Software Requirements for XM-Pro PLC

LEVEL – 1

Rev_1.3

Title: Software Requirements for XM-Pro PLC – LEVEL 1 -Rev1.3	Author	Ameya Morje & Sagar Gupta	Date	4 June 2021
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Contents

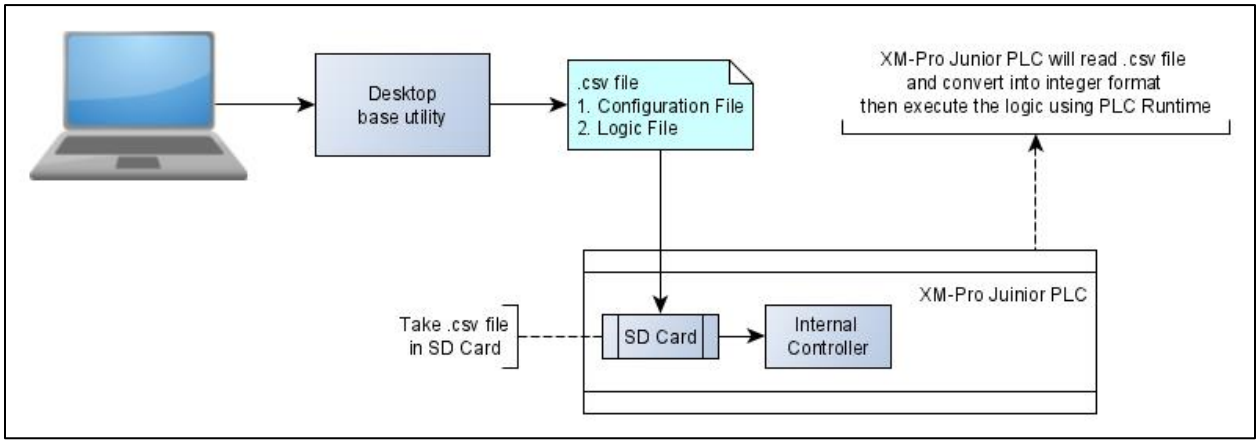
Software Requirement 3
Scheme of Software download Process 3
IO Configuration 4
New Addressing Scheme 4
Format 4
List of type of addresses 4
IO Addressing 5
List of Remote I/O to add in windows application 7
I/O Calculation 9
Operands requirement and suggested name according to instruction selection 10
Enable option on PLC Logic screen 14
Timer and Counter instruction block 14
New .csv file format: 15

Software Requirement

XM-Pro PLC programming software requires;

1. Instructions Set – We have divided instruction into 2 Phases.
2. Communication Protocol (Configuration & Function Block)– to communicate with slave devices
3. Compiles File – .CSV file, this includes 2 files. One for PLC Configuration and another one for PLC Logic.

Scheme of Software download Process



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IO Configuration

For IO configuration windows based utility will have a new form which includes all details of On-board IOs, a list of remote IOs and their details, similarly expansion IOs and local IOs.

The address of onboard IOs will be fixed, but according to the selection of remote IO, the user will able to assign an address as per the below list.

New Addressing Scheme

Format

Address Type	Type Number	Separator	3 Digit Word No.	Bit Separator	Bit No.
ex. Q	ex. 0	:	000 to 255	.	00 to 15

List of type of addresses

Block No.	Type	Logical Address (In word)	Remark	Comment
0	Output Address	Q0:000 to Q0:255	Digital + Analog Outputs. (local+Xpn+Remote)	Further allocate for DO, AO, Local, Expansion, Remote
1	Input Address	I1:0 to I1:255	Digital+Analog Inputs. (local+Xpn+Remote)	Further allocate for DI, AI, Local, Expansion, Remote
2	Flags	F2:0 to F2:255	These are mainly used as binary bits	Access as bit
3	Status	S3:0 to S3:255	PLC Status	
4	Integer Word	W4:0 to W4:255		For calculation results/operands
5	Floating Point	P5:0 to P5:255		For calculation results/operands
6	Timers	T6:0 to T6:255		Need to define functions of each byte/word
7	Counters	C7:0 to C7:255		Need to define functions of each byte/word
8	Reserved for future	X8.0 to X8.255		
9	Reserved for future	Y9.0 to Y9.255		

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10-60	User Data	U10:0 to U10.255 U60.0 to U60.255	User storage or large data like scanners, etc...	

CPU Select

In CPU slect option user should select cpu from following list

1. XM-Pro – Junior
2. XM-Pro – Senior

After selection of CPU from list I/O configuration related to that CPU will appear.

(Now for XM-Pro Senior don't assign anything or give popup like "not available till now")

IO Addressing

- In IO addressing tab on-board I/O address will assign automatically as per PLC selection.
- After the assignment of on-board I/O, the user will configure Remote I/O as per their requirement.
- When the user selects Remote I/O then in the next column list of remote I/O will appear and according to the selected user will assign addresses in the IO addressing tab.

IO List	Model	Type	Mode	Label	Logical Address	Tag
On-Board I/O	XM-Pro Junior	Digital Input		DI0	I1:000.00	
				DI1	I1:000.01	
				DI2	I1:000.02	
				DI3	I1:000.03	
				DI4	I1:000.04	
				DI5	I1:000.05	
				DI6	I1:000.06	
				DI7	I1:000.07	
		Analog Input	1) 0 to 10 V 2) 0 to 20 mA	AI0	I1:001	

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			3) 4 to 20 mA			
				AI1	I1:002	
		Digital Output		DO0	Q0:000.00	
				DO1	Q0:000.01	
				DO2	Q0:000.02	
				DO3	Q0:000.03	
				DO4	Q0:000.04	
				DO5	Q0:000.05	
		Analog Output	1) 0 to 10 V 2) 0 to 20 mA 3) 4 to 20 mA	AO0	Q0:001	
Remote I/O	MOD-DO-16	Digital Output		…	…	
Expansion IO	XM-DO-16	Digital Output		…	…	

I/O List – Combo box
Model – Combo box
Type – Combo box (but fix for given model list)
Mode – Only for Analog Input/Output – User will select from the given option, By default it will show option 1) 0 to 10V.In "Mode" we required a drop down menu for three options. The "Mode" Tab will be Activate or Enable for only Analog Inputs and Analog Outputs.

In case of Digital INput/Output it will be deactivated.
Label – Auto-generated as per model selection
Logical Address – Auto-generated as per model selection
Tag – User will enter

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List of Remote I/O and Expansion IO to add in windows application

Sr. No.	Remote Modules	Type	Mode	Label	Assign address accordingly
REMOTE IO					
1.	MOD-DO-4R	Digital Output	-	DO0 to DO3	4 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.03)
2.	MOD-DO-8R	Digital Output	-	DO0 to DO7	8 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.07)
3.	MOD-DO-16R	Digital Output	-	DO0 to DO15	16 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.15)
4.	MOD-DI-4	Digital Input	-	DI0 to DI3	4 Input bit address (i.e. I1:xxx.00 to I1:xxx.03)
5.	MOD-DI-8	Digital Input	-	DI0 to DI7	8 Input bit address (i.e. I1:xxx.00 to I1:xxx.07)
6.	MOD-DI-16	Digital Input	-	DI0 to DI15	16 Input bit address (i.e. I1:xxx.00 to I1:xxx.15)
7.	MOD-AI-2	Analog Input	1)0 to 10V 2)0 to 20mA 3)4 to 20mA	AI0 to AI1	2 Input word address (i.e. I1:xxx)
8.	MOD- AI-4	Analog Input		AI0 to AI3	4 Input word address (i.e. I1:xxx)
9.	MOD-AO-2	Analog Output		AO0 to AO1	2 Output word address
10.	MOD-AO-4	Analog Output		AO0 to AO3	4 Output word address
11.	MOD-DI8-DO6	DI&DO	-	DI0 to DI7, DO0 to DO5	8 Input bit address (i.e. I1:xxx.00 to I1:xxx.07) & 6 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.05)
12.	MOD-AI2-AO-2	AI & AO	1)0 to 10V 2)0 to 20mA 3)4 to 20mA	AI0 to AI1, AO0 to AO1	2 Input word address (i.e. I1:xxx) & 2 Output word address
13.	MOD-CFC-4	Other	-	CH1 to CH4	4 Output word address
14.	MOD- DIM-2-P	Other	-	CH1, CH2	2 Output word address

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15.	MOD-DIM-4-P	Other	-	CH1 to CH4	2 Output word address
16.	MOD-DO-4-R-S	Digital Output	-	DO0 to DO3	4 Output bit address
17.	MOD-DO-8-R-S	Digital Output	-	DO0 to DO5	8 Output bit address
18.	MOD-DO-16-R-S	Digital Output	-	DO0 to DO15	16 Output bit address
19.	MOD-CTP-6	Other	-	Key1 to key 6	6 Input bit address
EXPANSION IO					
20.	XM-DO-4R	Digital Output	-	DO0 to DO3	4 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.03)
21.	XM-DO-8R	Digital Output	-	DO0 to DO7	8 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.07)
22.	XM-DO-16R	Digital Output	-	DO0 to DO15	16 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.15)
23.	XM-DI-4	Digital Input	-	DI0 to DI3	4 Input bit address (i.e. I1:xxx.00 to I1:xxx.03)
24.	XM -DI-8	Digital Input	-	DI0 to DI7	8 Input bit address (i.e. I1:xxx.00 to I1:xxx.07)
25.	XM -DI-16	Digital Input	-	DI0 to DI15	16 Input bit address (i.e. I1:xxx.00 to I1:xxx.15)
26.	XM -AI-2	Analog Input	1)0 to 10V 2)0 to 20mA 3)4 to 20mA	AI0 to AI1	2 Input word address (i.e. I1:xxx)
27.	XM - AI-4	Analog Input		AI0 to AI3	4 Input word address (i.e. I1:xxx)
28.	XM -AO-2	Analog Output		AO0 to AO1	2 Output word address
29.	XM -AO-4	Analog Output		AO0 to AO3	4 Output word address
30.	XM -DI8-DO6T	DI&DO	-	DI0 to DI7, DO0 to DO5	8 Input bit address (i.e. I1:xxx.00 to I1:xxx.07) & 6 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.05)

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31.	XM -DI8-DO6R	DI&DO	-	DI0 to DI7, DO0 to DO5	8 Input bit address (i.e. I1:xxx.00 to I1:xxx.07) & 6 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.05)
32.	XM -AI2-AO2	AI & AO	1)0 to 10V 2)0 to 20mA 3)4 to 20mA	AI0 to AI1, AO0 to AO1	2 Input word address (i.e. I1:xxx) & 2 Output word address
33.	XM -DO-16T	Digital Output	-	DO0 to DO15	16 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.15)
34.	XM -DO-8T	Digital Output	-	DO0 to DO7	8 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.07)
35.	XM -DO-4T	Digital Output	-	DO0 to DO4	8 Output bit address (i.e. Q0:xxx.00 to Q0:xxx.03)

I/O Calculation

According to the assignment of address calculate the number of I/O. i.e.

Type of Address	Consider I/O for calculation
Output bit address	Digital Output
Input bit address	Digital Input
Output word address	Analog output
Input word address	Analog Input

***Note:** Keep empty the other two options i.e. Expansion I/O and Local I/O.

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Operands requirement and suggested name according to instruction selection

Sr. no.	Instruction Type	Instruction	Operands	Suggested Name	Default Data type
1.	Logical	NOT	Operand 1 Address	Input	Bool
			Operand 2 Address	Make Disable	
			Operand 3 Address	Make Disable	
			Operand 4 Address	Make Disable	
			Output Address	Output	Bool
2.	Logical	AND	Operand 1 address	Input 1	Bool
			Operand 2 address	Input 2	Bool
			Operand 3 address	Input 3	Bool
			Operand 4 address	Input 4	Bool
			Output address	Output	Bool
3.	Logical	OR	Operand 1 address	Input 1	Bool
			Operand 2 address	Input 2	Bool
			Operand 3 address	Input 3	Bool
			Operand 4 address	Input 4	Bool
			Output address	Output	Bool
4.	Logical	XOR	Operand 1 address	Input 1	Bool
			Operand 2 address	Input 2	Bool
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Bool
5.	Arithmetic	ADD	Operand 1 address	Input 1	Byte, Word, Real, Dword, Int
			Operand 2 address	Input 2	Byte, Word, Real, Dword, Int
			Operand 3 address	Input 3	Byte, Word, Real, Dword, Int
			Operand 4 address	Input 4	Byte, Word, Real, Dword, Int

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			Output address	Output	Byte, Word, Real, Dword, Int
6.	Arithmetic	SUB	Operand 1 address	Input 1	Byte, Word, Real, Dword, Int
			Operand 2 address	Input 2	Byte, Word, Real, Dword, Int
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Byte, Word, Real, Dword, Int
7.	Arithmetic	MUL	Operand 1 address	Input 1	Byte, Word, Real, Dword, Int
			Operand 2 address	Input 2	Byte, Word, Real, Dword, Int
			Operand 3 address	Input 3	Byte, Word, Real, Dword, Int
			Operand 4 address	Input 4	Byte, Word, Real, Dword, Int
			Output address	Output	Byte, Word, Real, Dword, Int
8.	Arithmetic	DIV	Operand 1 address	Input 1	Byte, Word, Real, Dword, Int
			Operand 2 address	Input 2	Byte, Word, Real, Dword, Int
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Byte, Word, Real, Dword, Int
9.	Arithmetic	MOD	Operand 1 address	Input 1	Byte, Word, Dword, Int
			Operand 2 address	Input 2	Byte, Word, Dword, Int
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Byte, Word, Dword, Int
10.	Arithmetic	MOV	Operand 1 address	Input	Bool, Byte, Word, Dword, Real, Int

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			Operand 2 address	Disabled	-
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Bool, Byte, Word, Dword, Real, Int
11.	Bit Shift	SHL,SHR,ROR,ROL	Operand 1 address	Input 1	Byte, Word, Dword
			Operand 2 address	Input 2	Byte, Word
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Byte, Word, Dword
12.	LIMIT	Disable	Operand 1 address	Max value	Byte, Word, Dword, Real, Int
			Operand 2 address	Actual value	Byte, Word, Dword, Real, Int
			Operand 3 address	Min value	Byte, Word, Dword, Real, Int
			Operand 4 address	Disabled	-
			Output address	Output	Byte, Word, Dword, Real, Int
13.	Compare	GT,GE,LT,LE,EQ,NE	Operand 1 address	Input 1	Bool, Byte, Word, Dword, Real, Int
			Operand 2 address	Input 2	Bool, Byte, Word, Dword, Real, Int
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Bool
14.	Edge Detector	Rising and falling Edge	Operand 1 address	Input	Bool
			Operand 2 address	Disabled	-
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output address	Output	Bool
15.	Counter	CTU, CTD	Operand 1 address	Count Up (Bool)	CTU/CTD
			Operand 2 address	Reset/Load (Bool)	-
			Operand 3 address	Preset value (Word)	-

			Operand 4 address	Disabled	-
			Output 1 address	Done (Bool)	-
			Output 2 address	Count value (Word)	-
16.	Timer	TON, TOF,TP	Operand 1 address	In (Bool)	TON/TOFF/TP
			Operand 2 address	Preset Value (dword)	-
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output1 address	Done (Bool)	
			Output 2 address	Elapsed time (Dword)	
17	Flipflop	RS	Operand 1 address	SET	Bool
			Operand 2 address	RESET1	Bool
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output1 address	Done	Bool
			Output 2 address	Disabled	-
18	Flipflop	SR	Operand 1 address	SET1	Bool
			Operand 2 address	RESET	Bool
			Operand 3 address	Disabled	-
			Operand 4 address	Disabled	-
			Output1 address	Done	Bool
			Output 2 address	Disabled	-

Timer (TON AND TOFF)

For Timer TON & Timer TOFF instruction data type same as Type means ,If "Timer TON" then datatype should be "TON" & if "Timer TOFF" datatype should be: TOFF" & & if "Timer TP" datatype should be: TP" on UI Oprands should have text "In" to "In (Bool)" & "Preset value" to " Preset value (Dword)".

Counter(CTU AND CTD)

For Counter instruction the data type same as Type means ,If "CTU" then datatype should be "CTU" & if "CTD" datatype should be "CTD". For CTU UI Oprands should have text "Count up" to " Count up (Bool)" & "Reset " to " Reset (Bool)" & "Preset value" to " Preset value (Word)" .

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For CTD UI text should be "Count up" to " Count down (Bool)" & "Reset" to "Load (Bool)" & "Preset value" to " Preset value (Word)" . For CTD instead of Reset replace text to Load (Bool).

Flipflop

Add one more instruction type “Flipflop” & RS & SR flipflop instruction data type must be “Bool” and operand text as per above table.

Enable option on PLC Logic screen

Need to add function **Enable** check box with a textbox on PLC Logic screen. For this one more column will be added in the .csv file.

Normally, the enable check box will be unchecked (□) and that time textbox will be invisible i.e. its represent by ‘-’ in the .csv file and if this check box is checked (✔) then the textbox will be visible and the user will enter bit address in it, and this address is added in enable column of .csv file.

Timer and Counter instruction block

For timer and counter naming one column will be added in the .csv file as well as the on grid view table. The naming of timer/counter will be appearing somewhere above or near the operands box heading. The name of the timer/counter should auto-generated as per timer/counter type and user selection.

For example;

1. If the user first select 0.01s TON Timer then it should be named as “T0”
2. Then if the user selects 0.01s TON Timer it should be named as “T1”
3. Then if the user selects 0.1s TON Timer it should be named as “T50”
4. Then if the user selects 0.1s TOFF Timer it should be named as “T51”
5. Likewise…

Timer type	Timer Name
0.01s TON Timer	T0 to T49
0.1s TON Timer	T50 to T199
1s TON Timer	T200 to T255
0.01s TOFF Timer	T0 to T49
0.1s TOFF Timer	T50 to T199
1s TOFF Timer	T200 to T255

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0.01s TP Timer	T0 to T49
0.1s TP Timer	T50 to T199
1s TP Timer	T200 to T255
Maximum Limit	**Maximum assignment of any 256 timer**

Counter type	Counter Name
CTU	C0 to C127
CTD	C128 to C255
Maximum Limit	Maximum assignment of any 256 counter

New .csv file format:

Total three columns will be going to add to the existing .csv file

1. **output2**
2. **one for Enable**
3. **T/C Type**

I.e. new sequence on .csv file.

Line Number	T/C Name	Output Type	Data Type	Enable	Output1	Output2	Opcode	Input 1	Input 2	Input 3	Input 4	Comments

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