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AC³ System
User Manual

User Manual
M.U.
Code: ISTR-MU AC3ENG01A

S2 SERIES

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Introduction

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^3 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 programing tool software for the AC^3 Systems, is tipically supplied on CD-ROM, 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^3 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^3 System (P04 panel, MP-02 CPU);
   - Mounting clamps;
   - Installation manual.

Using this manual

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

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

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

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

DANGER!

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

WARNING

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

Caution

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

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

Current Documentation on the Internet

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

1-1 Technical specification

1-1-1 AC3 System Assembly

The AC^3 System is composed by a P04 Touch Screen Panel device and an MP-02 Control Unit. The system, optionally, can be installed as splitted version where the P04 Panel can be installed remotely from the MP-02 Unit.

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

1-1-2 P04 Operator Panel

Display characteristics

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

Storage characteristics

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

Communication characteristics

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

Electrical characteristics

Item	Description
Power Supply	24VAC/DC, ±10%
Current consumption	300mA @ 24VDC
Internal fuse	Not available

Mechanical characteristics

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

Environmental characteristics

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

1-1-3 MP-02 CPU

CPU specifications

Item	Description
Processor	32 bit ARM
Program memory	2 MB Flash
Dynamic memory	16 MB RAM
Retentive memory	64 kB redundant (32 kB + 32 kB)
Memory data retention	10 years (with replaceable battery)
Real Time Clock	Available
Timer resolution	1 ms max.
Computing speed	70 Mips
Min. cycle time	≥5ms (typical 10ms)
Min. response time	Inputs Acquisition + cycles execution time
Communications port	Ethernet 10 Mb base T
Communications ports	1 RS485 + 1 RS232/485 selectable
Front LEDs	For digital I/Os, communication ports and CPU diagnostic

General and environmental specifications

Item	Description
Power supply voltage	24 VDC (-15... +25%)
Power consumption	10 W (+5 W with both the expansions)
Reverse polarity protection	Standard
Isolation class	II (50 Vrms), EN61010-1
Vibration resistance	10... 57 Hz, 0.0375 mm, 57... 150 Hz, 0.5 g (3 axis)
Shock resistance	15 g
Operating temperature	0… 55°C; (humidity: 5... 95%)
Storage temperature	-40… 70°C
Protection	IP20

High level analogue inputs

Item	Description
6 configurable	0... 10 V, 0/1... 5 V, 0... 1 V - 0/4... 20 mA
2 optional configurable	±10 V, ±5 V, ±1 V - 0/4... 20 mA
Acquisition time	Standard inputs: 170 ms, optional inputs: 40 ms
Resolution	16 bit
Accuracy	0.1%
Input impedance	>100 kΩ (V); 300 Ω (mA)
Isolation	800 V between Power supply and logics

Universal analogue inputs

Item	Description
2 optional configurable	±50 mV, ±100 mV, ±300 mV, ±1.25 V high impedance, TC (L, J, T, K, S, R, B, N, E, W3, W5), Pt100 (3 wire), Pt1000 and potentiometer (0.1... 10 kΩ)
Acquisition time	60 ms
Resolution	16 bit
Accuracy	0.1%
Input inpedance	10 MΩ (V)

Item	Description
Cold junction compensation Isolation	≤1°C/20°C ambient temperature 800 V between Power supply and logics 40 Vpp between the 2 channels (differential inputs)

Analogue Outputs

Item	Description
0/2/4 optional configurable	±10 V (±25 mA max.), 0/4... 20 mA
Update time	35 ms
Resolution	13 bit
Accuracy	0.1%
Isolation	800 V between Power supply and logics

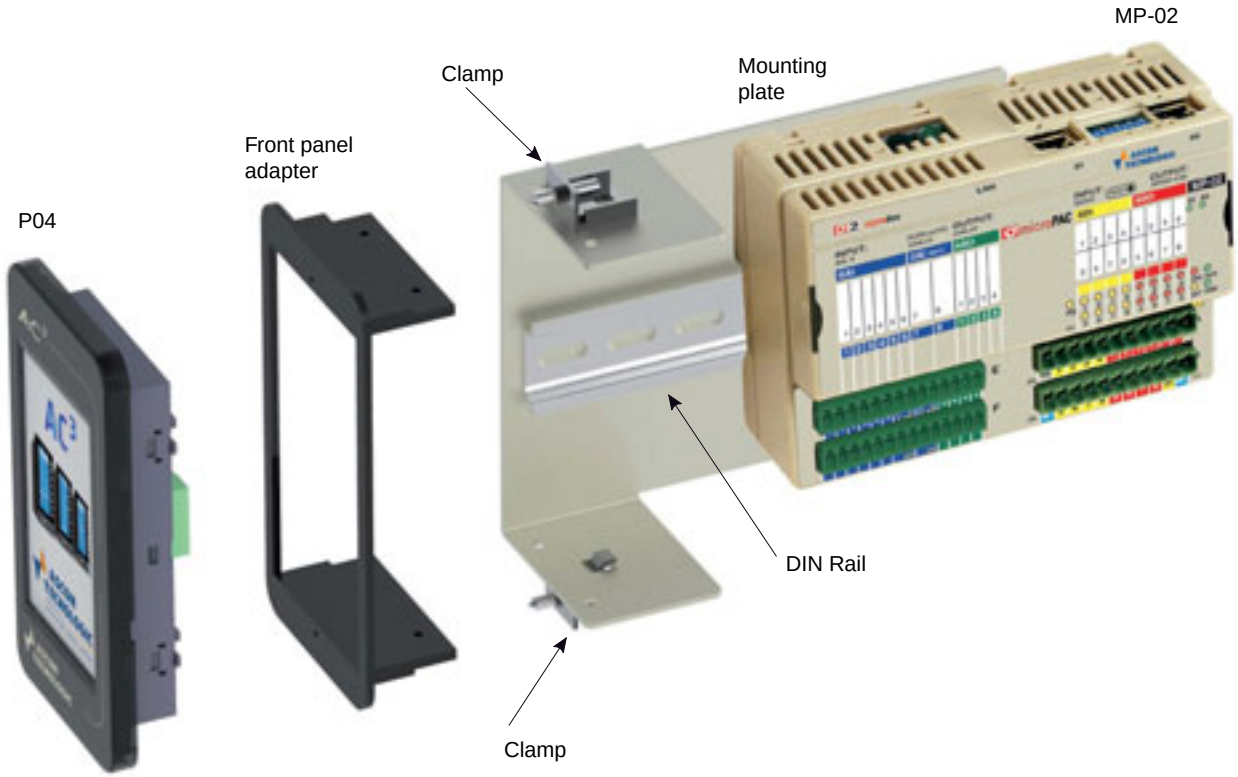
Digital Inputs

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

Digital Outputs

Item	Description
8... 40 with expansions	24VDC, 0.5 A
Type	Source (PNP)
Protection	Overvoltage and short circuit
Isolation	800V between Power supply and logics

1-1-4 Installation Kit



The installation kit is a mandatory item when the AC^3 System is to be installed in place of an AC Station or Front Panels mounted. 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 MP-02;
- 4 conical head Allen screws to assemble the mounting plate to the front panel adapter;
- 2 clamps to fix the structure to the font panel.

Mechanical characteristics

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

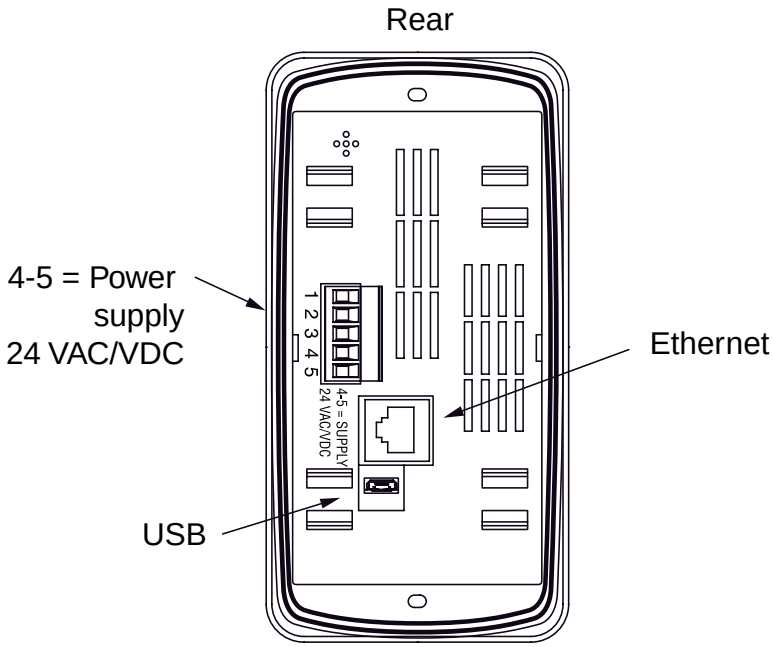
1-2 Hardware Description

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 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 in alternate and in 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 MP-02 Control Unit.

USB port

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

1-2-2 MP-02 CPU

Integrated I/Os

The AC^3 system base MP-02 unit has up to 28 I/O ports:

6 AI 6 analogue inputs configurable for mA, V;

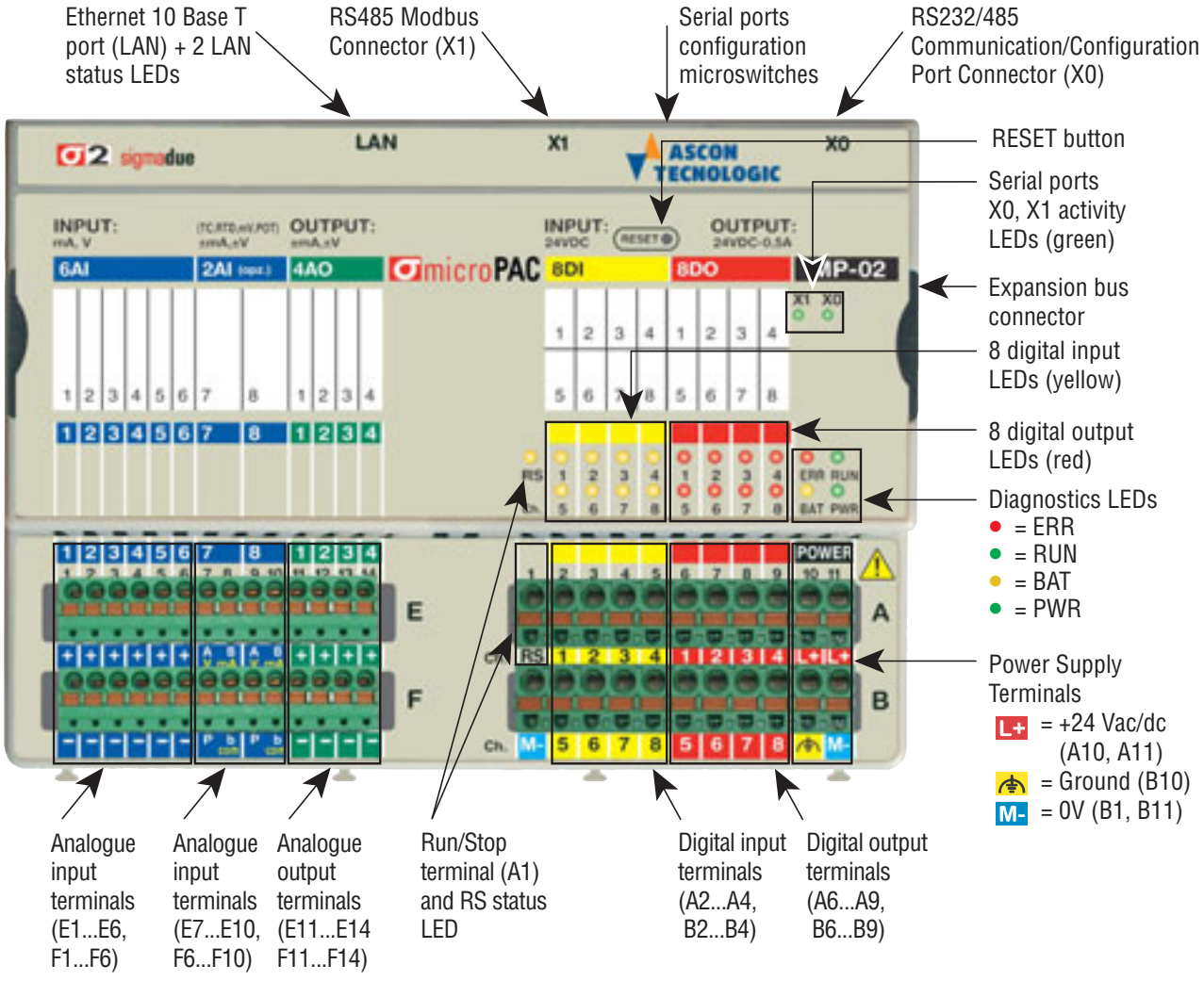
2 AI 2 optional universal or high level isolated analogue inputs configurable for:
- Thermocouples (L, J, T, K, S, R, B, N, E, W3, W5);
- RTD (PT100, PT1000);
- ±mA, ±V linear inputs;
- Potentiometers.

4 AO 4 optional high level analogue outputs;

RS RUN/STOP program functionality;

8 DI General Purpose Digital Inputs;

8 DO Isolated General Purpose Digital Outputs.



WARNING

The **RESET** button **does not restart** the CPU or the 1131 application, but ***resets all the stored Setup parameters and restores the defaut parameters*** (as well as those set by the user).

Terminal "A" connections

The "**A**" terminal block allows the connection of the +24V Power Supply, Run/Stop, 4 Digital Inputs and 4 Digital Outputs Signals.

The terminals are positioned as follows:

Pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Label	**RS**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**L+**	**L+**
Function	Run/Stop	DI1	DI2	DI3	DI4	DO1	DO2	DO3	DO4	POWER	
Signal	INPUT	INPUT	INPUT	INPUT	INPUT	OUT	OUT	OUT	OUT	+24V	+24V

Run/Stop Digital Input — Digital Input — Digital Output — Power Supply

1 **RS** Run/Stop terminal, connecting this terminal to a 24V source, it is possible to launch or stop the execution of the 1131 program loaded in the CPU;

2...5 **1...4** 4 Digital Inputs terminals, connecting this terminal to a 24V source, it is possible to change the status of the input;

6...9 **1...4** 4 Digital Outputs terminals. Each source type (PNP) digital output can manage a 24V 0.5A load;

10...11 **L+** 24VDC power supply terminals.

Terminal "B" connections

The "**B**" terminal block allows the connection of the 0V Power Supply, 4 Digital Inputs, 4 Digital Outputs Signals and the system hearth.

The terminals are positioned as follows:

Pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Label	**M-**	**5**	**6**	**7**	**8**	**5**	**6**	**7**	**8**	⏚	**M-**
Function	POWER	DI1	DI2	DI3	DI4	DO1	DO2	DO3	DO4	Ground	POWER
Signal	0V	INPUT	INPUT	INPUT	INPUT	OUT	OUT	OUT	OUT	Ground	0V

Power supply — Digital Input — Digital Output — Frame ground — Power supply

1 **M-** 0V power supply terminal.

2...5 **5...8** 4 Digital Inputs terminals, connecting this terminal to a 24V source, it is possible to change the status of the input

6...9 **5...8** 4 Digital Outputs terminals. Each source type (PNP) digital output can manage a 24V 0.5A load.

10 ⏚ Frame ground.

11 **M-** 0V power supply terminal.

Terminal "E" connections

The "**E**" terminal block allows the connection of 6 Analogue Inputs, 2 optional Analogue Inputs and 4 Analogue Outputs.

The terminals are positioned as follows:

Pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**9**	**10**	**11**
Label	**+**	**+**	**+**	**+**	**+**	**+**	**A V**	**B mA**	**A V**	**B mA**	**+**	**+**	**+**	**+**
Function	AI1	AI2	AI3	AI4	AI5	AI6	Univ. AI1		Univ. AI2		AO1	AO2	AO3	AO4
Signal	IN	IN	IN	IN	IN	IN	IN		IN		OUT	OUT	OUT	OUT

Analogue input (mA, V) | Analogue input (±mA, ±V) | Analogue ouput (±mA, ±V)

1...6 **+** 6 configurable analogue (linear) input positive (+) poles. These inputs can be configured as mA or V. The negative (-) poles are on connector "**F**";

7...10 **A...B** 2 universal/high level analogue (linear) inputs (No. 7, 8) (see the "*MP-02 Installation Manual*" for details). The Input number (0... 2) and type can be identified by the order code. The additional terminals of these 2 inputs are on connector "**F**";

11...14 **+** 4 analogue output positive (+) poles. The outputs number (0, 2, 4) is specified by the order code, the type can be set during the **CPU Setup phase** (see the "CPU Setup" chapter on the MP-02 User manual). The negative (-) poles are on connector "**F**".

Terminal "F" connections

The "**F**" terminal block allows to complete the connections of the I/Os present on the "**E**" terminal block.

The connector "**F**" has 14 terminals:

Pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Name	**-**	**-**	**-**	**-**	**-**	**-**	**P**	**b com**	**P**	**b com**	**-**	**-**	**-**	**-**
Function	AI1	AI2	AI3	AI4	AI5	AI6	Univ. AI1		Univ. AI2		AO1	AO2	AO3	AO4
Signal	IN	IN	IN	IN	IN	IN	IN		IN		OUT	OUT	OUT	OUT

Analogue input (mA, V) | Analogue input (±mA, ±V) | Analogue ouput (±mA, ±V)

1...6 **-** 6 configurable analogue (linear) input negative (-) poles;

7...10 **P...b** 2 universal/high level analogue (linear) inputs (No. 7, 8)(see the "*AC^3 System Installation Manual*" for details);

11...14 **-** 4 analogue output negative (-) poles.

1-2-3 AC³ System - AC Station Compatibility I/O Assignment Table

Tag	AC-Station Terminals	MP-02 Terminals	Meaning
AI_1	1 + / 2 -	E1 + / F1 -	High Level Analogue Input_1
AI_2	3 + / 2 -	E2 + / F2 -	High Level Analogue Input_2
AI_3	4 + / 5 -	E3 + / F3 -	High Level Analogue Input_3
AI_4	6 + / 5 -	E4 + / F4 -	High Level Analogue Input_4
AI_5	7 + / 8 -	E5 + / F5 -	High Level Analogue Input_5
AI_6	9 + / 8 -	E6 + / F6 -	High Level Analogue Input_6
AI_7	10 + / 11 -	E8 + / F8 -	High Level Analogue Input_7
AI_8	12 + / 11 -	E10 + / F10 -	High Level Analogue Input_8
DI_1	13 / 14	A2	Digital Input_1
DI_2	15 / 14	A3	Digital Input_2
DI_3	16 / 17	A4	Digital Input_3
DI_4	18 / 17	A5	Digital Input_4
DI_5	19 / 20	B2	Digital Input_5
DI_6	21 / 20	B3	Digital Input_6
DI_7	22 / 23	B4	Digital Input_7
DI_8	24 / 23	B5	Digital Input_8
+24 VDC_1	25 +	A11 +	24 VDC Power supply
+24 VDC_2	26 +	-	Not Present
AO_1	27 + / 28 -	E11 + / F11 -	Analogue Output_1
AO_2	29 + / 28 -	E12 + / F12 -	Analogue Output_2
AO_3	30 + / 31 -	E13 + / F13 -	Analogue Output_3
AO_4	32 + / 31 -	E14 + / F14 -	Analogue Output_4
DO_1	33 / 34	A6	Digital Output_1
DO_2	35 / 34	A7	Digital Output_2
DO_3	36 / 37	A8	Digital Output_3
DO_4	38 / 37	A9	Digital Output_4
DO_5	39 / 40	B6	Digital Output_5
DO_6	41 / 40	B7	Digital Output_6
DO_7	42 / 43	B8	Digital Output_7
DO_8	44 / 43	B9	Digital Output_8

1-2-4 Diagnostic LEDs

Referring to the image inserted at the previous page a description of the LEDs functions is given in the table below.

LED	Colour	Action (note 1)	Description
RS	Yellow	ON	RS input active (RUN program)
ERR	Red	Flickering (10Hz)	Checksum error in RETAIN data
		Single flash	CRC error in the configuration file, reset to default
		Double flash	Problem during file system mount
		Triple flash	Checksum VAR % RETAIN error (NOTE 2)
RUN	Green	ON	1131 program running
		OFF	1131 program stopped or not present
PWR	Green	ON	Power Supply present
BAT	Yellow	ON	Backup battery low

Note: The ERR LED flashing sequence has a specific meaning which needs to be acknowledged by the user as described on the dedicated MP-02 User manual.

Sequence	Meaning
Blinking	The LED blinks at a frequence of 2.5 Hz (slow)
Flickering	The LED blinks at a frequence of 10 Hz (fast)
Single flash	The LED lits once for at least 200 ms
Double flash	The LED lits twice with pulses of 200 ms each
Triple flash	The LED lits three with pulses of 200 ms each

1-2-5 Communication ports

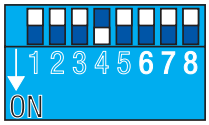
The CPU has 3 communication ports (see paragraph “3-8 Communications connections” in the MP-02 Installation Manual):

- The LAN Ethernet port (TCP/IP) is dedicated to interface the MP-02 Control Unit to the P04 Operator Touch Screen Panel. Alternatively the LAN port can be used to:
  - CPU configuration (see the “CPU Setup” chapter on the MP-02 User manual);
  - Programming, debuging and commissioning the application within the OpenPCS tool.
- The X0 Service RS232/485 port is available and can be used as:
  - Configuration port of the device with VT100 terminal;
  - Standard ASCII serial port;
  - Modbus RTU data exchange port.
- The X1 RS485 port is dedicated to emulate the original ARCNET network available on the AC-Station units; alternatively:
  - Modbus RTU data exchange port.

X0/X1 Ports DIP Switches

The Communications Ports electrical settings can be selected through the microswitches located between the Serial Port connectors.

The following table describes the selectable options.

Aspect	Switch	Port	Description	ON	OFF	Default
	1	X1	Termination Resistance (110Ω)	Enabled	Disabled	OFF
	2	X1	Pull-Down Line polarization	Enabled	Disabled	OFF
	3	X1	Pull-Up Line polarization	Enabled	Disabled	OFF
	4	X0	RS232 Selection	Enabled	Disabled	ON
	5	X0	RS485 Selection	RS485	RS232	OFF
	6	X0	Termination Resistance (110Ω)	Enabled	Disabled	OFF
	7	X0	Pull-Down Line polarization	Enabled	Disabled	OFF
	8	X0	Pull-Up Line polarization	Enabled	Disabled	OFF

1-2-6 Communication cables

RS232/485 Serial Service/ Port

X0 connector

The connector X0 on the MP-02 unit is an RJ45 type, with the following pinout:

Pin	1	2	3	4	5	6	7	8
Signal	D+ (RS485)	D- (RS485)	GND (RS485)	GND (RS232)	RX (RS232)	TX (RS232)	NC	NC

RS485 Port

X1 connector

The connector X1 on the MP-02 unit is an RJ45 type, with the following pinout:

Pin	1	2	3	4	5	6	7	8
Signal	D+ (RS485)	D- (RS485)	GND (RS485)	NC	NC	NC	NC	NC

LAN Ethernet 10baseT

LAN connector

The connector on the CPU module is an RJ45 type, with the following pinout:

Pin	1	2	3	4	5	6	7	8
Signal	TX+	TX-	RX+	NC	NC	RX-	NC	NC

For a more detailed explanation consult the "*AC³ Installation Manual*".

1-3 Resident Strategies

The AC³ 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.

1-4 Function Block Libraries

1-4-1 AT_AC3_Specific_Lib Description

Function Block name	Description
ALARM_ADV	This function block generates different types of alarms. It can be used also as a comparator
MP_AI_MNGT_AD	Performs an advanced conditioning of the desired microPAC AI value **ONLY**
ANALOG MULTIPLEXER 2 CHANNELS	This function block is a 2 to 1 multiplexer
RATIO TYPE MODE	Performs the Ratio SP calculation accordingly to the desired mode
ANALOG SP SELECTION	Performs the selection between several SP types

1-4-2 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 architectur
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

1-4-3 AT_AC3_Panels_Lib 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". **Note:** **n** is an index (value 1 or 2) that identifies the Function Block and the loops connected. In particular, when: **n = 1** (PAGE_2BARG_1) then x = 1 (first loop connected to the FB) and y = 2 (second loop connected to the FB). Otherwise when: **n = 2** (PAGE_2BARG_2) then x = 3 (first loop connected to the FB) and y = 4 (second 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" **Note:** **n** is an index (value 1, 2, 3 or 4) that identifies the Function Block and the loop connected. In particular, when: **n = 1** (PAGE_1BARG_1), Loop1 is connected to the FB; **n = 2** (PAGE_1BARG_2), Loop2 is connected to the FB; **n = 3** (PAGE_1BARG_3), Loop3 is connected to the FB; **n = 4** (PAGE_1BARG_4), Loop4 is connected to the FB.

Function Block name	Description
PAGE_2TRND_n	Perform the data exchange between the CPU and the touch screen front panel related to the "Loop_n Double Trend page". **Note:** **n** is an index (value 1, 2, 3 or 4) that identifies the Function Block and the loop connected. In particular, when: **n = 1** (PAGE_2TRND_1), Loop1 is connected to the FB; **n = 2** (PAGE_2TRND_2), Loop2 is connected to the FB; **n = 3** (PAGE_2TRND_3), Loop3 is connected to the FB; **n = 4** (PAGE_2TRND_4), Loop4 is connected to the FB.
PAGE_ALM_EVT_n	Perform the data exchange between the CPU and the touch screen front panel related to the "1… 64 Alarms & Events page". **Note:** **n** is an index (value: 1, 2, 3 or 4) that identifies the Function Block and the alarm block connected. In particular, when: **n = 1** (PAGE_ALM_EVT_1), the alarm block connected is the 1st (alarms 1... 16); **n = 2** (PAGE_ALM_EVT_2), the alarm block connected is the 2nd (alarms 17... 32); **n = 3** (PAGE_ALM_EVT_3), the alarm block connected is the 3rd (alarms 33... 48); **n = 4** (PAGE_ALM_EVT_4), the alarm block connected is the 4th (alarms 49... 64).
PAGE_DSP_NUM_n	Perform the data exchange between the CPU and the touch screen front panel related to the "1… 32 Numerical Display page". **Note:** **n** is an index (value: 1 or 2) that identifies the Function Block and the numerical value block displayed. In particular, when: **n = 1** (PAGE_DSP_NUM_1), the block of Numerical values connected is the **1st** (numercal signal inputs 1... 16); **n = 2** (PAGE_DSP_NUM_2), the block of Numerical values connected is the **2nd** (numercal signal inputs 17... 32).
PAGE_EDT_NUM_n	Perform the data exchange between the CPU and the touch screen front panel related to the "1… 32 Numerical Edit page". **Note:** **n** is an index (value: 1 or 2) that identifies the Function Block and the numerical value block displayed. In particular, when: **n = 1** (PAGE_EDT_NUM_1), the block of Numerical values connected is the **1st** (numercal signal inputs 1... 16); **n = 2** (PAGE_EDT_NUM_2), the block of Numerical values connected is the **2nd** (numercal signal inputs 17... 32).
PAGE_EDT_DIG_n	Perform the data exchange between the CPU and the touch screen front panel related to the "1… 32 Digital Commands page". **Note:** **n** is an index (value: 1 or 2) that identifies the Function Block and the digital input block connected. In particular, when: **n = 1** (PAGE_EDT_DIG_1) the block of Digital Inputs connected is the 1st (Digital Inputs 1... 16); **n = 2** (PAGE_EDT_DIG_2) the block of Digital Inputs connected is the 2nd (Digital Inputs 17... 32);
SP_PROG_MNGT	Currently not available

1-4-4 Configuration Function Block Descriptions

Function Block name	Description
SP_PROG_RECIPE	Currently not available
PAGE_CFG_PID_n	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. **Note:** **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** (PAGE_CFG_PID_1) configures the PID parameters of Control Loop 1; **n = 2** (PAGE_CFG_PID_2) configures the PID parameters of Control Loop 2; **n = 3** (PAGE_CFG_PID_3) configures the PID parameters of Control Loop 3; **n = 4** (PAGE_CFG_PID_4) configures the PID parameters of Control Loop 4.
PAGE_CFG_NUM_n	Perform the data exchange between the CPU and the touch screen front panel related to the "1…128 Numerical Configuration page" which is part of those ones accessible ONLY through the Configuration session by typing the correct password. **Note:** **n** is an index (values from 1 to 8) that identifies the Function Block and the Numerical Fields block connected. In particular, when: **n = 1** (PAGE_CFG_NUM_1) configures the first block of Numerical Fields (Num. fields: 1... 16); **n = 2** (PAGE_CFG_NUM_2) configures the second block of Numerical Fields (17... 32); n = 3 (PAGE_CFG_NUM_3) configures the third block of Numerical Fields (33... 48); **n = 4** (PAGE_CFG_NUM_4) configures the fourth block of Numerical Fields (49... 64); **n = 5** (PAGE_CFG_NUM_5) configures the fiveth block of Numerical Fields (65... 80); **n = 6** (PAGE_CFG_NUM_6) configures the sixth block of Numerical Fields (81... 96); **n = 7** (PAGE_CFG_NUM_7) configures the seventh block of Numerical Fields (97... 112); **n = 8** (PAGE_CFG_NUM_8) configures the eighth block of Numerical Fields (113... 128).

Function Block name	Description
PAGE_CFG_DIG_n	Perform the data exchange between the CPU and the touch screen front panel related to the "1… 128 Digital Commands page" **Note:** **n** is an index (values from 1 to 8) that identifies the Digital Inputs block connected. In particular, when: **n = 1** (PAGE_CFG_DIG_1) configures the first block of Digital Inputs (Digital Inputs: 1... 16); **n = 2** (PAGE_CFG_DIG_2) configures the second block of Digital Inputs (17... 32); **n = 3** (PAGE_CFG_DIG_3) configures the third block of Digital Inputs (33... 48); **n = 4** (PAGE_CFG_DIG_4) configures the fourth block of Digital Inputs (49... 64); **n = 5** (PAGE_CFG_DIG_5) configures the fiveth block of Digital Inputs (65... 80); **n = 6** (PAGE_CFG_DIG_6) configures the sixth block of Digital Inputs (81... 96); **n = 7** (PAGE_CFG_DIG_7) configures the seventh block of Digital Inputs (97... 112); **n = 8** (PAGE_CFG_DIG_8) configures the eighth block of Digital Inputs (113... 128).

1-4-5 Firmware Function Blocks List

The *Firmware function blocks* coming with the MP-02 (hardware version 4.0.3.2) are listed in this section. For each of the function blocks a short description is provided (see the "*AT Firmware Function Block Library*" [3] manual for details): refer to the specific help documentation available in the OpenPCS programming tool.

Function Block name	Description
ASCON_FLATTEN_TO_REAL	Convert the 4 bytes of the input parameters as the flattened equivalent of a real number which is then output-returned
ASCON_REAL_TO_FLATTEN	Convert the REAL variables in their FLATTEN equivalents
CLOSE_MODBUS_TCP_SERVER	Disable MBTCP/IP Server
CLOSE_SERIAL_COMM	Close the serial communication port
CONV_ASCII_TO_CHAR	ASCII conversion from binary code to character
CONV_CHAR_TO_ASCII	ASCII conversion from character to binary code
CTRL_HCMV	Automan Station for heat and cool regulation
CTRL_MV	Automan Station for single action regulation
CTRL_PID	PID algorithm
CTRL_SPLITMV	Automan Station for heat and cool regulation with split range
CTRL_SRV	Servomotors algorithm
CTRL_SRV_POS	Servomotors algorithm close loop (potentiometer)
CTRL_TPO	Time proportional output
CTD	Counter Down pulses
CTU	Counter Up pulses
CTUD	Counter Up/Down pulses
ENABLE_MODBUS_TCP_SERVER	Set and activate the MBTCP/IP Server agent
F_TRIG	Falling edge detection
R_TRIG	Rising edge detection
MB_TCP_CLOSE_CONN	Close one of the 10 active connections

Function Block name	Description
MB_TCP_CONN_STATUS	Show the status of a MBTCP/IP connection
MB_TCP_GET_CONN_BY_ADDR	Return information of a connection identified by the IP address of the client
MB_TCP_GET_CONN_CONFIG	Return configuration data of a specified active connection
MEMCOPY_FROM_M	Copies data from %M memory areas
MEMCOPY_TO_M	Copies data into %M memory areas
MEMCPY_I_TO_M	Copy a specific %I memory into a specific %M memory area
MEMCPY_M_TO_M	Copy a specific %M memory into a specific %M memory area
MEMCPY_M_TO_Q	Copy a specific %M memory into a specific%Qmemory area
MEMCPY_Q_TO_M	Copy a specific %Q memory into a specific %M memory area
MODBUS_GET_DIGITAL_SLAVE	Read 16 digital values from a memory area dedicated to an MB slave
MODBUS_GET_SLAVE_DATA	Read registers from a memory area dedicated to an MB slave
MODBUS_MASTER_EXECUTE	Execute a query in compliance with the MB protocol
MODBUS_MASTER_STATUS	Check the status of the MB agent.
MODBUS_SET_DIGITAL_SLAVE	Write 16 digital values to a memory area dedicated to an MB slave
MODBUS_SET_DWORD_DATA	Write two contiguous registers (4 bytes) to a memory area dedicated to an MB slave
MODBUS_SET_WORD_DATA	Write registers to a memory area dedicated to an MB slave
MODBUS_SLAVE_SETTINGS	Set the node_id and timeout parameters of the MB slave agent
MODBUS_SLAVE_STATUS	Check the status of the MB agent
OPEN_SERIAL_COMM	Configure the serial port and set the protocol used on it
RAND	Generete random numbers from 0... 65535
RESET_PULSE_COUNTER	Reset the counter value connected to a specific digital input
RTC_Setup	Set the system clock
RTC_GET_VALUES	Read the system clock
RS	Reset dominant Flip-Flop
SR	Set dominant Flip-Flop
SEND_EMAIL	Set the configuration for a client SMTP to send e-mail
SERIAL_IO_CONFIG	Configure the ASCII serial port
SERIAL_IO_READ	Read data from the ASCII serial port
SERIAL_IO_READ_BYTE	ASCII serial port Byte reading
SERIAL_IO_WRITE	Write data on the ASCII serial port
SERIAL_IO_WRITE_BYTE	ASCII serial port Byte writing
TOF	Delay OFF timer
TON	Delay ON timer
TP	Time pulse generator
WATCHDOG_SET	Configure the system watchdog
WATCHDOG_STATUS	Checking the status of the system watchdog

1-4-6 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 Function Block Library*" [**4**] manual for details).
The table hereafter reports the complete list of the function blocks of the library

Function Block name	Description
AVG_ADV_8REAL	Advanced Instantaneous Average calculation
AVG_MOVING	Moving Average calculation
AVG_RUNNING	Running Average calculation
CHAR_8_ARRAY	Analogue Conversion using 8 points
CHAR_16_ARRAY	Analogue Conversion using 16 points
CHARACTERIZER_8	Linear Interpolation with 8 points
CHARACTERIZER_16	Linear Interpolation with 16 points
COMPARATOR	Comparator with hysteresis Function Block
CONV_AD8	From BYTE to 8 bits
CONV_AD16	From WORD to 8 bits
CONV_AD32	From DWORD to 8 bits
CONV_DA8	From bits to BYTE
CONV_DA16	From bits to WORD
CONV_DA32	From bits to DWORD
COUNTER	Rising Edge Counter
DECODER_8	Decoder Function Block
FLIPFLOP_D	D Type FlipFlop Function Block
FLIPFLOP_JK	JK Type FlipFlop Function Block
HOLD_VALUE	Sample & Hold Function Block
INBETWEEN	Middle Selector Function Block
LIMITER_VALUE	Limiter Function Block
MIN_MAX_SELECTOR	Min/Max Selector Function Block
MONOSTABLE_DS	Monostable with Delay
MONOSTABLE_NED	Monostable with Delay on the Negative Edge
MONOSTABLE_PED	Monostable with Delay on the Positive Edge
MONOSTABLE_PUL	Monostable Pulse Generator
MUX_A8	Analog Multiplexer 8 Input
MUX_A16	Analog Multiplexer 16 Input
MUX_D8	Digital Multiplexer 8 Input
MUX_D16	Digital Multiplexer 16 Input
RESCALE	Rescaling Function Block
POWER_FAIL	Power Fail Condition Monitor
SLOPE_LIMIT	Slope Limiter
TIMER_ADV	Advanced countdown timer function block
TOTALIZER	Totalizer Function Block
TOTALIZER_AVD	Advanced Totalizer Function Block

1-4-7 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
AICOND_ADV	Advanced conditioning of an AI value
AICOND_Std.	Standard conditioning of an AI value
ALARM_ABS	Absolute Alarm Function Block
ALARM_ADVANCED	General Alarm Function Block
ALARM_BND	Band Alarm Function Block
ALARM_DEV	Deviation Alarm Function Block
ALARM_RATE	Rate Alarm Function Block
DEW_POINT	Dew Point calculation
F0_CALCULATION	Sterilization time for bacterial load reduction calculation
HR_DRY_WET_BULB	Relative humidity calculation method with dry/wet bulb
MASS FLOW	Compensate Flow calculation
MP_RTD_LIN	RTD Linear rescaling (for microPAC ONLY)
ZrO2_PROBE	% Carbon Potential calculation
ZrO2_PROBE_CLN	% Carbon potential probe cleaning management

1-4-8 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 MP-02 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 Function Block Library*” [**4**] manual for details).

Function Block name	Description
S2_CONTROLLER	Single Action Controller
S2_EZ_TUNE	Tuning with Modified Step Response Algorithm for Single Action Loops
S2_FILTER	First Order Filter
S2_HC_CONTROLLER	Heat and Cool Controller
S2_HC_EZ_TUNE	Tuning with Modified Step Response Algorithm for Heat and Cool Loops
S2_HC_TFUZZY	Tuning with Fuzzy Logic for Heat and Cool Loops
S2_HC_TNATFREQ	Tuning with Natural Frequency Algorithm for Heat and Cool Loops
S2_HC_TSTEPRESP	Tuning with Step Response Algorithm for Heat and Cool Loops
S2_HCMV	AutoMan station for output manual value direct access for double action loop
S2_MV	AutoMan station for output manual value direct access for single action loop
S2_SPLITMV	AutoMan station for output manual value direct access for double action loop with SplitRange
S2_TFUZZY	Tuning with Fuzzy Logic for Single Action Loops
S2_TNATFREQ	Tuning with Natural Frequency Algorithm for Single Action Loops
S2_TSTEPRESP	Tuning with Step Response Algorithm for Single Action Loops

1-4-9 AT_Communications_Lib

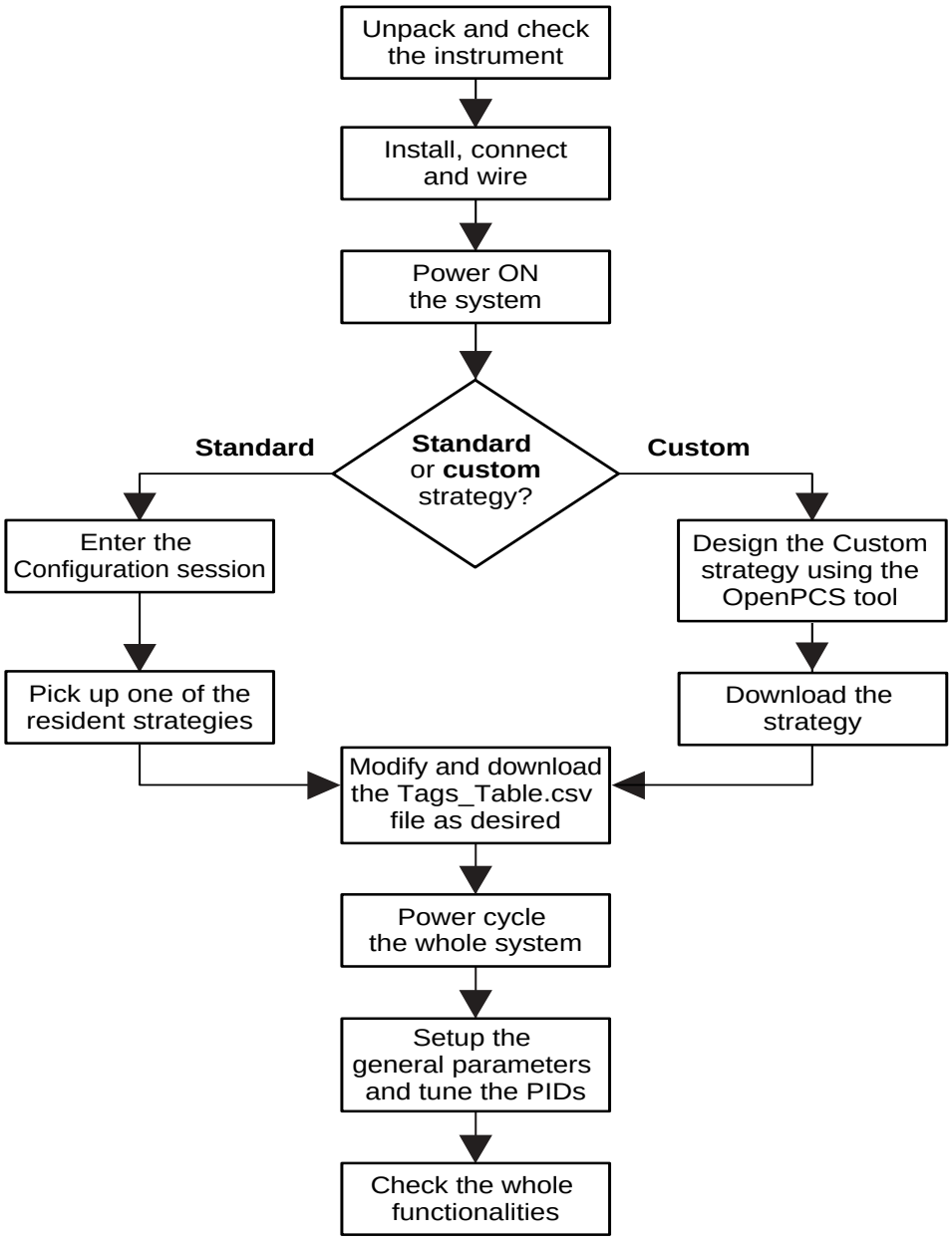
The *AT_Communications_Lib* allows a simplified access to the communication functions of MP-02 CPU (see the "*IEC 61131-3 Function Block Library*" [**4**] manual for details). Follows the complete list of the function blocks available with the library:

Function Block name	Description
COMMS_MNGT_MP0x	MP-0x Serial Comm Ports Management
MB_MST_SYNC	Modbus Master: Synchronization of operations
MB_MST_RD_COIL	Modbus Master: Coil reading
MB_MST_WR_COIL	Modbus Master: Coil writing
MB_MST_RD_WORD	Modbus Master: Word reading
MB_MST_WR_WORD	Modbus Master: Word writing
MB_16WORD_TO_ARRAY	Modbus Master: packaging of 16 WORD in an array
MB_ARRAY_TO_16WORD	Modbus Master: un-packaging of an array into 16 WORD
MB_MST_RD8_DINT	Modbus Master: conversion and management of 8 DINT read values
MB_MST_RD8_DWORD	Modbus Master: conversion and management of 8 DWORD read values
MB_MST_RD8_REAL	Modbus Master: conversion and management of 8 REAL read values
MB_MST_RD8_UDINT	Modbus Master: conversion and management of 8 UDINT read values
MB_MST_WR8_DINT	Modbus Master: conversion and management of 8 DINT write values
MB_MST_WR8_DWORD	Modbus Master: conversion and management of 8 DWORD write values
MB_MST_WR8_REAL	Modbus Master: conversion and management of 8 REAL write values
MB_MST_WR8_UDINT	Modbus Master: conversion and management of 8 UDINT write values
MB_SLV_RD8_DWORD	Modbus Slave: reading of 8 DWORD values
MB_SLV_RD8_REAL	Modbus Slave: reading of 8 REAL values
MB_SLV_RD16_WORD	Modbus Slave: reading of 16 WORD values
MB_SLV_RD32_DIGITAL	Modbus Slave: reading of 32 digital values
MB_SLV_RD_DIGITAL	Modbus Slave: reading of 1 digital value
MB_SLV_RD_DWORD	Modbus Slave: reading of 1 DWORD value
MB_SLV_RD_REAL	Modbus Slave: reading of 1 REAL value
MB_SLV_RD_WORD	Modbus Slave: reading of 1 WORD value
MB_SLV_WR8_DWORD	Modbus Slave: writing of 8 DWORD values
MB_SLV_WR8_REAL	Modbus Slave: writing of 8 REAL values
MB_SLV_WR16_WORD	Modbus Slave: writing of 16 WORD values
MB_SLV_WR32_DIGITAL	Modbus Slave: writing of 32 digital values
MB_SLV_WR_DIGITAL	Modbus Slave: writing of 1 digital value
MB_SLV_WR_DWORD	Modbus Slave: writing of 1 DWORD value
MB_SLV_WR_REAL	Modbus Slave: writing of 1 REAL value
MB_SLV_WR_WORD	Modbus Slave: writing of 1 WORD value
MODEM_CHECK	Modem operational verification
MODEM_CONF	Modem configuration management
MODEM_SMS_SEND	Modem SMS (Short text Message Service) send management
MP_SERIAL_PORTS	Set the configuration for the ModbusRTU ports of the MP-02 unit
SEND_EMAIL	SMTP server Configuration
SERIAL_PORTS	Set the configuration for the Modbus RTU ports of the CU unit
SYS_OPRS_MNGT	Set communication operational parameters on Modbus RTU and TCP agents
TCP_IP_PORT	Set the configuration for the Modbus TCP port

Chapter 2
Startup

STARTUP PROCEDURE

The flowchart lists steps you must carry out to have your AC³ system installed on the plant and properly controlling the Customer process.



2-1 Keyboard

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

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

-123.4 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;

LOC Changes the Set Point (SP) operating mode, admitted values:
LOC (Local) and **REM** (Remote);

Auto Selects the output operating mode between **AUTO** (Automatic) and **MAN** (manual); when in manual mode, the control output value can be changed touching the -123.4 button and editing the value on the numeric pad;

cmd# 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.

2-2 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 AC³ 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. "**Three 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. "**SP Prog. Mngt**" (1... 4) panel pages.

For the configuration panel pages the displaying order is:

1. "**System**" panel page;
2. "**PLC Configuration**" panel page;
3. "**SP Prog. recipe**" panel page;
4. "**Config. PIDs**" (1... 4) panel pages;
5. "**Config. Numerical**" (1... 8) panel pages;
6. "**Config. Digital**" (1... 8) 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 filed 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 filed can be used to define the corresponding Engineering Unit.

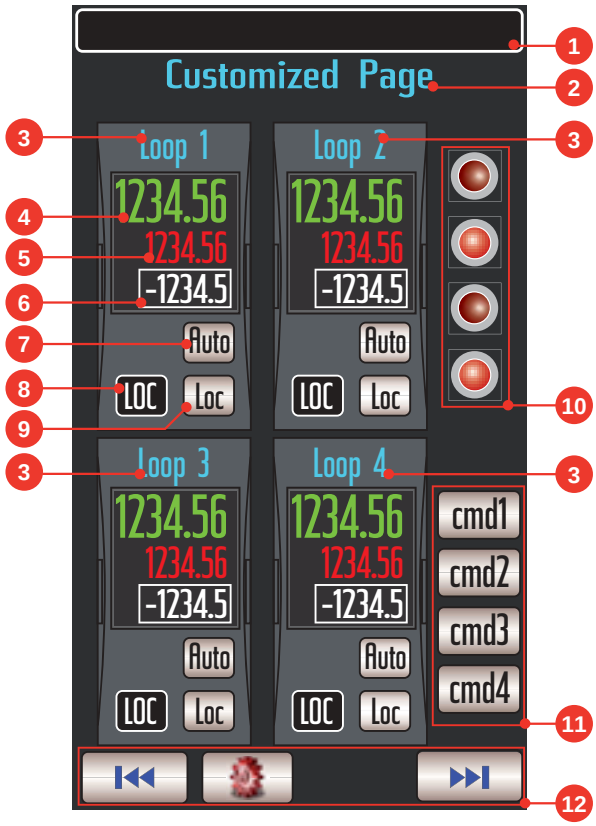
Edit Digitals:

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

SP Prog. Mngt:

Currently not available

2-2-1 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.

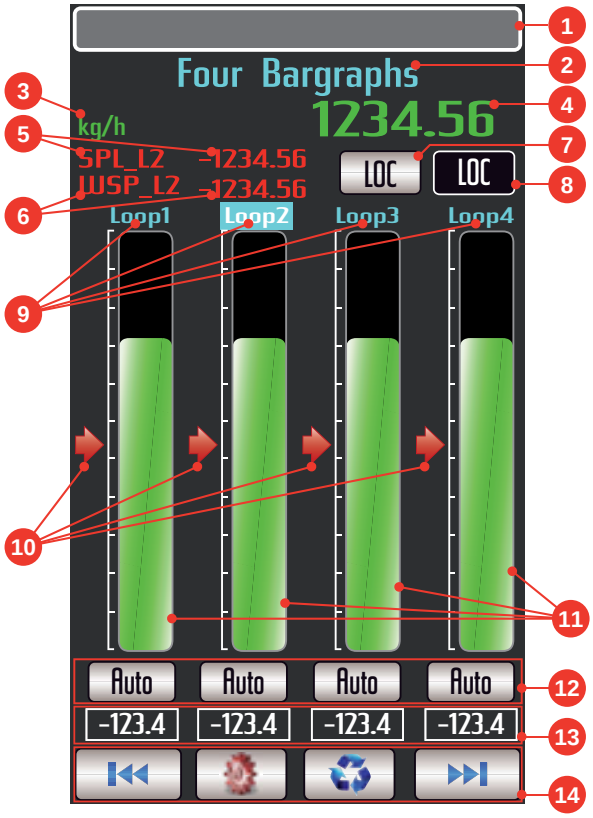
Additionally, four generic status LEDs and digital command buttons are available on the right side.

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 (Writable)**
   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. **Auto/Man Selection Button**
   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.

8. **Local/Remote Set Point Selection Button**
   Set Point operating mode button. Pressing with a finger on this area, the system 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.
9. **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.
10. **Programmable Status LEDs**
    These indicators can be programmed to point out the status of a variable.
11. **Programmable Command Buttons**
    These buttons can be programmed to activate/deactivate a specific command.
12. **Operative keys**
    Using these keys the user can easily move through the instrument pages. The command are: ***Back page***, ***Config***, ***Next page***.

2-2-2 Four Bargraph Panel

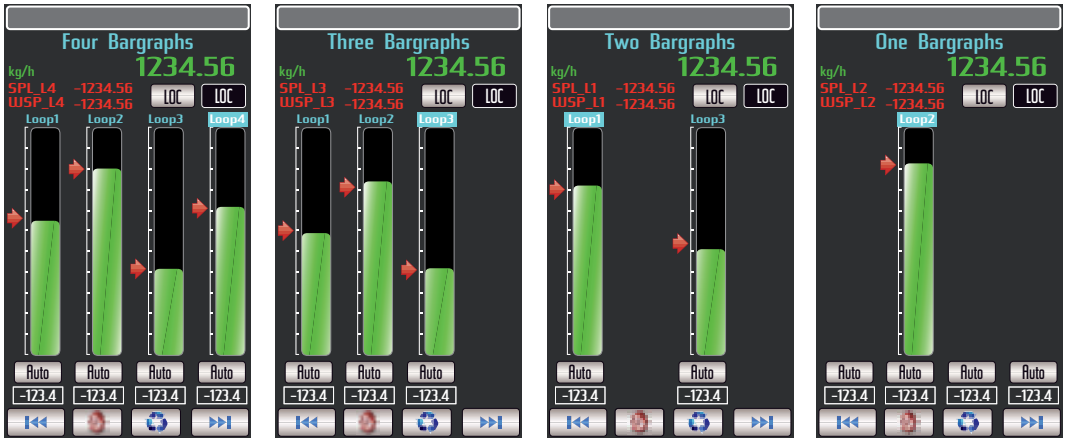


This display type is less rich of information than the previous one; because it lacks the output bargraph and the main variable engineering units, but surely, it is the most versatile; by selecting the amount of loops, it adds the corresponding bargraphs and the sliders. This way to operate improves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

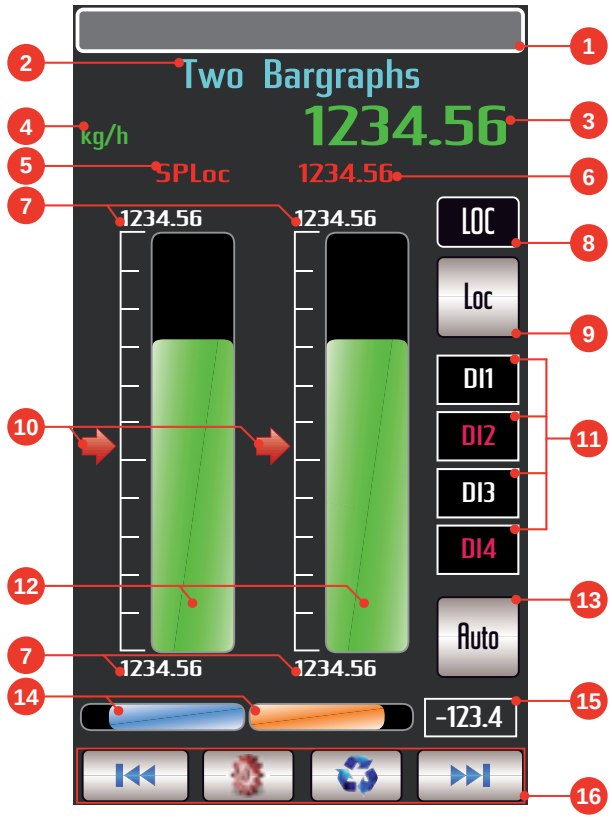
1. **Alarm Banner**
   This area is used by the system to display the active alarms. The messages scroll on the banner, from the right to the left, in order to warn the user about the active alarm conditions.
2. **Page Tag**
   This field of 16 alphanumeric characters represent the page description. It can be modified as desired from the Tags_Table.csv file.
3. **Engineering Units**
   This field of 8 alphanumeric characters represent the Engineering Units mnemonic related to the Variable value displayed (item ❹) 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: ***Back page***, ***Config***, ***Circle***, ***Next page***.

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.



2-2-3 Two Bargraph Panel



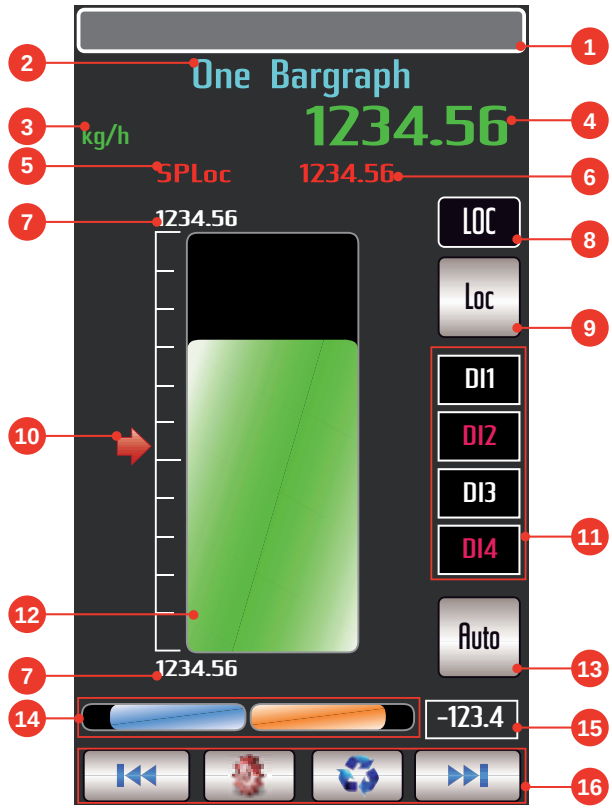
The main purpose of this display is to provide the front panel for those applications were two PID loops are typically required, such as a cascade control loop (Master and Slave).

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 units, 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 Units**
   This field of 8 alphanumeric characters represent the Engineering units mnemonic related to the specific value. It can be modified as desired from the Tags_Table.csv file.
5. **Scrolled Variable Tag**
   This 6 characters field is used first to show the SPLoc1/SPLoc2 or SPLoc3/SPLoc4 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 SPLoc1/SPLoc2 or SPLoc3/SPLoc4 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 with sign and decimals (default 4 integers and 2 decimals).
7. **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.
8. **Set Point Operating Mode**
   This field shows the actual selected SP operating mode of the loop. The status can be Loc or Rem (Local or Remote). The field changes accordingly to the "Circulating values" button (Loop_1/Loop_2 or Loop_3/Loop_4).
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. **SP Slider indicators**
    Graphical representation, through a red arrow slider, of the real time SP value.
11. **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).
12. **PV Bargraph**
    Green bargraph indication of the Process Variable.
13. **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).
14. **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).
15. **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).
16. **Operative keys**
    Using these keys the user can easily move through the instrument pages. The command are: ***Back page***, ***Config***, ***Circle***, ***Next page***.

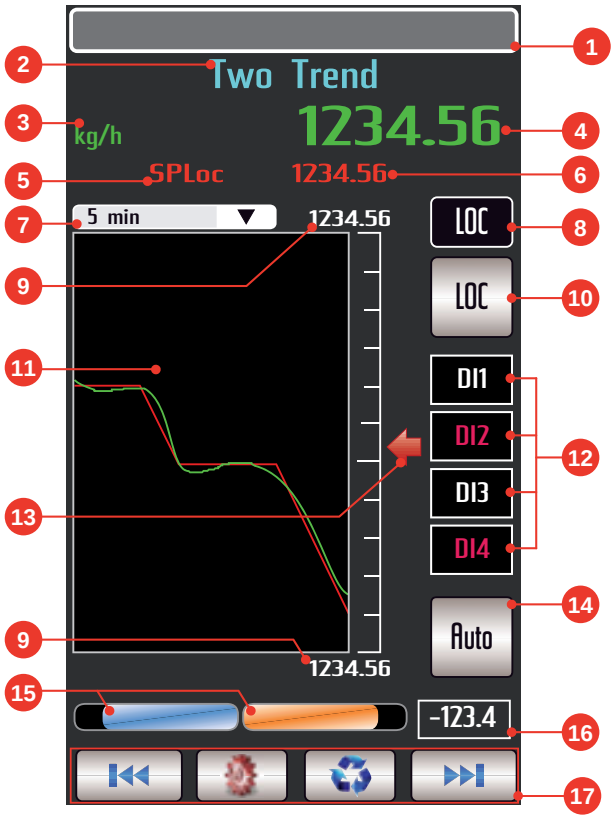
2-2-4 One Bargraph Panel



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 Units**
   This field of 8 alphanumeric characters represent the Engineering units 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 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.
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**
    Allow the operator to move through the available pages or to perform specific functions. The available commands/functions are: **Previous page**, **Configuration page**, **Circulating values** and **Next page**.

2-2-5 Double Trend Panel



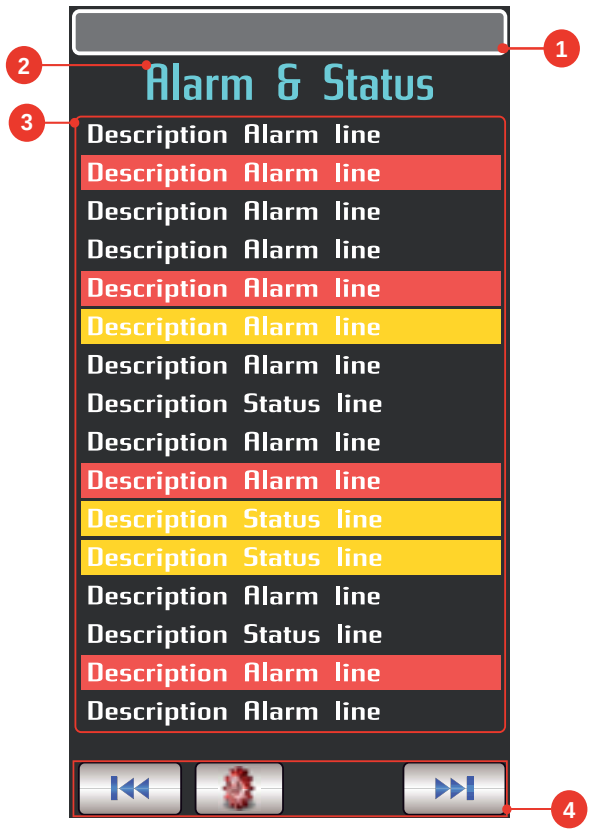
This display has almost the same functionality of the 2 Bar Panel module, with the addition of a trend chart of an analogue variable. Its main purpose is to provide the front panel of a simple control loop. The trend indication gives the operator a better understanding of the situation of the process, 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 Units**
   This field of 8 alphanumeric characters represent the Engineering units 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**
    Allow the operator to move through the available pages or to perform specific functions. The available commands/functions are: **Previous page**, **Configuration page**, **Circulating values** and **Next page**.

2-2-6 Alarm & Status Panel

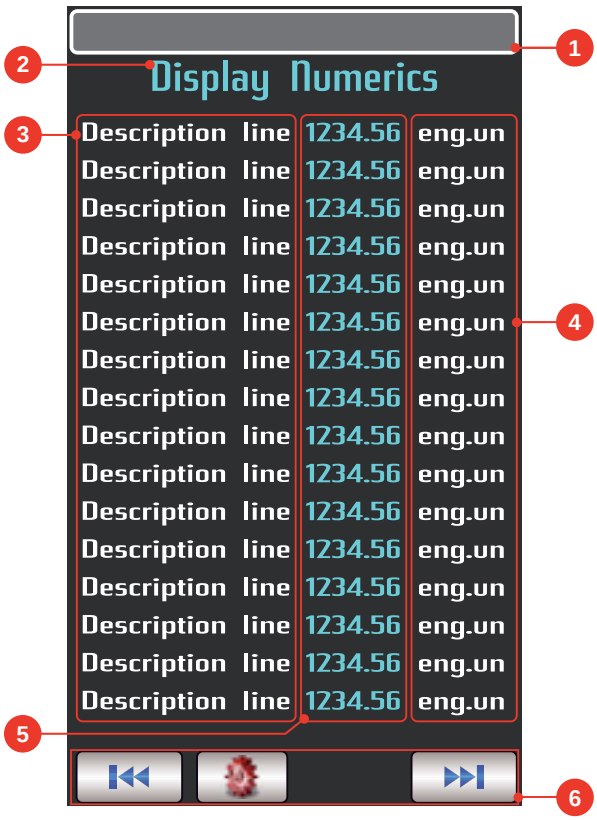


This module provides the functionalities of an alarm annunciator with 16 alarm messages. Each message is connected with a digital input, that defines the visualisation of the message. All the 16 messages are listed at a predefined position on the display, with different visualisation modes, according to the status of the associated digital input; in reverse, if the input is active, or in normal, if it is inactive.

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.
   Message Area
   This display is reserved for 16 alarm messages, each on a line of the display.
4. **Operative keys**
   Allow the operator to move through the available pages or to perform specific functions. The available commands/functions are: **Previous page**, **Configuration page** and **Next page**.

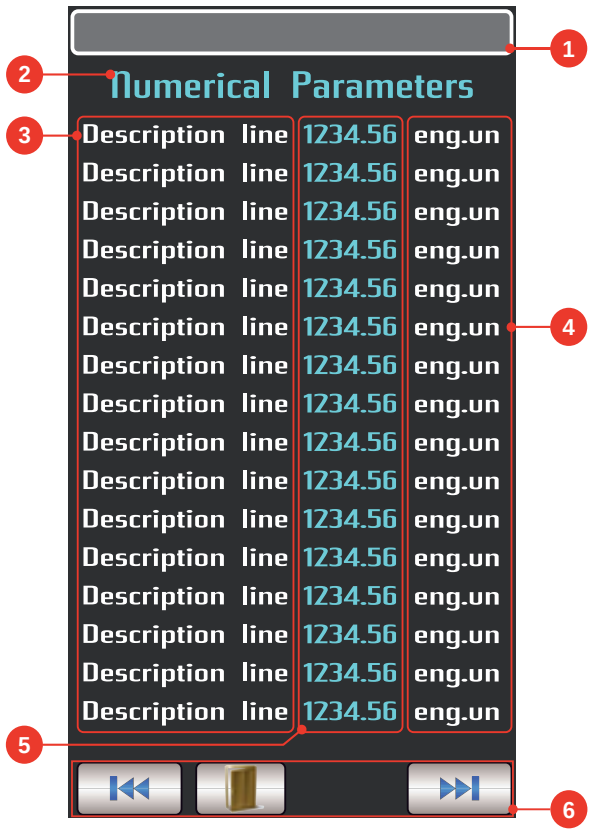
2-2-7 Display Numericals Panel



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 Units**
   Engineering units 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: **Previous page**, **Configuration page** and **Next page**.

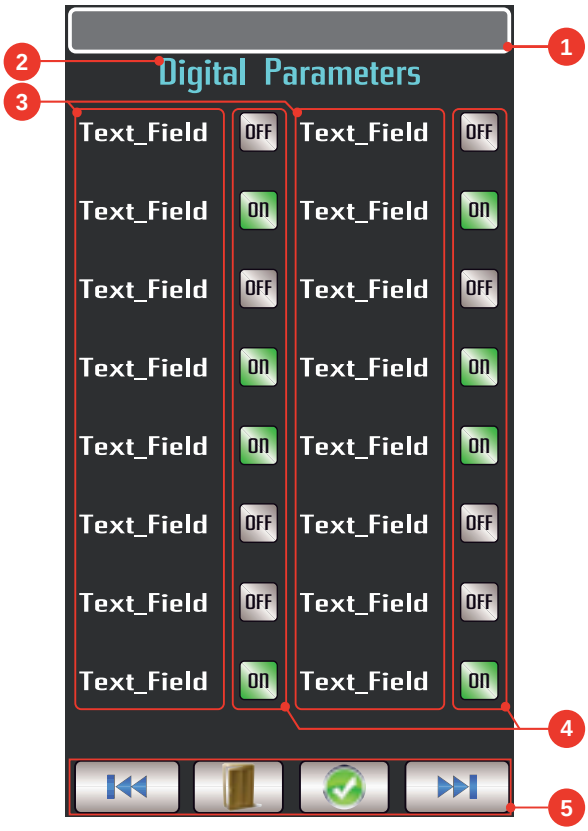
2-2-8 Edit Numericals Panel



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 Units**
   Engineering units 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**
   Using these keys the user can easily move through the instrument pages. The command are: **Back page**, **Exit** (back to the operational page), **Next page**.

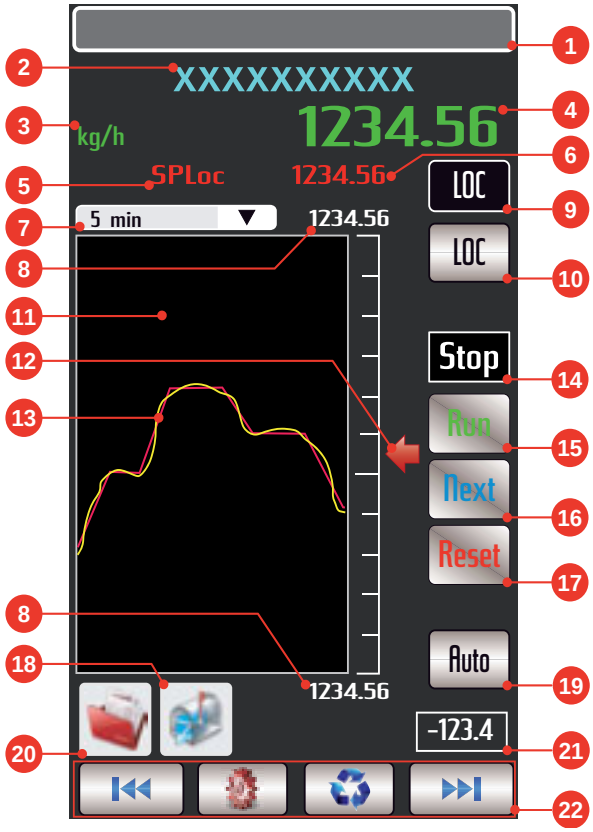
2-2-9 Edit Digitals Panel



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.
   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.
5. **Operative keys**
   Using these keys the user can easily move through the instrument pages. The command are: **Back page**, **Exit** (back to the operational page), **Cumulative Digital Input Write**, **Next page**.

2-2-10 SP Prog. Mngt Panel



This display provides a suitable interface to the Set Point programmer module, available on the AC30 controller, only. It provides both the trend of 2 variables and the status displays and the user commands to the Set Point programmer. Furthermore, it represents the status of 2 general purpose logic signals. The time span of the trend chart is defined by the user, by choosing between the following set: 1, 2, 5, 10, 30 minutes - 1, 2, 5 hours.

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 Units**
   This field of 8 alphanumeric characters represent the Engineering units mnemonic related to the specific value. It can be modified as desired from the Tags_Table.csv file.
4. **Scrolled Variable Tag**
   This 3 characters label, specified by the Customer, identifies the scrolled variable displayed.
   Pressing the  button, the tag, together with the corresponding value, of each variable of a list, is displayed, one at a time and sequentially. The list includes the LSP and the 5 analogue input signals of the module.
5. **Trend chart high/low scale Limits**
   They define the values of upper and lower limits of the scale. Each value consists of 6 characters plus the sign and the decimal point.
6. **Trend Chart**
   Area dedicated to the graphic display of the recent trend curve of one or more variables.
7. **Trend of BI1**
   Recent trend curve display of the analogue input signal BI1.

Trend of CI1
Recent trend curve display of the analogue input signal CI1.

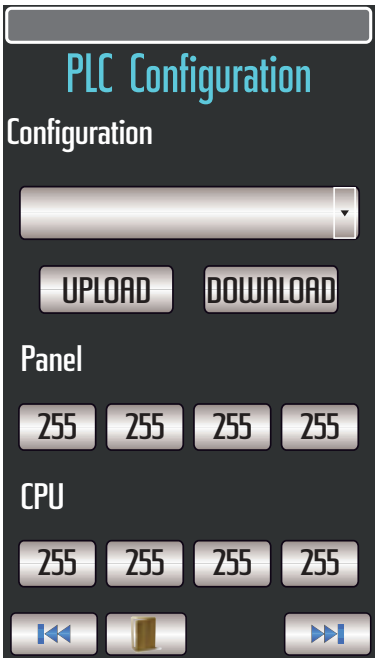
8. **Working Set Point Cursor**
   XXXXXXXXXXXXX.
9. **Time scale**
   Numerical display of the time span of the trend chart.
10. **Normal/Fast Function**
    Display of the running mode of the Programmer. The running mode can be changed, by mean of the two buttons and , selecting, respectively, the Fast and the Normal mode. After pressing the button, push the Enter key to confirm.
11. **Selection Cursor**
    Highlighting of the selected command. From this panel you can enter some commands to the Programmer. These are the ones listed at the lower line of the display (Normal/Fast, Next, Reset). To do it, you must first select the command, by moving the cursor with the button. The selected command is the one displayed in reverse. Once you have selected the command, follow the instruction related to it, to proceed.
12. **Next Function**
    Next command mnemonic. To send a Next command, that forces the Programmer to skip to the next segment, you must select this field and confirm with Enter.
13. **Reset Function**
    Reset command mnemonic. To send a Reset command you must select this field and confirm with Enter.
14. **Enter (OK function)**
    Icon of the Enter button, corresponding to the physical button . This button must be pressed to confirm the command that has been selected, as described at Point 1. It causes the starting of its execution.
15. **Operating mode**
    Display of the operating mode of the Programmer (Run or Hld). The user can change the operating mode, forcing the program to run or holding it, by mean of the button.
16. **Digital**
    Display, by mean of user defined, 3 character mnemonics of the status of 2 digital input signals. The user can define a mnemonic for each state of the digital signal.
17. **Set Point slider**
    Graphic representation, through a moving slider, of the real time value of the Set Point., corresponding to the analogue input signal CI1.
18. **Loc/Rem/Com**
    Display of the Set Point operating mode that the user has requested from the controller keyboard, by mean of the key. The choices are:
    LOCLocal Set Point
    REMRemote Set Point
    COMComputer Set Point
19. **Set Point Operating Mode**
    This short mnemonic reports the current Set Point operating mode of the loop.
20. **Scrolled Variable Value**
    Numerical display of the selected scrolled variable, selected by mean of the key. The list of the variables includes the Local Set Point and other analogue input signals of the module. It consists of 6 characters, including the sign and the decimal point.
21. **PV Variable Value**
    Numerical visualisation of the PV variable, consisting of 6 characters, including the sign and the decimal point. Usually, this variable corresponds to the one at input BI1.

22. **Operative keys**
    Using these keys the user can easily move through the instrument pages. The command are: ***Back page***, ***Config***, ***Circle***, ***Next page***.

2-3 Select a resident Strategy

At power up, the AC³ 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 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 AC³ 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 will appear;



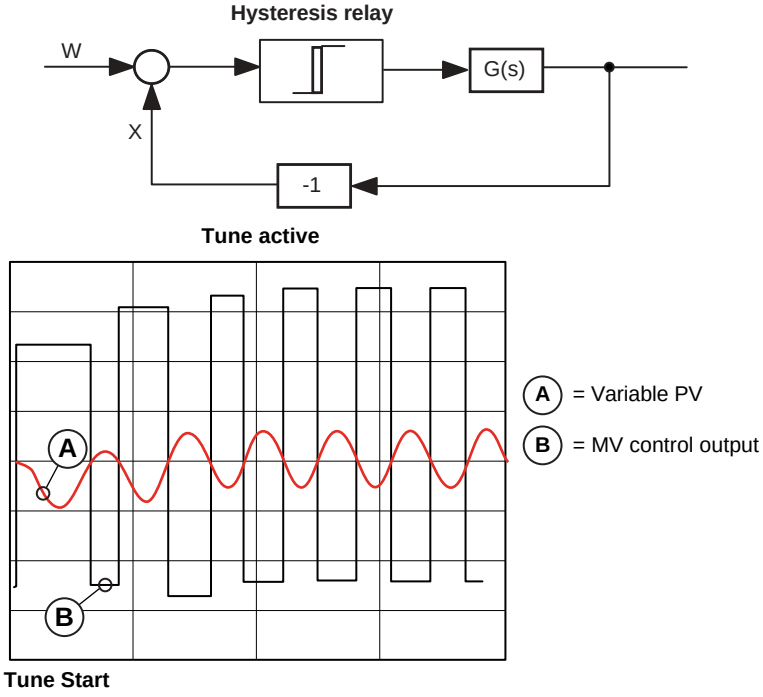
3. After that, the main menu page will be displayed: please choose the "Manage Configuration" option;
4. From the pull down menu select the desired control strategy and press the "Download" button;
5. A popup window will warn you to reboot the complete system: power cycle the AC³ system in order to get 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

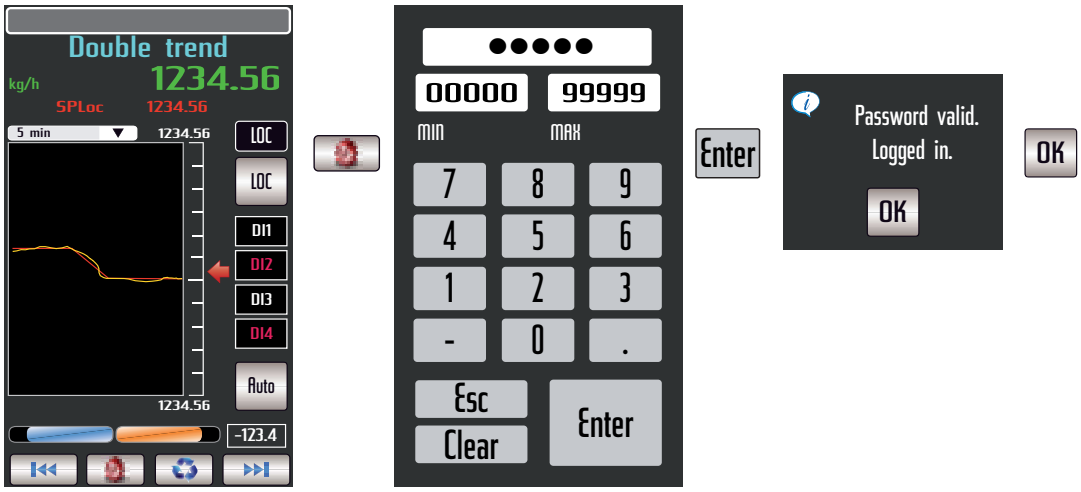
The Tuning method used in the AC³ systems is a highly sophisticated new generation algorithm which represents conceptually the "state of the art" in his context. Basically, the method on which is based can be represented like follows.



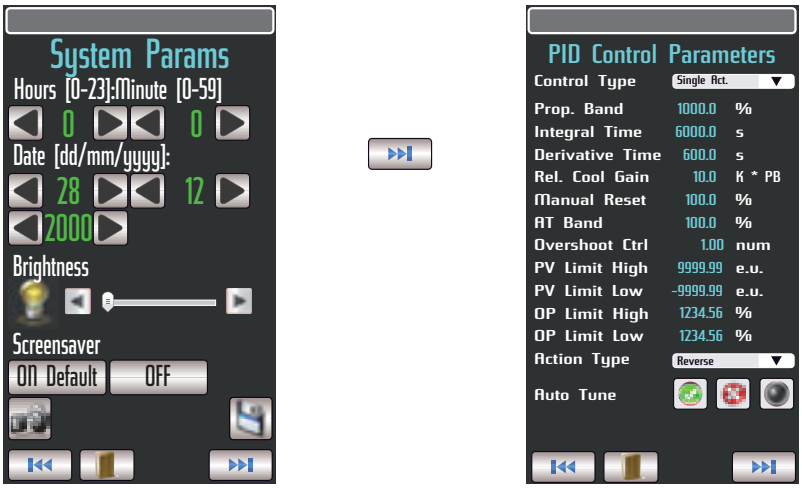
In the closed loop configuration as illustrated above, the hysteresis relay causes a continuous endless oscillation of the measured variable. These oscillations are carefully examined, in terms of amplitude and period, by the Tune algorithm which then, accordingly to these analyses, determines the optimal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

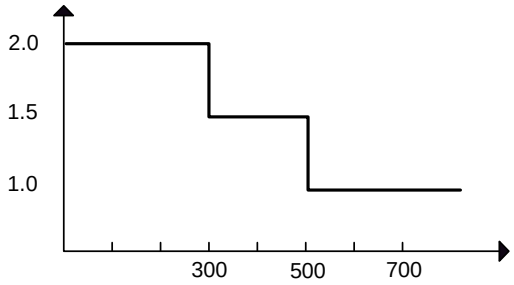
The word Gain scheduling is the historical name that does not mean only the Proportional band value can be changed but can be extended to all the 3 terms, including the integral time, the derivative time and the Relative Cooling Gain factor.

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.

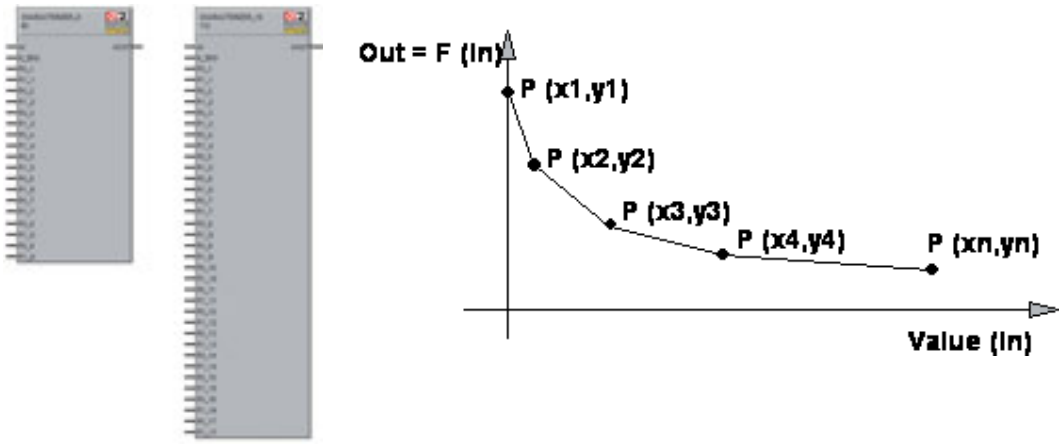
For instance, let supposed to have been calculated three sets of the 3 terms parameters, each one related to a specific process condition or SP range. You can imagine that each set has been computed automatically by the controller Tuning facility, as described in the Chapter 4.1.

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 value of the SP. This can be implemented automatically as illustrated below. A CHARACTERIZER_8 or 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.



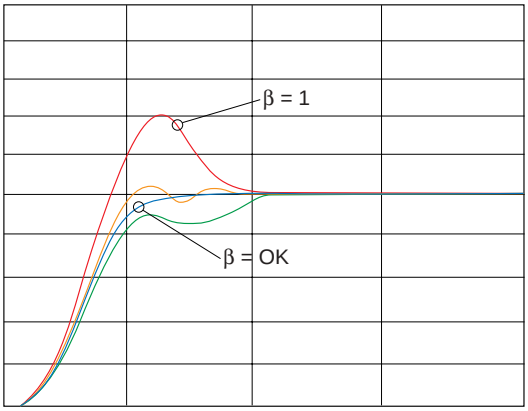
Graphical representation of the function block which can be used for this scope.

3-3 Two freedom degrees PID

In order to provide very effective control capabilities, the AC³ 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 AC³ systems are supplied with 3 serial ports:

X0 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;

X1 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 AC³ 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 withSCADA 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 (X1)

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 architcture could not be reproduced with the new system which cannot guarantee any compatibility with the old one.

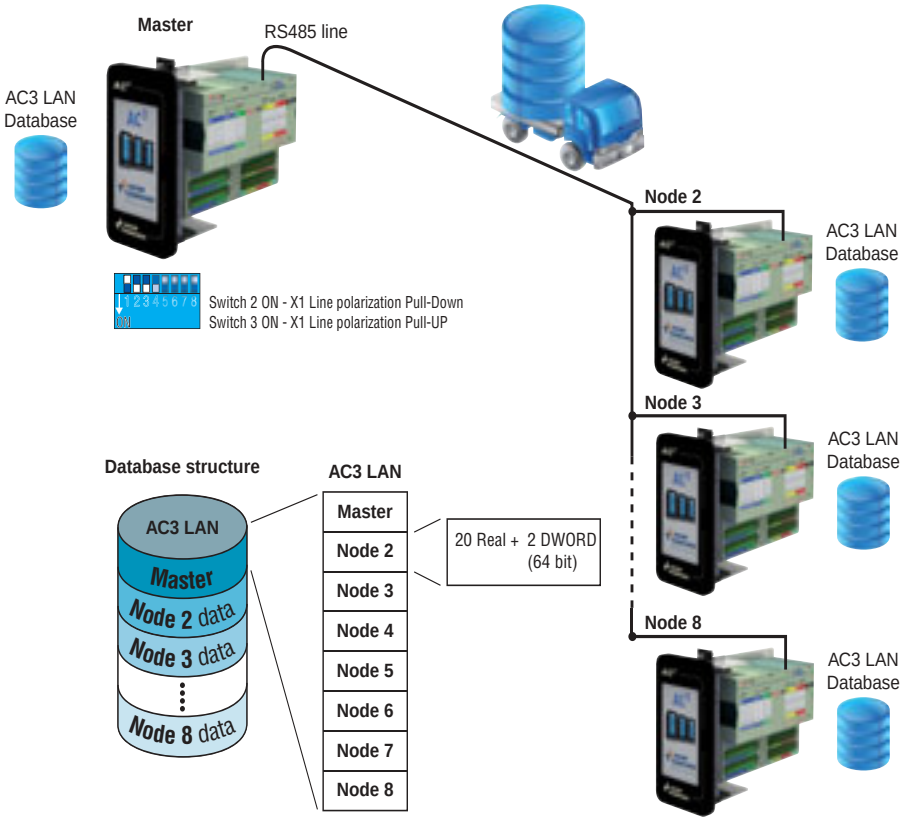
In order to reproduce as much as possible the functionality, a ModBus RTU Master/ Slave arcitecture between the units has been arranged.

The developer must configure in the applcation 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 dignostic 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 AC³ 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

The OpenPCS programming suite from Infoteam is provided on CD-ROM.
It is also available online at: www.infoteam.de.

4-1 Installing OpenPCS

4-1-1 Hardware and Software Requirements

OpenPCS requires a PC with at least:

- Pentium II, 1GHz;
- 512 MB RAM;
- 16 GB of free disk space;
- CD-ROM and 1024*768 resolution;
- Windows 2003 Server, Windows XP SPII or Windows Vista 32bit.

4-1-2 Installation

OpenPCS is provided on CD-ROM. The CD auto-starts a screen where you can select the software 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_673e.exe` file) available in `X:\Setup\` folder ("**X**": is the letter assigned to the CD-ROM drive in 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'.

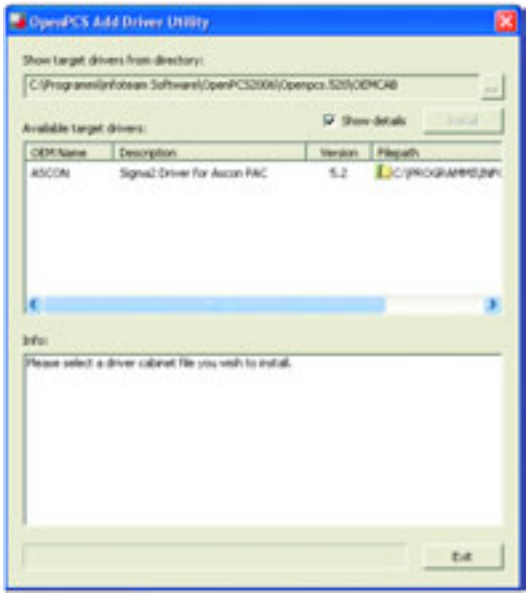
Note: Installations to substitute drives are not supported by Windows XP.

4-1-3 Starting OpenPCS

With Windows started choose:
Start → Programs → infoteam OpenPCS 6.7 → infoteam OpenPCS 6.7
this will open the Framework.

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

In order to work with the Ascon Tecnologic CPU target, you must install in OpenPCS a **cab** file. The file **AT_sigmadue_Lxx_Hyy_zzzz.cab** contains everithing describing Ascon Tecnologic sigma**due** Hardware, drivers, examples and utilities (**xx**, **yy** and **zzzz** are digits to identify the software version).
In the OpenPCS "*Extras*" menu, select "*tools – Driver install…*". "*Select*" the desired cabinet (e.g. AT_sigmadue_2015.cab), then "*Install*".



4-3 PC Ethernet port configuration

In order to communicate with the Ascon Tecnologic MP-02 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".

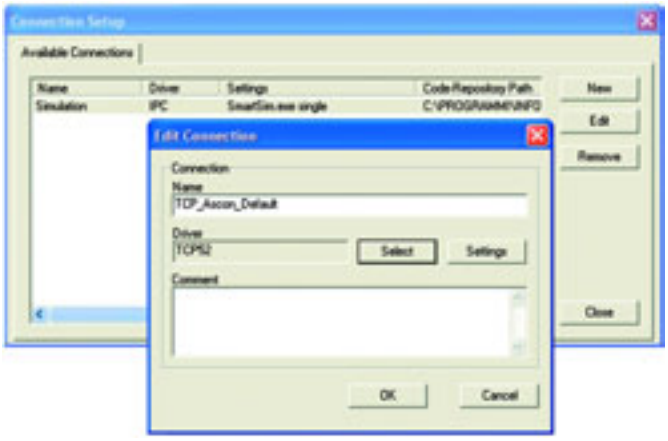
In the "General" sheet now you can set:

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 Proramming 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).

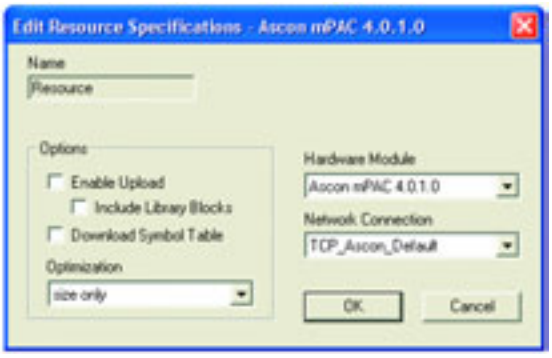


Click the "*Settings*" button to set the communication parameters.

The Port number and IP address must be the same as the ones configured into the CPU (for more details, please consult the MP-02 Quick Guide).
OpenPCS environment is now ready to communicate with the AT target.

4-4-2 OpenPCS Target resource Setup

Ascon Tecnologic 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 Tecnologic…*" 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\6.x.x\Online\TcpDriverTimeout_ms]
```

Value = "20000" means a timeout of 20 seconds.

Chapter 5
Advanced Function Block Libraries

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 Tecnologic srl's proprietary *IEC61131-3* libraries. These libraries cover different features aspects of the MP-02 unit: Modbus access, process control and logic management.

Description

1. *AT_AC3_Specific_Lib*
2. *AT_AC3_LAN_Mngt_Lib*
3. *AT_AC3_Panels_Lib*
4. *AT_Generic_Advanced_Lib* is a library which contains the most advanced Function Blocks coming from the Ascon AC Station Device.
5. 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 firm-ware of the control unit (CU-0x/MP-0x/ M81) 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.
6. *AT_Communications_Lib* is a Function Block library which simplifies the access to the MODBUS communication ports available in Ascon Tecnologic sigma**due** line devices.
7. *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.

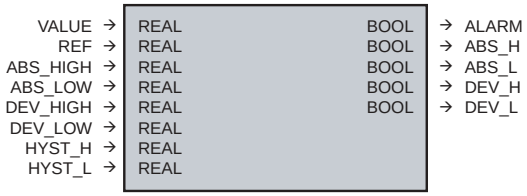
WARNING

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

5-1 AT_AC3_Specific_Lib Description

5-1-1 ALARM_ADV

FB Prototype



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

Input	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)

Description

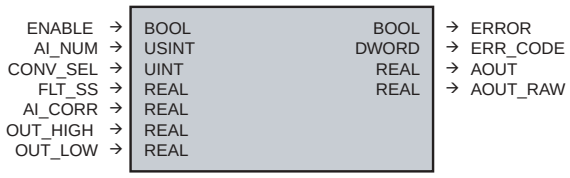
This function block generates different types of alarms. It can be used also as a comparator. Please note that all the alarm conditions are always evaluated.

Alarm Description

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

5-1-2 MP_AI_MNGT_ADV

FB Prototype



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 $-3.4E^{-38}$... $3.4E^{+38}$)
OUT_HIGH	REAL	High Scale Analogue output value [e.u.] (range $-3.4E^{-38}$... $3.4E^{+38}$)
OUT_LOW	REAL	Low Scale Analogue output value [e.u.] (range $-3.4E^{-38}$... $3.4E^{+38}$)

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 Variable Tables

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

Input Parameters Default

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
IN_HIGH	According to AI electrical scale
IN_LOW	According to AI electrical scale

Input	Default Value
OUT_HIGH	9999.9
OUT_LOW	-999.9

Reference Table

Output Reference Table

Output	Description
ERR_CODE.0	AI input limits invalid (possible divide by zero problem)
ERR_CODE.1	AI value Underrange
ERR_CODE.2	AI value Overrange
ERR_CODE.3	microPAC selected AI invalid

5-1-3 ANALOG MULTIPLEXER 2 CHANNELS

FB Prototype

Parameters

Input parameters

Input	Type	Description
AI_1	REAL	Analogue Input 1 (default value = 0.0)
AI_2	REAL	Analogue Input 2 (default value = 0.0)
DS_1	BOOL	Digital selection input (default value = FALSE)

Output parameters

Output	Type	Description
AOUT	REAL	Analogue Output (default value = 0.0)

Description

This function block is a 2 to 1 multiplexer. Alternatively one of the inputs AIN_1 or AIN_2, selected by the DS_1 digital input, is retransmitted on the AOUT output.

Selection Table

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

Input Parameters Default

DS_1	AOUT
FALSE	AI_1
True	AI_2

5-1-4 RATIO TYPE MODE

FB Prototype

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	Description
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**)

5-1-5 ANALOG SP SELECTION

FB Prototype

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.

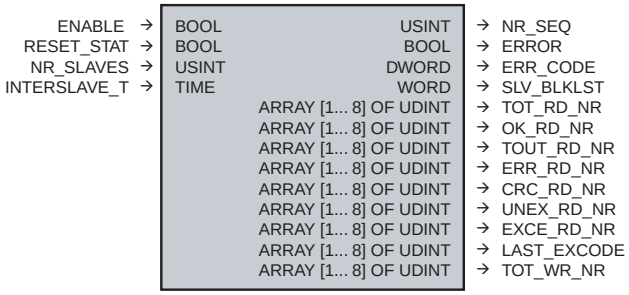
Selection Table

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

5-2 AT_AC3_LAN_Mngt_Lib Description

5-2-1 LAN_MST_SYNC

FB Prototype



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

Input	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_BLKLST	WORD	Device black list status [bit mask] (range 2#0 … 2#1111111)
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 Variable Table

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

Input Parameters Default

Input	Default Value
ENABLE	FALSE
RESET_STAT	FALSE
NR_SLAVES	1
INTERSLAVE_T	20 ms

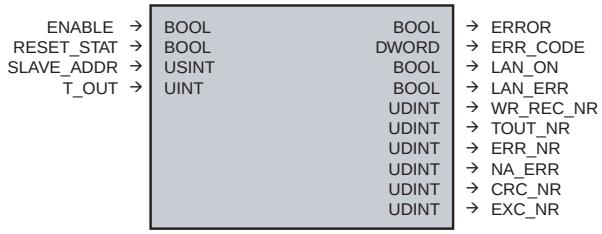
Reference Table

Output Reference Table

Output	Description
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

5-2-2 LAN_SLV_DIAG

FB Prototype



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 Variable Table

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

Input Parameters Default

Input	Default Value
ENABLE	FALSE
RESET_STAT	FALSE
SLAVE_ADDR	2
T_OUT	100 (100 * 100 ms = 10 seconds)
ENABLE	FALSE
IN_HIGH	According to AI electrical scale
IN_LOW	According to AI electrical scale

Reference Table

Output Reference Table

Output	Description
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

5-2-3 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

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)

Input	Default Value
RETRY	1

Reference Table

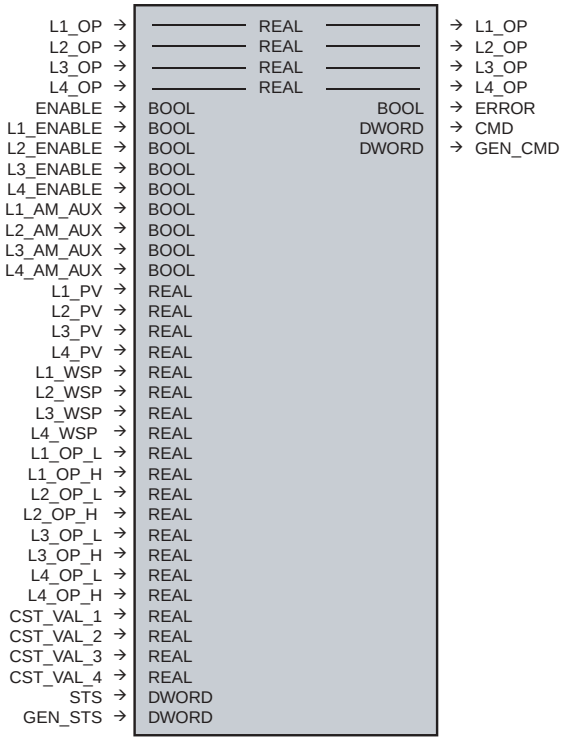
Output Reference Table

Output	Description
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

5-3 AT_AC3_Panels_Lib Description

5-3-1 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

Input	Type	Description
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_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 AC3 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 trough 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	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)**

Input	Description
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
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

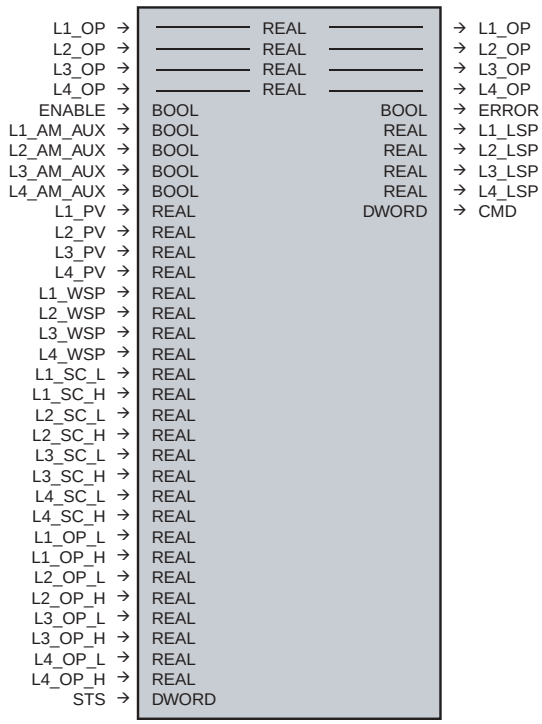
Output	Description
ERR_CODE.0	The function block already used
CMD.0	Loop_1 Auto/Manual command **(0 = Auto, 1 = Manual)**
CMD.1	Loop_1 SP Local/Remote selection command **(0 = Loc, 1 = Rem)**
CMD.2	Loop_1 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.3	Loop_1 Auto-Tuning Reset command **(Rising 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)**

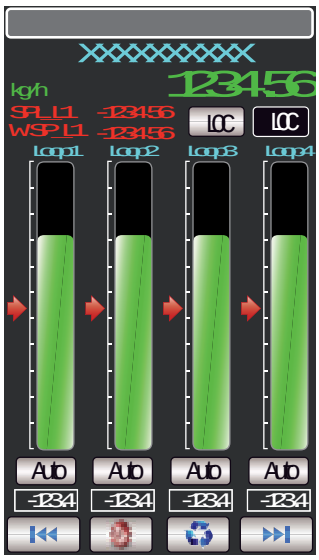
Output	Description
CMD.8	Loop_2 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.9	Loop_2 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.10	Loop_2 Control Action mode **(0 = Single, 1 = Double)**
CMD.11	Loop_2 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.12	Loop_3 Auto/Manual command **(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)**
CMD.15	Loop_3 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.16	Loop_3 Control Action mode **(0 = Single, 1 = Double)**
CMD.17	Loop_3 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.18	Loop_4 Auto/Manual command **(0 = Auto, 1 = Man)**
CMD.19	Loop_4 SP Local/Remote selection command **(0 = Loc, 1 = Rem)**
CMD.20	Loop_4 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.21	Loop_4 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.22	Loop_4 Control Action mode **(0 = Single, 1 = Double)**
CMD.23	Loop_4 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.24… 31	Reserved
GEN_CMD.0	Additional Generic_1 page displayed command (**0 = OFF, 1 = ON**)
GEN_CMD.1	Additional Generic_2 page displayed command (**0 = OFF, 1 = ON**)
GEN_CMD.2	Additional Generic_3 page displayed command (**0 = OFF, 1 = ON**)
GEN_CMD.3	Additional Generic_4 page displayed command (**0 = OFF, 1 = ON**)
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.

5-3-2 PAGE_4BARG_1

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_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)

Input	Type	Description
L1_SC_L	REAL	Loop_1 PV input Low Scale value [e.u.] (range -3.4E^{-38}... 3.4E^{+38})
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 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)
STS	DWORD	Overall PIDs Status bit mask

Output parameters

Output	Type	Description
ERROR	BOOL	Specific AC3 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

trough 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_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 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)**

Input	Description
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	Description
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 = Manual)**
CMD.13	Loop_3 SP Local/Remote selection command **(0 = Loc, 1 = Rem.)**
CMD.14	Loop_3 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.15	Loop_3 Auto-Tuning Reset command **(Rising Edge pulse)**

Output	Description
CMD.16	Loop_3 Control Action mode **(0 = Single, 1 = Double)**
CMD.17	Loop_3 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.18	Loop_4 Auto/Manual command **(0 = Auto, 1 = Manual)**
CMD.19	Loop_4 SP Local/Remote selection command **(0 = Loc, 1 = Rem.)**
CMD.20	Loop_4 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.21	Loop_4 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.22	Loop_4 Control Action mode **(0 = Single, 1 = Double)**
CMD.23	Loop_4 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.24… 31	Reserved

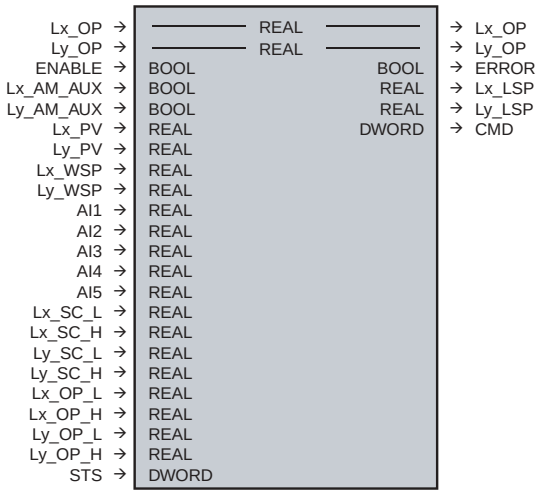
Note: The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

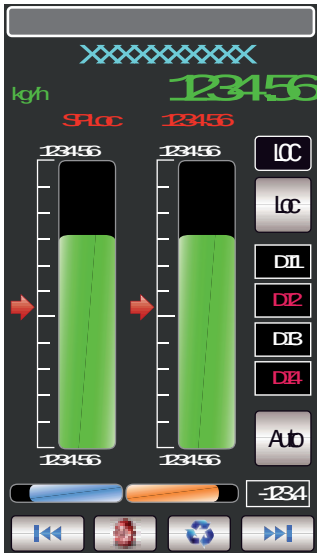
5-3-3 PAGE_2BARG_n

WARNING

n is an index (value 1 or 2) that identifies the Function Block and the loops connected. In particular, when:
n = 1 (PAGE_2BARG_1) then **x** = 1 (first loop connected to the FB) and **y** = 2 (second loop connected to the FB).
Otherwise when:
n = 2 (PAGE_2BARG_2) then **x** = 3 (first loop connected to the FB) and **y** = 4 (second loop connected to the FB)

FB Prototype





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.]

Input	Type	Description
AI5	REAL	Analog_5 generic value [e.u.]
Lx_SC_L	REAL	Loop_x PV input Low Scale value [e.u.] (range -3.4E^{-38}... 3.4E^{+38})
Lx_SC_H	REAL	Loop_x PV input Low Scale value [e.u.] (range -3.4E^{-38}... 3.4E^{+38})
Ly_SC_L	REAL	Loop_y PV input Low Scale value [e.u.] (range -3.4E^{-38}... 3.4E^{+38})
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 AC3 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 trough 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
Lx_AM_AUX	FALSE
Ly_AM_AUX	FALSE
Lx_PV	0.0
Ly_PV	0.0
Lx_WSP	0.0
Ly_WSP	0.0

Input	Default Value
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
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)**

Input	Description
STS.27	Loop_4 Auto-Tuning Fail pages displayed status **(0 = Ok, 1 = Fail)**
STS.28… 31	Reserved

Output Reference Table

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

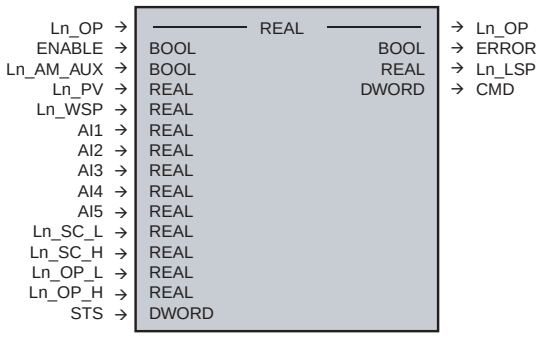
Note: The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

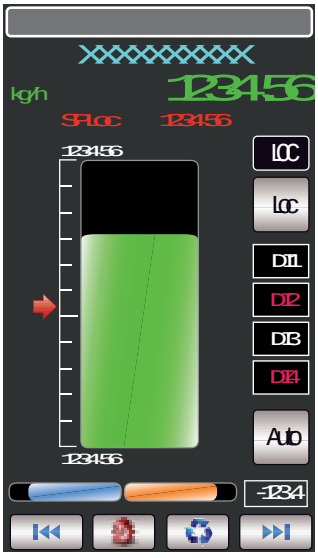
5-3-4 PAGE_1BARG_n

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 (PAGE_1BARG_1), the loop connected to the FB is Loop1;
n = 2 (PAGE_1BARG_2), the loop connected to the FB is Loop2;
n = 3 (PAGE_1BARG_3), the loop connected to the FB is Loop3;
n = 4 (PAGE_1BARG_4), the loop connected to the FB is Loop4.

FB Prototype





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 $-3.4E^{-38}$... $3.4E^{+38}$)
Ln_SC_H	REAL	Loop_n PV input Low Scale value [e.u.] (range $-3.4E^{-38}$... $3.4E^{+38}$)

Input	Type	Description
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 AC3 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 trough 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
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	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**)

Input	Description
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	Description
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 = Manual)**
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	Description
CMD.15	Loop_3 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.16	Loop_3 Control Action mode **(0 = Single, 1 = Double)**
CMD.17	Loop_3 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.18	Loop_4 Auto/Manual command **(0 = Auto, 1 = Manual)**
CMD.19	Loop_4 SP Local/Remote selection command **(0 = Loc, 1 = Rem.)**
CMD.20	Loop_4 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.21	Loop_4 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.22	Loop_4 Control Action mode **(0 = Single, 1 = Double)**
CMD.23	Loop_4 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.24… 31	Reserved

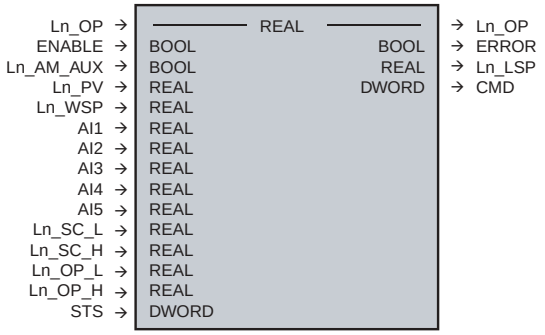
Note: The bit status and/or commands managed through the STS and CMD function block's pins should be connected to the same unique Global variables because the bit mask is conceptually organized into a bit mask fixed positions.

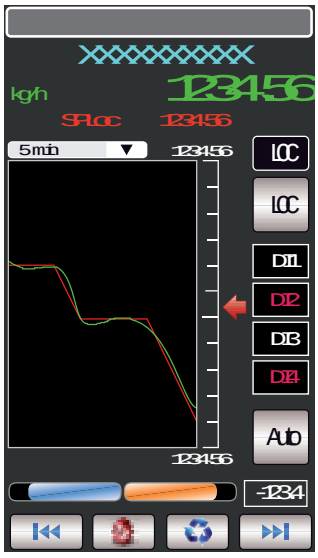
5-3-5 PAGE_2TRND_n

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 (PAGE_2TRND_1), the loop connected to the FB is Loop1;
n = 2 (PAGE_2TRND_2), the loop connected to the FB is Loop2;
n = 3 (PAGE_2TRND_3), the loop connected to the FB is Loop3;
n = 4 (PAGE_2TRND_4), the loop connected 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 $-3.4E^{-38}$... $3.4E^{+38}$)
Ln_SC_H	REAL	Loop_n PV input Low Scale value [e.u.] (range $-3.4E^{-38}$... $3.4E^{+38}$)

Input	Type	Description
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 AC3 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 trough 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.

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 (PAGE_2TRND_1), the loop connected to the FB is Loop1;
n = 2 (PAGE_2TRND_2), the loop connected to the FB is Loop2;
n = 3 (PAGE_2TRND_3), the loop connected to the FB is Loop3;
n = 4 (PAGE_2TRND_4), the loop connected to the FB is Loop4.

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)**

Input	Default Value
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

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**)

Input	Description
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	Description
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 = Manual)**
CMD.13	Loop_3 SP Local/Remote selection command **(0 = Loc, 1 = Rem.)**
CMD.14	Loop_3 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.15	Loop_3 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.16	Loop_3 Control Action mode **(0 = Single, 1 = Double)**
CMD.17	Loop_3 Control Type mode **(0 = Reverse, 1 = Direct)**
CMD.18	Loop_4 Auto/Manual command **(0 = Auto, 1 = Manual)**
CMD.19	Loop_4 SP Local/Remote selection command **(0 = Loc, 1 = Rem.)**
CMD.20	Loop_4 Auto-Tuning Run command **(Rising Edge pulse)**
CMD.21	Loop_4 Auto-Tuning Reset command **(Rising Edge pulse)**
CMD.22	Loop_4 Control Action mode **(0 = Single, 1 = Double)**
CMD.23	Loop_4 Control Type mode **(0 = Reverse, 1 = Direct)**
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.

5-3-6 PAGE_ALM_EVT_n

WARNING

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

n = 1 (PAGE_ALM_EVT_1), the alarm block connected is the 1st (alarms 1... 16);

n = 2 (PAGE_ALM_EVT_2), the alarm block connected is the 2nd (alarms 17... 32);

n = 3 (PAGE_ALM_EVT_3), the alarm block connected is the 3rd (alarms 33... 48);

n = 4 (PAGE_ALM_EVT_4), the alarm block connected is the 4th (alarms 49... 64).

FB Prototype

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

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 (PAGE_ALM_EVT_1), the alarms/events connected are: 1... 16;

n = 2 (PAGE_ALM_EVT_2), the alarms/events connected are: 16... 32;

n = 3 (PAGE_ALM_EVT_3), the alarms/events connected are: 32... 48;

n = 4 (PAGE_ALM_EVT_4), the alarms/events connected are: 48... 64.

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3 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 trough 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
STATUS	2#0
DSP_MODE	2#0
DSP_CONF	2#0

Reference Table

Input Reference Table

Input	Description
STATUS.0… STATUS.15	1… 64 Alarm or Event displayed status **(0 = Inactive, 1 = Active)**
STATUS.16… STATUS.31	Reserved
DSP_MODE.0… DSP_MODE.15	1… 64 Alarm or Event Operative mode **(0 = Event, 1 = Alarm)**
DSP_MODE.16… DSP_MODE.31	Reserved
DSP_CONF.0… DSP_CONF.15	1… 64 Alarm or Event Configuration view **(0 = Not Displayed, 1 = Displayed)**
DSP_CONF.16… DSP_CONF.31	Reserved

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 (PAGE_ALM_EVT_1), the alarms/events connected are: 1... 16;
n = 2 (PAGE_ALM_EVT_2), the alarms/events connected are: 16... 32;
n = 3 (PAGE_ALM_EVT_3), the alarms/events connected are: 32... 48;
n = 4 (PAGE_ALM_EVT_4), the alarms/events connected are: 48... 64.

Output Reference Table

Output	Description
ERR_CODE.0	The function block already used

5-3-7 PAGE_DSP_NUM_n

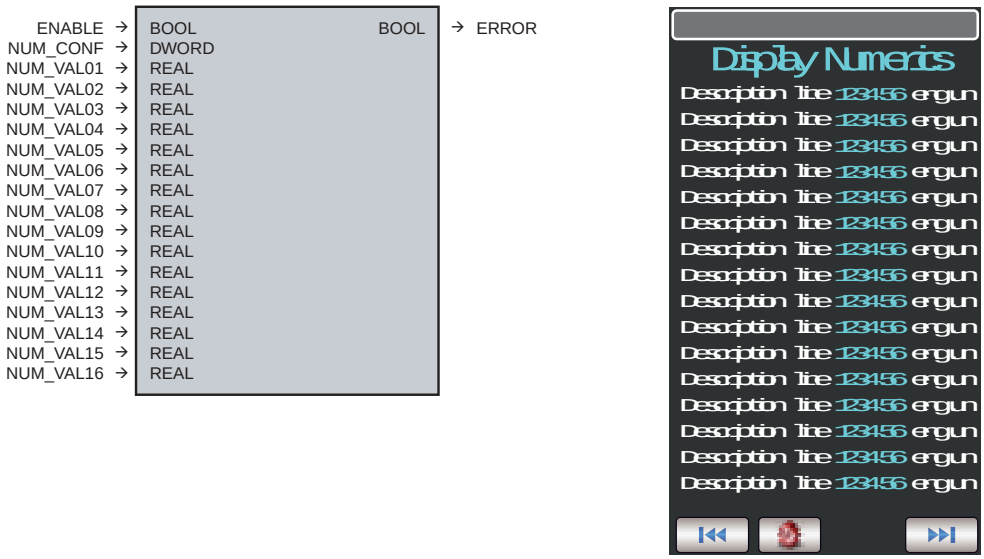
WARNING

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

n = 1(PAGE_DSP_NUM_1), the block of Numerical values connected is the 1st (numercal signal inputs 1... 16);

n = 2(PAGE_DSP_NUM_2), the block of Numerical values connected is the 2nd (numercal signal inputs 17... 32).

FB Prototype



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.]

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 (PAGE_DSP_NUM_1) the block of Numerical values connected is the 1st (numercal signal inputs 1... 16);

n = 2 (PAGE_DSP_NUM_2) the block of Numerical values connected is the 2nd (numercal signal inputs 17... 32);

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3 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 SPECIFIC PAGE has been used into the specific control strategy** and, in case, it will be highlighted trough 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
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	2#0
NUM_VAL13	0.0
NUM_VAL14	0.0
NUM_VAL15	0.0
NUM_VAL16	2#0

Reference Table

Input Reference Table

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

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 (PAGE_DSP_NUM_1) the block of Numerical values connected is the 1st (numercal signal inputs 1... 16);

n = 2 (PAGE_DSP_NUM_2) the block of Numerical values connected is the 2nd (numercal signal inputs 17... 32);

Output Reference Table

Output	Description
ERR_CODE.0	The function block already used

5-3-8 PAGE_EDT_NUM_n

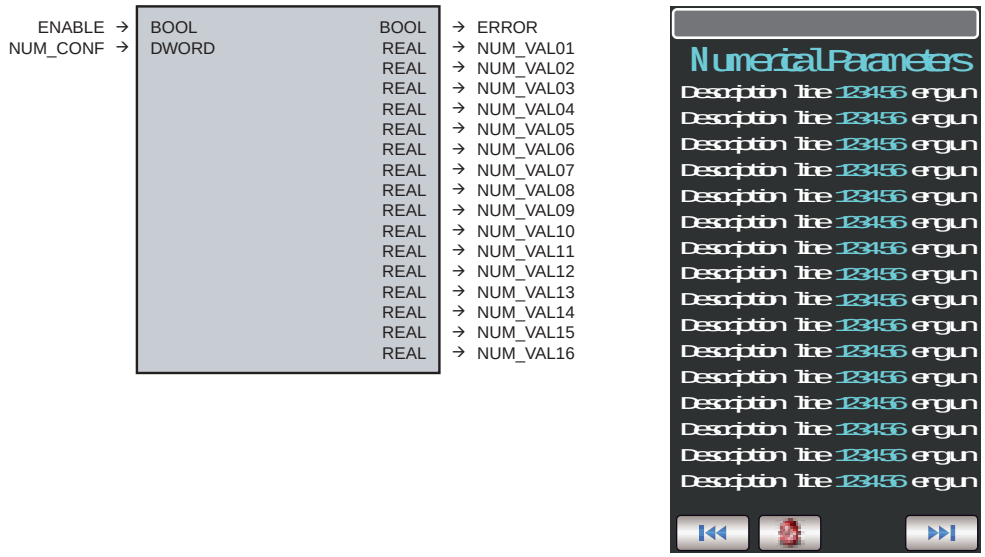
WARNING

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

n = 1 (PAGE_EDT_NUM_1) the block of Numerical values connected is the 1st (numercal signal inputs 1... 16);

n = 2 (PAGE_EDT_NUM_2) the block of Numerical values connected is the 2nd (numercal signal inputs 17... 32);

FB Prototype



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

WARNING

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

n = 1 (PAGE_EDT_NUM_1) the block of Numerical values connected is the 1st (numercal signal inputs 1... 16);

n = 2 (PAGE_EDT_NUM_2) the block of Numerical values connected is the 2nd (numercal signal inputs 17... 32);

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3 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.]

Output	Type	Description
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	Numericla_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 trough 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… 32 Numerical value configuration view **(0 = Not Displayed, 1 = Displayed)**
NUM_CONF.16… NUM_CONF.31	Reserved

WARNING

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

n = 1 (PAGE_EDT_NUM_1) the block of Numerical values connected is the 1st (numercal signal inputs 1... 16);

n = 2 (PAGE_EDT_NUM_2) the block of Numerical values connected is the 2nd (numercal signal inputs 17... 32);

Output Reference Table

Output	Description
ERR_CODE.0	The function block already used

5-3-9 PAGE_EDT_DIG_n

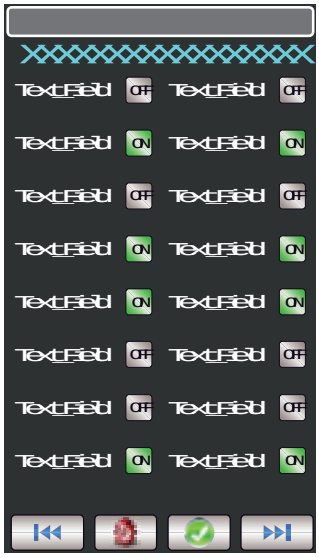
WARNING

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

n = 1 (PAGE_EDT_DIG_1) the block of Digital Inputs connected is the 1st (Digital Inputs 1... 16);

n = 2 (PAGE_EDT_DIG_2) the block of Digital Inputs connected is the 2nd (Digital Inputs 17... 32);

FB Prototype



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

WARNING

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

n = 1 (PAGE_EDT_DIG_1) the block of Digital Inputs connected is the 1st (Digital Inputs 1... 16);

n = 2 (PAGE_EDT_DIG_2) the block of Digital Inputs connected is the 2nd (Digital Inputs 17... 32);

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3 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 trough 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… 32 Digital Command Configuration view **(0 = Not Displayed, 1 = Displayed)**
DIG_CONF.16… DIG_CONF.31	Reserved

WARNING

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

n = 1 (PAGE_EDT_DIG_1) the block of Digital Inputs connected is the 1st (Digital Inputs 1... 16);

n = 2 (PAGE_EDT_DIG_2) the block of Digital Inputs connected is the 2nd (Digital Inputs 17... 32);

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

5-3-10 SP_PROG_MNGT

FB Prototype

Currently not available

Parameters

5-4 Configuration Function Block Descriptions

5-4-1 SP_PROG_RECIPE

FB Prototype

Currently not available

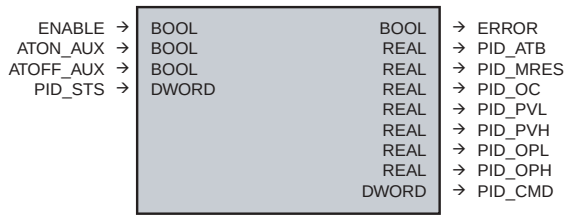
Parameters

5-4-2 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 (PAGE_CFG_PID_1) configures the PID parameters of Control Loop 1;
n = 2 (PAGE_CFG_PID_2) configures the PID parameters of Control Loop 2;
n = 3 (PAGE_CFG_PID_3) configures the PID parameters of Control Loop 3;
n = 4 (PAGE_CFG_PID_4) configures the PID parameters of Control Loop 4.

FB Prototype



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 AC3 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 value [e.u.] (-9999.99...9999.99)
PID_PVH	REAL	Loop_n PV input High range value [e.u.] (-9999.99...9999.99)
PID_OPL	REAL	Loop_n Control Output Low range value [e.u.] (-100.0...100.0)

Output	Type	Description
PID_OPH	REAL	Loop_n Control Output Low range value [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 trough 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.

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 (PAGE_CFG_PID_1) configures the PID parameters of Control Loop 1;
n = 2 (PAGE_CFG_PID_2) configures the PID parameters of Control Loop 2;
n = 3 (PAGE_CFG_PID_3) configures the PID parameters of Control Loop 3;
n = 4 (PAGE_CFG_PID_4) configures the PID parameters of Control Loop 4.

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)

TAG	Default Value
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 (**0 = OFF, 1 = ON**)
PID_STS.1	Loop_1 DI2 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.2	Loop_1 DI3 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.3	Loop_1 DI4 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.4	Loop_1 SP Selection pages displayed status **(0 = Loc, 1 = Rem)**
PID_STS.5	Loop_1 Auto-Tuning Oprs pages displayed status **(0 = Stop, 1 = Run)**
PID_STS.6	Loop_1 Auto-Tuning Fail pages displayed status **(0 = Ok, 1 = Fail)**
PID_STS.7	Loop_2 DI1 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.8	Loop_2 DI2 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.9	Loop_2 DI3 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.10	Loop_2 DI4 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.11	Loop_2 SP Selection pages displayed status **(0 = Loc, 1 = Rem)**
PID_STS.12	Loop_2 Auto-Tuning Oprs pages displayed status **(0 = Stop, 1 = Run)**
PID_STS.13	Loop_2 Auto-Tuning Fail pages displayed status **(0 = Ok, 1 = Fail)**
PID_STS.14	Loop_3 DI1 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.15	Loop_3 DI2 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.16	Loop_3 DI3 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.17	Loop_3 DI4 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.18	Loop_3 SP Selection pages displayed status **(0 = Loc, 1 = Rem)**
PID_STS.19	Loop_3 Auto-Tuning Oprs pages displayed status **(0 = Stop, 1 = Run)**
PID_STS.20	Loop_3 Auto-Tuning Fail pages displayed status **(0 = Ok, 1 = Fail)**
PID_STS.21	Loop_4 DI1 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.22	Loop_4 DI2 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.23	Loop_4 DI3 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.24	Loop_4 DI4 pages displayed status (**0 = OFF, 1 = ON**)
PID_STS.25	Loop_4 SP Selection pages displayed status **(0 = Loc, 1 = Rem)**
PID_STS.26	Loop_4 Auto-Tuning Oprs pages displayed status **(0 = Stop, 1 = Run)**
PID_STS.27	Loop_4 Auto-Tuning Fail pages displayed status **(0 = Ok, 1 = Fail)**
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 **(0 = Auto, 1 = Manual)**
PID_CMD.1	Loop_1 SP Local/Remote selection command **(0 = Loc, 1 = Rem)**
PID_CMD.2	Loop_1 Auto-Tuning Run command **(Rising Edge pulse)**
PID_CMD.3	Loop_1 Auto-Tuning Reset command **(Rising Edge pulse)**
PID_CMD.4	Loop_1 Control Action mode **(0 = Single, 1 = Double)**

Output	Description
PID_CMD.5	Loop_1 Control Type mode **(0 = Reverse, 1 = Direct)**
PID_CMD.6	Loop_2 Auto/Manual command **(0 = Auto, 1 = Manual)**
PID_CMD.7	Loop_2 SP Local/Remote selection command **(0 = Loc, 1 = Rem)**
PID_CMD.8	Loop_2 Auto-Tuning Run command **(Rising Edge pulse)**
PID_CMD.9	Loop_2 Auto-Tuning Reset command **(Rising Edge pulse)**
PID_CMD.10	Loop_2 Control Action mode **(0 = Single, 1 = Double)**
PID_CMD.11	Loop_2 Control Type mode **(0 = Reverse, 1 = Direct)**
PID_CMD.12	Loop_3 Auto/Manual command **(0 = Auto, 1 = Manual)**
PID_CMD.13	Loop_3 SP Local/Remote selection command **(0 = Loc, 1 = Rem)**
PID_CMD.14	Loop_3 Auto-Tuning Run command **(Rising Edge pulse)**
PID_CMD.15	Loop_3 Auto-Tuning Reset command **(Rising Edge pulse)**
PID_CMD.16	Loop_3 Control Action mode **(0 = Single, 1 = Double)**
PID_CMD.17	Loop_3 Control Type mode **(0 = Reverse, 1 = Direct)**
PID_CMD.18	Loop_4 Auto/Manual command **(0 = Auto, 1 = Manual)**
PID_CMD.19	Loop_4 SP Local/Remote selection command **(0 = Loc, 1 = Rem)**
PID_CMD.20	Loop_4 Auto-Tuning Run command **(Rising Edge pulse)**
PID_CMD.21	Loop_4 Auto-Tuning Reset command **(Rising Edge pulse)**
PID_CMD.22	Loop_4 Control Action mode **(0 = Single, 1 = Double)**
PID_CMD.23	Loop_4 Control Type mode **(0 = Reverse, 1 = Direct)**
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.

5-4-3 PAGE_CFG_NUM_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 = 1 (PAGE_CFG_NUM_1) configures the first block of Numerical Fields (Numerical Fields 1... 16);

n = 2 (PAGE_CFG_NUM_2) configures the second block of Numerical Fields (Numerical Fields 17... 32);

n = 3 (PAGE_CFG_NUM_3) configures the third block of Numerical Fields (Numerical Fields 33... 48);

n = 4 (PAGE_CFG_NUM_4) configures the fourth block of Numerical Fields (Numerical Fields 49... 64);

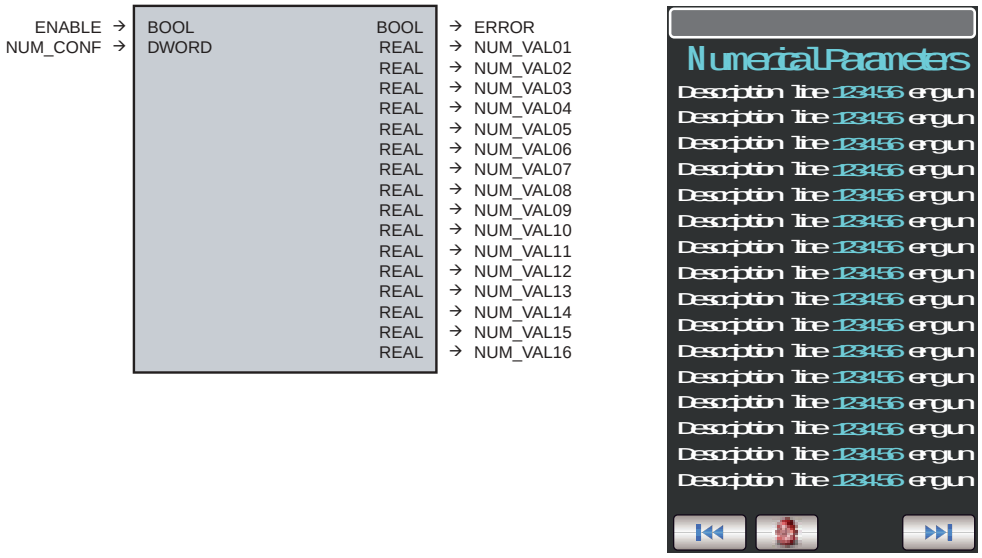
n = 5 (PAGE_CFG_NUM_5) configures the fiveth block of Numerical Fields (Numerical Fields 65... 80);

n = 6 (PAGE_CFG_NUM_6) configures the sixth block of Numerical Fields (Numerical Fields 81... 96);

n = 7 (PAGE_CFG_NUM_7) configures the seventh block of Numerical Fields (Digital Inputs 97... 112);

n = 8 (PAGE_CFG_NUM_8) configures the eighth block of Numerical Fields (Numerical Fields 113... 128).

FB Prototype



Parameters

Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
NUM_CONF	DWORD	1... 128 Numeric Edit values View Configuration bit mask

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3 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.]

Output	Type	Description
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…128 Numerical 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 trough 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… 128 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

WARNING

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

n = 1 (PAGE_CFG_NUM_1) configures the first block of Numerical Fields (Numerical Fields 1... 16);

n = 2 (PAGE_CFG_NUM_2) configures the second block of Numerical Fields (Numerical Fields 17... 32);

n = 3 (PAGE_CFG_NUM_3) configures the third block of Numerical Fields (Numerical Fields 33... 48);

n = 4 (PAGE_CFG_NUM_4) configures the fourth block of Numerical Fields (Numerical Fields 49... 64);

n = 5 (PAGE_CFG_NUM_5) configures the fiveth block of Numerical Fields (Numerical Fields 65... 80);

n = 6 (PAGE_CFG_NUM_6) configures the sixth block of Numerical Fields (Numerical Fields 81... 96);

n = 7 (PAGE_CFG_NUM_7) configures the seventh block of Numerical Fields (Digital Inputs 97... 112);

n = 8 (PAGE_CFG_NUM_8) configures the eighth block of Numerical Fields (Numerical Fields 113... 128).

5-4-4 PAGE_CFG_DIG_n

WARNING

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

n = 1 (PAGE_CFG_DIG_1) configures the first block of Digital Inputs (Digital Inputs 1... 16);

n = 2 (PAGE_CFG_DIG_2) configures the second block of Digital Inputs (Digital Inputs 17... 32);

n = 3 (PAGE_CFG_DIG_3) configures the third block of Digital Inputs (Digital Inputs 33... 48);

n = 4 (PAGE_CFG_DIG_4) configures the fourth block of Digital Inputs (Digital Inputs 49... 64);

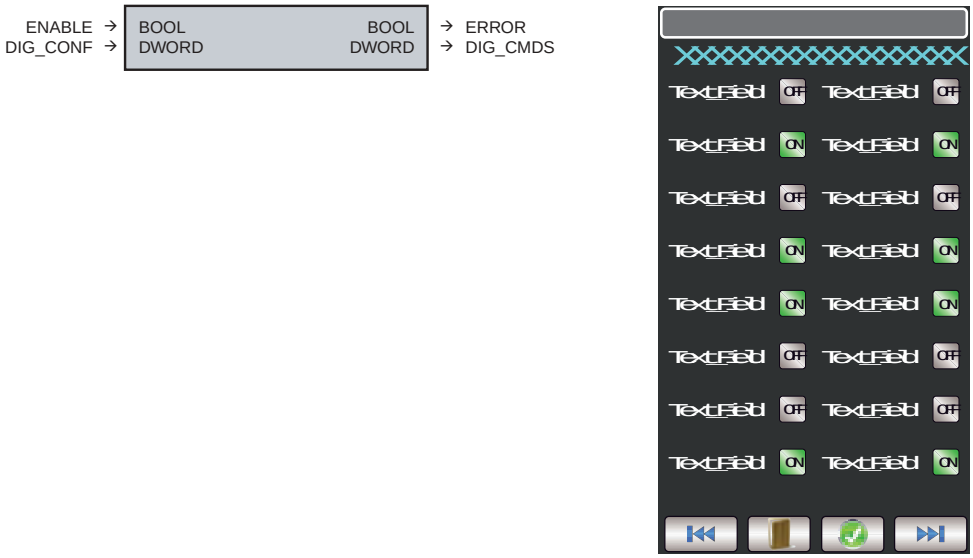
n = 5 (PAGE_CFG_DIG_5) configures the fiveth block of Digital Inputs (Digital Inputs 65... 80);

n = 6 (PAGE_CFG_DIG_6) configures the sixth block of Digital Inputs (Digital Inputs 81... 96);

n = 7 (PAGE_CFG_DIG_7) configures the seventh block of Digital Inputs (Digital Inputs 97... 112);

n = 8 (PAGE_CFG_DIG_8) configures the eighth block of Digital Inputs (Digital Inputs 113... 128).

FB Prototype



Parameters

Input Parameters

Input	Type	Description
ENABLE	BOOL	Command to ENABLE/DISABLE the FB execution
DIG_CONF	DWORD	1... 128 Digital Commands View Configuration bit mask

Output Parameters

Output	Type	Description
ERROR	BOOL	Specific AC3 page FB already used error state
DIG_CMDS	DWORD	1...128 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… 128 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 trough 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… 128 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…128 Digital Command
DIG_CMDS.16…DIG_CMDS.31	Reserved

WARNING

In the Function Block name PAGE_EDT_DIG_n, **n** is an index (values from 1 to 8) that identifies the Digital Inputs block connected. In particular, when:

n = 1 (PAGE_CFG_DIG_1) configures the first block of Digital Inputs (Digital Inputs 1... 16);
n = 2 (PAGE_CFG_DIG_2) configures the second block of Digital Inputs (Digital Inputs 17... 32);
n = 3 (PAGE_CFG_DIG_3) configures the third block of Digital Inputs (Digital Inputs 33... 48);
n = 4 (PAGE_CFG_DIG_4) configures the fourth block of Digital Inputs (Digital Inputs 49... 64);
n = 5 (PAGE_CFG_DIG_5) configures the fiveth block of Digital Inputs (Digital Inputs 65... 80);
n = 6 (PAGE_CFG_DIG_6) configures the sixth block of Digital Inputs (Digital Inputs 81... 96);
n = 7 (PAGE_CFG_DIG_7) configures the seventh block of Digital Inputs (Digital Inputs 97... 112);
n = 8 (PAGE_CFG_DIG_8) configures the eighth block of Digital Inputs (Digital Inputs 113... 128).

Chapter 6
Password and Access Control

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^3 system there are conceptually 3 access levels:

- Operational pages (some prearranged in Read/Write mode whilest some other in Read only or Write mode);
- Configuration pages, password protected (some prearranged in Read/Write mode whilest 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

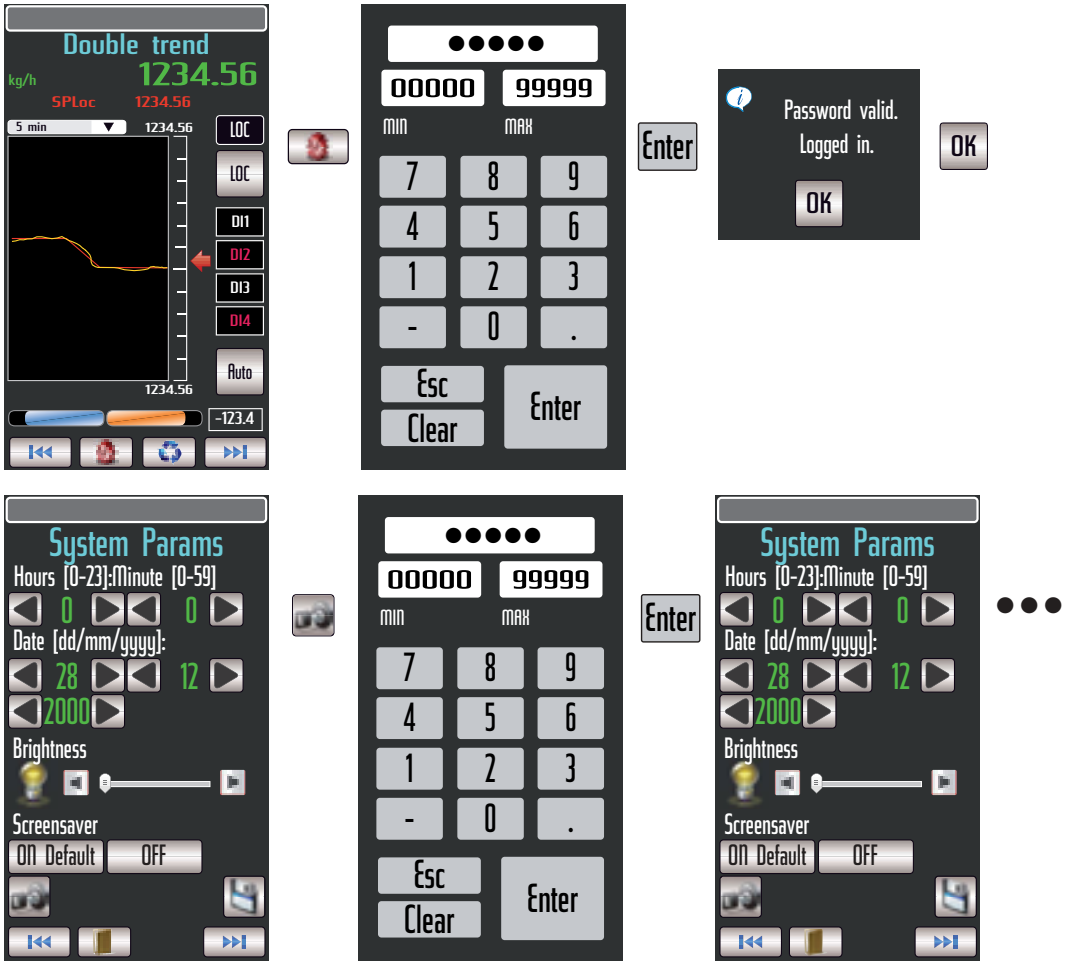
Allows the selection of the desired Control strategy:
(Custom, Ratio, Cascade, Override or 4 Loops), change the IP address of the P04 Operator panel and change the password specific of the System session.

Configuration session

Allows to configure the general AC^3 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.



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

Notes: **1.** The password consists of 5 numeric characters;

2. The AC³ system has 99999 as factory default password.

6-3-1 Password Recovery

Please contact the Customer Support.

Chapter 7
Maintenance and Diagnostic

7-1 TFTP Files Protocol Access

The MP-02 unit, part of the AC^3 system allows the user to access the internal some 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 identifcation 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 **ONLY** (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_MP-02_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 MP-02 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 MP-02
  `tftp –i <remote host address> get <remote file_name><local file name>`
- To PUT a file to the MP-02
  `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 MP-02 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 MP-02 is 192.168.5.11.

If the user wants to PUT the IEC61131 program file to the MP-02 unit, using the source file "*Sigma2_MP-0x*", the command will be:

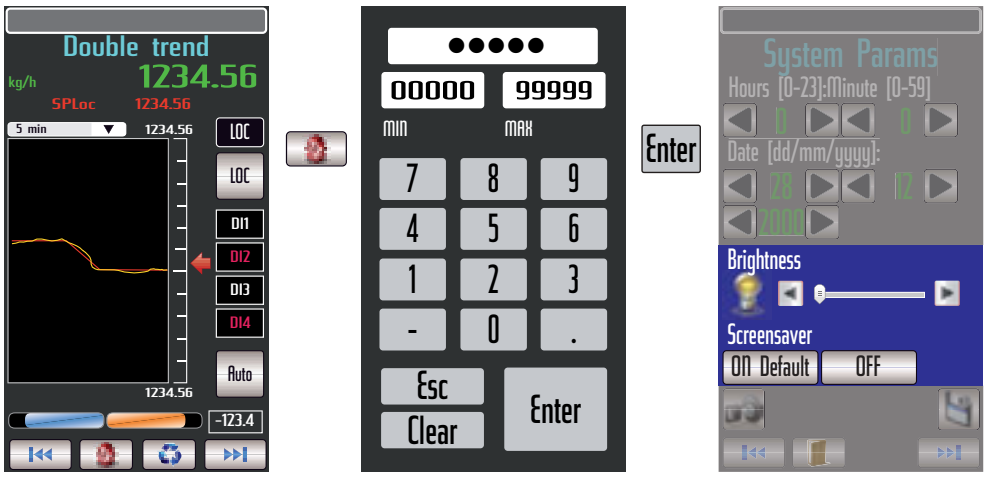
```
tftp -i 192.168.5.11 put Sigma2_MP-0x.prs /fs1/restore_file
```

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 Default 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.

In order to save the changes, press the button.

7-3 Error messages

The AC^3 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*" section 1-1-7 "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 *MP-02 User Manual*).

7-3-1 Terminal Connection Setup

Two ports are available on the CPU to enter the configuration session: the **X0** RS232 port for serial connection or the LAN port for the ethernet. Depending on the Setup used method, it is necessarry to:

- Choose the **X0** or the LAN port (consult the "*MP-02 Installation Manual*" **[9]** for details);
- Use the proper connection cable;
- Set the correct communications parameters;
- Run the communication program.

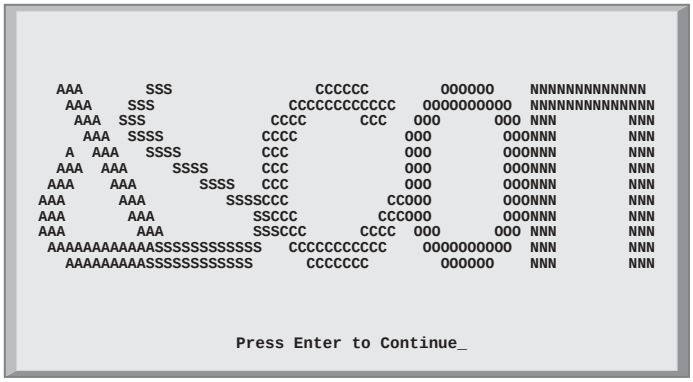
Once the Setup terminal (VT100 or PC) is correctly connected to the MP-02 basic unit, the user can start the configuration session. In *Appendix C* is inserted the tree structure of the Setup menus.

7-3-2 Starting the Setup Session

Accessing the Main Menu

To start the Setup session, **at Power ON** press the Return key (the PC sends a CR, Carriage Return, character to the CPU) **while RUN and ERR LEDs are blinking**. If the character CR is not sent in the defined time frame window (start-up timeout) the system skips the configuration session and runs the PLC application.

If the above described operations have been correctly followed, the welcome screen appears:



At this time, press Return again to access the Main menu page.
Please note that the system has a further timeout which controls the duration of the configuration session; this is the **inactivity** timeout. If the user does not work with the console for a time greater than this timeout, the configuration session will be ended automatically and the PLC application will be started.

Both the described timeouts can be set during the configuration. Too short timeouts, will affect the possibility to confortable work within the configuration session.
A menu item or a parameter value can be selected by typing the correspondent number and then press Return.

7-3-3 CPU Main Menu

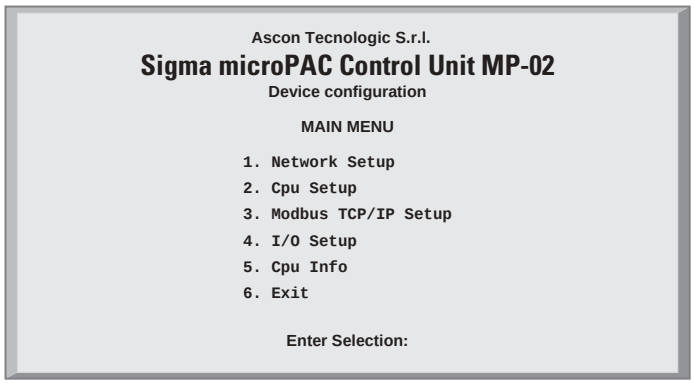


Figure 7.1 - Base Unit configuration Main Menu

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

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

7-3-4 CPU Info Menu

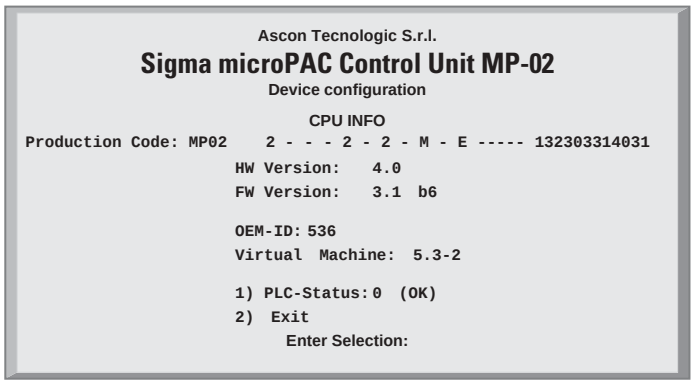


Figure 7.2 - CPU Info

Production Code (factory reserved information)	**Status**	**Message**
	OK	The system displays the production code (as shown)
	Error	The system displays the message: **Code Info Error - Invalid File** (note)
HW Version	Revision of the CPU hardware	
FW Version	Revision of the CPU firmware	
OEM-ID	Ascon Tecnologic CODE for the runtime software	
Virtual Machine	Version of the runtime software	

PLC-Status	CPU Status Indication, and acknowledge of the active alarms displayed	
	Possible Status Values are:	
	Value	**Type**
	0	**Normal status**
	1	**Data Configuration Error (DCE)**
	2	**Retain Error (RE)**
	3	DCE + RE
	4	**Battery Low (BL)**
	5	BL + DCE
	6	BL + RE
	7	BL + RE + DCE
	8	**(Flash) File System Error (FSE)**
	9	FSE + DCE
	10	FSE + RE
	11	FSE + RE + DCE
	12	FSE + BL
	13	FSE + BL + DCE
	14	FSE + BL+ RE
	15	FSE + BL + RE + DCE
	16	**Error Retain Data % (ER)**
	17	ER + DCE
	18	ER + RE
	19	ER + RE + DCE
	20	ER + BL
	21	ER + BL + DCE
	22	ER + BL + RE
	23	ER + BL + RE + DCE
	24	ER + FSE
	25	ER + FSE + DCE
	26	ER + FSE + RE
	27	ER + FSE + RE + DCE
	28	ER + FSE + BL
	29	ER + FSE + BL + DCE
	30	ER + FSE + BL + RE
	31	ER + FSE + BL + RE + DCE
Exit	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 AC3 system. This functionality was required when, due to a temporary failure of the hardware, normally generated by some anomalous external conditions, the unit seemed to behave erroneously or appeared completely locked and doesn't allow operating from the keyboard or the communication ports. In cases similar to the ones just described, it is possible to try to recover the situation by "resetting" the AC³ system.

In order to do that, it is necessary to follow the procedure described on Chapter 2, section 2-3 "Selection of a resident configuration" 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 Chapter 2, section 2-3 "*Select a resident strategy*".

7-5 Diagnostic Test and Calibration

This paragraph describes how to perform the diagnostic test of the MP-02 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 AC³ 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 MP-02 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*".

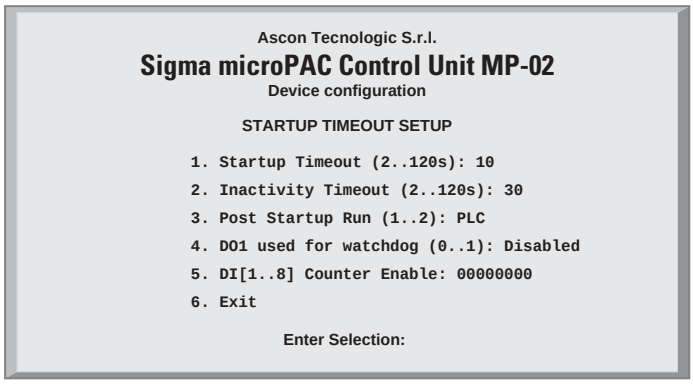


Figure 7.3 - Startup Setup Menu

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

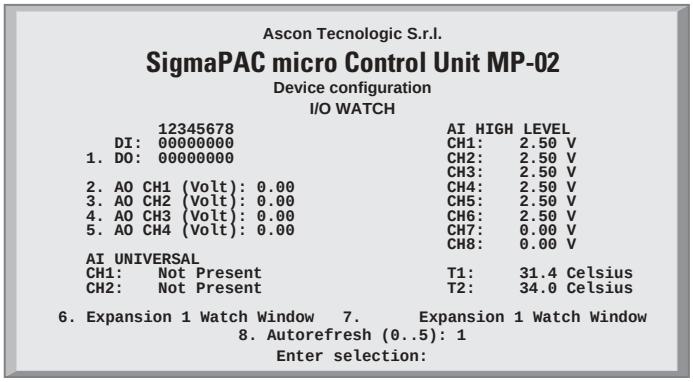


Figure 7.4 - I/O Watch Window

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

- Read the analogue inputs in engineering units;
- 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 temperture 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
Desired value	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 AC³ 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 AC³ system, as described int Chapter 1 Section 1-1, is composed by two components, the P04 front touch screen panel and the MP-02 CPU unit.
These components could be ordered separately also as spare parts as described in Chapter 9 "Ordering code".

Specifically, the only component that could be replaced by a final user is the MP-02 backup battery (model: CR-2450).

In case of battery replacement, the operator must follow the procedure described in the AC³ Installation Manual.

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

7-7 Spare Parts

Position	Description	Part number
1	P04 Touch Screen Operator Panel	AC3---0---P4U--ATA30
2	MP-02 Control Unit	AC3MP212-------ATA30
3	11 poles screw terminals connector	AP-S2/SPINA-V11
4	11 poles spring terminals connector	AP-S2/SPINA-M11
5	14 poles screw terminals connector	AP-S2/SPINA-V14
6	14 poles spring terminals connector	AP-S2/SPINA-M14

Chapter 8
Expansion Modules

8-1 General Information

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

Four types of Expansion I/O mudule are available:

- **MP-D1/08-08** to expand the system with 8 Digital Inputs (24 VDC) and 8 Digital Outpus (24 VDC, 0.5 A);
- **MP-D1/16-16** to expand the system with 16 Digital Inputs (24 VDC) and 16 Digital Outpus (24 VDC, 0.5 A);
- **MP-D2/08-08** to expand the system with 8 Digital Inputs (24 VDC) and 8 NO Relay Outpus (2 A).
- **MP-D4/08-08** to expand the system with 8 High Level Digital Inputs (120 VAC) and 8 NO Relay Outpus (2 A).

The modules type can be mixed in the system in order to obtain the desired configuration.

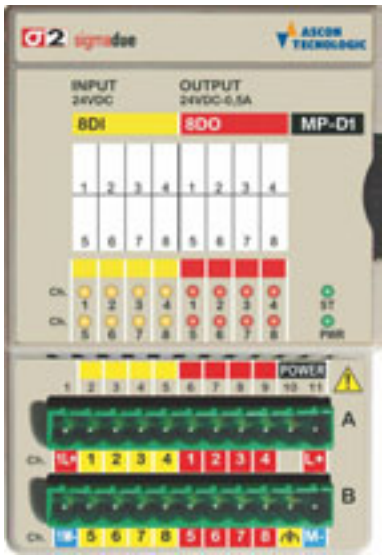
The Expansion modules must be installed on the DIN rail close to the right part of the CPU, using the dedicated connector (for details see the modules or the CPU Installation Manual).

WARNING

When installallig more than one MP-D1/16-16 module, pay attention to the fact that the DIN rail must be mounted on the rear panel as the depth of the system (CPU + modules) drastically increases.

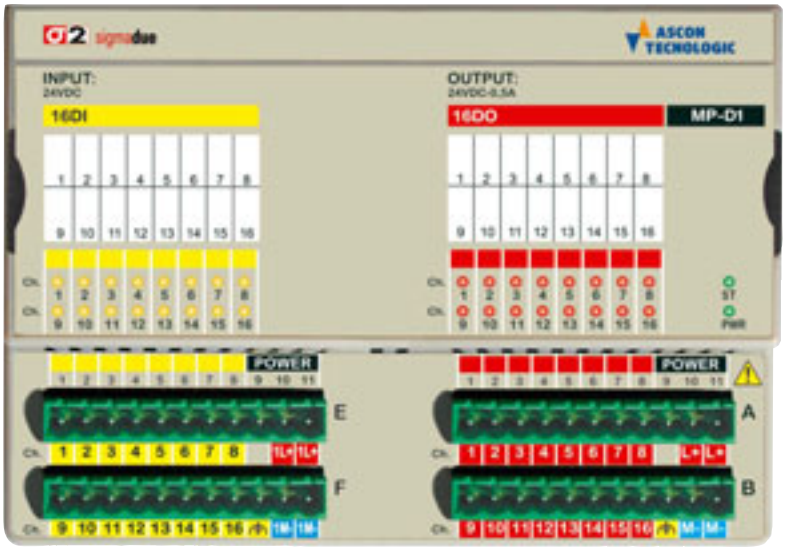
8-2 Technical Characteristics

8-2-1 MP-D1/08-08



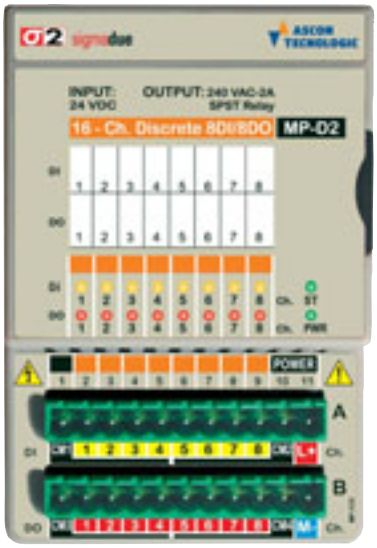
Digital Inputs	8 Optoisolated (24 VDC)
Digital Outputs	8 Digital Outpus (24 VDC, 0.5 A)
Power supply	A 24 VDC power supply is necessary to the inputs. No power supply is necessary for the main electronics of expansion I/O modules, as they are powered by the CPU through the dedicated connection cable.
Current consumption	5 W
Led	**ST**: module status, **PWR** (power supply ON) **8 yellow led** for the inputs **8 red led** for the outputs
Operating conditions	Operating Temperature: -10... +65°C
	Storage Temperature: -40... +85°C
	Relative Humidity: 5...95% Rh non condensing
	Vibrations resistance (3 axes): 10... 57Hz, 0.0375 mm/ 57...150 Hz, 0.5G
	Shock resistance (3 axes): 15G, 11 ms half sine
Phisical dimensions	H x W x D: 110 x 76 x 66 mm
Protection degree	IP20
Mounting	Rear panel on DIN RAIL 35 x 7.5 (EN50022)
CE Marking	EN 50081-2, EN 50082-2, EN 61010

8-2-2 MP-D1/16-16



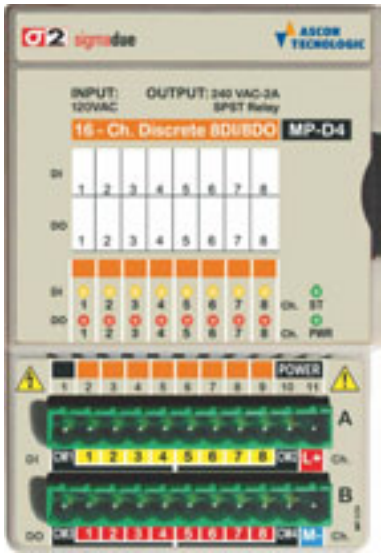
Digital Inputs	16 Optoisolated (24 VDC)
Digital Outputs	16 Digital Outpus (24 VDC, 0.5 A)
Power supply	A 24 VDC power supply is necessary to the inputs. No power supply is necessary for the main electronics of expansion I/O modules, as they are powered by the CPU through the dedicated connection cable.
Current consumption	5 W
Led	**ST**: module status, **PWR** (power supply ON) **16 yellow led** for the inputs **16 red led** for the outputs
Operating conditions	Operating Temperature: -10... +65°C
	Storage Temperature: -40... +85°C
	Relative Humidity: 5...95% Rh non condensing
	Vibrations resistance (3 axes): 10... 57Hz, 0.0375 mm/ 57...150 Hz, 0.5G
	Shock resistance (3 axes): 15G, 11 ms half sine
Phisical dimensions	H x W x D: 110 x 152 x 66 mm
Protection degree	IP20
Mounting	Rear panel on DIN RAIL 35 x 7.5 (EN50022)
CE Marking	EN 50081-2, EN 50082-2, EN 61010

8-2-3 MP-D2/08-08



Digital Inputs	8 Optoisolated (24 VDC)
Digital Outputs	8 Relay SPST NO Outpus (2 A at 120/240 VCA)
Power supply	A 24 VDC power supply is necessary to the inputs. No power supply is necessary for the main electronics of expansion I/O modules, as they are powered by the CPU through the dedicated connection cable.
Current consumption	5 W
Led	**ST**: module status, **PWR** (power supply ON) **8 yellow led** for the inputs **8 red led** for the outputs
Operating conditions	Operating Temperature: -10... +65°C
	Storage Temperature: -40... +85°C
	Relative Humidity: 5...95% Rh non condensing
	Vibrations resistance (3 axes): 10... 57Hz, 0.0375 mm/ 57...150 Hz, 0.5G
	Shock resistance (3 axes): 15G, 11 ms half sine
Phisical dimensions	H x W x D: 110 x 76 x 66 mm
Protection degree	IP20
Mounting	Rear panel on DIN RAIL 35 x 7.5 (EN50022)
CE Marking	EN 50081-2, EN 50082-2, EN 61010

8-2-4 MP-D4/08-08



Digital Inputs	8 Optoisolated High Level inputs (120 VCA)
Digital Outputs	8 Relay SPST NO Outpus (2 A at 120/240 VCA)
Power supply	A 24 VDC power supply is necessary to the inputs. No power supply is necessary for the main electronics of expansion I/O modules, as they are powered by the CPU through the dedicated connection cable.
Current consumption	5 W
Led	**ST**: module status, **PWR** (power supply ON) **8 yellow led** for the inputs **8 red led** for the outputs
Operating conditions	Operating Temperature: -10... +65°C
	Storage Temperature: -40... +85°C
	Relative Humidity: 5...95% Rh non condensing
	Vibrations resistance (3 axes): 10... 57Hz, 0.0375 mm/ 57...150 Hz, 0.5G
	Shock resistance (3 axes): 15G, 11 ms half sine
Phisical dimensions	H x W x D: 110 x 76 x 66 mm
Protection degree	IP20
Mounting	Rear panel on DIN RAIL 35 x 7.5 (EN50022)
CE Marking	EN 50081-2, EN 50082-2, EN 61010

8-2-5 Inputs and Outputs

Depending on the number of I/Os necessary to the application, it is possible to conveniently configure the system.

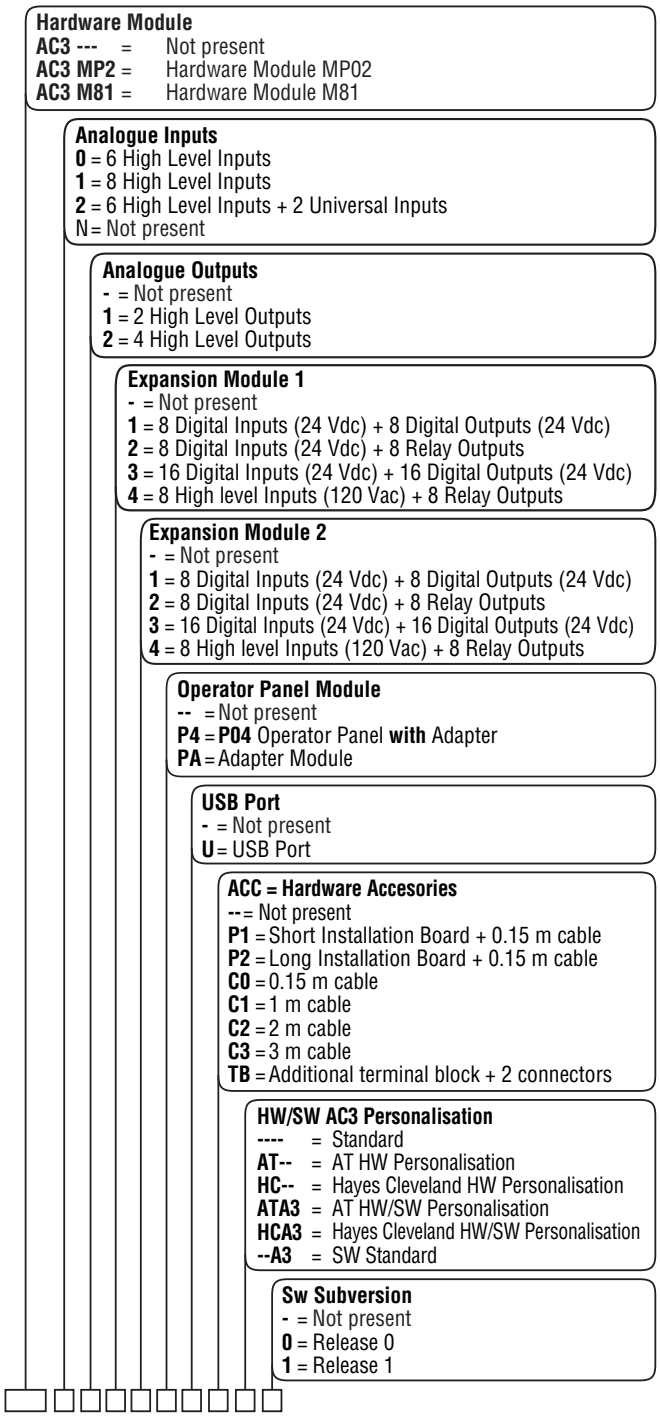
The CPU itself has up to:

- 6 mA/V analogue inputs;
- 2 universal analogue inputs (TC, RTD, mV, pot);
- 4 0/4... 20 mA or ±10V analogue outputs;
- 8 Optoisolated digital inputs (24 VDC);
- 8 Digital Outpus (24 VDC, 0.5 A).

Using the table that follows is possible to understand how many and which type of I/O modules are necessary to configure the system.

I/O requested (8 DI + 8 DO are in the CPU)	MPD1/08-08	MPD1/16-16	MPD2/08-08	MPD2/08-08
16 DI (24 VDC) + 16 DO (24 VDC, 0.5 A)	1	-	-	-
24 DI (24 VDC) + 24 DO (24 VDC, 0.5 A)	-	1	-	-
32 DI (24 VDC) + 32 DO (24 VDC, 0.5 A)	1	1	-	-
40 DI (24 VDC) + 40 DO (24 VDC, 0.5 A)	-	2	-	-
16 DI (24 VDC) + 8 DO (24 VDC, 0.5 A) + 8 Relay SPST NO (2 A at 120/240 VCA)	-	-	1	-
24 DI (24 VDC) + 16 DO (24 VDC, 0.5 A) + 8 Relay SPST NO (2 A at 120/240 VCA)	1	-	1	-
32 DI (24 VDC) + 24 DO (24 VDC, 0.5 A) + 8 Relay SPST NO (2 A at 120/240 VCA)	-	1	1	-
24 DI (24 VDC) + 8 DO (24 VDC, 0.5 A) + 16 Relay SPST NO (2 A at 120/240 VCA)	-	-	2	-
8 DI (24 VDC) + 8 DI (120 VCA) + 8 DO (24 VDC, 0.5 A) + 8 Relay SPST NO (2 A at 120/240 VCA)	-	-	-	1
16 DI (24 VDC) + 8 DI (120 VCA) + 16 DO (24 VDC, 0.5 A) + 8 Relay SPST NO (2 A at 120/240 VCA)	1	-	-	1
24 DI (24 VDC) + 8 DI (120 VCA) + 24 DO (24 VDC, 0.5 A) + 8 Relay SPST NO (2 A at 120/240 VCA)	-	1	-	1
16 DI (24 VDC) + 8 DI (120 VCA) + 8 DO (24 VDC, 0.5 A) + 16 Relay SPST NO (2 A at 120/240 VCA)	-	-	1	1
8 DI (24 VDC) + 16 DI (120 VCA) + 8 DO (24 VDC, 0.5 A) + 16 Relay SPST NO (2 A at 120/240 VCA)	-	-	-	2

Chapter 9
Order Code

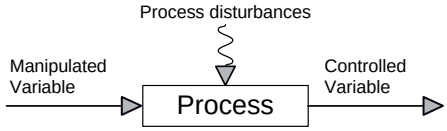


Appendix A
Resident Configurations

A-1 How to implement a PID controller

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 regulation process works, we have to consider that the process is a system, whose behaviour is determined by the 3 class of magnitudes, as shown in fig. 1:



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.

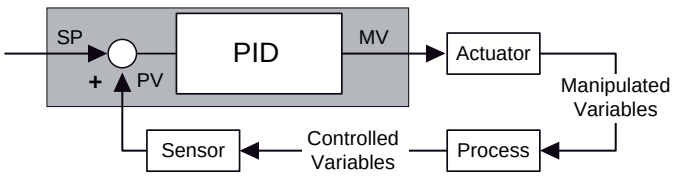
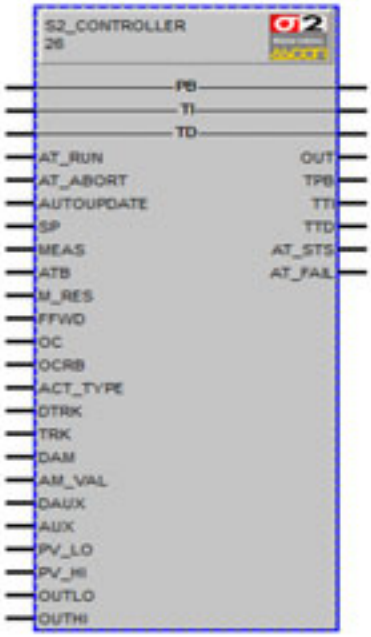


Fig. 2 shows the process, with the various magnitudes types and an elementary PID regulator. Following the considerations above, a block diagram of this PID loop can be easily determined. Differently from the AC-Station line, the implementation of a PID loop has been dramatically simplified. In fact, 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.

Fig 3 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.

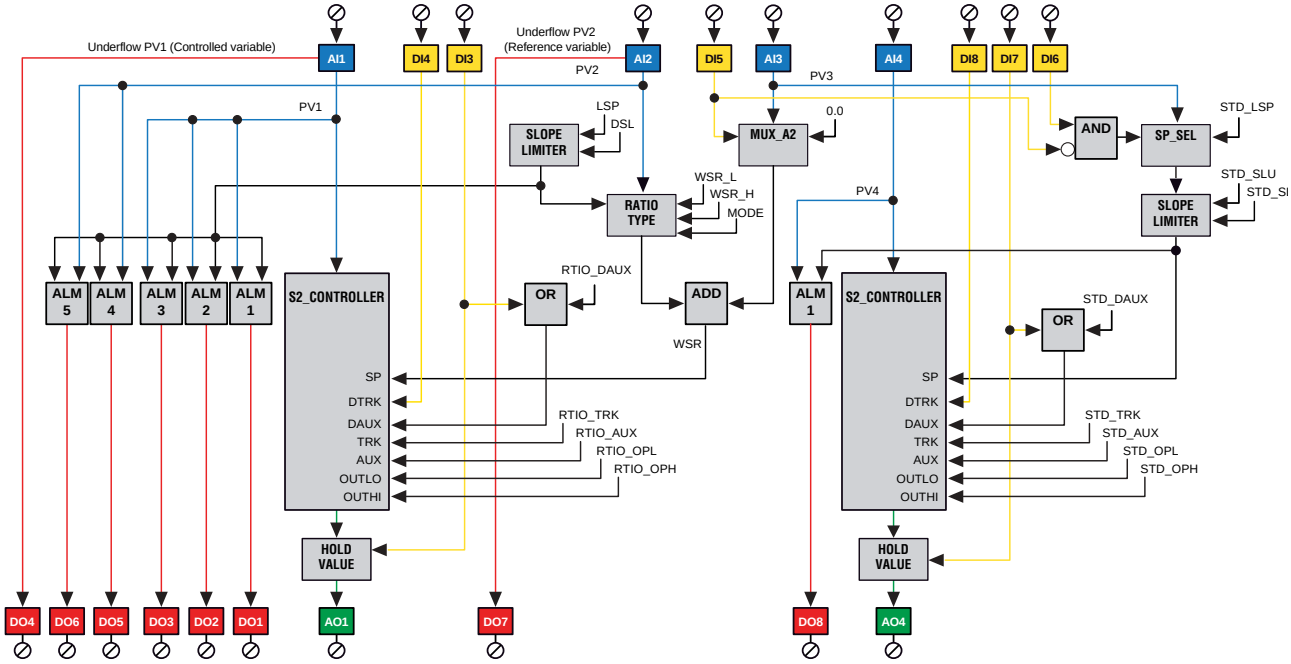
A-2-2 Project Tasks (POU) Organization and Order

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. **Ratio_Vars.STD.POE** Global Variables declaration file;
2. **Ratio_Vars.DIR.POE** Direct Variables declaration file;
3. **Ratio_Values_Mngt.ST** Variables application pre-set operations;
4. **Ratio_IO_Mngt.CFC** I/O conditioning operations;
5. **Ratio_Common_Oprs.ST** Application overhall general operations;
6. **Ratio_Loop_Mngt.CFC** Specific Ratio process control operations;
7. **Ratio_Loop_Std_Mngt.CFC** Generic Standard process control operations;
8. **Ratio_Pages.CFC** Overhall display Pages management;
9. **Ratio_Tags.CSV** 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 two bargraph from the left are used for the AI1 Controlled and AI2 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

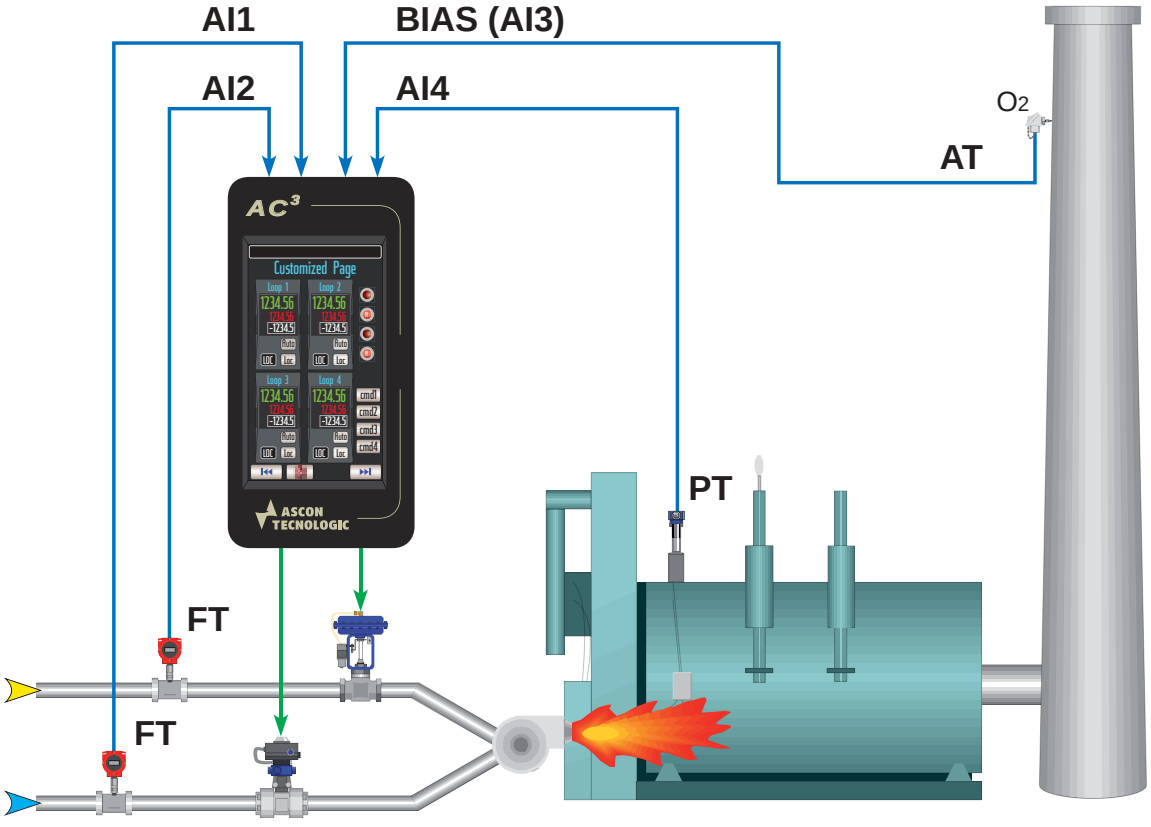
The purpose of the ratio loop is to control those processes where it is required to keep, at a predefined set, the ratio between two controlled variables. There are plenty of examples of processes of this type: for instance, the control of the blending between two fluids and the control of the combustion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

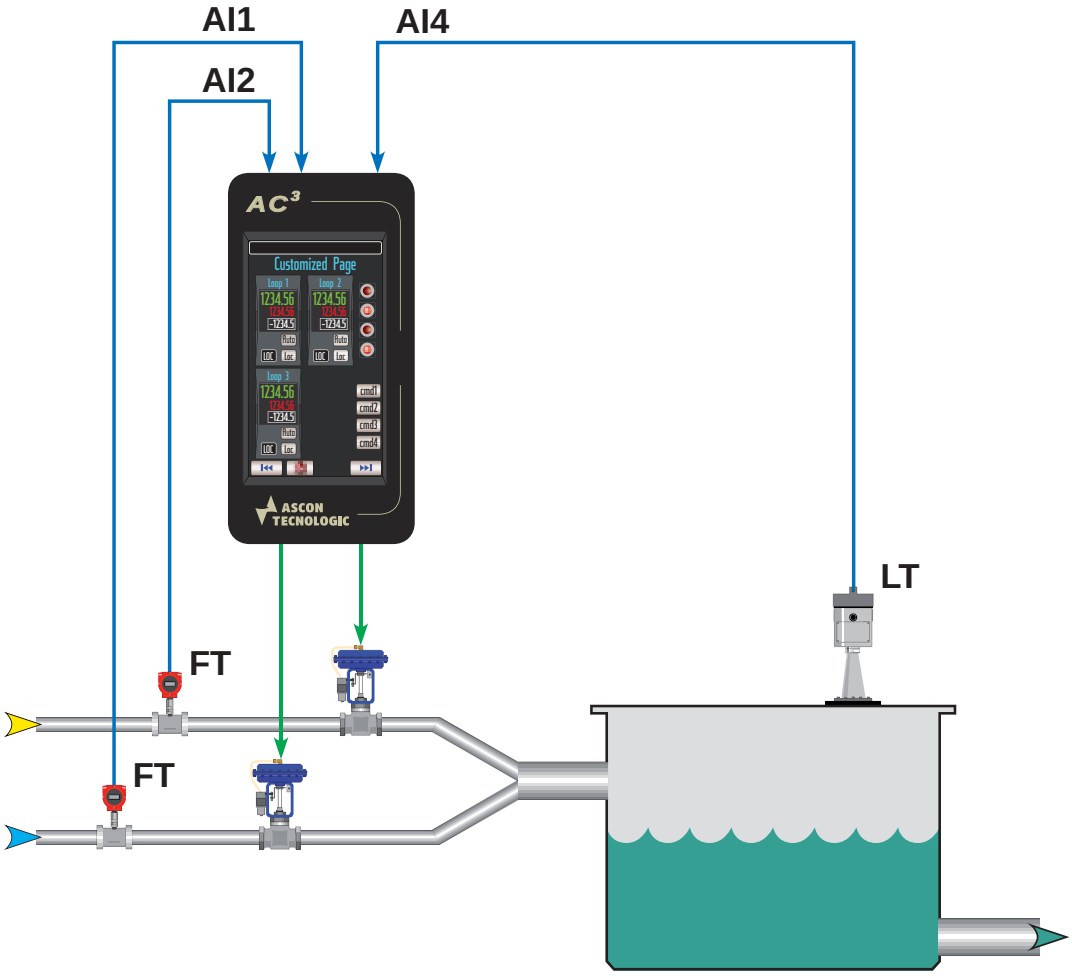
An example is shown in the picture below, related to the combustion control of a steam generator. The steam pressure is controlled by the Std Loop, whose output defines the energy (heat amount) to supply to the boiler, driving the gas valve.

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, Std Loop can be used for the control of the level of the tank where the fluid enters.



A-2-6 Signals I/O Table

I/O	Terminals	Type	Meaning
AI1	E1 +/F1 -	4... 20 mA	Controlled Variable
AI2	E2 +/F2 -	4... 20 mA	Reference Variable
AI3	E3 +/F3 -	4... 20 mA	Bias WSR Ratio/SP Remote Std Loop
AI4	E4 +/F4 -	4... 20 mA	Std. Loop Variable
AI5	E5 +/F5 -	4... 20 mA	Not Used - Available
AI6	E6 +/F6 -	4... 20 mA	Not Used - Available
AI7	E8 +/F8 -	4... 20 mA	Not Used - Available
AI8	E10 +/F10 -	4... 20 mA	Not Used - Available
AO1	E11 +/F11 -	4... 20 mA	Ratio Control Output
AO2	E12 +/F12 -	4... 20 mA	Not Used - Available
AO3	E13 +/F13 -	4... 20 mA	Not Used - Available
AO4	E14 +/F14 -	4... 20 mA	Std. Loop Control Output
DI1	A2	NO Digital Input	Not Used - Available
DI2	A3	NO Digital Input	Not Used - Available
DI3	A4	NO Digital Input	Hold OP Ratio
DI4	A5	NO Digital Input	Tracking OP Ratio
DI5	B2	NO Digital Input	Bias WSR Ratio/SP Remote Std Loop
DI6	B3	NO Digital Input	SP Remote Std Loop
DI7	B4	NO Digital Input	Hold control output Std. Loop
DI8	B5	NO Digital Input	Tracking control output Std Loop
DO1	A6	NO Digital Output	Ratio Alarm_1 Status
DO2	A7	NO Digital Output	Ratio Alarm_2 Status
DO3	A8	NO Digital Output	Ratio Alarm_3 Status
DO4	A9	NO Digital Output	Out of Range Controlled Variable
DO5	B6	NO Digital Output	Ratio Alarm_4 Status
DO6	B7	NO Digital Output	Ratio Alarm_5 Status
DO7	B8	NO Digital Output	Out of Range Reference Variable
DO8	B9	NO Digital Output	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.

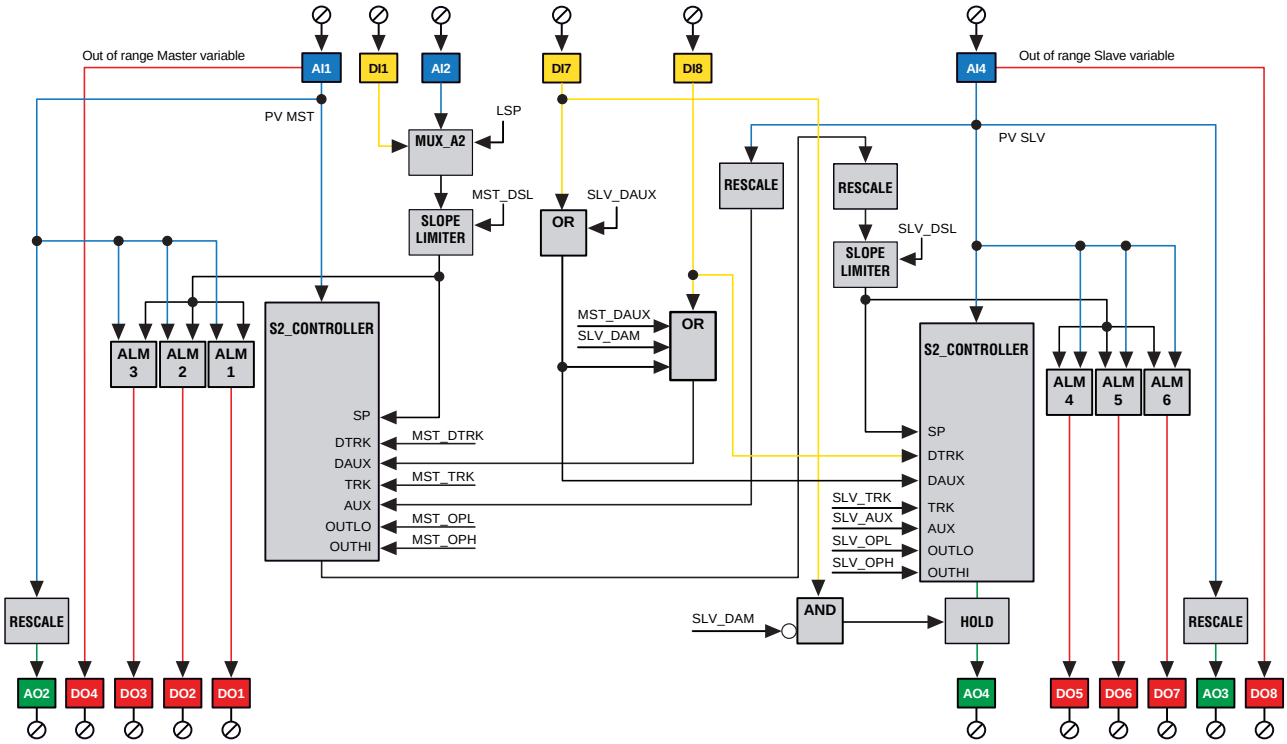
A-3-2 Project Tasks (POU) Organization and Order

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. **Cascade_Vars.STD.POE** Global Variables declaration file;
2. **Cascade_Vars.DIR.POE** Direct Variables declaration file;
3. **Cascade_Values_Mngt.ST** Variables application pre-set operations;
4. **Cascade_IO_Mngt.CFC** I/O conditioning operations;
5. **Cascade_Common_Oprs.ST** Application overhall general operations;
6. **Cascade_Loop_Mngt.CFC** Specific Cascade process control operations;
7. **Cascade_Pages.CFC** Overhall display Pages management
8. **Cascade_Tags.CSV** 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 Set Point

This feature is supported only on the Master Loop whilst the Slave one is conceptually always in a sort or 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 three 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 three 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 Retransmission

Master Loop

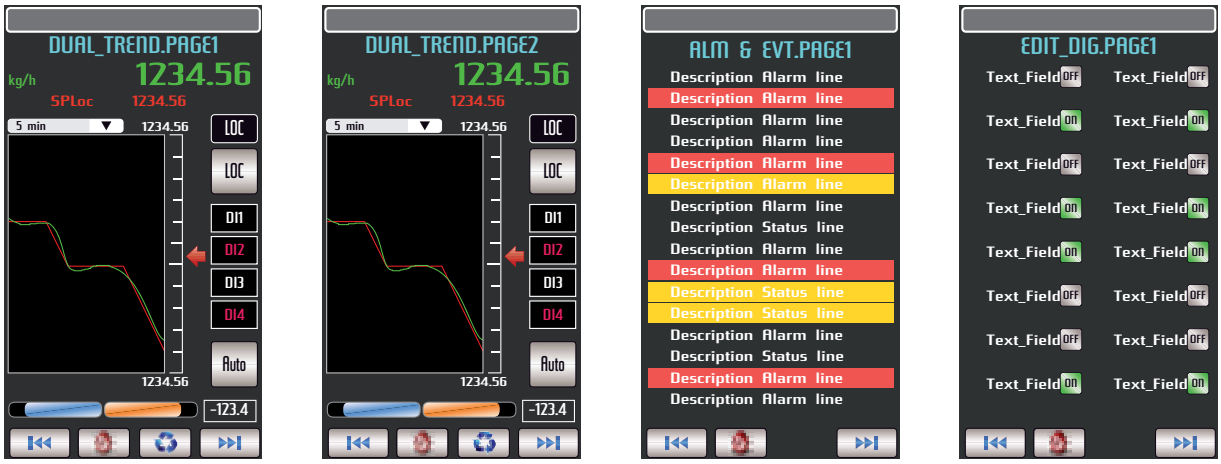
The AI1 Master variable is retransmitted, after a proper rescaling operation, on the AO2 output.

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.

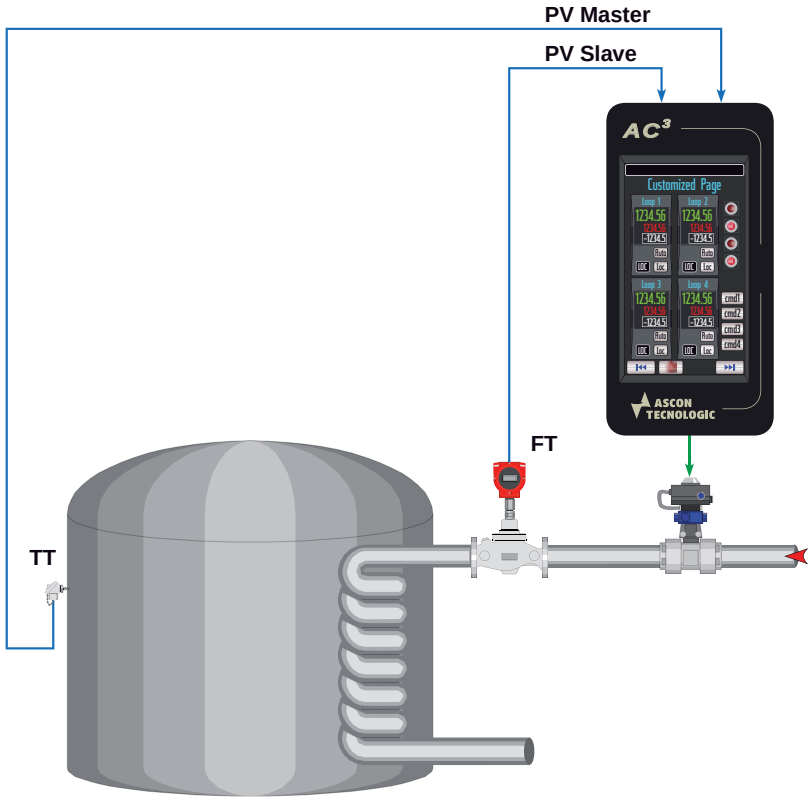
On the ALARMS & EVENTS panel page, the following alarms and forcing status are displayed:

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	Terminals	Type	Meaning
AI1	E1 +/F1 -	4... 20 mA	Master Variable
AI2	E2 +/F2 -	4... 20 mA	Remote SP Variable
AI3	E3 +/F3 -	4... 20 mA	Not Used - Available
AI4	E4 +/F4 -	4... 20 mA	Slave Variable
AI5	E5 +/F5 -	4... 20 mA	Not Used - Available
AI6	E6 +/F6 -	4... 20 mA	Not Used - Available
AI7	E8 +/F8 -	4... 20 mA	Not Used - Available
AI8	E10 +/F10 -	4... 20 mA	Not Used - Available
AO1	E11 +/F11 -	4... 20 mA	Not Used - Available
AO2	E12 +/F12 -	4... 20 mA	Master Variable Retransmission
AO3	E13 +/F13 -	4... 20 mA	Slave Variable Retransmission
AO4	E14 +/F14 -	4... 20 mA	Cascade Control output
DI1	A2	NO Digital Input	Master Remote SP selection
DI2	A3	NO Digital Input	Not Used - Available
DI3	A4	NO Digital Input	Not Used - Available
DI4	A5	NO Digital Input	Not Used - Available
DI5	B2	NO Digital Input	Not Used - Available
DI6	B3	NO Digital Input	Not Used - Available
DI7	B4	NO Digital Input	Slave Hold control output
DI8	B5	NO Digital Input	Slave Tracking control output
DO1	A6	NO Digital Output	Master Alarm_1 Status
DO2	A7	NO Digital Output	Master Alarm_2 Status
DO3	A8	NO Digital Output	Master Alarm_3 Status
DO4	A9	NO Digital Output	Out of Range Master variable
DO5	B6	NO Digital Output	Slave Alarm_4 Status
DO6	B7	NO Digital Output	Slave Alarm_5 Status
DO7	B8	NO Digital Output	Slave Alarm_6 Status
DO8	B9	NO Digital Output	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.

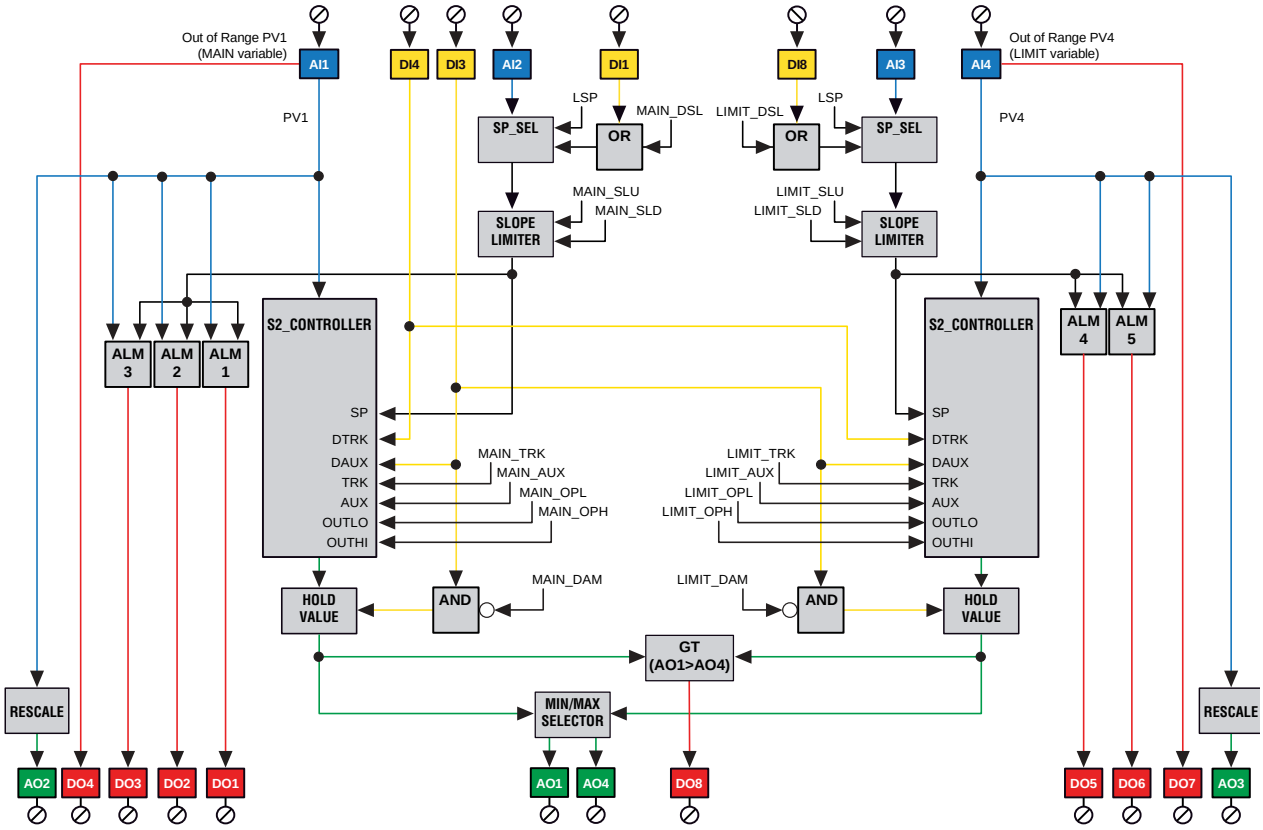
A-4-2 Project Tasks (POU) Organization and Order

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. **Override_Vars.STD.POE** Global Variables declaration file;
2. **Override_Vars.DIR.POE** Direct Variables declaration file;
3. **Override_Values_Mngt.ST** Variables application pre-set operations;
4. **Override_IO_Mngt.CFC** I/O conditioning operations;
5. **Override_Common_Oprs.ST** Application overhall general operations;
6. **Override_Loop_Mngt.CFC** Specific Override process control operations;
7. **Override_Pages.CFC** Overhall display Pages management
8. **Override_Tags.CSV** 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's status of the two control outputs.

Control

Main Loop

The AI1 Main variable is acquired, filtered, corrected and converted into the desired engineering units 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 units 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 Set Point

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.

Main and Slave Loops

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

a) **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.

b) **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.

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.

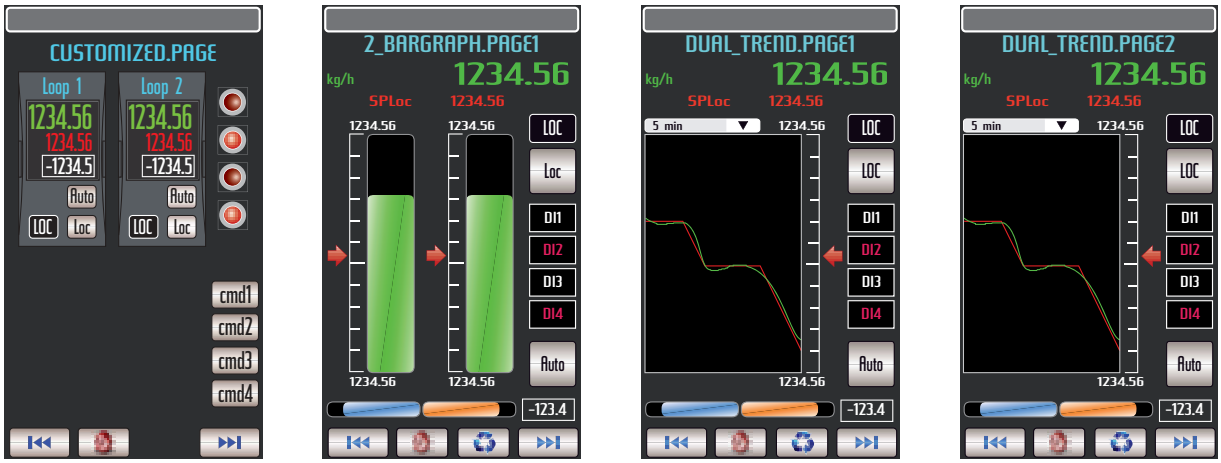
Variables retransmission

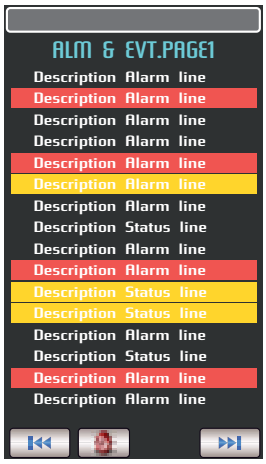
The AI1 Main variable is retransmitted, after a proper rescaling operation, on the AO2 output.

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-4-4 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, 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.

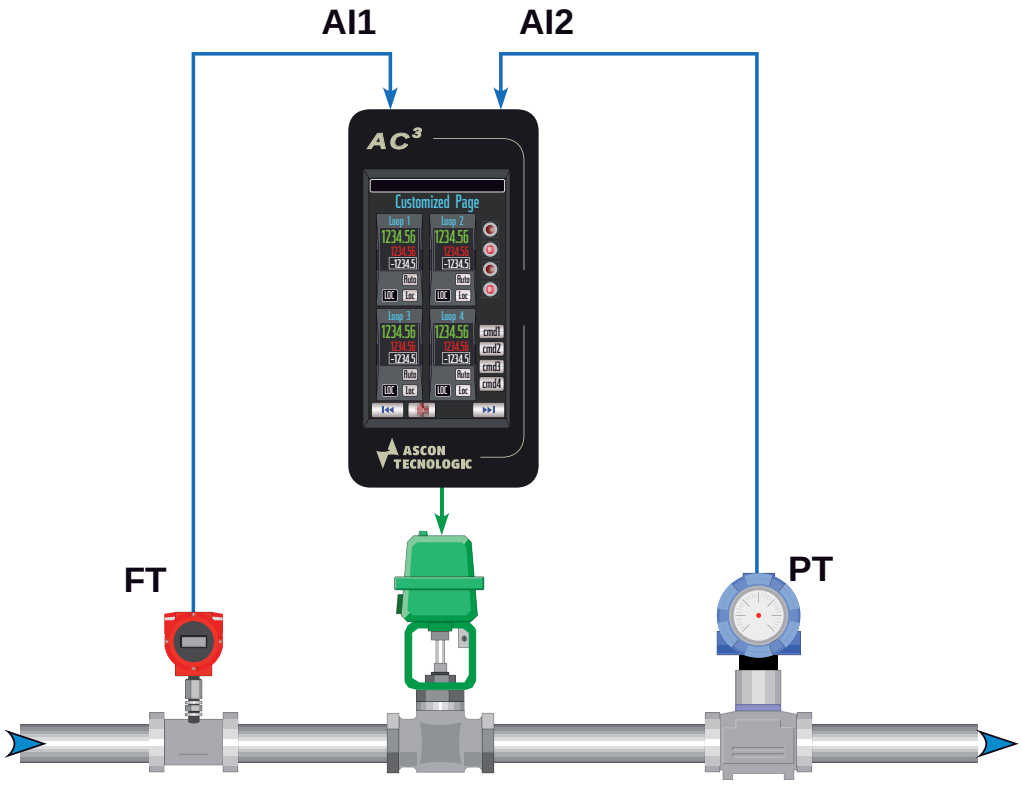
A-4-5 Applications

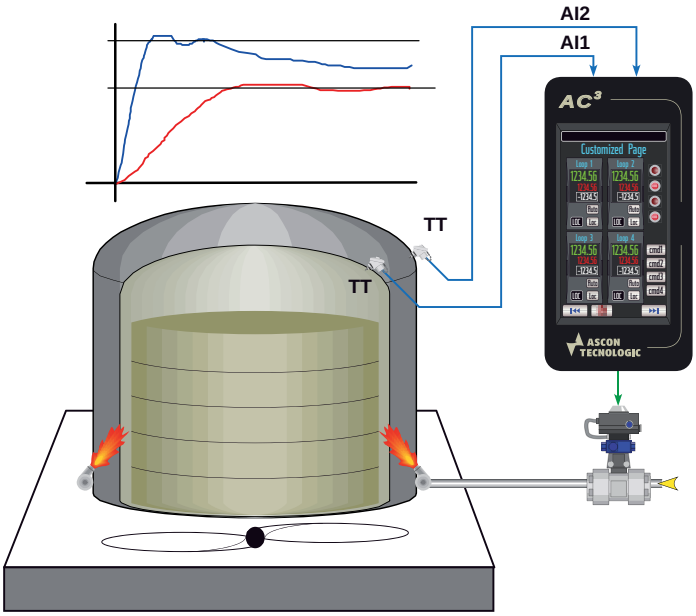
The override control is the right solution for controlling processes where more than one variable must be controlled at the same time. For instance, the process consists of a Main variable that must be kept at the SP and a Limit one that must not exceed a predefined threshold during normal operations, 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-4-6 Signals I/O Table

I/O	Terminals	Type	Meaning
AI1	E1 +/F1 -	4... 20 mA	Main Controlled Variable
AI2	E2 +/F2 -	4... 20 mA	Main Remote SP Variable
AI3	E3 +/F3 -	4... 20 mA	Limit Remote SP Variable
AI4	E4 +/F4 -	4... 20 mA	Limit Controlled Variable
AI5	E5 +/F5 -	4... 20 mA	Not Used - Available
AI6	E6 +/F6 -	4... 20 mA	Not Used - Available
AI7	E8 +/F8 -	4... 20 mA	Not Used - Available
AI8	E10 +/F10 -	4... 20 mA	Not Used - Available
AO1	E11 +/F11 -	4... 20 mA	Override Control output
AO2	E12 +/F12 -	4... 20 mA	Main Variable Retransmission
AO3	E13 +/F13 -	4... 20 mA	Slave Variable Retransmission
AO4	E14 +/F14 -	4... 20 mA	Not Used - Available
DI1	A2	NO Digital Input	Main Remote SP selection
DI2	A3	NO Digital Input	Not Used - Available
DI3	A4	NO Digital Input	Override Hold control output
DI4	A5	NO Digital Input	Override Tracking control output
DI5	B2	NO Digital Input	Not Used - Available
DI6	B3	NO Digital Input	Not Used - Available
DI7	B4	NO Digital Input	Not Used - Available
DI8	B5	NO Digital Input	Not Used - Available
DO1	A6	NO Digital Output	Master Alarm_1 Status
DO2	A7	NO Digital Output	Master Alarm_2 Status
DO3	A8	NO Digital Output	Master Alarm_3 Status
DO4	A9	NO Digital Output	Out of Range Master variable
DO5	B6	NO Digital Output	Slave Alarm_4 Status
DO6	B7	NO Digital Output	Slave Alarm_5 Status
DO7	B8	NO Digital Output	Out of Range Limit variable
DO8	B9	NO Digital Output	Main > Limit control output status

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.

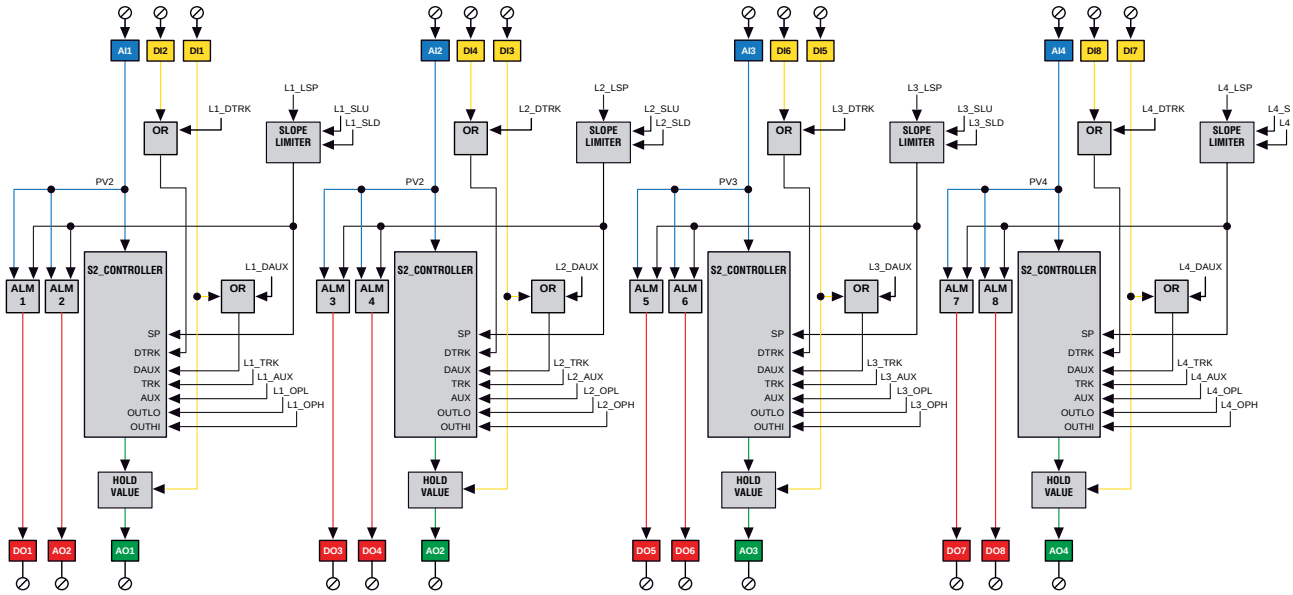
A-5-2 Project Tasks (POU) Organization and Order

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. **Four_Loops_Vars.STD.POE** Global Variables declaration file;
2. **Four_Loops_Vars.DIR.POE** Direct Variables declaration file;
3. **Four_Loops_Values_Mngt.ST** Variables application pre-set operations;
4. **Four_Loops_IO_Mngt.CFC** I/O conditioning operations;
5. **Four_Loops_Common_Oprs.ST** Application overhall general operations;
6. **Four_Loops_1_Mngt.CFC** Specific 4 loops process control operations;
7. **Four_Loops_2_Mngt.CFC** Specific 4 loops process control operations;
8. **Four_Loops_3_Mngt.CFC** Specific 4 loops process control operations;
9. **Four_Loops_4_Mngt.CFC** Specific 4 loops process control operations;
10. **Four_Loops_Pages.CFC** Overhall display Pages management
11. **Four_Loops_Tags.CSV** 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 idendical. 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, XXX

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

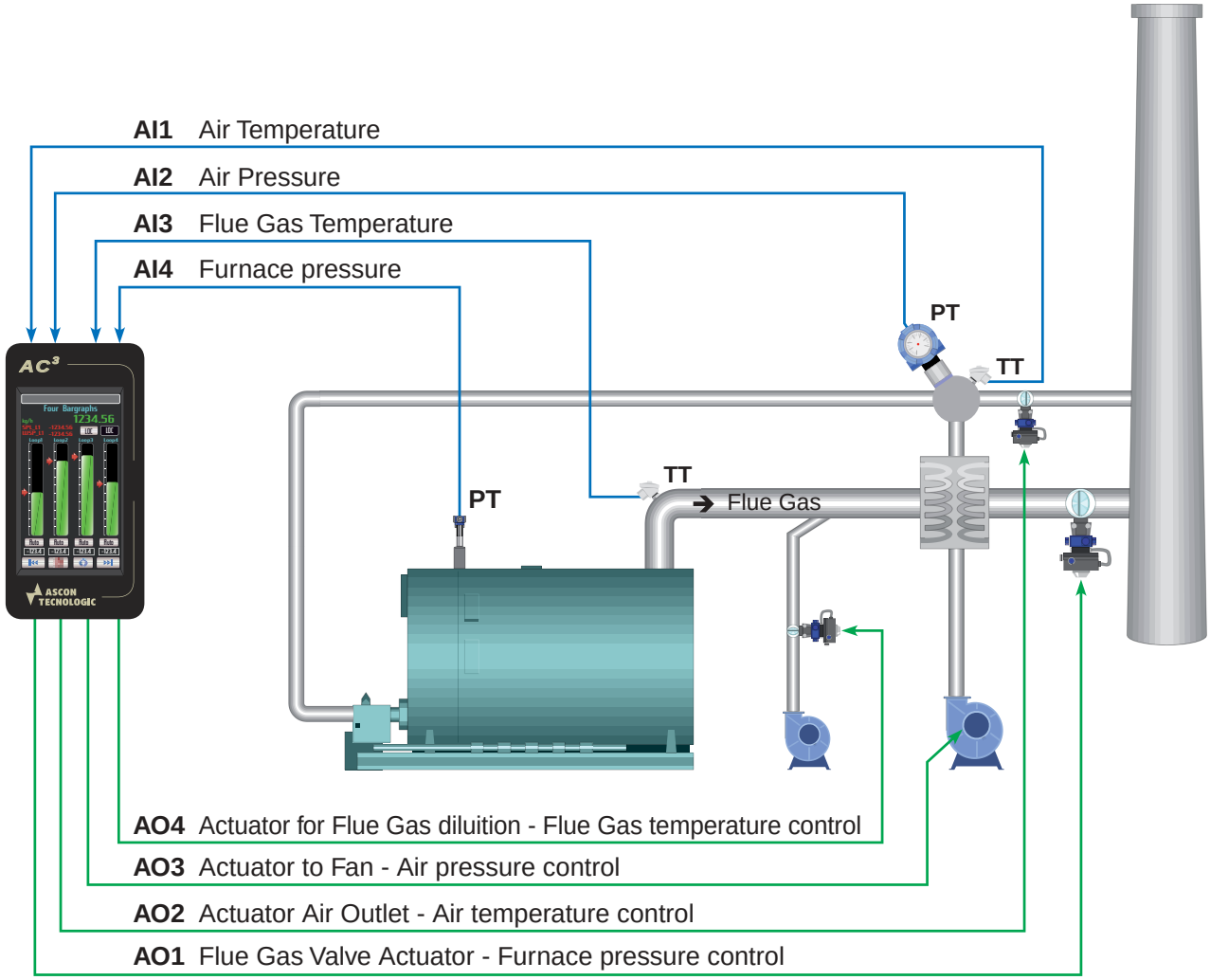
This easy to use configuration is for simple applications, where standard PIDs are required to control up to 4 independent variables in just one box, with perfectly identical characteristics.

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	Terminals	Type	Meaning
AI1	E1 +/F1 -	4... 20 mA	Loop1 Controlled Variable
AI2	E2 +/F2 -	4... 20 mA	Loop2 Controlled Variable
AI3	E3 +/F3 -	4... 20 mA	Loop3 Controlled Variable
AI4	E4 +/F4 -	4... 20 mA	Loop4 Controlled Variable
AI5	E5 +/F5 -	4... 20 mA	Not Used - Available
AI6	E6 +/F6 -	4... 20 mA	Not Used - Available
AI7	E8 +/F8 -	4... 20 mA	Not Used - Available
AI8	E10 +/F10 -	4... 20 mA	Not Used - Available
AO1	E11 +/F11 -	4... 20 mA	Loop1 Control Output
AO2	E12 +/F12 -	4... 20 mA	Loop2 Control Output
AO3	E13 +/F13 -	4... 20 mA	Loop3 Control Output
AO4	E14 +/F14 -	4... 20 mA	Loop4 Control Output
DI1	A2	NO Digital Input	Loop1 Control Output Hold
DI2	A3	NO Digital Input	Loop1 Control Output Tracking
DI3	A4	NO Digital Input	Loop2 Control Output Hold
DI4	A5	NO Digital Input	Loop2 Control Output Tracking
DI5	B2	NO Digital Input	Loop3 Control Output Hold
DI6	B3	NO Digital Input	Loop3 Control Output Tracking
DI7	B4	NO Digital Input	Loop4 Control Output Hold
DI8	B5	NO Digital Input	Loop4 Control Output Tracking
DO1	A6	NO Digital Output	Loop1 Alarm_1 Status
DO2	A7	NO Digital Output	Loop1 Alarm_2 Status
DO3	A8	NO Digital Output	Loop2 Alarm_3 Status
DO4	A9	NO Digital Output	Loop2 Alarm_4 Status
DO5	B6	NO Digital Output	Loop3 Alarm_5 Status
DO6	B7	NO Digital Output	Loop3 Alarm_6 Status
DO7	B8	NO Digital Output	Loop4 Alarm_7 Status
DO8	B9	NO Digital Output	Loop4 Alarm_8 Status