DAC Servo System
DAM 60/61
Installation Manual

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IMPORTANT USER INFORMATION

This document has been prepared in order to be used by OSAI. It describes the latest release of the product.
OSAI reserves the right to modify and improve the product described by this document at any time and without prior notice.
Actual application of this product is up to the user. In no event will OSAI be responsible or liable for indirect or consequential damages that may result from installation or use of the equipment described in this text.

INTRODUCTION

This manual provides the necessary information for the normal operation of the products described. The converters may be used, maintained and repaired only by those familiar with the operations manual and the work safety and accident prevention rules. The devices are built based on advanced technologies and designed to avoid accidents during operations. If the precautions described under the safety information are maintained, there will be no risk of injuries to people during installation and putting into service.

Start-up is forbidden, as long as the conformity of the machine, in which the above-mentioned devices are to be incorporated, with the EEC machine directives has not been verified.
The present technical specifications replace and cancel the previous one. In order to guarantee the best possible service, we reserve the right to change the information without prior notice.

ACRONYMS

AC	Alternate current
AM	Asynchronous motor
DAM	Power unit of the DAC converter
DC	Direct current
DIN	German Standardisation Office (Deutsches Institut für Normung e.V.)
EMC	Electromagnetic compatibility
EN	European Norm
HS	Main switch
IPM	Intelligent power module
MSL	Mean sea level
PE	Protection earth
PELV	Protective Extra Low Voltage, under 42 V with safe separation and grounding (EN50178)
SELV	Safety Extra Low Voltage under 42 V with safe separation
SM	Synchronous motor
ZK	Intermediate circuit
E.L.C.B.	Earth leakage current breaker

END OF PREFACE

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SAFETY INFORMATION

PRELIMINARY REMARKS

The working principles of the power converter and the motor induce earth leakage currents during operations, which can be dissipated via protective grounding. They may cause an earth leakage current breaker to intervene too early.

In case of a short-circuit to frame or to ground, the leakage current may contain a high portion of direct current which makes triggering a current-operated earth leakage current breaker more difficult or totally impossible. This means that it is prohibited to connect the power converter to the mains using only one earth leakage current breaker (preliminary standard EN 50178/VDE 0160/11.94, Sections 5.2.11 and 5.3.2.1).

The drives have to be installed in switching cabinets fulfilling the minimum protection requirements of the preliminary standard EN 50178/VDE 0160/11.94, Section 5.2.4 in order to protect against direct contact.

The plastic pieces covering the equipment connection act as additional guards preventing accidental contact during putting into service and during occasional use of the control elements close to the drive (DIN VDE 0106 Part 100, Accident Prevention Regulation VBG4 "Electrical Systems and Equipment").

At routine testing of this equipment, a high-voltage test is carried out that conforms with preliminary standard EN 50178/VDE 0160/11.94, Section. 9.4.5.

The protective measures and safety regulations according to DIN/VDE are mandatory personal safety.

Neglecting to fit PE connections on the equipment or the motor can cause serious injury to people and/or considerable damage.

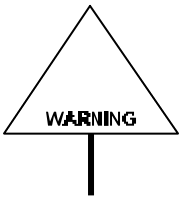
The equipment may only be run on mains with a ground conductor.

The sections under current take more than one minute to discharge.

GENERAL INFORMATION

These operating instructions contain all the information necessary for correct operation of the products described. The document is intended for specially trained, technically qualified personnel who are well-versed in all safety standards and putting into service.

The equipment/system is manufactured using state-of-the-art technology and is absolutely safe to operate. It can safely be installed and put into service without problems if the safety information in this manual below is followed.

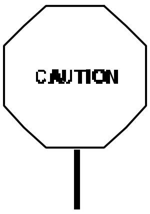


When operating electrical equipment, some parts of the equipment always carry dangerous voltages.
Ignoring these safety instructions and warnings may cause serious injuries and/or damage.
Only qualified personnel familiar with the safety standards, assembly, operation and maintenance instructions may carry out work on this equipment.

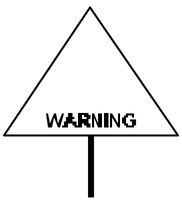
Danger Information

On the one hand, the information below is for your own personal safety and on the other to prevent damage to the described products or to other connected equipment.

In the context of the operating instructions and the product information, the terms used have the following meaning:



This symbol indicates that not observing the instructions will cause damage to the equipment and injuries to the operator.



This symbol warns of facts or circumstances which can cause damage to the equipment and injuries to the operator.

NOTE This draws your attention to important information about the product, handling of the product or refers to a particular section of the documentation.

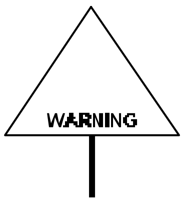
Qualified Personnel

In the context of the safety or product related information in this document, qualified personnel are considered to be persons who are familiar with setting up, assembling, putting into service and operating the product and who have appropriate qualifications for their activities.

They are people trained, instructed or authorised to put into service, ground and build circuits and equipment in accordance with officially recognised safety standards.

Or they are people trained or instructed to take care and operate the equipment in accordance with officially recognised safety standards.

Appropriate Use

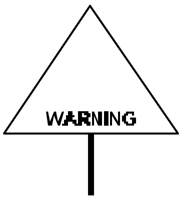


You may only use the equipment/system for the purposes specified in the operating instructions and in conjunction with the equipment and components recommended or authorised by OSAI S.p.A.

For safety reasons, you must not replace or add components.
The person responsible for the machine must immediately report any changes that occur which adversely affect the safety of the equipment/system.

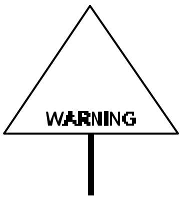
Appropriate use also requires observing the operating instructions and complying with the conditions of inspection and maintenance.

ASSEMBLY INFORMATION



Wrong lifting of the equipment can cause injuries and damages. The equipment should be lifted by qualified personnel using suitable tools.

- Install the units vertically in the electrical cabinet. If you have to install more than one unit, place them next to each other.

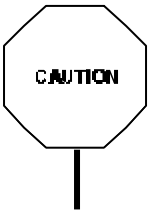


It is of absolute importance to observe the following air flow instructions Otherwise the equipment can overheat.

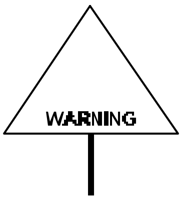
- The air flow has to go from the bottom to the top.
- Ensure that the air flow is not blocked in any way.
- Above and underneath the unit there has to be a minimum free space of:

  50 mm for DAM 60 and 80 mm for DAM 61

  and free circulation of the cooling air has to be guaranteed!
- The refrigerant temperature 50 mm underneath the equipment can be up to 45°C. If the temperature is higher (up to maximum of 55°C) the equipment power has to be reduced by 3% for every 1°C.
- Do not place other heat sources above or below the equipment.
- Avoid contamination levels 3 and 4, according to the preliminary standard EN 50178:1994 Section 5.2.15.2. The equipment is suitable for operation in closed cabinets (VDE 0558 Part 1a, Section 5.4.3.2.1 5.4.3.2.2).



The parts under tension need more than 1 minute to discharge.

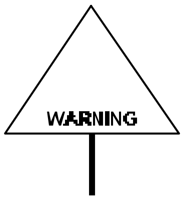


The user is responsible for assembling the above-mentioned equipment, the motor, the transformer in addition to any other equipment in accordance with the applicable safety regulations (i.e. EN, DIN, VDE). He also has to guarantee compliance with all the other national or local regulations for adjustments and protection of cables, grounding, breakers, overcurrent protection, etc.

During operation the equipment is protected against direct contact. It is therefore suitable for use in closed electrical machinery (DIN VDE 0558 Part 1/07.87, Section 5.4.3.2, preliminary standard EN 50178/VDE 0160/ 11.94, Sections 5.2.6, 5.2.7)

PUTTING INTO SERVICE

Warnings



The described equipment uses dangerously high voltages and has dangerous rotating parts (fans). Failure to observe the safety standards or warnings can cause death or grave injuries and serious damage.

The user is responsible for assembling the single power units, the motor in addition to any other equipment in accordance with the applicable safety regulations (e.g. DIN, VDE). He also has to guarantee compliance with all the other national or local regulations for adjustments and protection of cables, grounding, breakers, overcurrent protection, etc.

Most important for the protection of people are the DIN/VDE safety measures. If equipment, converter or motor are not connected to protection earth, injuries are unavoidable as the surfaces can be under dangerous voltages.

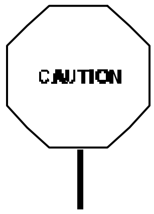
The mains and the power converter motor connectors carry a dangerous voltage also when the main switch is off.

For proceeding to putting into service ensure that the plastic covers (where present, e.g. DAM 61) for the power connections are closed.

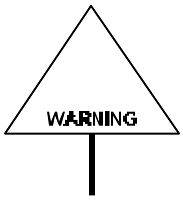
During the first start-up it is always possible that elements of the operating machine may make wrong or uncontrolled moves. Therefore take great care during this process.

Before starting the converter check carefully the functioning of all safety devices in order to prevent injuries.

Before directly or indirectly touching the motor shaft with your hands, be very careful. This is only allowed, when the shaft stands still and the converter is discharged. All exposed parts of the machine such as shafts, fans, etc. must be covered during operations.



Ensure that the key on the motor shaft cannot come out during motor rotation(e.g. during the tests on the motor bench or with detached load).



The protection against direct contact comprises all measures against the danger deriving from contact with the live parts of the electric devices. Therefore touching the live parts has to be made impossible by insulation or appropriately adjusting the protections. These are normal covers, barriers or procedures which prevent that people can come into contact with current carrying live parts.

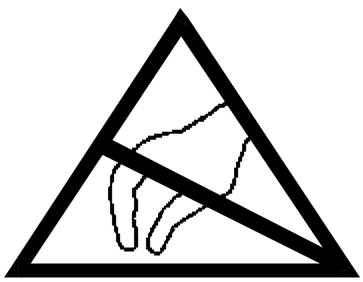
The cabinets have to be fitted with an emergency breaker to interrupt any potentially dangerous voltage. Those devices which could create an even greater danger when disabled do not belong to these breakers. The emergency switches have to be installed in places where they can be easily reached in case of danger. When operations are carried out which are more dangerous than the usual ones, a second person **has to be present**.

When the safety devices are dismounted for putting into service, repair and maintenance, make sure that the machine is taken out of service in accordance with the standards in force. At the end of the works for putting into service, repair and maintenance, the safety devices have to immediately be re-installed and tested.

NOTE:

Before touching the modules, discharge electrostatic charges from your body, in order to protect the electronic components against the high voltage stemming from electrostatic charges. The simplest method is to touch a grounded conducting object before touching these components.

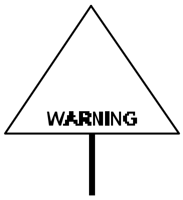
The units containing components or modules to be protected against electrostatic voltage are marked with the following label.



END OF CHAPTER

Chapter **2**

INSTALLATION STANDARDS



The described equipment uses dangerously high voltages and has dangerous rotating parts (fans). Failure to observe the safety standards or warnings can cause death or grave injuries and serious damage.

The user is responsible for assembling the single power units and the motor in addition to any other equipment in accordance with the applicable safety regulations (e.g. DIN, VDE). He also has to guarantee compliance with all the other national or local regulations for adjustments and protection of cables, grounding, breaker switches, overcurrent protection, etc.

The power cables of the converter are under voltage!

Before directly or indirectly touching the motor shaft with your hands, be very careful. This is only allowed when the controller stands still and the system is discharged. All exposed parts of the machine such as shafts, fans, etc. must be covered during operations.

The safety devices must never be disabled.

According to the applicable standards (EN 60204 Part 1 and VDE 0113 Part 1) stopping the converter by the enable inputs of the electronic control elements does not provide a safe switch-off condition. A defect in the converter’s electronic control elements can cause an accidental start of the motor.

You can only use variable speed commands in accordance with the EN specifications in force.

The intermediate circuit is under voltage!

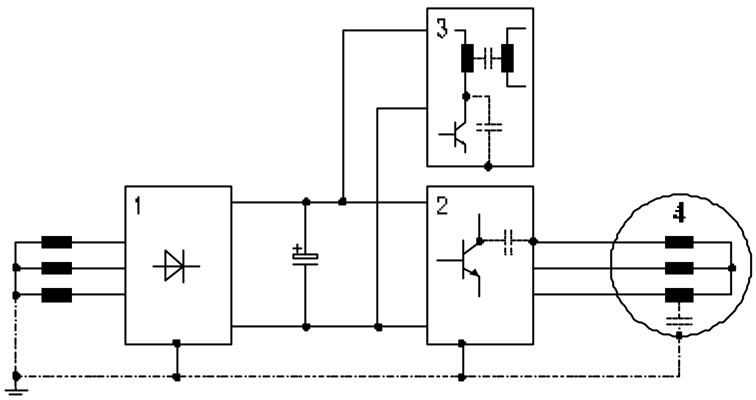
EMC INFORMATION (ELECTROMAGNETIC COMPATIBILITY)

General converter information

Modern semiconductor technologies such as IGBT aim at reducing the power loss in the converter by switching faster and so continuously reducing the power section dimensions. Therefore, if you let the converter run, you have to fulfil specific conditions in order to avoid electromagnetic effects due to the switching operations.

The disturbances can arise because of:

- capacitive earth leakage currents due to high voltage increases, when the transistors and IGBTs switch.



1 Power supply

2 Power section

3 Switching supply

4 Motor

- high currents and sudden current bursts in the motor line. The magnetic field disturbance have frequencies from a few hertz to 30 MHz. Because of the high power bursts there are additional electromagnetic fields with frequencies up to approx. 600 MHz.
- high frequency oscillators and fast logic circuits (electromagnetic fields from 16 MHz to 1 GHz).
- disturbances in the system and harmonics because of non sinusoidal switching and network loads especially from in-line switching converters (100 Hz ... 20 kHz).

EMC strongly depends on individual subassemblies and the components in the switching cabinet. As for the total cost of the machine it is preferable to localise the disturbances of the whole system rather than those of each individual component.

The information in the following pages allows you to configure your system based on the newest know-how on EMC and comply with the regulations in force.

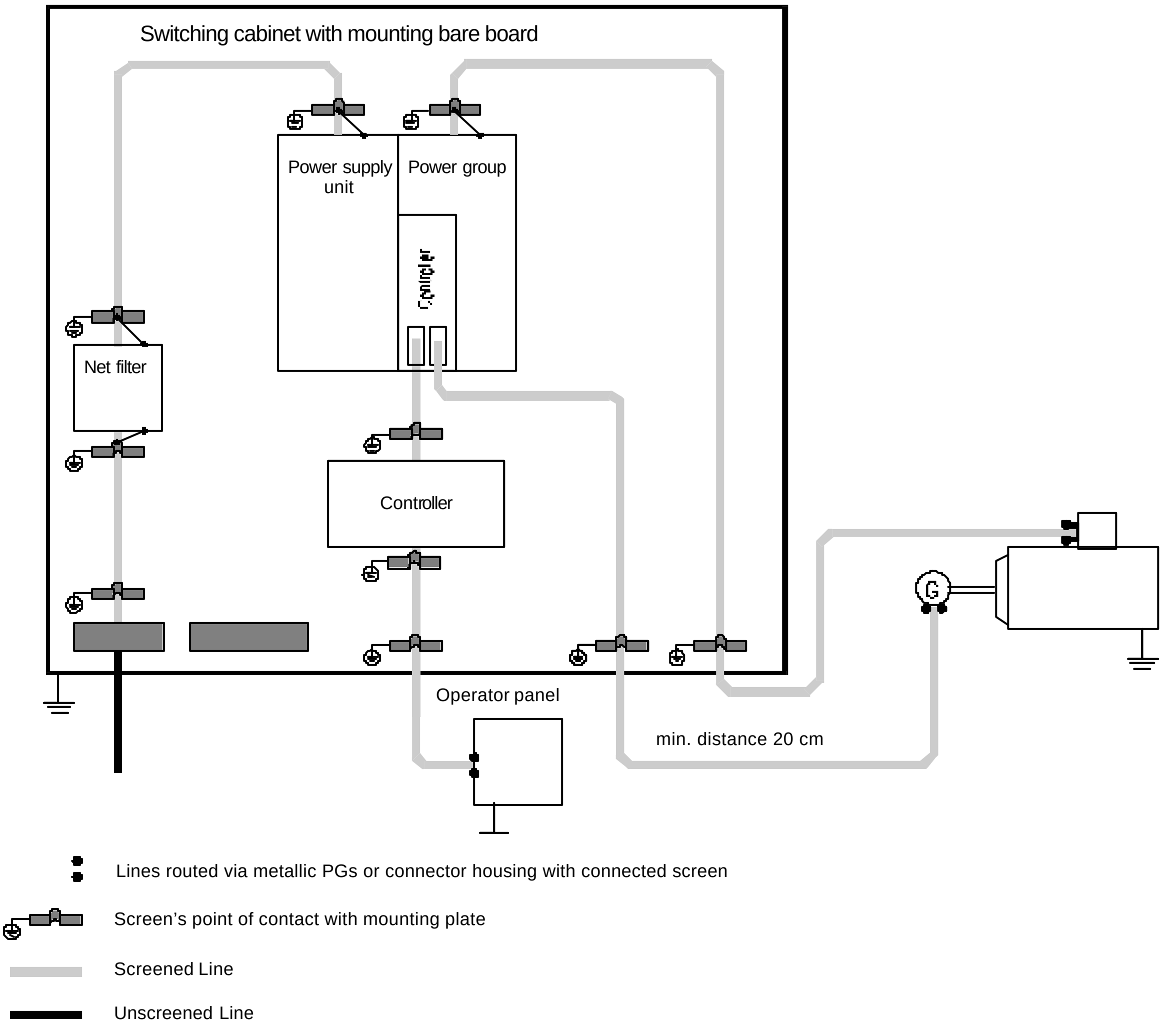
Measures for fulfilling EMC

In order to comply with EMC you have to configure the system as described in the following:

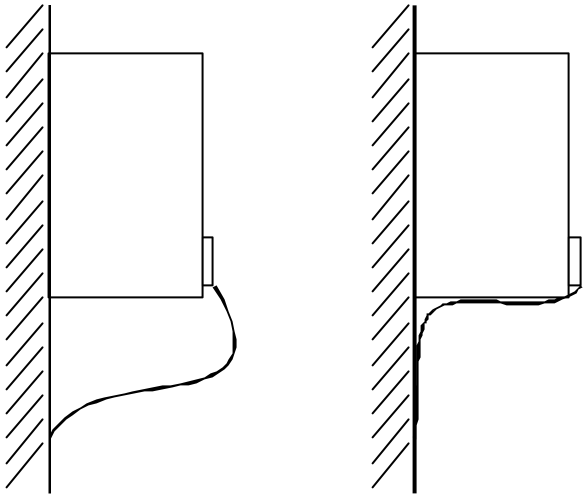
Cabling

- In order to avoid that the disturbances radiate outside the converter, **all** connection cables have to be shielded.

  Pay attention to the indications in the Section “Shielding ”



- In order to minimise the “antenna effect”, position the cable directly along the base of the metal frame.



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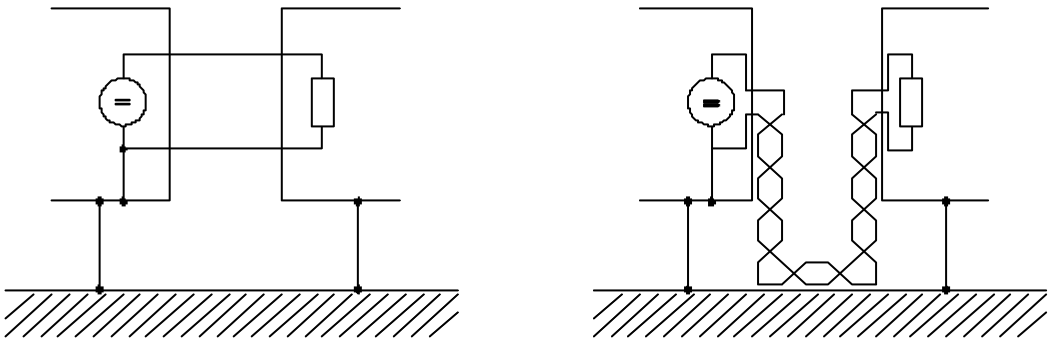
- All lines have to be positioned as near as possible to the conductors of the grounding system in order to reduce the effective area of the loop circuit for electromagnetic coupling.



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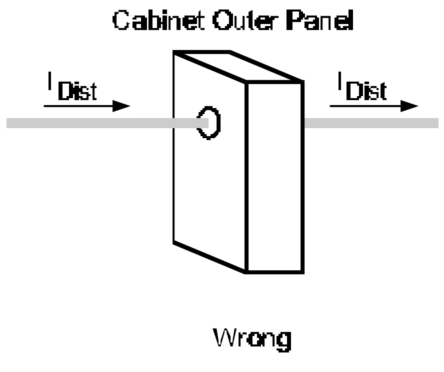
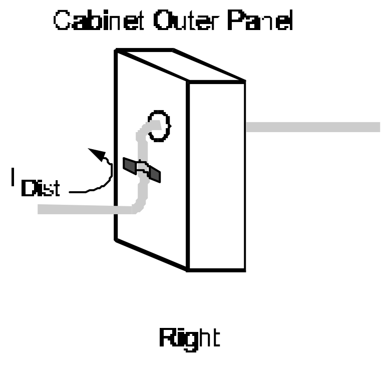
- When the signal and/or the control cables have to cross the power cables, they have to keep a distance of at least 20 cm.
- The lines with different EMC categories have to cross only at an angle of 90°.
- In case of differential signals (e.g. for differential amplifier signals for the speed value) twist the wires of each pair and also twist the wire pairs.
- The connection from the ground plate of the converter to ground should be as short as possible (less than 30 cm.). Use large cross sections (larger than 10 mm²).
- The disturbance sources such as fuses, transformers, diffusers and disturbance sensitive modules such as µPs, bus systems, etc. should be at least 20 cm away from the converter and its cables.
- Avoid spare cable coils.
- Unused cables **have** to be grounded on both ends (this creates an additional shielding effect and avoids capacitive coupling of dangerous voltages).

Grounding

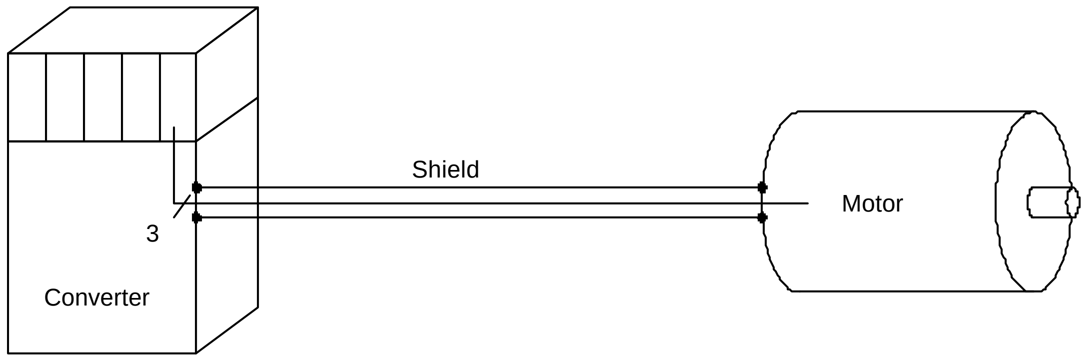
- In light of EMC, traditional star grounding is not the most suitable for reducing high frequency disturbances arising from converter operation. You can achieve better results with a reference surface which has to be connected to the earth of the device frame corresponding to an extended area (e.g. bare metal mounting plate and parts of the frame).
- If you do not have such a wide reference surface, you should install the equipotential main bus bar directly next to the converter as this device generates greater potential jumps than the other components in the switching cabinet because of the fast switching (if possible, the connection to ground should not be longer than 30 cm).
- All grounding cables and shieldings have to be as close as possible to the ground of the frame in order to minimise ground loops.
- If possible connect the controller reference potential to ground and make this connection with a cable of a cross section as large as possible and shorter than 30 cm.
- Remove insulation layers such as paint, glue, etc. from the frame's ground connections. If necessary use dented washers DIN 6798 or similar for guaranteeing permanent conductive contact. In order to avoid corrosion of the ground connections of the frame, use suitable metal combinations and protect the connection against conducting electrolytes with a protective cover (e.g. grease).
- Always connect both ends of the shieldings to the frame ground. The connection has to be attached on a large and conducting area. This is the only way to eliminate the effects of electromagnetic fields or high frequency disturbances. If ground loops present a problem, the receiving end should be connected galvanicly and the emitting ends capacitively.
- Where the cable shieldings go through panels separating areas with different EMC levels, the cables should be in contact with the panel.
- Cables crossing external panels of the shielding frames without special prevention (e.g. filters) can have a negative effect on the shielding capability of the frame. Therefore the shieldings of the cables going to the outside shielding panel of the frame have to be conductively connected at the point where the cables enter the frame.
- The distance of the last contact point of the shield from the cabinet exit has to be as short as possible.





Shielding

- The shielding against magnetic fields is effective if it is connected on both ends to the frame ground.
- In case of electric fields the shielding is effective if one end is connected to the frame ground.
- However, in case of high frequency fields both electric and magnetic (which depend on the line length) both ends of the shielding have to be connected because of their concatenation (electromagnetic field).



The connection of both ends of the shielding ensures that the conductor does not leave the "system tunnel" of the shielding.

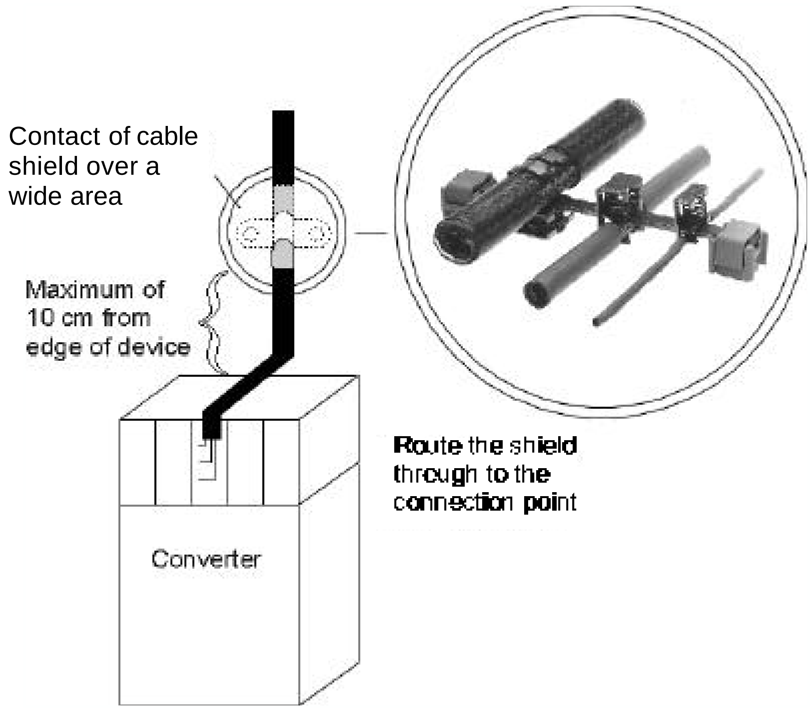
- The connection of both ends of the conductor shielding does not completely eliminate the influence of ground loops (potential differences in the grounding system of the structure). However, this is negligible if you adhere to the indications given in the Cabling and Grounding Sections.
- You can also create a capacitive RF connection of the shielding to the frame ground. This prevents the formation of low frequency interferences because of ground loops.
- The shielded cables passing through different EMC areas should not be interrupted by terminals, as this would considerably reduce the damping capacity of the shielding. The cables should be routed without interruption up to the subsequent module.
- Execute the connections with low shielding impedance and above an extended surface. Cable down-leads only 3 cm long (1 cm of wire = 10 nH) reduce the shielding effect in the megahertz range by up to 30 dB!

NOTE:
Braided shieldings should cover at least 85% of the cable surface.

The lines listed below have especially high disturbance levels:

– motor line
– external brake resistor line
– line between net filter and converter

- Indications for shielding connection:



Filtering

The converter does not need filtering for its functioning. However, under some circumstances it may be necessary to install filters in the input or output line in order to comply with the EMC standards. Drives without filtering can cause serious disturbances for other users connected to the same line be it within or outside the electric cabinet. Therefore the use of net filters is strongly recommended.

Filter Installation

- Install the filter next to the converter. If the lines are longer than 30 cm, the power line between the filter and the converter has to be shielded (on both ends connected to the frame ground).
- Create a distance of more than 30 cm between the filter input and output line.
- Create an extended connection between the filter basis and the frame ground.

Stray Currents

Because of the operation type, stray capacities in the filter, the net unit, the cables and the motor windings generate stray currents equal to or larger than 100 mA.
This means that converters with ELCB's can be incompatible!

In this respect follow the safety information in the preliminary standard EN 50178:1994 Section 5.2.11.2.

INSTALLATION STANDARDS FOR DAC DRIVES

Electric Cabinet with DAC/DSC Drives

- Shielded cables
  - Transducer cable between drive and motor (conn. X24, X25 on the drive)

    The cable is externally shielded and the wire pair inside it is twisted and shielded. The internal and external shielding are together connected to ground on both sides via the metal shell of the relative connectors. The correct assembly of the connector on the motor side is especially important as the closing of the connector has to guarantee a contact of the braiding with the metal shell of the connector on an extended surface.
  - Power cable between drive and motor (terminal strip X1 on the drive, contacts 9, 10, 11 and 12)

    Cable with three phases and ground. The shielding is connected on both ends to the ground terminal of the same cable (together with the ground wire). For the connection of the heat sensor you can use the same cable. In this case the cable has to house inside the external shielding and internally shielded twisted pair with the shielding grounded on the motor as well as on the drive side.
  - Encoder cable between drive and CNC (conn. X27 on the drive)

    The cable is externally shielded and the wire pairs inside are twisted and shielded. The external and internal shieldings are together grounded on the CNC as well as on the drive side.
  - Input/output cable between the drive and the CNC/ I/O module (conn. X26 on the drive)

    The cable is not shielded, however it contains a twisted and shielded pair bringing the reference from the CNC to the drive. The shielding is grounded on the drive as well as on the CNC side.
- Connection to ground

  The device's grounding system is connected to a grounding bar inside the panel. From this bar the ground wires go separately to each drive and are connected to terminal no. 8 of the terminal strip X1. The ground wire for the motor starts from terminal no. 9, which on the motor side is connected to the grounding bolt in the connector box.
- Grounding system

  During machine installation it has to be verified that the grounding system complies with the local regulations and has a sufficiently low impedance for discharging the disturbances caused by electromagnetic interferences.
- Input voltage

  400 Vac ± 10%, 24 Vdc ± 20%
- Net filter

  Use filters as described in the Installation Manual

END OF CHAPTER

TECHNICAL DATA

GENERAL

The drives of the DAM 60 family complement the DAC Servo System in the medium power range.

The DAM 61's are designed for higher power output.

They are structured as compact mono units including the DSV-6 controller and contain the mains power supply unit as well as the motor power unit.

The DSV-6 controller is provided for closed-loop control. This makes it possible to adapt drives to a vast range of requirements.

The internal functional modules are:

- The supply converter for generating the intermediate circuit voltage is designed as an unregulated diode bridge. To reduce the starting current inrush, the system charges the intermediate circuit capacitors via a charging resistor (an NTC thermistor).
- The IGBT motor-end inverter processes the transistor control signals, which the DSV-6 controller supplies, and provides the measuring signals for closed-loop control. The power unit has its own monitoring devices (power sectioning for automatic protection).
- DSV-6 control electronics, providing all the control functions for the power stage.

Functional Description

The units consist of three parts: the power supply on the mains site, the inverter on the motor side and the DSV-6 controller

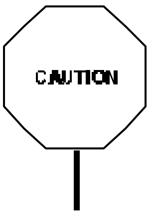
Input Current Converter

In the DAM 60, the input current converter is an unregulated rectifier with starting current load limiter.

Starting Current Load Limiter

If no adequate measures are taken the intermediate circuit capacitors lead to inadmissible high levels of starting current inrush when the mains is switched on. To avoid this, the starting current is limited by a resistance.

For this reason the DAM 60/61 has a resistor (an NTC thermistor) integrated in the intermediate circuit. This resistor limits the current inrush (except for brief mains outages) and takes on a low impedance after having charged the intermediate circuit.



As there is this charging resistor you must not connect any further capacitor to the DAM 60's intermediate circuit otherwise there is a risk to destroy the charging resistors.

Motor-side Power Module

The motor-side inverter comprises the IGBT power unit and the self-protection devices. Closed-loop control of the motor-side inverter is performed by the DSV-6 controller.

DSV-6 Controller

The motor controller designated as the DSV-6 controller is a digital solution for DAC Series drives for closed-loop motor control.

The DSV-6 controller electronics is already included in the DAM 60/61 drives.

In addition, the two VeCon circuits increase the controller’s computing power and storage capacitor. This results in a significant improvement in the device’s closed-loop control properties and quicker communications.

Closed Loop Control Functions

- Field-oriented closed-loop control for synchronous motors with resolver
- Speed control at 62.5 µs
- Position control at 62.5 µs
- Torque control at 62.5 µs
- The digital closed-loop control allows:
  - drift-free operation
  - high levels of control dynamics and rigidity across the entire speed range
  - Control range above 1:3000
- Depending on the requirements, you can operate the controller by means of
  - analog value setting inputs and digital switching inputs
  - RS232 serial port for operation, parameterization, putting into service and PC support as well as for archiving control parameter to disk.
  - serial port for positioning commands
  - SERCOS interface
  - master encoder

Inputs / Outputs

- Digital inputs (24 V):
  - enabling
  - rapid halt
  - 4 programmable control inputs
- Analog inputs:
  - 2 analog inputs (±10 V), 12 bit resolution
- Serial interfaces:
  - RS232 with a transmission rate of 9600 baud
- Digital outputs:
  - 1 relay contact message “ready for use”
  - 3 programmable control outputs
- Analog outputs:
  - 2 analog outputs (±10 V), 12 bit resolution

Communication Software

- PCBASS via PC and serial line
- WinBASS via PC and serial line
- Service channel via CNC and SERCOS interface

END OF CHAPTER

DSV-6 CONTROL MODULE

INTRODUCTION

For the DAM 60 and DAM 61 drives the DSV-6 module is an integral part of the drives. It contains all the electronics and signals for external connections and has the task to regulate current, position and speed. There is a perfectly identical basic version for the DAM60 and DAM61. The main features of this basic version are:

- command with analog signal (connector X26)
- resolution of the analog command: 12 bit
- RS 232 serial interface for access to the internal parameters (connector X23)
- programmable encoder emulation towards the CNC (connector X27)
- input for SinCos Encoder from the motor (connector X25)
- connector X24: not used

The following paragraphs provide a detailed description of the basic version.

In addition to the basic unit there are some special versions listed in the following table. As can be seen not all the options are available for the DAM 61 model. A certain option cannot be installed after delivery. This has to be specified and ordered with a separate product code.

Model ® **Option ¯**	**DAM 60**	**DAM 61**
16 bit	yes	no
Slave	yes (only 03/06 and 06/12)	no
Serial	yes	yes
SERCOS	yes	yes

Each special version derives from the basic version and retains all its features. The various options are realised by adding supplementary modules.

Below you will find the main features of the special versions compared to the basic version:

- DSV-6 with 16-bit resolution

retains all features of the basic version. The option consists in an additional 16-bit A/D converter board and its connector X37.

- DSV-6 slave

in comparison with the basic version it contains a board for connecting an incremental encoder on connector X24. The incremental encoder functions as master followed by the motor as slave in a ratio defined by parameters.

- DSV-6 with serial command

In respect to hardware and software this is identical to the basic version. However, the user can program it for point-to-point commands.

- DSV-6 with SERCOS digital interface

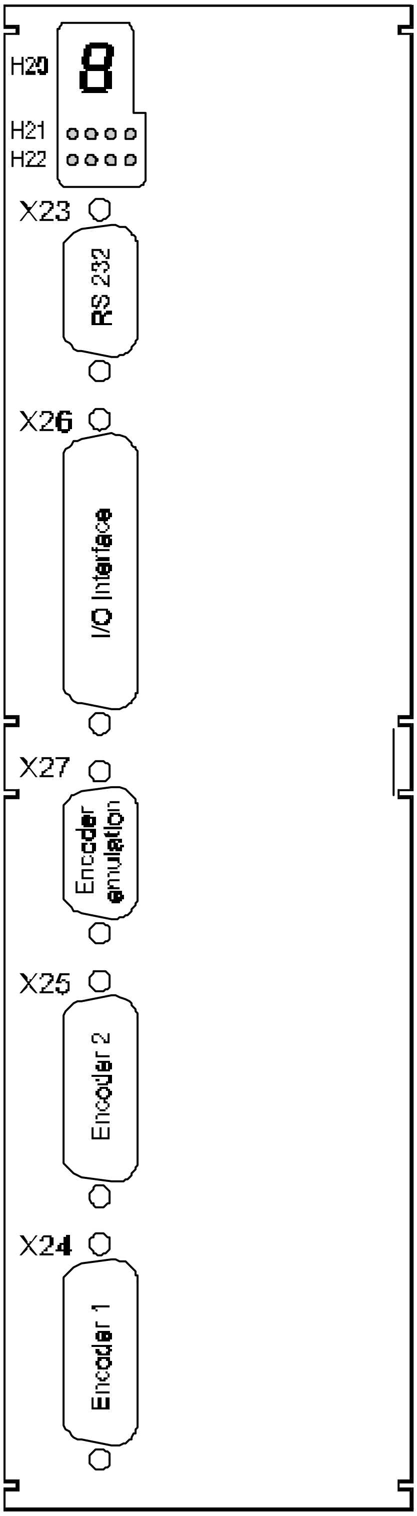
There is an additional board providing a digital interface, thus allowing data and command transfers according to the SERCOS standard.

You will find detailed descriptions of the special versions at the end of this chapter.

Electric Data

Internal system precision	16 bit calculation precision
Full system sampling time	62.5 µs
2 analog inputs voltage range type input resistance resolution	 -10 V ... +10 V differential input approx. 40 kΩ 12 bit
6 digital inputs low level high level input resistance	 0 V ... +7.5 V +13 V ... +30 V 2.5 mA
2 analog outputs voltage range max. output current resolution	 -10 V ... +10 V 1 mA 12 bit
1 relay output max. contact power max. voltage towards electronic ground	 24 V DC / 1 A 50 V
3 digital outputs supply voltage output current for each output	 + 24 V / 150 mA 50 mA
Encoder emulation	variable pulse number/turn external power supply 5Vdc ± 10% I_{INMAX} = 250mA (typical 80 mA)
Interfaces	2 encoder interfaces RS232 service interface

FRONT PANEL


H20
H21
H22
X23
RS 232
X26
I/O Interface
X27
Encoder emulation
X25
Encoder 2
X24
Encoder 1

DISPLAY

Seven-segment Display

A 7-segment display shows the current drive state.

The drive state also depends on the programming and use of the drive input signals. The connection and the programming of the inputs defined as Mode 1 is considered the default and recommended for the various applications. In this mode you can see the following states on the drive display during normal operation:

State 0: after switching on the 24 Vdc supply the drive runs its auto-diagnostics for approx. 1 sec

State 1: after the auto-diagnostics, if there were no errors and the inputs “rapid halt” and “enabling” are at 0 V.

State 3: after applying 24 Vdc at the “rapid halt” input, but without active enabling.

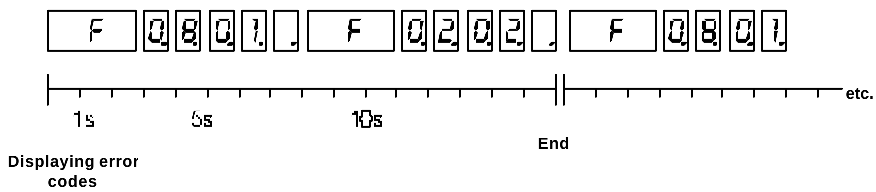
State 4: with the “enabling” input at 24 Vdc the drive goes into State 4. If there is also power connected the drive can control the motor.

24 Vdc supply	rapid halt	enabling	error	display
0 -> 24V	X	X	X	0
24V	0V	0V	No	1
24V	24V	0V	No	3
24V	24V	24V	No	4
24V	X	X	Yes	F n n n n

The following display mode is active **only** in the fault status:

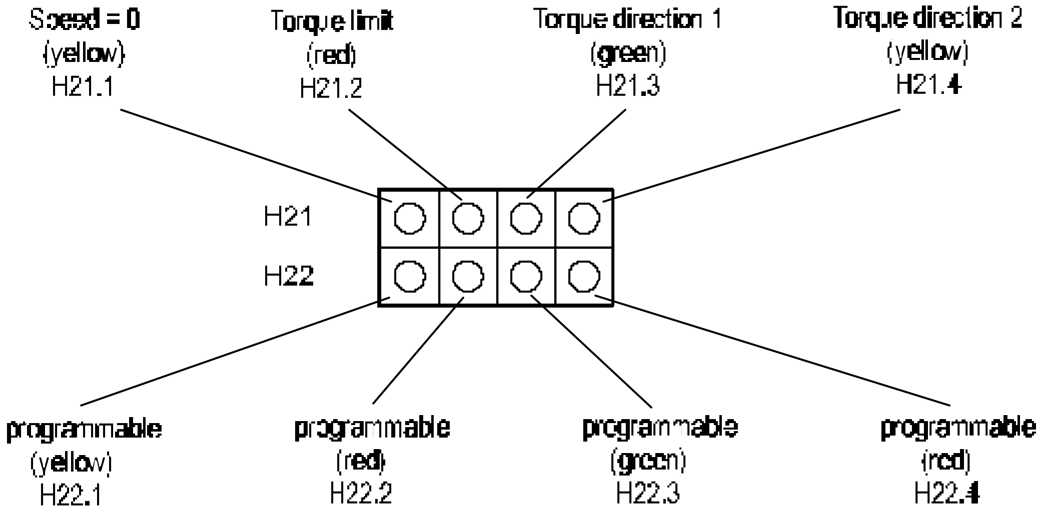
Initially the status identifier "F" is shown for three seconds to indicate the fault status. The "F" is followed by the four digits of the error code. The system outputs them with a decimal point which clearly differentiates this status from the others. After the last digit, the system deactivates the display – apart from the decimal point – for one second. After this, the entire procedure is repeated.
If several errors are pending, the system displays the entire list in this way.
If you cancel an error just when it is being shown in display mode the system still continues to display it until the end of this sequence. The next time the error list is processed this error is no longer visible.

Example in the case of error codes 0801 and 0202:



LED Display

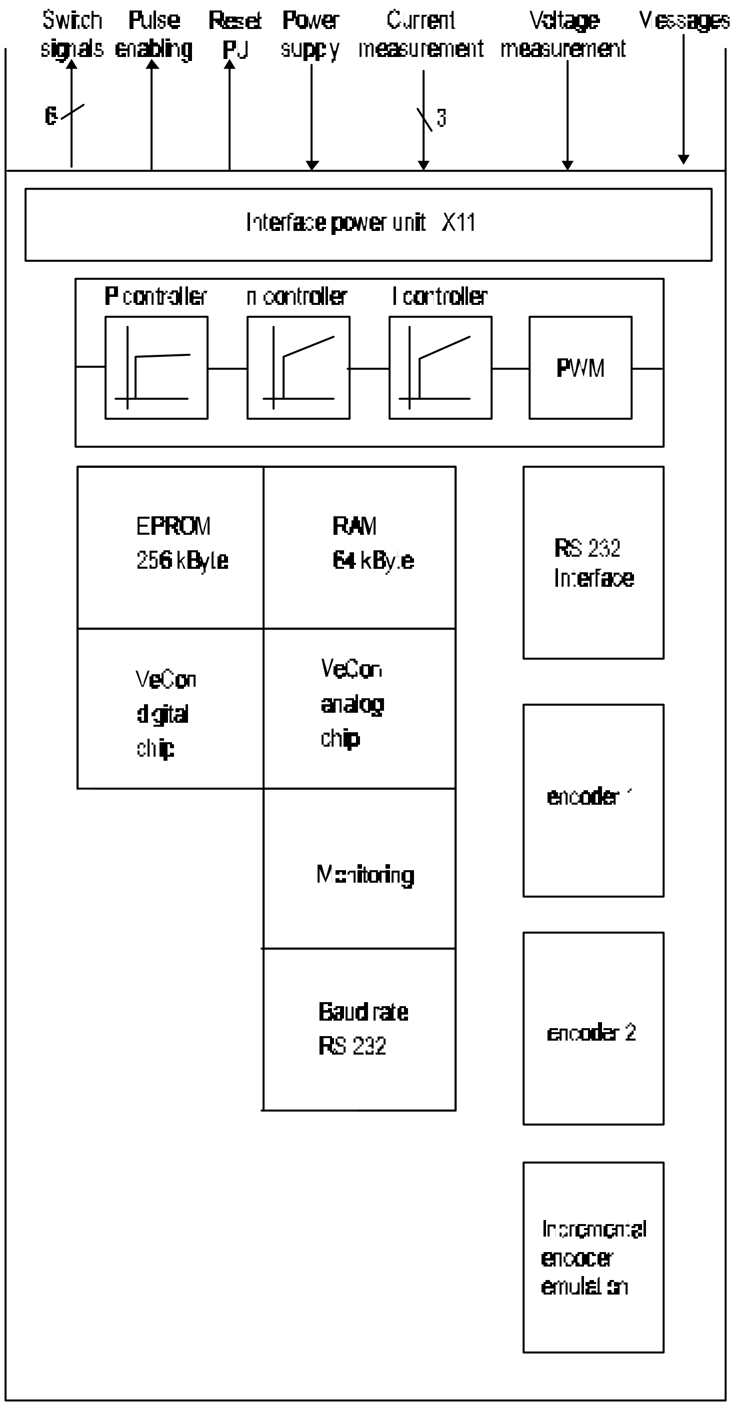
An LED display, which gives additional information, is located below the 7-segment display.



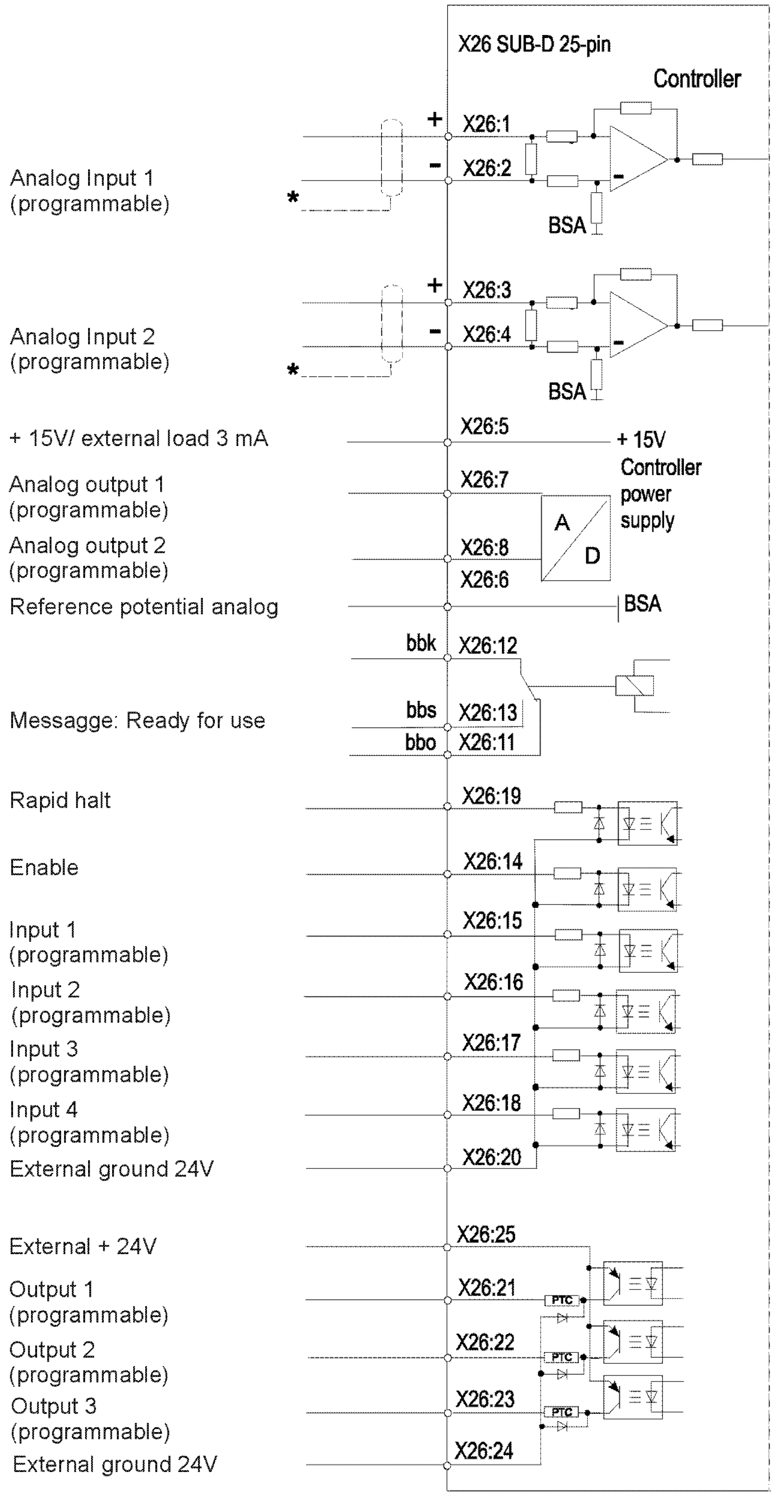
NOTE:
If the LED H21.2 (torque limit) lights up, this indicates that the drive supplies a current equal to its nominal current. This current limitation happens after an overload in order to protect the drive's power modules. It does not cause an error message.

TERMINAL DIAGRAM

Internal Block Diagram

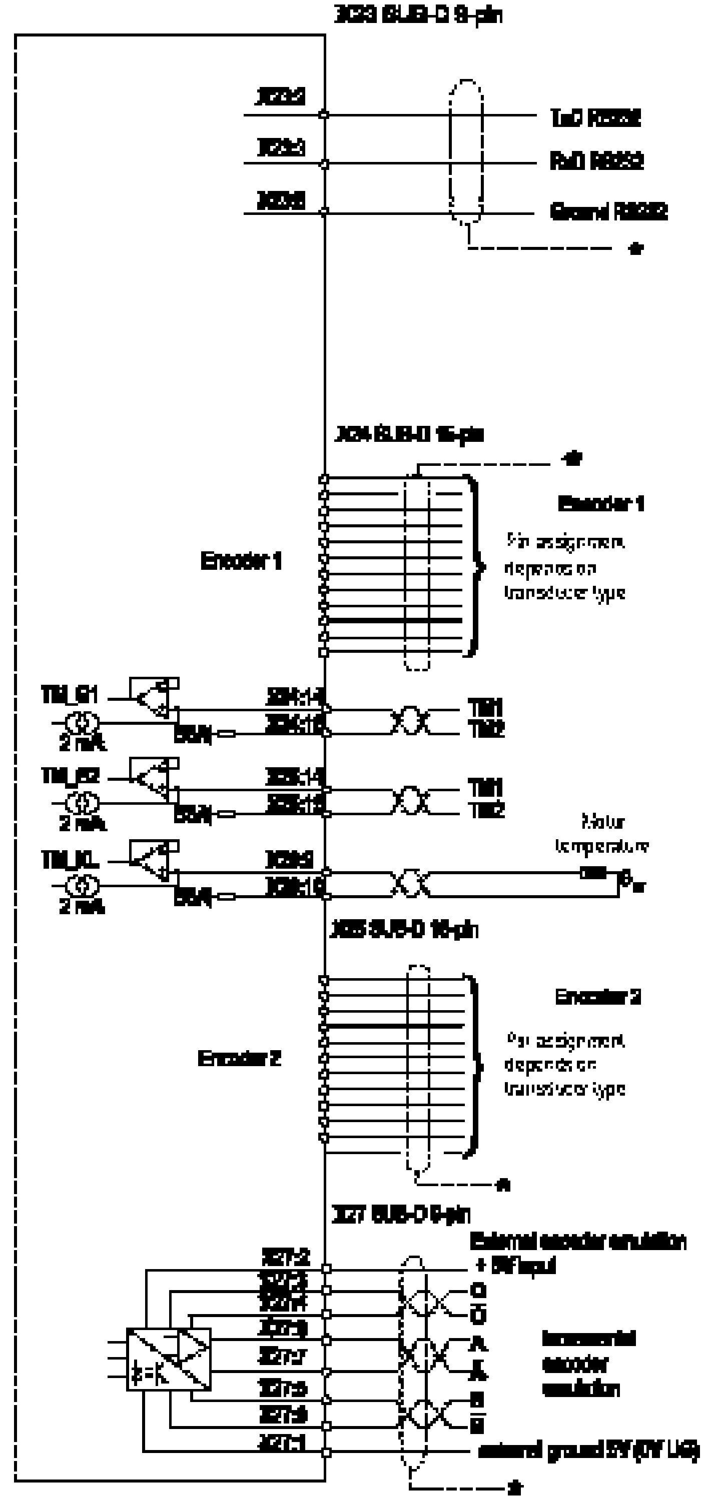


X26 Connector



* The cable shields must be connected to the plug housing
Twisted-pair wires

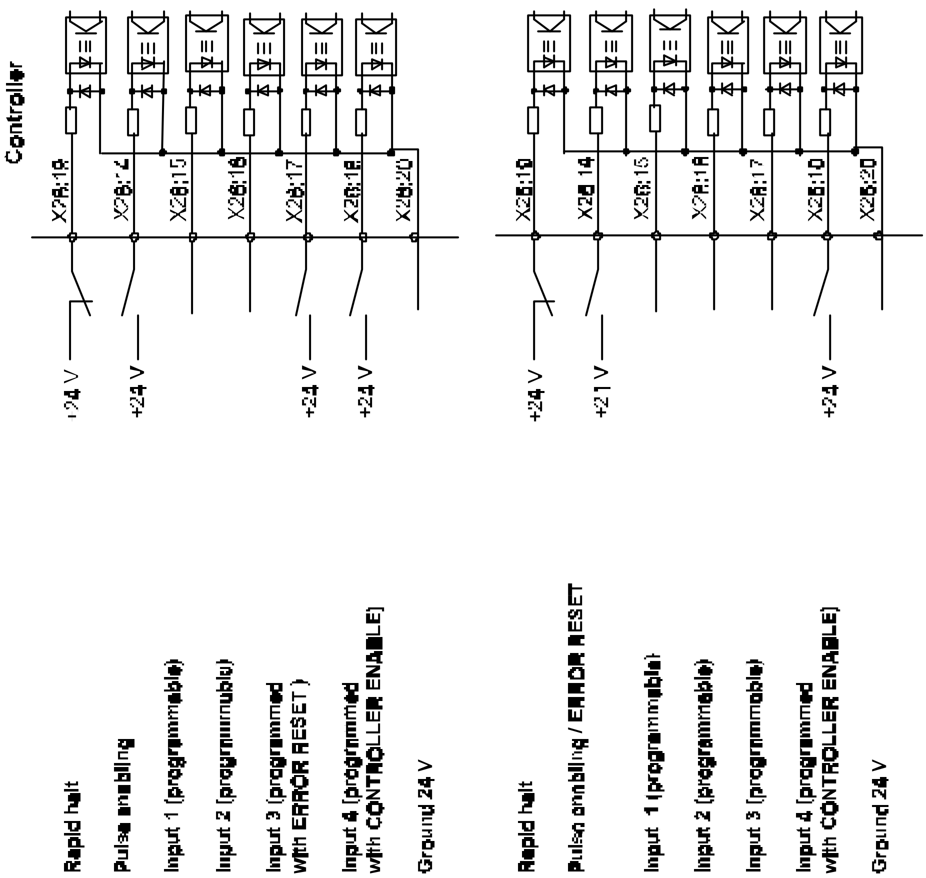
X23, 24, 27 Connectors



* The cable shields must be connected to the plug housings

Twisted-pair wires

DIGITAL INPUT CONNECTIONS



Mode 4 P136 = 0 (errors are accepted separately)
P136 = 1 (all errors are accepted together)

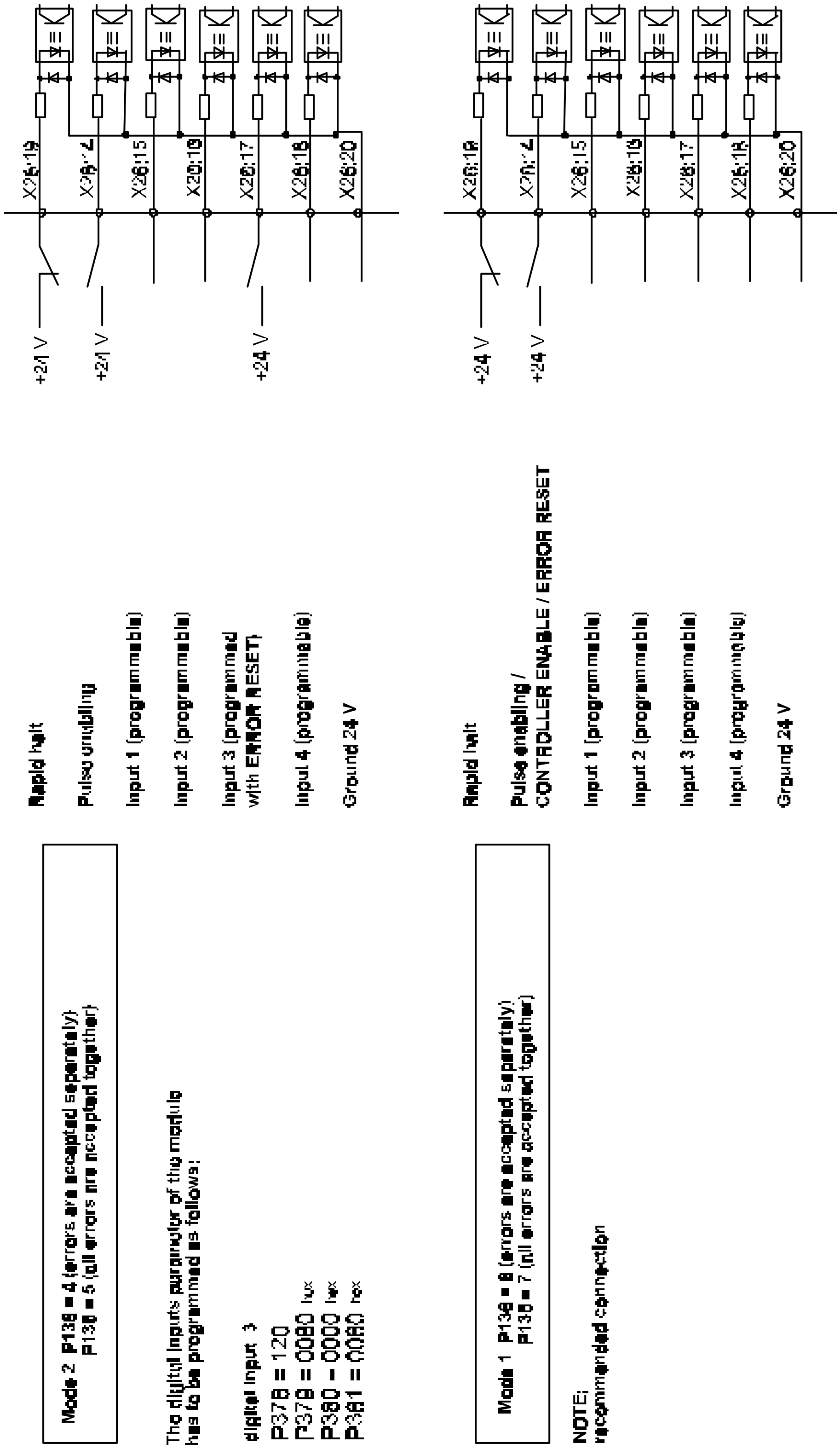
The digital inputs parameter of the module has to be programmed as follows:

digital Input 3	digital Input 4
P378 = 120	P342 = 120
P379 = 0060 hex	P343 = 0008 hex
P380 = 0000 hex	P344 = 0000 hex
P381 = 0060 hex	P345 = 0008 hex

Mode 3 P136 = 2 (errors are accepted separately)
P136 = 3 (all errors are accepted together)

The digital inputs parameter of the module has to be programmed as follows:

digital Input 4
P342 = 120
P343 = 0008 hex
P344 = 0000 hex
P345 = 0008 hex

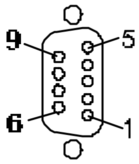


NOTE:
All the enablings are edge-triggered except for the emergency stop input.
The emergency stop input must be disabled (24 Vdc) before the other hardware enables.

CONNECTOR PIN ASSIGNMENT

RS232 Interface

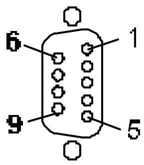
X 23 SUB-D 9-pin female



Pin no.	Assignment
1	not assigned
2	TxD RS232
3	RxD RS232
4	DTR, DSR
5	ground RS232
6	+5V RS232
7	RTS, CTS
8	RTS, CTS
9	not assigned

Incremental Encoder Emulation

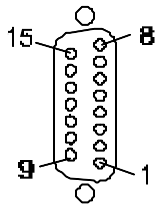
X27 SUB-D 9-pin male



Pin no.	Assignment
1	external power supply, 0V
2	external power supply, + 5V
3	incremental encoder emulation Z+
4	incremental encoder emulation Z-
5	incremental encoder emulation B+
6	not assigned
7	incremental encoder emulation A-
8	incremental encoder emulation A+
9	incremental encoder emulation B-

SINCOS Encoder

X25 SUB-D 15-pin female

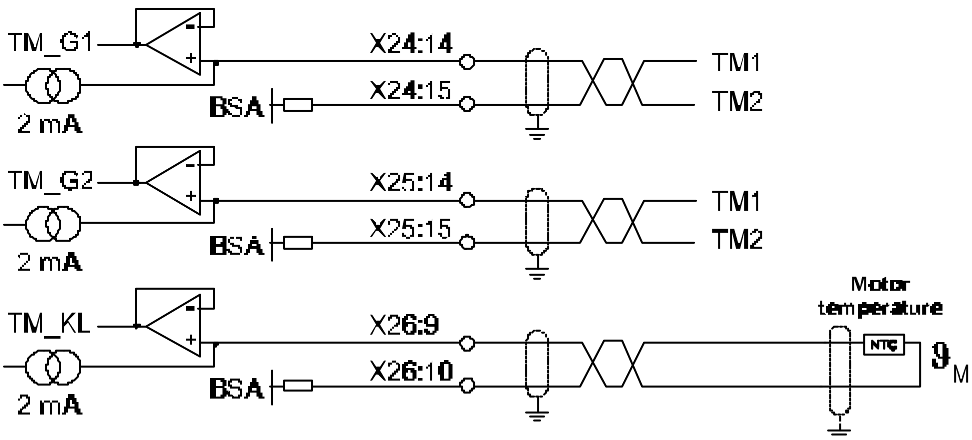


Pin no.	Assignment
1	ground
2	+8V
3	reserved *
4	reserved *
5	cos +
6	not assigned
7	sin -
8	sin +
9	cos -
10	not assigned
11	not assigned
12	RS485 +
13	reserved *
14	reserved *
15	RS485 -

* do not connect

Motor Temperature

The connectors X24 and X26 provide two inputs for acquiring the motor temperature. Only one of these inputs may be connected. The other input must always be open and cannot be used for additional external evaluation since this can lead to corrupted measuring results or the destruction of the internal measuring circuit.
For EMC reasons the heat sensor has to be connected to X26 as shown in the following figure:

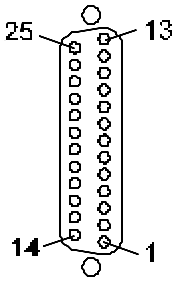


NOTE:
The encoder input is selected with parameter P152 MT.

Controlling the Heat Sensor:
For this, you must remove the cable that is used to collect the motor temperature from the closed-loop control unit. While the motor is cold (coil temperature of less than 80 °C), the resistance between the two connections in the cable must not exceed 1 kΩ.

Analog/Digital Interface

X26 SUB-D 25-pin female

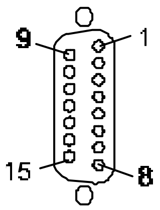


Pin no.	Assignment
1	analog input 1, differential signal +
2	analog input 1, differential signal -
3	analog input 2, differential signal +
4	analog input 2, differential signal -
5	analog power supply, + 15 V
6	analog power supply ground output, 0 Volt for analog outputs
7	analog output 1
8	analog output 2
9	input motor temperature +
10	input motor temperature -
11	NC contact of the ready for use relay
12	common contact of the ready for use relay
13	NO contact of the ready for use relay
14	pulse enabling (24 V)
15	digital input 1 (24 V)
16	digital input 2 (24 V)
17	digital input 3 (24 V),
18	digital input 4 (24 V)
19	rapid halt (24 V)
20	ground for digital inputs 1 to 4 respectively pulse enabling and rapid halt
21	digital output 1 (24 V)
22	digital output 2 (24 V)
23	digital output 3 (24 V)
24	ground digital outputs 1 to 3
25	+24 V for digital outputs 1 to 3

CONNECTION CABLES

Connection Cable for SinCos Encoder

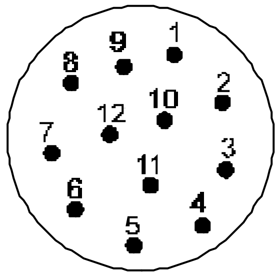
Drive-side connector



view of mating side

shell, 15-pin, male

Motor-side connector



view of mating side

round metal plug, 12-pin, female

Cable: LiYCY conductors 3x(2x0.14mm^2)+2x0.5mm^2 twisted pairs, external shielding.

The shielding has to be connected to the metal body of both connectors (drive as well as motor side)

Contact no. (drive)	Signal	Contact no. (motor)
1	ground 0.5 mm^2	10
2	+8V 0.5 mm^2	12
3		3
4		4
5	COS +	8
6		
7	SIN -	6
8	SIN +	5
9	COS -	1
10		
11		
12	RS485 +	2
13		11
14		9
15	RS485 -	7

NOTES:

– the twisted pairs: (ground, +8V), (SIN+, SIN-), (COS+, COS-), (RS485+, RS485-)

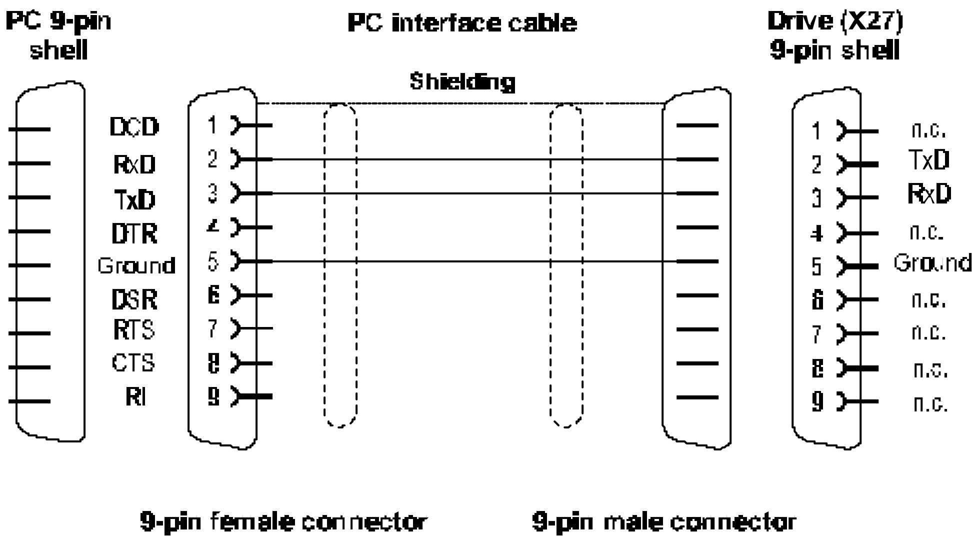
– the motor heat sensor is accessible via 2 terminals in the power connection box on the motor. It has to be connected to X26, contacts 9-10 on the drive using an external twisted and shielded cable. The shielding has to be connected on the motor as well as on the drive side.

Serial Connection Cable for PC

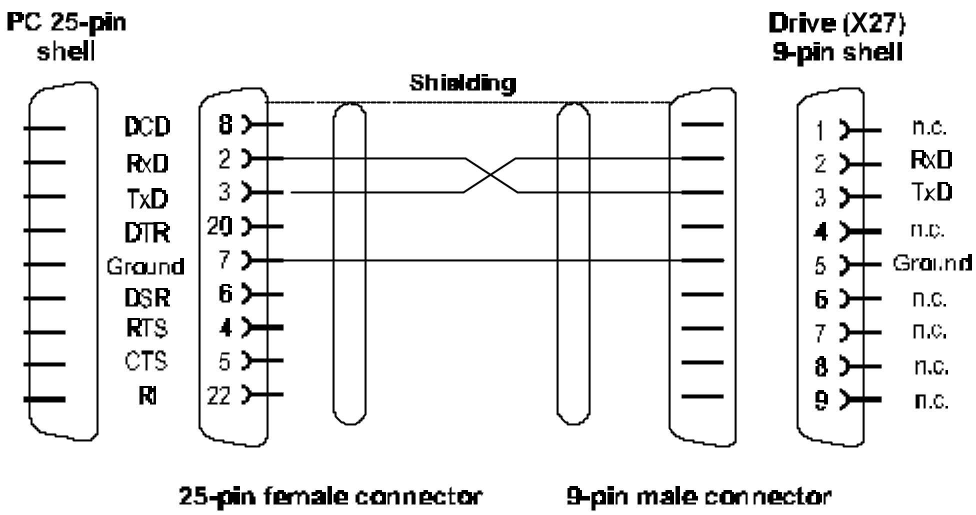
NOTE:
Connect PC in control cabinet or via isolating transformer.

For explanations concerning the communication program see the additional description in the programming manual.

- 9-pin PC connection



- 25-pin PC connection



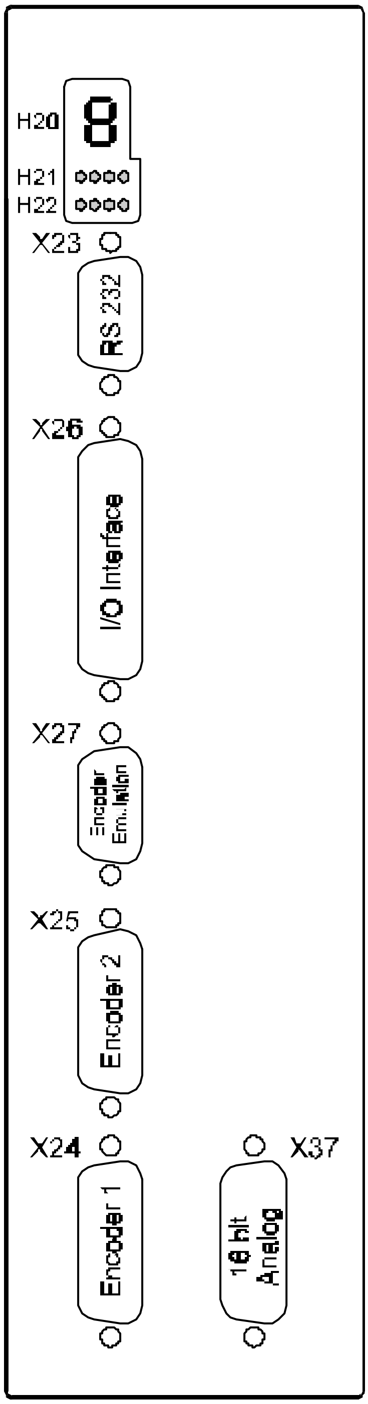
DSV-6 WITH 16-BIT RESOLUTION

Introduction

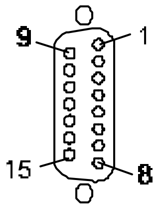
A board has been added to the DSV-6 with 16-bit resolution analog command. This board contains an analog/digital converter which transforms the analog signal from the CNC into 16-bit words. This technique allows more precise machining and with more fidelity to the command on the drive input.

The analog command has to be connected to connector X37 (instead of connector X26).

Front Panel


H20
H21
H22
X23
RS 232
X26
I/O Interface
X27
Encoder Emulation
X25
Encoder 2
X24
Encoder 1
X37
16 bit Analog

X37, 15-bit female shell connector

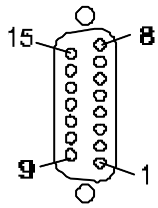


Contact	Signal
1	analog input ground
2…7	not connected
8	analog input +
9...14	not connected
15	analog input -

DSV-6 SLAVE

The difference in respect to the basic version of the DSV-6 module is the presence of the external incremental encoder board. The motor position is controlled by the pulses from the master encoder. The transmission ratio between master and slave can be programmed. The master encoder is connected to X24 as shown in the following table:

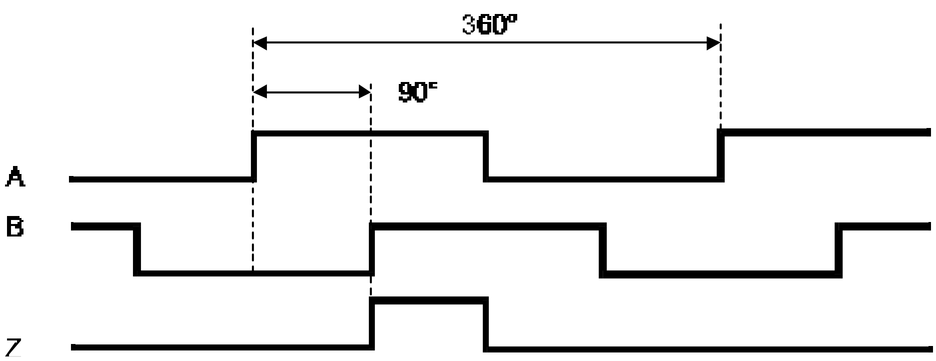
X24 SUB-D 15-pin female



Pin no.	Assignment
1	ground
2	+5V encoder power supply
3	Z+ channel (marker)
4	Z- channel (marker)
5	B+ channel
6	not assigned
7	A- channel
8	A+ channel
9	B- channel
10	not assigned
11	not assigned
12	reserved *
13	reserved *
14	not assigned
15	not assigned

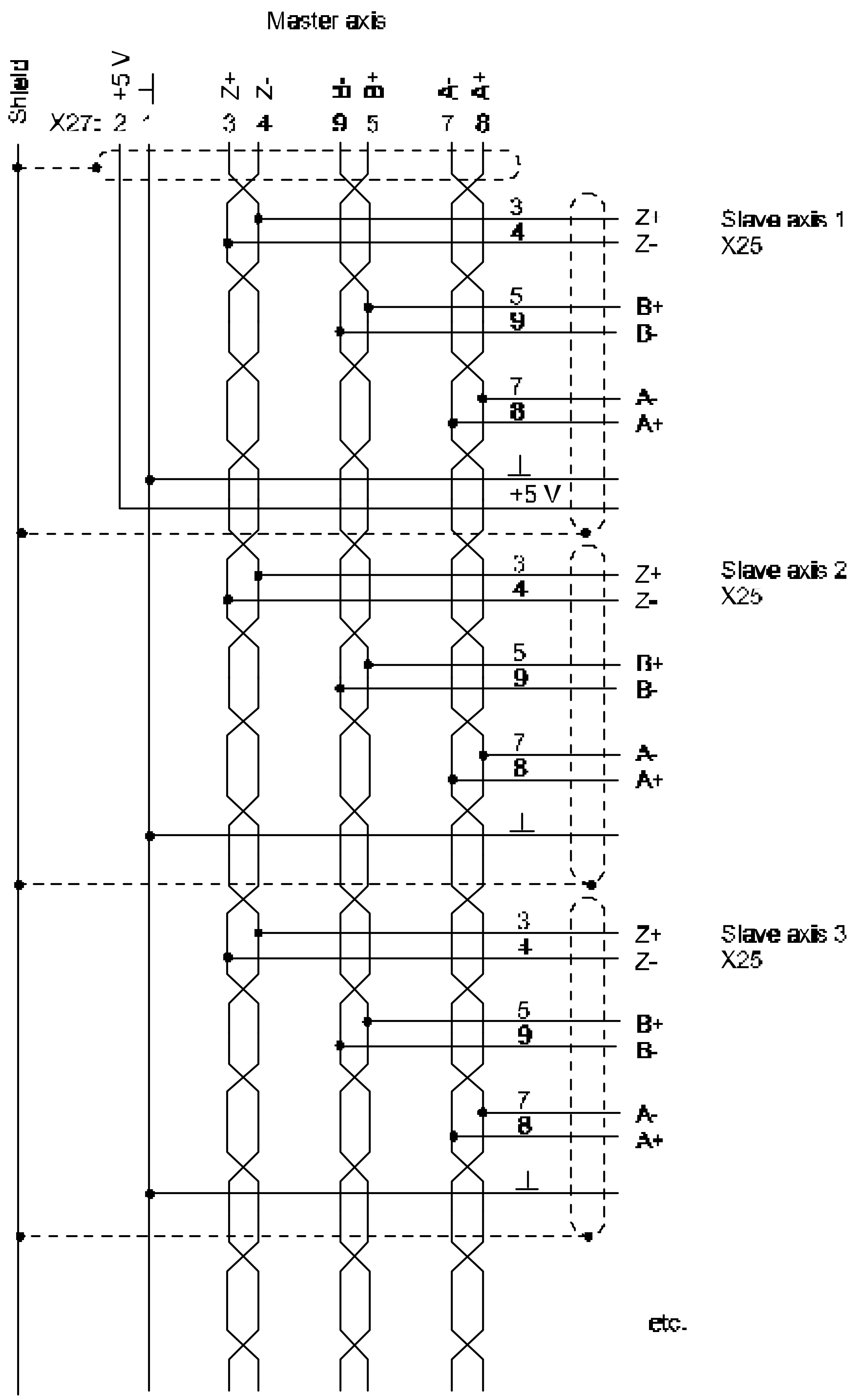
* do not connect

The signals from the encoder have to fulfil the following specifications:



high level: ≥ 2.5 V
low level: ≤ 0.5 V
max. frequency: 1.6 MHz
max. current at +5 V: 400 mA

The following diagram is an example for the connection of slave drives controlled by a master drive via its emulated encoder signals. The same diagram can also be used for a physical encoder, replacing the signals from connector X27 by those coming from the external encoder.



DSV-6 WITH COMMANDS VIA SERIAL LINE

Introduction

The DSV-6 controlled via serial line is an application of the basic version without any additional hardware or software as the basic version already contains the point-to-point positioning function and the communication protocol for transferring data and commands via an RS 232 serial connection. The set-up of the drive for this application consists in the adjustment of some parameters for the DSV-6 module. For the communication between the drive and the CNC you use the same connector (X23) as for the link with the PC for adjusting parameters.
The drive autonomously executes the procedure for homing the axes and the signal from the home position micro has to be connected to a programmable digital drive input and not to the CNC. We recommend to use input 2 as default connection.

Serial Cable for the Link between S/10 CNC and DAC Drive

A connection according to the RS-232 standard does not use differential signals and is therefore very sensitive against electromagnetic disturbances in its environment.

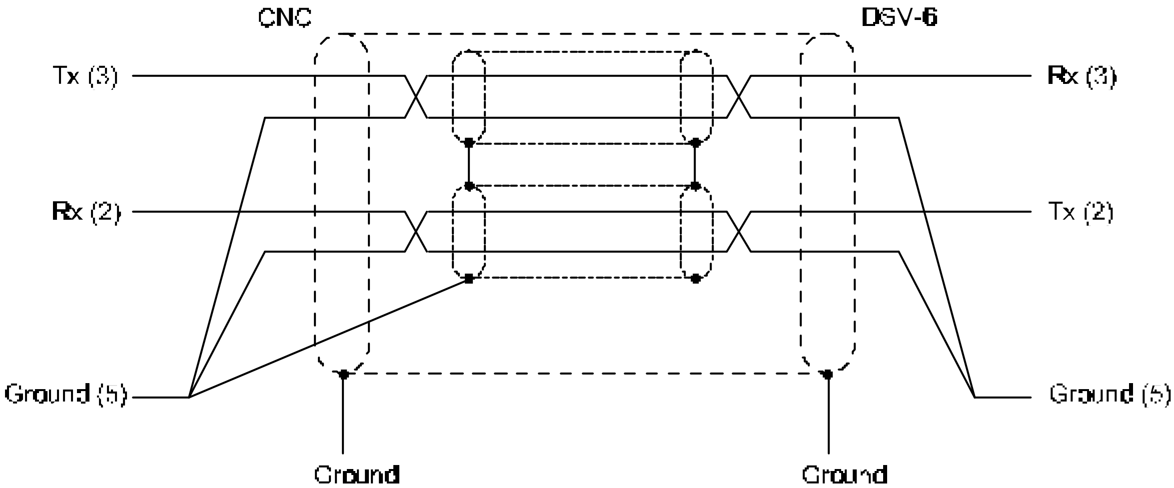
In order to reduce the disturbance level generated by the drives and possibly other devices in general, follow the instructions in the Installation Standards chapter in this manual.
Especially for the communication between the CNC and a drive via RS-232 communication follow the rules below:

- The back panel of the cabinet connected to ground, where the drives and the CNC are mounted, has to be conducting (galvanised) in order to guarantee an extended surface for discharging high frequency disturbances to ground.
- The cable used for serial communication must have external shielding with a covering rate of at least 85%. For the same reason mentioned above, the shielding must have an extended contact with the cabinet panel This can be achieved following the indications in the Shielding paragraph in the Installation Standards Chapter. This ground connection of the shielding has to be carried out on the CNC as well as on the drive side.
- The cable must contain two twisted pairs connected as follows:

Contact no. on CNC side (9-pin, female)	Signal function in the drive	Contact no. on drive side (9-pin, male)
2	TxD	2
3	RxD	3
5	ground 1	5
5	ground 2	5

Use one wire pair for the RxD signal / ground 1 and the other for TxD / ground2, thereby further increasing the signal immunity.

You can use a cable with shielded pairs. It is preferable that the external shielding is insulated against the internal shielding of the pairs. In this case the internal shields have to be connected to contact no. 6 of the CNC connector whereas on the drive side they have to be left unconnected and insulated from the external shielding as shown in the figure:



DSV-6 WITH SERCOS DIGITAL INTERFACE

Introduction

There is also a SERCOS version of the DAM 60 and DAM 61 drives, which uses the same structure as the basic version plus some additional modules. The basis version cannot be upgraded into a SERCOS version. A SERCOS drive has to be ordered under a different product code.

The differences from the basic version are as follows:

- Addition of a SERCOS interface board providing the connection of two optical fibre cables, transmission speed selection and address selection. It also generates display messages on the functioning of the SERCOS interface.
- Digital input 1 is set for receiving the trigger signal from a probe.
- Addition of an Interface board for an external incremental encoder accessible via connector X24.

Concerning the application there are the following differences:

- The analog signal from the CNC is no longer connected.
- The encoder emulation signals towards the CNC are no longer connected.
- The homing position micro has to be connected to the drive and not to the CNC as axis homing is completely controlled by the drive.
- A probe trigger signal can be connected to the digital input 1.
- An external encoder can be connected to connector X24.

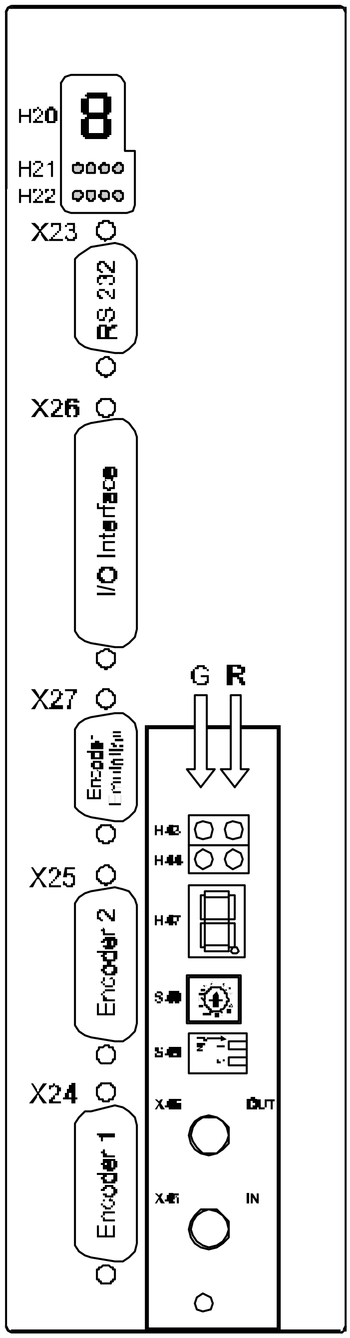
Connecting the Fibre Optic Cable:

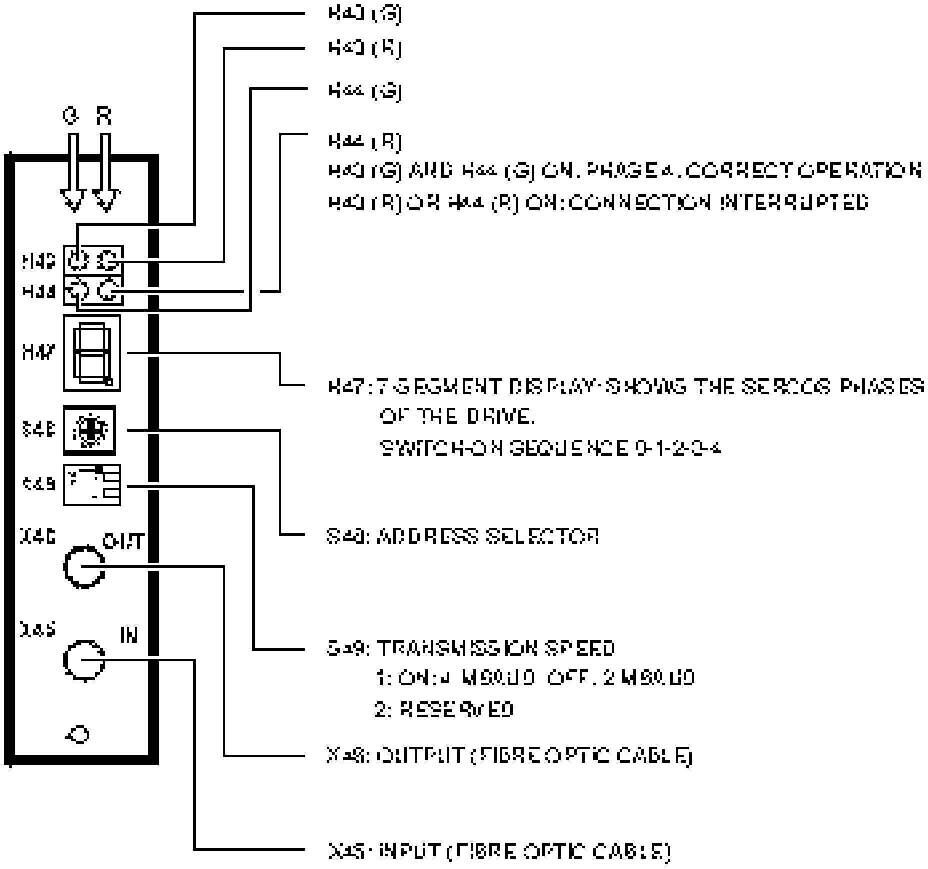
Select and order the cables in the right lengths for the connections between the various drives and the CNC. For long connections with paths outside the cabinet there are extra-long cables with reinforced sheaths. The external diameter of the normal cable is 2.2 mm. The reinforced one is 5.6 mm thick. Avoid cable applications which are longer than necessary. When placing the cable make sure that the minimum bending radius (30 mm for normal cables and 55 mm for reinforced ones) is maintained.

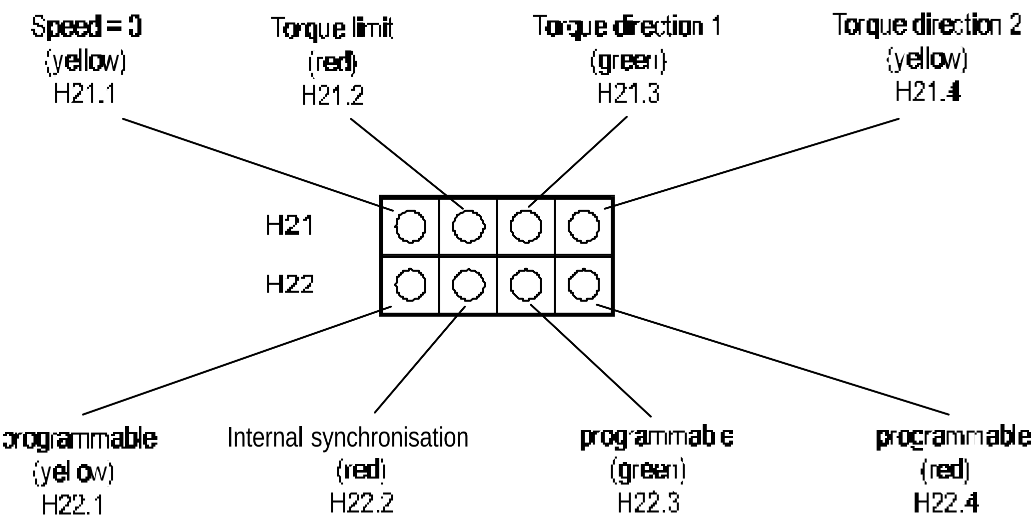
Connection Procedure for Fibre Optic Cables:

- Connect the connector “Tx” on the CNC to the connector “IN” of the first drive.
- Connect the connector “OUT” of a drive to the connector “IN” of the next drive.
- Connect the connector “OUT” of the last drive to the connector “Rx” of the CNC.
- Select the transmission speed with the selector S49-1.
- Select the drive address with the selector S48.
- There are some parameters in the drives dedicated for operations with the SERCOS interface which have to be suitably set.

Front Panel


H20
H21
H22
X23
RS 232
X26
I/O Interface
X27
G
R
X25
Encoder 2
X24
Encoder 1
OUT
IN


H43 (G)
H43 (R)
H44 (G)
G R
H44 (R)
H43 (G) AND H44 (G) ON: PHASE 4, CORRECT OPERATION
H43 (R) OR H44 (R) ON: CONNECTION INTERRUPTED
H43
H44
H47
H47: 7-SEGMENT DISPLAY: SHOWS THE SERCOS PHASES
OF THE DRIVE.
SWITCH-ON SEQUENCE 0-1-2-3-4
S48
S49
S48: ADDRESS SELECTOR
X48 OUT
X45 IN
S49: TRANSMISSION SPEED
1: ON: 4 MBAUD OFF: 2 MBAUD
2: RESERVED
X48: OUTPUT (FIBRE OPTIC CABLE)
X45: INPUT (FIBRE OPTIC CABLE)


Speed = 0
(yellow)
H21.1
Torque limit
(red)
H21.2
Torque direction 1
(green)
H21.3
Torque direction 2
(yellow)
H21.4
H21
H22
programmable
(yellow)
H22.1
Internal synchronisation
(red)
H22.2
programmable
(green)
H22.3
programmable
(red)
H22.4

Seven-segment Display

Display H20

After connecting the digital inputs as described further in the Digital Inputs Connections paragraph you can see the following states on the H20 display during normal operations:

State 0: after switching on the 24 Vdc supply the drive runs its auto-diagnostics for approx. 1 sec

State 1: after the auto-diagnostics, if there were no errors independent of the status of the “rapid halt” and “enabling” inputs.

State 2: after connecting power with 24 Vdc applied to the “rapid Halt” input regardless of the status of the “enabling” input.

State 4: After connecting the “enabling” input with 24 Vdc and issuing the enabling command from the CNC, the drive is in state 4 and able to control the motor.

24 Vdc supply	power	rapid halt	enabling	error	display
0 → 24V	0	X	X	X	0
24V	0	X	X	No	1
24V	400 Vac	24V	X	No	2
24V	400 Vac	24V	24V + SERCOS enabling command	No	4
24V	X	X	X	Yes	E

Display H47

This display is dedicated to the various operation phases of the SERCOS interface. After switching on it shows 0, until the CNC transmits the initialisation procedure for the SERCOS system. During initialisation it shows phases 1, 2, 3 and 4. During normal operations it displays 4. If the initialisation procedure is interrupted for any reason, the display shows the last state reached.

LED Display

LED H22.2

This lights up during the drive initialisation phase after switch-on and remains on during machine operations. It indicates synchronisation between the SERCOS interface board and the controller board.

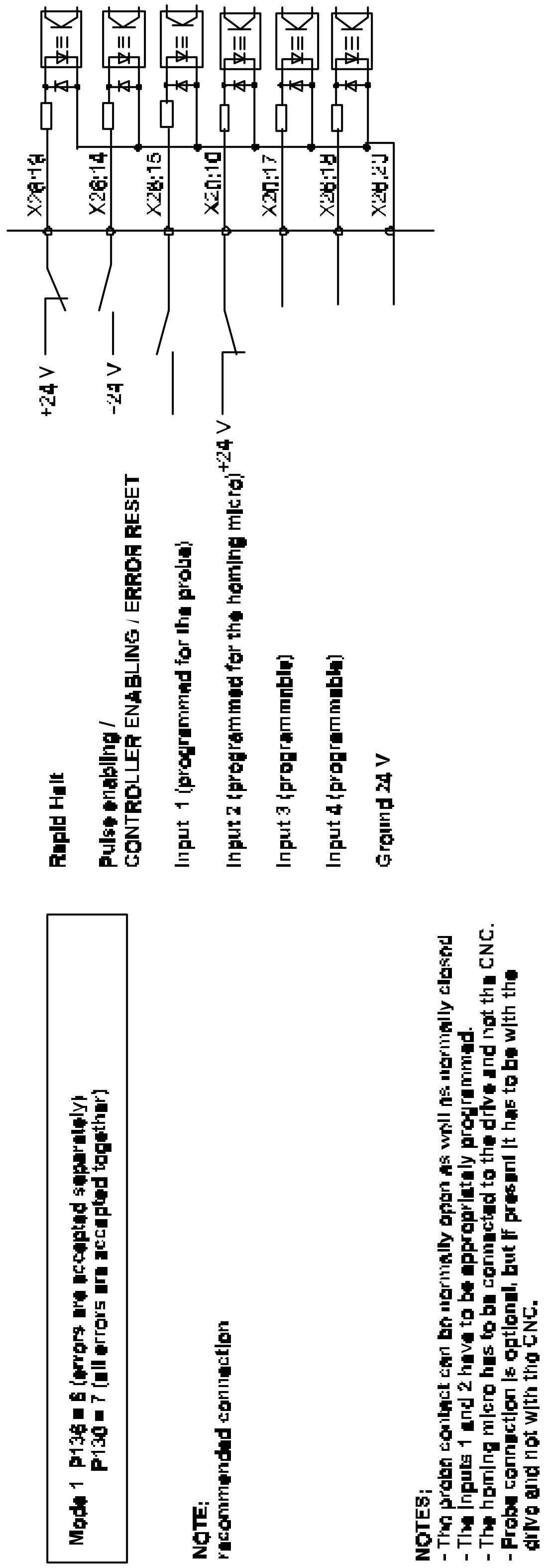
LED's H43(G) and H44(G)

If both are on, this indicates correct functioning of the SERCOS system.

LED's H43(R) and H44(R)

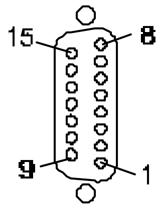
If at least one of the two LED's is on, the communication between drive and CNC is interrupted.

Digital Input Connections



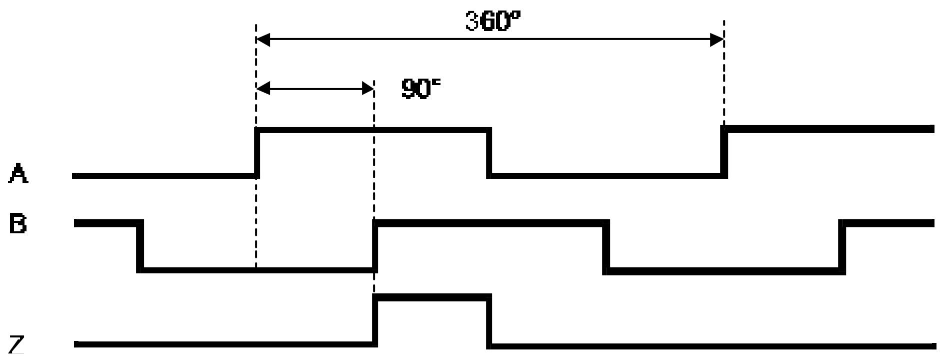
Incremental Encoder

The drives with SERCOS interface contain an adapter for an external incremental encoder with square wave signal and marker pulse. The external encoder has to be connected to the connector X24 of the drive. The cable to be used has to have shielded twisted pairs and external shielding. The shieldings have to be grounded on the drive as well as on the encoder side. When constructing the cable and selecting of the encoder keep to the following specifications:



Pin no.	Assignment
1	ground
2	external encoder power supply, + 5V
3	Z+ channel (marker)
4	Z- channel (marker)
5	B+ channel
6	not assigned
7	A- channel
8	A+ channel
9	B- channel
10	not assigned
11	not assigned
12	reserved *
13	reserved *
14	not assigned
15	not assigned

* do not connect

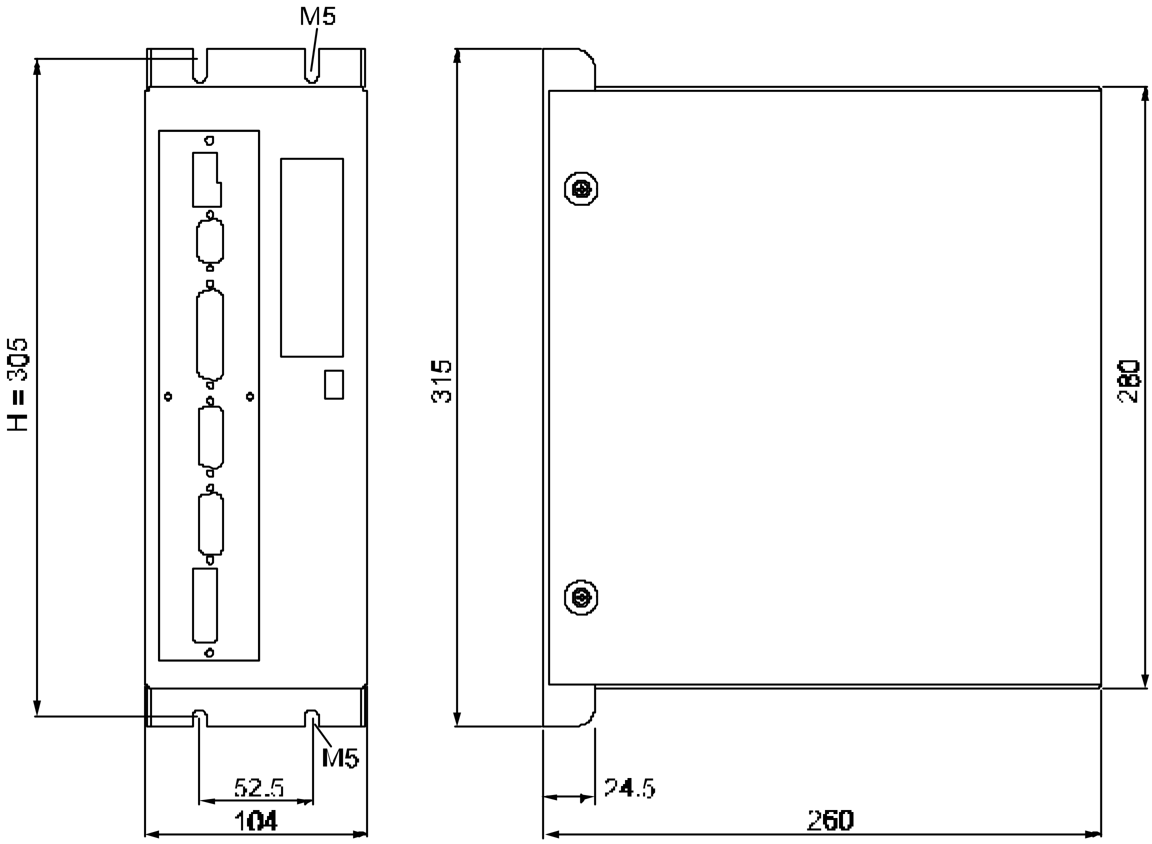


high level: ≥ 2.5 V
low level: ≤ 0.5 V
max. frequency: 1.6 MHz
max. current at +5 V: 400 mA

END OF CHAPTER

DAM 60

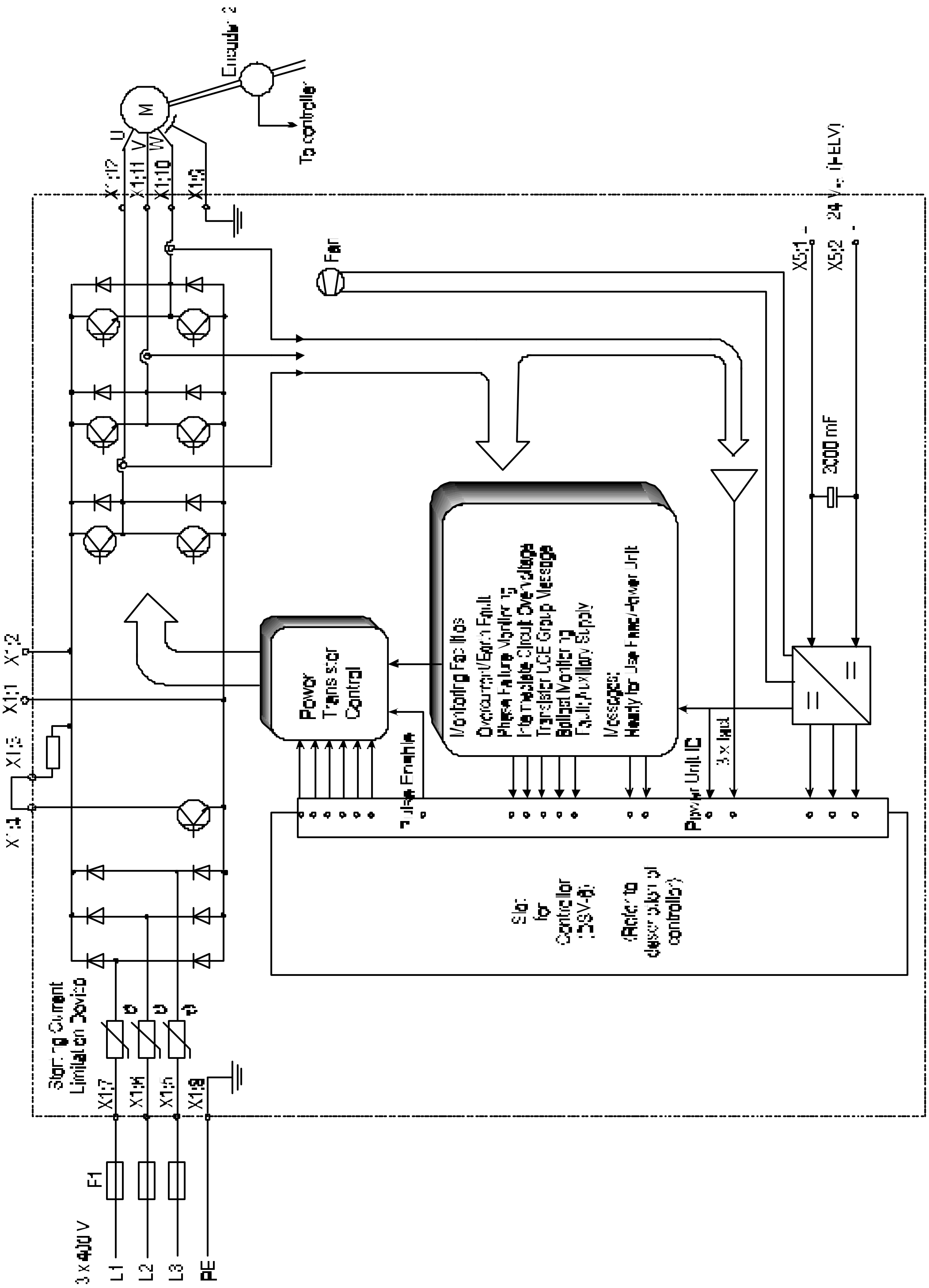
DIMENSIONS



NOTE:

"H" is the distance between the fixing holes to be used for the mounting plate in the electric cabinet in order to be able to mount and dismount the drives without having to unscrew the fixing screws completely.

BLOCK DIAGRAM



ELECTRIC DATA, POWER STAGE

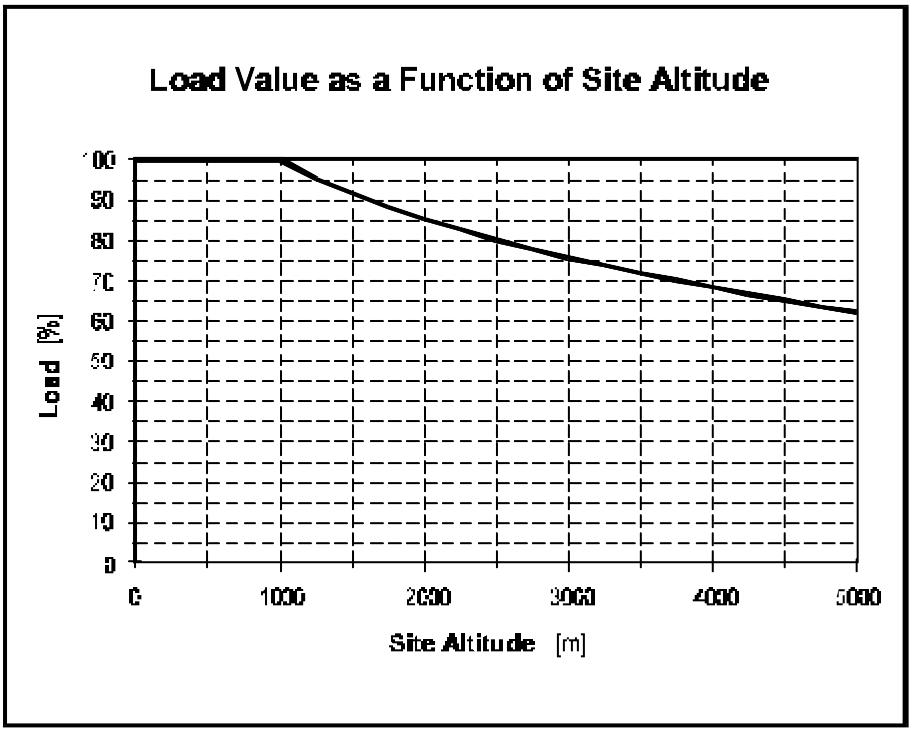
	DAM 60 - 03/06	DAM 60 - 06/12	DAM 60 - 12/24
Close loop controller	digital controller		
Supply voltage	3 x 400 V_{AC}, 50 - 60 Hz, ± 10 %		
Fuses (external)	16 A, for semiconductors (extra-fast)		
Protection system	IP 20		
Intermediate circuit nominal voltage	540 V DC		
Intermediate capacitor	220 µF		
Time between power connection and enabling	≥ 1.5 s		
Power connection frequency [1)]	≤ 6 per Hour		
Output voltage	0 ... supply voltage		
Output power	2 kVA	4 kVA	8 kVA
Typical motor power	1.1 kW	2.25 kW	4.5 kW
Nominal output current	3.25 A (3 A_{eff})	7.5 A (6 A_{eff})	15 A (12 A_{eff})
Peak output current [2)]	7.5 A (6 A_{eff})	15 A (12 A_{eff})	30 A (24 A_{eff})
Low voltage power supply	Supply voltage: +24 V_{DC} ±20%, 2A		
Braking resistor internal external	 240 Ω / 100 W 240 Ω / 100 W	 120 Ω / 200 W 120 Ω / 200 W	 60 Ω / 250 W 60 Ω / 250 W
max. insertion ratio with external resistor	1 : 33		
Power loss during nominal operation without low voltage supply without braking	60 W	110 W	170 W
Operating environ. temp. range T_B	0 ... 45° C (with power reduction up to 55° C)		
Coolant temperature range T_K	0 ... 45° C (with power reduction up to 55° C)		
Reduction of nominal output current (T_K = 45°... 55° C)	3%/deg. C		
max. altitude with nominal load [3)]	1000 m		
Relative humidity	15% ... 85% non condensing		
Storage temperature range	-30° C ... +70° C		

[1)] keeping a min. interruption of 30 s

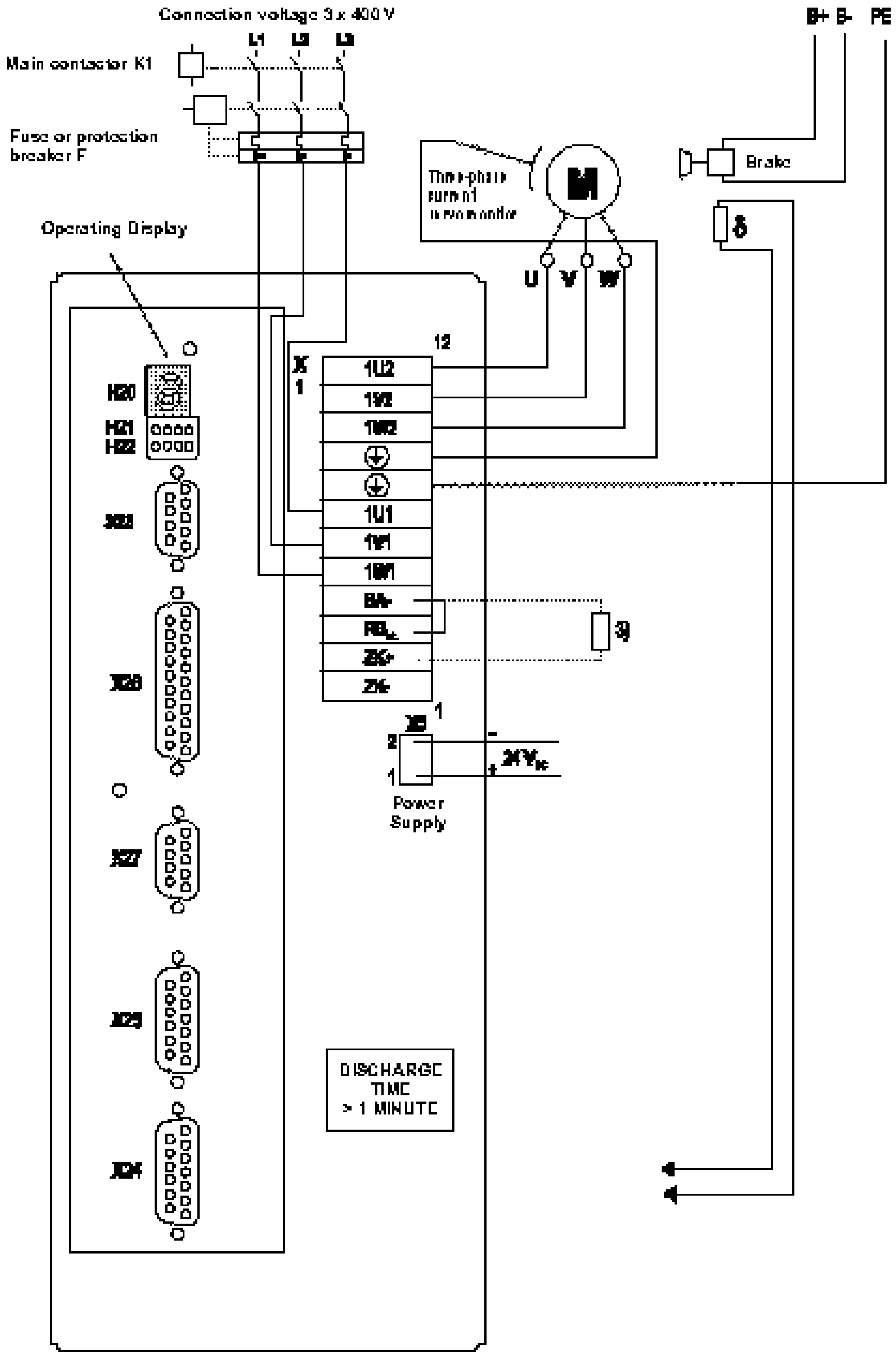
[2)] for max. 1 sec without precharging

[3)] for heights over 1000 m see characteristic curve 1

Characteristic Curve 1:

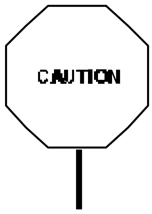
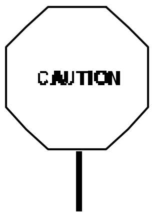
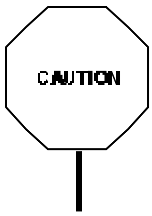


CONNECTION DIAGRAM, POWER



3) with external resistance remove jumper between X1:3 and X1:4

Connection Information

K1	main contactor  The converter cannot be enabled until the capacitors of the intermediate circuit have been fully charged i.e. for at least 1.5 sec after closing the main switch.
F	Safety breaker, delayed fuse, 2-2.3 the nominal current or motor safety breaker, corresponding to the power requirement of the converter and the start-up current inrush
1U2, 1V2, 1W2, ⏚ X1: 12, 11, 10, 9	Motor connections, cross section according to VDE 0113/0298 (for installation see the EMC information). Cross section 1.5 mm² up to 14A, 2.5 mm² up to 19A, 4 mm² up to 25 A, 6 mm² over 25A of the nominal motor current
1U1, 1V1, 1W1, ⏚ X1: 7, 6, 5, 8	Mains connection (transformer), for installation see above
ZK+, ZK- X1: 2, 1	Intermediate circuit connections. The discharging of the intermediate circuit capacitor requires at least one minute. If necessary the intermediate circuit can be quickly discharged via a resistor connected between terminals 1 and 2 Connect the external braking resistor between X1:2 ZK+ and X1:4 BA-.  Parallel connection of several devices to the intermediate circuit is not allowed. This would overload and destroy the limiter
X5:1, 2	For its operation the converter requires a + 24 VDC power supply! Contact 1: +24V; Contact 2: 0V
RB_{int} X1:3 BA- X1:4	Jumpered, if no external resistor connected Connection of a braking resistor between X1:2 ZK+ and X1:4 BA-.
	 If you use an external resistor you have to remove the jumper between X1:3 and X1:4, otherwise the braking transistor will be overloaded and destroyed.

Protection

Delayed fuses with a nominal current of 2 – 2.3 times the drive's nominal current have to be inserted for the mains connection cables. These also protect against possible overloads. We recommend fuses according to DIN VDE 0636 Part 21. These delayed fuses cannot protect the drive in case of internal malfunction e.g. a shortcircuit in the intermediate circuit (bus).

For this reason we recommend to use additional fuses in series to the delayed fuses to protect the components of the rectifier bridge inside the converter. The values are to be found in the table of the technical data. These fuses have to be extra-fast with features for semiconductor protection. We recommend fuses according to DIN VDE 0636 part 2.

Alternatively you can use magnetothermic breakers which have a thermic part (delayed action) and a magnetic part (fast action).

MESSAGES

Monitoring the Power Supply Unit

The monitoring devices require an auxiliary voltage of 24 Vdc (for X5) for their functioning.

The messages can be cancelled with a reset signal from the controller.
How to display and cancel messages is explained in the controller description.

- **Monitoring Overloads of the Braking Resistor**

  Monitoring of the overload can avoid an excessive load of the resistor. This monitoring device can be deactivated for external resistors.

Monitoring the Power Group on the Motor Side

There are the following monitoring devices:
overload of the motor lines
earth leakage current
intermediate circuit (Bus) voltage
power transistors (IPM)
auxiliary power supply

- **Overcurrent Messages**

  The system watches the currents of the motor phases and generates an overcurrent message if the phase current exceeds the allowed peak current by 30%. This message is saved and blocks pulse enabling.

  NOTE:
  The overcurrent message is considered as a protection. The controller ensures the limitation of the peak current allowed for the motor phase currents.

- **Monitoring the Earth Leakage Current**

  The system controls the earth leakage current of the power group – and together with it that of the motor phases – in order to check for possible fault versus ground. An earth leakage message is issued if these currents exceed 10% of the allowed peak current of the power group.

- **Monitoring the Intermediate Circuit (Bus)**

  The system controls the voltage level of the power group intermediate circuit. A message is issued when the intermediate circuit voltage reaches a critical value for the power group.

  NOTE:
  The voltage of the intermediate circuit can increase until it interrupts itself, if the drive is braking and the braking circuit is too small or does not exist at all.

- **Monitoring the Power Transistors**

  For the time of the power transistor activation the system controls the saturation voltage of the collector. If it finds too high a saturation voltage in the conductive state, this means that there is an overcurrent of the transistors. For example, this can be due to a short circuit between the motor terminals. Then the system issues a controlled halt which shuts off the transistors and generates a message. In addition the system controls the transistor temperature. If this exceeds 110°C, the system issues a message.

- **Monitoring the Auxiliary Voltage Supply**

  The system controls the auxiliary voltage supply of the power group and issues a message if the voltage is too low.

- **Monitoring the Heatsink Temperature**

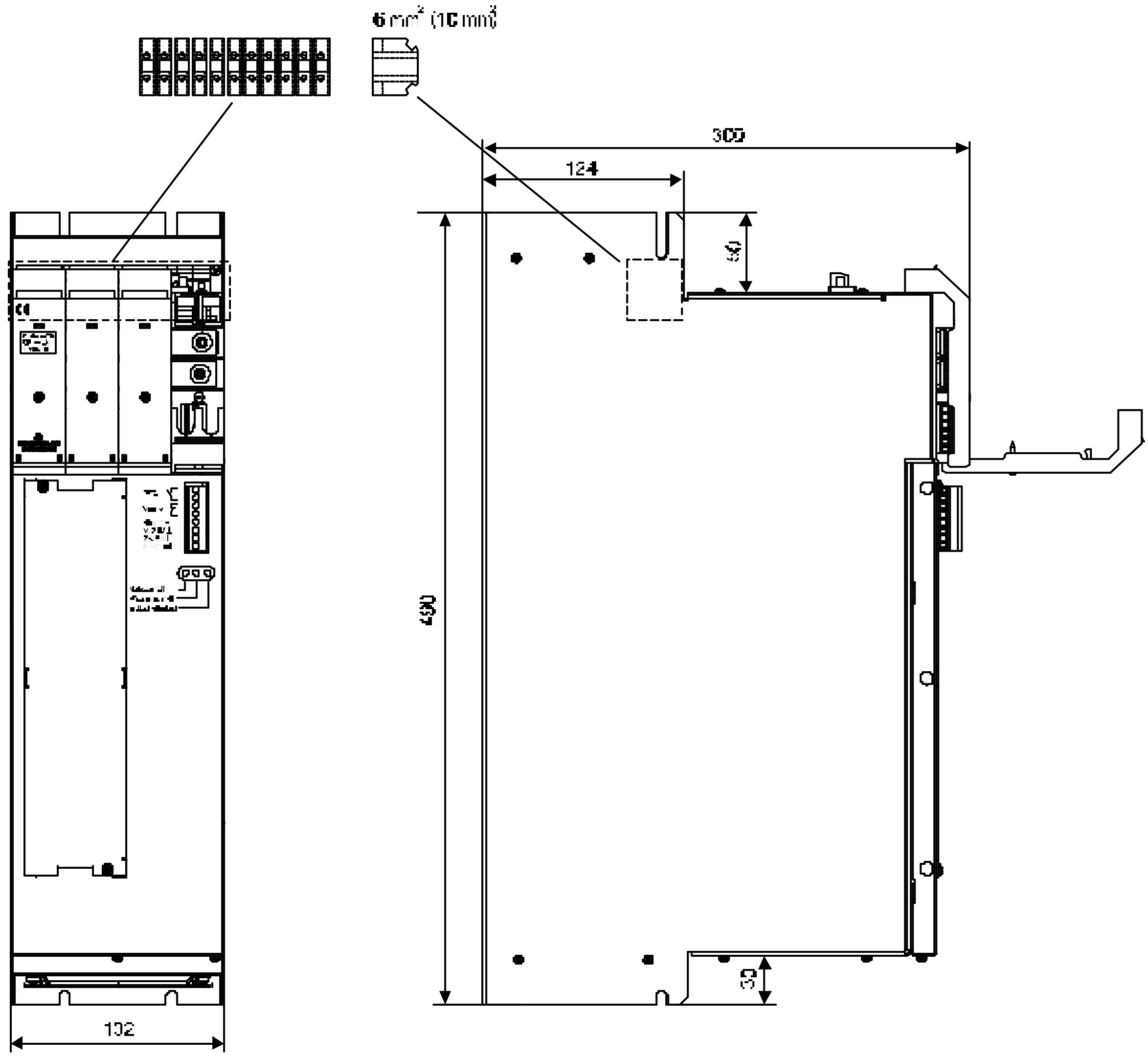
  The heatsink is equipped with a heat sensor which transfers its temperature value to the controller. Thus the controller monitors the heatsink temperature (see the controller description).

END OF CHAPTER

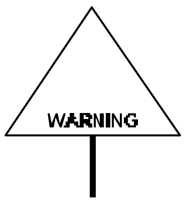
DAM 61

DIMENSIONS, INSTALLATION

Dimensions



Installation Note

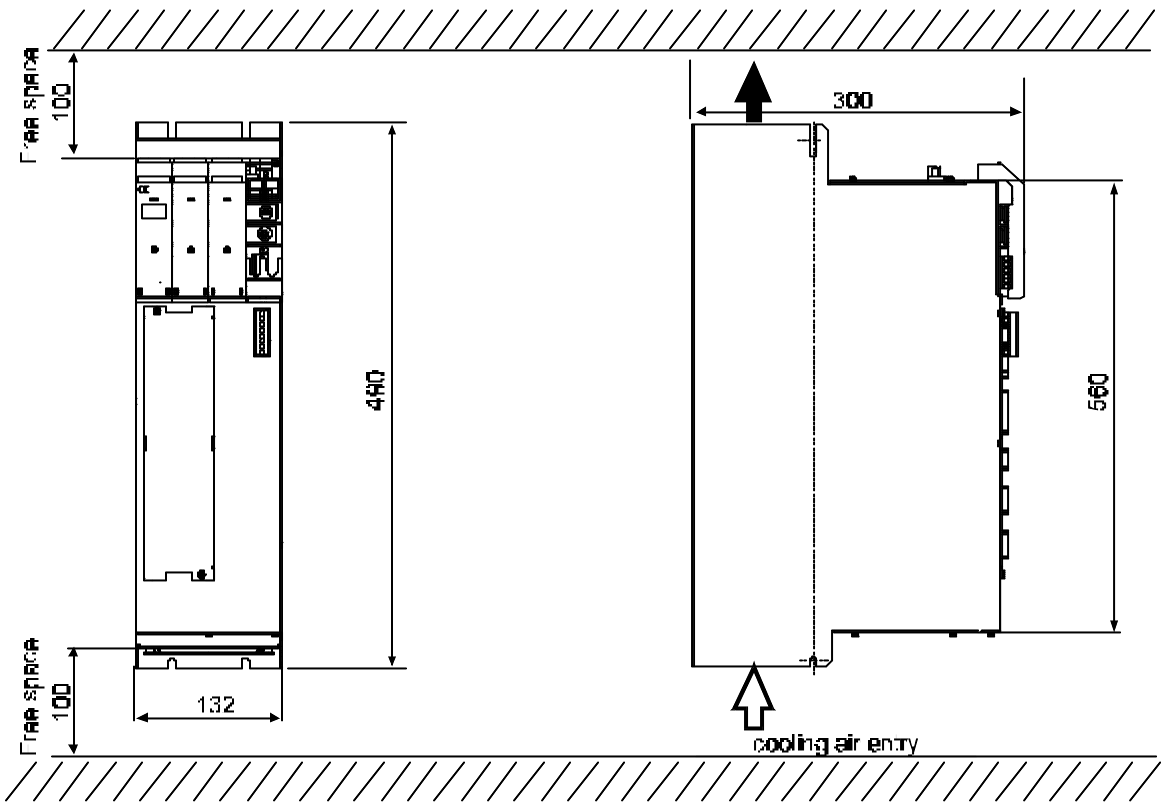


You have to maintain the following rules concerning ventilation.

If these notes are neglected there is a risk that the devices will overheat.

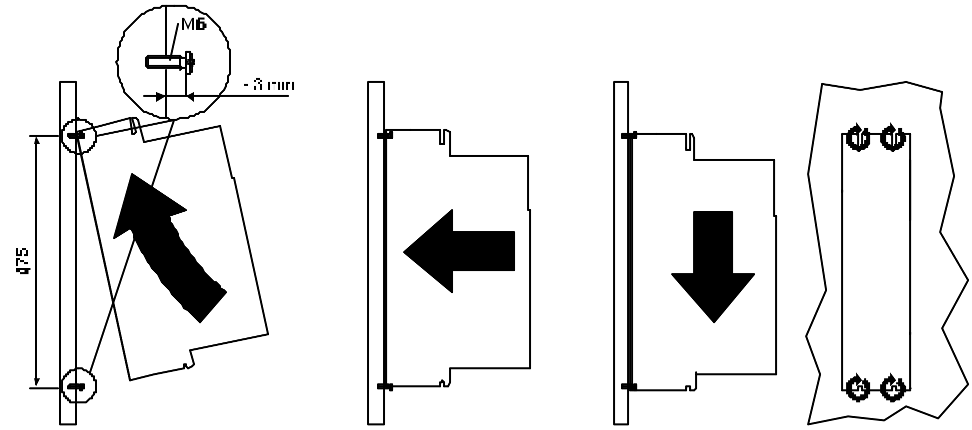
1. Provide sufficient inflow of fresh air and ensure good circulation!
2. The ventilation has to go from the bottom to the top. Make sure there is the required free space below and above the unit.
3. The nominal power of the unit can be achieved only up to a certain environment temperature! If it exceeds this prescribed value, the power has to be reduced.
4. There must be no additional heat source below and above the units.
5. Avoid dirt levels 3 and 4 according to pr EN 50178:1994 Para. 5.2.15.2. The devices are designed for installation and operation in closed spaces. (VDE 0558 Part 1a, Paras. 5.4.3.2.1 and 5.4.3.2.2).

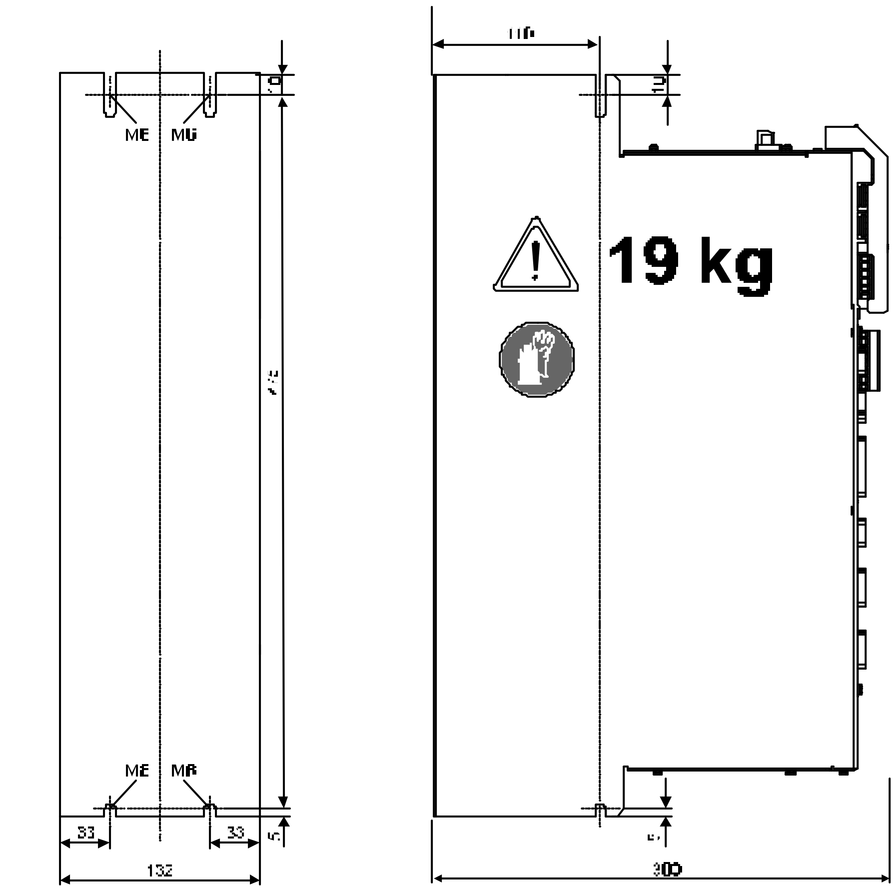
Free Space



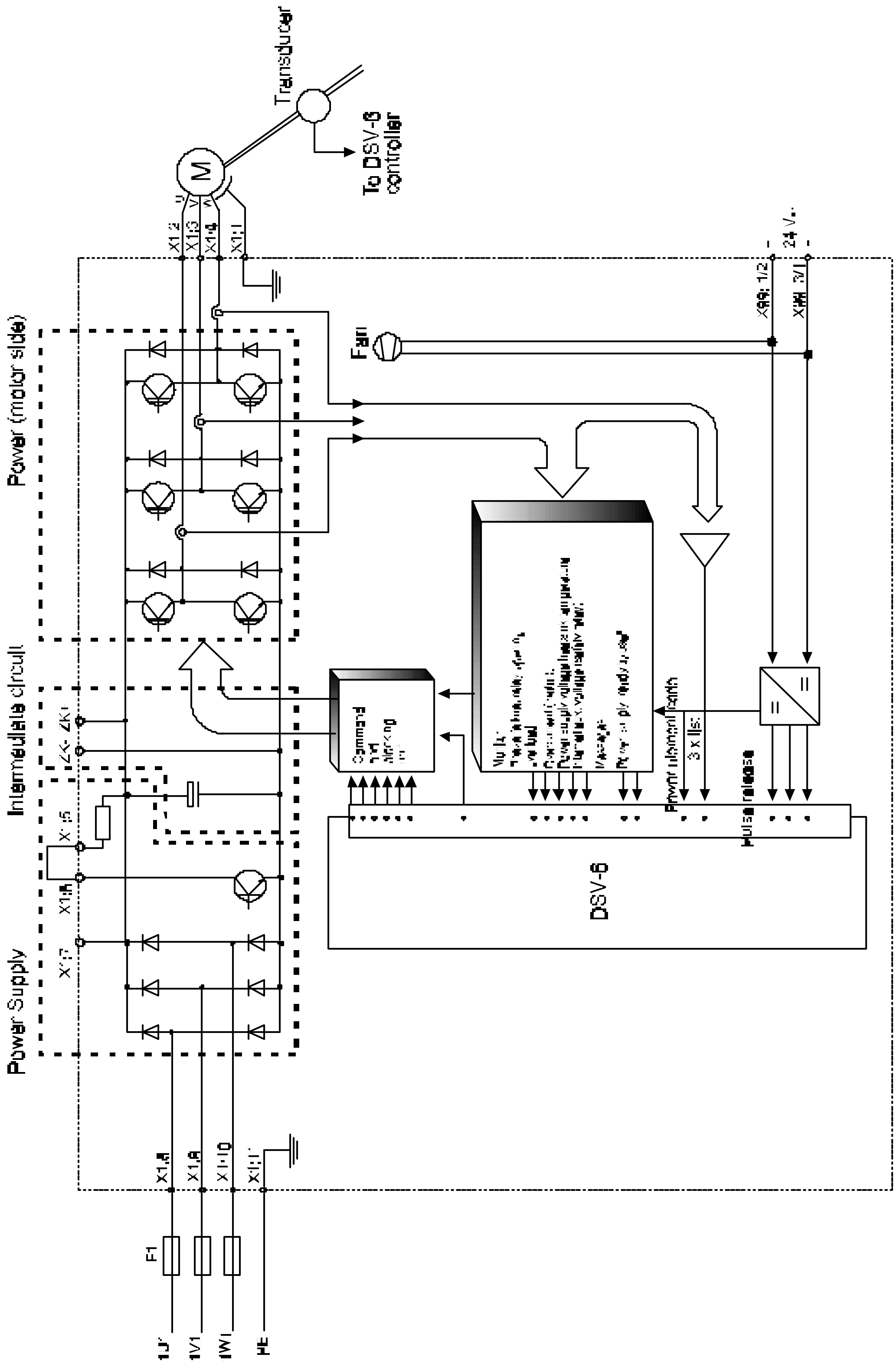
Fixing

Fix the module in a vertical position on the back or lateral side of the control cabinet.





BLOCK DIAGRAM

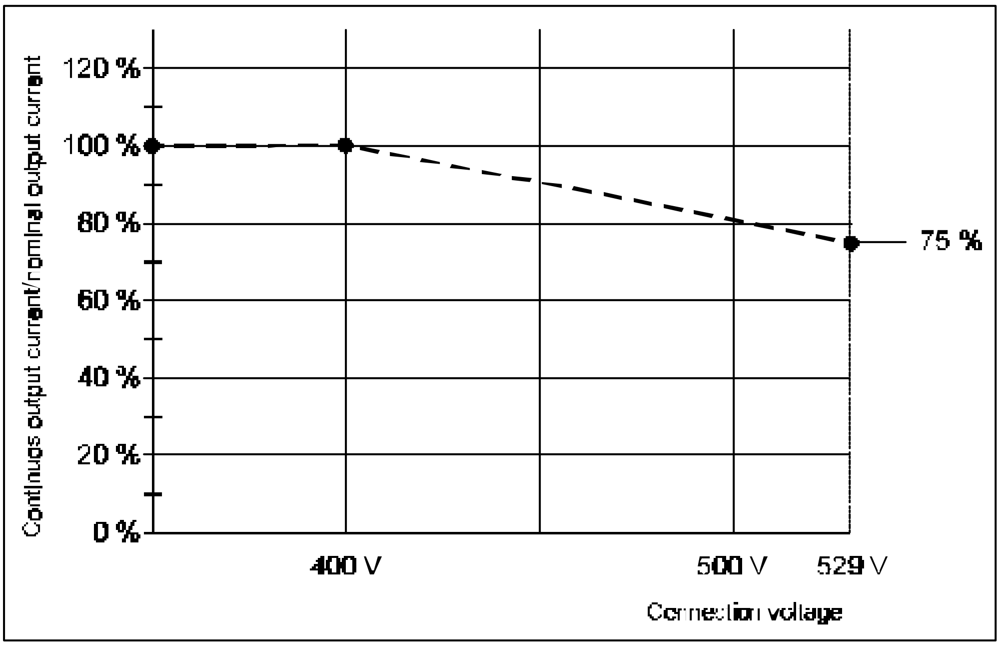


ELECTRICAL DATA, POWER STAGE

	DAM 61 – 20/30	DAM 61 - 30/45	DAM 61 - 40/60
Input voltage (mains)[1)]	3 x 400 - 460 V_{AC} -15% +15%, 48 - 62 Hz		
Supply voltage [2)]	+ 24 V_{DC} - 20% / +20% (max. 55 W)		
Power input	15 kVA	23 kVA	29 kVA
Nominal voltage of intermediate circuit [3)]	540 V_{DC}		
Intermediate circuit capacity	925 µF	1160 µF	1395 µF
Output voltage[4)]	3 x 0 V_{AC}... 95 % of the input voltage		
Output frequency [5)]	0 Hz. ...400 Hz		
Continuous output power at 4kHz [10)]	max. 13 kVA	max. 20 kVA	max. 27 kVA
Continuous output power at 8kHz [10)]	max. 10.5 kVA	max. 16 kVA	max. 21 kVA
max. continuous motor power at 4kHz [10)]	9 kW	14 kW	18 kW
max. continuous motor power at 8kHz [10)]	7.2 kW	11 kW	14.5 kW
Nominal output current [6) 7) 8)] at 4kHz [10)]	20 A	30 A	40 A
Nominal output current [6) 7) 8)] at 8kHz [10)]	16 A	24 A	32 A
Peak output current [6) 7) 9)] at 4kHz [10)]	30 A	45 A	60 A
Peak output current [6) 7) 9)] at 8kHz [10)]	30 A	45 A	60 A
Discharge current (external)	max. 40 A		
Power via intermediate circuit connection	max. 14 kW		
Internal braking resistor	32 Ω / 150 W (for short periods 18 kW (0.1 s)		
External braking resistor	> 20 Ω cont. power acc. to requirement up to max. 15 kW		
Overvoltage threshold	780 V		
Environment temperature [11)]	40 °C up to 55 °C with 3% °C degradation		
Dissipation [3)] Supply connection	245 W max. 55 W	350 W max. 55 W	460 W max. 55 W
Protection type	IP 20		
Installation altitude [12)]	max. 1000 m over sea level		
Relative humidity	15% ... 85% non condensing		
Storage temperature	-30 °C ... +70 °C		
Dimensions (L x L x H)	132 x 490 x 300 mm		
Weight	18.6 kg		

1. The voltage drift between phases must not exceed +/- 3.0 %.
2. according to DIN 19240.
   With low level input voltage with voltages < 24 V the fan throughput diminishes. In such cases it may be necessary to reduce the output current.
3. All nominal values refer to an input voltage of 400 V and a supply voltage of 24 V.
4. The output voltage is a square wave. The given value refers to the effective value.
5. The output frequency depends on the controller used.
6. Effective value at an environment temperature of 40° C.
7. Up to the nominal value of the input voltage the device supplies the max. nominal output currents. If the input voltage is higher than the nominal voltage, at constant power the output currents have to be reduced proportionally.

   Characteristic curve 1: output currents as a function of input voltage.



8. The continuous output current has to be reduced between 40° C and 55°C. Its value results from the following formula:

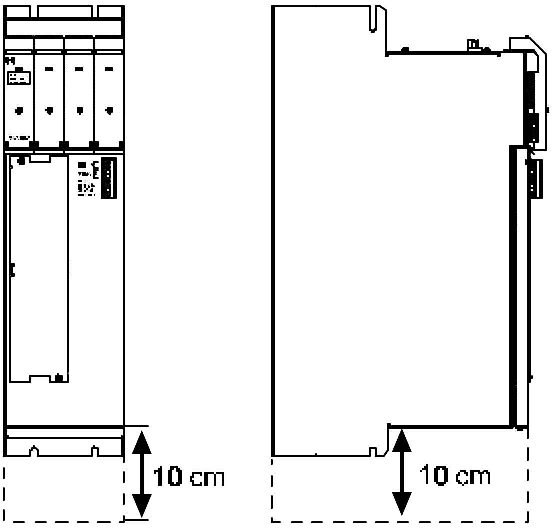
$$I_A = I_{A(40°C)} . (1 - \frac{\text{environment temperature} - 40°\,C}{°\,C} .0.03)$$

   Example: continuous output current = 30A, environment temperature = 47° C:

$$I_A = 30A \cdot (1 - (\frac{47°\,C - 40°\,C}{°\,C} \cdot 0.03)) = 30A \cdot 0{,}79$$

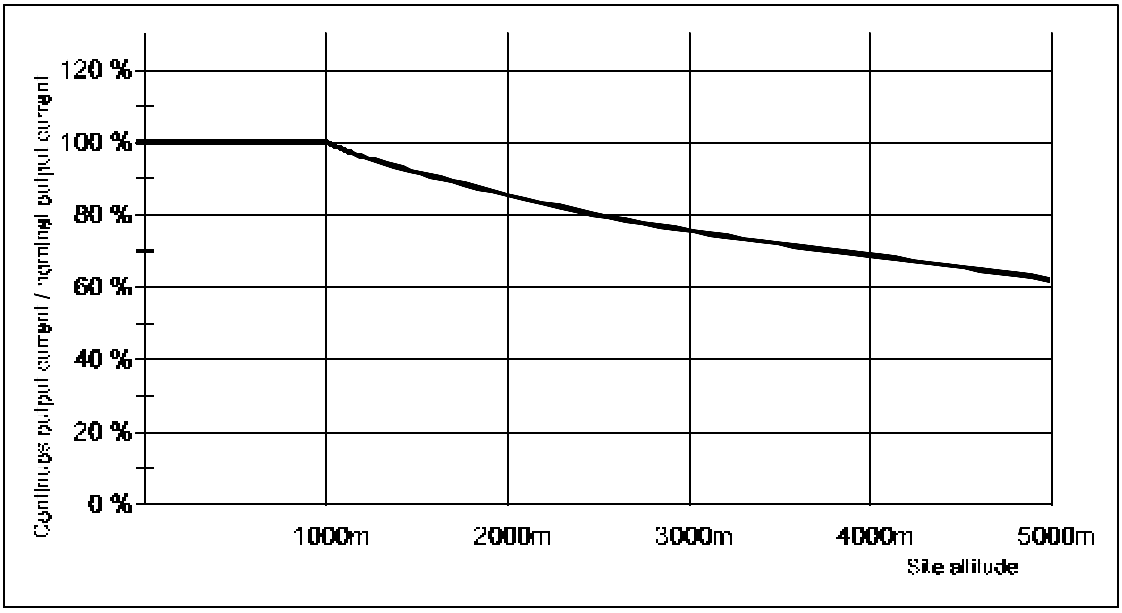
   therefore the nominal output current has to be reduced to: 23.7 A
9. The peak output current is available for periods ≤1s. The overload time is calculated so that the effective value taken from the output current does not exceed the nominal current.
10. PWM control frequency
    (see the description of parameter P103 in the programming manual).

11. The environment temperature is determined as follows:



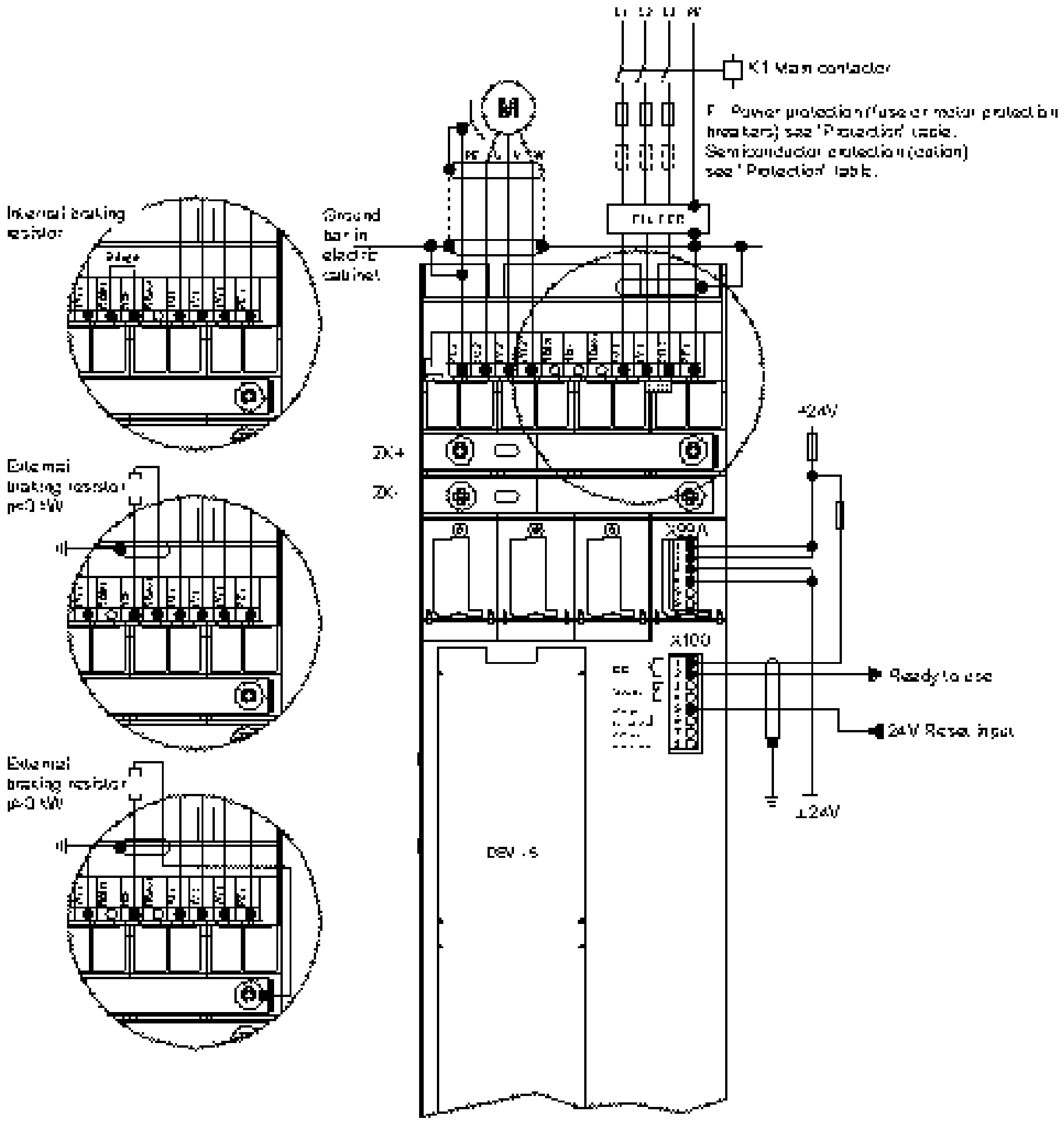
- Fix several measurement points, which cover the shown environment based on the attached drawing at a distance of 10 cm.
- Measure the temperature in these points.

12. Characteristic curve 2: Load level as a function of installation altitude



CONNECTION DIAGRAM

Overall Diagram



Protection

For the protection of the DAM 61 on the mains side as well as for the line, you can use fuses of the class gL DIN VDE 0636 para. 21 or automatic line breakers with a characteristic L curve according to DIN VDE 0641 A4. These fuses protect against overloads and damages due to faults, but cannot prevent destruction of the devices due to accidental shortcircuits or ground circuits in the intermediate circuit.

In addition semiconductor fuses DIN VDE 0636 para. 2 can be connected in series with the automatic cable fuses. These protect the circuit at the input of the drive.

Mains voltage		**400 V**	**480 V**
Cable protection	DAM 61 - 20/30 DAM 61 - 30/45	32 A	25 A
Cable protection	DAM 61 - 40/60	40 A	35 A
Semiconductor protection *	DAM 61 - 20/30 DAM 61 - 30/45	63 A	40 A
Semiconductor protection *	DAM 61 - 40/60	63 A	63 A

* If you use semiconductor fuses you have to remember the following:

If the mains return after a short interruption, the fuse may blow.

Braking Circuit

Depending on the application requirements you can connect either only the internal or only an external braking resistor. For this you have to consider the following:

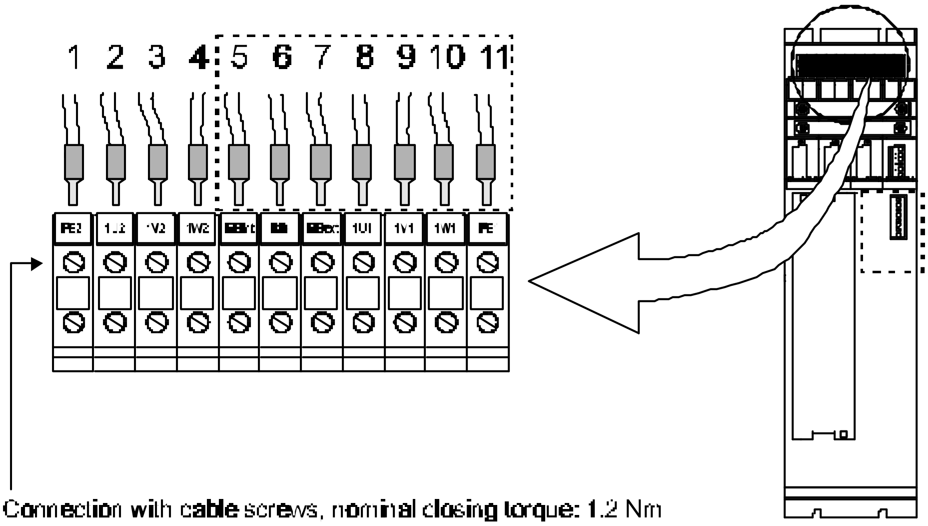
- Without an internal or external resistor the braking circuit for the intermediate circuit does not function. The “ready for use” signal is not active.
- The internal resistor is monitored for overloads. In case of an overload the “ready for use” signal will be disabled causing error 0110.

Resistors

- The internal resistor is enabled by setting a jumper between the terminals RB- and Rbint.
- External resistors with a continuous power < 3 kW are connected to the terminals RB- and Rbext.
- External resistors with a continuous power > 3 kW are connected to the terminals RB- and ZK+ (intermediate circuit bar under the protection cover for accidental touching).

Power Connections

Terminal strip X1



Terminal	Pos.[1)]	Designation	Voltage [2)]	Current [3)]	Cross section [4)]
PE2	1	ground connection			10 - 25 mm2 8 - 4 AWG
1U2	2	motor connection phase U	max. 570 V	max. 60 A	
1V2	3	motor connection phase V			
1W2	4	motor connection phase W			
RBint	5	braking resistor connection	between RB- and RBint/RBext max. 780 V_{DC}	max. 40 A	
RB-	6	**with internal resistor:**			
RBext	7	RB- is jumpered with RBint ATTENTION If you connect an external resistor, you have to remove the jumper between RB- and RBint! Otherwise the protection circuit of the internal resistor cancels out the effects of the external resistor which may damage the power unit. **with external resistor:** The resistor is connected to RB- and RBext.			
1U1	8	mains connection phase L1	400 V -15 % to 460 V +15%	max. 60A	
1V1	9	mains connection phase L2			
1W1	10	mains connection phase L3			
PE1	11	ground connection			

1. contact position
2. max. voltage between the contacts
3. max. current between the contacts
4. Design the connection cross sections according to the standards in force (among them VDE 0113/ 0298) depending on application circumstances.

   If you consider UL508C: only copper cables for 60°C / 70° C are allowed (UL508C, Nov 27, 1996, Tab. 39.2. nominal closing torque for the connection screws: 1.2 Nm).

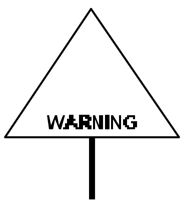
NOTES:
Connect the contacts 1U2, 1V2, 1W2 with the contacts U, V, W resp. on the motor.

Considering that the current inrush limitation works with the brake resistance, the drive can only be operated, if either the internal or an external resistor has been connected.

Completion note for complying with US UL508C (UL Standard for Safety for Power Conversion Equipment):

The devices are designed for connection to mains with a shortcircuit current of max. 5000 A (UL508C, Nov 27, 1996, Tab. 44.1).

Signal connections

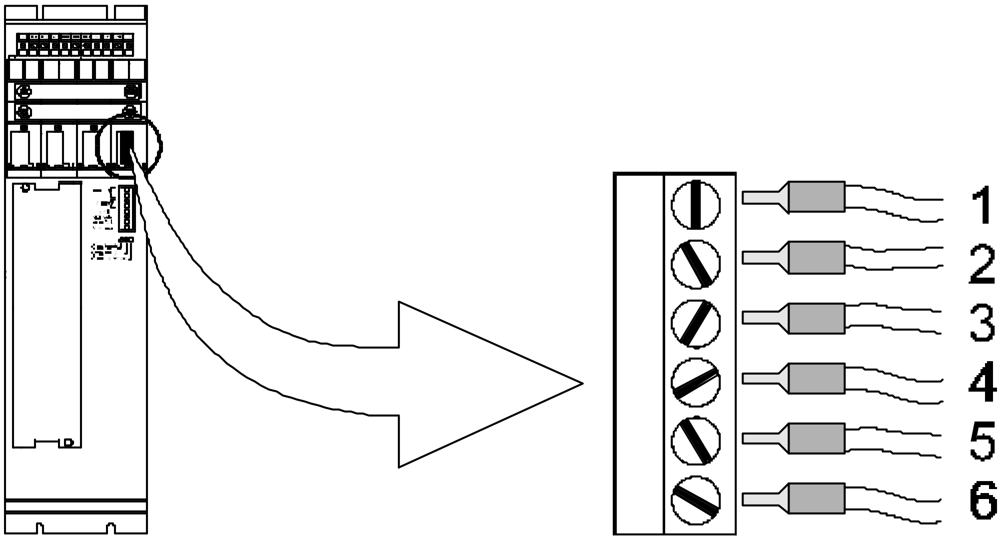


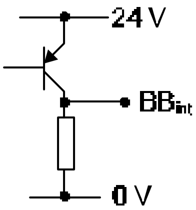
All externally provided control voltages (24 V) have to fulfil the rules for PELV or SELV.

The max. current allowed for each terminal must not be exceeded. Otherwise the unit will overload with the risk of damaging it.

The max. current of 10 mA for each relay contact must not be exceeded. Otherwise correct functioning is not guaranteed.

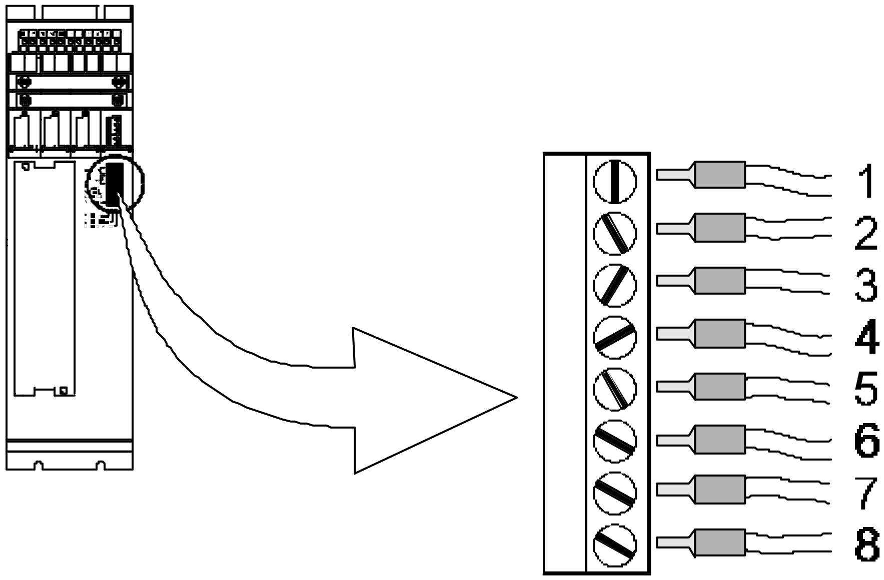
Terminal Strip X99A

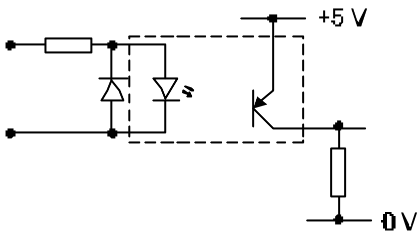


Terminal	Pos.	Designation	Voltage	Current	Cross section
+24 V	1	**+ 24 V_{DC} (PELV)** terminals 1 and 2 are internally jumpered	24 V +20 % 24 V -20 %	max. 10 A	0.2 - 2.5 mm^2 24 – 12 AWG
+24 V	2				
M 24 V	3	**Ground 24 VDC (PELV)** terminals 3 and 4 are internally jumpered	0 V		
M 24 V	4				
$BB_{int.}$	5	“ready to use” signal power supply 0 V: not ready 24 V: ready 	0 V or 24 V	max. 80 mA	
Zus.	6	bi-directional signal "Reset Bus"		-	

NOTE:
At the + 24 V power supply input there are capacitors (440µF), which cause a current inrush when the 24 V power supply is switched on!

Terminal Strip X100



Terminal	Pos.	Designation	Voltage	Current	Cross section
BB	1	**"ready to use"** signal[1] open contacts: power supply not ready	24 V	0.5 A	0.2 - 2.5 mm^2 24 – 12 AWG
	2	closed contacts: power supply ready			
Vorw.	3	**“warning”** signal[1] closed contacts: power supply: no warning	0 V		
	4	open contacts: power supply: warning			
Reset +	5	power supply reset error  	24 V	max. 20 mA	
M 24 V ⊥	6	negative point of inputs + Reset and ZK-Entl (identical with X99A; 3,4)	0 V		
ZK-Entl	7	command for activating the function “Discharge intermediate circuit ”	24 V	max. 20 mA	
nicht bel.	8	reserved	-	-	

1. This signal refers only to DAM 61 power supply unit, not to the controller!

CONTROL FUNCTIONS AND THEIR SIGNALS

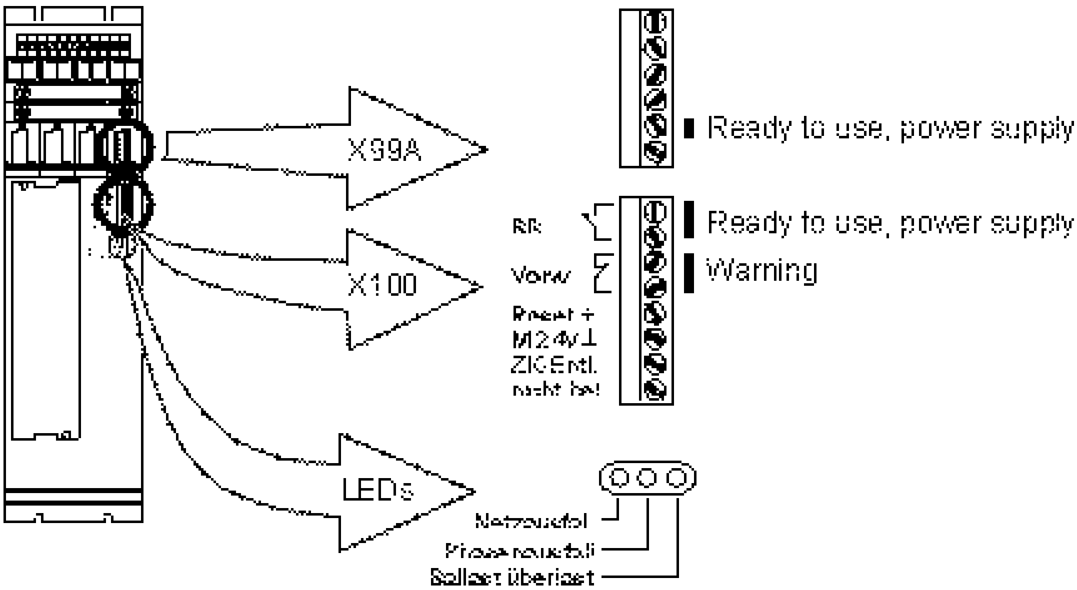
NOTE:
The control functions are only enabled, when the +24 V supply voltage (X99A) is switched on.

The control functions of the DAM 61 are subdivided into two groups.

The first group concerns the power supply, the second the power on the motor side. This subdivision corresponds to the drive’s internal structure.

Control Functions / Power Supply

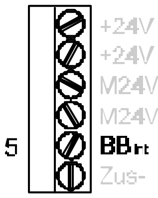
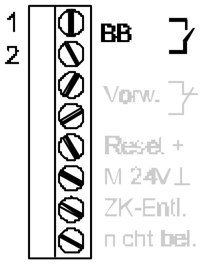
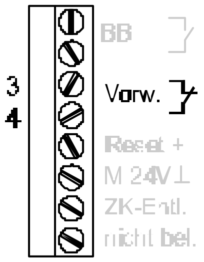
There are three indications which are displayed via LED’s. If none of the three is present, the “ready to use” signal is issued to the outside world via terminals and sent to the DSV-6 controller messages. The following figure shows the relative terminals and LED’s.



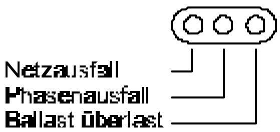
Control Functions / Power on Motor Side

The signals generated by the power module on the motor side are only sent to the DSV-6 controller where they are processed.

Signalling via Terminals (Power Supply)

Pin terminals	Description
 X99A	0V: power supply not ready for use 24V: power supply ready for use **NOTE:** This signal should not be used
 X100	contact open: power supply not ready for use contact closed: power supply ready for use
 X100	contact closed: warning not active contact open: warning active

Signalling via LEDs (Power Supply)

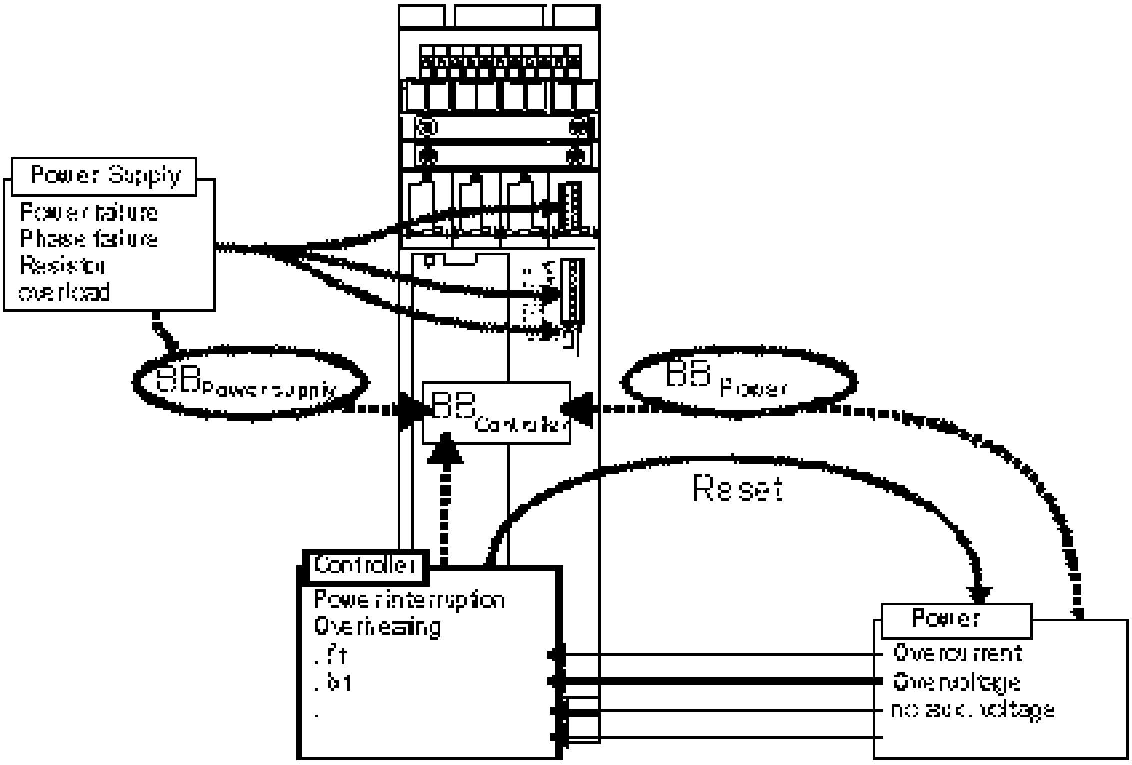
	The left LED is on: Mains power failure: at least two mains phases are down. The middle LED is on: Phase down: one mains phase without net voltage. The right LED is on: Resistance overload: the braking resistor is overloaded.

Ready to Use

There are three different signals for “ready to use” in a drive.

- "ready to use” /power supply " (X99 + X100)
  is generated by the control functions of the power supply controller.
- "ready to use / power ”
  is generated by the control functions of the motor power controller.
  The switched-on controller processes these two signals, adds its own control functions and, if necessary, generates the operation “ready to use / controller”.
- "ready to use / controller ” (DSV-6)
  is generated by the controller.

NOTE:
The drive can only be released on the signal “ready to use / controller” (see figure).



BB. ready for use

NOTE:
After switching on the +24 V supply and the mains voltage the drive is ready for operations in 3.5 sec.

Control Function

The following table provides an overview of all control functions. Explanations for the individual functions are given on the following pages.

Control functions			**Contact switching**	**Alarms signalled by the DSV-6**	**Reset**
Power supply	Phase down	WARNING	X100; 3,4	-	-
		↓ after 10 sec ↓			
		alarm “not ready for use ”	X 100; 1,2	F 0110[1)]	24 V [2)]
	Mains down	WARNING	X100; 3,4	-	-
		↓ Se U_{ZK} < 310V ↓			
		alarm “not ready for use ”	X 100; 1,2	F 0110[1)]	24 V [2)]
	Overload internal braking resistor		X100; 1,2 / 3,4	F 0110[1)]	24 V [2)]
Power motor side	Overcurrent (motor)		-	F 0202	controller[3]
	Overvoltage intermediate circuit (bus)		-	F 0201	controller[3]
	Overheating heatsink		-	F 0205	controller[3]

1. If there is a fault in the supply element, the controller V issues a signal common for the various faults.
2. Reset command: +24V at Reset+, on X100-5

   or

   Switch the +24 V supply off and on.

   This operation cancels **all** signals from the power supply element!

   If there is only a warning, you can set the drive into a defined state before the power unit disables the “ready to use” message.
3. The signalling is cancelled by a controller reset.

NOTE:
In order to be able to cancel an error signal, the cause for this message has to be removed.

Power Supply Control Functions

- **Phase failure**

  The voltage of all phases of the mains is monitored. If one of the net phases is down, the warning relay contact opens. The middle LED lights up showing the user that there is an operations fault. If the phase voltage returns within 10 secs. the warning is cancelled and operations continue as normal.

  If the voltage does not return within 10 secs., also the “ready to use” relay contact opens. This event is also signalled to the DSV-6 controller.

- **Mains power failure**

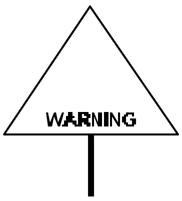
  If at least two phases are down the mains power failure condition exists. The control function opens the prealarm relay contact. At the same time the left LED lights up. This power failure causes the voltage in the intermediate circuit to drop. If it falls under 310 V, also the “ready to use” relay contact (X100, 1,2) opens:

  If the mains power returns, before the 310 V threshold has been reached, the prealarm is cancelled, the relay contact (X10, 1,2) is closed again and operations continue as normal.

NOTES:

- The DSV-6 controller cannot reset the “ready to use / power supply” signal F0110 issued by the V controller, even if the cause has been eliminated. For this you have to enable the RESET+ signal (X100-5) or switch the 24 V power supply off and on again.
- Mains power failure: considering that it takes more or less 30 mins, before it can be realised that this is a power failure of the mains, the central LED lights up briefly, before the left LED signals the power failure.
- In the case of a mains power failure, the time between the disappearance of the mains voltage and disabling of “ready to use / power supply” depends on the current load status of the intermediate circuit.
- After switching on the +24 V power supply the mains power failure control function only becomes enabled for power failure detection after the **Mains** have been recognised as **ok**. Hence the function is not automatically enabled if only the +24 V power supply has been switched on.

This requires however that the mains power failure time is set > 0 sec. See “Mains power failure time " in the description of the controller.

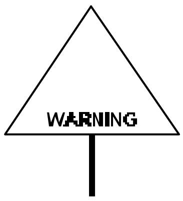


An automatic start of the drive may create risks to the user. You have to provide the necessary protection measures on the machine side!

- **Internal Braking Resistor Overload**

The internal braking resistor is monitored by electronic modelling its thermal behaviour.

If an overload is detected, the contacts of the “ready to use / power supply” (X100, 1,2) and the "warning" relay (X100; 3,4) open. The right LED lights up and the controller displays this error as “Power Supply Fault " (F0110).



If the output for the resistance becomes shortcircuited, the device will be damaged.

NOTE:
The internal resistor control function only protects the internal braking resistor. If you connect external resistors , you have to provide an overload protection e.g. by an automatic thermal breaker in the “ready to use” line.

Power Control Functions on the Motor Side

- **Overcurrent (Motor)**

  The current of each phase – 3 phase currents - is monitored individually.
  If one of the phase currents exceeds the peak current value by more than 30%, the drive generates a signal and switches off without current. The DSV-6 controller displays the overcurrent condition (F0202). This overcurrent error can be reset by the controller.

- **Overvoltage Intermediate Circuit (Bus)**

  The voltage level of the intermediate circuit is monitored.
  There will be a message, if the intermediate circuit voltage exceeds 800 V. The drive switches off without current. The DSV-6 controller displays the overvoltage condition (F0201). This overvoltage error can be reset by the controller.

NOTE:
The intermediate circuit voltage can increase up to switch-off, especially if the drive brakes and there is no or little load potential in the intermediate circuit.

- **Heatsink Overheating**

  The temperature of the heatsink is monitored.

  A linear heat sensor is mounted on the heatsink. The value of this sensor is transmitted to the controller. So the controller takes over control of the temperature. As soon as an excessive temperature (≥ 85°C) is detected, the DSV-6 controller displays the error F0205.

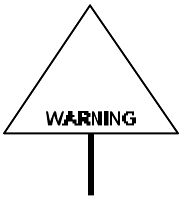
Additional Functions

Discharging the Intermediate Circuit (X100; 7)

Setting a 24 V signal discharges the intermediate circuit via the brake resistance. The power has to be disconnected from the drive input. The signal has to remain on until the intermediate current is discharged.

An approximation the discharge time can be calculated with the following formula:

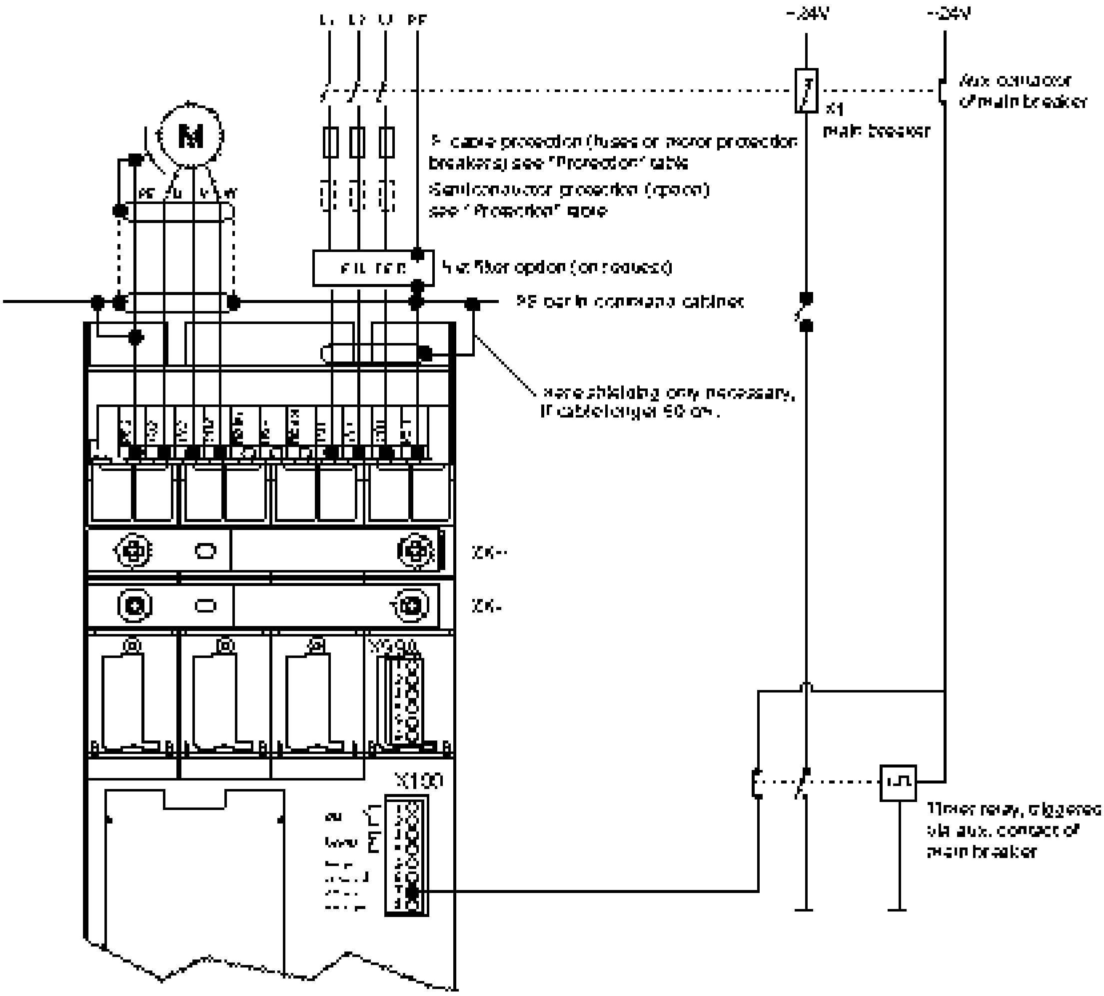
$$\text{discharge time} = \frac{4 \text{ x bus capacitor } [\mu\text{F}] \text{ x brake resistance } [\Omega]}{1000.000}$$



Ensure that the power is not switched on again, as long as the 24 V signal remains applied.

APPLICATION EXAMPLES

Connection for Intermediate Circuit (BUS, ZK) discharge



The drawing shows the contact state immediately after opening the main breaker. The bus discharges through the +24V on X100-7. After the timeout of the timer relay the +24 V are interrupted allowing a new switch-on.

Brake Resistance Dimensioning

We do not recommend oversizing (i.e. a resistor with too low resistance value).

Example:

- braking power requested by the application: 10 kW

The resistance is calculated with the formula:

$$R = \frac{U^2}{P} = \frac{780^2\,[V]^2}{10\,[kW]} = 61[\Omega]$$

This is the maximum value for dissipating the requested power. The minimum value is shown in the table of the technical data.

END OF CHAPTER