'Following error compensation (SAK)'

Translation of the "Original Dokumentation"
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Name: FKT_Schleppabstandskompensation_SAK_en

Version:

Version: 2019/45	
Change	**Letter symbol**
• Controller card KW-R27 added	STL

Previous version: 2017/14

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 V1.05 2010/32 (203194)
KW-R24-R (O954)	AE-R24-R V2.11 2016/46 (206643)
KW-R25 (O902)	AE-R25 V2.02 2014/23 (205217)
KW-R26 (O903)	AE-R26 V2.02 2014/23 (205215)
KW-R27 (O957)	AE-R26 V2.12 2018/40 (207284)
iX / iC / iDT5	iX V1.00 2011/21 (203699)
iX(-R3) / iC(-R3) / iDT5(-R3) /	iX V2.08 2015/46 (206017)
ihX	ihX V1.00 2015/06 (205440)

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1 'Following error compensation (SAK)'

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 / KW-R27 /

Because of the principle, there is always a difference present between setpoint position value and actual position value in the position control mode. This difference is referred to as following error. The following error is influenced by the velocity and the position controller amplification factor K_V (ID104 'Position loop factor KV').

To reduce the following error, the position controller can be set harder and/or the following error compensation can be activated.

The following error compensation works like a speed feed-forward control in principle.

An internal feed-forward value is formed from the difference between setpoint position value and actual position value and in dependence on the velocity. This internal feed-forward value is added internally to the external position setpoint.

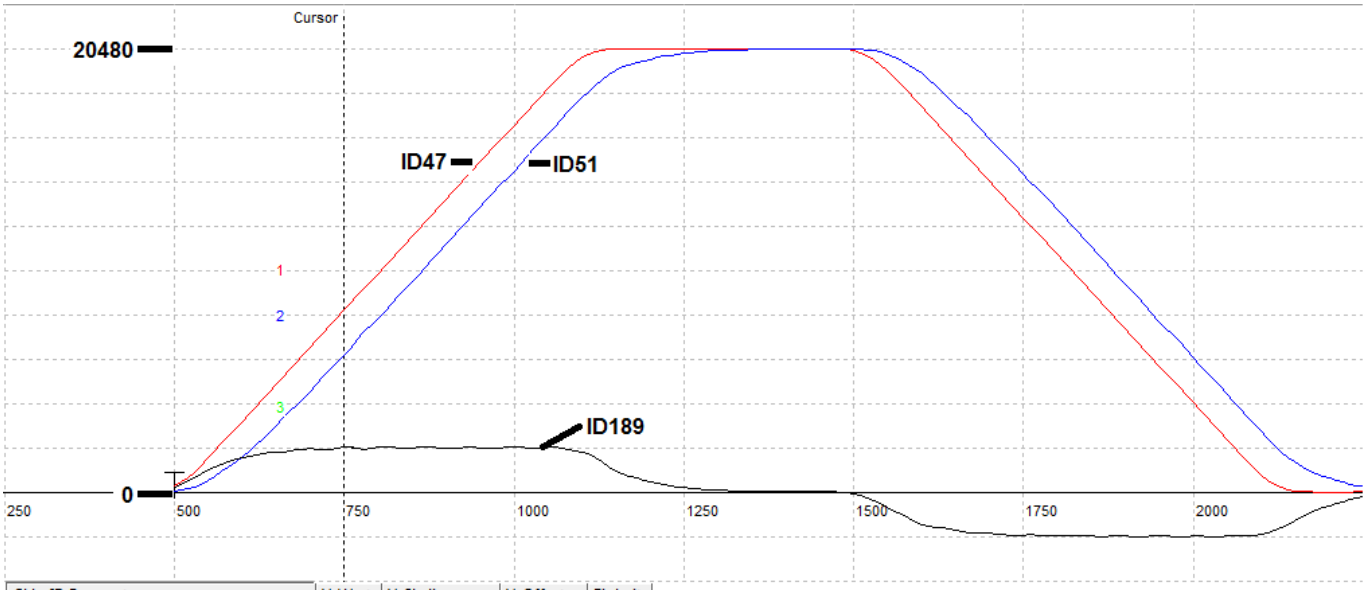
The following error compensation compensates the following error at constant velocity.

With SAK activated, the velocity-dependent following error (ID296 'Velocity feedforward gain') and the acceleration feed forward (ID348 'Acceleration feedforward gain') can be influenced by parameter.

Bus- or controller-dependent dead times can be compensated with ID32993 'Dead time compensation 2'. ID32993 functions for the setpoint specification by means of ID47 'Position command value' or the internal interpolator. ID32992 'Dead time compensation 1' compensates dead times for setpoint specification via the pulse encoder input.

Example: Absolute positioning +/- 20480 increments without following error compensation

A constant following error adapts itself for constant velocity.



CH - ID Parameter name	Y-Wert	Y-Skalierung	Y-Offset	Einheit
CH1 - 00047 Position command value	8392	2050	0	Inkr.
CH2 - 00051 Position feedback value	6307	2050	0	Inkr.
CH3 - 00189 Following dist.	2052	2050	0	Inkr.

Mathematical determination of the following error without following error compensation for the example measurement:

The maximum mathematical following error (SA) of a rotating drive results from:

$$\mathrm{SA}\ [\mathrm{Incr}] = \frac{\mathrm{n}\ \left[\frac{1}{\mathrm{min}}\right] \times \mathrm{ID116}\ [\mathrm{Incr}]}{\mathrm{ID104}\ \left[\frac{1}{\mathrm{min}}\right]}$$

Relevant values:

ID40 'Velocity feedback value' = approx. 100 rpm (determined from further measurement)

ID104 'Position loop factor KV' = 1000

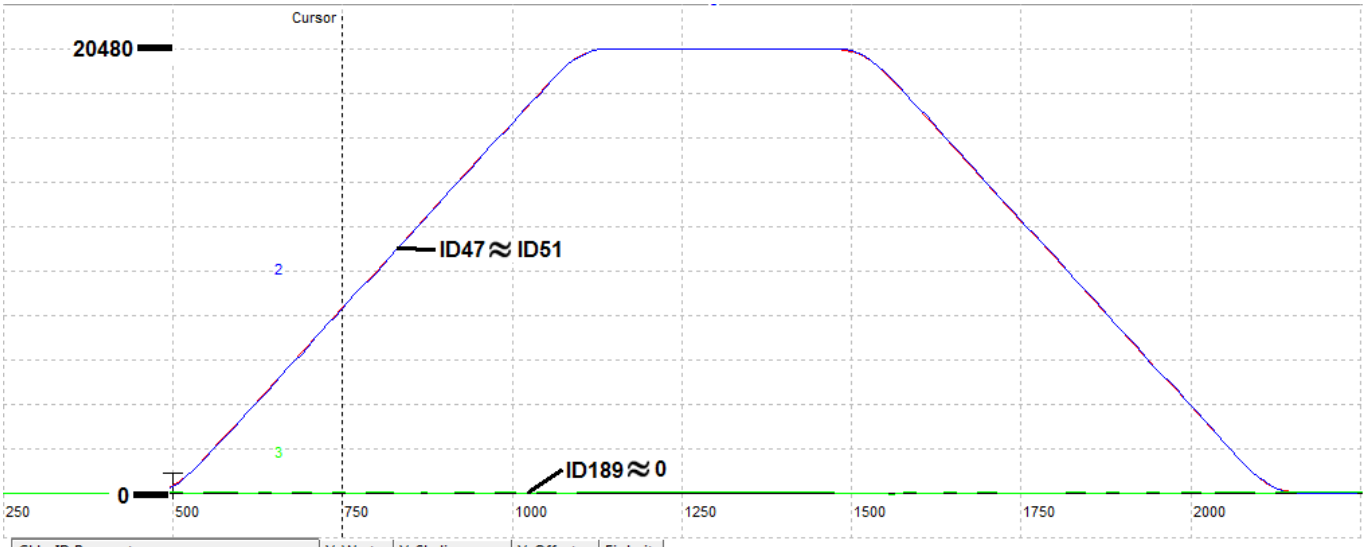
ID116 'Resolution motor encoder' = 20480 incr.

$$\mathrm{SA}\ [\mathrm{Incr}] = \frac{100\ \left[\frac{1}{\mathrm{min}}\right] \times 20480\ [\mathrm{Incr}]}{1000\ \left[\frac{1}{\mathrm{min}}\right]} = 2048$$

Example: Absolute positioning +/- 20480 increments without following error compensation

The following error is completely adjusted for constant velocity.

The following error can be reduced by ID348 'Acceleration feedforward gain' for positive and negative changes to acceleration.



CH - ID Parameter name	Y-Wert	Y-Skalierung	Y-Offset	Einheit
CH1 - 00047 Position command value	8530	2050	0	Inkr.
CH2 - 00051 Position feedback value	8471	2050	0	Inkr.
CH3 - 00189 Following dist.	26	2050	0	Inkr.

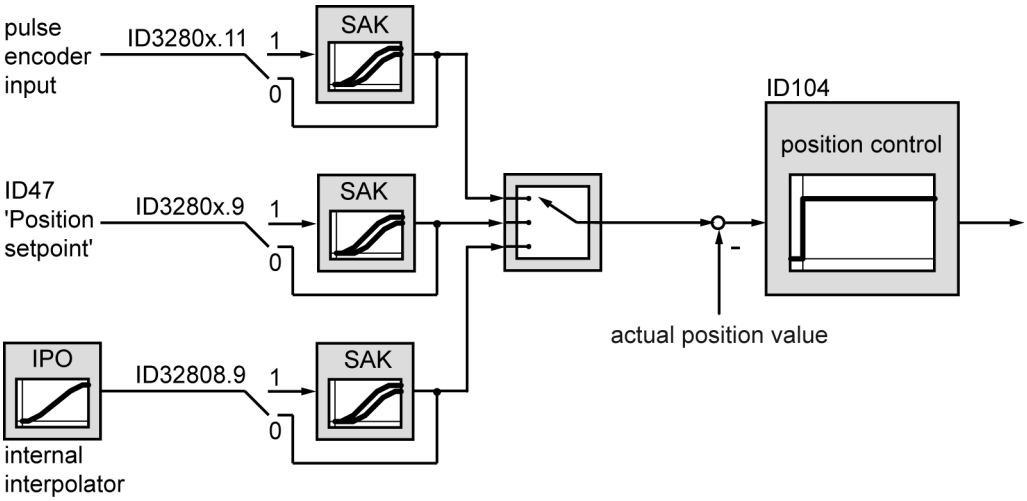
For active SAK ID3280x 'AMK operating modes' Bit 9, speed feed-forward control values may not be simultaneously specified via the ID37 'Additive velocity command value' resp. the speed feed-forward control according to ID34225 'Mode feed forward control' Bit 4 = 1 be active, otherwise feed-forward occurs twice.

2 Versions and startup

The setpoint preparation of the following error compensation (SAK) depends on the activated setpoint source. Position setpoints can be specified via the pulse encoder input, cyclically or by the internal interpolator.

The following error compensation (SAK) works in the position control operating mode and is activated in the active operating mode (ID3280x 'AMK operating modes'). The bit number depends on the configured setpoint source.

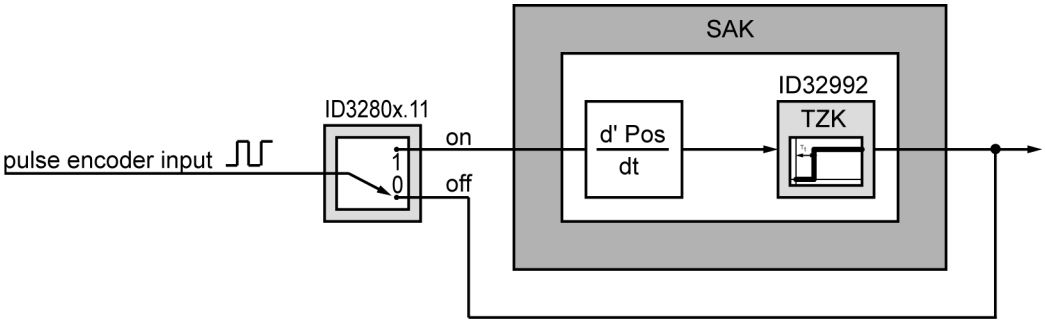
Simplified depiction of the setpoint preparation for the position controller



1) Supported hardware: KW-R06 / KW-R07 /

2.1 Setpoint source 'pulse encoder input'

Supported hardware: KW-R06 / KW-R07 /

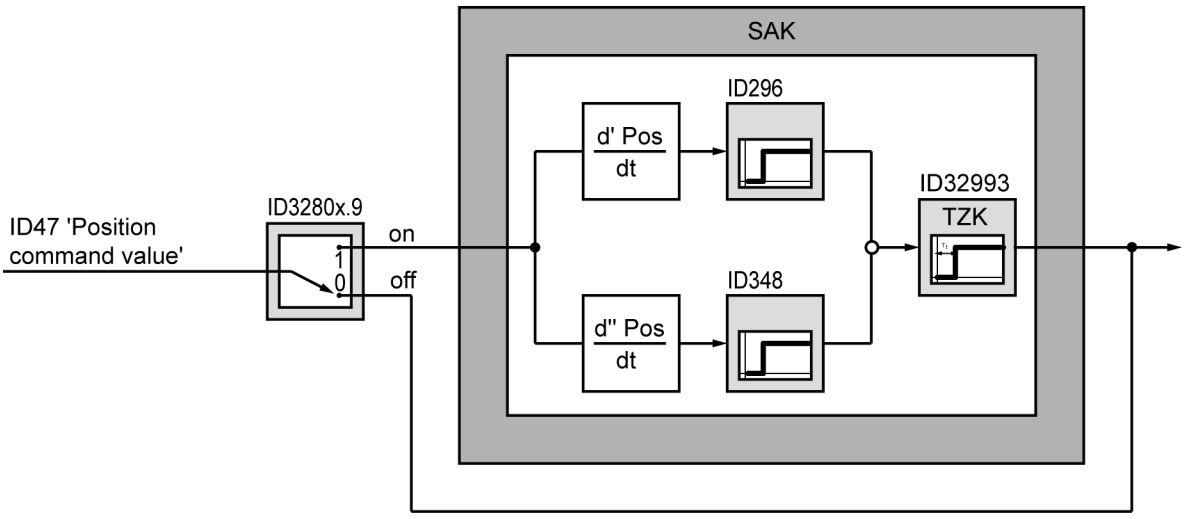


2.1.1 Relevant parameters

Parameter	Meaning / information
ID189 'Following distance'	The difference between the position setpoint and the actual position value is shown as a follow error (control deviation of the position controller) in ID189 in the position control operating mode. The following applies: Position setpoint: ID47 'Position command value' + internal interpolator (IPO) + pulse encoder input Actual position value: ID51 'Position feedback value'
ID3280x 'AMK operating modes' Bit 11	SAK pulse encoder input Bit 11 = 0: SAK deactivated Bit 11 = 1: SAK activated
ID3280x 'AMK operating modes' Bit 16-23	Code: 0x03 Setpoint specification via pulse encoder input active
ID32824 'Following distance'	Identical to the meaning of ID189 'Following distance'
ID32826 'Following error compensation value'	ID32826 shows the compensation value (pre-control value) for the active following error compensation (ID3280x 'AMK operating modes' Bit 9 = 1).
ID32992 'Dead time compensation 1'	ID32992 'Dead time compensation 1' compensates dead times for setpoint specification via the pulse encoder input.

2.2 Setpoint source 'cyclical position setpoints'

Supported hardware: KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / ihXT /KW-R25 / KW-R26 / KW-R27 /

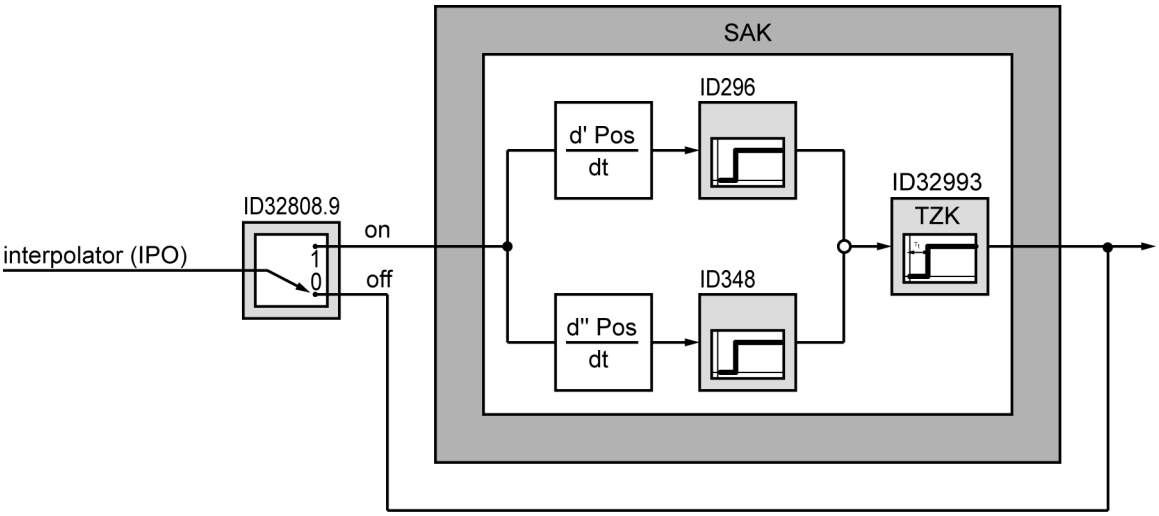


2.2.1 Relevant parameters

Parameter	Meaning / information
ID47 'Position command value'	Cyclical position setpoint from the PLC controller
ID296 'Velocity feedforward gain'	An internal feed-forward value is formed from the difference between setpoint position value and actual position value and in dependence on the velocity. This internal feed-forward value is added internally to the position setpoint. You can influence whether the internal feed-forward value is calculated up to 100% with the position setpoint or only on a percentage basis using ID296 'Velocity feedforward gain'. The standard setting of the amplification factor is 100%. The smaller the specified amplification factor is, the greater the speed-dependent following error becomes.
ID348 'Acceleration feedforward gain'	The acceleration feed-forward by ID348 'Acceleration feedforward gain' reduces the speed error and the resulting following error during the positive and negative acceleration. The standard setting of the amplification factor is 0% (acceleration feed-forward deactivated).
ID3280x 'AMK operating modes' Bit 9	SAK cyclical position setpoint specification Bit 9 = 0: SAK deactivated Bit 9 = 1: SAK activated
ID3280x 'AMK operating modes' Bit 16-23	Code: 0x41 or 0x43 Setpoint specification via cyclical setpoint specification active
ID32993 'Dead time compensation 2'	Bus- or controller-dependent dead times can be compensated with ID32993 'Dead time compensation 2'. ID32993 functions for the setpoint specification by means of ID47 'Position command value' or the internal interpolator.

2.3 Setpoint source 'Internal interpolator'

Supported hardware: KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / ihXT /KW-R25 / KW-R26 / KW-R27 /



2.3.1 Relevant parameters

Parameter	Meaning / information
ID296 'Velocity feedforward gain'	An internal feed-forward value is formed from the difference between setpoint position value and actual position value and in dependence on the velocity. This internal feed-forward value is added internally to the position setpoint. You can influence whether the internal feed-forward value is calculated up to 100% with the position setpoint or only on a percentage basis using ID296 'Velocity feedforward gain'. The standard setting of the amplification factor is 100%. The smaller the specified amplification factor is, the greater the speed-dependent following error becomes.
ID348 'Acceleration feedforward gain'	The acceleration feed-forward by ID348 'Acceleration feedforward gain' reduces the speed error and the resulting following error during the positive and negative acceleration. The standard setting of the amplification factor is 0% (acceleration feed-forward deactivated).
ID32808 'AMK position control' Bit 9	SAK internal interpolator Bit 9 = 0: SAK deactivated Bit 9 = 1: SAK activated
ID32808 'AMK position control' Bit 16-23	Code: 0x44 Setpoint specification via internal interpolator active
ID32993 'Dead time compensation 2'	Bus- or controller-dependent dead times can be compensated with ID32993 'Dead time compensation 2'. ID32993 functions for the setpoint specification by means of ID47 'Position command value' or the internal interpolator.