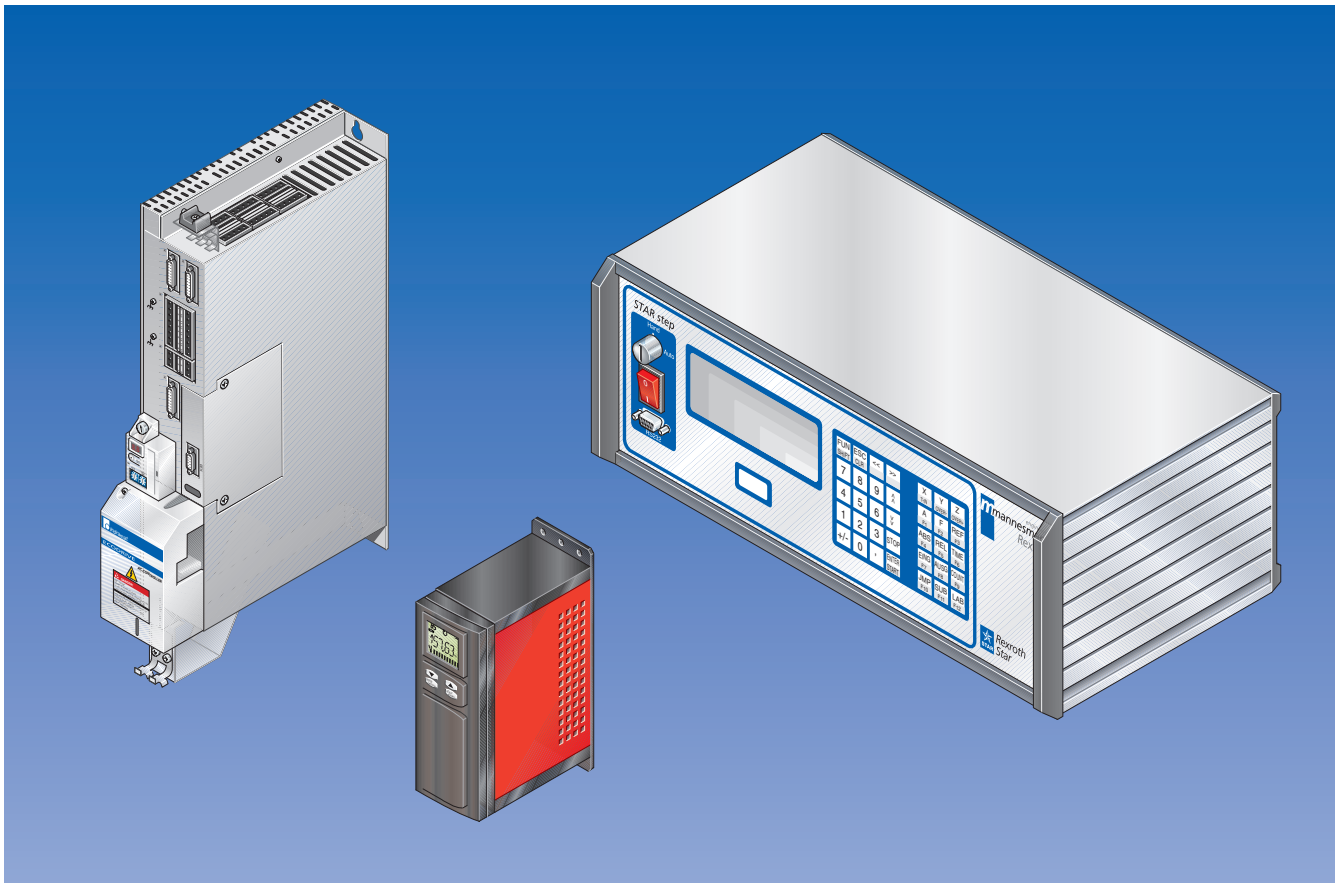
engineering
mannesmann
Rexroth



Controllers, Motors
Electrical Accessories

Back to Overview

RE 82 701/10.99

Rexroth
STAR Star

STAR Linear Motion Technology

Ball Rail Systems	Standard Ball Rail Systems Ball Rail Systems with Aluminum Runner Blocks Super Ball Rail Systems Wide Ball Rail Systems Miniature Ball Rail Systems Cam Roller Guides Accessories
Roller Rail Systems	
Linear Bushings and Shafts	Linear Bushings Linear Sets Shafts Shaft Support Rails Shaft Support Blocks Ball Transfer Units
Ball Screw Drives	
Linear Motion Systems	Linear Motion Slides Linear Modules Compact Modules Ball Rail Tables Linear Actuators ALU-STAR Profile System **Controllers, Motors, Electrical Accessories**

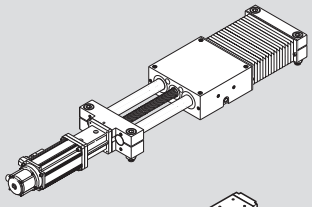
Rexroth Star GmbH
D-97419 Schweinfurt

REG. No. 1617 - 03

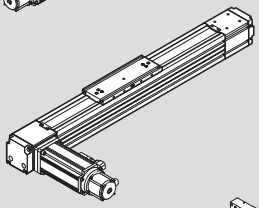
Controllers
Motors, Electrical Accessories

Drive Controls and Controllers
From the Linear System Through to the Complete Solution

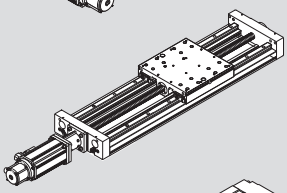
Linear Motion Systems with Motor Drives



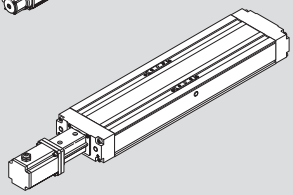
Linear Motion Slides



Linear Modules

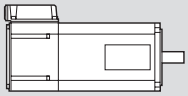


Ball Rail Tables



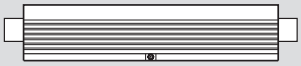
Compact Modules

Digital AC servomotor

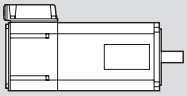


MKD
MHD

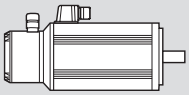
LSF



LD

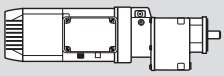


MKD



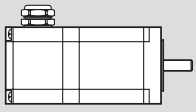
MDD

Three-phase motor



DFV

3-phase stepping motor



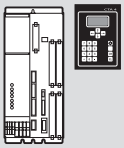
VRDM3

Motor calculations

The Complete Solution

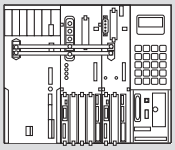
DKC

Digital controller
The low-cost solution for single-axis and multi-axis systems



DKS

Digital positioning module and DLC controls
The universal solution for one axis



DDS

Digital controllers and CLM analog positioning module
The convenient solution for multi-axis systems

VF1000S

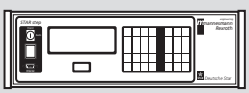
Frequency inverter
The convenient solution for driving three-phase asynchronous motors

WD3

Power output section
for control cabinet installation

PC

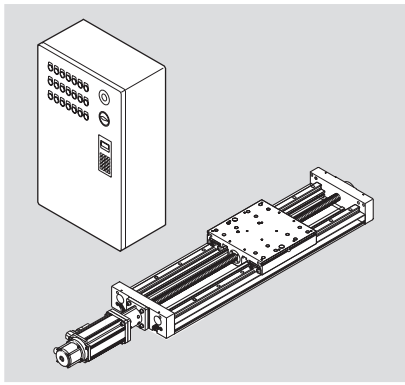
PC controller board
Stepping motor controller

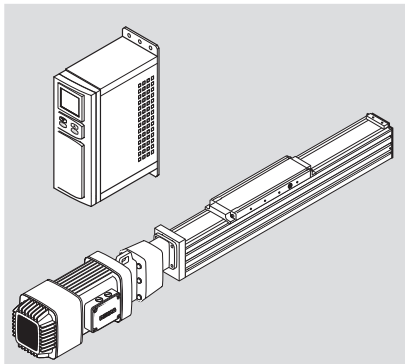


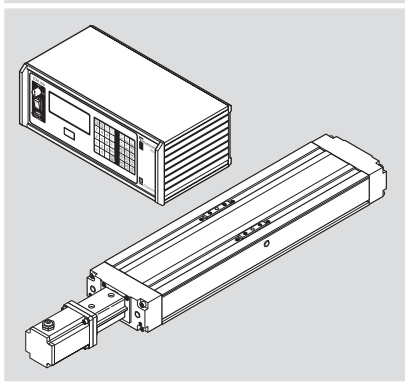
STAR step

Single-axis and multi-axis positioning controls with power output section
The complete solution

$$M_{eff} = \sqrt{\frac{(M_{Breq} + M_{tot})^2 \cdot t_{Breq} \cdot 2 + M_{tot}^2 \cdot t_{const} + M_{tot}^2 \cdot t_p}{t_{cycle} + t_p}}$$







DKC Digital Controller
Product Overview

The DKC intelligent digital controller is the low-cost solution with high functionality for single-axis and multi-axis drive and control applications. The DKC offers decisive competitive advantages in almost all areas of automation in which linear or rotary movements need to be automated and require a power rating of up to 10 kW.

The DKC as a digital automation drive:

Flexible configuration with different interfaces:

DKC 11.* / DKC 01.*
- **analog interface**
- **with stepping motor interface**
- **with positioning interface for 64 storable positions**

DKC 02.*
- **with SERCOS interface**

DKC 03.*
- **with Profibus-DP interface for 64 storable positions**

DKC 04.*
- **with Interbus interface for 64 storable positions**

DKC 05.*
- **with CANopen interface for 64 storable positions**

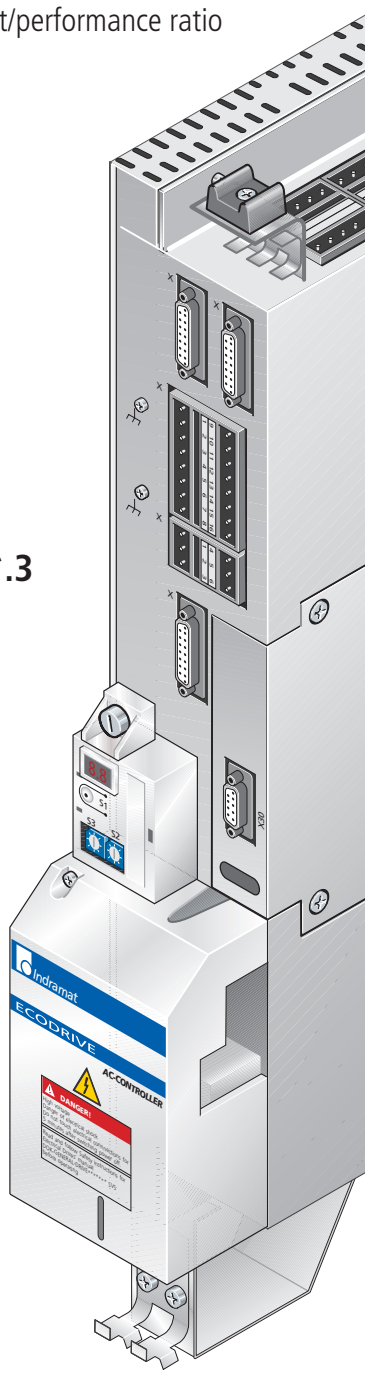
The matched combinations of the DKC compact controller and MKD maintenance-free AC servomotors with resolver feedback offer decided benefits.

Universal use.

In addition to many other fields of application, the DKC is ideally suited for the following tasks:

- Machining
- Transporting
- Positioning
- Palettizing

Optimum cost/performance ratio



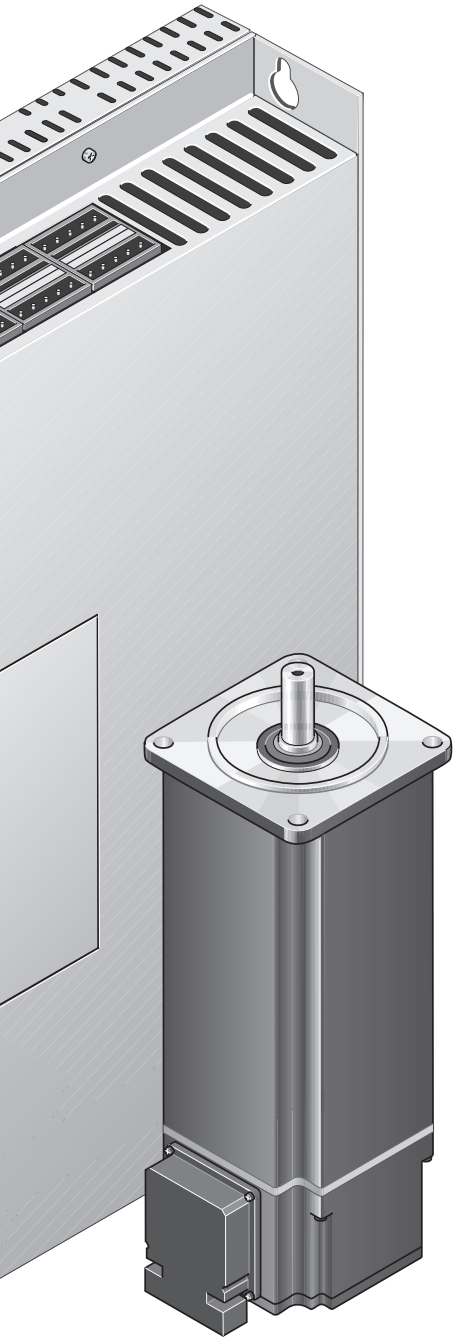
DKC.3**

Programming module with status and diagnosis display

Low power dissipation

Direct mains connection

▶ Built-in holding brake control



▶ Software travel limitation

▶ Incremental or absolute position actual value output

▶ External reset possible

▶ Maintenance-free synchronous motors

▶ Enhanced operational reliability

▶ Fast dynamic response

MKD

▶ Automatic controller optimization

▶ Simple start-up

DKC Digital Controllers
Advantages

Direct mains connection

Controller DKC	Voltage (V) AC
01.1-030-3	1-phase 230 ± 10%
**.1-040-7	3-phase 380 - 480 ± 10%
.3-*-*	1- or 3-phase 200 - 480 ± 10%

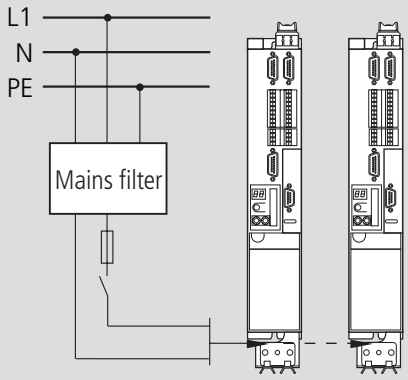
Several controllers can be connected in parallel to the respective mains through a single power contactor.

* applies to all available models

DKC **.1-030-3
DKC **.3-040-7
DKC **.*-100-7

Single-phase direct mains connection via mains filter to 230 V

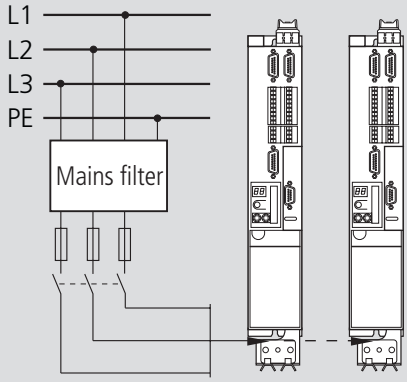
For power ratings up to 1.1 kW, the controllers can be directly connected to single-phase mains supplies.



DKC **.*-040-7
DKC **.*-100-7

Three-phase direct mains connection via mains filter to 380 V - 480 V

For power ratings up to 10 kW, the controllers can be directly connected to three-phase mains supplies.



Economical

Digital control concept

Drive parametrization, control, monitoring, and diagnostics are all carried out digitally.

Simple start-up

The start-up procedure is greatly simplified by the user-friendly DRIVE-TOP start-up and diagnostics program, which can be run under Windows™ on a PC.

Lower overall costs

This is achieved by eliminating the need for additional position sensors and providing for simple assembly and installation.

Incremental or absolute position actual value output

Homing cycles no longer required due to standard use of MKD motors with multi-turn resolver feedback.

Automatic parameter adjustment

Parameters adjusted automatically due to intelligent motor feedback to the controller.

Low power dissipation

Reduced power consumption due to IGBT power output stages.

Fast dynamic response

Provided by favorable torque to moment of inertia ratio.

Status and Diagnostics Display

Direct output of all messages through a two-digit, seven-segment display.

Maintenance-free synchronous motors

Compact, maintenance-free MKD synchronous motors available in various versions, equipped with a holding brake and multi-turn resolver feedback.

Easily integrated

Multiple application functionality

The digital controllers can be supplied with the following interfaces:

- Analog interface for speed and torque loops.
- Stepping motor interface for stepping motor drive functions.
- Positioning interface for position control with 64 storable positions.
- SERCOS interface for full utilization of digital drive technology.

Safe

Built-in holding brake control

The holding brake is directly controlled by the controller.

Software travel limit switches

These enhance the level of safety.

Enhanced operational reliability

Provided by maintenance-free synchronous motors with temperature monitoring and IP65 motor protection.

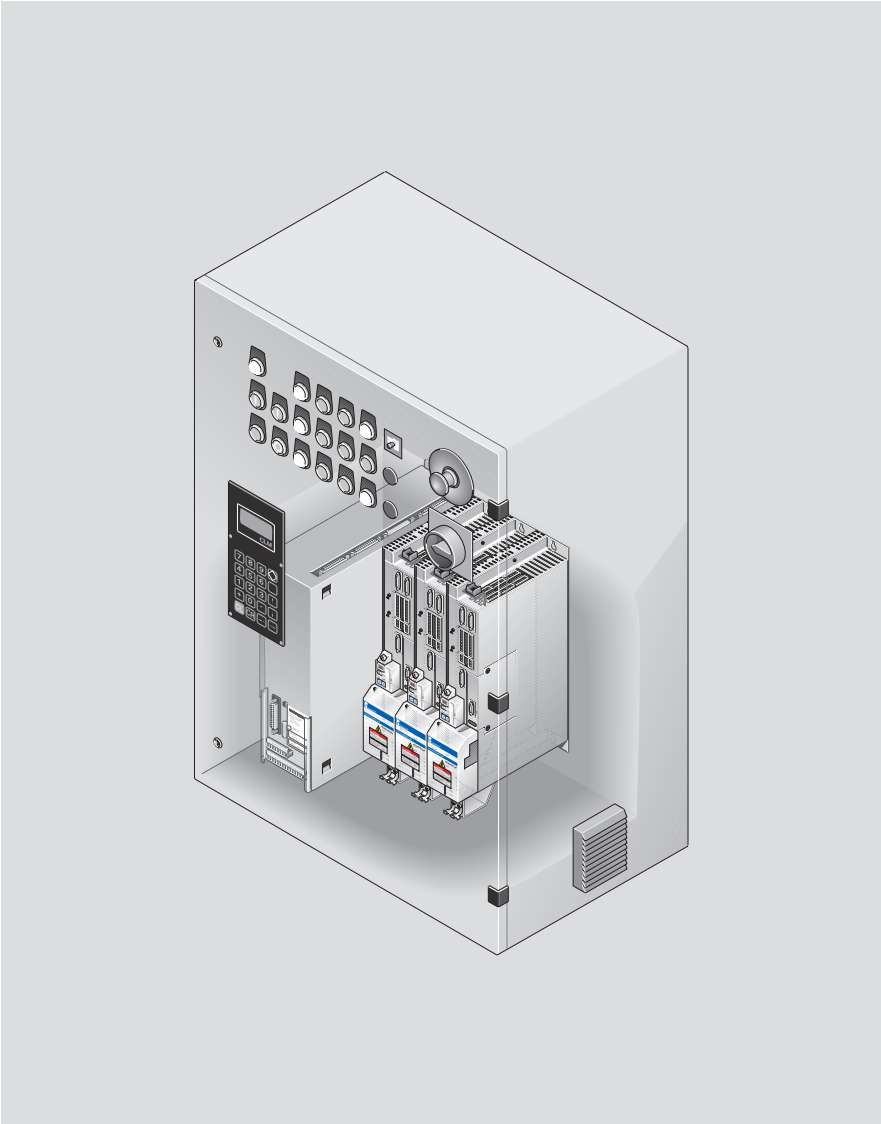
Programming module with status and diagnosis display

For start-up, rapid diagnostics and re-start without additional equipment after controller replacement.

Completely wired up in the control cabinet with the CLM controls

Available as a positioning unit completely wired in the control cabinet, with circuit diagram and documentation.

- Triple-lock power switch
- E-STOP mushroom-head pushbutton
- Signal lamps for power on, setup/ automatic mode, malfunction.
- Pushbutton for start/stop, axis forward/ backward, release brake
- Selector switch for setup/automatic mode
- Key switch for parameter input
- Inputs/outputs wired to terminal side
- Keyboard for CLM positioning controls installed in the control cabinet door



Further options on request:

- External control desk
- Additional instrumentation
- Installation of additional control and display elements
- Installation of decade switches
- Wiring on mounting board for installation in existing control cabinets
- Programming to customer specifications
- Additional operating/control terminal

Special configurations on request:

- Control cabinet with DKC and PLC
- Control cabinet with DKC and Siemens "Logo-Uhr" (low-cost PLC)
- Control cabinet with DKC and reversing contactor circuitry
- Control cabinet with DKC and controls to customer requirements

Details of the CLM controls can be found in the section entitled "DDS Digital Controller with CLM Analog Positioning Module".

Digital Controller DKC 11 / DKC 01
Interfaces

DKC 11 / DKC 01

Analog Interface

In this operating mode, the drive system is adapted to conventional NC controllers and works with ±10 V analog speed command values.

Position actual values without additional expense

The controller transmits the current rotor position to the NC controller as a position actual value. No separate position encoders and encoder cables are needed for indirect position control.

Incremental or absolute position actual values

The position actual values can be output either as incremental or absolute values.

Direct linear displacement measuring system

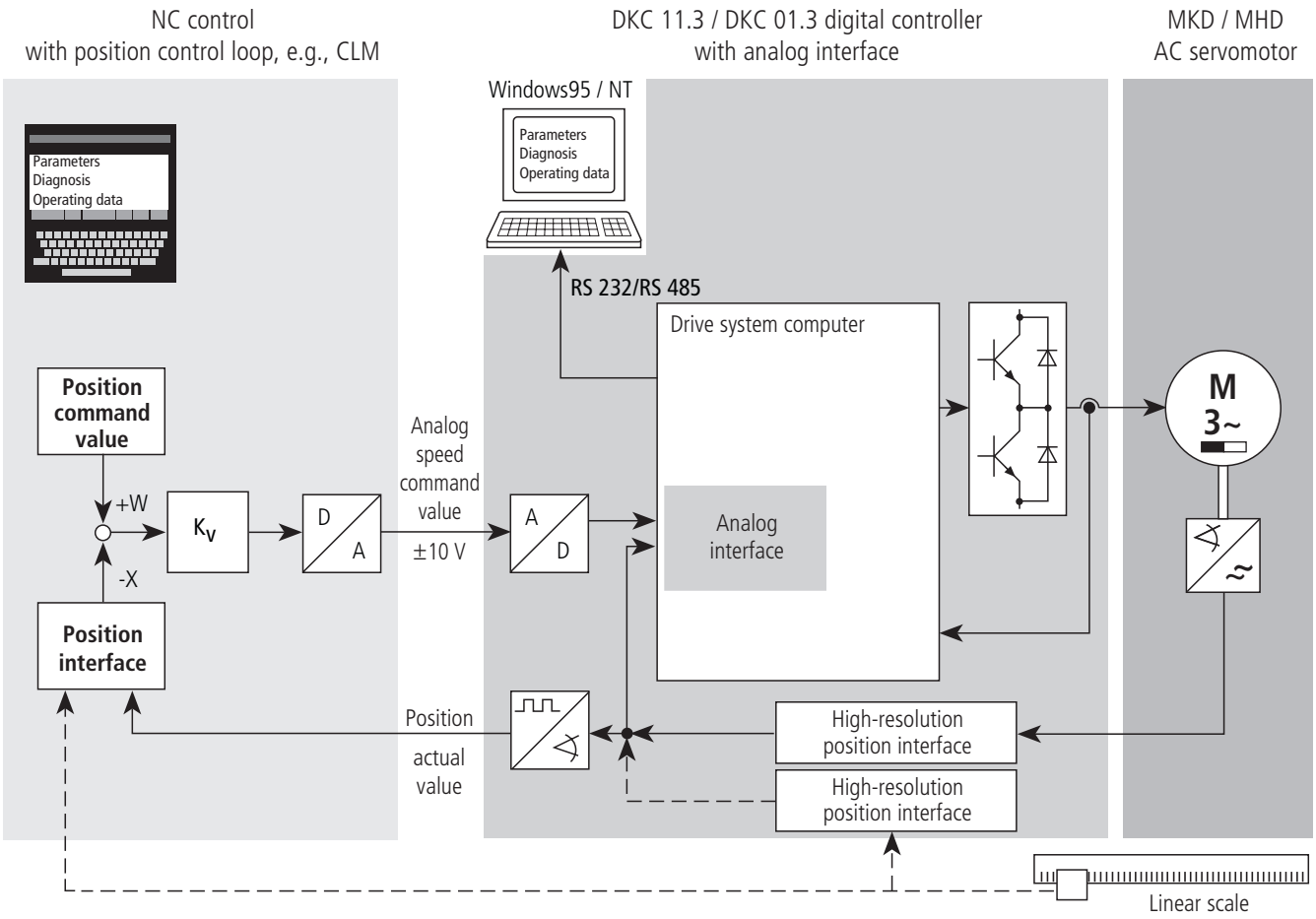
A direct linear displacement measuring system (e.g., magnetic or optical scale) can be connected up to the DKC **.3 controller, thus making it possible to drive a linear motor. (Input frequency max. 200 kHz)

Parametrically adjustable resolution of position actual values

Depending on the application and its accuracy requirements, 1 to 65536 increments can be parametrized as the number of lines per revolution.

Drift-free holding of the drive

Independently of the command value, the servomotor can be stopped by means of a switching input and held drift-free while under active control.



DKC 01

Stepping Motor Interface

In this operating mode, the drive system works as a position loop and simulates a stepping motor. The position command values are transmitted incrementally through pulses from the NC control system to the controller. The step width can be parametrized from 16 to 65536 steps per motor revolution.

Enhanced operational safety

The maximum stepping frequency of the motor is independent of the load and is limited only by the maximum speed. Unlike a stepping motor, "skipping" of steps is technically impossible.

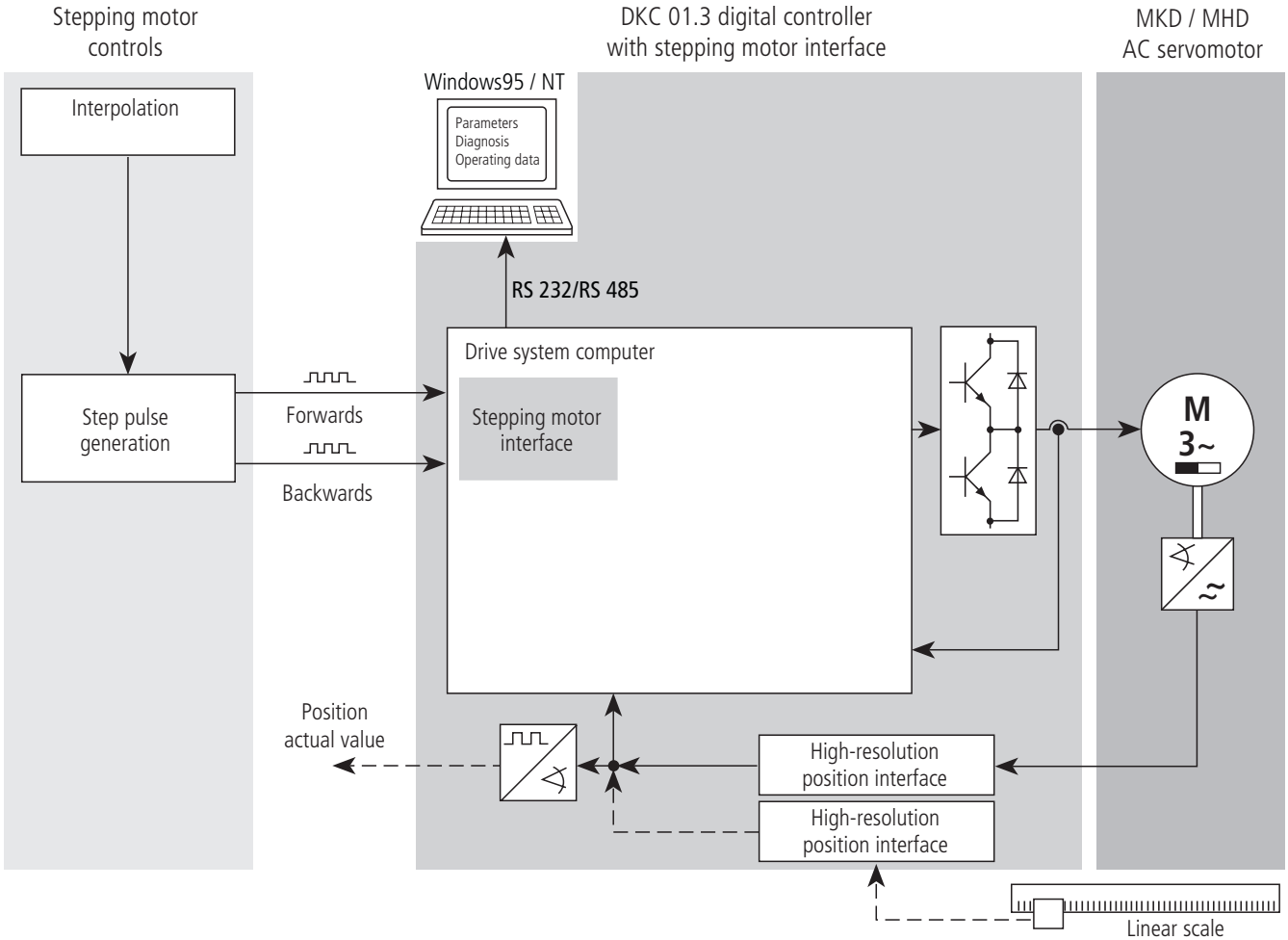
Supports a wide range of input signals

The stepping motor interface within the controller can be parametrized to accept the following signals from NC control system:

- Quadrature signals
- Forward/backward signals
- Step and direction signals

Electronic shaft at low cost

Incremental encoder signals from a control shaft are processed directly as position command value pulses. Such an electrical shaft can be implemented at low cost. The incremental encoder output and the stepping motor interface enable several drives to be easily synchronized by cascading.



Digital Controller DKC 01
Interfaces

DKC 01

Positioning Interface

In this operating mode, the drive system works as a position loop and automatically executes the selected positioning blocks. Each of the 64 storable positioning blocks contains the following information:

- Travel mode (relative/absolute)
- Target position
- Travel speed
- Acceleration
- Torque damping

Full NC functionality with a PLC control

Various control inputs and status outputs guarantee full NC functionality.

Control inputs:

- Approach to home position
- Positive jogging
- Negative jogging
- Feedrate override
- Reset

Status outputs:

- In home position
- Stopped
- In target position
- Fault warning

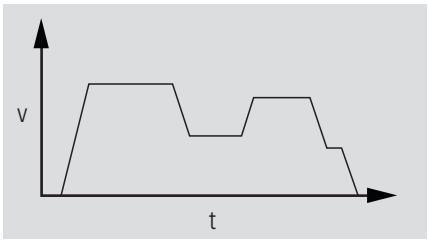
Simple, low-cost positioning axes

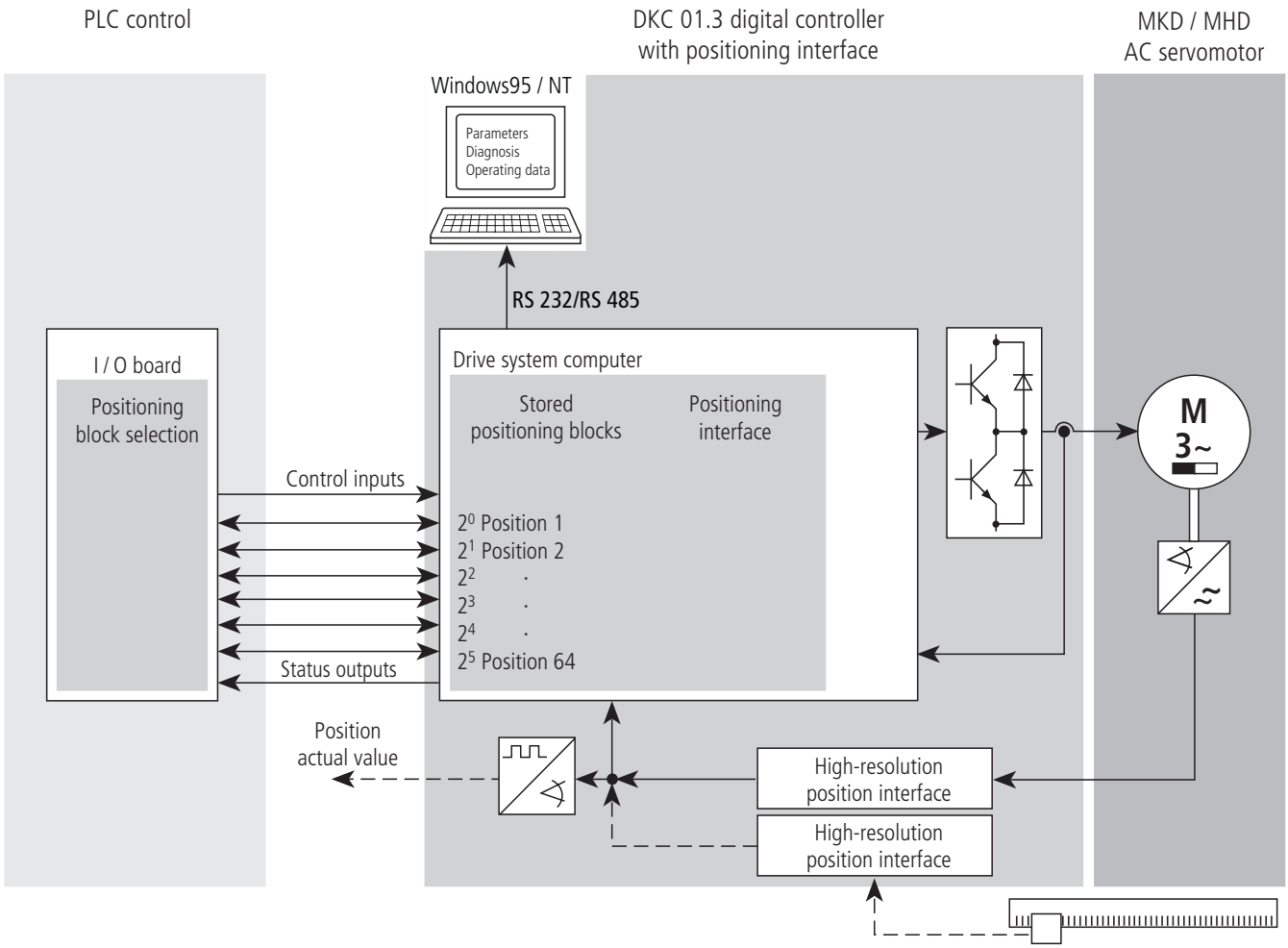
Selecting the positioning blocks through control inputs eliminates the need for positioning controller boards in the PLC.

Accurately defined motion sequences

The positioning blocks can be parametrized for target position, velocity, acceleration and torque damping. Both relative and absolute positions can be entered. Programming the 'progression to next block' function makes it possible to switch to another positioning block with different parameters without having to stop the motor.

Example:
Motion profile with progression to next block





Digital Controller DKC 02
Interfaces

DKC 02

SERCOS Interface*

This digital interface enables all the facilities and benefits of digital AC drive technology to be fully utilized.

Highly flexible

The SERCOS Interface permits preselection of and alternation between the following 4 operating modes during operation:

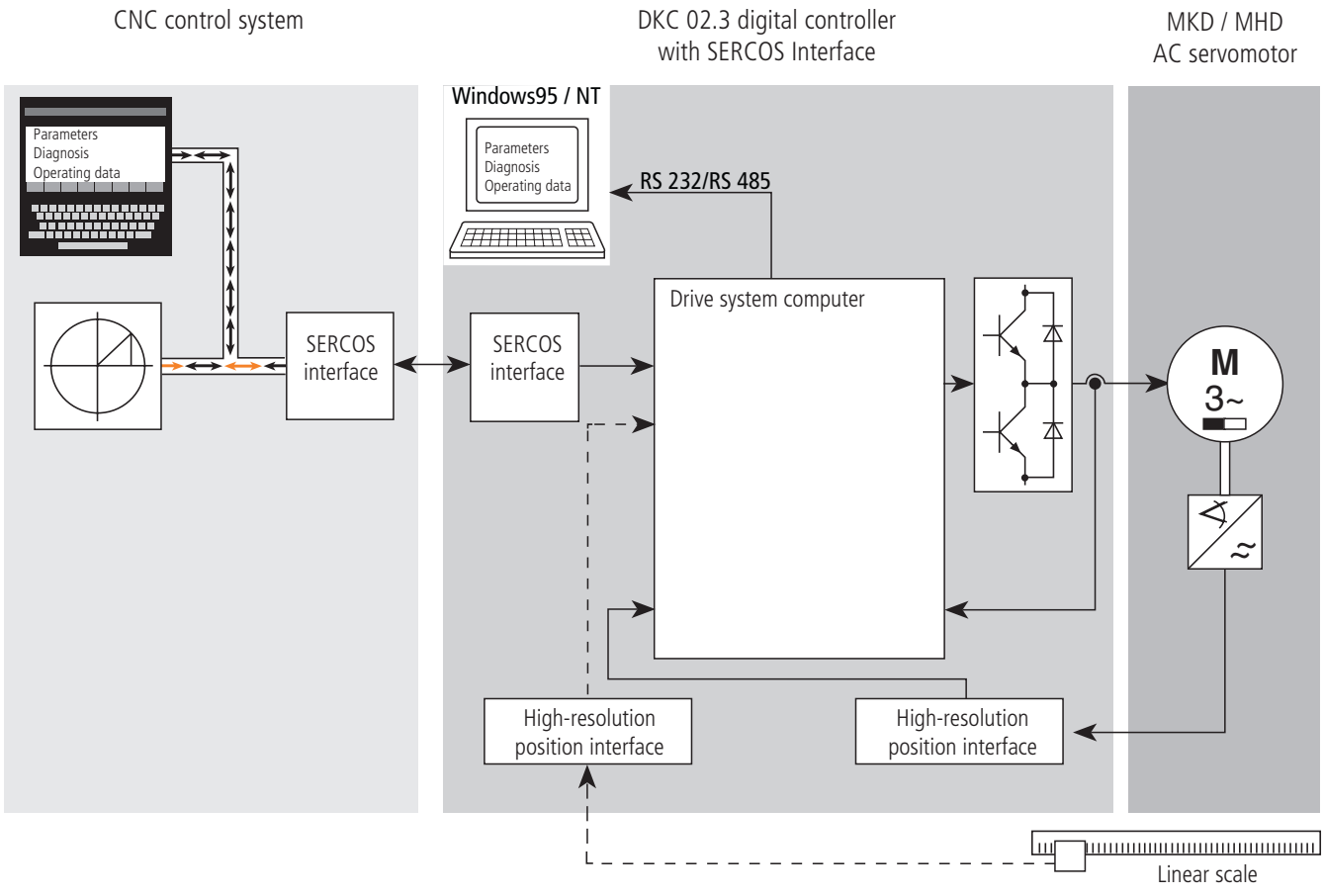
- Position control with indirect position detection in the motor, without or without lag error.
- Position control with direct position detection via linear scale or rotary encoder in the case of rotary indexing tables, with or without lag error.
- Speed control
- Torque control

Interference-free data exchange

SERCOS exchanges data between the CNC control system and the drive system via fiber-optic cables, thus avoiding any reciprocal interference between the systems.

**SERCOS Interface*

SERCOS Interface, the internationally standardized drive interface (IEC 1491), permits trouble-free interaction between digital drives and NC control systems of different manufacture while making the best possible use of the respective product characteristics.



Digital Controller DKC 03
Interfaces

DKC 03

Profibus-DP Interface*

When equipped with a Profibus-DP interface with extended FMS (Field bus Message Specification) services, the drive system will operate as a position loop, automatically executing up to 64 stored positioning blocks. Selected via the serial Profibus-DP interface, the positioning blocks contain the following:

- Travel mode
- Target position
- Speed
- Acceleration and deceleration
- Torque damping

Full NC functionality with a PLC control

Various control inputs and status outputs guarantee full NC functionality.

Control inputs:

- Approach to home position
- Positive jogging
- Negative jogging
- Travel block selection

Status outputs:

- In home position
- In motion
- In target position
- Travel block acknowledgment

Process data channel:

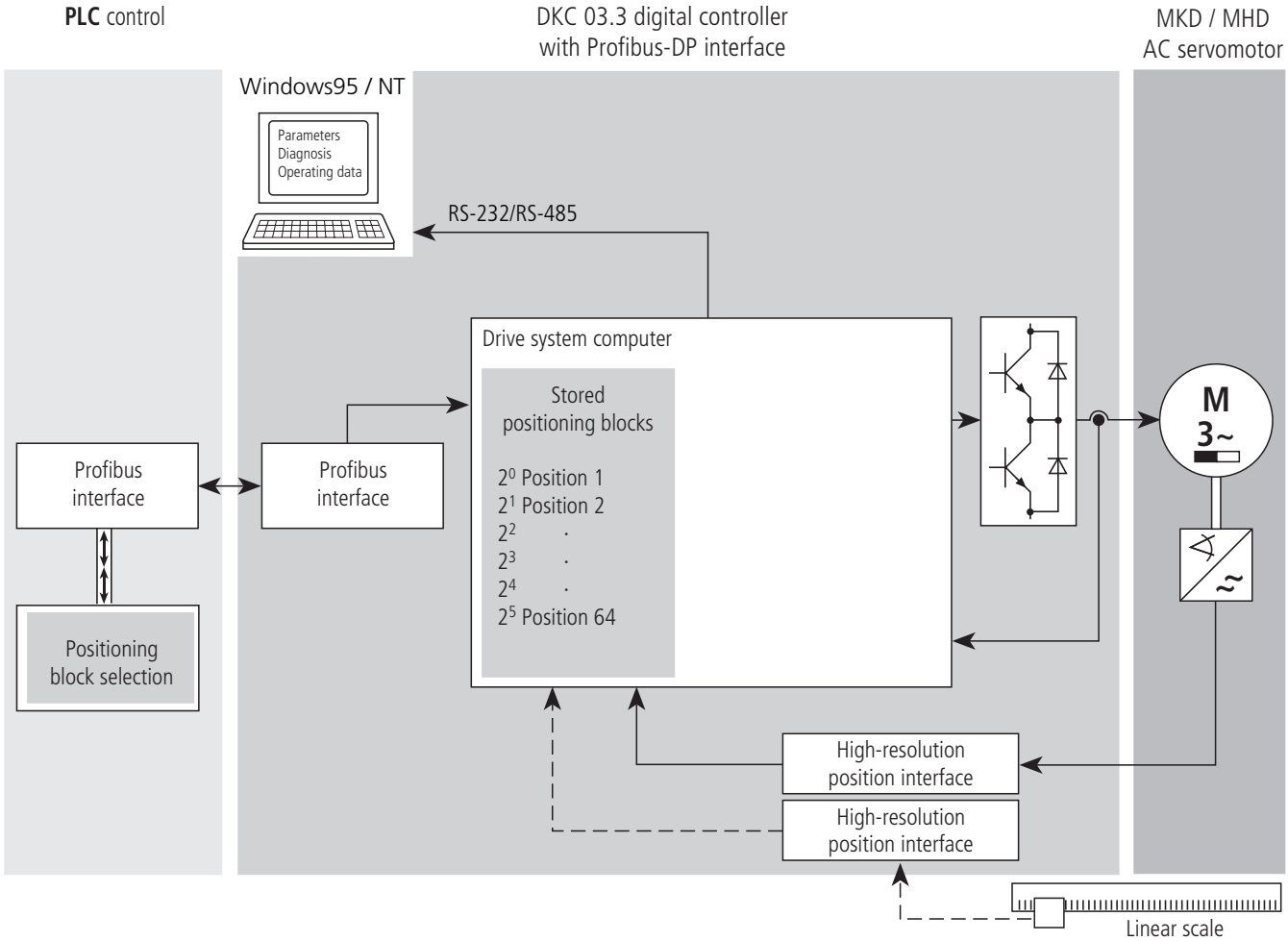
- Transmission of realtime data
- Parameter handling
- Transmission of positioning block data
- Cyclical speed and position target commands

Accurately defined motion sequences

The positioning blocks can be parametrized for travel mode, target position, velocity, acceleration, deceleration, and torque damping.
The positioning blocks can be executed as absolute dimensional data for absolute dimension programming or increments for incremental data programming.

**Profibus-DP interface*

Profibus-DP interface is a serial PLC periphery bus system for rapid transmission of I/O switching signals, such as enable, start, stop, etc. Profibus-DP eliminates the need for parallel I/O connections, thus considerably reducing the extent of wiring required.



DKC Digital Controller
DRIVE-TOP Diagnosis Program

Start-up and diagnosis

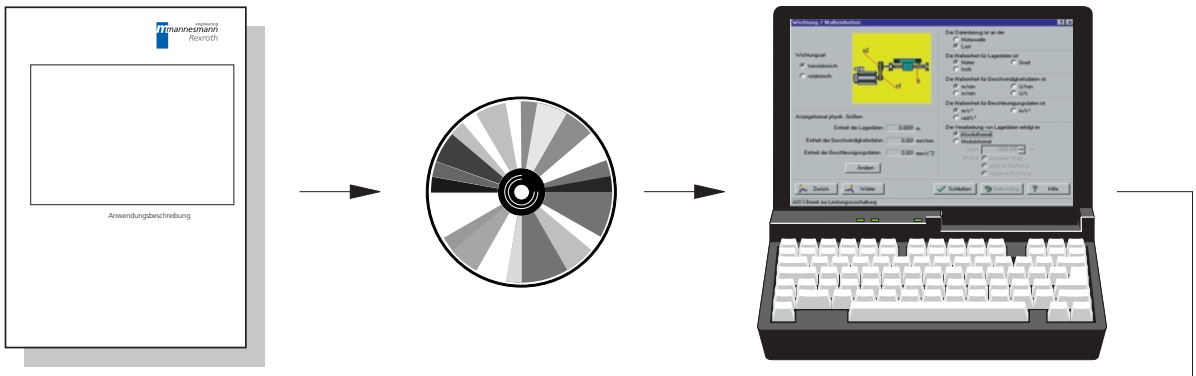
To ensure time-saving start-up and diagnostics, the drive system is (optionally) delivered complete with a clearly-structured applications manual and the user-friendly DRIVE-TOP start-up and diagnosis program.

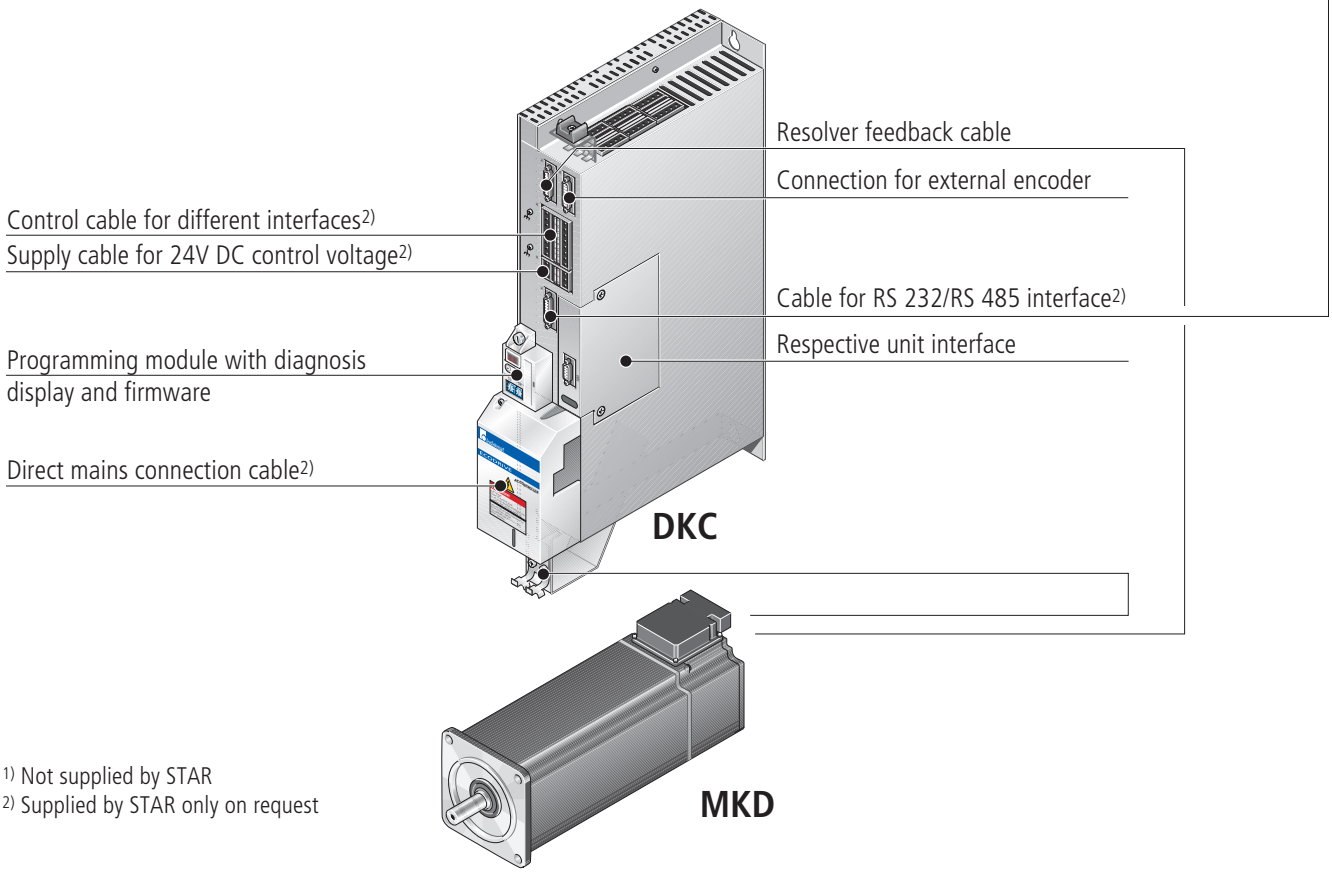
The DRIVE-TOP diagnosis program runs under Windows™ 95 and Windows™ NT. DRIVE-TOP guides the user easily and unerringly through the individual start-up steps.

Applications Manual
(optional)

DRIVE-TOP
Start-up and diagnosis program
CD-ROM
(optional)

PC[1] with Windows ™ 95 or Windows ™ NT





1) Not supplied by STAR
2) Supplied by STAR only on request

DKC Digital Controller

User-friendly Interface

Help functions

The extensive help functions and the graphic interface of the DRIVE-TOP diagnosis program simplify drive system start-up, parametrization and diagnostics.

Convenient start-up

Targeted questions guide the user quickly and unerringly through the specific parameter setting sequence for the application.

Graphic diagnostics display

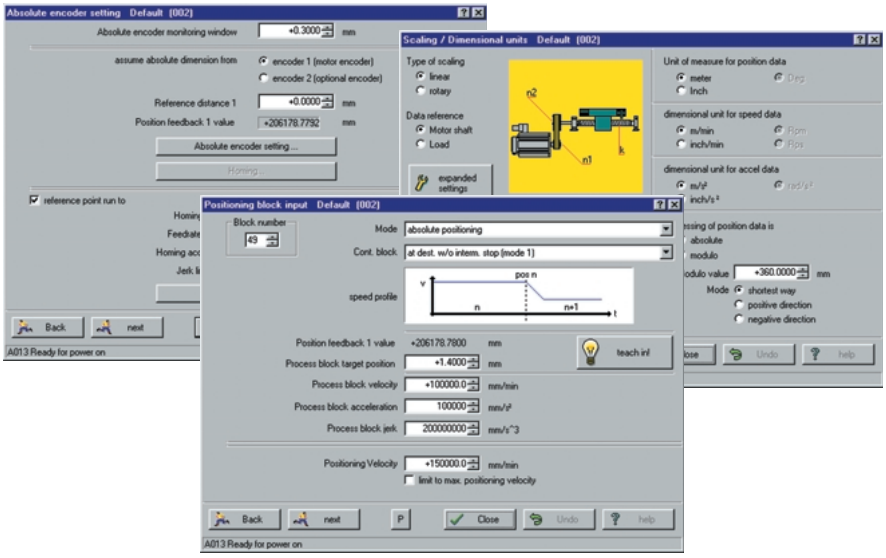
The graphic block diagrams clearly indicate the current internal status variables.

Graphic parametrization interface

Graphic function blocks clearly represent the drive system programming structure.

Extensive help texts

The program includes help texts for every function.



Model code

Digital Controller	DKC	**	. *	- ***	- *

Interface

01 = Analog, positioning and stepping motor interface
11 = Analog interface
02 = SERCOS interface
03 = Profibus-DP interface
04 = Interbus interface
05 = CANopen interface

Hardware version

01 = Controller generation 1
03 = Controller generation 3

Rated current

030 = 30 ampere
040 = 40 ampere
100 = 100 ampere

Link circuit voltage

3 = 300 V DC
7 = 700 V DC

Performance Data

MKD Motor connected to the DKC Controller

Motor MKD	Controller DKC	OF (%)	C	n_{max} (min^{-1})	M_{dN} (Nm)	M_{max} (Nm)	$-n_{100}$ (min^{-1})	$-n_{90}$ (min^{-1})	M_{100} (Nm)	M_{90} (Nm)	M_{KB} (Nm)	DC (%)	J_M ($kgcm^2$)	J_B ($kgcm^2$)	m_M (kg)	m_B (kg)	M_{Br} (Nm)	S (kVA)	U_{mains} (V) AC
025B-144	**.*-030	220	1	5600	0.8[1]	3.4	4750	4063	2.0	0.9	1.6	25	0.3	0.08	2	0.25	1	0.44	1 x 230
025B-144	**.*-040	220	1	9000	0.8[1]	3.4	9000	9000	3.4	3.4	1.6	25	0.3	0.08	2	0.25	1	0.56	3 x 400
041B-144	**.*-030	127	1	3000	2.7	9.1	2333	1934	5.4	3.2	3.1	76	1.7	0.16	4.4	0.25	2.2	0.69	1 x 230
041B-144	**.*-040	183	1	7000	2.7	10.3	7000	7000	10.3	10.3	4.6	34	1.7	0.16	4.4	0.25	2.2	1.17	3 x 400
041B-144	**.*-040	213	1	7000	2.7	5.3	7000	7000	5.3	5.3	5.3	26	1.7	0.16	4.4	0.25	2.2	1.17	3 x 400
071B-061	**.*-040	116	1	4400	8.0	24.6	4400	3982	24.6	8.9	8.6	87	8.7	0.38	8.8	0.37	5	2.05	3 x 400
071B-061	**.*-040	143	1	4400	8.0	10.5	4400	4358	10.5	8.9	10.5	58	8.7	0.38	8.8	0.37	5	2.05	3 x 400
071B-061	**.*-100	215	1	4400	8.0	30.0	4353	3838	28.2	8.9	16.0	25	8.7	0.38	8.8	0.37	5	2.05	3 x 400
090B-047	**.*-040	106	1	2900	12.0	27.0	2839	2494	24.3	9.1	12.0	100	43.0	1.10	14	0.65	11	2.08	3 x 400
090B-047	**.*-040	121	1	2900	12.0	13.6	2900	2798	13.6	9.1	13.6	78	43.0	1.10	14	0.65	11	2.08	3 x 400
090B-047	**.*-100	215	1	2900	12.0	42.9	2477	2132	24.3	9.1	24.3	24	43.0	1.10	14	0.65	11	2.08	3 x 400
112B-024	**.*-040	68	1	2000	18.2[2]	28.9	2000	1889	28.9	12.6	18.2	100	192.0	9.50	34	1.9	20	2.02	3 x 400
112B-024	**.*-100	161	1	1900	28.0	100.2	1631	1399	61.0	27.2	42.4	44	192.0	9.50	34	1.9	20	3.04	3 x 400
112B-024	**.*-100	161	2	1800	42.0	100.3	1630	1399	75.6	41.8	42.5	98	192.0	9.50	34	1.9	20	4.66	3 x 400
112B-048	**.*-100	107	1	3300	28.0	47.6	3300	3096	47.6	24.9	28.2	99	192.0	9.50	34	1.9	20	4.86	3 x 400
112B-048	**.*-100	107	2	3300	28.5[2]	47.7	3300	3095	47.7	24.9	28.5	100	192.0	9.50	34	1.9	20	5.01	3 x 400
112C-024	**.*-100	136	1	1900	38.0	81.6	1883	1651	78.1	34.9	48.3	62	270.0	9.50	41	1.9	36	4.00	3 x 400
112C-024	**.*-100	136	2	1900	49.1[2]	81.3	1883	1651	78.1	34.9	49.1	100	270.0	9.50	41	1.9	36	5.44	3 x 400
112D-024	**.*-100	106	1	1900	48.0	80.7	1900	1751	80.7	44.8	48.0	100	350.0	9.50	48	1.9	36	4.97	3 x 400
112D-024	**.*-100	106	2	1900	48.2[2]	80.7	1900	1751	80.7	44.8	48.2	100	350.0	9.50	48	1.9	36	5.07	3 x 400

The maximum torque M_{max} must be limited to the maximum permissible torque of the mechanical structure by adjusting the parameter "bipolar torque limit" during initial start-up.

1) Motor with brake
2) Limited by controller's continuous rated current
* applies to all available models

Key to symbols used

OF	Overload factor (parameter; input through controller software)
C	Cooling method: 1 = natural convection, 2 = fan-cooled
n_{max}	Maximum effective speed
M_{dN}	Continuous standstill torque
M_{max}	Maximum torque up to 400 ms duty cycle
$-n_{100}$	- at 100% mains voltage up to break-point speed "$n_{100\%}$"
$-n_{90}$	- at 90% mains voltage up to break-point speed "$n_{100\%}$"
M_{100}-M_{90}	Torque at maximum speed for 100% or 90% mains voltage
M_{KB}-DC	Short-time operating torque relative to duty cycle DC
J_M	Moment of inertia of the servomotor
J_B	Moment of inertia of the brake
m_M	Motor mass
m_B	Brake mass
M_{Br}	Brake holding torque
S	Connected power
U_{mains}	Mains connection

DKC Digital Controller
Ordering Code

DKC11.* with analog interface, DKC01.* with analog, positioning and stepping motor interface			No. of axes	Power supply: Direct mains connection	Power supply: Via mains filter	Power supply: Via mains filter with additional bleeder	Power supply: Mains filter for motor LD (single-phase)	Power section DKC (= number of controllers)	
Designation	**Part number**	**Motor assignment**							
Digital Controller DKC 01.*-040-7 analog, positioning and stepping motor interface 40 ampere	1132-140-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MHD (DKC1.3 only) LSF (DKC1.3 only) LD (DKC1.3 only)	1	00	01	11	21	01	
			2					02	
			3					03	
			4					04	
Digital Controller DKC 11.*-040-7 analog interface 40 ampere	1132-840-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MHD (DKC11.3 only) LSF (DKC11.3 only) LD (DKC11.3 only)	1	00	01	11	21	01	
			2					02	
			3					03	
			4					04	
Digital Controller DKC 01.*-100-7 analog, positioning and stepping motor interface 100 ampere	1132-110-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MKD 112*-*** MHD (DKC1.3 only) LSF (DKC1.3 only)	1	00	01	11	-	01	
			2					02	
			3					03	
			4					04	
Digital controller DKC 11.*-100-7 analog interface 100 ampere	1132-810-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MKD 112*-*** MHD (DKC11.3 only) LSF (DKC11.3 only)	1	00	01	11	-	01	
			2					02	
			3					03	
			4					04	

* applies to hardware version 3

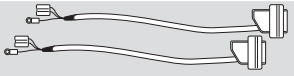
Ordering example

Ordering data		Explanation
Part number 1132-840-00		DKC 11.*-040-7 Digital Controller
Power connections	= 01	Mains connection via mains filter
Power section	= 03	DKC digital controllers to operate three MKD motors
Multi-axis controls	= 31	CLM control system for 3 axes with 16 inputs and 16 outputs
Control cabinet	= 31	Completely wired control cabinet with operating controls and displays in control cabinet door
DKC controller software	= 01	Start-up and diagnostics software for DKC Controller
CLM control software	= 01	"Motion Manager" PC program for programming and parametrizing the CLM control system
DKC documentation	= 13	Documentation on DKC Controller (German, in triplicate)
Multi-axis controls documentation	= 13	Documentation on CLM multi-axis control system (German, in triplicate)

	Multi-axis CLM controls			Control cabinet (completely wired)		Software DKC controller (DKC start-up and optimization)		Software CLM control		Documentation DKC controller				Documentation multi-axis controls		
										 						
	with-out	16 Is 16 Os	80 Is 48 Os	with-out		with-out	CD	with-out	Motion Manager	with-out	German D	English E	CD-ROM[1] D	CD-ROM[1] E	with-out	German D	English E
	00	-	-	00	-	00	01 (1 copy) 02 (2 copies) 03 (3 copies)			00	11 21 (1 copy) 12 22 (2 copies) 13 23 (3 copies)		31	41			
	00	11 21 31 41	13 23 33 43	00	11 13 21 23 31 33 41 43			00	01						00	11 21 (1 copy) 12 22 (2 copies) 13 23 (3 copies)	
	00	-	-	00	-												
	00	11 21 31 41	13 23 33 43	00	11 13 21 23 31 33 41 43			00	01						00	11 21 (1 copy) 12 22 (2 copies) 13 23 (3 copies)	

[1] The CD-ROM contains the documentation for the controller and the multi-axis controls

Motor and feedback cable to DKC



Motor assignment	Part number,… Length in m (max. 75 m)	Preassembled cable options		
		Motor side with connector	Controller side for DKC**.1	Controller side for DKC**.3
MKD 025B-144… MKD 041B-144… MKD 071B-061… MKD 090B-047…	1130-001-17,…	01	10	11
MKD 112B, uncooled MKD 112C, uncooled	1130-001-25,…	07	–	12
MKD 112D, uncooled	1130-001-40,…	08	–	13

DKC Digital Controller
Ordering Code

DKC02.* with SERCOS interface			No. of axes	Power supply: Direct mains connection	Power supply: Via mains filter	Power supply: Via mains filter with additional bleeder	Power supply: Mains filter for motor LD (single-phase)	Power section DKC (= number of controllers)
Designation	**Part number**	**Motor assignment**						
Digital Controller DKC 02.*-040-7 SERCOS interface 40 ampere	1132-240-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MHD (DKC2.3 only) LSF (DKC2.3 only) LD (DKC2.3 only)	1	00	01	11	21	01
			2					02
			3					03
			4					04
Digital Controller DKC 02.*-100-7 SERCOS interface 100 ampere	1132-210-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MKD 112*-*** MHD (DKC2.3 only) LSF (DKC2.3 only)	1	00	01	11	-	01
			2					02
			3					03
			4					04

DKC03.* with Profibus-DP interface			No. of axes	Power supply: Direct mains connection	Power supply: Via mains filter	Power supply: Via mains filter with additional bleeder	Power supply: Mains filter for motor LD (single-phase)	Power section DKC (= number of controllers)
Designation	**Part number**	**Motor assignment**						
Digital Controller DKC 03.*-040-7 Profibus-DP interface 40 ampere	1132-340-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MHD (DKC3.3 only) LSF (DKC3.3 only) LD (DKC3.3 only)	1	00	01	11	21	01
			2					02
			3					03
			4					04
Digital Controller DKC 03.*-100-7 Profibus-DP interface 100 ampere	1132-310-00	MKD 025B-144 MKD 041B-144 MKD 071B-061 MKD 090B-047 MKD 112*-*** MHD (DKC3.3 only) LSF (DKC3.3 only)	1	00	01	11	-	01
			2					02
			3					03
			4					04

* applies to hardware version 3

	Software DKC controller (DKC start-up and optimization)		**Documentation DKC controller**				
							
	without	with	without	German D	English E	CD-ROM D	CD-ROM E
	00	01 (1 copy) 02 (2 copies) 03 (3 copies)	00	11 (1 copy) 12 (2 copies) 13 (3 copies)	21 (1 copy) 22 (2 copies) 23 (3 copies)	31	41

	Software DKC controller (DKC start-up and optimization)		**Documentation DKC controller**				
							
	without	with	without	German D	English E	CD-ROM D	CD-ROM E
	00	01 (1 copy) 02 (2 copies) 03 (3 copies)	00	11 (1 copy) 12 (2 copies) 13 (3 copies)	21 (1 copy) 22 (2 copies) 23 (3 copies)	31	41

DKC Digital Controller
Ordering Data For Single Components

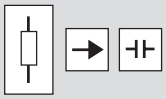
DKC controllers

Designation	Firmware	Part number
DKC01.3-040-7	Analog, positioning and stepping motor interface	1132-143-01
DKC11.3-040-7	Analog interface	1132-843-01
DKC02.3-040-7	SERCOS interface	1132-243-01
DKC03.3-040-7	Profibus-DP interface	1132-343-02
DKC4.3-040-7	Interbus interface	1132-443-02
DKC5.3-040-7	CANopen interface	1132-543-02
DKC01.3-100-7	Analog, positioning and stepping motor interface	1132-113-01
DKC11.3-100-7	Analog interface	1132-813-01
DKC02.3-100-7	SERCOS interface	1132-213-01
DKC03.3-100-7	Profibus-DP interface	1132-313-02
DKC4.3-100-7	Interbus interface	1132-413-02
DKC5.3-100-7	CANopen interface	1132-513-02

Mains filter

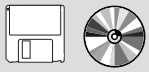
Designation	Description	Part number
Mains filter	1 x 230 V, 10 A	8617-001-06
Mains filter	3 x 380 - 430 V, 10 A	8617-002-06
NFE02.1	1 x 230 V, 8 A	1130-895-22
NFD02.1	3 x 380 - 480 V, 8 A	1130-895-02

Additional components



Designation	Description	Part number
NTM1.1-024-02	Mains filter 24V 2 A	1130-895-23
BZM01.3-01-07	Additional bleeder	1130-895-93
CZM01.3	Additional capacitor module	1130-895-94

Start-up and parametrization software

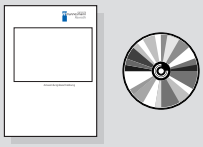


Designation	For controller/control system	Version	Part number
Drive-Top	DKC**.3	12VRS	1135-400-12
Drive- Help	DKC**.3	-	1135-400-19
Motion Manager	CLM	06VRS	1135-200-01

Preassembled cables

Designation	Description/Use	Part number
Interface cable	PC 9-pin for DKC**.3, length 5 m	1130-695-25
I/O cable	25-pin - for DKC01.3	IN PREPARATION

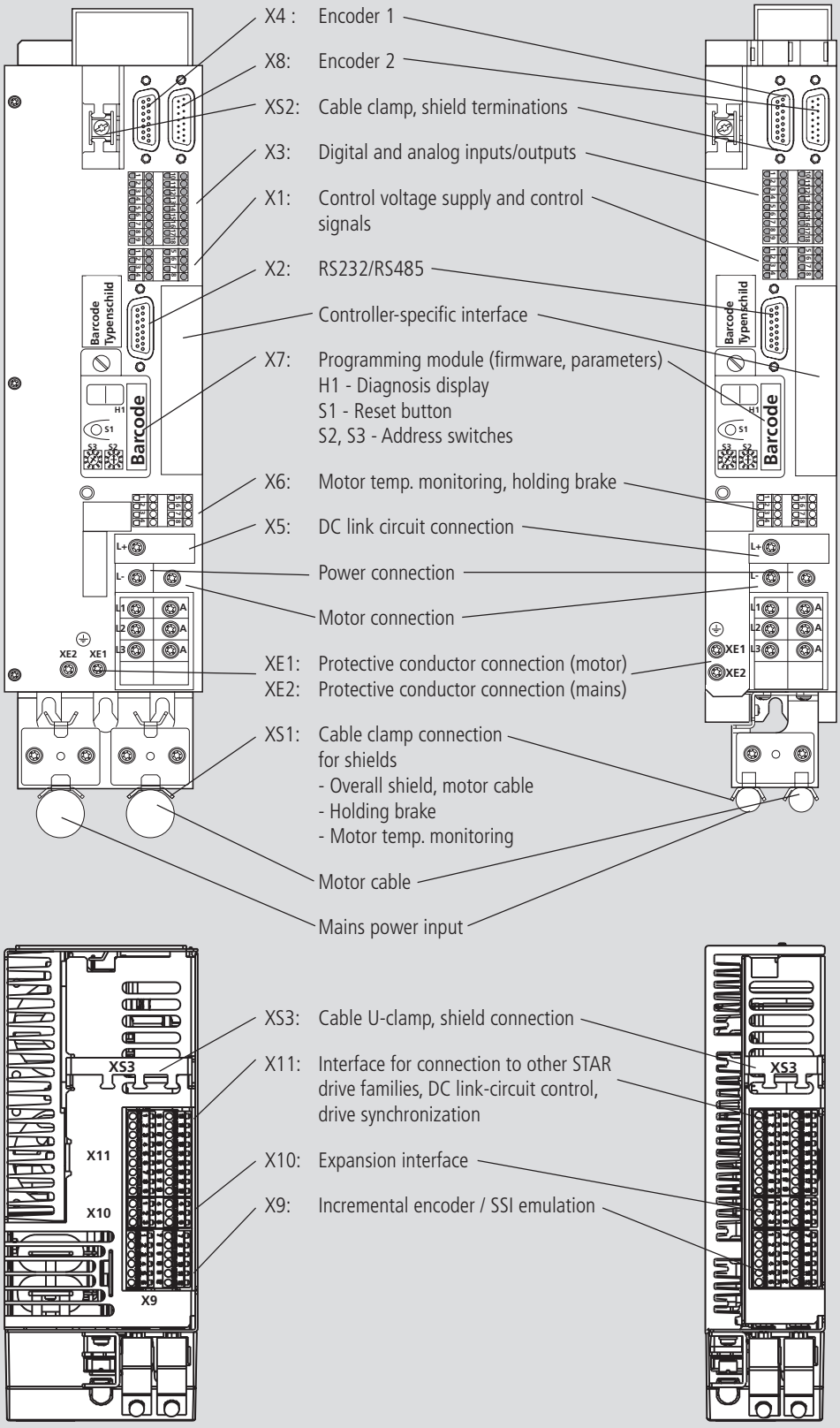
Documentation



Designation	For controller/control system	Part number			
		German	English	CD-Rom German	CD-Rom English
Project planning manual, DKC**.3	All DKC**.3	1130-895-66	1130-895-69	In preparation	
Function description, DKC firmware SMT	DKC**.3 with analog, positioning, SERCOS and stepping motor interface	1130-895-67	1130-895-70		
Function description, DKC firmware FGP	DKC**.3 with Profibus-DP interface / field bus	1130-895-72	1130-895-74		
DKC trouble-shooting, DKC firmware SMT	DKC**.3 with analog, positioning, SERCOS and stepping motor interface	1130-895-68	1130-895-71		
DKC trouble-shooting, DKC firmware FGP	DKC**.3 with Profibus-DP interface / field bus	1130-895-73	1130-895-75		
Programming and application manual, CLM	CLM positioning control module	1130-895-44	1130-895-45		

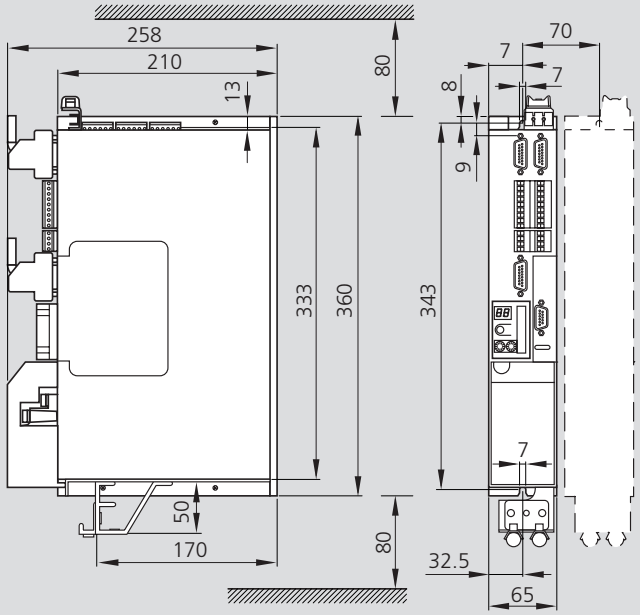
DKC Digital Controller
Electrical Connections - common to all controller models

DKC.3-100-7-FW** | **DKC**.3-040-7-FW**

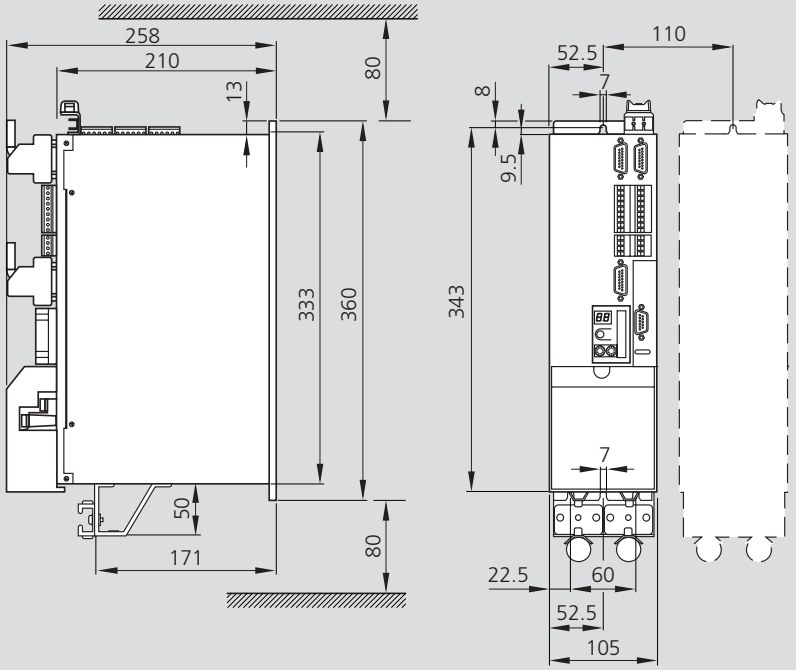


Dimensions

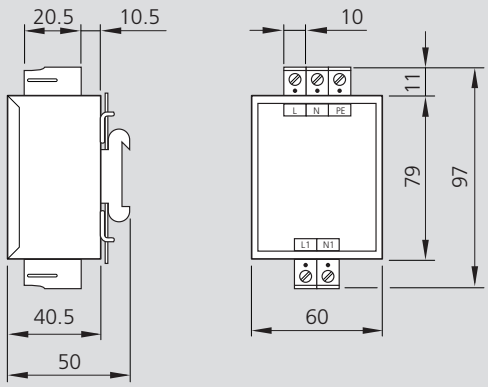
Digital Controller DKC **.3-040-7



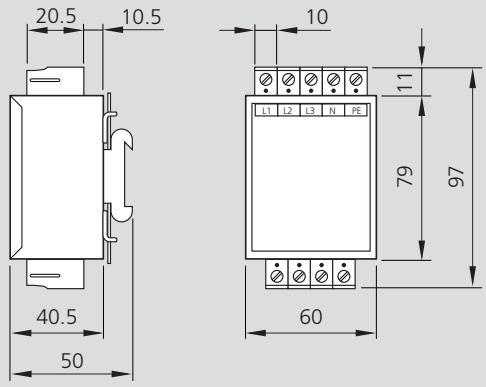
Digital Controller DKC **.3-100-7



Mains filter 1 x 230 V, 10 A Part number 8617-001-06



Mains filter 3 x 380 V, 10 A Part number 8617-002-06



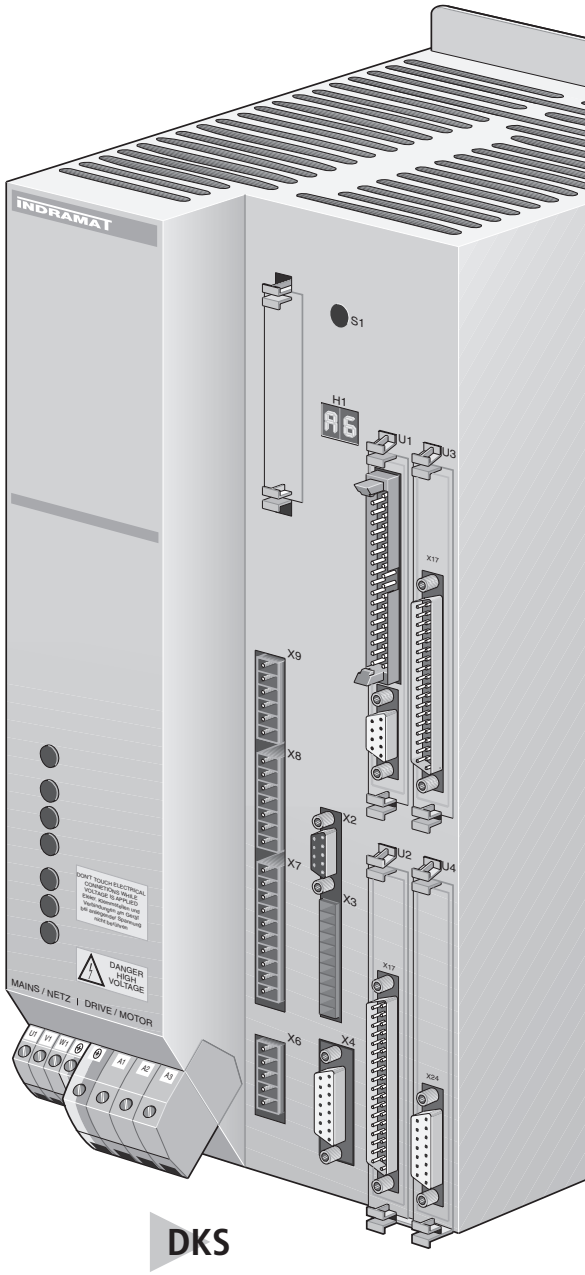
DKS Digital Positioning Module
Product Overview

The DKS digital positioning module is the cost-optimized solution for single-axis drive and control functions.
Combined with MDD or MKD digital AC servomotors, it can be successfully used wherever linear or rotary movements with power ratings of up to 8 kW have to be automated. With its outstanding performance data, flexible operating modes and numerous application-oriented functions, this automation module is the ideal control solution for applications such as:

- machine tools
- handling equipment
- assembly equipment
- material feed conveyors
- packaging machines
- textile machines
- printing machines

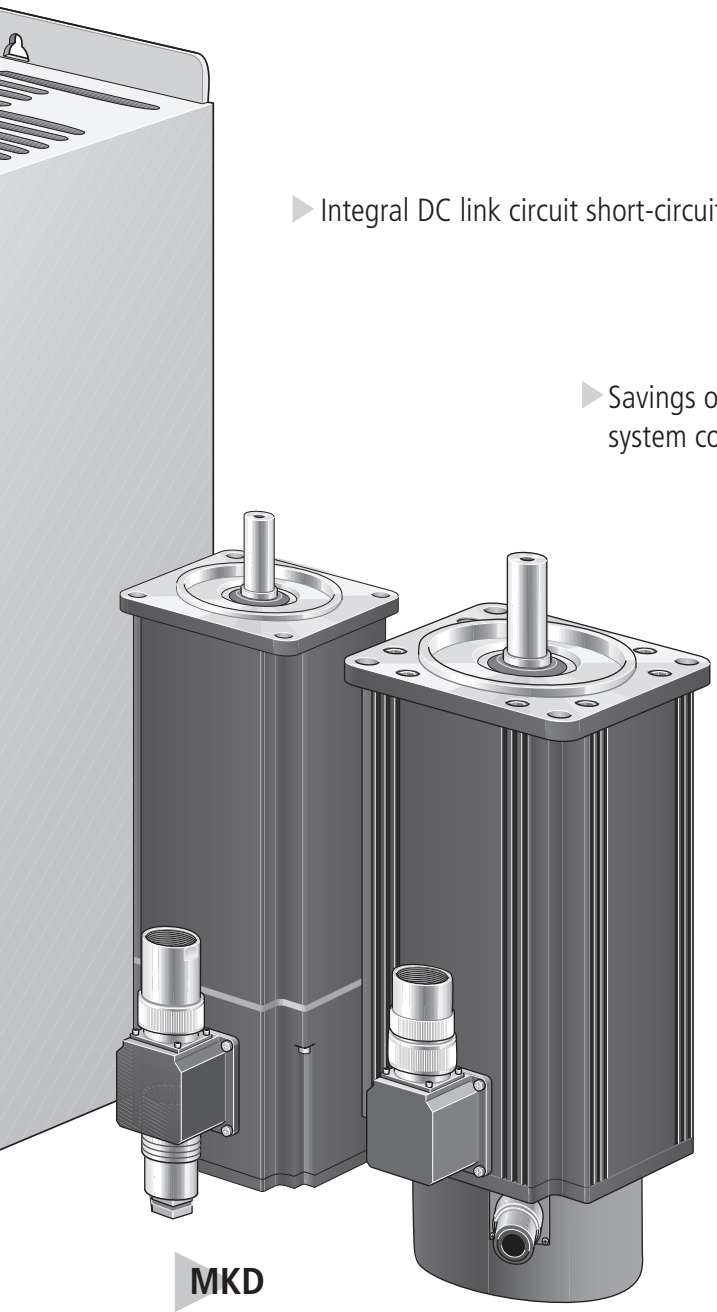
The DKS is a totally integrated package combining power supply and motion control electronics into one space-saving module designed for easy installation in a control cabinet and connection to the mains. Slots to accommodate various plug-in modules for control, I/O and measuring functions as well as the controller software enable the DKS to be configured for universal use.

By combining the DKS with highly responsive MDD or MKD AC servo-motors, the user obtains an optimized control and drive system.



Available complete with control cabinet

▶ Compact construction



▶ Integral DC link circuit short-circuit

▶ Savings on system components

▶ Time-saving start-up

▶ Built-in power contactor

▶ Highly accurate speed and positioning capability

MKD

MDD

▶ Single-phase or three-phase mains input

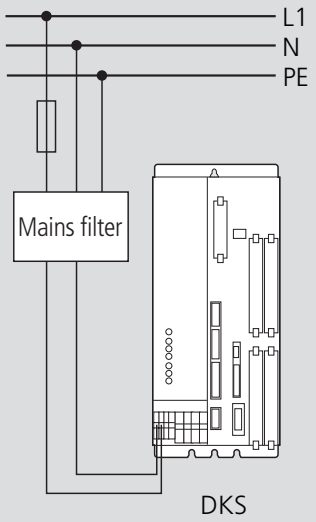
▶ Different power ratings available

DKS Digital Positioning Module Advantages

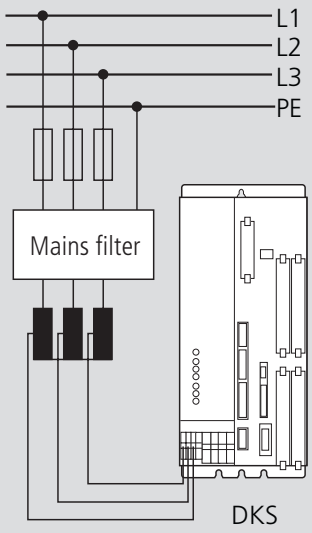
Single-phase or three-phase mains input

Depending on the power ratings, direct single-phase connection to 230 V or three-phase connection to AC mains through DST autotransformer or DLT isolation transformer.

Single-phase mains connection to 230 V AC
for power ratings up to 2 kW



Three-phase mains connection to 3 x 230 V at any desired voltages
for power ratings up to 8 kW



Economical

Compact construction

For installation in control cabinets with 300 mm depth.

Time-saving initial start-up and recommissioning

Achieved by the DDS2PC diagnosis program installed on PC or by the VT 100 terminal as well as exchangeable software modules.

Savings on system components

No additional position encoder required.

Built-in power contactor

Reduces the amount of wiring.

Highly accurate speed and positioning capability

Due to the drive's internal position loop with a cycle time of 250 µs.

Comprehensive diagnostic facilities

Malfunctions are recognized quickly on the diagnostic display on the DKS or through the interfaces.

Easily integrated

Units with different power ratings

Available up to 3 kW, 5 kW and 8 kW.

Low-noise drive control

For units up to 3 kW due to 8 kHz cycle frequency.

Safe

Built-in starting interlock

Prevents unintentional restarts in accordance with the safety-at-work requirements stipulated by professional trade associations.

Integral DC link circuit short-circuit

This feature guarantees safe stopping of the drive in the event of drive malfunctions.

Internal holding brake control circuit

The power supply, control and monitoring of the holding brake is handled directly by the DKS.

Completely wired up in the control cabinet

Available as a single-axis positioning unit completely wired in the control cabinet, with circuit diagram and documentation.

- Triple-lock power switch
- E-STOP mushroom-head pushbutton
- Signal lamps for power on, setup/ automatic mode, malfunction
- Pushbutton for start/stop, axis forward/ backward, release brake
- Selector switch for setup/automatic mode
- Key switch for parameter input
- Inputs/outputs wired to terminal side
- CTA keyboard for DLC positioning interface installed in the control cabinet door

Further options on request:

- External control desk
- Additional instrumentation
- Installation of additional control and display elements
- Installation of decade switches
- Wiring on mounting board for installation in existing control cabinets
- Programming to customer specifications

DKS Digital Positioning Module
Plug-in interface modules

The DKS as a single-axis positioning module with digital drive control

Equipped with the following interfaces, the DKS becomes an intelligent digital single-axis positioning module. In many cases, an additional PLC can be avoided altogether by using the extensive functions integral to these options:

DLC positioning interface

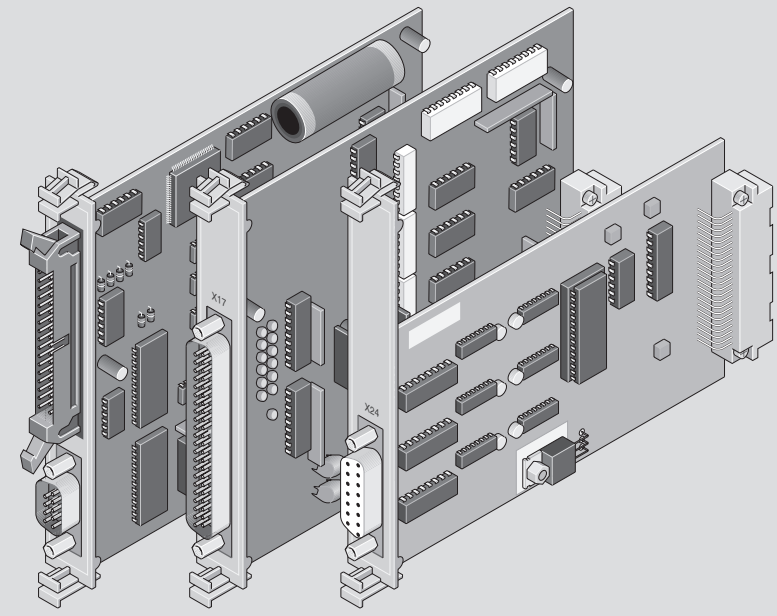
The positioning interface has a comprehensive set of commands allowing up to 3000 program blocks to be input into the application program.
Programs can be structured with up to 127 subroutine levels. (Technical data and programming commands can be found on pages 32 and 33.)

DEA digital I/O interface

Eight fixed and seven programmable inputs plus five fixed and eleven programmable outputs are available with this interface.
I/O expansion up to 45 inputs and 48 outputs is possible by installing two additional (DEA) interfaces.

DEF incremental position interface

This interface enables encoders to be connected for direct detection of the displacement or position of moving machine parts.
Squarewave voltage signals from linear scales or rotary encoders are resolved to a factor of 4 and evaluated.



DLC DEA DEF

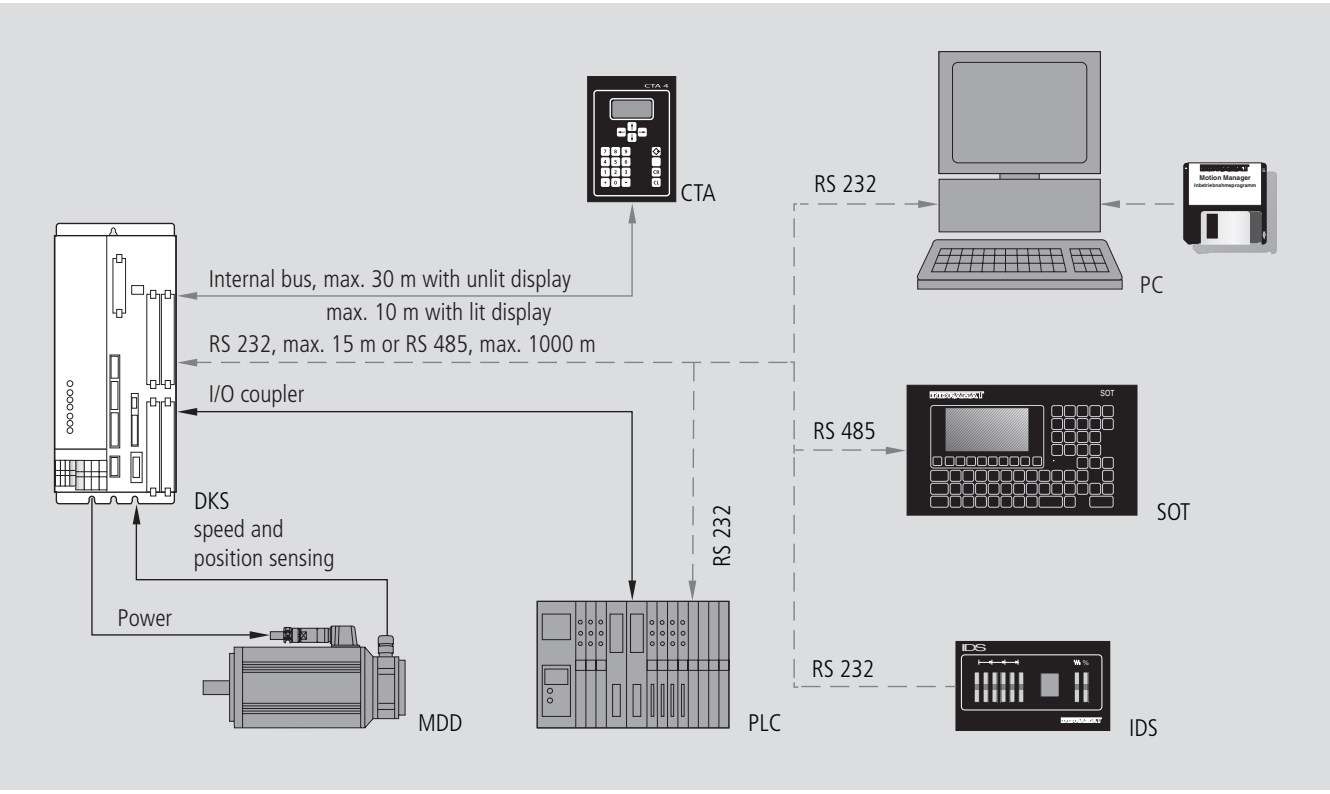
Convenient program and parameter input

The DKS is programmed by simply entering up to 3000 program blocks. Each block describes a sequence of motions or a specific status of the monitored inputs or the specified outputs.
The user-oriented programming language identifies each control or monitoring command by means of a three-character code. The block can include data such as the target position and the velocity.
After movement has begun, the DKS can monitor the current sequence of motions while simultaneously executing the next program block.

One parameter block is used to match the DKS to the mechanical and electrical conditions of a machine or system.
This parameter block is loaded into main memory each time the DKS is powered up and after exiting the parameter mode. The system then checks if all parameters are within their possible theoretical limits. An error message appears if parameters are missing or are outside the system limits.

Depending on the application requirements, the DKS can be programmed and/or parametrized in various ways:

- with the CTA programming keyboard,
- with a master PC via the RS 232 interface, e.g. using the Motion Manager PC program,
- with the IDS decade switch unit via the RS 232 interface,
- with the SOT programming terminal via the RS 485 interface,
- or with a master PLC via the RS 232 interface.



DKS Digital Positioning Module
Technical Data for the DLC Positioning Interface

Controller details

- 1 controllable axis
- Units definable in mm, m, inches, degrees, radians, etc.
- Built-in absolute value encoder
  Optional incremental encoder for direct measurement
- Programmable incremental or absolute dimensions
- Speed selection as % of v_{max}
- Maximum system and manual speeds programmable using parameters
- Feedrate and zeroing speed programmable in the user program
- Type 68000 microprocessor with 32-bit format

Operating modes

Parameter input, setup, automatic

Program data

- Programs of up to 3000 blocks
- Nesting of up to 127 subroutine levels
- 3 tasks possible

Display

- Two-digit diagnostic display
- Choice of languages for CTA:
  German, English, French, Spanish, Italian or Portuguese

Interfaces

- Parallel interface:
- 8 system inputs and 5 system outputs
- Machine functions:
- 7 inputs and 11 outputs, freely programmable in the user program

  Input level:
  "On" = 24 V DC
  "Off" ≤ 1 V DC

  Output level: 24 V DC
  I_{max} = 100 mA

  - Expandable up to 45 inputs and 48 outputs

- Controller interface:
  built in

- Data interface:
  - Serial: either RS 232 or RS 485
  - Selectable transmission format
  - Baud rate from 110 bps to 9600 bps

- Measuring system interface:
  - Built into drive: absolute-value encoder
  - For linear or rotary incremental encoders:
    1 MHz maximum sampling frequency

Software

- "Motion Manager" PC program for programming and parameter input to the DLC positioning interface (optional)

Power ratings

Modules with power ratings up to 3 kW, 5 kW or 8 kW

Environmental conditions

- Ambient temperature: 5 °C to 45 °C
- Storage temperature: - 30 °C to 85 °C

Programming Commands / Software

Feed commands

POI	Incremental feed with immediate progression to next block
PSI	Incremental feed with progression to next block on reaching target position
POM	Incremental feed via IDS decade switch unit or via inputs, with immediate progression to next block
PSM	Incremental feed via IDS decade switch unit or via inputs, with progression to next block on reaching target position
POA	Absolute feed with immediate progression to next block
PSA	Absolute feed with progression to next block on reaching target position
CON	Continuous running of an axis
ACC	Change acceleration
VCC	Change velocity
HOM	Move axis to home position
REF	Move axis to reference point (search)
REP	Limitation of search path for moving to reference point
FOL	Follower axis; slave axis performs all motions synchronously with master axis
PST	Position check
PBK	Termination of positioning cycles
COC	Cam control; 6 outputs are switched according to current position

Jump commands

JSR	Jump to subroutine
RTS	Return from subroutine
JMP	Jump to a program line
JST	Jump to a program line and then stop the program
BCA	Jump with output logic gating
BMB	Execute block with output logic gating
BCB	Jump to calculated target block with binary input setting
BCD	Jump to calculated target block with decimal input setting
BCE	Jump with input logic gating
BPE	Jump with logic gating of 10 inputs
BIO	Jump with input and output logic gating
BPA	Jump with logic gating of 10 outputs
BPT	Jump on reaching target axis position
BZP	Jump at position overrun
CST	Clear subroutine stack

Input and output commands

AEA	Switch output on/off
AKN	Interrogate input status
APE	Set 10 outputs simultaneously
ATS	Interrogate output status
AKP	Interrogate status of 10 inputs simultaneously
CIO	Copy I/O status
APJ	Set 10 outputs with program branching

Counter commands

BAC	Jump with workpiece count
COU	Count
CLC	Reset counter

Miscellaneous commands

WAI	Wait for set time delay
NOP	Blank line, no operation
SCA	Setup axis to a new absolute position
STH	Send to host computer
CLA	Clear absolute positioning
FAK	Multiplication factor
SO1	Read in position information via selector switches or PLC
SO2	Correct a position via analog input
VEO	Velocity override
WRI	Store an absolute position value
KDI	Copy position difference

Input example:

PSA 1 + 002500.00 600

Axis 1 will be positioned to absolute position 2500.00 mm at 600 ‰ of the maximum velocity selected. Once the axis is in position, the program moves to the next command block.

Motion Manager software

The control system can be started up without any additional software. If required, however, the "Motion Manager" software package (part number 1135-200-01) can be supplied as an option for convenient programming, data backup and program optimization.

DKS Digital Positioning Module
Plug-In Interface Modules

The DKS as a Drive Control Module with Analog Interface

When fitted with an analog interface, the DKS can be used as a digital drive control module for communication with control systems that have a ±10 Volt interface. The following features distinguish the DKS with analog interface from conventional drives:

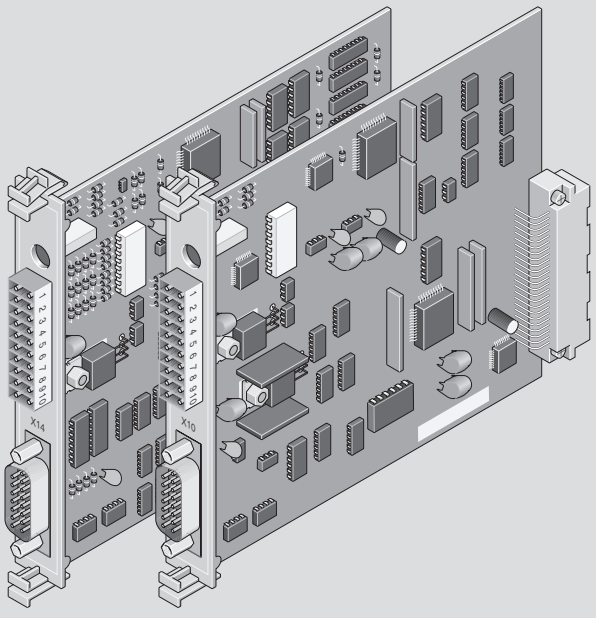
- The rotor position can be output to the control system either as an incremental encoder signal or an absolute-value encoder signal.
- Problem-free matching of position encoder signal resolution to different machine and control system conditions.
- The drive's internal speed control ensures drift-free stopping.
- The drive control module directly controls and monitors the holding brake.
- Two drive operating modes:
  – Speed control
  – Torque control

Analog interface with DAE incremental encoder emulator

The current axis position is indirectly detected via the digital servo feedback or resolver feedback in the motor and processed in the drive control module. The relative axis position is output to the control system via this interface in the form of squarewave incremental encoder signals. The number of encoder lines can be set via parameters.

Analog interface with DAA absolute-value encoder emulator

The current axis position is indirectly detected via the absolute digital servo feedback or the absolute resolver feedback in the motor and processed in the drive control module.
The absolute axis position is output to the control system via this interface in the form of absolute-value encoder signals in Gray code and SSI format.



DAE **DAA**

The DKS as a Drive Control Module with SERCOS Interface

When fitted with the SERCOS interface the DKS can be used as a digital drive control module for communication with SERCOS-compatible control systems.

DSS SERCOS interface

This digital interface enables all the facilities and benefits of digital AC drive technology to be fully utilized.
For example:

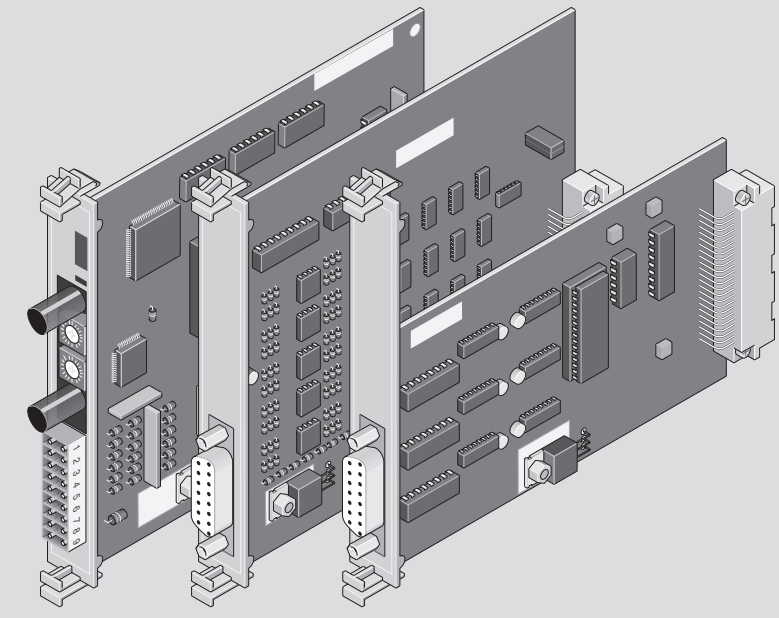
- Four pre-selectable drive modes that can be alternated during operation:
  - Position control with indirect position detection in the motor, with or without lag error.
  - Position control with direct position detection via linear scale or rotary encoder in the case of rotary indexing tables, with or without lag error.
  - Speed control
  - Torque control
- Interference-free data exchange between control systems and drives of different manufacture via fiber-optic cables.
- Input and display of all internal drive data, parameters and diagnostics via the control system.
- Savings on control system complexity, cable connections and position encoders.

DLF high-resolution position interface

This interface enables encoders to be connected for direct detection of the displacement or position of moving machine parts. Sinewave current signals from linear scales or rotary encoders are resolved to a factor of 2048 and evaluated.

DEF incremental position interface

This interface enables encoders to be connected for direct detection of the displacement or position of moving machine parts. Squarewave voltage signals from linear scales or rotary encoders are resolved to a factor of 4 and evaluated.



DSS DLF DEF

DKS Digital Positioning Module
Performance Data

MKD motor with DKS Positioning Module

Mains input 3 x 230 V AC																		
Motor	Controller	OF	n_{max}	M_{dN}	M_{max} - n_{100} - n_{90}			M_{100} - M_{90}		M_{KB} - DC		J_M	J_B	m_M	m_B	M_{Br}	S
MKD	DKS1.1-	(%)	(min^{-1})	(Nm)	(Nm)	(min^{-1})	(min^{-1})	(Nm)	(Nm)	(Nm)	(%)	($kgcm^2$)		(kg)	(kg)	(Nm)	(kVA)
025B-144	**W030B**	220	6200	0.8	3.4	8152	7032	2.4	1.2	1.6	25	0.3	0.08	2	0.25	1	0.56
041B-144	**W030B**	200	5100	2.7	9.9	4327	3705	5.8	2.6	5.2	27	1.7	0.16	4.4	0.25	2.2	0.83
041B-144	**W050A**	207	5100	2.7	11.0	4111	3489	5.8	2.6	5.4	25	1.7	0.16	4.4	0.25	2.2	0.83
071B-097	**W050A**	154	3600	8.0	12.8	3650	3314	15.4	8.5	11.6	47	8.7	0.38	8.8	0.37	5	1.55
071B-097	**W050A**	110	3600	8.0	18.7	3386	2924	15.4	8.5	8.5	90	8.7	0.38	8.8	0.37	5	1.55
071B-097	**W100A**	207	3600	8.0	32.0	2499	2037	15.4	8.5	15.4	27	8.7	0.38	8.8	0.37	5	1.55
090B-085	**W100A**	144	3200	12.0	39.6	2017	1642	12.6	4.0	16.9	51	43.0	1.10	14	0.65	11	2.21
090B-085	**W100A**	200	3200	12.0	29.2	2473	2098	12.6	4.0	23.6	26	43.0	1.10	14	0.65	11	2.21

MDD motor with DKS Positioning Module

Mains input 1 x 230 V AC																			
Motor	Controller	OF	n_{max}	M_{dN}		M_{max} - n_{100} - n_{90}			M_{100} - M_{90}		M_{KB} - DC - DC			J_M	J_B	m_M	m_B	M_{Br}	S	
MDD	DKS1.1-	(%)	(min^{-1})	(Nm)	(Nm)	(Nm)	(min^{-1})	(min^{-1})	(Nm)	(Nm)	(Nm)	(%)	(%)	($kgcm^2$)		(kg)	(kg)	(Nm)	(kVA)	
065B-N-060	**W030B**	220	4700	1.5	1.7[1]	4.4	3868	3271	2.6	1.4	2.8	29	38[1]	2.2	0.38	3.9	0.55	3	0.6	0.7[1]
071A-N-060	**W030B**	220	3800	2.2	-	6.0	3192	2693	4.0	2.3	4.4	25	-	4.4	0.38	6.5	0.3	3	0.7	-
071A-N-060	**W030B**	201	3800	2.2	-	6.4	3084	2585	4.0	2.3	4.1	29	-	4.4	0.38	6.5	0.3	3	0.7	-
071C-N-040	**W030B**	137	2500	6.6	8.8[1)2)]	8.8	2706	2375	8.8	7.0	8.8	56	100[1]	11.9	0.38	11	0.3	3	1.2	1.9[1]
071C-N-040	**W030B**	110	2500	6.6	7.2[1)2)]	11.8	2505	2175	11.8	7.0	7.2	83	100[1]	11.9	0.38	11	0.3	3	1.2	1.9[1]

Mains input 3 x 230 V AC																			
Motor	Controller	ÜF	n_{max}	M_{dN}		M_{max} - n_{100} - n_{90}			M_{100} - M_{90}		M_{KB} - ED - ED			J_M	J_B	m_M	m_B	M_{Br}	S	
MDD	DKS1.1-	(%)	(min^{-1})	(Nm)	(Nm)	(Nm)	(min^{-1})	(min^{-1})	(Nm)	(Nm)	(Nm)	(%)	(%)	($kgcm^2$)		(kg)	(kg)	(Nm)	(kVA)	
065B-N-060	**W030B**	220	6000	1,5	1,7[1]	4,4	5860	5063	4,1	2,4	2,8	29	38[1]	2,2	0,38	3,9	0,55	3	0,6	0,7[1]
071A-N-060	**W030B**	220	5300	2,2	-	6,0	4856	4191	4,5	2,3	4,4	25	-	4,4	0,38	6,5	0,3	3	0,7	-
071A-N-060	**W030B**	201	5300	2,2	-	6,4	4748	4083	4,5	2,3	4,1	29	-	4,4	0,38	6,5	0,3	3	0,7	-
071A-N-060	**W050A**	220	5300	2,2	-	6,8	4604	3939	4,5	2,3	4,4	25	-	4,4	0,38	6,5	0,3	3	0,7	-
071C-N-040	**W030B**	137	3500	6,6	8,8[1)2)]	8,8	3807	3366	8,8	6,9	8,8	56	100[1]	11,9	0,38	11	0,3	3	1,2	1,9[1]
071C-N-040	**W030B**	110	3500	6,6	7,2[1)2)]	11,8	3607	3166	11,8	6,9	7,2	83	100[1]	11,9	0,38	11	0,3	3	1,2	1,9[1]
071C-N-040	**W050A**	205	3500	6,6	9,9[1]	12,4	3562	3121	12,4	6,9	12,4	28	64[1]	11,9	0,38	11	0,3	3	1,2	1,9[1]
071C-N-040	**W050A**	137	3500	6,6	8,8[1)2)]	17,4	3223	2783	13,4	6,9	8,8	56	100[1]	11,9	0,38	11	0,3	3	1,2	1,9[1]
071C-N-040	**W100A**	220	3500	6,6	9,9[1]	20,5	3013	2573	13,4	6,9	13,1	25	57[1]	11,9	0,38	11	0,3	3	1,2	1,9[1]
090C-N-030	**W050A**	154	3000	10,4	15,0[1)2)]	15,0	3000	3000	15,0	15,0	15,0	48	100[1]	53,0	1,06	23	0,5	11	1,7	2,7[1]
090C-N-030	**W050A**	110	3000	10,4	10,7[1)2)]	23,5	3000	2854	23,5	19,5	10,7	95	100[1]	53,0	1,06	23	0,5	11	1,7	2,7[1]
090C-N-030	**W100A**	200	3000	10,4	16,0[1]	50,0	2299	1886	30,8	19,5	19,4	29	68[1]	53,0	1,06	23	0,5	11	1,7	2,7[1]
093C-N-030	**W100A**	186	2900	19,5	20,8[1]	34,0	2900	2653	34,0	17,6	34,0	33	37[1]	42,0	3,6	22	1,1	11	2,8	3,0[1]
093C-N-030	**W100A**	124	2900	19,5	20,8[1]	48,8	2784	2433	41,0	17,6	23,9	67	75[1]	42,0	3,6	22	1,1	11	2,8	3,0[1]

The maximum torque M_{max} must be limited to the maximum permissible torque of the mechanical structure.

1) Air-cooled motor

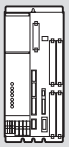
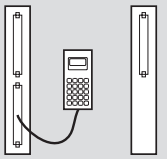
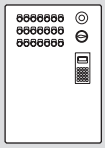
2) Limited to M_{KB} due to controller continuous current rating

Key to symbols used

OF	Overload factor (parameter; input through controller software)
n_{max}	Maximum effective speed
M_{dN}	Continuous standstill torque
M_{max}	Maximum torque up to 400 ms duty cycle
$-n_{100}$	- at 100% mains voltage up to break-point speed "$n_{100\%}$"
$-n_{90}$	- at 90% mains voltage up to break-point speed "$n_{100\%}$"
M_{100}-M_{90}	Torque at maximum speed for 100% or 90% mains voltage
M_{KB}-DC-DC	Short-time operating torque relative to duty cycle DC
J_M	Moment of inertia of the servomotor
J_B	Moment of inertia of the brake
m_M	Motor mass
m_B	Brake mass
M_{Br}	Brake holding torque
S	Connected power

DKS Digital Positioning Module
Ordering Data and Dimensions

Part number 1130-211-10 DKS Digital Positioning Module

Power supply =		Power section =	Feedback for motor		Configuration = (plug-in interface modules with connection accessories)					Control cabinet = (completely wired)		Controller software =		Control system software =		Documentation DKS controller =				
																			
1 x 230 V	3 x 230 V~ via auto-transformer	DKS 1.1-	Resolver feedback R	Digital servo feedback D	U1	U2	U3	U4		without	with	without	DDS2PC	without	Motion Manager for DLC	without	German D	English E	CD-ROM D	CD-ROM E
01	02	W030B	10	14	DAE				11	00		00	01	00	01	00	11	21	31	41
					DAA				12											
	02	W050A	11	15	DLC	DEA			13		11						15	25		
					DLC	DEA	DEA		14		12									
	04	W100A	12	16	DLC	DEA	DEA	DEA	15		13									
					DSS				16								16	26		

Further configurations, combinations and options, e.g. external control desk, decade switch, displays and customized programs, can also be supplied.

Motor and feedback cable to DKS

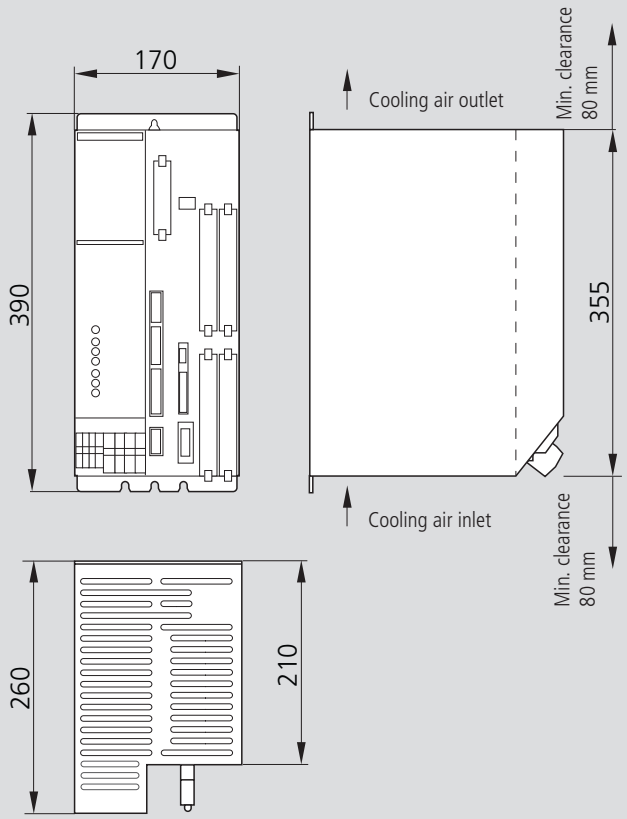
Motor assignment	Part number…, Length in m (max. 75 m)	Preassembled cable options Motor side with connector	Controller side without connector for DKS
MKD 025B-144… **MKD 041B-144…**	1130-001-17,…	01	40
MKD 071B-097…	1130-001-15,…	02	41
MKD 090B-085…	1130-001-40,…	03	42
MDD 065B-N-060… **MDD 071A-N-060…**	1130-001-17,…	04	43
MDD 071C-N-040…	1130-001-15,…	05	44
MDD 090C-N-030…	1130-001-25,…	06	45
MDD 093C-N-030…	1130-001-40,…	03	42

Ordering example

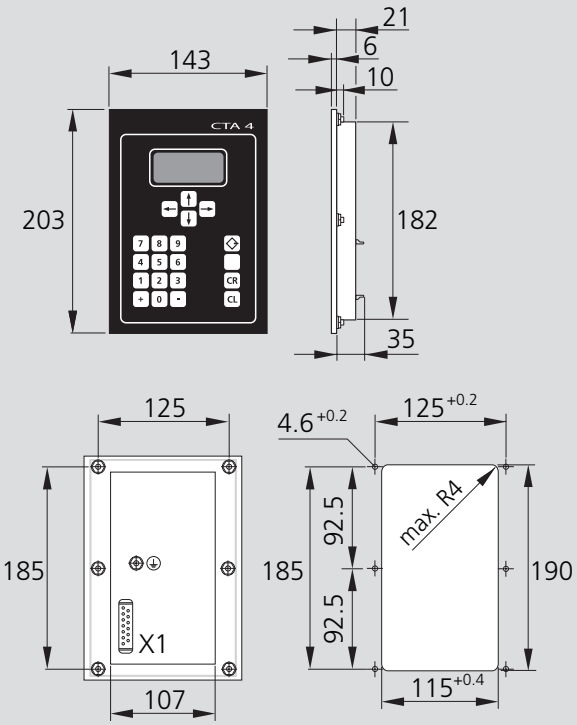
Ordering data		Explanation
Part number 1130-211-10		DKS Digital Positioning Module
Power connections	= 02	Three-phase connection via autotransformer
Power section	= 15	Power section DKS 1.1-W050A with 50 A rated current for operation of an MDD motor with digital servo feedback
Configuration	= 14	DLC positioning interface with two DEA I/O boards
Control cabinet	= 12	Completely wired control cabinet with operating controls and displays in control cabinet door
Controller software	= 00	Without controller software
Control system software	= 01	"Motion Manager" PC program for programming and parametrizing the DLC positioning interface
DKS Documentation	= 15	Documentation for DKS with DLC (German)

Dimensions

DKS Digital Positioning Module



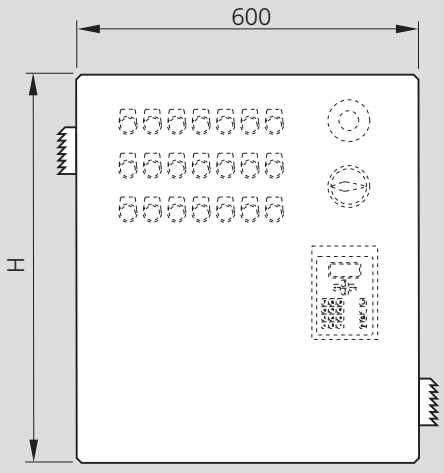
CTA 4



Mounting cutout
max. perm. panel thickness
5 mm

Control cabinet

	Control cabinet options	
	11	12. 13
H (mm)	760	1000



350 mm deep

DDS Digital Controller with CLM Analog Positioning Module
Product Overview

The digital AC servo drive system sets new standards in terms of dynamic response, smooth running and positioning accuracy. Its decentralized intelligence facilitates additional functions, such as linear interpolation and an electronic cam function.
High power density and a selective axis shutdown, approved by professional trade associations, are further features of this drive system.

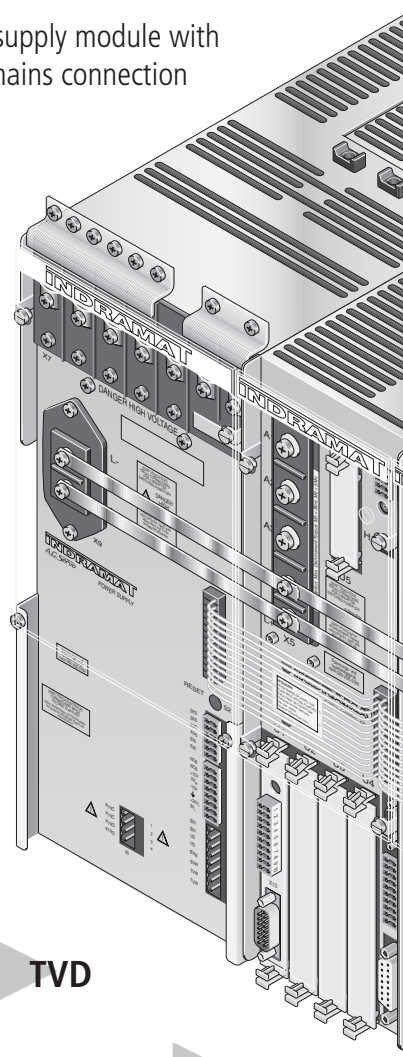
Maximum feedrates due to a precisely matched combination of:

- Power supply module with direct mains connection and mains regeneration capability
- Digital drive controller
- Servomotors with digital servo or resolver feedback

Effective drive monitoring and diagnostics significantly speed up start-up procedures and boost system availability. Furthermore, installation is greatly simplified as no separate position encoders and connection cables are required.

Combined with a CNC control system, this equipment can master complex motion sequences.

For optimum use, digital drives require a digital interface to the CNC control system. Digital AC servo drives from Star can be equipped with such an interface.



Power supply module with direct mains connection

Variable number of axes

TVD

DDS 2

Multiple diagnostic capabilities

Different power ratings available

▶ Built-in starting interlock

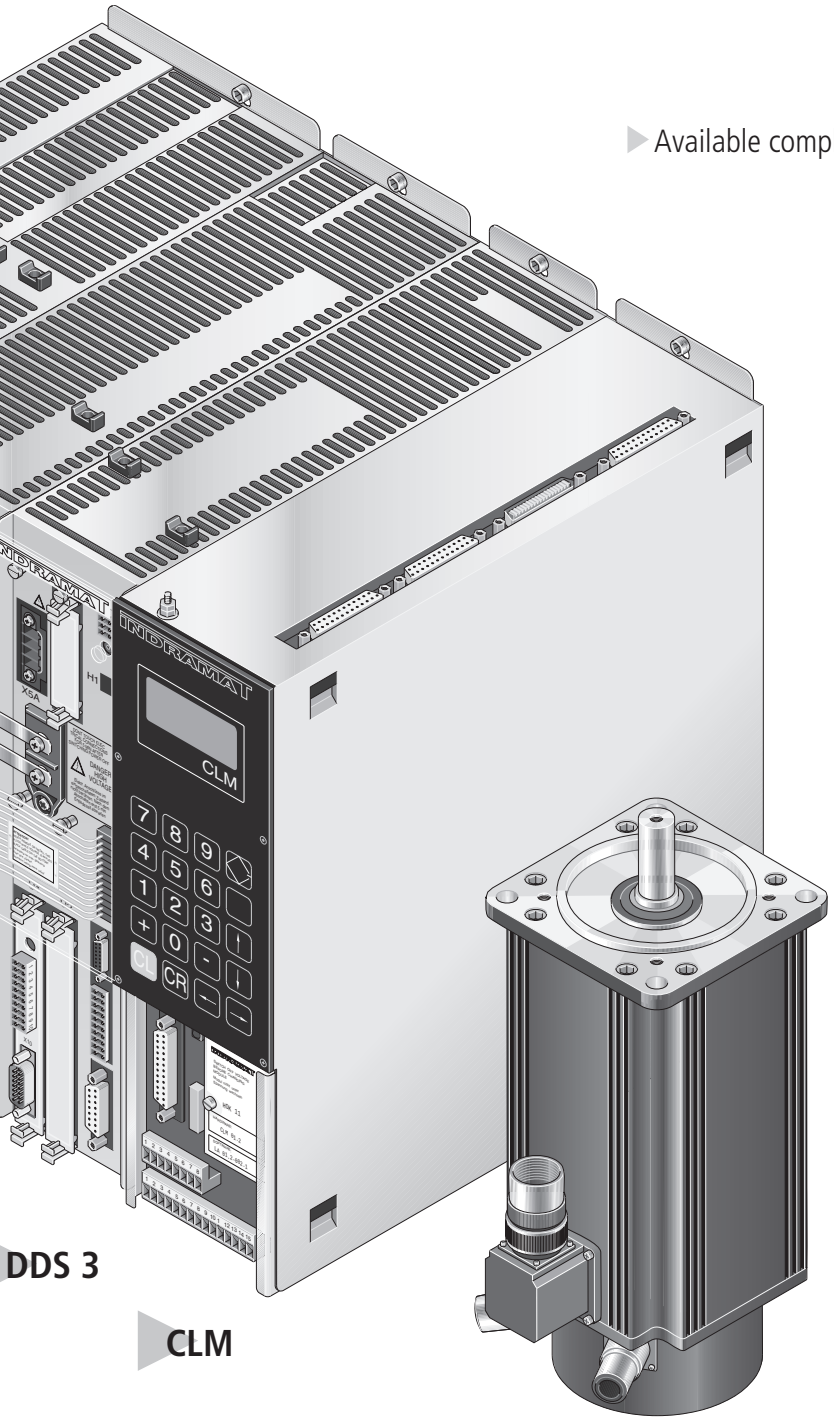
▶ Available complete with control cabinet

▶ Built-in power contactor

▶ Savings on system components

▶ Time-saving start-up

▶ Highly accurate speed and positioning capability



DDS 3

CLM

MDD

▶ Extensive range of interfaces available

DDS Digital Controller Interfaces

Positioning Interface

DDS controllers can be fitted with the DLC positioning interface. (For a description of the DLC, see DKS page 30.)

Analog interface

The following features distinguish digital AC servo drives with analog interface from conventional analog drives:

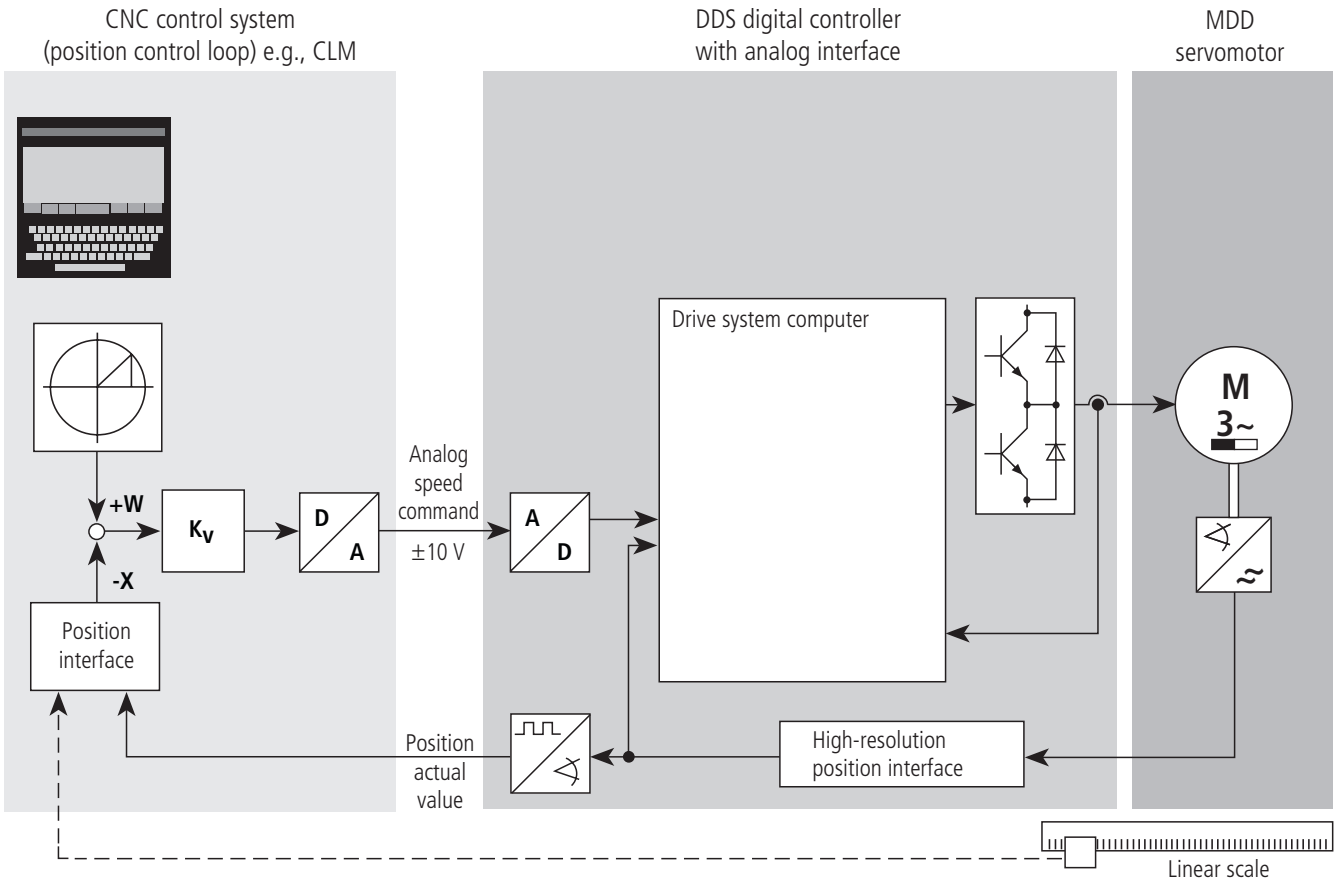
- The controller transmits the rotor position to the NC control system as a position actual value, either as an incremental encoder signal or an absolute-value encoder signal.
- The position encoder signal resolution can be parametrized to match different machine and control system conditions.
- A switching input ensures drift-free stopping of the digital drive.
- For 2-axis (or optionally 4-axis) systems, the analog interface can be used to run the proven CLM positioning module.

Analog interface with DAE incremental encoder emulator

The current axis position is indirectly detected via the digital servo feedback in the motor and processed in the drive control module.
The relative axis position is output to the control system via this interface in the form of squarewave incremental encoder signals. The number of encoder lines can be set via parameters.

Analog interface with DAA absolute-value encoder emulator

The current axis position is indirectly detected via the absolute digital servo feedback or the absolute resolver feedback in the motor and processed in the drive control module.
The absolute axis position is output to the control system via this interface in the form of absolute-value encoder signals in Gray code and SSI format.



DSS SERCOS interface

This digital interface enables all the facilities and benefits of digital AC servo drive technology to be fully utilized.
For example:

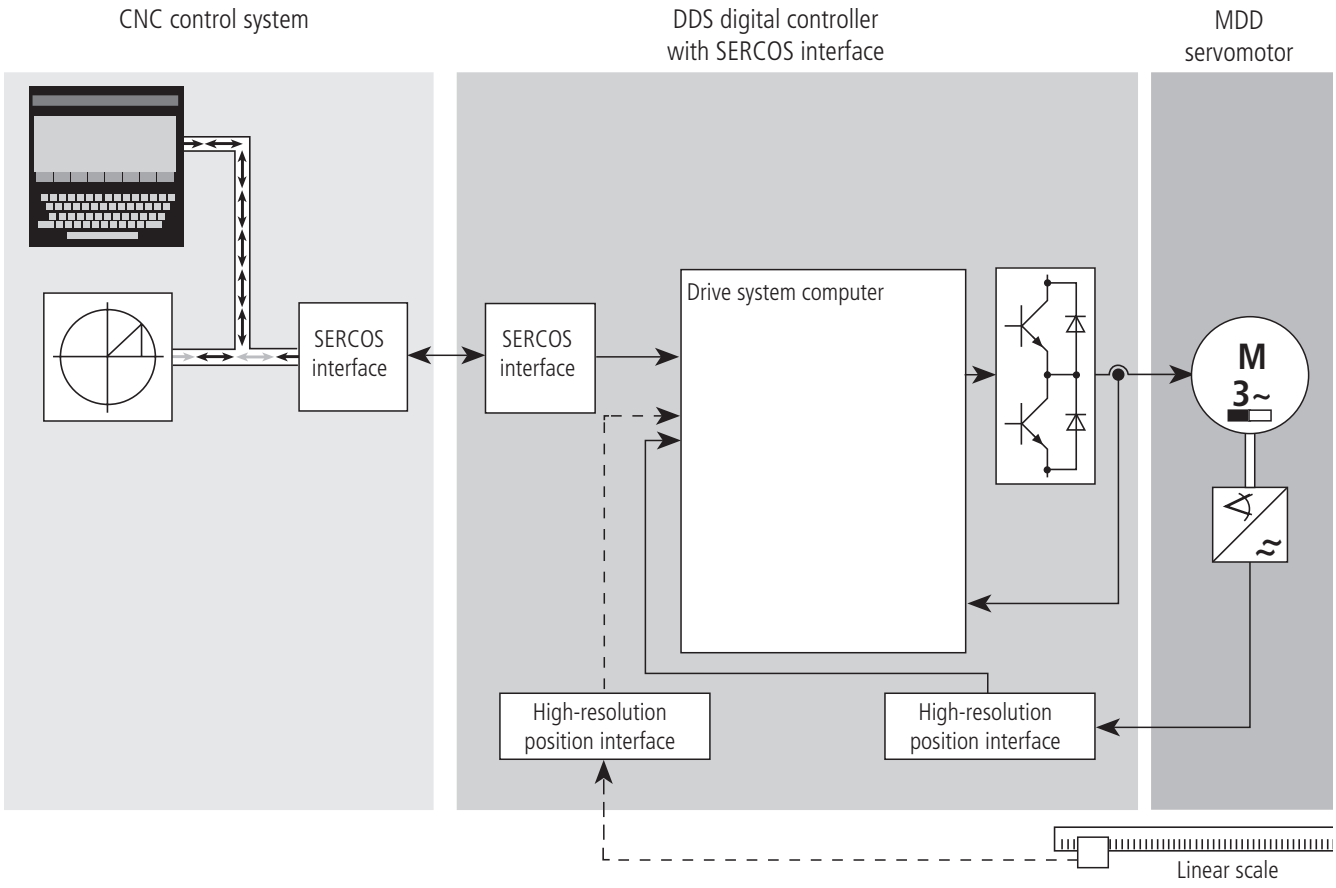
- The SERCOS permits interference-free interaction between control systems and drives of different manufacture via fiber-optic cables.
- The SERCOS interface provides four preselectable drive modes that can be alternated during operation:
  - Position control with indirect position detection in the motor, with or without lag error.
  - Position control with direct position detection via linear scale or rotary encoder in the case of rotary indexing tables, with or without lag error.
  - Speed control
  - Torque control

DLF high-resolution position interface

This interface enables encoders to be connected for direct detection of the displacement or position of moving machine parts. Sinewave current signals from linear scales or rotary encoders are resolved to a factor of 2048 and evaluated.

DEF incremental position interface

This interface enables encoders to be connected for direct detection of the displacement or position of moving machine parts. Squarewave voltage signals from linear scales or rotary encoders are resolved to a factor of 4 and evaluated.



DDS Digital Controller Advantages

Economical

Extensive product range

For almost every customer-specific application, the optimum technical and economical solution can be achieved by utilizing the following components:

- Power supply modules with direct mains connection and mains regeneration, available with internal or external cooling.
- DDS drive controllers with different power ratings, available in 2 different frame widths.
- MKD or MDD servomotors with a continuous torque range from 0.15 Nm to 88 Nm and a speed range from 1500 min $^{-1}$ to 10,000 min $^{-1}$.

High-quality, high-speed machining

- Precision feeding and a high degree of accuracy together with position repeatability provided by the drive's internal position control achieving a resolution of 1/2,000,000 revolutions with digital servo feedback.
- Position control without additional position encoder, or via linear scale on the machine.
- Exceptionally high contouring accuracy at high-speed point-to-point travel due to fine interpolation and lagless internal position control with a cycle time of 250 µs.
- Enhanced surface quality due to low torque ripple factor, high position resolution and short position loop cycle times.
- Linear scales with 0.02 mm measuring grids are scanned with 0.01 µm resolution up to 180 m/min feedrate.
- Parameters are used to match the controllers to different drive mechanisms (gears, screw leads, etc.) and adapt command and actual values to the installed control system.

Savings on system components

- The drive's internal high-resolution position sensing and control capabilities eliminate the need for separate position encoders, interfaces and connection cables.
- Power supply modules designed for direct connection to international three-phase AC mains ranging from 380 V/50 Hz to 460 V/60 Hz eliminate the need for mains transformers.
- Built-in power contactor and safety shutdown.

Easily integrated

Convenient and rapid start-up

- User-friendly data input and display directly on the NC terminal.
- NC-independent start-up using a graphic-based PC program.
- Easy adaptation to different machines and control systems by means of parameter input.
- Rapid diagnosis of all operating statuses provided by displays with clear text messages for localization and elimination of any malfunctions.
- Rapid initial start-up and recommissioning of standard machines by loading complete parameter sets.

Safe

Safe selective shutdown

The starting interlock built into the drive controllers is a safety function approved by professional trade associations. This makes it possible to secure individual motors in physically separated work areas against unintentional start-up after stopping to protect persons present in the danger zone. For the user, this results in the following advantages:

- Controllers for separate work areas can be powered by one single power supply module.
- No need for motor contactors in the motor supply cables.
- Controlled motor braking in the event of a mains power cut.
- Individual axes can be driven separately in setup mode.

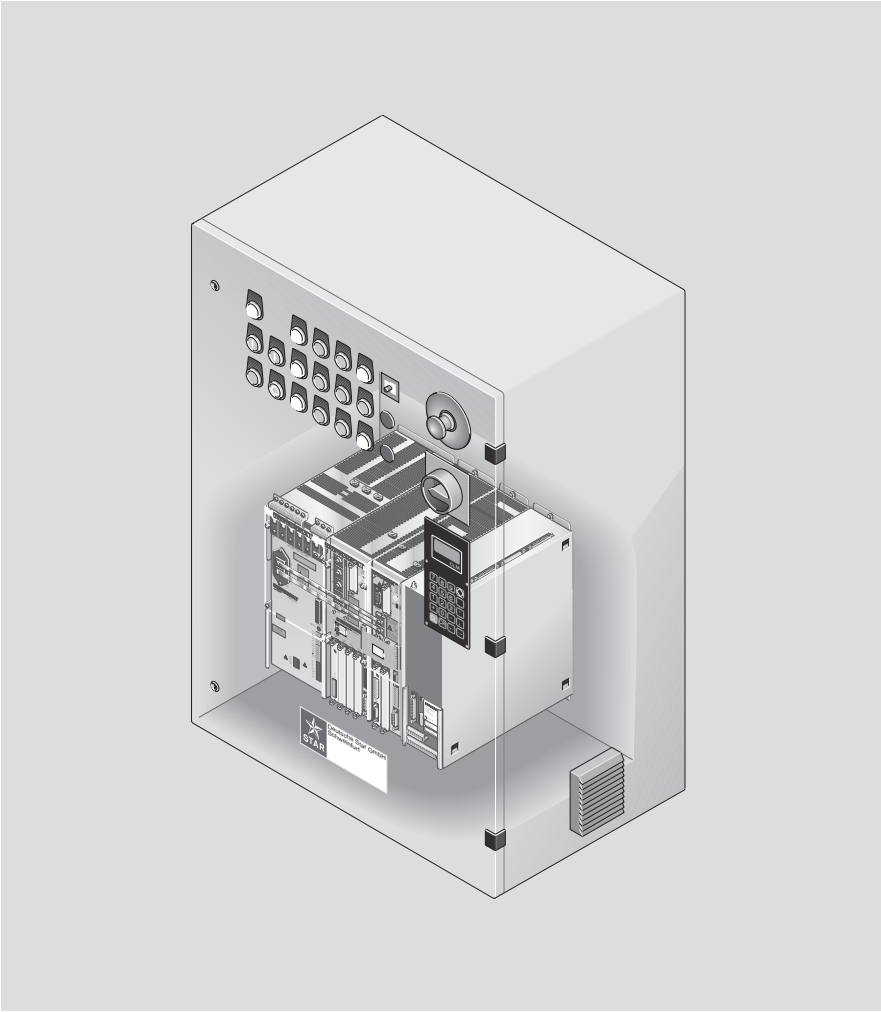
Completely wired up in the control cabinet with CLM control module

Available as a positioning unit completely wired in the control cabinet, with circuit diagram and documentation.

- Triple-lock power switch
- E-STOP mushroom-head pushbutton
- Signal lamps for power on, setup/ automatic mode, malfunction
- Pushbutton for start/stop, axis forward/ backward, release brake
- Selector switch for setup/automatic mode
- Key switch for parameter input
- Inputs/outputs wired to terminal side
- CLM keyboard for positioning control module installed in the control cabinet door

Further options on request:

- External control desk
- Additional instrumentation
- Installation of additional control and display elements
- Installation of decade switches
- Wiring on mounting board for installation in existing control cabinets
- Programming to customer specifications



CLM Controller
Technical Data

Control module details

- 2 axes (4 axes optional)
- Linear interpolation
- Units definable in mm, m, inches, degrees, radians, etc.
- Programmable incremental or absolute dimensions
- Speed selection as ‰ of v_{max}
- Maximum system and manual speeds programmable using parameters
- Feedrate and zeroing speed programmable in the user program
- Microprocessor with 32-bit format

Operating modes

Parameter input, setup, automatic

Program data

- Programs of up to 3000 blocks
- Nesting of up to 127 subroutine levels

Display

- Four-line LCD
- Choice of languages: German, English, French, Spanish, or Italian

Interfaces

- Parallel interface:
  - 16 system inputs and 16 system outputs
- Machine functions:
  - 16 inputs and 16 outputs, freely programmable in the user program
  - Expandable up to 80 inputs and 48 outputs (optional)

    Input level: "On" = 24 V DC
    "Off" ≤ 1.5 V DC

    Output level: 24 V DC
    I_{max} = 50 mA per output
- Controller interface:
  - 4 analog inputs ± 10 V
  - 2 analog outputs ± 10 V for actuation of 2 servo drives
  - 4 analog outputs ± 10 V for actuation of 4 servo drives (optional)
- Data interface:
  - Serial: either RS 232, RS 422 or RS 485
  - Selectable transmission format
  - Baud rate from 110 bps to 19,200 bps
- Measuring system interface:
  - For linear or rotary incremental encoders: 1 MHz maximum sampling frequency
  - For synchronous absolute-value encoders: synchronous serial transfer in Gray code, 250 kHz clock frequency

Power supply

+24 V DC; +/-20%, 1.5 A supplied by internal drive electronics

Environmental conditions

- Cooling method: natural convection
- Protection class: IP10
- Ambient temperature: 5 °C to 45 °C
- Storage temperature: - 30 °C to 85 °C
- Maximum operating altitude: 1000 m

Programming and parameter input

The program, parameters and data can be input into the CLM in various ways:

- with the 20-digit CLM membrane keyboard
- with the SOT intelligent programming terminal (optional)
- with the IDS decade switch unit or decade switches (optional)
- with an intelligent unit such as PC or PLC

The "Motion Manager" software package can be supplied (as an option) for convenient programming, parameter input and data backup using a commercially available AT or XT PC.

Programming Commands / Software

Feed commands

POI	Incremental feed with immediate progression to next block
PSI	Incremental feed with progression to next block on reaching target position
POM	Incremental feed via IDS decade switch unit or via inputs, with immediate progression to next block
PSM	Incremental feed via IDS decade switch unit or via inputs, with progression to next block on reaching target position
POA	Absolute feed with immediate progression to next block
PSA	Absolute feed with progression to next block on reaching target position
CON	Continuous running of an axis
ACC	Change acceleration
VCC	Change velocity
HOM	Move axis to home position
REF	Move axis to reference point (search)
REP	Limitation of search path for moving to reference point
FOL	Follower axis; slave axis performs all motions synchronously with master axis
PST	Position check
PBK	Termination of positioning cycles
COC	Cam control; 6 outputs are switched according to current position

Jump commands

JSR	Jump to subroutine
RTS	Return from subroutine
JMP	Jump to a program line
JST	Jump to a program line and then stop the program
BCA	Jump with output logic gating
BMB	Execute block with output logic gating
BCB	Jump to calculated target block with binary input setting
BCD	Jump to calculated target block with decimal input setting
BCE	Jump with input logic gating
BPE	Jump with logic gating of 10 inputs
BIO	Jump with input and output logic gating
BPA	Jump with logic gating of 10 outputs
BPT	Jump on reaching target axis position
BZP	Jump at position overrun
CST	Clear subroutine stack

Input example:

PSA 1 + 002500.00 600

Axis 1 will be positioned to absolute position 2500.00 mm at 600 ‰ of the maximum velocity selected. Once the axis is in position, the program moves to the next command block.

Motion Manager software

The control system can be started up without any additional software. If required, however, the "Motion Manager" software package (part number 1135-200-01) can be supplied as an option for convenient programming, data backup and program optimization.

Input and output commands

AEA	Switch output on/off
AKN	Interrogate input status
APE	Set 10 outputs simultaneously
ATS	Interrogate output status
AKP	Interrogate status of 10 inputs simultaneously
CIO	Copy I/O status
APJ	Set 10 outputs with program branching

Counter commands

BAC	Jump with workpiece count
COU	Count
CLC	Reset counter

Miscellaneous commands

WAI	Wait for set time delay
NOP	Blank line, no operation
SCA	Setup axis to a new absolute position
STH	Send to host computer
CLA	Clear absolute positioning
FAK	Multiplication factor
SO1	Read in position information via selector switches or PLC
SO2	Correct a position via analog input
VEO	Velocity override
WRI	Store an absolute position value
KDI	Copy position difference

DDS Digital Controller
Performance Data and Dimensions

MKD motor with DDS Controller

MKD selection data for DDS 2 and DDS 3 controllers with unstabilized DC link circuit voltage (TVM)

Motor	Controller	OF	n_{max}	M_{dN}	M_{max} - n_{100} - n_{90}			M_{100} - M_{90}		M_{KB} - DC		J_M	J_B	m_M	m_B	M_{Br}	P_{BM}	P_{DC}
MKD	DDS-	(%)	(min^{-1})	(Nm)	(Nm)	(min^{-1})	(min^{-1})	(Nm	(Nm	(Nm)	(%)	($kgcm^2$)		(kg)	(kg)	(Nm)	(kW)	(kW)
025B-144	**1.1-W030**	220	6200	0.8	3.4	8152	7032	2.4	1.2	1.6	25	0.3	0.08	2	0.25	1	0.56	2.90
041B-144	**3.1-W030**	133	5100	2.7	9.9	5100	3705	5.8	2.6	3.6	57	1.7	0.16	4.4	0.25	2.2	3.5	1.44
041B-144	**3.1-W030**	200	5100	2.7	5.2	5100	4598	5.8	2.6	5.2	27	1.7	0.16	4.4	0.25	2.2	2.31	1.44
041B-144	**3.1-W030**	207	5100	2.7	11.0	4111	3489	5.8	2.6	5.4	25	1.7	0.16	4.4	0.25	2.2	3.62	1.44
071B-097	**3.1-W050**	103	3600	8.0	19.2	3348	2886	15.4	8.5	7.9	100	8.7	0.38	8.8	0.37	5	5.9	2.98
071B-097	**2.1-W100**	207	3600	8.0	32.0	2499	2037	15.4	8.5	15.4	27	8.7	0.38	8.8	0.37	5	8.3	3.02
090B-085	**3.1-W050**	72	3200	12.0	21.3	2819	2444	12.6	4.0	8.7	100	43.0	1.10	14	0.65	11	5.78	2.92
090B-085	**3.1-W050**	144	3200	12.0	21.3	2819	2444	12.6	4.0	16.9	51	43.0	1.10	14	0.65	11	5.78	4.02
090B-085	**2.1-W100**	144	3200	12.0	39.6	2017	1642	12.6	4.0	16.9	51	43.0	1.10	14	0.65	11	8.37	4.02
090B-085	**2.1-W100**	200	3200	12.0	29.2	2473	2098	12.6	4.0	23.6	26	43.0	1.10	14	0.65	11	7.34	4.02
090B-085	**2.1-W150**	200	3200	12.0	48.0	1648	1273	12.6	4.0	23.6	26	43.0	1.10	14	0.65	11	8.6	4.02

MDD motor with DDS Controller

MDD selection data for DDS 2 and DDS 3 controllers with unstabilized DC link circuit voltage (TVM)

Motor	Controller	OF	n_{max}	M_{dN}		M_{max} - n_{100} - n_{90}			M_{100} - M_{90}		M_{KB} - DC -DC			J_M	J_B	m_M	m_B	M_{Br}	P_{DC}	
MDD	DDS-	(%)	(min^{-1})	(Nm)	(Nm)	(Nm	)(min^{-1})	(min^{-1})	(Nm)	(Nm)	(Nm)	(%)	(%)	($kgcm^2$)		(kg)	(kg)	(Nm)	(kW)	(kW)
065B-N-060	**3.1-W030**	220	6000	1.5	1.7[1]	3.8	6000	5329	3.8	2.4	2.8	29	37[1]	2.2	0.38	3.9	0.55	3	0.3	0.39[1]
065B-N-060	**3.1-W030**	192	6000	1.5	1.7[1]	4.4	5860	5063	4.1	2.4	2.5	36	46[1]	2.2	0.38	3.9	0.55	3	0.3	0.39[1]
065B-N-060	**3.1-W050**	220	6000	1.5	1.7[1]	4.4	5860	5063	4.1	2.4	2.8	29	37[1]	2.2	0.38	3.9	0.55	3	0.3	0.39[1]
071A-N-060	**3.1-W030**	200	5300	2.2	-	4.0	5300	4784	4.0	2.3	4.0	30	-	4.4	0.38	6.5	0.3	3	0.4	-
071A-N-060	**3.1-W030**	133	5300	2.2	-	6.3	4774	4109	4.5	2.3	2.9	60	-	4.4	0.38	6.5	0.3	3	0.4	-
071A-N-060	**3.1-W050**	220	5300	2.2	-	6.7	4634	3968	4.5	2.3	4.3	26	-	4.4	0.38	6.5	0.3	3	0.4	-
071C-N-040	**3.1-W050**	137	3500	6.6	8.8[1)2)]	17.4	3227	2786	13.4	6.9	8.8	56	100[1]	11.9	0.38	11	0.3	3	0.8	1.28[1]
071C-N-040	**2.1-W100**	220	3500	6.6	9.9[1]	20.5	3017	2576	13.4	6.9	13.1	26	57[1]	11.9	0.38	11	0.3	3	0.8	1.28[1]
090C-N-030	**2.1-W100**	200	3000	10.4	16.0[1]	49.5	2314	1902	30.8	19.5	19.3	29	69[1]	53.0	1.06	23	0.5	11	1.1	1.85[1]
093C-N-030	**2.1-W100**	186	2900	19.5	20.8[1]	34.0	2900	2653	34.0	17.6	34.0	33	37[1]	42.0	3.6	22	1.1	11	1.9	2.08[1]
093C-N-030	**2.1-W100**	124	2900	19.5	20.8[1]	48.8	2784	2433	41.0	17.6	23.9	67	76[1]	42.0	3.6	22	1.1	11	1.9	2.08[1]

Controllers with stabilized DC link circuit voltage (TVD) permit operation at higher speeds in certain cases.
The maximum torque M_{max} must be limited to the maximum permissible torque of the mechanical structure by adjusting the controller parameters during initial start-up.

1) Air-cooled motor

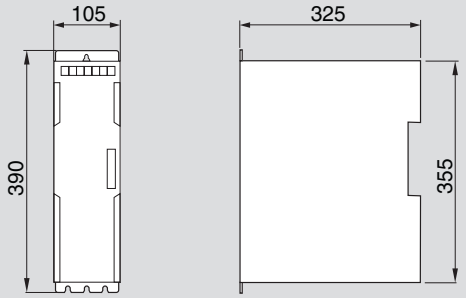
2) Limited to M_{KB} due to controller continuous current rating

Key to symbols used

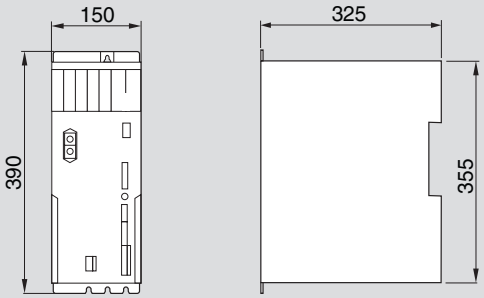
OF	Overload factor (parameter; input through controller software)
n_{max}	Maximum effective speed
M_{dN}	Continuous standstill torque
M_{max}	Maximum torque up to 400 ms duty cycle
$-n_{100}$	- at 100% mains voltage up to break-point speed „$n_{100\%}$"
$-n_{90}$	- at 90% mains voltage up to break-point speed „$n_{100\%}$"
M_{100}-M_{90}	Torque at maximum speed for 100% or 90% mains voltage
M_{KB}-DC-DC	Short-time operating torque relative to duty cycle DC
J_M	Moment of inertia of the servomotor
J_B	Moment of inertia of the brake
m_M	Motor mass
m_B	Brake mass
M_{Br}	Brake holding torque
P_{BM}	Peak mains feedback power
P_{DC}	DC link circuit continuous power rating

Dimensions

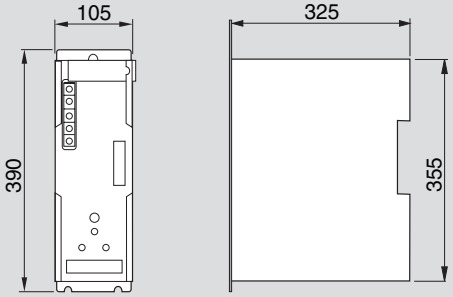
NAM mains connection module



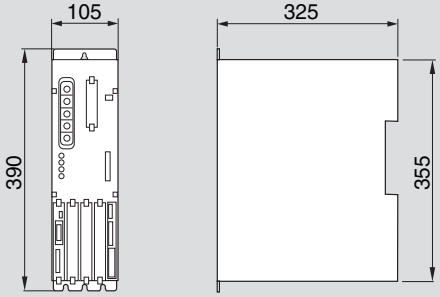
TVD power supply module



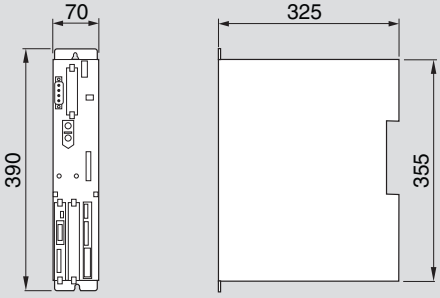
TVM power supply module



DDS 2 controller module



DDS 3 controller module



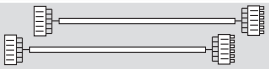
DDS Digital Controller
Ordering Data

Part number 1130-211-20 DDS Digital Controller

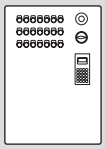
Power supply		Power section						Configuration (Interface modules with connection accessories)		
TVM	TVD	DDS3.1 / DDS2.1				Feedback for motor MKD	Feedback for motor MDD	Slot		
Unstabilized DC link circuit voltage	Stabilized DC link circuit voltage	Controller for	DDS... controller Axis 1	Axis 2	Axis 3	Axis 4	Resolver feedback R	Digital servo feedback D	U1	U2	
10		2 axes	**3.1-W030**	**3.1-W030**			21	51	DAE	-	21
			3.1-W050	**3.1-W030**			22	52	DAA	-	22
			3.1-W050	**3.1-W050**			23	53	DLC	DEA	23
			2.1-W100	**3.1-W030**			24	54	DSS	-	24
11	12		**2.1-W100**	**3.1-W050**			25	55			
			2.1-W100	**2.1-W100**			26	56			
	20	3 axes	**3.1-W030**	**3.1-W030**	**3.1-W030**		31	61	DAE	-	31
			3.1-W050	**3.1-W030**	**3.1-W030**		32	62	DAA	-	32
			3.1-W050	**3.1-W050**	**3.1-W030**		33	63	DLC	DEA	33
			3.1-W050	**3.1-W050**	**3.1-W050**		34	64	DSS	-	34
			2.1-W100	**3.1-W050**	**3.1-W030**		35	65			
	21		**2.1-W100**	**3.1-W050**	**3.1-W050**		36	66			
	30	4 axes	**3.1-W030**	**3.1-W030**	**3.1-W030**	**3.1-W030**	41	71	DAE	-	41
			3.1-W050	**3.1-W030**	**3.1-W030**	**3.1-W030**	42	72	DAA	-	42
			3.1-W050	**3.1-W050**	**3.1-W030**	**3.1-W030**	43	73	DLC	DEA	43
			3.1-W050	**3.1-W050**	**3.1-W050**	**3.1-W030**	44	74	DSS	-	44
	31		**3.1-W050**	**3.1-W050**	**3.1-W050**	**3.1-W050**	46	76			
			2.1-W100	**3.1-W050**	**3.1-W050**	**3.1-W030**	45	75			
			2.1-W100	**2.1-W100**	**3.1-W050**	**3.1-W050**	47	77			
			2.1-W100	**2.1-W100**	**2.1-W100**	**2.1-W100**	48	78			

The power supply is designed for an average effective speed of up to 25% of the maximum rated speed.
Further configurations, combinations and options, e.g. external control desk, decade switch, displays and customized programs, can also be supplied.

Motor and feedback cable to DDS



Motor assignment	Part number,… Length in m (max. 75 m)	Cable supply condition Motor side with connector	Controller side without connector for DDS2.1	DDS3.1
MKD 025B-144… **MKD 041B-144…**	1130-001-17,…	01	20	30
MKD 071B-097…	1130-001-15,…	02	21	31
MKD 090B-085…	1130-001-40,…	03	22	32
MDD 041B-N-100… **MDD 065B-N-060…** **MDD 071A-N-060…**	1130-001-17,…	04	23	33
MDD 071C-N-040…	1130-001-15,…	05	24	34
MDD 090C-N-030…	1130-001-25,…	06	25	35
MDD 093C-N-030…	1130-001-40,…	03	22	32

Multi-axis control module CLM			Control cabinet (completely wired)		Controller software		Control system software		Documentation DDS controller					Documentation Multi-axis control module		
																
without	16 Is 16 Os	80 Is 48 Os	without	with	without	DDS2PC	without	Motion manager for DLC or CLM	without	German D	English E	CD-ROM[1] D	CD-ROM[1] E	without	German D	English E
	21			21						11	21				11	21
		23		22				01								
										15	25				-	-
										16	26				-	-
	31			31						11	21				11	21
		33		32				01								
00			0		00	01	00		00	15	25	31	41	00	-	-
										16	26				-	-
	41			41						11	21				11	21
		43		42				01								
										15	25				-	-
										16	26				-	-

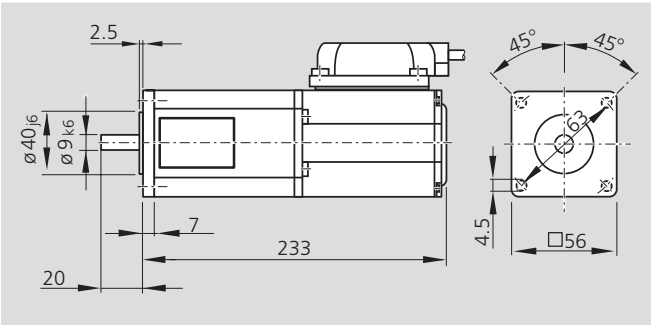
[1] The CD-ROM contains the documentation for both the controller and the multi-axis control module.

Ordering example

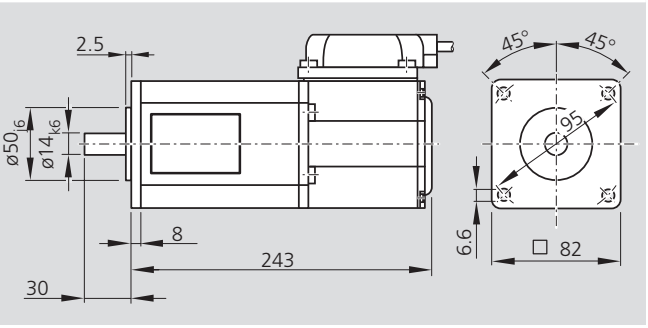
Ordering data		Explanation
Part number 1130-211-20		Servo control system with DDS controllers
Power supply module	= 10	The TVM power supply module provides the DC voltage for the DDS controllers
Power section	= 55	Power output section for operation of an MDD motor with DDS 2.1 W100 controller or MDD motor with DDS 3.1 W050 controller
Configuration	= 21	DAE analog interface with incremental value output
Multi-axis control module	= 21	CLM control module for two axes, with 16 inputs and 16 outputs
Control cabinet	= 21	Completely wired control cabinet with operating controls and displays
Controller software	= 01	"DDS2PC" PC program for controller optimization
Control system software	= 01	"Motion Manager" PC program for programming and parametrizing the DLC or CLM
DDS documentation	= 11	Documentation for DDS controller (German)
Multi-axis control module documentation	= 11	Documentation for CLM multi-axis control module (German)

Servomotors
Dimensions

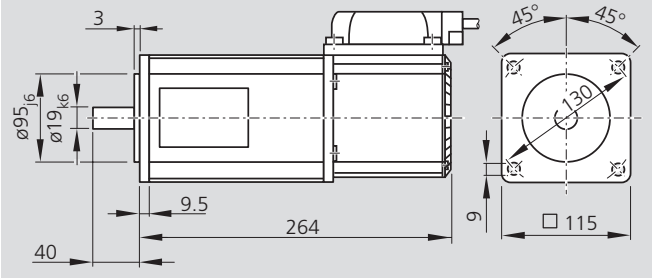
MKD 25B-144-KG1	MKD 25B-144KG0
Part number 8611-050-03	Part number 8611-053-03



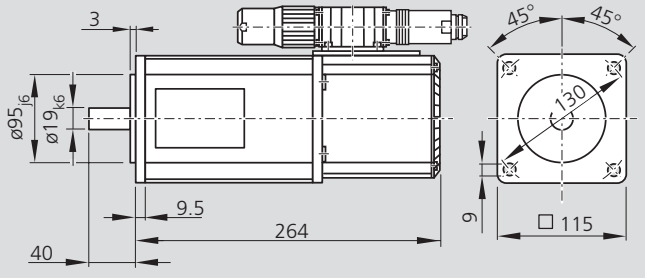
MKD 41B-144-KG1	MKD 41B-144-KG0
Part number 8611-010-03	Part number 8611-054-03



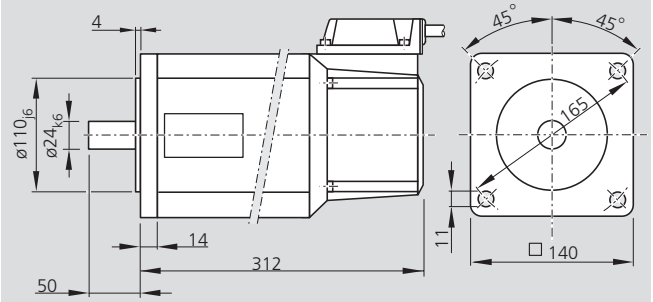
MKD 71B-061-KG1	MKD 71B-061-KG0
Part number 8611-011-03	Part number 8611-055-03



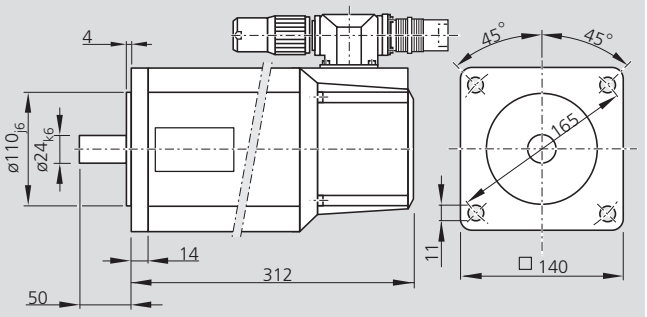
MKD 71B-097-KG1
Part number 8611-012-03



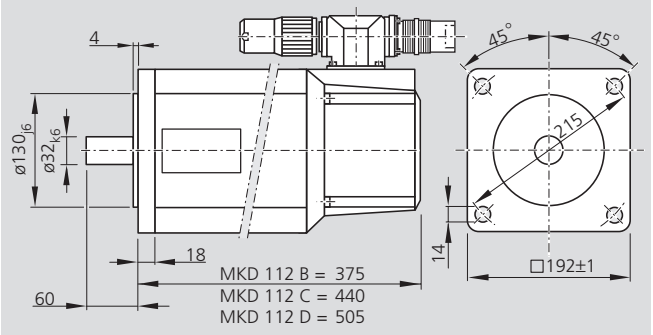
MKD 90B-047-KG1	MKD 90B-047-KG0
Part number 8611-013-03	Part number 8611-056-03



MKD 90B-085-KG1
Part number 8611-014-03



MKD 112

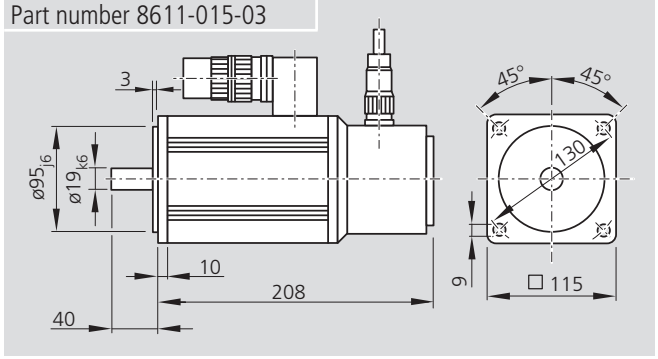


MKD 71B - 061- KG 1 — **Servomotors**

- 1 With holding brake
- 2 Without holding brake
- Cylindrical drive shaft
- Resolverfeedback Multiturn
- Winding code
- Overall motor length
- Motor frame size
- Digital servomotor

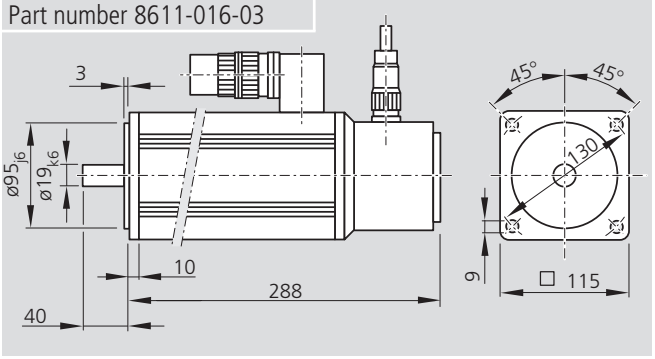
MDD 71A-N-060-N2S-095 GB1

Part number 8611-015-03



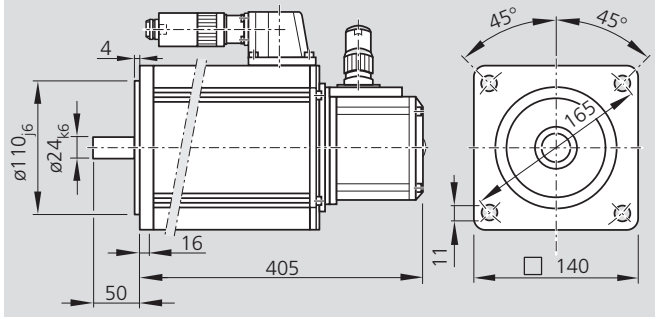
MDD 71C-N-040-N2S-095 GB1

Part number 8611-016-03



MDD 90C-N-030-N2L-110 GA2

Part number 8611-017-03



Frequency Inverter VF1000S SMART DRIVE Product Overview

These compact VF1000S series frequency inverters offer a cost-effective and convenient means of controlling three-phase asynchronous motors.

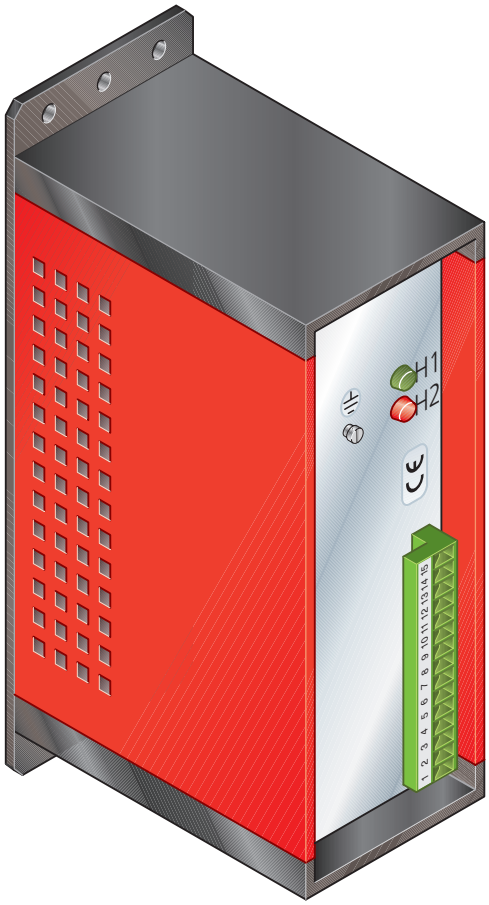
The power spectrum ranges up to 750 W for 4-pole motors. Velocity can be preselected by inputting three fixed frequencies or an analog command value.

Users have a choice of several different options:

From an unwired 2-quadrant frequency inverter through to a completely wired 4-quadrant frequency inverter controlled by PLC.

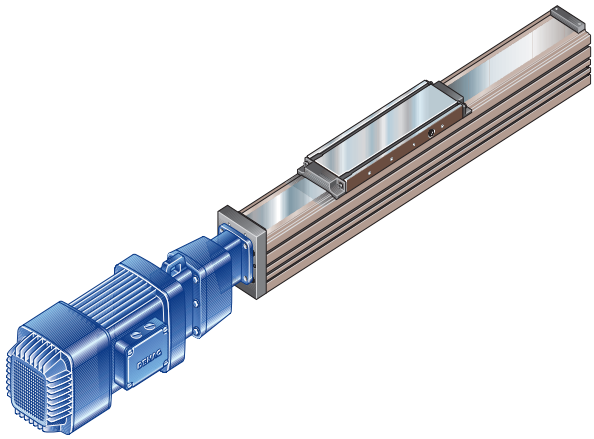
These frequency inverters are mainly employed for tasks involving transporting and positioning with relatively few stations, as well as simple machining or processing operations, such as cutting, sawing, or applying adhesives.

▶ Single or three-phase connection



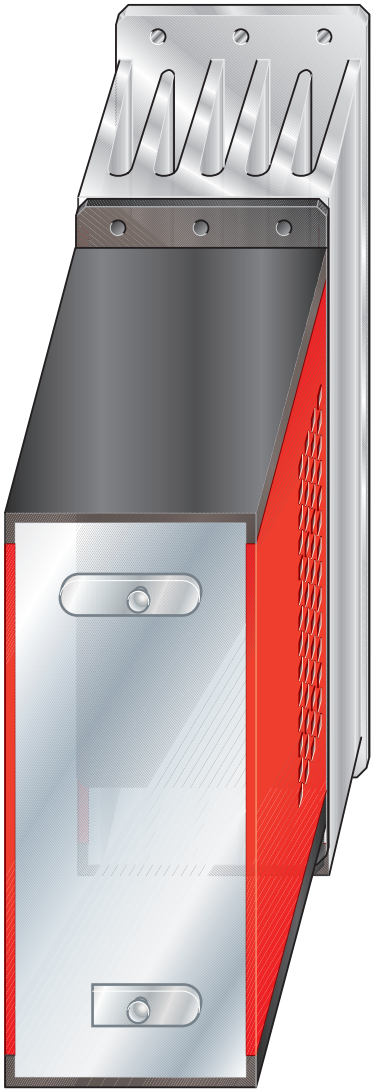
▶ Small, compact devices

Mannesmann Dematic



Braking chopper

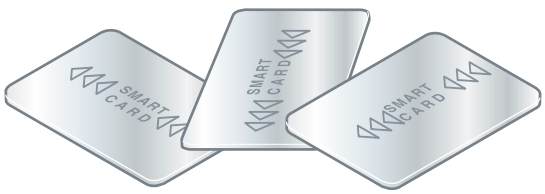
▶ Easy, reliable operation



Basic device with heat sink

▶ Multifunctional KEYPAD operating controls

Basic device with operating control unit



Memory card

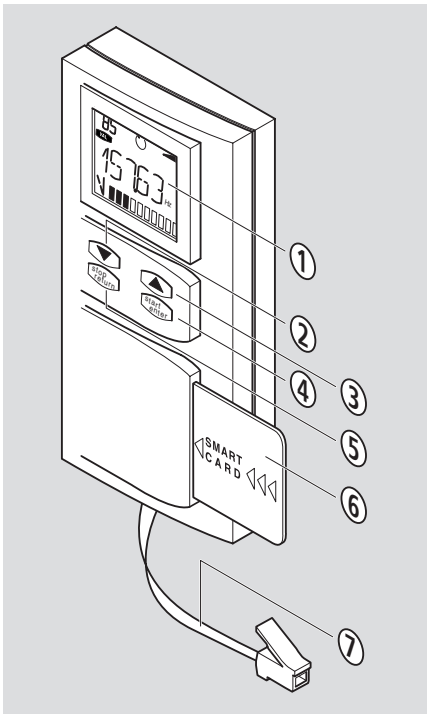
▶ Rapid adaptation via chipcard

Frequency Inverter VF1000S SMART DRIVE Operation and Menu Structure

KEYPAD Operating Controls

The multifunctional KEYPAD helps you keep your drive under control – simply and easily.

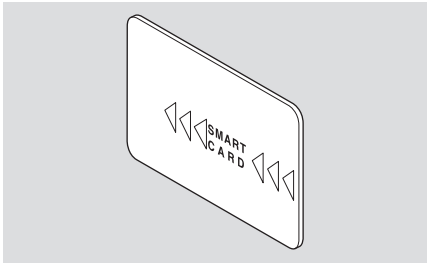
The KEYPAD is detachable and can thus be used to control other frequency inverters in the VF1000 series.



①	LCD display	140 segments, green/red backlit
②	"Down" cursor key	Return within menu structure
③	"Up" cursor key	Continue within menu structure
④	Start/Enter key	Start (CTRL menu), acknowledge message, or select menu
⑤	Stop/Return key	Stop (CTRL menu), cancel, or exit selected menu
⑥	SMARTCARD	Chipcard data memory, for storage of device settings
⑦	Connection cable	Length max. 0.35 m

SMARTCARD memory card

The SMARTCARD serves to store all parameters for data backup and data transmission. Your frequency inverter can be adapted to your application in a matter of seconds. Simply slot the SMARTCARD into the KEYPAD and press the appropriate keys to read data from or save it to the SMARTCARD.



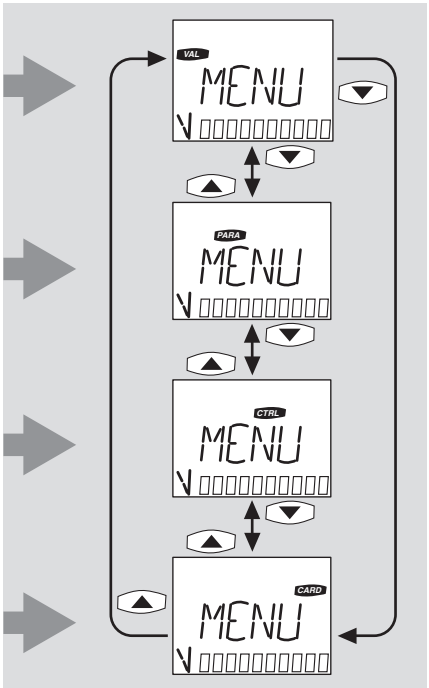
Main menus

VAL menu: displays actual values

PARA menu: changes parameters

CTRL: controls motor via KEYPAD

CARD menu: loads/stores device settings (GE) with the SMARTCARD (SC)

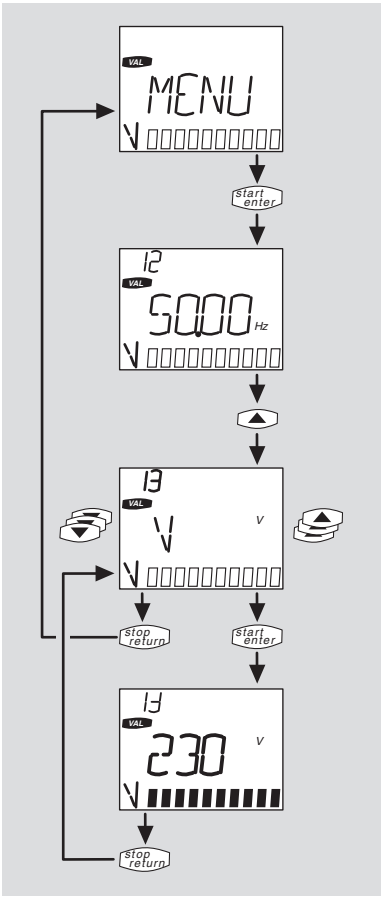


VAL menu (actual values) selected

Display actual values

Next actual value parameter

Establish new actual value



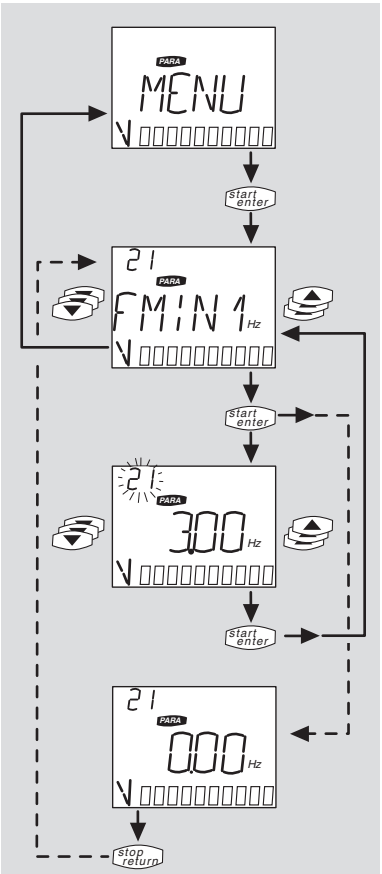
PARA menu (parameters) selected

Continue with Start/Enter

Select parameter, e.g., FMIN1

Change parameter setting in off-line mode (inverter stop)

Read parameter setting in on-line mode (inverter start)

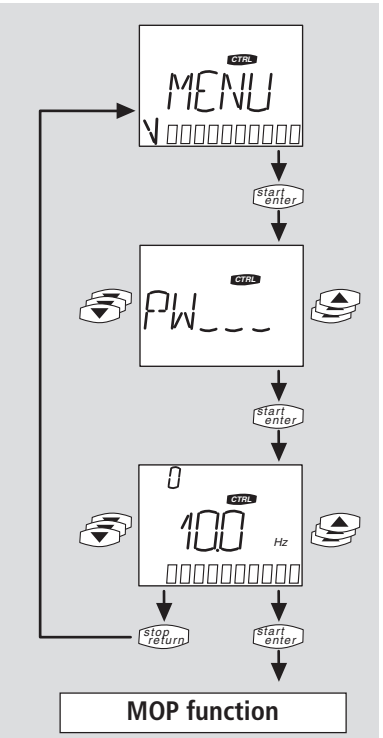


CTRL menu (control motor using KEYPAD) selected

Enter password
Factory setting = 573

Set frequency value (KEYPAD), e.g. 10 Hz

Start/Enter for activation of motor-operated potentiometer function (MOP)

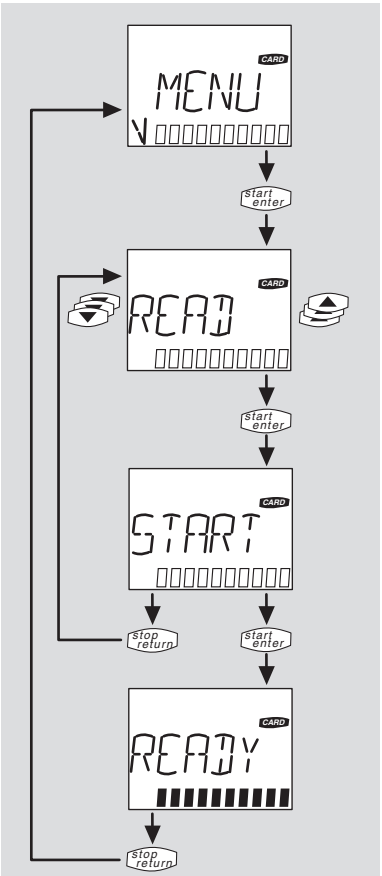


Load/store menu for device setting (GE) using the SMARTCARD (SC)

READ = load GE from SC
WRITE = save GE to SC
LOCK = write protect SC
UNLCK = cancel write protect

Start selected function using Start/Enter key

Function completed without error



Frequency Inverter VF1000S SMART DRIVE
Technical Data and Dimension Drawings

Motor-side output

	P (W)	S[1] (VA)	U (V)	I_N[1] (A) 230 V	I_N[1] (A) 400/460 V	1.1 x I_N[1] (A) 230 V	1.1 x I_N[1] (A) 400/460 V	1.5 x I_N[1] (A)	f (Hz)	Frequency resolution (%)
VF1202S	375	840	3x0 to 230	1.9	-	2.1	-	2.9	0 to 400	0.1 of F_{max} (0.05 Hz min.)
VF1204S	750	1400		3.2	-	3.5	-	4.8		
VF1402S		1450	3x0 to 400/460	-	1.9/1.7	-	2.1/1.9	2.9		

Mains-side input

	Mains voltage (V)	Asymmetrical mains voltage (%)	F (Hz)	I (A) T	η[1) 2)] (%)	P_V[2)] (W)
VF1202S	1 x 230 +15/-20%	-	48 to 62	1 x 10	96	25
VF1204S				1 x 10	95	35
VF1402S	3 x 400 -15% 3 x 460 +10%	≤ 3		3 x 10	94	45

Environmental conditions

	T_N (°C)	Cooling type	$_rF$ (%)	ΔP_T (%/°C)	ΔP_H (%/m)	T_L (°C)	T_T (°C)	Permissible vibration	Protection	Mounting
VF1202S	0 to 40	Convection	15 to 85, non dewing (VDE0160)	2,5 for range 40 to 50 °C	5 per 1000 m over 1000 m above s.l.: max. 2000 m above s.l.	-25 to +55 (VDE0160)	-25 to +70 (VDE0160)	2 g (IEC 68-2-6)	IP20, VBG4, NEMA1	vertical wall mounting
VF1204S										
VF1402S										

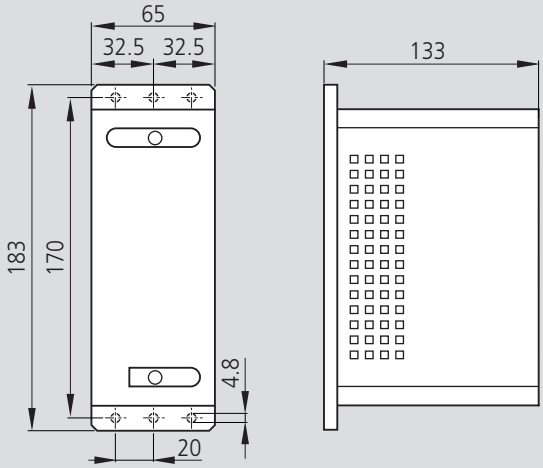
Key to symbols used

1) referred to output section switching frequency of 8 kHz
2) at rated voltage and rated current

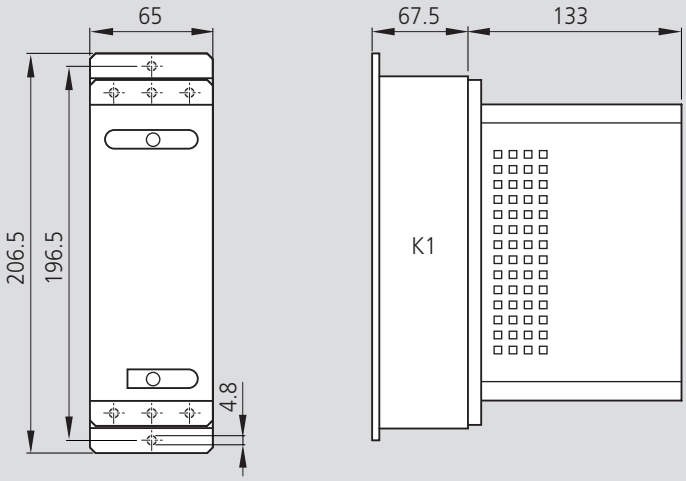
P	Recommended power rating with 4-pole standard motor
S	Device power rating referred to mains voltage
U	Voltage
I_N	Phase current
1.1 x I_N	Continuous current load
1.5 x I_N	Overload factor for 60 s
f	Rotating field frequency
I	Recommended mains protection
η	Efficiency
P_V	Power loss
T_N	Cooling air temperature (1,000 m above sea level)
F	Frequency
rF	Relative humidity
ΔP_T	Power loss as a function of cooling air temperature
ΔP_H	Power loss as a function of mounting altitude
T_L	Storage temperature
T_T	Transport temperature

Dimensions

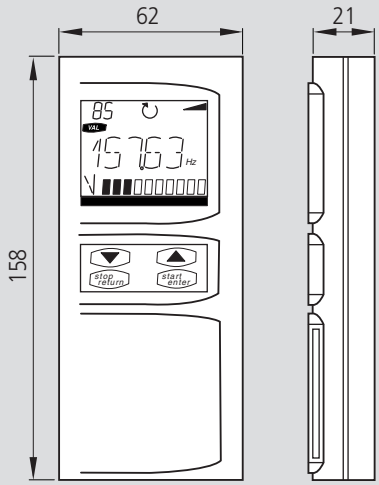
Basic device



Device with heat sink



Operating controls



Frequency Inverter VF1000S SMART DRIVE
Performance Data and Dimensions for BC1300/1400 and Mains Filter

Braking Chopper BC 1300/1400 for VF1000S

Technical Data

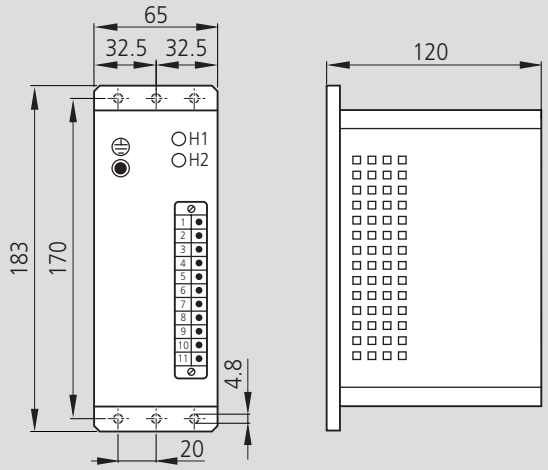
Braking chopper	Inverter	P_{eff} 100% DC (W)	P_{eff} 50% DC (W)	P_{eff} 25% DC (W)	P_{eff} 12% DC (W)	P_{eff} 6% DC (W)	P_p (kW)	P_{red} (kW)	I_{Br} (A) DC	U_{on} (V) DC	U_{off} (V) DC	Type of braking resistor	A (mm^2)	Term. 9/10 DC link circ. connection	Thermostat switch contact
BC1300	VF1202S VF1204S	90	140	210	310	450	1.5	0.7	4.0	390	381	Heating cartridge	1.5	maximum length 0.5 m	250 V ~ 10 A
BC1400	VF1402S								2.7	750	740				

Environmental Conditions

Braking chopper	Protection	T (°C)	H above s.l. (m)	rF (%)	Permissible vibration	Mounting
BC1300	IP10 (in installed condition)	0 to 40	1000 max.	15 to 85, non dewing	2 g (IEC 68-2-6)	vertical wall mounting
BC1400						

Dimensions

Braking chopper BC1300/1400



Key to symbols used

P_{eff}	Braking power
P_p	Peak braking power
P_{red}	Automatic power reduction (after 6 s)
I_{Br}	Brake current
U_{on}	Start-up current
U_{off}	Cut-out current
A	Connecting conductor area
T	Cooling air temperature
H	Mounting altitude above sea level
rF	Relative humidity

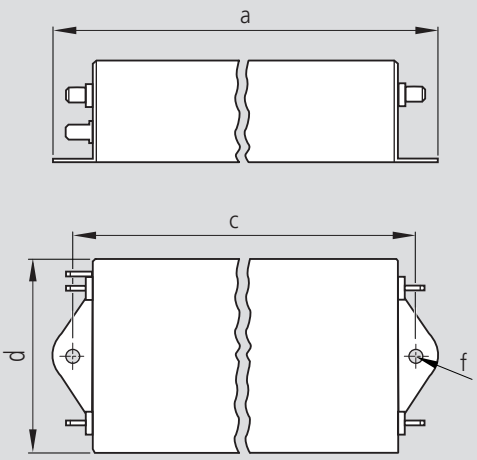
Mains Filter

Technical Data

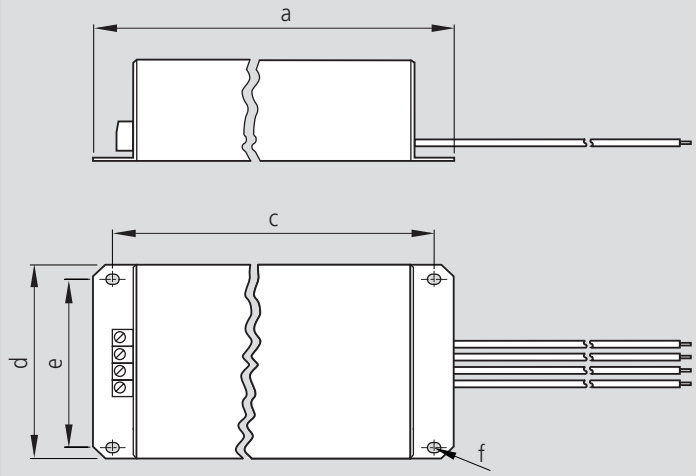
Inverter	Type	Limit curve	Rated current (A)	Rated voltage (V)	Working current (mA)	Overload	Connections
VF1202S	NFE6.1	Class B	6	1x230V AC + 10 %	0.21	1.5 x I_N for 1 minute per hour	Flat connector A6.3 x 0.8
VF1204S	NFE6.0				≤ 1.5		
VF1402S	NFD4.1		4	3x400V AC + 10 %	1.3		Input: term. 1.5 mm² Output: stranded wire

Dimensions

Mains filter NFE6.0, NFE6.1



Mains filter NFD4.1



Type	a	b	c	d	e	f	g
NFE6.0	159	44.5	143	50.8	-	4.7	-
NFE6.1	88.4	40	75	52	-	5.3	-
NFD4.1	145	40	135	75	55	7 x 5.3	300

Frequency Inverter VF1000S SMART DRIVE
Ordering Code

Part number	Model version		Mains filter		Heat sink		Operating controls		Memory card		Drive signals		Braking chopper	
			without	with	without	with	without	with	without	with			without	with
1130-390-00	VF1202S	01	00	01	00	01	00	01	00	01	Analog signal and 2 digital inputs	01	00	01
	VF1204S	02		02										
	VF1402S	03		03										02

Part number 1130-390-00

Ordering example

Ordering data		Explanation
Part number 1130-390-00		Frequency inverter
Model version	= 01	Type VF1202S
Mains filter	= 01	With external mains filter, single-phase 1 x 230 V AC
Heat sink	= 00	Without
Operating controls	= 01	With multifunctional operating control unit and chipcard drive
Memory card	= 01	With chipcard
Drive signals	= 01	Analog signal and two digital inputs
Braking chopper	= 00	Without

Completely wired frequency inverter with PLC control option and customized operating control unit on request.

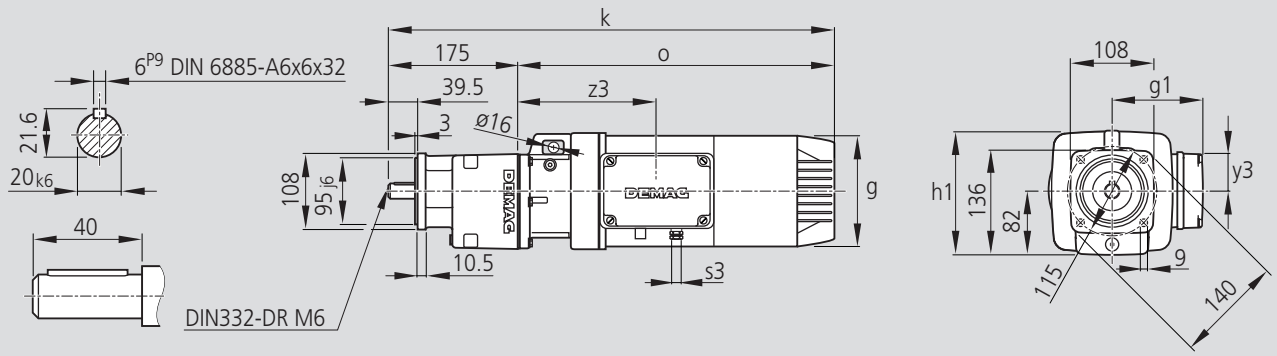
Three-Phase Motors
Data and Dimensions

Three-Phase Motors from Mannesmann Dematic with Spur Gearing

Technical Data

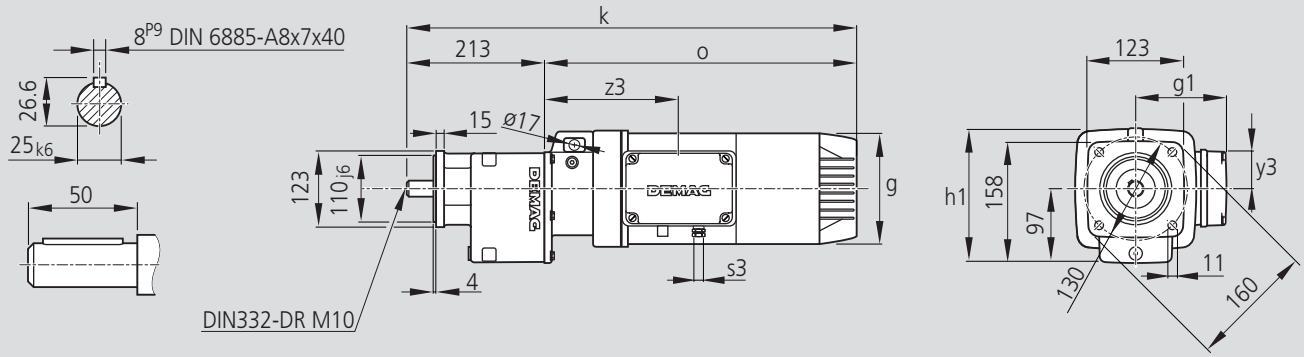
Motor type	Rated power P in [kW]	Rated speed n in [min^{-1}]	Rated torque M_N in [Nm]	Spur gearing	Reduction ratio i	Output speed n_{out} in [min^{-1}]	Output torque M_{out} in [Nm]
Z.A63B4	0.18	1380	1.2	DFV10DD	2.94 - 66.5	20 - 459	4 - 84
Z.A71A4	0.25	1390	1.7	DFV10DD	2.94 - 44.8	20 - 445	5 - 82
Z.A71B4	0.37	1380	2.5	DFV10DD DFV20DD	2.94 - 32.0 10.4 - 55.0	42 - 445 20 - 129	8 - 84 27 - 145
Z.A80A4	0.55	1410	3.7	DFV10DD DFV20DD	2.94 - 23.3 5.45 - 40.2	61 - 479 35 - 259	11 - 87 20 - 150
Z.A80B4	0.75	1410	5.1	DFV10DD DFV20DD	2.94 - 16.3 4.41 - 29.1	87 - 479 48 - 319	15 - 82 22 - 148

DFV 10 DD



Motor	k	o	g	g1	h1	s3	y3	z3
ZNA63/71 without brake	450	275	140	124	162	PG 13.5	51	157
ZBA63/71 with brake	525	350						
ZNA80/90A without brake	489	314	157	134	162	PG 16	51	170
ZBA80/90A with brake	581	406						

DFV 20 DD

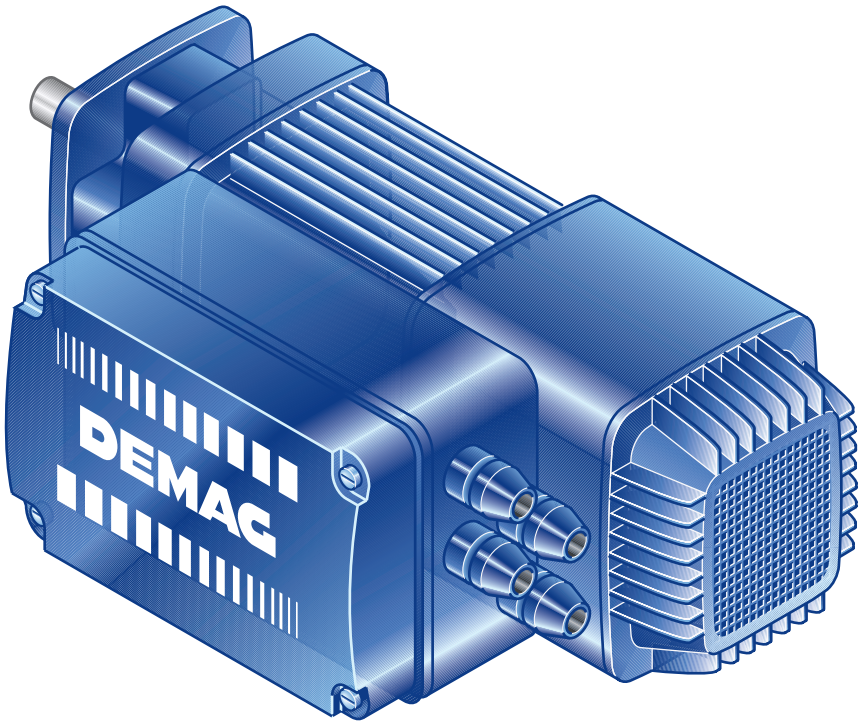


Motor	k	o	g	g1	h1	s3	y3	z3
ZNA63/71 without brake	488	275	140	124	182	PG 13.5	51	157
ZBA63/71 with brake	563	350						
ZNA80/90A without brake	527	314	157	134	182	PG 16	51	170
ZBA80/90A with brake	619	406						

Gear Motors with Integrated Frequency Inverters
Product Overview

Frequency inverters have been very much refined in recent years. The latest step in this development process has been to incorporate them directly in three-phase motors.

Motor types:
- Z.I 71 A4
- Z.I 71 B4
- Z.I 80 A4
- Z.I 80 B4
- Z.I 90 A4

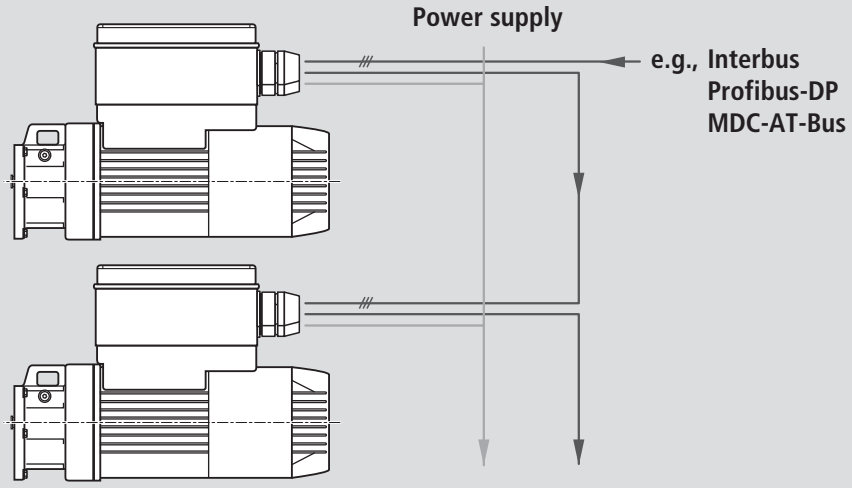


This offers several different advantages:

- Reduced installation effort
  Shielded motor cables and filters are no longer required.
- Easy start-up
  Since the motor and the frequency inverter have already been optimally paired and adapted, the number of parameters reduces to plant-specific settings only.
- Cost advantage due to smaller-size control cabinet
- Easy integration into master control systems via Interbus, Profibus-DP, MDC-AT-Bus, digital switching signals and analog command values

Variable-speed Gear Motors from Mannesmann Dematic

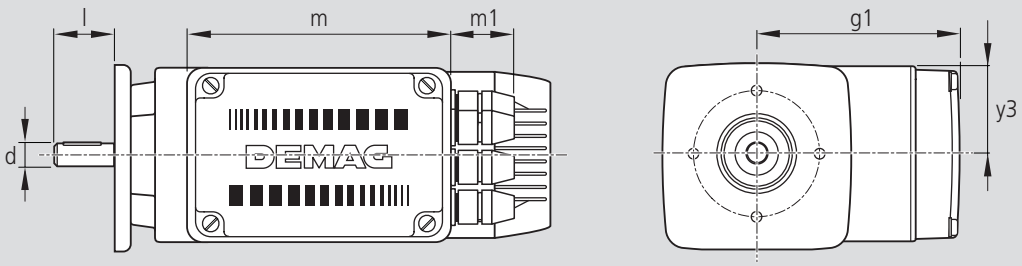
Technical Data



Mains voltage	Mains frequency	Motor power rating	Braking chopper	Braking resistor	Motor contactor	Protection	Ambient temperature
380 - 500 V +/- 10%	50/60 Hz	up to 1.9 kW	integrated	integrated (for move commands)	integrated	IP54	0 to 40 °C

Size	Type	g1	m	m1	y3	d	l
ZNI **ZBI**	71	207	225	61	77.5	14	30
ZNI **ZBI**	80 + 90 A	214	225	61	77.5	24	50

Ordering code in preparation!



Stepping Motor Power Output Stage Modules WD3-004 / WDM3-004
Product Overview

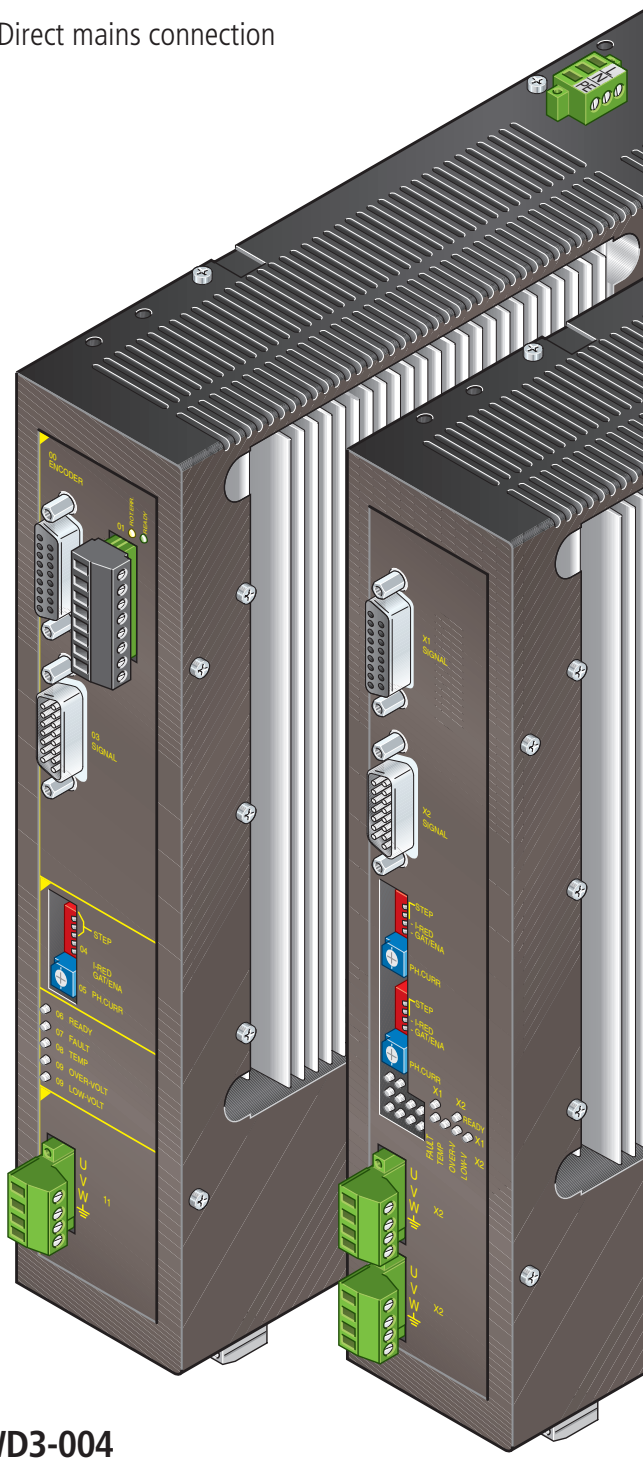
Stepping motor power output module for 3-phase stepping motors, for wall mounting.

- WD3-004 for one 3-phase stepping motor
- WDM3-004 for two 3-phase stepping motors

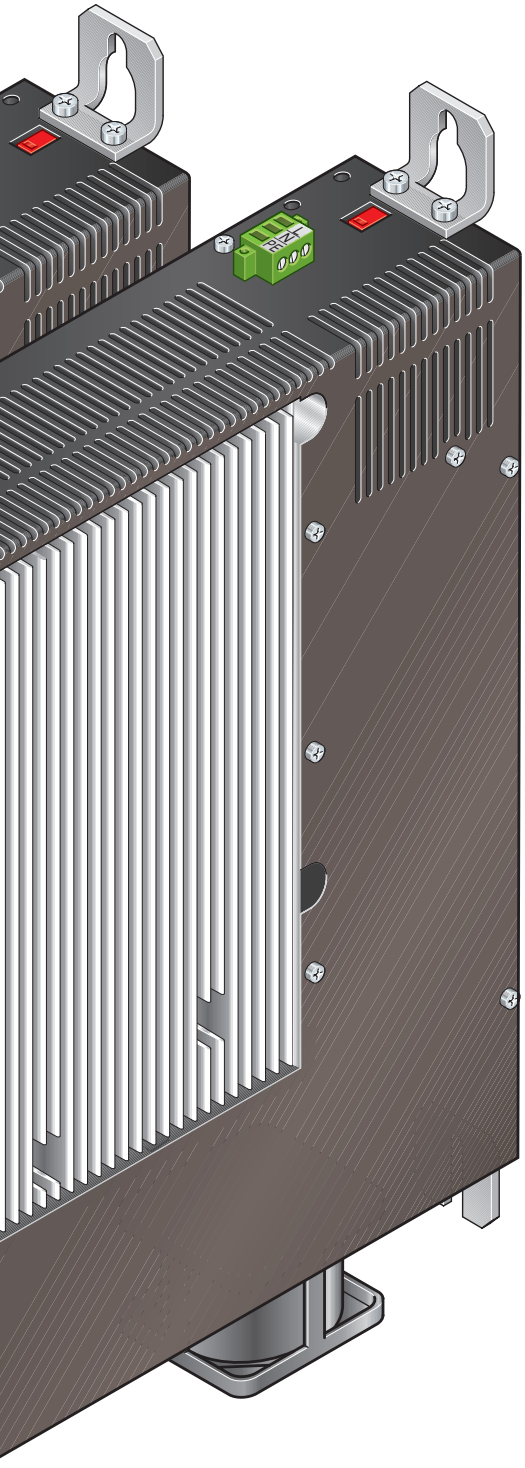
▷ Direct mains connection

▷ Failsafe operation

▷ Visual status display



WD3-004



WDM3-004

- Easy mounting

- Silent, economical and powerful

Stepping Motor Power Output Stage Modules WD3-004 / WDM3-004 Advantages/Functions

Economical

Mounting

Simple attachment by means of two screwholes in the mounting plate. The unit can be fastened to the mounting plate either by the rear panel or the left side panel.

Precise

Power supply

The power output stage runs on 230 V AC mains voltage (switchable to 115 V AC).

Control signals

All input signals are metallically isolated from the power output stage via opto-couplers. Depending on the unit type, the signal input levels will be 24 V or 5 V.

Processable control signals:

- Pulse
- Direction
- Gate / enable
- Current mode
- Micro-step

Current setting

Easy and precise setting using rotary coding switches.

Step number setting

Easy setting of the motor step number for standard or micro-step operation.

Visual display

LEDs for:

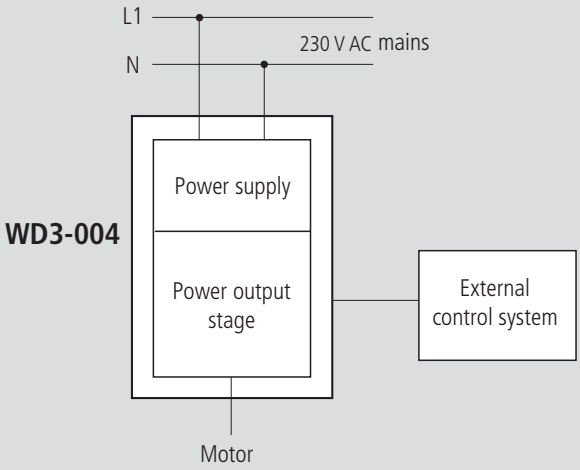
- Ready
- Overtemperature
- Power supply under-/overvoltage
- Short-circuit between motor phases

Step monitoring

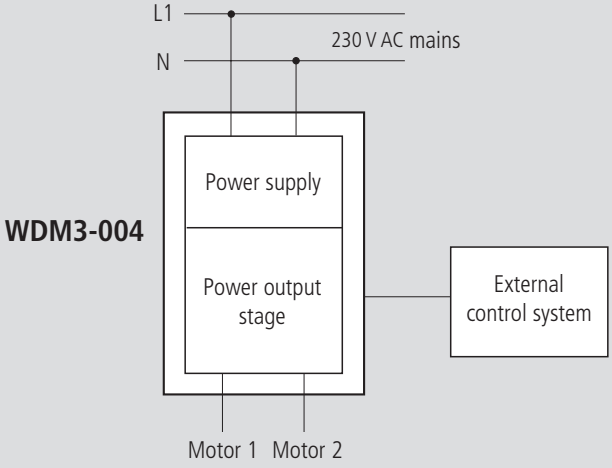
(optional / for WD3-004 only)

A pulse generator is used to transmit signals for correct or incorrect execution of positioning to the external control system.

Function diagram WD3-004



Function diagram WDM3-004



Stepping Motor Power Output Stage Modules WD3-004 / WDM3-004 Data and Dimensions

Mains-side Input

	U (V)		f (Hz)	I_{max} (A)	I_{on} (A)	I (A)	P_V (W)
WD3-004	230 115	-20%, +15%	50 to 60	5.5 10	max. 70	6 10	45
WDM3-004	230 115	-20%, +15%	50 to 60	6 10	max. 70	6 10	60

Motor-side Output

	I_P (A)	U_M (V)
WD3-004 **WDM3-004**	0.6 to 2.5	325

Input Signals

Signal inputs: pulse, direction, gate, current mode,
micro-step optodecoupled, polarity-reversal protected.

	f_S (kHz)	Step number standard	Step number micro-step	Signal level (V)	Signal voltage U_{high} (V)	Signal voltage U_{low} (V)	Input current (mA)	Input resistance (Ω)
WD3-004 **WDM3-004**	max. 200	200, 400, 500, 1000	2000, 4000, 5000, 10 000	**24**	20 to 30	< 3	10 to 25	2000
				5	2.5 to 5.25*	< 0.4	7 to 25	150

*) Pulse signal voltage 3.5 V to 5.25 V from stepping rate 50 kHz to 200 kHz at pulse-to-pause ratio 1:1

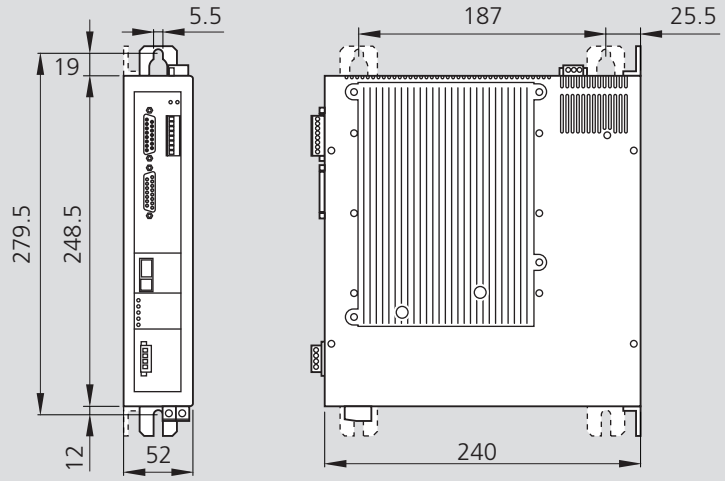
Environmental Conditions

	m (kg)	t (°C)	t_{st} (°C)	Protection	Cooling type	Mounting
WD3-004	3.2	0 to 50	-25 to +70	IP20	convection	vertical wall mounting
WDM3-004	3.4					

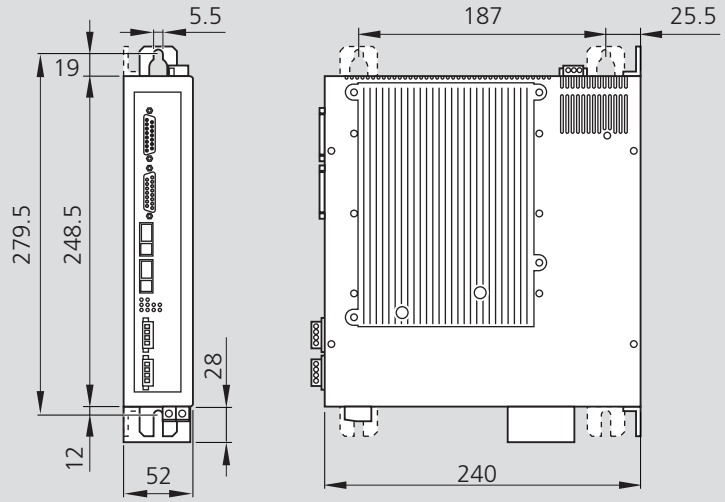
Key to symbols used

U	Mains voltage	I	Recommended mains protection
U_M	Motor voltage	I_P	Phase current
f	Mains frequency	P_V	Power loss
f_s	Stepping rate	t	Ambient temperature
I_{max}	Current consumption	t_{st}	Storage temperature
I_{on}	Start-up current	m	Mass

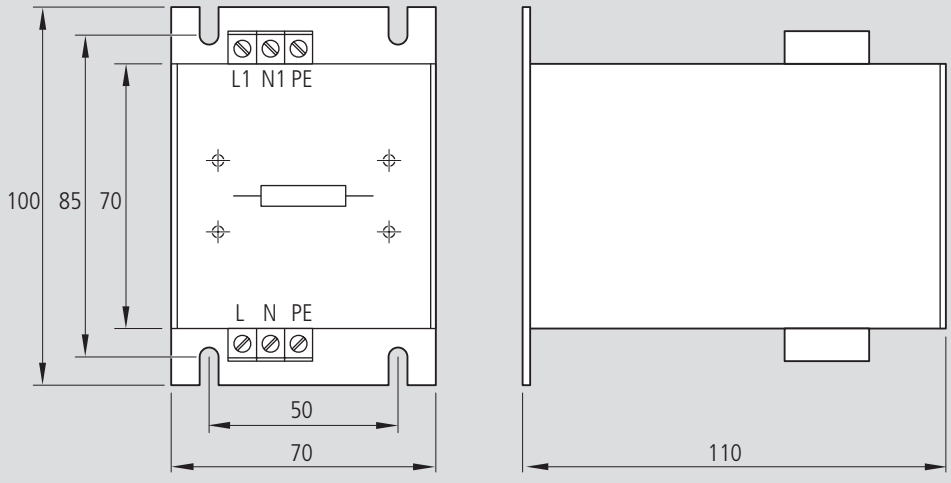
WD3-004



WDM3-004



Mains filter FF 343



TURBO-STEP PC Controller Boards and Controller Module CNC 45 S

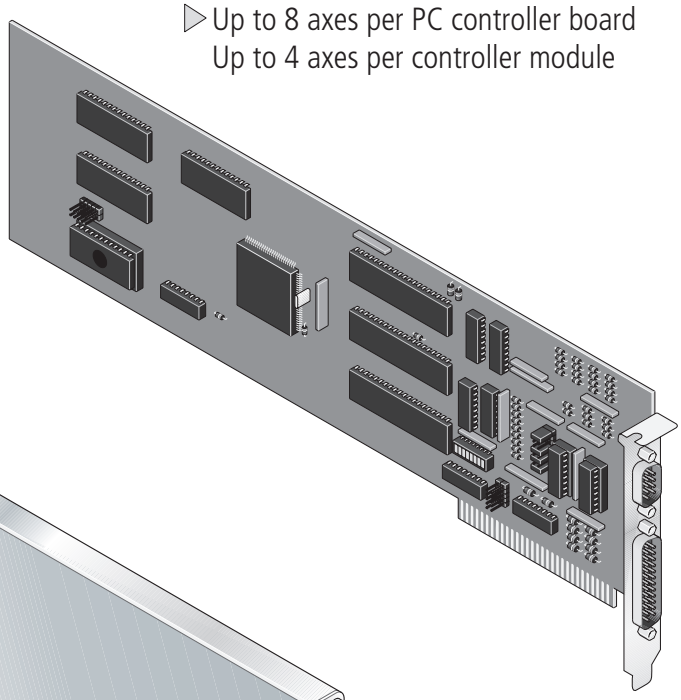
The quick and easy way to a complete system:
Installing a 1 to 8-axis stepping motor controller board in your PC.
Provides unlimited possibilities for CNC applications.

Programming with machine commands to DIN 66025, or integration into motion sequence routines written in high-level or machine language.

Applications:

- Machining
- Measurement
- Material transport

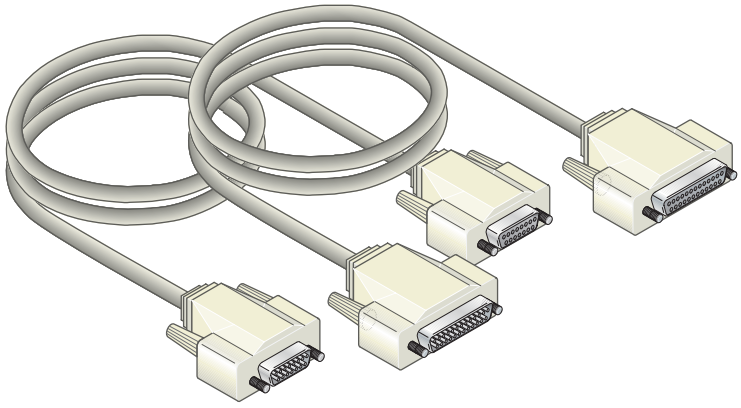
▷ Up to 8 axes per PC controller board
Up to 4 axes per controller module



Turbo-Step

▷ Effortless programming of motion sequences via PC

System box



▷ All I/Os provided with optocouplers for guaranteed protection of the PC

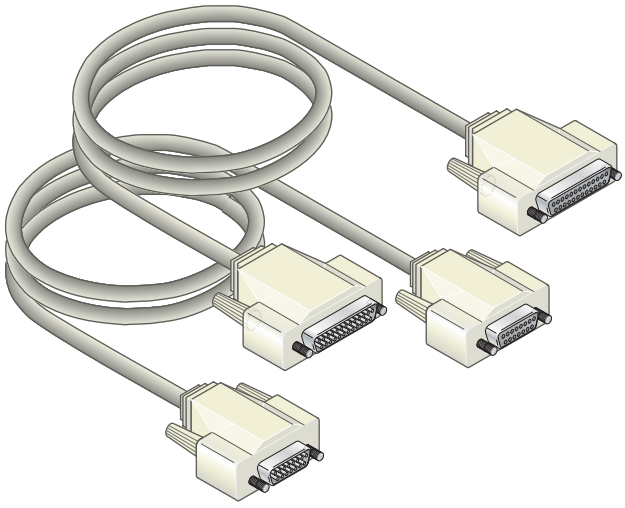
▷ Easily mounted using system box

▷ CNC 45 S

▷ Maximum economy,
even with single units

▷ Motion sequencing by PC
or controller module

▷ Wall-mounting system box



▷ Inexpensive and powerful

TURBO-STEP PC Controller Boards and Controller Module CNC 45 S Description

Technical Data

System components

TURBO-STEP 45 S controller module, system box, driver, CNC program, hardware test program.

Installation and connection

For installation in an ISA slot, wiring of motors, switches and signals via system box.

Output signals

Step and direction for each axis, min. level 5 V, as well as 1.5 A Darlington driver with protective diodes for free output bits (relays or solenoid valves).

Input signals

End positions, E-STOP, free input bits, max. level 24 V, presettable to high or low active.

CNC program to DIN 66025

Command editor and sequential program with perfect syntax test and help system. Clear presentation on color monitor, exceptionally user-friendly handling.

Driver

Libraries for C++ and TurboPascal, as well as DLL file for Windows applications.

Move commands in the numerical range -32768 to +32767:	**TURBO-STEP 45 S**
Linear interpolation X, Y	up to max. 50 kHz
Linear interpolation X, Y, Z	up to max. 50 kHz
Linear interpolation X, Y, U	up to max. 50 kHz
Circular interpolation X, Y	up to max. 50 kHz
Circular interpolation X, Y with tangential control in U	up to max. 25 kHz
Elliptical interpolation X, Y	up to max. 25 kHz
Elliptical interpolation X, Y with tangential control in U	up to max. 25 kHz

Move commands in the numerical range $-1.07 \cdot 10^9$ to $+1.07 \cdot 10^9$:	
Independent move commands X, Y, Z, U	up to max. 25 kHz
Spline interpolation X, Y, Z, U	up to max. 25 kHz

Function

TURBO-STEP 45 S

System concept with effective multitasking

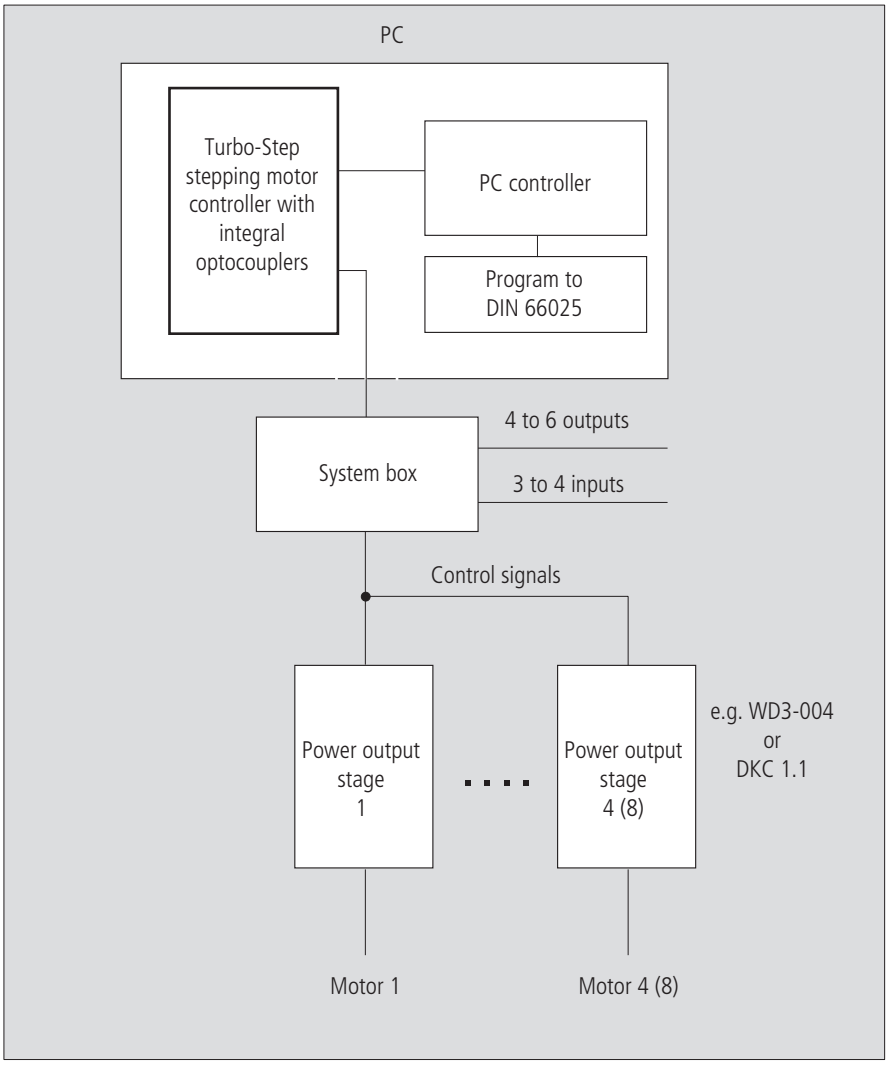
The TURBO-STEP 45 S controller is equipped with an integral processor, memory, timer and pulse shaper to generate and output motor signals directly from the PC without taking up any of the PC's internal computing resources. This permits extremely precise controlling of step pulse timing.

While this being done, the PC runs the CNC program or a program written by the user. The program sends commands consisting of only a few bytes to the controller. These commands set the ramps and the velocity and initiate axis movements. While the controller is executing a move command, the PC program has plenty of time to process the next command, perform other calculations or control a user-specific chart or diagram. The PC also has sufficient time available to provide ergonomically optimum visualization of data on the monitor.

The controller encompasses virtually all useful and desirable functions, e.g. continuous curves made up of arcs and linear segments with a common start and stop ramp, tangential control for a rotary axis, 2 to 4-axis reference point interpolation, and many more.

The Turbo-Step 85 S stepping motor controller is available for 8-axis applications. More information on this product can be obtained on request.

The stepping motor power output stage module WD3-004 and the digital DKC controller can be readily connected to the controller module.



TURBO-STEP PC Controller Boards and Controller Module CNC 45 S Function and Dimensions

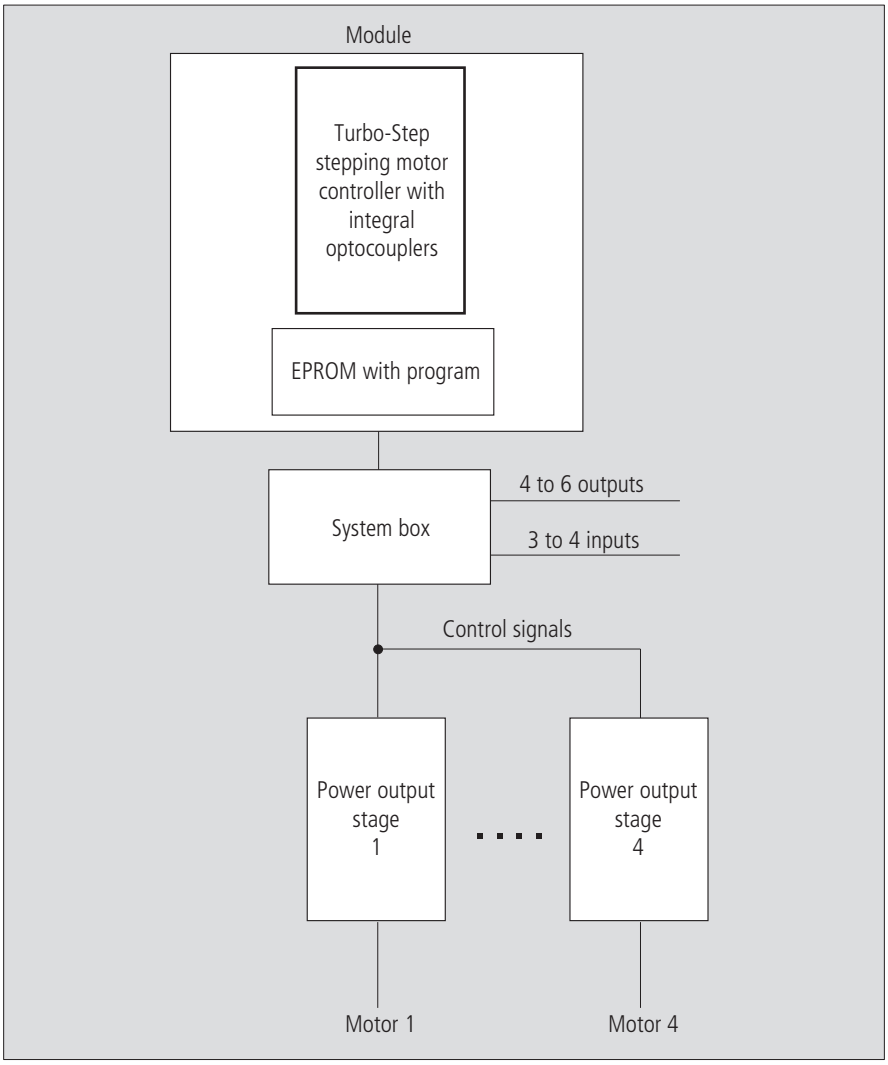
Function

CNC 45 S

Economical concept for fixed programmed sequences

The command set and the function principle of the controller are identical to those of the TURBO-STEP 45 S. The CNC 45 S is a stand-alone device which manages without an expensive PC.

A PC is, however, required to write the program for storage on the controller module's PC board. The completed CNC program is compiled and stored in an EPROM. This EPROM is then mounted on the controller module's PC board. Once the PC board has been reinstalled in the controller module, the plant is ready to operate.

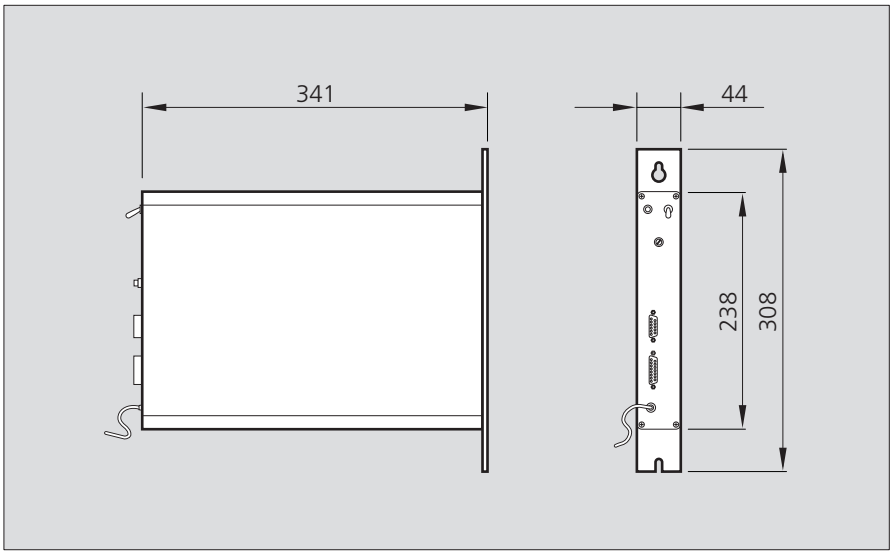


System Box

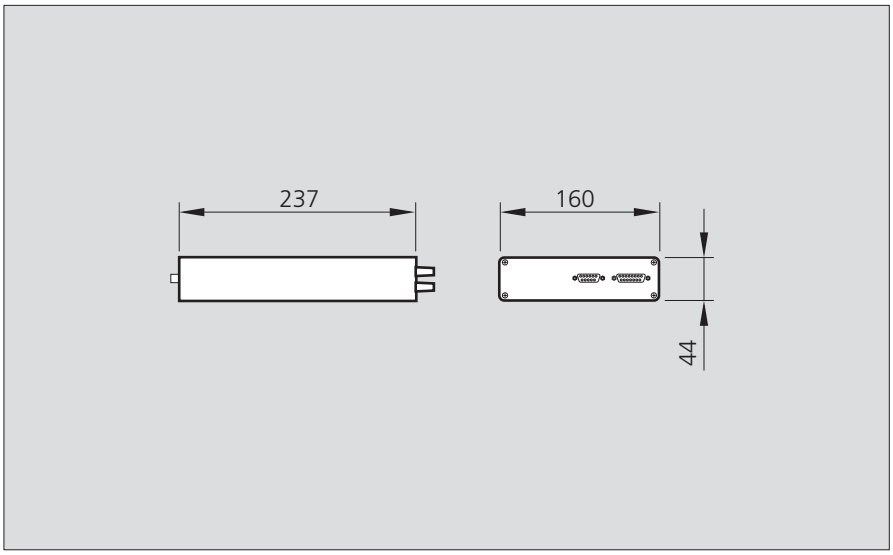
This connection box simplifies wiring of the controller, the output stages, limit switches, and other peripherals. All connections are made via screw terminals, thus eliminating the need for soldering.

Dimensions

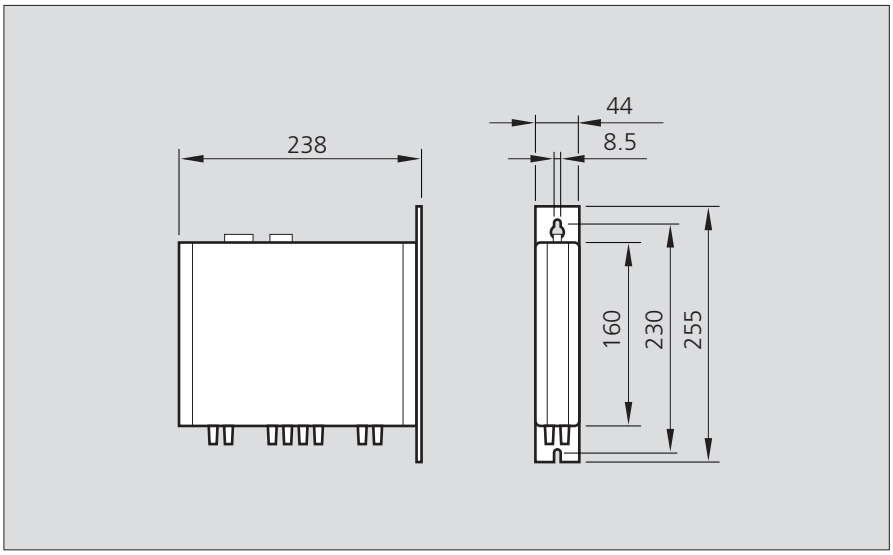
Controller Module CNC 45 S



System Box



System Box, wall mounting version



STAR step Positioning Controls
Product Overview

STAR step stepping motor controls for 1 to 4 axes with power controller for 3-phase stepping motors with integral PLC.

Application possibilities:

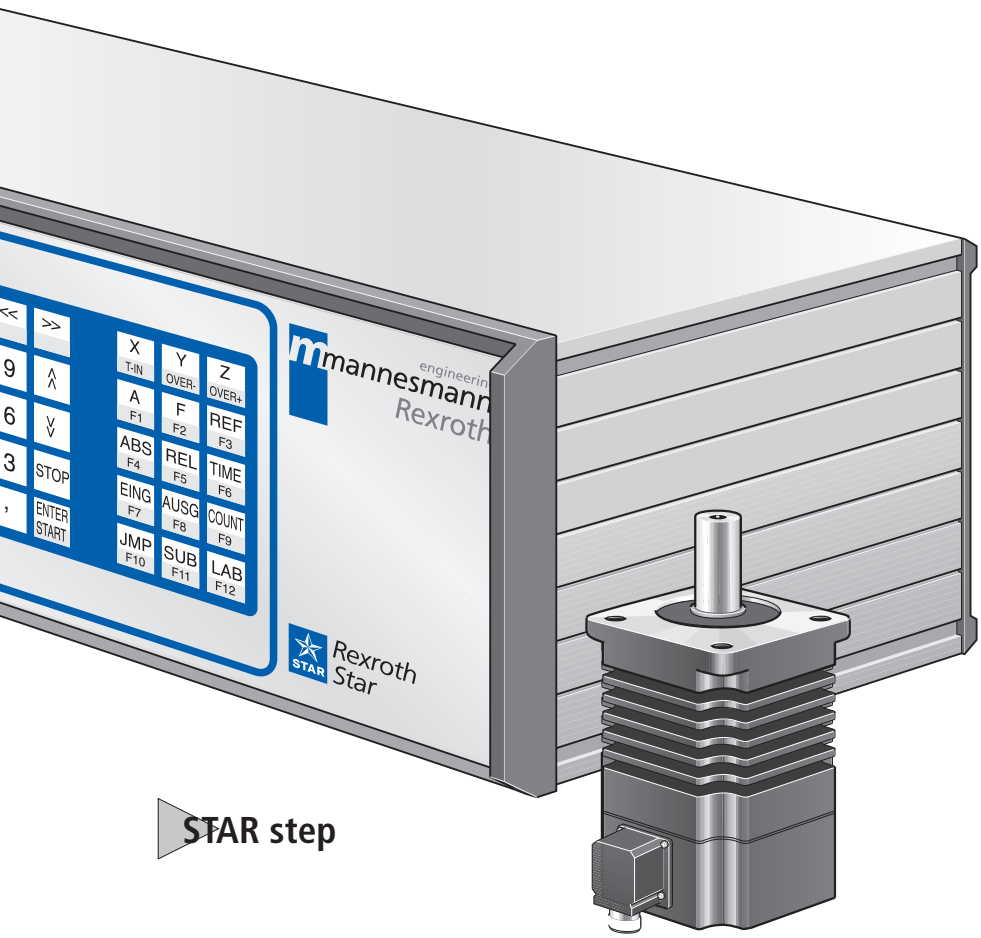
- Handling systems
- Positioning and feed tasks
- Dispensing/dosing machines
- Palletizing, etc.

▷ Ready for connection to 230 V AC

▷ Clearly structured keyboard and display
for immediate data recognition and ease of operation

▶ Powerful and economical

▶ Simultaneous axis positioning and control of complex machine motion sequences



▶ Self-monitoring ensures high operational reliability

▶ Plug connections simplify installation

▶ STAR step

▶ Fixed or mobile due to installation either in 19" rack or in table-top housing

STAR step Positioning Controls
Technical Data

Hardware

Mechanical design

STAR step position controls are available in two versions:

- 19" rack (for installation in control cabinet)
- Table-top housing, 3 (6) modules high

Electrical connections

Plug-in connections at the rear:

- 230 V AC mains input
- motor power supply
- reference and limit switches
- inputs/outputs

Operator interface

The control panel comprises:

- 4x20-character clear text display
- 35 keys

These allow:

- changing of machine parameters
- display of machine statuses
- programming in the MCstep programming language

PLC functions

The following are provided:

- 16 short-circuit-proof, positive action outputs (24 V DC / 1 A)
- 24 optodecoupled inputs (24 V DC / 10 mA)

These I/Os are used to control/monitor:

- pneumatic valves
- relays and contactors
- limit switches

I/O expansion (optional)

choice of:

- 24 digital inputs (24 V DC / 10 mA)
- 16 digital outputs (24 V DC / 1 A)

or:

- 4 analog inputs (0-10 V DC / 5 kΩ)
- 2 analog outputs (0-10 V DC / 20 mA)

Step monitoring (optional)

A pulse generator in the motor signals successful or unsuccessful completion of positioning to the control system.

Serial interface

RS 232:

- for UP/DOWNLOAD of programs
- for command transmission from a PC to the control system

RS 485 (optional):

- proprietary field bus system for control of a decentralized I/O module, control and operating elements, or power sections

External control panel (optional)

- hand-held terminal with 4x20-character LCD display
- 20 membrane keys
- electric handwheel and E-STOP button for remote control of the system

Remote maintenance (on request)

Remote maintenance including diagnostics and fault clearance can be performed via a modem connected to the control system.

Software

Programming

This may be done in two different ways:

- via the keyboard using MCstep, a simplified programming language with limited scope
- via a PC in PLC language (MC 1, optional)

Program and memory capacity

MC 1:
Solution of complex tasks

- multitasking (4 parallel PLC programs)
- macrotechnology possible
- symbolic programming
- up to 16,000 PLC commands
- program memory for storage of up to 28,000 variables
- 32 timers from 0.01 to 0.1 s

MC Step:

- 11 user-defined commands
- program memory with 1200 lines
- number of programs determined by settable program length (e.g., program length 400 lines = 3 programs)

Safety devices

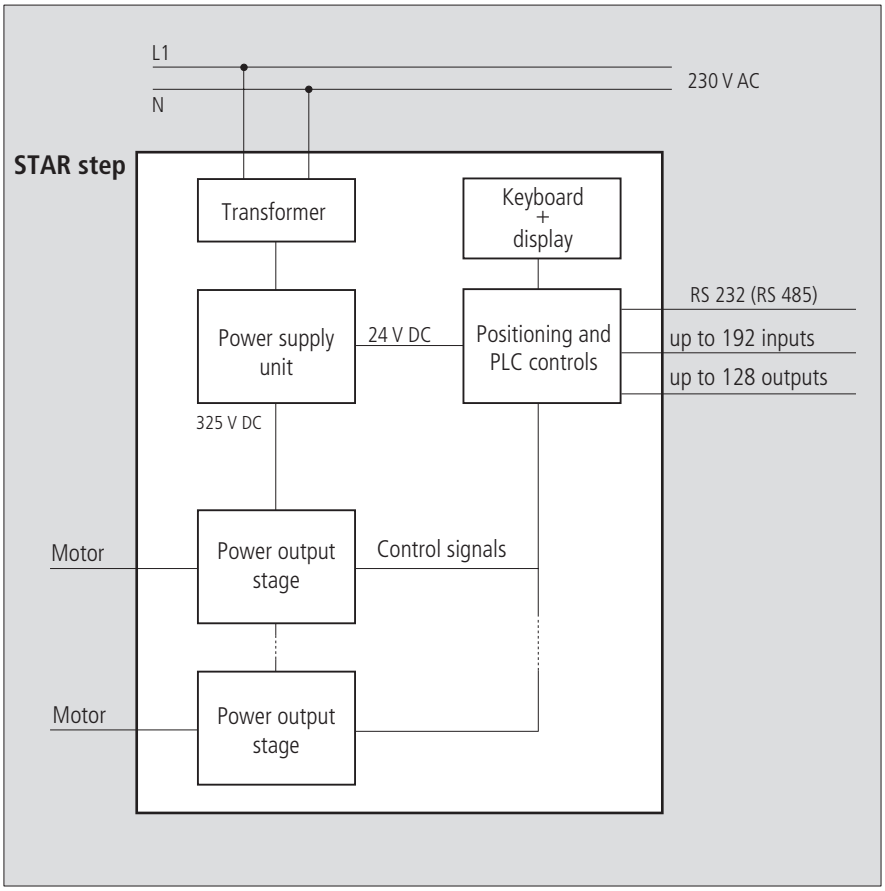
Safety functions

- interrogation of hard (mechanical) limit switches
- soft limit switches
- short-circuit-proof PLC outputs
- operating voltage monitoring for power sections
- temperature monitoring for power sections

E-STOP circuit (optional)

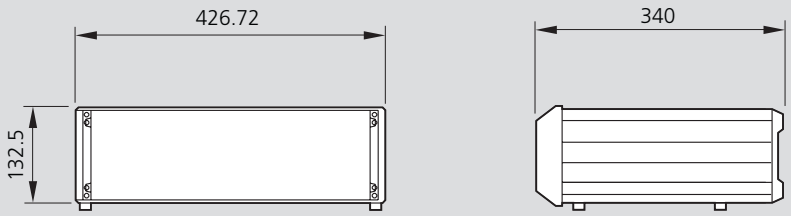
This option comprises a contactor to cut off the voltage supply to the power output stages, without cutting off the PLC voltage.

Function diagram



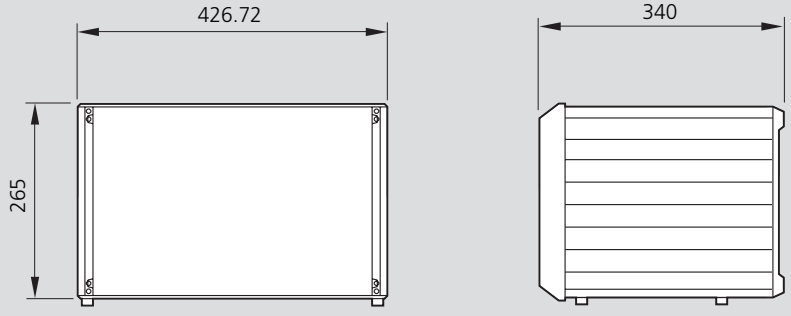
Dimensions

STAR step, 3 modules high



The STAR step 6-module size is required for versions with more than 3 encoders.

STAR step, 6 modules high



STAR step Positioning Controls Programming

MC step programming commands

ABS	Absolute positioning
REL	Relative positioning
REF	Reference cycle
F > >	Feedrate
TIM	Queuing
CNT	Counter
INP	Set inputs
OUT	Set outputs
LBL	Define flag
JMP	Conditional or unconditional jump to line, flag or program
SUB	Conditional or unconditional subroutine jump to line, flag or program

Additional functions:

Linear interpolation

If a program line contains two absolute positioning commands one after the other, these two axes will be operated in linear interpolation mode.

Waiting for entry

1. from keyboard

A flag can be set to halt the automatic program at a certain point. The display will show the next line in the program. Up to four commands can be edited in this program line. These new commands will be executed when the ENTER key is pressed.

2. from PC

A flag can be set to halt the automatic program at a certain point to wait for data transmission via the RS 232 interface.

Once the data has been transmitted it will be processed immediately and the automatic program subsequently resumed. (Drivers for C++, Delphi and Visual Basic are available for PC programming of this function.) (Software optional.)

On-line mode

In the as-delivered condition, the control system contains a single-command program permitting on-line command processing via PC. (Drivers for C++, Delphi and Visual Basic are available for PC programming of this function.)

External START/STOP

When this function is activated, the program sequence can be started or stopped in automatic mode via two external switches.

BCD inputs

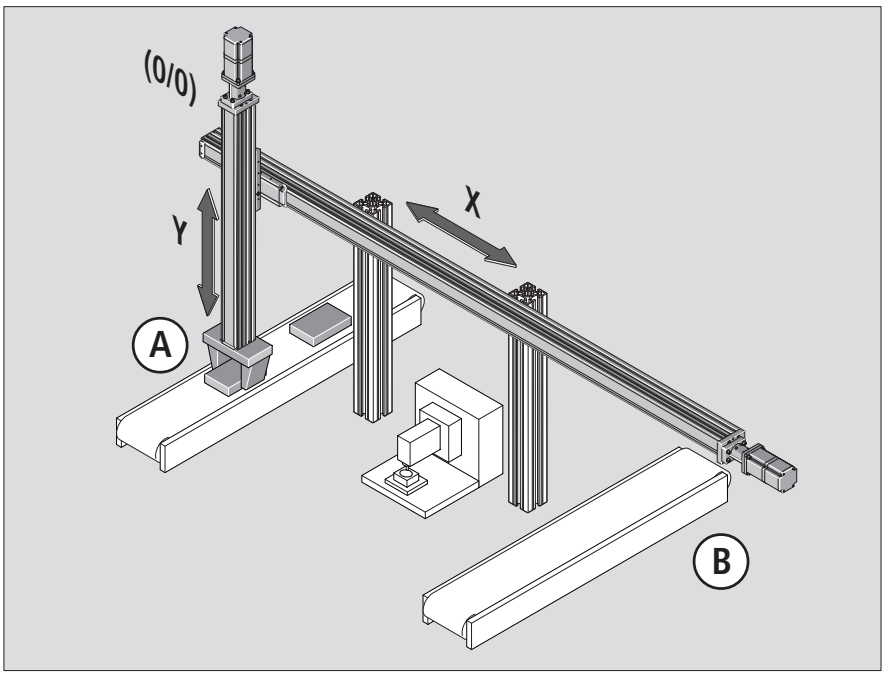
In the automatic mode, one of 32 programs can be selected via a BCD switch.

Programming Example:

Handling application for a two-axis pick-and-place system

Task:

On completion of the homing cycle and on receipt of a start signal, the axes are to move to position A (0/-1000). At this position, an object (e.g. a cardboard box) is to be picked up by a gripper. The axes lift the object over and around an obstacle to position B (1500/-1000) and place it there. This pick-and-place cycle is repeated 10 times. The system then returns to home position (0/0) and waits for a new start signal.



Programming:

Line	Command	Command option	Command data	Comment
01	REF	Y		Homing cycle of axis Y
02	REF	X		Homing cycle of axis X
03	LBL		2	Programming jump flag 2
	INP	=1?	1	Interrogate input 1 (start signal) for high level
	CNT	1 SET	10	Set counter 1 to 10
04	ABS	Y	-1000	Absolute positioning of axis Y to -1000
05	OUT	SET	1	Set output 1 (gripper)
	TIM		1.0	Wait 1 second
	ABS	Y	0	Absolute positioning of axis Y to 0
06	ABS	X	1500	Absolute positioning of axis X to 1500
07	ABS	Y	-1000	Absolute positioning of axis Y to -1000
08	OUT	RES	1	Reset output 1 (gripper)
	TIM		1.0	Wait 1 second
	ABS	Y	0	Absolute positioning of axis Y to 0
09	ABS	X	0	Absolute positioning of axis X to 0
10	CNT	1 DEC	1	Reduce counter 1 by 1
	JMP	1 LBL	2	Conditional jump to flag 2 if counter 1 is at 0
11	JMP	LIN	4	Unconditional jump to line 4

Note: Any line can contain up to 4 commands

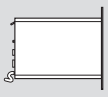
Stepping Motor Equipment
Ordering Data and Dimensions

Type designation / Part number	Axes	Version: Option	Version: Output stage	Rotation monitoring: Option	Rotation monitoring: Number	Holding brake: Option	Holding brake: Number
 **STAR step** 1131-212-00	1	01	D901	01	1 encoder	01	1 brake
	2	02	D902	02	2 encoders	02	2 brakes
	3	03	D901 + D902	03	3 encoders	03	3 brakes
	4	04	2 x D902	04	4 encoders	04	4 brakes

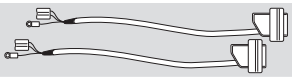
Type designation / Part number	Axes	Mains filter: without	Mains filter: with	Version: Option	Version: Output stage	Rotation monitoring: Option	Rotation monitoring: Number
 **WD3-004 WDM3-004** 1131-212-10	1	00	01	01	D901 24 V signals	00	without
				02	D901 5 V signals	01	1 encoder
	2			03	D902 24 V signals	00	without
				04	D902 5 V signals		

System box 1 with 5 V output level (for WD3-004 or WDM3-004)

System box 2 with 24 V output level (for DKC)

Type designation / Part number	Axes	Version: Option	Version: Description
 **TURBO-STEP** 1131-211-80	4	03	TURBO-STEP 45 S
		05	TURBO-STEP 45 S with system box 1
		06	TURBO-STEP 45 S with system box 2
	8	04	TURBO-STEP 85 S
 **CNC 45 S** 1131-211-90	4	01	Controller Module and system box 1
		02	Controller Module and system box 2

	Housing		E-STOP circuit		I/O expansion		Interface	
	Option	Version	Option	Description	Option	Inputs/Outputs	Option	Description
	01	19" rack	00	without	01	24 (I) / 16 (O) digital	01	with RS 232
	02	table-top housing	01	with E-STOP	02	4 (I) / 2 (O) analog	02	with RS 232 and RS 485



Cable set comprising:	Part number Length in m (max. 50 m)	Cable supply condition – motor side Terminal box (standard motor)	Cable supply condition – motor side With connector	Cable supply condition – control side STAR step	Cable supply condition – control side WD3-004 WDM3-004
Motor cable	1130-801-30	10	20	10	20
Motor and brake cable	1130-801-31	11	21	11	21
Motor and encoder cable	1130-801-32	-	22	12	22
Motor, brake and encoder cable	1130-801-33	-	23	13	23

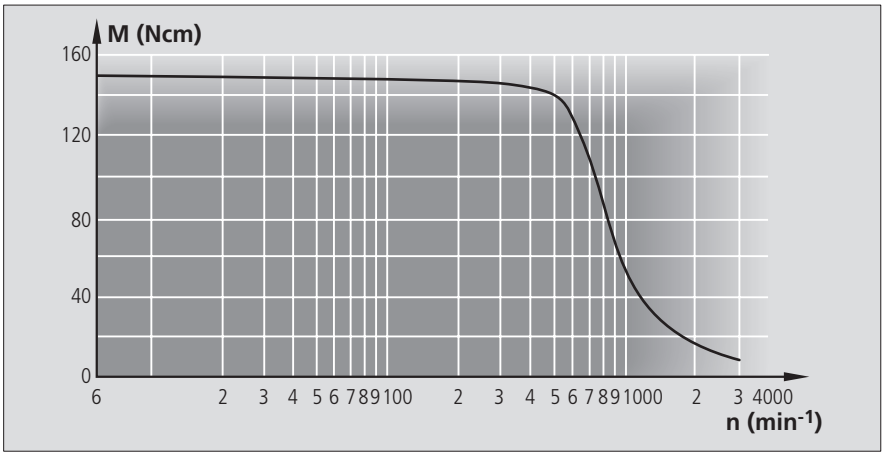
Ordering example

Ordering data		Explanation
STAR step stepping motor controls		Part number: 1131-212-00
Version	**= 02**	Power output stage D902
Rotation monitoring	**= 00**	Without rotation monitoring
Holding brake	**= 01**	For control of a holding brake
Housing	**= 01**	Completely wired in 19" rack
E-STOP circuit	**= 01**	With E-STOP circuit
I/O expansion	**= 02**	With an additional 4 analog inputs and 2 analog outputs
Interface	**= 01**	With RS 232 interface

Stepping Motor Equipment
Torque/Speed Diagrams and Dimensions

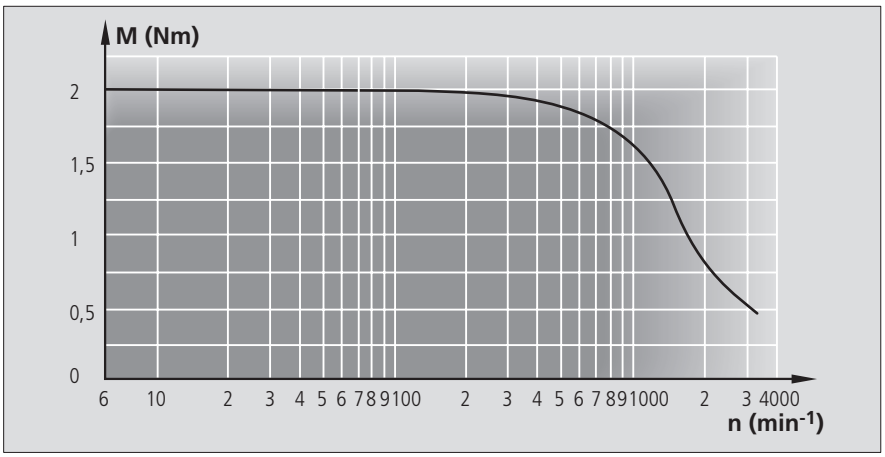
Power output sections
WD3-004 and WDM3-004

Motor
VRDM 368 / 50 LWB



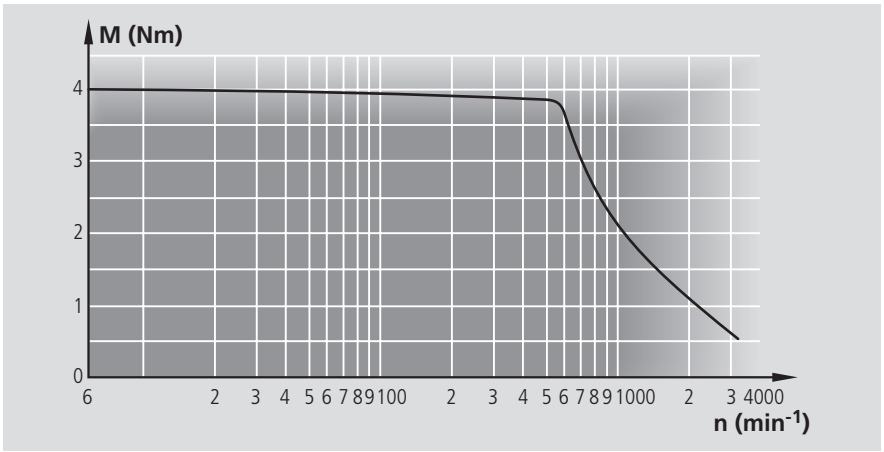
Power output sections
WD3-004 and WDM3-004: 1.8 A / 325 V

Motor
VRDM 397 / 50 LWB



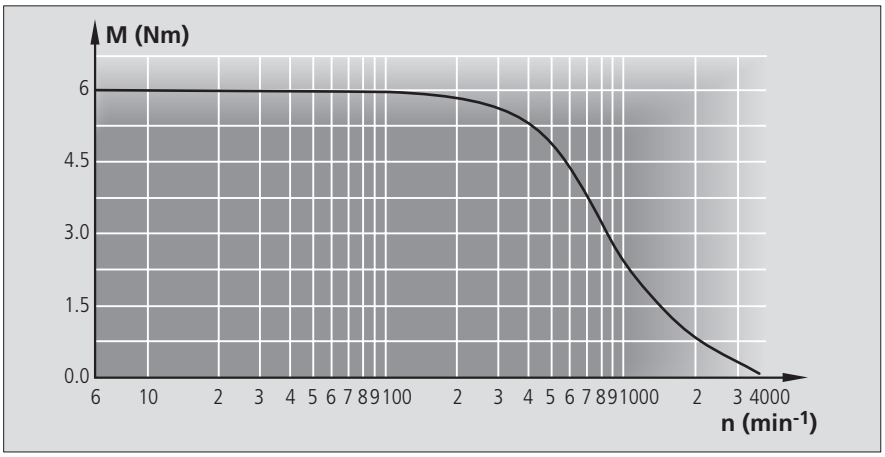
Power output sections
WD3-004 and WDM3-004: 2 A / 325 V

Motor
VRDM 3910 / 50 LWB



Power output sections
WD3-004 and WDM3-004: 2.3 A / 325 V

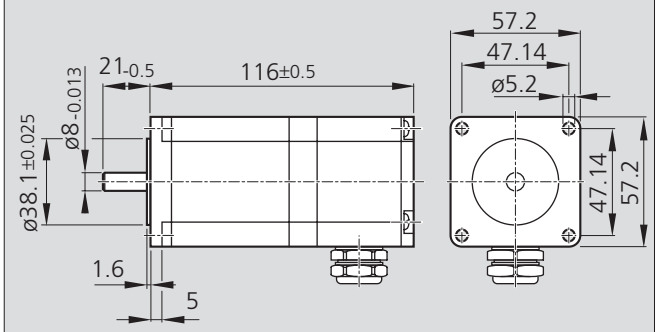
Motor
VRDM 3913 / 50 LWB



☛ **General note:**
These charts were plotted with the stepping motors set to 1000 steps/revolution.

Dimensions
3-phase stepping motors

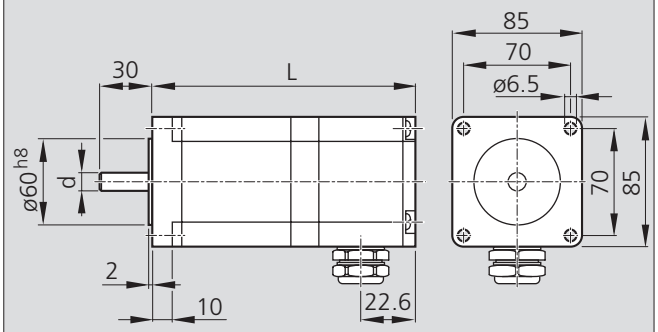
VRDM 368/50 LWB
Part number 8611-027-06



VRDM 397/50 LWB
Part number 8611-028-06

VRDM 3910/50 LWB
Part number 8611-029-06

VRDM 3913/50 LWB
Part number 8611-030-06



Type	L	d_{h6}
VRDM 397	110	12
VRDM 3910	140	12
VRDM 3913	170	14

Data
3-phase stepping motors

Motor		VRDM 368 50 LWB	VRDM 397 50 LWB	VRDM 3910/ 50 LWB	VRDM 3913/ 50 LWB
Stepping number		200 / 400 / 500 / 1000			
Step angle	(°)	1.8 / 0.9 / 0.72 / 0.36			
Maximum torque	(Nm)	1.5	2.0	4.0	6
Mass moment of inertia	($kgcm^2$)	0.38	1.1	2.2	3.3
Holding torque	(Nm)	1.74	2.26	4.52	6.78
Mass	(kg)	1.1	2.05	3.1	4.2

The 3-phase stepping motors are available with plug connectors and optionally with encoder and brake.

Motor Selection
Calculation Principles

For systems with toothed belt drive:

Values for

- acceleration time
- acceleration distance
- acceleration
- velocity

can be found in the respective linear motion system catalog.

For systems with ball screw drive:

Note:

The following calculation principles are for provisional dimensioning of linear motion systems only.

Servomotor acceleration characteristics

Horizontal installation:

(1) $M_B = 0.8 \cdot M_{max} - M_R$
$M_{max} \leq M_{perm}$

Vertical installation:

(2) $M_B = 0.8 \cdot M_{max} - M_R - M_G$
$M_{max} \leq M_{perm}$

M_B	=	Maximum motor accelerating torque	(Nm)
M_{max}	=	Maximum motor torque	(Nm)
M_R	=	Friction moment	(Nm)
M_G	=	Moment due to weight	(Nm)
M_{perm}	=	Maximum permissible drive torque	(Nm)

Moment due to weight

(vertical installation)

Condition: $S \cdot M_G < M_{brake}$

S : safety factor
recommended value $S \geq 2$

(3) $M_G = \frac{1.561 \cdot 10^{-3}}{i} \cdot m_{lin} \cdot P$

P	=	Screw lead	(mm)
i	=	Transmission ratio	
m_{lin}	=	Total moved mass	(kg)

Fixed base plate, moving carriage:

$m_{lin} = m_b + m_{fr}$

Fixed carriage, moving base plate:

$m_{lin} = m_{tot} - m_b$

m_b	=	Moved mass (carriage)	(kg)
m_{fr}	=	Additional load	(kg)
m_{tot}	=	Total mass (incl. linear motion system)	(kg)
m_{lin}	=	Total moved mass	(kg)

Mass moment of inertia of system with additional load

See table in the appropriate linear motion system catalog

For handling:

$6 \cdot J_M > J_{fr}$

For machining:

$1.5 \cdot J_M > J_{fr}$

J_{fr}	=	Mass moment of inertia of additional load	(kgm^2)
J_M	=	Mass moment of inertia of motor	(kgm^2)

(4) J_S = from linear motion system catalog

Mass moment of inertia

J_S : from linear motion system catalog

J_{fr} : $J_{fr} = \frac{J_S}{i^2} + J_K$

(5) $J_G = \frac{J_S}{i^2} + J_M + J_K + J_{RV}$

J_G	=	Total reduced mass moment of inertia	(kgm^2)
J_S	=	Mass moment of inertia of system with additional load	(kgm^2)
J_M	=	Mass moment of inertia of motor	(kgm^2)
J_K	=	Mass moment of inertia of coupling (motor side)	(kgm^2)
J_{RV}	=	Mass moment of inertia of timing belt side drive	(kgm^2)

Speed

v : see linear motion system catalog

(6) $n_1 = \frac{i \cdot v}{P} \cdot 1000$

$n_1 \leq n_{Mmax}$

v	=	Maximum velocity	(m/min)
n_1	=	Speed, motor side	(1/min)
n_{Mmax}	=	Maximum motor speed	(1/min)

Acceleration time

J_G : from equation (5)
M_B : from equation (1) or (2)

(7) $t_h = J_G \cdot \left(\frac{n_1 \cdot 0.10472}{M_B}\right)$

t_h	=	Acceleration time	(s)

Acceleration

(8) $a = \frac{v}{t_h \cdot 60}$

a	=	Acceleration	(m/s^2)

Acceleration distance

(9) $s_h = 0.5 \cdot a \cdot t_h^2$

s_h	=	Acceleration distance	(m)

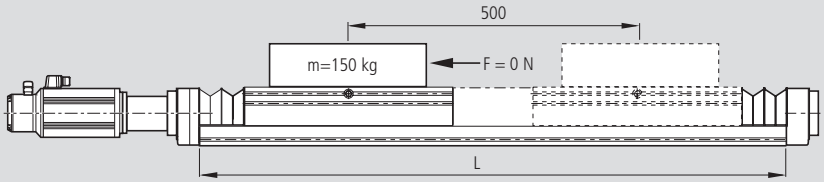
Motor Selection
Calculation Example

Ball Rail Table
TKK 30-325 Al

- L_T = 320 mm
- 2% preload
- with bellows
- with MDD 71C-N-040 motor (motor attachment and coupling, without gear)

Starting data

A mass of 150 kg is to be moved 500 mm within a maximum of 1.0 s (total time). The axis is installed horizontally.



Note

This calculation example is of a representative nature only. Calculations for other linear motion systems are performed analogously. The related values and charts can be found in the catalog for the linear motion system used. When dimensioning the drive, always take the motor/controller combination into consideration as the effective speed and maximum torque depend on the combination used. The selection tables can be found in the sections referring to the different controllers.

Selection of the ball screw drive

Taken from the "Aluminum Ball Rail Tables" catalog.

Length estimate:
Excess travel = 2 · P = 2 · 32 = 64 mm
L ≈ 1100 (from table)
$Travel_{max}$ = (stroke + 2 · excess travel) = 500 mm + 2 · 64 mm = 628 mm

$$v_{average} = \frac{\text{effective stroke}}{\text{total time}} = \frac{0.5\ m}{1.0\ s} = 0.5\ m/s = 30\ m/min$$

According to the chart for "maximum velocity", the permissible ball screw drive for v = 30 m/min and L ≈ 1100 mm is:

32 x 20; 32 x 32

According to the chart "maximum permissible drive torque" and the motor/controller combination MDD 71C-N-040 with DKS1.1-W050A and overload factor OF = 137% (Controllers catalog, page 36) M_{perm} (≈ 35 Nm) > M_{Mmax} (= 17.4 Nm):

Selected ball screw drive: KGT 32 x 20

Calculation

Length L

$Travel_{max}$ = (stroke + 2 · excess travel) = 500 mm + 2 · 40 mm = 580 mm
with excess travel = (2 · P) = 2 · 20 = 40 mm
L = 1020 (from table)
Max. travel = 582 mm

Acceleration torque M_B

$M_B = 0.8 \cdot M_{Mmax} - M_f = 0.8 \cdot 17.4\ Nm - 1.21\ Nm = 12.71\ Nm$ (1)

M_{Mmax} = 17.4 Nm < M_{perm} ≈ 35 Nm (from chart "Max. perm. drive torque")

Mass moment of inertia J_{tot}

with $J_S = 2465 \cdot 10^{-6}\ kgm^2$ (4)

Equations and data taken from catalog Ball Rail Tables

$J_K = 200 \cdot 10^{-6}\ kgm^2$

$J_{fr} = J_S + J_K + J_B$ (is disregarded= $(2465 + 200) \cdot 10^{-6}\ kgm^2 = 2665 \cdot 10^{-6}\ kgm^2$

For handling:

$J_M > \frac{J_{fr}}{6} > \frac{2665 \cdot 10^{-6}}{6} > 444 \cdot 10^{-6}\ kgm^2$

$J_M = 11.90\ kgcm^2 = 1190 \cdot 10^{-6}\ kgm^2$ (values from table on page 48)

$1190 \cdot 10^{-6}\ kgm^2 > 444 \cdot 10^{-6}\ kgm^2$ —> condition met

$J_{tot} = J_{fr} + J_M = (2665 + 1190) \cdot 10^{-6}\ kgm^2 = 3855 \cdot 10^{-6}\ kgm^2$

Speed n

$$n_1 = \frac{i \cdot v}{P} \cdot 1000 = \frac{1 \cdot 50\ \text{m/min}}{20\ \text{mm}} \cdot 1000 = 2500\ \text{rpm} \quad (6)$$

v = 50 m/min = 0.833 m/s, i = 1 (value from diagram "maximum velocity")

Acceleration time t_h

$$t_h = J_{tot} \cdot \left(\frac{n \cdot 0.10472}{M_B}\right) = 3855 \cdot 10^{-6} \cdot \left(\frac{2500 \cdot 0.10472}{12.71}\right) s = 0.0794\ s \quad (7)$$

Acceleration a

$$a = \frac{v}{t_h \cdot 60} = \frac{50\ \text{m/min}}{0.0794\ s \cdot 60} = 10.50\ \text{m/s}^2 \quad (8)$$

Acceleration distance s_h

$$s_h = 0.5 \cdot a \cdot t_h^2 = 0.5 \cdot 10.50\ \text{m/s}^2 \cdot (0.0794\ s)^2 = 0.0330\ m = 33.0\ mm \quad (9)$$

Discrete distance step s_k
at constant velocity

$$s_k = s - 2 \cdot s_h = 500\ mm - 2 \cdot 33.0\ mm = 434\ mm$$

Constant velocity v_k

$$v_k = n \cdot P = \frac{2500\ \text{rpm} \cdot 20\ mm}{1000} = 50\ \text{m/min} = 0.833\ \text{m/s}$$

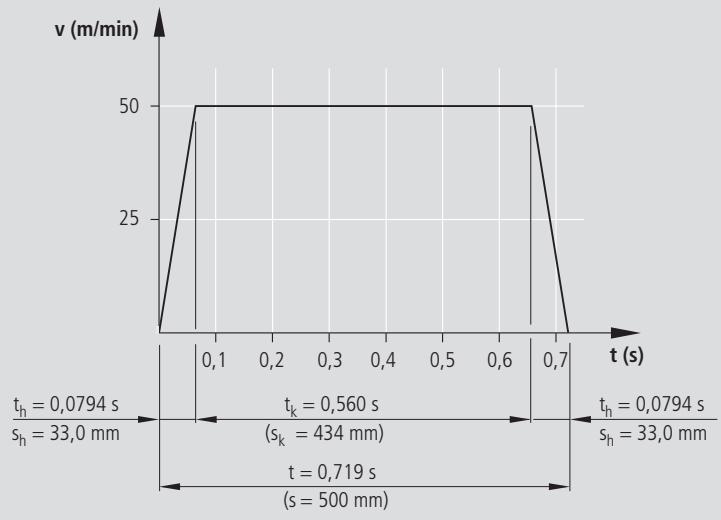
Discrete time step t_k
at constant velocity

$$t_k = \frac{s_k}{v_k} = \frac{0.434\ m}{0.833\ \text{m/s}} = 0.560\ s$$

Total time t

$$t = 2 \cdot t_h + t_k = 2 \cdot 0.0794\ s + 0.560\ s = 0.719\ s$$

Distance-time diagram



engineering
mannesmann
Rexroth

Deutsche Star GmbH
D-97419 Schweinfurt

Telephone +49-9721-937-0

Telefax (general) +49-9721-937-275

Telefax (direct) +49-9721-937-350

www.rexroth-star.com

Controllers, Motors,
Electrical Accessories
RE 82 701/10.99

Printed in Germany - p 99/.././..

Rexroth
STAR Star

Printed on chlorine-free bleached paper