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Technologies

FS Ladder

User's Manual

FS Ladder	v2.01
smartPLC firmware	v2.05 and v3-02
Last updated	2021-09-30

株式会社エフ・アイ・ティ
FIT CO.,LTD.

Change log

Date	Remarks
2019-02-25	The first edition of the manual for v2.00
2021-09-30	Information related FS Ladder v2.01 added

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1 Introduction

FS Ladder v2.01 application serves as a ladder diagram editor and compiler from the ladder diagram to a mnemonic program used by the smartPLC. It can also monitor and edit internal registers of smartPLC.

FS Ladder v2 is not iteration of version 1, it is written from the scratch.

FS Ladder v2 compared to version 1:

+ monitor and edit internal registers of smartPLC
+ improved error checking in instruction palette
+ automatic checking of actually visible part of ladder (disconnected wires, wrong connection)
+ color schemes (default, classic (v1 look), dark, user)
+ maximum number of rungs in ladder editor increased to 20000
+ compiler uses full potential of smartPLC firmware version 2 (note: firmware version 1 is not supported)
+ many other minor improvements
– new file format (note: file format of FS Ladder v1 is not supported)

FS Ladder v2.01 compared to version v2.00:

- supports smartPLC v3 (including file manager)
- minor fixes and improvements of user interface

1 - 1 System Requirements

In order to use the FS Ladder application, the following environment is necessary.

Software Requirements

- Operating System Microsoft Windows 7 Service Pack 1 or Windows 10.
  (Mac and Linux are not supported.)
- Microsoft .NET Framework 4.5 or higher installed.

For .NET Framework 4.5 downloads and installation guidelines, please visit the website of Microsoft Corporation.

* Microsoft and Windows are trademarks of Microsoft Corporation.

Hardware Requirements

- 2 GHz or faster processor
- 4 GB of RAM
- 20 MB of available hard disk space
- USB port (for a connection to smartPLC, not mandatory)

1-2 Installation of software

The chapter is explaining how to install FS Ladder on the hard disk of the computer.

1-2-1 Preparing for installation

Check the following.

- Windows 7 Service Pack 1 or Windows 10 is installed on your computer and it is working properly.
- Microsoft .NET Framework 4.5 or higher installed.
- Mbed Serial Port driver (virtual serial port over USB). For installation refer to smartPLC User's Manual section 7- 1 Installing the USB driver (6-1 in smartPLC v2 user's manual).
- There is minimum 20MB of a free space on your hard drive. If there is no space, please free it in advance.

1-2-2 Installation

1. Access the smartPLC product download page https://smartplc.org/about/downloadsEN.html
2. Click on the latest version of FS Ladder.
3. Save the file in an arbitrary location and unzip the zip file.
4. Run FS_Ladder_v2-xx-YYYY-MM-DD.exe
   xx – subversion
   YYYY – build year
   MM – build month
   DD – build day

1-2-3 Uninstalling FS Ladder

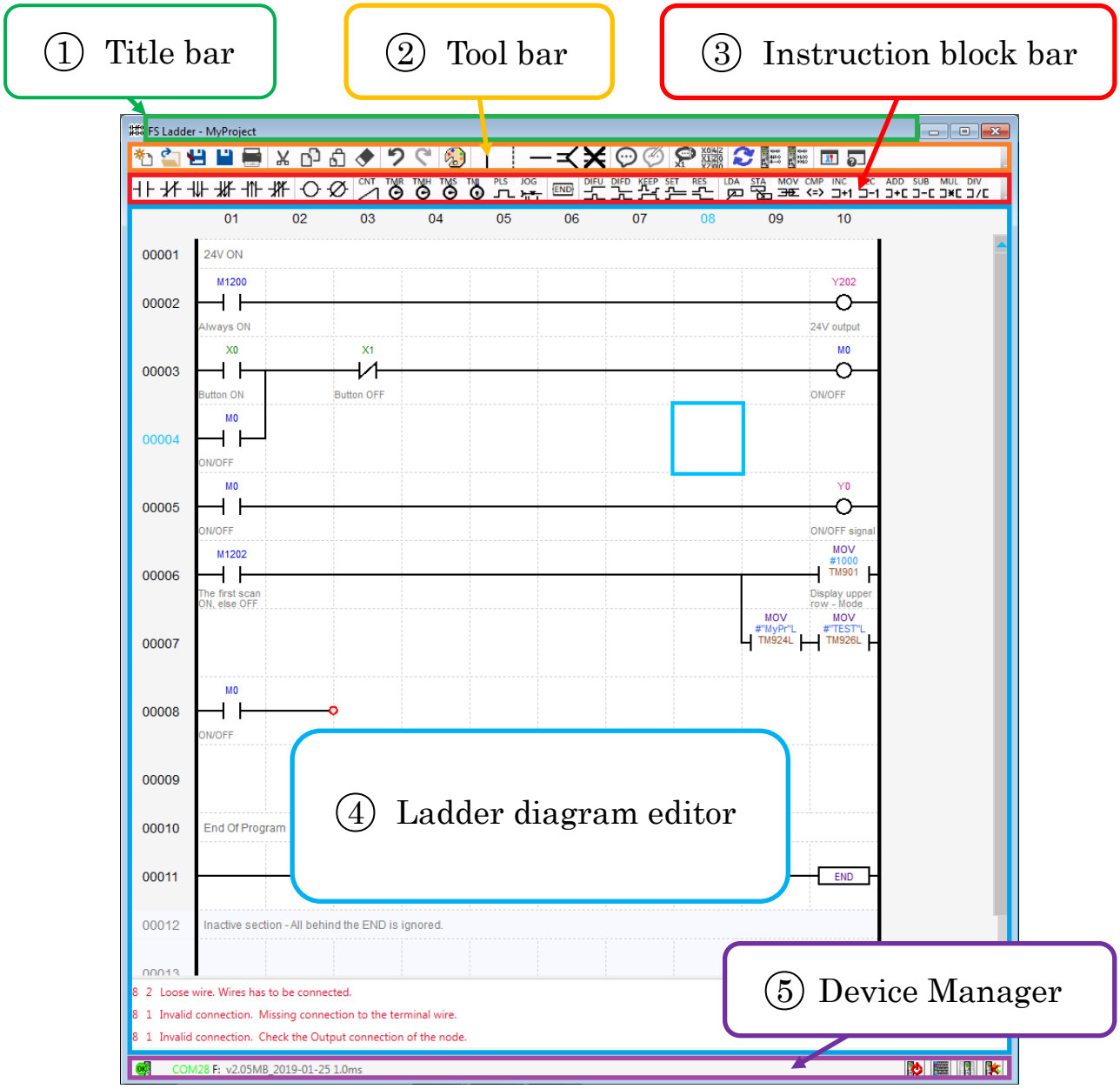
When FS Ladder is no longer needed, just delete the FS_Ladder_v2-xx-YYYY-MM-DD.exe.

2 Basics

This chapter explains the basic operation.

2-1 Application Window

After initialization, the main window of the FS ladder will appear. The main window has several sections.



①Title bar	Application name and the name of actually opened file
②Tool bar	Function buttons
③Instruction block bar	Buttons of instruction blocks
④Ladder diagram editor	Area of ladder diagram editor
⑤Device Manager	Area of device manager

2-2 Tool Bar

Icon	Name	Function
	New	Create a new file.
	Open	Open an existing file.
	Save as	Save the current file with a different name.
	Save	Save the current file. The file will be overwritten with new content.
	Print	Print ladder diagram.
	Cut	Copy and Cut selected cells.
	Copy	Copy selected cells.
	Paste	Paste the copied cells.
	Delete	Delete the selected cells.
	Undo	Cancel the previous operation
	Redo	Redo the operation you canceled with "Undo"
	Relay palette display	Show a relay and an instruction palette.
	Left vertical line	Insert a vertical connection line
	Left vertical line delete	Delete the vertical connection line
	Horizontal line	Insert a horizontal connection line.
	Insert rung	Insert a blank rung.
	Delete rung	Delete the selected rung.
	Insert comment rung	Insert an empty comment rung.
	Edit comment rung	Edit selected comment rung.
X1	Edit comments of operands	Edit the comments of device relays and memory registers (operands except the numeric constants).
X0 4 2 X1 2 0 X2 0 0	Device usage status	Show a list of usage status of each device relay/memory register.
	Make a Program	Create a mnemonic program text file from ladder diagram.
	Monitor in Ladder	Enable/disable a device monitoring in a ladder editor.
0100 0010	Device monitor	Show device monitor window.
	Settings	Show window with application settings.
	Help	Show a Help window (shortcuts, software version and License).

2-3 Instruction block bar

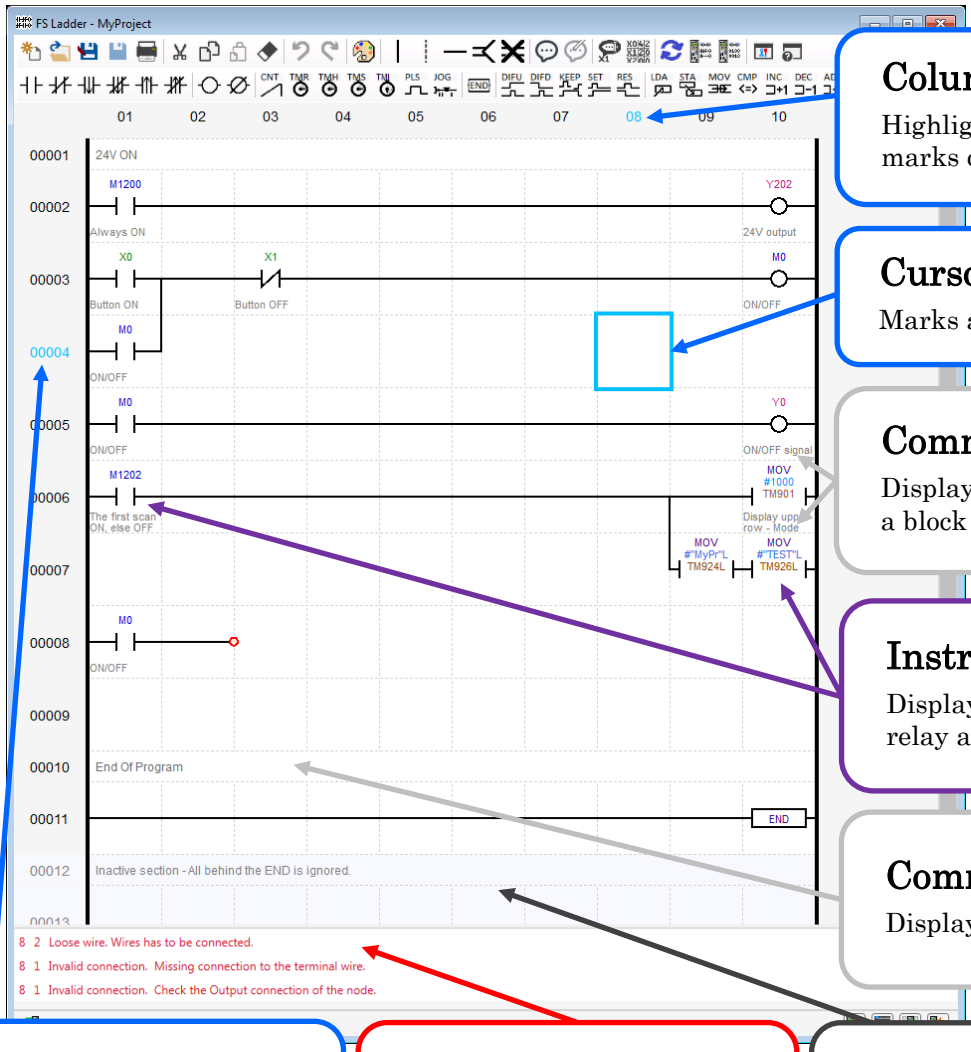
Icon	Name	Function
	Contact A (N.O)	Connect A contact (normally open)
	Contact B (N.C)	Connect B contact (normally closed)
	Contact A of Falling Edge Detector	Connect an A contact (N.O) of the Falling Edge Detector.
	Contact B of Falling Edge Detector	Connect an B contact (N.C) of the Falling Edge Detector.
	Contact A of Raising Edge Detector	Connect an A contact (N.O) of the Raising Edge Detector.
	Contact B of Raising Edge Detector	Connect an B contact (N.C) of the Raising Edge Detector.
	Coil	ON / OFF status of the circuit to the Output Relay.
	Coil bar	Inverted ON / OFF status of the circuit to the Output Relay.
CNT	Counter	It is 16bit incremental counter.
TMR	Timer (100ms)	A timer instruction with delay in 0.1s.
TMH	Timer (10ms)	A timer instruction with delay in 0.01s.
TMS	Timer (1ms)	A timer instruction with delay in 0.001s. (1*)
TMI	Timer interval in ms	A timer measures time in ms (1*)
PLS	Pulse	Send positioning pulses according to preset position.
JOG	Jog	Send positioning pulses with direction controlled by the program.
END	End	Indicates the end of the program
DIFU	Differentiate UP	When a rising edge on the input is detected then the relay specified by the operand is set ON for one scan cycle.
DIFD	Differentiate Down	When a falling edge on the input is detected then the relay specified by the operand is set ON for one scan cycle.
KEEP	Keep relay	When input SET is ON, the relay specified by the operand is set ON and when input RES is ON the relay is set OFF.
SET	Set	When the input condition is ON then set ON the relay specified by the operand.
RES	Reset	When the input condition is ON then set OFF the relay specified by the operand.
LDA	Load	Load the value specified by the operand to the internal register.
STA	Store	Store the value of the internal register to the destination specified by the operand.
MOV	Move	Transfer the value specified by the first operand to the destination specified by the second operand.
CMP <=>	Comparison	Compare the internal register with the value specified by the operand.
INC +1	Increment	Increment by one a value of the memory (DM, TM, CM) specified by the operand.

Icon	Name	Function
DEC ⊐−1	Decrement	Decrement by one a value of the memory (DM, TM, CM) specified by the operand.
ADD ⊐+⊏	Addition	Add a value specified by operand to the value of the internal register, the result is saved to the internal register.
SUB ⊐−⊏	Subtraction	Subtract a value specified by operand from the value of the internal register, the result is saved to the internal register.
MUL ⊐✱⊏	Multiplication	Multiply the internal register with the value specified by the operand.
DIV ⊐/⊏	Division	Divide the internal register by the value specified by the operand.

(1*) Accuracy of TMS (Timer 1ms) and TMI are limited by the length of SCAN time which is typically 1~10ms.

2-4 Ladder diagram editor

A description of the of the ladder diagram editor.



Column numbers
Highlighted column marks cursor position.

Cursor
Marks active block.

Comment
Displays a comment of a block or of an operand.

Instruction blocks
Displays instruction or relay and its operands

Comment rung
Displays user comment.

Rung numbers
Highlighted rung marks cursor position.

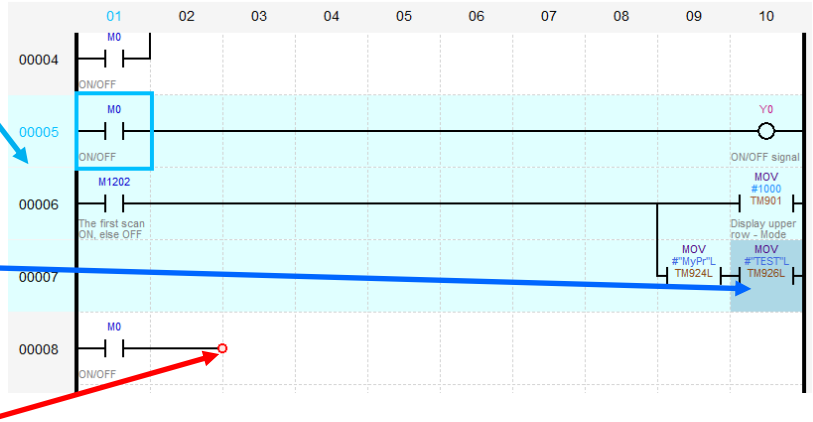
Error List
Displays errors detected on the visible area of a ladder.

Inactive section
All rungs behind the END instruction are ignored.

Selected Rungs
Highlighted rungs and blocks are selected ones.

Selection Cursor
Moves when selecting.

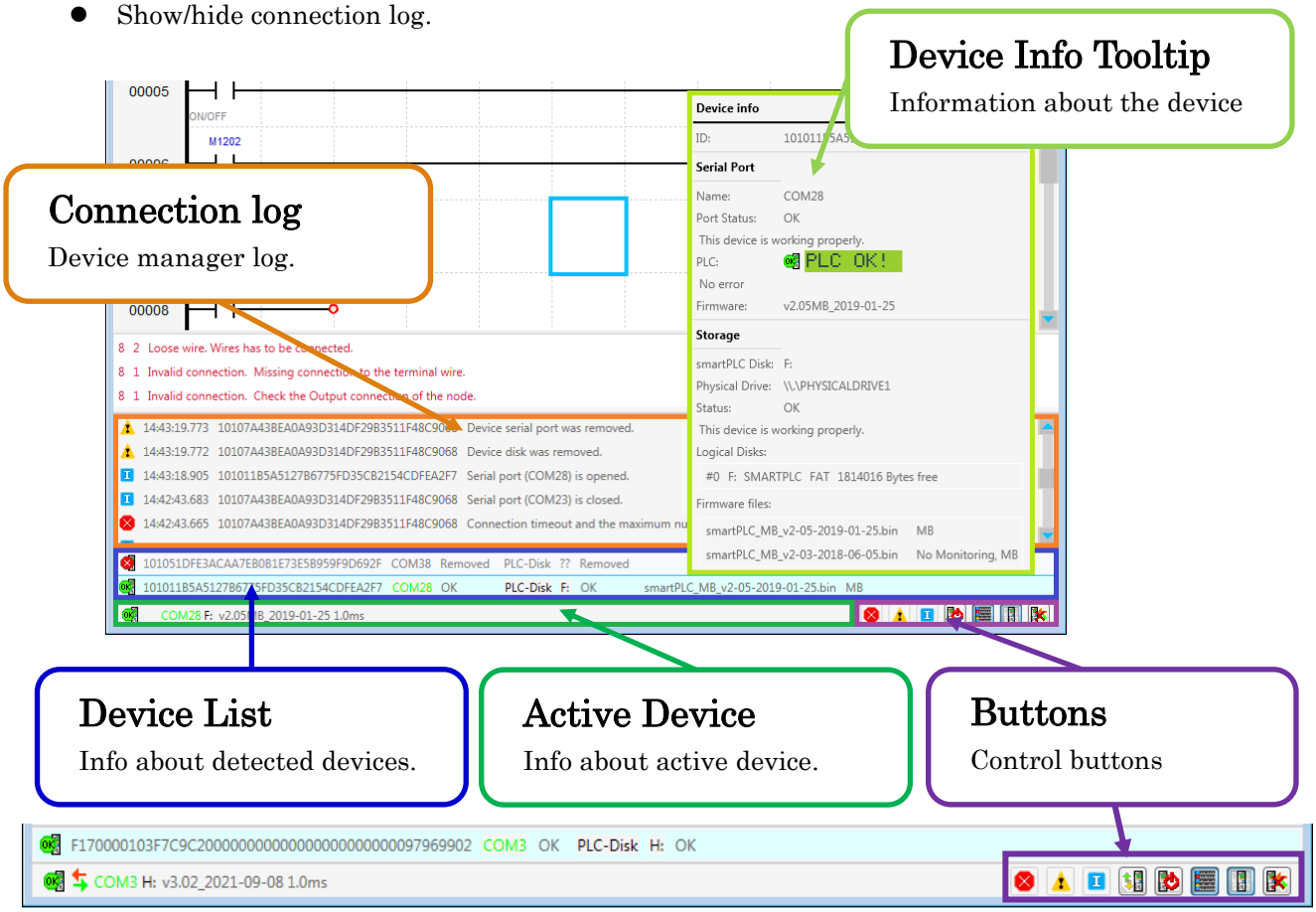
Loose wire mark
Indicates loose wire.



2-5 Device Manager

Device manager have following functions:

- Show information about an actually selected/active device, which is used for monitoring or editing.
- Select/connect to a device. Disconnect from the active device.
- Show/hide information about devices which were detected during an application run.
- Show/hide connection log.



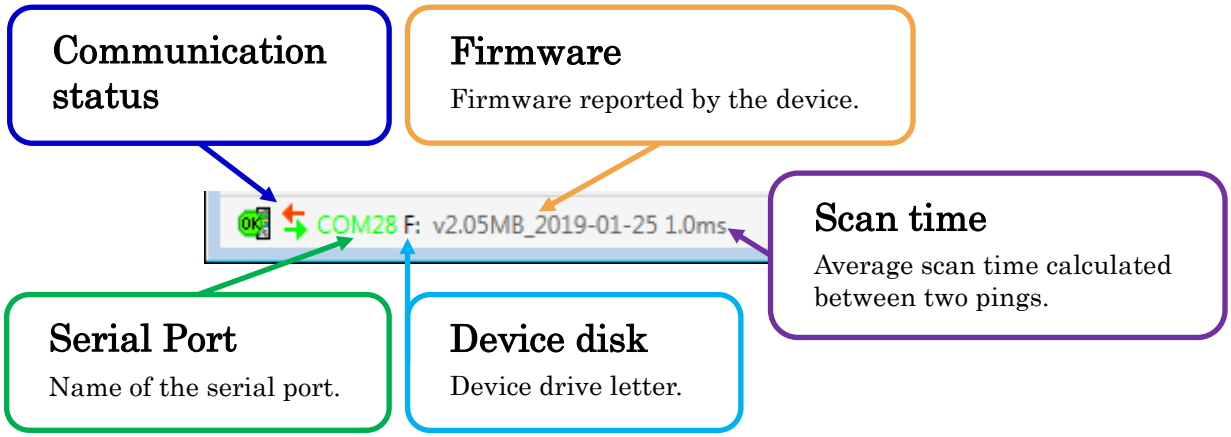
Icon	Name	Function
	Error Filter	Show/Hide Error logs
	Warning Filter	Show/Hide Warning logs
	Info Filter	Show/Hide Information logs
	File Manager	Opens file manager for smartPLC v3.
	Device Reset!	Reset active smartPLC.
	Logs	Show/Hide a list of logs
	Device list	Show/Hide a list of detected devices
	Stop	Stop communication with the device.

2-5-1 Select/activate device

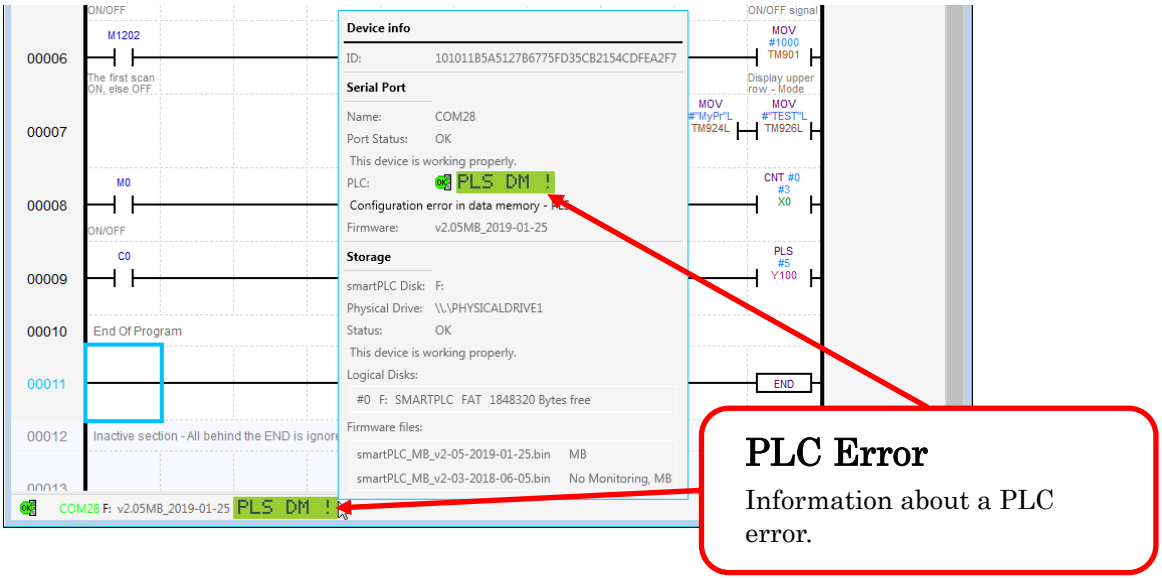
- Show device list by clicking on
- Select a device by the left click on its row in the device list.

2-5-2 Active device and communication status

The smartPLC firmware version 2.05 and higher is required for the communication between FS Ladder v2 and the smartPLC. RUN-STOP switch has to be in RUN position.



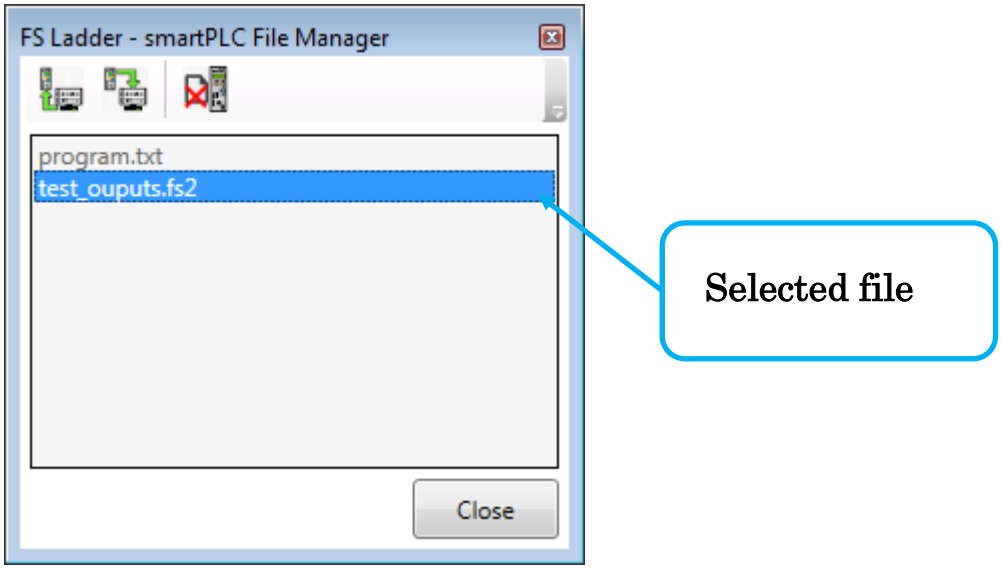
Icon	Meaning
	Communication with the device is okay.
	Communication with the device is having problems.
	Communication Error. No response after several attempts or continually receiving invalid data from the device. Check RUN-STOP switch. It has to be in RUN position.
	Serial port is closed.
	The device is not supporting a monitoring. It has old firmware.
	The device is unknown. Not a smartPLC or the device is not correctly configured (missing firmware file, wrong volume name, smartPLC is not running and so on)
	Reset request sent to the device, waiting for its reboot.
	An indicator of a sending data to the device.
	An indicator of a receiving data from the device.



2-5-3 File Manager for smartPLC v3

Open file manager by clicking on in device manager or press [Ctrl + Shift + ~].

Note: The file manager can be activated only when smartPLC v3 is selected.



Icon	Name	Function
	Upload File to Device	Upload file from PC to the device.
	Download File from Device	Download the selected file from device to PC.
	Delete File from Device	Delete the selected file from device.

File manager is designed to transfer small files (a few kilobytes) as are ladder files and program.txt. Transfer of larger files will take a very long time, because the priority is not the transfer speed, but the scan time of smartPLC. When uploading to device the file with the same name in device is automatically rewritten. File names should contain only Basic Latin (ASCII) characters.

2-5-4 Missing Device in the device list

In case when a device does not appear in the list check following.

- Is a USB cable connected to the smartPLC and the other side of the same cable is connected to the PC USB port?
- Is the USB cable damaged? Is it working with another device?
- Are the system USB drivers installed and working correctly?
- Is Mbed Serial Port driver (virtual serial port over USB) correctly installed (1 - 2 - 1 Preparing for installation).
- Can you see “mbed Serial Port” (with COM number) in Windows Control Panel→Hardware and Sound→Devices and Printers?

2-6 File operation

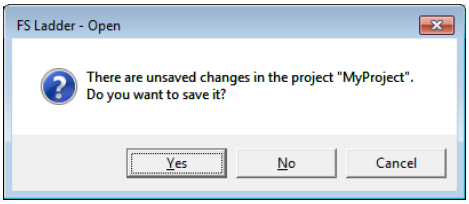
A description of the commands related to file operation

2-6-1 Create a new file

- Click on "New" or press [CTRL + N] to create a new file.
- When you working with a file that has not been saved, a confirmation screen will be displayed asking whether to save the file.

2-6-2 Open a file

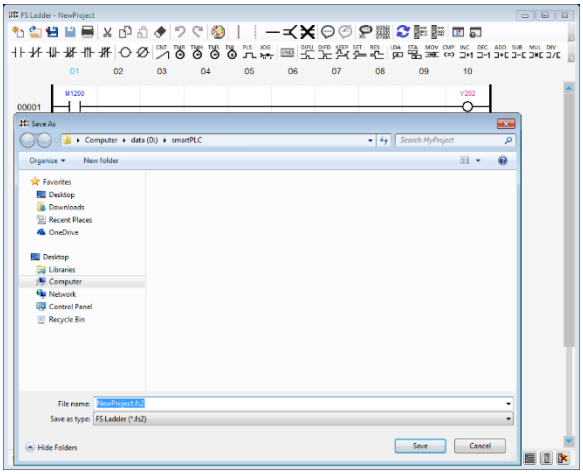
- Click on "Open" or press [CTRL + O] to open a saved file. An Open file dialog where you can choose the file will be displayed.
- When you working with a file that has not been saved, a confirmation screen will be displayed asking whether to save the file.

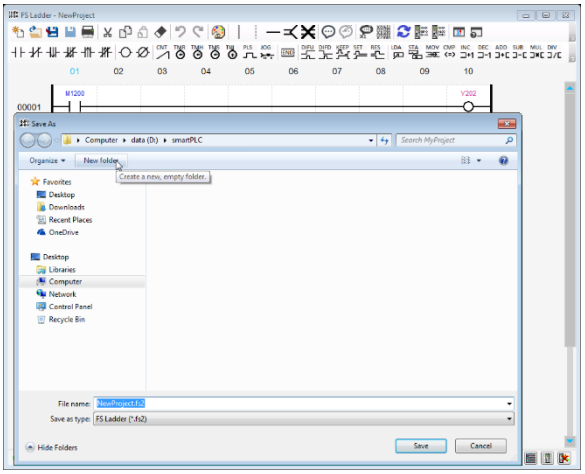


2-6-3 Save as

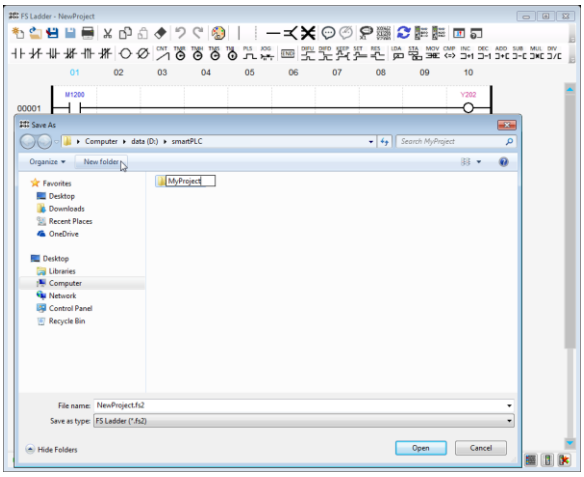
"Save As" can be used to create a project folder in the document folder and save the file with the ladder diagram in it.

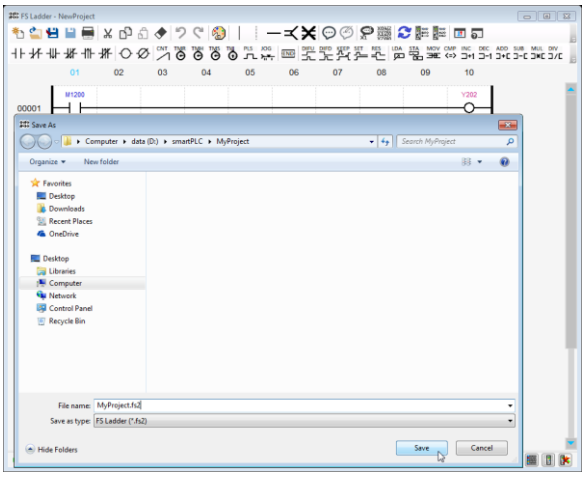
1. Click on "Save As" or press [CTRL + S] to save the file with a new name. A Save As file dialog where you can choose the file will be displayed.
2. Click on "New Folder".





3. Give a name to the created project folder.
4. Open the project folder, edit a file name and save.



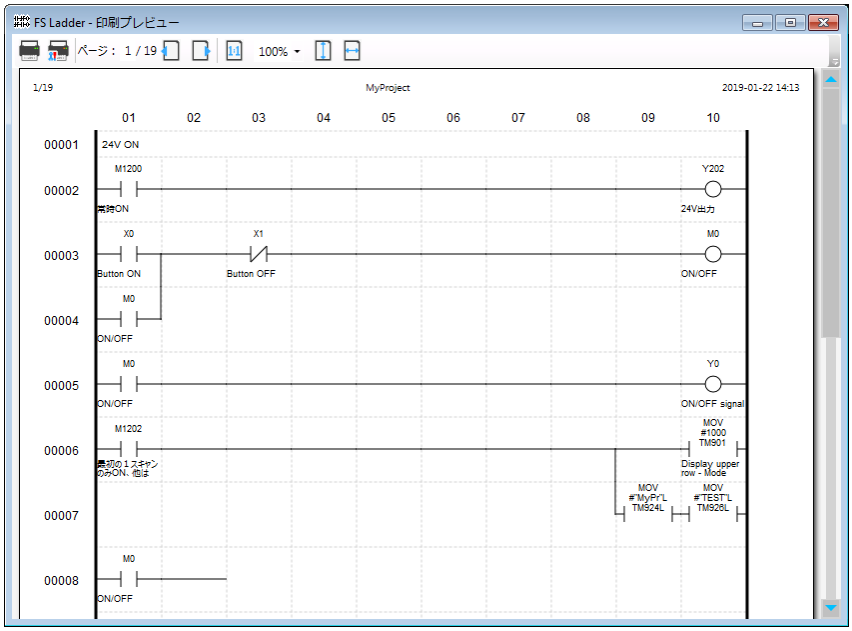


2-6-4 Save

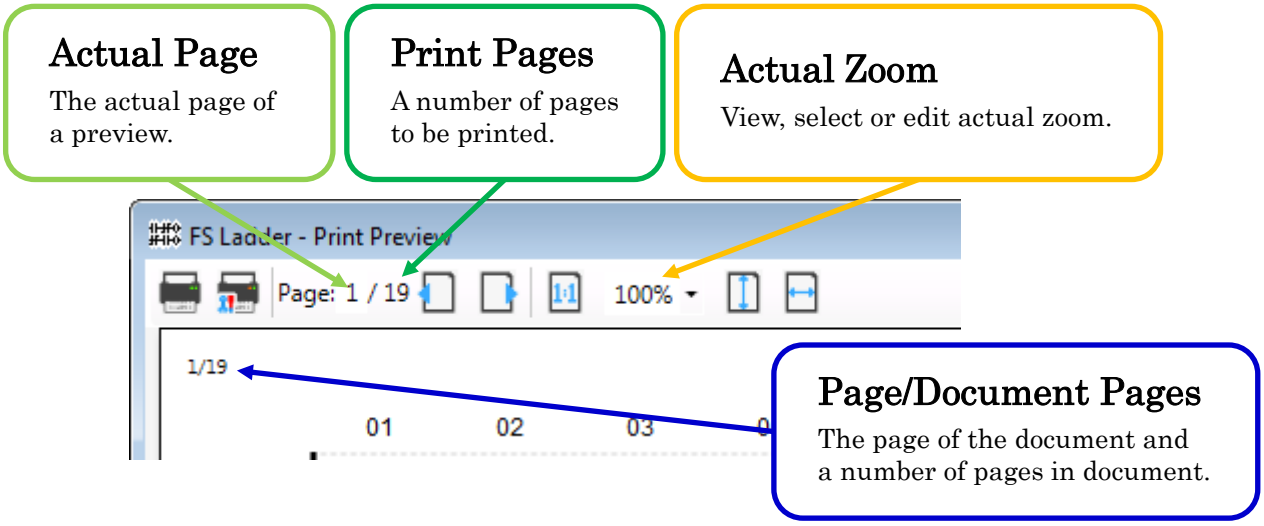
- Click on "Save" or press [CTRL + Shift + S] to save the file. Previous content of the file will be overwritten. When save is finished icon become inactive .
- "Save" is inactive if you are editing a new file or if you haven't done any changes to the opened file.

2-7 Print Preview and Printing

- Click on "Print Preview" [CTRL + P] to show window with print preview of a ladder diagram.



Icon	Name	Function
	Print	Print on default or preset printer
	Print Settings	Show print settings dialog window.
	Previous Page	Go to previous page.
	Next Page	Go to next page.
	Zoom 100%	Set zoom to 100%.
	Fit to Page Height	Toggle fit to page height.
	Fit to Page Width	Toggle fit to page width.

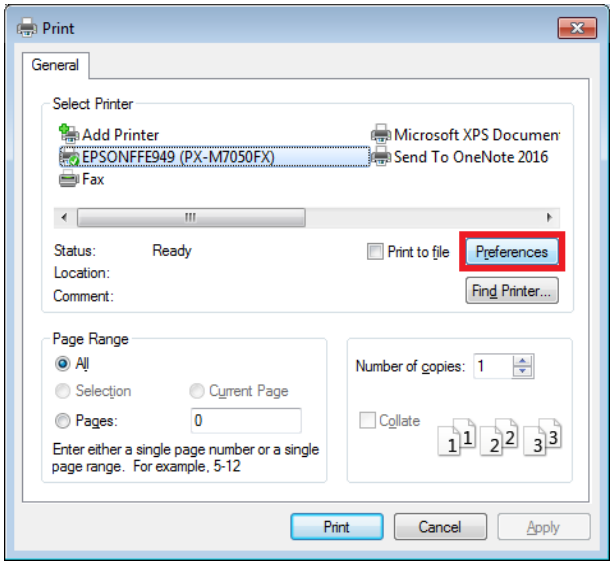


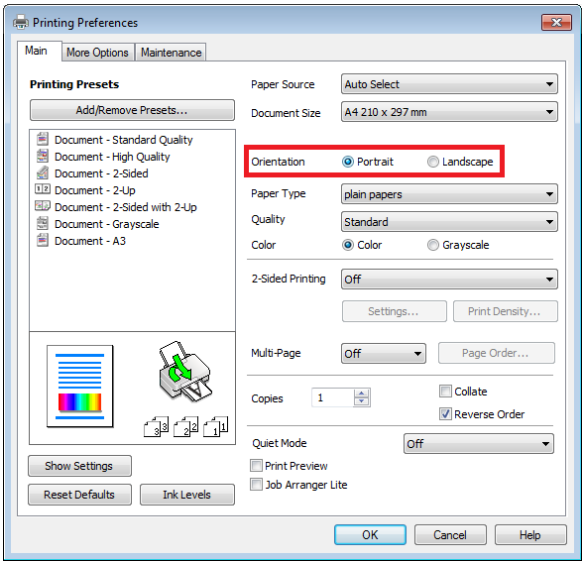
- Click and edit the actual preview page for fast navigation in documents with many pages.
- The actual print page and the preview document page can be different. This is because it can be set which pages to print in the print settings dialog.

2-7-1 Print Settings

- Click on "Print Settings" or press [CTRL + P] to open system print settings dialog window.

1. Select printer
2. In the preferences of the selected printer, you can choose an orientation of a printing (portrait or landscape).





3. Specify page range, number of copies, other detailed settings etc.
4. Press "Apply" to apply the changes.
5. Press "Print" to start printing or "Cancel" to return to print preview.

3 Creation of the Program

3-1 Basic workflow

The following steps shows a basic workflow from Ladder Diagram to smartPLC program execution.

Create a ladder diagram

・Create a ladder diagram using FS Ladder.

Save

・Save the ladder diagram with “Save As”.

Make a Program

・Create a mnemonic program file from the ladder.

Program update

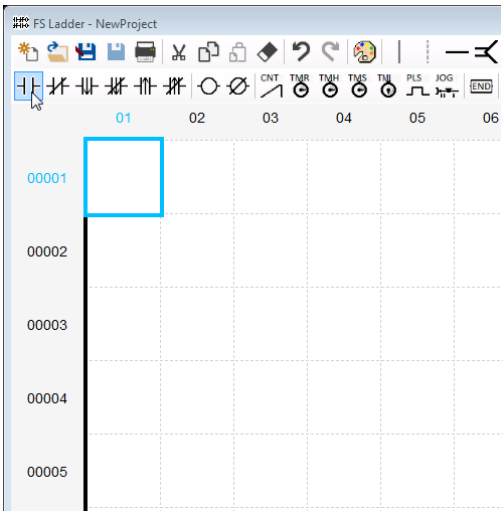
・Transfer the program file to the smartPLC.

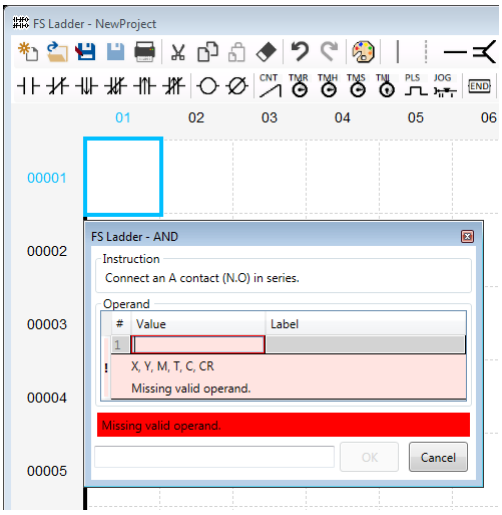
Program execution

・The program execution starts with a smartPLC restart.

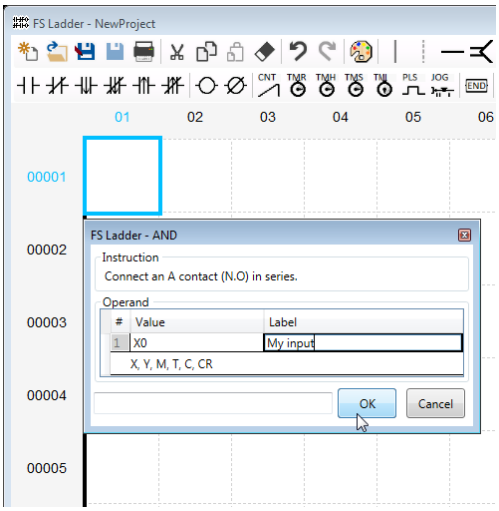
3-2 Inserting instruction block

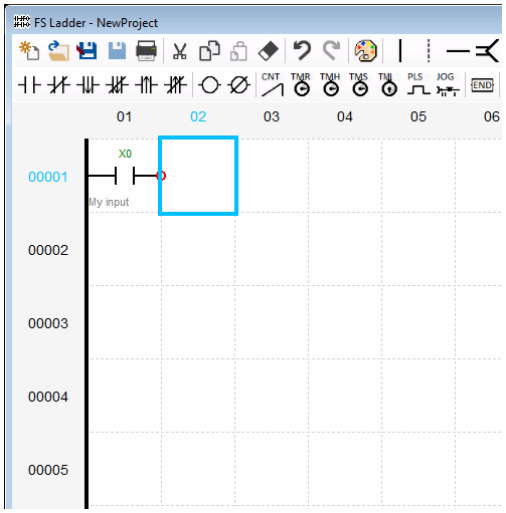
1. Click on a cell where you would like to insert an instruction block or move a cursor (the blue frame around the cell) with arrow keys.
2. Click on a required instruction block on the instruction block bar or press the shortcut of the block on the keyboard.





3. Set the operand values if any. You can also edit the labels of the operands.
   Notes:
   - The labels for numeric constants are disabled.
   - The error message in operand section is related to above operand and the error message above the "OK" button is related to the instruction.
   - The "OK" button is disabled if there is any error. In case of no errors including warning the button will be enabled.
   - You can see valid operand types for the operands in the operand description.
   - The first operand type is default, so if you start writing a number, the operand type will be automatically inserted.
   - The edit block before the "OK" button can be used to insert a block comment. If the block comment is inserted it will be displayed instead of operand comment. To remove the block comment just delete text in the edit box.
4. Press OK to insert the instruction block.

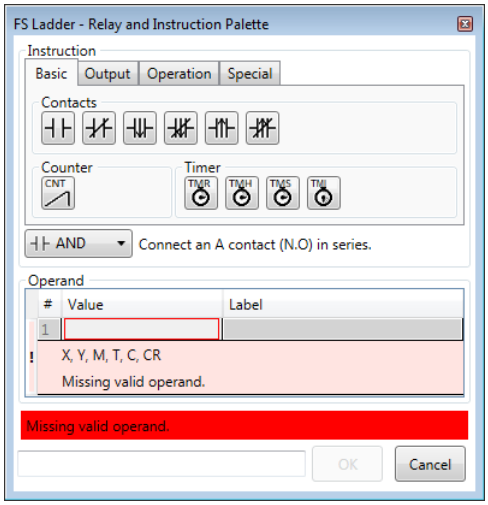




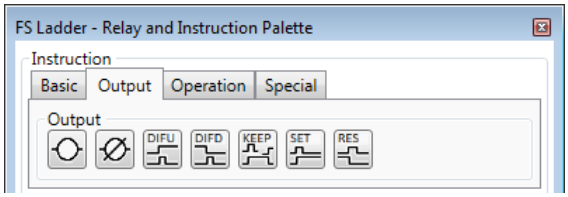
3-3 Relay and instruction palette

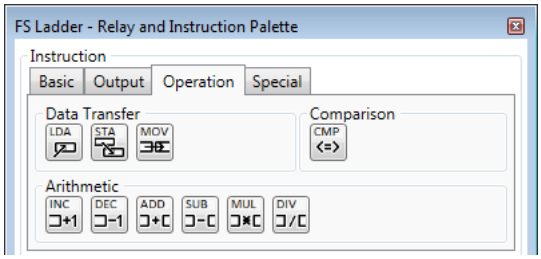
The palette dialog window allows you to choose a required instruction block.

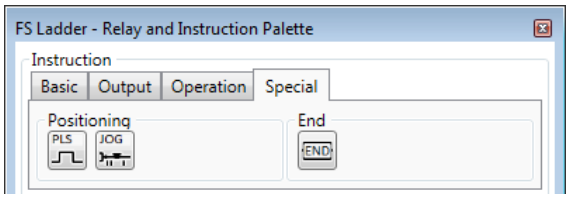
- Instruction blocks are split into groups (basic, output, operation, special).



- By selecting the tab label, the tab area will switch to appropriate group as shown below.





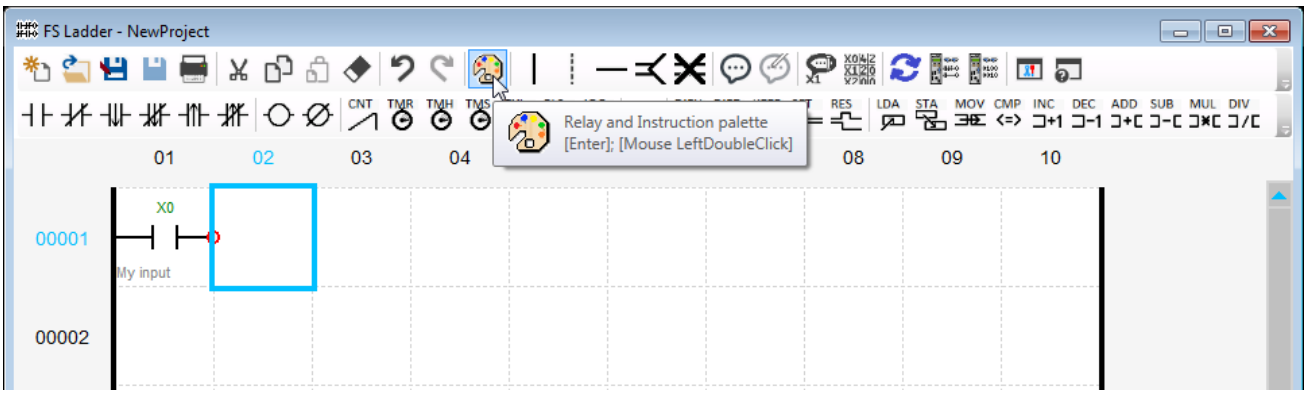


3-4 Usage of the palette

Steps to insert a block instruction to the ladder diagram using the relay and instruction pallet.

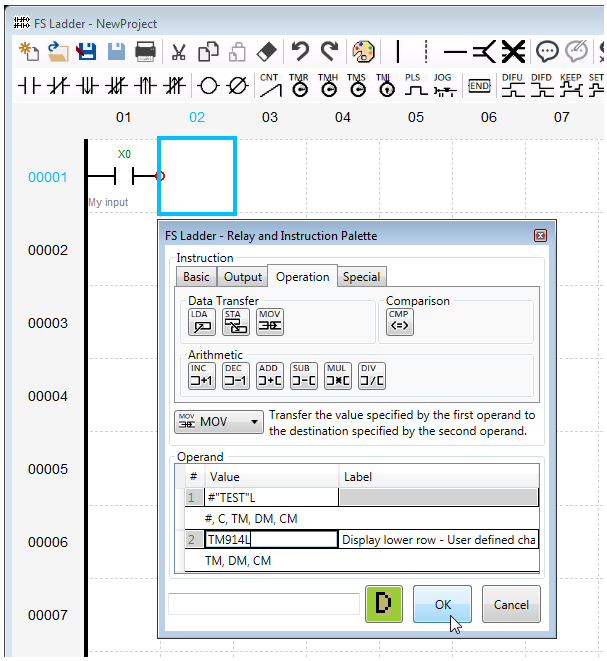
1. Click on a cell where you would like to insert an instruction block or move a cursor (the blue frame around the cell) with arrow keys.

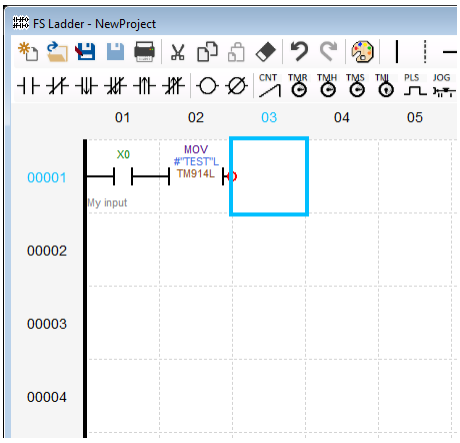
2. Click on "Relay and Instruction Palette" on the instruction block bar or press [Enter] key or double click on the block where to insert instruction.



3. Choose the required instruction type and click on it. Set the operand values if any. Edit the operand labels if needed.
   Notes:
   - Behavior operand editing and error checking is the same as when you inserting block. (refer to 3-2)
   - When operands are edited and afterwards is the instruction changed, the operand values are kept. If the instruction with less operands is selected, only applicable number of operands is kept, the rest is lost.

4. Press OK to insert the instruction block

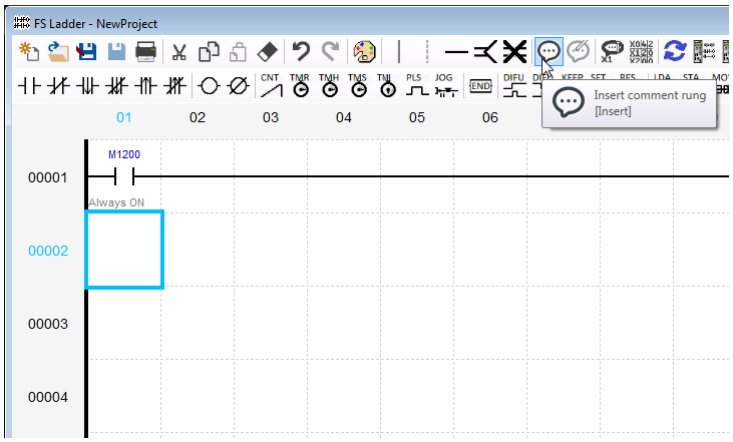


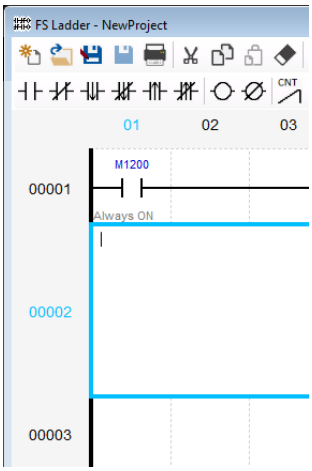


3-5 Comment Rungs

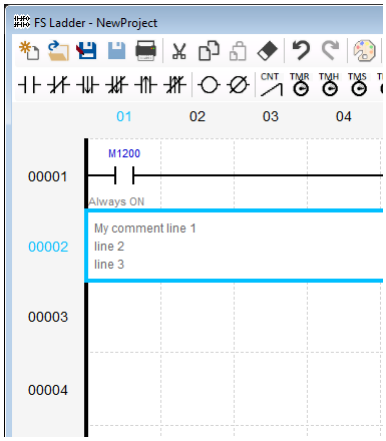
Steps to insert a comment rung.

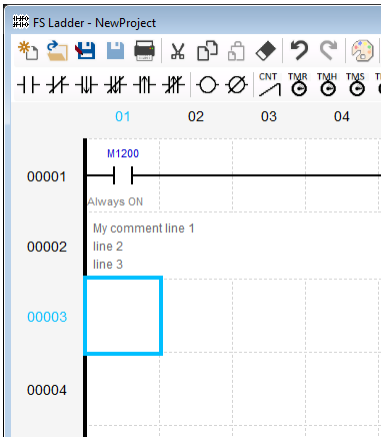
1. Move the cursor (by clicking or by arrow keys) to a row or to a comment line beneath the place where you would like to insert a comment line.
2. Click on the or press the [Insert] key.





3. Edit your comment.
   - Press the [Enter] key for new line (up to 8 lines of text is allowed).
   - Press [Ctrl + Ender] or click outside textbox to finish editing.
   - Press [Esc] to cancel editing.
4. Use arrow keys or mouse click to move cursor to next block.





Notes:

- You can select a comment line by clicking on it.
- For fast navigation between comments use [Ctrl + ↑] or [Ctrl + ↓].
- To edit already inserted comment
  - move cursor on it and click on or press the [Enter] key.
  - double click on it with left mouse button.
- To remove already inserted comment, move cursor on it and click on or press the [Delete].

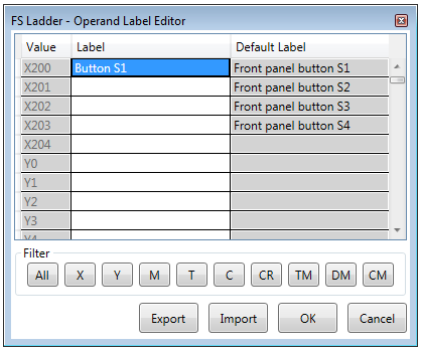
3-6 Edit labels of operands

Steps to edit labels of operands.

1. Open the operand label editor by clicking on or press [F3] key.
2. There are two ways how to edit labels in the editor.

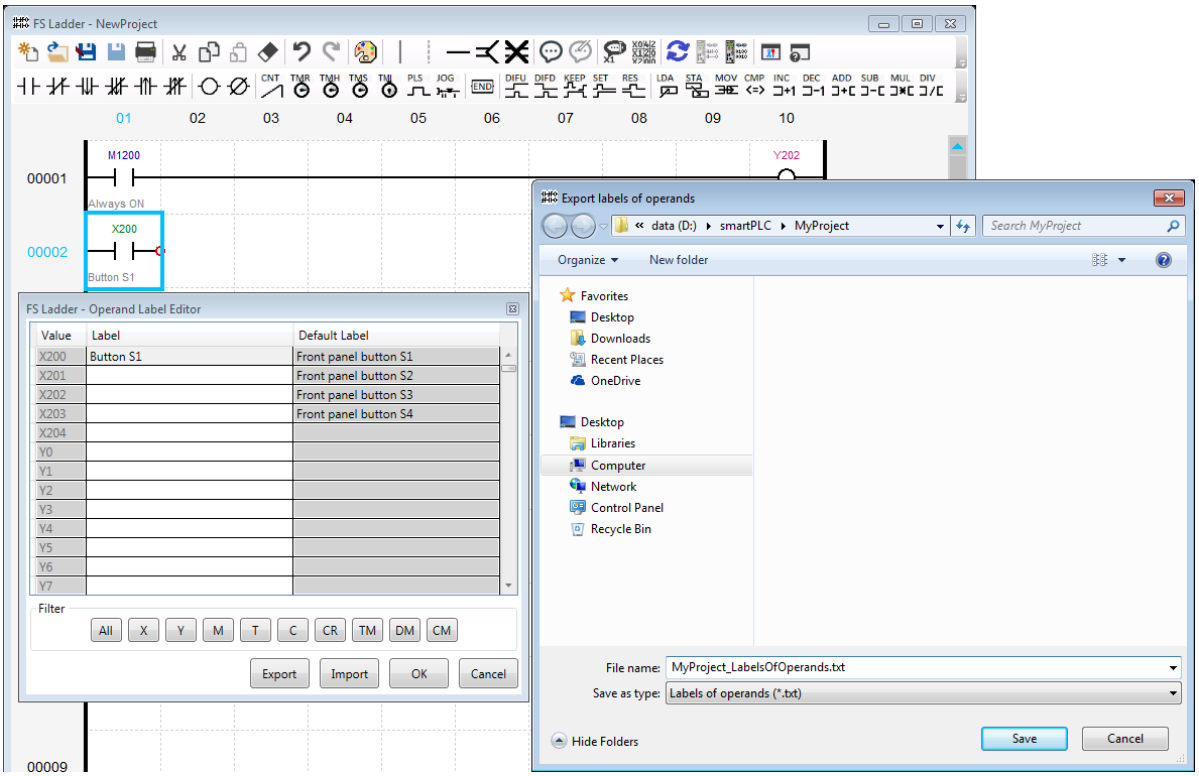
   I. Edit the requested operand label in data grid.

   - You can use the operand type filter to reduce view to requested operand type.
   - Default labels are used when the label is not set.
   - In opposite to the labels, the default labels automatically change according to selected language.



   II. Export, Edit, Import

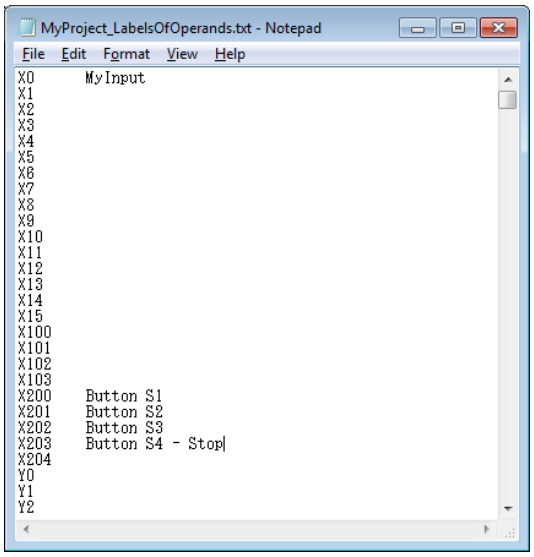
   ① Use the Export button to export the labels of operands.



② Edit the file.

The file format is simple Unicode text file. Operand name is separated by tabulator from its label. One text line can consist only one operand name with its label. Make sure that the editor supports Unicode text and also it does not replace tabulators with spaces.

As long as the file format will be kept any text editor or Microsoft Excel can be used to edit it.



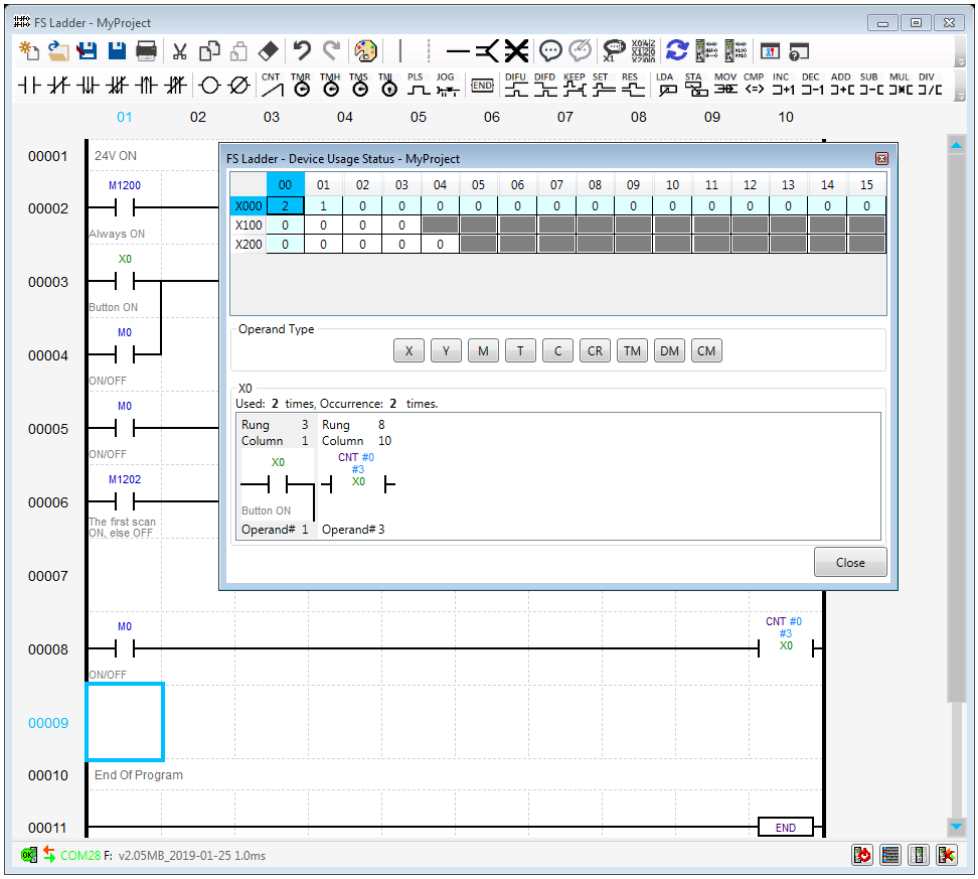
③ Use the Import button to import the labels of operands from the edited file.

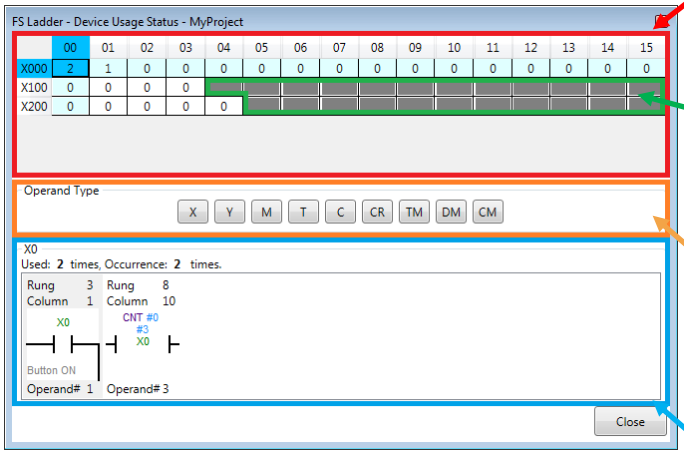
All lines of a text file with an invalid format are ignored without warning, so check the file format if nothing has been imported.

3-7 Device Usage Status

The usage status of the device informs you about device elements (relay, timer, data memory, etc.) used as operands in the program.

- Open the device usage status window by clicking on or press [F2] key.





Usage

Number of active uses.

Invalid

Nonexistent device elements (invalid operands)

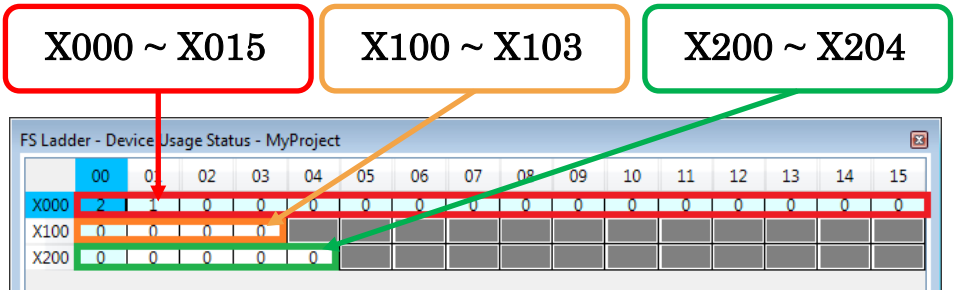
Operand type

Selection of an operand type.

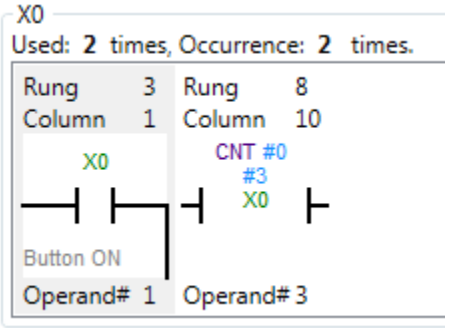
Operand info

Information about selected operand including block view.

- The number in the table indicates the number of active uses of the operand (the concrete part of the device facility).



- Operand information shows blocks in which is the operand used. It can also be used for the fast navigation in the ladder diagram. By clicking on the block in the list, the cursor will move to the block in the ladder diagram.



Notes:

- An occurrence is the sum of active usage count and inactive section usage count.
- 32bit operand generates usage for two 16bit operands. For example, TM0L is usage of TM0 and TM1.

3-8 Character Display

- You can display any character of display font (Alphabet, numbers, katakana, symbols) on the display.
- You can display a total of 16 letters, 8 letters on the upper row and 8 letters on the lower row of the display.
- Kanji cannot be used. FS ladder converts Hiragana and katakana full-width characters to katakana half-width characters.
- Characters from a row are split in groups of 2 or 4 characters. Each of the groups is saved in one 16bit or 32bit (two 16bit registers) special register in temporary memory.
- **Escape character**
  The escape character is backslash [\] on English keyboard or halfwidth “en” character [￥] on Japanese keyboard, it has 8bit code 92 (5Ch). There is no backslash [\] character in display font, the “en” character [￥] will be displayed instead.
  To write a Double Quotation Mark ["] an escape character has to be used before the character [\"] (or [￥"] in Japanese environment).
  To write the [￥] character use two backslashes [\\] (or [￥￥] in Japanese environment).

Display characters in relation to temporary memory (16bit access)

TM924	TM925	TM926	TM927
"CH"	**"AR"**	**"#0"**	**"13"**
TM914	TM915	TM916	TM917
"ｹﾞ"	"ｰﾑ"	"\\\""	"1\""

Display characters in relation to temporary memory (32bit access)

TM924L	TM926L
"CHAR"	**"#013"**
TM914L	TM916L
"ｹﾞｰﾑ"	"\\\"1\""

Procedure to display characters defined in TM memory (TM914L, TM916L and TM924L, TM926L)

① Set TM900 (or TM901) the display mode selection to 1000

② Specify characters in the TM memory with MOV or LDA + STA instructions

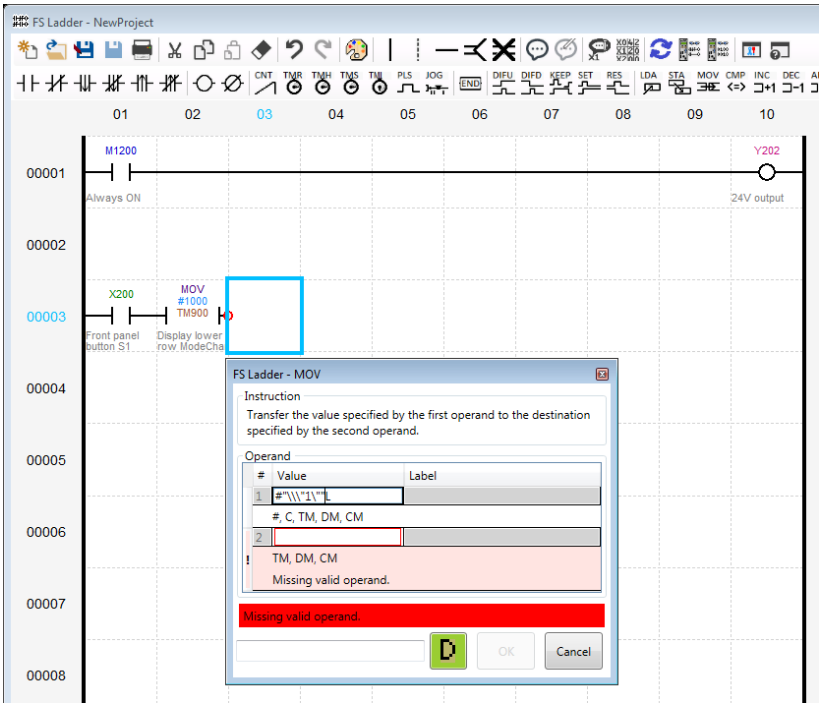
Concrete methods are explained in the following sections.

For more details on the topic, please refer to smartPLC user's manual.

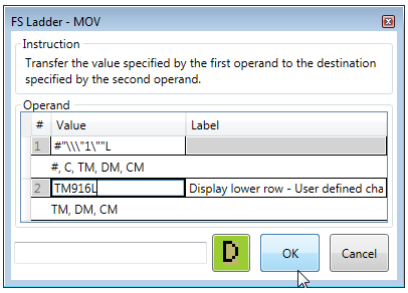
3-8-1 Character input from keyboard

Example: Display letters on the right side of the lower row of the display

1. Set TM900 (lower row display mode selection) to 1000 (user defined character)
2. Insert MOV instruction. For example, as the first operand enter #\\\"1\"" (or #"￥￥￥"1￥"" in Japanese environment).

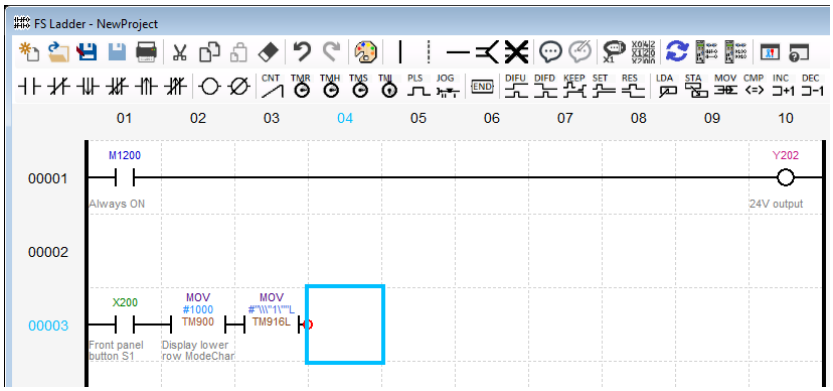


3. Enter the TM916L register for the right side of the lower row of the display (do not forget L) → click on OK.



4.

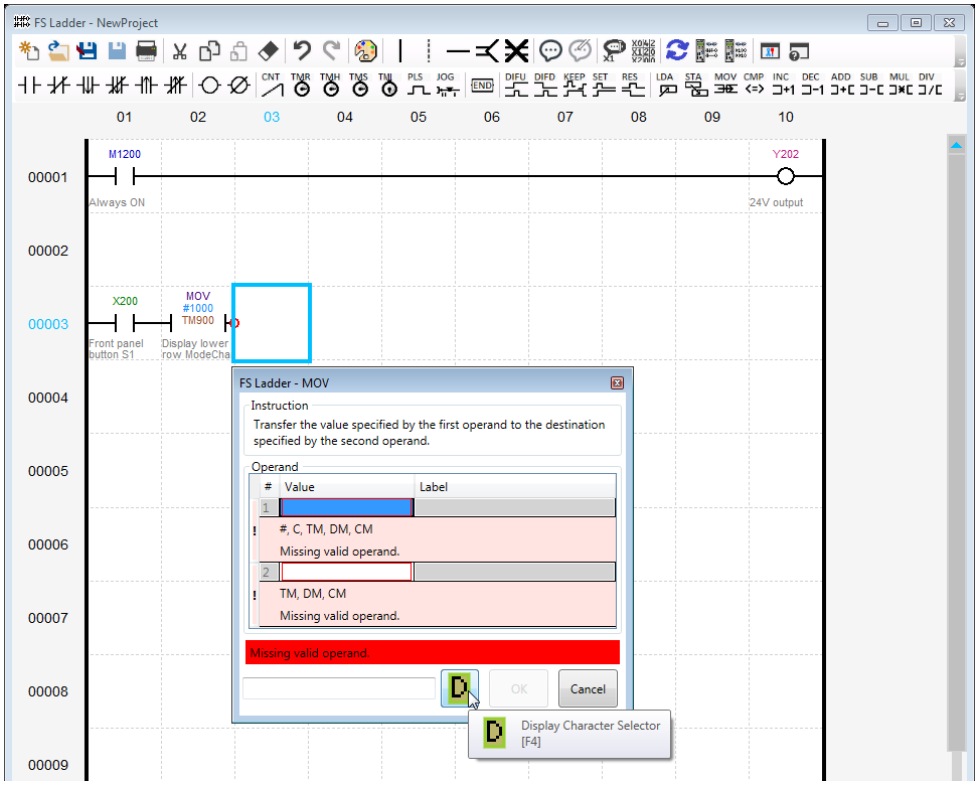
will be displayed on the right side of the lower row of the smartPLC display when the program is executed.



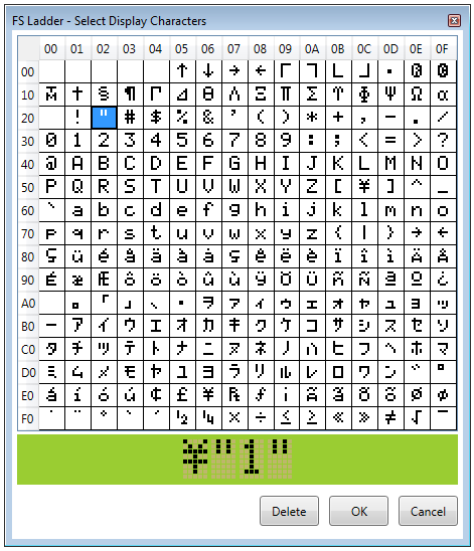
3-8-2 Character input by display character selector

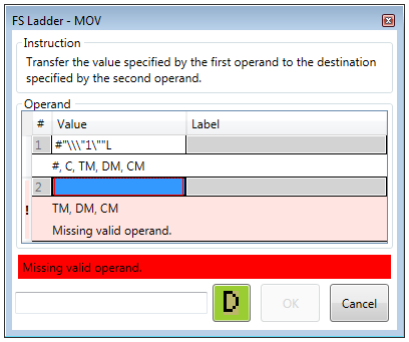
Example: Display letters on the right side of the lower row of the display

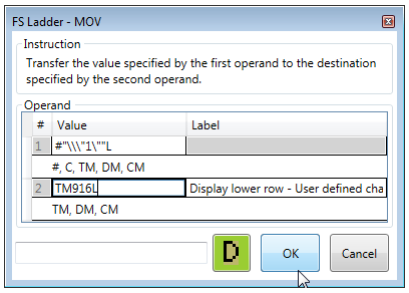
1. Set TM900 (lower row display mode selection) to 1000 (user defined character)
2. Insert MOV instruction. Click on “Display Character Selector” or press [F4]



3. A table with all display characters appears.
4. Click on the characters to be displayed in required order → click on OK. If you need to change character just, click "Delete" to remove last character and after click on the correct character.
5. Enter the TM916L register (do not forget L) → click on OK.



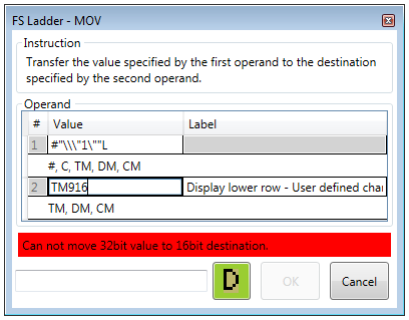




3-8-3 32bit → 16bit error

If you forget to attach "L" next to TM916 as shown below, an error message will be displayed and OK button will be disabled, because a 32bit number (here it is represented by 4 display characters) does not fit to a 16bit number.

To fix the error add 'L' to the end of TM916 → TM916L.



3-8-4 2 characters input

If you do not specify L at the end of the TM register number, the 16bit access will be used.

Display characters in relation to temporary memory (16bit access)

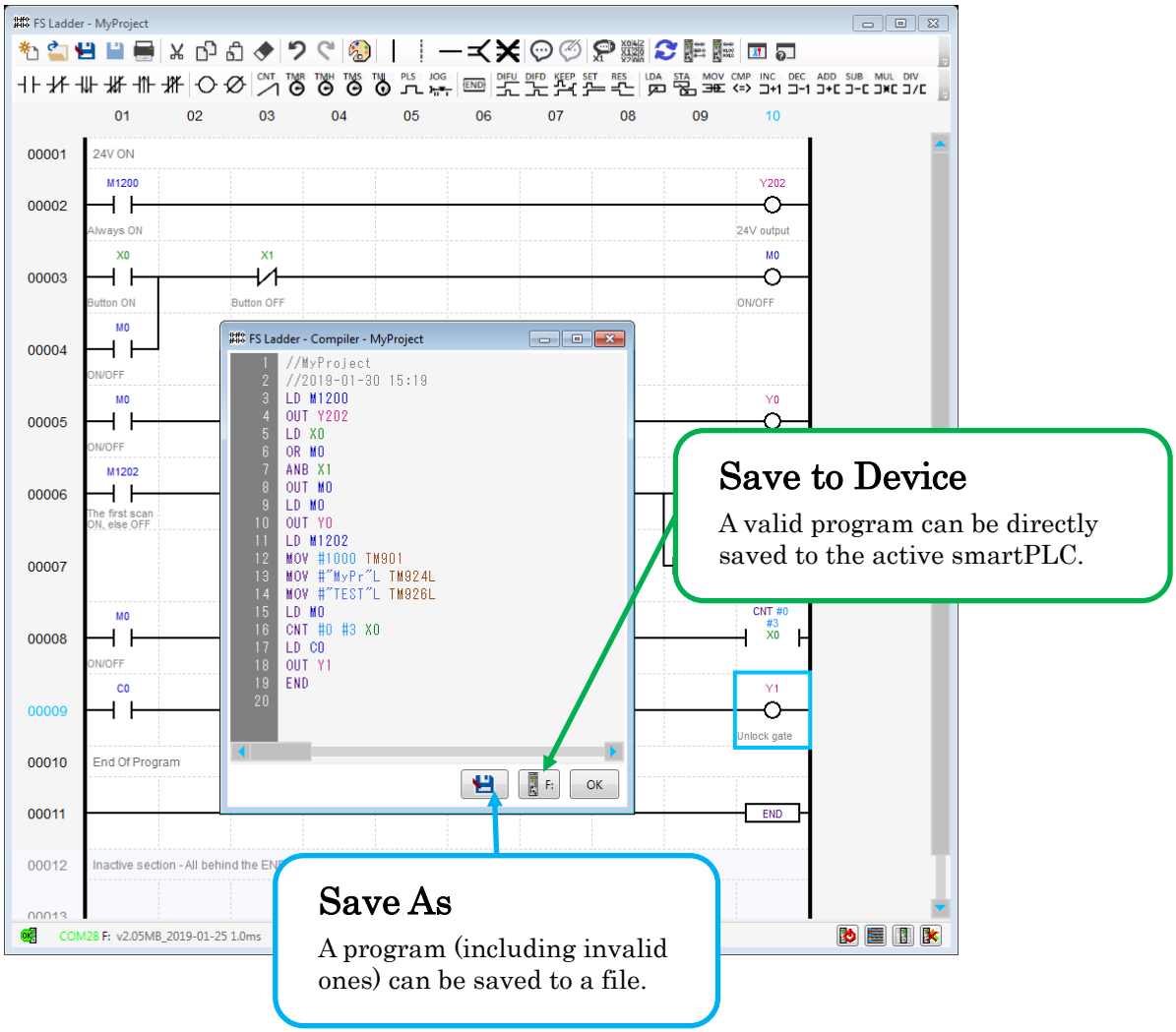
TM924 "CH"	TM925 "AR"	TM926 "#0"	TM927 "13"
TM914 "ｹﾞ"	TM915 "ｰﾑ"	TM916 "\\\""	TM917 "1\""

By using TM914 to TM917 and TM924 to TM927 without specifying L at the end of TM, it is possible to change two display characters at a time.

3-9 Make a Program

When you finish a ladder diagram you will need to save it as a mnemonic program which is readable by the smartPLC.

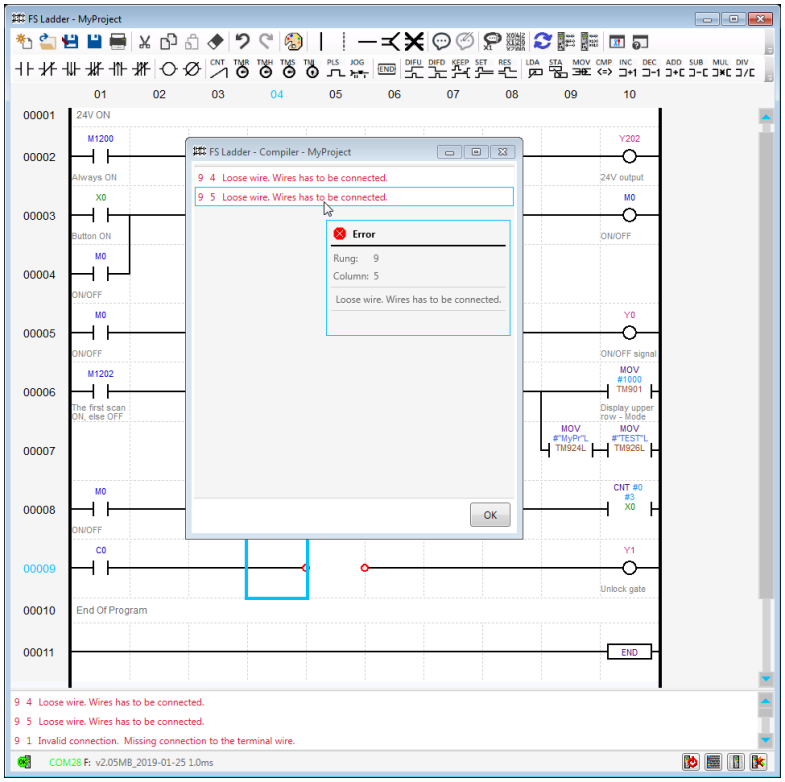
- Click on placed on the tool bar or press [F5] key.

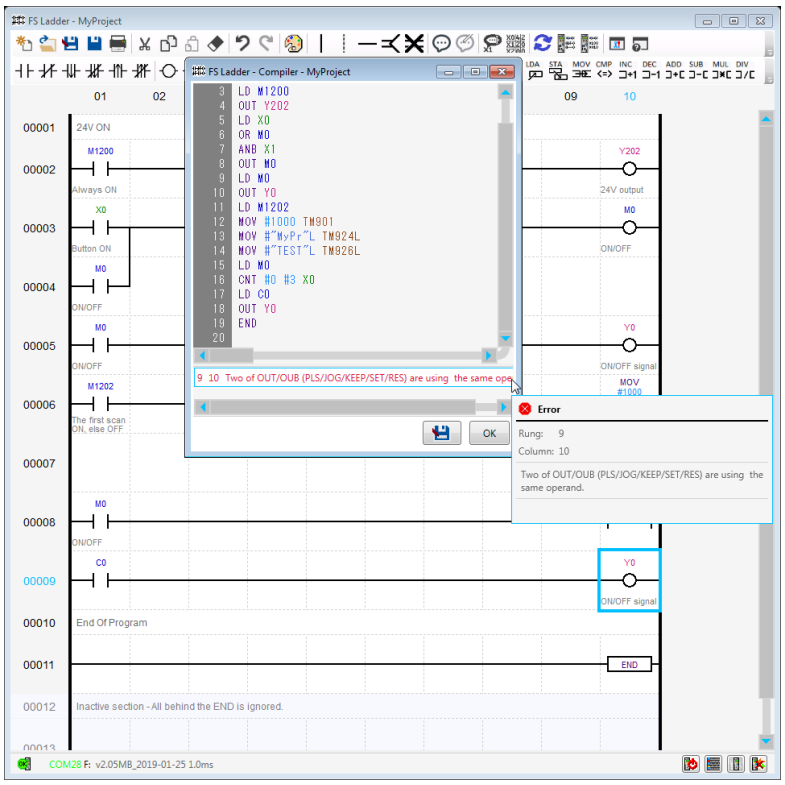


- "Save As" offers a default file name "program.txt", because SmartPLC executes only a user program with the file name "program.txt".
- Button "Save to Device" appears only if following conditions are met
  - ✓ A compiled program has no errors.
  - ✓ smartPLC is connected by USB cable and is selected and actively connected by Device Manager (refer to 2-5)
  - ✓ smartPLC v2 USB Mass Storage Device is working properly and is ready to use. It has to have a Volume Name "SMARTPLC". SmartPLC v3 does not use USB Mass Storage.
- When saving to the smartPLC v3 a previous program is overwritten.
- When saving to the smartPLC v2 a previous program is automatically renamed to a file name matching following pattern program_YYMMDD_HHmmss_fff.bkp
  - ➢ YY – year, MM – month, DD – day

- HH – hours (24), mm – minutes, ss – seconds
- fff – milliseconds

- In case of an invalid program a list of errors will be displayed. When you click on the line with the error text the cursor will move to the related block.





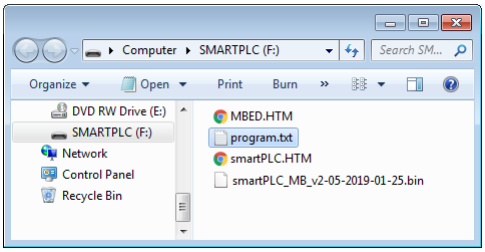
4 Run the program

This chapter explains how to run the program on the smartPLC.

4-1 Connection between smartPLC v2 and computer

You can change the program of the smartPLC v2 from a PC via USB.

When you connect the smartPLC with a personal computer with the included USB mini cable. The smartPLC drive will be recognized by the operating system (Windows7 or 10).



The following files are stored in the smartPLC virtual drive.

File name	Description
smartPLC*.bin	Firmware, * represents version v2 version, xx subversion, YYYY-MM-DD build date
smartPLC.HTM	smartPLC homepage, download site
program.txt	Mnemonic program
MBED.HTM	Mbed microcontroller home page

Note:

- There are two versions of firmware smartPLC_v2*.bin and smartPLC_MB_v2*.bin, because there are two versions of the main board. A blue one uses the smartPLC_MB_v2*.bin firmware. When updating a firmware, just keep in mind that *_MB_* version has to be replaced by another *_MB_* version, and smartPLC_v2*.bin with smartPLC_v2*.bin.

About MBED.HTM

SmartPLC uses the Arm Mbed IoT Device Platform developed by ARM, UK. Therefore, the Mbed home page MBED.HTM (English) is saved on the smartPLC drive. There is no problem opening the link, but Mbed and smartPLC are not related.

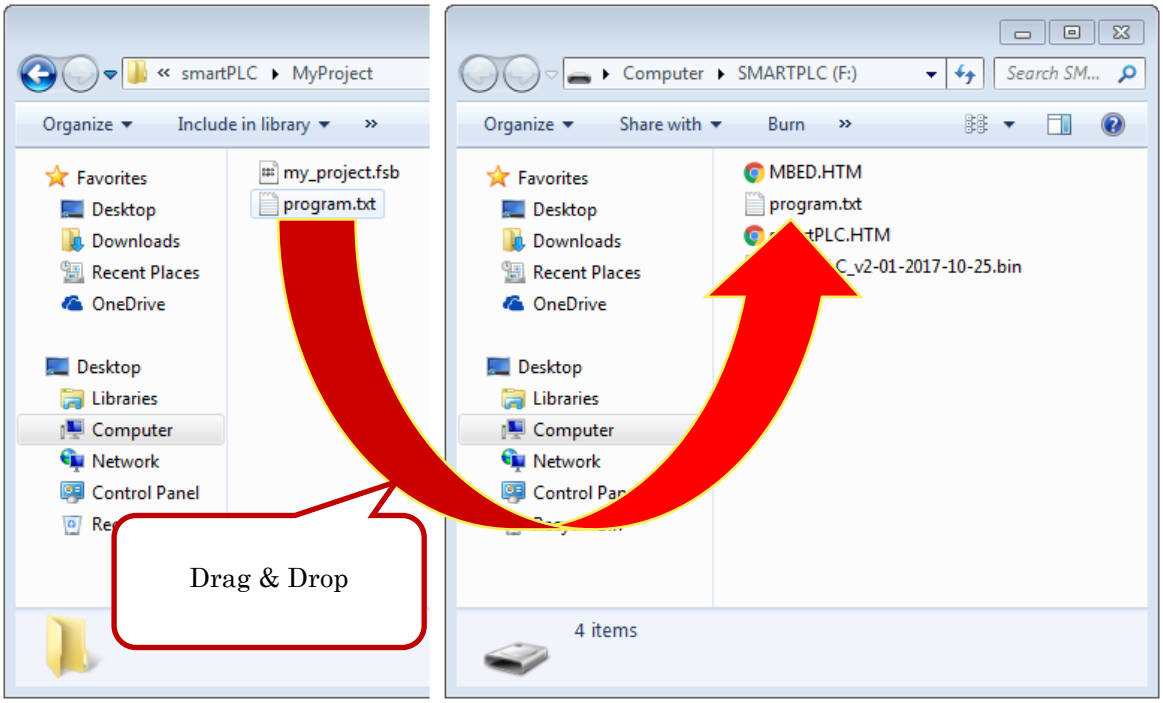
Please **DO NOT** ask about smartPLC at Mbed or ARM web pages or contacts.

* Mbed is a registered trademark of ARM, UK.

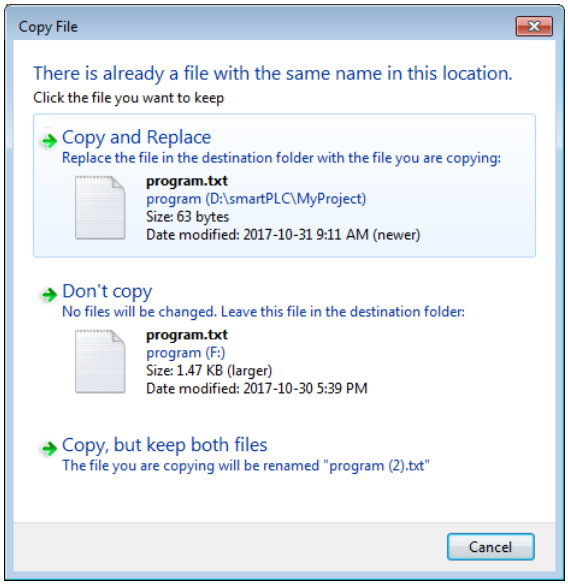
4-2 Copy the program to the smartPLC v2

If there is a previously created a mnemonic program saved on the disk drive. It can be copied to the smartPLC.

1. Open the project folder where program.txt is saved.
2. Connect the smartPLC v2 to the personal computer with a USB cable.
   Open the "SMARTPLC" drive.
3. Copy the program.txt from the project folder to the SMARTPLC drive.



4. If the program.txt already exists on the SMARTPLC drive, a following dialog box will be displayed. Select "Copy and Replace" to overwrite a previous program with the new one.

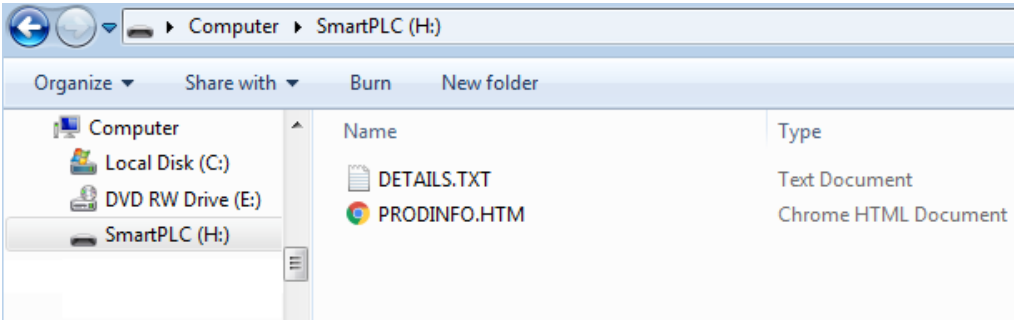


4-3 Connection between smartPLC v3 and computer

You can change the program of the smartPLC v3 from a PC via USB.

When you connect the smartPLC v3 with a personal computer with the included USB mini cable. The smartPLC drive will be recognized by the operating system (Windows7 or 10).

The smartPLC v3 virtual drive cannot store any files, it can be used only for updating smartPLC firmware.



Following files are on the smartPLC virtual drive.

File name	Description
DETAILS.TXT	DAPLink Firmware information, https://armmbed.github.io/DAPLink/
PRODINFO.HTM	smartPLC homepage, download site

4-4 Copy the program to the smartPLC v3

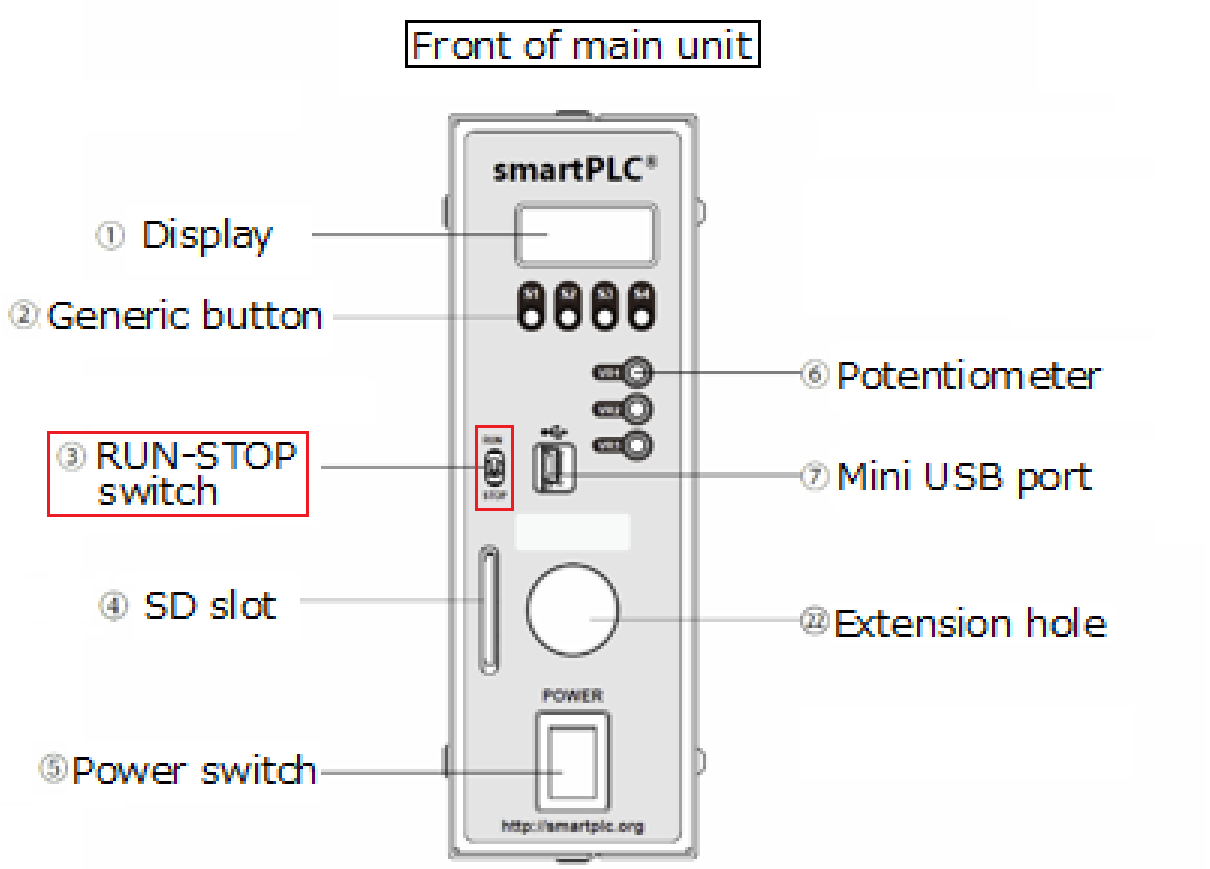
There is a file manager (2 - 5 - 3 File Manager for smartPLC v3) build in the FS Ladder v2.01.

1. Open file manager by clicking on in device manager or press [Ctrl + Shift + ~].
   Note: The file manager can be activated only when smartPLC v3 is selected.
2. Click on Upload to Device icon or press [Ctrl + U]
3. In file dialog select program.txt you would like to upload and press Open.

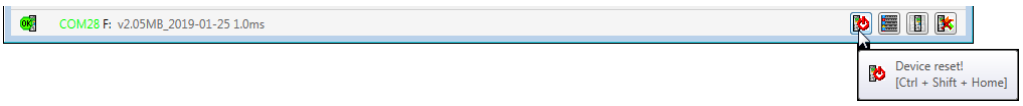
Note: The files with the same name are automatically overwritten.

4-5 Execute the program

- Manual reset with a RUN-STOP switch.
  1. Turn on the power switch of the smartPLC.
  2. Read the program with [RUN →] STOP → RUN on the RUN - STOP switch SW on the front of the main body of the smartPLC and start the control.



- Reset with the Device Manager



5 Device Monitor

Device monitor allows display and edit internal registers of smartPLC.

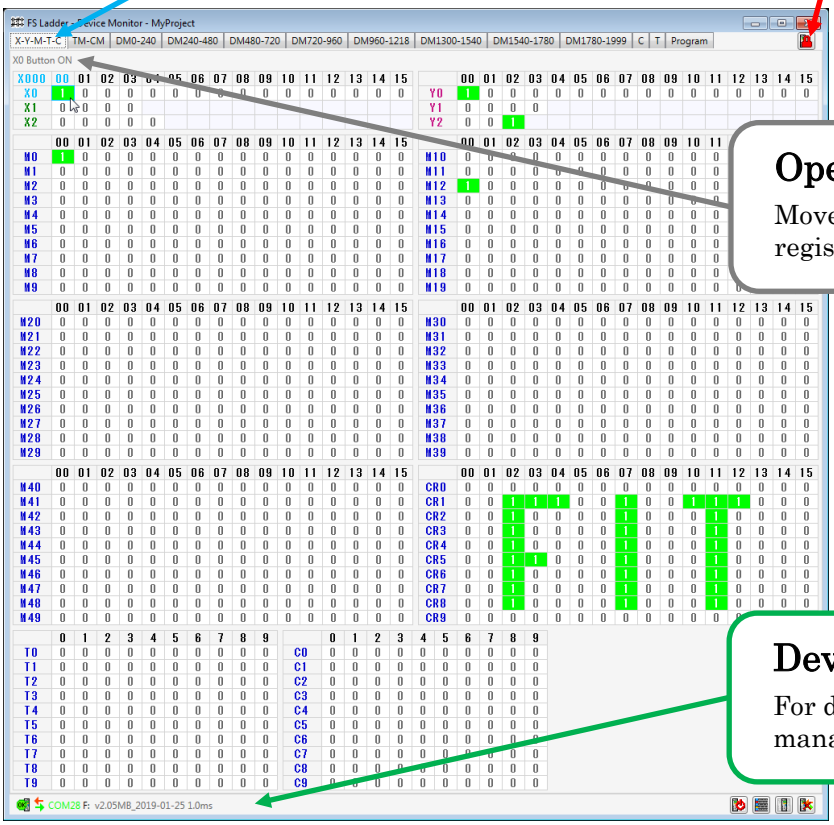
- Click on placed on the tool bar or press [Ctrl + F5] key.

Monitor Group

Select tab with a group of registers to monitor.

Edit Mode Lock

Enable or disable an edit mode. **Be careful!**



Operand Label

Move mouse cursor over a bit register to see its label.

Device Manager

For details the about device manager refer to 2 - 5

Tab Name	Description
X-Y-M-T-C	Monitor bit registers of input relays X, output relays Y, internal auxiliary bit memory M (including special registers), timers T, counters C and control memory CR
TM-CM	Monitor temporary memory and control memory registers.
DM*	Monitor data memory. (* stays for the range)
C	Monitor value and bit registers of counters
T	Monitor value and bit registers of timers

16bit registers

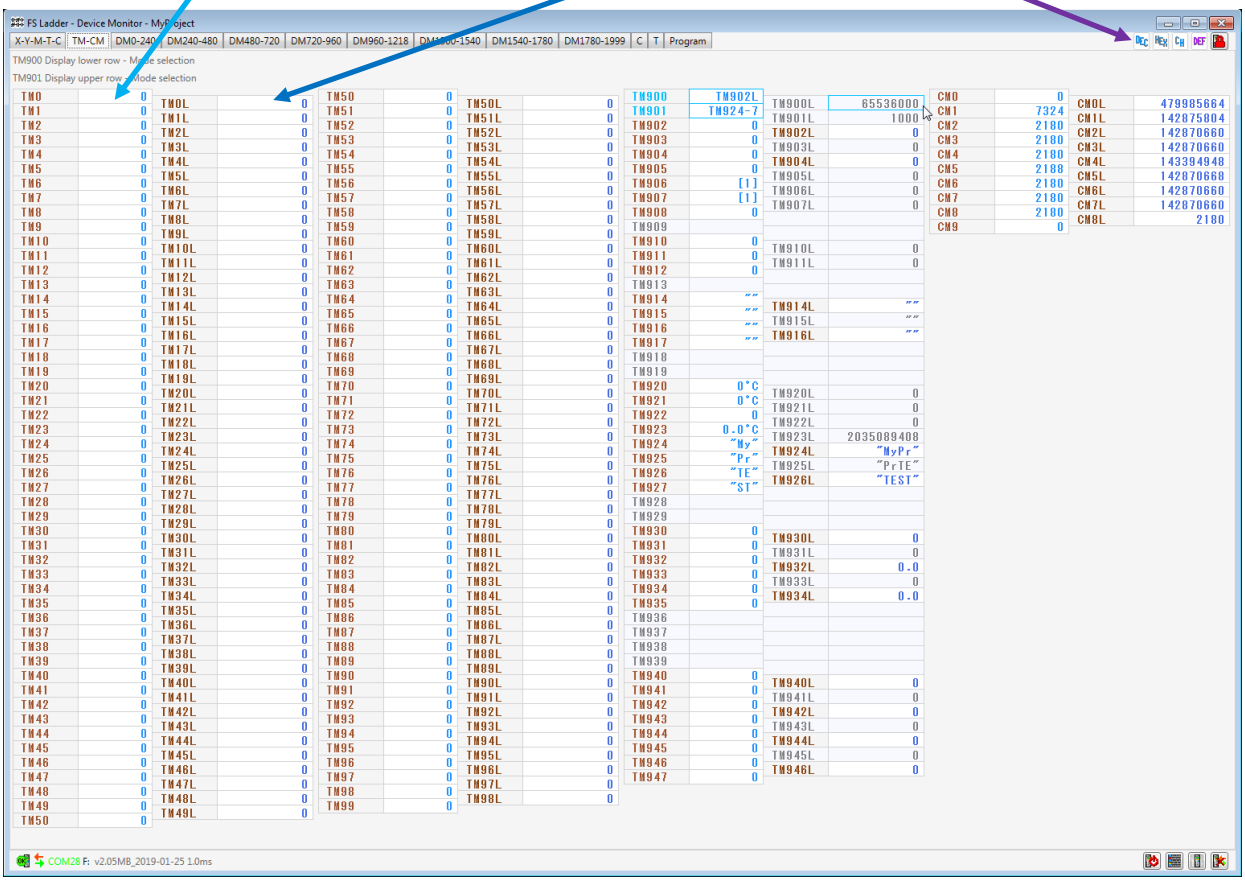
16bit values of registers

32bit registers

32bit values of registers

View mode

View mode buttons



5-1 View mode of 16bit and 32bit registers

There are several view modes for 16bit and 32bit registers. The view mode can be changed for each register individually by mouse right clicking on the register. By using view mode buttons DEC HEX CH, the view can be changed for all registers (except the individually set ones and some of special registers).

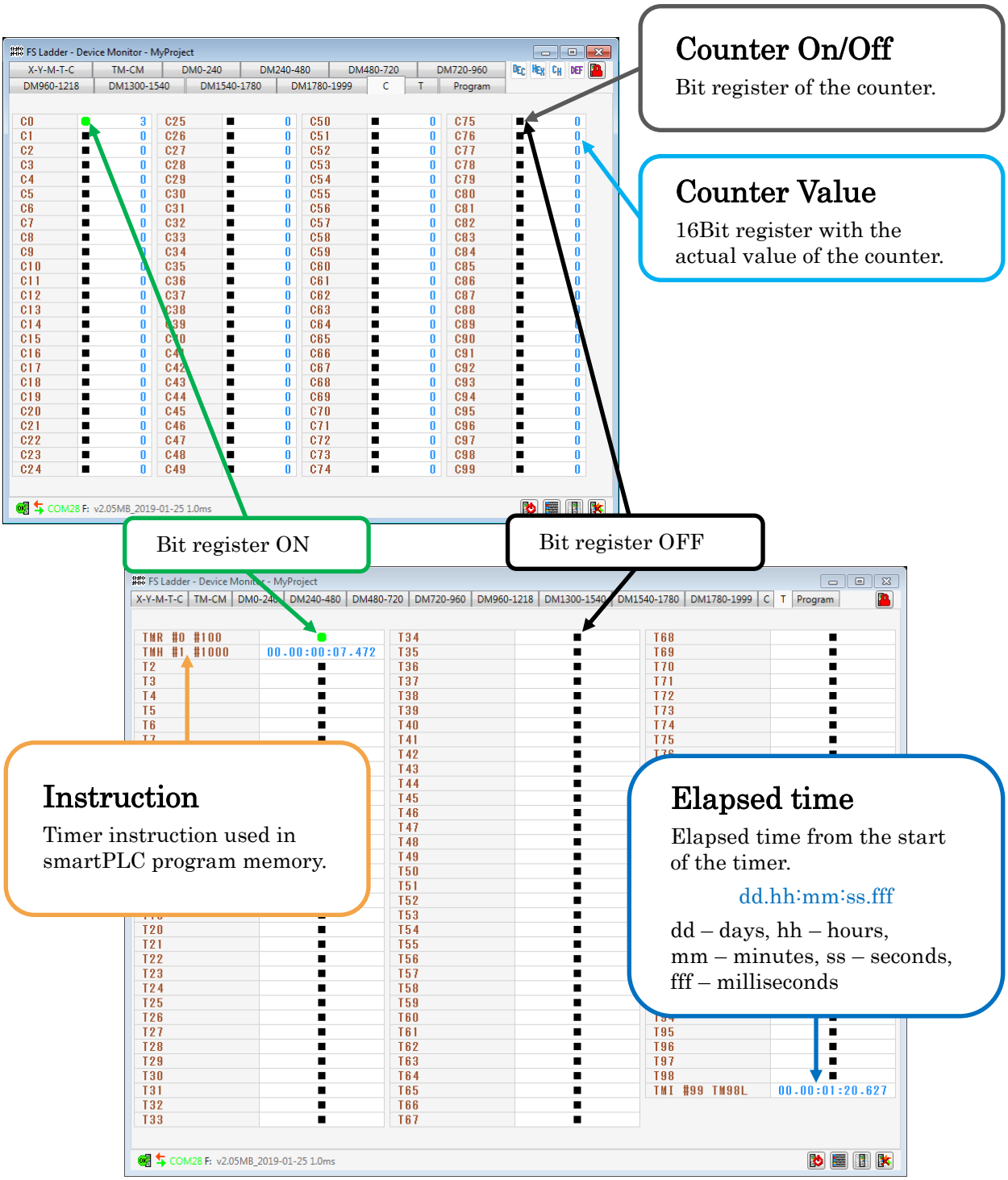
Icon	View Name	Function	Example TM901
DEC	Decimal	View registers as decimal values.	1000
HEX	Hexadecimal	View registers as hexadecimal values.	0x03E8
CH	Character	View registers as character values.	#"ƒ "
DEF	Default	Set default view mode to all registers without exceptions.	TM924-7
	Special	Some special registers have also its own special view mode.	TM924-7

Note TM901 is “Display upper row - Mode selection” and so when its value is 1000 then there will be displayed characters from registers TM924 to TM927 on the display upper row. If its value is 0 a value from TM904L will be displayed, for value 1 RUN will be displayed, and so on.

Registers can be also viewed as IP address (ex.: TM0 = .1.2, TM1 = 192.198., TM0L = 192.168.1.3.).

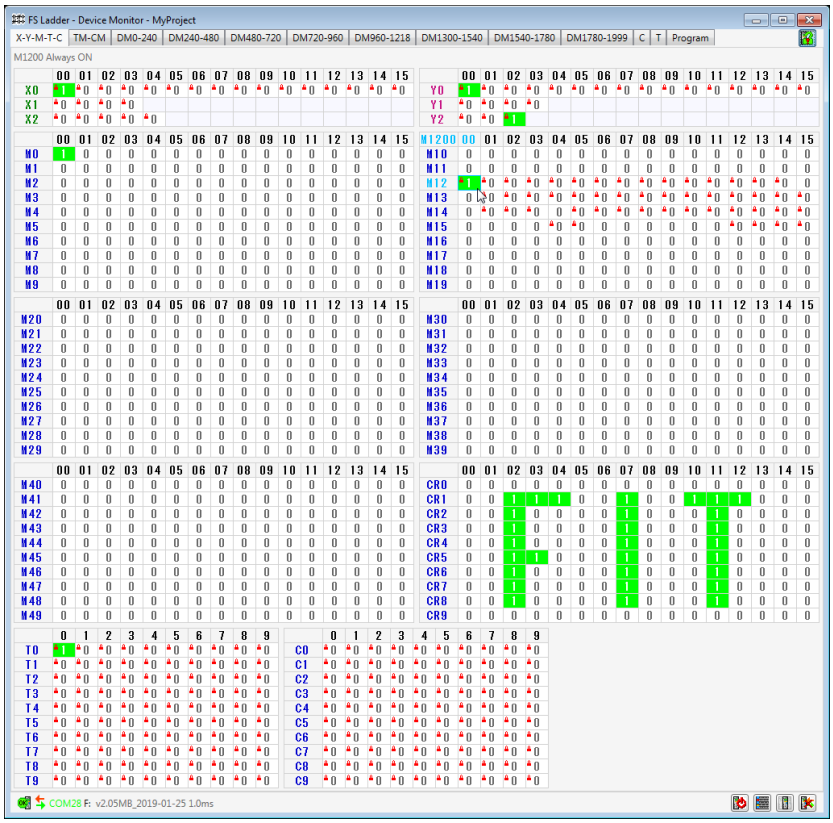
5-2 Monitoring timers and counters

Timers and counters have bit register which is indication if requested time or value was reached. Those bit registers can be monitored by clinking on the tab X-Y-M-T-C or on the tab T for timers and the tab C for counters. T and C tabs offers more information about the timers/counters.



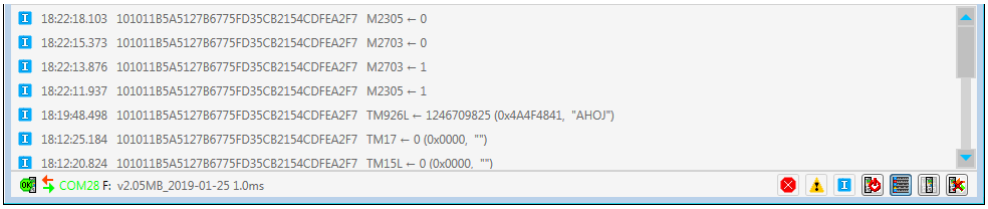
5-3 Edit mode

- Click on to activate Edit mode of Device Monitor. Read the warning message!
- Click on to deactivate the edit mode.



5-3-1 Fundamentals of Editing registers

- Registers marked with a lock symbol cannot be edited, because of conceptual or safety reasons.
- The edited value is set on the end of scan just before start of a new scan.
- The edited value is not forced, and so the program can change the edited register. The value can be changed only for a very short time (one scan) and so the change may be not visible in monitoring window. For this reason, the change confirmed by the device is logged in Device Manager Log.

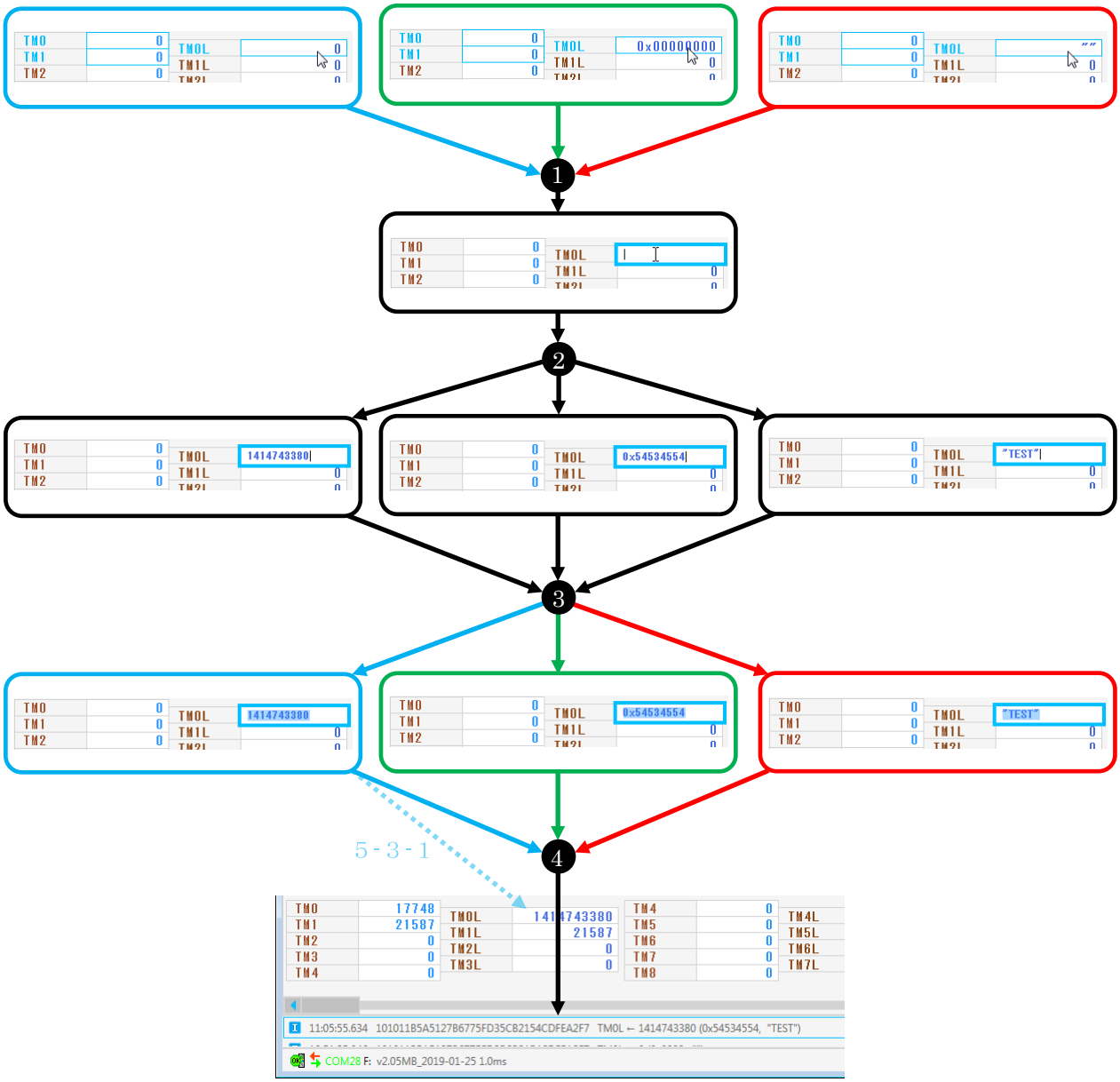


5-3-2 Editing bit registers

- A value of a bit register can be toggled by double clicking on it by the left mouse button.

5-3-3 Editing 16bit and 32bit registers

- Following workflow shows how to edit register



① Click by left mouse button on a register, which you would like to edit, and a text box will appear.

② Enter requested value in preferred format. Allowed formats are decimal, hexadecimal (starts with 0x), IP addresses (ex. 192.168.1.1) and characters (character string enclosed in double quotes).

- For inserting character, the Display Character Selector can be used. Press [F4] to activate it.

③ Press [Enter]. The entered value will change its format to the view format of the register and it will become selected.

- A view format can be temporarily changed by pressing [Ctrl + 1] for a decimal format, [Ctrl + 2] for a hexadecimal format or [Ctrl + 3] for a character format.

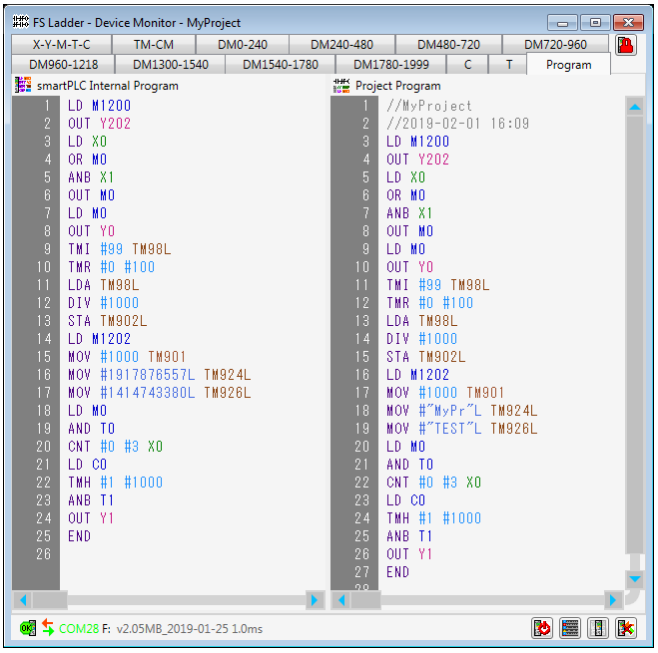
④ To set the value press [Enter], or to cancel press [Esc] or click outside the text box.
Refer to 5 - 3 - 1 to understand why the entered value may not appear.

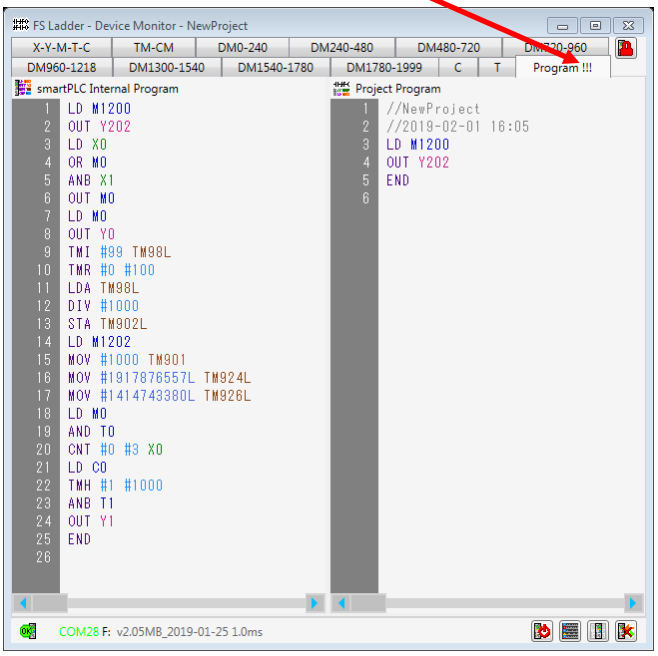
5-4 Program tab

- Program tab shows two programs. One is from smartPLC internal memory and the other one is compiled from the ladder editor.
- smartPLC Internal Program is decompiled from internal memory. It is actually running program, when there is not PLC error.
- Comment lines have no influence on program comparison.

!!!Different programs

!!! indicates different programs in ladder and smartPLC

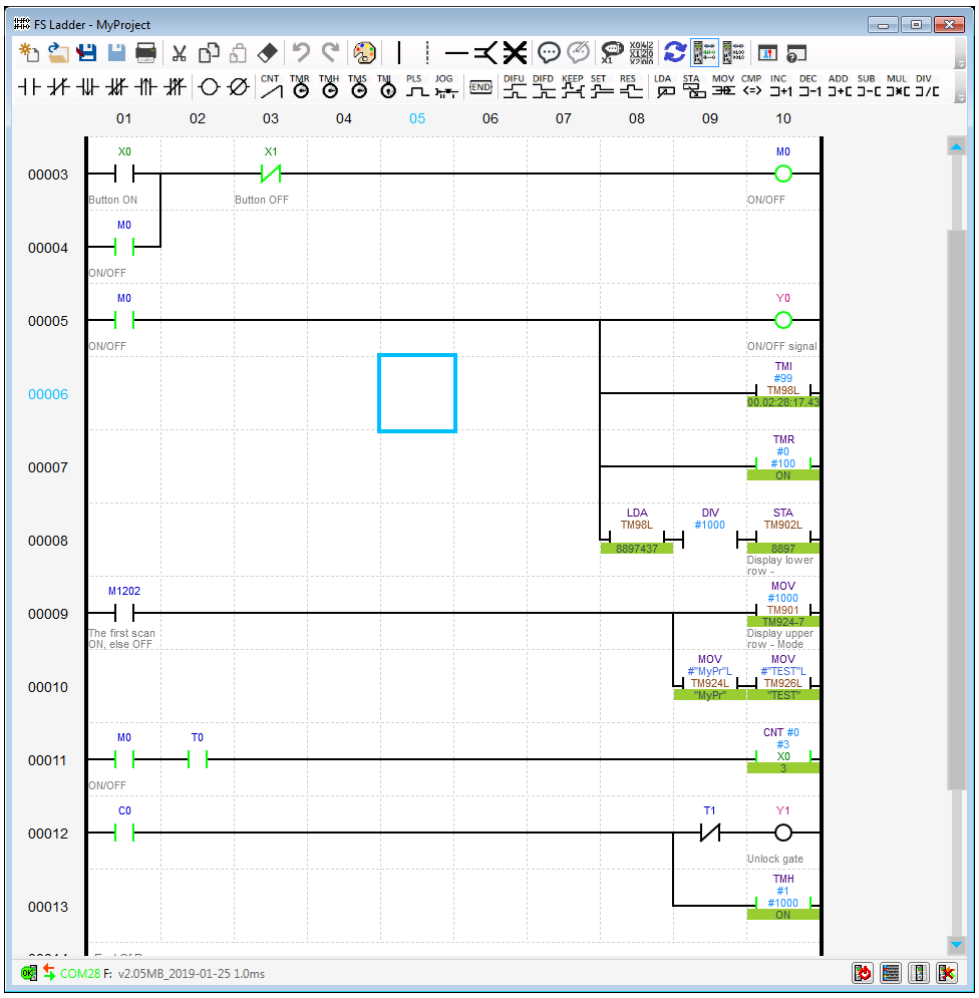




- Device Monitor and Monitoring in Ladder editor shows values even if there are different programs in smartPLC and the Ladder editor.

5-5 Device Monitor in Ladder Editor

- To activate/ deactivate monitoring in Ladder Editor, click on placed on the tool bar or press [Shift + F5] key.
- If there is no active device (refer to 2 - 5) the button is or will be disabled.
- In opposite to Device Monitor Window the monitoring in ladder does not allow change of a view format.
- MOV block shows value of second operand.
- Counter block shows actual value of the counter defined by the first operand and shape color indicates state of the bit register of the counter.
- Timer block shows elapsed time from start or ON when the time was reached or OFF if the timer is not active. Its shape color indicates state of the bit register of the timer.
- Elapsed time for timers have a little bit different format than in Device Monitor Window T tab. dd.hh:mm:ss.ff where dd are days, hh are hours, mm are minutes, ss are seconds and ff are milliseconds times ten plus any number from 0 to 9.
  Example: 01.14:53:10.33 means 1day 14hours 53minutes 10seconds and 330~339 milliseconds.



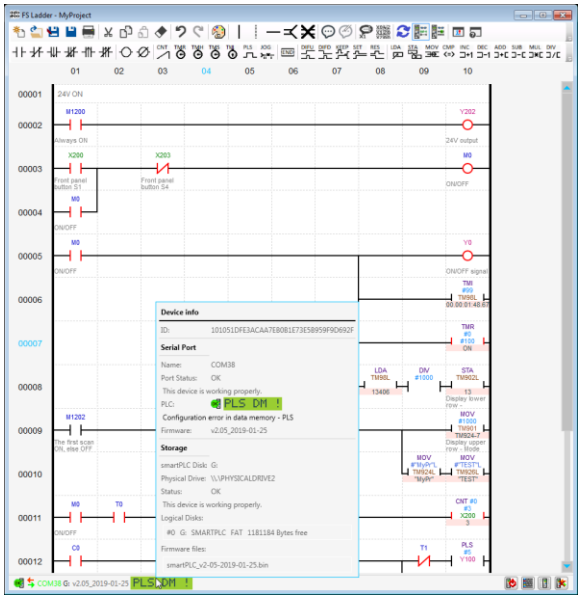
Above image is an example of a monitoring in the ladder editor. It shows following.

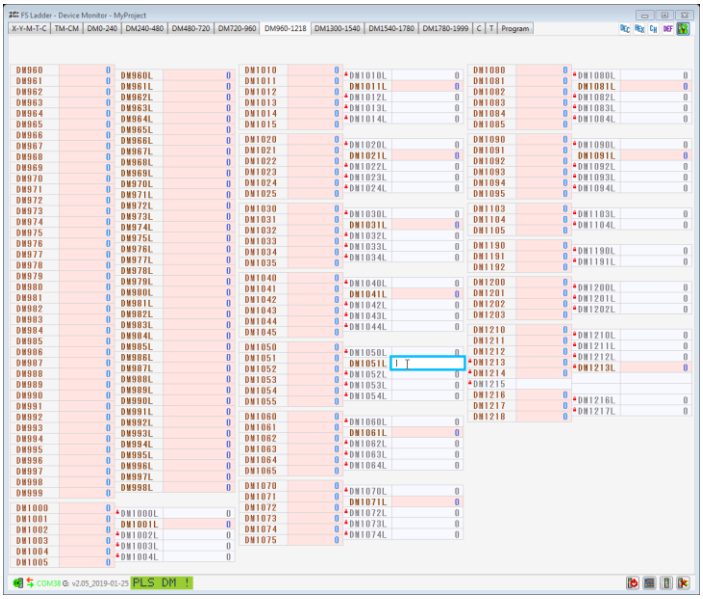
- X0 is OFF
- X1 is OFF and so its contact B is ON.
- M0 and Y0 are ON for around 2hours 28minutes 17seconds (elapsed time of T99)
- T0 has reached requested time (100*0.1s = 10s) and therefore is ON
- smarPLC display shows “MyPrTEST” on the upper row and number 8897 on the lower row of the display. Note in TM900 is 0 after reset and it means that there will be displayed value from the TM902L with unit defined in TM906 (which is also 0 after the reset) on the lower row of the display.
- Counter C0 reached value 3 and therefore is ON.
- Y1 is OFF, but it was ON for 10s (1000*0.01s), because timer T1 is ON.

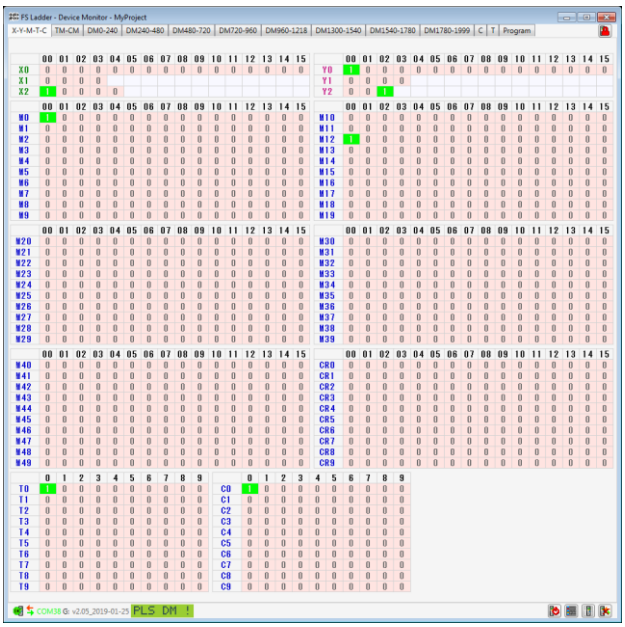
5-6 Device Monitor and PLC Error

If the device is in PLC error state, following applies.

- The error is displayed by the Device Manager.
- The Device Monitor will change color of value displays and active shapes to error colors.
- The values shown are not updating, because PLC scan cycle is stopped.
- Editing of internal values is allowed if enabled. This let you update invalid DM settings if necessary.



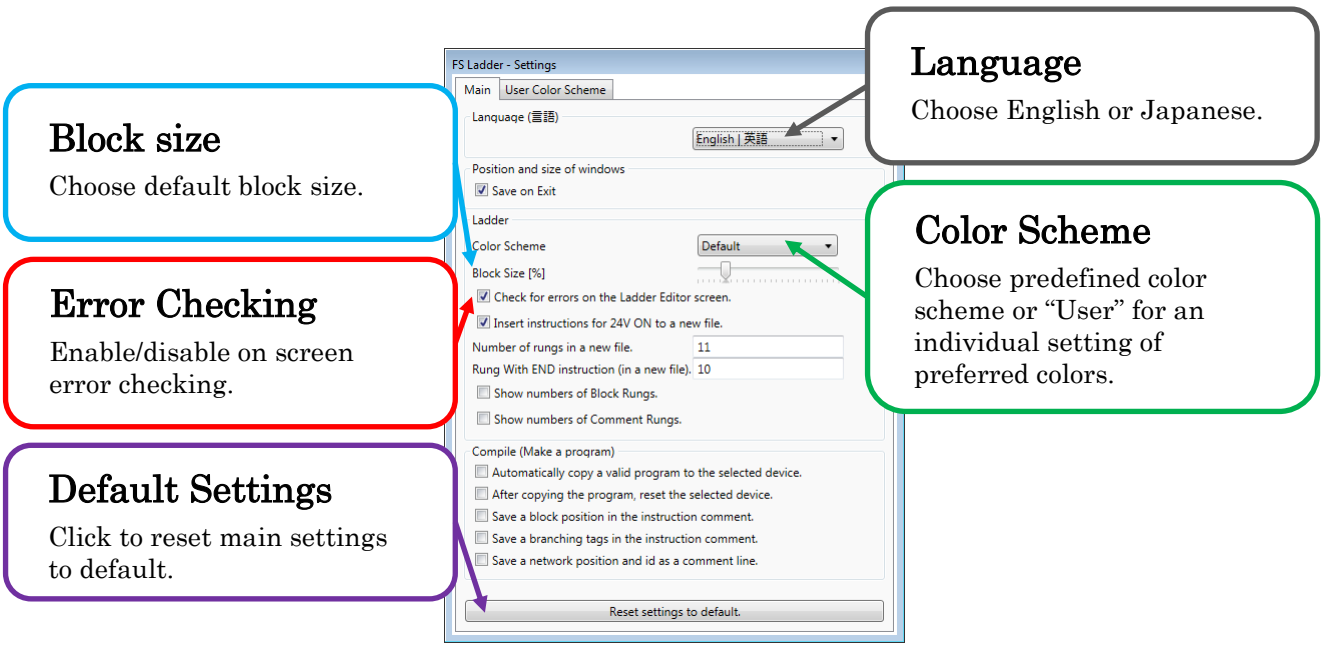




6 Settings

Settings allows set user preferences for the FS Ladder application.

- Click on placed on the tool bar or press [F10] key.

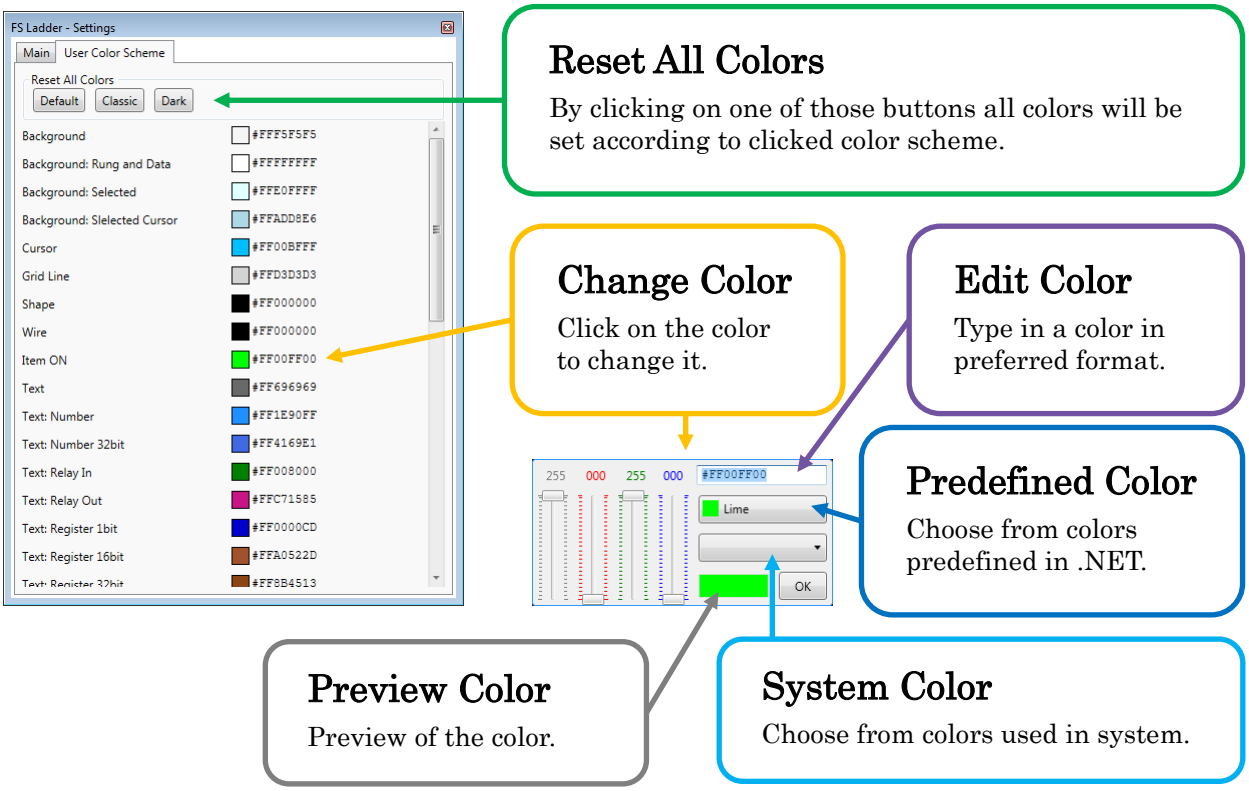


Notes

- On screen error checking is focused mainly on loose wires or invalid connections. It does not check for some types of errors missing END instruction, multiple use of output and so on. Those checks are made during making of program.
- Block size can be temporally changed pressing [Ctrl] + moving Scroll Wheel. It can be also set to 100% by [Ctrl + Middle Mouse Button Click]. Such change has no influence on preset block size in settings. The preset value will be used during the start of application.
- Reset to default settings will set the color scheme to default, but the colors of a user color scheme will remain intact.
- Even if "Show numbers of Comment Rungs" is checked, numbers of comment rungs are not visible for comment rungs with one-line comment, because there is not enough space to show them.

6 - 1 User Color Scheme

- To activate User color scheme set Color Scheme in Main tab (section Ladder) to User.



- The color can be changed by moving sliders or by choosing a new color from one of the Combo Boxes. Other possibility is to type in the preferred color.

Format	Description
#RGB	A hexadecimal number per color channel in the order red, green, blue.
#ARGB	A hexadecimal number per channel in the order alpha, red, green, blue.
#RRGGBB	Two hexadecimal numbers per color channel in the order red, green, blue.
#AARRGGBB	Two hexadecimal numbers per channel in the order alpha, red, green, blue.
0, 0, 0	A decimal number per color channel in the order red, green, blue.
0, 0, 0, 0	A decimal number per color channel in the order alpha, red, green, blue.
color name	A color name like in a combo box.

7 Appendix

7 - 1 Shortcuts

The list with all shortcuts can be found in the help window [F1].

Action	Shortcut
Help	[F1]
Settings	[F10]
Device Usage Status	[F2]
Operand Label Editor	[F3]
Make a program	[F5]
Enable/disable device monitor in the ladder editor.	[Shift + F5]
Device Monitor	[Ctrl + F5]
New	[Ctrl + N]
Open	[Ctrl + O]
Save	[Ctrl + Shift + S]
Save As	[Ctrl + S]
Print Preview	[Ctrl + P]
Stop communication with the device.	[Shift + Pause]
Device reset!	[Ctrl + Shift + Home]
Open File Manager.	[Ctrl + Shift + ~]
Cut	[Ctrl + X]
Copy	[Ctrl + C]
Paste	[Ctrl + V]
Delete	[Delete]
Delete rung	[Shift + Delete]
Insert block rung	[Shift + Insert]
Insert comment rung	[Insert]
Edit comment rung	[Enter]; [Mouse Left DoubleClick]
Undo	[Ctrl + Z]
Redo	[Ctrl + Y]
Move Left	[Left]
Move Right	[Right]

Action	Shortcut
Move Up	[Up]
Move Down	[Down]
Move to Comment Rung Up	[Ctrl + Up]
Move to Comment Rung Down	[Ctrl + Down]
Move to End	[End]
Move to Home	[Home]
Move Page Down	[Page Down]
Move Page Up	[Page Up]
Select Left	[Shift + Left]
Select Right	[Shift + Right]
Select Up	[Shift + Up]
Select Down	[Shift + Down]
Select to End	[Shift + End]
Select to Home	[Shift + Home]
Select Page Down	[Shift + Page Down]
Select Page Up	[Shift + Page Up]
Select All	[Ctrl + A]
Select rung up	[Ctrl + Shift + Up]
Select rung down	[Ctrl + Shift + Down]
Left horizontal line	[Alt + Left]
Horizontal line	[F9]; [Hyphen-minus]; [Alt + Right]
Left vertical line up	[Alt + Up]
Left vertical line down	[Alt + Down]
Set left vertical line	[F6]
Delete left vertical line	[Shift + F6]
Relay and Instruction palette	[Enter]; [Mouse Left DoubleClick]
Change contact A<->B (N.O <-> N.C)	[Tab]

7-2 Instruction block overview

The shortcut list is in the help screen [F1].

Icon	Instruction	Name	Shortcut
	AND	Contact A (normally open)	A
	ANB	Contact B (normally closed)	SHIFT+A or B
	ANF	Contact Falling Edge Detector, Contact A (normally open)	F
	ANFB	Contact Falling Edge Detector, Contact B (normally closed)	SHIFT+F
	ANP	Contact Rising Edge Detector, Contact A (normally open)	P
	ANPB	Contact Rising Edge Detector, Contact B (normally closed)	SHIFT+P
	OUT	Coil (Output Relay)	O
	OUB	Coil Bar (Inverted Output)	SHIFT+O
CNT	CNT	16bit Counter	C
TMR	TMR	Timer (100ms)	T
TMH	TMH	Timer (10ms)	SHIFT+T
TMS	TMS	Timer (1ms)	ALT+T
TMI	TMI	Timer-interval ms*	ALT+SHIFT+T
PLS	PLS	PLS positioning	ALT+P
JOG	JOG	JOG positioning	ALT+J
END	END	End of program	E
DIFU	DIFU	Differentiate UP	U
DIFD	DIFD	Differentiate Down	D
KEEP	KEEP	Keep Relay	K
SET	SET	Set	S
RES	RES	Reset	R

Icon	Instruction	Name	Shortcut
LDA	LDA	Load	ALT+SHIFT+L
STA	STA	Store	ALT+SHIFT+S
MOV	MOV	Move	ALT+SHIFT+M
CMP <=>	CMP	Comparison	ALT+C
INC +1	INC	Increment by one	ALT+I
DEC −1	DEC	Decrement by one	ALT+D
ADD +	ADD	Addition	ALT+A
SUB −	SUB	Subtraction	ALT+S
MUL *	MUL	Multiplication	ALT+M
DIV /	DIV	Division	ALT+SHIFT+D

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