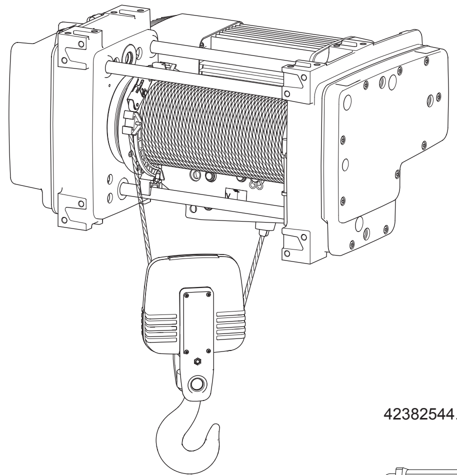
DEMAG
Cranes & Components

Demag DR 3 - 10 rope hoist

without electrical control



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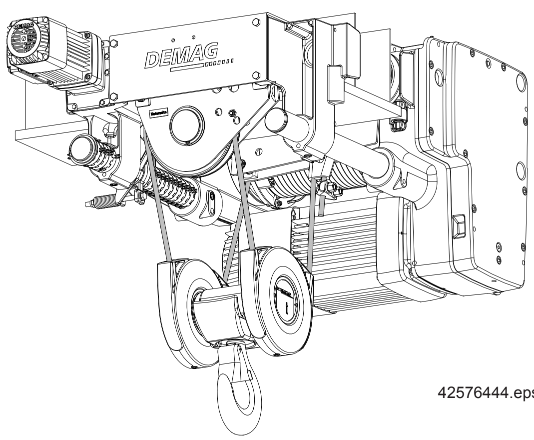

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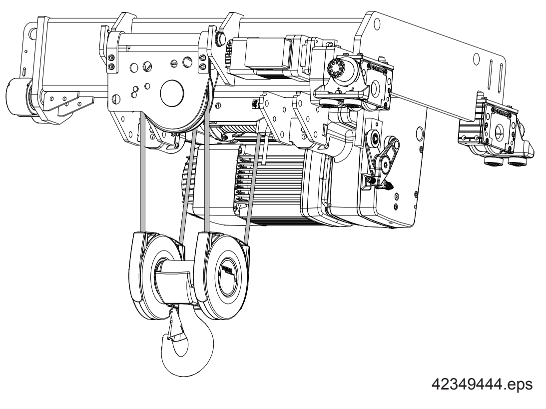

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Manufacturer

Demag Cranes & Components GmbH
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Telephone (+2335) 92-0 · Telefax (+2335) 927676
www.demagcranes.com

Please fill in the following table before first putting the chain hoist into service.

This provides you with a definitive documentation of your Demag rope hoist and important information if you ever have to contact the manufacturer or his representative.

Owner	
Where in use	
Range	
Serial number	
Main hoist motor number	
Operating voltage	
Control voltage	
Frequency	
Wiring diagram number	

Accompanying documents

Operating instructions

Demag FDR 3 - FDR 5- FDR 10 (PRO) rope hoist	214 932 44	720 **IS** 813
Demag EKDR 3 - EKDR 5- EKDR 10 (PRO) rope hoist	214 725 44	720 **IS** 813
Demag EZDR 5- EKDR 10 (PRO) rope hoist	214 961 44	720 **IS** 813
Demag FDR 3 - FDR 5- FDR 10 (COM) rope hoist	214 990 44	720 **IS** 813
Demag EKDR 3 - EKDR 5- EKDR 10 (COM) rope hoist	214 916 44	720 **IS** 813
Demag EZDR 5- EKDR 10 (COM) rope hoist	214 965 44	720 **IS** 813
Dedrive Compact DIC	214 708 44	720 **IS** 922
CD Dedrive Compact DIC	213 136 44	716 **IS** 922
External pulse encoder	214 372 44	720 **IS** 919
Z motor range	214 228 44	720 **IS** 919

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Contents

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Introduction

This document contains information on rope hoists without electrical control. It applies for DR-Pro, EKDR-Pro, EZDR-Pro, FDR-Pro, EKDR-Com, EZDR-Com and FDR-Com rope hoists.

Depending on the type, the standard scope of delivery includes:

- 12/2-pole hoist motor with Microtherm and EG integrated pulse generator
- GS and VE brake modules
- 4-pole hoist motor with Microtherm contact and mechanical mounting device for AG 1 - 3 external pulse generators
- GS and VE brake modules
- 4-pole cross-travel motor with Microtherm contact
- 8/2-pole cross-travel motor for EKDR
- GF and VE brake modules
- Base plate in the rope hoist electrical enclosure for connecting the hoist motor and sensors
- SGG geared limit switch
- MGS overload cut-off device, for double-groove design with ZMS

Pay attention to the following when designing the electrical equipment for DR rope hoists not supplied with electrical equipment:

Pole-changing motors are rated for intermittent duty. The basis for this is FEM 9.683, issue 10/1995

Derived from this document, we provide values for the duty factor and switching frequency for these motors in our documentation.

The specified values must not be exceeded. In order to ensure this, we recommend that timing elements be incorporated in the control system to prevent too frequent switching or too fast restoration of the supply to the two-pole winding.

The value should be set to at least 1 second.

For setting up the electronic circuit, we recommend that the SGDM hoist unit relay be used for this function.

Design overview

Example EKDR

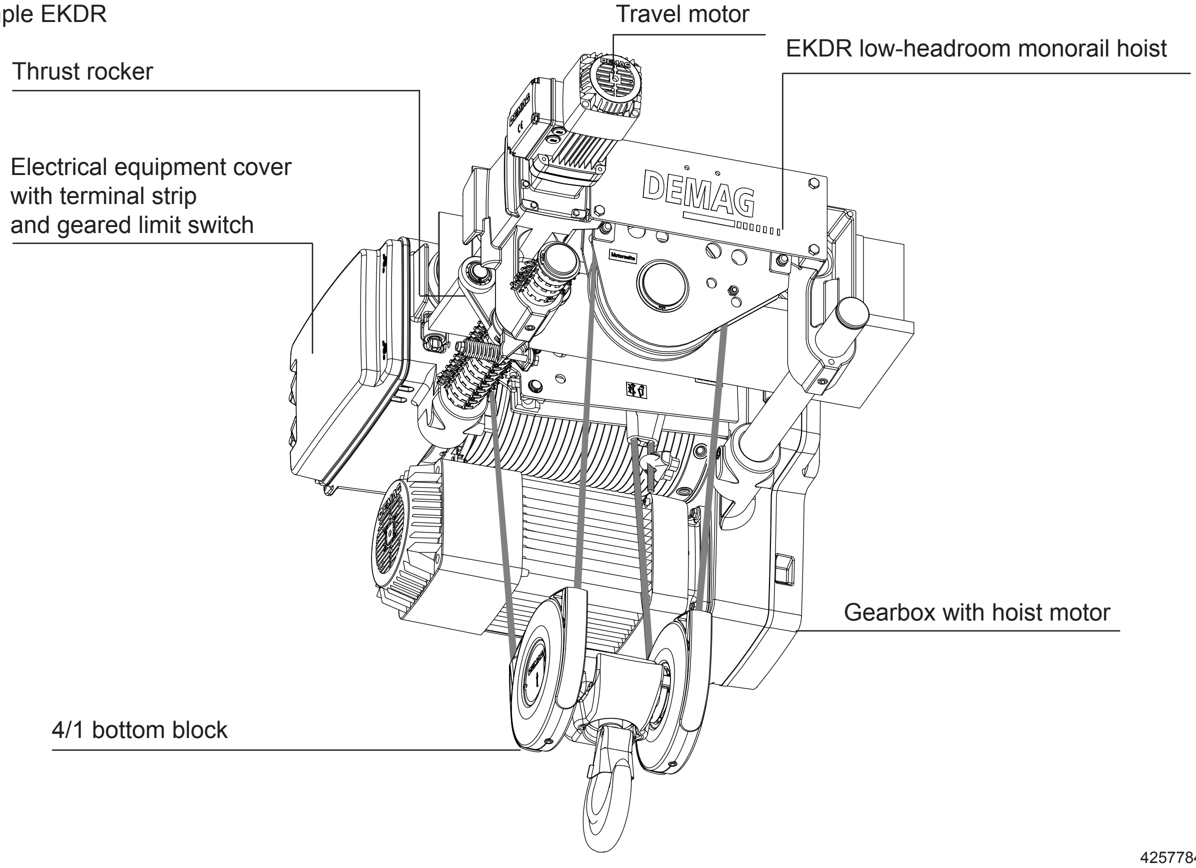

Fig. 1

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Explanation of size designation / type assignment

E	K	DR-Pro	3 -	3,2	4/1 -	6	Z -	6/1 -	400 -	00 -	50 -	30	300	45	

45	Rail head width in mm	only EZDR
300	Track gauge	
30	Maximum cross-travel speed in m/min	
50 -	Frequency [Hz]	
00 -	Electrical equipment code 1)	
400 -	Operating voltage [V]	
6/1 -	Hoist speed in m/min	
Z -	Motor type: Z = cylindrical rotor	
6	Hook path in m	
4/1 -	Reeving	
3,2	SWL in t	
3 -	Series 3; 5; 10	
DR-Pro	Demag rope hoist	
K	K = Low-headroom monorail hoist Z = Double-rail crab F = Stationary	
E	E = Electric travel unit	

1) Code 00 Prepared for electrical equipment supplied by the customer
Code 01 DR with internal electrics for application on a crane Including crane bridge housing and DSE-8R or DSE-10R control pendant with control cable.
Code 02 DR with solo electrical equpment for application as a solo travelling hoist. Including DSE-8R or DSE-10R control pendant with control cable.
Code 03 Like code 01 but control via DRC radio control system
Code 04 Like code 02 but control via DRC radio control system
Code 05 DR fitted with parallel “in“ interface

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DR-Pro selection criteria

The size of the hoist is determined by the load spectrum, average operating time per working day, SWL and reeving.

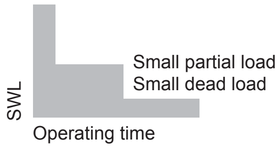
1. What are the operating conditions?
2. What is the specified safe working load?
3. To what height must the load be lifted?
4. What is the required lifting speed?
5. Do the loads need to be lifted and lowered with high precision?
6. Is horizontal load travel necessary?
7. How is the hoist to be controlled?

The load spectrum

(in most cases estimated) can be evaluated in accordance with the following definitions:

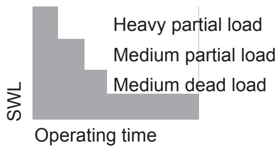
1 Light

Hoist units which are usually subject to very small loads and in exceptional cases only to maximum loads.



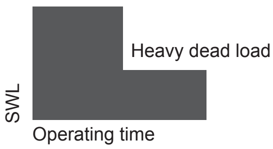
2 Medium

Hoist units which are usually subject to small loads but rather often to maximum loads.



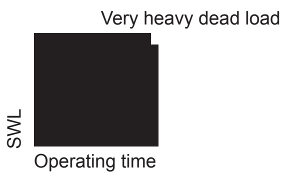
3 Heavy

Hoist units which are usually subject to medium loads but frequently to maximum loads.



4 Very heavy

Hoist units which are usually subject to maximum or almost maximum loads.



The group is determined by the load spectrum and operating time.

Load spectrum			Average operating time per working day in hours			
1	**Light**		2-4	4-8	8-16	over 16
2	**Medium**		1-2	2-4	4-8	8-16
3	**Heavy**		0,5-1	1-2	2-4	4-8
4	**Very heavy**		0,25-0,5	0,5-1	1-2	2-4
Group of mechanisms to		FEM	1Am	2m	3m	4m
		ISO	M4	M5	M6	M7

Group of mechanisms to FEM/ISO 1)	**1Am M4**	**2m M5**	**3m M6**	**4m M7**	**1Am M4**	**2m M5**	**3m M6**	**4m M7**	**2m M5**	**3m M7**	**4m M7**
Reeving arrangement	**2/1, 4/2 2)**				**4/1**				**6/1 2)**		
Range	**SWL in t**										
DR 3	---	1,6	1,25	1	---	3,2	2,5	2	-	-	-
DR 5	3,2	2,5	2	1,6	6,3	5	4	3,2	-	-	-
DR 10	6,3	5	4	3,2	12,5	10	8	6,3	16	12,5	10

Example

SWL	5 t
Load spectrum	“medium” from table
Hoist speed	6 m/min
Creep hoist speed	1 m/min
Reeving	4/1
Average hook path	3 m
No. of cycles/hour	20
Working time/day	8 hours

The average operating time per working day is estimated or calculated as follows:

$$\text{Operating time/day} = \frac{2 \cdot \text{average hook path} \cdot \text{no. of cycles/hour} \cdot \text{working time/day}}{60 \cdot \text{hoist speed}} =$$

$$\text{Operating time/day} = \frac{2 \cdot 3 \cdot 20 \cdot 8}{60 \cdot 6} = 2{,}66 \text{ hours}$$

For the medium load spectrum and an average daily operating time of 2,66 hours, the table shows group 2m. For a load capacity of 5 t and 4/1 rope reeving, the table indicates hoist size DR 5 - 5.

1) Gearbox service life 20 % above the FEM full load service life
2) 4/2 reeving only for DR 5 and DR 10, 6/1 only for EZDR 10

Selection table

Range	Group of mechanisms 1)		SWL [t]	Hook path [m]	Hoist speed [m/min]		
	FEM	ISO			V1	V2	V3 2)
DR 3	2/1						
F- / EK-	2m	M5	1,6	12; 20	12/2	18/3	1-25 3)
	3m	M6	1,25				
	4m	M7	1				
	4/1						
F- / EK-	2m	M5	3,2	6; 10	6/1	9/1,5	0,5-12,5 3)
	3m	M6	2,5				
	4m	M7	2				
DR 5	2/1						
F- / EK-	1Am	M4	3,2	12; 20; 30	9/1,5	12/2	0,8-16 3)
F- / EK- / EZ-	2m	M5	2,5		12/2	18/3	1-25 3)
	3m	M6	2				
	4m	M7	1,6				
	4/1						
F- / EK-	1Am	M4	6,3	6; 10; 15	4,5/0,8	6/1	0,4-8 3)
F- / EK- / EZ-	2m	M5	5		6/1	9/1,5	0,5-12,5 3)
	3m	M6	4				
	4m	M7	3,2				
	4/2						
F- / EK-	1Am	M4	3,2	9,9/16,3	9/1,5	12/2	0,8-16 3)
F- / EK- / EZ-	2m	M5	2,5		12/2	18/3	1-25 3)
	3m	M6	2				
	4m	M7	1,6				
DR 10	2/1						
F- / EK-	1Am	M4	6,3	12; 20; 30	8,0/1,4	0,4-9 2)	1-18 3)
F- / EK- / EZ-	2m	M5	5		10/1,7	1-18 2) 3)	1-25 3)
	3m	M6	4				
	4m	M7	3,2				
	4/1						
F- / EK-	1Am	M4	12,5	6; 10; 15	4,0/0,7	0,2-4,5 2) 3)	0,5-9 3)
F- / EK- / EZ-	2m	M5	10		5/0,8	0,5-9 2) 3)	0,5-12,5 3)
	3m	M6	8				
	4m	M7	6,3				
	4/2						
F- / EK-	1Am	M4	6,3	5,8; 11,35; 18,4	8,0/1,4	0,4-9 2) 3)	1-18
F- / EK- / EZ-	2m	M5	5		10/1,7	1-18 2) 3)	1-25 3)
	3m	M6	4				
	4m	M7	3,2				
	6/1						
EZ-	2m	M5	16	6,7; 13,3	2,7/0,4	0,7-6	-
	3m	M6	12,5				
	4m	M7	10				

1) Gearbox service life 20 % above the FEM value
2) Loads weighing up to one third of the rated load are moved at 1,5 times the rated speed using Prohub
3) for 400 V, 87 Hz delta operation

DR-Com selection criteria

The size of the hoist is determined by the load spectrum, average operating time per working day, SWL and reeving.

1. What are the operating conditions?
2. What is the specified safe working load?
3. To what height must the load be lifted?
4. What is the required lifting speed?
5. Do the loads need to be lifted and lowered with high precision?
6. Is horizontal load travel necessary?
7. How is the hoist to be controlled?

The load spectrum

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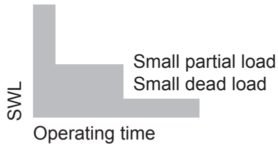
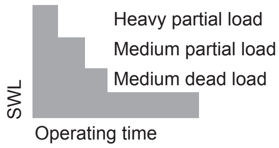
1 Light

Hoist units which are usually subject to very small loads and in exceptional cases only to maximum loads.



2 Medium

Hoist units which are usually subject to small loads but rather often to maximum loads.



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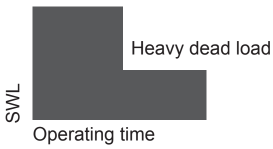
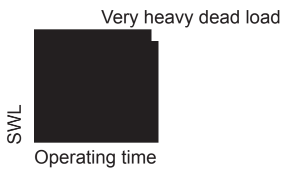
Hoist units which are usually subject to medium loads but frequently to maximum loads.



4 Very heavy

Hoist units which are usually subject to maximum or almost maximum loads.



The group is determined by the load spectrum and operating time.			
Load spectrum			Average operating time per working day in hours
1	**Light**		2-4
2	**Medium**		1-2
3	**Heavy**		0,5-1
4	**Very heavy**		up to 0,5
Group of mechanisms to		FEM	1Am
		ISO	M4

Group of mechanisms acc. to FEM/ISO	**1Am / M4**
Reeving arrangement	**4/1**
Range	**SWL in t**
DR 3	3,2
DR 5	5
DR 10	10

Example	
SWL	5 t
Load spectrum	“medium” from table
Hoist speed	4.5 m/min
Creep hoist speed	0.8 m/min
Reeving	4/1
Average hook path	3 m
No. of cycles/hour	10
Working time/day	8 hours

The average operating time per working day is estimated or calculated as follows:

$$\text{Operating time/day} = \frac{2 \cdot \text{average hook path} \cdot \text{no. of cycles/hour} \cdot \text{working time/day}}{60 \cdot \text{hoist speed}} =$$

$$\text{Operating time/day} = \frac{2 \cdot 3 \cdot 10 \cdot 8}{60 \cdot 4{,}5} = 1{,}7 \text{ hours}$$

For the medium load spectrum and an average daily operating time of 1,7 hours, the table shows group 1Am. For a load capacity of 5 t and 4/1 rope reeving, the table indicates hoist size DR 5 - 5.

Selection table

Range	Group of mechanisms		SWL [t]	Hook path [m]	Hoist speed [m/min]
	FEM	ISO			V1
DR 3	4/1				
F- / EK-	1Am	M4	3,2	6; 10	4,5/0,8
			2,5		
			2		
DR 5	4/1				
F- / EK- / EZ-	1Am	M4	5	6; 10;	4,5/0,8
			4		
			3,2		
DR 10	4/1				
F- / EK- / EZ-	1Am	M4	10	6; 10;	4/07
			8		
			6,3		

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Key data of pole-changing hoist drives DR 3 – DR 5 – DR 10

Design is in accordance with the VDE regulations and the design rules of the FEM, to meet the high demands made on electric hoists.

Main/creep lifting F6

DR 3 range Motor size	No. of poles	Hoist speed	PN [kW]	CDF [%]	n [rpm]	Starts/h	Rated current IN and start-up current IA for 50 Hz 400 V I_N [A]	 I_A [A]	cos φ_N	cos φ_A
ZBR 100 C 12/2 - B050	12	12/2; 6/1	0,55	20	430	240	4,6	7	0,53	0,72
	2		3,4	40	2800	120	8,5	40	0,78	0,88
ZBR 100 D 12/2 - B050	12	18/3; 9/1,5	0,8	20	410	240	5,7	9	0,55	0,75
	2		5,3	40	2780	120	11	55	0,88	0,85

Required supply cable conductor cross sections and fuse links

DR 3 range	Mains connection delay fuse for 50 Hz 1)	Supply lines 2) for 5% voltage drop ΔU and start-up current I_A for 50 Hz	
	400 V	400 V (ΔU 20 V)	
Motor size	A	mm²	m
ZBR 100 C 12/2	20	1,5	25
ZBR 100 D 12/2	25	1,5	19

Main/creep lifting F6

DR 5 range Motor size	No. of poles	Hoist speed	PN [kW]	CDF [%]	n [rpm]	Starts/h	Rated current IN and start-up current IA for 50 Hz 400 V I_N [A]	 I_A [A]	cos φ_N	cos φ_A
ZBR 100 D 12/2 - B050	12	9/1,5; 12/2 4,5/0,8; 6/1	0,8	20	410	240	5,7	9	0,55	0,75
	2		5,3	40	2780	120	11	55	0,88	0,85
ZBR 132 D 12/2 - B140	12	12/2; 18/3 6/1; 9/1,5	1,4	20	400	240	9,6	15,0	0,54	0,68
	2		8,9	40	2870	120	18,0	120,0	0,89	0,85

Required supply cable conductor cross sections and fuse links

DR 5 range	Mains connection delay fuse for 50 Hz 1)	Supply lines 2) for 5% voltage drop ΔU and start-up current I_A for 50 Hz	
	400 V	400 V (ΔU 20 V)	
Motor size	A	mm²	m
ZBR 100 D 12/2	25	1,5	19
ZBR 132 D 12/2	50	2,5	15

Main/creep lifting F6

DR 10 range Motor size	No. of poles	Hoist speed	PN [kW]	CDF [%]	n [rpm]	Starts/h	Rated current IN and start-up current IA for 50 Hz 400 V I_N [A]	 I_A [A]	cos φ_N	cos φ_A
ZBR 132 D 12/2 - B140	12	8,0/1,4; 10/1,7 4,0/0,7: 5/0,8	1,4	20	400	240	9,6	15,0	0,54	0,68
	2		8,9	40	2870	120	18,0	120,0	0,89	0,85

Required supply cable conductor cross sections and fuse links

DR 10 range	Mains connection delay fuse for 50 Hz 1)	Supply lines 2) for 5% voltage drop ΔU and start-up current I_A for 50 Hz	
	400 V	400 V (ΔU 20 V)	
Motor size	A	mm²	m
ZBR 132 D 12/2	50	2,5	15

1) Fuse links also apply in conjunction with a cross-travel motor.

2) The lengths of the supply lines are calculated on the basis of an earth-loop impedance of 200 mΩ.

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Key data of cross travel drives DR 3 – DR 5 – DR 10

The inverter-fed cross-travel drives of the “DR without electrical control” are designed for operation with a Demag frequency inverter in the 120 Hz range. We recommend that Demag DIC Dedrive Compact frequency inverters be used. Owing to the large input voltage range of the Dedrive Compact, “DR rope hoists without electrical control” can be operated with mains voltages of 380...480 V with 50...60 Hz. At 380 V, the max. frequency must be reduced by 5 Hz.

Key data of inverter-controlled cross-travel drives DR 3, DR 5, DR 10 - 2/1 - 4/1 - 4/2

DR 3 - 10 range **Motor size**	No. of poles	% CDF	Output P kW	Current at 220 V I (A)	cos φ	n at 50 Hz rpm	Recommended inverter type Dedrive Compact
ZBA 71 B4 DR B003	4	60	0,37	2,6	0,54	1375	DIC-4-004-E

Key data of inverter-controlled cross-travel drives EZDR 10 -Pro 6/1

DR 10 range **Motor size**	No. of poles	% CDF	Output P kW	Current at 220 V I (A)	cos φ	n at 50 Hz rpm	Recommended inverter type Dedrive Compact
ZBA 80 A4 DR B007 (2x)	4	60	0,55	1,7	0,68	1420	DIC-4-007-E

Key data of pole-changing cross-travel drives EKDR 3 and 5

Cross-travel speed 6 - 24 m/min at 50 Hz

DR 3 and 5 range **Motor size**	No. of poles	P kW	% CDF	n rpm	M_N Nm	Rated current I_N for 50 Hz 380 - 400 V I_N (A)	cos φ_N	I_A/I_N	M_A / M_N Nm	M_H Nm	J_{Mot} $kgm^2 \cdot 10^{-3}$	A h^{-1}	Weight kg
ZBF 71 A 8/2 - B003	8	0,09	40	675	1,25	0,76	0,61	1,60	2,7	2,5	6,90	620	12,2
	2	0,34		2785	1,15	1,00	0,73	3,50	2,6			500	

Key data of pole-changing cross-travel drives EKDR 10

Cross-travel speed 6 - 24 m/min at 50 Hz

DR 10 range **Motor size**	No. of poles	P kW	% CDF	n rpm	M_N Nm	Rated current I_N for 50 Hz 380 - 400 V I_N (A)	cos φ_N	I_A/I_N	M_A / M_N Nm	M_H Nm	J_{Mot} $kgm^2 \cdot 10^{-3}$	A h^{-1}	Weight kg
ZBF 80 A 8/2 - B020	8	0,13	40	630	1,95	1,45	0,64	1,20	2,1	3,5	12,75	620	19,5
	2	0,50		2790	1,70		0,73	4,50	2,6	4,0		500	

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Key data of inverter-operated hoist drives DR 3, DR 5, DR 10

Design is in accordance with the VDE regulations and the design rules of the FEM, to meet the high demands made on electric hoists.

The hoist drives of “DR rope hoists without electrical control” are designed for operation with a Demag frequency inverter in the 87 Hz range. We recommend that Demag DIC Dedrive Compact frequency inverters be used. Owing to the large input voltage range of the Dedrive Compact, “DR rope hoists without electrical control” can be operated with mains voltages of 380...480 V with 50...60 Hz. At 380 V, the max. frequency must be reduced by 5 Hz.

The specified motor data refer to 220 V, 50 Hz delta connection. Hoist motors are specified for max. 500 V operating voltage. Higher voltages on request.

Acceleration current of inverter-operated hoist motor = 1,2 x rated current I(A).

Rated cos phi of inverter-operated hoist motor = 1,0

Range	Reeving	Hoist speed [m/min]	Group of mecha-nisms FEM	Motor data					Hoist output	Inverter 1)	
				Type	Brake	No. of poles	% CDF	n at 87 Hz [rpm]	P_{hoist} [kW]	Type	Rated current at 2 kHz [A]
DR 3	2/1	1-25	2m	ZBR 100 B4	B050	4	60	2460	7,37	DIC-4-017	16,5
			3m						5,86	DIC-4-014	14
			4m						4,77	DIC-4-014	14
	4/1	0,5-12,5	2m	ZBR 100 B4	B050	4	60	2460	7,16	DIC-4-017	16,5
			3m						5,64	DIC-4-014	14
			4m						4,55	DIC-4-014	14
DR 5	2/1; 4/2	0,8-16	1Am	ZBR 112 A4	B140	4	60	2540	9,19	DIC-4-025	25
		1-25	2m	ZBR 132 B4				2530	11,45	DIC-4-025	25
			3m	ZBR 112 A4				2540	9,28	DIC-4-025	25
			4m						7,52	DIC-4-017	16,5
	4/1	0,4-8	1Am	ZBR 112 A4	B140	4	60	2540	8,91	DIC-4-025	25
		0,5-12,5	2m	ZBR 132 B4				2530	11,23	DIC-4-025	25
			3m	ZBR 112 A4				2540	9,66	DIC-4-025	25
			4m						7,29	DIC-4-017	16,5
DR 10	2/1; 4/2	0,4-9	1Am	ZBR 132 B4	B140	4	60	2530	10,01	DIC-4-025	25
		1-18	2m	ZBR 132 C4					16,10	DIC-4-040	40
			3m	ZBR 132 B4					12,94	DIC-4-032	32
			4m						10,42	DIC-4-025	25
		1-18	1Am	ZBR 132 C4	B140	4	50	2520	20,13	DIC-4-040	40
		1-25	2m						21,30	DIC-4-040	40
			3m				60	2530	17,19	DIC-4-040	40
			4m						13,84	DIC-4-032	32
	4/1	0,2-4,5	1Am	ZBR 132 B4	B140	4	60	2530	9,86	DIC-4-025	25
		0,5-9	2m	ZBR 132 C4					15,94	DIC-4-040	40
			3m	ZBR 132 B4					12,79	DIC-4-032	32
			4m						10,10	DIC-4-025	25
		0,5-9	1Am	ZBR 132 C4	B140	4	50	2520	19,81	DIC-4-040	40
		0,5-12,5	2m						21,09	DIC-4-040	40
			3m				60	2530	16,98	DIC-4-040	40
			4m						13,44	DIC-4-032	32

1) The inverter housing is not attached to the hoist unit and is included in the delivery as a separate item. The inverter housing must be attached by the customer, the standard cable length measures approx. 3 m.

The inverter housing measures (H x W x D) 600 x 880 x 300 mm. When an inverter housing is used, a min. distance of 100 mm from the top edge of the hoist unit must be maintained.

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Required supply cable conductor cross sections and fuse links

DR 3/5/10 range	Mains connection delay fuse for 50 Hz 400 V	Supply lines 1) for 5% voltage drop ∆U 400 V (∆U 20 V)	
Inverter type	A	mm²	m
DIC-4-040	50	6,0	97
DIC-4-032	35	4,0	80
DIC-4-025	35	2,5	65
DIC-4-017	16	1,5	58
DIC-4-014	16	1,5	70

Example for calculating the cross sections of the conductors of cables exceeding the length indicated in the table:

ZBR 100 C 2/12, 400 V required length 25 m

$$\frac{\text{Known cross-section} \cdot \text{required length}}{\text{Known cable length}} = \frac{2{,}5 \cdot 25}{16} = 4 \text{ mm}^2$$

1) The lengths of the supply lines are calculated on the basis of an earth-loop impedance of 200 mΩ.

Parameter setting for the recommended Dedrive Compact DIC frequency inverter

Please refer to the table below for the necessary parameter settings.

A rotary encoder feedback is required on the motor of hoist drives. We recommend using the Demag AG 2 external pulse generator in connection with the EM-ENC-02 expansion module for the Demag Dedrive Compact frequency inverter.

After the rated motor values have been entered, it is absolutely necessary to carry out a parameter identification.

The specified motor values are recommendations for optimum motor identification and, therefore, for optimum operation of the motors. The recommended values may differ from the data stamped on the motor type plate. (See footnote 4 for stamped motor data).

No.	Name	Unit	ZBA 4)		ZBR 4)			
			71 B4	90 A4	100 B4	112 A4	132 B4	132 C4
030	Configuration	-	410		210			
370	Rated voltage	V	220		220			
371	Rated current	A	2,6	5,1	12,4	14,9	26,5	34,0
372	Rated speed	rpm	1375	1400	1400	1440	1435	1440
373	No. of pole pairs	-	2		2			
374	Rated cos phi	-	0,54	0,74	0,79	0,83	0,85	0,84
375	Rated frequency	Hz	50		50			
376	Mech. rated power	kW	0,4	1,1	3,0	4,0	7,5	9,5
417	Frequency switch-off limit	Hz	250		100 (140)			
418	Minimum frequency	Hz	5		8			
419	Maximum frequency[1]	Hz	120		84 (133) 2)	85 (133) 2)		86 (133) 2)
420	Acceleration	Hz/s	25		42	42,5		43
421	Deceleration	Hz/s	50		42	42,5		43
490	Op. mode rotary encoder 1	-	0		4			
491	Div. marks rotary encoder 1	-	-		depending on the rotary encoder used			
721	Speed controller amplification	-	3		10			
722	Integral-action time of the speed controller	ms	200		100			
850	Operating mode (Prohub)		-		1-On 3)			
851	Field weakening enable		-		6-On 3)			
852	Field weakening start	%	-		166 3)			
853	Correction value lifting	%	-		15 3)			
854	Correction value lowering	%	-		10 3)			
855	Start of measurement	Hz	-		80,0 3)			
856	Field weakening factor		-		0,50 3)			

For further details regarding putting into operation, many possible control variants, various special functions for hoist units as well as the selection of further additional components of the Dedrive Compact DIC, please refer to the operating instructions 214 708 44 and 214 716 44. The admissible ambient conditions must be complied with.

1) At 380 V, the max. frequency must be reduced by 5 Hz.
2) In relation to the rated hoist speed. In brackets: f_{max} when the Prohub function is used to increase performance in the partail load range. For detailed information, see Dedrive Compact Application guidelines/operating instructions 214 716 44.
3) Programmed parameter when the Prohub function is used.
4) Stamped motor data:

ZBA 71 B 4 60%	U = 220 V	I = 2,6 A	n = 1375 rpm	Pair of poles = 2	cos phi = 0,54	f = 50 Hz	P = 0,37 kW
ZBA 90 A 4 60%	U = 220 V	I = 5,1 A	n = 1400 rpm	Pair of poles = 2	cos phi = 0,74	f = 50 Hz	P = 1,1 kW
ZBR 100 B 4 60%	U = 220 V	I = 16,9A	n = 1350 rpm	Pair of poles = 2	cos phi = 0,85	f = 50 Hz	P = 4,2 kW
ZBR 112 A 4 60%	U = 220 V	I = 18,7A	n = 1430 rpm	Pair of poles = 2	cos phi = 0,84	f = 50 Hz	P = 5,3 kW
ZBR 132 B 4 60%	U = 220 V	I = 29,0A	n = 1420 rpm	Pair of poles = 2	cos phi = 0,87	f = 50 Hz	P = 8,3 kW
ZBR 132 C 4 50%	U = 220 V	I = 49,0 A	n = 1410 rpm	Pair of poles = 2	cos phi = 0,84	f = 50 Hz	P = 13,3 kW
ZBR 132 C 4 60%	U = 220 V	I = 40,0A	n = 1420 rpm	Pair of poles = 2	cos phi = 0,83	f = 50 Hz	P = 10,9 kW

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Connection plate with terminal strip for 2-/12-pole DR hoist motor

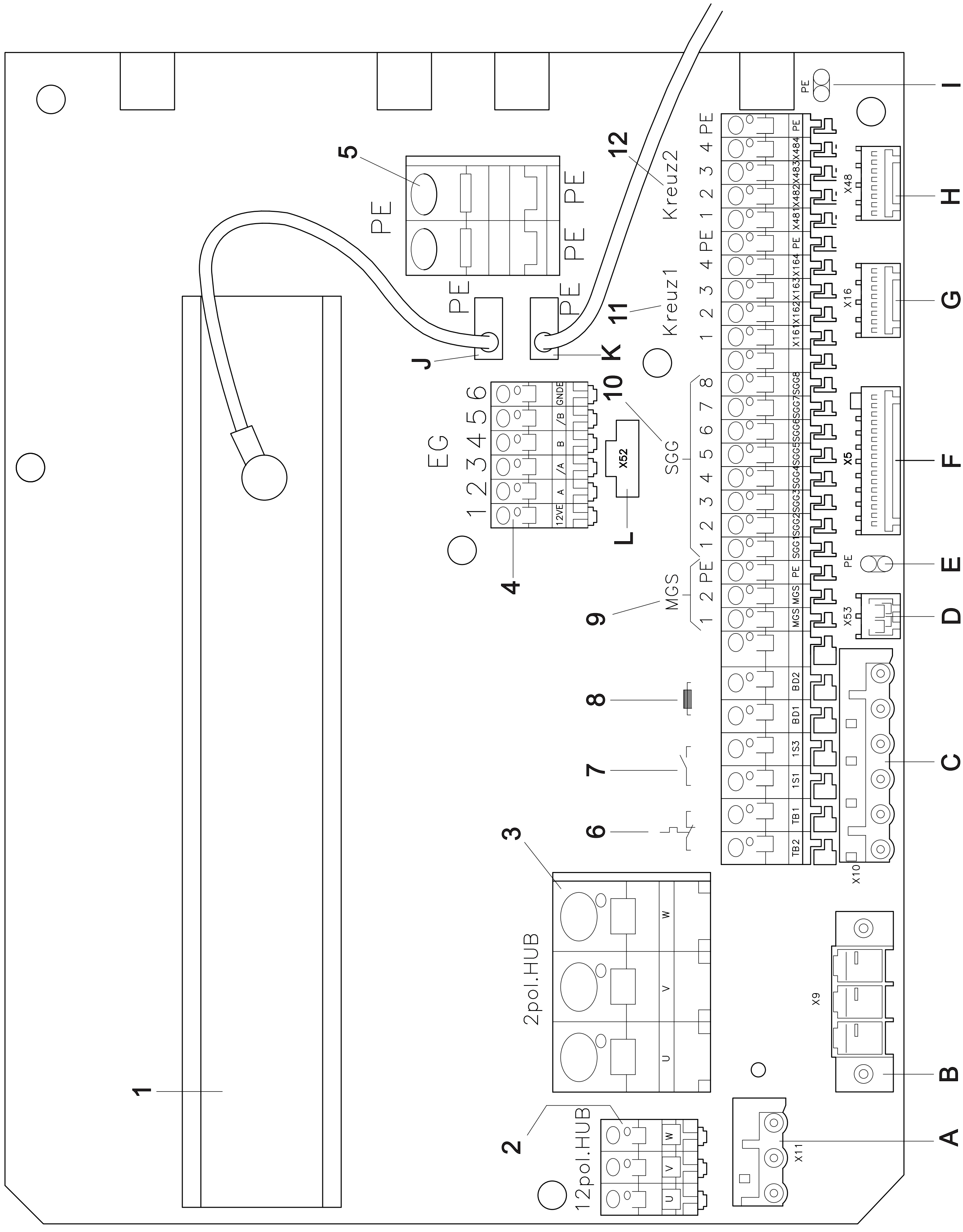

Fig. 2

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Attention!

GS modules must always be provided with a separate power supply when used with a pole-changing motor.

Connections to the customer’s equipment

1 Top-hat rail
2 12-pole hoist motor connection
3 2-pole hoist motor connection
4 EG integrated encoder
5 Protective earth conductor PE
6 Microtherm contact hoist motor
7 Brake release contact hoist motor
8 Brake hoist motor
9 MGS electro-mechanical overload protection
10 SGG geared limit switch
11 General cross-travel limit switch
12 Fast-to-slow cross-travel limit switch (v2 → v1)

All terminals can be connected with up to 4 mm² copper cross-section, except for the 2-pole hoist and PE terminals which must be connected up to 16 mm² copper cross-section.

Factory-made connections

A X11 terminal (12-pole hoist motor)
B X9 terminal (2-pole hoist motor)
C X10 terminal (hoist motor signals)
D X53 terminal (MGS)
E Protective earth conductor PE
F X5 terminal (SGG)
G X16 terminal (final lim. sw.)
H X48 terminal (fast-to-slow lim. sw.)
I Protective earth conductor PE
J Protective earth conductor PE
K Protective earth conductor PE
L X52 terminal (hoist motor integrated pulse generator)

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Connection plate with terminal strip for 4-pole DR hoist motor and hoist inverter operation

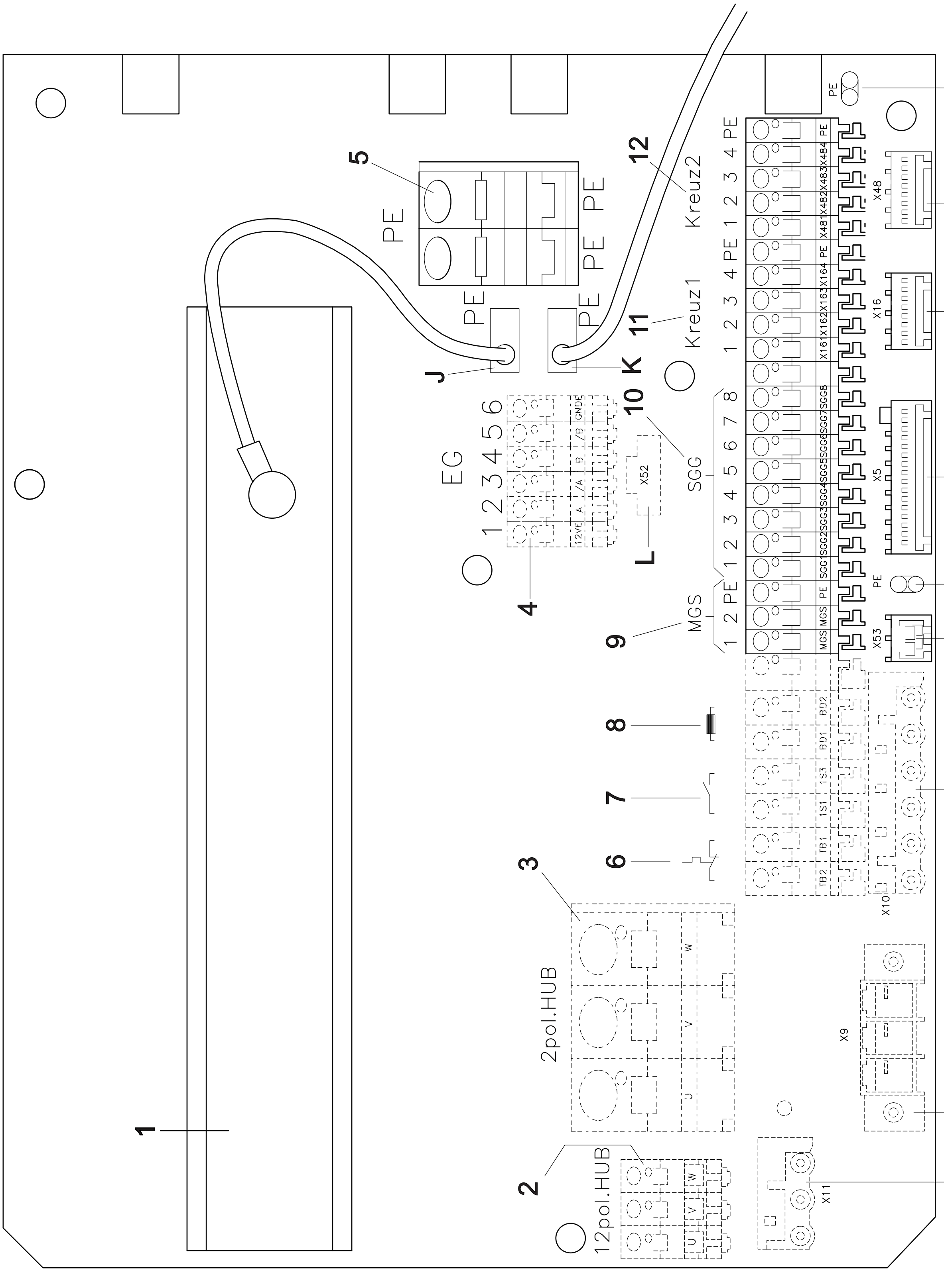

Fig. 3

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Attention!

GS modules must always be provided with a separate power supply when used with a pole-changing motor.

Connections to the customer‘s equipment

For DR units with 4-pole hoist motor, the connection is made directly in the motor terminal box

1 Top-hat rail
2 -
3 -
4 -
5 Protective earth conductor PE
6 -
7 -
8 -
9 MGS electro-mechanical overload protection
10 SGG geared limit switch
11 General cross-travel limit switch
12 Fast-to-slow cross-travel limit switch (v2 → v1)

All terminals can be connected with up to 4 mm² copper cross-section, except for the 2-pole hoist and PE terminals which must be connected up to 16 mm² copper cross-section.

Factory-made connections

A X11 terminal (12-pole hoist motor) 1)
B X9 terminal (2-pole hoist motor) 1)
C X10 terminal (hoist motor signals) 1)
D X53 terminal (MGS)
E Protective earth conductor PE
F X5 terminal (SGG)
G X16 terminal (final lim. sw.)
H X48 terminal (fast-to-slow lim. sw.)
I Protective earth conductor PE
J Protective earth conductor PE
K Protective earth conductor PE
L X52 terminal (hoist motor integrated pulse generator) 1)

1) These parts are not used in the 4-pole motor variant.

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Cable entry

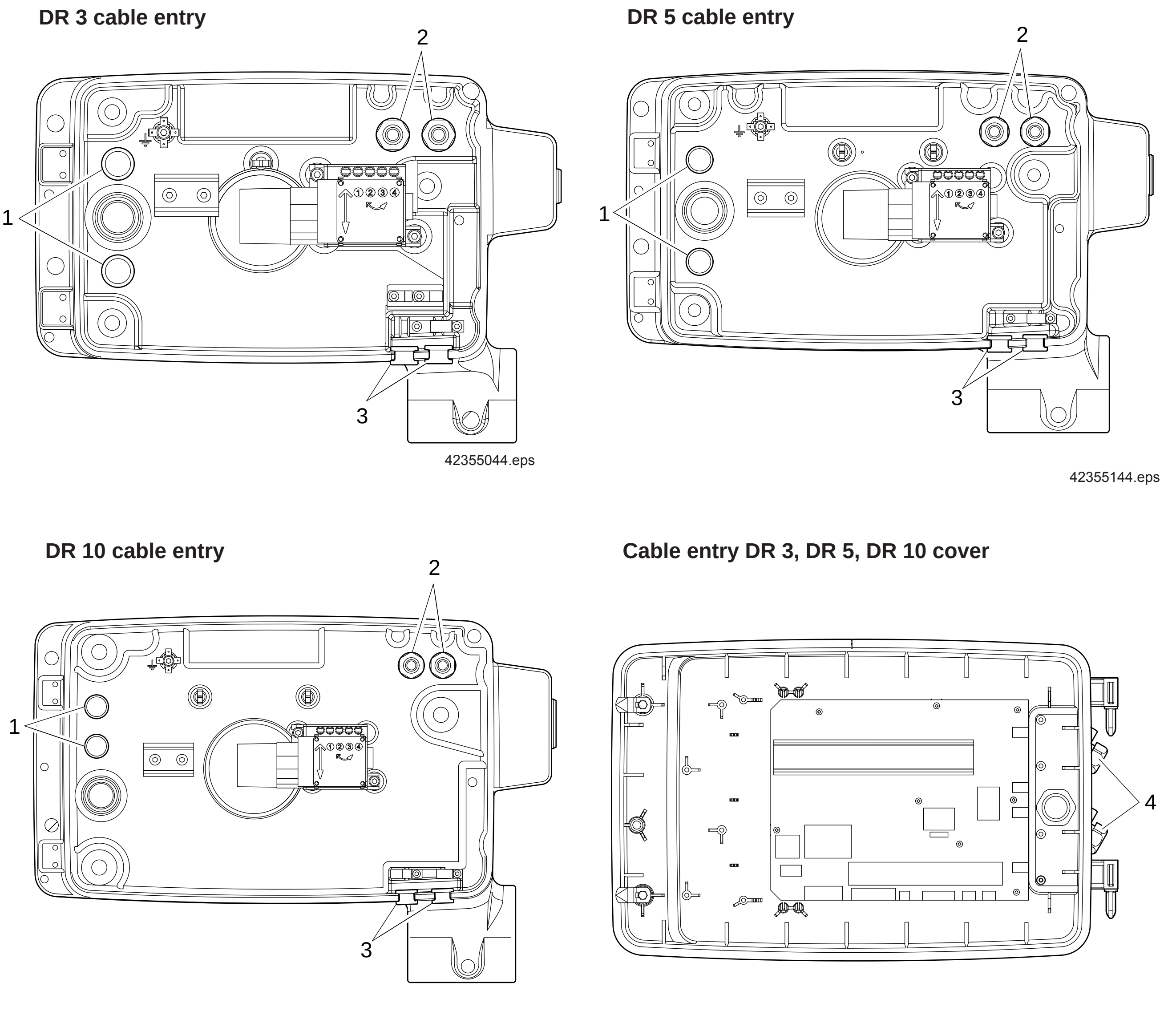


Fig. 4

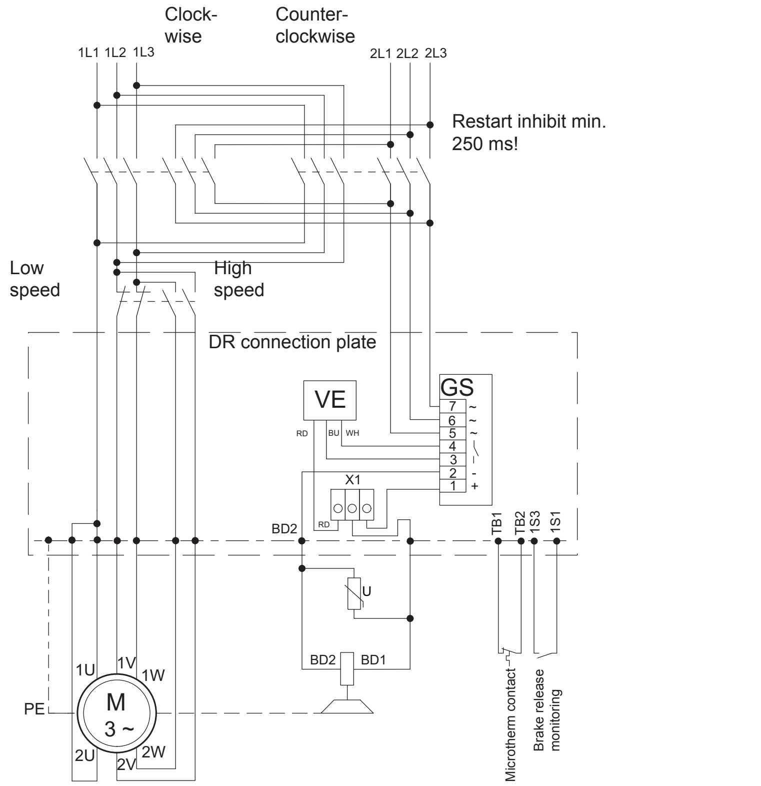
1 Round cable entry M25 1)
2 Round cable entry M20 1)
3 Twist-type cable entry gland for cable glands up to max. 12,5 mm
4 Round cable entry M25

1) Screw-type cable glands must have long threads (approx. 15 mm)
e.g. Schlemmer-Tec cable gland, manufacturer no. 5307620 (M20 x 1,5)
Schlemmer-Tec cable gland, manufacturer no. 5307125 (M25 x 1,5)

Block diagrams

Example for the connection of a hoist motor

Pole-changing hoist drive



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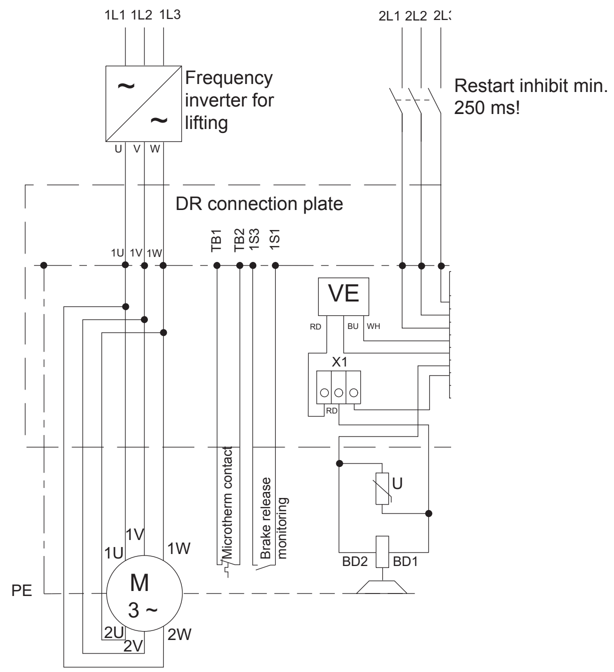
Frequency-controlled hoist drive



Attention!

Only operate GS and VE brake control modules when connected in the terminal box of the motor or on the connection plate with terminal strip for 4-pole DR hoist motor and hoist inverter operation. For DR hoists without electrical equipment: DO NOT operate the brake control modules in the switchgear cabinet but in the immediate vicinity of the brake!

Fig. 5

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Example for the connection of a cross-travel motor

Pole-changing cross-travel drive

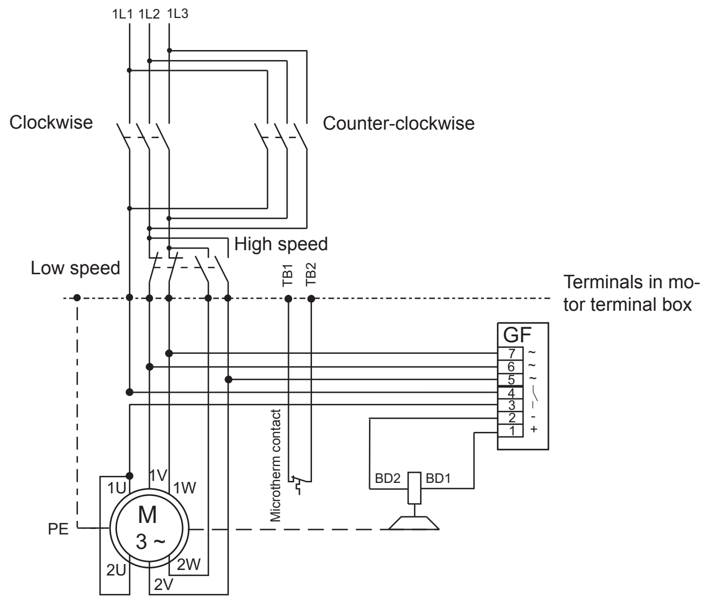

Fig. 6

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Frequency-controlled cross-travel drive

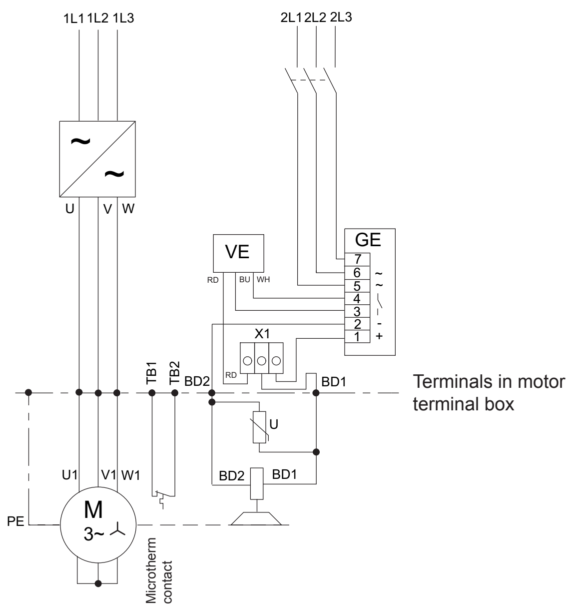

Fig. 7

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EG integrated encoder

See operating instructions “Motors, Z motor range”, ident no. 214 372 44

Brake release contact

See operating instructions “Motors, Z motor range”, ident no. 214 228 44

Note: **It must be ensured that the brake release contact is evaluated in the external electrical eqipment!**

Temperature sensor for hoist and cross-travel motor

See operating instructions “Motors, Z motor range”, ident no. 214 228 44

Different control modules are available for controlling the Demag disc brakes B003 to B680 with DC magnets.

Hoist applications with GS and VE brake control modules may only be operated in the terminal box of the motor or on the connection plate with terminal strip for 4-pole DR hoist motor and hoist inverter operation. All other GE and VE brake control modules may also be fitted and put into operation in the customer's switchgear cabinet.

In this case, the brake coil must be protected against cut-off voltage peaks by means of a varistor (part-no.: 260 898 84) in the motor terminal box.

All rectifiers feature varistor protection against overvoltage at the AC input and on the switching contact terminal as standard.

The brake rectifiers are approved for a max. voltage of 500 V AC.

Depending on the connection, the GE (cross-travel) and GS (hoist) rectifiers can be used for AC or DC brake control.

Brake application times are highly dependent on the way in which the brake is controlled.

For the DR without electrical equipment DC brake control using the VE module is required.

Operation with frequency inverters

If ZB cylindrical rotor brake motors are operated together with inverters, the brake must be provided with a separate power supply and control!

Brake control modules

- **GE brake rectifiers (normal excitation)**

  The cross travel drive of the DR is provided with the GE brake rectifier as standard. It mainly consists of a half-wave rectifier with integrated free-wheeling circuit.

- **GS brake rectifier (high-speed excitation)**

  ZBR motors of DR hoist drives are provided with the GS brake rectifier as standard.

  GS modules include a reversible rectifier which overexcites the brake for approx. 0,3 seconds to release it and then supplies it with the appropriate holding voltage from a half-wave rectifier (overexcitation factor 2,5 at 3-phase connection).

  Attention: When used with a pole-changing motor, the GS module must have a separate power supply!

  In order to ensure proper functioning when switching off with GS and VE modules, i.e. when switching with overexcitation, at least 250 ms must elapse between switching off and switching on again.

GF brake rectifier

The GF combination module combines three functions in one unit and is supplied together with the motor winding.

GF module function:

- Normal excitation of the brake;
- Switch-off in the DC circuit by means of integrated motor current detection;
- Protection of the low-speed winding by means of an integrated varistor set.

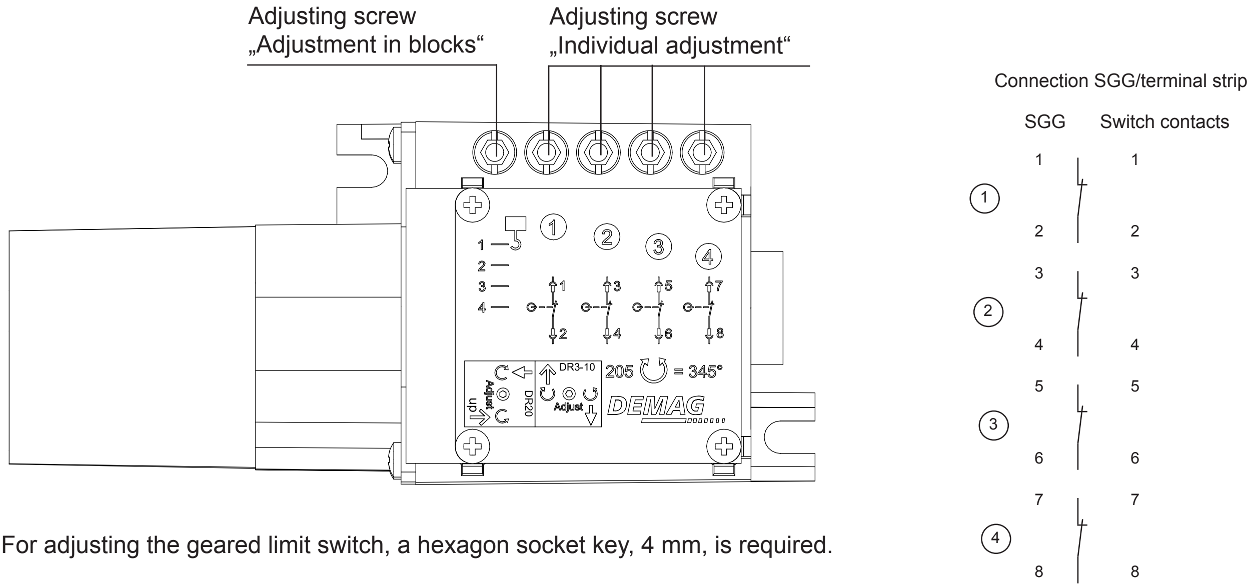
  GF modules must not be used together with an inverter (due to motor current detection) and may only be supplied with voltages between 220 and 550 V AC.

- **VE voltage relays (voltage-dependent high-speed trip relay)**

  VE voltage relays can be combined with GE, GS and GP brake rectifiers. The VE voltage relay **can only be used with a separate power supply of the brake.**

  This module will preferably be used for inverter-fed motors. It is used for rapid demagnetization of the brake to achieve fast brake application times without the need for additional wiring for brake switch-off in the DC circuit. The VE voltage relay detects the brake power supply. The contact in the DC circuit is opened when the brake is switched off.

SGG geared limit switch



For adjusting the geared limit switch, a hexagon socket key, 4 mm, is required.

Fig. 7

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SGG adjustment instructions

Before setting the switching points, make sure that live contacts are provided with a touch guard in order to protect them against accidental contact.

Allow for run-on!

Operating principle

Each contact is allocated to a cam disk which is infinitely adjustable.
The cam discs can be adjusted independently by means of the adjusting screws for „individual adjustment“.

Adjustment

When turning the adjusting screw for “individual adjustment” clockwise, the cam disc is also turned clockwise. The switching point is shifted upwards in accordance with the hook path.

When turning the screw anti-clockwise, the switching point is shifted downwards. Standard cam discs are designed in such a way that a max. useful path and a run-on path are available.

Setting the contacts for individual adjustment:

The geared limit switch is already permanently connected with the control system via the system connector cable. For setting the contacts, turn the adjusting screw for “individual adjustment” until the contact maker opens the contact.

If the run-on path is exceeded, the contact either opens or closes.

Setting the contacts for adjustment in blocks:

The contacts are adjusted in blocks by means of the adjusting screw for “adjustment in blocks”. All cam discs are adjusted together, while the relative adjustment of the individual contacts remains unchanged. When turning the adjusting screw for “adjustment in blocks” clockwise, the cam discs are also turned clockwise.

Approach switch-off points several times to check the limit switch functions are operating correctly!

Technical data

Transmission ratio:	i = 205 with adjustment of all cam discs in blocks designed for at least >1x10^6 switching operations
Schwitching contacts:	4
Contact type:	Changeover contact, snap-action contact, positively opening NC contact, contact material: silver/silver
Cam disc:	with 15° contact cams
Switching point repeat accuracy:	approx. +/-15 mm on the hook, at worst case with 2/1 reeving and 12 m hook path. In this case 47 rotations of the drive shaft with i = 205 result in an adjusting angle on the camshaft of 79,71°.
Electrical connection:	Terminal strip direct plug-in on the PCB.

Technical features:

Compliance with standards	EN 60204-1	IEC 947-5-1	EN 60947-T5-1
	EN 60529	EN50013	IEC 536
Ambient temperature	Continuous operation -40 °C to +80 °C		
Type of enclosure	IP 54		
Insulation class	II class		
Approvals	CE and CSA		

Technical features of the switching elements:

Positive opening depending on rated operating voltage U_i	VDE 0660 part 200 v. 7/92 250 VAC and 24/80 VDC
Continuous thermal current I_{th}	6 A
Utilisation category acc. to VDE 0660:	AC-15, 230 VAC/1,5 A DC-13, 60 VDC/0,5 A
Mechanical service life in switching cycles	10 x 10^6 switching operations
Terminal identification	Acc. to EN 50013
Approvals	CE-UL/CSA
Current load for plug-in connection	6 A / 85 °C 250 VAC

External dimensions:

Length up to pinion cover	approx. 165 mm
Housing dimensions	approx. 91 x 72 mm
Total height	approx. 95 mm

MGS electro-mechanical overload protection

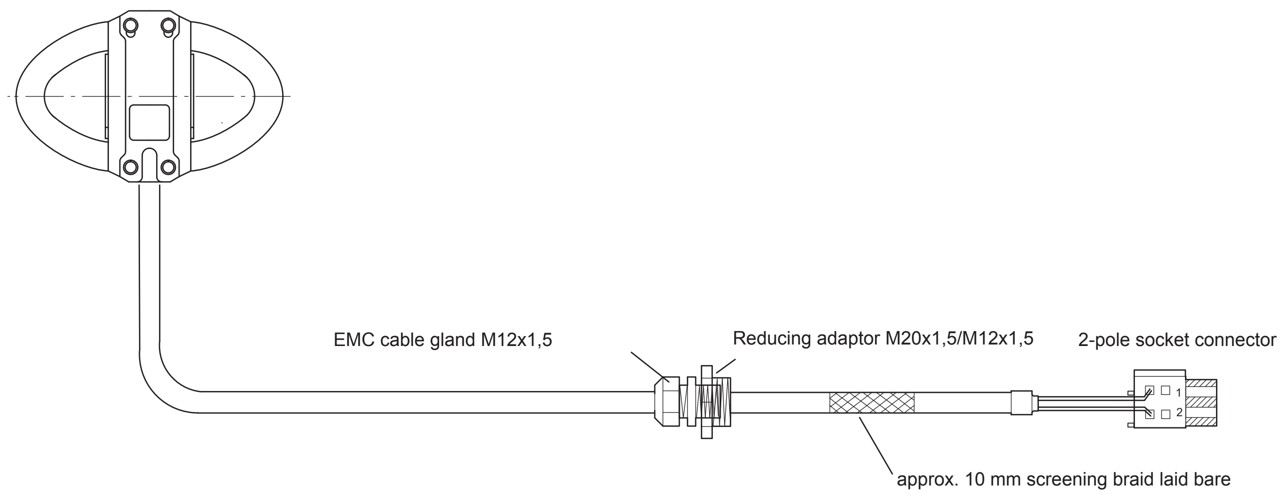

Fig. 8

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Depending on the type, the MGS overload protection is set to the DR rated load and already fitted in the DR hoist unit. In order to avoid oscillations of the system due to switching off and on again, the MGS contact must additionally be evaluated.

For the standard application we recommend using the MKA-2 contact evaluator. This device filters signals so that a premature release of lifting and the associated oscillations are prevented. The unit is available for three control voltage ranges and the corresponding unit must be included in the order.

In combination with MGS, only the “overload cut-out” function can be used.

MGS	**Load link**
Input voltage:	24 V, 9600 Hz
Output signal:	Load link NC contact -X53
V switching capacity:	4A/230 VAC; 1A/24 VDC
Ambient temperature:	-30° C to +80° C
Type of enclosure:	IP 67
Mounting position:	any

MKA-2 front panel/connection diagram/dimensions

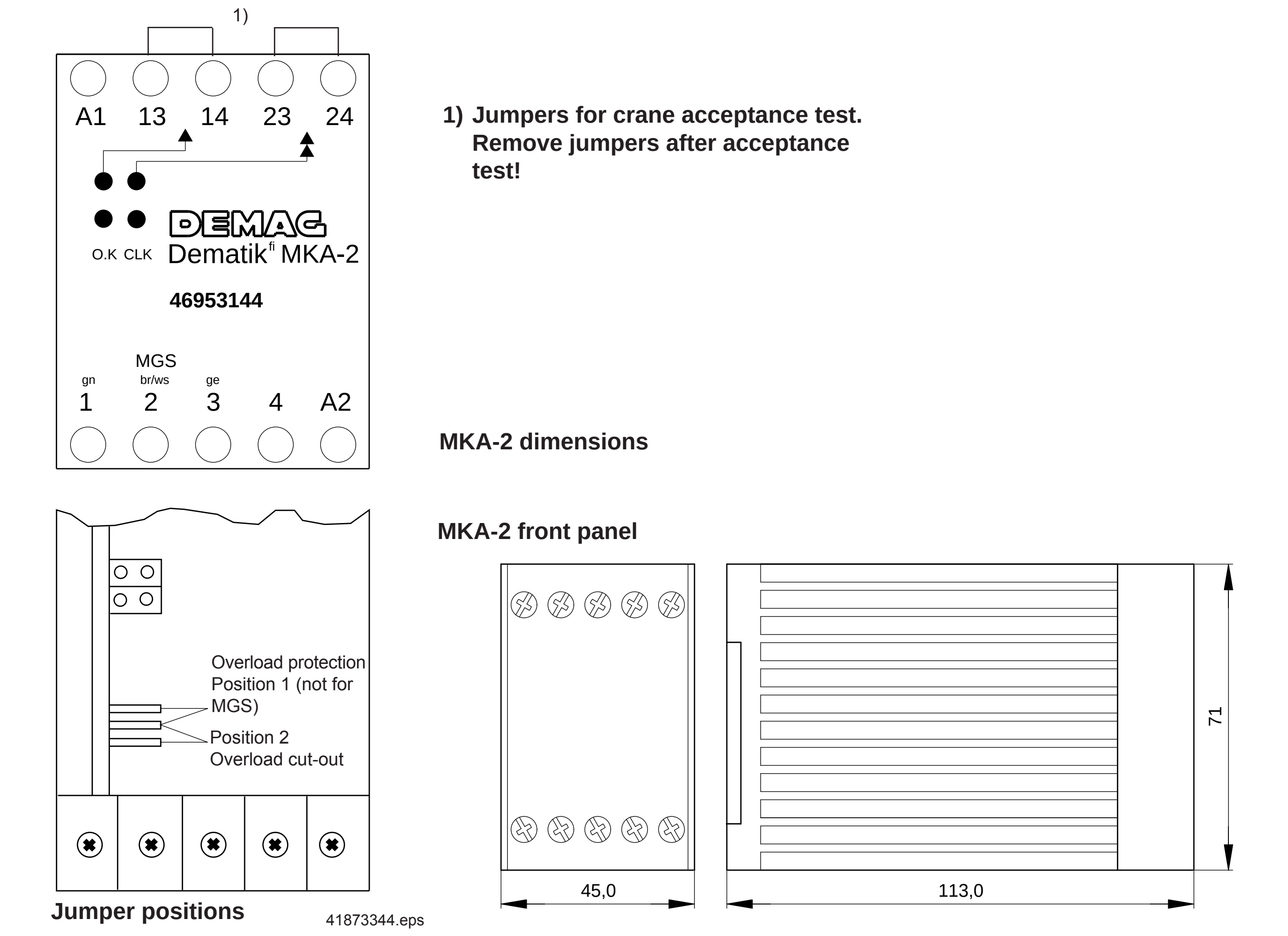

Fig. 9

Dematik® MKA-2 contact evaluator

Part no.:	For control voltage	220...240 V,	50/60 Hz	469 531 44
		110...120 V,	50/60 Hz	469 532 44
		42...48 V,	50/60 Hz	469 533 44
		24 V,	50/60 Hz	469 534 44

Deviating voltages in special designs:	
Possible contacts:	2 NO contacts
Rated breaking capacity:	230 V; 5 A / AC11, 4 A conditional rated short-circuit current
Operating voltage range:	90 to 100 % of the rated value
Rated consumption:	max. 4 VA
Ambient temperature range:	-20° C to +70° C
Mode:	suitable for continuous operation
Type of enclosure:	IP 40 to DIN 40 050.
Conductor connection:	max. 2 x 2,5 mm² with self-lifting clamping plates
Mounting position:	any
Mounting:	quick fastening on 35 mm mounting rail
Weight:	390 g

Block wiring diagram

Dematik® MGS/MKA-2 as overload cut-off unit

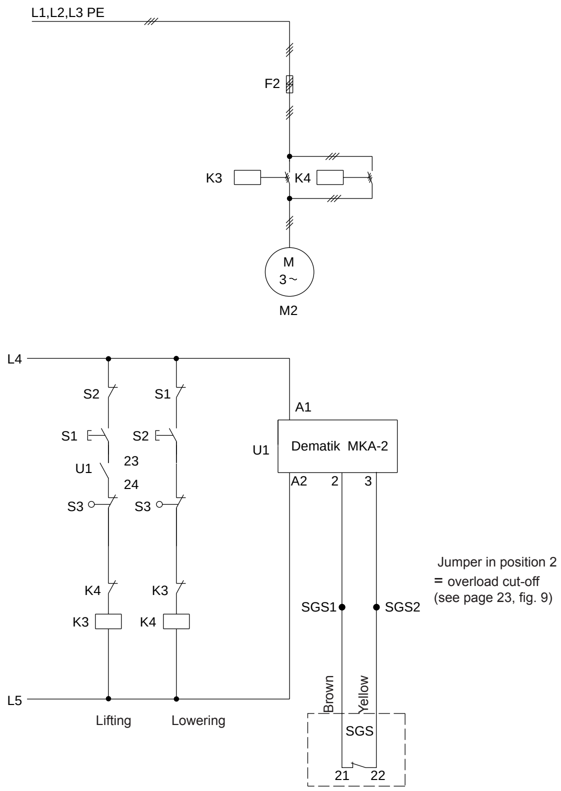

Fig. 10

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Equipment designation

B1	= SGG limit switch
F2	= Fuse “Main hoist motor”
K3	= Contactor ”Main lifting”
K4	= Contactor “Main lowering”
M2	= Main hoist motor
S1/S2	= Pushbutton lifting / lowering
S3	= Emergency limit switch lifting / lowering
U1	= MKA-2 contact evaluator

Function: MGS/MKA-2 as overload cut-off unit

The MGS load link is plugged in on the PCB in the MGS position (MGS 1, MGS 2, PE).

The outgoing terminal connections are connected to the MKA-2 contact evaluator:

DR terminal MGS 1 to MKA terminal 2 and DR terminal MGS 2 to MKA terminal 3.

The jumpers behind the front panel of the MKA-2 must be plugged in position 2, i.e. between the central and the lowest pin.

(See also description of MGS/MKA-2 load detector (206 689 44))

Only the limit load contact (switching point 2) is used.

Only use contacts 23-24 of the MKA-2.

Overload protection ZMS, FGB-2, FWL

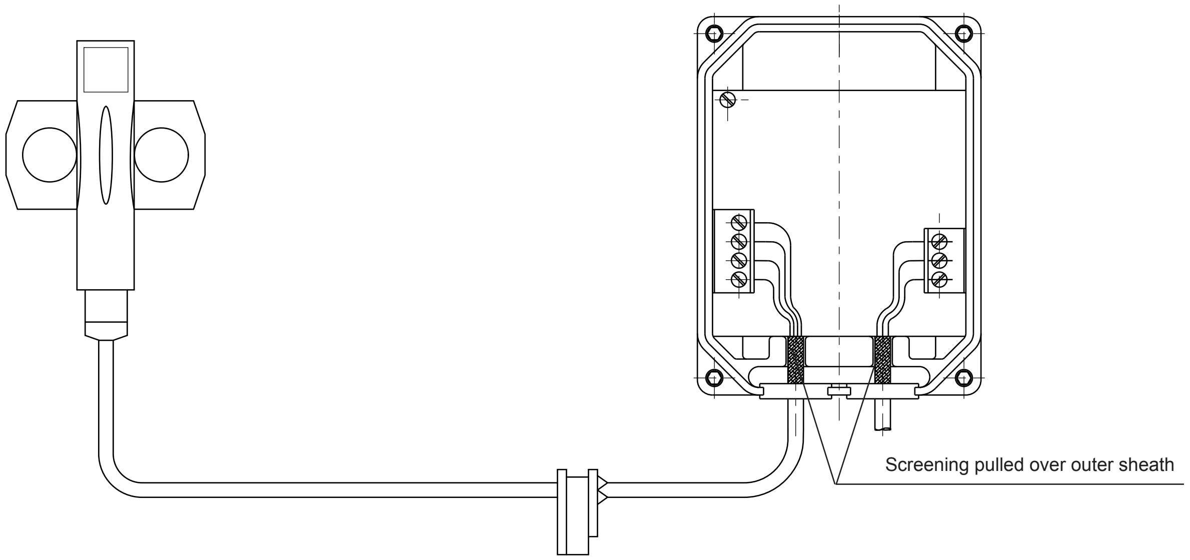

Fig. 11

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Calculation and setting of the overload switching point

Rope hoist	FEM	Rated load [t] 2/1	4/1	6/1	Lever A/B	4/2	Lever A/B	ZMS Rated load [t]	2/1 Value	2/1 S1 to S7	4/1 Value	4/1 S1 to S7	6/1 Value	6/1 S1 to S7	4/2 Value	4/2 S1 to S7	LF [x10^-3] 2/1	4/1	6/1	4/2
DR 3	2m	1,6	3,2	-	0,5	-		0,625	75	1101001	75	1101001	-	-	-	-	1,0596		-	-
	3m	1,25	2,5						60	0011110	60	0011110					2,2222			
	4m	1	2						49	1000110	49	1000110					4,3403			
DR 5	1Am	3,2	6,3	-	0,64	3,2	0,5	1,25	95	1011101	94	1011101	-	-	75	1101001	0,5053	0,5297	-	1,0596
	2m	2,5	5			2,5			75	1101001	75	1101001			60	0011110	1,0596			2,2222
	3m	2	4			2			61	1011110	61	1011110			49	1000110	2,0696			4,3403
	4m	1,6	3,2			1,6			50	0100110	50	0100110			40	0001010	4,0422			8,4771
DR 10	1Am	6,3	12,5	-	0,5	6,3	0,5	2	92	1101101	92	1101101	-	-	92	1101101	0,1389		-	0,1389
	2m	5	10	16		5		1,25	115	1100111	115	1100111	122	0101111	115	1100111	0,2778		0,2289	0,2778
	3m	4	8	12,5		4			93	1011101	93	1011101	115	1100111	93	1011101	0,5425		0,4800	0,5425
	4m	3,2	6,3	10		3,2			75	1101001	74	0101001	78	0111001	75	1101001	1,0596	1,1109	0,9375	1,0596

Calculation example for FWL overload cut-out

Rope hoist	A/B
DR 3 and 10	0,5
DR 5	0,64

Example:

DR 10-Pro, 8 t in 4/1
ZMS = 1,25t
A/B = 0,5

$$\text{FWL counter reading} = \frac{\text{Rated load} \cdot A/B \cdot 110}{\text{No. of ropes} \cdot \text{ZMS rated load}} + 5 = \frac{8t \cdot 0{,}5 \cdot 110}{4 \cdot 1{,}25t} + 5 = 93$$

For a detailed description see document 206 880 44

With a 4/2 rope reeving the “No. of ropes” = 2, since the load is only distributed to the rope drum and the compensating roller. With a 4/1 rope reeving, the load is distributed to four ropes and the ZMS is loaded with one quarter of the load on the hook.

FWL load spectrum recorder

Application

The service life of hoist units decisively depends on the selection of the correct group on mechanisms, i.e. on the correct assessment of the operating time and load spectrum. However, during the long service life the operating conditions may change, which results either in a longer or shorter service life. Thus e.g. a change from one-shift operation to two-shift operation of a production crane doubles the operating time per day and as a result the drive mechanisms wear down faster.

Since all hoist units are designed for specific periods of operation according to the rules of endurance strength, failures are to be expected after the calculated service life has elapsed.

The FWL records all loads exerted on the hoist unit during operation and is power-failure and long-term safe. The load spectrum recorder displays the operating time.

Thus a statement on the operating conditions and the calculated remaining duration of service of the hoist unit can be made at any time.

Mode of operation

The load spectrum recorder measures the lifted load and the hoist motor operating period.

The load measured is compared to the rated SWL and a relative load is calculated. Since wear of the moving parts of the hoist unit increases disporportionately with increasing load, the value of the relative load is evaluated correspondingly. Based on this evaluation, operation of the hoist unit at half rated load only results in $(1/2)^3 = 1/8$ of the load spectrum value reached with operation at rated load.

At ¼ rated load the load spectrum value is $(1/4)^3 = 1/64$ etc.

The operating time of the hoist unit is measured as cyclic duration factor of the lifting and lowering motion. Since wear is expected to be proportional to the operating time, the value measured in entered into the displayed load spectrum value proportional to the time. Thus double operating time at equal load corresponds to a double load spectum value.

The load spectrum recorder continuously collects the measured load of the hoist unit for any loads and operating intervals. Thus the displayed load spectrum value corresponds to the total load exerted on the hoist unit up to now. In contrast to the elapsed operating time counter, the load spectrum recorder does not only display the pure operating time of the hoist unit, but it records the load on the hoist unit which has much more significance for wear and evaluates it depending on its influence.

The counter in the load spectrum recorder is adjusted so that when the strain gauge carrier link is loaded with the rated SWL in the 1 Bm group of mechanism, the load spectrum value per second counts further +1.

Thus the load spectrum recorder is an efficient means for monitoring hoists units.

Since the displayed load spectrum value is recorded continuously, the owner may easily receive important data for the cost-efficient planning of maintenance and preventive repair work.

On the basis of the recorded load spectrum values, the utilization of hoist units can be analysed, in order to plan extension and rationalization measures appropriately.

In connection with the elapsed operating time counter, the load and operating time class acc. to FEM can be verified at any time.

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Calculation of the elapsed share of the safe working period (SWP)

The FWL load spectrum recorder makes is possible to determine the past duration of service and, consequently, also the remaining duration of service, i.e. the load spectrum. The nominal load of the ZMS unit is used as the reference nominal load for measuring purposes.

This means that the FWL counts the full load seconds of the ZMS. If the ZMS is not to be subjected to its own nominal load (for hoist unit rated load), the displayed value needs to be corrected by a specific factor. This correction factor must be entered into crane test and inspection booklet when the installation is put into operation. The duration of service S in hours (to FEM 9.755) is calculated by means of the following formula:

S = LK × LF

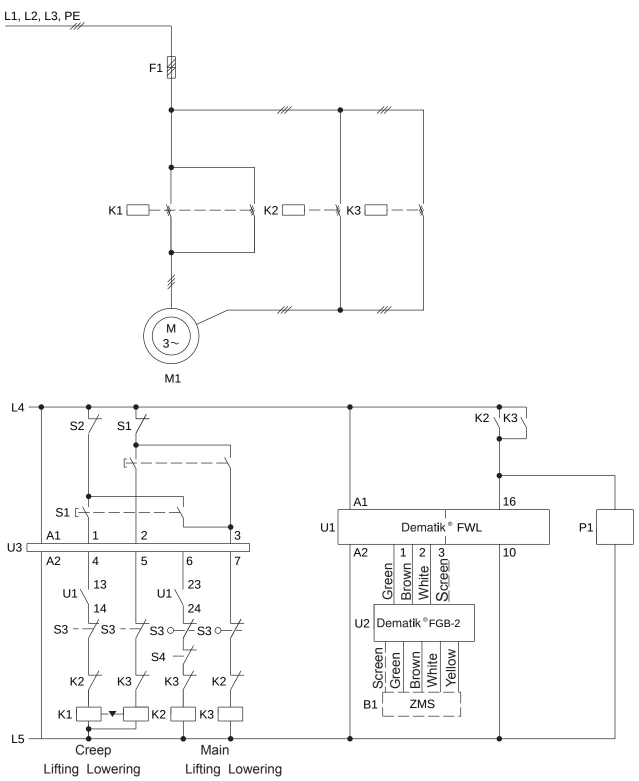
S = Duration of service in full load hours
LK = FWL counter reading
LF = Load spectrum factor

Example:

DR 3, 3m
Load spectrum counter = 10014
LF = 0,5425 x 10^{-3}

Full load hours S = 10014 x 0,0005425 = 5,43 hours

FGB-2/FWL as overload protection and load spectrum recorder for hoist units with pole-changing motor
Switch 8 ON = overload protection



Equipment designation
B1 = Strain gauge
F1 = "Hoist motor" fuse
K1 = Contactor"Creep lifting/creep lowering"
K2 = Contactor "Main lifting"
K3 = Contactor "Main lowering"
M1 = Creep - main hoist motor
P1 = Elapsed operating time counter
S1/S2 = Pushbutton lifting / lowering
S3 = Emergency limit switch lifting / lowering
S4 = "Main lifting" fast-to-slow limit switch
U1 = Frequency evaluator/load spectrum recorder, overload
U2 = FGB-2 frequency generator
U3 = Hoist unit control

(Please also note the information in chapter "Brake control")

Fig. 12

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Cross travel limit switch

Position switch XCK - MR

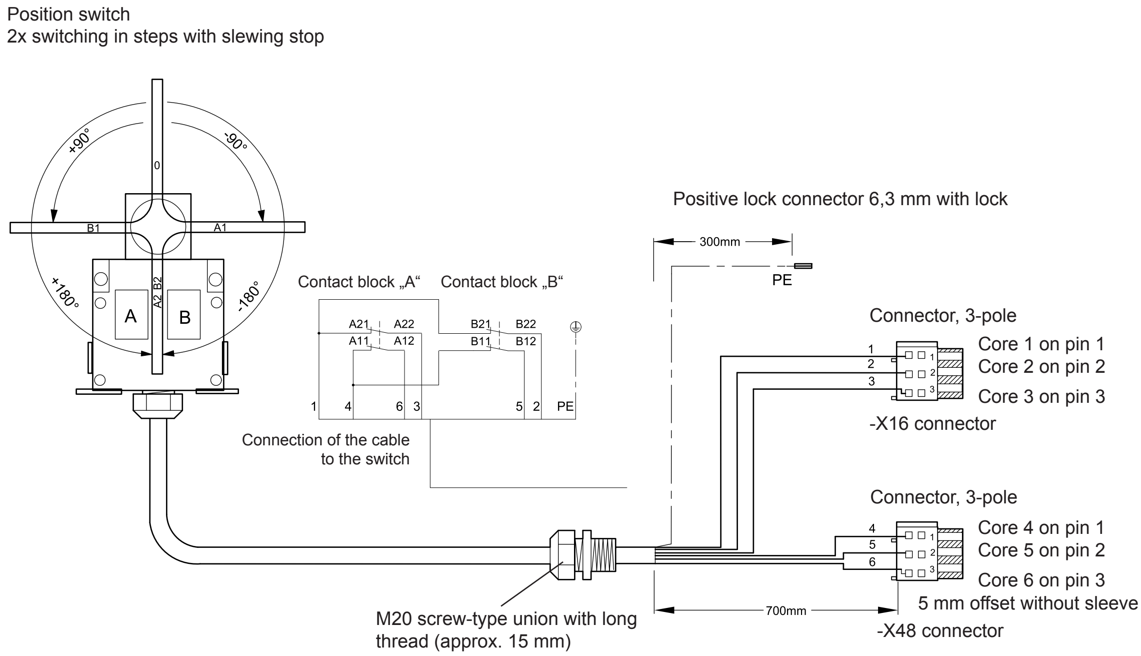

Fig. 13

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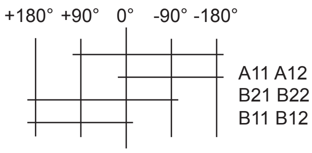
Switching crossbar positions with contact arrangement

Type XCK-MR54D1



With slewing stop

Key data:

Housing:	Die-cast zinc
Type of enclosure:	IP66
Mechanical life	2 million switching cycles
Actuating speed:	Max. 90 m/min
Min. moment for actuation:	0.5 Nm
Positive opening:	0.75 Nm
Cable entry:	3 x M20
Rated operating data:	AC-15: 240 V; 3 A DC-13: 125 V; 0,55 A
Connection/cross section:	Flat terminal with washer M3,5/max. 2 x 1,5 mm²
Earth lead connection/cross section:	Flat terminal with washer M3/max. 1,5 mm²
Short-circuit protection:	Fusible link 10 A, gG (gL)
Contact type:	No snap function, positive opening of NC 21-22

Optional packages

Cross travel inverter

DR-PRO and DR-COM

Package 1

Package	1.1	1.2
Inverter	DIC-4-004	DIC-4-007
	Part no.:	
	537 903 84	537 905 84
120 Ohm 0.4 KW braking resistor	-	537 732 84
220 Ohm 0,2 KW braking resistor	537 730 84	-

Order cable between trolley motor and FI separately, e.g. 4 x 1,5 + 2 x (2x0,5), part no.: 719 096 45

Cross travel limit switch

DR-PRO and DR-COM
Package 2

Selection via logic
Fitted in the factory

	Cross travel limit switch	
		Part no.:
EKDR 3 - 10	with mech. fitting	719 074 45
EZDR 5 - 10	with mech. fitting	719 174 45

Overload cut-out, F series

Only for DR-PRO
Package 3

Selection via logic
Fitted in the factory

Package	3.1	3.2	3.3	3.4	3.5	3.6	3.7
Rope hoist	DR 3	DR 5, 10	DR 3	DR 5, 10	DR 3	DR 5, 10	DR 10
ZMS 1)	0,625 t	1,25 t	0,625 t	1,25 t	0,625 t	1,25 t	2 t
	Part no.:						
	491 390 44	491 391 44	491 390 44	491 391 44	491 390 44	491 391 44	491 600 44
FGB-2 (terminals)	469 674 44						
FWL	42-48 V = 469 669 44						
	110-120 V = 469 668 44						
	220-240 V = 469 667 44						

Order cable LIYCY 3 X 0,5 mm² between FGB-2 and FWL separately, part -no.: 464 495 44

Accessories for parameter programming

Order an operating unit (key-pad, see table 1) or an interface module and the ‘Parcom Compact’ parameter programming software (see table 2) for programming the parameters.

Table 1

	Part no.:
KP 500 operating unit	537 722 84

Table 2

	Part no.:
KP232 interface module	537 769 84
RS 232 module CM - 232	537 723 84
PC data line 1,8 m	537 237 84
Parcom Compact Parameter programming software	537 752 84

1) ZMS is included in the basic price for DR 5 and DR 10 in double-groove design

Notes

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Notes

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