Homing cycle

Translation of the "Original Dokumentation"

Name: FKT_Referenzpunktfahrt_en

Version:

Version: 2018/44	
Change	**Letter symbol**
• New Document	STL

Previous version: -/-

Product version:

Product (AMK part no.)	Firmware Version (AMK part no.)
KW-R06 (O835) KW-R07 (O807) KW-R16 (O872) KW-R17 (O873)	AE-R05/R06 V1.10 2013/15 (204486)
KW-R24-R (O954)	AE-R24-R V2.11 2016/46 (206643)
KW-R25 (O902)	AE-R25 V2.11 2016/46 (206644)
KW-R26 (O903)	AE-R26 V2.11 2016/46 (206645)
iX / iC / iDT5 /	iX V1.03 2013/18 (204515)
iX(-R3) / iC(-R3) / iDT5(-R3)	iX V2.11 2017/05 (206765)
ihX	ihX V1.00 2015/06 (205440)

Publisher:
AMK Arnold Müller GmbH & Co. KG
Gaußstraße 37 – 39,
D-73230 Kirchheim/Teck
Germany
Phone: +49 7021/50 05-0,
Fax: +49 7021/50 05-176
E-Mail: info@amk-group.com
Homepage: www.amk-group.com
Personally liable shareholder: AMK Verwaltungsgesellschaft mbH, Kirchheim/Teck
Registration court: Stuttgart HRB 231283; HRA 230681

1 Homing cycle

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /

By means of a homing cycle, a reference is created between the actual position value of the controller and actual position of the drive.

There are different specifications of the homing cycle depending on the type of encoder:

- Incremental encoders and single-turn absolute value encoders:
  The reference point is lost with each power-down and after each decisive error event. e.g. encoder errors
  In these cases, the drive travels on a specified position and it is here that the actual position value is set.
- Multi-turn absolute value encoders:
  Homing only means the reading out of the current position without moving the drive.

The encoder type is located in the motor's type name:

Example: motor type DT

D T xx - xx - xx - X xx

|	|	|		|		Brakes and cooling system
|	|	|		|		**Encoder type**
|	|	|		Number of poles		
|	|	Index number of bar length				
|	Installation size					
|	Motor series Hightorque					
AMKASYN 3-phase motor						

Encoder types

Incremental encoder with zero pulse	
I	Optical sine encoder
Single-turn absolute value encoder	
E	Optical sine encoder/ EnDat interface
P	Inductive sine encoder / EnDat interface
R	Resolver / Inductive sine encoder
S	Optical sine encoder / RS485 interface
U	Capacitive sine encoder / RS485 interface
Y	Optical sine encoder / RS485 interface
Multi-turn absolute value encoder	
F	Optical sine encoder / EnDat interface
Q	Inductive sine encoder / EnDat interface
T	Optical sine encoder / RS485 interface
V	Capacitive sine encoder / RS485 interface
Y	Optical sine encoder / RS485 interface

2 Homing cycle with incremental encoders and single turn absolute value encoders

During the homing cycle, drives with incremental encoders or single turn absolute value encoders are moved to a specified position (cam). In addition, the next zero pulse of the encoder can be approached to increase the repeat accuracy of the homing cycle.

The homing point can also be adapted to the conditions of the machine with a parameterisable offset.

A homing cycle to a fixed stop is also possible, i.e. at a preset torque. From there, travel takes place back to the last zero pulse.

At the appropriate point, the actual position value in the controller is stored or can be set to 0.

2.1 Parametrization of the homing cycle according to SERCOS standard

The possibility of referencing the drive acc. to SERCOS III standard (named 'SERCOS mode') is given.

- Properties of the homing cycle:
  - In SERCOS mode, the properties of the homing cycle must exclusively be set by ID147 'Homing parameter'
  - In AMK mode, properties of the homing cycle can be set either by ID147 'Homing parameter'or by ID32926 'AMK homing cycle parameter'
- Acceleration and deceleration:
  - In SERCOS mode, ID42 'Homing acceleration' is used for acceleration as well as deceleration setpoint
  - In AMK mode, the setpoint values are effective either from ID136 'Positive acceleration' and ID137 'Negative acceleration' or from ID42 'Homing acceleration'
- Cam style:
  - In SERCOS mode, only a linear pulse cam can be used
  - In AMK mode, it is differentiated between linear and rotation cam, pulse and range cam
- Final position:
  - In SERCOS mode, at the end of the homing cycle and deceleration the drive is not positioned on the homing point
  - In AMK mode, the drive will return to the reference point at the end of the homing cycle

See 'ID147 'Homing parameter' bit string ' on page 18.
See 'ID32926 'AMK homing cycle parameter' bit string ' on page 19.

2.2 Homing variants

The following diagrams all show the positive rotating direction of the drive, i.e. right rotation looking at the A-bearing motor shaft (D147.0 = 0).

2.2.1 Homing on linear cams

In systems in which for example a carriage moves backwards and forwards controlled by position, this carriage must be brought to a specific position for homing. This is achieved by means of the homing cycle on a linear cam signal.

To do this, the drive is accelerated on its 'Homing velocity' (ID41). It travels as far as the cam, the homing point is set here, and the drive brakes to a standstill.

Exception:

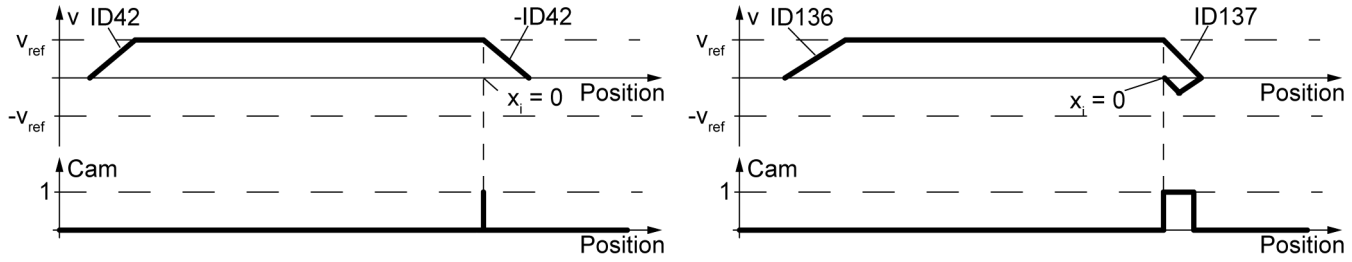
If the drive is already located on the (range) cam at the start of the homing cycle in AMK mode, it will initially run in the opposite way to the homing direction (in accordance with ID147.0) from the cam downwards. It is then homed as described above.

In SERCOS mode resp. in AMK mode using SERCOS parameters, the setpoint is generated by the control unit. It must recognise that the drive is positioned on the cam and first remove the drive.

SERCOS mode

AMK mode

In AMK mode, the drive **turns back** to the rising edge of the cam.



The following settings are to be installed for homing on linear cams:

SERCOS mode	
Parameter ID.bit = value	**Meaning**
ID32941.5 = 1	Acceleration / deceleration = ±ID42
ID42	'Homing acceleration'
ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam
ID147.2 = x	(cam signal depends on configuration)
ID147.5 = 0	Evaluate cam
ID147.6 = 1	Do not evaluate zero pulse
ID147.7 = 0	Drive is on free position after homing
ID147.10 = 0	Fixed stop is inactive
ID147.15 = 0	ID32926 'AMK homing cycle parameter' is not active

AMK mode using SERCOS 'Homing parameter' (ID147)		**AMK mode using 'AMK homing cycle parameter' (ID32926)**	
Parameter ID.bit = value	**Meaning**	**Parameter** ID.bit = value	**Meaning**
ID32941.5 = 0	Acceleration ID136, deceleration ID137	ID32941.5 = 0	Acceleration ID136, deceleration ID137
ID136	'Positive acceleration'	ID136	'Positive acceleration'
ID137	'Negative acceleration'	ID137	'Negative acceleration'
ID147.0 = 0	Homing direction positive	ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam	ID147.1 = 0	Homing on positive edge of the cam
ID147.2 = x	(cam signal depends on configuration)		
		ID32926.8 = 0	Setpoints from internal interpolator
ID147.5 = 0	Evaluate cam	ID32926.11 = 0	Evaluate cam
ID147.6 = 1	Do not evaluate zero pulse	ID32926.13 = 1	Do not evaluate zero pulse
ID147.7 = 0	Drive is on free position after homing		
ID147.10 = 0	Fixed stop is inactive	ID32926.9 = 0	Fixed stop is inactive
		ID32926.10 = 0	Actual position value is set to 0
		ID32926.12 = 0	Linear cam
		ID32926.14 = 1	Range cam
ID147.15 = 0	ID32926 'AMK homing cycle parameter' is inactive	ID147.15 = 1	ID32926 'AMK homing cycle parameter' is active, ID147.0 and ID147.1 are evaluated

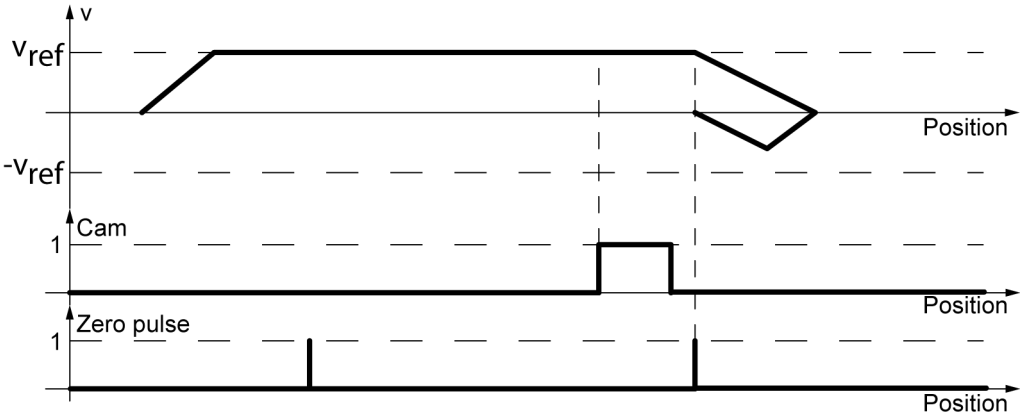
2.2.2 Homing on linear cams and zero pulse

In addition to the cam (see above), homing takes place on the next zero pulse of the encoder.

The drive is accelerated on its 'Homing velocity' (ID41), travels as far as the cam and then onto the following pulse of the encoder. There, the reference point is set and the drive brakes to a standstill.

In AMK mode, the zero pulse **turns back**.

AMK mode



The following settings are to be installed for homing on linear cams and zero pulse:

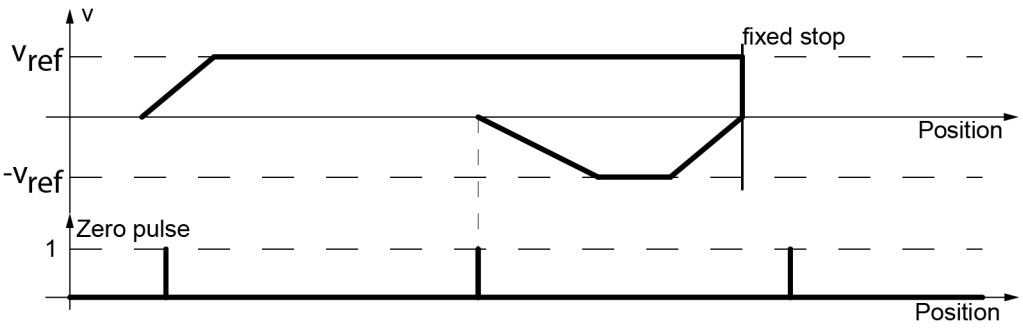
SERCOS mode	
Parameter ID.bit = value	**Meaning**
ID32941.5 = 1	Acceleration / deceleration = ±ID42
ID42	'Homing acceleration'
ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam
ID147.2 = x	(cam signal depends on configuration)
ID147.5 = 0	Evaluate cam
ID147.6 = 0	Evaluate zero pulse
ID147.7 = 0	Drive is on free position after homing
ID147.10 = 0	Fixed stop is inactive
ID147.15 = 0	ID32926 'AMK homing cycle parameter' is not active

AMK mode **using SERCOS 'Homing parameter' (ID147)**		**AMK mode** **using 'AMK homing cycle parameter' (ID32926)**	
Parameter ID.bit = value	**Meaning**	**Parameter** ID.bit = value	**Meaning**
ID32941.5 = 0	Acceleration ID136, deceleration ID137	ID32941.5 = 0	Acceleration ID136, deceleration ID137
ID136	'Positive acceleration'	ID136	'Positive acceleration'
ID137	'Negative acceleration'	ID137	'Negative acceleration'
ID147.0 = 0	Homing direction positive	ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam	ID147.1 = 0	Homing on positive edge of the cam
ID147.2 = x	(cam signal depends on configuration)		
		ID32926.8 = 0	setpoints from internal interpolator
ID147.5 = 0	Evaluate cam	ID32926.11 = 0	Evaluate cam
ID147.6 = 0	Evaluate zero pulse	ID32926.13 = 0	Evaluate zero pulse
ID147.7 = 0	Drive is on free position after homing		
ID147.10 = 0	Fixed stop is inactive	ID32926.9 = 0	Fixed stop is inactive
		ID32926.10 = 0	Actual position value is set to 0
		ID32926.12 = 0	Linear cam
		ID32926.14 = 1	Range cam
ID147.15 = 0	ID32926 'AMK homing cycle parameter' is not active	ID147.15 = 1	ID32926 'AMK homing cycle parameter' is active, ID147.0 and ID147.1 are evaluated

2.2.3 Homing on fixed stop

With this type of homing, the drive travels until the preset torque (ID126 'Torque threshold' or ID530 'Clamping torque') is reached. From this point, it **turns back** to the previous zero pulse of the encoder.

Homing to fixed stop does not run properly if the torque threshold is reached prematurely, for instance because the system is blocked. The controller cannot differentiate this case.



The following settings are to be installed for homing on fixed stop:

SERCOS mode	
Parameter ID.bit = value	**Meaning**
ID32941.5 = 1	Acceleration / deceleration = ±ID42
ID42	'Homing acceleration'
ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam
ID147.2 = x	(cam signal depends on configuration)
ID147.5 = 1	Do not evaluate cam
ID147.6 = 0	Evaluate zero pulse
ID147.7 = 0	Drive is on free position after homing
ID147.10 = 1	Fixed stop is active
ID530	'Clamping torque'
ID147.15 = 0	ID32926 'AMK homing cycle parameter' is not active

AMK mode using SERCOS 'Homing parameter' (ID147)		AMK mode using 'AMK homing cycle parameter' (ID32926)	
Parameter ID.bit = value	**Meaning**	**Parameter** ID.bit = value	**Meaning**
ID32941.5 = 0	Acceleration ID136, deceleration ID137	ID32941.5 = 0	Acceleration ID136, deceleration ID137
ID136	'Positive acceleration'	ID136	'Positive acceleration'
ID137	'Negative acceleration'	ID137	'Negative acceleration'
ID147.0 = 0	Homing direction positive	ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam	ID147.1 = 0	Homing on positive edge of the cam
ID147.2 = x	(cam signal depends on configuration)		
		ID32926.8 = 0	setpoints from internal interpolator
ID147.5 = 1	Do not evaluate cam	ID32926.11 = 1	Do not evaluate cam
ID147.6 = 0	Evaluate zero pulse	ID32926.13 = 0	Evaluate zero pulse
ID147.7 = 0	Drive is on free position after homing		
ID147.10 = 1	Fixed stop is active	ID32926.9 = 1	Fixed stop is active
ID530	'Clamping torque'	ID126	'Torque threshold'
		ID32926.10 = 0	Actual position value is set to 0
		ID32926.12 = x	(Cam type is not relevant)
		ID32926.14 = x	(Cam type is not relevant)
ID147.15 = 0	ID32926 'AMK homing cycle parameter' is not active	ID147.15 = 1	ID32926 'AMK homing cycle parameter' is active, ID147.0 and ID147.1 are evaluated

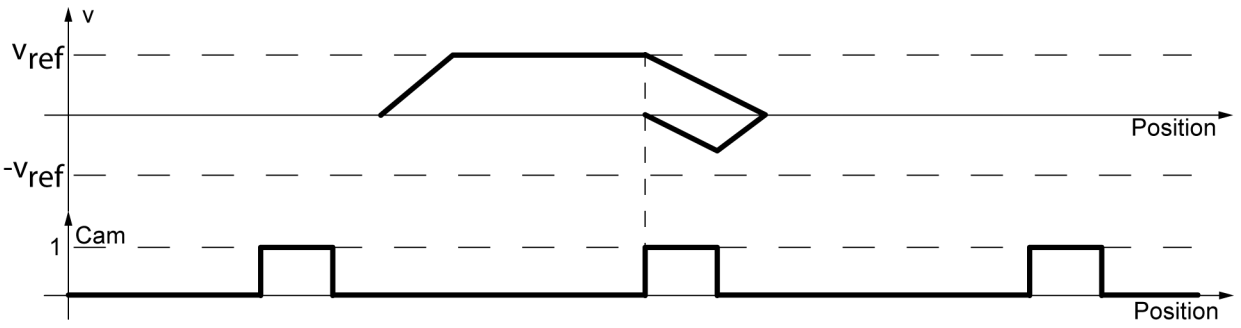
2.2.4 Homing on rotation cams

In systems in which, for example, work piece carriers are transported with the help of a spindle which can be positioned in each revolution, homing takes place on a rotation cam.

A homing on rotation cam can only be done in AMK mode with ID32926 'AMK homing cycle parameter' setting the porperties.

Acceleration takes place on 'Homing velocity' and travels as far as the cam. The drive is decelerated and turns **back to the cam**. The homing point is set here.

AMK mode

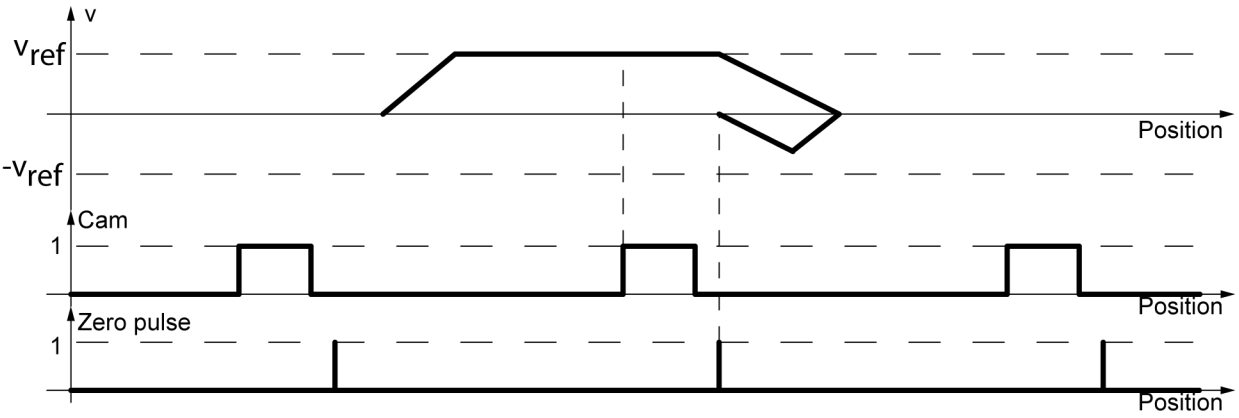


The following settings are to be installed for homing on rotation cams:

AMK mode using 'AMK homing cycle parameter' (ID32926)	
Parameter ID.bit = value	**Meaning**
ID32941.5 = 0	Acceleration ID136, deceleration ID137
ID136	'Positive acceleration'
ID137	'Negative acceleration'
ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam
ID32926.8 = 0	setpoints from internal interpolator
ID32926.11 = 0	Evaluate cam
ID32926.13 = 1	Do not evaluate zero pulse
ID32926.9 = 0	Fixed stop is inactive
ID32926.10 = 0	Actual position value is set to 0
ID32926.12 = 1	Linear cam
ID32926.14 = 1	Range cam
ID147.15 = 1	ID32926 'AMK homing cycle parameter' is active, ID147.0 and ID147.1 are evaluated

In the case of homing on rotation cams, the following zero pulse can also be taken into account.

AMK mode

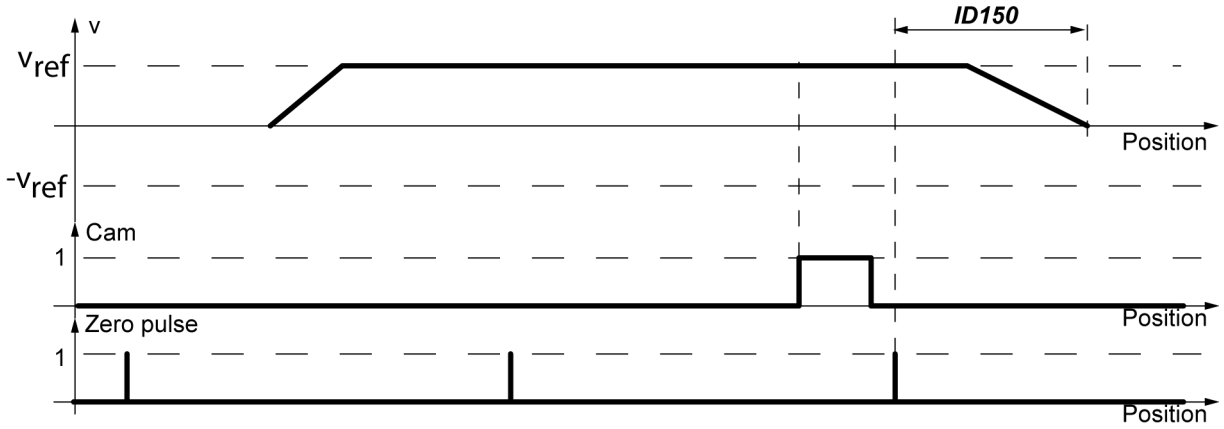


The following settings are to be installed for homing on rotations cams and zero pulse:

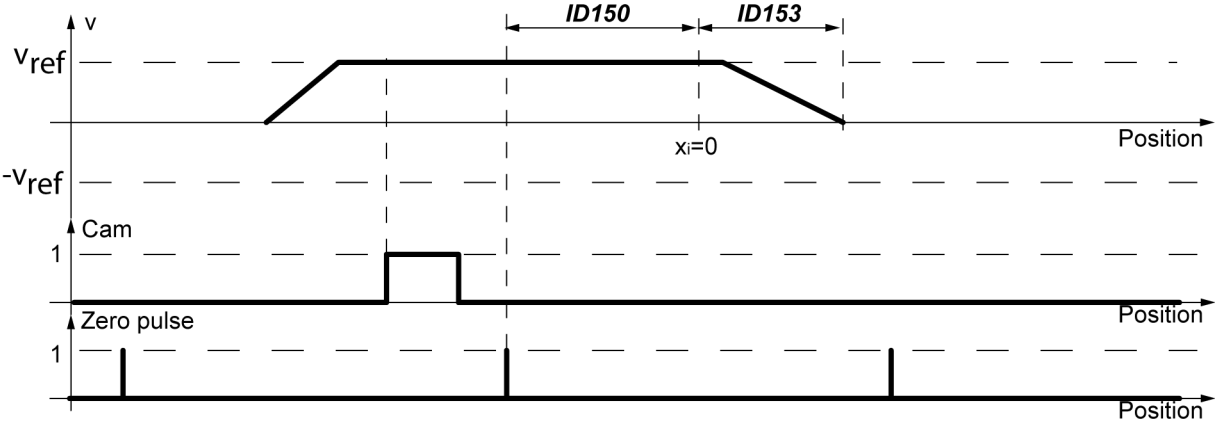
AMK mode using 'AMK homing cycle parameter' (ID32926)	
Parameter ID.bit = value	**Meaning**
ID32941.5 = 0	Acceleration ID136, deceleration ID137
ID136	'Positive acceleration'
ID137	'Negative acceleration'
ID147.0 = 0	Homing direction positive
ID147.1 = 0	Homing on positive edge of the cam
ID32926.8 = 0	Setpoints from internal interpolator
ID32926.11 = 0	Evaluate cam
ID32926.13 = 0	Evaluate zero pulse
ID32926.9 = 0	Fixed stop is inactive
ID32926.10 = 0	Actual position value is set to 0
ID32926.12 = 1	Linear cam
ID32926.14 = 1	Range cam
ID147.15 = 1	ID32926 'AMK homing cycle parameter' is active, ID147.0 and ID147.1 are evaluated

2.2.5 Displacement of the home position

In the case of homing on cams and / or zero pulse described above, the point of reference can also be displaced by a specified offset. An offset of this kind may be necessary, depending on the system, if there is a displacement between the zero pulse and the actual home position required. In this context, ID150 'Homing offset 1' forms the offset for the absolute encoder types E, I, P, S, U and resolvers.



By ID153, the absolute position for homing is defined. The 'Spindle angle position' is related to the actual position value $x_i = 0$ considering ID150 'Homing offset 1'. After reaching the homing position and setting the actual position value to 0, the drive moves to 'Spindle angle position' and displays this value as actual position.



For multi-turn absolute value encoders, parameter ID153 'Spindle angle position' has no influence..

2.3 Parametrization

Relevant parameters

Parameter	Parameter description	Meaning See document 'Parameter description' (AMK part no. 203704)
ID41 1)	'Homing velocity'	Drive-specific speed at which the drive travels to the homing point
ID42 1)	'Homing acceleration'	Drive-specific acceleration / deceleration (SERCOS mode)
ID47 2)	'Position command value'	Position setpoint from the controller when ID32926.8 = 1
ID52 2)	'Home reference position 1'	System-specific distance between machine zero point and the homing position
ID76 1)	'Position scaling data'	Processing format of the position data
ID103 1)	'Modulo value'	With modulo processing of the position data: number of increments with which the position data is reset to 0
ID126 1)	'Torque threshold'	Torque at which the fixed stop is recognized
ID136 1)	'Positive acceleration'	Drive-specific start acceleration (AMK mode)
ID137 1)	'Negative acceleration'	Drive-specific braking deceleration (AMK mode)
ID147 1)	'Homing parameter'	Development of the homing cycle See 'ID147 'Homing parameter' bit string ' on page 18.
ID148 2), 3)	'Drive homing cycle command'	The parent controller starts the homing cycle via this parameter and reads out the current status of the homing
ID150 1)	'Homing offset 1'	System-specific displacement between encoder homing position and zero position
ID153 1)	'Spindle angle position'	Angle position which is set after homing
ID173 3)	'Marker position A'	Actual position value at which the homing signal is recognized
ID400 3)	'Home switch'	Homing signal (e.g. cam) was recognized
ID403 3)	'Status actual position value'	Homing point is recognized Homing is completed
ID530 1)	'Clamping torque'	Torque value on which the fixed stop is recognised (SERCOS mode)
ID32808 3)	'AMK position control'	AMK internal operating mode (must not be changed)

Parameter	Parameter description	Meaning See document 'Parameter description' (AMK part no. 203704)
ID32926 1)	'AMK homing cycle parameter'	AMK specific settings for the homing cycle See 'ID32926 'AMK homing cycle parameter' bit string ' on page 19.
ID32940 1)	'High homing velocity'	Speed of the travel from the cam downwards when the drive is already standing at the start of the homing
ID32941 1)	'SERCOS service'	Homing acc. to AMK / SERCOS mode
ID32953 1)	'Encoder type'	Configuration of motor, speed, position encoder and motor model See 'ID32953 'Encoder type' bit string' on page 19.
ID32990 1)	'NK shift'	Lock-in range around the zero pulse in which the cam is recognized (only with single turn encoders I, R, S, E, P) (See 'Special case: Determining ID32990 'NK shift'' on page 13.)
ID34070 3)	'Home signal distance'	Distance between cam and zero pulse

1) The parameter value must be set specific to the application

2) Parameter value is written or read via the master controller

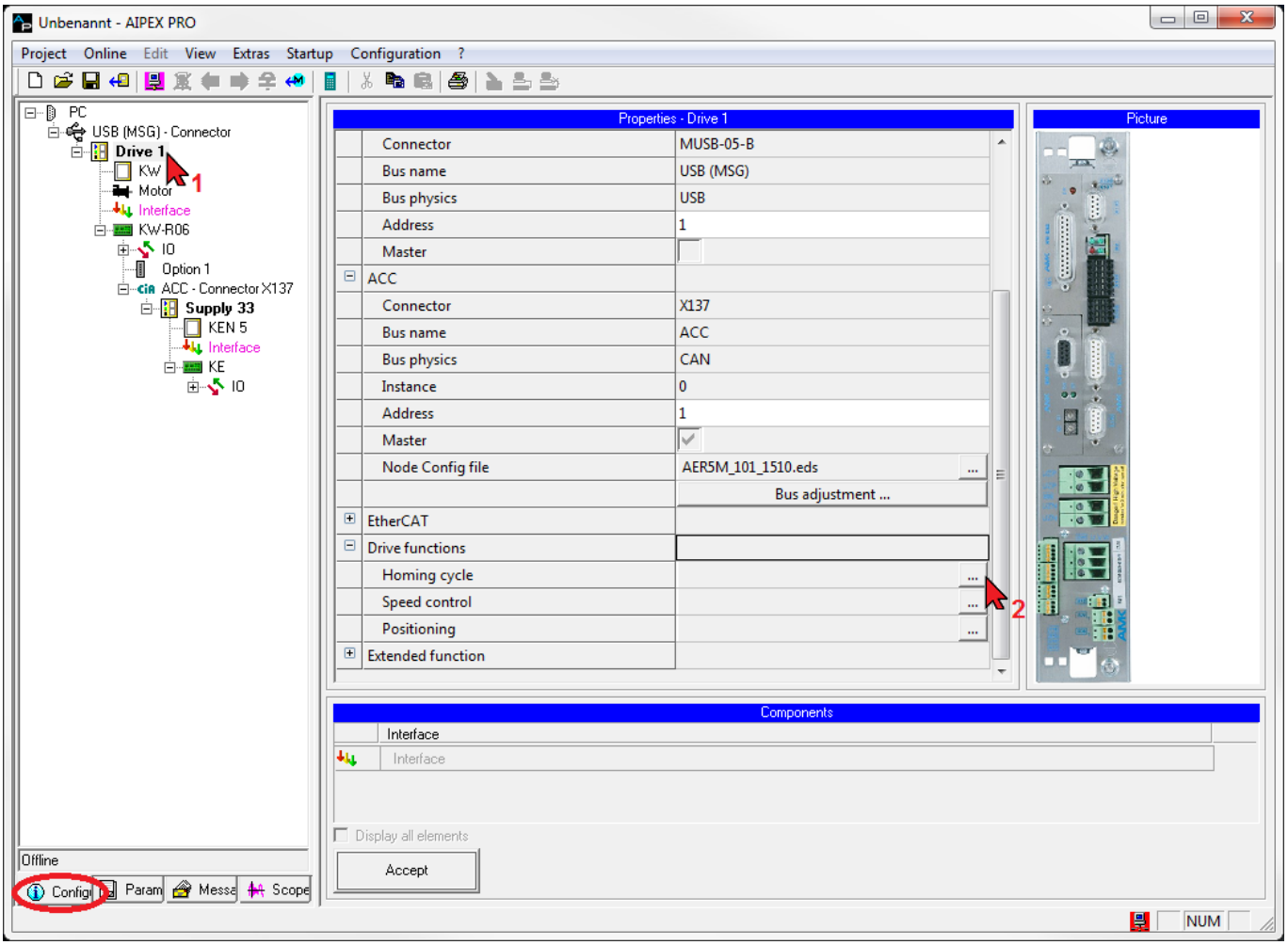
3) Parameter value is automatically generated by the controller card

2.3.1 Menu-controlled settings in the controller with AIPEX PRO

The parameters necessary for the homing cycle are set using the AIPEX PRO software, for instance the boundary conditions and the homing speed.

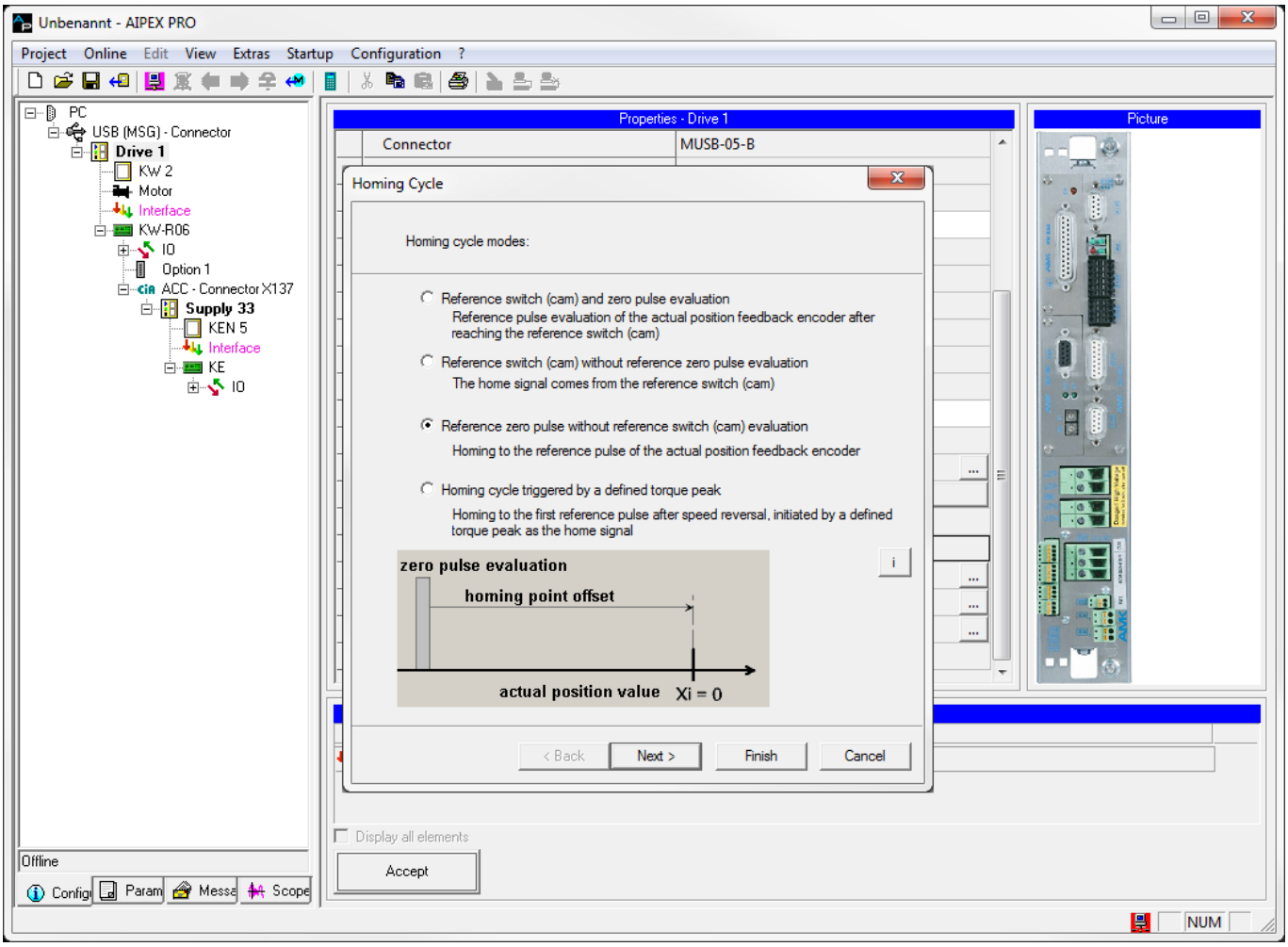
The drive for which the homing cycle is to be parametrized is selected in the device tree.

You will find the homing cycle under 'Drive functions', in the 'Configuration' tab and the 'Properties' window.



The variation of the homing cycle is selected first of all:

- cam and zero pulse
- cam only
- zero pulse only
- fixed stop



Further parameters required in each case are input in the subsequent steps.

After the parameters have been input, the parameter are listed and can be imported with '**OK**'. '**i**' shows the detailed parameter list.

2.3.2 Manual settings in the controller with AIPEX PRO

The required values in AIPEX PRO can also be entered directly in the parameter list instead of via the menu mode.

Values which are not retrieved via the menu, for example encoder type and accelerations, still have to be parameterized in this way.

Two examples are listed as follows:

- homing on cam
- homing on fixed stop.

Example 1: homing on cam (AMK mode)

Parameter	Value	Meaning
ID32953	encoder-dependent	The encoder type is read in from the encoder's electronic nameplate or from the motor database.
ID147	**1**000 0000 0000 00xx	Bit 15 = 1: ID32926 active
ID32926	0010 0x0x 0000 0000	Linear cam
	0000 0x0x 0000 0000	Linear cam with NIP
	Other settings: See document 'Parameter description' (AMK part no. 203704): ID32926 'AMK homing cycle parameter'	

Example 2: homing on cam (SERCOS mode)

Parameter	Value	Meaning
ID32953	encoder-dependent	The encoder type is read in from the encoder's electronic nameplate or from the motor database.
ID147	0000 0000 0000 0xxx	Bit 15 = 0: ID32926 not active Bit 7 = 0: drive on free position Bit 6 = 0: zero pulse evaluation Bit 5 = 0: cam evaluation
ID32941	0000 0000 00**1**0 0000	Bit 5 = 1: SERCOS mode

Example 3: homing on fixed stop (AMK mode)

Parameter	Value	Meaning
ID32953	encoder-dependent	The encoder type is read from the encoder's electronic nameplate or from the motor database.
ID147	**1**000 0000 0000 00xx	Bit 15 = 1: ID32926 active
ID126	drive-dependent	Torque threshold, when the fixed stop is recognized
ID32926	0000 0x1x 0000 0000	Fixed stop
	Other settings: See document 'Parameter description' (AMK part no. 203704): ID32926 'AMK homing cycle parameter'	

Example 4: homing on fixed stop (SERCOS mode)

Parameter	Value	Meaning
ID32953	encoder-dependent	The encoder type is read from the encoder's electronic nameplate or from the motor database.
ID147	000 0100 0010 0xxx	Bit 15 = 0: ID32926 not active Bit 10 = 1: homing on fixed stop Bit 7 = 0: drive on free position Bit 6 = 0: zero pulse evaluation Bit 5 = 1: no cam evaluation
ID530	drive-dependent	Torque threshold, when the fixed stop is recognised
ID32941	0000 0000 00**1**0 0000	Bit 5 = 1: SERCOS mode

*) x = wildcard for system and drive-based entries

2.3.3 Special case: Determining ID32990 'NK shift'

The virtual cam offset works with the encoder types I, R, S, E and P as a position encoder according to ID32953 'Encoder type'.

A homing cycle with cam signals lying very close together and an encoder zero setting (zero pulse) can cause the signals to not be clearly detected by the system. (The distance between both of the signals can be read from ID34070 'Home signal distance' after homing). With various applications, the cam signal and the zero position (zero pulse) are structurally set so that the distance between the signals cannot be changed.

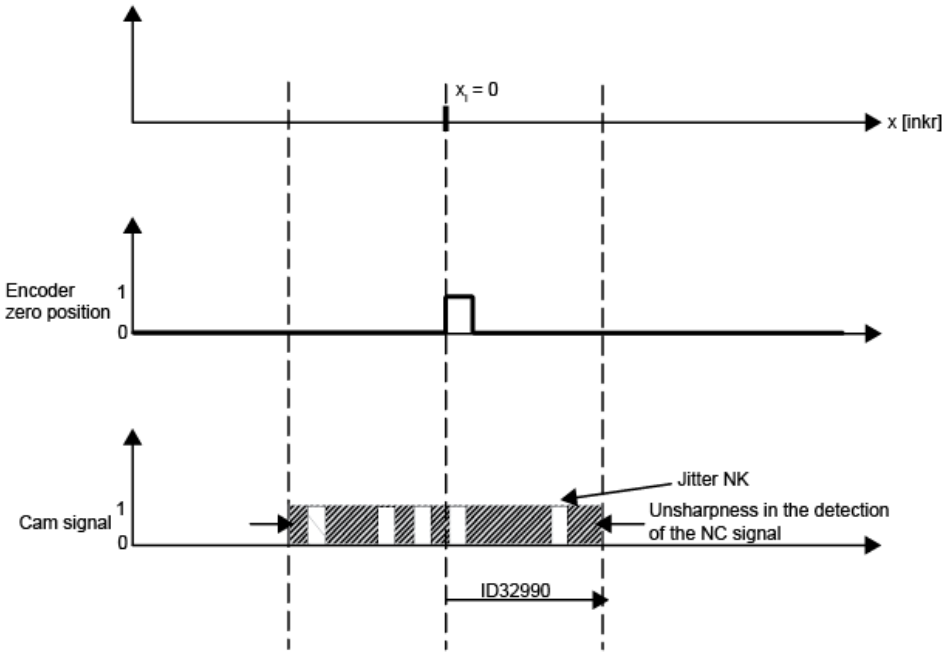
The homing cycle function first awaits the cam signal and then the encoder zero pulse. If both of the signals are too close together, it may occur that the zero pulse is detected first and then the cam. This results in the motor offsetting a revolution homing to its zero position.

The parameter ID32990 'NK shift' defines a permissible capture range behind each zero position in which a cam signal is expected by the system and is always assigned to the last encoder zero position. If the cam is detected in the capture range during homing, the homing takes place to the last encoder zero position. This takes place through a rotational direction reversing of the motor. The capture range has no effect if ID32990 'NK shift' is assigned with the value of zero.

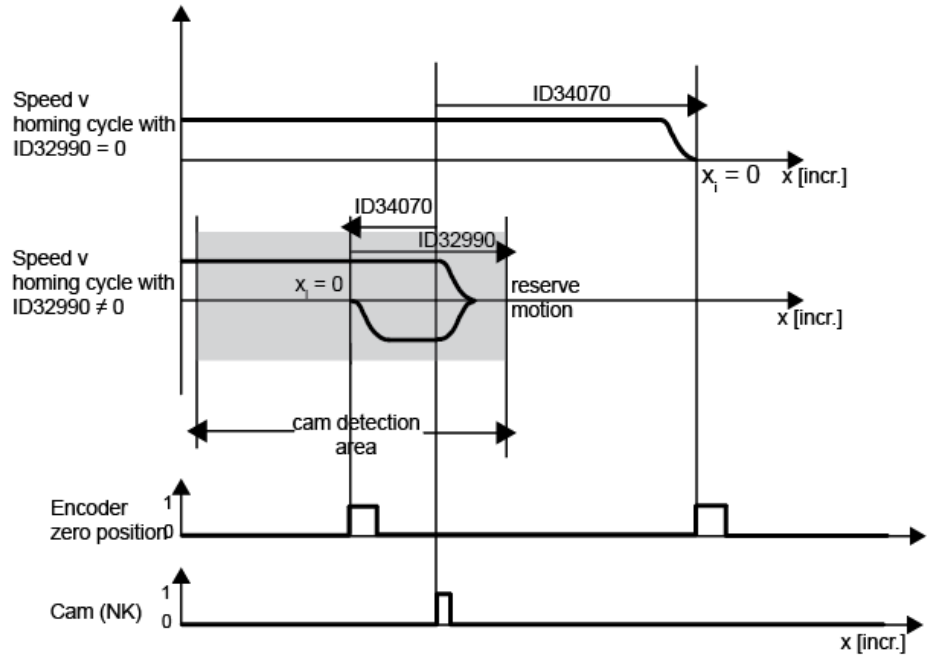
The following diagram illustrates the connections.

Outside of the capture range or for ID32990 'NK shift' = 0, the represented behavior corresponds to the homing without the capture range.

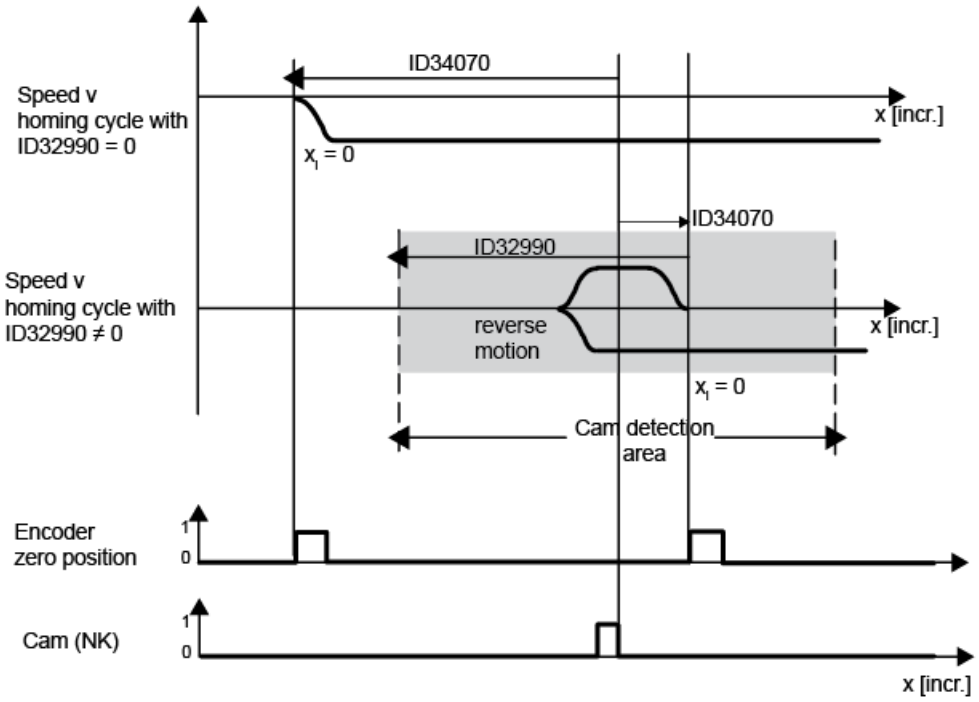
Blurring of the cam signal



Homing with ID32990 'NK shift' (positive start-up direction, ID150 'Homing offset 1' = 0)



Homing with ID32990 'NK shift' (negative start-up direction, ID150 'Homing offset 1' = 0)



The value for ID32990 'NK shift' is to be determined according to the following formulas.

The input takes place in increments. The encoder resolution depends on the set position encoder (internal motor encoder or external encoder, see actual position value source in ID32800 'AMK main operating mode'). Either ID116 'Resolution motor encoder' or ID117 'Resolution external position feedback system' is to be used in the following equations.

Due to the system, the following limitation applies for the range of values:

Range of values: 0 ≤ ID32990 < encoder resolution

Calculation of the range limits:

$$\mathbf{ID32990} = \frac{\mathbf{Encoder\ resolution}}{\mathbf{2}} + \mathbf{ID34070} \qquad \mathbf{for}\ |\mathbf{ID34070}| < \frac{\mathbf{Encoder\ resolution}}{\mathbf{2}}$$

$$\mathbf{ID32990} = \frac{\mathbf{3\times\ Encoder\ resolution}}{\mathbf{2}} - \mathbf{ID34070} \qquad \mathbf{for}\ |\mathbf{ID34070}| > \frac{\mathbf{Encoder\ resolution}}{\mathbf{2}}$$

When using the above formula, if a negative value results for ID32990 'NK shift', then the encoder resolution is to be added to this value.

Procedure for determining ID32990 'NK shift' with an unknown location of NK and zero position (zero pulse):

1. The real distance between the cam and zero position must be read from ID34070 'Home signal distance' after a homing cycle with ID32990 'NK shift' = 0.
2. Determine the boundary with the formulas.
3. The boundary is entered in ID32990 'NK shift'.
4. The reference position can be offset with ID150, 'Homing offset 1'.

Example:

1. The resolver is the position encoder and motor encoder ID116 = 65536
2. The real distance between the cam and the resolver zero position after a homing cycle with ID32990 = 0, result e.g. ID34070 = 50000
3. The desired virtual cam offset is then calculated according to the following formula:

   $$\mathbf{ID32990} = \frac{\mathbf{3\times\ Encoder\ resolution}}{\mathbf{2}} - \mathbf{ID34070} \qquad \mathbf{for}\ |\mathbf{ID34070}| > \frac{\mathbf{Encoder\ resolution}}{\mathbf{2}}$$

   $$\mathbf{ID32990} = \frac{\mathbf{3\times\ 65536}}{\mathbf{2}} - \mathbf{50000} = \mathbf{48304}$$

4. The reference position can be offset with the help of ID150 'Homing offset 1'.

2.4 Starting the homing cycle

A homing cycle can be started as follows:

- by setting a binary input
- by a command from the parent control unit

Binary input

The corresponding binary input must be assigned the code 33711 (homing cycle on homing point $x_i = 0$).

If a positive edge (0 → 1) is recognized from this input, the homing cycle starts and runs as described below.

Parent control unit

The homing cycle starts via ID148 'Drive homing cycle command':

Commands are started by the function code 0x3 being written in the parameter.

The status of the command is displayed by the parameter being read.

Read value	Meaning
0x0	Basic state, no command active
0x3	Command complete
0x7	Command currently active
0xF	Command completed with error

After the status is 0x3 or 0xF, the value 0x0 must be written in the parameter. The command is complete once the value 0x0 is read in the status.

A more convenient option is provided by the function blocks from the AMK library, which can be used in the CODESYS environment in AIPEX PRO. (See document 'Software description AIPEX PRO V3', AMK part-no. 204979)

Contained here are the components of the STANDARD_AXIS family which have, amongst other things, a Boolean input to start the homing cycle. (See document 'AFL - AMK function libraries', AMK part-no. 205795)

2.5 Development of the homing cycle

Called up from parent control unit	Called up via binary input
Command ID148 'Drive homing cycle command'is called up.	Binary input with code 33711 is set (edge 0 -→ 1).
Drive switches automatically to drive-internal position control after ID32808 'AMK position control'.	Drive switches automatically to drive-internal position control after ID32808 'AMK position control'.
Settings after ID147 'Homing parameter' and ID32926 'AMK homing cycle parameter' are valid.	Settings after ID147 'Homing parameter' and ID32926 'AMK homing cycle parameter' are valid.
Changes to the cyclical setpoints are ignored during the active command.	Changes to the cyclical setpoints are ignored during the active command.
Drive accelerates with ID136 'Positive acceleration' to the speed as per ID41 'Homing velocity'.	Drive accelerates with ID136 'Positive acceleration' to the speed as per ID41 'Homing velocity'.
After crossing the position encoder home position (cam and / or zero pulse), the drive brakes after ID137 'Negative acceleration' to a standstill.	After crossing the position encoder home position (cam and / or zero pulse), the drive brakes after ID137 'Negative acceleration' to a standstill.
The drive travels back to the home position.	The drive travels back to the home position.
The control reads out the position setpoint (ID47 'Position command value') of the drive via the service channel and sets its setpoint system to this position setpoint.	
The command is properly executed when the drive is standing and the actual position value is based on the home position (ID403.0 is set).	The command is properly executed when the drive is standing and the actual position value is based on at the home position (ID403.0 is set).
The controller deletes the command "Drive homing cycle command" and the drive follows the setpoints of the controller. *)	

*) If the 'Drive homing cycle command' is interrupted, the actual position value cannot be taken to the position encoder home position. ID403.0 is not set.

3 Homing with multi-turn absolute value encoders

A homing cycle with multi-turn absolute value encoders means that the current position of the encoder is read out. Even if the drive with a switched-off controller has been changed, the encoder "recognizes" its current position and reports this to the controller.

Only if the motor has been coupled to the machine again or if the encoder has been replaced must the encoder be informed of its current position.

Contact AMK service!

Appendix

ID147 'Homing parameter' bit string

Configuration ID147 'Homing parameter'

Bit no.	Condition	Meaning
0 (LSB)	0	Positive homing direction (clockwise rotation when looking at the A-bearing side motor shaft)
	1	Negative homing direction (counter-clockwise rotation when looking at the A-bearing side motor shaft)
1	0	Homing mark is the positive edge of the homing switch (cam)
	1	Homing mark is the negative edge of the homing switch (cam)
2	0	Homing switch (cam) connected to the controller  Parameter changes will only have an effect after power off/on.
	1	Homing switch (cam) connected to the drive  Parameter changes will only have an effect after power off/on.
3	0	Reserved
	1	Reserved
4	0	Reserved
	1	Reserved
5	0	Homing cycle with cam evaluation
	1	Homing cycle without cam evaluation (homing only to the homing mark (zero pulse) of the actual position encoder)
6	0	Homing cycle with encoder homing mark (zero pulse) evaluation after reaching the homing switch (cam)
	1	Homing cycle without encoder homing mark (zero pulse) evaluation. Homing switch (cam) is also the homing mark.
7	0	Drive stops after homing at any position. After the homing mark is recognised the drive brakes down until standstill and keeps this position. The controller must start at this position. The drive will not move back to the recognized homing point.
	1	The drive stops on the homing point after homing (encoder homing mark (Zero pulse) + ID150) by consideration of ID52. After the homing mark is recognized the drive brakes until standstill, reverses and moves back to the position where the homing mark was recognized.
8	0	Reserved
	1	Reserved
9	0	Homing cycle without hardware limit switch evaluation
	1	Homing cycle with hardware limit switch evaluation The hardware limit switch is handled like a cam. For configuration its necessary to set Bit 5 = 1, Bit 10 = 0 and Bit 15 = 0.
10	0	Homing cycle to fixed stop: inactive
	1	Homing cycle to fixed stop: active: A defined torque peak according ID530 effects that the drive changed the direction of rotation. The homing mark is the 1st zero pulse after the change of rotation.
11-14	0	Reserved
	1	Reserved
15 (MSB)	0	Bit string active according to ID147, ID32926 is not supported
	1	ID147 bit 0 and bit 1 active, ID32926 active

ID32926 'AMK homing cycle parameter' bit string

Configuration ID32926 'AMK homing cycle parameter'

Bit no.	Condition	Meaning
0 - 7	0	Reserved
	1	Reserved
8	0	Drive movement for the homing cycle via setpoints from the internal interpolator
	1	Drive movement for the homing cycle via the setpoint setting through a controller (external interpolation).
9	0	Homing cycle on fixed stop inactive
	1	Homing cycle on fixed stop: Reverse of rotational direction triggered by a defined torque peak after ID126, evaluation of the 1th encoder homing mark (zero pulse) after the directional rotation reverse.
10	0	The actual position value is set to zero upon detection of the homing mark
	1	The actual position value is not set to zero upon detection of the homing mark
11	0	Homing cycle with cam evaluation
	1	Homing cycle without cam evaluation (referencing only to the homing mark (zero pulse) of the current actual position value encoder)
12	0	**Cam arrangement** Linear cam: If the axis is on the cam, a move is made away from the cam against the homing direction (ID147, bit 0). If the axis is moved away from the cam signal, the direction of movement is reversed and again moved in the direction of the cam until the cam signal is active. The axis is homed.
	1	Rotation cam: If the axis is on the cam, rotation and homing always continues in the homing direction until the next cam.
13	0	**Encoder homing mark evaluation (zero pulse)** Homing cycle with encoder homing mark evaluation (zero pulse) after reaching the homing switch (cam)
	1	Homing cycle without encoder homing mark evaluation (zero pulse). The homing switch (cam) provides the homing mark at the same time.
14	0	**Cam type** Pulse cam
	1	Range cam, cam clearance speed according to ID32940 'High homing velocity'
15		Reserved

ID32953 'Encoder type' bit string

Configuration ID32953 'Encoder type'

Bit no.	Condition	Meaning
0-3 **Motor encoder** (Nibble 0)	0x0	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 /** I encoder **KW-R24-R /** Reserved
	0x1	**KW-R06 / KW-R07 /** H encoder, connected to the resolver input **iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /** H encoder, connected to the sine encoder input **KW-R16 / KW-R17 / KW-R24-R / KW-R25 / KW-R26 /** Reserved

Bit no.	Condition	Meaning
	0x2	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 /** T, V encoder [1) 2)] **KW-R24-R /** Reserved
	0x3	Reserved
	0x4	Reserved
	0x5	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 /** I encoder **KW-R24-R /** Reserved
	0x6	Reserved
	0x7	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 /** S, U encoder [2)] **KW-R24-R /** Reserved
	0x8	**KW-R06 / KW-R07 / KW-R24-R /** Resolver **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 /** Reserved
	0x9	**KW-R06 / KW-R07 /** Square wave pulse encoder **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0xA	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 /** E or F encoder Linear encoder LC183 and LC483 **KW-R24-R /** Reserved
	0xB	Reserved
	0xC	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 /** P or Q encoder **KW-R24-R /** Reserved
	0xD	**KW-R26 /** Y encoder **KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 /** Reserved

Bit no.	Condition	Meaning
4-7 **Motor model** (Nibble 1)	0x0	Asynchronous motor
	0x1	Non-field weakening synchronous motor
	0x2	U/f control
	0x3	Field weakening synchronous motor
	0x5	Sensorless operation of an asynchronous motor (Nibble 0 has to be set to the value 0)
	0x6	Asynchronous motor with voltage control (control of the magnetising current)
8-11 **Speed encoder** (Nibble 2)	0x0	like motor encoder
	0x1	**KW-R06 / KW-R07 /** H encoder, connected to the resolver input **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x2	**KW-R06 / KW-R07 /** T, V encoder [1) 2)] **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x3	Reserved
	0x4	Reserved
	0x5	**KW-R06 / KW-R07 /** I encoder **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x6	Reserved
	0x7	**KW-R06 / KW-R07 /** S, U encoder [2)] **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x8	**KW-R06 / KW-R07 /** Resolver **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x9	**KW-R06 / KW-R07 /** Square wave pulse encoder **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0xA	**KW-R06 / KW-R07 /** E or F encoder (Linear encoder LC183 and LC483) **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0xB	Reserved

Bit no.	Condition	Meaning
	0xC	**KW-R06 / KW-R07 /** P or Q encoder **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
12-15 **Position encoder** (Nibble 3)	0x0	like motor encoder
	0x1	**KW-R06 / KW-R07 /** H encoder, connected to the resolver input **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x2	**KW-R06 / KW-R07 /** T, V encoder [1) 2)] **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x3	Reserved
	0x4	Reserved
	0x5	**KW-R06 / KW-R07 /** I encoder **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x6	Reserved
	0x7	**KW-R06 / KW-R07 /** S, U encoder [2)] **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x8	**KW-R06 / KW-R07 /** Resolver **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0x9	**KW-R06 / KW-R07 /** Square wave pulse encoder **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0xA	**KW-R06 / KW-R07 /** E or F encoder (Linear encoder LC183 and LC483) **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved
	0xB	Reserved

Bit no.	Condition	Meaning
	0xC	**KW-R06 / KW-R07 /** P or Q encoder **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 /** Reserved

1) Also applies for the linear scale "LinCoder L230" from the company Sick/Stegmann with the Hiperface interface.
2) When switching on the power supply, or when doing a homing cycle, the encoder must not turn because the digital position is read twice and plausibility checked. If the difference between both read positions is out of the internal defined range, the diagnosis message 2310 'Encoder communication' info 1 = 7 is issued.

Encoder evaluation

E-, F-encoder:

The encoder evaluation (type E / F) is a combination of analogue and digital evaluation. The absolute value is generated in the encoder after mains on and send to the inverter via EnDat 2.1 protocol. The absolute value is evaluated in the inverter only once, during operation only the SIN/COS tracks are evaluated for the motor control. The multiturn encoder (type F) not need a homing. For singleturn encoder (type E) a homing cycle must be executed to built a relation between the machine position and the encoder signal. The necessary homing mark is built in the drive controller.

.

H-encoder:

The Hall encoder generates directly a SIN/COS signal with 1 period/revolution. Out of them the drive controller calculates the position angle of the rotor.

Per revolution the drive controller generates one homing mark to evaluate during the function homing cycle.

I-encoder:

The encoder evaluation (type I) is an analogue evaluation of the SIN/COS tracks and a homing signal.

The rotary rotor field of the permanent magnets of a synchronous motor is not aligned to the rotary stator rotary field. At synchronous motors with I-type encoder the alignment is done automatically with the function software commutation after the first switch on of the controller enable (RF) after mains on

.

The function software commutation automatically writes values in ID34174. As the function changes parameter values, the device will automatically startup the device at the next RF change. A device startup causes the temporarily changed parameter to be reset to its initial value. Temporary parameters must therefore be written cyclically or only after the software commutation function, followed by another RF change, on the application side.

P-, Q-encoder:

The encoder evaluation (type P / Q) is a complete digital evaluation. The absolute position is send via EnDat 2.1 commands cyclic synchronous from the encoder, triggered by the trigger signal (CLOCK) of the drive controller.

Any available SIN/COS signals are not evaluated!

R-encoder:

The evaluation electronic for the encoder signals scans the high frequency output signals of the encoder by an A/D converter at this time, where the exciter signal has his maximum. The scan cycle is known, because the evaluation electronic is generating also the exciter signal. The evaluation electronic scans the peak values of the encoder signal, in this way the exciter signal is eliminated. A SIN/COS signal with 1 period/revolution remains. Out of them the drive controller calculates the angle position of the rotor. To become a position relation between the machine and the encoder signals a homing cycle function must be executed. The necessary homing mark of the encoder (1/revolution) is built in the drive controller.

S-, T-, U-, V-encoder:

The encoder evaluation (type S / T / U / V) is a combination of analogue and digital evaluation. The absolute value is generated in the encoder after mains on and send to the inverter via Hiperface protocol. The absolute value is evaluated in the inverter only once, during operation only the SIN/COS tracks are evaluated for the motor control. The multiturn encoder (type T / V) not need a homing. For singleturn encoder (type S / U) a homing cycle must be executed to built a relation between the machine position and the encoder signal. The necessary homing mark of the encoder is built in the drive controller.

Y-encoder:

The Hiperface DSL protocol transmits digital data between an encoder and the drive controller by modulating the data into the supply line of the encoder. The absolute positions are send serial and cyclic synchronous from the encoder triggered by the trigger signal of the drive controller.