Function to avoid Slip-Stick effects

Translation of the "Original Dokumentation"
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Name: FKT_Anti-Slip-Stick_ID_en

Version:

Version: 2020/04	
Change	**Letter symbol**
• Controller card KW-R24-R added • Controller card KW-R27 added • Parametrize threshold ID33336 'Threshold variable torque limit' added	LeS / STL

Previous version: 2018/44

Product version:

Product (AMK part no.)	Firmware Version (AMK part no.)
KW-R24-R (O954)	AE-R24-R V2.13 2019/24 (207413)
KW-R25 (O902)	AE-R25 V2.12 2018/23 (206993)
KW-R26 (O903)	AE-R26 V2.12 2018/23 (206647)
KW-R27 (O957)	AE-R26 V2.12 2018/40 (207284)
iX(-R3) / iC(-R3) / iDT5(-R3) /	iX V2.12 2018/03 (207093)
ihX	ihX V2.12 2018/03 (207094)

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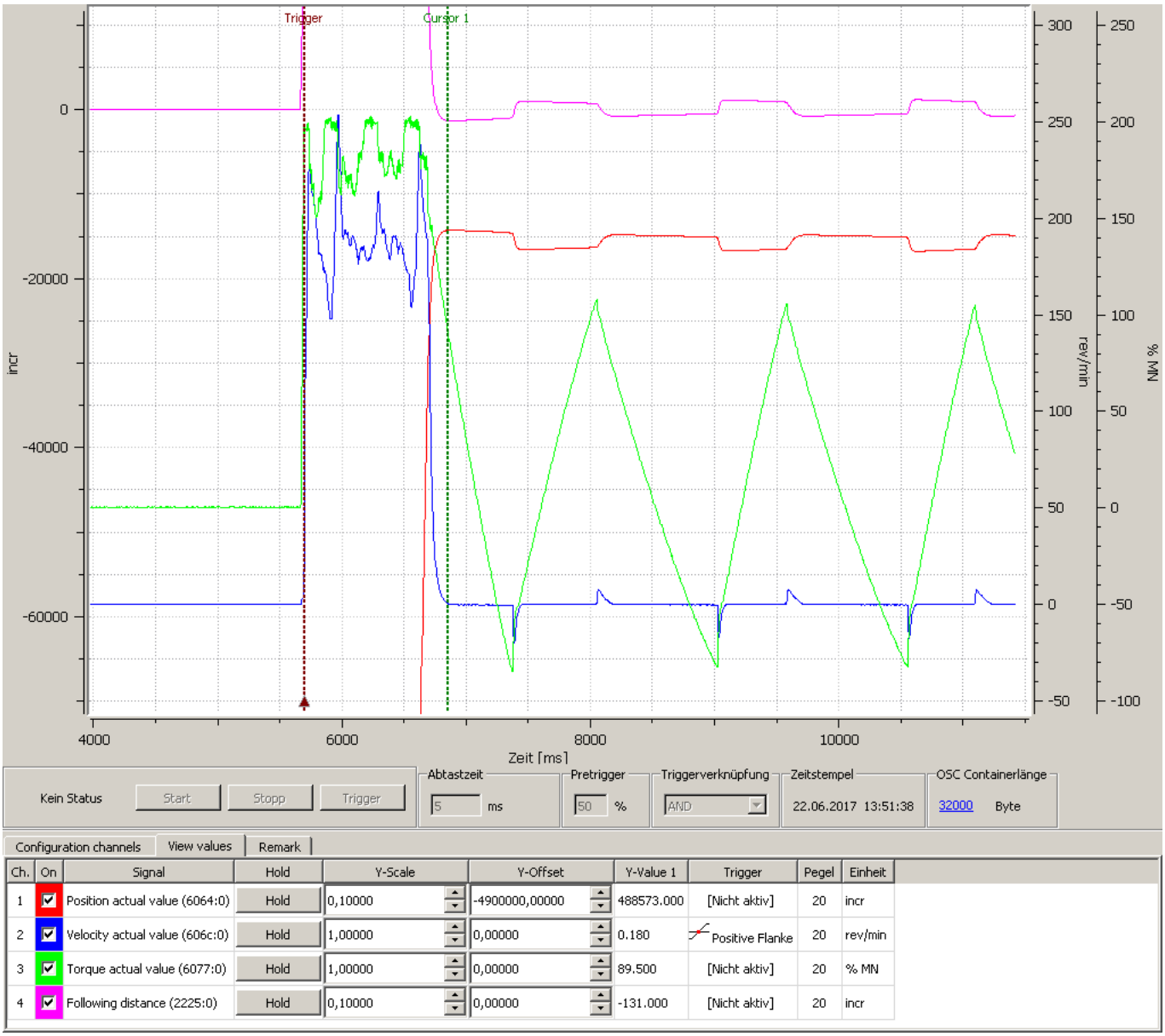
1 Slip-Stick effect

Slip-stick effects may occur during operation in applications with high static friction. In position control the axis comes to a standstill due to the high static friction with a following error or a control deviation. The deviation leads to an increasing I component of the speed controller, which in turn results in a growing moment on the shaft. The axis makes a jump around the target position, if the shaft torque overcomes the static friction and the sliding friction is lower. This behavior repeats constantly.

The overload monitoring additionally responds if the static friction is larger than the nominal torque. In unfavorable cases, this can results in an error and RF withdrawal.

Example:

The axis positions to the target, but stops with a permanent following error (Channel 4 - magenta) due to the static friction. It builds up a moment (Channel 3 - green) and when overcoming the static friction the axis jumps over the target position (speed Channel 2 - blue, position Channel 1 - red). The jerky position jumps around the target position are repeated. In this example, the static friction is asymmetrical, it is much larger in the positive direction.



Ch.	On	Signal	Hold	Y-Scale	Y-Offset	Y-Value 1	Trigger	Pegel	Einheit
1	☑	Position actual value (6064:0)	Hold	0,10000	-4900000,00000	488573.000	[Nicht aktiv]	20	incr
2	☑	Velocity actual value (606c:0)	Hold	1,00000	0,00000	0.180	Positive Flanke	20	rev/min
3	☑	Torque actual value (6077:0)	Hold	1,00000	0,00000	89.500	[Nicht aktiv]	20	% MN
4	☑	Following distance (2225:0)	Hold	0,10000	0,00000	-131.000	[Nicht aktiv]	20	incr

2 Measure to avoid the Slip-Stick effect

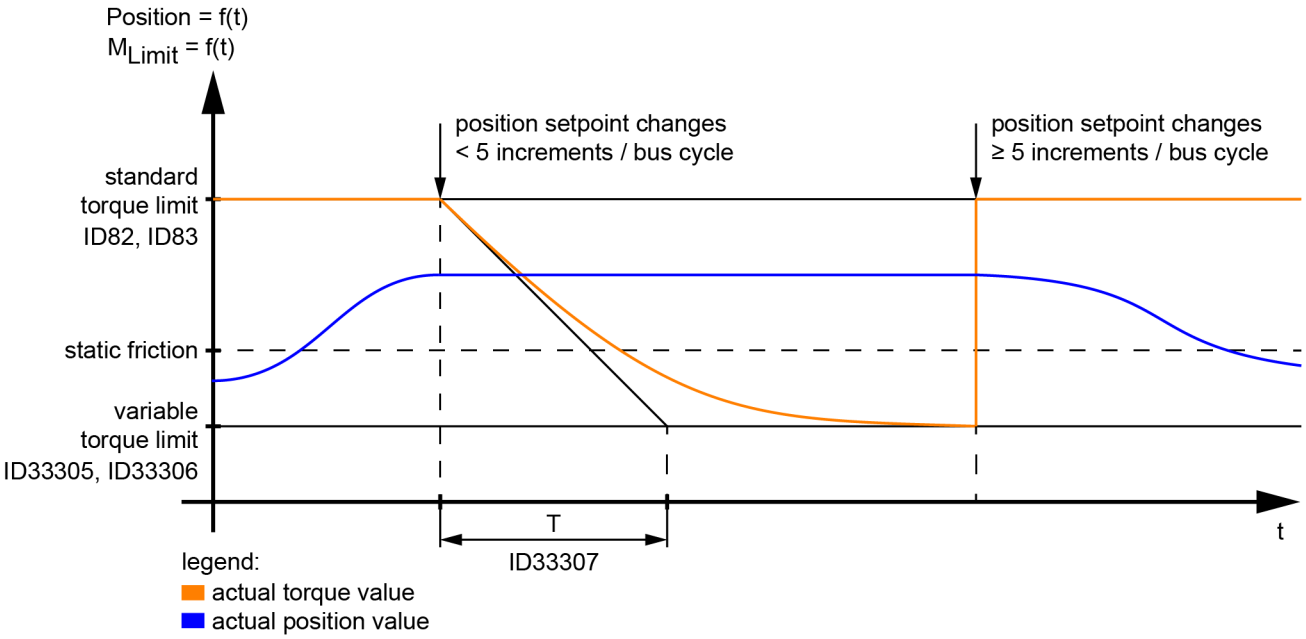
The slip-stick effect is avoided if in the position controlled standstill the torque limits are reduced to such an value that the static friction is not overcome.

The function is currently only usable in position control.

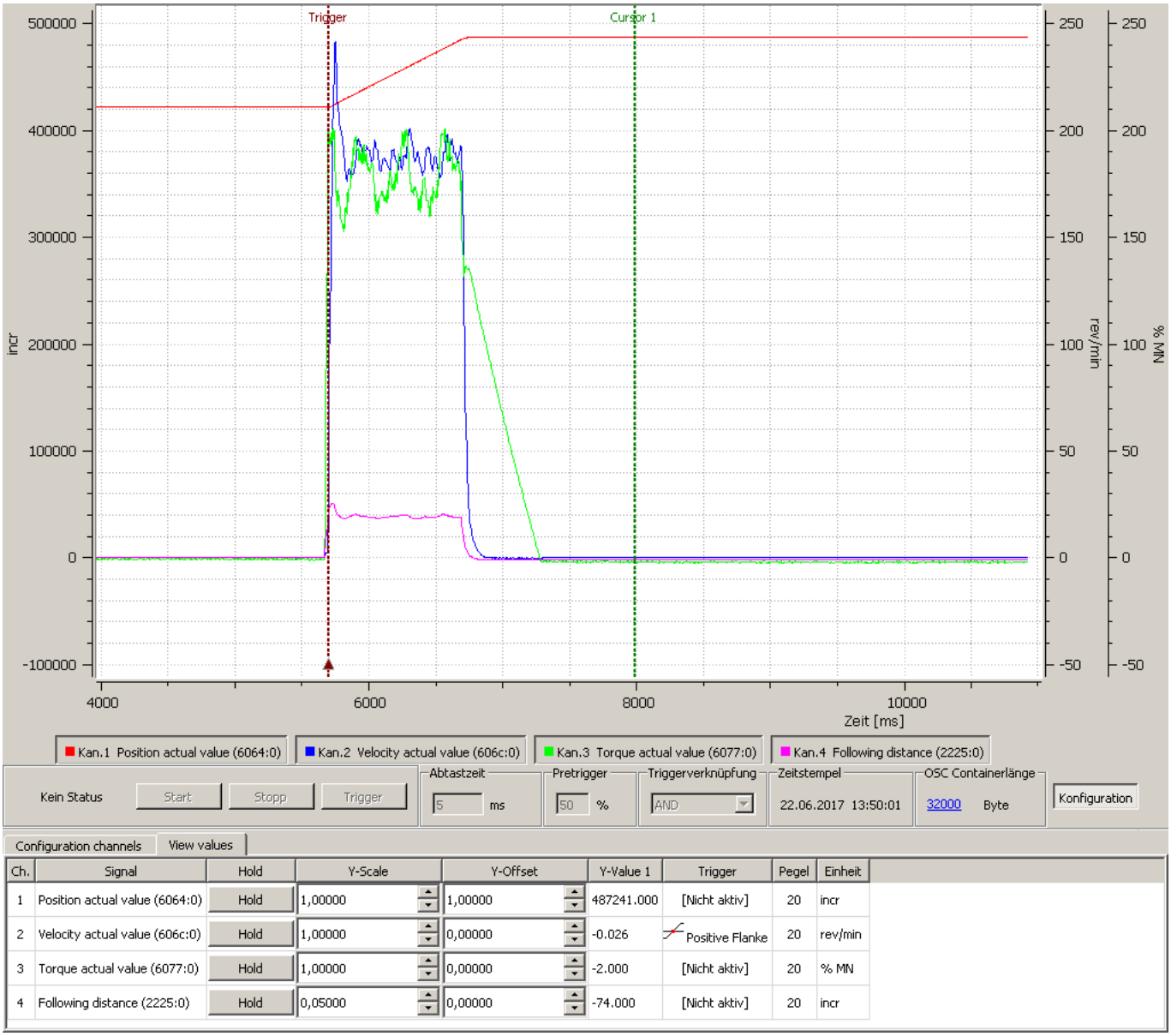
The function is activated via bit bar (ID33304 'Motion service switch' Bit 0). The torque limits (ID33305 'Variable positive torque limit' and ID33306 'Variable negative torque limit') are treated separately due to need for the suspended axes or asymmetric frictional behavior.

Almost at a standstill (position setpoint changes <5 increments / bus cycle-time parameterizable via ID33336 'Threshold variable torque limit') the standard torque limits with PT1 behavior are reduced to the variable torque limits. The variable torque limits and the filter time constant can be parameterized.

The variable torque limits must be selected smaller than the static friction . As a result, the slip-stick effect is avoided, however, any existing following error can not be completely degraded. The reduced torque limits are immediately increased back to the default values if setpoints are specified for a new movement.



Subsequent is a measurement with an activated reducing torque limits. The slip-stick effect no longer occurs.



Ch.	Signal	Hold	Y-Scale	Y-Offset	Y-Value 1	Trigger	Pegel	Einheit
1	Position actual value (6064:0)	Hold	1,00000	1,00000	487241.000	[Nicht aktiv]	20	incr
2	Velocity actual value (606c:0)	Hold	1,00000	0,00000	-0.026	Positive Flanke	20	rev/min
3	Torque actual value (6077:0)	Hold	1,00000	0,00000	-2.000	[Nicht aktiv]	20	% MN
4	Following distance (2225:0)	Hold	0,05000	0,00000	-74.000	[Nicht aktiv]	20	incr

2.1 Relevant parameters

Parameters	Meaning	
ID33304 'Motion service switch'	Bit 0	Function to avoid slip-stick effects = 0: inactive = 1: active
ID33305 'Variable positive torque limit'	'Variable positive torque limit' if the function to avoid slip-stick effects is active	
ID33306 'Variable negative torque limit'	'Variable negative torque limit' if the function to avoid slip-stick effects is active (enter with sign '-')	
ID33307 'Time constant variable torque limits'	'Time constant variable torque limits' describes the temporal transition behavior of the torque limits between normal mode and the variable values	
ID33336 'Threshold variable torque limit'	'Threshold variable torque limit' is the limit value of the position increase per bus cycle, from which the standard torque limits ID82 'Positive torque limit' / ID83 'Negative torque limit' act. For increases smaller than the threshold, the transition is made to the variables torque limits ID33305 'Variable positive torque limit' / ID33306 'Variable negative torque limit'	

Appendix

2.2 Parameters

2.2.1 ID33304 'Motion service switch'

Supported hardware:	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 /		
Sphere of action:	DRIVE	**Default value:**	0000 0000 0000 0000 (LSB)
Access:	READING / WRITING	**Scale:**	1
Temporarily changeable:	NO	**Unit:**	-
Data length:	4 byte	**Min. value:**	-
Signed:	NO	**Max. value:**	-
Format:	BIN		
List:	NO		

Configuration ID33304 'Motion service switch'

Bit no.	Condition	Meaning
0	0	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 / Function to avoid slip-stick effects inactive
	1	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 / Function to avoid slip-stick effects active
1	0	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 / Advanced position increase monitor inactive
	1	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 / Advanced position increase monitor aktive
2-31	0	Reserved
	1	Reserved

2.2.2 ID33305 'Variable positive torque limit'

Supported hardware:	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 /		
Sphere of action:	DRIVE	**Default value:**	0
Access:	READING / WRITING	**Scale:**	0.1
Temporarily changeable:	YES	**Unit:**	$\%M_N$
Data length:	2 byte	**Min. value:**	-3000.0 $\%M_N$
Signed:	NO	**Max. value:**	3000.0 $\%M_N$
Format:	DEC		
List:	NO		

This parameter is used by the following function:
'Anti Slip-Stick'

2.2.3 ID33306 'Variable negative torque limit'

Supported hardware:	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 /		
Sphere of action:	DRIVE	**Default value:**	0
Access:	READING / WRITING	**Scale:**	0.1
Temporarily changeable:	YES	**Unit:**	$\%M_N$
Data length:	2 byte	**Min. value:**	-3000.0 $\%M_N$
Signed:	YES	**Max. value:**	3000.0 $\%M_N$
Format:	DEC		
List:	NO		

This parameter is used by the following function:
'Anti Slip-Stick'

2.2.4 ID33307 'Time constant variable torque limits'

Supported hardware:	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 /		
Sphere of action:	DRIVE	**Default value:**	0
Access:	READING / WRITING	**Scale:**	1
Temporarily changeable:	YES	**Unit:**	ms
Data length:	2 byte	**Min. value:**	0
Signed:	NO	**Max. value:**	65535
Format:	DEC		
List:	NO		

ID33307 'Time constant variable torque limits' describes the temporal transition behavior of the torque limits between normal mode and the variable values.

This parameter is used by the following function:
'Anti Slip-Stick'

2.2.5 ID33336 'Threshold variable torque limit'

Supported hardware:	iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R25 / KW-R26 / KW-R27 /		
Sphere of action:	DRIVE	**Default value:**	5
Access:	READING / WRITING	**Scale:**	1
Temporarily changeable:	YES	**Unit:**	Increments
Data length:	4 byte	**Min. value:**	1
Signed:	NO	**Max. value:**	2147483647
Format:	DEC		
List:	NO		

This parameter'Threshold variable torque limit' is the limit value of the position increase per bus cycle, from which the standard torque limits ID82 'Positive torque limit' / ID83 'Negative torque limit' act. For increases smaller than the threshold, the transition is made to the variables torque limits ID33305 'Variable positive torque limit' / ID33306 'Variable negative torque limit'.