AMKASMART
Product Documentation IDT Motor with integrated servo controller

Version: 2008/16
Part-No.: 202092

AMK

About this documentation

Name: PDK_202092_IDT_Hardware_R2_en

What has changed:

Version	Change	Subject	Letter symbol
2008/16		R2 version	Koj

Reservation: We reserve the right to modify the content of the documentation as well as to the delivery options for the product.

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You can assist us in finding a fast and reliable solution for the malfunction by providing our service personnel with the following

- Information located on the ID plate of the devices
- the software version
- the device setup and application
- the type of malfunction, suspected cause of failure
- the diagnostic messages (error messages)

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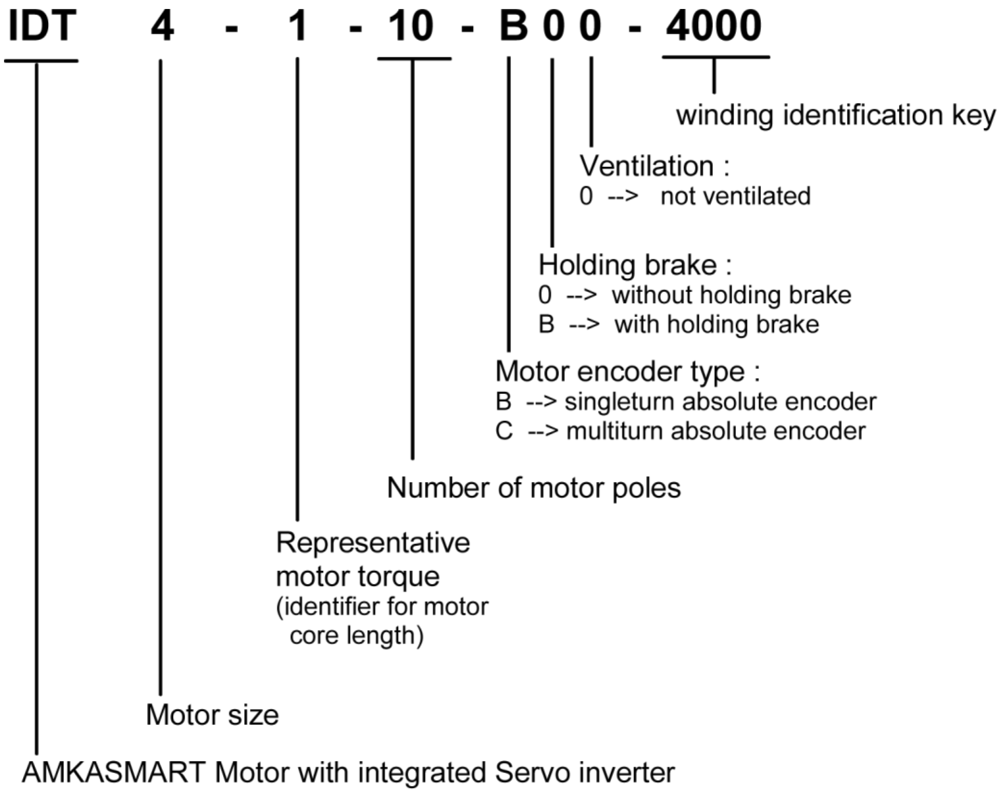
Content

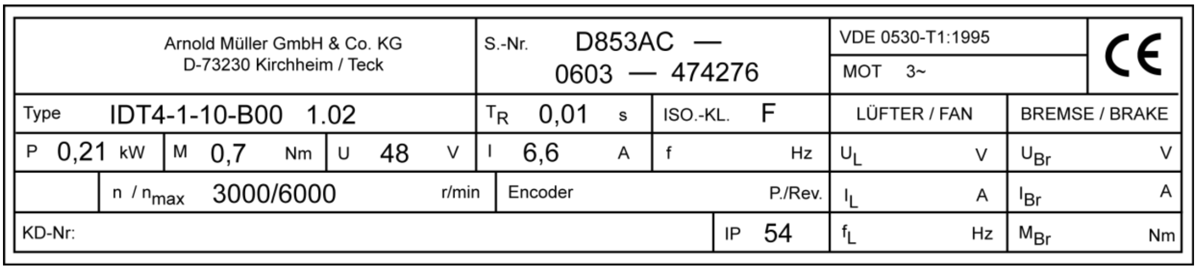
1 Product Presentation

1.1 Product name



IDT_Typenschlüssel

Nameplate



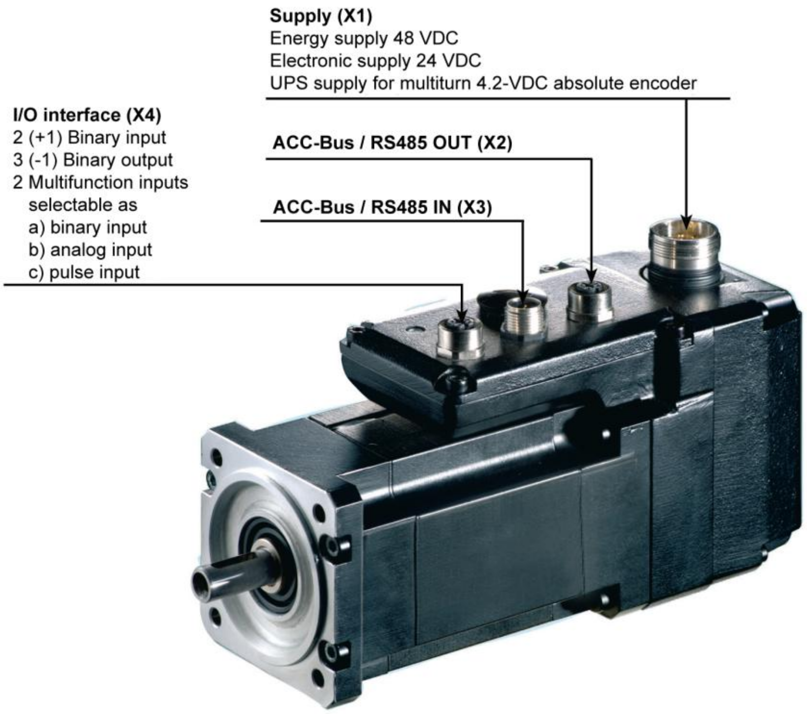
picture name: IDT_Typenschild

1.2 Order data

Designation	Order number
IDT4-1-10-B00-4000-B5	A1197AC
IDTG4-1-10-BB0-4000-B5	A1217AC
IDT2-2-10-B00-2500-B5	A1296AC
IDT4-4-10-B00-1300-B5	A1297AC
IDTG4-1-10-B00-400-B5	A1308AC
IDTG4-2-10-BB0-2500-B5	A1312AC

1.3 Product overview

The AMKASMART IDT product series combines the performance of the AMK high-torque servo motors with the most modern servo control in the most compact space. By integrating the power electronics and the regulating electronics in the motor there is no need for wiring between motor and servo controller. The control cabinet volume is significantly reduced. The regulating circuit is closed by the integrated absolute encoder and makes it possible to operate with position or speed regulation. The compact motor part provides high duration and maximum torques. If desired the motor can be equipped with a mechanical holding brake and a gearbox.



picture name: IDT_Übersicht_R2

Supply

Over the connection X1, each IDT is supplied with 48 V power voltage, 24 V electronic voltage and an uninterruptible power supply (USV) for IDT drives with multi-turn absolute encoder. A distributor box distributes the voltage to 4 IDT drives. The 48 V and 24 V are fed over one or more power supplies (dependent on the power required) into the distributor box. The USV voltage is provided over the integrated accumulators which are automatically loaded with 24 V. The binary In-and outputs, as well as the electronic control of the motor holding brake are provided with 24 V electronic voltage.

Regenerative energie

The integrated braking chopper in the distribution box makes a connection to an external braking resistance possible. As of an intermediate circuit voltage of 56 V the braking transistor diverts excessive energy via the connected braking resistance. The braking chopper is also available as a .top hat rail electronic.

Communication and drive commands

The IDT drive, which has been designed as a decentral servo drive, can be interlinked in a most easy manner to all other AMKASYN drives and controls. The CANopen interface is compatible to the ACC-bus from AMK. With this the IDT also offers real-time data exchange with other drives and controls. Commands, startup, and diagnostics by CANopen are just as possible as the integration of decentral I/O modules and other CANopen-compatible elements.

Integrated movement functions

Just as the AMKASYN servo drives KE/KW and KU, the IDT offers integrated movement functions:

- Torque control
- Operating mode analogue speed regulation
- Digital Speed and position control
- Positioning with adjustable ramps
- Reference point run to machine zero point
- Electronic transmission of any ratio
- Synchronization control between any number of axes
- Step-motor mode (rectangular pulse as position setpoint)

The integrated movement functions can be started by binary inputs. IDTs that are interlinked by the ACC bus with the control are commanded by the AMK fieldbus protocol (AFP).

Cyclic setpoint specification

In the ACC bus network the IDT can be supplied with cyclic setpoints via the ACC bus that are interpreted by the drive control as torque, speed, or position setpoints depending on the set operating mode. The setpoint is generated by the application program on the control or another IDT drive.

Communication and drive commanding via MODBUS RTU

The IDT with Modbus option can be operated by means of an external controller, via MODBUS RTU. The Modbus controller can read and write IDT data (bits or words). The IDT provides an interface consisting of 32 control and status words.

The AMK fieldbus protocol (AFP) is used for drive commands.

The following functions can be executed by means of AFP::

- Controlling the “Inverter ON” function,
- Diagnostics and troubleshooting
- Monitoring real-time bits for process control purposese
- Cyclic setpoint specification [t ≥ 5ms]
- Cyclic actual value analysis [t ≥ 1ms]
- Reading and writing parameters
- Temporary data changes
- Drive commands
  - Changing the operating mode
  - Speed regulation
  - Referencing
  - Positioning
  - Synchronising coupled axes
  - Changing values in the process..

For other options offered by the Modbus interface, please refer to the “Data contents” chapter.

Hint:	The superordinate controller has to support the Modbus RTU standard!

I/O interface

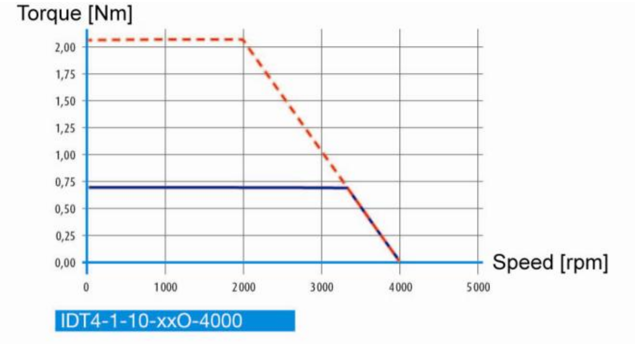
The I/O interface offers inputs and outputs with maximum flexibility.Together are 7 binary IO’s available. Free to use as 5 inputs and 2 outputs or 4 inputs and 3 outputs. In addition to a binary in- and output the inputs BE2, BE3 can be used as analogue input or 2 additional binary inputs or as square-wave pulse input. The functionality of the binary in- and outputs are configured by parameters depending on the application.

1.4 Technical data

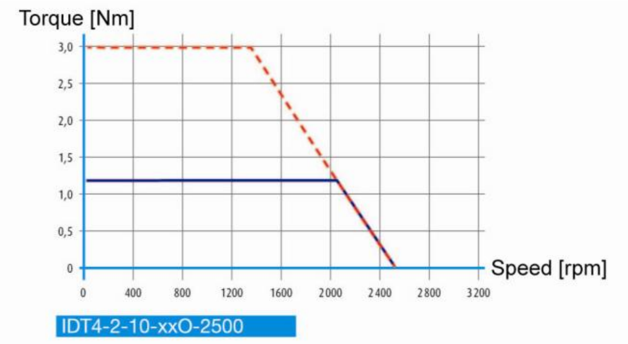
Designation (connection)		Unit	Motor type		
			IDT 4-1-10-4000	**IDT 4-2-10-2500**	**IDT4-4-10-1300**
	Cooling		by mounting flange or convection		
	Protective/monitoring functions		Excess temperature IDT interior (electronics Overcurrent monitoring acc. i^2t Overvoltage intermediate circui Control motor holding brake Control of the run-down after RF deactivation		
Nominal data (EN 60034-1) current and voltage as effective values					
U_N	Input voltage (X01)	VDC	48 +/- 10%		
I_N	Input current	A	6.6		
U_{HN}	Supply voltage electronics (X01)	V	24 ± 15%, waviness max. 5%		
I_{HN}	Current consumption electronics	A	0.3 (w/ brake 0.7)		
U_{USV}	Stand-by supply voltage (X01)	VDC	4.2 (min. 3.6)		
I_{USV}	Stand-by input current	µA	C type encoder < 200 B type encoder < 25		
n_N	Rated speed	rpm	3000	2000	1000
P_N	Rated power (shaft)	W	210	240	260
Electronic characteristics					
M_0	Permanent static torque	Nm	0.7	1.20	2.30
M_{0_T55}	Permanent static torque on 55°C ambient temperature	Nm	0.49	0.84	1.75
n_0	Idle speed	rpm	3000	2000	1000
M_{max}	Maximum torque	Nm	2.1	3.0	7.0
	Effectivity (total)		approx. 80%		
Mechanical characteristics					
n_{Max}	Mech. maximum speed	rpm	6000		
J_M	Rotor inertia	kg cm^2	0,36	0,68	1,44
L	Overall length	mm	153	183	243
m	Weight	kg	2	2.7	4.3
Motor holding brake					
L_{Br}	Overall length with brake	mm	186	216	276
M_{Br}	Torque of the holding brake	Nm	4		
J_{Br}	Inertia of the holding brake	kg cm^2	0.06		
m_{Br}	Weight of the holding brake	kg	0.7		

1.5 Torque - speed characteristic curves

Legend:
Maximum characteristic curve: - - - -
Nominal characteristic curve: ____



picture name: KennlinieDT4_1_10_xxO_4000



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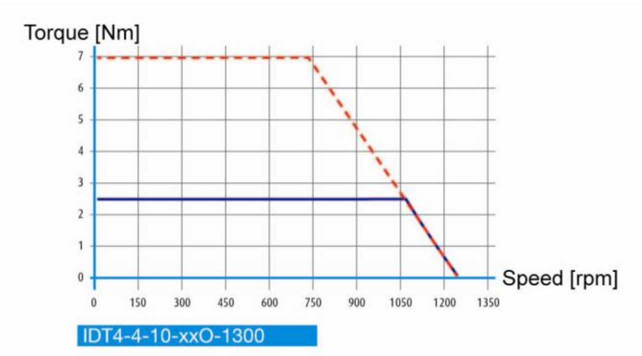
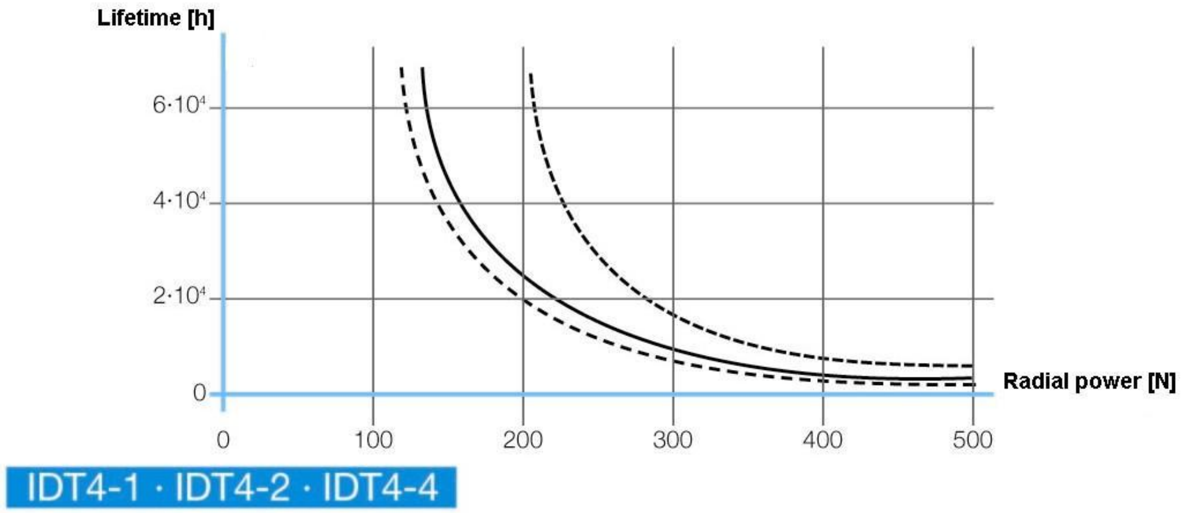


picture name: KennlinieDT4_4_10_xxO_1300

1.6 Shaft-(A)-bearing load

The curve service life in dependency to the effective radial force is based on the assumption that the radial force acts in the middle of the drive shaft.



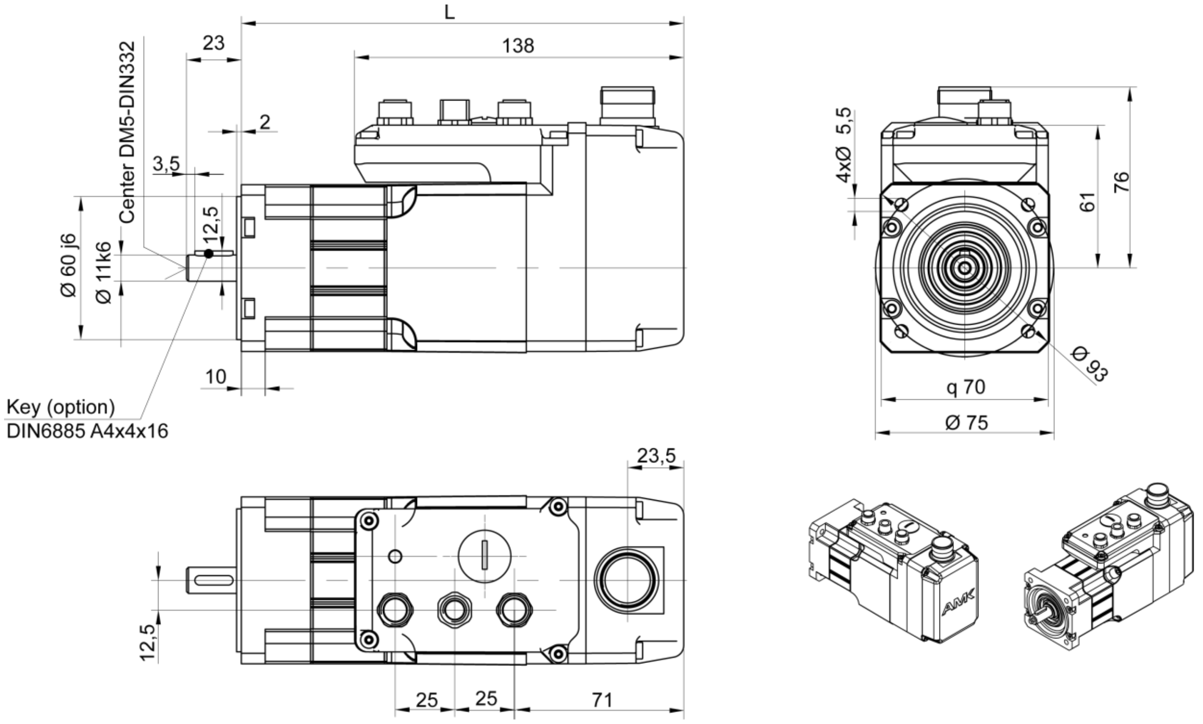
picture name: IDT_Wellenbelastung

The bearings have a nominal service life of 40,000 hours if the permitted radial and axial forces are not exceeded. If the bearings are subject to greater forces, then this has a negative effect on the service life of the bearings.

1.7 Ambient conditions

Designation	Value range	Explanation
Protection class	54 65 (optional)	(EN60529)
Ambient temperature	0°C to +40°C	In this range the specified technical data is valid. At operation outside of this range the motor torques are reduced.
	40°C to 50°C	Derating 2% per 1% temperature increase e.g. 45° corresponds -10% power decrease
Elevation of installation site	0 to 1000m above sea level	
Relative humidity	5% to 80%	Condensation is not permitted
Vibration stress	0.5g 2...200Hz 1..1.5g 2...50 Hz	Operation: Class 3M2 (EN60721-3-3) Transport: Class 2M2 (EN60721-3-2)
Electromagnetic compatibility		EN61800-3
Storage and shipping temperature	-25°C to +55°C	Store IDT dry, dust-free, vibration-free, and horizontally. Do not remove plastic protective covering that's on the drive shaft. It protects against moisture and mechanical damage.

1.8 Dimensional drawing and measurements



picture name: IDT_Abmessungen

Type	L (length without brake)	L (length with brake)
IDT4-1-10-xxO	153	186
IDT4-2-10-xxO	183	216
IDT4-4-10-xxO	243	276

2 Safety instructions

Please observe all applicable rules and regulations for the machine/system during installation. Within the EU the machine/system needs to meet the regulations of the machine directive 89/392/EEC, the low-voltage directive 73/23/EEC and the electromagnetic compatibility limit values directive 89/336/EEC.

Danger

Any electrical equipment attached has to be designed to meet the electrical safety standards in accordance with EN 50178 / EN 61800-2 / EN 61800-3 / EN 60204 when used as intended.

Only devices, electrical elements, or wiring may be connected to the signal interfaces that feature a "secure disconnection" of the connected circuits according to EN 50178.

Danger

Before working on the devices:

Disconnect power supply at the main switch. There is a risk of death when working under voltage!

Attention:
LED indicators do not signal the voltage-free state of the device terminals in OFF state.

Plug-in cards and any plugs should only be plugged in or unplugged when the device is free of voltage.

Only remove or attach cables to or from terminals when free of voltage.

Avoid touching the electrical connections; static discharge can destroy components.

Any work performed should be carried out only by trained and authorized technicians.

These are persons that have been well trained on the product and that are familiar with the transport, assembly, installation, control, and operation. They also have the appropriate qualifications of their vocation.

The technicians need to know and apply the valid regulations and standards for the electrical system/machine and safety.

(EU: low-voltage directive EN 60204, EN 292, EN 50178, national (German): accident prevention regulation VDE 0100, VBG 4, international IEC 60364, HD 384, IEC 60664)

Repair and work on devices that require them being opened may be carried out only by AMK Service and authorised personnel. Unauthorised opening of the devices means the loss of the warranty.

All documentation on the applied elements and the AMK safety regulations must be observed.

Generally there is a **danger** from electrical drives because of improper use, uncontrollable movements due to defective components, software errors, handling errors, errors in the installation and with components, errors because of environmental influences, and from touching current-carrying parts.

Improper handling of the devices and ignoring the warning notices can cause material damage and bodily injury.

Warning

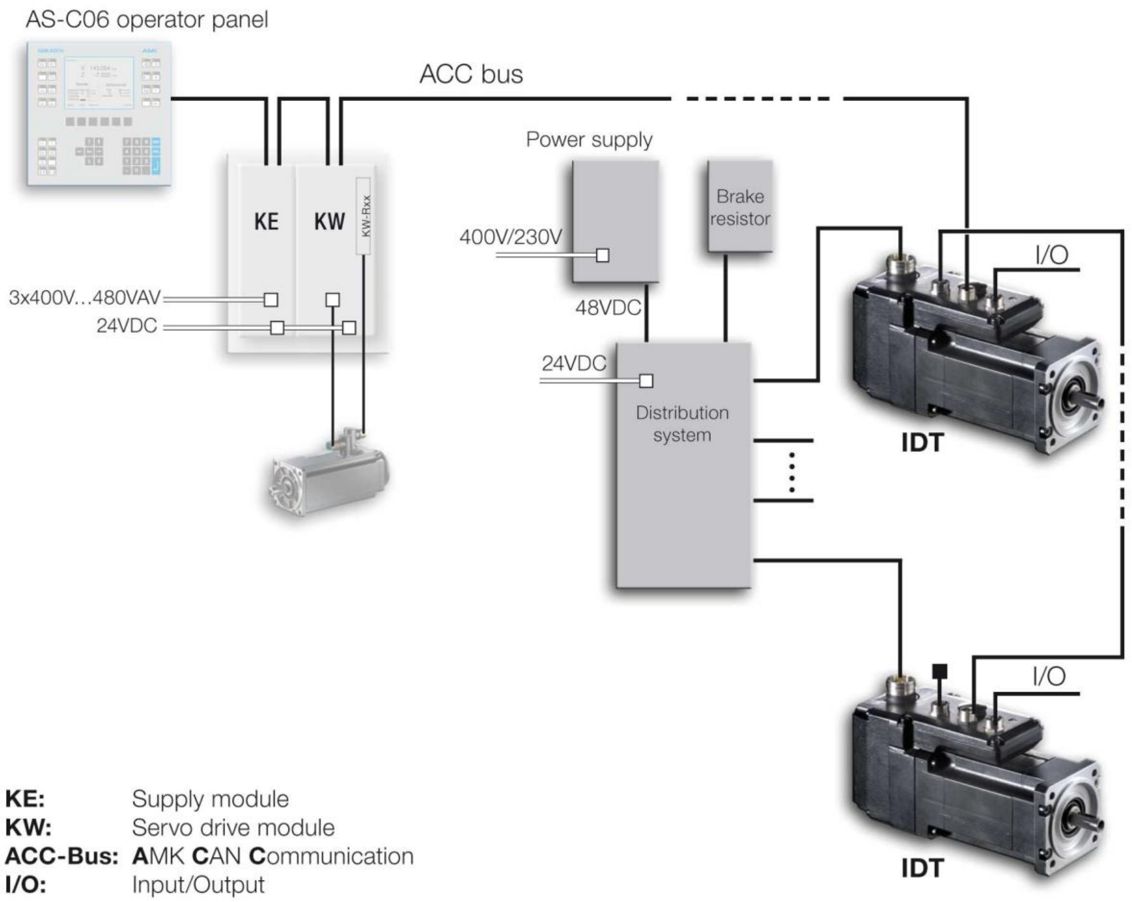
The system parameters may only be specified or modified by the machine's manufacturer.

The value in the parameter for limit speed has to be adapted to the process and may not exceed the maximum permitted speed of the motor. The values for the torque limits the run-up and -down times have to be adapted to the machine/equipment.

Incorrect parameters may influence the performance of the drive system and increase the risk of accident or damage.

3 System assembling and function

3.1 Overview - IDT in system interconnection



picture name: IDT_Systemverbund

3.2 Additional components

3.2.1 Connection cable power supply

Connection to terminal X1, M23x1, socket 6-pin

Designation	Part-No.	Description
IDT-LE2000	201105	Length: 2m, Plug angled
IDT-LE5000	201711	Length: 5m, Plug angled
IDT-LE10000	201106	Length: 10m, Plug angled

The Cable are applicable for trailing cable installation.
Minimum bend radius: 7,5 x outer diameter of the cable
Torsion rotation cycles: >3 Millionen

Designation	Part-No.	Description
IDT Starter KIT	46980	Cable power supply IDT-LE2000 additional with cable end sleeve

3.2.2 Ready to wear IDT cable power supply

Designation	Part-No.	Description
Ready to wear IDT cable power supply	46864	Cable power supply IDT / Distribution box IDT-X4 Both sides ready to wear Length: 2m, Plug angled Other length on request

3.2.3 Connection cable and bus-terminating resistor ACC Bus

Connection to the terminals X2 and X3, M12x1 one side pin, the other side socket, A-coded

Designation	Part-No.	Description
IDT-ACC500	201107	Length: 0.5m, Plug angled
IDT-ACC2000	201108	Length: 2m, Plug angled
IDT-ACC5000	201131	Length: 5m, Plug angled

The Cable are applicable for trailing cable installation.
Minimum bend radius: 7,5 x outer diameter of the cable
Torsion rotation cycles: >3 Millionen

3.2.4 Bus-terminating plug

Designation	Part-No.	Description
IDT-ACCT	201110	Resistance 2x120Ohm, Plug M12x1 pin of X2, Plug straight

The AMK bus-terminating resistor terminates the CAN Bus lines CAN_H and CAN_L as well as the hardware synchronisation lines SYNC_H and SYNC_L each with a 120 Ohm resistor.

3.2.5 EA-interface cable

Designation	Part no.:	Description
IDT-EA5000	201731	Length: 5m, Plug angled°, 8 pol.
Adapterkabel IDT 5p/8p	46999	Length: 5m, Plug angled°, 8 pol; socket straight 5 pol

The Cable (Part.no.: 201731) is applicable for trailing cable installation.
Minimum bend radius: 7,5 x outer diameter of the cable
Torsion rotation cycles: >3 Millionen

3.2.6 CAN – cable IDT / AS-C03

Designation	Part no.:	Description
CAN – cable IDT / AS-C03	201942	Length: 2m, M12 plug/ 9pol. SUB-D

3.2.7 Braking transistor

Designation	Part no.:	Description
IDT-BR50	46832	Switching for top hat rail in closed switch cabinet, Limitation of supply voltage (Brake threshold from 55VDC)

If the voltage on the connection X1, between Pin1 UZN and Pin 2 UZP, reaches 60V, the IDT of the operation software is switched off and spins off. This condition is displayed as a diagnose message 1059 “Overvoltage intermediate circuit”.

3.2.8 Braking resistance

Designation	Part no.:	Description
IDT-AR100	201226	Brake resistance 3 Ohm, power output 100W* for connection to the distribution box 4-fold. * The temperature switch limits the output of the braking resistance to 50W.

3.2.9 Distribution box

Designation	Part no.:	Description
IDT-X4	O764	With the voltage 48VDC and 24VDC the distribution box supplies up to 4 IDT. The 48V on each IDT is supplied over a DC fuse. The braking transistor for a connection to an outside braking resistance is integrated. The USV for stand-by supply of the multi-turn encoder is provided by NiMH-accumulators. The loading device for the accumulators is integrated. Protection class IP65

3.2.10 Power supply

Designation	Part no.:	Description
Power supply 48V / 10A	O808	IDT-power supply input 230V /output 48V/480W
Power supply 48V / 20A	O809	IDT-power supply input 3 * 400V /output 48V/1000W

Note: The power supplies can be switched parallel for power increase (max. 3).

3.2.11 Assembly unit IDT cable

Designation	Part no.:	Description
Assembly unit IDT cable	401209	1x M23 power plug angled 1x M25 screwed cable gland 1x socket 6x pins

3.2.12 Service and start-up Tool

Designation	Part no.:	Description
PC start-up Tool	O755	AMK PC software AIPEX (AMK startup and parametering explorer) inclusive converter USB-CAN, Circuit board AP-CI6 and connection cable

The service and startup tool connects the PC through the USB interface with the ACC-Bus of the AMK drive system. Over this interface the AMK software AIPEX can access the IDT and the AMK drive (see chapter startup)

The service and startup tool is available under component number 0755 and contains the following components:

Qty.	Parts number	Description
1	200808	Converter USB/CAN
1	46786	Adapter cable USB/CAN (2x Sub-D 9P)
1	46827	Circuit board AP-CI6 top rail hat assy.
1	201110	Bus-terminating plug M12
1	29240	Bus-terminating plug 6P (fire wire)
1	29543	Cable IEEE1394 (2 x Fire wire)
1	201108	CAN-cable IDT-ACC2000 M12 pin /bush 90°
1	46600	Programming system AIPEX

4 Assembly and Installation

4.1 General information on assembly and control of the holding brake

IDT servo drives are constructed in the mechanical version B5. All measurements can be found in the diagrams.

Inspect the IDT for visible damages before assembly. Damaged parts may not be assembled.

During assembly make sure the the flange connections can support the weight force of the motor as well as the forces exerted during operation.

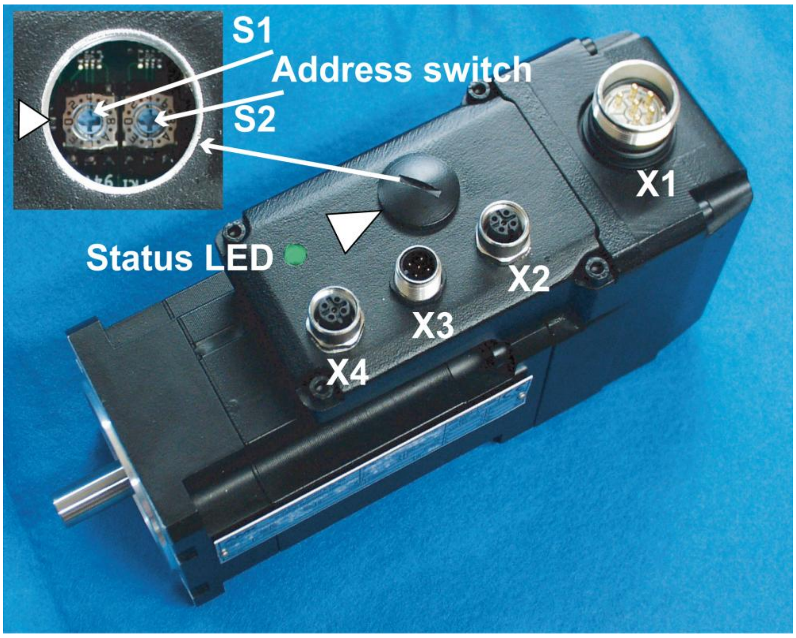
The function of an optionally existing holding brake needs to be checked. The rotor needs to be able to be turned by hand when the holding brake is open; no running noises (e.g. dragging) should be audible. The holding brake is controlled and opened by the IDT operating software with the “RF - Inverter ON” signal. The reaction time of the brake is factory set by AMK in the parameters ID206 and ID207 and can be modified if necessary.

Note:	The motor brake can be opened and closed by writing the parameter ID32843 SERVICE COMMAND when RF is not active ID32843=30 hex open brake ID32843=31 hex close brake

The motor needs to be properly mounded and aligned. Attaching the motor flange to the machine construction has to be absolutely planar.
Make sure that all electrical connections have been properly completed and the terminal screws are tight.

5 Connection technique

5.1 Electrical connections and signal configuration



picture name: IDT_Anschlüsse

5.1.1 Status LED

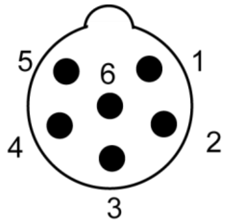
Colour	Status	Explanation
Green	System Ready, SBM	System Ready indicates the fault-free status of the system. After switching on the 24V.
Green (flashes)	Control active, QRF	The acknowledge inverter on (QRF="Quittierung Reglerfreigabe") signals that the drive is under voltage and is under control. Prerequisite for setting the inverter on is the error-free system status.
Red	Error	In the error state the Inverter ON is withdrawn from the drive and the System Ready signal message is cancelled. Depending on the cause of the error the drive is braked automatically to zero speed or it runs down.
Orange	Programming mode	AMK Service: A new firmware can be loaded in the programming mode.
Orange (flashes)	Warning	Even though there is a warning the drive can yet be operated under control. By reading out the diagnostics number, e.g. with AIPEX or by reading errors with the PLC, a reaction can be made to the warning.

5.1.2 ACC-Bus Address switch S1, S2

S1: high byte (factory setting: 0 hex)
S2: low byte (factory setting: 0 hex)

Example: Participant address 20 decimal → S1 = 1 hex, S2 = 4 hex

5.1.3 X1 Power connector M23x1, 6-pin, (pins) B-coded



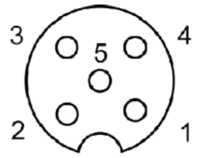
Picture name: IDT_X1

PIN	Signal	Cable core detection	Description
1	UZN	1	Negative intermediate circuit voltage (0V)
2	UZP	2	Positive intermediate circuit voltage (+48V)
3	PE	green/yellow	Lay on casing PE
4	GND	4	Ground
5	24V	5	+24V Electronics supply
6	UPS	6	Uninterruptible power supply for absolute encoder
	Shield		Lay on casing

The braid with the cable core detection 3 is not utilized and is cut-off.

CAUTION	**Short circuit/ change poles** The device can be destroyed if the poles of the supply voltage 24VDC or 48VDC will be changed. **preventive steps:** Check the wiring until first start up.

5.1.4 X2 ACC Bus OUT M12x1, 5-pin (socket) A-coded



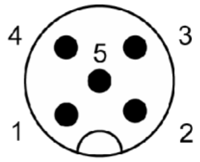
Socket M12
5 poles, A-coded

picture name: IDT_X2

	ACC- Bus configuration *		RS 485 configuration *	
PIN	**Signal**	**Description**	**Signal**	**Description**
1	GND/PE	Ground / cable shielding	GND/PE	Ground / cable shielding
2	SYNC_H	Hardware synchronisation High output	RS 485 +	RS 485 + interface
3	SYNC_L	Hardware synchronisation Low output	RS 485 -	RS 485 - interface
4	CAN_H	CAN_High output	CAN_H	CAN_High output
5	CAN_L	CAN_Low output	CAN_L	CAN_Low output

* Using the parameter ID34026 to define the fieldbus interface function at X2 – or X3 pin 2/3.

5.1.5 X3 ACC Bus IN M12x1, 5-pin (pins) A-coded



Plug M12
5 poles, A-coded

picture name: IDT_X3

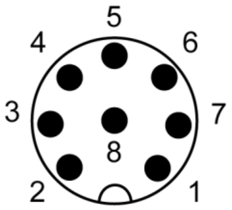
	ACC- Bus configuration*		RS 485 configuration*	
PIN	**Signal**	**Description**	**Signal**	**Description**
1	GND/PE	Ground / cable shielding	GND/PE	Ground / cable shielding
2	SYNC_H	Hardware synchronisation High output	RS 485 +	RS 485 + interface
3	SYNC_L	Hardware synchronisation Low output	RS 485 -	RS 485 - interface
4	CAN_H	CAN_High input	CAN_H	CAN_High input
5	CAN_L	CAN_Low input	CAN_L	CAN_Low input

* Using the parameter ID34026 to define the fieldbus interface function at X2 – or X3 pin 2/3.

Note: An AMK terminating plug is needed for each bus end

5.1.6 X4 I/O interface M12x1, 8-pin (socket) A-coded

All terminals are potential bounded, outputs are short circuit-proof.



Socket M12
8 poles, A-coded

picture name: ZCH_IDT_EA_X4

PIN	Signal	Cable core detection	Description	Level
1.	GND	White	Ground binary I/O	0V
2.	BA1 [1)]	Brown	Binary output 1	24V output / max. output current 250mA
3.	BE1	Green	Binary input 1 (24V)	24V Input not potential separated
4.	BE2 [2)]	Yellow	Binary input 2 (24V)	24V Input not potential separated
	AEI [2)]		Analog input inverted (-)	+/- 10V
	Track A [2)]		Square signal input	24V, 0V
5.	BE3 [2)]	Grey	Binary input 3 (24V)	24V Input not potential separated
	AEN [2)]		Analog input not inverted (+)	+/- 10V
	Track B [2)]		Square signal input	24V, 0V
6.	BE4	Pink	Binary input 4 (24V)	24V Input not potential separated
7.	BA2	Blue	Binary output 2	24V output / max. output current 100mA
8.	BA3 / BE5 [3)]	Red	Binary output 3 or Binary input 5 (24V)	24V output / max. output current 100mA 24V Input not potential separated

[1)] The BA1 output 24V can be used as supply voltage for sensors and has an internal overcurrent / short circuit protection. Maximum current is defined at 0.25A at 85°C.

[2)] The input pins 4 and 5 can be used alternatively as follows:

- Binary input BE2, BE3
- Analog input
- Pulse encoder input max. 100kHz input frequency

[3)] Pin 8 of the interface X4 (I/O interface M12x1, 8-pin) can be used as binary output BA3 or respectively as binary input BE5.

Note: If the BA3 and the BE5 are occupied at the same time with a code, then the diagnostic message 1366 “Definition input bits” is signalled.

5.1.6.1 Binary Inputs

Characteristic value

Nominal data	24V DC/ 8mA
Ground	GND
1-level min.	13V / 2mA
1-level max.	30,2V / 15mA
0-level min.	-3V / 0mA
0-level max.	5V / 15mA
min. signal time	2ms
Input resistance	

5.1.6.2 Binary Outputs

Characteristic value

Nominal data	24V DC/ 100mA
Ground	GND
1-level min.	V / mA
1-level max.	V / mA
0-level min.	V / mA
0-level max.	V / mA
rise/fall time	-
overload protection	short circuit-proof

5.1.6.3 Analogue Inputs AEI and AEN

Characteristic value

nominal input voltage/ maximum input voltage between AEI and AEN AEI and GND AEN and GND	 ± 10V / ± 15V ± 10V / ± 15V ± 10V / ± 15V
Input current	-
Input resistance for differential signal	-
Resolution AD-converter	12 Bit
Resolution per bit	4,88 mV
Limit frequency	-
Scanning time	-

5.1.6.4 Pulse generator input

Characteristic data

Max. cable length	
shield	connected to both sides
Max. input frequency	100 kHz input frequency
Input resistance	
Input voltage	24V DC
Input current	-
Input voltage min/max	-
Input current min/max	-
Scanning time	-

☞ If devices are linked to each other via square wave pulse encoder input they must be connected to the same ground.

5.1.7 Default assignment of the I/O interface

The following parameterised default setting is valid at delivery:

PIN	Signal	Explanation	Explanation	Parameterisation
3	BE1	Inverter ON (RF)	Switches the drive in control. The motor windings are under voltage. Prerequisite to set the inverter is the system ready message, see BA1	ID32978 = 32904
4	BE2	AEI	Analog input inverted (-)	ID32979 = 33917
5	BE3	AEN	Analog input not inverted (+)	ID32980 = 33917
6	BE4	-	no default configuration	ID32981 = 0
2	BA1	SBM - System Ready	The system ready message is set after the system has successfully started up and indicates the fault-free status of the system.	ID32865 = 33029
7	BA2	-	no default configuration	ID32866 = 0
8	BA3 / BE5	-	no default configuration	ID32867 = 0 ID32982 = 0

5.2 Cable cross-sections

Connection terminal	Unit	Recommended wire cross-sections
(X01) power connection (shielded)	mm^2/AWG	7* x 1.5 / AWG 16
(X02 / X03) CAN-Bus (shielded)		5 (4+PE) x 0.25 / AWG 24
(X04) I/O interface (shielded)		5 (4+PE) x 0.25 / AWG 24

* The braid with the cable core detection 3 is not utilized and is cut-off.

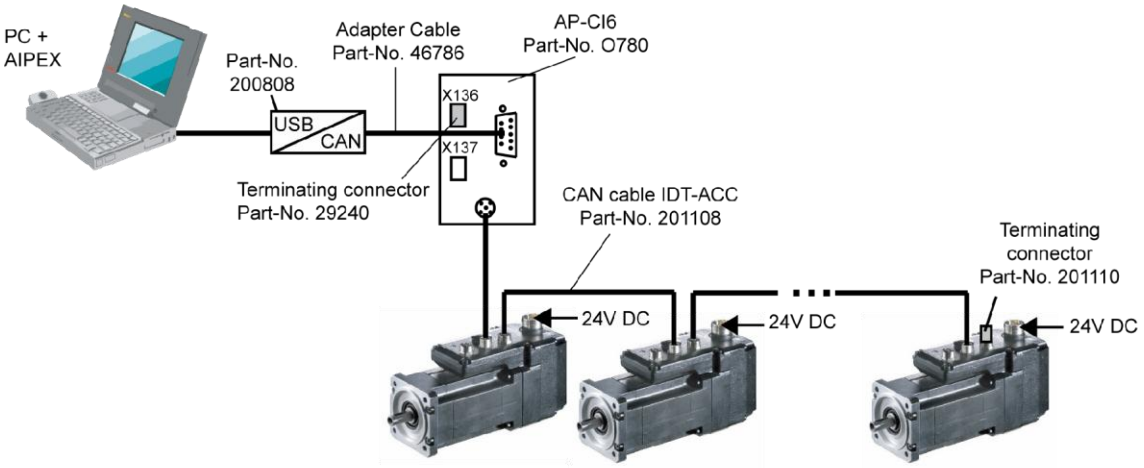
Note: Cross-sections according to EN 60204-1: Installation type C or UL 508C: Tab. 39.2.

6 Startup

The start-up takes place with the AMK PC software AIPEX (part number. 46600). Apart from the parameterisation of the specific application (for example Operating mode, Inverter parameter, set point source, Cycle times...) AIPEX offers various functions, as for example the Set-point generator, Oscilloscope function, Status monitor, Message configuration for the data exchange in the ACC-Bus. A connection needs to be made between the IDT and the PC. The connection is made through the ACCBus. The PC can be connected via the USB/CAN converter to the IDT ACC Bus interface X3. The service and start-up tool is available under part number O755 on AMK (Accessories). It contains all the components with part number in the following drawings. The various connection possibilities are displayed in the options 1, 2, and 3. Option 4 requires the additional converter USBRS232 (Part No. O748).

Note:	The IDT must be connected to 24V DC that the PC got online access to the IDT data. The configuration with AIPEX above CANopen/ACC-Bus is allways active, although with active interface Modbus. The direct configuartion above Modbus is not possible.

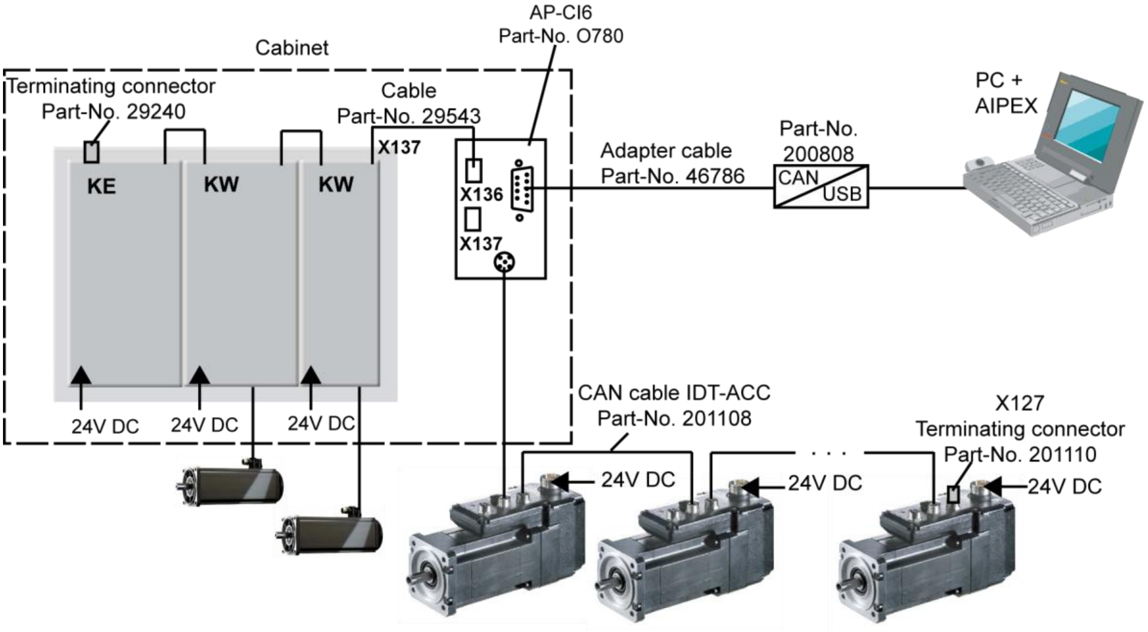
Option 1: Direct connection IDT – PC over ACC Bus



picture name: IDT_Inbetriebnahme_4

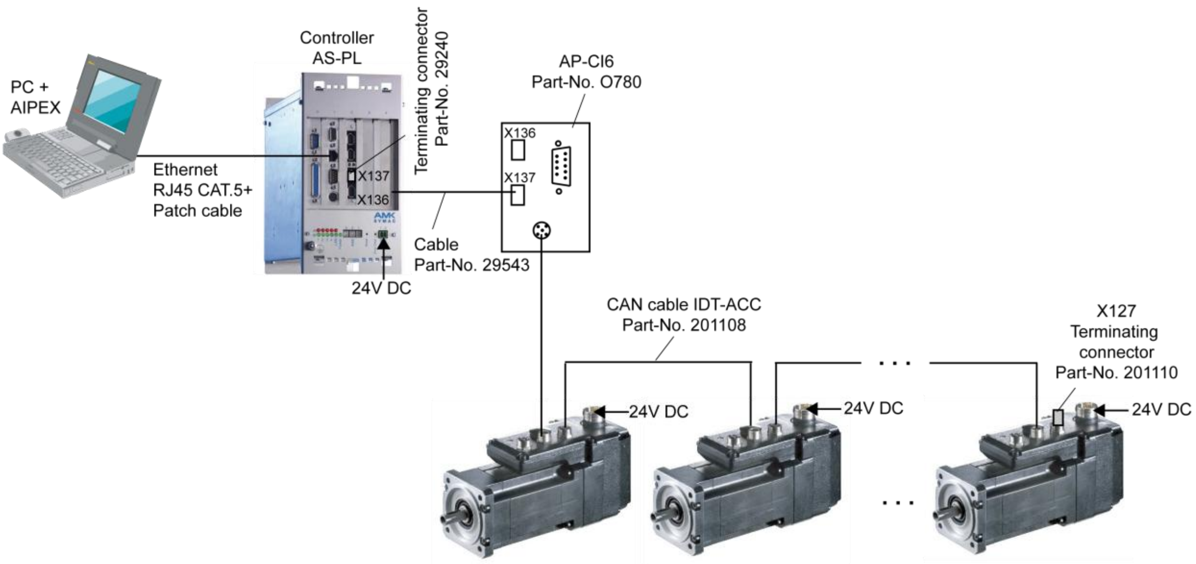
As an alternative the IDT can be connected by the ACC Bus with an AMK KE/KW- , KU system or with a AMKAMAC controller. In ACC Bus networks the PC can be connected with the ACC Bus Master from which AIPEX can access all AMK ACC Bus participants. The connection from the PC to the ACC Bus Master can be made by CAN Bus **(option 2),** Ethernet **(option 3)**, or by serial interface **(option 4)**. These options require an error-free ACC Bus in which the participants have been recognized by the ACC Bus Master by their set participant address.

Option 2: Connection IDT – PC in the system interconnection with KE/KW



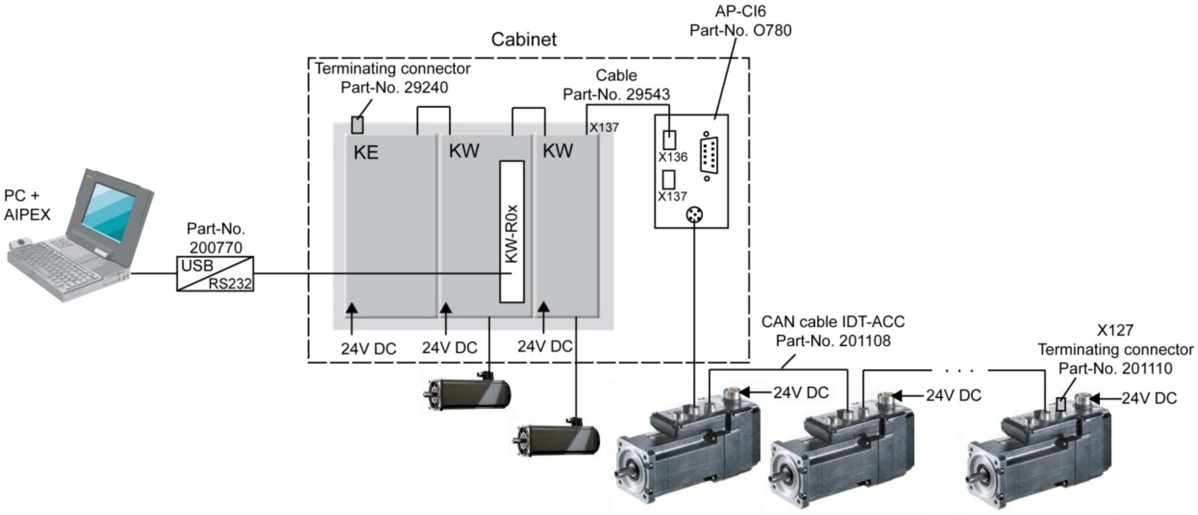
picture name: IDT_Inbetriebnahme_1

Option 3: Connection IDT – PC in System interconnection with the AMKAMAC controller



picture name: IDT_Inbetriebnahme_3

Option 4: Connection IDT – PC in the system interconnection with KE/KW over USB/RS232 converter



picture name: IDT_Inbetriebnahme_2

Note: Further information for parameterisation can be found in the documentation 'IDT parameter description' (part number 201380).

6.1 Networking

6.1.1 Networking via CANopen and ACC-Bus

The IDT drives are integrated into the AMKASYN ACC Bus network as slave participants. ACC Bus Master can be a servo inverter (e.g. KW or KU) or a controller (e.g. AMKAMAC AS-XX). The ACC Bus is meets the CAN Bus Standard 2.0B with CANopen protocol DS301 V4.01 extended by a hardware synchronisation signal.

The hardware synchronisation synchronises all drives and processes with a jitter of less than 1 µs and allows for data exchange in the ACC Bus in real-time. Two synchronous messages (PDOs) can be sent and received per IDT every 1 ms cycle time in the ID2 parameter. Altogether a maximum of 4 sending and 4 receiving messages can be configured for each IDT.

The message configuration is done in the AMK PC software AIPEX if an AMK control component is ACC Bus Master (CANopen Master).

To interlink various drives over the ACC-Bus, the communication parameter and the cycle time must be set in each participant.

ID2	SERCOS Cycle-time = ID1=ID32958
ID34023	The Bus participant alternatively with the address switch S1 and S2 at IDT
ID34024	Bus transfer rate
ID34025	Bus Mode (Master/Slave)
ID34026	Bus mode attribute (Hardwaresynchronisation)
ID34027	Bus failure characteristic

The parameters can be set by establishing a direct connection between PC and IDT over the ACC-Bus interface (see chapter Startup variant 1). After the communication parameter are correctly set in all participants, the drives can be interlinked over the ACC Bus. After a renewed system run-up, the participant, parametered as Acc Bus master, recognizes the connected slaves and initialises the bus connection. With the AMK PC program AIPEX, the PC can access all participants over the ACC Bus interface.

Further standard CANopen devices can be connected to the ACC Bus such as CAN I/O components or remote controllers.

The ACC Bus network must be terminated with the AMK bus-terminating resistor at the first and last participants.

Note: Further information for parameterisation can be found in the documentation 'IDT parameter description' (part number 201380).

6.1.2 Address switch for ACC Bus participant address

In the ACC bus network the participant address of the IDT is set between 2 and 40 hex (2 to 64 decimal) by the user with the two address switches (S1 and S2). (Address switches Electrical connections and signal configuration)

Every participant in the ACC Bus network needs to be assigned an individual participant address. Address 1 is reserved for the ACC Bus Master. The address switch is located under the PG cover. In the delivery status the participant address is set to 2.

S1: high byte (factory setting: 0 hex)
S2: high byte (factory setting: 0 hex)

If both address switches are set to zero (S1 = 0, S2 = 0), then the participant address can be parameterized by parameter ID34023 Bus participant address.

Note: An addressing by address switch has priority over the parameter addressing. The address of the address switch (at settings unequal to 0) overwrites the content of parameter ID34023.

6.1.3 ACC-Bus length of line

The length of line of a fieldbus cable depends on the transfer rate and the number of connected Bus participants. With each participant on CAN/ACC-Bus, the data transfer is delayed due to inductivities and capacities.

For the AMK devices the delay time is 2.5ns for each participant.

Standard cables have a data speed of 5ns/m. The delay time of 2.5ns is therefore equivalent to a distance of 0.5m for each Bus participant. The maximum length of line of a network (see following tables) reduces itself to 0.5m for each participant.

In the following tables the maximum length of cables are displayed in dependence of the transfer rate.

Transfer rate	Max. cable length
1000kBit/s	38m
500kBit/s	80m
250kBit/s	164m
125kBit/s	332m

Example:

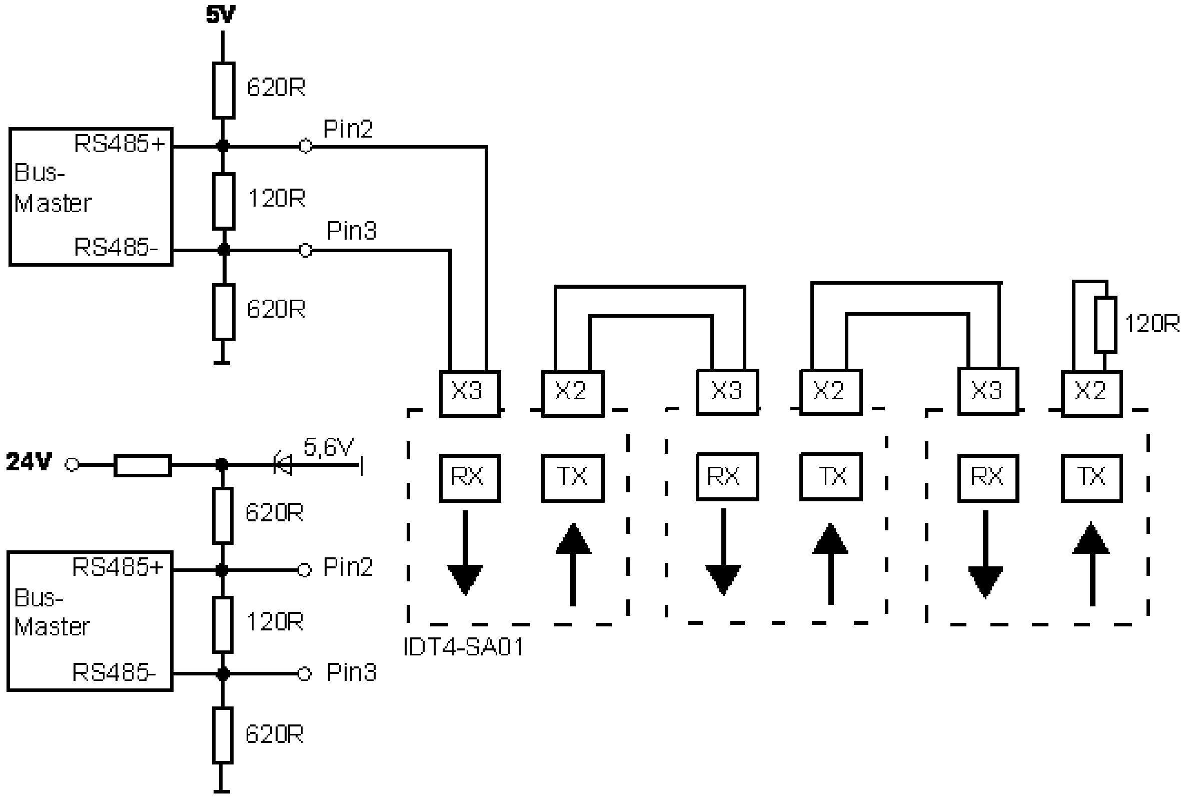
Transfer rate 500kBit/s:	80m
16 participants* → 0.5m	-8m
maximum Bus length	72m

* Participants of the AMK device series KE/KW, KU, IDT, SYMAC

In reality, the calculation example can deviate due, for example, to unsuitable cable. Furthermore a safety reserve of approx. 20% has to be projected into the calculation.

6.1.4 Networking via RS485 (Modbus)

The IDT drives are integrated into the Modbus network as slave devices. (Twisted pair cables can be ordered using AMK part no. 201108.)
Max. 32 devices can be connected (1 master - 31 IDT slaves). The following image illustrates the 5V DC and 24V DC voltage supply options.



picture name: IDT_Vernetzung_485

Note:	At the master, a terminating device (as per RS485 specification) with a pull-up resistor (620R at RS485+) and pull-down resistor (620R at RS485-) is required!

Use the parameter ID34026 to defined the fieldbus interface function at X2 – or X3 pin 2/3.

Bit	Wert	Meaning of the ID34026 bus mode attribute
8	0	ACC bus (hardware synchronisation, activation by bit 1 and bit 2)
	1	Modbus (+ AIPEX communication)

The ACC bus is for example for AIPEX always parallel in function.

Note:	The ACC bus is always active after the initial program loading. After a change, a system reset is necessary (24 V on/off).

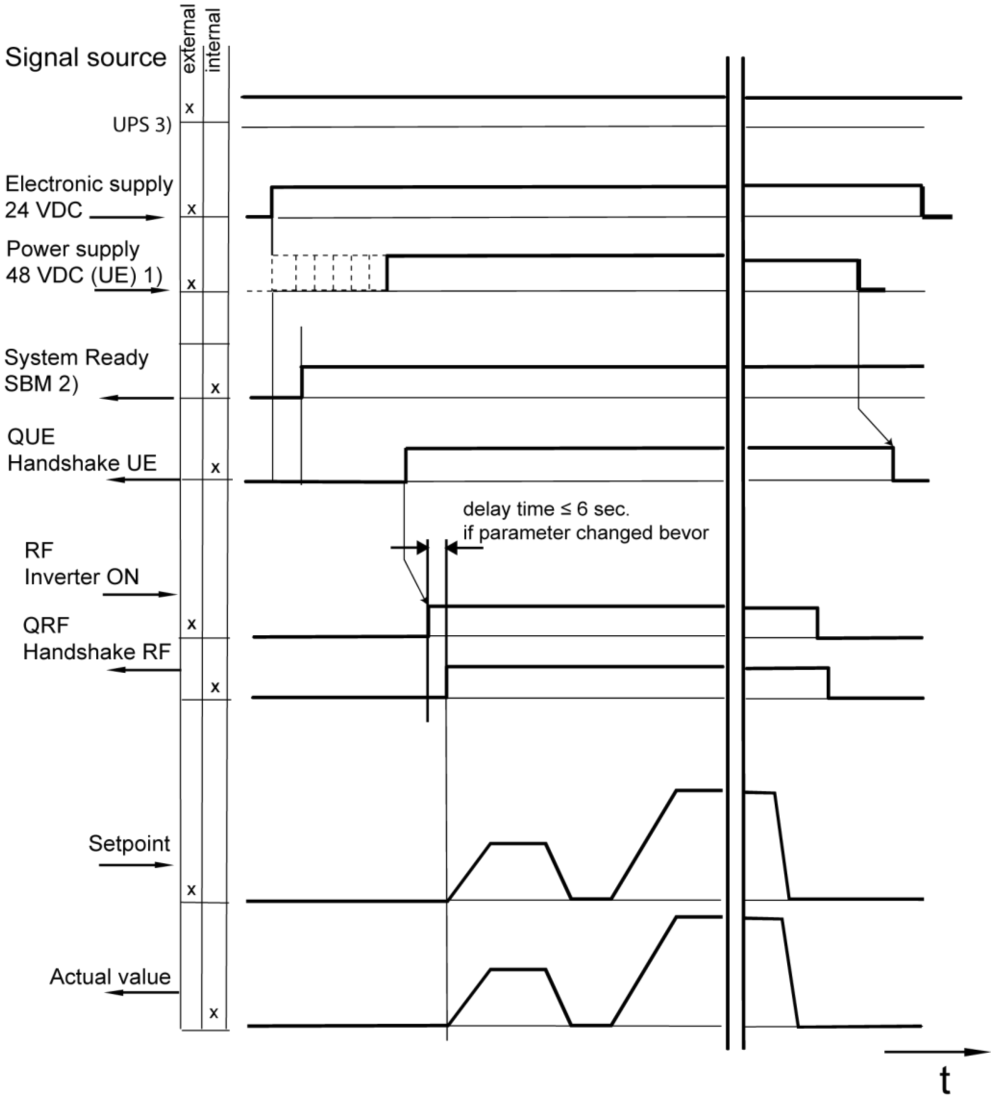
Bit no.	Value	Meaning of the ID34025 BUS mode
0...1	00	**Protocol** Reserved
	01	Modbus RTU
	10	Reserved
	11	Reserved
2	0	**Parity** No Parity
	1	Parity enabled according Bit 3
3	0	**Parity type** Odd parity
	1	Even parity
4	0	**Stop bits** 1 stop bit
	1	2 stop bits
5...7	000	**Data bits** 8 data bits
	001	7 data bits
8..11	0000	**Transmission delay** 0 ms
	…	
	1111	15 ms

The MODBUS baud rate can be configured by the ID34028 BUS output rate in 0.0 kBit.The following baud rates are supported: 1,2 kBit/s; 2,4 kBit/s; 4,8 kBit/s; 9,6 kBit/s; 19,2 kBit/s; 38,4 kBit/s; 57,6 kBit/s; 115,2 kBit/s.

Note: The default value 0.0 kBit/s corresponds to 9.6 kBit/s.

The address in ID34023 “BUS device address” is equally valid for the ACC bus as for MODBUS.

6.2 Switch-on diagram



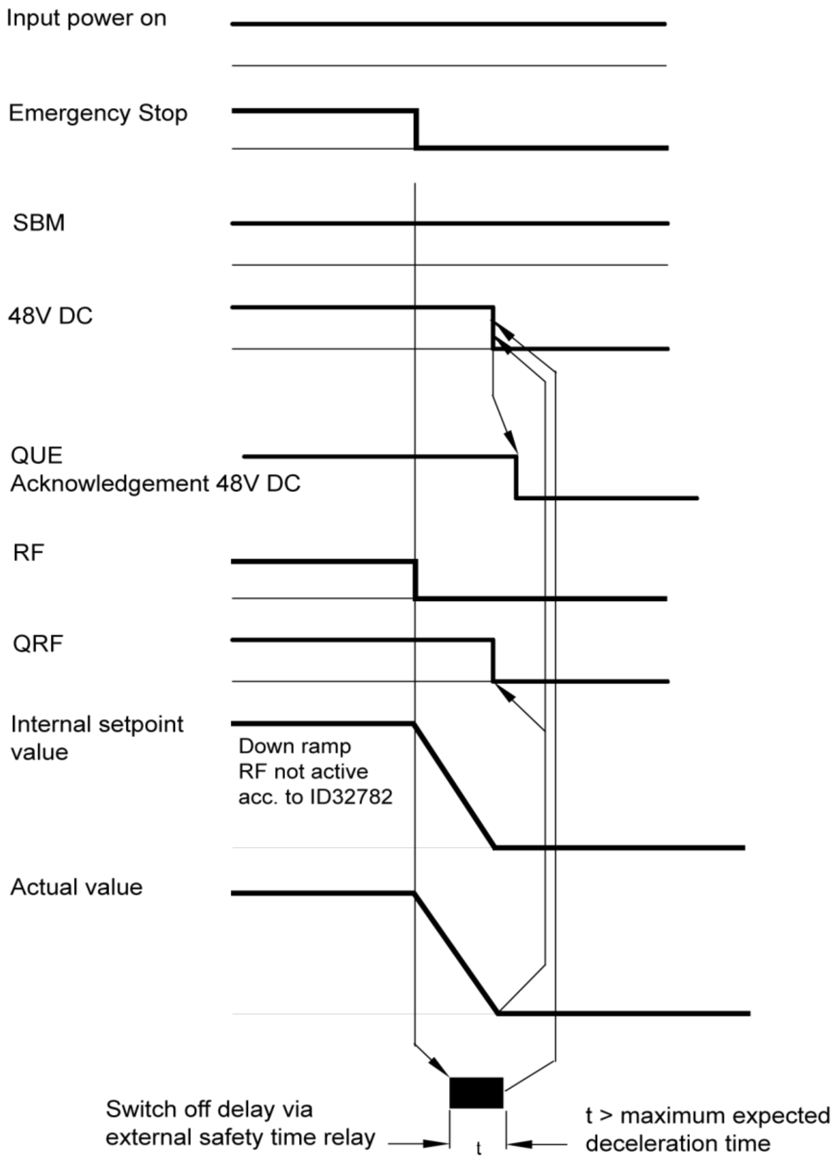
picture name: IDT_EIN_AUS

1)
The line voltage 48 VDC is laid simultaneously, or after the electronic voltage 24 VDC.

2)
The System Ready (SBM=1) signals the fault-free status of the modules. Monitoring this signal needs to be done by the superordinate control.

3)
UPS - uninterruptible power supply
Only with IDTs with multiturn absolute encoder (encoder type C)

6.3 Emergency-off diagram



picture name: IDT_NOTAUS

7 Functionality and commands

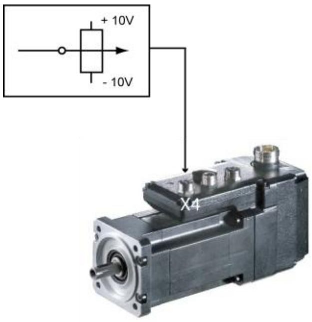
The IDT can be operated in the operating modes torque control, speed regulation, and position control. In the drive commands there is a difference between **cyclic set-point specification** by a control and the call up **internal functions** of the IDT operating system.

The access to internal functions such as

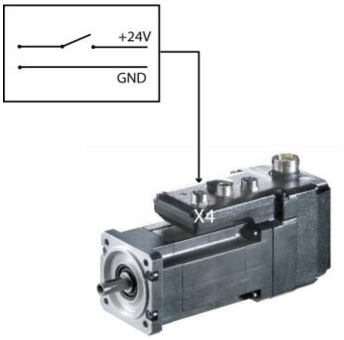
- Reference point run to machine zero point
- Relative and absolute positioning
- Change of operating mode
- Reading the diagnosis number
- reading and writing of parameters…

is done by binary signals or by the AFP protocol.

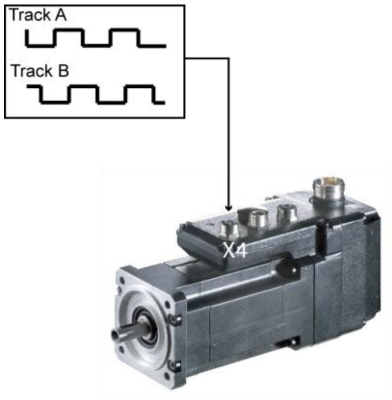
An individual IDT without ACC Bus connection can be operated via the X4 I/O interface by an analogue speed setpoint in the “analogue speed regulation” operating mode or in the step motor mode with a square-wave pulse signal as setpoint in the “position control” operating mode. Alternatively a selected internal function can be started by function assignment at a local binary input.



picture name: IDT_Analoge_Drehzahlregelung



picture name: IDT_Bewegungsfunktion



picture name: IDT_Synchronlauf_Rechteckimpulsgeber

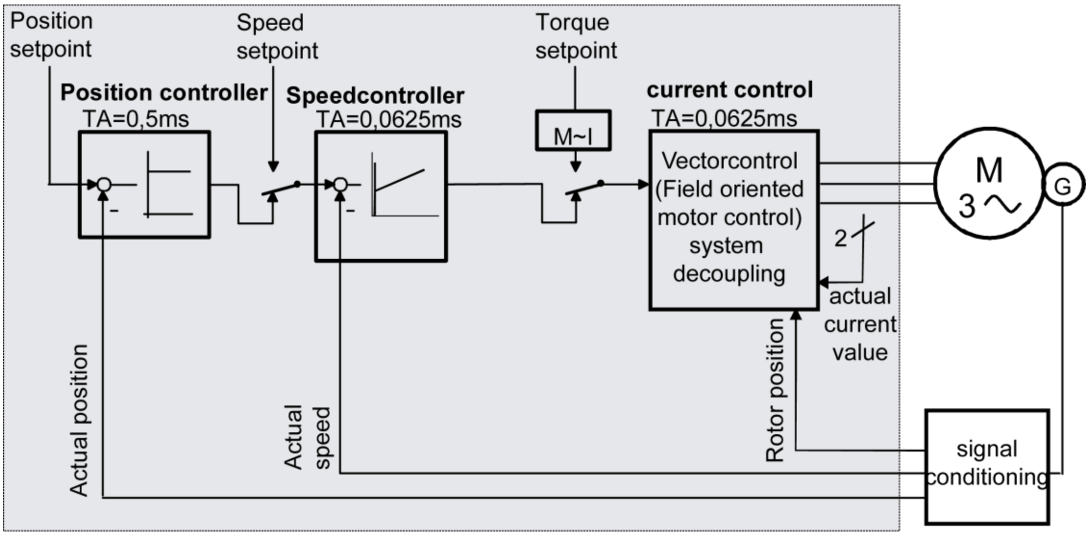
When operating the IDT at the ACC Bus the commands and the set-point specifications are given by the control. Cyclic set-points can be set by the control via the ACC Bus interface and function in dependency of the active operating mode. The ACC Bus transfers cyclic set-points to all participants simultaneously during the ACC Bus cycle time (ID2 SERCOS cycle time) and makes the synchronous operation of all connected drives possible.

The control has access to the internal functions by sending an AFP command over the ACC Bus or starts freely configurable functions in the binary I/O field of the IDT. The EA field contains 8 virtual binary inputs to which parameter functions can be assigned. Over the ACC Bus the drive can access the IDT EA field and start the functions.

For communication between control and IDT over the ACC Bus messages are configured that contain the desired data. The configuration is created in the message configurator in the AIPEX software and transferred in the ACC Bus Master.

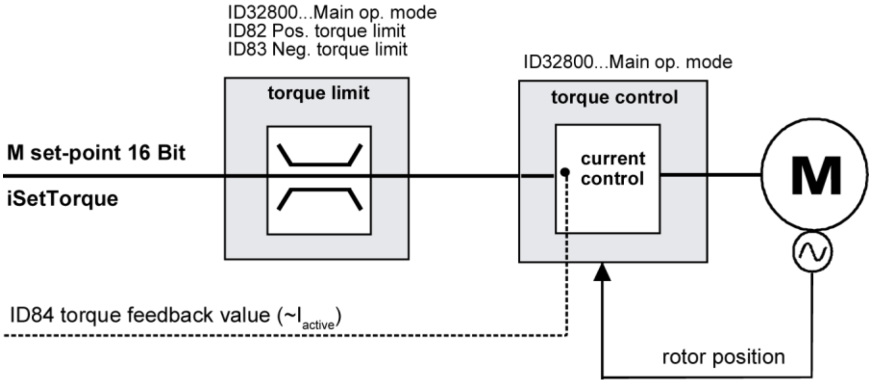
7.1 IDT Regulator structure

The following mappings display the regulating circuit, their scanning periods and the relevant parameters.



picture name: IDT_Reglerstruktur

7.1.1 Torque control

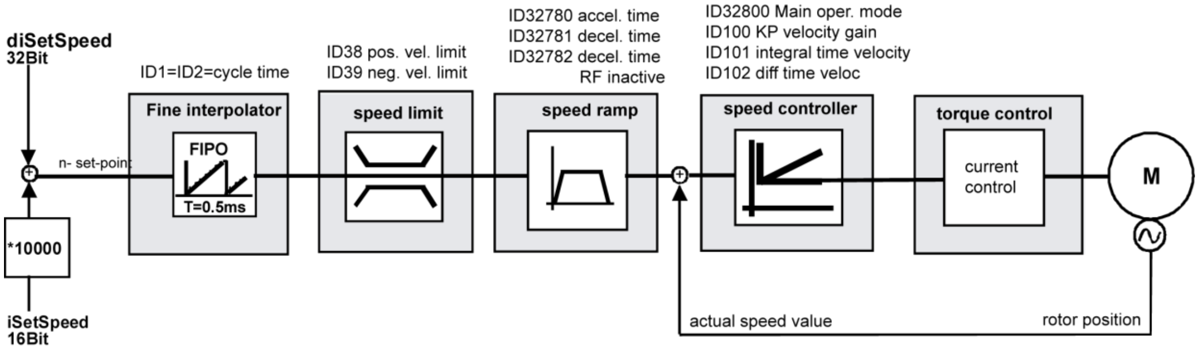


picture name: IDT_swquellenmomentsteuerung_id32800

Set-point and function activation

Setpoint source	Function start	Parameters / Prerequisites
Digital permanent set-point	-Local binary input	ID80 Digital torque set-point Function assignment to Local binary input Binary input field ID32874...ID32881 Message configuration
ACC Bus (Cyclic set-point specification)	Active operating mode torque control	ID32800=3C0002 hex Message configuration for transferring of cyclic torque set-point to IDT: Receiving variable: iSetTorque
ACC Bus (event controlled)	AFP protocol command MOM (code 212)	Message configuration for transferring of the AFP command: Receiving variable IDT ← control: lwAfpWriteBlock Transmit variable IDT → control lwAfpReadBlock

7.1.2 Speed regulation

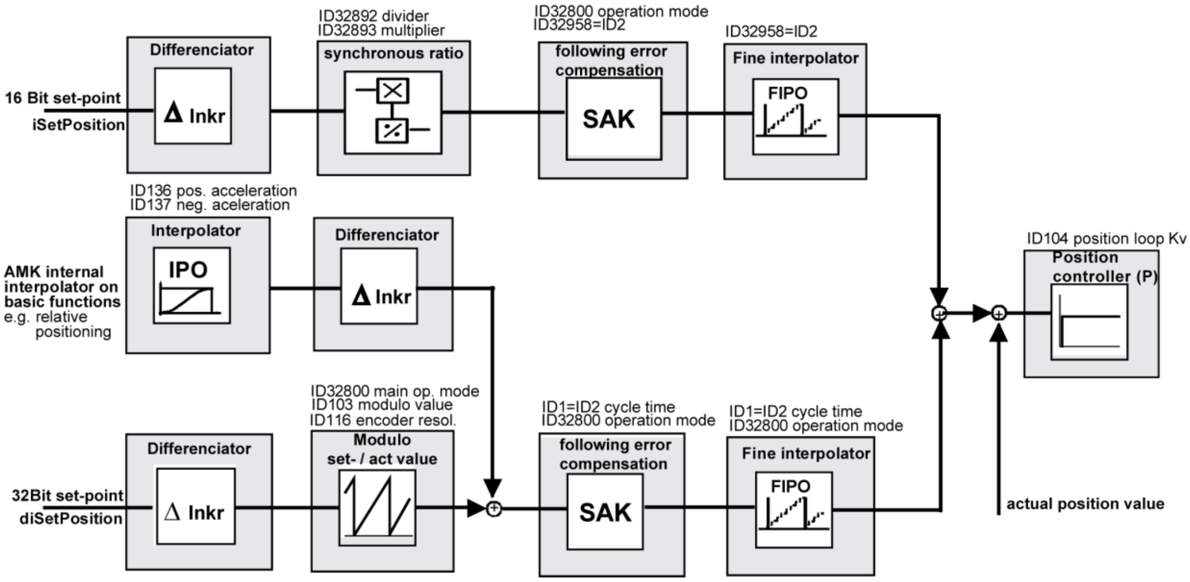


picture name: IDT_swquellendrehzahlreglung_id32800

Set-point and function activation:

Set-point source	Function start	Parameters / Prerequisites
Analogue set-point by connection X04 BE2, BE3	Active operating mode analogue speed regulation	ID32979=33917 hex ID32980=33917 hex ID32800=10043 hex ID32778 speed at 10V ID32779 speed offset
Digital permanent set-point	Local binary input Writing on binary input mapping ID34101 Writng the message variable byInp1Byte0 by ACC Bus	ID36 Digital speed set-point Function assignment to Local binary input Binary input field ID32874...ID32881 AIPEX Message configuration
ACC (Cyclic set-point specification)	Active operating mode speed regulation	ID32800=400043 hex (16 Bit setpoint) ID32800=410043 hex (32 Bit setpoint) Message configuration for transferring of cyclic speed set-points:Receiving variable IDT: diSetSpeed [1/10000rpm] (32 Bit setpoint) or iSetSpeed [rpm] (16 Bit setpoint)
ACC Bus (event controlled)	AFP protocol command DZR (code 213)	Message configuration for transferring of the AFP command: Receiving variable IDT ← control: lwAfpWriteBlock Transmit variable IDT → control lwAfpReadBlock

7.1.3 Position control



picture name: IDT_swquellenlageregelung_id32800

Set-point and function activation:

Setpoint source	Function start	Parameters / Prerequisites
Positioning with IDT internal positioning functions (e.g. relative/absolute positioning, reference point run...)	Local binary input Writing on binary input mapping ID34101 Writing the message variable byInp1Byte0 by ACC Bus	Function assignment to Local binary input Binary input field ID32874...ID32881 AIPEX Message configuration
ACC-Bus (Cyclic setpoint specification)	Active operating mode position control Position control with tracking error compensation	ID32800=400804 hex (16 Bit setpoint) ID32800=410604 hex (32 Bit setpoint) Message configuration for transferring of cyclic position setpoint differences: Receiving variable IDT: diSetPosition [inkr.] (32 Bit setpoint) or iSetPosition [inkr.] (16 Bit setpoint)
ACC Bus (event controlled)	Positioning command by AFP protocol	Message configuration for transferring of the AFP command: Receiving variable IDT ← control: lwAfpWriteBlock Transmit variable IDT → control lwAfpReadBlock

7.1.4 Controller optimisation

The setting and optimisation of the speed and position regulating circuit characteristics is done by the parameters ID100 speed regulation proportional gain K_p, ID101 speed regulation reset time T_N, ID102 speed regulation differentiating time T_d (rate time), and ID104 speed gain K_v

The regulating characteristics need to be adjusted specifically for the application when the motor is installed and under load. For this the motor is given a speed jump e.g. via AIPEX and the jump response is recorded and evaluated.

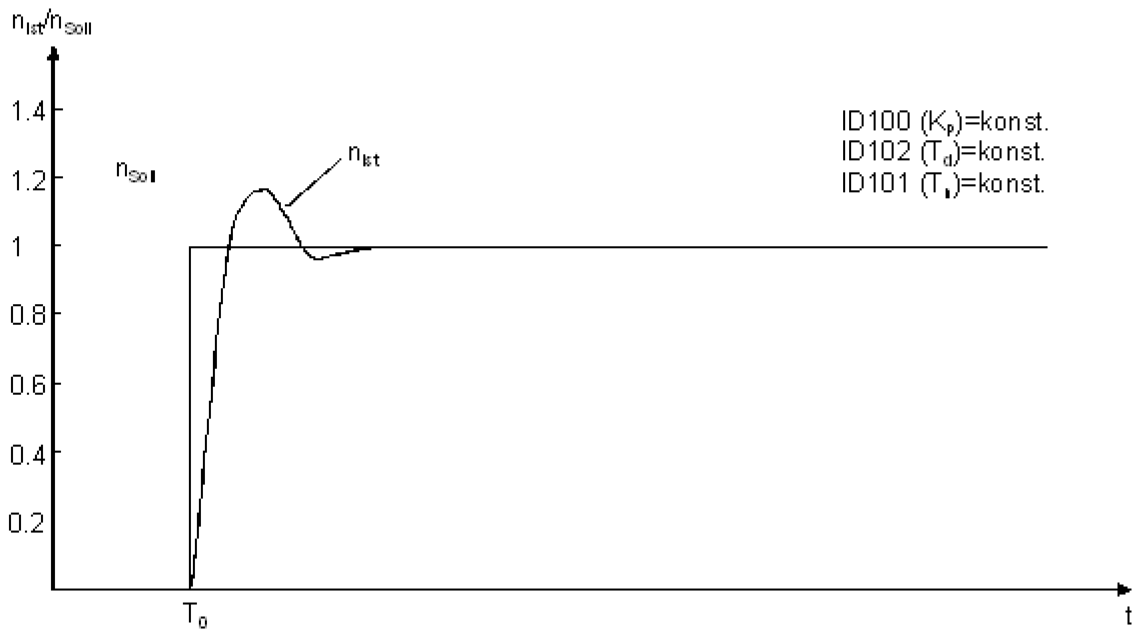
Example: Speed jump by AIPEX

A speed jump should be commanded over AIPEX. This can be made with the start-up function or be released over the parameterisation.

ID32800= 0x3 Main operating mode Speed regulation

ID36 = Speed set point (standard: 5% – 10% n_N) over the **temporary parameter default**

As an alternative the speed jump can be commanded by the control over the ACC Bus. The jump response can be recorded by the AIPEX oscilloscope and be evaluated. For an optimally set PI and PID controller the actual speed may overshoot the set-point jump by no more than 20% as an answer.



picture name: ZCH_IDT_Regler_pid_0201_001

Note: The steps for setting the control parameters ID100, ID101, ID102, and ID104 and the function are explained in the parameter description AMK part no. 201380 in the chapter speed parameters.

7.2 Analogue speed regulation

The analogue set-point is specified by the I/O interface pin 4 and 5. For the analogue speed regulation operating mode the following settings are necessary:

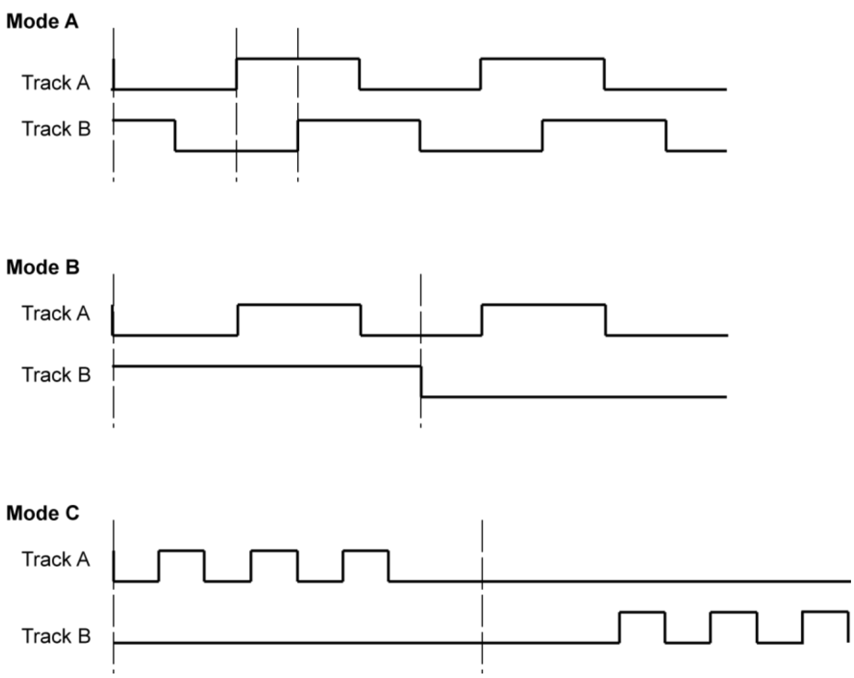
Parameter	Value [hex]	Explanation
ID32800 Main operating mode	10043	Setting the operating mode to analogue speed regulation
ID32979 BE2	33917	BE2 is configured for the set-point “analogue speed”
ID32980 BE3	33917	BE3 is configured for the set-point “analogue speed”
ID32778 Speed at 10V at analogue input		Speed set-point at the motor shaft at 10V at the analogue input
ID32779 Speed offset at analogue input		Compensation of the speed drift of the analogue input in rpm

Note: Analogue speed regulation is the default setting factory-set by AMK.

7.3 Step motor operation

In the step motor operation, the position setpoint for a square-wave pulse signal is specified. The signal option are set in parameter ID32799 “Configuration standard periphery”

Bit- No.	Value (hex)	Meaning according to ID32799
0 - 1	0	**Setting code for squarewave pulses input (X34)** Mode A: 2 squarewave pulses in quadrature (90° offset between track A and B)
	1	Mode B: Counting pulses track A, direction signal track B
	2	Mode C: Forward pulses track A, backward pulses track B
2 - 7		Reserved



picture name: IDT_Parameter_Rechteckimpulssignale

The impulse are indicated over the EA interface X4 PIN 4 and 5. The maximum input frequency is 100 kHz. For the operation mode step motor operation, the following settings are prerequisites:

Parameter	Value [hex]	Meaning
ID32800 Main operating mode	30804	Setting the operation mode position control with tracking error compensation in the 16 Bit channel
ID32979 BE2	33918	BE2 is configured for the setpoint specification “Step motor operation” (track A)
ID32980 BE3	33918	BE2 is configured for the setpoint specification “Step motor operation” (track B)

7.4 Actual position value and reference point run

Depending on the applied encoder type single-turn/multi-turn absolute value encoder, the IDT behaviour differs during a system run-up (e.g. after Net ON) and during the function “reference point run”.

7.4.1 Actual position value after system run up

The IDT is set by the factory in such way so that after a system run up, the actual position value always shows the value Zero (ID32773 Bit 23 = 0). This is independent from the applied encoder type single-turn (Type B) or the multi turn (Type C) absolute value encoder.

By parameterising, the IDT can be set in such way after a system run up, as to indicate the absolute actual position value (ID32773 Bit 23 = 1, only for type C encoder). In order to read a valid absolute value, the C encoder has to be supplied with voltage U_{USV}. On B-and C encoder which are parameterised as B type (ID32953 = 1 hex), the absolute value is displayed within one revolution.

The absolut encoder type C works with 2^{31} increments, that means after 2^{31} increments the counter has an overflow and starts with zero again. ,

7.4.2 Behaviour on the function “reference point run”

The function “reference point run” (e.g. the operation “referencing”), defines the zero point of the IDT actual position value and establishes a track connection to the machine. The function can be set-off over a binary input (see Functions through binary input on page 39) or be set-off by the control ACC-Bus with the AFP protocol (command REF, code 214) (.see AMK fieldbus protocol AFP for drive commands on page 41.)

On multi-turn absolute value encoders (Type C), the absolute value of the encoder is read and displayed as actual position value. The motor does not perform any movement during the reference point run. On B-encoders and C-encoders which are parameterised as B-Type (ID32953=1 hex), the referencing is performed by a motor movement to ID147 “Reference drive-Parameter” and ID32926 “AMK-Reference drive-Parameter”.

Note: The absolute value of an absolute value encoder has to be read during a motor standstill.

7.5 Functions through binary input

Functions can be assigned binary signals. There are local I/Os available at the IDT through which the configured functions can be started. **(Example 1)**

An I/O field with 8 binary inputs in the IDT operating software makes it also possible to call up functions through I/Os regardless of whether binary inputs are physically present or not. The function call is done by a 0 → 1 status change of the respective bit in the parameter of the I/O mapping. The status change is effected by the control by writing the respective bit in the I/O mapping parameter to the value 1, e.g. with the AFP command "Write parameters" code 7. **(Example 2)**

As an alternative the I/O mapping can be written by the message variable "byInp1Byte0" through the ACC Bus. **(Example 3)**

Example 1: Function start through local binary input

The movement function "Relative positioning" should be started by a positive edge at the binary input BE2 (connection X4).

ID-Number	Name	Function code	Binary input	Function	Start function via
32979	Port 3 Bit 1	33714	BE2	Positioning relative	BE2

The setpoints of the functions are defined via parameter:

ID180 Relative spindle position (e.g. 20000 Increments)
ID222 Spindle positioning speed (e.g. 1000 rpm)

Result:

The motor carries out the function "Relative positioning" once with each positive edge at the binary input BE2.

Note: After a system run-up the parameter changes are activated.

Example 2: Function start by ACC Bus by writing of parameters

The functions "Reference point run", "Relative positioning", and "Absolute positioning" are configured on the binary I/O field. The control should call up the functions using the AFP command (write parameter).

The function codes are assigned to the first three parameters of the I/O field.

I/O field IDT
ID32873 =40 Address input port 1

Control of the inputs by writing the parameter ID34101.

ID number	Designation	Function code	Binary inputs	Function	Function call up by
32874	Port 1 Bit 0	33711	E1	Reference point run	ID34101 Bit 0
32875	Port 1 Bit 1	33714	E2	Positioning relative	ID34101 Bit 1
32876	Port 1 Bit 2	33713	E3	Positioning absolute	ID34101 Bit 2
32877	Port 1 Bit 3	0	E4	free	ID34101 Bit 3
32878	Port 1 Bit 4	0	E5	free	ID34101 Bit 4
32879	Port 1 Bit 5	0	E6	free	ID34101 Bit 5
32880	Port 1 Bit 6	0	E7	free	ID34101 Bit 6
32881	Port 1 Bit 7	0	E8	free	ID34101 Bit 7

The set-points of the functions are set by parameters:

ID41 Reference run speed

ID147 Reference run parameter

ID32926 AMK Reference run parameter

ID180 Spindle path additive
ID222 Positioning speed for relative and absolute positioning

ID153 Angle position absolute

Result:
When the control writes the value 1 in the parameter ID34101 bit 0, then the function reference point run is stared. By writing bit 2 = 1 the relative positioning is started and by bit 3 the absolute positioning. With the AFP command WR_DATA (code 7) the control can write in parameters of the IDT.

Note:	After a system run-up the parameter changes are activated.

Note:	During commanding of movement functions through binary inputs the drive switches from the current operating mode to an AMK secondary operating mode. After the function has been carried out the drive remains in the AMK secondary operating mode and can be switched back to the original operating mode by the operating mode change function.

Example 3: Function start by ACC Bus by writing of the message variable byInp1Byte0

The functions “Reference point run”, “Relative positioning”, and “Absolute positioning” should be able to be called by the control by a ACC Bus message. The functions are started as soon as a positive edge has been detected in the message variable byInp1Byte0. The edge can be set either by a control or alternatively by a CAN I/O module. Functions are started by the edge change of the respective bit.

The function codes are assigned to the first three parameters of the I/O field.

I/O field IDT
ID32873 =40 Address input port 1

Control of the inputs by writing of the message variable “byInp1Byte0”.

ID number	Designation	Function code	Binary inputs	Function	Function call by message variable
32874	Port 1 Bit 0	33711	E1	Reference point run	byInp1Byte0 Bit 0
32875	Port 1 Bit 1	33714	E2	Positioning relative	byInp1Byte0 Bit 1
32876	Port 1 Bit 2	33713	E3	Positioning absolute	byInp1Byte0 Bit 2
32877	Port 1 Bit 3	0	E4	free	byInp1Byte0 Bit 3
32878	Port 1 Bit 4	0	E5	free	byInp1Byte0 Bit 4
32879	Port 1 Bit 5	0	E6	free	byInp1Byte0 Bit 5
32880	Port 1 Bit 6	0	E7	free	byInp1Byte0 Bit 6
32881	Port 1 Bit 7	0	E8	free	byInp1Byte0 Bit 7

The set-points of the functions are set by parameters:

ID41	Reference run speed
ID147	Reference run parameter
ID32926	AMK Reference run parameter
ID180	Spindle path additive
ID222	Positioning speed for relative and absolute positioning
ID153	Angle position absolute

Result:
When the control writes the value 1 in the message variable byInp1Byte0 bit 0, then the function reference point run is stared. By writing bit 1 = 1 the relative positioning is started and by bit 2 the absolute positioning. In the message configurator a message needs to be configured for this from the control to the IDT. The message variable byInp1Byte0 has to be configured as receiving variable of the IDT.

Note:	After a system run-up the parameter changes are activated.

Note:	During commanding of movement functions through binary inputs the drive switches from the current operating mode to an AMK secondary operating mode. After the function has been carried out the drive remains in the AMK secondary operating mode and can be switched back to the original operating mode by the operating mode change function.

7.6 AMK fieldbus protocol AFP for drive commands

The AFP protocol makes it possible to command the IDT from a control through the ACC Bus. The protocol consists of 8 bytes control data (from the control to the drive) and 8 bytes status data (from the drive to the control). This data exchange is configures by the AIPEX message configurator and stored in the ACC Bus Master. The AFP protocol is configured as an event-controlled message (transfer type Event) and transferred only during data change.

Variables in the message configurator:
Control data (control → IDT): Receiving variable IDT: lwAfpWriteBlock
Status data (IDT → control): Transmit variables IDT: lwAfpReadBlock

Note: During commanding of movement functions through AFP protocol the drive switches from the current operating mode to an AMK secondary operating mode. After the function has been carried out the drive remains in the AMK secondary operating mode and can be switched back to the original operating mode by the operating mode change function.

Note: For further documentation on AFP commands through an AMK PLC component, refer to AMK documentation PDK_200719_SPS_First-steps_de and PDK_027872_KUKW_AFP_de

7.7 Cyclic set-point specification

Depending on the active operating mode ID32800… the drive is in either torque control, speed regulation, or position control. Set-point specifications by ACC Bus are interpreted by IDT depending on the active operating mode as torque set-point, speed set-point, or position set-point. The set-point specification is done in the ACC cycle time (ID2 Sercos cycle time) and makes possible the cyclically synchronous transfer of set-points to all connected drives.

Cyclic set-points are configured in the AIPEX message configurator as synchronous messages (transfer type SYNC).

Note: For further documentation on cyclic set-point specification through an AMK PLC component, refer to AMK documentation PDK_200719_SPS_First-steps_de.

7.8 Modbus RTU driver

The Modbus driver supports reading and writing of bits and words used for data transfer between the controller and the IDTs. The data contents of the 36 send and receive words are predefined and are used to control and analyse the drive.

7.8.1 Data interface

The following Modbus function codes are supported by the IDT4 with the Modbus option.

Fct code		Explanation	Format
01_{dec}	01_{hex}	Read n bits (output) [1)]	0<n<255
02_{dec}	02_{hex}	Read n bits (input) [1)]	0<n<255
03_{dec}	03_{hex}	Read n words (output) [1)]	0<n<15
04_{dec}	04_{hex}	Read n words (input) [1)]	0<n<15
05_{dec}	05_{hex}	Write 1 bit	0→0000, 1→FF00
06_{dec}	06_{hex}	Write 1 word	
15_{dec}	$0F_{hex}$	Write n bits [2)]	0<n<255
16_{dec}	10_{hex}	Write n words	0<n<15

[1)]
"Input" or "output" refers to the point of view of the controller.

Note:	The superordinate controller has to support the RTU standard. The Modbus timing has to be observed. This means that the Modbus telegram is finished when at least 11 successive bits transmit value 0.

7.8.2 Data contents

The following variables are part of the IDT firmware, and make it possible to control and analyse the IDTs by means of the Modbus RTU protocol.

7.8.2.1 Control data to the IDT

Modbus word	**To IDT**	
	Name	**Explanation/unit**
0	wMode [1)]	**Application-specific ID**
1	wCtrl	**Bus contro** wCtrl.0: Setting the wCtrl.0 bit to 0 →1 gives release clearance for the current data (Modbus word 2 to15) to be read by the IDT. (Edge-controlled)
2	wDeviceCtrlBits	**Control bits** wDeviceCtrlBits.0 = Clear error wDeviceCtrlBits.8 = Inverter ON
3	wInputBits	**Virtual inputs 1 to 7** The inputs are mapped onto the input port 1 (ID32873) address. There ID32874 to ID32881 can be user-defined, to start functions.
4	diSetPosition A	**Set position A** [Incr] → ID34001 Position A
5		
6	diSetPosition B	**Set position B** [Incr] → ID34002 Position B
7		
8	iSetSpeed	**Speed setpoint A+B** [rpm] → ID34011 (Pos. A), ID34012 (Pos. B) Both IDs are assigned the same speed setpoint.
9	iSetTorque	**Torque threshold** [0.1% Mn] → ID126 Mdx torque threshold (for the reference point run function)
10	uiAcceleration	**Acceleration coefficient** [r/s²] → ID136 Positive acceleration
11	uiDecceleration	**Acceleration coefficient** [r/s²] → ID137 Negative acceleration
12	uiKp	**Speed control circuit** [1] → ID100 Speed Regulation - Proportional Gain K_P
13	uiTn	**Speed control circuit** [0.1 ms] → ID101 Speed Regulation - Reset Time T_N
14	uiTv	**Speed control circuit** [0.1 ms] → ID102 Speed Regulation Differentiating Time T_d

Modbus word	To IDT	
	Name	**Explanation/unit**
15	uiKv	**Position control circuit** [1] → ID104 Position loop Kv
16...31		Reserved
32	lwAfpWriteBlock [2)]	**AFP control word** (low byte:**command byte**, high byte:**control byte**
33		**Date 16** (e.g.16 bit setpoint)
34		**Date 32** low word (32 bit setpoint)
35		**Date 32** high word

7.8.2.2 Status data of IDT

Modbus word	From IDT Name	Explanation/unit
0	wMode [1)]	**Application-specific ID**
1	wState	**Bus state** wState.0: Acknowledgement (Modbus word 2 - 15) applied (0 → 1: edge-controlled)
2	wDeviceState	**Status bits** wDeviceState.0 = SBM System ready message wDeviceState.1 = QUE Acknowledgement DC bus enabled wDeviceState.2 = QFL Acknowledgement clear error wDeviceState.4 = WRN Warning wDeviceState.8 = QRF Acknowledgement controller enable
3	wRealTimeBits	**Real-time bit messages** wRealTimeBits.0 = | n_{set} - n_{act} | < n_{Window} (n_{act} = n_{set}), window acc. to ID157 wRealTimeBits.1 = | n_{act} | < n_{min}, zero velocity window ID124 wRealTimeBits.2 = | n_{act} | < n_x, threshold acc.to ID125 wRealTimeBits.3 = | M_{act} | > M_x, threshold acc. to ID126 wRealTimeBits.4 = | M_{act} | > M_{limit}, limits acc. to ID82, ID83 wRealTimeBits.5 = | n_{set} | > | n_{limit} |, limits acc. to ID38, ID39 wRealTimeBits.6 = In Position, window acc. to ID57 wRealTimeBits.7 = | P_{act} | ≥ P_x, threshold acc. to ID158 wRealTimeBits.8 = Negative position limit acc. to ID50 wRealTimeBits.9 = Drive angle synchronous, window acc. to ID228 wRealTimeBits.10 = Drive speed synchronous, windows acc. to ID32952 wRealTimeBits.11 = n_{act} ≥0 wRealTimeBits.12 = Acknowledgement actual value scaled wRealTimeBits.13 = ID32922 residual distance window reset wRealTimeBits.14 = Overcurrent message wRealTimeBits.15 = Positive position limit ID49
4	diActPosition	**Actual position** [Incr]→ ID51 Actual position The actual position of the axis is obtained by reading the variable.
5		
6		Reserved
7		Reserved
8	iActSpeed	**Actual speed** [RPM] Actual speed → ID40 The actual speed of the axis is obtained by reading the variable.
9	iActTorque	**Actual torque** [0.1%Mn] Actual torque → ID84 The actual torque of the axis is obtained by reading the variable.
10		Reserved
11		Reserved
12	wErrorCode	**Diagnostic message** The AMK error number of the axis is transmitted by reading the variable. For a detailed description of the diagnostic messages, refer to the AMK document "PDK_025786_Diagnose".
13…31		Reserved
32	lwAfpReadBlock [2)]	**AFP status word** (low byte: config. Status bits, high byte: Status bits)
33		Date 16 (e.g. 16 bit actual value)

Modbus word	From IDT	
	Name	Explanation/unit
34		Date 32 low word (e.g. 32 bit actual value)
35		Date 32 high word

[1)] wMode defines special application

[2)] Note on the AMK Fieldbus Protocol (AFP):
The following order has to be used when operating the AFP interface:
1. Writeword 33 to 35
2. Writeword 32 Control word (command byte, control byte)

Note: The toggle bit (BTG) in the control word may only be toggled if all the previous data are valid!

With AFP, you have the following options:

- Access to all parameters of the drive system
- Commands
- Diagnostics

Also see the following AFP documentation: PDK_027872_KUKW_AFP_de/en.doc

Note: Note: The superordinate controller has to support the RTU standard. The Modbus timing has to be observed. This means that the Modbus telegram is finished when at least 11 successive bits transmit value 0.

7.9 Modbus Standard Protocol

The **Modbus protocol** is a communication protocol based on a master/slave network.
It is possible to connect several slaves and one master
Modbus RTU (RTU: Remote Terminal Unit) transmits the data in binary form.

RTU mode

In RTU mode, the start of transmission is marked by a transmission pause of at least three digits. The duration of the transmission pause thus is dependent on the transmission speed. The address field consists of eight bits, which represent the receiver address. When the slave answers, it sends this address back to the master, so that the master know where the answer is from. The function field consists of 8 bits. If the slave received the request from the master correctly, it answers with the same function code. If an error occurred, it changes the function code, by setting the highest bit of the function field to 1. The data field contains information on which register the slave should read, and at which address it this register starts. The slave inserts the read data there, to send it to the master. In the event of an error, an error code is transmitted. The field for the check sum, which is determined by CRC, has 16 bits. The end of the message is marked by a transmission pause of at least 1.5 digits.

Start	Address	Function	Data	CRC check	End
Waiting time (at least 3 digits)	8 bit	8 bit	n*8 bit	16 bit	Waiting time (min. 1.5 digits)

7.9.1 Interface description

For each of the following commands, the protocol structure and an example are shown.

7.9.1.1 READ n WORDS (0 < n < 100)

Protocol structure: **MASTER >>>> SLAVE**

SLAVE	FCT	ADH	ADL	NO. OF WORDS	CRCH	CRCL

SLAVE	Slave address
FCT	Function code (03_{hex})
ADH	In hex, start address (high byte)
ADL	In hex, start address (low byte)
NO. OF WORDS	In hex, number of words to be read
CRCH	Check sum (high byte)
CRCL	Check sum (low byte)

Protocol structure: **SLAVE >>>> MASTER**

SLAVE	FCT	NBYTE	DATA	CRCH	CRCL

DATA	Data
NBYTE	Length of the data field

Example:
Read 10 words starting at address 0060_{hex}

MASTER >>>> SLAVE

SLAVE	FCT	ADH	ADL	NO. OF WORDS	CRCH	CRCL
[01]	[03]	[00]	[60]	[00] [0A]	[C5]	[D3]

SLAVE >>>> MASTER

SLAVE	FCT	NBYTE	DATA	CRCH	CRCL
[01]	[03]	[14]	[00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00] [00]	[A3]	[67]

7.9.1.2 WRITE OF n WORDS (1 < n < 100)

Protocol structure: **MASTER >>>> SLAVE**

SLAVE	FCT	ADH	ADL	NO. OF WORDS	NBYTE	DATA	CRCH	CRCL

SLAVE	Slave address
FCT	Function code (10H)
ADH	In hex, start address (high byte)
ADL	In hex, start address (low byte)
NO. OF WORDS	In hex, length of the data to be written, in words
NBYTE	Length of the data to be written, in bytes
DATA	Values to be written
CRCH	Check sum (high byte)
CRCL	Check sum (low byte)

Protocol structure: **SLAVE >>>> MASTER**

SLAVE	FCT	ADH	ADL	NO. OF WORDS	CRCH	CRCL

NO. OF WORDS	Length of WRITTEN data

Example:

Write 1_{hex} to address 2000_{hex}

2_{hex} to address 2001_{hex}

3_{hex} to address 2002_{hex}

MASTER >>>> SLAVE

SLAVE	FCT	ADH	ADL	NO. OF WORDS	NBYTE	DATA	CRCH	CRCL
[01]	[10]	[20]	[00]	[00] [03]	[06]	[00] [01] [00] [02] [00] [03]	[91]	[41]

SLAVE >>>> MASTER

SLAVE	FCT	ADH	ADL	NO. OF WORDS	CRCH	CRCL
[01]	[10]	[20]	[00]	[03]	[8B]	[C8]

7.9.1.3 READ DI n BITS (0 < n < 255)

Protocol structure: **MASTER >>>> SLAVE**

SLAVE	FCT	ADH	ADL	NO. OF BITS	CRCH	CRCL

SLAVE	Slave address
FCT	Function code (01H)
ADH	In hex, start address (high byte)
ADL	In hex, start address (low byte)
NO. OF BITS	In hex, number of bits to be read
CRCH	Check sum (high byte)
CRCL	Check sum (low byte)

Protocol structure: **SLAVE >>>> MASTER**

SLAVE	FCT	NBYTE	DATA	CRCH	CRCL

DATA	Values with the mapping Bit7…Bit0; Bit15…Bit8
NBYTE	Length of the data field

Example:

Read 16 bits, starting at address 0

MASTER >>>> SLAVE

SLAVE	FCT	ADH	ADL	NO. OF BITS	CRCH	CRCL
[01]	[01]	[00]	[00]	[00] [10]	[3D]	[C6]

SLAVE >>>> MASTER

SLAVE	FCT	NBYTE	DATA	CRCH	CRCL
[01]	[01]	[02]	[00] [00]	[B9]	[FC]

7.9.1.4 WRITE OF 1 BIT

Protocol structure: **MASTER >>>> SLAVE**

SLAVE	FCT	ADH	ADL	DATA	DATA	CRCH	CRCL

SLAVE	Slave address
FCT	Function code (05H)
ADH	In hex, start address (high byte)
ADL	In hex, start address (low byte)
DATA	Value Bit = 0 → [00] [00] Bit = 1 → [FF] [00]
CRCH	Check sum (high byte)
CRCL	Check sum (low byte)

Protocol structure: **SLAVE >>>> MASTER**

SLAVE	FCT	ADH	ADL	DATA	DATA	CRCH	CRCL

Example:

Write 1 bit to address 2000_{hex}

MASTER >>>> SLAVE

SLAVE	FCT	ADH	ADL	DATA	DATA	CRCH	CRCL
[01]	[05]	[20]	[00]	[FF]	[00]	[87]	[FA]

SLAVE >>>> MASTER

SLAVE	FCT	ADH	ADL	DATA	DATA	CRCH	CRCL
[01]	[05]	[20]	[00]	[FF]	[00]	[87]	[FA]

7.9.1.5 ERROR CODES

Each slave can return an answer with an error code (ERR).
In the event of an error, the function code (FCT) + 80_{hex} is returned.
Example: FCT = 01_{hex} Message in the event of an error: 81_{hex}.

Protocol structure: **Slave >>>> Master**

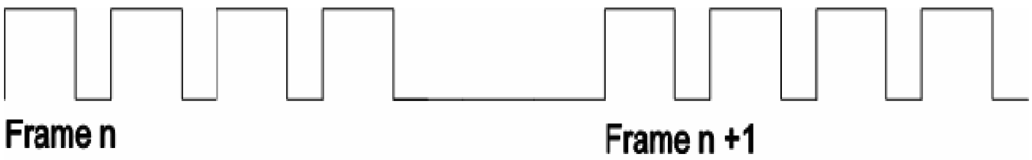
SLAVE	FCT + 0x80	ERR	CRCH	CRCL

Error codes
01 = unknown error code
02 = address error
03 = data error

Check sum calculation for Modbus (CRC16)

```
unsigned short CalcCrc(unsigned char *p, unsigned short len) {
 auto unsigned short Checksum=0xffff; // Return value
 auto unsigned short CRC;
 auto unsigned short i,n; // Counter
 for(n=0;n<len;n++){ // Loop across all bytes
 Checksum^=p[n];
 for(i=0;i<8;i++) { // Loop across 8 bit = 1 byte
 CRC=Checksum;
 Checksum>>=1
 if((CRC&1)!=0) {
 Checksum^=0x0A001;
     }
   }
  }
 return(Checksum);
}
```

7.9.2 Modbus timing



picture name: ZCH_IDT_Modbus_timing

The time between two digits has to be shorter than 1ms (at 9600 Baud) in each frame.

The pause between two digits always has to be shorter than the time required for one digit. (Independent of the transmission rate)

The time between two frames has to be a multiple of the time required for one digit. (Independent of the transmission rate)

7.9.3 Programming examples

The ulSetPositionA (set position A) variable has to be written to Modbus word 4 and 5.
[01] [10] [00] [04] [00] [01] [02] [POS] [POS] [POS] [POS] [CRC] [CRC]
The firmware takes the values from the Modbus words and writes them to ID34001 as soon as the wCtrl.0 bit has been set (edge-controlled).
Program structure for transmitting Modbus words 2-14 to a slave with address 1. The following values have to be transmitted:

Inverter ON
Set position A = 100000 incr.
Set position B = 0 incr.
Speed setpoint = 1000 rpm
Set torque = 50%
Positive acceleration = 100
Negative acceleration = 100
Kp = 50
Tn = 5
Tv = 0

```
send_buf[0] = 0x01; // Address (slave address 1)
send_buf[1] = 0x10; // Function (0x10 = write n words)
send_buf[2] = 0x00; // Starting address hi
send_buf[3] = 0x02; // Starting address lo
send_buf[4] = 0x00; // No of words hi (0x000D = 13 words = word 3->15)
send_buf[5] = 0x0D; // No of words lo
send_buf[6] = 0x1A; // Byte count (0x1A = 26)
send_buf[7] = 0x01; // wDeviceCtrlBits (0x0100 = bit 8 = enable controller)
send_buf[8] = 0x00; // wDeviceCtrlBits
send_buf[9] = 0x00; // wInputBits (Virtual inputs)
send_buf[10] = 0x00; // wInputBits
send_buf[11] = 0x00; // diSetPosition A (0x000186A0 = 100000)
send_buf[12] = 0x01; // diSetPosition A
send_buf[13] = 0x86; // diSetPosition A
send_buf[14] = 0xA0; // diSetPosition A
send_buf[15] = 0x00; // diSetPosition B (0x00000000 = 0)
send_buf[16] = 0x00; // diSetPosition B
send_buf[17] = 0x00; // diSetPosition B
send_buf[18] = 0x00; // diSetPosition B
send_buf[19] = 0x03; // iSetSpeed (RPM) (0x03E8 = 1000 rpm)
send_buf[20] = 0xE8; // iSetSpeed
send_buf[21] = 0x01; // iSetTorque (0x01F4 = 500 [0.1%])
send_buf[22] = 0xF4; // iSetTorque
send_buf[23] = 0x27; // uiSetAcceleration (0x2710 = 100)
send_buf[24] = 0x10; // uiSetAcceleration
send_buf[25] = 0x27; // uiSetDecceleration (0x2710 = 100)
send_buf[26] = 0x10; // uiSetDecceleration
send_buf[27] = 0x00; // uiKp (0x0032 = 50)
send_buf[28] = 0x32; // uiKp
send_buf[29] = 0x00; // uiTn (0x0032 = 50 [0.1ms])
send_buf[30] = 0x32; // uiTn
send_buf[31] = 0x00; // uiTv
send_buf[32] = 0x00; // uiTv
send_buf[33] = CRC
send_buf[34] = CRC
```

The data is transmitted as soon as the wCtrl.0 bit (edge-controlled) has been set.
The positioning is started via a binary input, which is parameterised using code 33881.

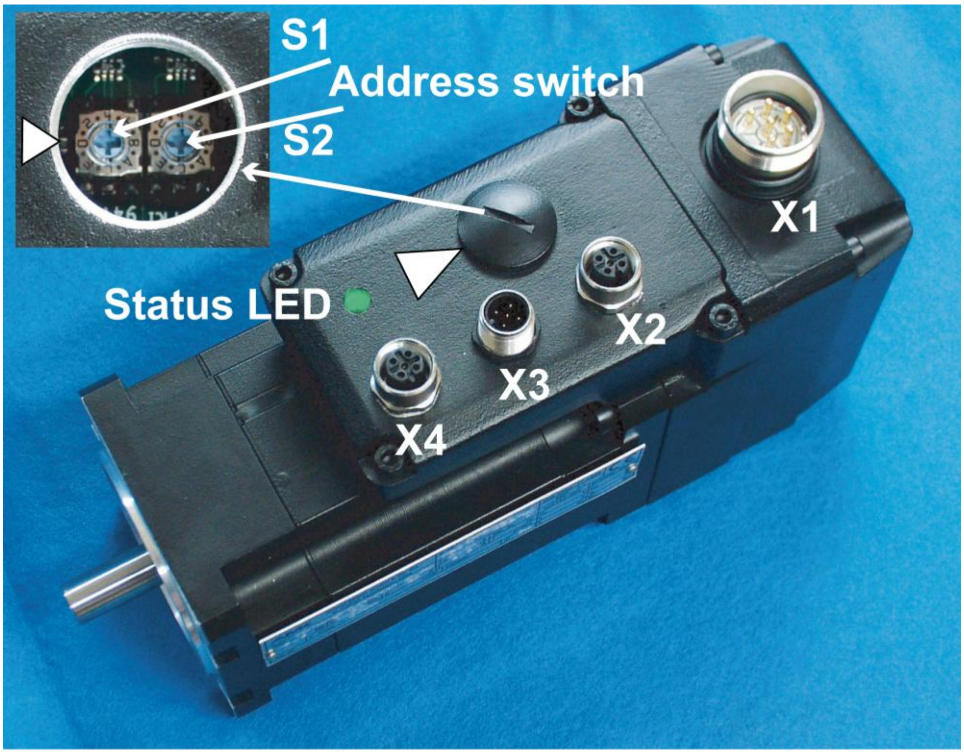
8 Transport, storage, maintenance, disposal

- Transport and storage must be done in the original packaging. Use shock absorbing surfaces.
- The devices need to be protected against condensation. Storage at a clean, dry location, protected against environmental influences. Avoid sudden changes in temperature and humidity. Ensure protection against salt fog, industrial fumes, corroding liquids, vermin, and mildew. Storage conditions according to EN 61800-2 for the duration of up to 1 year, maximum elevation 2000 metres.
- Ambient temperatures during transport and storage: -25 to +75°C.
- relative humidity: max. 95%, non-condensing.
- The devices require no maintenance.
- If necessary, clean the surfaces with a dust cloth and a cloth slightly moistened with neutral detergent. Do not use aerosols. Too much dirt, dust, or shavings can influence the motor negatively and cause it to malfunction in extreme cases. The motor casing serves to radiate the heat during operation. Insufficient heat radiation reduces the bearing service life and can lead to excess temperature shut-outs.
- Motor bearings should be replaced when the nominal bearing service life has been reached (40000h) or if running noises become audible. We recommend having the bearings replaced by AMK.
- Connections and cables need to be checked regularly for damages and be replaced if necessary.
- The devices have to be disposed of by certified recycling companies for electronics devices or separate the main components by electronics circuit boards, plastics, ferrous material (casing, screws, etc.), aluminium, copper, and disposing of through recycling firms.

9 Factory setting

Note: After „initial loading“ the IDT will be restored to factory setting. All the customer specific data’s will be deleted.

Steps	Meaning
S1 = F, S2 = 0	Switch the address switches to F0h to activate the function „initial loading“
Supply voltage 24V DC "AN"	Switch on the supply voltage
Status LED = AUS	“Initial loading” is active
Status LED = AN, colour "RED"	“Initial loading” finished
S1 = ?, S2 = ?	S1 = 0, S2 = 0, the station address will be taken from the ID 34023n. Default = address 2 S1 or S2 ≠ 0, the address can be set in HEX through the user
Supply voltage 24V DC "OFF"	Activation of the default parameter set
Supply voltage 24V DC "AN"	
Status LED = AN, colour "GREEN "	Parameterize the drive



picture name: ZCH_IDT_Anschlüsse

10 Appendix

10.1 List of the AFP commands

The following AFP commands are available.

Note: The commanding is described in detail in the documentation “AMK Fieldbus protocol AFP” (AMK-Order number: 27872).

Command	Code	Designation
B_NULL	0	Reset
B_BREAK	1	Abortion of a command
B_CLRERR	4	Delete error
B_RDERR	5	Read error number
B_RDDATA	6	Read ID
B_WRDATA	7	Write ID
B_RDBLK	8	Read ID list
B_WRBLK	9	write ID list
B_TMP	11	Write ID temporarily
B_ANZ	12	Actualization of actual messages
B_SWQ1	20	16 Bit setpoint source (only in position control)
B_SWQ2	21	32 Bit setpoint source (setpoint according to operation mode ID32800)
B_RDSOFT	25	Read Software version
B_RDIO	26	Read IO
B_WRIO	27	Write IO
B_RDTMP	28	Read ID temporarily
B_SYSHL	198	System booting
B_BAW0	200	Operating mode change to main operation mode 0
B_BAW1	201	Operating mode change to secondary operation mode 1
B_BAW2	202	Operating mode change to secondary operation mode 2
B_BAW3	203	Operating mode change to secondary operation mode 3
B_BAW4	204	Operating mode change to secondary operation mode 4
B_BAW5	205	Operating mode change to secondary operation mode 5
B_MOM	212	Torque control
B_DZR	213	Speed control
B_REFF	214	Homing cycle
B_POSA	216	absolute positioning
B_POSR	217	relative positioning
B_STOP	220	Drive Stop
B_Mess_START	225	Calliper start

Command	Code	Designation
B_MESS_STOP	226	Calliper stop

11 Further documentation

- IDT parameter description (Part-No. 201380)
- IDT Distribution box (Part-No. 201446)
- IDT braking chopper (Part-No. 201198)
- IDT Power supply (Part-No.)
- AMK Fieldbus protocol AFP (Part-No. 27872)
- Application interface API (Part-No. 200335)
- Diagnosis messages (Part-No. 25786)
- Tutorial – First steps (Part-No. 200719)
- AMK commissioning and parameter setting explorer AIPEX

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