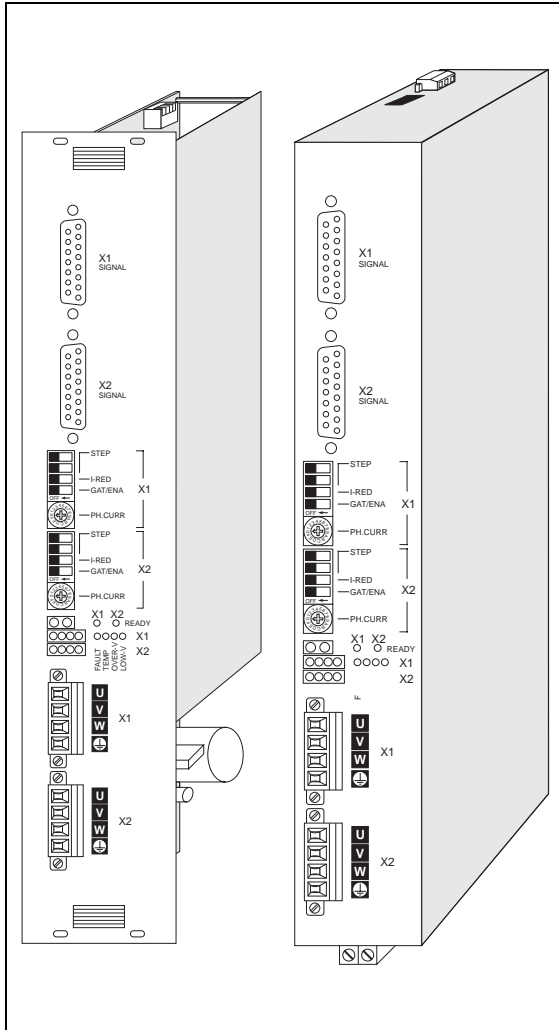


Power Drives for 3-Phase Stepping Motors

D 902
WDM3-004

Doc. no.: 220.902/Docu
Ident no.: 00441110290
Edition: d156 08.03

English



Made in Germany by:

Berger Lahr GmbH & Co. KG
Breslauer Str. 7
77933 Lahr



Safety instructions

Please read the following safety instructions carefully before installing and using the power drive.

- The intended use of the power drive ("Purpose") is described in this documentation and must be observed.
- The power drive may only be installed by a skilled electrician. The national regulations concerning
 - Prevention of accidents
 - Installation of electrical and mechanical systems
 - Radio interference suppressionmust be observed.
- The technical data of the power drive, in particular the ambient conditions, must be observed.
- The power drive should only be operated by trained personnel.
- Warranty will be voided by unauthorized modifications.
- Before installing accessories, please contact your Technical Consultant.
- Do not throw away the original packaging material; you may need to use it at a later date for shipment of the power drive.
- The safety symbols and safety instructions on the power drive and in the documentation manual must be strictly observed.

Symbols used



ATTENTION

Indicates danger of damaging the power drive or other system components, with a potential consequential danger of injuries.

DANGER

Indicates an immediate hazard for persons.



DANGER

Shock hazard due to high voltage on component.



DANGER

Hazard due to high temperatures on component.



ATTENTION

ESD warning (Electro-Static Discharge). The PC board or component may only be touched in an electrostatically protected environment.



NOTE

Important or additional information on the power drive or on the documentation.

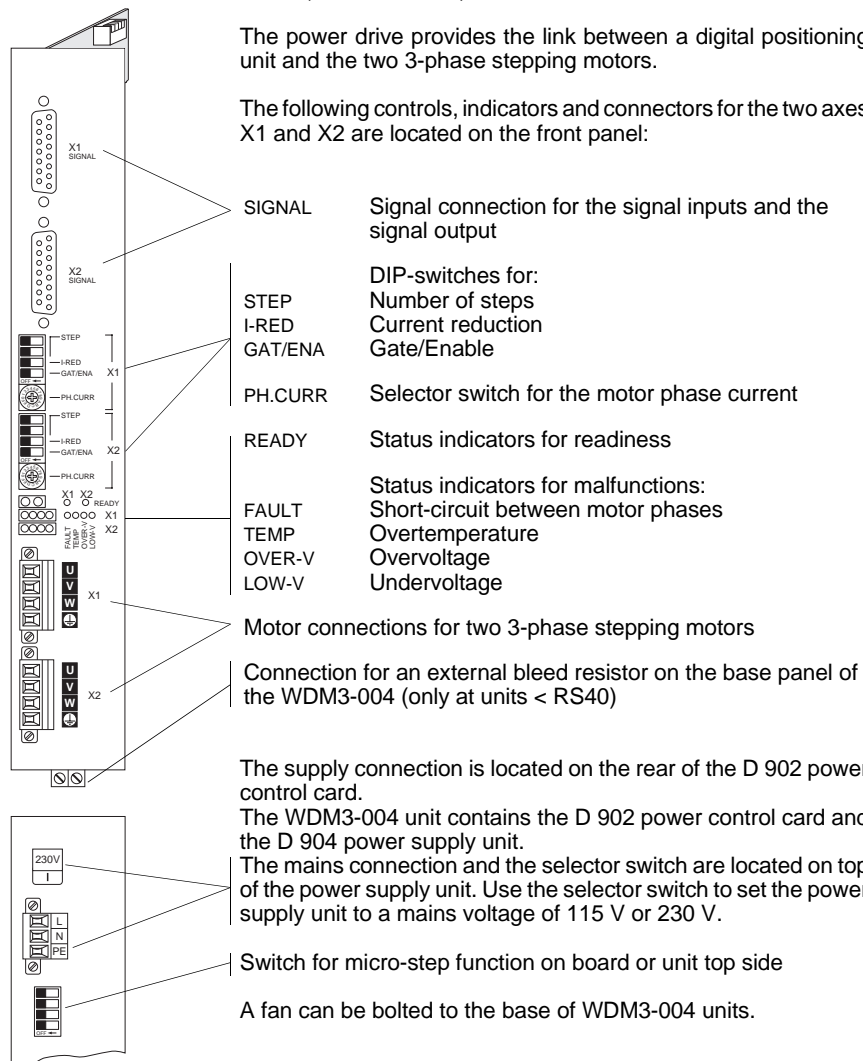
General description

Structure and characteristics

Purpose The D 902 or WDM3-004 power drives can be used for controlling two BERGER LAHR 3-phase stepping motors of type size 90, 325 V (VRDM 39...LW).

The power drive provides the link between a digital positioning unit and the two 3-phase stepping motors.

The following controls, indicators and connectors for the two axes X1 and X2 are located on the front panel:



English

General description

<i>Input signals</i>	The power drive (fig. 1) is controlled using the signal inputs for pulse, direction, gate/enable, PWM current control and micro-step.
<i>Card and unit variants</i>	The following card and unit variants are available: <ul style="list-style-type: none">– D 902.00 and WDM3-004.0 for 24 V signal voltage– D 902.01 and WDM3-004.1 for 5 V signal voltage
<i>Phase current</i>	The phase current can be adjusted from 0.6 A to 2.5 A using a selector switch.
<i>Number of steps</i> <i>Current reduction</i>	The DIP-switches can be used for adjusting the number of steps (200 to 10000 steps per revolution), the current reduction (reduction of the motor current to 70% when the motor is stopped) and the gate or enable functions.
<i>Gate/Enable</i>	
<i>Micro-step</i>	The micro-step function is adjusted using the micro-step switch or the micro-step signal input; it enables you to use a 10 times higher resolution, or number of steps (10 x 200, 10 x 400, 10 x 500 or 10 x 1000).
<i>LEDs</i>	Status indicators (LEDs) indicate operating states and any malfunctions.
<i>Power supply unit</i>	An external power supply unit is required to supply the D 902 power control card with the 325 VDC supply voltage. WDM3-004 units can be operated directly from the mains supply. Move the selector switch on the D 904 power supply unit to the specific mains voltage used in your country (115 V or 230 V). The power supply unit must have external fuse protection. The fan must be supplied from an external 24 V power supply unit.
<i>Installation in 19" rack unit</i>	The D 902 power control card has been designed for installation into a 19" standard rack housing (6 HU).
<i>Wall mounting</i>	The WDM3-004 unit has been designed for wall mounting in a switch cabinet.

General description

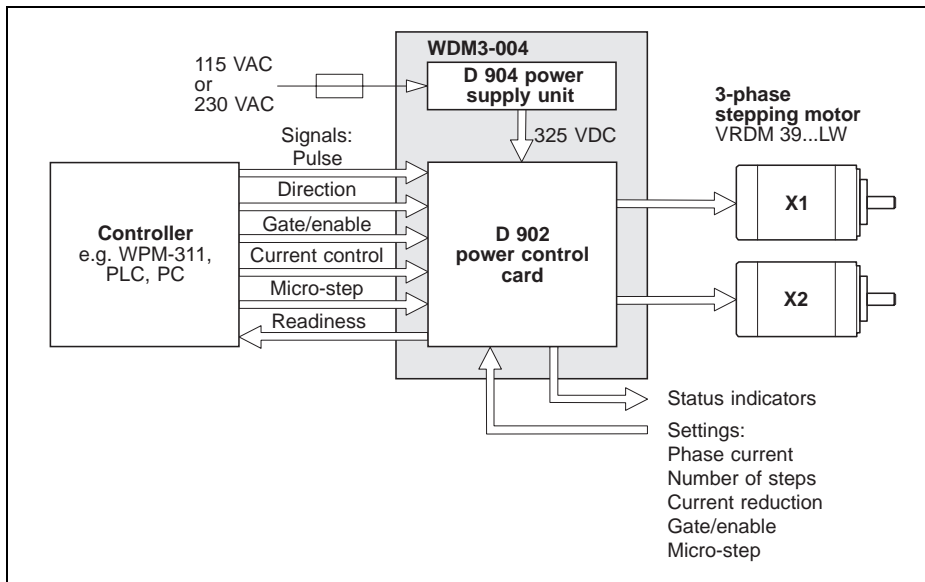


Fig. 1 Drive system

Functions The block diagram (fig. 2) shows the principal function blocks of the power drive for one axis.

Signal inputs and outputs The input signals (pulse, direction, gate/enable, current control and micro-step) are opto-isolated between the external controller and the internal electronic circuits. Readiness of the power drive is indicated by a relay contact and an LED during normal operation.

Status indicators Five status indicators each give readiness and malfunction information for an axis.

DIP-switches DIP-switches are used for setting the number of steps, current reduction and gate/enable.

Micro-step The micro-step function can be activated via the micro-step switch or via the micro-step signal input. The micro-step function can be used for achieving a 10 times higher number of steps (10 x 200, 10 x 400, 10 x 500 or 10 x 1000).

Selector switch The selector switch is used for setting the motor phase current.

General description

Power supply unit The D 902 card must be supplied with 325 VDC power from an external power supply unit. In WDM3-004 units, the D 904 power supply unit is installed.

The chopper-type power supply generates several internal electronic operating voltages (+5 V, +15 V and -15 V) from the 325 VDC input power. Additionally, the 325 VDC power is required for supplying the power amplifiers.

Bleed resistor A bleed resistor is fitted in order to dissipate large braking energies. The dissipating capacity can be increased by means of one or more external bleed resistors connected in parallel (only at units < RS40).

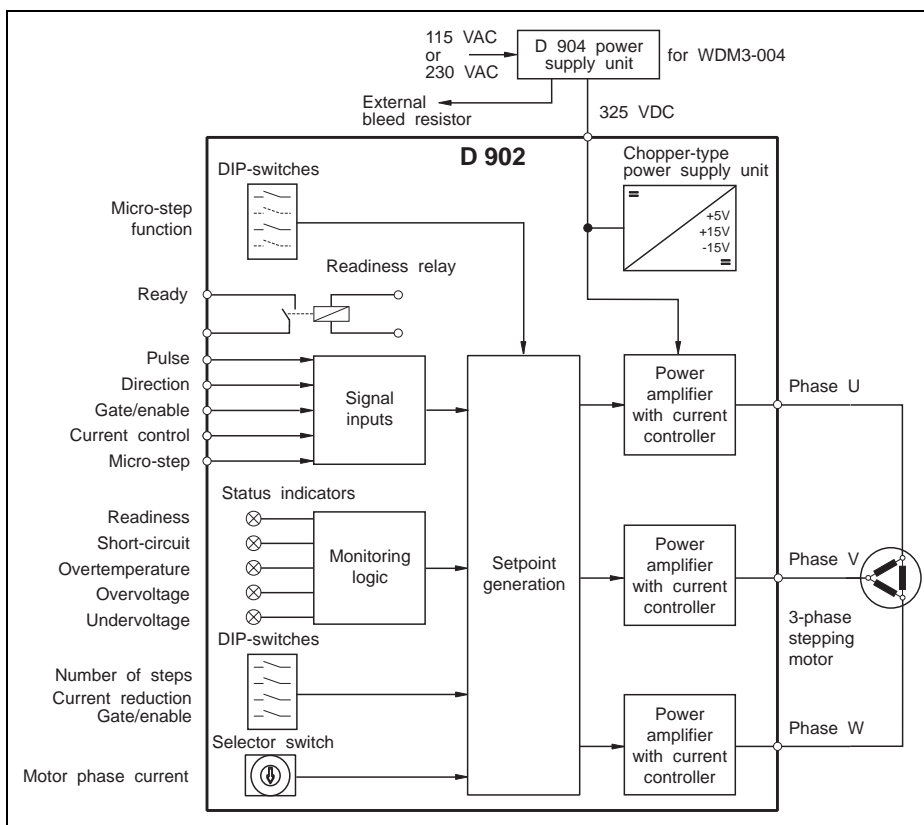


Fig. 2 Block diagram for controlling one axis

Technical data

Electrical data

<i>WDM3-004 supply</i>	Supply voltage, selectable	115 VAC 230 VAC to 240 VAC
	Mains frequency	50 Hz to 60 Hz
	Mains error protection	one period
	Rated power consumption	5.5 A at 115 VAC 3.0 A at 230 VAC
	Maximum power loss	60 W
	Starting current	maximum 70 A
	Leakage current (IEC60990)	Motor cable <5m : <10mA Motor cable 5-50m : <50mA
	External fuse ("K" characteristic)	6 A at 230 VAC 10 A at 115 VAC



NOTE

The devices may only be operated with fuse protection as specified above.

If necessary, use r.c.c.b. protection according to DIN VDE 0664, part 1/10.85.

<i>D 902 supply</i>	Supply voltage	260 VDC to 374 VDC
	Power consumption D 902	maximum 4.0 A
	Supply cable Length	0.5 m max.; twisted
<i>Motor connection</i>	Phase current	0.6 A to 2.5 A
	Motor voltage	3 x 325 VDC (connected to mains)
	Motor cable (observe EN 60204 standard)	
	Length	maximum 50 m
	Cross-section	0.75 mm ² at cable length ≤ 30 m ≥ 1.5 mm ² at cable length > 30 m
Shield connection	On both ends	

English

Technical data

Signal connection Signal inputs: Pulse, direction, gate/enable, current control, micro-step; opto-isolated, polarity reversal protection.

D 902.01, WDM3-004.1

Voltage control:

$U_{\text{high, min}}$ = 2.5 V*
 $U_{\text{high, max}}$ = 5.25 V*
 $U_{\text{low, max}}$ = 0.4 V
 $U_{\text{low, min}}$ = -5.25 V
 I_{max} = 30 mA

Current control:

$I_{\text{high, min}}$ = 7 mA
 $I_{\text{high, max}}$ = 25 mA
 $I_{\text{low, max}}$ = 0.2 mA
 $I_{\text{low, min}}$ = -25 mA
 U_{max} = 5.25 V

Input resistance = 150 ohms

D 902.00, WDM3-004.0

Voltage control:

$U_{\text{high, min}}$ = 20 V
 $U_{\text{high, max}}$ = 30 V
 $U_{\text{low, max}}$ = 3 V
 $U_{\text{low, min}}$ = -3 V
 I_{max} = 20 mA

Current control:

$I_{\text{high, min}}$ = 7 mA
 $I_{\text{high, max}}$ = 15 mA
 $I_{\text{low, max}}$ = 0.2 mA
 $I_{\text{low, min}}$ = -15 mA
 U_{max} = 30 V

Input resistance = 2000 ohms

* Pulse signal voltage 3.5 V to 5.25 V for pulse length/pulse interval < 10 μ s

Number of steps, adjustable in steps per revolution

Standard 200, 400, 500, 1000
Micro-step 2000, 4000, 5000, 10000

Pulse rate maximum 200 kHz

Signal output Readiness
Relay contact 36 VDC, 10 mA to 200 mA;
load resistance



DANGER

All signal inputs and outputs must be definitely isolated from the mains. The maximum voltage of the signal inputs towards ground must not exceed 60 VDC or 25 VAC.



NOTE

The 24 V voltage supply must meet the specifications of the DIN standard VDE 0160 on safety extra-low voltage.



NOTE

The signal connections meet the PELV (Protected Extra Low Voltage) specifications according to the DIN VDE 0160 standard.

Technical data

<i>Device protection</i>	Protection and monitoring circuits: Overtemperature, short-circuit between motor leads (no ground fault protection), under-voltage and overvoltage
	Type of protection
	D 902 IP 00 acc. to EN 60529: 1991
	WDM3-004 IP 20 acc. to EN 60529: 1991
Mechanical data	Dimensions
	D 902 233 x 160 x 51 mm
	(double eurocard format)
	WDM3-004 249 x 240 x 52 mm
	Weight
	D 902 approx. 1200 g
	WDM3-004 approx. 3400 g
Ambient conditions	Ambient temperature 0°C to +50°C
	Storage temperature -25°C to +70°C
	Relative humidity 15% to 85% (non-condensing)
Regulations	
<i>Machinery directive</i>	Insofar as the machinery corresponds to the machinery directive 89/392/EEC and the configuration meets the EMC test requirements specified by BERGER LAHR, conformity with the machinery directive is hereby certified.
<i>EMC directive</i>	If the EMC test requirements listed below and specified by BERGER LAHR are fulfilled, conformity with the following standards can be certified in accordance with the EMC directive 89/336/EEC:
	Radio interference suppression according to EN 50081-2: 1993
	Static discharge according to EN 60801-2: 1993, class 3
	Burst according to IEC 801-4: 1988, class 4
BERGER LAHR EMC test requirements	<ul style="list-style-type: none">– Use motor leads supplied by BERGER LAHR. Motor lead length is 10 m.– Insert a BERGER LAHR mains filter into the mains supply line.– Install the unit in a switch cabinet.– Use BERGER LAHR signal cables and wire them in accordance with the documentation.– Run signal, mains and motor cables separately (non-parallel) and ensure that the cable shield is connected to ground on a large surface area on both cable ends.– Install the mains filter directly at the unit. If this is not possible, use a shielded connection cable (1 m max.) between the filter and the unit.– Ensure that the filter and the unit are connected to ground on a large surface area (install on grounded metal plate or switch cabinet rear wall, or use a ground strap).

English

Technical data

Low-voltage equipment directive

Pursuant to the low-voltage equipment directive 73/23/EEC, the products are in conformity with the following standards:

Protection class 1 acc. to prEN 50178: 1994

Overvoltage Category III acc. to prEN 50178: 1994

Contamination Grade 2 acc. to prEN 50178: 1994



NOTE

The statements of conformity mentioned above refer to the stand-alone units.

Cards are components. Conformity with the EMC directive and the low-voltage equipment directive must be established by additional means such as mains filters, covers, etc. This is a prerequisite for conformity with the machinery directive.

Approvals

prEN 50178 classification VDE 0160/11.94

EN 60950 classification VDE 0805: 1993 + A2: 1994

UL 508 file no. 153 659

Installation

Scope of supply The package includes:

Qty.	Designation
1	D 902 power control card or WDM3-004 unit
1	Product insert
1	Ground strap for WDM3-004
1	Fan for WDM3-004
4	Mounting brackets for WDM3-004

The following variants are available, depending on the signal voltage:

Signal voltage	24 V	5 V
Power control card	D 902.00	D 902.01
Unit	WDM3-004.0	WDM3-004.1

English

Accessories The following accessories are optionally available:

Designation	Order number
Motor cable 3 x 1.5/2 x 1.0 mm ²	See power drive sales documentation
Motor cable 3 x 2.5/2 x 1.5 mm ²	
Mains filter	
Signal cable for pulse/direction	
Set of connectors for D 902	
Set of connectors for WDM3-004	
3-phase stepping motor VRDM 39...LW	



NOTE

A motor cable with a small cross-section may cause a torque loss at high speeds.

Installation

Installation



ATTENTION

The power control card may only be unpacked and installed in an electrostatically protected environment.



DANGER

The supply voltage must be disconnected whenever assembly work is carried out.



NOTE

If the power drive is installed without ventilation, maintain a minimum clearance of 10 cm above, below and to the sides of the drive. Leave 15 cm free in front of the unit to give room for fitting the cable connections.

The D 902 power control card (fig. 3) is designed for installation in a 19" standard rack housing (6 HU).

The WDM3-004 unit (fig. 4) has been designed for wall mounting in a vertical position in a switch cabinet. You can use the mounting brackets to fit the unit to the back or left-hand side of the cabinet. If the unit is fitted on the left-hand side, spacers with a thickness of 2.5 mm must be inserted.

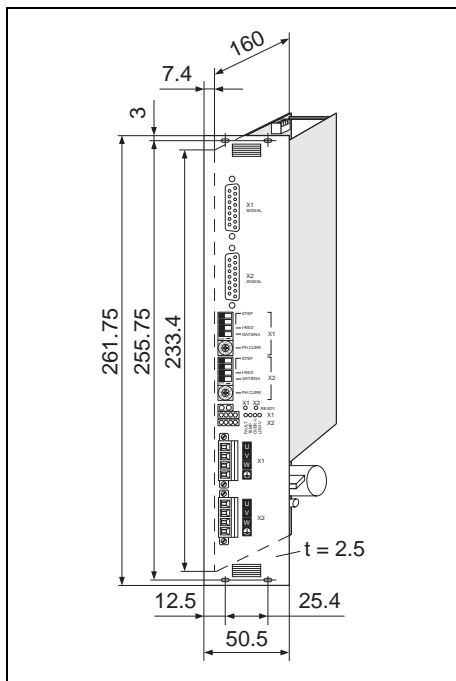


Fig. 3 Installation drawing for D 902 card

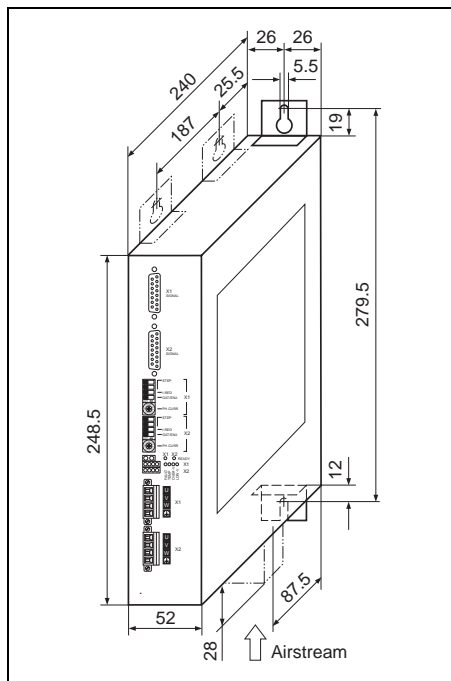


Fig. 4 Installation drawing for WDM3-004 unit

Installation

Ground strap Fasten the ground strap supplied to the bottom of the unit with M4 bolts (8 mm max.) in front of the bleed resistor connection and connect it to a grounded part of the switch cabinet.

Ventilation D 902 and WDM3-004 power drives can be operated without active ventilation, provided that the minimum clearances (10 cm) are observed and the ambient temperature does not exceed 50°C.

If the overtemperature LED "TEMP" lights up repeatedly, ventilation is required. The airstream in a ventilated 19" standard rack housing should be 1 m/s.

Fan for WDM3-004 The fan on the WDM3-004 unit must be mounted at the bottom. The airstream must pass through the unit from bottom to top (see fig. 3). The arrow on the fan indicates the direction of the airstream if the fan is connected correctly.

Fasten the fan with four screws at the bottom of the unit after having cut out the grille.

Connect the fan to the external 24 VDC voltage supply:

red	24VDC
black	24VGND

Wiring



DANGER

The supply voltage must be disconnected whenever wiring work is carried out.

The motor connection and the bleed resistor connection are linked to the supply connection (325 V).



ATTENTION

Run motor and signal cables separately and shield them on both ends.

Free, unassigned pins must not be wired.

The power drive must have external fuse protection (see Technical data).

Good heat dissipation must be ensured when installing a bleed resistor (accessory).

Installation

Wire the power drive as shown in fig. 5.



ATTENTION

Ensure that the mains and motor connectors are correctly inserted on the card or unit, and that their screws are fastened properly.



NOTE

An overvoltage fault may occur during dissipation of large braking energies if the capacitor's rating is insufficient (LED "OVER-V" lights up).

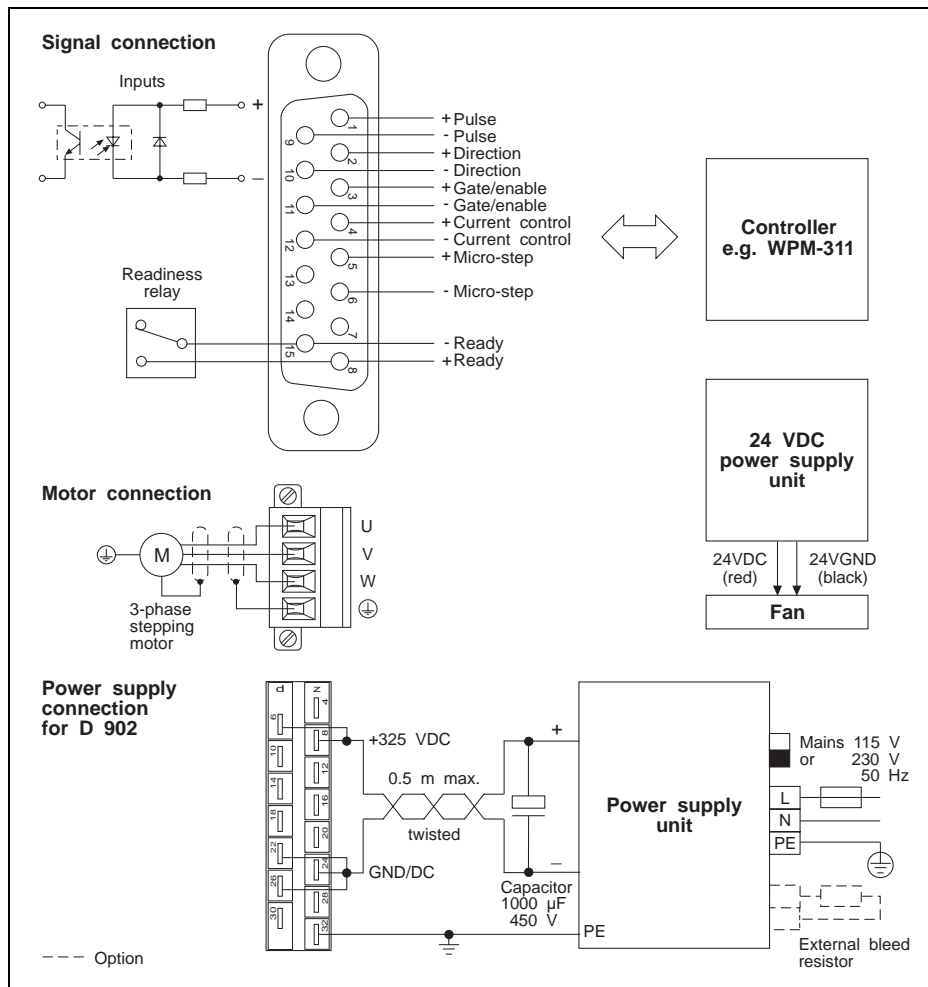


Fig. 5 Wiring

Motor connection

1. Release the two screws and remove the connector X1 or X2 (fig. 6-2) from the unit.
2. Preparation the motor cables (fig.6-1), an mount wire end ferrules on the device end of the motor cable.
3. Fasten the litz wires with screws.
4. Fasten the connector to the front panel (item X1 or X2).

Preparation the motor cable

The motor cables must be prepared as shown below.

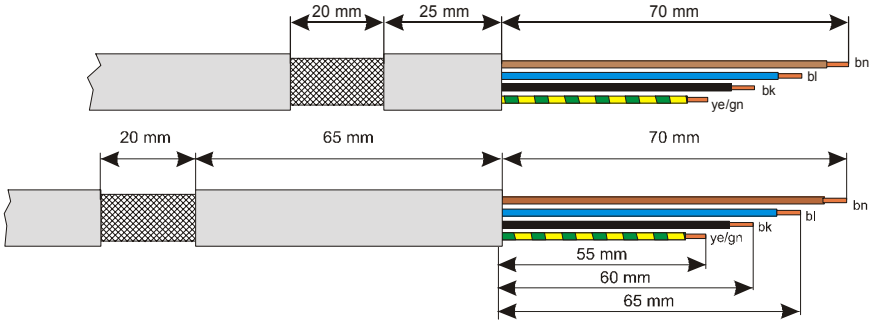


Bild 6-1 Preparation the motor cables

Motor connection X1 and X2

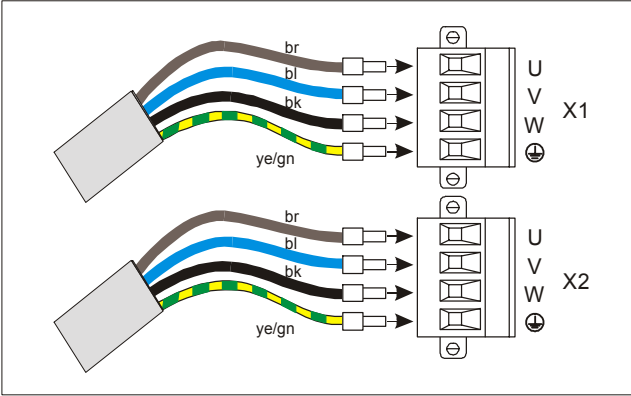


Bild 6-2 Motor connection

English

Installation



NOTE

The sense of rotation of the motor can be inverted by interchanging two motor leads. In this case, also the limit switch inputs LIMP and LIMN as well as the A und A signals of any rotation monitoring encoder connected must be interchanged.



ATTENTION

Connect the shield of the motor cable after the following assembly instruction!

Installing the motor cable

The following items required for installing the motor cable on the side of the device are included in the accessory bag:

Qty.	Designation
1	Terminal angle
2	Shield terminal
1	Screw M4 x 8
2	Screw M3 x 8 with serrated washer
1	Serrated washer M4

Installing the terminal angle

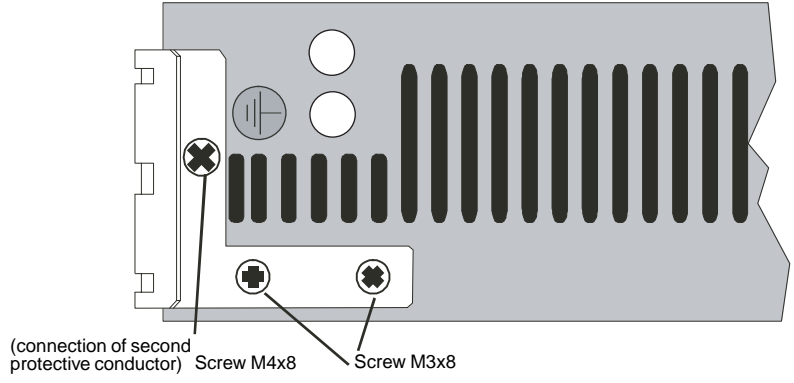


DANGER

*Electric shock from high voltage!
If longer screws are used, they may contact live parts.
This may result in fatal injury.*

The terminal angle is fastened to the bottom of the device with the screws and serrated washers supplied with the device. Correct installation of the terminal angle is extremely important for grounding the motor cable shield and for strain relief.

Installation



English

Fig. 6-3 Installing the terminal angle



DANGER
Electrical device with higher deflection current > 3,5mA. Connection of a second protective conductor absolutely necessary. Please note minimum cross-section according to IEC 60364-5-54.

Fastening the shield terminal

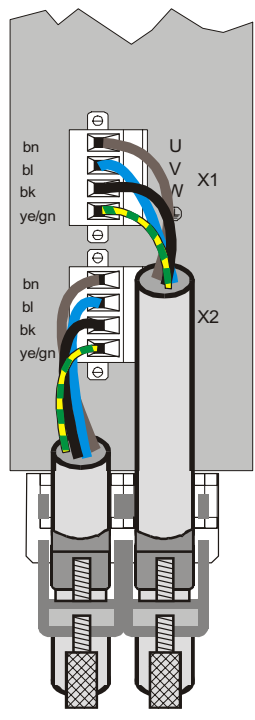


Fig. 6-4 Fastening the shield terminal

Installation

The shield angle is suspended on the bracket from below. The motor cable is not subject to strain and securely grounds shield when installed in this way.

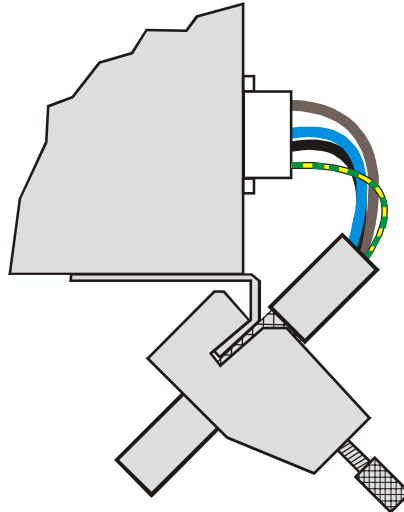


Fig. 6-5 Installed motor cable

Installation

Setup The following adjustments are equally valid for both axes X1 and X2 and must be made before switching on the supply voltage.



1. Set the mains voltage to 115 V or 230 V on the power supply unit.



ATTENTION

The setting must correspond to the actual mains voltage available.



DANGER!

Electrical shock from high voltage!

Observe safety instructions for work on electrical equipment.

Disconnect voltage from device before setting the switch.



PH.CURR

2. Set the motor phase current on the selector switch "PH.CURR" in accordance with the motor type plate.

Position	Phase current [A]
0*	0.6
1	0.8
2	0.9
3	1.0
4	1.1
5	1.3
6	1.4
7	1.5
8	1.6
9	1.8
A	1.9
B	2.0
C	2.1
D	2.3
E	2.4
F	2.5

* Factory setting



ATTENTION

The set phase current must be equal to or less than the nominal phase current specified on the motor type plate (the lower the set phase current, the lower the motor torque).

English

Installation

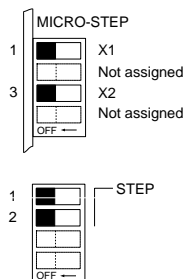


DANGER!
Electrical shock from high voltage!
Observe safety instructions for work on electrical equipment.
Disconnect voltage from device before setting the switch.

- Set the number of steps for one axis using the DIP-switches "STEP" and "MICRO-STEP" or via the micro-step signal input.

Assignment of the micro-step switch on card or unit top:
 Switch 1 for axis X1
 Switch 3 for axis X2

The number of steps for axis X1 or X2 can be taken from the following table:

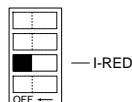


Micro-step Switch = OFF* Signal = 0	Micro-step Switch = ON Signal = 0	STEP switch 1	STEP switch 2
Switch = ON Signal = 1	Switch = OFF Signal = 1		
200	2000	ON	OFF
400	4000	ON	ON
500	5000	OFF	ON
1000*	10000	OFF*	OFF*

Signal input 0 = deenergized, 1 = energized

* Factory setting

- Set the current reduction using the DIP-switch "I-RED".



Current reduction	"I-RED"
On (active)	OFF*
Off (inactive)	ON

* Factory setting

- Set the function of the gate/enable signal input on the DIP-switch "GAT/ENA".



Function selection	"GAT/ENA"
Enable	OFF*
Gate	ON

* Factory setting

- Connect the supply voltage.
 If the unit is operating properly, or the power drive has been enabled, the LED "READY" lights up and the readiness relay is activated after switching on.



ATTENTION
 Before disconnecting the supply voltage, ensure that any vertical axis loads are prevented from falling down (e.g. use motor with brake).

Signal inputs
Pulse Square-wave pulses must be fed to the pulse input to set the motor shaft into rotation. Each positive pulse edge makes the motor move by one step when the gate input is deenergized. The sense of rotation is preset by the direction input. The number of steps is set using the two DIP-switches "STEP".

Direction If the signal input is deenergized, the motor turns in a clockwise direction as seen from the front towards the motor shaft (default). If the signal input is energized, the motor turns in a counterclockwise direction. The sense of rotation can be inverted by interchanging two motor phase leads.

Gate If the "GAT/ENA" DIP-switch is set to "ON" (gate function), any active pulses are disabled when the signal input is energized. In a multi-axis system, this function can be used for selecting individual axes.

English

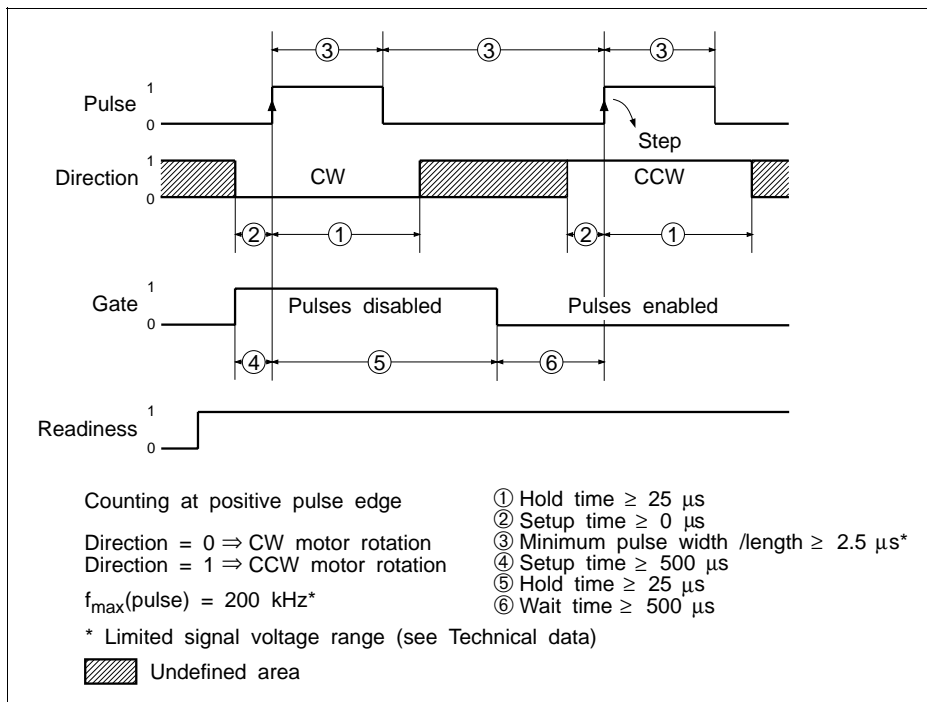


Fig. 6 Timing diagram

Operation

Enable If the "GAT/ENA" DIP-switch is set to "OFF" (enable function), the power drive is ready to operate when the signal input is energized; LED "READY" lights up after approx. 100 ms and the readiness relay contact is closed. If the enable input is deenergized, the "OVER-V" and "LOW-V" LEDs light up and the readiness relay contact is open (the internal ring counter for setpoint generation is reset). The input can be used for resetting error messages.

Micro-step The micro-step function can be selected using the micro-step signal input or the micro-step switch (see page 14). The timing of the micro-step signal input corresponds to the timing of the gate signal input (see fig. 6).

Number of steps	Micro-step signal input	Micro-Step switch
Standard	energized	ON
	deenergized	OFF
Micro-step	energized	OFF
	deenergized	ON

PWM current control The level of the motor phase current can be modified in the range from 0% to 100% using the pulse width modulated PWM signal (frequency range 10 kHz to 20 kHz). The set phase current flows when the signal input is deenergized. The motor phase current is switched off when the signal input is energized. The stationary motor then has no holding torque.



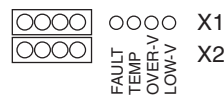
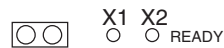
NOTE

If PWM current control is used, the enable function should be used at the same time. Otherwise, the full motor phase current will flow if the signal cable is not connected.

Signal output
Readiness When the power drive is operating properly, or enabled, the readiness relay contact is closed and the "READY" LED lights.

Malfunctions

Status indicators The ten LEDs on the power drive indicate operating states and any malfunctions for each of the two axes.



READY	Lights up when the power drive is operating properly (readiness signal is sent via signal connector). The supply voltage is in the rated range; see Technical data.
FAULT	Lights up in case of a short-circuit between two motor phase leads.
TEMP	Lights up in case of overtemperature (> 75°C) at the heat sink.
OVER-V	Lights up in case of overvoltage (> 410 V).
LOW-V	Lights up in case of undervoltage (< 200 V).
OVER-V and LOW-V	Light up if the enable input is inactive.
FAULT, TEMP, OVER-V and LOW-V	Light up in case of excessive pulse frequency or if interference pulses occur.



ATTENTION

If a malfunction occurs (LED "FAULT" to LED "LOW-V"), the motor is deenergized and the power drive status changes to "Not ready" (LED "READY" goes out). When the motor is deenergized, it does not have any holding torque. This may lead to undesirable effects.



NOTE

The fault condition can be cleared after eliminating the cause of the fault by switching the supply voltage off and on again or by deenergizing and reenergizing the enable input.

English

Malfunctions

Other malfunctions The following table lists possible malfunctions which are not indicated.

Malfunction	Cause	Rectification
No LED lights	Supply voltage not available	Check supply voltage
	Supply voltage not properly connected	Connect supply voltage properly
Motor does not turn and does not have a holding torque	Current control signal input active	Deactivate the signal input
	Enable signal input not active	
	Motor incorrectly wired	Wire motor properly
Motor does not turn but does have a holding torque	Gate signal input active	Deactivate the signal input
	Pulse signal input	Adjust timing and voltage level
Motor turns irregularly	Pulse and direction signal inputs	Adjust timing and voltage level
	Overload	Check load conditions
	Motor defective	Replace motor
Motor turns in wrong direction	Motor phase leads inverted	Connect motor phase leads properly
	Direction signal input incorrectly set	Ensure correct sense of rotation
Motor torque too low	Motor phase current incorrectly set	Adjust phase current