



**INDUSTRIAL  
CONTROL DIRECT**  
A BSD Industrial Company

**IMO**

*iSmart*

# Training Manual





**IMO Precision Controls**

1000 North Circular Rd  
Staples Corner

London  
NW2 7JP

Tel: +44 (0) 208 452 6444

Fax: +44 (0) 208 450 2274

Email: [sales@imopc.com](mailto:sales@imopc.com) or [applications@imopc.com](mailto:applications@imopc.com)

Web: [www.imopc.com](http://www.imopc.com)

# Table of Contents

<i>iSmart Overview</i> .....	7
<b>iSmart Part Number Breakdown</b> .....	<b>8</b>
<i>Installation of SMT-Configurator</i> .....	9
<i>iSmart Programming Environment</i> .....	12
<b>Ladder Programming Environment</b> .....	<b>13</b>
File Menu .....	13
Edit Menu .....	14
Operation Menu .....	15
View Menu .....	16
Help Menu .....	16
Icons .....	17
Programming Buttons .....	17
Used Contact / Coil .....	17
<b>FBD Programming Environment</b> .....	<b>18</b>
File Menu .....	19
Edit Menu .....	19
Operation Menu .....	20
View Menu .....	21
Window Menu .....	21
Help Menu .....	21
Page Format Button .....	21
<b>Programming Buttons</b> .....	<b>22</b>
Constants and Connectors .....	22
Logic Block .....	22
Function Block .....	23
<i>iSmart Programming Rules</i> .....	24
<i>Setting common options in the Operation Menu</i> .....	26
<b>RTC Set</b> .....	<b>26</b>
<b>Analogue Set</b> .....	<b>27</b>
<b>Password</b> .....	<b>27</b>
Level 1 Protection .....	28
Level 2 Protection .....	28
<b>Language</b> .....	<b>29</b>
<b>Module System Set</b> .....	<b>29</b>
<i>iSmart Programming Skill – Basic Ladder</i> .....	30
<b>Inputs</b> .....	<b>30</b>
<b>Function Key</b> .....	<b>31</b>
<b>Outputs</b> .....	<b>32</b>

<b>Assembling the Ladder .....</b>	<b>34</b>
AND Gate .....	34
OR Gate .....	34
Latching Circuits.....	34
Differential Contact and Pulse Coil Output .....	36
<b><i>iSmart Programming Skill – Basic FBD .....</i></b>	<b>37</b>
<b>Inputs .....</b>	<b>37</b>
<b>Function Key .....</b>	<b>38</b>
<b>Outputs.....</b>	<b>39</b>
<b>Internal Bits.....</b>	<b>40</b>
<b>Assembling the Function Block Diagrams.....</b>	<b>41</b>
AND Logic Gate .....	41
OR Logic Gate .....	41
Latching Circuits.....	42
Pulse Function.....	42
<b><i>Advanced iSmart Ladder Functions.....</i></b>	<b>43</b>
<b>Timer Function.....</b>	<b>44</b>
Setting up an On-delay timer .....	44
Setting up an Off-delay timer .....	46
<b>Counter Function .....</b>	<b>47</b>
Setting up an Up Counter.....	47
Setting up an Up / Down Counter.....	48
<b>Setting up a Real Time Clock Function .....</b>	<b>49</b>
<b>Setting up a Compare Function with an Analogue.....</b>	<b>50</b>
<b>Setting Up a HMI Function Coil.....</b>	<b>51</b>
<b><i>Advanced iSmart FBD Functions .....</i></b>	<b>53</b>
<b>Timer Function.....</b>	<b>55</b>
Setting up an On-delay timer .....	55
Setting up an Off-delay timer .....	56
<b>Counter Function .....</b>	<b>57</b>
Setting up an Up Counter.....	57
Setting up an Up / Down Counter.....	58
<b>Inserting a Real Time Clock Function .....</b>	<b>59</b>
<b>Inserting a Compare Function with an Analogue.....</b>	<b>60</b>
<b>Setting up a HMI Function Block.....</b>	<b>61</b>
<b><i>iSmart Communication Functions – Ladder .....</i></b>	<b>64</b>
<b>Remote I/O.....</b>	<b>64</b>
<b>iSmart Data-Link .....</b>	<b>66</b>
Three <i>iSmart</i> Example .....	67
Station ID = 0, Program 1.....	67
<b><i>Program Simulation.....</i></b>	<b>69</b>

<b>Simulation Tools.....</b>	<b>69</b>
<b>Simulating a Ladder Program.....</b>	<b>70</b>
<b>Simulating a FBD Program.....</b>	<b>71</b>
<i>Uploading and Downloading.....</i>	<i>72</i>
<b>Connecting the iSmart.....</b>	<b>72</b>
<b>Writing to the iSmart (downloading).....</b>	<b>74</b>
<b>Read from the iSmart (uploading) .....</b>	<b>75</b>
<b>Monitor .....</b>	<b>76</b>
<i>iSmart Tutorials .....</i>	<i>77</i>
<b>iSmart Programming Example 1: Greenhouse.....</b>	<b>77</b>
<b>iSmart Programming Example 2: Car Park .....</b>	<b>78</b>
<i>Solutions.....</i>	<i>79</i>
<b>Greenhouse Program.....</b>	<b>79</b>
<b>Car Park Program .....</b>	<b>82</b>



**IMO Precision Controls**

1000 North Circular Rd

Staples Corner

London

NW2 7JP

Tel: +44 (0) 208 452 6444

Fax: +44 (0) 208 450 2274

Email: [sales@imopc.com](mailto:sales@imopc.com) or [applications@imopc.com](mailto:applications@imopc.com)

Web: [www.imopc.com](http://www.imopc.com)

## *iSmart* Overview

The iSmart is our entry level Programmable Logic Controller. More so an intelligent relay that can be programmed in either Ladder Logic or Function Block Diagram. It is modular block type Logic controller and has several Input / Output, Supply voltage and communication options, including:

1. Relay or Transistor Outputs.
2. Real Time Clock as standard in all models.
3. Blind or with HMI screen in-built.
4. 12Vdc. 24Vdc or 100-230Vac supply.
5. Analogue inputs on DC models as standard.
6. Maximum of 44 I/O.
7. Modbus. Ethernet. DeviceNet. Profibus communication options.

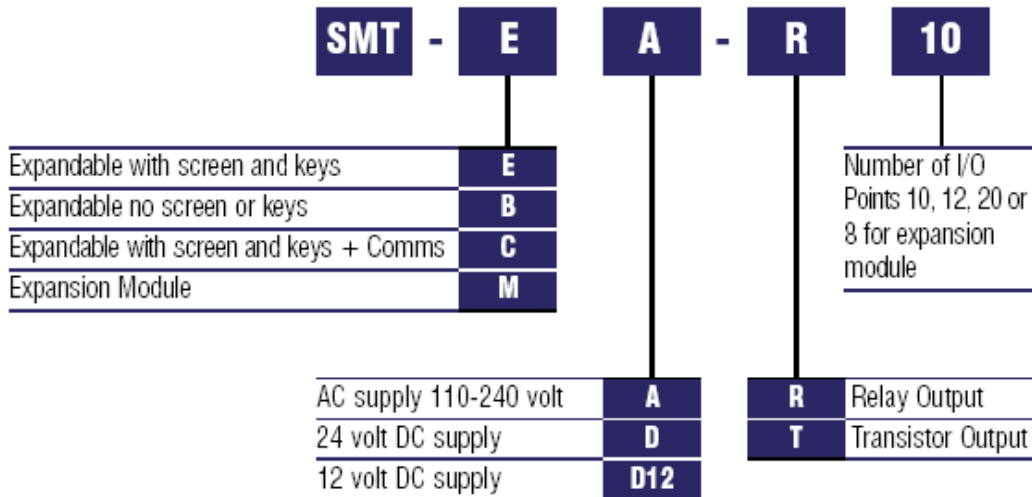


iSmart is the ideal solution to replace older timers and counters saving on wiring and adding flexibility.

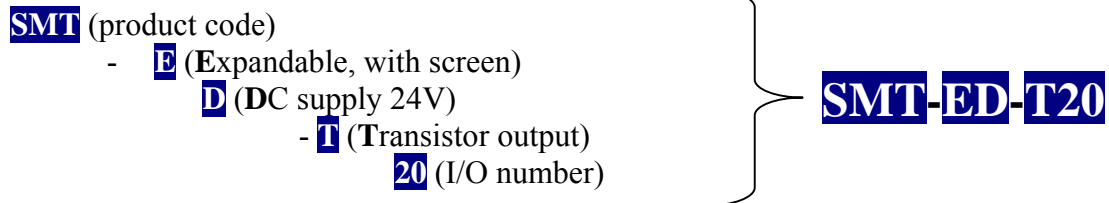
The analogue inputs included in the DC supply versions add pump level and simple process control. Two of the many uses of the iSmart.

## *iSmart* Part Number Breakdown

The part number has been made up so that it is easy to understand and build up to meet your requirements.



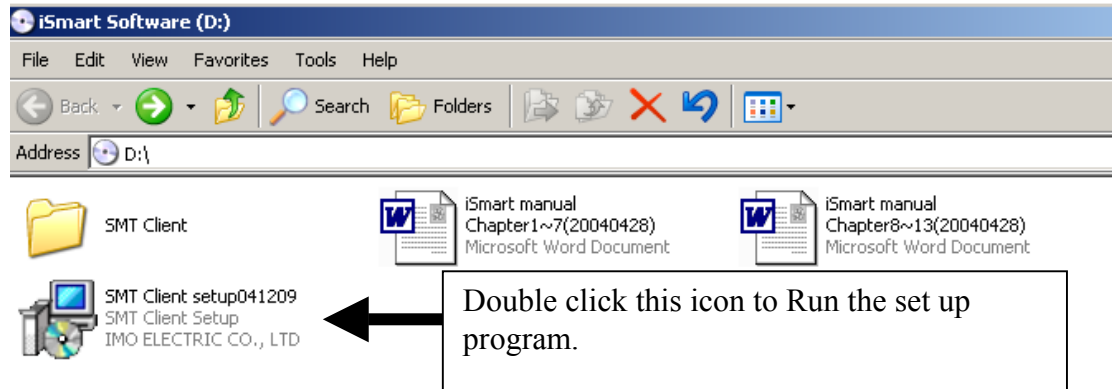
For example, if you were looking for a 20 I/O expandable transistor iSmart with a screen at 24Vdc, then the part number would be:



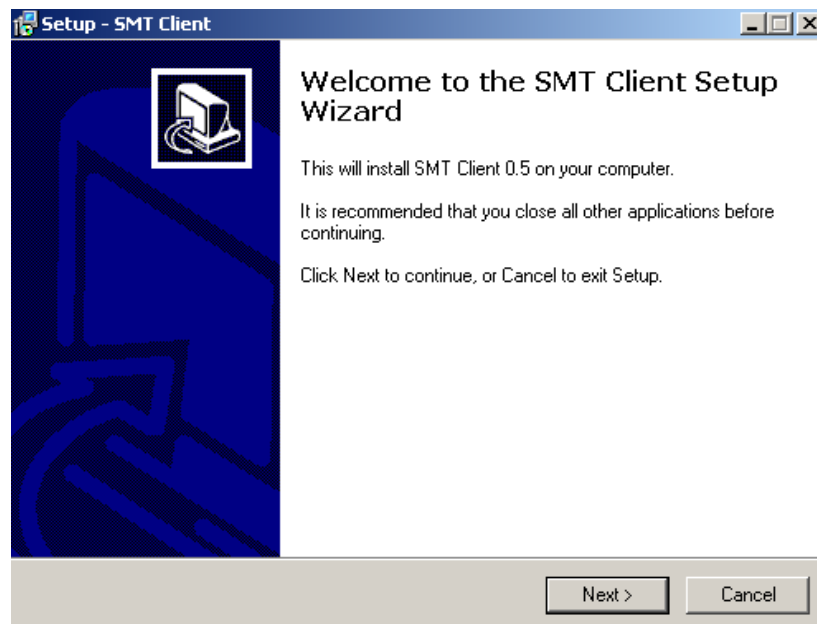


## Installation of SMT-Configurator

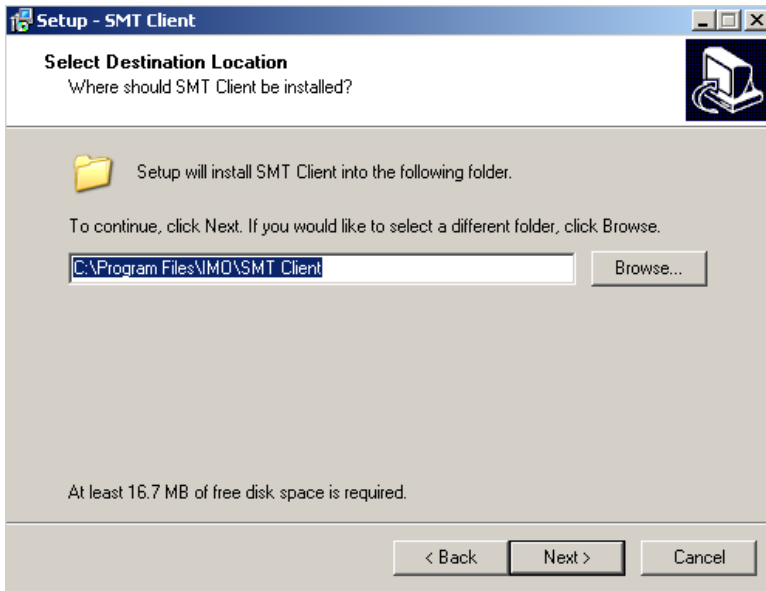
Insert the IMO iSmart Config & Manuals disk into the CD drive. If the CD doesn't auto-run then explore the CD in My Computer.



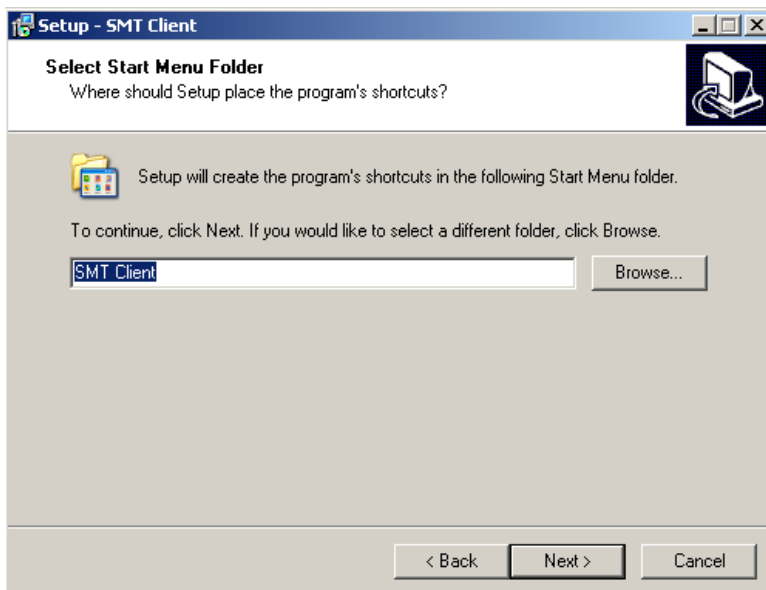
The Set up program will automatically run, just follow the seven steps.



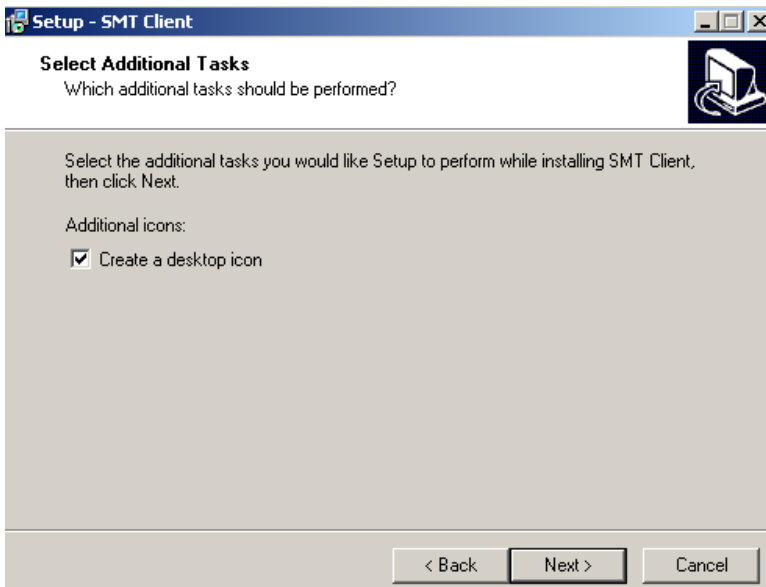
Step 1.  
Welcome message, with installation recommendations.



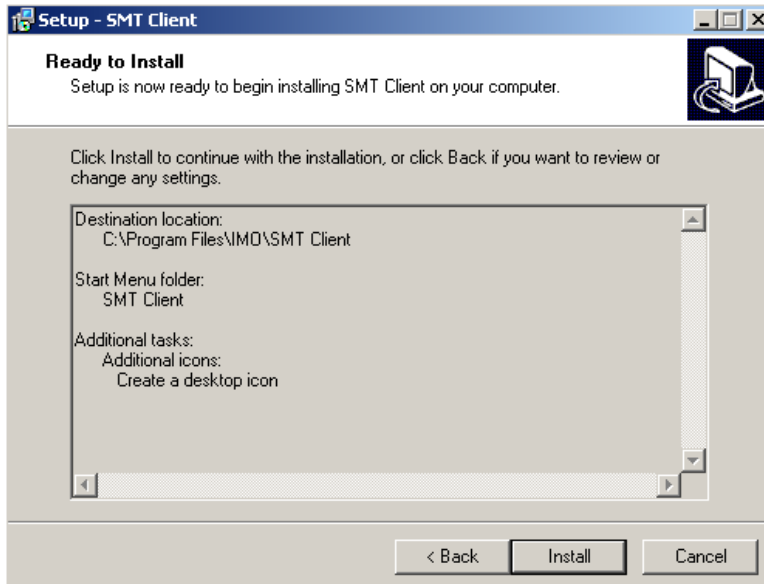
Step 2.  
Selecting a  
destination directory



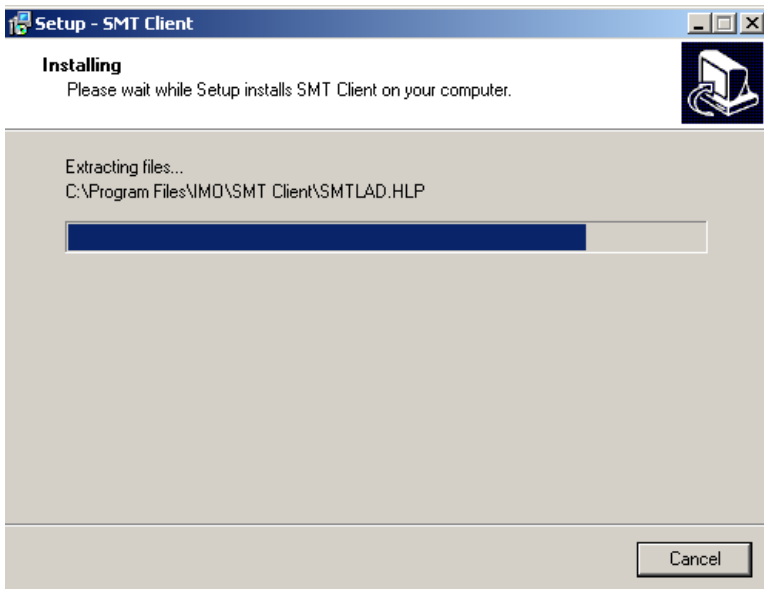
Step 3.  
Selecting a short cut  
folder.



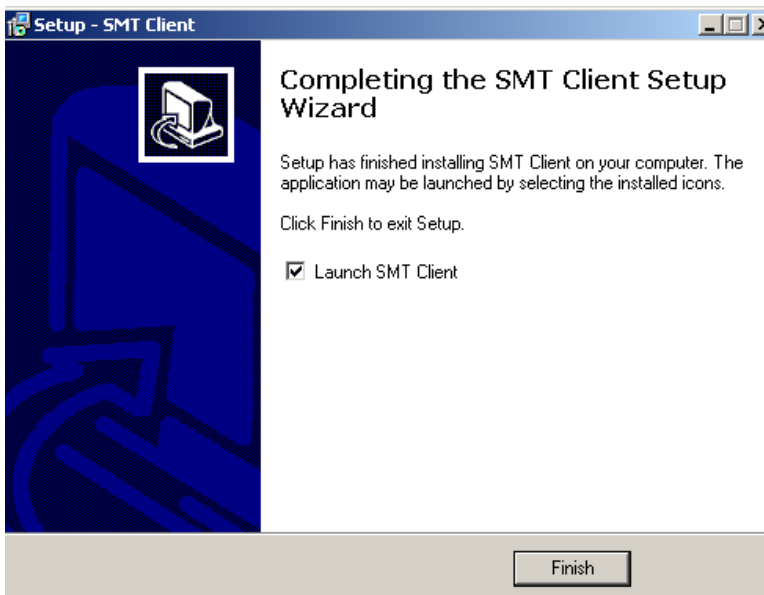
Step 4.  
Creating a desktop  
short cut item.



Step 5.  
Confirmation of the  
previous steps



Step 6.  
Installation Process.  
Can take a few moments  
depending on your PC.



Step 7.  
Installation complete.  
Prompts' you to begin  
programming straight  
away!

## *iSmart* Programming Environment

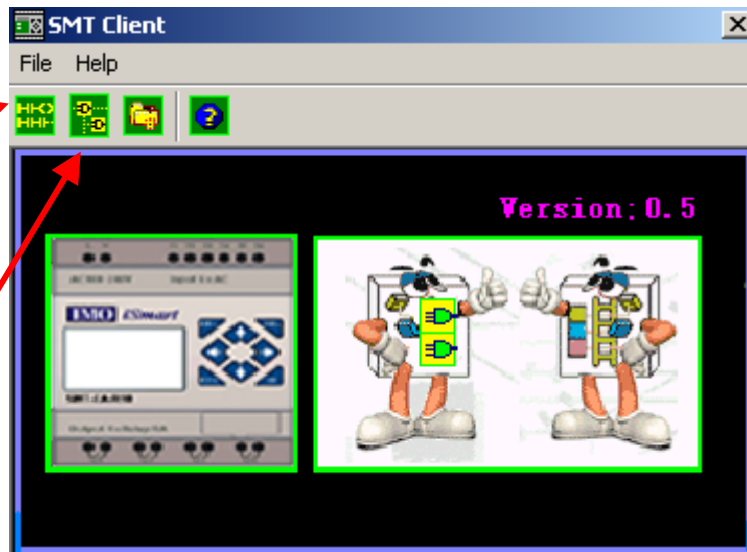
To open the iSmart programming software click on the icon.



The iSmart can be programmed in one of two ways: Ladder Logic or Function Block Diagram (FBD). Each way has its own distinct programming environment.

Click this button to open the Ladder programming environment

Click this button to open the FBD programming environment

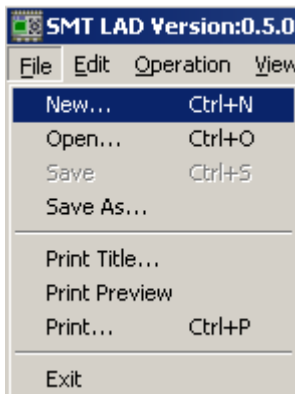


## Ladder Programming Environment

The screenshot shows the SMT LAD software interface with the following callouts:

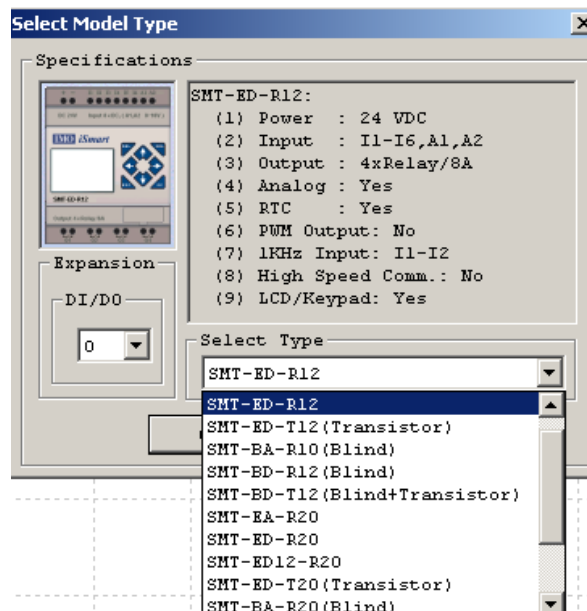
- Run / Stop, Save, Print, new, etc icons:** Points to the top toolbar.
- Memory capacity used:** Points to the 'Capacity: 800 free space.' text.
- Ladder Diagram workspace:** Points to the main grid area.
- Programming icons:** Points to the bottom toolbar.
- ID number (iSmart name):** Points to the 'ID: 00' field in the status bar.
- Model type:** Points to the 'Model: SMT-ED-R12' field in the status bar.
- Connection status:** Points to the 'Status: Stop' field in the status bar.
- iSmart mode:** Points to the 'Ver: x.x' field in the status bar.
- Program name:** Points to the 'None.gen' field in the status bar.
- Available I/O, timers, Counters, memory relays, etc.:** Points to the left-hand list of symbols.

## File Menu

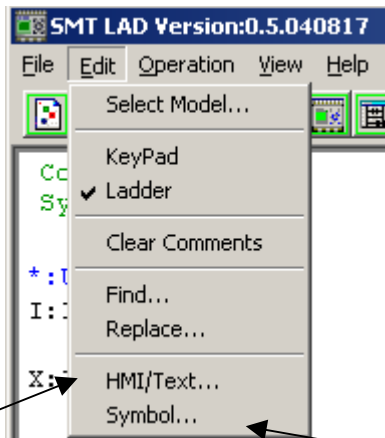


This is the menu we can use to create new programs, save programs and print out the diagram. In this menu we can also access the additional documentation features, such as print.

When a New program is selected a window pops up with a Model Select option. It also gives the details on the models of iSmart as you select the model number.



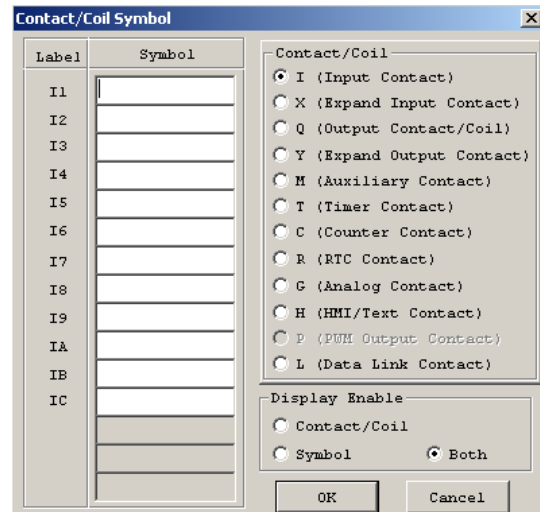
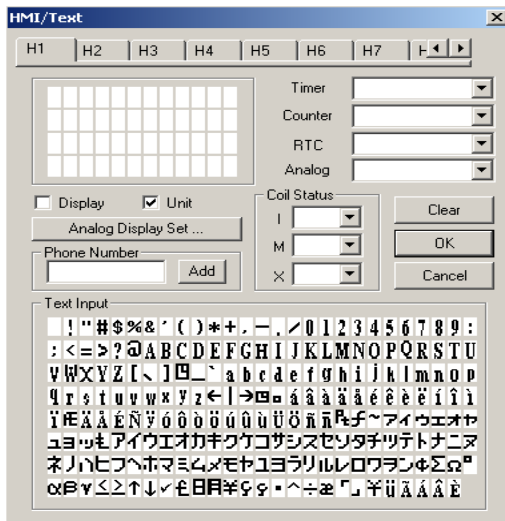
## Edit Menu



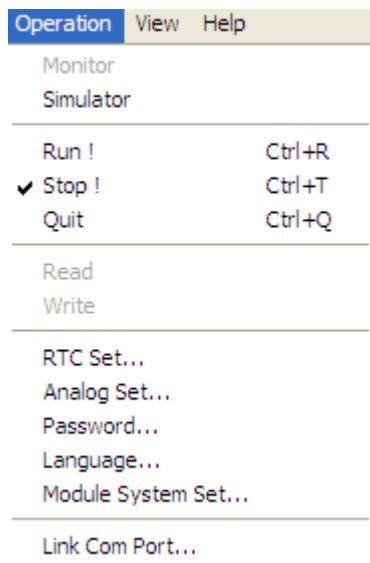
In the edit menu we can change the model selected initially. Change the view in the programming environment to show the Keypad, used instead of the Ladder diagram. Clear comments, find and replace items. This menu allows the user to select and modify the “Symbol” record where names can be given to Program elements, such as Inputs, Outputs. HMI text can also be edited from here,

HMI / text menu

Contact / Coil symbol edit



## Operation Menu



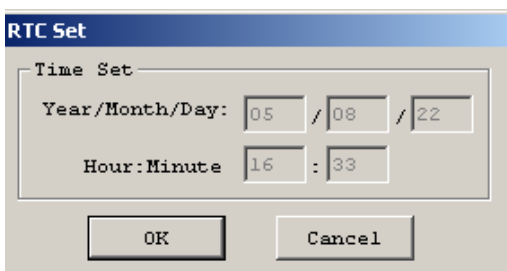
Some options are “greyed out” This is because an iSmart has not been connected, so there is nothing to monitor, read from or write to. We must “Link” to an iSmart before monitoring can begin.

From this menu the user can connect to the iSmart, set the RTC clock, system settings, RUN / STOP, Write and Read.

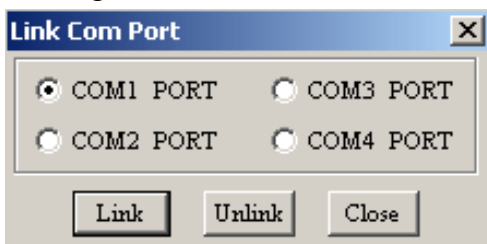
There is also a simulation option will allows the user to fully test their program without even connecting it to an iSmart.

(Details are in the Uploading / Downloading section)

### Main Operation Sub menus

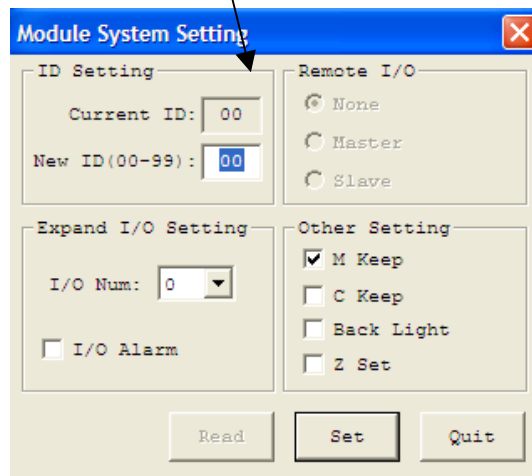


Click on the individual boxes to change the values.



When linking the iSmart, connect the programming cable (SMT-PC03) before powering up the iSmart. Then select the Link Com port.

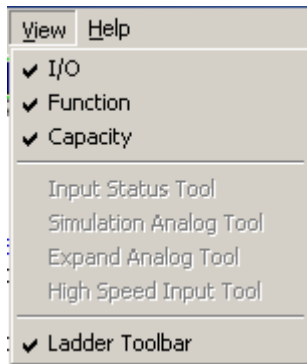
The model ID can be used for connecting multiple iSmart via serial comms



In module System settings, we can set the Counter and Memory to be retentive on Power down. The backlight to be on all the time, the number of expansion I/O modules connected and if the iSmart is a v1.8 firmware or above the Z keys to be used.

- ❖ *Connection Issues: When using a USB to serial converter ensure that the USB converter is assigned to one of the first 4 ports. This can be check in device manager in the Control Panel of Windows.*

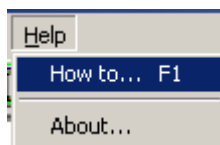
## View Menu



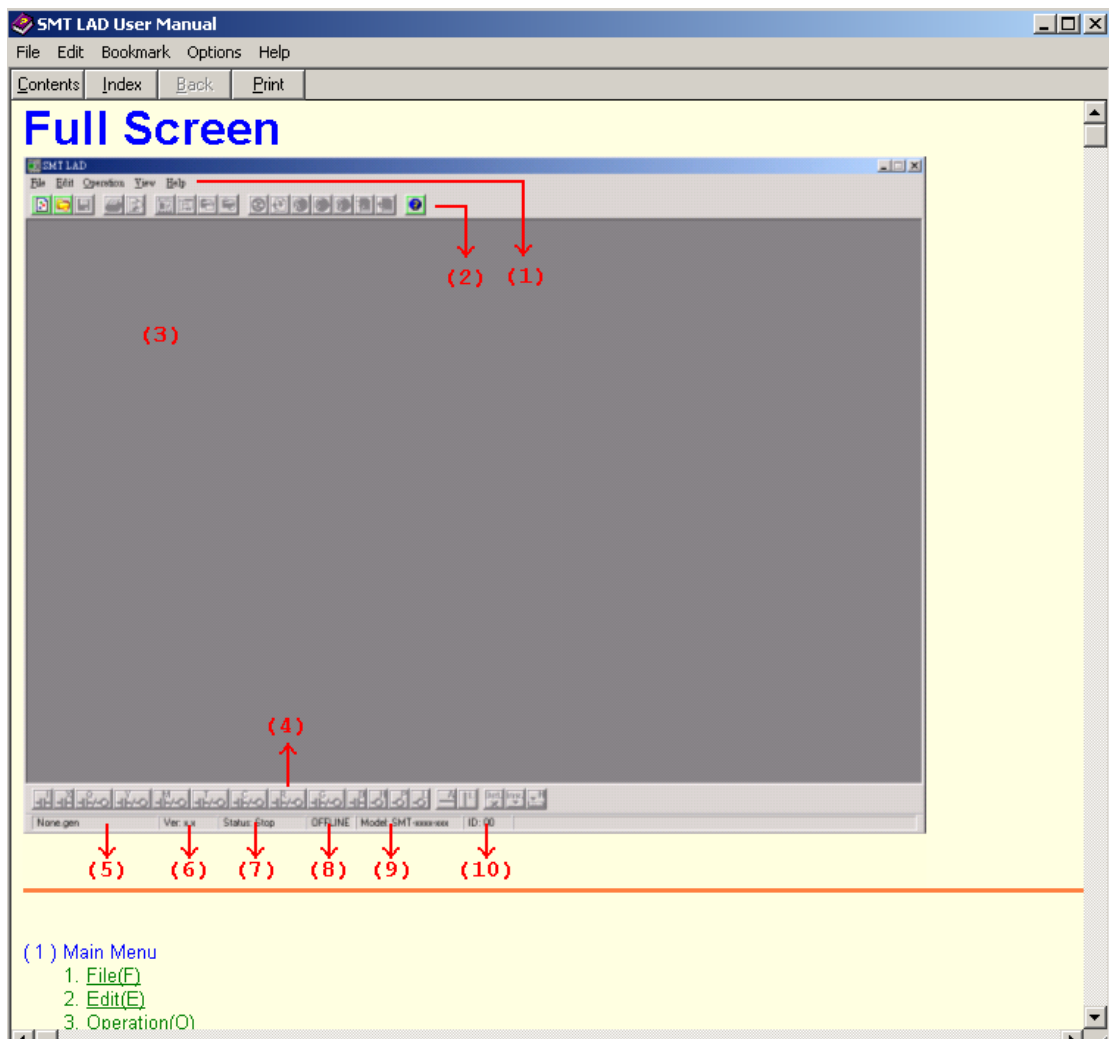
Here we can personalise the main window to suit the preference of the user.

The options “greyed out” are part of the simulation and monitoring options. The functions are activated when the iSmart is connected.

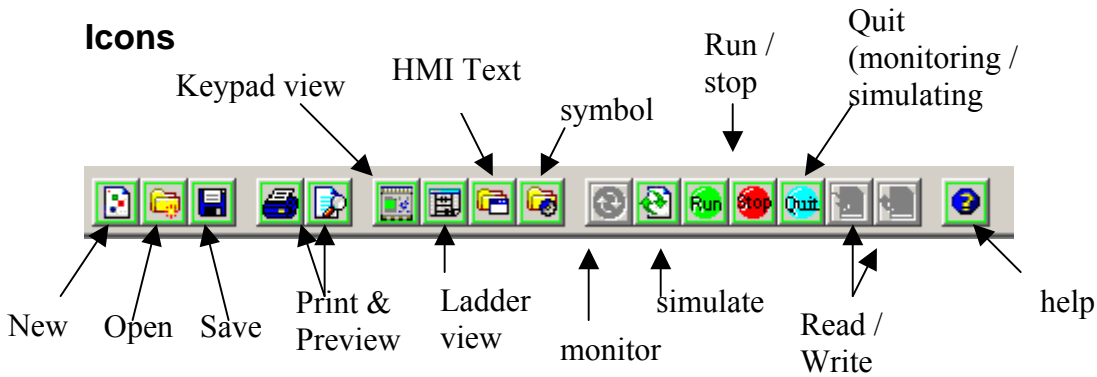
## Help Menu



In the Help menu we can load the extensive help function and confirm version of the software is on the computer. Below we can see the Help menu.



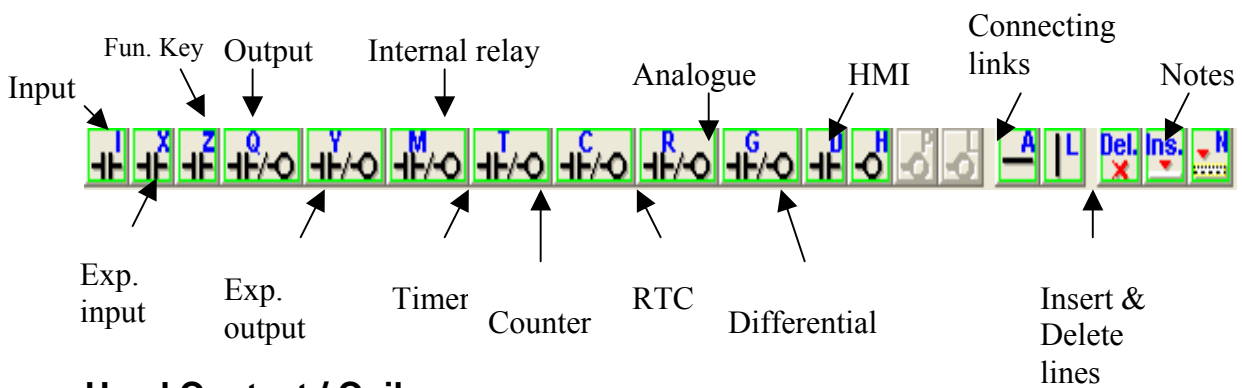




These icons appear just below the menus at the top of the screen. The icons are shortcuts to the most popular menu options. If you hover the mouse over an icon, a message will appear to inform you to its operation.

### Programming Buttons

The programming buttons are along the bottom of the window. The letters in blue above the symbol in each icon relates to a key on the Keyboard. This means that the keyboard can be used instead of the mouse to program.



### Used Contact / Coil

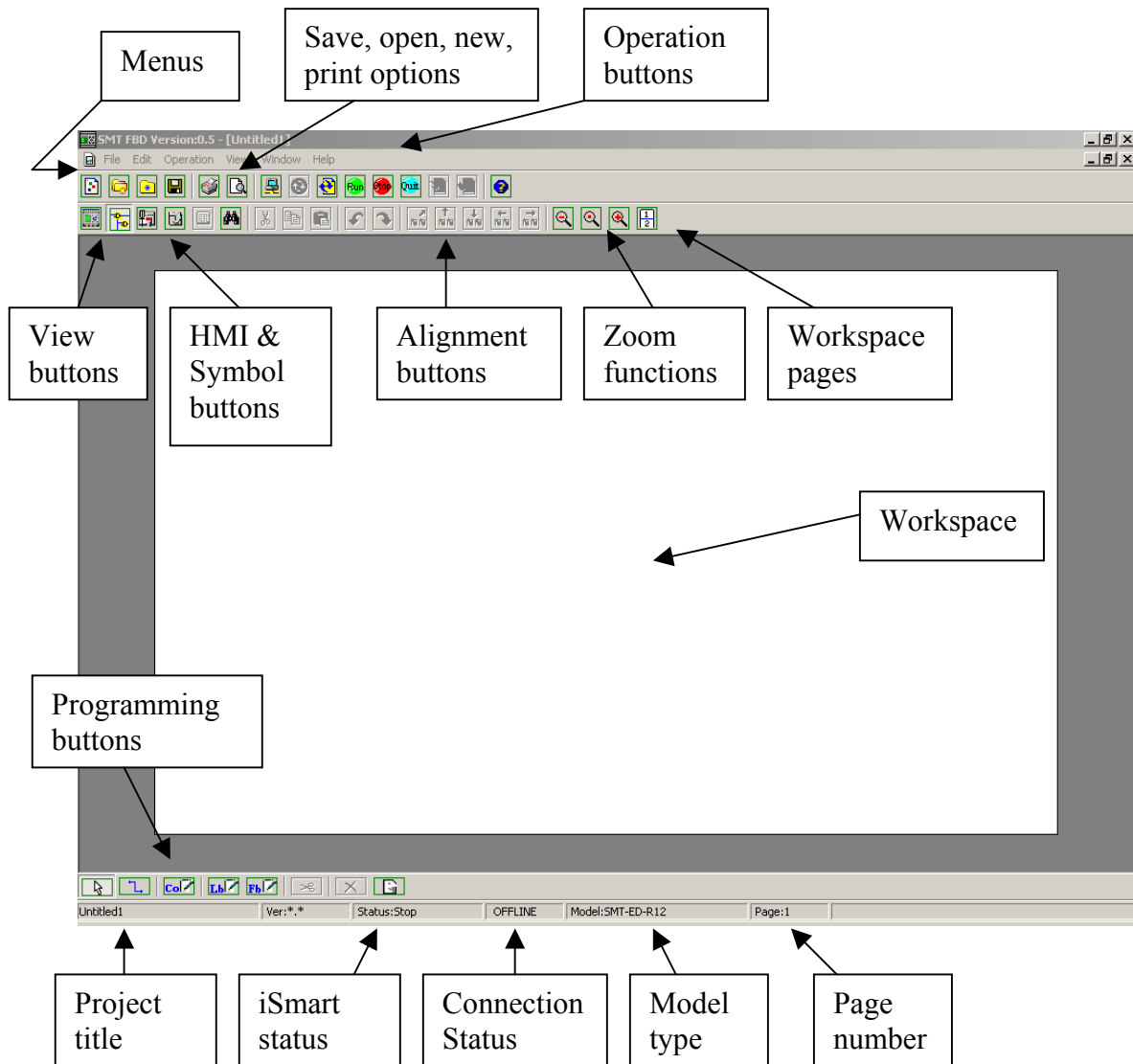
On the left hand side of the ladder diagram, we can see the full list of contacts and coils. As we program and use them there will be a blue asterisk (\*) indicating which elements are used in the program.

```

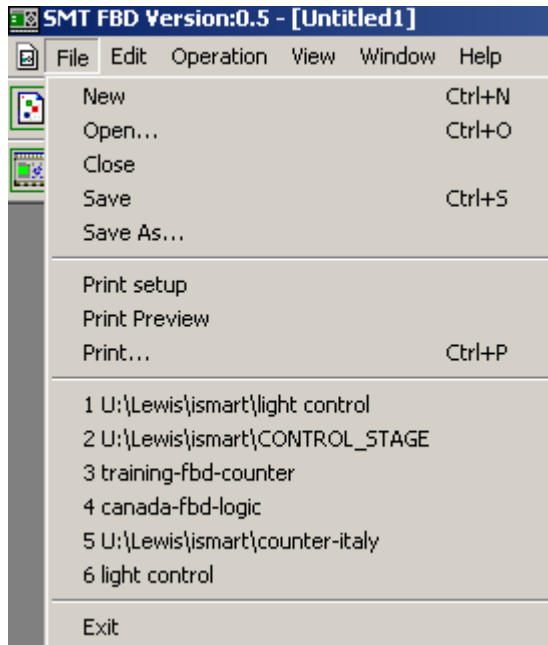
*:Used in Prog.
I:123456789ABC
Z:1234
X:123456789ABC
Q:12345678 P:1
Y:123456789ABC
M:123456789ABCDEF
T:123456789ABCDEF
C:123456789ABCDEF
R:123456789ABCDEF
G:123456789ABCDEF
H:123456789ABCDEF
L:12345678
D:0
    
```

## FBD Programming Environment

Function Block Diagram programming has a different look to ladder programming, which may be better suited to those that are comfortable with electrical drawings. At first there is no work space in the middle of the window and you are required to either open or start a new file.

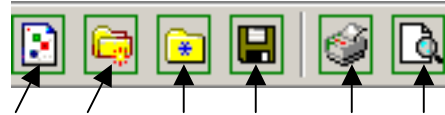


## File Menu



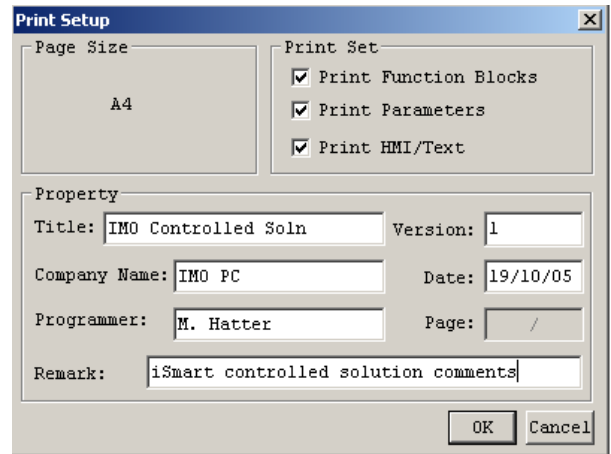
In the file menu projects can be saved, opened and printed. To set up the additional documentation such as title, version number and select Print Set up. Recent project can also be accessed.

Related buttons:



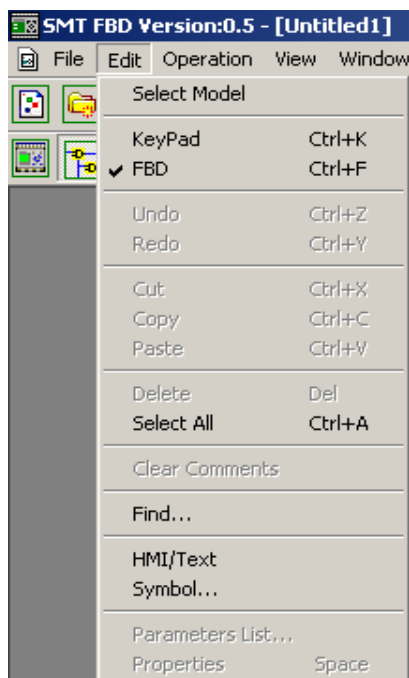
New, Open, Close, Save, Print, Preview

Print Setup option



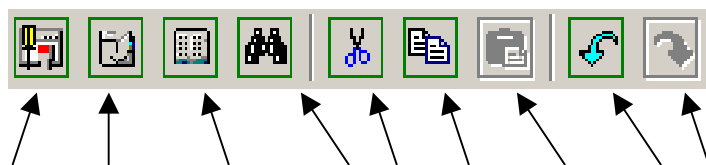
Enter the information you want to see on the print out and click OK to save

## Edit Menu

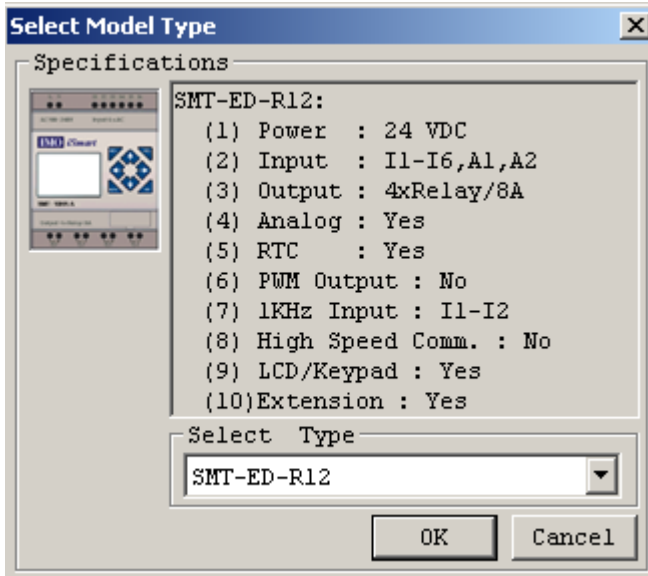


In this menu we can change the model selected, as well as copy, cut and paste items. We can also find blocks of program, view the parameter list and properties of the function blocks. Also add text as per the ladder “edit menu”

Related buttons

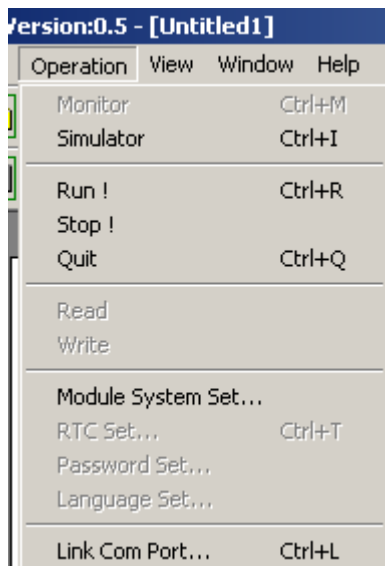


HMI, Symbol, Parameter list, Find, Cut, Copy, Paste, Undo, Redo



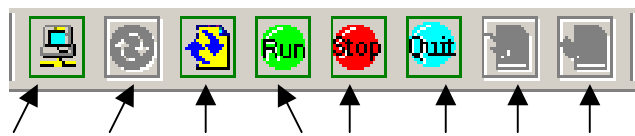
This window appears in the same way as when we start a new project. It provides information on the type of iSmart you are going to select.

### Operation Menu



In the operation menu, we can Monitor and simulate the program. Run, Stop and quit the program in the iSmart. Read from and write to the iSmart. We can also set the system data and link out to the com port.

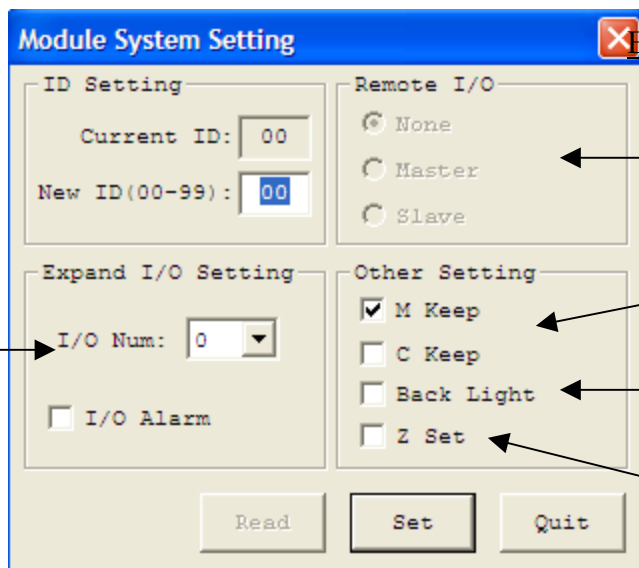
#### Related buttons



Link, Monitor, Simulate, Run, Stop, Quit, Read, Write

❖ Some options are only available when the SMT-Configurator is connected to an iSmart.

Expansion module settings, for the iSmart to recognise additional modules



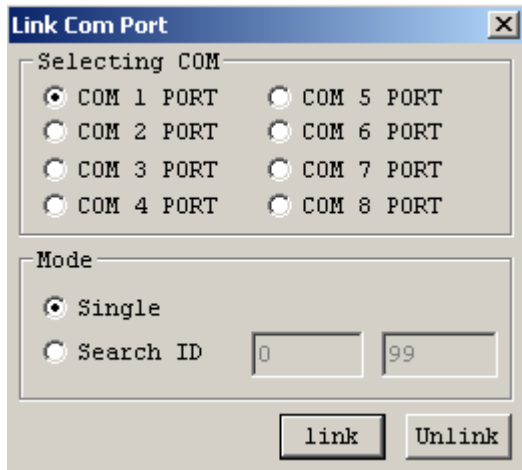
Edit the iSmart system settings online.

Remote I/O option is explained in the Com Functions settings

C keep and M keep are for memory retention on power down, as explained in the manual.

Backlight on permanently option

Z set to enable use of the arrow keys in users program (v1.8 models and above)

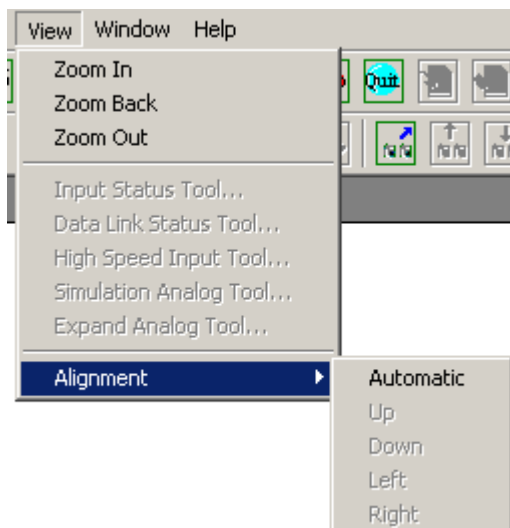


*Important note: Connect the programming cable (SMT-PC03) before powering on the iSmart*

The link COM port option in FBD is slightly different to Ladder and there is the option to Link a single iSmart, instead of searching through the range of ID numbers. Select the COM port to which the SMT-PC03 cable is connected. In FBD, it is possible to narrow the search for the iSmart ID

If using an USB-Serial converter please ensure that it has been assigned to a useable port in the software.

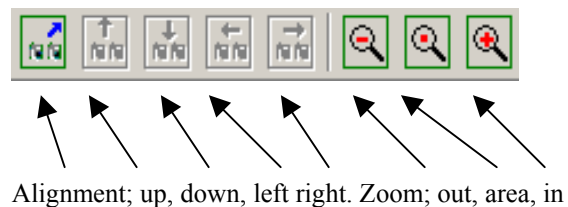
### View Menu



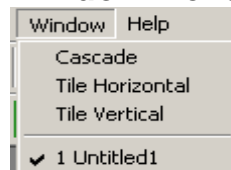
In the view menu the workspace can be zoomed in and out. The design can also be aligned to a part of the workspace.

The greyed out options are accessible in simulation and monitoring.

#### Related buttons

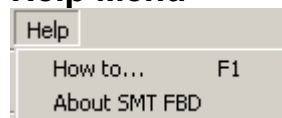


### Window Menu



Here we have the option to organise the main programming window and any windows open in the software

### Help Menu



Help button



Check the version of the software and access the extensive help file

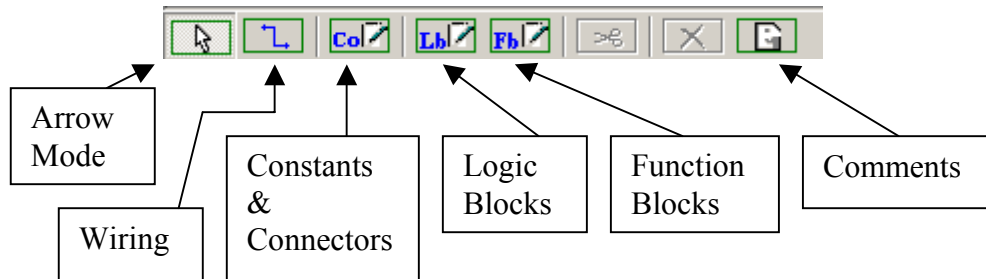
### Page Format Button



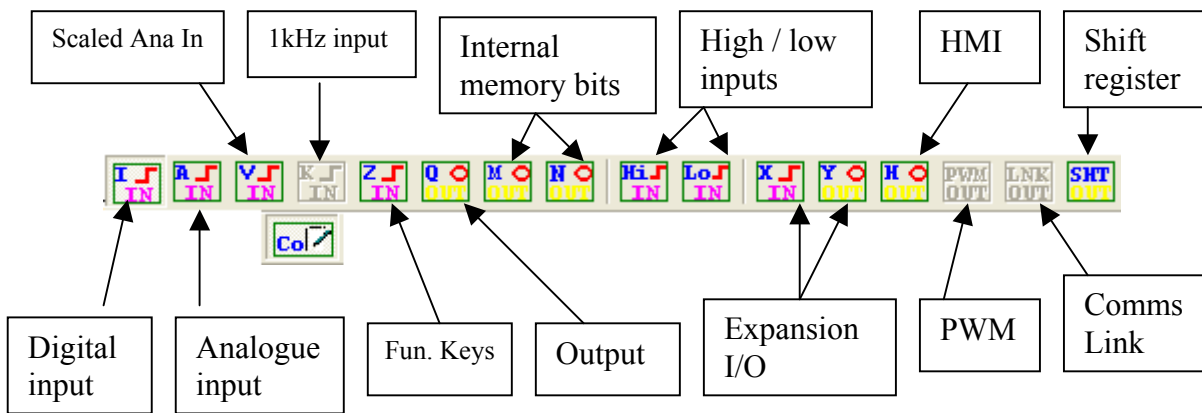
This button adds / subtracts pages to the workspace.

## Programming Buttons

Located at the bottom of the screen.

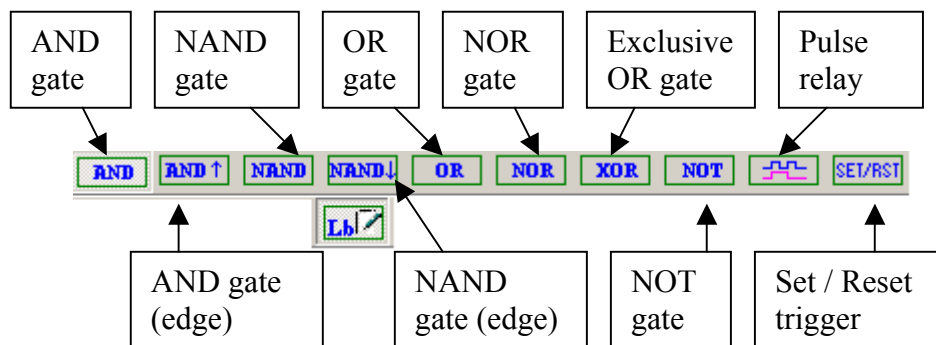


### Constants and Connectors



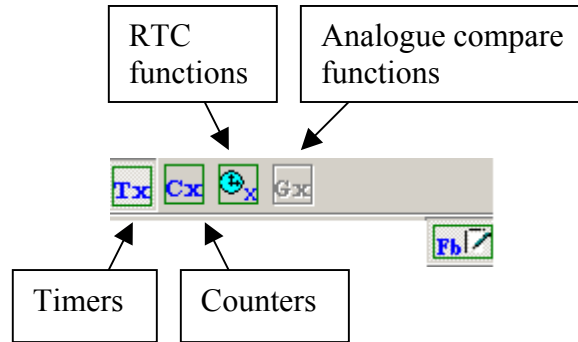
Special features are only available to particular iSmart's, the greyed out buttons are not available to the basic iSmart device. 1kHz input and PWM output are transistor model functions, and the Link out is a communication function available to the communication model.

### Logic Block



## Function Block

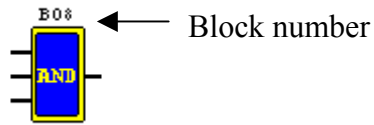
The greyed out feature is only available on the DC supply models. The Analogue compare functions can be used to compare other values, i.e. Counter Preset, Counter Current, Time Current, Time Preset.



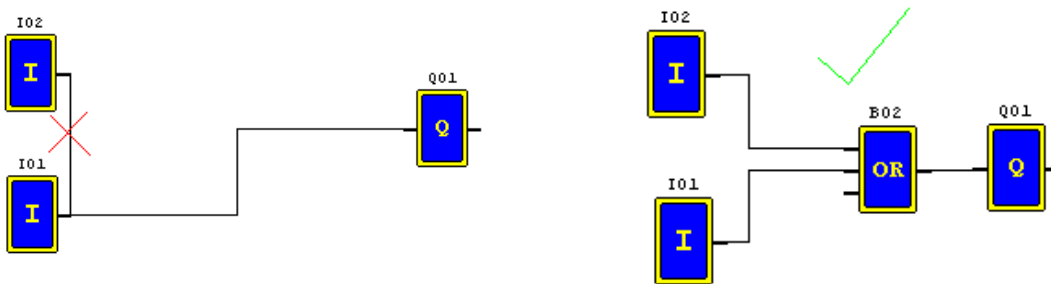
The maximum number of Blocks available in total is 99. The maximum number of each Function Block available is 15; therefore it is possible to have 15 Counters, 15 Timers, 15 RTC functions and 15 Compare functions (if available.).

## iSmart Programming Rules

- Max Number of Functions = 15 of each
  - i.e. Counters / Timers / Compare / HMI
- Max number of Blocks in FBD programming = 99

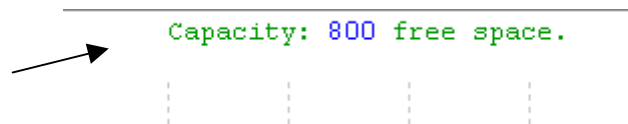


- Input blocks in FBD can not be linked directly together

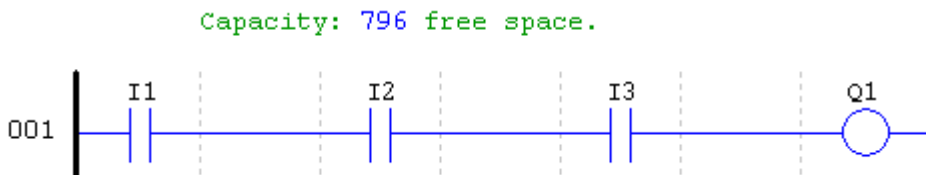


- Max number of steps in Ladder programming = 800

Display at the top of the ladder diagram



- Max number of steps to a line in ladder programming = 4
  - (Max number of contacts to a line = 3)
  - Therefore max number of lines = 200

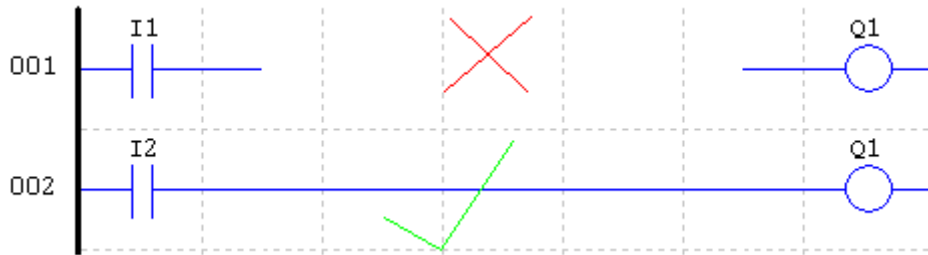


- Each line can have up to three inputs but only one output

- If a ladder line is used then it must be completed



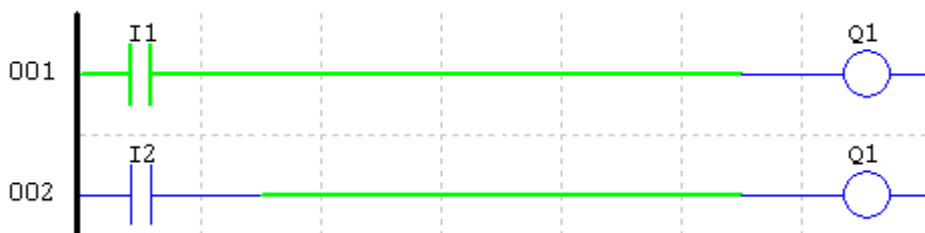
- o NOTE: No end statement is required at the end of a program.



- A function block can only be set once, in the output.

Attempt to insert T1 again into the program, at the green box and this error message will pop up.

- Coil Duplication in Ladder programming.
  - o When an output has been used more than once in the program it will only switch on when all the conditions are satisfied.



I1 is ON but Q1 is being tied low as I2 is OFF. Q1 will only be ON when both Q2 and Q1 are both ON.

## Setting common options in the Operation Menu

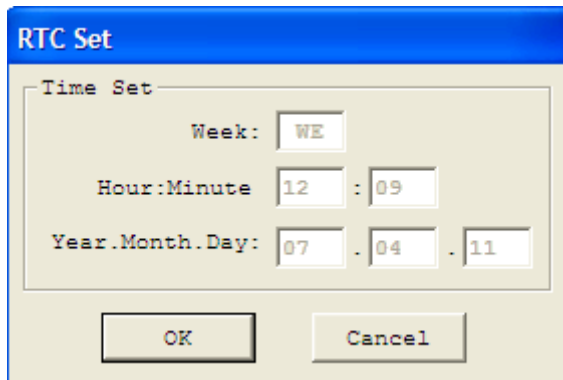
The operation menu is common to both programming languages with the options being the same. This menu is designed to allow the user to enter into the *iSmart* hardware its system options therefore if you wish to change the settings from the software the *iSmart* must be linked to the computer.



These menus are exactly the same as set out in the operation menu. Using the arrow keys, select and OK the user can enter the system settings through the front screen.

### RTC Set

All *iSmart*'s have an internal Real Time Clock (RTC) as standard and this needs to be set in order to allow accurate use of the RTC coils in the program. Please note there is no Day Light Saving option and this has to be performed manually as part of the end users system maintenance.



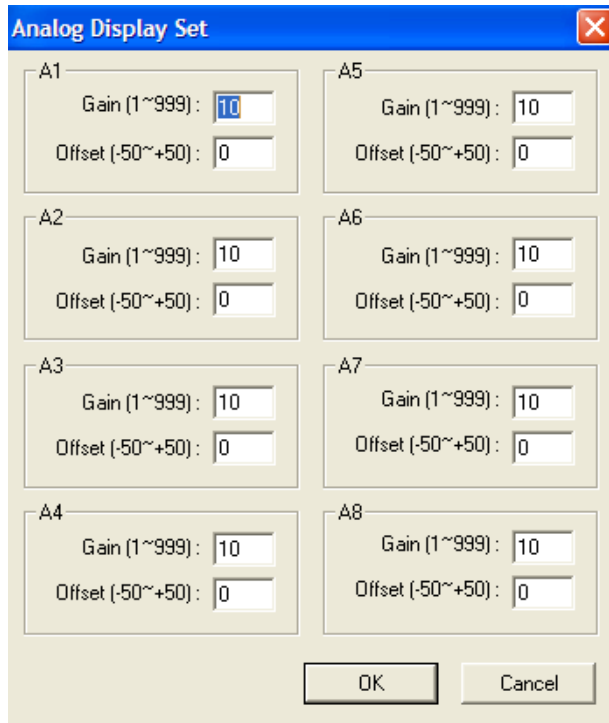
The *iSmart* must be linked to the computer before you can change its RTC value. By clicking the mouse on the boxes the data can then be entered. Press OK to save and exit.



Select the RTC SET menu and press OK. Once in the menu press SEL and the first column will get underlined. Use the arrow keys to move through the different columns and change the values. Press OK to save then ESC to exit.

## Analogue Set

This option only applies to *iSmart*'s with version 1.8 firmware and above. It allows the user to scale the analogue inputs with the option of a gain and offset.

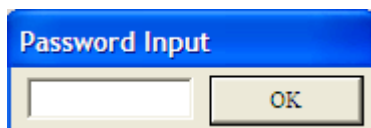


Select the ANALOG SET menu and press OK. Use the arrow keys to move to the input you wish to configure then press SEL. The data will then be underlined and you can use the arrow keys to change the values. Press OK to save then ESC to exit.

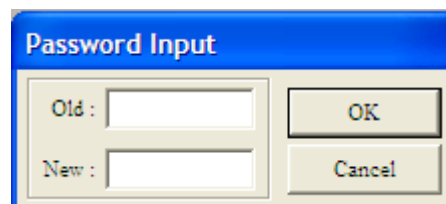
The Gain input can range from 1-999 with the offset ranging from -50 to +50.

## Password

*iSmart*'s with firmware less than v1.8 have a single stage password and *iSmart*'s with firmware greater than v1.8 can have a two stage password.



To set a password from the software the *iSmart* must be linked. Enter a four digit password when prompted in the box and press OK.



If a password has already been entered then the old password must first be entered before a new can be inputted



Through the *iSmart* screen. When in the password menu, press SEL then use the arrow keys to enter the 4-digit password. Press OK to enter. Once a password has been set a ✓ will appear in the top corner instead of the X.

## Level 1 Protection

This protects the user's program and function's parameters but allows access to the system menu and allows the user to stop the controller. The password will have to be a numeric password in the range 0001~9999 for *iSmart*'s with firmware less than v1.8 and 0001-0FFF for firmware versions 1.8 and greater.

<u>Menu</u>	<u>Permission</u>
Access to main system menu	Allowed
Ladder	Protected
Fun. Block	Protected
Write	Protected
Read	Protected
Clear Program	Protected
Run/Stop	Allowed
Password	Need to enter code to gain access
Set	Allowed
RTC Set	Allowed
Language	Allowed
Initial	Protected

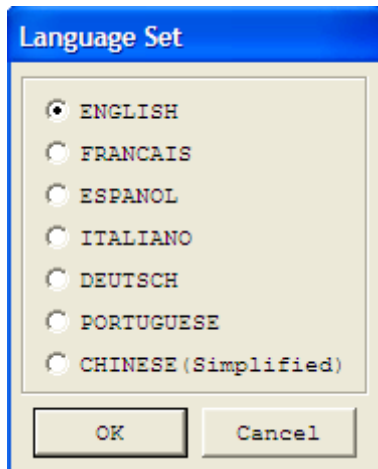
## Level 2 Protection

Level 2 protection is only available to *iSmart*'s with firmware of v1.8 or greater. This level protects the all the configuration in the *iSmart* by denying access to the system menu. The password will have to be an alpha-numeric password with the most significant bit (far left) as a hexadecimal letter (A-F). The password must be in the range A000~F999.

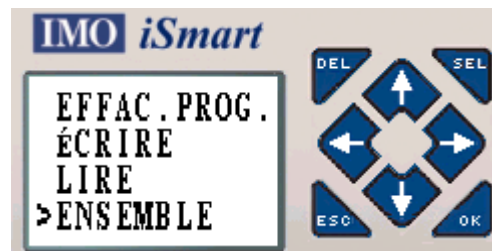
<u>Menu</u>	<u>Permission</u>
Access to main system menu	Protected
Ladder	Allowed once the password has been entered to gain access into the main menu.
Fun. Block	
Write	
Read	
Clear Program	
Run/Stop	
Password	Need to enter code to gain access
Set	Allowed once the password has been entered to gain access into the main menu.
RTC Set	
Language	
Initial	

## Language

This option allows the user to set the language of the user interface in the *iSmart* and the system menu. This option does not apply to the *iSmart-Configurator* software.

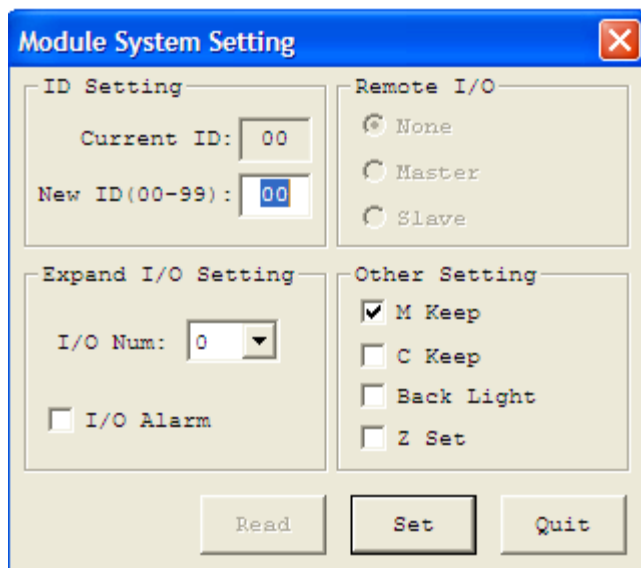


This system menu in the *iSmart* has now been changed to French



## Module System Set

In this option the user can set the System settings of the *iSmart* module itself.



Select the SET menu then press OK. Use the arrow keys to move up and down the options. To change an option press SEL and use the arrow keys to adjust. Press OK to set and ESC to exit.

Once you have selected your options you need to click the SET button to program the *iSmart* with the new system settings. To exit the menu, click QUIT.

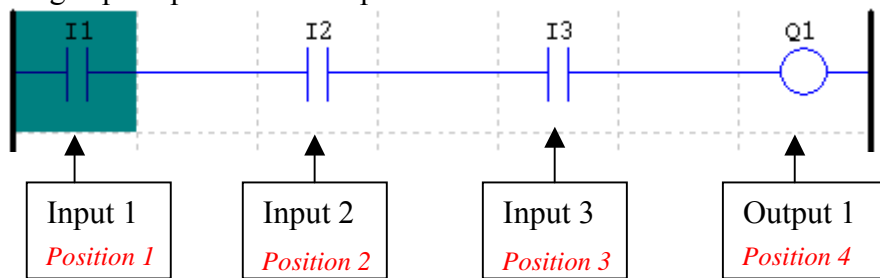
Z Set is a new function for use with the *iSmart* models that have a firmware version 1.8 and above. Do not select this option if the firmware is less than V1.8. This option needs to be checked to allow use of the arrow keys in the users program.

## iSmart Programming Skill – Basic Ladder

In this section we will discuss the basic programming skill in ladder logic. This will include Inputs, Outputs, AND gates, and OR gates.

### Inputs

An input to a ladder line is placed on the left hand side of the diagram up to position 3. It can either be: a direct input from a field device, an internal bit, an analogue input, a high speed pulse or an output from a function.

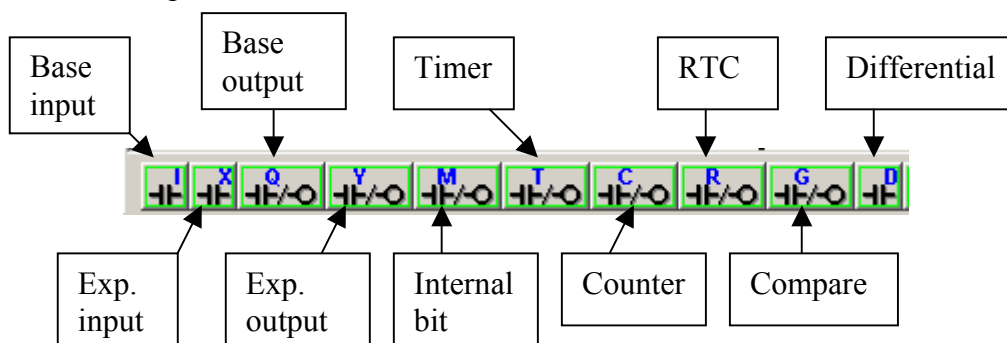


To insert an input either click on the button with the appropriate icon or press the keyboard short cut. Inputs have two options Normally Open or Normally Closed.

The 'Edit Contact' dialog box is shown with several callouts. At the top left is a preview of a normally open contact labeled 'I1'. The dialog has tabs for 'I', 'X', 'Q', 'Y', and 'M'. Below the tabs is a 'Select Contact NO.' field with a dropdown menu set to 'I' and a range '(1~9,A,B,C)'. Below that is the 'Contact Type' section with two radio buttons: 'STR' (Normally Open input (NO)) and 'STR NOT' (Normally closed input (NC)). The 'STR' option is selected. At the bottom are 'OK' and 'Cancel' buttons. Callouts include: 'Input number' pointing to the dropdown, 'Normally Open input (NO)' pointing to the 'STR' radio button, 'Normally closed input (NC)' pointing to the 'STR NOT' radio button, and 'Contacts & Function contacts' pointing to the tabs.

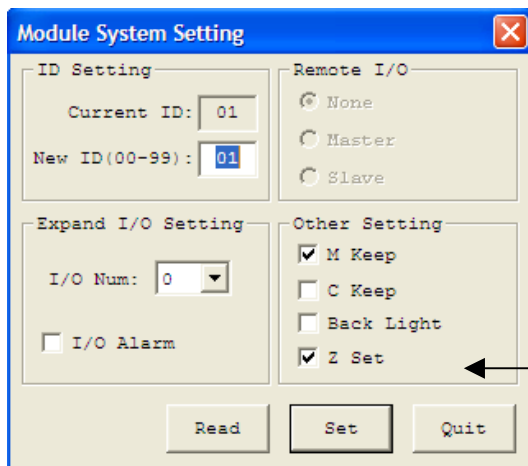
Click OK to confirm selection and return to programming

Available inputs; note the Functions, Outputs and Internal memory (M) bits can be an input and an output.



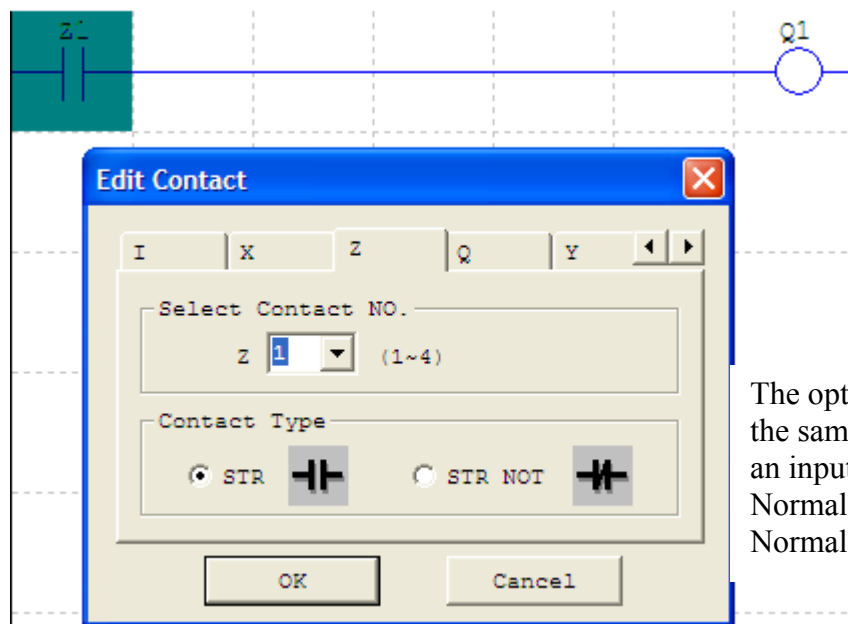
## Function Key

The arrow keys can be set as Z keys which the user can exploit in their program, this could remove the need for push buttons as selector inputs to an *iSmart* system. This option is only available on *iSmart*'s with firmware of V1.8 or greater. If you have an *iSmart* that doesn't have the required firmware then do not select the option in the module system set.



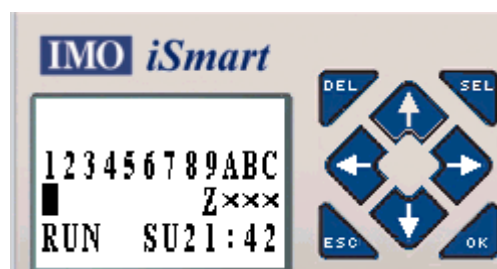
First before a Z input contact can be inserted into the ladder diagram the option must be checked in the Module System Set menu, found in the Operation drop down menu.

With the Z set checked, it is now possible to enter a Z contact as you would an input.

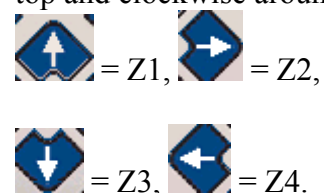


The options are just the same as if it were an input (I). It can be Normally Open or Normally Closed.

When running the program without any screens configured the Z keys can be monitored underneath the IO.



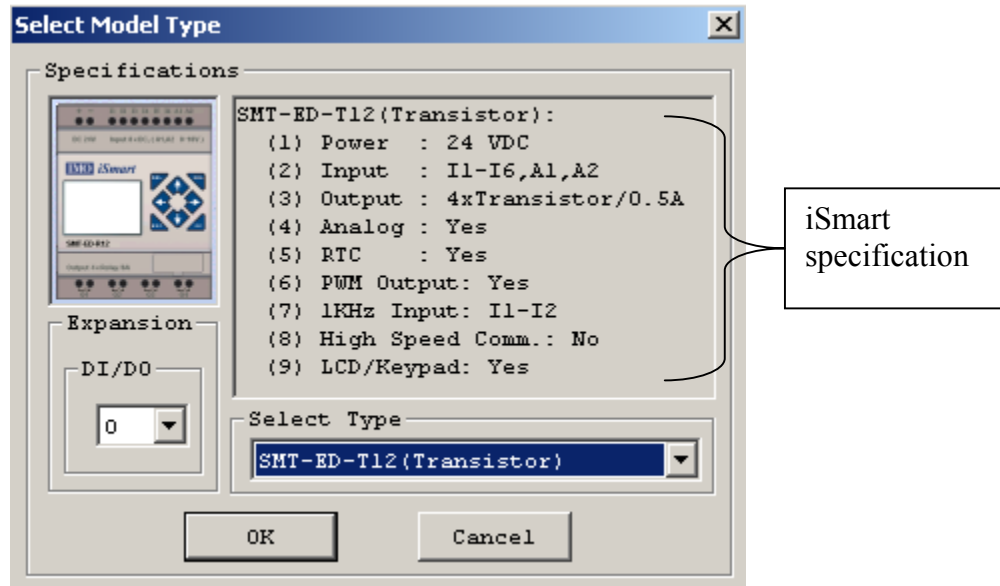
The Z keys are aligned from top and clockwise around.



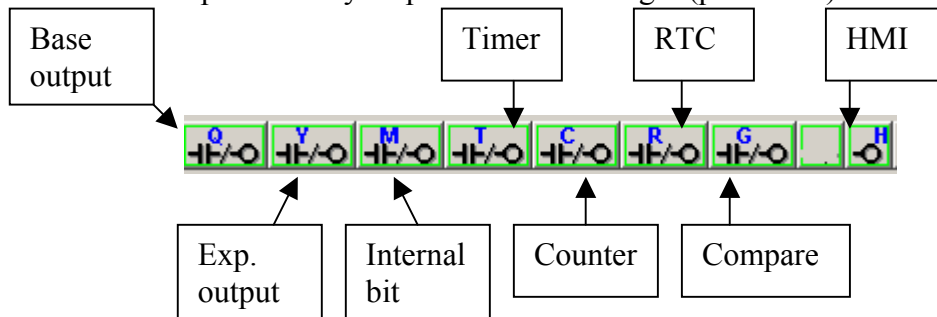
## Outputs

An Output from an iSmart can either be a Relay ON/OFF, Transistor ON/OFF or a High Speed Pulsed output, depending on the iSmart chosen.

The parameters of the iSmart can be found in the Edit menu, Select a Model.



Inserting an output is very similar to inserting an input. Select the button or keyboard short cut. An output can only be placed at the far right (position 4)

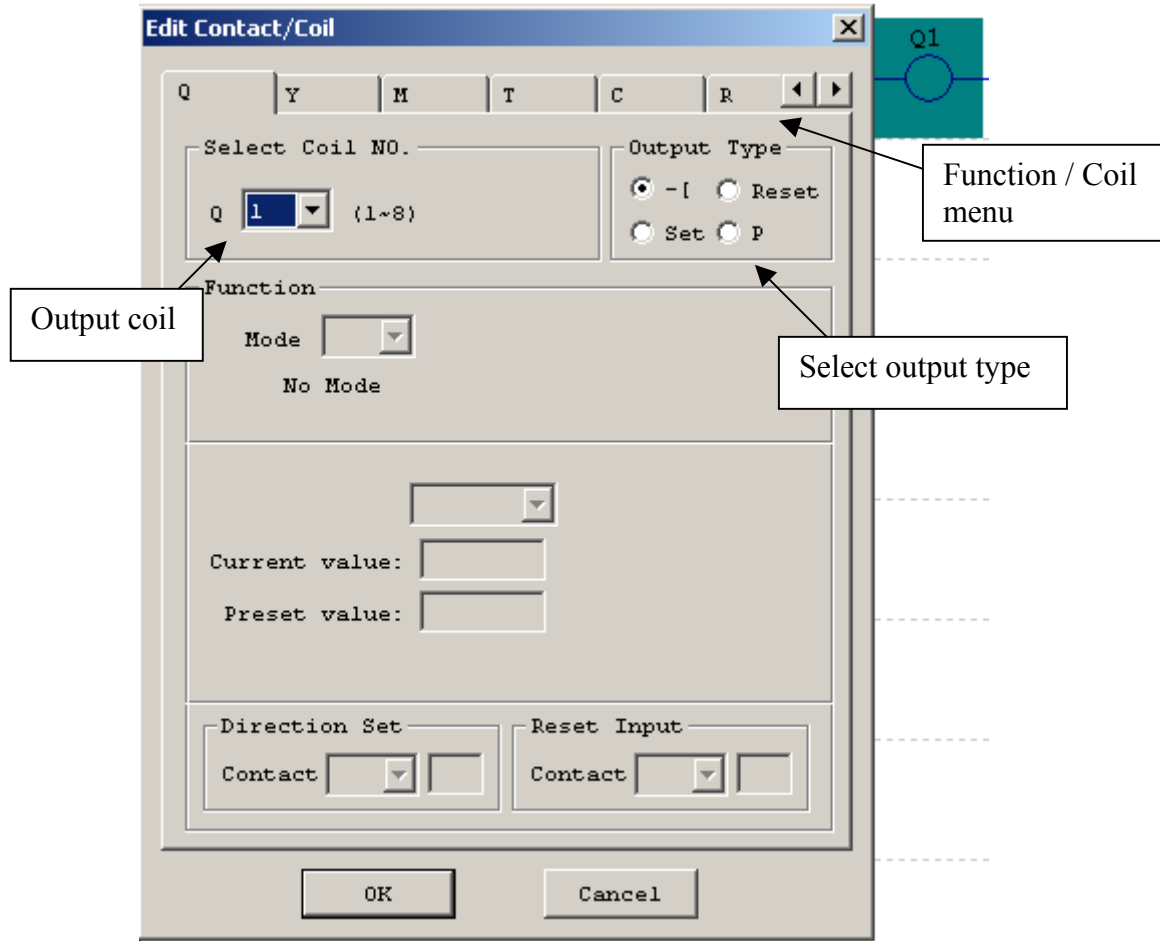


All the Functions are set up on the output side of the Ladder diagram, these will be discussed in the iSmart Programming – Advanced section (p37).



A normal output (Q or Y) has four options.

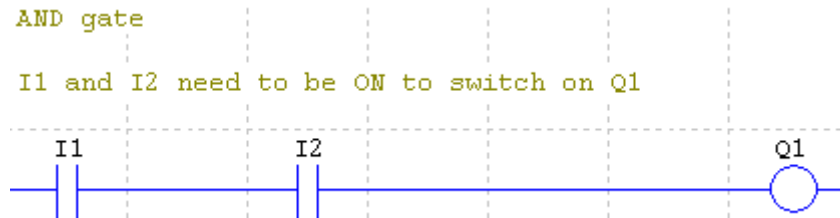
1. -(. Normally Open
2. Set. Sets a bit high (used with Reset.)
3. Reset. Resets a set bit low.
4. P. Toggle On or Off. (1 pulse sets it on, the next sets it off)



## Assembling the Ladder

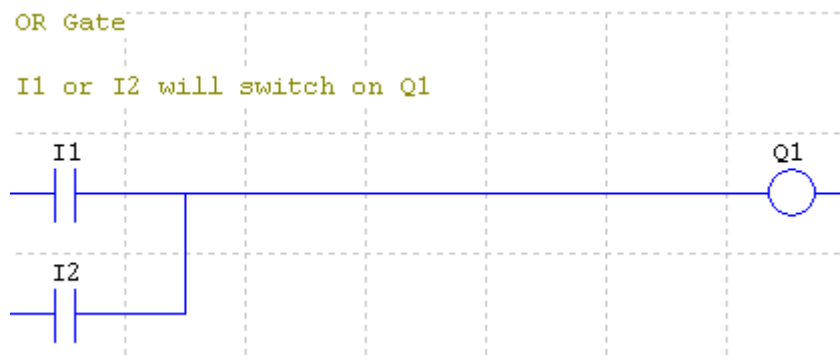
### AND Gate

Two input contacts in series is effectively an AND gate. I1 AND I2 must be ON before Q1 can be ON. We can have a maximum of a three input AND gate on one line.



### OR Gate

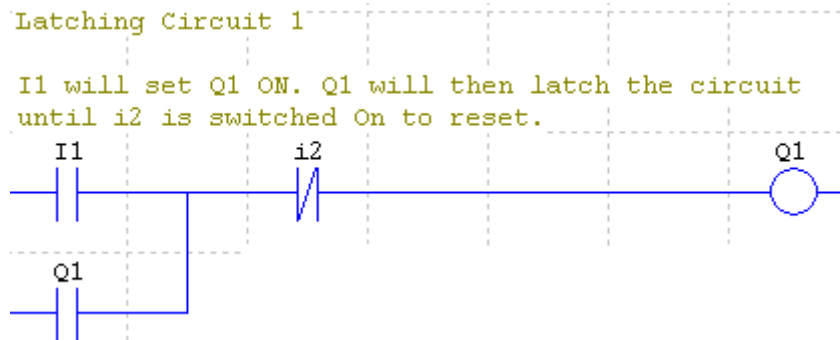
Having inputs in parallel lines and connected as shown, provides the logic of an OR gate. I1 OR I2 will switch on Q1.



### Latching Circuits

It is often important to Latch a bit on in applications. There are a couple of different ways to perform a latching circuit;

1. In this circuit I1 sets Q1 and then Q1 latches itself ON, with I2 being the reset.



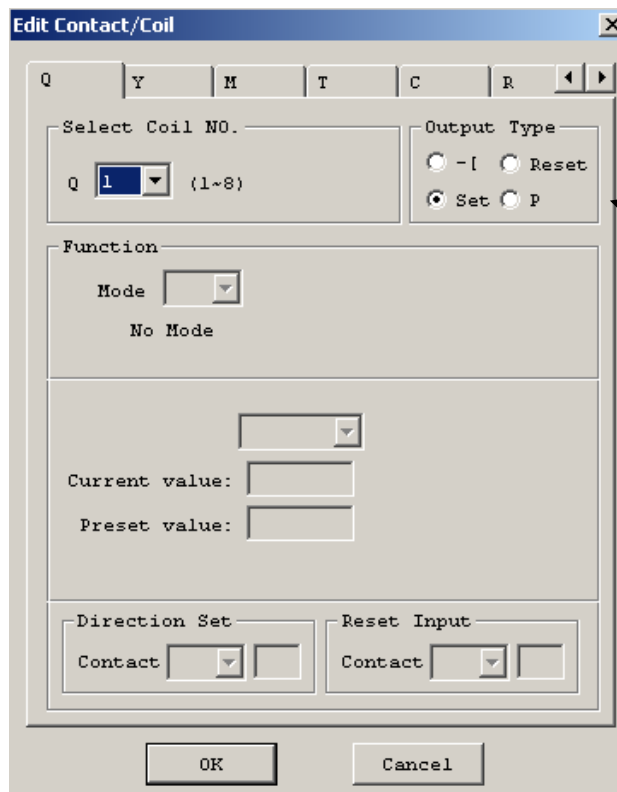
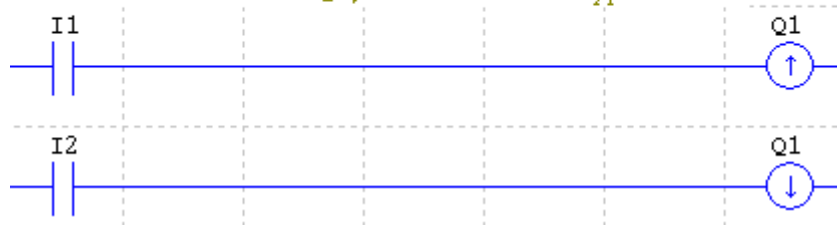
- This method is perhaps easier, than the previous method. It involves using a SET and RESET latch property on the output coil.

Latching Circuit 2

Set and Reset work in PAIRS

I1 will switch ON Q1, which is in Type SET.

I2 will switch OFF Q1, which is in Type RESET.



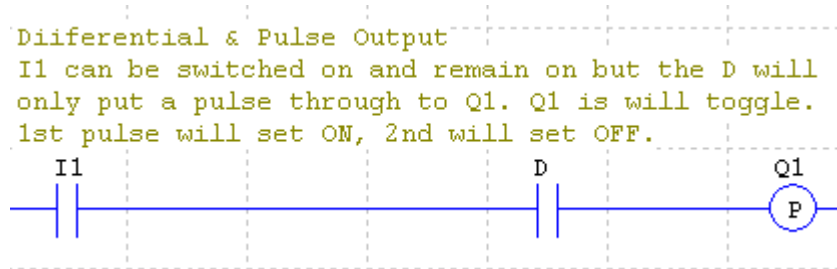
When entering the output coil, select the type in the coil parameter as SET and RESET.

- ❖ A SET coil must always have a RESET coil. If it doesn't, once it has been set it will remain set.

## Differential Contact and Pulse Coil Output

The final output type yet to be discussed is the Pulse output type (P). This output acts as a toggle switch. Such that on receiving the first pulse the output will be set high, whereas the next pulse it receives will do the opposite and reset it back to zero.

When I1 is switch on and remains on, the Differential contact only allows 1 pulse through to the output. This can be a useful function if you are just requiring an initial pulse from an input that remains ON.



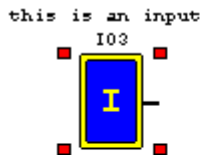
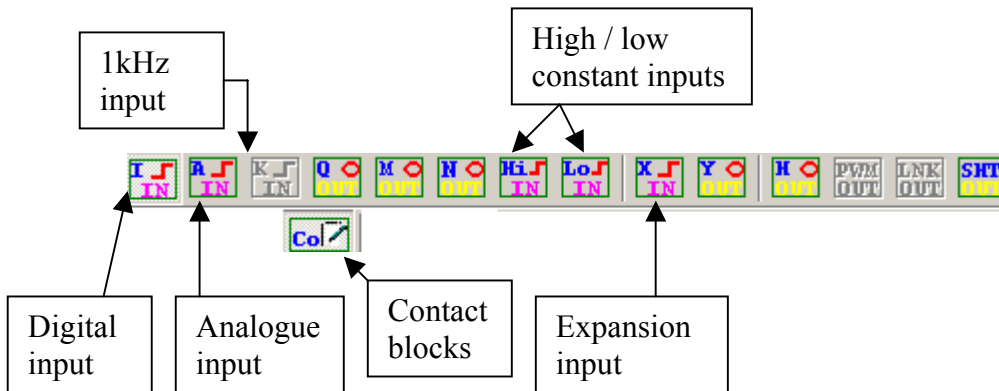
Q1 is set to output type P. The first pulse will set it High, and the next pulse will set it low.

## iSmart Programming Skill – Basic FBD

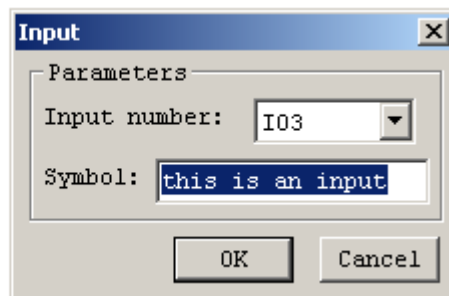
In this section we will discuss the basic programming skill in Function Block Diagram circuits. This will include inserting Inputs, Outputs, AND gate, and OR gate function blocks.

### Inputs

To insert an Input click on the constants and connectors button at the bottom of the screen. In this menu you can select all the inputs and outputs. The unavailable inputs to the iSmart model used are greyed out, for example the 1kHz high speed input as shown below. Click on the desired input button and this is now attached to the arrow icon, simply click on the workspace to insert an input as many times as required.



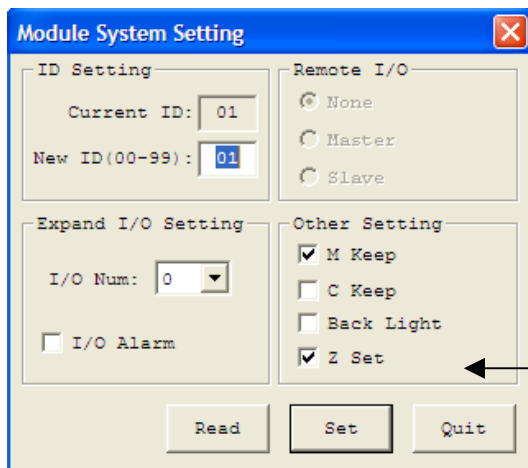
Double clicking on the input in the workspace brings up its parameters.



In FBD there are not many properties to the inputs. You can add symbol text for documentation purposes. If you want a normally closed input, you will need to use a NOT gate.

## Function Key

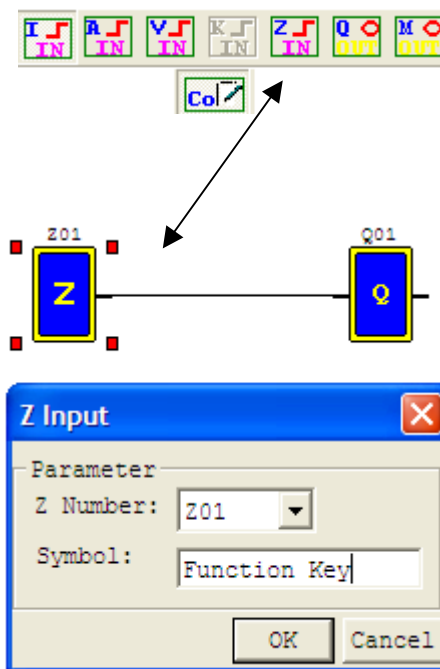
The arrow keys can be set as Z keys which the user can exploit in their program, this could remove the need for push buttons as selector inputs to an *iSmart* system. This option is only available on *iSmart*'s with firmware of V1.8 or greater. If you have an *iSmart* that doesn't have the required firmware then do not select the option in the module system set.



First before a Z input contact can be inserted into the ladder diagram the option must be checked in the Module System Set menu, found in the Operation drop down menu.

With the Z set checked, it is now possible to enter a Z input block as you would an input.

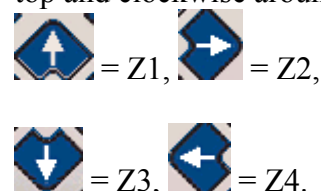
Select the Z input from the Contacts menu and insert the block into the programming area.



When running the program without any screens configured the Z keys can be monitored underneath the IO.



The Z keys are aligned from top and clockwise around.

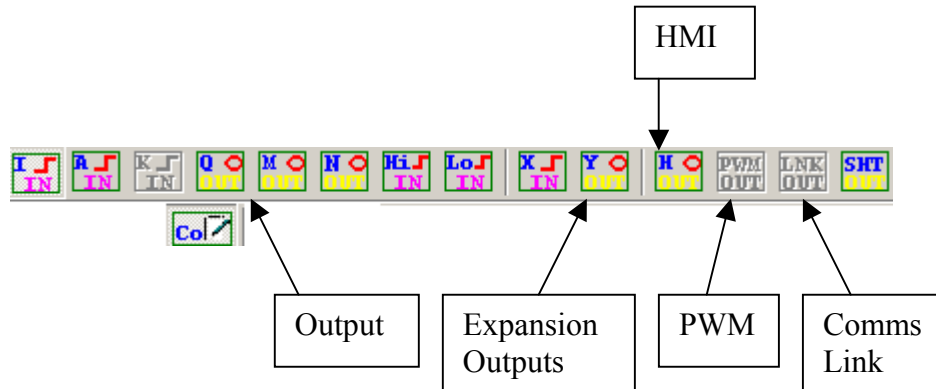


## Outputs

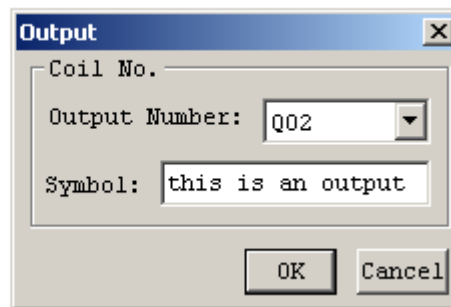
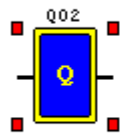
Inserting an output uses the same menu as the inputs, the only difference is the button selected. Once again the unavailable outputs to the selected iSmart model are greyed out.

The outputs, like the inputs in FBD differ from in Ladder. If you want to SET or RESET an output then you have to use the logic functions.

Note that the HMI and Comm. Link functions are outputs.



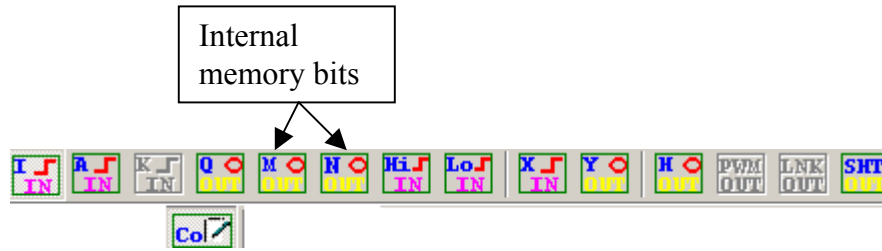
Outputs have both an input and an output from their function block, this allows them to be used to feedback a signal to operate another part of the circuit.



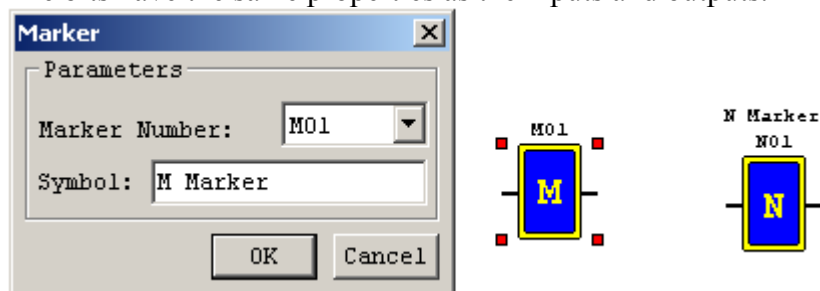
The output properties are identical to the input properties and only used for documentation.

## Internal Bits

In FBD programming there are two types of internal bits M and N, thus giving double the internal bits that are available in Ladder.



The bits have the same properties as the inputs and outputs.

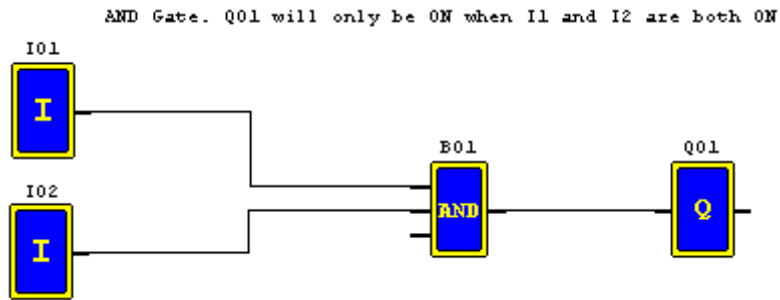




## Assembling the Function Block Diagrams

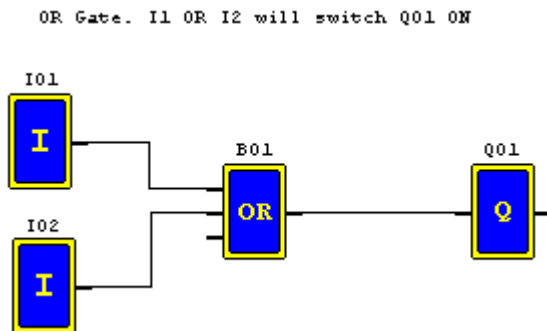
### AND Logic Gate

In FBD programming, like in Ladder programming the maximum AND gate possible is 3. If a node is left unconnected then it will be ignored. In the example below, I1 AND I2 need to be ON for Q1 to be ON.



### OR Logic Gate

The maximum number of inputs to an OR is once again 3. I1 OR I2 will operate Q1.



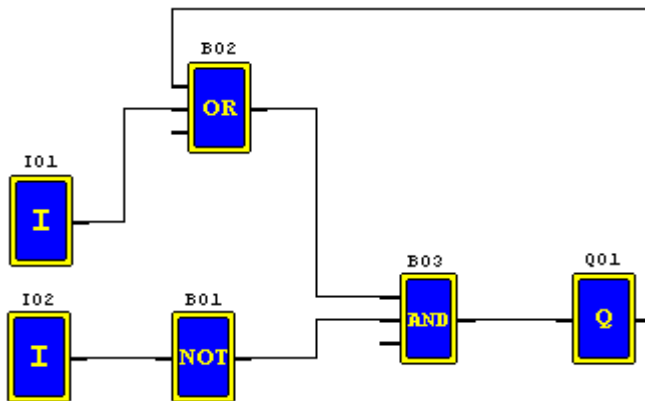
## Latching Circuits

It is often important to Latch a bit on in applications and there are a couple of different ways to perform a latching circuit.

The first circuit uses I1 to switch Q1 on, which then Latches itself on through the OR gate. I2 is then used to reset.

### Latching circuit 1

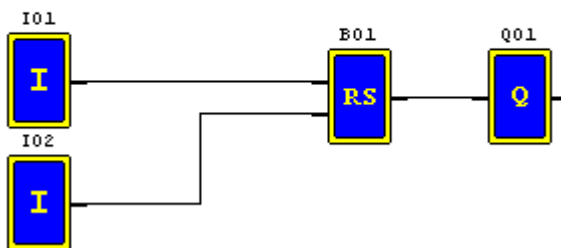
Latching Circuit. I1 will SET Q01 ON.  
Q01 will hold itself ON, until I2 is ON  
and RESETS



The Second circuit uses the SET and RESET function. I1 Set's and I2 Resets Q1.

### Latching circuit 2.

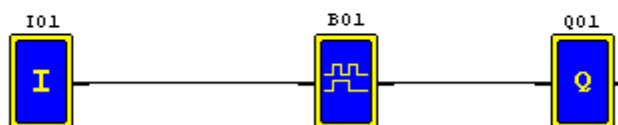
I1 is in the SET input of the RS Block.  
I2 is in the RESR input of the RS block.  
I1 SETS Q01 ON, I2 RESETS Q01.



## Pulse Function

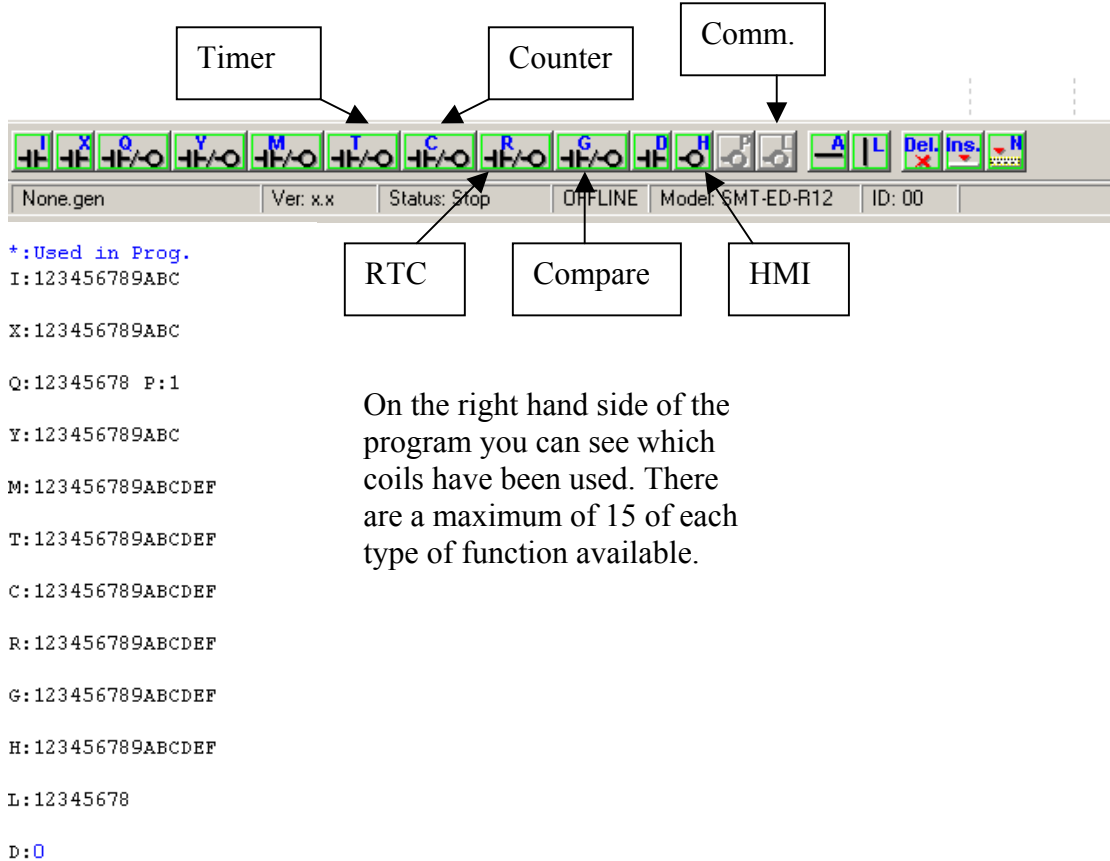
This function acts like a toggle switch. The first signal will set the output high and the second will reset it low.

Pulsed Output. On the 1st pulse from I1  
Q01 is SET ON. The next pulse from I1  
will switch Q01 OFF.



## Advanced *iSmart* Ladder Functions

All of the Functions are very similar to set up. First an output coil needs to be put into the program and the parameters set. Then an input contact needs to be put in for when the functions parameters have been met and the function output is active.



On the right hand side of the program you can see which coils have been used. There are a maximum of 15 of each type of function available.

- Timer modes:**
1. On Delay
  2. On Delay ( $T = t_1 + t_n$ )
  3. Off Delay
  4. Off Delay (-ve trigger)
  5. Flash, whilst enabled
  6. Flash, shot enabled
  7. Flash, T1 and T2 can differ

- Counter modes:**
1. Direction Input, Reset, I/P count, no overtaking, no power down retain
  2. Mode 1, but can go past preset
  3. Mode 1, but with power down retain
  4. Mode 2, but with power down retain
  5. Mode 2, + compare
  6. High Speed Counter
  7. Frequency counter

- RTC Modes:**
1. Every day action
  2. Interval time action
  3. Interval month action
  4. 30s interval action (> V1.8)

- Compare Modes:**
1.  $A_y - Ref \leq A_x \leq A_y + Ref$
  2.  $A_x \leq A_y$
  3.  $A_x \geq A_y$
  4.  $A_x \leq Ref$
  5.  $A_x \geq Ref$

- HMI Modes:**
1. Display
  2. No Display

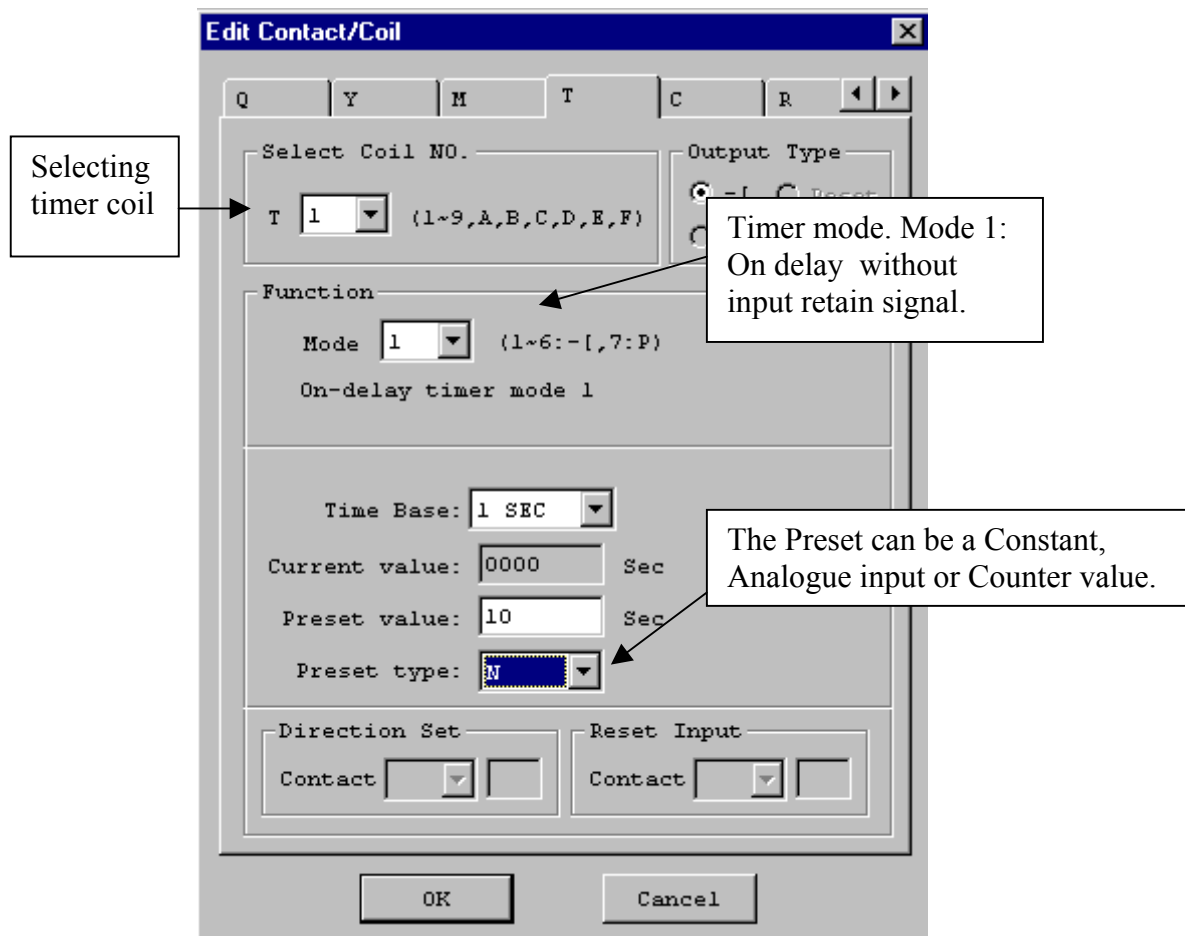
Please consult the manual for operation details.

## Timer Function

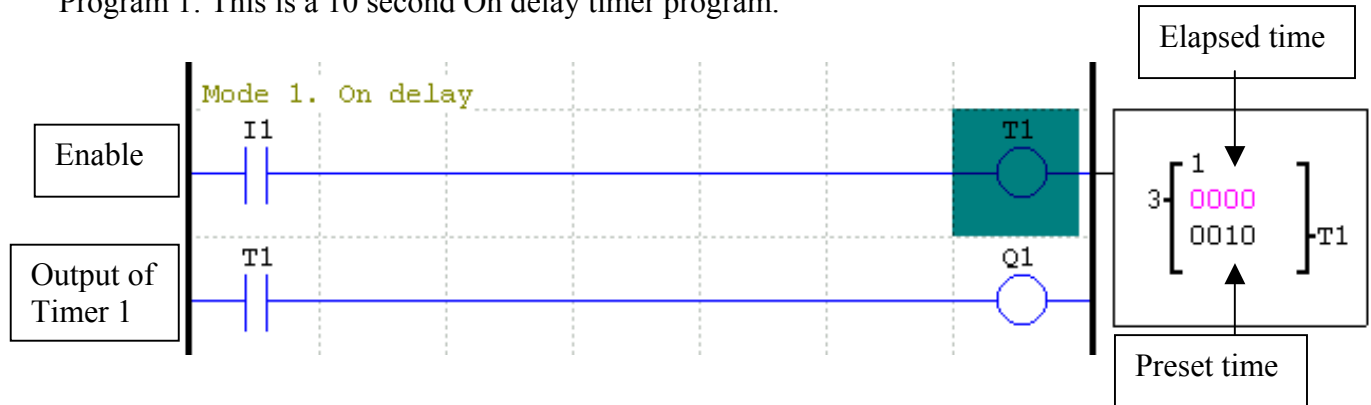
### Setting up an On-delay timer

On delay: Delays before output goes on.  
Requires an input to operate the timer.  
The timer counts up to the preset value from zero.  
When the preset is reached, the timer output is on.  
Removing the input, resets the timer.

Select a timer function from the menu at the bottom of the window and insert it on the right hand side of the workspace (position 4). The Edit Contact/Coil menu will pop up when you click it to the workspace, alternatively double click on the coil.



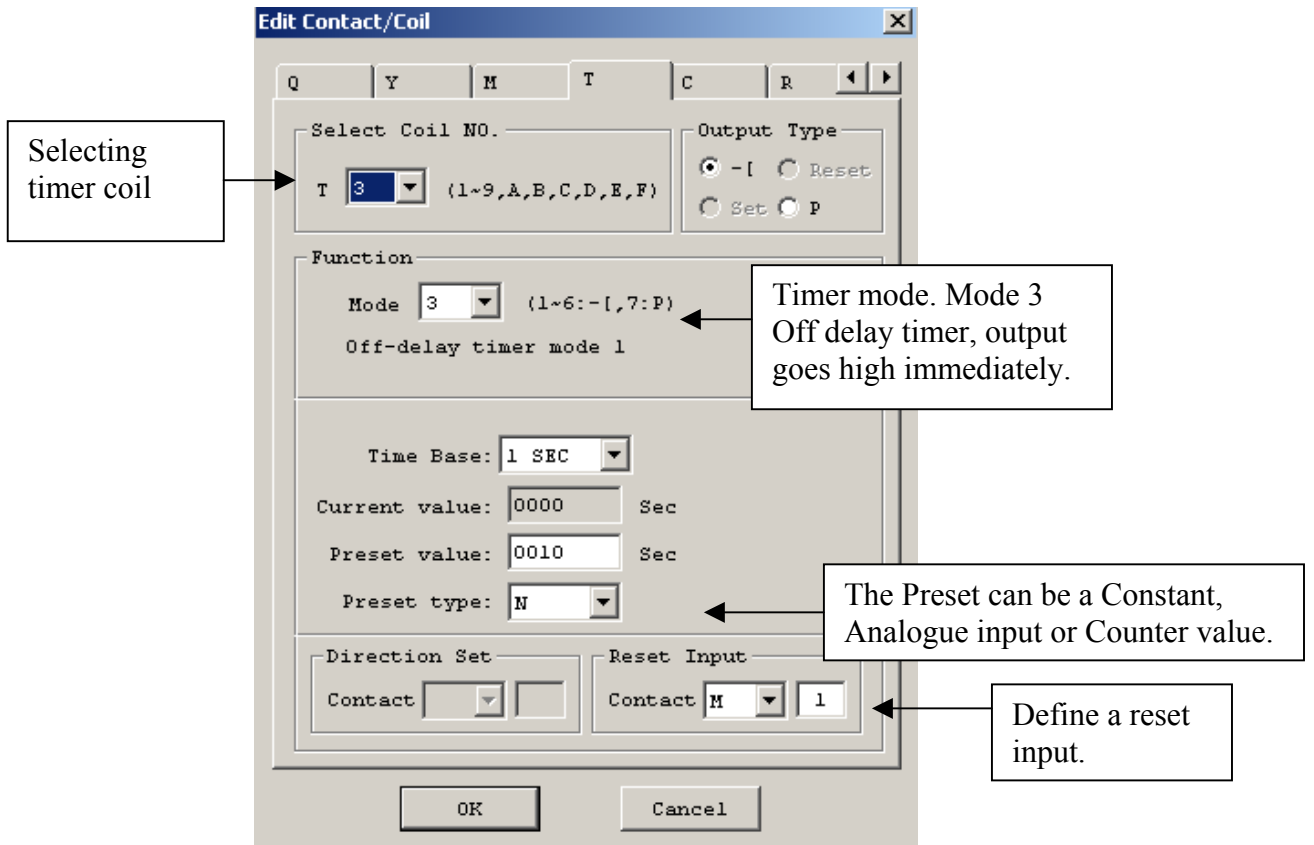
Program 1: This is a 10 second On delay timer program.



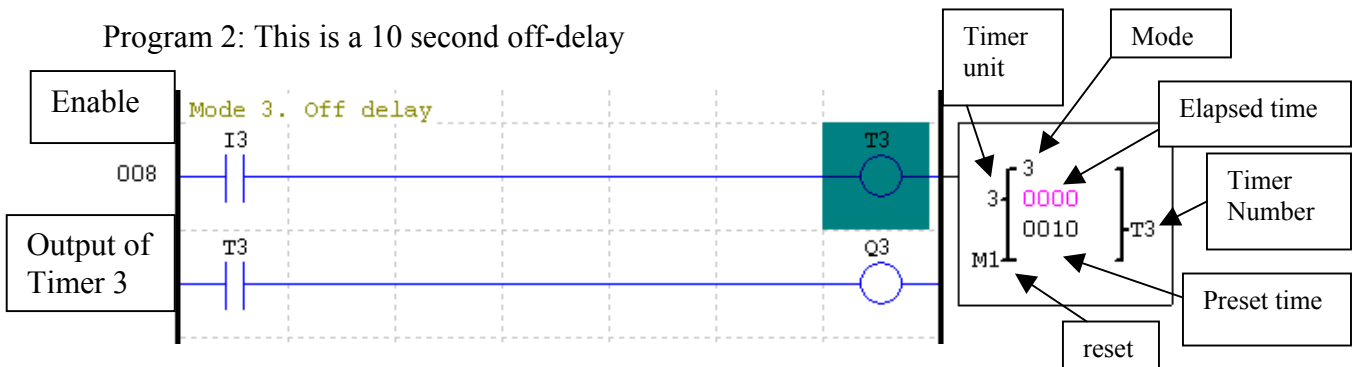
I1 will enable the timer, if it remains ON for the value of the preset time (10 seconds) then the timers output will go high and remain high as long as I1 is ON. When in monitor or simulation mode, if you highlight the T1 coil as shown then the box will appear where you can see its preset and current value.

## Setting up an Off-delay timer

Off-delay: An Off-delay timer will delay before it goes OFF.  
 Requires a start signal. On application of a start signal, the output will immediately go high.  
 Removal of the start signal will begin the timing.  
 The timer will count up to preset value, when it has reached the preset the output will switch off.  
 A reset input is required if timing has to be reset before completion.



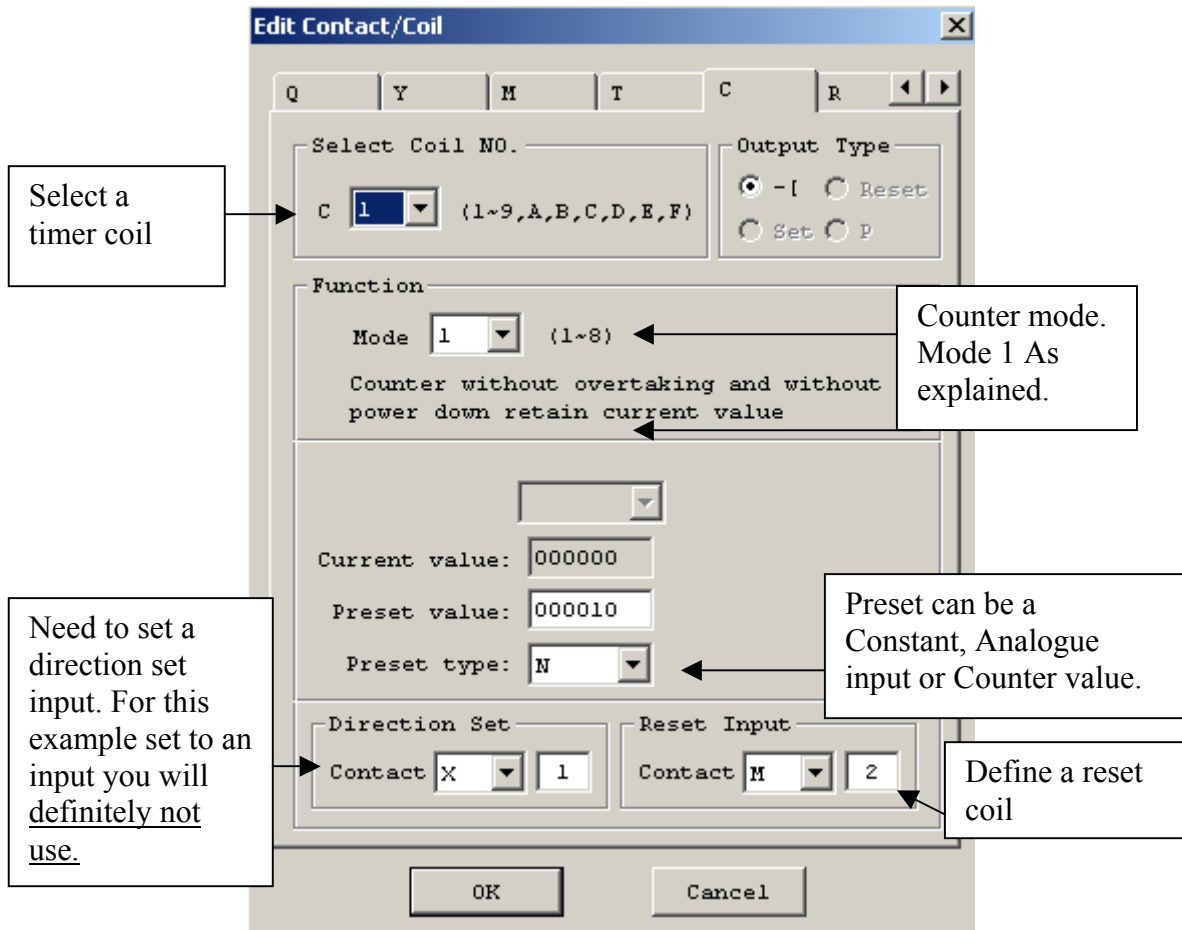
Program 2: This is a 10 second off-delay



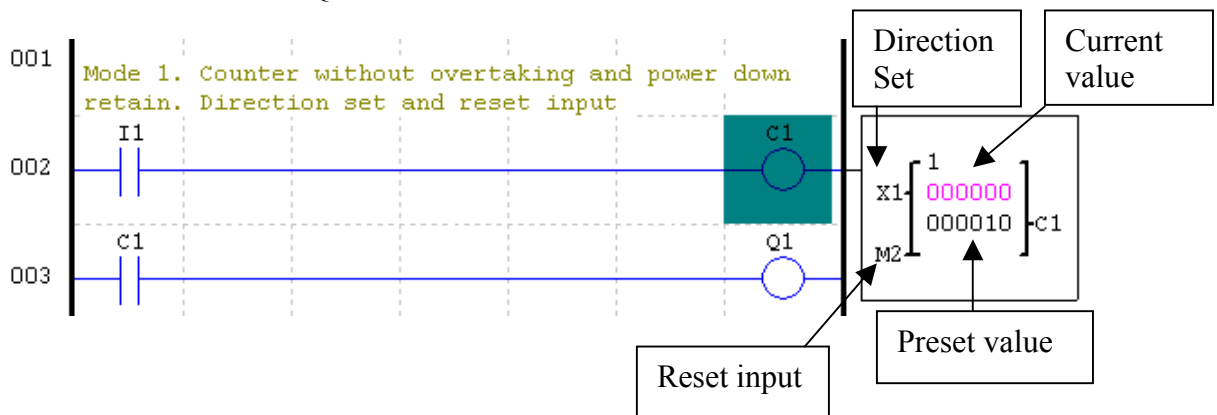
I3 will trigger the timer T3. The timer will remain high whilst I3 is on and will only start to time when I3 is switched OFF. T3 then remains on until the timer preset is reached.

## Counter Function Setting up an Up Counter

An Up counter simply counts up to a preset value, when it reaches its preset value the output of the counter goes high. It requires a reset input.



Program 3: Up count to 10. When I1 has been pulsed 10 times C1 will go high and switch of Q1.



## Setting up an Up / Down Counter

An Up / Down counter is the same as the Up counter but with the direction set utilised to have a down count. The Up input increments and the down input decrements the current value. When the counter is in the “Down count” mode, the counter output will go high when the current value reaches zero. In the “Up count” mode, the counter output will go high when the preset value is reached. There is also a reset input, when in Up mode it resets to zero, when in down mode it reset to the preset.

Select a counter coil

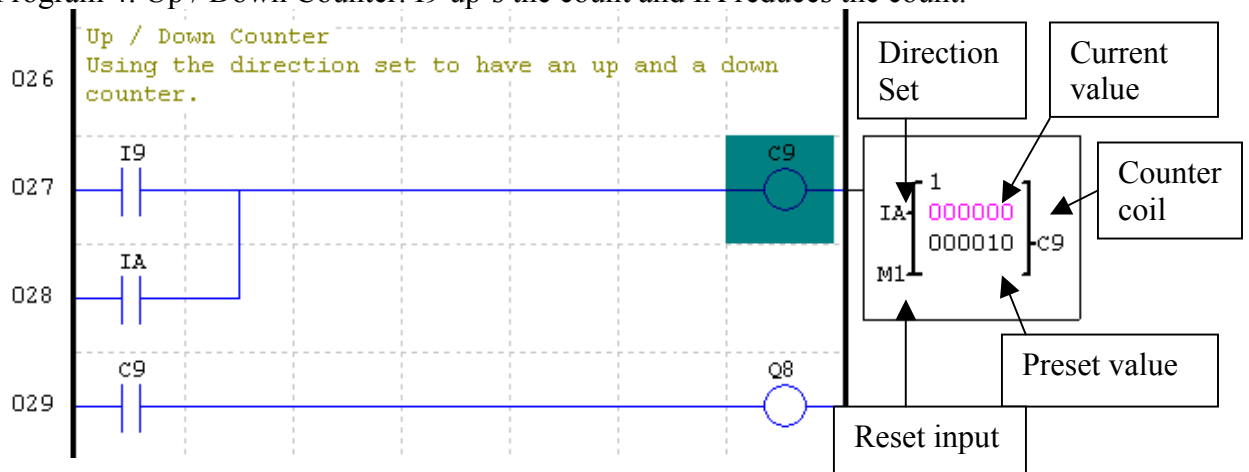
Counter mode. Mode 1 As explained.

Preset can be a Constant, Analogue input or Counter value.

Define a reset coil

This time we need to set a direction set input. For this example, set to the input IA.

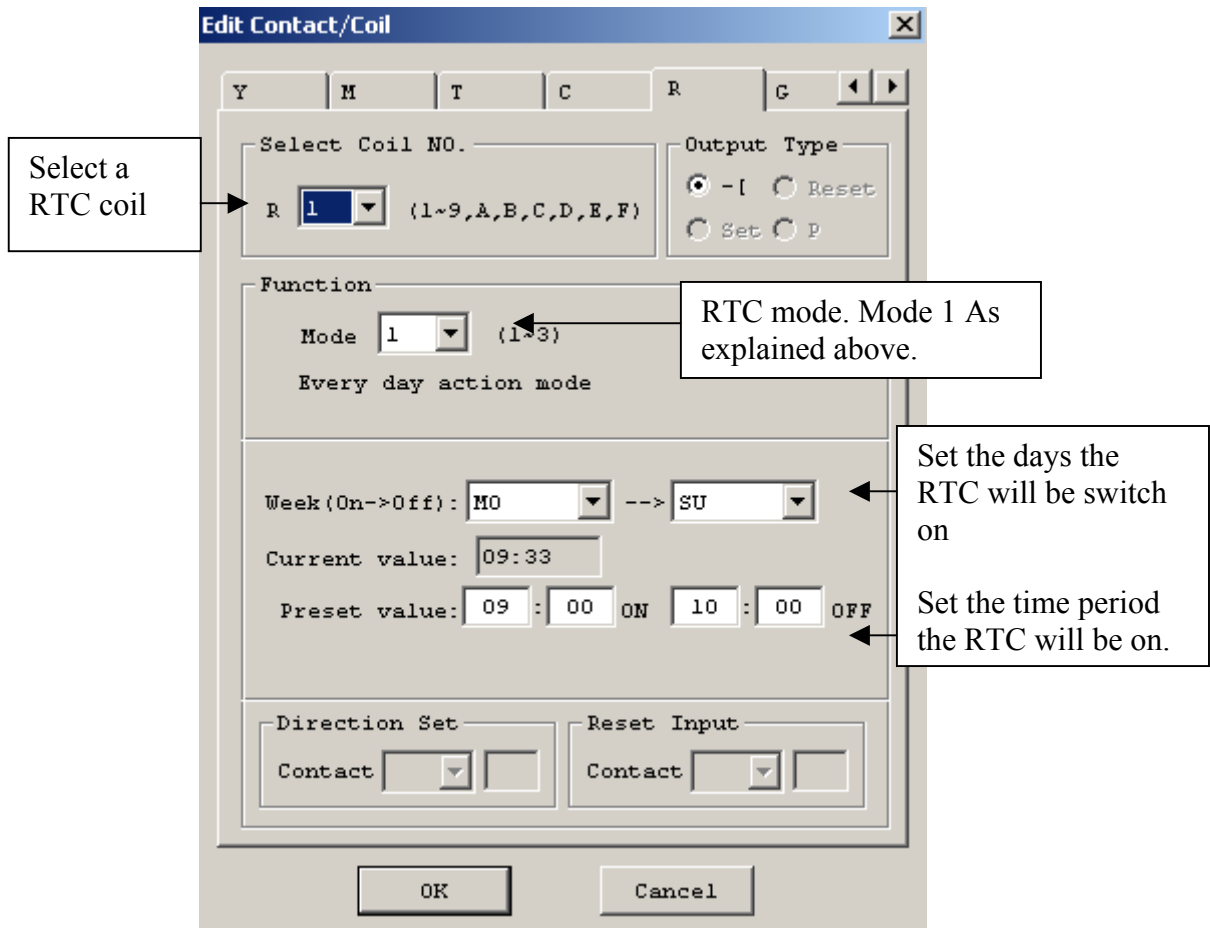
Program 4: Up / Down Counter. I9 up's the count and IA reduces the count.



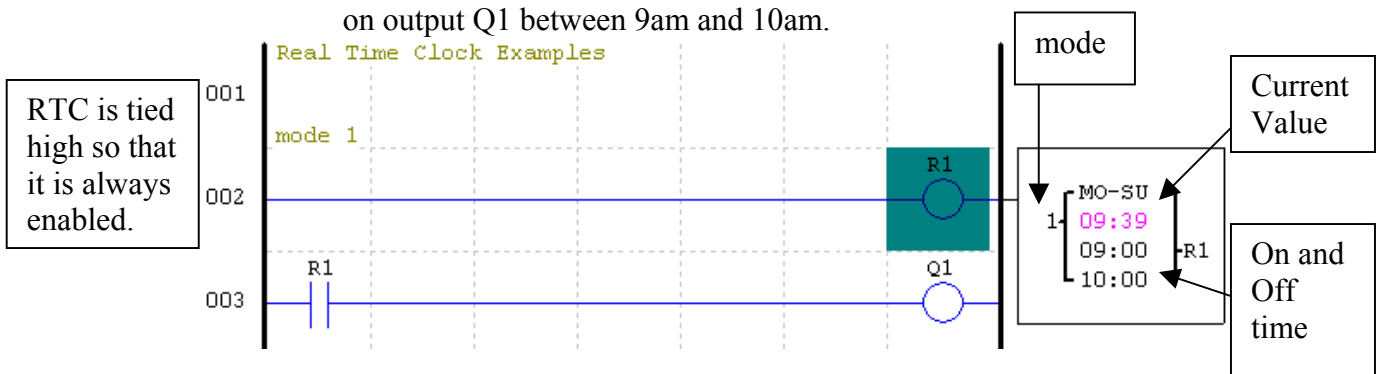


## Setting up a Real Time Clock Function

The RTC function allows events to happen in real time. The function has 3 modes; everyday, interval time and interval month action. This is an example of setting up an everyday action. We can set up a daily timing action for an event to be switched on for a period everyday. This is a very useful function with many applications, one example is for a set of Hall lights to come on every night for a certain period of time.

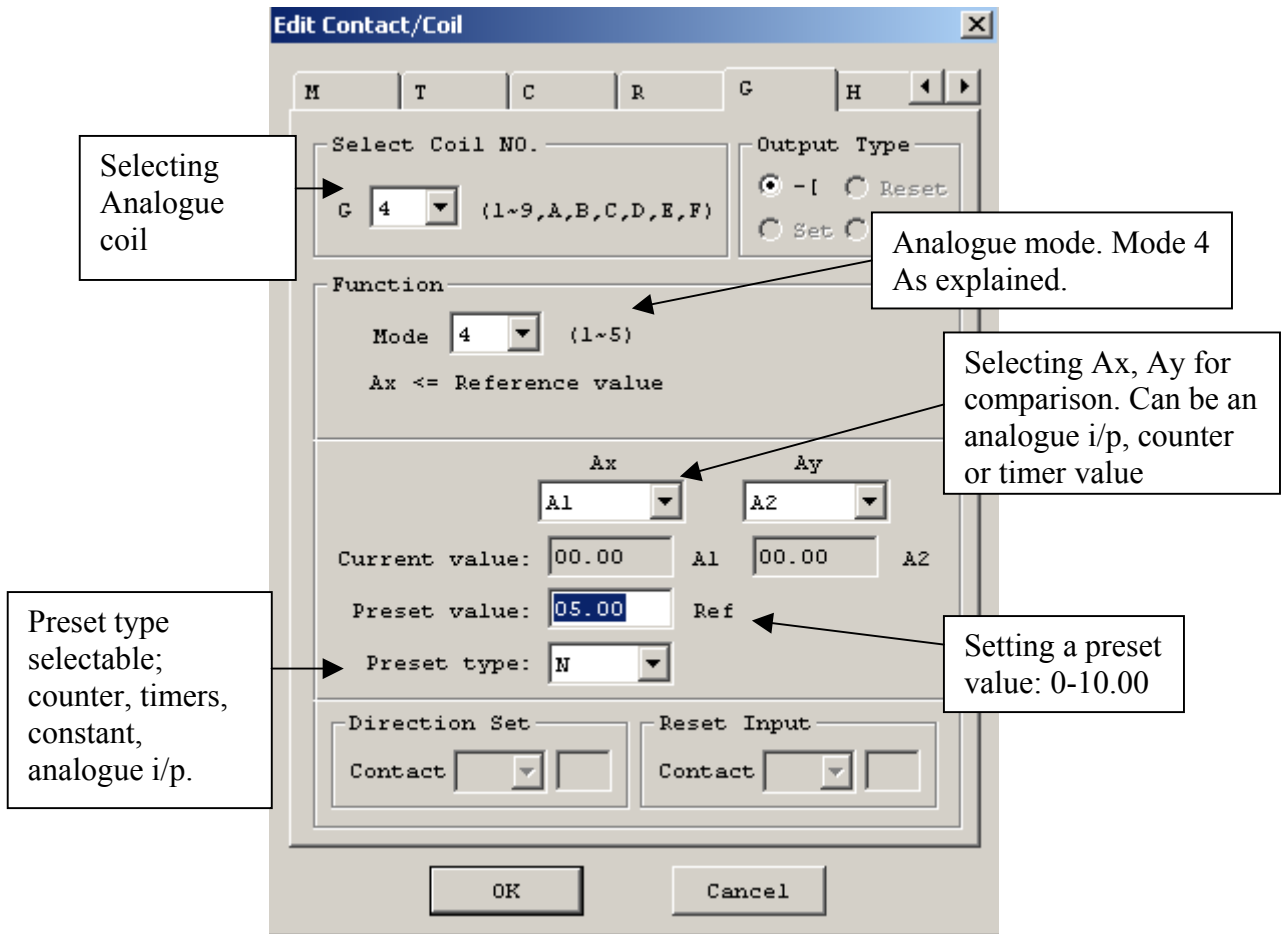


Program 5: RTC Everyday action. From Monday to Sunday the RTC will switch on output Q1 between 9am and 10am.

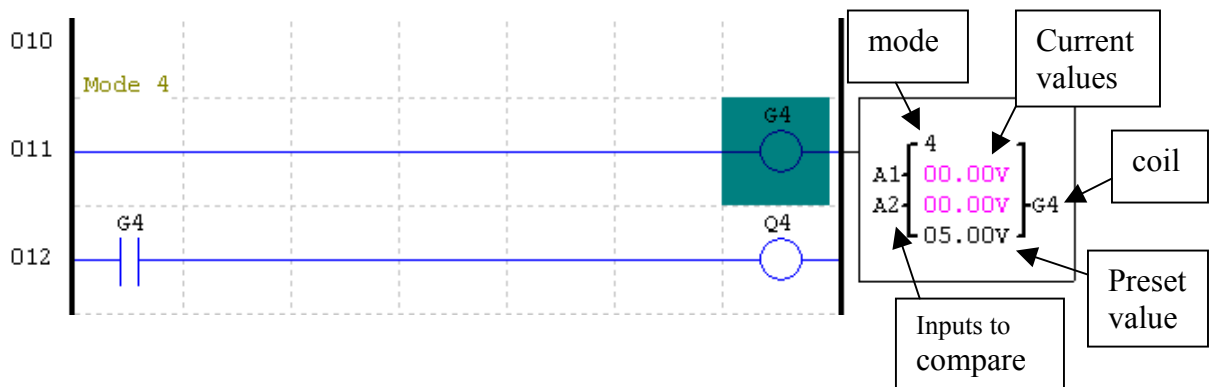


## Setting up a Compare Function with an Analogue

The DC powered iSmart has 0-10Vdc analogue inputs available and a comparison function. The comparison Function does not however only have to be used for the analogue values, it can be used to compare timer and counter values as well. The 12 I/O model has 2 analogue inputs and the 20 I/O model has 4. The analogue inputs can be configured to be additional discrete inputs and can also be used to set timer / counter presets. The comparison function has 5 modes of comparisons, with analogue / timer / counter values being compared to each other and a preset constant.

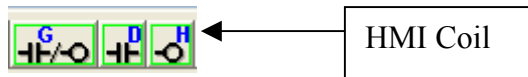


Program 6: Analogue comparison function in Mode 4: Ax <= Reference value. The reference value set as 5V. When A1 is less then or equal to 5V, G4 will switch on Q4.

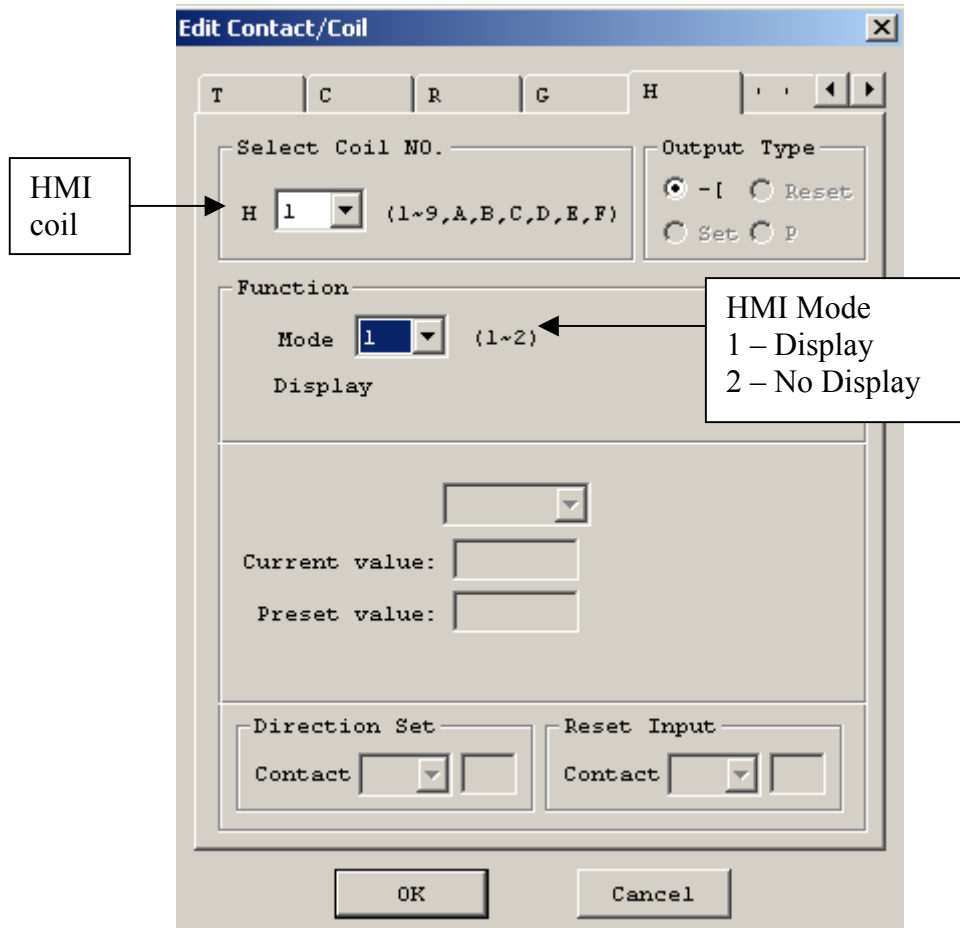


## Setting Up a HMI Function Coil

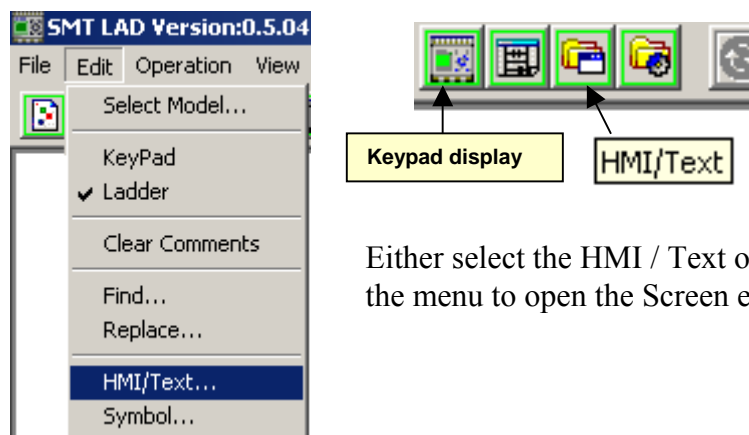
Select the HMI coil and insert into the program.



In order to display text and function status on the screen we need to set the H coils.



Now that the coil has set up we can enter the details we want to see on the screen.

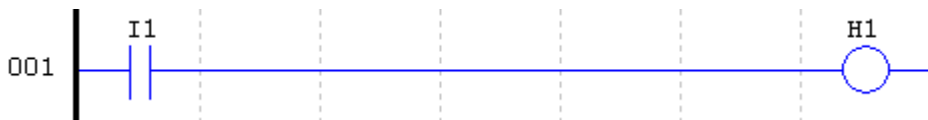


Either select the HMI / Text option or click on the button in the menu to open the Screen edit menu.

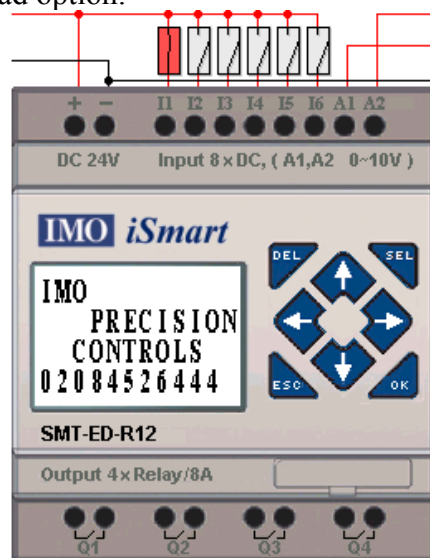
The screenshot shows the 'HMI/Text' configuration window. Callouts include:
 

- H coils:** Points to the H1-H7 selection tabs.
- 4 line by 12 character display:** Points to the main display area showing 'IMO PRECISION CONTROLS 02084526444'.
- Scale the analogue display:** Points to the 'Analog Display Set ...' button.
- Click on the characters you wish to enter:** Points to the 'Text Input' keyboard.
- Insert timer / counter / RTC / Analogue presets and current values:** Points to the dropdown menus for Timer, Counter, RTC, and Analog.
- Insert Coil status:** Points to the 'Coil Status' section with I, M, and X dropdowns.
- Preset values can be changed by through the screen by using the arrow keys:** Points to the 'Clear', 'OK', and 'Cancel' buttons.

Program 7: When input 1 is energised coil H1, will energise and the message Stored in H1 will be displayed. When input 1 is Off, the coil H1 will switch Off and the screen will go back to the main display.



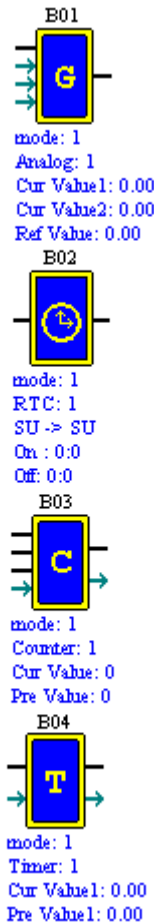
The HMI screen can be seen in simulation mode when programming in Ladder by clicking to view the Keypad option.



## Advanced *iSmart* FBD Functions

All of the Functions are very similar to set up and in appearance. They have an input side and an output side. The amount of I/O to a single block is determined by what mode is selected and it's function.

Input side: Every block will have an enable signal at the top. The rest of the inputs vary depending on function, i.e. a Counter can have a Reset, Direction and preset input.



Output side: Every block will have an output signal for when the condition is met. Counters and timers then have a current value output that can be used elsewhere.

The modes of the functions are exactly the same in FBD as they are in Ladder.

### Timer modes:

1. On Delay
2. On Delay ( $T = t_1 + t_n$ )
3. Off Delay
4. Off Delay (-ve trigger)
5. Flash, whilst enabled
6. Flash, shot enabled
7. Flash, T1 and T2 can differ

### RTC Modes:

1. Every day action
2. Interval time action
3. Interval month action
4. 30s interval action  
(> V1.8 hardware)

### HMI Modes:

1. Display
2. No Display

### Counter modes:

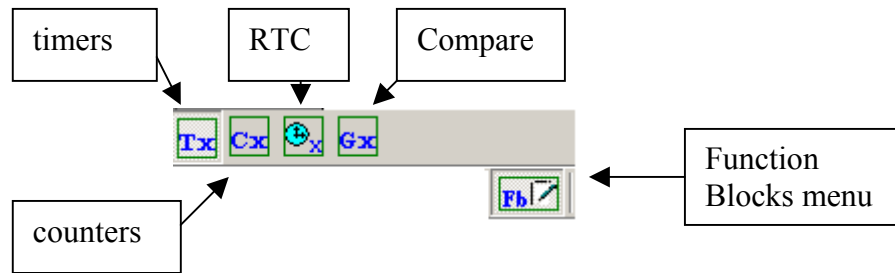
1. Direction Input, Reset, I/P count, no overtaking, no power down retain
2. Mode 1, but can go past preset
3. Mode 1, but with power down retain
4. Mode 2, but with power down retain
5. Mode 2, + compare
6. High Speed Counter
7. Frequency counter

### Compare Modes:

1.  $A_y - Ref \leq A_x \leq A_y + Ref$
2.  $A_x \leq A_y$
3.  $A_x \geq A_y$
4.  $A_x \leq Ref$
5.  $A_x \geq Ref$

Please consult the manual for operational details.

To insert a function use the tool bar on the bottom of the programming window.

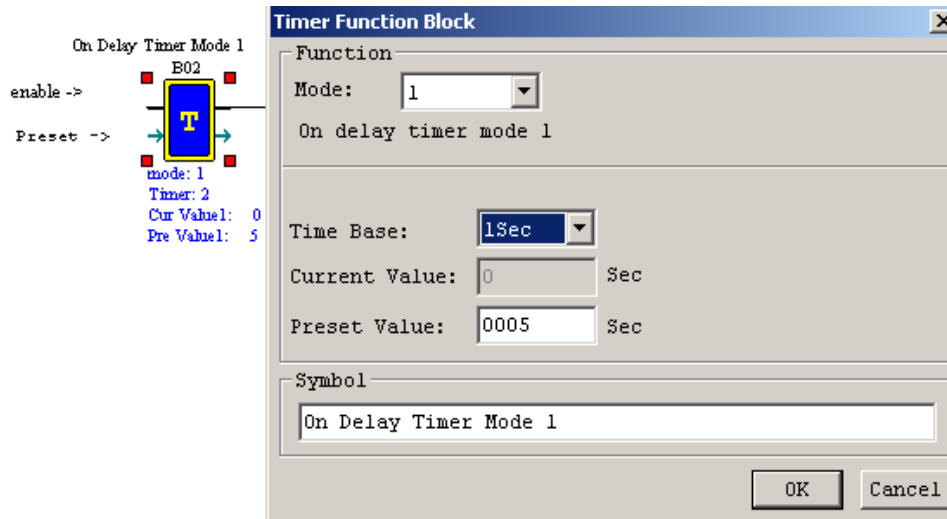


Once you've selected your function click it into the workspace. Its parameter menu will open up automatically when you've placed in the workspace. You can also bring up the menu by double clicking on the Function Block.

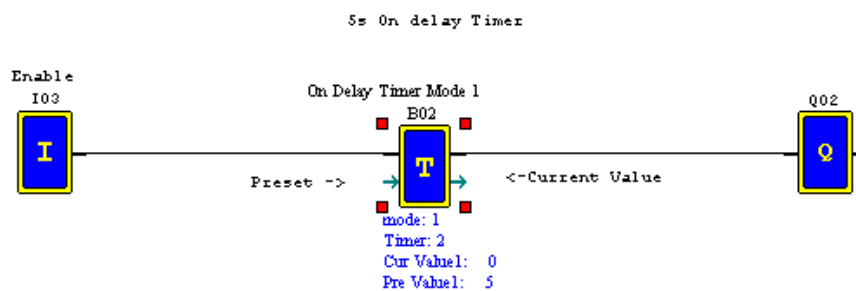
## Timer Function

### Setting up an On-delay timer

Select a timer function from the menu at the bottom of the window and insert it in the workspace. The Edit Contact/Coil menu will pop up when you click it into the work space, alternatively to bring up the menu, double click on the coil.



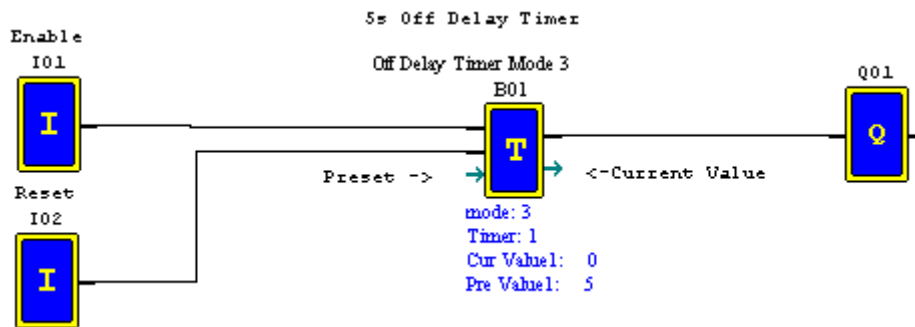
On delay: Delays before output goes on.  
 Requires an input to operate the timer.  
 The timer counts up to the preset value from zero.  
 When the preset is reached, the timer output is on.  
 Removing the input, resets the timer.



I3 will enable the timer; if it remains ON for the value of the preset time (5 seconds) then the timer output will go high and remain high as long as I3 is ON. The blue writing below the timer displays the parameter information. In simulation / monitor operation the current value when operated will start to count.

## Setting up an Off-delay timer

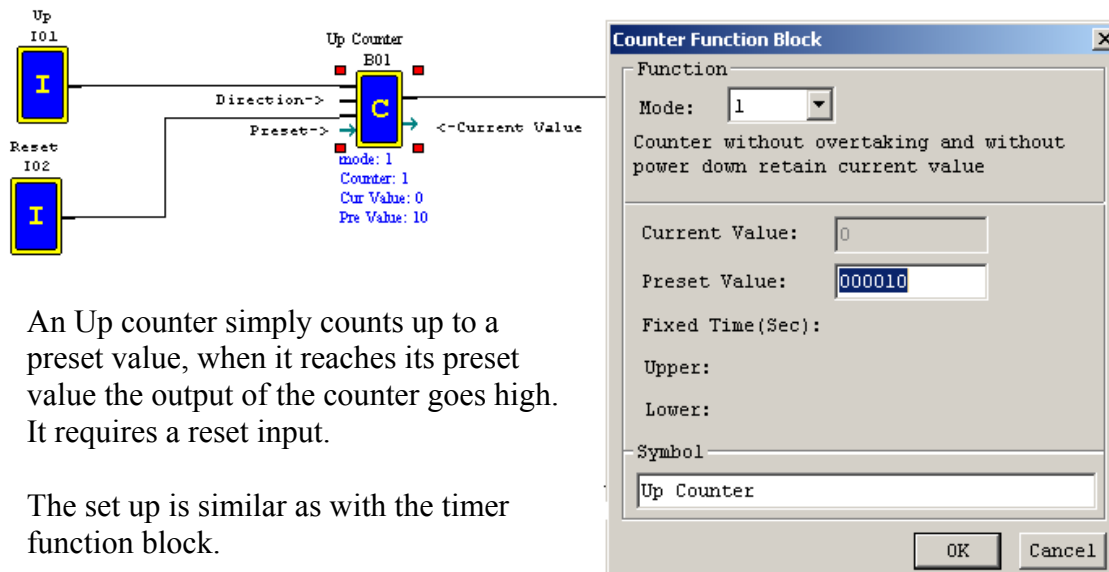
Off-delay: An Off-delay timer will delay before it goes OFF.  
Requires a start signal. On application of a start signal, the output will immediately go high.  
Removal of the start signal will begin the timing.  
The timer will count up to preset value, when it has reached the preset the output will switch off.  
A reset input is required if timing has to be reset before completion.



I1 will trigger the timer B01. The timer will remain high whilst I1 is on and will only start to time when I1 is switched OFF. Timer B01 remains on until the timing value has elapsed or the RESET input has been triggered.



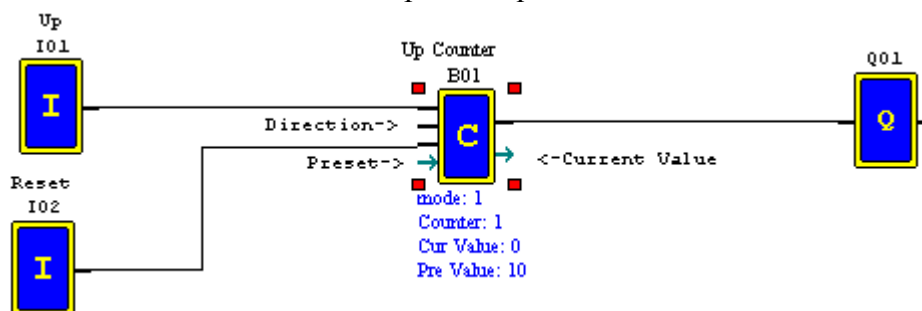
## Counter Function Setting up an Up Counter



An Up counter simply counts up to a preset value, when it reaches its preset value the output of the counter goes high. It requires a reset input.

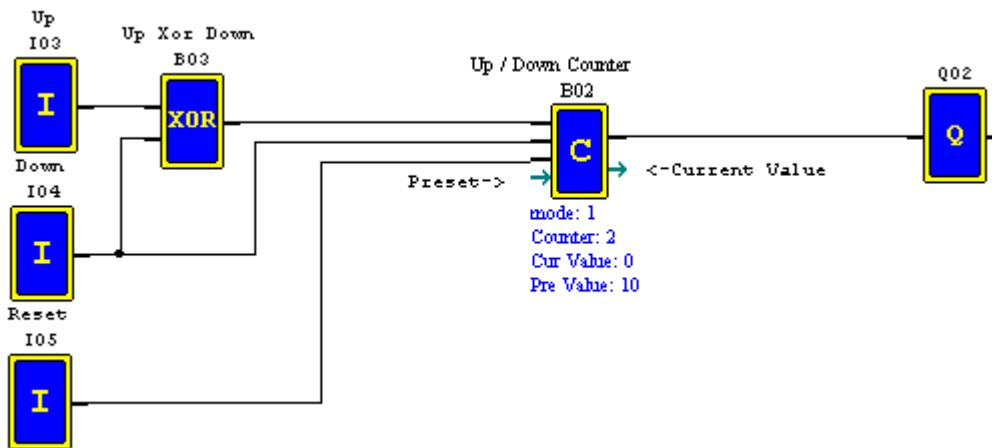
The set up is similar as with the timer function block.

The circuit below will count up to 10 and then switch on output Q01. In mode 1, there is no overrun (overtaking), so once the count has reached 10, further input pulses will not increase the count. A reset input is required to zero the counter.



## Setting up an Up / Down Counter

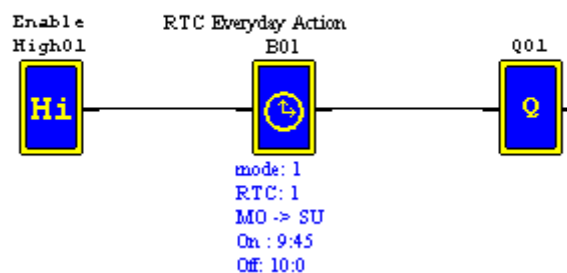
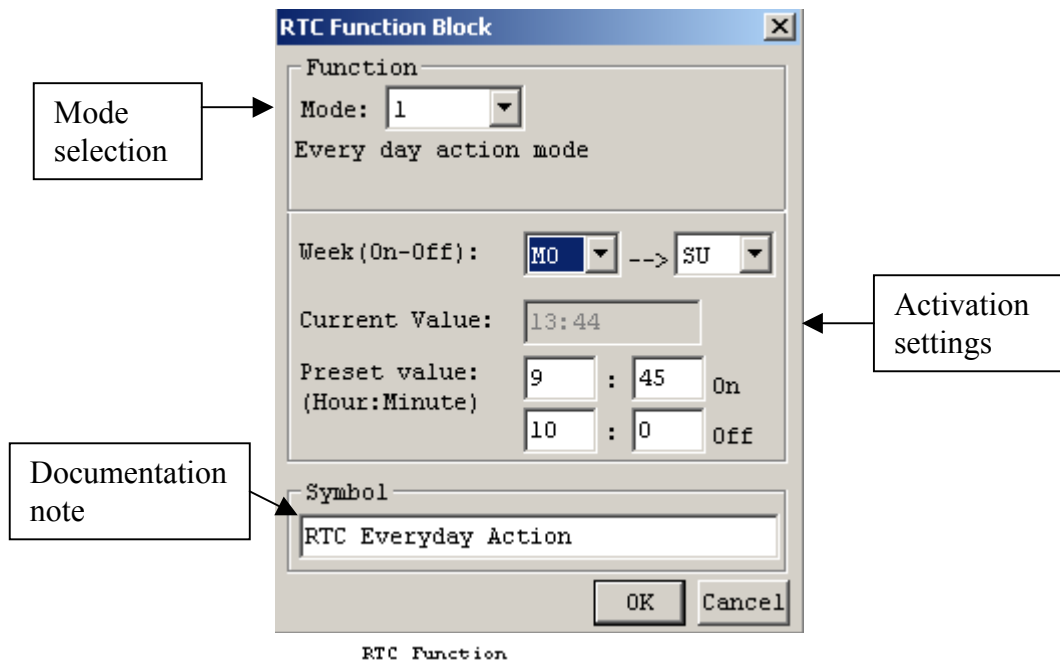
Note that with the UP counter the direction was never allocated. With an Up / Down counter the direction input is utilised. By using some logic we can have an UP/DOWN counter. When it is in the down count mode, the counter will go high when the current value reaches zero. In the Up count mode, the counter will go high when the preset value is reached. There is also a reset input, when in Up mode it resets to zero, when in down mode it reset to the preset.



In this circuit an XOR logic gate has been used to have either the counter counting UP or DOWN. The down input I04 sets the direction as well as the count input and hence we get a down count.

## Inserting a Real Time Clock Function

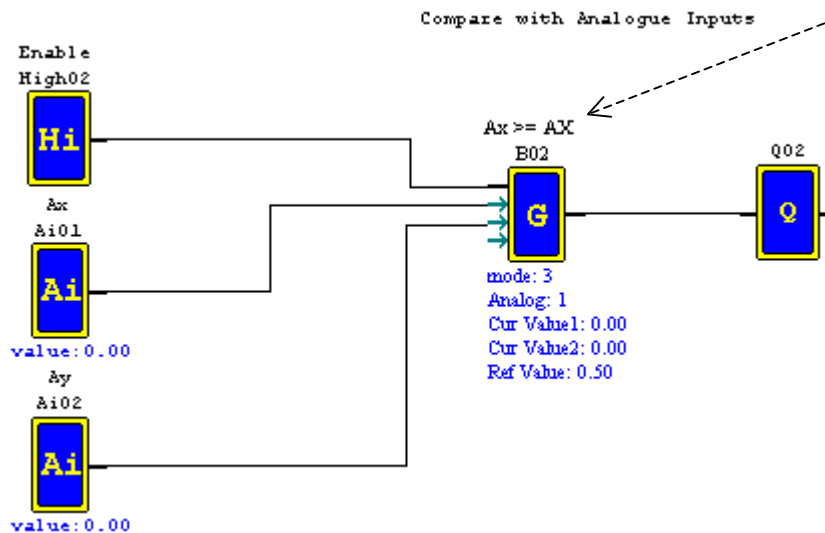
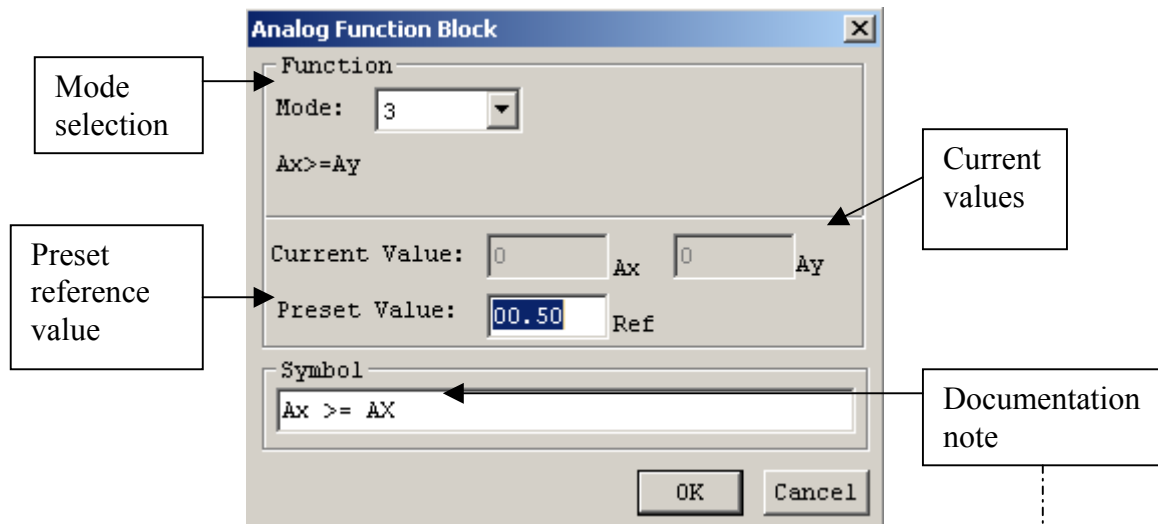
The RTC function allows events to happen in real time. The function has 3 modes; everyday, interval time and interval month action. Using a stair hall lights system as an example here is a demonstration of how to set up an everyday action RTC. In daily action we can set up a daily timing action for an event to be switched on for a period everyday. In this example, between the hours of 9.45 and 10.00, the RTC output will switch on and the output Q1 will switch on for the entire period.



The RTC circuit above is in Everyday action mode. From Monday to Sunday the RTC will switch on output Q1 between 9.45am and 10am. The function block is always enabled with the Hi input.

## Inserting a Compare Function with an Analogue

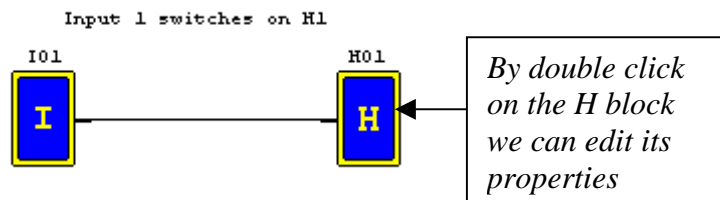
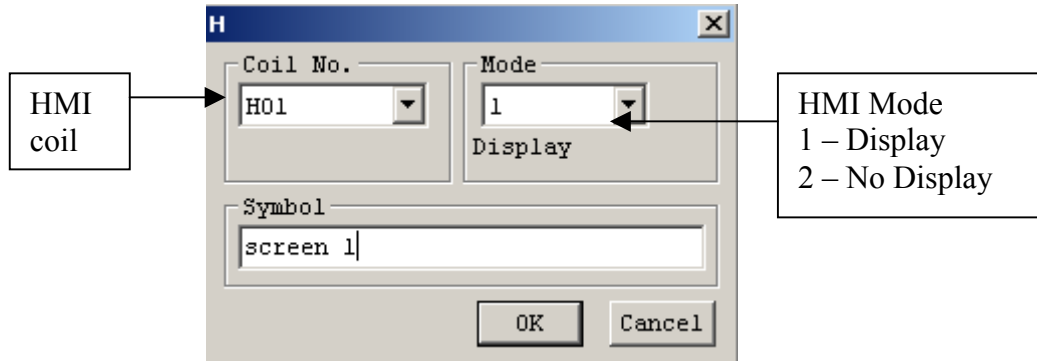
The DC supply iSmart has 0-10Vdc analogue inputs available and a comparison function. The comparison function does not however only have to be used for the analogue values, it can be used to compare timer and counter values as well. The 12 I/O model has 2 analogue inputs and the 20 I/O model has 4. The analogue inputs can be configured to be additional discrete inputs and can also be used to set timer / counter presets. The comparison function has 5 modes, using analogue / timer and counter values being compared to each other and a preset constant.



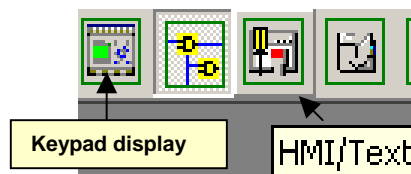
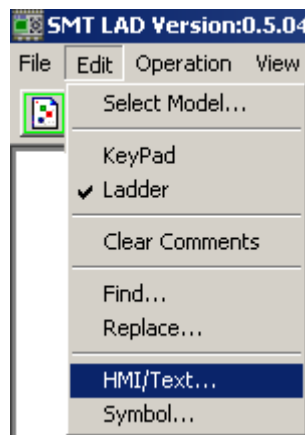
The circuit above has two analogue inputs into a comparison function that is set in the mode 3:  $Ax \geq Ay$ . There is a reference value set at 0.5V but this will be ignored. When A1 is greater than or equal to A2, the compare function B02 will switch on Q2.

## Setting up a HMI Function Block

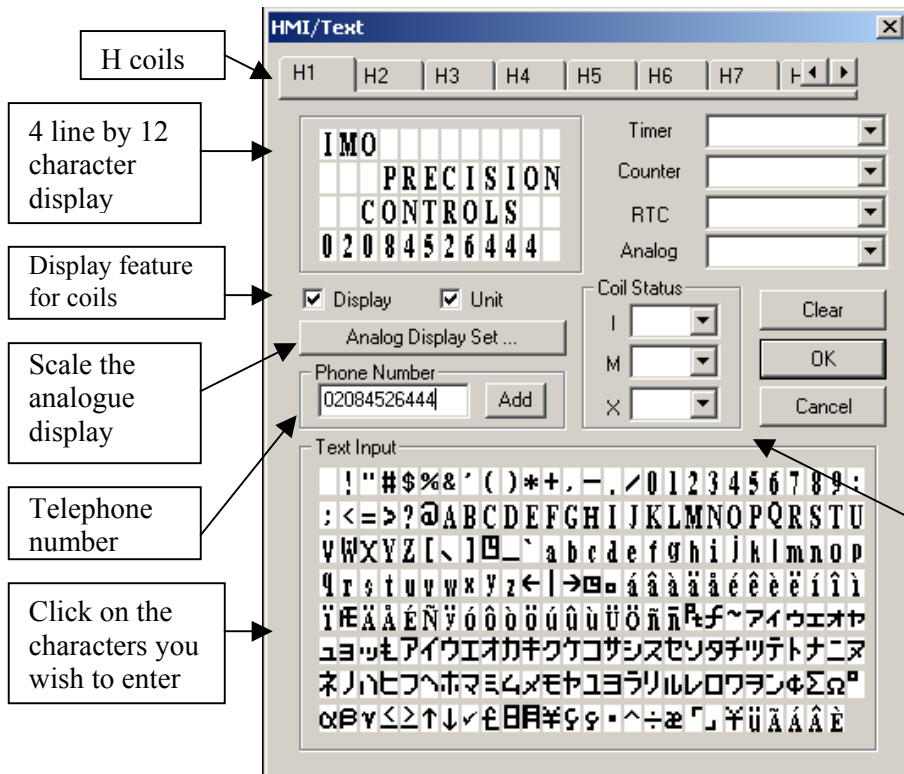
In order to display text and function status on the screen we need to set the H function. We begin by inserting a H function into the program.



Now that the function block has set up we can enter the details we want to see on the screen.



Either select the HMI / Text option or click on the button in the menu to open the Screen edit menu.

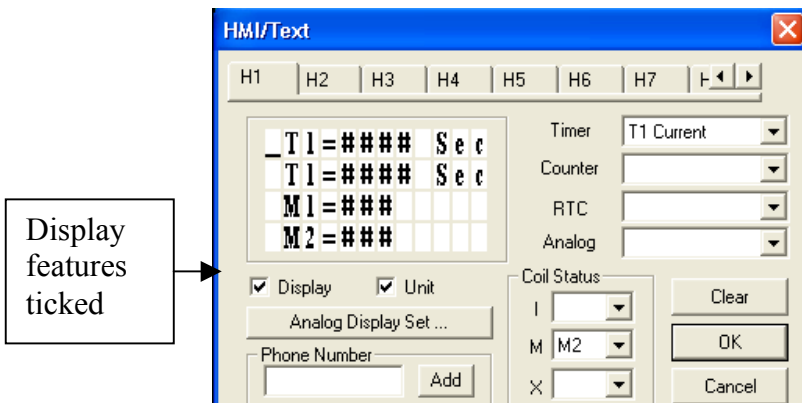


Insert timer / counter / RTC / Analogue presets and current values

Preset values can be changed by through the screen by using the arrow keys

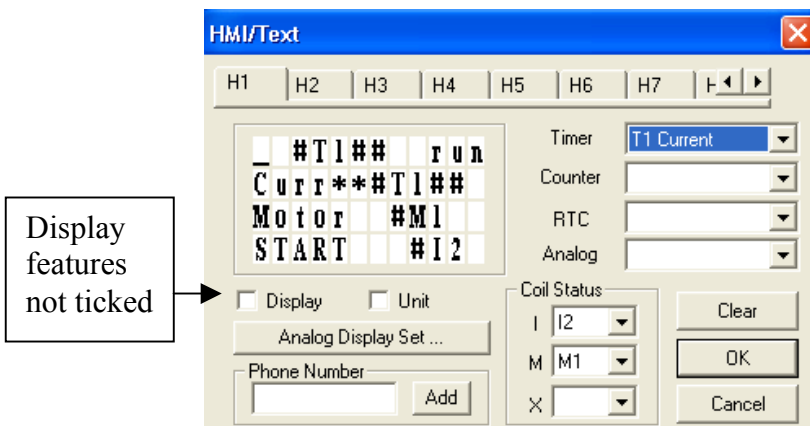
Insert Coil status

The coil status of an internal bit can be altered through the screen by using the arrow keys on the iSmart



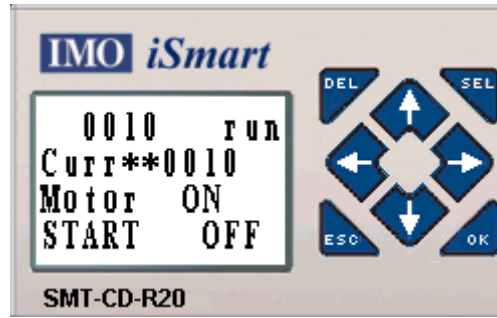
Display features ticked

With the display options ticked the timer / counter and coils status is given the default identifier, T1, C1, M1 etc, and the HMI line is used completely.

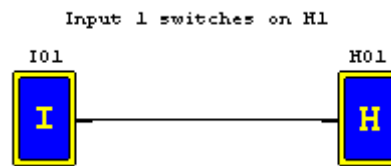


Display features not ticked

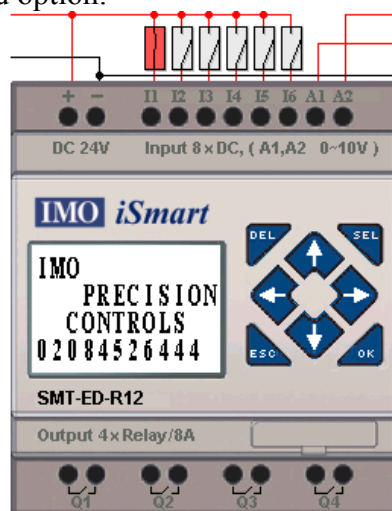
With the display options not ticked the timer / counter and coils status value is only displayed. A user defined identifier for T1, C1, M1 etc, can be entered, thus having more meaningful screen to the user.



When input 1 is energised function block H01, will energise and the message Stored in H1 will be displayed. When input 1 is Off, the function block H01 will switch Off and the screen will go back to the main display.



The HMI screen can be seen in simulation mode when programming in Ladder by clicking to view the Keypad option.



## *iSmart* Communication Functions – Ladder

In the iSmart range there is a 20 I/O module with in an built RS485 Modbus communication port. All of the iSmart range can also communicate with the IMO range of HMI's, through the Loader port.

The communication capable iSmart (C-type) also have two IMO protocols for inter-communication between iSmart's; Remote I/O and DataLink. The iSmart can also be a Modbus slave, for further information on Modbus communication, please refer to the iSmart Communication manual

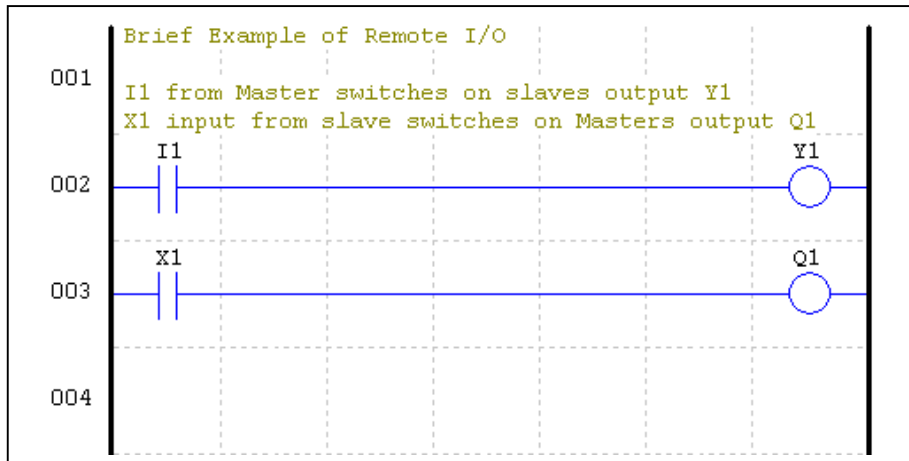
### **Remote I/O**



- Set to be master in iSmart parameters
  - User program valid
  - X = slave input
  - Y = slave output
  - Set to be slave in iSmart parameters
  - User program not valid
  - Input = X coil of master
  - Output = Y coil of master
- Master has a program, slave does not require a program
  - Expansion modules invalid
  - Remote I/O, expansion addressing becomes the slave addressing
  - Max 40 I/O: (2x SMT-CD-R20)
  - 1 Master and 1 Slave only
  - Set parameters, i.e. One to Master (M) and One to Slave (S) and **turn off and on** before using.



In the programming example below I1 on the master iSmart switches on the first output on the slave. X1 from the slave switches on the master's first output.

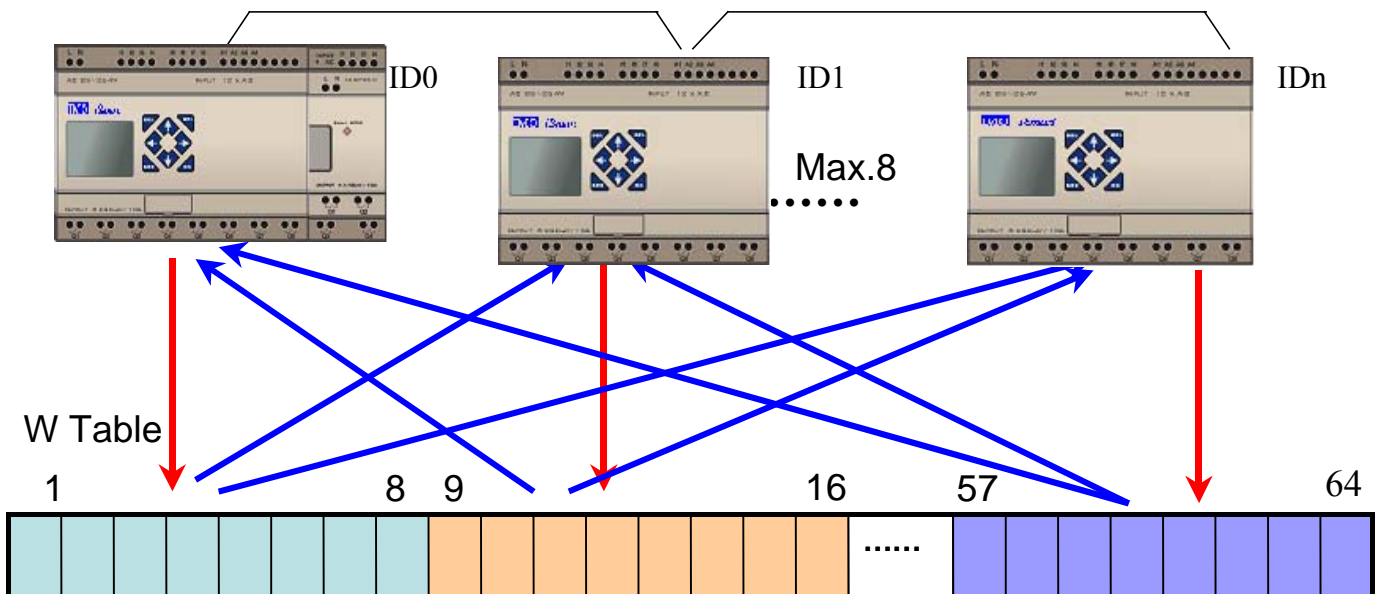


## *iSmart Data-Link*

- RS485 port, Modbus protocol with a Baud rate = 38400/1200m.
- SMT-CD-R20 / -T20 models only.
- Additional Modbus module for HMI /PC.
- Modbus module is isolated, where as the SMT-CD's are not.
- **Modbus slave** only.
- Maximum number of stations = 8.
- Max number of data transmission is 64 words:
  - 7\*8 points received from w1~w64 per station.
- Unlike the Remote I/O communication example, each station has its own program.

Can slave Inputs (I), Outputs (Q) or Internal latches (M) but must be of all same type. For receiving station to receive the data must be sent by the desired Station. Define the start point and size of packet for transmission (maximum of 8). Each station ID must be set in the following order: Station 1 to be ID0, station 2 to be ID1 and so on through to 7. Each station is assigned a transmission (Link) Word (8 bits). Each station can have a maximum of 8 communication link relays. When programming, the communication Relay (Link) must have timing, i.e. an on/off pulse connected to enable (cannot tie high!). The same station can send and receive different data but is limited to 8 words. ID0 uses 1st 8 words; ID2 uses next 8 and so on till ID7 with w57-w64. The wiring is a daisy-chain connection, i.e. A to A to A; B to B to B and so on.

Therefore to get data from station 2, the program must have a send command where it puts the data into words w9 – w16. The station then wanting this data must have a receive command to receive w9 – w16.



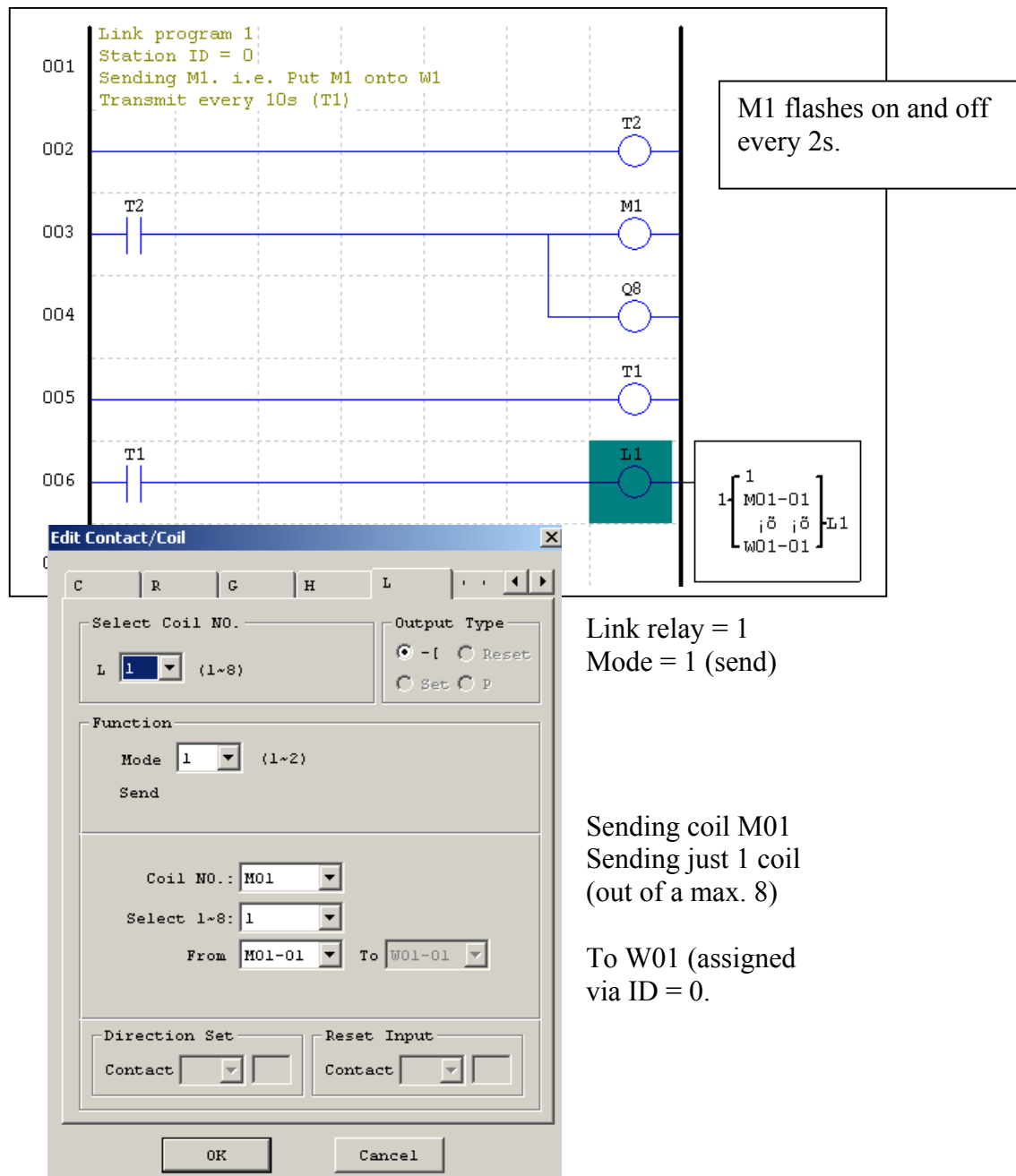
- Set up a Send parameter and a Receive Parameter
- Same station can Send and Receive
- ID0 uses 1<sup>st</sup> 8 words, ID2 uses next 8 and so on till ID7

### Three *iSmart* Example

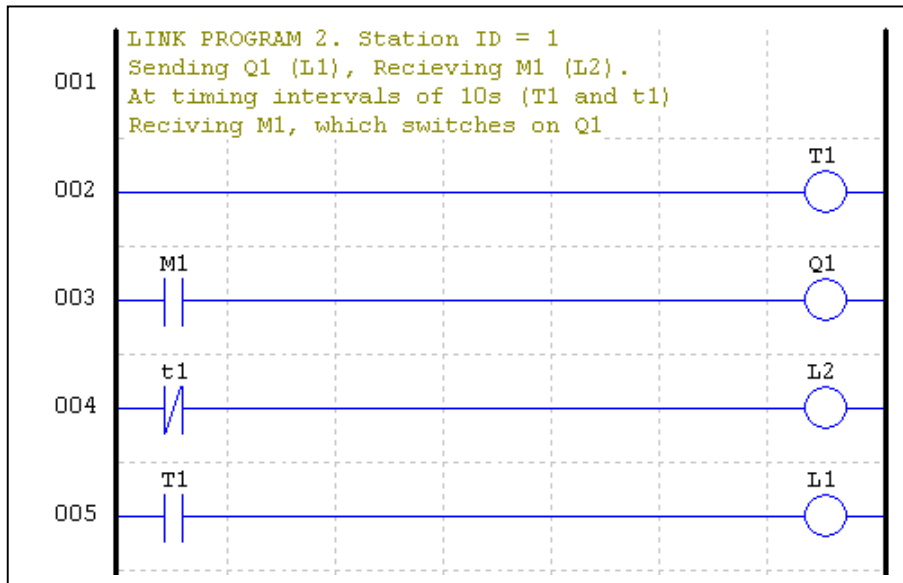
T2 in program 1 is a flash timer which switches on M1 and Q8 (just for indication). M1 is sent and received by Program 2. M1 in program 2 is then used to switch on Q1. Q1 is then sent by program 2 and received by Program 3. Program 3 stores Q1 in M1, which is used to switch on Q1 in Program 3.

Due to the different timing transmissions the outputs on the three stations come on at and stay on for different periods.

#### Station ID = 0, Program 1.

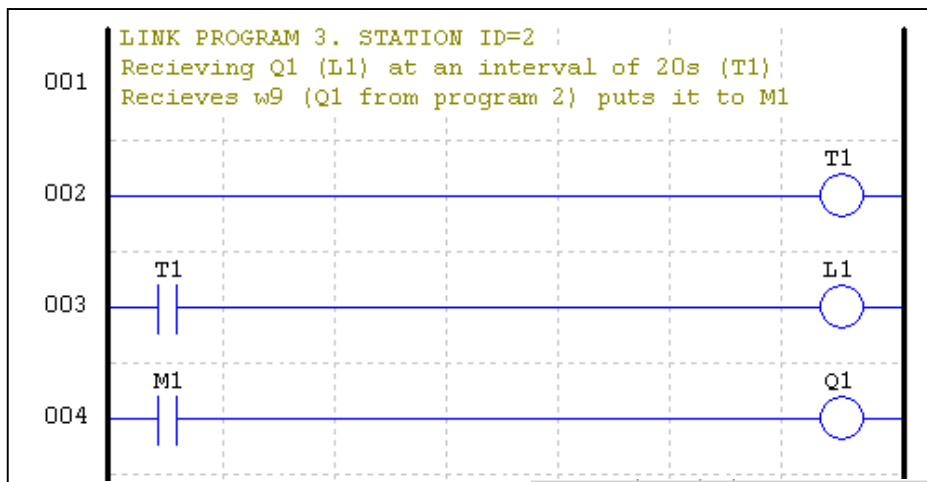


#### Station ID =1, Program 2.



M1 switches on Q1 which is sent to program 3.

### Station ID 2, Program 3.

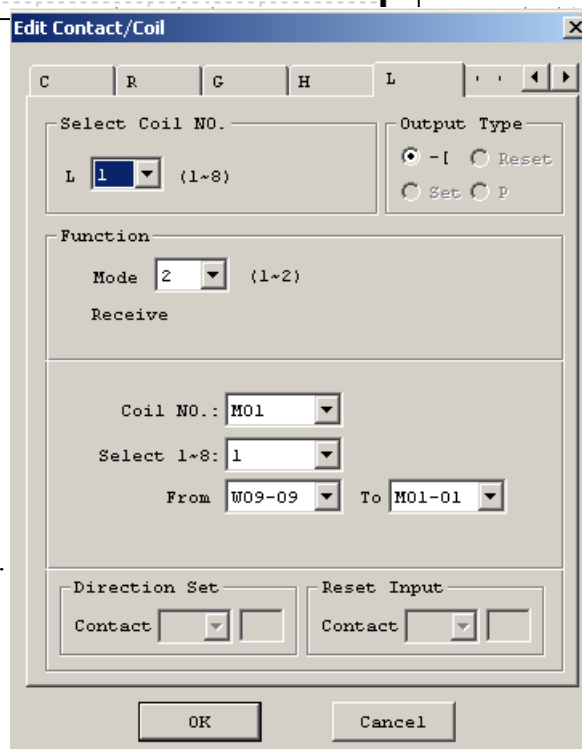


M1 Switches on Q1.

Link relay 1

Mode =2, receive

Receiving 1 bit from w9 and storing in M1.



## Program Simulation

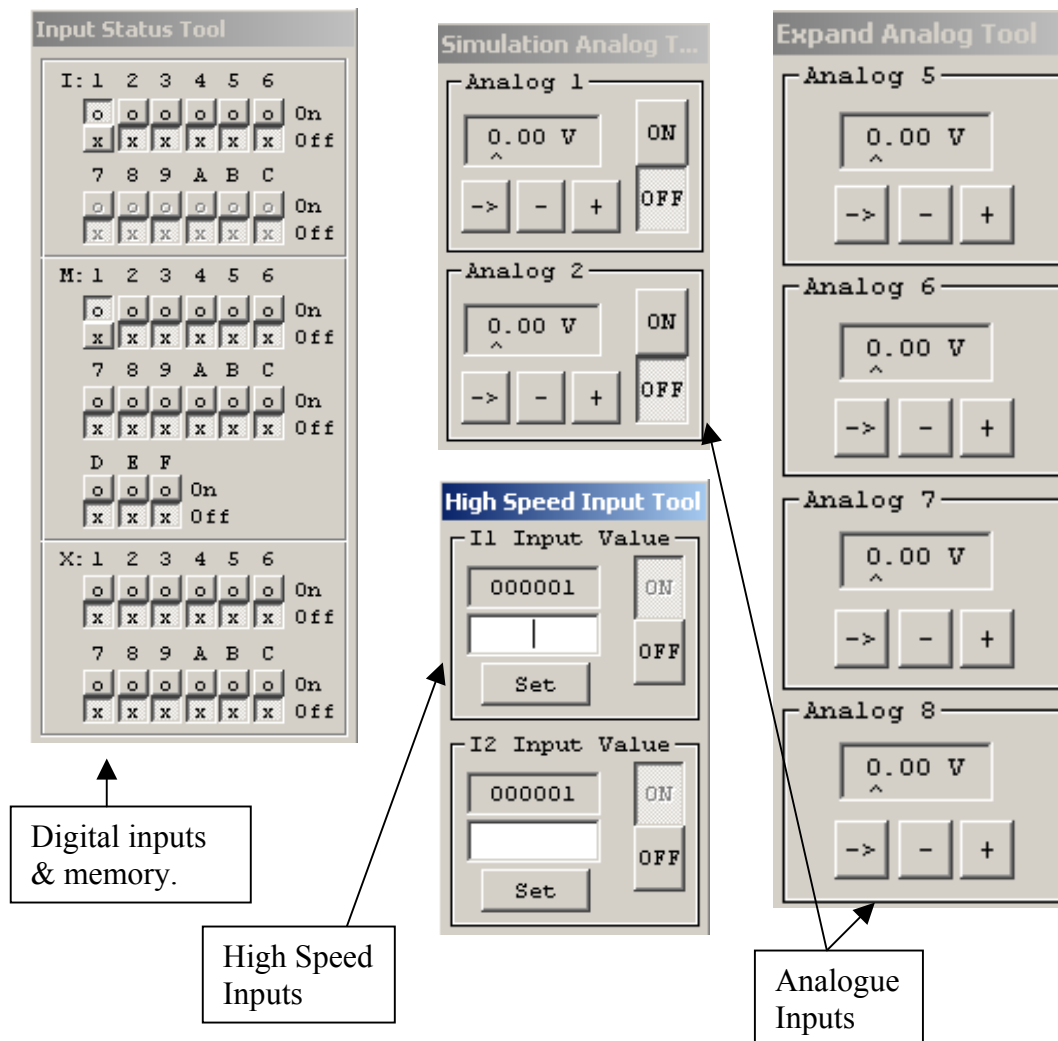
SMT-Configurator has a powerful simulation function available in both Ladder and FBD programming environments.



This is a powerful tool that allows the programmer to test his logic design without requiring any hardware.

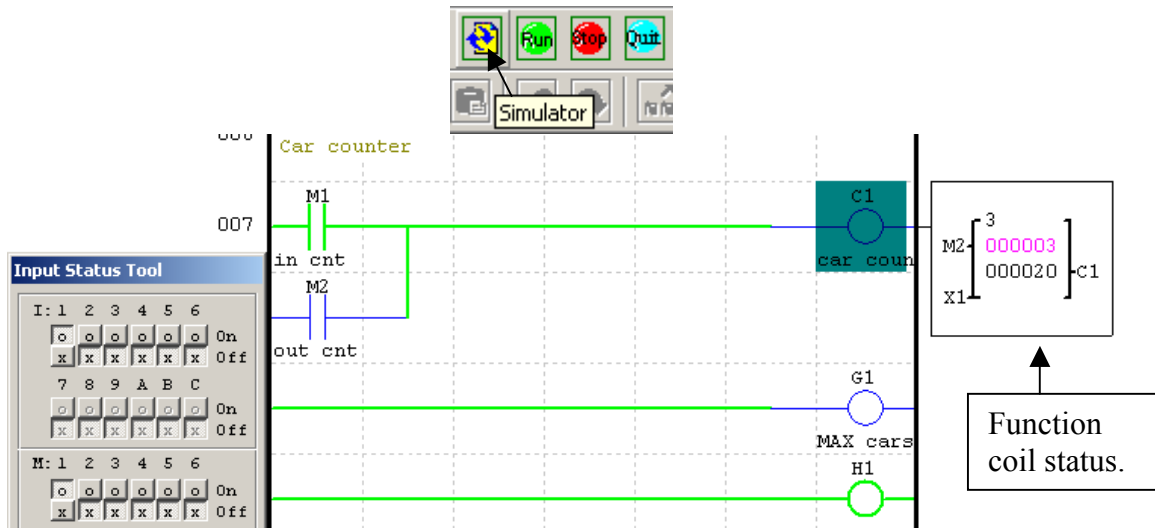
### Simulation Tools

The simulation function has 4 tools bars to replicate all possible inputs to the iSmart.



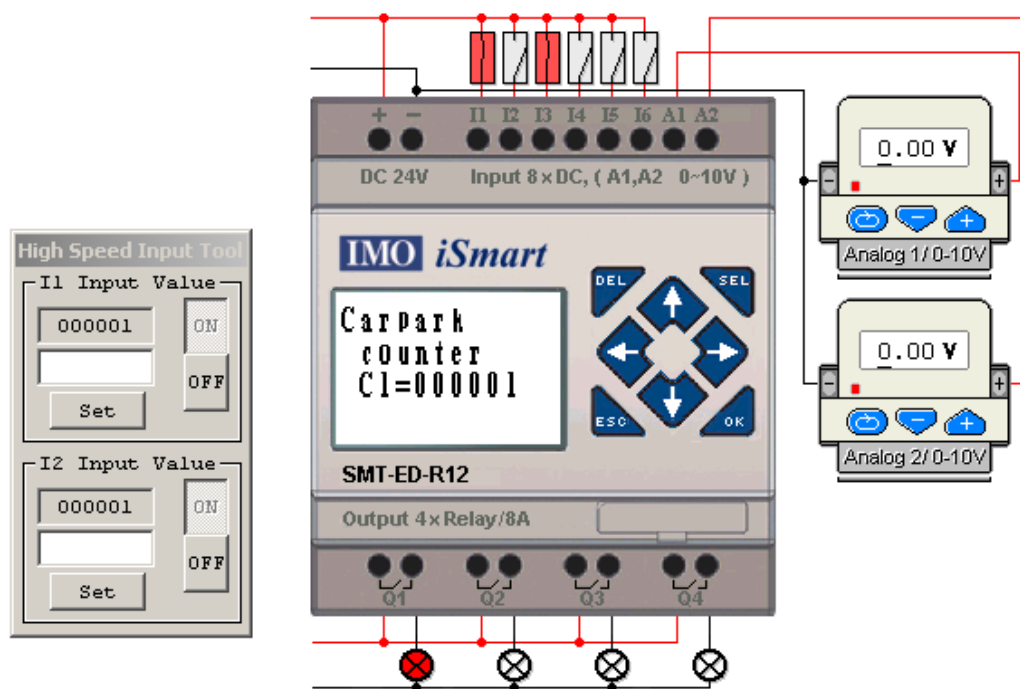
## Simulating a Ladder Program

By clicking on the simulation button, the function will run and the toolbars will appear.



Live lines, inputs and contacts will appear in Green. Non-live lines, inputs and contacts will remain unchanged (blue). By clicking on the Function coils, their status can be shown, with the current value in pink and preset in black.

In ladder programming it is also possible to simulate the keypad entry.

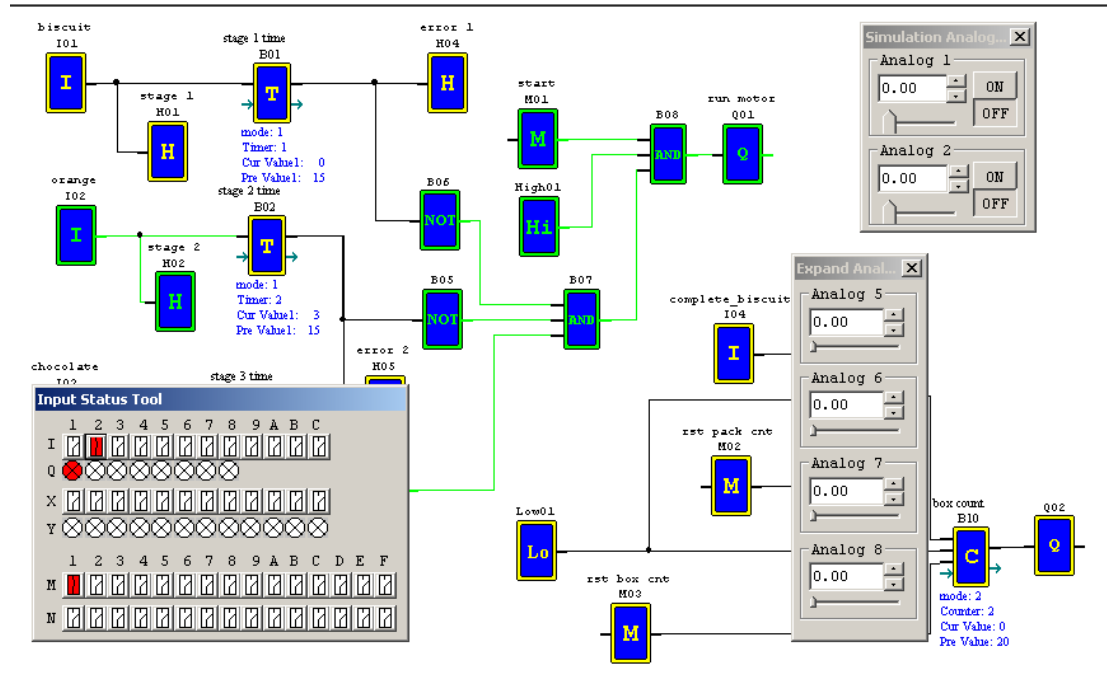


To exit the simulation, click the quit button.



## Simulating a FBD Program

The simulation feature is very similar in FBD, it has the same tool box options however the input status tool is slightly different with having an output indicator.



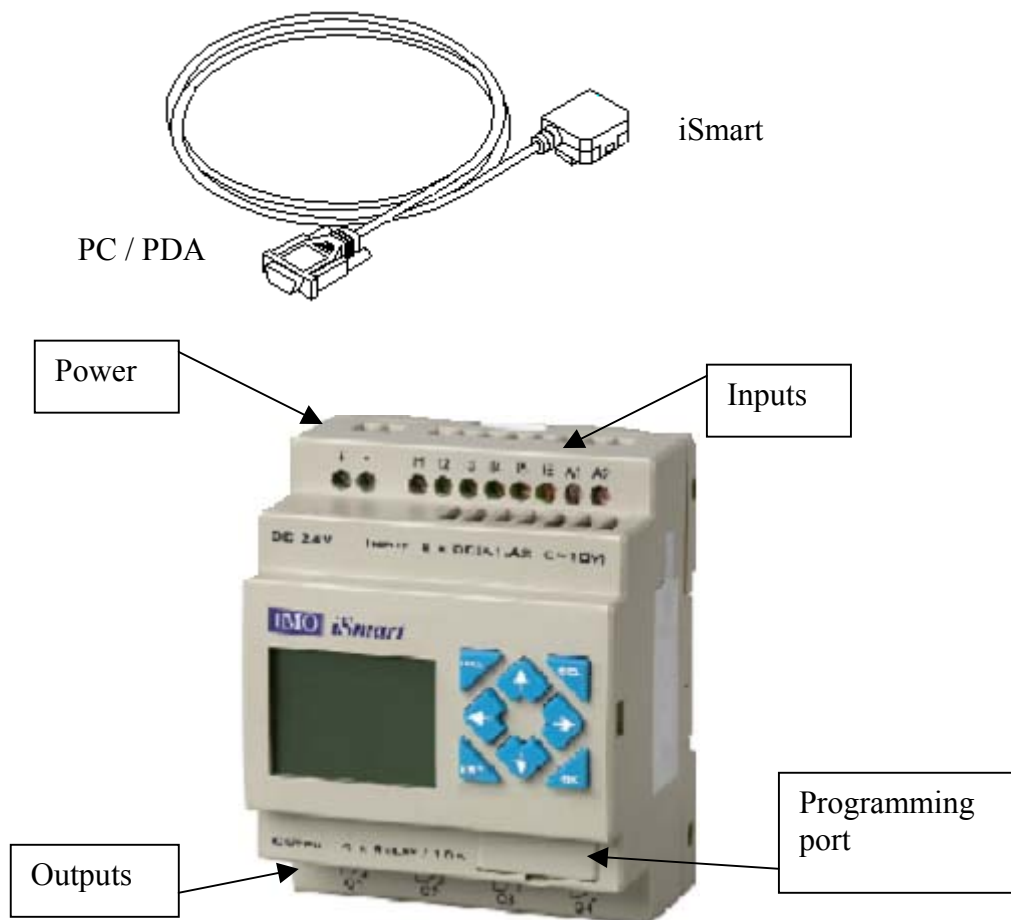
Once again the live wires and blocks are in Green. Below the function blocks, written in Blue can be seen the current value and preset values.

## Uploading and Downloading

Now that you have written a program you will need to download to an iSmart. Before download or upload is possible you need to connect the iSmart to a PC (or PDA)

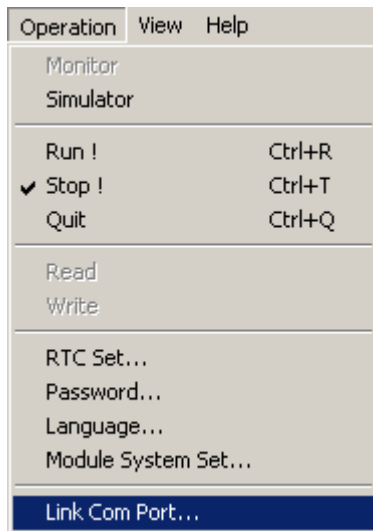
### Connecting the *iSmart*

First the cable needs to be connected to the iSmart before powering up the iSmart.

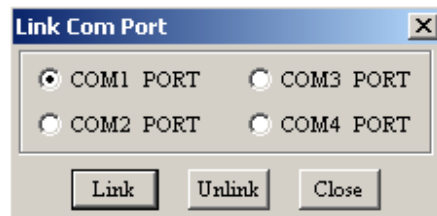


Then using the *iSmart* Configurator software link the iSmart.





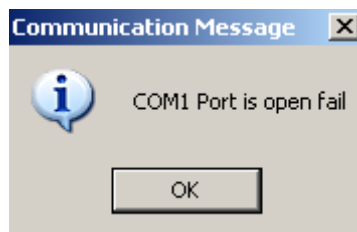
In the operation menu, select the option: Link com Port...  
A selection box will appear to choose the desired comm. port on the PC for the serial port.



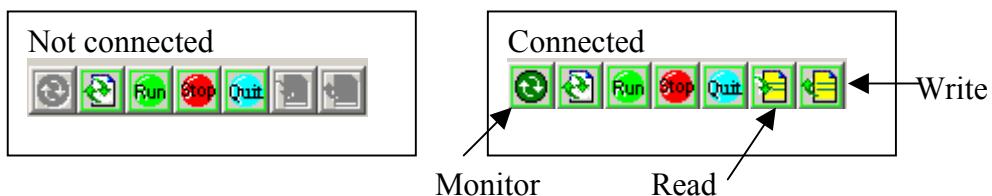
The program now begins to search for the connected iSmart with the matching ID number.



If another program is using the serial port and hasn't disconnected from it then this error message will appear. Try closing the other program and restart the link procedure.



Once connected further options will be available, i.e. Monitor, Upload and Download.

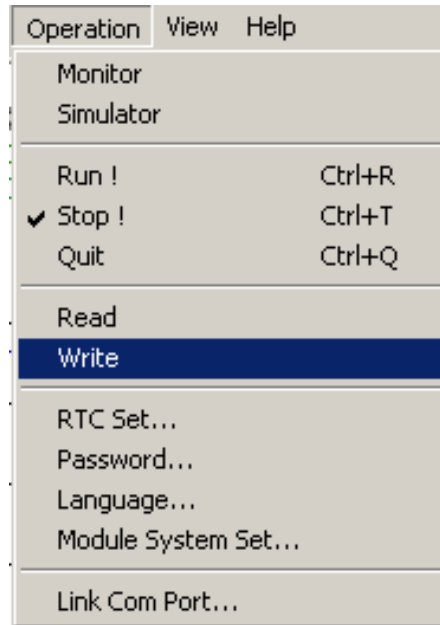
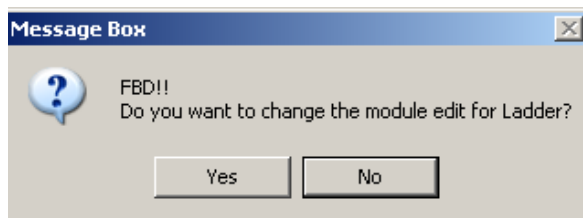


## Writing to the iSmart (downloading)

Using either the write button or option in the online menu we can write the program to the iSmart.

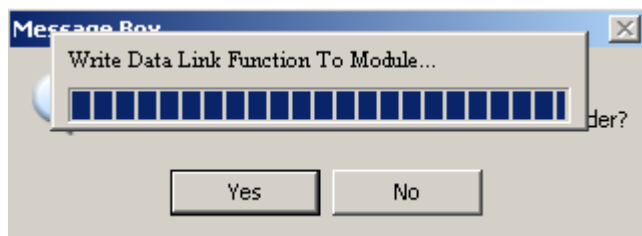


If the iSmart has been programmed in FBD or in Ladder and you would like to download a Ladder or FBD program. The configurator software will prompt you to check whether or not you want to change the iSmart to FBD or Ladder programming.



Click yes if you wish to continue.

The program will then begin to download all the parameters to the iSmart.

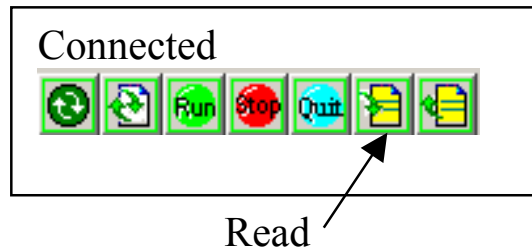
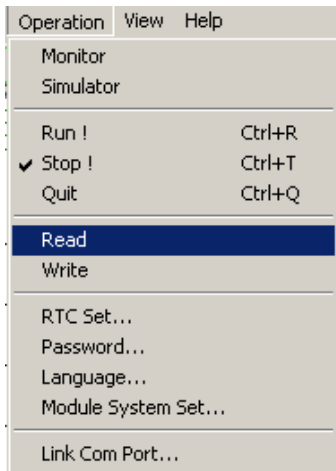


The Configurator software will go through all available functions and then complete.

## Read from the *iSmart* (uploading)

If the *iSmart* already has a program in it and you want to make alterations to it using a PC, then you will need to upload the program.

Select the Read option or button.



Just as with the Write function, the Configurator software will read in all available functions.



## Monitor

The last connect option is to monitor the program. This function will allow you to track the progress of the iSmart program whilst the machine is running. This is a very useful tool for debugging the program.

The screenshot displays the software's 'Monitor' mode. On the left, the 'Operation' menu is open, with 'Monitor' selected. To its right, a 'Connected' toolbar contains icons for Run, Stop, Quit, and other functions. Below these, the 'Input Status Tool' is visible, showing a grid of input and memory bits (I, M, X) with their current states (On/Off). The main area shows a ladder logic diagram with rungs 001 through 008. Rung 007 is highlighted in purple, indicating it is active. A green box highlights the 'G1' function block on rung 002. A callout box next to G1 shows its internal state: A1: 00.00V, A2: 00.00V, and a 5-bit output G1: 00.50V. A text label above the diagram reads: '- g7 - display - analogue reading an analogue value and display on screen'.

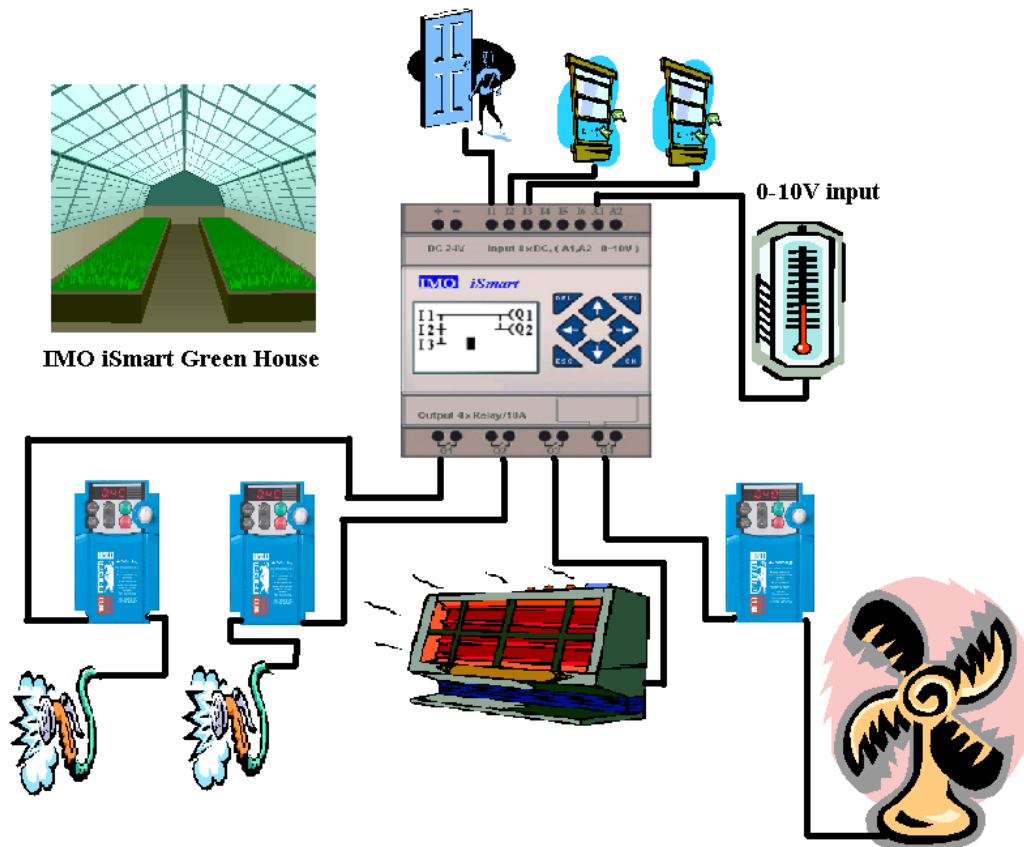
When monitoring, the live lines will be purple in colour and the input status toolbox will appear. Inputs cannot be forced on, but internal memory bits can be. By selecting the function blocks, shown above with the green box highlighting G1, it is possible to monitor the function blocks.

## iSmart Tutorials

Now that we have gone through the various functions in both ladder and FBD, it is time to put what we know into practice. This next section has two programming tutorials.

### iSmart Programming Example 1: Greenhouse

Design an automatic control system based around the iSmart Intelligent Relay to manage the environment of a greenhouse.



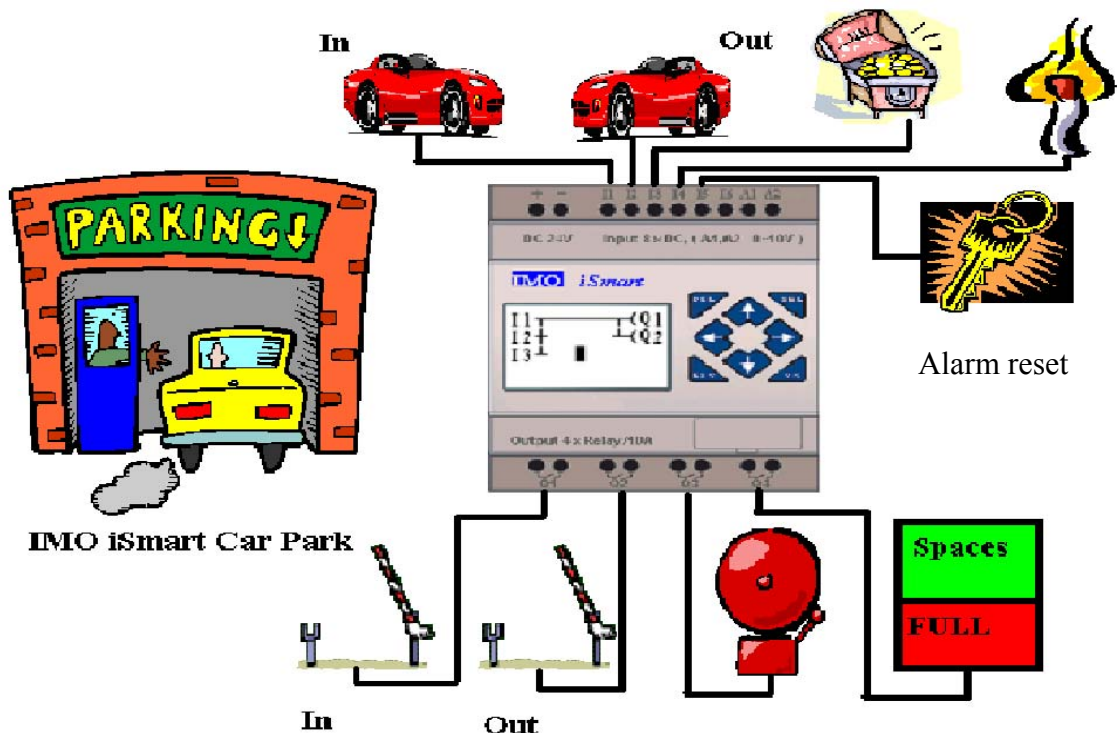
The plants in the greenhouse must be watered three times daily. There are two IMO Jaguar drives which control two pumps supplying the plants with water. They must not come on at the same time.

If the greenhouse gets too hot then a cooling fan must be switched on. Likewise if the greenhouse gets too cold then the heater must be switched on. The fan and heater cannot be on at the same time.

The water sprinkler must not switch on if the door is open and the iSmart must display if either of the two windows are open.

## *iSmart* Programming Example 2: Car Park

Design an automatic control system based around the iSmart Intelligent Relay to manage the automation of a small city car park.



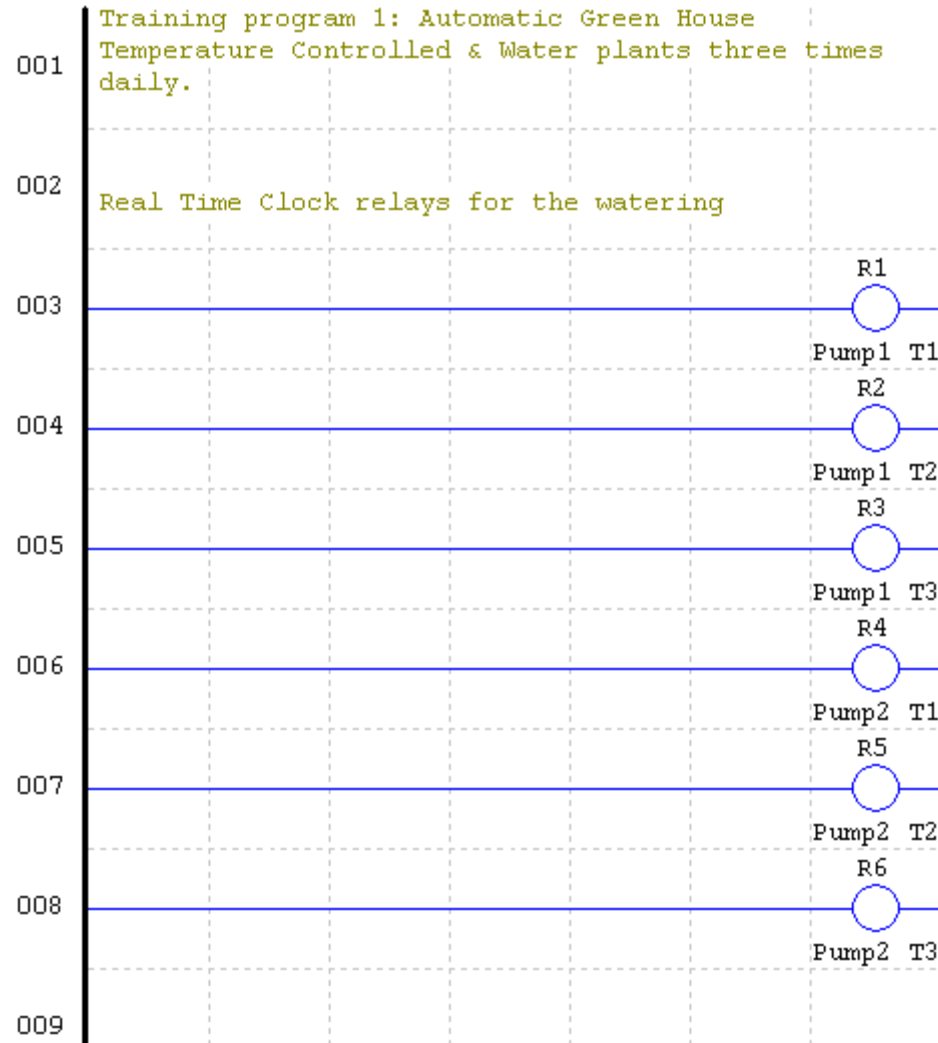
The maximum capacity of the car park is 20 cars. The entrance is separate to the exit at which there will be barriers. The entrance barrier will rise when the driver has pushed the entrance button and there are available spaces. The exit barrier will rise on the car approaching and having settled an appropriate fee. The exit barrier will automatically rise when there is a fire alarm, the entrance gate will not open and the bell will sound.

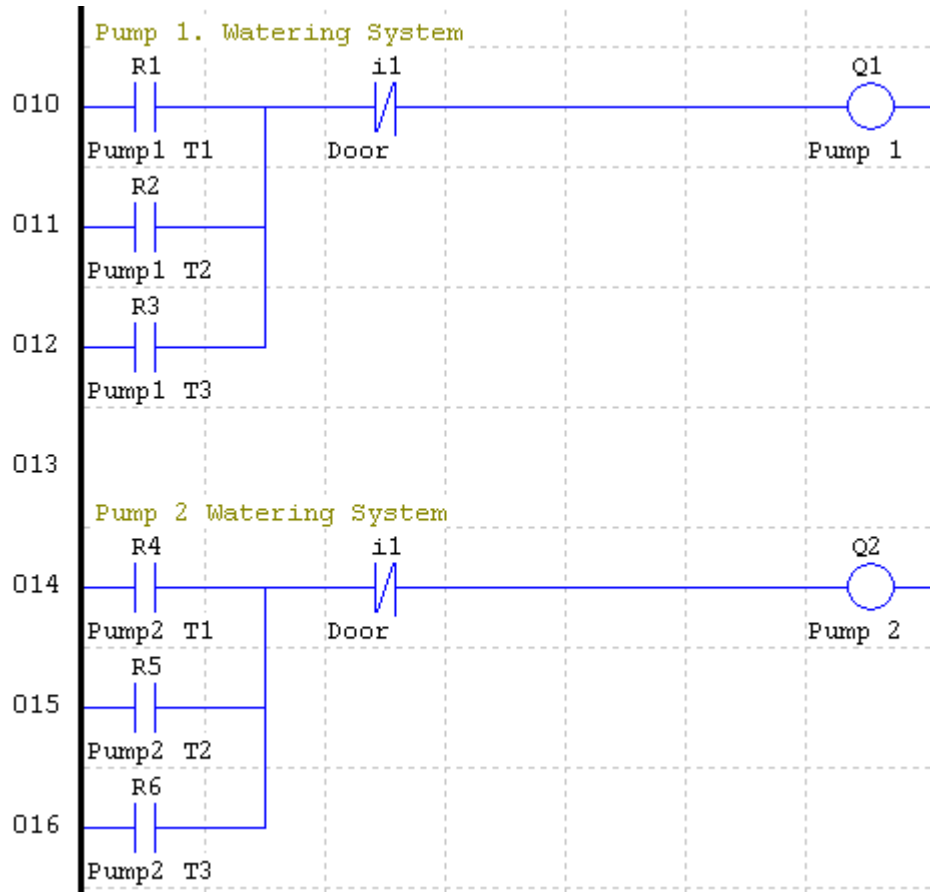
To reset the fire alarm the car park attendant must use a key.

There is no one correct solution to any programmable device solution but please find our solution to the programming tutorials in the Solutions section.

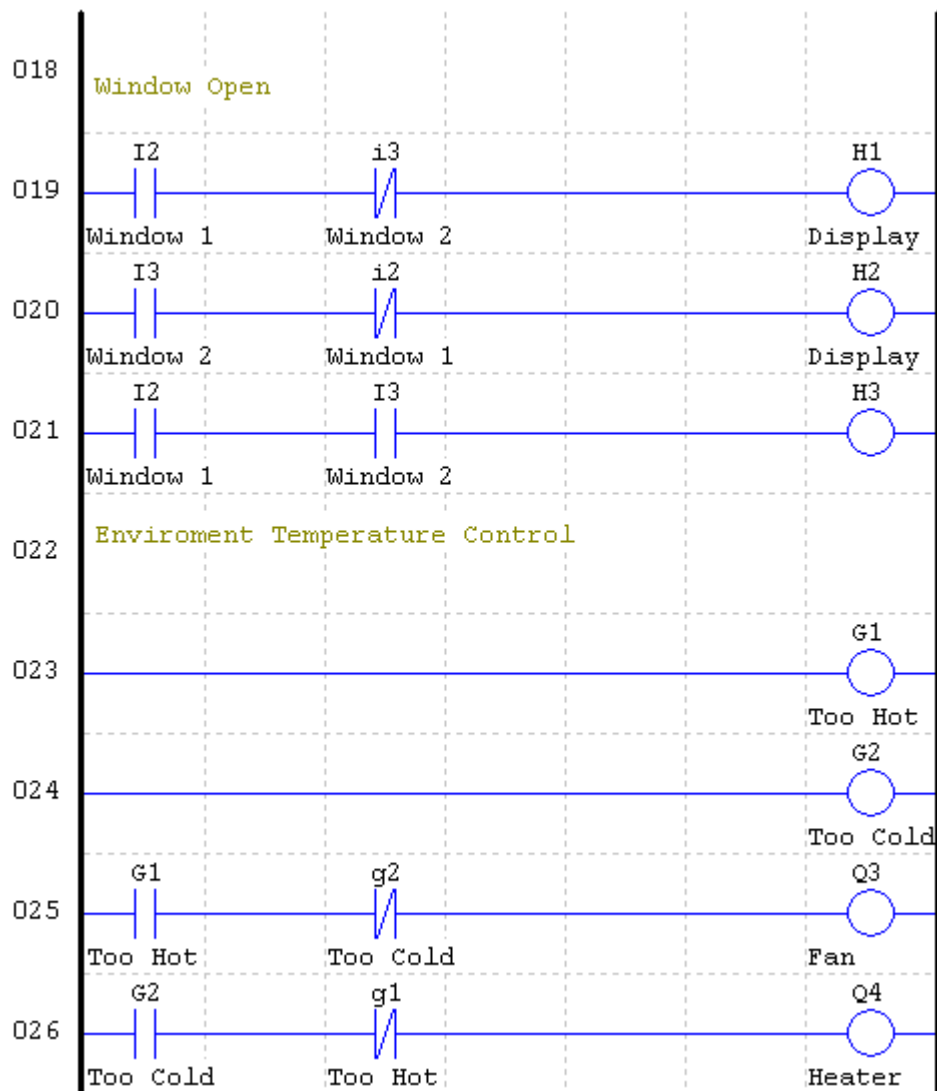
# Solutions

## Greenhouse Program

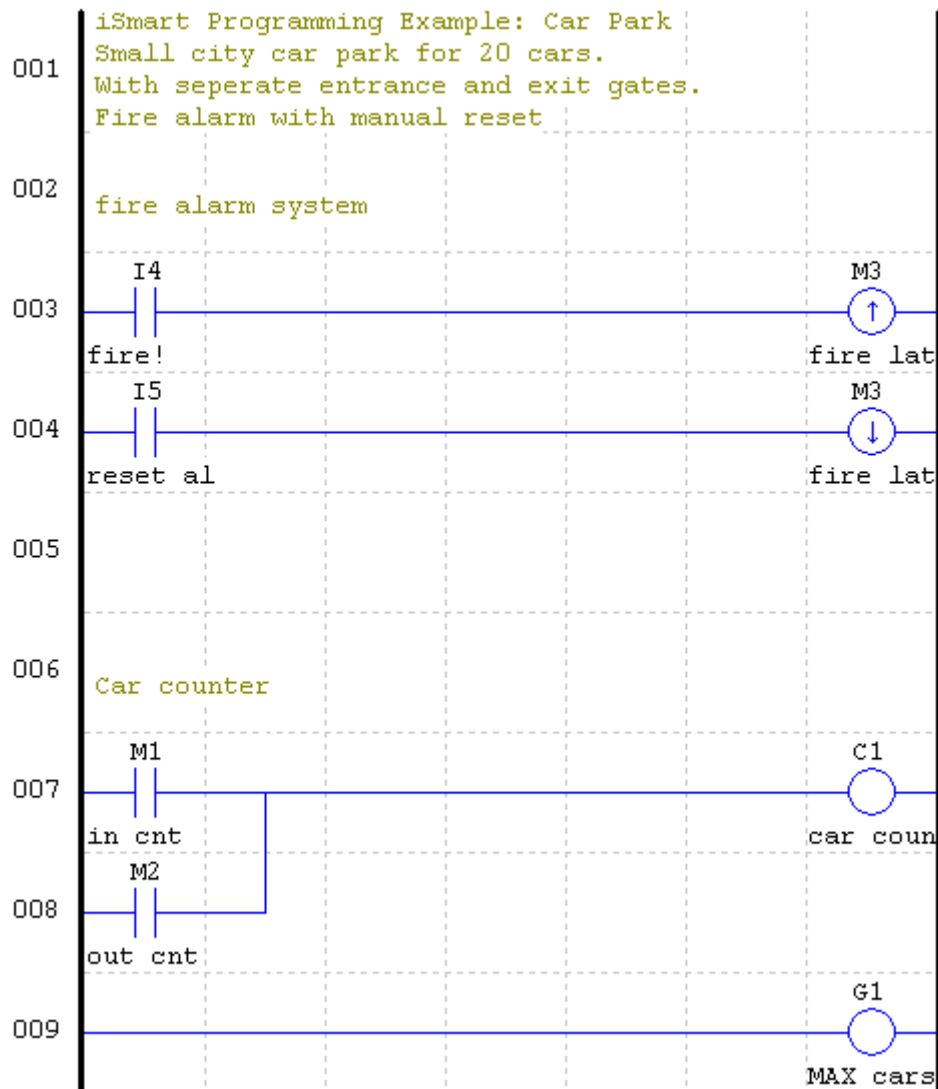


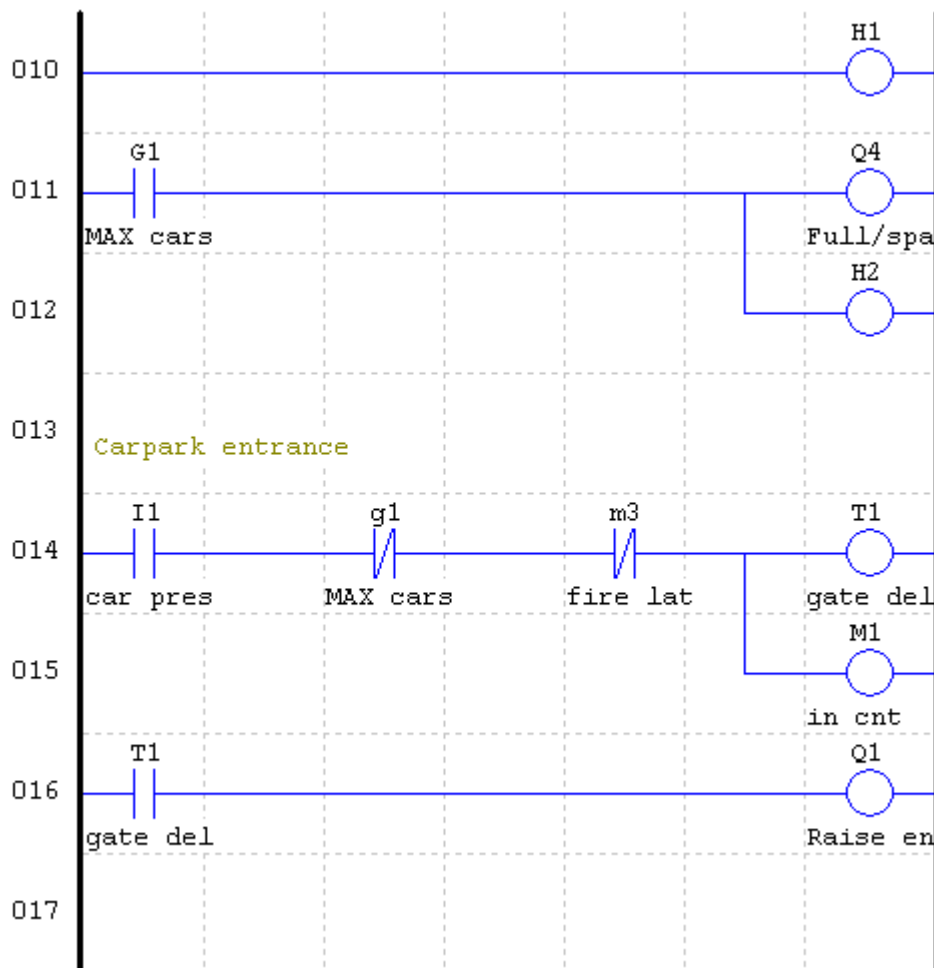


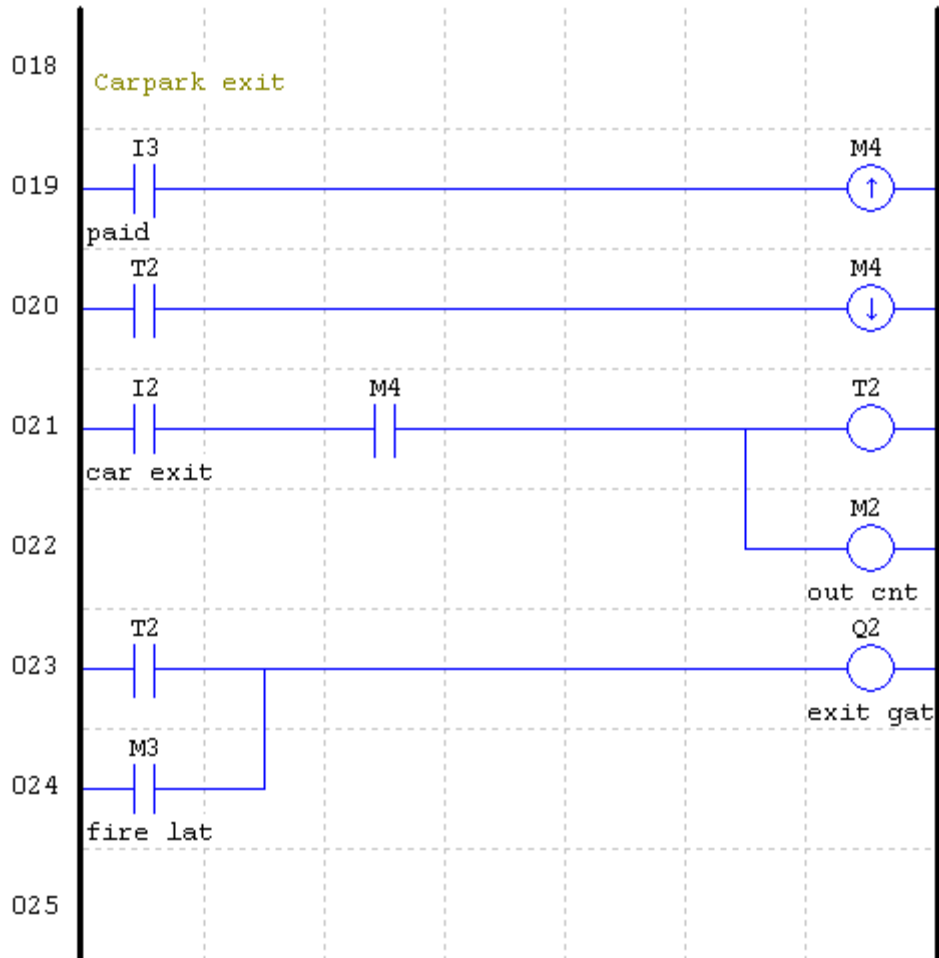




## Car Park Program











**IMO Precision Controls Limited**  
 1000 North Circular Road  
 Staples Corner, London  
 NW2 7JP United Kingdom  
 Tel: +44 (0)20 8452 6444  
 Fax: +44 (0)20 8450 2274  
 Email: [imo@imopc.com](mailto:imo@imopc.com)  
 Web: [www.imopc.com](http://www.imopc.com)



**IMO Jeambrun Automation SAS**  
 165 Rue Jean Jaures,  
 94700 Maisons Alfort  
 Paris, France  
 Tel: +33 (0)1 45 13 47 05  
 Fax: +33 (0)1 45 13 47 37  
 Email: [info@imopc.fr](mailto:info@imopc.fr)  
 Web: [www.imopc.fr](http://www.imopc.fr)



**IMO Deutschland**  
 Für weitere Einzelheiten  
 zu IMO Agenten und  
 Distributoren in Ihrer Nähe  
 schreiben. Sie bitte ein E-mail  
 an folgende Adresse:  
[imo@imopc.com](mailto:imo@imopc.com)



**IMO Italia**  
 Viale A. Volta 127/a  
 50131 Firenze, Italia  
 Tel: +39 800 783281  
 Fax: +39 800 783282  
 Email: [info@imopc.it](mailto:info@imopc.it)  
 Web: [www.imopc.it](http://www.imopc.it)



**IMO Canada**  
 Unit 10, Whitmore Road  
 Woodbridge, Ontario.  
 L4L 8G4 Canada  
 Tel: +1 905 265 9844  
 Fax: +1 905 265 1749  
 Email: [imocanada@imopc.com](mailto:imocanada@imopc.com)



- Cam Switches
- Din Terminals
- Drives
- Enclosures
- Fieldbus remote I/O
- Isolators & Switch Fuses
- MCB & RCD
- Motor Circuit Breakers
- Motor Control Gear
- Panel Meters
- Relays
- Signal Conditioning
- Sockets
- Timers
- Transformers & Power Supplies



- Drives
- Intelligent Terminals/HMI
- Limit Switches
- Photoelectric Switches
- PLCs
- Proximity Switches
- Temperature Controls



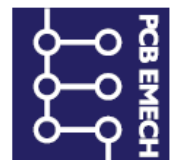
- Data Acquisition & Control
- Drives
- Intelligent Terminals/HMI
- Limit Switches
- Photoelectric Switches
- Proximity Switches
- PLCs
- Signal Conditioning
- Temperature Controls



- Lightguards
- Safety Limit Switches
- Safety Relays



- Jaguar VXM 0.37-500KW
- Jaguar VXSM 0.37-7.5KW
- Jaguar CUB 0.37-2.2KW



- Audible devices
- Chip-on-Board
- Device programmers
- LEDs & 7 seg. displays
- PCB Terminal blocks
- Relays - automotive
- Relays - power
- Relays - signal
- Switches

All IMO products are tried, tested and approved to relevant international quality standards

