Control loop setting

Translation of the "Original Dokumentation"

Name: FKT_Regelkreiseinstellung_en

Version:

Version: 2019/44	
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 (O901)	AE-R24 V2.03 2015/06 (205587)
KW-R24-R (O954)	AE-R24-R V2.11 2016/46 (206643)
KW-R25 (O902)	AE-R25 V2.03 2015/06 (205588)
KW-R26 (O903)	AE-R26 V2.03 2015/06 (205589)
KW-R27 (O957)	AE-R26 V2.12 2018/40 (207284)
iX / iC / iDT5 /	iX V1.03 2013/18 (204515)
iX(-R3) / iC(-R3) / iDT5(-R3) /	iX V2.08 2015/46 (206017)
ihXT /	ihX V1.00 2015/06 (205440)

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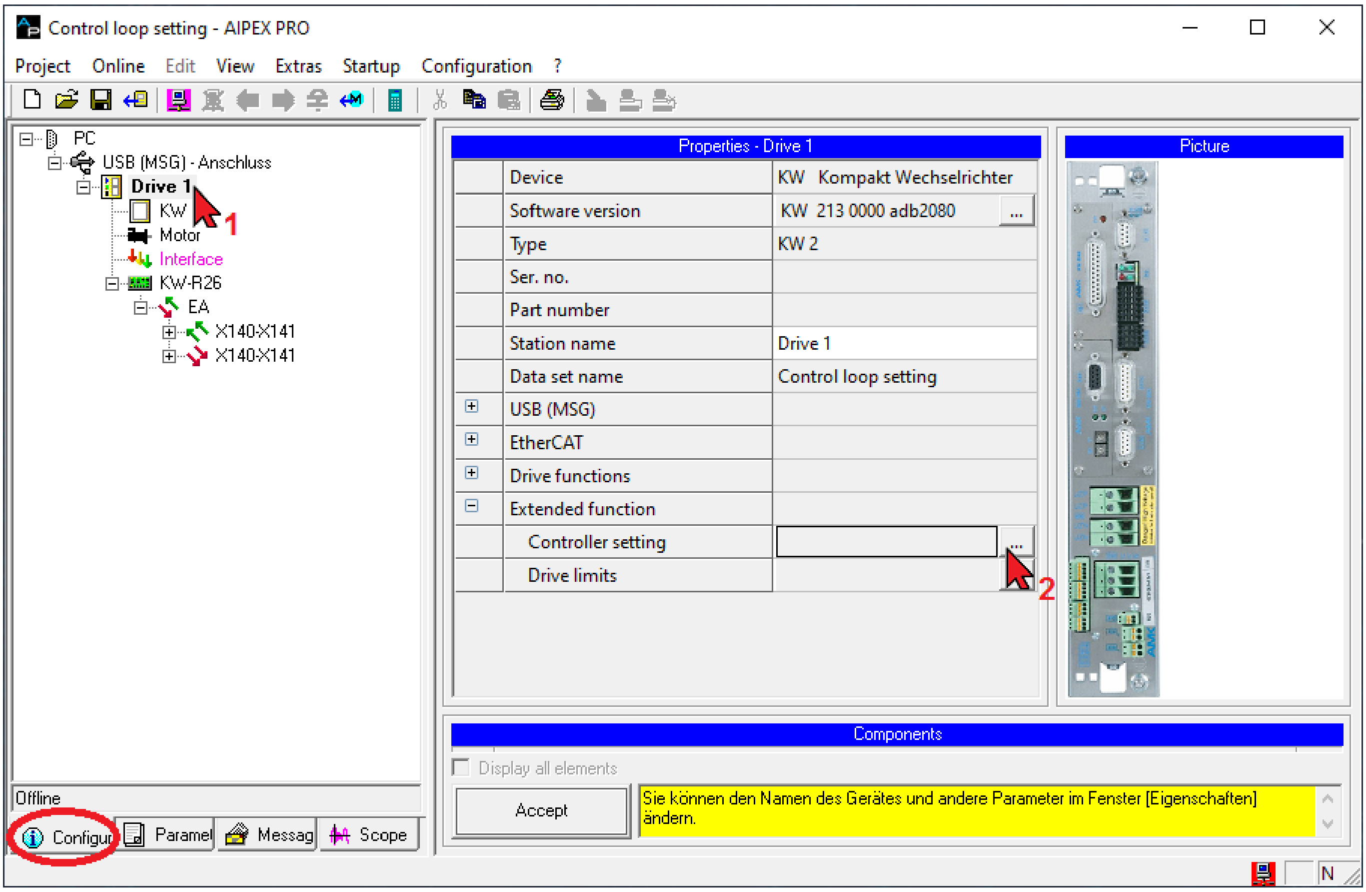
Registration court: Stuttgart HRB 231283; HRA 230681

1 Setting the control loop

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

The parameters required for the control loop are set using the AIPEX PRO software.

The drive for which the control circuit is to be parameterized is selected in the device tree.



You will find the control setting under 'Extended function', in the 'Configuration' tab and the 'Properties' window.

The controller structure will be selected first of all:

- Position controller
- Speed controller
- Torque controller

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

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

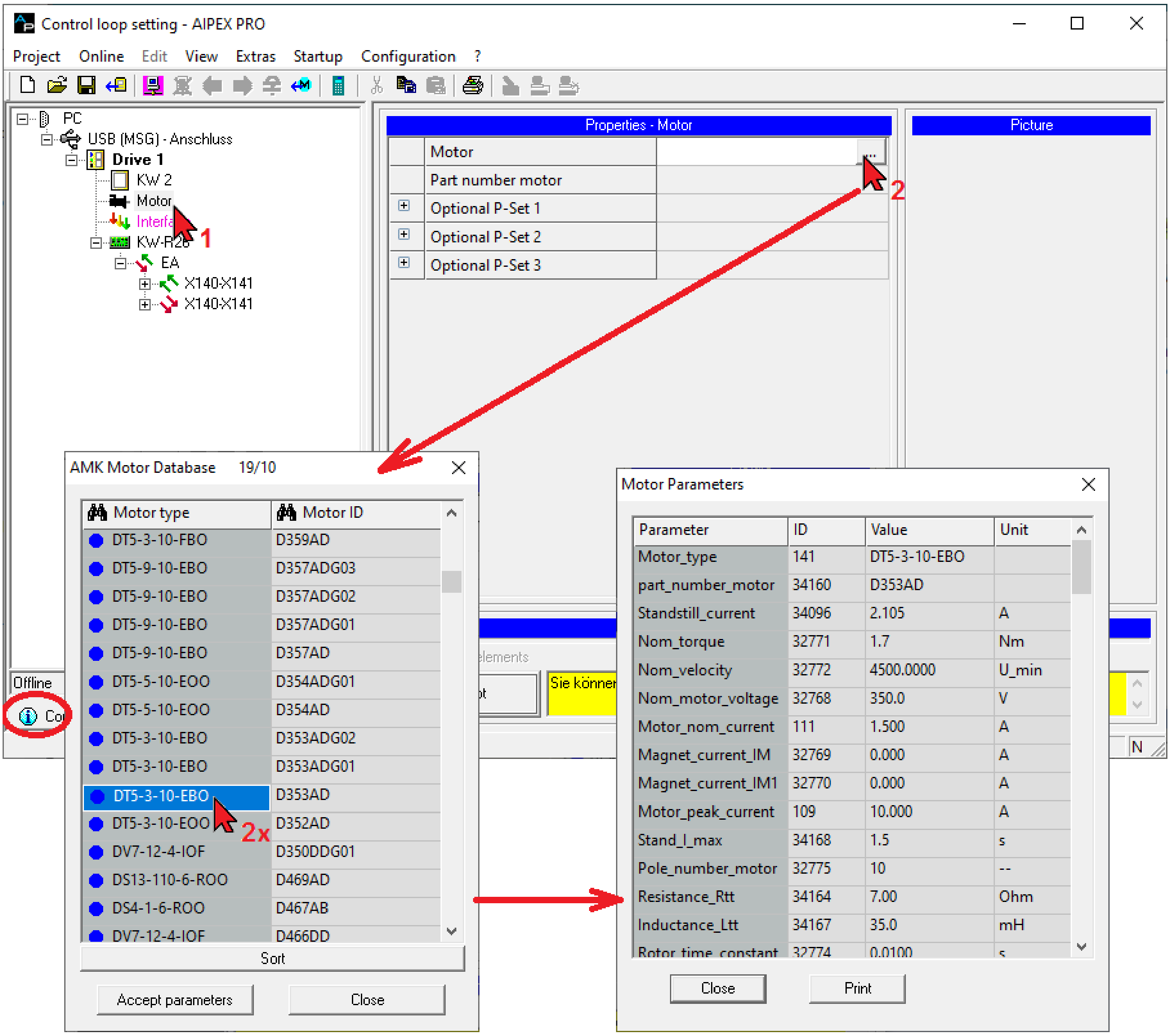
The required values in AIPEX PRO can also be entered directly in the parameter list instead of via the menu mode.

1.1 Current controller

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

E-, F-, P-, Q-, S-, T-, U-, V- and Y-encoders have an internal memory in which AMK saves motor parameters at the factory, the so-called 'electronic nameplate'.

For resolvers and encoders which do not contain an electronic nameplate, the data can be imported from the motor database stored in AIPEX PRO.



The ID32841 'Encoder list motor' specifies which parameters are saved in the encoder and cannot be changed by the user.

The parameters listed in the 'Encoder list motor' are only read in the following cases and overwrite the current values in the parameter set:

- Systems initially loaded
  It is checked during the system booting whether the motor parameters listed in ID32841 correspond to their initially loaded values. ID34160 'Part number motor' is ignored in this process.
  Only when the motor parameters from the 'Encoder list motor' have their initially loaded values will the parameter values be read from the encoder and overwrite the originally loaded values in all parameter sets.
- ID32843 'Service command' = 0x20
  The values of the parameters contained in the 'Encoder list motor' are read into the device by the encoder and overwrite there the current values in all parameter sets of the drive.

The motor data must be entered manually in the following cases:

- Motor types which have no electronic nameplate and are not stored in the motor database
- After the initial loading of the parameter set if at least one parameter has been changed manually

The values are to be found in the motor data sheet

1.2 Speed controller

Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

The PID speed controller needs to be set and optimized depending on the application.

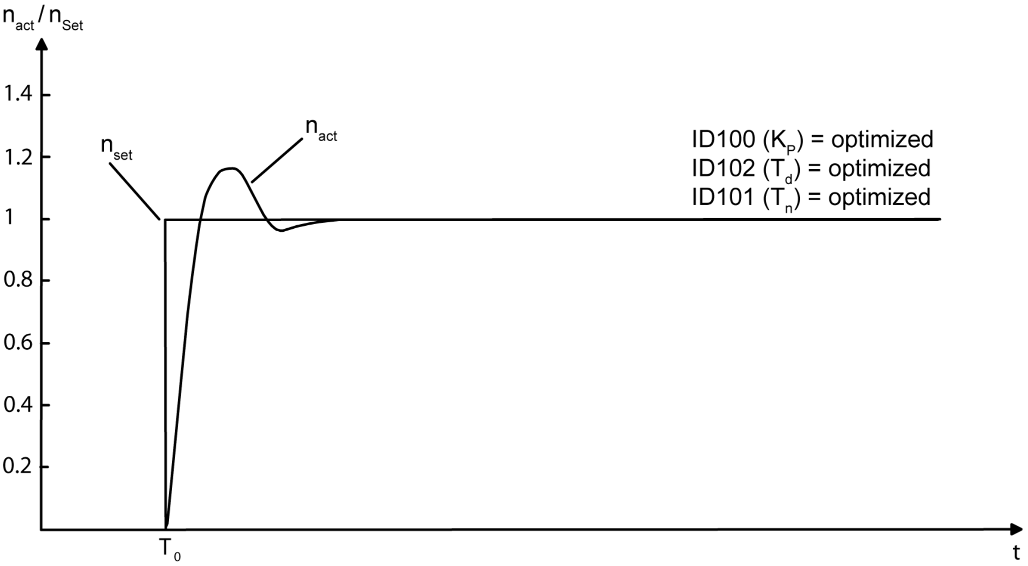
The precise mathematical description of all parameters of the control circuit has been shown often to be rather extensive and difficult in practical applications. Therefore, a simple procedure shall be presented here by which the controller can be set practically.

For that a speed jump (without ramp) needs to be given as a reference variable at the input of the controller. The jump answer (speed actual value) should be taken for evaluating the controller setting. When specifying the speed jump, make sure that the drive remains operated below the torque limit.

Set the controller as follows:

1. Setting ID100 'Speed control proportional gain KP' K_p, with ID101 = 0 (T_n), ID102 = 0 (T_d)
2. Setting ID101 'Integral-action time speed control TN' T_n, with ID100 = const. (K_p), ID102 = 0 (T_d)
3. Setting ID102 'Differentiating time speed control TD' T_d, with ID100 = const. (K_p), ID101 = const. (T_n)

Step response of the optimised speed control circuit



For an optimally set PID controller, the actual speed value may overshoot a setpoint step-change by no more than 20%.

Two PT1 filters can be configured at the output of the speed controller.
See ID32928 'Time filter 1' and ID32929 'Time filter 2'

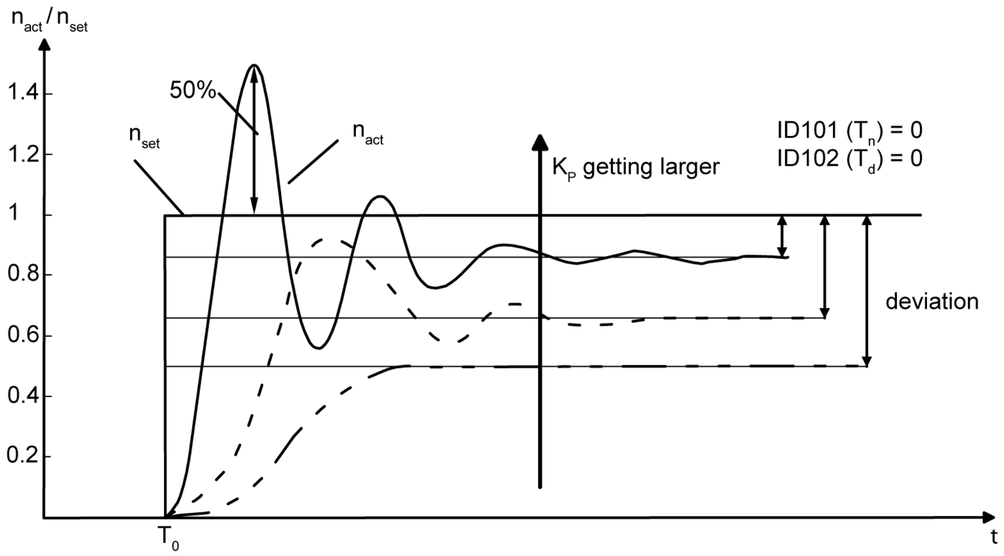
Relevant parameters:

Parameter	Name
ID100	'Speed control proportional gain KP'
ID101	'Integral-action time speed control TN'
ID102	'Differentiating time speed control TD'
ID32928	'Time filter 1'
ID32929	'Time filter 2'

1.2.1 Setting the proportional gain K_p

Set ID102 ('Differentiating time speed control TD', T_d) and ID101 ('Integral-action time speed control TN', T_n) to 0, the controller then works as proportional controller.

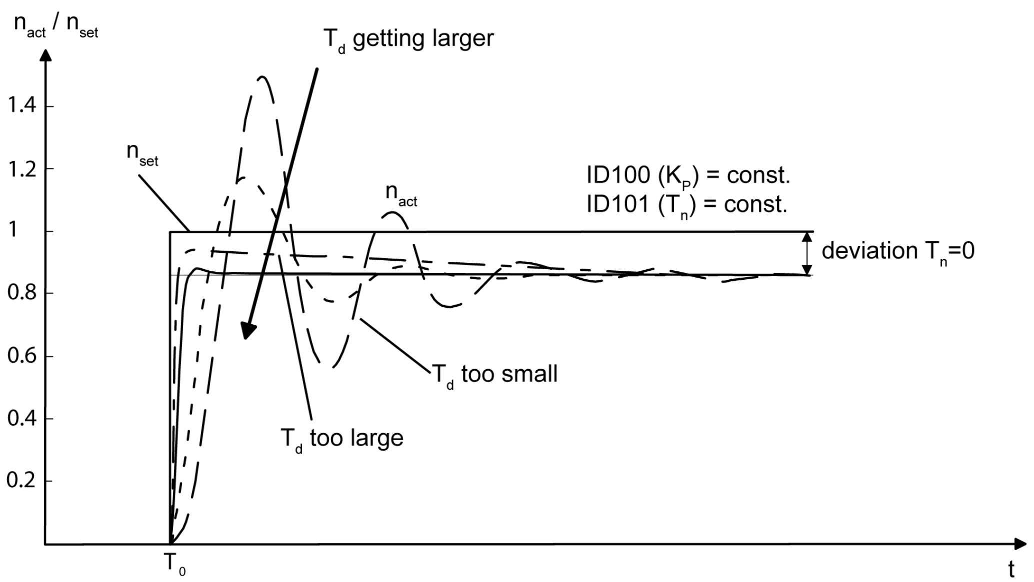
By increasing ID100 'Speed control proportional gain KP' K_P, the controller should be made to overshoot (50 % overshoots). The actual speed has a course then similar to the curve with the solid line:



Halve the determined value for 'Speed control proportional gain KP' K_P and enter the halved value in ID100.

1.2.2 Setting the differential time T_d

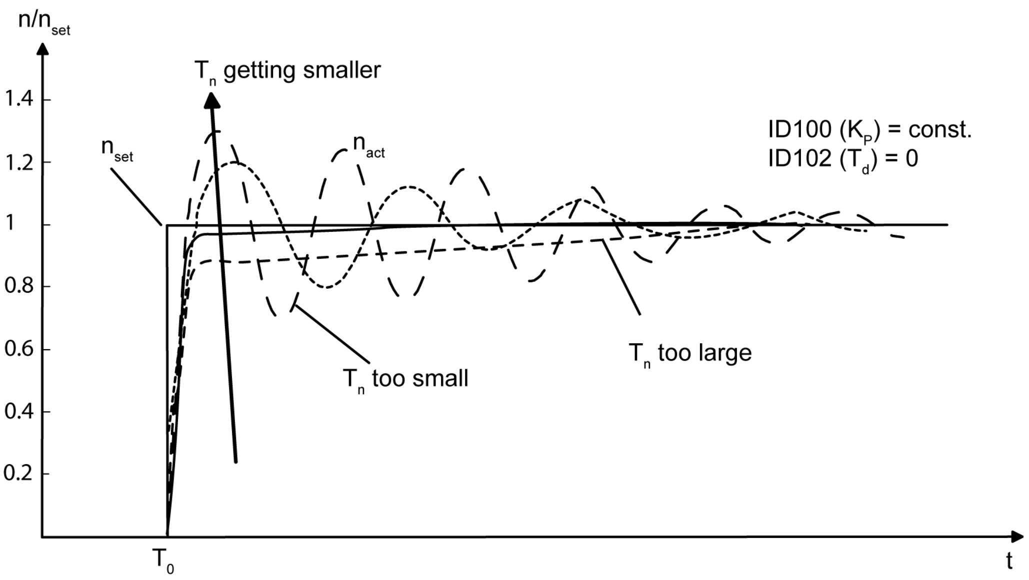
The differentiating time T_d is extended until the desired dampening of the jump answer is reached. The curve with the solid line serves as a reference point for setting the D-share.



1.2.3 Setting the reset time T_n

Using the integral proportion (I-proportion) in the controller, the controller deviation resulting from the P controller is adjusted.

The integration time is reduced (starting at an initial value e.g. 100ms) until the settling time is minimal. If the reset time is set optimally, the actual speed value curve (jump answer) roughly follows the curve with the solid line:



For an optimally set PI controller, the actual speed value may overshoot a setpoint jump by no more than 20% as an answer.

1.3 Position controller

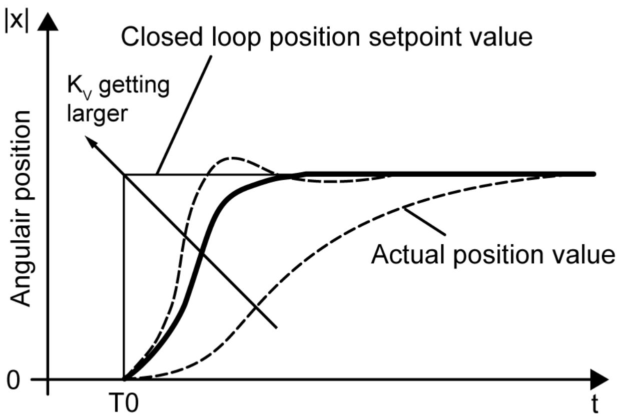
Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

Setting the proportional gain K_V

Before the position controller can be optimized, the optimization of the speed controller needs to be completed.

The proportional gain of the position controller (P controller) is set in ID104 'Position loop factor KV'.

If the drive is in position control, a setpoint step-change is specified and the step response (actual position value) is recorded for evaluation. In optimized state, the drive positions comparable to the solid line without overshoots:



Relevant parameters:

Parameter	Name
ID104	'Position loop factor KV'