Homing Procedures and Setup

Application Note 141

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1 Introduction

There are two classes of homing methods. The motion based method “Standard” derives the homing position from a move sequence. The second class is for absolute Encoders. These can use their absolute position information for homing. An absolute position of an absolute encoder is usually a position aligned to the motor phasing, not the position required in the machine coordinate system. The machine manufacturer defines the zero of each axis. This reference position of an axis is derived by a homing or calibration procedure during machine setup at the machine manufacturer place. Then the position offset between absolute encoder and machine coordinate system may be stored in various ways.

The zero of an axis may be derived in various ways, using Parameters.Homing.Method.

- Standard — by a homing search move, started by the control system
- AbsoluteEncoderXOffsetEncoder — from encoder persistency data of encoder[X].
- AbsoluteEncoderXOffsetDrive — from drive persistency data and the encoder[X] position.
- Immediate
- At Position

If two absolute encoders are used for one axis, only one can be the position reference. This is why the encoder number X has to be specified for absolute encoder based methods.

Homing commands of an axis are at Axes[].Commands.Homing.Command.

- Start — Start a motion based homing sequence
- Stop — Stop any motion based homing ongoing and related moves
- SaveEncoder — Save persistency data to an absolute encoder (axis must be disabled)
- InvalidateEncoder — Delete the persistency data of an absolute encoder (axis must be disabled)

The homing signal of an axis is the homing state Axes[].Signals.General.HomingState. It indicates not only the phases of a homing, but also homing errors.

2 Homing Method Standard

The motion based homing consists of four phases

- The first search phase is typically used to move into a marker, but various triggers can be chosen.
- Then a relocate move is used to get to the position, where the next search should start.
- The second search phase typically searches for an encoderIndex, but various triggers can be chosen.
- The move to home phase moves the axis to its final position.

The homing parameters of an axis are at Axes[].Parameters.Homing.

- Method — set to Standard
- FirstSearchMove — Parameters for the first search
- RelocateMove — Parameters for the relocate move
- SecondSearchMove — Parameters for the second search
- MoveToHomePosition — Parameters for the final move to the home position

Please note that the Home Position is not the same as the Reference Position (see Figure 1). The refer-

ence position is the position the encoder is set to at the found position of the second search move. The home position is the position where the axis will move to after successful homing. The home position is a parameter which will be the same for all machines of a series. The reference position is a command value received from the control system before homing and is typically calibrated during machine assembly.

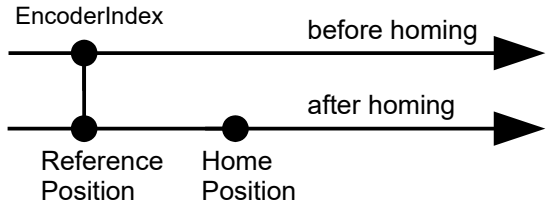


Figure 1: Difference between the reference position and the home position.

The following parameters are contained in the register nodes FirstSearchMove and SecondSearchMove.

- EventInput The trigger input to be searched for
- ActiveLow Choose TRUE if the event is active low
- SignedMaxDistance The maximum distance a search will move if no trigger event is found.
- DynamicReduction Values smaller than 1.0 will reduce the path planner velocity settings.

The sign of ***SignedMaxDistance*** has a special meaning. If the trigger is not active before the move, the axis will move into the direction indicated by the sign of this parameter. Otherwise, the direction will be reversed. Consider that ***ActiveLow*** does not affect the move direction. The following table illustrates the resulting move direction depending on the trigger state and the sign of ***SingnedMaxDistance***.

SignedMaxDistance	>0	>0	<0	<0
Initial trigger state	FALSE	TRUE	FALSE	TRUE
Resulting initial move direction	positive	negative	negative	positive

In case the EventInput register is set to PositionError the event will be triggered in case the absolute value of the master position error exceeds the threshold configured in register PositionErrorThreshold. This event input is suitable for example to detect a hard-stop.

The first and second search checks for an early trigger. It assumes the trigger condition is not reached within the first 5ms of the search. If the trigger is found earlier, it throws an early trigger error.

The folder with the homing phase “relocate move” contains the same parameter “DynamicReduction“ plus

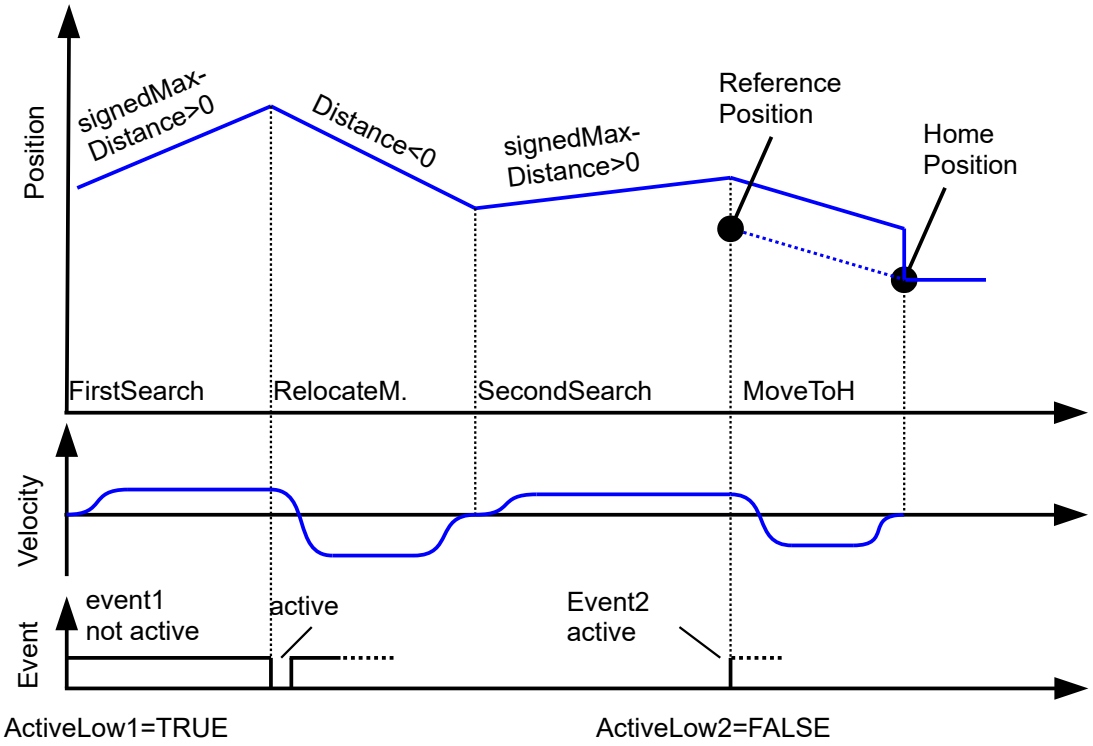
- Distance The signed distance to move.

The folder with the homing phase ***moveToHome*** contain the same ***DynamicReduction*** parameter plus

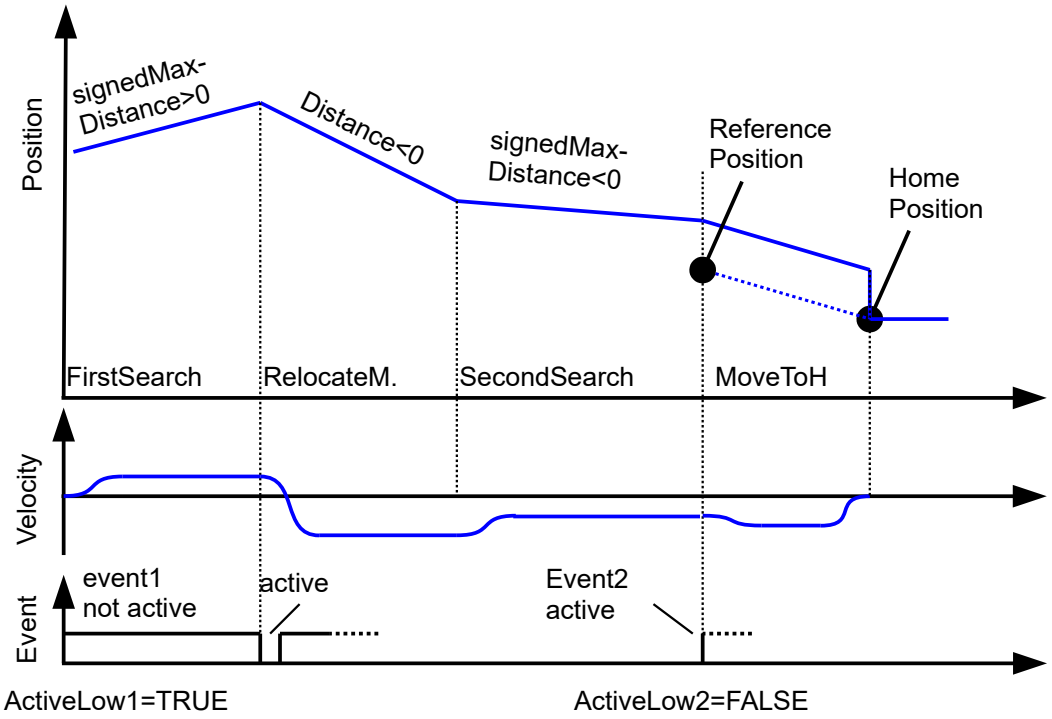
- Position The absolute position for the final move.

The homing of an axis is started with the command Start of ***Axes[].Commands.Homing.Command***. It can be interrupted with the command ***Stop*** of the same register. The register ***TestNotEnabled*** in the same folder allows testing the homing triggers by manually moving the axis. The states will behave as usual, but no motion commands are issued. ***ReferencePosition*** is the reference position as received from the control system. The first example is a move to the positive limit marker followed by a reverse

move and then move again to the positive direction to search the encoder index. Please note that the end position of the relocate move is attained in the axis mode standstill.

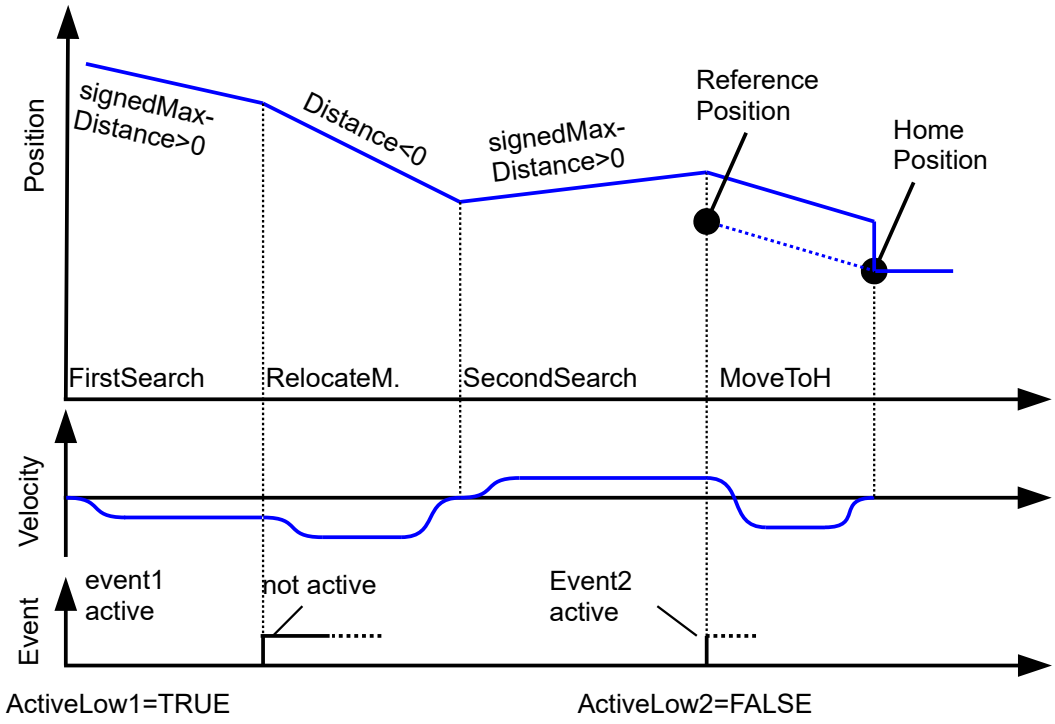


The second example is a move to the positive end marker followed by a reverse relocation move and then continue in the negative direction to search the encoder index. Since the relocation move and the secondSearch move are into the same direction, the axis will not stop in between for optimal motion behaviour. For technical reasons, the relocation move is a continuous move, not a discrete move.



The third sample was obtained with the same parameters as the second sample. This time the marker

was already occupied when starting. Therefore the first search moves into the opposite direction.



EventInput

3 Absolute Encoder Homing

The persistent position offset between absolute encoder and machine coordinate system can be stored in two ways. In the encoder itself or in the drive:

If the homing method ***AbsoluteEncoderXOffsetEncoder*** is selected, the position offset is loaded from the encoder EEPROM when the encoder is activated (after loading a configuration, resetting from an encoder error or during startup). If there is no such information in the encoder, the error ***NoPersistencyData*** is shown. The position offset is saved to the encoder with the command ***SaveEncoder*** ([1]) of the register ***Command.Homing.Command***. Please note that this is currently only possible in Disabled state.

If the homing method ***AbsoluteEncoderXOffsetDrive*** is selected, the position offset is loaded from the drive persistent data when the encoder is activated (after loading a configuration, resetting from an encoder error or during startup). The position offset is saved to the drive persistency when saving the drive persistency.

4 Homing Method Immediate

This homing method sets Homing Done without any action. There is no set position taking place. Final state is ***homingDone***.

1 With the command ***InvalidateEncoder*** the persistency data of the encoder may be cleared.

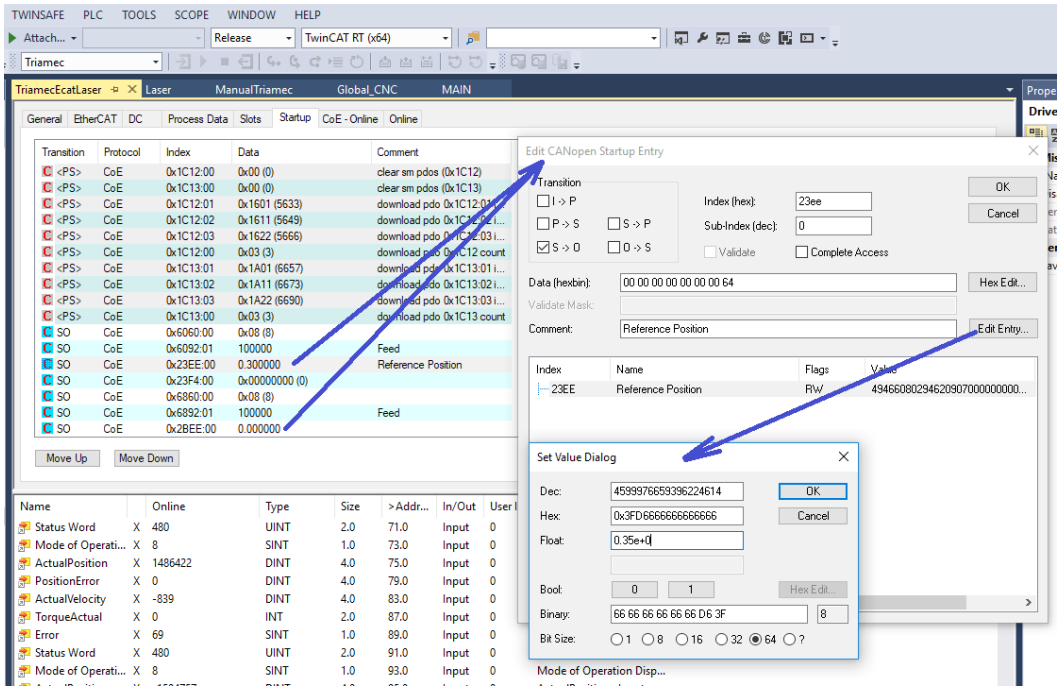
5 Homing Method AtPosition

This homing method sets the actual position to the commanded value referencePosition without any move. Final state is ***homingDone***.

6 TwinCAT Homing with EtherCAT

The reference position can be setup as shown in the following figure.

Note For correct use of EtherCAT Startup variables with 64 bit Floating point precision, use ESI descriptions Triamec1.8.xml or newer.



Homing from the CNC module

To setup homing with the TwinCAT CNC module, make sure the cyclic data of the drive contain the objects 0x6060 and 0x6061 (Mode of operation and mode of operation display). This is standard with the ESI file Triamec1.1.xml and newer as delivered with the sample code package 1.1.1.

The parameter list of the CNC axis module must contain the following entries for correct homing behavior:

kenngr.device_id	8	(turn off the target reached check before homing)
kenngr.set_refpos_mode	ABSOLUT	(P-AXIS-00278 : Modes for setting the homing pos)
kenngr.set_refpos_offset	0	(P-AXIS-00279 : [0.1um] or [10-4degree] Offset
kenngr.homing_type	DRIVE_CONTROLLED	(P-AXIS-00299 : Homing type

The homing sequence is then started using the G-code G74. The following sample program starts homing of Z first. When finished homing of X and Y start together:

```
G74 Z1 X2 Y2
```

The position of the reference marker 0x23EE (axis0) and 0x2BEE (axis1) may vary from machine to machine due to calibration considerations. In the sample codes, this position is set to 0.0 in the startup list. The type is a double with metric units (m or rad) as used during drive setup. It might be overwritten by COE register write commands as described in the “Triamec TwinCAT EtherCAT Quick Startup Guide”.

7 TwinCAT Homing with the Tria-Link fieldbus

The homing procedure of an axis is started with a one-time call

```
gAxis[].referenceStart := TRUE;
```

while the HMI is in the mode Automatic or MDI.

Please note that (in contrast to the EtherCAT fieldbus), the standard CNC command G74 is not functional. Consider using the HMI function "Reference" by adding the following code in the PRG_CNCChannelHandler before the call to CNCChannel:

```
IF PLCMachineMode[nChan].Homing THEN
    PLCMachineMode[nChan].Homing := FALSE;
    AxisGroup.referenceStart := TRUE;
END_IF
```

Homing from the CNC module

The parameter list of the CNC axis module must contain the following entries for correct homing behavior:

kenngr.device_id	8	(turn off the target reached check before homing)
kenngr.set_refpos_mode	ABSOLUT	(P-AXIS-00278 : Modes for setting the homing pos)
kenngr.set_refpos_offset	0	(P-AXIS-00279 : [0.1um] or [10-4degree] Offset
kenngr.homing_type	DRIVE_CONTROLLED	(P-AXIS-00299 : Homing type

8 TwinCAT Absolute Encoders with CNC

With the following entry in the axis data, the CNC immediately sets reference done without the need for homing:

kenngr.abs_pos_gueltig	1	(P-AXIS-00014 : Absolute measurement system)