MCXDesign user manual

MCXDesign Visual Programming Tool
Index
1.0 MCXDesign Setup......................................................................................................................................................................................................... 5
2.0 MCXDesign first steps .................................................................................................................................................................................................. 6
  2.1 RUN .................................................................................................................................................................................................................... 6
  2.2 MCXDesign project .................................................................................................................................................................................................... 6
    2.2.1 MCXShape and MCXDesign............................................................................................................................................................................. 7
    2.2.2 Open a project.................................................................................................................................................................................................. 7
    2.2.3 Create a new project.................................................................................................................................................................................. 7
    2.2.4 Create a new library.................................................................................................................................................................................. 7
    2.2.5 Open a library....................................................................................................................................................................................... 8
    2.2.6 Import an existing library.................................................................................................................................................................... 8
3.0 MCXDesign workbench..................................................................................................................................................................................................... 9
  3.1 Area 1 - Resources/Components/Projects ............................................................................................................................................. 9
    3.1.1 Resources .................................................................................................................................................................................................. 9
    3.1.2 Components.......................................................................................................................................................................................... 9
    3.1.3 Project.................................................................................................................................................................................................. 11
  3.2 Area 2 – Working area .................................................................................................................................................................................................... 12
    3.2.1 *Electric Wiring* View.............................................................................................................................................................................. 12
    3.2.2 *Logic* View.................................................................................................................................................................................................. 13
    3.2.3 *User Interface* view............................................................................................................................................................................... 13
  3.3 Area 3 – Property window................................................................................................................................................................................ 13
4.0 Debugger ........................................................................................................................................................................................................... 15
5.0 HOW TO ...................................................................................................................................................................................................................... 16
  5.1 HOW TO create the PK application file for MCX.................................................................................................................................................................. 16
  5.2 HOW TO manage alarms.................................................................................................................................................................................... 16
  5.3 HOW TO add a Resource................................................................................................................................................................................... 16
  5.4 HOW TO create a special component.......................................................................................................................................................... 18
    5.4.1 HOW TO create a Hotspot........................................................................................................................................................................ 18
    5.4.2 HOW TO create a Component............................................................................................................................................................... 18
    5.4.3 HOW TO create a Brick............................................................................................................................................................................. 19
    5.4.4 HOW TO create a Box.............................................................................................................................................................................. 20
    5.4.5 HOW TO create a Frame....................................................................................................................................................................... 21
    5.4.6 HOW TO create a Screen.................................................................................................................................................................... 21
  5.5 HOW TO change the blocks’ execution order.......................................................................................................................................................... 21
  5.6 HOW TO manage commands ........................................................................................................................................................................... 22
  5.7 HOW TO create your User Interface........................................................................................................................................................... 22
    5.7.1 HOW TO create a Screen ........................................................................................................................................................................ 22
    5.7.2 HOW TO create a loop of screens........................................................................................................................................................ 26
    5.7.3 HOW TO associate a screen to a menu line........................................................................................................................................... 26
    5.7.4 HOW TO manage icons.......................................................................................................................................................................... 27
    5.7.5 System ON/OFF...................................................................................................................................................................................... 27
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8</td>
<td>HOW TO configure I/Os</td>
</tr>
<tr>
<td>5.8.1</td>
<td>Analogue Input</td>
</tr>
<tr>
<td>5.8.2</td>
<td>Digital Input and Digital Output</td>
</tr>
<tr>
<td>5.8.3</td>
<td>Analogue Output</td>
</tr>
<tr>
<td>5.9</td>
<td>HOW TO add an expansion</td>
</tr>
<tr>
<td>5.10</td>
<td>HOW TO search for a resource</td>
</tr>
<tr>
<td>5.11</td>
<td>HOW TO manage Persistent (Eeprom) variables</td>
</tr>
<tr>
<td>5.12</td>
<td>HOW TO manage internal EEV driver (for MCX061V and MCX152V)</td>
</tr>
<tr>
<td>5.13</td>
<td>HOW TO make a Modbus master application</td>
</tr>
<tr>
<td>6.0</td>
<td>FAQ</td>
</tr>
<tr>
<td>Manual Version</td>
<td>MCXDesign Software Version</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Y2</td>
<td>V2.1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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1.0 MCXDesign Setup

1) From www.danfoss.com/mcx download the MCXDesign programming tool:

2) Run MCXDesignSetup and follow the indications (it is a good idea to keep the proposed installation folders)

There is no need to install any other element, as all the necessary software tools are automatically installed.
2.0 MCXDesign first steps

2.1 RUN

To run MCXDesign double click on the icon on the desktop or select MCXDesign in the MCXTools folder of the Start Menu folder. If you do not have a licence you have three months' free trial from the installation date. The expiry date is displayed in the bottom right corner of the "About" window that you can view by pressing ?->About menu.

2.2 MCXDesign project

A project in MCXDesign is made of:

- MCXDesign project file (e.g. DemoApp.mcxb)
- MCXShape configuration file (e.g. DemoApp.mcsx)
- Folder "App" with application source files, libraries and icons
- Folder "Libs" with all the libraries of graphic elements used in the project
- Folder "MyKFiles" with the file to be loaded into the MMIMYK accessory to transfer the application software into the MCX controller
- Other files (*.bat) used by MCXDesign
2.2.1 MCXShape and MCXDesign
You can toggle between MCXDesign and MCXShape by pressing the command “MCXShape” or “MCXDesign” in the right part of the menu bar.
Refer to the specific documentation for information about MCXShape usage.

2.2.2 Open a project
To open an existing project:
• Go to MCXDesign
• Select “File - Open” and select the *.mcxb file (e.g. DemoApp.mcxb).

2.2.3 Create a new project
To create a new project:
• Go to MCXDesign
• Select “File – New”
• Select the icon for the type of application you are interested in: MCX with LCD display, MCX with LED display, LCX06C
• Give a name to the new project and select the working folder (in a local path) where you have all the projects
• click on “Create New Project”. This opens a new project with some elements already managed, as per our default template (menu, few parameters, keyboard, alarms, alarm history, a few virtual functions just as an example) in order to help you to get started.

2.2.4 Create a new library
A library is a collection of graphical logic blocks.
To create a new library:
• Go to MCXDesign
• Select “File – New”
• Select the icon “Library”
• Give a name to the new library folder in “Project Name” and select the “Libs” folder of the project where you want to file the library. Note that it is mandatory to have all the libraries in the “Libs” folder.
A new folder with the name of your library is created inside the “Libs” folder.
This folder will store all the files related to the elements of you library
• Create the elements (bricks or components) of your library (see 3.1.2 Components)
• Save and reopen the project which the library belongs to in order to see the changes.

2.2.5 Open a library
To open an existing library:
• Go to MCXDesign
• Select "File - Open"
• Select the *.mcxlib type of files
• Select the desired library in the "Libs" folder of your project (e.g. MyLib.mcxlib)

2.2.6 Import an existing library
• Go to MCXDesign
• select "File – Add Library" and browse to the folder where the library is stored. The library will be automatically copied into the "Libs" folder of the current project. The project is then reloaded in order to make the new library available.

TIP
Libraries can be copied from one project to another simply by copying the related folder from the “Libs” folder of one project to the “Libs” folder of the other.
3.0 MCXDesign workbench

The MCXDesign working area is made of three parts

3.1 Area 1 - Resources/Components/Projects

3.1.1 Resources
List of all the available resources for the project: parameters, alarms, input/output, virtual functions, status variables, strings.

Resources are created with MCXShape and MCXDesign.
- To add Parameters, Alarms and Strings, select “MCXShape” and add them from there (see 5.3 HOW TO add a Resource)
- To add Virtual Functions for I/Os, right-click on the Resources panel of MCXDesign.
- To add Status Variables just add a Hotspot to the Logic sheet (see 3.1.2 Components)

3.1.2 Components
List of all the available components for designing your application software.
Components are grouped into libraries. There are some libraries delivered together with MCXDesign and some others are related to a project and are loaded when the project is open.
Red icons = basic logic blocks (e.g. AND, OR, etc.).
Green icons: advanced logic blocks
Blue icons = basic drawing tools, and some special components.

For each component there is an online help which explains the block’s features. To access the online help, select the component and press F1.

There are some special blocks in the CoreLib library that need a special description for their specifics and importance in building the control strategy.

The special components are as follows:

- **Hotspot**
  A “Hotspot” is a variable in RAM that is automatically exported to CAN and Modbus networks. Hotspots are also used to define input and output of the logic blocks and internal status variables. See 5.4.1 HOW TO create a Hotspot.

- **Component**
  A Component is an element used to create a new component made of basic logic blocks; A component is a part of a library which can be reused through all your projects. A component is marked with a wall icon in the upper right corner
3.1.3 Project
List of all the libraries that are used in the project.

A Brick is a component whose strategy is written in C++
A Brick is part of a library and can be reused through all your projects.
A Brick has no icon in the upper right corner

A Box is a way of grouping together a part of logic made not only by bricks or components but also including parameters, input and output.
A Box is not part of a library but is a part of your project. To reuse a Box in other projects you can simply cut and paste it.
A Box is marked with a box icon in the upper right corner

A Frame is a way of defining a comment to a piece of logic, and is useful for describing its features.

A Screen is a special component available only in the User Interface view. It is used to create loops of user interface screens.
To add or remove a library, access the “Libs” project folder where all the libraries are stored.

3.2 Area 2 – Working area
Space where you can design the I/O Configuration, the control logic and the user interface of your application. Drag and drop here the elements taken from the “Resources” and “Components” groups.

TIPS
- Ctrl + scroll wheel of your mouse to zoom
- Hold the mouse scroll wheel to move the drawing
- To delete a line, move the end of the line away from its connection point
- To add a line, drag the mouse from left (output of a component) to right (input of another component)

MCXDesign v2 version is made up of three views:
- “Electric Wiring” view for designing the Input/Output configuration
- “Logic” view for designing the control logic
- “User Interface” view for designing the User Interface

3.2.1 “Electric Wiring” View

Define the type of each MCX’s physical input and output and assign a virtual function to it.
For more info see 5.8 HOW TO configure I/Os.
3.2.2 “Logic” View

Connect the elements together in the “Logic” view to design your control logic.

3.2.3 “User Interface” View

Place and eventually connect together the Screen elements in the “User Interface” view to design your user interface. See 5.7 HOW TO create your User Interface.

**MENU and KEYBOARD**

The menu appearance and the usage of some keys are defined by a standard template and cannot be modified using MCXDesign.

The menu elements and their position in the menu tree are defined with MCXShape.

**Main keys’ function**

In the Main Screen:
- UP, DOWN, RIGHT, LEFT are used to navigate through the loop of screens according to what is defined in MCXDesign
- ENTER to access the Main Menu
- X to access the Alarm Screen with the alarms list
- UP held for 3s to switch the unit ON or OFF

In the Alarm Screen
- X to exit
- ENTER held for 3s to reset manual alarms

In the Main Menu screen:
- UP and DOWN to scroll through the menu
- ENTER to go one level down in the menu tree or enter into Edit Mode
- X to go one level back in the menu tree

In Edit Mode
- UP and DOWN to edit the value
- ENTER to save and exit from edit mode
- X to exit from edit mode without saving

3.3 Area 3 – Property window

Property window of each component or of the project.
To see the properties of an element, select it on the design sheet.
4.0 Debugger

Run the Debugger by clicking on the **Debugger** button in the toolbar. Click on **Stop** to stop it.

When you run the Debugger:
- The Simulator is executed
- The Property window is used to show the input/output data of the selected element in the logic sheet. The new function of the Property Window is signalled by the colour yellow.

**NOTE.**
Remember to stop the Debugger before changing the control logic.

**NOTE**
To see the values of User Interface data you must be in the right context. This means that you have to watch for the form that you want to debug on the simulator.
5.0 HOW TO ...

5.1 How TO create the PK application file for MCX

There are two ways:
1) Click the Save and Compile button on the MCXDesign toolbar

![Image of MCXDesignIDE]

2) Generate & Compile from MCXShape

NOTES.
The PK file is created inside the BIN folder
You can run simulator, etc from MCXShape as before. See specific documentation about MCXShape.
You can run the Debugger from MCXDesign.

5.2 HOW TO manage alarms

Alarms are configured in MCXShape. You set the alarm name, reset type, delay and actions in the MCXShape.
When you drag an alarm from the “Resources” into the logic area you retain all these settings. You simply have to define the trigger condition (see next picture)

![Image of alarm configuration]

5.3 HOW TO add a Resource

Some resources can be added from MCXShape and others from MCXDesign.

From MCXShape you can add parameters, alarms and strings
From MCXDesign you can add virtual functions for I/O and status variables

To add a new resource from MCXShape:
- Go to MCXShape
- Right-click over the Menu & Parameters, Alarms or Applications Strings area in MCXShape and add/change/delete the resource

  e.g. to add a parameter:
e.g. to add a string

If now you go back to MCXDesign by clicking on the MCXDesign command that you will find in the MCXShape menu bar, you will see the new resources available for the project.

To add a new resource from MCXSDesign:
- To add Virtual Functions for I/Os, right-click on the Resources panel of MCXDesign
- To add Status Variables, just add a Hotspot on the Logic sheet (see 3.1.2 Components)
NOTE
When you add a new resource (parameter, string, alarm, virtual function), you also have to define the name of the variable that will be used inside the code and that has to be unique. It is suggested to use the following name conventions and to start the names with these prefixes:

Parameters: \texttt{Params}*** (e.g. Params\_Setpoint)
Alarms: \texttt{AL}*** (e.g. AL\_HighPressure)
Strings: \texttt{DESCR}*** (e.g. DESCR\_String)
Analogue Input virtual function: \texttt{AI}*** (e.g. AI\_Temperature)
Analogue Output virtual function: \texttt{AO}*** (e.g. AO\_Inverter)
Digital Input virtual function: \texttt{DI}*** (e.g. DI\_MainSwitch)
Digital Output virtual function: \texttt{DO}*** (e.g. DO\_Compressor1)

5.4 HOW TO create a special component

5.4.1 HOW TO create a Hotspot

A "Hotspot" on the main logic sheet (not inside a Box or a Component) is a variable in RAM automatically exported to CAN and Modbus networks. Hotspots are also used to define input and output of the logic blocks and internal status variables.

To add a hotspot, follow the steps below:
1. Drag the hotspot into the working area
2. Assign the hotspot a name in the Property window
3. Assign the hotspot a DataType (INT, BOOL, etc) in the Property window
4. Assign the hotspot a type from Input, Output, Instance, ticking the right check box in the Property window. Instance means an internal variable that is neither input nor output
5. Connect the hotspot to the component you want (draw a line from the component to the hotspot)

5.4.2 HOW TO create a Component

A Component is an element used to create a new component made of basic logic blocks. A Component is a part of a library. A Component is marked with a wall icon in the upper right corner.
To create a new Component, follow the steps below:

1. Open an existing library or create a new one.
   TIP: You can run a new instance of MCXDesign to create a new component.
2. Drag a component into the working area and double-click on it to enter into the logic design view for that component
3. Place the hotspots you need
4. Design your logic, e.g.
   ![Diagram of a component design]
5. Exit from the Component creation mode using the button on the toolbar
6. Give a new name to the component in the Property window
7. Save and exit
8. Reopen the project to see the new library and/or component

5.4.3 HOW TO create a Brick

Brick
A Brick is a component whose strategy is written in C++.
A Brick is a part of a library.
A Brick has no icon in the upper right corner.

![Diagram of a Brick]

To create a new Brick, follow the steps below:

1. Open an existing library or create a new one
   TIP: You can run a new instance of MCXDesign to create a new Brick.
2. Drag a Brick into the working area and double-click on it to enter into the logic design view for that component
3. Give a name to the Brick (e.g. MyNewBrick)
   Pay attention that the name of the Brick must be a valid name for a class in C language (no spaces allowed)
4. Place the Hotspots that you need to define the input and output of the Brick
   E.g.:
   ![Diagram of Brick inputs and outputs]
5. Eventually place the Persistent variables you need. Persistent variables are variables that are stored in non-volatile memory.
   Persistent variables are loaded from Eeprom at startup and are saved when the special BOOL "Save" variable is set to 1 (see 5.11 HOW TO manage Persistent (Eeprom) variables).
6. Exit from the Brick creation mode using the button on the toolbar
7. Save (and generate the code)
8. Go into the library folder and edit the file `<name_of_the_library>_Brick.c` with your C++ editor.
   Note that the `*_Template.c` file is automatically generated at each save, therefore use it only as inspiration. All your logic has to be inserted into the `<name_of_the_library>_Brick.c` file which is created only once.

9. Finally, add into the library folder the images to be shown inside the brick (`img<name_of_the_brick>.png`) and in the Resources tree (`<name_of_the_brick>.png`).

5.4.4 HOW TO create a Box

A Box is a way of grouping together a part of logic made not only by bricks or components but which also includes parameters, input and output.

A Box is not part of a library but is a part of your project. To reuse a Box in other projects you can simply cut and paste it.

A Box is marked with a box icon in the upper right corner.

To create a Box, follow the steps below:
1. Drag and drop the Box component into your working area
2. If you have already designed the logic that you want to include in the Box, select the elements that you want to be put into the Box; otherwise go to point 4
3. Right-click and cut or copy the selected elements
4. Double-click on the Box to open it
5. Paste the elements or create a new logic inside the Box
6. Exit from the Box creation mode by using the button on the toolbar. Once created, you can open a Box by double clicking it.

5.4.5 HOW TO create a Frame

Frame
A Frame is a way of defining a comment to a piece of logic, which is useful to describe its features.
To create a Frame, follow the steps below:
1. Drag and drop the Frame element into your working area
2. Drag the bottom right corner of the Frame to resize it and move the Frame behind the logic you want to highlight
3. Using the Property window of the Frame, define the Frame’s appearance; and in particular set the Description and FillColor fields, e.g.:

5.4.6 HOW TO create a Screen

Screen
A Screen is a special component available only in the User Interface view. It is used to create loops of user interface screens. A Screen is similar to a Box but contains a screen and eventually some logic. As with a Box, it can be opened by double-clicking it. A Screen is characterised by having some special hotspots used for creating a loop of Screens.
See the next section for information on how to create a Screen.

5.5 HOW TO change the blocks’ execution order
To view the logic of the blocks’ execution order and/or to change it, right-click anywhere in your current logic view and select “Execution Order”.
A new window will open showing the list of all the logical blocks and hotspots used in the current logic view, sorted according to their execution order.
You can change the position of the elements in the list, thus changing their execution order. Select one element in the list and use the “Move Up” and “Move Down” buttons to position the element in the desired place.
5.6 **HOW TO manage commands**

To send a command to a block, use the MCXCommand element in the LibMCX library and connect it to the input of the block.

Right-click on the MCXShape menu and Edit an existing menu line or create a new one; in the OUT Code field, type the same name of the MCXCommand.

When this menu line is selected and executed, an impulse will be sent to the block input where the MCXCommand is connected.

5.7 **HOW TO create your User Interface**

5.7.1 **HOW TO create a Screen**

Screen

A Screen is a special component only available in the User Interface view. It is used to create loops of user interface screens.

A Screen is similar to a Box but contains a display screen and eventually some logic. As with a Box, it can be opened by double clicking it.

A Screen is characterised by having some special hotspots used for creating a loop of Screens.

To create a Screen, follow the steps below:

1. From the CoreLib library, drag and drop the Screen component into your working area
2. Double-click on the Screen to open it
3. Drag the User Interface components you want to put into the Screen into the screen working area.

You can use ready-prepared templates or create your own custom screen.

The User Interface components that you can use are the following:

- LCD and LED display templates already prepared for MCX display, taken from the DisplayInterfaceLCD and DisplayInterfaceLED libraries

Example of available templates:
• Elements to create your own screen taken from the library LibMCX:
### FormTemplate
To design your own screen for 128x64 pixel LCD displays (MCX08 or higher and MMIGRS). If Fixed=0 in the Property window, you can move the form while keeping the other elements that you have placed in the form fixed.

### SmallFormTemplate
To design your own screen for 98x64 pixel LCD displays (MCX06D). If Fixed=0 in the Property window, you can move the form while keeping the other elements that you have placed in the form fixed.

### Variable
To display a variable on your screen. Set the following properties in the Property window:
- Name: name of the variable used in the source code
- Decimals: number of decimal places
- Font Size: 1 (small), 8 (normal), 16 (large)
- Width: width of the variable

### FormHorizLine
To draw an horizontal line. Set the length of the line with the Width property in the Property window.

### FormVertLine
To draw a vertical line. Set the length of the line with the Width property in the Property window.

### VarText
To display a string into your screen. The text of the string can be written directly in the Property window in the Value field, writing the text between double quotes. However, to manage multiple languages, it is suggested to create the string in MCXShape. After creating in MCXShape, the string will be available among the String Table Resources in MCXDesign.

### VarImage
To display an icon into your screen. See 5.7.4 HOW TO manage icons

4. Connects the hotspots of the elements above to resources in your project and eventually adds the logic you need
5. Give a name to the form.

If the name used here is also used in the OUT_CODE property of a menu line in MCXShape, then the screen is linked to the menu (see 5.7.3 HOW TO associate a screen to a menu line).

**IMPORTANT NOTE.**
At the minimum, your user interface is made up of a main screen, which is shown at start-up. The main screen is defined by the name "MainForm" in the Property window. It is mandatory to have one MainForm.
6. Exit from the Screen creation mode by using the \( \text{button} \) on the toolbar (the name of the form will be automatically assigned to the Screen)

5.7.2 HOW TO create a loop of screens
A loop of screens is a set of screens connected by the UP, DOWN, LEFT, RIGHT keys.
To create a loop of screens, follow the steps below:
1. Create the screens you need.
2. Connect the screens in the desired order, drawing a connection line from the hotspot of the key you want to use for navigating in the loop to any of the input hotspots of the next screen.

Input hotspots: connect the arrow keys from another screen to any of these points

Example
Loop made of two screens, UP and DOWN key to move from one to the other

Arrow keys hotspots: connect the keys that you want to use for navigating in the loop to the hotspot of the next screen in the loop

5.7.3 HOW TO associate a screen to a menu line
You can add new screens or a loop of screens, associating them to specific menu lines, created with MCXShape.
1. Right click on the MCXShape menu and edit an existing menu line or create a new one.
2. In the field OUT Code, type the same name of your screen created with MCXDesign.
5.7.4 HOW TO manage icons
1. Drag the VarImage component into the Screen.
2. Fill the property IconIndex of the VarImage component with the index or the name of your icon. Available pictures, names and indexes are listed in the AGF_resources.c file inside the App folder of the project. Pictures are in the "images" folder inside the App folder.
3. To change an image you can simply edit an existing one with a Bitmap editor, retaining its name.
4. To add a new image (or change the name of an existing one) edit the "images.xml" file inside the "images" folder and add the image bitmap in the folder.

5.7.5 System ON/OFF
To function properly, the UI always needs the "System ON/OFF" variable, even if it is not connected to anything.
5.8 HOW TO configure I/Os

- Go to the Electric Wiring View
- From the Components panel, select the type of MCX you want to use and drag and drop it into the working area
Define the type of each I/O connecting the available types to the physical I/O. An automatic check of the connectable types is performed. It is not possible to assign a type that is not managed by the specific hardware.

For example, Al2 is assigned to be NTC-10KOhm.

Finally, assign a virtual function to the I/O. Virtual functions are available in the Resources panel (see 5.3 - HOW TO add a Resource).
Note about physical input/output and virtual functions:
- Physical input/output indicates the MCX input/output (e.g. AO1, AO2, etc) without any reference to the function of the input/output

5.8.1 Analogue Input
The following types of Analogue Inputs are available:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>NTC-10K</td>
<td>NTC 10 kOhm at 25 °C</td>
</tr>
<tr>
<td>NTC-100K</td>
<td>NTC 100 kOhm at 25 °C</td>
</tr>
<tr>
<td>NTC-2K</td>
<td>NTC 2 kOhm at 25 °C</td>
</tr>
<tr>
<td>Ni1000TKS</td>
<td>Ni 1000 Ohm at 0 °C</td>
</tr>
<tr>
<td>PT1000</td>
<td>Pt 1000 Ohm at 0 °C</td>
</tr>
</tbody>
</table>
4-20mA

0-20mA

0-1V

0-5V

0-5V NOP 0/5V without internal pull-up resistor for high impedance inputs

0-10V

ON/OFF  to use Al as DI

Analogue Input Properties
When you configure Analogue Input, you must also set the following properties in the Property Panel:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Name</td>
<td>AI_0-5V_1</td>
</tr>
<tr>
<td>Type</td>
<td>AI_0-5V</td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>FUNCTION [I]</td>
<td>INT</td>
</tr>
<tr>
<td>DECIMALS [I]</td>
<td>INT</td>
</tr>
<tr>
<td>MINIMUM [I]</td>
<td>0,0</td>
</tr>
<tr>
<td>MAXIMUM [I]</td>
<td>33,0</td>
</tr>
<tr>
<td>PERCENT [I]</td>
<td>INT</td>
</tr>
<tr>
<td>OVERRANGE [I]</td>
<td>BOOL</td>
</tr>
<tr>
<td>BOARD [O]</td>
<td>AI_TYPE</td>
</tr>
</tbody>
</table>

Decimals: number of decimals
Minimum: minimum value that the input can assume
Maximum: maximum value that the input can assume
Overrange: 0 or 1. 0 means that it is not permitted to exit from the min-max range: an alarm is generated in this case
Per cent: only for active probes. Use Per cent=10 to reduce the input range of the probe by 10%. Per cent=10 must be set for ratiometric pressure transmitters whose input ranges from 0.4 to 4.5V

5.8.2  Digital Input and Digital Output
You have two different objects to define Normally Open or Normally Closed contacts:

TIP.
You can easily switch from one type to the other after you have connected a normally open or normally closed DI/DO by simply right-clicking on the object and selecting "Invert Polarity"
5.8.3 Analogue Output
The following types of Analogue Outputs are available:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1V</td>
<td></td>
</tr>
<tr>
<td>0-5V</td>
<td></td>
</tr>
<tr>
<td>0-10V</td>
<td></td>
</tr>
<tr>
<td>EXV</td>
<td>Electronic Expansion Valve</td>
</tr>
<tr>
<td>PWM</td>
<td>Pulse Width Modulation</td>
</tr>
<tr>
<td>PPM</td>
<td>Pulse Position Modulation</td>
</tr>
<tr>
<td>FREQ</td>
<td>Frequency Modulation</td>
</tr>
</tbody>
</table>

5.9 HOW TO add an expansion
The MCX and the expansion are connected via CANbus: they must be configured to have different CAN ID and equal baudrate. Refer to the specific manual for the hardware requirements of a CANbus network; in particular remember to activate the R120 Ohm line termination on the first and last element of the network by making a bridge (short circuit) between connectors CANH and R120 of the first and last network nodes.

To add an expansion to your project:
- Go to the Electric Wiring View
- From the Components panel, in the MCXExpansions section, select the type of expansion you want (among EXC06D, MCX08M, MCX15B, MCX20B) and drag and drop it into the working area.

Note that LCX06C is not able to manage an expansion (it is not equipped with CANbus communication). If you add an expansion when your main board is LC06CX, you will get a warning at when compiling.
Note that the word “EXPANSION” is added on the right of the expansion type to distinguish the expansion board from the main board.

- Configure the expansion I/Os as you would do in a normal MCX.
- In the Logic view it is suggested to add the ExpansionManager brick taken from the ExpansionControlLib library. Without it, the expansion is supposed to have Node ID=10 and it is not possible to generate an alarm in case of lost communication.

Configure the Expansion Manager input pins:
  - EN: expansion enable (0=NO, 1=YES)
  - NODE ID: expansion address in the CANbus network (default=10)

Connect the Expansion Manager output ERROR pin if you want to generate an alarm when the communication with the expansion is not working. The ERROR pin must be connected to a special alarm created in MCXShape, whose variable name is AL_Exp_NoLink.

Example of “Expansion Manager” configuration:
For an exhaustive example of expansion usage download the application "DemoExpansion" from the MCX FTP area.

5.10 HOW TO search for a resource

Select the resource you want to search for and press the search button on the toolbar.

The result is a message listing all the views where the resource is used. Go to that view and press "Search Next" to highlight the resource.

5.11 HOW TO manage Persistent (Eeprom) variables

Persistent variables are variables that are stored in non-volatile memory (Eeprom). They can be created only inside a Brick: see 5.4.3 HOW TO create a Brick. Persistent variables are loaded from Eeprom at startup and are saved when the special BOOL "Save" variable is set to 1. The value to be stored in Eeprom must be assigned to the special DINT "DATA" variable.

Example:
1. Add a persistent variable to a new brick as in the following example. The name of the variable must be DATA.

2. Exit from the Brick creation mode using the button on the toolbar. Save (and generate the code) using the button in the toolbar.

The resulting code after saving the library is in the LIBS folder and is called <name_of_the_library>_Brick_Template.c. It looks like the following:

```c
struct DemoCOUNTER
{
    // public
    BOOL EN;
    DINT OUT;
    BOOL RESET;

    // private
    DINT DATA; //copy of the value saved in eeprom
    BOOL SAVE; //flag to trigger data saving in eeprom
};
```
void Init()
{
}

void Main()
{
}

3. Copy the template into the *.Brick.c file and add the logic you need.
   Note that the *.Template.c file is automatically generated when the brick is saved, therefore just use it as inspiration. All
   your logic must be inserted into the <name_of_the_library>_Brick.c file which is created only once and will never be
   overwritten.

Example of how to store in non-volatile memory the running time (seconds) of one element of your units. The time is saved every
20 minutes. Note that a higher frequency could affect the non-volatile memory lifetime.

struct DemoCOUNTER
{
   // public
   BOOL EN;   // enable counter
   BOOL RESET; // reset counter
   DINT OUT;   // counter output

   DINT DATA; //copy of the value saved in eeprom. NOTE: it’s a special variable, don’t change it
   BOOL SAVE; //flag to trigger data saving in eeprom. NOTE: it’s a special variable, don’t change it

   // private
   TTImserSec _tm;  //timer declaration
   BOOL _status;

   // subclasses
   void Init()
   {
      _status = 0;
      SAVE = 0;
   }

   void Main()
   {
      if(EN == 1) {
         if(_status == 0) {
            _tm.Start();
            _status = 1;
         }

         if(_tm.ElapsedSec() > 20 * 60) { // save every 20 minutes
            DATA = DATA + _tm.ElapsedSec(); // update with last counting
            SAVE = 1;
            _tm.Start();
         }

         OUT = DATA + _tm.ElapsedSec();
      }
      else { // EN == 0
         if(_status == 1) {
            DATA = DATA + _tm.ElapsedSec(); // update with last counting
            _status = 0;
         }
         OUT = DATA;
      }

      if(RESET == 1) {
         DATA = 0;
         OUT = DATA;
         SAVE = 1;
         RESET = 0;
         _tm.Start();
      }
   }
}
5.12 How to manage internal EEV driver (for MCX061V and MCX152V)

For an example of how to manage the Electronic Expansion Valve driver, download the application “DemoEXV” from the MCX FTP area at www.danfoss.com/mcx.

The main steps are the following:

1. In the Electric Wiring view select MCX061V or MCX152V: these are the MCX models equipped with internal stepper motor drivers
2. Configure the stepper motor output EXV1 and/or EXV2 connecting it to the AO_EXV analog output type
3. Define the virtual function associated to the output (Stepper Motor Position in the figure below)

4. In the Logic View use the StepperMotorDriver brick from the ExternalDevicesLib library to configure the driver

5. Now you can use your virtual function Stepper Motor Position to set the valve position.
   As described in the following example, the valve position can be set by a parameter or by the result of a calculation, like the one for controlling the Super Heat. In this case you can use the SuperHeat brick from the HVAC library. This library can be downloaded from the MCX FTP site. See 2.2.6 Import an existing library for information about how to add a library to a project.
5.13 HOW TO make a Modbus master application

For an example of a Modbus Master application download the application “DemoModbusMaster” from the MCX FTP area at www.danfoss.com/mcx.

IMPORTANT NOTE

On MCX equipped with one RS485 serial ports you must add the following instruction in the file InitDefines.c inside the App folder of your project: #define NO_COM. This instruction allows you to use the serial port as Modbus master but remember that now the port is not working anymore as Modbus slave. Therefore you will be able to upload an application via RS485 into the MCX only in the first five seconds after power up. After this period your new application will take control of the serial communication.

All the bricks for building a Modbus master application are inside the MCXModbusMasterLib library:

- MCXModbusMasterConfig is used to configure the Modbus serial port
  
  COM NUMBER=1 to use the RS485#1 in any MCX
  COM NUMBER=2 to use the RS485#2 in MCX15 and MCX20

- MCXModbusMasterRead is used to read a group of consecutive variables (maximum 5). At the NUMBER OF VALUES pin you specify the number of variables read by that brick.
  
  If you want to read more variables you can add another MCXModbusMasterRead, but you must connect it to the previous one through the OFFSET IN/OUT pins. Finally each MCXModbusMasterRead brick must have a unique and consecutive index at the INDEX input, starting from 1
In the example above, the brick with INDEX=1 allows you to read three registers (NUMBER OF VALUES=3) from address 642 to 644 of device with MODBUS ID=1. The brick with INDEX=2 one register with address 701 of the same device.

- **MCXModbusMasterWrite** is used to write one variable. The example below shows you how to write register 701 with the setpoint value when there's a change in its value.

You must add as many MCXModbusMasterWrite bricks as the number of variables to write. To trigger a Modbus write you can use also a command: see 5.6 HOW TO manage commands.
6.0 FAQ

Q: Is possible to change the size of characters displayed in custom screens?
A: YES, use the property FontSize of the VarText component.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>VarText_1</td>
</tr>
<tr>
<td>Type</td>
<td>VarText</td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>FontSize</td>
<td>NORMAL</td>
</tr>
<tr>
<td>NumberOfCharacters</td>
<td>11</td>
</tr>
<tr>
<td>Value [I] (string)</td>
<td>CONCAT_2.CUT</td>
</tr>
</tbody>
</table>

FontSize=SMALL (6 pixel height fonts) for small font
FontSize=NORMAL (8 pixel height fonts)
FontSize=LARGE (16 pixel height fonts) for double-sized font

Q: Is MCXDesign able to manage Chinese fonts?
A: Not yet

Q: Is MCXDesign able to manage an I/O Expansion?
A: Yes, from MCXDesign version 2. See 5.9 HOW TO add an expansion

Q: How do I program the function associated to each key?
A: The function of the keys is defined by the MCX default template. Via MCXDesign, you can define which arrow keys to use for moving into screen loops.

Q: Is the size of an application developed with MCXDesign greater than an application developed using C++?
A: Not necessarily, if the more critical parts are managed with bricks (whose logic is in C++)

Q: Can existing applications written in C++ be imported into MCXDesign?
A: No, they need to be rewritten. But you can copy the C code of subroutines into Bricks.

Q: Is LCX managed by MCXDesign?
A: Yes, from MCXDesign version 2.1

Q: Are hotspots writable via Modbus?
A: Yes, but the hotspot must be connected only to an input of a block otherwise its value will be overwritten by the block output. Or it can be a “free” hotspots, not connected to a block but used by the User Interface. In this case remember to set the INPUT property into the hotspot property window.

Q: How to know the address map of variables exported to Modbus?
A: Each parameter, alarm, and hotspot (status variable) is automatically exported to Modbus. Use the Print Variable List function of MCXShape inside the Print menu.