1: Mains Supply 24 Vdc Power Supply Connector**

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

#### **X2, X3: OP1... OP4 Digital Outputs**

These two 3 terminals connectors are used for the output channels from **OP1** up to **OP4**. Depending on the ordering code (field **B**) the outputs can be:

**Order Code M** X2 - 2 A SPST output relays, X3 - 0/12 Vdc outputs for SSR;

**Order Code R** X2 - 2 A SPST output relays, X3 - 2 A SPST output relays;

Order Code **S** X2 - 0/12 Vdc outputs for SSR, X3 - 0/12 Vdc outputs for SSR.

Order Code	X2 Connector			X Connector		
	C	OP1	OP3	C	OP3	OP4
<b>R</b>	Common	NO	NO	Common	NO	NO
<b>M</b>	Common	NO	NO	+	-	-
<b>S</b>	+	-	-	+	-	-

#### X4: COM2 - RS485 Serial Communication Port Connector

Through this connector is possible to activate the RS485 serial communication port only. A dedicated DIP switches bank allows to activate the electrical line polarization (+ and/or -) and/or termination (see the “*Installation Manual*” for more information). The **X4** RS485 connector provides the port to connect a fieldbus network using the Modbus protocol (master/slave) or serial ASCII. The connector has the following pinout:

Label	GND	D+	D-
<b>Signal</b>	Ground	Data +	Data -

#### X5: Digital channels Power Supply (24 Vdc)

This connector has been designed to expressively power the digital channels section of the CPU. The connector has the following pinout:

Label	+	-
<b>Signal</b>	24 Vdc	0 Vdc

#### X6: D01... D08 Standard Digital Input & CNT1... CNT2 Pulse counter

Through this connector is possible to manage the digital input channels from **D01** up to **D08** and the special fast pulse counter/frequency digital inputs. The connector has the following pinout:

Label	D01	...	D08	CNT1	CNT2
<b>Signal</b>	DI 01	...	DI 08	Pulse Count1	Pulse Count2

#### X7: D09... D16: Standard Digital Output

Through this connector is possible to manage the standard digital output channels from **D09** up to **D16**. The connector has the following pinout:

Label	+	-	D01	...	D08
<b>Signal</b>	24 Vdc	0 Vdc	DO 09	...	DO 16

#### X8: AI1... AI4: Universal Analogue Inputs & Auxiliary Power

This connector is dedicated to the AI management and provide also 2 different power supply for ratiometric signals (+5 Vdc) and passive transmitters (+12 Vdc). The connector has the following pinout:

5V RATIO, 12V & AI1... AI4 - Universal Analogue Inputs

Label	5V RATIO	12V	AI1 +	AI1 -	AI2 +	AI2 -	AI3 +	AI3 -	AI4 +	AI4 -
<b>Signal</b>	+5 Vdc	+12 Vdc	AI1 signal reference		AI2 signal reference		AI3 signal reference		AI4 signal reference	

### X9: AO1... AO2: Analogue Outputs

The **X9** connector is used to connect the first two Analogue Outputs (**AO1** & **AO2**) to the system. The connector has the following pinout:

Label	AO1 mA	AO1 V	GND	AO2 V	AO2 mA
Signal	AO1 Current +	AO1 Voltage +	Common (-)	AO2 Voltage +	AO2 Current +

### X10: AO3... AO4: Analogue Outputs

The **X10** connector is used to connect the last two Analogue Outputs (**AO3** & **AO4**) to the system. The connector has the following pinout:

Label	AO3 mA	AO3 V	GND	AO4 V	AO4 mA
Signal	AO3 Current +	AO3 Voltage +	Common (-)	AO4 Voltage +	AO4 Current +

### X11: USB Flash Drive Connector

The **X11** connector is a standard USB Type AB port to connect a flash drive (system files, firmware and/or data logging upload/download).

### X12: LAN Ether.net 10/100 baseT Connector

The **X12** connector is a standard Ethernet RJ45 type.

### X13: COM1 - RS 232/485 Communication Port Connector

A dedicated DIP switches bank allows to activate the electrical line polarization (+ and/or -) and/or termination (see the “*Installation Manual*” for more information). To select the desired operational mode (RS485 or RS232) please consult the Configuration Procedure for details.

The **X13** RS485/232 connector provides the port to connect a fieldbus network using the Modbus protocol (master/ slave) or serial ASCII. The connector has the following pinout:

Label	D-	D+	GND	TX	RX
Signal	Data-	Data+	RS485/232 Ground	RS232 Transmit	RS232 Receive

## 1-5 Resident Strategies

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The AC<sup>3</sup>nP Systems are supplied with the following resident configurations, already stored in the unit:

**Ratio** 1 Ratio Loop plus 1 simple Loop;

**Cascade** Cascade loop with Remote Set Point and PV retransmission;

**Override** 2 Loops interconnected as override controllers;

**4 Loops** 4 simple Loops each other independent.

More information about this strategies are illustrated in *Appendix A: Resident configurations*.



## 1-6 Function Block Libraries

### 1-6-1 AT\_AC3\_Specific\_Lib Description

Function Block name	Description
AI_MNGT_ADV	Performs an advanced conditioning of the desired AI for MP02, M81 and nP4
ALARM_ADV	This function block generates different types of alarms. It can be used also as a comparator
RATIO_TYPE	Performs the Ratio SP calculation accordingly to the desired mode
SP_SEL	Performs the selection between several AC <sup>3</sup> nP SP types
REAL_COMMS_MNGT	Performs the conversion for the COMMS_MNGT_nP4

### 1-6-2 AT\_AC3\_LAN\_Mngt\_Lib Description

Function Block name	Description
LAN_MST_SYNC	This function block has been designed to synchronize and manage the data exchange operations involved with the LAN architecture activities.
LAN_SLV_DIAG	This function block has been designed to perform and provide diagnostic information accordingly to the LAN architecture
LAN_SLV_NODE_n	This function block has been designed to perform the overall operations in order to update and synchronize the LAN database shared by all the configured devices

### 1-6-3 AT\_AC3\_PAGES\_OPRS\_LIB\_Vxx Description

Function Block name	Description
PAGE_CUSTOM	Performs the data exchange between the CPU and the touch screen front panel related to the "Custom Page"
PAGE_4BARG_1	Performs the data exchange between the CPU and the touch screen front panel related to the "Four Loops Bargraph Page"
PAGE_2BARG_n	Perform the data exchange between the CPU and the touch screen front panel related to the "Loop_n Bargraph page". <b>Note:</b> n is an index (value 1 or 2) that identifies the FB and the loops connected. In particular: n = 1 then x = 1 (1 <sup>st</sup> loop connected to the FB) and y = 2 (2 <sup>nd</sup> loop connected to the FB). Otherwise when: n = 2 then x = 3 (1 <sup>st</sup> loop connected to the FB) and y = 4 (2 <sup>nd</sup> loop connected to the FB).
PAGE_1BARG_n	Perform the data exchange between the CPU and the touch screen front panel related to the "Loop_x Bargraph page". <b>Note:</b> n is an index (value 1, 2, 3 or 4) that identifies the FB and the loop connected. In particular: n = 1 Loop1 is connected to the FB; n = 2 Loop2 is connected to the FB; n = 3 Loop3 is connected to the FB; n = 4 Loop4 is connected to the FB.

Function Block name	Description
<b>PAGE_2TRND_n</b>	Perform the data exchange between the CPU and the touch screen front panel related to the “ <i>Loop_n Double Trend page</i> ”. <b>Note:</b> <b>n</b> is an index (value 1, 2, 3 or 4) that identifies the FB and the loop connected. In particular: <b>n = 1 Loop1</b> is connected to the FB; <b>n = 2 Loop2</b> is connected to the FB; <b>n = 3 Loop3</b> is connected to the FB; <b>n = 4 Loop4</b> is connected to the FB.
<b>PAGE_ALM_EVT_n</b>	Perform the data exchange between the CPU and the touch screen front panel related to the “ <i>1... 64 Alarms &amp; Events page</i> ”. <b>Note:</b> <b>n</b> is an index (value: 1, 2, 3 or 4) that identifies the FB and the alarm block connected. In particular: <b>n = 1</b> the alarm block connected is the 1 <sup>st</sup> (alarms 1... 16); <b>n = 2</b> the alarm block connected is the 2 <sup>nd</sup> (alarms 17... 32); <b>n = 3</b> the alarm block connected is the 3 <sup>rd</sup> (alarms 33... 48); <b>n = 4</b> the alarm block connected is the 4 <sup>th</sup> (alarms 49... 64).
<b>PAGE_DSP_NUM_n</b>	Perform the data exchange between the CPU and the touch screen front panel related to the “ <i>1... 32 Numerical Display page</i> ”. <b>Note:</b> <b>n</b> is an index (value: 1 or 2) that identifies the FB and the numerical value block displayed. In particular, when: <b>n = 1</b> the block of Numerical values connected is the 1 <sup>st</sup> (numerical signal inputs 1... 16); <b>n = 2</b> the block of Numerical values connected is the 2 <sup>nd</sup> (numerical signal inputs 17... 32).
<b>PAGE_EDT_NUM_n</b>	Perform the data exchange between the CPU and the touch screen front panel related to the “ <i>1... 32 Numerical Edit page</i> ”. <b>Note:</b> <b>n</b> is an index (value: 1 or 2) that identifies the FB and the numerical value block displayed. In particular, when: <b>n = 1</b> the block of Numerical values connected is the 1 <sup>st</sup> (numerical signal inputs 1... 16); <b>n = 2</b> the block of Numerical values connected is the 2 <sup>nd</sup> (numerical signal inputs 17... 32).
<b>PAGE_EDT_DIG_n</b>	Perform the data exchange between the CPU and the touch screen front panel related to the “ <i>1... 32 Digital Commands page</i> ”. <b>Note:</b> <b>n</b> is an index (value: 1 or 2) that identifies the FB and the digital input block connected. In particular, when: <b>n = 1</b> the block of Digital Inputs connected is the 1 <sup>st</sup> (Digital Inputs 1... 16); <b>n = 2</b> the block of Digital Inputs connected is the 2 <sup>nd</sup> (Digital Inputs 17... 32);
<b>PAGE_4BARG_G1</b>	Performs the data exchange between the CPU and the touch screen front panel related to a generic “Four Bargraph Page”
<b>PAGE_2BARG_Gn</b>	Perform the data exchange between the CPU and the touch screen front panel related to a “Two Bargraph page”. <b>Note:</b> <b>n</b> is an index (value 1 or 2) that identifies the FB connected.
<b>PAGE_2TRND_Gn</b>	Perform the data exchange between the CPU and the touch screen front panel related to a “Double Trend page”. <b>Note:</b> <b>n</b> is an index (value 1 or 2) that identifies the FB connected.

## AT\_AC3\_PAGES\_CONF\_LIB\_Vxx Descriptions

Function Block name	Description
<b>PAGE_CFG_PID_n</b>	<p>Perform the data exchange between the CPU and the touch screen front panel, specifically related to the “Loop_n PID Configuration page” which is part of those ones accessible ONLY through the Configuration session by typing the correct password.</p> <p><b>Note:</b> n is an index (value: 1, 2, 3 or 4) that identifies the Control Loop that is to be configured. In particular:  <b>n = 1</b> configures the PID parameters of Control Loop 1;  <b>n = 2</b> configures the PID parameters of Control Loop 2;  <b>n = 3</b> configures the PID parameters of Control Loop 3;  <b>n = 4</b> configures the PID parameters of Control Loop 4.</p>
<b>PAGE_CFG_NUM_n</b>	<p>Perform the data exchange between the CPU and the touch screen front panel related to the “1...224 Numerical Configuration page” which is part of those ones accessible ONLY through the Configuration session by typing the correct password.</p> <p><b>Note:</b> n is an index (values from 1 to 14) that identifies the FB and the Numerical Fields block connected. In particular, when:  <b>n = 1</b> configures the 1<sup>st</sup> block of Numerical Fields (1... 16);  <b>n = 2</b> configures the 2<sup>nd</sup> block of Numerical Fields (17... 32);  ...  <b>n = 14</b> configures the 14<sup>th</sup> block of Numerical Fields (209... 224).</p>
<b>PAGE_CFG_DIG_n</b>	<p>Perform the data exchange between the CPU and the touch screen front panel related to the “1... 64 Digital Commands page”</p> <p><b>Note:</b> n is an index (values from 1 to 4) that identifies the Digital Inputs block connected. In particular, when:  <b>n = 1</b> configures the 1<sup>st</sup> block of Digital Inputs (1... 16);  <b>n = 2</b> configures the 2<sup>nd</sup> block of Digital Inputs (17... 32);  <b>n = 3</b> configures the 3<sup>rd</sup> block of Digital Inputs (33... 48);  <b>n = 4</b> configures the 4<sup>th</sup> block of Digital Inputs (49... 64).</p>
<b>PAGE_LIMITS_GEN</b>	System page to setup the input value limit groups
<b>PAGE_RECIPE_GEN</b>	System page to setup the generic parameter recipes (requires USB key)

## Firmware FBs List

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

Function Block name	Description
<b>CTRL_SPLITMV</b>	Automan Station for heat and cool regulation with split range
<b>CTRL_SRV</b>	Servomotors algorithm
<b>CTRL_SRV_POS</b>	Servomotors algorithm close loop (potentiometer)
<b>CTRL_TPO</b>	Time proportional output
<b>CTD</b>	Counter Down pulses
<b>CTU</b>	Counter Up pulses
<b>CTUD</b>	Counter Up/Down pulses
<b>DINT_TO_TIME</b>	Data type conversion from DINT to TIME
<b>ENABLE_MODBUS_TCP_SERVER</b>	Set and activate the MBTCP/IP Server agent
<b>F_TRIG</b>	Falling edge detection
<b>R_TRIG</b>	Rising edge detection
<b>MB_TCP_CLOSE_CONN</b>	Close one of the 10 active connections
<b>MB_TCP_CONN_STATUS</b>	Show the status of a MBTCP/IP connection
<b>MB_TCP_GET_CONN_BY_ADDR</b>	Return information of a connection identified by the IP address of the client
<b>MB_TCP_GET_CONN_CONFIG</b>	Return configuration data of a specified active connection
<b>MEMCOPY_FROM_M</b>	Copies data from %M memory areas
<b>MEMCOPY_TO_M</b>	Copies data into %M memory areas
<b>MEMCPY_I_TO_M</b>	Copy a specific %I memory into a specific %M memory area
<b>MEMCPY_M_TO_M</b>	Copy a specific %M memory into a specific %M memory area
<b>MEMCPY_M_TO_Q</b>	Copy a specific %M memory into a specific %Q memory area
<b>MEMCPY_Q_TO_M</b>	Copy a specific %Q memory into a specific %M memory area
<b>MODBUS_GET_DIGITAL_SLAVE</b>	Read 16 digital values from a memory area dedicated to an MB slave
<b>MODBUS_GET_SLAVE_DATA</b>	Read registers from a memory area dedicated to an MB slave
<b>MODBUS_MASTER_EXECUTE</b>	Execute a query in compliance with the MB protocol
<b>MODBUS_MASTER_STATUS</b>	Check the status of the MB agent.
<b>MODBUS_SET_DIGITAL_SLAVE</b>	Write 16 digital values to a memory area dedicated to an MB slave
<b>MODBUS_SET_DWORD_DATA</b>	Write two contiguous registers (4 Bytes) to a memory area dedicated to an MB slave
<b>MODBUS_SET_WORD_DATA</b>	Write registers to a memory area dedicated to an MB slave
<b>MODBUS_SLAVE_SETTINGS</b>	Set the node_id and timeout parameters of the MB slave agent
<b>MODBUS_SLAVE_STATUS</b>	Check the status of the MB agent
<b>OPEN_SERIAL_COMM</b>	Configure the serial port and set the protocol used on it
<b>RAND</b>	Generete random numbers from 0... 65535
<b>RESET_PULSE_COUNTER</b>	Reset the counter value connected to a specific digital input
<b>RTC_Setup</b>	Set the system clock
<b>RTC_GET_VALUES</b>	Read the system clock
<b>RS</b>	Reset dominant Flip-Flop

Function Block name	Description
<b>SR</b>	Set dominant Flip-Flop
<b>SEND_EMAIL</b>	Set the configuration for a client SMTP to send e-mail
<b>SERIAL_IO_CONFIG</b>	Configure the ASCII serial port
<b>SERIAL_IO_READ</b>	Read data from the ASCII serial port
<b>SERIAL_IO_READ_BYTE</b>	ASCII serial port Byte reading
<b>SERIAL_IO_WRITE</b>	Write data on the ASCII serial port
<b>SERIAL_IO_WRITE_BYTE</b>	ASCII serial port Byte writing
<b>TIME_TO_DINT</b>	Data type conversion from TIME to DINT
<b>TIME_TO_LREAL</b>	Data type conversion from TIME to LREAL
<b>TIME_TO_REAL</b>	Data type conversion from TIME to REAL
<b>TOF</b>	Delay OFF timer
<b>TON</b>	Delay ON timer
<b>TP</b>	Time pulse generator
<b>WATCHDOG_SET</b>	Configure the system watchdog
<b>WATCHDOG_STATUS</b>	Checking the status of the system watchdog

### AT\_Generic\_Advanced\_Lib

The AT\_Generic\_Advanced\_Lib is a function block library which includes a set of generic functionalities originally from the Ascon Tecnologic AC Station Device (see the “IEC 61131-3 FB Library” [4] manual for details).

The table hereafter reports the complete list of the function blocks of the library.

Function Block name	Description
<b>AVG_ADV_8REAL</b>	Advanced Instantaneous Average calculation
<b>AVG_MOVING</b>	Moving Average calculation
<b>AVG_RUNNING</b>	Running Average calculation
<b>CHAR_8_ARRAY</b>	Analogue Conversion using 8 points
<b>CHAR_16_ARRAY</b>	Analogue Conversion using 16 points
<b>CHARACTERIZER_8</b>	Linear Interpolation with 8 points
<b>CHARACTERIZER_16</b>	Linear Interpolation with 16 points
<b>COMPARATOR</b>	Comparator with hysteresis FB
<b>CONV_AD8</b>	From BYTE to 8 bits
<b>CONV_AD16</b>	From WORD to 8 bits
<b>CONV_AD32</b>	From DWORD to 8 bits
<b>CONV_DA8</b>	From bits to BYTE
<b>CONV_DA16</b>	From bits to WORD
<b>CONV_DA32</b>	From bits to DWORD
<b>COUNTER</b>	Rising Edge Counter
<b>DECODER_8</b>	Decoder FB
<b>FLIPFLOP_D</b>	D Type FlipFlop FB
<b>FLIPFLOP_JK</b>	JK Type FlipFlop FB
<b>HOLD_VALUE</b>	Sample & Hold FB
<b>INBETWEEN</b>	Middle Selector FB
<b>LIMITER_VALUE</b>	Limiter FB
<b>MIN_MAX_SELECTOR</b>	Min/Max Selector FB
<b>MONOSTABLE_DS</b>	Monostable with Delay
<b>MONOSTABLE_NED</b>	Monostable with Delay on the Negative Edge
<b>MONOSTABLE_PED</b>	Monostable with Delay on the Positive Edge
<b>MONOSTABLE_PUL</b>	Monostable Pulse Generator
<b>MUX_A8</b>	Analog Multiplexer 8 Input

Function Block name	Description
<b>MUX_A16</b>	Analog Multiplexer 16 Input
<b>MUX_D8</b>	Digital Multiplexer 8 Input
<b>MUX_D16</b>	Digital Multiplexer 16 Input
<b>RESCALE</b>	Rescaling FB
<b>POWER_FAIL</b>	Power Fail Condition Monitor
<b>SLOPE_LIMIT</b>	Slope Limiter
<b>TIMER_ADV</b>	Advanced countdown timer function block
<b>TOTALIZER</b>	Totalizer FB
<b>TOTALIZER_AVD</b>	Advanced Totalizer FB

#### AT\_Process\_Generic\_Lib

The AT\_Process\_Generic\_Lib is a function block library which contains a set of generic process function blocks useful for the IEC 61131 programming. The table here reported gives the complete list of the function blocks.

Function Block name	Description
<b>AI_COND_ADV</b>	Advanced conditioning of an AI value
<b>AI_COND_STD</b>	Standard conditioning of an AI value
<b>ALARM_ABS</b>	Absolute Alarm FB
<b>ALARM_ADVANCED</b>	General Alarm FB
<b>ALARM_BND</b>	Band Alarm FB
<b>ALARM_DEV</b>	Deviation Alarm FB
<b>ALARM_RATE</b>	Rate Alarm FB
<b>DEW_POINT</b>	Dew Point calculation
<b>F0_CALCULATION</b>	Sterilization time for bacterial load reduction calculation
<b>HR_DRY_WET_BULB</b>	Relative humidity calculation method with dry/wet bulb
<b>MASS_FLOW</b>	Compensate Flow calculation
<b>MP_RTD_LIN</b>	RTD Linear rescaling (for microPAC ONLY)
<b>nP4_AI_MNGT_ADV</b>	nP4 full advanced AI conditioning
<b>ZrO2_PROBE</b>	% Carbon Potential calculation
<b>ZrO2_PROBE_CLN</b>	% Carbon potential probe cleaning management

#### AT\_Process\_Control\_Lib

The AT\_Process\_Control\_Lib is a function block library dedicated to the process control. It combines advanced and basic PID functions, coming within the nP4 firmware, in order to provide a ready to use solution. The most advanced function blocks are the complete standard PID single action controller and the equivalent double action. Advanced auto-tuning function blocks are also included in the library, using different tuning algorithms such as the “*Natural Frequency*” or the “*Step Response*”. Follows the complete list of the function blocks available with the library (see the “IEC 61131-3 FB Library” [4] manual for details).

Function Block name	Description
<b>S2_CONTROLLER</b>	Single Action Controller
<b>S2_CONTROLLER_ADV</b>	Advanced Single Action Controller
<b>S2_EZ_TUNE</b>	Tuning with Modified Step Response Algorithm for Single Action Loops
<b>S2_FILTER</b>	First Order Filter
<b>S2_HC_CONTROLLER</b>	Heat and Cool Controller
<b>S2_HC_CONTROLLER_ADV</b>	Advanced Heat and Cool Controller
<b>S2_HC_EZ_TUNE</b>	Tuning with Modified Step Response Algorithm for Heat and Cool Loops
<b>S2_HC_TFUZZY</b>	Tuning with Fuzzy Logic for Heat and Cool Loops



Function Block name	Description
<b>S2_HC_TNATFREQ</b>	Tuning with Natural Frequency Algorithm for Heat and Cool Loops
<b>S2_HC_TSTEPRESP</b>	Tuning with Step Response Algorithm for Heat and Cool Loops
<b>S2_HCMV</b>	AutoMan station for output manual value direct access for double action loop
<b>S2_MV</b>	AutoMan station for output manual value direct access for single action loop
<b>S2_SPLITMV</b>	AutoMan station for output manual value direct access for double action loop with SplitRange
<b>S2_TFUZZY</b>	Tuning with Fuzzy Logic for Single Action Loops
<b>S2_TNATFREQ</b>	Tuning with Natural Frequency Algorithm for Single Action Loops
<b>S2_TSTEPRESP</b>	Tuning with Step Response Algorithm for Single Action Loops

### AT\_Communications\_Lib

The AT\_Communications\_Lib allows a simplified access to the communication functions of nP4 CPU (see the “IEC 61131-3 FB Library” [4] manual for details). Follows the complete list of the function blocks available with the library:

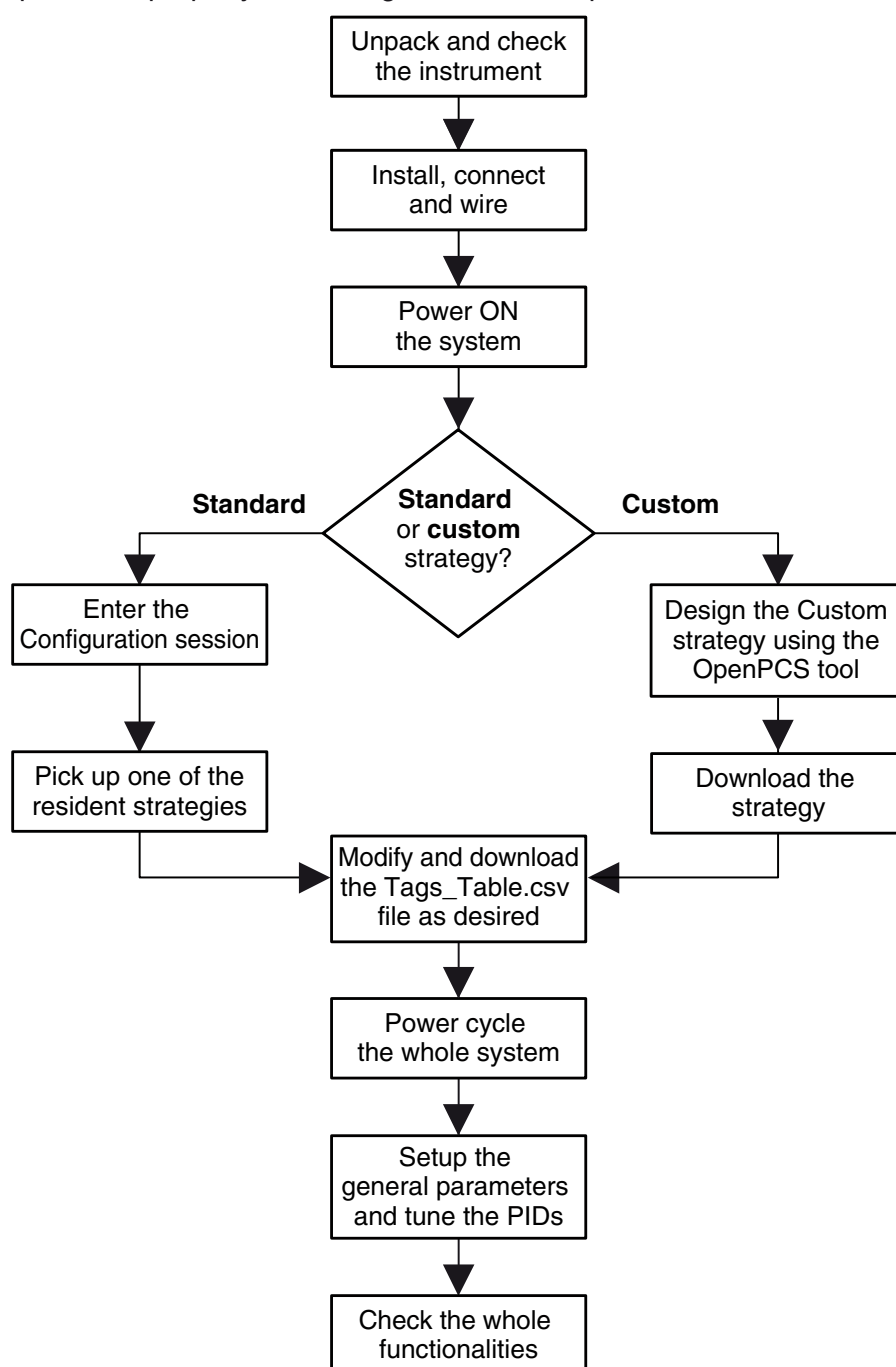
Function Block name	Description
<b>COMMS_MNGT_CU02</b>	CU-02 Serial Comm Ports Management
<b>COMMS_MNGT_M81</b>	M81 Serial Comm Ports Management
<b>COMMS_MNGT_MP0x</b>	MP-0x Serial Comm Ports Management
<b>COMMS_MNGT_nP4</b>	nP4 Serial Comm Ports Management
<b>EP4_EXP_MB</b>	eP4 Expansion full I/O management
<b>MB_MST_SYNC</b>	Modbus Master: Synchronization of operations
<b>MB_MST_RD_COIL</b>	Modbus Master: Coil reading
<b>MB_MST_WR_COIL</b>	Modbus Master: Coil writing
<b>MB_MST_RD_WORD</b>	Modbus Master: Word reading
<b>MB_MST_WR_WORD</b>	Modbus Master: Word writing
<b>MB_16WORD_TO_ARRAY</b>	Modbus Master: packaging of 16 WORD in an array
<b>MB_ARRAY_TO_16WORD</b>	Modbus Master: un-packaging of an array into 16 WORD
<b>MB_MST_RD8_DINT</b>	Modbus Master: conversion and management of 8 DINT read values
<b>MB_MST_RD8_DWORD</b>	Modbus Master: conversion and management of 8 DWORD read values
<b>MB_MST_RD8_REAL</b>	Modbus Master: conversion and management of 8 REAL read values
<b>MB_MST_RD8_UDINT</b>	Modbus Master: conversion and management of 8 UDINT read values
<b>MB_MST_WR8_DINT</b>	Modbus Master: conversion and management of 8 DINT write values
<b>MB_MST_WR8_DWORD</b>	Modbus Master: conversion and management of 8 DWORD write values
<b>MB_MST_WR8_REAL</b>	Modbus Master: conversion and management of 8 REAL write values
<b>MB_MST_WR8_UDINT</b>	Modbus Master: conversion and management of 8 UDINT write values
<b>MB_SLV_RD8_DWORD</b>	Modbus Slave: reading of 8 DWORD values
<b>MB_SLV_RD8_REAL</b>	Modbus Slave: reading of 8 REAL values
<b>MB_SLV_RD16_WORD</b>	Modbus Slave: reading of 16 WORD values



<b>Function Block name</b>	<b>Description</b>
<b>MB_SLV_RD32_DIGITAL</b>	Modbus Slave: reading of 32 digital values
<b>MB_SLV_RD_DIGITAL</b>	Modbus Slave: reading of 1 digital value
<b>MB_SLV_RD_DWORD</b>	Modbus Slave: reading of 1 DWORD value
<b>MB_SLV_RD_REAL</b>	Modbus Slave: reading of 1 REAL value
<b>MB_SLV_RD_WORD</b>	Modbus Slave: reading of 1 WORD value
<b>MB_SLV_WR8_DWORD</b>	Modbus Slave: writing of 8 DWORD values
<b>MB_SLV_WR8_REAL</b>	Modbus Slave: writing of 8 REAL values
<b>MB_SLV_WR16_WORD</b>	Modbus Slave: writing of 16 WORD values
<b>MB_SLV_WR32_DIGITAL</b>	Modbus Slave: writing of 32 digital values
<b>MB_SLV_WR_DIGITAL</b>	Modbus Slave: writing of 1 digital value
<b>MB_SLV_WR_DWORD</b>	Modbus Slave: writing of 1 DWORD value
<b>MB_SLV_WR_REAL</b>	Modbus Slave: writing of 1 REAL value
<b>MB_SLV_WR_WORD</b>	Modbus Slave: writing of 1 WORD value
<b>MODEM_CHECK</b>	Modem operational verification
<b>MODEM_CONF</b>	Modem configuration management
<b>MODEM_SMS_SEND</b>	Modem SMS (Short text Message Service) send management
<b>MP_SERIAL_PORTS</b>	Set the configuration for the ModbusRTU ports of the nP4 unit
<b>SEND_EMAIL</b>	SMTP server Configuration
<b>SERIAL_PORTS</b>	Set the configuration for the Modbus RTU ports of the CU unit
<b>SYS_OPRS_MNGT</b>	Set communication operational parameters on Modbus RTU and TCP agents
<b>TCP_IP_PORT</b>	Set the configuration for the Modbus TCP port

### 2-1 Startup Procedure

The flowchart lists steps you must carry out to have your AC<sup>3</sup>nP system installed on the plant and properly controlling the Customer process.













## 2-2 Keyboard



The display has touch screen functionalities and is programmed to have many different areas with specific functions.

### 2-2-1 Pushbuttons, display areas and other touch screen commands

-  User editable field. To change the value simply touch it: a numeric pad will appear and the desired value, in the admitted range, could be introduced and then confirmed or aborted. In the pages description the editable fields are indicated as writable;
-  Changes the Set Point (SP) operating mode, admitted values: LOC (Local) and REM (Remote);
-  Selects the output operating mode between AUTO (Automatic) and MAN (manual); when in manual mode, the control output value can be changed touching the button and editing the value on the numeric pad;
-  Allows the user to submit a user selectable command to the system;
-  These “LEDs” point out the status of a user selectable variable;
-  Moves back to the previous panel page;
-  Allows to access the configuration session (password protected);
-  When present, shows the next variable from the circular ones displayed on the SPLoc field present in the panel upper area;
-  When present, writes in one shot the status of all the digital commands available in the current page;
-  Moves forward to the next panel page.

## 2-3 Display

The display panel is based on a graphic 4.3" TFT LCD 262 k-colours 272 x 480 pixels high resolution touch screen display.



The AC³nP system is able to display several types of page panels specifically designed to manage all the functionalities developed into the control strategy. These panel displays have a complete user interface allowing the operator to have detailed information about process variables, activate commands and/or set parameters. The definition of types and quantities of the desired display panel pages is set by the developer into the selected or designed control strategy.

When the button  (prev. page) or  (next page) is pressed, the panels will be displayed in a factory defined priorities sequence. The order is not modifiable.

For the operational pages the display order is:

1. "Custom" panel page;
2. "Four Bargraph" panel page;
3. "Two Bargraph" (1... 2) panel pages;
4. "One Bargraph" (1... 4) panel pages;
5. "Double Trend" (1... 4) panel pages;
6. "Alarms & Status" (1... 4) panel pages;
7. "Display Numerical" (1... 2) panel pages;
8. "Edit Numerical" (1... 2) panel pages;
9. "Edit Digital" (1... 2) panel pages;
10. "Generic Four Bargraph" panel page;
11. "Generic Two Bargraph" (1... 2) panel pages;
12. "Generic Double Trend" (1... 2) panel pages.

For the configuration panel pages the displaying order is:

1. "System" panel page;
2. "PLC Configuration" panel page;
3. "Config. PIDs" (1... 4) panel pages;
4. "Config. Numerical" (1... 14) panel pages;
5. "Config. Digital" (1... 4) panel pages.

For a detailed description of the above please refer to the "Appendix A" of this manual.

### Custom Page

Front panel to manage up to four loops with numeric indications of Process Variable, Working Set Point and Output Value. The panel enables the user to submit commands for each loop (Auto/Man, Local/Remote, etc.) and also submit general commands (cmd1... cmd4).

#### **Four Bargraphs**

Front panel of four control loops, with bargraph indications of the process variable and Set Point with a scrolling alarms bar, common to all the 4 loops. Therefore, it is suitable for applications with up to 4 loops.

#### **Two Bargraphs**

Front panel of two control loops, usually connected in cascade, with numeric and bargraph indications of the most relevant variables and status display of logical signals or alarms.

#### **One Bargraph**

Front panel of a single control loop, with numeric indication of the relevant variables, bargraph display for the main ones (Process Variable, Set Point, Output) and status display of logical signals or alarms.

#### **Double Trend**

This is the front panel for a single loop, provides all the same numeric and digital indications of the One Bargraph Panel, with the addition of a trend chart, reporting graphically the recent trend of two analogue signals, like the Process Variable and the Set Point. The user, from a pull-down menu can select the chart time span between the following 7 choices: 5, 10, 15, 30 minutes - 1, 3, 6 hours.

#### **Alarms & Status**

It displays the status of 16 alarms and/or events. Each field accept a message up to 20 alphanumeric characters, with red or yellow background accordingly to the active status and desired setting.

#### **Display Numericals**

It displays up to 16 Read only analogue values. Each field is identified by a 16 characters label. A 6 characters field can be used to define the corresponding Engineering Unit.

#### **Edit Numericals**

It displays and allows to change up to 16 Read and Write analogue values. Each field is identified by a 16 characters label. A 6 characters field can be used to define the corresponding Engineering Unit.

#### **Edit Digitals**

It displays and allows to change up to 16 Read and Write digital command values. Each field is identified by a 10 characters label.

#### **Generic Four Bargraphs**

Front panel with 4 bargraph indications for process variable and Set Point with scrolling alarms bar, suitable for applications generic purposes.

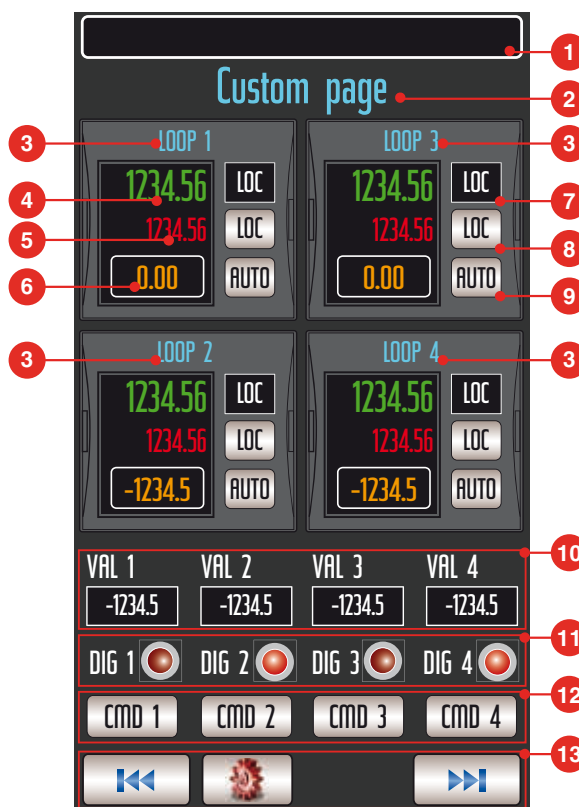
#### **Generic Two Bargraphs**

Front panel with 2 bargraph indications for process variable and Set Point with scrolling alarms bar, suitable for applications generic purposes.

#### **Generic Double Trend**

Double trend front panel, provides all the same numeric and digital indications of the One Bargraph Panel, with the addition of a trend chart, reporting graphically the recent trend of two analogue signals, like the Process Variable and the Set Point. The user, from a pull-down menu can select the chart time span between the following 7 choices: 5, 10, 15, 30 minutes - 1, 3, 6 hours.

## 2-3-1 Custom Page Panel



This page displays main parameters, commands and status of up to 4 controllers. The Process Variable, Working Set Point and Control Output values are numerically represented whilst Auto/Man and Loc/Rem commands can be performed through the dedicated buttons. The Loc/Rem status is pointed out beside the specific button. Additionally, four generic status LEDs and digital command buttons are available on the right side.

#### 1. Alarm Banner

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

#### 2. Page Tag

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the **Tags\_Table.csv** file.

#### 3. Loop Tag

This characters label, specified by the Customer, identifies the tag of the loop.

#### 4. Process Variable Value

Numerical visualisation of the loop controlled variable, it consists of 6 digits, plus sign and decimal point.

#### 5. Working Set Point Value

Numerical display of the loop Working Set Point value. When in Local mode, pressing on this area, appears the keyboard to input the desired Set Point value. If changes to the Local Set Point are not permitted, exiting from the input session (through the keyboard), the new value is discarded.

#### 6. Output Value (Writable)

Numerical value, in percentage, of the control output of each loop. When in manual mode, pressing on this area, appears the keyboard to input the desired output value. If changes to the output are not permitted, exiting from the input session (through the keyboard), the new value is discarded.

#### 7. Local/Remote Set Point Selection Button

Set Point operating mode button. Pressing with a finger on this area, the sys-

tem toggles the Set Point of the loop from the **LOC** (Local) to the **REM** (Remote) one. **LOC** (Local) is written in black on white field while **REM** (Remote) is written in black on red field.

**8. Local/Remote Set Point Status Display**

As the command to switch from the **LOC** (Local) to the **REM** (Remote) Set Point usage can arrive also from the communication port, this area indicates which Set Point is currently in use.

**9. Auto/Man Selection Button**

- 10.** Output operating mode button. Pressing with a finger on this area, the operator can notify to the system that the loop must be forced to a specific functioning mode. Possible modes are: **AUTO** (Automatic) written in black on white field or **MAN** (Manual) written in black on red field.

**11. Variables display area**

nmjwd

**12. Digital inputs Status LEDs**

These indicators point out the status of the digital inputs.

**13. Programmable Command Buttons**

These buttons can be programmed to activate/deactivate a specific command.

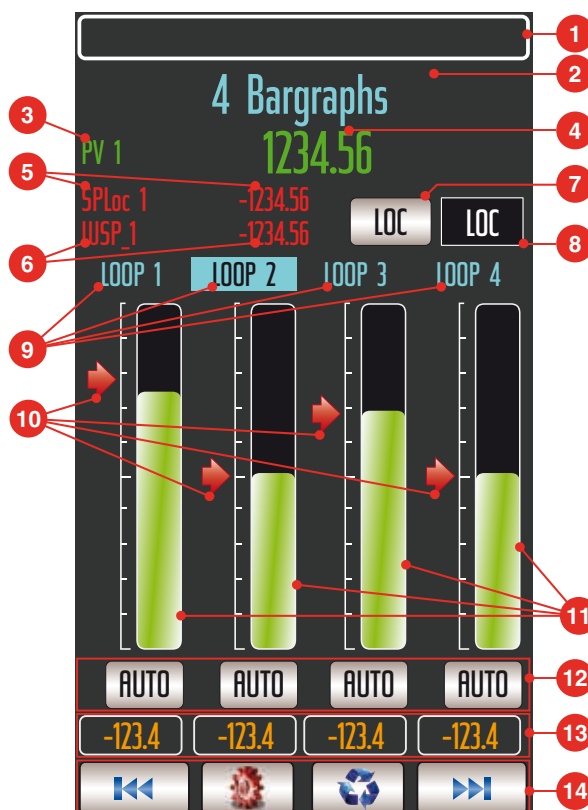
**14. Operative keys**

Using these keys the user can easily move through the instrument pages.

The command are: , , .



## 2-3-2 Four Bargraph Panel



This display type is less rich of information than the previous one because it lacks the output bargraph and the main variable engineering unit, but surely, it is the most versatile, by selecting the amount of loops, it adds the corresponding bargraphs and the sliders. This way to operate improves dramatically the readability, because the panel is not always filled with 4 bargraphs, when you need, for exaple, just two.

#### 1. Alarm Banner

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.


#### 2. Page Tag

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the *Tags\_Table.csv* file.

#### 3. Engineering unit

This field of 8 alphanumeric characters represent the engineering unit mnemonic related to the Variable value displayed (item 4) of the selected Loop. It can be modified as desired from the *Tags\_Table.csv* file.

#### 4. Process Variable Value

Numerical visualisation of the process variable of the selected loop, consisting of 6 characters, including sign and the decimal point. Using the  button, the user can select a specific loop. The selected loop is pointed out using the reverse video display mode (Loop 2 in the example).

#### 5. Local Set Point Label and Value (SPL) (Writable)

**SPL\_Ln** (Set Point\_Local\_Loop#) Mnemonic label and numerical value of the Local Set Point of the selected loop (Loop 2 in the example). Pressing on this area, appears the keyboard to input the desired Set Point value for the selected loop. If changes to the Local Set Point are not permitted, exiting from the input session (through the keyboard), the new value is discarded.

#### 6. Working Set Point label and Value (WSP)

**WSP** (Working\_SetPoint\_Loop#) Mnemonic label and value of the Working

Set Point of the selected loop (Loop 2 in the example).

#### 7. Local/Remote Set Point Selection Button

Set Point operating mode button of the selected loop (Loop 2 in the example). Pressing with a finger on this area, the system toggles the Set Point of the selected loop from the **LOC** (Local) to the **REM** (Remote) one. **LOC** (Local) is written in black on white field while **REM** (Remote) is written in black on red field.

#### 8. Local/Remote Set Point Status Display

As the command to switch from the **LOC** (Local) to the **REM** (Remote) Set Point usage can arrive also from the communication port, this area indicates which Set Point is currently in use on the selected Set Point.

#### 9. Loops tag

This characters label (8 alphanumeric characters), specified by the Customer, identifies the loop tag. The loop selected has its tag displayed in reverse.

#### 10. Set Point sliders

Graphic representation, through a moving slider, of the Set Point in use for loops 1, 2, 3 and 4.

#### 11. Bargraphs

Bargraph indication of the process variables of loops 1, 2, 3 and 4.

#### 12. Auto/Man

Output operating mode button of each loop. Pressing with a finger on this area, the operator can notify to the system that the loop must be forced to a specific functioning mode. Possible modes are: **AUTO** (Automatic) written in black on white field or **MAN** (Manual) written in black on red field.

#### 13. Output Value (Writable)

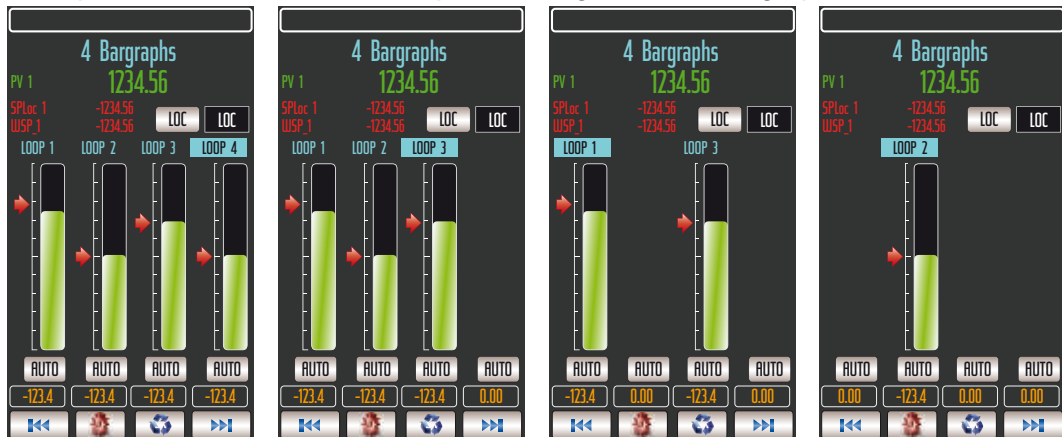
Numerical value, in percentage, of the control output of each loop. When in manual mode, pressing on this area, appears the keyboard to input the desired output value. If changes to the output are not permitted, exiting from the input session (through the keyboard), the new value is discarded.

#### 14. Operative keys

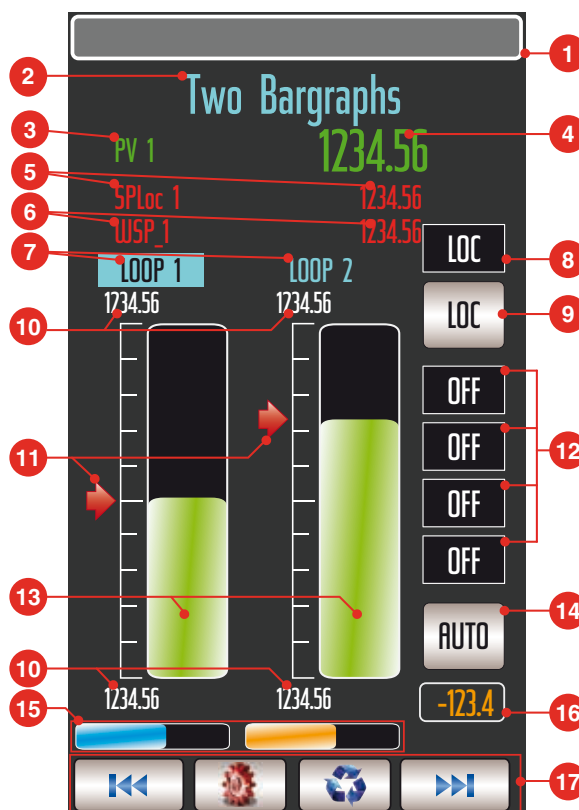
Using these keys the user can easily move through the instrument pages.

The command are: , , , .

The following are few examples of the types of display you can achieve with this panel. The type of visualisation is automatically selected, according to the connections performed on the module inputs, through the AC-Prograph software.



## 2-3-3 Two Bargraph Panel



The main purpose of this display is to provide the front panel for those applications where two PID loops are typically required, such as a cascade control loop (Master and Slave).

In this case, the Master loop values and status can be displayed on the left side (Loop1) while the ones related to the Slave can be displayed on the right (Loop2). The PID control output displayed relates to the loop selected by the "Circulating values" button. The Master one, which is converted into the Slave SP, is also displayed, in engineering unit, as the SP value. For this reason, the only SP modifiable by the user is the Master one.

#### 1. Alarm Banner

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

#### 2. Page Tag

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the **Tags\_Table.csv** file.

#### 3. Main Variable Value

Numerical visualisation of the main Process Variable, consisting of 6 numbers with sign and decimals (default 4 integers and 2 decimals). The field changes accordingly to the "Circulating values" button (Loop\_1/Loop\_2 or Loop\_3/Loop\_4).

#### 4. Engineering unit

This field of 8 alphanumeric characters represent the engineering unit mnemonic related to the specific value. It can be modified as desired from the **Tags\_Table.csv** file.

#### 5. Local Set Point Label and Value (SPL)(Writable)

**SPL\_Ln** (Set Point\_Local\_Loop#) Mnemonic label and numerical value of the Local Set Point of the selected loop (Loop 1 in the example). Pressing on this area, appears the keyboard to input the desired Set Point value for the selected loop. If changes to the Local Set Point are not permitted, exiting from

the input session (through the keyboard), the new value is discarded.

**6. Working Set Point label and Value (WSP)**

**WSP** (Working\_SetPoint\_Loop#) Mnemonic label and value of the Working Set Point of the selected loop (Loop 1 in the example).

**7. Loops tag**

This characters label (8 alphanumeric characters), specified by the Customer, identifies the loop tag. The loop selected has its tag displayed in reverse.

**8. Local/Remote Set Point Status Display**

As the command to switch from the **LOC** (Local) to the **REM** (Remote) Set Point usage can arrive also from the communication port, this area indicates which Set Point is currently in use on the selected Set Point.

**9. Loc/Rem button**

Allows to select the desired **LOC** or **REM** (Local or Remote) **SP** operating mode. The field changes accordingly to the “*Circulating values*” button (Loop\_1/Loop\_2 or Loop\_3/Loop\_4).

**10. Scale High/Low limits**

These fields define the values of upper and lower limits of the scale. Each value consists of 6 characters, including the sign and the decimal point.

**11. SP Slider indicators**

Graphical representation, through a red arrow slider, of the real time **SP** value.

**12. Digital Status**

These fields can be used to display up to 4 digital status conditions such as alarms or simple logic status. The related tags can be modified as desired from the **Tags\_Table.csv** file. The field changes accordingly to the “*Circulating values*” button (Loop\_1/Loop\_2 or Loop\_3/Loop\_4).

**13. PV Bargraph**

Green bargraph indication of the Process Variable.

**14. Auto/Man button**

Allows to select the desired AUTO or MAN (Automatic or Manual) PID control output mode. The field changes accordingly to the “*Circulating values*” button (Loop\_1/Loop\_2 or Loop\_3/Loop\_4).

**15. Output bargraph**

Light blue/Orange horizontal bargraph showing the loop control output value. Can display both the heat and cool output values. The field changes accordingly to the “*Circulating values*” button (Loop\_1/Loop\_2 or Loop\_3/Loop\_4).

**16. Output value**

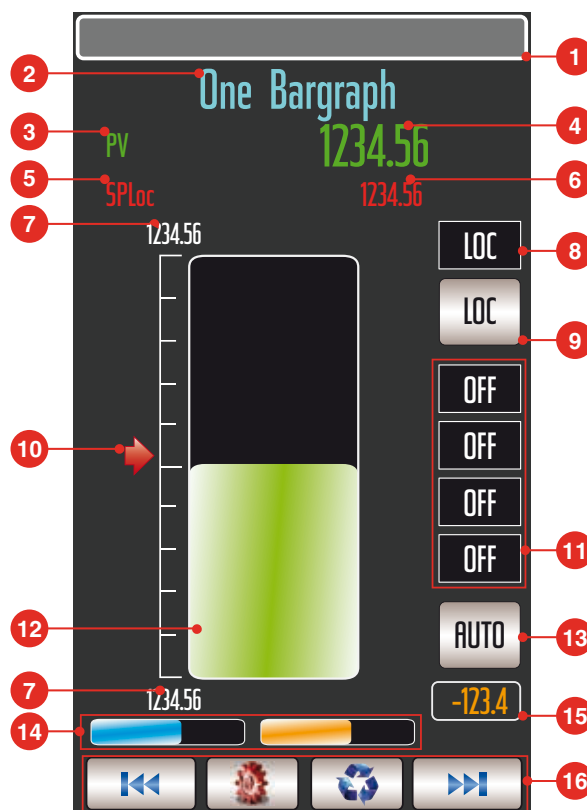
This field is used to show/edit the numerical control output value of the loop in percentage. The field changes accordingly to the “*Circulating values*” button (Loop\_1/Loop\_2 or Loop\_3/Loop\_4).

**17. Operative keys**

Using these keys the user can easily move through the instrument pages.

The command are: , , , .

## 2-3-4 One Bargraph Panel

**1. Alarm Banner**

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

**2. Page Tag**

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the **Tags\_Table.csv** file.

**3. Engineering unit**

This field of 8 alphanumeric characters represent the engineering unit mnemonic related to the specific value. It can be modified as desired from the **Tags\_Table.csv** file.

**4. Main Variable Value**

Numerical visualisation of the main Process Variable (PV), consisting of 6 numbers with sign and decimals (default 4 integers and 2 decimals).

**5. Scrolled Variable Tag**

This 6 characters field is used first to show the Local SP tag. Then, by pressing the circulating button, it can show up to 5 more generic tags associate to the relative values (AI1, AI2, AI3, AI4 and AI5). The related tags can be modified as desired from the **Tags\_Table.csv** file.

**6. Scrolled Variable Value**

This field is used first to show/edit the Local SP value. Then, by pressing the circulating button, it can show up to 5 more generic numeric values (AI1, AI2, AI3, AI4 and AI5). It consists of 6 numbers plus sign and decimal point.

**7. Scale high/low Limits**

These fields define the values of upper and lower limits of the scale. Each value consists of 6 characters plus the sign and the decimal point.

**8. Set Point Operating Mode**

This field shows the actual selected SP operating mode for the loop. The

status can be **LOC** or **REM** (Local or Remote).

**9. Loc/Rem button**

Allows to select the desired **LOC** or **REM** (Local or Remote) SP operating mode.

**10. Set Point Slider indicator**

Graphical representation, through a red arrow slider, of the real time SP value.

**11. Digital Inputs Status**

These fields can be used to display up to 4 digital status conditions such as alarms or simple logic status. The related tags can be modified as desired from the **Tags\_Table.csv** file.

**12. PV Bargraph**

Green bargraph indication of the Process Variable (PV).

**13. Auto/Man**

Allows to select the desired **AUTO** or **MAN** (Automatic or Manual) PID control output mode.

**14. Output bargraph**

Light Blue/Orange horizontal bargraph showing the loop control output value. Can display both the heating and cooling output values.

**15. Output Value**

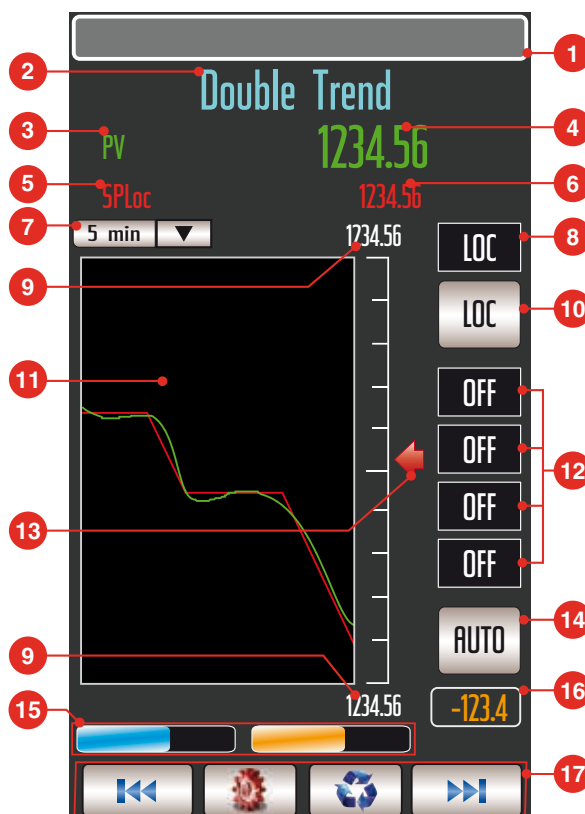
This field is used to show/edit the numerical control output value of the loop in percentage.

**16. Operative keys**

Using these keys the user can easily move through the instrument pages.

The command are: , , , .

## 2-3-5 Double Trend Panel



This display has almost the same functionality of the 2 Bar Panel module, with the addition of a trend chart of an analogue variable. Its main purpose is to provide the front panel of a simple control loop. The trend indication gives the operator a better understanding of the situation of the process, than just the real time display of process data.

This display is provided in all the resident strategies of the AC System.

#### 1. Alarm Banner

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

#### 2. Page Tag

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the **Tags\_Table.csv** file.

#### 3. Engineering unit

This field of 8 alphanumeric characters represent the engineering unit mnemonic related to the specific value. It can be modified as desired from the **Tags\_Table.csv** file.

#### 4. Main Variable Value

Numerical visualisation of the main Process Variable, consisting of 6 numbers plus sign and decimal point.

#### 5. Scrolled Variable Tag

This 6 characters field is used first to show the Local SP tag. Then, by pressing the circulating button, it can show up to 5 more generic tags associate to the relative values (AI1, AI2, AI3, AI4 and AI5). The related tags can be modified as desired from the **Tags\_Table.csv** file.

#### 6. Scrolled Variable Value (Writable)

This field is used first to show/edit the Local SP value. Then, by pressing the circulating button, it can show up to 5 more generic numeric values (AI1, AI2, AI3, AI4 and AI5). It consists of 6 numbers plus sign and decimals (default 4



integers and 2 decimals).

**7. Time Scale**

Numerical display of the time span of the trend chart. The user defines this value by choosing between the following set: 1, 2, 5, 10, 30 min - 1, 2, 5 hours.

**8. Set Point Operating Mode**

This field shows the actual selected SP operating mode for the loop. The status can be **LOC** or **REM** (Local or Remote).

**9. Scale high/low Limits**

They define the values of upper and lower limits of the scale. Each value consists of 6 characters, including the sign and the decimal point.

**10. Loc/Rem button**

Allows to select the desired **Loc** or **REM** (Local or Remote) SP operating mode.

**11. Trend Chart**

Area dedicated to the graphic display of the recent trend curve of a variable. The time width of the chart corresponds to 75 samples.

**12. Alarms and Digital**

Display, by mean of user defined, 3 characters mnemonics, of the status of the 3 digital inputs of the module. These inputs are used for representing alarms or simple logic status.

**13. Set Point Slider**

Graphic representation, through a moving slider, of the real time value of the Set Point. The slider is moved in steps of 0.5%.

**14. Auto/Man**

Allows to select the desired AUTO or MAN (Automatic or Manual) PID control output mode.

**15. Output bargraph**

Light Blue/Orange horizontal bargraph showing the loop control output value. Can display both the heating and cooling output values.

**16. Output Value**

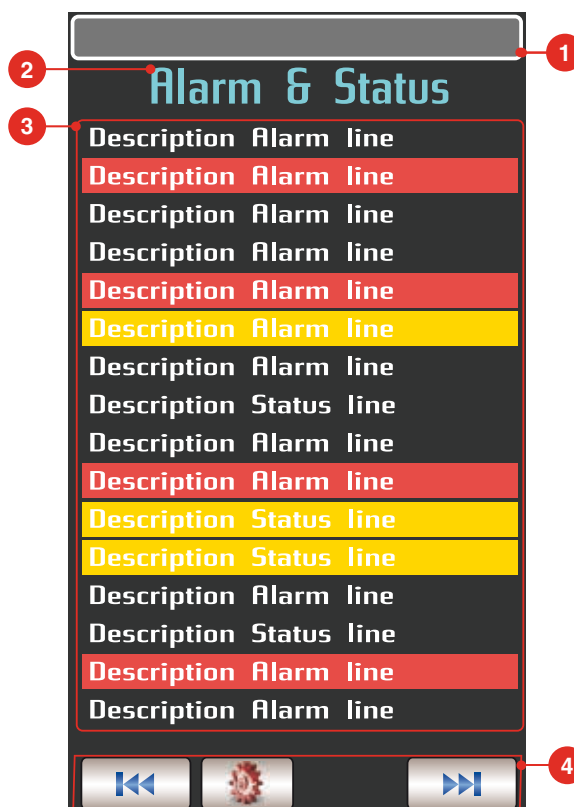
This field is used to show/edit the numerical control output value of the loop in percentage.

**17. Operative keys**

Using these keys the user can easily move through the instrument pages.

The command are: , , , .

## 2-3-6 Alarm &amp; Status Panel



This module provides the functionalities of an alarm annunciator with 16 alarm messages. Each message is connected with a digital input, that defines the visualisation of the message. All the 16 messages are listed at a predefined position on the display, with different visualisation modes, according to the status of the associated digital input; in reverse, if the input is active, or in normal, if it is inactive. The status is reported in red in case of an alarm whilst in yellow are reported the events. This display can be used not only for alarms, but for listing digital status, too.

#### 1. Alarm Banner

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

#### 2. Page Tag

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the **Tags\_Table.csv** file.




#### 3. Alarm Messages

The alarm message is a 16 alphanumeric character string (including space and symbols) associated to a digital input signal. If this signal is in the active state, the message is displayed in reverse, otherwise in normal.

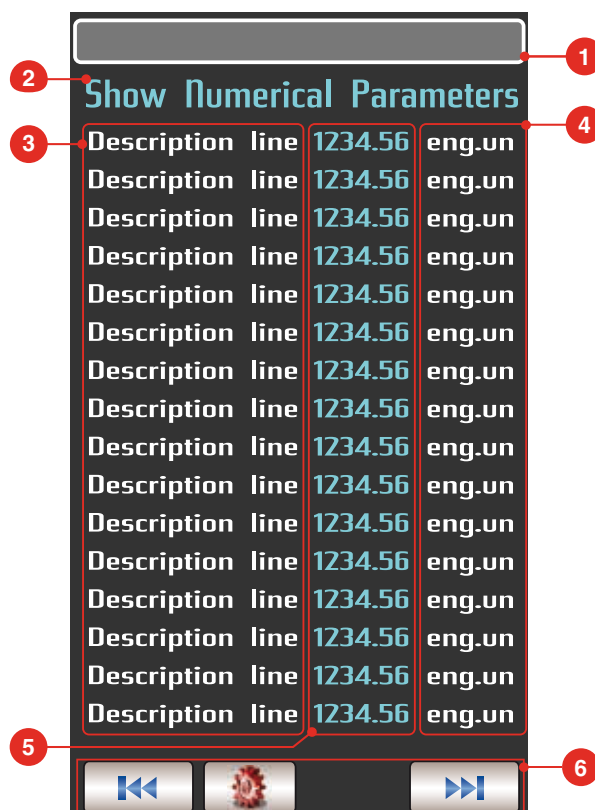
#### 4. Message Area

This display is reserved for 16 alarm messages, each on a line of the display.

#### 5. Operative keys

Allow the operator to move through the available pages or to perform specific functions. The available commands/functions are: , , .

## 2-3-7 Display Numericals Panel



This display provides the functionalities of a set of analogue indicators. It displays both the value and the 6 characters tag, of up to 12 analogue variables, connected to it, as analogue inputs.

### 1. Alarm Banner

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

### 2. Page Tag

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the **Tags\_Table.csv** file.

### 3. Variable Tags

This 16 characters label, specified by the Customer, identifies the displayed variable.




### 4. Engineering unit

Engineering unit mnemonic, consisting of a string of 3 alphanumeric characters maximum.

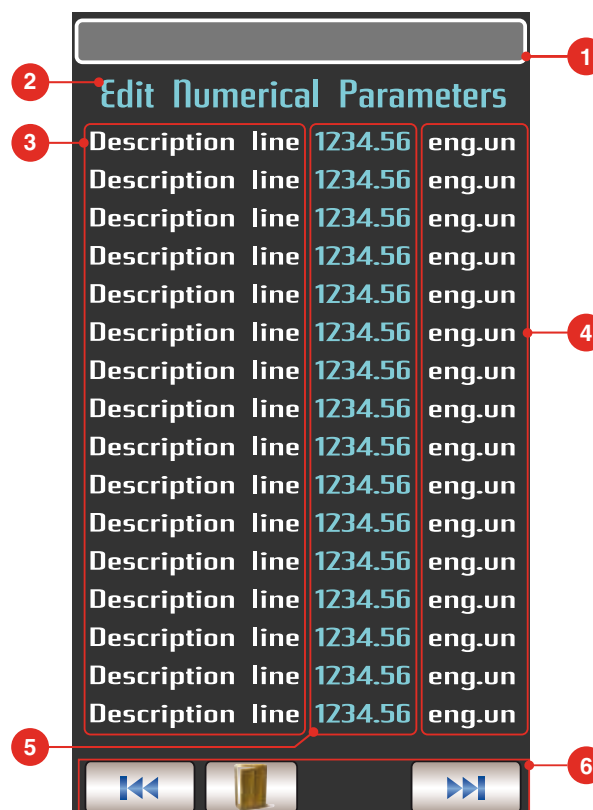
### 5. Variable Values

Numerical display of the analogue input signal. It consists of 6 characters, plus the sign and the decimal point.

### 6. Operative keys

Allow the operator to move through the available pages or to perform specific functions. The available commands/functions are: , , .

## 2-3-8 Edit Numericals Panel



This panel allows the editing of up to 16 analog-type variables. Each variable is characterized by a tag (max. 10 characters) and an engineering unit (max. 3 characters).

**1. Alarm Banner**

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

**2. Page Tag**

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the **Tags\_Table.csv** file.

**3. Variable Tags**

This 10 alphanumeric character label, specified by the Customer, identifies the displayed variable.




**4. Engineering unit**

Engineering unit mnemonic, consisting of a string of 3 alphanumeric characters maximum.

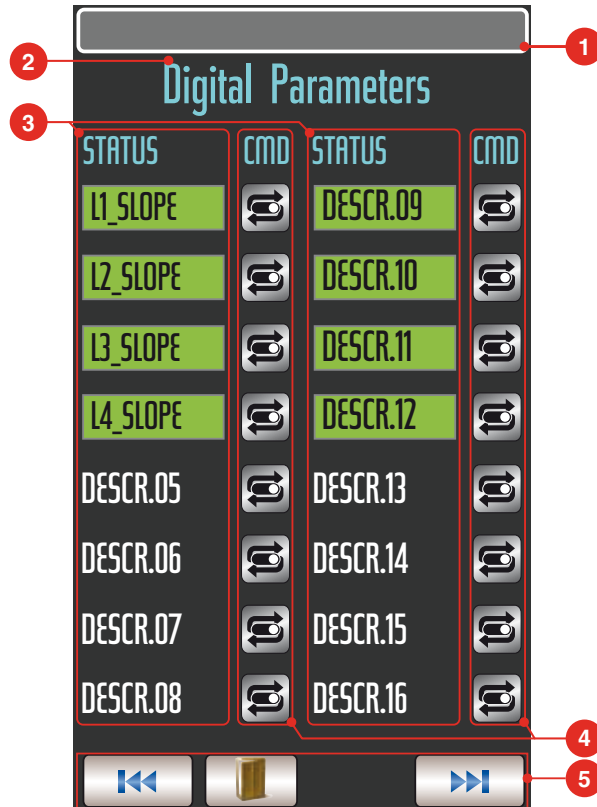
**5. Variables Values**

Numerical display of the analogue input signal. It consists of 6 characters, plus the sign and the decimal point.

**6. Operative keys**

Allow the operator to move through the available pages or to perform specific functions. The available commands/functions are: , , .

### 2-3-9 Edit Digitals Panel



This display provides the functionality of a control panel for digital commands. It has 16 outputs, that are driven all together, by the pattern selected through one of the 3 supported selection modes: **Keyboard**, **Supervisory Computer** and the **4 Digital Inputs**. Through these modes, a number from 0 to 15 is specified, that forces the 4 digital outputs to assume a well defined pattern, corresponding to the binary coding of the number and identified by an alphanumeric label, for immediate understanding.

#### 1. Alarm Banner

This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.

#### 2. Page Tag

This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the Tags\_Table.csv file.

#### 3. Item Area

This area consists of 16 lines, each associated to a defined output pattern (named item) and identified by an alphanumeric, custom defined tag. In AC\_Prograph the user configures the Item (1... 16). The star symbol on the right of the item name specifies the last item selected, whose pattern has set the digital outputs.




#### 4. Enter Key

Enter key, required to confirm the choice operated with the button 6 and 7, in order to proceed with the execution.

#### 5. Item Selection Key

Through this key, the user scrolls the cursors on all the items, to point to the item to select. This selection operation is possible only if the highest priority has been assigned to the keyboard.

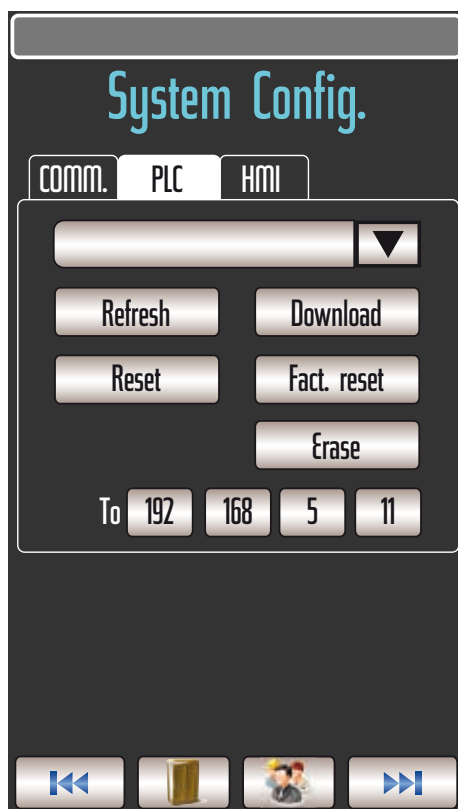
#### 6. Operative keys

Allow the operator to move through the available pages or to perform specific functions. The available commands/functions are: , , .

## 2-4 Select a resident Strategy

At power up, the AC<sup>3</sup>nP system can either show on the display the first panel of the selected downloaded strategy or the “*Cannot read Operative Page Variable. Aborting Execution*” message when no configuration has been already selected or in case of error. In both cases, you can select a new control strategy (if present) from the dedicated page which is accessible ONLY by typing the correct password. In case, the sequence of operations would be the following:

1. Power on the AC<sup>3</sup>nP system and wait until the OS will be fully operational;
2. Press the “*Configuration page*” button and introduce the correct password [11235]: the following page appears;



3. After that, the main menu page will be displayed: please choose the “*Manage Configuration*” option;
4. From the pull down menu select the desired control strategy and press the “*Download*” button;
5. A popup window will warn you to reboot the complete system: power cycle the AC<sup>3</sup>nP system in order to get active the changes.

After the complete boot - up, the strategy and the related panel pages will be correctly displayed and ready to use.



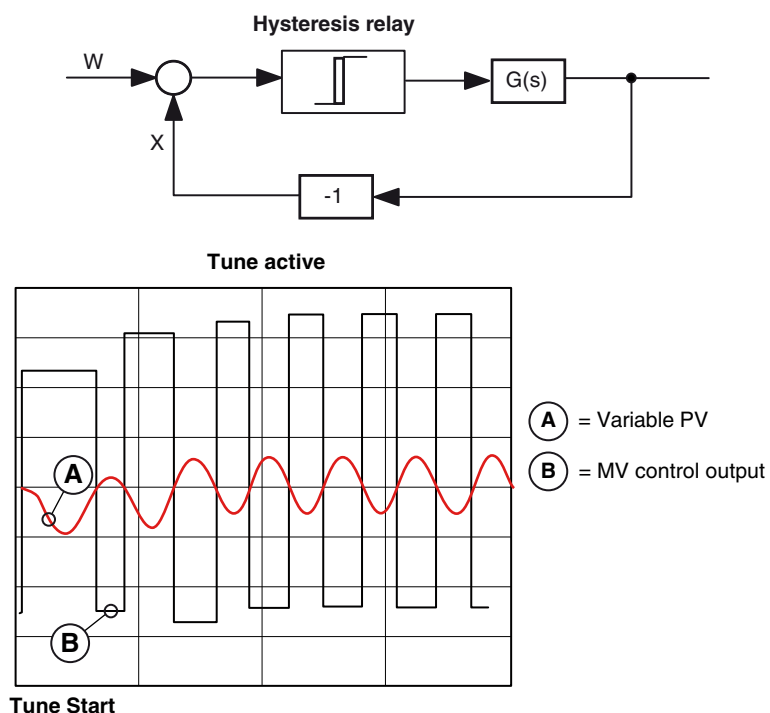


# Chapter 3

## PID, Tune and Communication

### 3-1 Tuning

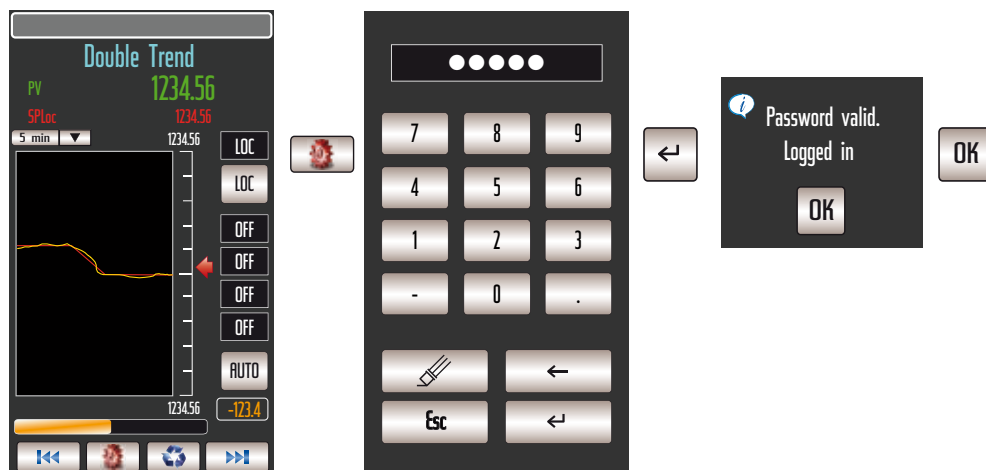
The Tuning method used in the AC<sup>3</sup>nP systems is a highly sophisticated new generation algorithm which represents conceptually the “*state of the art*” in his context. Basically, the method on which is based can be represented like follows.



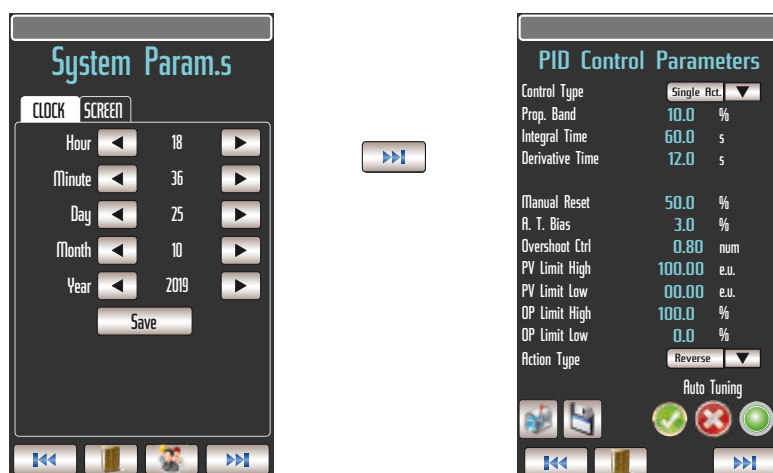
In the closed loop configuration as illustrated above, the hysteresis relay causes a continuous endless oscillation of the measured variable. These oscillations are carefully examined, in terms of amplitude and period, by the Tune algorithm which then, accordingly to these analyses, determines the optimal PID terms values.

To use the Auto - Tuning function is quite simple but in some cases a good knowledge of the process is needed, such as in case of a Cascade condition. The Auto - Tuning function can be activated even on more than one PID loop at the time but in those situations where there is an interaction between two or more loops, it must be executed keeping in mind all the particular concerns related to the whole process. It can work with every single or double action process, either in steady conditions or during transients. Furthermore, the Tune algorithm is automatically fitted to the type of PID (P, PI or PID) selected. **In case of double action control is mandatory to run the Auto - Tune in the “heating area” in order to get a correct calculation of the parameters.**

In case of need to execute an Auto - Tuning function, from a whatever operational page, the steps to be followed are:



Once displayed the desired loop “PID Control Parameters” page and verified that all the parameters are set to the correct values, press the “**Start**” (🟢) button to run the Auto - Tuning function.



During the Tuning process, a green LED indication will show the operational status of the function until the end of it. In case of problems or failure of the function, the LED will switch to red. It is possible to abort the Tuning procedure at any time by pressing the “**Abort**” (🔴) button.

The Auto - Tuning function calculated parameters, at the end of the processing, overwrites the original PID terms parameters values with the new ones.

## 3-2 Gain Scheduling

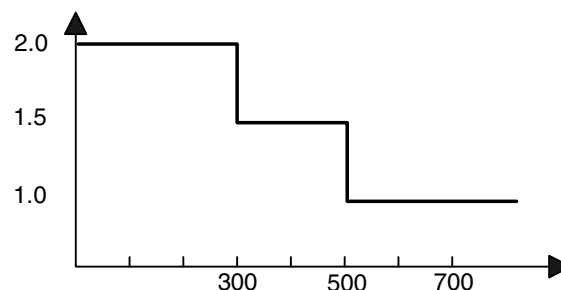
Gain scheduling is based on the technique of changing the value of the 3 terms parameters of the PID algorithm accordingly to a desired logic such as the value of whatever variable (like the SP or the PV variable), the controlled variable and/or other process signals. The main purpose of this functionality is to adjust automatically the 3 terms parameters when dynamic changes occur on the controlled process like, for example, a load change. The gain scheduling is a very effective control technique with superb results, but its diffusion has been limited by the high skills and the considerable development efforts required to be implemented.

The word Gain scheduling is the historical name that does not mean only the Proportional band value can be changed but can be extended to all the 3 terms, including the integral time, the derivative time and the Relative Cooling Gain factor. In order to get the functionality, the developer has simply to arrange and manage the specific conditions to be and then change dynamically the specific parameter global variables to the desired or needed values.

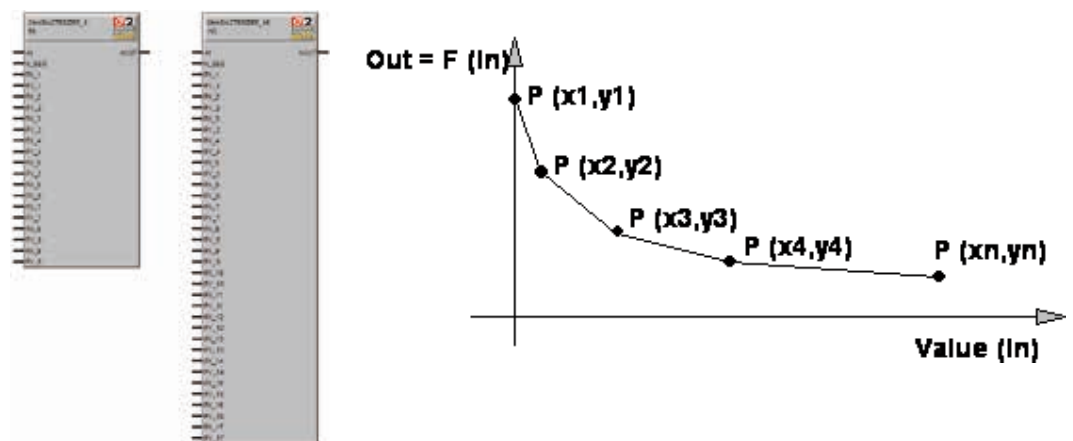
For instance, let supposed to have been calculated three sets of the 3 terms parameters, each one related to a specific process condition or SP range. You can imagine that each set has been computed automatically by the controller Tuning facility, as described in the **Chapter 4.1**.

Set Point Range	Optimal PB
0-300	10
300-500	13.3
500-700	20

The best result is achieved if the parameters are set according to the SP value. This can be implemented automatically as illustrated below. A *CHARACTERIZER\_8* or *CHARACTERIZER\_16* function block module, which would use as input variable the PID Working SP, selects the appropriate value used then as direct PB value of the desired PID control loop.



Example of a Characterisation curve.



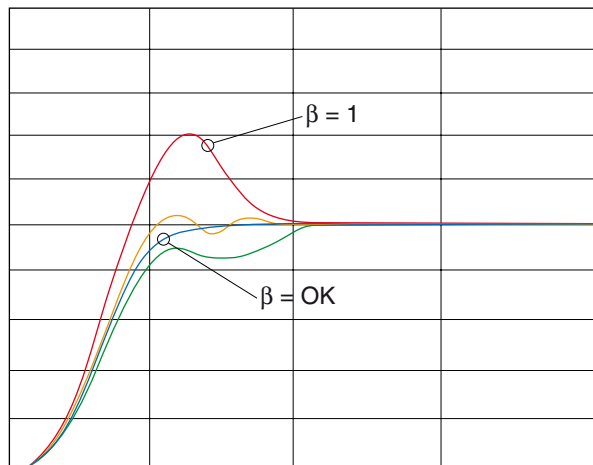
Graphical representation of the function block which can be used for this scope.

### 3-3 Two freedom degrees PID

In order to provide very effective control capabilities, the AC<sup>3</sup>nP systems are supplied with a PID algorithm with two degree of freedom.

This second degree corresponds to the O.C. parameter (Overshoot Control) that provides a sort of SP Weighting which determines the error then used by the PID algorithm. The benefits of using this parameter is a consistent reduction of overshoot and undershoot phenomena, during the SP changes.

This O.C. parameter, also named SP Weighting, has the same characteristics of the SP Filtering that is used by other Vendors, because it does not change the response at steady conditions. It modifies the position of some zeroes in the closed loop transfer function and this causes a better more response to overshoots. The following picture illustrates the concept and better response achieved with an optimal value of O.C.



Several simulation studies have demonstrated how the SP Weighting technique could be more efficient than the SP Filtering because, in case of identical conditions of dumping amplitude, it reaches the target SP in a shorter time.

## 3-4 Communications

---

The AC<sup>3</sup>nP systems are supplied with 3 communication ports:

- X13** Port used to configure the Basic Unit and for Modbus or ASCII communications. It can be set, through external microswitches, either as RS232 or as RS485;
- X4** This port is an RS485 dedicated to ARCNET emulation;
- LAN** Ethernet port (TCP/IP) used to configure, program, debug, commission and for Modbus TCP data exchange.

### 3-4-1 Programming port (LAN)

The programming port is mainly used to download custom strategies in the AC<sup>3</sup>nP system, by mean of the OpenPCS programming tool. This port is also used to exchange data with the P04 Operator Panel.

The original AC Station controllers had a port dedicated to exchange data with SCADA systems. In order to maintain the compatibility has been created a specific ModBus database which emulates as much as possible the original one.

### 3-4-2 Communication port emulating the ARCNET functionality (X4)

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#### **WARNING!**

The original AC Station controllers could be equipped with a dedicated port used to exchange data between up to 8 remote AC controllers. The same architecture could not be reproduced with the new system which cannot guarantee any compatibility with the old one.

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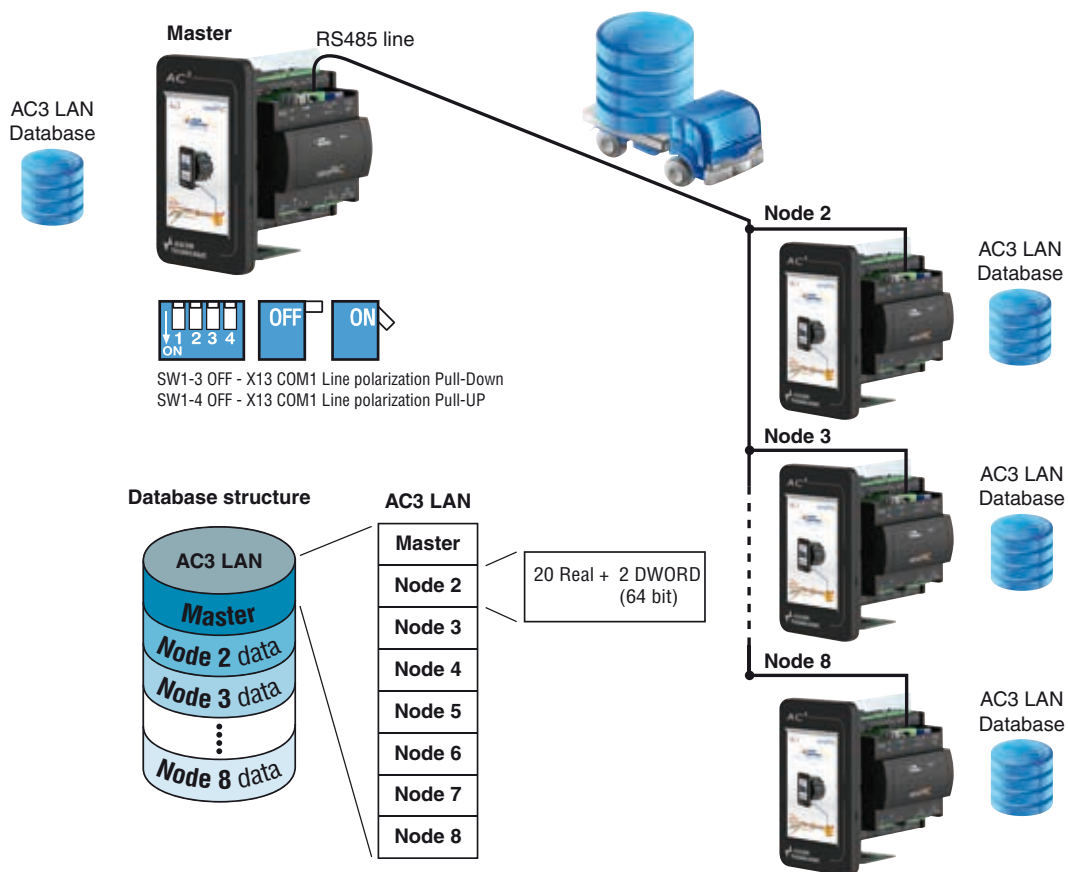
In order to reproduce as much as possible the functionality, a ModBus RTU Master/Slave architecture between the units has been arranged.

The developer must configure in the application one of the units as Master of the Network. The Master unit synchronizes the database of information exchange among the other device interconnected. It performs also the communications diagnostic checks.

ARCNET architecture offers the advantage to softwiring between up to 8 systems located at a distance inversely proportional to the selected communications speed (maximum distance between the first and the last system). This easy to use functionality, with the plug and play feature, provides the transmission of real time signals among the controllers, when developing remote control strategies, involving a cluster of AC<sup>3</sup>nP systems.

## Communcation ARCNET

Interface	RS485 differential
Baud Rate	Up to 38400 baud
Data length	7... 8
Parity	None/Even/Odd
Stop bit	1... 2
Address	2... 8
Mode	ModBus protocol with Master/Slave architecture



# Chapter 4

## OpenPCS Programming Tool

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The OpenPCS programming suite from Infoteam is provided on USB key. It is also available online at: [www.infoteam.de](http://www.infoteam.de).

### 4-1 Installing OpenPCS

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#### 4-1-1 Hardware and Software Requirements

OpenPCS requires a PC with at least:

- Intel Core i3;
- 4 GB RAM;
- 16 GB of free disk space;
- USB 2.0 port and 1280\*768 resolution;
- Windows 7 32 bit or higher.

#### 4-1-2 Installation

OpenPCS is provided on USB key. From the main home screen you can select the software version you want to install. If auto-start is not activated or does not work, please start the last distributed OpenPCS programming tool version (e.g. `OpenPCS_Ver_715e.exe` file) available in `X:\Setup\` folder ("**x**": is the letter assigned to the USB key drive by your PC).

At the end of the installation, you will be asked if you want to install hardware drivers. If drivers were provided with your PLC, enter the path to the hardware driver, otherwise click "**Exit**". If drivers were received for your PLC, a license key for OpenPCS was also included. See Licence Editor for how to insert a licence key. If you did not receive a hardware driver nor a licence key, OpenPCS is still fully functional, but restricted to '*SIMULATION*'.

**Note:** Installations to substitute drives are not supported by Windows XP.

#### 4-1-3 Starting OpenPCS

With Windows started choose:

**Start → Programs → infoteam OpenPCS 7.1 → infoteam OpenPCS 7.1**  
this will open the Framework.



## 4-2 AT target .cab file Installation - Configuring OpenPCS

In order to work with the Ascon Technologic CPU target, you must install in OpenPCS a .cab file. The file **AT\_sigmatdue\_zzzz.cab** contains everything describing Ascon Technologic sigmadue Hardware, drivers, examples and utilities (zzzz are digits to identify the software version).

In the OpenPCS “Extras” menu, select “tools – Driver install...”. “Select” the desired cabinet (e.g. AT\_sigmatdue\_2020.cab), then “Install”.



## 4-3 PC Ethernet port configuration

In order to communicate with the Ascon Technologic nP4 you must set the IP address and subnet mask of your PC. To do this, go to the:

**Start → Control Panel → Network Connection → LAN**

right-click it with your mouse to show the context menu, and select “Properties”.

In the “General” sheet select “Internet Protocol” and chose “Properties”.

In the “General” sheet now you can set:

IP address	192.168.5.xx	xx: all except 11
subnet mask	255.255.255.0	

## 4-4 OpenPCS Setup

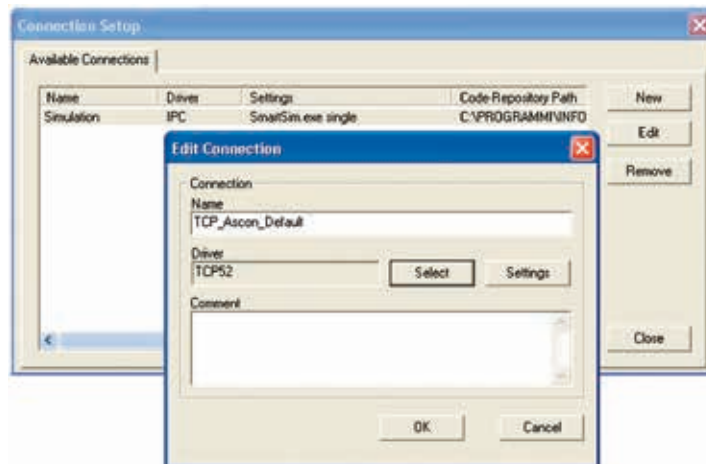
### 4-4-1 OpenPCS connection Setup

To connect the OpenPCS Programming Tool system to the Ascon Tecnologic target, a new connection must be defined.

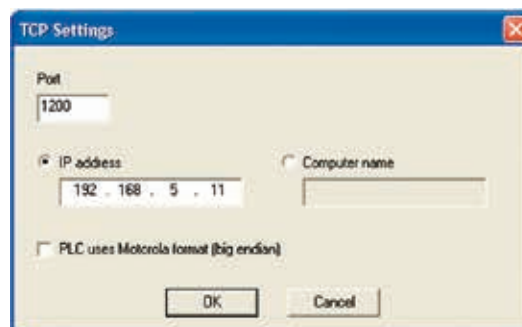
Select “*Connections...*” item in the “*PLC*” menu. In the window of “*OpenPCS Connection Setup*” select “*New*”.

Now in the window “*Edit connection*” it is possible to set the new connection. In the field “*Name*” you can name the new connection.

Press the “*Select*” button, pick up the Ascon Tecnologic CPU and choose the TCP52 driver (see the picture that follows).



Click the “*Settings*” button to set the communication parameters.

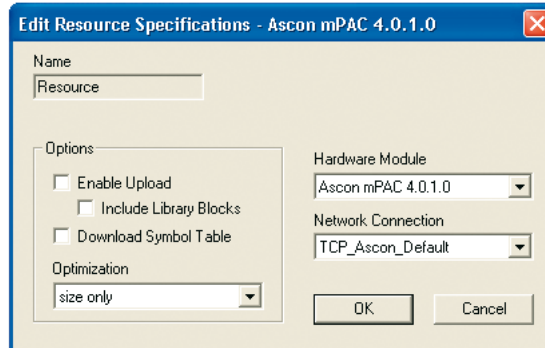


The Port number and IP address must be the same as the ones configured into the CPU (for more details, please consult the nP4 Quick Guide).

OpenPCS environment is now ready to communicate with the AT target.

#### 4-4-2 OpenPCS Target resource Setup

Ascon Technologic provides dedicated project templates already tailored for the various type of hardware platforms supported. In order to check the actual configuration select the “*Resource Properties*” item in the PLC menu, then “*Ascon Technologic...*” in the “*Hardware Module*” field and finally choose the newly created TCP connection in the “*Network Connection*” field.



The “*Optimization*” menu allows to compile the project in three different ways:

- *Size only* refers to the standard code and performs the optimization reducing the memory occupancy.
- **Normal** refers to the NCC (Native Code Compilation) and performs the optimization trying to find the better balance between memory occupancy and performance.
- *Speed only* refers also to the NCC, but performs the optimization considering only the maximum performance.

**Note:** The speed increment achieved compiling in the different optimization methods can be approximatively from 8 to 10. It depend a lot by the amount of Firmware Function Blocks used in the application. Please note that the use of NCC does not permit the user to insert break points in debugging projects.

#### Setup Communication Timeout

The Ethernet Port communication timeout monitors the communications between OpenPCS and the target CPU. When dealing with large programs, it may be necessary to set a longer driver timeout. The default value is 20000ms and can be increased, if needed, using the following register key:

```
[HKEY_LOCAL_MACHINE\SOFTWARE\infoteam Software GmbH\
OpenPCS\7.x.x\Online\TcpDriverTimeout_ms]
```

Value = “**20000**” means a timeout of 20 seconds.

# Chapter 5

## Advanced Function Block Libraries

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### 5-1 Purpose

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

The purpose of this document is to describe the structure and use of Ascon Tecnologia srl's proprietary IEC61131-3 libraries. These libraries cover different features aspects of the nP4 unit: Modbus access, process control and logic management.

### 5-2 Description

1. *AT\_AC3\_Specific\_Lib\_Vxx*;
2. *AT\_AC3\_LAN\_Mngt\_Lib\_Vxx*;
3. *AT\_AC3\_PAGES\_OPRS\_Lib\_Vxx*;
4. *AT\_AC3\_PAGES\_CONF\_Lib\_Vxx*;
5. *AT\_Generic\_Advanced\_Lib* is a library which contains the most advanced function Blocks coming from the Ascon AC Station Device;
6. The *AT\_Process\_Control\_Lib* is a Function Block library dedicated to the process control. It uses the basic functionalities dedicated to the PID implementation present in the firmware of the control unit (CU-0x/MP-0x/M81, nP4) device in order to provide solution ready to use. In fact in the library there is the implementation of a complete standard regulator in both version: single action and double action for heat and cool application. Please note that are present also different function blocks dedicated to the tuning algorithms;
7. *AT\_Communications\_Lib* is a Function Block library which simplifies the access to the MODBUS communication ports available in Ascon Tecnologia line devices;
8. *AT\_Process\_Generic\_Lib* is a Function Block library which contains a set of generic functionalities that come from the Ascon AC Station Device useful for the IEC 61131 programming.



#### **WARNING!**

For further details about the libraries described at items 4... 7, please refer to the Ascon Tecnologia "IEC 61131-3 Function Block Library" manual.

---

## 5-3 AT\_AC3\_Specific\_Lib Description

### 5-3-1 ALARM\_ADV

FB Prototype

VALUE	REAL	BOOL	ALARM
REF	REAL	BOOL	ABS_H
ABS_HIGH	REAL	BOOL	ABS_L
ABS_LOW	REAL	BOOL	DEV_H
DEV_HIGH	REAL	BOOL	DEV_L
DEV_LOW	REAL		
HYST_H	REAL		
HYST_L	REAL		

Parameters Input Parameters

Input	Type	Description
VALUE	REAL	Input value (default value = 0.0)
REF	REAL	Reference value (default value = 0.0)
ABS_HIGH	REAL	Absolute Alarm Max (default value = 0.0)
ABS_LOW	REAL	Absolute Alarm Min (default value = 0.0)
DEV_HIGH	REAL	Deviation Alarm Max (default value = 0.0)
DEV_LOW	REAL	Deviation Alarm Min (default value = 0.0)
HYST_H	REAL	Alarm Hysteresis High (default value = 1.0)
HYST_L	REAL	Alarm Hysteresis Low (default value = 1.0)

Output Parameters

Output	Type	Description
ALARM	BOOL	Cumulative Alarm Conditions (default value = FALSE)
ABS_H	BOOL	Absolute High Alarm (default value = FALSE)
ABS_L	BOOL	Absolute Low Alarm (default value = FALSE)
DEV_H	BOOL	Deviation High Alarm (default value = FALSE)
DEV_L	BOOL	Deviation Low Alarm (default value = FALSE)

This function block generates different types of alarms. It can be used also as a comparator. Please note that all the alarm conditions are always evaluated.

Alarm Description

Alarm	Description
Absolute High	The output ABS_H is active if it is TRUE the condition: <b>VALUE &gt; (ABS_HIGH + HYST_H)</b>
Absolute Low	The output ABS_L is active if it is TRUE the condition: <b>VALUE &lt; (ABS_LOW - HYST_L)</b>
Deviation High	The output DEV_H is active if it is TRUE the condition: <b>VALUE &gt; (REF + (DEV_HIGH + HYST_H))</b>
Deviation Low	The output DEV_L is active if it is TRUE the condition: <b>VALUE &lt; (REF + (DEV_LOW - HYST_L))</b>

**5-3-2 MP\_AI\_MNGT\_ADV***FB Prototype*

ENABLE	BOOL	ERROR
AI_NUM	USINT	ERR_CODE
CONV_SEL	UINT	AOUT
FLT_SS	REAL	AOUT_RAW
AI_CORR	REAL	
OUT_HIGH	REAL	
OUT_LOW	REAL	

*Parameters* **Input Parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
AI_NUM	USINT	microPAC Analogue input selection [num] (range 1... 8)
CONV_SEL	UINT	Conversion selection [num] (range 0... 3)
FLT_SS	REAL	Filter time constant: a value of 0.0 is intended to disable the filter action and the output will assume the input value [seconds](reasonable range 0.0... 60.0)
AI_CORR	REAL	Analogue Input correction value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
OUT_HIGH	REAL	High Scale Analogue output value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
OUT_LOW	REAL	Low Scale Analogue output value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Error status
ERR_CODE	DWORD	Error code. [bit mask] (range 2#0 ... 2#1111)
AOUT	REAL	Analogue output value converted, corrected and filtered
AOUT_RAW	REAL	Analogue output raw value

*Description* This function block performs an advanced conditioning of the desired microPAC AI value **ONLY**. When the ENABLE command becomes TRUE, the specific AI will be first recognized in terms of electrical type and limits and then the value will be first rescaled by using the OUT\_HIGH/OUT\_LOW parameters, then converted into the engineering unit selected by the CONV\_SEL parameter, corrected by adding AI\_CORR and finally filtered by the FLT\_SS value. When the ENABLE command is forced to FALSE, the AI raw value is copied **AS IS** on the AOUT output.

*Default* Here are reported the default values for the input/output parameters:

*Variable* **Input Parameters Default***Tables*

Input	Default value
ENABLE	FALSE
AI_NUM	1
CONV_SEL	0 = No conversion (default) 1 = From °C to °F 2 = From Bar to PSI 3 = From Liters to US Gallons
FLT_SS	3.0
AI_CORR	0.0
OUT_HIGH	9999.9
OUT_LOW	-999.9

*Reference*   **Output Reference Table**

*Table*

<b>Output</b>	<b>Reference table</b>
ERR_CODE.0	AI input limits invalid (possible divide by zero problem)
ERR_CODE.1	AI value Underrange
ERR_CODE.2	AI value Overage
ERR_CODE.3	microPAC selected AI invalid



**5-3-3 RATIO\_MODE***FB Prototype*

ENABLE	BOOL	ERROR
PV_REF	REAL	ERR_CODE
SP_RATIO	REAL	WSR_VALUE
SP_LIM_L	REAL	
SP_LIM_H	REAL	
CTRL_MODE	BOOL	

*Parameters* **Input Parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
PV_REF	REAL	Analogue Ratio Reference measure [e.u.]
SP_RATIO	REAL	Desired Ratio SP value [num] (range 0.001... 1000.0)
SP_LIM_L	REAL	Ratio SP Low limit value [num] (range 0.001... SP_LIM_H)
SP_LIM_H	REAL	Ratio SP High limit value [num] (range SP_LIM_L... 1000.0)
CTRL_MODE	BOOL	Ratio Type calculation [bool] (Direct/Reverse)

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Error status
ERR_CODE	DWORD	Error code [bit mask] (range 2#0... 2#1111)
WSR_VALUE	REAL	Calculated Working SP Ratio

*Description* This function block performs of the Ratio SP calculation accordingly to the desired mode. When the ENABLE command is active, the output WSR value is computed by using a direct or reverse relation between the Reference variable and the desired SP. When the ENABLE command is disabled, the Reference variable is directly applied as WSR\_VALUE.

**Direct Mode**  $WSR = PV\_REF * SP\_RATIO$

**Reverse Mode**  $WSR = PV\_REF / SP\_RATIO$

*Default Variable Tables* **Input Parameters Default**

Input	Default value
ENABLE	FALSE
PV_REF	0.0
SP_RATIO	1.0
SP_LIM_L	0.01
SP_LIM_H	10.0
CTRL_MODE	FALSE (Direct Mode)

*Reference Table* **Output Reference Table**

Output	Reference table
ERR_CODE.0	SP_LIM_L lower than admitted value (0.001)
ERR_CODE.1	SP_LIM_H higher than admitted value (1000.0)
ERR_CODE.2	SP_LIM_L higher than SP_LIM_H
ERR_CODE.3	SP_RATIO value out of admitted range

*Selection Table*

Enable	CTRL_MODE	WSR_VALUE
FALSE	FALSE	PV_REF
FALSE	TRUE	PV_REF
TRUE	FALSE	$PV\_REF * SP\_RATIO$ (Direct Mode)
TRUE	TRUE	$PV\_REF / SP\_RATIO$ (Reverse Mode)

### 5-3-4 SP\_SEL

FB Prototype

ENABLE	BOOL	REAL	SP_VALUE
SP_LOC	REAL		
SP_REM	REAL		
SP_AUX1	REAL		
SP_AUX2	REAL		
DI1_SEL	BOOL		
DI2_SEL	BOOL		
SP_SECUR	REAL		

#### Parameters Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
SP_LOC	REAL	Analogue Local SP value (default value = 0.0)
SP_REM	REAL	Analogue Local REM value (default value = 0.0)
SP_AUX1	REAL	Analogue Local AUXILIARY_1 value (default value = 0.0)
SP_AUX 2	REAL	Analogue Local AUXILIARY_2 value (default value = 0.0)
DI1_SEL	BOOL	Digital selection input 1 (default value = FALSE)
DI2_SEL	BOOL	Digital selection input 2 (default value = FALSE)
SP_SECUR	REAL	Analogue Local SP value (default value = 0.0)

#### Output Parameters

Output	Type	Description
SP_VALUE	REAL	Selected SP output value(default value = 0.0)

**Description** This function block performs the selection between several SP types. When the ENABLE command is active, the output SP value will be selected accordingly to the DI1 and DI2 binary combination, whilst the output SP\_VALUE is forced to the value specified by SP\_SECUR.

**Selection Table**

Enable	DI2_SEL	DI1_SEL	SP_VALUE
FALSE	FALSE	FALSE	SP_SECUR
FALSE	FALSE	TRUE	SP_SECUR
FALSE	TRUE	FALSE	SP_SECUR
FALSE	TRUE	TRUE	SP_SECUR
TRUE	FALSE	FALSE	SP_LOC
TRUE	FALSE	TRUE	SP_REM
TRUE	TRUE	FALSE	SP_AUX1
TRUE	TRUE	TRUE	SP_AUX2

## 5-4 AT\_AC3\_LAN\_Mngt\_Lib Description

### 5-4-1 LAN\_MST\_SYNC

*FB Prototype*

ENABLE  
RESET\_STAT  
NR\_SLAVES  
INTERSLAVE\_T

BOOL  
BOOL  
USINT  
TIME  
  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT  
ARRAY [1... 8] OF UDINT

NR\_SEQ  
ERROR  
ERR\_CODE  
SLV\_BLKLIST  
TOT\_RD\_NR  
OK\_RD\_NR  
TOUT\_RD\_NR  
ERR\_RD\_NR  
CRC\_RD\_NR  
UNEX\_RD\_NR  
EXCE\_RD\_NR  
LAST\_EXCODE  
TOT\_WR\_NR

#### Parameters Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
RESET_STAT	BOOL	Command to reset the communication diagnostic statistics
NR_SLAVES	USINT	Amount of LAN Slave devices connected [num] (range 2... 8)
INTERSLAVE_T	TIME	Interslave communication time delay between polling the devices [ms] (reasonable range from 20 ms to some seconds)

#### Output Parameters

Output	Type	Description
NR_SEQ	USINT	Number of Slave node to be operated
ERROR	BOOL	Error status
ERR_CODE	DWORD	Error code [bit mask] (range 2#0 ... 2#11111)
SLV_BLKLIST	WORD	Device black list status [bit mask] (range 2#0 ... 2#11111111)
TOT_RD_NR	ARRAY [1... 8] OF UDINT	No. of total overall devices reading operation table
OK_RD_NR	ARRAY [1... 8] OF UDINT	No. of total Correct devices reading operation table
TOUT_RD_NR	ARRAY [1... 8] OF UDINT	No. of total Timeout devices reading operation table
ERR_RD_NR	ARRAY [1... 8] OF UDINT	No. of total Error devices reading operation table
CRC_RD_NR	ARRAY [1... 8] OF UDINT	No. of total CRC devices reading operation table
UNEX_RD_NR	ARRAY [1... 8] OF UDINT	No. of total Unexpected devices reading operation table
EXCE_RD_NR	ARRAY [1... 8] OF UDINT	No. of total Exception devices reading operation table
LAST_EXCODE	ARRAY [1... 8] OF UDINT	No. of total ExCode devices reading operation table
TOT_WR_NR	ARRAY [1... 8] OF UDINT	No. of total Overall devices writing operation table

*Description* This function block has been designed to synchronize and manage the data exchange operations involved with the LAN architecture activities. When the ENABLE command becomes TRUE, the function block starts the communication with the amount of devices defined by the NR\_SLAVES parameter in order to keep the common LAN database updated between all the “clients” (the architecture is anyway a Master/Slave). The function block performs also a lot of communication

diagnostic analysis that are then available as specific outputs. When the ENABLE command is forced to FALSE, all the LAN activities will be immediately stopped. The overall statistics can be reset at any time by using the specific RESET\_STAT command.

*Default* Here are reported the default values for the input/output parameters:

*Variable* **Input Parameters Default**

<b>Input</b>	<b>Default value</b>
ENABLE	FALSE
RESET_STAT	FALSE
NR_SLAVES	1
INTERSLAVE_T	20 ms

*Reference* **Output Reference Table**

<b>Output</b>	<b>Description</b>
ERR_CODE.0	Number of Slaves not admitted
ERR_CODE.1	Master X1 Port not available
ERR_CODE.2	Master Protocol not available
ERR_CODE.3	Master X1 Port Invalid Configuration
ERR_CODE.4	At least one Slave device in black list

**5-4-2 LAN\_SLV\_DIAG***FB Prototype*

ENABLE  
RESET\_STAT  
SLAVE\_ADDR  
T\_OUT

BOOL  
BOOL  
USINT  
UINT

BOOL  
DWORD  
BOOL  
BOOL  
UDINT  
UDINT  
UDINT  
UDINT  
UDINT  
UDINT

ERROR  
ERR\_CODE  
LAN\_ON  
LAN\_ERR  
WR\_REC\_NR  
TOUT\_NR  
ERR\_NR  
NA\_ERR  
CRC\_NR  
EXC\_NR

*Parameters* **Input Parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
RESET_STAT	BOOL	Command to reset the communication diagnostic statistics
SLAVE_ADDR	USINT	Amount of LAN Slave devices connected [num] (range 2... 8)
T_OUT	UINT	Communication timeout on the devices [multiples of 100 ms] (reasonable range form 10 s to some seconds)

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Error status
ERR_CODE	DWORD	Error code [bit mask] (range 2#0 ... 2#1111111)
LAN_ON	BOOL	LAN Network communication status
LAN_ERR	BOOL	LAN Network communication error
WR_REC_NR	UDINT	No. of total communication writing requests received
TOUT_NR	UDINT	No. of total communication Timeout detected
ERR_NR	UDINT	No. of total communication writing requests received with errors
NA_ERR	UDINT	No. of total Port Not Available errors
CRC_NR	UDINT	No. of total requests received with CRC errors
EXC_NR	UDINT	No. of total Exception Code requests processed

*Description* This function block has been designed to perform and provide diagnostic information accordingly to the LAN architecture. When the ENABLE command becomes TRUE, it starts to scan the communication data exchange traffic to the specific LAN Slave device defined by the SLAVE\_ADDR parameter. All the operations are analyzed and then provided as outputs from the function block, for example, for statistical purposes. When the ENABLE command is forced to FALSE, all the activities will be freezed immediately to the last values. The overall statistics can be reset at any time by using the specific RESET\_STAT command.

*Default* Here are reported the default values for the input/output parameters:

*Variable* **Input Parameters Default***Tables*

Input	Default value
ENABLE	FALSE
RESET_STAT	FALSE
SLAVE_ADDR	2
T_OUT	100 (100 * 100 ms = 10 seconds)
ENABLE	FALSE

*Reference  
Table*

**Output Reference Table**

<b>Output</b>	<b>Reference table</b>
ERR_CODE.0	Number of Slaves not admitted
ERR_CODE.1	Slave X1 Port not available
ERR_CODE.2	Slave Protocol not available
ERR_CODE.3	Slave X1 Port Invalid Configuration
ERR_CODE.4	Timeout on the LAN Communication
ERR_CODE.5	CRC error detected on the last request received
ERR_CODE.6	Exception Code detected on the last request received

## 5-4-3 LAN\_SLV\_NODE\_n

**WARNING!**

*n* is an index (values from 1 to 8) that identifies the Function Block and the Numerical Fields block connected. In particular, when:

*n* = 2      LAN\_SLV\_NODE\_2;  
*n* = 3      LAN\_SLV\_NODE\_3;  
*n* = 4      LAN\_SLV\_NODE\_4;  
*n* = 5      LAN\_SLV\_NODE\_5;  
*n* = 6      LAN\_SLV\_NODE\_6;  
*n* = 7      LAN\_SLV\_NODE\_7;  
*n* = 8      LAN\_SLV\_NODE\_8.

*FB Prototype*

NR\_SEQ  
T\_OUT  
RETRY

USINT  
UINT  
USINT

BOOL  
DWORD  
BOOL  
BOOL  
BOOL  
BOOL

ERROR  
ERR\_CODE  
BLKLST  
STS\_RUN  
STS\_DONE  
STS\_FAIL

*Parameters*      **Input Parameters**

Input	Type	Description
NR_SEQ	USINT	Input that MUST be connected to the LAN_MST_SYNC corresponding output [num]
T_OUT	UINT	Communication timeout on the devices [multiples of 100 ms] (reasonable range from 1 s some some seconds)
RETRY	USINT	Number of retry to get the information [num] (range 0... 255, reasonable values 1... 3)

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Error status
ERR_CODE	DWORD	Error code [bit mask] (range 2#0 ... 2#11111)
BLKLST	BOOL	Slave Blacklist status
STS_RUN	BOOL	Read operation in progress status
STS_DONE	UDINT	Read operation correctly executed status
STS_FAIL	UDINT	Read operation failed status

*Description*      This function block has been designed to perform the overall operations in order to update and synchronize the LAN database shared by all the configured devices. When the NR\_SEQ parameter indicates that is possible to execute the activities to read the database with the latest refreshed values and update the specific section dedicated to the Slave node *n* (values for *n*: 2... 8). All the operation steps are monitored and provided as output status from the function block for general purposes. In case of whatever failure the operation will be retried for the amount of times specified by the RETRY parameter.

*Selection Table*      Here are reported the default values for the input/output parameters.

**Input Parameters Default**

Input	Default value
NR_SEQ	0
T_OUT	10 (10 * 100 ms = 1 second)
RETRY	1

*Reference  
Table*

**Output Reference Table**

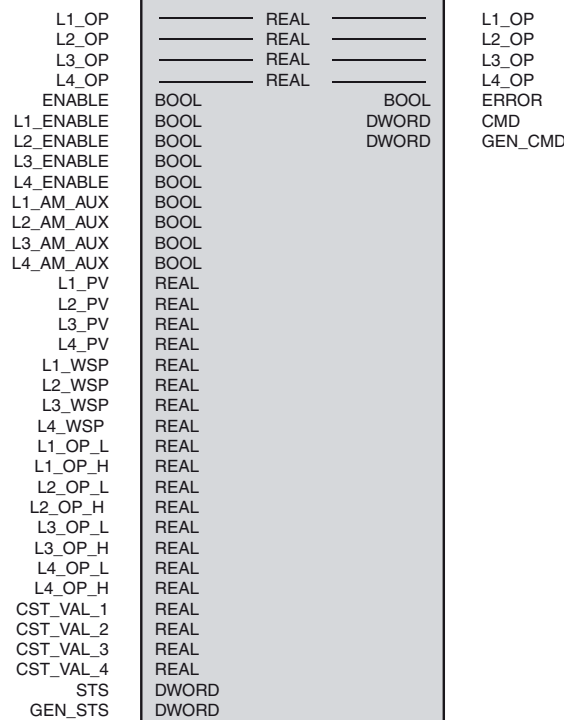
<b>Output</b>	<b>Reference table</b>
ERR_CODE.0	Slave Device in Blacklist
ERR_CODE.1	Timeout error on the last reading request
ERR_CODE.2	CRC error detected on the last reading request
ERR_CODE.3	Unwaited answer detected on the last reading request
ERR_CODE.4	Exception Code detected on the last reading request



## 5-5 AT\_AC3\_Panels\_Lib Description

### 5-5-1 PAGE\_CUSTOM

FB Prototype



Parameters Input and Output Parameters

Input & Output	Type	Description
L1_OP	REAL	Loop_1 Control Output value [%] (range L1_OP_L... L1_OP_H)
L2_OP	REAL	Loop_2 Control Output value [%] (range L2_OP_L... L2_OP_H)
L3_OP	REAL	Loop_3 Control Output value [%] (range L3_OP_L... L3_OP_H)
L4_OP	REAL	Loop_4 Control Output value [%] (range L4_OP_L... L4_OP_H)

**Note:** The above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable otherwise **you will get some errors while compiling**.

Input parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
L1_ENABLE	BOOL	Command to ENABLE/DISABLE the Loop_1 related graphical object view
L2_ENABLE	BOOL	Command to ENABLE/DISABLE the Loop_2 related graphical object view
L3_ENABLE	BOOL	Command to ENABLE/DISABLE the Loop_3 related graphical object view
L4_ENABLE	BOOL	Command to ENABLE/DISABLE the Loop_4 related graphical object view
L1_AM_AUX	BOOL	Loop_1 Output Auto/Manual digital command
L2_AM_AUX	BOOL	Loop_2 Output Auto/Manual digital command
L3_AM_AUX	BOOL	Loop_3 Output Auto/Manual digital command
L4_AM_AUX	BOOL	Loop_4 Output Auto/Manual digital command

Input	Type	Description
L1_PV	REAL	Loop_1 Process value [e.u.](L1_SC_L... L1_SC_H)
L2_PV	REAL	Loop_2 Process value [e.u.](L2_SC_L... L2_SC_H)
L3_PV	REAL	Loop_3 Process value [e.u.](L3_SC_L... L3_SC_H)
L4_PV	REAL	Loop_4 Process value [e.u.](L4_SC_L... L4_SC_H)
L1_WSP	REAL	Loop_1 Working SP value [e.u.](L1_SC_L... L1_SC_H)
L2_WSP	REAL	Loop_2 Working SP value [e.u.](L2_SC_L... L2_SC_H)
L3_WSP	REAL	Loop_3 Working SP value [e.u.](L3_SC_L... L3_SC_H)
L4_WSP	REAL	Loop_4 Working SP value [e.u.](L4_SC_L... L4_SC_H)
L1_OP_L	REAL	Loop_1 Control Output Low limit value [%](range 0... 100.0)
L1_OP_H	REAL	Loop_1 Control Output High limit value [%](range 0... 100.0)
L2_OP_L	REAL	Loop_2 Control Output Low limit value [%](range 0... 100.0)
L2_OP_H	REAL	Loop_2 Control Output High limit value [%](range 0... 100.0)
L3_OP_L	REAL	Loop_3 Control Output Low limit value [%](range 0... 100.0)
L3_OP_H	REAL	Loop_3 Control Output High limit value [%](range 0... 100.0)
L4_OP_L	REAL	Loop_4 Control Output Low limit value [%](range 0... 100.0)
L4_OP_H	REAL	Loop_4 Control Output High limit value [%](range 0... 100.0)
CST_VAL_1	REAL	Additional Analogical_1 display value
CST_VAL_2	REAL	Additional Analogical_2 display value
CST_VAL_3	REAL	Additional Analogical_3 display value
CST_VAL_4	REAL	Additional Analogical_4 display value
STS	DWORD	Overall PIDs Status bit mask
GEN_STS	DWORD	Additional 4 Status bit mask

#### Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC <sup>3</sup> nP page FB already used error state
CMD	DWORD	Overall PIDs Commands bit mask
GEN_CMD	DWORD	Additional 4 Commands bit mask

*Description* This function block has been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “Custom Page”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

Default  
Variable  
Tables

Here are reported the default values for the input/output parameters:

#### Input Parameters Default

Input	Default value
ENABLE	FALSE
L1_ENABLE	TRUE
L2_ENABLE	FALSE
L3_ENABLE	FALSE
L4_ENABLE	FALSE
L1_AM_AUX	FALSE
L2_AM_AUX	FALSE
L3_AM_AUX	FALSE
L4_AM_AUX	FALSE
L1_PV	0.0
L2_PV	0.0
L3_PV	0.0
L4_PV	0.0
L1_WSP	0.0
L2_WSP	0.0
L3_WSP	0.0
L4_WSP	0.0
L1_OP_L	0.0
L1_OP_H	0.0
L2_OP_L	0.0
L2_OP_H	0.0
L3_OP_L	0.0
L3_OP_H	0.0
L4_OP_L	0.0
L4_OP_H	0.0
CST_VAL_1	0.0
CST_VAL_2	0.0
CST_VAL_3	0.0
CST_VAL_4	0.0
STS	2#0
GEN_STS	2#0

Reference  
Table

#### Input Reference Table

Input	Reference table
STS.0	Loop_1 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.1	Loop_1 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.2	Loop_1 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.3	Loop_1 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.4	Loop_1 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.5	Loop_1 Auto-Tuning Oprs pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.6	Loop_1 Auto-Tuning Fail pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.7	Loop_2 DI1 pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.8	Loop_2 DI2 pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.9	Loop_2 DI3 pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.10	Loop_2 DI4 pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.11	Loop_2 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem</b> )

Input	Reference table
STS.12	Loop_2 Auto-Tuning Oprs pages displayed status (0 = Loc, 1 = Rem)
STS.13	Loop_2 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.14	Loop_3 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.15	Loop_3 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.16	Loop_3 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.17	Loop_3 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.18	Loop_3 SP Selection pages displayed status (0 = Loc, 1 = Rem)
STS.19	Loop_3 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.20	Loop_3 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.21	Loop_4 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.22	Loop_4 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.23	Loop_4 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.24	Loop_4 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.25	Loop_4 SP Selection pages displayed status (0 = Loc, 1 = Rem)
STS.26	Loop_4 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.27	Loop_4 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.28... 31	Reserved
GEN_STS.0	Additional Generic_1 page displayed status (0 = OFF, 1 = ON)
GEN_STS.1	Additional Generic_2 page displayed status (0 = OFF, 1 = ON)
GEN_STS.2	Additional Generic_3 page displayed status (0 = OFF, 1 = ON)
GEN_STS.3	Additional Generic_4 page displayed status (0 = OFF, 1 = ON)
GEN_STS.4... 31	Reserved

**Output Reference Table**

Output	Reference table
ERR_CODE.0	The function block already used
CMD.0	Loop_1 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.1	Loop_1 SP Local/Remote selection command (0 = Loc, 1 = Rem)
CMD.2	Loop_1 Auto-Tuning Run command (Rising Edge pulse)
CMD.3	Loop_1 Auto-Tuning Reset command (Rising Edge pulse)
CMD.4	Loop_1 Control Action mode (0 = Single, 1 = Double)
CMD.5	Loop_1 Control Type mode (0 = Reverse, 1 = Direct)
CMD.6	Loop_2 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.7	Loop_2 SP Local/Remote selection command (0 = Loc, 1 = Rem)
CMD.8	Loop_2 Auto-Tuning Run command (Rising Edge pulse)
CMD.9	Loop_2 Auto-Tuning Reset command (Rising Edge pulse)
CMD.10	Loop_2 Control Action mode (0 = Single, 1 = Double)
CMD.11	Loop_2 Control Type mode (0 = Reverse, 1 = Direct)
CMD.12	Loop_3 Auto/Manual command (0 = Auto, 1 = Man)
CMD.13	Loop_3 SP Local/Remote selection command (0 = Loc, 1 = Rem)
CMD.14	Loop_3 Auto-Tuning Run command (Rising Edge pulse)

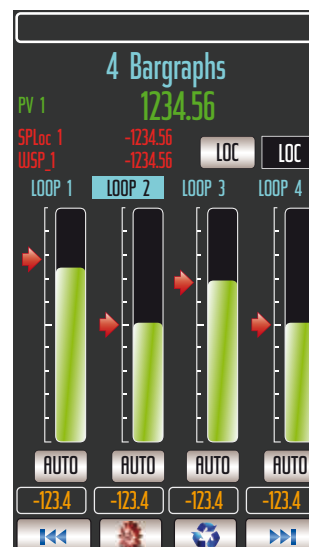
Output	Reference table
CMD.15	Loop_3 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.16	Loop_3 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.17	Loop_3 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.18	Loop_4 Auto/Manual command ( <b>0 = Auto, 1 = Man</b> )
CMD.19	Loop_4 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem</b> )
CMD.20	Loop_4 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.21	Loop_4 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.22	Loop_4 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.23	Loop_4 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.24... 31	Reserved
GEN_CMD.0	Additional Generic_1 page displayed command ( <b>0 = OFF, 1 = ON</b> )
GEN_CMD.1	Additional Generic_2 page displayed command ( <b>0 = OFF, 1 = ON</b> )
GEN_CMD.2	Additional Generic_3 page displayed command ( <b>0 = OFF, 1 = ON</b> )
GEN_CMD.3	Additional Generic_4 page displayed command ( <b>0 = OFF, 1 = ON</b> )
GEN_CMD.4... 31	Reserved

**Note:** The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

## 5-5-2 PAGE\_4BARG\_1

FB Prototype

G1_OP	REAL		G1_OP
G2_OP	REAL		G2_OP
G3_OP	REAL		G3_OP
G4_OP	REAL		G4_OP
ENABLE	BOOL	BOOL	ERROR
G1_AM_AUX	BOOL	REAL	G1_LSP
G2_AM_AUX	BOOL	REAL	G2_LSP
G3_AM_AUX	BOOL	REAL	G3_LSP
G4_AM_AUX	BOOL	REAL	G4_LSP
G1_PV	REAL	DWORD	CMD
G2_PV	REAL		
G3_PV	REAL		
G4_PV	REAL		
G1_WSP	REAL		
G2_WSP	REAL		
G3_WSP	REAL		
G4_WSP	REAL		
G1_SC_L	REAL		
G1_SC_H	REAL		
G2_SC_L	REAL		
G2_SC_H	REAL		
G3_SC_L	REAL		
G3_SC_H	REAL		
G4_SC_L	REAL		
G4_SC_H	REAL		
G1_OP_L	REAL		
G1_OP_H	REAL		
G2_OP_L	REAL		
G2_OP_H	REAL		
G3_OP_L	REAL		
G3_OP_H	REAL		
G4_OP_L	REAL		
G4_OP_H	REAL		
STS	DWORD		



### Parameters Input and Output Parameters

Input & Output	Type	Description
L1_OP	REAL	Loop_1 Control Output value [%] (range L1_OP_L... L1_OP_H)
L2_OP	REAL	Loop_2Control Output value [%] (range L2_OP_L... L2_OP_H)
L3_OP	REAL	Loop_3 Control Output value [%] (range L3_OP_L... L3_OP_H)
L4_OP	REAL	Loop_4 Control Output value [%] (range L4_OP_L... L4_OP_H)

**Note:** The above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable otherwise **you will get some errors while compiling**.

### Input parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
L1_AM_AUX	BOOL	Loop_1 Output Auto/Manual digital command
L2_AM_AUX	BOOL	Loop_2 Output Auto/Manual digital command
L3_AM_AUX	BOOL	Loop_3 Output Auto/Manual digital command
L4_AM_AUX	BOOL	Loop_4 Output Auto/Manual digital command
L1_PV	REAL	Loop_1 Process value [e.u.](L1_SC_L...L1_SC_H)
L2_PV	REAL	Loop_2 Process value [e.u.](L2_SC_L...L2_SC_H)
L3_PV	REAL	Loop_3 Process value [e.u.](L3_SC_L...L3_SC_H)
L4_PV	REAL	Loop_4 Process value [e.u.](L4_SC_L...L4_SC_H)
L1_WSP	REAL	Loop_1 Working SP value [e.u.](L1_SC_L...L1_SC_H)
L2_WSP	REAL	Loop_2 Working SP value [e.u.](L2_SC_L...L2_SC_H)
L3_WSP	REAL	Loop_3 Working SP value [e.u.](L3_SC_L...L3_SC_H)
L4_WSP	REAL	Loop_4 Working SP value [e.u.](L4_SC_L...L4_SC_H)
L1_SC_L	REAL	Loop_1 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )

Input	Type	Description
L1_SC_H	REAL	Loop_1 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L2_SC_L	REAL	Loop_2 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L2_SC_H	REAL	Loop_2 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L3_SC_L	REAL	Loop_3 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L3_SC_H	REAL	Loop_3 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L4_SC_L	REAL	Loop_4 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L4_SC_H	REAL	Loop_4 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L1_OP_L	REAL	Loop_1 Control Output Low limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L1_OP_H	REAL	Loop_1 Control Output High limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L2_OP_L	REAL	Loop_2 Control Output Low limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L2_OP_H	REAL	Loop_2 Control Output High limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L3_OP_L	REAL	Loop_3 Control Output Low limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L3_OP_H	REAL	Loop_3 Control Output High limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L4_OP_L	REAL	Loop_4 Control Output Low limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
L4_OP_H	REAL	Loop_4 Control Output High limit value [%] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
STS	DWORD	Overall PIDs Status bit mask

#### Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
L1_LSP	REAL	Loop_1 Local SP value [e.u.](L1_SC_L...L1_SC_H)
L2_LSP	REAL	Loop_2 Local SP value [e.u.](L2_SC_L...L2_SC_H)
L3_LSP	REAL	Loop_3 Local SP value [e.u.](L3_SC_L...L3_SC_H)
L4_LSP	REAL	Loop_4 Local SP value [e.u.](L4_SC_L...L4_SC_H)
CMD	DWORD	Overall PIDs Commands bit mask

**Description** This function block has been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “4 Loops Bargraph page”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.



**Default** Here are reported the default values for the input/output parameters:

**Variable** **Input Parameters Default**

**Tables**

Input	Default value
ENABLE	FALSE
L1_AM_AUX	FALSE
L2_AM_AUX	FALSE
L3_AM_AUX	FALSE
L4_AM_AUX	FALSE
L1_PV	0.0
L2_PV	0.0
L3_PV	0.0
L4_PV	0.0
L1_WSP	0.0
L2_WSP	0.0
L3_WSP	0.0
L4_WSP	0.0
L1_SC_L	0.0
L1_SC_H	0.0
L2_SC_L	0.0
L2_SC_H	0.0
L3_SC_L	0.0
L3_SC_H	0.0
L4_SC_L	0.0
L4_SC_H	0.0
L1_OP_L	0.0
L1_OP_H	0.0
L2_OP_L	0.0
L2_OP_H	0.0
L3_OP_L	0.0
L3_OP_H	0.0
L4_OP_L	0.0
L4_OP_H	0.0
STS	2#0

**Reference** **Input Reference Table**

**Table**

Input	Reference table
STS.0	Loop_1 DI1 pages displayed status (0 = OFF, 1 = ON, inactive)
STS.1	Loop_1 DI2 pages displayed status (0 = OFF, 1 = ON, inactive)
STS.2	Loop_1 DI3 pages displayed status (0 = OFF, 1 = ON, inactive)
STS.3	Loop_1 DI4 pages displayed status (0 = OFF, 1 = ON, inactive)
STS.4	Loop_1 SP Selection pages displayed status (0 = Loc, 1 = Rem)
STS.5	Loop_1 Auto-Tuning Oprs pages displayed status (0 = Loc, 1 = Rem)
STS.6	Loop_1 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.7	Loop_2 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.8	Loop_2 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.9	Loop_2 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.10	Loop_2 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.11	Loop_2 SP Selection pages displayed status (0 = Loc, 1 = Rem)
STS.12	Loop_2 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.13	Loop_2 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.14	Loop_3 DI1 pages displayed status (0 = OFF, 1 = ON)



Input	Reference table
STS.15	Loop_3 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.16	Loop_3 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.17	Loop_3 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.18	Loop_3 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.19	Loop_3 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.20	Loop_3 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.21	Loop_4 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.22	Loop_4 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.23	Loop_4 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.24	Loop_4 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.25	Loop_4 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.26	Loop_4 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.27	Loop_4 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.28... 31	Reserved

Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used
CMD.0	Loop_1 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.1	Loop_1 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.2	Loop_1 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.3	Loop_1 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.4	Loop_1 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.5	Loop_1 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.6	Loop_2 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.7	Loop_2 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.8	Loop_2 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.9	Loop_2 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.10	Loop_2 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.11	Loop_2 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.12	Loop_3 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.13	Loop_3 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.14	Loop_3 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.15	Loop_3 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.16	Loop_3 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.17	Loop_3 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.18	Loop_4 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.19	Loop_4 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.20	Loop_4 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.21	Loop_4 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.22	Loop_4 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.23	Loop_4 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.24... 31	Reserved

**Note:** The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

### 5-5-3 PAGE\_2BARG\_n



**n** is an index (value 1 or 2) that identifies the Function Block and the loops connected. In particular, when:

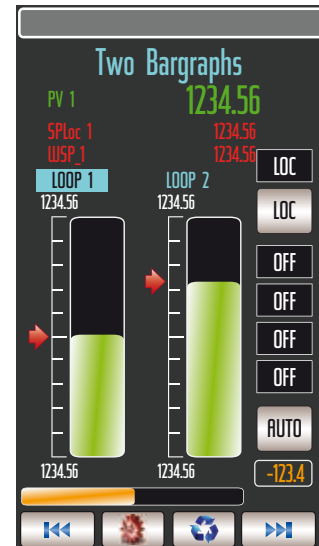
**n = 1** then **x = 1** (1<sup>st</sup> loop linked to the FB) and **y = 2** (2<sup>nd</sup> loop linked to the FB).

Otherwise when:

**n = 2** then **x = 3** (1<sup>st</sup> loop linked to the FB) and **y = 4** (2<sup>nd</sup> loop linked to the FB).

#### FB Prototype

Gx_OP	REAL	Gx_OP
Gy_OP	REAL	Gy_OP
ENABLE	BOOL	ERROR
Gx_AM_AUX	BOOL	Gx_LSP
Gy_AM_AUX	BOOL	Gy_LSP
Gx_PV	REAL	CMD
Gy_PV	REAL	
Gx_WSP	REAL	
Gy_WSP	REAL	
AI1	REAL	
AI2	REAL	
AI3	REAL	
AI4	REAL	
AI5	REAL	
Gx_SC_L	REAL	
Gx_SC_H	REAL	
Gy_SC_L	REAL	
Gy_SC_H	REAL	
Gx_OP_L	REAL	
Gx_OP_H	REAL	
Gy_OP_L	REAL	
Gy_OP_H	REAL	
STS	DWORD	



#### Parameters Input and Output Parameters

Input & Output	Type	Description
Lx_OP	REAL	Loop_x Control Output value [%] (range Lx_OP_L... Lx_OP_H)
Ly_OP	REAL	Loop_y Control Output value [%] (range Ly_OP_L... Ly_OP_H)

**Note:** the above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable otherwise **you will get some errors while compiling**.

#### Input parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
Lx_AM_AUX	BOOL	Loop_x Output Auto/Manual digital command
Ly_AM_AUX	BOOL	Loop_y Output Auto/Manual digital command
Lx_PV	REAL	Loop_x Process value [e.u.](Lx_SC_L... Lx_SC_H)
Ly_PV	REAL	Loop_y Process value [e.u.](Ly_SC_L... Ly_SC_H)
Lx_WSP	REAL	Loop_x Working SP value [e.u.](Lx_SC_L... Lx_SC_H)
Ly_WSP	REAL	Loop_y Working SP value [e.u.](Ly_SC_L... Ly_SC_H)
AI1	REAL	Analog_1 generic value [e.u.]
AI2	REAL	Analog_2 generic value [e.u.]
AI3	REAL	Analog_3 generic value [e.u.]
AI4	REAL	Analog_4 generic value [e.u.]
AI5	REAL	Analog_5 generic value [e.u.]
Lx_SC_L	REAL	Loop_x PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Lx_SC_H	REAL	Loop_x PV input High Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Ly_SC_L	REAL	Loop_y PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )

Input	Type	Description
Ly_SC_H	REAL	Loop_y PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
Lx_OP_L	REAL	Loop_x Control Output Low limit value [%] (range 0... 100.0)
Lx_OP_H	REAL	Loop_x Control Output High limit value [%] (range 0... 100.0)
Ly_OP_L	REAL	Loop_y Control Output Low limit value [%] (range 0... 100.0)
Ly_OP_H	REAL	Loop_y Control Output High limit value [%] (range 0... 100.0)
STS	DWORD	Overall PIDs Status bit mask

#### Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
Lx_LSP	REAL	Loop_x Local SP value [e.u.](Lx_SC_L... Lx_SC_H)
Ly_LSP	REAL	Loop_y Local SP value [e.u.](Ly_SC_L... Ly_SC_H)
CMD	DWORD	Overall PIDs Commands bit mask

*Description* These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “Loop\_n Bargraph page”.

The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

*Default* Here are reported the default values for the input/output parameters.

#### Variable Input Parameters Default

*Tables*

Input	Default value
ENABLE	FALSE
Lx_AM_AUX	FALSE
Ly_AM_AUX	FALSE
Lx_PV	0.0
Ly_PV	0.0
Lx_WSP	0.0
Ly_WSP	0.0
AI1	0.0
AI2	0.0
AI3	0.0
AI4	0.0
AI5	0.0
Lx_SC_L	0.0
Lx_SC_H	0.0
Ly_SC_L	0.0
Ly_SC_H	0.0
Lx_OP_L	0.0
Lx_OP_H	0.0

Input	Default value
Ly_OP_L	0.0
Ly_OP_H	0.0
STS	2#0

Reference  
Table

Input Reference Table

Input	Description
STS.0	Loop_1 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.1	Loop_1 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.2	Loop_1 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.3	Loop_1 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.4	Loop_1 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.5	Loop_1 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.6	Loop_1 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.7	Loop_2 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.8	Loop_2 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.9	Loop_2 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.10	Loop_2 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.11	Loop_2 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.12	Loop_2 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.13	Loop_2 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.14	Loop_3 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.15	Loop_3 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.16	Loop_3 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.17	Loop_3 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.18	Loop_3 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.19	Loop_3 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.20	Loop_3 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.21	Loop_4 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.22	Loop_4 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.23	Loop_4 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.24	Loop_4 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.25	Loop_4 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.26	Loop_4 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.27	Loop_4 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.28... 31	Reserved

Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used
CMD.0	Loop_1 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.1	Loop_1 SP Local/Remote selection command (0 = Loc, 1 = Rem.)
CMD.2	Loop_1 Auto-Tuning Run command (Rising Edge pulse)
CMD.3	Loop_1 Auto-Tuning Reset command (Rising Edge pulse)
CMD.4	Loop_1 Control Action mode (0 = Single, 1 = Double)
CMD.5	Loop_1 Control Type mode (0 = Reverse, 1 = Direct)
CMD.6	Loop_2 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.7	Loop_2 SP Local/Remote selection command (0 = Loc, 1 = Rem.)
CMD.8	Loop_2 Auto-Tuning Run command (Rising Edge pulse)
CMD.9	Loop_2 Auto-Tuning Reset command (Rising Edge pulse)
CMD.10	Loop_2 Control Action mode (0 = Single, 1 = Double)

Output	Reference table
CMD.11	Loop_2 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.12	Loop_3 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.13	Loop_3 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.14	Loop_3 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.15	Loop_3 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.16	Loop_3 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.17	Loop_3 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.18	Loop_4 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.19	Loop_4 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.20	Loop_4 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.21	Loop_4 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.22	Loop_4 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.23	Loop_4 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.24... 31	Reserved

**Note:** The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

## 5-5-4 PAGE\_1BARG\_n



n is an index (value 1, 2, 3 or 4) that identifies the Function Block and the loop connected. In particular, when:

n = 1 means the loop linked to the FB is Loop1;

n = 2 means the loop linked to the FB is Loop2;

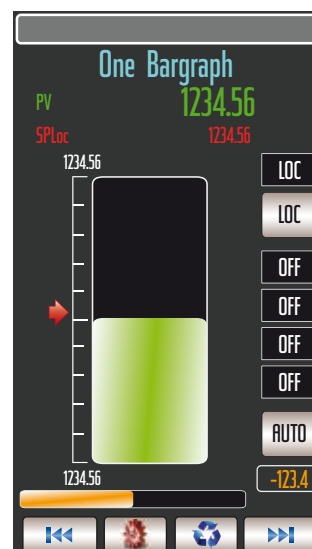
n = 3 means the loop linked to the FB is Loop3;

n = 4 means the loop linked to the FB is Loop4.

### FB Prototype

Ln_OP	REAL	
ENABLE	BOOL	BOOL
Ln_AM_AUX	BOOL	REAL
Ln_PV	REAL	DWORD
Ln_WSP	REAL	
AI1	REAL	
AI2	REAL	
AI3	REAL	
AI4	REAL	
AI5	REAL	
Ln_SC_L	REAL	
Ln_SC_H	REAL	
Ln_OP_L	REAL	
Ln_OP_H	REAL	
STS	DWORD	

Ln\_OP  
ERROR  
Ln\_LSP  
CMD



### Parameters Input and Output Parameters

Input & Output	Type	Description
Ln_OP	REAL	Loop_n Control Output value [%] (range Ln_OP_L...Ln_OP_H)

**Note:** The above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable **otherwise you will get some errors while compiling**.

### Input parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
Ln_AM_AUX	BOOL	Loop_x Output Auto/Manual digital command
Ln_PV	REAL	Loop_n Process value [e.u.](Ln_SC_L... Ln_SC_H)
Ln_WSP	REAL	Loop_n Working SP value [e.u.](Ln_SC_L... Ln_SC_H)
AI1	REAL	Analog_1 generic value [e.u.]
AI2	REAL	Analog_2 generic value [e.u.]
AI3	REAL	Analog_3 generic value [e.u.]
AI4	REAL	Analog_4 generic value [e.u.]
AI5	REAL	Analog_5 generic value [e.u.]
Ln_SC_L	REAL	Loop_n PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Ln_SC_H	REAL	Loop_n PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Ln_OP_L	REAL	Loop_n Control Output Low limit value [%] (range 0...100.0)
Ln_OP_H	REAL	Loop_n Control Output High limit value [%] (range 0...100.0)
STS	DWORD	Overall PIDs Status bit mask



**Output Parameters**

Output	Type	Description
ERROR	BOOL	Specific AC <sup>3</sup> nP page FB already used error state
Lx_LSP	REAL	Loop_x Local SP value [e.u.](Lx_SC_L... Lx_SC_H)
CMD	DWORD	Overall PIDs Commands bit mask

*Description* These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “Loop\_x Bargraph page” (where x is the number of the loop connected to the Function Block and its value changes from 1 to 4) . The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

*Default* Here are reported the default values for the input/output parameters.

**Input Parameters Default**

*Variable*

*Tables*

Input	Default value
ENABLE	FALSE
Ln_AM_AUX	FALSE
Ln_PV	0.0
Ln_WSP	0.0
AI1	0.0
AI2	0.0
AI3	0.0
AI4	0.0
AI5	0.0
Ln_SC_L	0.0
Ln_SC_H	0.0
Ln_OP_L	0.0
Ln_OP_H	0.0
STS	2#0

*Reference*  
*Table*

**Input Reference Table**

Input	Reference table
STS.0	Loop_1 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.1	Loop_1 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.2	Loop_1 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.3	Loop_1 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.4	Loop_1 SP Selection pages displayed status (0 = Loc, 1 = Rem)
STS.5	Loop_1 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.6	Loop_1 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.7	Loop_2 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.8	Loop_2 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.9	Loop_2 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.10	Loop_2 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.11	Loop_2 SP Selection pages displayed status (0 = Loc, 1 = Rem)
STS.12	Loop_2 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.13	Loop_2 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.14	Loop_3 DI1 pages displayed status (0 = OFF, 1 = ON)

Input	Reference table
STS.15	Loop_3 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.16	Loop_3 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.17	Loop_3 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.18	Loop_3 SP Selection pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.19	Loop_3 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.20	Loop_3 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.21	Loop_4 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.22	Loop_4 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.23	Loop_4 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.24	Loop_4 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.25	Loop_4 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem</b> )
STS.26	Loop_4 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.27	Loop_4 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.28... 31	Reserved

Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used
CMD.0	Loop_1 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.1	Loop_1 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.2	Loop_1 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.3	Loop_1 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.4	Loop_1 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.5	Loop_1 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.6	Loop_2 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.7	Loop_2 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.8	Loop_2 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.9	Loop_2 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.10	Loop_2 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.11	Loop_2 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.12	Loop_3 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.13	Loop_3 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.14	Loop_3 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.15	Loop_3 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.16	Loop_3 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.17	Loop_3 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.18	Loop_4 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.19	Loop_4 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.20	Loop_4 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.21	Loop_4 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.22	Loop_4 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.23	Loop_4 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.24... 31	Reserved

**Note:** The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.



## 5-5-5 PAGE\_2TRND\_n

**WARNING!**

**n** is an index (value 1, 2, 3 or 4) that identifies the Function Block and the loop connected. In particular, when:

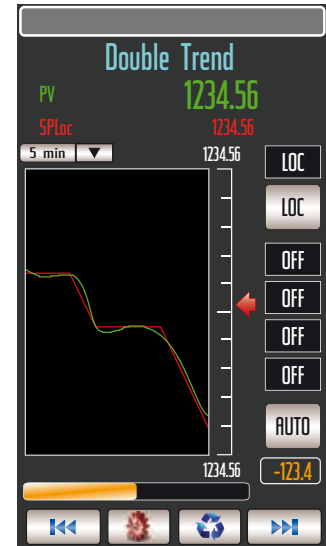
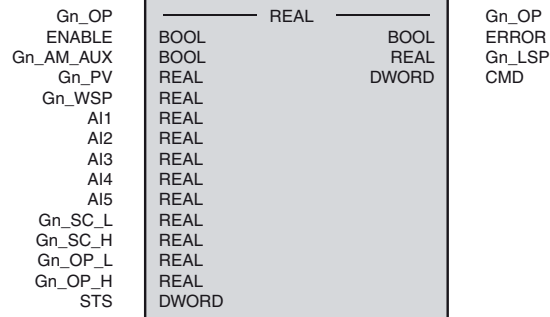
**n = 1** means the loop linked to the FB is Loop1;

**n = 2** means the loop linked to the FB is Loop2;

**n = 3** means the loop linked to the FB is Loop3;

**n = 4** means the loop linked to the FB is Loop4.

*FB Prototype*



*Parameters* **Input and Output Parameters**

Input & Output	Type	Description
Ln_OP	REAL	Control Output value [%] (range Ln_OP_L...Ln_OP_H)

**Note:** The above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable **otherwise you will get some errors while compiling**.

**Input parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
Ln_AM_AUX	BOOL	Loop_n Output Auto/Manual digital command
Ln_PV	REAL	Loop_n Process value [e.u.](Ln_SC_L... Ln_SC_H)
Ln_WSP	REAL	Loop_n Working SP value [e.u.](Ln_SC_L...Ln_SC_H)
AI1	REAL	Analog_1 generic value [e.u.]
AI2	REAL	Analog_2 generic value [e.u.]
AI3	REAL	Analog_3 generic value [e.u.]
AI4	REAL	Analog_4 generic value [e.u.]
AI5	REAL	Analog_5 generic value [e.u.]
Ln_SC_L	REAL	Loop_n PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Ln_SC_H	REAL	Loop_n PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Ln_OP_L	REAL	Loop_n Control Output Low limit value [%] (range 0...100.0)
Ln_OP_H	REAL	Loop_n Control Output High limit value [%] (range 0...100.0)
STS	DWORD	Overall PIDs Status bit mask

## Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
Ln_LSP	REAL	Loop_n Local SP value [e.u.](Ln_SC_L... Ln_SC_H)
CMD	DWORD	Overall PIDs Commands bit mask

**Description** This function block has been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “Loop\_n Double Trend page”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

**Default Variable Tables** Here are reported the default values for the input/output parameters.

### Input Parameters Default

Input	Default value
STS.0	Loop_1 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.1	Loop_1 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.2	Loop_1 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.3	Loop_1 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.4	Loop_1 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.5	Loop_1 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.6	Loop_1 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.7	Loop_2 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.8	Loop_2 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.9	Loop_2 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.10	Loop_2 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.11	Loop_2 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.12	Loop_2 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.13	Loop_2 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.14	Loop_3 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.15	Loop_3 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.16	Loop_3 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.17	Loop_3 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.18	Loop_3 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.19	Loop_3 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.20	Loop_3 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.21	Loop_4 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.22	Loop_4 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.23	Loop_4 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.24	Loop_4 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.25	Loop_4 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.26	Loop_4 Auto-Tuning Oprs pages displayed status (0 = Stop, 1 = Run)
STS.27	Loop_4 Auto-Tuning Fail pages displayed status (0 = Ok, 1 = Fail)
STS.28... 31	Reserved

**Reference Table**

Input	Reference table
STS.0	Loop_1 DI1 pages displayed status (0 = OFF, 1 = ON)

Input	Reference table
STS.1	Loop_1 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.2	Loop_1 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.3	Loop_1 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.4	Loop_1 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.5	Loop_1 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.6	Loop_1 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.7	Loop_2 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.8	Loop_2 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.9	Loop_2 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.10	Loop_2 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.11	Loop_2 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.12	Loop_2 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.13	Loop_2 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.14	Loop_3 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.15	Loop_3 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.16	Loop_3 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.17	Loop_3 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.18	Loop_3 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.19	Loop_3 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.20	Loop_3 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.21	Loop_4 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.22	Loop_4 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.23	Loop_4 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.24	Loop_4 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.25	Loop_4 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.26	Loop_4 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
STS.27	Loop_4 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
STS.28... 31	Reserved

Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used
CMD.0	Loop_1 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.1	Loop_1 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.2	Loop_1 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.3	Loop_1 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.4	Loop_1 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.5	Loop_1 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.6	Loop_2 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.7	Loop_2 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.8	Loop_2 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.9	Loop_2 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.10	Loop_2 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.11	Loop_2 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.12	Loop_3 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.13	Loop_3 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.14	Loop_3 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.15	Loop_3 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.16	Loop_3 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.17	Loop_3 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )

Output	Reference table
CMD.18	Loop_4 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.19	Loop_4 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.20	Loop_4 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
CMD.21	Loop_4 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
CMD.22	Loop_4 Control Action mode ( <b>0 = Single, 1 = Double</b> )
CMD.23	Loop_4 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
CMD.24... 31	Reserved

**Note:** The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

## 5-5-6 PAGE\_ALM\_EVT\_n

**WARNING!**

Depending on index (value: 1, 2, 3 or 4) specified in the Function Block name, the Alarm/event number changes. In particular, when:

***n* = 1** The alarms/events connected are: 1... 16;

***n* = 2** The alarms/events connected are: 16... 32;

***n* = 3** The alarms/events connected are: 32... 48;

***n* = 4** The alarms/events connected are: 48... 64.

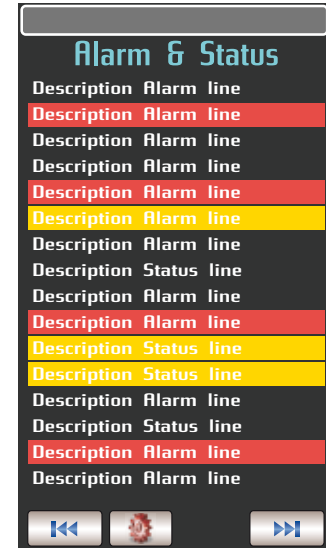
*FB Prototype*

ENABLE  
STATUS  
DSP\_MODE  
DSP\_CONF

BOOL  
DWORD  
DWORD  
DWORD

BOOL

ERROR



*Parameters* **Input Parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
STATUS	DWORD	Alarms or Events 1... 64 Status bit mask
DSP_MODE	DWORD	Alarms or Events 1... 64 Operational Type selection bit mask
DSP_CONF	DWORD	Alarms or Events 1... 64 View Configuration bit mask

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Specific AC <sup>3</sup> nP page FB already used error state

*Description* This function block has been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “1... 64 Alarms & Events page”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code.

*Default* Here are reported the default values for the input/output parameters.

*Variable* **Input Parameters**

*Tables*

Input	Default value
ENABLE	FALSE
STATUS	2#0
DSP_MODE	2#0
DSP_CONF	2#0

Reference  
Table

### Input Reference Table

Input	Reference table
STATUS.0... STATUS.15	1... 64 Alarm or Event displayed status <b>(0 = Inactive, 1 = Active)</b>
STATUS.16... STATUS.31	Reserved
DSP_MODE.0... DSP_MODE.15	1... 64 Alarm or Event Operative mode <b>(0 = Event, 1 = Alarm)</b>
DSP_MODE.16... DSP_MODE.31	Reserved
DSP_CONF.0... DSP_CONF.15	1... 64 Alarm or Event Configuration view <b>(0 = Not Displayed, 1 = Displayed)</b>
DSP_CONF.16... DSP_CONF.31	Reserved

### Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used

## 5-5-7 PAGE\_DSP\_NUM\_n

**WARNING!**

*n* is an index (value: 1 or 2) that identifies the Function Block and the numerical value block displayed. In particular, when:

*n* = 1 The block of Numerical values connected is the 1<sup>st</sup> (numerical inputs 1... 16);

*n* = 2 The block of Numerical values connected is the 2<sup>nd</sup> (numerical inputs 17... 32).

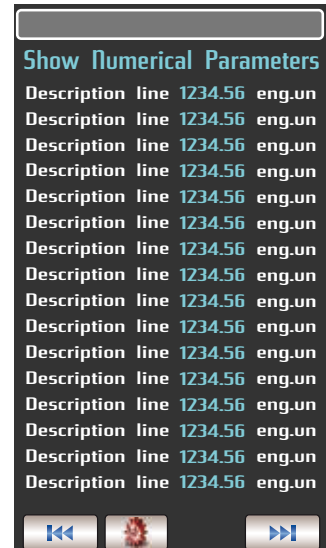
*FB Prototype*

ENABLE  
NUM\_CONF  
NUM\_VAL01  
NUM\_VAL02  
NUM\_VAL03  
NUM\_VAL04  
NUM\_VAL05  
NUM\_VAL06  
NUM\_VAL07  
NUM\_VAL08  
NUM\_VAL09  
NUM\_VAL10  
NUM\_VAL11  
NUM\_VAL12  
NUM\_VAL13  
NUM\_VAL14  
NUM\_VAL15  
NUM\_VAL16

BOOL  
DWORD  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL

BOOL

ERROR



*Parameters* **Input Parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
NUM_CONF	DWORD	1... 32 Numeric values View Configuration bit mask
NUM_VAL01	REAL	Numerical_1 displayed value [e.u.]
NUM_VAL02	REAL	Numerical_2 displayed value [e.u.]
NUM_VAL03	REAL	Numerical_3 displayed value [e.u.]
NUM_VAL04	REAL	Numerical_4 displayed value [e.u.]
NUM_VAL05	REAL	Numerical_5 displayed value [e.u.]
NUM_VAL06	REAL	Numerical_6 displayed value [e.u.]
NUM_VAL07	REAL	Numerical_7 displayed value [e.u.]
NUM_VAL08	REAL	Numerical_8 displayed value [e.u.]
NUM_VAL09	REAL	Numerical_9 displayed value [e.u.]
NUM_VAL10	REAL	Numerical_10 displayed value [e.u.]
NUM_VAL11	REAL	Numerical_11 displayed value [e.u.]
NUM_VAL12	REAL	Numerical_12 displayed value [e.u.]
NUM_VAL13	REAL	Numerical_13 displayed value [e.u.]
NUM_VAL14	REAL	Numerical_14 displayed value [e.u.]
NUM_VAL15	REAL	Numerical_15 displayed value [e.u.]
NUM_VAL16	REAL	Numerical_16 displayed value [e.u.]

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Specific AC <sup>3</sup> nP page FB already used error state

*Description* These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “1... 32 Numerical Display page”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPE-**



**CIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

Here are reported the default values for the input/output parameters:

Default  
Variable  
Tables

#### Input Parameters

Input	Default value
ENABLE	FALSE
NUM_CONF	2#0
NUM_VAL01	0.0
NUM_VAL02	0.0
NUM_VAL03	0.0
NUM_VAL04	0.0
NUM_VAL05	0.0
NUM_VAL06	0.0
NUM_VAL07	0.0
NUM_VAL08	0.0
NUM_VAL09	0.0
NUM_VAL10	0.0
NUM_VAL11	0.0
NUM_VAL12	0.0
NUM_VAL13	0.0
NUM_VAL14	0.0
NUM_VAL15	0.0
NUM_VAL16	0.0

Reference  
Table

#### Input Reference Table

Input	Reference table
NUM_CONF.0... NUM_CONF.15	1... 32 Numerical value configuration view (0 = Not Displayed, 1 = Displayed)
NUM_CONF.16... NUM_CONF.31	Reserved

#### Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used



## 5-5-8 PAGE\_EDT\_NUM\_n



$n$  is an index (value: 1 or 2) that identifies the Function Block and the numerical value block connected. In particular, when:

$n = 1$  The block of Numerical values connected is the 1<sup>st</sup> (numerical inputs 1... 16);

$n = 2$  The block of Numerical values connected is the 2<sup>nd</sup> (numerical inputs 17... 32).

FB Prototype

ENABLE  
NUM\_CONF

BOOL  
DWORD

BOOL  
REAL

ERROR  
NUM\_VAL01  
NUM\_VAL02  
NUM\_VAL03  
NUM\_VAL04  
NUM\_VAL05  
NUM\_VAL06  
NUM\_VAL07  
NUM\_VAL08  
NUM\_VAL09  
NUM\_VAL10  
NUM\_VAL11  
NUM\_VAL12  
NUM\_VAL13  
NUM\_VAL14  
NUM\_VAL15  
NUM\_VAL16

#### Edit Numerical Parameters

Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
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Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
Description line 1234.56 eng.un  
Description line 1234.56 eng.un



Parameters Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
NUM_CONF	DWORD	1... 32 Numeric Edit values View Configuration bit mask

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
NUM_VAL01	REAL	Numerical_1 Edit value [e.u.]
NUM_VAL02	REAL	Numerical_2 Edit value [e.u.]
NUM_VAL03	REAL	Numerical_3 Edit value [e.u.]
NUM_VAL04	REAL	Numerical_4 Edit value [e.u.]
NUM_VAL05	REAL	Numerical_5 Edit value [e.u.]
NUM_VAL06	REAL	Numerical_6 Edit value [e.u.]
NUM_VAL07	REAL	Numerical_7 Edit value [e.u.]
NUM_VAL08	REAL	Numerical_8 Edit value [e.u.]
NUM_VAL09	REAL	Numerical_9 Edit value [e.u.]
NUM_VAL10	REAL	Numerical_10 Edit value [e.u.]
NUM_VAL11	REAL	Numerical_11 Edit value [e.u.]
NUM_VAL12	REAL	Numerical_12 Edit value [e.u.]
NUM_VAL13	REAL	Numerical_13 Edit value [e.u.]
NUM_VAL14	REAL	Numerical_14 Edit value [e.u.]
NUM_VAL15	REAL	Numerical_15 Edit value [e.u.]
NUM_VAL16	REAL	Numerical_16 Edit value [e.u.]

**Description** These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “1... 32 Numerical Edit page”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be

highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

*Default Variable Tables* Here are reported the default values for the input/output parameters.

#### Input Parameters

Input	Default values
ENABLE	FALSE
NUM_CONF	2#0

*Reference Table* **Input Reference Table**

Input	Reference table
NUM_CONF.0... NUM_CONF.15	1... 32 Numerical value configuration view (0 = Not Displayed, 1 = Displayed)
NUM_CONF.16... NUM_CONF.31	Reserved

#### Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used

## 5-5-9 PAGE\_EDT\_DIG\_n



$n$  is an index (value: 1 or 2) that identifies the Function Block and the digital input block connected. In particular, when:

$n = 1$  the block of Digital Inputs connected is the 1<sup>st</sup> (Digital Inputs 1... 16);

$n = 2$  the block of Digital Inputs connected is the 2<sup>nd</sup> (Digital Inputs 17... 32);

FB Prototype

ENABLE  
DIG\_CONF

BOOL  
DWORD

BOOL  
DWORD

ERROR  
DIG\_CMDS



Parameters Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
DIG_CONF	DWORD	1... 32 Digital Commands View Configuration bit mask

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC <sup>3</sup> nP page FB already used error state
DIG_CMDS	DWORD	1...16 Digital Commands bit mask

**Description** These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “**1... 32 Digital Commands page**”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code.

**Default Variable Tables** Here are reported the default values for the input/output parameters.

Input Parameters

Input	Default values
ENABLE	FALSE
DIG	2#0

Reference  
Table

### Input Reference Table

Input	Reference table
DIG_CONF.0... DIG_CONF.15	1... 32 Digital Command Configuration view (0 = Not Displayed, 1 = Displayed)
DIG_CONF.16... DIG_CONF.31	Reserved

### Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used
DIG_CMDS.0...DIG_CMDS.15	1...16 Digital Command
DIG_CMDS.16...DIG_CMDS.31	Reserved

### Input Reference Table

Input          Description

DIG\_CONF.0... DIG\_CONF.15    1... 32 Digital Command Configuration view (0  
= Not Displayed, 1 = Displayed)

DIG\_CONF.16... DIG\_CONF.31    Reserved

### Output Reference Table

Output          Description

ERR\_CODE.0          The function block already used

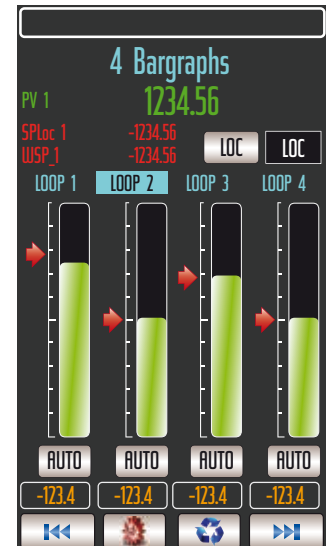
DIG\_CMDS.0...DIG\_CMDS.15    1...16 Digital Command

DIG\_CMDS.16...DIG\_CMDS.31    Reserved

## 5-5-10 PAGE\_4BARG\_G1

FB Prototype

G1_OP	REAL	G1_OP
G2_OP	REAL	G2_OP
G3_OP	REAL	G3_OP
G4_OP	REAL	G4_OP
ENABLE	BOOL	ERROR
G1_AM_AUX	BOOL	G1_LSP
G2_AM_AUX	BOOL	G2_LSP
G3_AM_AUX	BOOL	G3_LSP
G4_AM_AUX	BOOL	G4_LSP
G1_PV	REAL	CMD
G2_PV	REAL	
G3_PV	REAL	
G4_PV	REAL	
G1_WSP	REAL	
G2_WSP	REAL	
G3_WSP	REAL	
G4_WSP	REAL	
G1_SC_L	REAL	
G1_SC_H	REAL	
G2_SC_L	REAL	
G2_SC_H	REAL	
G3_SC_L	REAL	
G3_SC_H	REAL	
G4_SC_L	REAL	
G4_SC_H	REAL	
G1_OP_L	REAL	
G1_OP_H	REAL	
G2_OP_L	REAL	
G2_OP_H	REAL	
G3_OP_L	REAL	
G3_OP_H	REAL	
G4_OP_L	REAL	
G4_OP_H	REAL	
STS	DWORD	



## Parameters Input and Output Parameters

Input & Output	Type	Description
G1_OP	REAL	Generic_1 Control Output value [%] (range G1_OP_L... G1_OP_H)
G2_OP	REAL	Generic_2 Control Output value [%] (range G2_OP_L... G2_OP_H)
G3_OP	REAL	Generic_3 Control Output value [%] (range G3_OP_L... G3_OP_H)
G4_OP	REAL	Generic_4 Control Output value [%] (range G4_OP_L... G4_OP_H)

**Note:** The above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable **otherwise you will get some errors while compiling.**

## Input parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
G1_AM_AUX	BOOL	Generic_1 Output Auto/Manual digital command
G2_AM_AUX	BOOL	Generic_2 Output Auto/Manual digital command
G3_AM_AUX	BOOL	Generic_3 Output Auto/Manual digital command
G4_AM_AUX	BOOL	Generic_4 Output Auto/Manual digital command
G1_PV	REAL	Generic_1 Process value [e.u.](G1_SC_L...G1_SC_H)
G2_PV	REAL	Generic_2 Process value [e.u.](G2_SC_L...G2_SC_H)
G3_PV	REAL	Generic_3 Process value [e.u.](G3_SC_L...G3_SC_H)
G4_PV	REAL	Generic_4 Process value [e.u.](G4_SC_L...G4_SC_H)
G1_WSP	REAL	Generic_1 Working SP value [e.u.](G1_SC_L...G1_SC_H)
G2_WSP	REAL	Generic_2 Working SP value [e.u.](G2_SC_L...G2_SC_H)
G3_WSP	REAL	Generic_3 Working SP value [e.u.](G3_SC_L...G3_SC_H)
G4_WSP	REAL	Generic_4 Working SP value [e.u.](G4_SC_L...G4_SC_H)
G1_SC_L	REAL	Generic_1 PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )

Input	Type	Description
G1_SC_H	REAL	Generic_1 PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
G2_SC_L	REAL	Generic_2 PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
...	...	...
G4_SC_L	REAL	Generic_4 PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
G4_SC_H	REAL	Generic_4 PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
G1_OP_L	REAL	Generic_1 Control Output Low limit value [%] (range 0...100.0)
G1_OP_H	REAL	Generic_1 Control Output High limit value [%] (range 0...100.0)
G2_OP_L	REAL	Generic_2 Control Output Low limit value [%] (range 0...100.0)
...	...	...
G4_OP_L	REAL	Generic_4 Control Output Low limit value [%] (range 0...100.0)
G4_OP_H	REAL	Generic_4 Control Output High limit value [%] (range 0...100.0)
STS	DWORD	Overall PIDs Status bit mask

#### Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC <sup>3</sup> nP page FB already used error state
G1_LSP	REAL	Generic_1 Local SP value [e.u.](G1_SC_L...G1_SC_H)
G2_LSP	REAL	Generic_2 Local SP value [e.u.](G2_SC_L...G2_SC_H)
G3_LSP	REAL	Generic_3 Local SP value [e.u.](G3_SC_L...G3_SC_H)
G4_LSP	REAL	Generic_4 Local SP value [e.u.](G4_SC_L...G4_SC_H)
CMD	DWORD	Overall Commands bit mask

**Description** This function block has been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “**4 Bargraphs Generic page**”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

**Default Variable Tables** Here are reported the default values for the input/output parameters.

#### Input Parameters Default

Input	Default value
ENABLE	FALSE
G1_AM_AUX	FALSE
G2_AM_AUX	FALSE
G3_AM_AUX	FALSE
G4_AM_AUX	FALSE
G1_PV	0.0
...	...
G4_PV	0.0

Input	Default value
G1_WSP	0.0
...	...
G4_WSP	0.0
G1_SC_L	0.0
G1_SC_H	0.0
G2_SC_L	0.0
...	...
G4_SC_L	0.0
G4_SC_H	0.0
G1_OP_L	0.0
G1_OP_H	0.0
G2_OP_L	0.0
...	...
G4_OP_L	0.0
G4_OP_H	0.0
STS	2#0

Reference  
Table

Input Reference Table

Input	Reference table
STS.0	Not available
STS.1	Not available
STS.2	Not available
STS.3	Not available
STS.4	Generic_1 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.5	Not available
STS.6	Not available
STS.7	Not available
STS.8	Not available
STS.9	Not available
STS.10	Not available
STS.11	Generic_2 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.12	Not available
STS.13	Not available
STS.14	Not available
STS.15	Not available
STS.16	Not available
STS.17	Not available
STS.18	Generic_3 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.19	Not available
STS.20	Not available
STS.21	Not available
STS.22	Not available
STS.23	Not available
STS.24	Not available
STS.25	Generic_4 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.26	Not available
STS.27	Not available
STS.28... 31	Reserved

### Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used
CMD.0	Generic_1 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.1	Generic_1 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.2	Not available
CMD.3	Not available
CMD.4	Not available
CMD.5	Not available
CMD.6	Generic_2 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.7	Generic_2 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.8	Not available
CMD.9	Not available
CMD.10	Not available
CMD.11	Not available
CMD.12	Generic_3 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.13	Generic_3 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.14	Not available
CMD.15	Not available
CMD.16	Not available
CMD.17	Not available
CMD.18	Generic_4 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
CMD.19	Generic_4 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
CMD.20	Not available
CMD.21	Not available
CMD.22	Not available
CMD.23	Not available
CMD.24... 31	Reserved



## 5-5-11 PAGE\_2BARG\_Gn

**WARNING!**

$n$  is an index (value 1 or 2) that identifies the Function Block connected.

In particular, when:

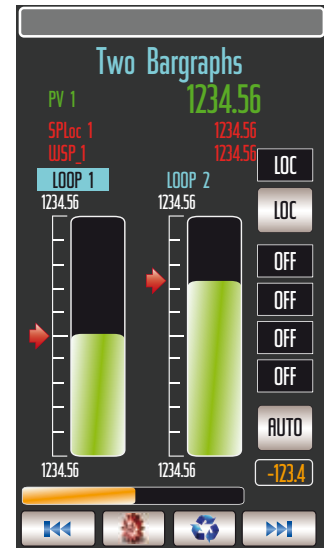
$n = 1$  then  $x = 1$  (1<sup>st</sup> group of info linked to the FB) whilst  $y = 2$  the 2<sup>nd</sup>.

Otherwise when:

$n = 2$  then  $x = 3$  (3<sup>rd</sup> group of info linked to the FB) whilst  $y = 4$  the 4<sup>th</sup>.

*FB Prototype*

Gx_OP	REAL	Gx_OP
Gy_OP	REAL	Gy_OP
ENABLE	BOOL	ERROR
Gx_AM_AUX	BOOL	Gx_LSP
Gy_AM_AUX	BOOL	Gy_LSP
Gx_PV	REAL	CMD
Gy_PV	REAL	
Gx_WSP	REAL	
Gy_WSP	REAL	
AI1	REAL	
AI2	REAL	
AI3	REAL	
AI4	REAL	
AI5	REAL	
Gx_SC_L	REAL	
Gx_SC_H	REAL	
Gy_SC_L	REAL	
Gy_SC_H	REAL	
Gx_OP_L	REAL	
Gx_OP_H	REAL	
Gy_OP_L	REAL	
Gy_OP_H	REAL	
STS	DWORD	

*Parameters* **Input and Output Parameters**

Input & Output	Type	Description
Gx_OP	REAL	Generic_x Control Output value [%] (range Gx_OP_L... Gx_OP_H)
Gy_OP	REAL	Generic_y Control Output value [%] (range Gy_OP_L... Gy_OP_H)

**Note:** The above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable **otherwise you will get some errors while compiling**.

**Input parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
Gx_AM_AUX	BOOL	Generic_x Output Auto/Manual digital command
Gy_AM_AUX	BOOL	Generic_y Output Auto/Manual digital command
Gx_PV	REAL	Generic_x Process value [e.u.](Gx_SC_L... Gx_SC_H)
Gy_PV	REAL	Generic_y Process value [e.u.](Gy_SC_L... Gy_SC_H)
Gx_WSP	REAL	Generic_x Working SP value [e.u.](Gx_SC_L... Gx_SC_H)
Gy_WSP	REAL	Generic_y Working SP value [e.u.](Gy_SC_L... Gy_SC_H)
AI1	REAL	Analog_1 generic value [e.u.]
AI2	REAL	Analog_2 generic value [e.u.]
AI3	REAL	Analog_3 generic value [e.u.]
AI4	REAL	Analog_4 generic value [e.u.]
AI5	REAL	Analog_5 generic value [e.u.]
Gx_SC_L	REAL	Generic_x PV input Low Scale value [e.u.] (range -3.4E-38... 3.4E+38)
Gx_SC_H	REAL	Generic_x PV input Low Scale value [e.u.] (range -3.4E-38... 3.4E+38)

Input	Type	Description
Gy_SC_L	REAL	Generic_y PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
Gy_SC_H	REAL	Generic_y PV input Low Scale value [e.u.] (range $-3.4E^{-38}$ ... $3.4E^{+38}$ )
Gx_OP_L	REAL	Generic_x Control Output Low limit value [%] (range 0... 100.0)
Gx_OP_H	REAL	Generic_x Control Output High limit value [%] (range 0... 100.0)
Gy_OP_L	REAL	Generic_y Control Output Low limit value [%] (range 0... 100.0)
Gy_OP_H	REAL	Generic_y Control Output High limit value [%] (range 0... 100.0)
STS	DWORD	Overall PIDs Status bit mask

### Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
Gx_LSP	REAL	Generic_x Local SP value [e.u.](Gx_SC_L... Gx_SC_H)
Gy_LSP	REAL	Generic_y Local SP value [e.u.](Gy_SC_L... Gy_SC_H)
CMD	DWORD	Overall PIDs Commands bit mask

**Description** These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the "Generic\_n Bargraph page".

The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

**Default** Here are reported the default values for the input/output parameters:

### Variable Input Parameters Default

Input	Default value
ENABLE	FALSE
Gx_AM_AUX	FALSE
Gy_AM_AUX	FALSE
Gx_PV	0.0
Gy_PV	0.0
Gx_WSP	0.0
Gy_WSP	0.0
AI1	0.0
AI2	0.0
AI3	0.0
AI4	0.0
AI5	0.0
Gx_SC_L	0.0
Gx_SC_H	0.0
Gy_SC_L	0.0
Gy_SC_H	0.0
Gx_OP_L	0.0

Input	Default value
Gx_OP_H	0.0
Gy_OP_L	0.0
Gy_OP_H	0.0
STS	2#0

Reference  
Table

Input Reference Table

Input	Reference table
STS.0	Generic_1 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.1	Generic_1 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.2	Generic_1 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.3	Generic_1 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.4	Generic_1 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.5	Not available
STS.6	Not available
STS.7	Generic_2 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.8	Generic_2 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.9	Generic_2 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.10	Generic_2 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.11	Generic_2 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.12	Not available
STS.13	Not available
STS.14	Generic_3 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.15	Generic_3 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.16	Generic_3 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.17	Generic_3 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.18	Generic_3 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.19	Not available
STS.20	Not available
STS.21	Generic_4 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.22	Generic_4 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.23	Generic_4 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.24	Generic_4 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
STS.25	Generic_4 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
STS.26	Not available
STS.27	Not available
STS.28... 31	Reserved

## 5-5-12 PAGE\_2TRND\_Gn



### WARNING!

$n$  is an index (value 1 or 2) that identifies the Function Block connected.

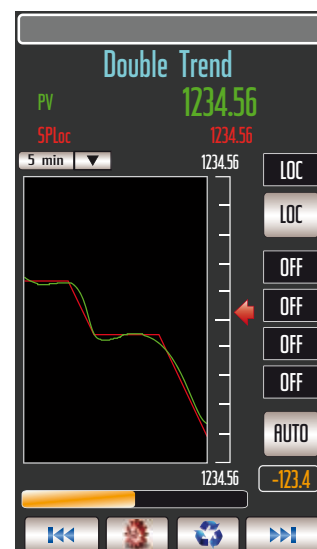
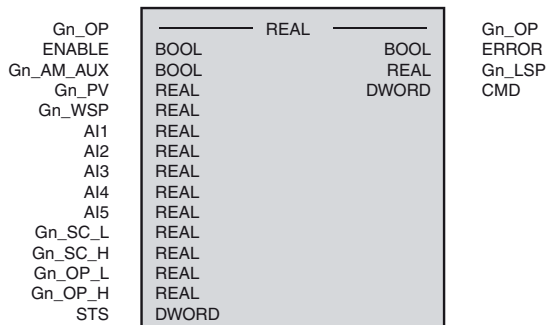
In particular, when:

$n = 1$  then  $x = 1$  (1<sup>st</sup> group of info linked to the FB) whilst  $y = 2$  the 2<sup>nd</sup>.

Otherwise when:

$n = 2$  then  $x = 3$  (3<sup>rd</sup> group of info linked to the FB) whilst  $y = 4$  the 4<sup>th</sup>.

### FB Prototype



### Parameters Input and Output Parameters

Input & Output	Type	Description
Gn_OP	REAL	Control Output value [%](range Gn_OP_L... Gn_OP_H)

**Note:** The above type of FB's pins **MUST BE ALWAYS CONNECTED** to a local or global variable **otherwise you will get some errors while compiling**.

### Input parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
Gn_AM_AUX	BOOL	Generic_n Output Auto/Manual digital command
Gn_PV	REAL	Generic_n Process value [e.u.](Gn_SC_L... Gn_SC_H)
Gn_WSP	REAL	Generic_n Working SP value [e.u.](Gn_SC_L...Gn_SC_H)
AI1	REAL	Analog_1 generic value [e.u.]
AI2	REAL	Analog_2 generic value [e.u.]
AI3	REAL	Analog_3 generic value [e.u.]
AI4	REAL	Analog_4 generic value [e.u.]
AI5	REAL	Analog_5 generic value [e.u.]
Gn_SC_L	REAL	Generic_n PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Gn_SC_H	REAL	Generic_n PV input Low Scale value [e.u.] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Gn_OP_L	REAL	Generic_n Control Output Low limit value [%] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
Gn_OP_H	REAL	Generic_n Control Output High limit value [%] (range -3.4E <sup>-38</sup> ... 3.4E <sup>+38</sup> )
STS	DWORD	Overall PIDs Status bit mask

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
Gn_LSP	REAL	Generic_n Local SP value [e.u.](Gn_SC_L... Gn_SC_H)
CMD	DWORD	Overall PIDs Commands bit mask

*Description* This function block has been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “**Double Trend Generic page**”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

*Default Variable Tables* Here are reported the default values for the input/output parameters.  
**Input Parameters Default**

Input	Default value
STS.0	Generic_1 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.1	Generic_1 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.2	Generic_1 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.3	Generic_1 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.4	Generic_1 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.5	Not available
STS.6	Not available
STS.7	Generic_2 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.8	Generic_2 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.9	Generic_2 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.10	Generic_2 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.11	Generic_2 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.12	Not available
STS.13	Not available
STS.14	Generic_3 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.15	Generic_3 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.16	Generic_3 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.17	Generic_3 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.18	Generic_3 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.19	Not available
STS.20	Not available
STS.21	Generic_4 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.22	Generic_4 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.23	Generic_4 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.24	Generic_4 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.25	Generic_4 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.26	Not available
STS.27	Not available
STS.28... 31	Reserved

Reference  
Table

Input Reference Table

Input	Reference table
STS.0	Generic_1 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.1	Generic_1 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.2	Generic_1 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.3	Generic_1 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.4	Generic_1 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.5	Not available
STS.6	Not available
STS.7	Generic_2 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.8	Generic_2 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.9	Generic_2 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.10	Generic_2 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.11	Generic_2 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.12	Not available
STS.13	Not available
STS.14	Generic_3 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.15	Generic_3 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.16	Generic_3 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.17	Generic_3 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.18	Generic_3 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.19	Not available
STS.20	Not available
STS.21	Generic_4 DI1 pages displayed status (0 = OFF, 1 = ON)
STS.22	Generic_4 DI2 pages displayed status (0 = OFF, 1 = ON)
STS.23	Generic_4 DI3 pages displayed status (0 = OFF, 1 = ON)
STS.24	Generic_4 DI4 pages displayed status (0 = OFF, 1 = ON)
STS.25	Generic_4 SP Selection pages displayed status (0 = Loc, 1 = Rem.)
STS.26	Not available
STS.27	Not available
STS.28... 31	Reserved

Output Reference Table

Output	Reference table
ERR_CODE.0	The function block already used
CMD.0	Generic_1 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.1	Generic_1 SP Local/Remote selection command (0 = Loc, 1 = Rem.)
CMD.2	Not available
...	...
CMD.6	Generic_2 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.7	Generic_2 SP Local/Remote selection command (0 = Loc, 1 = Rem.)
CMD.8	Not available
...	...
CMD.12	Generic_3 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.13	Generic_3 SP Local/Remote selection command (0 = Loc, 1 = Rem.)
CMD.14	Not available
...	...
CMD.18	Generic_4 Auto/Manual command (0 = Auto, 1 = Manual)
CMD.19	Generic_4 SP Local/Remote selection command (0 = Loc, 1 = Rem.)
CMD.20	Not available
...	...
CMD.24... 31	Reserved



## 5-5-13 PAGE\_CFG\_PID\_n

**WARNING!**

*n* is an index (value: 1, 2, 3 or 4) that identifies the Control Loop that is to be configured. In particular, when:

*n* = 1 configures the PID parameters of Control Loop 1;

*n* = 2 configures the PID parameters of Control Loop 2;

*n* = 3 configures the PID parameters of Control Loop 3;

*n* = 4 configures the PID parameters of Control Loop 4.

*FB Prototype*

ENABLE  
ATON\_AUX  
ATOFF\_AUX  
PID\_STS

BOOL  
BOOL  
BOOL  
DWORD

ERROR  
PID\_ATB  
PID\_MRES  
PID\_OC  
PID\_PVL  
PID\_PVH  
PID\_OPL  
PID\_OPH  
PID\_CMD

*Parameters* **Input Parameters**

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
ATON_AUX	BOOL	Loop_n Auto-Tuning Run alternative direct command
ATOFF_AUX	REAL	Loop_n Auto-Tuning Stop alternative direct command
PID_STS	DWORD	Overall PIDs Status bit mask

**Output Parameters**

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
PID_ATB	REAL	Loop_n Auto-Tuning Band [% of range PID_PVL and PID_PVH](0... 100.0)
PID_MRES	REAL	Loop_n Manual Reset [%](range -100.0... 100.0)
PID_OC	REAL	Loop_n Overshoot Control [num] (admitted range 0.01... 1.00)
PID_PVL	REAL	Loop_n PV input Low range [e.u.](-9999.99... 9999.99)
PID_PVH	REAL	Loop_n PV input High range [e.u.](-9999.99... 9999.99)
PID_OPL	REAL	Loop_n Control Output Low range [e.u.](-100.0... 100.0)
PID_OPH	REAL	Loop_n Control Output Low range [e.u.](-100.0... 100.0)
PID_CMD	DWORD	Overall PIDs Commands bit mask

*Description* These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “**Loop\_n PID Configuration page**” which is part of those ones accessible **ONLY** through the Configuration session by typing the correct password. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy**

and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

Default  
Variable  
Tables

Here are reported the default values for the input/output parameters.

#### Input Parameters Default

Input	Default value
ENABLE	FALSE
ATON_AUX	FALSE
ATOFF_AUX	FALSE

#### Output Parameters Default

Output	Default value
ERROR	2#0
PID_ATB	3.0
PID_MRES	50.0
PID_OC	0.8
PID_PVL	0.0
PID_PVH	100.0
PID_OPL	0.0
PID_OPH	100.0
PID_CMD	2#0

#### Parameters Default

TAG	Default value
PID_PB	10.0 (suggested)
PID_TI	60.0 (suggested; the value 0.0 disables the TI action)
PID_TD	12.0 (suggested; the value 0.0 disables the TD action)
PID_RCGA	1.0 (suggested)

Reference  
Table

#### Input Reference Table

Input	Description
PID_STS.0	Loop_1 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.1	Loop_1 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.2	Loop_1 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.3	Loop_1 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.4	Loop_1 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
PID_STS.5	Loop_1 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
PID_STS.6	Loop_1 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
PID_STS.7	Loop_2 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.8	Loop_2 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.9	Loop_2 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.10	Loop_2 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.11	Loop_2 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
PID_STS.12	Loop_2 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
PID_STS.13	Loop_2 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
PID_STS.14	Loop_3 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.15	Loop_3 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.16	Loop_3 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.17	Loop_3 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )



Input	Description
PID_STS.18	Loop_3 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
PID_STS.19	Loop_3 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
PID_STS.20	Loop_3 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
PID_STS.21	Loop_4 DI1 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.22	Loop_4 DI2 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.23	Loop_4 DI3 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.24	Loop_4 DI4 pages displayed status ( <b>0 = OFF, 1 = ON</b> )
PID_STS.25	Loop_4 SP Selection pages displayed status ( <b>0 = Loc, 1 = Rem.</b> )
PID_STS.26	Loop_4 Auto-Tuning Oprs pages displayed status ( <b>0 = Stop, 1 = Run</b> )
PID_STS.27	Loop_4 Auto-Tuning Fail pages displayed status ( <b>0 = Ok, 1 = Fail</b> )
PID_STS.28... 31	Reserved

Output Reference Table

Output	Description
ERR_CODE.0	The function block already used
PID_CMD.0	Loop_1 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
PID_CMD.1	Loop_1 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
PID_CMD.2	Loop_1 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
PID_CMD.3	Loop_1 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
PID_CMD.4	Loop_1 Control Action mode ( <b>0 = Single, 1 = Double</b> )
PID_CMD.5	Loop_1 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
PID_CMD.6	Loop_2 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
PID_CMD.7	Loop_2 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
PID_CMD.8	Loop_2 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
PID_CMD.9	Loop_2 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
PID_CMD.10	Loop_2 Control Action mode ( <b>0 = Single, 1 = Double</b> )
PID_CMD.11	Loop_2 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
PID_CMD.12	Loop_3 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
PID_CMD.13	Loop_3 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
PID_CMD.14	Loop_3 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
PID_CMD.15	Loop_3 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
PID_CMD.16	Loop_3 Control Action mode ( <b>0 = Single, 1 = Double</b> )
PID_CMD.17	Loop_3 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
PID_CMD.18	Loop_4 Auto/Manual command ( <b>0 = Auto, 1 = Manual</b> )
PID_CMD.19	Loop_4 SP Local/Remote selection command ( <b>0 = Loc, 1 = Rem.</b> )
PID_CMD.20	Loop_4 Auto-Tuning Run command ( <b>Rising Edge pulse</b> )
PID_CMD.21	Loop_4 Auto-Tuning Reset command ( <b>Rising Edge pulse</b> )
PID_CMD.22	Loop_4 Control Action mode ( <b>0 = Single, 1 = Double</b> )
PID_CMD.23	Loop_4 Control Type mode ( <b>0 = Reverse, 1 = Direct</b> )
PID_CMD.24... 31	Reserved

**Note:** The bit status and/or commands managed through the **PID\_STS** and **PID\_CMD** function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

## 5-5-14 PAGE\_CFG\_NUM\_n



### WARNING!

**n** is an index (values from 1 to 14) that identifies the Function Block and the Numerical Fields block connected. In particular, when:

**n = 1** configures the 1<sup>st</sup> block of Numerical Fields (Numerical Fields 1... 16);

**n = 2** configures the 2<sup>nd</sup> block of Numerical Fields (Numerical Fields 17... 32);

...

**n = 14** configures the 14<sup>th</sup> block of Numerical Fields (Numerical Fields 209... 224).

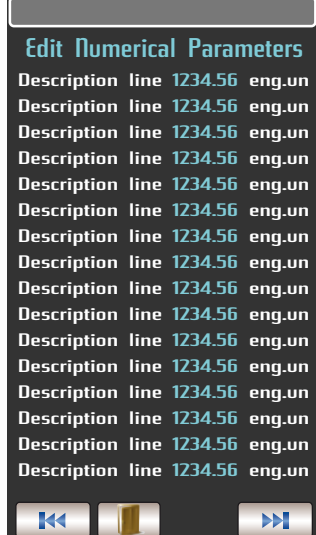
FB Prototype

ENABLE  
NUM\_CONF

BOOL  
DWORD

BOOL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL  
REAL

ERROR  
NUM\_VAL01  
NUM\_VAL02  
NUM\_VAL03  
NUM\_VAL04  
NUM\_VAL05  
NUM\_VAL06  
NUM\_VAL07  
NUM\_VAL08  
NUM\_VAL09  
NUM\_VAL10  
NUM\_VAL11  
NUM\_VAL12  
NUM\_VAL13  
NUM\_VAL14  
NUM\_VAL15  
NUM\_VAL16



Parameters Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
NUM_CONF	DWORD	1... 16 Numeric Edit values View Configuration bit mask

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
NUM_VAL01	REAL	Numerical_1 Edit value [e.u.]
NUM_VAL02	REAL	Numerical_2 Edit value [e.u.]
NUM_VAL03	REAL	Numerical_3 Edit value [e.u.]
NUM_VAL04	REAL	Numerical_4 Edit value [e.u.]
NUM_VAL05	REAL	Numerical_5 Edit value [e.u.]
NUM_VAL06	REAL	Numerical_6 Edit value [e.u.]
NUM_VAL07	REAL	Numerical_7 Edit value [e.u.]
NUM_VAL08	REAL	Numerical_8 Edit value [e.u.]
NUM_VAL09	REAL	Numerical_9 Edit value [e.u.]
NUM_VAL10	REAL	Numerical_10 Edit value [e.u.]
NUM_VAL11	REAL	Numerical_11 Edit value [e.u.]
NUM_VAL12	REAL	Numerical_12 Edit value [e.u.]
NUM_VAL13	REAL	Numerical_13 Edit value [e.u.]
NUM_VAL14	REAL	Numerical_14 Edit value [e.u.]
NUM_VAL15	REAL	Numerical_15 Edit value [e.u.]
NUM_VAL16	REAL	Numerical_16 Edit value [e.u.]

*Description* These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “1... 224 Numerical Configuration page” which is part of those ones accessi-

ble ONLY through the Configuration session by typing the correct password. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled.** No other kinds of control are performed by the internal function block code so eventually problems of variables scaling must be managed externally.

*Default Variable Tables* Here are reported the default values for the input/output parameters.  
**Input Parameters**

Input	Default value
ENABLE	FALSE
NUM_CONF	2#0

*Reference Table* **Input Reference Table**

Input	Description
NUM_CONF.0... NUM_CONF.15	1... 16 Numerical value Configuration view (0 = Not Displayed, 1 = Displayed)
NUM_CONF.16... 31	Reserved

**Output Reference Table**

Output	Description
ERR_CODE.0	The function block already used

## 5-5-15 PAGE\_CFG\_DIG\_n



### WARNING!

**n** is an index (values from 1 to 4) that identifies the Function Block and the Digital Inputs block connected. In particular, when:

**n = 1** configures the 1<sup>st</sup> block of Digital Inputs (Digital Inputs 1... 16);

**n = 2** configures the 2<sup>nd</sup> block of Digital Inputs (Digital Inputs 17... 32);

**n = 3** configures the 3<sup>rd</sup> block of Digital Inputs (Digital Inputs 33... 48);

**n = 4** configures the 4<sup>th</sup> block of Digital Inputs (Digital Inputs 49... 64).

FB Prototype

ENABLE  
DIG\_CONF

BOOL  
DWORD

BOOL  
DWORD

ERROR  
DIG\_CMDS



Parameters

### Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
DIG_CONF	DWORD	1... 16 Digital Commands View Configuration bit mask

### Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3nP page FB already used error state
DIG_CMDS	DWORD	1...16 Digital Commands bit mask

**Description** These function blocks have been designed to easily perform the data exchange between the CPU and the touch screen front panel, specifically related to the “**1... 64 Digital Commands page**”. The mechanism to establish the data exchange is activated only when the ENABLE command becomes TRUE. **At the boot up only, the system performs a check to verify that ONLY ONE FB for each SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted through the specific ERROR state. The same specific type FBs eventually used into the control strategy will be automatically disabled. No other kinds of control are performed by the internal function block code.

**Default Variable Tables** Here are reported the default values for the input/output parameters.

### Input Parameters

Input	Default value
ENABLE	FALSE
DIG	2#0

*Reference  
Table***Input Reference Table**

Input	Description
DIG_CONF.0... DIG_CONF.15	1... 16 Digital Command Configuration view <b>(0 = Not Displayed, 1 = Displayed)</b>
DIG_CONF.16... DIG_CONF.31	Reserved

**Output Reference Table**

Output	Description
ERR_CODE.0	The function block already used
DIG_CMDS.0...DIG_CMDS.15	1...16 Digital Command
DIG_CMDS.16...DIG_CMDS.31	Reserved



# Chapter 6

## Password and Access Control

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### 6-1 Description

---


This chapter describes the access levels and how to manage the various type of available pages in order to avoid undesired operations. The application developer can decide the amount, type and accessible mode to the parameters.

In the actual AC<sup>3</sup>nP system there are conceptually 3 access levels:

- Operational pages (some prearranged in Read/Write mode whilst some other in Read only or Write mode);
- Configuration pages, password protected (some prearranged in Read/Write mode whilst some other in Read only or Write mode);
- System page, specifically password protected, allows to change the internal control strategy and the IP address of the P04 Operator panel.

### 6-2 Setting Access Modes

---

From a whatever operational page the user can access both the System and Configuration session. This can be done pressing the  button and typing the specific password:

#### System session

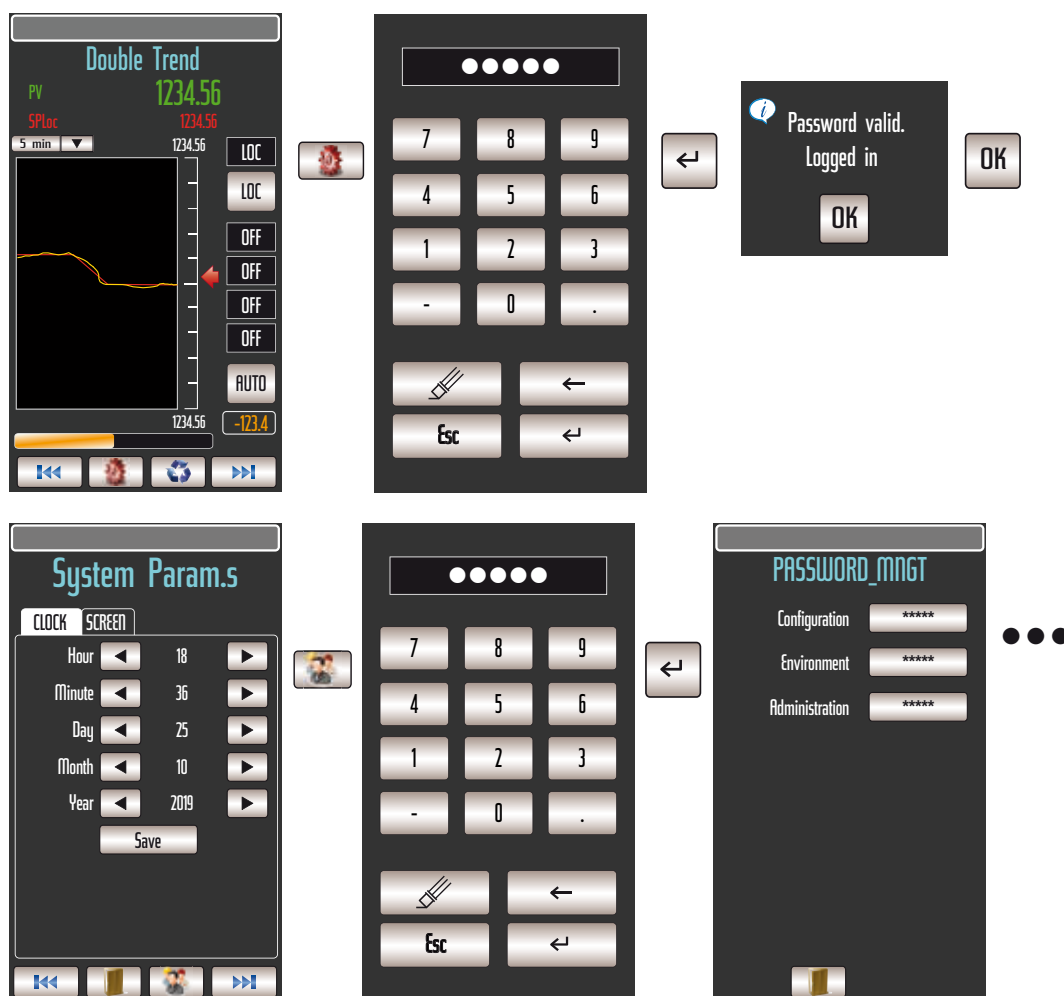
Allows the selection of the desired Control strategy: (Custom, Ratio, Cascade, Override or 4 Loops), change the IP address of the P04 Operator panel and change the password specific of the System session.

#### Configuration session

Allows to configure the general AC<sup>3</sup>nP system operational parameters (Date/Time, display brightness, screensaver page and change the password specific of the Configuration session) and all the parameters used by the application accordingly to the management strategy (defined by the developer).

## 6-3 Password Change

The following picture shows the steps required to change the actual password.



In the **PASSWORD\_MNGT** panel touching on the button of the password to be changed, the user accesses the numeric keypad with which can specify the new password number. Depending on the level of password inserted, the system shows the password or passwords that can be changed.



At the end of the procedure, the new password will be immediately active.



- Notes:**
1. The password consists of 5 numeric characters;
  2. There are 3 levels of password:
    - **Configuration:** Allows to modify only the System configuration;
    - **Environment:** Allows to modify the values of the applications parameters;
    - **Management:** Allows to modify the values of the **COSA??**
  3. Each level of password allows to modify the password of the same level and those that are less important (Administration = more important, Configuration = less important);
  4. The AC<sup>3</sup>nP system has 99999 (Configuration) as factory default password.

## 6-4 Password Recovery

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Please contact the Customer Support.



# Chapter 7

## Maintenance and Diagnostic

### 7-1 TFTP Files Protocol Access

The nP4 unit, part of the AC<sup>3</sup>nP system allows the user to access some internal files of the device through the TFTP (Trivial File Transfer Protocol). With this protocol it is possible to upload or download device configuration, IEC61131 program, retained variables and error log files. For security reasons, the file access is limited and fixed. The following table lists the accessible ones:

File name	Description
/fs1/restore_file	Name of the IEC61131 program file
/fs1/sys_file	Name of the configuration file
/fs1/prodstr_file	Product identification file
/fs1/errlog_file	Name of the RUNTIME errors file
/fs2/retain	Name of the classic retained variable file
/fs2/perc_ret	Name of the % retained variable file
/fs2/stop_prg	Stops the PLC program (note 1)
/fs2/run_prg	Starts the PLC program (note 1)
/fs2/erase_prg	Erases the PLC program (note 1)
/fs2/ack_alm	Acknowledges the retentive variables file error alarm <b>ONLY</b> (note 2)
/fs2/reset	Reset command file (note 3)

- Notes:**
1. These TFTP commands have no error feedback because they do not establish any TFTP data exchange.
  2. Because the Acknowledge command cannot be retained, it is not possible to use it for all the other alarm status. To acknowledge those ones you have to use the standard procedure as described in the “Error Messages” section.
  3. This TFTP command gets no feedback from the CPU because it resets itself. To establish a connection between the CPU unit and the PC, the IP address of the device (see AT\_MU\_nP4\_EN manual for details) and the logic port to be used (**69** for the TFTP) are needed. The TFTP protocol has only two different services:
    - GET
    - PUT

The **GET** service allows the user to upload a file from the nP4 unit, while the PUT service allows files to be downloaded.

Using the TFTP client usually available in Windows installation (please see C:\Windows\System32\tftp.exe) the possible commands are:

- To **GET** a file from the nP4  
`tftp -i <remote host address> get <remote file_name><local file name>`
- To **PUT** a file to the nP4  
`tftp -i <remote host address> put <local file name><remote file_name>`

For example, if the user wants to **GET** the configuration file from the nP4 unit, and

store it in a local file named “configuration.bin”, the command is:

```
tftp -i 192.168.5.11 get /fs1/sys_file configuration.bin
```

where the IP address of the nP4 is 192.168.5.11.

If the user wants to PUT the IEC61131 program file to the nP4 unit, using the source file “Sigma2\_MP-0x”, the command will be:

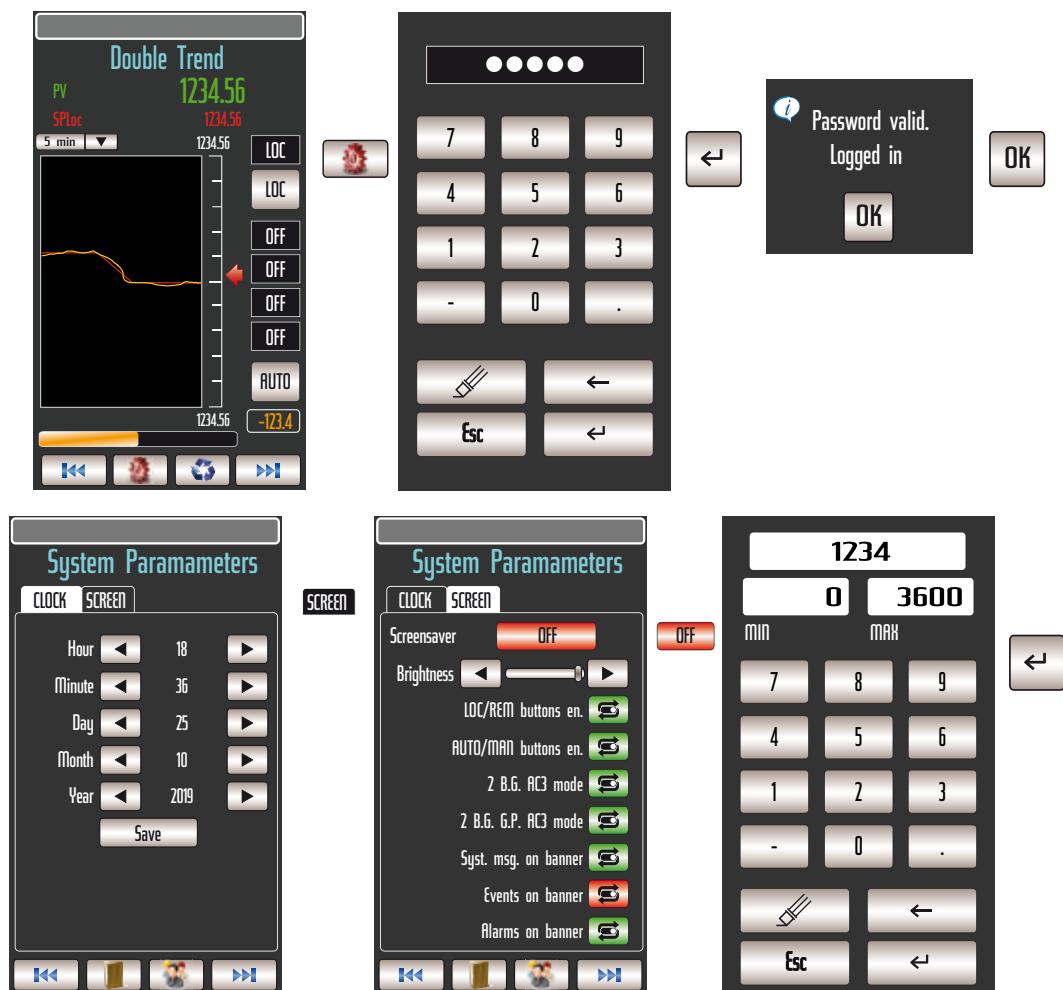
```
tftp -i 192.168.5.11 put Sigma2_MP-0x.prs /fs1/restore_file
```

Please note that the application binary file which contains the compiled program with OpenPCS is located in the project folder “project\_name/\$GEN\$/Resource” and has always the name “file\_name.prs”.

## 7-2 P04 Operator Panel Brightness and Screensaver Adjustment

The brightness and the screen saver time of the front panel LCD display can be adjusted in order to perfectly match the installation site. These operations are carried out from the specific Configuration page.

The following pictures show the procedure on how to change these two parameters.



Once reached the System Params page, the contrast of the display can be changed using the specific buttons or directly by moving the slider. The LCD display reflects immediately the setting.

The screensaver function can be used to save energy and increase the display lifetime. To activate the function, press the **ON** button and type the amount of seconds after which the display will be automatically turned OFF. To disable the screensaver, simply press the **OFF** button.

The changes are automatically saved exiting the panel (**EXIT** button).

## 7-3 Error messages

The AC<sup>3</sup>nP system runs in background several diagnostic functions, capable to detect a range of faults and alert the operator with popup windows or LED indications (for more details about **ERR LED** management, please refer to “*Chapter 1 General information*” paragraph “1-3-1 Diagnostic LEDs”). In some cases, these faults are caused by wrong parameter assignments or other instrument configuration mistakes. When one of these anomalous situations arises, one of the above described indications will be generated.

The operator, in case of an ERR LED indication, must acknowledge the message, by following a specific procedure.

During the power up phase, a time frame window allows the operator to access the Configuration session by using a VT100 terminal or a Personal Computer with a Hyper Terminal program or a Telnet client (for more details of the Configuration session, please refer to the *nP4 User Manual*).

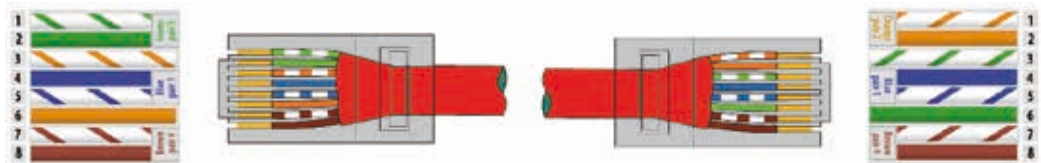
### 7-3-1 Terminal Connection Setup

There are 2 ports available on the CPU to enter the configuration session: the Ethernet LAN port or the **X0** RS232 serial port. Depending on the setup METHOD USED, the user must:

- Set the **X0** or the LAN port (consult the “*AC<sup>3</sup>nP Installation Manual*” for details);
- Use the proper connection cable;
- Set the correct communications parameters;
- Run the communications program.

*Ethernet LAN  
communications  
connection*

In order to connect a VT100 terminal or a PC with a Telnet client program (such as Hyper Terminal), connect a LAN crossover cable having the following characteristics:



*Setting the  
communications  
parameters*

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

<b>IP Address</b>	192.168.5.11 (Factory default)
<b>Port</b>	23



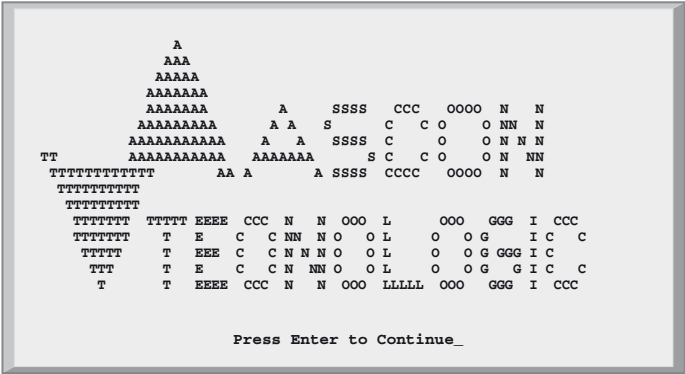
#### Caution

*Appendix A* describes connection and the setup details of the ports connection and configuration of the communication ports.

7-3-2 Starting the Setup Session

Accessing the Main Menu

To open the Configuration session, while the CPU powers ON and the RUN LED will start 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 above described operations have been correctly followed, the welcome screen appears:



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**.

7-3-3 CPU Main Menu

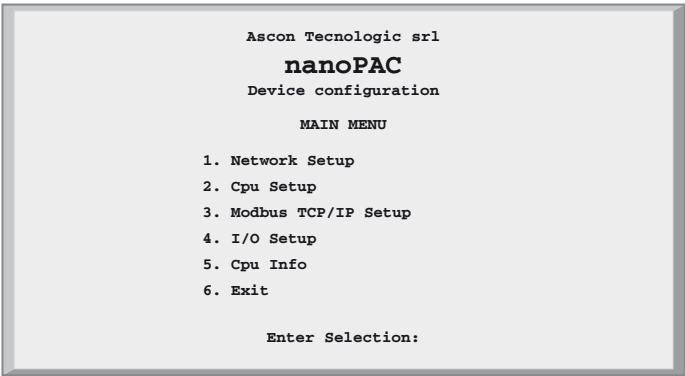


Figure 7.1 Base Unit configuration Main Menu

The Main Menu (see Figure 7.1) has 6 different items:

Item	Description
Network Setup	CPU communication ports settings
CPU Setup	Specific CPU parameters
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

## 7-3-4 CPU Info Menu

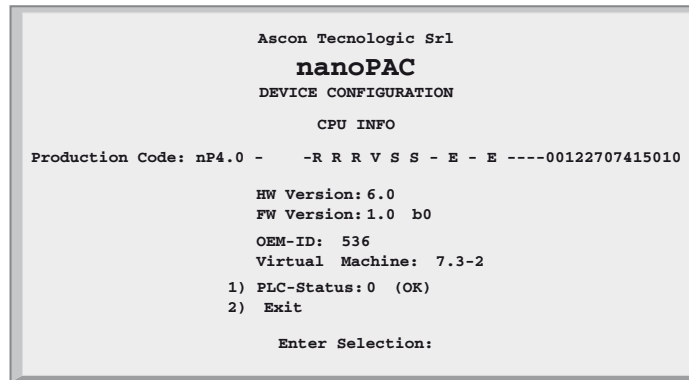


Figure 7.2 CPU Info

	Status	Message
<b>Production Code</b> (factory reserved information)	OK	The system displays the production code (as shown)
	Error	The system displays the message: <b>Code Info Error - Invalid File</b> (note)
<b>HW Version</b>	Revision of the CPU hardware	
<b>FW Version</b>	Revision of the CPU firmware	
<b>OEM-ID</b>	Ascon Technologic ID code for the runtime system	
<b>Virtual Machine</b>	Version of the runtime software	
<b>PLC-Status</b>	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)
<b>Exit</b>	Return to previous menu	

**Note:** The Production Code is registered in the file: */fs1/prodstr\_file* and **must not be touched/modified** by anyone.

Active alarms are acknowledged by entering 1 and then Return key.

**Caution**

Anyway, in case of whatever serious problem, please contact the Technical Service support.

## 7-4 Master Reset

A real “*Master Reset*” function as the one implemented in the original AC-Station units is not available in the new AC<sup>3</sup>nP system. This functionality was required when, due to a temporary hardware failure, normally generated by some anomalous external conditions, the unit seemed to behave erroneously or appeared completely locked and does not allow operating from the keyboard or the communication ports. In cases similar to those just described, it is possible to try to recover the situation by “resetting” the AC<sup>3</sup>nP system.

In order to do that, it is necessary to follow the procedure described at “2-4 Select a resident Strategy” and from there press the “*Master Reset*” button.



### **DANGER!**

This operation will delete the actual control strategy used by the CPU!!!

**Do not power cycle the unit!!!**

After this operation, it will be necessary to load a new desired control strategy as described on “2-4 Select a resident Strategy”.

## 7-5 Diagnostic Test and Calibration

This paragraph describes how to perform the diagnostic test of the nP4 on-board I/O. It is recommended to use a digital multimeter/calibrator to have as much as possible accurate measures of the analogue signals generated to or from (inputs and outputs) the AC<sup>3</sup>nP system during the test phase, like the ASCOCAL 10 series model or others with similar performances.

### 7-5-1 Entering the Diagnostic Test session

The nP4 unit comes with an integrated diagnostic page from where it is possible to test the on-board I/Os. This session can be activated from the STARTUP TIMEOUT MENU using the entry “*Post Startup Run*”.

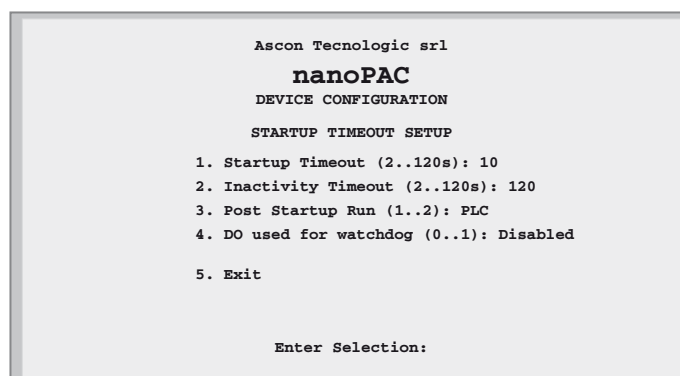


Figure 7.3 Startup Setup Menu

To run the “*I/O Watch Window*”, the value “**I/O Watch**” must be set to “**3**” and the value “**2**” must be specified to activate the diagnostic session. The following table shows the possible values:

Value	Value displayed	Meaning
1	PLC	Exiting the configuration session the system runs the PLC 1131 application
2	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 diagnostic one.



## 7-5-2 I/O Watch Window

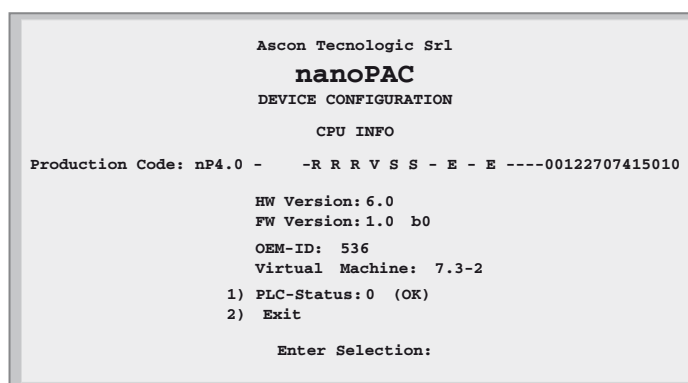


Figure 7.4 I/O Watch Window

Using the “I/O Watch Window” the user can:

- Read the analogue inputs in engineering unit;
- Read the digital inputs in binary format;
- Set the analogue output values in percentage (0... 100);
- Set the digital outputs in binary format;
- Read the temperature values coming from the internal board (used for the cold junction compensation in case of TC input) and used for internal purposes only.

The window is refreshed continuously in order to display the actual I/O values. The refresh rate can be adjusted by the entry 8 (Autorefresh). The following table shows the possible values:

Value	Refresh rate
0	No refresh (static mask)
1... 5	Time between 2 refresh operations (1... 5 seconds)

To set an output value, the user must select the desired output number (1 for the digital, 2... 5 for the analogue output) and then type the desired value:

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

**Examples Digital Output Channels**

Digital Output	DO 1	DO 2	DO 3	DO 4	DO 5	DO 6	DO 7	DO 8
<b>Desired value</b>	0	0	1	0	0	0	1	1
Enter selection	1							
Insert new value	00100011							

**Analogue Output Channels**

**Ch1 Output Type:** 0... 10V  
**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.

### 7-5-3 Calibrations

Differently from the original AC-Station controller which allowed performing on site calibration for both analogue inputs and outputs, on the new AC<sup>3</sup>nP system this is not possible anymore. For this reason, in case of suspect problems concerning this matter, the unit must be returned to factory for a complete recalibration process.

## 7-6 Faulty Components Replacement

---

The AC<sup>3</sup>nP system, as described at “1-1 Technical specification”, is composed by two components, the P04 front touch screen panel and the nP4 CPU unit. These components could be ordered separately also as spare parts as described in Chapter 9 “Order code”.



### Caution

In case of whatelse faulty component problems, please contact the Technical Service support.

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## 7-7 Spare Parts

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Position	Description	Part number
1	P04 Touch Screen Operator Panel	AC3NP-----P-ATA41
2	nP4 Control Unit	AC3NP4x----2I--ATA41

**Note:** The “x” character represents the amount of Analogue Outputs present in the nP4 control unit.

# Chapter 8

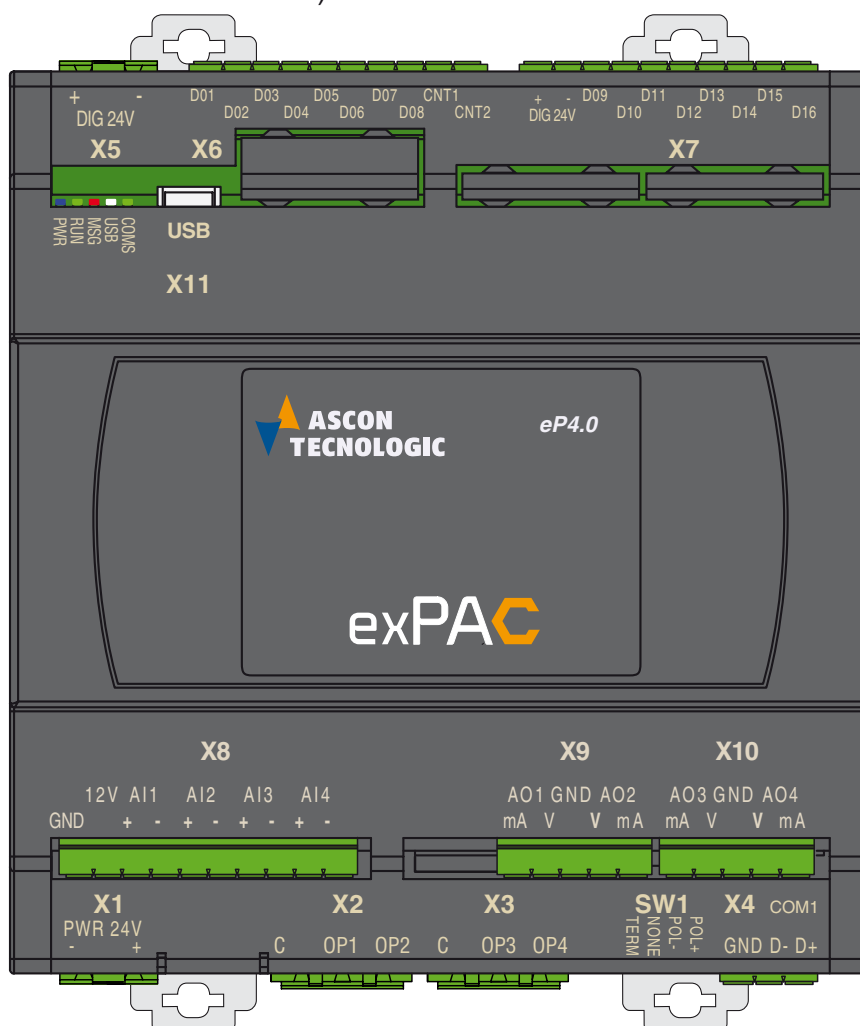
## Expansion Modules

### 8-1 General Information

Up to 2 expansion modules can be connected to the CPU in order to obtain the desired number of I/Os.

The specific eP4 expansion module is equipped with an RS485 modbus RTU interface and adds 8 Digital Inputs (24 Vdc), 8 Digital Outputs (24 Vdc, 0.5 A), 4 universal analogue inputs [mA, V, thermocouple, PT100 (2 wires), PT1000, NTC, potentiometer or 5 V Ratiometric], 4 high level analogue outputs (mA or V), up to 4 SPST relays or SSR drive and 2 fast DI for pulse counts (up to 5 kHz) or frequency (available soon).

The expansion modules must be installed on the DIN rail close to the right part of the CPU, using the dedicated X4 RS485 port (for details see the modules or the CPU Installation Manual).



## 8-2 Technical Characteristics

### 8-2-1 AC3NP--M~~x~~-----ATA41

**Note:** The “~~x~~” character represents the amount of Analogue Outputs present in the nP4 expansion module.

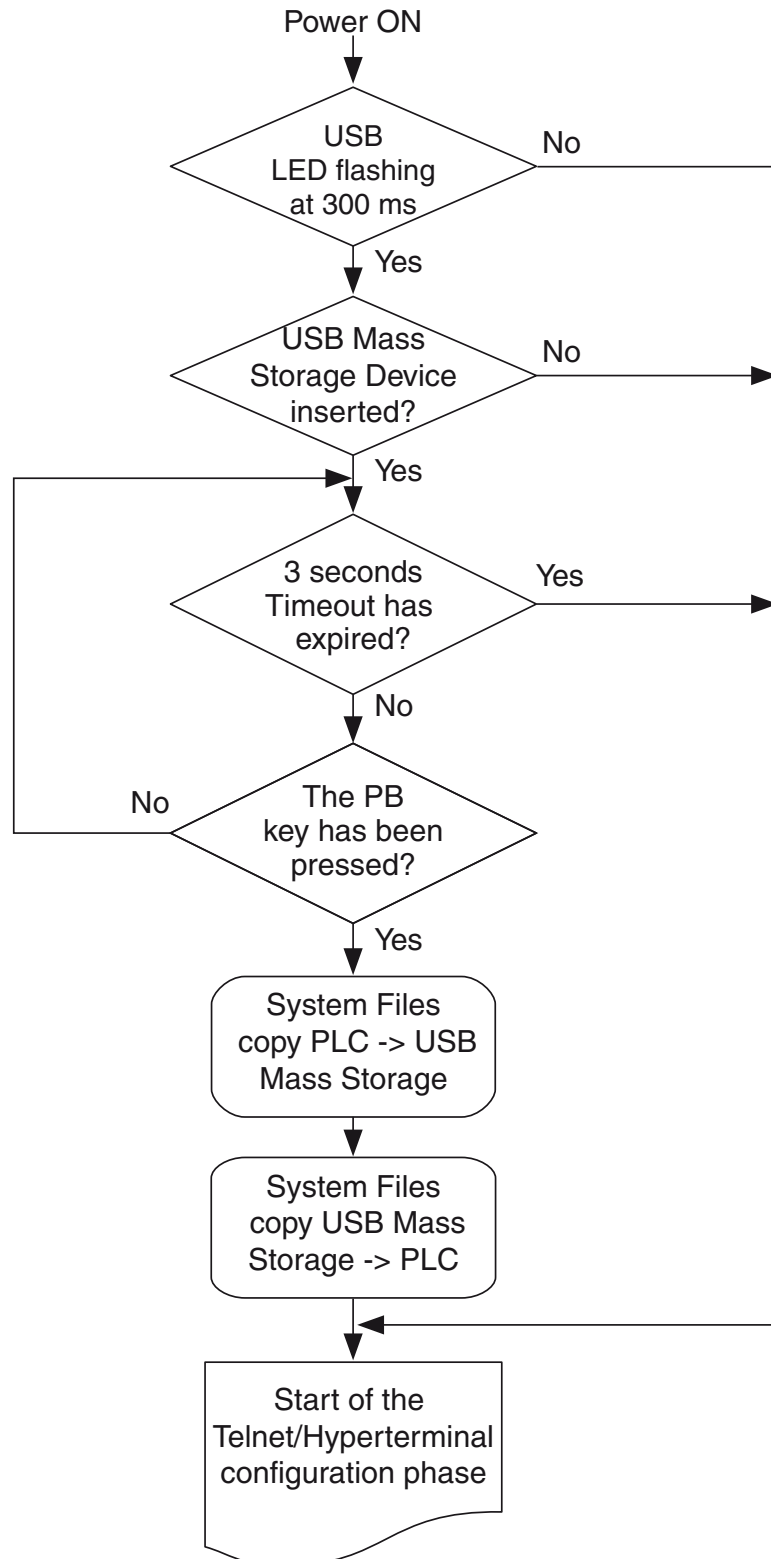
<b>Universal Analogue Inputs</b>	Configurable between: 0/1... 5 V, 0/2... 10 V, 0/4... 20 mA, TC (J, K, L, N, R, S, T), PT100 (2 wires), PT1000, NTC (103AT-2), Potentiometer, 5 V Ratiometric
	16 bit resolution
	Accuracy 0.1% of span (linear), 0.2% (temperature)
	Input Impedance >100 kW, <200 W (mA)
<b>Analogue Outputs</b>	Configurable 0/1... 5 V, 0/2... 10 V, 0/4... 20 mA
	12 bit resolution
	Accuracy 0.1 % full scale
<b>8/16 + 2 Digital I/O</b>	8 (16 I/O mix) sink type IEC611131-2 type 3
	High-side output 0.7 A each
	2 input sink type IEC611131-2 type 3 for counters and frequency (5 kHz max.)
	Protection: reverse polarity and overvoltage
<b>4 Relay/SSR Drive</b>	Relay 2 A, 240 Vac, or SSR Drive max. 20 mA, 12 V
	Protection: Overvoltage
	Insulation 2500V (Relay), 800V SSR Drive with respect power supply, analogue & digital I/Os and serial comms ports (isolated version)
<b>Communication port</b>	RS485 (optional/isolated)
<b>Protocol</b>	Proprietary protocol for local expansion, Modbus RTU (Slave)
<b>Power Supply</b>	24 Vdc (-15... +25%)
<b>Power consumption</b>	12 W
<b>Dimensions/Weight</b>	W x H x D 108 x 110 x 60 mm (6 DIN module)/512 g
<b>Mounting</b>	On Omega DIN A rail
<b>Protection</b>	IP 20
<b>Insulation</b>	800 V between digitals, power supply and Analogue Inputs, Analogue Outputs, serial comm ports (isolated version)
<b>Operating/storage temperature</b>	-20... 50°C (-4... 122°F)/-40... 70°C (-40... 158°F)
<b>Operating Humidity</b>	5... 95 RH% without condensation

### 8-3 Configuring the Expansion Module with the USB Mass Storage Device

The **eP4** expansion module is equipped with a USB port type AB which can operate in Host mode and manage a USB Mass Storage Device (**USB key**) to download/upload the specific system files. The processes are executed in the order described in the specific procedure.

#### 8-3-1 Power up sequence

The following flowchart illustrates the steps performed by the unit during power up sequence.



### 8-3-2 Upload System Files from the eP4 Expansion Unit

After the boot-up phase, if the above described procedure has been properly executed, the eP4 copies the internal files on the USB key 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

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

### 8-3-3 Download System Files to the eP4 Expansion Unit

Once the files upload process described at paragraph 8.3.2 reaches the end, the eP4 copies the same files **from the USB key** to the internal 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
/fs2/retain	0:sys_sts/ret_var.bin

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

# Chapter 9

## Order Code

	<b>CPU Module</b> AC3nP = Module nP4	
	<b>Analogue Inputs +I/O Configuration</b> - = None D = 4 Universal Inputs + 16 DIO + 2 DI CNT 4 = 4 Universal Inputs + 8 DI + 2 DI CNT + 8 DO	
	<b>Analogue Outputs</b> - = None 2 = 1 module with 2 <b>not</b> isolated analogue outputs 4 = 2 modules with 2 <b>not</b> isolated analogue outputs each	
	<b>First expansion module</b> -- = None L1 = Local 4 UI + 8DI + 8DO + 2 DI CNT + 4 OP relays L2 = Local 4 UI + 2 AO + 8DI + 8 DO + 2 DI CNT + 4 OP relays L3 = Local 4 UI + 4 AO + 8DI + 8 DO + 2 DI CNT + 4 OP relays L4 = Local 8 UI + 8 DI + 8 DO + 2 DI CNT + 4 OP relays L5 = Local 8 UI + 2 AO + 8 DI + 8 DO + 2 DI CNT + 4 OP relays L6 = Local 8 UI + 4 AO + 8 DI + 8 DO + 2 DI CNT + 4 OP relays M1 = Modbus 4 UI + 8 DI + 8 DO + 2 DI CNT + 4 relays OP M2 = Modbus 4 UI + 2 AO + 8 DI + 8 DO + 2 DI CNT + 4 relays OP M3 = Modbus 4 UI + 4 AO + 8 DI + 8 DO + 2 DI CNT + 4 relays OP	
	<b>Second expansion module</b> -- = None L1 = Local 4 UI + 8DI + 8DO + 2 DI CNT + 4 OP relays L2 = Local 4 UI + 2 AO + 8DI + 8 DO + 2 DI CNT + 4 OP relays L3 = Local 4 UI + 4 AO + 8DI + 8 DO + 2 DI CNT + 4 OP relays L4 = Local 8 UI + 8 DI + 8 DO + 2 DI CNT + 4 OP relays L5 = Local 8 UI + 2 AO + 8 DI + 8 DO + 2 DI CNT + 4 OP relays L6 = Local 8 UI + 4 AO + 8 DI + 8 DO + 2 DI CNT + 4 OP relays M1 = Modbus 4 UI + 8 DI + 8 DO + 2 DI CNT + 4 relays OP M2 = Modbus 4 UI + 2 AO + 8 DI + 8 DO + 2 DI CNT + 4 relays OP M3 = Modbus 4 UI + 4 AO + 8 DI + 8 DO + 2 DI CNT + 4 relays OP	
	<b>Serial ports</b> 2I = RS232/485 Isolated + RS485 Isolated	
	<b>Operator panel</b> - = None P = P04 Operator panel <b>with</b> Adapter A = Adapter	
	<b>ACC = Cabling and accessories</b> - = None C = Short Installation Board + 0.2 m cable L = Long Installation Board + 0.2 m cable 0 = 0.2 m cable 1 = 1 m cable 2 = 2 m cable 5 = 5 m cable	
	<b>HW/SW AC3 Customization</b> xxxx = Reserved (internal use only)	
	<b>SW Subversion</b> x = Reserved (internal use only)	





# Appendix A

## Resident Configurations

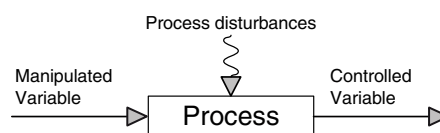
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### A-1 How to implement a PID controller

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The purpose of a PID loop is to control a variable of an industrial process. The purpose of an industrial process is to produce materials, products or energy, using the minimum quantity of energy and providing the maximum level of safety. To achieve this target with an high level of quality standard, each single element of the process must work precisely. That means that each variable of the process must be, finely, tuned and kept as much as possible close to the pre is called regulation, and the PID is the PID is one of the tool that does it.

To understand how the control process works, we must consider that the process is a system, whose behaviour is determined by the 3 class of magnitudes, as shown in the figure that follows.



The controlled variables are the chemical, physical and electrical magnitudes, that must be controlled and kept at the Set Point, in order to produce efficiently and with an high degree of quality. For instance, pressures, levels, flows, temperature etc. are controlled variables. They are, usually, named with the mnemonic PV (Process Value), while its Set Point is named SP.

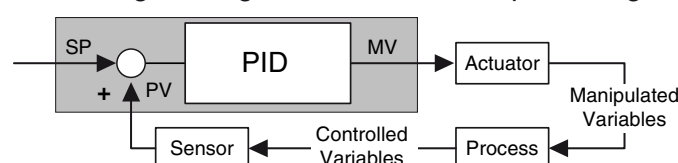
The manipulated variables are the ones the regulation system moves continuously, in order to carry out the control action and keep stable and close the controlled variable to the Set Point. For instance, air, water, oil, gas, energies, fuels etc. are manipulated variable.

The disturbances are transient situations, related to physical magnitudes, that interfere, randomly and abruptly, with the process and have the effect of moving “PV” far away from “SP”. For instance, the simple change of the Set Point can be considered a disturbance.

Therefore, the purpose of controller is to carry out all the actions required to satisfy the equation:

$$PV - SP = 0$$

generating a control output, that, driving dedicated actuators, acts on the manipulated variables. This control output is named M.V. (Manipulated Value) and, not having a well defined engineering unit, is indicated in percentage.

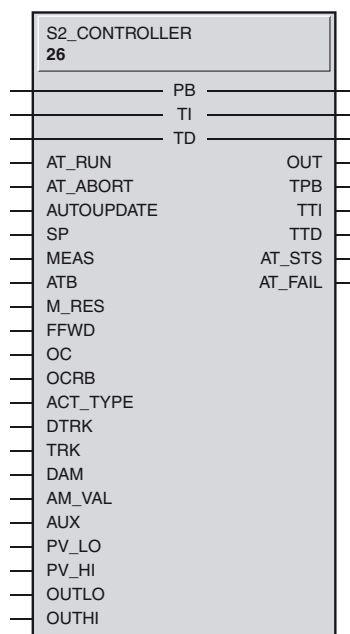


The illustration shows the process, with the various magnitudes types and an elementary PID regulator. Following the considerations above, a block diagram of this

PID loop can be easily determined. Differently from the AC-Station line, the implementation of a PID loop has been dramatically simplified. In fact, previously it was necessary to interconnect 3 different function blocks (**SVD**, **PID** and **MV**) in order to get one, now everything has been embedded in just one single function block called **S2\_CONTROLLER** which performs all the specific functions and more.

The **S2\_CONTROLLER** output can be directly linked to the specific global variable which applies then the calculated control output to the terminals.

The illustration that follows shows the **S2\_CONTROLLER** function block which performs a complete PID control loop.



The function block implements a lot of functionalities such as Auto-Tuning, Feed Forward, Overshoot Control, Output Tracking and Auxiliary and a complete Auto/Manual station. These functions are eventually very helpful to manipulate, when and/or if needed, the control output to drive an external actuator. The SP slopes and control output Hold functions are available through specific dedicated function blocks that should be used in conjunction with it.

## A-2 Ratio

### A-2-1 Description

The following paragraphs are provided to help the user to better understand all the information concerning the specific control strategy and, in particular:

- Project Tasks (POU) Organization and Order;
- Block diagram representation;
- Set of display panels used within the application;
- Application examples;
- I/O table related to the signals managed from/to the field.

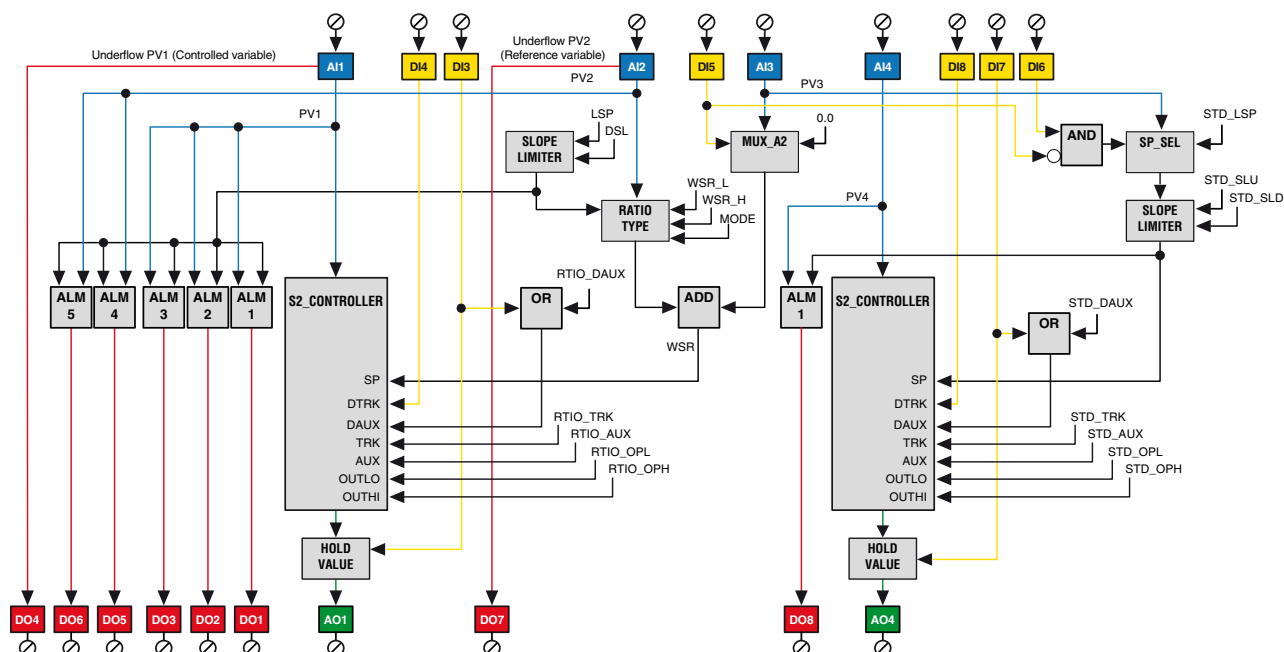
### A-2-2 Project Tasks (POU) Organization and Order

In order to obtain the proper operations coming with the functions of the strategy, it is necessary to link the tasks that have been developed as follows:

1. <b>Ratio_Vars.STD.POE</b>	Global Variables declaration file;
2. <b>Ratio_Vars.DIR.POE</b>	Direct Variables declaration file;
3. <b>Ratio_Values_Mngt.ST</b>	Variables application pre-set operations;
4. <b>Ratio_IO_Mngt.CFC</b>	I/O conditioning operations;
5. <b>Ratio_Common_Oprs.ST</b>	Application overhaul general operations;
6. <b>Ratio_Loop_Mngt.CFC</b>	Specific Ratio process control operations;
7. <b>Ratio_Loop_Std_Mngt.CFC</b>	Generic Standard process control operations;
8. <b>Ratio_Pages.CFC</b>	Overhall display Pages management;
9. <b>Ratio_Tags.CSV</b>	Display pages specific tags excel CSV file.

### A-2-3 Block Diagram

The following diagram provides an overall understanding of the process control and logic that have been arranged for the specific purpose. For this reasons the function block representation has been simplified to enhance readability and the specific functionalities meaning.



This configuration consists of:

- An advanced Ratio Loop;
- A Standard single action loop.

The first loop is the main one and implements a full ratio control algorithm, which calculates the SP correlating the Reference analogue input signal (**AI2**) and the

Controlled one.

Additionally have been implemented the following important functionalities:

- BIAS on the Local SP (WSR);
- Control Output forcing modes;
- Up to 3 Alarms on AI1;
- Up to 2 Alarms on AI2.

The second loop is a Standard PID loop having the following functionalities:

- Remote SP (through **AI3** if this signal is not used for the Ratio BIAS);
- Control Output forcing modes;
- Alarm on the controlled variable AI4.

#### Control **Ratio Loop**

Both the AI1 Controlled and AI2 Reference variables are acquired, filtered, corrected and converted into the desired engineering unit by the specific and dedicated **MP\_AIMNGT\_ADV** function blocks with out of range detection. These two variables are managed by the **RATIO\_TYPE** function block which computes the Working SP Ratio for the loop accordingly to the selected type of ratio (direct or reverse), as in the following formulas:

**Direct ratio** = AI2 x Ratio SP = WSR

**Inverse ratio** = AI2/Ratio SP = WSR

The Working SP Ratio (**WSR**) becomes then the working SP used by the **S2\_CONTROLLER** to control the **AI1** variable. The loop control output is then used to drive the actuator which has to be connected to the **AO1** analogue output.

#### **Standard Loop**

The **AI4** Controlled variable is acquired, filtered, corrected and converted into the desired engineering unit by the specific and dedicated **MP\_AI\_MNGT\_ADV** function blocks with out of range detection. Then, it is managed by the dedicated **S2\_CONTROLLER** function block which performs the PID calculation accordingly to the desired SP. It generates the control output value to drive the actuator which has to be connected to the **AO4** analogue output.

**BIAS** The BIAS feature consists in a simple math sum of a quantity to the Ratio SP (**WSR**), before to be used as SP of the Controlled Variable by the **S2\_CONTROLLER**, provided by the analogue BIAS input (**AI3**). This feature can be enabled or disabled by using the digital input **DI5**.

**Remote SP** This feature is supported only on the Standard Loop and can be enabled or disabled by using the **DI6** digital input and in combination with the **DI5**. The Remote SP can be selected, by using the dedicated **SP\_SEL** function block, between the standard Local SP, coming from the front panel pages or the analogue input **AI3**. The choice is univocally alternative to using **AI3** as **BIAS** input for the *Ratio* loop.

**Forcing Modes** These operations are alternative to the **S2\_CONTROLLER PID** output calculation. The functionalities provided by the two loops are slight different, as described below.

#### **Ratio Loop**

The control output forcing mode available within this configuration, selectable through the **DI3** and **DI4** are:

- **Tracking:** It can be enabled by the activation of the **DI4** digital input and it produces as result the control output forcing to the constant value editable from the specific Configuration page.
- **Hold:** It can be enabled by the activation of the **DI3** digital input or the **DAUX** command coming from the dedicated front panel page, and it produces as result the freezing of the control output at the last value calculated at the time

before the transition.

DI3	DI4	Selected Value
OFF	OFF	No forcing
OFF	ON	Output Tracking
ON	OFF	Output Hold
ON	ON	Output Tracking

An important point to keep in mind is that the Output Tracking is handled directly by the **S2\_CONTROLLER** function block whilst the Output Hold is managed by a dedicated external **HOLD\_VALUE** one.

### Standard Loop

Both the previous described functions have been available also on the additional Standard Loop.

The Tracking mode sets the control output to the constant value, editable from the specific Configuration page, until the **DI8** is activated or the **DTRK** command coming from the dedicated front panel page whilst the Hold function freezes the loop control output while the **DI7** digital input is activated.

DI7	DI8	Selected Value
OFF	OFF	No forcing
OFF	ON	Output Tracking
ON	OFF	Output Hold
ON	ON	Output Tracking

### Alarms Ratio Loop

There are three alarms either on the **AI1** Controlled variable, according to the working mode desired for each of the **ALARM\_ADV** function blocks that have been used. The status of each alarm is then reported as digital output through **DO1**, **DO2** and **DO3**.

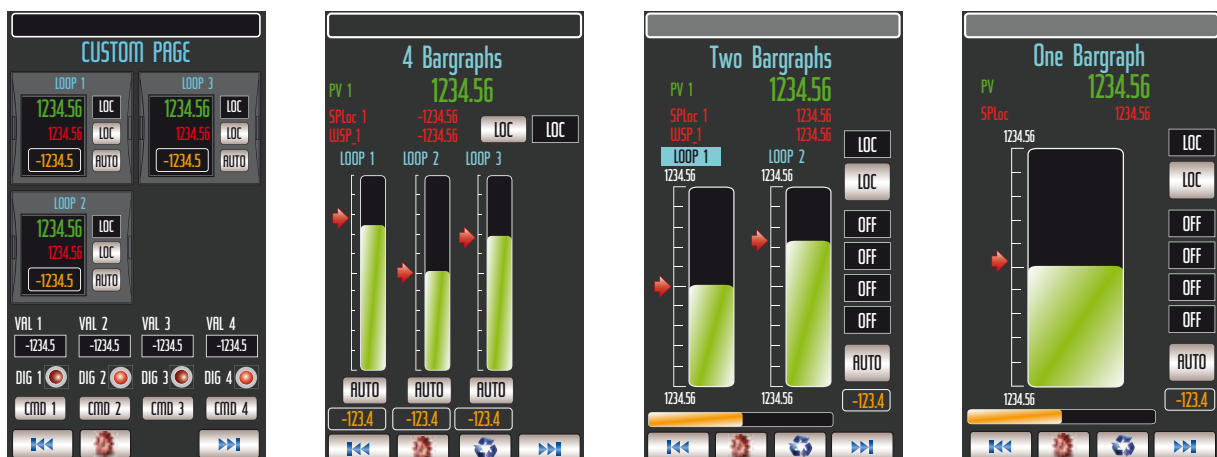
Two alarms are implemented by the additional **ALARM\_ADV** function blocks on the **AI2** Reference variable. Also in this case, the status is reported as digital output through **DO5** and **DO6**.

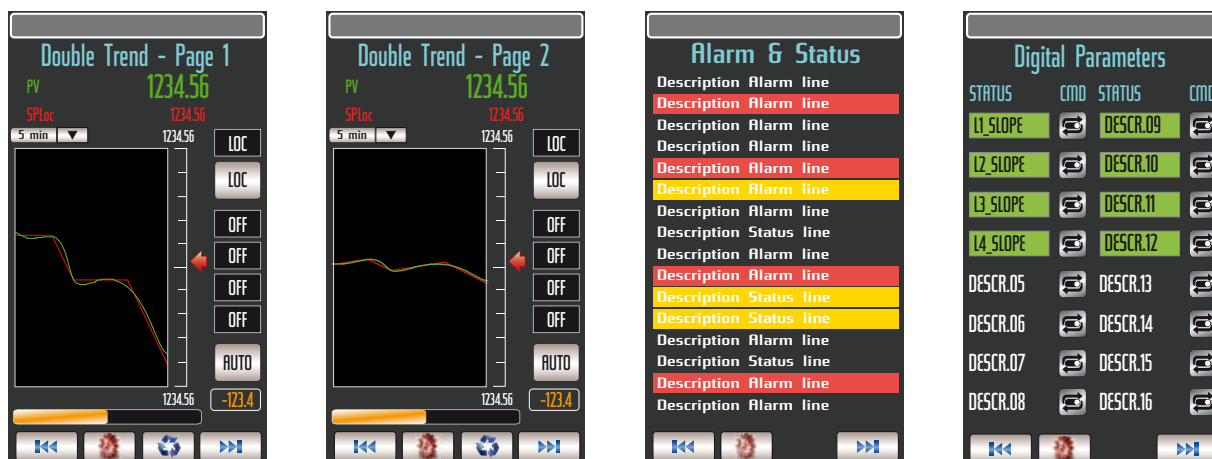
Both the **AI1** Controlled variable and **AI2** Reference variable Out of Range status is detected and applied as digital output through **DO4** and **DO7**.

### Standard Loop

This loop is provided with a unique alarm either on the controlled variable **AI3**, according to the working mode desired on the **ALARM\_ADV** function block. The status of the alarm is applied as digital output through **DO8**.


## A-2-4 Graphic Display





The pictures above show the different types of display panels, providing the most effective interface for this strategy configuration. After the Custom page, three more panel pages consisting in a 3 bargraph display, the alarm list and the Forcing mode list are intended to provide a quite complete interface for this configuration.

Referring to the 3 bargraph display, the 2 bargraph from the left are used for the **A11** Controlled and **A12** Reference variables whilst the third one belongs to the additional Standard Loop.

If you want to operate on a loop, first you have to select it, by pressing the  button. The loop selected is highlighted by the fact that the background colour of the specific Tag changes from dark grey to light blue. Once the loop has been selected, it is possible to change either the SP or the **A/M** station operating mode. Furthermore, the parameters shown in the upper part of the panel relates to the selected loop.

The alarms status is displayed by the scrolling bar present on top of all the available pages within an application. When an alarm becomes active, the related alarm description scrolls continuously, to alert the operator. Anyway, the operator can get a more detailed view of the alarms, by looking at the specific “Alarms & Events” panel pages.

Furthermore, this configuration provides four more additional panel pages, 2 for each loop, with the well know bargraph and trend displays, as shown in the pictures above.

## A-2-5 Applications

The purpose of the ratio loop is to control those processes where it is required to keep, at a predefined set, the ratio between two controlled variables. There are plenty of examples of processes of this type: for instance, the control of the blending between two fluids and the control of the combustion (air and gas mix).

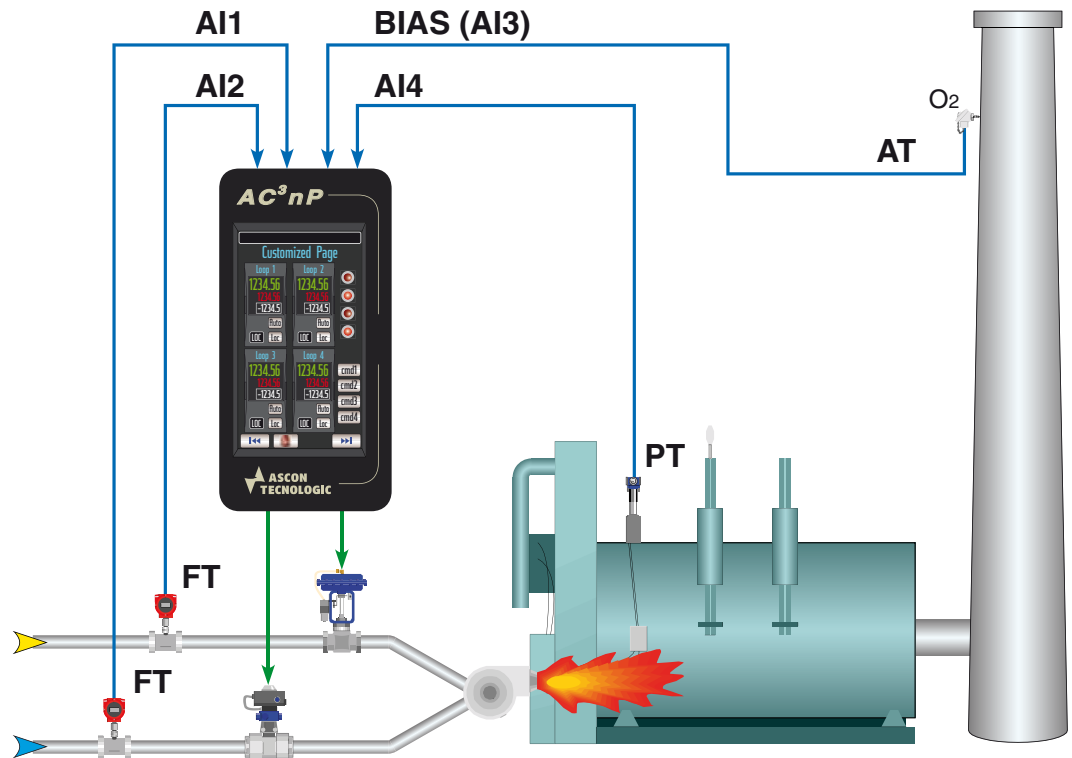
The second basic PID loop can be used to control an independent variable of the process, where the ratio control is required.

An example is shown in the picture below, related to the combustion control of a steam generator. The steam pressure is controlled by the Std Loop, whose output defines the energy (heat amount) to supply to the boiler, driving the gas valve.

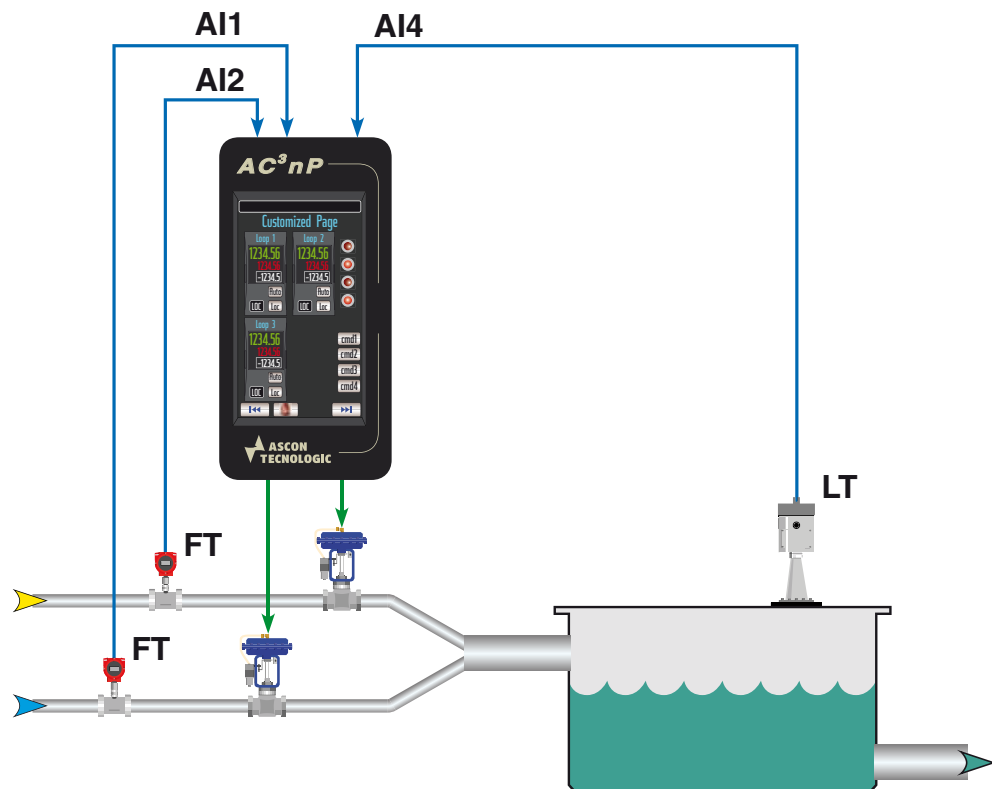
The ratio loop controls the air flow rate, that, in order to optimise the combustion, must be kept to a predefined ratio with the instantaneous gas flow rate. The ratio loop receives the gas flow rate, as PV2, and its output drives the air door. The control of combustion can be, further, improved by measuring the oxygen in the fumes and correcting, according to the measure, the air/gas ratio SP, by mean of the Bias input.

Furthermore, using the digital inputs, some additional functionalities can be implemented, like forcing the closure of the gas valve, tracking the valve at the start up

and disabling the oxygen bias when the production is at the minimum level.



Another application of the ratio loop is in controlling the dosing of an additive to a fluid with variable flow. In this application, the standard Loop can be used to control the level of the tank where the fluid enters.





## A-2-6 Signals I/O Table

I/O	Conn.	Terminals	Type	Description
<b>COM1</b>	X13	D+, D-, GND	RS232/485	Not used
<b>COM2</b>	X4	D+, D-, GND	RS485	Modbus Slave_1 Agent
<b>ETH</b>	X12		Ethernet	P04 connection
<b>AI1</b>	X8	+/-	PT1000	Controlled Variable
<b>AI2</b>		+/-	4... 20 mA	Reference Variable
<b>AI3</b>		+/-	...	Bias WSR Ratio/SP Remote Std. Loop
<b>AI4</b>		+/-	...	Std. Loop Variable
<b>AO1</b>	X9	mA/GND	4... 20 mA	Ratio Control Output
<b>AO2</b>		mA/GND	4... 20 mA	Not Used - Available
<b>AO3</b>	X10	...	...	Not Used - Available
<b>AO4</b>		...	...	Std. Loop Control Output
<b>DI1</b>	X6	D01/+24 Vdc	Sink +24 Vdc	Not Used - Available
<b>DI2</b>		D02/+24 Vdc	Sink +24 Vdc	Not Used - Available
<b>DI3</b>		D03/+24 Vdc	Sink +24 Vdc	Hold OP Ratio
<b>DI4</b>		D04/+24 Vdc	Sink +24 Vdc	Tracking OP Ratio
<b>DI5</b>		D05/+24 Vdc	Sink +24 Vdc	Bias WSR Ratio/SP Remote Std. Loop
<b>DI6</b>		D06/+24 Vdc	Sink +24 Vdc	SP Remote Std Loop
<b>DI7</b>		D07/+24 Vdc	Sink +24 Vdc	Hold control output Std. Loop
<b>DI8</b>		D08/+24 Vdc	Sink +24 Vdc	Tracking control output Std Loop
<b>OP_1</b>	X2	OP1/C	Relay 2 A	Not Used - Available
<b>OP_2</b>		OP2/C	Relay 2 A	Not Used - Available
<b>OP_3</b>	X3	OP3/C	Relay 2 A	Not Used - Available
<b>OP_4</b>		OP4/C	Relay 2 A	Not Used - Available
<b>DO1</b>	X7	D09/+24 Vdc	High side 0.7 A	Ratio Alarm_1 Status
<b>DO2</b>		D10/+24 Vdc	High side 0.7 A	Ratio Alarm_2 Status
<b>DO3</b>		D11/+24 Vdc	High side 0.7 A	Ratio Alarm_3 Status
<b>DO4</b>		D12/+24 Vdc	High side 0.7 A	Out of Range Controlled Variable
<b>DO5</b>		D13/+24 Vdc	High side 0.7 A	Ratio Alarm_4 Status
<b>DO6</b>		D14/+24 Vdc	High side 0.7 A	Ratio Alarm_5 Status
<b>DO7</b>		D15/+24 Vdc	High side 0.7 A	Out of Range Reference Variable
<b>DO8</b>		D16/+24 Vdc	High side 0.7 A	Std. Loop Alarm_1 Status



## A-3 Cascade

### A-3-1 Description

The following drawings below are provided to help the user to better understand all the information concerning the specific control strategy and, in particular:

- Project Tasks (POU) Organization and Order;
- Block diagram representation;
- Set of display panels used within the application;
- Application examples;
- I/O table related to the signals managed from/to the field.

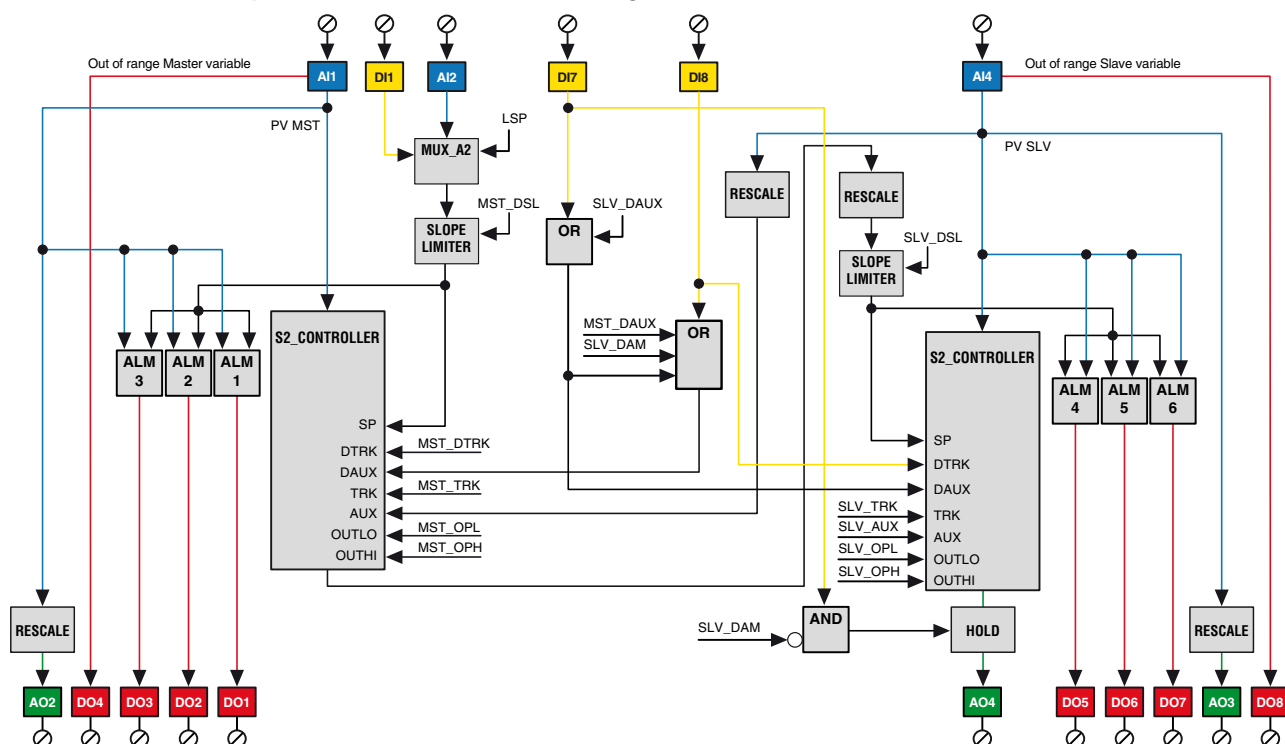
### A-3-2 Project Tasks (POU) Organization and Order

In order to obtain the proper operations coming with the functions of the strategy, it is necessary to link the tasks that have been developed as follows:

1. <b>Cascade_Vars.STD.POE</b>	Global Variables declaration file;
2. <b>Cascade_Vars.DIR.POE</b>	Direct Variables declaration file;
3. <b>Cascade_Values_Mngt.ST</b>	Variables application pre-set operations;
4. <b>Cascade_IO_Mngt.CFC</b>	I/O conditioning operations;
5. <b>Cascade_Common_Oprs.ST</b>	Application overhaul general operations;
6. <b>Cascade_Loop_Mngt.CFC</b>	Specific Cascade process control operations;
7. <b>Cascade_Pages.CFC</b>	Overhaul display Pages management
8. <b>Cascade_Tags.CSV</b>	Display pages specific tags excel CSV file.

### A-3-3 Block Diagram

The following diagram provides an overall understanding of the process control and logic that have been arranged for the specific purpose. For this reasons the function block representation has been simplified to enhance readability and the specific functionalities meaning.



This configuration consists of 2 loops interconnected in a Cascade configuration and, in particular:

- The Master control loop;
- The Slave control loop.

The Master control output becomes the working SP of the Slave. Additionally have been implemented the following important functionalities:

- Local/Remote SP selection;
- SP Slopes limitation;
- Control Output forcing modes;
- Up to 3 Alarms on the AI1 variable;

The Slave control loop is conceptually a standard PID loop having the following functionalities:

- SP Slopes limitation;
- Control Output forcing modes;
- Up to 3 Alarms on the AI4 variable.

#### Control Master Loop

The **AI1 Master** variable is acquired, filtered, corrected and converted into the desired engineering unit by the specific and dedicated **MP\_AI\_MNGT\_ADV** function block with out of range detection. Then, it is managed by the dedicated **S2\_CONTROLLER** function block which performs the **PID** calculation accordingly to the desired SP. The output is then adjusted to the **AI4** Slave process variable range by a dedicated **RESCALE** function block and becomes the working SP into the **Slave S2\_CONTROLLER** module.

#### Slave Loop

The **AI4 Slave** variable is acquired, filtered, corrected and converted into the desired engineering unit by the specific and dedicated **MP\_AI\_MNGT\_ADV** function block with out of range detection. Then, it is managed by the dedicated **S2\_CONTROLLER** function block which performs the **PID** calculation accordingly to the **Master SP**. It generates the control output value to drive the actuator which has to be connected to the **AO4** analogue output.

The **Slave variable** is also adjusted to the **Master range**, by a dedicated **RESCALE** function block, and connected to the **Master loop AUX input**. Any of the **Slave control output** forcing produces a “synchronization” on the **Master control loop output**. This “feedback” connection is required in order to perform a **bumpless refresh** in case of Auto/Manual and/or output forcing actions: on every change, the **Master output** is instantly realigned to the **Slave variable value**.

**Remote SP** This feature is supported only on the **Master Loop** whilst the **Slave** one is conceptually always in a sort of **Remote SP** condition. It can be enabled or disabled by using the **DI1** digital input. The **Remote SP** can be selected, by using the dedicated **SP\_SEL** function block, between the standard **Local SP**, coming from the front panel pages or the analogue input **AI2**.

DI1 or CASC_XXX_CSP	Selected Value
OFF	Local SP
ON	Remote SP (AI2)

**Forcing Modes** These operations are alternative to the **S2\_CONTROLLER PID** output calculation. The functionalities provided by the two loops are slight different, as described below.

#### Slave Loop

The control output forcing mode available within this configuration, selectable through the **DI7** and **DI8** are:

- **Tracking:** It can be enabled by the activation of the **DI4** digital input and it produces as result the control output forcing to the constant value editable from the specific Configuration page.
- **Hold:** It can be enabled by the activation of the **DI3** digital input or the **DAUX** command coming from the dedicated front panel page, and it produces as result the freezing of the control output at the last value calculated at the time

before the transition.

DI7	DI8	Selected Value
OFF	OFF	No forcing
OFF	ON	Output Tracking
ON	OFF	Output Hold
ON	ON	Output Tracking

An important point to keep in mind is that the *Output Tracking* is handled directly by the **S2\_CONTROLLER** function block whilst the *Output Hold* is managed by a dedicated external **HOLD\_VALUE** one.

#### Alarms Master Loop

There are 3 alarms on the **AI1 Master variable**, according to the working mode desired for each of the **ALARM\_ADV** function blocks that have been used. The status of each alarm is then reported as digital output through **DO1**, **DO2** and **DO3**. The **AI1 Out of Range variable** status is detected and applied as digital output through **DO4**.

#### Slave Loop

There are 3 alarms on the **AI4 Slave variable**, according to the working mode desired for each of the **ALARM\_ADV** function blocks that have been used. The status of each alarm is then reported as digital output through **DO5**, **DO6** and **DO7**. The **AI2 Out of Range variable** status is detected and applied as digital output through **DO8**.

#### Variable Master Loop

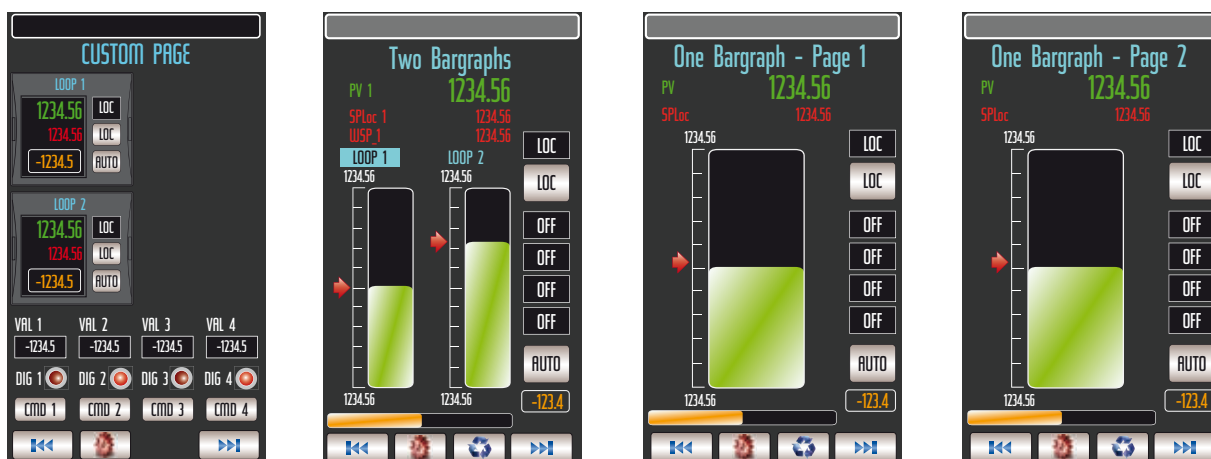
*Retransmission* The **AI1 Master variable** is retransmitted, after a proper rescaling operation, on the **AO2** output.

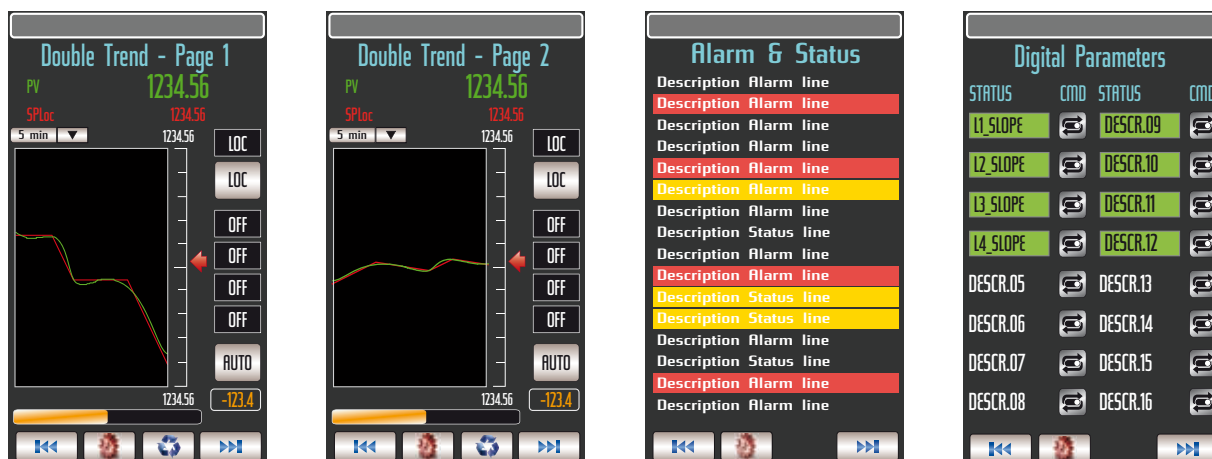
#### Slave Loop

The **AI4 Slave variable** is retransmitted, after a proper rescaling operation, on the **AO3** output.

The **RESCALE** function blocks allow the operator to set the retransmitting output ranges that could be different from the input variable ones. This feature could be very helpful in those cases where it is necessary to partialize an input variable range in order to achieve sensible improvements on the retransmission output resolution.

### A-3-4 Graphic Displays






The pictures above show the different types of display panels, providing the most effective interface for this strategy configuration. After the Custom page, seven more panel pages consisting in a 2 bargraph display, two single bargraph and two double trend, forcing mode commands plus the alarm list are intended to provide a quite complete interface for this configuration.


Concerning the 2 bargraph display, the **Master variable** is displayed both at the top, with large size digits, and with the bargraph on the left while the **Master Working SP (WSP)** is displayed by the slider.

About the Slave loop, the controlled variable is displayed by the bargraph on the right and the **Working SP** is also displayed by the specific slider.

Both Master and Slave control output, driving respectively the Slave WSP and the external actuator, are displayed by the horizontal bargraph and numerically when the specific loop will be selected.

If you want to operate on a loop, first you have to select it, by pressing the  button. The loop selected is highlighted by the fact that the background colour of the specific Tag changes from dark grey to light blue. Once the loop has been selected, it is possible to change either the SP or the **A/M** station operating mode. Furthermore, the parameters shown in the upper part of the panel relates to the selected loop.

The alarms status is displayed by the scrolling bar present on top of all the available pages within an application. When an alarm becomes active, the related alarm description scrolls continuously, to alert the operator. Anyway, the operator can get a more detailed view of the alarms, by looking at the specific “*Alarms & Events*” panel pages.

Additionally, by pressing the  button, in the scrollable top display area, will be shown, in the order, the following variables:

- MST\_WSP** Master loop Working SP;
- SLV\_WSP** Slave loop Working SP.

The SP operating mode is displayed on the top - right area, by side the button which allows to select it. The status and functionalities are related to the selected loop.

The four squared digital indications, on the right side of some panels, are used to indicate some operational status accordingly to the selected loop and, in particular:

1. **TRK** Tracking OP Master loop TRK Tracking OP Slave loop;
2. **AUX** Auxiliary OP Master loop AUX Auxiliary OP Slave loop;
3. **SLP** SP Slope Master loop HOLD Hold OP Slave loop;
4. **KO\_AI** Master loop KO\_AI Slave loop.

These are simple instantaneous indications: for a more detailed description of those, the **ALARMS & EVENTS** panel page provides univocal information on each of the digital status or forcing actions.

The digital status of an alarm or event is indicated, by type colour, in reverse mode if active or normal mode if inactive.

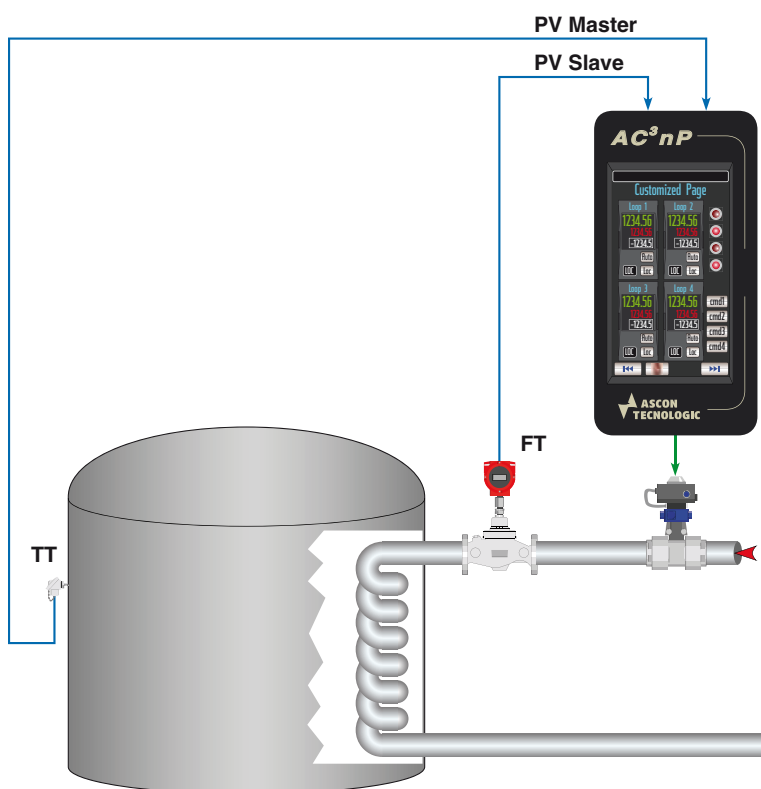
On the ALARMS & EVENTS panel page, the following alarms and forcing status are displayed:

MST ALARM_1	Indicating the Alarm_1 status on the Master loop;
MST ALARM_2	Indicating the Alarm_2 status on the Master loop;
MST ALARM_3	Indicating the Alarm_3 status on the Master loop;
MST AI_KO	Indicating a problem of the AI1 Master input;
SLV ALARM_4	Indicating the Alarm_4 status on the Slave loop;
SLV ALARM_5	Indicating the Alarm_5 status on the Slave loop;
SLV ALARM_6	Indicating the Alarm_6 status on the Slave loop;
SLV AI_KO	Indicating a problem of the AI4 Slave input;
MST OP TRACKING	Indicating the Tracking Output forcing to a value on the Master loop;
MST OP AUXILIARY	Indicating the Auxiliary Output forcing to a value on the Master loop;
SLV OP TRACKING	Indicating the Tracking Output forcing to a value on the Slave loop;
SLV OP AUXILIARY	Indicating the Auxiliary Output forcing to a value on the Slave loop;
SLV OP HOLD	Indicating the Output frozen at the last value on the Slave loop.

Furthermore, this configuration includes also single bargraph display and the double pens trend which provide the same functionalities of the previous panel but, additionally, a programmable time width chart, showing the trend curves of the controlled variables and SP.

### A-3-5 Applications

A typical case where a cascade architecture provides excellent results is when the manipulated variable is influenced indirectly by other process variables or external events. An example is shown in the picture below.



The target is to control the tank temperature by managing the hot fluid flow rate to the heat exchanger. This can be achieved, using just one loop, by measuring

the temperature of the tank and controlling the flow rate regulating valve of hot fluid. This solution, in most cases, is unsatisfactory because it generates continuous instability on the controlled variable. This is due to the fact the fluid pressure increases and, consequently, the flow rate increases, but the temperature takes a lot of time to rise up in order to have a response on the valve control output. The effect is a big heat accumulation in the tank that creates the instability.

The Cascade control provides a perfect solution in these cases because the Temperature loop, with its slow inertia, is controlled by a separate loop whose output defines the target flow rate of the fluid. This target flow rate becomes the set of the Slave loop controlling the flow rate, that having as measured variable the instantaneous flow rate, is capable to compensate immediately the changes of fluid pressure.

### A-3-6 Signals I/O Table

I/O	Conn.	Terminals	Type	Description
<b>COM1</b>	X13	D+, D-, GND	RS232/485	Not used
<b>COM2</b>	X4	D+, D-, GND	RS485	Modbus Slave_1 Agent
<b>ETH</b>	X12		Ethernet	P04 connection
<b>AI1</b>	X8	+/-	PT1000	Master Variable
<b>AI2</b>		+/-	4... 20 mA	Remote SP Variable
<b>AI3</b>		+/-	...	Not Used - Available
<b>AI4</b>		+/-	...	Slave Variable
<b>AO1</b>	X9	mA/GND	4... 20 mA	Not Used - Available
<b>AO2</b>		mA/GND	4... 20 mA	Master Variable Retransmission
<b>AO3</b>	X10	...	...	Slave Variable Retransmission
<b>AO4</b>		...	...	Cascade Control output
<b>DI1</b>	X6	D01/+24 Vdc	Sink +24 Vdc	Master Remote SP selection
<b>DI2</b>		D02/+24 Vdc	Sink +24 Vdc	Not Used - Available
<b>DI3</b>		D03/+24 Vdc	Sink +24 Vdc	Not Used - Available
<b>DI4</b>		D04/+24 Vdc	Sink +24 Vdc	Not Used - Available
<b>DI5</b>		D05/+24 Vdc	Sink +24 Vdc	Not Used - Available
<b>DI6</b>		D06/+24 Vdc	Sink +24 Vdc	Not Used - Available
<b>DI7</b>		D07/+24 Vdc	Sink +24 Vdc	Slave Hold control output
<b>DI8</b>		D08/+24 Vdc	Sink +24 Vdc	Slave Tracking control output
<b>OP_1</b>	X2	OP1/C	Relay 2 A	Not Used - Available
<b>OP_2</b>		OP2/C	Relay 2 A	Not Used - Available
<b>OP_3</b>	X3	OP3/C	Relay 2 A	Not Used - Available
<b>OP_4</b>		OP4/C	Relay 2 A	Not Used - Available
<b>DO1</b>	X7	D09/+24 Vdc	High side 0.7 A	Master Alarm_1 Status
<b>DO2</b>		D10/+24 Vdc	High side 0.7 A	Master Alarm_2 Status
<b>DO3</b>		D11/+24 Vdc	High side 0.7 A	Master Alarm_3 Status
<b>DO4</b>		D12/+24 Vdc	High side 0.7 A	Out of Range Master variable
<b>DO5</b>		D13/+24 Vdc	High side 0.7 A	Slave Alarm_4 Status
<b>DO6</b>		D14/+24 Vdc	High side 0.7 A	Slave Alarm_5 Status
<b>DO7</b>		D15/+24 Vdc	High side 0.7 A	Slave Alarm_6 Status
<b>DO8</b>		D16/+24 Vdc	High side 0.7 A	Out of Range Slave variable



## A-4 Override

### A-4-1 Description

The following drawings below are provided to help the user to better understand all the information concerning the specific control strategy and, in particular:

- Function block diagram representation;
- Set of display panels used within the application;
- I/O table related to the signals managed from/to the field.

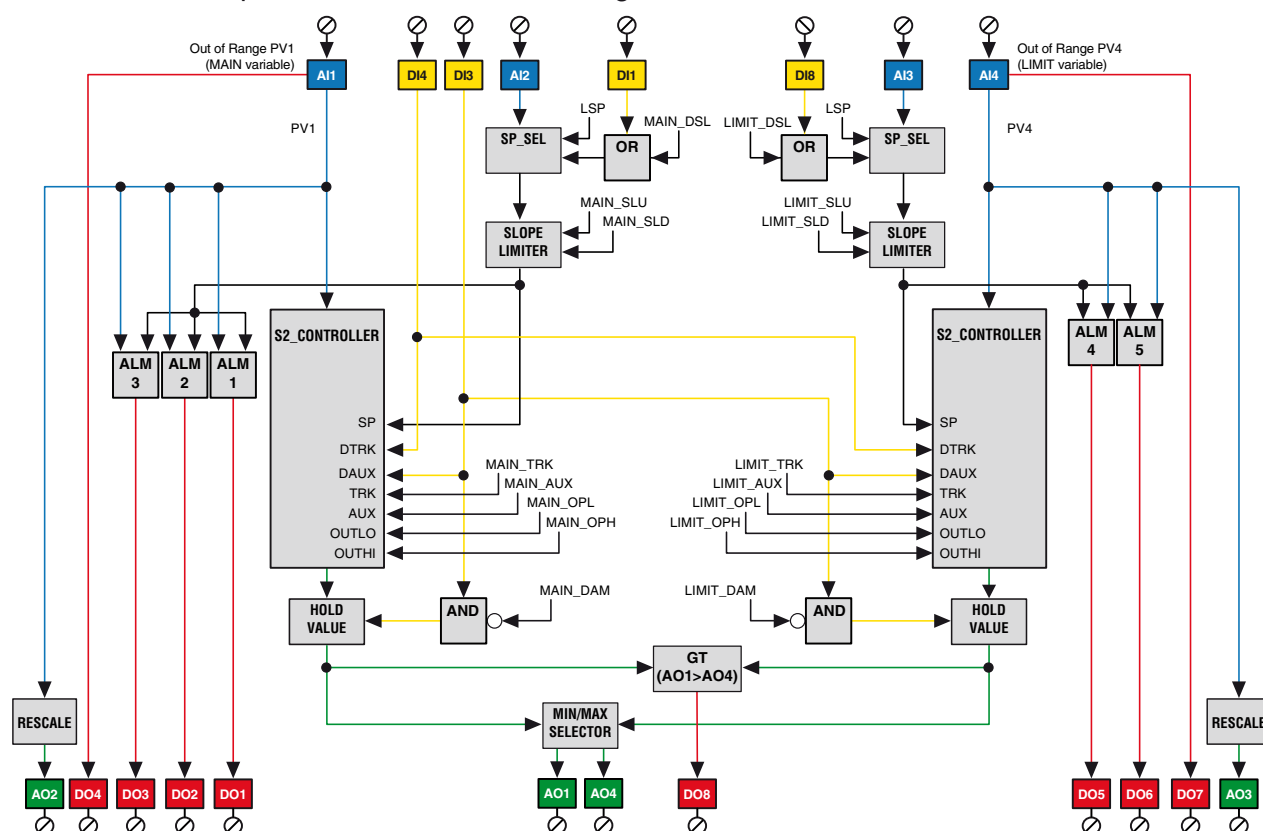
### A-4-2 Project Tasks (POU) Organization and Order

In order to obtain the proper operations coming with the functions of the strategy, it is necessary to link the tasks that have been developed as follows:

1. <b>Override_Vars.STD.POE</b>	Global Variables declaration file;
2. <b>Override_Vars.DIR.POE</b>	Direct Variables declaration file;
3. <b>Override_Values_Mngt.ST</b>	Variables application pre-set operations;
4. <b>Override_IO_Mngt.CFC</b>	I/O conditioning operations;
5. <b>Override_Common_Oprs.ST</b>	Application overhaul general operations;
6. <b>Override_Loop_Mngt.CFC</b>	Specific Override process control operations;
7. <b>Override_Pages.CFC</b>	Overhaul display Pages management
8. <b>Override_Tags.CSV</b>	Display pages specific tags excel CSV file.

### A-4-3 Block Diagram

The following diagram provides an overall understanding of the process control and logic that have been arranged for the specific purpose. For this reasons the function block representation has been simplified to enhance readability and the specific functionalities meaning.



This configuration consists of 2 loops interconnected in an Override configuration and, in particular:

- The Main control loop;
- The Limit control loop.

The control outputs from the two loops are then compared and, accordingly to the desired mode (greater or minor), will be applied to the external actuator. Additionally have been implemented the following important functionalities:

- Local/Remote SP selection;
- SP Slopes limitation;
- Control Output forcing modes;
- Up to 3 Alarms on the Main variable;
- Up to 2 Alarms on the Limit variable;
- Comparison status of the two control outputs.

#### Control Main Loop

The **AI1** Main variable is acquired, filtered, corrected and converted into the desired engineering unit by the specific and dedicated **MP\_AI\_MNGT\_ADV** function block with Out of range detection. Then, it is managed by the dedicated **S2\_CONTROLLER** function block which performs the PID calculation accordingly to the desired SP.

#### Limit Loop

The **AI4** Limit variable is acquired, filtered, corrected and converted into the desired engineering unit by the specific and dedicated **MP\_AI\_MNGT\_ADV** function block with out of range detection. Then, it is managed by the dedicated **S2\_CONTROLLER** function block which performs the PID calculation accordingly to the desired SP.

Both the control outputs from **Main** and **Limit loops** are then **compared** and only the one complaining with the desired working mode will be then applied as effective control output value to drive the actuator which has to be connected to the **AO1** analogue output.

Some of the forcing modes (Tracking and Hold) are acting on both the **S2\_CONTROLLER** module. The Bumpless transfer output is common to both the loops, in order to keep the two PID aligned.

**Remote SP** This feature is supported both on the Main and Slave loops. It can be enabled or disabled by using the **DI1** and **DI8** digital inputs. The Remote SP can be selected, by using the dedicated **SP\_SEL** function block, between the standard Local SP, coming from the front panel pages or the analogue inputs AI2 and AI3.

DI1 (DI8) or OVRD_xxx_CSP	Selected Value
Off	Local SP
On	Remote SP AI3 (AI3)

**Forcing Modes** These operations are alternative to the **S2\_CONTROLLER PID** output calculation. The functionalities provided by the two loops are slight different, as described below.

#### A-4-4 Main and Slave Loops

The control output forcing mode available within this configuration, selectable through the **DI3** and **DI4** are:

- **Tracking:** It can be enabled by the activation of the **DI4** digital input and it produces as result the control output forcing to the constant value editable from the specific Configuration page.
- **Hold:** It can be enabled by the activation of the **DI3** digital input or the **DAUX** command coming from the dedicated front panel page, and it produces as result the freezing of the control output at the last value calculated at the time before the transition.

DI3	DI4	Selected Value
OFF	OFF	No forcing
OFF	ON	Output Tracking



DI3	DI4	Selected Value
ON	OFF	Output Hold
ON	ON	Output Tracking

An important point to keep in mind is that the Output Tracking is handled directly by the **S2\_CONTROLLER** function block whilst the Output Hold is managed by a dedicated external **HOLD\_VALUE** one.

#### Alarms Main Loop

There are three alarms on the **AI1 Main variable**, according to the working mode desired for each of the **ALARM\_ADV** function blocks that have been used. The status of each alarm is then reported as digital output through **DO1**, **DO2** and **DO3**. The **AI1 Out of Range** variable status is detected and applied as digital output through **DO4**.

#### Limit Loop

There are two alarms on the **AI4 Slave variable**, according to the working mode desired for each of the **ALARM\_ADV** function blocks. The status of each alarm is then reported as digital output through **DO5** and **DO6**.

The **AI4 Out of Range** variable status is detected and applied as digital output through **DO7**.

An additional alarm performs the comparison between the control outputs of the Main and the Limit loop, determining which of the two loop is driving the output and flagging it out through the **DO8**.

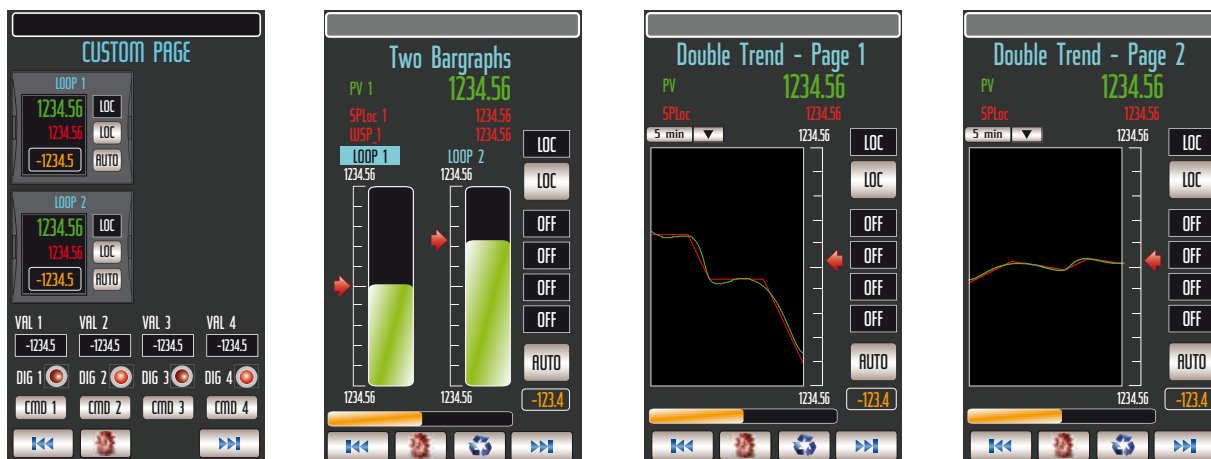
#### Variable Retransmission

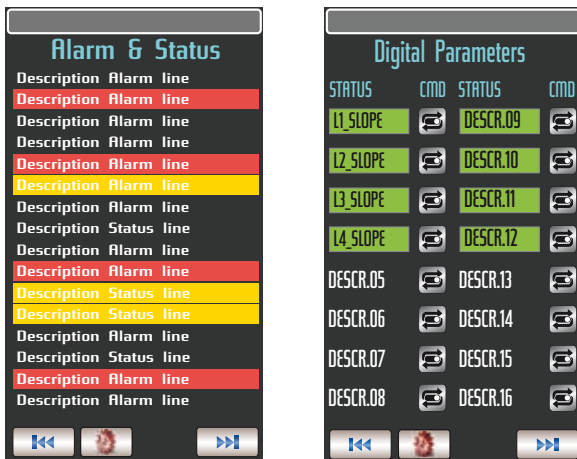
The **AI1 Main variable** is retransmitted, after a proper rescaling operation, on the **AO2** output.

The **AI4 Limit variable** is retransmitted, after a proper rescaling operation, on the **AO3** output.

The **RESCALE** function blocks allow the operator to set the retransmitting output ranges that could be different from the input variable ones. This feature could be very helpful in those cases where it is necessary to partialize an input variable range in order to achieve sensible improvements on the retransmission output resolution.

### A-4-5 Graphic Display






The pictures above show the different types of display panels, providing the most effective interface for this strategy configuration. After the Custom page, five more panel pages consisting in a 2 bargraph display, two double trend, forcing mode commands and the alarm list are intended to provide a quite complete interface for this configuration.


Concerning the 2 bargraph display, the Main variable is displayed both at the top, with large size digits, and with the bargraph on the left while the Main Working SP (**WSP**) is displayed by the slider.

About the Limit loop, the controlled variable is displayed by the bargraph on the right and the Working SP is also displayed by the specific slider.

Both Main and Limit control output, compared to select the one which drives the external actuator, are displayed by the horizontal bargraph and numerically when the specific loop will be selected.

If you want to operate on a loop, first you have to select it, by pressing the  button. The loop selected is highlighted by the fact that the background colour of the specific Tag changes from dark grey to light blue. Once the loop has been selected, it is possible to change either the SP or the **A/M** station operating mode. Furthermore, the parameters shown in the upper part of the panel relates to the selected loop.

The alarms status is displayed by the scrolling bar present on top of all the available pages within an application. When an alarm becomes active, the related alarm description scrolls continuously, to alert the operator. Anyway, the operator can get a more detailed view of the alarms, by looking at the specific “*Alarms & Events*” panel pages.

Additionally, by pressing the  button, in the scrollable top display area will be shown, in the order, the following variables:

**MST\_RSP** Main loop Remote SP;

**SLV\_RSP** Slave loop Remote SP.

The SP operating mode is displayed on the top - right area, by side the button which allows to select it. The status and functionalities are related to the selected loop.

The four squared digital indications, on the right side of the panels, are used to indicate some operational status accordingly to the selected loop and, in particular:

1. **TRK Tracking OP Main loop** TRK Tracking OP Limit loop;
2. **HLD Hold OP Main loop** HLD Hold OP Slave loop;
3. **MAIN OP Main > Limit** MAIN OP Main > Limit;
4. **KO\_AI Main loop** KO\_AI Limit loop.

These are simple instantaneous indications: for a more detailed description of those, the **ALARMS & EVENTS** panel page provides univocal information on each of the digital status or forcing actions.

The digital status of an alarm or event is indicated, by type colour, in reverse mode if active or normal mode if inactive.

On the ALARMS & EVENTS panel page, the following alarms and forcing status are displayed:

MAIN ALARM_1	Indicating the Alarm_1 status on the Main loop;
MAIN ALARM_2	Indicating the Alarm_2 status on the Main loop;
MAIN ALARM_3	indicating the Alarm_3 status on the Main loop;
MAIN AI_KO	indicating a problem of the AI1 Main input;
LIM ALARM_4	indicating the Alarm_4 status on the Limit loop;
LIM ALARM_5	Indicating the Alarm_5 status on the Limit loop;
LIM AI_KO	Indicating a problem of the AI4 Limit input;
OP TRACKING	indicating the Tracking Output forcing to a value on both Main and Limit loop;
OP HOLD	Indicating the Output frozen at the last value on both Main and Limit loop.

Furthermore, this configuration includes also double pens trend which provide a programmable time width chart, showing the trend curves of the controlled variables and SP.

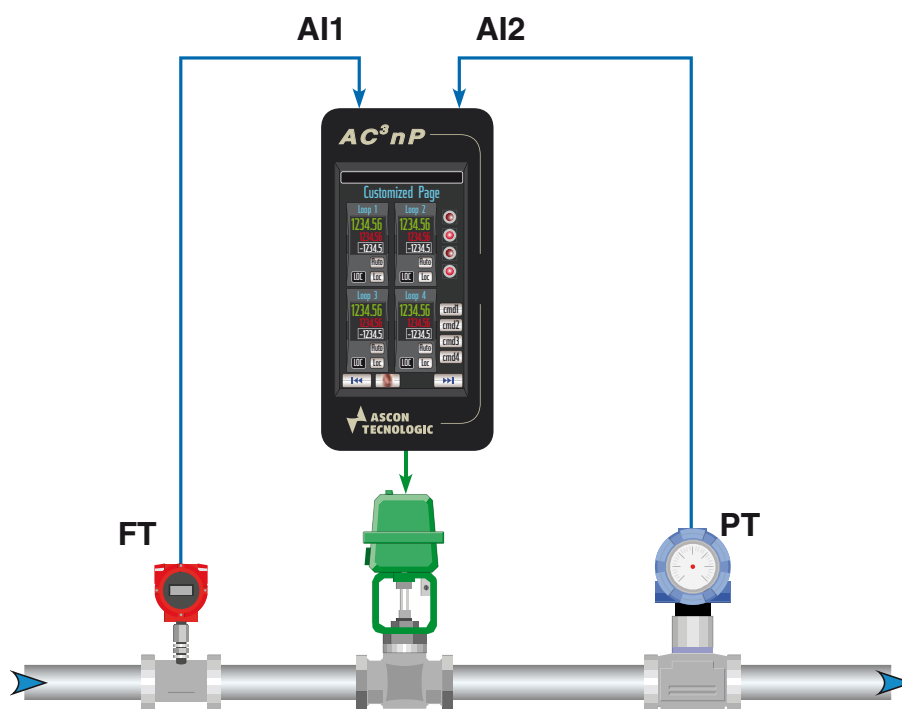
#### A-4-6 Applications

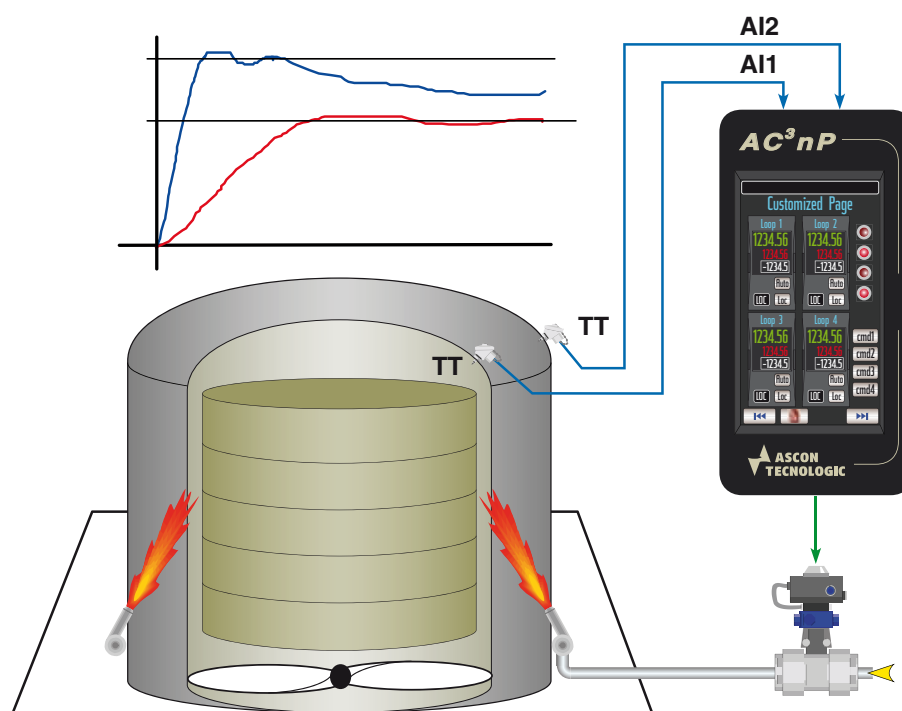
The override control is the right solution for controlling processes where more than one variable must be controlled at the same time. For instance, the process consists of a Main variable that must be kept at the SP and a Limit one that must not exceed a predefined threshold during normal operations, start up or when unexpected changes occur.

A few examples of a process requiring the override control could be:

- Flow control with a maximum limit on the pressure;
- Control of the pressure with a limit on the flow;

Control of the temperature of an object with limit on the heating elements maximum temperature.




**A-4-7 Signals I/O Table**

I/O	Conn.	Terminals	Type	Description
COM1	X13	D+, D-, GND	RS232/485	Not used
COM2	X4	D+, D-, GND	RS485	Modbus Slave_1 Agent
ETH	X12		Ethernet	P04 connection
AI1	X8	+/-	PT1000	Main Controlled Variable
AI2		+/-	4... 20 mA	Main Remote SP Variable
AI3		+/-	...	Limit Remote SP Variable
AI4		+/-	...	Limit Controlled Variable
AO1	X9	mA/GND	4... 20 mA	Override Control output
AO2		mA/GND	4... 20 mA	Main Variable Retransmission
AO3	X10	...	...	Slave Variable Retransmission
AO4		...	...	Not Used - Available
DI1	X6	D01/+24 Vdc	Sink +24 Vdc	Main Remote SP selection
DI2		D02/+24 Vdc	Sink +24 Vdc	Not Used - Available
DI3		D03/+24 Vdc	Sink +24 Vdc	Override Hold control output
DI4		D04/+24 Vdc	Sink +24 Vdc	Override Tracking control output
DI5		D05/+24 Vdc	Sink +24 Vdc	Not Used - Available
DI6		D06/+24 Vdc	Sink +24 Vdc	Not Used - Available
DI7		D07/+24 Vdc	Sink +24 Vdc	Not Used - Available
DI8		D08/+24 Vdc	Sink +24 Vdc	Not Used - Available
OP_1	X2	OP1/C	Relay 2 A	Not Used - Available
OP_2		OP2/C	Relay 2 A	Not Used - Available
OP_3	X3	OP3/C	Relay 2 A	Not Used - Available
OP_4		OP4/C	Relay 2 A	Not Used - Available

I/O	Conn.	Terminals	Type	Description
<b>DO1</b>	X7	D09/+24 Vdc	High side 0.7 A	Master Alarm_1 Status
<b>DO2</b>		D10/+24 Vdc	High side 0.7 A	Master Alarm_2 Status
<b>DO3</b>		D11/+24 Vdc	High side 0.7 A	Master Alarm_3 Status
<b>DO4</b>		D12/+24 Vdc	High side 0.7 A	Out of Range Master variable
<b>DO5</b>		D13/+24 Vdc	High side 0.7 A	Slave Alarm_4 Status
<b>DO6</b>		D14/+24 Vdc	High side 0.7 A	Slave Alarm_5 Status
<b>DO7</b>		D15/+24 Vdc	High side 0.7 A	Slave Alarm_6 Status
<b>DO8</b>		D16/+24 Vdc	High side 0.7 A	Out of Range Slave variable

## A-5 4 Loops

### A-5-1 Description

The following drawings below are provided to help the user to better understand all the information concerning the specific control strategy and, in particular:

- Project Tasks (POU) Organization and Order;
- Block diagram representation;
- Set of display panels used within the application;
- Application examples;
- I/O table related to the signals managed from/to the field.

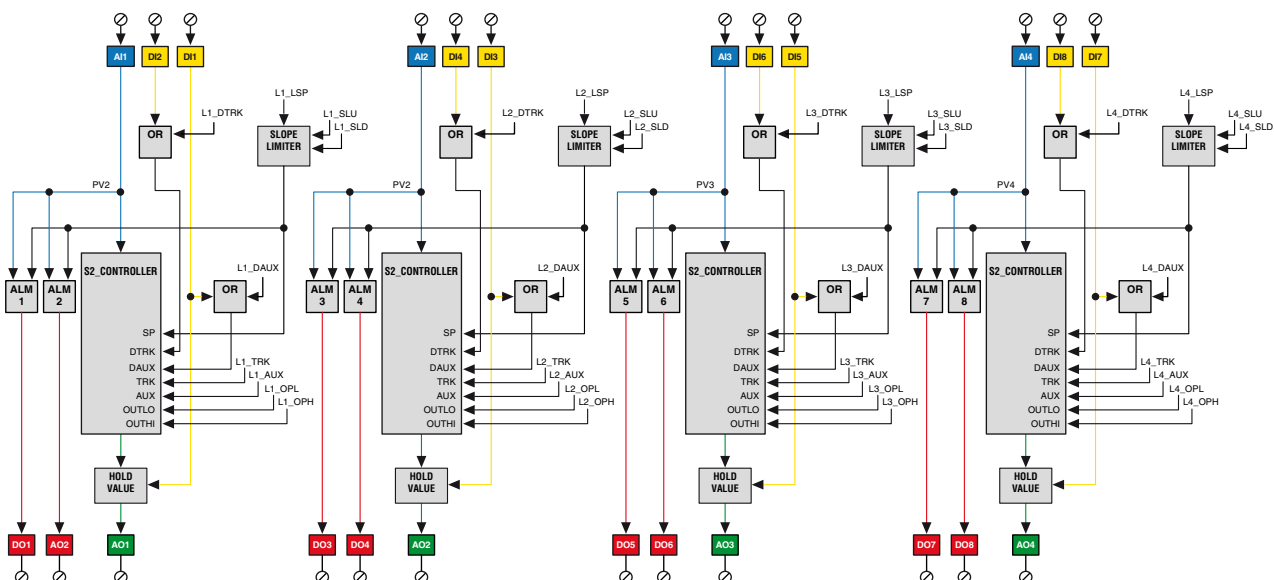
### A-5-2 Project Tasks (POU) Organization and Order

In order to obtain the proper operations coming with the functions of the strategy, it is necessary to link the tasks that have been developed as follows:

- |                                     |  |
|-------------------------------------|--|
| 1. <b>Four_Loops_Vars.STD.POE</b>   | Global Variables declaration file;           |
| 2. <b>Four_Loops_Vars.DIR.POE</b>   | Direct Variables declaration file;           |
| 3. <b>Four_Loops_Values_Mngt.ST</b> | Variables application pre-set operations;    |
| 4. <b>Four_Loops_IO_Mngt.CFC</b>    | I/O conditioning operations;                 |
| 5. <b>Four_Loops_Common_Oprs.ST</b> | Application overhall general operations;     |
| 6. <b>Four_Loops_1_Mngt.CFC</b>     | Specific 4 loops process control operations; |
| 7. <b>Four_Loops_2_Mngt.CFC</b>     | Specific 4 loops process control operations; |
| 8. <b>Four_Loops_3_Mngt.CFC</b>     | Specific 4 loops process control operations; |
| 9. <b>Four_Loops_4_Mngt.CFC</b>     | Specific 4 loops process control operations; |
| 10. <b>Four_Loops_Pages.CFC</b>     | Overhall display Pages management            |
| 11. <b>Four_Loops_Tags.CSV</b>      | Display pages specific tags excel CSV file.  |

### A-5-3 Block Diagram

The following diagram provides an overall understanding of the process control and logic that have been arranged for the specific purpose. For this reasons the function block representation has been simplified to enhance readability and the specific functionalities meaning.



This configuration provides a 4 independent basic PID loops, including output forcing mode and 2 alarms that behave according to the working mode desired for each of the **ALARM\_ADV** function block.

The descriptions that follow refer to Loop1 only due to the fact all of them are identical. They differ only by the specific I/O managed by themselves.

**Control** The **AI1 Controlled variable** is acquired, filtered, corrected and converted into

the desired engineering unit by the specific and dedicated **MP\_AI\_MNGT\_ADV** function block with Out of Range detection. Then, it is managed by the dedicated **S2\_CONTROLLER** function block which performs the PID calculation accordingly to the desired SP. It generates the control output value to drive the actuator which has to be connected to the **AO1** analogue output.

**Forcing Modes** These operations are alternative to the **S2\_CONTROLLER PID** output calculation. The Tracking mode sets the control output to the constant value, editable from the specific Configuration page, until the **DI2** is activated or the **DTRK** command coming from the dedicated front panel page whilst the Hold function freezes the loop control output while the **DI1** digital input is activated.

DI1	DI2	Selected Value
OFF	OFF	No forcing
OFF	ON	Output Tracking
ON	OFF	Output Hold
ON	ON	Output Tracking


**Alarms** Two alarms are implemented by additional **ALARM\_ADV** function blocks on the **AI1** Controlled variable. The status is reported as digital output through **DO1** and **DO2**.

#### A-5-4 Graphic Displays



The pictures above show the different types of display panels, providing the most effective interface for this strategy configuration. After the Custom page, 7 more panel pages consisting in a 4 bargraph display, the alarm list and the Forcing mode list are intended to provide a quite complete interface for this configuration.

The panel with the 4 bargraphs provides a complete view of all the 4 loops, with a fine level of details on the most important parameters.

If you want to operate on a loop, first you have to select it, by pressing the .



button. The loop selected is highlighted by the background colour of the specific Tag that changes from dark grey to light blue. Once the loop has been selected, it is possible to change the SP and/or the **A/M** station operating mode. Furthermore, the parameters shown in the upper part of the panel relates to the selected loop. The status of the alarms is displayed by the scrolling bar present on all the pages available within an application. When an alarm becomes active, the related alarm description scrolls continuously, to alert the operator. Anyway, the operator can get a more detailed view of the alarms, looking at the specific “Alarms & Events” panel pages.

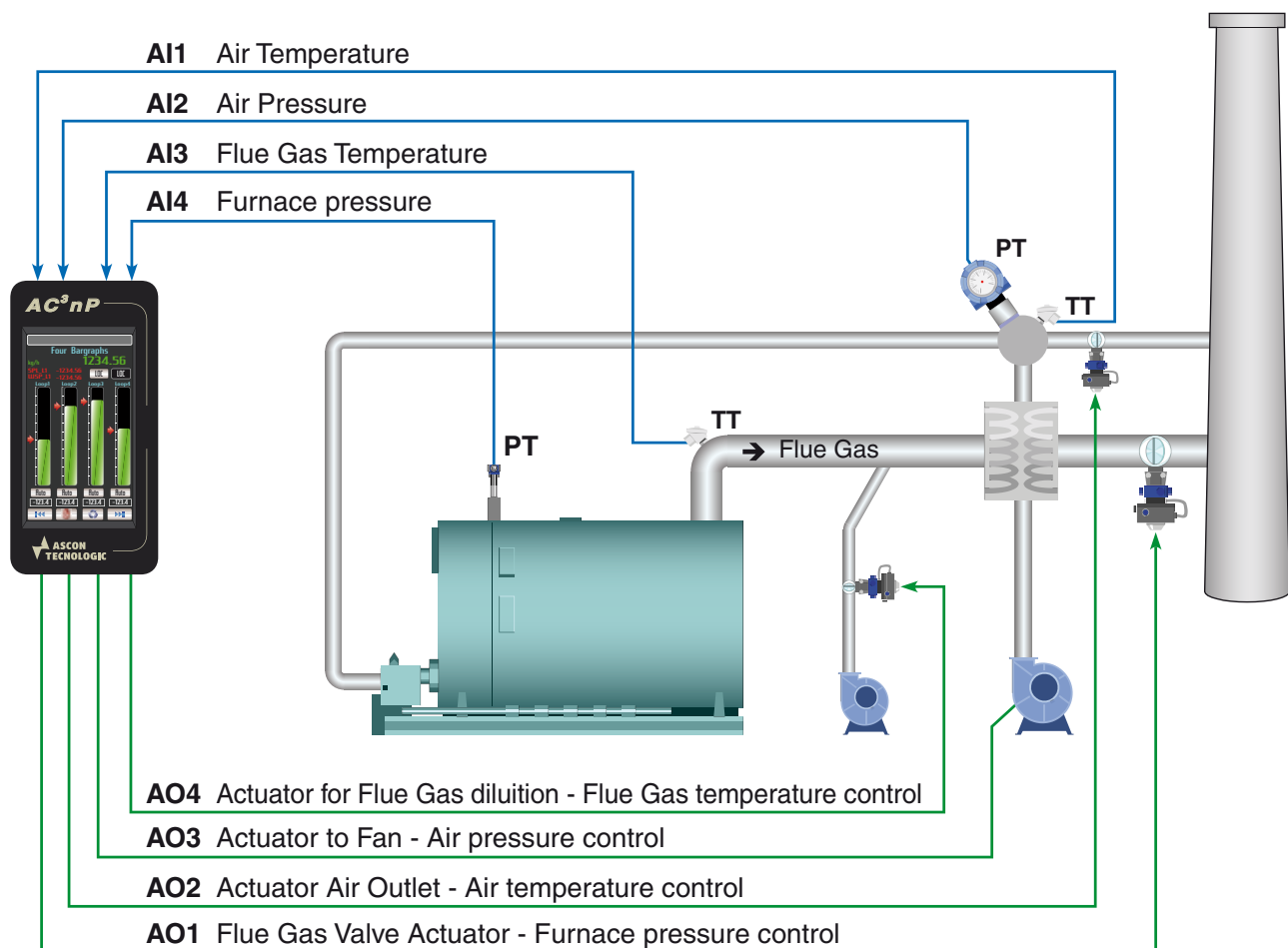
### A-5-5 Applications

This easy to use configuration is for simple applications, where standard PIDs are required to control up to 4 independent variables in just one box, with perfectly identical characteristics.

Furthermore, the loops have some additional functionalities, such as alarms and output forcing modes, to achieve more advanced results than a basic PID.

A typical example of a process where this configuration can be applied, is the control of a combustion heating furnace. The loops could be used to control:

- Air pressure;
- Air temperature;
- Furnace pressure;
- Co-generator flue gas temperature.





## A-5-6 Signals I/O Table

I/O	Conn.	Terminals	Type	Description
COM1	X13	D+, D-, GND	RS232/485	Not used
COM2	X4	D+, D-, GND	RS485	Modbus Slave_1 Agent
ETH	X12		Ethernet	P04 connection
AI1	X8	+/-	PT1000	Loop1 Controlled Variable
AI2		+/-	4... 20 mA	Loop2 Controlled Variable
AI3		+/-	...	Loop3 Controlled Variable
AI4		+/-	...	Loop4 Controlled Variable
AO1	X9	mA/GND	4... 20 mA	Loop1 Control Output
AO2		mA/GND	4... 20 mA	Loop2 Control Output
AO3	X10	...	...	Loop3 Control Output
AO4		...	...	Loop4 Control Output
DI1	X6	D01/+24 Vdc	Sink +24 Vdc	Loop1 Control Output Hold
DI2		D02/+24 Vdc	Sink +24 Vdc	Loop1 Control Output Tracking
DI3		D03/+24 Vdc	Sink +24 Vdc	Loop2 Control Output Hold
DI4		D04/+24 Vdc	Sink +24 Vdc	Loop2 Control Output Tracking
DI5		D05/+24 Vdc	Sink +24 Vdc	Loop3 Control Output Hold
DI6		D06/+24 Vdc	Sink +24 Vdc	Loop3 Control Output Tracking
DI7		D07/+24 Vdc	Sink +24 Vdc	Loop4 Control Output Hold
DI8		D08/+24 Vdc	Sink +24 Vdc	Loop4 Control Output Tracking
OP_1	X2	OP1/C	Relay 2 A	Not Used - Available
OP_2		OP2/C	Relay 2 A	Not Used - Available
OP_3	X3	OP3/C	Relay 2 A	Not Used - Available
OP_4		OP4/C	Relay 2 A	Not Used - Available
DO1	X7	D09/+24 Vdc	High side 0.7 A	Loop1 Alarm_1 Status
DO2		D10/+24 Vdc	High side 0.7 A	Loop1 Alarm_2 Status
DO3		D11/+24 Vdc	High side 0.7 A	Loop2 Alarm_3 Status
DO4		D12/+24 Vdc	High side 0.7 A	Loop2 Alarm_4 Status
DO5		D13/+24 Vdc	High side 0.7 A	Loop3 Alarm_5 Status
DO6		D14/+24 Vdc	High side 0.7 A	Loop3 Alarm_6 Status
DO7		D15/+24 Vdc	High side 0.7 A	Loop4 Alarm_7 Status
DO8		D16/+24 Vdc	High side 0.7 A	Loop4 Alarm_8 Status



# Appendix B

## AT SigmaPAC Wizard Tool

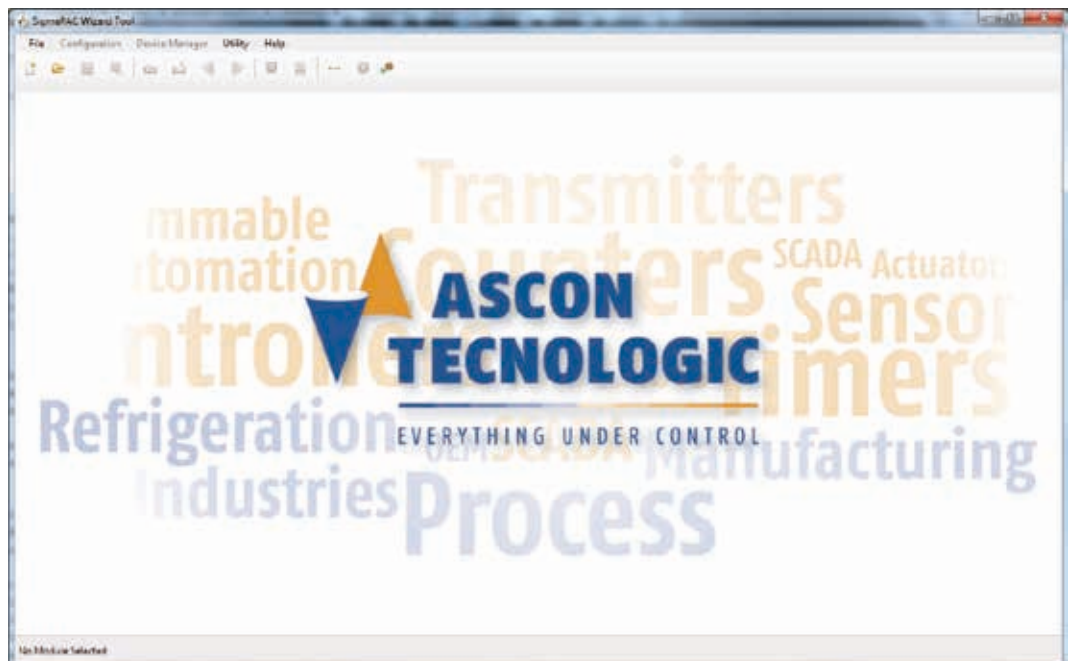
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The SigmaPAC Wizard Tool is an application especially designed to perform the offline hardware configuration of any Ascon Tecnologic's programmable CPUs. Through the same application it is possible to perform some remote commands, manage the diagnostic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

### B-1 User Interface

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



*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 displayed in graphical icon form.

#### File menu

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

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



## 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 typically used to load the Configuration data into a CPU from a memory stick. The binary format is compatible with all the Ascon Technologic CPUs.
  2. The file selection is made through a specific page.



## Device manager

Menu entry	Icon	Description
Device Commands (1)		Shows a panel from where the user can <b>Start</b> or <b>Stop</b> the CPU, <b>Acknowledge</b> the alarms, Erase the program file or <b>Reset</b> 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 “Persistence setup menu” screen reappears as confirmation for complete PLC program erasing.

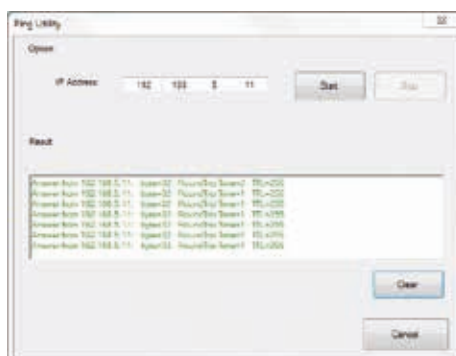
2.



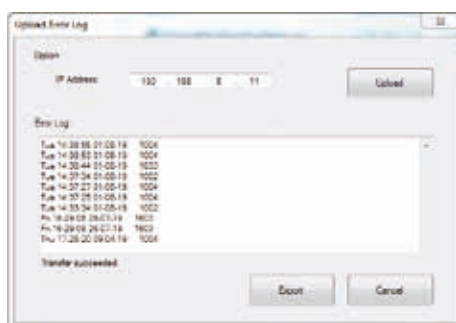
## Utility

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

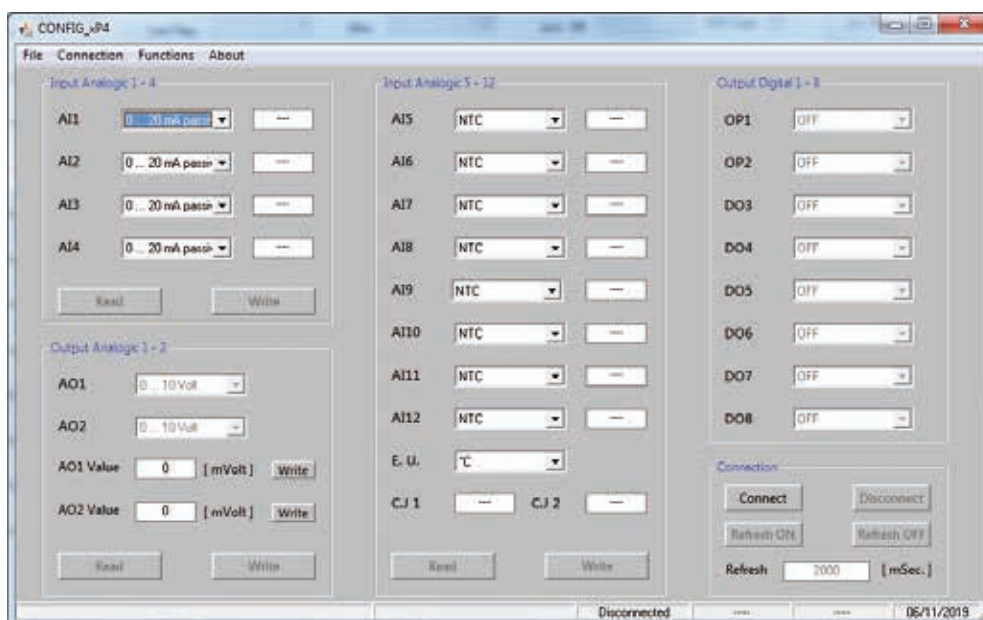
Notes: 1.



2.



3.



## B-2 How to perform the CPU Setup

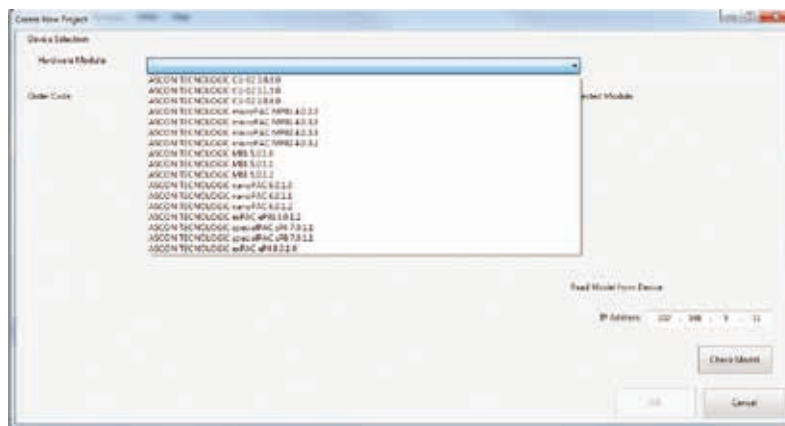
To be able to establish the connection with the CPU, it is necessary to:

- 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

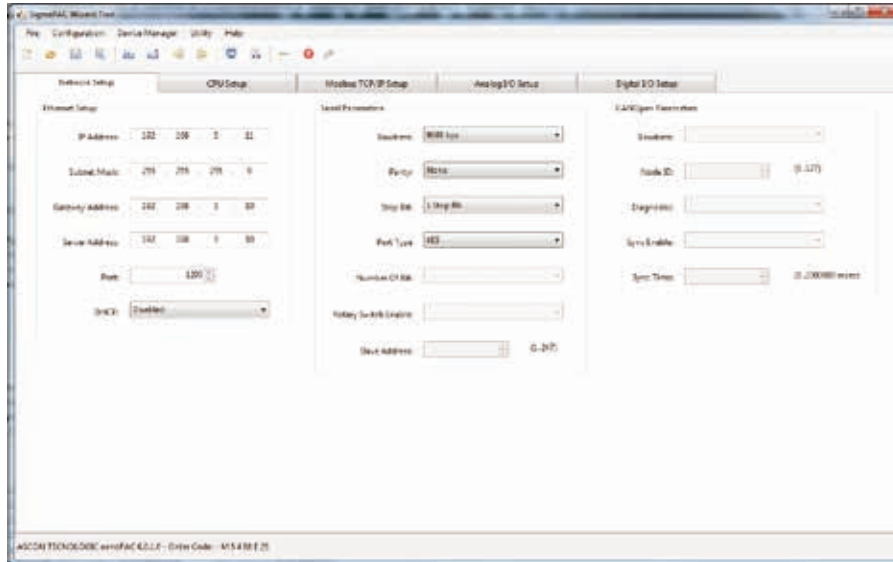
When a CPU is not connected to the PC, the configuration is a little more complex.

- 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 Technologic NanoPAC X.X.X.X);

- Once the software has recognized the choice, complete the mask by selecty-ing 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
<b>IP Address</b>	CPU IP Address	0.0.0.0/ 255.255.255.255	192.168.5.11
<b>Subnet Mask</b>	CPU subnet mask	0.0.0.0/ 255.255.255.255	255.255.255.0
<b>Gateway Address</b>	Network Gateway Address	0.0.0.0/ 255.255.255.255	192.168.5.10
<b>DNS Server Address</b>	DNS Server Address	0.0.0.0/ 255.255.255.255	192.168.5.10
<b>Port</b>	OpenPCS Port	0... 65535	1200
<b>DHCP</b>	DHCP Protocol Status	Disable/Enable	Disabled

### B-3-2 Serial Setup Menu

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

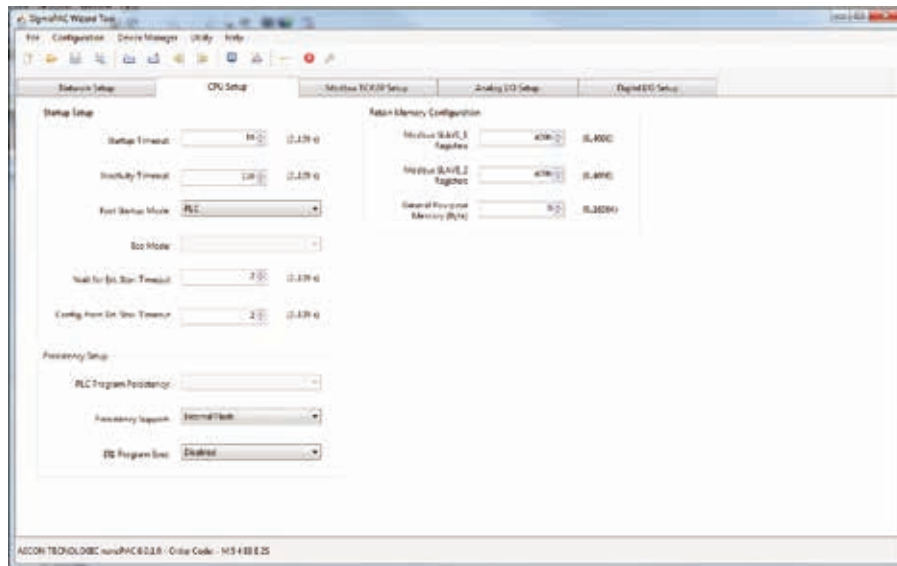
**Note:** The COM2 port can be configured from the OpenPCS ambient **ONLY**.

### B-3-3 CanOpen Menu

The CanOpen port is **not present** on the nP4 CPU. All the field are greyed be-cause **not active**.



## B-4 CPU Setup



### B-4-1 Startup Setup Menu

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

### B-4-2 Persistency Setup Menu

Item	Description	Range	Factory Default
<b>Erase PLC Program</b>	Command to erase the PLC program from flash memory	-	-
<b>PLC Program Persistency</b>	Function to save PLC program into flash memory	Disabled/Enabled	Enabled
<b>Persistency Support</b>	Media where to save copy of the PLC program	Internal Flash/USB key	Internal Flash
<b>DI Control Program Exec</b>	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
<b>MB Slave 1 Split register</b>	Amount of Slave 1 Modbus agent retained registers	0... 4096	4096	10 ms
<b>MB Slave 2 Split register</b>	Amount of Slave 2 Modbus agent retained registers	0... 4096	4096	10 ms
<b>Simple Split byte</b>	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 re-freshed 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!

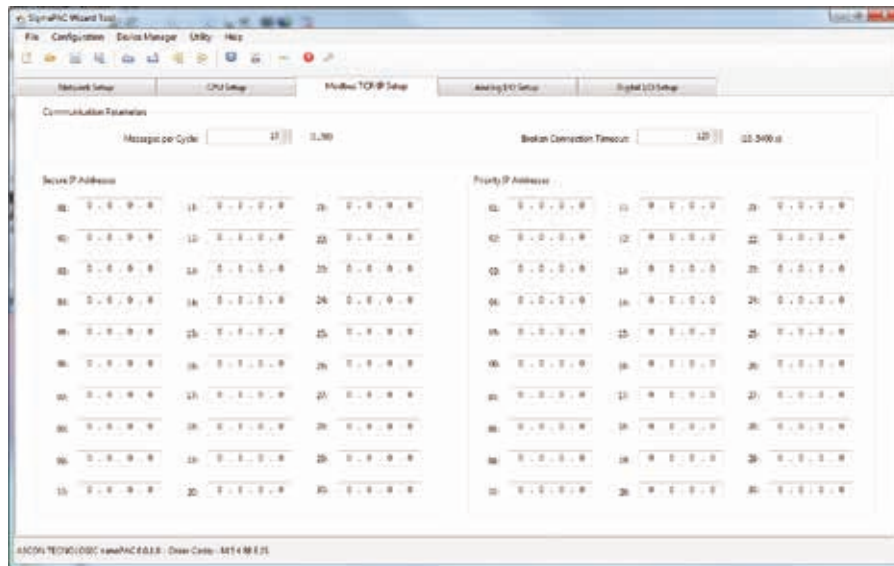
- In case of “*Cold start*” command, the standard retentive variables will be reset or preset to the initialization value whereas the % retentive variables will be reset. In case of retain file corruption error, both the two memory areas are separately reset or initialized.
- In case of “*Warm Start*” 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 the 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 nanoPAC nP4.0 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
<b>Messages per Cycle</b>	Max. number of processed messages per cycle	1... 50	10
<b>Broken Connection Timeout</b>	Inactivity Timeout of a TCP/IP connection	10... 5400 (s)	120
<b>Secure Address Setup</b>	Secure IP Address Setup Menu	-	-
<b>Priority Address Setup</b>	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

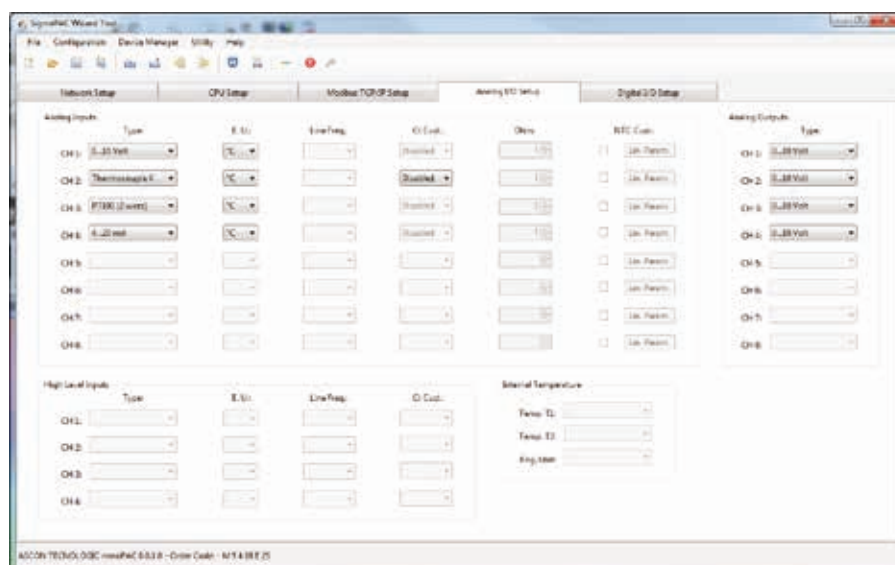
If the security function will be enabled (please see the “AT\_Firmware\_Lib Manual”), the list of addresses present in this menu will indicate the external Modbus TCP/IP Clients allowed to access the CPU Modbus TCP/IP server. To add a new address, enter the new one in the first free position of the list. 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.

Local Analogue I/O Setup Menu

## B-6 Local Analogue I/O Setup Menu



### B-6-1 Setting the AI Channels

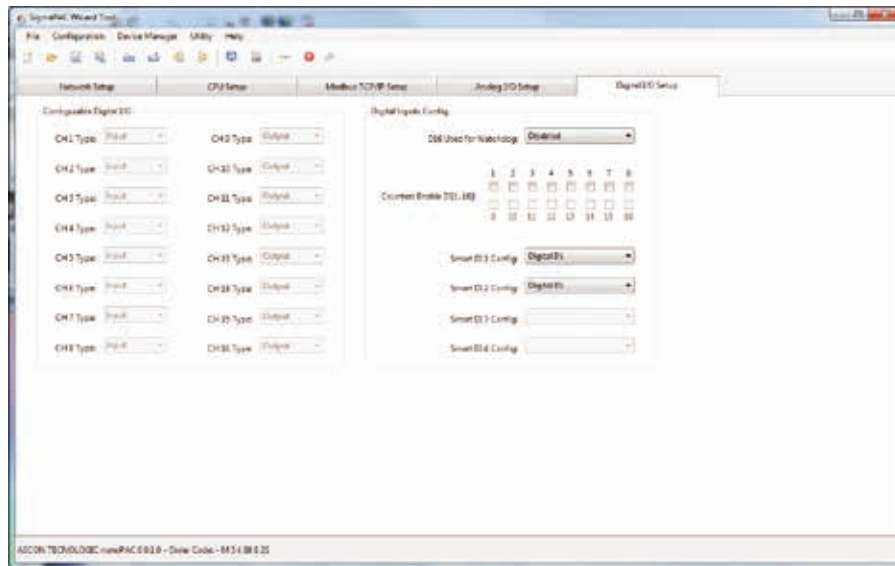
**Note:** The corresponding configuration choices for all the 4 analogue input channels is as described in the following table.

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-7 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-7-1 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-7-2 Digital Input/Output Config

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

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All the documents of the **sigmaline** products (those with “Code” after the title) can be freely downloaded from the Ascon Tecnologic website:

[www.ascontecnologic.com](http://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. “*AC<sup>3</sup>nP System Installation Manual*” (code: ISTR-MI AC<sup>3</sup>nPENG00)
10. “*nP4 Installation manual*” (code: ISTR-MInP4ENG01)
11. “*nP4 User manual*” (code: ISTR-MUnP4-ENG01)
12. “*Modbus I/O expansion module Model xP4 - Installation Guide*”  
(code: ISTR-FIxp4ENG00)
13. “*Modbus I/O expansion module Model xP4 - User Guide*”  
(code: ISTR-FUxp4ENG00)





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