

# Pneumatic Studio 2015



**Software  
for  
Industrial Automation**

## Section one: 2D Simulations

- **Pneumatic**
- **Electro-pneumatic**
- **PLC**

# **Pneumatic Studio 2015**

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## Introduction

The **Pneumatic Studio** program allows the user to draw **pneumatic circuits**, **electro-pneumatic circuits** and **PLC Ladder schemes**, and to test their functioning by means of **virtual simulation**.

The **Pneumatic Studio** program can be set up in **Italian** or in **English**.

The **electro-pneumatic** components can be installed on the screen in “**Europe**” or in “**US**” mode.

The **simulations** can be launched in the **standard** mode or **step by step**.

A **diagnostic system** blocks the simulation launch in the event of drawing errors made by the circuit, for example if a pneumatic valve is not fed.

Errors which do not hinder the simulation but which do not, however, allow the desired operation sequence, can be detected by the diagnostic system on request: for example there is a limit switch pneumatic valve with no corresponding cylinder limit switch reference in the drawing.

In the current **2015** version **pneumatic and electro-pneumatic circuits and Ladder schemes** can be saved on files with a “**.pn2**” file extension, so as the **2012** version.

In the last **2010** version **pneumatic and electro-pneumatic circuits and Ladder schemes** was saved on files with a “**.pn0**” file extension.

You can open files with “**.pn8**” or “**.pn0**” extension anyway, and save them with “**.pn2**” extension.

You cannot save files with “**.pn0**” extension.

More than 100 **pneumatic, electro-pneumatic and PLC solved problems** are attached to the complete version of **Pneumatic Studio** in the folder “**Files**”.

The **demo** version of **Pneumatic Studio 2015** contains the simulations of various demonstration files.

## The 3D simulation

Pneumatic Studio Program presents an important innovation: a section dedicated to robotics with 3D simulations of working isles made by **robots, feeders, conveyors, unloading stations**, and so on.

This innovation allows you at first to create in the 2D section pneumatic, electropneumatic, electric and PLC circuits and then to match any actuator of the circuits to an object of the 3D screen.


You will be able to make two simulation. The first allows you to check the pneumatic, electropneumatic or electric circuit in 2D screen. The second simulation shows you the movements of feeders, robots and conveyors in the 3D screen.

Naturally, the movements of the objects in the 3D screen will match exactly the movements of the related actuators in the 2D screen.



The description of this section of **Pneumatic Studio 2015** is the argument of the part second of the User Manual

## Files management


### New

By clicking on the button  the components on the screen are deleted, after being saved, if necessary.


### Save

The circuits obtained by installing the components on the screen can be saved on files with a “.pn2” extension. The buttons on the button menu to save a file are  (Save) and  (Save as).  
Note: you will save the objects of the 2D screen and of the 3D screen.


### Save selection

Only the selected components can be saved on files with a “.pn2” extension. The button on the button menu to save the selected components is  (Save selection).  
Note: you can do this operation only in the 2D screen.

### Open

A window enabling to open the previously saved “.pn2” files appears by clicking on the button  on the button menu.

### Import

By selecting the **Open** option, the components on the screen are deleted, after being saved, if necessary. By selecting the **Import** option, the components on the screen are not deleted and the components of the imported file are added to the already existing ones. The button to press is  (Import).

## Settings

### The language

The language can be set up in “**English**” or “**Italian**” from the drop-down menu. The menus, the panels, the windows and all diagnostic messages will be displayed in the set-up language. Select the option **Language** from the drop-down menu.

### The symbols of the electric components

The symbols of the electric components can be set up in “**Europe**” or in “**US**” mode from the drop-down menu. The drawings of the components on the screen, on the electric components panel and in the generation and modification windows of the components will be in line with the set-up mode.

Electric components panel in “**Europe**” mode.





Electric components panel in “US” mode.



From the drop-down menu select the option **Settings**.


## The grid

The grid can be activated by clicking on the button  (**Dots mode**) or on the button  (**Lines mode**).

The components, whose positioning is controlled by the Snap, are placed in the reference space shown on the grid.

The grid colours are automatically set up according to the screen colours.

## The Snap

The **Snap** mode can be set up as ON or OFF by means of the button .

Only the electric components not the pneumatic ones are controlled over by the **Snap**.

The electric components as well as the lines and the junctions can be set up as “**subjected to the Snap**”.

When the Snap mode is OFF the electric components, the lines and the junctions can be freely moved on the screen.

When the Snap mode is ON no shift related to the positioning can be performed on the electric components, on the lines and on the junctions which are “**subjected to the Snap**” that is, their position is imposed by Grid.



The operations to generate or modify the electric components make it possible to set up or remove the feature of being “**subjected to the Snap**”.


A line and a junction created through the electric components panel are set up as “**subjected to the Snap**”. This feature can be eliminated by modifying or editing the component.

A line and a junction created through the pneumatic components panel are set up as not “**subjected to the Snap**”. This feature can be set up by modifying or editing the component.

## The zoom

Six zoom levels can be created, ranging from zoom 1 with very small components to zoom 6 with very big components.

The components can be enlarged by clicking on the **zoom +** button  and can be reduced by clicking on the **zoom –** button .

All installed components can be displayed on the screen by clicking on **zoom all** button .

## The colours

The colours can be edited by clicking on the button  of the menu.

It is possible to edit the colours of the screen, of the mouse reference lines, of the selected and deselected components, of the pressure and of the discharged pneumatic lines together with the closed-circuit and open-circuit electric lines.

The colours of the grid are automatically set according to the screen colour.

### The reference lines of the mouse

The mouse reference lines can be visible or invisible.

From the drop-down menu select the options **View \ Reference Lines \ Cursor**.

### The reference lines of the drag panel

The references lines of the drag panel can be made visible while dragging a component in order to ease the positioning of a component in relation to the position of the others.

From the drop-down menu select the options **View \ Reference lines \ Component Drag**.

### The references lines of the lines

When a new line is created, in order to focus on the references in relation to the other components, a horizontal or vertical reference line is traced next to the cursor: if a vertical segment is traced the reference line will be horizontal, whereas the reference line will be vertical if the horizontal segment is traced.

From the drop-down menu select the options **View \ Reference Lines \ New Line**.

### The coordinates

It is possible to display or hide the **X-axis** and **Y-axis** coordinates ruler by selecting the options **View \ Coordinates** from the drop-down menu.

### The button menu

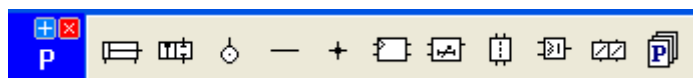
It is possible to display or hide the button menu by selecting the options **View \ Button Bar** from the drop-down menu.

## Components management

### Generation

The electric components as well as the pneumatic components can be generated by clicking on the panel buttons of the Electric and Pneumatic components panels respectively.

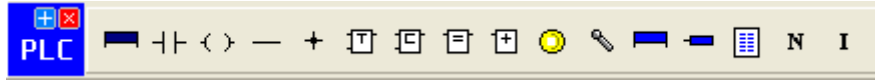
**Pneumatic components panel:**




**Electric components panel:**



**PLC components panel:**



The panel of the pneumatic components can be displayed or hidden by pressing the button .

The panel of the electric components can be displayed or hidden by pressing the button .

The panel of the PLC components can be displayed or hidden by pressing the button .

The lines and the junctions can be immediately positioned on the screen. As regards the other components, a window where to select the desired features becomes visible on the screen.


## Selection

A component can be selected by clicking on it with the left button of the mouse. Several non-adjacent components can be selected by clicking on them while holding the **SHIFT** button pressed.

Several adjacent components can be selected by clicking on a dot out of the screen, dragging the mouse and then releasing it when the broken frame has included all the components in question.


Note: in the 3D screen you may select only one object.

## Select all


All components can be selected by clicking on the button .

Note: you can do this operation only in the 2D screen.

## Edit

The features can be edited either by selecting the component and clicking on the button  or by clicking on the component itself with the right button of the mouse. A window to modify the features of the component then appears.


## Copy and Paste

One or more components can be copied and pasted first by selecting them, then by clicking on the button  and by dragging the frame towards the desired position, finally releasing the button of the mouse.

The “copied” **pneumatic and electric components** are given the same name as the “original” components with the addition of the underscore “\_”. For example a coil named “X”, when copied, will be named as “\_X”.


Note: the “copied” **PLC input and output components** are given the same name as the “original” components, there is no addition of the underscore “\_”.

## Cut and Paste

One or more components can be cut and pasted first by selecting them, then by clicking on the button  and by dragging the frame towards the desired position, finally releasing the button of

the mouse. Cut and paste means nothing but moving one or more components from one position to another.

## Delete

A component can be deleted either by selecting the component and clicking on the button  or by clicking on the component itself with the right button of the mouse. The option “Delete the component” must then be selected from the window that becomes visible on the screen.

## Undo and Redo


The last operation performed is undone by clicking on the button **Undo** .

The last undone operation is restored by clicking on the button **Redo** .

## Repeat last command

When the button “x” on the keyboard is pressed, holding down the button **ALT**, the last command performed is repeated (ex. A new line, a new junction and so on).

## Printing

When the simulation is not run, the circuit displayed on the screen can be printed by clicking on the button : the limit switch pneumatic valves will always be displayed as “**not commutated**”.

When the “**normal**” simulation is performed the print button is **disabled**.

When the “**step by step**” simulation is performed the print button is not **disabled**: this enables to print the limit switch pneumatic valves in the relative simulation phase as **commutated** or **not commutated**.

## Recommended requirements for the installation

- Operating system: Windows 8, Windows 7, Windows Vista, Windows XP.
- Processor: 1,81 GHz or over
- Ram: 1,25 Gb minimum

Note: Pneumatic Studio can run with less resources, but more slowly.

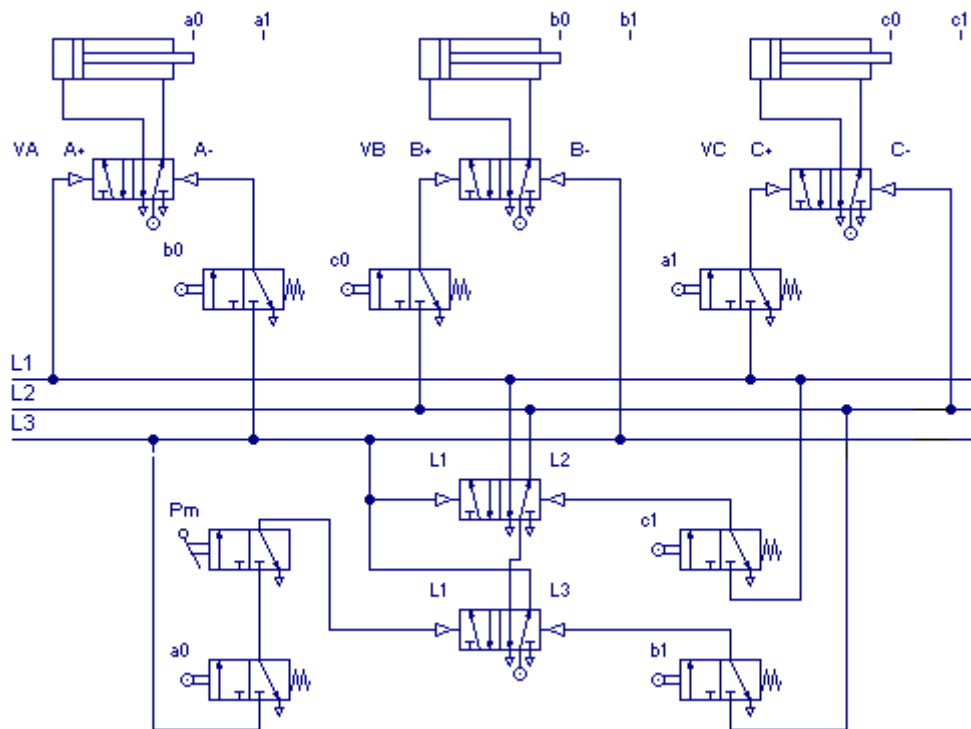
## Credits

**Pneumatic Studio** has been devised and created by **OmegaSoftware** of Dr Eng. G. Aversano.


[www.machinesimulator.com](http://www.machinesimulator.com) [info@machinesimulator.com](mailto:info@machinesimulator.com)

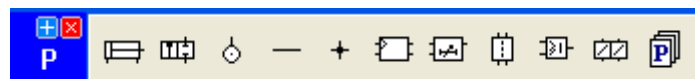


## Part 1. Pneumatic



### Components management

The panel of the pneumatic components can be displayed or hidden by pressing the button .



You can **create a pneumatic component** by clicking on the panel buttons of the Pneumatic components.


The lines and the junctions can be immediately positioned on the screen. As regards the other components, a window where to select the desired features becomes visible on the screen.

You can **modify a pneumatic component** by clicking the same component with the right button of the mouse: an Edit window will appear.

To **erase a pneumatic component** select the component and then press the button **CANC** on the keyboard of the computer.


### Texts



In addition to pneumatic and electric elements, texts can also be displayed on the screen.

A window that allows the user to type a text and select the style, the dimensions and the colours of the letters appears by pressing the button .

You can choose to show the text only in the 2D screen, only in the 3D screen or in the 2D and in the 3D screen.

### To create a Line

- Press the button  of the electric components panel or that of the pneumatic components panel: the cursor will change from “arrow” to “hand”.
- Click (press and release) the **left** button of the mouse to start the drawing of the line.
- Move the mouse without press any button.
- Click (press and release) the **left** button of the mouse to break the line: every time you click the **left** button of the mouse you draw a segment of the line.
- If you want to finish the drawing of the line click the **right** button of the mouse.

If the button  of the **pneumatic** components panel  is pressed the line will be automatically set up as “**not subjected to the Snap**”.



Every time the left button of the mouse is pressed the line bends. The line segments can be vertical or horizontal, they can not be inclined. If the right button of the mouse is pressed the line is interrupted.

The lines are created in the “**continuous**” style. In the editing phase it is possible to change the line style into “**broken**”. In this phase the feature “subjected to the Snap” can be set up or left out.

**The lines drawn in the simulation phase can function indistinctively as electrical or pneumatic lines.**

### Creation of the pressure sources

Press the button  of the pneumatic components panel. The pressure source symbol can be a triangle or a circle with a dot in the middle.

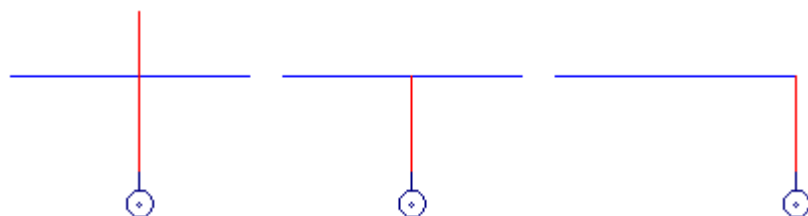
By clicking with the right button of the mouse on the button  of the pneumatic components panel, it will change to , and vice versa. The pressure source will be created with the symbol in use at that moment. In the editing phase it is possible to switch from one symbol to another.

### How to use junctions

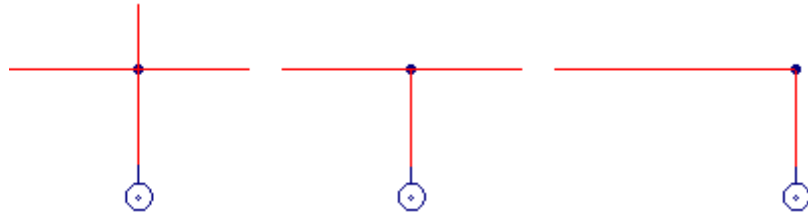
In the following examples we'll show you how to use junctions in pneumatic circuits. The under pressure lines are **red**, the flat lines are **blue**.

Note: the component positioned at the end of a line don't need any junction, it is connected with the line automatically.

Lines not connected through junctions:



Lines connected through junctions:



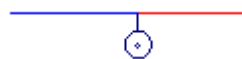
Pressure source and line not connected through junction:



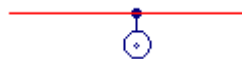
Pressure source and line connected through junction:



Pressure source and two lines not connected through junction:



Pressure source and two lines connected through junction:



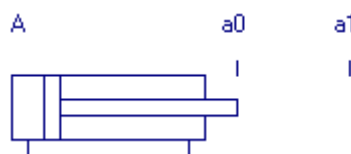
## Cylinders

You can create simple acting or double acting cylinders.

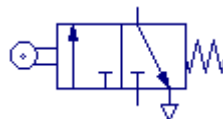
## Limit Switches

Whenever you create a cylinder, for example named “A”, you must assign the names to the limit switches, for example “a0” and “a1”.

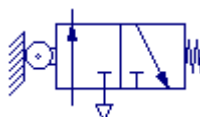
The cylinder is automatically drawn with his limit switch references and, if you want, with the limit switch names.



You can give to a limit switch reference the name of a pneumatic “limit switch type” valve

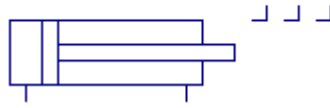



Note: When you install a pneumatic “limit switch type” valve the program draws it without the mechanical contact. During the simulation if a pneumatic limit switch valve is not activated the program draws it without the mechanical contact, on the contrary the program draws it with his mechanical contact:



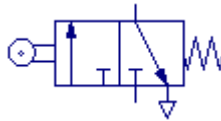
## Sensors

When you install or modify a cylinder you can install one, two or three pneumatic sensors. The program will draw the cylinder with his sensor references:



Note: Of you want to see on the screen the name of the sensor reference you have to add a text (press the button  ).





You can give to a pneumatic sensor reference the name of a “limit switch tipe” pneumatic valve:







## Distribution valves

If you create a pneumatic distribution valve you can choose the number of positions (2 or 3), the number of ports (2, 3, 4 or 5), the type of the left control (pneumatic, button or lever) and the type of the right control (pneumatic, spring or lever).

## The simulation

The simulation can be run in “**normal**” mode by clicking on the button  (which turns into  ) or “**step by step**” by clicking on the button  (which turns into  ). When the simulation is run step by step it proceeds by continuously pressing the button **ENTER**.

The user interacts with the simulation by clicking on the buttons and on the levers of the pneumatic, electro-pneumatic and electric components.

To interrupt the **normal simulation** press the button  (which turns into  ), to interrupt the **step by step simulation** press the button  (which turns into  ).

In the simulation, the drop-down menu and the button menu are disabled except for the **zoom +** e **zoom -** buttons.

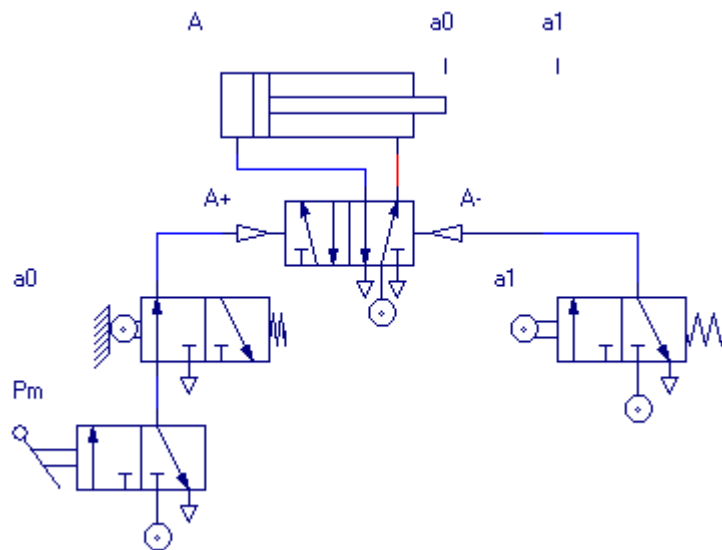
**Attention. In the step by step simulation the functioning of the timers is inevitably distorted.**

In the simulation **two different colours** are used to draw the discharged pneumatic lines and the pressure pneumatic lines.

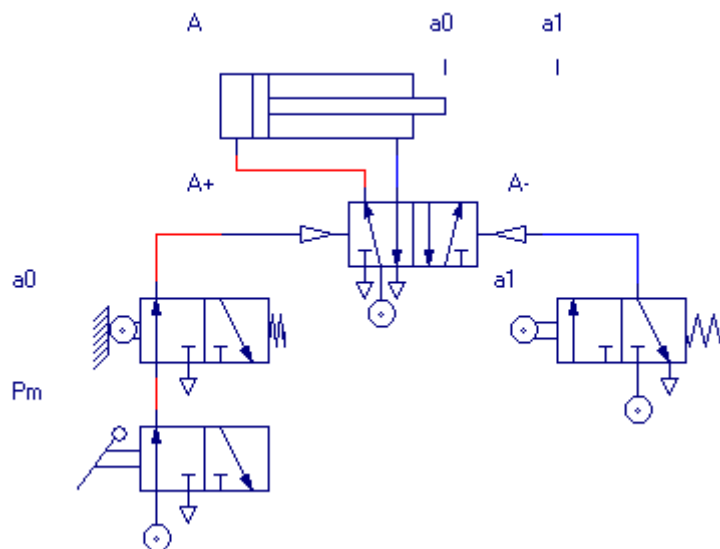
In the simulation the same pressure is exerted on all charged pneumatic lines. As a consequence, the valves, whose functioning depends on the air pressure value (like the pressure regulator) and those altering the air pressure value (like the throttles) will filter out the pressure air, as a simple open valve does. For further details read the section **Pneumatic graphic symbols**.

Let's see the simulation of a simple pneumatic circuit, **A+ A-**.

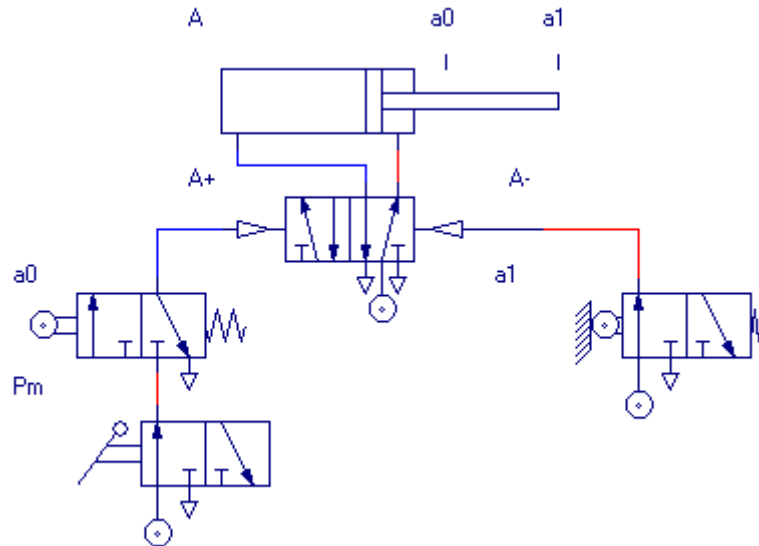
If the starter pneumatic valve is not pressed the cylinder is in the negative position, the limit switch “a0” is activated and the limit switch “a1” is not activated.



When you press the starter the compressed air comes to the left acting “A+” of the distribution valve “VA”, then this valve will send the compressed air to the positive chamber of the cylinder. The cylinder will execute the positive stroke.



When the cylinder arrives at the stroke end it activates the pneumatic limit switch “a1”.

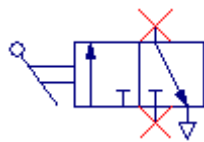


The limit switch “a1” sends the compressed air to the right acting “A-“ of the pneumatic valve “VA”. This valve will send the compressed air to the negative chamber of the cylinder. The cylinder will execute the negative stroke.

### The diagnostic analysis

When the simulation is run the program checks that all components are connected to the lines or to the power or pneumatic supply.


If one or more components are not connected, the simulation is not run: the item to correct is indicated by a cross and a notice message is delivered.




The simulation is, instead, allowed to run if there are some lines with disconnected terminals (as is usually the case with electric circuit drawings).

The crosses can be erased by clicking on the **redraw** button .

The simulation may not run as desired either due to wrong logic applied in order to connect the components (in this case the diagnostic analysis is of no use) or for other reasons: for example because two lines have not been connected through a junction or because the limit switch reference of a cylinder has neither a corresponding pneumatic valve nor a corresponding electric contact, or because a coil has no corresponding electric contact, or because a solenoid of an electric circuit does not have any electro-pneumatic valve with the same left or right name and so on.

To resort to the diagnostic analysis press the button .


## Printing

When the simulation is not run, the circuit displayed on the screen can be printed by clicking on the button : the limit switch pneumatic valves will always be displayed as “**not commutated**”.

When the “**normal**” simulation is performed the print button is **disabled**.

When the “**step by step**” simulation is performed the print button is not **disabled**: this enables to print the limit switch pneumatic valves in the relative simulation phase as **commutated** or not **commutated**.

## Reports

A window showing the list of the components of the circuit displayed on the screen becomes visible by clicking on the button  of the menu.

At the user's discretion, the following options are shown for each component: **Amount, Unit price, Total price, Supplier and Note**.

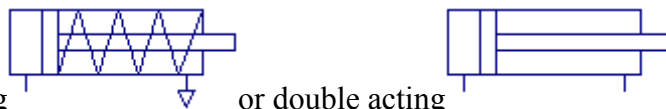
The user can also enter the approximate length of the air tube and of the electric wire used.

The **total expenditure** of the circuit components is shown.

By clicking on the button “**Manage records**” a window appears where the user can enter, for each component, the **unit price**, the **supplier** and any **notes**: by clicking on the button “**Confirm changes**” the entered data will be stored by the program and will be available each time the program is launched.

## Pneumatic Components

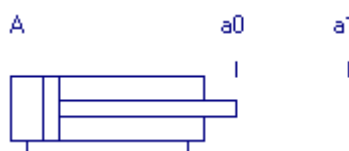
### Cylinders



- **Type**: single acting or double acting
- **Orientation**: to the four directions of the plane
- **Speed**: adjustable
- **Limit switches**: two (pneumatic or electric)
- **Sensors**: three (pneumatic or electric)
- **Labels**: cylinder name and limit switches name

### Limit switches

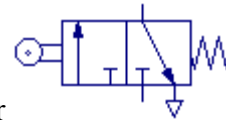
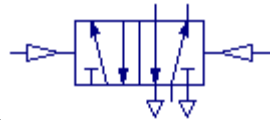
The limit switches may be considered pneumatic or electric, you must not specify the type to the program.



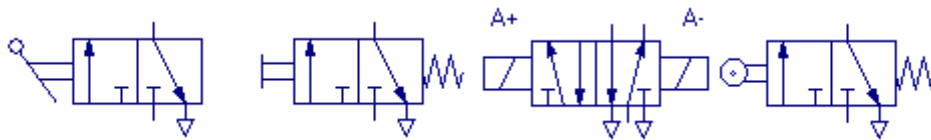
## Sensors

The sensors can be selected pneumatic or electric: you must specify the type to the program.

## Valves ( 2 positions )



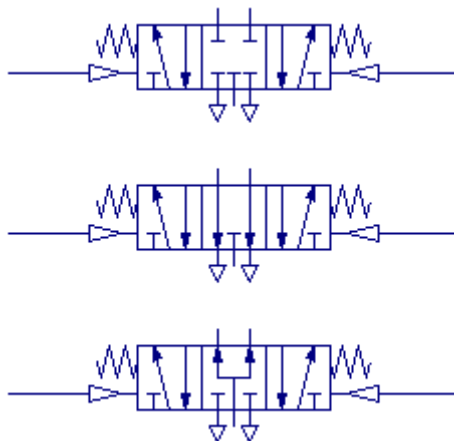
- **Type:** distribution or limit switch / sensor
- **Orientation:** to the four directions of the plane
- **Ports:** 2, 3, 4, 5
- **Positions:** 2
- **Configurations:** 2
- **Left acting:** lever, pneumatic, electric, button, roller
- **Right acting:** lever, pneumatic, electric, spring



- **Labels:** valve name and actings name

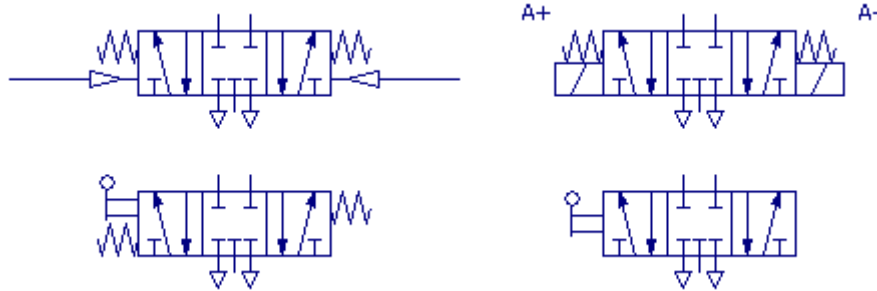
## Valves ( 3 positions )

- **Type:** distribution
- **Orientation:** to the four directions of the plane
- **Ports:** 3, 4, 5
- **Positions:** 3
- **Types:** closed ports, opened ports, under pressure ports





- **Actings:** pneumatic with springs, electric with springs, lever with springs, lever





- **Labels:** valve name and actings name

## Pressure sources

- **Symbol:** triangle  or circle 
- **Orientation:** to the four directions of the plane

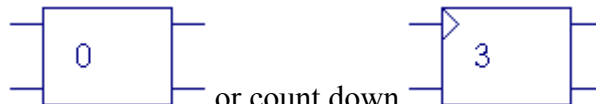
## Lines

- **Type:** continuous or broken

## Junctions

•

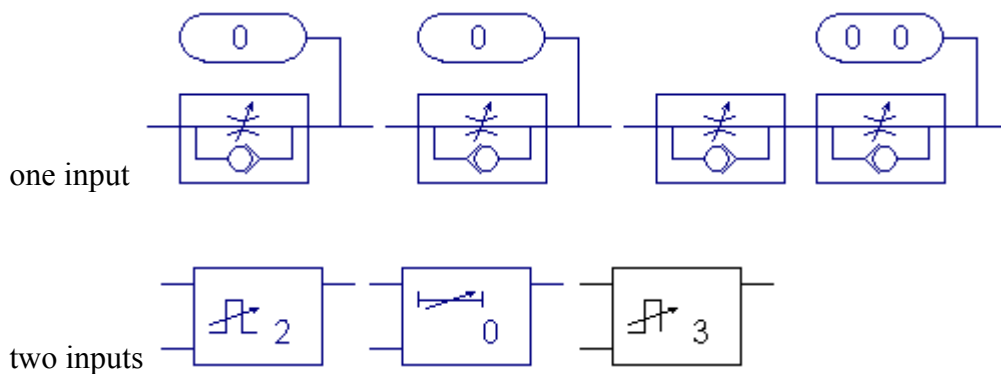
## Counters



- **Type:** count up or count down
- **Orientation:** to the four directions of the plane

## Timers

- **Type:**

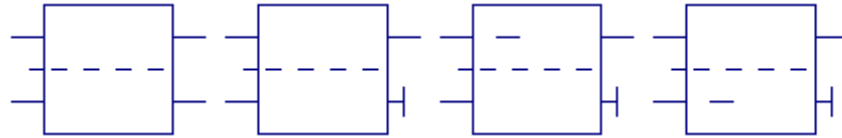


- **Orientation:** to the four directions of the plane for the “two inputs” type
- **Delays:**

one input type: on, off, on/off  
two inputs type: on, off, single shot

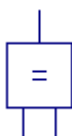
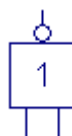
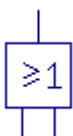

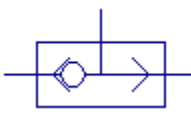
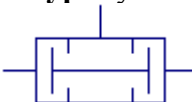
## Memories

- **Type:** Two outputs or one outputs (simple, set prevalent an reset prevalent)



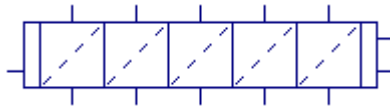
- **Orientation:** to the four directions of the plane

## Logic units

- **Type:** yes , not , or , and ; pneumatic or , pneumatic and 

- **Orientation:** to the four directions of the plane


## Sequencers



- **Max modules:** 30

- **Orientation:** to the four directions of the plane

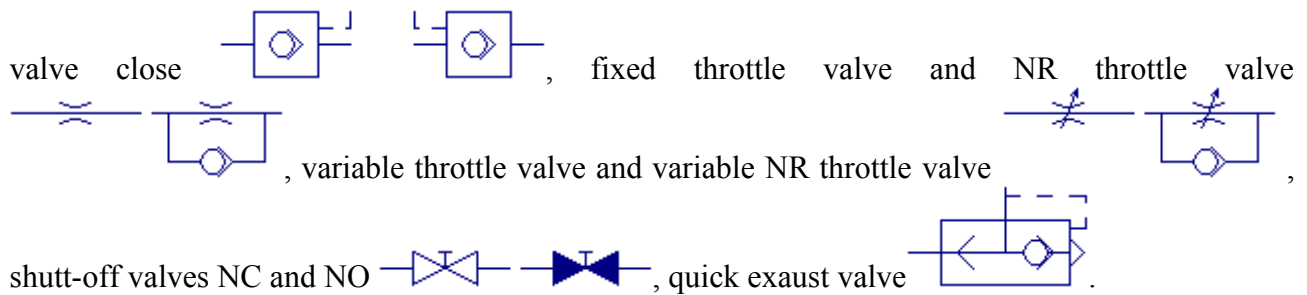
## Pneumatic graphic symbols

A window that allows the user to choose the pneumatic graphic symbols to be installed on the screen opens by clicking on the button  of the pneumatic components panel.

The pneumatic graphic symbols are divided into the following categories: **flux regulators**, **pressure regulators**, **accessories**, **compression station**.

## Flow controls

- **Components:** check valve , pilot-operated check valve open and pilot-operated check



- **Orientation:** to the four directions of the plane.

- **Simulation:** The NC and NA shut-off valves are regulated by the simulation and function as their real counterparts. Moreover, by clicking on the NA and NC shut-off valves they switch to an open or to a closed state.

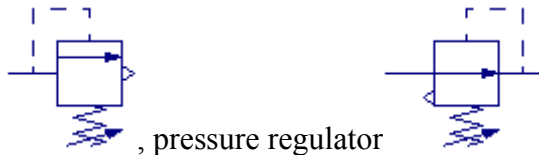
The check valve is regulated by the simulation and function as its real counterpart.

The quick exhaust valve is regulated by the simulation and function as its real counterpart.

Pilot-operated check valve open and pilot-operated check valve close are regulated by the simulation and function as their real counterparts.

The throttle valves are not regulated by the simulation, they function as open valves.

## Pressure controls

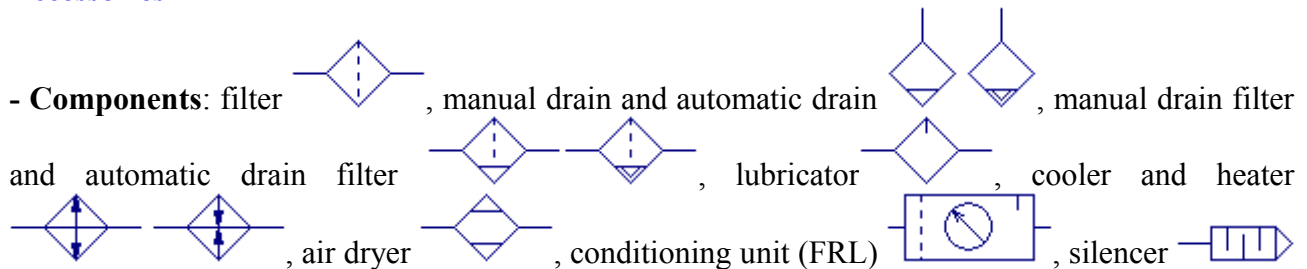


- **Components:** pressure relief valve , pressure regulator

- **Orientation:** to the four directions of the plane.

- **Simulation:** these components are not regulated by the simulation. The pressure relief valve functions as closed valve, the pressure regulator functions as open valve.

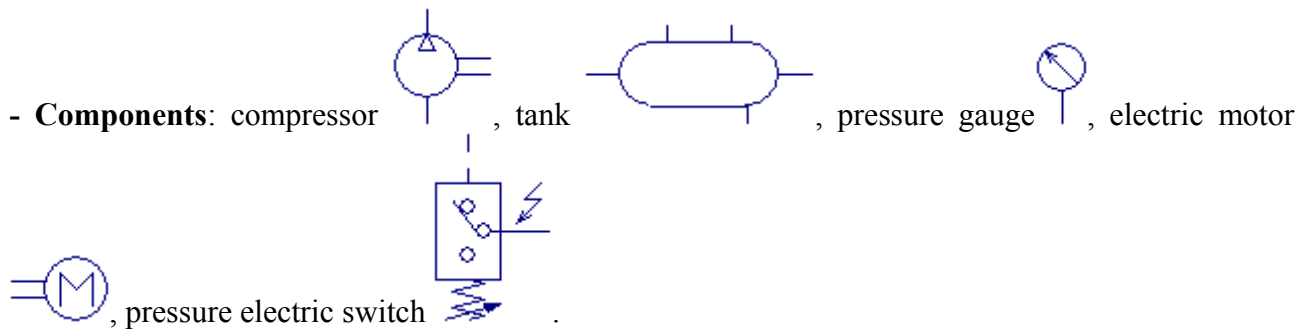
## Accessories



- **Orientation:** to the four directions of the plane.

- **Simulation:** these components are not regulated by the simulation. Manual drains, automatic drains and silencer functions as closed valves, the other components functions as open valves.

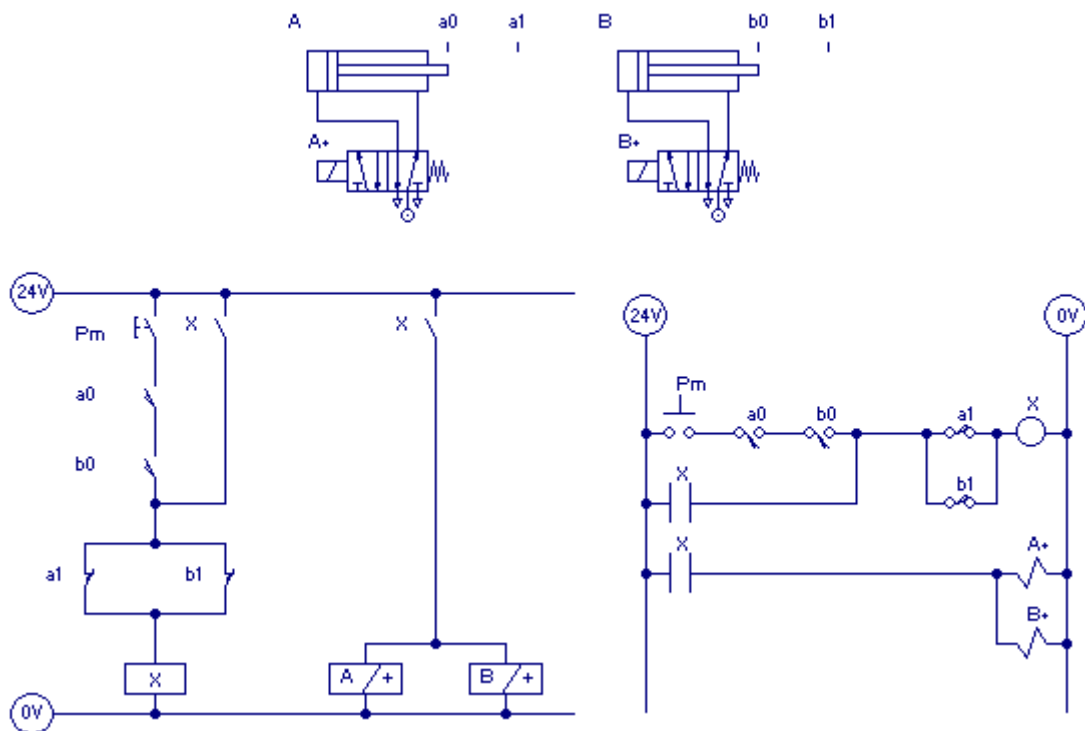
## Compression station




- **Orientation:** to the four directions of the plane.

- **Simulation:** the compressor and the tank are regulated by the simulation. The compressor functions as a pressure source, the tank functions as open valve. The other components are not regulated by the simulation.

## Part 2. Electropneumatic



## Components management

The panel of the pneumatic components can be displayed or hidden by pressing the button .




You can **create an electric component** by clicking on the panel buttons of the Electric components. The lines and the junctions can be immediately positioned on the screen. As regards the other components, a window where to select the desired features becomes visible on the screen.


You can **modify an electric component** by clicking the same component with the right button of the mouse: an Edit window will appear.



To **erase an electric component** select the component and then press the button **CANC** on the keyboard of the computer.

### Texts

In addition to pneumatic and electric elements, texts can also be displayed on the screen. A window that allows the user to type a text and select the style, the dimensions and the colours of the letters appears by pressing the button .

### To create a Line

- Press the button  of the electric components panel or that of the pneumatic components panel.
- Click (press and release) the **left** button of the mouse to start the drawing of the line.
- Move the mouse without press any button.
- Click (press and release) the **left** button of the mouse to break the line: every time you click the **left** button of the mouse you draw a segment of the line.
- If you want to finish the drawing of the line click the **right** button of the mouse.

When the **Snap** is “ON”, if the button  of the **electric** components panel  is pressed the line will be automatically set up as “**subjected to the Snap**”.

The cursor will change from “arrow” to “hand”. Every time the left button of the mouse is pressed the line bends. The line segments can be vertical or horizontal, they can not be inclined. If the right button of the mouse is pressed the line is interrupted.

The lines are created in the “**continuous**” style. In the editing phase it is possible to change the line style into “**broken**”. In this phase the feature “subjected to the Snap” can be set up or left out.

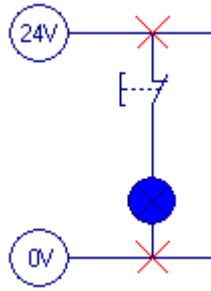
**The lines drawn in the simulation phase can function indistinctively as electrical or pneumatic lines.**

### How to use junctions

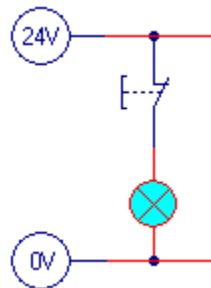
In the following examples we'll show you how to use junctions in electric circuits. The under current lines are **red**, the other lines are **blue**.

Note: the component positioned at the end of a line don't need any junction, it is connected with the line automatically.

Components not connected with lines:



Components connected with lines through junctions:



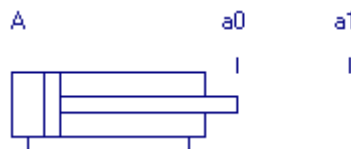
## Cylinders



You can create simple acting or double acting cylinders.

## Limit Switches

Whenever you create a cylinder, for example named “A”, you must assign the names to the limit switches, for example “a0” and “a1”.

The cylinder is automatically drawn with his limit switch references and, if you want, with the limit switch names.




You can give to a limit switch reference the name of an electric limit switch (“**Europe**” symbol  or “**US**” symbol  ).



## Sensors

When you install or modify a cylinder you can install one, two or three electric sensors. The program will draw the cylinder with his sensor references:



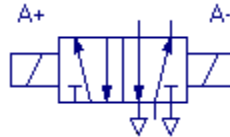
Note: Of you want to see on the screen the name of the sensor reference you have to add a text (press the button  ).

You can give to an electric sensor reference the name of a “sensor type” electric contact ( “Europe”

symbol  or “US” symbol  ).

### Distribution valves

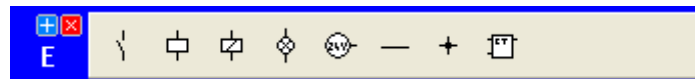
If you create a pneumatic distribution valve you can choose the number of positions (2 or 3), the number of ports (2, 3, 4 or 5), the type of the left control (electric) and the type of the right control (electric, or spring).



### The symbols of the electric components

The symbols of the electric components can be set up in “**Europe**” or in “**US**” mode from the drop-down menu. The drawings of the components on the screen, on the electric components panel and in the generation and modification windows of the components will be in line with the set-up mode.

Electric components panel in “**Europe**” mode.







Electric components panel in “**US**” mode.







From the drop-down menu select the option **Settings**.

## The simulation

The simulation can be run in “**normal**” mode by clicking on the button  (which turns into  ) or “**step by step**” by clicking on the button  (which turns into  ). When the simulation is run step by step it proceeds by continuously pressing the button **ENTER**.

The user interacts with the simulation by clicking on the buttons and on the levers of the electric components.

To interrupt the **normal simulation** press the button  (which turns into  ), to interrupt the **step by step simulation** press the button  (which turns into  ).

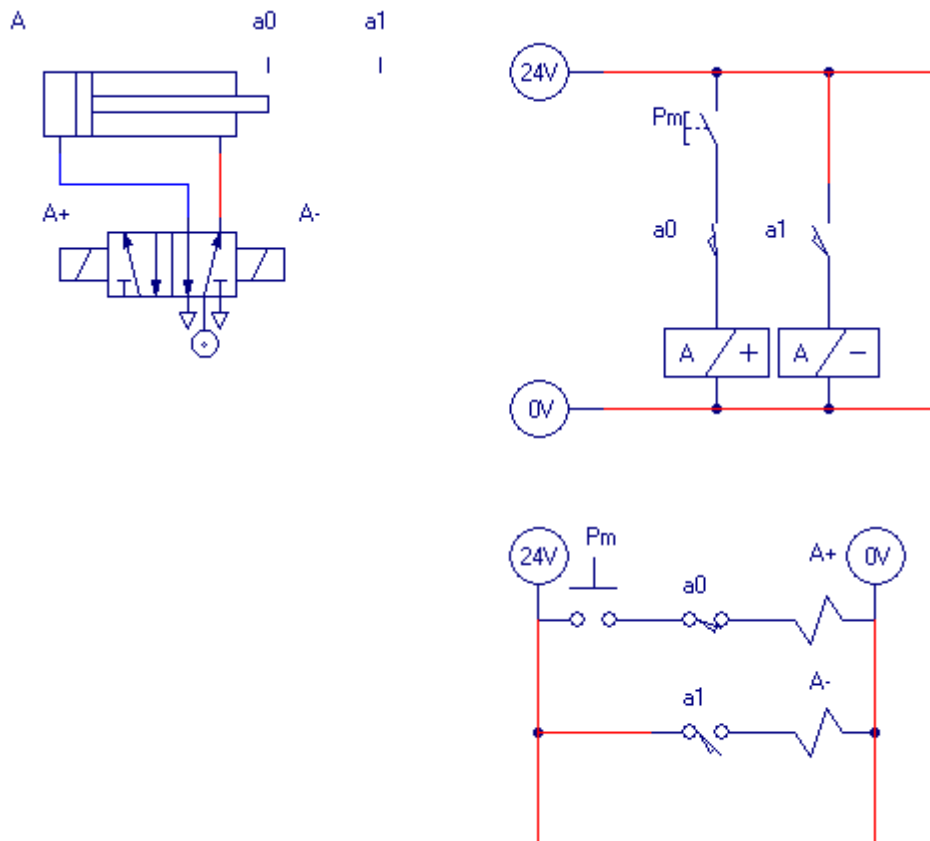
In the simulation, the drop-down menu and the button menu are disabled except for the **zoom +** e **zoom -** buttons.

**Attention. In the step by step simulation the functioning of the timers is inevitably distorted.**

In the simulation **two different colours** are used to draw the electrical lines of an open circuit and those of a closed circuit.

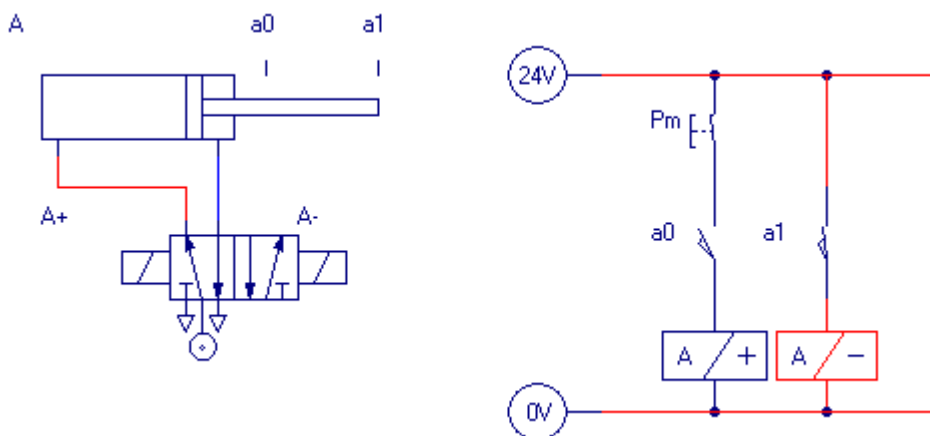
Let's see the simulation of a simple electro-pneumatic circuit, A+ A-.

If the electric starter button is not pressed the cylinder is in the negative position, the electric limit switch “a0” is activated and the electric limit switch “a1” is not activated.

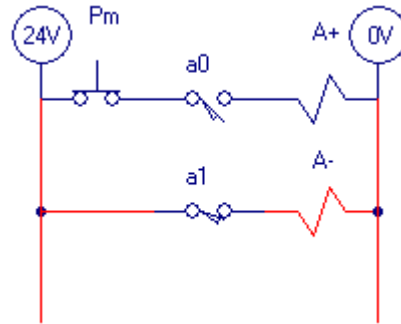


When you press the starter button the current comes to the left solenoid “A+” of the distribution valve “VA”. This valve will send the compressed air to the positive chamber of the cylinder. The cylinder will execute the positive stroke.

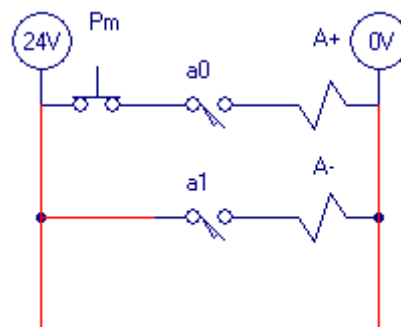
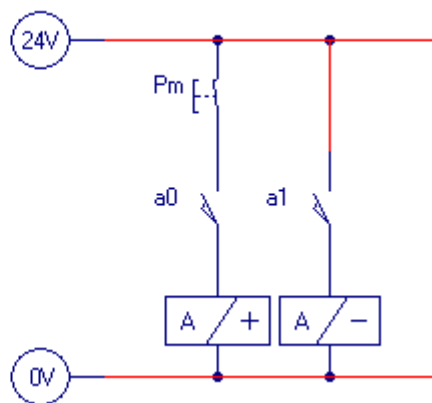
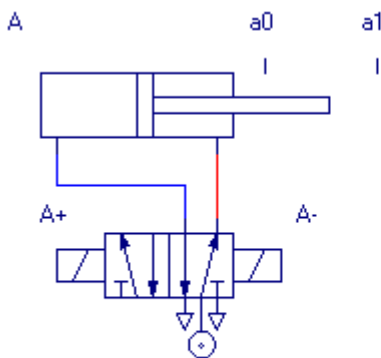
When the cylinder arrives at the stroke end it activates the electric limit switch “a1”.







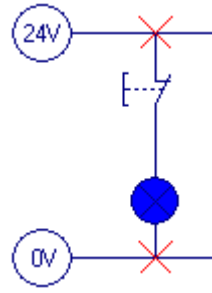
This limit switch sends the current to the solenoid “A-“ of the distribution valve “VA”. The valve “VA” then sends the compressed air to the negative chamber of the cylinder. The cylinder executes the negative stroke.



## The diagnostic analysis

When the simulation is run the program checks that all components are connected to the lines or to the power or pneumatic supply.


If one or more components are not connected, the simulation is not run: the item to correct is indicated by a cross and a notice message is delivered.




The simulation is, instead, allowed to run if there are some lines with disconnected terminals (as is usually the case with electric circuit drawings).

The crosses can be erased by clicking on the **redraw** button .

The simulation may not run as desired either due to wrong logic applied in order to connect the components (in this case the diagnostic analysis is of no use) or for other reasons: for example because two lines have not been connected through a junction or because the limit switch reference of a cylinder has neither a corresponding pneumatic valve nor a corresponding electric contact, or because a coil has no corresponding electric contact, or because a solenoid of an electric circuit does not have any electro-pneumatic valve with the same left or right name and so on.

To resort to the diagnostic analysis press the button .


## Printing

When the simulation is not run, the circuit displayed on the screen can be printed by clicking on the button .

When the “**normal**” simulation is performed the print button is **disabled**.

When the “**step by step**” simulation is performed the print button is **enabled**.

## Reports

A window showing the list of the components of the circuit displayed on the screen becomes visible by clicking on the button  of the menu.

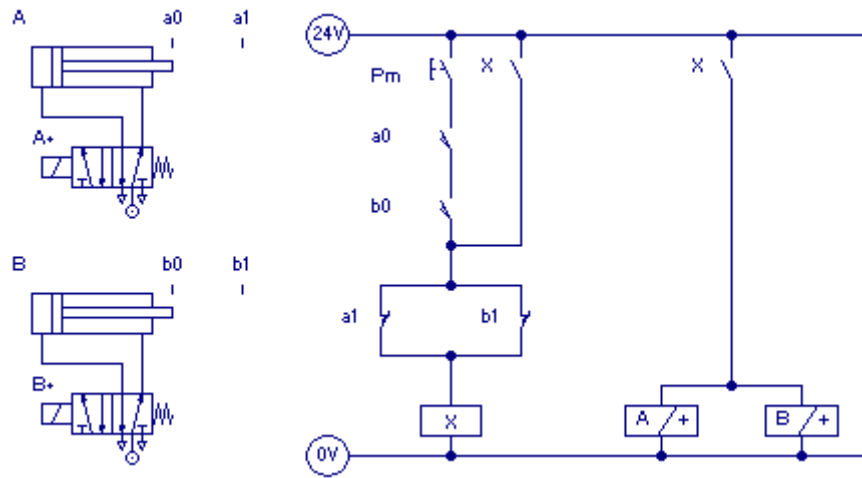
At the user’s discretion, the following options are shown for each component: **Amount, Unit price, Total price, Supplier and Note**.

The user can also enter the approximate length of the electric wire used.





The **total expenditure** of the circuit components is shown.

By clicking on the button “**Manage records**” a window appears where the user can enter, for each component, the **unit price**, the **supplier** and any **notes**: by clicking on the button “**Confirm changes**” the entered data will be stored by the program and will be available each time the program is launched.

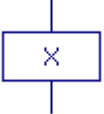
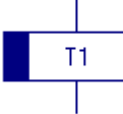
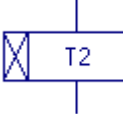
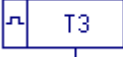


## Electric components – “EUROPE” mode



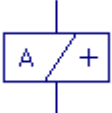
### Contacts

- **Components:** contacts  , buttons  , limit switches  , sensors 
- **Type:** NO and NC






### Coils

- **Components:** coils  , coil with off delay  , coil with on delay  ,
- flashing coil  , set  , reset  .

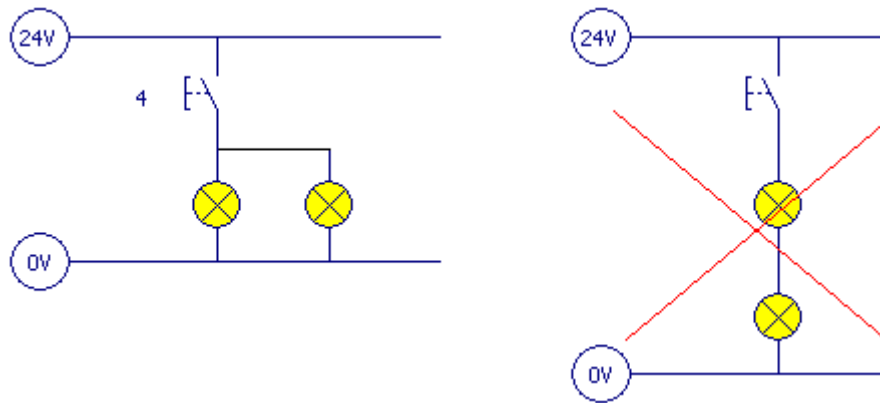
### Solenoids

- **Component:** solenoid 


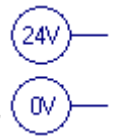
### Lamps

- **Colors:** white  , red  , yellow  , green  , blue 

- **Simulation:** if you want to light some lamps at the same time draw the lamps in parallel, not in series.



### Power sources

- Symbols: "+/-" , "24V/0V" .



### Lines

- **Type:** continuous and broken.

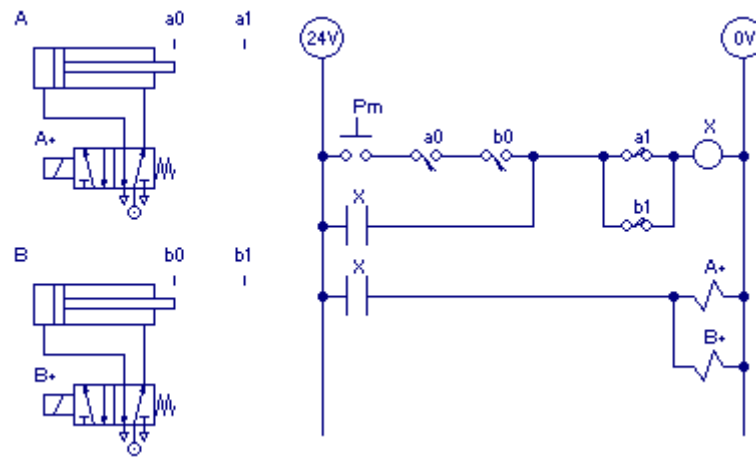
### Junctions

•





### Electric counter

- **Type:** count up , count down .







## Electric components – “US” mode




## Contacts

- **Components:** contacts , , buttons , limit switches 
- **Type:** NO e NC






## Coils

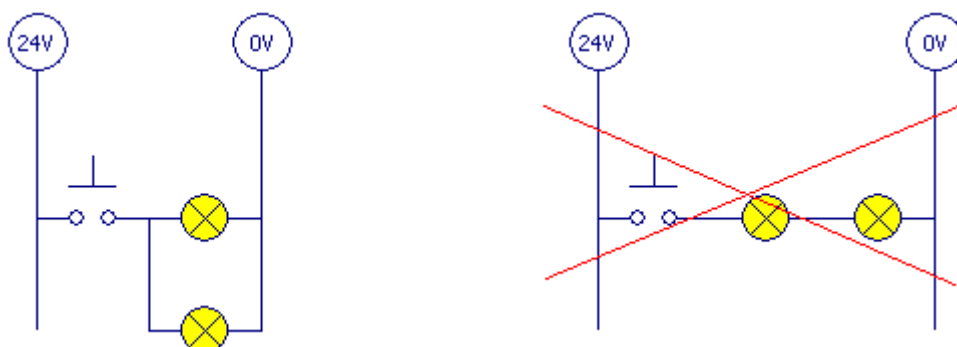
- **Components:** coil , coil with off delay , coil with on delay , flashing coil , set , reset .

## Solenoids




- **Component:** solenoid 

## Lamps

- **Colors:** white , red , yellow , green , blue 
- **Simulation:** if you want to light some lamps at the same time draw the lamps in parallel, not in series.



## Power sources

- Symbols: "+/-" , "24V/0V"  .



## Lines

- **Type:** continuous and broken.

## Junctions

- 

## Electric counters

- **Type:** count up , count down .

## New components in the 2D screen

### Electric motor

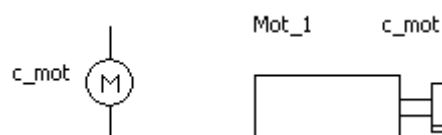
You can install an electric motor in the 2D screen and to use it as actuator for a feeder, a linear conveyor or a rotary conveyor in the 3D screen. You cannot use it as the actuator of an element of a robot. This is the aspect of an electric motor:



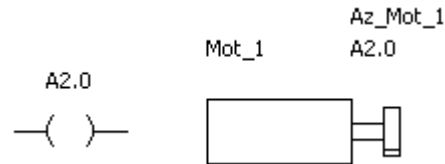
In the simulation the movement of the motor is shown with the rotation of the connected wheel.


When you install an electric motor you must assign the name of the motor and the name of the related contact of the electric circuit.

If the electric circuit is cabled the contact is a **Motor Contact**:



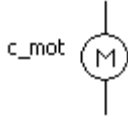
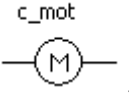
If the electric circuit is a PLC program, the electric contact is a simply PLC output element:




You can create an electric motor by pressing the button  .

## Motor contact

A motor contact of a cable electric circuit activates an electric motor in the 2D screen.

This is the aspect of a motor contact in the setting “Europe mode”  , and this is the aspect in the setting “USA mode”  .

You can create a motor contact by pressing the button  .

# Part 3. PLC programming

## Introduction

The **Pneumatic Studio** program allows the user to draw **PLC Ladder Schemes**, to install **cylinders, limit switches, sensors, valves, buttons and lamps**, and to test their functioning by means of **virtual simulation**.

You can use the codes of any PLC language programming.

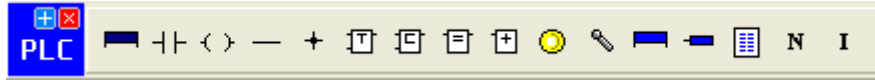
## Component management

















You can **create a PLC component** by clicking on the panel buttons of the PLC components. **The lines and the junctions can be immediately positioned on the screen. As regards the other components, a window where to select the desired features becomes visible on the screen.**

You can **modify a PLC component** by clicking the same component with the right button of the mouse: an Edit window will appear.

To **erase a PLC component** select the component and then press the button **CANC** on the keyboard of the computer.


The **panel of the PLC components** can be displayed or hidden by pressing the button .




	Main program heading
	Input component
	Output component
	Line
	Junction
	Timers
	Counters
	Comparisons
	Mathematical operation
	Lamp
	Button
	Block heading
	Block call
	Report
	Show components names
	Show components addresses

### Texts

In addition to pneumatic and electric elements, texts can also be displayed on the screen.

A window that allows the user to type a text and select the style, the dimensions and the colours of the letters appears by pressing the button .

### To create a Line

- Press the button  of the electric components panel or that of the pneumatic components panel: the cursor will change from “arrow” to “hand”.
- Click (press and release) the **left** button of the mouse to start the drawing of the line.
- Move the mouse without press any button.
- Click (press and release) the **left** button of the mouse to break the line: every time you click the **left** button of the mouse you draw a segment of the line.



- If you want to finish the drawing of the line click the **right** button of the mouse.

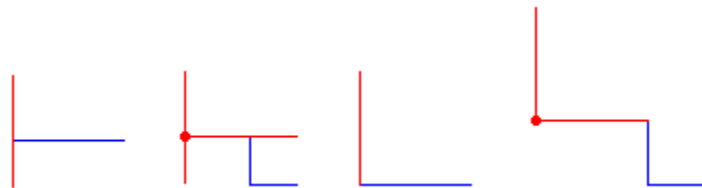
When the Snap is “ON”, if the button  of the **PLC** components panel  is pressed the line will be automatically set up as “**subjected to the Snap**”.

The lines are created in the “**continuous**” style. In the editing phase it is possible to change the line style into “**broken**”. In this phase the feature “subjected to the Snap” can be set up or left out.

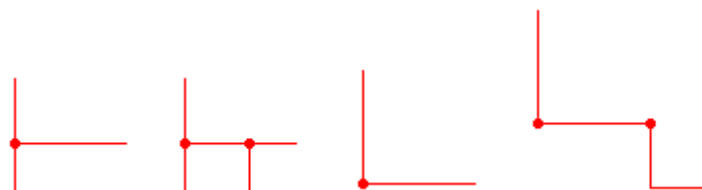
**The lines drawn in the simulation phase can function indistinctively as electrical or pneumatic lines.**

### How to use junctions

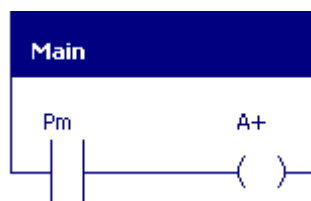
In the following examples we’ll show you how to use junctions in electric circuits. The under current lines are **red**, the other lines are **blue**:



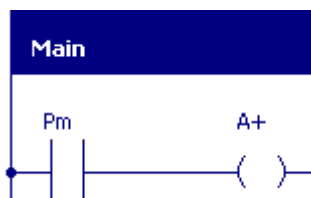
Lines connected through junctions:



The components connected to the ends of lines don’t need junctions:

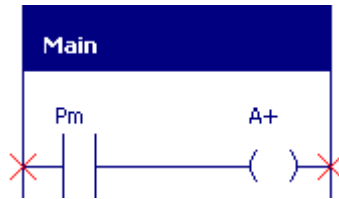


The components connected to intermediate points of lines need junctions:



When the simulation is run the program checks that all components are connected to the lines.

**If one or more components are not connected, the simulation is not run: the item to correct is indicated by a cross and a notice message is delivered.**



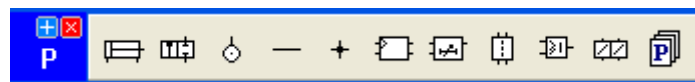
## To create a program


**NOTE:** Create at first the virtual components of the machines (cylinders, limit switches, sensors, valves, buttons and lamps) with their names and addresses, and after draw the Ladder circuit, on the purpose to simplify the installation of inputs and outputs of the Ladder.

So let's create at first a simple electro-pneumatic circuit with a **cylinder A**, two **limit switches a0** and **a1**, and a **distribution valve VA**, and then let's draw a Ladder diagram to realize the cycle A+A-.

### Cylinder A installation

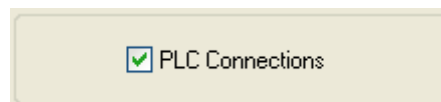
From the panel of the pneumatic components



let's press the button : a dialog window will appear.

Set the cylinder type as double acting, assign the name **A** to the cylinder and the names **a0** and **a1** to the limit switches.

To assign the PLC addresses to the limit switches set the option "PLC Connection" to enable the addresses typing.



Assign the address **E0.0** to the first limit switch, and the address **E0.1** to the second.

First Limit Switch	Second Limit Switch
Name <input type="text"/>	Name <input type="text"/>
PLC Address <input type="text"/>	PLC Address <input type="text"/>

To show the labels, select the "Name" or "Address" option.

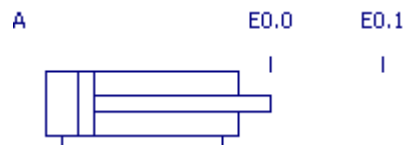
**Labels**

<input checked="" type="checkbox"/> Cylinder	<input checked="" type="radio"/> Name <input type="radio"/> Address
<input checked="" type="checkbox"/> First Limit Switch	<input checked="" type="radio"/> Name <input type="radio"/> Address
<input checked="" type="checkbox"/> Second Limit Switch	<input checked="" type="radio"/> Name <input type="radio"/> Address

Press the **OK** button and introduce the cylinder on the screen.  
If you choose the option “Name” you take this configuration:



Instead, if you choose the option “Address” you take this other one:



Note: if you would like to install a sensor you have to set at first the option “**Install Sensors**” and then the option “**Electric**”.

☒ Add Sensors

☐ Pneumatic

☒ Electric

A dialog panel appears: you can install up to three sensors with their names and addresses.

1st Sensor

☒ Add

Name


PLC Address

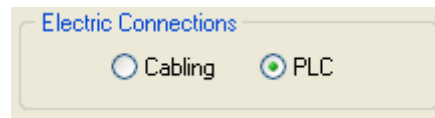


Cylinder with sensors:

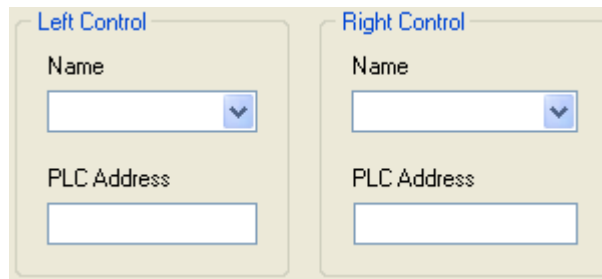
If you need to show the label of a sensor, insert a text (press the button ).

## **Distribution valve VA installation**

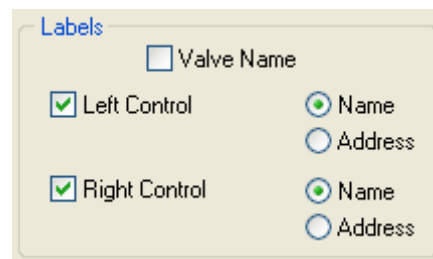
From the panel of the pneumatic components press the button : a dialog window will appear. Set the valve type **5/2**, assign the name **VA** to the valve and the names **A+** and **A-** to the actings. To assign the PLC addresses to the left and right actings set the options “Electrical” and “PLC Connections”.



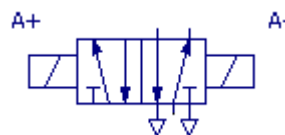
Assign the address **A2.0** to the left acting, and the address **A2.1** to the right one:



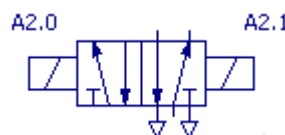
To show the labels, select the “Name” or “Address” option.



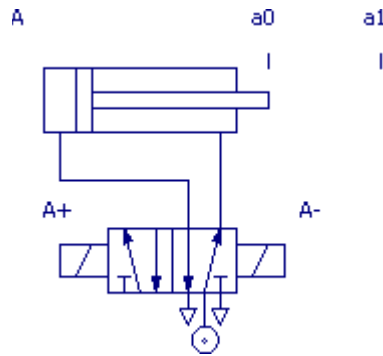
Press the **OK** button and introduce the valve on the screen. If you choose the option “Name” you take this configuration:




Instead, if you choose the option “Address” you take this other one:



Draw the pneumatic lines and put the pressure source:





To install a button on the screen press the button  of the PLC components panel: a dialog window will appear.


Type the name **Pm** and the address **E1.0**, select the type of button (monostable or bistable), the type of contact (**N.A.** or **N.C.**) and the labels (name and address). Press the **OK** button and introduce the button on the screen:

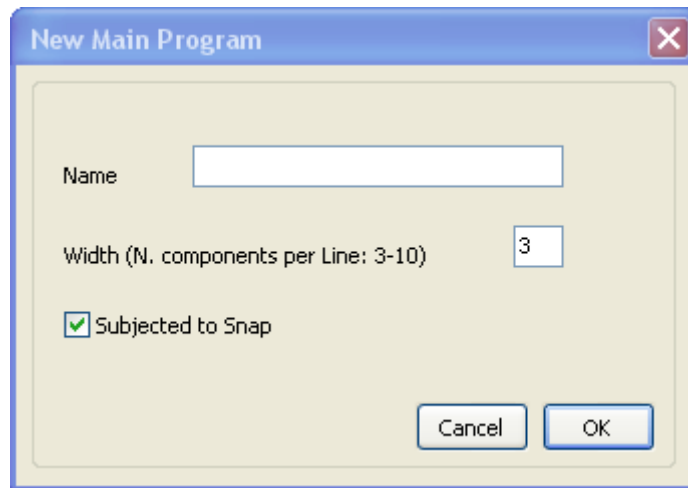


### To create the Ladder diagram

Note: to insert the Ladder components on the screen in a fast way **show the grid** and **set the Snap**

“ON”: press the buttons  and .


At first we must to insert the heading of the main program. Press the button : a dialog window will appear.



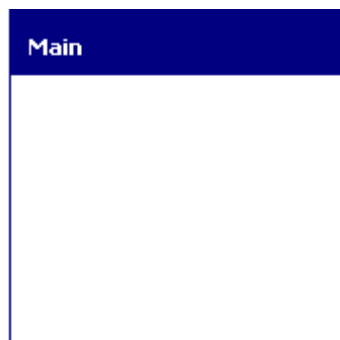
Type the **name** (for example **Main**) and the **length** of the heading. Select the **Snap** option.

Press the **OK** button to confirm the installation and put the heading on the screen.




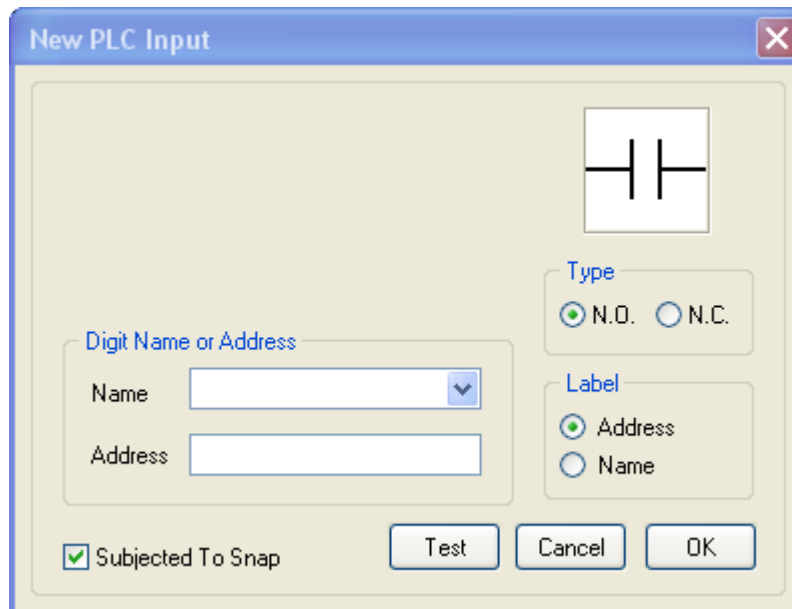
Note: after the installation of the heading, the button  will become disabled because you can insert only one heading on the screen.

Now draw a line on the left of the heading and a line on the right: these two lines means the positive and the negative lines of the main program.



Let's realize the line of the Ladder diagram regarding to the logic equation  $Pm * a0 = A+$ .

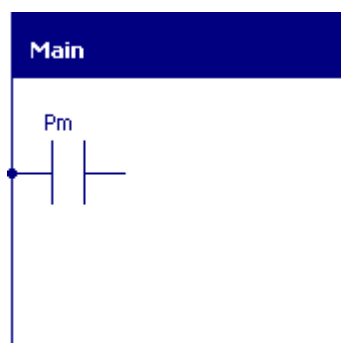
To install an input component press the button  of the PLC components panel.



Select the type (**N.O.**), select the label (**Address**) and set the component **subjected to snap**. Select or type the name of the related component (**Pm**).

**Note: it isn't necessary to type the address, the program will select it automatically.**

Press the **OK** button and put the component in the Ladder diagram in this way:

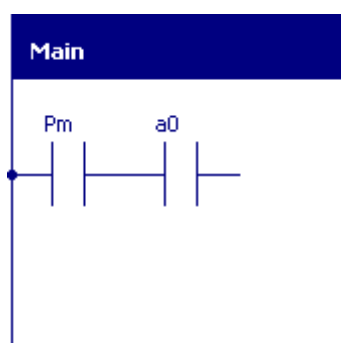



**To create an input component related to a memory, digit only the address.**

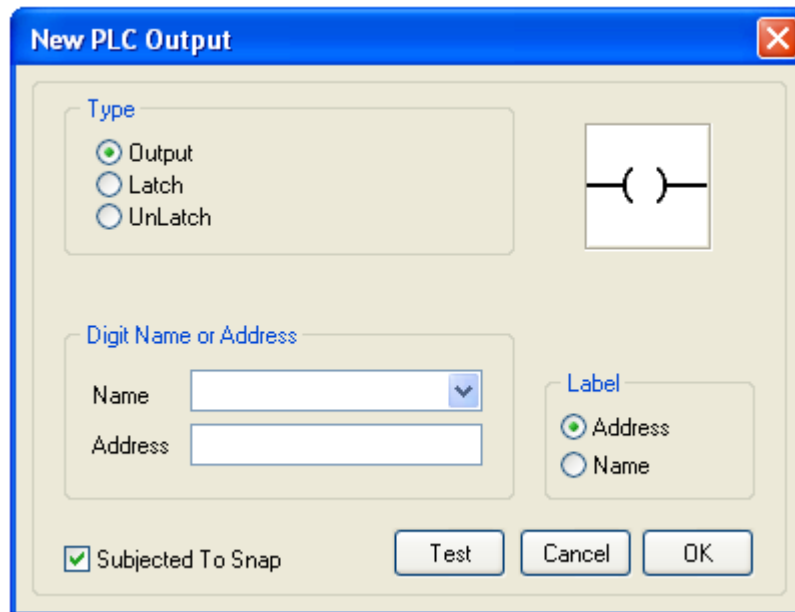
**To create an input component related to a counter or a timer, digit only the name.**

Connect the component to the line with a junction.

Repeat the steps described and install an input component related to the limit switch **a0**.



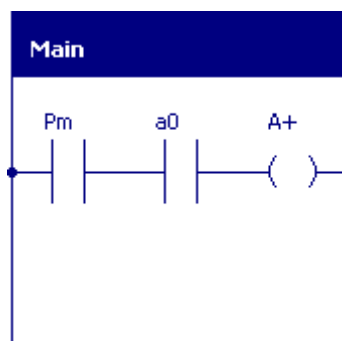
To install an output component press the button  of the PLC components panel.



Select the type (**Output**), select the label (**Address**) and set the component **subjected to snap**.  
Select or type the name of the related component (**A+**).

**Note: it isn't necessary to type the address, the program will select it automatically.**

Press the **OK** button and put the component in the Ladder diagram in this way:

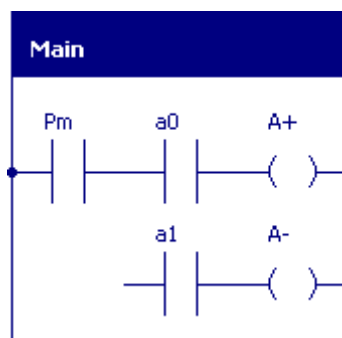


Connect the component to the line with a junction.

**To create an output component related to a memory, digit only the address.**

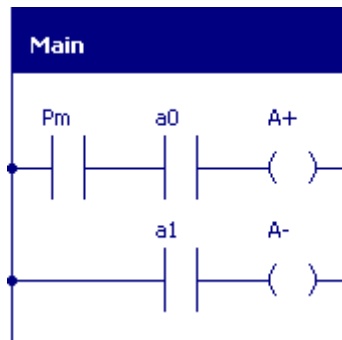
Now we have to realize the line of the Ladder diagram regarding to the logic equation **a1 = A-**.

We know how to install the input component related to the limit switch **a1** and the output component related to the the right acting **A-**.

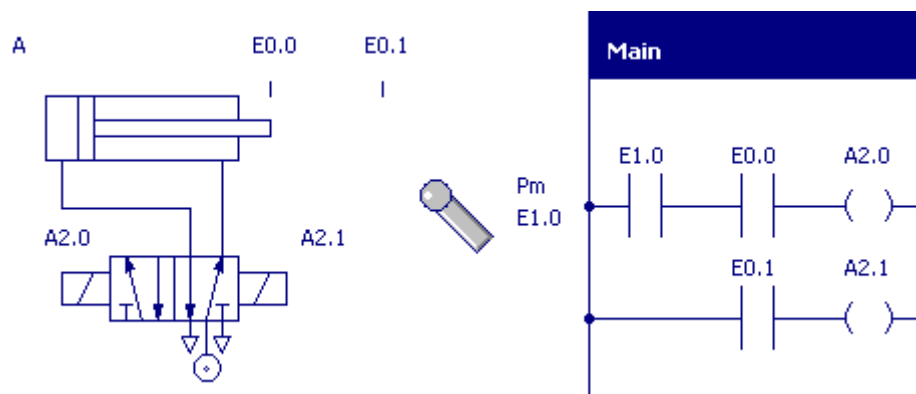


Connect the component **a1** with the positive line of the main program.

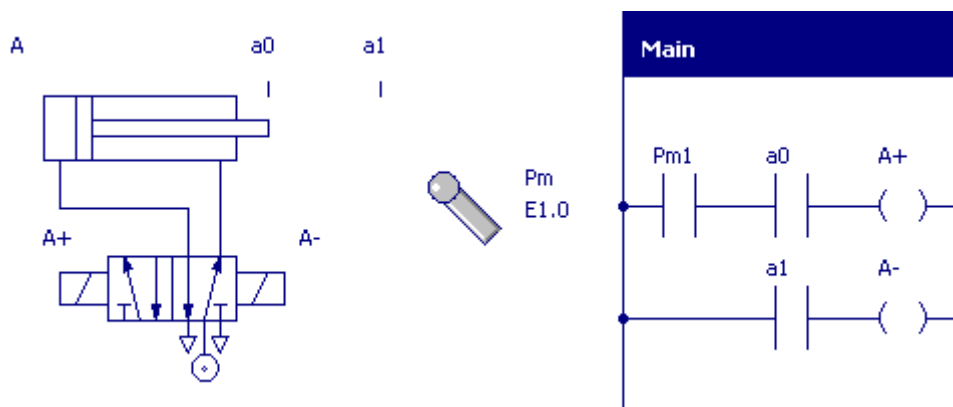








If you press the button **I** of the PLC components panel all the labels of the virtual machine and of the Ladder will show the addresses.







If you press the button **N** of the PLC components panel all the labels of the virtual machine and of the Ladder will show the names.



The simulation can be run in “**normal**” mode by clicking on the button  (which turns into ) or “**step by step**” by clicking on the button  (which turns into ). When the simulation is run step by step it proceeds by continuously pressing the button **ENTER**.


The user interacts with the simulation by clicking on the button **Pm**.

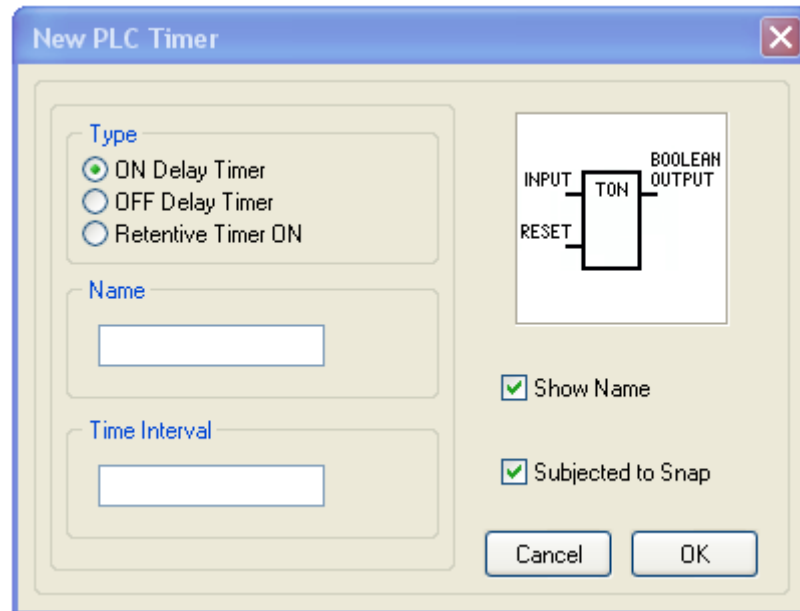
To interrupt the **normal simulation** press the button  (which turns into ) , to interrupt the **step by step simulation** press the button  (which turns into ).

In the simulation, the drop-down menu and the button menu are disabled except for the **zoom +** e **zoom -** buttons.

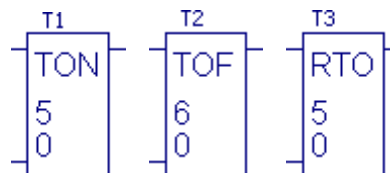
In the simulation **two different colours** are used to draw the under current lines and the others.

### Timer installation

To install a timer press the button .

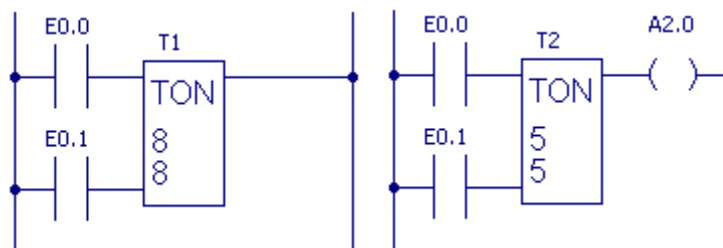


The timers may be of three types: on delay (**TON**), off delay (**TOF**), retentive on delay (**RTO**).



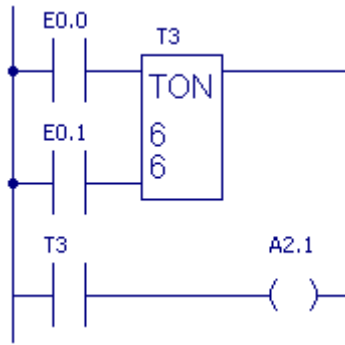
The input and the reset belong to a positive edge transition.

You can connect the timer output to the negative line of the program or to an output component.




The lamp with address A2.0 is ligthed if the timer is on the “1” logic.

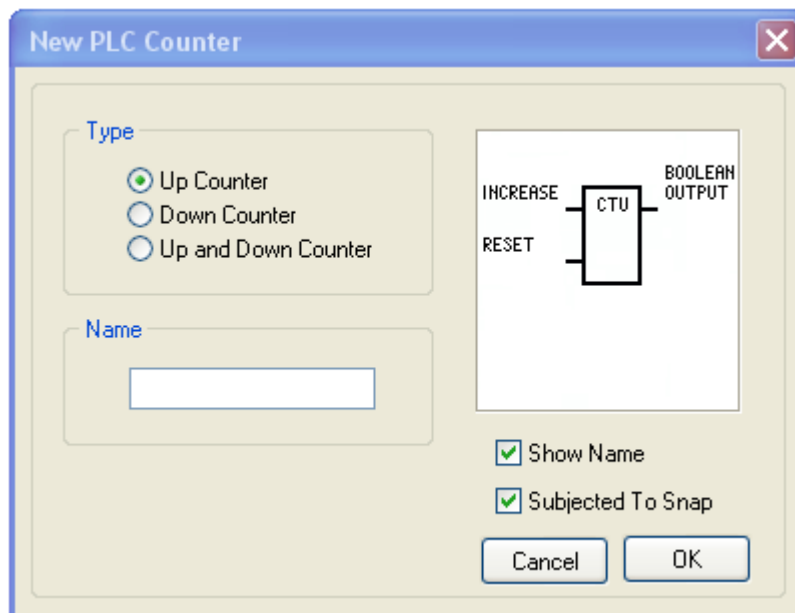
You can give the name of a timer to an input component:



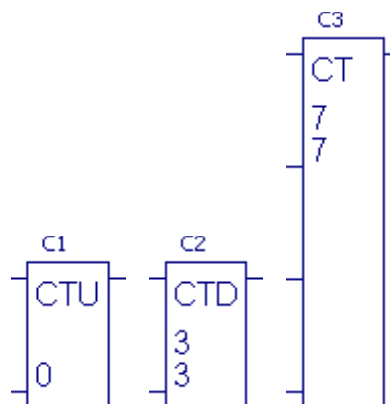
The lamp with address A2.1 is lighted if the timer is on the “1” logic.

### **Counter installation**

To install a counter press the button .

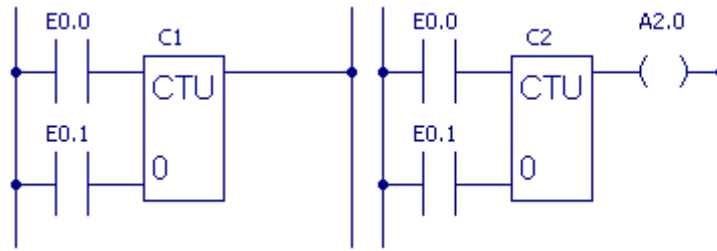


The counters may be of three types: count up (CTU), count down (CTD), count up and down (CT).



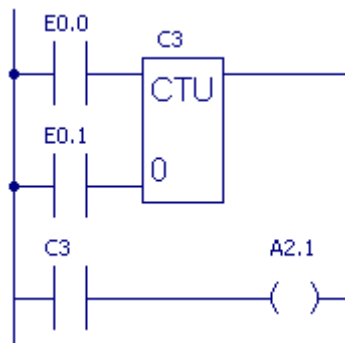
All inputs belong to a positive edge transition.

You can connect the counter output to the negative line of the main program or to an output component.




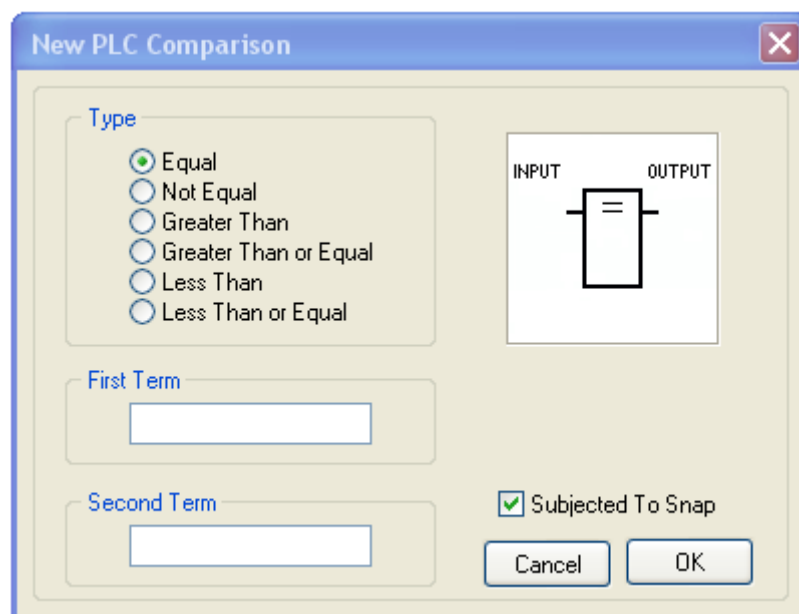
The lamp with address A2.0 is lighted if the counter value is more than 0.

You can give the name of a counter to an input component. The lamp with address A2.1 is lighted if the counter value is more than 0.

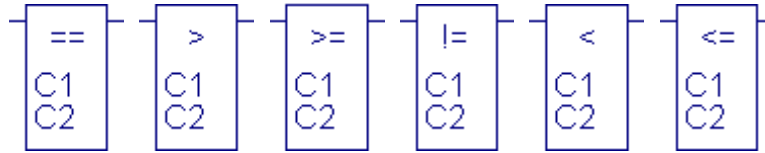


### **Comparison installation**

To install a comparison press the button .

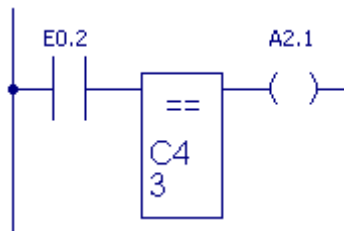


The comparison may be of six types: equal, greater than, greater than or equal, not equal, less than, less than or equal.



The input may be connected directly to the positive line of the power supply (the comparison will be always executed), or it belongs to an input component (the comparison will be executed if the component is on the “1” logic).


The comparison output must always be connected to an output component.

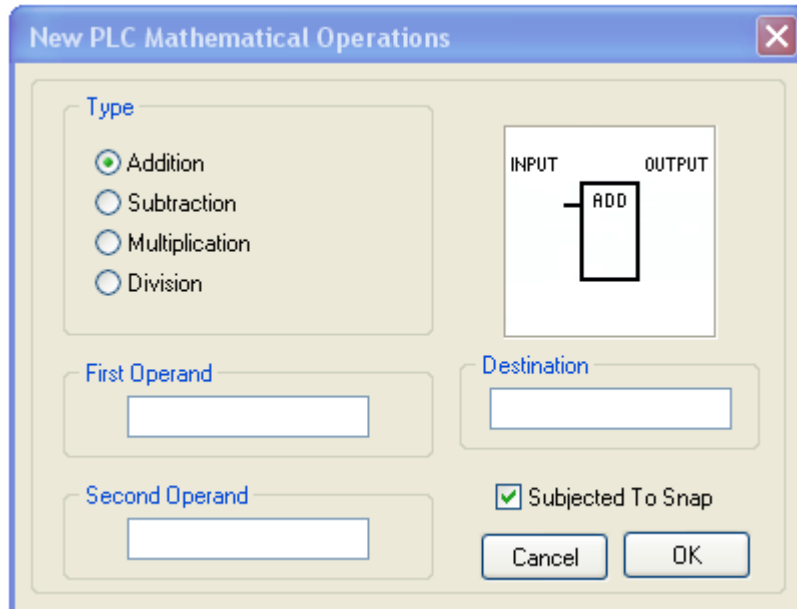


If the comparison is “true” the output is on the “1” logic.

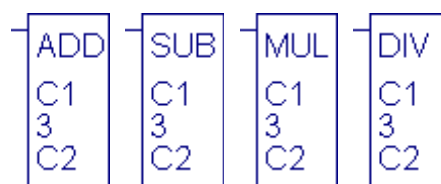
The comparison may be executed between two counters or between a counter and a number.

### **Mathematical operation installation**

To install a mathematical operation press the button .

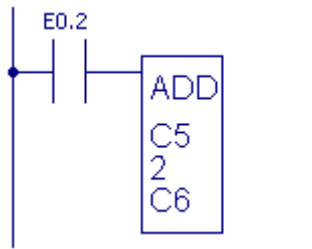


The mathematical operations may be of four types: addition, subtraction, multiplication, division.



The inputs belong to a positive edge transition.

The terms of the operations may be two counters or one counter and a number.  
The destination of the operation must be a counter.



### **Block installation**

To install a block press the button .

The 'New Block' dialog box contains the following fields and options:


- Name:** A text input field.
- Width (N. components per Line: 3-10):** A numeric input field with the value '3'.
- Subjected to Snap:** A checked checkbox.
- Buttons:** 'Cancel' and 'OK' buttons at the bottom right.

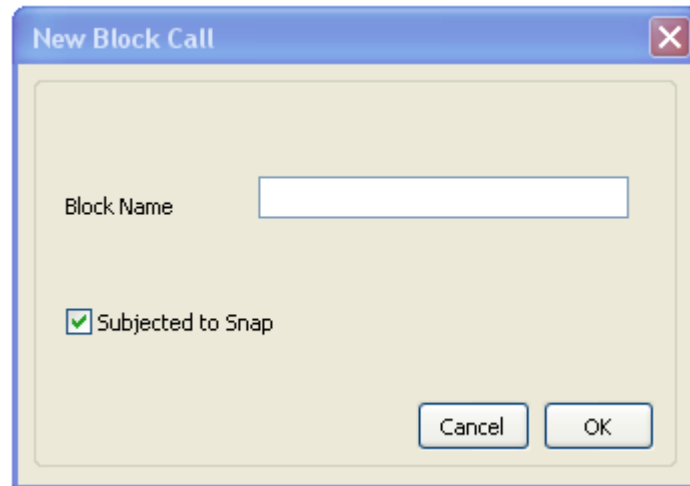
You can create a block in the same way you install the main program.

The **block** will be considered by the program if the related **block call** is activated.



### **Block call installation**

To install a block call press the button .

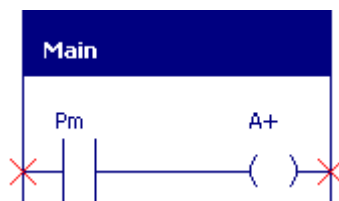


A block call may be connected directly to the positive line of the main program (or of another block), or it belongs to a component input.



### The diagnostic

When you launch the simulation the program checks all connections. If one or more components are not connected the simulation don't run: a red cross appears where you must make the correction, and a message is shown.




The simulation is, instead, allowed to run if there are the left and right lines of the main program with disconnected terminals.

The crosses can be erased by clicking on the **redraw** button .

The simulation may not run as desired either due to wrong logic applied in order to connect the components (in this case the diagnostic analysis is of no use) or for other reasons: for example because two lines have not been connected through a junction or because the limit switch reference of a cylinder has neither a corresponding pneumatic valve nor a corresponding electric contact, or because a coil has no corresponding electric contact, or because a solenoid of an electric circuit does not have any electro-pneumatic valve with the same left or right name and so on.

To resort to the diagnostic analysis press the button .


## Printing

When the simulation is not run, the circuit displayed on the screen can be printed by clicking on the button .

When the “**normal**” simulation is performed the print button is **disabled**.

When the “**step by step**” simulation is performed the print button is **enabled**.

## Reports

To show the report dialog window press the button  of the PLC component panel.

You can choose the options **Hardware components** (you obtain the list of the virtual components connected to the PLC) and **Ladder components** (you obtain the list of the components of the main program and the of the blocks).