

Hi4 Function Manual

# Embedded PLC User's Manual

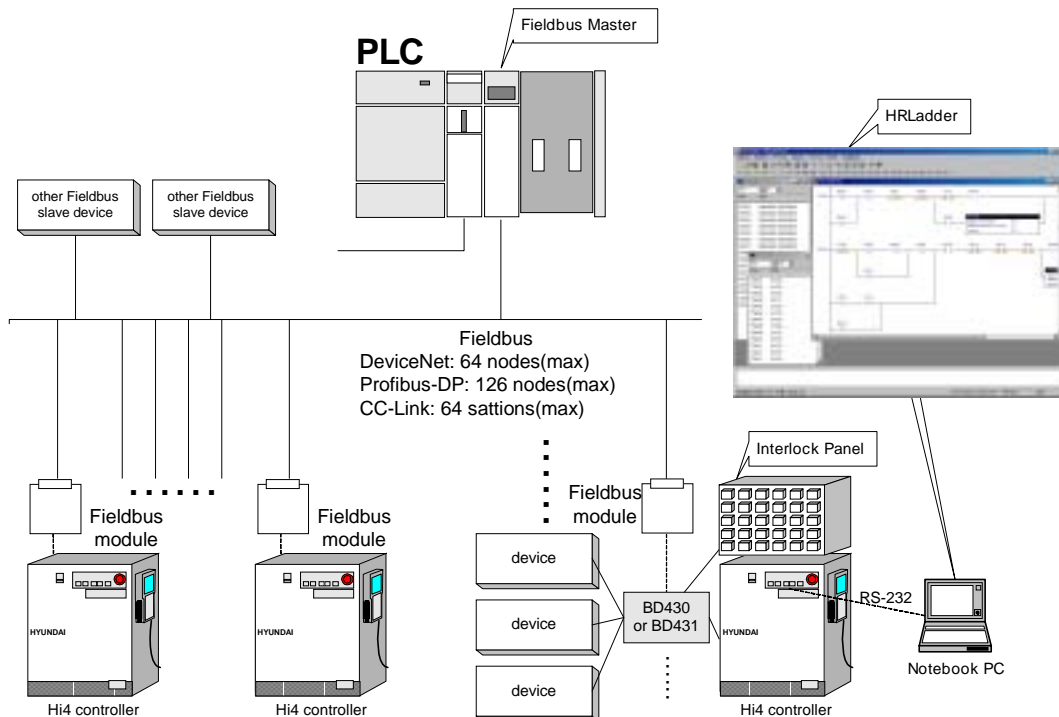
( version 1.3 )

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1.Outline

Embedded PLC function installed in Hi 4 controller adopts commercial PLC function. As shown in the figure below, HRLadder in PC or notebook being connected to the controller can be executed to write/edit program, or download to the controller and upload ladder program being executed in controller and monitor the status of execution in controller.



2. Controller setting

2.1 Embedded PLC Function Enable/Disable

To enable the use of Embedded PLC, make DIP5=On in the main CPU board(BD411).  
 To disable the use of Embedded PLC, make DIP5=Off.

2.2 Selection mode of Embedded PLC operation

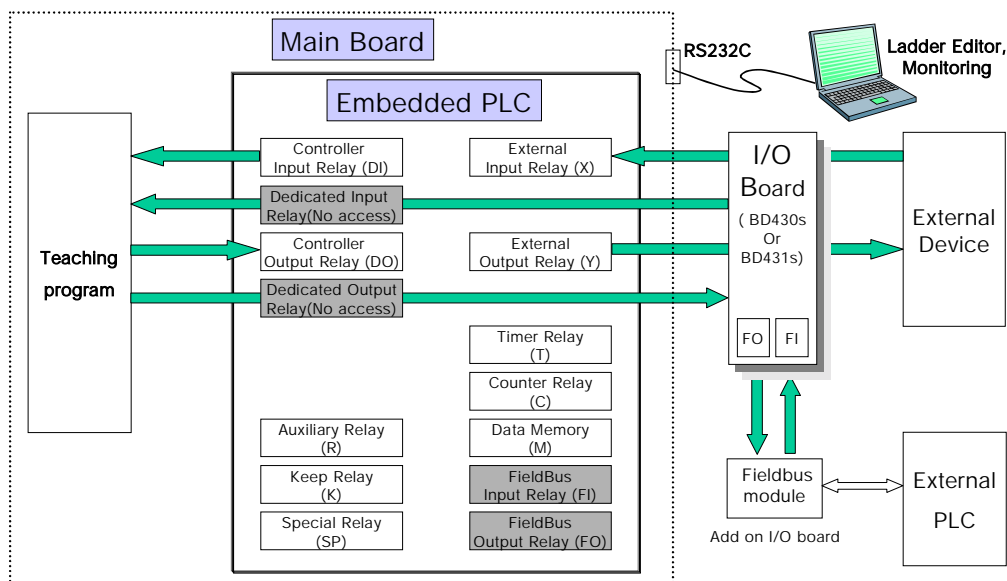
- ① Operation : As pressing [PF5]{Cond Set} → [PF1]{AppliCnd},  
 "8: Emb.PLC mode=<Stop,R-Stop,R-Run,Run>" is displayed, and select operation mode with [SHIFT]+[←][→].
  - ② Stop : Stop Embedded PLC operation.(DI,Y,R relay is simultaneously deleted with Stop)
  - ③ R-Stop/R-Run : Remote Mode which can select R-Stop and R-Run from HRLadder in PC connecting to the controller. (DI,Y,R relay is simultaneously clear with Stop)
  - ④ Run : PLC execution condition. Only monitoring is possible with HRLadder in PC.
- Note) Download in HRLadder is only possible in Stop or R-Stop.  
 All relay is cleared at the same time of download.

2.3 Relay states monitoring on T/P in controller

With [PF1]{Service} → 1: Monitoring → "6: 24: PLC X Relay(External Input) ~ 29: PLC C Relay(counter)", relay states can be monitored.

2.4 Internal Scan time : "sc" is displayed at the bottom, status bar of HRLadder. If it can not be handled within 10msec due to step increase, Scan time is automatically increased.

3. In/Output block diagram : Relay in gray color boxes are reserved



4. Relay specification

4.1 Relay points

		Point	Relay No.(1bit)	Type	Channel(16/8bit)	Type
External In/Output relay (BD430, BD431)	default	Input 32	X01~X32	1	XW01~XW02	2
		Output 32	Y01~Y32	4	XB01~XB04	3
	Expand 1B/D (64/64) Max.3	Input 192 (FieldBus:224)	X33~X224 (FieldBus:upto 256)	1	XW03~XW14	2
		Output 192 (FieldBus:224)	Y33~Y224 (FieldBus:upto 256)	4	YB01~YB04	6
Controller In/Output relay (Teach/Playback)	General	Input 256	DI001~DI256	7	DIW01~DIW16	8
		Output 256	DO001~DO256	10	GI01~GI32	9
FieldBus relay (DeviceNet/Profibus)		Input 256	FI001~FI256	25	DOW01~DOW16	11
		Output 256	FO001~FO256	28	GO01~GO32	12
Auxiliary relay		1024	R0001~R1024	31	FIW01~FIW16	26
Keep relay		1024	K0001~K1024	34	FIB01~FIB32	27
					FOW01~FOW16	29
Special relay		32	SP01~SP32	37	FOB01~FOB32	30
					SPB01~SPB04	39
Timer relay		64	T01~T64	40	TW01~TW64	41
					TB01~TB128	42
Counter relay		256	C001~C256	43	CW001~CW256	44
					CB001~CB512	45
Data memory(16bit)		512	reserved	46	MW001~MW512	47
					MB001~MB1024	48
System memory		256	reserved	49	SMW001~SMW256	50

Table 1. Gray color sections are reserved

#### 4.2 Outline on Relay

Data size for the same relay can be defined with 3 types

But timer and counter shows the same area of bit(T/C) and word(TW/CW). Bit(T/C) is active when TW/CW value is 0.

- ① External In/Output relay : Actual signal input/output through BD430 and BD431
- ② Controller general In./output relay : In/Output signal being used in Teach program (M signal/I signal)
- ③ Auxiliary relay :Aux relay being used in PLC program
- ④ Keep relay : Relay to keep on/off condition regardless main switch is turned to OFF
- ⑤ Special relay : Relay defined for special purpose (Details in later)
- ⑥ Timer relay : Relay to operate Timer, contact is On when value is 0.(nonvolatile)
- ⑦ Counter relay : Relay to operate Counter, contact is On when value is 0.(nonvolatile)
- ⑧ Data memory : Use when temporary data are read or stored in application instruction. (nonvolatile)
- ⑨ System memory : Used in special purpose

#### 4.3 Special relay

Relay No	Description	Remark
SP01	Always On relay	Controller states
SP02	Always Off relay	
SP03	Only one scan is On at the start	Internal timer
SP04	0.1sec clock ( 0.05sec On → 0.05sec Off )	
SP05	0.2sec clock ( 0.1sec On → 0.1sec Off )	
SP06	1초 clock ( 0.5초 On → 0.5초 Off )	
SP07	Relay On at not convert data to BCD, ....	Result at TOD execution
SP08	Relay On at exist carry of calculation	Result at arithmetic CMD
SP09~SP32	Reserved	

#### 4.4 Backup relay & memory

- ① Keep relay
- ② Output relay
- ③ Timer relay
- ④ Counter relay
- ⑤ Data memory

#### 4.5 Timer & counter

- ① Timer and counter support down-counting only.
- ② Timer / counter value is the following meaning.

timer & counter	Description
0	contact On (=counting complete)
-1	contact Off
other	contact Off, timing & counting ( on running )

- ③ When Timer / Counter is active, preset value is stored in timer / counter.
  - Ⓐ Timer base can be set in 10msec by user.
  - Ⓑ TON : When Timer Value < 0, store initial value as "timer base × preset".
  - Ⓒ CTD : When Counter value < 0, store initial value as preset value. or down counting at rising to active state.

- ④ Counting can be up to 32767msec because Timer value is processed internally with 16 bit value
- ④ When Timer / Counter is inactive,
  - ⓐ Make Timer value to -1.
  - ⓑ Counter values maintains its value.
- ⑤ Timer is decremented in every 10msec.
- ⑥ Counter counts contact point in every scan

5. Instruction specification

5.1 Basic Instructions

Instruction			Description
Mnemonic	Full name	Symbol	
RUNG	Rung		Shows rung, when input at first in starting ladder program
BST	Branch Start		Start of branch(cf, branch number is unlimited)
BND	Branch End		End of branch.
NXB	Nested Branch		Branch in repeat
XIC	Examine if Closed	-   -	Generally A contact (Normally closed)(inactive=ON)
XIO	Examine if Open	-  -	Generally B contact (Normally open)(Active=OFF)
INV	Inverting	-//-	Inverts the result. (OR wiring↔AND wiring co-inversion)
OTE	Output Energize	-( )-	Generally relay output. (All relay the possible output)
OTL	Output Latch	-(L)-	latches output relay to High. (All relay the possible output)
OTU	Output Unlatch	-(U)-	Makes output relay to low. (All relay the possible output)
OSR	One Shot Rising	-(OSR)-	Maintain ON while one scan
RES	Reset	-(RES)-	Reset timer or counter
TON	Time On Delay	-	Generally down-counting timer. (If value is 0, Relay On)
CTD	Count Down	-	Generally down-counting counter. (If value is 0, Relay On)

## 5.2 Application instructions

Instruction			Description
Mnemonic	Full name	Symbol	
EQU	Equal	-□-	If two relay values are equal(=), active(same as signal input).
NEQ	Not Equal	-□-	If two relay values are different(<>), active.
LES	Less Than	-□-	If the first relay value is less than the second relay value, active.
GRT	Greater Than	-□-	If the first relay value is bigger than the second relay value, active.
LEQ	Less Than or Equal	-□-	If the first relay value is less than or equal to the second relay value, active.
GEQ	Grtr Than or Equal	-□-	If the first relay value is bigger than or equal to the second relay value, active.
TOD	Convert to BCD	-□-	When Rung is active, converts first relay value(integer) to BCD and store in second Relay. When of BCD is out of conversion range, SP07 is set.
FRD	Convert form BCD to Integer	-□-	When Rung is active, converts first relay value(BCD) to integer and store in second Relay. When value (A'~'F'), not BCD, exists, SP07 is set.
MOV	Move	-□-	When Rung is active, store the first relay value in the second Relay.
ADD	Add	-□-	When Rung is active, add the first relay value with the second relay value and store the result in the third relay.
SUB	Subtract	-□-	When Rung is active, abstract the first relay value from the second relay value and store the result in the third relay.
MUL	Multiply	-□-	When Rung is active, multiply the first relay value with the second relay value and store the result in the third relay.
DIV	Divide	-□-	When Rung is active, divide the first relay value with the second relay value and store in the third relay.
SEG	7'Segment	-□-	When Rung is active, 7segment value as to the first relay value(4bit) is stored in the second relay.
COP	Copy data	-□-	When Rung is active, the numbers from the first relay till the third operand is copied to the second relay.

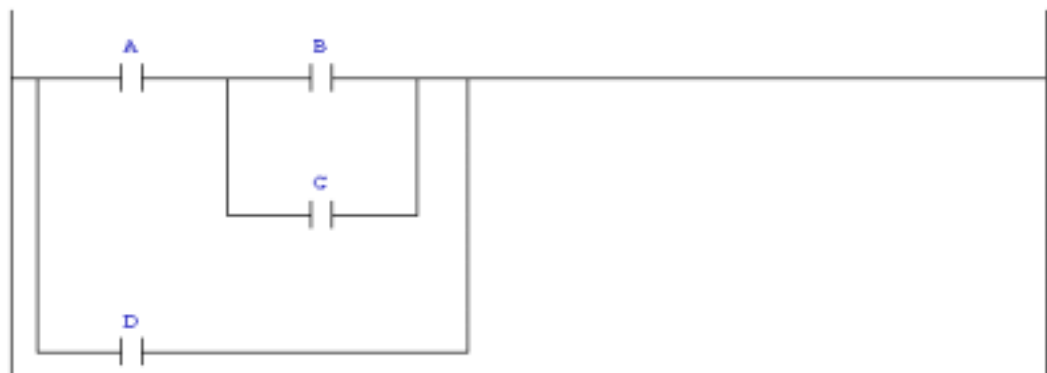
5.3 Usable operands of each instruction

Cmd	Relay	X		Y		DI		DO		R		K		SP		T		C		M		Const
		B	W	B	W	Gl	W	Gc	W	B	W	B	W	B	W	B	W	B	W	B	W	
XIC		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
XIO		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OTE		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OTL		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OTU		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
OSR		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RES		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TON	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3'rd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CTD	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EQU	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NEQ	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LES	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRT	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LEQ	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GEQ	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TOD	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
FRD	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MOV	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ADD	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3'rd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SUB	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3'rd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MUL	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3'rd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIV	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3'rd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SEG	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
COP	1'st	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2'nd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3'rd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

- ① X mark in the above table indicate not useable.
- ② Constant : Binary, Decimal, Hexadecimal. Starting with &B for binary, Starting with &H for Hexadecimal, and without Prefix for Decimal.
- ③ W in Relay means 16bit and B(include Gl and GO) means 8bit.
- ④ Data size is selected depending on selection of relay type.
- ⑤ W in Relay and B(include Gl and GO) all are processed as signed value.
  - ➔ In such instruction as move, take a note that signed is expanded in moving B(8bit) value to W(16bit) value.
    - ( ex, When move RB(-1=0xFF) to RW, the result is (-1=0xFFFF) )
- ⑥ In COP instruction case, 1st and 2nd relay size shall be identical.

5.4 Relation between Ladder and mnemonic → User needs to know only ladder.

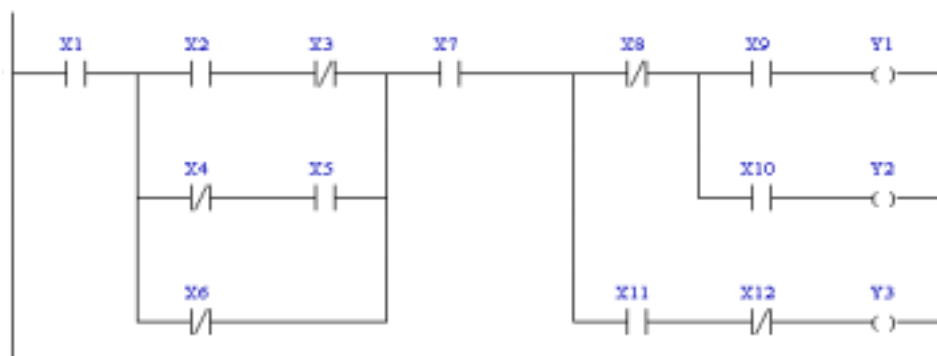
① Ladder Sample 1 :



mnemonic :

BST XIC A BST XIC B NXB XIC C BND NXB XIC D BND

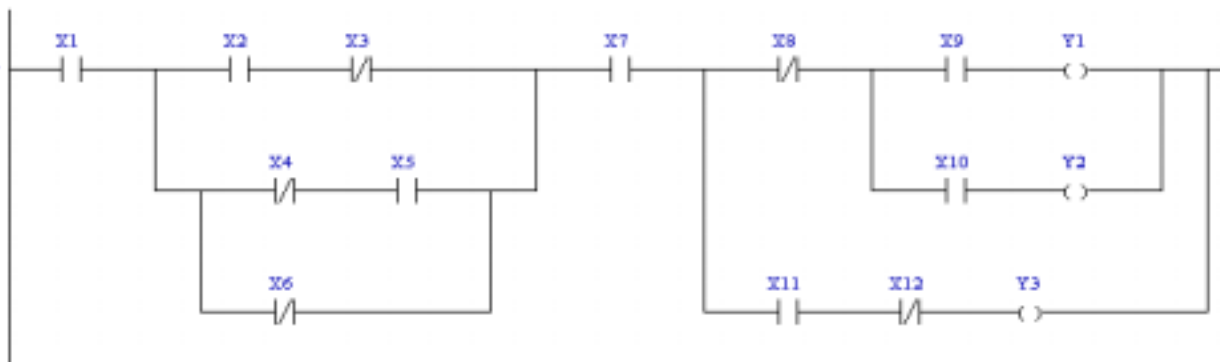
② Ladder Sample 2 :



mnemonic :

SOR XIC X1 BST XIC X2 XIO X3 NXB BST XIO X4 XIC X5 NXB XIO X6 BND BND  
 XIC X7 BST XIO X8 BST XIC X9 OTE Y1 NXB XIC X10 OTE Y2 BND  
 NXB XIC X11 XIO X12 OTE Y3 BND

or click HRLadder symbol(branch gap) to display the following.





## 6. Ladder Editor

### 6.1 Environment

- ① OS : Windows 95/98/ME/2000
- ② Pentium : Over P100MHz
- ③ Display : At least VGA 640×480

### 6.2 Main Function : provided in either PC or notebook

- ① Ladder diagram Edit
- ② Ladder diagram Print
- ③ PLC monitor : Display in ladder & relay table
- ④ Syntax check : Displays rung & step causing error
- ⑤ Character search/replace : Search range(comment/mnemonic/operands) define / Position move
- ⑥ Job file save/load
- ⑦ Balloon Help
- ⑧ Display step number / scantime(max, average) at status bar
- ⑨ Rung comment, relay comment, relay comment table (export/import for Excel Edit )
- ⑩ Supports Help function

### 6.3 Ladder Edit spec : Similar to Rockwell RSLogix 500(AB PLC)

- ① Input instruction with Tool box button
- ② Delete/Insert/Copy/ Paste/ Drag & move of Rung and instruction
- ③ Provide comment of Rung and instruction
- ④ Operand Edit / Copy
- ⑤ Edit window zoom in, zoom out, scroll
- ⑥ Multi file edit
- ⑦ Unlimited input for Branch(block) & instruction
- ⑧ Provide 1/8/16 bit type of Relay index

## 7. Execution spec

- 7.1 scan time : At the minimum 10msec(about 2000step), increases according to step number.