em4 soft Online Help

1. em4 soft Online Help

(§ 1.1)

Online Help e**m4** soft version 1.2
04/2014

1.1 Overview of the programming workshop

(§ 1.)

(§ 1.1.1)

At a Glance

Subject of this Chapter

This chapter provides an overview of the programming workshop

What's in this Chapter?

This chapter contains the following topics:

- Overview of the Programming Workshop(§ 1.1.1)
- Creating or Modifying the Configuration of an Application(§ 1.1.2)

1.1.1 Overview of the Programming Workshop

(§ 1.1)

(§ 1.1.2)

Languages Used

The controller offers 1 programming language:

- FBD language: Function Block Diagram

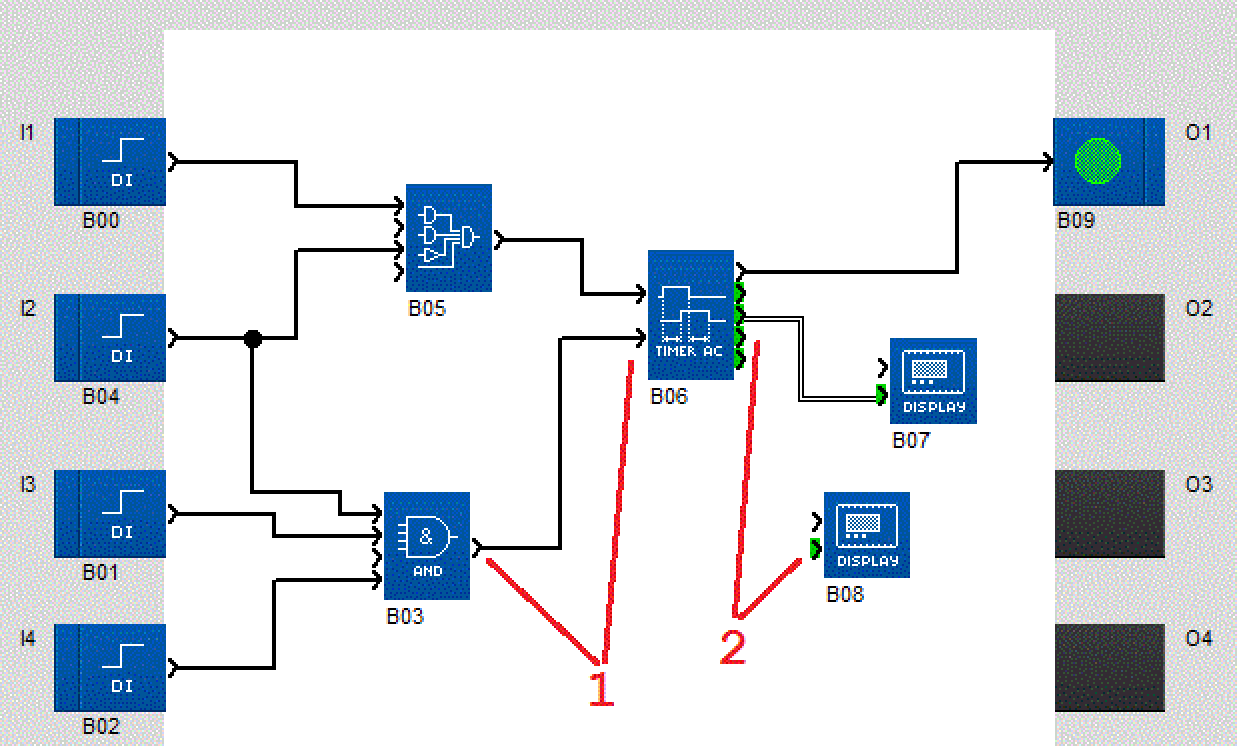
This language use:

- Predefined function blocks:
  - Timers

  - Counters
- Specific functions:
  - Time management
  - Character string
  - Communication, etc.

FBD mode

FBD mode allows graphic programming based on the use of predefined function blocks.
It offers a large range of basic functions: timer, counter, logic, etc.
Example of a program in FBD language:



Connection Types

There are several connection types: bit, analog (integer), SFC(§ 1.4.2.9.1) (Grafcet).

- **Bit: (see 1 in the above drawing)**
  Symbolized by a single black line and a black incoming or outgoing arrow. This connection can take the values 0 or 1.
- **Analog or integer: (see 2 in the above drawing)**
  Symbolized by a double black line and a black incoming or outgoing arrow on a green background. This connection is an integer with a value between -32768 and +32767.

Operating Modes

There are several operating modes for the programming workshop:

- **Edit mode**
  Edit mode is used to construct programs in FBD mode, which corresponds to the development of the application.
  In order to simplify the wiring, note that:
  - Non-connected enable inputs are by default "enabled", see the **Display** blocks in the example.
  - Non-connected inputs in **Logic** blocks are not taken into account, see the **AND, BOOLEAN** blocks in the example.
- **Simulation mode**
  In simulation mode the program is executed offline directly in the programming workshop (simulated on the PC).
  In this mode, each action on the chart (changing the state of an input, output forcing) updates the simulation windows.
- **Debugging mode**
  In Debugging mode, the program is executed on the controller, the programming workshop is connected to the controller (PC ↔ controller connection).

The different windows are updated cyclically.

In simulation and monitoring modes, it is possible to:

- View the output states and function block parameters of the program corresponding to the wiring sheet in the supervision window.
- Force the inputs/outputs to test program behavior under specific conditions.

> **Note**: A non-connected **BIT** input takes the value 0.
> A non-connected **ANALOG** input takes the value 0000.

1.1.2 Creating or Modifying the Configuration of an Application

◁□□□□ (§ 1.1.1) □□□□▷ (§ 1.2)

Introduction

This is an important phase, as it determines the future configuration of the work environment.

Description

The **Menu: File** / **New** 🗋 and the **Menu: Controller** / **Choose the type of controller** are used to choose or modify the type of controller and/or extensions as well as the programming language.

This function displays a series of screens:

- The first is used to choose the type of controller
- The second is used to add an extension if necessary

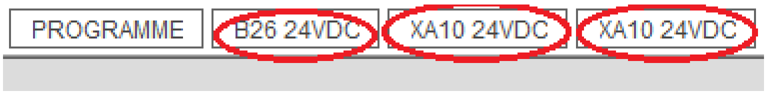
Creating an Application

Procedure for creating an application:

Step	Action
1	Select the menu **File** / **New**. **Result**: The **Choice of Controller** window appears.
2	In the **Select your controller category** zone, select the category by clicking on the corresponding check box. The controllers are grouped by categories corresponding to: • The number of inputs/outputs • The presence or absence of an operator display • to finalising the product. **Result**: the list of corresponding controllers appears in the **Choose the Type of Controller** zone.
3	Select the controller by double-clicking on the corresponding line then confirm using the **Next >** button. **Result**: • In the **Type of Controller** window: a summary of the above selection • In the **Choose Associated Extensions** window ○ **Compatible extensions**: listing the extensions compatible with the base selected above
4	In the **Choose Associated Extensions** zone, select the extension type to be added in the **Compatible extensions** list by double-clicking on the corresponding line or by using the **Add** button. **Result**: the selected extension appears after the drawing of the base. The extension can be removed by clicking on it and then using the **Delete** button.
5	Confirm the configuration by clicking on the **Next>** button.
6	The edit window appears with a blank wiring sheet. For each controller type (+ extensions where applicable) there is a drawing background displayed in the Edit window surrounded by I/O specific to the type chosen as well as a specific set of FB functions and MACRO presented in the function bar. All functions incompatible with the selected controller, or all Macros containing a function incompatible with the selected controller is shown with dark grey shading in the function bar. The names of the controller and extensions are displayed above the wiring sheet

Modifying the Configuration of an Application

Procedure for modifying the configuration of an application:

Step	Action
1	Click on the **menu : Controller** / **Choose the type of controller...** or click the **button of the base or an extension**  **Result**: The **Controller Choice** window appears on screen.
2	Confirm the changes by clicking on the **Next** button. **Result**: The wiring sheet is displayed on the screen.

1.2 How to start with the programming workshop

□□□□ (§ 1.1.2)

□□□□ (§ 1.2.1)

At a Glance

Subject of this Chapter

This chapter explains, through a set of questions and answers, how to use the programming workshop.

What's in this Chapter?

This chapter contains the following topics:

1.2.1 Glossary

◁□□□□ (§ 1.2) □□□□▷ (§ 1.2.2)

Description

Definitions of commonly-used terms are provided to make the help easier to read.

- **AC**: Alternative Current (230AC, 24AC)
- **MAC address**: Media Access Control. Unique (worldwide) hardware address of a network card or peripheral coded on 6 bytes. It is assigned by the device manufacturer.
- **LCD display**: Screen placed on some controller boxes to enable standalone use of the controller (control, parameter setting, monitoring, etc.) via the use of keys.
- **Application**: User program
- **Modular or expandable controller**: Controller that can be connected side-by-side with additional intelligent communication units (Modbus, Ethernet), or I/O units, etc. known as Extensions.
- **Debugging** : Action used to scan data and parameters modified in the controller from the workshop, on a PC (online mode) or on the controller LCD display.
- **FB** : Functional Block : function block used with the FBD
- **FBD**: Function Block Diagram : Programming language
- **Wiring sheet**: Work surface of the Edit window: Includes the input and output plots for an application
- **Drag/Drop**: Operation which consists of left-clicking and moving the mouse while holding down the left button, then releasing the button at the required position on the screen.
- **GRAFCET** : The IEC 60848 GRAFCET is used to describe or specify the system behaviour, from an "external" point of view.
- **Chart**: Drawing of the program in the Edit window (also called diagram)
- **Workshop HMI**: Human Machine Interface of the programming workshop executed on a PC, tablet, etc.
- **LD**: Ladder Diagram
- **Controller software** : Firmware saved in the controller memory. This firmware ensures controller operation.
- **Macro**: A MACRO is a group of function blocks. It is characterized by its number, its name, its links, its internal function blocks and its input/output connections.
- **Archived Macro**: This is a MACRO which is moved using Drag/Drop from the FBD diagram to the function bar's MACRO tab. It is saved in the ClsM3 workshop context for editing new FB.
- **Shortcut menu**: Menu that appears by right-clicking the mouse.
- **Monitoring**: Action used to read/write controller data from an application on a PC, tablet, smartphone, etc.
- **Function bar tab**: Function bar button which displays a series of functions or Macros.
- **Customizable function bar tab**: Function bar button in which the workshop user is able to use Drag/Drop to gather together all the functions and/or Macros he wants. These buttons and their content are saved in the Workshop context for editing new FBD.
- **Gateway**: Device that connects networks of different architectures, working on the application layer. This term may refer to a router.
- **Program**: See application
- **Diagram**: Program drawing in the program window
- **SFC**: Sequential Function Chart, the SFC language is used to describe (part of) the "internal" structure of the system firmware. It is adapted to the "GRAFCET" specification language
- **Supervision**: Term characterizing the HMI Software window displaying the program data and parameters scanned during a simulation or monitoring phase
- **DISCR**: Discrete (digital input or output)
- **Connection types**:
  - DISCR (Discrete)
  - ANA (analog)

- Status token (SFC)

1.2.2 How to create a new program

□□□□ (§ 1.2.1) □□□□ (§ 1.2.3)

Description

See Creating an Application(§ 1.1.2).

See Edit window(§ 1.4.1.1).

1.2.3 How to Program an Application Using the Programming Software

□□□□ (§ 1.2.2) □□□□ (§ 1.2.4)

Description

- FBD Programming from the Programming Software(§ 1.4.3).

1.2.4 How to connect the programming workshop to the controller

□□□□ (§ 1.2.3) □□□□ (§ 1.2.5)

Description

See Configuring the communication between the programming workshop and the controller (§ 1.5.1.1)

See Controller connection(§ 1.5)

1.2.5 How to transfer the program from the PC to the controller

□□□□ (§ 1.2.4) □□□□ (§ 1.2.6)

Description

See Transferring the program from the PC to the controller (§ 1.5.1.2)

See Controller connection(§ 1.5)

1.2.6 How to protect the controller resident program

□□□□ (§ 1.2.5) □□□□ (§ 1.2.7)

Description

See Protection of the program saved on the controller(§ 1.5.1.7)

See Write option window(§ 1.6.1.4)

1.2.7 How to Debug an Application Without Loading it onto the Controller: Simulation

(§ 1.2.6)

(§ 1.2.8)

Introduction

Before loading a program onto a controller, it is possible to simulate execution using the programming workshop.
In simulation mode, for each action that the user performs, there is a corresponding simulation, whose results are displayed in the Front Panel(§ 1.2.7), Edit(§ 1.2.7) and Supervision(§ 1.2.7) windows (not available in this version).

Access

After creating a diagram in the wiring sheet, click on the S icon in the controller bar to access simulation mode.

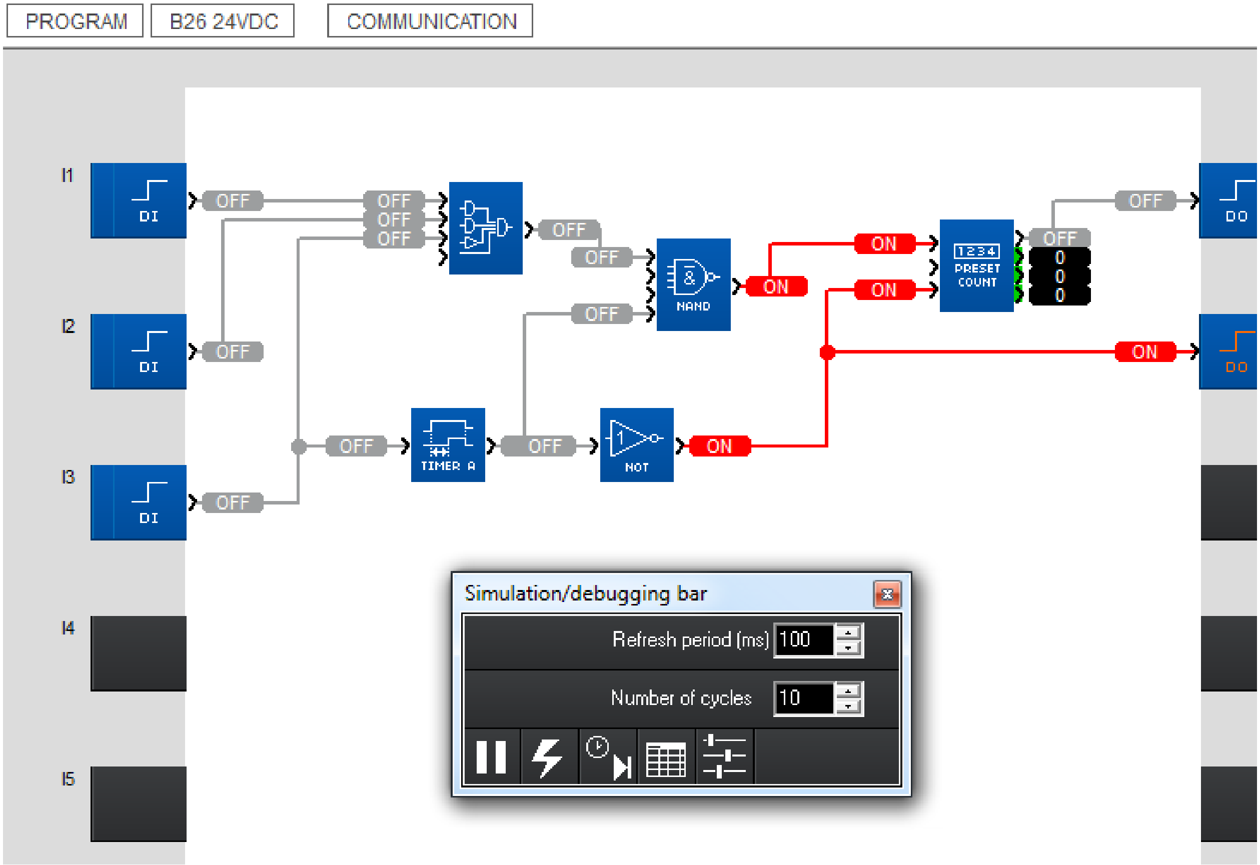
Front Panel Window

The **Front Panel** window is automatically available as soon as Simulation mode is launched. The keys can be used like real keys. Each click allows use of any function that could be accessed from the front panel of a real controller. The result of these actions is then displayed in the simulation on the LCD screen.

In simulation on the "Front Panel" window, click on **OK** with the mouse + **Escape** on the keypad and release simultaneously to replace the display on the DISPLAY screen with the menu display.

The Edit (Simulation Mode) and Supervision Windows (not available in this version)

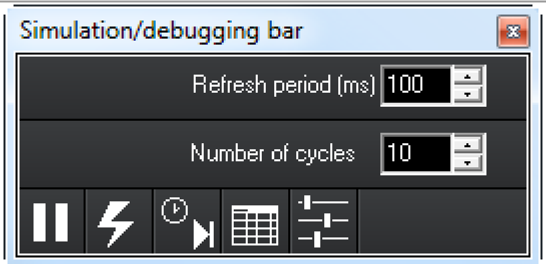
The **Edit** (simulation mode) and **Supervision** windows (not available in this version) accessible via the **menu : Window** are illustrated by an FBD example in the following illustration:



Refresh period (ms) 100

Number of cycles 10

The table below lists the different elements:

Number	Description
1	 Simulation/debugging bar Refresh period (ms) 100 Number of cycles 10 Simulation/debugging The simulation/debugging window is used to modify simulation rates or to simulate certain events affecting the controller. This highlights all the transient problems, in particular upon launching the application and when power is restored following a power failure. The **Refresh period** corresponds to the frequency with which the output and parameter values are updated in the open application windows. The **Number of cycles** integer is the number of cycles executed during a refresh period.
2	Edit window The edit window shows the program on a wiring sheet and is used to view the various states and numerical values being used. The states and values may be temporarily modified or permanently forced by double-clicking or right-clicking.
3 (not available in this version)	Supervision window The supervision window displays inputs and outputs for a selection of functions. The functions are chosen in **Edit** mode, see How to Prepare the Supervision Window(§ 1.2.7).
4	Link in active state The color is different according to state. Active (ON) or Inactive (OFF) state is specified on each side of the link.
5 (not available in this version)	The same function block with animated inputs/outputs and parameters in the edit and supervision windows.

How to Prepare the Supervision Window (not available in this version)

To select the functions to be displayed in the supervision window, proceed as follows.

Step	Action
1	Switch to Edit mode by clicking on the E button.
2	Open the supervision window from the **Window** menu.
3	Select**: Window** / **Tile**. **Result**: The supervision and edit windows appear one below the other.
4	Select a function in the edit window.
5	Drag and drop the function onto the supervision window.
6	Repeat steps 3 to 5 to drop as many functions as necessary.

How to Control Simulation

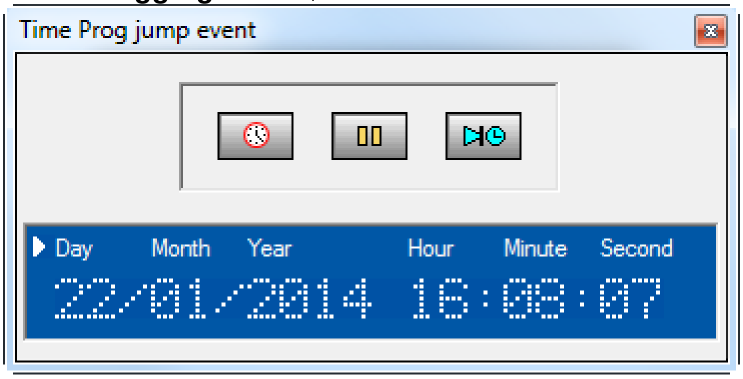
The table below lists the possible actions on a simulation:

To...	proceed as follows:
Stop or restart simulation...	Use the pause button ⏸ in the **Display/Simulation Bar/Debugging** window or the one in the jump event window.
Highlight all transient problems...	Set the **Number of Cycles** to 1 and increase the **Refresh Period** in the **Display/Simulation Bar/Debugging** window
Browse the application operation...	Increase the **Number of Cycles** to 255 in the **Display/Simulation Bar/Debugging** window
Go directly to an event or a date and precise time...	Click on the ⏭ button to go to the Time Prog Jump Event window(§ 1.2.7).
Simulate a power failure followed by a power return...	• Click on the ⚡ button (the simulator clock will freeze).

	Click again on the ⚡ button.
Simulate a power failure followed by a power return at a particular date and time...	Click on the ⚡ button (the simulator clock will freeze). Select**: Controller** / **Read/Write date and time**. Enter the desired date and time for power return in the **Date** and **Time** fields of the Set Clock window. Confirm by clicking on the **Write to the controller** button. Click again on the ⚡ button.
Display a summary table...	Click on the ▦ button to go to the Function Blocks(§ 1.2.7) window.
How to Modify or Force Analog Inputs...	Click on the ☰ button to go to the Modification and Force to Simulation and Debugging mode(§ 1.4.3.3.3) page.

Time Prog Jump Event Window

The **Time Prog Jump Event** window, accessible using the button ⏭ in the **Display/Simulation Bar/Debugging** window, looks like this:



Day Month Year Hour Minute Second
22/01/2014 16:08:07

The table below lists the different elements:

Number	Description
1	The date and time displayed show the simulation time. They depend on the number of cycles executed for each refresh period and on the basic cycle time(§ 1.6.1.1).
2	The **Set Clock** button is used to advance or put back the date and time (confirm by clicking on the **Write to the controller** button).
3	The **Pause** button is used to stop or restart simulation.
4	The **Next event** button is used to advance to the next **Time Prog** event. This button can only be used if events have been defined using a Time Prog function.

Function Blocks Window

The **Function Blocks** window, accessible using the **Summary Table** button ▦ in the **Display/Simulation Bar/Debugging** window, summarizes for each function:

- The symbol
- The type of function
- The block number
- The parameters (for the relevant functions)
- Whether the Save on power failure(§ 1.2.20) option has been selected
- The current value (for relevant functions)
- Whether it is possible to modify function parameters from the controller front panel
- The comment entered by the user

It also provides access to the parameters for each function by double-clicking on the relevant line.

1.2.8 How to Monitor and Modify an Application Running on the Controller: Debugging

(§ 1.2.7) (§ 1.2.9)

Description

To remotely monitor or modify the behavior of a program running on a controller, the user can use the debugging function. This debugging allows the user:

- To temporarily modify or permanently force:
  - Any of the function outputs
  - The majority of the function parameters
  - As well as all the buttons on the controller front panel
- Then to display periodically the execution of the program, observing:
  - The values of the controller I/O and its extensions
  - The block outputs
  - The current state of the parameters and the displays of the controller front panel when online

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Switch to Controller and programming workshop debugging Mode

The programmer can only switch to this mode if the controller:

- contains a program in which parameter modification is not read/write protected by a password
- contains a program in which parameter modification is read/write protected and where the programmer knows the password

The HMI checks whether a password protects the program and parameters or the controller parameters. If this is the case, the HMI displays the Password dialog window. The chart in the Edit window must be consistent with the program in the controller. The HMI starts the "Compare the controller data with the program" function. If a difference is found, the HMI returns to edit mode.

Following these checks, simply click on the D button in the toolbar to switch to debugging mode. After this action, the following is displayed:

- Either, in the controller toolbar, a set of icons that can be used to start and stop application execution in the controller and the frequency at which output and parameter values are updated in the open application windows.
- Or in a "Simulation/Debugging" window

This shows:

- The state of the controller I/O and any extensions
- The program states
- The I/O and parameters (including output parameters) of the FBD function blocks

The current value of each link is displayed near the function block output. Debugging mode is independent of the "Controller On/Off" function. If the controller is off, only modifications to the parameters and the inputs on the buttons of the controller front panel are displayed.

> **Note:** The Debugging mode cannot be considered as a dependable debugging method, because on the online controller that switches to debugging mode, the basic cycle time(§ 1.6.1.1) is extended by the communication times between the PC and the controller and possible permanent forcing times applied to the application. No guarantee can be given concerning the actual duration of cycle times during this operating mode. Moreover, during this operating mode, the WATCHDOG action(§ 1.6.1.1) linked to the application is deactivated.
> In addition, when applications without permanent forcing are executed, the application may run on the controller for a time that is much shorter than the refresh period of the PC debugging windows. It is not therefore possible to observe actions on the controller that are executed at less than twice the debugging screens refresh period (Shannon

sampling rule).

Front Panel Window

This window allows you to click with the mouse on any key on the controller front panel which is depicted in the window. The keys in the Front Panel window can be used like keys on the actual controller front panel. Any function which can be accessed from the front panel of an actual controller can be applied to the actual controller with a single mouse click. The result of these actions is then displayed in the copy on the LCD screen.

Debugging Control

The commands that can be used to control debugging are:

- The **Stop** button on the controller bar
- The **On** button
- The time between 2 displays of controller data on the screen (modifiable value)

The **refresh frequency** of the Debugging bar corresponds to the frequency at which the output and parameter values are updated in the application windows that are open during debugging mode: decreasing this frequency, and consequently the refresh period, reduces the workload of the programming workshop that monopolizes the PC to the detriment of other system or user programs.

Note: Modification of the refresh frequency is essential in order to limit the time allotted to the programming workshop by the Windows system. This is because in older Windows systems or small PC configurations, the load used by the programming workshop in debugging mode significantly slows down open applications running in parallel or system operations.

The Edit Window

Display

- Displays user programs written in chart form.
- Shows the FBD discrete links in "inactive" color.
- Shows the FBD discrete links in "active" color.
- Shows each active step of an SFC chart in "active" color.
- Shows the current value of each numerical link on an FBD chart.
- Animates all FBD functions that have only one discrete output, according to the state of this discrete output.
- Shows the value of all the FBD function parameters, by double-clicking on the function block.

Forced values are highlighted in the Edit and Supervision windows by a change in background color.

FBD Actions

- Can be used to temporarily modify the state of any Discrete or Token output or link of an FBD chart, by left-clicking on it with the mouse (change from ON/OFF).
- Can be used to temporarily modify the state of any FBD chart output or numerical link, by left-clicking on it with the mouse, entering a signed integer value in the "Analog Value" window, and then confirming by pressing OK.
- Can be used to permanently force the state of any Discrete or Token link or output of an FBD chart, by right-clicking on it with the mouse, selecting "Force and maintain" in the menu displayed, entering ON or OFF in the "Permanent Forcing" window, and then confirming by pressing OK.
- Can be used to permanently force the state of any numerical link output of an FBD chart, by right-clicking on it with the mouse, selecting "Force and maintain" in the menu displayed, entering a signed integer value in the "Analog Value" window, and then confirming by pressing OK.
- Can be used to modify the value of a subset of FBD function parameters, by double-clicking on the function block, modifying one or more of the non-grayed out parameters and confirming by pressing OK.,
- Can be used to release a forced output or link by right-clicking on it with the mouse and selecting "Release" in the menu displayed.
- Can be used to release all forced outputs or links by right-clicking in the window with

the mouse and selecting "Release all" in the menu displayed.

Supervision Window (not available in this version)

Display

- Displays the FBD edit functions selected in this window as FBD function blocks.
- Shows the discrete FBD function block outputs that are OFF in "inactive" color (blue by default).
- Shows the discrete FBD function blocks that are ON in "active" color (red or pink by default) (discrete outputs and FBD blocks that are active and not supplied with power are displayed in orange).
- Shows each active step of an SFC chart in "active" color (red by default).
- Shows the current value of each numerical output of an FBD function block.
- Animates all FBD function blocks that have only one discrete output, according to the state of its discrete output.
- Shows the value of all the FBD function block parameters, by double-clicking on the function block or right-clicking on each contact or coil with the mouse, and then selecting "Settings window" in the menu that is displayed.

Forced values are highlighted in the Edit and Supervision windows by a change in background color.

Actions

- Can be used to temporarily modify the state of any Discrete or Token output of an FBD function block, by left-clicking on it with the mouse (change from ON/OFF)
- Can be used to temporarily modify the state of any FBD function block output or numerical link, by left-clicking on it with the mouse, entering a signed integer value in the "Analog Value" window, and then confirming by pressing OK.
- Can be used to permanently force the state of any Discrete or Token output of an FBD function block, by right-clicking on it with the mouse, selecting "Force and maintain" in the menu displayed, entering ON or OFF in the "Permanent Forcing" window, and then confirming by pressing OK.
- Can be used to permanently force the state of any numerical output of an FBD function block, by right-clicking on it with the mouse, selecting "Force and maintain" in the menu displayed, entering a signed integer value in the "Analog Value" window, and then confirming by pressing OK.
- Can be used to modify the value of a subset of FBD function block parameters, by double-clicking on the function block, modifying one or more non-grayed out parameters, then confirming by pressing OK. This action can also be performed by right-clicking each contact or coil with the mouse, then selecting "Settings window" in the menu displayed, modifying one or more non-grayed out parameters, then confirming by pressing OK.
- Can be used to release a forced output by right-clicking on it with the mouse and selecting "Release" in the menu displayed.
- Can be used to release all forced outputs by right-clicking in the window with the mouse and selecting "Release all" in the menu displayed.

1.2.9 Meaning of the Error Codes on the Controller Front Panel

◁□□□□ (§ 1.2.8) □□□□▷ (§ 1.2.10)

Description

See Description of Errors(§ 1.6.1.12)

See Fault menu(§ 1.3.4.2)

1.2.10 How to diagnose the state of the controller

◁□□□□ (§ 1.2.9) □□□□▷ (§ 1.2.11)

Description

See Controller diagnostics(§ 1.5.1.6)

See Version menu(§ 1.3.4.3)

1.2.11 How to control the controller from the programming workshop

(§ 1.2.10) (§ 1.2.12)

Description

See ON/OFF program execution commands(§ 1.5.1.4).

See Debugging Mode

1.2.12 How to Control the Controller from the Front Panel

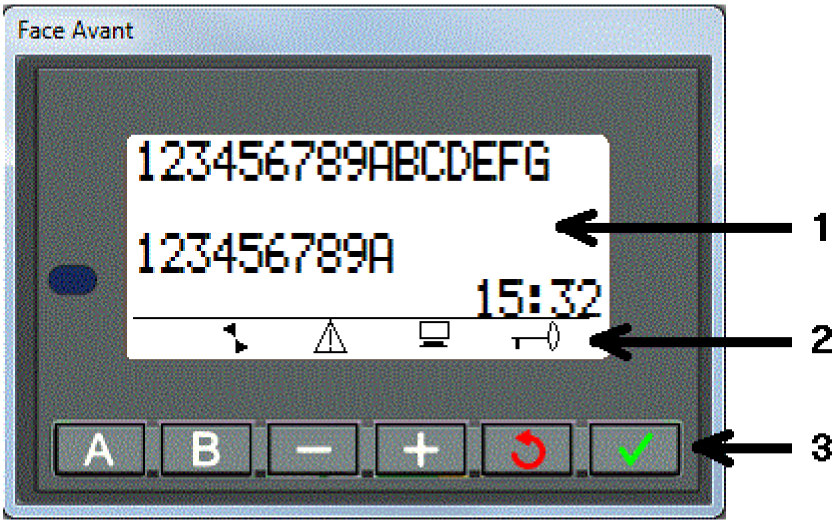
(§ 1.2.11) (§ 1.2.13)

Description

The LCD display and the command keys can be used to:

- Identify the controller and its extensions
- Monitor the state of the controller
- Configure the controller and its extensions (date, time, etc.)
- Configure and execute a user program
- Transfer user programs to and from a memory cartridge

The front panel looks like this:



1 First 4 lines on the screen where the menus and elements associated with each menu are displayed.
2 Illustrative symbols (in the above example all 4 symbols are present)
3 Command keys

Note: By default the LCD screen is on
The LCD screen is switched on and off using the "Light" FB, should it be OFF.

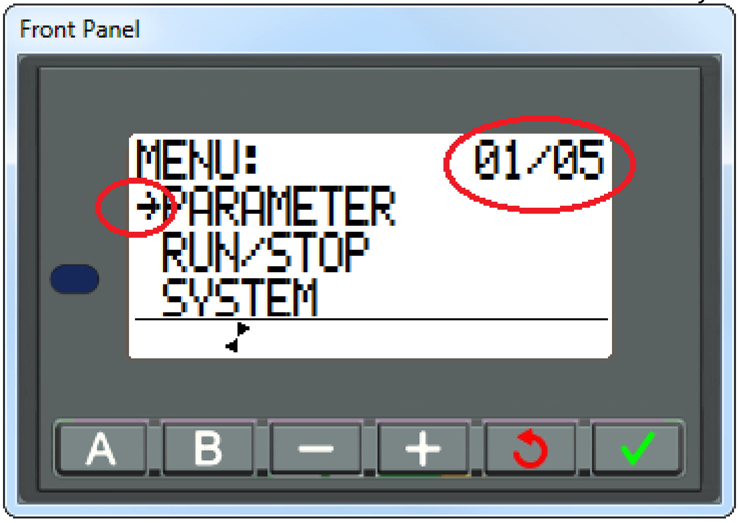
First 4 Lines

On the first 4 lines of the screen, the display consists of:

- Either information
- Or several actions that can be selected. In this case, only the field that flashes can be selected and its selection triggers an action

An arrow indicates the selected menu.
Should the information and actions to be performed not fit in the 4 lines, the line number and total number of lines are displayed in the top right-hand corner.

These lines can be accessed via the ⊟ and ⊞ keys.



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On the product, pressing the **OK** (green) and **ESC** (red) keys simultaneously replaces the display on the DISPLAY screen with the menu display.

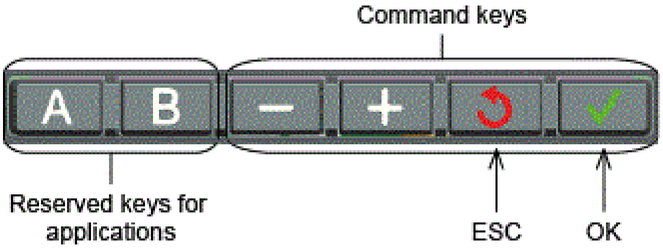
Symbols

The symbols are described in the table below:

Symbol	Meaning
✦	State of the controller. In ON mode it is moving, in OFF mode it is stationary.
⚠	Faults have appeared (see FAULT menu(§ 1.3.4.2)).
🖥	The controller is connected to the programming workshop.
🔑	The application is protected by a password.

Command Keys

The command keys are the 4 right-hand arrow keys:



The command keys are described in the table below:

Key	Functions according to the situations
⊟	• Movement in the screen downwards or to the right • Decrease a previously selected value
⊞	• Movement in the screen upwards or to the left • Increase a previously selected value

↺	- Display of the screen for the menu associated with the field that is flashing - Selection of a value to be modified
✓	- Return to the previous menu when the application is **OFF** - Return to the I/O menu or possibly an active menu when the application is **ON**

1.2.13 How to Configure an Application from the Controller Front Panel

(§ 1.2.12) (§ 1.2.14)

Description

Setting the parameters for a user program makes it possible to:

- Change the Summer time and Winter daylight saving time switchover settings
- Configure each of the functions that make up the application

A function’s parameters can only be set from the controller front panel if **Modification authorized** has been checked for this function in the programming workshop.

See PARAMETERS Menu(§ 1.3.2)

1.2.14 How to Dynamically Modify Program Data Using the Controller Front Panel

(§ 1.2.13) (§ 1.2.15)

Description

Program data can be modified dynamically, using the **FBD Display** function. See FBD DISPLAY(§ 1.4.2.4.1)

1.2.15 How to recover the controller resident program in the programming workshop

(§ 1.2.14) (§ 1.2.16)

Description

See Transferring the program from the controller to the PC (§ 1.5.1.3)

See Compare the Data in the Controller with the Program(§ 1.5.1.5)

1.2.16 How to Check an Application Using the Programming Workshop

(§ 1.2.15) (§ 1.2.17)

Overview

The check command launches program compilation.

Two types of check can be used for an application:

- The first checks consistency of the diagrams
- The second checks the performance of the user application, i.e. the compatibility of:
  - The memory usage
  - The user application cycle times
  - The memory capacities

  - The controller execution speed

Diagram Consistency Check

Compilation is carried out automatically in the following cases:

- Switching from Edit mode to Simulation/Debugging mode
- Transferring the program to the controller

Consistency of FBDs: This only concerns SFC network wiring errors. FBD networks always behave consistently: inconsistent wiring is impossible, and if an input is not hard-wired it is set to a constant value that does not affect execution of the function or makes it passive. See the online help for each function.

User Application Performance Check

This appears in the **Compilation Result** window in the following cases:

- Activation of the **menu/Controller/Check the program**
- Switching from Edit mode to Simulation/Debugging mode
- Transferring the program to the controller

These performance checks are useful on a simulator as they can be used to obtain a controller that meets the requirements of the proposed application, once the application has been created and simulation-tested.

> **Note:** When optional, the window is only displayed when the controller capacities (memory space and execution speed) are too low in relation to the user program being checked.

> **Note:** The compilation time for programs that use more than 128 FBDs or SFCs and numerous loops, may exceed several minutes.

User Application Memory Size Check

The program compiler calculates the volumes used in the different controller memory zones:

- Parameters.
- Bit data (block outputs):
- Other data (function block outputs).
- Program zone: the number of bytes corresponding to all program function blocks displayed in FBD, and all functions that can be programmed on the selected controller type (independently of the programming workshop).

In the event of capacity overflow, the window is still displayed and the overflow zones are shown in red.

The zones shown in blue alert the user to the fact that the size of the application memory zone concerned is very close to the maximum capacity of the corresponding memory zone on the selected controller.

User Application Estimated Duration Check

The compiler also calculates the estimated duration of the program by adding together the individual cycle times of each function used.

The user application runs periodically and its execution period is defined by the user in the basic cycle(§ 1.6.1.1) time.

This time corresponds to the minimum sampling period of the controller inputs (exception: High-speed counter function) and the minimum time for modifying the output values. The application response time is therefore twice the duration of this period.

> **Note:** (Take account of the fact that the compiler arranges the functions of an FBD diagram from inputs to outputs, cutting the loops as close as possible to the outputs and SFC diagrams from each INIT STEP or RESET INIT, to the downstream steps.)

Not all automation applications need blocking on overrun of the target application execution period. Indeed, in some cases such blocking is dangerous.

Consequently, the user may decide whether or not to use a WATCHDOG(§ 1.6.1.1) that will generate an alarm or error if the application is in ON mode on the controller, when the application cycle time, added to the duration of the processing specific to

operation of the controller and any extensions, exceeds the duration of the selected period.
A WATCHDOG warning may be returned to an FBD program to enable activation of a retrieval sequence in the application. This is done using the controller status(§ 1.4.2.6.11) function.

> **Note:** All functions have a defined maximum cycle time, with one exception in FBD: The cycle time of the TIME PROG function may vary from 1 to 51 depending on the number of events used.

To determine the duration of the program execution period, programmers must:

- Take into account the estimated duration in the compilation results table.
- Carefully read and apply the recommendations written in the online help file: available duration for the program.

To guarantee a constant program cycle time, you must also carry out appropriate tests on the controller to verify that alarm or error 505 does not appear.

Duration of Processing Specific to Operation of the Controller and any Extensions

In addition to the processing time for the function blocks contained in the application program, there are a number of additional processing operations during an execution period which can easily be defined (as long as fixed) and are therefore taken into account when calculating the time available for executing the application on each period (compilation result).
But there are others, which can be either occasional or hard to quantify or account for.
Episodic processes:

- Clock management: switch between summer and winter time.
- Compensation for clock drift once a week, every Sunday at 1 o'clock in the morning.

The WATCHDOG is always ineffective while one of these operations takes place.

> **Note:** If the application presents no danger to people or equipment in the event of an increase in the cycle time, simply disable the WATCHDOG(§ 1.6.1.1). Otherwise, you must check the maximum execution period.

> **Note:** Modifying parameters using other commands (PARAMETERS, etc.) increases the application execution period by a variable time. The WATCHDOG is always ineffective in this controller operating mode (Controller status(§ 1.4.2.6.11)).

> **Note:** In the same way, the display of various data (text, data, hour, date) by active functions, on the controller LCD display increases the application cycle time by a variable duration. This duration depends on the type of data to be displayed and, for the FBD, on the number of DISPLAYS simultaneously active.

> **Note:** In Debugging mode, the cycle times are increased by the communication times between the PC and the controller. No guarantee can be given concerning the actual cycle times during this operating mode. The WATCHDOG is always ineffective in this controller operating mode (Controller status(§ 1.4.2.6.11)).

Maximum Application Execution Period on the Controller Check

Given the problems of accurately estimating the user application cycle time and that of certain processing operations specific to controller operation, in which increasing the application execution period may present a danger to people or equipment, you must perform the relevant tests on the controller to make sure that alarm 505 (cycle overflow) does not appear, in order to guarantee the maximum cycle time of your program. See WATCHDOG(§ 1.6.1.1).

1.2.17 How to check the controller software

□□□□ (§ 1.2.16)

□□□□ (§ 1.2.18)

Description

See Controller diagnostics(§ 1.5.1.6)

See Fault menu(§ 1.3.4.2)

1.2.18 How to use the backup memory cartridge

(§ 1.2.17)

(§ 1.2.19)

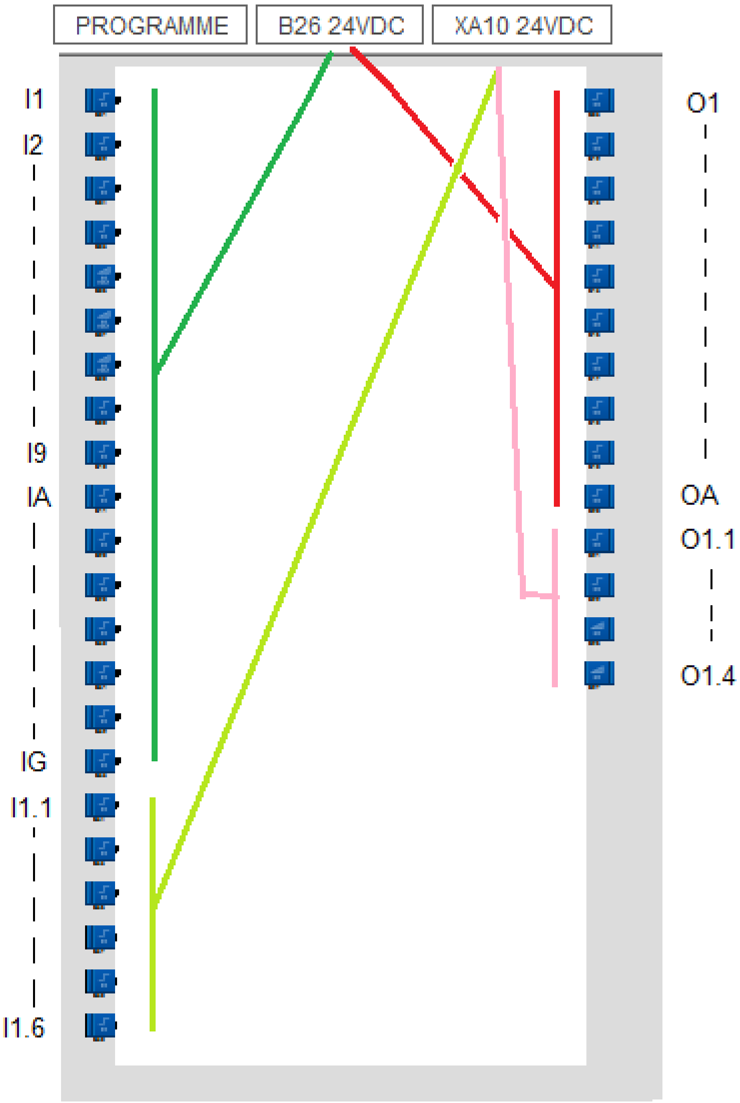
Description

Physical Inputs/Outputs are addressed as "row" "column" depending on their position:

	Base	Extension 1	Extension 2
Column	0	1	2
Row	1 ... 9, A..F	1 ... 9, A..F	1 ... 9, A..F
Addressing Inputs	from 0.1 to 0.F	from 1.1 to 1.F	from 2.1 to 2.F
Addressing Outputs	from 0.1 to 0.F	from 1.1 to 1.F	from 2.1 to 2.F

Note: in the workshop, the 0. is implicit for the base

Example with a 16 I/O base and a 10 I/O extension



1.2.19 How to Configure the Language of the Programming Workshop and the Controller

(§ 1.2.18) (§ 1.2.20)

Description

To configure the language used in the programming workshop and on the controller front panel, proceed as follows:

Step	Action
1	Use the **menu: File (§ 1.6.1.2)** → **Preferences ...** in the programming workshop.
2	Update the controller software(§ 1.5.1.11).

1.2.20 How the Controller Behaves in the Event of Power Failure

(§ 1.2.19) (§ 1.2.21)

Power Failure

A power failure causes the following behavior:

- The application is blocked, the controller LCD display freezes, and the buttons stop working and all controller outputs are deactivated..

- The programming software displays the following message: The target peripheral is not reacting. Check the connection.
- All communication stops
- The date and time continue to increment during the power failure on controllers equipped with a clock (battery powered).

Restart Following a Power Failure

The controller checks all its extensions are operating normally, then returns the data saved on the power failure, and restarts the application execution with a specific initialization sequence for power return.
This sequence initializes all function inputs and outputs, except the outputs of the functions protected by a checked **Save on power failure** parameter.
In this case, these outputs are not reset, and therefore retain the value they had at the time of the power failure.
To find out which function outputs are protected on power failure, consult the function description.

1.2.21 How to Import an Application Developed with Millenium 2 into Millenium 3

⇦□□□□ (§ 1.2.20)

□□□□⇨ (§ 1.2.22)

Description

See Conversion of Older Applications Using e**m4**(§ 1.6.1.7).

1.2.22 How to customise the function bar

⇦□□□□
(§
1.2.21)

□□□□⇨ (§ 1.3)

Role and Content of the function bar

To realise a FBD program, the different functions or Macros to be inserted in the wiring sheet are found in a function bar. A function type is brought together in each of the function bar's tabs.

When the mouse passes over one of the tabs, the dialogue box displays the types of functions that it contains.

This function bar is divided into four parts:

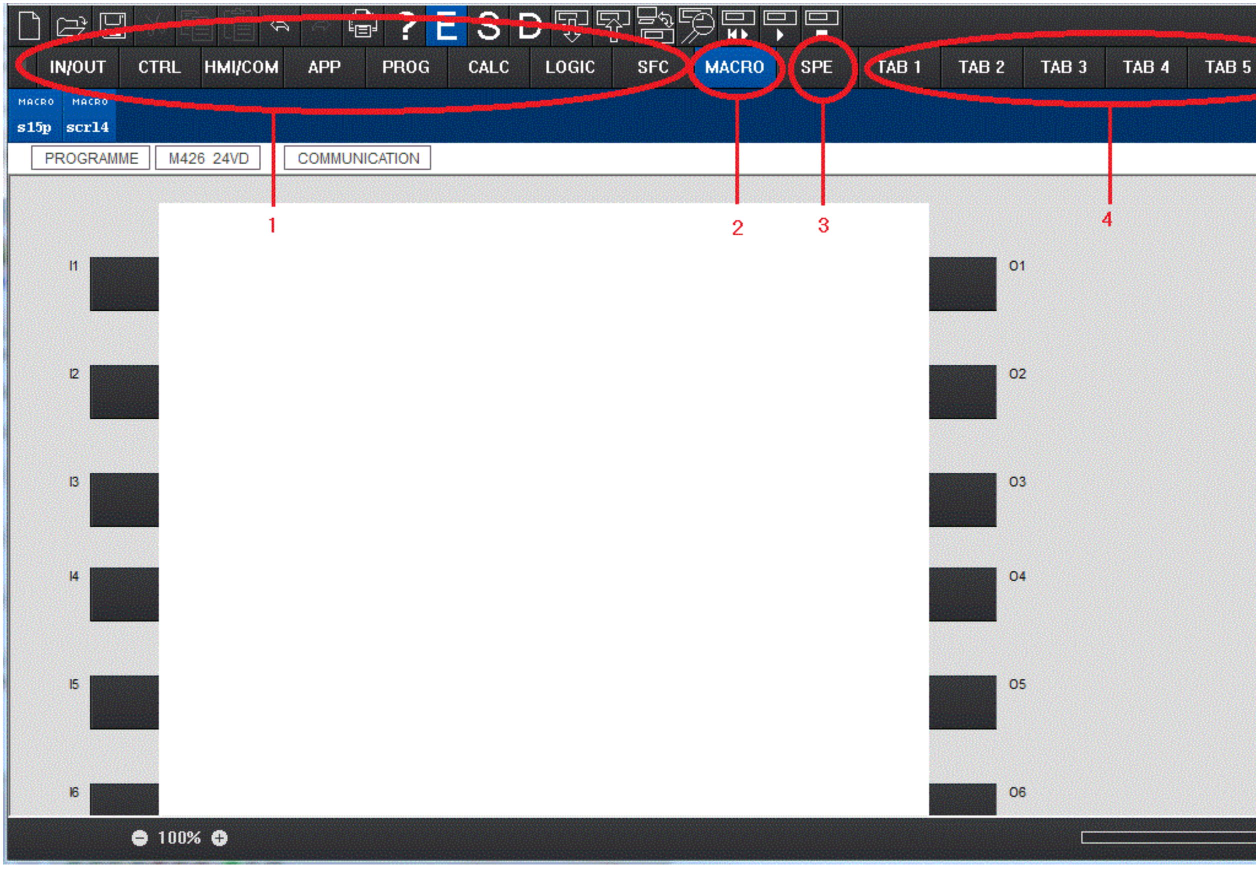
1 All the manufacturer tabs that contain all the application-specific functions and the standard functions available with the ClsM3 workshop. These tabs are situated to the left of the function bar.

2 The MACRO tab that contains all the macros archived by the ClsM3 workshop user.

3 The SPE function tab that contains all the application-specific functions for a given user.

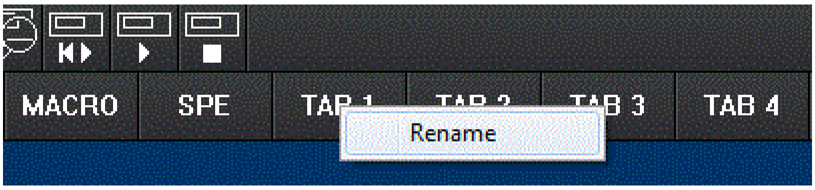
4 All the customizable tabs that contain, by type defined by the user, the standard functions, the application-specific functions and the archived macros.These tabs are situated to the right of the function bar.

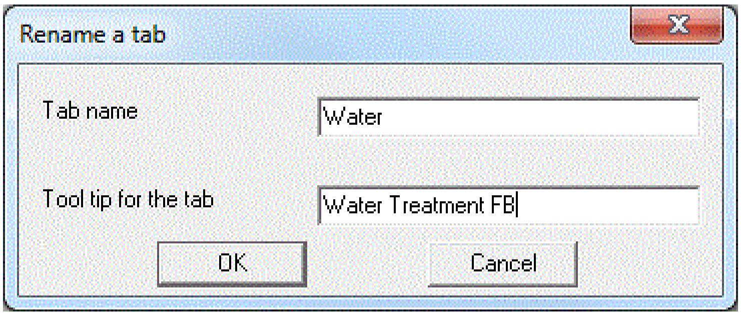
Exemple :



Rename a customizable tab

A customizable tab is selected by a left-click on the mouse above this tab. This displays the tab's content. A right-click opens a contextual menu.



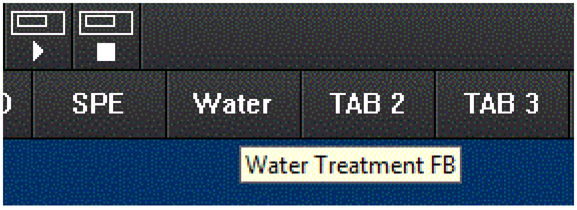


Tab name: Water

Tool tip for the tab: Water Treatment FB

Activate the Rename command, Enter a name not exceeding 9 characters and confirm your choice by clicking on OK. The name appears in the tab.

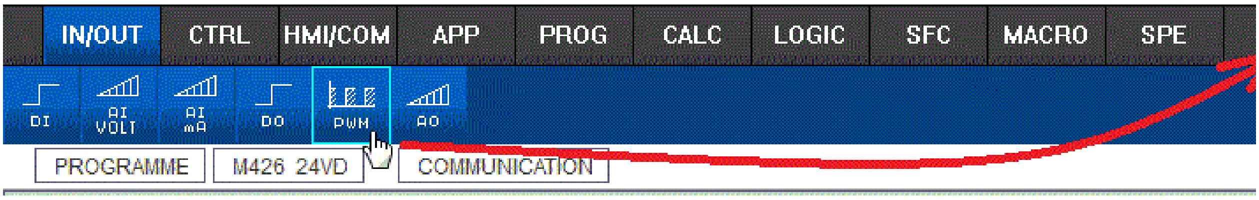
For example: here "Water" and in the tool tip: "Water treatment FB".

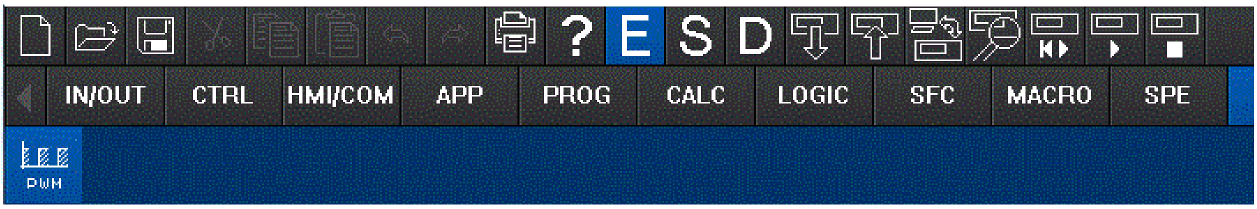


Store the functions and macros in a customizable tab

To store functions or macros in a customizable tab, the user may:

- Either select (left-click) a function or a MACRO in one of the manufacturer tabs, in the SPE tab, or in the MACRO tab and Drag/Drop it on the name of the customizable tab chosen. Scroll down with the cursor, a "+" appears, release.
- Or select (left-click) a function on the wiring sheet and Drag/Drop it to the name of the customizable tab chosen. Scroll down with the cursor, a "+" appears, release.

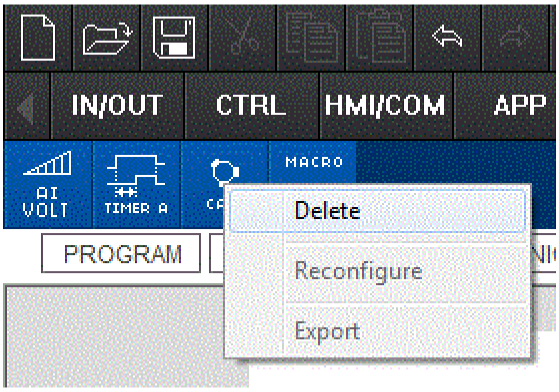




Note: the functions will be stored in the customizable tab according to the order in which they have been introduced into this tab.

Delete the functions and macros in a customizable tab

To remove functions or macros from a customizable tab, the user must select (right-click) a function or a MACRO in one of the customizable tabs to display the contextual menu and activate the Delete command.



1.3 Functions Accessible from the Front Panel

(§ 1.2.22) (§ 1.3.1)

At a Glance

Subject of this Section

What's in this Part?

This part contains the following chapters:

- How to Control the Controller from the Front Panel?(§ 1.2.12)
- INPUTS-OUTPUTS Screen(§ 1.3.1)
- PARAMETER Menu(§ 1.3.2)
- RUN/STOP Menu(§ 1.3.3)
- SYSTEM Menu(§ 1.3.4)
- INTERFACE Menu(§ 1.3.5)
- COMMUNICATION Menu(§ 1.3.6)

1.3.1 INPUTS-OUTPUTS Screen

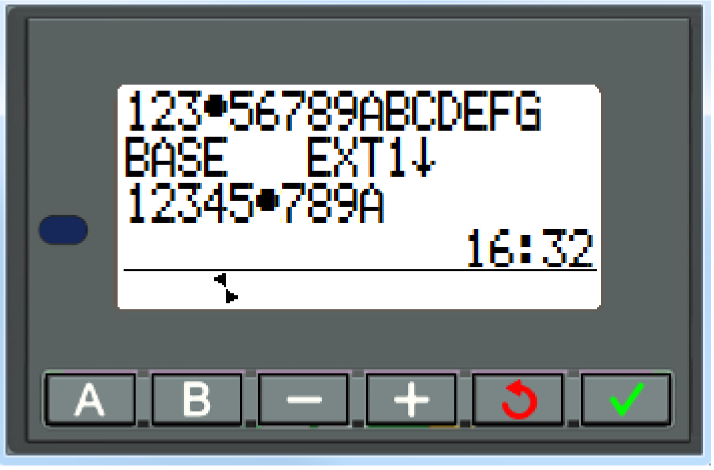
(§ 1.3) (§ 1.3.2)

Description

The **INPUTS-OUTPUTS** screen is displayed by default, when no display function (**TEXT** or **DISPLAY**) is active and regardless of:

- The programming type
- The mode: **OFF** or **ON**

Illustration:



Line 1 : State of inputs: 1 to 9, A to G

Line 2: if there is an extension (indicated here by EXT1), the state of the I/O can be seen by by pressing the "-" key

Line 3 : State of outputs: 1 to 9, A.

Line 4 : Clock.

When the program is in **ON** mode, active states of the I/O are indicated by a dot (e.g.: input 4, output 6).

INPUTS.

- The dot indicates that the bit input is physically at 1. If this input is analog, it is the switching threshold which is represented.

OUTPUTS.

- The dot indicates that the output has been activated by the application but does not represent the actual output status. For example in the case of an overloaded solid-state output, it is activated by the application but released by the electronics for safety.

Access to the Main Menu

Pressing the **OK** key switches the display from the INPUTS-OUTPUTS screen to the main menu:

- PARAMETERS Menu(§ 1.3.2)
- ON/OFF Menu(§ 1.3.3)
- SYSTEM menu(§ 1.3.4)
- INTERFACE Menu(§ 1.3.5)
- COMMUNICATION Menu(§ 1.3.6)

Display Functions

The main **INPUTS-OUTPUTS** screen is replaced by the content of the display functions if a **DISPLAY** or **TEXT** function is active.
If several display functions are active simultaneously, all the blocks are displayed. If there is any overlap between the fields displayed, the DISPLAY for the highest block number is shown.

Switching Between Screens

It is possible to go from the **DISPLAY** or **TEXT** screen to the **INPUTS-OUTPUTS** screen and vice-versa.

To:	**proceed as follows:**
Display the inputs-outputs screen...	Press and hold down the key ⟲.
Go back to the **DISPLAY** or **TEXT** screen...	Release the key ⟲

1.3.2 PARAMETERS Menu

◁□□□□ (§ 1.3.1) □□□□▷ (§ 1.3.3)

Description

This menu is used to enter and modify the application parameters directly on the screen using the controller keys.
If there are parameters authorized for changing they are listed in the window; otherwise a **NO PARAMETERS** message appears.
Modification is possible in controller ON and OFF mode .

FBD Mode

The FBD functions with modifiable parameters are the following:

- Numerical Constant-Type (NUM) Inputs(§ 1.4.2.3.6),
- Clocks (Time Prog)(§ 1.4.2.3.14),
- Gain(§ 1.4.2.7.1),
- Timers(§ 1.4.2.3.1): TIMER A/C, Timer BW, TIMER B/H, TIMER Li, Totalisers,
- Counters: PRESET COUNT(§ 1.4.2.3.16),
- CAM block(§ 1.4.2.5.1),
- Preset H-Meter(§ 1.4.2.3.18),

Only the functions used in the program, that have parameters, and whose option **Authorized Modification** option is enabled are listed in the **PARAMETER** menu.

Parameter Modification

Parameter modification procedure:

Step	**Action**

1	Place the cursor over the **PARAMETERS** menu in the main menu (PARAMETERS flashing) and confirm by pressing the **OK** button ✓. **Result:** the parameters window opens to the first parameter.
2	Select the block to modify: - place the cursor over the number of the function block, - press the **OK** button, - Use the ⊞ and ⊟ keys to scroll through the function block numbers, until you reach the right one, - confirm by pressing the **OK** button.
3	Select the name of the parameter to modify: - place the cursor over the name of the parameter of the function block, - press the **OK** button, - Use the ⊞ and ⊟ keys to scroll through the names of the parameters, until you reach the right one, - confirm by pressing the **OK** button.
4	Select the value of the parameter to modify: - Place the cursor over the value to modify. - press the **OK** button, - Use the ⊞ and ⊟ keys to scroll through the possible values, until you reach the right one, - confirm by pressing the **OK** button.
5	Repeat steps 2, 3 and 4 for each to the functions to modify.
6	Press twice on the **ESC** ↺ button to return to Inputs/Outputs screen.

1.3.3 ON/OFF Menu

⇦ (§ 1.3.2) ⇨ (§ 1.3.4)

Description

This function is used to start or stop the program in the controller:

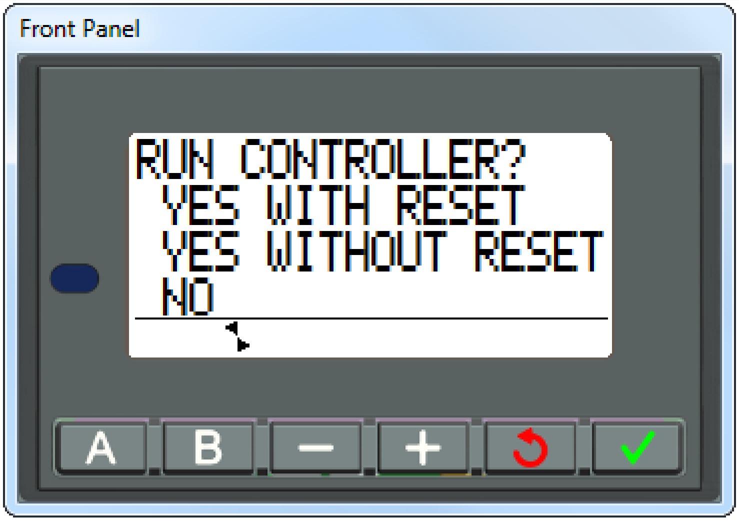
- In **OFF** mode: The program is stopped and the outputs disabled.
- In **ON** mode (with or without initialization of saved parameters): The program is executed.

Startup

In OFF mode, when the ON/OFF menu is accessed, the interface offers the user the following 3 choices to start the program:

- **ON**: The current values for which the **Save on power failure** option was activated are maintained.
- **RESET SAVED VALUES AND START**: All current values (counters, timers, etc.) are reset before the program starts (default selection).
- **CANCEL**: The program is not started.

Illustration:



RUN CONTROLLER?
 YES WITH RESET
 YES WITHOUT RESET
 NO

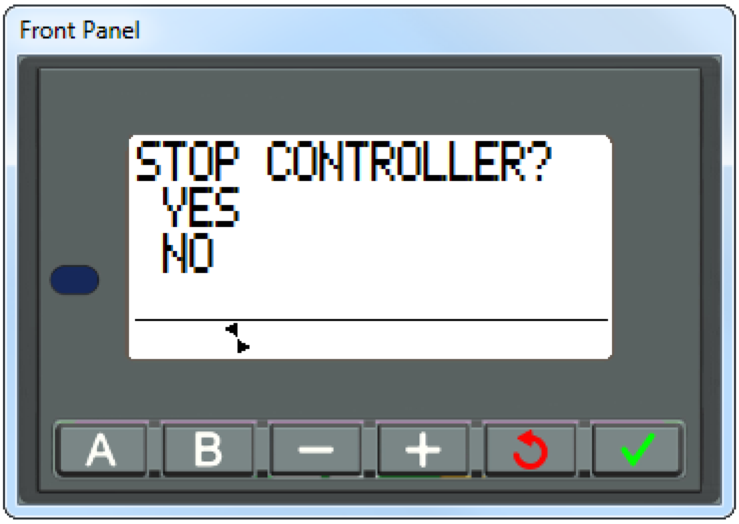
The navigation keys (+, -) are used to change the selection.

Off

In ON mode, when the ON/OFF menu is accessed, the interface offers the user the following 3 choices to start the program:

- **YES** : the controller changes to OFF then back to the previous menu
- **NO** : the controller stays ON then back to the previous menu

Illustration :



STOP CONTROLLER?
 YES
 NO

The navigation keys (+, -) are used to change the selection.

Case of the LED

The LED on the front panel of the controller acts as an indicator light:

- If the LED flashes slowly (3 Hz), the controller is OFF (even if there is a non-blocking fault).
- If the LED flashes quickly (5 Hz), the controller is OFF with a fault.
- If the LED remains on, the controller is powered up and ON.

Note: On power-up, the controller is ON, except in the event of a blocking fault.

Note: To acknowledge a blocking fault, power down the controller, then power it up again.

1.3.4 SYSTEM Menu

◁□□□□ (§ 1.3.3) □□□□▷ (§ 1.3.4.1)

At a Glance

Subject of this Chapter

The **SYSTEM** menu gives access to the following functions:

- CLOCK(§ 1.3.4.1)
- FAULT(§ 1.3.4.2)
- VERSION(§ 1.3.4.3)

Note: use the navigation key to return to the main menu ⟲.

1.3.4.1 CLOCK Menu

⇦□□□□ (§ 1.3.4) □□□□⇨ (§ 1.3.4.1.1)

At a Glance

Subject of this Chapter

The **CLOCK** menu provides access to the following functions:

- CHANGE DAY/HOUR Menu(§ 1.3.4.1.1)
- CHANGE SUMMER/WINTER Menu(§ 1.3.4.1.2)

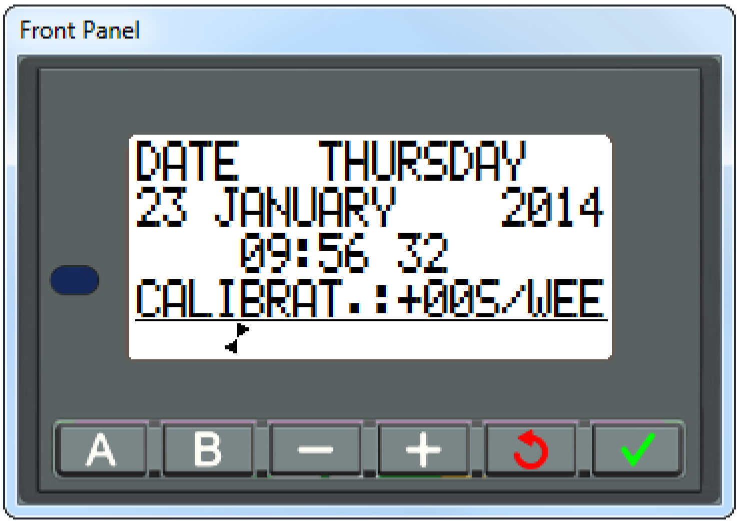
Note: use the navigation key to return to the main menu ⟲.

1.3.4.1.1 CHANGE DATE/TIME Menu

⇦□□□□ (§ 1.3.4.1) □□□□⇨ (§ 1.3.4.1.2)

Description

This function is used to configure the date and time on controllers that have a clock.
Illustration:



```
DATE    THURSDAY
23 JANUARY    2014
     09:56 32
CALIBRAT.:+00S/WEE
```

The modifiable parameters are:

- Day/month/year
- Hour, minutes, seconds
- CALIBRAT: Calibration of the controller internal clock in seconds per week

Clock Calibration

The quartz that controls the controller's real-time clock has a variable monthly drift depending on the environmental conditions in which the controller is used.
The maximum value for this drift is approximately one minute per month.
To estimate this drift, observe the drift on the controller clock compared to a standard reference clock for a few weeks or more.

Example:

If you wish to compensate this drift, you can, for example, make a -15 second correction per week to compensate for a + 60 second drift per month. This compensation is executed on Sunday at one o'clock in the morning.

> **Note:** This correction will be pointless if the controller is subject to prolonged power failures or to signification temperature variations.

Clock Configuration

Procedure:

Steps	Description
1	Select the parameter to modify using the navigation keys ⊟ and ⊞.
2	Press the **OK** key ☑. **Result**: The selected parameter flashes.
3	Modify the parameter value. The navigation keys ⊟ and ⊞ are used to change the current value.
4	Confirm your changes by pressing the **OK** key ☑.

> **Note:** The controller contains a software module that determines the day of the week when the user selects the day of the month in the year.

> **Note:** You are not allowed to modify the time on a product between 02.00 and 03.00 in the morning on the changeover days from summer to winter time (at 03.00 it is 02.00).

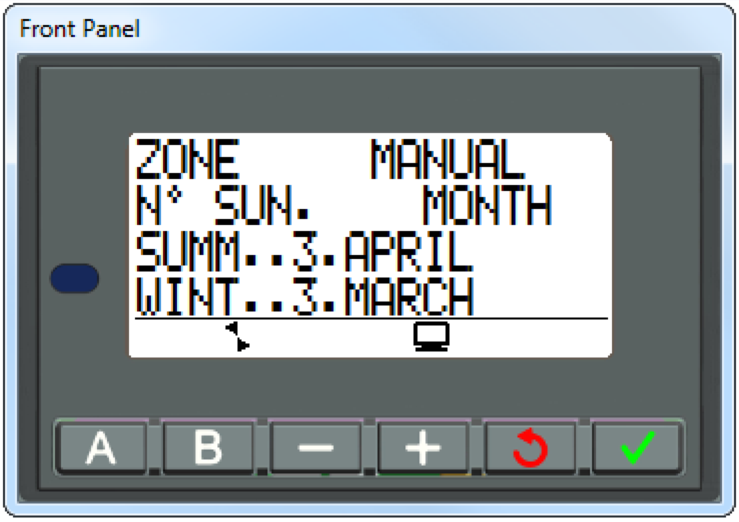
1.3.4.1.2 CHANGE SUMMER/WINTER Menu

◁□□□□ (§ 1.3.4.1.1)

□□□□▷ (§ 1.3.4.2)

Description

This function is used to change the daylight saving time automatically (summer/winter) for controllers with a clock.
Illustration:



```
ZONE      MANUAL
N° SUN.     MONTH
SUMM..3.APRIL
WINT..3.MARCH
```

The possible operating modes are as follows:

- **DISABLED**: no change
- Depending on the zone: The change takes place automatically, the dates are preset according to the geographic zone:
  - **EUROPE**, or
  - **USA**
- **MANUAL**: The change takes place automatically, but you must specify the date of the change, for both summer and winter, as follows:
  - Month: **MONTH**
  - Number of the Sunday in the month: **SUN No.** (1, 2, 3, 4 or 5)

Configuring the Time Change

To configure a time change, proceed as follows:

Step	Action
1	Select the parameter to modify using the navigation keys − and +.
2	Press the green **OK** key ✓. **Result**: The selected parameter flashes.
3	Modify the parameter value. The keys − and + are used to change the current value.
4	Confirm your changes by pressing the green **OK** key ✓.

Note: You are not allowed to modify the time on a product between 02.00 and 03.00 in the morning on the changeover days from summer to winter time (at 03.00 it is 02.00).

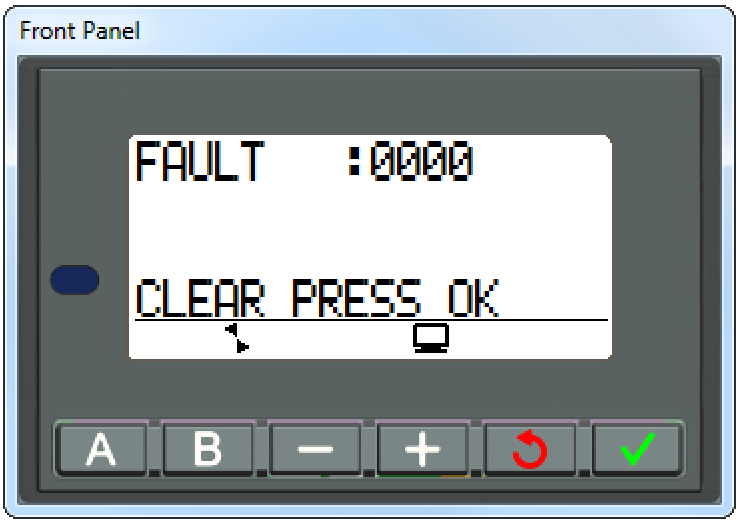
1.3.4.2 FAULT Menu

(§ 1.3.4.1.2) (§ 1.3.4.3)

Description

When a fault is detected by the controller software, an icon appears at the bottom of the screen. The FAULT menu is used to display the type of fault: error or warning, cycle overflow, basic cycle time too long, etc.).

Illustration:



Front Panel

```
FAULT    :0000

CLEAR PRESS OK
```

Description of Errors

See Description of Errors(§ 1.6.1.12)

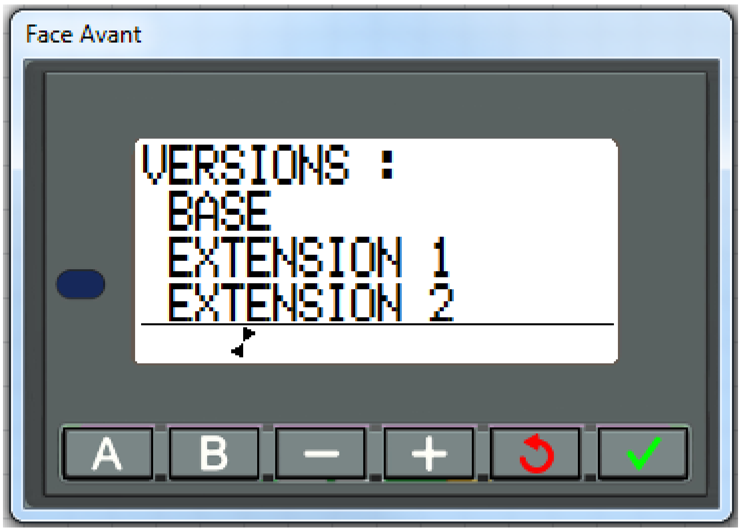
1.3.4.3 VERSION Menu

(§ 1.3.4.2) (§ 1.3.5)

Description

This function is used to identify the module with its hardware and software versions:

Illustration :



Face Avant

```
VERSIONS :
 BASE
 EXTENSION 1
 EXTENSION 2
```

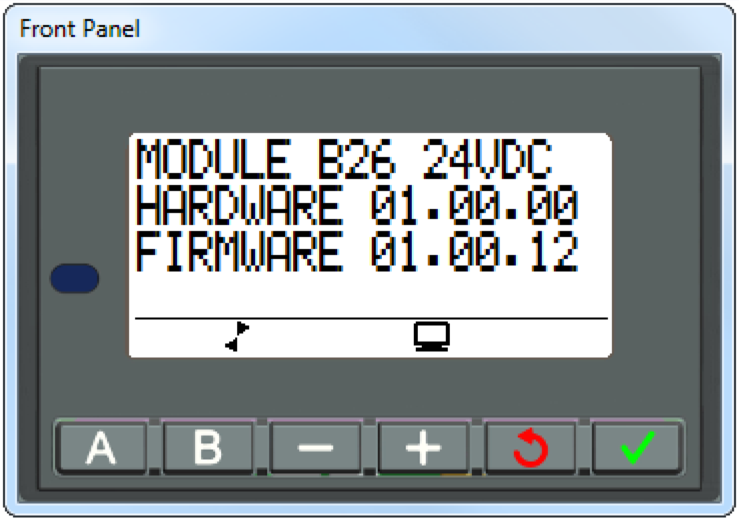
An initial menu is used to select:

- BASE
- EXTENSION 1
- EXTENSION 2

The scroll buttons (+,-) are used to change the selection.

To quit, press the **ESC** button; the display returns to the screen of the version menu.

Example with BASE selected:



MODULE B26 24VDC
HARDWARE 01.00.00
FIRMWARE 01.00.12

- MODULE: module type
- HARDWARE: hardware version
- FIRMWARE: controller firmware version

To quit, press the **ESC** button; the display returns to the screen of the version menu.

1.3.5 ACCESSORY Menu

□□□□ (§ 1.3.4.3) □□□□ (§ 1.3.5.1)

What's in this Chapter

This chapter contains the following topics:

- MODBUS Menu(§ 1.3.5.1)
- SAVE Menu(§ 1.3.5.2)

1.3.5.1 MODBUS Menu

□□□□ (§ 1.3.5) □□□□ (§ 1.3.5.2)

Description

This function can be used to change the slave number from 1 to 247.

1.3.5.2 SAVE Menu

□□□□ (§ 1.3.5.1) □□□□ (§ 1.3.6)

1.3.6 COMMUNICATION Menu

□□□□ (§ 1.3.5.2) □□□□ (§ 1.3.6.1)

Overview

Aim of This Chapter

The **COMMUNICATION** menu provides access to the following functions:

- PARAMETERS,
- INFORMATION.

This chapter describes the characteristics of these functions.

Note: use the navigation key to return to the main menu ↺.

What's in this Chapter

This chapter contains the following topics:

- PARAMETERS menu(§ 1.3.6.1)
- INFORMATION menu(§ 1.3.6.2)

1.3.6.1 PARAMETERS

◁□□□□ (§ 1.3.6) □□□□▷ (§ 1.3.6.2)

Description

The **PARAMETERS** menu provides access to the following functions:

- PIN CODE.

The PIN CODE is supplied by the operator in the form of 4 digits.

- Select the digit using the + and - buttons
- OK: the digit blinks
- + or - to increment or decrement the digit
- once all 4 digits have been entered, go to VALIDATE and confirm with OK.

Note: use the navigation key to return to the main menu ↺.

1.3.6.2 INFORMATION

◁□□□□ (§ 1.3.6.1) □□□□▷ (§ 1.4)

Description

The INFORMATION menu provides information about communication:

- PLMN,
- POWER RECEIVED,
- IMEI,
- MSISDN,
- URL NUMBER,
- APN

This chapter describes the characteristics of these functions.

Note: use the navigation key to return to the main menu ↺.

- PLMN: operator name
- Power received: this is expressed in dB
- IMEI: unique radio module number
- MSISDN: SIM card telephone number
- Port: not used

- URL number: not used

- APN: Operator access point for data exchanges,
for example 'orange.m2m.spec'

1.4 FBD Language

□□□□ (§ 1.3.6.2) □□□□ (§ 1.4.1)

At a Glance

Subject of this Section

This section describes the use of FBD (Functional Block Diagram) programming language for the controller.

What's in this Part?

This part contains the following chapters:

- Overview of FBD language(§ 1.4.1)
- FBD Language Elements(§ 1.4.2)
- FBD Programming(§ 1.4.3)
- Example of an FBD Application(§ 1.4.4)

1.4.1 Overview of FBD language

□□□□ (§ 1.4) □□□□ (§ 1.4.1.1)

At a Glance

Subject of this Chapter

This chapter provides a general description of FBD language.

What's in this Chapter?

This chapter contains the following topics:

- FBD Program Edit Window(§ 1.4.1.1)
- Function Bar(§ 1.4.1.2)

1.4.1.1 FBD Program Edit Window

□□□□ (§ 1.4.1) □□□□ (§ 1.4.1.2)

Overview

FBD mode allows graphic programming based on the use of predefined function blocks and pre-defined or archived Macros.
In FBD programming, there are two types of window and two displays:

- The edit window
  - Program view
  - Settings view
- The supervision(§ 1.4.1.1) window

Edit Window in Program View

The FBD programs are created in the edit window in **Program view**. This can be accessed by using the

E button.

The edit window is made up of three zones:

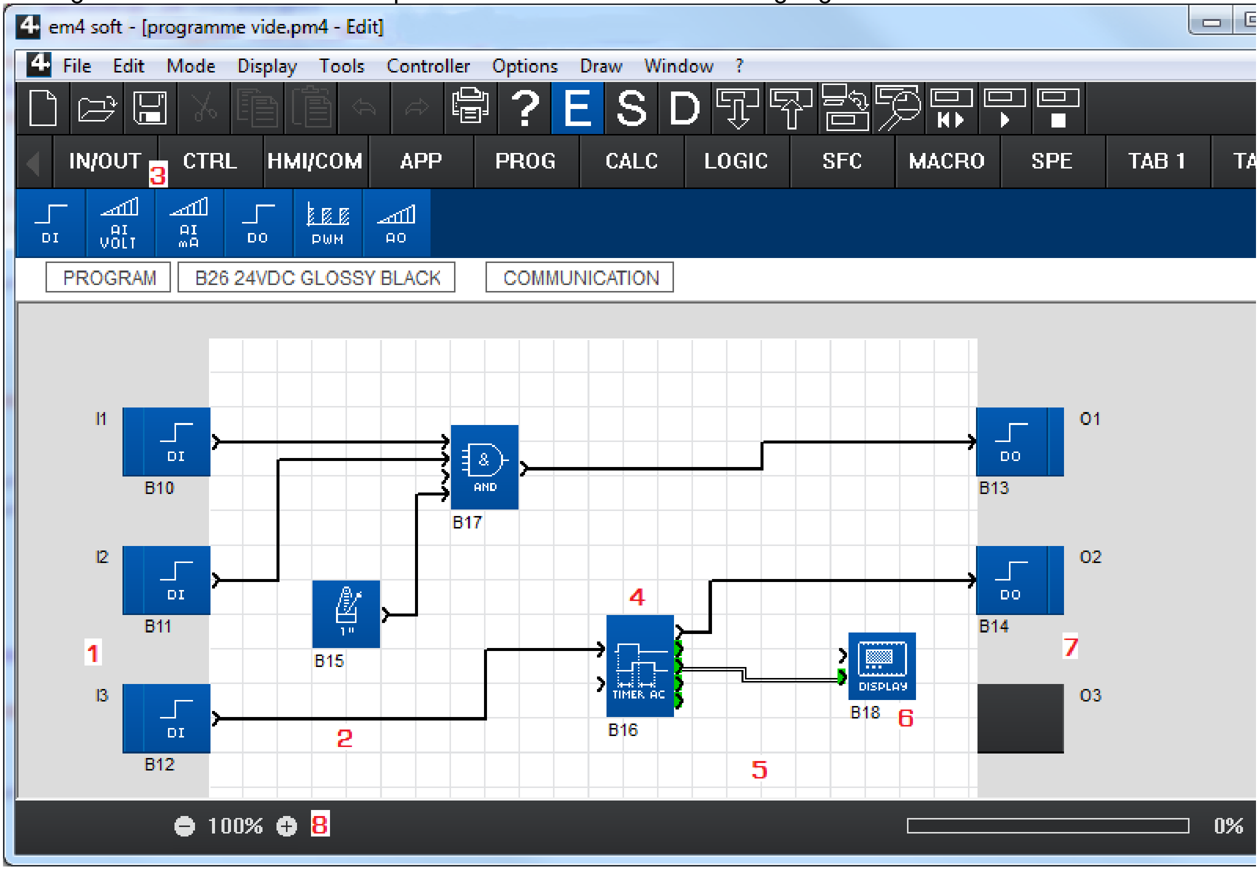
- The wiring sheet, where the functions and Macros that make up the program are inserted.
- The Inputs zone on the left of the wiring sheet where the inputs are positioned.
- The Outputs zone on the right of the wiring sheet where the outputs are positioned.

The I/O are specific to the type of controller and extension chosen by the user.

The program in the edit window corresponds to the program that is:

- compiled
- transferred to the controller
- compared to the contents of the controller
- used in simulation mode
- used in supervision mode
- used in debugging mode

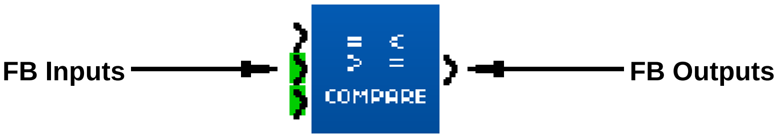
The figure below shows an example of an edit window in FBD language:



The table below lists the different elements in the edit window:

Number	Description
1	Function block input zone.
2	Connection between two function blocks.
3	Function bar.
4	Function block.
5	Wiring sheet.
6	Function block number.
7	Output function block zone.
8	Zoom
9	Memory capacity of specific functions

Details of FB



Symbol	Description
❯	1 bit
▶	16 bits

There is a **Validation** input on the top left of the FB for the most part of function blocks.

This input functions as follows :

State	Status
0	No validated
1 ou Not connected	Validated
0 → 1	Memorization of outputs in the current state

Edit Window in Settings View

Settings view can be accessed in Edit mode via the Display/Settings View menu. It is used to list all automation functions with parameters used in the application.
The general interface allows the user to view all the information:

- **Block**: function block diagram
- **Function**: Timer, Counter, etc.
- **Block num**: function block ID
- **Parameters**: the target value for a counter, etc. ,
- **Save on power failure**: indicates whether the Save on power failure(§ 1.2.20) option has been selected
- **Modification authorized**: indicates whether or not parameter modification is possible from the controller front panel
- **Comment** : comments associated with the function.

To adjust the various parameters, double-click on the desired line.

Supervision Window (not available in this version)

The Supervision window can also be accessed from the following modes:

- **Simulation** : the **Mode/Simulation** menu or using the simulation button S on the controller bar
- **Debugging Mode/Debugging** menu or by using the D debugging button on the controller bar

It contains the functions, without their connections, that the programmer has extracted (using Drag/Drop or Copy/Paste) from the edit window.
The window can also contain drawings(§ 1.4.3.1.6), text and images.
In simulation and debugging mode the parameters and outputs of the functions present are updated.

1.4.1.2 Function Bar

◁□□□ □
(§ 1.4.1.1)

□ □□□▷ (§ 1.4.2)

At a Glance

To create an FBD program, the different functions or Macros to be inserted in the wiring sheet are available in a function bar. Each of the tabs in the function bar groups a function type.
When the mouse is moved over one of the tabs, the dialog box displays the type of functions that it

contains.
This function bar is divided into four parts:

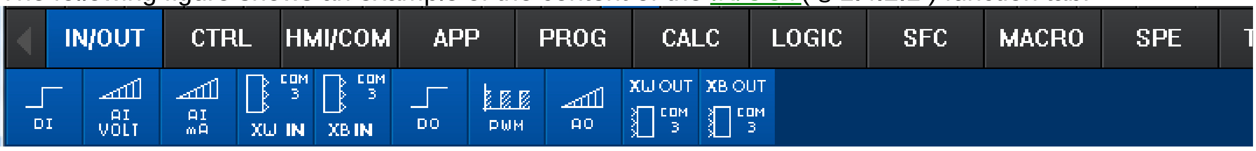
- All the manufacturer tabs that contain all the application-specific functions and the standard functions available with the workshop. These tabs are situated to the left of the function bar.
- the SPE function tab that contains all the application-specific functions for a given user.
- The MACRO function tab that contains all the Macros archived by the workshop user.
- All the customizable tabs that contain, by type defined by the user, the standard functions, the application-specific functions and the archived macros.These tabs are situated to the right of the function bar.

The standard or application-specific functions and Macros that are incompatible with the controller's choice are shown with dark grey shading.

Examples of tabs in the function bar
Important note: these examples are non-contractual and are subject to future developments

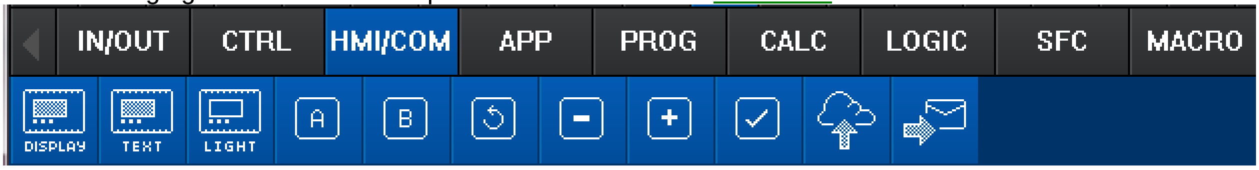
IN/OUT Functions Bar

The following figure shows an example of the content of the IN/OUT(§ 1.4.2.1) function tab:



HMI/COM Functions bar

The following figure shows an example of the content of the HMI/COM function tab:



1.4.2 FBD Language Elements

(§ 1.4.1.2) (§ 1.4.2.1)

At a Glance

Subject of this Chapter

This chapter describes the different elements of the FBD language.

What's in this Chapter?

This chapter contains the following sections:

1.4.2.1 Different Input Blocks

(§ 1.4.2) (§ 1.4.2.1.1)

At a Glance

Subject of this Section

This section describes the different input blocks available using FBD language.

What's in this Section?

This section contains the following topics:

Discrete-type (digital)(§ 1.4.2.1.1), voltage analog(§ 1.4.2.1.2), current analog(§ 1.4.2.1.3), network inputs(§ 1.4.2.1.4).

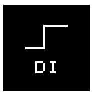
1.4.2.1.1 Discrete-Type Inputs

(§ 1.4.2.1) (§ 1.4.2.1.2)

At a Glance

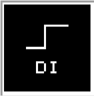
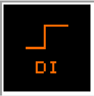
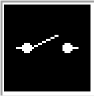
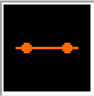
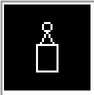
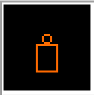
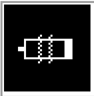
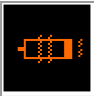
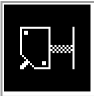
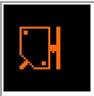
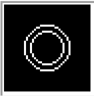
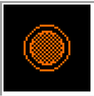
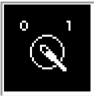
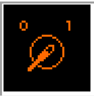
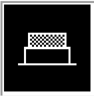
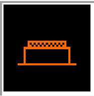
The Discrete-type input is available for all controller types. Discrete inputs can be arranged over all the controller inputs.

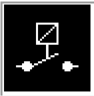
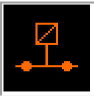
Access

The Discrete input function  is accessible in the **IN/OUT** function bar.

Type of Discrete Inputs

The Digital input type can be selected from the **Parameters** window, **comments** tab. This is then displayed in the edit and supervision windows.

Type	Display in the Inactive state	Display in the Active state
Discrete input		
Contact		
Limit switch		
Proximity sensor		
Presence sensor		
Illuminated pushbutton		
Selector switch		
Pushbutton		

Normally open relay		

Custom Image

It is also possible to import a customized image, one for the inactive state and one for the active state. The size of this image should be the smallest possible (several Kb).
Standard format: 43x43 .bmp .jpg .gif

Filtered Discrete-Type Input

A filter can be selected from the **Parameters** window. Behind the Discrete input, a filter is added to reduce or even eliminate disturbances.
A Discrete input is filtered using a constant level detection algorithm (1 or 0) on the "sensor" signal, measured over a certain time frame. If the signal is stable throughout the entire detection period, the output of the symbol from the filtered Discrete input takes the value of the measured signal. Otherwise it remains unchanged.
The filtered Discrete inputs can be arranged at any controller input.
The value of the parameter (between 1 and 255) entered in the **Parameters** window may be used to define the minimum time during which the signal must be stable. This value is a multiple of the duration of the basic cycle(§ 1.6.1.1) of the controller.

Etat de l'entrée

It is also possible to change the input state:
NO: normally open
NC: normally closed

Simulation and Debugging Modes

In Simulation or Debugging modes it is possible to force the digital inputs. In this case, the input symbol is displayed as shown in the above table.

1.4.2.1.2 Analog voltage Input

(§ 1.4.2.1.1) (§ 1.4.2.1.3)

Overview

The Voltage analog type input is available on all types of controller supplied with a DC voltage.
The Voltage analog input voltage is converted into a numerical integer value by a 12-bit analog to digital converter. The integer value of the output is between 0 and 4095.
Analog inputs can only be arranged on the inputs between I5 and IG.

Access

The AI VOLT Voltage analog input function is accessible from the **IN/OUT** window.

Parameter

By default, this voltage varies between 0 and 10V DC.
The type of electrical connection at the input can be configured in the **Parameters** window:

- 0 - 10 V
- 0 - 30 V or potentiometer, selected if the input is connected to a potentiometric device with a power supply between 0 Volts and the controller supply voltage

Types of Analog Input

The Analog input type can be selected from the **Parameters** window, **comments** tab. This is then displayed in the edit and supervision windows.

Type	**Display in edit mode**
Input (by default)	AI VOLT
Input	0....10
Potentiometer	0....VCC - +
Temperature	TEMP
Water	WATER
Hygrometry	HYGRO
Light	LIGHT
Motion	MOTION
Motor	MOTOR
Pressure	PRESS

Custom Image

It is also possible to import a customized image from the **Comments** window. The size of this image should be the smallest possible (a few Kb).
Standard format: 43x43 .bmp .jpg .gif

Filtered Analog Input

A filter can be selected from the **Parameters** window.
Behind the analog input, a **low pass** filter is added. This function is available on all the types of controllers supplied with a DC voltage.
The Analog input voltage is converted into a digital integer value by a 12-bit analog/digital converter. The whole output value is between 0 and 4095.
The Analog inputs can only be placed on the inputs numbered from I5 to IG.

A **low pass** filter restores the entire input signal (frequency, amplitude and phase-shift), whose frequency is considerable lower, to a typical filter frequency, called a **cut-off frequency**. When the frequency of the input signal nears the **cut-off frequency**, the output signal, of the same frequency, becomes increasingly lower and phase-shifted. When the frequency of the input signal is equal to the **cut-off frequency**, the output signal is lowered by around 30%, and phase-shifted by 45º. For a frequency above and rising from the **cut-off frequency**, the reduction becomes greater (until it reaches total elimination) and the phase-shifting approaches 90º.

The **Parameters** window is used to define:

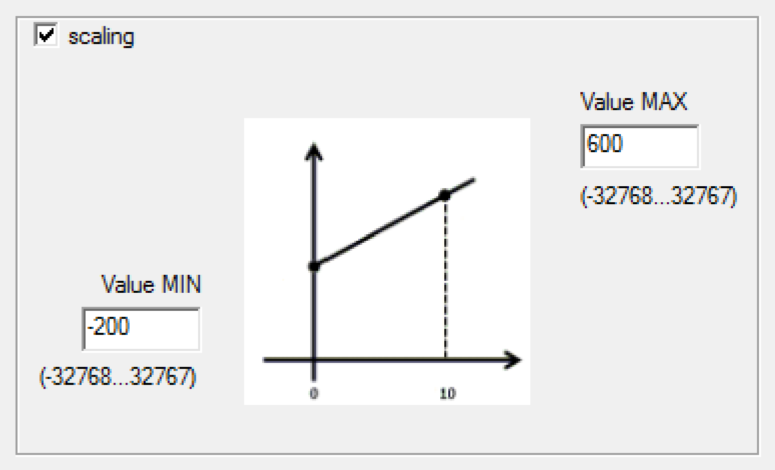
- The input voltage. By default, this voltage varies between 0 and 10Vdc. The potentiometer is chosen if the input is connected to a potentiometer device powered between 0 volts and the voltage of the controller power supply.
- The **cut-off frequency** of the **low pass** filter (between 0.06 and 88.25 Hz)

CAUTION

The potentiometer option is selected if the input is connected to a potentiometric device supplied between 0 Volts and the tester supply voltage.
Whenever a modification is made to the basic cycle time, you must check or modify the cut-off frequency
Failure to follow these instructions can result in injury or equipment damage.

Scaling

A scale can be selected from the **Parameters** window.



☑ scaling

Value MAX
600
(-32768...32767)

Value MIN
-200
(-32768...32767)

For example here with a sensor from -20°C to + 60°C in 1/10ths of a °C.

Simulation and Debugging Modes

In Simulation or Debugging modes it is possible to force (between 0 and 4095) the output of the analog inputs.

Delay in Availability of Measurements

The availability of analog input measurements is delayed by a few ms in the following situations:

- Power return following a power cut
- Variation between 0 and full scale

1.4.2.1.3 Analog current Input

(§ 1.4.2.1.2)

(§ 1.4.2.1.4)

Overview

The Current analog type input is available on all types of controller supplied with a DC voltage.
The analog input current is converted into an integer digital value by an 11-bit analog to digital converter. The integer value of the output is between 0 and 2000 (20mA).
Current analog inputs can only be arranged on the inputs between ID and IG.

Access

The Current analog input function AI mA is accessible from the **IN/OUT** window.

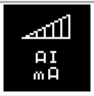
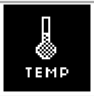
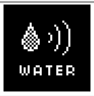
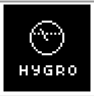
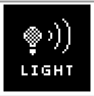
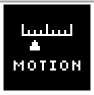
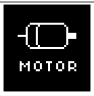
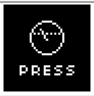
Parameter

By default this current varies between 0 and 20 mA.
The type of acquisition can be configured in the **Parameters** window:

- 0 - 20 mA
- 4 - 20 mA

Types of Analog Input

The Analog input type can be selected from the **parameter** setting window, **comments** tab. This is then displayed in the edit and supervision windows.

Type	Display in edit mode
Input (by default)	
Temperature	
Water	
Humidity	
Light	
Movement	
Motor	
Pressure	

Custom Image

It is also possible to import a customized image from the Comments window. The size of this image should be the smallest possible (a few Kb).
Standard format: 43x43 .bmp .jpg .gif

Filtered Analog Input

A filter can be selected from the **Parameters** window.
Behind the analog input, a **low pass** filter is added. This function is available on all the types of controllers supplied with a DC voltage.
The analog input current is converted into an integer digital value by an 11-bit analog to digital converter. The integer value of the output is between 0 and 2000.
The Analog inputs can only be placed on the inputs numbered from ID to IG.

A **low pass** filter restores the entire input signal (frequency, amplitude and phase-shift), whose frequency is considerable lower, to a typical filter frequency, called a **cut-off frequency**. When the frequency of the input signal nears the **cut-off frequency**, the output signal, of the same frequency, becomes increasingly lower and phase-shifted. When the frequency of the input signal is equal to the **cut-off frequency**, the output signal is lowered by around 30%, and phase-shifted by 45º. For a frequency above and rising from the **cut-off frequency**, the reduction becomes greater (until it reaches total elimination) and the phase-shifting approaches 90º.

The **Parameters** window is used to define:

- The input current. By default this current varies between 0 and 20 mA.

The 4 - 20 mA option is used to manage the bit at the output of the input plot. This bit is set to 1 if the current is less than 4 mA.

- The **cut-off frequency** of the **low pass** filter (between 0.06 and 88.25 Hz)

CAUTION

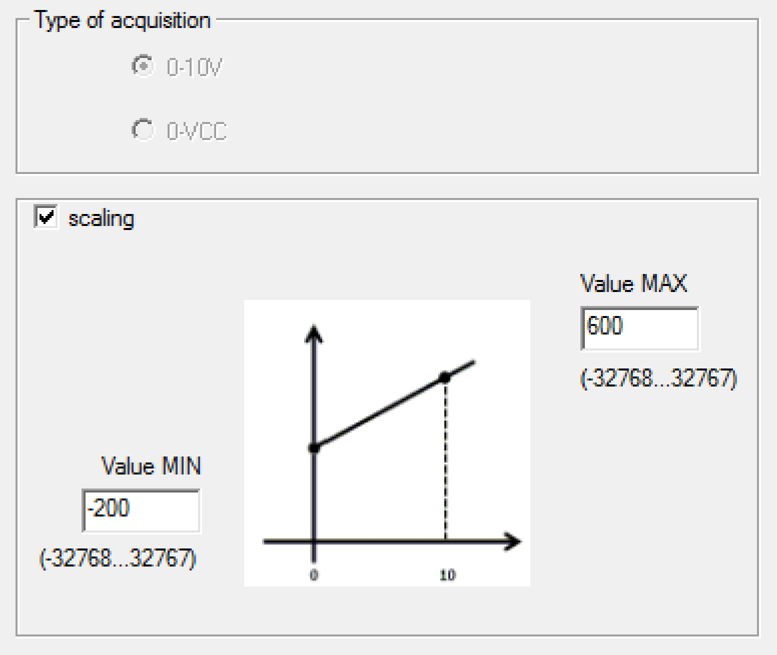
The potentiometer option is selected if the input is connected to a potentiometric device supplied between 0 Volts and the tester supply voltage.

Whenever a modification is made to the basic cycle time, you must check or modify the cut-off frequency

Failure to follow these instructions can result in injury or equipment damage.

Scaling

A scale can be selected from the **Parameters** window.



Type of acquisition

● 0-10V

○ 0-VCC

☑ scaling

Value MAX

600

(-32768...32767)

Value MIN

-200

(-32768...32767)

For example here with a sensor from -20°C to + 60°C in 1/10 of a °C and a 4-20 mA acquisition type.

Simulation and Debugging Modes

In Simulation or Debugging modes it is possible to force (between 0 and 2000) the output of the analog inputs.

Delay in Availability of Measurements

The availability of analog input measurements is delayed by a few ms in the following situations:

- Power return following a power cut
- Variation between 0 and full scale

1.4.2.1.4 Network Input

(§ 1.4.2.1.3)

(§ 1.4.2.2)

Description

The **XWIN, XBIN network** input function blocks are used to receive, via a communication port, data destined for memory space in the controller's fixed addresses.

Access

The XW IN XB IN functions can be accessed from the **IN/OUT** function bar.

Inputs/Outputs

The function delivers eight output values (16 bits or 1 bit depending on the FB) called Value 1 to Value 8. These outputs allow the application programmed in the controller to use the data sent by the network (COM 0 to COM 3).
COM 0: communication port of the accessory, e.g. Modbus.
COM 1: communication port of extension 1
COM 2: communication port of extension 2
COM 3: communication port of the base card, e.g. 2G, 3G, Ethernet network.

Parameters

The user selects a range of eight addresses from the **Parameters** window. The address ranges available are as follows:

- XWIN 1 - 8
- XWIN 9 - 16
- XWIN 17 - 24
- XBIN 25-1
- XBIN 25-2

Parameters file

This file, in XML format, associates a label that can be used by all the network devices with each data item.
The label is a character string.

1.4.2.2 Different Output Blocks

(§ 1.4.2.1.4)   (§ 1.4.2.2.1)

At a Glance

Subject of this Section

This section describes the different output blocks available using FBD language.

What's in this Section?

This section contains the following topics:

Discrete-type (digital)(§ 1.4.2.2.1), PWM(§ 1.4.2.2.2), analog(§ 1.4.2.2.3), network outputs(§ 1.4.2.2.4).

1.4.2.2.1 Discrete-Type Outputs

(§ 1.4.2.2)   (§ 1.4.2.2.2)

At a Glance

The controllers feature two types of Discrete outputs:

- **Solid state** outputs,
- **Relay** outputs.

Access

The Discrete output function DO is accessible from the **IN/OUT** window.

Types of Discrete Outputs

The Digital output type can be selected from the **Parameters** window, **comments** tab. This is then displayed in the edit and supervision windows.
The selection is made using the output's inactive-state symbol.

Type	**Display in the Inactive state**	**Display in the Active state**
Discrete Output	DO	DO
Normally open relay	⊸	⊸
Lamp	💡	💡
Valve	🚰	🚰
Audible signal	📢	📢
Green indicator light	🟢	🟢
Red indicator light	🔴	🔴
Orange indicator light	🟠	🟠
Heating	♨	♨
Fan	✇	✇

Custom Image

It is also possible to import a customized image, one for the inactive state and one for the active state. The size of this image should be the smallest possible (several Kb).
Standard format: 43x43 .bmp .jpg .gif

Simulation and Debugging Modes

In Simulation or Debugging modes, outputs are displayed in the active or inactive state with their corresponding symbols (shown in the table above).

Note : To avoid an error (Warning nÂ°6), you have to connect power supply of the static outputs before or at the same time with the product supply.

1.4.2.2.2 PWM-Type Output

⇦□□□□ (§ 1.4.2.2.1) □□□□⇨ (§ 1.4.2.2.3)

Overview

The controller has 2 discrete solid state outputs (O1, O2) that can be controlled using **PWM** (pulse width modulation).
The **mean value** of the PWM output voltage is then proportional to the setpoint.
This enables a value between 0 and 100% of its maximum value to be controlled using a discrete output. 0% corresponds to setpoint 0 and 100% corresponds to setpoint 100.

Access

The **PWM** output function PWM can be accessed from the **IN/OUT** function bar.

Frequencies

The basic frequency of all the **PWM**-type controller outputs can be set from the **Configuration** tab of the Program Configuration(§ 1.6.1.1) window.
The **Frequency of all controller PWMs** parameter enables the basic frequency for **PWM**-type outputs to be selected from the following values:

- 1758 Hz
- 452 Hz
- 226 Hz
- 113 Hz
- 56 Hz
- 14 Hz

Note : To avoid an error (Warning nÂ°6), you have to connect power supply of the static outputs before or at the same time with the product supply.

1.4.2.2.3 Analog Type Output

⇦□□□□ (§ 1.4.2.2.2) □□□□⇨ (§ 1.4.2.2.4)

At a Glance

Analog outputs are available on some extension models. The 0 to 10V outputs are on 10 bits from 0 to 1023

Access

The Discrete output function AO is accessible from the **IN/OUT** window.

1.4.2.2.4 Network Output

⇦□□□□ (§ 1.4.2.2.3) □□□□⇨ (§ 1.4.2.3)

Description

The **XWOUT, XBOUT network output** function blocks are used to transmit, via a communication port, data.

Access

The XW OUT XB OUT functions can be accessed from the **IN/OUT** function bar.

Inputs/Outputs

The function has eight input values (16 bits or 1 bit depending on the FB) called Value 1 to Value 8. These inputs allow the application programmed in the controller to send data to the network (COM 0 to COM 3).
COM 0: communication port of the accessory, e.g. Modbus.
COM 1: communication port of extension 1
COM 2: communication port of extension 2
COM 3: communication port of the base card, e.g. 2G, 3G, Ethernet network.

Parameters

The user selects a range of eight addresses from the **Parameters** window. The address ranges available are as follows:

- XWOUT 26 - 33
- XWOUT 34 - 41
- XWOUT 42 - 49
- XBOUT 50-1
- XBOUT 50-2

Parameters file

This file, in XML format, associates a label that can be used by all the network devices with each data item.
The label is a character string.

1.4.2.3 CTRL functions : control

(§ 1.4.2.2.4) (§ 1.4.2.3.1)

At a Glance

Subject of this Section

This section describes the different CTRL functions available using FBD language.

What's in this Section?

This section contains the following topics:

Timer, flip-flop, trigger, comparison, time programmer, slow and high-speed counter, chronometer, etc.

1.4.2.3.1 TIMERS

(§ 1.4.2.3) (§ 1.4.2.3.2)

Overview

The **TIMERS** function block provides access to the following types of timers:

- **Timer A/C** is used to delay or prolong actions over a predetermined time:
  - Function A: Timer on-delay
  - Function C: Timer off-delay
  - Function A-C: Combination of functions A and C
- **Timer BW** is used to create a pulse for the duration of a cycle on the output from an input edge.
- **Timer Li** is used to create flashing (the durations of on and off states can be configured):
  - Function Li: The flashing cycle starts with an ON state.
  - Function L: The flashing cycle starts with an OFF state.
- **Timer B/H** creates a pulse on the output of the rising edge of the input.
  - Function B: Regardless of the duration of the command pulse, the output is active for a duration that has been set.
  - Function H: The output is inactive at the end of a set time or on the falling edge of the command.
- The **totaliser** creates a pulse on the output when the period during which the input was active reaches (one or more times) a set value.

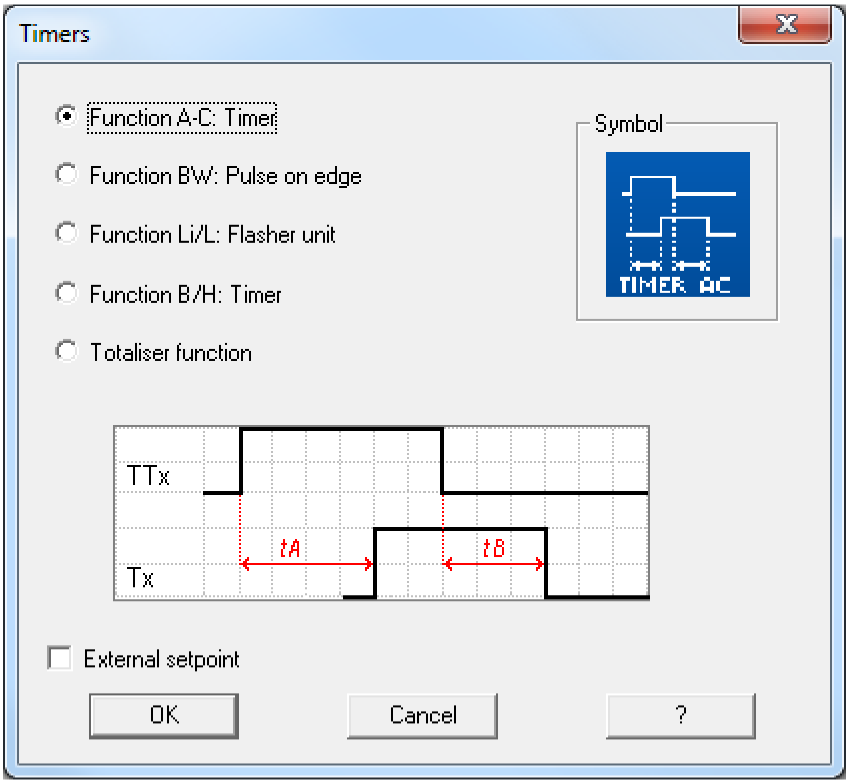
Access

This function block is accessible from the **CTRL** function bar.

Choice of Timer

To place a timer on the wiring sheet and select its type, proceed as follows:

Step	Action
1	Click on the icon of the **FBD** function bar, hold down the mouse button and slide the icon to the required place. **Result**: The following window appears:

	 Timers ● Function A-C: Timer ○ Function BW: Pulse on edge ○ Function Li/L: Flasher unit ○ Function B/H: Timer ○ Totaliser function Symbol TIMER AC TTx Tx tA tB □ External setpoint OK Cancel ?
2	Select the desired type of timer from the 5 types available in this window.
3	If required, you can check the **External setpoint** box: in this case the on time(s) or off time(s) will be integer-type timer block inputs rather than being internal configurable parameters. **Note**: Function unavailable for the timer type BW.

Inputs/Outputs

Timer inputs:

	Timer A/C	Timer BW	TIMER Li	Ti
Command	✓	✓	✓	✓
Reset	✓	-	-	✓
On delay setpoint value	✓	-	-	
Off delay setpoint value	✓	-	-	
On setpoint value	-	-	✓	✓
Off setpoint value	-	-	✓	
Number/Duration of flashes	-	-	✓	
Total time setpoint value	-	-	-	

Key:

✓: Input always available on this timer.

✓: Input available on this timer only if the **External setpoint** box was checked when the timer type was selected.

Timer outputs:

	Timer A/C	Timer BW	TIMER Li	Ti
Output	✓	✓	✓	✓
On delay setpoint value	✓	-	-	
On delay current value	✓	-	-	
Off delay setpoint value	✓	-	-	
Off delay current value	✓	-	-	
On setpoint value	-	-	✓	✓
On current value	-	-	✓	✓
Off setpoint value	-	-	✓	
Off current value	-	-	✓	
Number/Duration of flashes	-	-	✓	
Current value number/duration of flashing	-	-	✓	
Total time setpoint value	-	-	-	

Total time current value	-	-	-	-

Key:

✓: Output always available on this timer.

✓: Output available on this timer only if the **External setpoint** box **was left unchecked** when the timer type was selected.

Timer A/C Parameters

In the programming workshop

The **Parameters** window is used to:

- **Select the time unit of the delays**; these delays can be expressed in seconds (9 hrs 6 min 7 s maximum = 32,767), tenths of seconds or number of cycles.
- **Set the ON delay value** for function A, only if the **External setpoint** box **was left unchecked** when the timer type was selected.
- **Set the OFF delay value** for function C, only if the **External setpoint** box **was left unchecked** when the timer type was selected.
- Possibly **activate** the **Save on power failure** parameter. It enables the timer to be restarted at the point where it stopped after a power failure(§ 1.2.20).

The combination of both the ON and OFF delays can be used to obtain a function A/C.

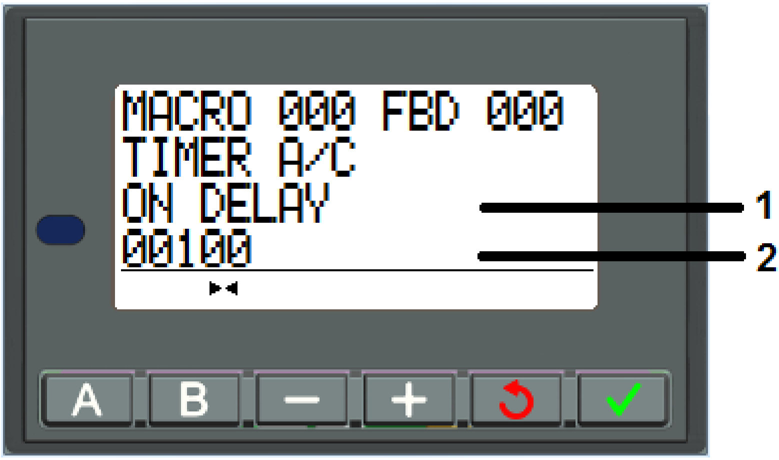
From the front panel

From the PARAMETERS(§ 1.3.2) menu, you can set:

- The value of the **On delay** parameter
- The value of the **Off delay** parameter

To modify the parameters from the controller front panel, check the **Modification authorized** box in the **Parameters** window.

Illustration:

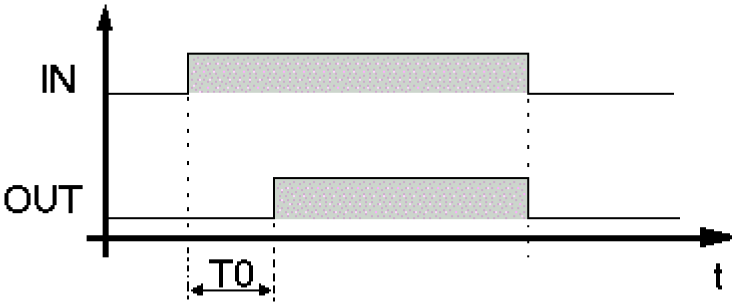


1 Name of the parameter displayed

2 Value of the parameter displayed

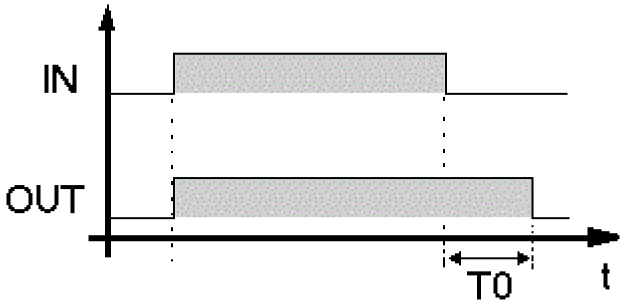
Timing Diagrams For Timer A/C

Function A:



T0 : ON Delay.

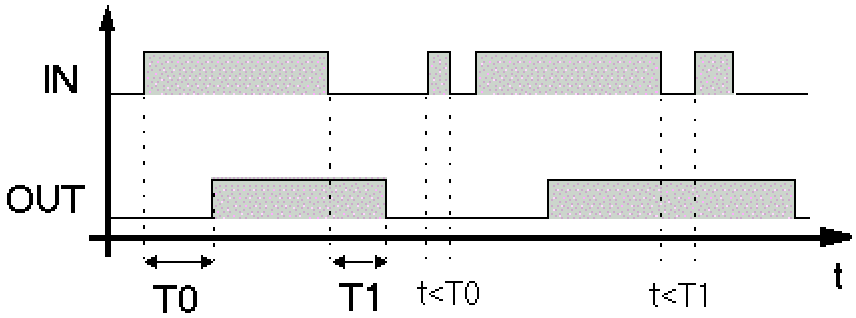
Function C:



T0 : OFF Delay.

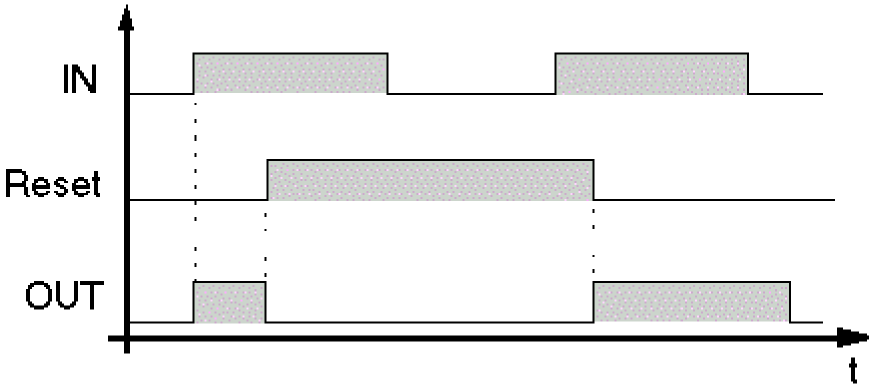
Note: Each pulse on the COMMAND input of the TIMERS timer block resets the current value to 0.

Function A-C:



T0 : ON Delay, T1 : OFF Delay.

Example with reset:



Timer BW Parameters

In the programming workshop

The **Parameters** window is used to select the type of edge on the input that will generate the pulse on the output.

Select:

- **From OFF to ON** to generate a pulse on each rising edge of the input
- **From ON to OFF** to generate a pulse on each falling edge of the input
- **From OFF to ON and from ON to OFF** to generate a pulse on each rising edge and each falling edge of the input

Timer Li Parameters

The **Parameters** window is used to:

- **Select the time unit of the delays**, these delays can be expressed in seconds (9 hrs 6 min 7 s maximum = 32,767), tenths of seconds or number of cycles.
- **Select the type of flashing**: select **function Li** for the flashing to begin with an **On** state, and select **function L** for the flashing to begin with an **Off** state.
- **Set the On time value**, only if the **External setpoint** box **was left unchecked** when the timer type was selected.
- **Set the Off time value**, only if the **External setpoint** box **was left unchecked** when the timer type was selected.
- **Select the stop mode of the flashes**, select:

  - **Number of flashes** in order to stop after a set number of flashes (enter the value of the number of flashes, if the **External setpoint** box **was left unchecked** when the timer type was selected).
  - **Duration of flashes** in order to stop after a set time (enter the value of the duration, if the **External setpoint** box **was left unchecked** when the timer type was selected).
  - **Continuous flashing** so that the flashes do not stop until the **Command** input is active.
- Possibly **activate** the **Save on power failure** parameter. It enables the timer to be restarted at the point where it stopped after a power failure(§ 1.2.20).

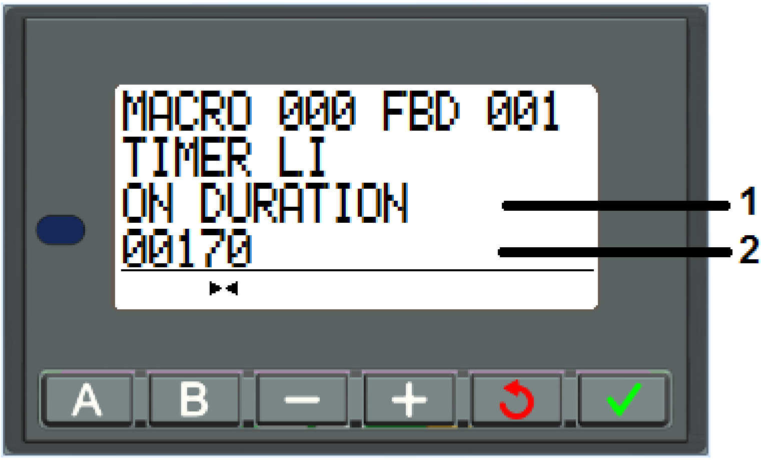
From the front panel

From the PARAMETERS(§ 1.3.2) menu, you can set:

- the value of the **On time** parameter
- the value of the **Off time** parameter
- the value of the **counting setpoint** parameter corresponding either to the duration of flashing, or to the number of flashes

  To modify the parameters from the controller front panel, check the **Modification authorized** box in the **Parameters** window.

Illustration:

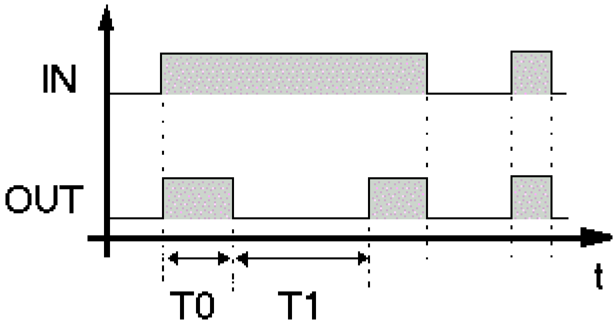


MACRO 000 FBD 001
TIMER LI
ON DURATION
00170

1 Name of the parameter displayed
2 Value of the parameter displayed

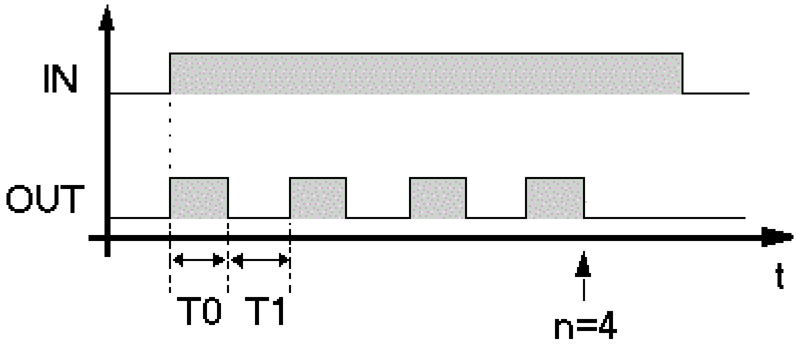
Timing Diagrams For Timer Li

Continuous flashing mode:



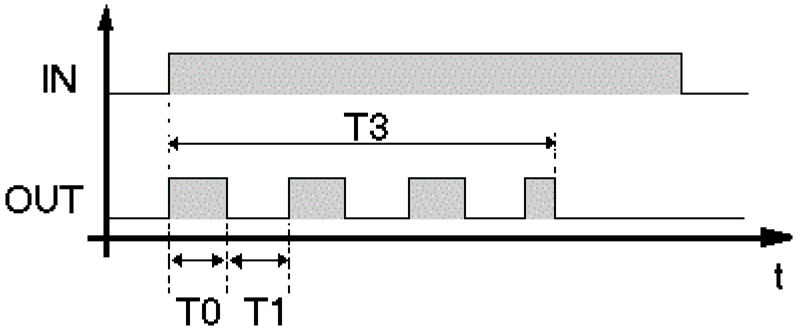
T0 : ON Time, T1 : OFF Time.

Number of flashes mode:



T0 : ON Time, T1 : OFF Time.

Duration of flashes mode:



T0 : ON Time, T1 : OFF Time, T3 : Flashing period elapsed.

Timer B/H Parameters

In the programming workshop

The **Parameters** window is used to:

- **Select the time unit of the ON time**; this time can be expressed in seconds (9 hrs 6 min 7 s maximum = 32,767), tenths of seconds or number of cycles.
- **Set the On time value**, only if the **External setpoint** box **was left unchecked** when the timer type was selected.
- **Select the operating mode of the timer**, select **Function B** so that the output remains active regardless of the duration of the command pulse; select **Function H** so that the output switches to the inactive state on the falling edge of the command.
- Possibly **activate** the **Save on power failure** parameter. It enables the timer to be restarted at the point where it stopped after a power failure(§ 1.2.20).

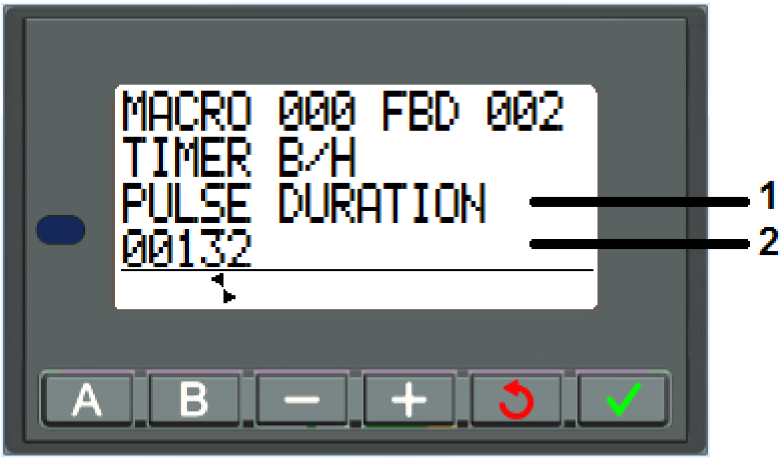
From the front panel

From the PARAMETERS(§ 1.3.2) menu, you can set:

- The value of the On time: **pulse duration**.

  To modify the parameters from the controller front panel, check the **Modification authorized** box in the **Parameters** window.

Illustration:

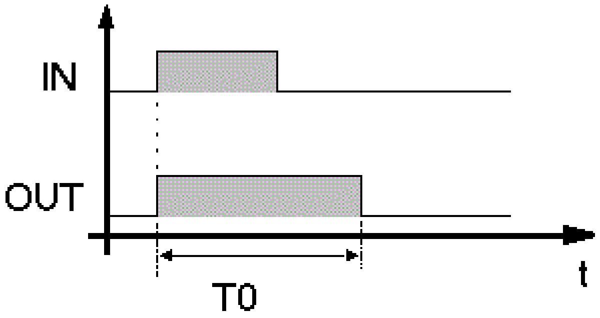

MACRO 000 FBD 002
TIMER B/H
PULSE DURATION
00132

1 Name of the parameter displayed

2 Value of the parameter displayed

Timing Diagrams For Timer B/H

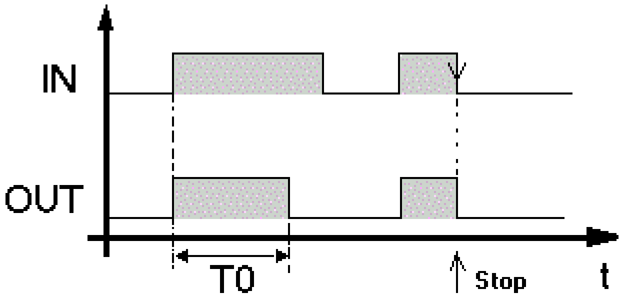
Function B:



T0 : ON Time.

Note: Each pulse on the timer COMMAND input resets the current value to 0.

Function H:



T0 : ON Time, Stop : Falling Edge of the command input.

Totaliser Parameters

In the programming workshop

The **Parameters** window is used to:

- **Select the time unit of the ON time**; this time can be expressed in minutes, seconds (9 hrs 6 min 7 s maximum = 32,767), tenths of seconds or number of cycles.
- **Set the value T** of the time to be reached, only if the **External setpoint** box **was left unchecked** when the timer type was selected
- **Select the totaliser operating mode** , select:
  - **At** so that the totaliser output switches to the **active** state when the time spent in the **inactive** state by the input reaches the set time
  - **Ht** so that the totaliser output switches to the **inactive** state when the time spent in the **inactive** state by the input reaches the set time
  - **T** so that the totaliser output switches to the **active** state when the time spent in the **active** state by the input reaches the set time
  - **Tt** so that the totaliser output switches to the **active** state for a set time when a pulse is detected on the input
- Possibly **activate** the **Save on power failure** parameter. It enables the timer to be restarted at the point where it stopped after a power failure(§ 1.2.20)

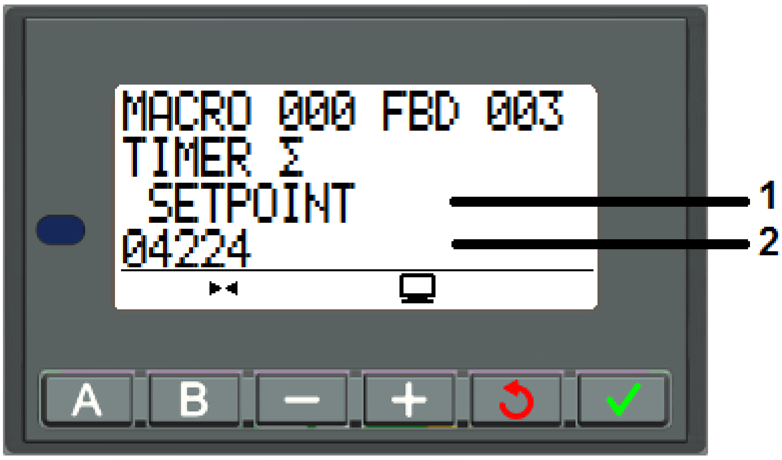
From the front panel

From the PARAMETERS(§ 1.3.2) menu, you can set:

- The value of the On time: **pulse duration**.

  To modify the parameters from the controller front panel, check the **Modification authorized** box in the **Parameters** window.

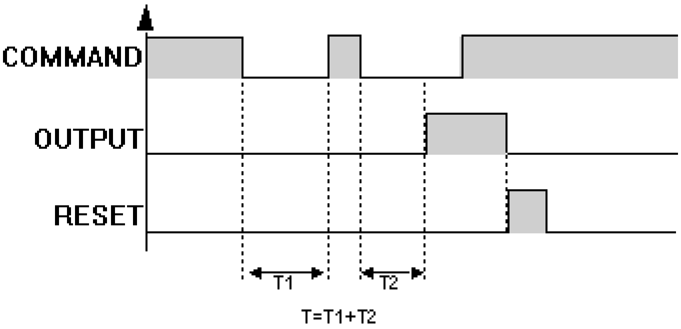
Illustration:


MACRO 000 FBD 003
TIMER Σ
SETPOINT
04224

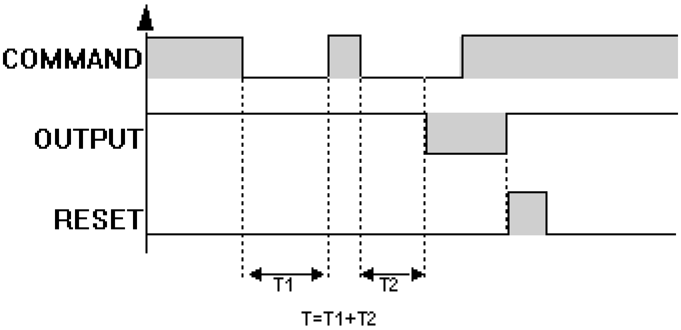
1 Name of the parameter displayed
2 Value of the parameter displayed

Totaliser Timing Diagrams

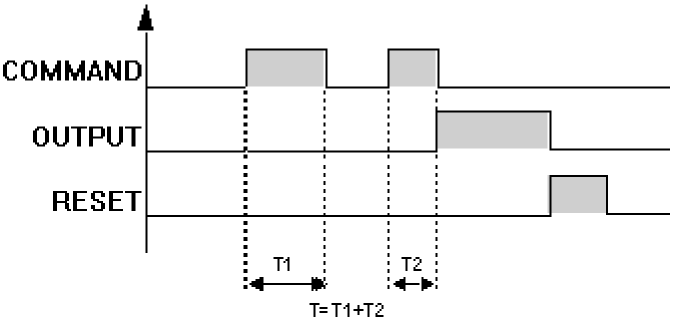
Function At:



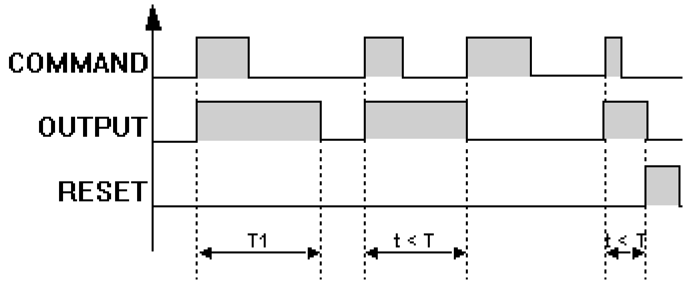
Function Ht:



Function T:



Function Tt:

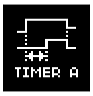


Parameter Modification

To modify the parameters from the controller front panel, check the **Modification authorized** box in the **Parameters** window.

1.4.2.3.2 TIMER A

◁□□□□ (§ 1.4.2.3.1) □□□□▷ (§ 1.4.2.3.3)



This function is used to delay actions for a predefined time. This is a simplified version of TIMER A-C.

- **FUNCTION A** : On-delay

Input:

- **COMMAND:**
  - When the input is inactive the output is inactive.
  - When the input is active the output will be active after a predefined time.

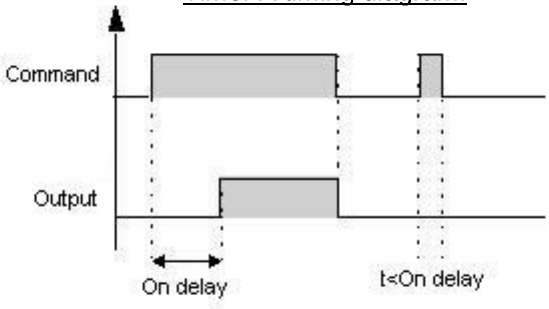
Output:

- **OUTPUT** : Value corresponding to the input as defined above.

Parameters:

- **UNIT** : Used to select the time unit for the delays, which can be expressed in seconds (9 hrs 6 min 7 s maximum = 32,767), tenths of seconds or in number of cycles.
- **ON DELAY** : Used to set the ON DELAY value for function A.

Timer A timing diagram:



1.4.2.3.3 Bistable Impulse Relay Function

◁□□□□ (§ 1.4.2.3.2) □□□□▷ (§ 1.4.2.3.4)

Description

The **BISTABLE** impulse relay function switches the **OUTPUT** state on each rising edge (change from inactive to active) of the **COMMAND** input.

Access

The impulse relay function BISTABLE is accessible from the **CTRL** function bar.

Inputs/Outputs

Description of the inputs:

- **COMMAND**: this is the input that controls changes in the output state, whose type is Discrete(§ 1.4.2.1.1).
- **RESET**: when this command is active, the OUTPUT always remains inactive, regardless of the COMMAND input transitions.

Note: If the RESET input is not connected, it is considered to be inactive.

Description of the output:

- **OUTPUT**: this is the impulse relay output, whose type is Discrete.
  This value depends upon the state of the RESET input.
  If the RESET input is:
  - Inactive: the OUTPUT changes state in line with the transitions of the COMMAND input,
  - Active: the OUTPUT always remains inactive.

1.4.2.3.4 SET and RESET function

(§ 1.4.2.3.3) (§ 1.4.2.3.5)

At a Glance

The **SET RESET** function operates as follows:

- Activation of the **SET** input activates the output, which remains so even if the **SET** input is then deactivated,
- Activation of the **RESET** input deactivates the output,
- If both inputs are active, the state of the output depends on the configuration of the function:
  - The output is active if the **SET has priority** option is configured,
  - The output is inactive if the **RESET has priority** option is configured.

Non-connected inputs are set to the **Inactive** state.

Access

This SET RESET function is accessible from the **CTRL** function bar.

1.4.2.3.5 TIMER SET RESET SWITCHING

(§ 1.4.2.3.4) (§ 1.4.2.3.6)

SET
RESET

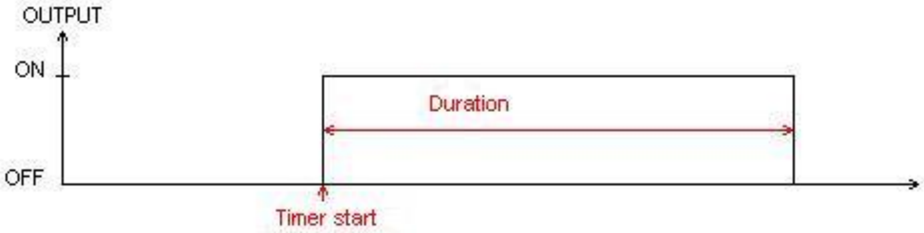
This function is designed to trigger operation of a particular device at a fixed time for a period set by the user.

Inputs:

- **TIMER START** : Corresponds to the time the output trips, and must comply with the following format: example for a trip at 09:30, enter 930 on the Timer start input, for 22:45 enter 2245, etc. The value should never exceed 2359 or 23:59.
- **DURATION** : Corresponds to the period during which the output must be active, and must comply with the following format: example for a duration of 5 hrs 10 mins, enter 510 on the Duration input.

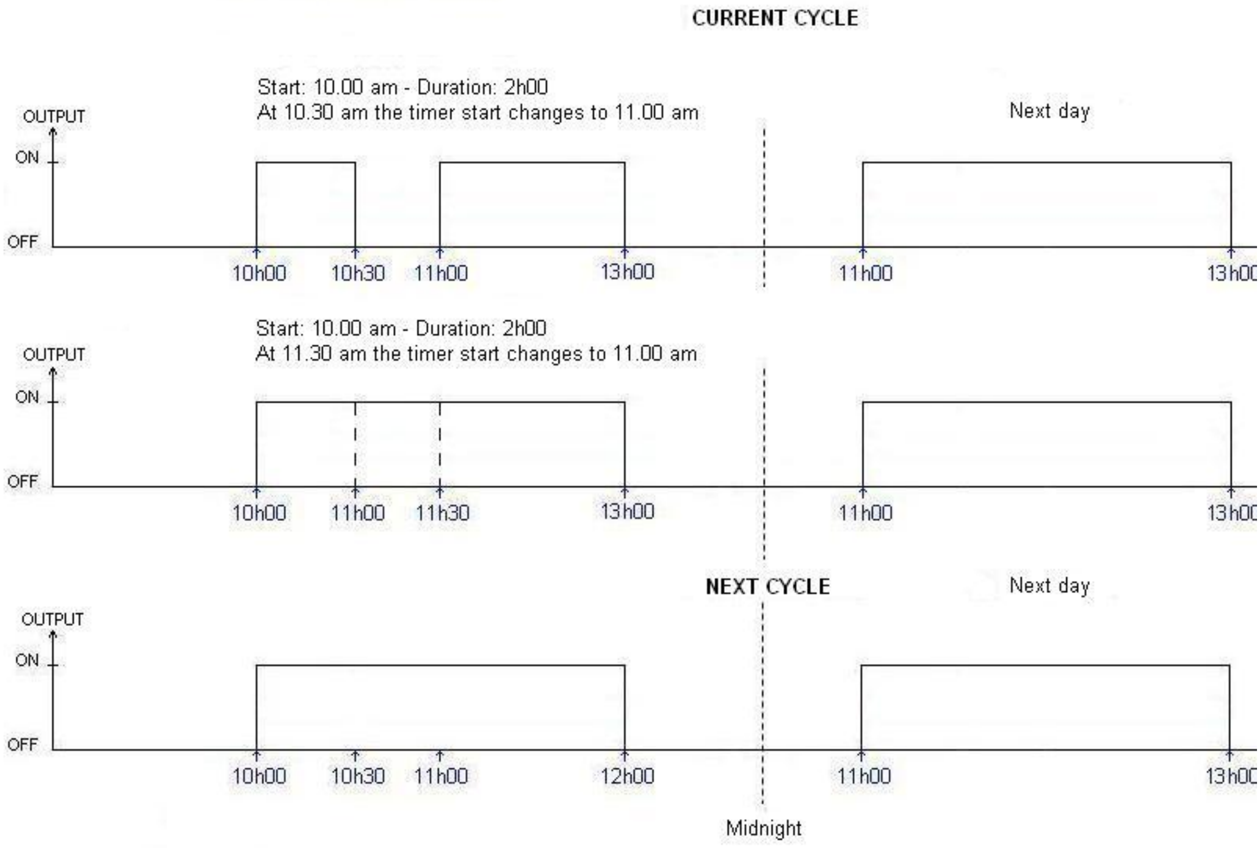
Output:

- **OUTPUT** : The output is at ON when the value currently on the TIMER START input equals the hour-minute on the controller for a period equal to the value currently on the DURATION input.



Parameters:

- **TIME CHANGE** : Used to choose the moment at which the time change that occurred as an input is taken into account when the output is at ON:
  - **CURRENT CYCLE** : A change on the TIMER START or DURATION input causes the end time to be recalculated. These changes are taken into account immediately.
  - **NEXT CYCLE** : A change on the TIMER START or DURATION input is not taken into account during the current cycle, the output remains at ON until the end of the cycle set previously. The new setting will be taken into account on the next cycle, i.e. when the output changes from ON to OFF.



1.4.2.3.6 1 Second Clock

⇦□□□□ (§ 1.4.2.3.5) □□□□⇨ (§ 1.4.2.3.7)

Blinking Input

The blinking input function is active every second. Its active symbol is 1" and its inactive symbol is 1".

1.4.2.3.7 Schmitt Trigger

⇦□□□□ (§ 1.4.2.3.6) □□□□⇨ (§ 1.4.2.3.8)

Description

The SCHMITT **TRIGGER** function allows an analog value to be monitored relative to two thresholds.
The output changes state if:

- The input value is lower than the minimum value
- The input value is higher than the maximum value

If the input is between the two, the output does not change state.
Each of the **FROM ON TO OFF** and **FROM OFF TO ON** setpoints can just as easily be the minimum or maximum value. This involves reverse operation of the function.
These two operations are shown in the diagrams(§ 1.4.2.3.7).
If the **ENABLE** input is in inactive state, the output remains inactive. The output does not change state if the **ENABLE** input changes from Active to Inactive state.

Access

The TRIGGER function is accessible from the **CTRL** function bar.

Inputs/Outputs

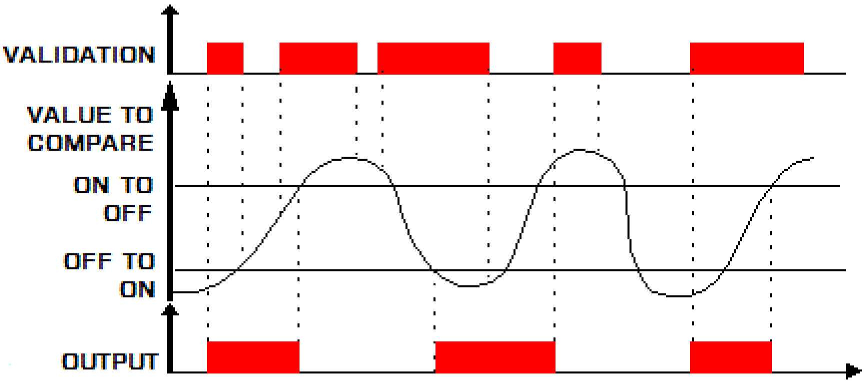
The function uses four inputs:

- A **VALUE TO COMPARE** Integer-type input
- An **ON TO OFF SETPOINT** Integer-type input
- An **OFF TO ON SETPOINT** Integer-type input
- An **ENABLE FUNCTION** Discrete-type input

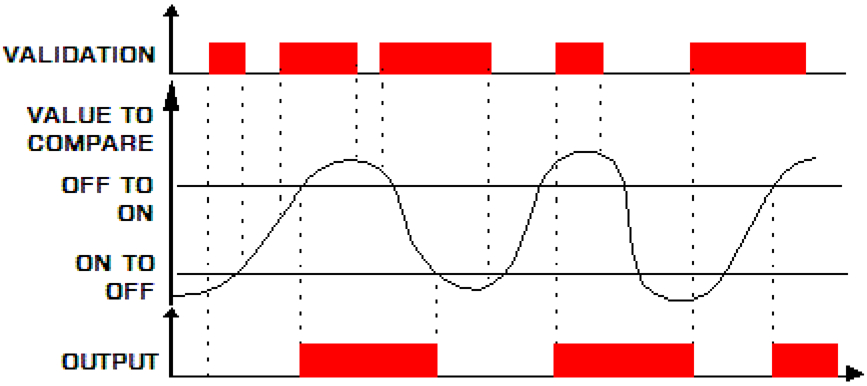
The function delivers a discrete **OUTPUT**.

Operating Diagrams

The figure shows the different states that the output can have in the case when the **ON TO OFF SETPOINT** is > the **OFF TO ON SETPOINT**:



The figure shows the different states that the output can have in the case when the **OFF TO ON SETPOINT** is > the **ON TO OFF SETPOINT**:



1.4.2.3.8 COMP IN ZONE Comparison

(§ 1.4.2.3.7) (§ 1.4.2.3.9)

Description

The **COMP IN ZONE** comparison function is used to compare one value between two setpoints (the MIN and MAX values of the zone).

Access

The < < COMP IN ZONE function is accessible from the **CTRL** function bar.

Inputs/Outputs

The comparison function uses:

- a discrete **ENABLE FUNCTION** input; this input is Active if it is not connected,
- A **VALUE TO COMPARE** input whose type is Integer,
- A **MIN VALUE** input, whose type is Integer,
- A **MAX VALUE** input, whose type is Integer,
- A discrete **OUTPUT**.

The OUTPUT indicates the result of the comparison when the ENABLE FUNCTION input is active.

The OUTPUT does not change state when the ENABLE FUNCTION input is inactive.

Parameters

From the **Parameters** window, you can select the state of the output according to the result of the comparison:

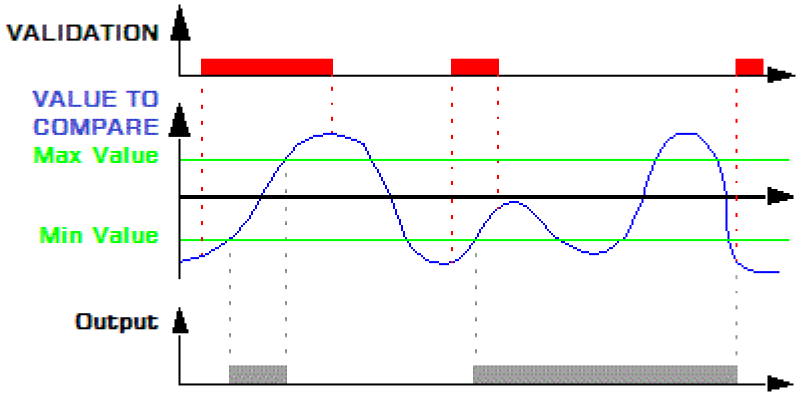
- **ON in the zone**: the output will be active if the input value is between the two setpoints (MIN and MAX),
- **OFF in the zone**: the output will be inactive if the input value is between the two setpoints (MIN and MAX).

If MINI is greater than MAXI, then for:

- **ON in the zone**: the output always remains inactive,
- **OFF in the zone**: the output always remains active.

Comparison Function

The diagram below shows the different states the output can take, depending on the input value to compare and the enable input:



1.4.2.3.9 COMPARE Function for Comparing Two Analog Values

◁□□□□ (§ 1.4.2.3.8) □□□□▷ (§ 1.4.2.3.10)

Description

The **COMPARE** function is used to compare two analog values.

Access

The COMPARE function is accessible from the **CTRL** function bar.

Inputs/Outputs

The function uses:

- an **ENABLE FUNCTION** Discrete-type input.
- a **VALUE 1** Integer-type input,
- a **VALUE 2** Integer-type input.

If the **VALUE 1** or **VALUE 2** input is not connected, the value is set to 0.
The function provides a discrete-type **OUTPUT**.
The output is active if the result of the comparison between **VALUE 1** and **VALUE 2** is true **and** if the **ENABLE FUNCTION** input is active or not connected.
The output does not change state if the **ENABLE FUNCTION** input changes from Active to Inactive state.

Parameters

The comparison operators that can be chosen from the **Parameters** window are:

Symbol	**Description**
>	Greater than.
≥	Greater than or equal to.
=	Equal to.

≠	Different.
≤	Less than or equal to.
<	Less than.

1.4.2.3.10 MULTICOMPARE Multiple comparison

(§ 1.4.2.3.9) (§ 1.4.2.3.11)

This function is used to activate the output corresponding to the value present on the "Value" input.

Inputs:

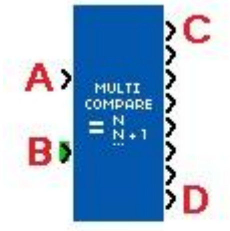
- **VALIDATION** : Function validation input. Until this input is activated, the function remains inert. **VALIDATION** est is active implicitly if it has not been connected.
- **VALUE** : Value to be compared.

Outputs:

- **VALUE N** Output ON if Value = Value N.
- **VALUE N + 1** : Output ON if Value = Value N + 1.
- **VALUE N + 2** : Output ON if Value = Value N + 2.
- **VALUE N + 3** : Output ON if Value = Value N + 3.
- **VALUE N + 4** : Output ON if Value = Value N + 4.
- **VALUE N + 5** : Output ON if Value = Value N + 5.
- **VALUE N + 6** : Output ON if Value = Value N + 6.
- **VALUE N + 7** : Output ON if Value = Value N + 7.

Operation:

The comparison value (Value N) can be configured. It must be between 0 and 32760.



A : Validation.
B : Value.
C : Value N.
D : Value N+7.

1.4.2.3.11 HL SWITCH Comparison of 5 values

(§ 1.4.2.3.10) (§ 1.4.2.3.12)

This function compares a value against 5 thresholds.

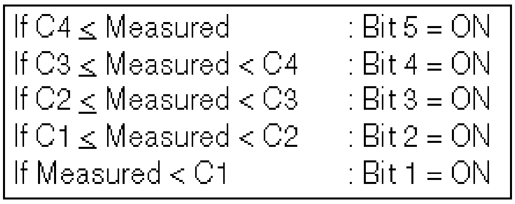
Inputs:

- **MEASURED input** : value to be compared.
- **SETPOINT 4 input** : threshold value of setpoint 4 if the "External" box on the parameters page is checked.

- **SETPOINT 3 input** : threshold value of setpoint 3 if the "External" box on the parameters page is checked.
- **SETPOINT 2 input** : threshold value of setpoint 2 if the "External" box on the parameters page is checked.
- **SETPOINT 1 input** : threshold value of setpoint 1 if the "External" box on the parameters page is checked.

Outputs:

- Output bits 1 to 5 of the block correspond to the following equations:
  - Output **Bit 5** is ON if the measured input is greater than or equal to setpoint 4.
  - Output **Bit 4** is ON if the measured input is greater than or equal to setpoint 3 and less than setpoint 4.
  - Output **Bit 3** is ON if the measured input is greater than or equal to setpoint 2 and less than setpoint 3.
  - Output **Bit 2** is ON if the measured input is greater than or equal to setpoint 1 and less than setpoint 2.
  - Output **Bit 1** is ON if the measured input is less than setpoint 1.
  - The setpoint values must be in the following sequence: C4 > C3 > C2 > C1.



If C4 ≤ Measured	: Bit 5 = ON
If C3 ≤ Measured < C4	: Bit 4 = ON
If C2 ≤ Measured < C3	: Bit 3 = ON
If C1 ≤ Measured < C2	: Bit 2 = ON
If Measured < C1	: Bit 1 = ON

- **SETPOINT 4** output : threshold value of setpoint 4 if the "External" box on the parameters page is not checked (can be modified via display).
- **SETPOINT 3** output : threshold value of setpoint 3 if the "External" box on the parameters page is not checked (can be modified via display).
- **SETPOINT 2** output : threshold value of setpoint 2 if the "External" box on the parameters page is not checked (can be modified via display).
- **SETPOINT 1** output : threshold value of setpoint 1 if the "External" box on the parameters page is not checked (can be modified via display).

Parameters:

- **Setpoint 4** : [3 ; 32767] threshold value of setpoint 4 if the "External" box is not checked.
- **Setpoint 3** : [2 ; 32766] threshold value of setpoint 3 if the "External" box is not checked.
- **Setpoint 2** : [1 ; 32765] threshold value of setpoint 2 if the "External" box is not checked.
- **Setpoint 1** : [0 ; 32764] threshold value of setpoint 1 if the "External" box is not checked.
- **External** : this box allows you to choose how the setpoint values are adjusted.
- **Timer** : [0 ; 32767] time delay for triggering the output bit.
  When the threshold is reached, the time delay starts and at the end of the period, a new acquisition of the measurement input confirms whether or not the threshold has been reached.

1.4.2.3.12 Min Max Function

(§ 1.4.2.3.11)

(§ 1.4.2.3.13)

Description

The **Min Max** function extracts the minimum and the maximum of a signal.

Access

The Min Max function is accessible from the **CTRL** function bar.

Inputs/Outputs

Description of inputs:

- **Initialization**: Initialization input of the Min Max function, of the Discrete(§ 1.4.2.1.1)-type.
- **Value**: Value of the analog input connected to the Min Max function. This is an integer between -32.768 and 32.767.

Description of the outputs:
The outputs depend on the state of the INITIALIZATION input.

- If the Initialization input is inactive, then:
  - **Minimum** is equal to the minimum of the **Value** input from the last passage to the inactive state of the initialization input,
  - **Maximum** is equal to the maximum of the **Value** input from the last passage to the inactive state of the initialization input,
- If the Initialization input is ON then the outputs are equal to the **Values** input.

> **Note:** If the **Initialization** input is not connected, then it is considered to be inactive.

1.4.2.3.13 REDUCED AVERAGE Calculating the average value

◁□□□□ (§ 1.4.2.3.12) □□□□▷ (§ 1.4.2.3.14)

This function updates the configured average of a number of values by deleting the minimum and maximum values. The input value is sampled each time the value changes or every N cycles.

Input:

- **VALIDATION** : Enables the function. If this input is not activated, the function remains inactive. Activated implicitly if it has not been connected.
- **INPUT** : Sampled value for calculating the reduced average.

Output:

- **OUTPUT** : Reduced average.

Parameters:

- **NUMBER OF SAMPLES** : Number of sampled values for calculating the average (from 4 to 32767).
- **SAMPLING** : On each change of the value on the "INPUT" or every N cycles (from 1 to 32767).

1.4.2.3.14 TIME PROG Programmer

◁□□□□ (§ 1.4.2.3.13) □□□□▷ (§ 1.4.2.3.15)

Description

The **TIME PROG** daily/weekly/yearly programmer is used to enable the time slots during which actions can be executed.
This function allows a maximum of 51 events to be defined, which are used to control its output.

Access

The TIME PROG function TIME PROG is accessible from the **CTRL** function bar.

Outputs

OUTPUT: this is the programmer validation output.
When one of the cycles that has been set up as a parameter is reached, the output is active (the output remains active for the entire duration of this cycle.)

Parameters

In the programming workshop

A cycle is defined by:

- The **type of action**: ON or OFF
- The **time** at which it will take effect: Hour/Minute
- The activation **mode**

Cycles can be activated in different ways:

- **Periodically**: Triggering of an event on certain weeks of each month (weekly) or certain days of the week (daily).
  In this case, you will have access to a new set of choices:
  - Weekly: This choice is enabled by default and all weeks are selected, with the possibility of selecting only certain weeks.
  - Daily: This choice is enabled by default and all days are enabled, with the possibility of selecting only certain days (in which case the Daily option is no longer valid).
- **Date**: Triggering of a single event on a specific date.
  In this case the day, the month and the year should be configured (if necessary, click on the calendar icon).
- **Annually**: Triggering of an event once a year.
  In this case, the month and the day should be configured (if necessary, click on the calendar icon).
- **Monthly**: Triggering of an event once a month.
  In this case, only the day should be configured (if necessary, click on the calendar icon).

> **Note:** The weeks indicated in Weekly mode do not correspond to calendar weeks (Monday to Sunday), but are instead defined in relation to the number of days since the start of the month (the first seven days of the month form the first week).

Modification from the Front Panel

To modify the parameters from the controller front panel, check the **Modification authorized** box in the **Parameters** window.
From the front panel, only the parameter values can be modified.
It is not possible to:

- Add or delete an event
- Modify the type (periodic, annual, monthly, and date)

Creating a Cycle

Procedure for creating a new cycle:

Step	Action
1	Create a new cycle by pressing the **New** button in the **Parameters** tab. **Result:** A new event number appears in the Current cycle box.

2	Configure the time when the event should take place: Hour/Minute.
3	Configure the type of action: ON or OFF.
4	Configure the activation mode according to your criteria (by default, the cycle will be triggered every day at the time indicated).
5	Confirm by clicking **OK**. **Result:** The new cycle is saved and the parameter setting window is closed.

Modifying a Cycle

Procedure for modifying a cycle:

Step	Action
1	Select the cycle to modify using the **Current cycle** drop-down menu in the **Parameters** tab. **Result:** The configuration of the selected cycle is opened.
2	Modify the required parameters.
3	Confirm by clicking **OK**. **Result:** The new cycle is saved and the parameter setting window is closed.

Clearing a Cycle

Procedure for clearing a cycle:

Step	Action
1	Select the cycle to clear using the **Current cycle** drop-down menu in the **Parameters** tab. **Result:** The configuration of the selected cycle is opened.
2	Clear the cycle using the **Clear** button. **Result:** The cycle disappears from the drop-down menu.
3	Confirm by clicking **OK**.

Summary of the Configuration

To take stock of all the cycles created and the conditions that trigger them, simply select the **Summary** tab and browse the list of the cycles configured.
The **Clear** button allows you to delete the designated cycle by clicking in the Summary tab list.
The **Number** button allows you to assign a new number (not yet used) to a designated event by clicking in the **Summary** tab list.
To modify the characteristics of a cycle, simply double-click on the desired line: the parameter setting window opens on the selected cycle.

Simulation and Debugging Mode

Clock Configuration

In simulation mode, it is the clock specific to the simulator that is taken into account. This clock is initialized during the switch to simulation mode with the time/date of the clock in the PC on which the programming workshop is running. The clock parameters can be modified subsequently:

- Using the Read/Write date and time command on the controller menu
- Using the CLOCK command in the MISCELLANEOUS choice, which can be accessed using the buttons on the front panel
- Using the Time Prog Jump Event(§ 1.2.7) window

Modifying the TIME PROG parameters

These parameters cannot be modified by opening the parameter setting window in Simulation and Debugging modes.

1.4.2.3.15 WEEK Configurable time programmer

WEEK

(§ 1.4.2.3.14) (§ 1.4.2.3.16)

WEEK

The WEEK function is a programmer used to enable the time slots during which actions can be executed.
This function can define a maximum of 42 events called a "cycle" which are used to control its "OUTPUT" output.

It is possible to change the parameters which define an event (hour, minute, state) via the inputs or outputs (using a display unit).
The hours, minutes must be entered in ascending order for each of the days.

Example:

For Monday :
Cycle 0 : ON at 8h00.
Cycle 1 : N.A..
Cycle 2 : OFF at 9h00.
Cycle 3 : ON at 10h00.
etc.

When the cycle value is changed via the "CYCLE" input, the output cycle value "CYCLE" is refreshed and is the same as the "CYCLE" input, which is not true when the cycle is changed via the "CYCLE" output; in this case the "CYCLE" input may differ from the "CYCLE" output. The hour, minute and state output values displayed are then those corresponding to the value of the "CYCLE" output.

It is not advisable to change the function parameters via the Parameters page in simulation or debugging mode.

Operation:

- Writing via the function inputs:
  - Changes in the values of the hour, minute, state parameters are only taken into account on a rising edge of the "NETWORK WRITE" input and if at least one of the 3 parameters differs from those in memory.
  - Changes on the cycle input can be used to view the stored values on the display outputs. It can also be used to identify the cycle(s) which do not conform to ascending order in the event of an error.
- Writing via the function outputs:
  - Changes in the values of the hour, minute, state parameters are made via a display; these changes are taken into account when the OK button is pressed, if the value of the modified parameter differs from that which has been stored.
  - Changes on the "CYCLE" output can be used to view the stored values on the display outputs. It can also be used to identify the cycle(s) which do not conform to ascending order in the event of an error.
- Error management:
  - An error is detected when the day is changed (one day = 6 cycles, Monday -> cycles 0, 1, 2, 3, 4, 5) if the ascending order of hours and minutes for the day prior to this change has not been respected. The "ERROR" output is then the same as the day containing the error (if the error output is 2 then there is an error on one of the Tuesday cycles, cycles 6, 7, 8, 9, 10 or 11).
  - If an error is present on the error output, the hour, minute and state parameters can only be written on cycles where the error is. While the error is present, it is not possible to change cycle parameters which do not correspond to the day on the "ERROR" output.
  - If when changing the day via the input or the cycle output (day containing the error to another day) ascending order is again detected, the error is corrected and the error output once again equals 0 which means there is no error. All the parameters can then be changed again.

Inputs:

- **VALIDATION** : The function is active if the input is ON, and it is ON if not connected.
- **NETWORK WRITE** : Used to write the hour, minute, state values present as inputs when a rising edge is detected.
- **CYCLE** Used to select the output values to be displayed (the output values are refreshed when the value of the "CYCLE" input is changed). Can also be used to select the cycle for writing the hour, minute and state values present as inputs.
- **HOUR** : Represents the hour to be written when there is a rising edge on the **NETWORK WRITE** input in the cycle present as an input.
- **MINUTE** : Represents the minutes to be written when there is a rising edge on the **NETWORK WRITE** input in the cycle present as an input.
- **STATE** : Represents the state to be written when there is a rising edge on the **NETWORK WRITE** input in the cycle present as an input. 0: OFF, 1: ON, 2: Not Applicable (N.A.).
- **OFFSET** : Used to time-shift the occurrence of events (in minutes). Example: If ON at 08.00 and OFFSET= - 120 then the output equals ON at 06.00 instead of 08.00. This input is useful for example with the Heat curve function.
- **MODE OFF:MODIFS/ON:RUN** :
  - MODIFS mode can be used to view the hours, minutes, state values of the Cycle and Cycle+1 corresponding to the value present as an input or as a cycle output.
  - RUN mode can be used to view the hours, minutes, state values corresponding to the current Cycle and Cycle+1 (in relation to the product time and day).

> **Note :** MODIFS mode can be used to view the hours, minutes, state values of the Cycle and Cycle+1 corresponding to the value present as an input or as a cycle output. RUN mode can be used to view the hours, minutes, state values corresponding to the current Cycle and Cycle+1 (compared to the time and day on the M3).

Outputs:

- **OUTPUT** : is ON or OFF depending on the events stored and depending on the date/time on the product.
- **CYCLE** (can be modified via display) : Used to select the output values to be displayed (the output values are refreshed when the value of the cycle output is changed). Also used to select the cycle for writing the hour, minute and state values.
- **DAY** : Corresponds to the day with which the values present on the hour, minute and status outputs are associated. Monday: 1, Tuesday: 2, Wednesday: 4, Thursday: 8, Friday: 16, Saturday: 32, Sunday: 64.
- **HOUR** (can be modified via display): Represents the hour to be written when the OK button on the display connected to it is pressed.
- **MINUTE** (can be modified via display): Represents the minutes to be written when the OK button on the display connected to it is pressed.
- **STATE** (can be modified via display): Represents the state to be written when the OK button on the display connected to it is pressed. 0: OFF, 1: ON, 2: Not Applicable (N.A.)
- **ERRORS** : Represents the day containing the error if the ERROR output is other than 0. If the ERROR output is 0, there is no error.
- **FAULT** : Is ON if the offset exceeds 255 minutes or if the offset causes an event trip for the day before the current day.

Parameters:

- **DAY** : Selection of the day for which you wish to modify the cycle values.
- **HOUR** : Hour corresponding to the event trip.
- **MINUTE** : Minute corresponding to the event trip.
- **STATE:** :
  - **OFF** : If the event is true (hour and minute on the product is higher or the

same as the hour and minute of the corresponding cycle) then the "OUTPUT" output changes to OFF.

- **ON** : If the event is true (hour and minute on the product is higher or the same as the hour and minute of the corresponding cycle) then the "OUTPUT" output changes to ON.
- **N.A.** : The event is not taken into account.

1.4.2.3.16 PRESET COUNT Up/Down Counter

◁□□□□ (§ 1.4.2.3.15)

□□□□▷ (§ 1.4.2.3.17)

Description

The **PRESET COUNT** up/down counter function is used to up-count from 0 to the preset value, or to down-count from this value to 0.
Several functions are available:

- Up-counting(§ 1.4.2.3.16) and forcing the counter to 0 on initialization,
- Up-counting(§ 1.4.2.3.16) and forcing the counter to 0 on initialization and when the count value has been reached,
- Down-counting(§ 1.4.2.3.16) and forcing the counter to the preset value on initialization,
- Down-counting(§ 1.4.2.3.16) and forcing the counter to the preset value on initialization and when 0 has been reached.

Access

This function 1234 PRESET COUNT is accessible from the **CTRL** function bar.

Inputs/Outputs

The up/down counter uses:

- A discrete **UP-COUNT** input,
- A discrete **DOWN-COUNT** input,
- A discrete **INITIALIZATION** input.

The up/down counter provides:

- A discrete **OUTPUT**,
- The preset value (1),
- The current counter value (1),
- The output timer value (1).
  (1) these integer values are displayed in Simulation and Debugging mode.

Parameters

In the programming workshop
From the **Parameters** window, you can adjust:

- The **Upcounting to the preset value** or **Downcounting from the preset value**,
- The **Preset** or **Setpoint** value (**1**),
- The **Single** cycle for initializing the counter only on initialization,
- The **Repetitive** cycle for initializing the counter on initialization, and when the current count value reaches 0 or the preset value.

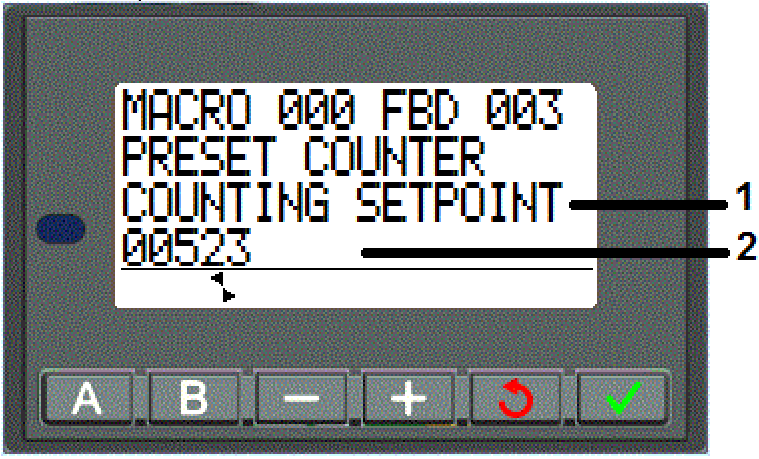
For the **Repetitive** cycle, the **DURATION OF THE PULSE** (x 100ms) corresponding to the time for which the output is **Active**.
The **Save on power break** parameter, if selected, enables the current value of the timer to be retrieved following a power failure.
From the front panel

From the PARAMETER(§ 1.3.2) menu, you can adjust:

- The **Preset** or **Counting setpoint** value,
- The **DURATION OF PULSE** value (for a repetitive cycle).

Illustration

Illustration: parameters of the counter



```
MACRO 000 FBD 003
PRESET COUNTER
COUNTING SETPOINT
00523
```

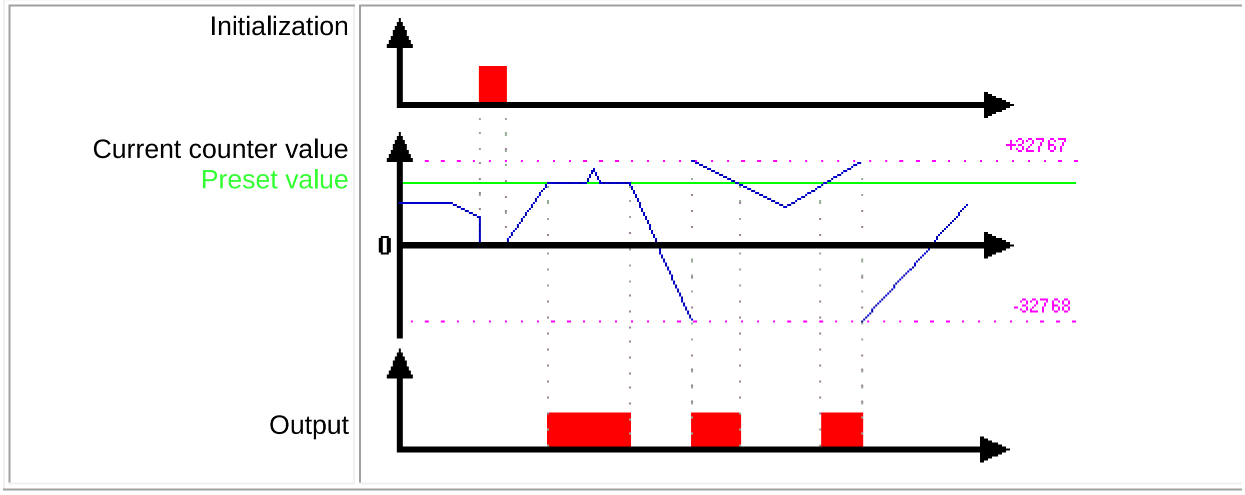
1 Name of the parameter displayed
2 Value of the parameter displayed

Parameter Modification

To modify the parameters from the front panel of the controller, check the **Authorized modification** box of the **Parameters** window.

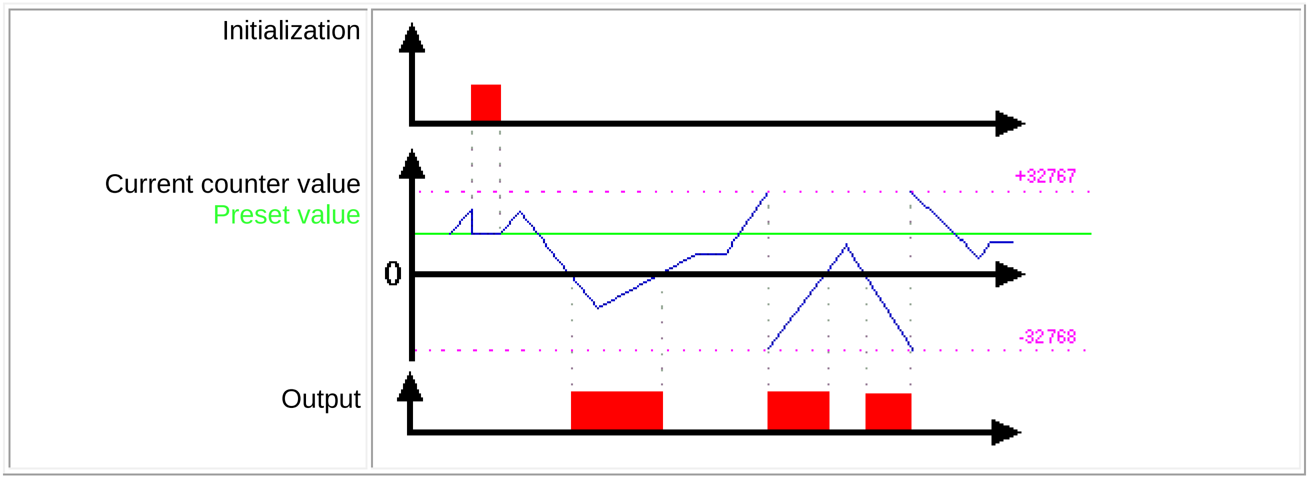
Up-Counting Function in Single Cycle Mode

For the next four graphs, the blue curve represents the internal value of the counter, when it increases there are pulses at the counting input and when it decreases, at the down-counting input.
The following diagram shows the operation of the counter with initialization at 0:



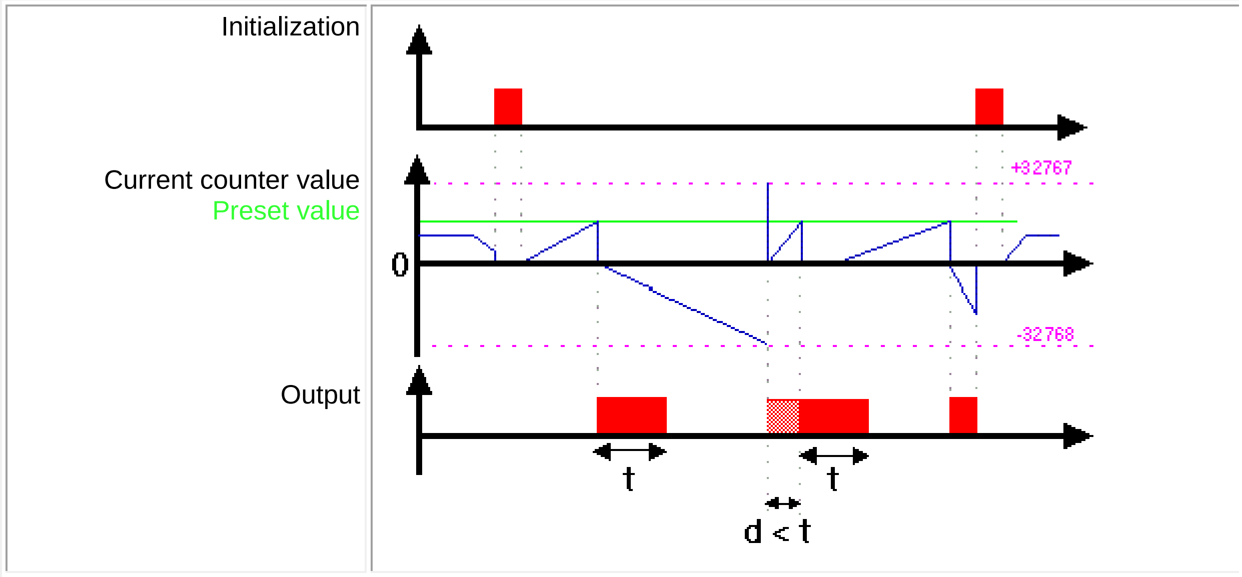
Down-Counting Function in Single Cycle Mode

The following diagram shows the operation of the down-counter with initialization at the preset value:



Up-Counting Function in Repetitive Cycle Mode

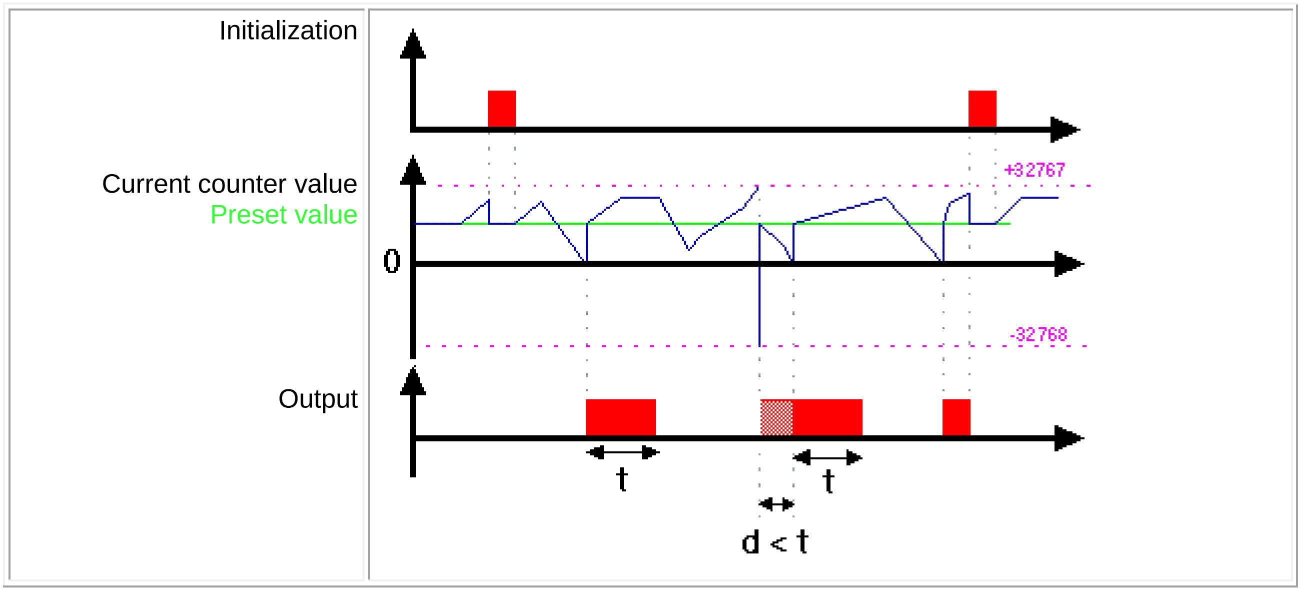
The following diagram shows the operation of the counter with forcing to 0 of the current value on initialization, or when the count value has reached the preset value:



The output switches to the **Inactive** state when the predefined pulse duration value has run out. If the switch condition is Active before the switch to the Inactive state, the output pulse is prolonged by the DURATION OF THE PULSE (Timing).

Down-Counting Function in Repetitive Cycle Mode

The following diagram shows the operation of the down-counter with forcing to the preset value of the current value on initialization, or when the count value has reached 0:



The output switches to the **Inactive** state when the predefined pulse duration value has run out. If the switch condition is Active before the switch to the Inactive state, the output pulse is prolonged by the DURATION OF THE PULSE (Timing).

1.4.2.3.17 UP/DOWN COUNT Up/Down Counter

(§ 1.4.2.3.16) (§ 1.4.2.3.18)

Description

The **UP/DOWN COUNT** function is used to up-count or down-count from a preset value resulting from a calculation outside the function.
A level 1 on the **PRESET FORCING** input is used to change the counter with the value available at the **PRESET** input.
The **PRESET** input can be connected to the NUM constant, to an analog input, or to any other kind of output on a function block which delivers an INTEGER-type value.
A rising edge on the:

- **UPCOUNTING**: increments the counter.
- **DOWNCOUNTING**: decrements the counter.

State of the **OUTPUT**:

- **1**: when the counting number has been reached, the **OUTPUT** switches to 1 and remains so for as long as the counting number is greater than or equal to the **PRESET** value,
- **0**: if the transitions on the **DOWNCOUNT** input switch the counting number back to a value less than the **PRESET** value.

Activation of the **RESET** or **PRESET FORCING** inputs enable the counter to be relaunched.
As long as the **RESET** input is at 1, the **OUTPUT** remains at 0. When the **RESET** input switches to 0, the up/down count operation is relaunched from zero.

Access

This function 1234 UP DOWN COUNT is accessible from the **CTRL** function bar.

Inputs/Outputs

The up/down counter uses the following inputs:

- **UPCOUNTING**, Discrete type,

- **DOWNCOUNT**, Discrete type,
- **RESET**, Discrete type,
- **PRESET FORCING**, Discrete type,
- **PRESET**, integer type.

The up/down counter provides the following outputs:

- **OUTPUT**, Discrete type,
- **CURRENT VALUE**, integer type, between -32768 and 32767.

Parameters

The **Save on power break** parameter, if selected, enables the current value of the timer to be retrieved following a power failure(§ 1.2.20).

1.4.2.3.18 PRESET H-METER Preset Hour Counter

(§ 1.4.2.3.17) (§ 1.4.2.3.19)

Description

The **PRESET H-METER** hour counter function measures the duration of input activation. When this duration reaches a preset value, the output is activated.
The duration can be set in hours (Maxi 32767) and minutes.
Activation of the **RESET** input allows the output to be deactivated and the current values initialized.

Access

This function HH-MM PRESET H·METER is accessible from the **CTRL** function bar.

Inputs/Outputs

The counter uses:

- A discrete **COMMAND** input,
- A discrete **RESET** input.

If these two inputs are not connected, they are set respectively to Active and Inactive.
The counter provides:

- A discrete **OUTPUT**,
- The copy of the setpoint of the number of hours (1),
- The current value of the number of hours (1),
- The copy of the setpoint of the number of minutes (1),
- The current value of the number of minutes (1),
  (1) these integer values are displayed in Simulation and Debugging mode.

Parameters

You can set:

- The preset **Hour** value, which is a value between 0 and 32767,
- The preset **Minute** value, which is a value between 0 and 59.

If the **Save on power failure** parameter is selected, it enables the timer to be restarted at the point where it stopped after a power failure(§ 1.2.20).

Modification from the front panel

To modify the parameters from the front panel of the controller, check the **Authorized modification** box of the **Parameters** window.

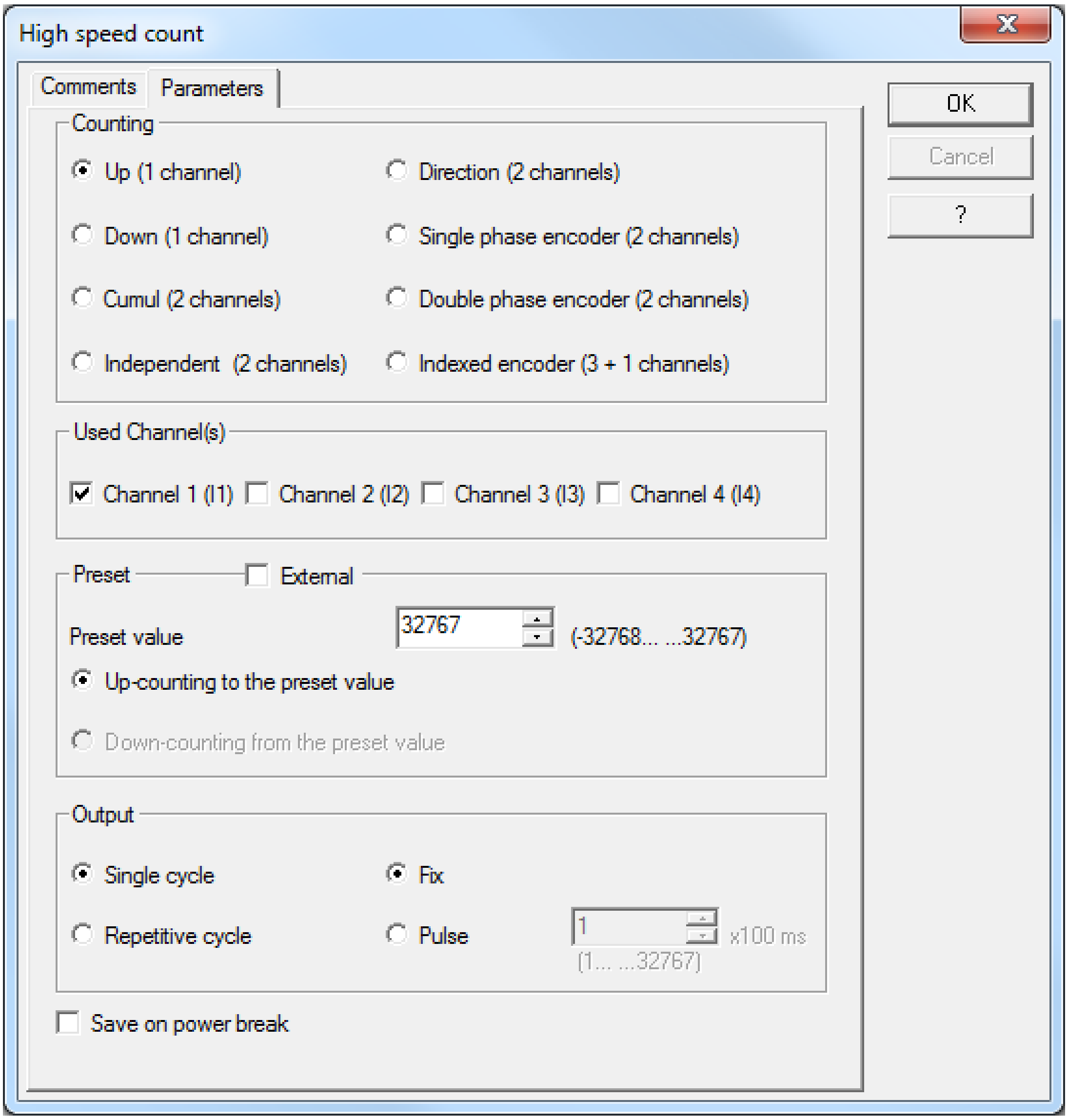
1.4.2.3.19 HIGH SPEED COUNT

(§ 1.4.2.3.18)

(§ 1.4.2.3.20)

This function is used to count the pulses arriving at inputs I1 to I4 of a controller powered by a DC supply, at rates in excess of one pulse every 2 ms.

How the Graphic Interface Works



Counting

● Up (1 channel) ○ Direction (2 channels)

○ Down (1 channel) ○ Single phase encoder (2 channels)

○ Cumul (2 channels) ○ Double phase encoder (2 channels)

○ Independent (2 channels) ○ Indexed encoder (3 + 1 channels)

Used Channel(s)

☑ Channel 1 (I1) □ Channel 2 (I2) □ Channel 3 (I3) □ Channel 4 (I4)

Preset □ External

Preset value 32767 (-32768... ...32767)

● Up-counting to the preset value

○ Down-counting from the preset value

Output

● Single cycle ● Fix

○ Repetitive cycle ○ Pulse 1 x100 ms (1... ...32767)

□ Save on power break

The window opens as soon as the block is placed on the edit sheet; there are 5 groups of parameters. The OK button saves the selected parameters.

The Cancel button cancels changes made since opening the block.

The Backup on power failure box is used to save the parameter table in the event of a power failure.

On first opening the block, the Cancel button, the closing x, and the keyboard shortcut Alt+F4 are deactivated so that use of channels has to be saved.

- Implicit inputs:
  - Controller inputs I1 to I4 are used for the different types of counting. There is no need to place a discrete input symbol on the corresponding input plot to confirm use of inputs I1 to I4, nor to make a connection between the plot and the HIGH SPEED COUNT application-specific function since this link is implicit. However these plots can still be used in the standard manner, for example to examine the

  - logical status of the inputs when the counting pulses on the inputs are stopped.
  - Whether the OFF to ON or ON to OFF edges are taken into account depends on the operating mode chosen for the counter in the Parameters window.

- Explicit inputs:
  - **Activation** : Set to 1 if not connected. If the **Activation** input is at 0, no further counting is done.
  - **Reset** : Set to 0 if not connected. If the **Reset** input is at 1, no further counting is done and the values are reset.
  - **Preset** : Input inactive if the external preset option is not checked. This input is Integer type (-32768..+32767), and can be used to enter an external **Preset** value if the box is checked.

This application-specific function has 5 outputs (**OUTPUT, ERROR, PRESET VALUE, COUNT/SPEED, TIME DELAY**).

- **Output** : If the counter number has reached the preset value (or 0 in downcounting mode), the **output** is set to 1. It remains active depending on whether the output parameter is fixed or pulsed.
- **Error** : Output active when the counter exceeds -32768 or +32767 or when the maximum frequency is reached. The count is no longer reliable.
- **Preset value** : The internal or external preset is displayed as an output. Value between -32768 and +32767.
- **Counter/Speed** : This output indicates the current counter value. Value between -32768 and +32767.
- **Time delay** : This output indicates the current value of the time delay in the case of a pulsed output. 0 if fixed output. Value between +1 and +32767 if pulsed output.

Selecting the Counting Mode.

Only one counting mode can be selected per high-speed counter (exclusive option).
There are 3 different types of counter: 1-channel, 2-channel, and 4-channel counters.
1-channel counting modes are the **Up** and **Down** modes. Only one channel is required (I1, I2, I3 or I4).

If **Up** is selected, the **Upcount to preset** option is automatically checked and the "Downcount from preset" option is grayed out and unchecked (in the 'Preset' part).
If **Down** is selected, the **Downcount from preset** option is automatically checked and the "Upcount to preset" option is grayed out and unchecked (in the 'Preset' part).

2-channel counting modes are the **Cumul**, **Independent**, **Directional**, **Phase**, **Phase 2** (double) modes. To click on one of these modes, it is essential that channel groups I1 & I2 or I3 & I4 are free in the **Channel(s) used** zone. Otherwise this mode cannot be chosen (option grayed out).

The 4-channel counting mode is the Indexed counting mode. It is essential that all channels are free if this mode is chosen. Otherwise this mode cannot be chosen (option grayed out).

Selecting the Channel Used.

A high-speed counter block always uses at least 1 channel. The channels used by the other blocks are indicated on the parameter-setting sheet: they are grayed out and checked.

If **Up** or **Down** mode is selected, choosing 1 available channel will deselect the previously chosen channel.

If **Cumul**, **Independent**, **Single phase**, **Double phase** or **Directional** mode is selected, only a pair of channels can be clicked on: I1 & I2 or I3 & I4. For example, by clicking on I1 or I2, channels I1 and I2 will be selected. I1 cannot be chosen if I2 is not available, nor I2 if I1 is not available. The same applies to channels I3 and I4.

If **Index** mode is selected, all 4 channels are checked and grayed out.

Selecting the Preset.

If External preset is selected, the value of the internal preset can no longer be chosen, and the Preset value box is grayed out. If External preset is unchecked, the value of the preset can once again be chosen.
The preset value that can be entered is within the range -32768 to +32767.

If Up mode is selected, the "Upcount to preset" option is checked and the "Downcount from preset" option is unchecked. If Down mode is selected, the "Downcount from preset" option is checked and the "Upcount to preset" option is unchecked.

For all other mode selections both options are available, but only one at a time.

Selecting the Output.

Two types of output can be chosen: Single shot or Repetitive cycle.

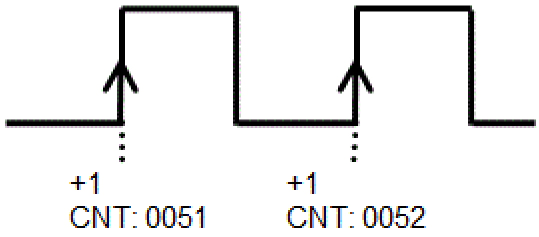
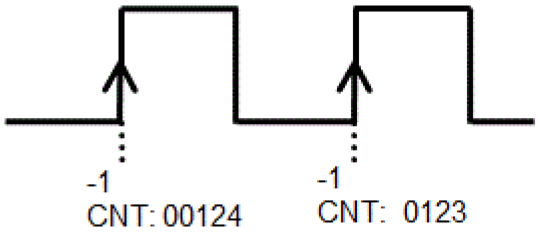
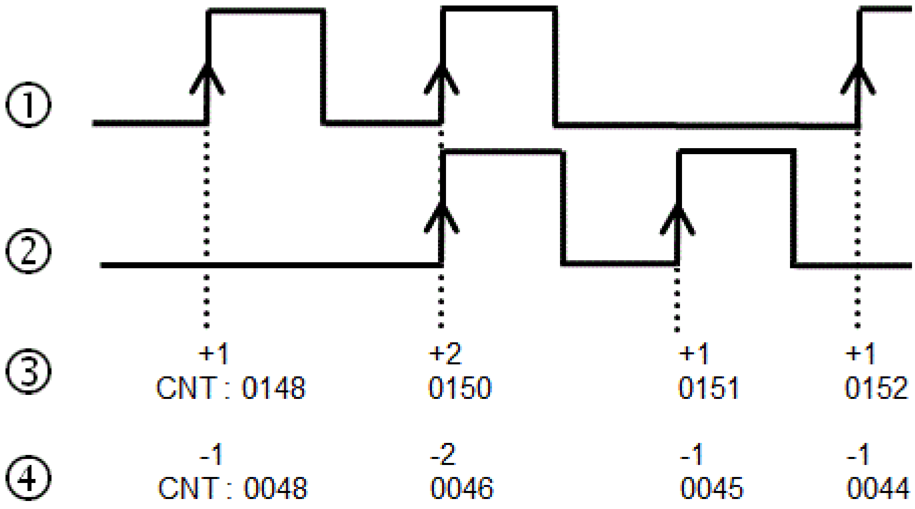
In Single shot either the fixed or pulsed option can be chosen. If Fixed option is activated, the value of the pulse can no longer be chosen, and the value selection box is grayed out. If Pulsed option is activated, the value of the pulse can once again be chosen.

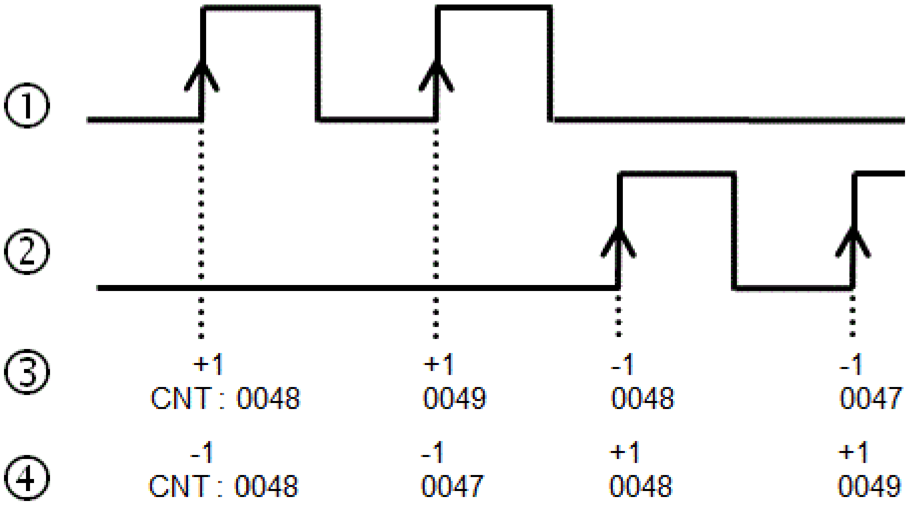
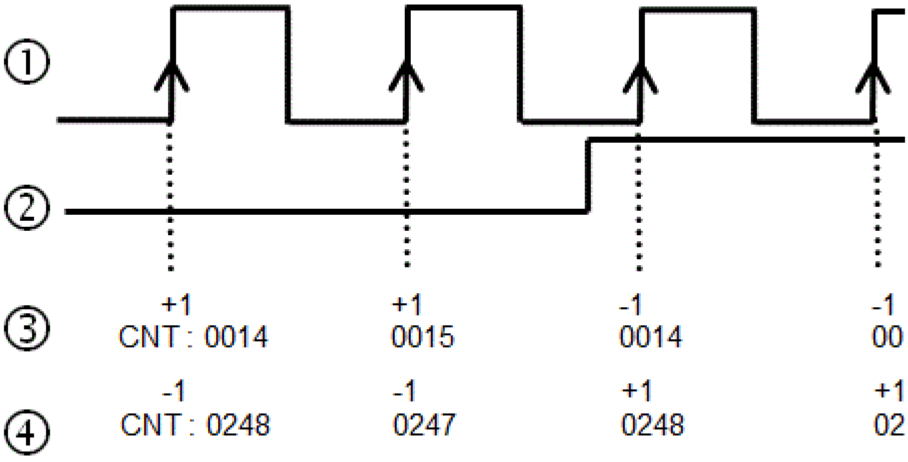
In Repetitive cycle, Fixed option is grayed out and Pulsed option is the only option available. The value of the pulse can be chosen.

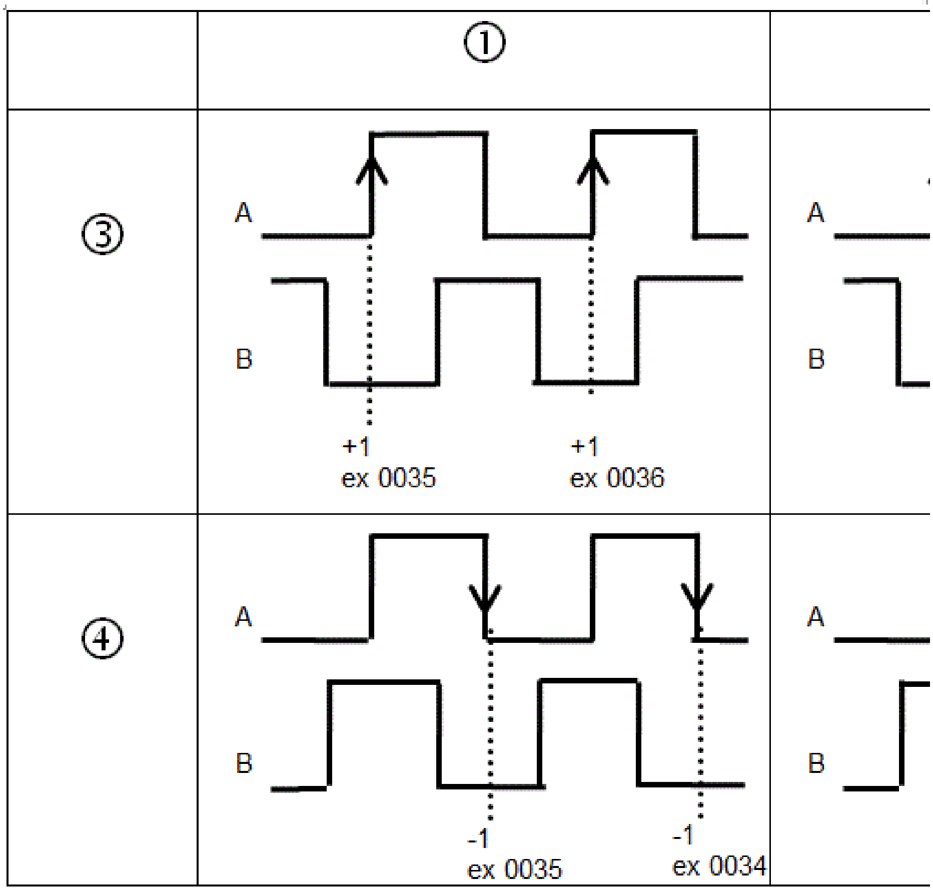
The value of the pulse is between +1 and +32767 (actual pulse = value x 100 ms).

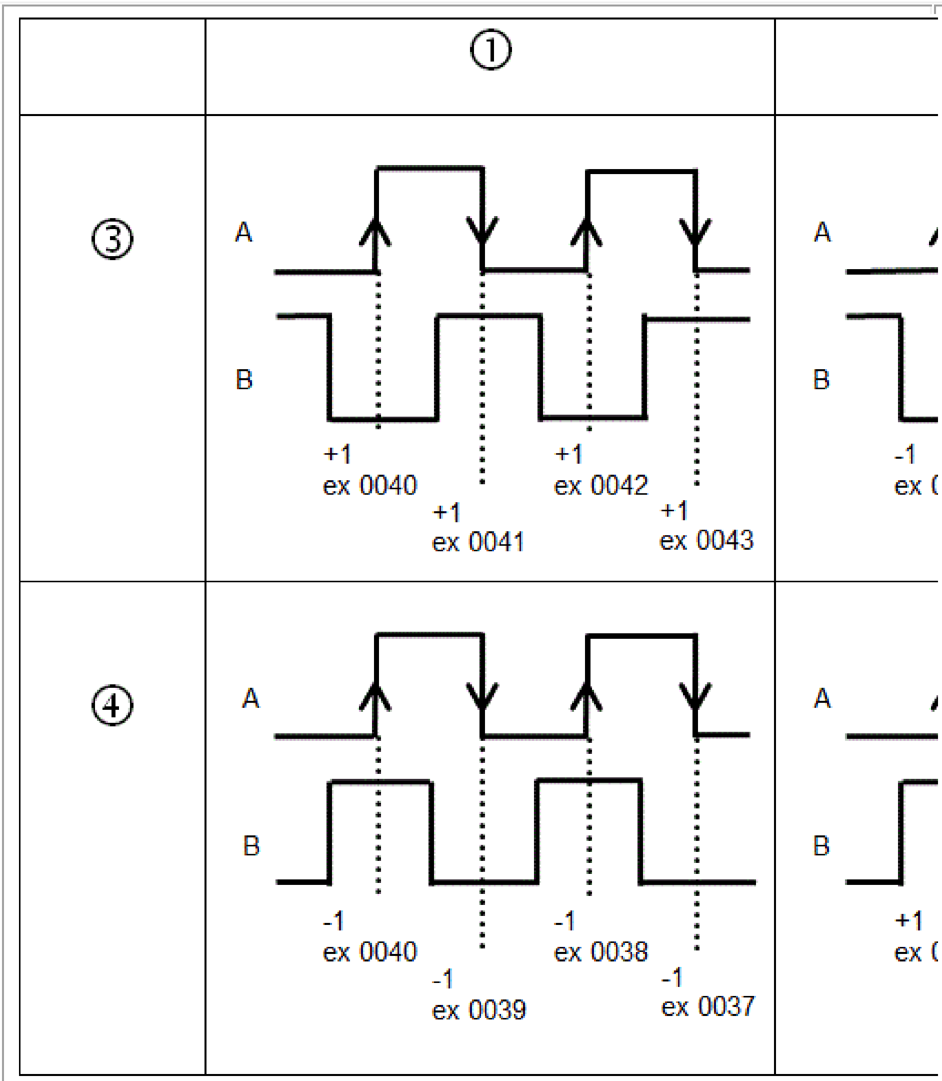
Backup.

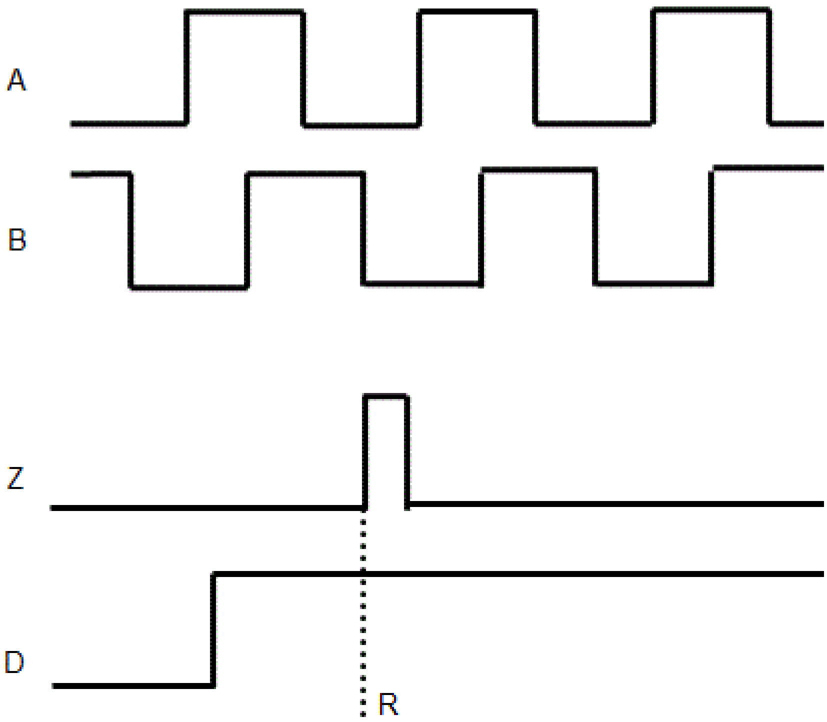
The Parameters tab contains the box (which is checked by default) that saves the count after a controller power failure.

Counting Modes	**Diagrams**	Count on rising edge
UP		The counter upcounts on the rising edge of the chosen input (I1, I2, I3, I4).
DOWN		The counter downcounts on the rising edge of the chosen input (I1, I2, I3, I4).
CUMUL	 ① ② ③ ④ +1 CNT : 0148 +2 0150 +1 0151 +1 0152 -1 CNT : 0048 -2 0046 -1 0045 -1 0044	The counter counts on the rising edge of I1 & I2, or I3 & I4. 1 : Input I1 or I3 2 : Input I2 or I4 3 : option: Upcount to the preset 4 : option: Downcount from the preset

INDEPENDENT	 ① ② ③ ④ +1 CNT : 0048 +1 0049 -1 0048 -1 0047 -1 CNT : 0048 -1 0047 +1 0048 +1 0049	The counter upcounts on the rising edge of I1 and downcounts on the rising edge of I2, or upcounts on the rising edge of I3 and downcounts on the rising edge of I4. 1 : Input I1 or I3 2 : Input I2 or I4 3 : option: Upcount to the preset 4 : option: Downcount from the preset
DIRECTIONAL	 ① ② ③ ④ +1 CNT : 0014 +1 0015 -1 0014 -1 00 -1 CNT : 0248 -1 0247 +1 0248 +1 02	The counter upcounts on channel I1, direction of counting reversed according to the state of input I2. or The counter upcounts on channel I3, direction of counting reversed according to the state of input I4. 1 : Input I1: counting in the direction of the cycle 2 : Input I2: direction of counting reversed 3 : COUNT output.

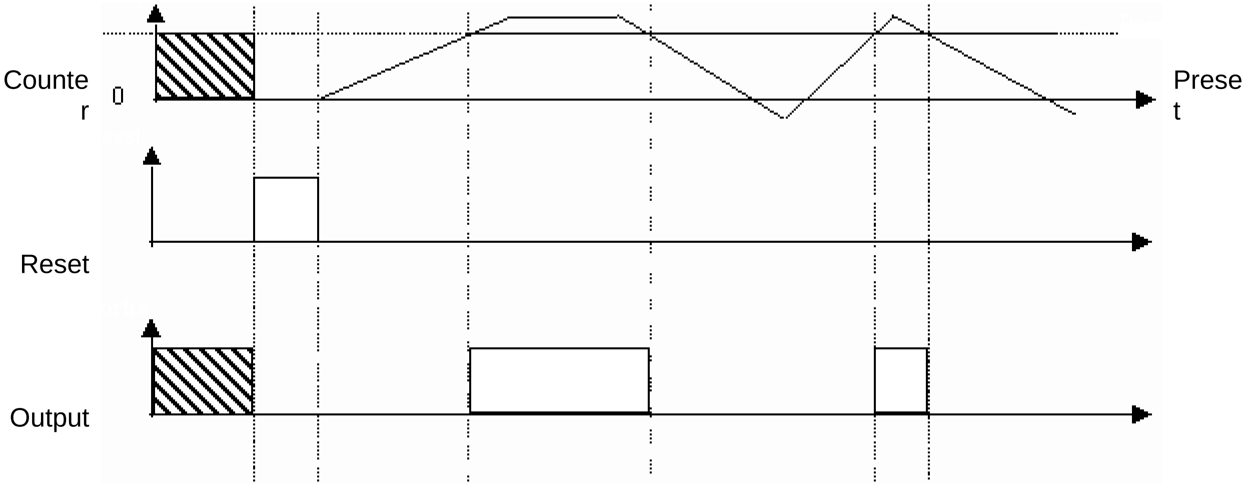
		Upcount to the preset option 4 : COUNT output, Downcount from the preset option
PHASE	 ① ③ A B +1 ex 0035 +1 ex 0036 A B ④ A B -1 ex 0035 -1 ex 0034 A B	The counter is incremented on each rising edge of I1 when the phase-shift between I1 and I2 is +90° (+pi/2) and is decremented on each falling edge of I1 when the phase-shift between I1 and I2 is –90° (-pi/2). Or the counter is incremented on each rising edge of I3 when the phase-shift between I3 and I4 is +90° (+pi/2) and is decremented on each falling edge of I3 when the phase-shift between I3 and I4 is –90° (-pi/2). 1 : Upcount to preset 2 : Downcount from preset 3 : UPCOUNT direction 4 : DOWNCOUNT direction

PHASE 2: Double phase	 ① ③ A B +1 ex 0040 +1 ex 0041 +1 ex 0042 +1 ex 0043 A B -1 ex (④ A B -1 ex 0040 -1 ex 0039 -1 ex 0038 -1 ex 0037 A B +1 ex (	The counter is incremented on each edge (rising or falling) of I1 when the phase-shift between I1 and I2 is +90° (+pi/2) and is decremented on each edge (rising or falling) of I1 when the phase-shift between I1 and I2 is -90° (-pi/2). Or The counter is incremented on each edge (rising or falling) of I3 when the phase-shift between I3 and I4 is +90° (+pi/2) and is decremented on each edge (rising or falling) of I3 when the phase-shift between I3 and I4 is -90° (-pi/2). 1) Upcount to preset 2) Downcount from preset 3) UPCOUNT direction 4) DOWNCOUNT direction

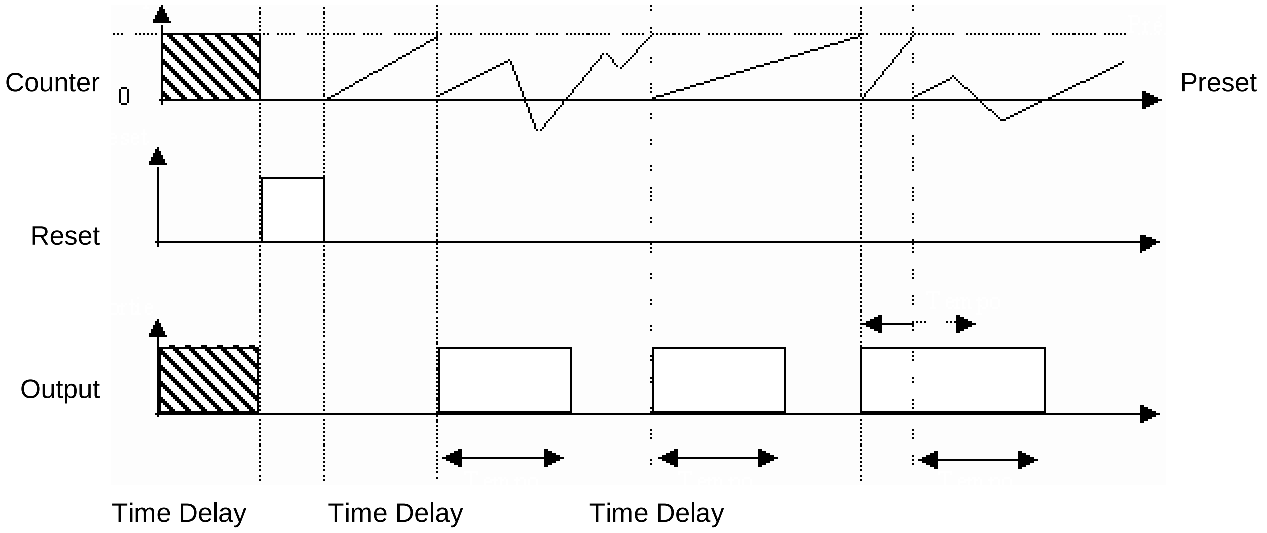
		A: Channel A B: Channel B
INDEX		The counter is incremented on each rising edge of I1 when the phase-shift between I1 and I2 is +90° (+pi/2) and is decremented on each falling edge of I1 when the phase-shift between I1 and I2 is -90° (-pi/2). Operation is identical to the Phase mode with an additional channel Z. A pulse appears on this channel on each encoder revolution, which determines a reference position. This pulse usually lasts for 90° electrical. A: Channel A B: Channel B Z: Index R: Mechanical reset to the pre-introduction value

Upcount to preset mode

Single shot : The output is fixed or pulsed
The pulse is adjustable in 100 ms intervals from +1 to +32767

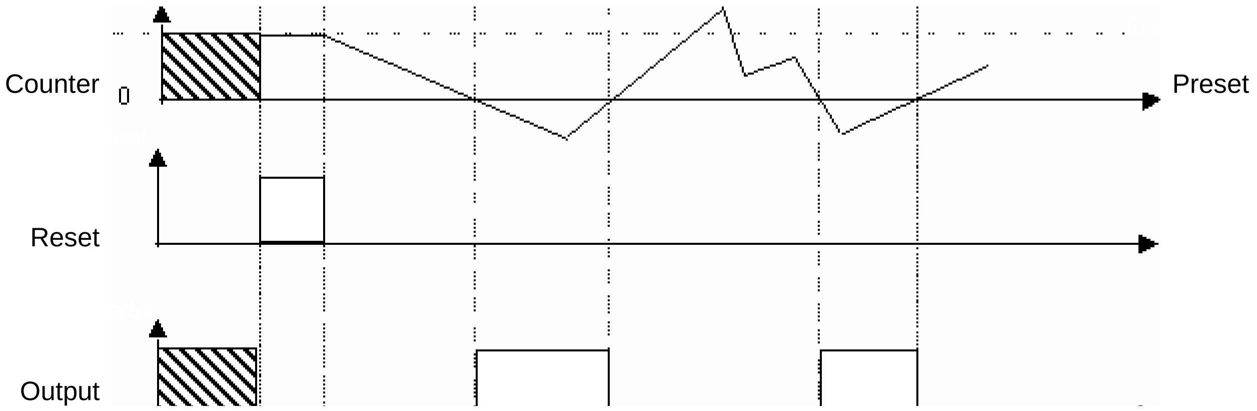


Repetitive cycle : The output is pulsed
The pulse is adjustable in 100 ms intervals from +1 to +32767

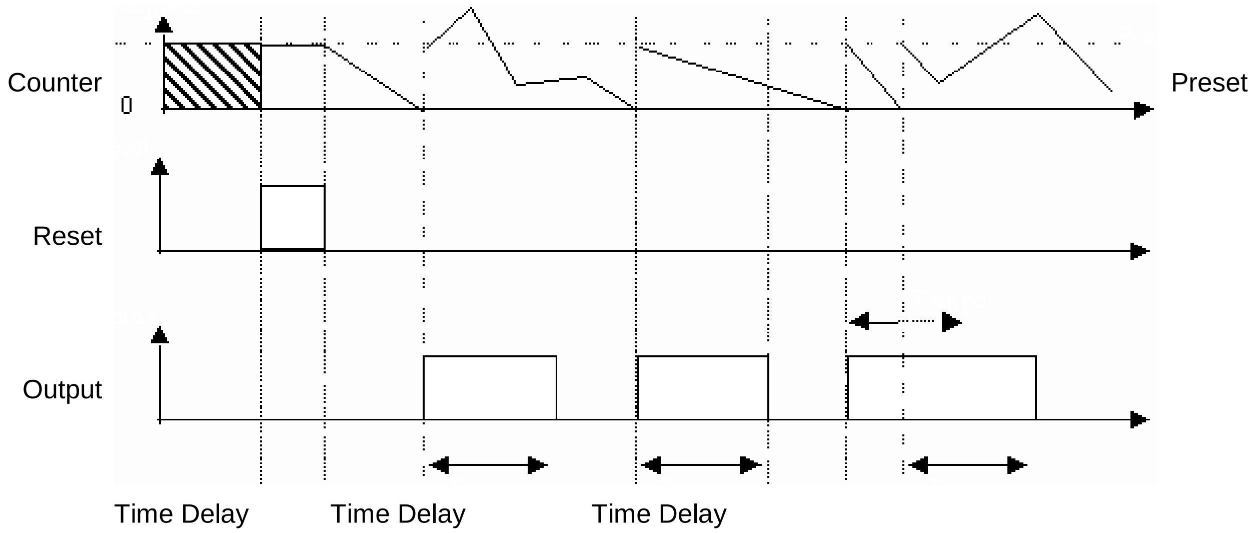


Downcount from preset mode

Single shot



Repetitive cycle



Possible Combinations

🟦	1-channel counter
🟧	2-channel counter
🟩	4-channel counter

I1	I2	I3	I4	Frequency	Counter total
🟦				60kHz	1
	🟦			60kHz	1
		🟦		60kHz	1
			🟦	60kHz	1
🟦	🟦			40kHz	2
🟦		🟦		40kHz	2
🟦			🟦	40kHz	2
	🟦		🟦	40kHz	2
	🟦	🟦		40kHz	2
		🟦	🟦	40kHz	2
🟧				40kHz	1
		🟧		40kHz	1
🟦	🟦	🟦		30kHz	3
🟦	🟦		🟦	30kHz	3
🟦		🟦	🟦	30kHz	3
	🟦	🟦	🟦	30kHz	3

🟧		🟦		30kHz	2
🟧			🟦	30kHz	2
🟦		🟧		30kHz	2
	🟦	🟧		30kHz	2
🟦	🟦	🟦	🟦	20kHz	4
🟧		🟧		20kHz	2
🟩				20kHz	1

⚠	**CAUTION** If the frequency is exceeded, at first there is a loss of pulses. If there is further increases of frequency, the WATCHDOG triggered and there is a reset of the product. **Failure to follow these instructions can result in injury or equipment damage.**

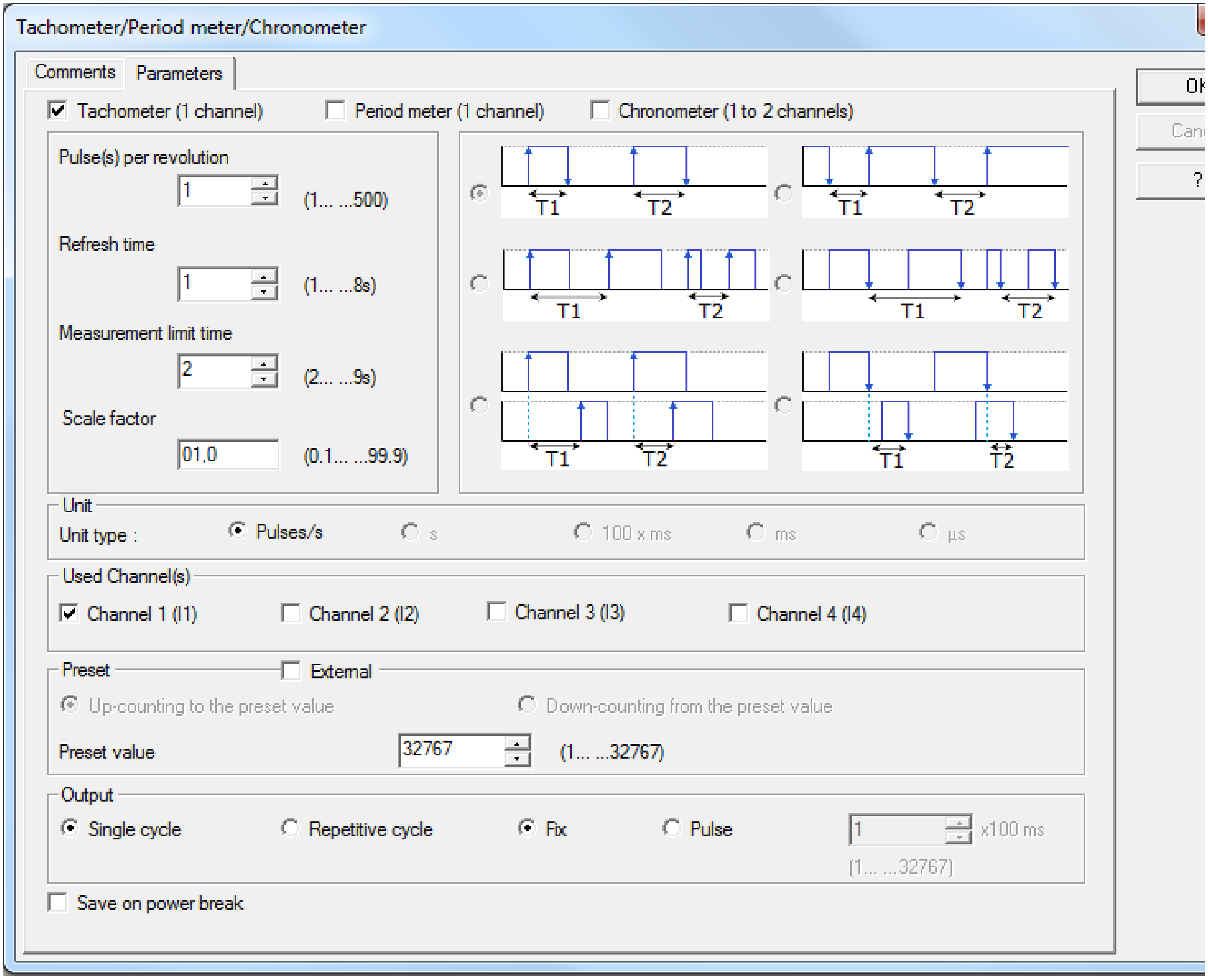
1.4.2.3.20 Tachometer, Chronometer, Period meter

□□□□ (§ 1.4.2.3.19)

□□□□ (§ 1.4.2.4)

This function is used to count the time or the frequency between pulses arriving at inputs I1 to I4 of a controller powered by a DC supply, at rates in excess of one pulse every 2 ms.

How the Graphic Interface Works



Tachometer/Period meter/Chronometer

Comments | Parameters

☑ Tachometer (1 channel) □ Period meter (1 channel) □ Chronometer (1 to 2 channels)

Pulse(s) per revolution: 1 (1... ...500)

Refresh time: 1 (1... ...8s)

Measurement limit time: 2 (2... ...9s)

Scale factor: 01,0 (0.1... ...99.9)

Unit

Unit type : ● Pulses/s ○ s ○ 100 x ms ○ ms ○ µs

Used Channel(s)

☑ Channel 1 (I1) □ Channel 2 (I2) □ Channel 3 (I3) □ Channel 4 (I4)

Preset □ External

● Up-counting to the preset value ○ Down-counting from the preset value

Preset value: 32767 (1... ...32767)

Output

● Single cycle ○ Repetitive cycle ● Fix ○ Pulse 1 x100 ms (1... ...32767)

□ Save on power break

The window opens as soon as the block is placed on the edit sheet, there are 5 groups of parameters. The OK button saves the selected parameters.
The Cancel button cancels changes made since opening the block.
The Backup on power failure box is used to save the parameter table in the event of a power failure.

On first opening the block, the Cancel button, the closing x, and the keyboard shortcut Alt+F4 are deactivated so that use of channels has to be saved.

- Implicit inputs:
  - Controller inputs I1 to I4 are used for the different types of counting. There is no need to place a discrete input symbol on the corresponding input plot to confirm use of inputs I1 to I4, nor to make a connection between the plot and the TACHOMETER/PERIOD METER/CHRONOMETER application-specific function since this link is implicit. However these plots can still be used in the standard manner, for example to examine the logical status of the inputs when the counting pulses on the inputs are stopped.
  - Whether the OFF to ON or ON to OFF edges are taken into account depends on the operating mode chosen in the Parameters window.

- Explicit inputs:
  - **Activation** : Set to 1 if not connected. If the **Activation** input is at 0, no further calculations are made.
  - **Reset** : Set to 0 if not connected. If the **Reset** input is at 1, no further calculations are made and the values are reset.
  - **Preset** : Input inactive if the external preset option is not checked. This input is Integer type (-32768..+32767), and can be used to enter an external **Preset** value if the box is checked.

  This application-specific function has 5 outputs (**OUTPUT, ERROR, PRESET VALUE, COUNT/SPEED, TIME DELAY**).
  - **Output** : If the counter number has reached the preset value (or 0 in downcounting mode), the **output** is set to 1. It remains active depending on whether the output parameter is fixed or pulsed.
  - **Error** : Output active when the counter exceeds -32768 or +32767 or when the maximum frequency is reached. The calculation is no longer reliable.

- **Preset value** : The internal or external preset is displayed as an output. Value between -32768 and +32767.
- **Counter/Speed** : This output indicates the current counter value. Value between -32768 and +32767.
- **Time delay** : This output indicates the current value of the time delay in the case of a pulsed output. 0 if fixed output. Value between +1 and +32767 if pulsed output.

Selecting the Mode.

Only one mode can be selected of the 3 available: Tachometer, Period meter, Chronometer.

Tachometer mode uses one channel (I1, I2, I3 or I4). On clicking on Tachometer mode, the Cycle parameters can be set in turn (range +1 to +500), Refresh period (range +1 to +8 s), Measurement limit period (range +2 to +9 s), and Scale factor (range between +0.01 and 99.9). It is not possible to choose a unit.

The **Period meter** mode uses one channel (I1, I2, I3 or I4). On clicking on Period meter mode, the Cycle parameters can be set in turn (range +1 to +500), Refresh period (range +1 to +8 s), Measurement limit period (range +2 to +9 s), and Scale factor (range between +0.01 and 99.9). The unit can be set and there is a choice between "100 x ms", "ms" and "µs".

Chronometer mode uses one channel (I1, I2, I3 or I4) or two channels (I1 & I2 or I3 & I4). On clicking on Chronometer mode, a choice is offered between the different chronometer modes defined by the timing diagrams. A two-channel timing diagram represents a timing diagram using two channels. The unit can be set and there is a choice between "s" and "100 x ms". The preset direction can be chosen and the "Upcount to preset" and the "Downcount from preset" options in the Preset group are available.

Selecting the Unit.

If Tachometer mode is selected, there is no choice, only "pulse/s".
If Period meter mode is selected, there is a choice between "100 x ms", "ms" and "µs".
If Chronometer mode is selected, there is a choice between "s" and "100 x ms".

Selecting the Channel Used.

A tachometer/period meter/chronometer block always uses at least 1 channel. Channels used by the other blocks are indicated on the parameter-setting sheet: they are grayed out and checked.

If 1-channel Tachometer, Period meter or Chronometer mode is selected, clicking on 1 available channel will deselect the previously selected channel and will select the new channel.

If 2-channel Chronometer mode is selected, this can only use a pair of channels: I1 I2 or I3 I4. For example, by clicking on I1 or I2, channels I1 and I2 will be selected. I1 cannot be chosen if I2 is not available, nor I2 if I1 is not available. The same applies to channels I3 and I4.

Selecting the Preset

If external preset is checked, the value of the internal preset can no longer be chosen, and the value selection box is grayed out. If external preset is unchecked, the value of the preset can once again be chosen.
The preset value that can be entered is within the range +1 to +32767.

In Tachometer and Period meter mode, the "Upcount to preset" and "Downcount from preset" options cannot be chosen. Only one of the two Chronometer mode options can be chosen.

Selecting the Output

Two types of output can be chosen: single shot or repetitive cycle.

In single shot either the fixed or pulsed option can be chosen. If fixed option is activated, the value of the pulse can no longer be chosen, and the value selection box is grayed out. If pulsed option is activated, the value of the pulse can once again be chosen.

In repetitive cycle, fixed option is grayed out and pulsed option is the only option available. The value of the pulse can be chosen.

The value of the pulse is between +1 and +32767 (actual pulse = value x 100 ms).

Backup.

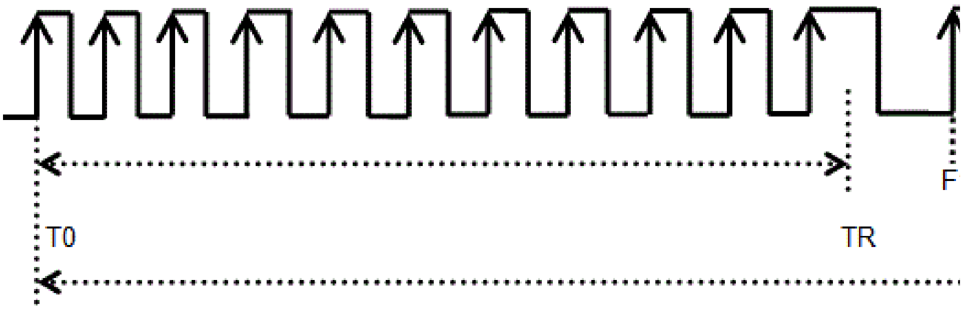
The Parameters tab contains the box (which is checked by default) that saves the count after a controller power failure.

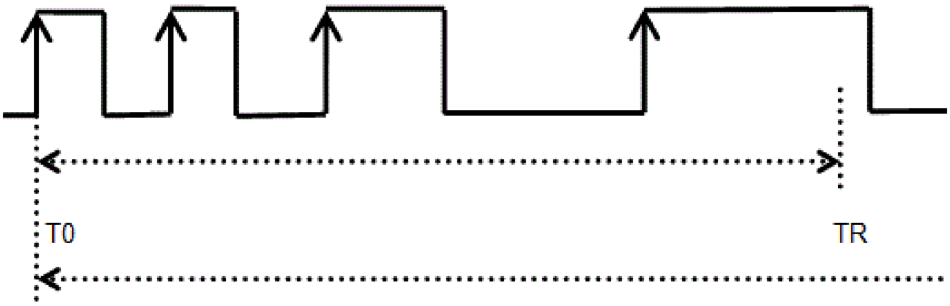
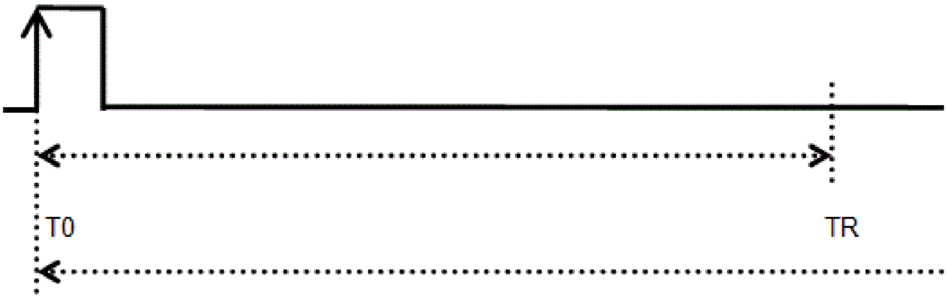
Tachometer Mode.

The tachometer operates in two stages:

- **Triggering the measurement validation phase**

  - As soon as a rising edge appears on the input, the function scans the input during a period T0-TL. When a new rising edge appears on the input, the measurement limit phase gets under way.
  - If this is not the case, no measurement occurs.
- **Triggering the Measurement Phase**
  - From the previous rising edge, the function scans the input during the **Measurement limit phase** (from T0 to TL).
    If rising edges appear on the input during the **Refresh period**, as soon as the first rising edge (F1) appears between TR and TL, the speed is calculated as follows and the system reverts to the measurement validation phase on the next rising edge (F2) that appears on the input.
  - **Pulses per revolution** : This is the number of pulses (rising edges) corresponding to one encoder revolution, one tachometer wheel revolution, etc.
  - **Scale Factor** : This is a multiplication coefficient.

	Diagrams	
Triggering the Measurement Phase		T0: Tachometer measurement start time F1: First rising edge after TR TR - T0: Refresh period. Minimum period after which end of measurement can be acknowledged. TL - T0: Measurement limit period. Maximum period after which end of measurement should have been achieved. (If this period is reached without a pulse appearing on the

		input, the speed is zero)
		If during the refresh period (from T0 to TR) more than one rising edge appear on the input, but none in the period TR to TL, the calculated speed is zero and the system returns to the validation phase after the second period has elapsed.
		If during the whole of this period (from T0 to TR) only one rising edge appears on the input, the calculated speed is zero and the system returns to the validation phase after the period has elapsed.

Calculating the Speed:

Calculation occurs without loss of accuracy, irrespective of the parameters. However this implies that the number of pulses counted in tachometer function during a measurement period must not exceed ≈ 43000.

N: Number of pulses recorded during the measurement phase.

NPPS : **N**umber of **P**ulses **P**er **S**econd : number of pulses per second

PPr : **P**ulses **P**er **r**evolution : pulses per revolution

Coeff : Multiplication coefficient (value of "Scale factor" parameter)

T_M : Measurement period (in seconds)

NPPS=N/T_M

v : speed or its equivalent of the measured process. The measurement unit is arbitrary and corresponds to the application's needs: m/s, no. of objects per second, etc.

v = (NPPS * Coeff) / PPr

As the calculated value of the speed must be less than or equal to 32767, the number of pulses per second can be, at the most, equal to the maximum NPPS = (32767 * PPr)/Coeff with "Max. NPPS" less than or equal to 32767.

Example:

The speed of conveyor belt is measured using a roller connected to a tachometer wheel. The roller runs over 5 cm of ∅. The wheel gives 10 pulses per revolution. We wish to find the belt travel speed in cm/s.

The belt travels by π * ∅ = 15.7 cm per roller revolution.

The *Cycle(s) per revolution* is therefore fixed at **10** and *Scale factor* at **15.7**.

The belt travels on average 50 cm/s, resulting in N = NPPS* T_M = v*PPr/Coeff* T_M, or<

N = 50*10/15,7* T_M = 31* T_M

In the chosen application the conveyor belt is permanently running and has a quasi-constant speed. A long refresh period can therefore be chosen which can increase accuracy, for example 8 s and 9 s for the measurement limit period.

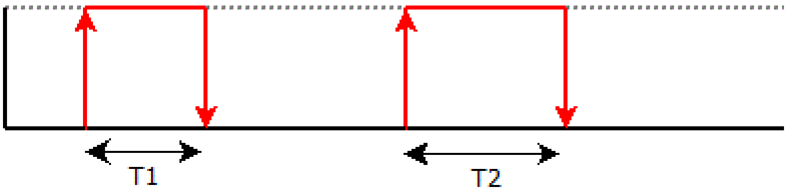
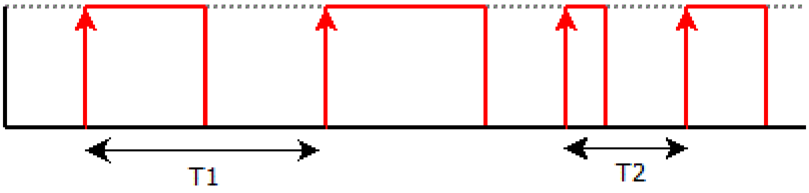
In our example N = 31*9 = 279, which is well below 32,767 and therefore leaves a large margin for error.

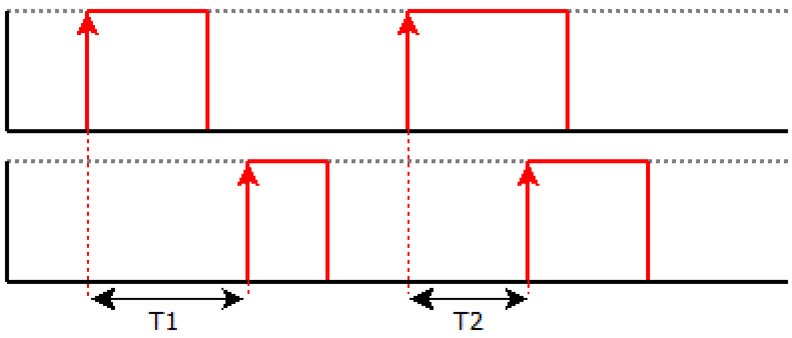
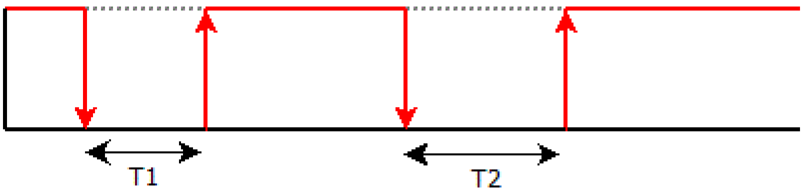
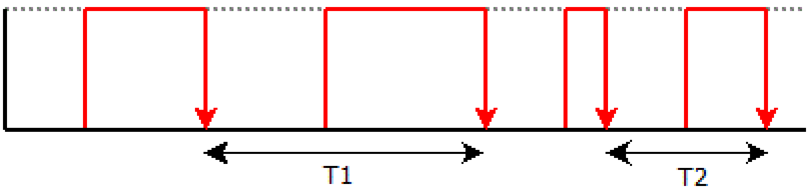
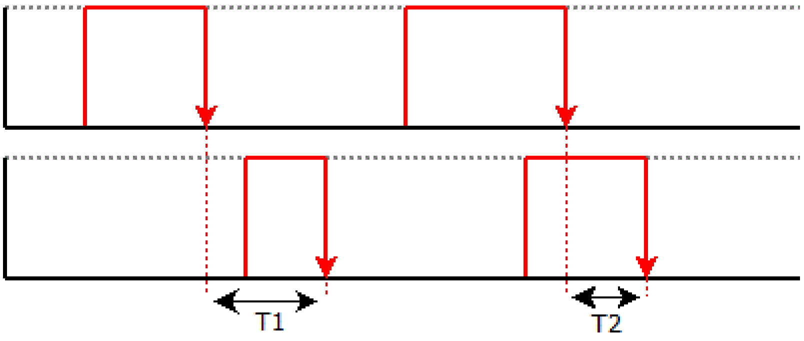
Period Meter Mode.

The period is calculated on the basis of the tachometer parameters. It is the average time between each pulse during the measurement period.

Chronometer Mode.

Depending on the chosen mode, 4 or 2 independent chronometers can be obtained:

	Diagrams	
4 independent chronometers **Start** : On rising edge **Stop** : On falling edge		Input I1, I2, I3 or I4
4 independent chronometers **Start / stop** :		Input I1, I2, I3 or I4

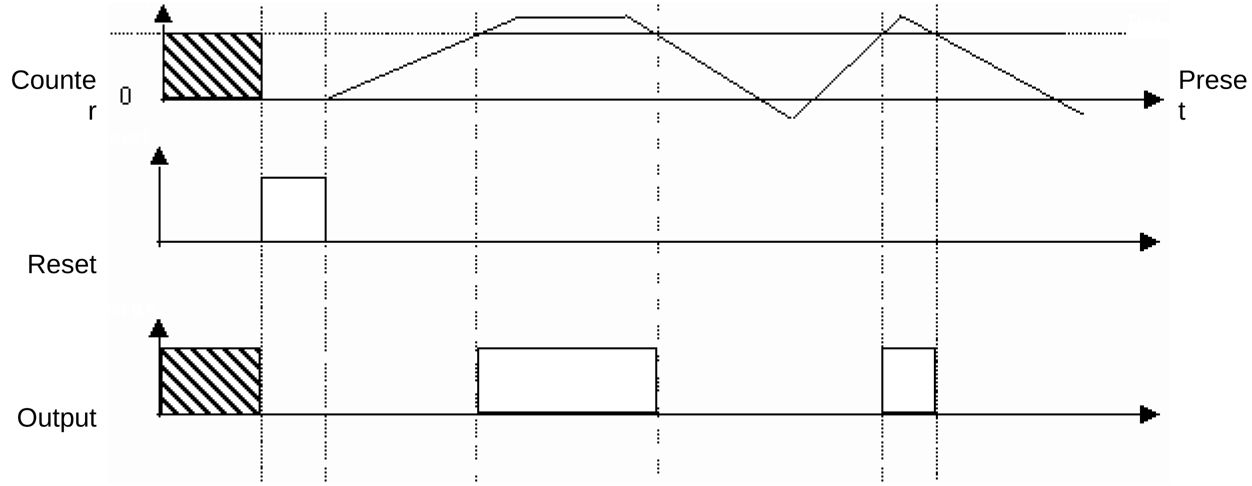
On Rising edge		
2 independent chronometers **Start** : On Rising edge of one channel **Stop** : On Rising edge of the other channel		A: input I1 or I3 B: input I2 or I4 Caution: 2 edges on channel A cause a return to the previous counter value.
4 independent chronometers **Start** : On falling edge **Stop** : On rising edge		Input I1, I2, I3 or I4
4 independent chronometers **Start / stop** : On Falling edge		Input I1, I2, I3 or I4
2 independent chronometers **Start** : On Falling edge of one channel		A: input I1 or I3 B: input I2 or I4 Caution: 2 edges on

Stop : On Falling edge of the other channel		channel A cause a return to the previous counter value.

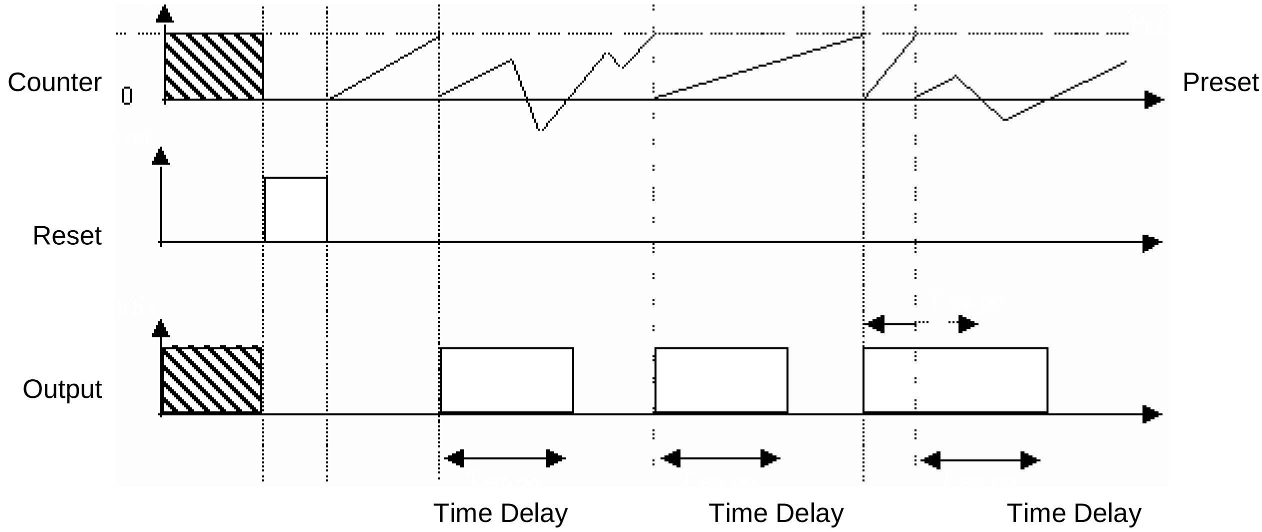
Ttotal = T1 + T2 +… …+ Tn.

Single shot/repetitive cycle: Upcount to preset mode

Single shot : The output is fixed or pulsed
The pulse is adjustable in 100 ms intervals from +1 to +32,767

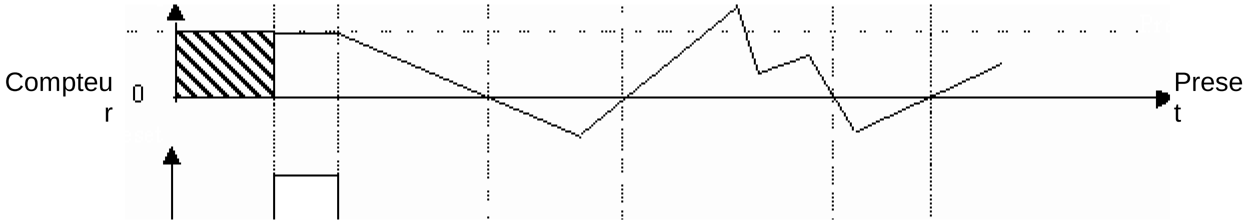


Repetitive cycle : The output is pulsed
The pulse is adjustable in 100 ms intervals from +1 to +32,767



Single shot/repetitive cycle: Downcount from preset mode

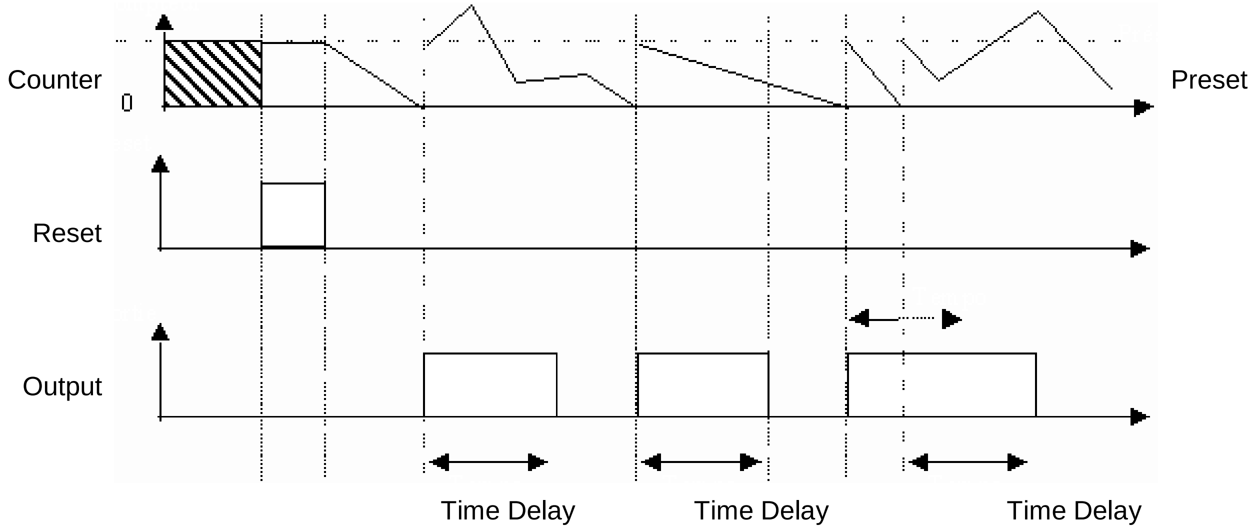
Single shot : The output is fixed or pulsed
The pulse is adjustable in 100 ms intervals from +1 to +32,767



Reset

Sortie

Repetitive cycle : The output is pulsed
The pulse is adjustable in 100 ms intervals from +1 to +32,767



Possible Combinations

🟦 1-channel Tachometer, Chronometer, Period meter

🟧 2-channel Tachometer, Chronometer, Period meter

I1	I2	I3	I4	Frequency	Total
🟦				60kHz	1
	🟦			60kHz	1
		🟦		60kHz	1
			🟦	60kHz	1
🟦	🟦			40kHz	2
🟦		🟦		40kHz	2
🟦			🟦	40kHz	2
	🟦		🟦	40kHz	2
	🟦	🟦		40kHz	2
		🟦	🟦	40kHz	2
🟧				40kHz	1

		🟧		40kHz	1
🟦	🟦	🟦		30kHz	3
🟦	🟦		🟦	30kHz	3
🟦		🟦	🟦	30kHz	3
	🟦	🟦	🟦	30kHz	3
🟧				30kHz	2
🟧			🟦	30kHz	2
🟦		🟧		30kHz	2
	🟦	🟧		30kHz	2
🟦	🟦	🟦	🟦	20kHz	4
🟧		🟧		20kHz	2

⚠ **CAUTION**

If the frequency is exceeded, at first there is a loss of pulses.
If there is further increases of frequency, the WATCHDOG triggered and there is a reset of the product.
Failure to follow these instructions can result in injury or equipment damage.

1.4.2.4 HMI/COM Functions : HMI/Communication

◁ (§ 1.4.2.3.20) ▷ (§ 1.4.2.4.1)

At a Glance

Subject of this Section

This section describes the different HMI/COM functions available using FBD language.

What's in this Section?

This section contains the following topics:

Display, keys, data logging, event, recipe, etc.

1.4.2.4.1 Display on the LCD DISPLAY Screen

◁ (§ 1.4.2.4) ▷ (§ 1.4.2.4.2)

Description

The **DISPLAY** function is used to display text, a date, a time or a numerical value on the LCD display instead of the controller INPUTS-OUTPUTS screen:
The DISPLAY function is used to display information on the following:

- Text (maximum 72 characters),
- Numerical values corresponding to the output of a block function used in the application.

Up to 16 DISPLAY blocks can be enabled simultaneously in one program. If this

number is exceeded, only the first 16 blocks activated are displayed.
On the product, pressing the **OK** (green) and **ESC** (red) keys simultaneously replaces the display on the DISPLAY screen with the menu display.
In simulation on the "Front Panel" window, click on **OK** with the mouse + **Escape** on the keypad and simultaneously release to replace the display on the DISPLAY screen with the menu display.
Pressing the **ESC** key again returns the display to the DISPLAY screen.

> **Note:** Both ASCII-standard characters and accented characters can be used.

> **Note:** Characters and symbols that are not displayed in the data entry window when keyed are not supported.

Access

The DISPLAY function DISPLAY is accessible from the **HMI** function bar.

Inputs

- **ENABLE FUNCTION**: This is the Discrete(§ 1.4.2.1.1)-type DISPLAY function control input.
  The state of this input determines block operation: if the ENABLE FUNCTION input is active, the information is displayed on the LCD; otherwise there is no display.
  If this input is not connected, then it is considered to be active.
- **VALUE INPUT**: This is the selection input that determines the nature of the information to be displayed. If this input is:
  - Not connected: The display corresponds to the selection made in the **User options** zone.
  - Connected to the output of a function block: The display corresponds to the value sent by this output.

Parameters

The adjustable parameters depend on whether or not the VALUE INPUT is connected
1st case: VALUE INPUT not connected
The display corresponds to the selection made in the **User options** zone.
Depending on the options chosen, the following can be displayed:

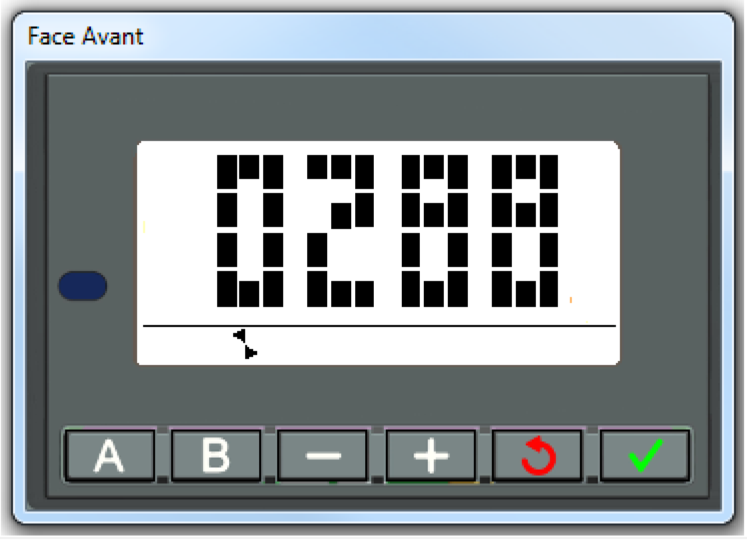
- **Text**: a string of characters
- **Date**: the current value of the internal date of the device on which the program is executed (controller or simulator)
- **Time**: The current internal time value
- **Calibration**: Drift value of the controller's internal clock

2nd case: VALUE INPUT connected
The integer value present on the input is converted into a string of characters, whose display format depends on the option that has been selected:

- **Integer 1/1 - 1/10000**
- **Calendar date**
- **Bar chart**
- **Maxinumber**

Description of the display modes:

Display mode	Description
1/1	Signed integer
1/10 - 1/10000	Signed decimal number; the fractional part represents the number of digits following the decimal
Year	The input value must be between 1 and 99 corresponding to a display between 2001 and 2099.
Month	The input value must be between 1 and 12, corresponding to a display indicating the first four letters of the name of the month.
Weeks	The input value must be between 1 and 31. Five digits are displayed.
Day of the month	The input value must be between 1 and 31.

Days	The input value must be between 1 and 127. Seven letters, corresponding to the day of the week, are displayed.
Hour	The input value must be between 0 and 23. Two numbers are displayed.
Minute	The input value must be between 0 and 59. Two numbers are displayed.
Bargraph from left to right or from right to left	A bar is formed on the first line of the screen. The number of black squares, from left to right or from right to left corresponds to the value of the input. For an input of eighteen the line is completely filled. Beyond that, the line is filled by triangles pointing to the right or to the left. To take account of the interval in a numerical value, insert a Gain function between the value and the DISPLAY block. For example to display a value between 0 and 1023 as a bar chart, configure the Gain function with A=18, B=1023.
Maxinumber	The input value is displayed so that the full height of the screen is filled. Example 

Note: For the formats Day of the month/Hour/Minute, no consistency check is carried out.

- **Modification authorized**: Authorizes modification directly from the screen displaying the following values:
  - The integer data connected to the VALUE INPUT of function blocks (Modification is only possible if the data can be modified).
  - The controller's current internal date or time value.
  - Correction of the drift of the controller internal clock (this last action does not work in simulation mode).

Operating mode

Description of the interface

Each display function is identified by a block number: BXX.

This identifier is found:

- On the wiring sheet: The number is located in the bottom left corner of the block
- In the parameter setting window/Parameters tab: the number is in the drop-down menu in the top left corner of the window.

The parameter setting window displays the resulting string from all blocks (BXX) used in the wiring sheet.

The parameter setting window opens by default on the function block number from which the dialog box was opened.

For the selected block, all text affecting it appears in orange.

In the event of any overlap, the text appears in reverse video mode in blue on an orange background.

The non-overlapping text corresponding to the other selected blocks appears in white.

Entering one of the parameters of a DISPLAY block

Description of the entry procedure:

Step	Description
1	Is the VALUE INPUT connected? • If yes, then specify the display format.

	- If no, then enter text in the **User options** box.
2	Position the start of the text using the mouse:
3	Confirm using the green **OK** key. **Result:** The new DISPLAY block is saved and the parameters window is closed.

Note: If the strings are superimposed, a warning is displayed in the grid: the boxes appears in blue on an orange background, all valid strings are displayed in white.

How to Modify Data from the Front Panel

When the **Modification authorized** option is checked, it is possible to modify the data displayed directly from the display screen by proceeding as follows:

Step	Action
1	Use the ⊞ and ⊟ keys to place the cursor on the data to modify.
2	Confirm by pressing the **OK** key ☑. **Result**: The selected data flashes.
3	Use the ⊞ and ⊟ keys to scroll to the desired value.
4	Confirm by pressing the **OK** key ☑.

1.4.2.4.2 TEXT Function

(§ 1.4.2.4.1) (§ 1.4.2.4.3)

Description

The **Text** automation function is used to display texts and/or numerical values (current value, preset value, etc.) on the LCD display instead of the **INPUTS-OUTPUTS** screen:
Several text blocks can be used simultaneously in one program, but only the block with the highest number is displayed.
Pressing the green **OK** and red **ESC** keys simultaneously replaces the display on the TEXT screen with the main menu display.
Pressing the **ESC** key again returns the display to the TEXT screen.

Access

The TEXT function is accessible from the **HMI** function bar.

Inputs

The **Text** function has two discrete inputs:

- **Set**: Activation of the Set input prompts the display.
- **Reset**: Activation of the **Reset** input cancels the display. Reset has priority over Set.

The Text function has four analog inputs which are displayable values.

- **Value 1**
- **Value 2**
- **Value 3**
- **Value 4**

Character String Display

The cursor is positioned at the start of the string displayed in the window:

- By left-clicking on the box (which then flashes)
- By using the arrow keys on the computer keyboard

Description of the entry procedure:

Step	Action
1	Position the cursor at the start of the text.
2	Type the text to be displayed using the keyboard.
3	Confirm by clicking **OK**. **Result**: The new **Text** block is saved and the parameter-setting window is closed.

Note: The character string is limited to four lines. If the user continues to enter characters, each additional character overwrites the one in the last box.

Note: Both ASCII-standard characters and accented characters can be used. Characters and symbols that are not displayed in the data entry window when keyed are not supported.

Note: If the text entered on a line covers an existing numerical value, the latter is deleted.
If a numerical value is positioned over text that has already been entered, the characters it covers are overwritten.

Displaying a Numerical Value

Positioning:
To position the value (4 maximum) on the line, simply drag and drop it to the edit window.
Selection:
The value to be displayed is selected in the window located above the edit window.
This window lists the following elements:

- **Date**: The current value of the internal date (day.month.year) of the device on which the program is executed (controller or simulator)
- **Hour**: The current internal time value (hours:minutes)
- Calibration(§ 1.3.4.1.1): Drift value of the controller's internal clock
- List of displayable values, i.e. the function analog inputs

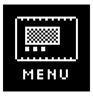
Clear Text

Description of the procedure:

Step	Description
1	Activate the zone to be cleared. With the mouse: Left-click, move the mouse over the zone to be selected, holding down the left mouse button, then release the button. **Result**: The selected zone flashes.
2	Clear using the **Delete** key on the keyboard.

1.4.2.4.3 MENUSCROLL

◁□□□□ (§ 1.4.2.4.2) □□□□▷ (§ 1.4.2.4.4)



This function is used to set one of the digital outputs to ON.

Inputs:

- **VALIDATION** : Function validation input. Until this input is activated, the function remains inert. **VALIDATION** is active implicitly if it has not been connected.

- **PLUS** input : Sets the active output to OFF and the next to ON provided that the number in "Number of outputs" has not been reached.
- **MINUS** input: Sets the active output to OFF and the previous one to ON provided that the "Active position number" is other than 1.
- **RESET** : Resets the first output to ON and all the others to OFF.

Outputs:

- **Position 1.**
- **Position 2.**
- **Position 3.**
- **Position 4.**
- **Position 5.**
- **Position 6.**
- **Position 7.**
- **Position 8.**
- **Active position number.**

Parameters:

- **Number of outputs** : Defines the number of digital outputs used [2 ..8].

Only one output is active at a time. It is selected by means of the **PLUS** and **MINUS** inputs. At the start, position 1 is at ON then subsequent ones can be set to ON in succession until "Active position number" = "Number of outputs".

While the Reset input is active, all outputs are set to OFF and once deactivated, only position 1 is at ON.

This function can be useful for menu scrolling if displays are wired as outputs.

1.4.2.4.4 LCD Screen Backlighting Output

◁□□□ □ (§ 1.4.2.4.3) □ □□□▷ (§ 1.4.2.4.5)

At a Glance

The **LCD Screen BACK LIGHT** screen Backlighting output is used to control backlighting of the controller LCD display by the program, by default Backlighting is on.
As long as the input is not connected or connected and active, backlighting is on.
This function cannot be arranged on the controller outputs.

Access

The LCD Screen Backlighting Output function LIGHT is accessible from the **HMI/COM** window.

Simulation and Debugging Modes

The following table lists the symbols of the LCD Screen Backlighting function in Simulation or Debugging modes.

Input State	Symbol in Simulation and Debugging mode	Description
Inactive	LIGHT	The LCD screen is off.

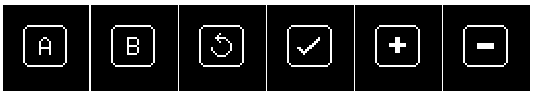
Active	LIGHT	The LCD screen is back-lit.

1.4.2.4.5 Buttons on the Front Panel

(§ 1.4.2.4.4)

(§ 1.4.2.4.6)

Button-type Inputs



Button-type inputs correspond to the keys available on the front panel of the controller. These inputs can be inserted in an FBD diagram and, in Simulation and Debugging mode, can simulate contacts

Type	Display in Inactive state	Display in Active state
A	A	A
B	B	B
-	−	−
+	+	+
Esc	⟲	⟲
OK	✓	✓

1.4.2.4.6 DATALOGGING

(§ 1.4.2.4.5)

(§ 1.4.2.4.7)

Description

When the function bloc **Datalogging** is activated, it allows to:

- Send alarm messages to mobile phones, for the **Alert** version.
- Send alarm data to e**m4**-web, for the **Remote** version.

It is possible to use up to 3 **Datalogging** function blocs in the same program.

> **Note :** The **Datalogging** function is only available on the controllers having a commmunication board. For more informations about the communication interface, please refer to the Communication Interface via the 2G Connection(§ 1.5.4) page.

The Event(§ 1.4.2.4.7) function have priority on the **Datalogging** function.
We cannot simulate this function.

Access

This function is accessible from the function bar **HMI/COM**.

Inputs

The **Datalogging** function bloc contains the following inputs:

- **Command**, according to the setting of the function bloc, the data are sent during the detection of a rising front on this input or periodically,
- **Value1**, digital variable associated with this function bloc
- **Value2, digital variable associated with this function bloc**

....

- **Value8**, digital variable associated with this function bloc

The values of variables connected to the inputs **Value1** to **Value8** (according to the configuration of the function bloc) can be:

- Displayed in messages sent by SMS or email, for the **Alert** version.
- Sent to **em4**-web, for the **Remote** version.

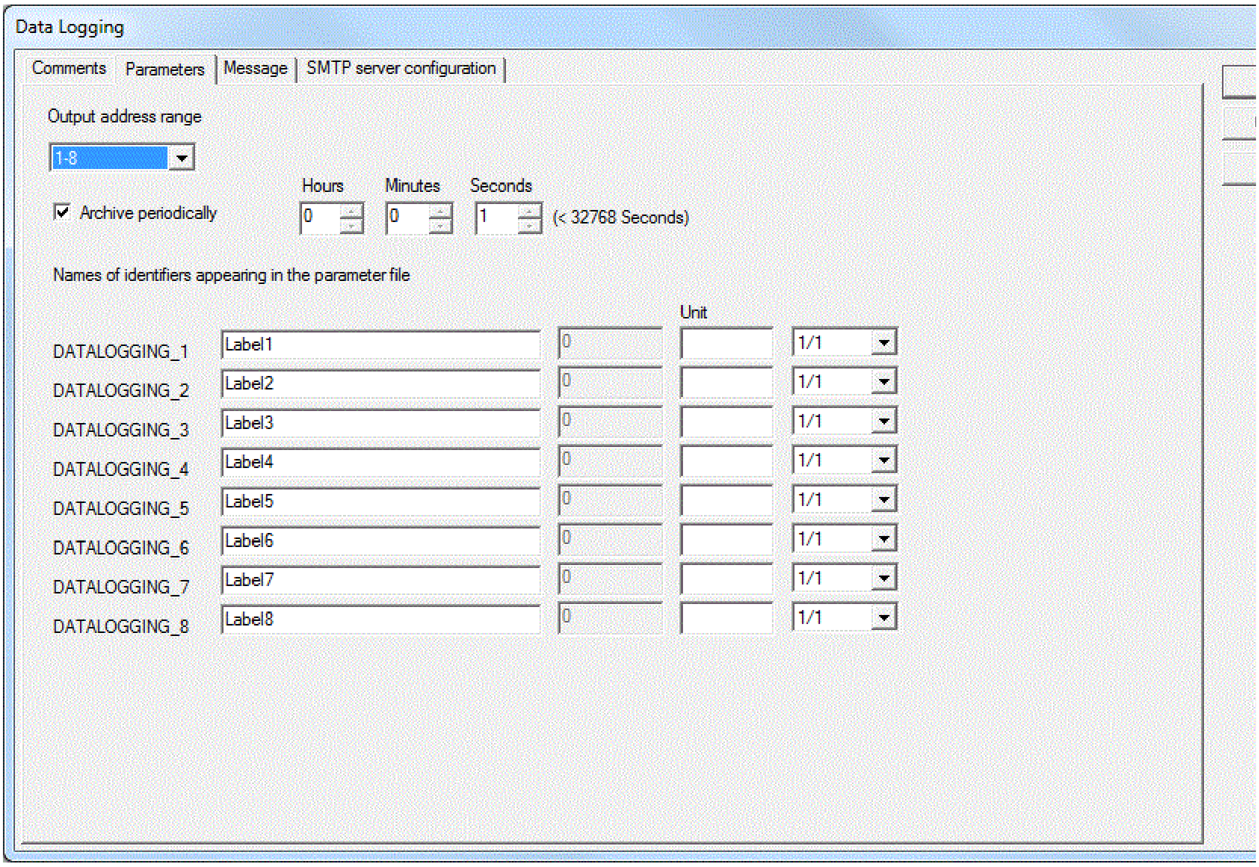
Outputs

The **Datalogging** function bloc contains the following output:

- **State**, each time the function bloc is validated, this output is ON during the recording.

Setting from the workshop

Double-click on the function bloc to open the configuration window. Use the various tabs of this window to configure the bloc.



Output address range: 1-8

☑ Archive periodically Hours 0 Minutes 0 Seconds 1 (< 32768 Seconds)

Names of identifiers appearing in the parameter file

			Unit	
DATALOGGING_1	Label1	0		1/1
DATALOGGING_2	Label2	0		1/1
DATALOGGING_3	Label3	0		1/1
DATALOGGING_4	Label4	0		1/1
DATALOGGING_5	Label5	0		1/1
DATALOGGING_6	Label6	0		1/1
DATALOGGING_7	Label7	0		1/1
DATALOGGING_8	Label8	0		1/1

In the **Parameter** tab:

- **Adress range of outputs**: Allows to choose to which group of address the block belongs: 1-8, 9-16 or

17-24.

- **Archive periodically**: if the box is not marked, it is the rising front on the **Command** input which validate the sending of data.
  If the box is marked, the data are sent periodically according to time parametrized in box **Hours Second Minutes**
- **Names of identifiers**: Names of identifiers are saved in a parameter file.

In the **Message** tab:

- This tab allows the Composition of an SMS/Email(§ 1.5.4.4)

1.4.2.4.7 EVENT

(§ 1.4.2.4. 6)

(§ 1.4.2.5)

Description

When the **Event** function bloc is activated, it allows to:

- Send alarm messages to mobile phones, for the **Alert** version.
- Send alarm data to e**m4**-web, for the **Remote** version.

It is possible to use up to 24 **Event** function blocks in the same program corresponding to 24 events numbers.

> **Note :** The **Event** function is only available on the controllers having a commmunication board.
> For more informations about the communication interface, please refer to the Communication Interface via the 2G Connection(§ 1.5.4) page.
> The **Event** function have priority on the Datalogging(§ 1.4.2.4.6) function.
> We cannot simulate this function.

Access

This function is accessible from the **HMI/COM** function bar.

Inputs

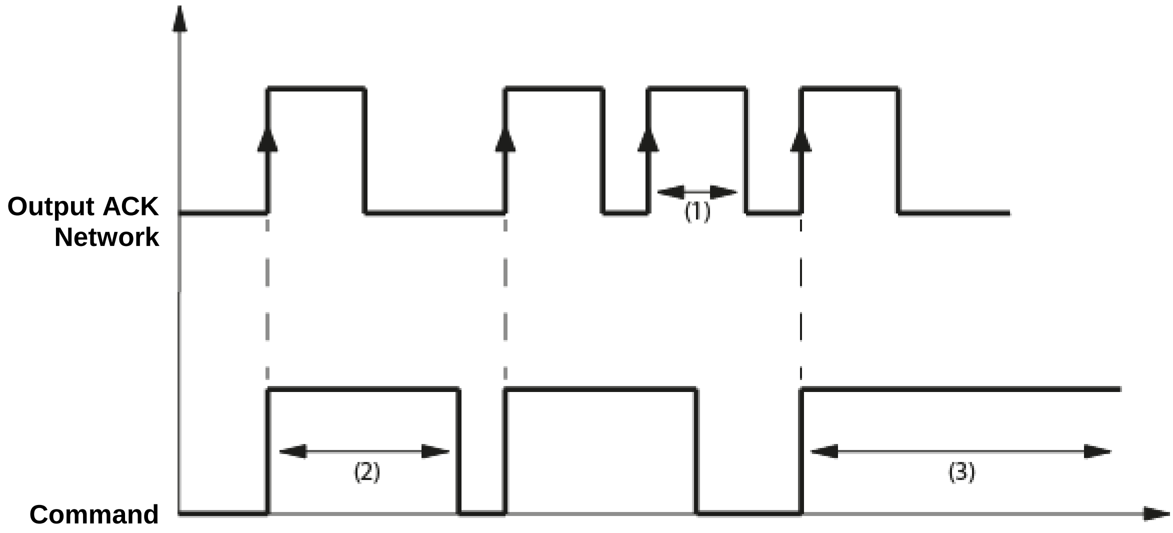
The **Event** function block has the **following inputs**:

- **Command**, data are sent upon the detection of a rising edge on this input,
- **Value1**, numerical variable associated with this function block,
- **Value2**, numerical variable associated with this function block,
- **Reset Ack Appli**, reset the sendings in case of no answer.

Output

The **Event** function block has the **following output**:

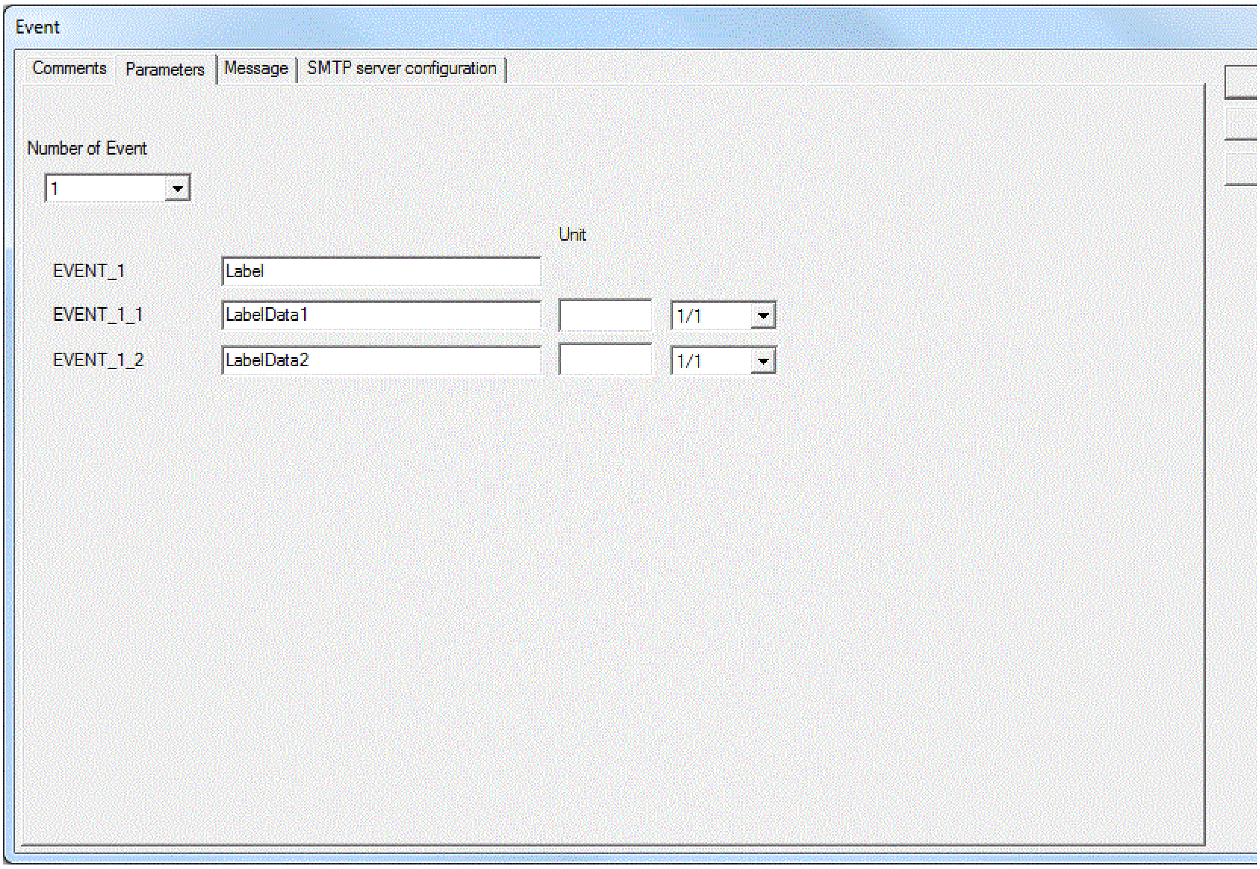
- **Output ACK Network**, indicates the correct sending of the information :



(1) Sending ignored
(2) Sending in progress
(3) Fault, activate the **Reset Ack Appli** input.

Setting from the workshop

Double-click on the function bloc to open the configuration window. Use the various tabs of this window to configure the bloc.



Number of Event: 1

		Unit	
EVENT_1	Label		
EVENT_1_1	LabelData1		1/1
EVENT_1_2	LabelData2		1/1

In the **Parameter** tab:

- **Number of Event**: Allows to choose the number of the event associated with the FB: 1 to 24.
- **EVENT_N**: The event is saved in a parameter file.

In the **Message** tab:

- This tab allows the Composition of an SMS/Email(§ 1.5.4.4)

1.4.2.4.8 RECIPE

⇦ (§ 1.4.2.4.7) ⇨ (§ 1.4.2.5)

1.4.2.5 APP functions : Application

⇦ (§ 1.4.2.4.8) ⇨ (§ 1.4.2.5.1)

At a Glance

Subject of this Section

This section describes the different APP functions available using FBD language.

What's in this Section?

This section contains the following topics:

Cam timer, pump management, level, temperature, twilight, solar tracking, filtration, heat curve, PID, etc.

1.4.2.5.1 CAM BLOCK Cam Programmer

⇦ (§ 1.4.2.5) ⇨ (§ 1.4.2.5.2)

At a Glance

The cam programmer function **CAM BLOCK** controls a set of 8 built-in cam wheels.
On its 8 outputs (representing the 8 wheels), the function provides the state corresponding to the current position of the shaft wheels.
The cam configuration can be set; for each position, output state is adjustable.
Once the maximum value has been reached, the cam restarts from its initial position (output returns to 0).

Access

The CAM BLOCK function CAM is accessible from the **APP** function bar.

Inputs/Outputs

Description of the inputs:

- **MOVE FORWARD**: this is the input that controls cam progress; it moves one step forward at each rising edge (change from inactive to active).
- **MOVE BACKWARD**: this is the input that controls backward cam movement; it moves one step backward at each rising edge (change from inactive to active).

Note: The MOVE FORWARD input takes priority over the MOVE BACKWARD input.

Note: If the MOVE FORWARD and MOVE REVERSE inputs are not connected, they are set to inactive.

- **RESET** (initialization): When this input is active, the cam is replaced to its initial position: the POSITION output is forced to 0.

Note: The RESET input takes priority over the MOVE FORWARD and MOVE BACKWARD inputs.

Note: If the RESET input is not connected, it is set to inactive.

Description of the outputs:

- **OUTPUT 1 to 8**: state corresponding to the current position of the shaft (representing the 8 wheels),
- **POSITION**: current cam position (0 to 49).

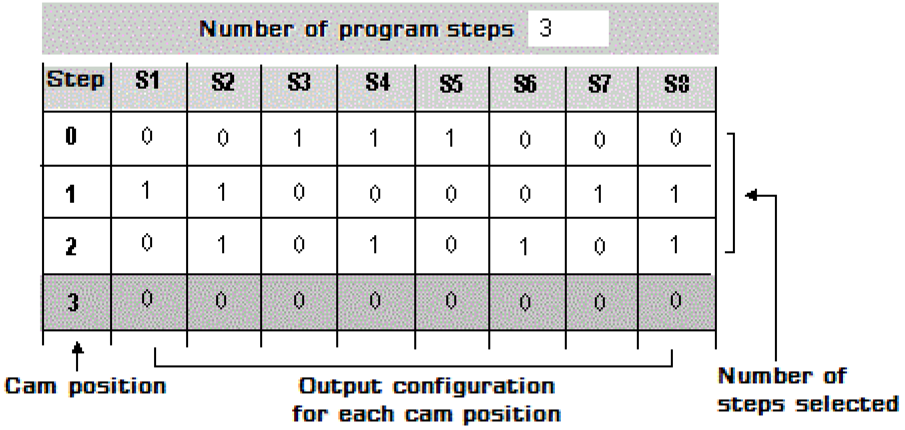
Parameters

From the programming workshop

From the **Parameters** window, you may adjust:

- **The number of program steps**: Its value is between 1 and 50,
- **Output status [1..8]**: for each position of the shaft.

The following figure shows an example of a part of parameters window:



Number of program steps 3

Step	S1	S2	S3	S4	S5	S6	S7	S8
0	0	0	1	1	1	0	0	0
1	1	1	0	0	0	0	1	1
2	0	1	0	1	0	1	0	1
3	0	0	0	0	0	0	0	0

When selected, the **Save on power fail** parameter enables the current value of the timer to be retrieved following a power failure(§ 1.2.20).

Modification of Parameters from the Front Panel

To modify the parameters from the front panel of the controller, check the **Authorized modification** box of the **Parameters** window.

From the PARAMETERS(§ 1.3.2) menu, it is possible to modify bit-wise the contents of all the cam programmer steps, but it is not possible to modify the number of steps.

After you have entered the block number, then enter:

- **The step number**: Value between [0..49],
- **Output status [1..8]**: For each output one can set the value to INACTIVE (empty diamond) or ACTIVE (black diamond).

1.4.2.5.2 ANGULAR CAM TIMER

(§ 1.4.2.5.1) (§ 1.4.2.5.3)

This function describes operation of a cam timer with the angle made by the cams as the command input. The number of steps can be selected, as can the state of the 2 outputs.

Inputs:

- **VALIDATION** : Enables the function. If this input is not activated, the function remains inactive. Activated implicitly if it has not been connected.
- **ANGLE** : Timer command input (from 0° to 359°). The outputs vary according to this value and the OUTPUT STATE parameter.

Outputs:

- **OUTPUT 1** : Output 1 is related to the value in the OUTPUT 1 column in the

OUTPUT STATE table. If the value of the angle in the ANGLE input is higher or the same as a value N in the ANGLE column in the OUTPUT STATE table and less than the value N+1 in the table, the value of the corresponding OUTPUT 1 column is copied to OUTPUT 1 (1 => output at ON, 0 => output at OFF).

- **OUTPUT 2** : Output 2 is related to the value in the OUTPUT 2 column in the OUTPUT STATE table. If the value of the angle in the ANGLE input is higher or the same as a value N in the ANGLE column in the OUTPUT STATE table and less than the value N+1 in the table, the value of the corresponding OUTPUT 2 column is copied to OUTPUT 2 (1 => output at ON, 0 => output at OFF).

Parameters:

- **NUMBER OF DEGREES** Equivalent to the wheel step number (2 to 72 steps of 5° to 180°).
- **OUTPUT STATES** : Table summarising the output states for each position. These states can be modified by clicking in the corresponding boxes.

1.4.2.5.3 PUMPS MANAGEMENT (Tank management with circular pump changeover)

(§ 1.4.2.5.2)

(§ 1.4.2.5.4)

This function is used to set to ON a maximum of four digital outputs which can be activated (OUTPUT 1 ... OUTPUT 4). This number is equal to the maximum number of digital inputs (from 2 to 4) in the ON state. In addition, the outputs set to ON are selected so that in the event of prolonged operation, each output will have been set to ON the same number of times.
The ON duration of the outputs is set to equal values by applying the following technique:

- As the number of ON inputs increases, the outputs changing to ON are those following the order of the PILOT OUTPUT NUMBER: 1 for OUTPUT 1, 2 for OUTPUT 2, 3 for OUTPUT 3 and 4 for OUTPUT 4. For example, if the "outputs controlled" parameter has the value 4, if PILOT OUTPUT NUMBER has the value 3 and just one input is set to ON, only the OUTPUT 3 output will be set to ON. As soon as two inputs change to ON, the OUTPUT 3 output remains at ON and the OUTPUT 4 output changes to ON. As soon as a third input changes to ON, the OUTPUT 3 and OUTPUT 4 outputs remain ON and OUTPUT 1 changes to ON.
- As soon as the number of outputs decreases, the outputs changing to OFF will be those which have been in the ON state the longest. As soon as one output changes to OFF, PILOT OUTPUT NUMBER takes the value of the output number after the output(s) which has (have) just been set to OFF. To complete the above example, as soon as one input changes to OFF, the OUTPUT 3 output changes to OFF and PILOT OUTPUT NUMBER displays the integer value 4.

The Parameters tab in the parameterisation box contains the number of outputs which may change to ON depending on the number of inputs which are set to ON. The values of this parameter are fixed at 2, 3 or 4.

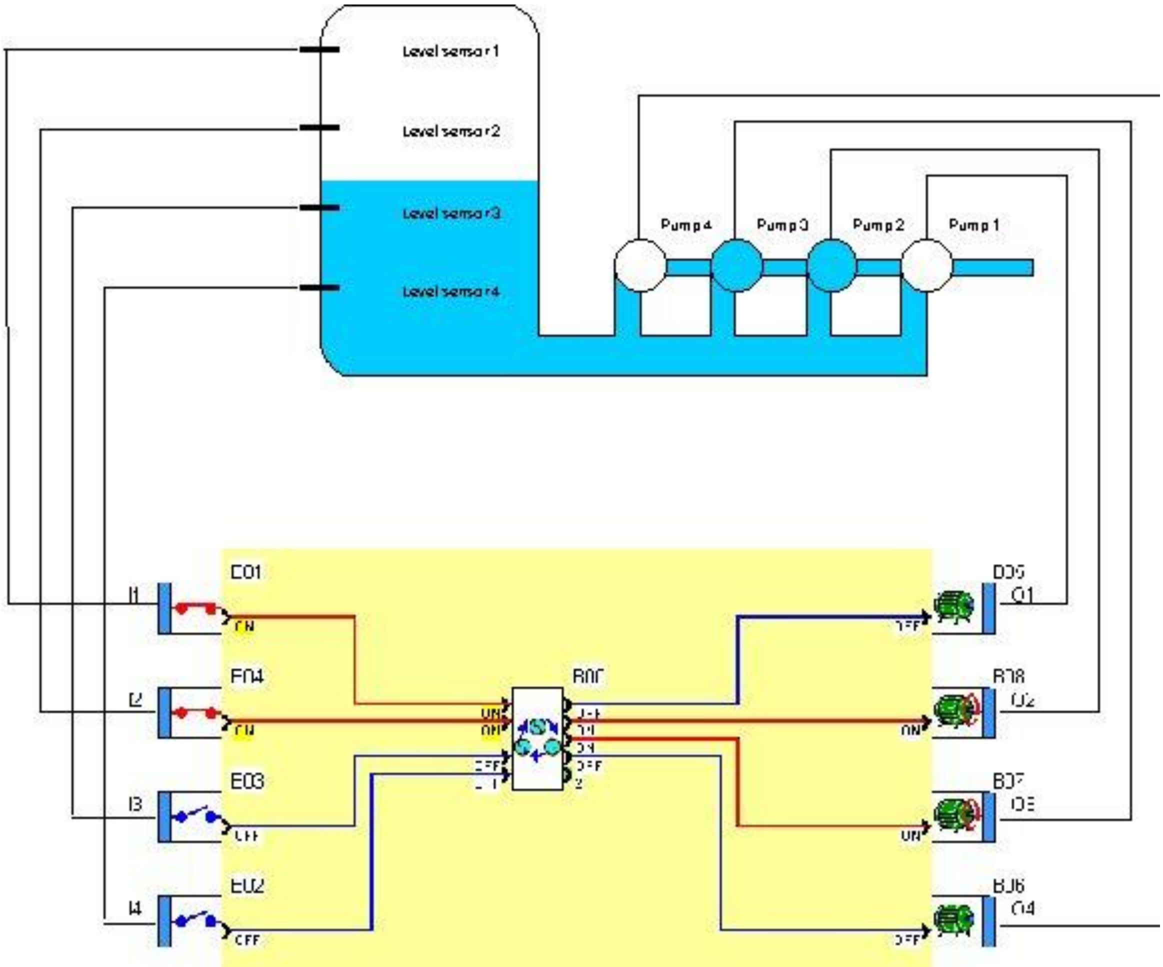
- If the value of the parameter is fixed at 2, only the OUTPUT 1 and OUTPUT 2 outputs are used and may therefore change to ON. In this case, if more than two inputs change to ON, the OUTPUT 1 and OUTPUT 2 outputs remain at ON and the OUTPUT 3 and OUTPUT 4 outputs remain fixed at OFF.
- If the value of the parameter is fixed at 3, only the OUTPUT 1, OUTPUT 2 and OUTPUT 3 outputs are used and may therefore change to ON. . In this case, if four inputs change to ON, the OUTPUT 2, OUTPUT 2 and OUTPUT 3 outputs remain at ON and OUTPUT 4 remains fixed at OFF.
- If the value of the parameter is fixed at 4, only the OUTPUT 1, OUTPUT 2, OUTPUT 3 and OUTPUT 4 outputs are used and may therefore change to ON.

All inputs which are not connected have the value OFF.
When the program is initialised, PILOT OUTPUT NUMBER is fixed at 1.
The Parameters tab contains the default check box which reinitialises PILOT OUTPUT NUMBER

to 1 (and defines the first output activated when the first input changes to 1) after a controller power failure.

Example of use:

Filling a tank with a group of four pumps operating in parallel. The operating duration of each pump is the same.



The "number of outputs controlled" parameter is fixed at 4.

- On initialisation, PILOT OUTPUT NUMBER has the value 1. On initialisation, if the tank is in the state indicated and if a sensor above the water is in the ON state, when the user program is executed, the INPUT 1 and INPUT 2 inputs are ON, INPUT 3 and INPUT 4 are OFF and OUTPUT 1 and OUTPUT 2 are ON.
- Assuming that the tank is full, INPUT 2 changes to OFF and OUTPUT 1 changes to OFF. PILOT OUTPUT NUMBER indicates the value 2.
- Assuming that the tank is empty, INPUT 2 changes back to ON, OUTPUT 3 changes to ON and OUTPUT 2 remains ON.
- Assuming that the tank refills, INPUT 2 changes back to OFF, OUTPUT 2 changes to OFF and PILOT OUTPUT NUMBER indicates the value 3.
- Assuming that the tank continues to refill, INPUT 1 changes to OFF, OUTPUT 3 changes to OFF and PILOT OUTPUT NUMBER indicates the value 4.

1.4.2.5.4 FLOW

(§ 1.4.2.5.3) (§ 1.4.2.5.5)

This function enables the flow of a liquid in a pipe to be calculated using a differential pressure element or by measuring the dynamic pressure.

Inputs:

- **"VALIDATION"** input : The status of this VALIDATION input determines the operation of the block:
    - if the **VALIDATION** input is inactive, the calculation output retains the latest calculated value.
    - if the **VALIDATION** input is not connected, it is deemed to be active.
- **PRESSURE 1** input : value of pressure sensor P1 (in mbar).
- **PRESSURE 2** input : value of pressure sensor P2 (in mbar).
- **EXTERNAL DENSITY** input : value of density if the "External" box on the parameters page is checked (in kg/m3).

Outputs:

- **CALCULATION ERROR** : equal to ON if the calculated flow is less than -32768, greater than 32767 or if P1 is less than P2 or if D1 is less than D2, the volumetric flow rate output is set to 0.
- **VOLUMETRIC FLOW RATE** : result of calculation (in l/s).
- **INTERNAL DENSITY** : value used to calculate the flow if the "External" box is not checked (in kg/m3, can be modified via display).

Parameters:

- **Sensor type** : choice of sensor used.
- **Constant** : D1, D2 or S depending on the sensor used.
- **Density** : value used to calculate the flow if the "External" box is not checked (in kg/m3).

Warnings relating to the use of this function:

- A) This block is only suitable for incompressible liquids, i.e. those whose density is not affected by temperature.
- B) The flow regime is described as "turbulent" and not laminar. Most industrial applications have a turbulent flow regime. Re > 4000.

This block is not suitable for gases.

- C) The design of the differential pressure elements must comply with the standards ISO 5167-1, ISO 5167-2, 5167-3 and 5167-4 for Europe, API 2530 for USA.
- D) The pipe must be full and not contain any deposits. The operation of the system is continuous, with little variation in pressure and temperature. The medium must be homogeneous and unvarying over time.

1°) Differential pressure element:

- There are three main types of differential pressure element:
    - diaphragm
    - venturi
    - nozzle

2°) Flow metering by dynamic pressure:

- There are two main types:
    - pitot sensor
    - annubar or Barton sensor

The only difference between the two is a constant. In the first case it is a coefficient relating to the differential pressure element, in the second case it concerns the cross-section of the pipe.

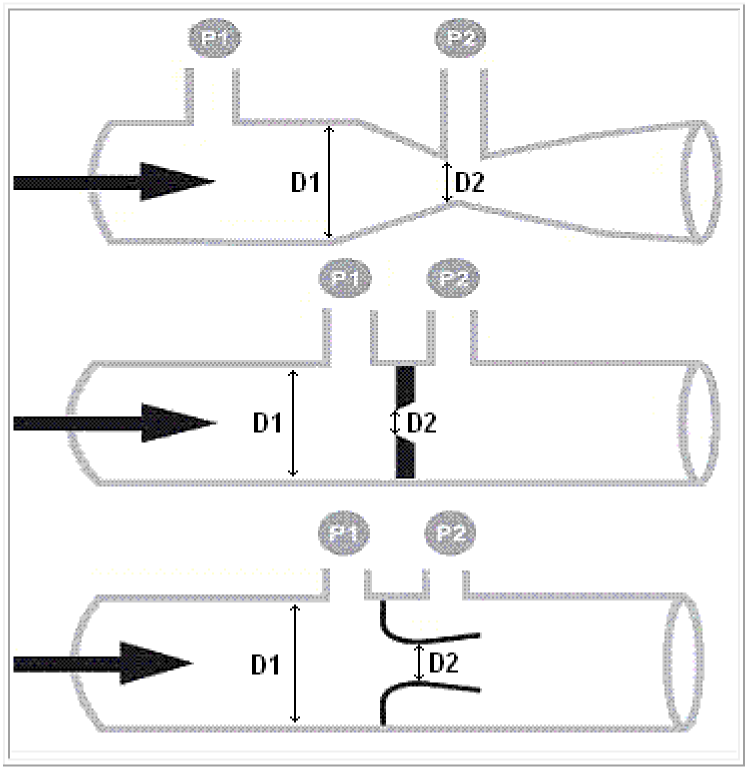
OPERATION:

The flow calculation is based on the differential pressure elements. Any flow measurement using a differential pressure element involves an obstacle that creates

a delta P and a measurement of differential pressure; this makes it necessary to perform two pressure measurements.
The main advantage of a flow meter with a differential pressure element is that there is no need to go through a calibration process, provided that these elements have been designed in accordance with the established standards (ISO 5167-1, ISO 5167-2, 5167-3 and 5167-4 for Europe, API 2530 for USA).
All these standards are derived from the work of Bernoulli. We regard flow measurements as only possible within the framework of a **constant density.**.

1°) Differential pressure element:

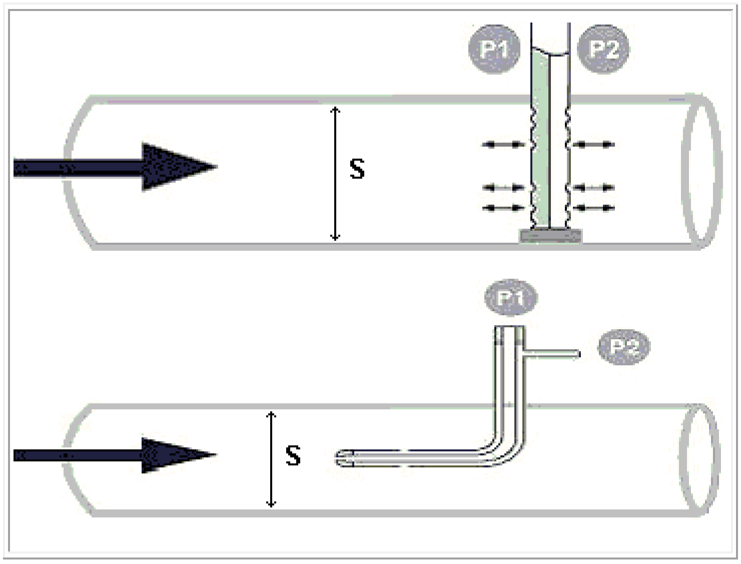
Practical expression of flow for a differential pressure flow meter:



- D1: upstream diameter in cm (1 ≤ D1 ≤ 100).
- D2: downstream diameter in cm (0 ≤ D2 ≤ 100).
- Density of liquid in kg/m3 (500 ≤ p ≤ 4000).
- P1: upstream pressure measurement in mbar.
- P2: downstream pressure measurement in mbar.
- P1 > P2

2°) Flow metering by dynamic pressure:

Practical expression of flow with a dynamic pressure flow meter:



- S: constant: cross-section of pipe in cm2 (0 ≤ S ≤ 10000).
- Density of liquid in kg/m3 (500 ≤ p ≤ 4000).
- P1: upstream pressure measurement in mbar.
- P2: downstream pressure measurement in mbar.
- P1 > P2

1.4.2.5.5 LEVEL

(§ 1.4.2.5.4) (§ 1.4.2.5.6)

This function allows to calculate the level of a liquid, with or without constant density, in an open or closed tank, using pressure sensors.

Inputs:

- **"VALIDATION"** input : the status of this VALIDATION input determines the operation of the block:
  - if the **VALIDATION** input is inactive, the calculation output retains the latest calculated value.
  - if the **VALIDATION** input is not connected, it is deemed to be active.
- **PRESSURE 1** input : value of pressure sensor P1 (in mbar).
- **PRESSURE 2** input : value of pressure sensor P2 (in mbar).
- **PRESSURE 3** input : value of pressure sensor P3 (in mbar).

Outputs:

- **LEVEL FAULT** : equal to ON if the calculated level is less than the low level value entered on the parameters page.
- **CALCULATION FAULT** : equal to ON if there is not P1 > P3 > P2 at the inputs.
- **LEVEL CALCULATION OUTPUT** : result of calculation (in cm).

Parameters:

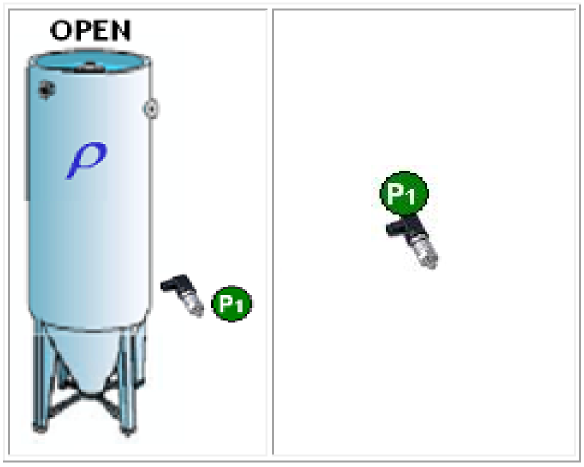
- **Type of tank** : choice of tank used (type A, B, C or D).
- **Density of liquid** : Density of liquid used in the tank (in kg/m3), in the case of constant density (tank type A or B).
- **Height of sensor P3** : Distance between sensors P3 and P1 (in cm), in the case of variable density (tank type C or D).
- **Low level** : tank level monitoring value (in cm), activates the LEVEL FAULT output.

Some common densities expressed in kg/m3:

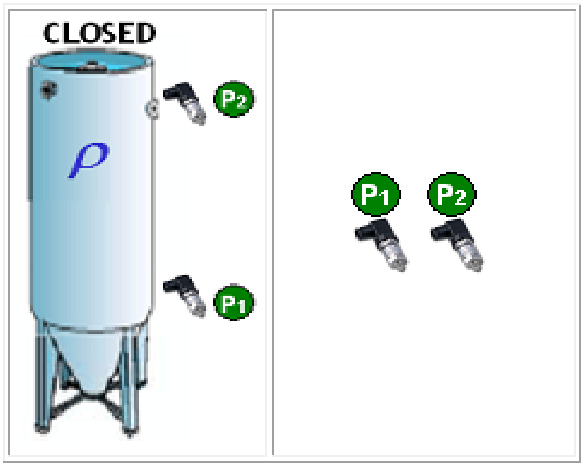
Water	1000
Acetone	790
Acetic acid	1049
Seawater	1030
Ethanol	789
Ether	710
Glycerine	1260

Description of tank types A, B, C and D and calculation methods:

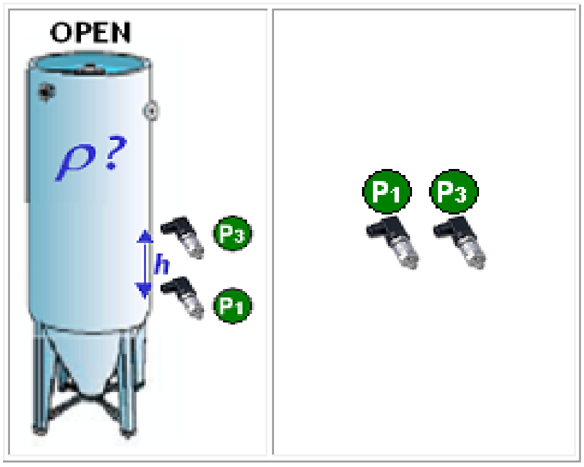
- Tank type A (open tank with known and stable density):



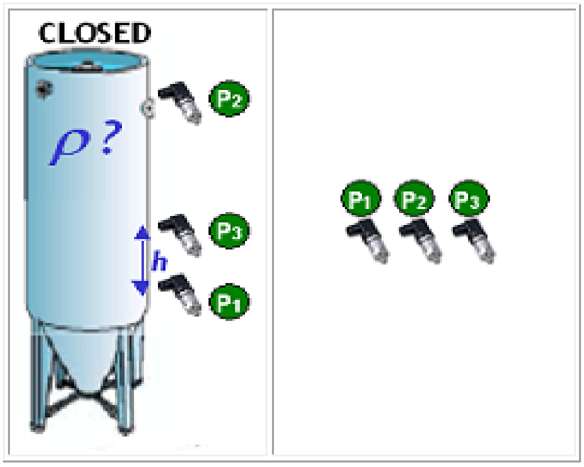
- Tank type B (closed or pressurised tank with known and stable density):



- Tank type C (open tank with unknown or unstable density):



- Tank type D (closed or pressurised tank with unknown or unstable density):



1.4.2.5.6 NTC1

(§ 1.4.2.5.5) (§ 1.4.2.5.7)

This function carries out the temperature measurement. It is dedicated to NTC1 (-25 to +85 °C).

Input:

- **ANA Input**: Input connected to the product analog input (potentiometer).

Output:

- **Temperature** : gives the temperature in °C * 100.

Output parameter:

- **Correction**: correction of temperature by step of 1/10 of °C.

1.4.2.5.7 NTC2

(§ 1.4.2.5.6) (§ 1.4.2.5.8)

This function measures temperature. It is designed for NTC2 type CTNs (-35°C to +120°C).

Input:

- **Analog input** : Input connected to the product analog input (potentiometer).

Output:

- **Temperature** : Gives the temperature in °C * 100.

Output parameter:

- **Correction** : Temperature correction in steps of 1/10th of a °C.

1.4.2.5.8 NTC3

(§ 1.4.2.5.7) (§ 1.4.2.5.9)

This function measures temperature. It is designed for NTC3 type CTNs (0°C to +200°C).

Input:

- **ANALOG INPUT** : Input connected to the product analog input (potentiometer).

Output:

- **TEMPERATURE** : Gives the temperature in °C * 100.

Output parameter:

- **CORRECTION** : Temperature correction in steps of 1/10th of a °C.

1.4.2.5.9 LUX-I : Interior light sensor

(§ 1.4.2.5.8) (§ 1.4.2.5.10)

This function measures light. It is designed for photoresistors and internal light meters, i.e. for values between 0 and 8000 Lux.

Input:

- **ANALOG INPUT** : Input connected to the product analog input (potentiometer).

Output:

- **MEASURED VALUE** : Gives the light level in Lux.

Application example :

88 970 183, luminosity probe LDR-I, from 0 to 3000 Lux.

1.4.2.5.10 TWILIGHT Sunset / Sunrise

(§ 1.4.2.5.9) (§ 1.4.2.5.11)

This function calculates the sunrise and sunset times and also the twilight times in relation to the latitude and longitude read on the function block inputs. It is used to generate high levels on its "MORNING PULSE" and "EVENING PULSE" outputs according to the user parameters.

Inputs:

Controller geographical coordinates:

- **LONGITUDE** : value between -18000 and 18000 (representing -180°00 to 180°00, East (-), West (+)).
- **LATITUDE** : value between -9000 and 9000 (representing -90°00 to 90°00, South (-), North(+)).
- **TIME ZONE** : represents the time difference in minutes compared with GMT depending on the country where the controller is located.

Note: the latitude and longitude must be entered in hundredths. Example: 8962 for an actual value of 89°62.

Outputs:

- **SUNRISE HOUR** : represents the sunrise hour in relation to the geographical position and date of the controller.
- **SUNRISE MINUTE** : represents the sunrise minutes in relation to the geographical position and date of the controller.
- **SUNSET HOUR** : represents the sunset hour in relation to the geographical position and date of the controller.
- **SUNSET MINUTE** : represents the sunset minutes in relation to the geographical position and date of the controller.
- **MORNING PULSE** : this output is at ON when the conditions entered in the parameters are fulfilled (see parameters).
- **EVENING PULSE** : this output is at ON when the conditions entered in the parameters are fulfilled (see parameters).

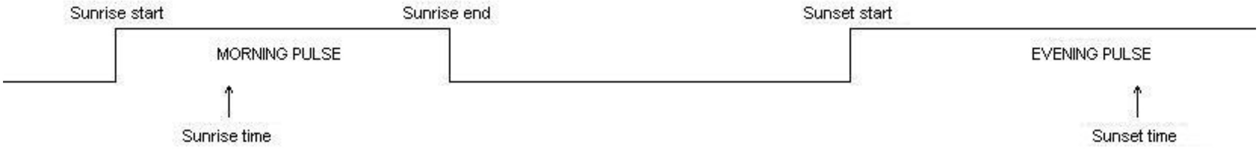
Parameters:

- SUNRISE/SUNSET TYPES:
  - **CIVIL TWILIGHT** : used to calculate the time when the sun is 6° below the horizon at sunrise (dawn) and sunset (twilight).
  - **NAUTICAL TWILIGHT** : used to calculate the time when the sun is 12° below the horizon at sunrise (dawn) and sunset (twilight).
  - **ASTRONOMICAL TWILIGHT** : used to calculate the time when the sun is 18° below the horizon at sunrise (dawn) and sunset (twilight).
  - **SUNRISE/SUNSET** : represents the official sunrise and sunset times.
  - **MANUAL** : Used to select the height of the sun, in degrees, for calculating the official sunrise and sunset times (-20°0 to 0°0 in increments of 0.1).

- SUNRISE HOUR MINUTES:
  - **START** : represents the time when the **MORNING PULSE** output changes to ON if **Fixed** is checked.
  - **Negative OFFSET** represents the offset to be subtracted from the sunrise hour minute value if **Offset -** is checked. In this case the value obtained represents the time when the **MORNING PULSE** output changes to ON.
  - **END** : Represents the time when the **MORNING PULSE** output changes to OFF if **Fixed** is checked.
  - **Positive OFFSET** represents the offset to be added to the sunrise hour minute value if **Offset +** is checked. In this case the value obtained represents the time when the **MORNING PULSE** output changes to OFF.

- SUNSET HOUR MINUTES:
  - **START** : represents the time when the represents the time when the **EVENING PULSE** output changes to ON if **Fixed** is checked.
  - **Negative OFFSET** represents the offset to be subtracted from the sunset hour minute value if **Offset -** is checked. In this case the value obtained represents the time when the **EVENING PULSE** output changes to ON.
  - **END** : represents the time when the **EVENING PULSE** output changes to OFF if **Fixed** is checked.
  - **Positive OFFSET** represents the offset to be added to the sunset hour minute value if **Offset +** is checked. In this case the value obtained represents the time when the **EVENING PULSE** output changes to OFF.

Operating diagram:



Particular operating scenarios:

- If 'sunrise start time' is > 'sunrise time' then 'sunrise start time' = 'sunrise time' – 1 min.
- If 'sunrise end time' is < 'sunrise time' then 'sunrise end time' = 'sunrise time' + 1 min.
- If 'sunset start time' is > 'sunset time' then 'sunset start time' = 'sunset time' – 1 min.
- If 'sunset end time' is < 'sunset time' then 'sunset end time' = 'sunset time' + 1 min.

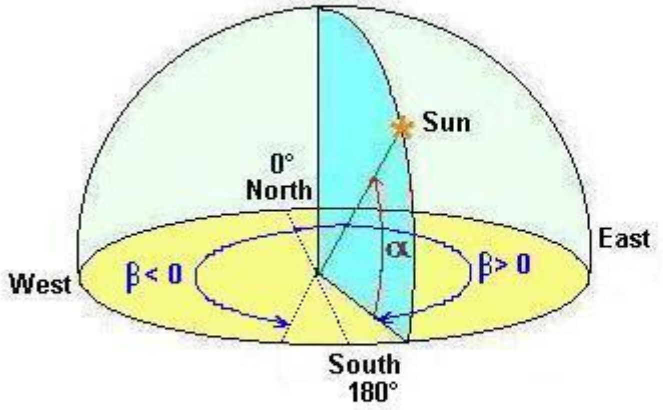
Example :

- **Paris** : latitude = 48°51N, longitude = 2°20E
  - Latitude = 4885
  - Longitude = -233
  - Time zone = 60
- **Buenos Aires** : latitude = 34°20S, longitude = 58°30W
  - Latitude = -3433
  - Longitude = 5850
  - Time zone = -180

1.4.2.5.11 SOLAR TRACKING: DUAL AXIS

(§ 1.4.2.5.10) (§ 1.4.2.5.12)

This function calculates the sun's position so that a sun dial can be placed. This positioning depends on the two angles calculated by the function: the elevation angle and the azimuth angle (see diagram).



Alpha: Elevation, Beta: Azimuth.

To do this calculation, the function uses latitudes and longitudes, the date and time zone of the measurement location.

Inputs:

- **VALIDATION** : function validation input. Until this input is activated, the function remains inert. Validation is active implicitly if it has not been connected.
- **LATITUDE** : represents the latitude at the measurement location (-90°00 S to 90°00 N).
- **LONGITUDE** :represents the longitude at the measurement location (-180°00 E

to 180°00 W).

Note : : the latitude and longitude must be entered in the following format: 8962 for an actual value of 89°62.

Note : : the latitude and longitude must be entered in hundredths, not in seconds.

- **TIME ZONE** : Represents the time zone at the measurement location. It must be entered in minutes (see map below).

Town	Latitude	Longitude	Time difference	Time zone
Los Angeles	34°08	118°37	-8hrs	-480 min
Washington	38°88	77°03	-4hrs	-240 min
Brasilia	-15°75	47°95	-3hrs	-180 min
Bamako	12°67	7°98	0hrs	0 min
Paris	48°85	-2°33	+1hr	+60 min
Cairo	30°00	-31°28	+2hrs	+120 min
Moscow	55°75	-37°62	+3hrs	+180 min
New Delhi	28°62	-77°22	+5hrs30	+330 min
Canberra	-35°30	-149°13	+10hrs	+600 min

Outputs:

- **ELEVATION ANGLE** : represents the elevation angle, i.e. the height of the sun (-90°00 to 90°00. Positive elevation angle: Sun above the horizon, Negative elevation angle: Sun below the horizon).

- **AZIMUTH ANGLE** : represents the azimuth angle, i.e. the rotation (from the north) needed in order to position oneself facing the sun (-180°00 to 180°00).

1.4.2.5.12 Swimming pool Filtration

⇦□□□□ (§ 1.4.2.5.11)

□□□□⇨ (§ 1.4.2.5.13)

This function gives a filtration time in relation to the water temperature.

Inputs:

- **VALIDATION** : Enables the function. If this input is not activated, the function remains inert. Activated implicitly if it has not been connected.
- **+20%** : Filtration time increased by 20%.
- **-20%** : Filtration time reduced by 20%.
- **-50%** : Filtration time reduced by 50%.
- **START TIME** : Represents the time when the FILTRATION output changes to ON. This is the time when filtration starts. For example, 1500 represents 15.00 hours.
- **TEMPERATURE °C** : Temperature input in 1/10 degrees. This input is only taken into account for values between 0°C and 48°C.

Outputs :

- **FILTRATION** : This output changes to ON when the e**m4** time is greater than or equal to the **START TIME**. It changes to OFF when the product time exceeds the filtration start time + the **FILTRATION TIME**.
- **FILTRATION TIME** : Filtration time in minutes which varies according to the water temperature. The filtration time is recalculated each time the temperature varies.

Parameters:

- **OPERATION AT 100%** : If the temperature input is higher than the operation at 100% parameter when the filtration time equals the selected curve maximum ('normal' filtration time or -20%).
- **MINIMUM OPERATING TIME** : If the calculated filtration time is lower than the minimum operating time parameter, the filtration time will equal the minimum operating time parameter.

1.4.2.5.13 DEFROST

⇦□□□□ (§ 1.4.2.5.12)

□□□□⇨ (§ 1.4.2.5.14)

The DEFROST function is used to optimize operation of an air-conditioning unit heat exchanger.
The defrost output changes to ON when the input temperature is less than the minimum temperature for a time T (T being the cumulative duration of passages below the minimum temperature). If the temperature rises to higher than the maximum temperature during the defrost cycle, the defrost output

reverts to OFF even if it has not finished. This output can be triggered and stopped by means of the corresponding inputs.

Inputs:

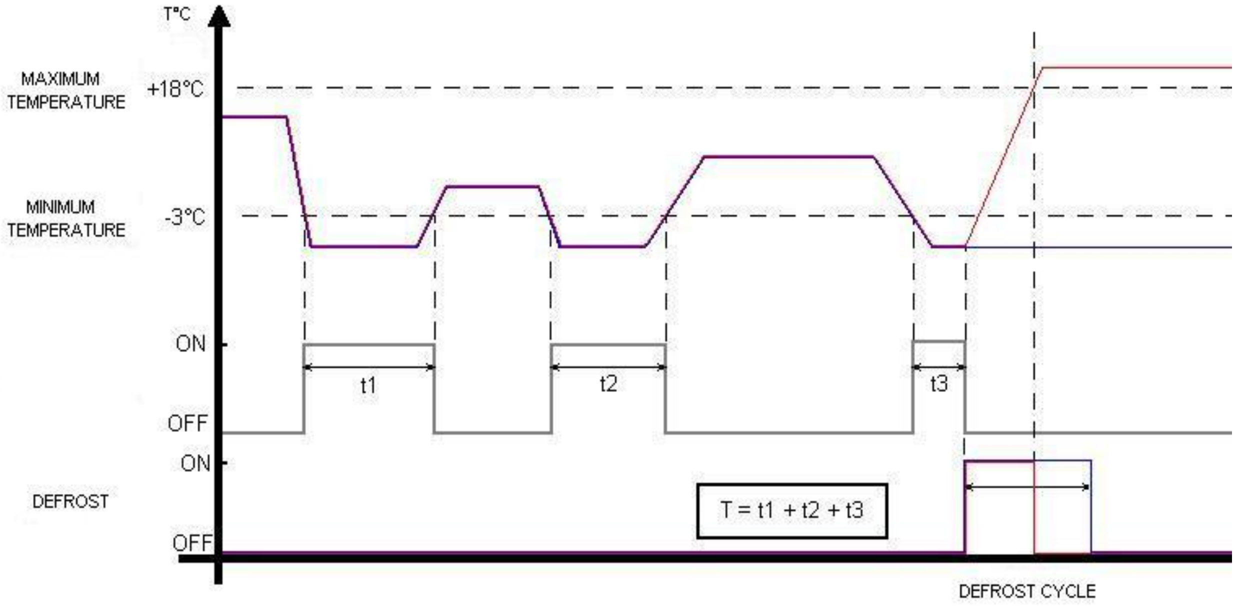
- **VALIDATION** : Enables the function. If this input is not activated, the function remains inactive. Activated implicitly if it has not been connected.
- **TEMPERATURE** : Air temperature in °C*100 (-32768°C to 32767°C).
- **MANUAL DEFROST ON** : Sets the defrost output to ON if the temperature is less than the maximum temperature.
- **MANUAL DEFROST OFF** : Sets the defrost output to OFF (Priority stop).

Outputs:

- **DEFROST** : The defrost output is at ON when the CUMULATIVE OPERATING TIME has elapsed.
- **CUMULATIVE TIME** : Measured duration, in minutes, when the temperature is less than the minimum temperature or duration of the current defrost cycle.

Parameters:

- **CUMULATIVE OPERATING TIME** : Time T, in minutes, at the end of which the function triggers defrosting (1 to 32767).
- **DEFROST CYCLE** : Duration of defrosting in minutes (1 to 32767).
- **MAXIMUM TEMPERATURE** : Temperature in °C above which defrosting is stopped (10°C ... 20°C).
- **MINIMUM TEMPERATURE** : Temperature in °C below which the time T is measured (-10°C ... 0°C).



1.4.2.5.14 HEAT CURVE

(§ 1.4.2.5.13) (§ 1.4.2.5.15)

This function is used to modulate the heating water temperature according to the atmospheric conditions. The function uses automatic regulation depending on the temperature outdoors called the temperature curve or "water ratio". For every variation in the outdoor temperature, the regulation automatically adjusts the heating temperature according to the temperature curve. This makes it possible to always have the right heating temperature with optimum efficiency.

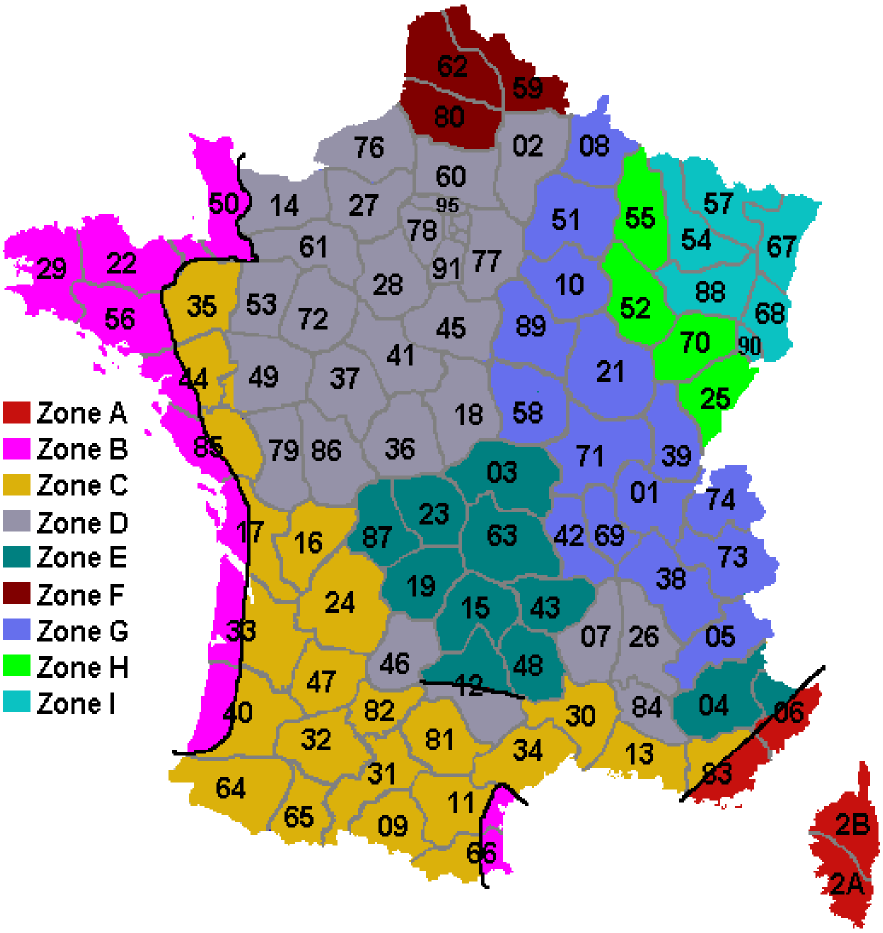
- Start time optimization:

- The aim is to optimize the precise moment when the boiler should start up in the morning to change from the night-time temperature to that for daytime.
- The first time, it is estimated that it will take 2 hours to change from 17°C (night) to 20°C (day), therefore in order to have 20°C at 8 o'clock in the morning, the function will take account of the day setpoint at [8 hours (daytime temperature hour input) – 2 hours] = 6 o'clock in the morning.
- If the "start time optimization" box is checked, in this example at 6 o'clock in the morning, this starts a timer in minutes which will stop once the setpoint temperature is reached. This value replaces the 2 hours previously in memory and can be used to find out the installation slope in °C/min.

Inputs :

- **VALIDATION** : regulation activated if the **VALIDATION** input is ON.
- **STANDARD OUTDOOR T°C :** : daytime outdoor temperature which on average will only fail to be achieved on one day a year. Enter 810 for 8.10°C.
  - Example for France :

	Zone								
Altitude band in meters	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
0 to 200	**-2**	**-4**	**-5**	**-7**	**-8**	**-9**	**-10**	**-12**	**-15**
201 to 400	**-4**	**-5**	**-6**	**-8**	**-9**	**-10**	**-11**	**-13**	**-15**
401 to 600	**-6**	**-6**	**-7**	**-9**	**-11**	**-11**	**-13**	**-15**	**-19**
601 to 800	**-8**	**-7**	**-8**	**-11**	**-13**	**-12**	**-14**	**-17**	**-21**
801 to 1000	**-10**	**-8**	**-9**	**-13**	**-15**	**-13**	**-17**	**-19**	**-23**
1001 to 1200	**-12**	**-9**	**-10**	**-14**	**-17**		**-19**	**-21**	**-24**
1201 to 1400	**-14**	**-10**	**-11**	**-15**	**-19**		**-21**	**-23**	**-25**
1401 to 1600	**-16**		**-12**		**-21**		**-23**	**-24**	
1601 to 1800	**-18**		**-13**		**-23**		**-24**		
1801 to 2000	**-20**		**-14**		**-25**		**-25**		
2001 to 2200			**-15**		**-27**		**-29**		



- **MAXIMUM WATER T°** : maximum water temperature for which the size of the heating installation has been determined in order to ensure comfort at the "standard outdoor temperature". Enter 7000 for 70.00°C.
- **NON-HEATING OUTDOOR T°** : temperature above which it is no longer necessary to have the heating on. Enter 1500 for 15.00°C.
- **MINIMUM WATER T°** : when the temperature outdoors equals the "non-heating outdoor temperature" the water temperature reaches a minimum temperature. Enter 3000 for 30.00°C.
- **DAY SETPOINT** : desired indoor temperature during the day. Enter 2000 for 20.00°C.
- **NIGHT SETPOINT** : desired indoor temperature at night. Enter 1700 for 17.00°C.
- **OUTDOOR SENSOR T°** : temperature used when calculating the "outdoor delta" which can be used to obtain the optimum water temperature for heating. Example: 1015 corresponds to 10.15°C.
- **WATER SENSOR T°** : water temperature feedback used for regulation. Example: 1015 corresponds to 10.15°C.
- **INDOOR SENSOR PRESENCE**: activation of compensation with ambient temperature sensor.
- **INDOOR SENSOR T°** : activation of compensation with ambient temperature sensor. Example: 2015 corresponds to 20.15°C.
- **DAYTIME TEMPERATURE HOUR** : hour corresponding to the start of regulation according to the day setpoint. Enter 8 for 08.00.
- **NIGHT-TIME TEMPERATURE HOUR** : hour corresponding to the start of regulation according to the night setpoint. Enter 22 for 22.00.

Outputs :

- **HEATING** : heating control, if set to ON, heating is on, if set to OFF heating is not on.
- **OFFSET** : time corresponding to the start time optimization in minutes.
- **HYSTERESIS** : used to avoid the output jumping around the setpoint value (0 ≤

hysteresis ≤ 25°C) (modifiable via the display).

Parameters :

- **HYSTERESIS** : used to avoid the output jumping around the setpoint value (0 ≤ hysteresis ≤ 25°C) (modifiable via the display).
- **MIN TIME BEFORE RESTART** : period during which the output cannot be changed to ON. This timer is triggered each time the **HEATING** output changes to OFF.
- **START TIME OPTIMIZATION** : if this box is checked, the function calculates the heating time needed to reach the setpoint when changing from night-time --> daytime.

1.4.2.5.15 PID AUTO-TUNING

□□□□ (§ 1.4.2.5.14)

□□□□ (§ 1.4.2.6)

PID

This function is an auto-tuning proportional-integral-derivative (PID) controller.

Inputs:

- **VALIDATION** : Digital input. The function remains inactive while the input is inactive. However, it is implicitly active if the input is not connected.
- **CURRENT VALUE** : 16-bit input which can be used to acquire the value to be controlled (indicated by the sensor).
- **ENABLE_AUTO-TUNING** : Digital input. Auto-tuning is initiated when the function detects a pulse on this input. The input is inactive when it is not connected.
  This method is applicable only when the system is around an operating point and able to oscillate.
- **GAIN (Kp)** : Proportional gain. The proportional part of PID control constitutes the most elementary form of feedback, where the command signal is simply the difference between the setpoint and the value to be controlled, multiplied by the gain Kp. Intuition tells us that by increasing this gain, the command signal acts on the system more strongly and thus reduces the difference faster. However, an excessively large proportional gain will give rise to oscillatory behaviour, resulting in a reduction or even loss of stability.
- **Ti** Integral time. In the case of a proportional controller, the appearance of a command signal that is not zero means that it is subject to the existence of a discrepancy between the setpoint and the value to be controlled. The use of this command therefore usually causes quadrature droop. This is eliminated by using the integral term. This generates, from even the slightest constant sign error signal, a command whose amplitude never stops growing. The consequence of this will be to cancel out any permanent discrepancy. The downside is the destabilising effect it may cause.
- **Td** : Derivative time. When, at a given time, the measured error increases, it is logical to assume that, at a later time, it will be even greater. The idea of the derivative term is therefore to predict the future error so as to be able to correct it directly, without waiting for it to appear. A proportional-derivative controller can be interpreted as a proportional correction affecting the predicted error, where the prediction is made by adding its derivative term weighted by the Td factor to the momentary discrepancy (linear extrapolation).
- **VALID PARAMS Kp, Ti, Td** : Digital input. The Kp, Ti, Td parameter inputs are loaded in the controller on every cycle when this input is active.
- **PRESET VALUE** : Input with 16 signed bits which can be used to fix the regulation setpoint.

Outputs:

- **ANA/PWM OUTPUT** : This is an analog output that can be connected to a 0-10 V analog output FB (0 - 1000) or a PWM FB (0 - 100). This is the OUTPUT of a proportional-integral-derivative (PID) controller whose parameters can be modified or auto-tuned. It is the command destined for the input of the system to be controlled.

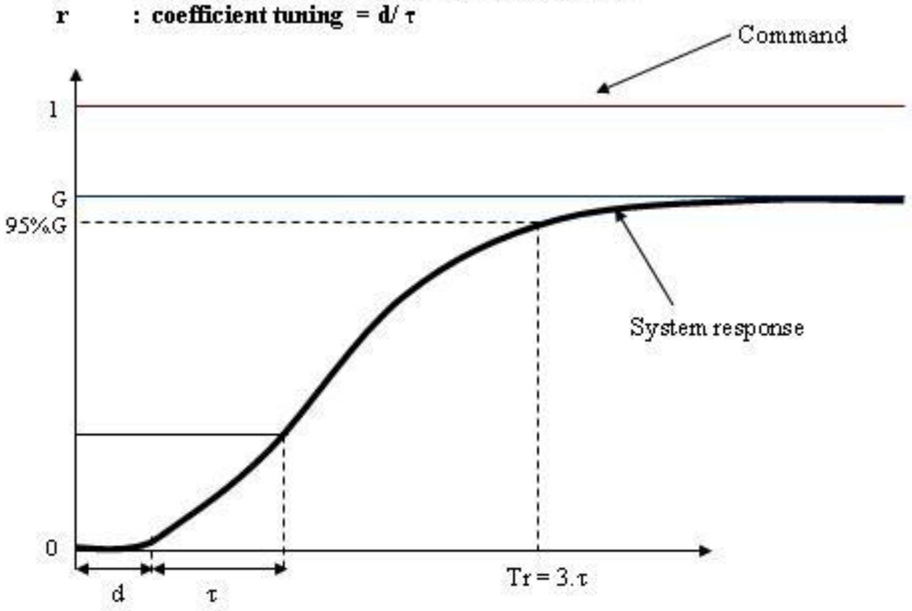
- **Kp, Ti, Td** : Output parameters which can be modified from a display screen.
- **STATE** : This output indicates the controller operating phase; its states range from 0 to 6.
  - **STATE 0** : Inactive state or controller not enabled.
  - **STATE 1** : Setpoint tracking.
  - **STATE 2** : Setpoint reached (State desired by regulation; the purpose of regulation).
  - **STATE 3** : Initialisation of auto-tuning or tracking the operating point.
  - **STATE 4, 5, 6** : Auto-tuning or parameter search stages.

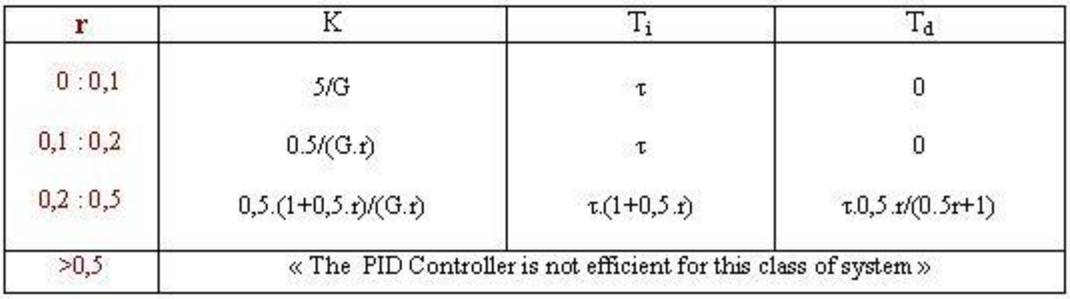
Parameters:

- **RESPONSE TIME** : This is the time it takes the system to reach a static value when it is energized by a step (see diagram). It is used to initialise (approximately) those parameters for starting regulation. It is advisable to perform auto-tuning after any initialization other than "MANUAL".
- **Kp, Ti, Td** : These parameters are taken into account when the function starts if parameter initialisation is in "MANUAL" mode.
- **ACTION** : This parameter is used to select the the direction of the output action. Example of a thermal system: In Heat mode, the OUTPUT must increase so that the temperature reaches a setpoint higher than the current temperature. This is the default mode for controlling radiator type systems. In Cool mode, the logic is reversed. The more the OUTPUT increases, the more the value of the temperature acquired as a feedback decreases. This is the mode used to control refrigerator type systems. This parameter should be defined according to the system controlled. *Incorrect parameter setting can cause a discrepancy in the temperature.*.
- **ANA/PWM OUTPUT**: sets the output as 0 - 1000 or 0 - 100.
- **Ti/T** : This is the ratio between the integral time (Ti) and the sampling period (T). It is between 10 and 100. It is used to set the sampling period indirectly.

Parameter setting:

G : static gain
d : delay
Tr : Time response of system Tr = 3.τ
τ : Time constant *of system consider as 1st order*.
r : coefficient tuning = d/ τ





r	K	T_i	T_d
0 : 0,1	5/G	τ	0
0,1 : 0,2	0.5/(G.r)	τ	0
0,2 : 0,5	0,5.(1+0,5.r)/(G.r)	τ.(1+0,5.r)	τ.0,5.r/(0.5r+1)
>0,5	« The PID Controller is not efficient for this class of system »		

Note : The PID controller parameters can be modified online via the display function. These modifications are instantly taken into account in the next cycle.

Note : The sampling period is calculated automatically using the integral time Ti and the ratio Ti/T; the minimum value of T is 0.1 s.

CAUTION

When you apply the new values of Kp, Ti, Td, you should re-check the state of your equipment so as to be forewarned of any damage which might be due to unwanted transients.

Failure to follow this instruction can result in serious injury or equipment damage.

1.4.2.6 PROG Functions : Programmation

(§ 1.4.2.5.15)

(§ 1.4.2.6.1)

At a Glance

Subject of this Section

This section describes the different PROG functions available using FBD language.

What's in this Section?

This section contains the following topics:

Numerical value, latching, management of time, status, etc.

1.4.2.6.1 Level 1, Level 0

(§ 1.4.2.6) (§ 1.4.2.6.2)

Discrete Constant-Type Inputs

There are two types of Discrete constants: the **1** constant 1 and the **0** constant 0. These two constants can be used to set the function inputs to 1 or 0.
In Simulation or Debugging modes it is possible to force these inputs in the reverse order. The symbol then appears in orange...

1.4.2.6.2 YES

(§ 1.4.2.6.1) (§ 1.4.2.6.3)

This function can be used to copy the input to the output.

Input:

- **Digital input**.

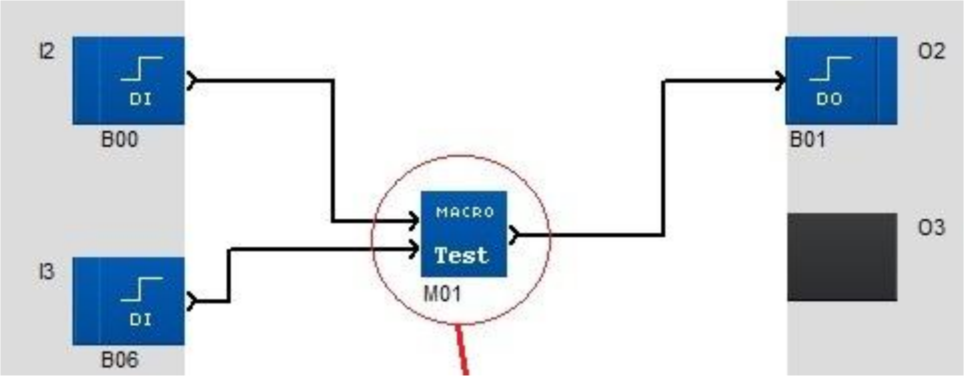
Output:

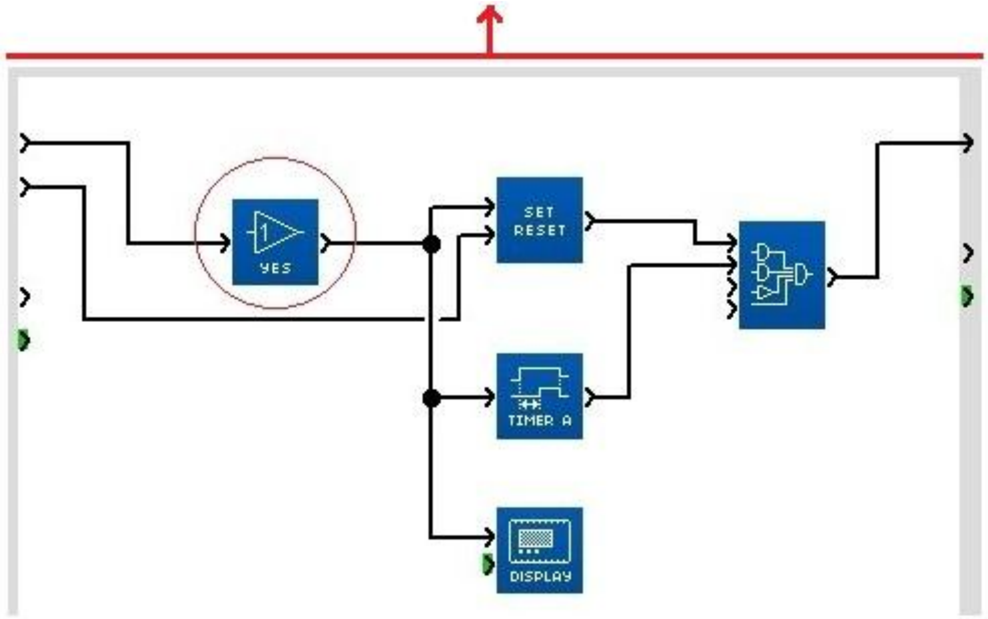
- **Digital output**.

Operation:

This is very helpful when macros are being used, to be able to connect an input to several blocks.

Example





1.4.2.6.3 NUM Numerical Value

□□□□ (§ 1.4.2.6.2) □□□□ (§ 1.4.2.6.4)

Numerical Constant-Type Inputs

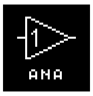
The numerical constant **NUM** NUM is an integer with a value between -32768 and +32767.
This constant can be used to set values to the functions' non-connected inputs:

- GAIN,
- COMP IN ZONE,
- TRIGGER.

The value of the constant can be set in the **Parameters** window.
In Simulation or Debugging modes it is possible to modify the constant.

1.4.2.6.4 YES NUM

□□□□ (§ 1.4.2.6. 3) □□□□ (§ 1.4.2.6.5)



This function can be used to copy the input to the output.

Input:

- **NUM input.**

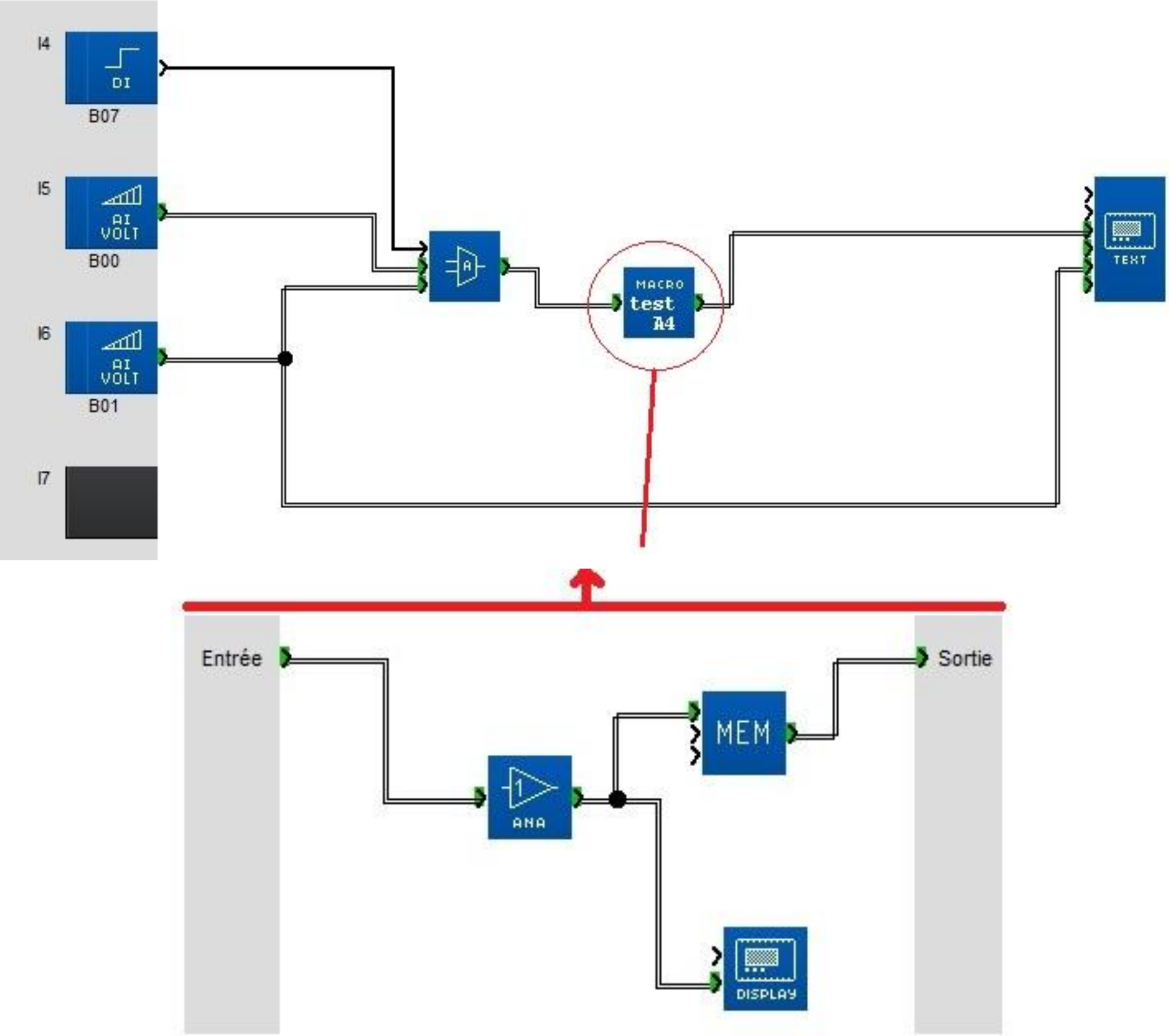
Output:

- **NUM output.**

Operation:

This is very helpful when macros are being used, to be able to connect an input to several blocks.

Example:



1.4.2.6.5 MEMORIZING 1 value (MEM)

(§ 1.4.2.6.4)

(§ 1.4.2.6.6)

MEM

This function is used to save a value between -32768 and 32767
The value stored in the function is permanently available on OUTPUT.

On power-up, the saved value depends on the option chosen in the "parameters" window:

- If **Save on power break** is at NO, then the saved value at the time of the last power break is deleted and replaced with 0.
- If **Save on power break** is at YES, then the saved value at the time of the last power break is unchanged.

When the MEMORIZING input changes from 0 to 1, the saved value is deleted and replaced with the new value present on INPUT at this moment.
This value remains frozen, regardless of any INPUT variations, until the next time MEMORIZING changes from 0 to 1.

When the MEMORIZING input returns to 0, the value is still saved.

When the RESET TO ZERO input changes from 0 to 1, the saved value is deleted and replaced with 0. This input has priority over MEMORIZING
As long as the RESET TO ZERO input remains at 1, the saved value remains at 0 regardless of the MEMORIZING states or transitions
When the RESET TO ZERO input returns to 0, the saved value remains at zero until the next MEMORIZING transition.

1.4.2.6.6 STORAGE : 8 storage values

□□□□ (§ 1.4.2.6.5) □□□□ (§ 1.4.2.6.7)

This function calculates a sliding average on values stored in the memory.

On starting up the application, the FB STORAGE function block is active by default. When rising edge appears at input VALIDATION, the byte value present on the input VALUE is stored.
This value can be read on the MEMORY_1 output. At this point, when there is only one value in the memory, the average value read on the output AVERAGE is identical to the MEMORY_1 value.
At the 2nd rising edge at the input VALIDATION, the byte value present on the input VALUE is stored in the MEMORY_2 output. The average value read on the output AVERAGE is equal to the value (MEMORY_1 + MEMORY_2) / INDEX and so on up to MEMORY_8. The INDEX output counts the number of values stored in the memory. Once 8 values have been stored, the next rising edge at input VALIDATION shift all values, MEMORY_8 replaces MEMORY_7, the new value is stored in the space freed in MEMORY_8 and all the bytes stored are shift by one MEMORY_7 to MEMORY_6 and so on down to MEMORY_1. The value previously stored in MEMORY_1 before the new capture is lost. The AVERAGE value is recalculated.

The integer value of the calculated mean is truncated. A pulse at the input RAZ resets all values stored to zero, including the AVERAGE and the INDEX.

ENTREES :

- **VALIDATION** : DISC. When rising C_ON , this store in memory.
- **RESET** : DISC. When rising C_ON, all outputs are reset to zero.
- **VALUE** : S16. Value to be stored in the memory.

OUTPUTS :

- **MEMORY_1** : S16. 1st value stored in the memory.
- **MEMORY_2** : S16. 2nd value stored in the memory.
- **MEMORY_3** : S16. 3rd value stored in the memory.
- **MEMORY_4** : S16. 4th value stored in the memory.
- **MEMORY_5** : S16. 5th value stored in the memory.
- **MEMORY_6** : S16. 6th value stored in the memory.
- **MEMORY_7** : S16. 7th value stored in the memory.
- **MEMORY_8** : S16. 8th value stored in the memory.
- **AVERAGE** : S16. Average value.
- **INDEX** : S16. Number of values stored in memory.
- **MAX** : S16. Maximum of the values stored in memory.
- **MIN** : S16. Minimum of the values stored in memory.

1.4.2.6.7 ARCHIVE : 2 storage values

(§ 1.4.2.6.6) (§ 1.4.2.6.8)

Overview

The **ARCHIVE** data archiving function enables two values to be saved simultaneously with their date-stamping information.

Access

The ARCHIVE function is accessible from the **PROG** function bar.

Inputs/Outputs

Description of the inputs:

- **LATCHING**: This is the archive function command input (Discrete(§ 1.4.2.1.1) type) on each rising edge (transition from inactive to active), the VALUE input is memorized.
  If this input is not connected, then it is set to inactive.
- **RESET**: When this input (Discrete(§ 1.4.2.1.1) type) is active, it forces the VALID ARCHIVE to inactive: previously saved values are still available.
  If this input is not connected, then it is set to inactive.
- **ARCHIVE VALUE 1**: this is the first input that is saved. The whole value present on this input is saved with its date-stamping information: time and date (all of this information is available on the outputs).
  If this input is not connected, then it is set to inactive.
- **ARCHIVE VALUE 2**: second input saved
  If this input is not connected, then it is set to inactive.

Description of the outputs:

- **VALID ARCHIVE**: this output (Discrete(§ 1.4.2.2.1) type) indicates the validity of the storage in process:
  - Inactive: no data available
  - Active: data available
- **MINUTE**: minute value of the date-stamping information (0 to 59) (INTEGER type)
- **HOUR**: hour value (0 to 23) (INTEGER type)
- **DAY**: day value (1 to 31) (INTEGER type)
- **MONTH**: month value (1 to 12) (INTEGER type)
- **YEAR**: year value (0 to 99) (INTEGER type)
- **ARCHIVE 1**: whole value present on the VALUE 1 input (INTEGER type)
- **ARCHIVE 2**: whole value present on the VALUE 2 input (INTEGER type)

Parameters

From the programming workshop

When selected, the **Save on power failure** parameter enables the current value of the counter to be retrieved following a power failure(§ 1.2.20).

Storage Mechanism

If the LATCHING input is activated several times, only the data concerning the last activation is memorized.

Display of Saved Values

Saved values can be displayed; in order to do this, simply connect the outputs of the ARCHIVE function to the DISPLAY blocks.
The DISPLAY function can modify the displayed value if the **Modification authorized** parameter is checked.

Note: Any modification risks damaging the consistency of the archived data: VALUE/DATE.

1.4.2.6.8 RANDOM

◁□□□□ (§ 1.4.2.6.7) □□□□▷ (§ 1.4.2.6.9)

This function provides a pseudo-random value between the minimum and maximum values set by the user. The user chooses the time at which the value needs to appear as an output.

Inputs:

- **VALIDATION** : Enables the function. If this input is not activated, the function remains inactive. Activated implicitly if it has not been connected.
- **TRIGGER** : Its rising edge allows a pseudo-random value to be displayed as an output.

Outputs:

- **VALUE PULSE** : This output sends a pulse when a new pseudo-random value is displayed as a Value output.
- **VALUE** : Pseudo-Random value (from -32767 to 32767).

Parameters:

- **CYCLE(S)** : Number of cycles defined as trigger period (from 2 to 32767).
- **0,1s** : Number of tenths of seconds defined as trigger period (from 1 to 32767).
- **1s** : Number of seconds defined as trigger period (from 1 to 32767).
- **INPUT** : Trigger option via the function TRIGGER input.
- **MAX VALUE** : Maximum value permitted as an output (from -32767 to 32767).
- **MIN VALUE** : Minimum value permitted as an output (from -32768 to 32766).

1.4.2.6.9 HOUR MINUTE

◁□□□□ (§ 1.4.2.6.8) □□□□▷ (§ 1.4.2.6.10)

This function provides the controller hour and minutes.

Outputs:

- **HOUR**: Value of the controller hour (0 to 23)
- **MINUTE**: Value of the controller minute (0 to 59)

1.4.2.6.10 HOUR MINUTE Conversion

◁□□□□ (§ 1.4.2.6.9) □□□□▷ (§ 1.4.2.6.11)

CONV

This function is used to convert a time period in the "hour : minute" format to minutes and vice versa.

Inputs:

- **"Hour : Minute"** : represents the time period in "hour : minute" format to be converted to minutes (0 to 32759).

> **Note** : The format of this input must be as follows: value 1530 for 15.30.

- **Minute** input : Represents the time period in minutes to be converted to "hour : minute" format (0 to 19679).

> **Note** : If one of the input values is negative, its corresponding output is set to 0.

Outputs:

- **Minute** output : Represents the result of the conversion into minutes (0 to 19679).
- **"Hour : Minute"** output : Represents the result of the conversion into "hour : minute" format (0 to 32759).

1.4.2.6.11 Controller STATUS

◁□□□□ (§ 1.4.2.6.10) □□□□▷ (§ 1.4.2.6.12)

Description

This function allows the user to access the controller status and modify the behavior of its FBD and/or SFC program according to particular states.
Only an alarm status is available (the warning can be retrieved by the application), as the error causes the application to switch OFF and the status function block is therefore no longer executed.

Access

The STATUS function is accessible from the **PROG** function bar.

Inputs/Outputs

This function block does not have an input.
The function has seven outputs:

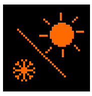
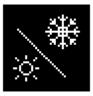
- **ALARM STATUS**: Active as soon as an alarm(§ 1.6.1.12) (warning) is detected in the controller. In this case, the corresponding code is available on the ALARM NUMBER output. The only way to return this output to inactive status and set the ALARM NUMBER to zero is to use the front panel FAULT menu with the CLEAR and YES commands. Usage: Allows the user program to be put into a known "fallback" state in the event of a fault.
- **DEBUGGING ON**: Active when the user program is correctly executed on the controller and a Monitoring session is activated from the programming workshop.
  Otherwise, this output is inactive.
  Usage: In this operating mode, the watchdog action in the configuration is systematically deleted regardless of the programmer's initial choice. If in the user program, the watchdog action (error/warning) is essential, this output allows the user program to be put into a known state with no consequences (making no changes) for the outputs controlled.

- **PARAMETERS ON**: Sends a pulse when the user program is correctly executed on the controller and a parameters modification action is activated either from the programming workshop, or after execution in the PARAMETER menu on the front panel of the LCD.
  Otherwise, this output is inactive.
  Usage: In this operating mode, the watchdog action in the configuration is systematically deleted regardless of the programmer's initial choice. If, in the user program, the watchdog action (error/warning) is essential, this output allows the user program to be put into a known state with no consequences (making no changes) for the outputs controlled.
- **COLD START**: Sends a pulse during the first execution cycle of a user program when it switches from OFF to ON (new application, loss of context, etc.). All the variables are reset.
  COLD START corresponds to a change from OFF to ON with Reset.
  Usage: This pulse allows the programmer to insert specific initializations in his program, for example, initializing the SFC "RESET-INIT" function, which confers saving on a power failure in the SFC chart containing it.
- **WARM START**: Sends a pulse during the first execution cycle of a user program when power is restored following a power failure occurring when the program was in RUN mode.
  WARM START is triggered by the end of a mains power failure simulation or ON without Reset.
  Usage: This pulse lets the programmer insert specific initializations in his program once the power has been restored.
- **FLASH CYCLE**: Delivers a periodic signal that switches alternately from ON to OFF at each execution of the user program (RUN mode). Its period is equal to twice the duration of the execution period described in the configuration,
- **ALARM NUMBER**: Provides the alarm code in signed integer format when the ALARM STATUS output is active.

1.4.2.6.12 SUMMER/WINTER time

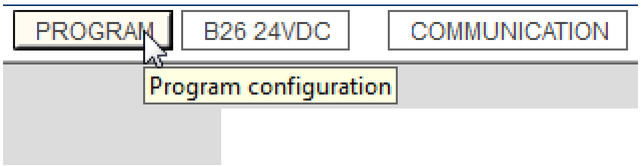
(§ 1.4.2.6.11) (§ 1.4.2.7)

Summer Time Input

The summer time input function is active  throughout summer time, and inactive throughout winter time .

Note: To confirm this function:

- display the **Program configuration** window: **menu: File/Properties**, or by selecting the "program" button",



- select the **Date format** tab,
- check the **Activate the summer/winter time change** box,
- define the dates when the time change takes place:

- Either using one of the preset geographic zones,
- Or by manually configuring the date (month/Sunday).

1.4.2.7 CALC Functions : Calculation

◁□□□□ (§ 1.4.2.6.12) □□□□▷ (§ 1.4.2.7.1)

At a Glance

Subject of this Section

This section describes the different CALC functions available using FBD language.

What's in this Section?

This section contains the following topics:

Gain, maths operations, multiplexer, demultiplexer, decimal & binary conversions, register, table from a spreadsheet, etc.

1.4.2.7.1 GAIN Function

◁□□□□ (§ 1.4.2.7) □□□□▷ (§ 1.4.2.7.2)

Description

The **Gain** function enables analog values to be converted by changing the scale and offset.
Gain calculation formula: **y = a/bx + c**

Access

The gain function GAIN is accessible from the **CALC** function bar.

Inputs/Outputs

Description of the inputs:

- **ENABLE FUNCTION**: gain function input command, whose type is Discrete(§ 1.4.2.1.1).
  The state of this input determines operation of the block: if the ENABLE FUNCTION input is inactive, the CALCULATION OUTPUT retains the last calculated value.
- **CALCULATION INPUT**: value of the analog input connected to the gain function.
  This is an integer between -32768 and 32767.

Description of the output:

- **CALCULATION OUTPUT**: output value of the gain function.
  This value depends upon the state of the ENABLE FUNCTION input.
  If the ENABLE FUNCTION input is:
  - inactive, then the CALCULATION OUTPUT equals the last calculated value, when the ENABLE FUNCTION input is inactive,
  - active, then the CALCULATION OUTPUT is equal to the result of the gain calculation formula.

> **Note:** if the ENABLE FUNCTION input is not connected, then it is considered to be active.

Parameters

In the programming software

From the **Parameters** window, you can adjust:

- **A/B** which corresponds to the **gain** applied by the function with:
  - **A**: being a numerator (from -32768 to 32767),
  - **B**: denominator (from -32768 to -1 and from 1 to 32767)
- **C** which is the **offset** applied by the function, and is an integer between -32768 and 32767.

In addition, it is possible to define an **operating range** by setting limits for the function output:

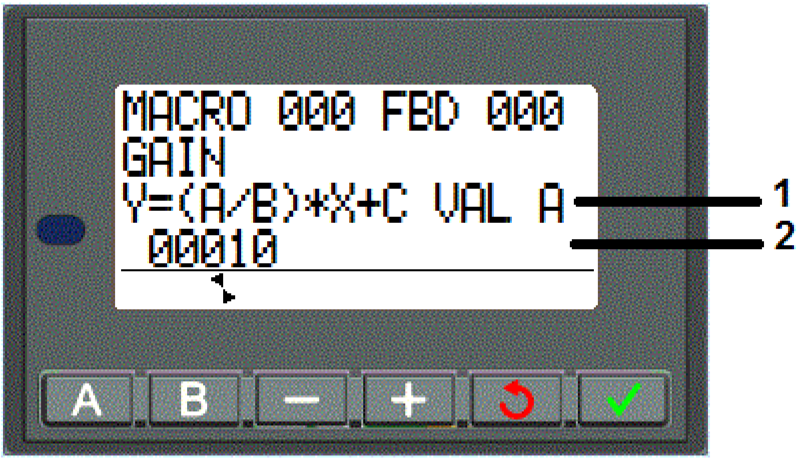
- Lower limit: integers between -32768 and 32767,
- Upper limit: integers between -32768 and 32767.

From the front panel

From the PARAMETER(§ 1.3.2) menu, you can set the parameter values:

- **A**: gain numerator
- **B**: gain denominator (value 0 prohibited),
- **C**: offset,
- **upper limit**,
- **lower limit**.

Illustration:



MACRO 000 FBD 000
GAIN
Y=(A/B)*X+C VAL A
00010

1 Name of the parameter displayed
2 Value of the parameter displayed

Parameter Modification

To modify the parameters from the front panel of the controller, check the **Authorized modification** box of the **Parameters** window.

1.4.2.7.2 ADD-SUB Arithmetic Function

(§ 1.4.2.7.1) (§ 1.4.2.7.3)

Description

The **ADD-SUB** Addition and/or Subtraction function enables simple operations to be carried out on integers:

- Addition,
- Subtraction.

Calculation formula: **Out = I1 + I2 - I3**

Access

The ADD-SUB function is accessible from the **CALC** function bar.

Inputs/Outputs

Description of the inputs:

- **INPUT 1**: first input value of the formula (integer(§ 1.1.1)),
- **INPUT 2**: second input value of the formula (integer(§ 1.1.1)),
- **INPUT 3**: third input value of the formula (integer(§ 1.1.1)).

> **Note:** If the INPUTS are not connected, they are set to 0.

- **ERROR PROPAGATION**: this input, whose type is Discrete(§ 1.1.1), is used to propagate errors (or saturations) from calculation functions (ADD-SUB or MUL-DIV) carried out upstream.

> **Note:** If ERROR PROPAGATION is at 1, then the operations are not performed and the ERROR/OVERRUN output is set to 1.

> **Note:** If ERROR PROPAGATION is not connected, it is set to 0.

Description of the outputs:

- **CALCULATION OUTPUT**: this is the value of the calculation formula output (integer(§ 1.1.1)).
- **ERROR/OVERRUN**: this output, whose type is Discrete(§ 1.1.1), indicates any presence of saturation errors).
  This output is activated in the following cases.
  - The consequence of the operations is a result that is not included in the interval [-32768, +32767],
  - The ERROR PROPAGATION input is active.

Examples

Simple addition: simply do not use the **INPUT 3** input.
Simple subtraction: simply do not use one of the **INPUT 1 or 2** inputs.

1.4.2.7.3 MUL-DIV Arithmetic Function

(§ 1.4.2.7.2) (§ 1.4.2.7.4)

Description

The **MUL-DIV** Multiplication and/or Division function enables simple operations to be carried out on integers:

- Multiplication,
- Division.

Calculation formula: **Out = I1 * I2 / I3**

Access

The MUL-DIV function is accessible from the **CALC** function bar.

Inputs/Outputs

Description of the inputs:

- **INPUT 1**: first input value of the formula (integer(§ 1.1.1)).
- **INPUT 2**: second input value of the formula (integer(§ 1.1.1))
- **INPUT 3**: third input value of the formula (integer(§ 1.1.1))

Note: If the INPUTS are not connected, they are set to 1.

- **ERROR PROPAGATION**: this input, whose type is Discrete(§ 1.1.1), is used to propagate errors (or saturations) from calculation functions (ADD-SUB or MUL-DIV) carried out upstream.

Note: If ERROR PROPAGATION is at 1, then the operations are not performed and the ERROR/OVERRUN output is set to 1.

Note: If ERROR PROPAGATION is not connected, it is set to 0.

Description of the outputs:

- **CALCULATION OUTPUT**: this is the value of the calculation formula output (integer(§ 1.1.1)).
- **ERROR/OVERRUN**: this output, whose type is Discrete(§ 1.1.1), indicates any presence of saturation errors).
  This output is activated in the following cases:
  - The consequence of the operations is a result that is not included in the interval [-32768, +32767],
  - The ERROR PROPAGATION input is active,
  - The INPUT 3 equals 0.

Examples

Simple multiplication: simply do not use the **INPUT 3** input.
Simple division: simply do not use one of the **INPUT 1 or 2** inputs.

1.4.2.7.4 SIN COS

(§ 1.4.2.7.3) (§ 1.4.2.7.5)

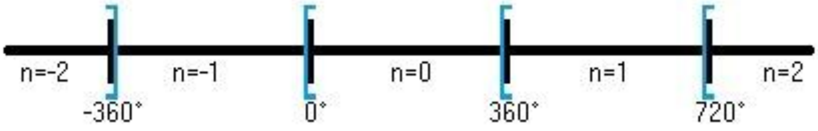
This function is used to calculate the cos and sin of an angle.

Inputs:

- **Validation** : Function validation input. Until this input is activated, the function remains inert. Validation is active implicitly if it has not been connected.
- **Angle** : Represents the angle in degrees. Its value must be between -32768 and 32767 for an angle between -3276.8° and 3276.7° (900 = 90°).

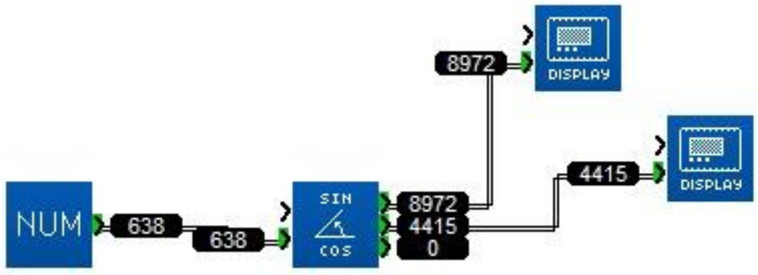
Outputs:

- **Sin** : Result of ("Angle" sin) x 10000.
- **Cos** : Result of ("Angle" cos) x 10000.
- **Revolution** : Revolution number -10<= n <= 9



Performance:

The function calculates the cos and the sin to the nearest 0.0001 by rounding up or down as appropriate.



Sin (63°8) = 0.8972 and Cos (63°8) = 0.4415.

1.4.2.7.5 SQUARE ROOT

(§ 1.4.2.7.4) (§ 1.4.2.7.6)

This function is used to calculate the square root of the number present as an input with accuracy to two decimal points.

Inputs:

- **VALIDATION** : Function validation input. Until this input is activated, the function remains inert. Validation is active implicitly if it has not been connected.
- **CALCULATION** input : The value must be between 0 and 32767.

Outputs:

- **CALCULATION** output : The result is presented in the format "Root" x 100.

Operation:

Example:

For X = 20000 => Root of X = 141.42. The value read as an output of the function is 14142.
If used as an input, the number is negative and the result is 0.

Performance:

The calculation is accurate to 0.01 either way.

1.4.2.7.6 BIT MULTIPLEXER with 2 input channels

(§ 1.4.2.7.5) (§ 1.4.2.7.7)

This function is used to copy the selected input to the outputs Q and /Q.

Inputs:

- **VALIDATION** : Function validation input. Until this input is activated, the function remains inert. Validation is active implicitly if it has not been connected.
- **Channel A.**
- **Channel B.**

- **SELECTION** : Used to choose the input to be copied as an output.

Outputs:

- **Output Q** : Retranscribes the selected input state.
- **Output /Q** : Retranscribes the selected input complementary state.

Operation:

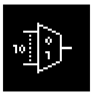
Truth table:

Validation	Channel A	Channel B	Selection	Q Output	/Q Output
0	X	X	X	0	0
1	0	X	0	0	1
1	1	X	0	1	0
1	X	0	1	0	1
1	X	1	1	1	0

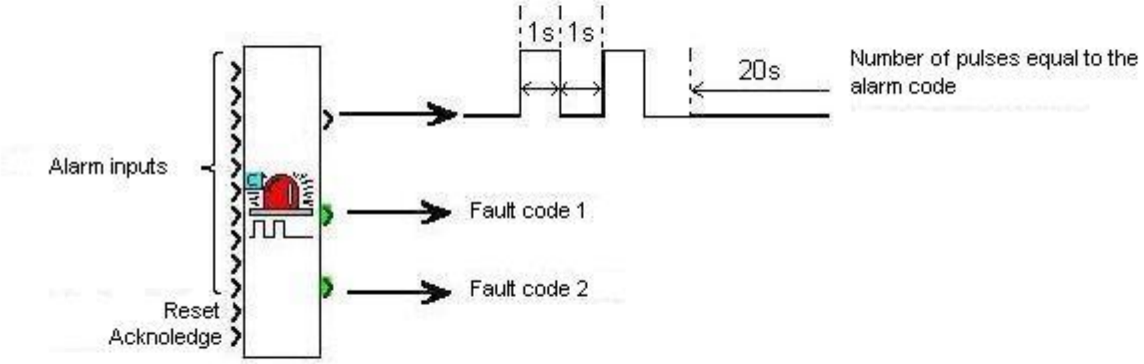
1.4.2.7.7 BIT MULTIPLEXER with 10 input channels

(§ 1.4.2.7.6)

(§ 1.4.2.7.8)



This function is designed to pass on activation of the inputs to an output in a coded manner. For example, it can be used to access a modem via its digital input in order to send SMS messages.



The function has 10 digital inputs for 10 possible faults within the application.
The digital output is used to send the fault code.

Encoding :

The digital output sends a number of pulses equal to the number of the activated input. If input 5 is activated, 5 pulses will be generated at the output. The time at the top limit is one second, the same as at the bottom limit. 20 blank seconds are left between two sets of pulses sent to ensure the modem works correctly.

Storing faults :

The function processes 2 faults and stores up to 7 faults. The two "fault code" outputs represent the codes (or numbers) of the first two inputs activated.

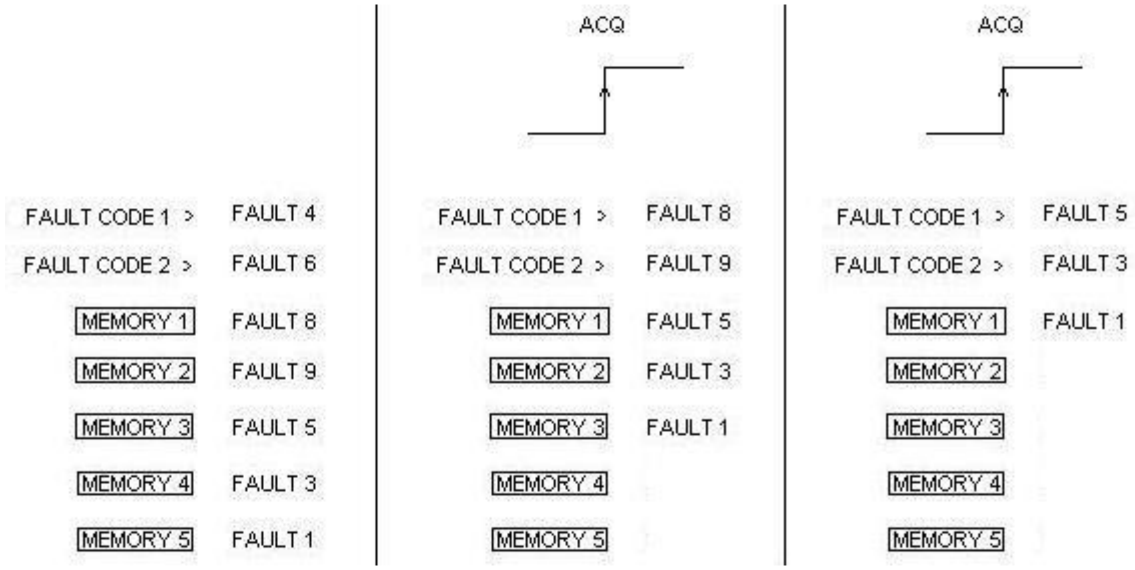
Reset input :

This input is used to reinitialize the function. The outputs are reset, no further pulses are sent and any faults in the memory are cleared.

Acknowledge input :

This input is used to acknowledge the last 2 faults that appeared. On each rising edge detected on this input, 2 faults stored on the "fault code" outputs are shifted in order of appearance.

Example :



FAULT CODE 1 >	FAULT 4	FAULT CODE 1 >	FAULT 8	FAULT CODE 1 >	FAULT 5
FAULT CODE 2 >	FAULT 6	FAULT CODE 2 >	FAULT 9	FAULT CODE 2 >	FAULT 3
MEMORY 1	FAULT 8	MEMORY 1	FAULT 5	MEMORY 1	FAULT 1
MEMORY 2	FAULT 9	MEMORY 2	FAULT 3	MEMORY 2	
MEMORY 3	FAULT 5	MEMORY 3	FAULT 1	MEMORY 3	
MEMORY 4	FAULT 3	MEMORY 4		MEMORY 4	
MEMORY 5	FAULT 1	MEMORY 5		MEMORY 5	

Note : Non-connected inputs are at 0 by default.

1.4.2.7.8 MUX Analog Multiplexer with 2 Input Channels

(§ 1.4.2.7.7)
(§ 1.4.2.7.9)

Description

The **MUX** function carries out two input channel multiplexing on the OUTPUT.

Access

The multiplexing function is accessible from the **CALC** function bar.

Inputs/Outputs

Description of the inputs:

- **SELECTION**: this input is used to choose the input channel to apply to the output.
- **CHANNEL A**: this is the multiplexer input A, whose type is integer(§ 1.1.1).
- **CHANNEL B**: this is the multiplexer input B, whose type is integer(§ 1.1.1).

Description of the output:

- **OUTPUT**: this is the multiplexer output.
  This value depends upon the state of the SELECTION input.
  If the SELECTION input is:
  - inactive: the OUTPUT corresponds to CHANNEL A,
  - active: the OUTPUT corresponds to CHANNEL B.

Note: If the SELECTION input is not connected, then it is considered to be inactive.

Note: If CHANNELS A or B are not connected, then they are set to 0.

1.4.2.7.9 MUX Analog Multiplexer with 4 Input Channels

(§ 1.4.2.7. 8)

(§ 1.4.2.7.10)

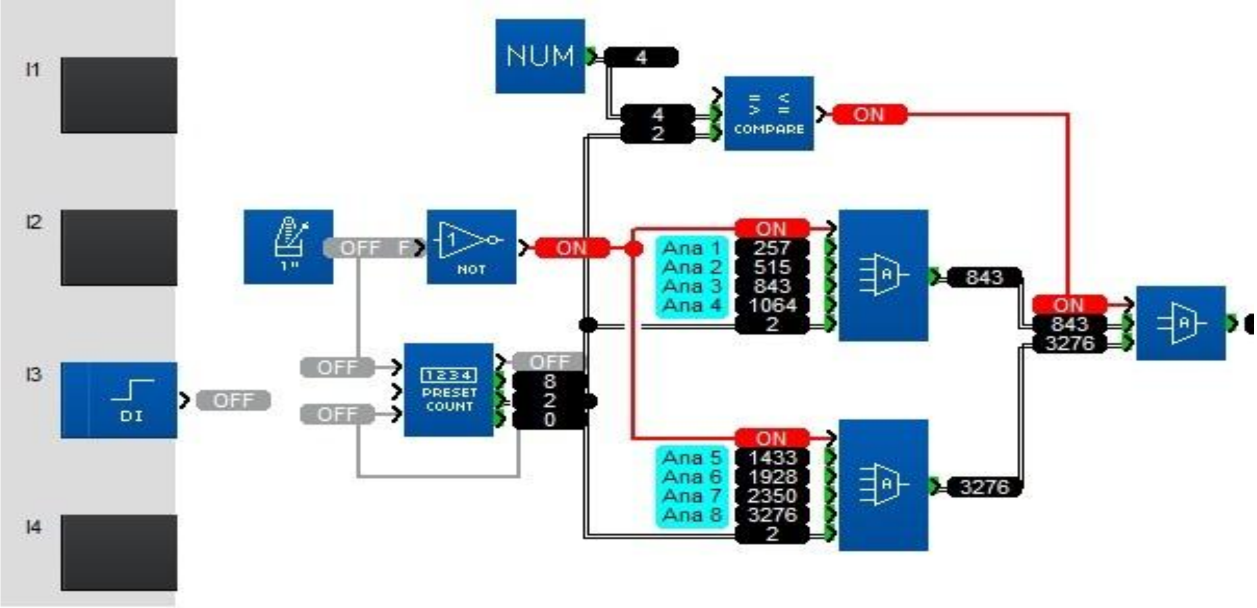
This function multiplexes the WORD inputs. It is used to route the value of one of the inputs selected by the ADDRESS input to the output. The input is routed to the output on each rising edge of the VALIDATION input.
The BASE ADDRESS parameter allows several blocks to be used at the same time to multiply inputs.

- The Parameters tab contains :
  - **BASE ADDRESS** : Contains the address of the INPUT 1 input.
  - **SAVE ON POWER BREAK** : Chooses whether or not the function is reinitialised if the controller power supply is disconnected.

When they are not connected, the digital input is in the OFF state and the WORD inputs contain 0.

Example:

When the BASE ADDRESS parameter contains the value 0 these inputs have addresses 0, 1, 2, 3 respectively, and in this case if the ADDRESS input equals 2 the VALUE of the third input will be copied to the output.
If a second block is being used, 8 inputs can be demultiplexed by putting the value 4 as the BASE ADDRESS in the second block and connecting the VALIDATION and ADDRESS inputs to the same source.



1.4.2.7.10 DEM Analog Demultiplexer with 4 Output Channels

(§ 1.4.2.7. 9)

(§ 1.4.2.7.11)

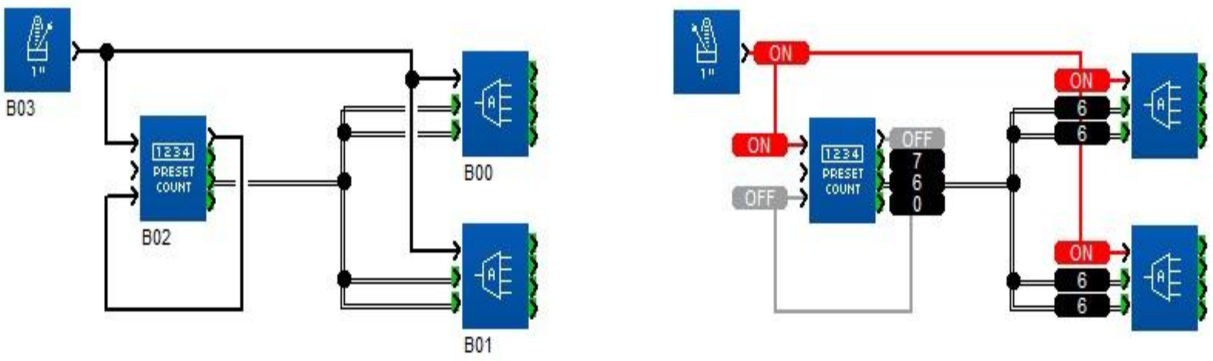
This function demultiplexes integers. It is used to route the input value onto one of the 4 OUTPUTS on each rising edge of the VALIDATION input.
A VALUE copied to an output does not revert to 0 when a VALUE is written to another ADDRESS.
The BASE ADDRESS parameter allows several blocks to be used at the same time to multiply outputs.

- The Parameters tab contains :
  - **BASE ADDRESS** : Contains the address of the ADDRESS 1 output.
  - **SAVE ON POWER BREAK** : Chooses whether or not the function is reinitialised if the controller power supply is disconnected.

When they are not connected, the ADDRESS and VALUE inputs are set to zero.

Example:

When the BASE ADDRESS parameter contains the value 0 these outputs have addresses 0, 1, 2, 3 respectively, and in this case if the ADDRESS input equals 2 the VALUE will be copied to the third output. If a second block is being used, 8 outputs can be demultiplexed by putting the value 4 as the BASE ADDRESS in the second block and connecting the VALIDATION and ADDRESS inputs to the same source.

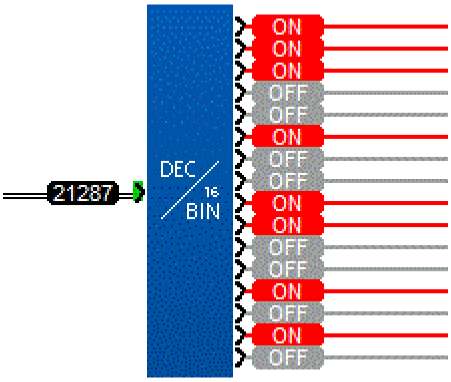


1.4.2.7.11 DEC/BIN Words-to-Bits Conversion

□□□□ (§ 1.4.2.7.10) □□□□ (§ 1.4.2.7.12)

Description

The **DEC/BIN** function breaks down an integer (16-bit) type input into 16 bit-type outputs.
Illustration:



Access

The DEC 16 BIN function is accessible from the **CALC** function bar.

Inputs/Outputs

This function supports 1 integer type 16-bit input:
This function supports 16 discrete outputs: **BIT01** (least significant byte) ... **BIT16** (most significant byte).

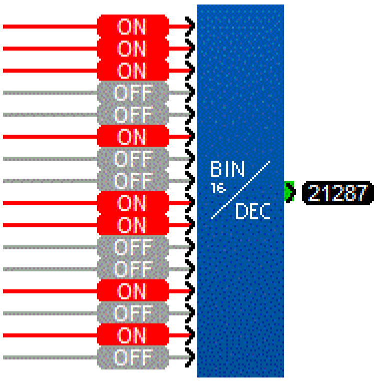
1.4.2.7.12 BIN/DEC Bits to Words Conversion

□□□□ (§ 1.4.2.7.11) □□□□ (§ 1.4.2.7.13)

Description

The **BIN/DEC** function produces a 16-bit integer-type output from 16 inputs of the following type: Bit

Illustration:



Access

The BIN 16 DEC function is accessible from the **CALC** function bar.

Inputs/Outputs

This function supports 16 discrete inputs: **BIT01** (least significant byte) ... **BIT16** (most significant byte).
This function supports one 16-bit integer-type output.

1.4.2.7.13 SPLIT BY 4

(§ 1.4.2.7.12)

(§ 1.4.2.7.14)

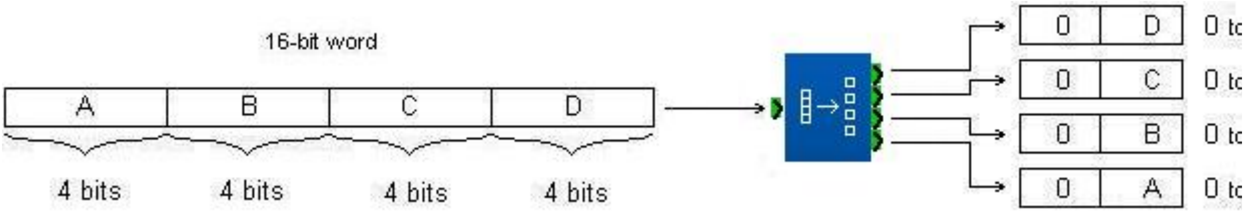
This function is used to split a 16-bit word into four 16-bit words with values between 0 and 15.

Input:

- **INPUT**: 16-bit words to be split.

Outputs:

- **OUTPUT 1 LOW**: 16-bit words varying from 0 to 15.
- **OUTPUT 2**: 16-bit words varying from 0 to 15.
- **OUTPUT 3**: 16-bit words varying from 0 to 15.
- **OUTPUT 4 HIGH**: 16-bit words varying from 0 to 15.



1.4.2.7.14 SPLIT BY 2

(§ 1.4.2.7.13)

(§ 1.4.2.7.15)

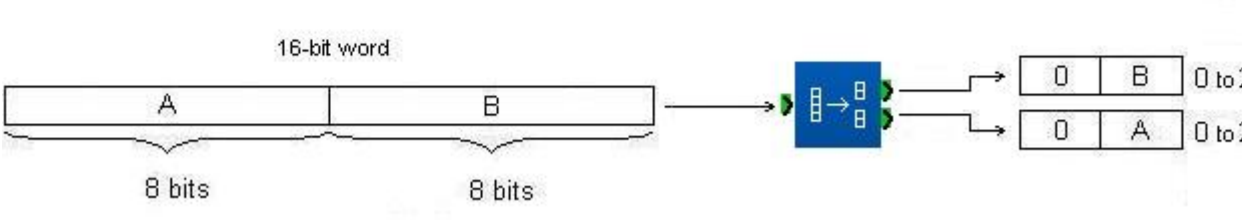
This function is used to split a 16-bit word into two 16-bit words with values between 0 and 255.

Input:

- **INPUT**: 16-bit words to be split.

Outputs:

- **OUTPUT 1 LOW**: 16-bit words varying from 0 to 255.
- **OUTPUT 2 HIGH**: 16-bit words varying from 0 to 255.



1.4.2.7.15 SHIFT REGISTER bit

(§ 1.4.2.7.14)

(§ 1.4.2.7.16)

This function operates the shifting of bits in a 16-bit word on each rising edge of the clock.

Inputs:

- **CLOCK** : A rising edge detected on this input causes shifting of the 16-bit word and loading of the bit currently on the Data input in place of the least significant bit of the 16-bit word.
- **DATA** : Value of the bit to be loaded on a rising edge of the clock input.
- **RESET** : Used to reset the 16-bit word and all the outputs to zero.

Outputs:

- **B0**: Value of the bit in position 0 of the 16-bit word.
- **B1**: Value of the bit in position 1 of the 16-bit word.
- **B2**: Value of the bit in position 2 of the 16-bit word.

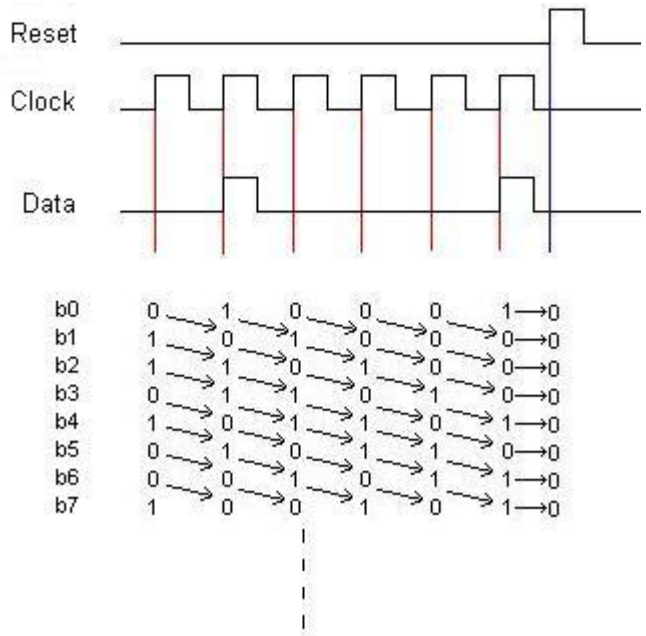
...

- **B13**: Value of the bit in position 13 of the 16-bit word.
- **B14**: Value of the bit in position 14 of the 16-bit word.
- **B15**: Value of the bit in position 15 of the 16-bit word.
- **NEXT BLOCK BIT**: Bit ready to be copied to another shift register block on the next rising edge of the clock input.

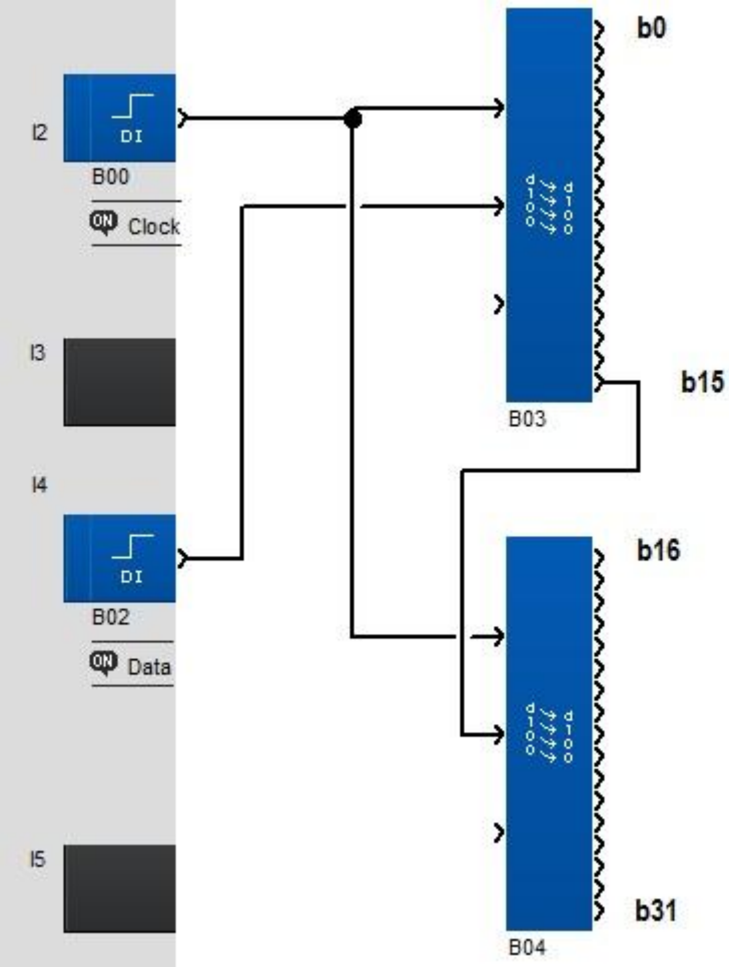
Parameter:

- **SAVE ON POWER BREAK**: Chooses whether or not the function is reinitialised if the controller power supply is disconnected.

Principle:



Example with two shift registers:



1.4.2.7.16 SHIFT REGISTER word

(§ 1.4.2.7.15) (§ 1.4.2.7.17)

This function shifts the 16-bit words on each rising edge of the clock.

Inputs:

- **CLOCK** : A rising edge detected on this input shifts the 16-bit words OUT0 to OUT1, OUT1 to OUT2 ..., OUT7 to NEXT OUT. The last word is lost.
- **DATA** : Value of the word to be loaded on a rising edge of the CLOCK input.
- **RESET** : Used to set the all the outputs to zero.

Outputs:

- **OUT 0** : Output 0.
- **OUT 1** : Output 1.
- **OUT 2** : Output 2.
- **OUT 3** : Output 3.
- **OUT 4** : Output 4.
- **OUT 5** : Output 5.
- **OUT 6** : Output 6.
- **OUT 7** : Output 7.
- **NEXT OUT** : Bit ready to be copied to a shift register on the next edge

Parameter:

- **SAVE ON POWER BREAK** : Chooses whether or not the function is reinitialised if the controller power supply is disconnected.

1.4.2.7.17 TRANSFER FUNCTION y=f(x)

(§ 1.4.2.7.16) (§ 1.4.2.7.18)

This function is a table of correspondence between the X input and the Y output.

Input:

- **X** : When the input equals a value present in column X of the table, the corresponding value in column Y is then applied as an output. If the value present as an input is between two values in the X column then an approximate value of Y is calculated as follows:
  - OUTPUT = (INPUT-X1) * (Y2-Y1)/(X2-X1) + Y1.

Output:

- **Y** : Value corresponding to the X input in the table.

Parameter:

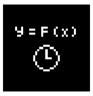
- The table of correspondence is created from a csv file which is opened by clicking on "File, Open, *.csv".
- The file must comply with the following format :
  - Using a spreadsheet, create two columns, one for the Xs and one for the Ys.

  - Each box must contain a single value.
  - -32768 ≤ X ≤ 32767.
  - -32768 ≤ Y ≤ 32767.
  - The file must contain a maximum of 256 rows.
  - The values of the Xs must be arranged in ascending order.
  - Save the file in .csv format with the ';' or ',' separator. Do not use ',' or '.' (32,000 or 32.000). Only use whole numbers.

Example of file

1.4.2.7.18 TIMER TRANSFER FUNCTION

(§ 1.4.2.7.17) (§ 1.4.2.8)



This function is a correspondence table for the Minutes operating time and the Y output.

Inputs:

- **VALIDATION** : Enables the function, at 1 if not connected. Once enabled, the value of the Y output corresponding to t0 is enabled. The output value is calculated once a minute, in accordance with the table or using the formula: Y = (MINUTES-X1) * (Y2-Y1)/(X2-X1) + Y1, if the value is not in the table (where MINUTES1 < MINUTES < MINUTES2, Y1 = f(MINUTES1) and Y2 = f(MINUTES2)).
- **RESET** : If enabled, return to t0.

Outputs::

- **Y** : Corresponding table value (exact value or approximate value).
- **CHRONOMETER** : Current value in minutes elapsed since the function was enabled.
- **END OF CYCLE** : Last minutes value reached.

Parameter:

- The table of correspondence is created from a csv file which is opened by clicking on "File, Open, *.csv".
- The file must comply with the following format:
  - Using a spreadsheet, create two columns, one for the Xs and one for the Ys.
  - Each box must contain a single value.
  - 0 ≤ Minutes ≤ 32767.
  - -32768 ≤ Y ≤ 32767.
  - The file must contain a maximum of 256 rows.
  - The values of the Minutes must be arranged in ascending order.
  - Save the file in .csv format with the **;** separator.

Example of file.

1.4.2.8 LOGIC functions

(§ 1.4.2.7.18) (§ 1.4.2.8.1)

In FBD language, it is possible to use logic functions and Boolean functions in the block diagrams.

1.4.2.8.1 Logic Functions

◁□□□□ (§ 1.4.2.8) □□□□▷ (§ 1.4.2.8.2)

At a Glance

In FBD language, it is possible to use logic functions in the block diagrams. The available functions are:

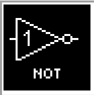
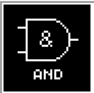
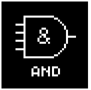
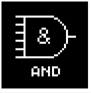
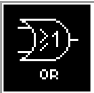
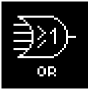
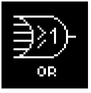
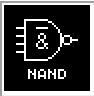
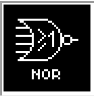
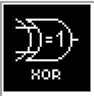
- The **NOT** function (NOT),
- The **AND** function (AND),
- The **OR** function (OR),
- The **NAND** function (NAND),
- The **NOR** function (NOR),
- The **EXCLUSIVE OR** function (XOR).

Access

These inputs can be accessed from the **LOGIC** window.

Logical functions

The following table shows the various logic functions:

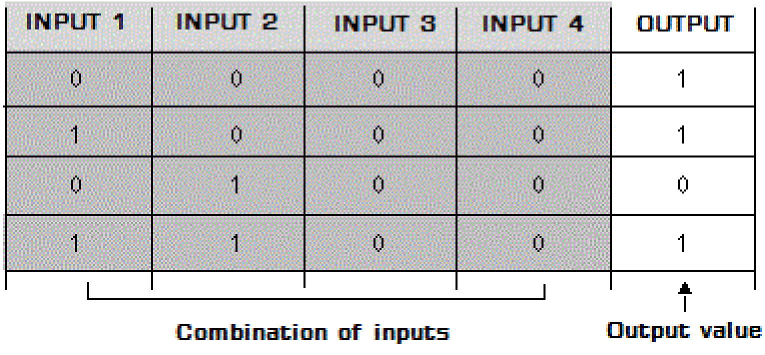
Function	**Symbol**	**Description**	**Number of inputs**	**Input type**
NOT		If the input is inactive or not connected, the output is active. If the input is active, the output is inactive.	1	Digital
AND	  	If all the inputs are active or not connected, the output is active. If at least one input is inactive, the output is inactive.	2, 4, 6	Digital
OR	  	If at least one input is active, the output is active. If all the inputs are inactive or not connected, the output is inactive.	2, 4, 6	Digital
NAND		If at least one input is inactive, the output is active. If all the inputs are active or not connected, the output is inactive.	4	Digital
NOR		If all the inputs are inactive or not connected, the output is active. If at least one input is active, the output is inactive.	4	Digital
EXCLUSIVE OR		If an input is inactive and the other input is active or not connected, the output is active. If both inputs are active or inactive or not connected, the output is inactive.	2	Digital

1.4.2.8.2 BOOLEAN EQUATION with 4 inputs/1 output

□□□□ (§ 1.4.2.8.1) □□□□ (§ 1.4.2.8.3)

At a Glance

The **BOOLEAN** function gives the value of the output according to the combination of inputs.
The function has four inputs, and therefore 16 combinations. These combinations can be found in a truth table; for each of these, the output value can be adjusted. The number of configurable combinations depends on the number of inputs connected to the function.
Non-connected inputs are set to 0.
The following diagram shows an example of part of the Boolean function truth table:



INPUT 1	INPUT 2	INPUT 3	INPUT 4	OUTPUT
0	0	0	0	1
1	0	0	0	1
0	1	0	0	0
1	1	0	0	1

Combination of inputs
Output value

Access

The function is accessible from the **LOGIC** function bar.

Parameters

Having connected at least one input, you can configure the value of the output in the truth table, in the **Parameters** window.
The output values can be **0** for the Inactive state, and **1** for the Active state.
By selecting the **Output ON if result is TRUE** option, the output takes the value configured in the truth table.
By selecting the **Output OFF if result is TRUE** option, the output takes the inverse value of the value configured in the truth table.

1.4.2.8.3 BOOLEAN EQUATION with 6 inputs/2 outputs

□□□□ (§ 1.4.2.8.2) □□□□ (§ 1.4.2.9)

This function executes logic operations for all possible Boolean equations with six inputs and two outputs.
To select a Boolean equation, simply connect the selected INPUTS.
Once the connection has been made, open the Parameters window under the Parameters tab to display a truth table containing all possible combinations of the values present on the function input blocks (greyed out) and the output values which will be issued by the two outputs corresponding to the input combination (white field which can be edited by the user).
The values displayed correspond to 0 for OFF and 1 for ON. The value can be

inverted by clicking on it with the mouse.
The result of each output can be inverted. If the user selects the "Output ON if result is TRUE" option in the Parameters window the function block OUTPUT will be exactly as indicated in the truth table. If the user selects the "Output OFF if result is TRUE" option the OUTPUT will be the inverse of what is indicated in the truth table.
As indicated in the truth table, the non-connected input values are all set to 0 (OFF).

1.4.2.9 SFC Functions

□□□□ (§ 1.4.2.8.3)

□□□□ (§ 1.4.2.9.1)

At a Glance

Subject of this Section

This section provides information on the different SFC (Sequential Function Chart) functions using FBD language.

What's in this Section?

This section contains the following topics:

Overview of functions, using steps, transitions, divergences, convergences, loops, etc.
SFC functions, errors, etc.

1.4.2.9.1 Presentation of SFC Functions

□□□□
(§
1.4.2.9)

□□□□ (§ 1.4.2.9.2)

General

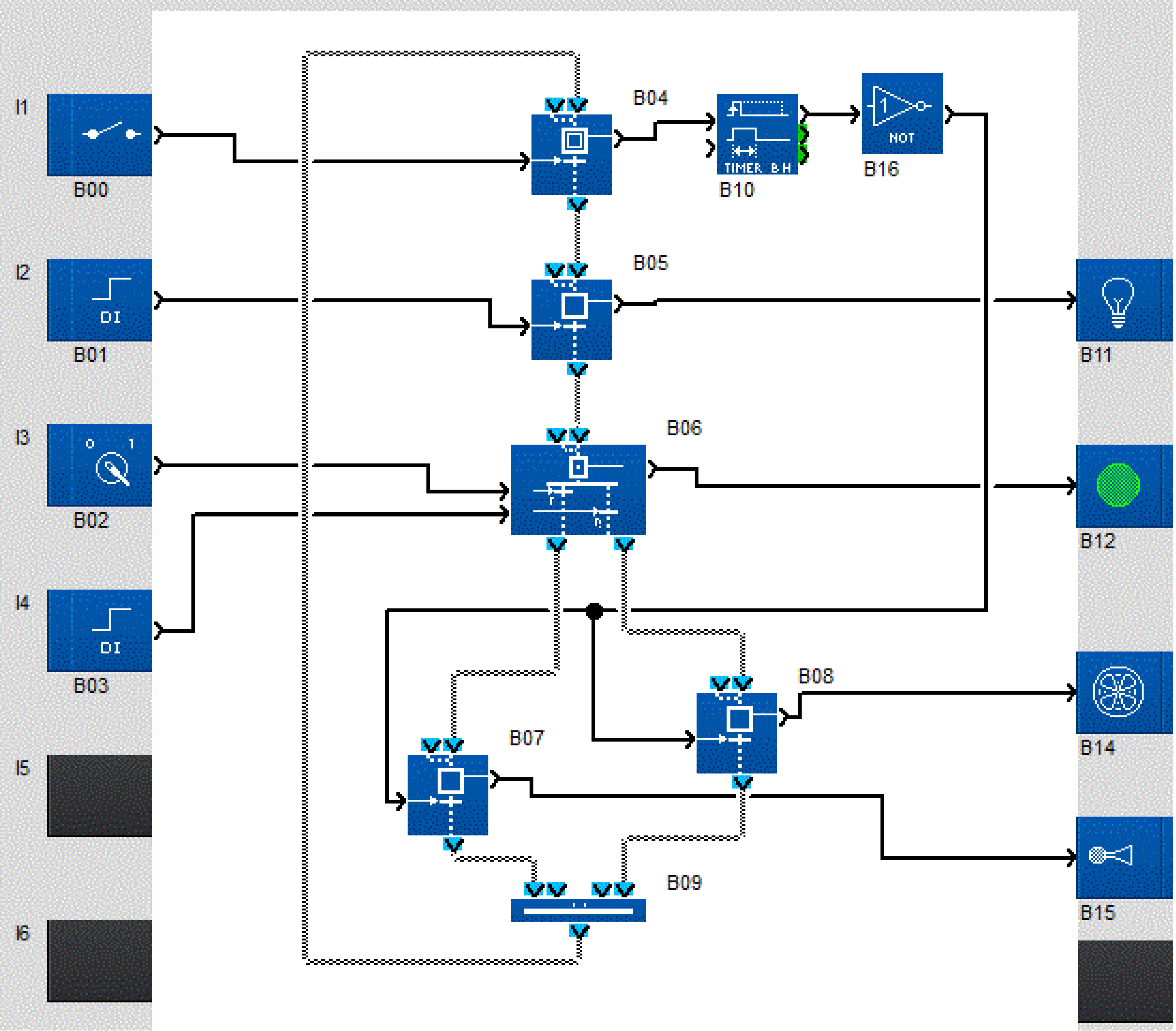
SFC (Sequential Function Chart) functions are similar to Grafcet language, according to standard IEC 1131-3.
Grafcet is used to represent the functioning of a sequential automation operation in a structured and graphic form.
The principle is simple: a graph containing SFC functions is read from top to bottom, and is principally composed of:

- Steps,
- Transitions.

Steps are all placed in succession, and are controlled by transitions. When a step is active, you must wait for the following transition to become active before carrying on to the following step. Associated with each step is an action (OUTPUT), which sends orders to other functions (Discrete output / logical / standard functions).

FBD Representation

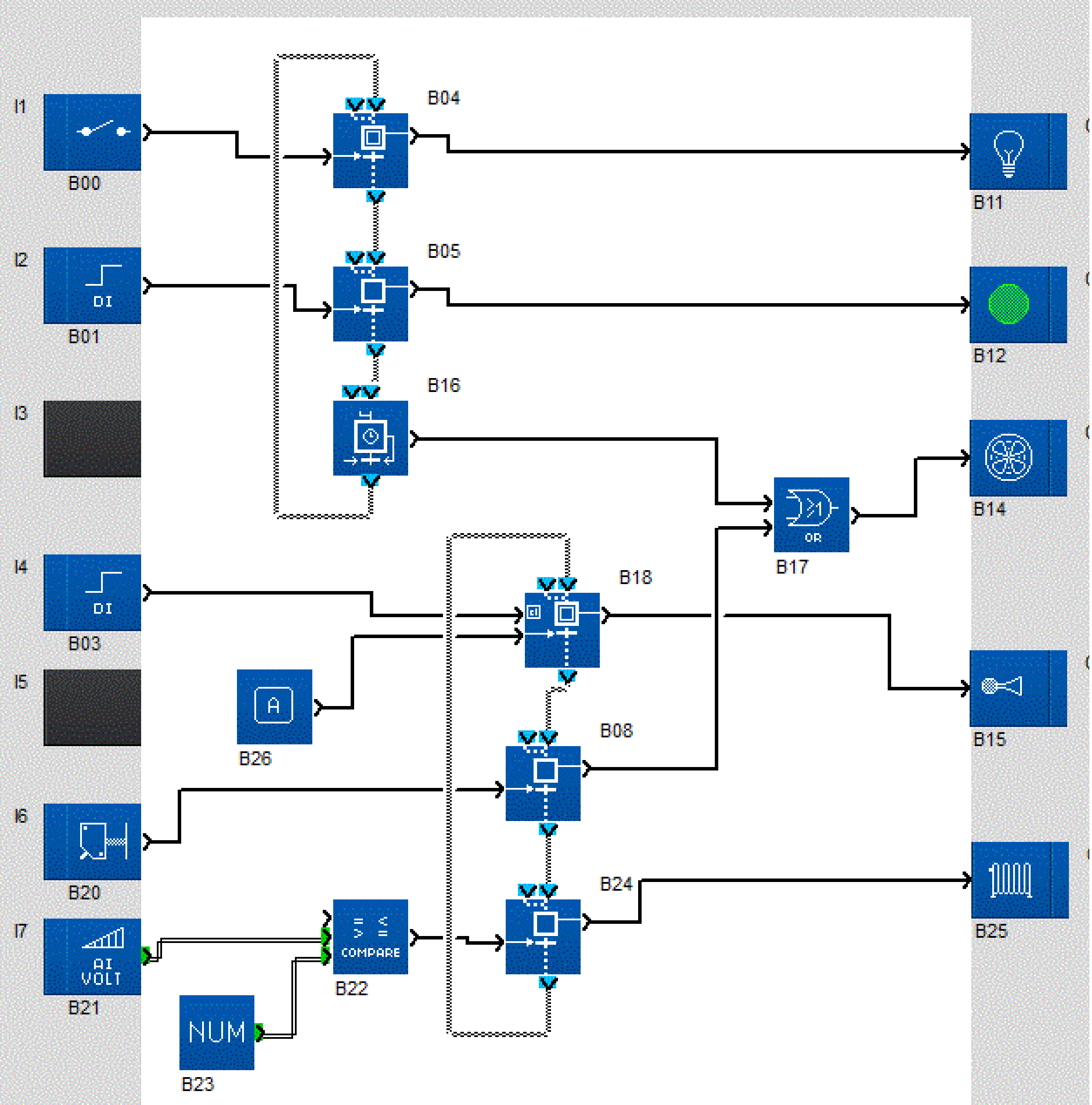
The following diagram shows a Grafcet representation with SFC functions in FBD language:



Independent Charts

An **independent chart** is a set of SFC functions interconnected by input and output function links. Each of the charts performs an automation function. In a wiring diagram it is possible to create various independent charts.

The following diagram shows an example of **two** independent charts in a wiring diagram:



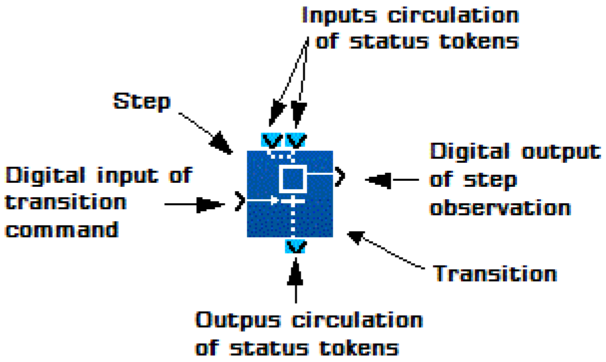
1.4.2.9.2 Using the SFC Steps and Transitions

◁□□□□ (§ 1.4.2.9.1) □□□□▷ (§ 1.4.2.9.3)

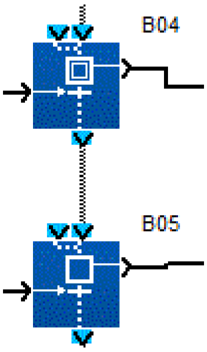
Description

Steps and transitions can be used to represent and control consecutive operating phases.
Each operating phase is represented by a symbol called a **step**. When this operating phase takes place, the step is said to be active. In this case the step is said by definition to contain a **status token**.
The step's active status is seen by the setting to ON of a **observation Discrete** of the step.
For the operating phase to terminate, the phase ending must be authorized or commanded. For this, a **transition command Discrete** input is set to ON.
The **transition** is then said to be passing and the status token crosses it. It therefore disappears from the step and is led to the **status token circulation output**.
Consequently, the observation Discrete is set to OFF.
When the operating phase is terminated, the step becomes inactive and the

observation Discrete switches to OFF.
Illustration:


Inputs circulation of status tokens
Step
Digital output of step observation
Digital input of transition command
Transition
Outpus circulation of status tokens

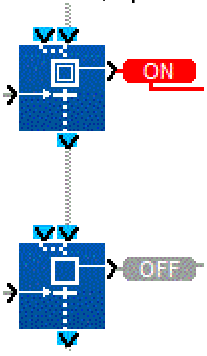
The switching off of an operating phase (B01) is immediately followed by the start-up of the following operating phase (B02). The following operating phase is also symbolized by a new step, and its end is also controlled by a transition.
Illustration:



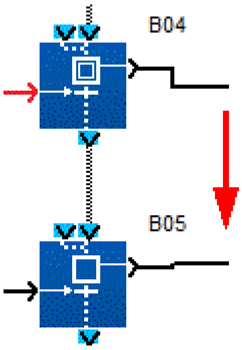
To show the fact that the switching off of operating phase B01 is followed (in sequence) by operating phase B02, the B01 status token circulation output is linked to one of the circulation inputs of the B02 status tokens.
In this case, when the switch to ON of the B01 transition command makes this passing, the token present in the B01 step "falls" through the passing transition to the B02 step, where it stays as long as the Discrete command input of the B02 transition remains set to OFF (blocked transition).
The Discrete observation output for the B02 step activity switches to ON. As soon as the the B02 transition becomes passing, the token now present in step B02 escapes by the status token circulation output, the operating phase associated with the step of block B02 ends and the Discrete observation output of step 2 switches to OFF.

Operation

The mechanism is broken down into four steps.
Phase 1, operation in progress: step 1 active (stable status)

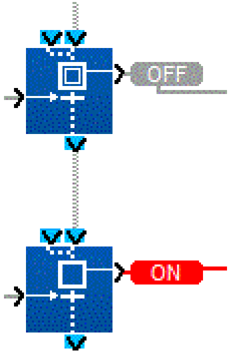


End of operating phase 1: transition 1 active (momentary status)

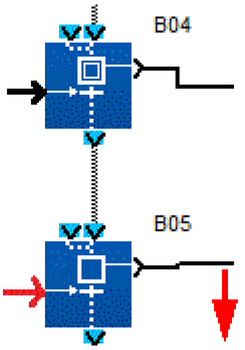


Status
token circulation

Phase 2, operation in progress: step 2 active (stable status)



End of operating phase 2: transition 2 active (momentary status)



Status
token circulation

If step 1 is inactive, the associated operating phase (B01) is not in progress, so the status token is not present in step 1 by definition. Hence, switching the Discrete input command of transition 1 to ON, causing the passing transition to have no effect as there is no token in step1, it cannot "fall".
The Discrete inputs controlling each transition and Discrete outputs that observe each step can be connected to the other FBD blocks with Discrete inputs and outputs.
For example, a Boolean combination of inputs can command transition 1, a button can command transition 2, the step 1 observation Boolean can switch a relay and the step 2 observation Boolean can activate the message display.

1.4.2.9.3 Use of AND Divergences

(§ 1.4.2.9.2) (§ 1.4.2.9.4)

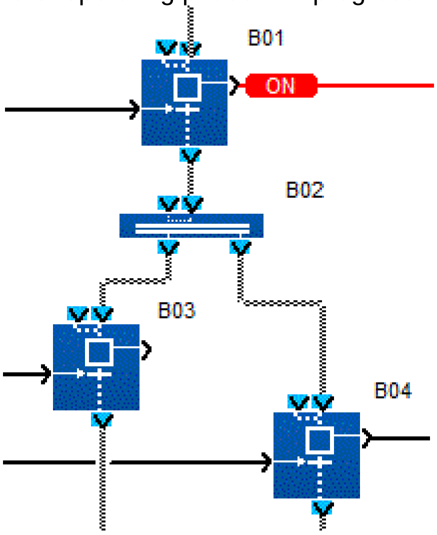
Description

The **AND divergence** is used to represent and command simultaneous operating phases. This representation of a string of operating phases describes the opposite mechanism to the AND convergence(§ 1.4.2.9.5).
An operating phase (B01) can be followed by two operating phases that take place at the same time, and which assign, for example, two command devices to the same hardware.

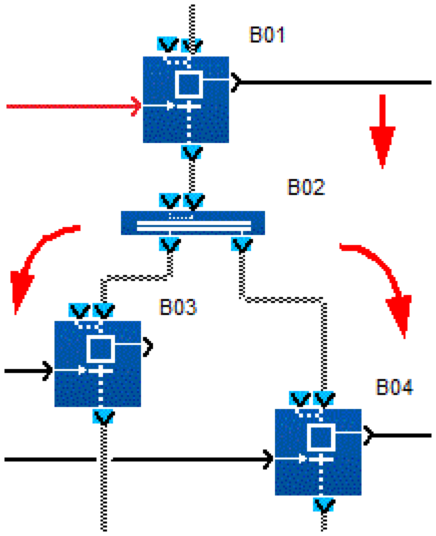
To represent this operating mode, a function called **AND DIVERGENCE TO 2 SFC BRANCHES** (or DIV AND 2) is used, which is linked to two step functions that each symbolize one of the simultaneous operating phases.
When the transition command input of block B01 is set to ON, the token, if present in step B01, migrates from this step, through transition B01, then doubled into two tokens which, each one falling into steps B03 and B04, show the activation of the two parallel operating phases.

Mechanism

End of operating phase 1 in progress: step B01 active (stable status)



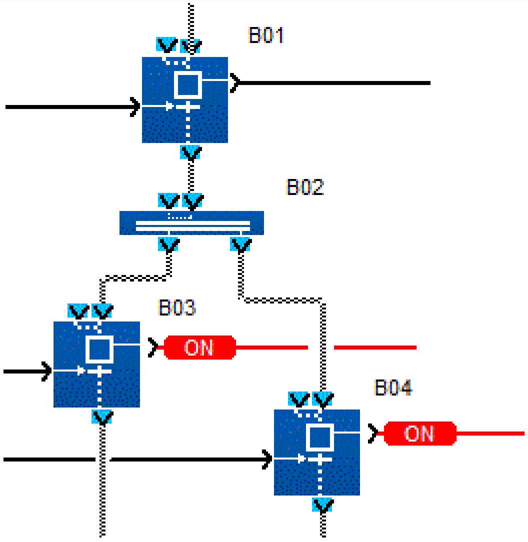
End of operating phase 1: transition 1 active (momentary status)



Status token circulation

Status token doubling

Operation phases 2 and 3 simultaneously in progress: steps B03 and B04 active (stable statuses)



1.4.2.9.4 Use of OR Divergences

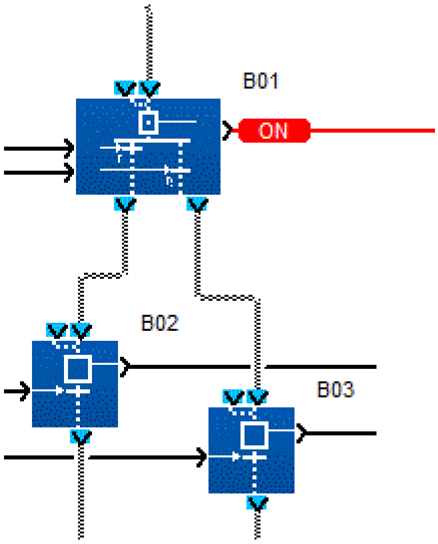
(§ 1.4.2.9.3) (§ 1.4.2.9.5)

Description

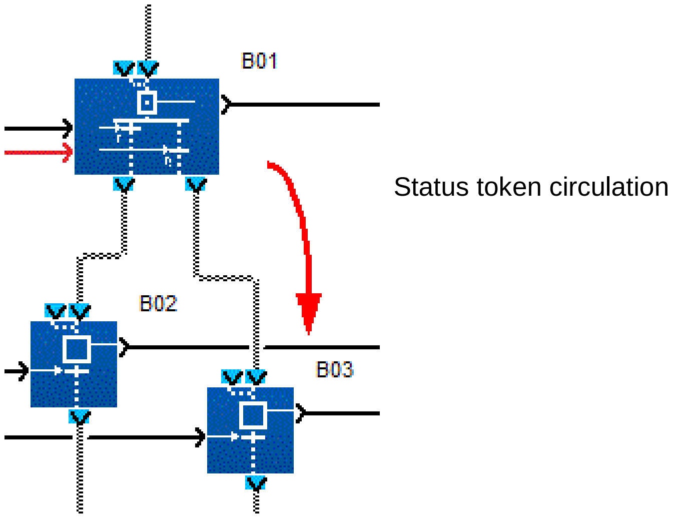
The **OR divergence** is used to sequence after an operating phase one or two operating phases from a choice of two possible phases.
This representation of a string of operating phases describes the opposite mechanism to the OR convergence(§ 1.4.2.9.6) (CONV-OR 2).
A B01 operating phase can be followed by two operating phases which form a non-exclusive alternative: operating phase B02, B03 or both are activated at the end of operating phase B01.
To represent this operating mode, a function called **OR DIVERGENCE WITH 2 SFC BRANCHES** (or DIV OR 2) is used, which is linked to two step functions that each symbolize one of the operating phases for the choice available (B02 and/or B03).
If the status token is present in the step (operating phase B01), the choice is made by forcing to ON one and/or the other of the command inputs of each B01 transition, which are respectively linked downstream to steps B02 and B03.
This therefore causes the end of operating phase B01, the migration of the token from step B01, through the passing transition(s) (the command input of which is set to ON) to the step connected to it.

Examples

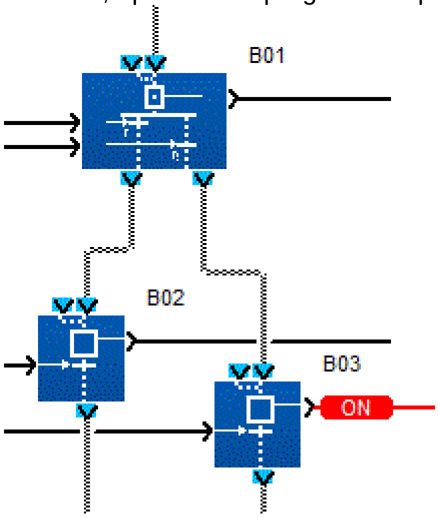
Example 1: one of the two transitions available is active.
Phase 1, operation in progress: step B01 active (stable status):



End of operating phase 1: B01 transition 2 active (momentary status):

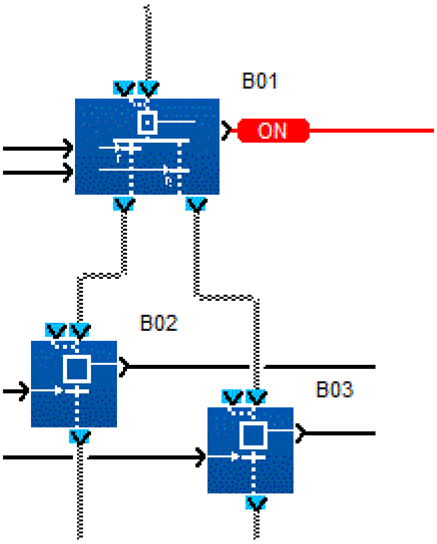


Phase 3, operation in progress: step B03 active (stable status):

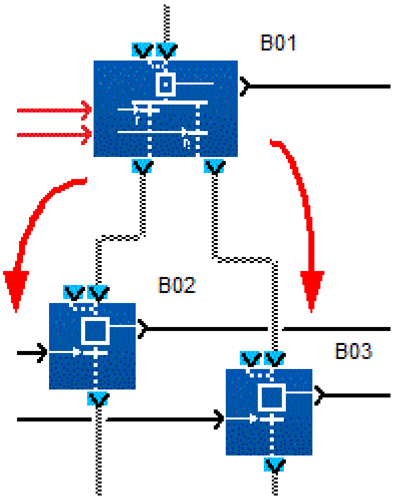


Example 2: both transitions are passing at once.

Phase 1, operation in progress: step B01 active (stable status):

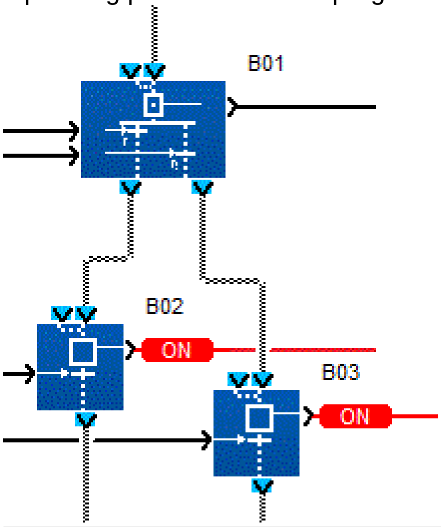


End of operating phase 1: B01 transition 1 and 2 active (momentary status):



Status token doubling

Operating phase 2 and 3 in progress: steps B02 and B03 active (stable statuses):



Note: If you want the choice between the two following operating phases to be exclusive, one of the two transitions must be commanded by an AND combining the command of the first transition with the reverse of the command of the second transition.

1.4.2.9.5 Use of AND convergences

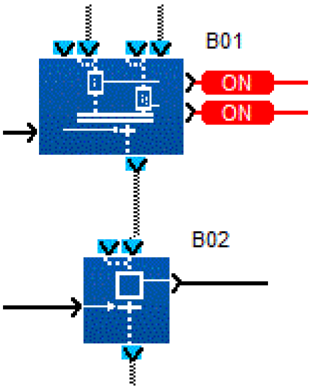
(§ 1.4.2.9.4) (§ 1.4.2.9.6)

Description

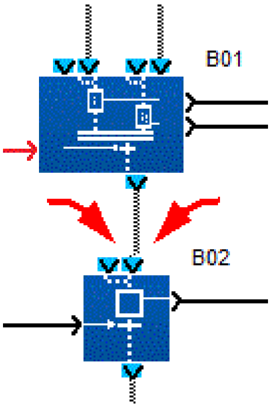
The **AND convergence** is used to sequence a single operating phase after simultaneous operating phases. This representation of a string of operating phases describes the opposite mechanism to the AND divergence(§ 1.4.2.9.3).
Two simultaneous operating phases (B01 steps 1 and 2) can be followed by a single operating phase, which can only be triggered after the **simultaneous end of both previous phases**.
To represent this operating mode, an SFC function is used called **AND CONVERGENCE WITH 2 SFC BRANCHES** (or CONV AND 2), which is linked to the two upstream step functions, each of which symbolizes one of the simultaneous operating phases, and to a downstream step which symbolizes the single phase which links onto the two previous operating phases.
Each of the tokens migrates from its respective step, through its associated transition, fuses into a single token, which, falling into step B02, shows the activation of the next single operating phases.

Mechanism

Operating phase 1 and 2 in progress: B01 step 1 and 2 simultaneously active (stable status):



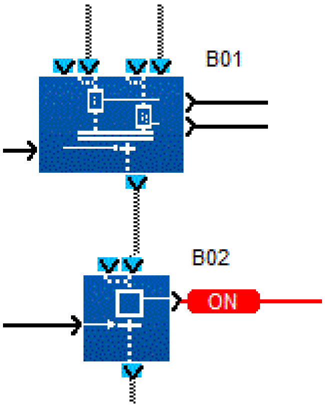
End of operating phase 1 and 2: transition B01 active (momentary status):



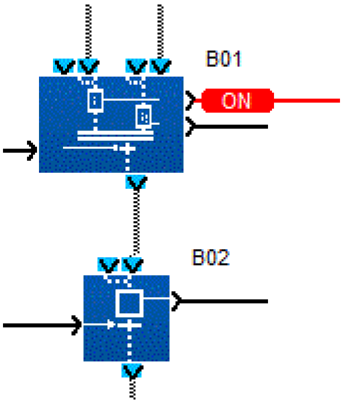
Fusing of 2 status tokens.

Circulation of resulting token.

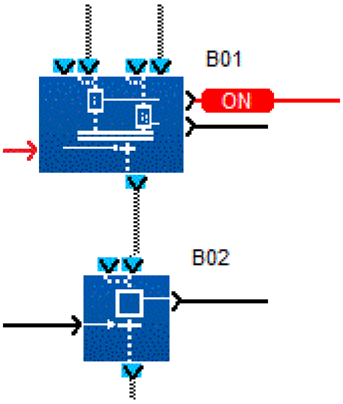
Phase 3, operation in progress: step B02 active (stable status):



If a single token is present in one of the upstream steps and the other is empty (inactive), then even if the transition is set to ON, nothing happens. The step containing the token stays active (Discrete observation output of the step set to ON) and the downstream step (B03) stays inactive.
Phase 1, operation in progress: only step 1 is active (stable status) but step 2 is inactive:



Phase 1, operation in progress: transition B01 active (stable status):



1.4.2.9.6 Use of OR convergences

(§ 1.4.2.9.5)

(§ 1.4.2.9.7)

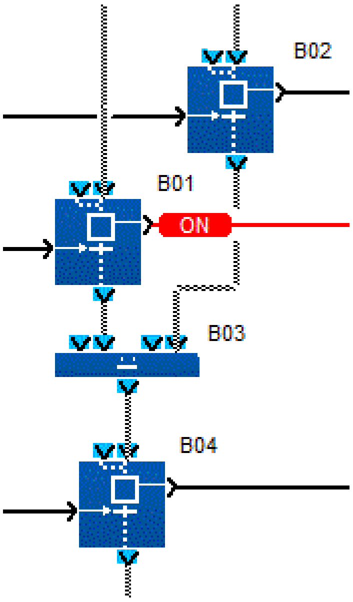
Description

The **OR convergence** is used to sequence a same operating phase after one or the other of two previous operating phases (simultaneous or not). This representation of a string of operating phases describes the opposite mechanism to the OR divergence(§ 1.4.2.9.4) (DIV OR 2).
Two operating phases, simultaneous or not, (steps B01 and/or B02) are followed by a

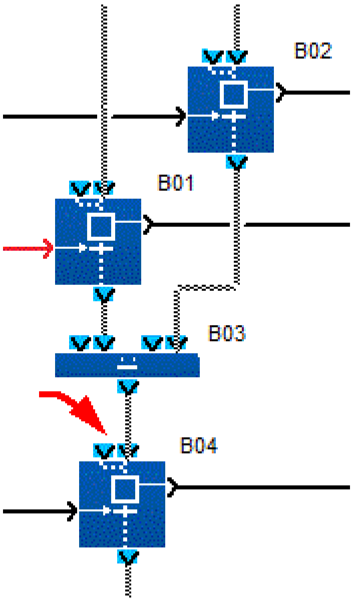
single operating phase which can only be triggered after the end of one of the two previous phases (once transition B01 or B02 is set to ON).
To represent this operating mode, an SFC function is used called **OR CONVERGENCE WITH 2 SFC BRANCHES** (or CONV OR 2), which is linked to the two upstream transitions, each of which control the end of an operating phase (step B01, step B02), and to a downstream step (B03) which symbolizes the single phase which is linked after one or the other of the two previous operating phases.
The first command input that makes a transition passing while the activation token is present in the associated step, lets the token migrate to the downstream step (B03) which symbolizes the commitment of operating phase 3.

Example

Example 1: transition 1 is made passing while operating phase 1 is in progress.
Phase 1, operation in progress: B01 step 1 active (stable status):

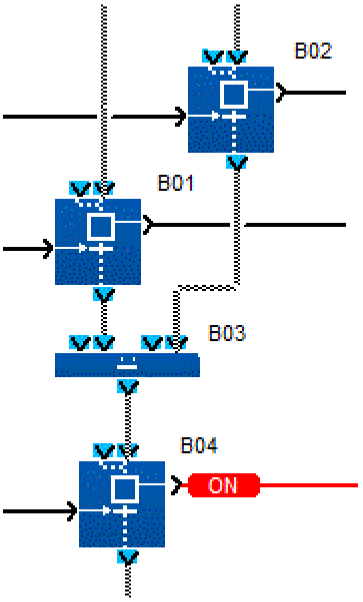


End of operating phase 1: transition B01 active (momentary status):

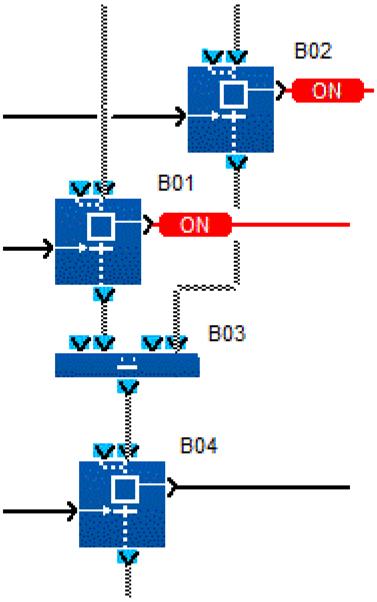


Status token circulation

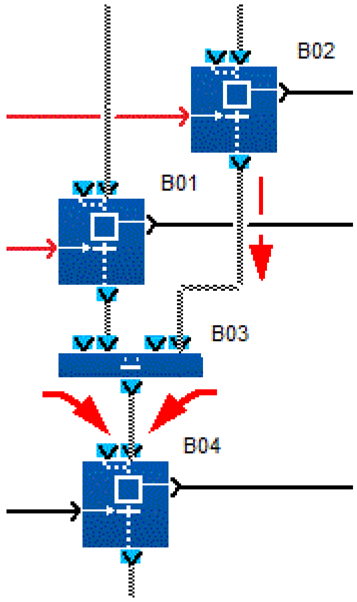
Phase 3, operation in progress: B04 step 1 active (stable status):



Example 2: transition 1 and transition 2 are made simultaneously passing while operating phases 1 and 2 are simultaneously in progress.
Operating phases 1 and 2 simultaneously in progress: step B01 and B02 simultaneously active (momentary status):

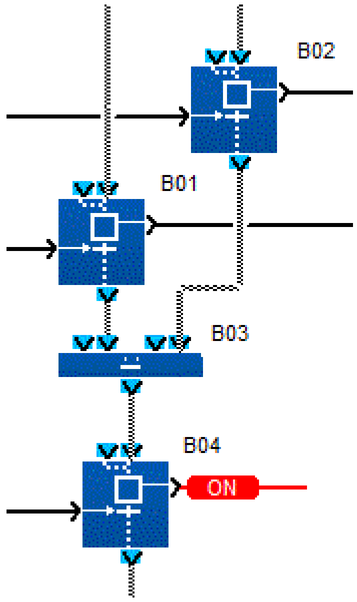


Simultaneous end of operating phases 1 and 2: transition B01 and B02 simultaneously active (momentary status):



Status token circulation and fusion

Phase 3, operation in progress: step B04 active (stable status):



1.4.2.9.7 Using SFC loops

(§ 1.4.2.9.6)

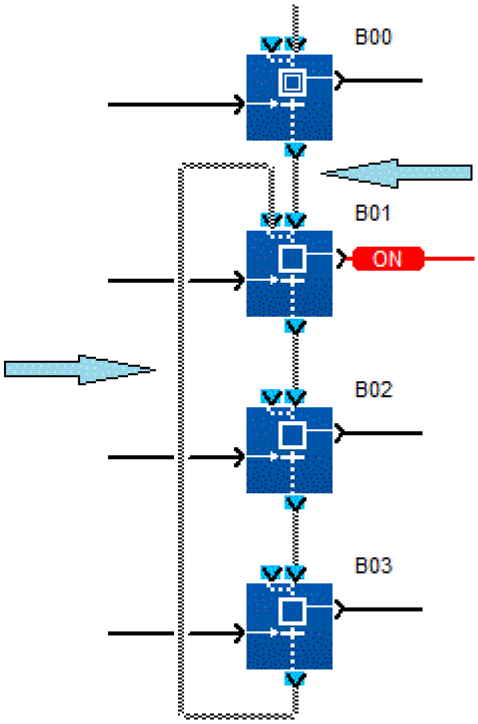
(§ 1.4.2.9.8)

Description

Loops are used to build a sequence of operating phases without end.
Most PLCs are designed to operate by continually linking a sequence of operating phases after an initialization phase. To create this link, the programmer must loop to itself "status token circulation"-type links.

Example

End of operating phase 1 in progress: step B01 active (stable status)



This joining of 2 performed inside the inside the function behaves as an OR convergence (CONV OR 2)

Relooping of a status token circulation-type link

1.4.2.9.8 Initialization of an SFC at the Start of the Program

(§ 1.4.2.9.7) (§ 1.4.2.9.9)

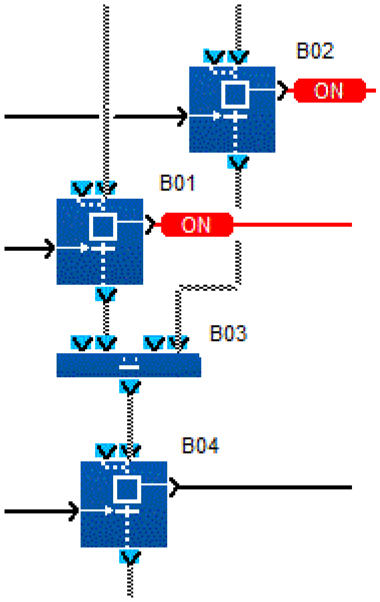
Description

On launching (initializing) the program containing an SFC, you must know which operating phase needs to be activated first, and therefore which step contains a status token at the time of initialization.
To show this step in the chart, it is essential to use at least one SFC function called **INITIAL SFC STEP** (INIT STEP) or **RESETTABLE INITIAL SFC STEP** (RESET-INIT) per independent SFC.
An independent SFC is a set of SFC functions connected together by links between the token inputs/outputs (circulation of status tokens).
On launching the user program (once the INITIALIZE AND SWITCH ON order is executed):

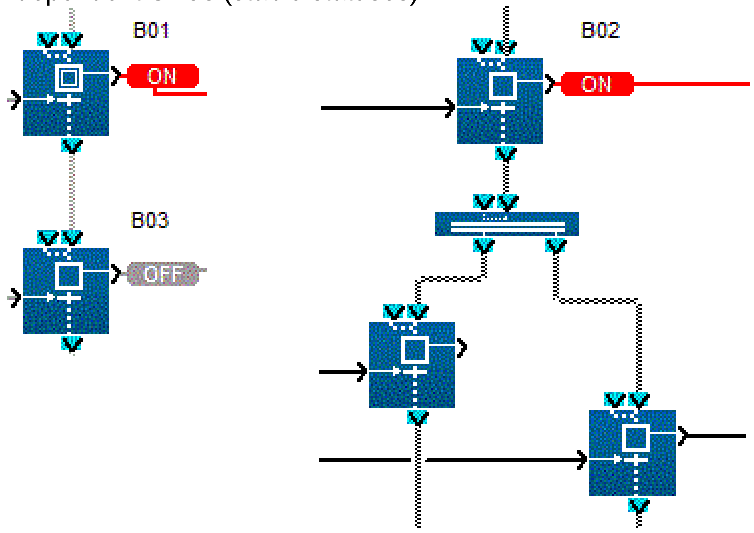
- All charts that contain one or more INITIAL SFC STEP (INIT STEP) functions are automatically initialized. This or these INIT STEP functions contain a status token which symbolizes the same number of active operating phases.
  All other steps belonging to the other functions contain no token, and all the operating phases they symbolize are inactive.
- This automatic initialization also takes place on restart after a power outage. The positions the status tokens had at the time of the power outage are lost,
- In all the charts containing a RESET-INIT function, it is now MANDATORY, RIGHT AT THE START OF THE PROGRAM, to place an ON signal on the REINITIALIZATION input, and to disable the module OUTPUTS which may be subject to interference. On restart after a power outage, the positions the status tokens had at the time of the power outage are restored.

Example

Example 1: SFC with two INIT STEP functions.
Initialization and switch on of the program, initial operating phases 1 and 2 simultaneously in progress, step B01 and B02 simultaneously active (stable statuses)



Example 2: two independent SFC each have an INITIAL SFC STEP function. Initialization and switch on of the program, initial operating phases 1 and 2 simultaneously in progress, step B01 and B02 simultaneously active in two independent SFCs (stable statuses)



1.4.2.9.9 Initialization of SFC Charts

(§ 1.4.2.9.8) (§ 1.4.2.9.10)

At a Glance

A program containing one or more SFC charts must be initialized when launched. To perform this initialization you must insert at least one INIT STEP(§ 1.4.2.9.13) function or a RESET-INIT(§ 1.4.2.9.12) function in each of the independent charts. If a chart contains the RESET-INIT(§ 1.4.2.9.12) function, it can also be initialized when the program is running.

Initialization at Startup or on Power Return

On program startup, when the **Initialize and switch on** command is executed, or when power is restored, the following occurs:

- All the **STEP OUTPUTS** of the **INIT SFC** or **RESET-INIT** functions are activated and all the other chart functions are deactivated,
- The former step states are lost.

If a chart contains a **RESET-INIT** function, the steps are restored to the states they were in at the time of the power outage.

⚠	CAUTION
	RESET input At the start of an SFC chart it is mandatory to connect to the **REINITIALIZATION** input of the RESET INIT function the **COLD START** output for the STATUS(§ 1.4.2.6.11) function. **Failure to follow this instruction can result in injury or equipment damage.**

Initialization in Progress

When a program containing one or more independent SFC charts is running, a chart containing the **RESET-INIT** function can be reset independently of the other SFC charts. This initialization is performed by activating the **REINITIALIZATION** of the **RESET-INIT** function which achieves the following:

- All the **STEP OUTPUTS** of the **INIT SFC** and **RESET-INIT** functions are activated and all the other chart functions are deactivated,
- The functions of the other independent charts are not affected.

As long as the **REINITIALIZATION** is active, the steps are forced as described above regardless of the transition values of the chart functions.

1.4.2.9.10 Re-initialization of an SFC in the Course of the Program

(§ 1.4.2.9. 9)

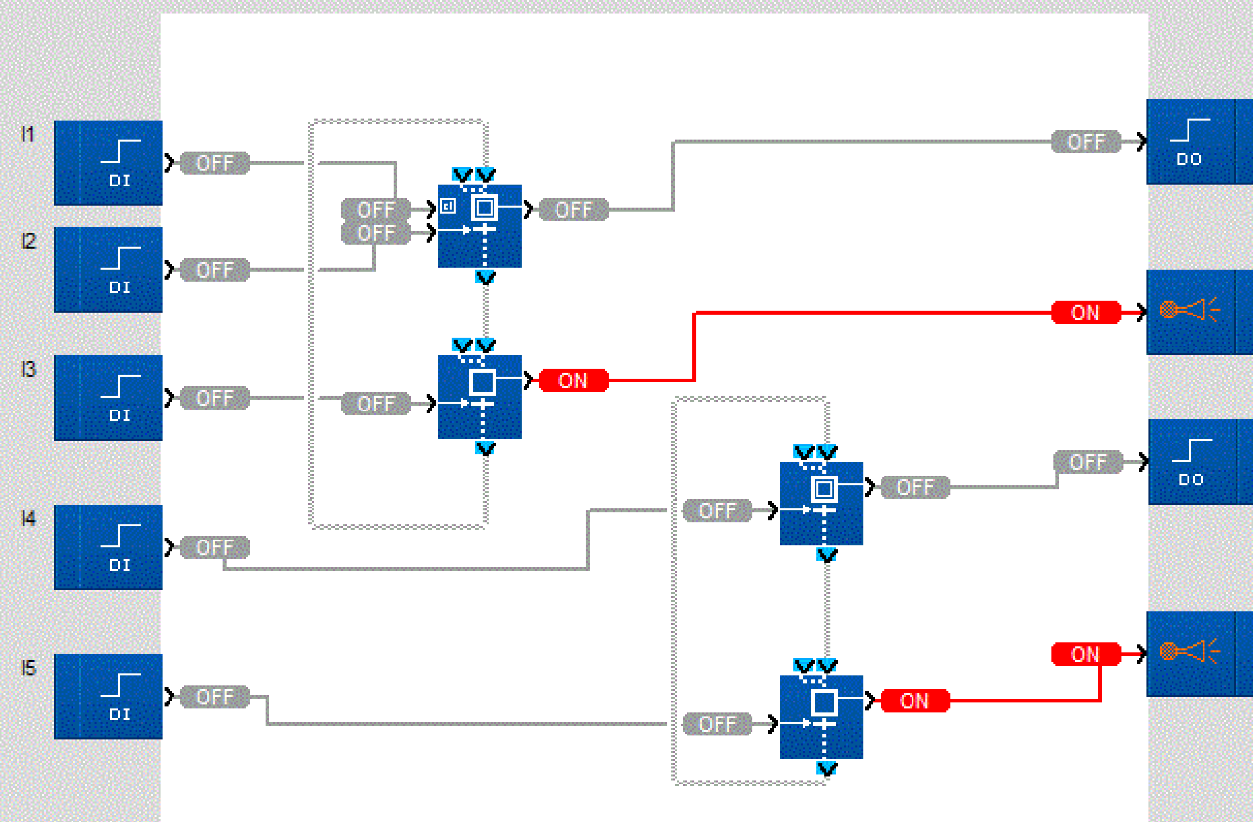
(§ 1.4.2.9.11)

Description

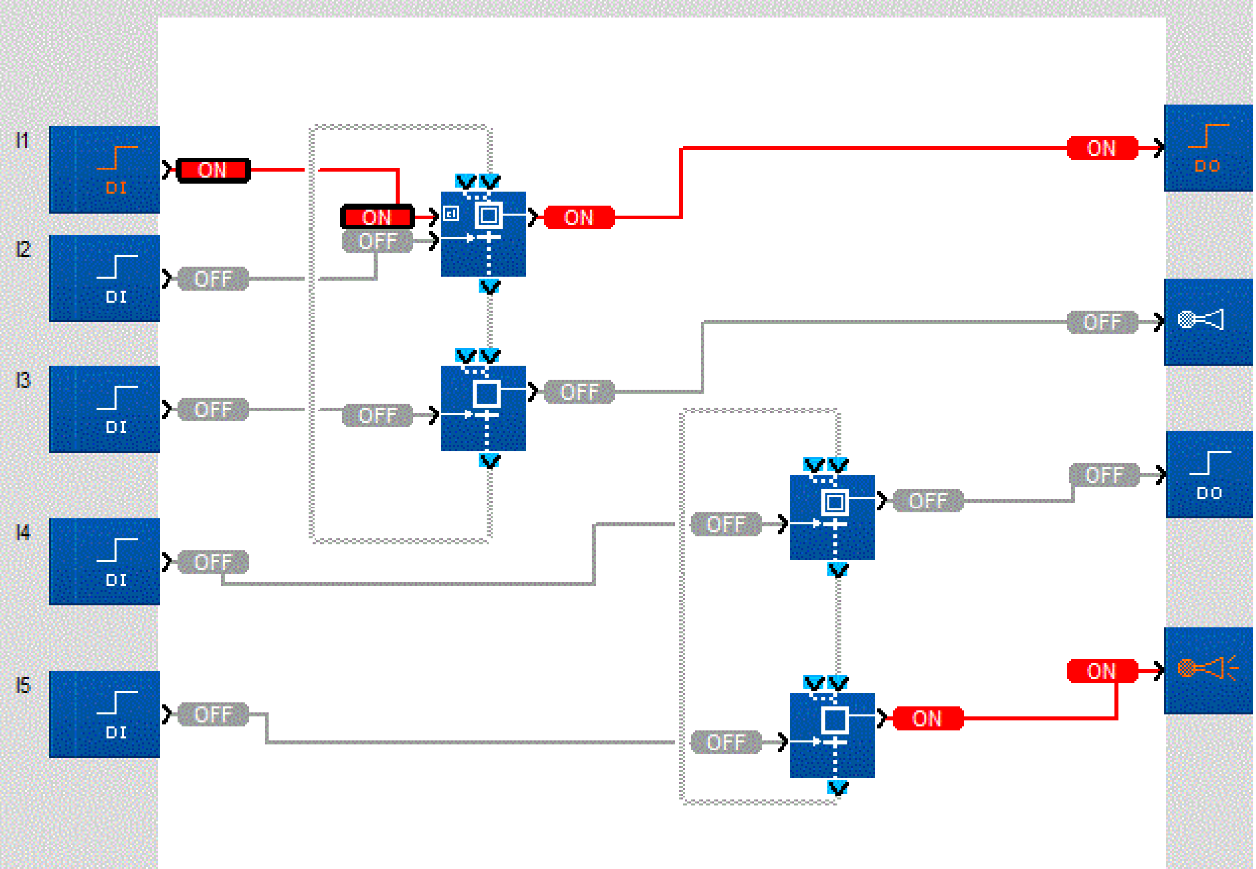
Over the course of the program containing one or more independent SFCs, a chart containing the **RESET-INIT** function can be reinitialized independently from the other SFCs. This initialization is triggered by setting to ON the Discrete input called **REINITIALIZATION** of the RESET-INIT function.
This input can be connected to the other FBD blocks using Discrete outputs. For example, a Boolean combination of inputs can command this initialization input.
During execution of the user program, once the REINITIALIZATION input of the RESET-INIT function switches to ON, each INIT STEP function and the RESET-INIT function belonging to the same SFC each contain a status token that symbolizes the same number of active operating phases.
All other steps belonging to the other functions of the same SFC contain no token: all the operating phases they symbolize are inactive.
All other functions belonging to other SFCs independent from the previous one are not assigned.
As long as the REINITIALIZATION input is set to ON, the steps are forced as described above without taking into account the values applied to the command inputs associated with all transitions of the chart functions.

Example

The left-hand SFC chart has an initial step which can be reinitialized and the right-hand one an initial step. In this example, the non-initial steps are active.



Initialization while the program is running: activation of the Reset input activates the initial step of the left-hand chart but has no effect on execution of the right-hand chart.



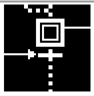
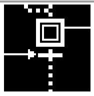
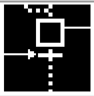
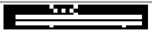
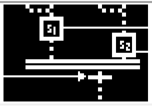
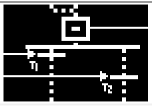
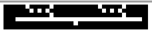
1.4.2.9.11 SFC Functions

(§ 1.4.2.9.10)

(§ 1.4.2.9.12)

At a Glance

The following table shows the different functions that make up an SFC program:

Name	Symbol	Description
Initial Step(§ 1.4.2.9.13)		Initial step of an SFC chart.
Resettable initial step(§ 1.4.2.9.12)		Initial step of an SFC chart with initialization of the step by command. Initializes the entire connecting chart containing the reset init.
Step(§ 1.4.2.9.14)		Step which transmits an order to another FBD function.
AND Divergence(§ 1.4.2.9.17)		Transition of one or two steps toward two steps.
AND Convergence(§ 1.4.2.9.18)		Transition of two simultaneous steps toward one step.
OR Divergence(§ 1.4.2.9.15)		Transition of a step toward one or two steps.
OR Convergence(§ 1.4.2.9.16)		Transition of one to four steps toward a single step.

1.4.2.9.12 Resettable Step

□□□□ (§ 1.4.2.9.11) □□□□ (§ 1.4.2.9.13)

Description

The **RESET INIT** function can be used, when the **RESET** function is activated:

- to activate the **STEP OUTPUT** for the function, which is the initial step of the SFC chart,
- and to reinitialize all of the other active steps in the chart to which it belongs.

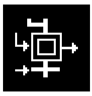
If the **RESET** input is not active, it operates in the following manner:

- If **INPUT 1** or **INPUT 2** is active, then the **STEP OUTPUT** is activated and remains active even after the inputs have disappeared,
- If the **TRANSITION** input is active, then the **STEP OUTPUT** is deactivated and the **STEP TRANSITION OUTPUT** is activated,
- If none of the inputs is active and only the **STEP OUTPUT** is inactive, then the output remains inactive.

During a power failure, this function enables current values of the chart to be saved and retrieved when power is restored.

Note: An SFC chart can have only one **RESET** function. Each of the program's independent charts can contain only one **RESET INIT** function.

Access

The  function is accessible from the **SFC** function bar.

Inputs/Outputs

The function uses:

- Two inputs, **INPUT 1** and **INPUT 2** to activate the step output,
- A **RESET** input for the program and its steps,
- A **TRANSITION** input to deactivate the step located downstream from this one.

> **Note:** If not connected, inputs other than **RESET** are in inactive state.

The function provides:

- A **STEP OUTPUT**,
- A **STEP TRANSITION OUTPUT**.

Warning

> **CAUTION**
>
> **RESET input**
> At the start of an SFC chart it is mandatory to connect to the **REINITIALIZATION** input of the RESET INIT function the **COLD START** output for the STATUS(§ 1.4.2.6.11) function and to disable the outputs of the controller which are dependent on the outputs of the SFC chart steps.
> **Failure to follow these instructions can result in injury or equipment damage.**

1.4.2.9.13 SFC Initial Step

(§ 1.4.2.9.12)

(§ 1.4.2.9.14)

Description

The **INIT STEP** function is an initial step of an SFC chart. It operates normally as follows:

- If **INPUT 1** or **INPUT 2** is active, then the **STEP OUTPUT** is activated and remains active even after the inputs have disappeared,
- If the **TRANSITION** input is active, then the **STEP OUTPUT** is deactivated and the **STEP TRANSITION OUTPUT** is activated,
- If none of the inputs is active and only the **STEP OUTPUT** is inactive, then the output remains inactive.

> **Note:** An SFC chart must have at least one **INIT STEP** function. Each of the program's independent charts can contain several **INIT STEP** functions.

If there is no **RESET INIT** function in the SFC chart, then the **INIT STEP** function is automatically initialized in the following cases:

- Beginning of a simulation session,
- when switching to ON mode,
- when normal operation is resumed following a power failure.

Access

The function is accessible from the **SFC** function bar.

Inputs/Outputs

The function uses:

- Two inputs **INPUT 1** and **INPUT 2** to activate the step output,
- A **TRANSITION** input to activate the step located downstream from this one.

> **Note:** If not connected, inputs are in inactive state.

The function provides:

- A **STEP OUTPUT**,

- A **STEP TRANSITION OUTPUT**.

1.4.2.9.14 SFC Step

(§ 1.4.2.9.13) (§ 1.4.2.9.15)

Description

The **STEP** function is a step of an SFC chart. The step symbolizes an operational phase of a control device or PLC.
An action is connected to each **STEP OUTPUT** to transmit commands to other functions (Discrete, logical, standard output). It operates in the following manner:

- If **INPUT 1** or **INPUT 2** is active, then the **STEP OUTPUT** is activated and remains active even after the inputs have disappeared,
- If the **TRANSITION** input is active, then the **STEP OUTPUT** is deactivated and the **STEP TRANSITION OUTPUT** is activated,
- If none of the inputs is active and only the **STEP OUTPUT** is inactive, then the output remains inactive.

Access

The function is accessible from the **SFC** function bar.

Inputs/Outputs

The function uses:

- Two inputs **INPUT 1** and **INPUT 2** to activate the step output,
- A **TRANSITION** input to activate the step located downstream from this one.

Note: If not connected, inputs are in inactive state.

The function provides:

- A **STEP OUTPUT**,
- A **STEP TRANSITION OUTPUT**.

1.4.2.9.15 Divergence to OR

(§ 1.4.2.9.14) (§ 1.4.2.9.16)

Description

The **DIV OR 2** function enables a transition of one step to be simultaneously made toward one or two steps.

- If the **STEP INPUT 1** or **STEP INPUT 2** is active, then the **STEP OUTPUT** is activated,
- If the **TRANSITION INPUT 1** and the **STEP OUTPUT** is active:
  - The **STEP OUTPUT** is deactivated,
  - **TRANSITION OUTPUT 1 WITH DIVERGENCE TO OR** is activated.
- If the **TRANSITION INPUT 2** and the **STEP OUTPUT** is active:
  - The **STEP OUTPUT** is deactivated,
  - **TRANSITION OUTPUT 2 WITH DIVERGENCE TO OR** is activated.
- If the **TRANSITION 1** and **TRANSITION 2** inputs are active and the **STEP OUTPUT** is active:
  - The **STEP OUTPUT** is deactivated,
  - The **TRANSITION OUTPUT 1 WITH DIVERGENCE TO OR**and the **TRANSITION OUTPUT 2 WITH DIVERGENCE TO OR** are activated.

Access

The function is accessible from the **SFC** function bar.

Inputs/Outputs

The function uses:

- Two inputs, **INPUT 1** and **INPUT 2** to activate the step output,
- Two inputs, **TRANSITION 1** and **TRANSITION 2** to activate the transition step output(s).

Note: If not connected, inputs are in the inactive state.

The function provides:

- A **STEP OUTPUT**,
- A **TRANSITION OUTPUT 1 WITH DIVERGENCE TO OR**,
- A **TRANSITION OUTPUT 2 WITH DIVERGENCE TO OR**.

1.4.2.9.16 Convergence to OR

□□□ □ (§ 1.4.2.9.15) □ □□□ (§ 1.4.2.9.17)

Description

The **CONV OR 2** function enables a transition of one to four step(s) to be simultaneously made toward one step.

- If **INPUT 1** or **INPUT 2** or **INPUT 3** or **INPUT 4 OF CONVERGENCE TO OR** is active, then the **OUTPUT OF CONVERGENCE TO OR** is activated,
- If none of these inputs is active, then the **OUTPUT OF CONVERGENCE TO OR** is inactive.

Access

The function is accessible from the **SFC** function bar.

Inputs/Outputs

The function uses four input s that allow activation of the transition output.

- **INPUT 1 OF CONVERGENCE TO OR**,
- **INPUT 2 OF CONVERGENCE TO OR**,
- **INPUT 3 OF CONVERGENCE TO OR**,
- **INPUT 4 OF CONVERGENCE TO OR**.

Note: If not connected, inputs are in the inactive state.

The function provides an **OUTPUT OF CONVERGENCE TO OR**.

1.4.2.9.17 Divergence to AND

□□□ □ (§ 1.4.2.9.16) □ □□□ (§ 1.4.2.9.18)

Description

The **DIV AND 2** function enables a transition of one or two steps to be simultaneously made toward two steps.

- If **INPUT 1** or **INPUT 2 of DIVERGENCE TO AND** is active, then **OUTPUT 1** and **OUTPUT 2 OF DIVERGENCE TO AND** are activated,

- If none of these inputs is active, then **OUTPUT 1** and **OUTPUT 2 OF DIVERGENCE TO AND** are inactive.

Access

The function is accessible from the **SFC** function bar.

Inputs/Outputs

The function uses two inputs that allow activation of the transition outputs:

- **INPUT 1 OF DIVERGENCE TO AND**,
- **INPUT 2 OF DIVERGENCE TO AND**.

Note: If not connected, inputs are in inactive state.

The function provides two outputs:

- **OUTPUT 1 OF DIVERGENCE TO AND**,
- **OUTPUT 2 OF DIVERGENCE TO AND**,

1.4.2.9.18 Convergence to AND

(§ 1.4.2.9.17)

(§ 1.4.2.9.19)

Description

The **CONV AND 2** function enables a transition of two steps to be simultaneously made toward one step.

- If **INPUT 1** or **INPUT 2** is active, then **STEP OUTPUT 1 OF CONVERGENCE TO AND** is activated and remains active even after the inputs have disappeared,
- If **INPUT 3** or **INPUT 4** is active, then **STEP OUTPUT 2 OF CONVERGENCE TO AND** is activated and remains active even after the inputs have disappeared,
- If **STEP OUTPUT 1 OF CONVERGENCE TO AND** and **STEP OUTPUT 2 OF CONVERGENCE TO AND** are active and the **TRANSITION** input is also active, then:
  - **STEP OUTPUT 1** and **STEP OUTPUT 2 OF CONVERGENCE TO AND** are deactivated,
  - The **TRANSITION OUTPUT** is activated.
- If none of these inputs is active, then **STEP OUTPUT 1** and **STEP OUTPUT 2 OF CONVERGENCE TO AND** are inactive,
- If the **TRANSITION** input is active but **STEP OUTPUT 1** or **STEP OUTPUT 2 OF CONVERGENCE TO AND** is inactive, **STEP OUTPUT 1** or **STEP OUTPUT 2 OF CONVERGENCE TO AND** does not change state and the **TRANSITION OUTPUT** remains inactive.

Access

The function is accessible from the **SFC** function bar.

Inputs/Outputs

The function uses:

- Two inputs **INPUT 1** and **INPUT 2** to activate step output 1,
- Two inputs **INPUT 3** and **INPUT 4** to activate step output 2,
- A **TRANSITION** input to activate the step located downstream from this one.

> **Note:** If not connected, inputs are in inactive state.

The function provides:

- A **STEP OUTPUT 1 OF CONVERGENCE TO AND**,
- A **STEP OUTPUT 2 OF CONVERGENCE TO AND**,
- A **TRANSITION OUTPUT**.

1.4.2.9.19 Wait SFC Step

◁□□□□ (§ 1.4.2.9.18) □□□□▷ (§ 1.4.2.9.20)

This function is used to set up a wait phase or step for a PLC or a device.

If a status token is present at STEP INPUT 1 or STEP INPUT 2, it is stored immediately in the function step, switching the STEP OUTPUT to ON.

This token remains stored in the step until the time defined by the WAIT TIME parameter has elapsed. At this point, the status token crosses the transition and disappears from the step. The STEP OUTPUT is set to OFF and the token is then available on the STEP TRANSITION OUTPUT and can be stored in the step or steps connected downstream of this output.

If there is no status token present at either input (STEP INPUT 1 and STEP INPUT 2) and if the step does not already contain a status token, the step remains empty and the STEP OUTPUT indicates OFF.

The non-connected STEP INPUT 1 or STEP INPUT 2 inputs are at neutral values for the function, ie. no token present in the step input.

1.4.2.9.20 Move SFC Step

◁□□□□ (§ 1.4.2.9.19) □□□□▷ (§ 1.4.2.9.21)

This function is used to set up a move step for a motor controlled by the PLC to a position specified on the TARGET input.

The motor is controlled by the following three outputs:

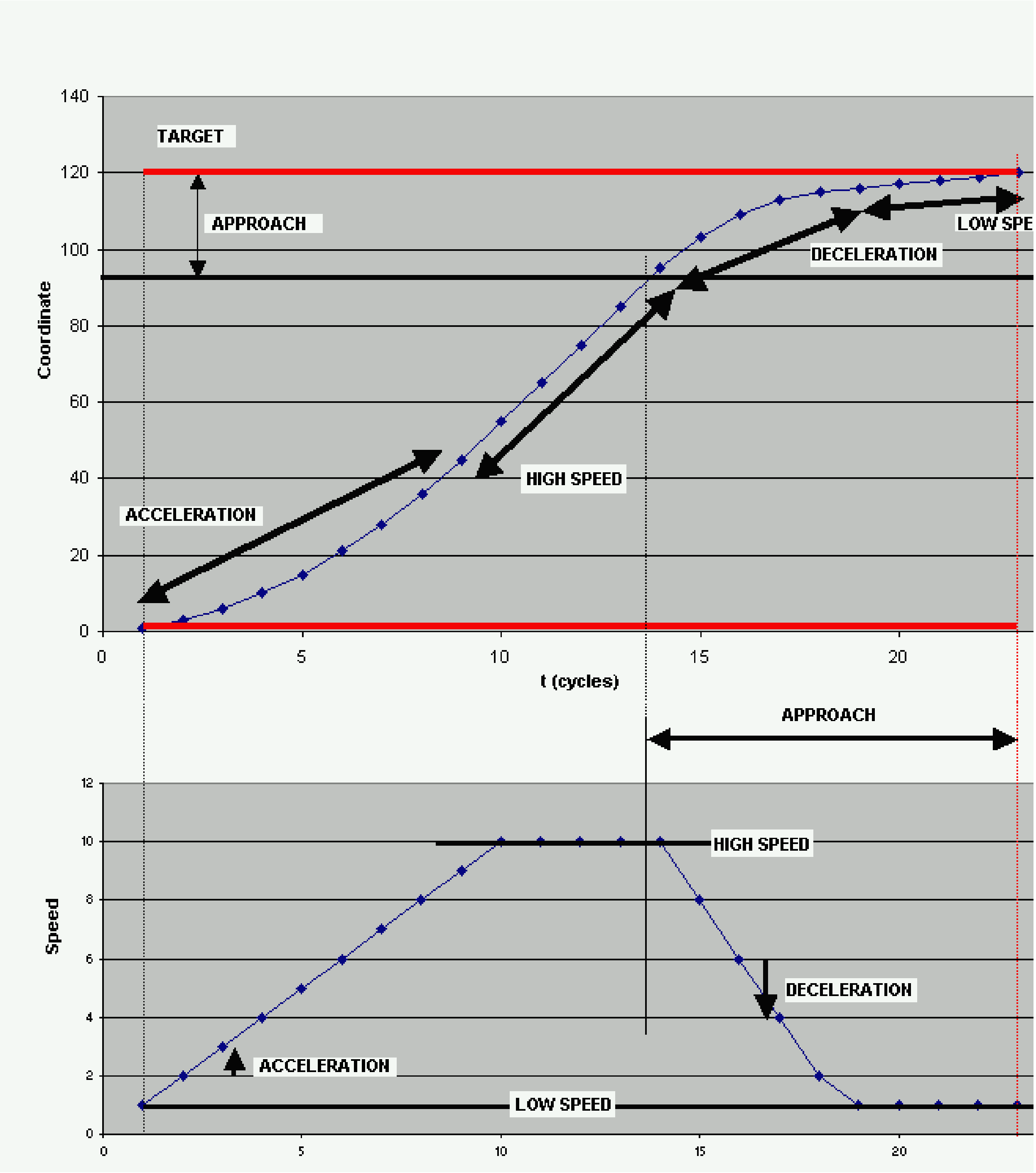
- **ON (0 or 1)** : The motor runs when the ON signal is at 1. Otherwise, it stops (with optional braking depending on the motor configuration)
- **DIRECTION (0 ou 1)** : Indicates the direction of motor rotation (1 clockwise, 0 anticlockwise)
- **SPEED (0 à 30000):** : Indicates the motor speed in rpm

> **Note 1** : When several move steps are linked, it is possible to combine their motor control signals using the MOTOR MULTIPLEXER function.

The move consists of 5 steps:

- Acceleration to HIGH SPEED (**ACCELERATION and HIGH SPEED** parameters)
- Constant speed plateau until the motor reaches the approach zone (**APPROACH** parameter)
- Deceleration to LOW SPEED (**DECELERATION and LOW SPEED** parameters)
- Low-speed approach until the motor reaches the target position (**TARGET** input)

- Stop on target. Transition to the next SFC step



Move parameters:

- **HIGH SPEED (maximum) (0 à 30000)** : Indicates high speed in rpm (see note 2)
- **LOW SPEED (minimum) (0 à 30000)** : Indicates low speed in rpm (see note 2)

Note 2 : In order to bring the speed output within the PWM range [0..100], a GAIN block must be inserted just before the analog output controlling the motor speed. This block should be set to 100/N where N is the maximum motor speed.

- **ACCELERATION (0 à 2767)** : Indicates the speed increment on each PLC cycle (see note 3)
- **DECELERATION (0 à 2767)** : Indicates the speed decrement on each PLC cycle (see note 3)

Note 3 : The standard PLC cycle is 10 ms. Setting acceleration to 10 will make the motor accelerate by 10 rpm every 10 ms, hence from 0 to 1000 rpm in 1 second. If the cycle is 20 ms, then the motor will accelerate from 0 to 1000 rpm in 2 seconds

- **APPROACH (0 à 32767)** : Indicates the distance before the target during which the motor decelerates and then approaches at low speed before stopping (notes 4 and 5)
- **TARGET (-32768 à 32767)** : Indicates the value to be reached on the POSITION input in order for the move to be deemed complete (see note 4).

Note 4 : (EXAMPLE) Motors in the CROUZET 80040xxx and 80080xxx brushless range generate 12 pulses per revolution. A position of 1200 therefore corresponds to 1200/12=100 motor rotations. If the motor is fitted with a gearbox with ratio 10, the geared motor output shaft will therefore make 100/10=10 rotations. And if the output shaft drives a belt on a 40 mm diameter pulley, this belt will advance by 10 x 3.14 x 40 = 1256 mm = 1.256 m

Note 5 : For optimum stopping, adjust the APPROACH parameter so as to obtain a short plateau at low speed before stopping. If the plateau does not exist, increase the APPROACH parameter. If the plateau is unnecessarily long, reduce the APPROACH parameter. If the motor slows down too abruptly, reduce the DECELERATION parameter

If a status token is present at STEP INPUT 1 or STEP INPUT 2, it is stored immediately in the function step, switching the ON output controlling the motor to 1.

This token remains stored in the step until the move is complete. In this case, the status token crosses the transition and disappears from the step. The ON output is set to 0 and the token is then available on the STEP TRANSITION OUTPUT and can be stored in the step or steps connected downstream of this output.

Depending on the DIRECTION OF MOVEMENT option, the move is performed as follows:

- **ASCENDING DIRECTION** : The DIRECTION output is at 1, the move only occurs if the TARGET value is greater than the POSITION value, until the TARGET position is reached. When POSITION is greater than TARGET, the move is immediately deemed to be complete.
- **DESCENDING DIRECTION** : The DIRECTION output is at 0, the move only occurs if the TARGET value is less than the POSITION value, until the TARGET position is reached. When POSITION is less than TARGET, the move is immediately deemed to be complete.
- **AUTOMATIC DIRECTION:** : The DIRECTION output is at 1 or at 0, depending on whether TARGET is greater or less than POSITION. The move is deemed to be complete when the POSITION has returned to the TARGET value.

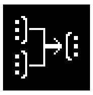
Note 6 : This function is based on the convention that DIRECTION = 1 makes the motor rotate in order to make the POSITION value increase, and vice versa. This is the case with CROUZET brushless motors. In cases where the motor or its rotation sensor do not respect this convention, a NOT relay should be placed just before the logic output controlling the motor direction.

⚠ CAUTION

If this convention is not respected, the motor will rotate indefinitely, which could move the system it is driving beyond its limits.
There is is no guarantee that the function will work correctly when the speed output is forced to values in excess of 30000, whether by manual forcing or when using a display.
Failure to follow this instruction can result in serious injury or equipement damage.

1.4.2.9.21 Motor Multiplexer

◁□□□ □ (§ 1.4.2.9.20) □ □□□▷ (§ 1.4.2.9.22)



This function is designed to combine the motor control signals produced by two linked MOVE SFC steps.

A motor is controlled by the following three signals:

- **ON (0 ou 1)** : The motor runs when the ON signal is at 1. Otherwise, it stops (with optional braking depending on the motor configuration)
- **DIRECTION (0 ou 1)** : Indicates the direction of motor rotation (1 clockwise, 0 anticlockwise)
- **SPEED (0 à 32767)** : Indicates the motor speed in revolutions per minute.

> **Note** : When more than two MOVE SFC steps are linked, it is possible to combine them by cascading several MOTOR MULTIPLEXER blocks: The three motor control signals at the multiplexer output combining the first two steps are in turn combined with the three signals produced by the third step, etc.

> **Note** : In order to bring the speed output within the PWM range [0..100], a GAIN block must be inserted before the analog output controlling the motor speed. This block should be set to 100/N where N is the maximum motor speed.

This function combines the ON1, DIRECTION1 and SPEED1 inputs of the first motor with the ON2, DIRECTION2 and SPEED2 inputs of the second motor.

At the output:

- **ON** is at 1 if at least one input (ON1 or ON 2) is at 1
- If ON1 is at 1 and ON2 at 0, **DIRECTION** and **SPEED** correspond to the DIRECTION1 and ON1 inputs
- If ON2 is at 1 and ON1 at 0, **DIRECTION** and **SPEED** correspond to the DIRECTION2 and ON2 inputs
- If ON1 and ON2 have the same value, then **DIRECTION** = 0 and **SPEED** = 0

> **Note** : In principle, for the same motor, there can only be one active MOVEMENT SFC step at any given time (ie. ON=1). If several steps combined by a cascade of MOTOR MULTIPLEXER blocks are active simultaneously, then the outputs of the last block will have the values ON=1, DIRECTION=0 and SPEED=0, which will prevent the motor from moving.

1.4.2.9.22 Errors and Warnings Detected in an SFC Chart

(§ 1.4.2.9.21)

(§ 1.4.3)

At a Glance

When editing a chart, you can cause structural errors. The workshop detects them and generates errors and warnings when:

- Switching from **Edit** mode to **Simulation** mode,
- changing from **Edit** mode to **Debugging** mode,
- Using the following commands:
  - **Controller** → **Write to the controller**,
  - **Controller** → **Compare the controller data with the program**,
  - **Edit** → **Check the program**.

In all cases, the workshop displays a dialog box in the "Compilation results" window with a list of Errors and/or Warnings, and puts a red frame around the function(s) where errors have been found.
The SFC errors are displayed in bold red on the wiring sheet.

Errors

The following table describes the **errors** according to their numbers:

Type of error	Description
Error 60	An SFC does not have an initial **INIT STEP** function, and no resettable initial **RESET INIT** function. No step will be active when the program is initialized.
Error 61	An independent SFC has several resettable initial **RESET INIT** functions.

Warnings

The following table describes the **warnings** according to their numbers:

Type of warning	Description
Warning 70	This warning is generated if several warnings of different types are detected.
Warning 71	This warning is generated if an SFC function output is linked directly to several SFC function inputs. The AND Divergence function **DIV AND** can be used to clear this error.
Warning 72	This warning is generated if: - An output from an SFC function is not connected to another function, - None of the inputs from an SFC function except **RESET INIT** and **INIT STEP** are connected to a function.

1.4.3 FBD Programming

(§ 1.4.2.9.22)

(§ 1.4.3.1)

Overview

Aim of This Chapter

This chapter describes the different functions that can be accessed from the programming workshop in FBD mode.

What's in this Chapter?

This chapter contains the following sections:

1.4.3.1 Creating an FBD Application in the Programming Workshop

(§ 1.4.3)

(§ 1.4.3.1.1)

At a Glance

Subject of this Section

This section describes the different functions linked to programming in the programming workshop in FBD mode.

What's in this Section?

This section contains the following topics:

1.4.3.1.1 Configuring FBD Program Editing

(
§ 1.4.3.1)

(§ 1.4.3.1.2)

At a Glance

Before creating an FBD program(§ 1.1.2), you must first set up several options to facilitate editing, such as:

- Defining the wiring mode,
- Displaying the editing grid.

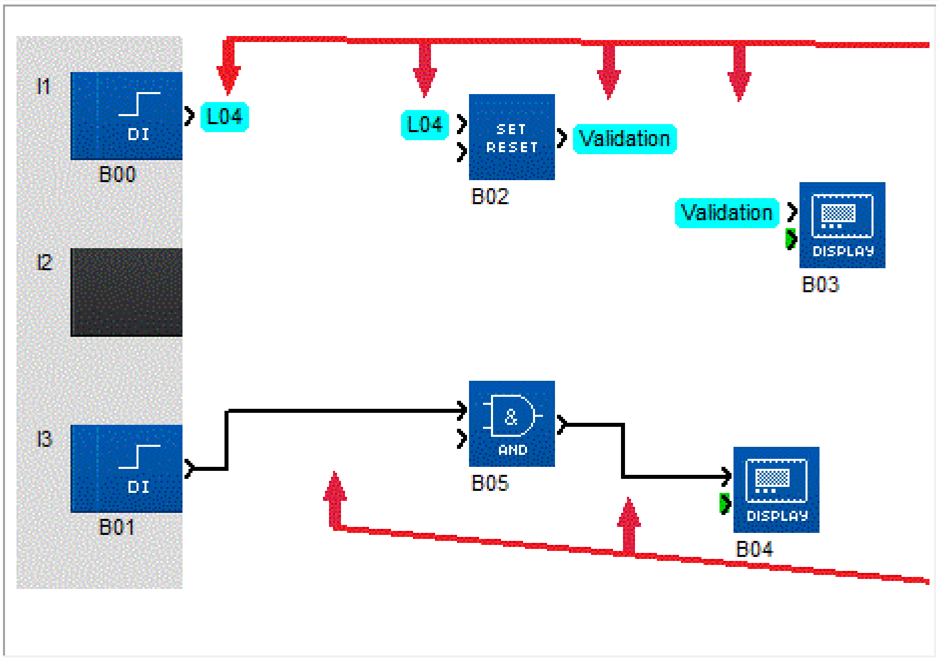
Wiring Mode

The links between the function blocks can be of the following type:

- **Wire** by clicking **Tools** / **Wiring mode** / **Wire**,
- **Text** by clicking **Tools** / **Wiring mode** / **Text**, The text is inserted by default, and can be modified later.

> **Note:** The text displayed at the beginning and end of the link is Lxx type by default (e.g. L04) but can be modified.

Once the type of link is selected, all new links created will be of the selected type.
The following diagram shows an example of a program with wire- and text-type links:



Text-type links

Wire-type links

> **Note:** Wire mode linking is the default setting on opening the workshop.

Modifying the type of wiring on a link

Double-clicking on the link takes you to a window where you can modify the type of link or the link text.

Displaying the Grid

To help you align blocks in the wiring sheet, you can display a grid by clicking **Display** / **Grid**.

1.4.3.1.2 Inserting Function Blocks

□□□□ (§ 1.4.3.1.1) □□□□ (§ 1.4.3.1.3)

At a Glance

To create an FBD program, you must insert various function blocks (FB) in the wiring sheet, then link these together.
The Edit mode is the default mode on opening the application. This is generally accessible by clicking **menu:Mode** / **Edit** during programming, to switch from one

mode to another.

All types of blocks can be placed on the sheet, (including the IN inputs and the OUT outputs).

The only restrictions apply to IN blocks and OUT blocks that can be positioned on their dedicated squares only in the event of compatibility between the equipment's input or output type (controller or extension) and the function block chosen.

If there is an incompatibility, it will not be possible to place the block. If the plot already has a block, a barred circle appears.

Inserting Function Blocks

The following procedure describes how to insert a function block in a wiring sheet:

Step	Action
1	Select the type of function or Macros to insert. • IN/OUT • CTRL • HMI/COM • APP • PROG • CALC • LOGIC • SFC • MACRO Important note: these examples of function types are non-contracual and are subject to futur developments.
2	Left-click on the icon corresponding to the function or the Macro to insert.
3	Drag/drop the selected icon to the wiring sheet.
4	Position the function or the Macro in the required location on the wiring sheet.
5	Repeat steps 2 to 5 to insert all the functions required for the program.

Input Blocks

Note: The following input blocks can only be inserted in the input plots on the left of the wiring sheet to create a link to the hardware:

- Discrete input (DI),
- Voltage analog input (AI VOLT),
- Current analog input (AI mA),

Plot Position

The positions or relative positions of the input and output plots can be changed in order to make the wiring diagram as clear as possible. To do this, proceed as follows:

Step	Action
1	Extend the wiring surface if necessary.
2	Designate the plot to move: • Click on the left part of the plot for inputs or on the right part for outputs, if it contains the drawing of an IN or OUT type block, and keep the mouse button pressed down, • left click anywhere on the plot if it is empty, and keep the mouse button pressed down,
3	Move the plot to the required space, release the mouse button.

1.4.3.1.3 Creating Links between Function Blocks and/or MACRO

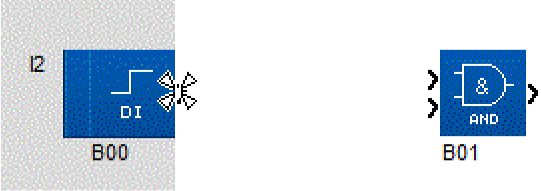
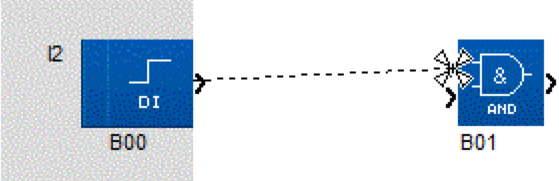
◁□□□□ (§ 1.4.3.1.2) □□□□▷ (§ 1.4.3.1.4)

Overview

After positioning the function blocks in the wiring sheet, you have to link them together. If you have created MACROS(§ 1.4.3.2.5), they should be connected similarly. You can link an output of a block (function block or MACRO) to an input of another block or to loop an output back to an input on the same block.

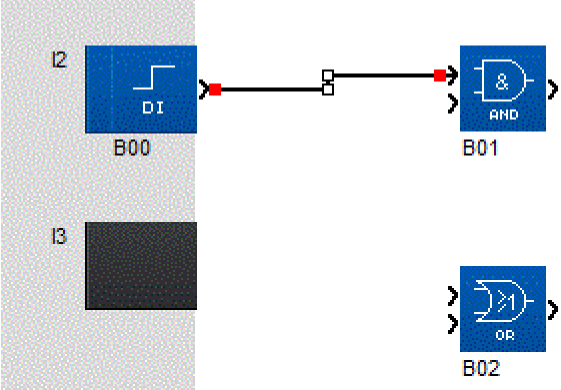
How to Connect one Block to Another

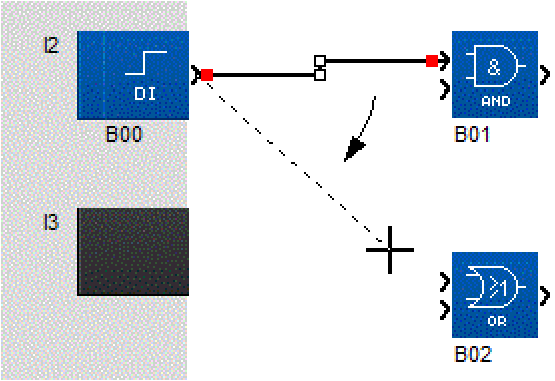
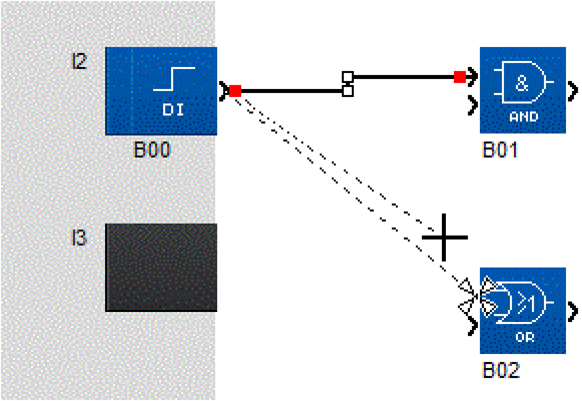
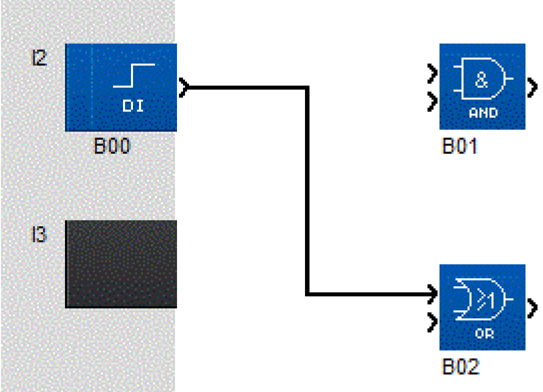
The following procedure shows how to connect one block to another:

Step	Action
1	Left-click on an output of a block. **Result**: The mouse cursor is displayed as a star. 
2	Keep the left button held down.
3	Continuing to hold down the button, move the cursor over a block input. **Result**: The cursor is displayed as a star.  If when moved over the input of a block, the cursor is shown as a circle with a line through it, this means that the link destination is not correct (incompatible types).
4	Release the mouse button. **Result**: A line or numbers are shown between the two linked blocks.

How to Change the Start Point of a Link

The following procedure shows how to change the start point of a link

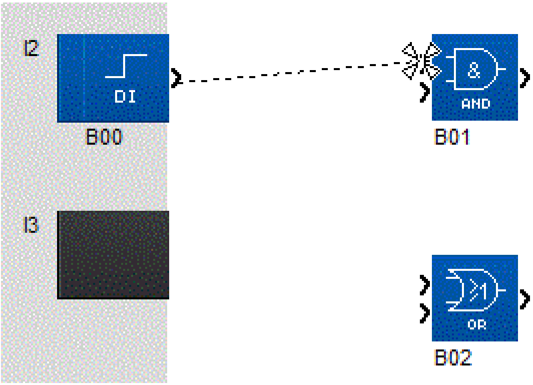
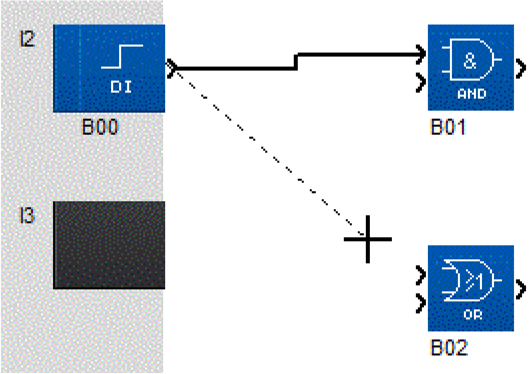
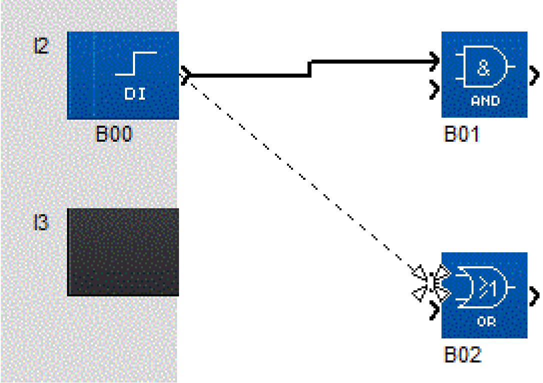
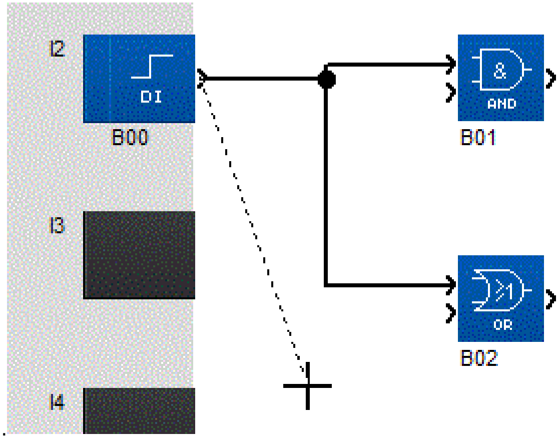
Step	Action
1	Select the link by clicking on it with the mouse. Illustration 
2	Press the **Shift** key.
3	Holding down the **Shift** key, use the mouse to select the end of the link to be modified. **Result**: The cursor is displayed as a star.

	
4	Keep the left button held down. **Note**: At this stage the **Shift** key can be released.
5	Continuing to hold down the button, drag the cursor over the input or output of another block. **Result**: The cursor is displayed as a star.  If when moved over the input of a block, the cursor is shown as a circle with a line through it, this means that the link destination is not correct (incompatible types).
6	Release the mouse button. **Result**: A line or numbers are shown between the two linked blocks. 

How to Connect one Block to Several Others

The following procedure shows how to connect one block to several others:

Step	Action
1	Press the **Ctrl** key.
2	Holding down the **Ctrl** key, left-click on an output of a block.
3	Holding down the **Ctrl** key and the left mouse button, move the cursor over a block input. **Result**: The cursor is displayed as a star.

	
4	Holding down the **Ctrl** key, release the mouse button. **Result**: A line or numbers are shown between the two linked blocks and another dotted line appears. 
5	Continuing to hold down the **Ctrl** key, move the cursor over another block input. **Result**: The cursor is displayed as a star. 
6	Continuing to hold down the **Ctrl** key, click on another block input. **Result**: Another link is created.
7	Repeat steps 5 and 6 to create as many links as necessary  I2 DI B00 I3 I4 & AND B01 ≥1 OR B02
8	Release the **Ctrl** key and click anywhere on the wiring sheet.

Types of Link

Depending on the type of data traveling along the link, there are different types of link.
By default the links are represented as follows:

- Discrete data: Continuous black line
- Signed integers between -32768 and +32767: Black double line
- Link between SFC function blocks: Black interwoven lines

How to Modify the Type of Wiring or Text of a Link

The following procedure shows how to change the appearance of a link.

Step	Action
1	Double-click on the link whose type is to be changed.
2	Select the **Wiring mode** box to change the link from text type to wiring type or Select the **Text** box to change the link from wiring type to text type, and enter the new text.

1.4.3.1.4 Function Block Parameters

(§ 1.4.3.1.3) (§ 1.4.3.1.5)

At a Glance

Each of the function blocks has a parameters window. This window consists of one, two or three tabs:

- **Comments** for all function blocks,
- **Parameters** depending on the function block type (FBD PRESET COUNT),
- **Summary** depending on the function block type (FBD TIME PROG).

Simply double click on the function block to access this window.

Comments Tab

Comments
In the **Comment** zone you can enter a comment of up to three lines of a maximum of 16 characters.
On Inputs(§ 1.4.2.1.1)/Discrete Outputs(§ 1.4.2.2.1) and Analog Inputs(§ 1.4.2.1.2) function blocks, from the comment tab you can also choose the type of function block symbol that will be displayed in the wiring sheet.
When a comment has been associated with a function block, an **ON/OFF** symbol is displayed underneath and to the left of the block.
The comment is displayed in 2 different ways:

- By selecting the corresponding box in the Comments tab,
- By clicking on the symbol underneath the FB.

Block number
The following option is also available: **Display the block number** on the comment tab. This option is activated by default.
In Simulation or Debugging mode, on launching either of these modes, the block number is hidden. This can be displayed for each block by opening the parameter setting window.
Symbols used for block
For certain types of block, you can choose specific symbols to be used when shown in the wiring sheet (FBD DI, OUT).
When this function is available, the list of available icons is shown in a menu at the bottom of the window.
To change the icon, simply double click on the desired symbol.

Parameters

Most function blocks have a **parameters** tab. In this tab, you have to set the function block's specific parameters. These parameters are described in detail in the help for each of the blocks.

Summary

Some function blocks also have a **Summary** tab (FBD TIME PROG). This window lists all the actions configured for the block. It provides you with an overview of the configuration.

1.4.3.1.5 Display Options

(§ 1.4.3.1.4) (§ 1.4.3.1.6)

At a Glance

For an FBD program, several different display options are available with:

- Comments,
- Zoom,
- Block numbers.

Comments

All of the function blocks can have an associated comment. These comments are displayed above the block in the wiring sheet.
You can choose to display:

- The comment for a block,
- All comments with the command **Display** → **Comment** → **All**,
- No program comment **Display** → **Comment** → **None**.

Displaying a Comment

The following table shows the procedure for displaying a function block comment:

Step	Action
1	Double-click on the block, **Comments** tab, select the "Display Comment" box.
2	Click on the OFF symbol, if a comment is associated with the block, the symbol is visible. **Result:** The comment for the block is displayed.

Zoom Function

The command **Display** → **Zoom** allows you to use the zoom to display a part of the program in detail.

Block Numbers

As with the comments, you can choose to display the program function block numbers.

- All of the function block numbers with the command **Display** → **Block numbers** → **All**,
- None of the program function block numbers **Display** → **Block numbers** → **None**.

1.4.3.1.6 Draw

(§ 1.4.3.1.5) (§ 1.4.3.1.7)

Overview

In the edit and supervision sheet, you can create square, ellipse or line forms or text.

You can also insert an image in Bmp format.
The line width (3 widths), line color and background color can also be changed.

Creating a Drawing

The table below shows the procedure for inserting a drawing in the wiring or supervision sheet:

Step	Action
1	Select the **Draw** menu or the **Display, Drawing Bar** menu
2	Select the type of drawing to be created: - **Line** ╲ - **Rectangle** □ - **Ellipse** ◯ - **Text** A
3	Draw the desired form in the wiring or supervision sheet.
4	If you selected **Text**, if necessary, double-click on the object created and enter the text.

Inserting an Image

The table below shows the procedure for inserting an image in the wiring or supervision sheet:

Step	Action
1	Select the **Draw** menu or the **Display, Drawing Bar** menu
2	Select **Image** 🖼. Result: The **Open** window appears.
3	Select the image file in bmp format.
4	Confirm with **Open**.
5	Left-click on the wiring or supervision sheet. Result: A dotted zone the size of the image appears.
6	Place the zone corresponding to the image on the wiring or supervision sheet.
7	Release the left mouse button. Result: The image appears.

Border

You can create a drawing that is a **rectangle** or **ellipse** with or without a **border**. By default, the border option is selected. If you would like to remove it or confirm your choice, use the **Draw** / **Border** command. The border color can be modified in the same way as that of a line.

Line Width

The table below shows the procedure for changing a line width or border of a drawing:

Step	Action
1	Select the drawing to modify.
2	Select the **Width** sub-menu from the **Draw** menu ☰.
3	Choose the width type. - single line - double line - triple line

	Result: The drawing width is modified.

Background Color

The table below shows the procedure for changing the background color of a drawing:

Step	Action
1	Select the drawing to modify.
2	Select the **Background Color** icon in the **Drawing bar** Result: The **Color** window appears.
3	Choose the new background color.
4	Confirm with **OK**.

Line and Border Color

The table below shows the procedure for changing the color of borders and lines in a drawing:

Step	Action
1	Select the drawing to modify.
2	Select the **Line Color** icon in the **Drawing bar** Result: The **Color** window appears.
3	Choose the new line color.
4	Confirm with **OK**.

1.4.3.1.7 Find

(§ 1.4.3.1.6) (§ 1.4.3.1.8)

Overview

The **Find** command is used to find the following in the edit and supervision windows:

- A function block, from its comment or block number,
- A link, from its name

Procedure

The following table shows the procedure for using the **Find** function:

Step	Action
1	Select the **Find** command from the **Edit** menu. Result: the **Find** window appears.
2	Enter the string of characters to be found in the **Find** zone.
3	Check the **Whole word only** box so that the search is carried out only on the string to be found.
4	Check the **Match case** box so that the search takes the case into account (upper and lower case letters).
5	Launch the search by pressing **Next**. Result: • If the search is successful, the function block is highlighted in the window. • If the search is not successful, the **No block found** window appears.
6	Relaunch the search by pressing **Next** until the **No more blocks** window is displayed.

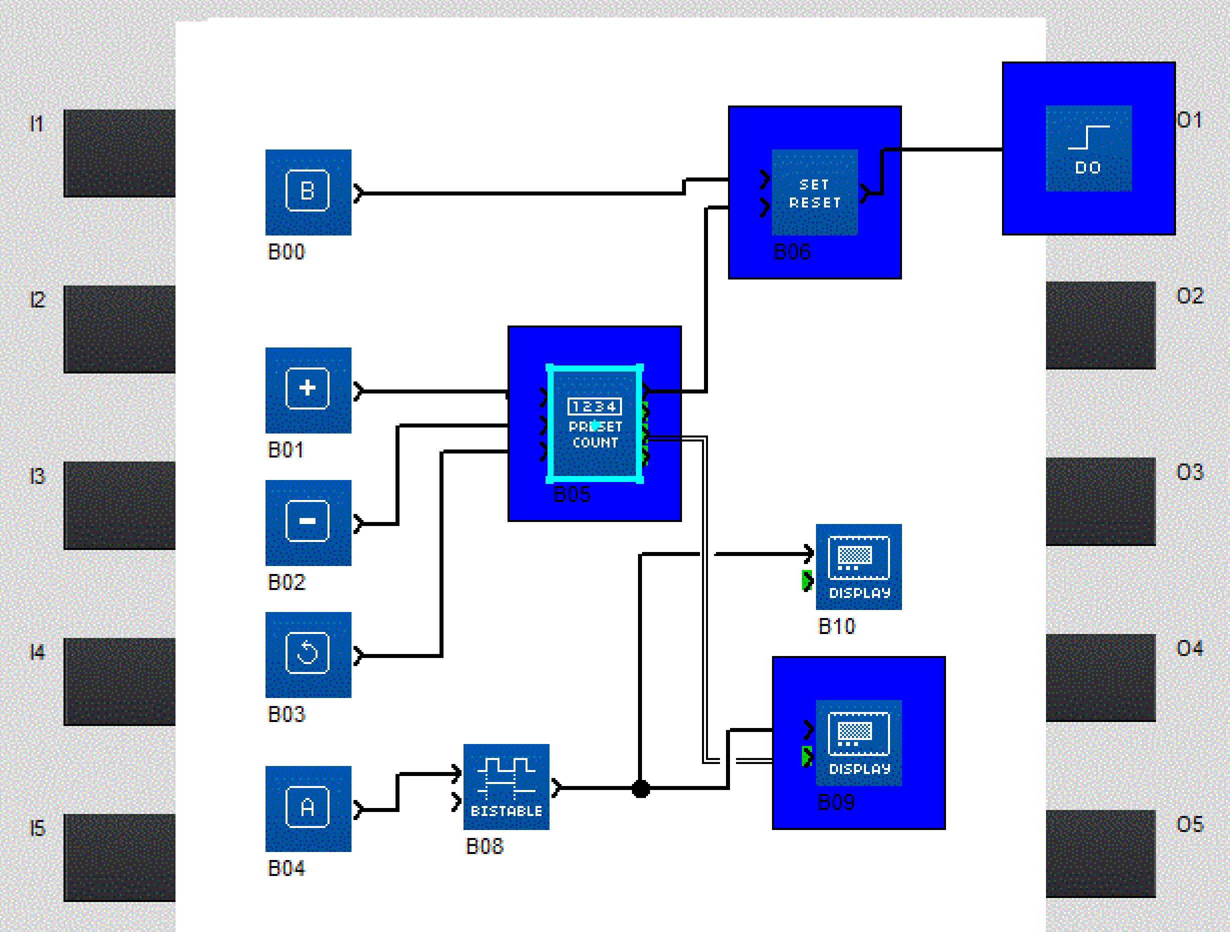
1.4.3.1.8 Display Dependencies

(§ 1.4.3.1.7) (§ 1.4.3.1.9)

Description

Display Dependencies highlights all blocks that depend on a given starting point. The starting point is a block or a link. All blocks forming a path originating from a starting point and ending at outputs are indicated by a blue frame around the block.

In the following example, the starting point is the block B05:



How to Display Dependencies

To display dependencies, proceed as follows:

Step	Action
1	From the **Edit/Activate Dependencies Mode** command.
2	Click on the starting point which may be either: • a block or • a link

How to Cancel It

To cancel the display of dependencies, from the **Edit/Activate Dependencies Mode** command.

1.4.3.1.9 Use of Application-Specific Functions

(§ 1.4.3.1.8) (§ 1.4.3.2)

Overview

The programming workshop can be enhanced with additional function blocks called application-specific functions.

What is an Application-Specific Function?

An application-specific function is an optional function which can be added to the function bar and introduced into an application in the form of function blocks. If an application-specific function is used in an application, its description file must be written in the controller. Each description file uses a space in the controller memory, which is characterized by a progress bar at the the bottom right of the screen.

Example: HIGH SPEED COUNT is an application-specific function.

How to Access Application-Specific Functions

To access the application-specific functions, proceed as follows:

Step	Action
1	Install the software containing the desired application-specific functions in the installation directory of the programming workshop.
2	Launch the programming workshop.
3	Select **Menu: Controller** / **List of application-specific functions** / **In the em4 soft application...** **Result**: The List of available application-specific functions(§ 1.4.3.1.9) window appears.
4	Select the application-specific functions which should appear in the function bar.
5	Open or create an application.
6	Click on the APP tab, where most of the application-specific functions are located. **Result**: The application-specific functions appear. The desired function blocks can be inserted in the wiring sheet (see Inserting Function Blocks(§ 1.4.3.1.2)).

Application-Specific Function Help

Each application-specific function has its own help. This help can be accessed by double-clicking on the application-specific function in the wiring sheet then clicking on the **Help** button in the Settings window.

Maximum Number of Slots

Each controller has a maximum number of slots that can be used by the application-specific functions. A progress bar indicates the amount of memory used by the application compared to the controller memory.
When the user places an Application-Specific function block on the wiring sheet, there are two possible scenarios:

- If the application-specific function is already present in the application, the progress bar does not move.
- Otherwise the progress bar indicates the new memory occupancy.

Example: The **Heat curve** application-specific function occupies approximately 1% and that of the **Swimming pool filtration** application-specific function occupies approximately 5%. If an application contains several **Heat curve** function blocks and several **Swimming pool filtration** function blocks, they use approximately 6% of the memory.

List of Available Application-Specific Functions Window

The list of application-specific functions installed is accessible via **Menu: Controller** / **List of Application-Specific Functions** / **In the em4 soft application...**
The information displayed is described below.

- Function name: This is the name that appears in the function help balloon
- Gen num: Unique number identifying the function

- Version: Version of the function. The version of the controller software with which the function is compatible is indicated in brackets
- Loadable binaries:
  - If YES, the application-specific function can be used on a compatible controller.
  - If NO, the function can be used to construct programs and simulate them but not to write them in the controller. (bm4 file missing)

The **Add** button is used to add a function to the function bar
The **Delete** button is used to delete a function from the function bar

Writing to the Controller

The application-specific function description file is transferred to the controller at the same time as the application.

How to See the Controller Application-Specific Functions

To have the list of controller application-specific functions select **Menu: Controller** / **List of application-specific functions** / **In the controller...**

1.4.3.2 Manipulating FBD Objects

◁□□□ □ (§ 1.4.3.1.9)

□ □□□▷ (§ 1.4.3.2.1)

At a Glance

Subject of this Section

This section describes the manner in which objects in the wiring and supervision sheets should be manipulated: how to select, move, duplicate or delete objects, etc.

What's in this Section?

This section contains the following topics:

- How to Select Objects(§ 1.4.3.2.1)
- How to Create Composite Objects(§ 1.4.3.2.2)
- How to Delete and Duplicate Objects(§ 1.4.3.2.3)
- How to Position Objects(§ 1.4.3.2.4)
- How to Create, Modify or Archive a MACRO(§ 1.4.3.2.5)

1.4.3.2.1 How to Select Objects

◁□□□ □ (§ 1.4.3.2)

□ □□□▷ (§ 1.4.3.2.2)

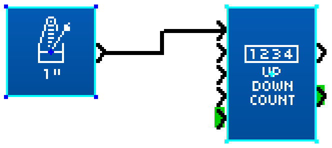
Overview

In a wiring or supervision sheet, function blocks, MACROS and drawings are objects. When objects are created, it is sometimes necessary to select certain ones in order to position or group them, etc. The selection or deselection of objects is therefore a basic operation when creating an FBD program.

How to Select One or More Objects

The table below describes the operations to carry out in order to select one or more objects.

If you would like to select...	**Then**
an isolated object.	Left-click on the object.
Several contiguous objects.	Frame the objects to be selected by defining a selection zone. **Result**: All the selected objects are highlighted by small colored

	squares located at each corner of the block. 
Several objects scattered about in the wiring sheet.	Press the **Shift** key, then click on the objects to be selected while continuing to hold down the **Shift** key. **Result**: All the selected objects are highlighted by small colored squares located at each corner of the block.

How to Deselect a Block of Selected Objects

The table below describes the operations to carry out in order to deselect a block.

Step	Action
1	Press the **Shift** key and keep the key pressed down.
2	Left-click the selected block that you wish to deselect. **Result**: The colored squares associated with the object disappear, showing that the block is no longer included in the selection.

1.4.3.2.2 How to Create Composite Objects

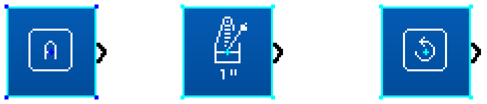
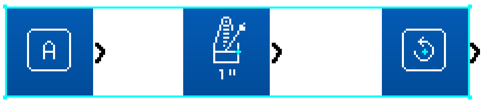
(§ 1.4.3.2.1) (§ 1.4.3.2.3)

Overview

The objects in a wiring or supervision sheet are sometimes associated to form a single composite object. In the same way, it is sometimes necessary to ungroup a composite object into several single objects, in order to manipulate them individually.

How to Associate a Group of Objects

The table below describes the operations to carry out in order to associate a group of objects.

Step	Action
1	Select the objects to associate. **Result**: The selection is represented by small colored squares located on each element of the selection. 
2	Activate the **Group** command in the **Tools** menu, or by right-clicking, the cursor being on an FB. **Result**: The objects are grouped into a single **composite object**. The resulting object is represented by small colored squares located at each corner of the object. 

How to Ungroup a Group of Objects

The table below describes the operations to carry out in order to ungroup a group of objects.

Step	Action
1	Select the composite object to ungroup. **Result**: The composite object is represented by small colored squares.

2	Activate the **Ungroup** command in the **Tools** menu, or by right-clicking, the cursor being on an FB. **Result**: All the objects contained in the composite object are displayed with their small colored squares.

1.4.3.2.3 How to Delete and Duplicate Objects

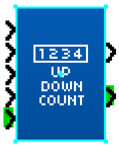
(§ 1.4.3.2.2) (§ 1.4.3.2.4)

Overview

Sometimes it may be necessary to delete an object or duplicate a given object in the wiring sheet.

How to Delete Objects

The table below describes the operations to carry out in order to delete one or more objects.

Step	Action
1	Select the object(s) to be deleted. **Result**: The selection is represented by small colored squares located on each corner of the block. 
2	Press the **Delete** or **Backspace** key. **Result**: The selected objects are deleted.

How to Copy Objects Using the Mouse

The table below describes the operations to be carried out in order to copy one or more objects using the mouse.

Step	Action
1	Select the object(s) to be copied.
2	Left click on one of the selected objects.
3	Keep the mouse button pressed down and press the **CTRL** key.
4	Drag the selected object(s) to the chosen spot. **Result**: During the movement, the selection is shown by a dotted zone.
5	Release the mouse button. **Result**: The copy of the selection is positioned at the chosen spot.

How to Cut, Copy or Paste Objects

The table below shows the operations to carry out to cut, copy or paste one or more objects.

Step	Action
1	Select the object(s) to be manipulated. **Result**: The selection is represented by small colored squares located on each corner of the block.
2	Select the command to execute, **Menu/Edit** or right-click on the mouse: - **Cut** - **Copy** - **Paste** **Result**: **Cut** deletes the selected objects and stores them on the clipboard. **Copy**

	duplicates the selected objects onto the clipboard and **Paste** duplicates the clipboard contents onto the screen.

Note: The keyboard shortcuts Ctrl C, Ctrl V and Ctrl X can also be used respectively to copy the selected function blocks, and either paste or delete them.

1.4.3.2.4 How to Position Objects

⇦□□□ □ (§ 1.4.3.2.3)   □ □□□⇨ (§ 1.4.3.2.5)

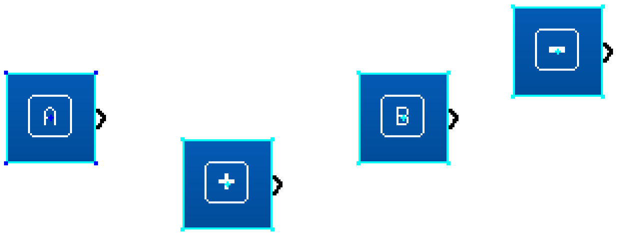
At a Glance

It is sometimes necessary in a wiring or supervision sheet to position an object in relation to another.

- To align objects,
- To center objects,
- To distribute objects
- To position the objects in the foreground and background in relation to others.

How to Align a Group of Objects

The following table describes the operations to carry out when aligning a group of objects:

Step	Action
1	Select the objects to align. **Result**: All of the selected objects are highlighted by small colored squares placed at each corner of the block. 
2	From the **Align** command in the **Tools** menu, the drawing bar or by right-clicking on the mouse, select: • Align left , • Align right , • Align top , • Align bottom . **Result**: The selected objects are aligned according to the choice made.

How to Center a Group of Objects

The following table describes the operations to carry out when centering a group of objects:

Step	Action
1	Select the objects to center. **Result**: All of the selected objects are highlighted by small colored squares placed at each corner of the block.
2	From the **Align** command in the **Tools** menu, the drawing bar or by right-clicking on the mouse, select:

	- Center vertically , - Center horizontally . **Result**: The selected group of objects is centered.

How to Distribute a Group of Objects

The following table describes the operations to carry out when distributing a group of objects:

Step	Action
1	Select the objects to distribute. **Result**: All of the selected objects are highlighted by small colored squares placed at each corner of the block.
2	From the **Align** command in the **Tools** menu, the drawing bar or by right-clicking on the mouse, select: - Distribute vertically, , - Distribute horizontally. . **Result**: The selected group of objects is distributed.

How to Bring an Object to the Foreground

The following table describes the operations to carry out when bringing an object to the foreground:

Step	Action
1	Select the object to be brought to the foreground. **Result**: The selected object is highlighted by small colored squares placed at each corner of the block.
2	From the **Align** command in the **Tools** menu, the drawing bar or by right-clicking on the mouse, select: - Bring to front **Result**: The object selected is brought to the foreground.

How to Send an Object to the Background

The following table describes the operations to carry out when sending an object in the background:

Step	Action
1	Select the object to be sent to the background. **Result**: The selected object is highlighted by small colored squares placed at each corner of the block.
2	From the **Align** command in the **Tools** menu, the drawing bar or by right-clicking on the mouse, select: - Send to back **Result**: The object selected is sent to the background.

1.4.3.2.5 How to Create or Modify a MACRO

(§ 1.4.3.2.4)

(§ 1.4.3.2.6)

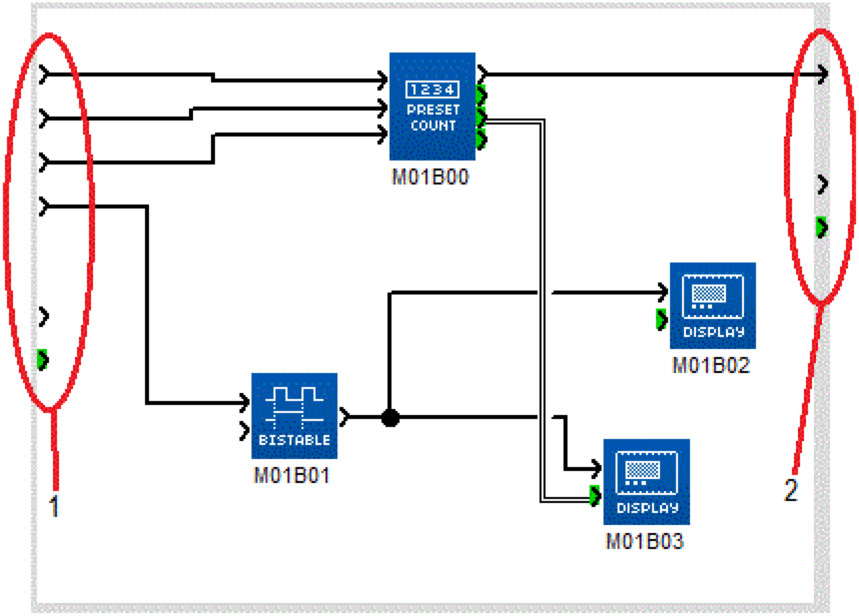
What is a MACRO?

A MACRO is a group of function blocks. It is characterized by its number, its name, its links, its internal

function blocks (255 maximum) and its input/output connections.
Inside the MACRO:

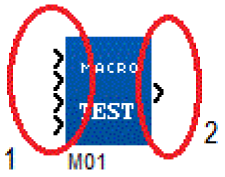
- The input connections are each connected to one function block input maximum
- Each function block output can be connected to a function block input or to an output connection.

Seen from outside, a MACRO behaves like a function block with inputs and/or outputs likely to be connected to links(§ 1.4.3.1.3). However, a MACRO cannot be inserted in another MACRO.
Example:
Internal view of a MACRO:



1 Input connections (each connected to one function block input maximum)
2 Output connections

External view of the same MACRO in the edit window:



1 Inputs (only the effective input connections are shown)
2 Output (only the effective output is shown)

Maximum Number of MACROS

The maximum number of MACROS (including instances(§ 1.4.3.2.5) taht are result of a duplication) is 64 per application.

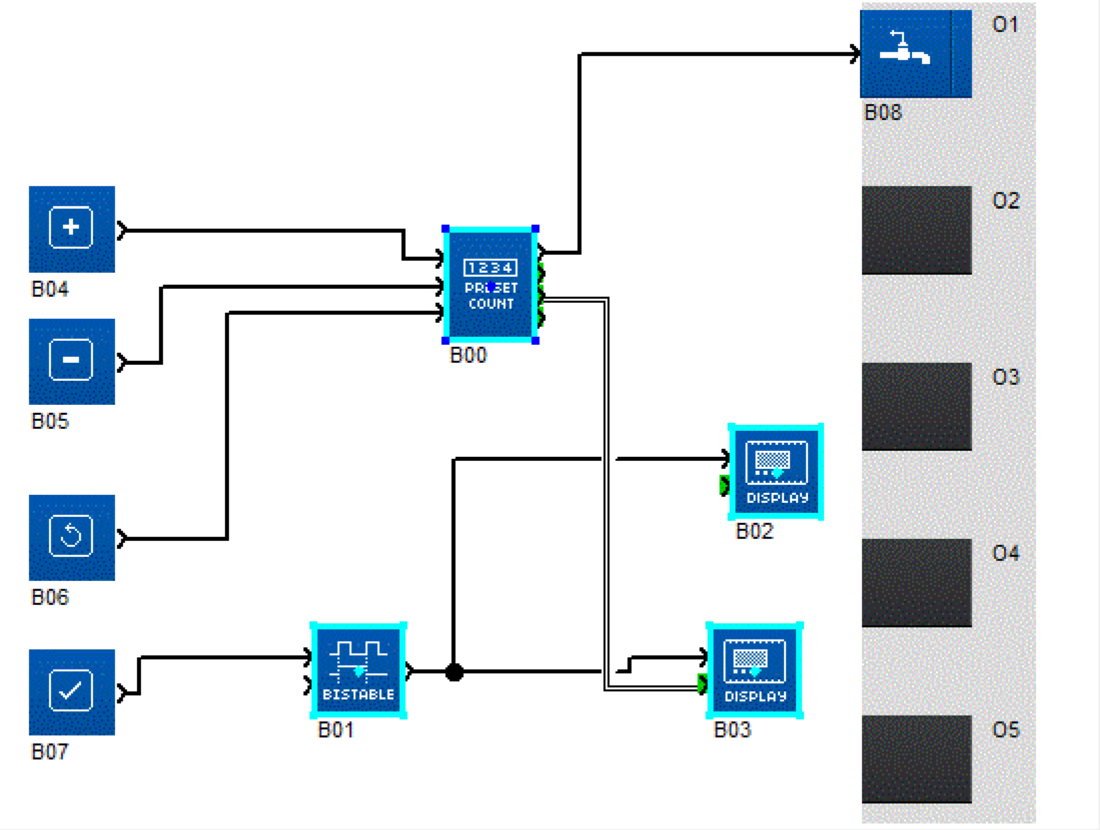
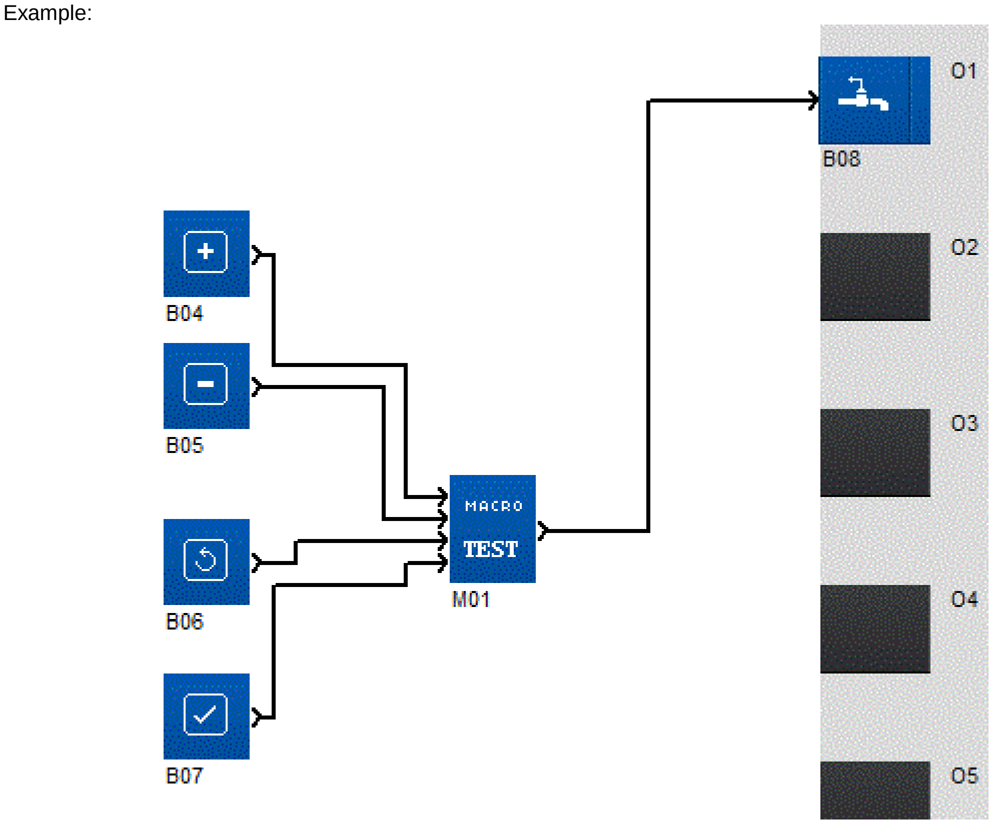
Saving a MACRO

A MACRO is saved by saving the application in which it is found (see Saving an Application(§ 1.6.1.9)).

How to Create a MACRO

A MACRO is created in several steps:

Step	Action
1	Select(§ 1.4.3.2.1) the function blocks on the wiring sheet that you wish to appear in the MACRO. Example:

<table>
<tr><td></td><td>
</td></tr>
<tr><td>2</td><td>Select the <b>Tools</b>/<b>Create a MACRO</b> command from the pop-up menu, or right-click on <b>Create a MACRO</b>.</td></tr>
<tr><td>3</td><td>Fill in the Macro Properties(§ 1.4.3.2.5) dialog box (the only compulsory field is <b>MACRO identifier</b>).</td></tr>
<tr><td>4</td><td>Close the dialog box by clicking on <b>OK</b>.
<b>Result</b>: All function blocks selected in step 1 are then shown by a single block (that of the MACRO) in the edit window.
Example:

</td></tr>
</table>

Manipulating a MACRO

Once created, a MACRO can be manipulated like a function block and in particular it can be:

- Selected(§ 1.4.3.2.1)
- Associated with other objects(§ 1.4.3.2.2)
- Duplicated in the Edit window(§ 1.4.3.2.3)
- Imported from another workshop (import MACRO)(§ 1.4.3.2.6)
- Exported out of the workshop (export MACRO)(§ 1.4.3.2.6)
- Copied/cut between two Software Workshops(§ 1.4.3.2.3)
- Deleted(§ 1.4.3.2.3)

  But it may also be archived in the functioning workshop and be used again at a later date to create or modify a FBD application

Instances of a MACRO

A macro created by duplication is deemed to be a new instance of the original macro.
Modifications made to the graphic or properties(§ 1.4.3.2.5) of an instance are automatically made on other instances of the macro. They are equivalent to recompiling the macro. On the other hand, modifications to the comment or internal function block parameters are specific to each instance of the macro. One may thus find two instances of the same macro that have different parameters.
If the last instance of a macro is cut or deleted, a message warns the user. It is then possible to cancel the operation.

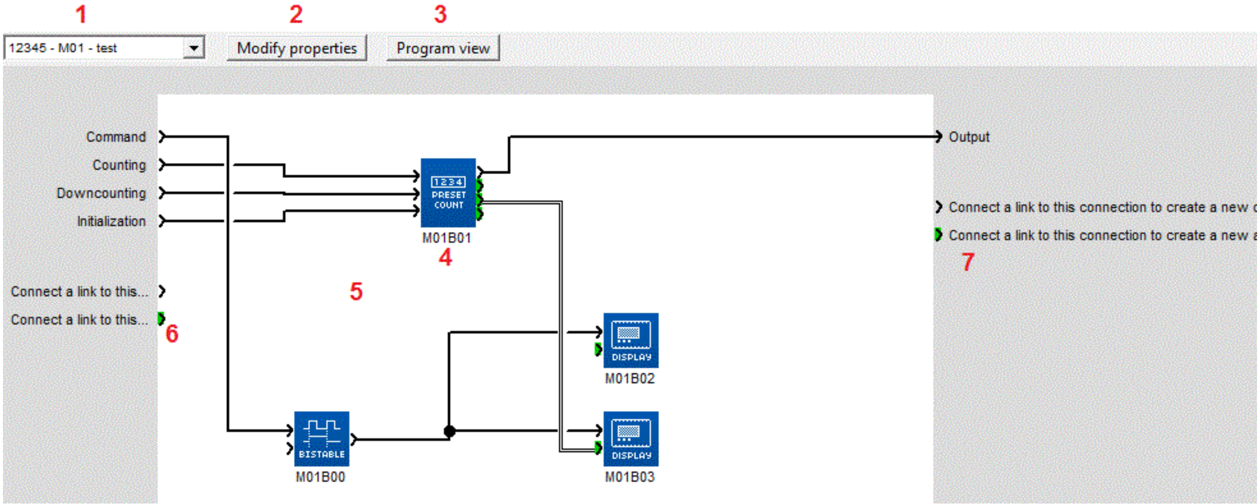
The MACRO Properties Dialog Box

The MACRO Properties dialog box is used to enter or modify the properties of a MACRO. If the MACRO has been duplicated, the modifications will affect all instances of the MACRO(§ 1.4.3.2.5).
The dialog box is accessible when a MACRO is created or in the pop-up menu by selecting **Display macro** then the **Modify properties** button.
The MACRO parameters are as follows:

- **MACRO identifier** (1 to 5 characters)
- **Name of the MACRO** (optionally, 25 characters maximum), the name of the Macro is visible on the edit sheet when the cursor passes over the Macro
- **Symbol for the block**, i.e. the appearance of the block that represents the MACRO in the main wiring sheet, and may be any of the following:
  - **Standard image** (The MACRO identifier is then used as the block symbol), or
  - **Custom image** (To insert a custom image, click on the **...** button)
- **Name of inputs** (if necessary, modify the input label in the **Label** box of the table)
- **Name of outputs** (if necessary, modify the output label in the **Label** box of the table)

The MACRO Window

MACROS can be modified in the **MACRO** window accessible from the **Windows** menu (except when protected by a password. See Password Protection(§ 1.4.3.2.5)).



Note: To return to the edit window from the MACRO window, click on the Program view button.

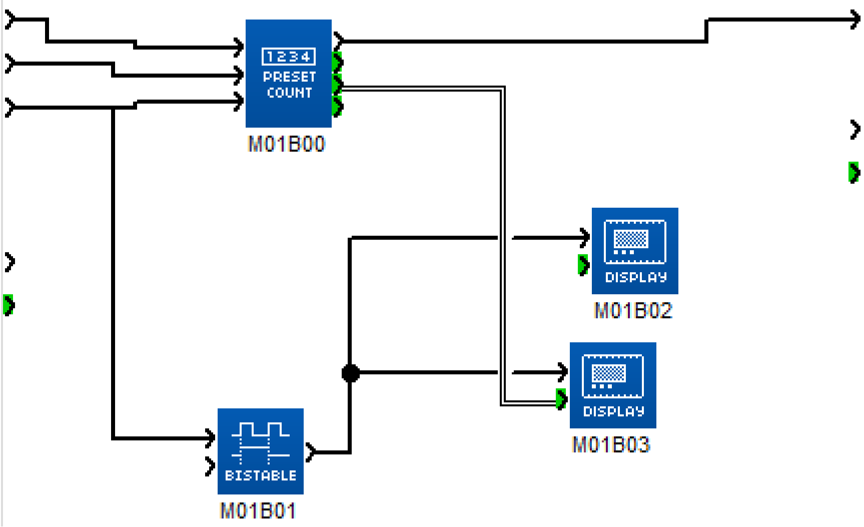
The table below lists the different elements in the **MACRO** window.

Element	**Function**
1: Drop-down list	Select the MACRO from the list of all the project MACROS and, if applicable, from the different instances(§ 1.4.3.2.5).
2: **Modify properties** button	Access the MACRO Properties(§ 1.4.3.2.5) dialog box.

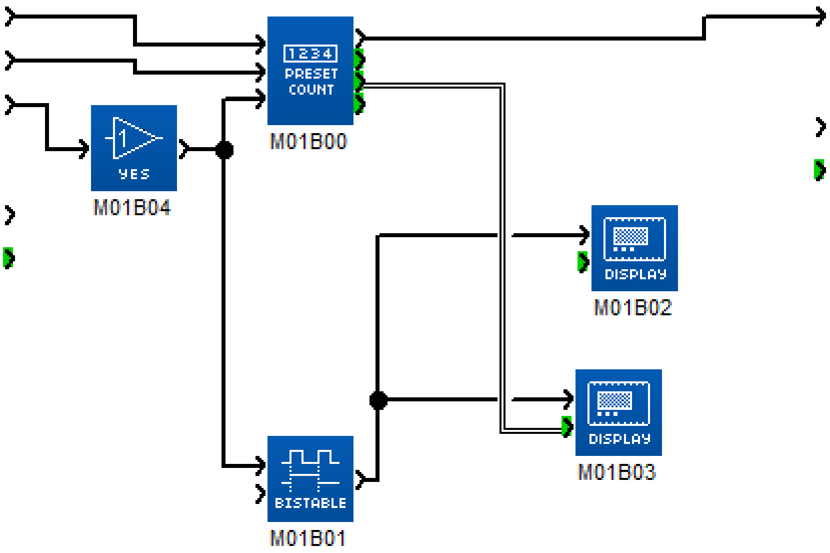
3: **Program View** button	Access the main programming sheet by clicking on it.
4: Function block internal to the MACRO	Access the internal function block parameters by double-clicking on them. (If the MACRO has been duplicated, the parameter modifications will only affect the current instance(§ 1.4.3.2.5) of the MACRO).
5: MACRO wiring sheet	Modify the graphic of the MACRO and in particular: • Add or delete a link between two function blocks • Add a function block from the function bar or from the edit window • Delete a function block (If the MACRO has been duplicated, these modifications will affect all instances of the MACRO(§ 1.4.3.2.5)). If the macro is archived, the Workshop offers the user the opportunity to create a macro with a new ID in the edited application, but does not modify the archived macro). It is not possible to connect two input connections to the same function block input (see Design Tip(§ 1.4.3.2.5)).
6: Input not connected	Create a new link to the input of a function block on the wiring sheet. An additional input of the MACRO will then appear in the edit window. (If the MACRO has been duplicated, these modifications will affect all instances of the MACRO(§ 1.4.3.2.5)).
7: Output not connected	Create a new link from the output of a function block on the wiring sheet. An additional output of the MACRO will then appear in the edit window. (If the MACRO has been duplicated, these modifications will affect all instances of the MACRO(§ 1.4.3.2.5)).

Design Tip

Inside a Macro, it is not possible to connect two input connections to two inputs on different function blocks.



Instead, we recommend adding a digital or analog YES function as appropriate.



How to Modify the Graphic of an Instance of a MACRO While Retaining Other Instances

Modifying the graphic of a single MACRO instance essentially means creating a new MACRO. Follow the steps below:

Step	Action
1	Select the MACRO instance by right-clicking the mouse.
2	Select **Display MACRO** in the pop-up menu.
3	Select **Menu: Edit** / **Select all**.
4	Select **Menu: Edit** / **Copy**.
5	Click on the Program view button to return to the main wiring sheet.
6	Select **Menu: Edit** / **Paste**.
7	Reposition the selection if necessary.
8	Select **Create a MACRO** in the pop-up menu.
9	Fill in the MACRO Properties(§ 1.4.3.2.5) dialog box (the only compulsory field is **MACRO identifier**).
10	Close the dialog box by clicking on **OK**.
11	Select **Display MACRO** in the pop-up menu.
12	Use the MACRO window(§ 1.4.3.2.5) to create the I/O connections and make modifications.

How to Modify a MACRO Comment

To modify a MACRO comment, proceed as follows:

Step	Action
1	Double-click on the MACRO
2	Modify the comment.
3	Confirm by clicking on OK.

Password Protection

A password may if necessary be used to protect the MACROS of a project. It is independent of the application password. It is a 4-digit number (0000 is not a valid password).
This protection is defined in the program configuration window accessible via the **PROGRAM** button or via **Menu: File** / **Properties**, **Configuration** tab.
The same password protects all project MACROS. It is requested when the project is opened.
If the password is not entered when the project is opened the following functions are not available:

- Access to the MACRO window
- Copy a MACRO
- Print MACROS

Archiving a Macro

Once created, the Macro may be archived in the workshop. It may then be re-used as a function block to create or modify an application when using the workshop at a later date.

To archive a Macro, select it with left-click and Drag/Drop it from the wiring sheet to the function bar's MACRO tab. It then appears in the Macro tab as a block available for programming. Drag/Drop it from the function bar to the wiring sheet in order to use it in a FBD program. The parameters for each function contained in the macro are the parameters of the example that has been archived.

Note 1 : if the wiring sheet already contains an example of the same Macro when it is Dragged/Dropped from the function bar, a new example appears in the wiring sheet.

Note 2 : A user may not archive a Macro with the same ID as a Macro that has already been archived. To do this, he must change the Macro's ID.

Note 3 : If an open program contains a Macro ID identical to a Macro archived in the workshop:

- If the two Macros are identical (identical FBD network, different block function parameters and comments) the archived Macro is accessible from the function bar.

- If the two Macros are different (different FBD network) the archived Macro is not accessible from the function bar and is shown greyed out.

To delete a Macro from the archive, it is necessary to display the content of the function bar's MACRO tab, select the Macro's symbol in the function bar by right-clicking on the mouse, and select Delete in the contextual menu or press the Delete key. It disappears from the MACRO tab in the function bar but it does not disappear from the FBD application being edited.

Note 4 : The Macro is also removed from all the function bar's customizable tabs

To reconfigure an archived Macro, it is necessary to display the content of the function bar's MACRO tab, select the Macro's symbol in the function bar by right-clicking on the mouse and select Reconfigure in the contextual menu. The “Macro configuration” window opens.

- If the user modifies the name of the archived Macro or the input output labels, this affects the archive but not the examples used in the wiring sheet.
- If the user modifies the ID of the archived Macro or its symbol, the user is informed by the workshop that he is in the process of creating a new archived MACRO and is going to replace the old Macro in the archives. However, this modification only affects the archive, not the examples used on the wiring sheet.

Note 5 : the user may then re-archive the old Macro by using one of the examples still on the wiring sheet. This allows him to create a new macro based on an existing macro.

1.4.3.2.6 How to import or export a MACRO

◁□□□□ (§ 1.4.3.2.5) □□□□▷ (§ 1.4.3.3)

Import a MACRO

The **File** / **Import** / **Macro** command can be used to import a macro exported as mm4 file. The macro is added in the function bar (displayed with any FBD program)

How to import a MACRO

MACROS are imported as follows :

Step	**Action**
1	Select the **Menu: File** / **Import** / **MACRO**.
2	Select the .mm4 file corresponding to the MACRO to import. (The MACRO to import is named with its ID).

During import some checks are made.

- If the MACRO is compliant with the workshop and if no MACRO with the same ID already exists in the workshop then the MACRO is imported and added in the function bar (displayed with any FBD program).
- If the MACRO is not compliant with the workshop a message is displayed. The import is canceled.
- If a MACRO with the same ID already exists the user must choose to continue or to cancel the action.

Export a MACRO

The user can export only MACROS present in the "MACRO" tab of the function bar (displayed with any FBD program).

How to export a MACRO

MACROS are exported as follows :

Step	**Action**

1	Edit a FBD program.
2	Choose "MACRO" tab from the function bar.
3	Right-click on the MACRO to export then choose "Export".
4	Select the folder to export to.

The exported MACRO is a .mm4 file named with the ID of the MACRO.
The exported MACRO can be then imported in another workshop.
The MACRO can be exported with an associated help in PDF format, right-click on the MACRO to be exported and select "Reconfigure", "Associated Help"

1.4.3.3 Debugging / Monitoring an FBD Application in the Programming Workshop

⇦□□□□ (§ 1.4.3.2.6)   □□□□⇨ (§ 1.4.3.3.1)

At a Glance

Subject of this Section

This section describes the different functions linked to debugging the application in the programming workshop.

What's in this Section?

This section contains the following topics:

- Simulation Mode(§ 1.4.3.3.1)
- Debugging Mode(§ 1.4.3.3.2)
- Modification and Forcing in Simulation and Debugging Mode(§ 1.4.3.3.3)

1.4.3.3.1 Simulation Mode

⇦□□□□ (§ 1.4.3.3)   □□□□⇨ (§ 1.4.3.3.2)

Introduction

Before loading a program onto a controller, it is possible to simulate execution using the programming workshop.

Access and Control

See: How to Debug an Application Without Loading it onto the Controller: Simulation(§ 1.2.7).

Modification and Forcing

See: Modification and Forcing in Simulation and Debugging Mode(§ 1.4.3.3.3).

1.4.3.3.2 Debugging Mode

⇦□□□□ (§ 1.4.3.3.1)   □□□□⇨ (§ 1.4.3.3.3)

Overview

In debugging mode, the controller is linked to the software workshop's host computer. In this mode you can perform the following actions from the edit and supervision windows and from the front panel:

- View the states of function block outputs
- View and modify function block parameters

- Force the state of function block inputs and outputs (maximum of 10 function block outputs simultaneously)
- Modify the state of the buttons on the front panel
- Force the state of function block links

Monitoring mode can be accessed from the **Mode:Debugging** menu.
In debugging mode, the different windows are all updated on each cycle. For example, if a function block is placed in the edit and supervision window, when any action is performed on this function block from the edit window, it is also updated in the supervision window.
(See How to Monitor and Modify an Application Running on the Controller from the Programming Workshop: Debugging(§ 1.2.8))

Unavailable Functions

In debugging mode, the following functions are not available:

- Graphic editing of programs
- Transfer program
- Delete program
- Compare program
- Switch to Simulation mode
- Modify communication parameters

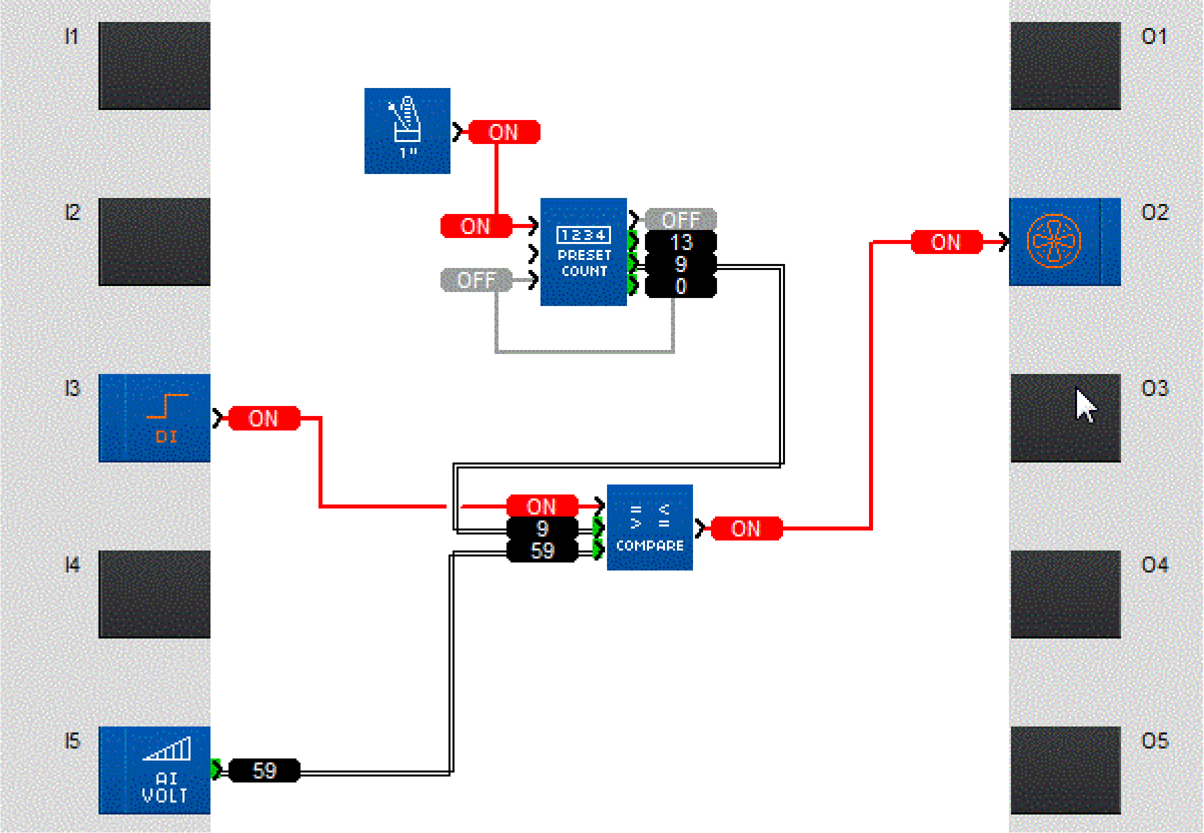
Access to Debugging Mode

Debugging is accessed by the **Mode: Debugging** menu or by using the D icon.
The following scenarios may arise:

- An application is open in the programming workshop: the version on the controller is compared with that of the programming workshop:
  - If the programming workshop application is the same as the application on the controller, Debugging mode is started.
  - If the programming workshop application is different from the application on the controller, the versions must be synchronized by transferring the PC program to the controller or the controller program to the PC.
- No application is open in the programming workshop: in this case, the programming workshop offers to send the application currently being executed on the controller back to the PC.

Diagram

The program states in the application windows are represented the same way as those in Simulation(§ 1.4.3.3.1) mode.
The figure below shows an example of edit and supervision windows in simulation mode:



1.4.3.3.3 Modification and Forcing in Simulation and Monitoring Mode

(§ 1.4.3.3.2) (§ 1.4.4)

Overview

In simulation or debugging mode, you can modify the parameters of function blocks and inputs, and force link states.
Forced values are highlighted by a change in color according to the state.

How to Modify the Parameters of a Function

During simulation or debugging, it is possible to modify the parameters of a function in the Edit window or in the window of a MACRO.

Step	Action
1	Double-click on the symbol representing the function. (This operation can be performed in the edit window, in the function summary table(§ 1.2.7) or in the supervision window.) **Result**: The function parameter window opens.
2	Modify one or more function parameters.
3	Click on **OK**.

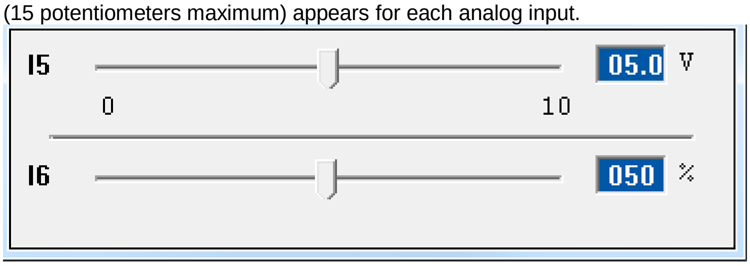
How to Modify or Force Discrete Inputs

During simulation or monitoring, it is possible to modify or force discrete inputs by clicking on them with the mouse. Each click reverses the state of the input.
In debugging mode, this action corresponds to forcing. It is maintained until the moment of release(§ 1.4.3.3.3).

How to Modify or Force Analog Inputs

During simulation or debugging, it is possible to modify or force analog inputs.

Mode	Procedure(s)	Result

Simulation	Method 1: - Click on the input with the mouse. - Modify the value in the **Analog Value** window.	The simulated input value is modified until the moment of release(§ 1.4.3.3.3).
	Method 2: - If the input has already been modified, release forcing(§ 1.4.3.3.3) - Click on the button. **Result**: A potentiometer (in volts or % depending on the input configuration) (15 potentiometers maximum) appears for each analog input.  - Click on the cursor and move it while holding down the left mouse button.	The simulated input value is modified.
Debugging	- Click on the input with the mouse. - Modify the value in the **Analog Value** window.	The input value is forced until the moment of release(§ 1.4.3.3.3).

How to Force a Discrete Link

During simulation or debugging, it is possible to force a discrete link in the Edit window or a discrete link between two objects in the window of a MACRO(§ 1.4.3.3.3).

To force a discrete link...	**proceed as follows:**	**Result:**
Momentarily...	Click on the link.	The state of the link is momentarily reversed.
Permanently...	- Click on the link with the right mouse button. - Click on **Force and maintain**. - Choose the state into which the link should be forced.	The link remains in the chosen state until the moment of release(§ 1.4.3.3.3).

How to Force an Analog Link

During simulation or debugging, it is possible to force an analog link in the Edit window or an analog link between two objects in the window of a MACRO(§ 1.4.3.3.3).

To force an analog link...	**proceed as follows:**	**Result:**
Momentarily...	- Click on the link. - Enter the value to which the link should be forced.	The link remains at the chosen value until a system or user action causes its modification.
Permanently...	- Click on the link with the right mouse button. - Click on **Force and maintain**. - Enter the value to which the link should be forced.	The link remains in the chosen state until the moment of release(§ 1.4.3.3.3).

Forcing a Link in a MACRO

During simulation or debugging, it is possible to force a link in the window of a MACRO on condition that it is a link between two MACRO function blocks or from a function block to an output. It is not possible to force a link connected to a MACRO input.
To open the MACRO window, right-click on the MACRO then select **Display MACRO** in the pop-up menu.
See, according to the type of link:

- How to Force a Discrete Link(§ 1.4.3.3.3)
- How to Force an Analog Link(§ 1.4.3.3.3)

How to Release Forcing

The forced links(s) and forced inputs can be released in the following manner.

To release...	**proceed as follows:**
a link or an input ...	- Click on the link or input with the right mouse button. - Click on **Release**.
all forced links and forced inputs ...	- Click on the wiring sheet with the right mouse button. - Click on **Release all**.

1.4.4 Example of an FBD Application

(§ 1.4.3.3. 3)

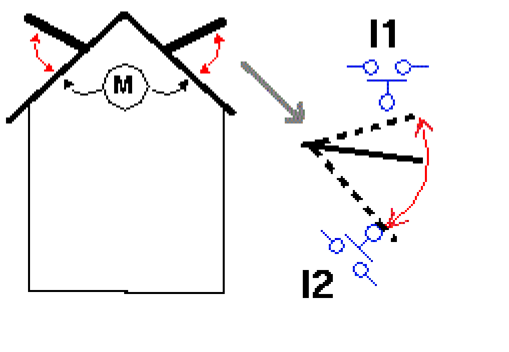
(§ 1.5)

Description

This example describes how a greenhouse's window panes can be managed automatically.

Specifications

The owner of a greenhouse would like to acquire an installation to manage the opening and closing of the ventilation window panes located on the greenhouse roof.
The greenhouse has two window panes to provide ventilation. The opening of these window panes is controlled by a motor and 2 sensors that indicate whether the window panes are open or closed:

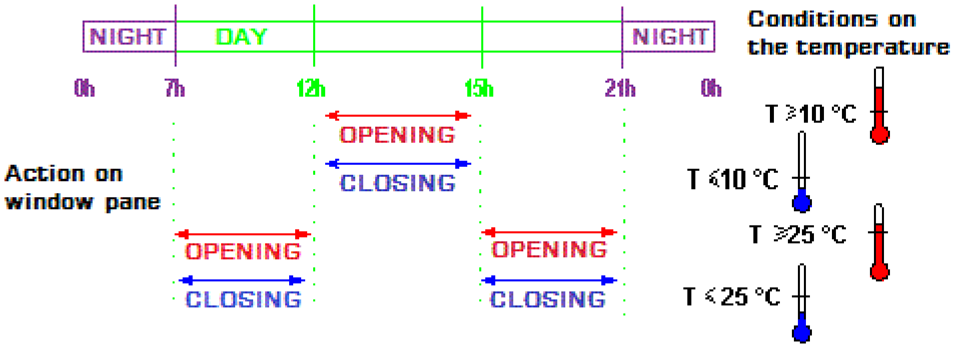
	Window pane open Window pane closed

During the day, the window panes open to ventilate the structure from 12:00 to 15:00, at the time of day when, in principle, the temperature is the highest. However, if the temperature is less than 10ºC, the window panes do not open, or when they are already open, they close.
In addition, the window panes open during the day when the temperature reaches 25ºC. If the temperature falls below 25 ºC, the window panes must close again.
Finally, at night, the window panes remain closed regardless of the temperature.
Program description, 3 time ranges are used:

- Range 1: Night, from 21:00 to 07:00
- Range 2: Day, from 07:00 to 12:00 and from 15:00 to 21:00

- Range 3: Noon, from 12:00 to 15:00

Summary:



Input/Output Table

Description of the inputs:

Input	Description
I1	Window panes open (Discrete)
I2	Window panes closed (Discrete)
I5	Temperature (analog)

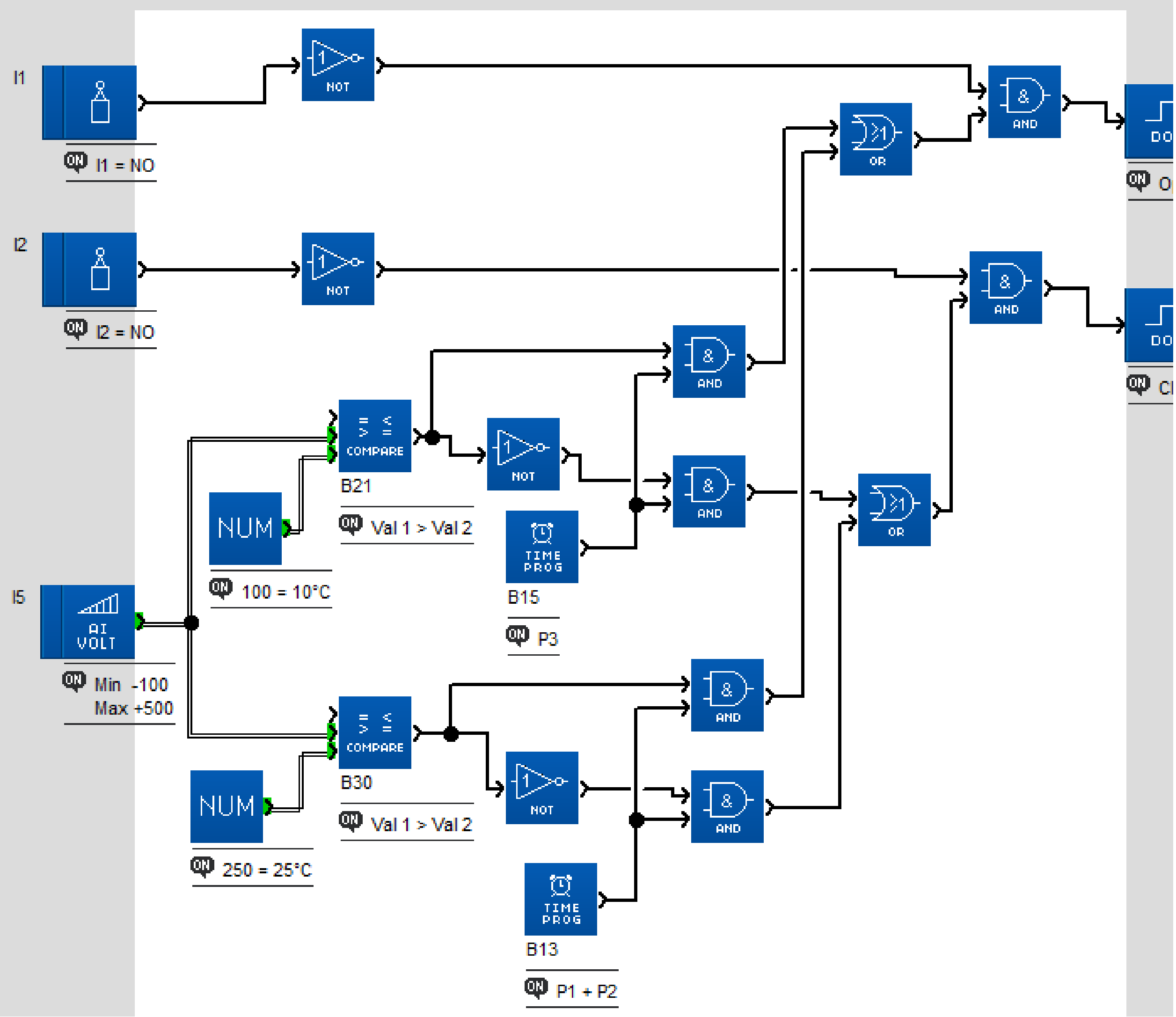
Description of the outputs:

Output	Description
O1	Opening of the window panes (Discrete)
O2	Closing of the window panes (Discrete)

The temperature is supplied by a sensor with output voltage of 0 to 10 V.

FBD wiring sheet

Description:



Description of the Parameters

Analog comparator B21

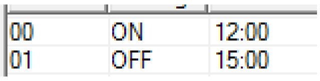
Value1 > Value2

Analog comparator B30

Value1 > Value2

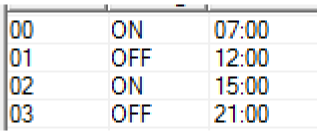
Daily programmer B15, B13

B15



00	ON	12:00
01	OFF	15:00

B13



00	ON	07:00
01	OFF	12:00
02	ON	15:00
03	OFF	21:00

1.5 Controller Connections

(§ 1.4.4)

(§ 1.5.1)

At a Glance

Subject of this Section

This section describes the functions and parameters related to connection to the controller.

What's in this Part?

This part contains the following chapters:

- Connection with the Programming Workshop(§ 1.5.1)
- Communication via the Modbus accessory(§ 1.5.2)
- Communication via the Ethernet connection(§ 1.5.3)
- Communication via the 2G connection(§ 1.5.4)

This table indicates the various options according to the type of communication:

	read/write an application	write Firmware	Debugging : read/write	Monito read/ XBIN, XBO XWC
USB accessory	X	X	X	
Bluetooth accessory	X	X	X	
RS485 accessory				X
2G SMS networked base				X
2G e-Connect networked base	X	X	X	X

1.5.1 Connection with the Programming Workshop

(§ 1.5) (§ 1.5.1.1)

At a Glance

Subject of this Chapter

This chapter describes the different functions related to the connection of the controller to the programming workshop.

What's in this Chapter?

This chapter contains the following topics:

- Configuring Communication Between the Programming Workshop and the Controller(§ 1.5.1.1)
- Transferring the Program from the PC to the Controller(§ 1.5.1.2)
- Read in the Controller(§ 1.5.1.3)
- ON/OFF Program Run Commands(§ 1.5.1.4)
- Compare the Controller Data with the Program(§ 1.5.1.5)
- Controller Diagnostics(§ 1.5.1.6)
- Protection of the Program Saved on the Controller(§ 1.5.1.7)
- Clear the Program Contained in the Controller(§ 1.5.1.8)
- Read/Write date and time(§ 1.5.1.9)
- Configuring the Controller Language(§ 1.5.1.10)
- Update the Controller Software(§ 1.5.1.11)

1.5.1.1 Configuring Communication Between the Programming Workshop and the Controller

(§ 1.5.1) (§ 1.5.1.2)

Description

To establish communication between the programming workshop and the controller, one of the following links can be used:

- **With the accessory** :
  - USB communication
  - Bluetooth communication
- **With a networked base** :
  - 2G e-Connect communication

Prior Action

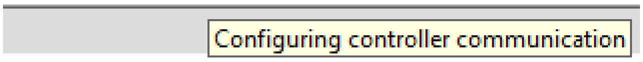
Before launching the connection between the programming workshop and the controller, check the following elements:

If using...	**ensure that:**
a USB link	• The controller is physically connected to the programming workshop (PC). • The connection is correctly configured.
a Bluetooth link	The Bluetooth adapter and its driver have been installed. **Note:** : The driver assigns a com port to the adapter.
a 2G link	• A SIM card is present. • An aerial is present.

Access

For the accessory: The **Configuring the Connection...** function can be accessed from the **menu: Controller**/**Configure Connection**.

For the networked base: click on the **COMMUNICATION** button on the edit sheet.



A Configuring Communication(§ 1.5.4.3) window appears.

1.5.1.2 Transferring the Program from the PC to the Controller

(§ 1.5.1.1) (§ 1.5.1.3)

Description

The **Write to the controller** function translates the program into data that can be loaded into the controller and transfers it from the PC to the controller.
This command opens the window: **Compilation results**, if the result of the compilation is:

- **Compilation successful**, then the application is transferred to the controller,
- **Failed**, the error number appears, the program must be edited, the error corrected and the write command launched again.

The transfer is only possible if the controller:

- Is not blocked by having sent an incorrect password,
- Is stopped.

The program will be written on the controller only in the following cases:

- The controller does not contain a program,
- The controller contains a program that is not read/write protected with a password,
- The controller contains a program that is read/write protected with a password, and

the password is known.
(In this case, the **Password** dialog box appears).

If all conditions are met, the Write options(§ 1.6.1.4) dialog box appears.

Note: Only an FBD program that has been compiled without any error will be written to the controller.

Note: The type of controller declared in the program must be compatible with the controller connected:

- Hardware version of the controller,
- controller firmware version,
- Controller software build number less than or equal to that of the controller,
- Same extension,
- Same hardware version and same extension software version.

Note: The controller software is implicitly updated when a program is transferred to a controller containing different software.
The controller software update is only allowed when the software loaded is designed for the same controller:

- Same hardware version,
- Same boot version and build number less than or equal to the boot of the controller to be loaded.

Access

The **Write to the controller** function can be accessed from the **Controller** menu.

Controller default software

If a communication problem appears (3 attempts), then you can try loading the controller firmware with the **menu: Controller**/Update the Controller Firmware and Language(§ 1.5.1.11)
(Check that the serial line is not disturbed).

Procedure

Procedure for transferring the program to the controller:

Step	Action
1	Activate the menu **Controller:Write to the controller**. **Result**: The program checking is launched and the **Compilation results** window opens.
2	Depending on the results of the check: - **Compilation successful**: Confirm with the **OK** key. **Result**: The **Write Options** dialog box appears. - **Failed**: Correct the errors and then start again at **step 1.**
3	Select Write Options(§ 1.6.1.4): - Protection of the program saved on the controller(§ 1.5.1.7): Protect reading and modification of the program with a password. - Save modifications before writing, - Start debugging mode and switch on the controller.
4	Confirm your changes by pressing the **OK** key. **Result**: The **Write Options** dialog box disappears.
5	Start the transfer by pressing on the **OK** key.

1.5.1.3 Read in the Controller

□□□□ (§ 1.5.1.2) □□□□ (§ 1.5.1.4)

Description

The **Read in controller** function translates the data contained in the controller in order to restore a program that can be edited in the programming workshop.
The programming workshop will be able to read the contents only if the controller:

- Contains a program that is not read/write protected with a password, or,
- Contains a program that is read/write protected with a password, and the password is known.
  (In this case, the **Password** dialog box appears).

The data retrieved by reading contains references to the application during its transfer:

- The name of the application file,
- The access path: relative to the **File:Preferences... work directory.**

> **Note:** The access path is limited to a maximum of 128 characters (program name with extension included).
> If this limit is exceeded (only the file name and its extension are saved), then a window is displayed to prompt the user to complete the access path.

Access

The **Read in the controller** function can be accessed from the **Controller** menu.

Restoring the Program

Using the information concerning the application present on the controller (name of the source file and location on the PC), the workshop tries to reload the application file from the PC.
The aim of this search is to retrieve the graphic representations:

- Positions related to the function blocks,
- Positions of links between functions,
- Comments,
- Screen backgrounds,
- Drawings.

> **Note:** Modifications may have been made after the write from the application to the controller if:
> - At the level of the programming workshop: the application has changed,
> - At the controller level: modification of the parameters using the front panel.
>
> In the case where differences in parameters appear, the dialog box asks the user if s/he would like to update the programming workshop program with the parameters read in the controller.

There are certain cases where the program cannot be retrieved:

- Program differences appear between the file containing the program on the PC and the application read on the module,
- The file containing the program on the PC is not accessible.
  To reread the original application saved on the PC, use the path (128 characters) in the configuration of the application loaded on the controller, then try an absolute path, then a path relative to the one defined as a preference. If only the name.ext can be found, look for the name in the preferences directory, or ask the user to pinpoint the location of the file for you.

In these circumstances, the **Program construction** window opens and suggests an alternative procedure:

- **Construction using the file specified by the user**: the user manually enters the file path of the application to be retrieved.
- **Automatic construction of the program**: in this case, the programming workshop interprets the data retrieved on the controller and rebuilds the corresponding application (the file is regenerated).

> **Note:** The program loaded into the controller does not contain information concerning page setup (drawing, comment, relative position of the function blocks and links); a default page setup is thus produced.

> **Note:** All of the function parameters are retrieved.

1.5.1.4 ON/OFF Program Run Commands

(§ 1.5.1.3) (§ 1.5.1.5)

Description

These commands can be used to remotely control a controller connected to the PC. Once the connection has been made, control can be carried out using the front panel window, with which the user can interact as if it were the actual front panel of the controller.
This function is used to start and stop the program in the controller:

- **Start controller and Reset saved parameters** : all the current values (counters, timers, etc.) are reset to zero before the start up of the program,
- **Start the controller without Reset** : the actual values for which the **Save on power break** option were activated are maintained,
- **Turn the controller off** : the program no longer runs, the outputs are deactivated.

Access

The ON/OFF Program Run Commands can be accessed from the **Controller** menu.

Controller Status Upon Power Failure

In the event of a power failure, the program is immediately stopped, parameters of the type **initialization on power break** or **latching on power break** are saved.
(See How the controller behaves in the event of power outage(§ 1.2.20)).
A break in the link between the workshop and the controller is indicated in the workshop by an error message (if the workshop is in Debugging mode, it switches to Edit mode).
When power is restored, the controller itself executes an **ON** command, initializing only the non-saved data.

Controller Status on Blocking Error

If the event of a controller blocking error (break or disruption in the link between the module and its extensions), the controller places itself in **OFF** mode:
The cause of the blockage can be viewed on the front panel of the controller.
To restart the controller, having removed the reason for the blockage, simply use the **Start controller and Reset saved parameters** command.
See What the error code displayed on the front panel of the controller means(§ 1.2.9),

1.5.1.5 Compare the Controller Data with the Program

(§ 1.5.1.4) (§ 1.5.1.6)

Description

This function tests the identity between the data contained in the controller and the data produced by compiling the programming workshop's application.
If the controller's data is protected by a password, the user is prompted to enter it in the **Password** window.
The comparison is carried out on the program (including parameters) contained:

- In the controller

- In the programming workshop edit window on the PC.

Access

The **Compare the controller data with the program** function can be accessed from the **Transfer** menu.

1.5.1.6 Controller Diagnostics

(§ 1.5.1.5) (§ 1.5.1.7)

Description

The diagnostics function allows you to view all characteristics of the controller to which the programming workshop is connected.
The Controller diagnostics dialog window can only be accessed if the controller is connected to the PC.
The diagnostics window is made up of 2 tabs:

- **Hardware**: characteristics of the controller (hardware and software),
- **Application**: Characteristics of the application built into the controller (user program).

Access

The **Controller diagnostics** function can be accessed from the **Controller** menu.

Hardware

The hardware tab provides the following information:

- The controller type and version/release of the hardware and software,
- Numbers and types of controller inputs and outputs,
- connected extension(s) and version(s)/release(s), only for the extendable controllers,
- Controller status (On, Off, Blocked in Error, Warning),
- Controller language,
- Error code (No error, Binary fault, Communication fault, Target Error or Warning),

> **Note:** The hardware-related information is always accessible, regardless of whether the program is protected by a password.

Application

The application tab provides the following information:

- The name of the program, its author, and version,
- Memories used/maximum memories,
- All of its configuration parameters: Basic cycle time, WATCHDOG action, Password

> **Note:** The information relating to the application is only available if the controller contains a program that is not password-protected or if the user knows the password.

1.5.1.7 Protection of the Program Saved on the Controller

(§ 1.5.1.6) (§ 1.5.1.8)

Description

The option for protecting the program transferred to the controller can be activated at the end of the Write to the controller procedure(§ 1.5.1.2).
The protection is activated in the **Write options** dialog box that contains the parameter: **Protect reading and modification of the program with a password**: if this option is validated, the password data entry zones are activated.

> **Note:** After 5 unsuccessful tries, the module is locked for a duration of 30 minutes.

1.5.1.8 Clear the Program Contained in the Controller

(§ 1.5.1.7) (§ 1.5.1.9)

Description

The program's clear function can be used to erase the application loaded on the controller, as well as related information (password), but does not affect the controller and its software.
This operation is very useful for removing a program whose password you have forgotten.

> **Note:** The program clear command is still valid, even if the controller is protected by a password.

Access

The **Clear the contents of the controller** function can be accessed from the **Controller** menu.

1.5.1.9 Read/Write date and time

(§ 1.5.1.8) (§ 1.5.1.10)

Description

The set clock window sets the date and time: It is divided into two zones:

- **Date** zone,
- **Time** zone.

Access

The **Read/Write date and time** function can be accessed from the **Controller** menu.

Settings:

The date is configure using the field in the **Date** zone.
The **Time** zone sets:

- Hours,
- Minutes,
- Seconds
- Controller clock drift: in seconds per week.

Procedure

Set clock procedure of the controller:

Step	Action

1	Click on **menu :Controller** → **Read/Write date and time**.
2	Enter the new clock parameters.
3	Confirm your changes by clicking **Write to the controller**. **Result**: the workshop sends the new values to the controller.

1.5.1.10 Configuring the Controller Language

□□□□ (§ 1.5.1.9) □□□□ (§ 1.5.1.11)

Description

This function is used to change the controller interface language.
All messages can be viewed in 5 languages:

- English
- French
- German
- Italian
- Spanish

Access

The **Controller language** function is accessible from the **menu: File** → **Preferences**.

Procedure

Procedure for updating the controller language:

Step	Action
1	Select the **menu: File** → **Preferences**.
2	In the **Controller language** zone, select the language in the drop-down menu.
3	Confirm by clicking on **OK**.
4	Select the **menu: Controller** → **Update Controller Firmware and Language**.
5	In the **Select the controller firmware** window confirm by clicking on **OK**. **Result:** The software workshop sends the new values to the controller.

1.5.1.11 Update the Controller Software

□□□□ (§ 1.5.1.10) □□□□ (§ 1.5.2)

Description

This command can be used to load the firmware into the module to:

- reload the firmware,
- change the version/release.

This triggers clearing of the program that was loaded into the controller, as well as all of the controller's configuration parameters.
This operation is also very useful for removing a program whose password you have forgotten.

Note: The firmware is implicitly updated when a program is transferred to a controller containing older compatible firmware.

Access

The **Update the controller software** function can be accessed from the **Controller** menu.

Procedure

Procedure for updating the controller software:

Step	Action
1	Click on **Menu:** Controller / **Update Controller Firmware and Language**
2	Select the firmware to be downloaded
3	Validate the transfer by pressing the **OK** key. **Result:** The software workshop sends the new values to the controller.

What to do in the case of apparent failure of the controller?

A brief power failure during loading could make the controller seem to fail. In fact, in this case, the controller will display nothing because its software has been lost. In this case, proceed as follows:

Step	Action
1	Create a new power failure for 10 seconds.
2	Restart the procedure for updating the controller software.

1.5.2 Communication via the Modbus Interface

⇦ (§ 1.5.1.11)

⇨ (§ 1.5.3)

Description

The Modbus protocol is a **master/slave** protocol that allows one, and only one, master to request responses from slaves, or to act based on the request.
To use Modbus functions a **Modbus RS485** interface needs to be added.

> **Note:** The Modbus interface only operates in 2-wire slave Modbus mode.

Functional Description

The Modbus interface has the following features:

- Connection on a Modbus network: 2-wire
- Maximum network length: 1000 meters (9600 bauds)
- Line terminated at both ends (Line terminators: 1nF, 120 ohms in series)
- Use of a shielded cable
- Screw terminal block connections
- GND signal connected directly to the protection ground at one point on the bus

> **Note:** Line polarization is not available on interfaces.

Parameter Setting

The network can be configured in the software workshop. Click on the "COMMUNICATION" button on the edit sheet and then on the Modbus tab.

Transmission mode:

- RTU
- ASCII

Speed in bauds

Transmission speed (bauds): 1200, 2400, 4800, 9600, 19200, 28800, 38400 and 57600.

Parity

- Even
- Odd
- None

Modbus slave address:

- Network address: 1 to 247

Default settings: RTU, even parity, address 1, 1200 bauds, 1 stop bit.

Data Exchanged

Name	R/W	Address
XWIN	R/W	0001
XWIN	R/W	0002
: :	: :	: :
XWIN	R/W	0023
XWIN	R/W	0024
XBIN	R/W	0025
XWOUT	R	0026
XWOUT	R	0027
: :	: :	: :
XWOUT	R	0048
XWOUT	R	0049
XBOUT	R	0050

MSB STATUS	R	0051	0x0000	
LSB STATUS	R	0052	0x0000 : Stop	0x0001 : Run 0x0002 : Debugging 0x0040 : Front-panel parameter setting 0x0800 : Power failure
MSB STATUS	R	0053	See warning/error code	
LSB STATUS	R	0054	See warning/error code	
CLOCK	R/W	0055	second	
	R/W	0056	minute	
	R/W	0057	hour	
	R/W	0058	day	
	R/W	0059	date	
	R/W	0060	month	
	R/W	0061	year	
SUMMER/WINTER	R/W	0063	Changeover	0x0000 : not confirmed 0x0001 : Europe 0x0002 : USA 0x0003 : manual
	R/W	0064	SUMMER month	0x0001 : January 0x000C : December
	R/W	0065	SUMMER date	0x0001 : 1st Sunday 0x0005 : 5th Sunday
	R/W	0066	WINTER month	0x0001 : January 0x000C : December
	R/W	0067	WINTER date	0x0001 : 1st Sunday

				0x0005 : 5th Sunday
DRIFT	R/W	0068	Drift	0x0001 : 1st Sunday 0x0005 : 5th Sunday
RUN/STOP	W	0069	0x0000 : Stop	0x0001 : Run

1.5.3 Communication Via Ethernet Extension

(§ 1.5.2) (§ 1.5.3.1)

1.5.3.1 Overview

(§ 1.5.3) (§ 1.5.3.2)

1.5.3.2 Acquisition of IP Addresses

(§ 1.5.3.1) (§ 1.5.3.3)

1.5.3.3 Communication on the Ethernet Network

(§ 1.5.3.2) (§ 1.5.3.4)

1.5.3.4 Specific Requests to the TCP Diagnostics

(§ 1.5.3.3) (§ 1.5.4)

1.5.4 Communication Interface via the 2G Connection

(§ 1.5.3.4) (§ 1.5.4.1)

At a Glance

Subject of this Chapter

This chapter describes the programming software functions for the 2G communication interface.

What's in this Chapter?

This chapter contains the following topics:

- Overview(§ 1.5.4.1)
- Directories(§ 1.5.4.2)
- Configuring the 2G Communication Interface(§ 1.5.4.3)
- Sending an Email via SMS(§ 1.5.4.4)
- Description of the Error Codes of the 2G Communication Interface(§ 1.5.4.5)

1.5.4.1 2G Communication: Overview

(§ 1.5.4) (§ 1.5.4.2)

Description

"2G" communication is radio communication that is available in 2 formats:

- 2G SMS: the product communicates with a smartphone, a PC, an em4, using SMS.
- 2G e-Connect: the product communicates with a server and at the other end, a tablet, a PC, an em4, etc. connected to the server

Configuring the Interface

Certain parameters such as the PIN code, the Access Point Name (APN), the COM port, etc. need to be entered using the Configuring Controller Communication(§ 1.5.4.3) window.

Directory

A directory can be accessed from the Directory(§ 1.5.4.2) menu. This directory is used to store the various recipients with their telephone number, email, profile.

Sending an Email

The procedure for sending an email is described in this page(§ 1.5.4.1).

1.5.4.2 Directories Menu

⇦□□□□ (§ 1.5.4.1)

□□□□⇨ (§ 1.5.4.3)

Description

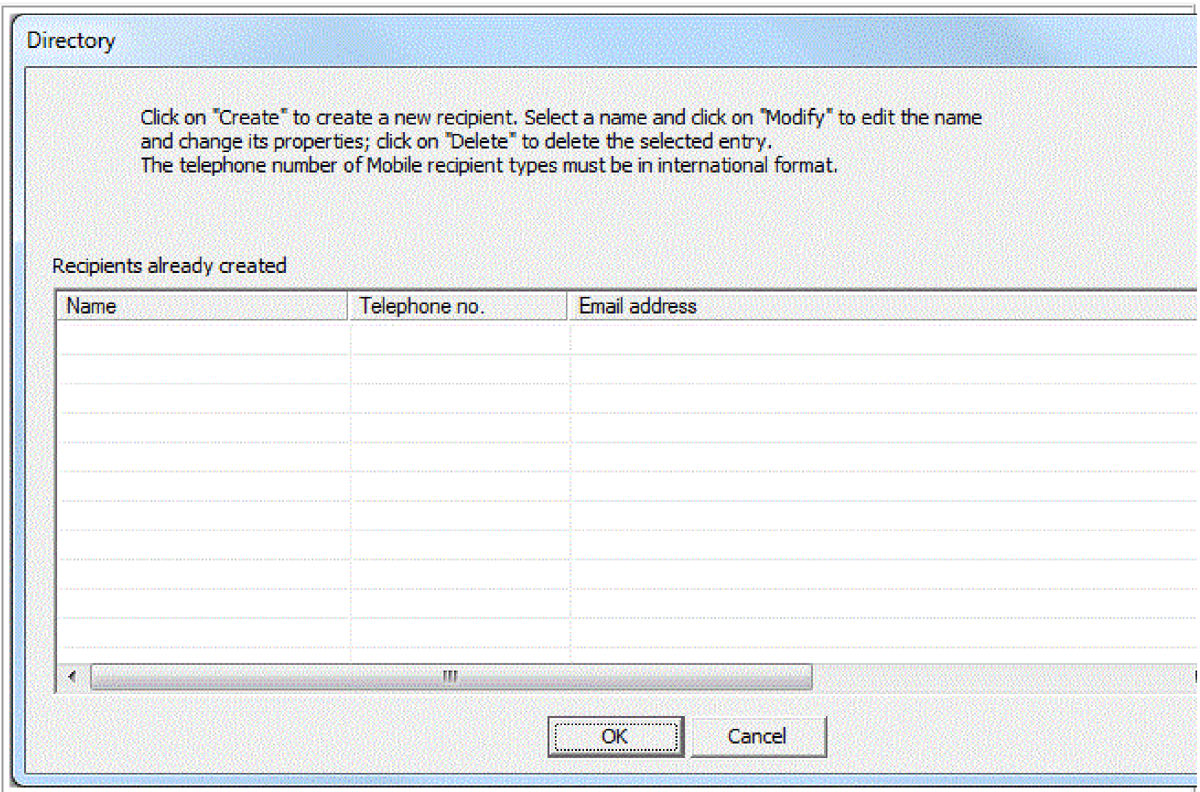
The **Directory** menu contains programming software functions that are used to create or modify a directory, and are necessary to use the 2G communication interface.

To create or modify the directory of recipients, proceed as follows:

Directory of Recipients

The general directory of recipients is independent of the program being edited. It is used to save information about the recipients used regularly in the programs. To create or modify the general directory of recipients, proceed as follows:

Step	Action
1	Click on the **menu : Directory** / **Directory**. Result: The General Directory of Recipients window appears and for each recipient shows the following:

	 Directory Click on "Create" to create a new recipient. Select a name and click on "Modify" to edit the name and change its properties; click on "Delete" to delete the selected entry. The telephone number of Mobile recipient types must be in international format. Recipients already created Name | Telephone no. | Email address OK Cancel - The **name** of the recipient, - His **telephone number**, - His **Email address**, - His **Profile**, **Note:** : To configure the connection, click on this link: Configuring the 2G Communication Interface(§ 1.5.4.3).
2	It is possible: - To add recipients: click on the Create(§ 1.5.4.2) button, - To modify a recipient: select the recipient then click on the **Modify** button, - To delete a recipient: select the recipient then click on the **Delete** button,
3	Confirm by clicking on the **OK** button.

Creating a Recipient

When creating a new recipient, after clicking on the **Create** button, proceed as follows::

Step	Action
1	Select the type of recipient from among: - **Administrator**, 1 maximum, who has all rights without restriction, - **Operator**, 6 maximum, with some access restrictions, - **User**, 3 maximum, with read-only data access.
2	Enter recipient name (20 characters maximum).
3	Enter his telephone number or his Email. Use the international format for mobile telephones, for example: +336******** Email: string of 64 characters maximum **Note:** To send an **Email via SMS**, the syntax to use in the recipient Email is specific to each network operator. Contact the modem SIM card's network operator and refer to the Composition of an SMS/Email(§ 1.5.4.4) section for more information.
4	Confirm by clicking on the **OK** button.

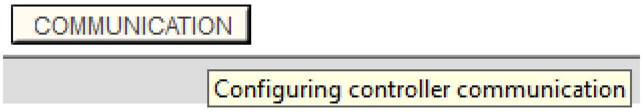
1.5.4.3 Configuring the 2G Communication Interface

(§ 1.5.4.2)

(§ 1.5.4.4)

Access

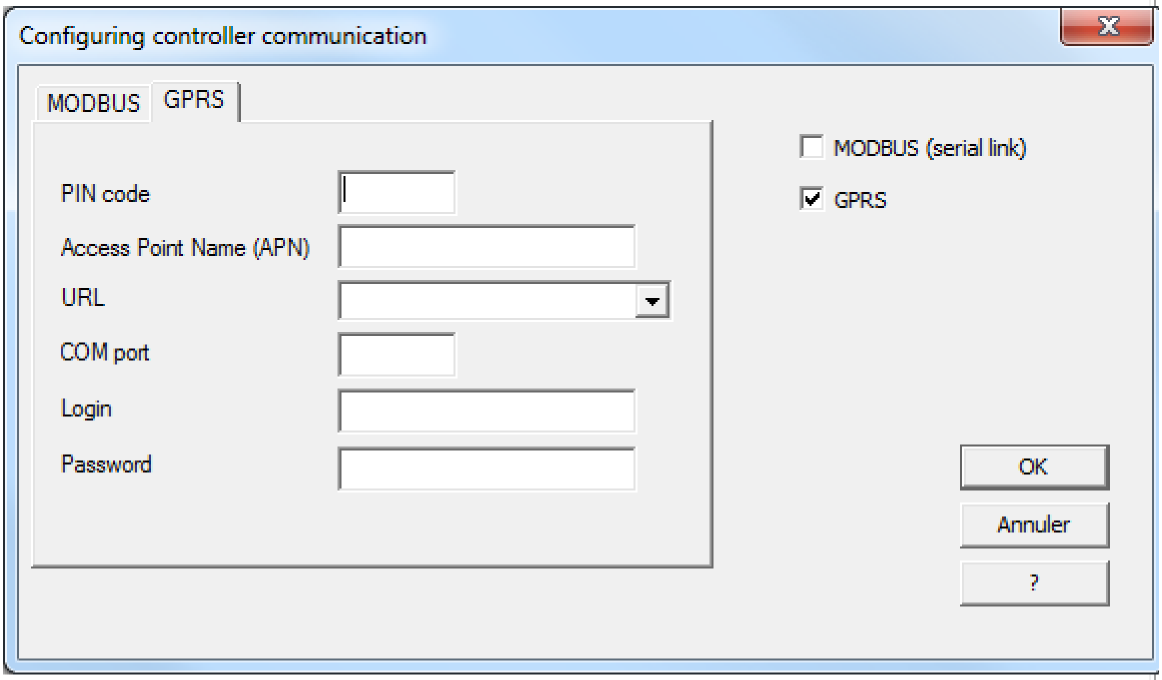
With a networked base: click on the **COMMUNICATION** button on the edit sheet:



A **Configuring Communication** window appears.

Configuring Controller Communication

Procedure :

Step	Action
1	Click on the GPRS tab  Configuring controller communication MODBUS GPRS PIN code Access Point Name (APN) URL COM port Login Password ☐ MODBUS (serial link) ☑ GPRS OK Annuler ?
2	Fill in the various boxes: - **PIN code** : This code is provided by the operator - **Access Point Name (APN)*** : This address is provided by the operator - **URL** : (128 characters) Not available in this version - **COM port** : Not available in this version - **Login*** : (30 characters) The Login is provided by the operator - **Password*** : The Password is provided by the operator
3	Confirm changes by pressing the **OK** button.

- A directory(§ 1.5.4.2) then needs to be created.

* Only to send emails

1.5.4.4 Composition of an SMS/Email

(§ 1.5.4.3)

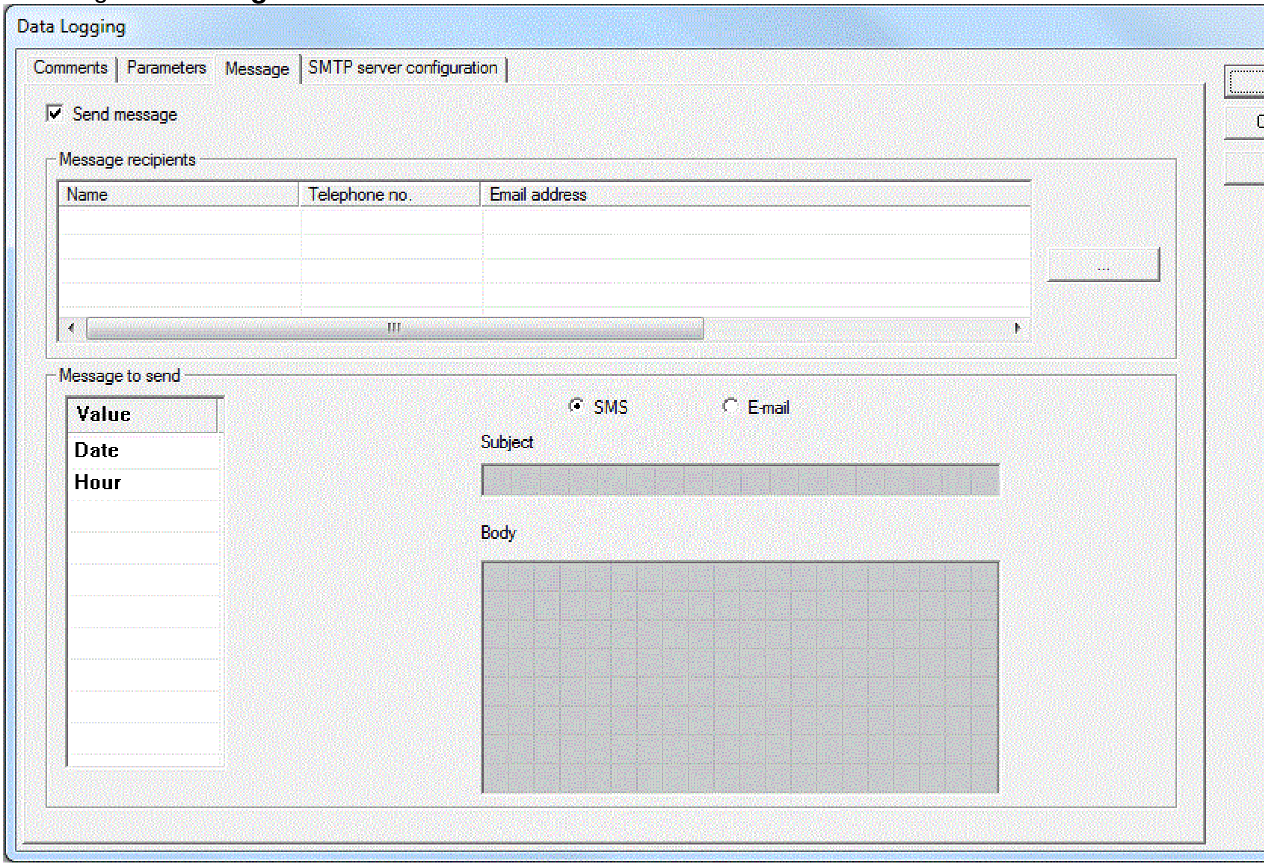
(§ 1.5.4.5)

Description

Here we describe how to compose an SMS, or an Email.

Access

From an Event(§ 1.4.2.4.7) or Datalogging(§ 1.4.2.4.6) function by double-clicking on the FB and selecting the **Message** tab:



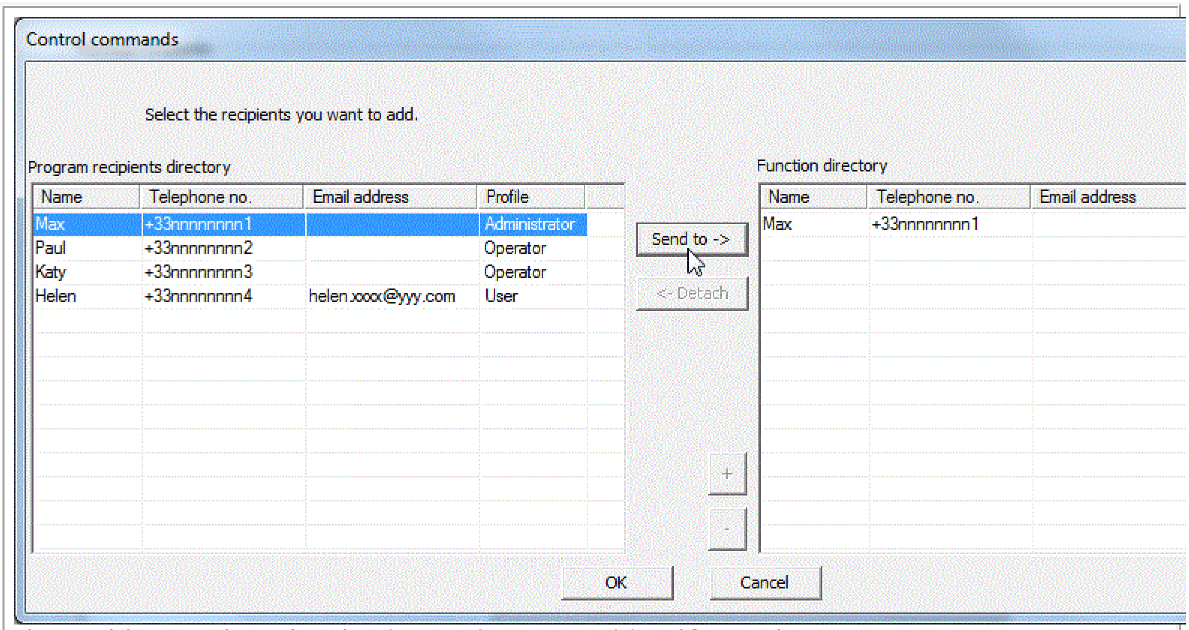
☑ Send message

● SMS ○ E-mail

Click on the **Send message** box to confirm the window.

Procedure:

Step	Actions
1	Click on the button ... of the **Message Recipient** zone to add a recipient or modify the list of recipients of this message.



Control commands

Select the recipients you want to add.

Program recipients directory

Name	Telephone no.	Email address	Profile
Max	+33nnnnnnnn1		Administrator
Paul	+33nnnnnnnn2		Operator
Katy	+33nnnnnnnn3		Operator
Helen	+33nnnnnnnn4	helen.xxxx@yyy.com	User

Function directory

Name	Telephone no.	Email address
Max	+33nnnnnnnn1	

	These recipients are chosen from the Directory of Program Recipients(§ 1.5.4.2).
2	For each new recipient to be added, select it in the **directory of the program** and click on the **Send to ->** button.
3	Organize the recipients in the order of priority by using the **+** and **-** buttons.
4	For each recipient to be deleted, select it in the **directory of the function** and click on the **<- Detach** button.
5	Confirm by clicking on the **OK** button.
6	Choose SMS or Email
7	Click in the rectangle under the **Subject** part, and type your text.
8	In the central rectangle under the **Body** part, type your text.
9	In the **Value** window, click on **Date**, **Time**, **Value 1**, **Value 2**, etc. and drag/drop the selected variable in the central rectangle under the **Body** part.
10	Proceed in the same way to add other values, and you are thus composing the **Body** of your message.
11	Confirm changes by pressing **OK**.

Note: **Value 1**, **Value 2**, etc. can be formatted with decimals.

Envoi d'Email

To email sending, you must specify the URL in the **SMTP server Configuration** tab
The administrator must have an email adress, this is this adress that will be used as email sender.

Note: The access to some of SMTP server is protected, in this case inform the **Password** field.

1.5.4.5 Description of the 2G Communication Interface Error Codes

(§ 1.5.4.4) (§ 1.6)

Description

Here we describe the errors detected by the communication interface software.

Error Codes

The majority of errors are fed back to the application, please consult the list of errors(§ 1.6.1.12).

In some specific cases, the application may not be informed of communication errors.
For example:
- When the SMTP server is not compatible with the SIM card used,
- or the communication block parameters have not been set.

In these situations communication is blocked; to unblock it switch the base OFF/ON.

1.6 Functions of the Programming Workshop

◁□□□□ (§ 1.5.4.5) □□□□▷ (§ 1.6.1)

At a Glance

Subject of this Section

This section describes the different functions available in the programming workshop.

What's in this Part?

This part contains the following chapters:

1.6.1 Functions

◁□□□□ (§ 1.6) □□□□▷ (§ 1.6.1.1)

At a Glance

Subject of this Chapter

This chapter describes the different functions available in the programming workshop.

What's in this Chapter?

This chapter contains the following topics:

1.6.1.1 Program Configuration

□□□□ (§ 1.6.1) □□□□ (§ 1.6.1.2)

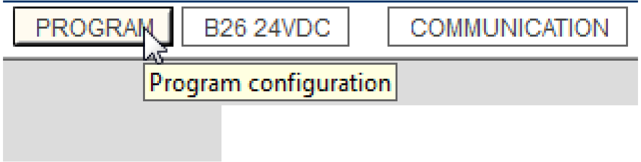
Description

The program configuration window is used to set the different parameters linked to the application.
The window includes at least the following four tabs:

- Properties(§ 1.6.1.1)
- Configuration(§ 1.6.1.1)
- History(§ 1.6.1.1)
- Date format(§ 1.6.1.1)

Access

The **Program configuration** function is accessible from the **PROGRAM** icon



Properties

The **Properties** tab is used to define the following elements:

- Project name (maximum 24 characters)
- Author (maximum 32 characters)
- Version (0 ≤ V ≤ 255 , 0 ≤ I ≤ 255),
- Comment (maximum 9 lines)

> **Note:** When printing the comment, only line feeds introduced by the user with the **Enter** key are taken into account.

Configuration

The **Configuration** tab is used to set the following parameters:

- Adjustment of the controller basic cycle(§ 1.6.1.1) time
- WATCHDOG(§ 1.6.1.1) action (control of the controller basic cycle time)
- Frequency of all controller PWMs(§ 1.4.2.2.2), only for controllers with PWM-type outputs
- Restricted access(§ 1.6.1.1) to the Parameters menu of the controller front panel
- Activate MACRO password protection(§ 1.4.3.2.5)

History

The **History** tab is used to track changes in the application.
The programmer can save the following information for each change:

- Date
- Programmer name
- Version
- Comment

Date Format

The **Date format** tab is used to set:

- The format in which the date will be displayed, to be chosen from the following three options:
  - Day/Month/Year
  - Month/Day/Year
  - Year/Month/Day

- Automatic summer/winter time change.
  Here you can activate or deactivate automatic time change, and choose the changeover dates. (See How to Activate Automatic Time Change(§ 1.6.1.1))

Basic Cycle

To be executed by the controller, this program is translated as a set of ordered instructions, where each instruction corresponds to a function.
This set of instructions (functions) is executed periodically, therefore at regular time intervals. This time interval is called the **basic cycle time**.
This time therefore corresponds to the sampling period of analog data read as inputs of the controller and its extensions and to the refresh period of the outputs of the controller and its extensions.
This time can be set from 6 ms to 90 ms in 2 ms steps, by default: 10 ms.
Make sure that:

- Input variations that are too rapid are not masked by a cycle time that is too slow
- The speed of output variation is compatible with system commands

(See also How to Debug an Application without Loading it onto the Controller: Simulation(§ 1.2.7)

WATCHDOG

The WATCHDOG monitors the application cycle time added to the duration of processing specific to the operation of the controller and any extensions. An overflow occurs if this time exceeds the basic cycle time.
In the case of overflow, the different actions of the WATCHDOG are as follows:

- **INACTIVE**: normal operating mode
- **ALARM**: A warning state is set and the warning number corresponding to **Cycle overflow** is accessible in the **FAULT** menu
- **ERROR**: The program stops (OFF mode) and the error number corresponding to: **Cycle overflow** is accessible in the **FAULT** menu.

Note: In certain communication phases, the cycle times are increased by the communication times between the PC and the controller. No guarantee can be given concerning the actual cycle times during this operating mode. The WATCHDOG is always inhibited in this controller operating mode (Controller status(§ 1.4.2.6.11)).

Restricted Access

If the Restricted access option is selected then the **ON/OFF** menu on the front panel will no longer be accessible after writing to the controller. Only the **PARAMETERS** menu functions will be accessible.

How to Activate Automatic Time Change

To activate automatic summer/winter time change, proceed as follows:

Step	Action
1	Click on the **PROGRAM** button. **Result**: The program configuration window appears on the screen.
2	Click on the **Date Format** tab.
3	Check the **Activate summer/winter time change** by clicking on the box.
4	Choose the dates for the time change. To do this, there are two ways to proceed: • By using the drop-down list in front of the **Zone** parameter, to select a **geographic zone** from the three below: ○ Europe ○ USA ○ Other For these three zones, the dates of time changes are preconfigured and do not require any other adjustment. • By choosing **Other** in the drop-down list opposite the **Zone** parameter, then by manually specifying the month and the Sunday of the two time changes.
5	Click on the **OK** button.

1.6.1.2 Preferences of the Programming Workshop

(§ 1.6.1.1) (§ 1.6.1.3)

Description

The programming workshop preferences window is used to configure the general characteristics of the workshop:

- **Programming workshop language**: language used in the programming workshop,
- **Controller language**: the HMI language of the programming workshop front panel (LCD),
- **Working directory**: path of the directory where the applications are saved on the PC (the access path is limited to a maximum of 128 characters, including the program name and its extension).
- **Printing** : To configure the headers and footers(§ 1.6.1.11).

Access

The **Preferences** function can be accessed from the **File** menu.

1.6.1.3 Program Check

(§ 1.6.1.2) (§ 1.6.1.4)

Overview

The **Controller** / **Check the program** menu launches program compilation. The **Compilation Results** window displays the compilation result as well as a list of the resources used and available.

Compilation is carried out automatically in the following cases:

- Changeover from Edit to Simulation mode
- Changeover from Edit mode to Debugging mode
- Transferring the program to the controller

How to Display or Hide the Compilation Results Window

The table below shows the different display options for the **Compilation Results** window.

To...	**proceed as follows:**
Deactivate systematic display of the window	Check the **Do not display during simulation or loading in the controller mode** box.
Display the window when the systematic display is deactivated	Select **Controller** / **Check the program**
Activate systematic display of the window	Uncheck the **Do not display during simulation or loading in the controller mode** box.

Results Window Elements

The available resources depend on the controller type. The compiler calculates the volumes of resources used in the different memory zones of the controller.

If the values calculated are greater than the available values, they appear in red.

The table below shows the different elements that are displayed in the **Compilation Results** window:

Elements	**Description**
Parameters zone	The parameters of the function blocks or automation functions. Two bytes for each integer and 1 byte for the other types.
Zone for discrete data, etc.	Data in bit format.

	One bit per discrete or Boolean element or per SFC step bit.
Zone for other data types	Data in byte format. Two bytes for each integer.
Program zone	The number of bytes corresponding to all the program function blocks and automation functions.
Estimated program duration (ms)	Sum of all of the individual execution times for each function used.
Controller basic cycle time (ms)	Configured cycle time. See Basic Cycle(§ 1.6.1.1).

1.6.1.4 Write Options Window

□□□□ (§ 1.6.1.3)   □□□□ (§ 1.6.1.5)

Description

The **Write options** window appears before the application is transferred onto the controller: **menu: Controller / Write to the controller**.
This window is used to:

- Protect the controller program,
- Save the modifications made using the software workshop before the program is written to the controller,
- Automatically launch the ON mode on the controller,

Protection

This option is used to protect the program by a password.
The user must enter the password for certain operations.
In the software workshop, the password protects access to the following functions:

- Modification of the program contained in the controller,
- Rereading of the program contained in the controller,
- Destruction by transferring another program,
- Debugging,
- Comparison of the controller data with the program,
- Controller diagnostics.

Save Changes

This option is used to automatically save modifications made using the software workshop before the program is written to the controller.

Automatic Launch of ON Mode

This option can be used to automatically switch the controller to ON mode at the end of the transfer.

1.6.1.5 Import an Application

□□□□ (§ 1.6.1.4)   □□□□ (§ 1.6.1.6)

Overview

The **File** / **Import** command can be used to transfer all or part of another application into the current application.

How to Import FBD Function Blocks and FBD MACROS

FBD function blocks and/or MACROS are imported as follows.

Step	**Action**

1	From an FBD application, select the **menu: File** / **Import**.
2	Select the file containing the function blocks to be imported and confirm. **Note**: For importing to be possible the chosen file must contain an FBD application.
3	Select the **menu: Window** / **Tile**. **Result**: The current application and the imported application windows appear one below the other. **Note**: If the **Import** application contains MACROS, these cannot be displayed at this stage.
4	In the **Import** application window, select the useful function blocks and/or MACROS.
5	Drag and drop these function blocks and/or MACROS into the current application window. **Note**: If a MACRO has been placed in the current window, it can now be opened using the **Display MACRO** pop-up menu.

1.6.1.6 Importing/Exporting a MACRO

⇦□□□□ (§ 1.6.1.5) □□□□⇨ (§ 1.6.1.7)

Overview

The **File** / **Import** / **MACRO** command is used to import a macro.

It is also possible to export a macro(§ 1.4.3.2.6).

1.6.1.7 Conversion of Older Applications

⇦□□□□ (§ 1.6.1.6) □□□□⇨ (§ 1.6.1.8)

At a Glance

The programming workshop lets you open and convert applications created with versions in .pm3 format (minimum version AC7 V2.5.0).

Procedure

The following table shows the procedure for opening an older application:

Step	Action
1	Select the **Open** command from the **File** menu.
2	Select the file made using the older application.
3	Confirm with **Open**. **Result**: A conversion confirmation window will appear.
4	Confirm with **OK**.
5	Check and correct, if necessary, the imported program, especially the positions of the inputs and outputs and the PWM frequencies. Application-specific functions are not imported in this version.

1.6.1.8 Setting the Clock

⇦□□□□ (§ 1.6.1.7) □□□□⇨ (§ 1.6.1.9)

Overview

The controller clock can be set by one or other of the following methods:

- Using the programming workshop(§ 1.5.1.9)

- via the front face of the product, Clock(§ 1.3.4.1) menu,

1.6.1.9 Saving an Application

□□□□ (§ 1.6.1.8) □□□□ (§ 1.6.1.10)

Overview

When it is saved, the user application and its configuration are stored on the PC.

Access

The save functions: **Save** and **Save As** can be accessed from the **File** menu.

1.6.1.10 Printing the Program

□□□□ (§ 1.6.1.9) □□□□ (§ 1.6.1.11)

At a Glance

Printing an application enables you to create full documentation for the application. It consists of:

- A wiring diagram for the application,
- Wiring diagram(s) of macro(s),
- The content of the supervision window,
- A table with the following for each symbol:
  - A representation of the symbol,
  - Its chart number,
  - The associated comment,
  - The parameter(s) with their values and their descriptions.

Commands

The following table lists the commands available from the **File** menu used for printing:

Command	**Description**
Print	Used to print the document.
Print preview	Used to preview the print job to check for the desired result.
Print setup	Opens the print setup window.

Print Options

Different items may be printed and several options are offered from the **Menu: File / Print setup**:

- **Cover Page**: Cover page print of the program properties defined by the **Menu: File / Properties...**
- **Edit window**: Print of the wiring diagrams with the print area options,
- **Macro window**: Print the Macro wiring diagrams, with the same print area options as the ones in the edit window, (this option is only available if there is at least one macro and if the macro protection(§ 1.4.3.2.5) allows),
- **Supervision window**: Print the supervision window with the print area options,
- **Summary table** : Print the function summary table.
- **Page Setup** to define the paper, orientation, margins.
- Headers and footers(§ 1.6.1.11).

Print Area Options

The print area options for the Edit, Macro, and Supervision windows which can be accessed from the **Menu: File** → **Print setup** are described in the following table:

Option	Description
All	Prints the entire wiring sheet.
Visible part	Prints first the visible part of the screen at the time of printing according to the current zoom factor. The non-visible part of the screen is printed on any space left on the page.
Selection	Prints first the selected objects at the time of printing according to the current zoom factor. Concerning the unselected objects, they are printed on any space left on the page.
Number of sheets (1, 2 or 4 sheets)	Indicates the number of sheets that will be used to print each diagram
Includes the background	Prints the background of the wiring sheet

1.6.1.11 Page Header and Footer for Application Printing

(§ 1.6.1.10) (§ 1.6.1.12)

At a Glance

This function is used to insert the following into the printed application document:

- A logo,
- Text with:
  - Comments,
  - The name of the application file,
  - The page numbers and number of pages,
  - The time and the date (current, last modification).

The window is broken down into 2 series of 3 white boxes. The upper 3 correspond to the header and the lower 3 to the footer.
Several text items or a logo can be inserted into each of the boxes.
The default contents of each of the six boxes are:

- **Upper left:** The name of the project file followed by the version,
- **Upper-middle:** Logo:
- **Upper-right:** Project name (entered in the **Property** tab of the **Program Configuration** window),
- **Lower-left:** Project name (entered in the **Property** tab of the **Program configuration** window),
- **Lower-middle:** Date of the last project save,
- **Lower-right:** The page number and total number of pages.

The procedures to use for customizing these default values are described further on: see Inserting a Logo(§ 1.6.1.11) and Inserting Text(§ 1.6.1.11).

Note: A logo and text cannot occupy the same box.

Inserting a Logo

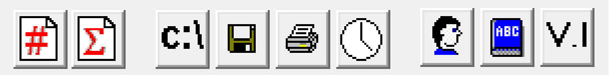
The following table shows the procedure for inserting a logo:

Step	Action
1	Select the **Print setup** command from the **File** menu. **Result**: the **Print setup** window appears.
2	Press the **Headers and footers** button. **Result**: the **Select headers and footers** window appears.
3	Position the mouse cursor in one of the upper or lower boxes where you would like to place the logo.
4	Check the **Logo** box.

5	Press the **... button**. **Result**: the **Open** window appears.
6	Select the logo file (.bmp, .jpg, .gif).
7	Confirm with Open. **Result**: the file path name appears in the selected box.

Inserting Text

The following table shows the procedure for inserting text:

Step	Action
1	Select the **Print setup** command from the **File** menu. **Result**: the **Print setup** window appears.
2	Press the **Headers and footers** button. **Result**: the **Select headers and footers** window appears.
3	Position the mouse cursor in one of the upper or lower boxes where you would like to place the text.
4	Check the **Text** box.
5	Press the icon corresponding to the text that you would like to insert:  Page number, number of pages, File name, file date, date of printing, time of printing, Author, title, version. **Result**: the inserted text appears between { }.
6	Repeat step 5 to insert another text item in the same box or resume the procedure from step 3.
7	Confirm with **OK**.

1.6.1.12 Error Description

(§ 1.6.1.11) (§ 1.6.1.13)

Description

The Default menu(§ 1.3.4.2) of the **controllers with screen** is used to display and acknowledge the errors or warnings detected by the controller software.
To acknowledge an error or warning on a controller without screen, switch it off then on again.

Possible Errors

List of errors:

1	Base WARNING	Cycle time (program configuration(§ 1.6.1.1) : Watchdog action: alarm)
2	Base WARNING	Surcharge sortie PWM ou sortie non alimentée
3	Base WARNING	Dialog problem with the accessory
4	Base WARNING	Accessory missing
5	Base WARNING	Problem with the serial Flash memory
6	Base WARNING	Clock problem (RTC)
7	Base WARNING	Problem on current inputs
500	Base fault	Fault during Firmware updating via the communication card
501	Base fault	Fault during Firmware updating
502	Base fault	Fault during BootLoader updating

503	Base fault	Memory internal fault
504	Base fault	SPI bus fault
505	Base fault	Cycle time(§ 1.6.1.1) (program configuration: Watchdog action: error)
506	Base fault	Fault when numbering a block in the application
507	Base fault	Base type fault
508	Base fault	Extension 1 type fault
509	Base fault	Extension 2 type fault
510	Base fault	The serial Flash memory is damaged
511	Base fault	Fault when updating the communication card
512	Base fault	Internal WATCHDOG(§ 1.6.1.1) fault, reset problem
1000	Extension 1 WARNING	Surcharge sortie PWM ou sortie non alimentée
1001	Extension 1 WARNING	Surcharge entrée analogique
1002	Extension 1 WARNING	Surcharge sortie analogique
1500	Extension 1 fault	No communication with extension 1
1501	Extension 1 fault	Défaut Firmware extension 1
2000	Extension 2 WARNING	Surcharge sortie PWM ou sortie non alimentée
2002	Extension 2 WARNING	Surcharge entrée analogique
2003	Extension 2 WARNING	Surcharge sortie analogique
2500	Extension 2 fault	No communication with extension 2
2501	Extension 2 fault	Défaut Firmware extension 2
3000	Com card WARNING	Card not connected to the operator's GPRS network
3001	Com card WARNING	GPRS not displayed but in the process of connecting
3002	Com card WARNING	GPRS registration rejected.
3003	Com card WARNING	The status of the GPRS network connection is unknown
3004	Com card WARNING	The card has been disconnected by the operator
3005	Com card WARNING	Technical problem (aerial, etc.), card not connected to the operator's GPRS network
3006	Com card WARNING	GSM not displayed but in the process of connecting
3007	Com card WARNING	GSM registration rejected.
3008	Com card WARNING	The status of the GSM network connection is unknown
3009	Com card WARNING	SIM card: status unknown
3010	Com card WARNING	SIM card: busy
3011	Com card WARNING	SIM card: the card is locked by a PIN code
3012	Com card WARNING	SIM card: locked by a different code from the PIN, e.g.: PUK or PIN2

3013	Com card WARNING	SIM card: there is no card in the socket
3014	Com card WARNING	SIM card: the card is present but not responding
3015	Com card WARNING	SIM card: the socket is inserted but the card status is unknown
3016	Com card WARNING	SIM card: all attempts to communicate with the card have failed
3017	Com card WARNING	The aerial is missing, can only be used with detectable aerials
3018	Com card WARNING	Temperature too high or too low
3019	Com card WARNING	The communication card is no longer responding.
3020	Com card WARNING	Défaut communication SMTP
3021	Com card WARNING	Défaut envoi Mail
3022	Com card WARNING	Défaut configuration SMS
3023	Com card WARNING	Défaut serveur SMS
3024	Com card WARNING	Défaut lecture SMS
3025	Com card WARNING	Défaut envoi SMS
3026	Com card WARNING	Défaut envoi SMS car serveur non connecté
3027	Com card WARNING	Défaut envoi SMS car serveur occupé
3028	Com card WARNING	Défaut envoi SMS car destinataire erroné
3030	Com card WARNING	Initialisation de la communication avec le serveur a échoué
3031	Com card WARNING	Ouverture de la connexion avec le serveur a échoué
3032	Com card WARNING	Création de la connexion avec le serveur a échoué
3033	Com card WARNING	La connexion avec le serveur a échoué
3500	Com card fault	The Firmware content is incorrect
3501	Com card fault	The BootLoader content is incorrect
3502	Com card fault	Memory internal fault
3503	Com card fault	The communication card application has not been verified
3504	Com card fault	Error during execution of the communication card application
3505	Com card fault	Serial Flash memory fault
3506	Com card fault	The sender/receiver part is no longer responding
3507	Com card fault	Failure while writing the communication card µc internal flash memory
3508	Com card fault	There is not enough memory to work correctly.
3509	Com card fault	The supply voltage is outside the acceptable range
3510	Com card fault	Temperature too high or too low, the module has

		stopped to avoid damaging itself

1.6.1.13 Splitting the Wiring Sheet

(§ 1.6.1.12)

(§ 1.6.2)

Introduction

The wiring sheet can be split in 2. Splitting is used to display 2 different parts of the wiring sheet on the same screen.

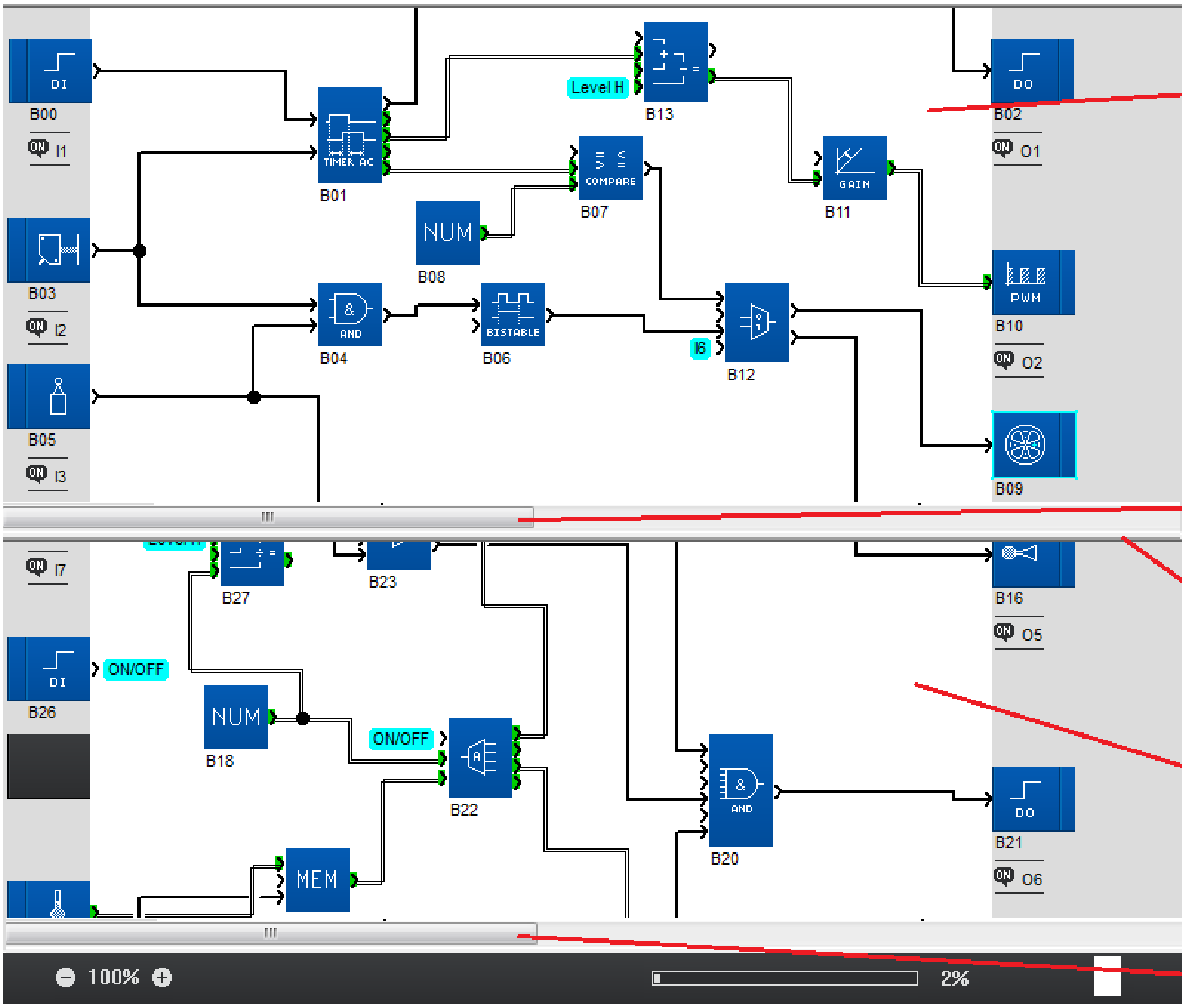
How to Split the Display

To split the display, proceed as follows:

Step	Action
1	Select the **menu: Window** / **Split display**.
2	Move the cursor to the place where you wish to split the display.
3	Click on the left mouse button. **Result**: The wiring sheet will split vertically into two displays.

Structure of the Split Wiring Sheet

The split wiring sheet is structured as follows:



The elements of the split wiring sheet are described below:

Number	Element
1	Display of the upper part.
2	Vertical scroll bar for the upper part.
3	Horizontal scroll bar for the upper part.
4	Splitting bar.
5	Display of the lower part.
6	Vertical scroll bar for the lower part.
7	Horizontal scroll bar for the lower part.

Use of the Split Wiring Sheet

The split wiring sheet can be used to perform the following actions:

To...	proceed as follows:
Make the desired function blocks appear in the upper part...	Move the scroll bars for the upper part.
Make the desired function blocks appear in the lower part...	Move the scroll bars for the lower part.
Move the splitting bar to the desired location...	Click on it with the mouse.
Connect the function blocks of the upper and lower part...	• Click on the start block output. • Join the start block input by holding down the left mouse button and crossing the splitting bar, if necessary. • Release.

How to Cancel the Split Display

To cancel the split display select the **menu: Window** / **Cancel split**.

Result:

- The lower display disappears
- The upper display is displayed on the entire wiring sheet

> **Note:** To cancel the split display, you can also click on the splitting bar and drag it down to the scroll bar of the lower display or to the footer.

1.6.2 Description of Menus

(§ 1.6.1.13)

(§ 1.)

Description

Description of the programming workshop menus

- File(§ 1.6.2)
- Edit(§ 1.6.2)
- Mode(§ 1.6.2)
- Display(§ 1.6.2)
- Tools(§ 1.6.2)
- Controller(§ 1.6.2)
- Options(§ 1.6.2)
- Directories(§ 1.6.2)
- Draw(§ 1.6.2)
- Window (§ 1.6.2)
- ?(§ 1.6.2)

File Menu

Description of commands in the File menu:

Command	Description
New (§ 1.1.2)	Creates a new project

Open	Opens an existing project
Close	Closes the project being edited **(*)**
Save(§ 1.6.1.9)	Saves the project being edited **(*)**
Save As(§ 1.6.1.9)	Saves the project being edited under another name **(*)**
Print...(§ 1.6.1.10)	Prints the project **(*)**
Print preview(§ 1.6.1.10)	Lets the user view the project as it will appear when printed **(*)**
Print setup...(§ 1.6.1.10)	Configures the print characteristics of the project **(*)**
Import...	Import Application(§ 1.6.1.5) : Imports the edit window of another project **(*)** Import Macro(§ 1.4.3.2.6) : Imports a macro **Note**: Only programs, parts of programs or Macros of the same type as the one being edited can be imported.
Properties...(§ 1.6.1.1)	The different parameters linked to the application can be set in the **Program Configuration** window.**(*)**
Preferences...(§ 1.6.1.2)	Configures the general characteristics of the programming workshop.
No. name_file.pm3	Lists the last 4 files opened recently.
Exit	Closes the programming workshop.

Note: (*) Only available if a project file is open in the programming workshop.

Edit Menu

Description of commands in the Edit menu:

Command	**Description**
Cancel...	Cancels the last operation carried out (50 cancellation levels).
Redo	Redoes the action which was previously undone.
Cut	Copies and deletes the selected element (placed on the clipboard)
Copy	Copies the selected elements to the clipboard
Paste	Pastes the element from the clipboard
Clear	Clears the contents of all of the selected boxes
Select All	Selects the entire wiring sheet
Find...	Searches for a function in the program using its name or an associated comment.
Activate display dependencies mode(§ 1.4.3.1.8)	Activates or deactivates the mode used to display the functions depending on a node or function.

Mode Menu

Description of commands in the Mode menu:

Command	**Description**
Edit(§ 1.1.1)	Used to build programs, which corresponds to development of the application.
Simulation(§ 1.1.1)	The program is executed offline directly in the programming workshop (simulated on the PC).
Debugging(§ 1.1.1)	The program is executed on the controller, the programming workshop is connected to the controller.

Display Menu

Description of commands in the Display menu:

Command	**Description**
Function bar.	Displays or hides the function bar
Drawing bar	Displays or hides the drawing bar.
Simulation/Debugging bar	Displays or hides the simu/debugging bar.
Program view	Used to create or modify a program. • Program view in FBD mode(§ 1.4.1.1)
Settings view	Lists all the automation functions with parameters used in the application. • Settings view in FBD mode(§ 1.4.1.1)
Comments	Used to show/hide the program comments (the comments are displayed under the function block).
Block numbers	Displays/hides the function block numbers

Grid	Submenus: - **Display the grid**: Shows/hides the wiring sheet grid.

Tools Menu

Description of commands in the Tools menu (FBD-specific):

Command	Description
Align(§ 1.4.3.2.4)	Positions objects in relation to one another: - Left - Right - Top - Bottom - Center objects vertically - Center objects horizontally
Distribute	Distribute objects: - Distribute horizontally - Distribute vertically
Order(§ 1.4.3.2.4)	Positions objects in relation to one another: - Bring to front - Send to back
Group(§ 1.4.3.2.2)	Creates composite objects
Ungroup(§ 1.4.3.2.2)	Ungroups composite objects
Create a Macro(§ 1.4.3.2.5)	Groups together several FBD functions in one Macro.
Display Macro(§ 1.4.3.2.5)	Displays the details of a Macro.
Save Macro(§ 1.4.3.2.5)	Archive your macro in the Macro tab of the Function Bar.
Renumber functions	Used to reassign the numbers of consecutive blocks starting from number B00.
Renumber links	Used to reassign numbers of consecutive links
Wiring mode(§ 1.4.3.1.3)	Used to change the type of link between the function blocks: - Text - Wiring (This option specifies the type for all future links)

Controller Menu

Description of commands in the Controller menu:

Command	Description
Choose the type of controller...(§ 1.1.2)	Choice of controller type with its associated functions and connected extensions.
Configure Connection...(§ 1.5.1.1)	Establish the connection parameters between the programming workshop and the controller
Read in the controller(§ 1.5.1.3)	Transfers the application from the controller to the PC
Write to the controller(§ 1.5.1.2)	Transfers the application from the PC to the controller
Compare the data in the controller with the program(§ 1.5.1.5)	Used to compare the data contained in the controller and the data produced by compiling the programming workshop's application.
Clear the controller contents(§ 1.5.1.8)	Clears the program and erases all data in the controller
Controller diagnostics(§ 1.5.1.6)	The diagnostics function allows you to view the controller characteristics.
Check program(§ 1.6.1.3)	Checks program consistency.
Start controller and Reset saved parameters(§ 1.5.1.4)	Initializes and starts the program.
Start controller without Reset(§ 1.5.1.4)	Starts the program without initializing the current values of functions for which the Save on power failure is activated.
Turn the controller off(§ 1.5.1.4)	Stops the program.
Read/Write date and time(§ 1.5.1.9)	Used to configure the controller clock.
List of application-specific functions	Submenus: - **In the controller ...**: displays the list of application-specific functions available in the controller. - **In the application ...**: used to display and modify the list of application-specific functions that can be used in the application.
Update Controller Firmware and Language(§ 1.5.1.11)	Downloads a new version of the firmware and/or the new language(§ 1.5.1.10) to the controller

Remote Control of Front Panel	Used to remotely control the controller connected to the PC. **ON**: starts the program **OFF**: stops the program

Options Menu

Description of commands in the Options menu:

Command	**Description**
Date format(§ 1.6.1.1)	Sets the date format in the **program configuration** window.

Directories Menu

Description of commands in the Directories menu:

Command	**Description**
Directory(§ 1.5.4.2)	Used to configure the telephone numbers and access rights of recipients associated with a program.

Draw Menu(§ 1.4.3.1.6)

In the edit and supervision sheet it is possible to create shapes such as lines, rectangles, ellipses or text. You can also insert an image in BMP, JPG, GIF format. It is possible to modify the borders and line width.

Window Menu

Description of commands in the Window menu:

Command	**Description**
Cascade	Organizes the windows in cascade
Tile	Tiles the windows horizontally
Arrange icons	Rearranges the windows
Split display/Cancel split(§ 1.6.1.13)	Divides the display in two parts, each displaying one part of the wiring sheet./Cancel this split.
List of open windows	Activates the selected window, Front panel, Supervision or Edit

Help menu

Description of commands in the **Help** menu:

Command	**Description**
Help	Provides access to the online help
About the programming workshop	Displays program information, the version number and copyright details