Servo Motion

AC500eco Onboard IO Advanced Functions

Application Note 512

Rev A (English)

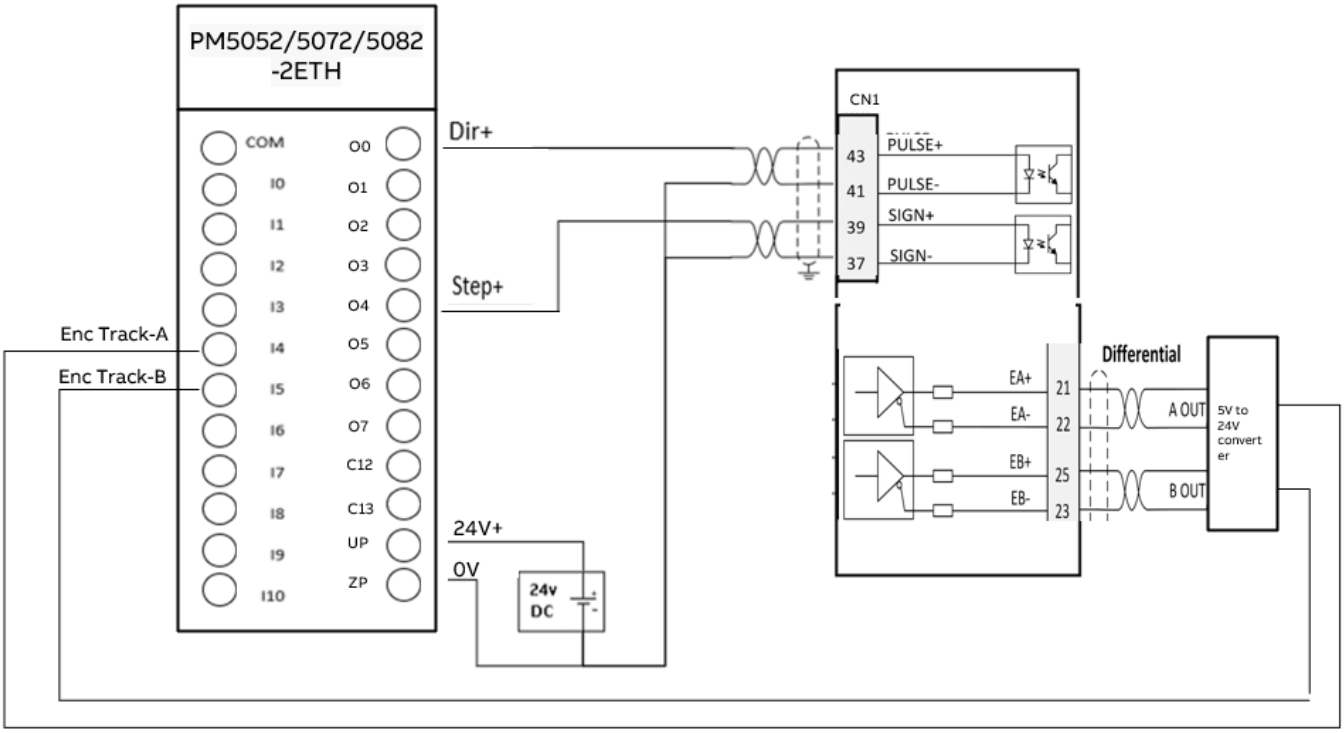
Documentation Introduction

The onboard I/O channel of the ABB AC500eco PLC integrates advanced functions such as Encoder Counter, Touch Probe, Interrupt and Limit Switch, which are commonly used in counting applications and encoder axis applications in motion control. This document uses ABB PM5052PLC as an example to introduce how to configure and program in Automation Builder to use Onboard IO-related function blocks and provide a simple application.

Contents

1.Introduction

The IO channel of the AC500eco PLC body integrates an encoder counting function, which can be used for high-speed pulse counting or encoder shaft generation, and can be combined with probes, comparison outputs, etc., to achieve more complex applications. In this paper, the E530 servo driver pulse output or other 24V HTL external encoder source is used to connect the encoder input channel of the PLC as the counting data source of the PLC, and the OBIOEncoderCounter function block and OBIOTouchProbe function block are introduced respectively OBIOLimitSwitch function block, OBIOInterrupt related function block. The wiring of the PLC and E530 servo drive is as follows:



At present, Eco PLC integrates 2 200K AB phase encoder counting channels and 4 x 200K pulse output channels. In the above wiring diagram, we use a 200K high-speed pulse output channel PTO0 (DO0, DO4) to drive the E530 servo, and then connect the 5V differential signal of the pulse output driven by the E530 to the 5V differential to 24V single-ended adapter board, and finally connect the PLC encoder counting channel as the counting data source. At the same time, an external switch signal is connected to DI0 to trigger the interrupt and DI1 to trigger the probe. DO6 is configured to compare outputs.

2.Software and hardware versions

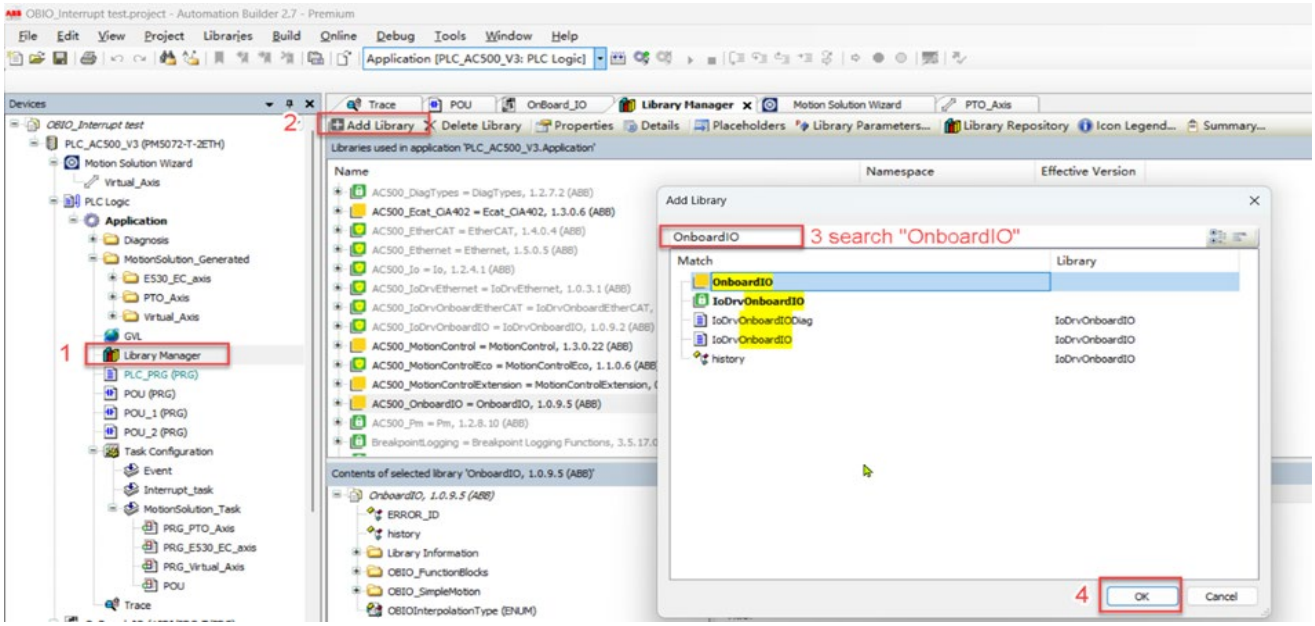
The test and accompanying routines in this application note are based on the following hardware and software versions:

PLC programming software	Automation builder	AB2.7
Eco PLC	PM5052	V3
Servo drive debugging software	ABB Servo Composer	V1.03
Servo drives	ABB E530PT	Firmware: 1.1.0.4

When using OBIO-related function blocks, you need to add a "AC500_OnboardIO" library file in the automation builder.

Here's how it works:

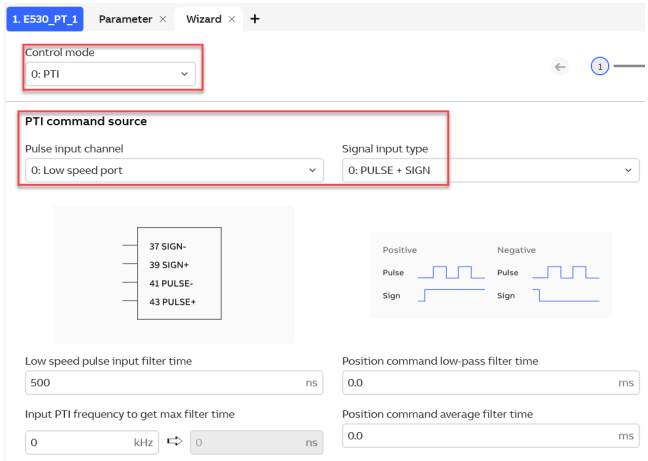
1.Library Manager-> 2.Add Library->3.Search OnboardIO-> 4.click OK to add OnboardIO library.



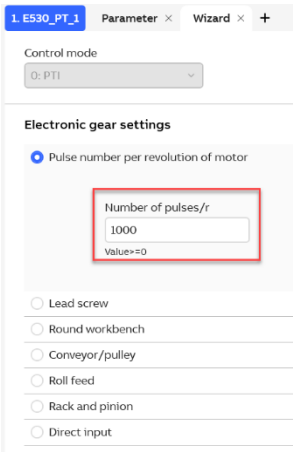
3.Basic configuration of servo drives

In this demonstration, the E530 driver is set to PTI mode, the number of pulses required for one rotation of the motor is 1000, the PTO signal source selects the motor encoder feedback, and the number of PTO pulses per revolution of the motor is 10000 Servo composer is configured as follows:

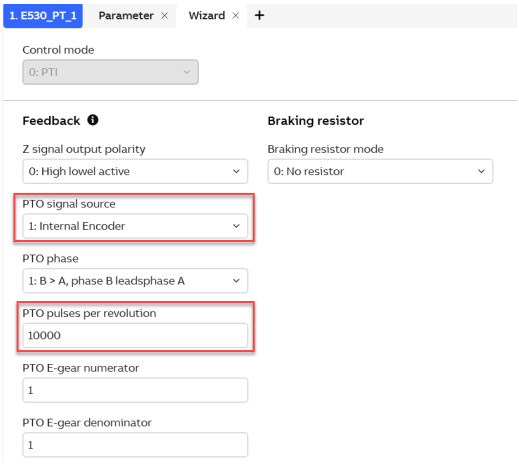
Open the Wizard



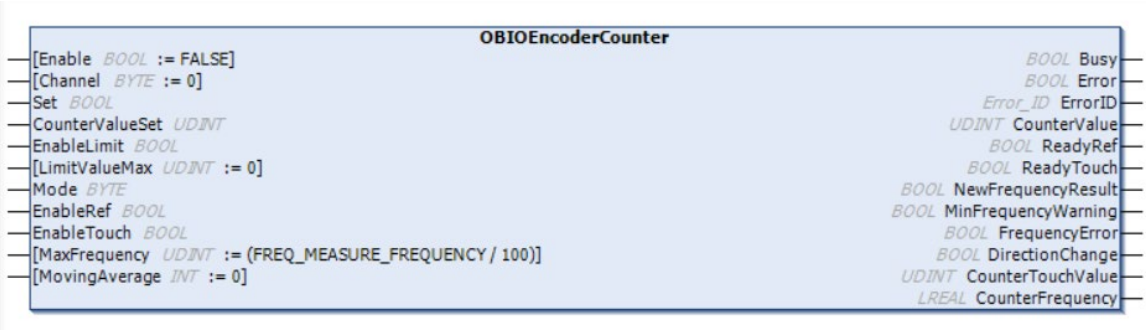
Then Enter Pulses



Then enter Source



4. Introduction of high-speed counting function OBIOEncoderCounter

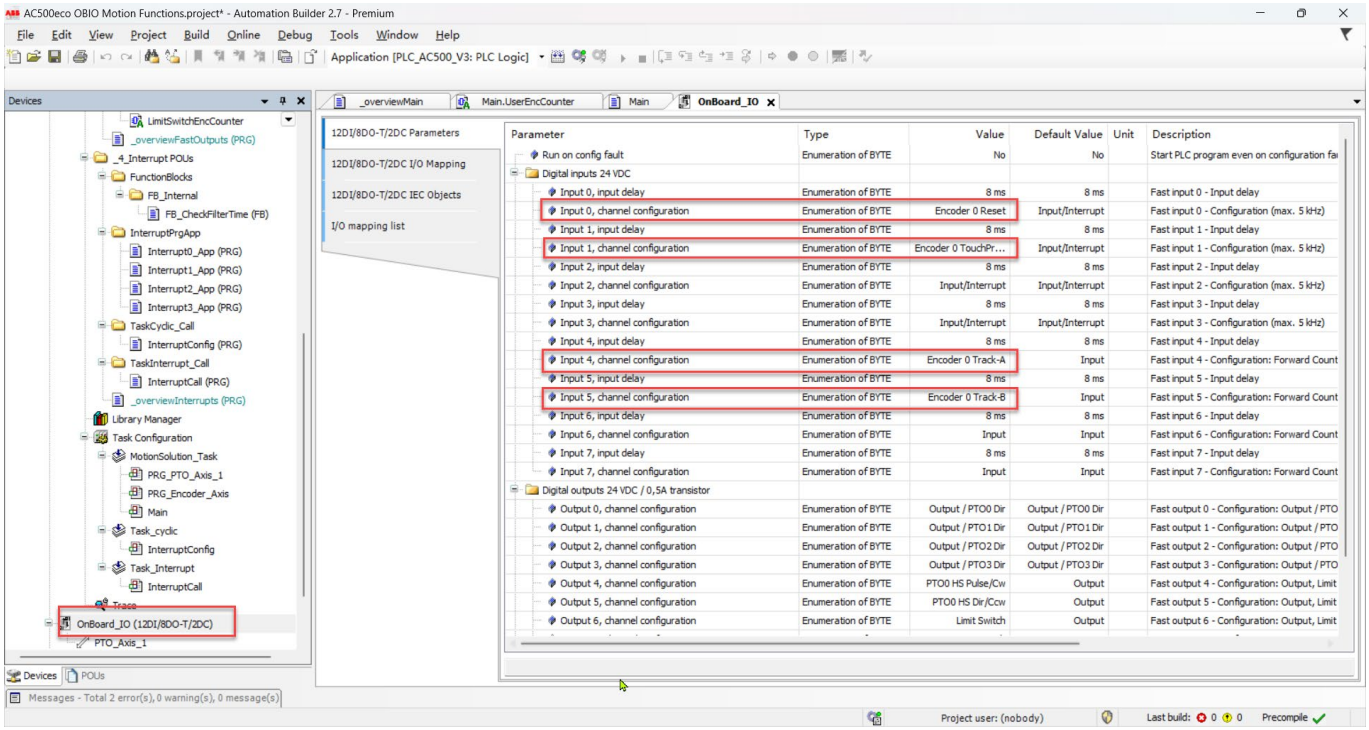


This function block is used for encoder counting in the eco V3 PLC, which currently integrates two encoder counting channels, Encoder0 (Input4/5) and Encoder1 (Input6/7), with a maximum counting frequency of 200kHz.

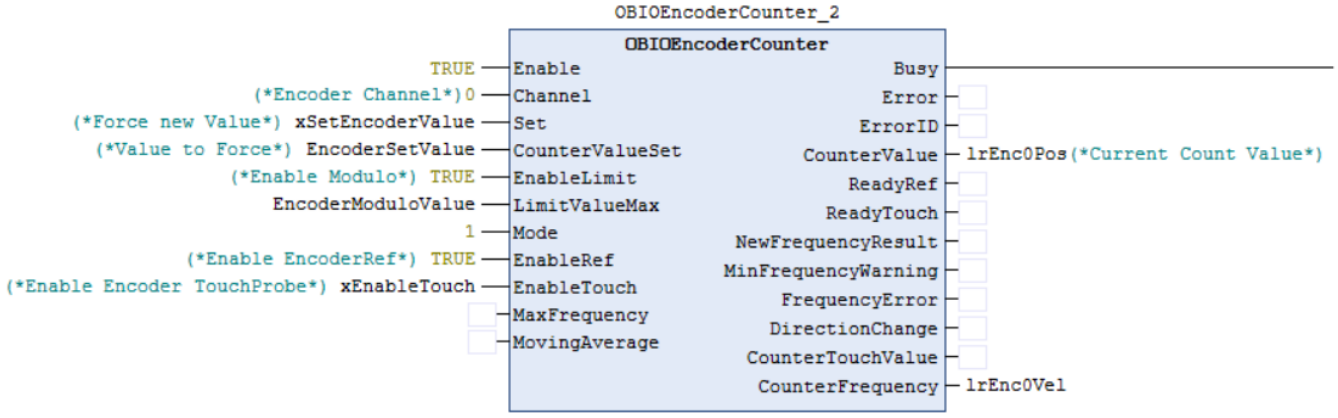
The input and output pins are described as follows:

range	Pin name	data type	Initial value	illustrate
Input	Enable	Bool	FALSE	The rising edge enables the counting operation, and the output pin Busy will be set to True. The falling edge interrupts the counting operation, and after the break, all output pins are reset.
	Channel	BYTE	0	Count the channel number, select channel 0/1 for the encoder count.
	Set	Bool		The rising edge signal sets the value of CounterValue to the value of CounterValueSet
	CounterValueSet	UDINT		CounterValue
	EnableLimit	UDINT		The count value is limited, if false, the count value CounterValue is infinite, and when it is true, the count value CounterValue is from 0 to LimitValueMax, the count value reaches the maximum and then recounts from 0. The rising edge signal for this input sets a new LimitValueMax value.
	LimitValueMax	UDINT	0	The upper limit of the count value CounterValue, when EnableLimit=true, the count value CounterValue will be 0 to LimitValueMax- 1.
	Mode	BYTE		Mode=0 is the encoder quadrature mode, and the rising/falling edges of all AB phases will be counted. Mode=1 is the pulse plus direction mode, and the rising edge of the Enable triggers the setting of the counting mode.
	EnableRef	Bool		Enable the reference mode. When EnableRef=true, the rising edge signal of the Encoder reset input configured in OnboardIO will set the count value CounterValue to CounterValueSetvalue.
	EnableTouch	Bool		Enable the probe function. When EnableTouch= true, the rising edge signal of the Encoder 0 Touchprobe input configured in OnboardIO will capture the current actual count value as the CounterTouchValue.
	MaxFrequency	UDINT		Frequency measurement accuracy reference value, which usually does not need to be set.
	MovingAverage	INT	0	When the values are 2, 3, and 4, the values corresponding to 2, 3, and 4 cycles are output to CounterFrequency, and usually do not need to be set.
Output	Busy	BOOL		The count operation is running while the output pin Error is False.
	Error	BOOL		The counting operation has a failure and stops counting.
	Error_ID	Error_ID	0	Fault codes.
	CounterValue	UDINT		Actual count value.
	ReadyRef	BOOL		Indicates that EnableRef is ready.
	ReadyTouch	BOOL		Indicates that the CounterTouchValue is ready.
	NewFrequencyResult	BOOL		New frequency measurements are available.
	MinFrequencyWarning	BOOL		Below the minimum measurement frequency.
	FrequencyError	BOOL		Frequency measurement failure.
	DirectionChange	BOOL		Compared to the previous cycle, the counting direction changes.
	CounterTouchValue	UDINT		The captured counter value, which is valid in ReadyTouch
	CounterFrequency	LREAL		Count frequency measurements.

Before use, the encoder count channel needs to be configured on the Onboard IO: OnBoard_IO-> Input 4/5-> Encoder 0 Track-A/B, Input 0 is configured as the encoder count reset signal channel, and Input 1 is configured as the encoder count probe signal channel



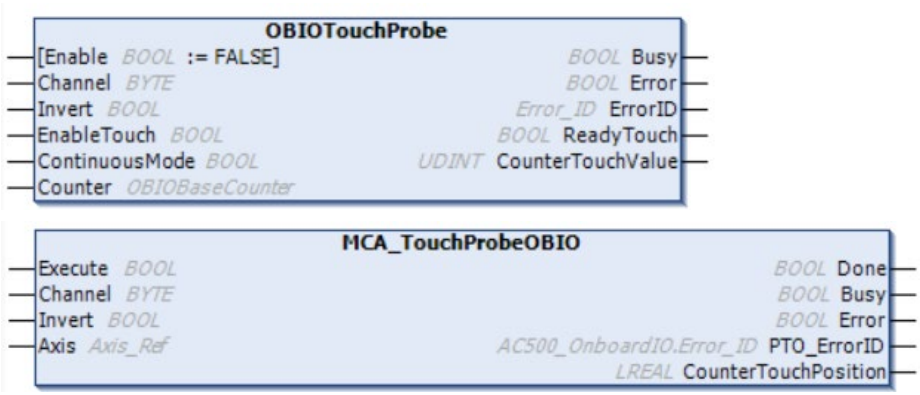
Then call and instantiate the OBIOEncoderCounter function block in the program, as shown in the following figure:



In this example, Input4/5 is configured as Encoder 0 (Channel=0), the counting method is pulse plus direction (Mode=1), and the upper limit of the count is set to EncoderModuloValue=20000 (CounterValue will be in the range of 0 to 19999Perimeter counting). When xSetEncoderValue=True, the value of CounterValue will be forcibly set to the value of EncoderSetValue. Encoder Count Reference Mode (EnableRef=True) is enabled, and when Input 0 has a rising edge signal, the value of CounterValue will be forcibly set to the value of EncoderSetValue。 When XEnbaleTouch=True and Input 1 has a rising edge signal, the current actual count value is captured and displayed in CounterTouchValue.

5.Probe function OBIOTouchProbe, MCA_TouchProbeOBIO introduction

The Eco PLC input channel integrates the probe function, and the probe capture will be independent of the PLC cycle cycle, saving the probe capture value with as little delay as possible. The main probe function blocks used are OBIOTouchProbe and MCA_TouchProbeOBIO. Talking about different probe functions that can be configured for different data sources, this chapter will be divided into encoder axis, encoder count, and PTO axis to introduce probe functions.



OBIOTouchProbe for probe capture for encoder counting and encoder axis position, MCA_TouchProbeOBIO probe capture for PTO axis position.

The input and output pins of the OBIOTouchProbe function block are described as follows:

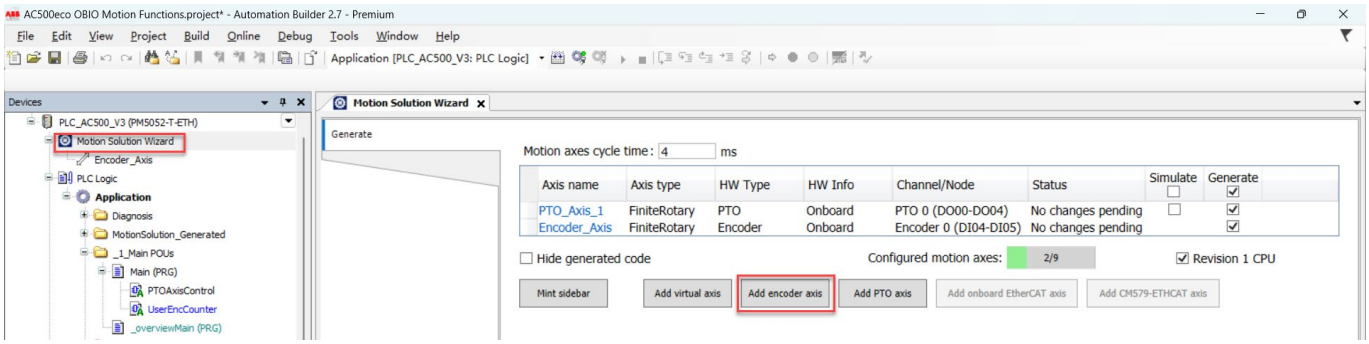
range	Pin name	data type	Initial value	illustrate
Input	Enable	Bool	FALSE	The rising edge enables probe operation, and the output pin Busy is set to True. The falling edge interrupts probe operation, after which all output pins are reset.
	Channel	BYTE	0	Probe channel numbers 0-3, which need to be configured in the Onboard IO.
	Invert	Bool		Invert=false, the rising edge signal triggers the probe, Invert=True, the falling edge signal triggers the probe
	EnableTouch	Bool	FALSE	Enables the probe trigger mode to capture the current count value as the CounterTouchValue when the probe trigger channel configured in the Onboard IO has a rising edge signal.
	ContinuousMode	BOOL	0	When EnableTouch=True, and ContinuousMode=True, the probe function will automatically re-trigger. In this mode, the output pin, ReadyTouch, will output a True signal for one scan cycle. When ContinuousMode=false, the rising edge signal of the EnableTouch triggers the next probe and ReadyTouch will remain True untilEnableTouch=false。
Output	Busy	BOOL	FALSE	The probe operation is running while the output pin Error is False.
	Error	BOOL	FALSE	The probe operation is faulty and has stopped.
	Error_ID	Error_ID	NO_Error	Fault codes.
	CounterTouchValue	UDINT		The captured counter value, which is valid in ReadyTouch
Inout	Counter	OBIOBaseCounter		Link the data source where the probe function is functional

The input and output pins of the MCA_TouchProbeOBIO function block are described as follows:

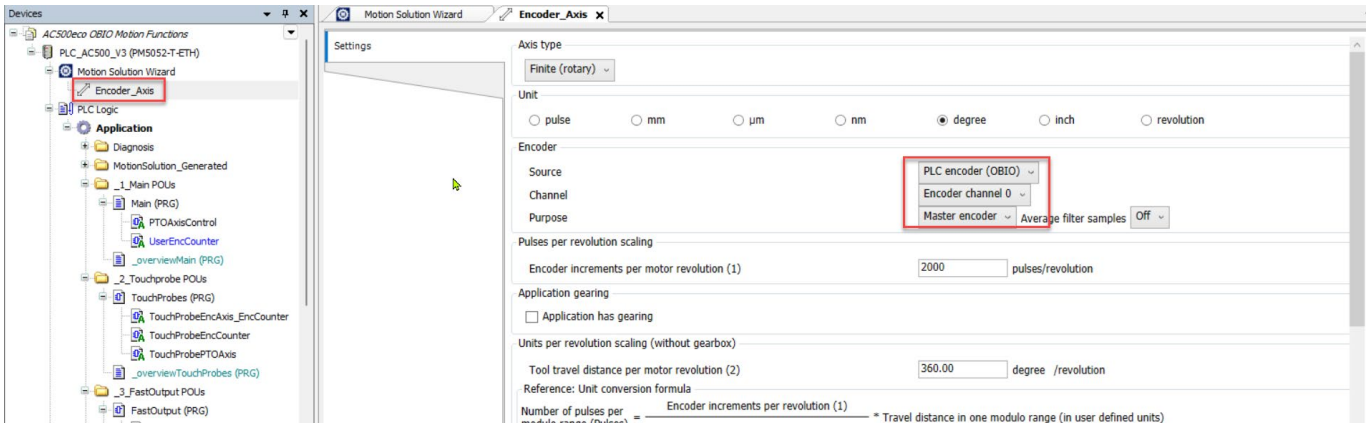
range	Pin name	data type	Initial value	illustrate
Input	Execute	Bool	FALSE	The rising edge enables probe operation
	Channel	BYTE	0	Probe channel numbers 0-3, which need to be configured in the Onboard IO.
	Invert	Bool		Invert=false, the rising edge signal triggers the probe, Invert=True, the falling edge signal triggers the probe
	Axis		FALSE	Link to PTO shaft
Output	Done	BOOL		Indicates that the CounterTouchPosition is ready.
	Busy	BOOL	FALSE	The probe operation is running while the output pin Error is False.
	Error	BOOL	FALSE	The probe operation is faulty and has stopped.
	PTO_ErrorID	AC500_OnboardIO. Error_ID	NO_Error	Fault codes.
	CounterTouchPosition	LREAL		Captures the current position value, which is valid in ReadyTouch

5.1 Probe function of encoder shaft Encoder_Axis:

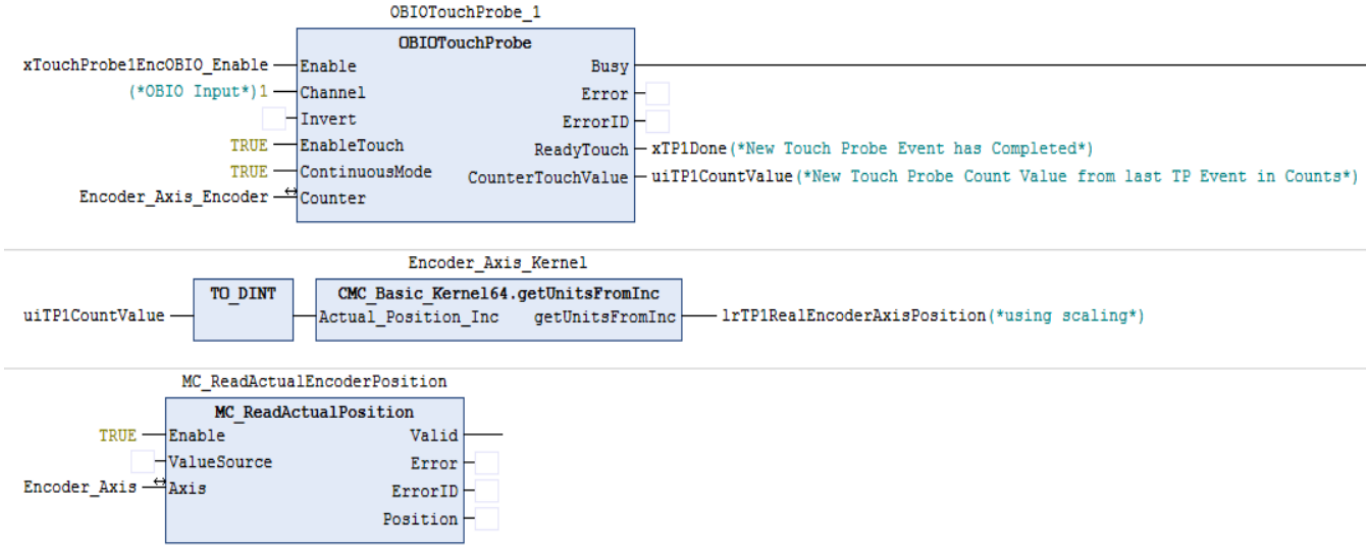
First, in the Motion Solution Wizard, add 1 encoder axis, Motion Solution Wizard -> add encoder axis:



Then select the data source, channel and destination of the encoder axis on the encoder axis configuration page, and in this example, Encoder channel 0(Input4/5) is used as the data source of the encoder axis for the encoder spindle.



Then call and instantiate the OBIOTouchProbe and CMC_Basic_Kernel64.getUnitsFromInc function blocks in the program

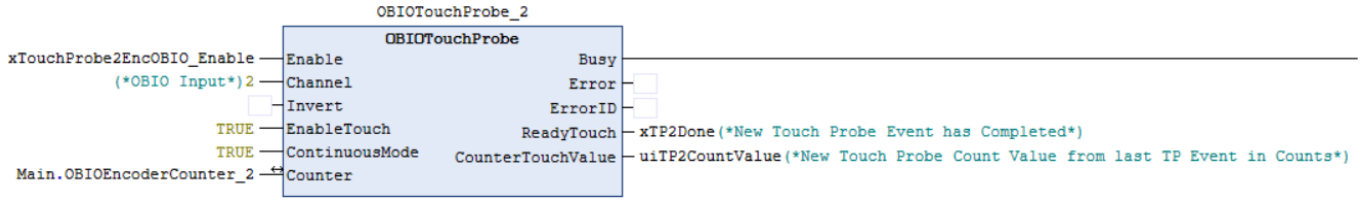


In this example, for the encoder axis Encoder_Axis, OBIOTouchProbe is configured, Input 1 is configured as TouchProbe1 (Channel=1), and the counting source of the encoder axis is linked to the counter, and the continuous trigger mode (ContinousMode=) is activatedTrue）。When the encoder axis is running, when there is a rising edge signal in Input1, the TouchProbe function is triggered, the encoder axis count value is captured (note that this value is the number of pulses, not the actual position of the encoder axis), and then use the CMC_Basic_ The Kernel64.getUnitsFromInc function block converts the captured count value into the actual position of the encoder axis.

5.2 Probe function for encoder counting:

Unlike the count of the encoder shaft, the encoder count is simply a count of the number of input pulses.

Start by calling and instantiating OBIOTouchProbe: in the program



In this example, OBIOTouchProbe is configured for encoder counting, Input 2 is configured as TouchProbe2 (Channel=2), and then the encoder count source is linked to the counter and the continuous trigger mode (ContinousMode=True) is activated. When the OBIOEncoderCounter_2 function block is counting, and there is a rising edge signal in Input2, the TouchProbe function is triggered to capture the current counting value.

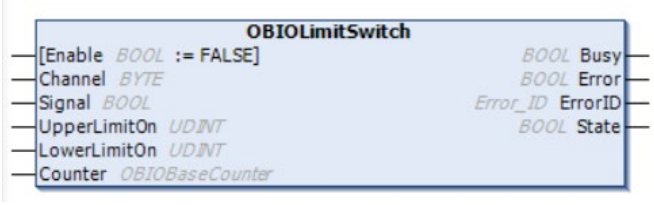
5.3 Probe function of PTO axis:

First, add the PTO axis in the Motion Solution Wizard, and then configure Input 3 as Touchpeobe3 in the Onboard IO; The MCA_TouchProbeOBIO:: is then invoked and instantiated in the program

In this example, for the probe function of the PTO axis, a MCA_TouchProbeOBIO is configured, Input 3 is configured as TouchProbe3 (Channel=3), and the PTO axis is linked to the axis. When the PTO axis is running, when there is a rising edge signal in Input3, the TouchProbe function is triggered to capture the current actual position of the PTO axis.

6. Introduction to the Limit Switch function for comparative output

The Eco PLC output channel integrates a compare output function, which will be independent of the PLC cycle cycle, with as little delay as possible to quickly output the channel. The function block used is OBIOLimitSwitch, which is mainly used to configure 1 output channel, and when the data of the Counter count reaches the set upper and lower limits, the configured output channel is activated. In this chapter, we will introduce the Compare Output feature.

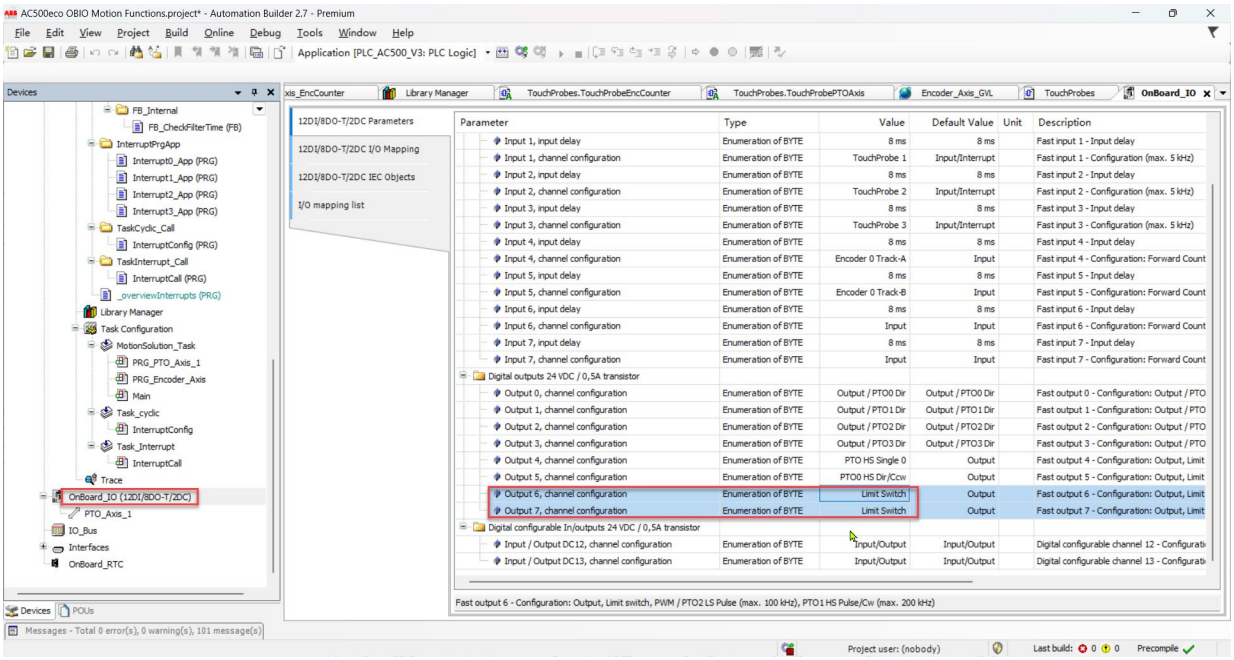


OBIOLimitSwitch Input/Output Pin Description:

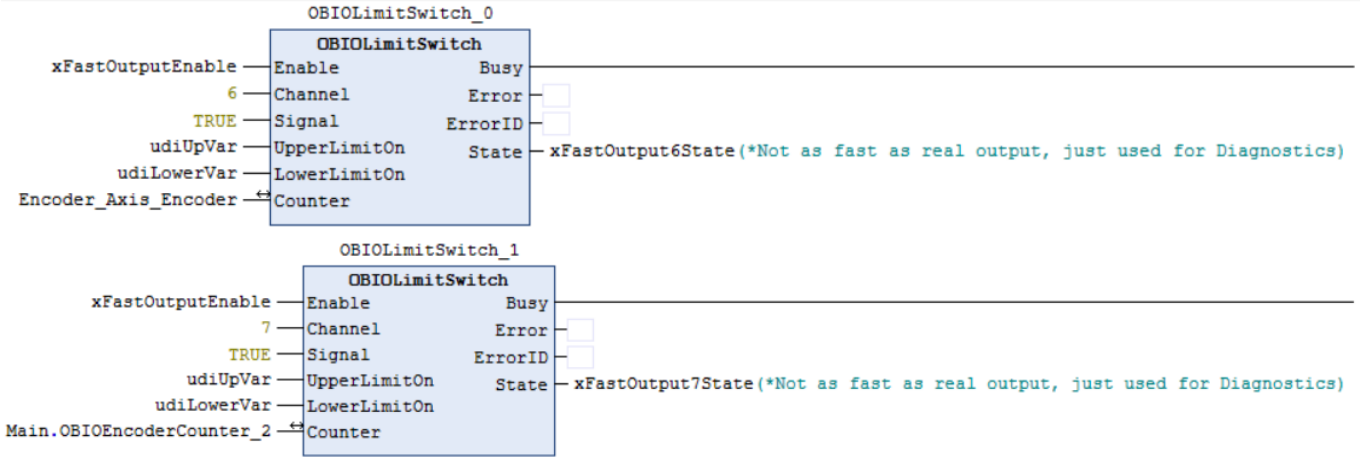
range	Pin name	data type	Initial value	illustrate
Input	Enable	Bool	FALSE	The rising edge enables the comparison of output operations
	Channel	BYTE	0	Compare output channel numbers 0-7, which needs to be configured in the Onboard IO.
	Signal	Bool		When the count value is between UpperLimitOn and LowerLimitOn, select whether the configured channel output signal is high or low.
	UpperLimitOn	UDINT		Upper limit
	LowerLimitOn	UDINT		under the limit
Output	Busy	BOOL		Indicates that the CounterTouchPosition is ready.

	Error	BOOL	FALSE	The compare output operation is running with the output pin Error set to False.
	ErrorID	Error_ID	NO_Error	The compare output operation is faulty and has stopped.
	State	BOOL		Fault codes.
Inout	Counter	OBIOBaseCounter		Link to the counting source that the Compare Output function does

Configure the required output channel in the Onboard IO as Limit Switch.



The OBIOLimitSwitch function block is then called and instantiated in the program



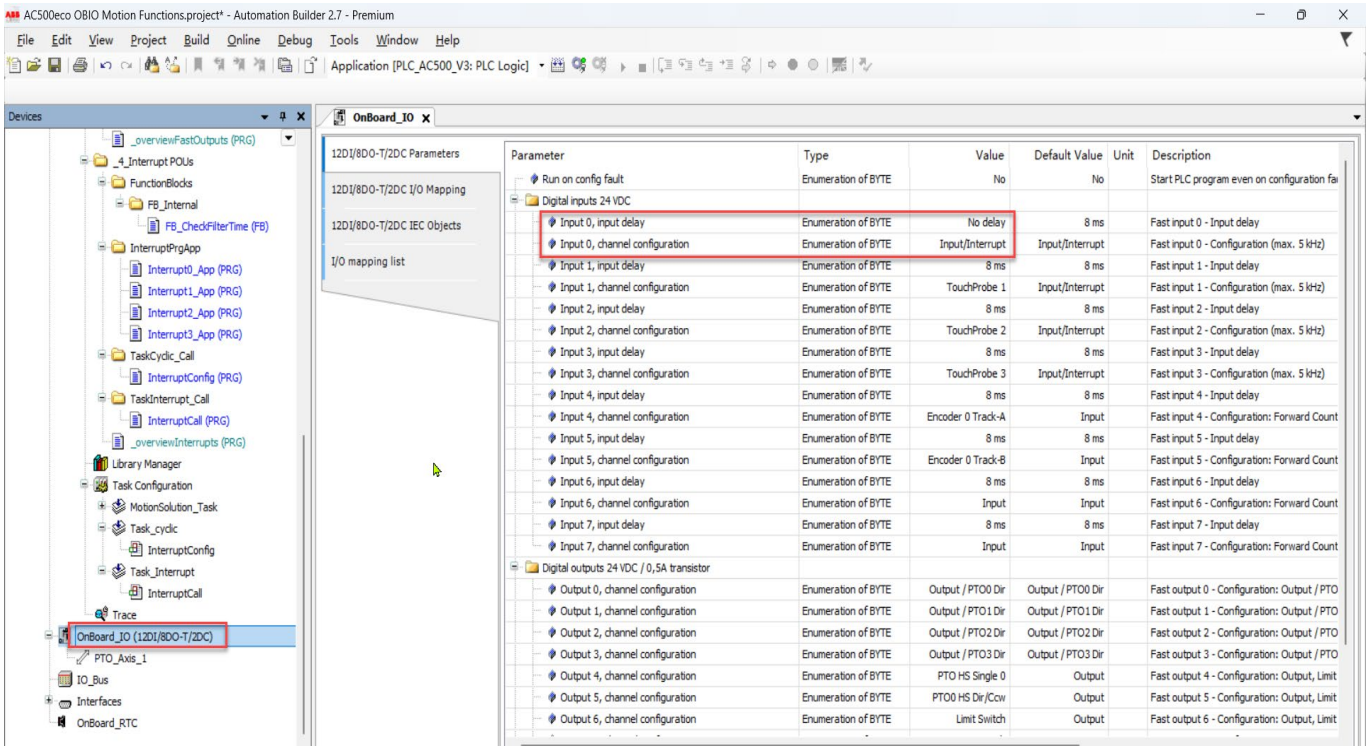
In this example, DO6 and DO7 are configured as Limit Switch (Channel=6/7), the upper limit is set to udiUpVar=200, and the lower limit is set to udiLowerVar=100

And link to the encoder axis counting source and encoder counting source respectively, set signal=true, when the 100< count value < 200, DO6 and DO7 will output high.

7. Introduction to the Interrupt function

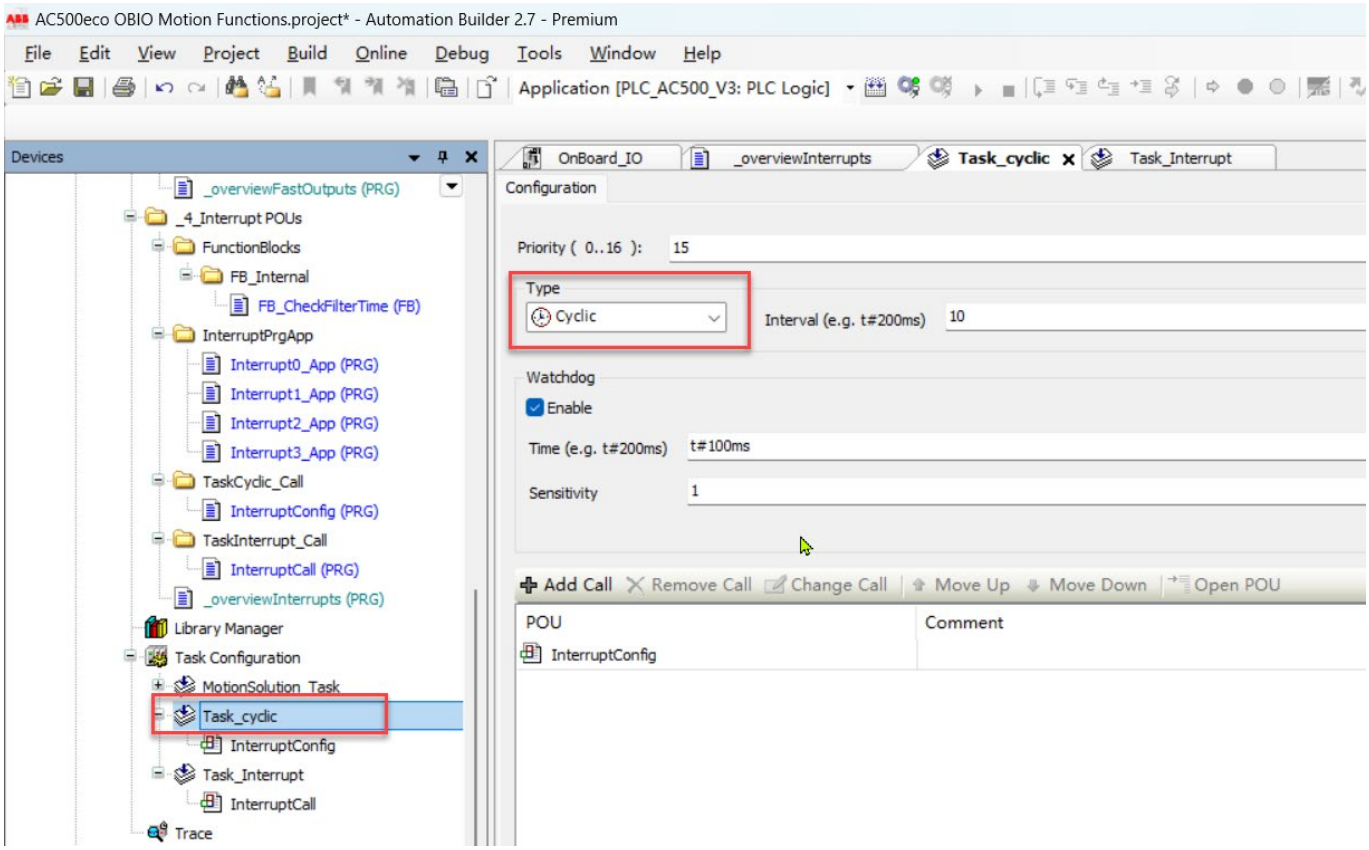
Eco PLC integrates the function of triggering and executing interrupt task in the input channel, the 4 channels of DI0 to DI3 of eco PLC can be configured as interrupt signal sources, and the rising edge signal of the interrupt input channel triggers the interrupt task, and the maximum interrupt sampling frequency of Eco PLC is currently 5kHz. This chapter describes how to use the interrupt function.

In this example, the DI0 channel is set to Interrupt and the input delay time device is No delay.

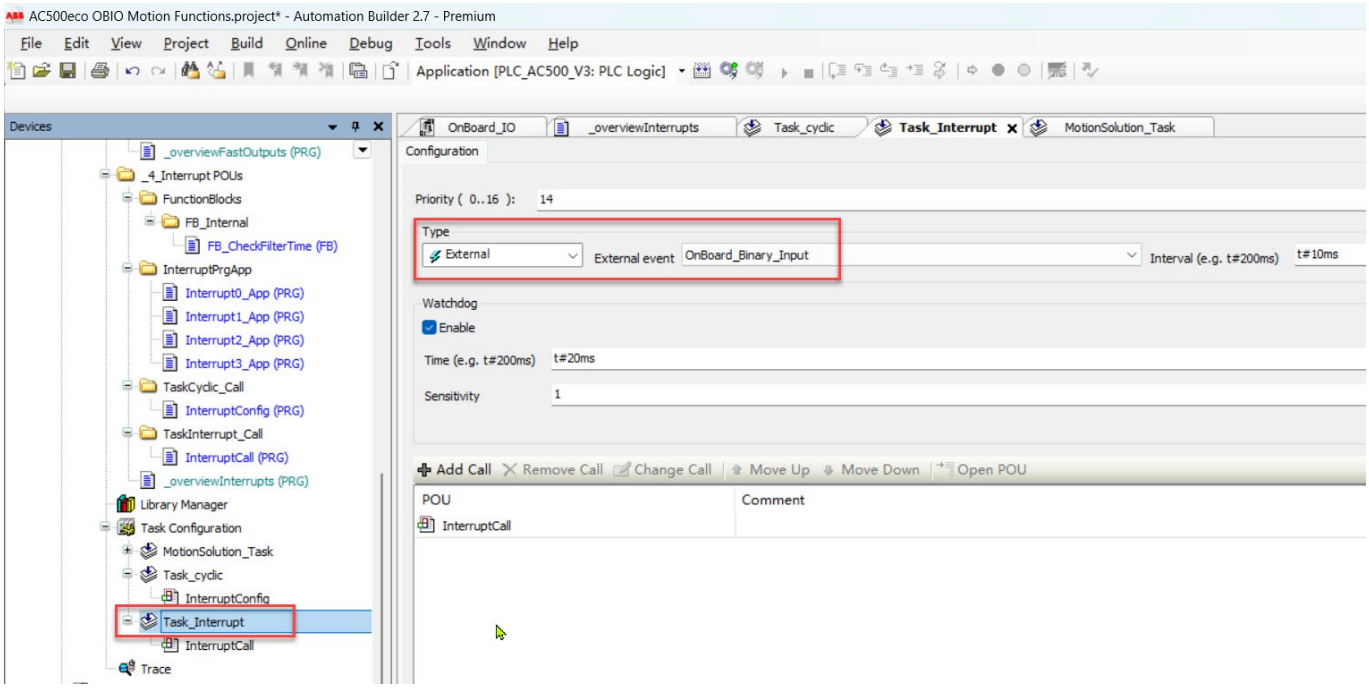


Then, create a cyclic-task and an external-task, and set at least one interrupt task and one recurring task in the user project when using the interrupt function.

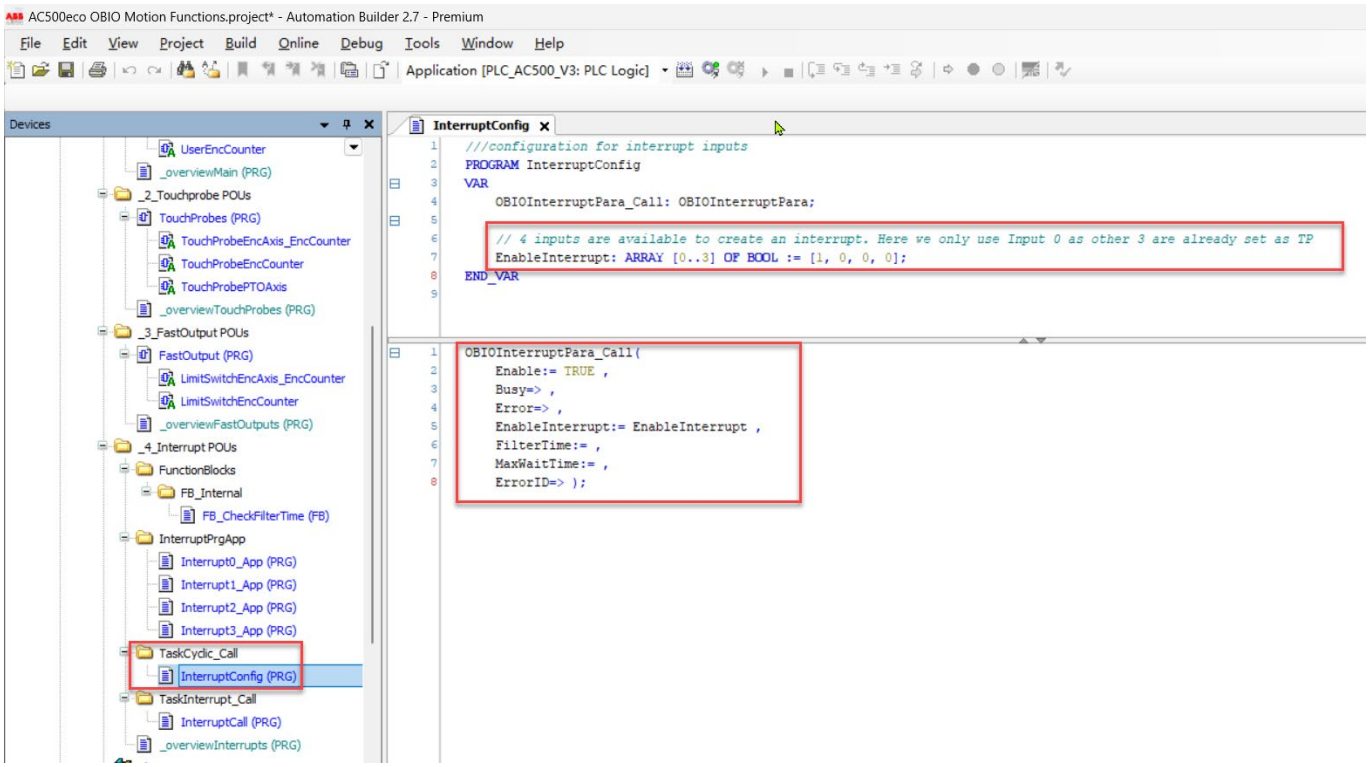
To create a cyclic-task, the following task is created:



Create an interrupt task External-task:



Call and instantiate the OBIOInterruptPara function block in the program of the loop task, and create an array variable that correlates which channel is used as the interrupt signal



In this example, the DI0 channel has been configured as an interrupt Interrupt, so as shown in the figure above, you need to create an array in the program EnableInterrupt: ARRAY [0..3] OF BOOL := [1, 0, 0, 0], where the first element of the array is 1, and the mapping DI0 channel is configured as the interrupt input function.

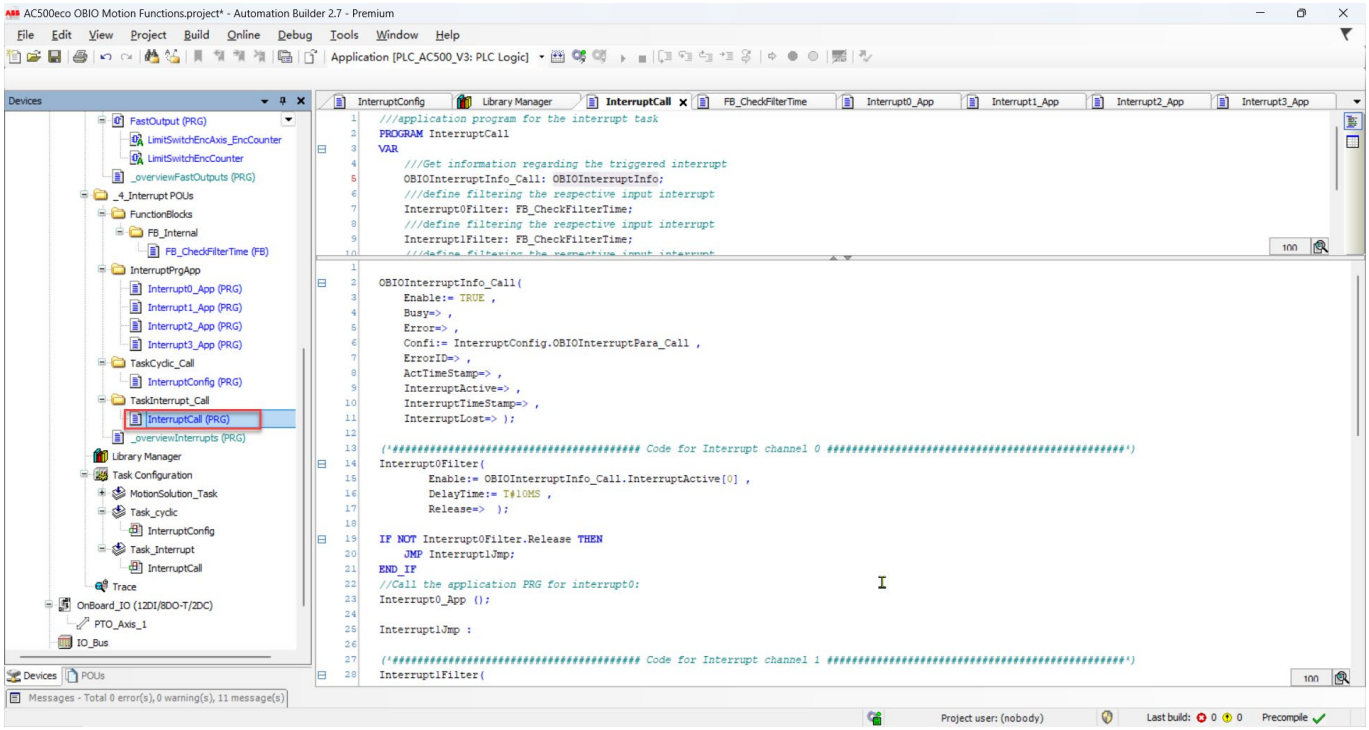
The function of the OBIOInterruptPara function block is to configure the parameterization and enable interrupting the input function. Its input and output pins are described as follows:

range	Pin name	data type	Initial value	illustrate
Input	Enable	Bool	FALSE	Ascending edge enables to interrupt parameter configuration operations
	EnableInterrupt	ARRAY [0..arrLimit] OF BOOL		To enable the interrupt channel corresponding to DI0 to DI3, you need to configure it in the Onboard IO, and then create an array variable in the program to map the DI0-3 channels
	FilterTime	UDINT		Set the filtering time (microseconds) as the minimum distance between the 2 interrupt events
	MaxWaitTime	UDINT		If no event is detected, set the maximum time (in microseconds) for starting the task
Output	Busy	BOOL	FALSE	The interrupt operation is running with the output pin Error set to False
	Error	BOOL	FALSE	The outage is faulty and has stopped
	ErrorID	Error_ID	NO_Error	Fault codes

Then call and instantiate the OBIOInterruptInfo function block in the Interrupt-task program, which is not required. Its main role is to provide information about which input channel triggered the interrupt task, and the timestamp when it occurred. This function block can only be called in interrupt the task. Its input and output pins are described as follows:

range	Pin name	data type	Initial value	illustrate
Input	Enable	Bool	FALSE	Ascending edge enables interrupts information operations
Output	Busy	BOOL	FALSE	The interrupt operation is running with the output pin Error set to False
	Error	BOOL	FALSE	The outage is faulty and has stopped
	ErrorID	Error_ID	NO_Error	Fault codes
	ActTimeStamp	UDINT		Timestamps are calculated from the time the interrupt is triggered. If you use FilterTime and >1 interrupt occurs in a row, this time may not be the same as InterruptTimeStamp
	InterruptActive	ARRAY [0..arrLimit] OF BOOL		Interrupt activation indication
	InterruptTimeStamp	ARRAY [0..arrLimit] OF UDINT		The timestamp of each interrupt occurs, see ActTimeStamp
	InterruptLost	ARRAY [0..arrLimit] OF UDINT		If the outage is too fast, the number of lost interrupts is counted. Different binary inputs can be close together, but the ascending segment of a particular input needs to be separated from the FilterTime, otherwise the information will be lost.
Inout	Confi	OBIOInterruptPara		Link to the interrupt configuration OBIOInterruptPara (FB).

Finally, write the program that needs to be executed in the interrupt task and call it in the interrupt task.



In this example, OBIOInterruptInfo is called in the interrupt task program, and a program FB_CheckFilterTime is written to determine whether the deltaTime between the interrupts triggered by each channel is less than the set interval（DelayTime=10ms）。When the actual interrupt trigger interval > the set interval, release will be True, otherwise it will be false. The PTO axis and encoder axis positions are also mathematically calculated in the interrupt program.

8.Summary

1. When each function block is used, it is necessary to associate the relevant input and output channels, and configure the input and output channels as special functions, and the channels configured as special functions will not be used for other logic control;
2. When the encoder axis is generated, the Motion solution will automatically call the OBIOEncoderCounter function block, and the Mode pin of the OBIOEncoderCounter can be modified in the Kernel program to modify the encoder axis counting mode (pulse + direction mode/AB phase quadrature mode);
3. When configuring the input channel, "TouchProbe 0/1/2/3" is used with the function blocks "OBIOTouchProbe" and "MCA_TouchProbeOBIO", and the Touchprobe channel "Chananel" needs to be selected in the function block. "Encoder 0/1 Touchprobe" is used in conjunction with the Encoder 0/1 and "OBIOEncoderCounter" function blocks.
4. The maximum acquisition frequency of interrupt input signal is 5kHz, 200ns, and signals exceeding 5kHz frequency or lasting less than 200ns may not be able to trigger the interrupt function normally.
5. When using the interrupt function, in addition to configuring the input channel as the interrupt function, the user needs to call OBIOInterruptPara in the program and establish the channel of array variables to associate the interrupt signal, and at least one interrupt task and one loop task must be set in the user's project. When any 1 channel that has been configured for interrupt function is activated, the PLC will perform the interrupt task.

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