Operation modes and control loops

Translation of the "Original Dokumentation"
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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)
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1 Operation modes and control loops

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 /

Each parameter set contains the freely configurable ID32800 'AMK main operating mode' and in addition 5 'AMK secondary operating modes' (ID32801 - ID32805) for application-specific use.

One of the following operating modes can be selected in each of the parameters:

- position control
- speed control
- torque control / current control

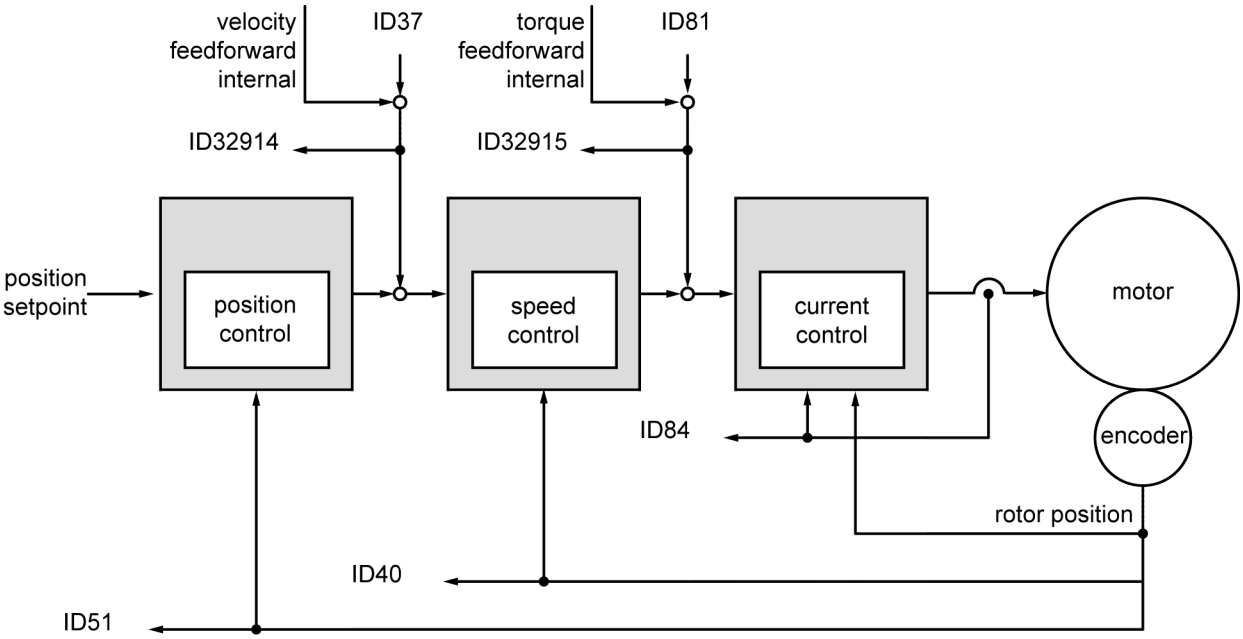
Different boundary conditions can be defined depending on the operating mode selected, e.g. with / without FIPO, with / without SAK.

The secondary operating modes ID32806 to ID32809 are preconfigured at the factory and may not be changed by the user. Drive-controlled movement functions, e.g. homing cycle or deceleration after RF is withdrawn, are only correctly implemented when the factory setting is retained.

The control circuits of the operating modes interlock in the form of a cascade:

Position control is not supported by:

- KW-R24



ID37	'Additive velocity command value'	ID84	'Torque feedback value'
ID40	'Velocity feedback value'	ID32914	'Sum of additive velocities'
ID51	'Position feedback value'	ID32915	'Sum of additive torques'
ID81	'Additive torque command value'		

The individual controller functions are described in detail in the following sections:

Relevant parameters

The operating modes are set in the parameters ID32800 - ID32809. Changes to these parameters only become effective after a 0→1 edge change of the controller enable (RF).

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID32800 [1)]	'AMK main operating mode'	Main operating mode The main operating mode becomes active after mains ON and an activated controller enable.

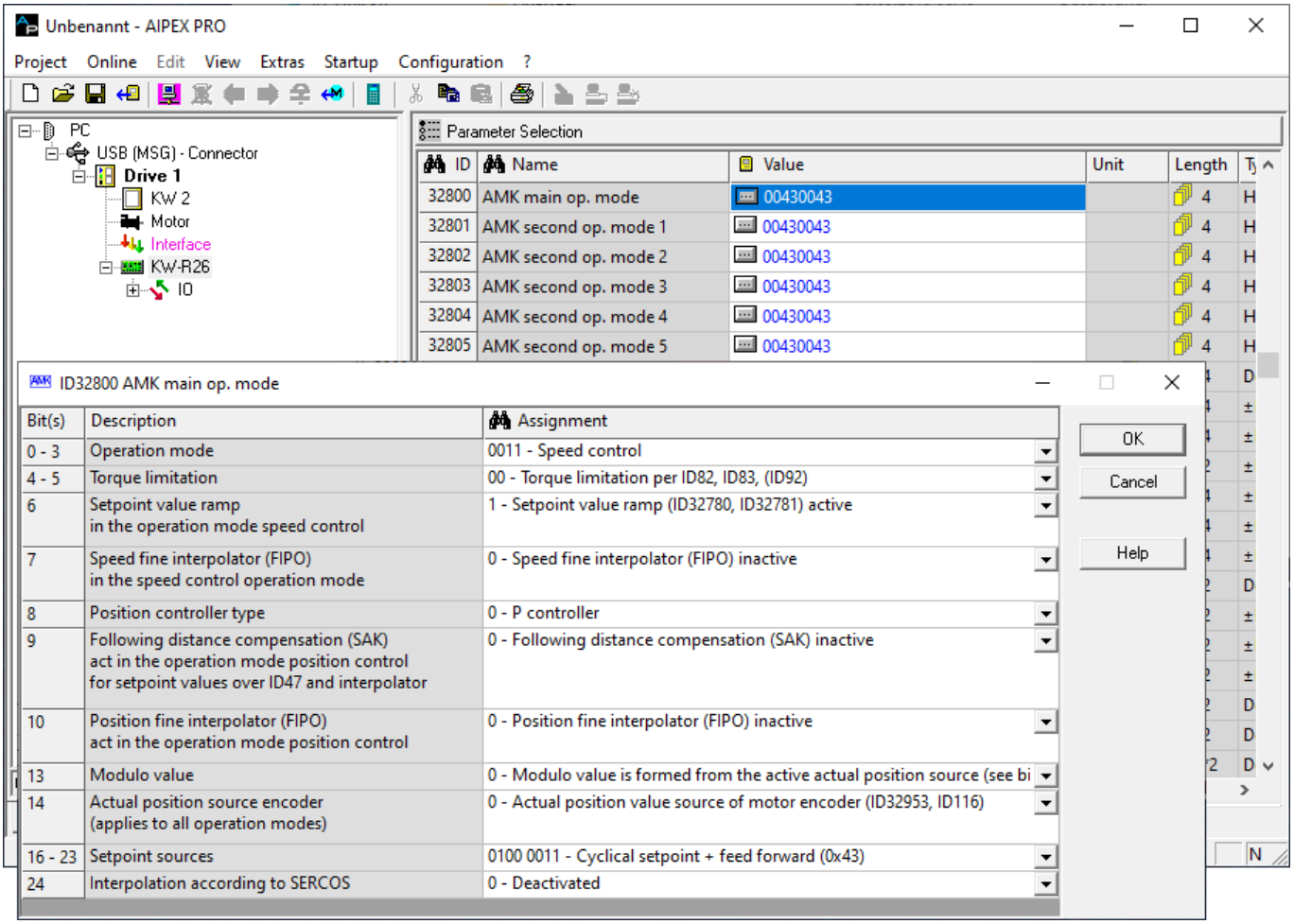
Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID32801 1)	'AMK secondary operating mode 1'	Secondary operating modes The last used operating mode is always active after a system booting by ID33730 or the command 'Clear Error' and activated controller enable.
ID32802 1)	'AMK secondary operating mode 2'	
ID32803 1)	'AMK secondary operating mode 3'	
ID32804 1)	'AMK secondary operating mode 4'	
ID32805 1)	'AMK secondary operating mode 5'	
ID32806 1), *)	'AMK secondary operating mode 6'	AMK internal operating mode: speed control with ramp, setpoint source analogue input
ID32807 1), *)	'AMK digital torque control'	AMK internal operating mode: torque control
ID32808 1), *)	'AMK position control'	AMK internal operating mode: position control with FIPO, setpoint source IPO
ID32809 1), *)	'AMK digital speed control'	AMK internal operating mode: speed control with ramp

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

*) The AMK internal operating modes are protected with a password. Only their boundary conditions and not their configuration may be changed.

Setting the operating modes with AIPEX PRO

Using the AIPEX PRO software, the parameters ID32800 'AMK main operating mode' and ID32801 ... ID32805 'AMK secondary operating modes' are configured. The corresponding value can be generated via a selection menu or input directly as a hexadecimal value.



Further information on the operating mode parameters, on configuration and meaning of the individual bits:
See document 'Parameter description' (AMK part no. 203704): ID32800 ... ID32805.

The individual operating modes and their required parameters are described in the following sections.

Change of operating mode

After mains ON and an activated controller enable, the 'AMK main operating mode' is active. The last used operating mode is always active after a system booting by ID33730 'System booting' or the command 'Clear Error' and activated controller enable.

When in operation, the controller can switch between the operating modes via the bus protocol or the operating mode can be changed via binary inputs.

Higher-ranking PLC controller

The function blocks of the AMK library offer a convenient way to change operating modes. They can be used in the CODESYS environment in AIPEX PRO. (See document 'Software description AIPEX PRO V3', AMK part no. 204979)

For instance, the functional block 'SET_SET_POINTS_AND_FEED_FORWARD_GEAR' is contained in the AMK library 'AMKAflConfig.lib'. Using it, an operating mode is activated and the corresponding setpoint is predefined.
(See document 'AFL - AMK function libraries', AMK part no. 205795)

In order to switch into the different operating modes using the library blocks, the operating mode parameter must be allocated as follows:

Parameter	Name	Value	Meaning
ID32800	'AMK main operating mode'	0x0043xxx3	Speed control
ID32801	'AMK secondary operating mode 1'	0x0043xxx4	Position control
ID32802	'AMK secondary operating mode 2'	0x0043xxx3	Speed control
ID32803	'AMK secondary operating mode 3'	0x0043xxx2	Torque control

x: Drive- and equipment-specific input

The function blocks switch into the corresponding auxiliary operating mode without checking its configuration.

Regardless of the AMK function blocks, the switch takes place using the parameter ID134 'Master control word', bit 8 - 10. In addition, the bits 14 and 15 must be activated otherwise the setpoints are not processed.

Binary Input

The operating modes can also be activated via binary modes. To do this, the parameters of the inputs must be assigned to the corresponding function codes.

Codes for the binary inputs

Code	Function
33700	Activate main operation mode
33701	Activate secondary operation mode 1
33702	Activate secondary operation mode 2
33703	Activate secondary operation mode 3
33704	Activate secondary operation mode 4
33705	Activate secondary operation mode 5

The relevant operating mode is switched with an 0→1 edge at the input. The new operating mode will be active after a 0→1 edge of the controller enable (RF).

The binary inputs of the respective port are activated with the following parameters:
ID32873 'Address input port 1' = 40
ID32968 'Address input port 2' = 41
ID32977 'Address input port 3' = 32

Example for parametrization:

Parameter	Value	Meaning
ID32873	40	Input port 1 is activated
ID32874	33700	Binary input 1: The main operating mode is activated with 0 → 1 edge
ID32875	33701	Binary input 2: The auxiliary operating mode 1 is activated with 0 → 1 edge
ID32876	33702	Binary input 3: The auxiliary operating mode 2 is activated with 0 → 1 edge
ID32877	33703	Binary input 4: The auxiliary operating mode 3 is activated with 0 → 1 edge

2 Drive controller

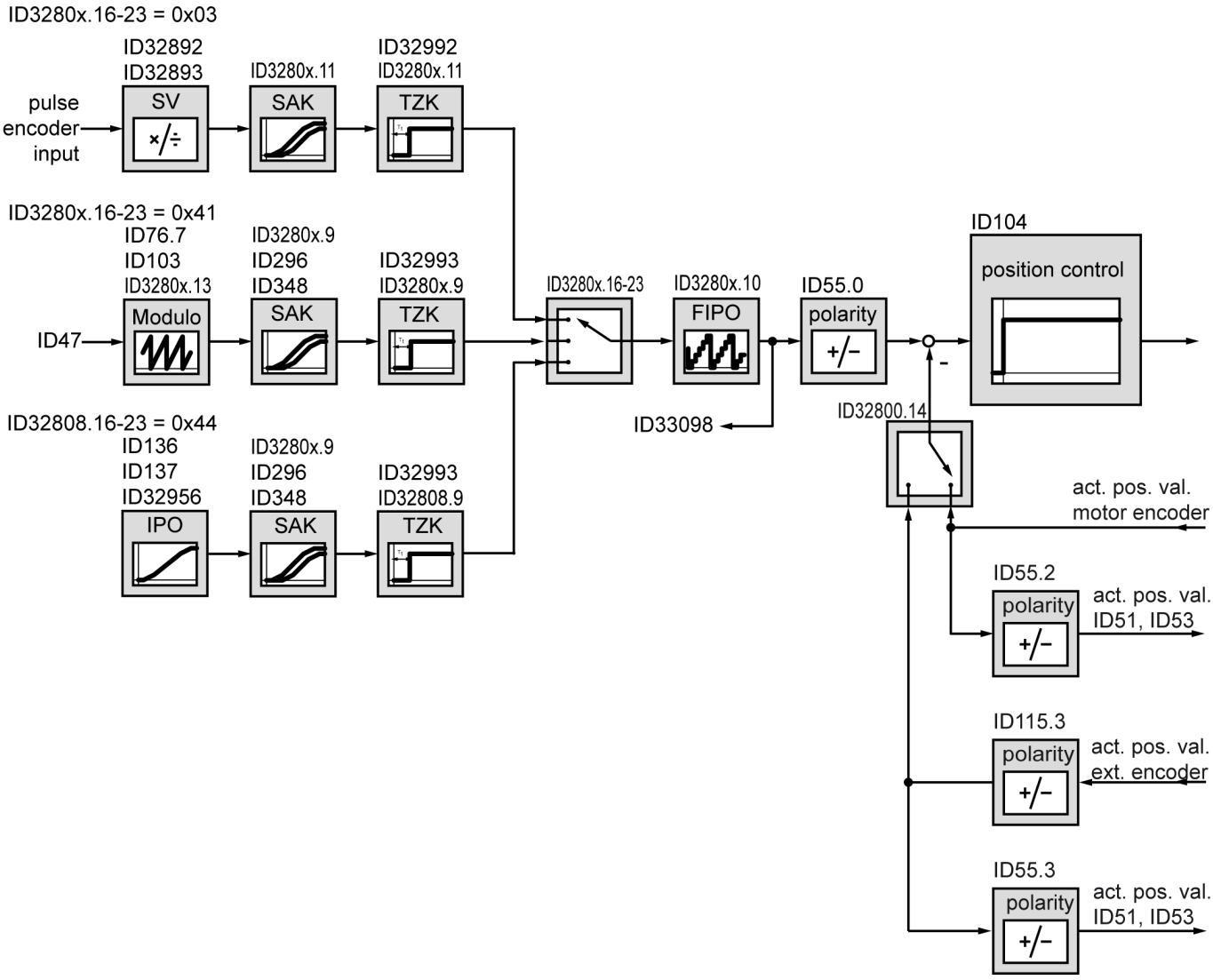
2.1 Position control

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 /

The position controller operates as a P controller with a sampling time of 250 µs.

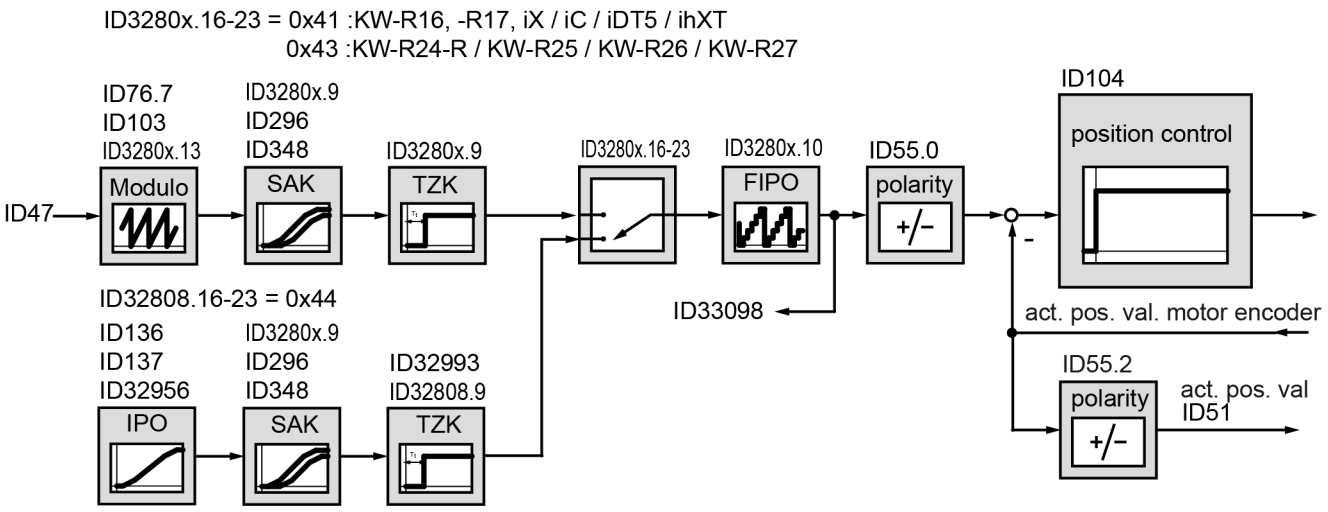
Setpoint preparation

Meaning for KW-R06 / KW-R07 /



ID47	'Position command value'
ID51	'Position feedback value'
ID53	'Position feedback value 2'
ID55	'Closed loop polarity'
ID76	'Position scaling data'
ID103	'Modulo value'
ID104	'Position loop factor KV'
ID115	'Position feedback type'
ID136	'Positive acceleration'
ID137	'Negative acceleration'
ID296	'Velocity feedforward gain'
ID348	'Acceleration feedforward gain'
ID32800	'AMK main operating mode'
ID32808	'AMK position control'
ID32892	'Synchronous setpoint pulses divider'
ID32893	'Synchronous setpoint pulses multiplier'
ID32956	'Additional acceleration value'
ID32992	'Dead time compensation 1'
ID32993	'Dead time compensation 2'
ID33098	'Increase position value'
ID33104	'Position feedback modulo'

Meaning for KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /



ID47	'Position command value'
ID51	'Position feedback value'
ID55	'Closed loop polarity'
ID76	'Position scaling data'
ID103	'Modulo value'
ID104	'Position loop factor KV'
ID136	'Positive acceleration'
ID137	'Negative acceleration'
ID296	'Velocity feedforward gain'
ID348	'Acceleration feedforward gain'
ID32800	'AMK main operating mode'
ID32808	'AMK position control'
ID32956	'Additional acceleration value'
ID32993	'Dead time compensation 2'
ID33098	'Increase position value'
ID33104	'Position feedback modulo'

Legend

FIPO	Fine interpolator
IPO	Interpolator
Modulo	Modulo processing of the position setpoints
Polarity	Polarity of the setpoints and actual values
SAK	Following error compensation
SV	Setpoint offsetting
TZK	Dead time compensation

The source of the position setpoint is switched with the help of the bits 16 - 23 from the operating mode parameters ID32800 - ID32805:

- pulse encoder input X132 (valid for KW-R06 / -R07)
- fieldbus (master controller, ID47 'Position command value')
- internal interpolator

See document 'Parameter description', (AMK part no. 203704): ID32800 'AMK main operating mode'.

The position setpoints can either be loaded with a following error compensation and/ or a fine interpolator.
The minimum cycle time for the setpoint presetting is determined by the bus cycle time.

Position control with setpoint from pulse encoder input

The pulse encoder input can be used as setpoint source, e.g. for software pulse transmission (valid for KW-R06 / -R07).

Position control with digital setpoint

The setpoint is preset cyclically in increments via the fieldbus as a 32 bit value (ID47 'Position command value') by the parent controller.

Position control with setpoint from the internal interpolator

The internal interpolator operates on the basis of the auxiliary operating mode ID32808 'AMK position control'. For example, it generates position setpoints if the drive function 'homing cycle' is called up.

Relevant parameters

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID47 2)	'Position command value'	Digital setpoint: position setpoints of the controller
ID51 3)	'Position feedback value'	Actual position values of the actual position value encoder can be assessed by the controller or transferred via the service channel
ID53 3)	'Position feedback value 2'	
ID55 1)	'Closed loop polarity'	Polarities of the position data are inverted. (Polarities are switched outside the control path.)
ID76 1)	'Position scaling data'	Digital setpoint: processing the position data
ID103 1)	'Modulo value'	Digital setpoint: final value of position data in modulo format.
ID104 1)	'Position loop factor KV'	Proportional gain K_V of the position controller.
ID115 1)	'Position feedback type'	Control direction of an external actual position value encoder
ID136 1)	'Positive acceleration'	Setpoint from internal interpolator: approach acceleration
ID137 1)	'Negative acceleration'	Setpoint from internal interpolator: braking acceleration
ID32800 1)	'AMK main operating mode'	Main operating mode See 'ID32800 - ID32809 'AMK operating modes' bit string ' on page 19.
ID32801 ... ID32805 1)	'AMK secondary operating modes'	Secondary operating modes
ID32892 1)	'Synchronous setpoint pulses divider'	Setpoint from pulse encoder input: setpoint offsetting Position setpoints are offset with the factors and in this way the ratio between inbound increments of the master encoder and the motor can be changed.
ID32893 1)	'Synchronous setpoint pulses multiplier'	
ID32956 1)	'Additional acceleration value'	Setpoint from internal interpolator: Number of interpolation cycles until constant acceleration is reached
ID32992 1)	'Dead time compensation 1'	Setpoint from pulse encoder input: system-specific feed forward time for dead time compensation for 16 bit position setpoints (following error compensation active)
ID32993 1)	'Dead time compensation 2'	Digital setpoint or setpoint from pulse encoder input: system-specific feed forward time for dead time compensation for 32 bit position setpoints
ID33098 3)	'Increase position value'	32 bit position increase per SERCOS cycle
ID33104 3)	'Position feedback modulo'	Modulo actual position value 0 ≤ ID33104 ≤ ID103

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

Setting the position controller with AIPEX PRO

The parameters for the position controller are set using the AIPEX PRO software, for instance the setpoint source and the proportional gain.

The following parameters are temporary parameters. They can be changed even if the controller enable (RF) has been activated:

- ID104 'Position loop factor KV'
- ID136 'Positive acceleration'
- ID137 'Negative acceleration'
- ID32892 'Synchronous setpoint pulses divider'
- ID32893 'Synchronous setpoint pulses multiplier'

Examples of parametrization

Example 1: setpoint via pulse input

Parameter	Bit	Value	Meaning
ID32800	0 - 3	0x04	Position control
	10	1	LR with FIPO
	11	1	LR with SAK and TZK
	16 - 23	0x03	Setpoint source: pulse encoder input
ID55		0000 0000 0000 0000	No inversion of the setpoints and actual values
ID32893/ID32892		10/3	"Gear factor" setpoint: the setpoint, which comes from the pulse encoder, is, multiplied with the factor (here 10/3), preset to the position controller.

Example 2: setpoint via control

Parameter	Bit	Value	Meaning
ID32800	0 - 3	0x04	Position control
	10	1	LR with FIPO
	9	1	LR with SAK and TZK
	16 - 23	0x43	Cyclical setpoint specification (ID47)
ID55		0000 0000 0000 0000	No inversion of the setpoints and actual values

Example 3: setpoint from the internal interpolator

Parameter	Bit	Value	Meaning
ID32800	0 - 3	0x04	Position control
	10	1	LR with FIPO
	9	1	LR with SAK and TZK
	16 - 23	0x44	Setpoint source: internal interpolator
ID55		0000 0000 0000 0000	No inversion of the setpoints and actual values

2.2 Speed control

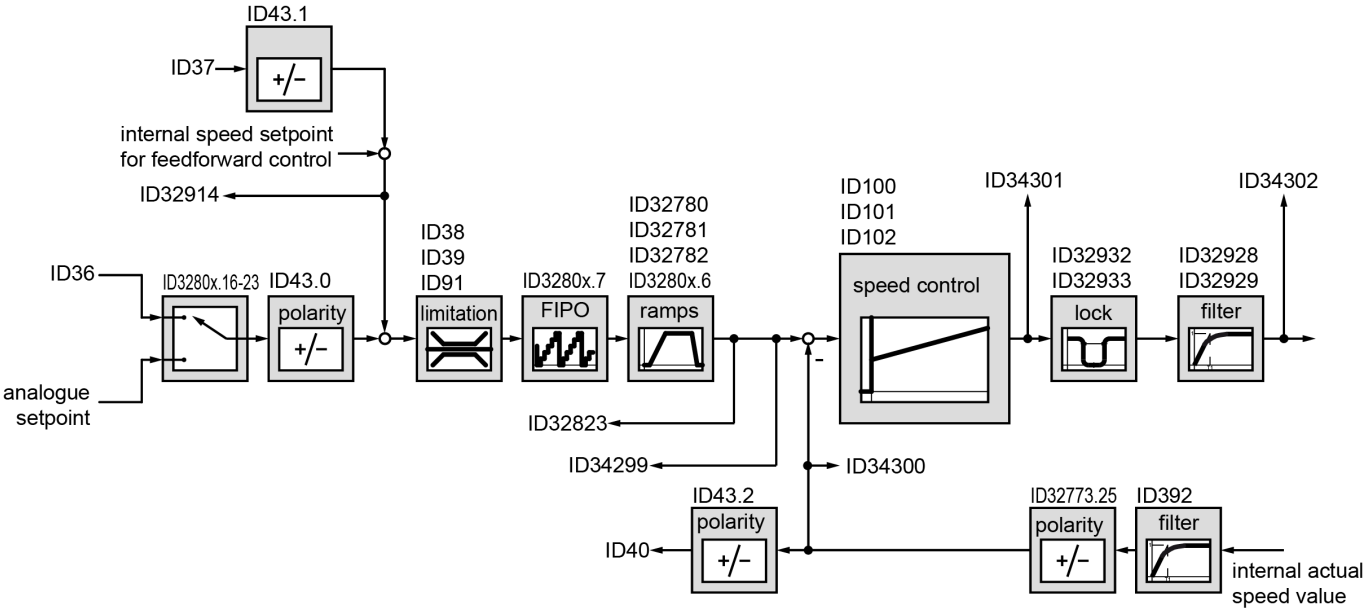
Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

The speed controller operates as a PID controller with a sampling time of 125 µs.

Setpoint preparation

Analogue setpoint is not supported by:

- KW-R24
- KW-R24-R
- KW-R25
- KW-R26
- KW-R27



ID36	'Velocity command value'	ID32781	'Deceleration ramp'
ID37	'Additive velocity command value'	ID32782	'Deceleration ramp RF inactive'
ID38	'Positive velocity limit'	ID32800	'AMK main operating mode'
ID39	'Negative velocity limit'	ID32823	'Velocity control command after ramp'
ID40	'Velocity feedback value'	ID32914	'Sum of additive velocities'
ID43	'Velocity polarity'	ID32928	'Time filter 1'
ID91	'Bipolar velocity limit'	ID32929	'Time filter 2'
ID100	'Speed control proportional gain KP'	ID32932	'Barrier frequency'
ID101	'Integral-action time speed control TN'	ID32933	'Bandwidth'
ID102	'Differentiating time speed control TD'	ID34299	'Velocity setpoint in control'
ID392	'Velocity feedback filter'	ID34300	'Velocity actual value in control'
ID32773	'Service bits'	ID34301	'Torque setpoint filter input'
ID32780	'Acceleration ramp'	ID34302	'Torque setpoint filter output'

Legend

Limitation	Setpoint limitation
Filter	Low-pass filter PT1
FIPO	Fine interpolator
IPO	Interpolator
Modulo	Modulo processing of the position setpoints
Polarity	Polarity of the setpoints and actual values
Ramps	Acceleration and deceleration ramp
SAK	Following error compensation

Block	Band-stop filter
SV	Setpoint offsetting
TZK	Dead time compensation

Speed control with digital setpoint

The 'Velocity command value' (ID36) is preset as a 32 bit value in format 0.0001 rpm (example: setpoint 10,000 equals 1 rpm). The minimum cycle time for the setpoint presetting is determined by the bus cycle time.

Speed control with analogue setpoint

The speed setpoint is preset at the analogue input of the controller with a resolution of 12 bit as a ±10 V signal. The analogue input is read once every 250 µs.

Relevant parameters

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID36 [2]	'Velocity command value'	Digital speed setpoint from the controller
ID37 [3]	'Additive velocity command value'	Additive speed setpoint
ID38 [1]	'Positive velocity limit'	Maximum speed setpoint in positive rotating direction
ID39 [1]	'Negative velocity limit'	Maximum speed setpoint in negative rotating direction
ID40 [3]	'Velocity feedback value'	Actual value of the speed encoder
ID43 [1]	'Velocity polarity'	Polarities of the speed data
ID91 [2]	'Bipolar velocity limit'	Maximum speed setpoint in positive and negative rotating direction (ID91 takes priority over ID38 / ID39)
ID392 [1]	'Velocity feedback filter'	Time constant for averaging the actual speed value
ID32773 [1]	'Service bits'	Bit string with which drive-specific functionalities are activated Bit 25: activate actual speed value inversion See 'ID32773 'Service bits' bit 25' on page 19.
ID32778 [1]	'Speed relative to 10V at A1'	Analogue setpoint: final speed value at 10 V input voltage
ID32779 [1]	'Speed offset for A1'	Analogue setpoint: compensation of the speed setpoint (0.0001 rpm) ID34037 and ID32779 both affect the output value of the AD converter. It is recommended that only one of the two parameters is used.
ID32780 [1]	'Acceleration ramp'	Times for acceleration and deceleration between speed 0 rpm and ±ID113 'Maximum speed'
ID32781 [1]	'Deceleration ramp'	
ID32782 [1]	'Deceleration ramp RF inactive'	Slow to a halt when the controller enable is withdrawn. The time entered is valid for deceleration from maximum speed (ID113) to speed 0.
ID32800 [1]	'AMK main operating mode'	Bit string for free configuration of the operating mode See 'ID32800 - ID32809 'AMK operating modes' bit string ' on page 19.
ID32823 [2]	'Velocity control command after ramp'	Speed setpoint supplied to the speed controller
ID32897 [3]	'Analog Input A1'	Analogue setpoint: adjacent voltage at the analogue input
ID32914 [2]	'Sum of additive velocities'	Total of ID37 'Additive velocity command value' and the internal speed feed forward values
ID32928 [1]	'Time filter 1'	Time constant of the low-pass filter 1
ID32929 [1]	'Time filter 2'	Time constant of the low-pass filter 2
ID32932 [1]	'Barrier frequency'	Trap frequency of the band filter
ID32933 [1]	'Bandwidth'	Trap bandwidth of the band filter

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID34037 1)	'Offset analog input 1'	Analogue setpoint: compensation of the speed setpoint (0.01 V) ID34037 and ID32779 both affect the output value of the AD converter. It is recommended that only one of the two parameters is used.
ID34299 3)	'Velocity setpoint in control'	Speed setpoint in front of the speed controller
ID34300 3)	'Velocity actual value in control'	Actual speed value, fed-back to the speed controller
ID34301 3)	'Torque setpoint filter input'	Torque setpoint from the speed controller in front of the filter
ID34302 3)	'Torque setpoint filter output'	Torque setpoint behind filter

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

Setting the speed controller with AIPEX PRO

The parameters for speed control are set using the AIPEX PRO software, for instance the setpoint source and the proportional gain.

The following parameters are temporary parameters. They can be changed even if the controller enable (RF) has been activated:

- ID38 'Positive velocity limit'
- ID39 'Negative velocity limit'
- ID100 'Speed control proportional gain KP'
- ID101 'Integral-action time speed control TN'
- ID102 'Differentiating time speed control TD'
- ID392 'Velocity feedback filter'
- ID32780 'Acceleration ramp'
- ID32781 'Deceleration ramp'
- ID32928 'Time filter 1'
- ID32929 'Time filter 2'

Examples of parametrization

Example 1: setpoint via analogue input

Parameter	Bit	Value	Meaning
ID32800	0 - 3	0x03	Speed control
	6	0	Ramps inactive
	16 - 23	0x01	setpoint source: Analogue input
ID43		0000 0000 0000 0000	No inversion of the setpoints and actual values

Example 2: setpoint via controller

Parameter	Bit	Value	Meaning
ID32800	0 - 3	0011	Speed control
	6	1	Ramps active
	16 - 23	0x43	Cyclical setpoint specification
ID43		0000 0000 0000 0000	No inversion of the setpoints and actual values
ID32780 / ID32781		200 ms / 100 ms	Acceleration and deceleration time of the ramps

2.3 Torque control

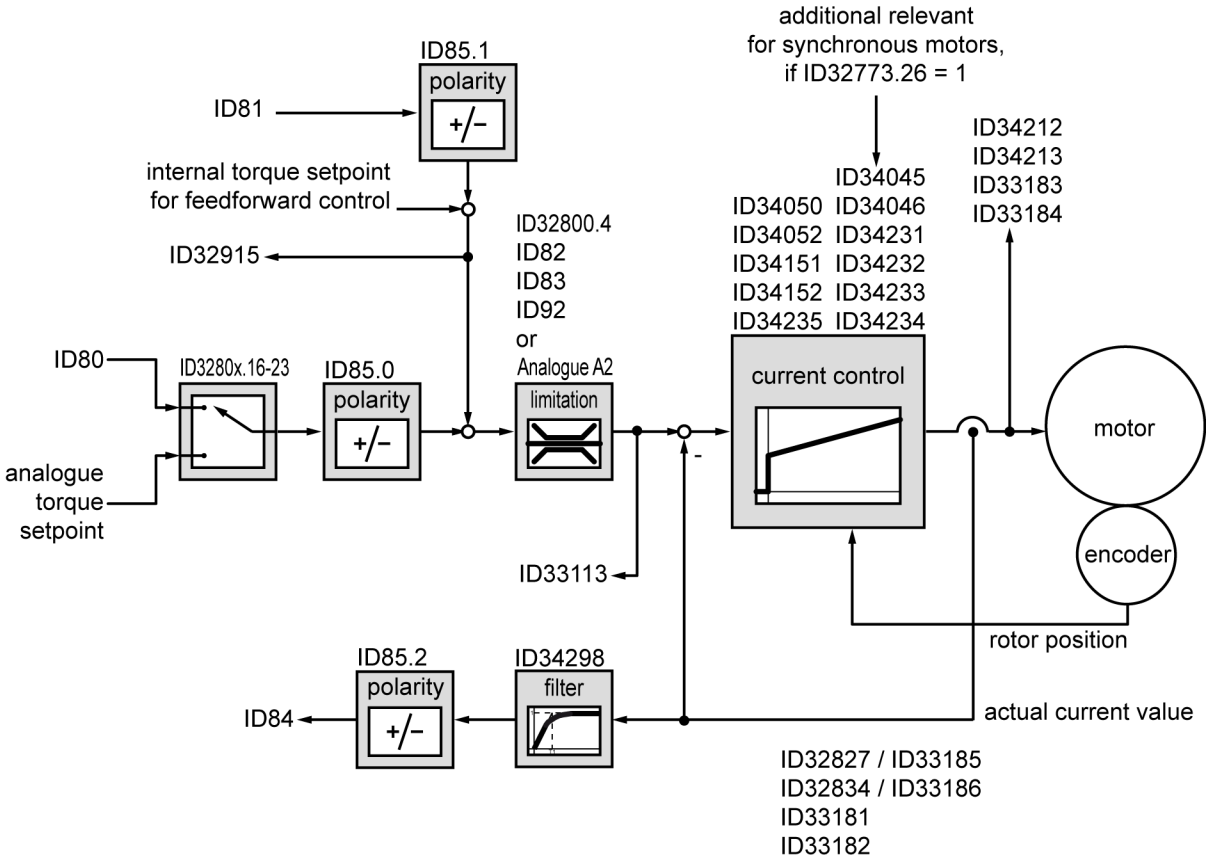
Supported hardware:	KW-R06 / KW-R16 / KW-R07 / KW-R17 / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /

With the torque controller, the drive is controlled via the subordinate current control circuit. The current controller operates as a PI controller with a sampling time of 62.5 µs.

Setpoint preparation

Analogue setpoint is not supported by:

- KW-R24
- KW-R24-R
- KW-R25
- KW-R26
- KW-R27



ID80	'Torque command value'
ID81	'Additive torque command value'
ID82	'Positive torque limit'
ID83	'Negative torque limit'
ID84	'Torque feedback value'
ID85	'Torque polarity'
ID92	'Bipolar torque limit'
ID32773	'Service bits'
ID32827	'Magnetising current feedback'
ID32834	'Torque current feedback'
ID32915	'Sum of additive torques'
ID33113	'Torque setpoint at controller'
ID33181	'Actual current Ia'
ID33182	'Actual current Ib'
ID33183	'Voltage Ua'
ID33184	'Voltage Ub'

ID33185	'Magnetizing current feedback '
ID33186	'Torque current feedback'
ID34045	'Inductance path D'
ID34046	'Inductance path Q'
ID34050	'Current path Q integral-action time TN'
ID34052	'Current path D integral-action time TN'
ID34151	'Current path Q proportional gain KP'
ID34152	'Current path D proportional gain KP'
ID34212	'Voltage path Q'
ID34213	'Voltage path D'
ID34231	'Feed forward control voltage path Q'
ID34232	'Feed forward control voltage path D'
ID34233	'Phase resistance'
ID34234	'Voltage constant Ke'
ID34235	'Increase motor voltage'
ID34298	'Torque feedback filter'

Legend

Limitation	Setpoint limitation
Filter	Low-pass filter PT1

Polarity	Polarity of the setpoints and actual values
Block	Band-stop filter

Torque control with digital setpoint

The ID80 'Torque command value' is preset as a 16 bit value by the controller. The 'Torque feedback value'(ID84) is formed from the actual current value. The minimum cycle time for the setpoint presetting is determined by the bus cycle time.

Torque control with analogue setpoint

The torque setpoint is preset at the analogue input of the controller with a resolution of 12 bit as a ±10 V signal. The analogue input is read once every 250 µs.

Relevant parameters

Parameter	Name	Meaning See document 'Parameter description' (AMK part no. 203704)
ID80 2)	'Torque command value'	Digital torque setpoint from the controller
ID81 3)	'Additive torque command value'	Additive torque setpoint
ID82 1)	'Positive torque limit'	Limitation of the torque
ID83 1)	'Negative torque limit'	Limitation of the torque
ID84 3)	'Torque feedback value'	Actual torque value (proportional to the actual current value)
ID85 1)	'Torque polarity'	Polarities of the torque data
ID92 2)	'Bipolar torque limit'	Maximum permissible torque
ID32777 1)	'Torque relative to 10V at A1'	Analogue setpoint: torque setpoint at 10 V input voltage
ID32827 3)	'Magnetising current feedback'	Magnetising current
ID32834 3)	'Torque current feedback'	Torque of forming current
ID32915 3)	'Sum of additive torques'	Total of all feed forward values
ID33113 3)	'Torque setpoint at controller'	Filtered torque setpoint for display
ID34037 1)	'Offset analog input 1'	Analogue setpoint: compensation of the setpoint (0.01 V)
ID34045 1)	'Inductance path D'	Direct inductance (see motor data sheet)
ID34046 1)	'Inductance path Q'	Quadrature inductance (see motor data sheet)
ID34050 1)	'Current path Q integral-action time TN'	Correcting time constant (see motor data sheet)
ID34052 1)	'Current path D integral-action time TN'	Correcting time constant (see motor data sheet)
ID34151 1)	'Current path Q proportional gain KP'	Gain Q-axis (see motor data sheet)
ID34152 1)	'Current path D proportional gain KP'	Gain D-axis (see motor data sheet)
ID34212 3)	'Voltage path Q'	Effective value of the current controller output voltage in the Q-branch
ID34213 3)	'Voltage path D'	Effective value of the current controller output voltage in the D-branch
ID34231 3)	'Feed forward control voltage path Q'	Display of the voltage feed forward value
ID34232 3)	'Feed forward control voltage path D'	Display of the voltage feed forward value
ID34233 1)	'Phase resistance'	Strand resistance of the motor coil
ID34234 1)	'Voltage constant Ke'	Voltage constant
ID34235 1)	'Increase motor voltage'	Advantage factor
ID34298 1)	'Torque feedback filter'	Filter time constant for smoothing the actual torque value

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

Setting the torque control with AIPEX PRO

The parameters required for the torque control are set using the AIPEX PRO software, for instance torque limits and motor data.

The motor and encoder data are transferred by means of the so-called "electronic nameplate" into the controller.

The following parameters are temporary parameters, i.e. they can be changed even if a controller enable (RF) has been activated:

- ID82 'Positive torque limit'
- ID83 'Negative torque limit'
- ID34050 'Current path Q integral-action time TN'
- ID34052 'Current path D integral-action time TN'
- ID34151 'Current path Q proportional gain KP'
- ID34152 'Current path D proportional gain KP'

Examples of parametrization

Example 1: setpoint via analogue input

Parameter	Bit	Value	Meaning
ID32800	0 - 3	0x02	Torque control
	16 - 23	0x01	Setpoint source: analogue input
ID85		0000 0000 0000 0000	No inversion of the setpoints and actual values

Example 2: setpoint via controller

Parameter	Bit	Value	Meaning
ID32800	0 - 3	0x02	Torque control
	16 - 23	0x43	Cyclical setpoint specification
ID85		0000 0000 0000 0000	No inversion of the setpoints and actual values

Appendix

ID32773 'Service bits' bit 25

Bit no.	Condition	Meaning
25	0	Inversion of the actual speed value inactive
	1	Inversion of the actual speed value The inverted actual speed value is not only used for the display, but also for the speed control. See ID43 'Velocity polarity' on page 1.

ID32800 - ID32809 'AMK operating modes' bit string

Configuration ID32800 - ID32809 'AMK operating modes'

High word			Low word	
Bit 31				Bit 0 (LSB)
0 0 0 0	**X X X X**	**X X X X X X X X**	X X X X X X X X	X X X X X X X X
reserved	**Advanced operating mode**	**Setpoint source**	Operating mode, extensions, options	

Meaning of the bits ID32800 - ID32809

Bit no.	Condition	Meaning
0-3	0x0	No operating mode defined
	0x1	Reserved
	0x2	**KW-R06 / KW-R16 / KW-R07 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Torque control
	0x3	Speed control
	0x4	**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 /** Position control **KW-R24 /** Reserved
	0x5	**KW-R06 / KW-R16 / KW-R07 / KW-R17 /** Parallel connection of the servo controller (operating mode for the slave) **iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Reserved
	0x6	Reserved
	0x7	Reserved
4	0	Torque limiting per ID82, ID83, (ID92)
	1	**KW-R06 / KW-R16 / KW-R07 / KW-R17 /** Torque limiting per analogue input A2 **iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Reserved
5	0	Reserved
	1	Reserved
6	0	Setpoint ramp inactive
	1	Setpoint ramp in the speed control operating mode (ID32780, ID32781) active

Bit no.	Condition	Meaning
7	0	Speed fine interpolator (FIPO) inactive
	1	Speed fine interpolator (FIPO) in the speed control operating mode inactive (does not work with analogue setpoint setting!) The speed fine interpolator supplies 1 speed setpoint/250µs, synchronised to ID2 'SERCOS cycle time'.
8	0	**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 /** Position controller type P-controller **KW-R24 /** Reserviert
	1	Reserved
9 [2)]	0	**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 /** Following error compensation (SAK) inactive **KW-R24 /** Reserviert
	1	**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 /** Following error compensation in the position control operating mode for setpoints via ID47 and setpoints from the drive-internal interpolator **KW-R24 /** Reserviert
10 [1)]	0	**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 /** Position fine interpolator (FIPO) inactive **KW-R24 /** Reserviert
	1	**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 /** Position fine interpolator (FIPO) active in the position control operating mode The position fine interpolator supplies 1 position setpoint/250µs, synchronised to ID2 'SERCOS cycle time'. **KW-R24 /** Reserviert
11 [2)]	0	**KW-R06 / KW-R07 /** Following error compensation (SAK) inactive **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Reserved
	1	**KW-R06 / KW-R07 /** Active following error compensation in the position control operating mode for setpoints via pulse encoder input **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Reserved
12	0	Reserved
	1	Reserved

Bit no.	Condition	Meaning
13	0	**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 /** Modulo value is formed from the active actual position value source (see bit 14). **KW-R24 /** Reserved
	1	**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 /** Modulo value is formed according to ID103. **KW-R24 /** Reserved
14	0	**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 /** Actual position value source of motor encoder ID32953 'Encoder type', ID116 'Resolution motor encoder'  The actual position value source must be set in the ID32800'AMK main operating mode' and automatically applies for the operating modes. **KW-R24 /** Reserved
	1	**KW-R06 / KW-R07 /** The actual position value source of the external encoder ID32953 'Encoder type', ID117 'Resolution external position feedback system', ID115 'Position feedback type', gear ratio ID121 'Load gear input revolution', ID122 'Load gear output revolution' is taken into consideration  The actual position value source must be set in the ID32800 'AMK main operating mode' and automatically applies for all operating modes. Bit 14 is not evaluated if a second. encoder is selected in ID34297 'Encoder type 2'. **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Reserved
15	0	Reserved
	1	Reserved

Bit no.	Condition	Meaning
16-23	0x01	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT /** Analogue input A1 (Speed control) **KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Reserved
	0x03	**KW-R06 / KW-R07 /** Pulse encoder input **KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) / ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Reserved
	0x3C 0x41	**KW-R06 / KW-R07 / KW-R16 / KW-R17 / iX / iC / iDT5 / iX(-R3) / iC(-R3) / iDT5(-R3) /** Cyclical setpoint setting via real-time Ethernet • ID36 'Velocity command value' • ID47 'Position command value' • ID80 'Torque command value' Plus the feed forward values via real-time Ethernet • ID37 'Additive velocity command value' • ID81 'Additive torque command value' **KW-R06 / KW-R07 /** Pulse encoder input
	0x43	**ihXT / KW-R24 / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** Cyclical setpoint setting via real-time Ethernet • ID36 'Velocity command value' • **ihXT / KW-R24-R / KW-R25 / KW-R26 / KW-R27 /** : ID47 'Position command value' • ID80 'Torque command value' Plus the feed forward values via real-time Ethernet • ID37 'Additive velocity command value' • ID81 'Additive torque command value'
	0x44	**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 /** Internal interpolator
	0x48	Reserved for AMK internal use: Setpoint setting through internal modules
24-27	0x00	Default operating mode
	0x01	Interpolation with internal interpolator according to SERCOS
28-31	0	Reserved
	1	Reserved

1) This parameter is used by the following function:
   'Fine interpolator position (FIPO)'
2) This parameter is used by the following function:
   'Following error compensation (SAK)'

Further values offered in AIPEX PRO under bit 16-23 are not supported any longer by new firmware versions.