

## 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.

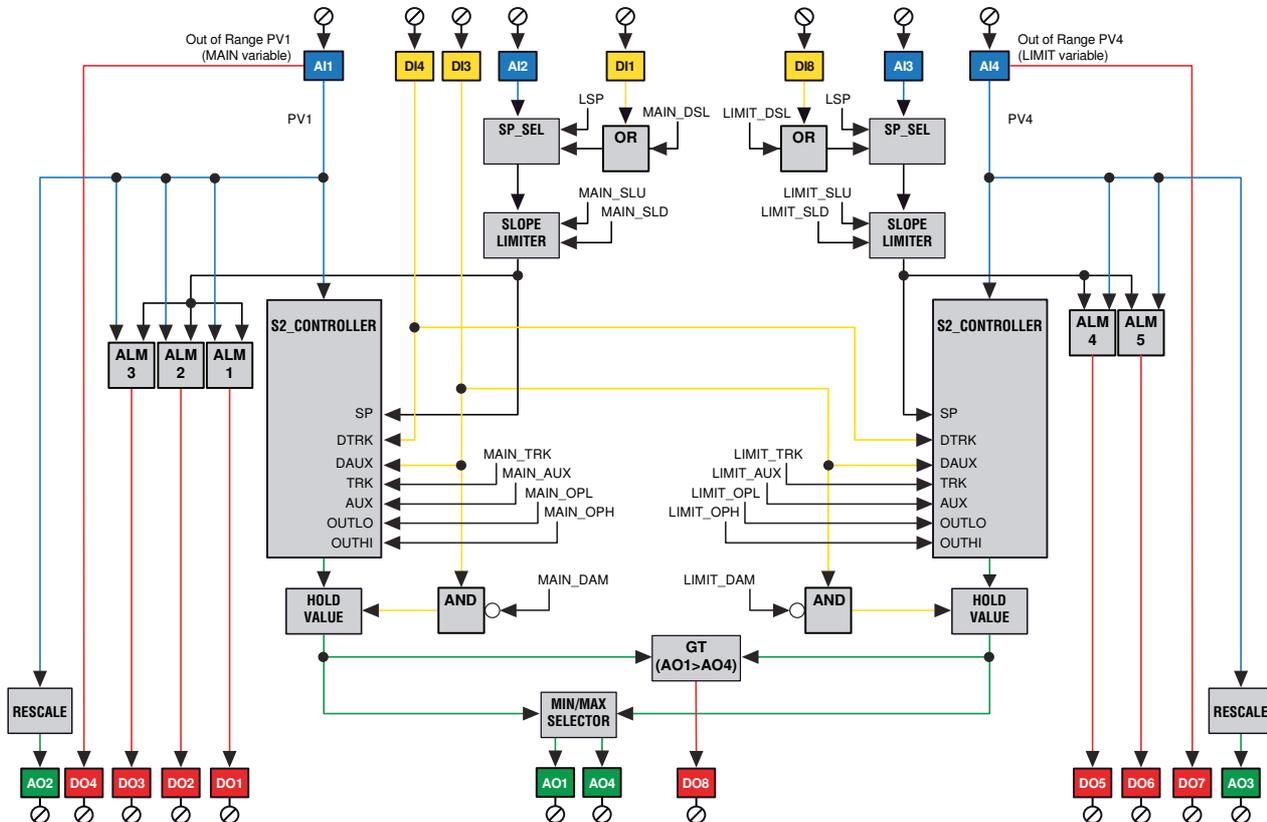
### A-4-2 Project Tasks (POU) Organization and Order

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 overall general operations;
6. **Override\_Loop\_Mngt.CFC** Specific Override process control operations;
7. **Override\_Pages.CFC** Overall 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:

- 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.

**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.

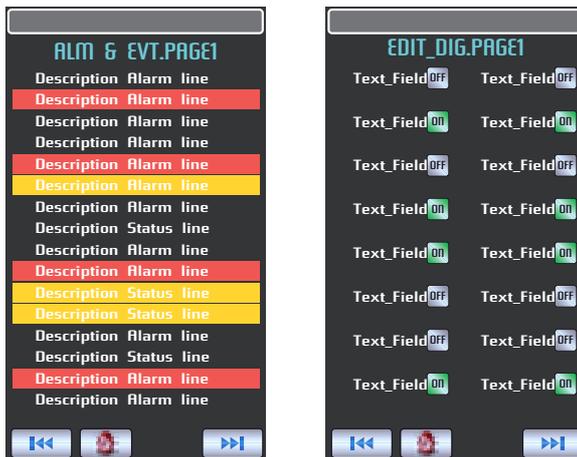
*Variables retransmission* The AI1 Main variable is retransmitted, after a proper rescaling operation, on the AO2 output.

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. <b>TRK</b> Tracking OP Main loop | <b>TRK</b> Tracking OP Limit loop; |
| 2. <b>HLD</b> Hold OP Main loop     | <b>HLD</b> Hold OP Slave loop;     |
| 3. <b>MAIN</b> OP Main > Limit      | <b>MAIN</b> OP Main > Limit;       |
| 4. <b>KO_AI</b> Main loop           | <b>KO_AI</b> 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.

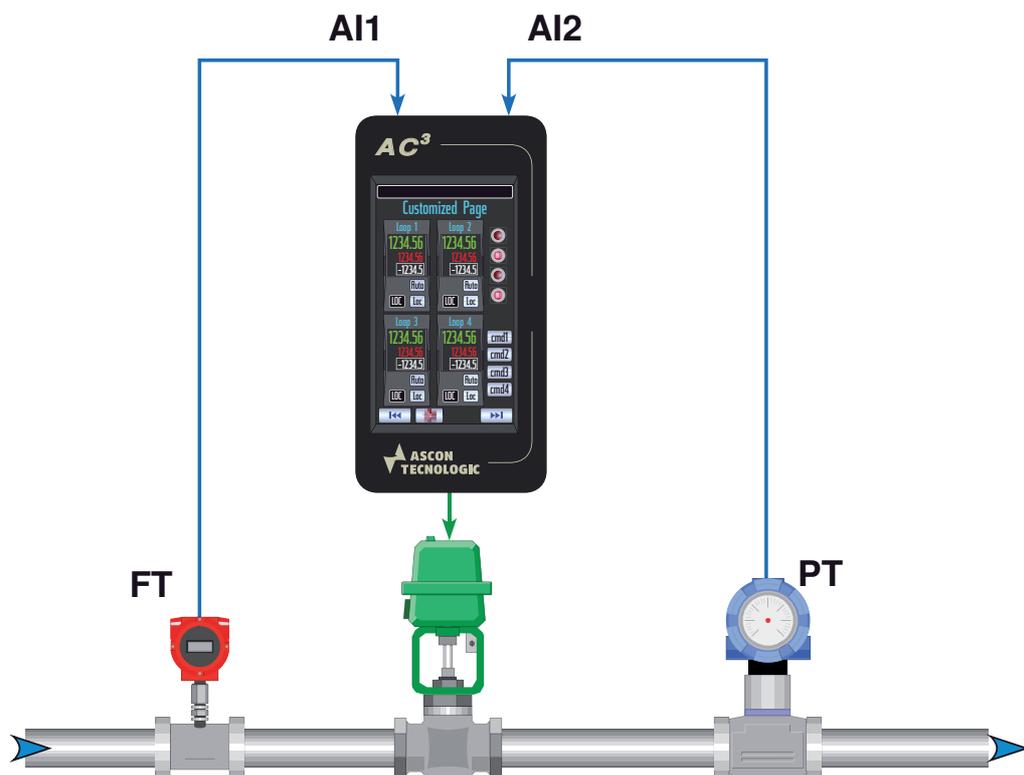
### A-4-5 Applications

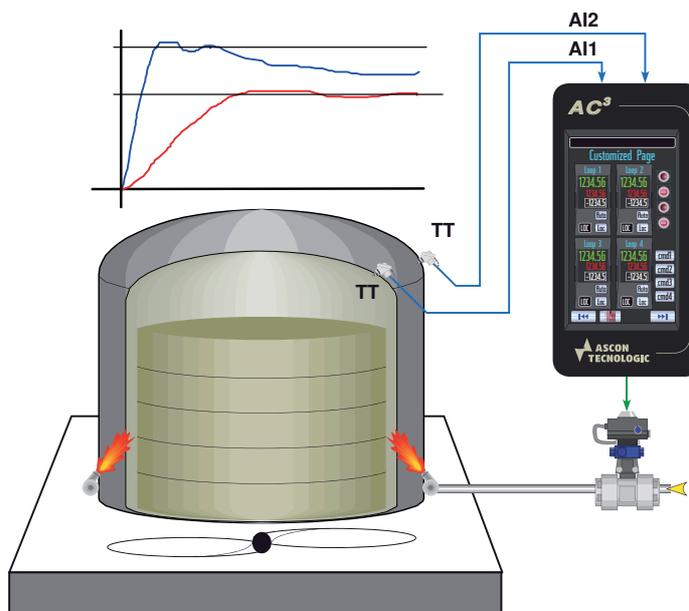
The override control is the right solution for controlling processes where more than one variable must be controlled at the same time. For instance, the process consists of a Main variable that must be kept at the SP and a Limit one that must not exceed a predefined threshold during normal operations,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