

4.3 LEARNING TO USE FBD (FUNCTIONAL BLOCK DIAGRAM) LANGUAGE

4.3.1 Getting started

4.3.1.1 FBD: A language offering multiple possibilities

Zelio Logic may be programmed in FBD (Function Block Diagram) language, a graphic language offering multiple possibilities. With Zelio Logic, you may also add SFC-Grafset functions to your application.

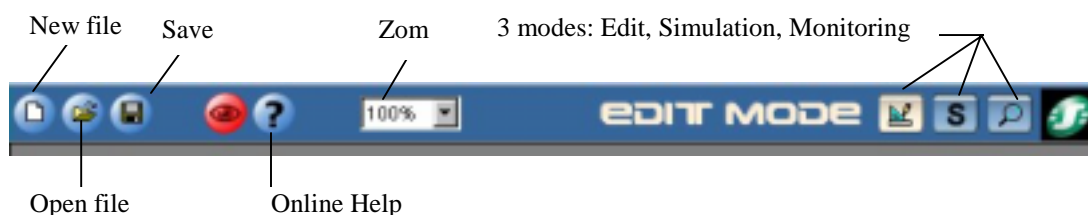
4.3.1.2 Accessing Help

In Zelio Soft 2, you may access Help from the menu bar by clicking on the ? menu, then on **Help**, or by clicking directly on the ? icon available in the tool bar.

To directly access Help for a function in use, click on ? in the function parameter window (access by double-clicking on the corresponding block).

4.3.1.3 Toolbar

The toolbar contains shortcuts to menu elements. It also allows you to choose the **mode**: Editing, Simulation or Monitoring. Hover the mouse arrow over any button to see the action associated with the button.



4.3.2 Entering a program in FBD

4.3.2.1 Modes

Once you have selected the appropriate module and the FBD language, you are ready to program your application.

The reference for the Zelio Logic version selected will appear in the lower right corner (1):



The software provides a choice of three modes: **Edit mode (1)**, **Simulation mode (2)** and **Monitoring mode (3)** (Supervision). You may select the modes in the **Mode** menu or with the toolbar in the upper right. The selected mode appears to the left of the 3 icons (4):



Edit mode allows you to edit the program and the supervision window. This is the default mode. **Simulation mode** allows you to simulate the program before transferring it to the module. **Monitoring mode** enables you to visualize the input and output statuses of the module in real time.

A **Supervision window** is available in simulation and supervision mode. This window allows you to visualize the inputs/outputs that you have previously chosen and placed. This allows you to have a permanent overview of the application to ensure efficient monitoring. Drawing functions can be used to illustrate the application.

4.3.2.2 Edit Mode: programming the application

Entering a program on the wiring sheet.

When you have selected your type of module and the FBD, a wiring sheet then appears:



The default is **Edit mode**: The sheet shows the module inputs **(1)**, the module outputs **(3)** and one zone which is reserved for block programming **(2)**.

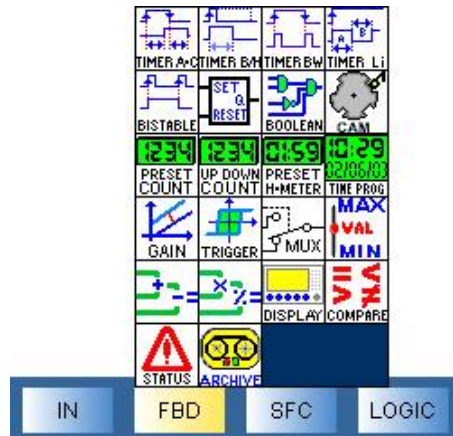
Point to the appropriate icon at the bottom of the sheet to create a block on the sheet:




- (1)** Inputs
- (3)** Grafcet/SFC functions
- (5)** Outputs

- (2)** FBD Functions
- (4)** Logic Functions

You may see the list of available elements by placing the mouse pointer over one of these icons:



Click and drag the blocks to put them into place on the wiring sheet. The  symbol appears when it is impossible to place the block into a given zone.

After having placed the various blocks, you can interconnect them : click and drag from the output **>** of the first block to the input **>** of the second block then release the mouse button. To build your application :

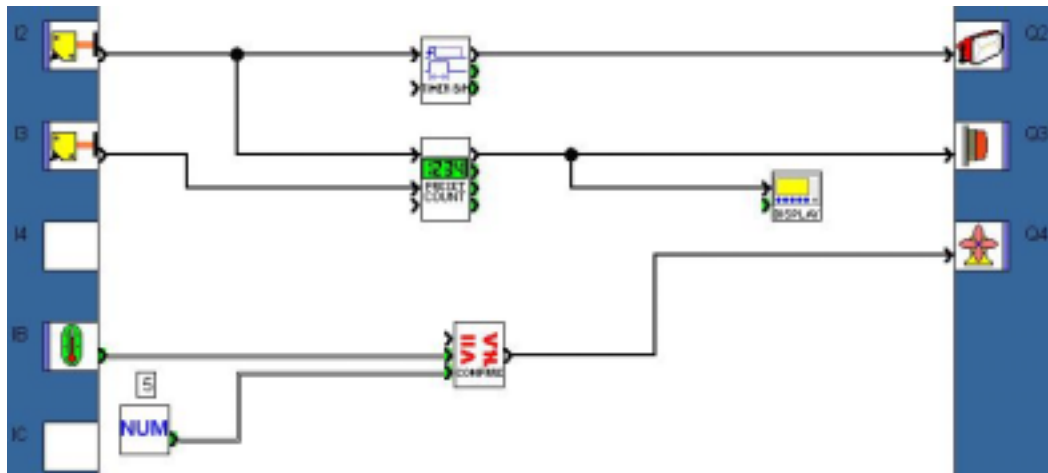
Select the input blocks and place them on the input lug, select the output blocks and place them on the output lugs. Then select the function blocks, and wire the different points. Double click on the functions to configure them.

It is possible to change the input or output type. This option does not change anything from an operating point of view.

If you want to change an input or output type, just double click on the icon and choose an alias.

You can add a commentary and drawings on the wiring sheet. To do so use the **Draw** menu.

For example: If you want to control car park entrances/exits. Each entrance **I1** activates the light for 1 minute (output **Q2**) and increments the counter. Each exit decrements it. When the car park is full (25 cars) an indicator lamp lights (output **Q3**) and the module displays "CAR PARK FULL" ». In addition, when the temperature exceeds a threshold, a fan starts up (output **Q4**)



Click on the link below to access the example:

[\(Ex 11\)](#)



Supervision Window

Select **Window** then **Supervision**. Simply click and drag the inputs/outputs and block function that you have chosen from the wiring sheet to the supervision window. You may illustrate your application using the tools in the **Drawing** menu. You may also choose a background image in Bmp format. This window clearly displays the elements you placed in the wiring sheet in their environment. When you go into simulation or monitoring mode, the inputs and outputs are updated. It is also possible to force an input in the same way as in the edit window.

Program configuration

The program configuration allows you to customize your file by giving the project name and author, and it is also possible to adjust certain configurations and choose the date format.


Click on the corresponding



icon in the lower bar to access the program configuration.

4.3.3 Functions

Note: The following descriptions are illustrated with functional examples.

Click on the  icon to access the descriptions.

If Zelio Soft 2 software is installed, click on the link to open the program. You may then select simulation mode **(1)** and start the module (**RUN**) **(2)**.



For further details on a function described below, refer to Help: Double-click on the block and then on ?

4.3.3.1 Inputs



TOR. Discrete Inputs

The application can be customized by selecting another icon to show a presence detector or a backlit pushbutton for example.

To change icons, place a Discrete block on the wiring sheet, then double click on it. Different types of Discrete inputs are then offered.



Analog inputs

This type of input accepts an incoming voltage of 0 to 10 V corresponding to a value of 0 to 255.

The application can be customized by selecting another icon to show a temperature sensor or a potentiometer for example.



Filtered inputs

Filtered digital or analog inputs can be inserted in the wiring. These types of inputs can be used to eliminate parasites.



Integer input (NUM IN)

NUM 0 1

Constants

Constants can be inserted in the wiring.

There are analog constants and digital constants.



1 sec clock

A 1 second clock can be wired at the input.



Summer/winter time change

The output for this function is OFF when winter daylight saving time applies, and ON when summer time applies. The switch from winter to summer time is displayed on the screen.



Buttons

The 4 buttons of the front panel of the Zelio, **Z1**, **Z2**, **Z3**, **Z4** can be used in your application.

Input examples

Click on the link below to access the example:

[\(Ex 12\)](#)



4.3.3.2 Outputs



Discrete output

The application may be customized by selecting another icon to show, for example, a fan or heating resistor.

To change icons, place a Discrete block on the wiring sheet, then double click on it. Different types of Discrete outputs are then offered



Integer Output (NUM OUT)



Backlight output

This output is used to drive the backlighting of the module screen.

Examples of outputs

Click on the link below to access the example:

[\(Ex 13\)](#)



4.3.3.3 FBD (Function Block Diagram) Function blocks

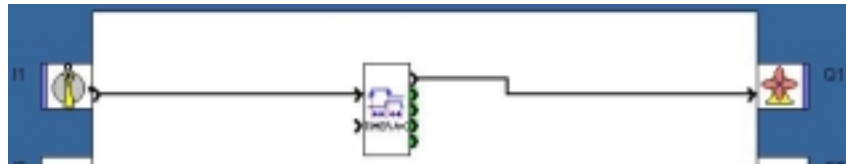
Note: Simply double click on the block to access the corresponding function configuration.



A/C Timer

It is used to delay passage to ON or to OFF, or both, with respect to the input signal by applying this delay to the output signal. This block can be used to set a timer for function A or function C.

The A/C Timer is connected as follows:



For example: to avoid overconsumption on boiler start-up, the heating elements are heated progressively. The first heating element is started up, followed by the second element 5 seconds later (or 50x100 ms), and likewise when the boiler is turned off.

Click on the link below to access the example:

[\(Ex 14\)](#)



"LATCHING" Save data function available.



B/H Timer

It is used to set the output signal to high status for a selected amount of time. It is triggered by a input pulse (B function) or when the input is in high status (function H).

For example: A stairway timer. When the button is pressed, the light stays lit for 2 minutes. (function B).

Click on the link below to access the example:

[\(Ex 15\)](#)



"LATCHING" Save data function available.



BW Timer

It supplies a pulse lasting one cycle on the leading or trailing edge or both edges of an input according to the setting selected in the parameters.



Blinker

It is used to generate pulses on the leading edge of the input.

"LATCHING" Save data function available.



Bistable

The principle of this block is the well-known trip-switch mechanism. An initial pulse suffices to set the output to 1 and a second pulse sets it to 0.



Flip-flop

This is an element composed of two inputs: **R** and **S**. R for Reset and S for Set. To activate the output, the generation of a pulse on S suffices, to deactivate it a pulse must be generated on R. The priority is used to define the status of the output when both inputs are set to 1.



Boolean Function

It accepts four inputs. The output reacts according to the truth table described in

the parameters.

Double-click on the block, or right click and select the configuration window, to access the parameters of the Boolean function .

For example: Execution of the Boolean equation $Q1 = (I1+I2) \times (I3+I4) = (I1 \text{ or } I2) \text{ and } (I3 \text{ or } I4)$

Click on the link below to access the example:

[\(Ex 16\)](#)



Camshaft

This function is used to create a cam programmer

"LATCHING" Save data function available.



Counter

This function is used to count to a value specified in the configuration window. When this value is reached, the output goes to 1 until reset if the fixed output is selected or for a certain amount of time if the pulse output is selected. The counting value and the maximum value can be visualized. It is possible to count from zero to the specified value (count up) or from the specified value to zero (count down)

The COUNT UP DOWN block is used to set the pre-selection value at the input, while it can be programmed for the PRESET COUNT block.

For example: A machine produces parts. One part is produced per second. This is shown by a blinking function Li (OnT=1s, OffT=0.1s). The counter is incremented by 1 each time a part is produced. The machine stops when the number of pieces produced reaches 5, and an operator packages them. The operator presses the button again to reset the counter and start production up again.

Click on the link below to access the example:

[\(Ex 17\)](#)



"LATCHING" Save data function available.



Time counter

This function measures the length of the input's 1 status. Past a pre-selected time, the output changes status. For example, this block can be used as a maintenance alert on a machine.

"LATCHING" Save data function available.



Weekly and yearly programmer

This function is used to activate or deactivate the output at a given time during the day, week or year. This block is event-based. To create an event, go the **Parameters** tab, and click on **New** to create a cycle. Choose the time when this event occurs, then specify the status of the output for that instant. The event frequency can be selected. Use the calendar to the right of the screen.

The **Summary** tab gives the description of the programmed events.



The gain function

This function allows the use of a scale factor, it is applicable to all analog data.



Schmitt trigger

The output changes status if the input is less than the minimum value. The output changes status again if the input is greater than the maximum value. If the input is in between both values, the output remains unchanged.

This function is used to situate a high threshold and a low threshold with respect to an analog variable.

For example: To control room temperature, the heater is set to come on when the temperature is 3°C below the setpoint and to turn off when the temperature goes 2°C over the setpoint. A Schmitt trigger is used with room temperature, maximum setpoint (setpoint + 2°C) and minimum setpoint (setpoint - 3°C) as input.

Click on the link below to access the example:

[\(Ex 18\)](#)



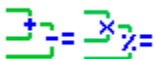
Multiplexer function

This function is used to select channel A or channel B as output.



Zone comparison

Used for applications using analog data.



+ - x / operations

The combination of these two blocks enables you to perform many operations with numerical constants.



LCD Display

This block is used to display text or an integer on the LCD on the front panel of the module. For example, a decimal can be displayed from an integer.

For example: We want to display the number of vehicles present in an underground car park. If the maximum is reached (10 in this case), a message displays "Car park full".

Click on the link below to access the example:

[\(Ex 19\)](#)



*Note: After switching to Simulation mode and starting up the module, select **3 Front Panel** in the **Window** menu to display the module screen. On the module screen, select **FBD display** by clicking once on the **DOWN button** then on **Menu/Ok**. The messages then appear on the screen.*



Comparison of two values

This block is used to compare two analog values using the operators =, >, >=, <, <=, !=. The output is the Discrete type and it is activated if the comparison is true.



Module status function

This function enables us to see the status of the module.

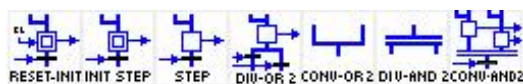


Archiving function

Providing several items of information at output, including the date and time, this function is used to display and modify information on the screen.

"LATCHING" Save data function available.

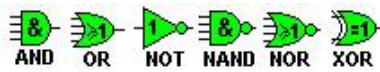
4.3.3.4 Grafcet / SFC (Sequential Function Chart)



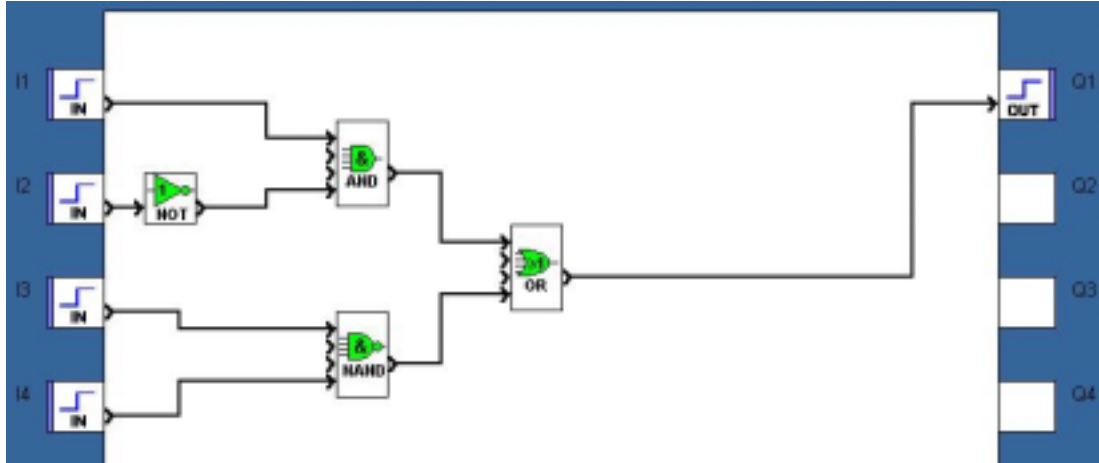
The SFC functions are like Grafcet language. The principle is simple since it concerns sequential programming, the steps succeeding one another framed by transitions. When a step is active, you must wait until the transition that follows is active to go onto the next step.

Note: An application using Grafcet functions is developed in the applications library in FBD language under the name "Indoor/Outdoor Lighting of a Home"(Level 2).

4.3.3.5 Logic Functions



For example: $Q1 = [I1 \text{ AND } (\text{NOT } I2)] \text{ OR } [I3 \text{ NAND } I4]$



Click on the link below to access the example:

[\(Ex 20\)](#)



Note: it is often possible to simplify wiring by replacing logic functions with a Boolean block.