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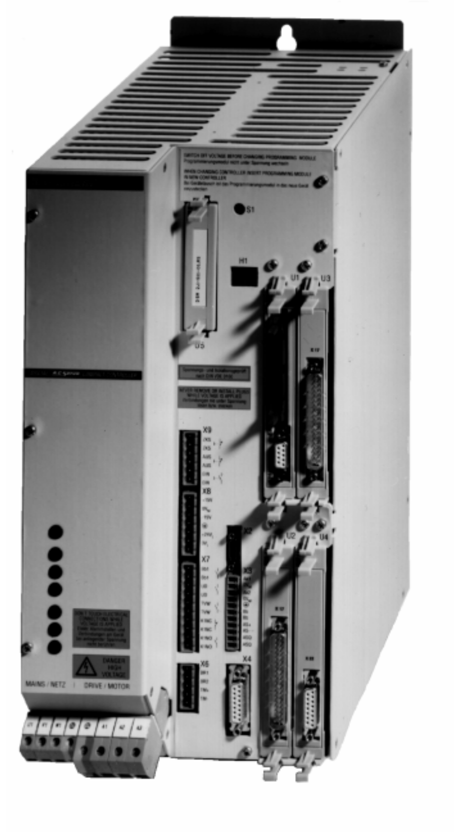

DKS and MDD

Digital Intelligent AC Servo Drives

With Single-Axis Positioning Card

Application Manual

DOK-CONTRL-DKS+MDD+DLC-ANW1-EN-P

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Indramat

Titel

DKS and MDD
Intelligent Digital AC Servo Drives with Single-Axis Positioning Card

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This documentation is used:

– As a procedurally-oriented set of instructions for setting up the digital AC servo drive equipped with a single-axis positioning card including jogging of the axes, for use by properly trained setup personnel

– Familiarization with safety information relating to working with the digital servo AC drive

– Familiarization with the functions of the servo drive and its use on the machine

– Parameterization of the DKS during setup

– Backing up the parameters set up on the DKS after completion of setup

– For error diagnostics and correction of errors on the digital servo AC drive

– Basic parameterization and setup of the single-axis positioning card; traversing the axis in jog mode

What is this document not used for?

– Setup and parameterization of the DLC 1.1 single-axis positioning card. For this module please use documentation „DLC1-A, Single-Axis Positioning Card for Digital Servo Drives, Programming Manual, Doc. No. 109-0852-4102“.

Meaning of the symbols used in this documentation

Symbol	Meaning	Explanation
	Hazard to personnel and damage to machine	Information on items to be done and to be avoided to prevent injury to personnel and extensive damage to equipment
	Note:	Passages marked by this symbol contain special information, suggestions for things to do or to avoid in order to prevent damage to equipment

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Validity

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1. System Overview

1.1. Digital AC servo drive

Intelligent digital AC servo drives are microprocessor-controlled brushless AC drives offering superior dynamic and precision servo control characteristics.

All key functions:

- drive control
- monitoring
- parameterization
- diagnostics

are performed digitally by a signal processor based on high-resolution measurement of the rotor position across the full speed range.

Digital AC servo drives, because of their:

- superior performance data
- flexible operating modes and
- applications-oriented functions

are especially well suited for the following applications:

- – CNC machine tool axes
- – electronic gearboxes, for example for gear milling machines
- – textile machines
- – grinding and polishing machines
- – robots
- – handling systems
- – assembly equipment
- – woodworking machines
- – packaging machines
- – printing machines

Intelligent digital INDRAMAT AC servo drives can be used with the following variable interfaces:

- SERCOS interface
- analog interface
- single-axis positioning card

Additional interfaces are being developed

1.2. Interfaces on the Digital AC Servo Drive

1.2.1. SERCOS Interface

Digital servo drives equipped with a SERCOS interface allow AC servo motors to be operated with a SERCOS interface (master module). The SERCOS interface is a serial real-time communications system. It was developed cooperatively by the Verein Deutscher Werkzeugfabriken e.V. (VDW) and the Fachverband Elektrischer Antriebe im Zentralverband Elektrotechnik e.V. (ZVEI) as a proposed standard (DIN IEC/TC44).

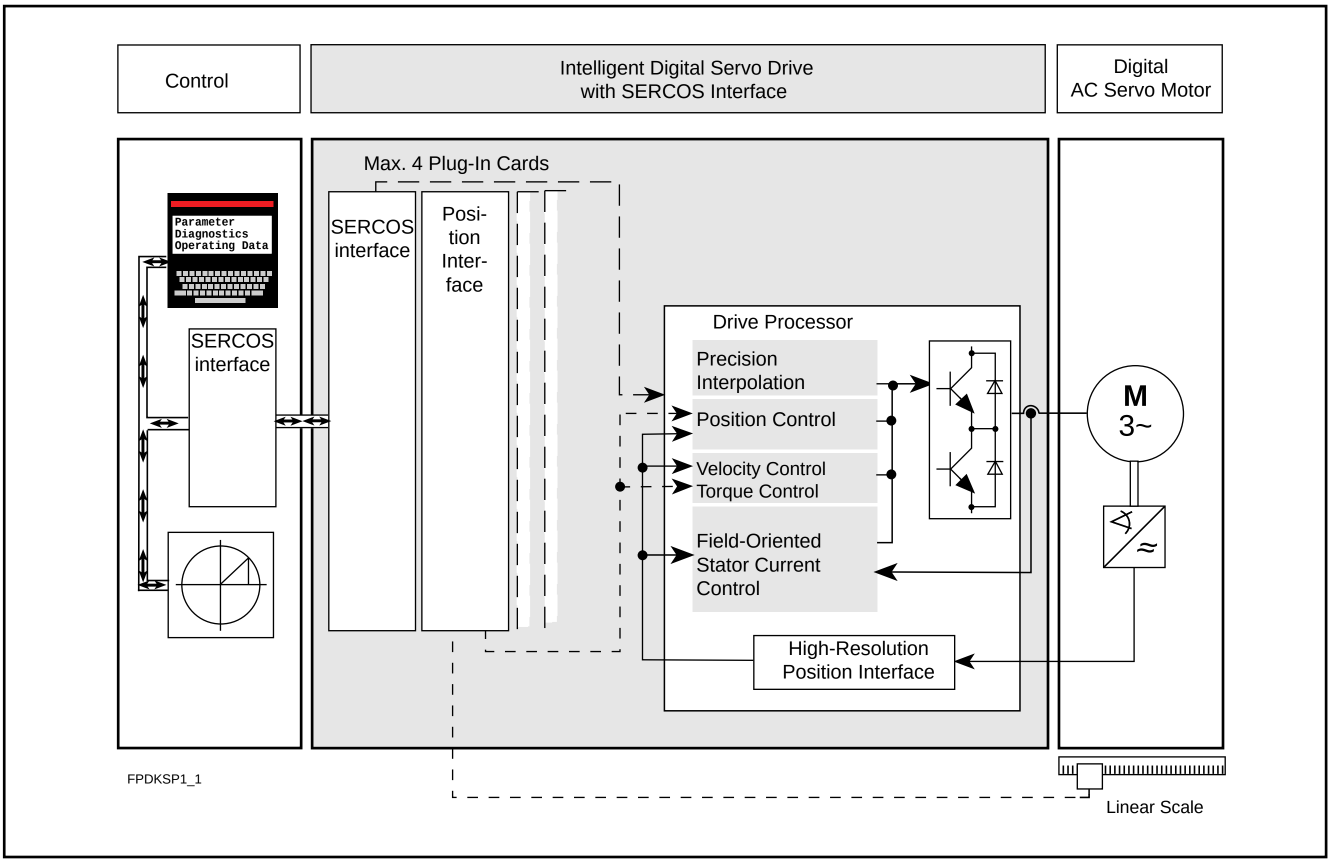


Fig. 1.1: CNC axis with digital AC servo drive and SERCOS interface.

In order to completely exploit all the capabilities and advantages of intelligent digital AC servo drives, it is necessary to use the SERCOS interface.

These capabilities and advantages are:

- Display and input of all drive-internal data, parameters and diagnoses via the terminal on SERCOS-compatible controllers
- Use of the high resolution from 0.0001 RPM to maximum RPM
- Use of the built-in precision interpolation and precision control for positioning, continuous path control and C axis mode, including a high-speed range. Cycle time: 0.250 ms, resolution: 0.00001 mm to 180 m/min with linear scales at a measurement indexing constant of 20 μm, free of following error.
- Standardization of position, velocity, acceleration, and load data and adaptation to machine parameters such as gears, spindle leads.
- Lower costs for controls, cabling, and position encoders.

1.2.2. Analog Interface

Servo drives equipped with the analog interface permit intelligent digital AC servo drives to be operated by conventional controllers equipped with a ± 10-V interface. The following operating modes are possible:

- Velocity Mode
- Torque Mode (master/slave applications)

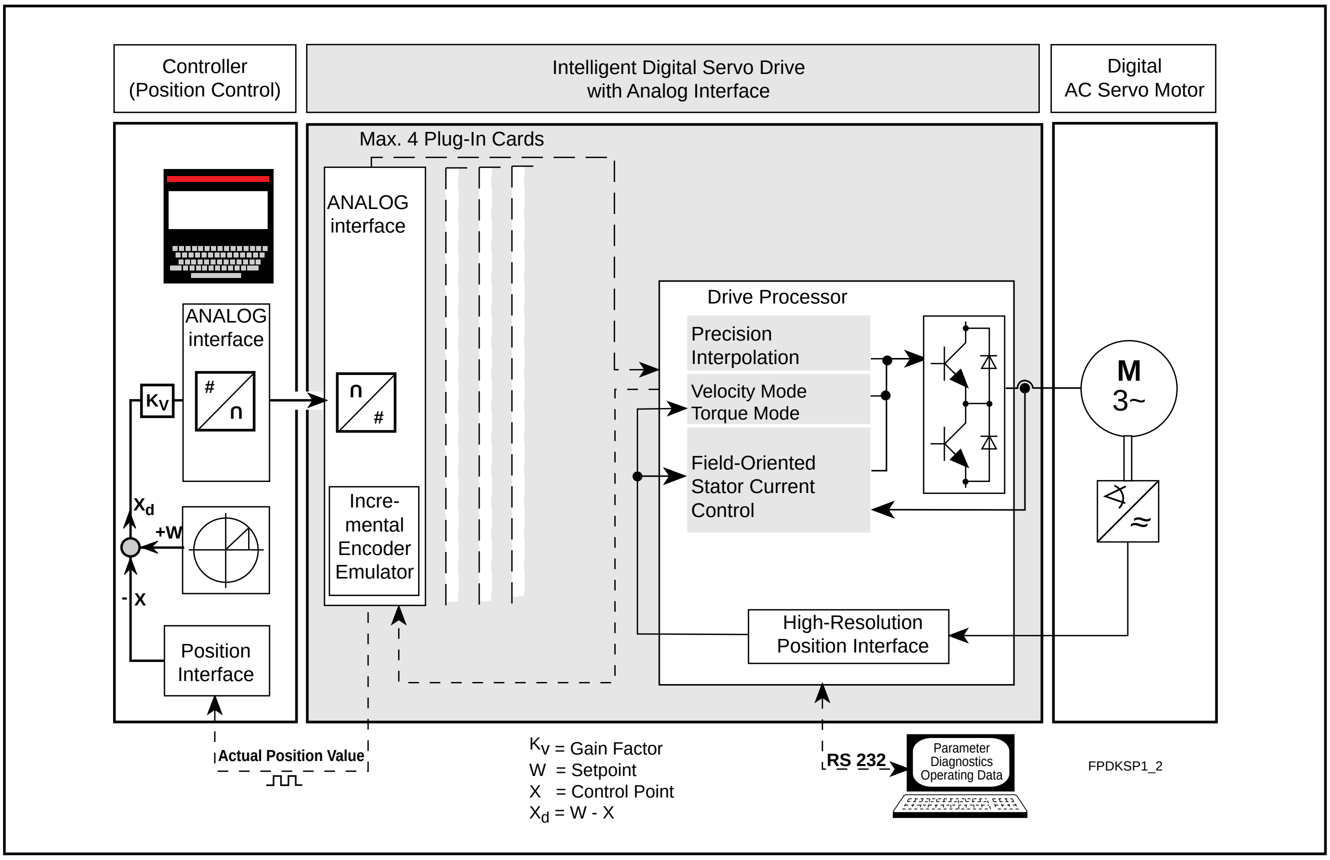


Fig. 1.2: CNC axis with digital servo AC drive and ± 10-V analog interface.

Digital AC servo drives equipped with an analog interface differ from conventional AC servo drives in the following functional areas:

- Optional output of rotor position as:
- Incremental encoder signal or as
- Absolute position encoder signal for use as the actual position value in the controller, which has the following advantages:
- Elimination of an additional measurement system with cabling to servo motor
- Shorter motor length
- The resolution of the position encoder signals is easily adapted to various machine and controller configurations through parameterization.
- Drift-free positioning after the digital servo AC drive has been successfully stopped via a switched input. The stopped position is maintained under velocity control in the drive as long as it is enabled.
- Control and monitoring of the motor holding brake via the servo drive

1.2.3. Single-Axis Positioning Card

When the DLC 1.1 single-axis positioning card is installed on the servo drive, it becomes an intelligent digital single-axis positioning controller.

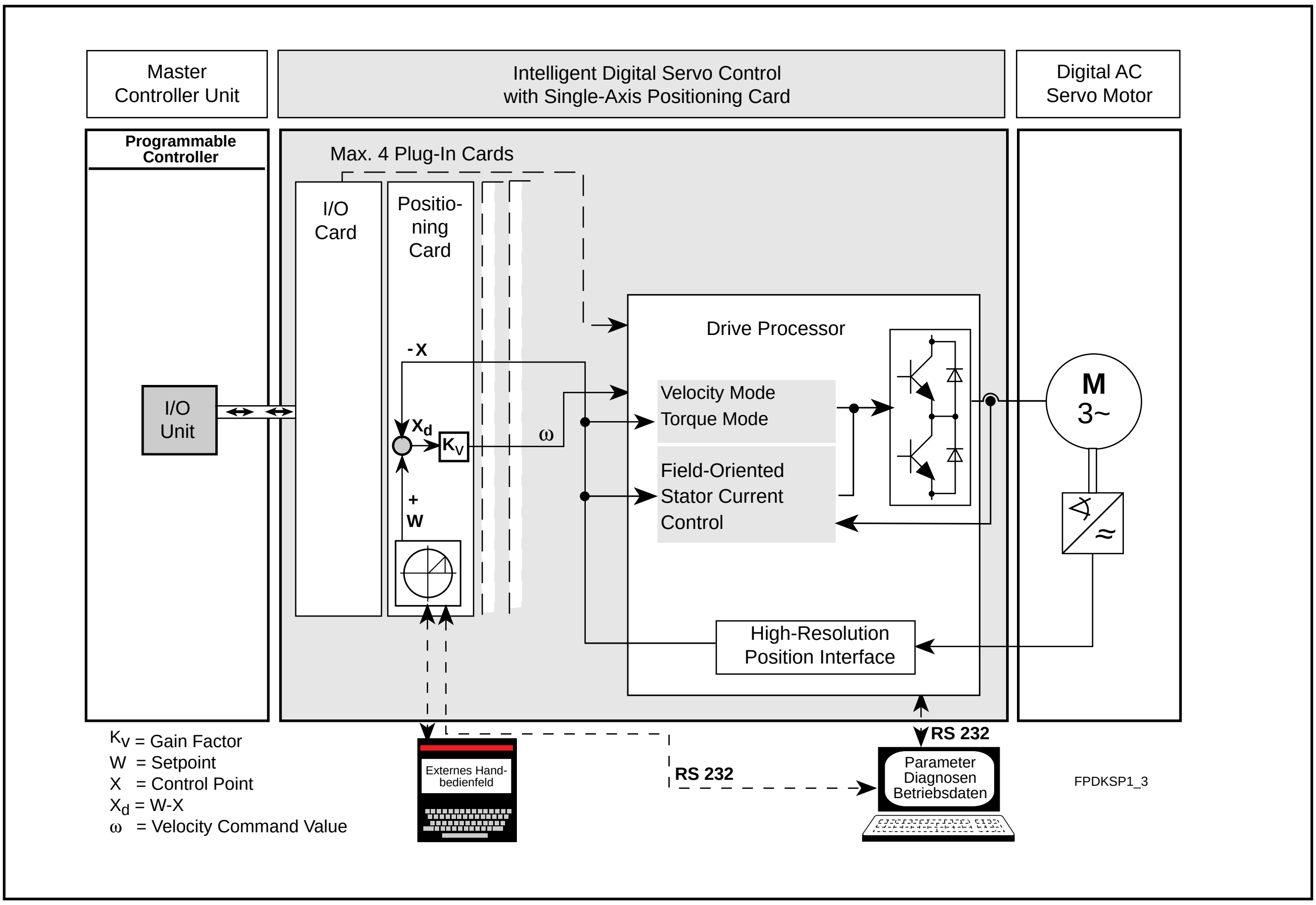


Fig. 1.3: CNC axis with digital servo AC drive and DLC 1.1 single-axis positioning card.

The DLC 1.1 single-axis positioning card offers the following features:

- User-friendly programming language
- Easy input of up to 3000 program blocks (for example, position to be traversed to, velocity, monitoring of inputs, outputs to be set, movements)
- Monitoring the current movement sequence while simultaneously executing the next program block
- Adapting the drive to the mechanical and electrical characteristics of the machine by entering various parameters
- Monitoring the parameter blocks which were entered for errors and conformity to preset system limits
- Various possibilities for parameterization/programming. (CTA programming keypad, IDS 10 X switch unit, master PC, SOT programming terminal, master PLC)

Further information on the single-axis positioning card may be found in documentation 109-0852-4102, „DLC1-A Single-Axis Programming Card for Digital Servo Drives, Programming Manual.“

1.3. Digital Servo Drive Design Approaches

Servo controls for digital AC servo drives can be supplied in the following chassis configurations:

- Modular design
- Compact design (protection classes IP 10 and IP 65)

1.3.1. Modular Design of Power Supply and Servo Drive Units

The drive system consists at least of one power supply, one servo drive and one type MDD AC servo motor.

This arrangement permits AC servo drives and AC main spindle drives of various powers to be flexibly combined into drive systems fed by a common power supply module. Various power supply units are available, which can be connected directly to 3-phase power systems from 3-phase 380 to 460 V AC, 50-60 Hz. These units are not described in this documentation.

1.3.2. Antriebsregelgeräte in Kompaktbauform

Digital servo drives are also offered in a space-saving design. A single chassis contains:

- the power supply unit and
- the servo drive

Here the drive system consists of:

DKS 1.1 compact servo drive and MDD servo motor

The DKS 1.1 can be shipped for installation in enclosures in protection class IP 10.

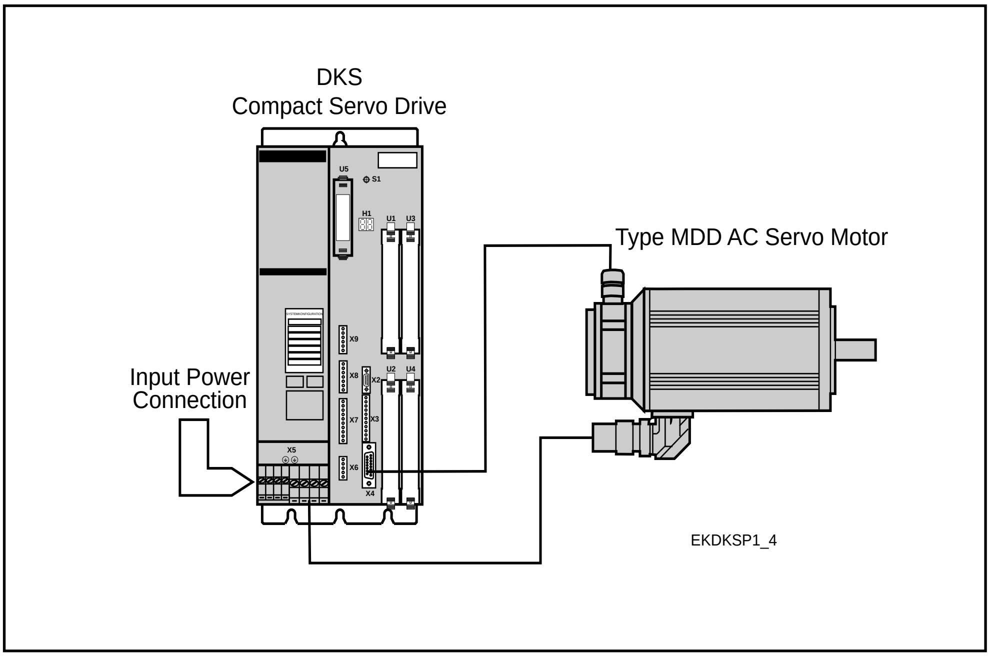


Fig. 1.4: Digital AC servo drive consisting of the servo drive in the space-saving DKS 1.1 configuration and an MDD servo motor.

The DKS 1.1 is designed to be installed in an enclosure of protection class IP 10.

Servo drives in the compact design are characterized by the following features:

- Direct connection to 3-phase power systems operating at 230V AC (±10%), 50-60 Hz.
- A DKS 1.1-030B-... can be connected to a 230V (50-60 Hz) single-phase system.
- Easily adapted to performing various functions by installing different plug-in cards.
- The servo drives are shipped with the necessary cards as complete system configurations.
- The 30-A unit is also available as a low-noise servo drive (clock frequency of the final power stage: 18 kHz).
- The full range of DKS compact servo drive products includes units which can handle a peak current of from 30 A to 100 A. Thus, servo motors having rated motor outputs from 4.5 kW to 16.0 kW can be controlled by these units.

2. Digital AC servo drive with single-axis positioning card

Figures 2.1 and 2.2 identify the servo drive components. These components are described in detail in the following sections. The position of the labels is shown to make it easier to identify the servo drive. The precise type codes can be used to order replacement components from INDRAMAT.

2.1. Component names on the DKS 1.1 servo drive

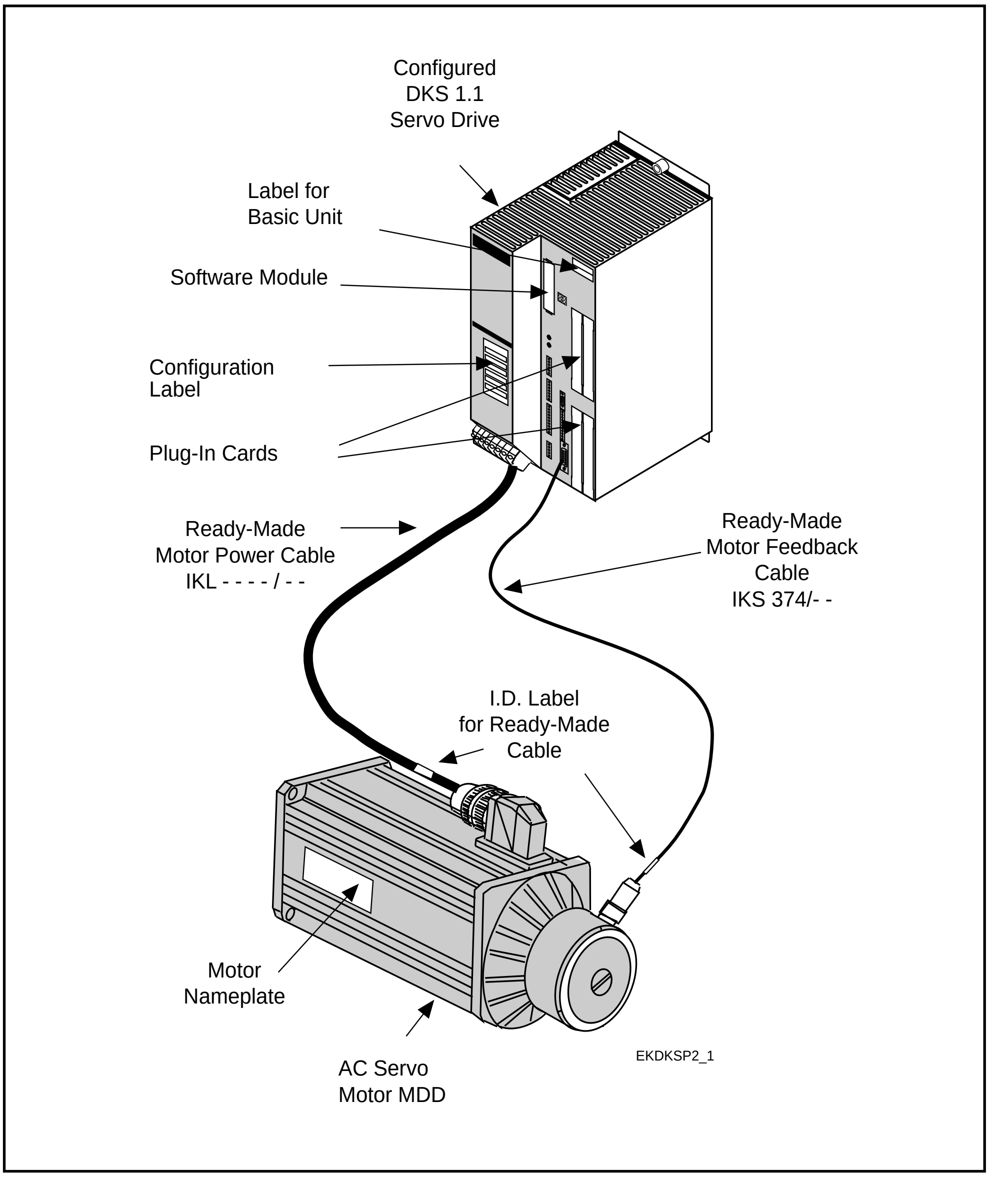


Fig. 2.2: Labelling the individual components of an AC servo drive made up of an MDD servo motor and a DKS drive controller.

2.2. Servo drive components

The servo drive can be used for various applications. It must be customized to perform specific functions. This is accomplished by installing various plug-in cards on the basic unit, together with a corresponding software module. A basic unit fitted out in this manner is referred to as a „configured servo drive.“ The configured servo drive and the digital MDD AC servo motor together form a system configuration. Pretested available system configurations are listed in the documentation „DKS1 and MDD, Intelligent Digital AC Servo Drive Selection Catalog for System Configurations“ (doc. no. 209-0069-4364).

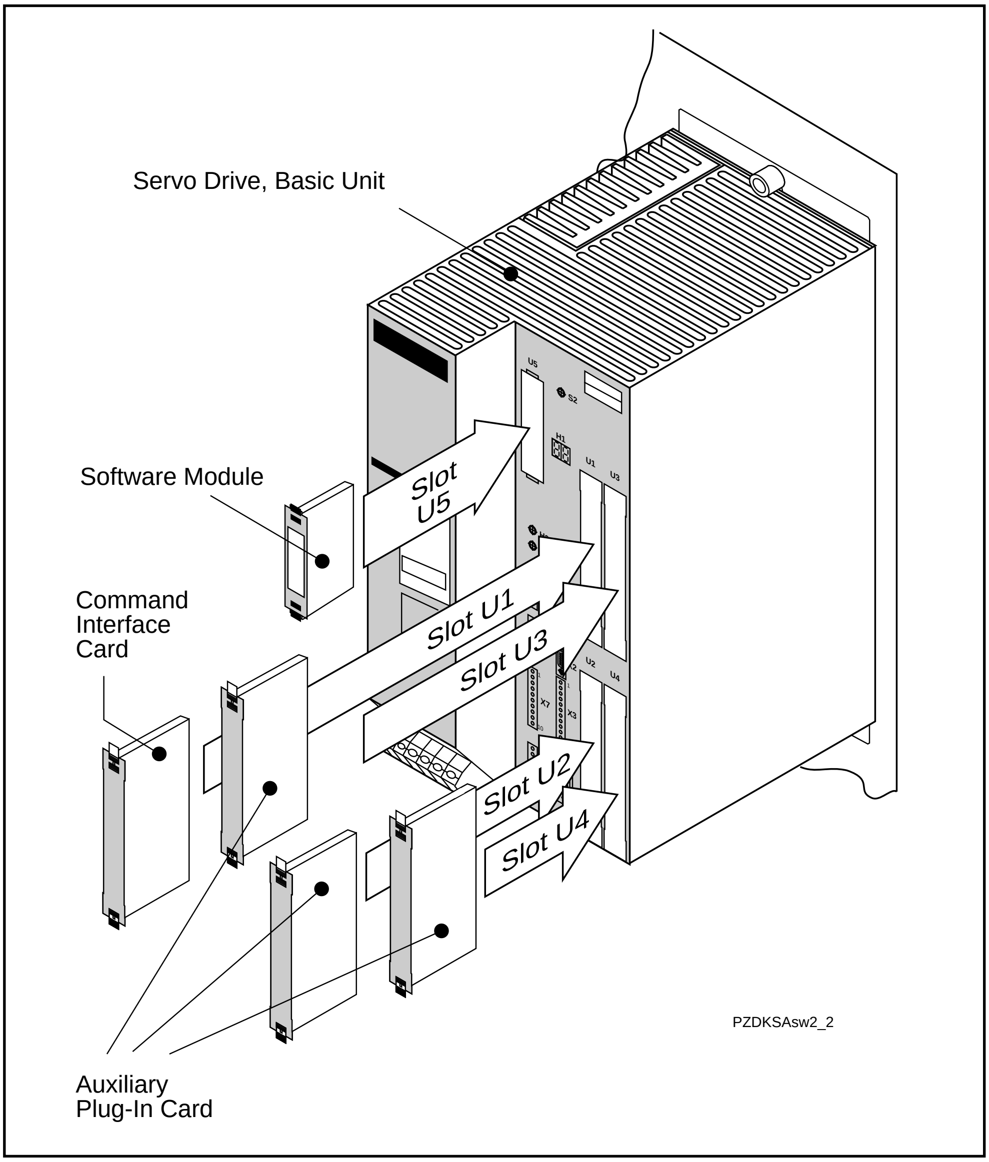


Fig. 2.2: Components for configuring the servo drive (basic unit); installation of cards in correct slot locations.

The unconfigured basic unit is not functional.

Command Interface Card

The term „command interface card“ is a general term for various plug-in cards. These plug-in cards provide interfaces to controllers, or the interface card itself represents the controller. The command interface card itself is always located in slot U1.

The following command interface cards are available:

DLC 1.1

The „single-axis DLC 1.1. positioning card“ upgrades the DKS to a standalone single-axis positioning controller.

Software module

The software module contains the operating software and the servo drive parameters. Different software modules are required for the various functions. Which software module is required will depend on the chosen system configuration. In the event of hardware replacements, the software module with the previously entered parameters is simply installed on the new equipment.

Auxiliary Plug-In Cards

The term „auxiliary plug-in card“ is a general term for additional plug-in cards which are available as options to implement specific functions.

The following auxiliary plug-in cards are presently available for DKS drive controllers with single-axis positioning cards:

The „input/output (I/O) DEA interfaces“ are I/O cards, each having 15 inputs and 16 outputs, used for exchanging binary signals.

DEA 4.1
DEA 5.1
DEA 6.1

The DEA 4.1, DEA 5.1 and DEA 6.1 cards differ in the addresses set on them. If the DEA 4.1 is used with the DLC 1.1 single-axis positioning card, the controller uses 8 inputs and 5 outputs. Seven inputs and 11 outputs are available for further assignment.

DEF 1.1
DEF 2.1

The „DEF 1.1 and DEF 2.1* incremental position interface“ cards are used to input square wave signals to the servo drive in order to evaluate data from an external measuring system located directly on the machine. Different addresses are set on each card.

The following is a list of plug-in cards which are not operated with the DLC 1.1 single axis positioning card. The list is provided to help identify various drive configurations.

Command interface cards:

DAA X.X = analog interface with absolute encoder emulation
DAE X.X = analog interface with incremental encoder emulation
DSS X.X = SERCOS interface

Auxiliary plug-in cards:

DFF X.X = single-turn encoder interface
DLF X.X = high-resolution position interface (sinusoidal signals)
DPF X.X = pulse wire encoder, absolute encoder, interface
DQM X.X = communication module for anti-backlash drive
DZF X.X = tooth-gear encoder interface
CLC-D X.X = single axis controller for digital drives

Servo Drive, basic unit

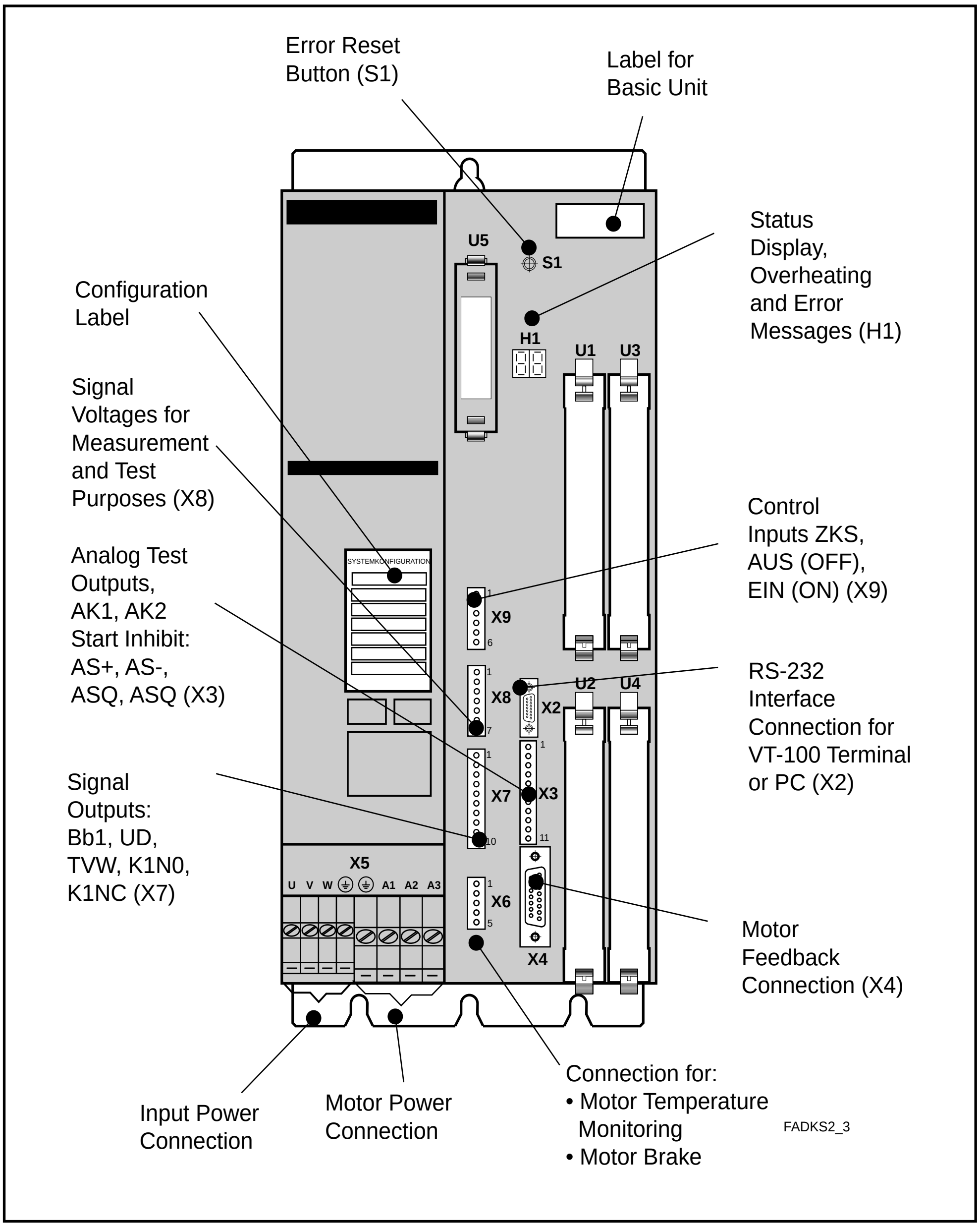


Fig. 2.3: Identification of terminals, displays and buttons on a DKS basic unit.

Configuration label

The configuration label shows the type code numbers for:

- the configured servo drive
- the basic unit
- the software module in slot U5
- and the plug-in cards in slots U1 to U4

The configuration label provides information as to which cards are installed in the servo drive. Before setting up the servo drive, check the configuration indicated on the configuration label.

If there is a malfunction, the information on the configuration label can be used to obtain a replacement or basic unit. A replacement unit is obtained by installing the cards indicated on the configuration label into the basic unit.

DKS basic unit label

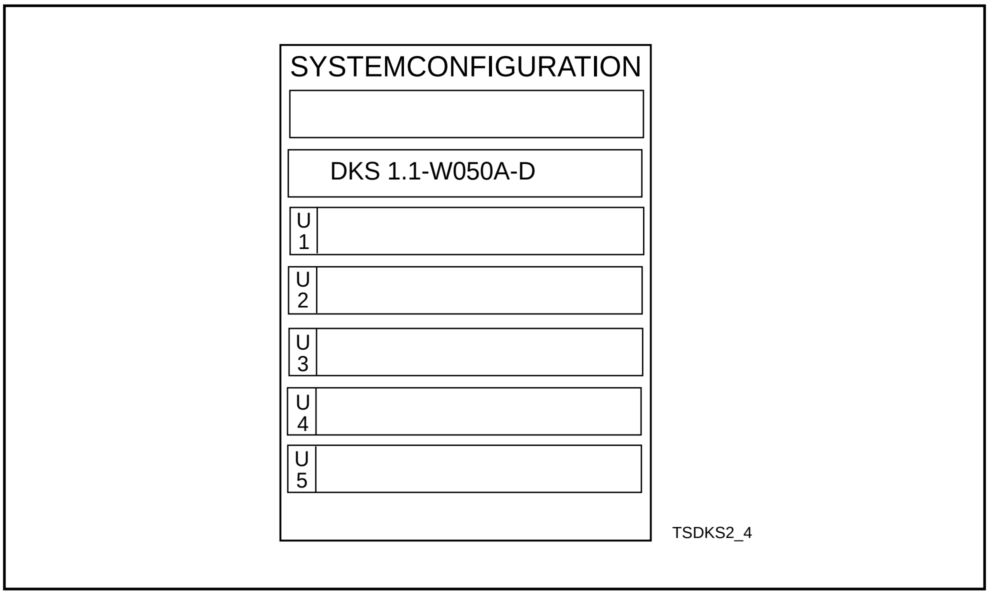


Fig. 2.4: Servo drive label, basic unit.

If the basic unit has cards installed in it, they are also entered on the servo drive label (basic unit), Fig. 2.4.

The position of the label is shown in Fig. 2.3. The following key may be used to interpret the type code.

Model number key for DKS basic unit

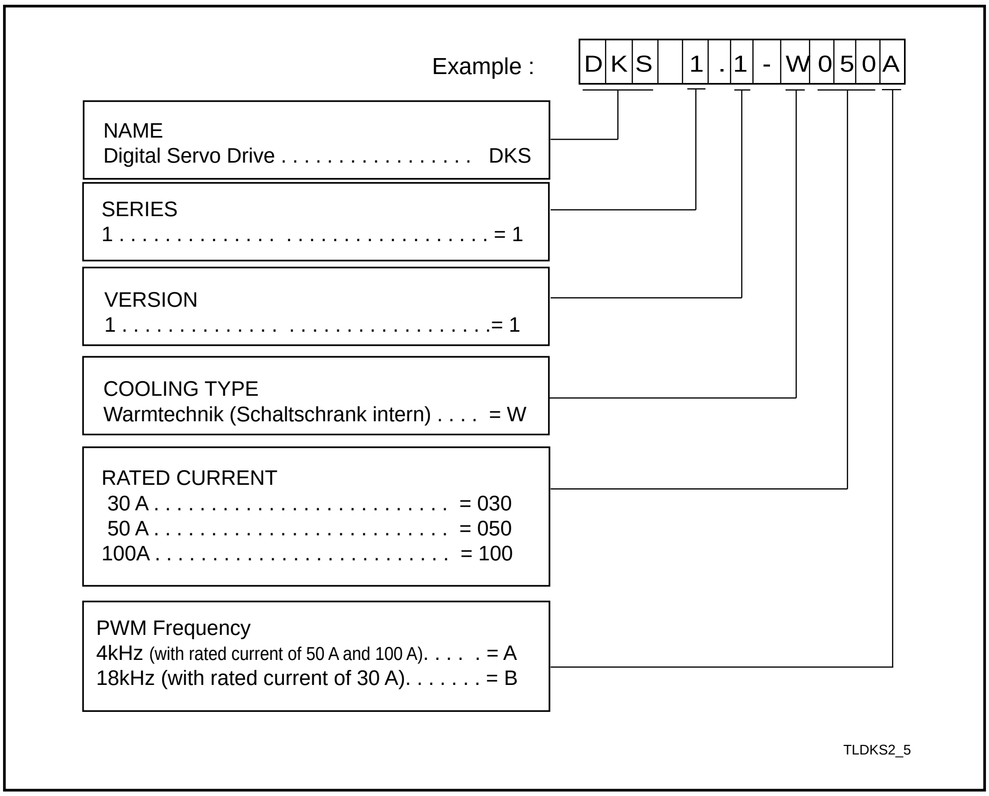


Fig. 2.5: Key for interpreting DKS basic unit type code.

DKS sample type code

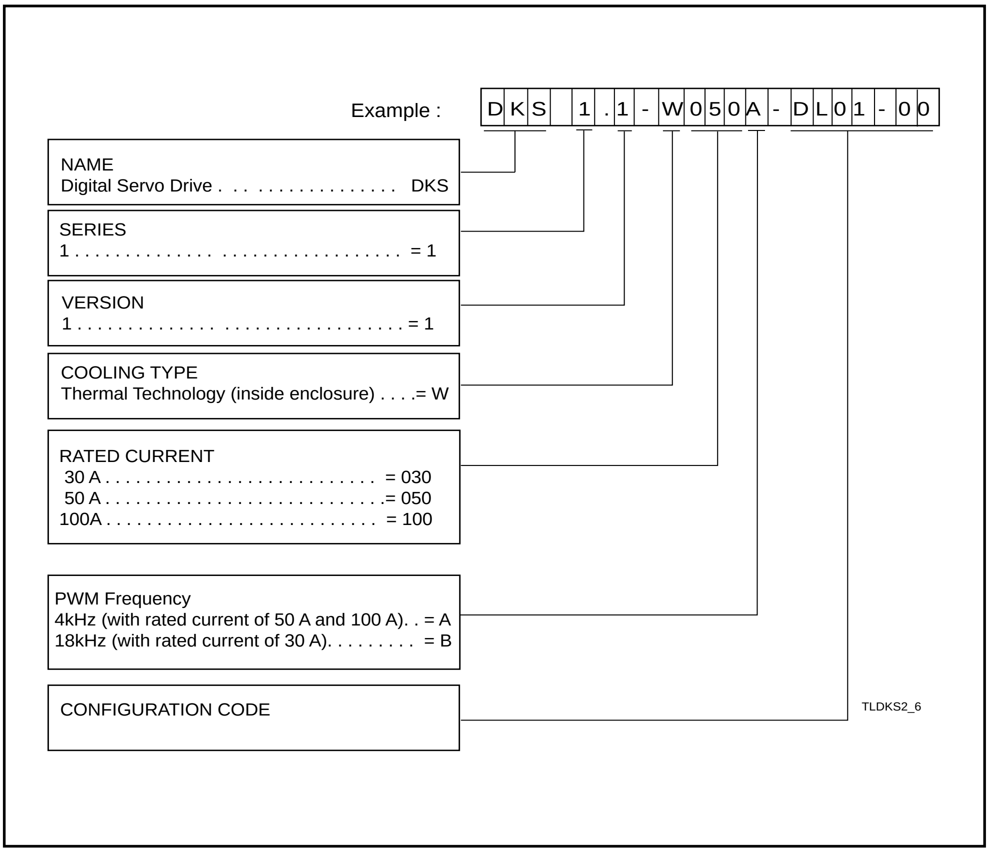


Fig. 2.6: Example of a type code for a configured DKS (system configuration DL 01).

System configuration label

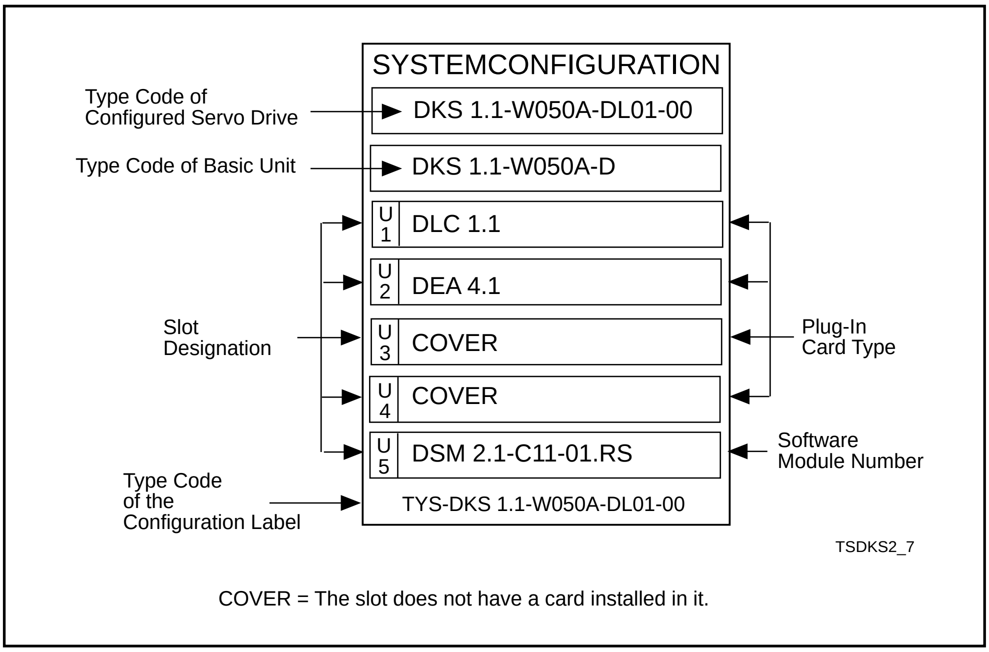


Fig. 2.7: Example of a system configuration label (configured basic unit, system configuration DL 01).

Command interface card DLC 1.1, single-axis positioning card

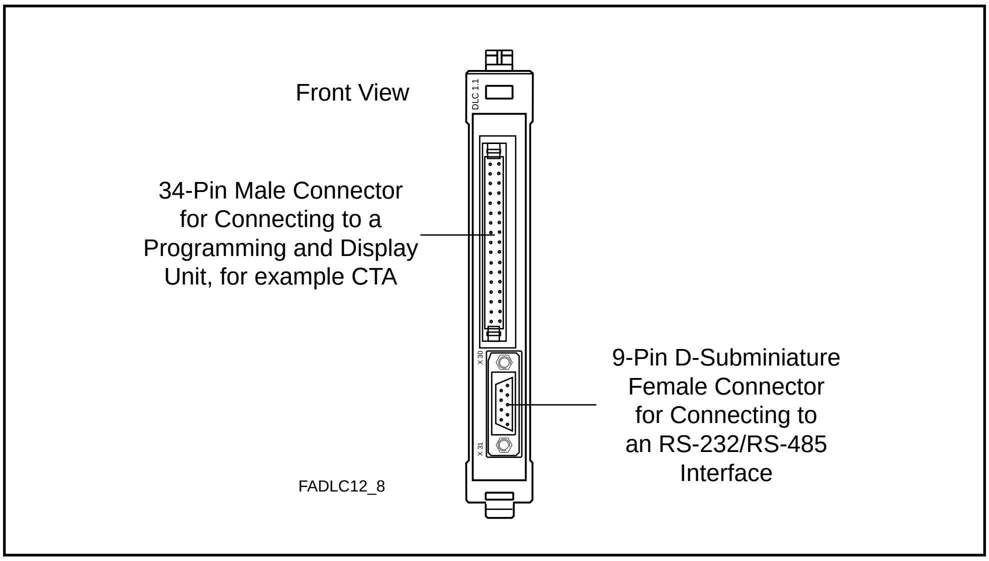


Fig. 2.8: Labelling the parts of a DLC 1.1 single-axis positioning card.

A detailled description of the single-axis positioning card may be found in the DLC 1A documentation, „Single-Axis Positioning Card for Digital Servo Drives-Programming Manual,“ doc. no. 109-0852-4102.

Eight inputs and five outputs are used by the DLC on the DEA 4.1. Seven inputs and 11 outputs remain available for assignment.

If there is a second DEA on the servo drive (DEA 5.1, DEA 6.1), then an additional 22 inputs and 27 outputs are available.

Type codes for the command interface cards

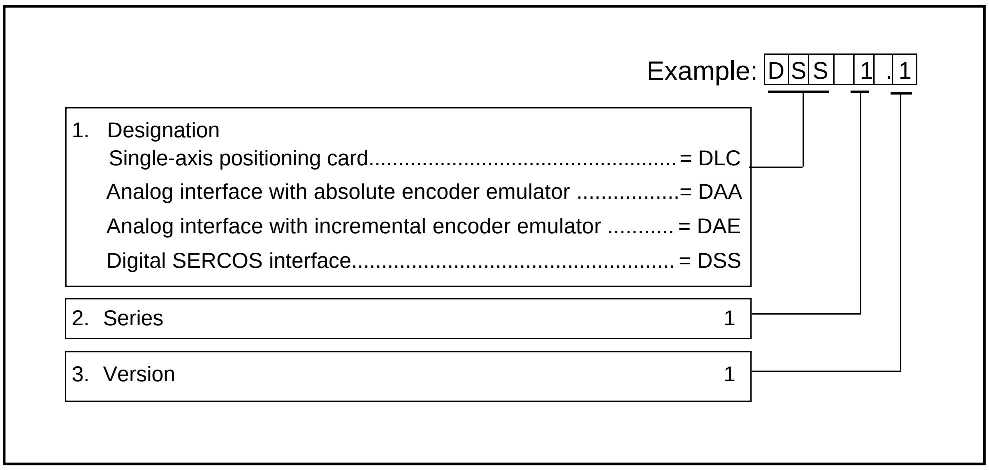


Fig. 2.9: Key for interpreting the command interface type codes.

DEA 4.1 auxiliary plug-in card

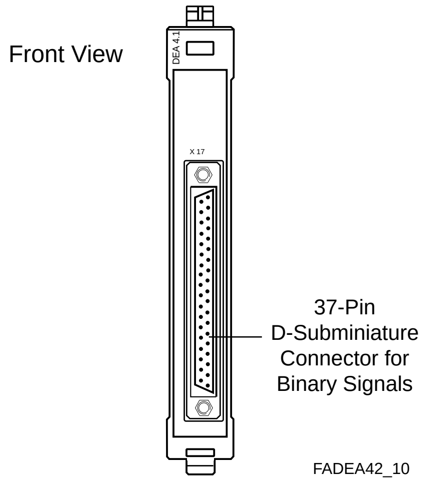


Fig. 2.10: Identification of parts on the DEA 4.1 auxiliary plug-in card.

Key to auxiliary plug-in cards type codes

Example: D L F 1 . 1

1. Designation
   Digital incremental position interface (square wave signals) =DEF
   Digital high-resolution position interface (sine wave signals) =DLF
   Digital toothed disc encoder interface .... =DZF
   Input/output card... =DEA

2. Series 1

3. Version 1

Fig. 2.11: Key to interpreting type codes of auxiliary plug-in cards.

Software module

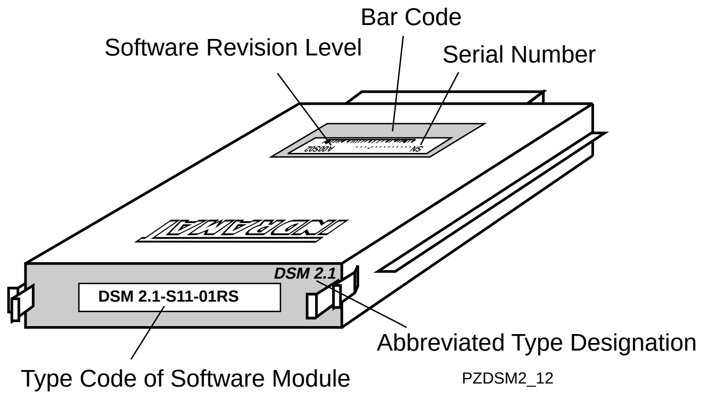


Fig. 2.12: Identification of key features on the software module.

The software module contains:

- servo drive parameters
- software for setting up the DKS
- motor data contained in the feedback system on the attached MDD servo motor
- data/parameter sets for the motor/drive combination which were changed in tuning the drive to the mechanical characteristics of the machine during setup

Advantage when replacing equipment

It is not necessary to re-tune the replacement servo drive to the system in the event of a malfunction. Simply remove the software module from the faulty drive and install it on the new replacement unit. This configures the drive for the motor and machine.

Duplication

Software modules can be duplicated for additional identical machines or to back up the parameters. This is done over a serial interface.

The velocity loop parameter values determined by INDRAMAT are stored in the software module. They can be called up upon request at setup. (The default parameters can be reset from the control parameter menu.)

The user-specific parameters are set on-site on the machine to the machine-dependent values.

It is the responsibility of the customer to document and manage the user-specific parameter values.

Compatibility of software modules

The latest engineering revision level (software module update) used for operating the drive will be shipped without a change in the ordering data (type code). Software modules shipped after August 1994 are mutually compatible.

Key to Software Module Type Code

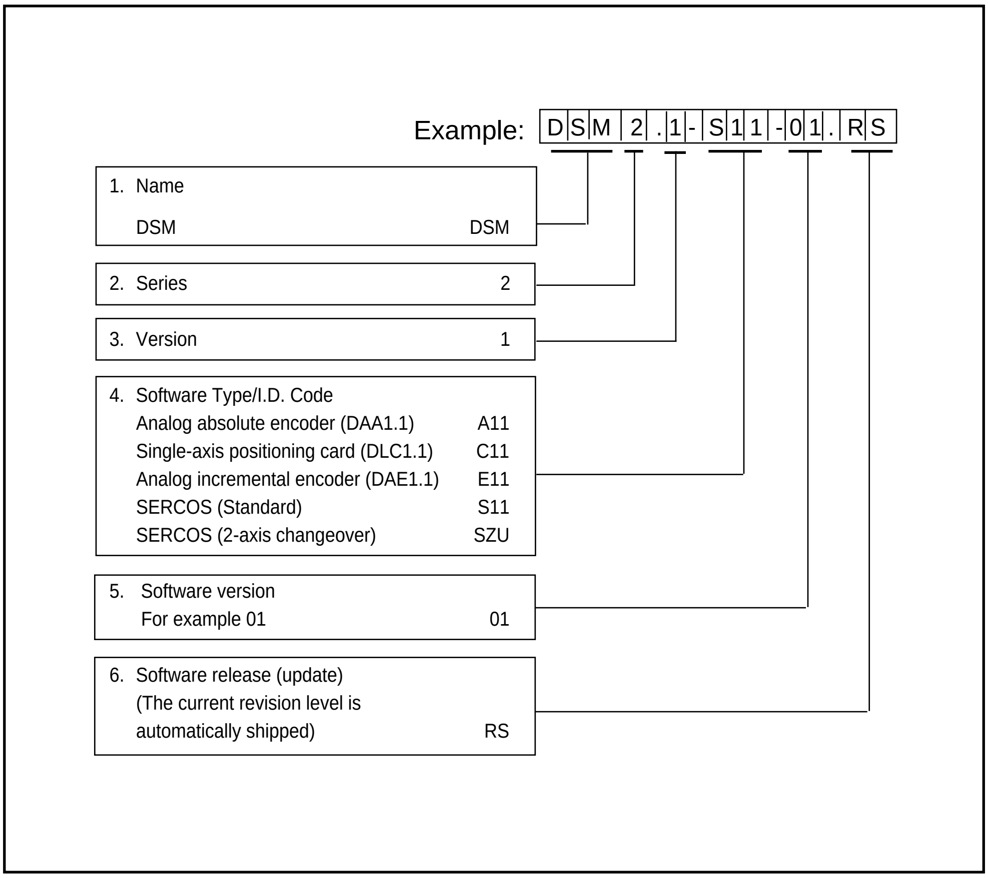


Fig. 2.13: Key to interpreting the software module type code.

Digital AC Servo Motors

MDD digital AC servo motors are supplied in the following feedback versions:

- Motors with „digital servo feedback“ (DSF)
- Motors with „digital servo feedback and Multi-turn encoder“ (DSF + MTG)
- Motors with „resolver feedback“ (RSF)
- Motors with „resolver feedback and Multi-turn encoder“(RSF + IDG)

As shown below, the motors are used for various applications depending on their characteristics:

Feedback Options and their Characteristics

	Digital Feedback Sensor principle: Optical scanning of a coded disc	**Resolver Feedback** Sensor principle: Rotary transformer with angle-dependent coupling ratio
Position resolution achieved	$256 \times 2^{13} = 2{,}097{,}152$ increments/revolution	$3 \times 2^{13} = 24{,}576$ increments/revolution
System accuracy	± 0.5 angular minutes	± 7 angular minutes
Multi-turn version	4095.99 rotor revolutions	4095.99 rotor revolutions
Available on	MDD 065 to MDD 117	MDD 021 to MDD 117
Suitable for applications involving	High demands on control cynamics, consistent speeds, absolute accuracy	Lower demands with respect to consistent speed and absolute accuracy
Applications	Servo applications in: - machine tool axis - robotics applications, - handling systems, - assembly equipment, - woodworking machines, - packaging machines - textile machine, - printing machines	Handling, infeed axis, low-cost applications, etc.

Fig. 2.14: Characteristics of the feedback versions available for MDD motors.

Key to type codes of MDD motors

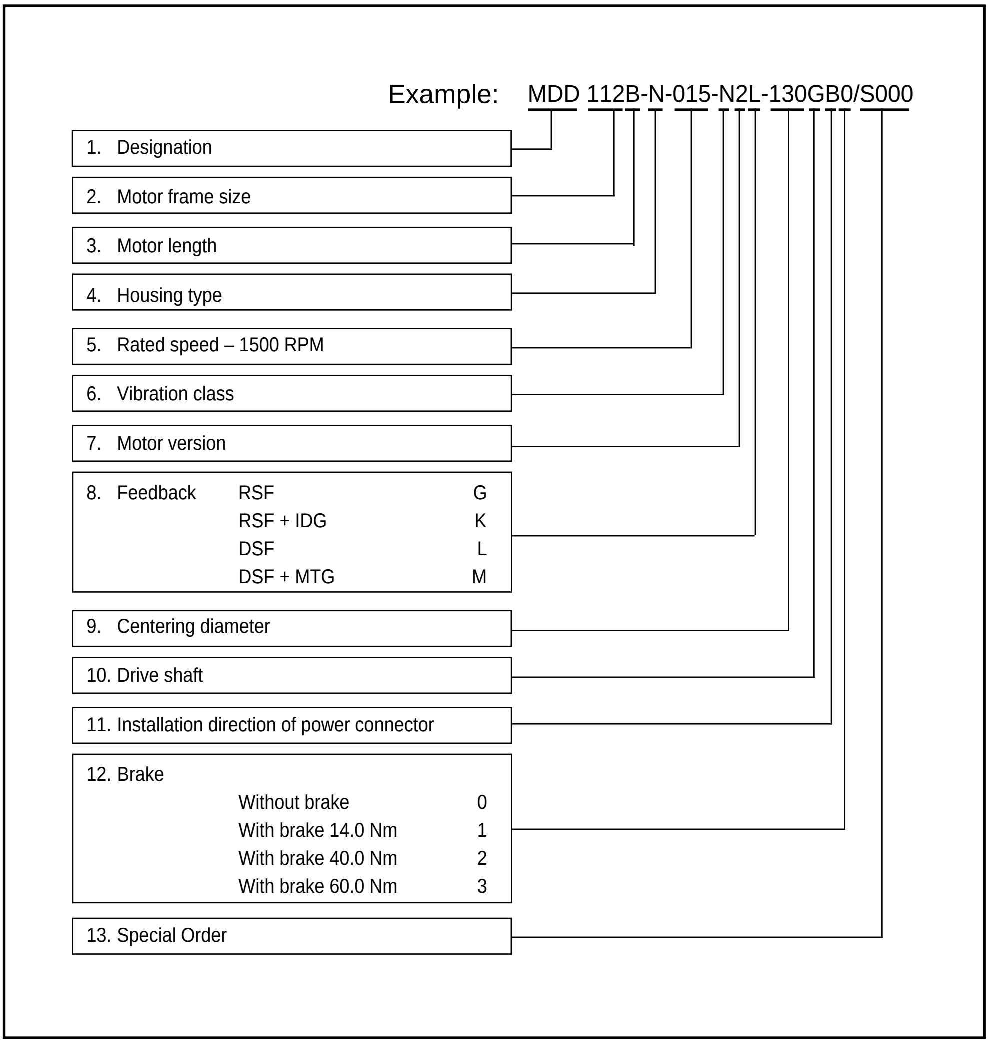
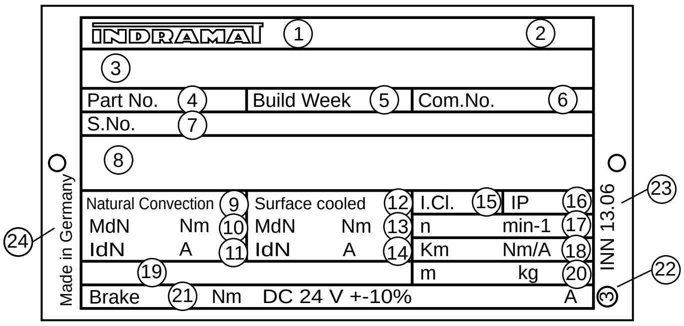


Fig. 2.15: Type codes for MDD servo motors, feedbacks and brakes.

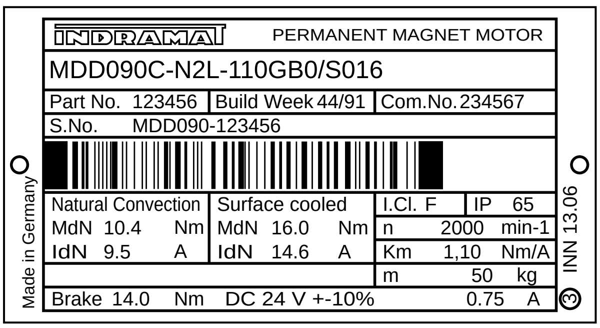
Additional data may be obtained from the appropriate motor documentation.

MDD servo motor nameplate



1	**INDRAMAT-Logo**	
2		Type of machine
3		Motor type code
4	**Part.No.**	Part number
5	**Build Date**	Production week and year
6	**Com.No.**	Commission number
7	**S.No.**	Serial number
8		Bar Code
9	**Natural convection**	Cooling type: natural convection
10	**MdN**	Continuous stall torque for natural convention in Nm
11	**IdN**	Continuous stall current for natural convention in A
12	**surface cooled bzw. liquid cooled**	Cooling type: surface cooled or liquid cooled
13	**MdN**	Continuous stall torque for surface or liquid cooling in Nm
14	**IdN**	Continuous stall current for surface or liquid cooling in A
15	**I.Cl.**	Insulation class
16	**IP**	Protection class
17	**n**	Motor speed in RPM
18	**Km**	Torque constant in Nm/A
19		Empty block
20	**m**	Weight in kg
21	**Brake**	Brake Holding torque in Nm, Rated voltage in V (including indication of tolerance range) Rated current in A
22 23 24		For administrative use

Example of a completed MDD nameplate



TSMDD2_16

Fig. 2.16: Nameplate example for MDD servo motors with explanations of the markings on the plate.

3. Basic safety data

3.1. Proper use

Intelligent digital AC servo drives are built in a state-of-the-art design using accepted engineering practices. Nevertheless, their use can result in hazards to life and limb of the users or to third parties or in damage to the machine and other equipment.

Proper use of the machine/system means that it must be used in a technically flawless condition in accordance with the machine/system manufacturer‘s operating instructions.

The AC servo drive is part of the machine/system. It cannot of itself ensure that the entire machine/system in which it is used will afford full personnel protection. Safety is only possible when the AC servo drive is expertly integrated in the complete safety system of the machine/system utilizing the drive‘s own safety functions.

The following must be noted:

Only trained personnel should be permitted to perform the setup work. The instructions for working with the drives provided in this application manual must be followed. This also applies to the instructions in the machine manufacturer‘s technical documentation.

Work on electrical components of the machine/system must only be undertaken by skilled electricians or trained personnel under the direction and supervision of a skilled electrician in accordance with standard engineering practices.

3.2. Safety hazards when working with the drives

In setting up a servo drive, the following faults can result in increased potential for accidents and damage to the drive and machine:

- wiring errors on the motor, servo drive and feedback
- faults in the controller
- disabling of monitoring devices

3.3. Personnel Safety

Hazards from axis motion

Danger to personnel can be caused by:

- Unintended starting of servo axes caused by trouble and faults in the machine or drive.
- Traversing of axes in an unprotected operating zone on a machine.

Protection against unintended starting is achieved by:

- Shutting off the power contactor (EMERGENCY STOP).
- Shutting off the main switch during long interruptions in service. In such cases, the main switch must be suitable protected against being unintentionally turned on again. Examples: installing a warning sign or removing the key if the main command controls can be locked up.

Hazard Due to Contact with Electrical Parts

Potentially life-threatening voltages can be encountered at power connection terminals U1, V1, W1 and at motor power connections A1, A2 and A3.

Even when the power is shut off, hazardous voltages can be expected at terminals A1, A2 and A3 when the motor is turning (motor ramp-down speed).

Protection against indirect contact with voltage-carrying parts

Do not use current-operated circuit breakers with INDRAMAT equipment. Protection on the input power side from indirect contact must be provided by other means (an overcurrent protection device which reduces the voltage to zero per DIN/VDE 0160, section 6.5.2.4).

3.4. Preventing drive damage

Damage potential due to incorrect connection

The electronic components on INDRAMAT drives are provided with extensive protective circuits and are also protected against overloading.

Nevertheless, the following must be noted:

- Only specified voltages may be applied to inputs.
- No voltages may be applied to outputs.
- Do not connect input power and motor cables to ±15 V and +24 V low voltage outputs. The two systems must be adequately isolated from each other.

Potential external or high voltage damage

The INDRAMAT drive components are high-voltage tested per VDE 0160 when the individual parts are tested.

If a high-voltage test or a separate-source voltage-withstand test is performed on the machine‘s electrical equipment, then all the connections on the devices must be disconnected or pulled out to avoid damage (permitted per VDE 0113).

Potential electrostatic damage

Electrostatic charges may damage electronic components. Objects and persons which can come into contact with components and circuit boards must be discharged by grounding.

- Personnel must touch a conductive, grounded object to discharge any static which may have built up on their bodies.
- When performing soldering work, discharge the soldering iron/gun.
- Discharge parts and tools by setting them on a conductive surface.
- Components which can be damaged by static electricity, e.g., software modules, must always be stored or shipped in conductive packaging.

3.5. Preventing machine damage

To prevent damage to the machine, please note the following:

- The EMERGENCY STOP button must be located within easy reach.
- Only trained personnel should set the drive into motion via the single-axis positioning card.

4. Setup aids

4.1. Aids for setting up the drive

There are several aids used for commissioning the drive and controller:

- DLC-ISB-3 interface control unit and cable
- personal computer equipped with a program for emulating a VT-100 terminal, or a VT-100 terminal itself
- IN 391 service cable
- Selection data, doc. no. 209-0069-4302

4.1.1. Measurement instruments

The following measurement instruments are required:

- multimeter for measuring voltage
- oscilloscope or recorder
  (Only required for recording test data during prototype setup; also helpful for troubleshooting.)

See section 10.5 for outputting signals used internally in the drive for test purposes.

4.1.2. IN 391 service cable

A PC or a VT-100 terminal can be connected to the DKS at connector X2 via the IN 391 service cable. The PC and the VT-100 terminal must not be connected to the servo drive while voltage is being applied to them. The ready-made type IN 391 cable can be ordered from INDRAMAT for making this connection. This cable is available in four different lengths (2, 5, 10 and 15 meters.)

4.1.3. Personal Computer

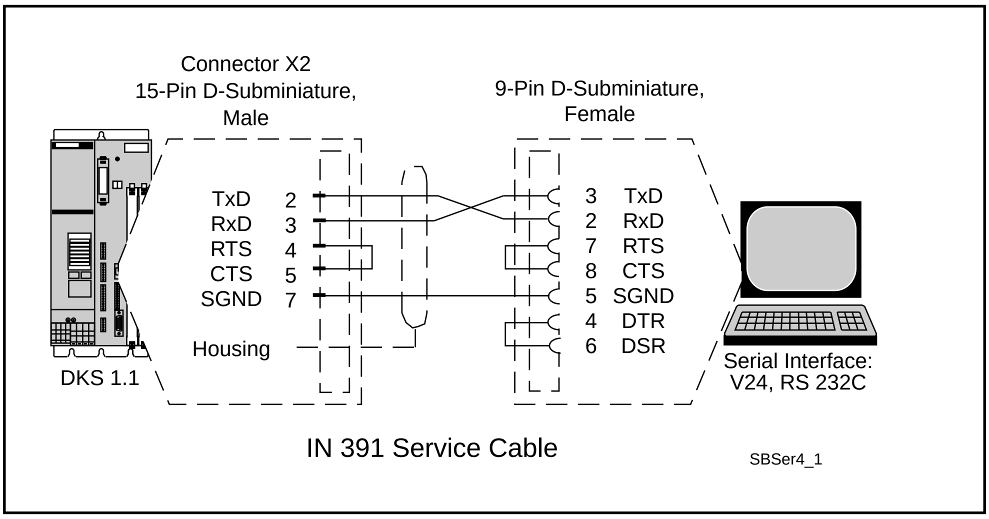


Fig. 4.1: Service cable IN 391 pinouts.

The personal computer must meet the following requirements:

- IBM compatible
- MS-DOS operating system
- RS-232 interface
- diskette drive or hard disk drive present for storing parameters
- emulation software for the VT-100 terminal is installed

The emulation software causes the PC to act like a VT-100 terminal. This allows the user interface program stored in the servo drive to be displayed on the PC monitor. A suitable terminal emulation program may be ordered from INDRAMAT. The parameters must be set according to the operating instructions for the terminal emulation program.

4.1.4. VT-100 Terminal

The minimum hardware required to view and operate the user interface program implemented on the DKS is a VT-100 terminal.

Electronic data backup outside the DKS is not possible with a VT-100 terminal. The VT-100 terminal does not have any data storage media.

Required terminal settings:

Parameter	Value to be set
Terminal type	VT-100
Columns	80
Lines	24
Line Feed	Off (only CR upon ENTER)
Automatic Wrapping	Off
Backspace Key	Active
Control Codes	Invisible
Parity	8 data bits
Stop Bit	1
Transfer Rate [1]	9600 baud

[1] It is not possible to establish communication between the drive and the input device at a different baud rate.

Fig. 4.2: Required terminal settings.

Information on proper operation of the VT-100 terminal is in the operating instructions provided with the terminal.

4.2. Aids for setting up the DLC controller

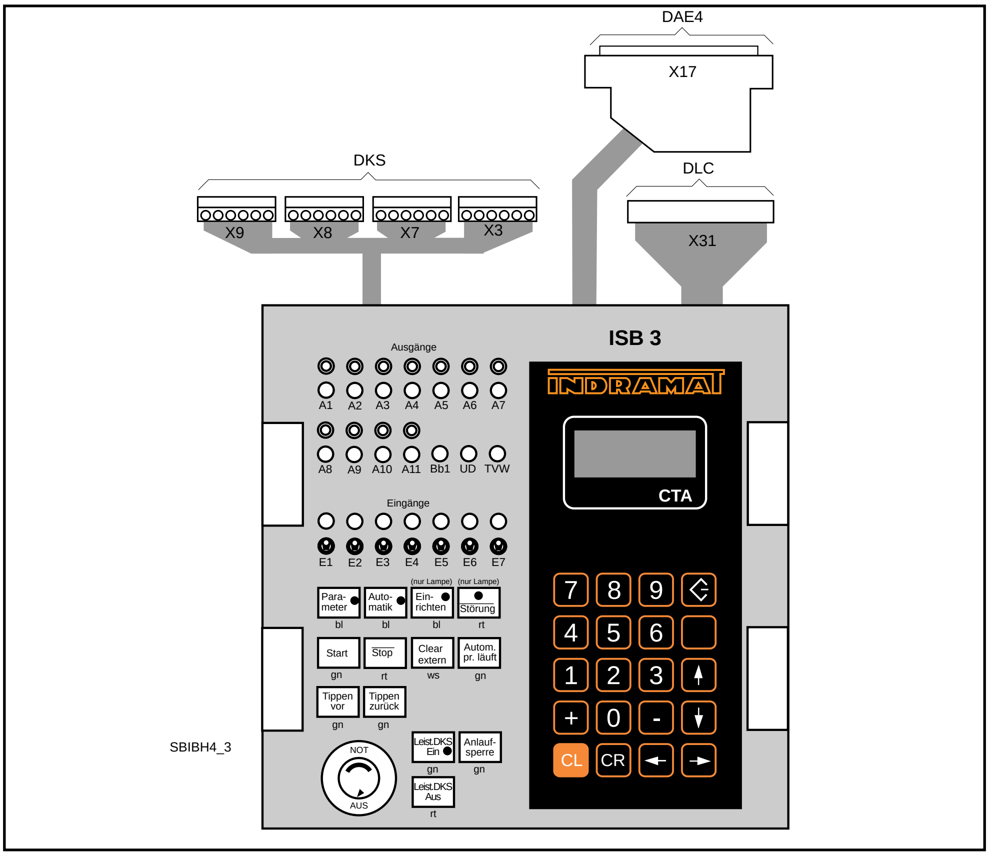


Fig. 4.3: Layout of the DLC-ISB-3.

The DLC-ISB-3 interface control unit makes it possible to set up a DKS with a DLC 1.1 single-axis positioning card. This unit contains a display and input keypad, buttons, switches, inputs and outputs. The interface control unit may be ordered from INDRAMAT as part no. 255641. The interface control unit does not have a built-in power supply. The 24 V needed to power the display is supplied by the DKS. The unit is supplied complete with all connection cables.

4.3. Connecting the setup aids

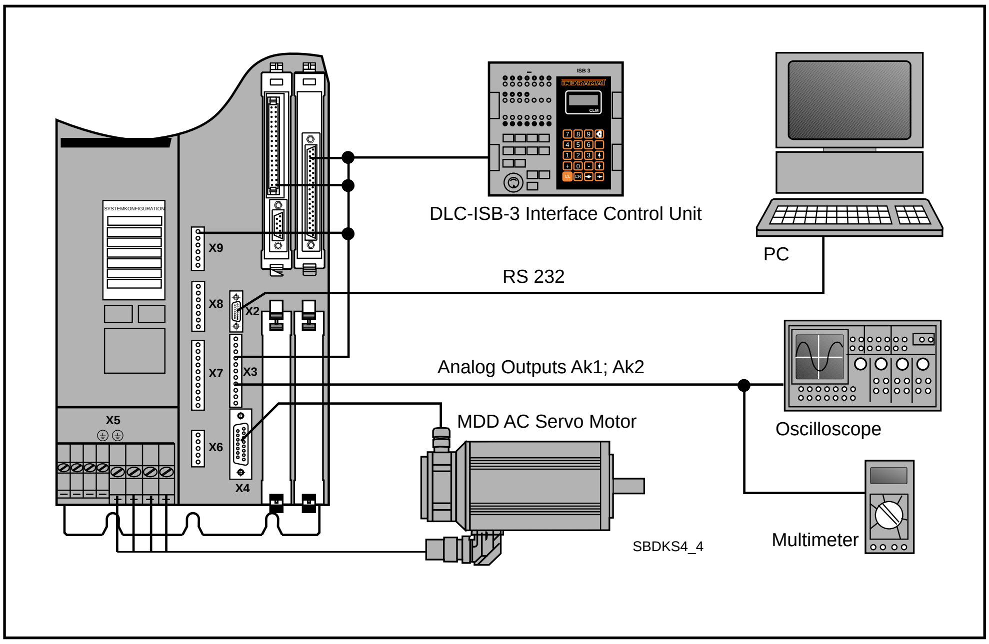


Fig. 4.4: Connecting the setup aids to the DKS.

5. Operating the servo drive for setup and diagnostics

Requirements:

- The DKS servo drive must be installed, connected electrically and tested.
- The AC servo motor must be connected to the servo drive using the power and feedback cables.
- The personal computer or the VT-100 terminal must be connected to the servo drive via service cable IN 391.
- The VT-100 terminal emulation program must be running (only on PC)

5.1. Using the Parameterization and Diagnostics

After the above requirements have been met, proceed as follows:

1. Turn on the input power

The parameterization and diagnostic program stored in the DKS reports as follows:

Start the parametrization and diagnostics program with <ENTER> or <RETURN>.

Start the program by pressing <ENTER>.

Main menu

The MAIN MENU appears.

By pressing the following keys in the MAIN MENU you will be taken to:

1 the „DRIVE STATUS“ menu

2 the „PARAMETERS MENU“

3 the „LANGUAGE SELECTION“ menu

These menus may be exited by pressing the <ESC> key. Each time you press <ESC> you will be taken to the previous menu until eventually you back out of the program.

Drive status

The „DRIVE STATUS“ menu provides current information on:

- the following signal statuses for the drive input and signal outputs on the analog interface card which is being used:

  TVW - temperature advance warning
  RF - drive enable (set via DLC)
  AH - drive halt
  Nullimp - zero pulse (reference mark)

- motor/servo drive combinations
- RPM, current, motor torque data
- rotor position

Parameters menu

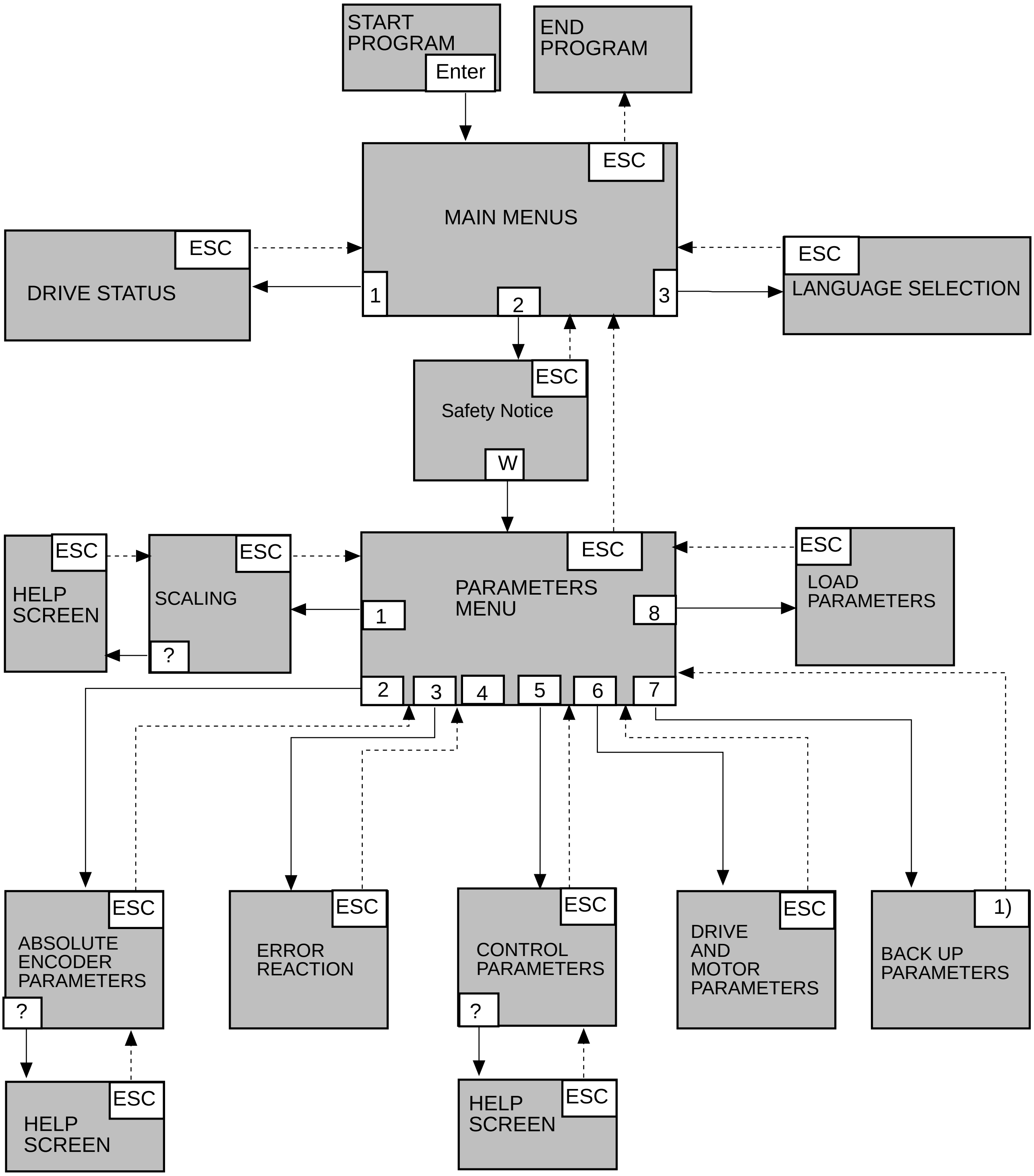
Pressing keys one through eight of the „PARAMETERS MENU“ will take you to the various menus used for entering parameters. The parameters contain the settings needed to operate the servo drive.

Language selection

You can select between German and English in the „LANGUAGE SELECTION“ menu.

The function levels of the user interface are represented in the following diagrams.

The file format is: text (ASCII).



1) See section 5.2.

Note: The blocks with white backgrounds correspond to keys on the keypad.

Fig. 5.1: Function levels on the user interface of the parametrization and diagnostics programs.

Absolute

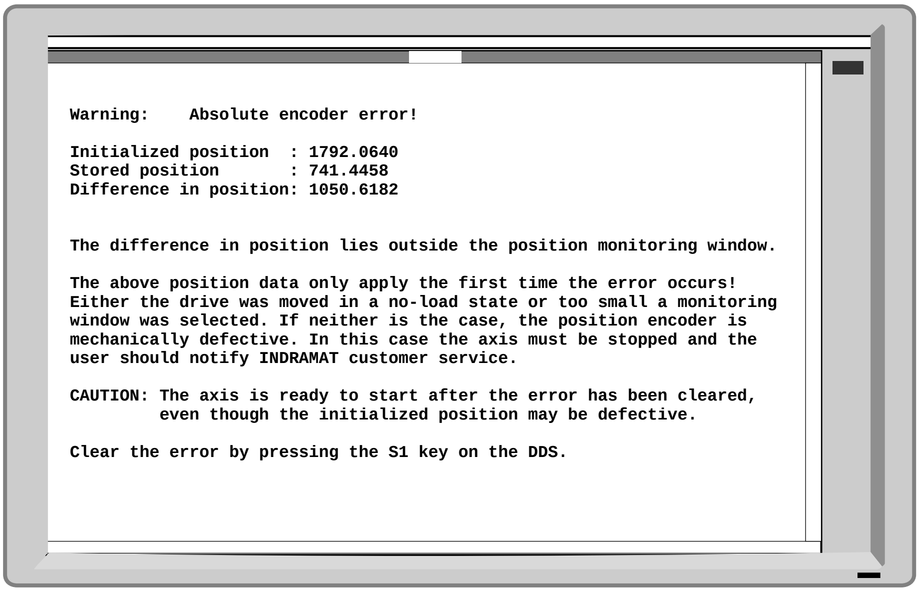


Fig. 5.2: Absolute encoder error.

Start Program (Screen Display)

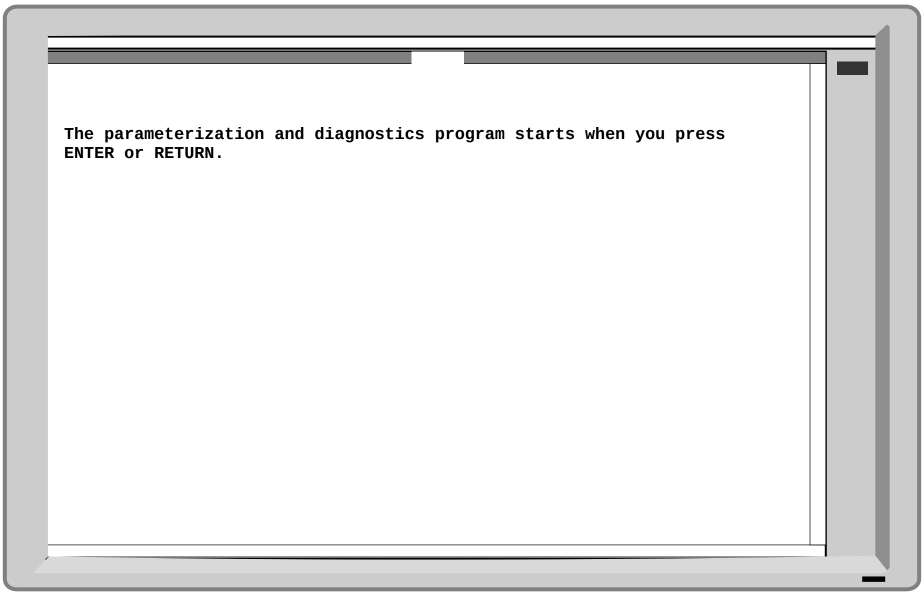


Fig. 5.3: Program start (screen display).

Main Menu

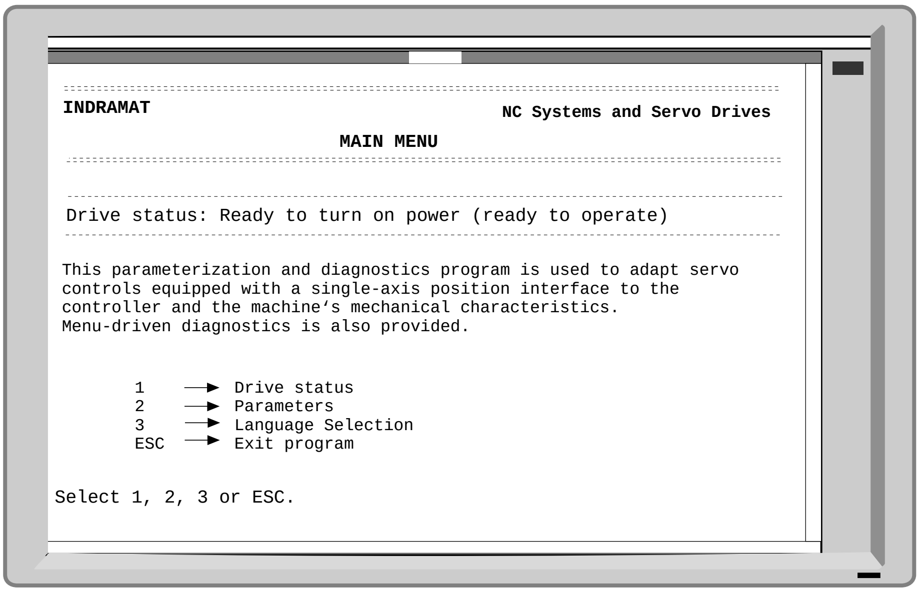


Fig. 5.4: Main menu.

Drive Status

```
                         DRIVE STATUS

Drive Status: Ready for power-on (ready to operate)

 Motor model                     : MDD 071B-N-03-N21-095GB0
 Control model                   : DKS1.1-W025-D
 Software version                : DSM 2.1-E11-01.02 M TEST 23.09.92

 Current operating mode          : Drehzahl-Regelung
 RPM setpoint             (RPM)  : 0.0000
 RPM actual value         (RPM)  : 0.0000
 Current setpoint           (A)  : 0.00
 Motor torque              (Nm)  : 0.00
 Rel. motor torque          (%)  : 0.00

 Rotor position: revolutions     : 0.0135
                 angle           : 4.8683

                        TVW    RF    Ah    Ired1   Ired2
 Internal status :       1      1     1      1       1

 ESC ──► Return to main menu
```

Fig. 5.5: „DRIVE STATUS“ menu.

Language Selection

```
Drive Status: Ready for power-on (ready to operate)

 In diesem Menue können Sie zwei Sprachen auswählen
 Für DEUTSCH drücken Sie "1"!

 In this menu you can select two languages.
 For ENGLISH press "2"

 Wahl / selection :

 ESC ──►  Return to main menu
```

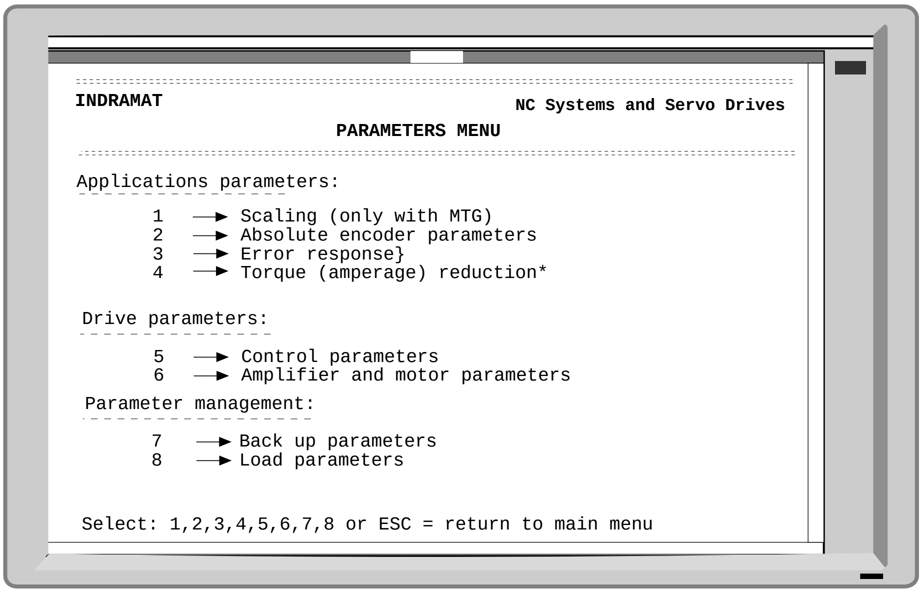
Fig. 5.6: „LANGUAGE SELECTION“ Menu

Safety Notice

```
INDRAMAT                                  NC Systems and Servo Drives
                      PARAMETERIZATION

 WARNING !    Incorrect parameter settings can result in
              damage to the drive and machine.

 Measures required to set up the drive:

            * Find the application parameters in the
              controller manual and machine documentation..

            * Find the control parameters in the system
              parameters list.

You have read the warnin! ──►Continue by pressing w
or exit the menu by pressing ESC.:
```

Fig. 5.7: Safety warning for „PARAMETERS MENU.“

Parameters Menu

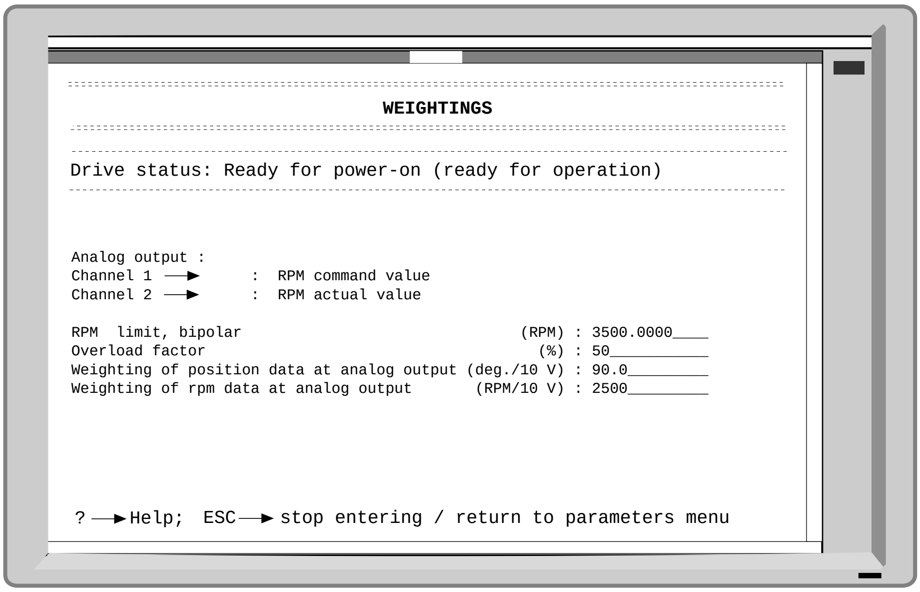


```
INDRAMAT                                      NC Systems and Servo Drives
                          PARAMETERS MENU

Applications parameters:

      1   ──► Scaling (only with MTG)
      2   ──► Absolute encoder parameters
      3   ──► Error response}
      4   ──► Torque (amperage) reduction*

Drive parameters:

      5   ──► Control parameters
      6   ──► Amplifier and motor parameters

Parameter management:

      7   ──► Back up parameters
      8   ──► Load parameters

Select: 1,2,3,4,5,6,7,8 or ESC = return to main menu
```

Fig. 5.8: „PARAMETERS MENU“ in the parameterization and diagnostics program.

*Not available at this time.

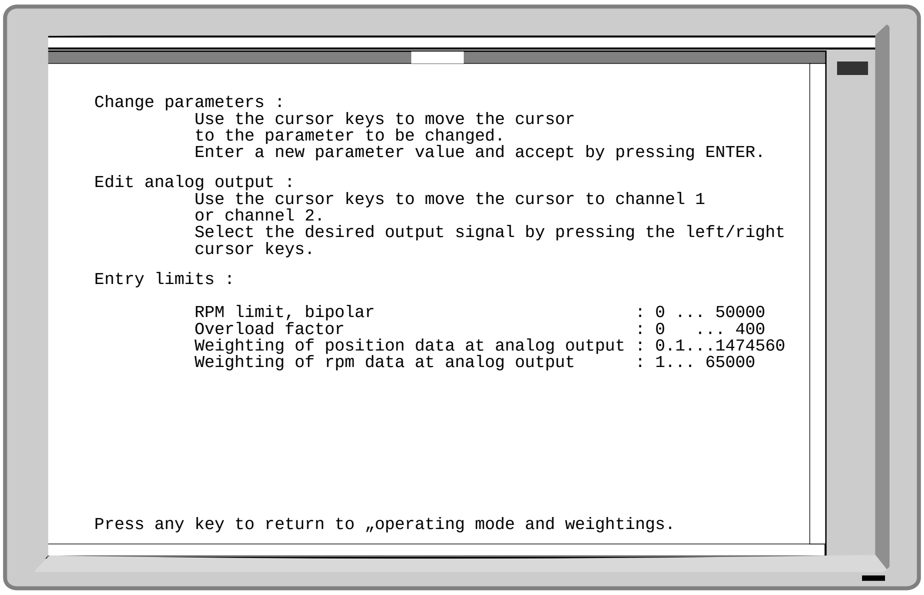
Scaling Feedback Versions with DSF or RSF



```
                            WEIGHTINGS

Drive status: Ready for power-on (ready for operation)

Analog output :
Channel 1 ──►      :  RPM command value
Channel 2 ──►      :  RPM actual value

RPM  limit, bipolar                             (RPM) : 3500.0000____
Overload factor                                   (%) : 50___________
Weighting of position data at analog output (deg./10 V) : 90.0_________
Weighting of rpm data at analog output       (RPM/10 V) : 2500_________

? ──►Help;  ESC──► stop entering / return to parameters menu
```

5.9: „SCALING“ menu.

Scaling Feedback Versions with DSF or RSF Help Screen



```
Change parameters :
          Use the cursor keys to move the cursor
          to the parameter to be changed.
          Enter a new parameter value and accept by pressing ENTER.

Edit analog output :
          Use the cursor keys to move the cursor to channel 1
          or channel 2.
          Select the desired output signal by pressing the left/right
          cursor keys.

Entry limits :

          RPM limit, bipolar                          : 0 ... 50000
          Overload factor                             : 0   ... 400
          Weighting of position data at analog output : 0.1...1474560
          Weighting of rpm data at analog output      : 1... 65000

Press any key to return to „operating mode and weightings.
```

Fig. 5.10: Help screen for the „SCALING“ menu.

Scaling, Feedback Versions with Absolute Encoder Option (DSF + MTG or RSF + IDG)

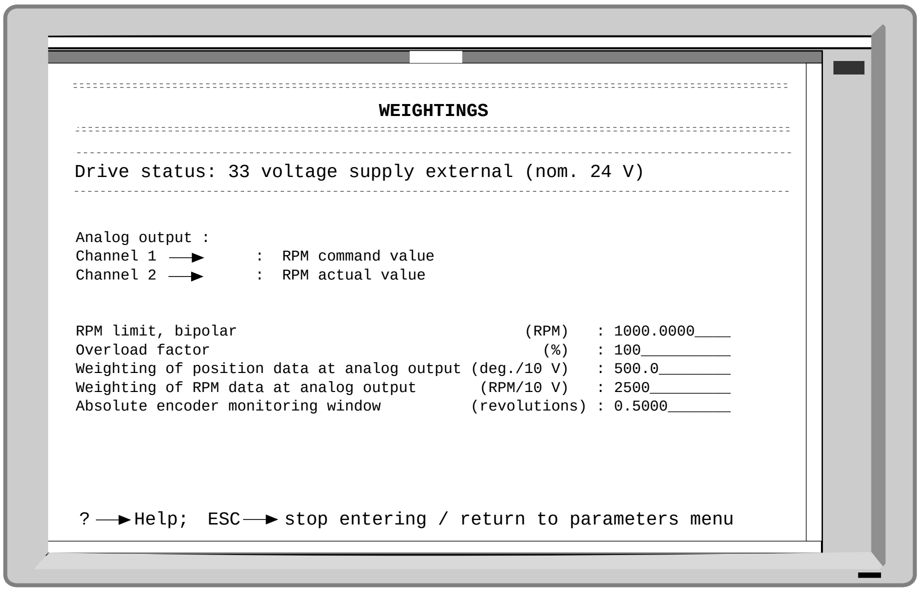


Fig. 5.11: Scaling menu for motors equipped with absolute encoder option.

Scaling, Feedback Versions with Absolute Encoder Option (DSF + MTG or RSF + IDG) Help Screen

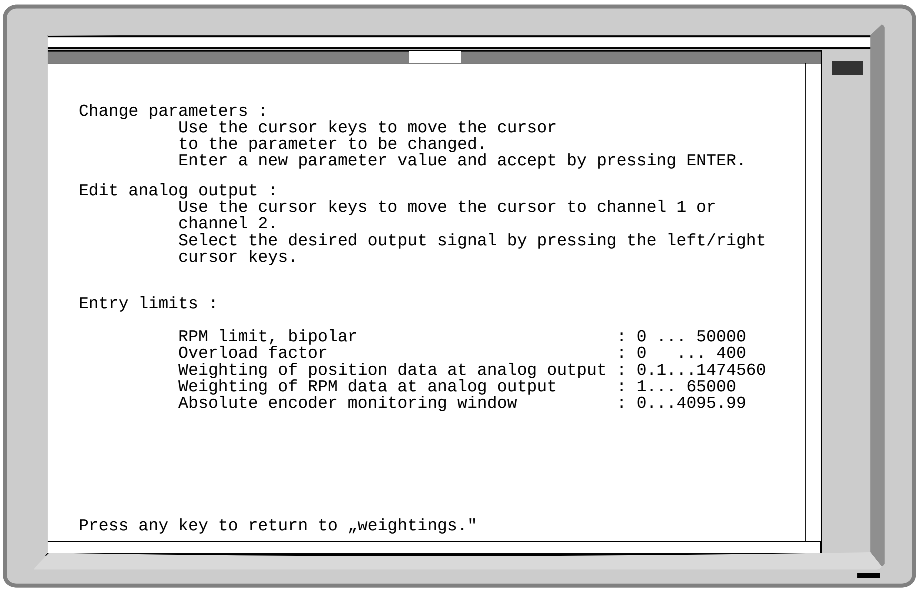


Fig. 5.12: Scaling menu.
Help screen for feedback types using the absolute encoder option.

Absolute Encoder Parameters

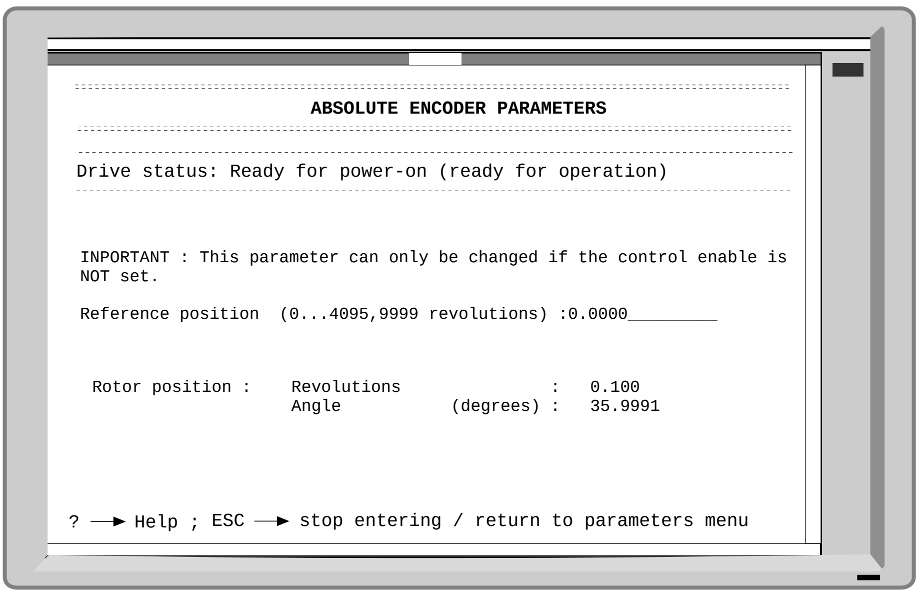


Fig. 5.13: „ABSOLUTE-VALUE ENCODER PARAMETERS“ menu.

Absolute Encoder Parameter Help Text

```
Edit Parameters :

          Move the cursor keys to move the cursor to the parameter
          to be changed.
          Enter a new parameter value and accept by pressing ENTER.



Press any key to return to „Position Evaluation."
```

Fig. 5.14: Help text for the „Absolute Value Encoder Parameters". menu.

Error Reaction

```
                         ERROR RESPONSE

Drive Status: Ready for power on (Ready)

0 --> The drive automatically switches to rpm control and sets 0
      as the rpm setpoint. The brake is applied after a maximum 400 ms
      and after an additional 100 ms the torque is released.
      DDS: error message to the power supply unit (package response)
      DKS: error message to the internal power supply
           (discontinue power protection)

1 --> As in Error Response 0, however no error message to the power
      supply unit, (package response) or to the internal power supply

2 --> The drive immediately switches to a torque-free state. If a brake
      is present, it is engaged immediately. No error message
      (no package response).

The current setting is 0________-->change to:

Enter changes, confirm by pressing „ENTER"; ESC = return to parameter menu
```

Fig. 5.15: „ERROR REACTION" menu.

Control Parameters

```
                         CONTROL PARAMETERS

Drive Status: Ready for power on (Ready)

Analog output :
Channel 1 -->    :  rpm setpoint
Channel 2 -->    :  rpm actual value

Current control proportional amplification 1     (V/A)  : 70.00________
RPM control proportional amplification 1     (mAs/rad)  : 2500_________
RPM control reset time                            (ms)  : 20.0_________
RPM control DI component                     (mAs/rad)  : 0____________
RPM control DP component                    (µAs2/rad)  : 0____________
Smoothing filter time constant                (µsec.)  : 1000_________
Reset to default parameters             -->    ENTER   : ............

? -->Help;  ESC-->Stop entering / return to parameters menu
```

Fig. 5.16: „CONTROL PARAMETERS" menu

Control Parameters - Help Screen

```
Change parameters :
          Use the cursor keys to move the cursor to the parameter to be changed.
          Enter a new parameter value and accept by pressing ENTER.
Edit analog output :
          Use the cursor keys to move the cursor to channel 1 or channel 2.
          Select the desired output signal by pressing the left/right cursor keys.
Entry limits :
          Current control proportional amplification 1: (1...15.93)„Current control base ampl.“
          RPM control proportional amplification       : 0 ... 65000
          RPM control reset time                       : 0.1... 6500
          RPM control DI component                     : 0 ... 35000
          RPM control DP component                     : 0 ... 65000
          Smoothing filter time constant               : 250.. 65000
Reset to default parameters:
          Default values for the parameterization of the control are set
          in the motor feedback. With this command, the current control
          parameters are replaced by the default parameters.



Press any key to return to the control parameters menu.
```

Fig. 5.17: Help Screen for „CONTROL PARAMETERS“ menu

Amplifier/Motor Parameters

```
                              LOAD PARAMETERS

If you are using the INDRAMAT „DDS2PC“ terminal emulation
software, first press „J“ if you wish to continue with the
loading of parameters (otherwise press „N“). Then press „ALT-L“
and enter the parameter file.

If you are using a different emulator, proceed as follows:
   - Press „J“ to continue (H1 on the DDS must display „--“).
   - Put the emulation program in the send mode (upload).
   - Enter the file name (for loading the parameters).
   - Select text or ASCII format.
   - Start the transfer at the PC.

Should „load parameters“ be performed? Yes ——► j
```

Fig. 5.18: „AMPLIFIER/MOTOR PARAMETERS“ Menu.

Back Up Parameters

```
                            BACK UP PARAMETERS

Machine manufacturer  :
System No.            :
Machine Model         :
Axis Designation      :
Date, Prepared by     :

Back up parameters:
- If DDS2 PC is used as the emulation program, simply press
  <Alt-S>, otherwise:
- Put emulation program in the receive mode (download).
- Enter file name (for backing up parameters).
- Select text or ASCII format.
- Press key S1 on DDS2, which starts the transfer of data.
- After the last character has been received ($), BE CERTAIN
  to exit the receive mode.
– Then press any key.

NOTE: To exit the menu without backing up parameters, press
      the S1 button on the drive control and then press any key.
```

Fig. 5.19: „BACK UP PARAMETERS“ menu.

Load Parameters

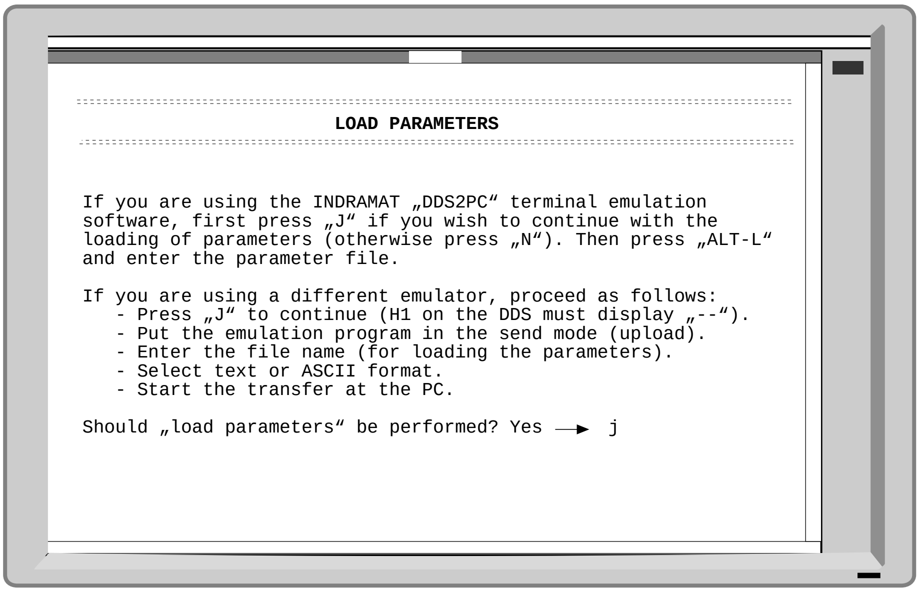


Fig. 5.20: „LOAD PARAMETERS“ menu

5.2. Backing Up Drive Data

Back Up Parameters Using a Personal Computer

The file format is : text (ASCII).

Procedure:

1. In the „PARAMETERS MENU“ select the submenu „BACK UP PARAMETERS.“
2. Enter the data needed to identify the machine (see Fig. 5.21).
   - A maximum of 55 alphanumeric characters may be used per entry field.
   - Complete each entry by pressing the <ENTER> key.
3. Put the emulation program in the receive mode (download).
4. Enter the file name for the parameter file which is to be backed up.
5. Press the S1 key on the DKS. This starts the transfer.
6. The data transfer is completed after the last „$“ character (see description in the emulation program being used).
7. Press any key to return to the user interface.

The parameter file can only be edited with a text editor, for example the DOS editor or the Norton editor. These editors do not insert any control characters.

The backed-up file can be edited as follows using the editor:

- **Insert any desired information in the file heading before the „:“ control character.**
- **Parameter values: numbers following „:“**
- **The „$“ character is used as the end-of-file code; it therefore must not be removed or changed.**

The attachment in section 12.3 contains an example of a parameter file printout.

Load Parameters Into the Drive

In the case of axes which have the same parameters, it is possible to load a previously saved parameter file into a different drive.

Procedure:

1. In the „PARAMETERS MENU“ select the „LOAD PARAMETERS“ submenu.
2. Put the emulation in the send mode. (upload).
3. Select parameter file.
4. Start the transfer by pressing <ENTER>.
5. After the transfer has been completed, the program will ask you to press any desired key.

6. Operating the DLC-ISB-3 Interface Control Unit

6.1. Description, Display Capabilities

The DLC-ISB-3 interface control unit assists in setting up DKS servo drives equipped with a single-axis positioning card.

The ISB-3 contains:

- a CTA I/O unit with a liquid crystal display
- an emergency-stop button
- 7 displays with test jacks for outputs
- 7 available inputs with displays
- analog test outputs for service purposes, AK1 and AK2
- a keypad for controller functions
  - selection of operating mode (parameters, automatic/setup)
  - jog forward and backward (push button)
  - start/stop (push button)
  - clear (push button)
- push buttons for DKS power ON/OFF
- a switch for the start inhibit

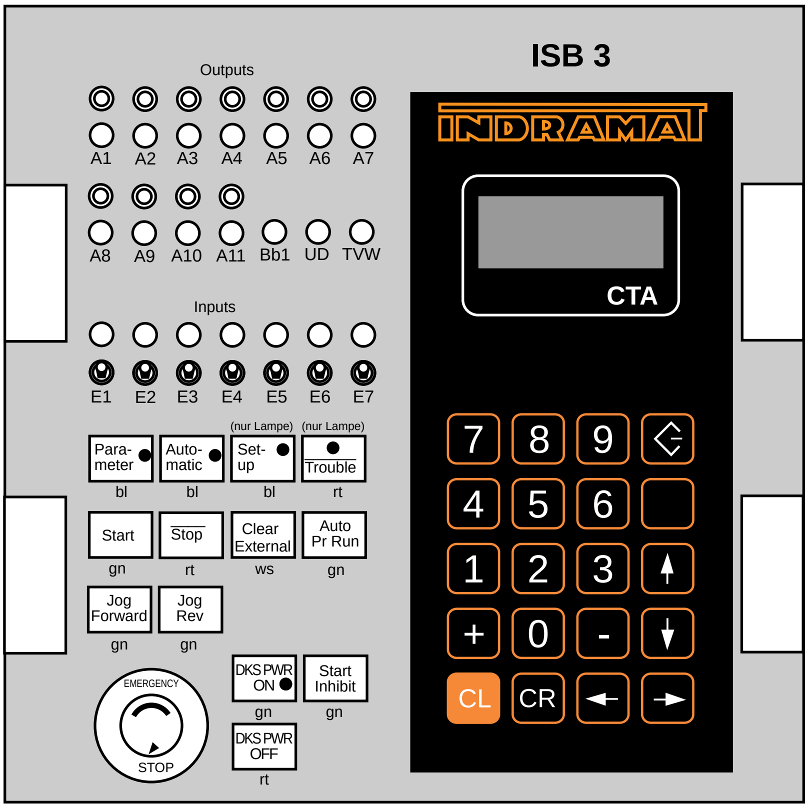


Fig. 6.1: DLC-ISB-3 interface control unit.

The interface control unit is to be connected as shown in Fig. 4.4.

6.2. Description of the Entry Keys

Input Keys/Switches

Function	Key	Switch
EMERGENCY STOP	x	-
Power ON	x	-
Power OFF	x	-
Parameter	-	x
Automatic/Setup	-	x
Start	x	-
Immediate Stop	x	-
Jog Forward	x	-
Jog Backward	x	-
Start Inhibit	-	x

Fig. 6.2: Assignment of keys/switches to functions.

Entry unit on the DLC-ISB-3

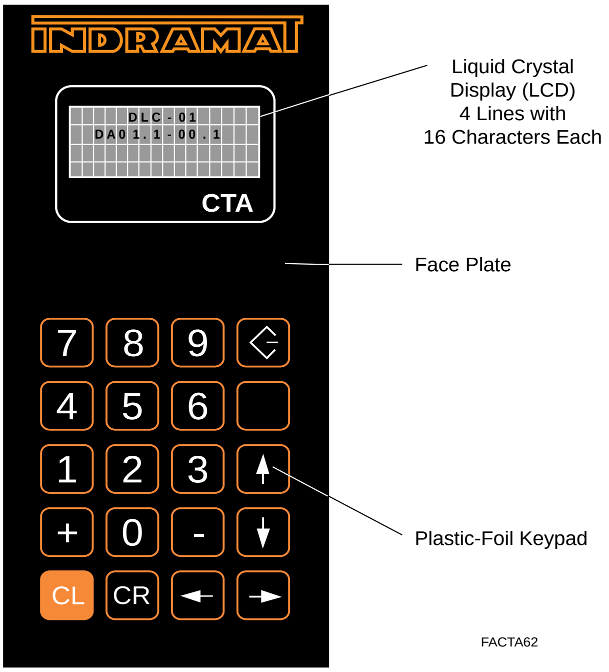


Fig. 6.3: Identification of parts on the input unit for the DLC-ISB-3 interface control unit.

CTA entry unit

The entry unit contains a liquid crystal display with 4 lines of 16 characters each.

A cursor blinks at the point where the confirmed character is placed during entry.

Entry Keys
Data Keys

0 to **9** — Enter program or parameter data.

+ **-** — Sign.prefix.

CL — Use this key to clear faults.

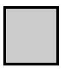
CR — This key can be pressed to move the cursor to various entry positions.

← **→** — Cursor right, cursor left.

↓ **↑** — 1. In the basic cursor position, these keys are used to switch between the various display options.

2. In the program entry display mode, these keys can be used to scroll through the program commands. To do this, the cursor must be located after the command in the first display line.

Save key.
This key is only active with „program entry.“ After this key has been pressed, the displayed data are placed in the program memory. After the data have been transferred to memory, the next block is displayed and the cursor is placed after the command.



Blank key.
Pressing the „Blank Key“ causes the unit to switch between parameter blocks A1 00 and B0 00.

Display Options

The display can be used for various purposes. The number and type of display options is determined by the operating mode.

Operating Modes	Display Options
Parameter	Parameter Entry
Setup	1. DLC 1 software version / controller status/ drive status 2. Program input 3. Setup operating mode 4. Position display / position error Distance to go / RPM 5. Counter 6. Status of inputs/outputs
Automatic	1. DLC 1 software version/controller status/ drive status 2. Program input 3. Setup operating mode 4. Position display / position error Distance to go / RPM 5. Counter 6. Status of inputs/outputs

Fig. 6.4: Display options in the DLC operating modes.

Change the Display Mode

After turning on the controller or after acknowledging an error, the DLC 1 either displays the software number or parameter entry is active.

The display mode can be changed at any time as follows:

1. Place the cursor in the basic position (1st line, 3rd character)
   Use ➡ or the ⬅ or the **CR** key to do this.
2. Change the display mode by pressing ⬆ and ⬇.

6.3. Basic Parameterization of the Controller

Basic parameterization of the controller must be performed, prior to input of a program into the DLC.

The parameters and user program are stored on the DLC card. This data can be lost. Please back up the data outside the controller (for example on an external computer or as a printout).

The parameters are checked at each power-on, pressing of the clear key with trouble, or when parameters are read in. An error message appears with incorrect or missing entries.

After leaving the parameter entry mode, all parameter-dependent program blocks are recalculated. The following message appears on the display: „Please wait."

Select the „parameters" operating mode to enter the controller parameters using the interface control unit.

Danger of accidents due to uncontrolled axis motion.

Do not switch to the parameter entry operating mode until the servo axis has stopped. A change from the „automatic" operating mode (program running) to the „parameter entry" mode causes the servo axis to brake immediately to a stop.

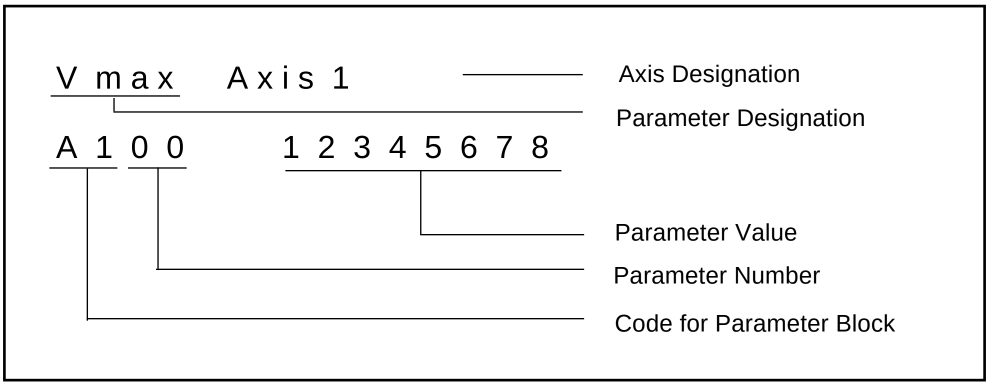


Fig. 6.5: Structure of display format for parameter entry.

The individual parameters may be input by entering the parameter number directly or by scrolling using the „+" and „-" keys.

Activity to Be Performed	Displays		Controller Operating Mode
	DKS- H1	CTA Display	
Power ON	-0 -1 -2 -3 -4..to bb	„Wait for retrigger“ „Ready to operate	Setup/Automatic
Parameter Entry **Switch to Parameter Entry Mode**	bb	V max A 1 00 00000000 *Cursor blinks*	Parameter Entry
Selection of para-meters by means of: **1. Entering a number at the poin at which the cursor is blinking** **(for example: if a "1" is entered, the display changes as follows)** **2. [+] or [↑]** **[−] or [↓]**	bb	Hom Setup Para A 1 10 00000000 *Cursor has jumped one place to the right.* Homing Offset A 1 11 00000000 *or* *Cursor* Set up homing A 1 12 00000000 *Cursor*	Parameter Entry
Change parameter block from: **A1 00 to B0 00** **Results:**	bb	V max A 1 00 00000000 *Move cursor* V max A 1 00 00000000 *Cursor entry „0“* Blank B 0 00 00000000 *Cursor*	Parameter Entry
[ ] Blank key **Press 1 time** **Press 2 times** **Press 3 times** **Press 4 times, etc.**	bb	A 1 00 00000000 *Cursor position* A 1 00 00000000 *New cursor position* A 1 00 00000000 *New cursor position* B 0 00 00000000 *Cursor position* A 1 00 00000000 *Cursor position*	Parameter Entry

TBDLC6_6

Fig. 6.6: Turn on the DLC / enter parameters.

Activity to Be Performed	Displays		Controller Operating Mode
	DKS- H1	CTA Display	
Enter parameter values ← → **Results:**		V max A 1 00 00000000 *Move cursor* V max A 1 00 00000000 *Cursor entry „1“* V max A 1 00 10000000 *Cursor*	Parameter entry
Save Parameter Values: **Press this key to accept the entered value; the next parameter will be displayed.**	bb	A 1 00 00000000 A 1 01 00000000	Parameter entry
Program Entry: **Only possible in the setup or automatic modes** **Turn on setup mode.** **Switch display.** **Press ↑ or ↓** ↑ **When pressed one time, the display goes to the program entry mode.** ↑ **When pressed two times, the program status is displayed.** ↑ **Pressed three times**	AF	Drive diagnostics 102 Drive enable E 0000 JMP 0 100 A: Progr Status Task1: 0000 JMP Task3: 2003 BOA Absolute Measurement/ relative measurement Pos: A - 000000.00 SF: +000000.00 Rest: -000000.00	Setup/ Automatic Parameter entry TBDLC6_7

Fig. 6.7: Entering parameters, entering a program

Activity to Be Performed	Displays		Controller Operating Mode
	DKS- H1	CTA Display	
[↑] **Pressed four times**	AF	E: 0300 Counter	Setup / automatic
[↑] **Pressed five times**		System inputs . . 1 . 1 . . .	
[↑] **Pressed six times**		Drive diagnostics 102 Drive enable *Display is once again located at the beginning*	
Select Program Blocks: [←] [→] **Move cursor to program block number and enter desired numbers** **Results:** **Continue moving through program blocks by pressing** [+] **or** [−] **or enter new numbers**	AF	E: 0000 JMP *Cursor position* 0300 *After program start cursor jumps to program block 0300* E: 0300 JMP *Cursor position* 0300 E: 0300 NOP	
Select Program Commands **Use** [→] **or** [←] **to place the cursor in a position behind the display** **use** [↑] **or** [↓] **to select the program commands. For example, numbers mus be entered at the locations marked X. Then save the entry by pressing [save symbol].** [save] **The display then jumps to the next program block number.**	AF	E: 0300 NOP *Cursor-position* E: 0300 PFA X XXXXXX.XX X	Setup / automatic

TBDLC6_8

Fig. 6.8.: Entering a program

Start Program

Required Conditions: A program must be entered. Power ON.

1. Select the **Automatic** operating mode.
2. Press the **Start** Button
3. A program can be stopped by pressing the **immediate stop** button. Drive enable signal internally remains at 1 (drive is still enabled).
4. The interrupted program can be continued by once again pressing the start button.

Emergency STOP

If emergency STOP is pressed, the DKS H1 display shows **Ab** (drive ready), (the internal drive enable is 0).
The display shows: **emergency STOP**

Power OFF

The DKS H1 display outputs error message „26“ undervoltage error.

This error can be cleared by pressing „CLEAR“ key. H1 then displays „bb“.

7. Setup for Initial Start-up of Servo Drive in Jog Mode

7.1. Tests in No-Load State

Input Power Requirements

Before each setup, check to be certain that the input power system meets the requirements for connection to the DKS being used. Recommendations for grounding requirements on the input power system, connection to the input power system, control circuits, and EMERGENCY STOP may be found in the DKS Project Planning Manual, Doc. No.: 209-0069-4355.

Drive Components

The installed drive components must be compatible with the voltages applied to them.

Please check to be sure that the components listed on the system configuration label actually correspond to the components used on the servo drive (see Section 2.7):

The data on the configuration label must correspond to those components actually used in the servo drive.

If they do not, then the AC servo drive and the machine´s mechanical system can be damaged!

Wiring Layout

Check wiring for short circuits, discontinuities, incorrect connections, and wire conductor cross sections.

Grounding system

- Make all ground connections in accordance with the recommendations provided by INDRAMAT.
- Take all safety measures applicable to the machines into account.
- Ground the motor to the corresponding servo drive (DKS).
- Connect the central ground reference point on the DKS with the input power ground.

Indirect contact can result in accidents.
Do not disconnect ground connections.
The ground connections form a functional grounding system, which has a protective function.

Electromagnetic Compatibility

- Connect the servo drive housing so that it is in electrical contact with the back wall of the enclosure (for electromagnetic compatibility).

Power Wiring

- Use stranded wire cables for lines running from the servo drives to the motor or use four-conductor cable (3 X phase 1 X ground).
- Check the conductor cross sections to be certain they meet the VDO 0113 standard.
- The motor documentation outlines the required conductor cross sectional areas.

Terminals and Plug-In Connections

Check for:

- Good contact. Contacts must be clean and dry.
- Connections well seated at terminals.
- Proper tightening of subminiature connections.

Shielding

The shielding of the motor feedback cable and the lines to the temperature sensor must be connected to the ground connection on the servo drive.

Connecting a Power Transformer

When installing a power transformer, check to be certain that the transformer output voltage and the DKS connection voltage match.

EMERGENCY STOP

It is possible that the servo drive will not function properly if an EMERGENCY STOP situation occurs in the system. Power circuit protection must be provided. Improper drive motion must be expected until the servo drive stops. The extent of this improper motion will depend on the type of problem and the operating status of the servo drive at the time the problem occurs. Provisions must thus be made on the system side to eliminate potential safety hazards.

Machine axes, which must be held in position after the servo drive is stopped, will require a holding brake. MDD servo motors are optionally available with a brake (see the corresponding motor documentation).

7.2. Turning on the Input Power Voltage

Warning! Potential Hazard!

Be alert for uncontrolled drive motion!

- **Place the emergency stop button within easy reach.**
- **Test the operation of the emergency-stop chain.**

The area within the range of motion of the servo axis must be clear of all personnel.

Set the max. traverse speed in such a way that the operator can always safely stop the servo axis (parameter V_{max} = A100 in DLC).

Do not change the direction of motor rotation by switching two conductors in the motor power cable. Switching the conductors can damage the motor. Instead use DLC parameter A1 09.

7.3. Entering Parameters for Initial Startup/Jog Mode

Requirements

- The DLC-ISB-3 interface control unit must be connected to the DLC 1.1 and the DKS.
- The PC must be connected to the DKS.
- The user must be familiar with the parameterization and diagnostics program (see Section 5).
- The user must be familiar working with the DLC-ISB-3 interface control unit.

7.3.1. Parameterization of DKS Based on an Example using an MDD Servo Motor with DSF and MTG

Activities to Be Performed	Notes	H1 Display on DKS
Connect 24 V DC auxiliary voltage to the DEA 4.1. Power up the DKS	With the ISB-3, the 24 V DC is applied via the DKS. The DKS passes through initialization phases 1 through 9	***bb***

Fig. 7.1: DKS with MDD, DSF and MTG

Call Program/Menu	Enter the Parameters	Notes
Start emulation program in the PC. (DDS2PC, PROCOMM etc.)		
Menu Call up **scalings**	**<Bipolar RPM limit>** **<Overload Factor>** **<Position monitoring window>**	Enter values n_{max} of the MDD motor For example, 100%. This corresponds to the continuous stall torque of the motor. For example, 0.0001 revolutions (1/10000 motor revolutions)
Menu **Absolute encoder** Call up **parameters**	**<Reference parameters>**	Set to 0.00, later to the same value as the „homing offset“ control parameter.
Menu **Error reaction**	**<Error reaction>**	Set the desired error reaction
Menu **Torque/current reduction**	**<Torque/current reduction>**	Currently, the preset reductions cannot be activated.
Menu **Drive parameters**	**<Reset default parameters>**	This sets the servo drive‘s reset states. Additional adjustments may be made via DLC 1.1.

Fig.7.2: Reset to standard parameters

Activities to Be Performed	Notes	H1 Display on DKS
Press Power ON button (terminal 9) for five seconds.	There is an approximately five-second power-on delay. Then the power stage in the DKS is activated.	***Ab*** ***AF***

Fig.7.3:DKS with MDD, DSF and MTG

Back Up Parameters

The parameters entered in the servo drive may be backed up. This should always be done to make certain that the data in the optimized parameters are never lost. These data can also be printed out. It makes sense to make such backed-up data part of the machine file.

Call Menu	Enter	Remarks
Back up **parameters** menu	1. Enter the requested machine data. 2. Press **<Alt S>** 3. Enter file name. 4. Acknowledge by pressing **<ENTER>** 5. Press **"S1"** button on the DKS	The parameters are now backed up.

Fig. 7.4: Saving parameters

Load Parameters

The loading of parameters is used to utilize data blocks in similar axes. This eliminates the need to enter the parameters separately.

Parmameters can be loaded into drives of similar axes. This eliminates the need to enter the parameters individually.

Parameters can only be loaded when the drive enable signal is low (drive disabled). The drive enable signal is set internally by the DLC. This status is displayed in the drive status menu.

Drive Enable Status depending on ON/OFF at Terminal X9 on the DKS

Drive Enable	Status	Display H1
Set	**ON** is active at terminal X9.	***AF***
Is not set	**OFF** is active at terminal X9.	***bb***

Fig. 7.5: Enable signal depending on ON/OFF

Load Parameters

Call Menu	Enter	Remarks
Load parameters	1. Press <Alt L> 2. Enter file name. 3.<ENTER> 4.<Clear> on the setup aid	The parameters are loaded. Drive enable is set again.

Fig. 7.6: Load parameters

This enters the parameters in the servo drive.

7.3.2. Parameterization of the DLC Single-Axis Positioning Card

In addition to parameterizing the drive, the single-axis positioning card must also be parameterized. Once a few provisional parameters have been entered, the servo axis can be jogged.

The parameters are entered by using the CTA input unit on the DLC-ISB-3 interface control unit.

In order to avoid accidents or damage to the machine caused by unexpected axis motion, the axis is first set up in such a way that it can only be moved with low dynamics (acceleration, gain factor, velocity).

This permits:

- the setting up of positive stops,
- the calibration of cam switches and similar safety features,
- checking to be certain that the specified traverse directions are correct

If necessary, the drive's velocity loop may be optimized in jog mode. This procedure is described in 8.7.

In most applications, it has been sufficient to set the drive parameters to the default values. See 7.3.1.

Final tuning of the drive to the machine‘s mechanical characteristics is then undertaken using the DLC controller.

The parameters are listed in parameter number order. The parameters can also be called up in this order using the keypad on the interface control unit. The logical order of parameter entry is given in column 4 in Figs. 7.7 and 7.8.

Input units

The parameter values are entered as input units. A dimensional unit is decided upon – for example, mm or degrees. It must then be used throughout.

Example for a Linear Axis

The following values are an example of the drive/machine‘s mechanical characteristics:

Linear axis having a spindle lead of	4 mm
MDD servo motor having a maximum speed of	2000 RPM
MDD servo motor with (4096 motor revolutions)	DSF and MTG

Place the axis traverse path in the middle of the absolute encoder traverse path. Place the tool slide in the middle of the traverse path. Then enter a reference value, e.g., 2048, in the absolute encoder parameters menu.

Enter 2048 x feed constant 4 mm = 8192 in homing offset control parameter A1 11.

Explanation of Some Controller Parameters

Drive sensitivity A1 21
Maximum motor speed is entered here. (It is 2000 RPM in the example.)

Feed constant A1 08
Enter the 4 mm spindle lead here.

V_{max} A1 00

The parameter value to be entered must first be calculated from parameters A1 21 and A1 08. The relationship is:

$$\frac{\text{A1 21} \times \text{A1 08}}{60} =$$

$$\frac{2000 \times 4\text{ mm}}{60} = 133{,}33$$

====== Enter this value.

V_{min} A1 01

A value is entered here which is approximately 1/10 of **V_{max} A1 00**. The axis moves at this speed in jog mode (for example 13.3).

Acceleration A1 02
This value is first set to 1.

Feed constant A1 08
A gear ratio or the spindle lead is entered here.

A detailled explanation of the controller parameters is outlined in the document „DLC1-A Single-Axis Positioning Card for Digital Servo Drives: Programming Manual,“ doc. no. 109-0852-4102-00.

The values stated or calculated in the example are entered as parameter values for the appropriate parameters in Figs. 7.7 and 7.8.

Axis-specific parameters

Name	Parameter	Parameter value	Order of parameter entry
Max velocity	A1 00	00013333	4.
Jog velocity	A1 01	00001333	5.
Accel rate	A1 02	00000100	6.
Position gain	A1 03	00000100	7.
Unassigned	A1 04	00000000	
Unassigned	A1 05	00000000	
Position tol	A1 06	11000002	8.
Pos pre-signal	A1 07	00000000	9.
Feed Constant	A1 08	00040000	3.
Direction	A1 09	00000000	10.
(Reversing direction of rotation)		(01000000)	
Homing setup parameter	A1 10	00000000	11.
Homing offset	A1 11	00800000	12.
Homing ack Parameter	A1 12	00000000	
Min travel	A1 13	00000000	
Max travel	A1 14	00000000	
Special function	A1 15	00000000	
Rotary Table	A1 16	00000000	
Knee Point	A1 17	00000000	
Unassigned	A1 18	00000000	
Unassigned	A1 19	00000000	
Feed Angle Mon	A1 20	00000000	
Drv Input Sen	A1 21	20000000	2.
Monitoring Window	A1 22	00000020	13.
Follow Axis	A1 23	00000000	
Unassigned	A1 24	00000000	
Unassigned	A1 25	00000000	

Fig. 7.7: Axis-specific parameters and their order of entry.

General parameters

Designation	Parameter	Parameter Value	Order of Parameter Entry
Unassigned	B0 00	00000000	
Unassigned	B0 01	00000000	
Unassigned	B0 02	00000000	
Serial Interface	B0 03	09600181	1)
Serial Interface	B0 04	11000000	2)
Memory Display	B0 05	00000000	
Start Tasks 2 and 3	B0 06	00000000	
Language	B0 07	00020000	1.
Unassigned	B0 08	00000000	
Unassigned	B0 09	00000000	
Unassigned	B0 10	00000000	
Manual Vector	B0 11	00000000	
Interrupt Vector	B0 12	00000000	
Override	B0 13	00000000	
Restart Vector	B0 14	00000000	
Unassigned	B0 15	00000000	
Measure Encoder	B0 16	00000000	
Measure Encoder Lines/Rev	B0 17	00000000	
Measure Encoder Feed Constant	B0 18	00000000	
Measure Encoder Offset	B0 19	00000000	
Unassigned	B0 20	00000000	
Unassigned	B0 21	00000000	
Unassigned	B0 22	00000000	
Unassigned	B0 23	00000000	

1) Setting: Baud rate: 9600; Interface: RS-232; Parity: None;
Word Length: 8 byte; Number of Stop Bytes: 1

2) Setting: Hand shake: Hand shake RTS/CTS off; Transmission acknowledgment on.

7.8: General parameters.

7.3.3. Example of a Simple Program (Programmed Traverse Cycle)

After these parameters have been entered, the axis can be jogged in the setup mode by pressing „jog forward“ and „jog backward.“

The actual motor velocity value and the actual motor current value can be evaluated using analog outputs AK1 and AK2 on terminal X3. The axis can be moved in both directions in the „jog mode.“ Motor speed corresponds to the velocity entered in the jog velocity parameter A1 01. The axis was initially parameterized in such a way that the machine's mechanical system can be set up without danger to personnel or the risk of damaging the machine.

If the control settings need to be tuned for optimal machine performance, the parameters acceleration A1 02 and position gain A1 03 can be changed. The behavior of the actual motor current should be evaluated.

An additional option for evaluating the drive/machine mechanical system is to operate the axis in a simple traverse cycle. This traverse cycle is produced using a simple program.

In the example shown, the traverse distance of the multi-turn encoder is placed in the center of the working area of the machine table.

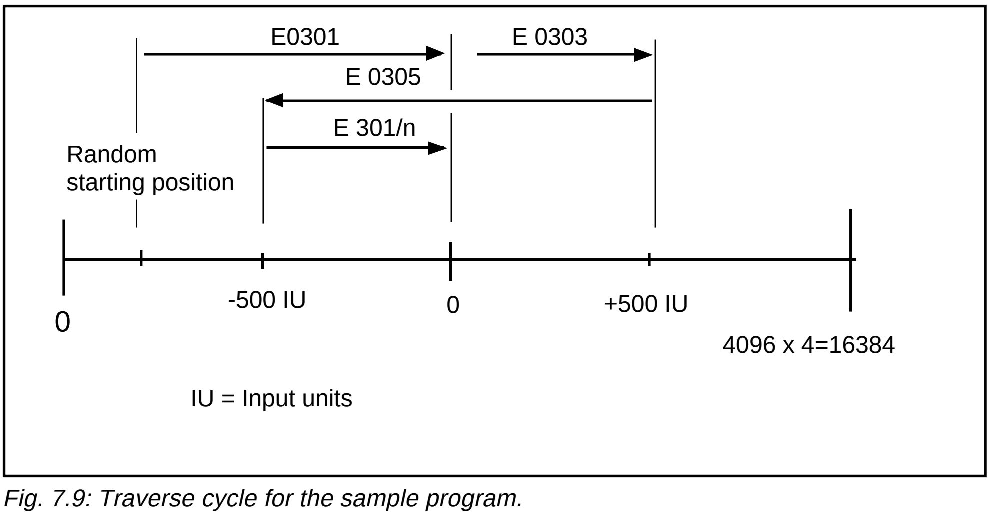


Fig. 7.9: Traverse cycle for the sample program.

Select the program entry using the entry keypad:

Enter the following commands:

Entering the program (Program Loop)

Program commands	Remarks
E 000 JMP 301	Jump to data block 301
E 0301 PSA 1 +000000.00 333	Position absolute at zero point at 33.3% of V_{max}
E 0302 WAI 01.00	Wait cycle 1.00 sec
E 0303 PSA 1 +00000500 999	Position absolute to position +500 in input units at 99.9% of V_{max}
E 0304 WAI 0100	Wait cycle 1.00 sec
E 0305 PSA 1 -00000500 999	Position absolute to position -500 in input units at 99.9% of V_{max}
E 0306 WAI 0100	Wait cycle 1.00 sec
E 0307 JMP 0301	Jump back to program block 301, program executes from the top.

Fig. 7.10: Entering a simple program.

Initiate Program

In order to activate the program, set <automatic mode> and press the <start key>.

The program can be terminated at any time by entering <immediate stop>. The interrupted program routine can be continued by once again pressing <start>.

8. Setup of the Digital AC Servo Drive with Single-Axis Positioning Card

8.1. Error reaction

Various error reactions can be specified in the intelligent AC servo drive (Fig. 8.1.).

Errors which can lead to a drive error reaction are:

22 „Motor encoder fault“

24 „Power supply overcurrent“

60 „Bridge overcurrent“

61 „Ground fault circuit breaker“

67 „Hardware synchronization error“

69 „±15 volt error“

70 „+24 volt error“

71 „±10 volt error“

72 „+8 volt error“

73 „Driver stage power dupply

(Further information on these errors may be found in section 10.)

Potential for accidents due to unanticipated axis motion! The errors listed above do not allow the drive to be brought to a stop in a controlled manner.

Error reaction in the DKS

1. The faulty drive sends an error message to the power supply section of the DKS.
2. The DKS turns off the power.
3. The error message „undervoltage“ permits the drives to be properly brought to a stop by the controller. Execution of the process-controlled stop depends on the available residual energy in the DC bus.
4. The braking distance can be shortened by activating DC bus „short-circuiting" (dynamic braking).

Activation of „short-circuit braking„ acts upon the AC servo drive regardless of the preset error reaction.

Setting the error reaction

The following settings are offered by the „ERROR REACTION“ menu:

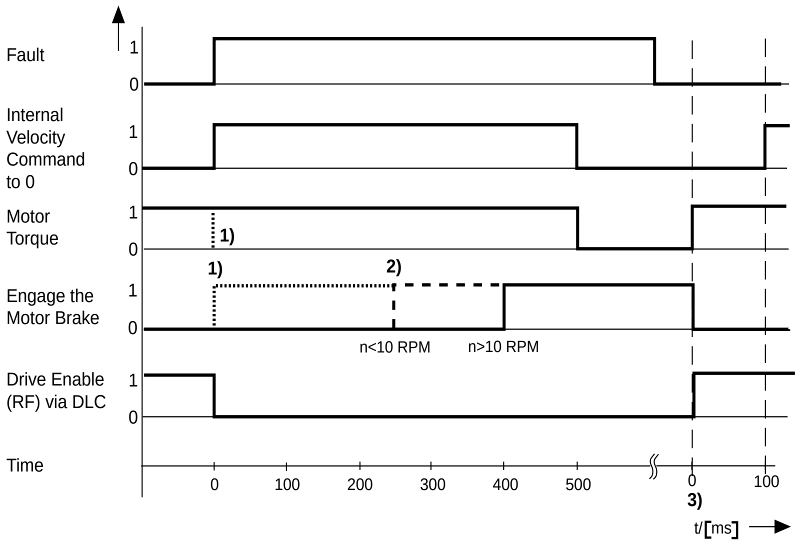
Error reaction	Drive reaction when a fault occurs
0	– Switch to velocity control – Brake at maximum deceleration – Motor is torque-free after 500 ms – Open ready contact Bb X3-6/7 on the servo drive (see section 8.4) – Turn off the supply of power in the DKS
1	– Same error reaction as in **0** – No error message to the internal power supply system in the DKS
2	**Error response „2“ is not practical for motors equipped with a brake. The brake will be worn out after 20,000 motor revolutions against the engaged brake.** – Motor torque drops out immediately (axis coasts) – Motor holding brake, if present, engages immediately – Ready state contact Bb X3-6/7 on the servo drive opens (section 7.4.)

Fig. 8.1: Optional error reactions on the DKS.

Independent of the selected error reaction, the error can be evaluated immediately via the following error detection system in a controller and via the Bb contact (X3 pin 6/7) on the servo drive (see section 8.4). This means that it is always possible to stop the drives quickly by using the controller, regardless of which error response is selected.

Error reaction and brake control

Figure 8.2 depicts the behavior of the brake, depending on the selected error reaction.



1) If error reaction 2 is selected, the brake is applied immediately.
The motor is immediately switched off to a torque-free state.

2) Error Reaction 0:
The brake engages when the speed falls below 10 RPM.
The brake engages after 400 ms, even if the motor speed is > 10 RPM.

3) After the cause of the fault has been cleared, the DLC issues drive enable, and the brake releases immediately.
In order to permit the brake to release in a reliable manner, the velocity command is set to 0 internal to the drive for a period of 100 ms.

FPDKSHB8_2

Fig. 8.2: Brake operation as a function of the error reaction.

8.2. Start Inhibit

Manufacturing systems, conveyor lines and machine tools frequently consist of spatially separate working areas such as processing units, transport, handling, and storage systems.

In such units, workers must often perform work in hazardous areas while other areas on the machine remain in operation. If personnel must be present in an area where an axis is working, the axis must first be stopped and then prevented from restarting unintentionally.

The start inhibit function provides a means of preventing the attached motor from starting up unintentionally if a fault occurs. This feature is used to shut off separate working areas in a machine or system in a reliable manner.

The DKS servo drives are equipped with a start inhibit feature. This prevents a servo axis from starting up unexpectedly. When the drive start inhibit is activated, the power output stage is disabled by a relay contact.

Uncontrolled axis motion can be hazardous!

Do not use the start inhibit to stop a moving axis.

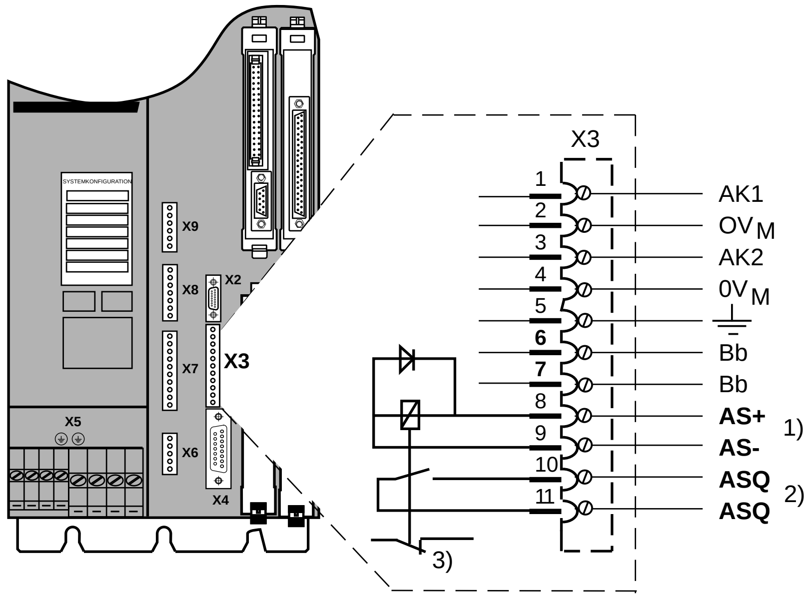
Once the start inhibit is activated, it is no longer possible to traverse the drive using the controller and the servo drive. The motor immediately loses all torque; the axis can no longer be brought to a stop in a controlled manner.

Before activating the start inhibit on vertical axes, securely clamp the axis in position using a mechanical brake.

If AS is active, no voltage is applied to the motor brake, that is, the holding brake is applied.

Activating the Start Inhibit

The start inhibit is activated by applying a voltage of +24 V to the AS+ and AS- terminals on connector X3. The status of the start inhibit relay (output stage disabled) in the drive is acknowledged by the closed potential-free relay contacts (output ASQ - ASQ). See Fig. 8.3. This can be evaluated by the DLC.



1) AS+, AS- - Control input for relay coil
Voltage 20-30 V DC
Power 1.5 W

2) ASQ, ASQ - Potential-free contact
24V, 1A

SBDKS8_3

3) Contact in the unit to activate the power electronic circuitry.

Fig. 8.3: Control input and signal output for the start inhibit on the DKS servo control.

Status diagnostics

If the start inhibit is active, the message „AS“ (Anlaufsperre - start inhibit) appears on the H1 status display on the servo drive.

Additional information

Typical applications for the start inhibit are described in the document „Start Inhibit with DDS2 Servo Drives“, (doc. no. 209-0069-4313).

Timing diagram for activating the start inhibit

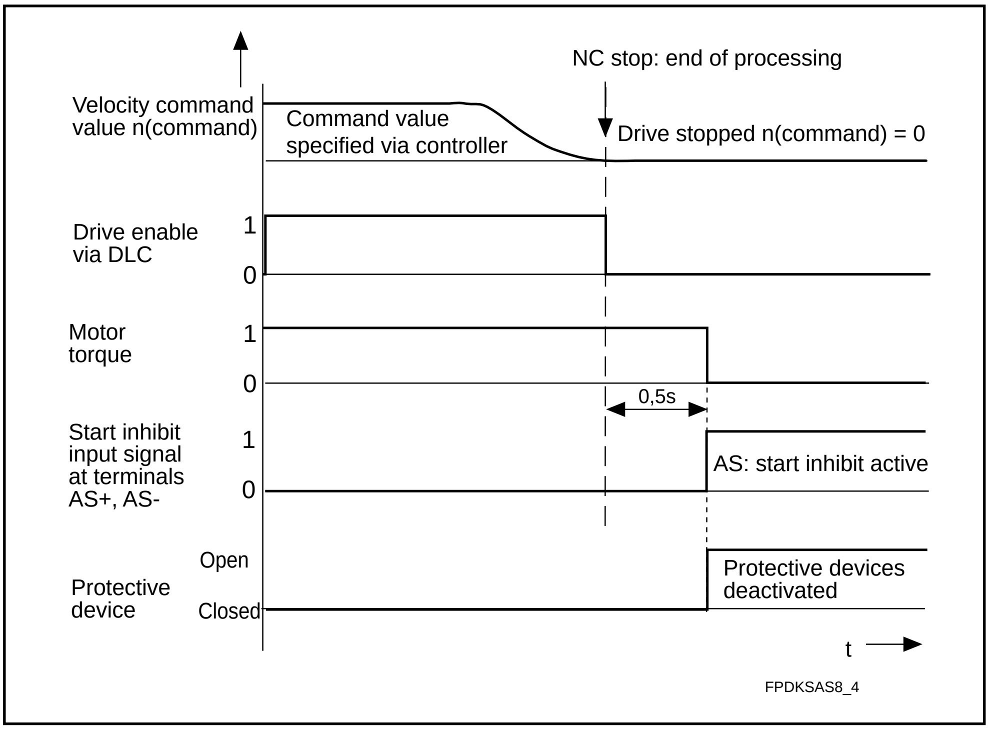


Fig. 8.4: Timing diagram for activating the start inhibit.

8.3. Motor Holding Brake Function

Servo axes must be prevented from carrying out unwanted moves when they are turned off, if such movement can damage machines or injure personnel. Such protection is optionally offered by INDRAMAT through the installation of motor brakes.

The MDD motor brake is not designed to be a service brake. It will be completely worn out after approximately 20,000 motor revolutions with the brake applied.

When no current is applied to the motor brake, a force is applied against the brake/anchor disc on the servo motor. This reliably holds the axis in position. The brake is controlled by the servo drive and depends on the status of the drive enable signal, which is applied by the DLC (see Fig. 8.6), and on the selected error reaction (see Fig. 8.7). Voltage is supplied to the brake via a 24-V DC source (see Fig. 8.5) supplied internally from the DKS. The DC voltage is high enough to ensure that all brake types supplied by INDRAMAT can be actuated.

Connecting the motor brake

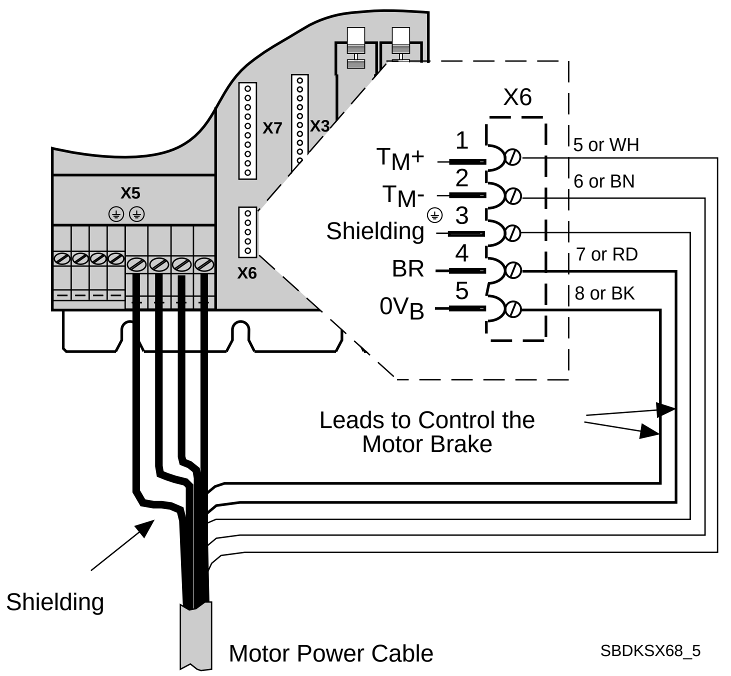
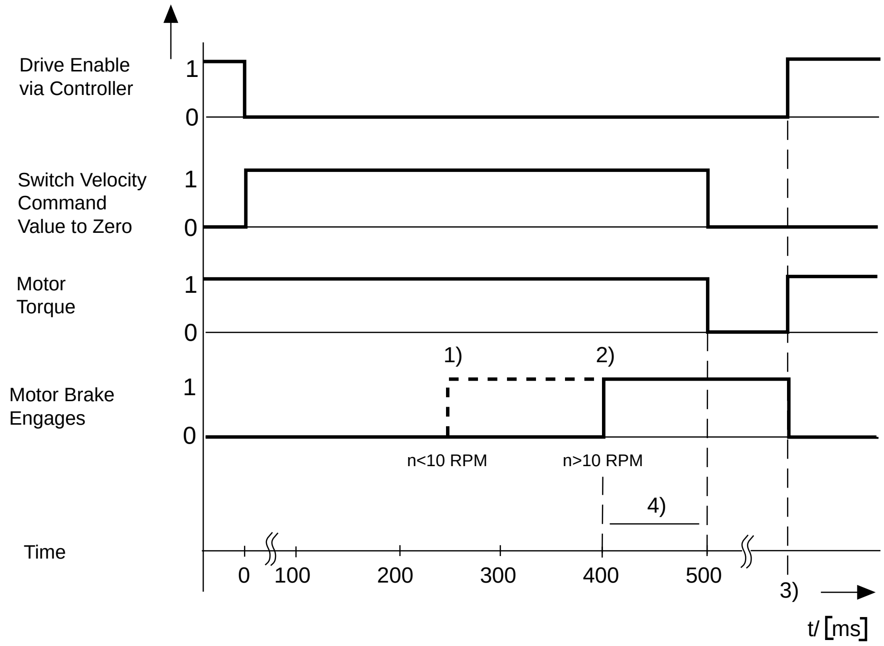


Fig. 8.5: Connecting the brake at connector X6.

Brake status dependent on drive enable signal from the DLC



1) The motor brake engages at a speed < 10 RPM.

2) The brake engages after 400 ms, even if the motor speed is greater than 10 rpm.

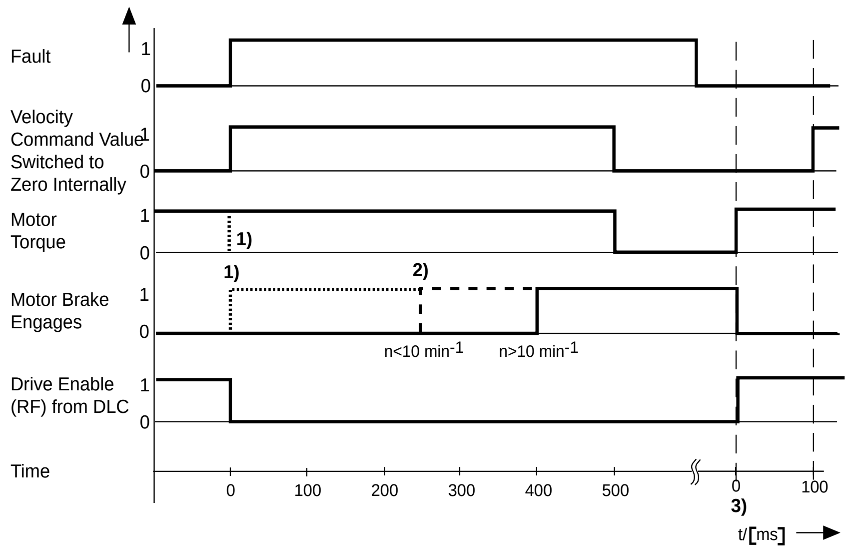
3) The brake releases at the same time the drive enable is set.
Drive enable is initiated by the DLC.

4) **Note:** The motor becomes torque-free 100 ms after the brake engages.

FPDKSRF8_6

Fig. 8.6: Timing diagram for the brake as a function of drive enable from the DLC.

Brake behavior as a function of the selected error reaction



1) The brake engages immediately when error reaction 2 is set.
The motor is immediately switched to a torque-free state.

2) Error reaction 0:
The brake engages when the speed drops below 10 RPM. The brake engages after 400 ms, even if the motor speed is greater than 10 RPM.

3) After the cause of the fault has been eliminated and the drive enable has again been set via the controller, the brake releases immediately. In order the ensure that the brake releases in a reliable manner, a command value of zero is set internally in the drive for a period of 100 ms.

FPDKSHB8_7

Fig. 8.7: Timing diagram of brake responses based on drive fault reactions.

Manually releasing the brake

In those cases where a drive enable is not issued and it is necessary to move the servo axis manually, the brake can be released as follows:

Potential hazard to personnel and damage to machines. Secure vertical axes so that they do not move unintentionally!

Procedure:

1. Disconnect the leads used to control the brake (X6/4 and X6/5).
2. Apply an external DC voltage of +24 V to the wire marked „7“ or „red.“
3. The wire marked „8“ or „black“ must have „0 V“ applied to it.
4. This releases the brake.
5. Move the axis to the desired position.
6. Disconnect the external DC voltage.
7. Connect the wires to X6 as shown in Fig. 8.5.

Check releasing of the brake

Releasing the brake on the servo motor can be heard. To do this, briefly activate the brake successivly a number of times and listen for a striking sound in the motor each time the brake is applied.

Check the sizing of the brake

During setup, measure the torque due to gravity applied to the motor (see section 9.1).

The brake holding torque stated in the data sheet for the motor must be greater than the torque produced by the weight of the axis. Shock and vibration during operation of the machine will require that the holding torque be oversized by at least 30%, since the dynamic torques are superimposed on the static torque.

Diagnostics

Faults in the brake and its actuating system (see section 10. Diagnostics and Troubleshooting.)

8.4. Ready State

Machines and systems are continously monitored to avoid interrupting production. The DKS servo drive uses signal contact „Bb“ for this purpose.

„Bb“ is a potential-free contact on connector X3, pin 6/7 which, in the event of a drive error, informs the attached DLC or PLC exactly which machine is affected (see Fig. 8.9).

The servo drive reporting this error can then be displayed on the controller or PLC.

Bb Contact Status

Status of the Bb contact	Meaning of the status
	Fault in the AC servo drive
	Servo drive is error-free

Fig. 8.8: Status of Bb contact at terminal X3.

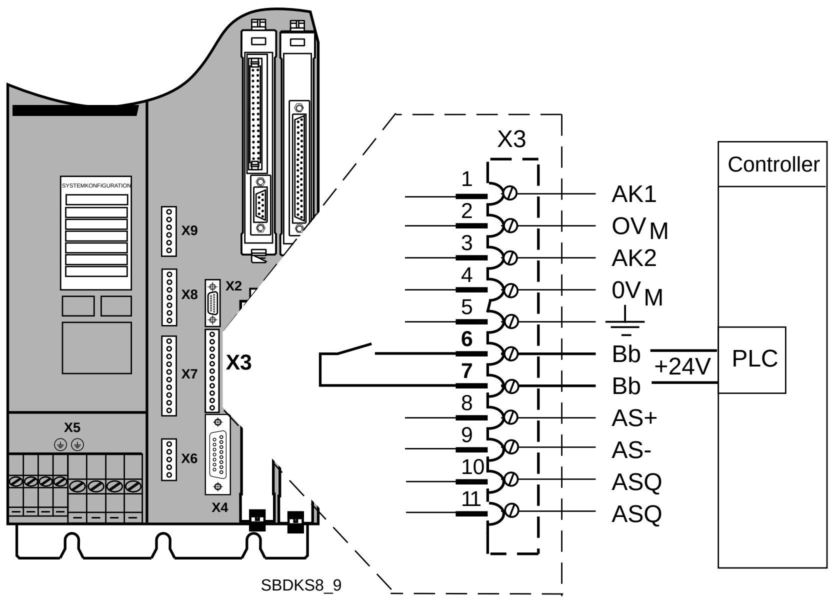


Fig. 8.9: Bb message contact to external evaluation.

Status diagnostics

Status diagnostics are messages relating to the ready state of the drive. They are display on status display H1.

„Ready“ Drive ready to have power applied

If the input voltage has been applied and the servo drive has no errors active, the message „Bb“ ready for operation appears on the „H1“ status display on the servo drive.

„Drive Ready“ to deliver power

After the power-on button has been pressed, the „H1“ status display changes to „Ab“ – drive ready.

„Drive Enable“ Drive follows the command value

When the DLC sets the drive enable signal, the internal control circuits are enabled. The „H1“ display changes to „AF“ [Antriebsfreigabe = drive enable]. The drive follows the commands from the DLC.

8.5. Temperature Monitors

In order to avoid interruptions of production, the digital AC servo drive has three temperature monitors. One is for the servo drive, one for the AC servo motor, and one for the bleeder resistor on the DKS internal supply section.

Causes for overheating can be:

- build-up of dirt and dust at heat transfer points
- overloading due to the processing cycle
- failure of the cooling systems on the servo drive
- failure of the cooling systems on the AC servo motor

Operation

The temperatures of the servo drive and the servo motor are monitored independently and continuously. If an unacceptably high temperature occurs, a temperature warning is output for 30 seconds.

Warning via „H1“ Status Display

The following temperature warnings blink on the display:

50 „Amplifier overtemperature – warning“

51 „Motor overtemperature – warning“

52 „Bleeder overtemperature – warning“

Internal error response in the drive

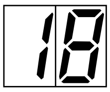
The controller must cause the drive to stop in a controlled manner appropriate to the process within 30 seconds; after that, the digital drive responds in accordance with the selected error reaction.

Note

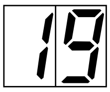
Temperature warnings 50 and 51 cannot be evaluated at this time.

Error message

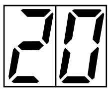
The following error messages are output to status display H1:



„Amplifier overtemperature – shutdown“



„Motor overtemperature – shutdown“ (see also section 10.3)



„Bleeder overtemperature – shutdown“

Warning via signal output „TVW“

A 24-V signal is present at signal output „TVW“ (terminal X7) for evaluation by the controller. For example, this signal can be directed to a free input on the DEA card and then evaluated in the controller program. This signal only evaluates bleeder overload.

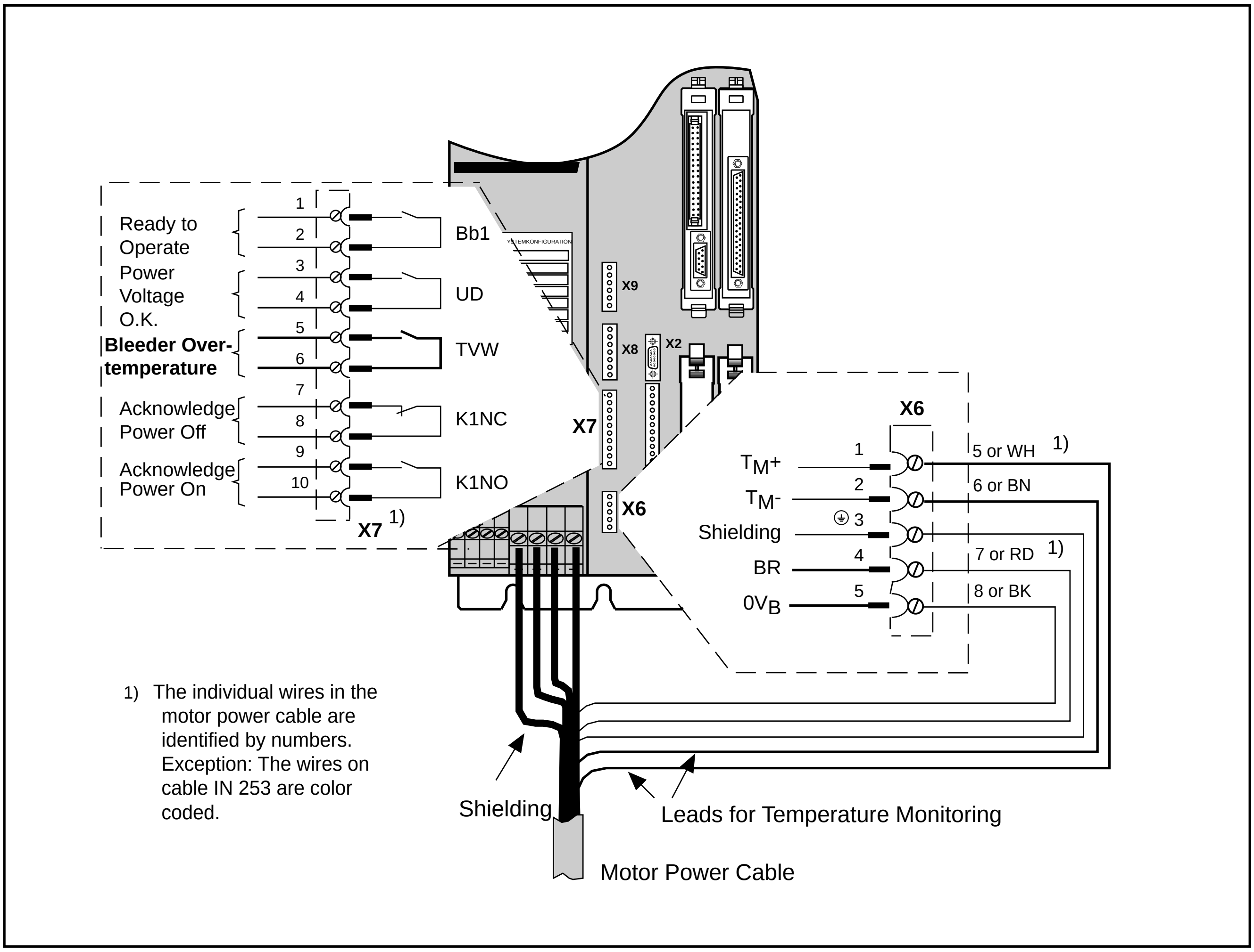


Fig. 8.10: Inputs and outputs on the servo drive for temperature monitoring.

8.6. Actual Position Determination

Measuring systems are nedded to permit a controller to process positions on machine axes. These measuring systems can be connected directly to the machine´s mechanical system (direct position measuring system), or to the motor (indirect position measuring system).

8.6.1. Position feedback using the motor measuring system

Indirect position determination is achieved using the MDD servo motor´s feedback. The motor feedback can be for either an indirect relative position or an indirect absolute position system. The motor´s rotor position is determined by the feedback and processed by the drive as a high resolution signal.

Matching the count direction to the machine

Matching the travel direction of the axis to the count direction of the machine coordinate system is done by setting DLC parameter A109.

8.6.1.1. Indirect relative position determination

Motors with resolver feedbacks (RSF) or digital servo feedbacks (DSF) are available for indirect relative position determination.

8.6.1.2. Indirect absolute position determination

For indirect absolute position determination, motors are available with resolver feedbacks plus the multi-turn encoder option (RSF + IDG), or with digital servo feedbacks plus the multi-turn encoder option (DSF + MTG). Resolution is up to 4096 motor revolutions.

Setting the absolute reference

The absolute reference between the machine´s mechanical system and the motor´s measuring system is set as follows:

1. Locate the axis in a gaged reference position. Then, either ....

2a. start the VT-100 emulation program (DDS2PC, for example). Enter the value of the gaged reference position (e.g., 2048) in the menu for absolute encoder. Or,

2b. enter the gaged reference position in the DLC parameter A111, Homing Offset.

This sets the indirect motor measuring system to the machine´s mechanical system.

Exceeding the maximum traverse range will cause the current absolute position value to be lost.

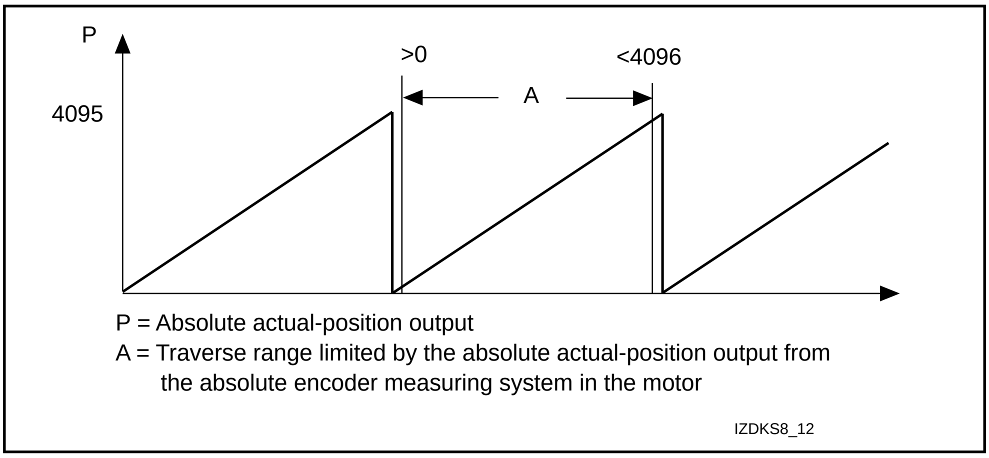


Fig. 8.11: Determination of absolute actual position.

Traverse commands lying outside the permissible traverse area will result in an increased risk of accident for personnel and potential machine damage.

The usable travel range can be set in DLC parameters A113, minimum travel, and A114, maximum travel (see DLC 1 application documentation). Always set the usable travel range so that when decelerating the servo axis from maximum velocity, it does not exceed the maximum travel range.

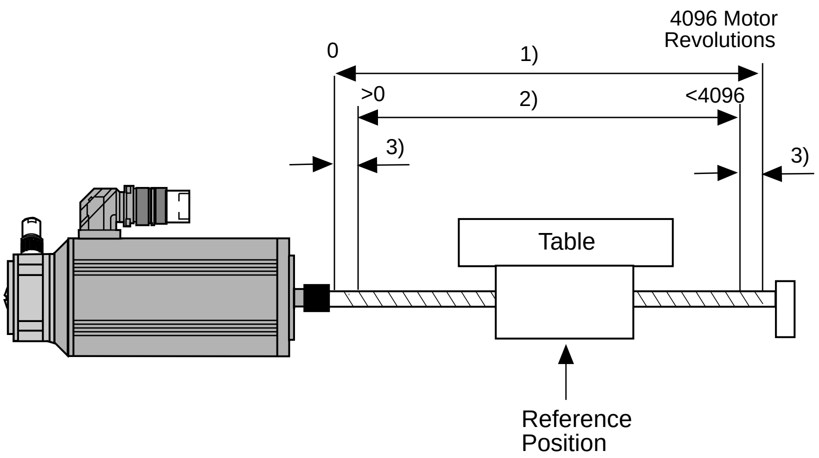


Fig. 8.12: Example of setting the reference position using the „absolute encoder parameter“ for the MDD servo motor with multi-turn encoder feedback.

Absolute encoder monitor

When a DKS equipped with an absolute encoder motor (multi-turn) is turned off, the current actual position is saved. When the unit is turned on again, the position determined by evaluating the absolute encoder is compared with this saved position value. If the different is greater than the absolute encoder monitoring window, which is parametrized in the "operating mode/scaling" menu, then error 76, "absolute encoder error", is generated.

Uncontrolled axis motion can cause accidents. The axis was moved in the power-off state, and it is located outside the position parametrized in the "absolute encoder monitoring window".

Check whether a new traverse command will cause damage.

Action:

• Reset the error using the error reset button (S1), see Fig. 2.3.
• If error 76 cannot be reset, there is a feedback fault. Replace the motor.

8.6.2. Actual position determination using a machine mounted measuring system (direct position determination)

A measuring system which provides square-wave signals and mounted directly on the machine can be evaluated by the DEF 1.1 auxiliary plug-in card. The use of such a measuring system is described further in the application documentation on the DLC 1-A single-axis positioning card.

8.7. Velocity Loop Tuning

The digital AC servo drive is adapted to the machine‘s mechanical characteristics by calling up the velocity control parameters of the motor feedback system (see section 7.3.1. „DKS Parameterization“). This sets the servo drive's default parameters. If machine operation becomes unstable, this may be due to the following causes:

- Mechanical play between the motor shaft and the machine
- Insufficient machine rigidity
- Inertia mismatch
  (ideal condition: ratio of rotor mass moment of inertia to external mass moment of inertia = 1:1)

The above causes then lead to:

- Poor surface finish on the workpieces
- Increased wear in the machine mechanical system

These things should be avoided.

In cases where such causes cannot be eliminated or can only be partially corrected, the INDRAMAT intelligent AC servo drive offers a means of adapting to the problem by means of servo tuning. Fig. 8.13 provides a block diagram showing how the control parameters function.

The default settings of the velocity loop should only be changed by personnel who have a solid understanding of control technology.

If the default settings do not produce the desired results, please consult INDRAMAT service.

Functions of velocity loop parameters

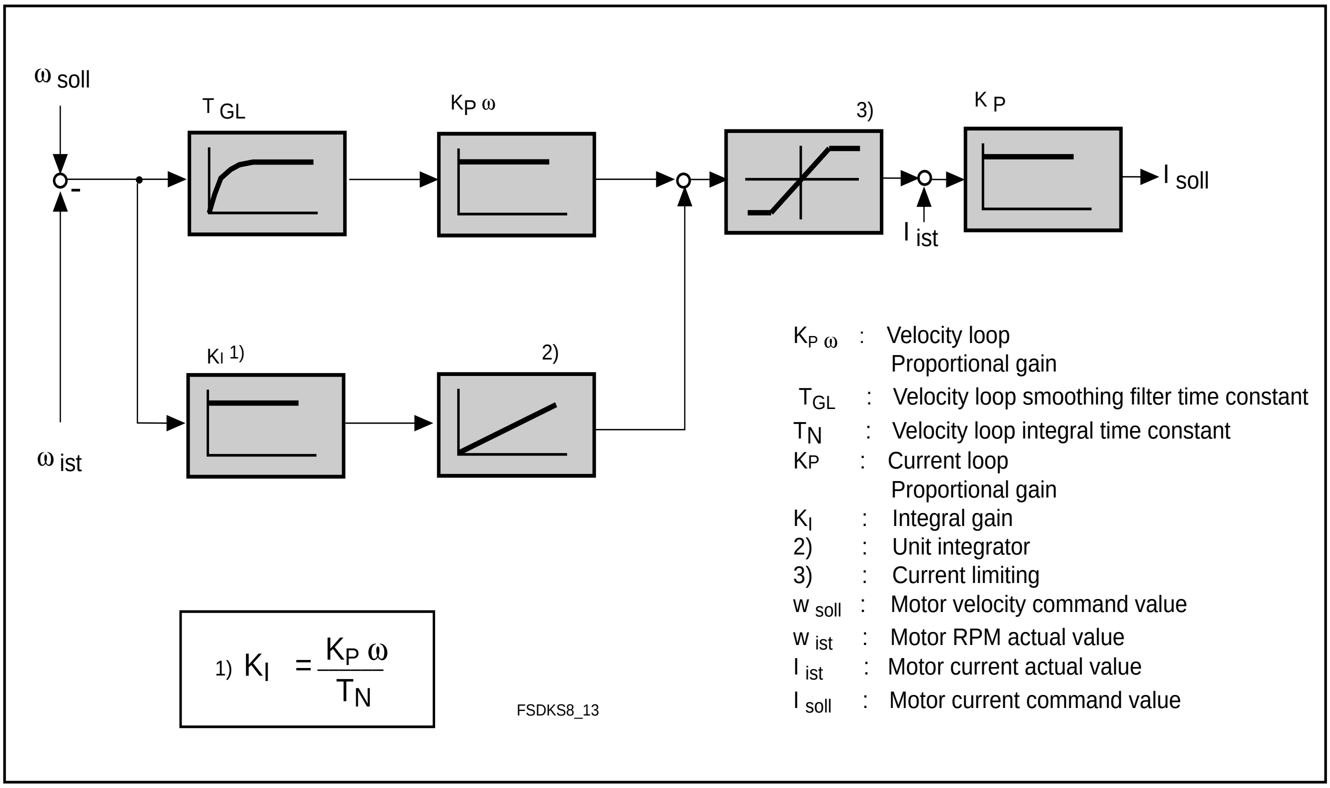


Fig. 8.13: Block diagram of the velocity loop.

Velocity Loop Proportional gain „Kpw“

The parameter Kpw sets the proportional gain of the velocity loop.

Velocity Loop Reset Time "T_N"

The definition of the velocity loop reset time is shown in Figure 8.14.

In the representation of the transfer function for a PI control shown below, a sudden change (step command) in the "Ue" input variable to a constant value is assumed and the slope for the output variable "Ua" is shown.

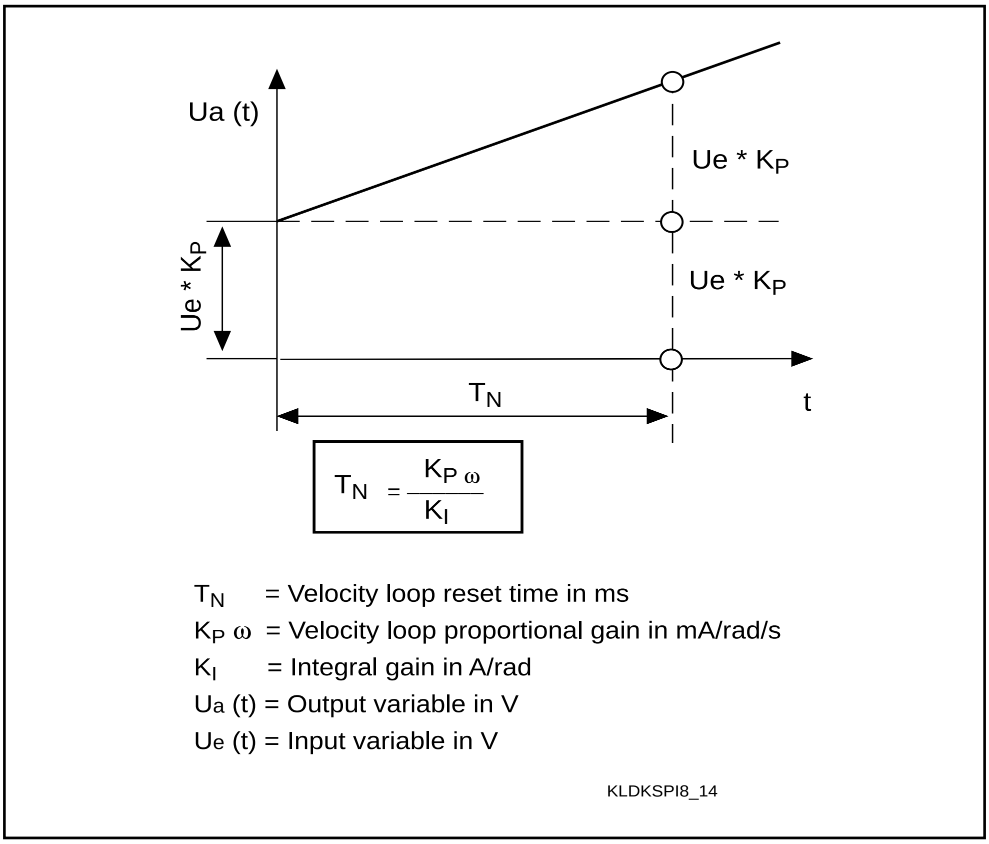


Fig. 8.14: Transfer function for a PI control.

Smoothing Time- Constant "T_{GL}"

In the proportional section of the velocity loop, a time constant can be activated.This constant is to smooth the velocity command from the controller and for limiting the bandwidth of the velocity loop.

If the filter is turned off here, then the smallest entry value of 250 ms is set.

Current Loop Proportional Gain "K_P"

The parameter KP determines the current loop proportional gain.

This value is set individually for each motor by INDRAMAT and must not be changed.

8.8. Reaction to a Power Failure and an E-STOP

In the event of a power failure or an emergency-stop, there is a danger that the machine and workpiece will be damaged by the immediate braking of the servo axes.

8.9. Determining the „M_{KB}“ Short-Term Operating Torque

The MKB is entered using the „overload factor“ parameter. The value for the motor/servo drive combination used is found in the Selection data list, doc. no. 209-0069-4302-00 DE.1

If a short-term operating torque different from that found in the above list is required for the motor/servo drive combination which is in use, then this torque value can be changed by using the „overload factor“ parameter. The following applies to the overload factor in the „OPERATING MODE/SCALING“ menu:

Overload factor

$$\textbf{Overload Factor}^{1)} = \frac{M_{KB}}{M_{dN}} \times 100 \text{ in } \%$$

M_{KB} = Short-term operating torque in Nm
M_{dN} = Continuous stall torque in Nm
1) Entry limits = 0 ... 400 in %

The short-time operating torque for intermittent operation can be selected according to the ED, duty cycle, column of the selection data list as above (operation mode S6 per DIN 57530/VDE0530). The maximum cycle time depends on the size of the motor and is indicated in the operating curves of the relevant motor documentation. For lower short-term torque levels, the duty cycle can be calculated as follows:

$$ED = \frac{(M_{dN})^2}{(M_{KB})^2} \times 100 \text{ in } \%$$

ED = Duty cycle in %
M_{dN} = Continuous stall torque in Nm
M_{KB} = Short-term operating torque in Nm

The continuous standstill torque MdN can be output from the AC servo motor in continuous operation as follows:

- up to 25% of n_{max} (max. NC available speed).
- up to an ambient temperature of 45°C.

Here, an excess temperature of 60 K results on the motor housing depending on the thermal time constant. For higher speeds, the continuous torque can be found in the applicable motor documentation.

9. Final setup activities

9.1. Testing the servo drive

Set Safety Limit Switches

Set safety limit switches on the axes to provide sufficient clearance to the axis end stops:

Procedure:

1. Check to be sure that the cams are of sufficient length.
2. Traverse the axis at maximum velocity to the safety limit switch.
3. Measure the braking distance.
4. With vertical axes, perform the measurement in both directions.
5. Set the determined braking distance as the minimum distance between the machine final stop and the safety limit switch.

Verify drive power requirements

Verifying power requirements of the drive is done by monitoring the torque output of the servo motor. Determine the torque output of the motor in one of the following ways:

Method 1:

- Select the drive status menu in the parameter and diagnostics program.
- Operate the axis.
- Read the momentary torque load in Nm and in % of the continuous stall torque of the unventilated motor.

Method 2:

- Call the „SCALING“ menu from the parameterization and diagnostics program (see section 5.1).
- Analog output: Call channel 2: electrical current command value by pressing the right cursor key „→„ or the left cursor key „←„.
- Attach a multimeter or oscilloscope to the selected analog diagnostic output (connector X3)
- Measure the analog voltage at the output.

Calculate current command value

- Calculate the current command value I_{soll} as follows:.

$$I_{soll} = \frac{V_{AKmax}}{U_{AK}} \cdot I_{type}$$

V_{AK} = Voltage measured at AK diagnostic output

V_{AKmax} = 10V - maximum output voltage at AK diagnostic output

I_{TYPE} = Drive current type in A

I_{soll} = Current command in A

Calculating the torque output of the servo motor

- The torque output of the servo motor, M_{load}, is calculated from the current command as follows:

$$\mathbf{M_{load} = I_{soll} \cdot K_m}$$

I_{soll}	= Current command in A
M_{load}	= Load torque in Nm
K_m	= Torque constant in Nm/A

Obtain the motor torque constant K_m from one of the following sources:

- from the motor name plate
- from the "AMPLIFIER/MOTOR PARAMETERS" menu, torque constant parameter
- from the motor documentation

Verify the torque output of the servo motor under the following conditions to be sure that the drive stays in the save operating area:

- torque at maximum feedrate
- torque during rapid traverse
- torque during acceleration

Torque at maximum feed rate

Measure the torque at the minimum and maximum feedrate. The torque should not exceed 60% of the continuous stall torque, M_{dN}.

Reasons for increased base torque:

- Axis clamp does not release.
- Inadequate lubrication.
- High friction on the slide guides.
- Poorly set weight balance.
- Mechanical binding in the drive axis.
- Motor brake not released (24V DC not applied).
- Incorrect dimensioning of the drive equipment.

Torque in Rapid Traverse

In rapid traverse (positioning moves), motor torque should not exceed 75% of the contiuous stall torque.

Reasons for increased torque:

- Poor hydraulic weight balance (pressure change dependent on velocity).
- Fluid buildup on the teenth in an oil bath gearbox.
- Toothed belt too tight.
- Lubricating film strips off
- Ball screw too tight.
- Drive hardware sized incorrectly.

Setting accelerating torque

Obtain the value for M_{max}, maximum torque for the motor-drive combination from the selection list. Motor torque during acceleration should not exceed 80% of M_{max}.

Set the acceleration torque as follows:

1. Apply the current command signal to diagnostic output 1 or 2 (see section 10.5) and record it.
2. Using the DLC, operate the system at maximum velocity.
3. Keep increasing the acceleration until the drive goes to a current limiting condition.
4. Recuce the acceleration rate by 20%.

If the above setting is insufficient for the machine cycle, the system is not sized properly.

For axes performing interpolation, the acceleration settings should be equal. Use the value of the drive with the lowest acceleration.

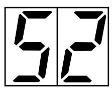
Setting the weight balance

The weight balance must be set in such a way that the motor current draw exhibits a constant minimum value when the machine axis moves upward and downward. This test should be performed in the feed velocity range as well as in rapid traverse.

Check the regenerated energy

Peak generated power:
Use the DLC to command the DKS axes to traverse at rapid traverse speed and then brake with the emergency-stop function. The DKS should not shut down issuing error message 25, "Overvoltage".

Continuous regenerated power:
The axis must operate at least 15 minutes in the load cycle where the maximum regenerated energy (braking energy) is to be expected. During this test, the DKS should not shut down issuing error message "bleeder overload shutdown"; error code "20".

It is permissible for the "bleederoverload warning"  to appear briefly.

If a shutdown occurs in either of the tests, the DKS layout must be corrected.

9.2. Data Backup

Back up data using the "axis specific data list"

After start-up, it is essential that the parameters be backed up. In addition to backing up the parameters as a file, they can also be saved in a list--the „Axis-Specific Data List.“ The „Axis-Specific Data List“ provides an additional backup of the contents of the axis-specific parameters. It is to be stored in the machine file folder. This list should be completed by the setup personnel upon initial start-up by entering the parameter contents.

The „Axis-Specific Data List“ can be photocopied to document the parameter contents for additional axes. The „Axis-Specific Data List“ is found in the Appendix.

Back up data using a PC

Backing up of the axis-specific parameter contents is described in section 7.

10. Diagnostics and Trouble-shooting

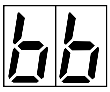
Faults and warnings detected by the drive as well as operating statuses are displayed by the 2-digit H1 „status display“ (see Fig. 2.3).

If errors are detected while the microprocessor in the DKS is initializing, the error which occurred most recently is displayed on the DKS status display. The user program outputs a list of all the initialization errors which occurred. The initialization errors are 83, 84, 87,88, 89, 91.

Warnings from the servo drive and command errors will blink on the display. At the same time the operating statuses and error messages can be called up via the diagnostics text in the „Drive Status“ information line, the user interface in the drive status menu on the DKS (see section 5, Fig. 5.5), or they can be displayed using the DLC-ISB-3 interface control unit.

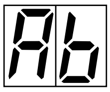
10.1. Drive diagnostic codes

The operating statuses of the drive are displayed by outputting a combination of letters:



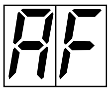
bb „Ready to operate“

Meaning:
The drive is ready for high voltage power.



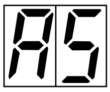
Ab „Drive ready“

Meaning:
The control and power section of the drive is ready to operate.



AF „Drive enable“

Meaning:
Drive enable was issued and caused the drive to activate. This is followed by a velocity command from the DLC controller.



AS „Start inhibit“

Meaning:
The power output stages are disabled. This signal is used to switch the drive to a torque-free state regardless of the present operating mode of the drive system.

The power output stages are enabled by deactivating the start inhibit. A drive enable must then be re-issued by the DLC.

AH

AH „Drive halt“

Meaning:
The drive is stopped at the parameterized deceleration, and it remains in closed-loop control

10.2. Status Displays during Drive Initialization

-1

Clear the data in RAM

-2

Check and if necessary clear the parameter memory (EEPROM) in the software module. With new software modules, this display is output for approximately 15 seconds.

-3

Transfer program (EEPROM → RAM)

-4

Check hardware (data RAM)

-5

Initialize hardware

-6

Initialize software (EEPROM data → RAM; parameter limits)

-7

Initialize software /oscilloscope function, feedback

-8

Initialize software

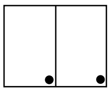
-9

Position initialization

10.3. Error Diagnostics and Troubleshooting Using the Status Display on the Servo Drive

Reset the error message after each time a fault has been corrected. The error message is reset by pressing the S1 error reset button on the DKS (see Fig. 2.3). The DKS must also be reset with „Clear“ signal input. The controller then issues drive enable (RF).

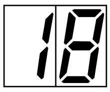
The servo drive is once again ready to operate after this resetting of the error message.



„Watchdog“
The processor in the DKS is not working.

Cause:
1. Software module not present or defective.
2. Processor defective.

Action:
1. Install or replace the software module.
2. Replace DKS.

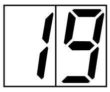


„Amplifier overtemperature shutdown“

An unacceptably high temperature was detected in the power output stage of the DKS. The DKS then issued warning 50 „amplifier overtemperature warning“ for 30 seconds. Then, depending on which error reaction was selected, the drive shut down and issued the above error message.

Cause:
1. Failure of the built-in blower on the equipment.
2. Failure of enclosure climate control system.
3. Wrong enclosure climate control with respect to heat removal.

Action:
1. If a blower fails, replace the DKS.
2. Correct the functioning of the enclosure climate control system.
3. Check the size of the enclosure.



„Motor overtemperature shutdown“

The motor has overheated. The DKS outputs warning 51 „motor over-temperature warning“ on the H1 display for 30 seconds. Then, depending on the selected error reaction, the drive stopped and issued the above error message (see error reaction options section 8.1 „Error Reaction.“

Cause:
1. The motor was overloaded. The effective torque which the motor had to produce exceeded the max. continuous stall torque for too long.
2. A break in the line to the motor temperature monitor.

Action:
1. Check the motor layout. In the case of systems which have been operating for a relatively long time, check whether the operating conditions have changed (look for dirt, friction, masses which may have shifted, etc.).
2. Check the wire to the motor temperature control X6/1; X6/2 for a proper ground connection or a break.

20

„Bleeder overtemperature shutdown“

Cause:
Continuous regenerated power too high.

Action:
- Change the processing cycle
- Select a DKS having a higher rated current

22

„Motor encoder error“

The signals on the motor encoder/feedback are monitored. If the signals are out of tolerance, this error message is output and the supply of power is turned off.

Cause:
1. The feedback cable is defective or not connected.
2. Motor feedback is defective.

Action:
1. Check feedback cable.
2. If no defect is found in the cable, the feedback is defective. Replace the motor

There is a danger of an accident occurring due to uncontrolled axis motion. On drives equipped with an absolute value encoder function, reset the absolute measurement reference when the motor is replaced (see section 8.6 „Absolute Encoder Parameters“).

24

„Overcurrent“

Cause:
One of the three phase currents has reached a value greater than 1.5 the drive rated current.

Action:
1. Check the motor cable.
2. Check the servo drive parameters. To do this, consult with INDRAMAT service.

25

„Overvoltage

The DC bus voltage has reached an excessively high value (Ud > 475 V). To protect the power stage of the DKS, the drive was temporarily switched to a torque-free state.

Cause:
The regenerated energy of the braking motor could not be converted fast enough by the bleeder resistor.
Bleeder circuit defective.

Action:
Use a DKS having a higher rated current.
Check the application.
Replace the DKS.

See section 9.1. Check regenerated energy.

26

„Undervoltage error“

The DC bus voltage is monitored in the DKS. If the voltage falls below +200 volts, the drive is shut down in accordance with the selected error reaction.

Cause:
1. The DLC does not function properly in enabling the drives.
2. DKS malfunction
3. Problem in the input power (phase missing)

Action:
1. Check the logic used to enable the drive in the DLC.
2. Eliminate the DKS malfunction (replace).
3. Eliminate the problem in the power source.

33

„Error external voltage source“

Various auxiliary plug-in cards have electrically isolated inputs and outputs. An external supply voltage must be applied to properly operate these inputs and outputs. If this voltage is outside the permissible range, the above error message results.

Action:
Check external supply voltage. The voltage range and tolerances may be found in the applicable interconnect diagram in the configuring documents (see Plug-In Cards for Intelligent Digital Servo Drives, Project Planning Manual, 209-0069-4356).

46

„Error external encoder: maximum frequency exceeded“

The interface module used to connect the external measurement system may be operated up to a maximum input frequency. The error indicates that this maximum frequency was exceeded.

Maximum input frequency:	DEF 1.1	=	1000 kHz
	DEF 2.1	=	1000 kHz
	DLF 1.1	=	150 kHz

Action: Reduce speed

47

„Error detecting reference mark on external encoder“

Cause:
1. DLF 1.1 defective.
2. Reference mark channel on the external encoder defective.

Action:
1. Replace the DLF 1.1 card.
2. Contact INDRAMAT service since the attached encoder is not compatible with the evaluation circuits.

48

„Absolute Encoder Battery Voltage Low“

When absolute encoders contain a battery in the feedback circuit, the battery voltage is monitored. If the voltage is less than 2.8 V, this message is issued. The absolute encoder function then only has battery backup for approximately four additional weeks.

Potential for accident due to unintended axis motion. After this 4-week period has elapsed, the absolute dimension reference may be lost.

Cause:
Battery voltage too low.

Action:
Replace the battery as soon as possible.

50

„Amplifier overtemperature warning“ (blinking)

The temperature of the heat sink in the DKS has reached the maximum permissible temperature. The drive will follow the velocity command for a period of 30 seconds. Thus, a controlled shutdown of the axis is possible via the DLC controller (for example: stop machining, retract tool preventing a "crash," etc.)

After 30 seconds the drive will respond according to the error reaction parameter; see section 8.1.

Cause:
1. Failure of blower in the unit
2. Failure of the enclosure climate control system
3. Inadequate cooling in the enclosure.

Action:
1. In the event of a blower failure, replace the DKS.
2. Repair the enclosure climate control system.
3. Check the size of the enclosure.

51

„Motor overtemperature warning“ (blinking)

The motor has overheated. The velocity command will be followed for a period of 30 seconds. Thus, a controlled shutdown of the axis is possible via the DLC controller (for example: stop machining, retract tool preventing a "crash," etc.)

After 30 seconds the drive will respond according to the error reaction parameter; see section 8.1.

Cause:
The motor was overloaded. The effective torque required of the motor exceeded the maximum permissible continuous stall torque for too long.

Action:

Check the motor layout. In the case of systems which have been operating for a relatively long time, check whether the operating conditions have changed (look for dirt, friction, masses which have shifted, etc.).

52

„Bleeder overtemperature warning“ (blinking)

The motor briefly enters the bleeder‘s overload range when it reverses.

The contact on push-in terminal X7 (Figure 8.10) is closed and can be evaluated. If a specified limit is exceeded, error code 20 „bleeder overtemperature shutdown“ is displayed.

60

„Bridge circuit overcurrent“

The current in the power transistor bridge has exceeded a value of two times the device peak current. The drive is immediately switched to a torque-free state.

Cause:
1. Short circuit in the motor cable
2. Power output section of the DKS is defective.

Action:
1. Check the motor cable for a short circuit. If there is a short, replace cable.
2. Replace DKS.

61

„Ground fault (earth conn) circuit tripped

The total of the phase currents is monitored. In normal operation, the total = 0. If the total of the currents is greater than 0.5 x I_N, the ground fault circuit is triggered.

Cause:
1. Defective motor cable
2. Short to ground in the motor.

Action:
1./2. Check the motor cable and motor for a short to ground and if necessary replace.

67

„Hardware synchronization defective“

Cause:
1. The pulse width modulator on the DKS is synchronized by the phase control circuit. Proper synchronization is monitored. If synchronization is incorrect, this error message is output.

Action:
1. Replace DKS; send in for inspection.

68

„Brake Fault“

With MDD motors with an integrated brake, the DKS takes over control of the brake. The brake current is monitored. If the brake current is outside the permissible range, this error message is output.

Cause:
1. The supply voltage for the brake is produced in the DKS. It is monitored (24 V ±10%). The brake is not properly connected; short circuit.
2. The motor cable is loose or is incorrectly connected (wrong polarity).
3. Brake defective.
4. DKS defective.

Action:
1. Check the supply voltage.
2. Check the motor cable.
3. Replace the motor.
4. Replace the DKS.

69

„±15 Voltage error“

Trouble was detected in the ±15 V power.

Cause:
External short circuit, DKS defective.

Action:
Replace DKS, correct the short circuit.

70

„+ 24 Voltage error“

Trouble was detected in the + 24 V power source.

Cause:
External short circuit, DKS defective.

Action:
Replace DKS, correct the short circuit.

71

„+10 Volt error“

There is a problem in the supply voltage for the current sensors.

Cause:
Defect in DKS

Action:
Replace DKS

72

„+8 Volt error“

There is a problem in the supply voltage for the encoder systems.

Cause:
Short circuit in the motor encoder cable or in the cable for external encoders.

Action:
Check cable and replace if necessary.

73

„Driver Stage Power Supply“

There is a problem in the supply voltage for the driver stages.

Cause:
Defect in the servo drive

Action:
Replace the servo drive.

76

„Absolute encoder error“

The current actual position is stored when a DKS equipped with an absolute encoder motor (Multi-turn) is turned off. When the motor is powered on again, the position determined by the absolute encoder evaluation is compared with the stored value. If the difference is greater, then the parameterized absolute encoder monitor window P-0-0097, error code 76 „absolute encoder error,“ is generated and reported to the controller.

Cause:
1. It is the first time the unit was powered on (stored position is not valid).
2. The axis was moved in the power-off condition by more than the distance parameterized in absolute value encoder monitoring window P-0-0097 and is outside its position window.
3. Position initialization is incorrect (feedback defective).

Potential for accidents due to unintended axis motion.

Action:
1. Clear the error (establish axis reference).
2. Check whether a new traverse command will cause damage.
   If not, clear the error.
3. Check the reference position. If the reference dimension is incorrect, replace the motor.

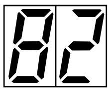
81

„Program RAM defective“

During drive initialization the memory blocks in the servo drive are checked. If the check detects an error, this error is reported.

Cause:
Hardware error in the servo drive.

Action:
Replace servo drive.

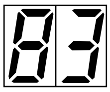


„Data RAM Defective“

During drive initialization the memory blocks in the servo drive are checked. If the check detects an error, this error is reported.

Cause:
Hardware error in the servo drive.

Action:
Replace servo drive.

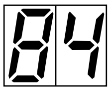


„Error reading drive data“

During drive initialization the operating software fetches data from an EEPROM and places it the servo drive. If this access fails, the above error is issued.

Cause:
Hardware defective in the servo drive.

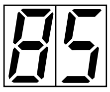
Action:
Replace servo drive.



„Invalid drive data“

Cause:
EEPROM is blank or has invalid values.

Action:
Reprogram the EEPROM, contact INDRAMAT service.

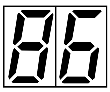


„Error writing drive data“

An error was detected when data were loaded into the drive‘s internal EEPROM.

Cause:
Hardware defective

Note:
This error can only occur in test procedures performed in the plant.



„Cannot write to parameter memory “

Cause:
It is not possible to write to the parameter memory on the programming module.

Action:
1. Back up the parameter set from the programming module.
2. Replace the software module.
3. Load the parameter set into a new module.

87

„Invalid parameter memory data“

During initialization of the servo drive, it was found that one or more parameters in the software module are invalid.

Cause:
1. The software module was not previously initialized.
2. The operating software EEPROMs in the software module were replaced.
3. Hardware fault on the software module.

Action:
1./2. Initialize the user interface (see section 5.1) and call each submenu under the „parameters menu“ in sequence. Invalid parameters will be marked by „***“. Enter new parameters at these locations.
3. Replace the software module.

88

„Error reading motor data“

All motor data are stored in a data memory in the motor feedback. An error was encountered when these data were read.

Causes:
1. Motor feedback cable defective.
2. Motor feedback defective.

Action:
1. Check motor feedback cable, replace as needed.
2. Replace motor.

89

„Motor data invalid“

Cause:
EEPROM is blank or has invalid values.

Action:
Reprogram the EEPROM, contact INDRAMAT service.

90

„Error writing motor data“

An error was detected when data were written into the motor feedback.

Cause:
1. Defective feedback cable.
2. Defective motor feedback.

Action:
1. Check cable and replace as needed.
2. Replace motor.

91

„Configuration error“

Cause:
1. The software and hardware configurations are not compatible.
2. Plug-in cards defective, not installed, or inserted incorrectly.

Action:
1. Check the servo drive per the configuration label and, if necessary, replace software or hardware.
2. Check plug-in cards.

92

„Absolute encoder not calibrated“

The parameter reference position and/or counting direction in the „ABSOLUTE ENCODER PARAMETERS“ menu could not be read.

Cause:
1. This parameter was not entered.
2. DSF feedback defective.

Action:
1. Enter parameter or confirm.
2. Replace motor.

93

„DLC Watchdog“

The DLC is monitored by the servo drive for proper status. If the processor systems on the servo drive and the processor system on the DLC are not synchronized, error 93 is generated in the DKS.

Cause:
DLC card defective.

Action:
Replace DLC card. If the error is still present after replacing the DLC card, replace the DKS.

10.4. Input Errors and Error due to Incorrect Storage of Data in the DKS

Errors of this type generally only occur when working with a PC or VT-100 terminal on the DKS. They are displayed on the user interface.

„Parameters outside the entry limits“

Cause:
Parameter entry above or below the permissible limit.

Action:
Enter valid numerical value.

„Cannot write to parameter memory“

Cause:
An error was detected upon an attempt to store the entered parameter to the software module.

Action:
Try to enter again. If the error message appears again, replace the software module.

Procedure:
1. Back up the parameters from the old software module.
2. Replace the software module.
3. Enter the parameters in the new software module (see section 5).

„Cannot write over parameters with drive enabled“

Cause:
An attempt was made to change a parameter in the operating mode/scaling menu when drive enable was set by the DLC.

Action:
Reset drive enable by selecting the parameter entry operating mode; re-enter the parameter.

„Commutation adjustment not possible: drive enable not reset“

Cause:
The commutation offset setting was initialized while drive enable was set by the DLC.

Action:
Reset the drive enable by selecting the parameter entry operating mode; re-initialize.

„Commutation adjustment not possible: turn on power“

Cause:
The commutation offset setting was initialized without turning on the power.

Action:
Turn on the power and re-initialize.

„Commutation adjustment not possible: start inhibit active“

Cause:
The commutation offset setting was initialized with start inhibit active.

Action:
Deactivate the start inhibit input at X3 pin 8/9 and re-initialize (see section 8.2, Fig. 8.3).

10.5. Selecting Signals to be Output to the Analog Outputs

Values generated inside the drive can be output for test purposes via the two analog outputs on the DKS (X3/1/2; X3/3-4).

Analog Signal Output

The DKS provides the option of using the „scaling“ menu or the „drive parameters“ menu on the user interface to select two signals from a series of signals to produce an analog output on AK1 at connectors X3.1 and X3.2 or AK2 at connectors X3.3. and X3.4. See section 10.1 for the meaning of these signals.

The entry field „velocity data scaling at the analog output“ is used to specify the scaling to be used when outputting velocity data on analog output channels 1 or 2. The entry unit is RPM/10 V.

The „position data scaling for analog output [degrees/10 V]“ is used to scale the position data on analog output channels 1 or 2. The unit is degrees/10 V. It must be noted that the full voltage range is 20 V (±10 V).

The following signals can be output via entry field
„analog output: channel 1 →:“ or
„analog output: channel 2 →:“ by pressing the right or left cursor keys:

- velocity command
- velocity actual value
- position actual value
- current value
- motor encoder sine signal
- motor encoder cosine signal

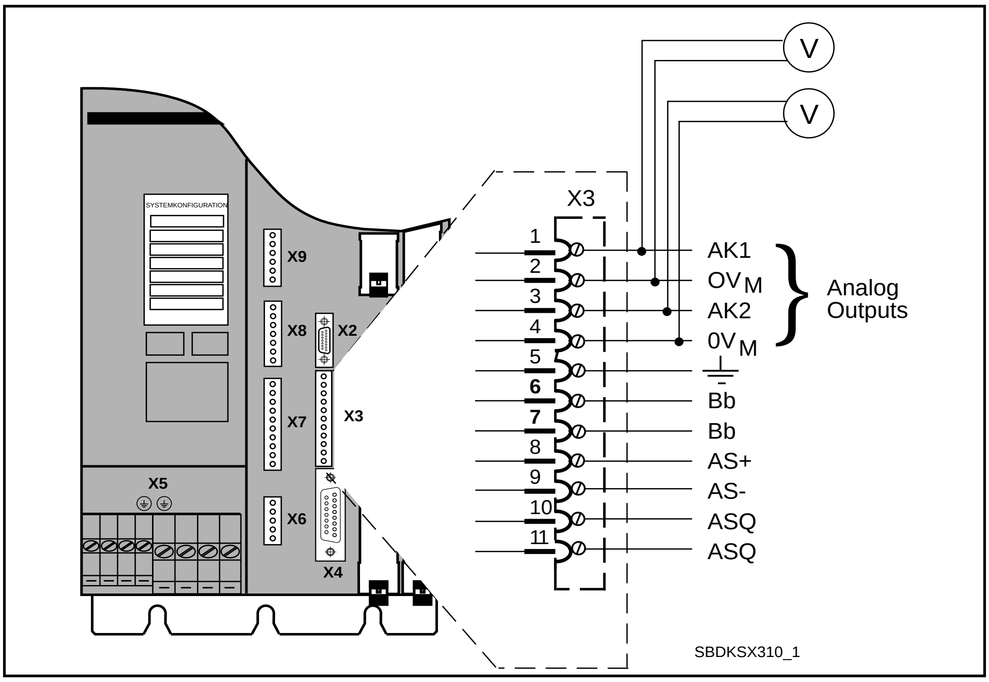


Fig. 10.1: Connecting voltmeters to the analog outputs on the servo drive

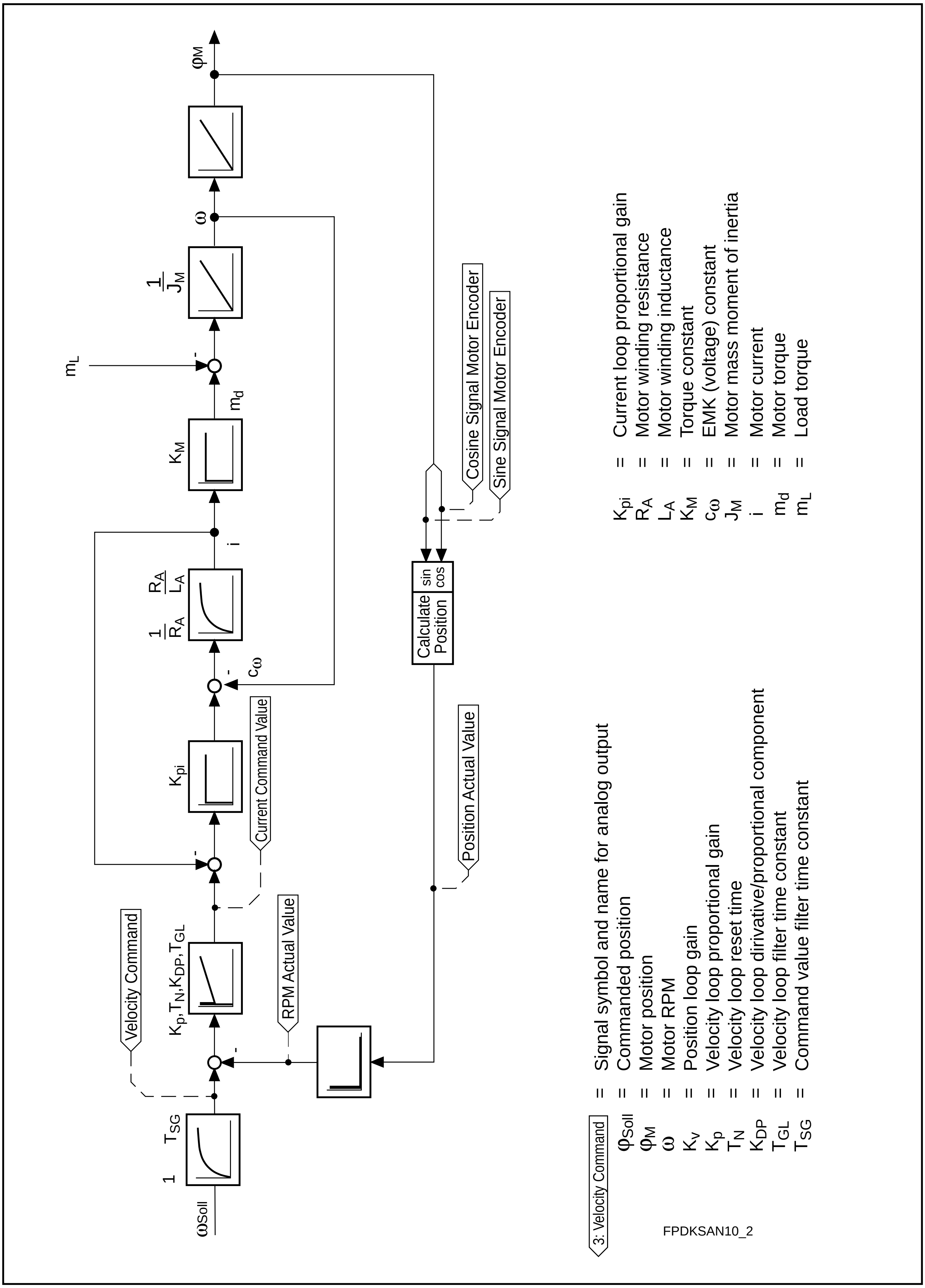


Fig. 10.2: Analog output at the DKS.

10.6. Replacing Defective Units

Machine and production downtime must be kept as low as possible. Machine and system functionality must be restored as quickly and inexpensively as possible. INDRAMAT drives have their own diagnostic displays and message signals, which permit defective drive components to be identified quickly and reliably.

The equipment which has failed and has been replaced can be reparameterized easily simply by installing the software module from the defective unit into the replacement unit. Recalibration is not necessary. This means that replacement is the fastest and most effective way to bring a machine back into service.

Basic Information on Replacing Drive Components

The functionality of failed equipment cannot be restored with certainty unless the failed parts are replaced with identical replacement parts. To do this, the respective type codes must be stated correctly.

The type codes are found on the labels located on the drive components. The position of the labels is shown in section 2. When returning defective components, please fill out and return the Malfunction Report (section 12.1). This will eliminate the need for time-consuming inquiries and will ensure that the components returned by you are repaired as quickly as possible.

Ordering replacement Parts

Replacement parts may be ordered from the INDRAMAT service department.

Instructions for Replacing Components Safely

Accidents can result due to potentially fatal voltages and axis motion.

Therefore always:

- **Open all main switches and prevent them from being closed again before working with electrical equipment.**
- **Block vertical axes to prevent vertical movement. Ensure that drives are stopped.**

  If there is axis motion, potentially fatal voltages may be present at the motor terminals.
- **Remove or connect push-in connections with power off.**
- **Remove or install plug-in cards with power off.**

Replacing a Servo Drive

- Open the main switch; prevent it from closing again.
- Disconnect input power lines.
- Disconnect motor power cable.
- Disconnect feedback connector; unscrew and remove all other connections on the basic unit and feed modules.
- Remove the screws on the upper and lower sides of the housing and remove the DKS.
- Install a new DKS and tighten down the mounting screws.
- Remove the DSM . . . software module from the defective DKS and install it in the new replacement unit.
- Connect the replacement unit in accordance with the machine wiring diagram.
- Restart the system.

Replacing an AC Servo Motor

- Open the main switch; prevent it from closing.
- Check to be certain that the motor has stopped.
- Disconnect the feedback connector.
- Disconnect the motor power plug.
- Remove the motor/proceeding according to the machine builder´s instructions.
- Install the replacement motor.
- Plug in the motor power connector.
- Plug in the feedback connector.
- Establish the dimension reference on servo axes on which the actual position values are determined indirectly by means of a measuring system on the motor side (see Section 8.6).
- Turn on the main switch again.

Information on Replacing Cables

When replacing cables:

- In order to prevent the entry of foreign matter, cover the open holes on power connections with protective caps.
- Only make connections when both halves of the connection are clean and dry.

Replacing Power Cables

- Open the main switch; prevent from closing.
- Be certain that the motor is stopped.
- Loosen the screws on the motor power cable, remove the motor power connector, disconnect the power cable at the DKS.
- Connect a new power cable to the DKS
- Plug the power connector into the motor.
- Tighten the screws.
- Turn on the main switch again.

Cable Replacement Feedback Cable, Connection Cable for Plug-In Cards

- Turn off the DKS.
- Replace the cable.
- Turn on the DKS.

11. List of DKS Parameters

11.1 Application Parameters

Name	Unit
Operating mode (1=torque/ 2=velocity)	
Bipolar velocity limit value	RPM
Overload factor	%
Velocity command value for max. velocity	V
Velocity at maximum command value	RPM
Command value smoothing filter time constant	ms
Position data scaling for analog output	degrees/10V
Velocity data scaling for analog output	RPM/10V
Line count of incremental encoder	
Marker pulse offset	
Torque reduction 1 to	%
Torque reduction 2 to	%
Torque reduction 3 to	%
Selected error reaction	Current code number

11.2 Drive Parameters

Current loop proportional gain 1	V/A
Velocity loop proportional gain	mAs/rad
Velocity loop reaction time	ms
Velocity loop derivative/integral gain	mAs/rad
Velocity loop derivative/proportional gain	µAs2/rad
Smoothing time constant	µsec
Reset to default parameters	Enter

The drive parameters are set automatically.

Drive Parameters

Motor parameters for motors of series MDD ≥ 065 are automatically set.

Motor Parameters for Motor Series MDD ≥ 065

Motor type	
Continuous standstill torque	Nm
Maximum motor	RPM
Rotor mass moment of inertia	kgm^2
Torque constant K_m	Nm/A
Motor peak current	A
Continuous standstill current	A

11.3 DLC Parameters

A - axis specific parameters; pg. 59
B - general parameters; pg. 60
C - drive parameters; not available

12. Appendix

12.1. Malfunction Report

Fault Report

for digital AC servo drives DKS and MDD

Part no.: 259 354

This Fault Report helps clarify faults and identify their causes. It is a mandatory requirement for identifying and eliminating hidden, sporadic and application-caused problems.

- Always include a Fault Report when sending in a repair.
- Fault Reports can be either sent into the appropriate INDRAMAT location, or to the INDRAMAT quality control location listed on the reverse side.

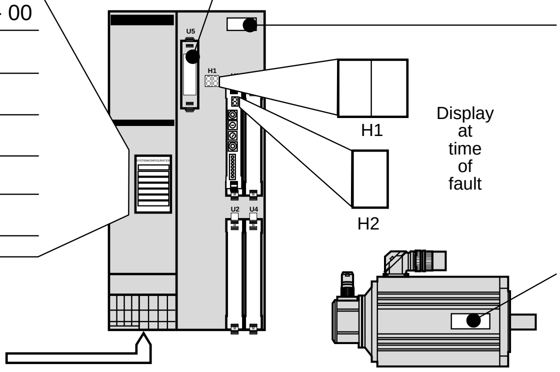
INDRAMAT would like to thank you for your efforts with a quick and thorough processing.

Fault report dated:	Company:	Location:	Date:
	Department:	Name:	Telephone:

Information about the faulty drive:

Software module information:
DSM _._ - _ _ _
S.No.: _ _ _ _ _ _ -
_ _ _ _ _ A _ _ S _ _

Configuration rating plate information:
DKS _._ - _ _ _ _ - _ _ - 00
U5:
U1:
U2:
U3:
U4:



Basic unit rating plate information:
DKS _._ - _ _ _ _ - _
S.No.: _ _ _ _ _ _ -
_ _ _ _ _ A _ _ S _ _

Motor information:
Motor type:
Serial no.:

Mains input:
single-phase ☐
three-phase ☐

Information about the machine at which the fault occurred:

Machine manuf.: ____________ Type: ____________ No. of hours run: ____________

Machine number: ____________ Commissioning date: ____________

Manufacturer and type of machine controller: ____________

Machine axis in which fault occurred: ____________

Detailled description of the fault:

Additional information:

Fault status:	Causes:	Side affects:	
☐ is constantly present ☐ when starting up ☐ occurs sporadically ☐ occurs after approx. ___ hrs. ☐ occurs with vibrations ☐ is temperature-depedent	☐ unknown ☐ fault connection ☐ external cause ☐ mechanical damage ☐ loose line connection ☐ humidity in unit ☐ object in unit	☐ problem in the mechanics ☐ controller broke down ☐ motor broke down ☐ cable broke ☐ defective blower ☐ defective feedback	Is there an air conditioner in the control cabinet? Y / N ☐ Have there been similar problems with this axis before ? How often: ____________
☐ Additional information:			Did the fault occur on specific days or at specific times of the day?

StörDKSS1

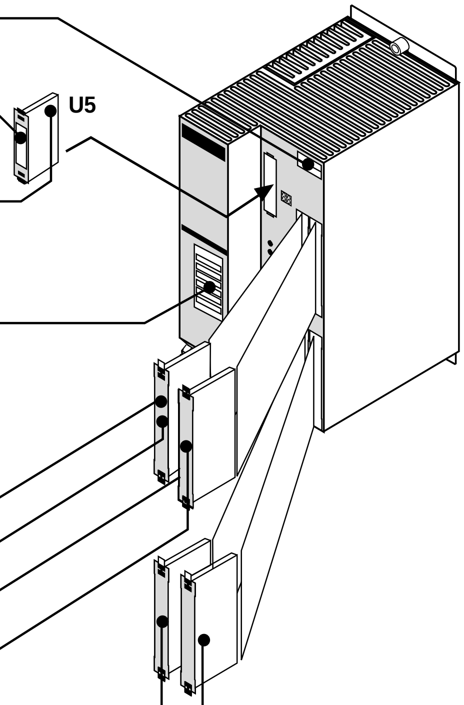
Fig. 12.1: Malfunction report

Detailled information about the faulty drive controller:

The functions of digital drive controllers are determined by the configuration via the software and plug-in modules.
Faulty modules or non-permissible configurations can cause faults.
The following details are absolutely necessary for running a comprehensive check in the case where the plug-in module is not sent in.

Unit rating plate

Slot	
U5	Software module: DSM _._ - _ _ _ Ser.No.: _ _ _ _ _ _ - _ _ _ _ _ A _ _ S _ _
	Configuration rating plate Plug-in module: Fault diagnostics: Record display at time fault occurred: **H2: if present**
U1	**Type:** **Serial no.:** **Software:**
U3	**Type:** **Serial no.:** **Software:**
U2	**Type:** **Serial no.:** **Software:**
U4	**Type:** **Serial no.:** **Software:**



INDRAMAT GmbH
Bgm.-Dr.- Nebel- Straße 2
Abt. QSP

D-97816 Lohr am Main

StörDKSS2

Fig. 12.2: Malfunction report, p. 2.

12.2. Axis-specific data list

Axis-Specific Data List / Sheet 1

The axis-specific data list is used to provide an additional backup of the parameter contents.

Include this data list with the documents in the machine documentation file.

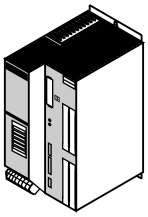
Machine manufacturer: :..

System no: :...

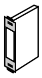
Machine model: :...

Axis designation: :...

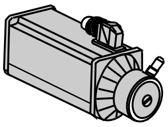
Axis Equipment



Servo Drive :DKS 1.1...



Software Module :DSM 2.1-...



MDD Servo Motor :MDD ....

Date Prepared :................................

Prepared by :...................................

Approved by :..................................

Company :...

FBDKS12_2

Fig. 12.3: Axis-specific data list.

Axis-Specific Data List / Sheet 2

1. Application Parameters

Name	Current Value	Unit
Bipolar velocity limit		RPM
Overload factor		%
Scaling of position data for analog output		V
Scaling of velocity data for analog output		RPM
Reference position		grad
Torque reduction 1 [1]		%
Torque reduction 2 [1]		%
Torque reduction 3 [1]		%
Selected error reaction		÷

1) Cannot be activated at this time

2. Drive Parameters

Name	Current Value	Unit
Current loop proportional gain 1		V/A
Velocity loop proportional gain		mAs/rad
Velocity loop reset time		ms
Velocity loop derivative/proportional gain		$\mu As^2/rad$
Velocity loop derivative/integral gain		mAs/rad
Smoothing time constant		µsec
Continuous standstill torque		Nm
Maximum motor torque (n_{max})		U/min
Rotor mass moment of inertia		kgm^2
Torque constant K_m		Nm/A
Motor peak current		A
Continuous motor standstill current		A

FBDKS12_3

Fig. 12.4: Axis-specific data list.

12.3. Example of a Parameter File Printout

Axis-Specific Data List

Machine manufacturer	:INDRAMAT
System no.	:1234
Machine model	:Laboratory sample
Axis name	:X axis
Servo drive	:DKS 1.1-W030B-D
MDD servo motor	:MDD065B-N-040-N2L-095GB0

OPERATING MODE, WEIGHTINGS

S-0-0091 RPM limit, bipolar:	460.0000 RPM
P-0-0006 Overload factor	400 %
P-0-0042 Scaling position data with analog output	360.0 degrees/10 V
P-0-0040 Scaling rpm data with analog output	5000 rpm/min/10 V

ERROR REACTION

P-0-0007 Error reaction	: 0	---

TORQUE/CURRENT REDUCTION

P-0-0505 Torque reduction 1	: 10	%
P-0-0506 Torque reduction 2	: 10	%
P-0-0507 Torque reduction 3	: 15	%

CONTROL PARAMETERS

S-0-0106 Current loop proportional gain - 1	: 40.00	V/A
S-0-0100 Velocity loop proportional gain	: 800	mA * sec/rad
S-0-0101 Velocity loop reset time	: 12.0	ms
P-0-0003 Velocity loop DI gain	: 0	mAs/ra
P-0-0002 Velocity loop DP gain	: 0	µAs2/rad
P-0-0004 Smoothing filter time constant	: 600	µs

Prepared by Hans Mustermann, 1/14/94

FBDKS12_5

Fig. 12.5: Example of a parameter file printout.

12.4. DKS Terminal Interconnect Diagrams

12.4.1. DKS Terminal Interconnect Diagram for Motors with Resolver Feedback

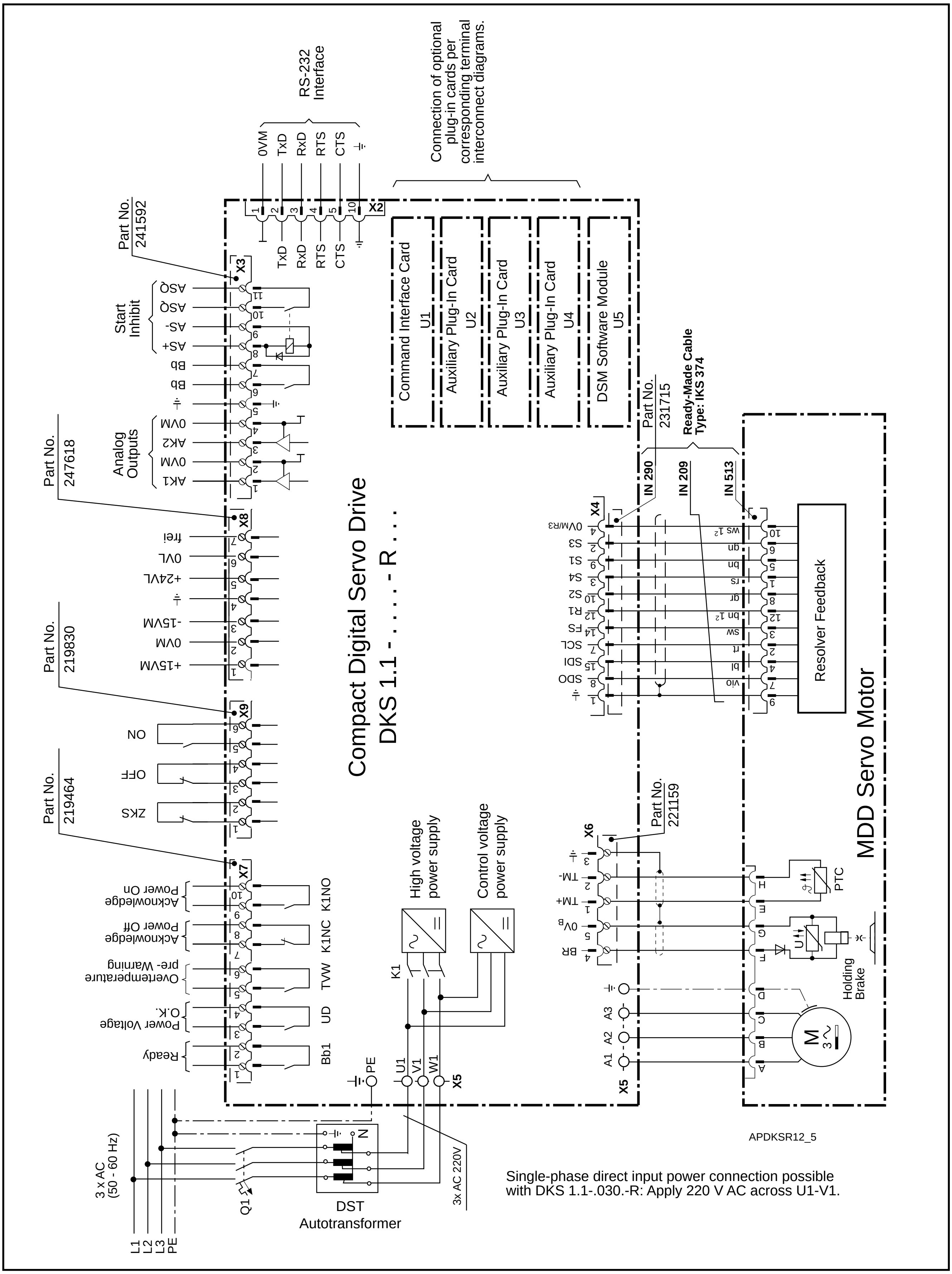


Fig. 12.6: Terminal interconnect diagram for DKS-....-R... for motors with RSF resolver feedback.

12.4.2.DKS Terminal Interconnect Diagram for Motors with Digital Servo Feedback

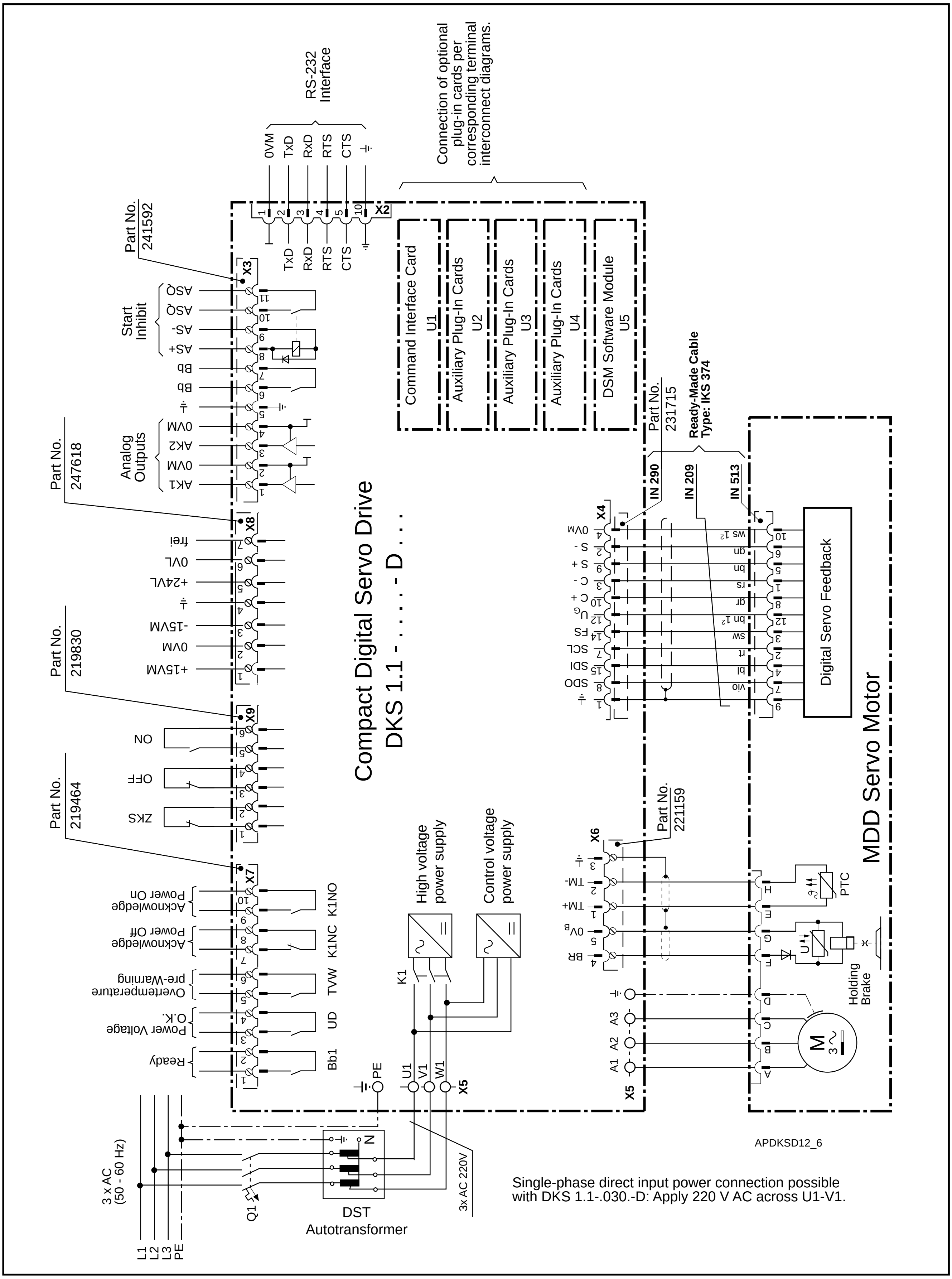


Fig. 12.7: Terminal interconnect diagram for DKS- ....-D... for motors with digital feedback.

12.5. Interface Description, Terminal Blocks X9, X8, X7, X6, X3, X2

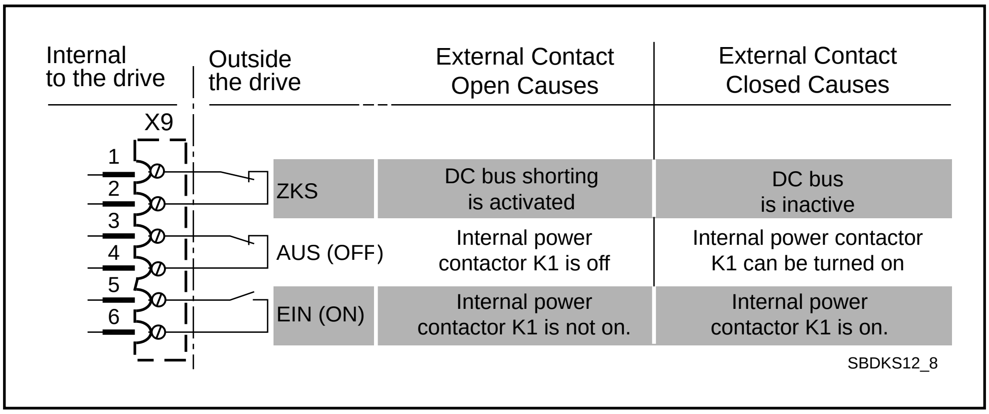


Fig. 12.8: Operating states of the inputs on push-in terminal block X9, DC bus shorting, power contactor.

ZKS DC bus Shorting Input

The power contactor on the DKS cannot be turned on unless the ZKS input is closed.

As an additional safety feature accompanying the braking of the drive to a stop when trouble occurs in the drive‘s electronic system, the DC bus voltage is shorted when the ZKS input is open.

AUS (Off) Input

Only when the AUS (off) input is closed can the power contactor in the DKS be activated.

If the AUS (off) input is opened, for example in the event of NOT-AUS (emergency stop), then the power contactor on the DKS is turned off immediately.

EIN (On) Input

The ON pulse must be present for approx. 5 seconds (power-on delay).
If the ZKS and AUS inputs are closed and the internal ready state in the drive is ready, when the EIN input closes a soft start is performed for the power section in the DKS.

The power contactor in the DKS is then automatically activated. The power contactor then goes to a self-holding state.

Push-In Terminal Block X8, Signal Voltages

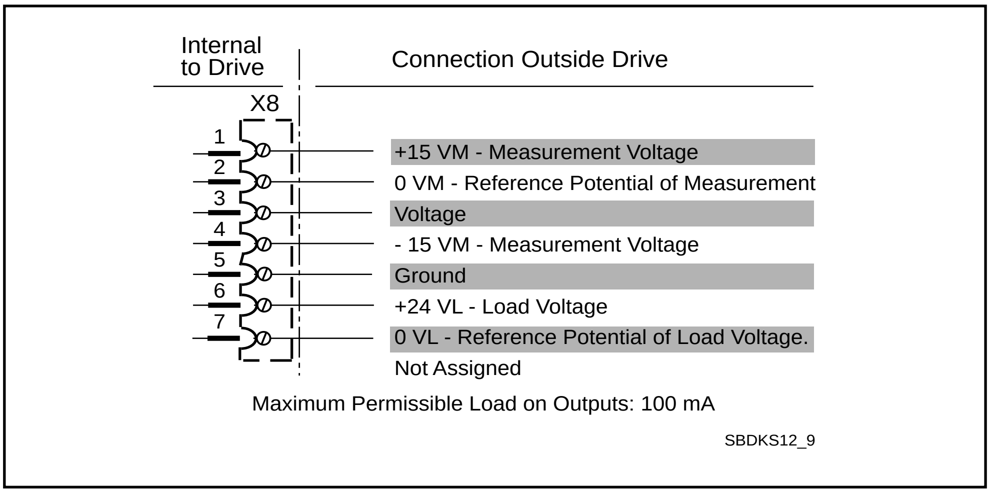


Fig. 12.9: Signal voltages at push-in terminal block X8.

Signal Voltages for Measurement and Test Purposes

The signal voltages can be drawn from terminal block X8. These terminals are used for measurement and test purposes. If these voltages are used outside the DKS, care must be taken to ensure that no interference voltages are injected in the drive (use short, shielded leads).

The voltage outputs are short-circuit proof. The maximum load of 100 mA must not be exceeded if the drive is to function properly.

Push-In Terminal Block X7, Signal Outputs

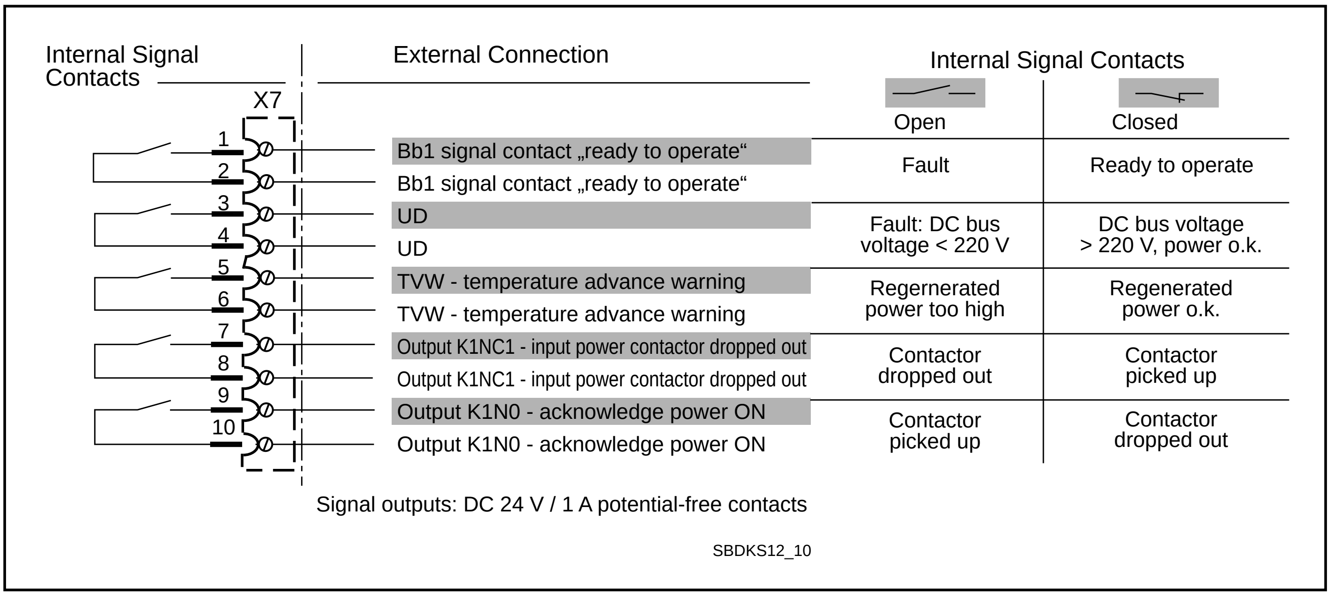


Fig. 12.10: Signal outputs push-in terminal X7.

Signal Output Bb1

Bb1 (ready 1) is a high priority contact on the DKS. The Bb1 contact signals that the drive system is ready for high voltage.

The interlocks in the drive do not allow the power contactor in the DKS to be activated until this contact is closed. If a fault occurs, the contactor is de-energized and the Bb1 contact opens. In this case, the drive cannot normally provide controlled braking.

The Bb1 contact can be used to cause DC bus short-circuiting (dynamic braking) to be activated.

The Bb1 contact closes if voltage is applied to X5/U1, X5/V1 and X5/W1 and there are no faults in the system.

The Bb1 contact opens if the following faults occur:

- Bridge circuit monitor trips
- Failure of the ±15 VM / +24 VL signal voltage
- Heat sink temperature in the DKS too high
- Overcurrent in the power section of the DKS
- Overvoltage
- Bleeder overloaded

Signal Output UD

The UD contact acknowledges that the internal DC power supply in the DKS is operating properly.

It opens if the DC bus voltage drops below 200 V.

The drive system‘s response to this fault depends on how the error reaction is set (see also section 8.1. Error Reaction).

If NC-controlled stopping is required, the UD contact is evaluated by the DLC. To accomplish this, the output must be routed to an unused input on the DEA. This input must be scanned and evaluated when the program is executing.

Signal Output TVW

The TVW temperature advance warning contact is open if the continuous regenerated power is greater than the continuous bleeder power. If the bleeder load increases until thermal overload occurs, the supply of power in the DKS is interrupted. The TVW contact can be evaluated in the controller in order to limit the regenerated power before a power shutdown occurs.

Signal Output K1NO Acknowledge Power On

It is possible to scan the K1NO output to determine whether the input power contactor has dropped out. A closed K1NO contact can be used as a condition for the drive enable set by the DLC. To accomplish this, the output must be routed to an unused input on the DEA. This input must be scanned and evaluated when the program is executing.

Signal Output K1NC1 Acknowledge Power out

It is possible to scan the K1NC1 output to determine whether the input power contactor has dropped out. These contacts can be used, for example, as a condition for enabling a door interlock.

Push-In Terminal Block X3 Analog Inputs and Outputs

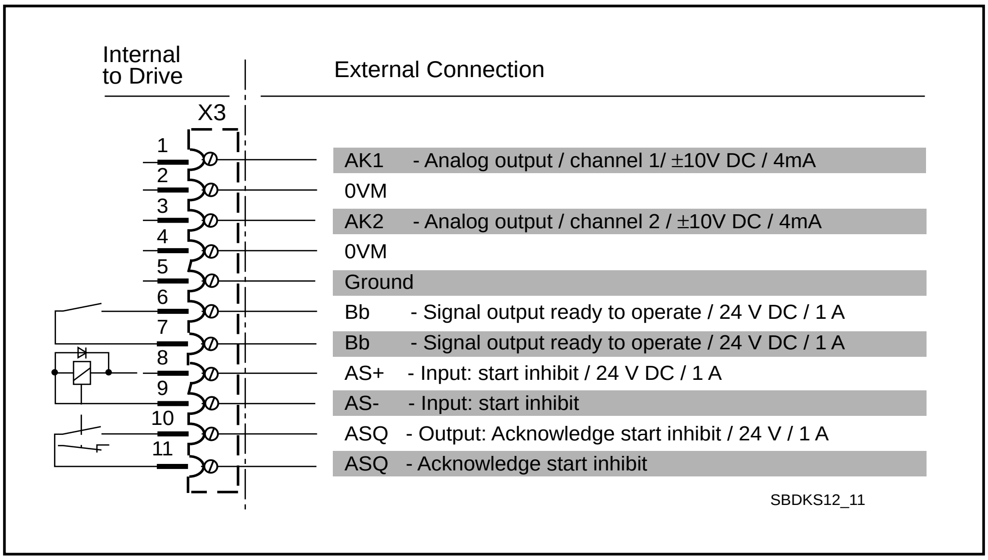


Fig. 12.11: Analog inputs and outputs on push-in terminal X3.

AK1 / AK2 Outputs

The analog outputs can be used to output internal values in the drive for test purposes (for example, during setup).

Bb Outputs

The „Bb“ contact closes when the internally generated control voltage is applied and all monitoring functions report the proper status. The servo drive is ready for high voltage power to be applied (power ON, terminal X9).

Activation of Start Inhibit AS+ / AS -

The start inhibit feature prevents the attached motor from starting up unintentionally in the event of an error. Activating the start inhibit causes the motor power output circuit to be shut off. The start inhibit is used to reliably shut off separate functional areas in a machine or system. Start inhibit is not used to stop moving axes (see Section 8.2).

Additional information on the start inhibit feature may be found in the description „Start Inhibit - Function on DDS Servo Drives,“ Doc. No.: 209-0069-4313-XX).

Acknowledge Start Inhibit ASQ

When start inhibit is active, the disabled drive output stages are acknowleged by the closed potential-free acknowlegment output contact ASQ - ASQ. The DLC can scan the ASQ contacts to determine the status of start inhibit.

Terminal X4

Motor Feedback The motor feedback is connected to terminal X4 as shown on the terminal interconnect diagram for the DKS 1.1 Compact Drive.

Only those motor/servo drive combinations which are documented in the configuration sheets may be operated together.

It is preferable to use INDRAMAT feedback cable to make the connection between the servo drive and the feedback from the MDD servo motor. When INDRAMAT feedback cable is used, the maximum cable length is 75 meters. Additional information on INDRAMAT feedback cable may be found in the motor documentation.

When setting up servo drives equipped with a single-axis positioning card, a VT-100 terminal or a PC equipped with a VT-100 terminal emulation program can be connected to this interface. See section 4.1.2.

Terminal X5 Motor Power Connection, Input Power Connection

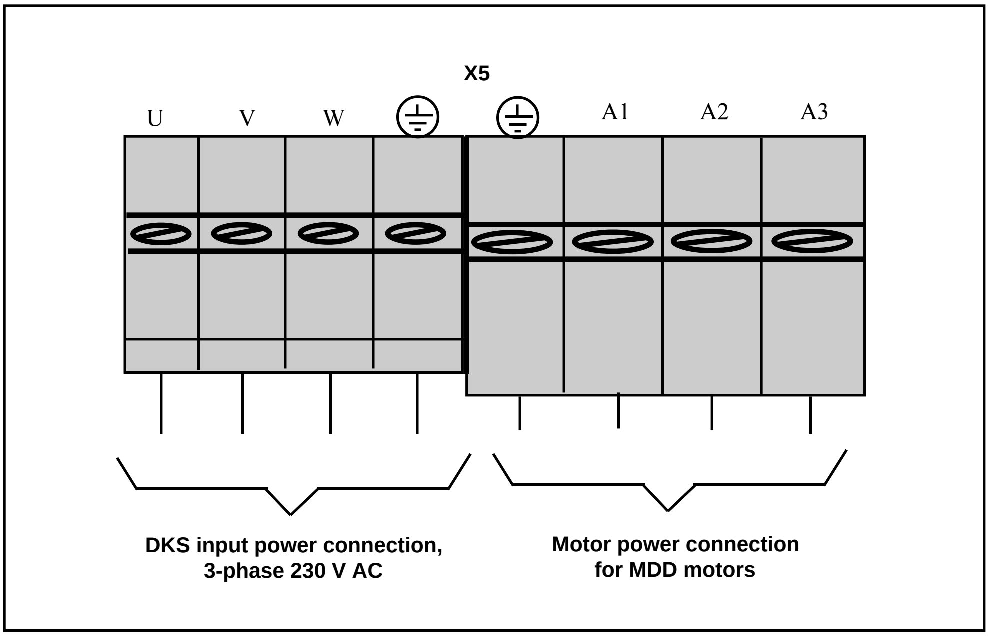


Fig. 12.12: DKS power connection at terminal X5.

It is preferable to use an INDRAMAT motor power cable for the lines between the servo drives and the AC servo motor.

The INDRAMAT motor power cable contains:

- 3 wires for the motor power connection
- 1 wire for the ground connection
- a separate shielded wire pair for motor temperature monitoring (PTC resistance in the motor)
- a separate shielded wire pair for the motor brake

The motor power cable can be obtained ready-made from INDRAMAT.

Optionally, the cable can also be configured as four individual stranded- wire cables (3 phases, 1 ground wire) with separately routed shielded temperature resistance and brake connection wires.

Additional information on technical data, connection and cross sectional areas may be found in the description of the motor and the cable catalogue.

When INDRAMAT cable is used, the maximum cable length is 75 meters.

Push-In Terminal Block X6
Motor Temperature Monitor,
Motor Holding Brake

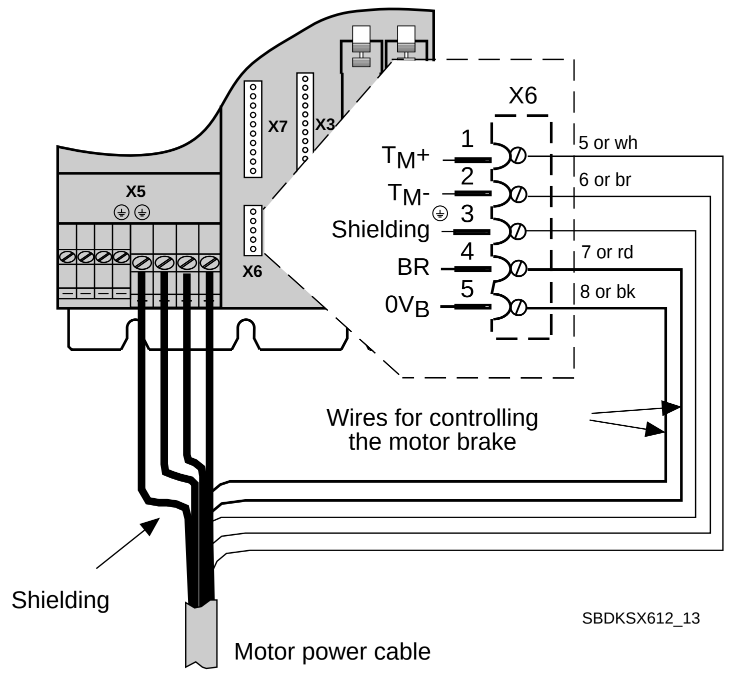


Fig. 12.13: Connecting the motor brake and the motor temperature monitor at push-in terminal block X6.

MDD servo motors can be delivered equipped with a motor brake.

The motor brake on the MDD motors is designed as a holding brake and not as a service brake. The brake will be fully worn out after 20,000 motor revolutions against the brake disks.

Controlling the motor brake:
Application and release of the motor brake is controlled and monitored by the DKS servo drive.

The holding brake is controlled by an internal power supply (characteristic load 1.6A).

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14. Glossary

Absolute encoder

Absolute-value encoder, Multiturn encoder, absolute-position encoder

A position encoder which outputs a position relative to a reference point which was established during start-up. The position is output as soon as the supply voltage is turned on. Traversing to the reference point is not necessary during operation.

Application-specific parameters

The application-specific parameters are used to adapt and adjust the AC servo drive to the mechanical characteristics of the machine. They are listed in „10. Diagnostics and Troubleshooting."

Base Torque

No-load torque, friction torque

The torque required to move the drive and attached mechanical system at a constant velocity (machine-dependent).

Bleeder

Load resistance, bleeder resistance, chopper resistance

An electronically controlled braking resistance which converts any excess energy produced when motors are braked into heat.

Drive enable

Signal to activate the drive when the power is turned on

Digital servo feedback

DSF

A position encoder used in AC servo motors with intelligent digital drives for high-resolution measurement of the rotor position (resolution: 1/2,000,000 revolutions). Measurement is absolute within one revolution.

DKS

Servo drive amplifier, servo drive module

Drive-specific parameters

The „drive-specific" parameters" are used to parameterize the DKS and the AC servo motor. They are listed in „10. Diagnostics and Troubleshooting."

Following error

On CNC machines equipped with position control circuits the following error is the difference between the position command value and the position actual value.

Gain factor

Gain factor

On a position control which is subject to a following error, the gain factor indicates the velocity (m/min) at which a following error of 1 mm is produced.

High-resolution position interface

DLF

Sine wave position encoder signals are processed at high resolution (2048X multiplication) in the DKS.

Incremental encoder — *Position encoder, relative position encoder*

Incremental encoders deliver a defined number of measuring cycles per revolution or per distance. Gaging a position relative to a reference point is accomplished by traversing to the reference point after the power is turned on and then continuously decoding the measuring cycle count depending on the direction in the controller or in the drive.

Interface — *Interface, interface board/card*

The data transfer point for the exchange of signals between drives, controllers, encoders, etc. On intelligent digital servo drives, the basic interfaces are built in. In addition, different interfaces for various applications can be plugged into the units as optional cards.

Motor Brake Fail-Safe Principle — An optional electromagnetic brake installed in the servo motor. It is used to prevent undesired servo motor (servo axis) motion when the motor is in the power-off state. The brake clamps down when no power is applied to it. It is not used for braking in the event of an EMERGENCY STOP!

Multi-turn encoder — *Multi-turn absolute-value encoder, MTG*

Absolute position measurement over more than one motor revolution. AC servo motors may optionally be equipped with Multi-turn encoders (absolute measurement of rotor position over 4092 revolutions).

Peak current, DKS — The peak current which the DKS can deliver over 300 ms short-term operation.

Position loop — A control loop used to control the position of a system.

Position interface — An interface used to exchange position data

Pulse wire, absolute encoder — *IDG*

Resolver feedback option on AC servo motors used with intelligent digital drives to measure the rotor position over 4096 revolutions.

Radial surface cooling — *Radial forced-air cooling*

Forced-air cooling of a motor housing to increase the continuous torque using a blower installed radial to the motor axis (optional)

Reference point, traverse to — *Referencing, go to reference point*

Traversing to a reference mark used to establish an absolute reference in an incremental system

Regenerated power, continuous — The continuous power which AC servo motors deliver to the bleeder or, with electrical systems capable of accepting power inputs, which they feed into the power system during braking--in other words, when operating as a generator.

Resolver — *Angular position transducer*

An inductive angular position transducer which generates AC voltages whose amplitudes are angle-dependent. Absolute measurement relative to 360 (cyclically absolute).

Resolver feedback — *RSF*

A position encoder used with intelligent digital drives for the cyclical absolute measurement of the rotor position (uses the resolver measurement principle)

Velocity loop — *Speed control*

A type of drive operating mode used with the SERCOS and analog interfaces in which the drive sets the RPM, i.e. the velocity of the machine part which is being moved, in a highly dynamic manner to match the RPM command value present in the drive.

Servo feedback — A special device on a servo motor used to detect the rotor position and to measure the rotor RPM. (Cyclical absolute position determination)

Signal processor — *Microprocessor*

A microprocessor which uses parallel processing to achieve high processing speeds

Singleturn encoder — *Singleturn absolute encoder*

A position encoder which generates absolute position information during a single revolution of the motor.

Software module (DSM) — A module in the DKS containing the operating software and the drive parameters

Status display — A two-character display on the DKS used to display operating statuses and error messages

Surface cooling — *Forced-air cooling, cooling unit*

Forced-air cooling with an external blower (optional).

Toothed disc encoder interface — An interface for high-resolution position measurement utilizing a toothed disc encoder or a high-resolution main spindle position encoder

Vibration severity grade — The vibration severity grade is used to evaluate how quietly machines operate (effective value of vibration velocity).

Watchdog — A watchdog is a circuit which monitors the microprocessor to be certain that it is functioning properly. An error message is generated if the watchdog does not detect a trigger pulse from the processor every 2 ms.

15. Index

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