

MICRO THERMO TECHNOLOGIES

MT Alliance Multi-Purpose Controller (MPC) User's Guide

Document No.71-GEN-0082-R1.2 MTA V4.1

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1 Preface

1.1 *Using this manual*

This manual is intended for anyone developing custom applications with the MPC system. It requires knowledge of the basic tools in the MT Alliance system.

1.2 *Conventions used in this manual*

For your convenience, several screen captures have been added to describe the procedures. Some images contain numbered balloons to help illustrate the procedure.

You will also come across certain terms in **bold** to better understand the text.

2 MPC Operation

The **MPC** is a customised application program design tool.

The MPC plug-in is a tool that assists the designer during the development stage of an application on a MT500 module.

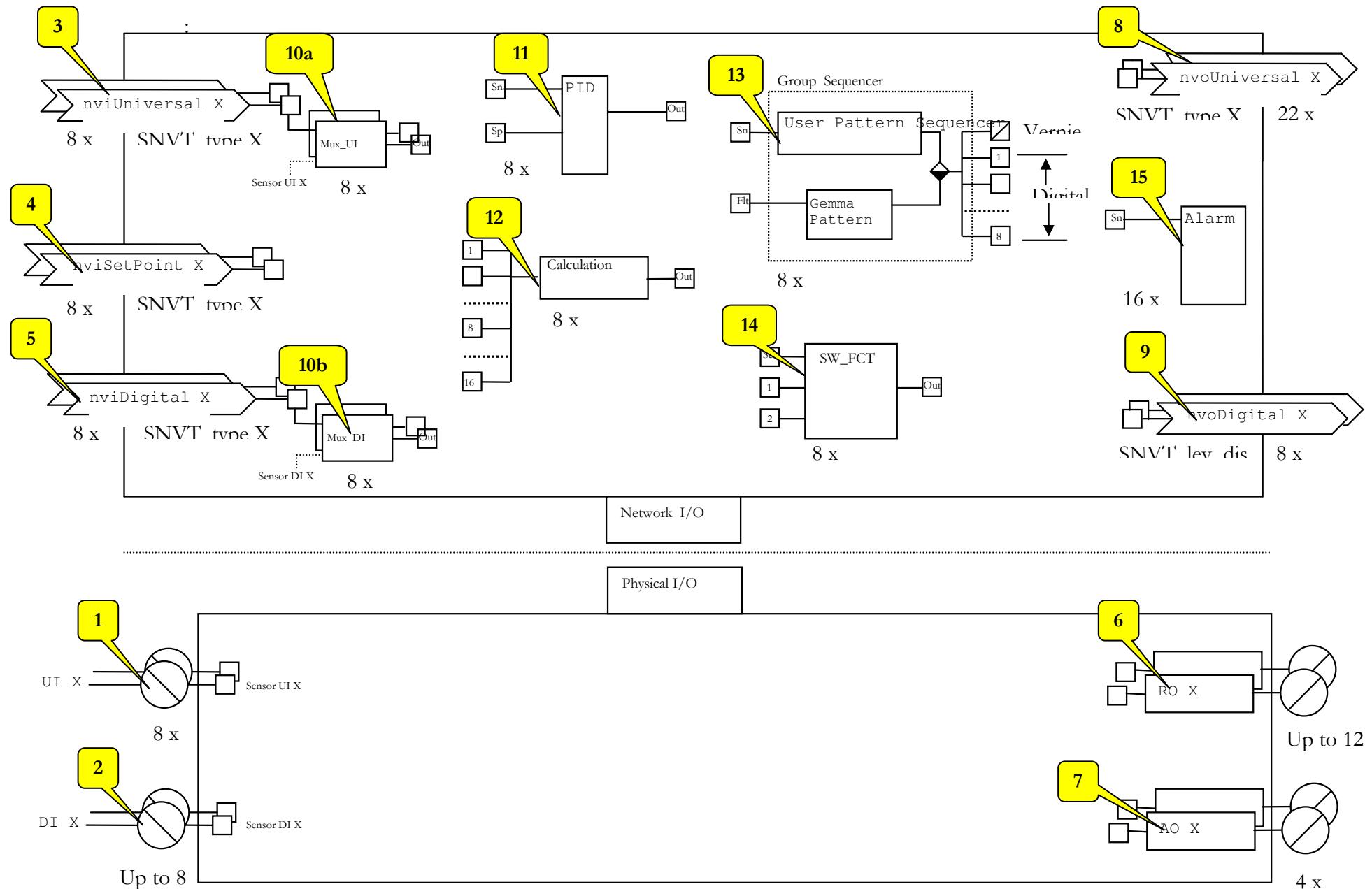
The following pages explain the various system components: inputs (physical and network), outputs (physical and network) and building blocks (e.g. PID, Switch).

2.1 Functional diagram of the MPC

The diagram below shows an overview of the MPC program blocks.

Numbered balloons help establish a link between each drafted block and its explanation. Balloons, and their corresponding explanations, are numbered from 1 to 15 for easy location of the block in the diagram.

Potential connections (internal links) between each of these blocks are listed in Appendix 1 – Table of Possible Internal Links , on page 57.



2.2 Physical inputs:

2.2.1 UIX.Sensor Analog Inputs (Block 1):

There are eight (8) universal inputs (UIX(1-8).Sensor) in each controller. To use them, they must be configured by giving them a Physical Type and a sensor model.

If the Physical Type is **Switch**, the UIX.Sensor is digital and will assume a Boolean value of **0** or **1** depending on the sensor reading. It can then be connected to:

1. Blocks with digital inputs.
2. nvoUniversalX output variables (1 to 22).
3. nvoDigitalX output variables (1 to 8).

If the Physical Type is **Analog** and the sensor reading has the same resolution as the type, it can be used with:

1. Blocks with analog inputs.
2. nvoUniversalX network variables (1 to 22).

2.2.2 DIX.Switch Digital Inputs (Block 2):

The number of digital inputs (DIX.Switch) available depends on the MT500 module used.
(504: None; 508: four (4) DI; 512: eight (8) DI)

They can be used with:

1. Blocks with digital inputs.
2. nvoUniversalX output variables (1 to 22).
3. nvoDigitalX output variables (1 to 8).

2.3 SNVT Input Variables:

2.3.1 UIX.nviUniversalX Input Variables (Block 3):

By default, and when the plug-in Physical Type is None, the eight (8) inputs are of **Temperature** type. After having associated a Physical Type to the UIX, the SNVT assumes the same type and becomes available for internal links.

If they are of **Switch** type, they can be transformed into an **SNVT_lev_disc** by connecting them to an nvoDigitalX.

2.3.2 nviSetPointX Input Variables (Block 4):

There are eight (8) nviSetPointX available in the node. To have a different type than that of the default universal SNVT (i.e. **Temperature**), they must be connected to a **PID SetPoint** input whose **Measure** input is already connected. This is the only internal link allowed.

Usually, nviSetPointX originate from a **command point** in Alliance or from a network connection (binding) originating from another node.

2.3.3 UIX.nviDigitalX Input Variables (Block 5):

These eight (8) SNVT's are always available, even if no DIX inputs are configured or present (module MT-504). They have an **SNVT_lev_disc** type, but the node allows us to transform them into **SNVT_switch** by connecting them to an nvoUniversalX Output variable.

When they are used, a value greater than 0 is considered ON whereas 0 is considered OFF.

2.4 List of MPC-Supported Physical Types:

Variable Name	Model Name in Alliance
SNVT_temp_p	Temperature
SNVT_press	Press Med Range
SNVT_press_p	Press Low Range
SNVT_lev_percent	Percent or Humidity
SNVT_lev_disc	Switch
SNVT_lux	Illumination
SNVT_flow	Flow
SNVT_amp	Current
SNVT_power_kilo	Elect.Power
SNVT_ppm	Gas Concentration
SNVT_pwr_fact	Power Factor

2.5 Physical Outputs:

2.5.1 ROX Digital Outputs (Block 6):

The number of relays depends on the module used.
(504: four (4) RO; 508: four (8) RO; 512: twelve (12) RO)

They are of digital type and can receive any digital command.

2.5.2 AOX Analog Outputs (Block 7):

The four (4) (504, 508 and 512) of them are of **SNVT_lev_percent** type and can be connected to all the block outputs and inputs of the same type.

2.6 SNVT Output Variables:

2.6.1 nvoUniversalX Output Variables (Block 8):

Twenty-two (22) in total, their type is configured by the plug-in according to their internal link. When they are not in use, their default type is **SNVT_temp_p**.

When they are of **SNVT_switch** type:

- If their source is **digital**, they reflect one of the two following values: “Value = 100% and State = 1” or “Value = 0% and State = 0”;

- If their source is a **percentage value**, they send either a “Value in % and State = 1” or a “Value = 0 and State = 0”.

For all other types, they propagate the value received in the SNVT resolution.

All blocks and inputs can be connected to one of the nvoUniversalX.

The value transmitted is only based on the filter applied on the nvoUniversalX.

2.6.2 nvoDigitalX Output Variables (Block 9):

Eight (8) in total, they are always available, even if no DI inputs are configured or present.

They can be connected either to another node or to a **measure point** in Alliance.

Of **SNVT_lev_disc** type and using the Boolean values 0 and 1, they can be connected to all blocks with a digital output.

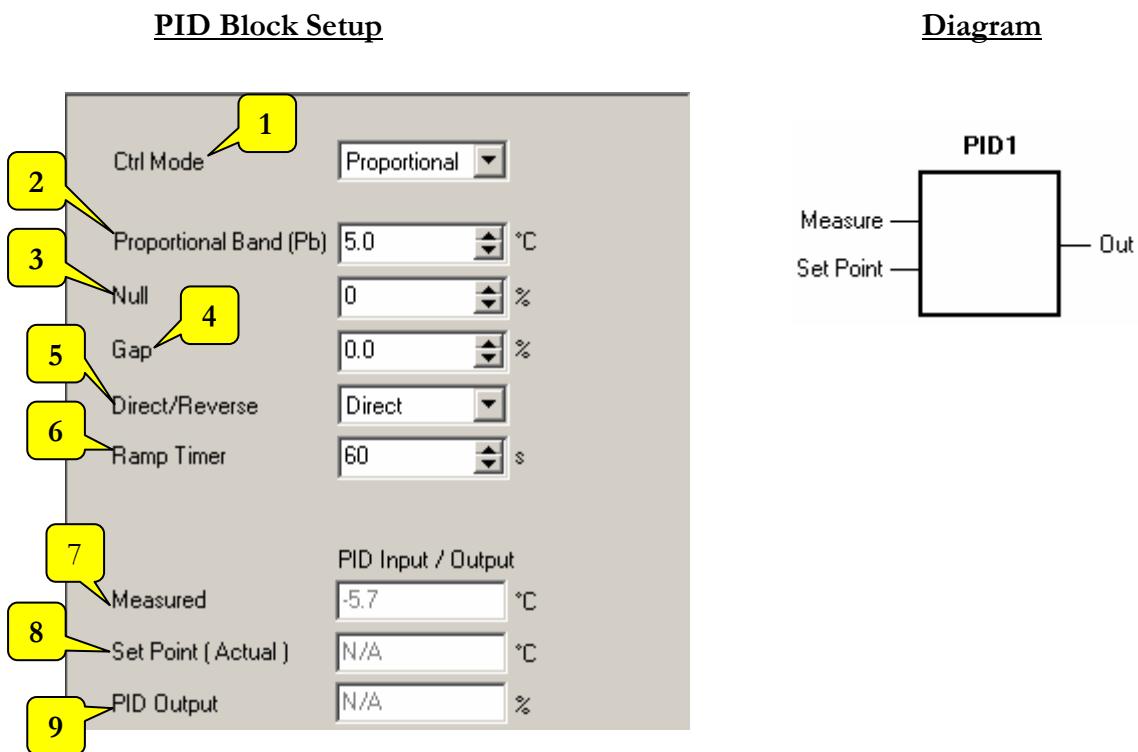
The value transmitted is only based on the filter applied on the nvoDigitalX.

2.7 Building Blocks:

2.7.1 UIX.Mux (Block 10a) and DIX.Mux (Block 10b) Blocks:

The Mux block is used to **choose** either the UIX.Sensor physical input or the SNVT UIX.nviUniversalX on a UIX block by prioritizing the latter.

2.7.2 PID's (Block 11):



In the plug-in, a type (e.g. temperature, pressure) is assigned to the PID when its **PID.Measure input** is linked either to an analog input, an analog output or an analog block output. Then, an nviSetPoint can be connected with its **PID.SetPoint input**, which effectively assigns the type to nviSetPoint.

The PID output is of **SNVT_lev_percent** (%) type and can be connected to all blocks and outputs compatible with this type of output.

The PID block output is rounded off to the nearest unit and is limited to values included between 0% and 100%.

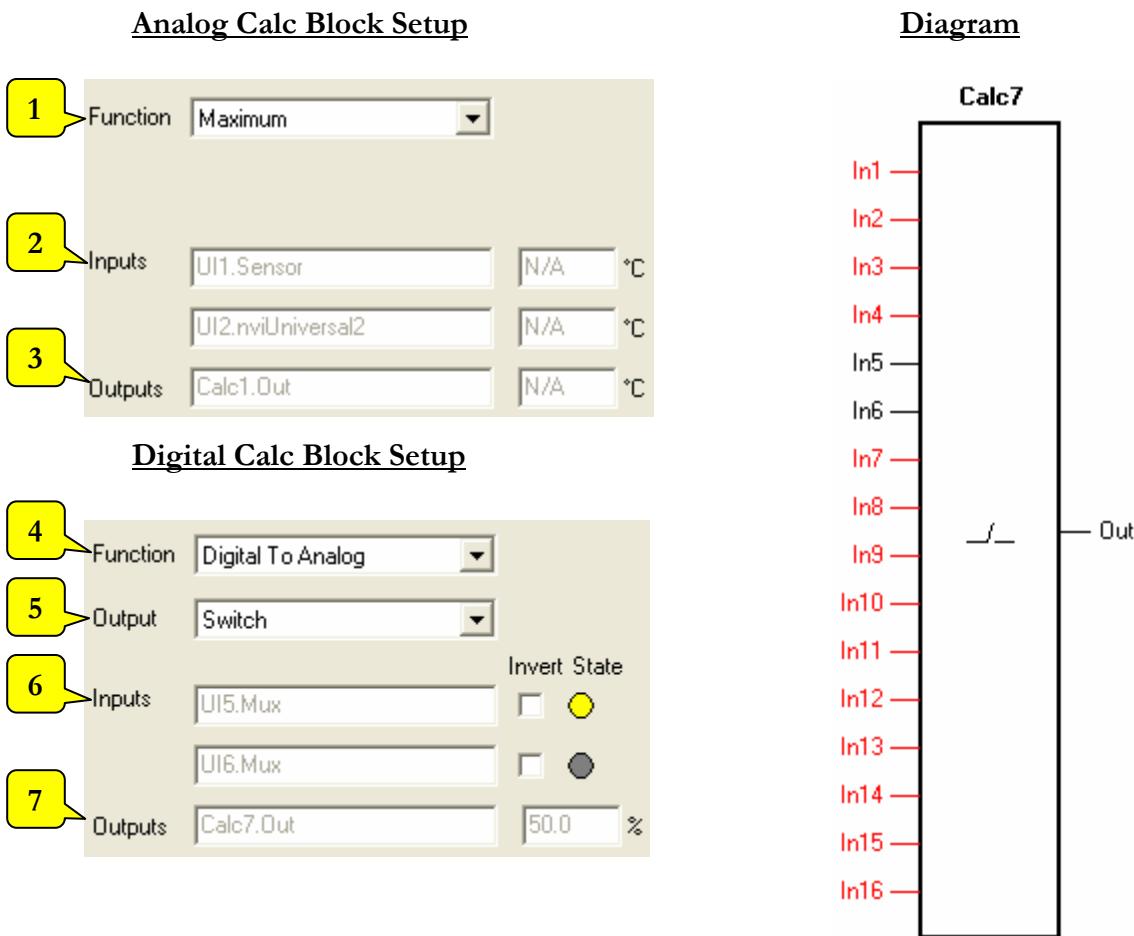
The integral component is integrated in the PID operation, but not the derived component.

PID Block Setup (references to diagram above)

- 1- **Ctrl Mode** – Allows the user to choose between Proportional only mode and PID mode.

- 2- **Proportional Band** – Allows the user to adjust the process control range. E.g.: with a 5-degree PB; with a 5-degree difference (error margin) between the measure and the set point; the PID output yields 100%; with a 2.5-degree difference (error margin) between the measure and the set point; the PID output yields 50%, etc.
- 3- **Null** – Allows the user to get a percentage at the PID output, in proportional mode, when the measure is equal to the set point (no error).
- 4- **Gap** – Allows for a difference or error margin (measure – set point) to cross between the new calculated and the previous PID output before changing the PID output value.
- 5- **Direct/Reverse** – Enables the user to reverse the action of the PID output.
A direct action: when the PID output **increases** while the process measure **increases**.
For example: cooling, if the reading goes from **21 to 22** degrees while the PID output goes **from 0 to 100%**.
A reverse action: when the PID output **increases** while the process measure **decreases**.
For example: heating, if the reading goes from **20 to 19** degrees while the PID output goes **from 0 to 100%**.
- 6- **Ramp Timer** – Allows the user to change the time needed for the PID to increase its output from 0% to 100%. A 100-sec ramp means that the PID output will not change more quickly than $100\% / 100 \text{ sec} = 1\%/\text{sec}$.
Note: Useful in proportional mode to slow down the controller's response.
- 7- **Measure** – Allows the user to view the value of the process measure point at the PID Block input. (if an output SNVT (e.g.: **nvoUniversal12**) was connected to *Pid.measure*).
- 8- **Setpoint** – Allows the user to view the value of the set point at the PID Block input. (if an output SNVT (e.g.: **nvoUniversal12**) was connected to *Pid.Setpoint*).
- 9- **Pid Output** – Allows the user to view the PID block output value. (if an output SNVT (e.g.: **nvoUniversal12**) was connected to *Pid.out*).

2.7.3 Calculations (Block 12):



After connecting a first input, the block will only accept inputs of the same type as the first one, which can then be connected to any other block or output compatible with that type. The plug-in makes functions available according to the physical inputs connected to the block:

If the block is used in digital mode, it must be connected to analog input UIX.Mux blocks, configured as Switch type, and to digital input DIX.Mux blocks.

However, if the block is used in analog block, it must be connected to UIX.Sensor analog inputs and UIX.nviUniversalX input variables.

Mode	DIGITAL	ANALOG
8 first IN1-8 bits	UIX.Mux	UIX.Sensor
8 last IN9-19 bits	DIX.Mux	UIX.nviUniversalX

The node performs the function specified in the plug-in on page **Block**:

Function	Result	
Analog	AVG	Average of block inputs
	MIN	The smallest input
	MAX	The greatest input
	DIF12	Difference between the first and the second configured block input
	DIF21	Difference between the second and the first configured block input
Digital	AND	The designated logical function is applied to all configured block inputs
	NAND	
	OR	
	NOR	
Digital to Analog	DA	Digital to Analog converter that returns a percentage based on the number of digital inputs to 1 on the number of configured inputs

In analog mode, the block type depends on the type of configured inputs.

In digital mode, the type is Switch, except if the selected function is DA. The type is then a percentage and the plug-in gives the choice of outputting the result to an nvoUniveralX output variable of either **SNVT_lev_percent** or **SNVT_switch** type.

Analog Calc Block Setup (references to diagram above)

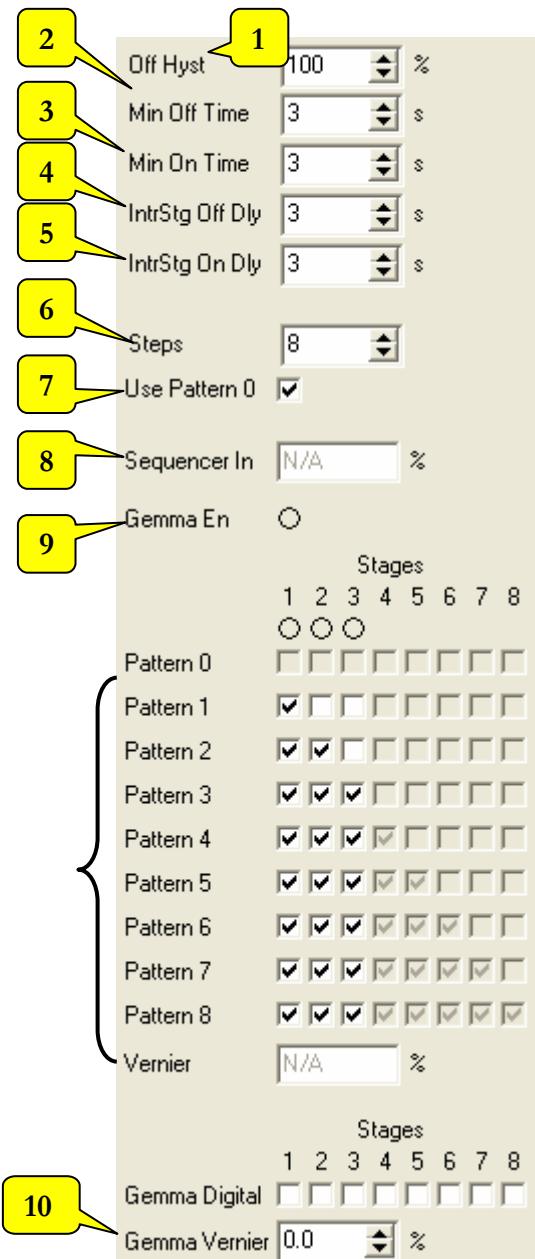
- 1- **Function** – Allows the user to make a selection in the table of analog functions above.
- 2- **Inputs** – Allows the user to view the value of each block input.
- 3- **Outputs** – Allows the user to view the block output value.

Digital Calc Block Setup

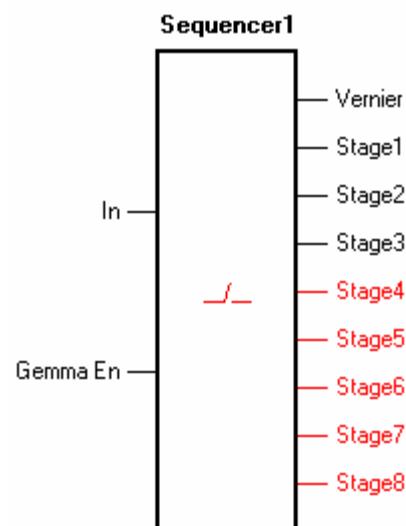
- 4- **Function** – Allows the user to make a selection in the table of digital functions above.
- 5- **Output** – Used for tests only.
- 6- **Inputs** – Allows the user to view the value of each block input. In addition to being able to reverse its state.
- 7- **Outputs** – Allows the user to view the block output value.

2.7.4 Sequencers (Block 13):

Sequencer Setup



Diagram



The sequencer is used to convert a percentage value from 0 to 100% in one or several stages of digital outputs.

For example: If we configure four (4) stages, the sequencer will distribute the value in % (100) over the number of stages ($100/4=25$). Each stage will then be activated in units of 25%. If

the sequencer input is 64%, 2 stages will be activated while the third stage will only be activated once the input reaches 75%.

This block activates or deactivates its digital outputs (1-8) (stages) based on the pattern specified by the plug-in on the **block** page. The analog output is calculated only if the Vernier stage is used. The current pattern (step) and the value of the Vernier stage depend on the number of steps that the block must use and the percentage of input received. The block can also take into consideration a Gemma condition (**failsafe condition**). If this condition is used, the block outputs are forced to predetermined values in the Gemma pattern when the condition is activated. When a Gemma condition is returned, the block operation is reset again.

In the plug-in, the block stages can be assigned either to the ROX output relays or to the nvoDigitalX or nvoUniversalX network variables, or as an input to another block.

The Vernier output can be connected either to the AOX analog output relays or to the nvoUniversalX output variables, or to input of another block.

Sequencer Block Setup (references to diagram above)

- 1- Off Hyst¹** – Allows the user to change the mode in which the block is configured.
- 2- Min Off Time** – Allows the user to change the minimum time that the controller must remain in a stage (if the PID output goes from one stage to the next).
- 3- Min On Time** – Allows the user to change the maximum time that the controller must remain in a stage (if the PID output goes from one stage to the next).
- 4- IntrStg Off Dly** – Allows the user to change the Off delay between each stage.
- 5- IntrStg On Dly** – Allows the user to change the On delay between each stage.
- 6- Steps¹** – Allows the user to configure the number of stages contained in the sequencer (**MAX 8**).
- 7- Use Pattern 0** – Allows the user to opt for Pattern 0 or not.
- 8- Sequencer In** – Allows the user to view the sequencer input value.
- 9- Gemma En (failsafe condition)** – Allows the user to view the state of the failsafe condition.
- 10- PatternX (stages)** – Allows the user to configure outputs based on each stage.
- 11- Vernier** – Allows the user to view the Vernier value (in %).
- 12- Gemma Digital (digital failsafe stage)**– Allows the user to configure outputs associated with the failsafe stage.
- 13- Gemma Vernier (analog failsafe stage)** – Allows the user to configure the Vernier value at the failsafe stage.

Without the Vernier, the boundary nears the halfway mark of the gap by a factor inversely proportional to the hysteresis.

With the Vernier, the boundary closes in by taking into account the effect of the Vernier stage whose value is adjusted during the step transition (pattern). The hysteresis is used to compensate when the Vernier stage doesn't correspond to 2 normal digital stages.

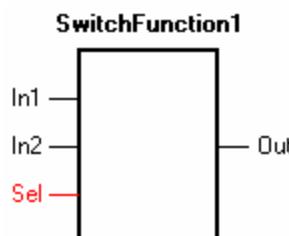
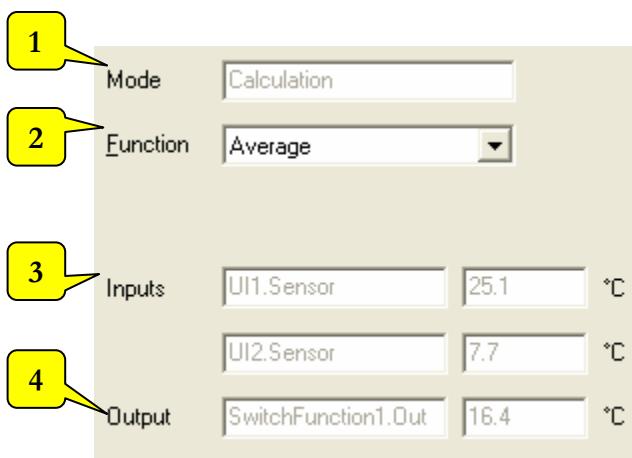
¹ The number of steps determines their gap and the hysteresis changes the boundaries:

When the Vernier stage is used, its value varies from 0% to 100% in the first two steps, from 100% to 0% in the last two (2) steps and between the transition value and 100% or between the transition value and 0% based on whether the block input increases or decreases. The Vernier stage variation over the steps allows the user to operate the sequencer in BarGraph or Binary mode by configuring patterns accordingly.

2.7.5 SwitchFunctions (SWF) (Block 14):

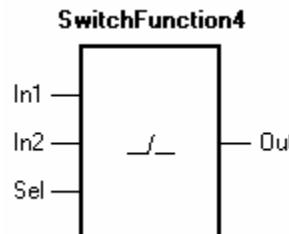
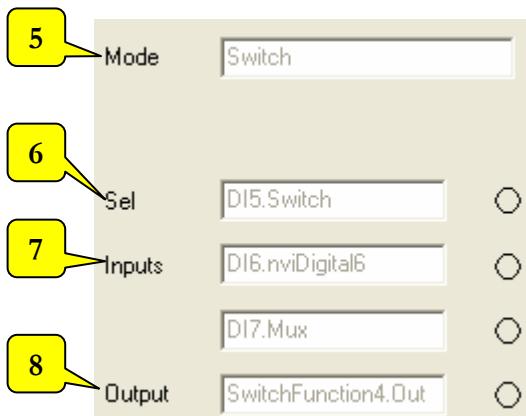
SWF Block Setup without selector button

Diagram



SWF Block Setup with selector button

Diagram



The operation of this block is similar to that of the **Calculation** block but with one major difference: inputs are limited to two (2) and can be from other sources than the physical inputs or SNVT and are integrated with a Switch operation mode.

If the **Sel** input is configured (an internal connection was made on **SwitchFunction.Sel**), the bloc operates in Switch mode:

When input 1 is activated, it is routed to the block output. When it is inactive, input 2 is the one routed to the output.

When the Sel input is not configured, the block operates in Calculation mode and applies a function on the analog or digital inputs.

In analog mode, the block type depends on the type of the first input connected (1 or 2).

In digital mode, the type is Switch, except if the selected function is **DA**, in which case the type is percentage and the plug-in offers to output the result to an nvoUniversalX variable of **SNVT_lev_percent** or **SNVT_switch** type.

The plug-in makes functions available according to the physical inputs connected to the block²:

Function		Result
	None	Overrides the registry to 0
Analog	AVG	Average of block inputs
	MIN	The smallest input
	MAX	The greatest input
	DIF12	Difference between the first and the second configured block input
	DIF21	Difference between the second and the first configured block input
	SUM	Sum of the two inputs
Digital	AND	The designated logical function is applied to all configured block inputs
	NAND	
	OR	
	NOR	
	XOR	
	XNOR	
Digital to Analog	DA	Digital to Analog converter that returns a percentage based on the number of digital inputs to one (1) on the number of configured inputs

SWF Block Setup Without Selector Button (references to diagram above)

- 1- Mode** – Allows the user to view the block setup mode.
- 2- Function** – Allows the user to make a selection in the table of analog functions above.

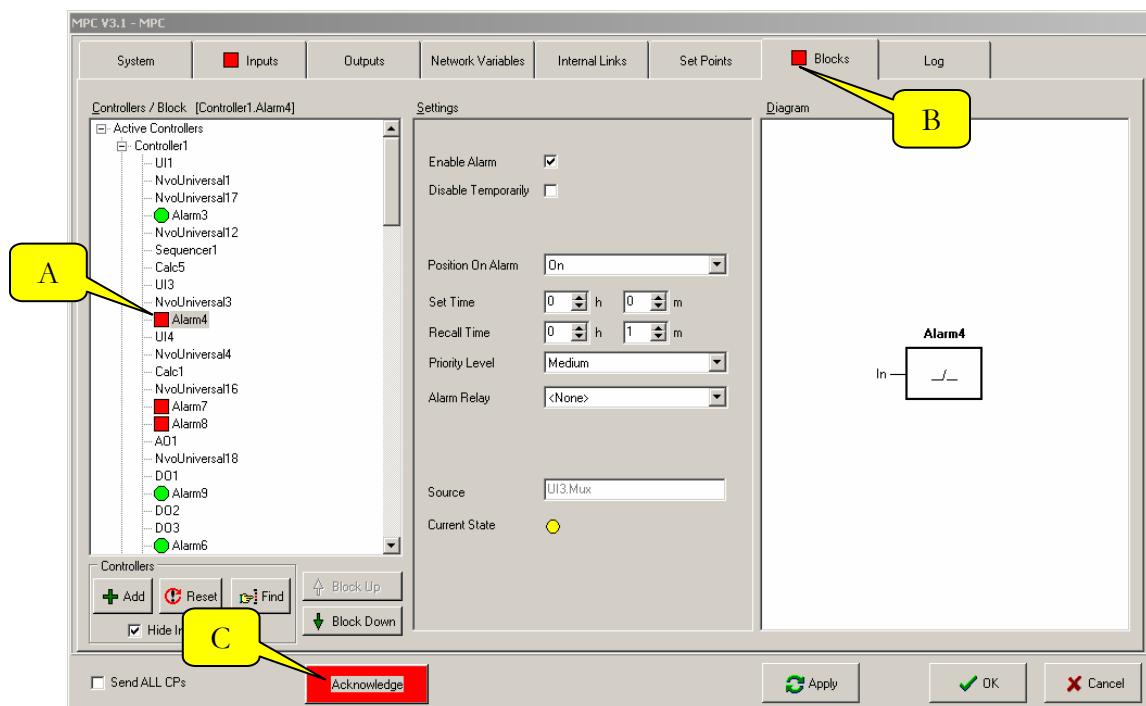
² Note: If one of the two inputs is not connected, it will be used by the node to run the function by considering its **value to 0** and of the same type as the block, except when using the DA function where there's the possibility of connecting only one input.

- 3- Inputs** – Allows the user to view the value of each block input.
- 4- Outputs** – Allows the user to view the block output value.

SWF Block Setup with selector button

- 5- Mode** – Allows the user to view the block setup mode.
- 6- Sel (Selector)** – Allows the user to view the value of the block selector input.
- 7- Inputs** – Allows the user to view the value of each block input.
- 8- Outputs** – Allows the user to view the block output value.

2.7.6 Alarm (Block 15)



This block allows you to define alarms sources and settings.

If a source is in alarm, a red square displays in front of the alarm block in question (A) and on the **Blocks** tab (B) (this allows the user to view it immediately regardless of the active tab). However, a blue circle appears on the **Blocks** tab if no alarm is active but at least one alarm is temporarily or definitely disabled (no check mark in **Enable Alarm**). If everything is normal (no block in alarm or temporarily disabled), a green circle displays on the **Blocks** tab.

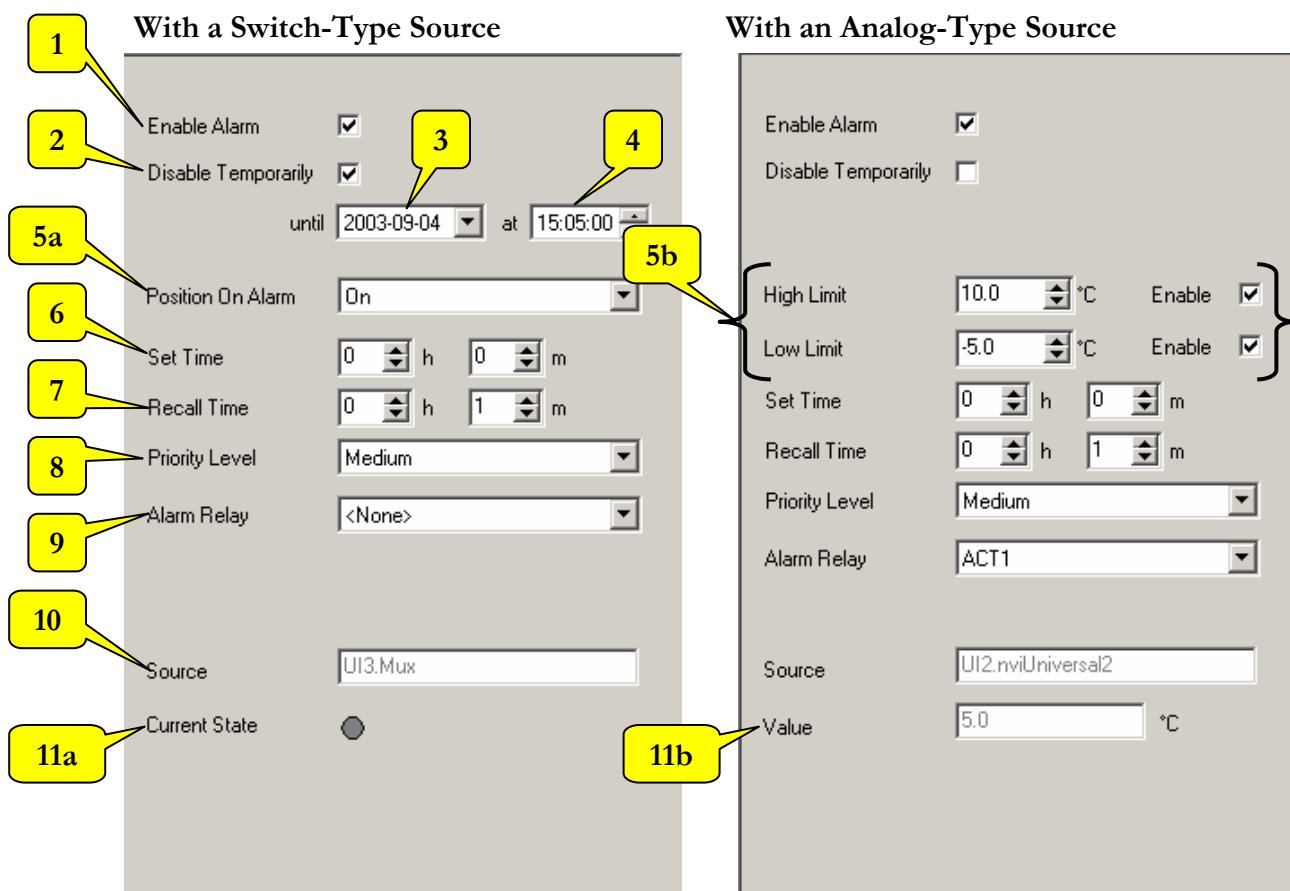
Alarm blocks can be connected from any block output (Appendix 1 – Table of Possible Internal Links

Table on page 57).

To configure an alarm block, you must first establish an internal link from a block output to the input of one of the 16 alarm blocks available.

(In the Merlin version only: When one of the block alarms is triggered, an **Acknowledge (C)** button appears at the bottom of the plug-in. This button is used to acknowledge all alarms from all of the plug-in blocks concurrently. To acknowledge one alarm at a time, you must exit the plug-in and use the Alliance acknowledge button.

Alarm Block Setup (references to diagram below)



- 1- **Enable Alarm** – Allows the user to permanently enable or disable the alarm for this block.
- 2- **Disable Temporarily** – This option is available only if the alarm is activated. By checking this box, it is possible to disable the alarm for a specific interval. Once the interval is over, the alarm will be automatically re-enabled. By checking this box, two fields appear:
 - 3- **Until** – Indicates the interval ending **date**.
 - 4- **At** – Indicates the **time** at which the interval will end.

If the source type is Switch:

5a – Position On Alarm – Allows the user to select from a drop-down list whether or not an alarm should activate when the **switch** is in the ON or OFF position.

If the source type is Analog:

5b- High and Low Limit – All the values included between these two limits will be considered as standard and won't generate alarms. You can take both limits into consideration by checking both boxes (**Enable**) or take only one into consideration by checking the appropriate box.

6- Set Time – The time required before a limit overshoot is considered as abnormal and an alarm is generated.

7- Recall Time – Time between an alarm is acknowledged and another one is generated if the alarm condition is not corrected and the value received is still outside the limits.

8- Priority Level – Indicates the alarm priority:

- **High** – High priority alarm. Needs immediate attention to prevent the controller from stopping.
- **Medium** – Intermediate priority alarm.
- **Low** – Low priority alarm.
- **Notice** – Even if the controller configuration assumes the contrary, no alarm relays will be activated if the alarm is triggered.

9- Alarm Relay – Allows the user to select from a drop-down list whether or not a **relay** should be activated on the **alarm controller** once an alarm is triggered.

10- Source – Allows the user to view the source connected to the alarm block.

If the source type is Switch:

11a- Current State – Allows the user to view the state of the alarm source.

- A grey circle indicates an inactive digital status (*Off*).
- A yellow circle indicates an active digital status (*On*).

If the source type is Analog:

11b- Value – Allows the user to view the value of the alarm source.

3 The Hardware

3.1 MPC Controller

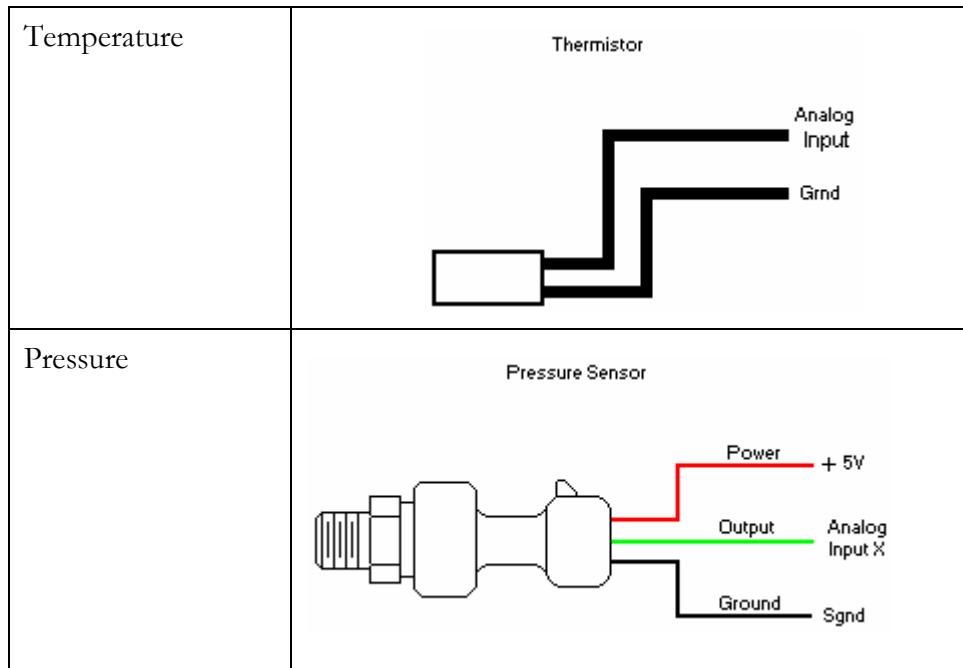
Given the large number of possible configurations for the MPC, the software enables the use of an MT-504, 508 or 512 controller.

Their features are as follows:

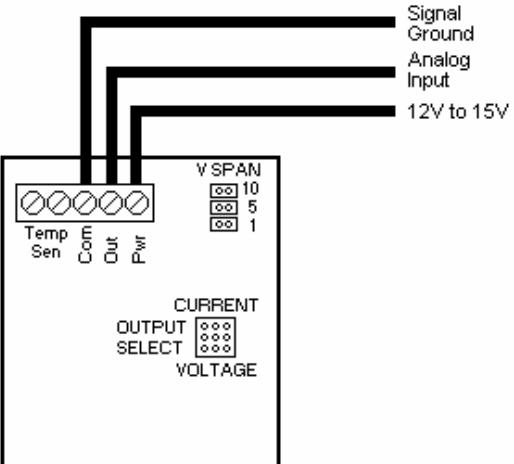
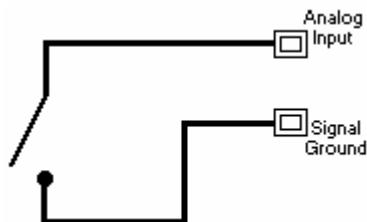
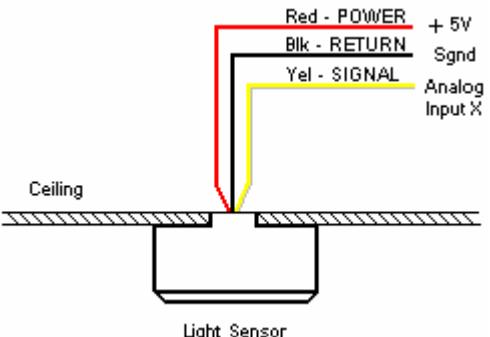
Type of I/O	MT504	MT508	MT512
Analog Inputs	8	8	8
Digital Inputs	0	4	8
Analog Outputs	4	4	4
Digital Outputs	4	8	12

3.2 Sensor Connections

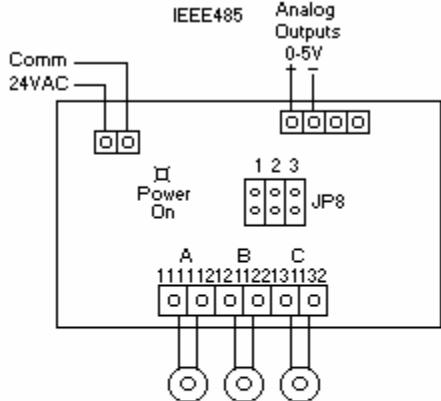
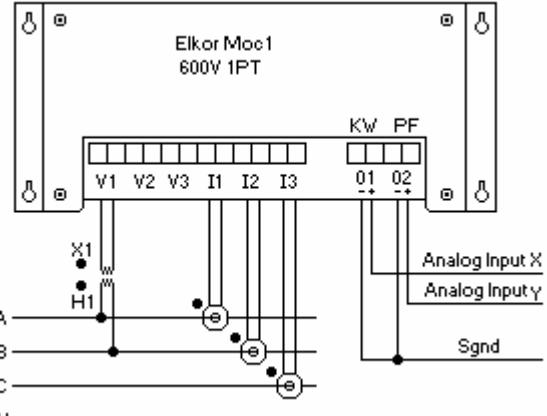
Example of each type of sensor supported. (Temp, hum, amp, press)



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Humidity	 <p>The diagram shows a four-wire connection to an MPC module. The wires are labeled: Signal Ground, Analog Input, and 12V to 15V. The module has terminals for V SPAN (10, 5, 1), Temp Sen (E, C, P, W), CURRENT OUTPUT (000, 000), SELECT (000), and VOLTAGE.</p>
Switch	 <p>The diagram shows a single-pole switch connected in series with an analog input terminal on the MPC module. The other side of the switch is connected to signal ground.</p>
Lighting	 <p>The diagram shows a light sensor mounted on a ceiling. Three wires are connected to the MPC module: Red - POWER (+ 5V), Blk - RETURN (Sgnd), and Yel - SIGNAL (Analog Input X).</p>
Flow	N/A

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<p>Current</p>  <p>Note: <u>For 3 phase:</u> JP8 with jumper "1" applied output #1=(1a1b1c)I3 and jumpers "2" & "3" select the current for output #2.</p> <p><u>For single phase:</u> JP8 no jumpers Output 1= Current A Output 2= Current B</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>J2</th> <th>J3</th> <th>Output2</th> </tr> </thead> <tbody> <tr> <td>ON</td> <td>ON</td> <td>1a</td> </tr> <tr> <td>ON</td> <td>OFF</td> <td>1b</td> </tr> <tr> <td>OFF</td> <td>OFF</td> <td>1c</td> </tr> </tbody> </table>	J2	J3	Output2	ON	ON	1a	ON	OFF	1b	OFF	OFF	1c	<p>Power</p> 
J2	J3	Output2											
ON	ON	1a											
ON	OFF	1b											
OFF	OFF	1c											

Power Factor	<p>The diagram shows the connection of an Elkor Moc1-3 PT module to a power source and a load. The module has three voltage inputs (V1, V2, V3) connected to phases A, B, and C respectively, and a neutral (N) input. It also has three current inputs (I1, I2, I3) connected to phases A, B, and C respectively. The module outputs KW and PF signals. External analog inputs X and Y are connected to the module, and a ground connection (Sgnd) is shown.</p>
Gas Concentration	<p>The diagram shows the connection of a CPC 809-1550 gas concentration sensor. The sensor has two magnetic coils and a signal output. It requires a 12VDC power supply. The signal output is connected to an MT3208 or MT5XX module, which provides power (+V, -V) and ground (GND) to the sensor. The signal output from the module is connected to an Analog Input on the MPC controller.</p> <p>Needs an external 12VDC power supply</p>

3.3 Sensors Supported

Temperature	<ul style="list-style-type: none"> ➤ 023-0043/46/48 Hvac Therm 10K Type3 ➤ 023-0072/73 Therm 10K Type2 (Green &Orange Lead)
Pressure (Low Range)	<ul style="list-style-type: none"> ➤ 023-0083 Diff Press 500 Pa (1-5V) ➤ 023-0135 Low Press (0.25 à 4 WC) 1-5V or 4 @ 20mA

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Pressure (Med range)	➤ 952-0001 100psig (0.5-4.5V) ➤ 952-0002 500psig (0.5-4.5V) ➤ 952-0004 200psig (0.5-4.5V)
Humidity	➤ 023-0026/43 5...95%rh (0.25-4.75V)
Switch	➤ Low side switch for MT-500
Lighting	➤ 023-0142/55 100/250 Fc (1-10V) ➤ All CES sensors
Flow	➤ N/A
Current	➤ All ETAMP3 sensors (Elkor) ➤ All MOC1 sensors (Elkor)
Electrical Power	➤ All MOC1 sensors (Elkor)
Gas Concentration	➤ 023-0014 R21 R22 1000 ppm (2-10V) ➤ 023-0015 Diesel 500 ppm (2-10V) ➤ 023-0071 R134,152,500,502,123 (2-10V)
Power Factor	➤ N/A

4 MT Alliance

After the physical installation, the application programme and the operations settings must be loaded in the controller. To do so, the node must be supplied and the various sensors that enable control must be connected.

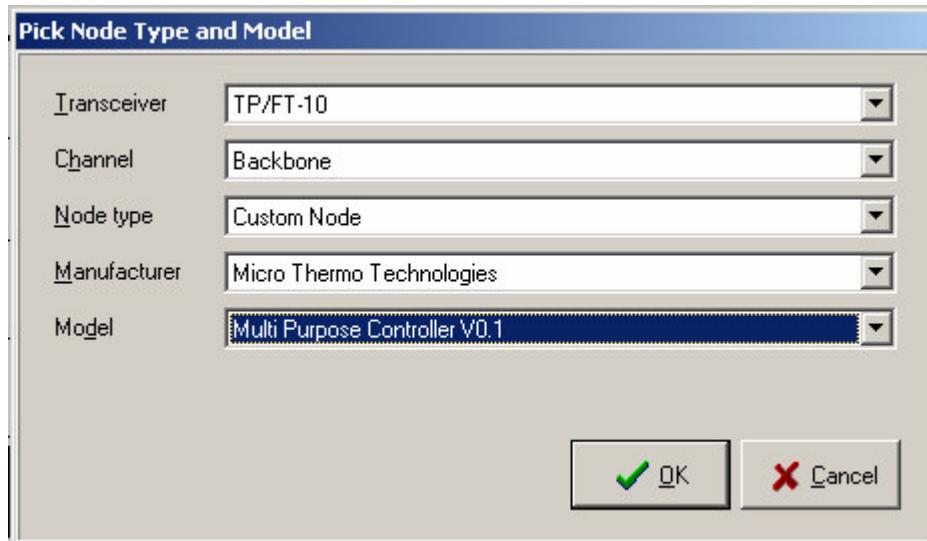
4.1 Adding the Process View

1. Click the desired subsystem button.
2. In the **Configure** menu, select **Views**.
3. The **View Configuration** window opens.
4. Select the view that precedes your own.
5. Click the **Insert After** button. A new view without any images appears.
6. Type the name of the view (e.g.: your process name) in the **View Name** field.
7. Click the **Change Image** icon. The Open File dialog box appears. Select the Process.bmp file to get a graphic representation of your process.
8. If you wish, you can check the **Zoom** box. Thus, only their status will be seen in the normal view when you place measure points on the close up of the view.

4.2 Adding the MPC Node

Now that the process view is present, you need to add the node.

1. In the **Subsystems** menu, select your subsystem or click the desired subsystem button. In the **Mode** menu, select **Configuration**. When entering this mode, a **Components** toolbox appears in the bottom right corner of the window. It contains all the items that can be placed in the view.
2. Select the view that you created at the previous step by clicking on the tab displaying its name.
3. Drag and drop a **Node** icon from the toolbox to your process system view. As soon as the icon is dropped, the **Node Definition** window opens. Select the item representing the site installation in each drop-down list. Click the **OK** button to finish or **Cancel** to clear the node.



*** To move an icon, select it while pressing the **CTRL** key and move it with your mouse.

Once the node is placed, it must be configured and associated with the controller.

1. Click the node icon. The **Custom Node Information** dialog box opens.
2. Select the **Details** tab.
3. Type a unique name for the node in the **Identification** field and, if you wish, in the **Notes** field.
4. Select the **Commands/Status** tab.
5. In the **Installation** group, click the **Install** button.
6. The **Install a Custom Node** dialog box opens and prompts you to click the **Service** button of the MPC Node. For manual entry, see the “Node Installation” manual. As soon as you press the Node Service button, the software download begins. The plug-in loads the software in the node. Once the load is completed, the window buttons are activated.
7. Click **OK** to close the window.
8. Click to accept and save the changes.

4.3 Adding the Plug-in

At this stage, the MPC controller contains the software, but not the operation settings. These settings depend on the sensors used and their features. To setup the sensors, you must first install a plug-in.

1. Drag and drop a **Plug-in** icon from the toolbox to the desired location on the view. Click on the plug-in icon to configure it.
2. The **Plug-In Information** dialog box opens.

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Information as it is shown in the table below:

Plug-In Button Configuration - MPC Plg

Details		Configuration	Log
Type	<input checked="" type="radio"/> MI Plug-In <input type="radio"/> LNS Plug-In		
Scope	Node		
Node Name	MPC		
LonMark Object	<None>		
Manufacturer ID	Micro Thermo Inc.		
Plug-In Name	MPC		
Plug-In Version	3.1		
Visibility			
<input type="radio"/> Always visible <input checked="" type="radio"/> Maintenance and Configuration <input type="radio"/> Configuration only			
Alliance\Images\RunTime Cfg\Plugin.bmp			
From now on, "Shift - Click" or "Right - Click" on the Plug-In button to return to this form.			

4.4 Network Variable Connections

To enable full operation of the process, network variables from other nodes might be connected. Examples of necessary connections are shown in the table below. The complete procedure to make these connections follows afterward.

Output		Input	
Node	NV	Node	NV
MPC	nvoUniversal1	Mechanical room	nviTemp1
RTU-1	nvoSpaceTemp	MPC	nvoUniversal5

To make the connections, proceed as follows:

1. Select **Network Connections** in the **Network** Menu. The **Network Variable Connections** window opens.
2. Click the **+Connect** button. The **Connection Type** window opens.
3. Select the **Connect one output to one input** button.
4. In the **Node** drop-down list, select the source node (**MPC** in this example).
5. In the **Variable** drop-down list, select the output variable (**nvoUniversal1** in this example).
6. Click on **Next**.
7. The window that opens allows you to choose the input variable to which you wish to connect the **nvoUniversal1** variable. You must then select the target node (**Equipment room**) in the drop-down list.
8. Next, select the **nviTemp1** variable in the list that appears.
9. Click **Add**. The variable is moved to the **Target List** section.
10. Click **Next** to open the connection window.
11. Click **Next**, then **Connect** to make the connection.
12. Repeat the procedure for all the connections to be made.

5 MPC Plug-in

To configure the process using the MPC, you must configure the inputs/outputs, adjust the control settings and send this data to the node.

Note that the plug-in icon is only visible in maintenance mode and/or in configuration mode. It is therefore invisible for standard users. To run the plug-in in maintenance mode, just click the plug-in icon. In configuration mode, click the plug-in³, icon to open the **Plug-In Information** window. Then, click **Run plug-in** in the **Configuration** tab.

5.1 General

5.1.1 State

The MPC plug-in is designed to allow technicians to configure their application, unlike other Alliance plug-ins that enabled them to get a visual overview of the process via the Process tab.

(**In the Merlin version only:** When an alarm is triggered in the MPC node, the plug-in turns red, if an alarm is disabled, the plug-in turns blue and when everything is normal, the plug-in is green).

5.1.2 Apply, Accept (OK) or Cancel Changes

When changes are made in the plug-in, the **Apply** button is enabled. The possible operations are:

Apply – When clicking this button, a confirmation dialog box appears. When accepting to apply the changes, the plug-in saves values, adds them to the system log and attempts to send them to the node. Once the operation completed, the **Apply** button becomes greyed out and the plug-in remains open. However, if the technician doesn't agree to save the changes (**by clicking No in the confirmation dialog box**), the save operation will be interrupted and no action will be taken. It is critical to make sure that all settings have been transmitted to the node without any error messages, otherwise the node might not work properly.

OK (Accept) – When clicking this button, a confirmation dialog box appears. When accepting to apply the changes, the plug-in saves values, adds them to the system log, attempts to send them to the node, and closes the plug-in. However, if

³Since the MTA 4.0 (XP) version, for the first use only, it runs automatically all other times, except if you right click on it or press the Shift key and select Config plug-in.

Multi-Purpose Controller (MPC) User's Guide

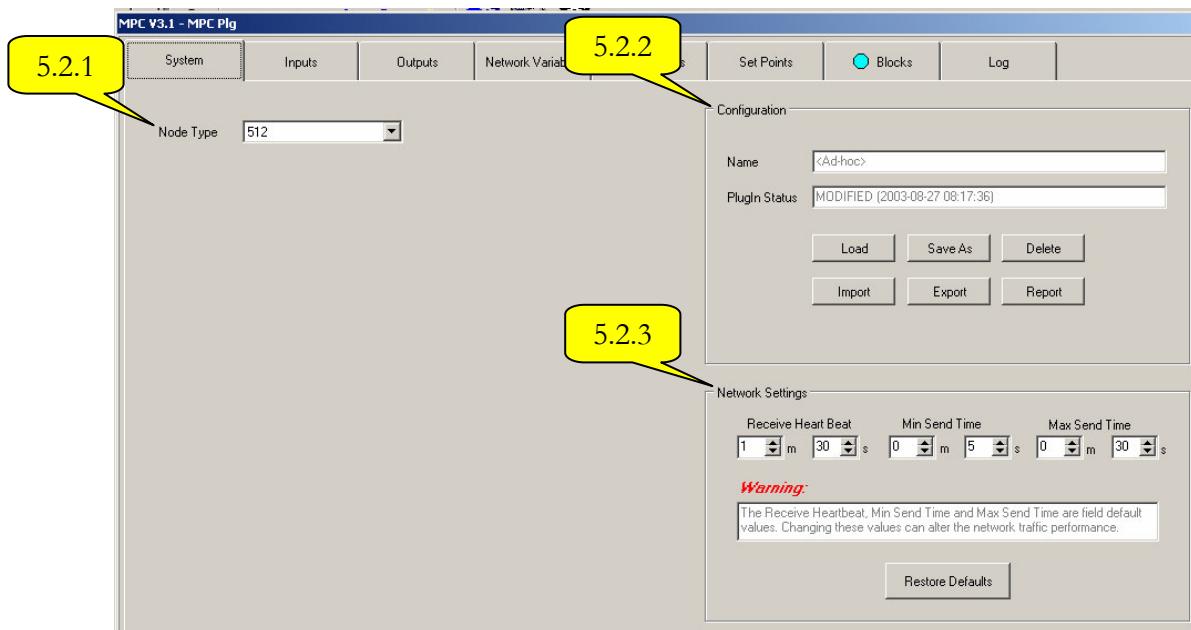
the technician doesn't agree to save the changes (by clicking **No** in the confirmation dialog box), the save operation will be interrupted, no action will be taken with the node, but the plug-in will be closed.

Cancel – when clicking this button, a confirmation dialog box appears and asks the user if he wants to cancel his changes. Clicking **YES** will cancel all changes and close the plug-in. However, if the technician selects **NO**, the cancel operation itself will be cancelled and the plug-in will not be closed.

Normally, when the technician clicks **Apply** or **OK** to confirm he wishes to keep the changes made, the software transfers only the edited settings to the node.

When in doubt, it's possible to override sending all setting by selecting the **Send All CP's** radio button at the bottom of the plug-in. This is an additional security. This option force sends all configuration settings to the node rather than only modified settings. We recommend selecting this radio button when you want the node to be perfectly synchronized with the plug-in.

5.2 System Tab



5.2.1 Node Type

With the MPC, there are three (3) possible choices of controller: MT504, MT508 and MT512. Make your selection based on the physical inputs and outputs required by your process.

5.2.2 Configuration

The group of settings required to configure a controller is called a *configuration*.

Name – the name of the current configuration. If no configuration was saved, it displays <Ad-hoc>.

Plug-in Status – the relationship between the stamp of the last plug-in save (shown in parentheses) and the stamp of the configuration.

If ConfigDateTime = Plug-inDateTime : Status is 'SYNCHRONIZED'

If ConfigDateTime = Plug-inDateTime : Status is 'MODIFIED'

If ConfigDateTime = Plug-inDateTime : Status is 'OUT OF DATE'

An identical or slightly modified configuration can be useful to perform an installation on other controllers or on another site. Here are the possible options to user various configurations:

Load – Opens a dialog box to select a configuration in a list of previously saved or imported configurations. The list is empty if no configurations were saved or imported.

Save_As – Opens a dialog box to save the current configuration and insert it in the current configuration list on the site. It is possible to create a new configuration or to overwrite an existing configuration by giving it the same name.

Delete – Opens a dialog box allowing the user to delete configurations included in the configuration list.

Import – Allows the user to transfer one or several configurations contained in a text file (created with the **Export** command) to the list of configurations available on the site. If a configuration with the same name already exists, the user can overwrite the existing version.

Export – Allows the user to transfer in a text file one or several configurations contained in the list of saved configurations. The possibility to export and import configurations allows the user to transfer configurations between various sites. Since the size of the text file is very reasonable, it is possible to copy the file on a floppy or to send it via modem to another site.

Report – Generates a complete report on the screen of the active configuration. The report can be redirected to a Windows-defined printer. We recommend that you print a configuration report and keep it with the rest of the secondary cooling system documentation.

5.2.3 Network Settings

This group displays several settings which determine the MPC controller's performance as a component of the LonWorks network. For regular users, these values are read-only (shaded fields), since a change without an extensive knowledge of the network configuration and setting signification can lead to a degradation of the controller and network performance. For this reason, users who log on with a SuperUser code (username + Dailycode) are the only ones who can change these settings:

Receive Heartbeat – If the controller doesn't receive an update for an input network variable, it considers that the message sender is absent from the network; consequently, it is desirable for security reasons to choose a default value on the process level.

Min Send Time – This setting is directly used to decrease network traffic due to the too frequent changes of the network variables. It is the minimum time between the transmission of two different values of a variable.

Max Send Time – If a network variable doesn't change during this period, the controller will send an update of the value to prevent that the nodes which aren't

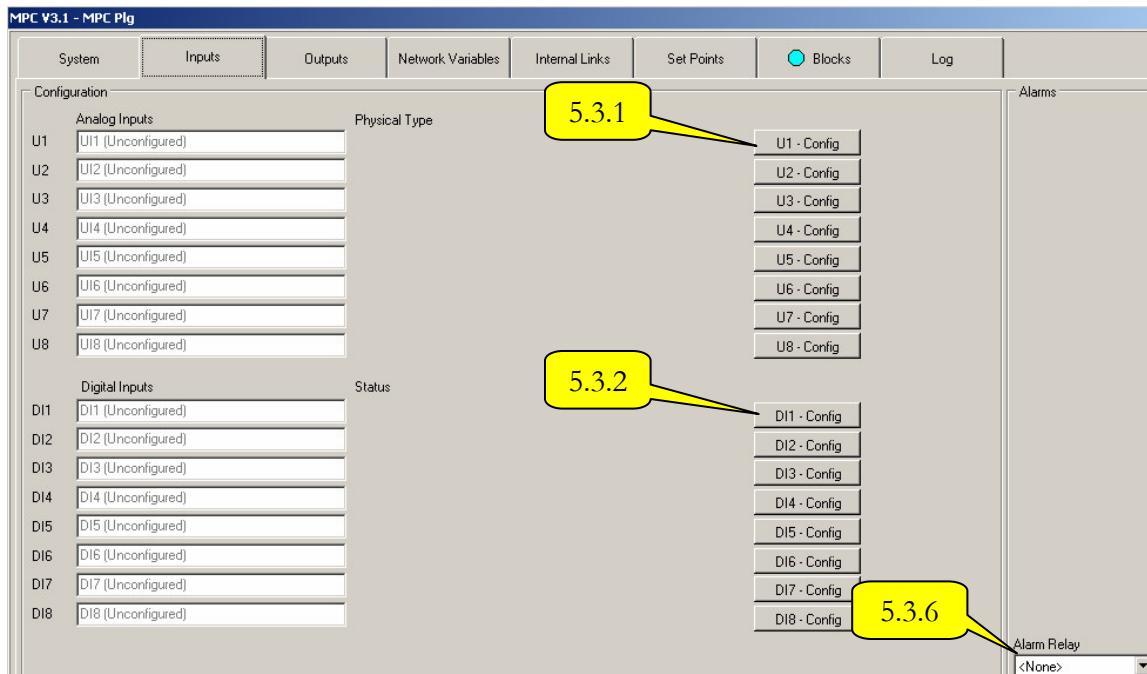
Multi-Purpose Controller (MPC) User's Guide

receiving updates consider the node as out and replace its values by default values. As you can see, there is a link between the node settings **Max Send Time** and **Receive Heart Beat**, which receives the controller updates:

Receive Heart Beat >= 3 * Max Send Time

Restore Defaults – Will reset all settings to their initial default value.

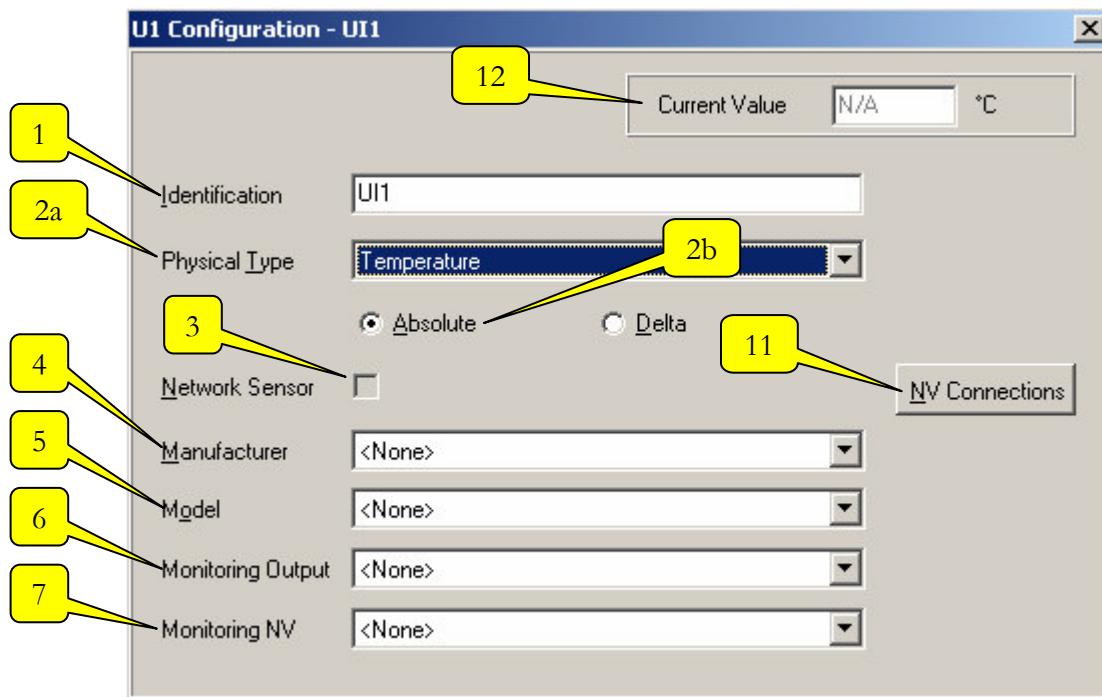
5.3 Input Tab



5.3.1 Analog Inputs

Analog Inputs (U1 to U8) – All analog inputs can be configured with an analog sensor or left without any sensor by choosing <None> in the **Physical Type** drop-down list (see Step 2) during the input configuration. Each input can be configured, whether for a physical sensor or for an SNVT from another node.

Input Configuration



To configure an input, proceed as follows:

1- Identification – Type the name of the sensor assigned to the process in the **Identification** field. (E.g.: Room Temperature) By default, the identification is the name of the variables. This name must be unique.

2a- Physical Type – Select the type of sensor that you wish to associate to the input in the drop-down list. (E.g.: Temperature)⁴

2b- Sensor Category – Select the sensor category by choosing between **Absolute** or **Delta** (differential).

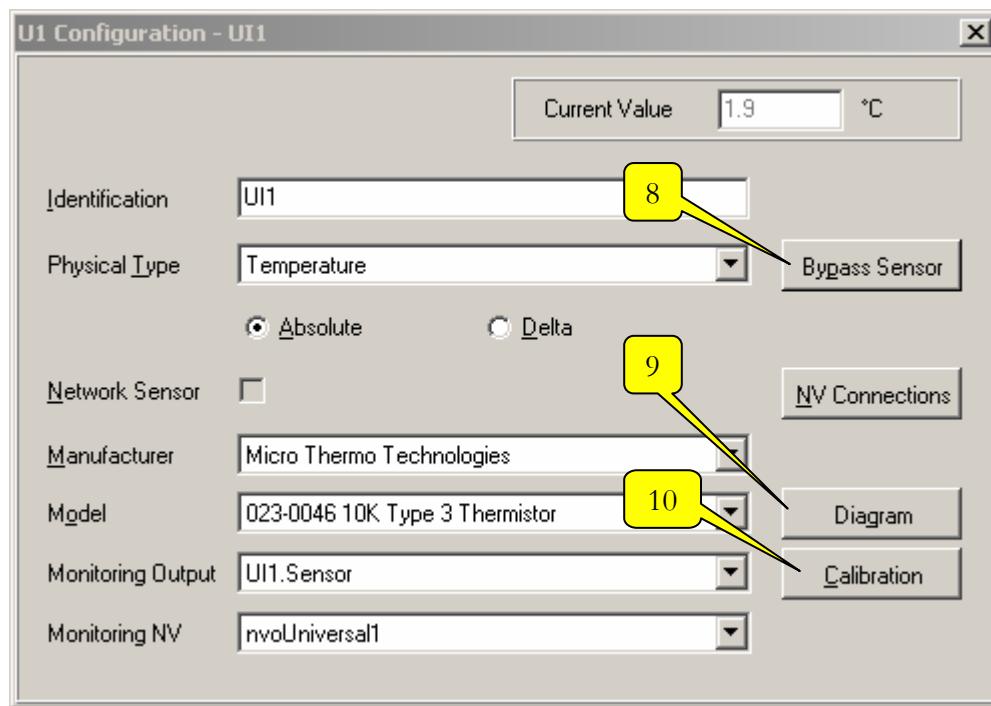
3- Network Sensor – If the sensor is present (physically connected to the MPC node), the check box will be empty. If the sensor comes from the network, i.e. physically connected to another node than the MPC and the network connection is established, the box will be checked.

4- Manufacturer – If the sensor is present, you must choose a manufacturer in this drop-down list. If the sensor comes from the network, i.e. physically connected to another node than the MPC, leave the drop-down list on **None** and establish the network connection.

⁴ See the list of sensor types supported by MPC on page 22

5- Model – When the user selects a sensor which is on an input and then selects a manufacturer, a list of types made by this manufacturer and compatible with the sensor will be displayed. Select the sensor model in the drop-down list.

Once the Manufacturer and Model lists are filled in, 3 buttons (8, 9 and 10) are added to the interface:

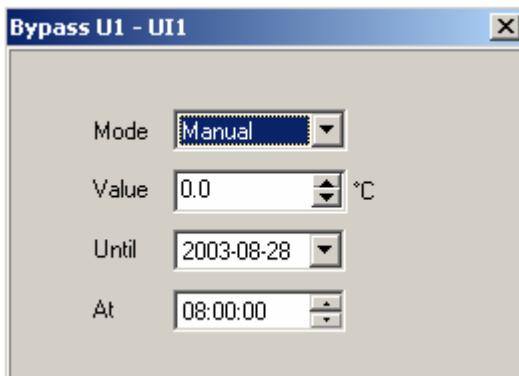


6- Monitoring Output – To establish internal links from the sensor, you must assign an internal output variable to it. You must choose among the following: 1- **Sensor** 2- **Mux** 3-**Universal**⁵

7- Monitoring NV – In order to establish network connections to other nodes, to Alliance (CustomPoint) or to the MPC plug-in (to see the values inside the plug-in), you must assign a network output variable to it. You must choose among the following: **nvoUniversalX (1-22)**

⁵ Refer to page 9 for the definition of each term.

8- Bypass Sensor



a) Mode

All analog inputs can reflect the sensor value or can be overridden to a specific value.

Auto – The analog input value matches the sensor value.

Manual – The analog input value matches the value entered in the **Value** field.

b) Value

Type the desired value in the field.

c) Until

Indicates the date on which the bypass will end.

d) At

Indicates the time at which the bypass will end.

9- Diagram

By clicking this button, you can view a diagram of the chosen sensor's connection with its electric connections.

10- Calibration

To correct an error between the actual value and the value read by the sensor, the technician can calibrate it by changing its origin shift (Offset). Calibration is an iterative operation which consists of comparing a measure with a standard value and eliminating the difference. After several iterations, the difference is so small that the values are considered as equal and the sensor is calibrated. Then, just click on the Done button to close the dialog box. To eliminate the value difference, use one of the following methods:

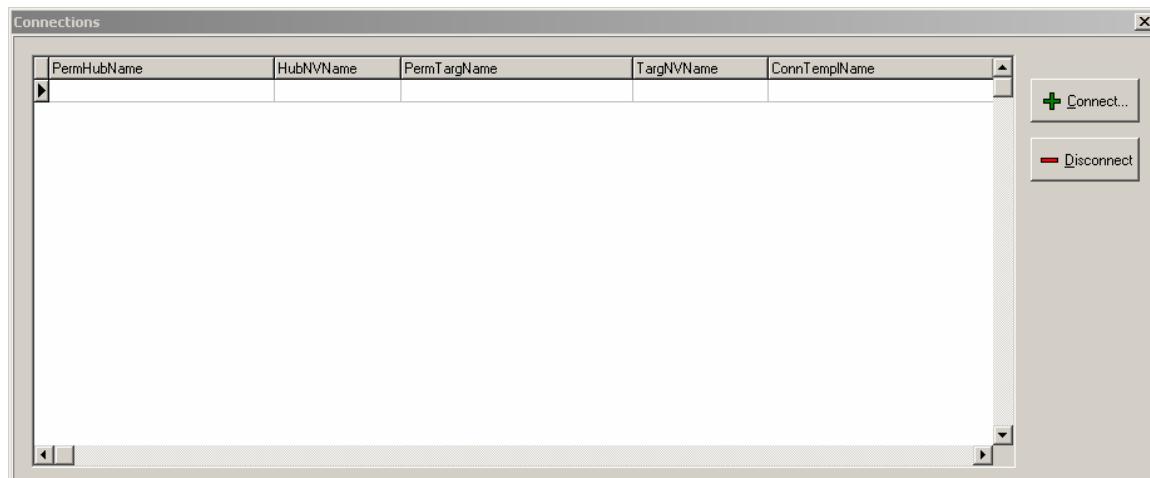
Set Calibration Value

- When entering the actual value and clicking the Apply button, the plug-in calculates the offset between this value and the one read by the sensor. The controller uses this result as a calibration and displays an update of the value read.

Set Offset

- It is possible that the sensor manufacturer provides the offset value. In this case, just enter this value to calibrate the sensor, then click the Apply button. Then, check that the offset is very small.

11- NV Connection – This button allows the user to establish network connections in the same way as in the Alliance-Network-NetworkConnection menu, but within the same plug-in.



12- Current Value – When the sensor is selected and all the settings are sent to the node, the value received by the node is displayed.

5.3.2 Digital Inputs

Digital Inputs (DI1-8)

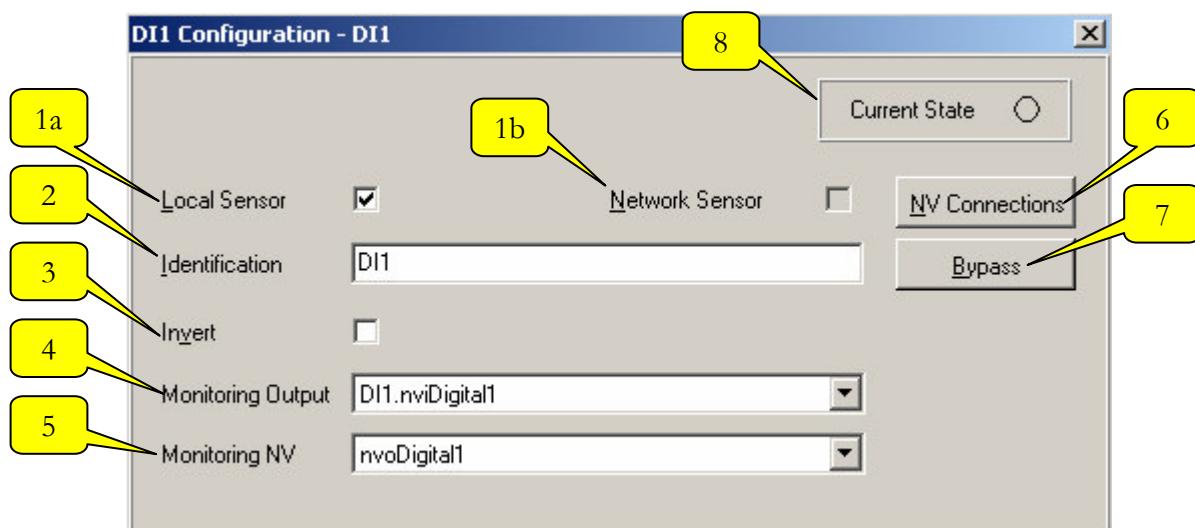
All digital inputs can be configured with:

1a- A (physical) digital sensor by selecting the **Local Sensor** box.

1b- A network sensor by leaving the **Local Sensor** box blank and by establishing the network connection, the Network Sensor checkbox will be selected.

Each input can be configured, whether for a physical sensor or for an SNVT from another node.

Input Configuration



2- Identification – Type the name of the sensor assigned to the process in the **Identification** field. (E.g.: Proof of operation of the hood). By default, identifications are the names of variables. This name must be unique.

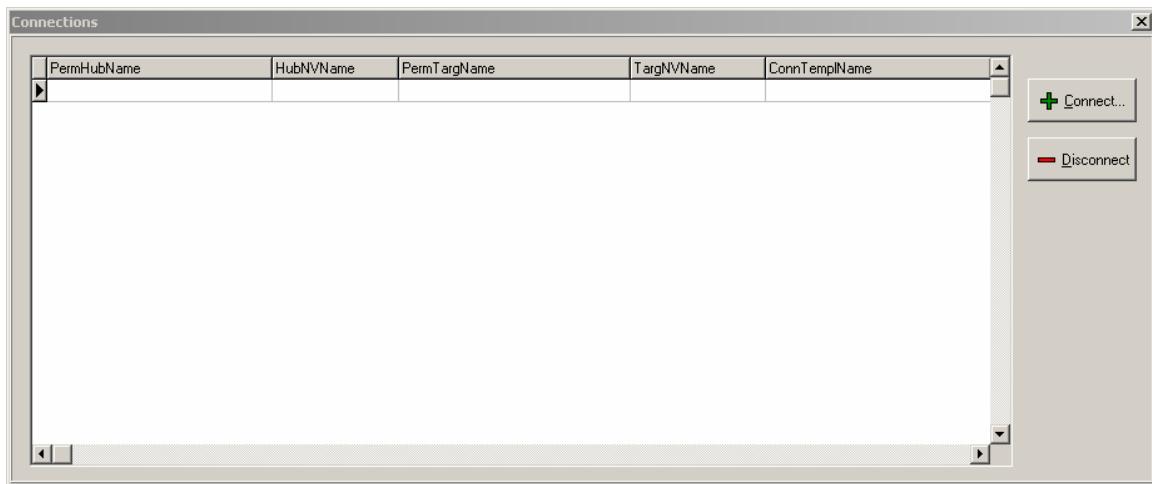
3- Invert – By checking this box, the switch position will be considered as logically inverted, which means that the controller will use the inverted position of the actual switch position. This affects the alarm logic, the network variable containing the sensor value and all the internal calculations based on this sensor value.

4- Monitoring Output – To establish internal links from the sensor, you must assign an internal output variable to it. You must choose among the following: 1- **Digital** 2- **Mux**.⁶

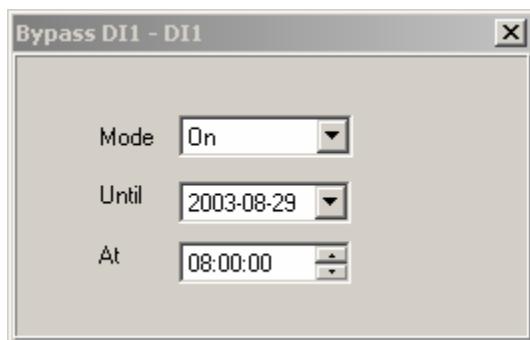
⁶Refer to page 9 for the definition of each term.

5- Monitoring NV – In order to establish network connections to other nodes, to Alliance (CustomPoint) or to the MPC plug-in (to see the values inside the plug-in), you must assign a network output variable to it. You must choose among the following: nvoUniversalX (1-22) or nvoDigitalX (1-8)

6- NV Connection – This button allows the user to establish network connections in the same way as in the Alliance-Network-NetworkConnection menu, but within the same plug-in.



7- Bypass



a) Mode

All the digital inputs can reflect the switch status, or can be overridden to a specific value.

Auto – the digital input value refers to the switch position (which can be affected by the **Invert**_check box).

On – the digital input is overridden to ON.

Off – the digital input is overridden to OFF.

b) Until – Indicate the bypass ending date.

c) At – Indicate the time at which the bypass will end.

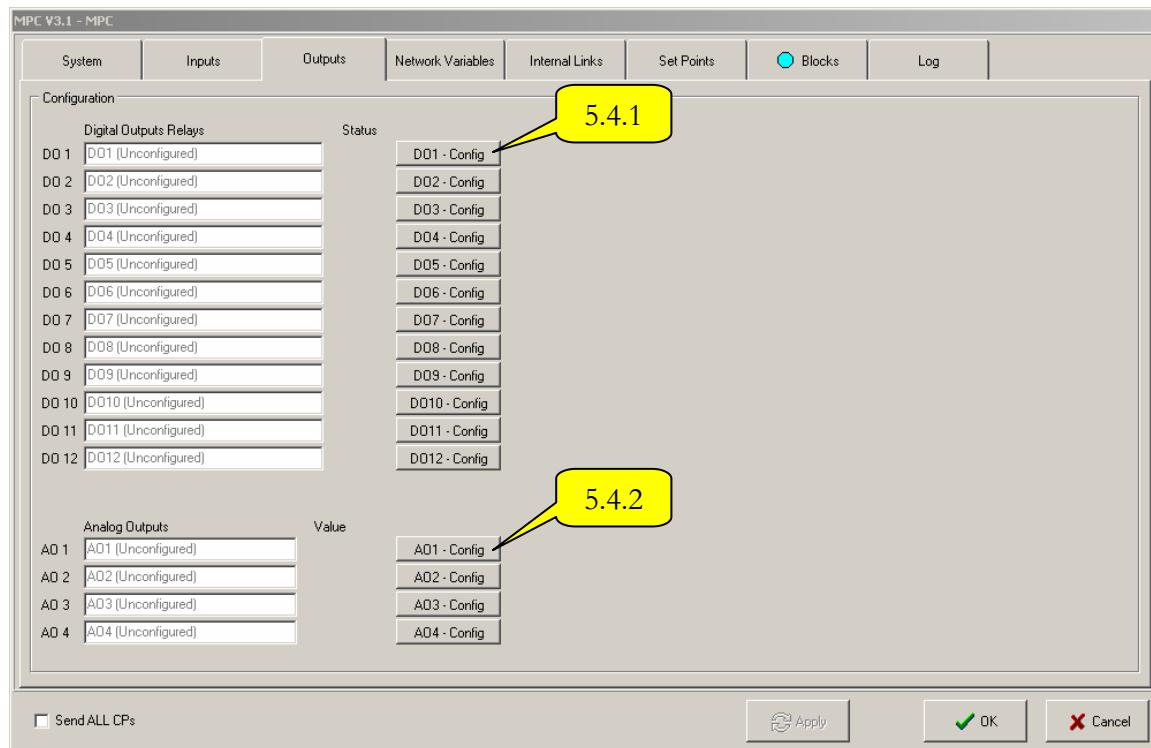
When the deadline arrives, the bypass mode ends and the controller returns to **Auto** mode. The bypass mode is indicated in blue in the background of the **DI x if no alarm is active_label**.

8- Current Value – When the switch is selected and all the settings are sent to the node, the value received by the node is displayed (which can be affected the **Invert** check box).

5.3.3 Alarm Relay

This drop-down list allows you to select the alarm node output that will be enabled when an alarm is triggered. You can select one or no output by selecting None if you don't want the alarms to be sent to your central.

5.4 Output Tab



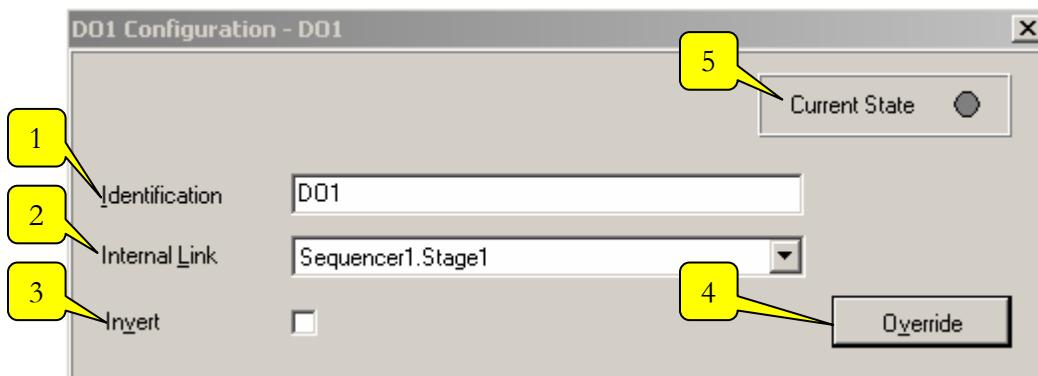
5.4.1 Digital Outputs

The user can select all the existing controls of the MPC system among the different possibilities while considering that the outputs are dedicated to:

Status – When the node has received its configuration settings, the output status is indicated:

- * **Yellow Circle** – Relay is enabled (ON).
- * **Grey Circle** – Relay is disabled (OFF).

Output Configuration

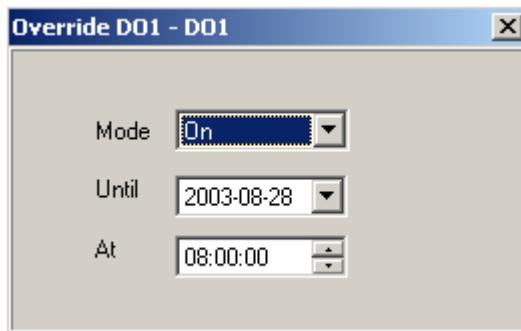


1- Identification – Type the name of the output assigned to the process in the **Identification** field. (E.g.: Heating Stage 1) By default, the identification is the name of the variables. This name must be unique.

2- Internal Link – In order to enable or disable the physical relay, an internal link⁷ must be established from the block output; to do so, you must make a selection in the drop-down list.

3- Invert – By checking this box, the relay position will be considered as logically inverted, which means that the controller will use the inverted position of the actual relay position.

4- Override



All digital outputs can receive an override command that will last for a determined time. In this case, the relay status will be determined by the override command and not by the controller's strategy. The available commands are:

a) Mode

Auto – The digital output is controlled by the strategy.

On – The digital output is overridden to ON for a specific time.

Off – The digital output is overridden to OFF for a specific time.

When the override command has a value other than **Auto**, two fields appear:

b) Until

– Indicates the interval ending date.

c) At

– indicates the time at which the interval will end.

When the deadline is reached, the output returns to **Auto** mode.

The bypass mode is indicated in blue in the background of the **DOx** label if no alarm is active and by a blue circle on the outputs tab.

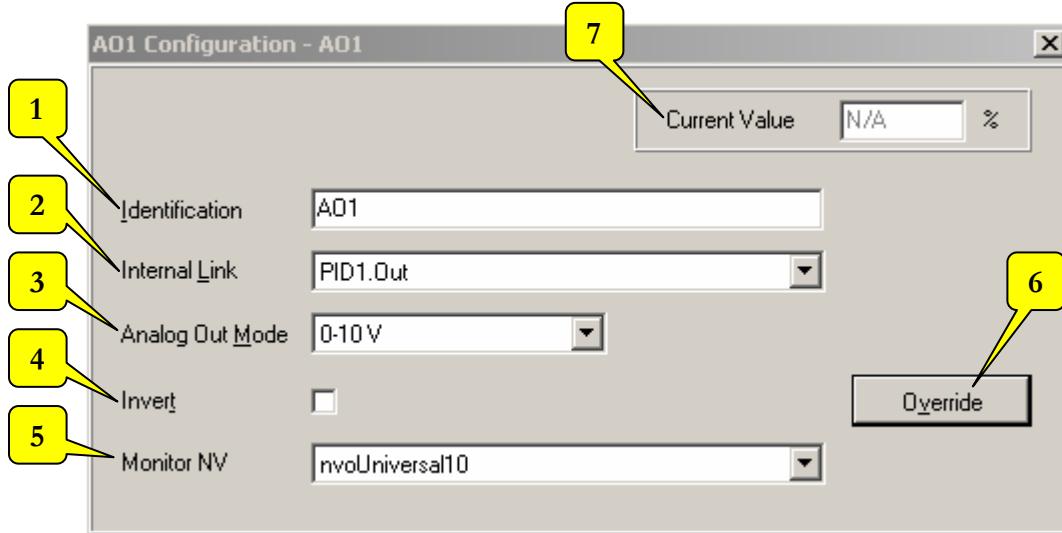
5- Current State – indicates the output actual position (which can be affected by the **Invert** check box).

⁷ The internal link established here replaces an internal link made from the Internal Link tab, a process that will be described later.

When the node has received its configuration settings, the output status is indicated by a:

- * **Yellow Circle** – Relay is enabled (ON).
- * **Grey Circle** – Relay is disabled (OFF).

5.4.2 Analog Outputs



1- Identification – Type the name of the output assigned to the process in the **Identification** field. (E.g.: Heating Stage 1) By default, the identification is the name of the variables.

2- Internal Link – In order to enable or disable the physical analog output (AO1-4), an internal link⁸ must be established from the block output; to do so, you must make a selection in the drop-down list.

3- Analog Out Mode – To complete the analog output configuration, you must select of the following in the drop-down list: 0-5V , 0-10V, 2-10V, 4-20mA.

4- Invert – By checking this box, the output position will be considered as logically inverted, which means that the controller will use the complement position to 100% of its range. E.g.: If the output is configured in 0-5V, typically: 100% = 5V; 0% = 0V; therefore 25% = 1.25V.

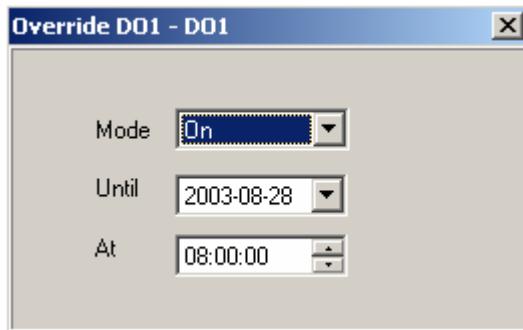
Inverted: 100% = 0V; 0% = 5V; therefore 25% = 3.75V.

5- Monitor NV – To establish network connections to other nodes, to Alliance (CustomPoint) or to the MPC plug-in (to see the values inside the plug-in), you must assign a network output variable to it.

You must choose among the following: **nvoUniversalX (1-22)**

⁸ The internal link established here replaces an internal link made from the **Internal Link** tab, a process that will be described later.

6- Override



All analog outputs can receive an override command that will last for a determined time. In this case, the analog output value will be determined by the priority command (**Override**) and not by the controller strategy (**Auto**). The available commands are:

Mode

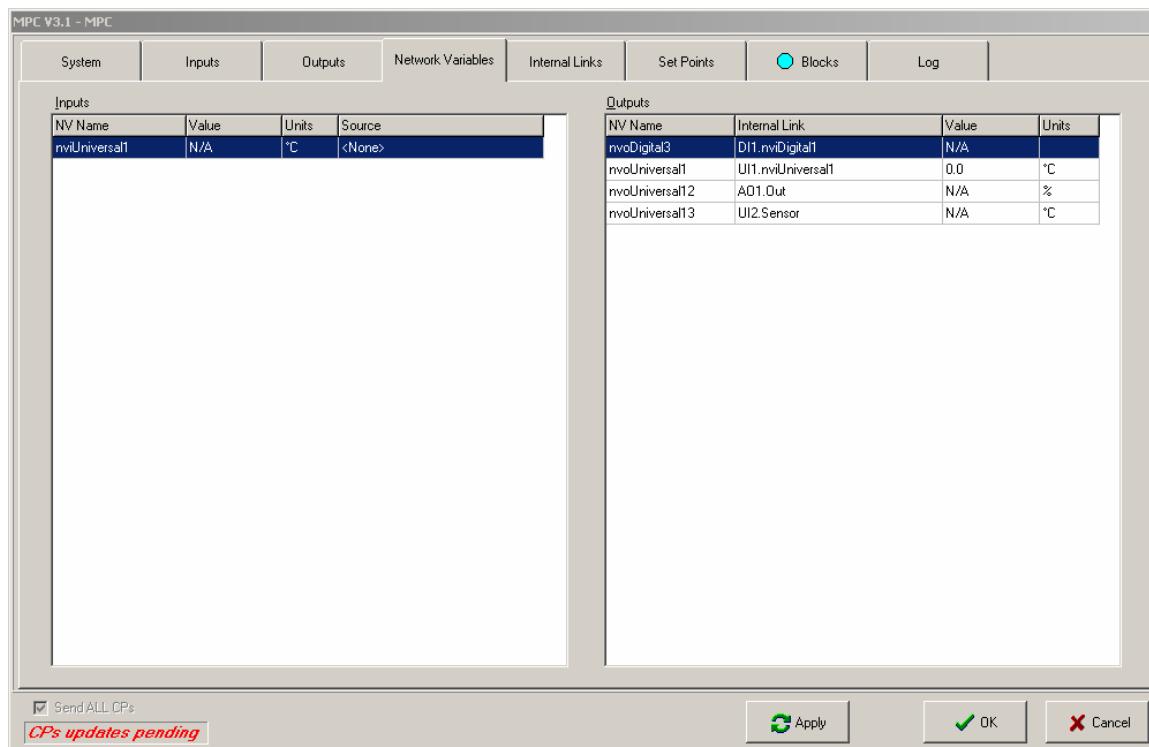
- a) **Auto** – The digital output is controlled by the strategy.
- b) **Manual** – The analog output is overridden to the **value** field value for a specific interval.
- c) **Value** – Allows the user to enter the priority command value (override). When the override command has a value other than **Auto**, two fields appear:
- d) **Until** – Indicates the interval ending date.
- e) **At** – Indicates the time at which the interval will end.

When the deadline is reached, the output returns to **Auto** mode.

The bypass mode is indicated in blue in the background of the **AOx** label if no alarm is active and by a blue circle on the outputs tab.

7- **Current Value** – indicates the output current value (which can be affected by the **Invert** check box).

5.5 Network Variables Tab

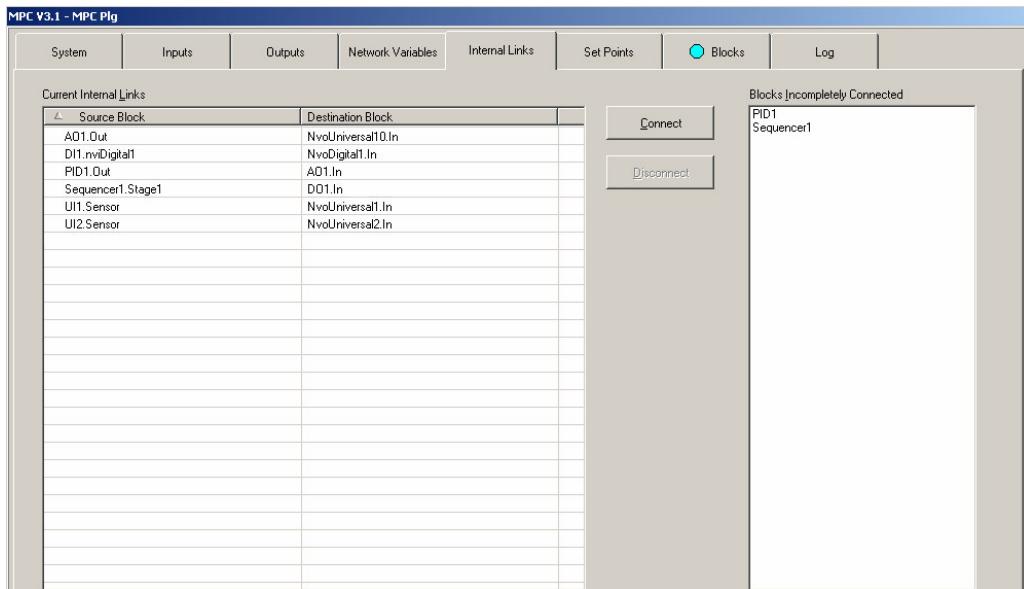


This page allows the user to view all input and output network variables from the MPC node. Here is a list of possible input and output variables:

Inputs: nviUniversalX(1-8), nviDigitalX(1-8), nviSetpoint(1-8)

Outputs: nvoUniversalX(1-22) , nvoDigitalX(1-8)

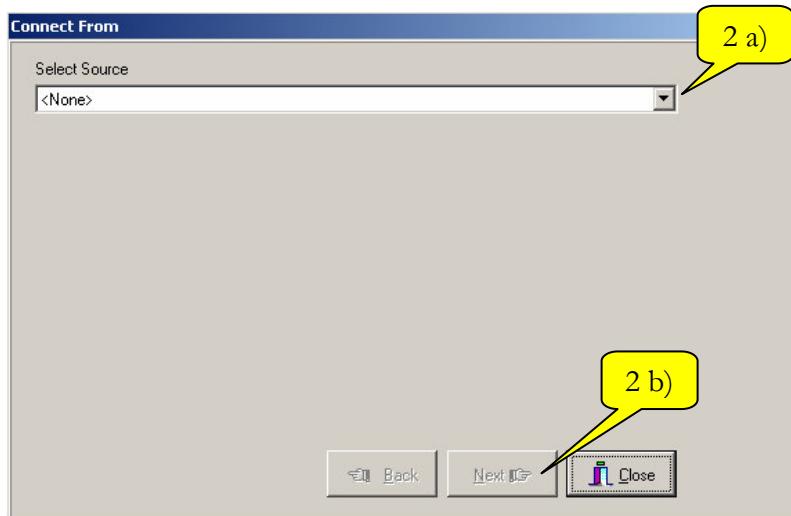
5.6 Internal Links Tab



This page allows the user to view all internal links already established (in the right pane), to make internal connections **(1)**, to disconnect existing internal connections **(2)** and to view blocks on which connections are missing that need to be completed.

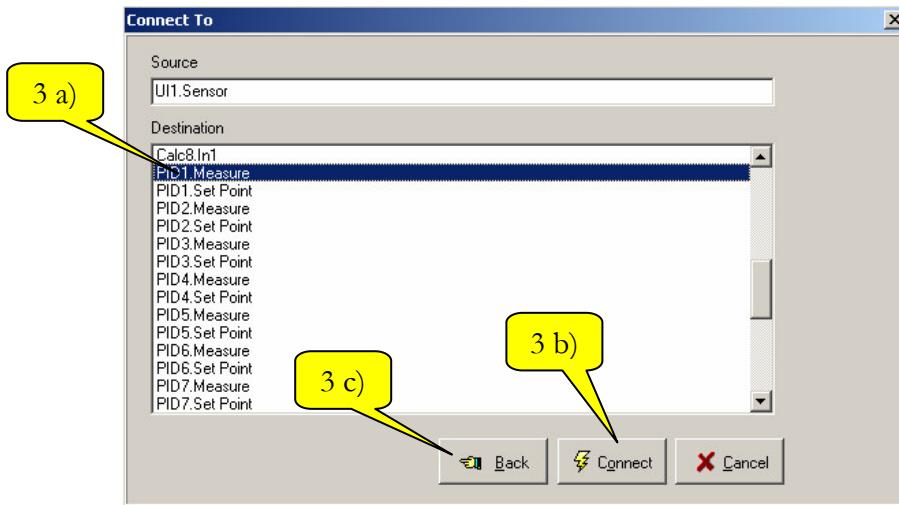
Connect – Connection is made in three simple steps:

1- When clicking the **Connect** button, the following window appears:



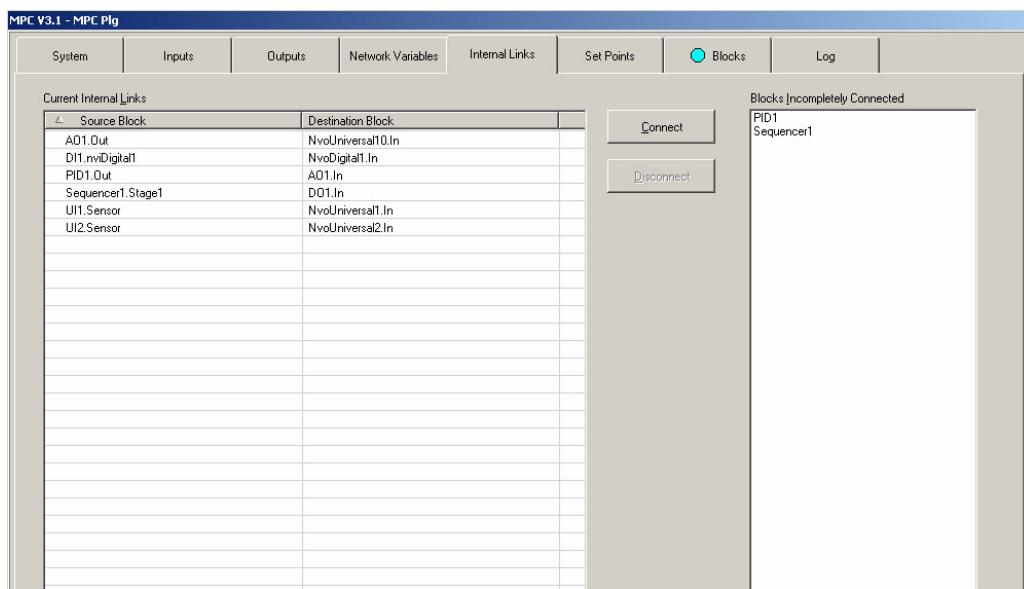
- 2-** Connect From
- Select your source variable in the **drop-down list**.
 - Press the **Next** button.

3- Your source variable now displays at the top of the page in the **Source** text field.



- a) Select your destination variable in the list of available variables compatible with your source variable by clicking on it.
- b) Press the **Connect** button.
- c) You can return and edit your source if you have selected the wrong source in the previous step.

Disconnect – You can disconnect any internal connection simply by selecting it in the left-hand list and by clicking on the **Disconnect** button.



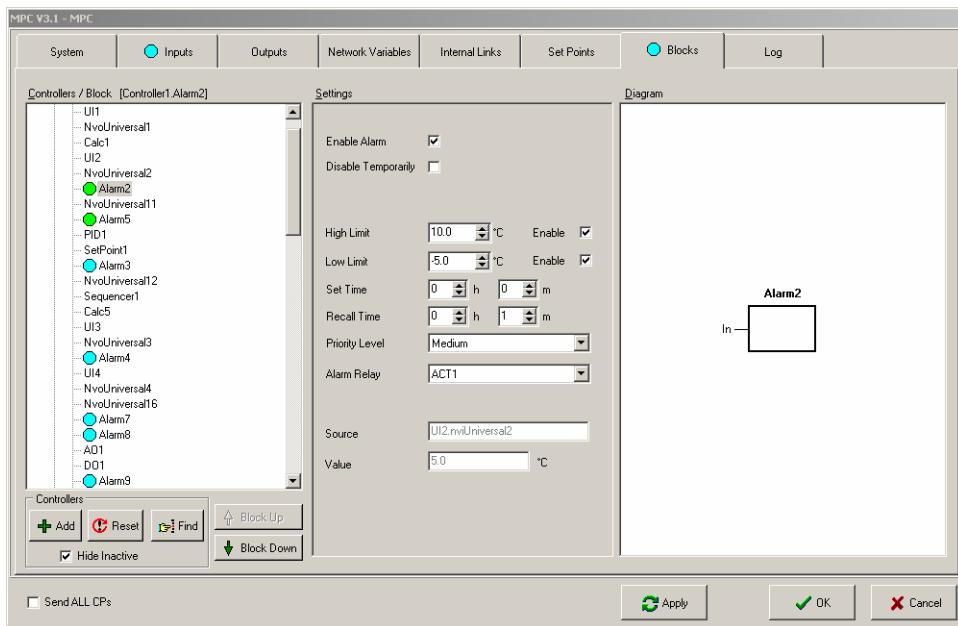
5.7 Setpoints Tab

	Value
Set Point 1	N/A
Set Point 2	N/A
Set Point 3	N/A
Set Point 4	N/A
Set Point 5	N/A
Set Point 6	N/A
Set Point 7	N/A
Set Point 8	N/A

This page allows the user to view all set points from the network (from another node or Alliance with a CommandPoint).

- 1- When the network connection is established with the MPC, a hyperlink allows you to access the Alliance command point without having to exit the plug-in.

5.8 Blocks Tab



The Block tab is made up of three windows. The following sections explain the operation of each window:

5.8.1 Controllers/Block

In the tree view, you can see each active block (with at least one internal link connected) in various controllers.

A controller contains all the blocks associated to the same process (blocks linked to each other).

All the blocks can be moved from one controller to another using the **Block Up** and **Block Down** buttons and you can add controllers.

5.8.2 Settings

This window allows you to view the configuration settings of each block by selecting them in the tree view (in the right pane) (See **2.7 Building Blocks**) for their specific settings.

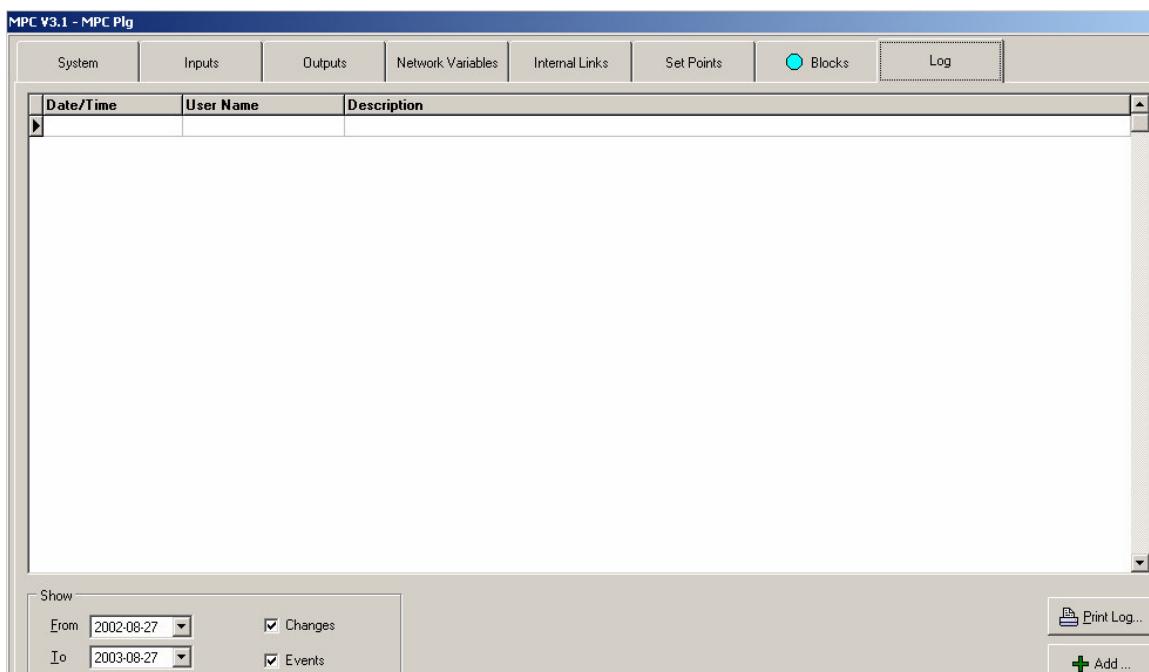
5.8.3 Diagram

This window contains a diagram of the selected block with its inputs and outputs. The block is drawn in black. The colour of inputs and outputs depends on the state of the block settings. When the connection (internal link) of the input or output is missing,

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the diagram (of the input or output) appears in red. When the connection is present, the diagram returns to black.

5.9 Log Tab



All the changes made to the plug-in are recorded in the log. For each change, the log records the date and time, the name of the user who logged in and the description of the change.

To view the log, the technician can select a time period, and/or different types of modifications (change or event type). He can also add an entry to the log. For tracking purposes, a report can be generated and printed.

6 MPC Project Methodology

Programs designed with the MPC should be considered as official programs and be submitted to the same process as standard R&D projects. The only difference is the people involved in the process (members of engineering and/or operations instead of R&D). The MPC is a software development tool in the same capacity as NeuronC or Visual Control for R&D, but it doesn't require any programming knowledge. This section details the application development methodology. These steps help the developer in the development process. This methodology also gives all the documents that need to be generated at the end of each step. This documentation is vital for the application support.

Here is a detailed description of each step:

6.1 General Process Diagram

- Mechanical drawing of the process
- Measure points of the process (analog, digital sensors)
- Control points (analog, digital actuators)
- Functional description of the various block in the process

6.2 Description of the process check sequences

6.3 Selection of the MT module (504-508-512)

6.4 Functional Profile Diagram

- Assigning physical inputs/outputs
- Description of physical inputs/outputs
- Assigning network variables
- Description of SNVTs (cross-reference)

6.5 Process Control Block Diagram

6.6 Programming the Process Control Block Diagram

6.7 Tests

6.7.1 Programme Laboratory Tests

6.7.2 Site Beta Tests (installation + performance)

6.8 TQC

6.8.1 Create BMP of the process for Alliance + Custom point

6.8.2 Sequence (Bloc) Diagram + Descriptions (process and variable)

6.8.3 Writing manual

7 Tutorial (Example of MPC Use)

Appendix 1 – Table of Possible Internal Links

Input/Output	Pid.Meas	Pid.Setpt	SwF.In1	SwF.In2	SwF.Sel	Calc.In1-8	Calc.In9-16	Seq.In	Seq.GemmaEn	AO.In	DO.In	NvDigital.In	NvUniversal.In	Alarm.In
Di.Mux		X	X	X		X		X		X	X	X	X	X
Di.nvDigitalX		X	X	X				X		X	X	X	X	X
Di.Switch		X	X	X				X		X	X	X	X	X
Setpoint.Out	X													X
Ui.Mux (Switch)		X	X	X				X		X	X	X	X	X
Ui.nvUniversal (Switch)		X	X	X				X		X	X	X	X	X
Ui.Sensor (Switch)		X	X	X				X		X	X	X	X	X
Ui.Mux (Analog except %)	X	X	X	X										X
Ui.nvUniversal (Analog except %)	X	X	X	X										X
Ui.Sensor (Analog except %)	X	X	X	X										X
Ui.Mux (Percent)	X	X	X	X										X
Ui.nvUniversal (Percent)	X	X	X	X										X
Ui.Sensor (Percent)	X	X	X	X										X
Pid.Out	X	X	X	X				X		X	X	X	X	X
Calc.Out (Digital)		X	X	X				X		X	X	X	X	X
Calc.Out (Analog except %)	X	X	X	X				X		X	X	X	X	X
Calc.Out (Percent)	X	X	X	X				X		X	X	X	X	X
SwF.Out (Digital)		X	X	X				X		X	X	X	X	X
SwF.Out (Analog except %)	X	X	X	X				X		X	X	X	X	X
SwF.Out (Percent)	X	X	X	X				X		X	X	X	X	X
Sequencer.Stage		X	X	X				X		X	X	X	X	X
Sequencer.Vernier	X	X	X	X				X		X	X	X	X	X
AO.Out	X	X	X	X				X		X	X	X	X	X
DO.Out		X	X	X				X		X	X	X	X	X

Legend:

Pid.meas = Pid.Measure
 Pid.Setpt = Pid.Setpoint
 SwF = SwitchFonction
 Seq. = Sequencer

Revisions History

REV	Description	Revised by	Date
1.0	English translation of the document (original French version : 71-GEN-0035)	MAC	23-oct-03
1.1	Translation Verification	JG	28-oct-03
1.2	Final verification	CBC / JRT	03-nov-03
1.3	Adjustments to the document to reflect changes brought to MPC module	JFB	TBD
2.0	Publishing	JG	TBD