

Power Drive

WD5-008

Doc. no. 211.262/DGB 11.98

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Edition: d133 Nov. 98

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**Suggestions
Corrections**

WD5-008
Power Drive

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Sender

Name:

Company / Dept.:

Address:

Phone:

If you have found any faults within this documentation, or have any suggestions, we would also be pleased to receive any comments and suggestions.

Suggestions and/or Corrections

Safety requirements

Please read the following safety requirements prior to installation, operation, maintenance and repair of the device.

- The intended use of the device is described in this manual in chapter "Purpose" and must be observed.
- Installation, maintenance and repair of the device shall be performed by a qualified electrician. National regulations concerning
 - accident prevention
 - installation of electrical and mechanical systems
 - radio interference suppressionshall be observed.
- The technical data of the device, particularly the ambient conditions, shall be observed.
- The device shall only be operated by trained personnel. BERGER LAHR offers training courses.
- The warranty is invalidated in case of unauthorized modification or opening of the device.
- Please ask your BERGER LAHR technical consultant prior to installing accessories not listed in the chapter "Description of accessories". The address is to be found on the rear cover.
- The safety symbols and notes on the device and in the manual shall be observed.

Explanation of symbols



ATTENTION

Reference to a danger for the device or components, possibly resulting in the endangering of human life.

DANGER

Reference to a direct endangering of human life.



DANGER

High voltage at component, do not touch.



DANGER

High temperature at component, do not touch.



ATTENTION

Warning against electrostatic discharge (ESD).

Only touch the PC-board or component in an electrostatically-protected environment.



NOTE

Important or additional information concerning the device or the manual.

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1 General Description

1.1 Construction and Characteristics

Construction

The Power Drive WD5-008 comprises of the following components (see figure 1-1):

- Current selection switch, for selecting the motor phase current;
- Parameter switch, for selecting the functions: rotation monitor, current reduction, rotation direction and step angle;
- Numerical status indicator;
- Signal connection for the drive of the power unit;
- Rotation sensor connection for the rotation monitoring function;
- Motor connection for a 5 phase stepping motor: wall mounted;
- Mains/-ballast connection for voltage supply (115V or 230V alternating current) and for connecting an external ballast resistor for dissipating the brake energy;
- (Back of equipment:) *Mounting bracket* with screw connections for mounting the equipment to a wall and also as a heat conductor;

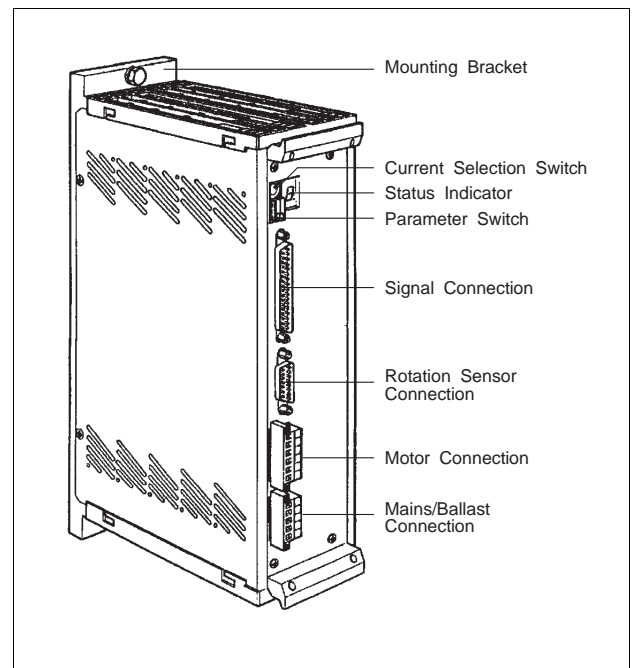


Figure 1-1 Power Drive WD5-008

Characteristics

The Power Drive WD5-008 is designed for wall mounting:

- The equipment can be mounted on a wall (e.g. in a switch cabinet);
- The heat conduction is effected by the mounting bracket (external cooling might also be required);
- All operational controls, indicators and all connections are to be found on the equipment front panel;

Further characteristics are:

- Operation with mains current
- Short circuit and short to earth protection of output stage
- Optoencoupled signal inputs and outputs.



NOTE

Equipment variants see Appendix 6.1

General Description

1.2 Use / System Integration

The Power Drive WD5-008 is used for the drive and the rotation monitoring of a 5 phase stepping motor of the wall mounting series. It is the link between a positioning controller (e.g. PLC) and the stepping motor (see figure 1-2). The equipment is constructed for mounting in a cabinet.

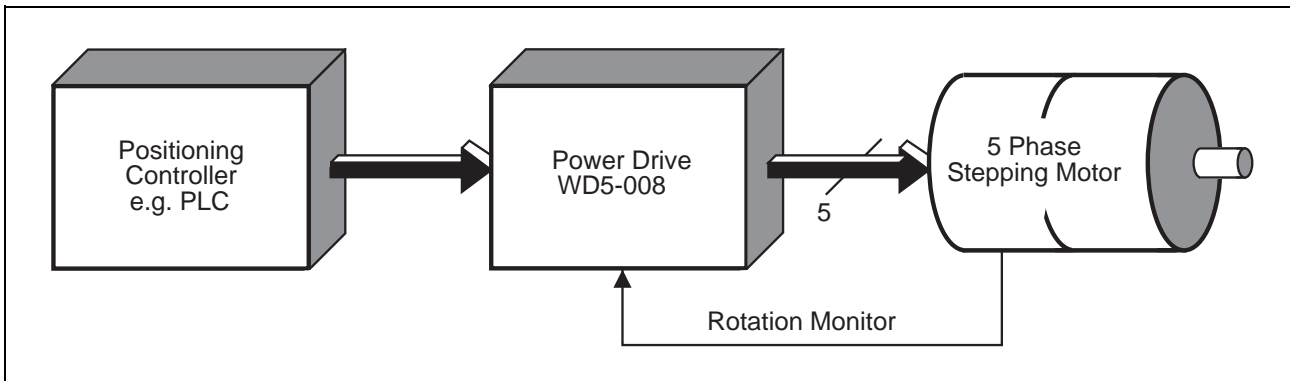


Figure 1-2 System Integration

Motor Types

The Power Drives of the WD5 series are constructed for the operation with special BERGER LAHR stepping motors. The special features of these motors are:

- 5 phase technique
- 5 wire connection
- Operating voltage of 325 V DC.



ATTENTION

Only the motors listed in the table underneath can be operated with WD5-008.

The table gives the appropriate motor sizes and motor models.

Series	Standard Operation SM	Rotation Monitor SM - DÜ	Servo Step Operation SSM
60	VRDM 568/50 LWC	VRDM 568/50 LWC	VRDM 568/50 LVC
90	VRDM 597/50 LWC	VRDM 597/50 LWC	VRDM 597/50 LVC
	VRDM 5910/50 LWC	VRDM 5910/50 LWC	VRDM 5910/50 LVC
	VRDM 5913/50 LWC	VRDM 5913/50 LWC	VRDM 5913/50 LVC
110	VRDM 51117/50 LWC	VRDM 51117/50 LWC	VRDM 51117/50 LVC
	VRDM 51122/50 LWC	VRDM 51122/50 LWC	VRDM 51122/50 LVC

1.3 Function

Figure 1-3 shows the most important function blocks of the equipment:

- In the *mains supply circuit* the mains voltage of 230 V AC or 115 V AC is transformed to an intermediate circuit voltage of 325 V DC.
- The *switch power supply* provides the supply voltage for the internal electronics modules.
- At the *signal interface* the In-/Outputsignal (see also section 3.1) between external control and internal electronic are optoencoupled. The base setting for the phase current, current reduction, boost, rotation direction and rotation monitoring is set on the parameter switch (see section 2.5).
- The *rotation sensor interface* is needed for the optoencoupling of the rotation sensor signals for the rotation monitor (recognition of contouring error).
- The regulator circuit *control electronics - output stage - current regulator* transforms the input signals *pulse* and *direction* into the output signals for the drive of the stepping motor. The block *control electronics* contains the *ring counter logic*, which defines the current pattern. The current regulator keeps the phase current on the predefined value.
- The status of the equipment is registered in the block *protection and monitoring*. Possible errors are shown via the status indicator as well as via the signal output (see section 3.1.2 and 4.1).

For further information on the meaning and function of the different drive/control signals see section 3.1.

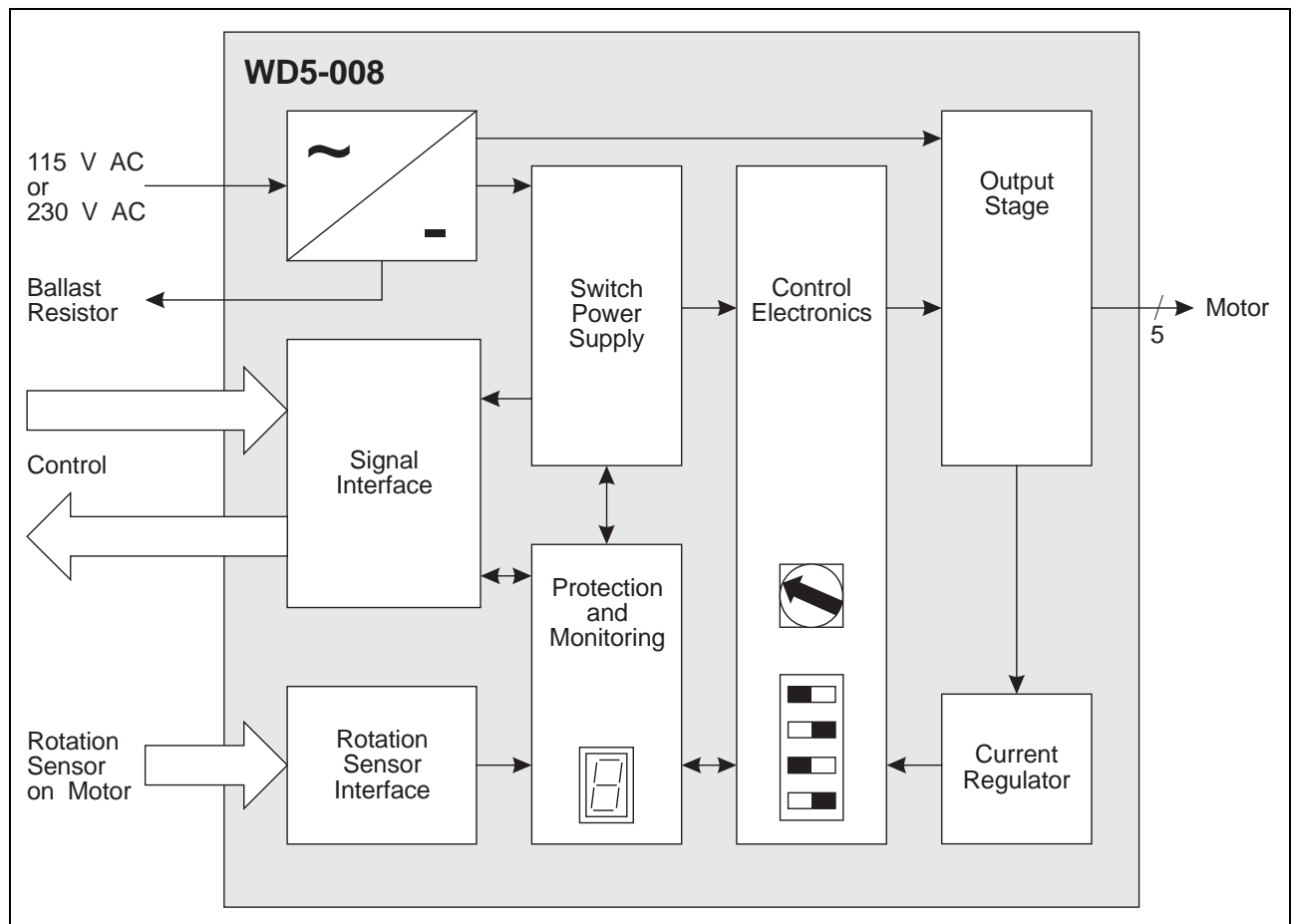


Figure 1-3 Function Connection Diagram WD5-008

General Description

1.4 Technical Data

1.4.1 Electrical Data

1.4.1.1 Mains Connection

Power connection voltage, adjustable for

	115 V AC, -20% +15%
	230 V AC, -20% +15%
Current at switch on (initial current)	30 A
Fuse	6.3 A slow
Frequency	50 - 60 Hz
Power consumption	max. 1600 VA
Power dissipation	max. 120 W

1.4.1.2 Motor Connection

Protected in case of short circuit between motor phases

Max. cable length	without filter	50 m
	with filter	100 m
Cable diameter		0.75 mm ²
Screen connection		both sides
Motor voltage		325 V DC
Phase current	in 16 stages from 0.75 to 4.5 A	

1.4.1.3 Rotation Sensor Connection

This connection must be safely isolated from the mains.

Max. voltage to earth	60 V DC
Max. cable length	100 m
Cable diameter	2 x 0.5 / 10 x 0.25 mm ²
Screen connection	both sides

1.4.1.4 Signal Connection

This connection must be safely isolated from the mains.

Max. voltage (power resistance) to earth	60 V DC
Cable diameter	0.25 mm ²
Screen connection	the control side only

Electrical Characteristics of the Optocoupler-Inputs

Optoencoupled and protected against reverse polarity.

The signal voltage level is typespecific

	TTL	or	24 V
Max. input voltage	5.25 V		30 V
Switch on point U _E	2.5 V		20 V
Switch off point U _A	0.4 V		3 V
Typical input current at nominal current			10 mA

Electrical Characteristics of the Optocoupler-Outputs

Optoencoupled, protected against reverse polarity, inductive resilient, short circuit protected.

Max. voltage drop U _R	28 V
Max. switch current I _L	10 mA
Voltage drop at 10 mA	max. 2 V

1.4.1.5 Equipment Protection

System of protection	IP 20 according to DIN 40050 / IEC 529
Protection class	1
Protection switches	Short circuit monitoring Excessive temperature recognition Over- and undervoltage recognition Motorwire interruption recognition

1.4.2 Mechanical Data

Dimensions see figure 1-4

Weight without heat sink approx. 2.3 kg
with heat sink approx. 5.9 kg

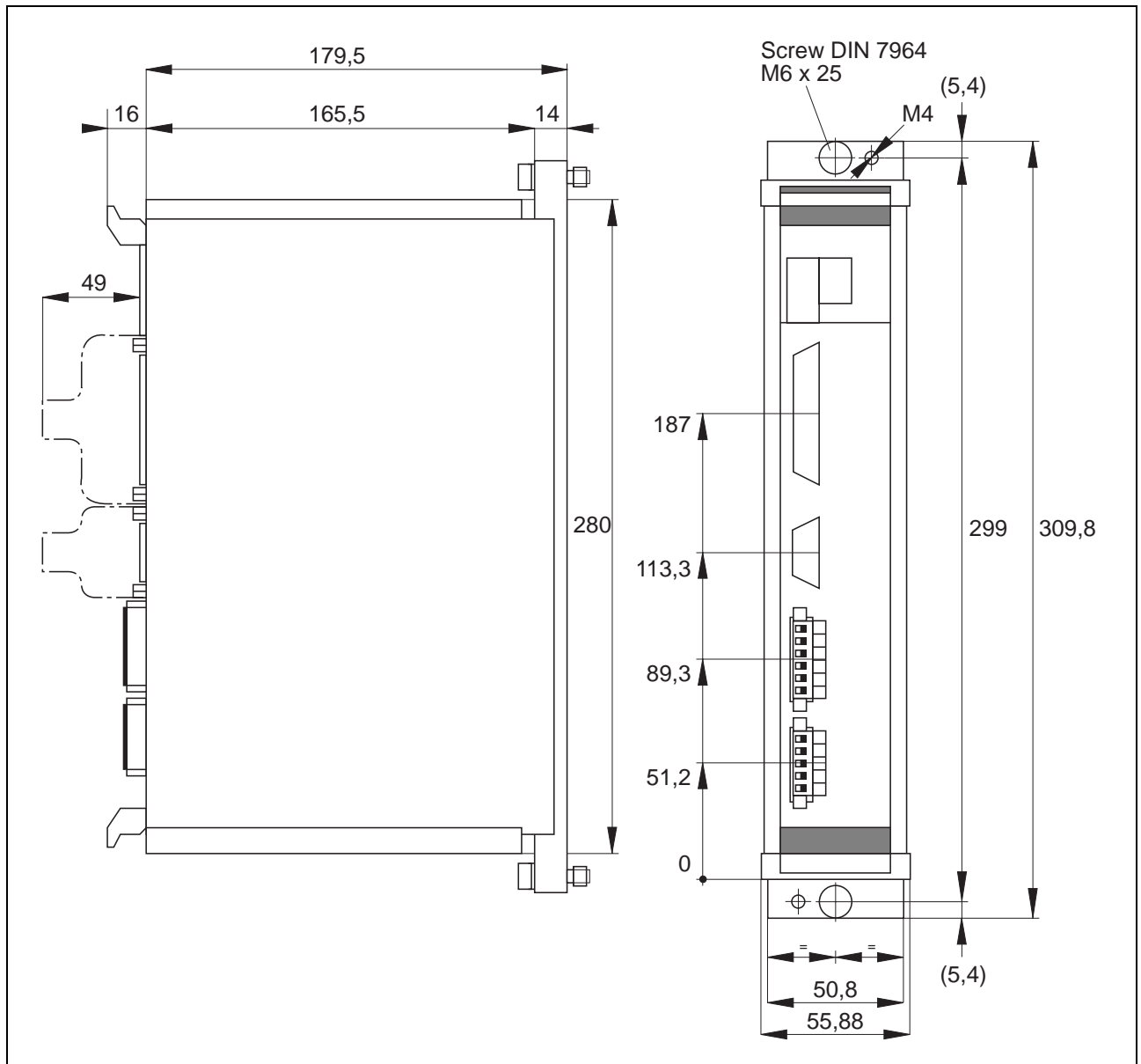


Figure 1-4 Equipment Dimensions

General Description

1.4.3 Ambient Conditions

Working conditions	0°C to 50°C
Storage temperature	-25°C to 70°C
Humidity class	F in accordance with DIN 40040
Radio shielding	in accordance with VDE 0871-A when the additional Mains and Motor rating filters are used. (see Accessories List)
Overvoltage stability	in accordance with VDE 0160 Class 2
Resistance to interference	in accordance with VDE 0843 / IEC 801

2 Installation

2.1 Parts Specification

The specification is to be checked for completeness.

Included in the specification are (see figure 2-1).

Item	Description	Order Number
1	WD5-008.xx1-01	in accordance with type key
1	Plug Shell Mains Connection	
1	Plug Shell Motor Connection	
1	Heat Conduction Paste	
1	Technical Documentation WD5-008	Doc. no. 211.262/DGB

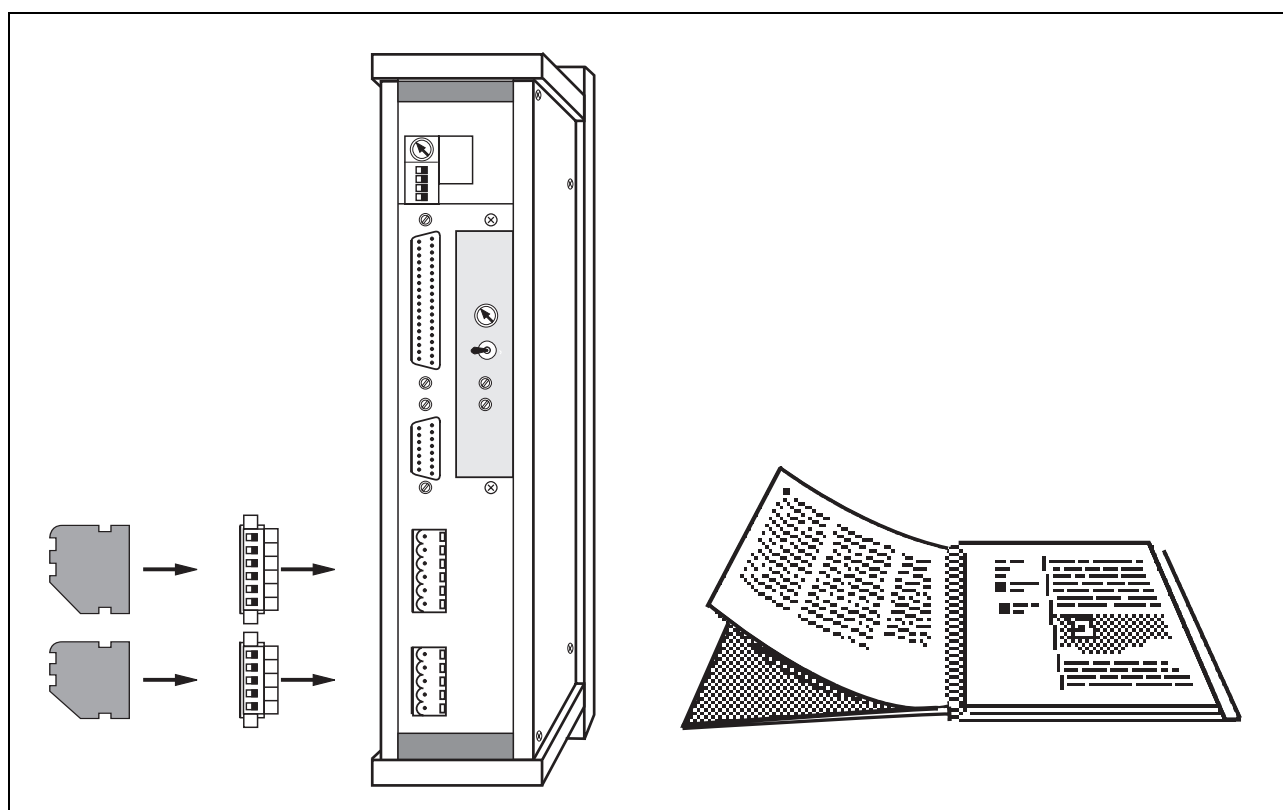


Figure 2-1 Parts Specification

Installation

2.2 Accessories

The following items can be delivered on specific order:

Description	Order Number
Ballast Resistor	62501100600
Rotation Sensor Cable	see Appendix
Terminal Adapter D 732	62010732006
Heatsink	62500901000
Fan Assembly	62501201000
Motor Cable	see Appendix
Motor Rating Filter	62501100100
Mains Power Filter	62501100200
Interface Tester D 690	62010690006
Stepping Motor	see Doc-no. 371
Signal Cable	see Appendix
Plug Set WD5-008	62501000100



NOTE

For a description of accessories see Appendix 6.2.

2.3 Mounting

The equipment must be mounted inside a switch cabinet which incorporates forced air-cooling. The mounting wall must be a good conductor of heat and have a smooth mounting surface because the heat loss is conducted away via mounting bracket. The maximum power dissipation of the equipment amounts to 120 W.



ATTENTION

The inlet air to the switch cabinet must be clean and there must be a good air supply system.



NOTE

If the equipment is not able to dissipate sufficient heat in the switch cabinet, a heatsink and also a fan assembly can be fitted to the equipment, see sections 6.2.4 and 6.2.5. The correct cooling conditions can be achieved by using the heatsinks, fans and cables recommended by BERGER LAHR. With other solutions it will be necessary to measure the temperature on the mounting bracket, see sections 6.2.4.2 "Dimensioning of a heatsink".

For the mounting of the equipment, an SW10 open-end adjustable wrench is required; no further special tools required.

1. Drill 2 holes into the mounting wall, for dimensions see Figure 6-6
2. Apply heat-conducting paste between the back of the equipment and the mounting wall
3. Fasten the equipment with M6 screws.

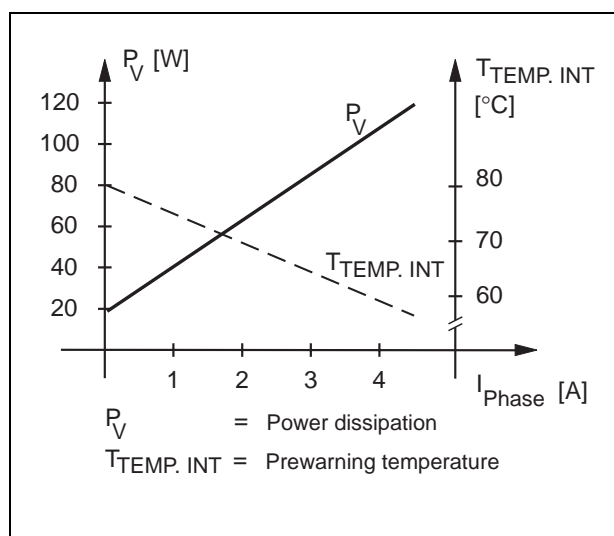


Figure 2-2 Power Dissipation Diagram



NOTE

Note the distance between the centre lines of the equipment where there are combinations of several pieces of equipment, see table (data in mm).

Distance between centre lines (in mm) for equipment combinations	WD5-008	WDP5-118	WDP5-228	WP-318	WP-111	WP-231	WP-311
WD5-008	87	87	87	87	74	74	74
WDP5-118	87	87	87	87	74	74	74
WDP5-228	87	87	87	87	74	74	74
WDP5-318	87	87	87	87	74	74	74
WP-111	74	74	74	74	61	61	61
WP-231	74	74	74	74	61	61	61
WP-311	74	74	74	74	61	61	61



NOTE

The mounting of the heatsink and fan assembly to the equipment is described in sections 6.2.4 and 6.2.5.

2.4 Cabling

2.4.1 General Information

All electrical connections are made via multi-pole plug connections on the front panel of the equipment (figure 2-3). Ready made cables are available as accessories (see section 2.2).



DANGER

Make sure that mains voltage is turned off before connecting cables to the equipment!



ATTENTION

- The installation of the power connections (motor, mains, ballast) is to be carried out by a skilled electrician in accordance with VDE 0105!
- Ensure the strain relief and screening of the cables.
- Every signal conducting pair has to be twisted before the connection.
- Mains-, motor- and signal cables have to be wired so that there is a spacial distance between the cables.
- The motor connection is linked with the mains potential.



NOTE

Signal and rotation sensor connections are electrically isolated from the mains.

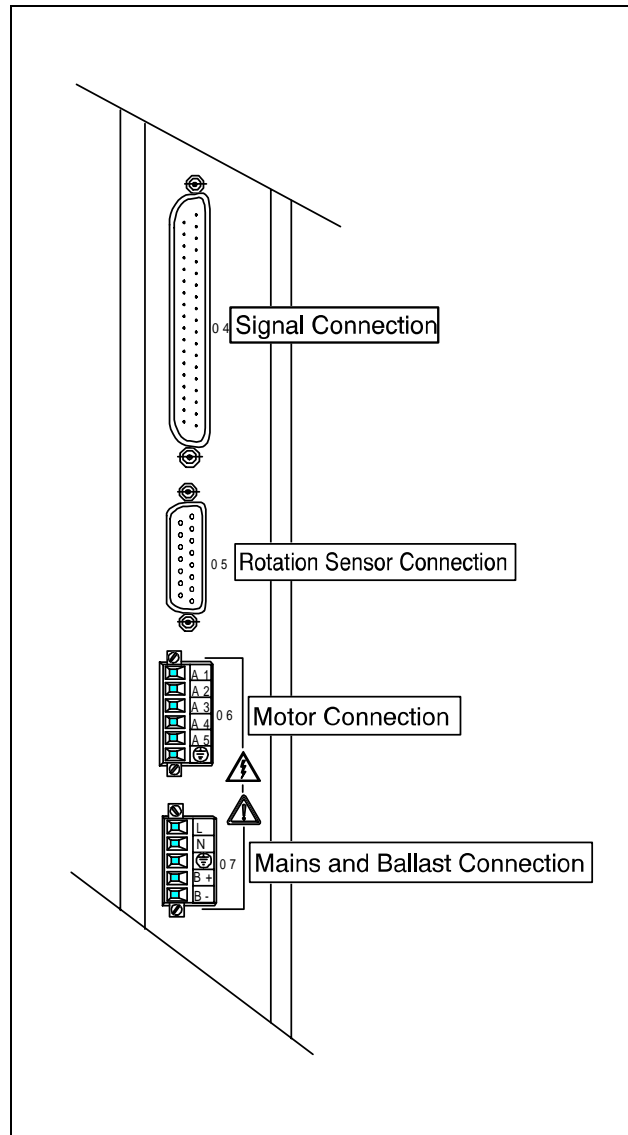


Figure 2-3 Connection Overview

2.4.2 Connecting the Motor

1. Prepare the 5 wires of the motor cable and the screen which are to be connected to the plug with 'boot lace' ferrules.
2. Insert the six wires according to figure 2-4 into the cap of the mating plug and tighten the screws.
3. Join the plug shell halves together.
4. Set the plug onto the connection 06 and tighten screws.



ATTENTION

- To keep losses in the cable and in the power drive at a minimum, it is recommended to keep the wiring as short as possible.
- The maximum length of the motor cable is 100 m. From a cable length of 50 m onwards a motor rating filter (see Accessories) is to be connected in line between the motor connection and the beginning of the cable.



DANGER

Switch off mains power before releasing the lock of the motor plug.

2.4.3 Adjusting the Equipment to the Mains Voltage

The equipment can be adjusted to the mains voltage of 115 V AC or 230 V AC (works set up/ adjustment see chapter 6.1 equipment variants):



ATTENTION

The setting up of the equipment to suit the Mains voltage is only to be carried out by, or under the guidance of BERGER LAHR service personnel.

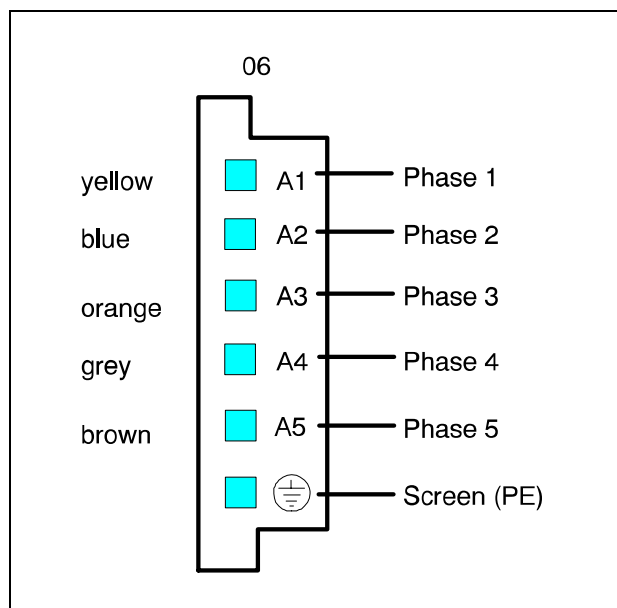


Figure 2-4 Motor Connection

Installation

2.4.4 Connecting the Mains Power Cable

1. Prepare the wires of the mains cable with 'boot lace' ferrules.
2. Insert the 5 wires into the mating plug terminal block and tighten screws (see figure 2-5).
3. Join the plug shell halves together.
4. Set the plug onto connection 07 and tighten screws.



DANGER

Make sure that mains power is disconnected before releasing mains cable! The mains plug must not be inserted while connections are being made and the power supply must not be turned on.



NOTE

- A mains filter can be inserted in the circuit to provide screening from interference, see section 6.2.8.
- A ballast resistor should be connected to B+ or B- if display "4" lights up during braking in operation, see section 6.2.1.

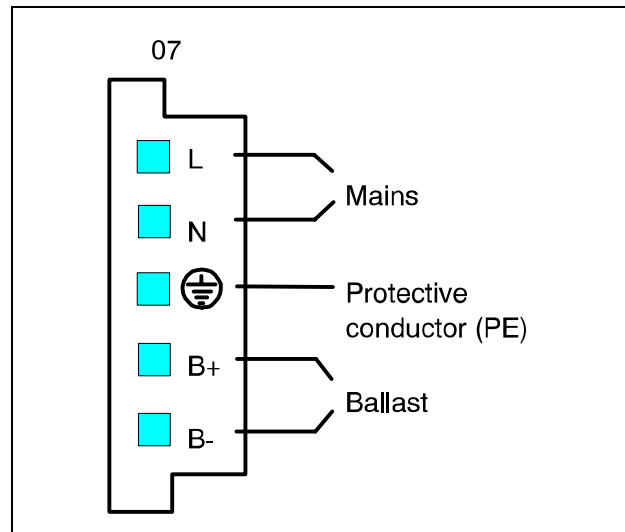


Figure 2-5 Mains and Ballast Connections

2.4.5 Connecting the Signal Cable

1. Twist the wires of the signal cables in pairs and solder them onto the 37 pins Sub-D-socket, according to figure 2-6.
2. Insert cable into the cable entry clamp (strain relief) and clamp it. Connect the screen on the side of the control with earth (GND).



NOTE

When using a push-pull drive, it may be useful to connect the screen to the plug shell on both ends of the cable.

3. Put on socket shell.
4. Plug socket to socket connection panel 04 and tighten screws.



ATTENTION

- Maximum length of the signal cable: 50 m.
- All signal connections shall be safely isolated from the mains (maximum voltage to earth: 60 V DC).
- The normal earth for the signal wire V_{IN} must be connected on the control side with V_{IN} GND.
- The normal earth for the signal wire START/STOP and $\overline{F_H}/\overline{F_L}$ must be connected on the control side with GND.

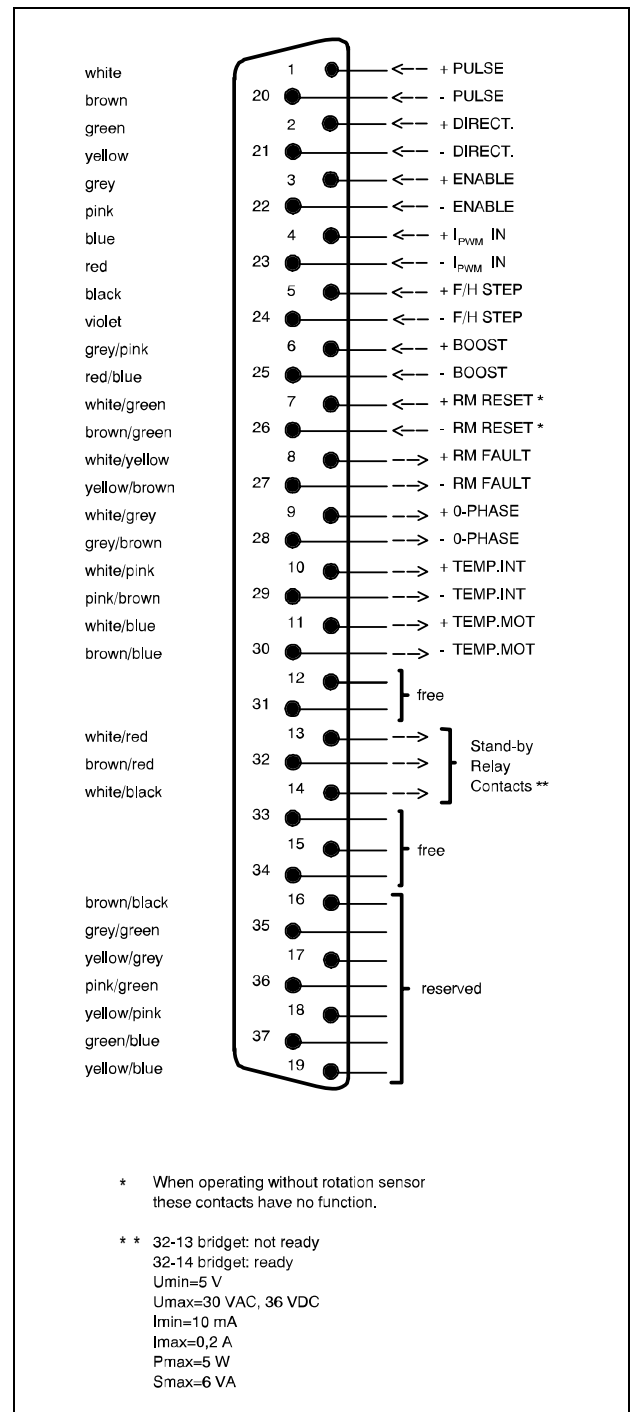


Figure 2-6 Wiring the Signal Socket

Installation

Circuitry of the Optocoupler Signal Interface

For the electrical isolation of the signal inputs and outputs optocouplers are used; the type-specific circuits are shown in figure 2-7.

In the case of an alternating signal voltage level choose the equipment variant with 5 V signal level. Also wire into the external feeder additional protective resistors to ensure a current of approx. 10 mA.

Figure 2-8 shows the possible connections of the signal Inputs and Outputs. The Push-Pull drive (which is also used in the BERGER LAHR Positioning Controller) offers the advantage of a higher signal to noise ratio.

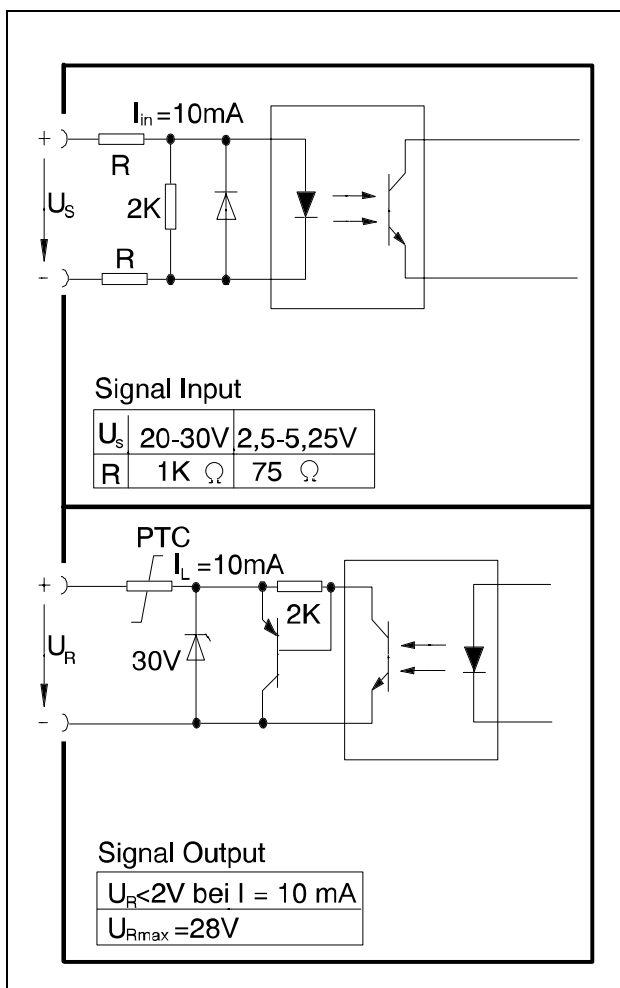


Figure 2-7 Internal Connections of Signal Interface

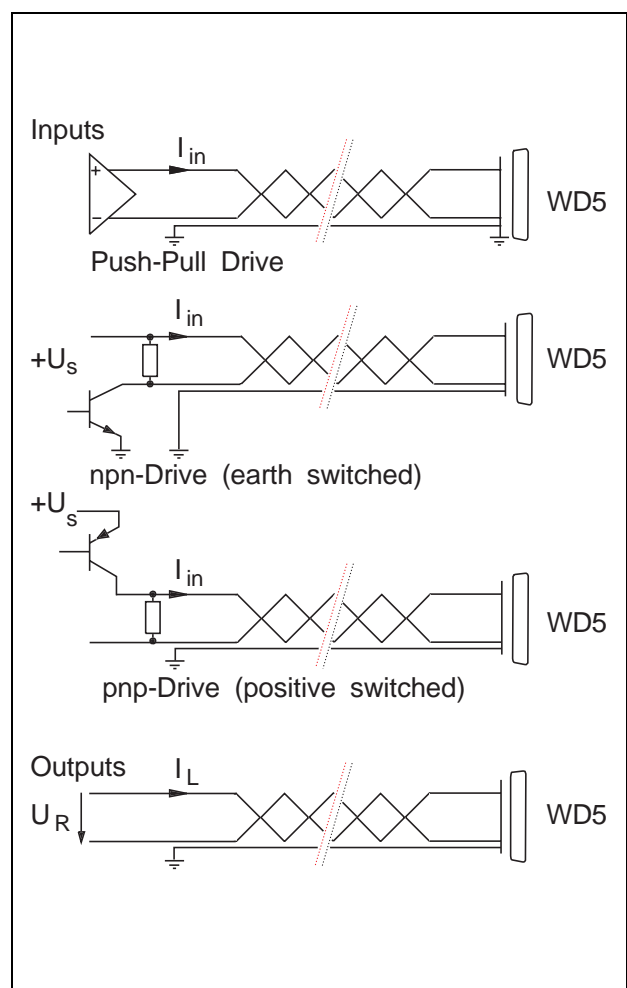


Figure 2-8 External Connections of Signal Interface

2.4.6 Connecting the Rotation Sensor

Some motor types have a built-in rotation sensor (see table in section 1.2)

1. Connection on the side of the equipment:
Solder the wires of the rotation sensor cable onto the pins of the 15 pins Sub-D-socket, see figure 2-9.
2. Insert the screen into the cable entry clamp/strain relief and clamp it.
3. Put on the plug shell.
4. Plug the plug onto socket 05 and tighten screws. Attach the screen to plug shell.
5. Twist the wires of the rotation sensor cable in pairs according to figure 2-9.
6. Make the connection on the side of the motor with 12 pins+PE-circular connector according to figure 2-9. Also attach the screen to the cable entry clamp.
7. Switch the DIL switch 03 to: rotation monitor active (see section 2.5 Initial Operation).

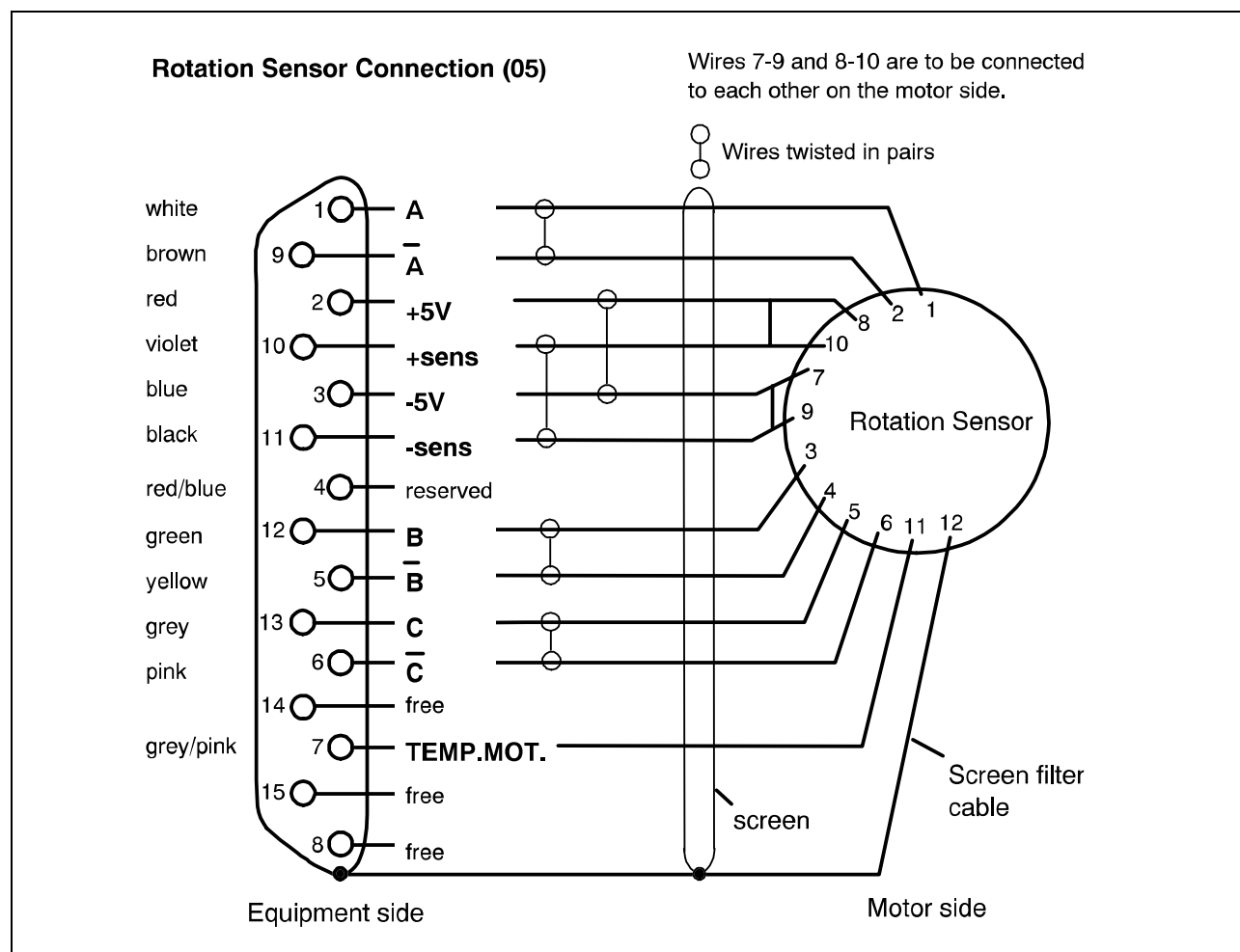


Figure 2-9 Wiring of the Rotation Sensor

2.5 Initial Operation

2.5.1 Checklist for Initial Operation

Before you make initial adjustments to the equipment check the following points:

- Has the mounting of the equipment and the heat-sink respectively been carried out correctly (see section 2.3)?
- Is the air supply and air removal ensured?
- Has the correct motor type been built in (see section 1.2)?
- Has the equipment been wired correctly (see section 2.4)?
- Has the equipment been adjusted to the given mains voltage?
- Have motor-, signal- and rotation sensor cable been wired so that there is a spacial distance between them?



NOTE

The wiring of the signal interface can be tested with the Interface Tester D 690 (see Accessories).

2.5.2 Basic Adjustments

The basic adjustments are made with the Current Selection Switch and the Parameter Switch (see figure 2-10) as follows:



DANGER

High Current – Switch off equipment before making any adjustments!

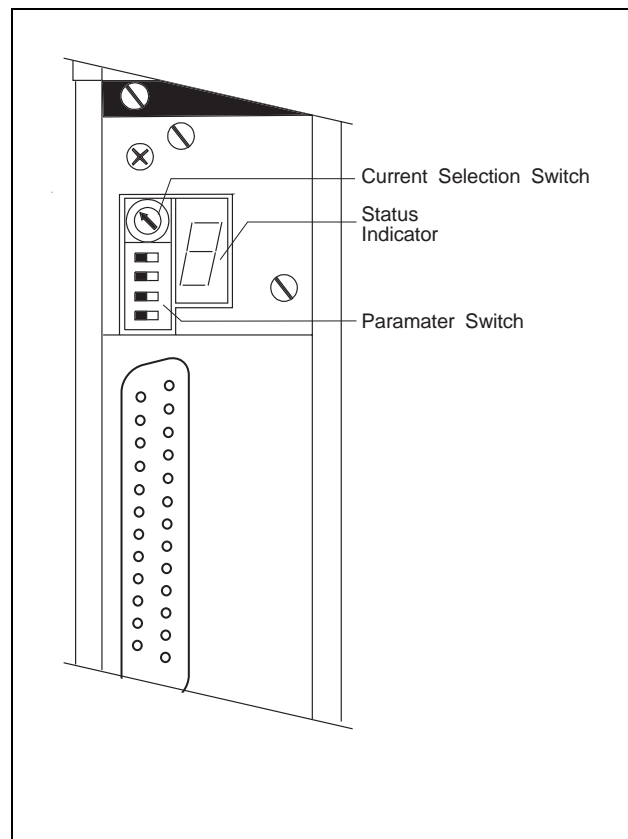


Figure 2-10 Adjustment Elements

Adjustment of the Phase Current

1. Unscrew and remove the plexiglass cover from the front panel of the equipment.
2. Adjust phase current at the rotary switch 01 (see figure 2-12) according to the motor data label. Pay attention to the diagram in figure 2-11.

For possible adjustments see figure 2-12. If the phase current which is stated on the motor data label should not be adjustable, choose the next smaller value.



ATTENTION

Never choose too high a current! The maximum phase current is not to be exceeded and if, then only for a short time (boost-signal), to avoid a motor overload. Ensure appropriate cooling (temperature on the housing of the equipment 100°C maximum)!



NOTES

- Smaller phase currents are allowed but they reduce the rotation moment accordingly.
- The automatic power reduction should, if possible, always be switched on in order to reduce the power dissipation (see figure 2-13).

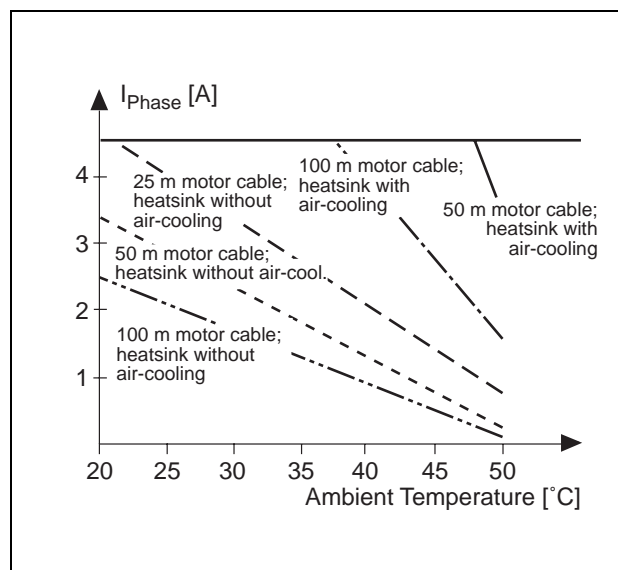


Figure 2-11 Permitted Phase Current Dependent on Ambient Temperature and Length of Motor Cable

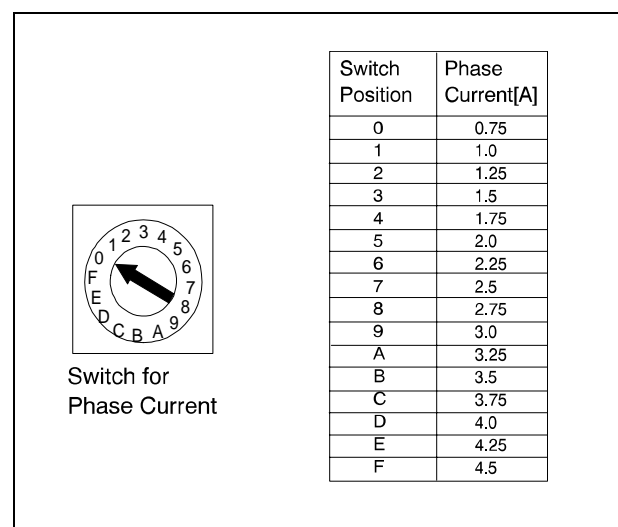


Figure 2-12 Switch Settings Phase Current Selection Switch

Installation

Parameter Adjustment

1. Adjust desired parameters according to figure 2-13 with the DIL switch 03 (see figure 2-10). The basic adjustment as set by BERGER LAHR is depicted.
2. After finishing the adjustments do not forget to put the plexiglass cover back on.

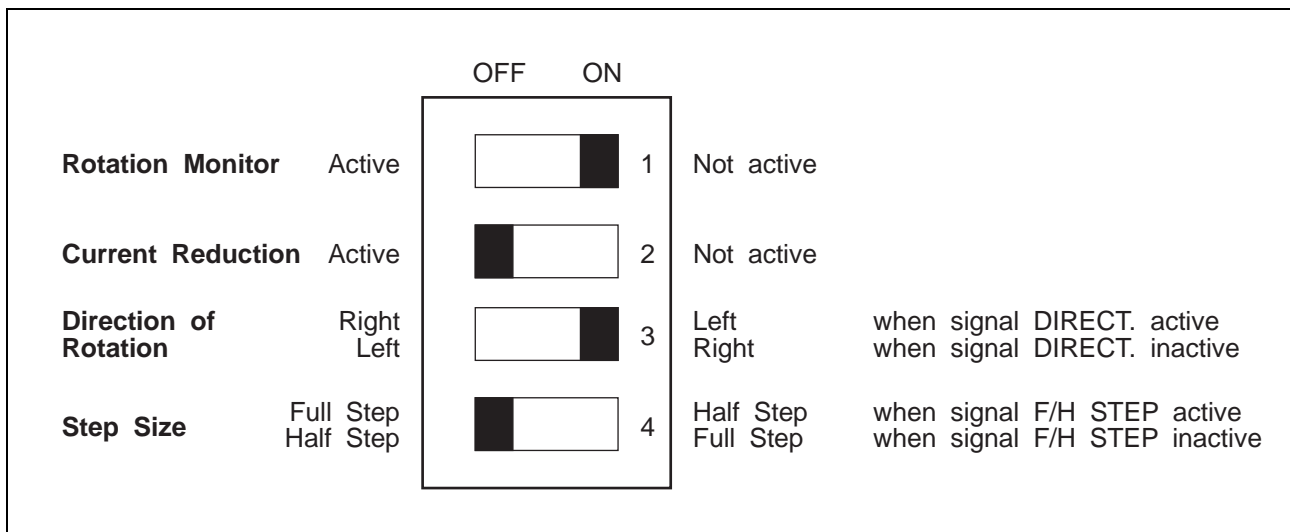


Figure 2-13 Switch Settings Parameter Switch



NOTES

- The effects of the signal inputs DIRECT and F/H STEP can be inverted with the parameter switches 3 (rotation direction) and 4 (step width) respectively.
- When current reduction is active, at a standstill (pulse frequency < 10 Hz) the motor phase current is reduced to 50%. This leads to a cooling of the motor and a reduction of the stopping moment by approximately 50%.



ATTENTION

- Caution mains current- operate the equipment only when the plexiglass cover is in place!
- For motors **with Rotation Sensor** the parameter switch 1 for the rotation monitoring must be set on **active**, for motors **without Rotation Sensor** the switch must be set on **not active**.

3 Operation

3.1 Drive

The Power Drive WD5-008 is linked with the external drive unit via the signal connection 04.

The meaning and functions of the individual signals are described below:



NOTE

The signal wiring can be tested with the Interface Tester D 690 (see Accessories).

3.1.1 Input Signals



NOTE

Input 'active' means current flow through the Optocoupler.

BOOST (Current Increase)

- Input 'not active': Nominal current (as set on Rotary Switch 01)
- Input 'active': Double nominal current (but max. 4.5 A)



ATTENTION

Current increase via BOOST above the nominal current of the motor is only allowed for short time spans (20% of the switching-on time of the motor, maximum 10 secs).



NOTE

If the BOOST is activated during a motor standstill, an active current reduction is blocked.

F/H STEP (Stepangle)

Dependent on the adjustment of the parameter switch 03/4 (see figure 2-13):

- Input 'not active': Half Step (Parameter Switch OFF)
 - Input 'active': Full Step (Parameter Switch OFF)
- or
- Input 'not active': Full Step (Parameter switch ON)
 - Input 'active': Half Step (Parameter Switch ON)



NOTE

When set on 'Half Step' the motor makes 1000 steps / rotation, on 'Full-step' it makes 500 steps/ rotation.

Operation

PULSE (Step)

With each increasing signal edge on the PULSE-Input the motor carries on one more step.

DIRECT. (Direction of Rotation)

Dependent upon the position of the Parameter Switch 03/3 (see figure 2-13):

- Input 'not active': Right hand rotation (Parameter Switch ON)
 - Input 'active': Left hand rotation (Parameter Switch ON)
- or
- Input 'not active': Left hand rotation (Parameter Switch OFF)
 - Input 'active': Right hand rotation (Parameter Switch ON)



NOTE

Rotation Direction when looking at the motor shaft (flange side).

For the signal response times for PULSE and DIRECT. See figure 3-1.

IPWMIN (Current Control)

Input for the Pulse Width modulated signal for the Phase Current Control (0-100% or Boost 0-200% of the set phase current). The PWM signal lies in the frequency range from 10...20 kHz.



NOTE

The Signal Frequency should be selected from outside of the audio range (approx. 20 kHz).

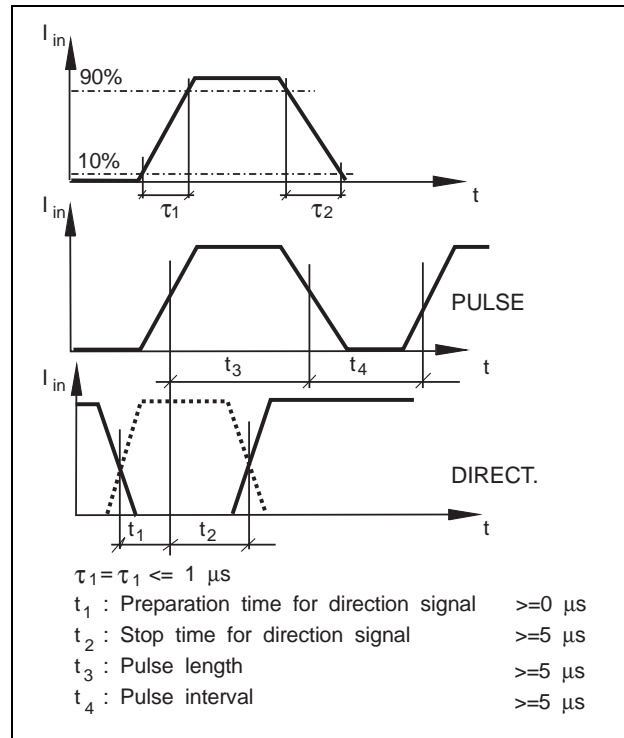


Figure 3-1 Response Time PULSE/DIRECT.

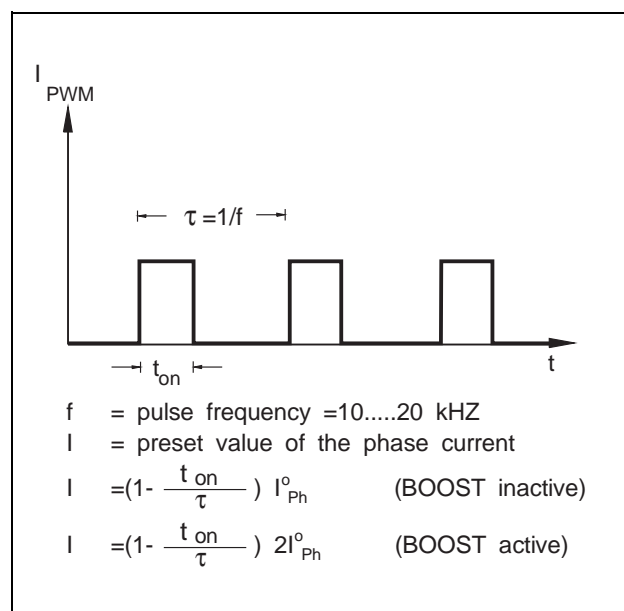


Figure 3-2 Phase Current Control via input IPWMIN

ENABLE (Enabling Command)

- Input 'active': enabling command power unit.
- Input 'not active': Elimination of a not saved error report (see section 4.2) and resetting of the ring counter (see output signal 0-Phase). The motor is disconnected from the current.



ATTENTION

With Input ENABLE 'not active' the motor is powerless, that means it has no stopping moment.



NOTE

Should the error report be repeated switch off mains voltage and resolve error with the Trouble Shooting Table (section 4.2).

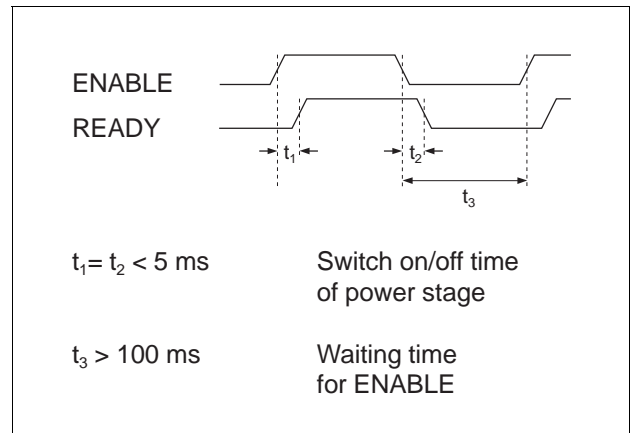


Figure 3-3 ENABLE/READY switching times

RM RESET (Reset Rotation Monitor)

Input 'active' when motor is at a standstill (no pulses): reset of the rotation monitor after recognizing a contouring error (status indicator "1", see section 4.2) and reset of the ring counter (see O-PHASE, section 3.1.2.)

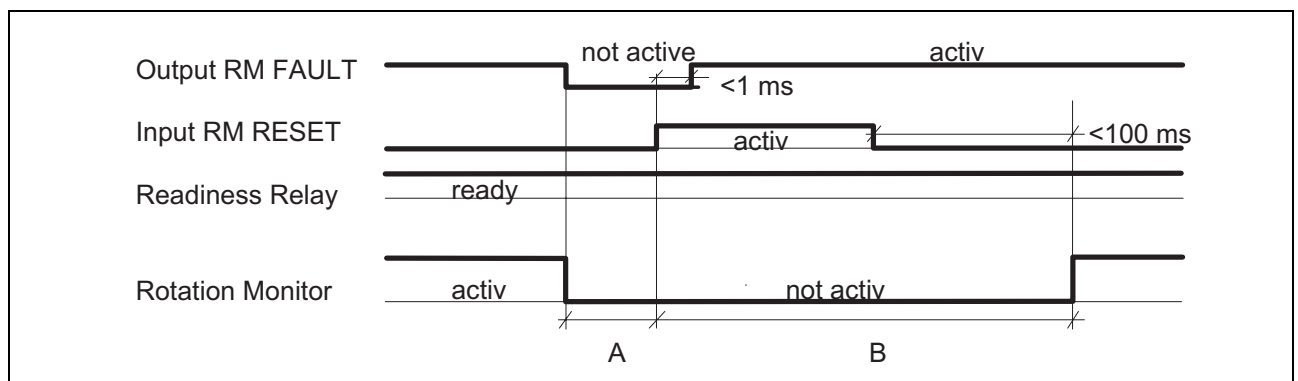


Figure 3-4 Signal Times RM RESET

NOTE



- Signal times for RM RESET see figure 3-4. In the time zone A the rotation monitor is switched off, but the monitor can be driven. In the time zone B the rotation monitor is switched on; while in this state

the motor must not be driven, i.e. there are no pulses allowed.

- During activation of the RM RESET, an active current reduction is blocked (see figure 2-13).

Operation

3.1.2 Output Signals



NOTE

Output 'active' means low resistance.
Output 'not active' means high resistance.

RM FAULT (Fault Rotation Monitor)

This output switches 'not active' (high resistance) when the rotation monitor recognizes a contouring error. The equipment is reset by Input RM RESET (see section 3.1.1).



NOTE

If a contouring error (contouring distance > 16 half steps) is signalled via the RM FAULT output, the motor remains powered-up and the PULSE input is opened. The standby relay indicates "ready".

0-PHASE (Ring Counter Count Zero)

Each time the ring counter count is zero the output is switched 'not active' (high resistance), see figure 3-5.



NOTE

Figure 3-5 shows the dependence of the output signal 0-PHASE on the ring counter at Full Step operation. At Half Step operation the ring counter has a cycle of 20 steps.

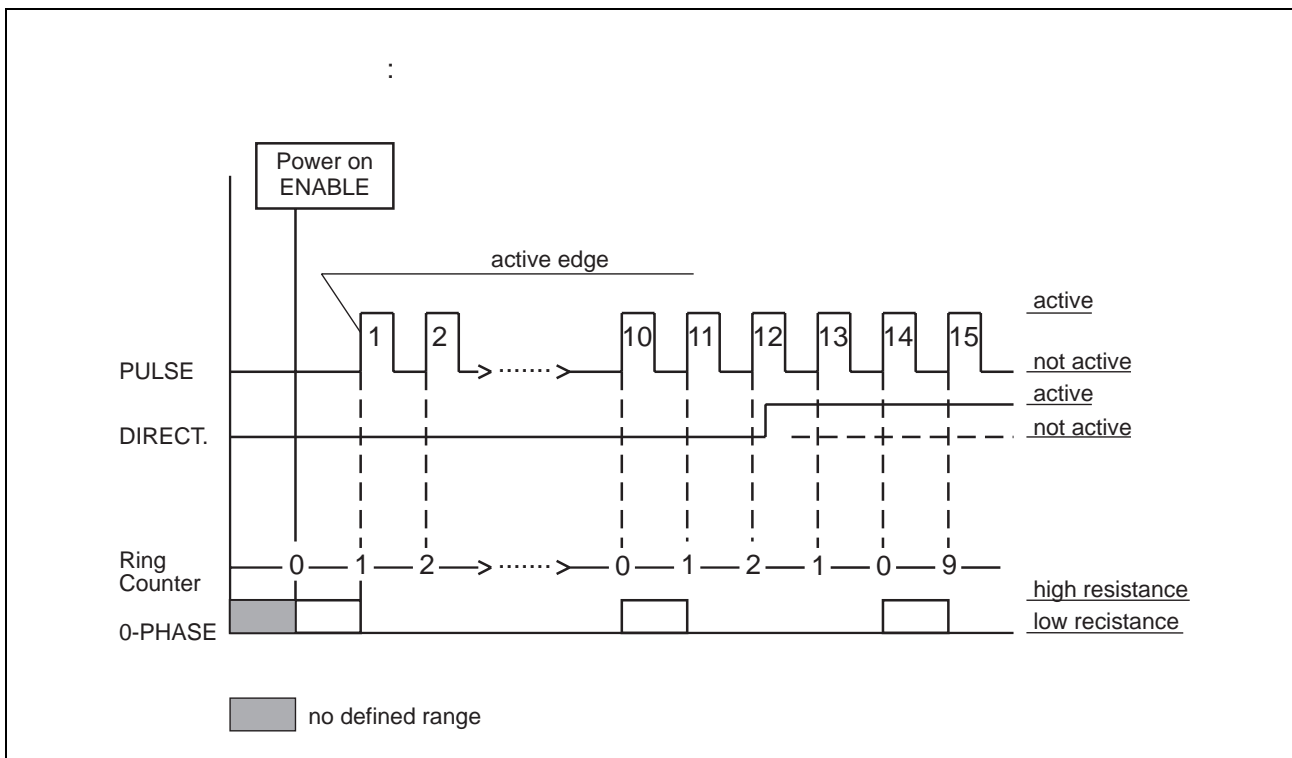


Figure 3-5 Dependence of the 0-PHASE Output on the Ring Counter count at Full Step

TEMP.INT. (Temperature Prewarning Internal)

Dependent upon phase current and the temperature of the heatsink the output TEMP.INT. is switched to 'not active' (high resistance) see figure 3-6.

TEMP.MOT. (Motor Temperature)

At a motor temperature of 95°C and above the output TEMP.MOT. switches to 'not active' (high resistance).

Readiness Relay Contacts

When the equipment is ready to operate the contacts 32-14 are connected. In the case of an error the contacts 32-13 are connected.



NOTE

For further information on errors see chapter 4.

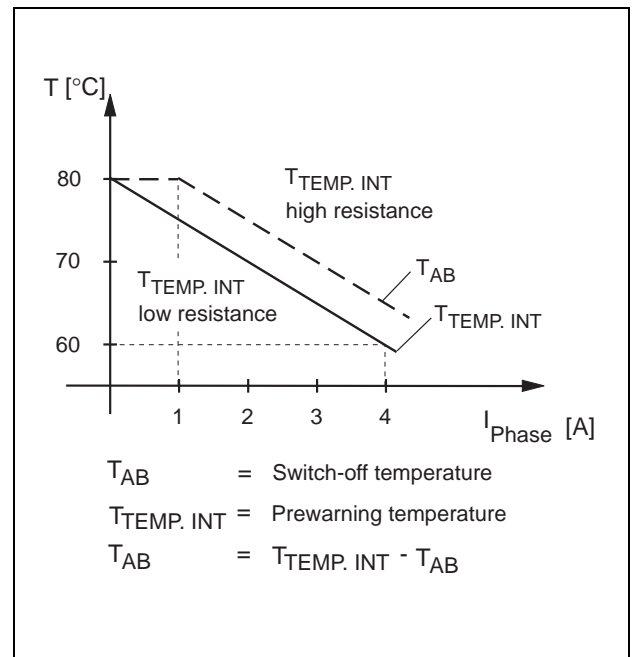


Figure 3-6 Typical Switch Behaviour TEMP. INT. in Dependence on Phase Current and the Heatsink Temperature

3.2 Switching On

Switch on the mains voltage at external switch.

After the equipment has been switched on it reports its readiness, after approx. 1.5 s (the red point on the 7 segment indicator 02 is lit).



NOTE

If instead of the red point a figure is lit, an error is indicated (see section 4.2). If the figure 8 is lit the ENABLE-Input has not been wired.

3.3 Operating Possibilities

The operation takes place via the drive signals from the external drive unit (see section 3.1); a manual operation of WD5-008 is not intended.

3.4 Switching Off

Switch off mains voltage at external switch.



ATTENTION

Disconnection of the mains cable is only permitted after all phases of the supply voltage have been switched off.

4 Errors / Faults

4.1 Status Indicator

Several monitoring and security functions establish the proper operation of the equipment. The condition of the equipment is conveyed to the exterior by two methods:

- *visually* via a 7 Segment-LED-Indicator
- *electrically* via the Readiness Relay contacts and the signal outputs TEMP. INT., TEMP. MOT. and RM FAULT (see section 3.1.2). In this way the actual condition of the Power Drive is reported to the superordinate control unit (e.g. PLC).

In the table below the possible equipment conditions and the respective consequences for the equipment output are shown.

The following section contains notes on how to remove errors quickly.

Indication	Readiness-Relais	Meaning	Motor Output	Signal Outputs
.	ready	Equipment ready	active *	
.	ready	Motor temperature warning	active	TEMP. MOT not active**
0	ready	Equipment temperature warning	active	TEMP. INT not active**
1	ready	Rotation monitor	active	RM FAULT not active**
2	ready	Ballast working	active	
3	not ready	Exc. temperature	not active	
4	not ready	Short circuit	not active	
6	not ready	Undervoltage	not active	
7		(not occupied)		
8	not ready	ENABLE not active	not active	
9		(not occupied)		

* This is valid when there is no signal at the input IPWMIN

** Under normal conditions the signal outputs TEMP. INT, RM FAULT, TEMP. MOT are active, witch means low resistance



ATTENTION

According to the type of the fault there will be no current at the motor output. The the stopping moment of the motor falls down to zero.

4.2 Trouble Shooting Guide

Indication	Readiness	Possible cause of faults	Fault	Remedy
No figures		No mains voltage available		Check Return equipment
		Internal fuse defective	Equipment is set to 115 V AC but should be working on 230 V AC	Exchange equipment check mains connection against data label
Standby indicator flashes		Internal failure		Exchange equipment and return
8	External reset	Input ENABLE not active		Wire input ENABLE
6	Voltage under-/overload	Equipment is set to 230 V AC	Input voltage = 115 VAC	Disconnect equipment, call BERGER LAHR
		Mains voltage outside tolerance		
4	Short circuit or short to earth *	Internal ballast switch overload		Connect external ballast resistor
		Short circuit in plug, cable or motor (phase to phase, phase to earth)		Switch off equipment! remove short circuit, exchange motor
3	Exc. temperature*	Temperature on the mounting bracket is too high		Decrease current, or enlarge heatsink or forced aircooling
2	Ballast switch active	Energy is supplied by the monitor		
1	Error in the rotation monitor *	No rotation sensor available		Switch switch 03 to OFF
		Rotation sensor not correctly connected		Check
		Start/Stop frequency too high	Motor is offset or struck	Decrease frequency
0	Temperature warning	Temperature on mounting bracket is too high (see figure 3-6) CAUTION! Equipment switches off when permitted max. temp. is exceeded by 5°C		Decrease phase current Enlarge heatsink Forced air cooling (see accessories)
.	Standby indicator			



NOTE

The fault indications which are marked in the Trouble Shooting Table with a * are saved in the equipment and can be

reset by input ENABLE (see section 3.1.1).

4.3 Storage and Shipping

When equipment or insert cards are stored the following points have to be taken into consideration:

- the maximum humidity (see 1.4 Technical Data) is not to be exceeded!
- the storage temperature (see 1.4 Technical Data) is not to be exceeded!
- the stored parts have to be protected from dirt and dust!
- equipment and insert cards which show the following symbol are obly to be unpacked, stored or installed in working areas which are electrostatically protected!
- equipment and insert cards which have accumulators should be connected to the mains at least once a month!
- the original packing has to be saved!



When equipment and insert cards are shipped, the following points have to be taken into consideration:

- equipment and insert cards should, if possible, only be shipped in their original packing!
- insert cards should be packed *without* batteries or accumulators into covers which convey electrostatic on both sides (if possible use the original packing)!
- insert cards should be packed with batteries or accumulators into covers which convey electrostatic on the outside and anti-electrostatic on the inside (if possible use the original packing)!
- equipment or insert cards with the following symbol should only be packed in electrostatically protected working areas!



5 Maintenance

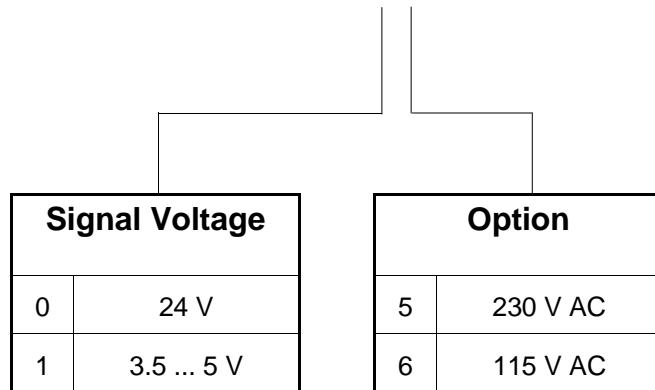
WD5-008 requires no maintenance.

6 Appendix

6.1 Equipment Variants

Type Code for Wall Mounted Equipment WD5

WD5 - 0 0 8. x x 1 - 0 x



6.2 Description of Accessories

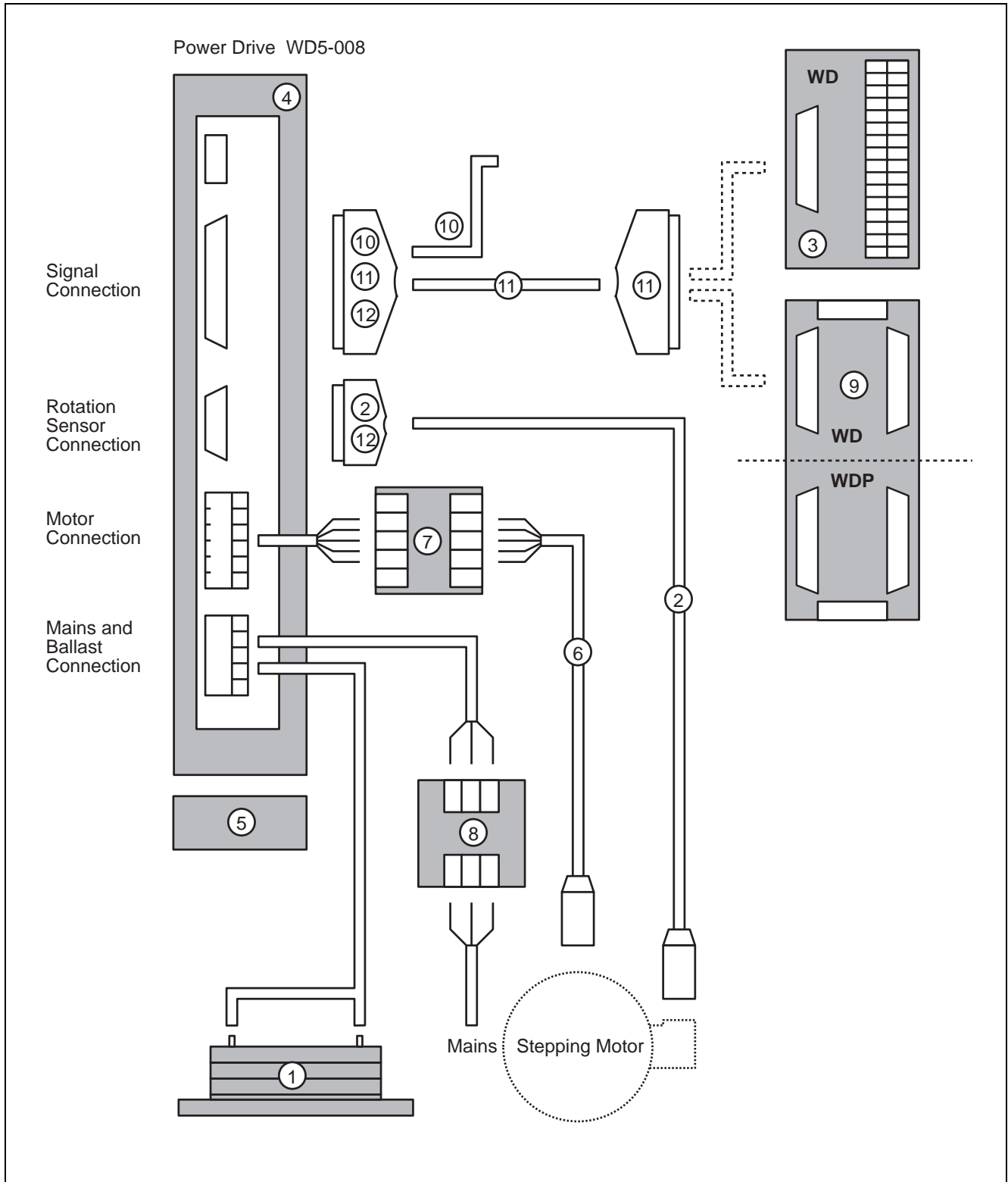


Figure 6-1 Accessories

The following accessories can be delivered on special order:

Position in figure 6-1	Description	Order Number	Reference
1	Ballast Resistor	62501100600	see Paragraph 6.2.1
2	Rotation Sensor Cable	62501404xxx	see Paragraph 6.2.2
3	Terminal Adapter D 732	62010732006	see Paragraph 6.2.3
4	Heatsink	62500901000	see Paragraph 6.2.4
5	Fan Assembly	62501201000	see Paragraph 6.2.5
6	Motor Cable	62501301xxx	see Paragraph 6.2.6
7	Motor Rating Filter	62501100100	see Paragraph 6.2.7
8	Mains Filter	62501100200	see Paragraph 6.2.8
9	Interface Tester D 690	62010690006	see Paragraph 6.2.9
10	Signal Cable, Control Side Open	62501401xxx	see Paragraph 6.2.10
11	Signal Cable for Interface Tester or Terminal Adaptor	62501402xxx	see Paragraph 6.2.10
12	Plug Set WD5-008	62501000100	see Paragraph 6.2.11

Appendix

6.2.1 Ballast Resistor

For reducing an increased braking energy a Ballast Resistor HSD 70 is used.



ATTENTION

With the mounting of the ballast resistor adequate cooling must be ensured.

1. Switch off mains voltage.
2. Loosen Screws and remove mains connector (see figure 6-2).
3. Remove Mains Connector Cover.
4. Attach 'boot lace' ferrules to the ends of the ballast resistor jumper connections that are to be connected to the mains connector.
5. Connect wires from ballast resistor to terminals B+ and B- and tighten terminal screws.
6. Locate and clamp cables in place in connector housing.
7. Replace Mains Connector Cover.
8. Relocate Mains Connector in position 07 on front panel, replace screws and tighten.

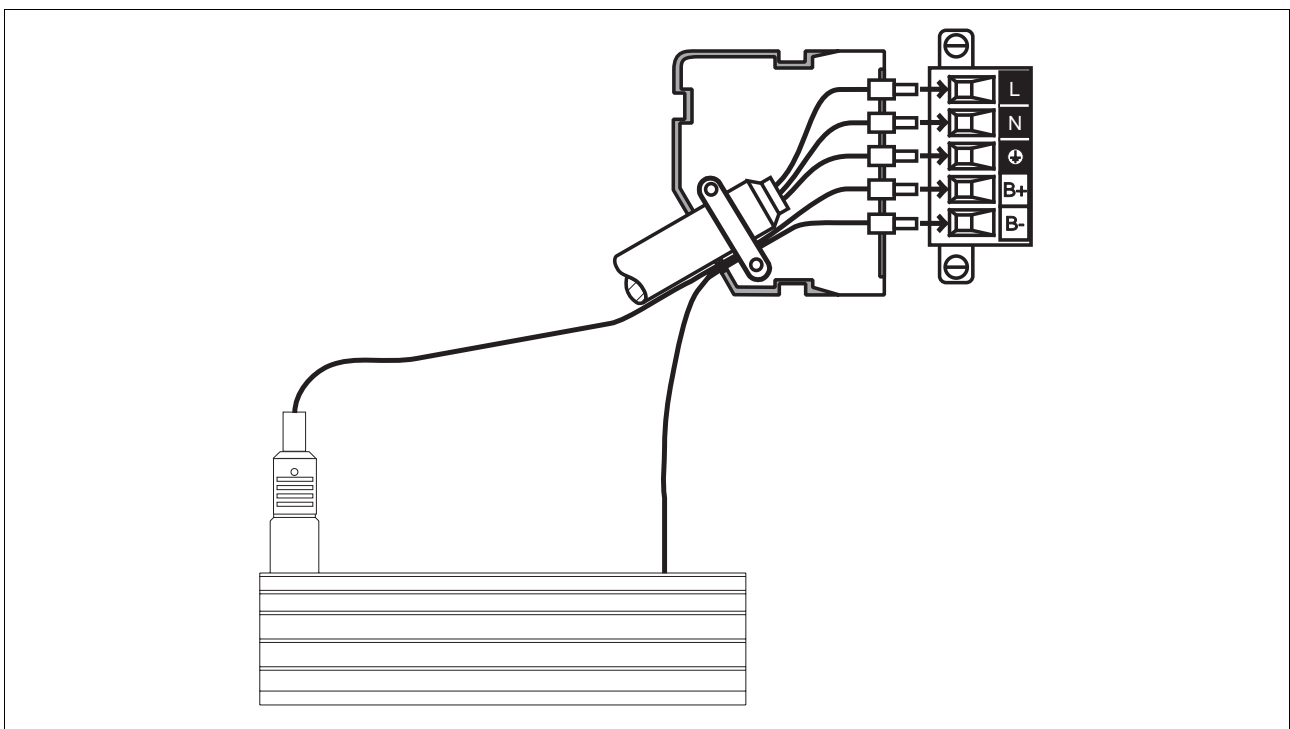


Figure 6-2 Ballast Resistor Connection

6.2.2 Rotation Sensor Cable

The Rotation Controller Cable can be ordered in the following length:

Cable Length	Order Number
5 m	62501404050
10 m	62501404100
15 m	62501404150
20 m	62501404200
50 m	62501404500

The rotation Sensor Cable includes:

Description	Order Number
15 pole plug	N4-673-247
plug shell (15 pole)	N4-673-237
12 pole socket	N8-704-89
12 contacts	N8-704-90
cable	H6-928-50

The Rotation Sensor Connection is shown and described in chapter 2.4.8.

6.2.3 Terminal Adapter D732

6.2.3.1 General Description

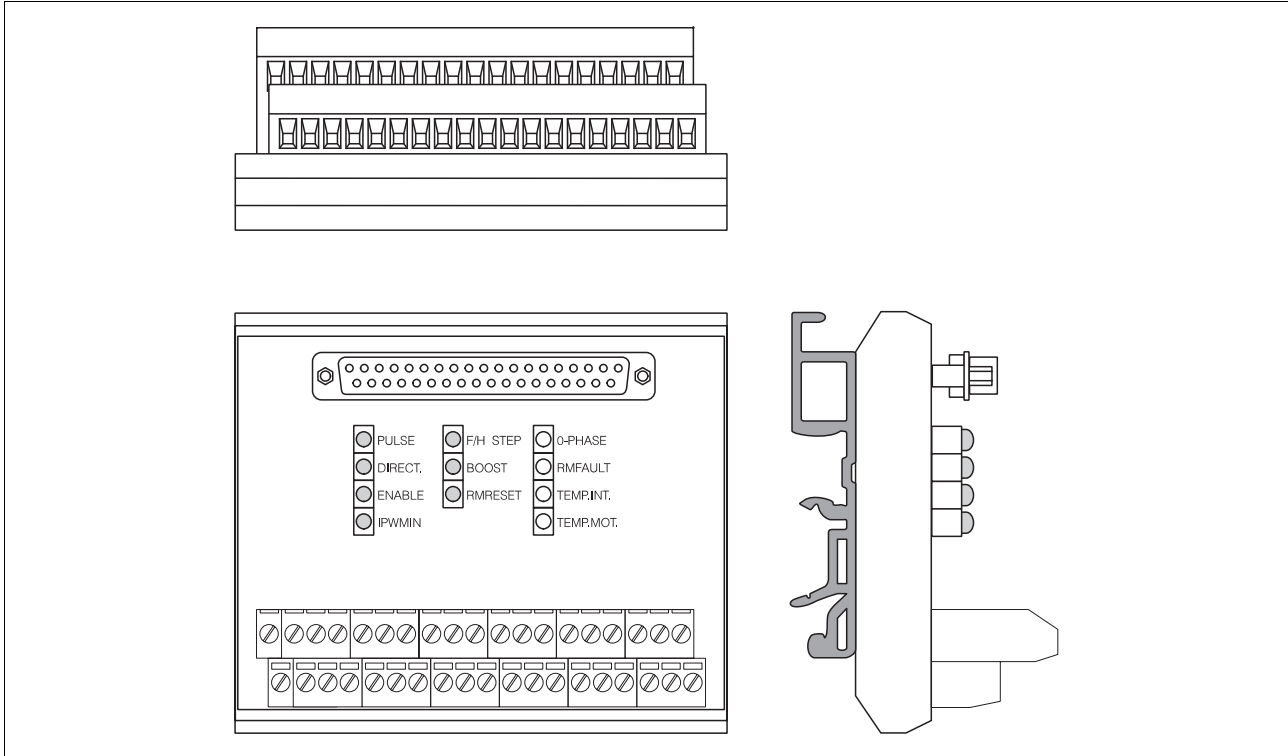


Figure 6-3 Terminal Adapter D732

The Terminal Adapter D 732 is used for connecting the BERGER LAHR power units of the series WD with a control unit.

The Terminal Adapter D 732 consists mainly of a printed circuit board on which the one Sub-D-plug, 11 LEDs and two connector blocks are installed. The LEDs indicate the signal status of particular inputs and outputs. The signal conditions of the outputs are indicated by yellow LEDs, the signal conditions of the inputs are indicated by green LEDs. All inputs and outputs are conveyed onto the connector blocks. The assignment of terminals is shown on the following page.

The link to the power unit connection of the WD equipment is made via a cable and the Sub-D-plug. No additional operating voltage has to be connected.



NOTE
The equipment is subject to the regulations of the Protective Low Voltage.

6.2.3.2 Technical Data

Electrical Data

Signal Voltage	24 V ±10%
Current Intake per LED	approx. 2 mA ±20%
Current reduction at inputs	< 0.1 V
Current reduction at outputs	< 3 V

Mechanical Data

Dimensions	approx. 113 x 78 x 52 mm
Weight	approx. 180 g

Ambient Conditions

Storage Temperature	-25°C to +75°C
Operating Temperature	0°C to +55°C
Humidity Class	F in accordance to DIN 40 040

Assignment of Terminals

Pin	Abbreviation	Meaning	← I/→ O
1	+ PULSE	Pulse	←
2	+ DIRECT.	Direction	←
3	+ ENABLE	Enabling Command Power Unit	←
4	+ IPWMIN	PWM Current-Control	←
5	+ F/H STEP	Stepangle Full Step/Half Step	←
6	+ BOOST	Current Increase	←
7	+ RM RESET	Rotation Monitor Reset ¹⁾	←
8	+ RM FAULT	Rotation Monitor Error ¹⁾	→
9	+ 0-PHASE	Zero-Phase	→
10	+ TEMP.INT.	Temperature Monitor Heatsink	→
11	+ TEMP.MOT	Temperature Monitor Motor ¹⁾	→
12	-	-	-
13	READY NC	Relay Contact Power Unit not ready	→
14	READY NO	Relay Contact Power Unit Ready	→
15	-	-	-
16	START/STOP	Oscillator Start/Stop ²⁾	←
17	VIN GND	Oscillator Control Current Ground ²⁾	←
18	PULSE OUT	Oscillator Pulse Output ²⁾	→
19	GND OUT	Oscillator Output Ground ²⁾	→
20	- PULSE	Pulse	←
21	- DIRECT.	Direction	←
22	- ENABLE	Enable Command Power Unit	←
23	- IPWMIN	PWM Current Control	←
24	- F/H STEP	Stepangle Full Step/Half Step	←
25	- BOOST	Current Increase	←
26	- RM RESET	Rotation Monitor Reset ¹⁾	←
27	- RM FAULT	Rotation Monitor Error ¹⁾	→
28	- 0-PHASE	Zero-Phase	→
29	- TEMP.INT.	Temperature Monitor Heatsink	→
30	- TEMP.MOT	Temperature Monitor Motor ¹⁾	→
31	-	-	-
32	READY C	Relay Contact	-
33	-	-	-
34	-	-	-
35	FL/FH	Oscillator Frequency down/up ²⁾	←
36	VIN	Oscillator Control Voltage -/+ 10 V ²⁾	←
37	DIR.OUT	Oscillator Direction Output ²⁾	→
38	-	Screen Connection	-

I= Input O= Output

¹⁾ When operated without Rotation Sensor these signals have no function

²⁾ These signals are present only with WDO power units

Appendix

6.2.3.3 Parts Specification

Item	Description	Order Number
1	D 732	62010732006

6.2.3.4 Accessories

Item	Description	Order Number
1	Cable 1.5 m	62501402015

6.2.3.5 Mounting

With the foot element the Terminal Adapter can be hooked onto the mounting rails DIN EN which are available on the market.

6.2.3.6 Initial Operation

1. Switch off equipment WD, and the control.
2. Connect Terminal Adapter D 732 with cable to WD equipment, see figure 6-4.



ATTENTION

Only use the original cable (see accessories) or a screened cable!

3. Tighten fixing screws of the plugs.
4. Wire the Terminal Adapter with the control.
5. Switch on equipment WD and control.

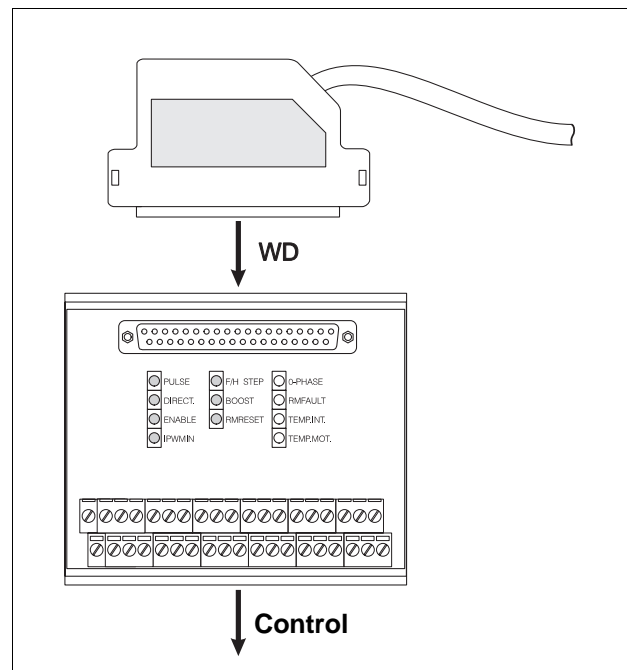


Figure 6-4 Initial Operation of Terminal Adapter D732

6.2.4 Heatsink

6.2.4.1 BERGER LAHR heatsink

The correct cooling conditions for the WD power drive can be obtained with a BERGER LAHR heat-sink.

The heatsink (figures 6-5 and 6-6) can be mounted inside or outside of the switch cabinet.



NOTE

Consider the additional room required and the distances between the middle axes in the case of combined mounting of several units of equipment, see table (indications in mm).

Distances between centre lines for equipment combinations	WD5-008	WDP5-118	WDP5-228	WDP5-318	WP-111	WP-231	WP-311
WD5-008	87	87	87	87	74	74	74
WDP5-118	87	87	87	87	74	74	74
WDP5-228	87	87	87	87	74	74	74
WDP5-318	87	87	87	87	74	74	74
WP-111	74	74	74	74	61	61	61
WP-231	74	74	74	74	61	61	61
WP-311	74	74	74	74	61	61	61

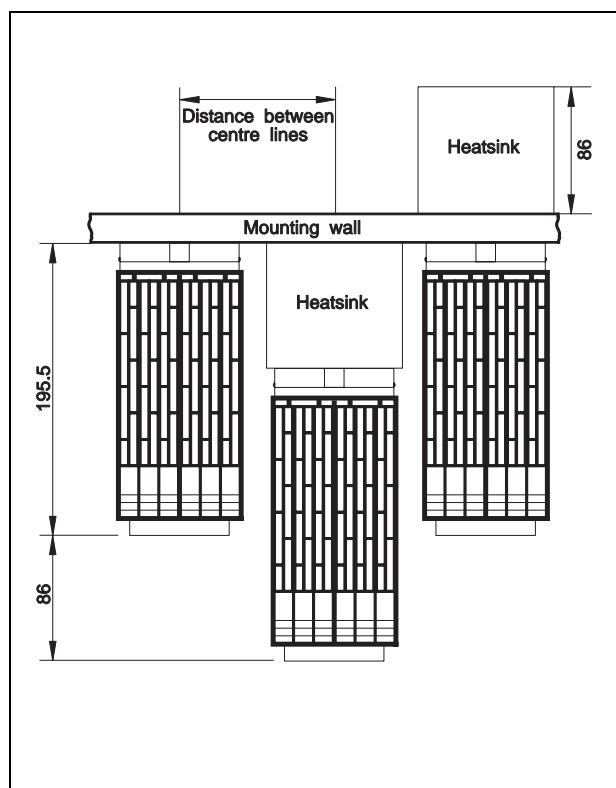


Figure 6-5 Mounting of Heatsink

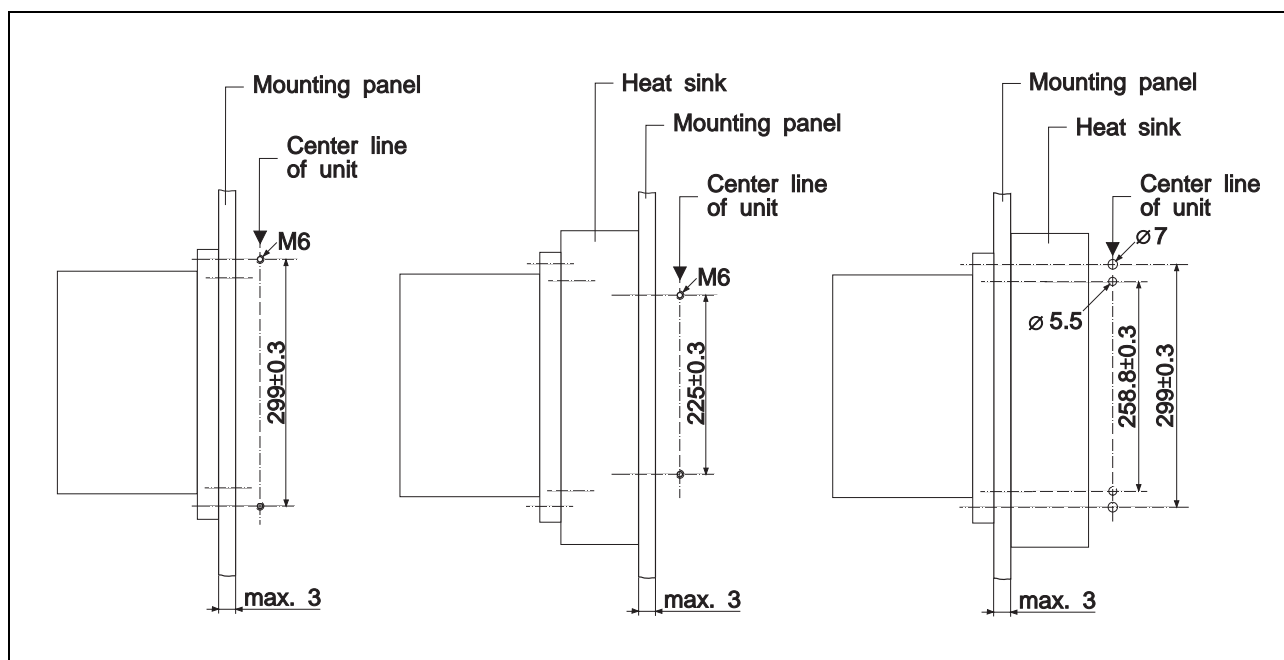


Figure 6-6 Drilling Schemes

Mounting of the Equipment with the Heatsink Inside the Switch Cabinet

1. With the heatsink mounted inside the switch cabinet (see figure 6-5).
2. Drill two holes into the mounting wall and tap a thread M6 (see figure 6-6).
3. Attach heatsink with two screws (M6) (see figure 6-7) to the mounting wall.
4. Apply the heat conducting paste between the back panel of the equipment and the mounting wall.
5. Set equipment onto the two guide pins of the heatsink and tighten screws (SW 10).



NOTE

Take into consideration the distances between units in the case of combined mounting of equipment, see table on page 6-9.

Mounting of the Equipment with the Heatsink Outside the Switch Cabinet

1. With the heatsink mounted outside the switch cabinet (see figure 6-5).
2. Drill four holes into the mounting wall (see figure 6-6).
3. Remove the two guide pins of the heatsink.
4. Apply the heat conducting paste between the heatsink and the mounting wall.
5. Screw the heatsink with two screws (M6) onto the mounting wall (see figure 6-7).
6. Apply the heat conducting paste between the back panel of the equipment and the mounting wall.
7. Set the equipment onto the two guide pins of the heatsink and tighten the two screws (SW 10).

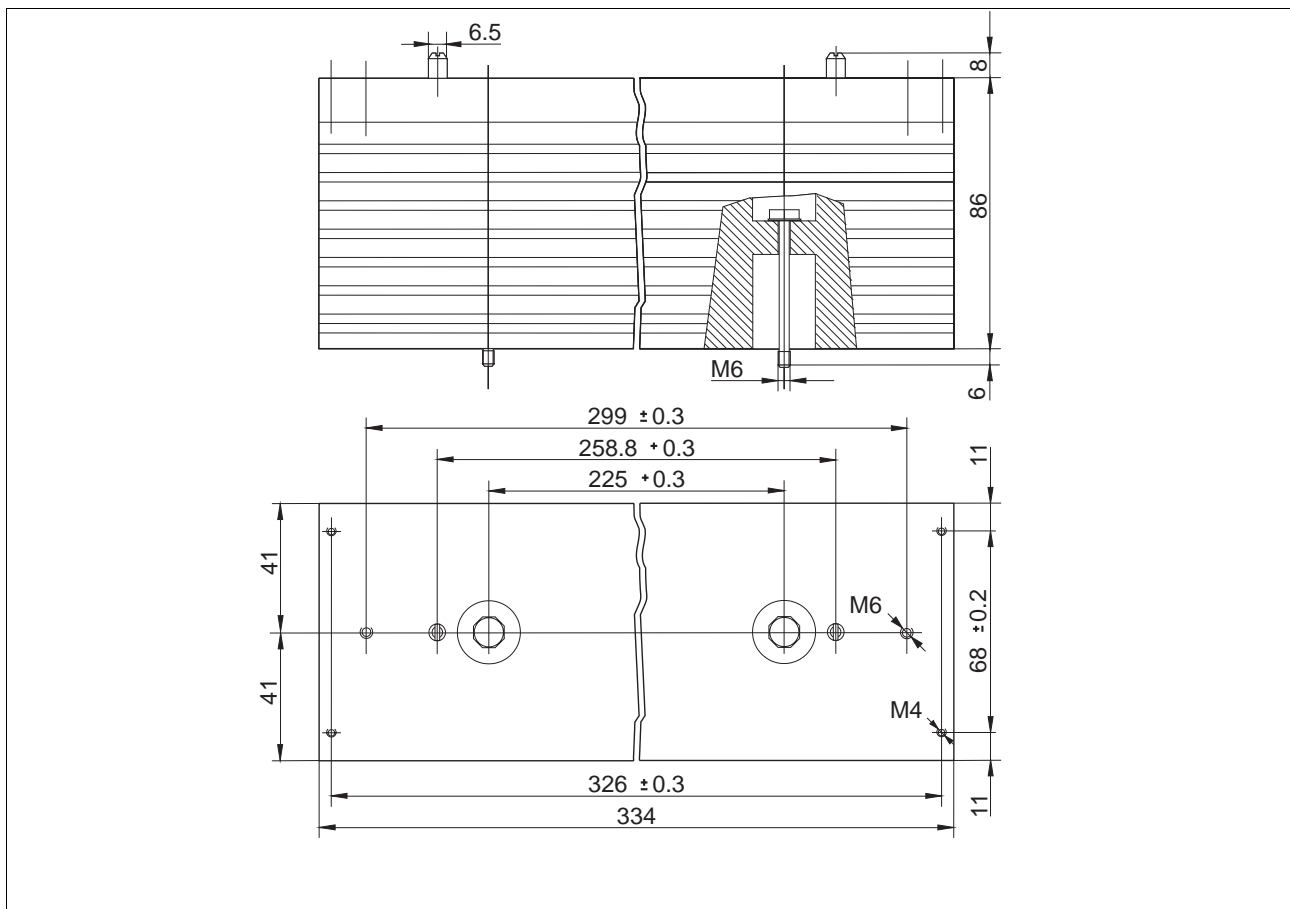


Figure 6-7 Heatsink Dimensions

6.2.4.2 Dimensioning of a heatsink

If a BERGER LAHR heatsink is not used, the heatsink must be dimensioned as follows for wall mounting. In order to select a heatsink with sufficient thermal conductivity it is necessary to determine the thermal resistance. The following variables need to be known to calculate the thermal resistance R_{th} :

- Power dissipation of P_V of the equipment
- Ambient temperature T_U
- Prewarning temperature $T_{TEMP.INT.}$ of the equipment

1. Calculation of the power dissipation P_V

The first step is to determine the power dissipation P_V which has to be eliminated by the heat sink. P_V depends mainly on motor cable and phase current. The following formula is used to calculate the power dissipation:

$$P_V = \frac{1+ED}{2} \cdot (k_1 C_K L_K + k_2 I_{Ph} + P_R)$$

$\frac{1 + ED}{2}$ = Influence of the duty cycle with
ED = duty cycle in %

$k_1 C_K L_K$ = Influence of the motor cable with
 $k_1 = 0,04 \text{ W/nF}$
 C_K = capacitance of the motor cable
in nF at 100 m
 L_K = Length of motor cable in m

$k_2 I_{Ph}$ = Influence of the phase current with
 $k_2 = 23,5 \text{ W/A}$
 I_{Ph} = phase current in A
 $P_R = 5 \text{ W}$ internal losses

For the general calculation this gives us:

$$P_V = \frac{1 + ED}{2} \cdot (0,04 \frac{W}{nFm} \cdot C_K L_K + 23,5 \frac{W}{A} \cdot I_{Ph} + 5 \text{ W})$$

If the accessory motor cable as supplied by BERGER LAHR is used, the following formula is obtained for calculation of the power dissipation:

$$P_V = \frac{1 + ED}{2} \cdot (0,4 \frac{W}{m} \cdot L_K + 23,5 \frac{W}{A} \cdot I_{Ph} + 5 \text{ W})$$

The cable capacitance C_K is 10 nF at 100 m.

2. Calculation of the necessary thermal resistance R_{th}

The following equations are applicable:

$$R_{th} = \frac{T_{TEMP.INT.} - T_U}{P_V}$$

$$T_{TEMP.INT.} = T_{max} - k_0 I_{Ph}$$

$$T_{TEMP.INT.} = 80^\circ\text{C} - 5 \frac{^\circ\text{C}}{\text{A}} \cdot I_{Ph}$$

This gives us the following equation for the thermal resistance:

$$R_{th} = \frac{80^\circ - 5 \frac{^\circ\text{C}}{\text{A}} \cdot I_{Ph} - T_U}{P_V}$$

$T_{TEMP.INT.}$ = prewarning temperature

T_{max} = maximum permissible temperature on mounting bracket

$k_0 I_{Ph}$ = influence of the phase current on the prewarning temperature

I_{Ph} = phase current

T_U = ambient temperature

P_V = power dissipation

To check the dimensioning of the heatsink, the temperature on the mounting bracket should be measured. This temperature must be smaller than the prewarning temperature $T_{TEMP.INT.}$ of the equipment. See Figure 6-8.

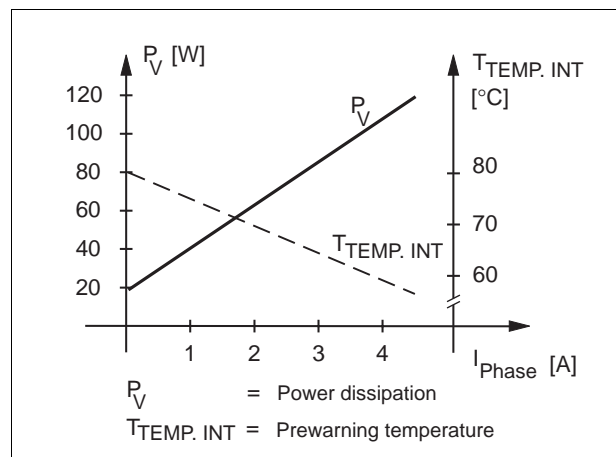


Figure 6-8 Power dissipation diagram



NOTE

The thermal resistance of the heatsink supplied by BERGER LAHR is 0.5 K/W without additional air cooling and 0.17 K/W when a fan is used. The equipment itself can also be air-cooled (minimum air flow 1 m/s) instead of using a heatsink.

Appendix

6.2.5 Fan Assembly

For improving the removal of waste heat, the heat-sink can be equipped with a fan.

The fan (figure 6-8) is hooked onto the bottom of the heatsink and screwed on with two screws.

Connect the fan with external voltage supply:
24 V DC.

Further fan assemblies can be connected in parallel via the second clamp pair.

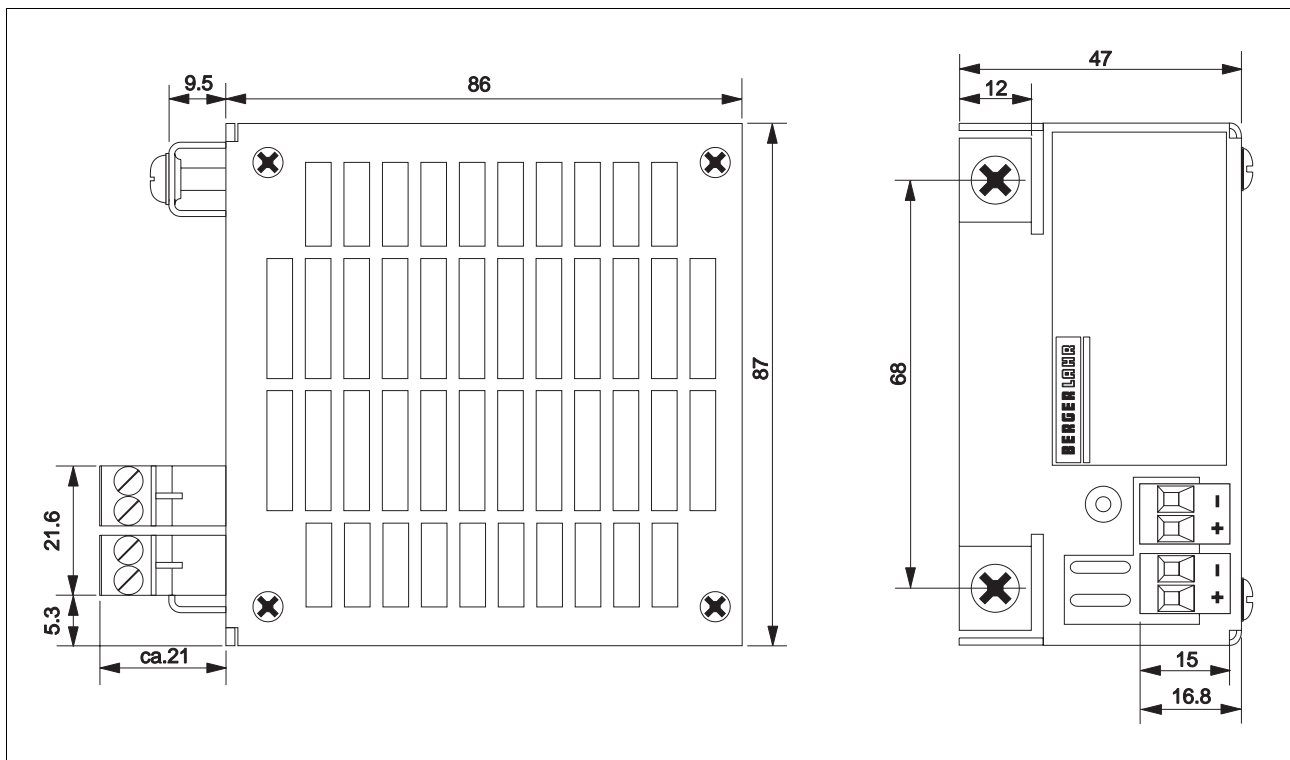


Figure 6-9 Dimensions: Fan Assembly

6.2.6 Motor Cable

The Motor Cable can be ordered in the following length:

Cable length	Order Number
5 m	62501301005
10 m	62501301010
15 m	62501301015
20 m	62501301020
50 m	62501301050

The Motor Cable includes:

Description	Order Number
6-pole plug	N8-704-91
6 contacts	N8-704-92
cable	H6-928-51

The motor connection is shown and described in chapter 2.4.2.

6.2.7 Motor Rating Filter

A Motor Rating Filter is connected in line with the motor cable when the motor cable is 50 m or longer and to ensure radio shielding/ interface suppression (also under 50 m) in accordance to VDE 0871/ limiting value class A.

The filter must be installed in the switch cabinet near the device and provided with external ventilation.

Only use the motor cable approved by BERGER LAHR. Other cables could generate higher currents due to a higher capacity, which could lead to the destruction of the devices.

Ambient conditions

Storage temperature -25°C to +70°C

Operating temperature
 up to a phase current of 4 A 0°C to 50°C
 up to a phase current of 5 A 0°C to 40°C

Humidity class F acc. to DIN 40 040 (non-condensing)

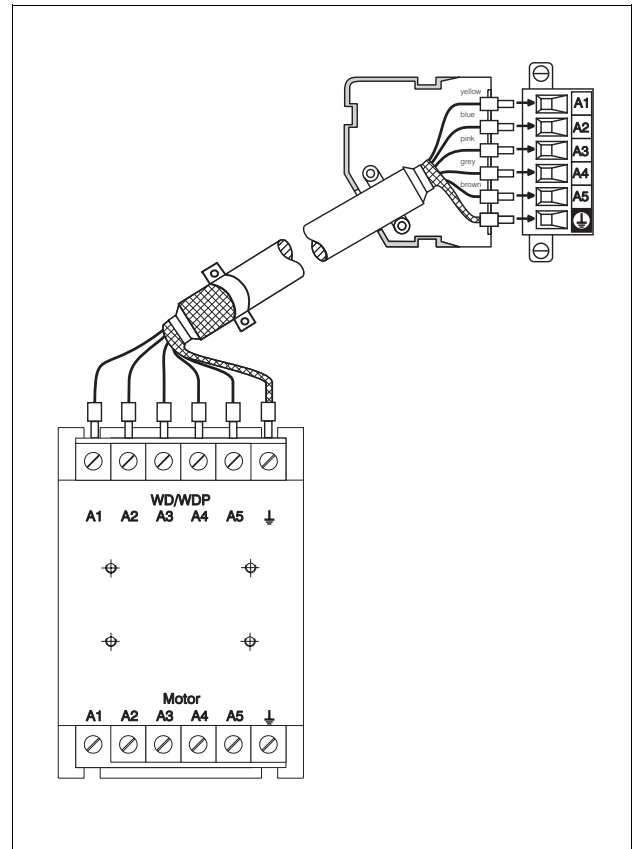


Figure 6-10 Motor Rating Filter

Appendix

6.2.8 Mains Filter

The Mains Filter is connected in line with the mains cable to ensure interference suppression in accordance to VDE 0871/ limiting value class A.

The connection to the Mains filter should be of $\geq 2.5 \text{ mm}^2$

Ambient conditions

- Storage temperature -25°C to +70°C
- Operating temperature 0°C to 55°C
- Humidity class, components F acc. to DIN 40 040
- Humidity class, tested to IEC 68 part 2-3 at:
 - Air temperature +40°C, +2°C
 - Relative humidity 93%, +2%, -3% non-condensing

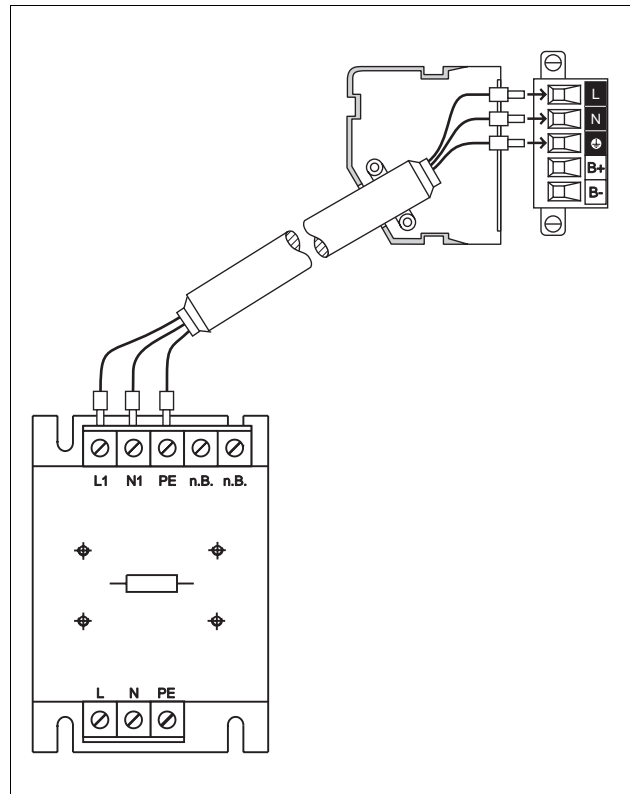


Figure 6-11 Mains Filter

6.2.9 Interface Tester D 690

6.2.9.1 General Description

The Interface Tester D 690 is used for testing the signal conditions for BERGER LAHR wall mounting equipment:

- WD5-xxx (Power Drive)
- WP-xxx (Positioning Unit)
- WDP5-xxx (Positioning Unit with Power Drive)

The Interface Tester D 690 consists mainly of a printed circuit board on which 6 Sub-D-plugs and sockets and 43 LEDs are installed. The signal meanings of the LEDs are explained on the following page. The signal conditions of the outputs are indicated by yellow, the signal conditions of the inputs by green LEDs. The Interface Tester is divided into two parts. As can be seen in figure 6-11, one part is intended for the WD, the other for WP/WDP equipment. The Interface Tester is connected in line with the signal wire of the equipment.

No additional voltage has to be connected. The diagnostic sockets on each end of the base plate are intended for measurement and testing procedures.

6.2.9.2 Technical Data

Electrical Data

Signal Voltage WP/WDP part	24 V ±10%
Signal Voltage WD part	3.5 to 24 V ±10%
Current Intake per LED	approx. 2 mA
Current reduction at tester	0,1 V

Mechanical Data

Dimensions	approx. 205 x 80 x 32 mm
Weight	approx. 150 g

Ambient Conditions

Ambient Temperature when Operating	0°C to 55°C
Storage Temperature	-25°C to 75°C
Humidity Class	F in accordance with DIN 40 040



NOTE

The equipment is subjected to the regulations of the Protective Low Voltage.

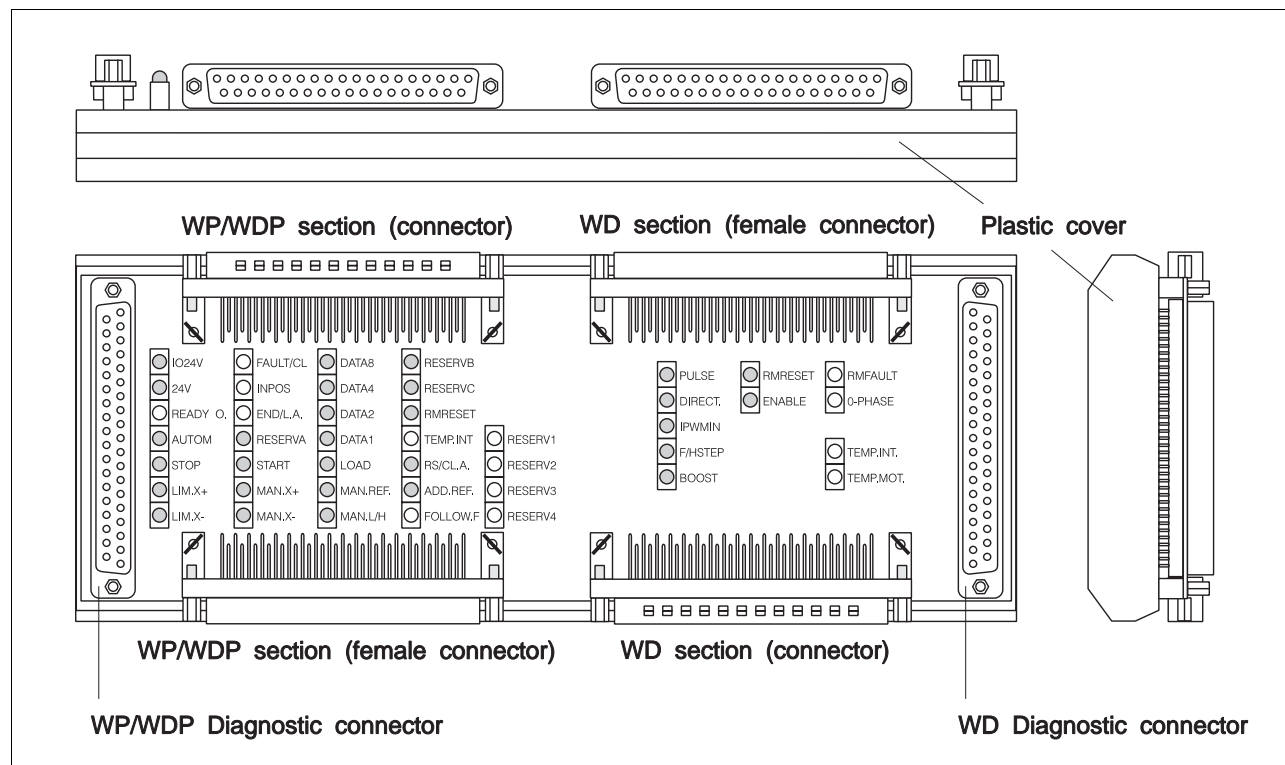


Figure 6-12 Interface Tester D 690

Appendix

WD Part

Pin	Abbreviation	Meaning	Signal Logic	← I/→ O
1/20	PULSE	Pulse	Pulse	←
2/21	DIRECT.	Direction	selectable	←
3/22	ENABLE	Enable Power Unit	active high	←
4/23	IPWMIN	PWM Current Control	Pulse	←
5/24	F/H STEP	Stepangle Full Step/Half Step	selectable	←
6/25	BOOST	Current Increase	active high	←
7/26	RM RESET	Rotation Monitor Reset	active high	←
8/27	RM FAULT	Rotation Monitor Error	active low	→
9/28	0-PHASE	Zero-Phase	active high	→
10/29	TEMP.INT.	Temperature Monitor Heatsink	active low	→
11/30	TEMP.MOT	Temperature Monitor Motor	active low	→

WP/WDP Part

Pin	Abbreviation	Meaning	Signal Logic	← I/→ O
18	IO24V	I/O Supply Voltage		←
19	IO24V	I/O Supply Voltage		←
16	24V	System Supply Voltage		←
17	24V	System Supply Voltage		←
15	READY O.	Ready for Operation	active high	→
25	AUTOM	Automatic	active high	←
23	STOP	Stop	active low	←
20	LIM.X+	Positive Limit Switch	active low	←
1	LIM.X-	Negative Limit Switch	active low	←
14	FAULT/CL	Fault/Clock	active high	→
33	INPOS	Position reached	active high	→
34	END/L.A.	Program End/Load acknowledge	active high/low	→
4	START	Start	active high	←
26	MAN.X+	Manual Drive. Positive Rotation Direction	active high	←
7	MAN.X-	Manual Drive. Negative Rotation Direction	active high	←
28	DATA8	Program Number 2 ³	active high	←
9	DATA4	Program Number 2 ²	active high	←
29	DATA2	Program Number 2 ¹	active high	←
10	DATA1	Program Number 2 ⁰	active high	←
5	LOAD	Save Position	active high	←
27	MAN.REF.	Manual Reference Drive	active high	←
8	MAN.L/H	Slow/Fast Manual Drive	active high	←
22	RM RESET	Rotation Monitor Reset	active high	←
32	TEMP.INT.	Temperature Monitor Heatsink	active high	→
24	RS/CL.A	Program Start/Clock acknowledge	active high	←
6	ADD.REF.	Additional Reference Switch	active low	←
13	FOLLOW.F.	Contouring Distance: Limit	active high	→
35	24VGND	System Supply Voltage Ground		←
36	24VGND	System Supply Voltage Ground		←
37	IOGND	I/O-Supply Voltage Ground		←

I = Input O= Output

6.2.9.3 Scope of Supply

Item	Description	Order Number
1	D 690	62010690006

6.2.9.4 Accessories

Item	Description	Order Number
1	Cable 1.5 m for WD	62501402015
1	Cable 1.5 m for WDP	62501408015
2	Foot Elements	00050090045

6.2.9.5 Mounting

The Interface Tester can be hooked onto the mounting rails DIN EN which are available on the market with the foot element.

6.2.9.6 Initial Operation

1. Switch off equipment WP/WDP or WD.
2. Connect the Interface Tester D 690 in line with the cable between WP/WDP or WD equipment and periphery, see figure 6-13.



ATTENTION

The insertion of the Interface Tester can reduce the immunity to interference of the signal inputs. Use only the cable provided or a screened signal cable.

3. Tighten screws on the plug.
4. Switch on the equipment WP/WDP or WD.
5. If desired the signal conditions at the diagnostic socket can be tested with a measuring instrument. The pin assignment of the diagnostic socket is the same as the pin assignment of the signal plug.
6. Test the interface.



NOTE

The only Outputs which can be tested are those that were wired in by the customer.

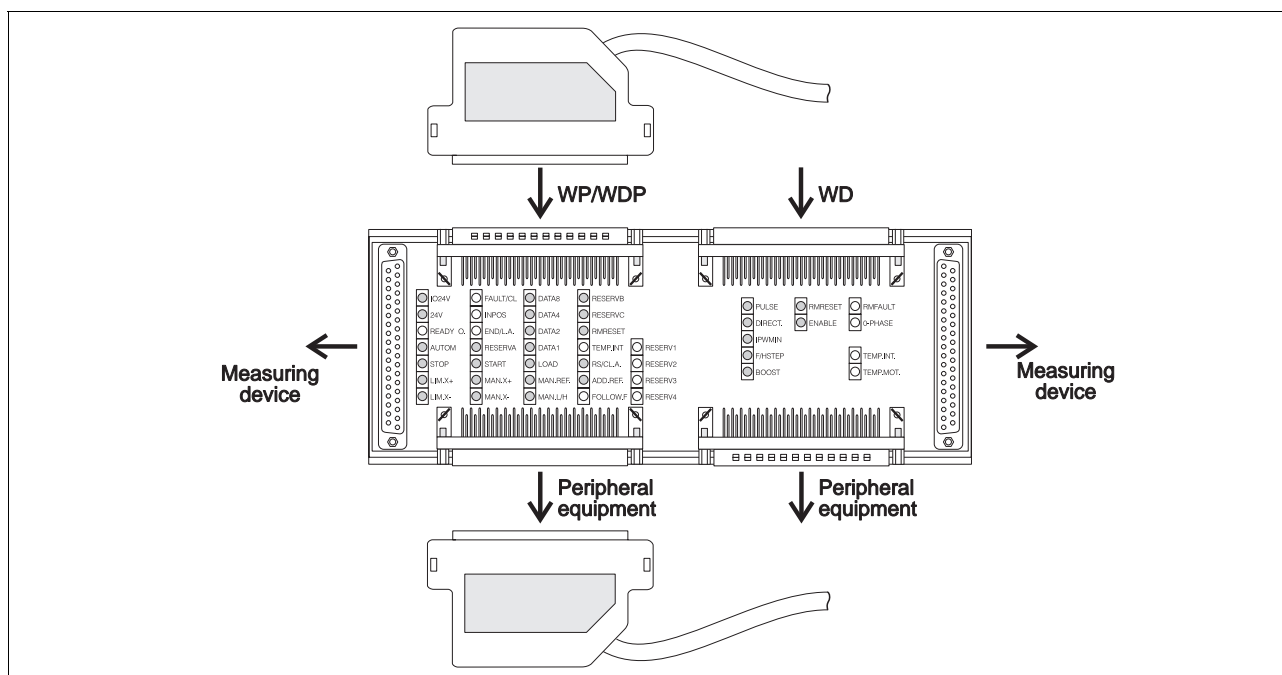


Figure 6-13 Initial Operation of Interface Tester D690

Appendix

6.2.10 Signal Cable

The signal cable open at the end of the drive side can be ordered in the following length:

Cable length	Order Number
1 m	62501401010
2 m	62501401020
5 m	62501401050
10 m	62501401100
25 m	62501401250

The Signal Cable includes:

Description	Order Number
37 pole socket	N4-673-203
Plug shell (37 pole)	N4-673-239
Cable	H6-928-44

The Signal connection is shown and described in chapter 2.4.7.

The Signal Cable for the Interface tester or the Terminal adaptor can be ordered in the following lengths:

Cable length	Order Number
1 m	62501402010
2 m	62501402020
5 m	62501402050
10 m	62501402100

The Signal Cable includes:

Description	Order Number
37 pole socket	N4-673-203
37 pole plug	N4-673-249
Plug shell (37 pole)	N4-673-239
Cable	H6-928-44

6.2.11 Plug Set WD5-008

The plug set includes:

Description	Order Number
15 pole plug	N4-673-247
Plug shell (15 pole)	N4-673-237
37 pole socket	N4-673-203
Plug shell (37 pole)	N4-673-239

6.3 Definition of Terminology

Ballast Resistor	Resistor for reducing the motor's braking energy
Boost	Short time increase of the set phase current to increase the rotation moment when accelerating or braking the motor
Clockwise Rotation	This means, looking onto the motor shaft (flange side) the rotation is clockwise (= positive drive direction)
Contouring Distance	Dynamic difference between the position of the rotor- and the stator-rotational field
Contouring Error	Positioning error which occurs when the contouring distance is becoming to big or to small
Counterclockwise	This means, looking onto the motor shaft (flange side) the rotation is counterclockwise (= negative rotation)
Current Control	Controlling the phase current with a pulse width modulated input signal (IPWMIN)
ENABLE Command	Signal input for activating the drive ENABLE
5-Phase Stepping Motor	Special stepping motor for wall mounting equipment from BERGER/LAHR
Full Step	Rotation angle of the 5-Phase stepping motor per step 72° (corresponding with 500 steps/rotation)
Half Step	Rotation angle of the 5-Phase stepping motor per step 0.36° (1000 steps/rotation)
Phase Current	The current which is flowing through the motor winding
Pulse Frequency	Number of driving pulses per second; With each pulse the motor makes one step.
Pulse Width Modulation	Controlling of an analogue range via the relation of pulse width/and the length of a period of an input signal (see also current control)
Ring Counter	Cyclicly running counter with topped decoding logic for producing the current pattern for the 5 phases of the stepping motor
Rotation Monitor / Rotation Sensor	Switch for recognizing a contouring error
Start/Stop Frequency	Highest pulse frequency at which the motor can start and stop without contouring error, with a defined load.
Step	Turning of the motor shaft of the stepping motor for a fixed angle (see also Half Step/ Full Step)
Step Angle	Nominal angle around which the motor shaft of the stepping motor is turning at each drive impulse (see also Half Step/Full Step)

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