



**PLCnext**

**FB\_Stepper\_MotionBlock**

**Version: 1.0**

**For AXC F 2152 Only**

**For PLCnext Engineer  $\geq$  2023.6**



## Table of Contents

1. Overview .....	3
2. Change Notes .....	3
3. Function Blocks .....	3
4. FB_Stepper_MotionBlock .....	4
4.1 Overview .....	4
4.2 Change Notes .....	5
4.3 Function Block Call .....	5
4.4 Input Parameters .....	5
4.5 Output Parameters .....	7
5. AXL I/O Hardware - PLCnext Required Settings .....	8
5.1 AXL SE DO 16/1 .....	8
5.2 AXL F DO xxxx .....	8
5.3.1 AXL F PWM2 Parameter .....	8
5.3.2 AXL F PWM2 DataList .....	8
5.3.3 AXL F PWM2 Wiring Overview .....	9
6.0 PLCnext Engineer Required Setup and Settings .....	11
6.1 TASK / ESM Settings .....	11
6.2 Axioline F Settings .....	11
6.3 Axioline F Settings .....	12



## 1. Overview

The Function Block **FB\_Stepper\_MotionBlock** allows for a simple and integrated environment for Programming a Stepper Motor System. This includes Homing and Absolute Positioning features . All dimensions are in millimeters.

## 2. Change Notes

Library Version	Library Build	PLCnext Engineer Version	Change Notes	Supported PLC
1	20231106	>= 2023.6	Initial Release	AXC F 2152

## 3. Function Blocks

Function Block	Description	Ver	Supported Articles	License
FB_Stepper_MotionBlock_V1	Creates Interface for Programming Stepper Drives	1		none



## 4. FB\_Stepper\_MotionBlock

### 4.1 Overview

The FB\_Stepper\_MotionBlock function block uses Input Variables to change the standard Stepper Motor 'Counts' into Real-World millimeter Units. With the Entry of the Stepper Counts per Motor Revolution and the Distance in millimeters the Motor Shaft Travels per 1 Rotation, this Function Block will then allow Homing and Absolute Position Moves using mm units – instead of 'COUNTS'. This is particularly useful when you want to know total output travel in distance – rather than calculate every time a 'count' is moved. Measuring or Calculating true Travel distances is now integrated.

This Function Block Requires the use of the AXL F PWM Module. See Section 5 for Required Set Up of the Module and the Required Settings to the PLCnext Engineer Task and Settings.

Failure to Make the required Changes may result in poor or unrepeatable performance of the system.

Since Absolute Positioning is active, a Successful Home must occur before an Absolute Command is Accepted.

In Order to Successfully Home the Motor, a physical Limit Switch must be installed and connected to the In\_HomeLimitSwitch Input on the Function Block via a standard Digital Input.

When Home is Requested, the Motor will Move negative toward the Limit Switch. Once the Switch is detected the Homing Routine will Complete the Function.

If desired, a Home Offset (In\_HomeOffsetPosition) can be entered, which once Homing is Completed, this Value will be forced in the Current Position of the Motor – No actual Movement Occurs. This can be a very useful feature if due to mechanical reasons the need is to have the 'Home Position' different from the location of the Home Switch.

HOMING and START Commands are accepted on a Rising Edge and will be terminated using the STOP input.

**Note:** The STOP Command takes priority over Homing and Start Commands and must first be 'OFF' or 'FALSE' for any movement to occur.

Once Homed, the Software Overtravel Functions are activated if their value is not equal to the Default of 0.00. A value in 0.00 Disables the function of the associated OverTravel Function.

**Note:** The AXC F 2152 has a maximum scan time of 1ms. This Function Block provides a Pulse of 50% Duty Cycle – meaning that the fastest Frequency Output would be 500 Hz (1ms On / 1ms Off).

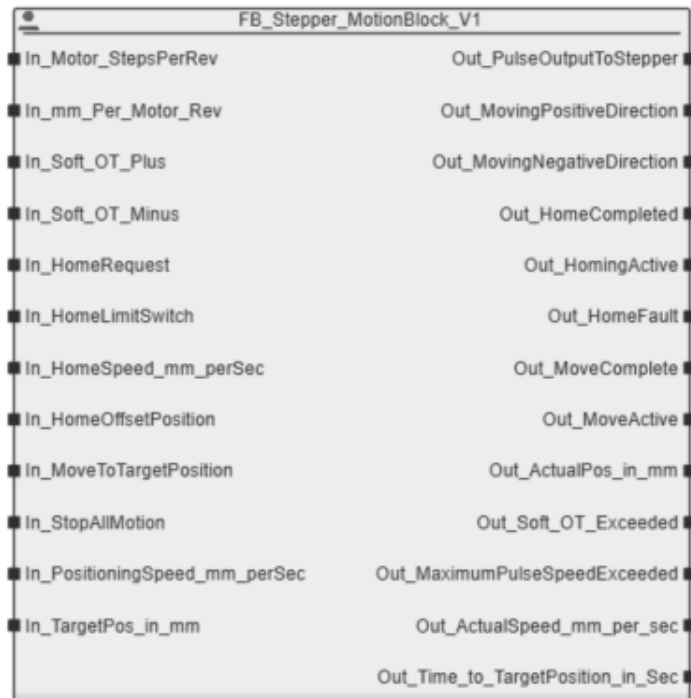
This Function Blocks does not parameterize or control any AXIO Module.



## 4.2 Change Notes

Version	Change Note
1	Initial Release

## 4.3 Function Block Call



## 4.4 Input Parameters

Name	Type	Description
In_Motor_StepsPerRev	REAL	Enter the Number of Counts that the Stepper Motor Expects for 1 Motor Revolution.
In_mm_Per_Motor_Rev	REAL	Enter the Distance in mm that the System Output moves when the Motor turns 1 Revolution
In_Soft_OT_Plus	REAL	<p>Enter the Software Positive Overtravel Value. This is only valid after a successful Homing Sequence and activated only if the value is not equal to 0.00.</p> <p>If a 'Start' command is issued and the Target Position is Greater than this value, the Output 'Out_Soft_OT_Exceeded' will be Active and the Move will not be completed.</p>

In_Soft_OT_Minus	REAL	Enter the Software Negative Overtravel Value. This is only valid after a successful Homing Sequence and activated only if the value is not equal to 0.00. If a 'Start' command is issued and the Target Position is Greater than this value, the Output 'Out_Soft_OT_Exceeded' will be Active and the Move will not be executed.
In_HomeRequest	BOOL	On a Rising edge, a Homing Sequence is initiated. A 'Stop' command will cancel the Homing Sequence.
In_HomeLimitSwitch	BOOL	Connect the Physical Home Limit Switch Input Tag to this Terminal. A successful Home Sequence cannot be executed with this Input.
In_HomeSpeed_mm_perSec	REAL	Enter the Homing Speed in mm that the system moves towards the Home Switch.
In_HomeOffsetPosition	REAL	Enter the Value that the systems assigns to the Home Limit Switch location AFTER a successful Home Sequence. The default value is 0.00 and can be used to artificially 'move' the homing reference point to a position other than the physical Limit Switch location.
In_MoveToTargetPosition	BOOL	On a Rising edge, a Move to Target Position is initiated at the PositioningSpeed. A 'Stop' command will cancel this Sequence. If a CmdPos is greater than the Software OT Plus Value OR if the CmdPos is Less than the Software OT Minus Value, The Output the Output 'Out_Soft_OT_Exceeded' will be Active and the Move will not be executed.
In_StopAllMotion	BOOL	This Input Stops all Motion. Motion cannot be initiated until this Input is OFF or FALSE
In_PositioningSpeed_mm_perSec	REAL	When a rising edge of a 'Start' Input is received, the System will move that this speed from its current position to the CmdPos below. Please note that the Actual Position Speed is recalculated and displayed at the Output "Out_ActualSpeed mm per Sec".
In_TargetPos_in_mm	REAL	When a rising edge of a 'Start' Input is received, the System will move that from its current position to the CmdPos at the PositioningSpeed above. If a CmdPos is greater than the Software OT Plus Value OR if the CmdPos is Less than the Software OT Minus Value, The Output the Output 'Out_Soft_OT_Exceeded' will be Active and the Move will not be executed.

## 4.5 Output Parameters

Name	Type	Description
Out_PulseOutputToStepper	BOOL	This Output Bit must be a Global Variable and Must be Tied to the Physical output 'Step' to the Drive. See Section 6.2
Out_MovingPositiveDirection	BOOL	If the Stepper is moving in the 'Positive' Direction, This Bit is On. This Could be used for Setting the 'Direction' Input on the Stepper Drive.
Out_MovingNegativeDirection	BOOL	If the Stepper is moving in the 'Negative' Direction, This Bit is On. This Could be used for Setting the 'Direction' Input on the Stepper Drive..
Out_HomeCompleted	BOOL	Indicates that a successful Home Sequence has been completed. Initiating another Home Command will cancel this output and the System must then successfully execute a new Home Command.
Out_HomingActive	BOOL	Indicates that a Homing Sequence is currently Active.
Out_HomeFault	BOOL	Indicates that a Homing Sequence took longer than 60 seconds and therefore was automatically aborted. If this error occurs, verify the In_HomeLimitSwitch Input to verify performance and Try to Home again. A Request to Home System will automatically reset this Fault Output.
Out_MoveComplete	BOOL	A Position move was executed and the Motor was able to reach the desired position within tolerance.
Out_MoveActive	BOOL	A Position move was Requested and the Target Position has not yet been reached.
Out_ActualPos_in_mm	REAL	Actual Position in mm of the System (Valid only after a Successful Home Sequence has been completed). If Out_HomeCompleted is FALSE or OFF, this Position is not Valid.
Out_Soft_OT_Exceeded	BOOL	A Position Move was requested, but the Target Position was Outside of the Soft Travel Limits entered.
Out_MaximumPulseSpeedExceeded	BOOL	The Programmed Speed is Beyond the capability of this PLC and will be limited to the Value of "Out_ActualSpeed_mm_per_sec that is calculated below.
Out_ActualSpeed_mm_per_Sec	REAL	Based on the Closest Scan available, this value displays the True Output Pulse Scan that will actually be provided.
Out_Time_to_TargetPosition_in_Sec	REAL	This Calculates the Time it Takes to get from the Current Position to the Next Target Position, using the 'Out_ActualSpeed_mm_per_Sec' velocity above. The Calc = $\text{ABS} (\text{Out\_ActualPos\_in\_mm} - \text{In\_TargetPos\_in\_mm}) / \text{Out\_ActualSpeed\_mm\_per\_Sec}$

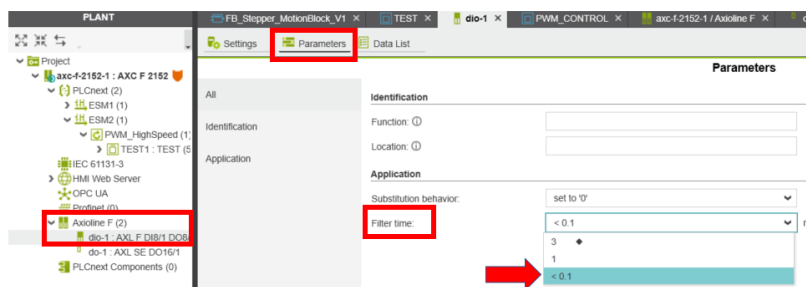
## 5. AXL I/O Hardware - PLCnext Required Settings

### 5.1 AXL SE DO 16/1

When using the Smart Elements AXL SE DO/16 Card as the pulse to the Stepper Drive requires no settings, as the frequency of this output is fixed at 1200 hz (1200 pulses/output). When using the AXC F 2152, the maximum frequency output is 500hz, which is the limiting factor, as this Function Block provides a 50% Duty Cycle. Therefore, a 1ms Scan ON and 1ms Scan OFF, results in 500 Hz.

### 5.2 AXL F DO xxxx

When using Any of the Standard AXL F DO Cards, the 'Filter Time' time settings will affect the performance of the Pulse Output to the Stepper. If a chosen Filter Time is greater than the Pulse Output, the system will not perform to the desired level. The suggestion is to set this value to the Maximum Speed (< 0.1ms) as shown below, so the system is not limited.



#### 5.3.1 AXL F PWM2 Parameter

The Operating Mode of the AXL F PWM2 Module ('Parameters') must be set to Push-Pull Output (as Shown Below):

Channel	
Substitute value behavior during bus reset (PDOOUT):	0 is output to all output bits
Operating mode:	Push-pull output

#### 5.3.2 AXL F PWM2 DataList

A Global Variable must be Assigned to the FB\_Stepper\_MotionBlock's 'Out\_PWM\_PushPull\_Output' terminal.

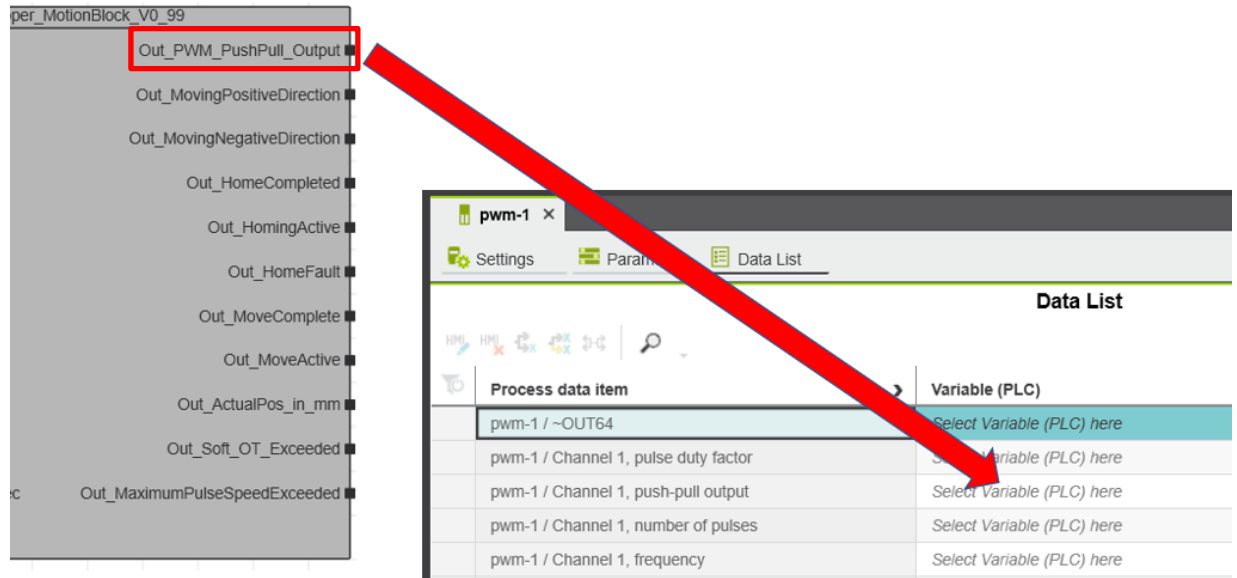
This Global Variable must then be Selected as the Push-Pull Output Variable in the DataList of the Appropriate channel of the PWM Module.

This is the Only Required Connection for the FB to then properly control the 'Steps' to the Drive.



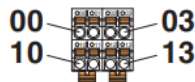


Additionally, These MUST be a connection of the Direction Bits (Either the Out\_MovingPositiveDirection or the Out\_MovingNegativeDirection) from the Function Block below to the Stepper Drive in order for the correct Shaft Direction of the Motor to Occur. If the Motor is moving in the wrong Direction, Select the Opposite output used as this may rectify the issue.



### 5.3.3 AXL F PWM2 Wiring Overview

Depending on the Channel Selected and the Voltage Required by the Stepper System, use the Following Guide Below to Select the Appropriate Output.



Terminal point	Color	Assignment		
Channel 1				
00	Orange	PWM01_24V	PWM output 1	24 V DC
10	Orange	GND	Reference potential	
01	Orange	PWM01_5V	PWM output 1	5 V DC
11	Orange	GND	Reference potential	
Channel 2				
02	Orange	PWM02_24V	PWM output 2	24 V DC
12	Orange	GND	Reference potential	
03	Orange	PWM02_5V	PWM output 2	5 V DC
13	Orange	GND	Reference potential	

For Example.. If the Stepper system was 24VDC Input for Stepping and Channel 1 is Used,

Terminal 00 is the +Step Command, while Terminal 10 is the Voltage Common signal.



**NOTE:** The Direction Signal is NOT included in the above wiring and must use a Standard Digital Output Signal from a Separate Output Card To be achieved. This signal would then be attached to the Variable associate with the Out\_MovingPositiveDirection or Out\_MovingNegativeDirection Terminal from the Main Function Block.



## 6.0 PLCnext Engineer Required Setup and Settings

This FB\_Stepper\_MotionBlock Function Block depends on the proper settings. Failure to implement them as described below may result in undesired or unacceptable performance.

### 6.1 TASK / ESM Settings

This Function Block depends on the proper settings. Set up a Specific Task with 'Cyclic' 1ms Time Frame. In this example, we created a Task in ESM2 and Called it 'PWM\_HighSpeed'.

**Note:** Do not put the entire program in the Task... It is necessary for ONLY the FB\_Stepper\_MotionBlock to be executed at this performance rate. It is suggested that the rest of the program be in ESM1 or at a Higher Priority (this FB must be the Highest Priority) at whatever Type/Scan Rate is desired. The counting utilized in this FB requires tight performance.

Enter task name here								
Enter program instance name here				Enter program name here				
TEST1	and by cycle			TEST1				
^ PWM_HighSpeed		Cyclic task			4	0	0	
^ ESM2								

### 6.2 Axioline F Settings

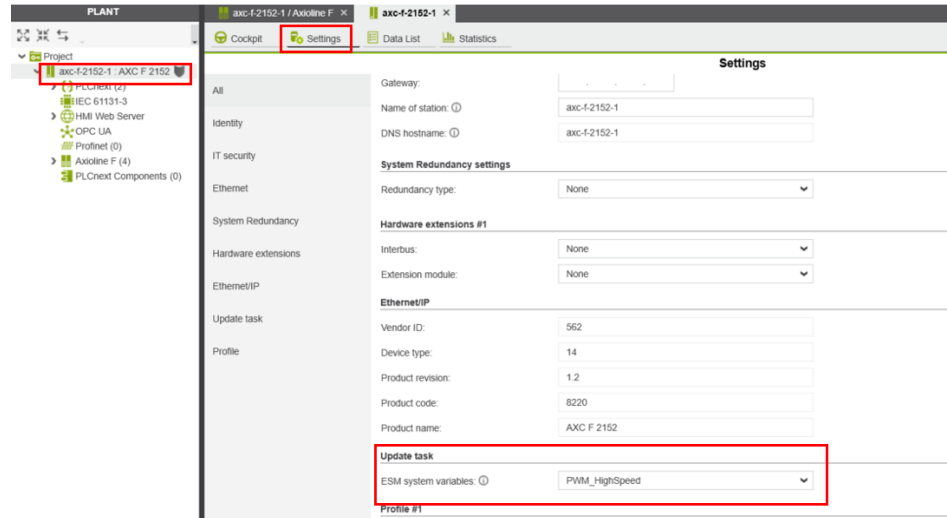
Select the Update and Trigger Tasks to be the same Name of the Task Created in step 5.4.1

Note the Selections for Update Task and Trigger Task Match the Task Above(PWM\_HighSpeed).

The screenshot shows the 'Settings' window for the 'Axioline F controller'. The 'Update task' and 'Trigger task' fields are both set to 'PWM\_HighSpeed'. The 'Profile' field is set to '7.0.0'.

## 6.3 Axioline F Settings

The Last Setting is the AXC-F Setting... The 'Update Task' Selection should be set to the Same High Speed Task as was done in Section 5.4.2



**Settings**

Gateway:

Name of station:

DNS hostname:

**System Redundancy settings**

Redundancy type:

**Hardware extensions #1**

Interbus:

Extension module:

**Ethernet/IP**

Vendor ID:

Device type:

Product revision:

Product code:

Product name:

**Update task**

ESM system variables:

**Profile #1**