DDC and MDD
Digital Intelligent AC Servo Drives with Single Axis Positioning Module

Application Manual

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

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Indramat

Title	DDC and MDD Digital Intelligent AC Servo Drives with Single Axis Positioning Module
Type of documentation	Applications Manual
Document code	DOK-CONTRL-DDC+MDD+DLC-ANW1-EN-E1,44
Internal file reference	• Mappe13 • DDC01-AN.pdf • 209-0069-4393-00
Reference	This electronic document is based on the hardcopy document with document desig.: DOK-CONTRL-DDC+MDD+DLC-ANW1-EN-P • 08.96

The purpose of this documentation

This applications manual is intended

- to supply information on the components of digital AC servo drives
- to offer mounting guidelines
- to assist when checking electrical connections of digital AC servo drives with single-axis positioning modules
- to assist in determining drive and controller parameters for setup operations
- to offer commissioning support through to setup operations
- to support the application of DLC functions
- to assist in locating and clearing faults

Editing sequence

Doc. designtion of previous editions	Status	Comment
DOK-CONTRL-DDC+MDD+DLC-ANW1-EN-P	Aug. 96	1st edition
DOK-CONTRL-DDC+MDD+DLC-ANW1-EN-E1,44		1st edition E-Doc

Publisher INDRAMAT GmbH • Bgm.-Dr.-Nebel-Straße 2 • D-97816 Lohr Telefon 0 93 52 / 40-0 • Tx 689421 • Fax 0 93 52 / 40-48 85 Dept ENA (DE, FS)

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1.   Introducing the System

Digital AC Drives   Digital AC drives are microprocessor controlled, brushless, three-phase current drives with high dynamics and precise servo drive features.

The entire scope of

- drive control,
- monitoring,
- parametrization and
- diagnosis

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

Digital AC drives with with a DLC single-axis positioning module   By equipping the drive with the DLC 1.1 single-axis positioning module means that the drives can be operated as digital intelligent single-axis positioning controllers.

K_V = loop gain factor
W = reference input variable
X = controlled variable
$X_d = W-X$
ω = speed command value
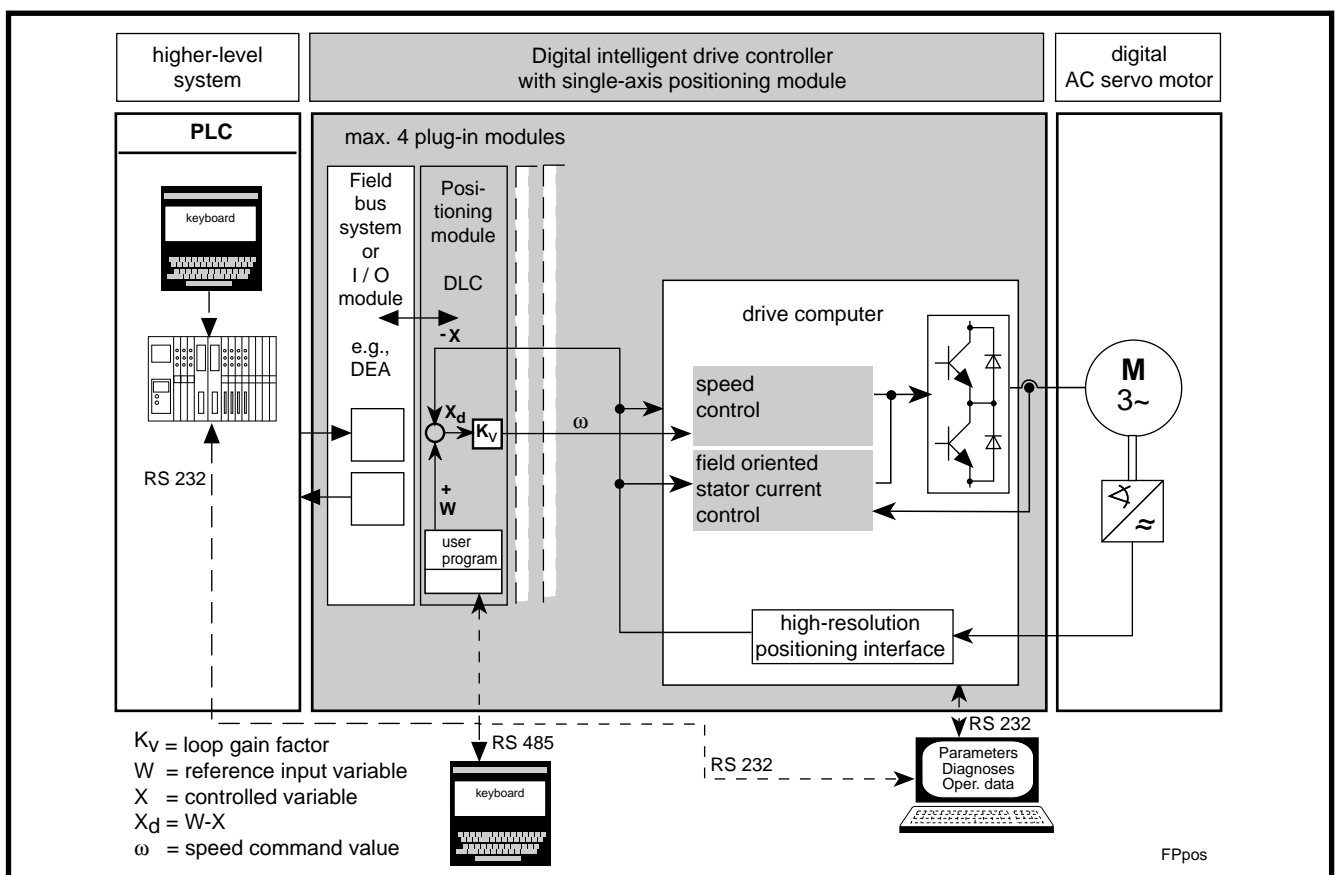
Fig 1.1: Digital AC servo drives and single-axis positioning modules DLC 1.1

The DLC 1.1 single-axis positioning module offers the following features:
- A user-oriented programming language.
- Easy input of up to 3,000 program blocks, e.g., position and speed entries, input queries, output settings and markers for control and motion sequences.
- A current motion sequence can be monitored while the next program block is simultaneously being executed.
- The drive can be matched to both the mechanical and electrical conditions of the machine by means of parameters.
- The input parameter blocks are monitored for errors and maintaining the limit values of the system which have been entered.
- It is possible to parametrize/program with, e.g., a CTA programming keypad, an IDA decade switch unit, a higher-ranking PC, an SOT programming terminal or a higher-ranking PLC.

For more detailed information about single-axis positioning modules, see doc. no. 109-0852-4102 „DLC1-A, Single-Axis Positioning Module for Drive Controllers, Programming Guidelines".

1.1.   Types of Digital Drives

Drive controllers for digital AC servo drives are available in the following housing designs:
- modular housing
- compact housing (protection categories IP10 and IP65)

Drive controllers for modular housing

A drive package is made up of one supply unit and several drive controllers.

This type of construction makes it possible to combine AC servo drives and AC main spindle drives with various outputs to drive packages that receive their power from a shared supply unit. Supply modules are available that can be directly connected to three-phase mains of 3 x AC 380 to 460 V, 50 to 60 Hz. INDRAMAT makes the necessary documentation available.

Drive controllers for compact housing

DKS01.1 drive with
protection category IP 10

DDC01.1 drive with
protection category IP 65

FAgeräte
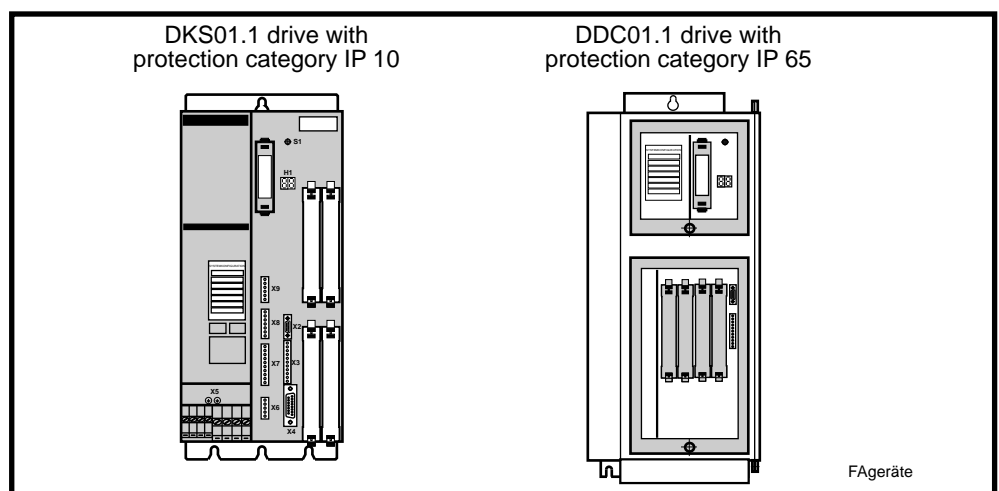
Fig 1.2: Drive controllers in compact housing

Drive controllers in compact housing combine a mains rectifier and a drive controller in one unit.

Mounting directly to the forward feed unit

INDRAMAT drive controllers with integral DLC single-axis positioning moudle have been especially designed for the requirements of complex finishing facilities, e.g., transfer systems.

The drive controllers with protection category IP 65 can be directly installed to the forward forward feed unit. This means that motor power and feedback cables which are long and conducted through the entire facility thus making them susceptible to excessive faults are no longer needed.

The forward forward feed unit can be operated as a standalone unit. It can also be tested independently of the machinery.

PZtransfer
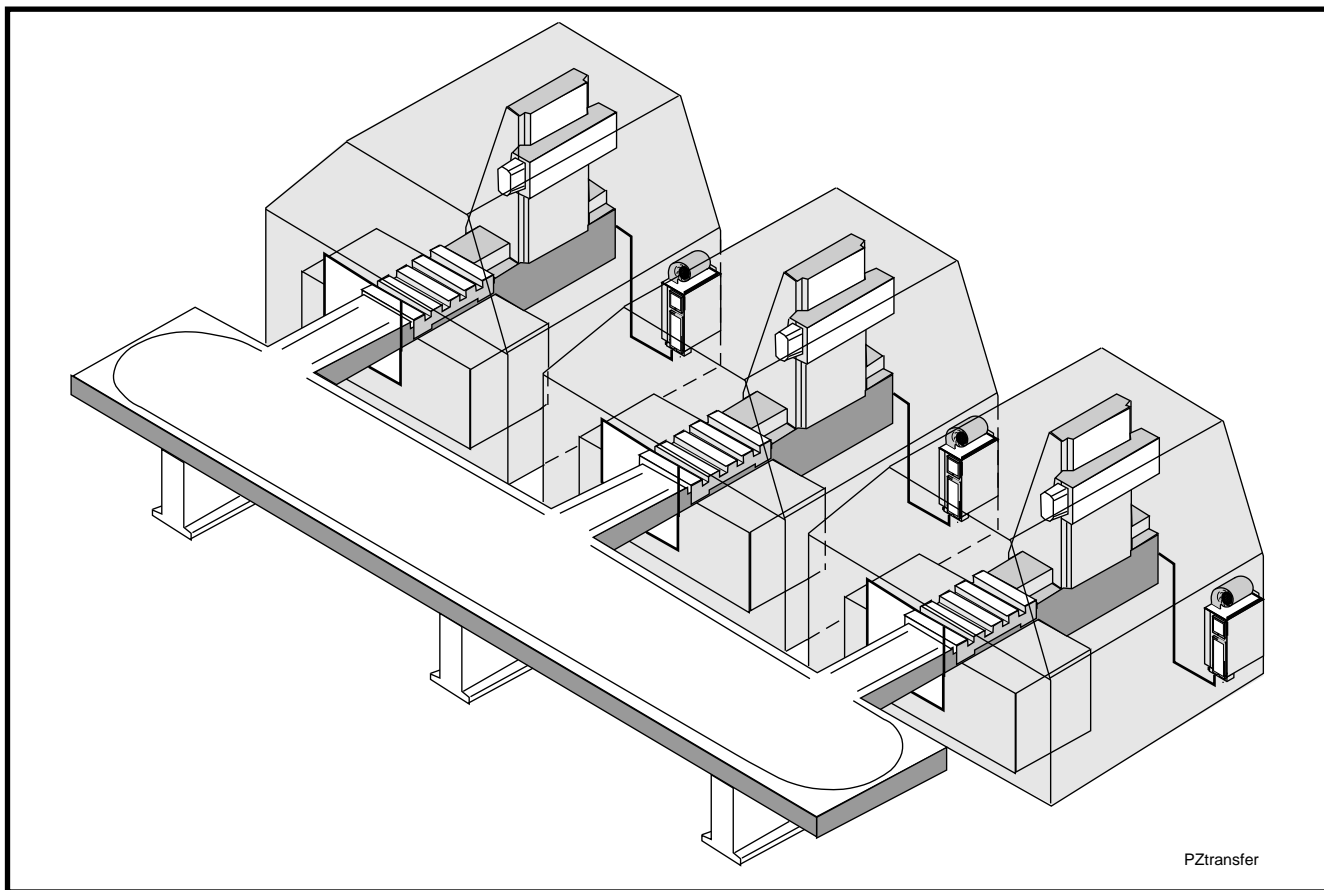
Fig 1.3: Mounting directly to the forward forward feed unit

2. Components of Digital AC Servo drives with a DLC Single-Axis Positioning Module

Components of digital AC servo drives with DDC 1.1 and DLC single-axis positioning module

Configured DDC 1.1 drive

Configuration rating plate

Software module

Plug-in module

Power supply

Motor power cable

Interface to machine controller

Motor feedback cable

AC servo motor MDD

PZantrDDC
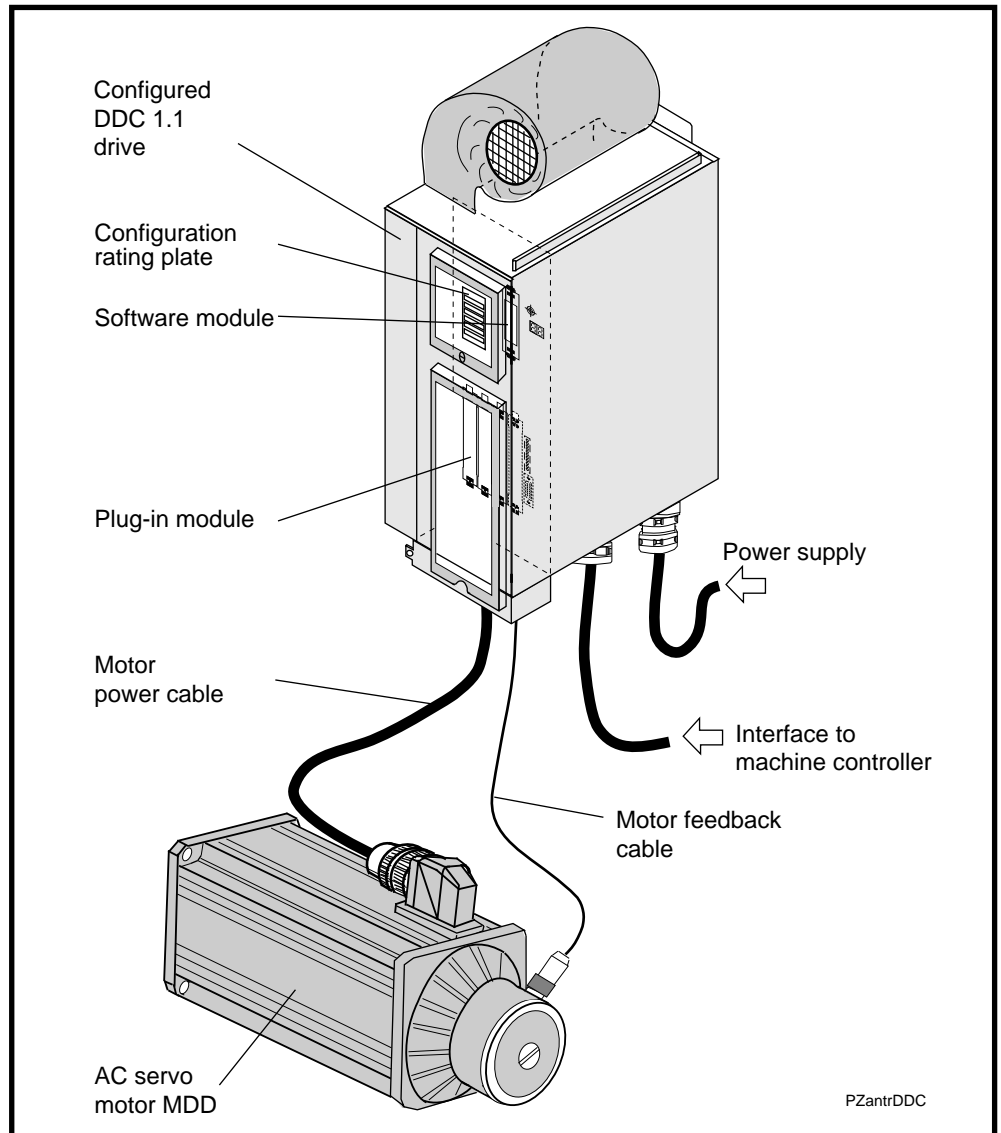
Fig 2.1: Digital AC drive with DDC drive controller

Components of the drive controller

The implementation of drive controllers for the most varying of tasks means that it must be possible to functionally adjust the respective drive controller. This is achieved by equipping the basic unit with different auxiliary plug-in cards and a matching software module. The thus equipped basic unit is designated a "configured drive controller". This configured drive controller together with a digital MDD AC servo motor creates a "system configuration".

Configured drive controller

The configured DDC drive is supplied by INDRAMAT as a fully equipped unit.

A configured drive controller is made up the following components:
- the basic unit
- a DLC single-axis positioning module
- the software module
- an optional auxiliary plug-in module
- the configuration rating plate
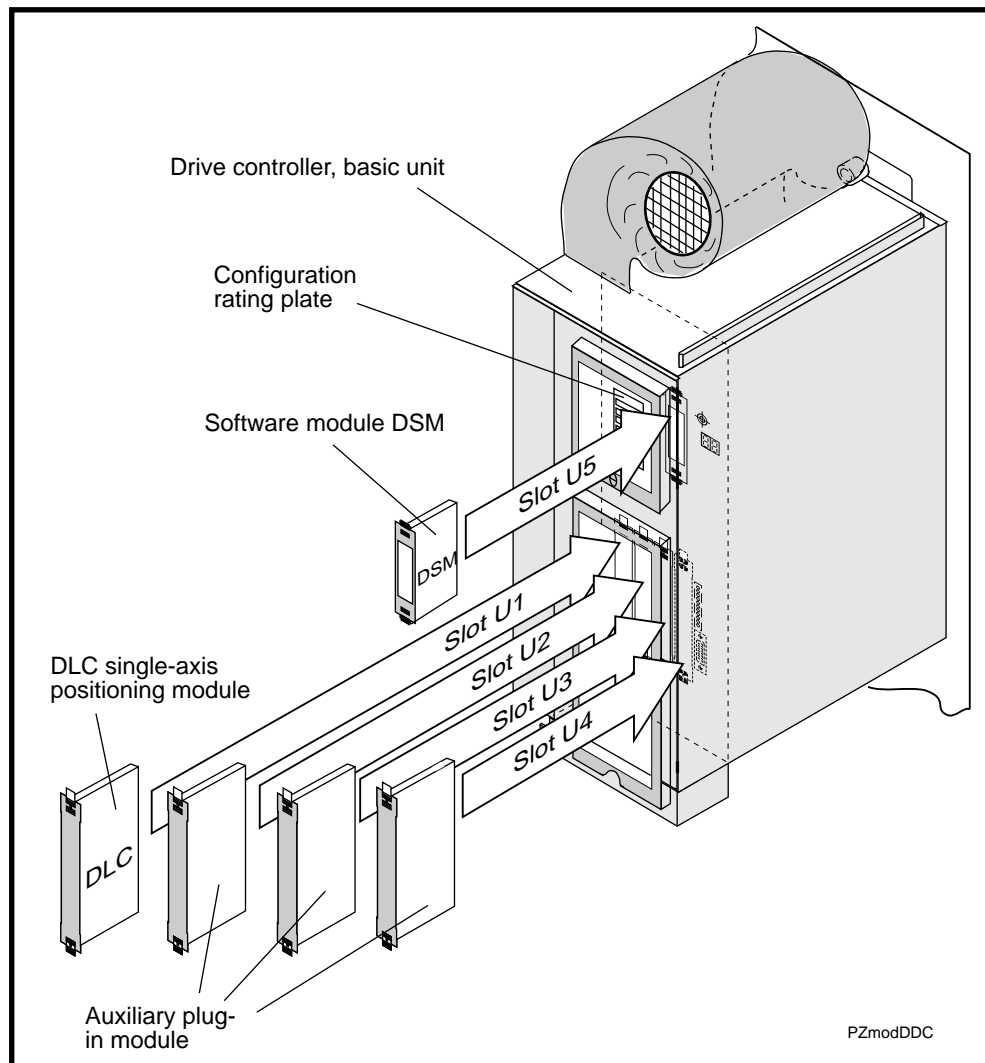
Fig 2.2: DDC1 configured drive controller

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2.1. Basic Unit

The basic unit is made up of a DC bus rectifier, the bleeder resistor for taking up the energy generated during braking and a mains section for the control voltages. Plug-in modules are inserted into slots U1 through U5 to accomodate specific requirements.
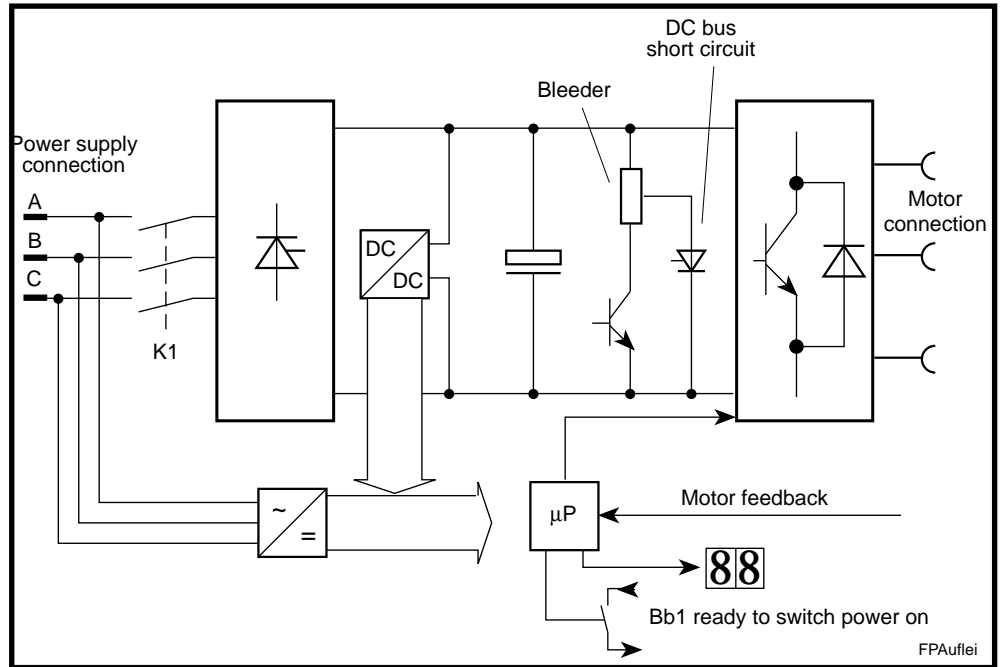
Fig 2.3: Block diagram of a DDC 1 basic unit

2.2. DLC 1.1 Single-Axis Positioning Module

The single-axis positioning module expands the drive controller to create a standalone single-axis positioning controller. This controller can be programmed with up to 3,000 program blocks. Each program block specifies one motion sequence or a specific state of the inputs that require monitoring or of the outputs that need to be set.
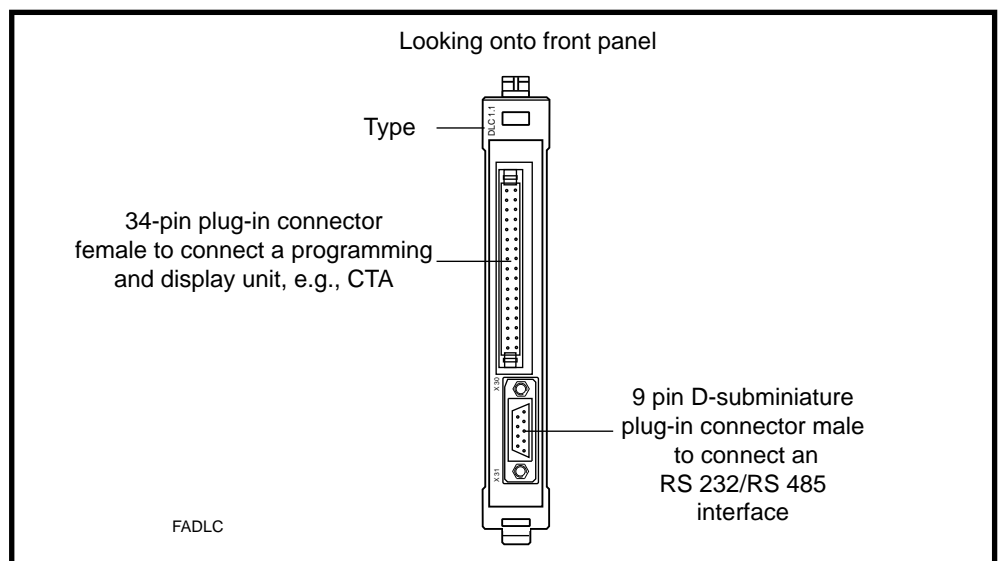
Fig 2.4: A front view of a DLC

2.3.   Software Module

Parameters, stored in the software module, are implemented for matching the drive controller to the motor and the mechanical system of the machine.
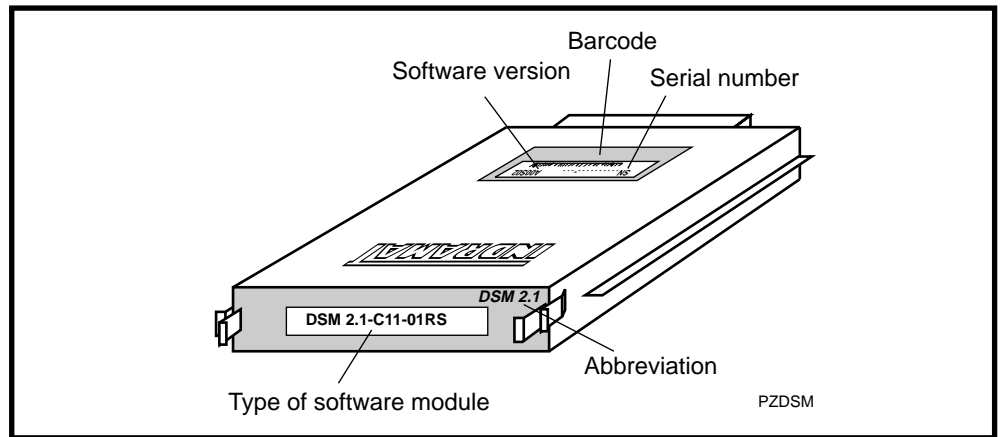
Fig 2.5: A DSM 2. software module

Advantages when replacing equipment

Operating software and drive parameters are stored on the DSM software module. This means that in the event that a unit must be replaced it is not necessary to re-tune the replacement. Simply remove the software module from the faulty drive and install it on the new replacement unit. This configures the drive for 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.

Standard software module

The drive-specific parameters determined by INDRAMAT are stored in the feedback of the MDD motors and are activated during commissioning as needed.

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 sotware modules

The latest engineering revision level (software module update) used for operating the drive will be shipped without a change in the order numbers, i.e., the type codes becoming necessary. New software modules are compatible to those already shipped.

2.4.   Auxiliary Plug-In Cards

The following plug-in cards have been summarized under the heading of "Auxiliary Plug-In Cards".

Input/output interfaces   Type: DEA 4.1, DEA 5.1 and DEA 6.1

These plug-in modules each have 15 inputs and 16 outputs with which the drive can exchange binary signals.

Different addresses are set on each card.

The DEA 4.1 has eight inputs and five outputs for functions such as E-stop input, signalling of operating mode and fault messages. Still available are seven inputs and eleven outputs.

Interbus S interface module   Type: DBS 2.2

With the interbus S DBS 2.2 interface module, the drive is connected to an interbus S data highway. The DBS 2.2 can only be used in conjunction with the single-axis positioning module **DLC 2.1**. The operating modes target position entry and local operations are possible. In local operations, it is possible to replace the physical I/O level with the interbus S interface module.
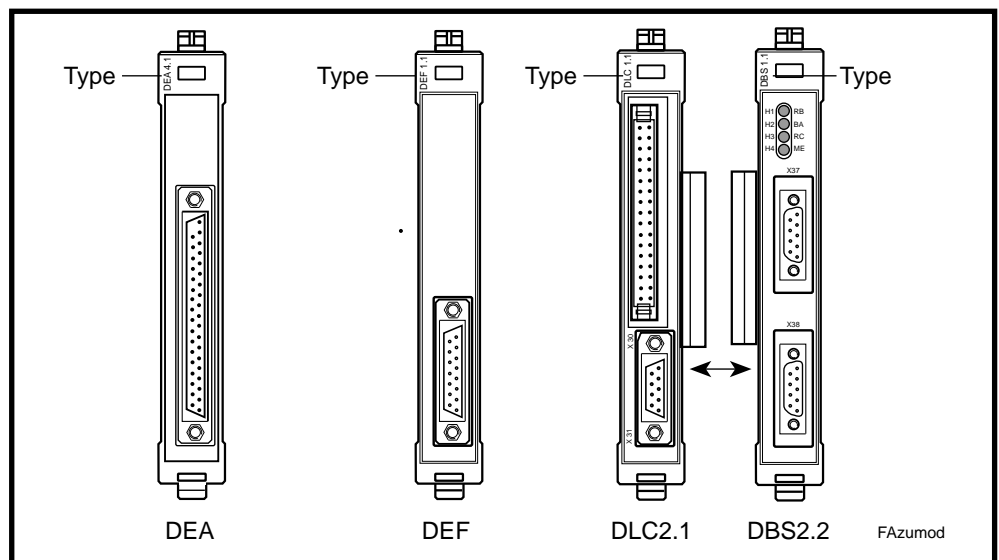
Fig 2.6: Auxiliary plug-in cards

2.5.   Configuration Rating Plate

The type designation is on the configuration rating plate:
• the configured drive controller
• the basic unit
• the software module in slot U5
• the plug-in modules in slots U1 through U4

With the use of this type designation, it is possible to determine which components should be in which slots.

In the event of a problem, the information on the rating plate can be used to quickly locate a replacement for the problem part or a new basic unit can be quickly fitted. A replacement unit is obtained by inserting the specifically required modules into the basic unit specified on the rating plate.

> **Only those configurations specified by INDRAMAT may be used. The configuration rating plate lists those modules which can be used with a specific drive. Prior to commissioning a drive, make sure that the one specified on the rating plate is the one that is actually in use in this case.**
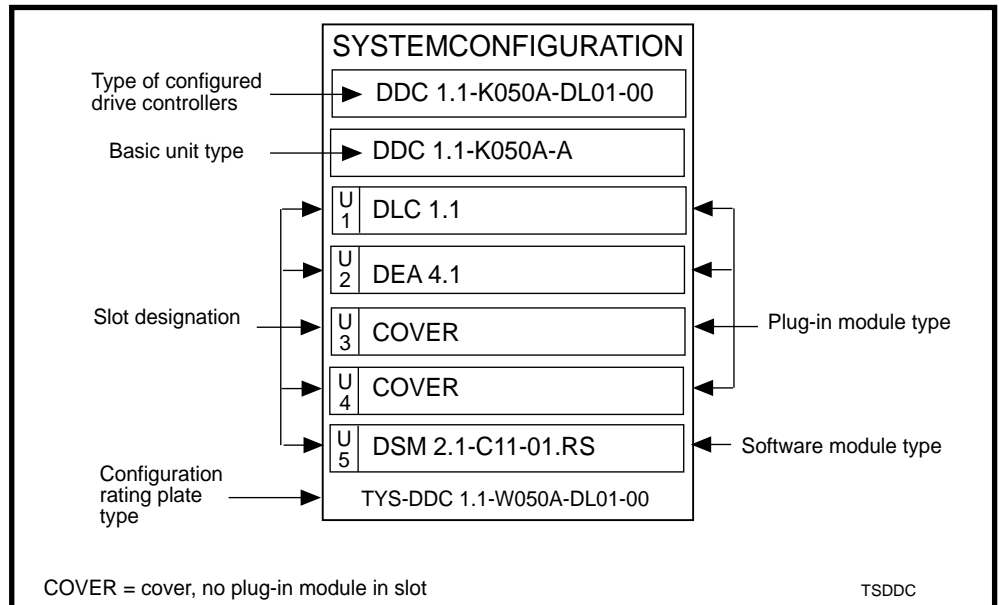
Fig 2.7: An example of a configuration rating plate
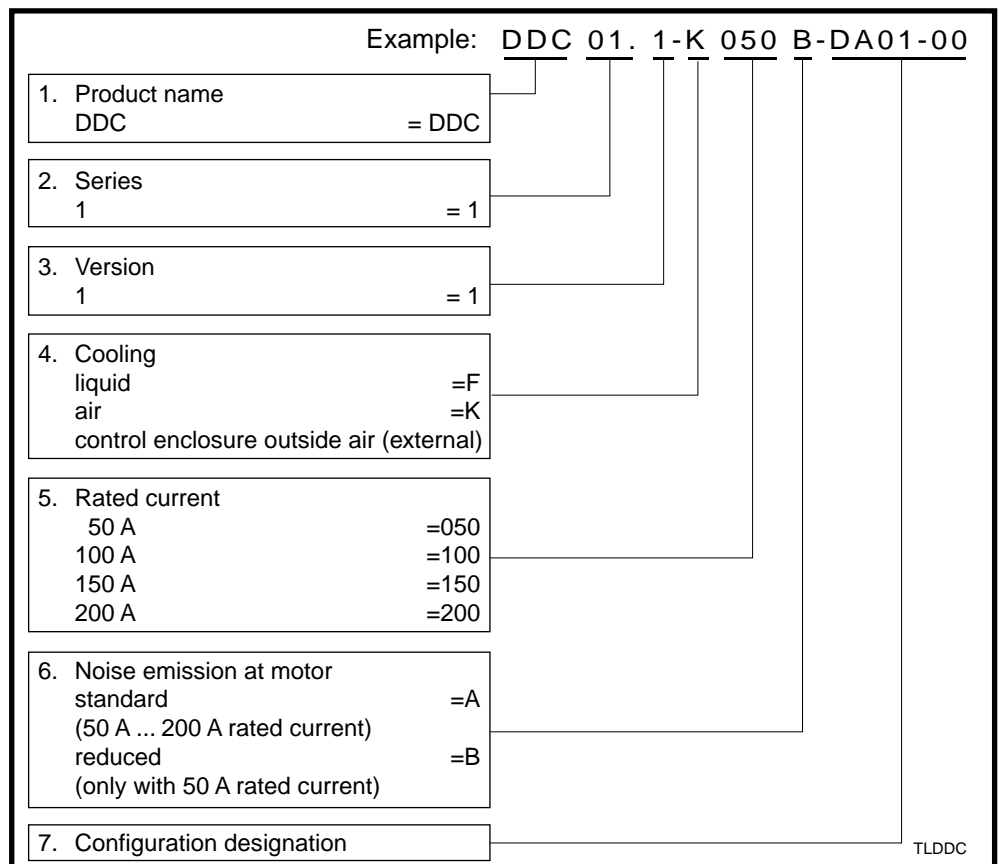
Fig 2.8: DDC drive type codes

2.6.   Digital AC Servo Motors
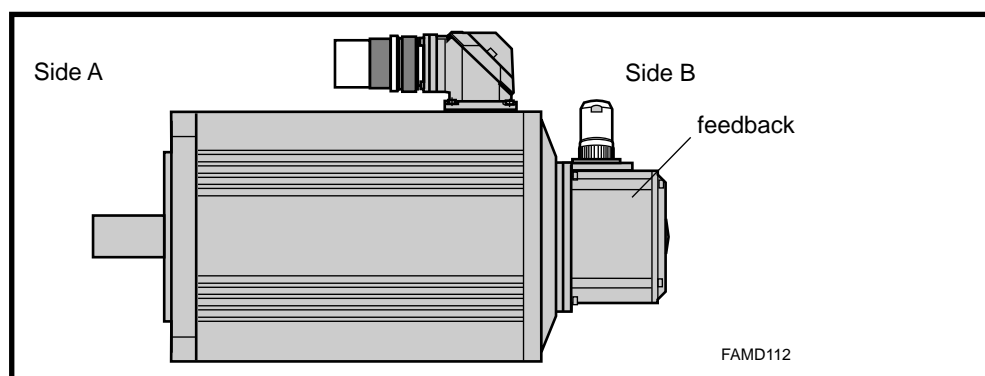
Fig 2.9: An MDD motor

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

• motors with digital servo feedback (DSF)
• motors with digital servo feedback and multiturn encoders (DSF+MTG)

Feedback data

	Digital Feedback Sensor Principle: optical probing of code disc
Position resolution achieved	256 x 2^{13} = 2 097 152 increments/revolutions
System accuracy	+/- 0.5 angular minutes
Multiturn type	4 095.99 rotor revolutions
Available with	MDD 065 through MDD 115
Suitable applications	high demands made of control dynamics, synchronous behavior, absolute accuracy

Fig 2.10: Feedback features

MDD motor type codes

Example: M D D 1 1 2 B - N - 0 1 5 - N 2 L - 1 3 0 G B 0

1. Name

2. Motor size

3. Motor length

4. Housing type:

5. Rated speed

6. Balance class

7. Side B shaft end

8. Motor feedback
RSF	G
RSF + IDG	K
DSF	L
DSF + MTG	M

9. Centering diameter

10. Output shaft

11. Power conn., mounting orientation

12. Blocking brake
without blocking brake	0
with blocking brake 14.0 Nm	1
with blocking brake 40.0 Nm	2
with blocking brake 60.0 Nm	3

TLMDD

Fig 2.11: Type codes for an MDD servo motor for decoding the feedback version and executing the holding brake

The respective motor documentation can offer supplementary data on this subject.

Rating plate

INDRAMAT   PERMANENT MAGNET MOTOR

MDD090C-N2L-110GB0/S016

| Part No. 123456 | Build Week 44/91 | Com.No. 234567 |

S.No.   MDD090-123456

Made in Germany

Natural Convection	Surface cooled	I.Cl. F	IP	65
MdN 10.4 Nm	MdN 16.0 Nm	n	2000	min-1
IdN 9.5 A	IdN 14.6 A	Km	1.10	Nm/A
		m	50	kg
Brake 14.0 Nm	DC 24 V +-10%		0.75	A

INN 13.06

TSMDD

Fig 2.12: An MDD motor rating plate

Upon commissioning, check to make sure that the continuous torque of the motor, as designated on the rating plate, is not exceeded.

3. Mounting and Assembly

3.1. Mounting the drive

Directly to the forward feed unit A DDC 1 drive has a protection category of IP 65 and can be directly mounted to the forward feed unit.

Cooling The units must be mounted in such a way that the flow of the cooling air is not prevented from either entering or exiting the machine.

> **The DDC 1.1 generally requires no maintenace. If it is operated in a highly polluted environment and the blower mesh and heatsinks are at risk of becoming excessively dirty (e.g., with foundry dust), then regular controls are recommended. If the operation of either the blower or the heatsink are already affected by severe dirt, then these must be cleaned.**

Safety distances The bleeder resistor in the DDC heats up during operations. Any flammable materials or parts that could be affected by this hot air stream (e.g., PVC cable ducts) should maintain a minimum distance of 300 mm to the air outlet.
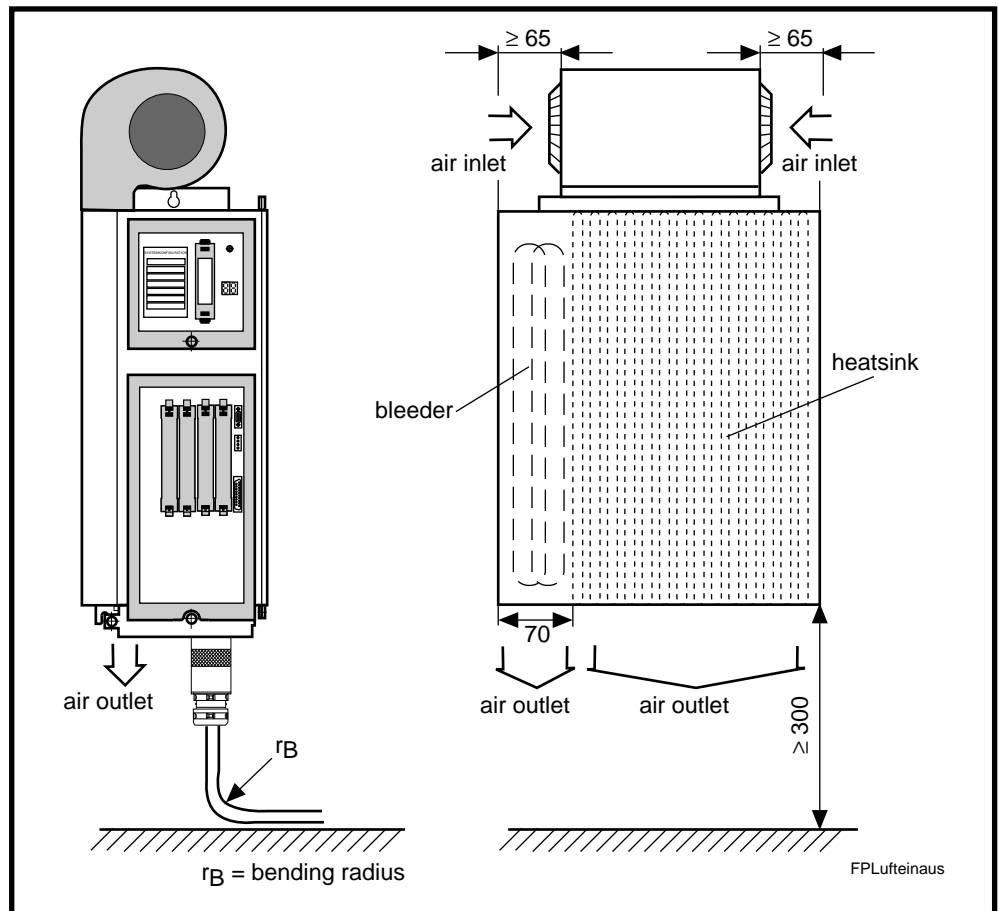
Fig 3.1: DDC with air inlet and outlet and position of the bleeder resistor

3.2. Power connections of the DDC

The power connectors of the DDC (X7), the motor power connector (X5) and the interface to the machine control (X8) on the DDC must be IP 65 connectors.

The motor feedback cable and the connections of the optional plug-in modules are inserted into the DDC. These are fed through the cable leadthroughs on the underside of the DDC. Make sure that these are properly installed so that the IP65 protection category of the DDC is in not negatively affected.

Installation guidelines
for cable leadthrough

1. Release screw ①
2. Open cover shroud ②
3. Release knurled screw ③
4. Pull sheet-metal cover off ④
5. Remove gasket ⑤
6. Place cable in the gasket ⑤
7. Following instructions in reverse order
8. Screw ① tightly into place until cable leadthrough is totally sealed.

Tighten the mounting bolts ⑥ of the protective shroud firmly into place. Otherwise, the protection category IP 65 cannot be guaranteed.

EXDDC

Fig 3.2: Installing cable leadthroughs

3.3. DDC - dimensional data
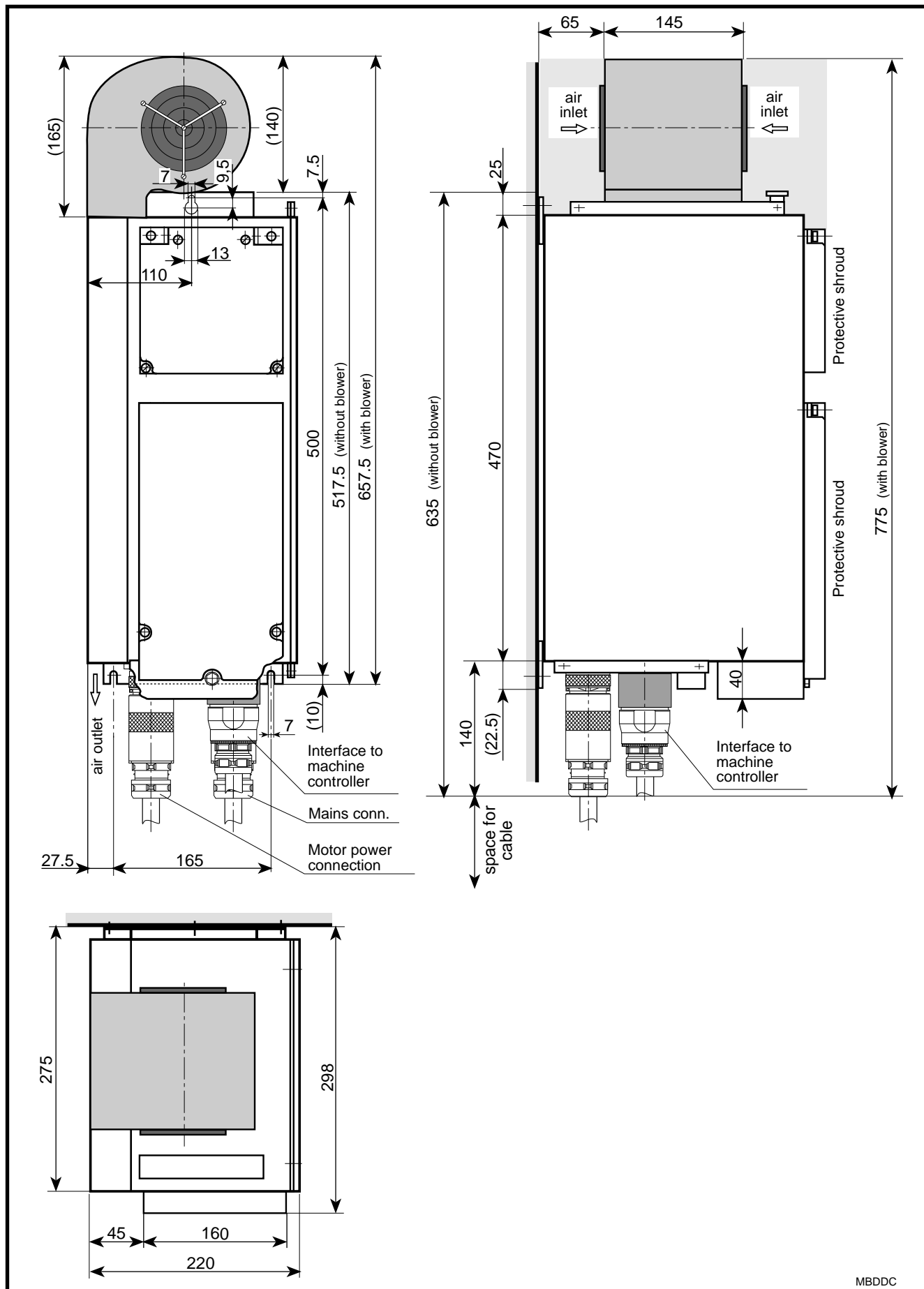
Fig 3.3: Dimensional data - DDC 1.1

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3.4. Frontal view - DDC 1

Slot for software module (U5)

Configuration rating plate

Basic unit rating plate

Slot for command interface card (U1)

Cable leadthrough

Motor power connection

Blower connector

Fault reset key (S1)

Status display, warning and error signals (H1)

RS-232 interface connection for VT-100 terminal or PC (X2)

Analogue inputs and outputs (X3)

Motor feedback connection (X4)

Additional slots (U2, U3, U4) for auxiliary plug-in modules

Interface to machine controller

Mains connection

FADDC

Fig 3.4: Frontal view - DDC 1

3.5.   Coupling the Feed Motor to the Machine

Radial and axial compensation

There must always be sufficient radial and axial compensation in relationship to all other machine parts.

Coupling with a toothed belt

A recirculating ball screw should preferrably be coupled via a toothed belt reduction gear with a mounted overhung toothed lock washer. The stable front bearings of the INDRAMAT servo motor, in this case, help meet the required prerequisites. This has proven itself to be a precise and reliable mode of coupling in every day use. The reduction gear also offers greater rigidity and dynamic stability to the feed axis.

Direct coupling

If the feed motor is coupled directly onto the recirculating ball screw, then it becomes necessary to use a torsionally stiff, but radially and axially compensating coupling. The axial compensation must be able to pick up the axial displacement which results from the expansion due to heat of motor and recirculating ball screw or even from the axial motions of machine components. Without sufficient axial compensation it is possible to damage the axial bearing in the feed motor.

Gear coupling

Only gears with straight teeth should be used to avoid axial forces on the motor shaft and position shifting resulting from axial compensation. Arrange the first pinion of the gear so that it can move in either direction (without additional support bearing).

☞

Thermal deformtions affect side A of the motor. This means that the A side of the motor shaft end can shift up to 0.6 mm with respect to the motor housing. As a result, there is a shifting of position
- **of drive pinions with helical teeth mounted to the motor output shaft but not axially fixed to the machine or**
- **of drive pinions with helical teeth axially fixed to the machine with bevel gear pinions on which thermal stress can occur. The latter can lead to damage on side B of the motor.**

4.   Electrical Connections

INDRAMAT drive controllers with integral single-axis positioning module DLC have been specifically designed to meet the extensive demands of such machines and facilities as transfer facilities, sequential finishing devices and so on.

The drives with protection category IP 65 can be directly installed on the forward feed unit. This means that long interference susceptible connections between the forward feed unit and the control enclosure have been reduced to a minimum. The single-axis positioning module is integrated in the drive. There is no need for a corresponding connection in the machine.
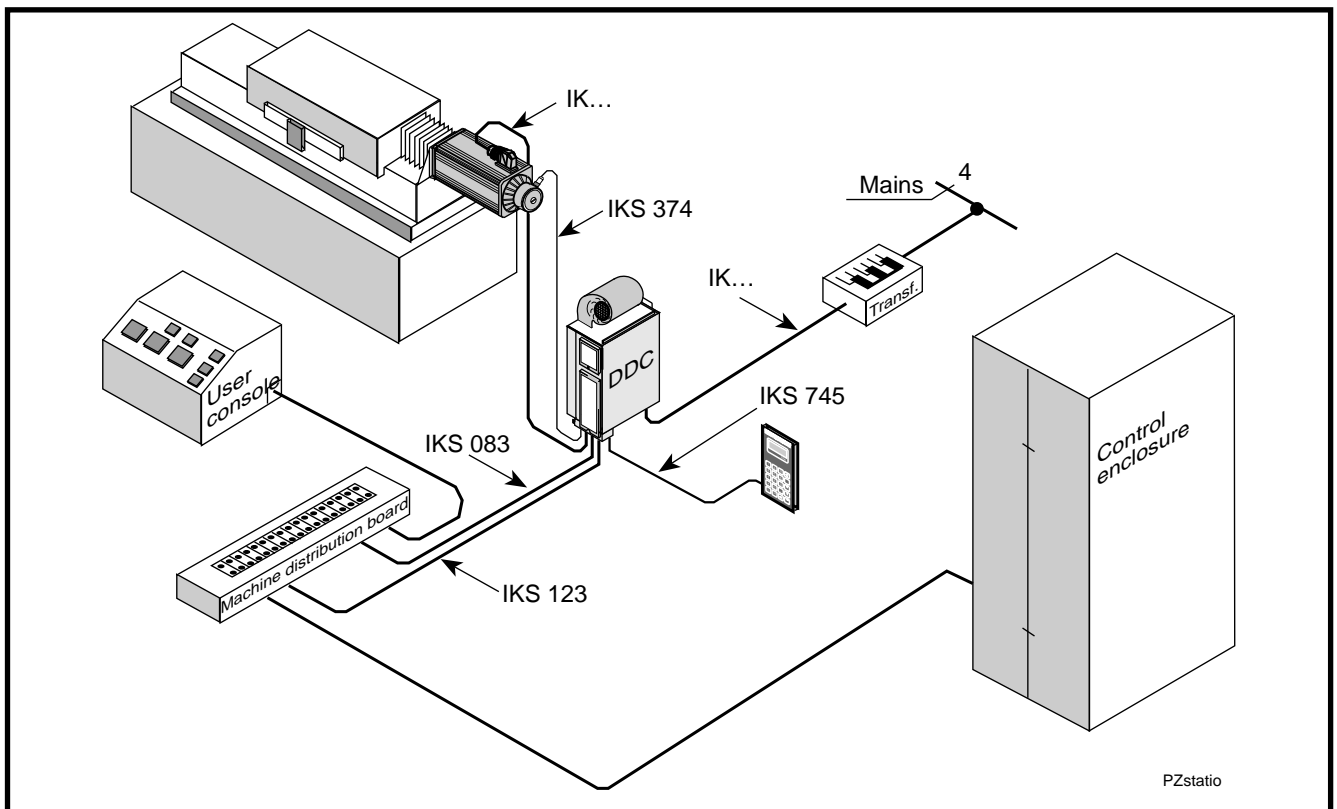
Fig 4.1: Examples of station connections - DDC

One feature of both the single-axis positioning module and the drive is their considerable insusceptibility to systems and circuitry interference. Some guidelines must, nonetheless, be observed during installation to avoid, to the greatest possible extent, the affects of interference.

Avoid coupling in interference

- Signal lines must basically be grounded with shields.
- With analog signals, the shield must generally be connected one-sided, over the greatest possible surface area on the unit side of the chassis/housing. With digital signals, it is advisable to lay the shield on both ends of the cable over the greatest surface possible on the chassis/housing.
- Signal and control leads must be routed at least 10 cm away from power cables. Routing in separate cable ducts is the best solution.
- Signal and control leads should only cross power cables at angle of 90°.
- Such inductive loads as contactors, relays and magnetic valves should only be operated with suitable overvoltage limitors.
- Ground drives as per INDRAMAT guidelines.

Supplementary documentation

See „Electromagnetic Compatibility (EMC) in AC Drives", doc. no. 209-0049-4305-01.

4.1. Terminal diagram - DDC 1.1
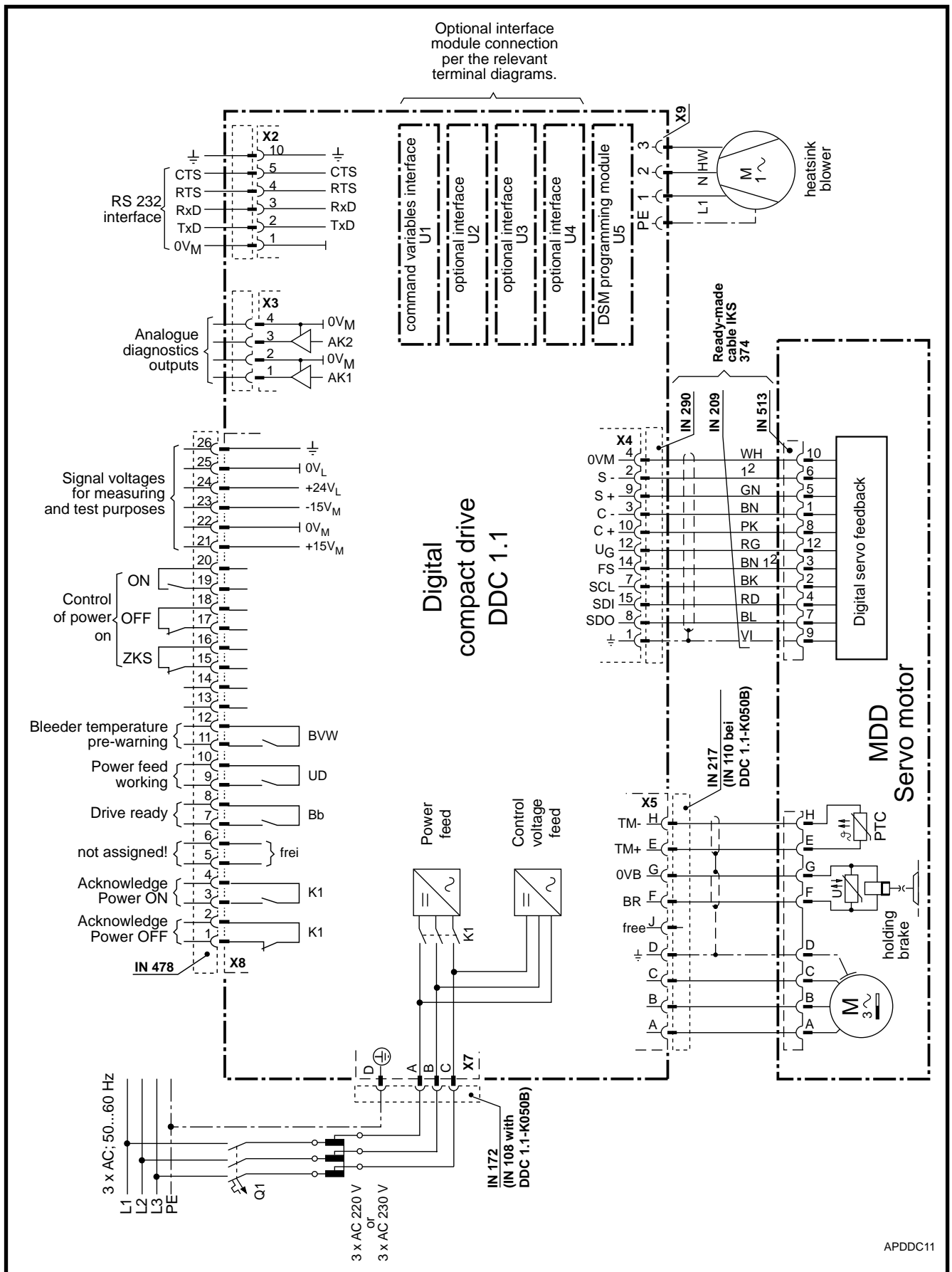
Fig 4.2: Terminal diagram - DDC 1

4.2. Controlling the Mains Contactor

Application   • If a synchronous motor, for example an MDD, is mounted to the DDC.

Features   DC bus dynamic braking always bring synchronous motors to a standstill regardless of whether the electronics of the drive are still functional or not. The DC bus dynamic brake is **only applied when there is a problem in the drive.**

In the case of an emergency stop (E-stop) or if the machine is shut off, then the drives are braked in a **regulated manner by the electronics of the drive** at maximum torque.

How it works   Once the E-stop relay closes, then the auxiliary relays K3 and K4 switch the mains contactor on. If there is an error in K3 or K4, then it is not possible to switch it on.

When the E-stop relay opens, then K3 and K4 safely switch the mains contact K1 off. At the same time, the machine control switches the **drive enable signal** (RF input with analog interface, E-stop input of the DEA 4 if the single-axis positioning module DLC is used). This brings about, drive-internally, a command value to zero of the drive. The drive is brought to a controlled stop.

A drive error signal from the Bb contact of the DDS, an error message from the NC control (servo error) or if the limit switch is overshot, then the mains contactor is switched off and the DC bus dynamic brake applied.

The signal sequence as depicted below is the one recommended when powering up a DDS drive controller.

t1 > 3 s; t3 > 10 ms; t4 >= 20 ms; t5 > 0.3 s   SVDDC
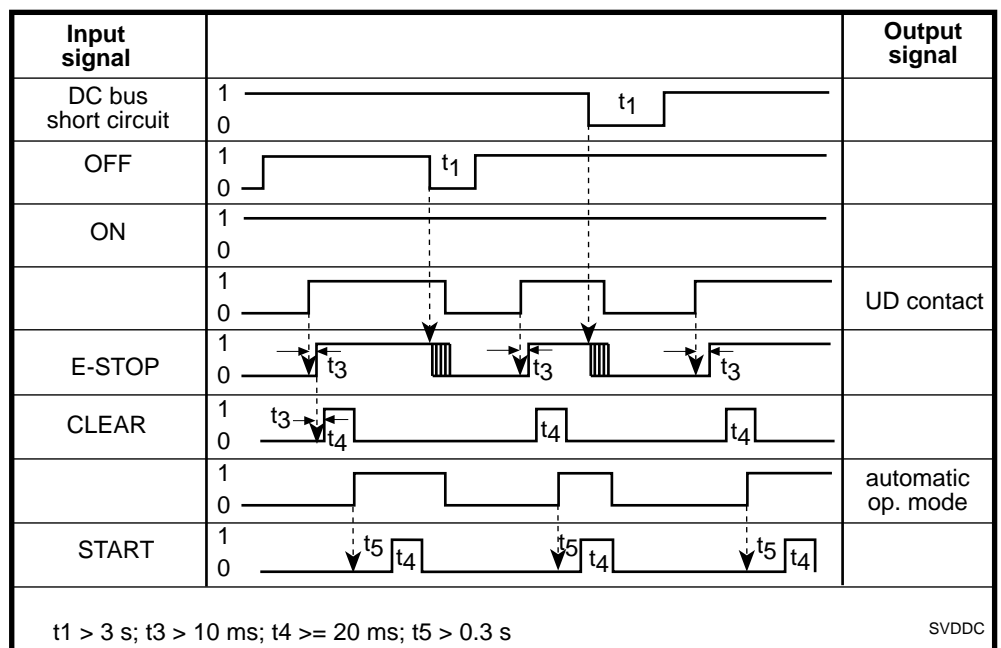
Fig 4.3: Signal sequence diagram for powering up a DDC with DLC single-axis positioning module

DDC control • with DC bus dynamic brake
• if E-Stop relay is used

Bb = Ready to operate
F1 = Power supply fuse
K1 = Mains contactor in DDC
K3 = Aux. relay for switching K1
K4 = Aux. relay for switching K1
K10 = E-stop relay
Q10 = Master switch
S1 = E-stop
S2 = Axis end position
S4 = Power off
S5 = Power on
S11 = Safety door monitor
S12 = Safety door monitor

Example: Depending upon the safety requirements at the machine, additional monitoring and locking measures may need to be taken!

1) If the controller of the machine switches the E-stop input of the DLC off while the UD contact is open, then the message "Emergency Off" is stored every time the power is switched off. During a program cycle, the machine controller can cancel the message "E-STOP" before the program starts with the use of a CLEAR signal. Under some circumstances, it is possible to cancel error diagnoses. With a general powering down, the E-Stop input of the DLC does not have to be switched off. During a general powering down, the machine controller can, e.g., suppress the evaluation of the UD contact. The machine controller can, however, only start the program if the UD contact is closed.

2) If the machine does not require an E-Stop relay, then the ON and OFF buttons can be mounted directly on the DDC.

SSanstNETZ

Fig 4.4: Mains contactor control in the DDC with DC bus dynamic brake and safety door monitor

4.3. DLC 1.1 Single-Axis Positioning Module
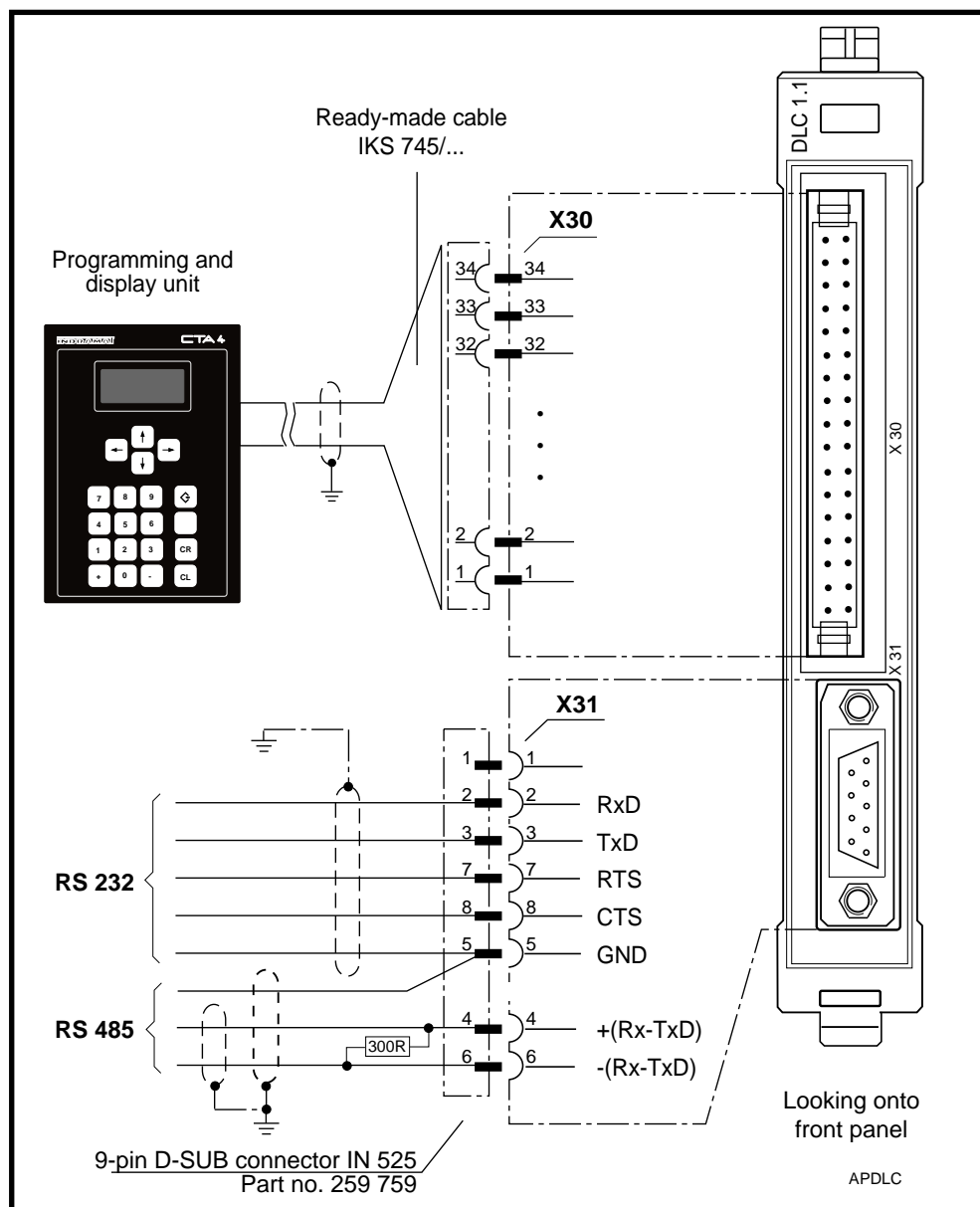
Fig 4.5: DLC 1.1 - terminal connecting plan

Cross-linking drive controllers via the RS 485
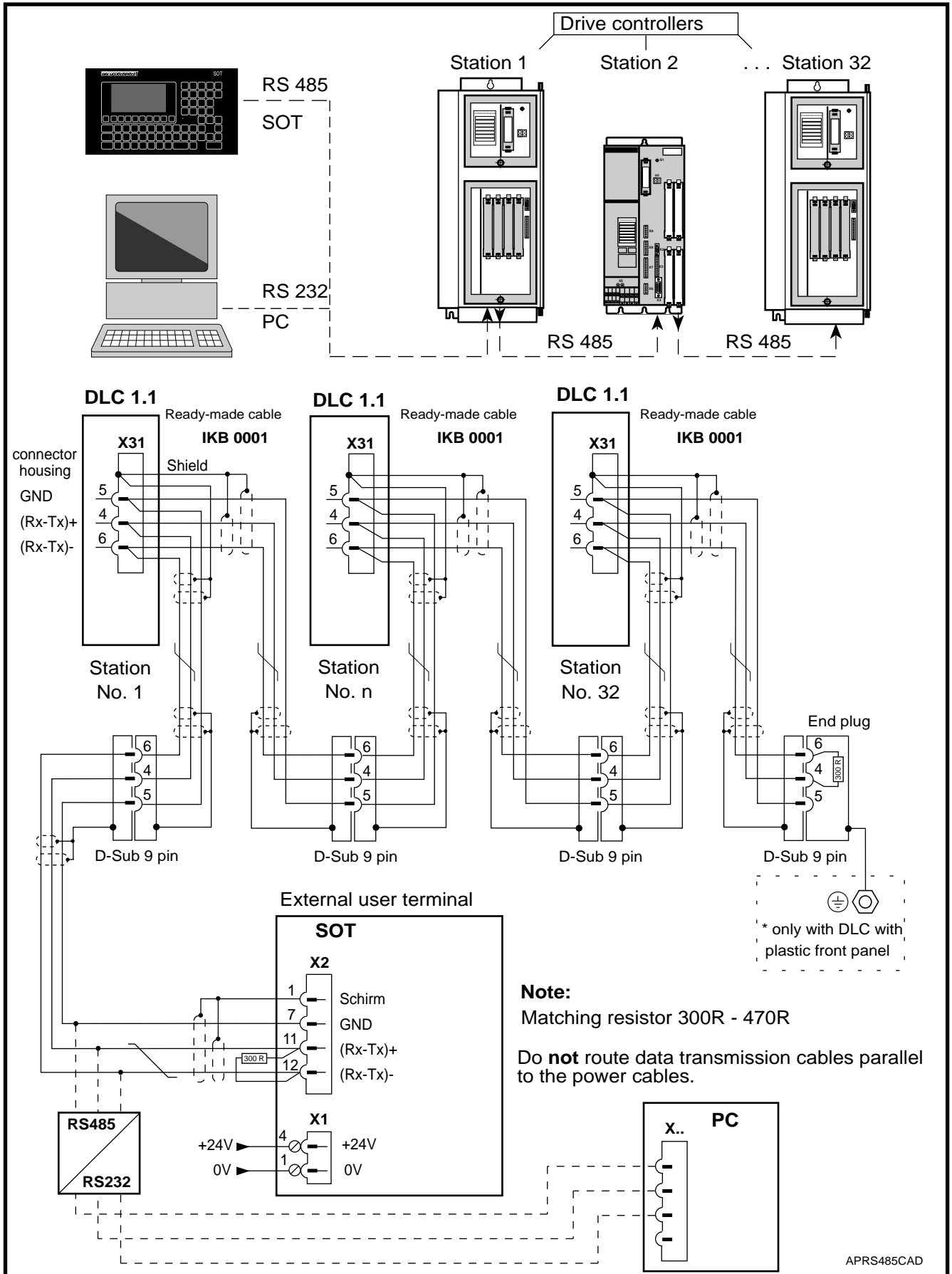
Fig 4.6: Cross-linking drive controllers

4.4. DEA 4.1, DEA 5.1 and DEA 6.1 Input/Output Interfaces
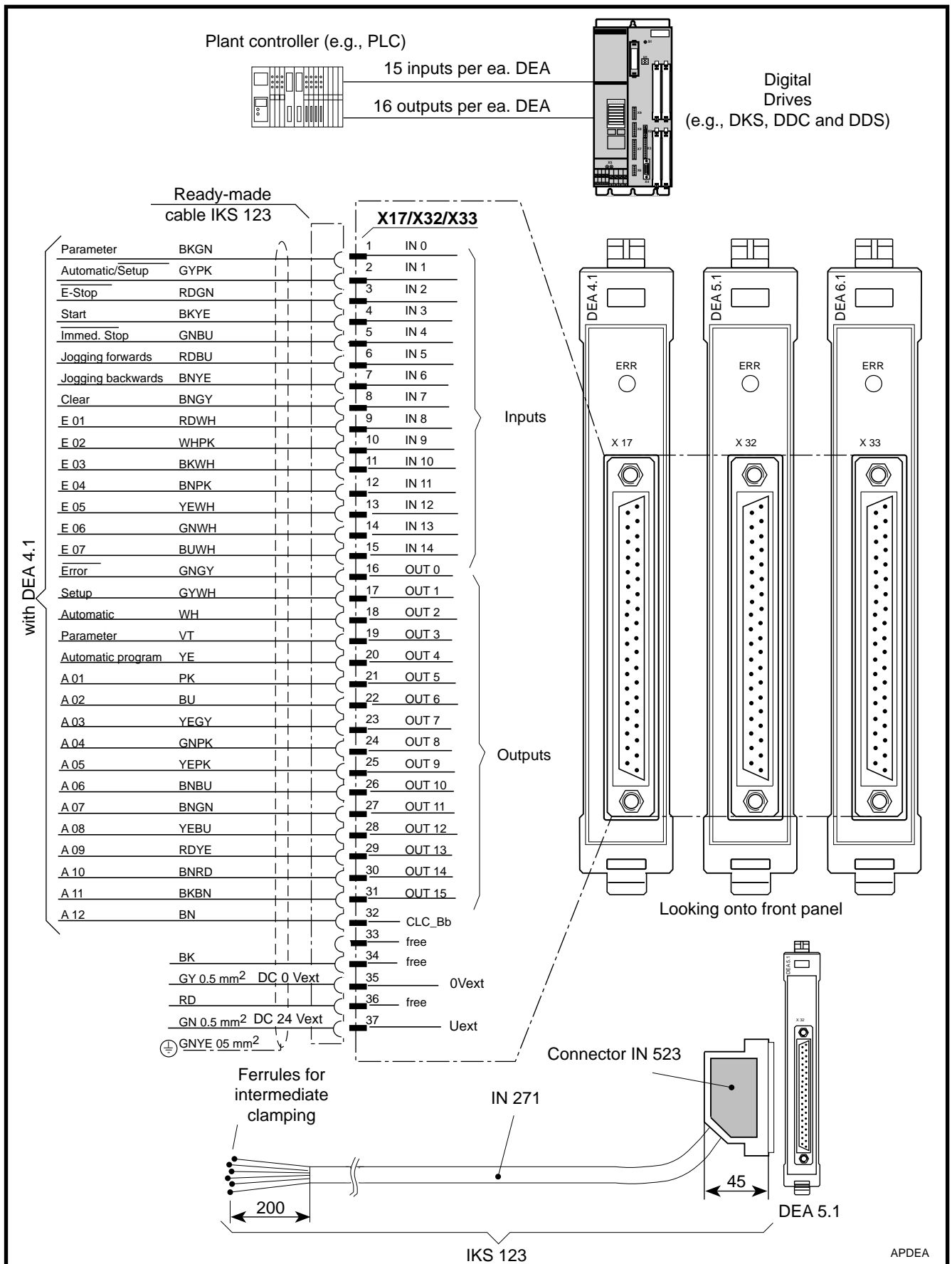
Fig 4.7: DEA - terminal connecting diagram

Technical data DEA 4.1, DEA 5.1, DEA 6.1,

Designation		Unit	min.	typical	max.
Supply voltage	**+U$_{ext}$**	V	18	24	32
Current consumption	**I$_{ext}$**	A	0.15	0.2 [1]	2.2 [2]
Inputs X17/1…15	**+U$_{High}$**	V	14	24	32
	+U$_{Low}$	V	0	< 1	3
Outputs X17/16…31	**+U$_{High}$**	V	U$_{ext}$-2	U$_{ext}$-1	U$_{ext}$
	+U$_{Low}$	V	0	1,6	2
	I$_L$	mA	0	-	100 [3]

1) Current consumption of 0.2 A without load at outputs of 24 V

2) Current consumption of 2.2 A loading all outputs with 100 mA ea.

3) Current at make for lamps must be limited by means of resistor (e.g., 100 R) to 250 mA.

Illustration of basic priniciple of digital intput and output circuitry

1) Free-wheeling diode integrated into load inductance in driver assembly.
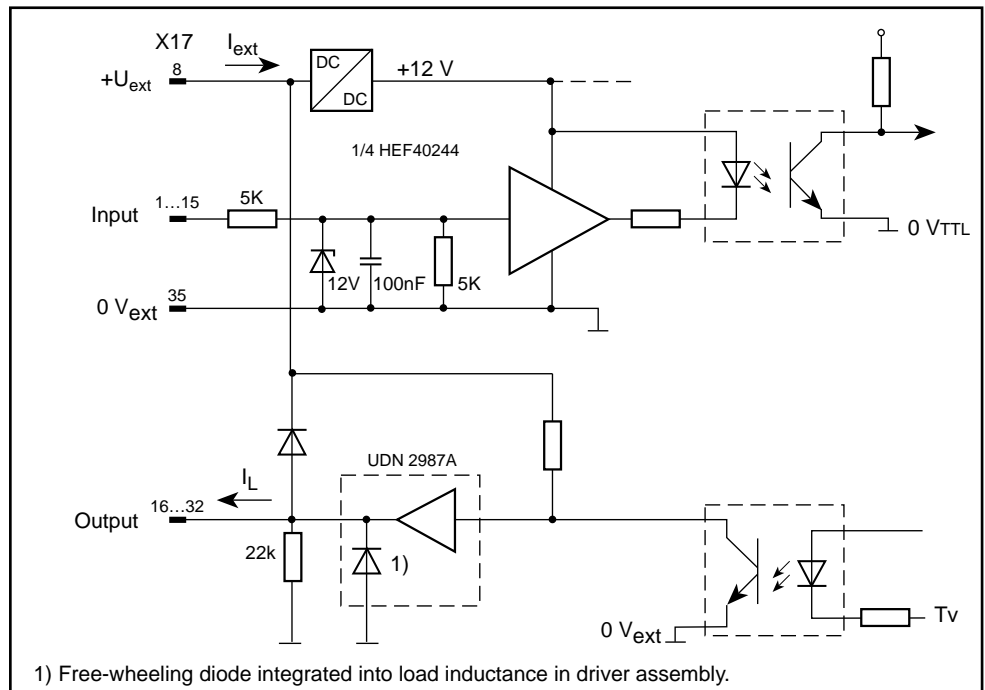
Notes on loading output signals Out 0…15

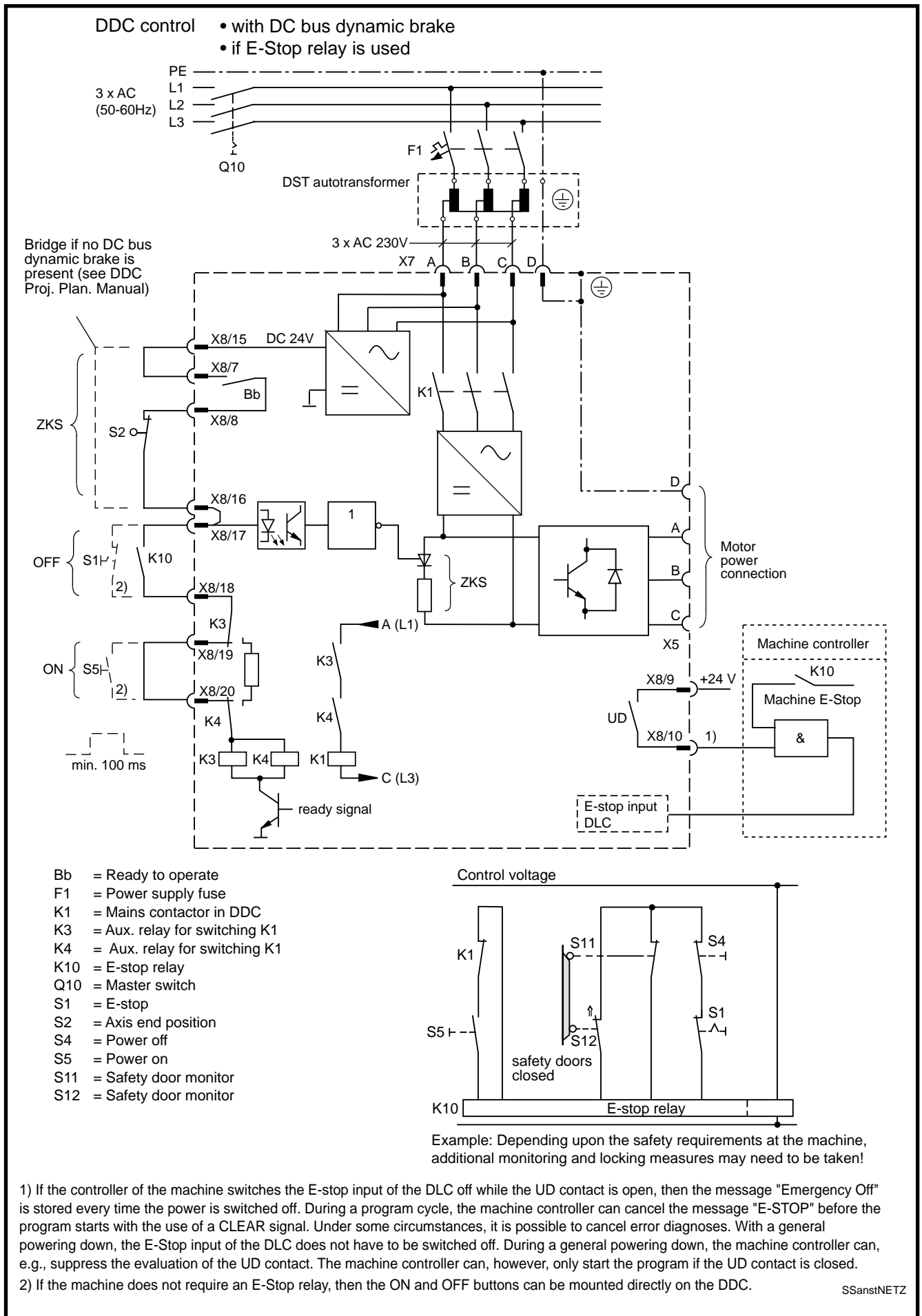**Driver, UDN 2987 A, limits short-circuit currents to 350 mA. If the short-circuit limit is active longer than 1 μs, then the effected output will be locked (I$_L$=0). The other outputs remain functional. The effected outputs remain locked until the supply voltage has been switched on and off once in rapid sequence.**

Notes on LED ERR

If driver UDN 2987 A has switched off one or several outputs because of overload, then the error will be displayed by the switched on LED.

SPDAE

Fig 4.8: Technical data and block diagram of a DEA

4.5. Positioning Interface for DEF 1.1 and DEF 2.1 Square-Wave Signals
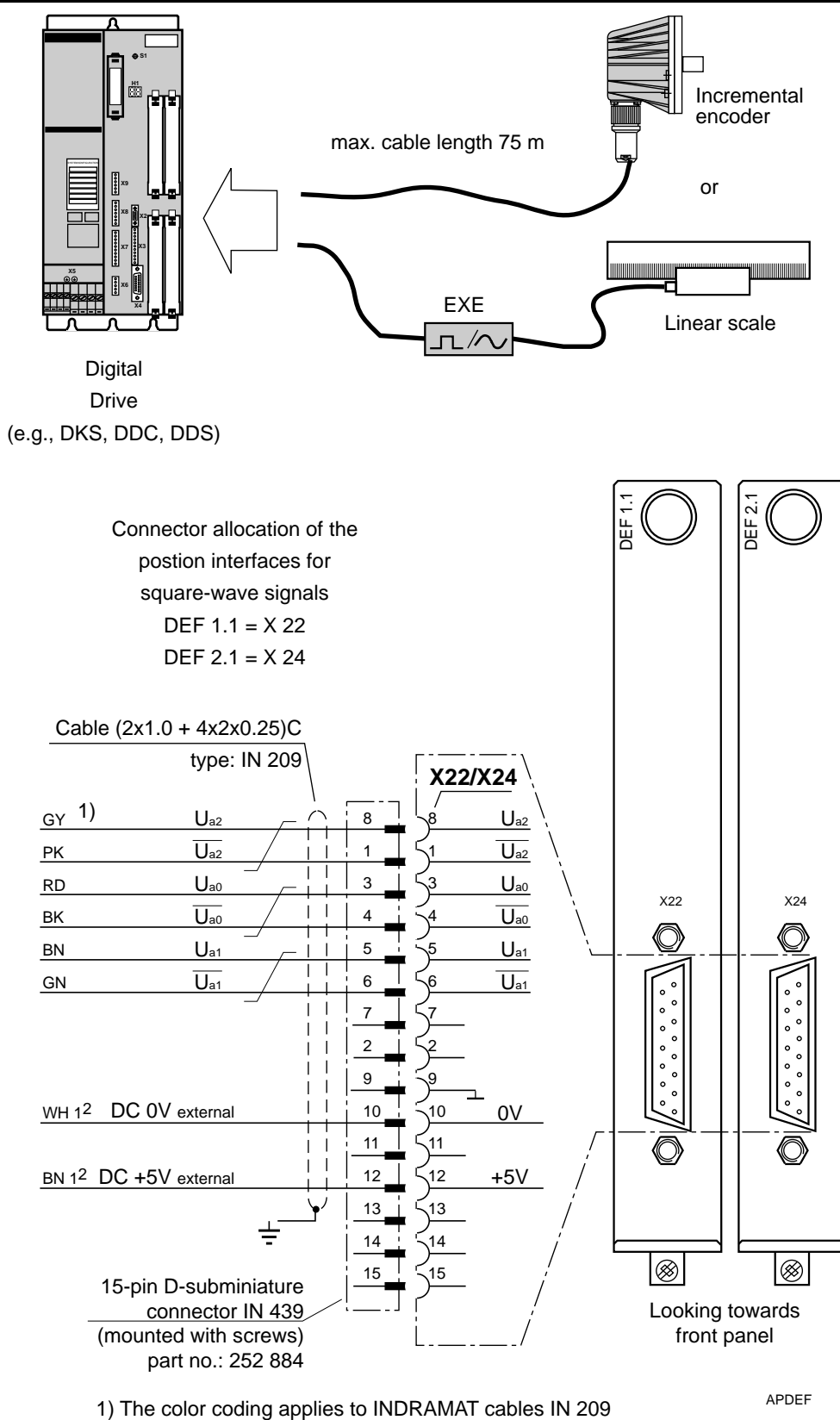
Fig 4.9: DEF 1.1 and DEF 2.1 terminal connecting plan

Voltage source of the external measuring system

Designation	Unit	min.	typic./ value	max.
Output voltage +5 V	V	4.75	5	5.25
Output current of the +5 V	mA			250

Voltage level and phase angle of the input signals

Designation		Unit	min.	typic./ value	max.
Signal voltage	U_{High}	V	2.5		
Signal voltage	U_{Low}	V			0.5
Phase angle	U_{a1}	° el.		0	
Phase angle	U_{a2}	° el.		90	
Maximum input frequency		kHz			1000
Signal cycle interpolation				4-fold	
Homing point delay t1		ns			50
Edge distance t2		ns	250		

Block diagram
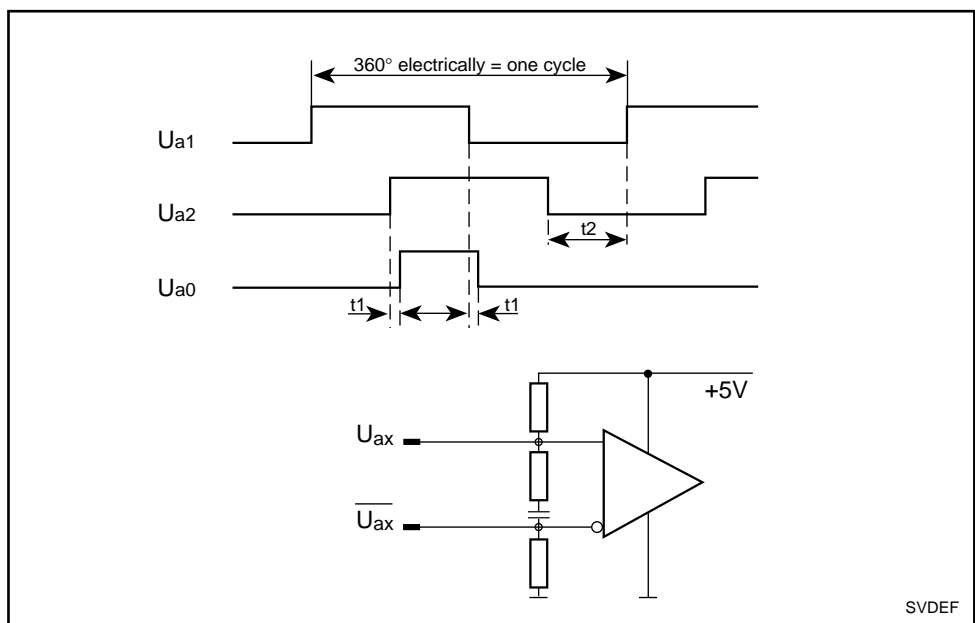
Fig 4.10: DEF - technical data and input wiring

4.6.   INTERBUS S Connection
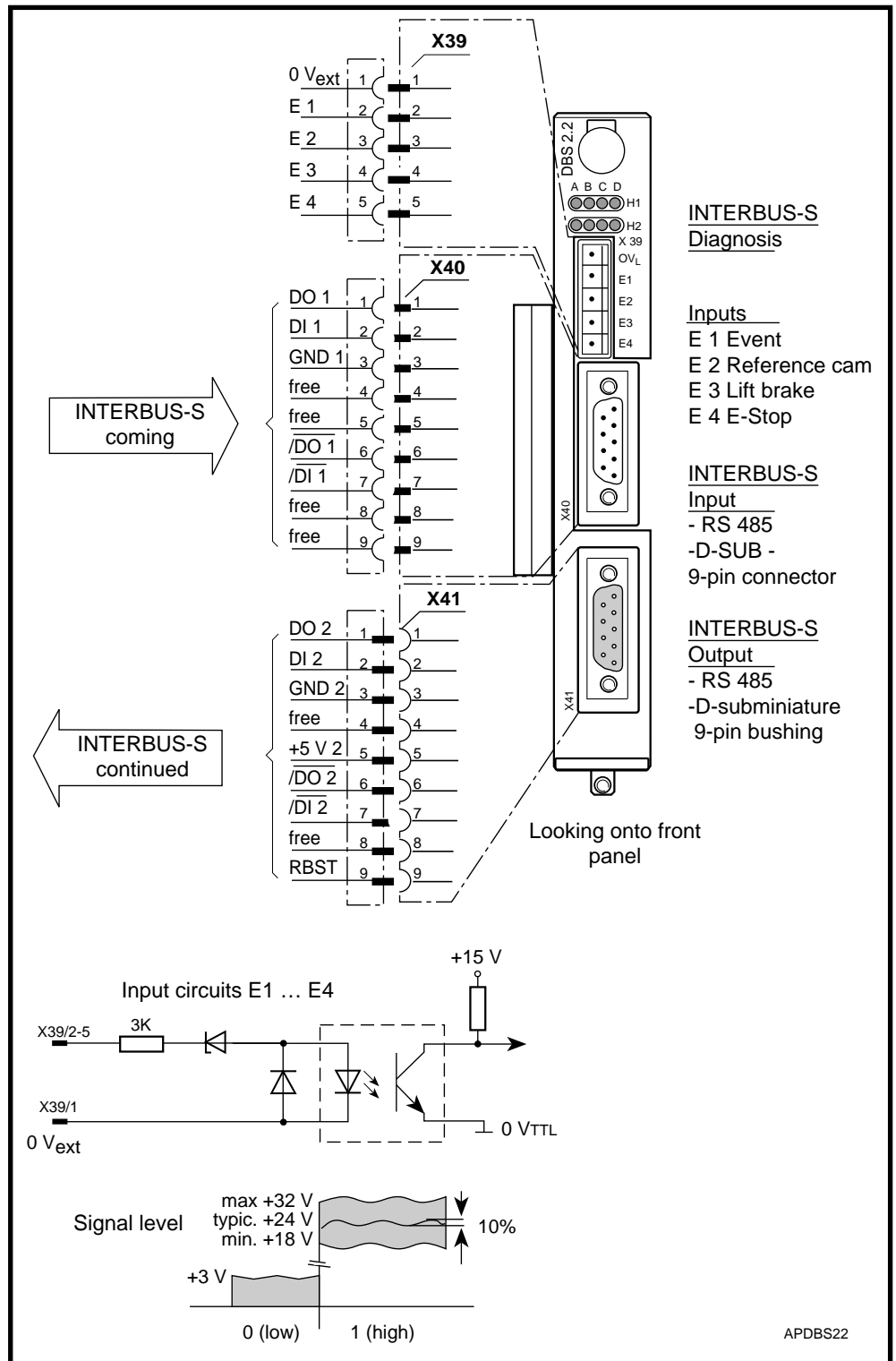
Fig 4.11: INTERBUS S Connection
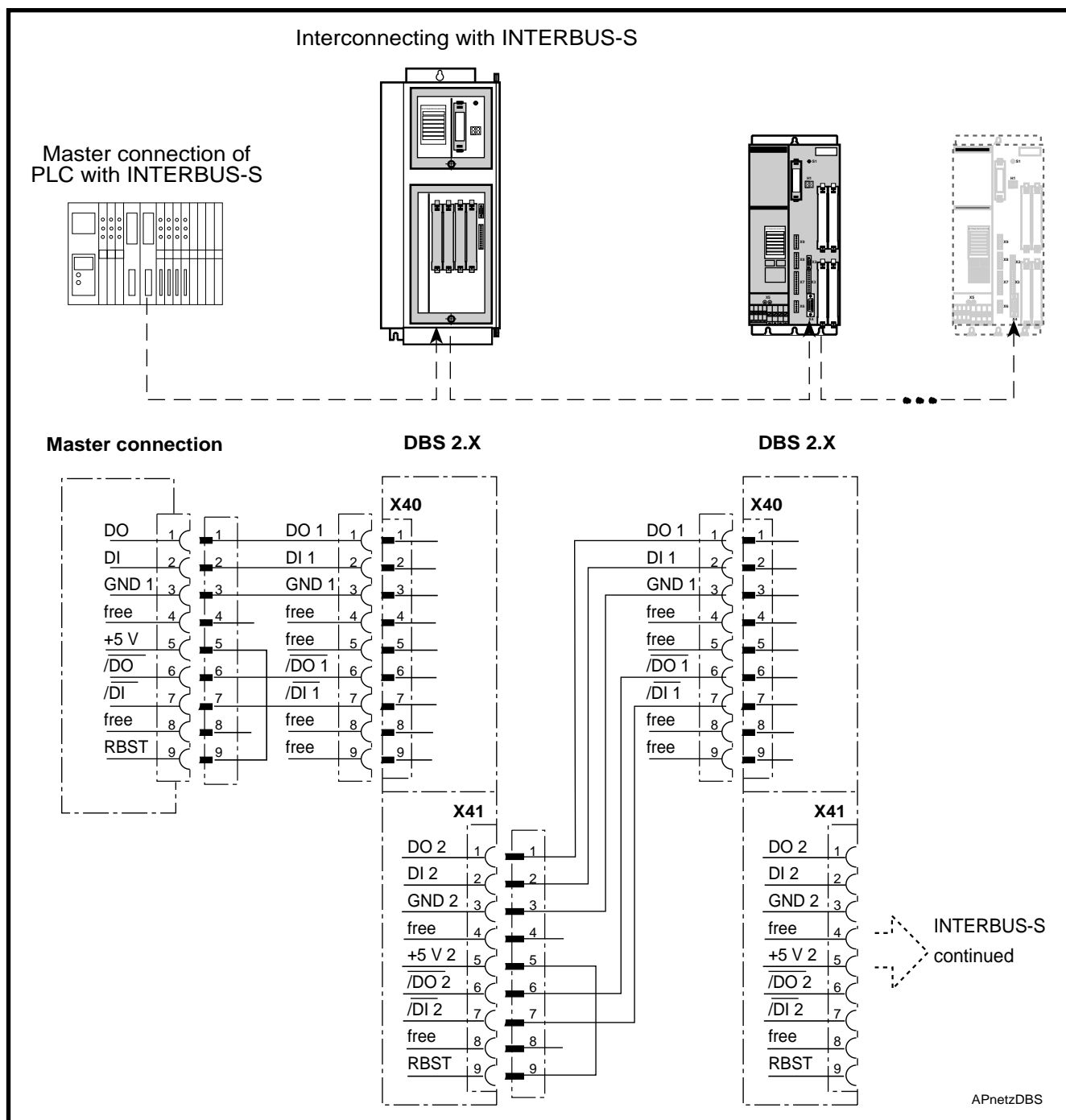
Fig 4.12: Cross-linking drive controllers with the INTERBUS-S

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5. Start-Up Aids

5.1. Minimum Equipment

The DLC single-axis positioning module and the drive controller can be parametrized with the use of a CTA programming and display unit. A multimeter is needed for measuring and test purposes. The selection data manual „DDC with MDD" (doc. no. 209-0069-4363-XX) is also needed.

5.2. Recommended Equipment for Service and Start-Up of the Drive Controllers

Personal Computer (PC)

The PC must be equipped with the following:
• IBM compatible
• MS-DOS
• RS-232 interface
• disk drive or hard drive for storing the parameters
• emulation software for the emulation of a VT-100 terminal

Emulation Software DDS 2 PC

The emulation software emulates a VT-100 terminal. This software is needed to visualize the user interface stored in the drive controller on the monitor of the PC.

Service Cable IN 391

With the use of service cable IN 391, it is possible to connect a PC or a VT-100 terminal to the drive controller via connector X2.

Do not connect either the PC or the VT-100 terminal to the drive controller while they are carrying current. INDRAMAT makes the ready-made cable IN 391 available for the connections. It can be ordered in four lengths, i.e., 2, 5, 10 and 15 meters.
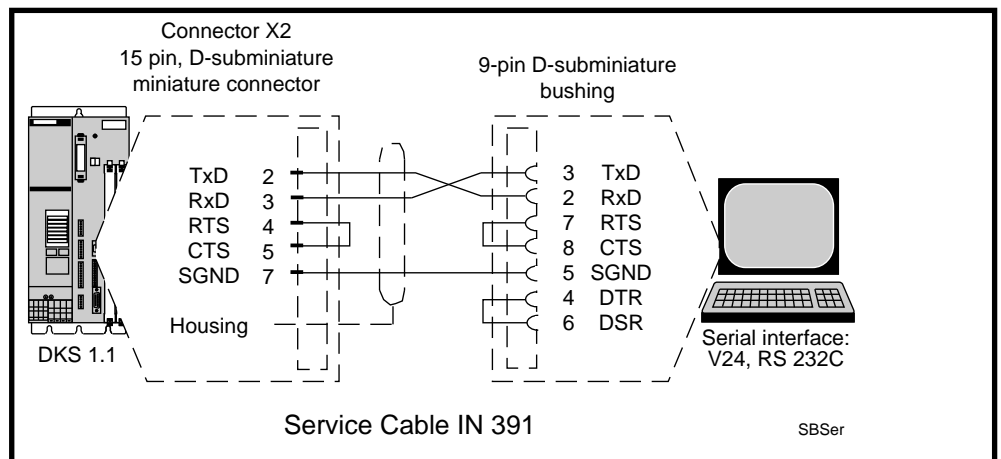
Fig 5.1: Service cable IN 391 connections

Oscilloscope

An oscilloscope can be used to test speed control settings and drive loads during acceleration.

5.3. Recommended Equipment for Service and Start-Ups of DLC Single-Axis Positioning Modules

Interface Switch Box ISB-3

The following functions can be performed with the ISB-3.

- Parametrization and diagnoses via the CTA
- Drive messages (Bb, UD, BVW) can be queried via the LED.
- 11 freely programmable outputs can be queried via the LED and insulated test terminals
- DLC system outputs can be queried
- Switching of DLC system inputs
- Switching of seven freely-programmable inputs
- Power source can be switched on and off
- E-stop cutoff
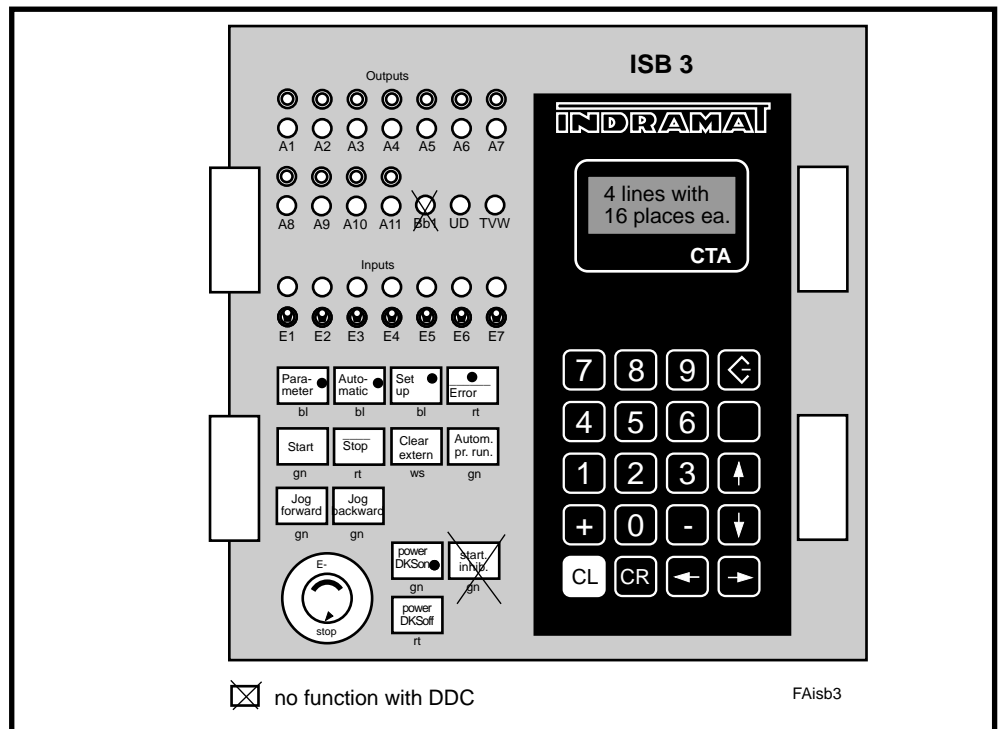
Fig 5.2: Interface ISB-3 switch box

Motion Manager

The Motion Manager is an editor and communications program for writing and transmitting CLC user programs. It facilitates DLC programming.

The Motion Manager can run on IBMcompatible computers (PC).

Minimum requirements made of the PC:
- MS-DOS
- RS-232 interface
- drisk drive

INDRAMAT Cable IKS 046

It is possible to connect a PC to the RS 232 interface of the DLC using cable IKS 046.
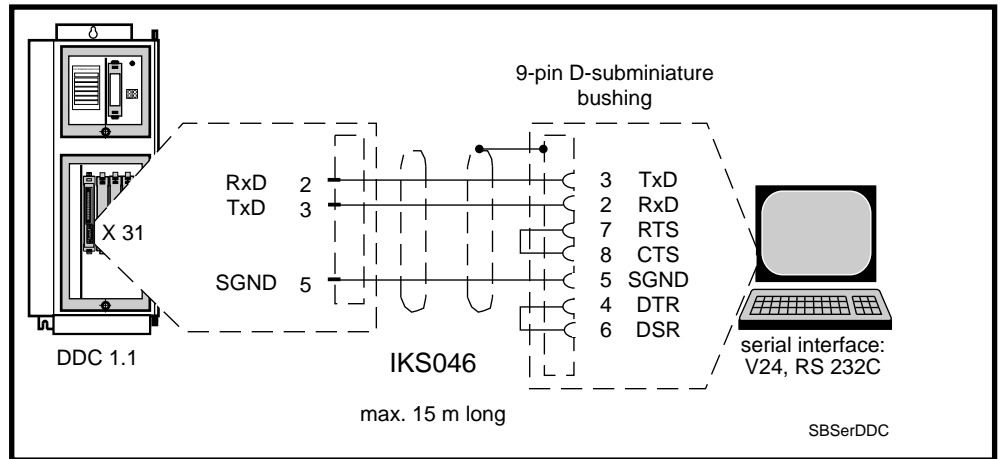
Fig 5.3: Connector assignment of the RS232 interface of the DLC

5.4. Connecting the Start-Up Aids
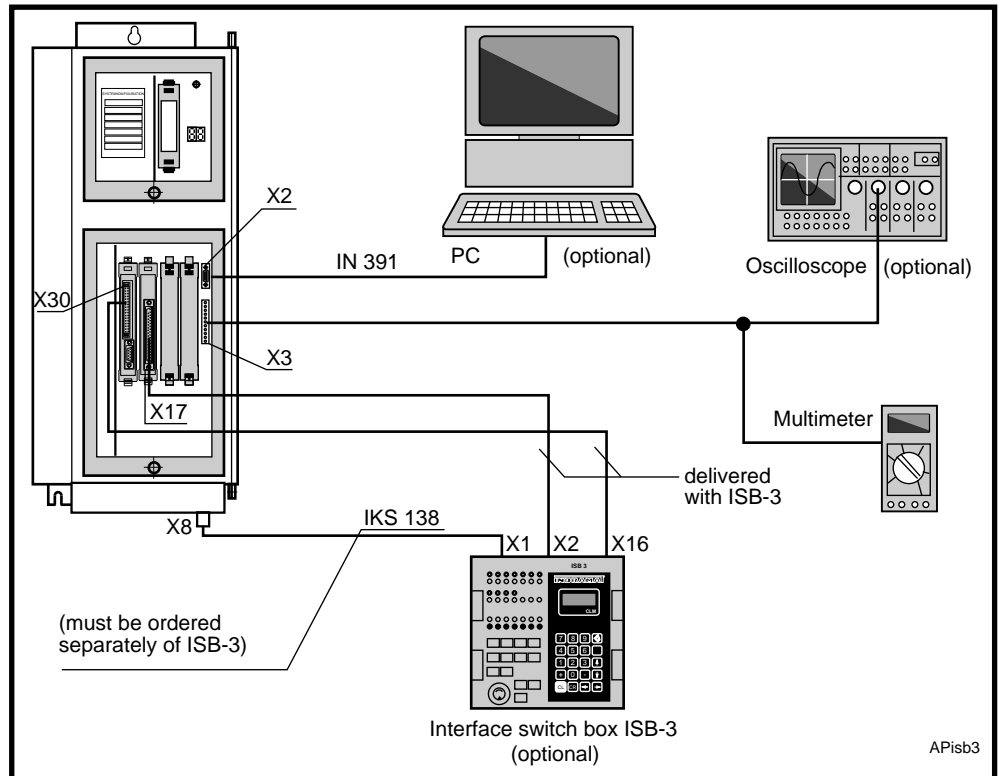
Fig 5.4: Connecting the start-up aids

6.   Parameter Input

6.1.   Parameter Input Aids

Motion Manager   Using the editor and communications program „Motion Manager" it is possible to input and secure the DLC control parameters, e.g., feed constants, amplification of position control and so on.

DDS2PC   It is possible to access the user interface of the drive with the DDS2PC. Such drive parameters as speed control amplification, maximum drive speed and so on can be optimized and secured as needed with it.

CTA   All control and drive parameters can be input and optimized, as needed, with the CTA programming display unit. The parameters are stored on the DLC card which is backed up by a lithium battery with a lifespan of approximately ten years.

Source of danger:	**Parameters can be cleared.**
Possible consequences:	**Extensive machine down times.**
How to avoid:	**Secure data outside of the drive.**

The parameters can be stored on either disk or hard drive with the use of the „Motion Manager" and the „DDS2PC". These can then be printed out in the form of a parameter list. We recommend filing a parameter list with the machine documentation.

Parameter Input   The user interface of the programs „Motion Manager" and „DDS2PC" make it easy to input all parameters.

How to handle the programming and CTA display unit when inputting parameters is described in the following section.

6.2. Using the CTA to Input Parameters
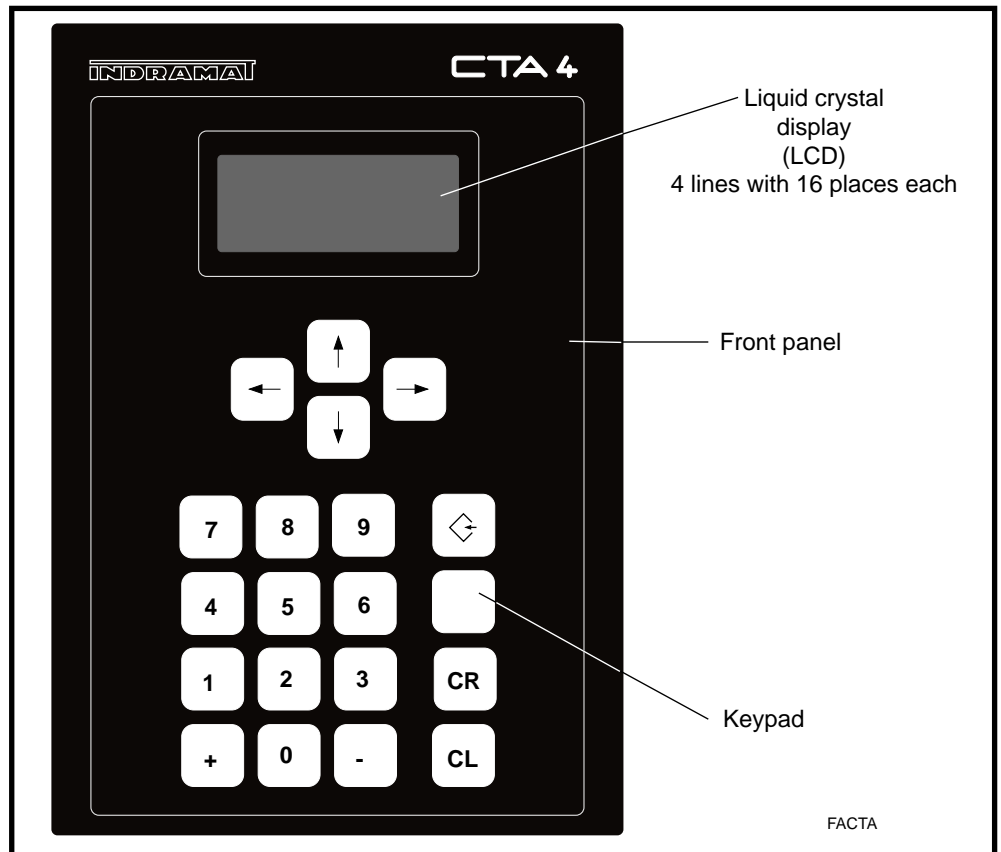
Fig 6.1: The CTA - a programming and diagnostics unit

Keyboard Functions

[0] to [9]	Input of program or parameter data
[+] [-]	1. Qualifying sign input 2. Scrolling up or down in program or parameter block
[CL]	Key for clearing errors.
[CR]	With this key, the cursor is placed on defined input positions. (not effectual in parameter mode)
[←] [→]	Cursor right, cursor left.
[↓] [↑]	1. From the basic position of the cursor, these keys are used to switch from one display to the other. 2. These keys are used to call up commands in programm input mode. The cursor must be placed at position behind the command. 3. In parameter mode, these keys can be used to switch between parameter blocks A100...C000
[◇]	Input key To assume parameters, press input key.
[ ]	Free key - scrolling between parameter blocks A100, B000 and C000.

MTCTA

Fig 6.2: Keyboard functions

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6.3.   Parameter Input Preparations

Applying distribution voltage

The distribution voltage must be applied to the drive controller for inputting parameters.

3 x 230 V AC (+ 10 % - 15%) (with the DDC 1.1)

Conditions at the Mains

Before applying the distribution voltage check whether the mains meets the requirements of the drive controller. Guidelines for earthing conditions of the supply source, mains connections, control circuits, E-stop circuits and so on are detailed in the Project Planning Manual DDC (209-0069-4381-XX).

Drive Components

The drive components installed must be suited to the respective mains voltage.

> **Please ascertain that the data on the configuration rating plate agrees with that on the plug-in module inserted into the drive controller. If these do not agree, then damage to the AC servo drive and the mechanics of the machine can result!**

Wiring

Check wiring for short-circuits, breaks, incorrect connections and lead diameters.

Earthing

- Make sure that the earthing corresponds to all the INDRAMAT connection recommendations.
- Include the applicable protective measures required for the machine.
- Earth the motor to the drive controller.
- Connect the earth conductor of the drive controller to the mains earth.

> **Danger**
>
> Source of danger: **Risk of accident from dangerous voltage levels**
>
> Possible consequences: **Danger to life and limb.**
>
> How to avoid: **Do not undo the earth connections. They create a functional earth with protective functions.**

Electromagnetic compatibility

- Connect the housing of the drive controller with the machine chassis so that it is electrically conductive.

Power leads

- The leads of the drive controllers to the motor should be twisted or a four-strand cable (3x phase, 1x earth).
- Check to make sure that the lead diameters comply with the EN 60204 guidelines.
- The required lead diameters are detailed in the motor documentation.

Contact points and plug-in connectors

Check for:
- secure contacts - they may not be dirty or moist
- contact points must be firmly and permanently in place
- subminiature connectors must be firmly and permanently in place

Shields   The shield of both the motor feedback cable and the thermosensor leads must be clamped to the relevant connection to earth of the drive controller.

Connecting a power transformer   Check to make sure that the transformer output voltage and the mains voltage of the drive controller are compatible when installing a power transformer.

E-Stop Sequence   Due to wiring faults, the mains contactor will, in all likelihood, cut in as soon as the mains voltage cuts in. This is why we recommend checking the E-stop sequence. No POWER ON command may be pending.

⚠️ Danger

Source of danger:	**Reckon with uncontrolled drive movements.**
Possible consequences:	**Severe injury to personnel and serious damage to machines.**
How to avoid:	• **Locate E-stop button within quick access.**
	• **Check E-stop sequence function.**
	• **Personnel may not remain within the range of motion of the servo axis.**
	• **Set maximum traverse rate so that the user can secure a rapid and safe standstill of the servo axis at any time (parameter Vmax; A 100 in DLC).**
	• **Rotational direction of the servo motor cannot be altered by interchanging two strands of the motor power cable. This could cause serious damage to the motor.**

6.4.   Inputting Parameters

How to input the parameters using the CTA is described in the following section. For details on other methods see section 6.1.

The distribution voltage must be applied to the drive controller so that parameters can be input. There must be +24V at the input „Parameter" of the DLC. The CTA must be connected with the DLC.

⚠️ Warning

Source of danger:	**Incorrect parameters are input.**
Possible consequences:	**Damage to machine is possible.**
How to avoid:	• **Parameters may only be input by personnel with expert knowledge of the machine.**
	• **Protect the operating mode parameter against access, e.g., by means of a key-operated switch.**

Activity to be Performed	Controller Operating Mode	CTA Display	Comments
Power ON	setup/ automatic	"wait for re-trigger" "Ready to operate"	H1-DDC displays "bb" once initialization is complete
Parameter entry **Switch to parameter entry mode**	Parameter	V max A 1 00 00000000 └─── *Cursor blinks*	Controller displays parameter A100 an. H1-DDC displays "bb".
Select parameter by entering numeric value **1. Entering a "1" at cursor position will display parameter A110.** **2. Entering a "2" new cursor position will display parameter A112.**	Parameter	V max A 1 00 00000000 └─── *Cursor Position* Hom. setup para. A 1 10 00000000 └─── *Cursor moves one place to right* Hom. setup para. A 1 12 00000000 └─*Cursor moves one place to right*	A parameter can be selected directly by entering the three digit parameter number. Using ⊞ and ⊟ scrolling in parameter block is possible. H1-DDC displays "bb".
Changing parameter block **from A1 00 to B0 00** ☐ **hit spacer key once** **twice** **three times** **four times**	Parameter	V max A 1 00 00000000 Free B 0 00 00000000 Analog output channel 1 C 0 00 00000000 Set standard drive parameter C 1 00 00000000 Code: 00005301 V max A 1 00 00000000	H1-DDC displays "bb".
Entering parameter value ◄ ► **Results:**	Parameter	V max A 1 00 00000000 └─── →*Move cursor to right* V max A 1 00 00000000 └ *input 1* V max A 1 00 10000000 └─── *Cursor*	For detailled parameter descriptions see "DLC1-A single axis positioning module for digital drive control - program instructions" H1-DDC displays "bb".
Store parameter values ↺ **press to store programmed values; the next parameter will be displayed.**	Parameter	V max A 1 00 00000000 V min A 1 01 00000000 └ *Cursor*	H1-DDC displays "bb". TBpar

Fig 6.3: Using the CTA to input parameters

6.5. Explanatory Notes on Several Important DLC Parameters

DLC parameters important to the setup mode are explained in detail in the following section.

The programming guidelines "DLC1-A Single-Axis Programming Modules for Digital Drive Control" explain all DLC parameters in detail (see doc. no. 109-0852-4102-XX).

Maximum Speed **Parameter A1 0 0**

Input range: 0.10 ... 50 000.00

Decimal places: 2 or 3 depending on parameter B 007

$$v_{max} = \frac{n_{max}}{60} \bullet VK$$

v_{max} = maximum speed

n_{max} = maximum motor rpm

VK = feed constant

The following value results for Example 1, acc. to section 6.6:

$$v_{max} = \frac{n_{max}}{60} \bullet h \bullet \frac{Z_1}{Z_2} = \frac{2880 min^{-1}}{60} \bullet 10mm \bullet \frac{35}{56} = 300 \frac{mm}{s}$$

Input value: 000300,00

Setup speed **Parameter A 1 0 1**

Input range 0.10 ... 50 000.00

Decimal places: 2 or 3 depending on parameter B 007

Speed in setup mode if system operation jogging forward or backward is set to logical 1.

A 101 ≤ A 100

 Caution

The speed which may be used in setup mode depends on the construction of the machine. To avoid damage to the machine, do not select a very high speed.

Acceleration **Parameter A 1 0 2**

Input range: 1 ... 9999 9999

Decimal places: 0 or 1 depending on parameter B 007

Check whether the acceleration programmed here is acceptable to the mechanical system of the machine.

Value for example 1, section 6.6

$a = 1m/S^2$

Input value: 0000 1000

KV Factor   **Parameter A 1 0 3**

Input range: 0.01 ... 30.00

Decimal places: 2

The KV factor is used to define positional amplification. The KV factor determines the maximum lag distance derived from the maximum speed.

KV = 1 equals a lag distance of 1 mm with a speed of 1 m/min

The KV factor must be adjusted to match the mechanical conditions.

A KV factor which is too small reduces drive dynamics.

A KV factor which is too big leads to drive instability.

Start with KV = 1.00 when determining the optimum value.

Feed Constant   **Parameter A 1 0 8**

Input range: 0.1000 ... 5000.0000 or 0.01000 ... 500.00000

Decimal places: 4 or 5 depending on parameter B 007

That path is set here which results from one rotation of the position encoder. It can be input in any unit of measurement, e.g., mm, cm, inch, degrees and so on. The unit set here is designated the input unit (EGE). All other units must relate to this one.

Value for example 1, section 6.6

$$VK = h \bullet \frac{Z_1}{Z_2} = 10mm \bullet \frac{35}{56} = 6.25mm$$

Input value: 0006,2500

Working direction   **Parameter A 1 0 9**
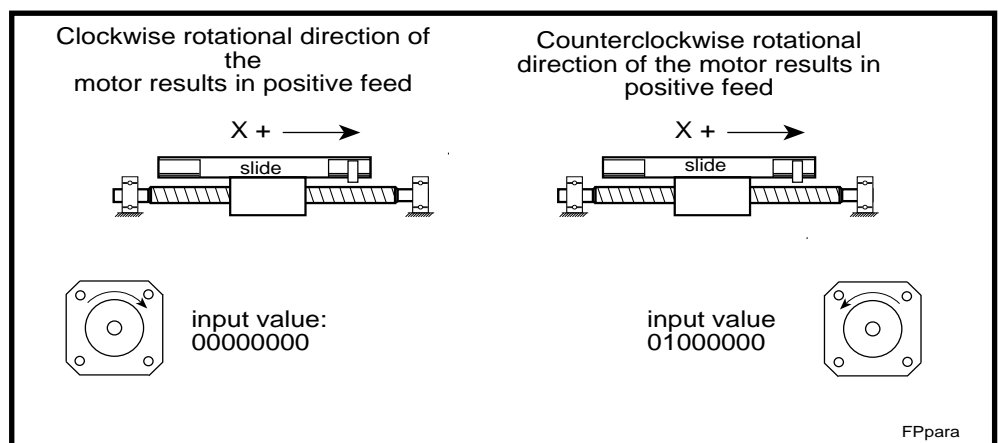
Fig 6.4: Setting parameter A109

Go to Zero Point **Parameter A 110**

The direction of zero point search is specified in this parameter as well as the type of feed axis (linear axis or rotary table) and the position encoder (incremental or absolute).

```
0 0 0 1 1 0 0 0
```

0 = linear axis; 1 = rotary table with shortest path;
2 = rotary table with programmed direction

search speed as % of maximum speed

0 = incremental encoder without go to zero enable
1 = incremental encoder with go to zero enable
2 = multiturn or singleturn encoder

Zero point search: 0=forwards; 1=backwards
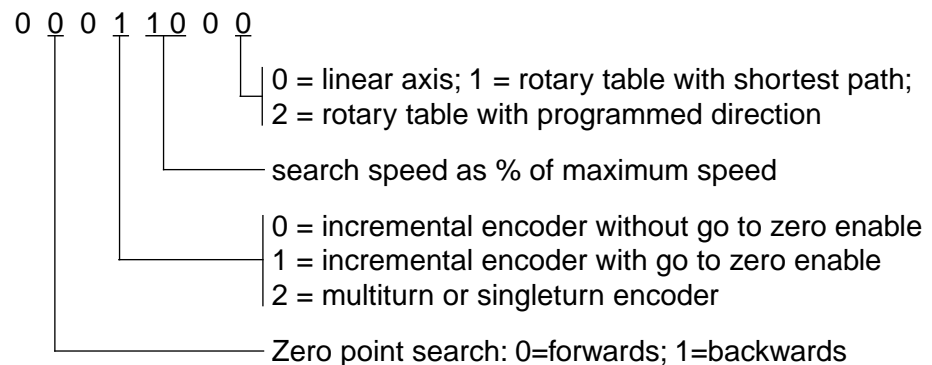
Rotational direction of the motor with zero point search (looking onto motor shaft)

Parameter A 1 0 9	Parameter A 1 1 0	Rotational direction
0 0 0 0 0 0 0 0	0 0 * * * * * * (forwards)	right
0 0 0 0 0 0 0 0	0 1 * * * * * * (backwards)	left
0 1 0 0 0 0 0 0	0 0 * * * * * * (forwards)	left
0 1 0 0 0 0 0 0	0 1 * * * * * * (backwards)	right

Fig 6.5: Rotational direction of the motor when searching zero point

Go to zero, homing **Parameter A 1 1 2**

```
0 1 0 2 0 0 0 1
```

output 01...72; axis in reference

input 01...37; homing switch
(00= referencing to zero point)

input 01...37; start referencing
(00 = referencing only possible with HOM command)
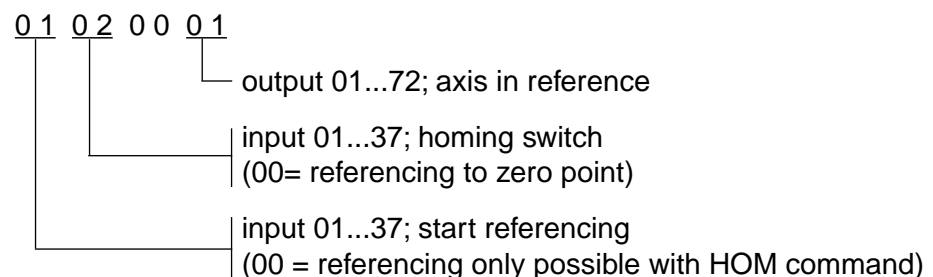
Travel Range Limits **Parameters A 1 1 3 and A 1 1 4**

$$\pm k\,k\,k\,k\,k\,k.k\,k$$

Decimal places: 2 or 3 depends on parameter B 007

Limits only effective with absolute position detection or after homing.

In setup mode, the drive stops upon reaching the travel range limit without emitting an error message.

In automatic mode, an error message is generated once the programmed position exceeds the travel range limit.

The position of the travel range limit as it relates to the zero point of the machine is not affected, i.e., shifted, by offset programming (A 111).

Rotary table, gear ratio   **Parameter A 1 1 6**

Input range: respectively 0001 9999

Decimal places: 0

Example: i = 120

Input

0 1 2 0   0 0 0 1

gear output (table)

gear input (motor)
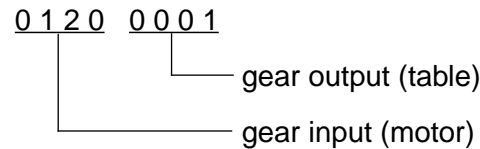
Maximum motor speed   **Parameter A 1 2 1**

Input range: 0001 ... 9999

Decimal places: 0

Maximum motor speed is fixed here.

Input value for example 1, section 6.6

$$n_{max} = \frac{v_{max} \bullet 60}{h} \bullet \frac{Z_2}{Z_1} = \frac{300mm \bullet 60s}{s \bullet min \bullet 10mm} \bullet \frac{56}{35} = 2880min^{-1}$$

Input value: 2880 0000

Direct position measurement, following axis, measuring wheel   **Parameter A 1 2 3**

5 1 0 0 2 0 0 0

with measuring wheel operations - input activating the measuring wheel; 01...37

with measuring wheel operation, direct position measurement, per cent deviation between motor and external encoders 00...99; 00 = monitor OFF

1 = external encoder 1; parameter B016...B019
2 = external encoder 2; parameter B020...B023

Operating mode:
0 = position determined by motor encoder
2 = following axis
3 = position control with measuring wheel
4 = measuring wheel as feed corrector
5 = direct position measurement with linear scale or
      incremental encoder

Display and language selection

Parameter B 0 0 7

The language and the number of decimal places of the CTA are fixed here.

0 0 0 2 0 0 0 0

02 = standard
03 = additional decimal places for an even finer resolution

00 = German; 01 = English; 02 =French;
03 = Spanish; 04 = Italian; 05 = Portugese

Encoder input and working direction of the external position measuring device

Parameter B 0 1 6

1 0 0 0 0 0 0 0

Working direction:
0 = drive motor and external position encoder have same rotational direction
1 = drive motor and external position encoder do not have same rotational direction

Encoder input:
1 = DEF 1 plug-in module
2 = DEF 2 plug-in module
3 = DFF plug-in module

External position measurement resolution

Parameter B 0 1 7

0 0 0 0 1 2 5 0

Input range: 100 ... 20000

Number of pulses per encoder revolution or linear scale number of pulses per motor revolution.

Example of linear scale: division period = 20μ; feed constant = 5mm; pulse replication = 5-fold

$$B017 = \frac{\text{feed constant}}{\text{division period}} \bullet \text{pulse replication} = \frac{5mm}{0.02mm} \bullet 5 = 1250$$

Input value: 000 01250

Feed constant for external position measurement

Parameter B 0 1 8

Input range: 0.1 ... 5000.0000

Decimal places: 4 or 5 depending on parameter B 007

Path per revolution of the external position encoder or with linear scale - traversing path for the number of pulses as per B 017.

Example: feed constant 5 mm

Input value: 0005.0000

6.6. Example 1 - Linear Axis with Absolute Position Measurement (in motors with integrated multiturn encoder)
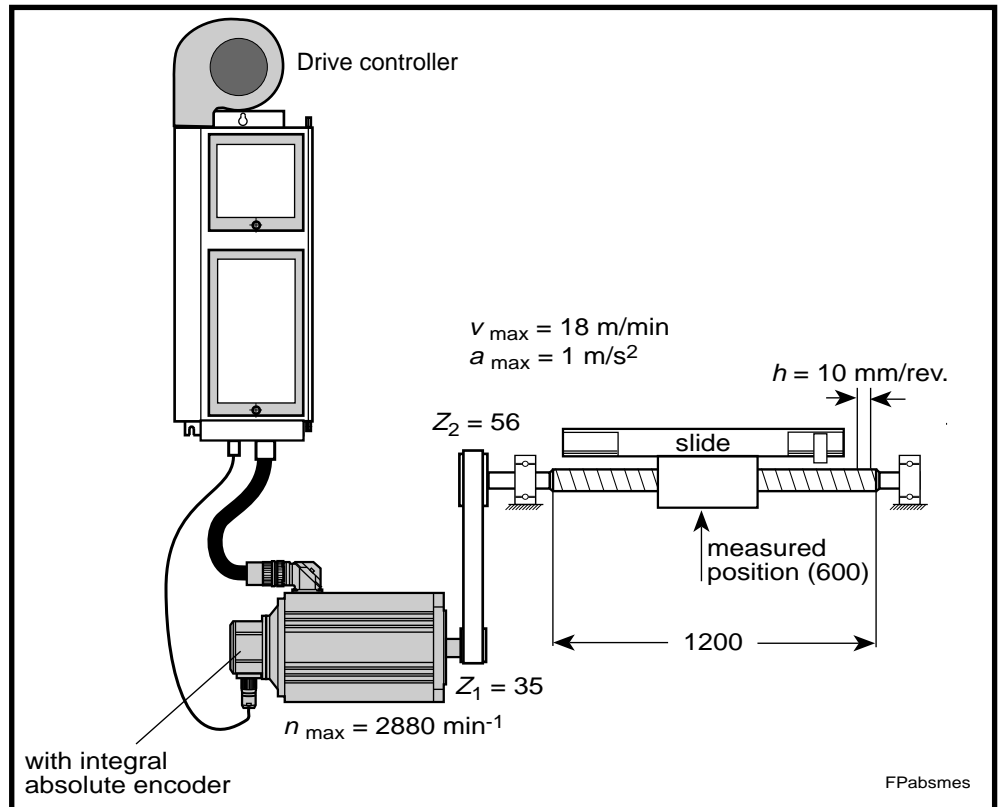
Fig 6.6: Linear axis with absolute position measurement

Setup mode parameter
The parameters needed for the setup mode are listed in the following section. All other parameters must be set to 00000000. There is a list of all parameters at the end of this section. Details on important parameters can be found in section 6.5.

Source of danger:	**Incorrect parameters input.**
Possible consequences:	**Possible damage to machine.**
How to avoid:	**Only personnel with machine expertise may input parameters.**

Warning

- **Check parameters with *. The values listed in the following parameter list only apply to Example 1. These must be adjusted to the machine.**

- **The speed control parameters marked with ** depend on the motor-controller combination, load and the machine mechanics. Set standard speed control parameters.**

- **Parameter overload factor marked with *** must be matched to the motor/controller combination. See setting overload factor.**

- **The machine manufacturer is responsible for the DLC parameters. These can only be changed with his permission.**

Name	Parameter	Input	Notes (for further details see section 6.5)
v_{max}	A100 *	000300.00	$v_{max} = \dfrac{n_{max}}{60} \bullet h \bullet \dfrac{Z_1}{Z_2} = \dfrac{2880 \text{min}^{-1}}{60} \bullet 10\text{mm} \bullet \dfrac{35}{56} = 300 \dfrac{\text{mm}}{\text{s}}$
v_{min}	A101 *	000030.00	e.g., 10% of v_{max} = 30 mm/s
Acceleration	A102 *	00001000	1000 mm/s^2
KV factor	A103 *	0000 01.00	
Switching threshold	A106 *	00 0000.10	
Feed constant	A108 *	0006.2500	$VK = h \bullet \dfrac{Z_1}{Z_2} = 10\text{mm} \bullet \dfrac{35}{56} = 6{,}25\text{mm}$
Direction	A109 *	0 0 000000	00 = clockwise rotation of motor effects positive feed 01 = counterclockwise rotation of motor effects negative feed
Homing setup parameter	A110	0 0 0 2 00 0 0	
Travel range minimum	A113 *	+ 000000.00	
Travel range maximum	A114 *	+ 000100.00	
Maximum speed	A121 *	2880 0000	$n_{max} = \dfrac{v_{max} \bullet 60}{h} \bullet \dfrac{Z_2}{Z_1} = \dfrac{300\text{mm} \bullet 60\text{s}}{\text{s} \bullet \text{min} \bullet 10\text{mm}} \bullet \dfrac{56}{35} = 2880 \text{min}^{-1}$
Monitoring	A122	0 0 00 0 010	
Interface	B003	0960 0 1 8 1	
Display	B007	00 02 0 0 00	02 = standard setting 03 = additional decimal places
Overload factor	C002 ***	00000200	
Monitoring Speed control loop	C005	00000001	
Absolute encoder Monitoring window	C006 *	0000.5000	
Absolute encoder Homing position	C007 *	0000.0000	
Error reaction	C008	00000000	
Current regulator: Amplification	C009 **	000012.00	
Speed controller: Amplification	C010 **	00001300	
Speed controller: Follow-up time	C011 **	0000020.0	
Speed controller: Smoothing	C012 **	00002000	

Fig 6.7: Parameter list for example 1 - linear axis with absolute position measurement

6.7. Example 2 - Linear Axis with Incremental Position Measurement (e.g., motors with digital DSF servo feedback)

Fig 6.8: Linear axis with incremental position measurement

Parameter for setup mode

The parameters needed for setup mode are listed below. All other parameters must be set to 00000000. There is a list of all parameters at the end of this section. Details on important parameters can be found in section 6.5.

Warning

Source of danger:	**Incorrect parameters input.**
Possible consequences:	**Possible damage to machine.**
How to avoid:	**Only personnel with machine expertise may input parameters.**

- **Check parameters with *. The values listed in the following parameter list only apply to Example 2. These must be adjusted to the machine.**

- **The speed control parameters marked with ** depend on the motor-controller combination, load and the machine mechanics. Set standard speed control parameters.**

- **Parameter overload factor marked with *** must be matched to the motor/controller combination. See setting overload factor.**

- **The machine manufacturer is responsible for the DLC parameters. These can only be changed with his permission.**

Name	Parameter	Input	Notes (for further details see section 6.5)
v_{max}	A100 *	000300.00	$$v_{max} = \frac{n_{max}}{60} \bullet h \bullet \frac{Z_1}{Z_2} = \frac{2880\,min^{-1}}{60} \bullet 10mm \bullet \frac{35}{56} = 300\frac{mm}{s}$$
v_{min}	A101 *	000030.00	e.g., 10% of v_{max} = 30 mm/s
Acceleration	A102 *	00001000	1000 mm/s^2
KV factor	A103 *	0000 01.00	
Switching threshold	A106 *	00 0000.10	
Feed constant	A108 *	0006.2500	$$VK = h \bullet \frac{Z_1}{Z_2} = 10mm \bullet \frac{35}{56} = 6.25mm$$
Direction	A109 *	0 0 000000	00 = clockwise rotation of motor effects positive feed 01 = counterclockwise rotation of motor effects positive feed
Homing setup parameter	A110 *	0 0 0 1 10 0 0	10 = Homing speed 10% of v_{max}
Homing setup parameter	A112 *	01 02 00 03	01 = start homing input 02 = Homing point switch input 03 = Output in reference
Maximum speed	A121 *	2880 0000	$$n_{max} = \frac{v_{max} \bullet 60}{h} \bullet \frac{Z_2}{Z_1} = \frac{300mm \bullet 60s}{s \bullet min \bullet 10mm} \bullet \frac{56}{35} = 2880\,min^{-1}$$
Monitoring	A122	0 0 00 0 010	
Interface	B003	0960 0 1 8 1	
Display	B007	00 02 0 0 00	02 = standard setting 03 = additional decimal places
Overload factor	C002 ***	00000200	
Monitoring Speed control loop	C005	00000001	
Error reaction	C008	00000000	
Current regulator: Amplification	C009 **	000012.00	
Speed controller: Amplification	C010 **	00001300	
Speed controller: Follow-up time	C011 **	0000020.0	
Speed controller: Smoothing	C012 **	00002000	

Fig 6.9: Parameter list for example 2 - linear axis with incremental position measurement

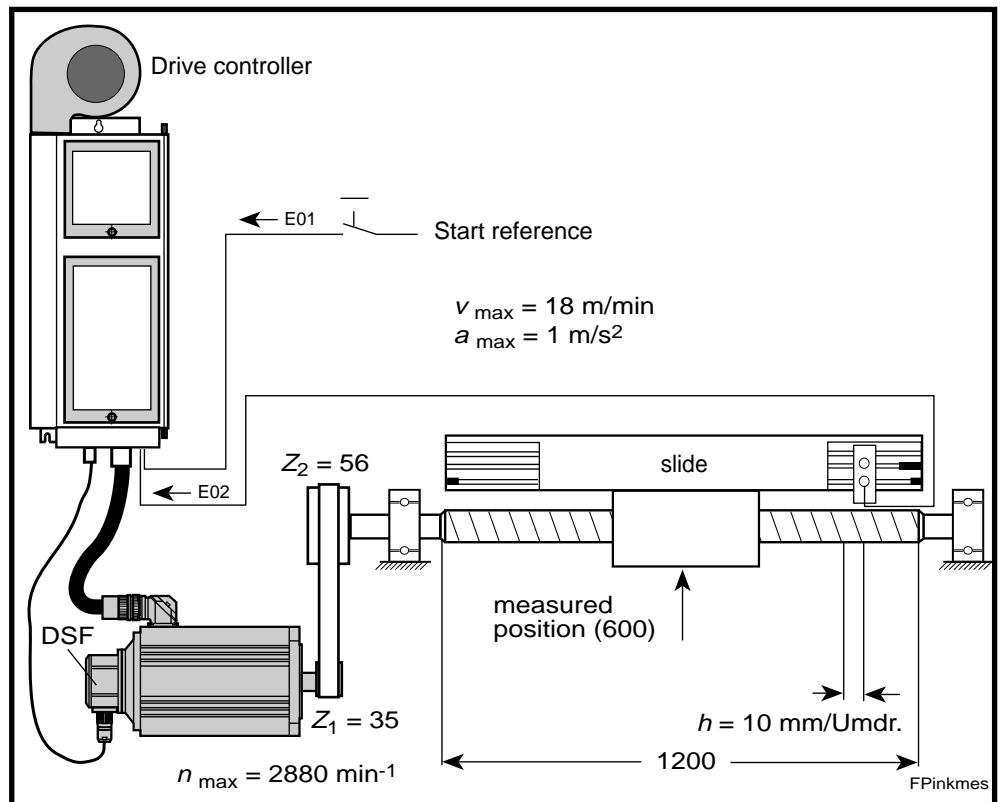## 6.8. Example 3 - Linear Axis with Direct Position Measurement

Fig 6.10: Linear axis with direct position measurement capabilities

Parameter for setup mode

The parameters needed for setup mode are listed below. All other parameters must be set to 00000000. There is a list of all parameters at the end of this section. Details on important parameters can be found in section 6.5.

Source of danger:	**Incorrect parameters input.**
Possible consequences:	**Possible damage to machine.**
How to avoid:	**Only personnel with machine expertise may input parameters.**

Warning

- **Check parameters with *. The values listed in the following parameter list only apply to Example 3. These must be adjusted to the machine.**

- **The speed control parameters marked with ** depend on the motor-controller combination, load and the machine mechanics. Set standard speed control parameters.**

- **Parameter overload factor marked with *** must be matched to the motor/controller combination. See setting overload factor.**

- **The machine manufacturer is responsible for the DLC parameters. These can only be changed with his permission.**

Name	Parameter	Input	Notes (for further details see section 6.5)
v_{max}	A100 *	000240.00	$v_{max} = \dfrac{n_{max}}{60} \bullet h \bullet \dfrac{Z_1}{Z_2} = \dfrac{2880\,min^{-1}}{60} \bullet 10mm \bullet \dfrac{29}{58} = 240\dfrac{mm}{s}$
v_{min}	A101 *	000024.00	e.g., 10% of v_{max} = 24 mm/s
Acceleration	A102 *	00001000	1000 mm/s^2
KV factor	A103 *	0000 01.00	
Switching threshold	A106 *	00 0000.10	
Feed constant	A108 *	0006.2500	$VK = h \bullet \dfrac{Z_1}{Z_2} = 10mm \bullet \dfrac{29}{58} = 5mm$
Direction	A109 *	0 0 000000	00 = clockwise rotation of motor effects positive feed 01 = counterclockwise rotation of motor effects positive feed
Homing setup parameter	A110 *	0 0 0 1 10 0 0	10 = homing speed 10% of v_{max}
Homing setup parameter	A112 *	01 02 00 03	01 = start homing input 02 = homing point switch input 03 = output in reference
Maximum speed	A121 *	2880 0000	$n_{max} = \dfrac{v_{max} \bullet 60}{h} \bullet \dfrac{Z_2}{Z_1} = \dfrac{240mm \bullet 60s}{s \bullet min \bullet 10mm} \bullet \dfrac{58}{29} = 2880\,min^{-1}$
Monitoring	A122	0 0 00 0 010	
Following axis	A123 *	5 1 0 0 20 00	51 = external encoder 1 (mit DEF 1.1) 20 = permissible deviation in % between motor and external encoders
Display	B007	00 02 0 0 00	02 = standard setting 03 = additional decimal places
external encoder 1	B016*	1 0 0 00000	100 = working direction of motor and external encoder same 101 = working direction of motor and external encoder not the same
external encoder 1 pulse	B017 *	000 01250	$B017 = \dfrac{feed\ constant}{divisional\ period} \bullet pulse\ replication = \dfrac{5mm}{0.02mm} \bullet 51250$
external encoder 1 VK	B018 *	0005.0000	$VK = h \bullet \dfrac{Z_1}{Z_2} = 10mm \bullet \dfrac{29}{58} = 5mm$
external encoder 1 offset	B019	00000000	in preparation
Overload factor	C002 ***	00000200	
Monitoring Speed control loop	C005	00000001	
Error reaction	C008	00000000	
Current regulator: Amplification	C009 **	000012.00	
Speed controller: Amplification	C010 **	00001300	
Speed controller: Follow-up time	C011 **	0000020.0	
Speed controller: Smoothing	C012 **	00002000	

Fig 6.11: Parameter list for example 3 - linear axis with direct position measurement

6.9. Example 4 - Rotary Table with Incremental Position Measurement

$n_{table} = 25$ min^{-1}

Homing switch

Start reference

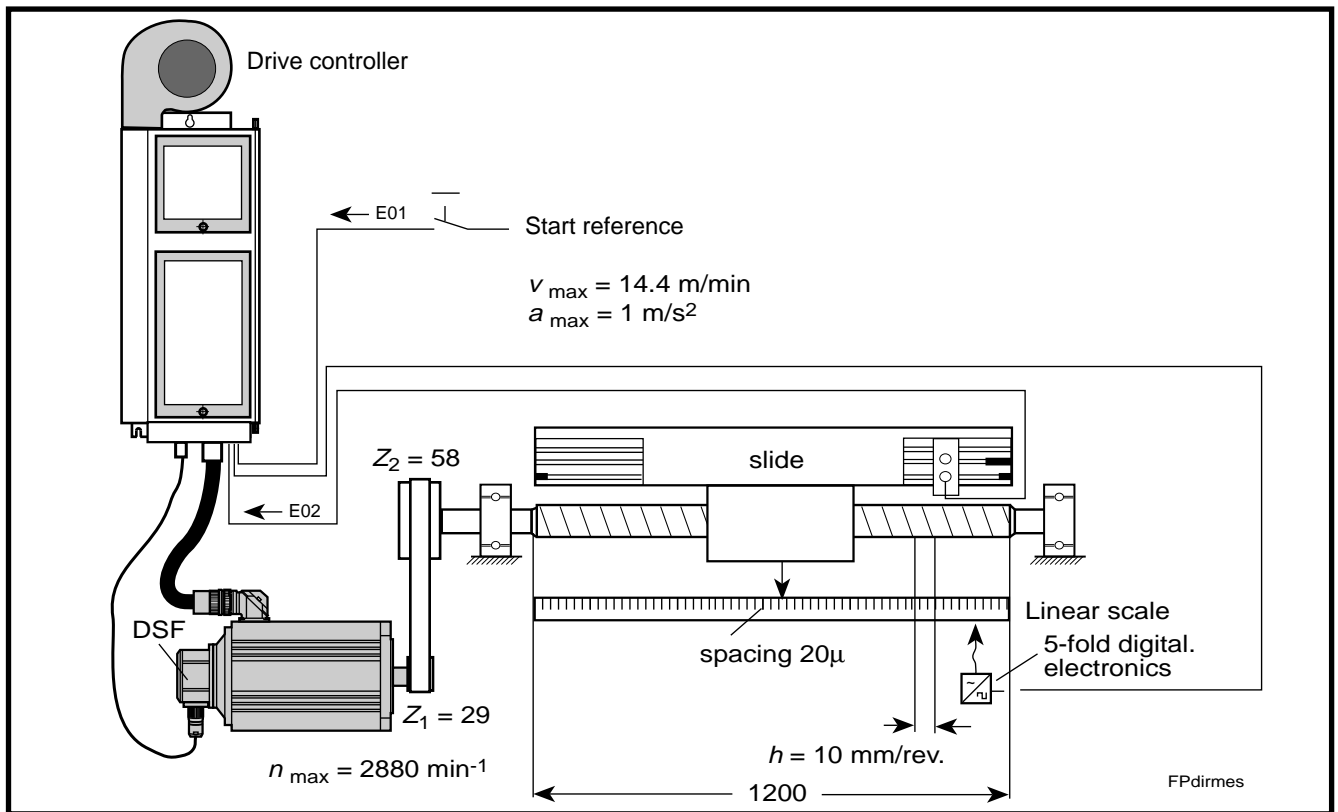$i = 120$
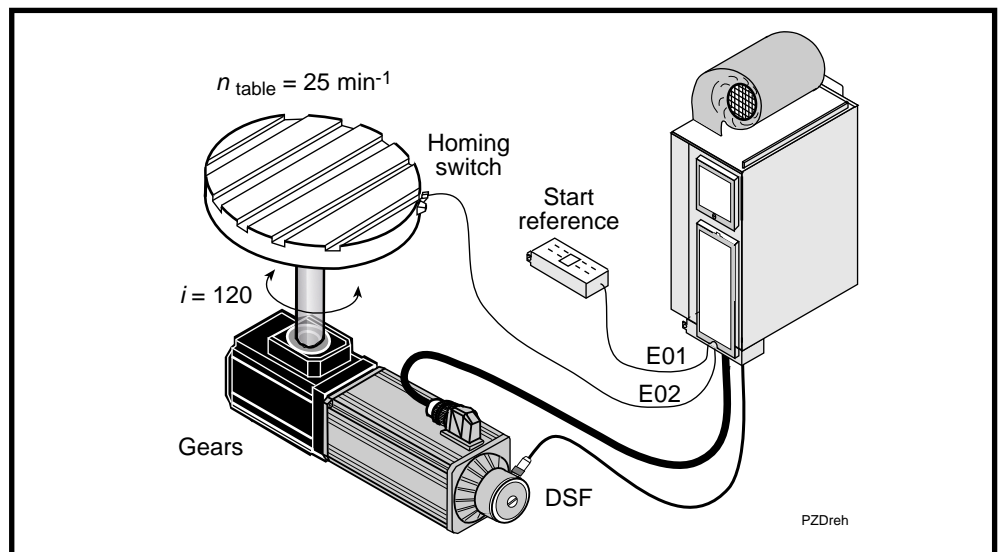
E01

E02

Gears

DSF

PZDreh

Fig 6.12: Linear axis with incremental position measurement capabilities

Parameter for setup mode

The parameters needed for setup mode are listed below. All other parameters must be set to 00000000. There is a list of all parameters at the end of this section. Details on important parameters can be found in section 6.5.

Warning

| Source of danger: | **Incorrect parameters input.** |

Possible consequences: Possible damage to machine.

How to avoid: **Only personnel with machine expertise may input parameters.**

- **Check parameters with *. The values listed in the following parameter list only apply to Example 4. These must be adjusted to the machine.**

- **The speed control parameters marked with ** depend on the motor-controller combination, load and the machine mechanics. Set standard speed control parameters.**

- **Parameter overload factor marked with *** must be matched to the motor/controller combination. See setting overload factor.**

- **The machine manufacturer is responsible for the DLC parameters. These can only be changed with his permission.**

Name	Parameter	Input	Notes (for further details see section 6.5)
v_{max}	A100 *	000300.00	$$v_{max} = \frac{n_{tisch}}{60} \bullet 360° \bullet \frac{Z_1}{Z_2} = \frac{25min^{-1}}{60s} \bullet 360° \bullet \frac{35}{56} = 150\frac{°}{s}$$
v_{min}	A101 *	000015.00	e.g., 10% of v_{max} = 15 degrees/s
Acceleration	A102 *	00001000	1000 degree/s^2
KV factor	A103 *	0000 01.00	
Switching threshold	A106 *	00 000.100	
Feed constant	A108 *	360.00000	$$VK = \frac{360°}{\text{Table rotation}}$$
Direction	A109 *	0 0 000000	00 = clockwise rotation of motor effects positive feed 01 = counterclockwise rotation of motor effects positive feed
Homing setup parameter	A110 *	0 0 0 1 10 0 2	10 = homing speed 10% of v_{max}
Homing setup parameter	A112 *	01 02 00 03	01 = start homing input 02 = homing point switch input 03 = output in reference
Maximum speed	A121 *	3000 0000	$n_{max} = n_{tisch} \bullet i = 25min^{-1} \bullet 120 = 3000min^{-1}$
Monitoring	A122	0 0 00 0 010	
Display	B007	00 03 0 0 00	02 = standard setting 03 = additional decimal places
Overload factor	C002 ***	00000200	
Monitoring Speed control loop	C005	00000001	
Error reaction	C008	00000000	
Current regulator: Amplification	C009 **	000012.00	
Speed controller: Amplification	C010 **	00001300	
Speed controller: Follow-up time	C011 **	0000020.0	
Speed controller: Smoothing	C012 **	00002000	

Fig 6.13: Parameter list for example 4 - Rotary table with incremental position measurement

6.10. Parameter List for the Machine Documents

☞ **As a result of a fault, parameters could be cleared. We recommend that a completely filled out copy of this parameter list be filed with the machine documentation so that the machine could be made operational in this case as quickly as possible.**

Customer: :

Machine no.:   :

Axis designation: :

DLC software status: :

Name	Parameter	Input	Notes
v_{max}	A100	S a a a a a a a a	
v_{min}	A101	S a a a a a a a a	
Acceleration	A102	S a a a a a a a a	a only if B007 = 0* 03
KV factor	A103	S a a a a a a a	
Encoder	A104	S a a a a a a a	
free	A105	S a a a a a a a	
Switching threshold	A106	S a a a a a a a	
Preliminary signal	A107	S a a a a a a a a	a only if B007 = 0* 03
Feed constant	A108	S a a a a a a a a	
Direction	A109	S a a a a a a a	
Homing setup parameter	A110	S a a a a a a	
Homing offset	A111	S a a a a a a a a	
Homing setup parameter	A112	S a a a a a a a	
Travel range minimum	A113	S a a a a a a a a a	
Travel range maximum	A114	S a a a a a a a a a	
Special function	A115	S a a a a a a a	
Rotary table	A116	S a a a a a a a	
Break point	A117	S a a a a a a a a	a only if B007 = 0* 03
free	A118	S a a a a a a a	
free	A119	S a a a a a a a	
Feed monitoring	A120	S a a a a a a a	
Maximum speed	A121	S a a a a a a a	
Monitoring	A122	S a a a a a a a	
Following axis	A123	S a a a a a a a	
free	A124	S a a a a a a a	
free	A125	S a a a a a a a	
Continued on next page			

Name	Parameter	Input	Notes
free	B000	S a a a a a a a	
free	B001	S a a a a a a a	
free	B002	S a a a a a a a	
Interface	B003	S a a a a a a a	
Interface	B004	S a a a a a a a	
Storage display	B005	S a a a a a a a	
Start Task 2 & 3	B006	S a a a a a a a	
Display	B007	S a a a a a a a	
free	B008	S a a a a a a a	
free	B009	S a a a a a a a	
free	B010	S a a a a a a a	
Hand vector	B011	S a a a a a a a	
Interrupt vector	B012	S a a a a a a a	
Override	B013	S a a a a a a a	
Restart vector	B014	S a a a a a a a	
free	B015	S a a a a a a a	
external encoder 1	B016	S a a a a a a a	
Ext. enc. 1 pulse	B017	S a a a a a a a	
Ext. enc. 1 VK	B018	S a a a a a a a a	
Ext. enc. 1 offset	B019	S a a a a a a a	
external encoder 2	B020	S a a a a a a a	
Ext. enc. 2 pulse	B021	S a a a a a a a	
Ext. enc. 2 VK	B022	S a a a a a a a a	
Ext. enc. 2 Offset	B023	S a a a a a a a	
Analog output: channel 1	C000	S a a a a a a a	
Analog output: channel 2	C001	S a a a a a a a	
Overload factor	C002	S a a a a a a a	
Scaling: position data	C003	S a a a a a a a a	
Scaling: speed data	C004	S a a a a a a a	
Monitoring speed control loop	C005	S a a a a a a a	
Absolute encoder monitoring window	C006	S a a a a a a a a	
Absolute encoder homing position	C007	S a a a a a a a a	
Error reaction	C008	S a a a a a a a	
Current regulator: Amplification	C009	S a a a a a a a a	
Speed controller: Amplification	C010	S a a a a a a a	
Speed controller: Follow-up time	C011	S a a a a a a a a	
Speed controller: Smoothing	C012	S a a a a a a a	
Release: external brake control	C013	S a a a a a a a	

Fig 6.14: Parameter list for machine documentation file

6.11. Parameter Input Limits

Parameter	Designation		Min. data	Max. data
A100	Maximum speed	EGE/sec	0 0 0 0 0 0 1 0	0 5 0 0 0 0 0 0
A101	Setup speed	EGE/sec	0 0 0 0 0 0 1 0	0 5 0 0 0 0 0 0
A102	Acceleration	EGE/sec^2	0 0 0 0 0 0 1 0	9 9 9 9 9 9 9 9
A103	KV factor		0 0 0 0 0 0 0 1	0 0 0 0 3 0 0 0
A106	Switching threshold	EGE	0 0 0 0 0 0 0 1	0 0 9 9 9 9 9 9
A108	Feed constant	EGE	0 0 0 0 1 0 0 0	5 0 0 0 0 0 0 0
A111	Zero offset	EGE	0 0 0 0 0 0 0 0	0 9 9 9 9 9 9 9
A113	Minimum traversing range limit	EGE	0 0 0 0 0 0 0 0	9 9 9 9 9 9 9 9
A114	Maximum traversing range limit	EGE	0 0 0 0 0 0 0 0	9 9 9 9 9 9 9 9
A116	Rotary table		0 0 0 0 0 0 0 1	0 0 0 0 9 9 9 9
A117	Break point	EGE/sec^2	0 0 0 0 0 0 0 1	0 0 9 9 9 9 9 9
A121	Drive sensitivity		0 0 0 1 0 0 0 0	9 9 9 9 0 0 0 0
A122	Position monitoring window		0 0 0 0 0 0 0 1	0 0 0 0 0 1 0 0
B017	external encoder 1 pulse		0 0 0 0 0 1 0 0	0 0 0 2 0 0 0 0
B018	external encoder 1 feed constant	EGE	0 0 0 0 1 0 0 0	5 0 0 0 0 0 0 0
B021	external encoder 2 pulse		0 0 0 0 0 1 0 0	0 0 0 2 0 0 0 0
B022	external encoder 2 feed constant	EGE	0 0 0 0 1 0 0 0	5 0 0 0 0 0 0 0
C002	Overload ...		0 0 0 0 0 0 0 0	0 0 0 0 0 4 0 0
C006	Absolute encoder - monitoring...		0 0 0 0 0 0 0 0	4 0 9 5 9 8 9 7
C007	Absolute encoder homing position		0 0 0 0 0 0 0 0	4 0 9 5 9 9 9 9

Fig 6.15: Parameter input limits

7.   Commissioning

Prior to starting up the drive it is necessary to program both the drive para-meters and the DLC controller parameters. See section 6 for details.

Switch power on for inputting parameters.

Danger

Source of danger:	**High voltage levels.**
Possible consequences:	**Danger to life and limb.**
How to avoid:	• **Observe the following points and warning guideli-nes in section 6.3.**
	• **After installation, check that the permanent con-nections of the grounded conductors in all elec-trical equipment are as per the connection diagram.**
	• **Wait the capacitor discharge time. This equals about five minutes. Then access the points of contact.**
	• **Do not touch the eletrical point of contacts of any components if current is being conducted.**
	• **Leakage current exceeds 3mA. Thus, never ope-rate drive unless protective conductor is connec-ted.**
	• **Only operate drive controller when closed.**

7.1.   Powering Up

Switching into Setup Mode

If there is no on signal at the parameter and automatic outputs, then setup mode is on. The following messages are displayed if there are no faults:

CTA display: ready to operate

H1 DDC: bb

Checking E-Stop Sequence

Check to make sure that all switches and circuits of the E-stop sequence are functional. If the E-stop sequence is open, then it should not be possible to switch the power contactor in the drive controller on. The message "E-stop" must appear on the CTA display (press the key ⌷cl of CTA to clear the fault message).

Switching On the Power

The mains contactor in the DDC can be switched on if the wiring has been laid out as per the INDRAMAT terminal connecting diagram and the E-stop sequence is closed. An error can immediately cause dangerous drive movements. The following instructions must be observed.

Danger

Source of danger:	**Dangerous movements**
Possible consequences:	**Danger to life and limb and property damage.**
How to avoid:	**The protection of personnel must be secured in the plant by taking superordinate steps. These steps are plant-specific and must be determined by the manufacturer after an analysis of the possible dangers and faults. Observe all safety instructions of the plant.**

Observe the following in particular:

- **Personnel must be kept clear of the machine movement range. Possible measures to prevent personnel unintentionally accessing the machine are protective fences, protective railings, protective coverings and light curtains or barriers.**

- **Fences and coverings should be strong enough to withstand maximum possible momentum.**

- **E-stop switches must be mounted in the immediate vicinity of the operator so these can be easily reached. Check that the E-Stop sequence works before starting up.**

- **Make sure the drives are brought to a standstill before accessing or entering the danger zone.**

- **Avoid operating high-frequency, remote control and radio equpment near the equipment electronics and supply leads. If use of such a unit cannot be avoided, check the system and the plant for possible malfunctions at all positions of normal use before the first start-up. If necessary, carry out a special EMC test on the plant.**

- **Do not use a very high setup speed (parameter A101). The user must be able to bring the plant or machine to a standstill with the use of the E-stop switch and before serious damage can occur.**

Power is switched on

Message displayed with power on.

CTA display:	drive enable
H1 DDC:	AF

7.2. Check the Traversing Direction (Working Direction) of the Feed Axis

Depending upon the construction of the machine, the motor must rotate in either a clockwise or counterclockwise direction to move the forward feed unit in a positive direction.

Parameter **A109** is used to match the rotational direction of the motor to the prevailing mechanical conditions.

Caution

Source of danger:	**A command to move can cause the machine to move in the opposite direction.**
Possible consequences:	**Damage to machine can ensue.**
How to avoid:	• **Maintain sufficient distance to the limit stop.**
	• **The machine operator must be able to trigger the E-stop in time.**

Check Traversing Direction

With a positive signal at input "jog forward" of the DEA 4.1 (X17/6) there must also be a positive machine feed response. If there is a negative feed, then adjust parameter A109.

Command:	jog forward
Results:	negative feed
Measure:	A109 of 0 0 000 000 to 0 1 000 000

7.3. Establishing a Reference Dimension

Incremental position measuring system

If an incremental position measuring system is used, i.e., either DSF or a linear scale, then it is necessary to run a homing cycle each time the control voltage is swtiched on. See setions 8,.1 and 8.2 for details.

Absolute position measuring system

A reference dimension must only be established once in the case where an axis with a multiturn encoder (MTG) is started up. It is not necessary to run a homing cycle each time the control voltage is switched on. See section 8.3.

7.4. Determining Short-Term Torque - Setting the Overload Factor

Short-term torque

The short-term torque M_{KB} of the drive must be set with parameter C002 „Overload factor" .

The standard value of the motor/drive combination generally used is listed in the selection data of the document entitled „DDC with MDD", doc. no. 209-0069-4368-XX.

If a short-term torque other than that listed should be needed, then it is possible to determine this "overload factor" by means of the following relationship.

> **The parameter „Overload factor" affects the values listed in the selection data for torque M_{max} and M_{KB} and ON time ED.**
>
> **If the settings are higher than those listed in the selection data, then the values for**
>
> **• ON time ED and**
>
> **• possibly the acceleration capabilities of the drive**
>
> **are reduced.**

Overload factor The following applies to the overload factor:

$$\text{ÜF} \approx \frac{\boldsymbol{M_{KB}}}{\boldsymbol{M_{dN}}} \bullet \mathbf{100\%}$$

ÜF = C002 overload factor in %

M_{KB} = short-term torque in Nm

M_{dN} = continuous torque at standstill in Nm

ON time ED The ON time for short-term torque is listed in the selection data of „DDC with MDD", doc. no. 209-0069-4368-XX. ON time, ED, is calculated as shown below if shorter short-term torques are required:

$$\text{ED} = \left(\frac{\boldsymbol{M_{KB}}}{\boldsymbol{M_{dN}}}\right)^{\mathbf{2}} \bullet \mathbf{100\%}$$

ED = ON time in %

M_{KB} = short-term torque in Nm

M_{dN} = continuous torque at standstill in Nm

Continuous standstill torque

The servo motor can output a continuous standstill torque during continuous operations

- of up to 25 % of nmax (maximum NC usable speed) and
- up to an ambient temprature of 45°C.

In accordance with the thermal time constant, the motor housing will achieve a temperature of 60K. To accomodate higher rpms, see the relevant motor operating curve for the continuous torque.

7.5. Error Reaction

The drive response in the event of a **drive error** can be set with digital drive controllers. Three responses are possible.

Possible error reactions with drive errors

- Braking at maximum torque with automatic powering down - Error reaction 1
- Braking at maximum torque without automatic powering down - Error reaction 2
- Torque disconnect without automatic power disconnect - Error reaction 3

Error reaction selection

Error reaction	Drive reaction with a drive error
0	• Braking at maximum torque • Torque disconnect of drive after 500 ms • Automatic power disconnect • Ready to operate Bb (X8 - 7/8) opens • Holding brake applied at n > 10min^{-1} but no more than 400 ms
1	• Braking at maximum torque • Torque disconnect of drive after 500 ms • No automatic power disconnect • Ready to operate Bb (X8 - 7/8) opens • Holding brake applied at n > 10min^{-1} but no more than 400 ms
2	• Drive immediately goes torque-free • No automatic power disconnect • Ready to operate Bb (X8-7/8) opens • Holding brake applied immediately

Fig 7.1: Drive reactions with drive errors

Caution

Source of danger:	**The holding brake wears down after 20,000 revolutions against the closed holding brake.**
Possible consequences:	**Machine could be damaged.**
How to avoid:	**Do not set in motors with holding brake error reaction 2.**

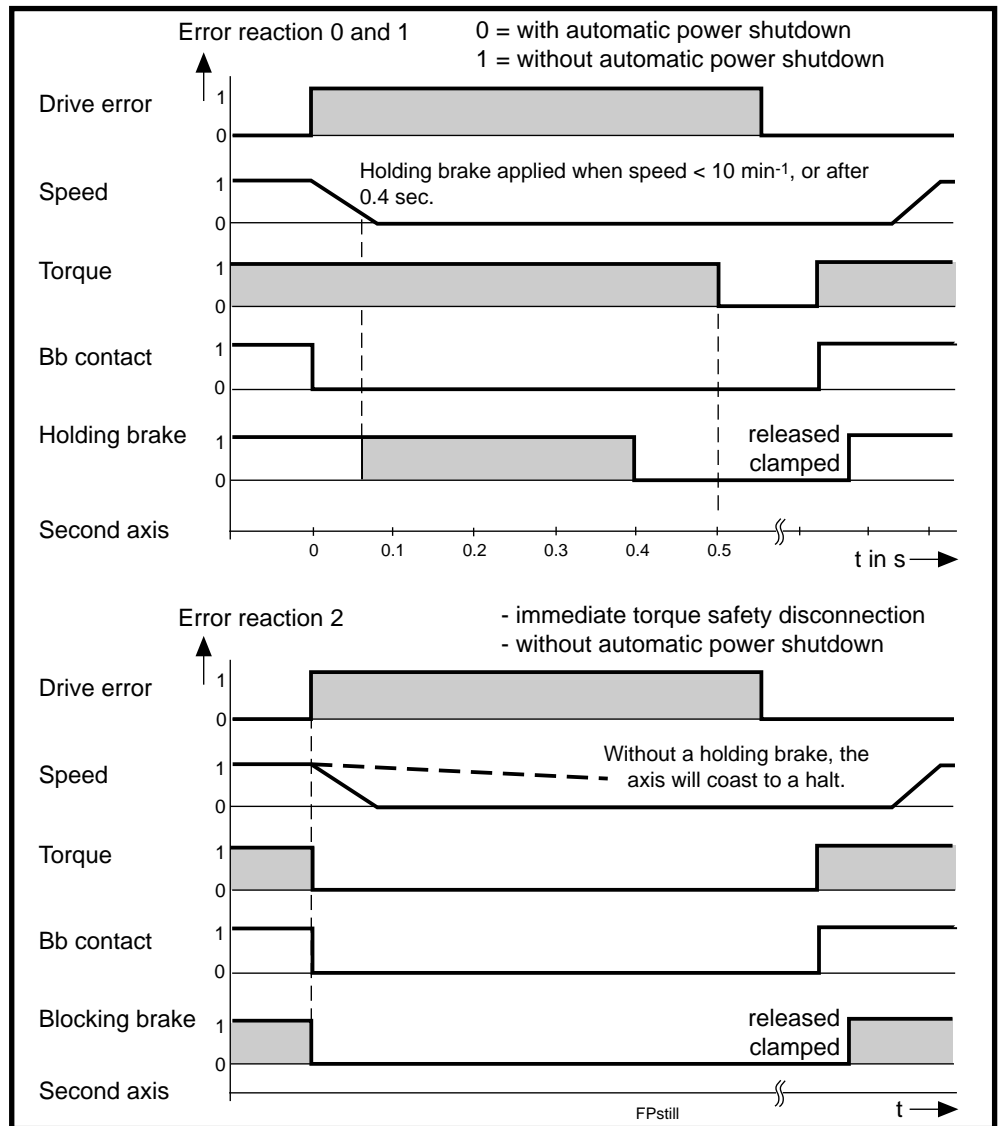*Bringing the drive to a standstill in terms of the error reaction*

Fig 7.2: Bringing the drive to a standstill depending on the error reaction

Caution

Source of danger:	**The following errors do not permit a defined standstill of the drive.**
Possible consequences:	**Machine damage is possible.**
How to avoid:	**Apply DC bus dynamic brake. See DDC1.1 Project Planning Manual, doc. no. 209-4381-XX for details.**

Error number	Name
22	motor encoder error
24	overcurrent
25	overvoltage
60	bridge fuse
61	earth fault fuse
67	hardware synchronization faulty
69	± 15V error
70	± 24V error
71	± 10V error
72	± 8V error
73	voltage source driver stage

Fig 7.3: Error number

The errors that are detected in the DLC single-axis positioning module (error in the position control loop), are always braked to a standstill at maximum possible motor torque regardless of the error reaction which has been set. Power is not shutdown.

DLC Error Messages

List of the DLC Error Messages	
absolute encoder error	no power
axis switched off 1	maximum limit switch 1
axis number incorrect	maximum override A1
W-Dog drive	minimum limit switch 1
battery empty	positive feedback
operting mode	not setup 1
division error	E-stop
DPR illegible	zero point switch 1
store block number	parameter loss
external encoder	position monitoring 1
error input parameter	program loss
HOM - command A1	RTS nesting
IDS break error	SAC command
IDS format length	lag error
IDS format sign	software combination
IDS checksum error	a non-permissible block
illegal command	feed monitor 1
JSR nesting	WRITE command
no BCD Input	target position < limit 1
configuration	target position < limit 1
no zero pulse 1	system error 1

Fig 7.4: List of DLC error messages

Setting error reaction
- Switch operating mode parameter on
- with ☐ select parameter block
- call up parameter C008
- input error reaction
- press ⊜

7.6. Check Motor Holding Brake

To keep suspended axes from slumping, it is necessary to use motors with integrated holding brakes.

⚠️

Warning

Source of danger:	**The motor holding brake is not a working brake. It wears down after 20,000 revolutions against the closed brake.**
Possible consequences:	**Damage can be caused by slumping feed axes.**
How to avoid:	• **Use INDRAMAT drive controllers only to control the motor holding brake.**
	• **When projecting the machine, make sure that the braking time of the drive does not exceed 0.4 seconds. Use a service brake for longer braking periods.**
	• **Do not set error reaction 2 in motors with holding brakes.**

Holding brake function   To release the holding brake, apply + 24V DC. The holding brake is clamped with a power disconnect.

An INDRAMAT drive controller controls the holding brake. The set error reaction affects the control of the holding brake.

Control of holding brake as depends on error reaction

1) The blocking brake is immediately applied is error reaction 2 is set.
The motor is immediately switched torque free.

2) Error reaction 0 :
The blocking brake is applied when rpm falls below 10 min^{-1}, but no later than 400 ms

3) The automatic program can be started 300 ms after the UC contact has closed.

4) The UD contact opens with error reaction 1 and 2 only, if the Bb contact is switched into the E-stop loop.

FPDDChb

Fig 7.5: Control of the holding brake depending on the error reaction

Check holding brake load

- Call up parameter C 001
- Input 0000 0000.
- Switch on setup mode.
- The release of the holding brake must be audible.
- Measure the voltage at analog output channel 2 (X3-3/4) with motor at standstill.
- Calculate load torque.

$$M_\text{L} = \frac{U_\text{AK2}}{10V} \bullet I_\text{typ} \bullet K_\text{m}$$

M_L = load torque in Nm

U_AK2 = voltage at analog output channel 2 in V

I_typ = rated current in A of equipment

K_m = torque constant in Nm/A

Load torque should not exceed 70% of the rated torque of the motor holding brake as is specified in the data sheet.

Manual release of the holding brake

If the feed axis is, for example, to be manually moved during a start-up, then the holding brake can be released by applying 24V DC.

⚠️ Warning

Source of danger:	**Danger of unintentional machine motions.**
Possible consequences:	**Injury and machine damage from slumping feed axis.**
How to avoid:	**Secure suspended axes against unintentional motion.**

Release holding brake:
- Pull out motor connector
- Apply 24V DC to the holding brake connections
- +24V at pin F of the motor connector
- 0 V at pin G of the motor connector - use separate motor connector.
- The release of the holding brake must be audible.
- Reclamp the holding brake after moving the axis.

7.7. Parametrizing the Speed Controller

Standard speed controller parameters are stored in the motor feedback of the MDD motor. These standard speed controller parameters suffice for most applications. The speed controller does not generally need to be adapted.

Standard speed controller parameters can be set with the use of a PC (emulation software DDS2PC required) or via the CTA programming and display unit.

Setting standard speed controller parameters with a CTA

- switch operating mode parameter on
- press ☐ until parameter block C 100 is displayed
- enter 5301
- press ⟨⟨⟩⟩

Speed controller-Parameter adaption

If feed axes do not meet the demands required for stability, then the causes are generally to be found in the mechanical system of the machine. The unfavorable affects of batches that are too large, lack of sufficient rigidity or extrinsic moments of inertia that are excessive can, under some circumstances, be reduced by a correctly adapted speed controller parameter. Only by reworking the construction of the machine can the time-consuming task of adapting the speed controller be avoided.

⚠️ Caution

Source of danger:	**Incorrectly matched speed controller parameters affect the mechanical system of the machine.**
Possible consequences:	**Poor results, reduced service life of the machine, and possible damage to the machine.**
How to avoid:	**Speed controller parameters may only be set by qualified personnel.**

Overview of the Speed Controller Parameters

Speed controller parameter	Parameter number
Speed controller proprotional amplification K_{pw} [mA / (rad/s)]	C 010
Speed controller follow-up time T_N [ms]	C 011
Smoothing time constant T_{GL} [µs]	C 012

Fig 7.6: Overview of speed controller parameters

$$1) \quad K_I = \frac{K_{P\,\omega}}{T_N}$$

$K_{P\,\omega}$: speed controller proportional gain
T_{GL} : smoothing time constant
T_N : speed controller follow-up time
K_P : current controller proportional gain
K_I : integral gain
ω_{soll} : command value motor rpm
ω_{ist} : actual value motor rpm
I_{ist} : actual value motor current
I_{soll} : command value motor current
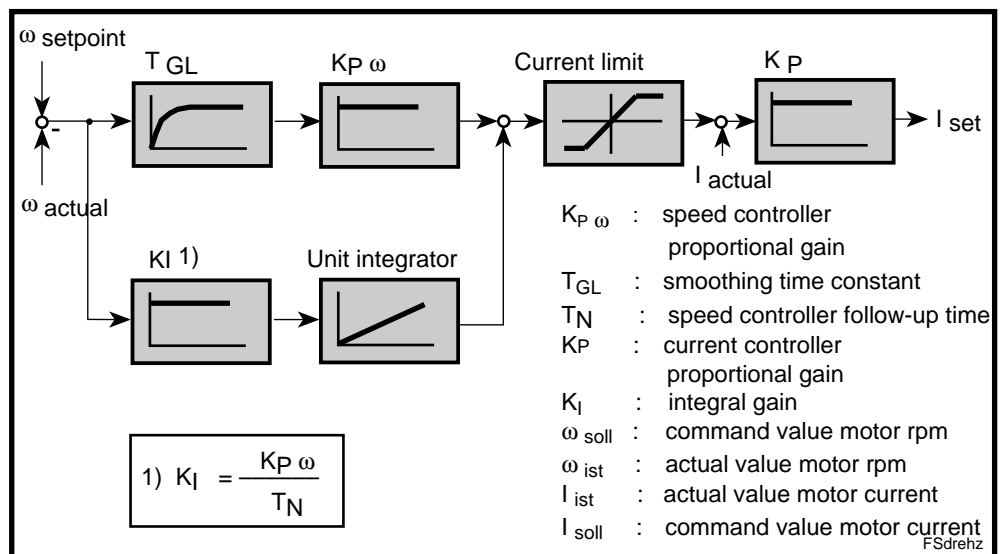
Fig 7.7: Speed controller - terminal diagram

Smoothing time constant The smoothing time constant can be used
- to suppress the quantization effects in the detection of the actual speed value and
- to filter the resonance frequency caused, e.g., by coupling.

The smallest input value is 250 µs. This means that the smoothing time constant is switched off.

Current regulator Do not change the standard current regulator parameter.

⚠

Caution

Source of danger:	**Damage to drive controller as a result of incorrect set current regulator (parameter C009).**
Possible consequences:	**The drive controller can be thermally damaged.**
How to avoid:	**Do not change the standard parameter set by INDRAMAT.**

7.8. Check Drive Load

To check drive load and the mechanical system of the machine, measure motor current at feed velocity, in rapid traverse and during acceleration.

The motor current can be measured at analog output channel AK2 (X3-3/4). In parameter C 001, 0000 0000 must be programmed. Load torque can be calculated using the motor current.

$$M_L = \frac{U_{AK2}}{10V} \bullet I_{typ} \bullet K_m$$

M_L = load torque in Nm

U_{AK2} = voltage at analog output channel 2 in V

I_{typ} = rated current in A of machine

K_m = torque constant in Nm/A

Load torque at feed velocity Do not exceed 60% of the continuous torque of the motor during standstill and at maximum feed velocity.

Causes of excessive load torque:
- axis clamp has not been released
- insufficient lubricant
- blocking brake not released - check connection
- weight counterbalance not sufficient
- recirculating ball screw sluggish
- too much tension in slideways

Load torque in rapid traverse Do not exceed 75 % of the continuous torque of the motor when in rapid traverse.

Load torque during acceleration   The current limit of the drive controller should not respond when the drive is either accelerating or decelerating. Reduce acceleration is necessary (parameter A 102).
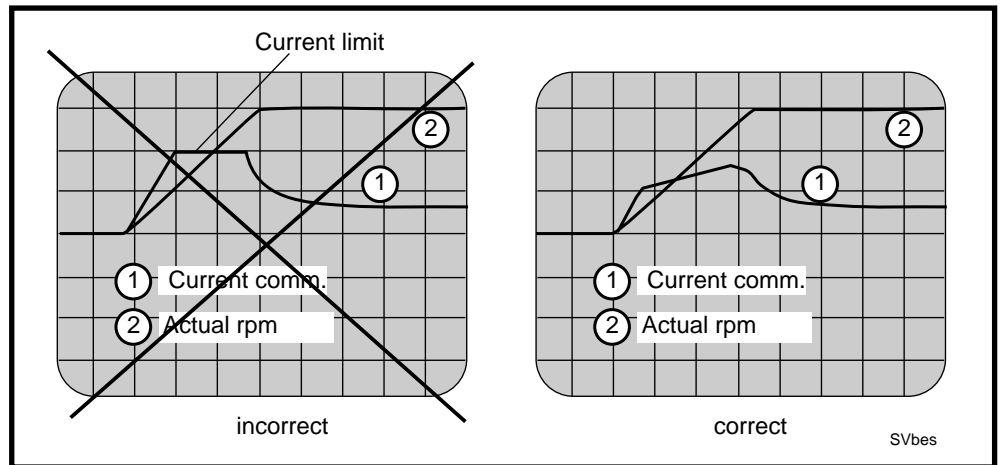
Fig 7.8: Current path during acceleration

Weight counterbalance   Set weight counterbalance so that the drive pulls the same current in both directions.

Continuous regenerative power   Run the machine for at least 15 minutes with that load cycle with which the highest continuous feedback power can be anticipated, i.e., short cycle time, highest motor speed or greatest number of delays. Bleeder overload shutdown may not occur. If the bleeder prewarning contact opens, or the message "bleeder overtemperature warning" (error 52) is signalled, then approximately 75% of the continuous regenerative power is achieved.

7.9.   Securing Data

As a result of an error, either parameters or the program can be erased. It is thus recommended that data be secured outside of the drive controller itself as well.

On disk or harddrive   With the editor and comminications program „Motion-Manager" it is possible to easily store parameters and program on either the disk or the hard drive.

Parameter list   We recommend filing a complete copy of the parameter list, as shown in section 6, with the documents of the machine.

8. Functions of the DLC Single-Axis Positioning Module

8.1. Homing a Linear Axis with Indirect, Relative Position Detection (e.g., DSF digital servo feedback)

Axes with relative position detection, e.g., the DSF, must be equilibrated to a machine reference point once the distribution voltage is switched on.

Referencing prerequisites
- The safety limit switch must be in the E-stop sequence
- Reference switch connected to DEA 4 and checked
- Parameters A 110 and A 112 programmed
- No interference contour (workpiece) between current position and reference switch
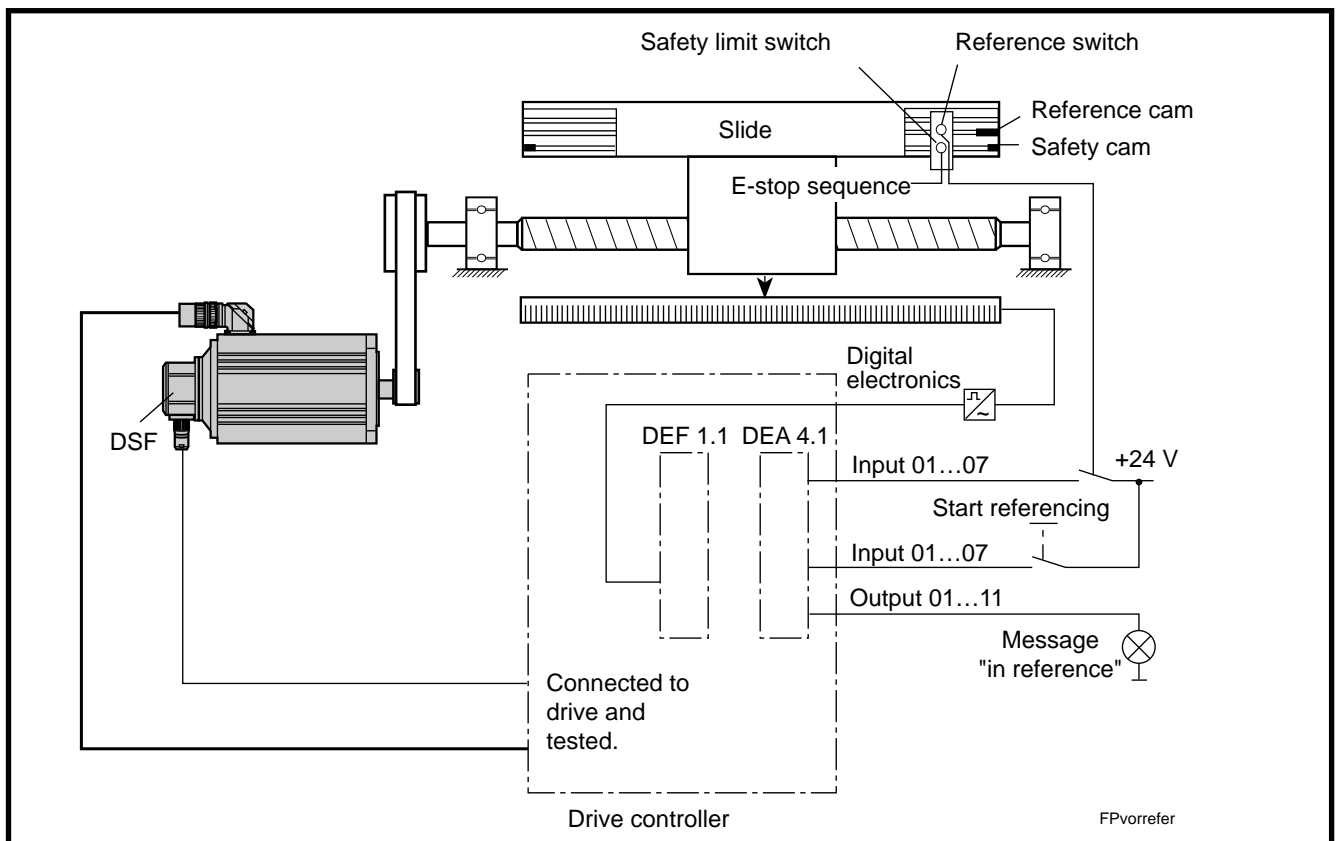- Conduct drive start-up as outlined in section 7
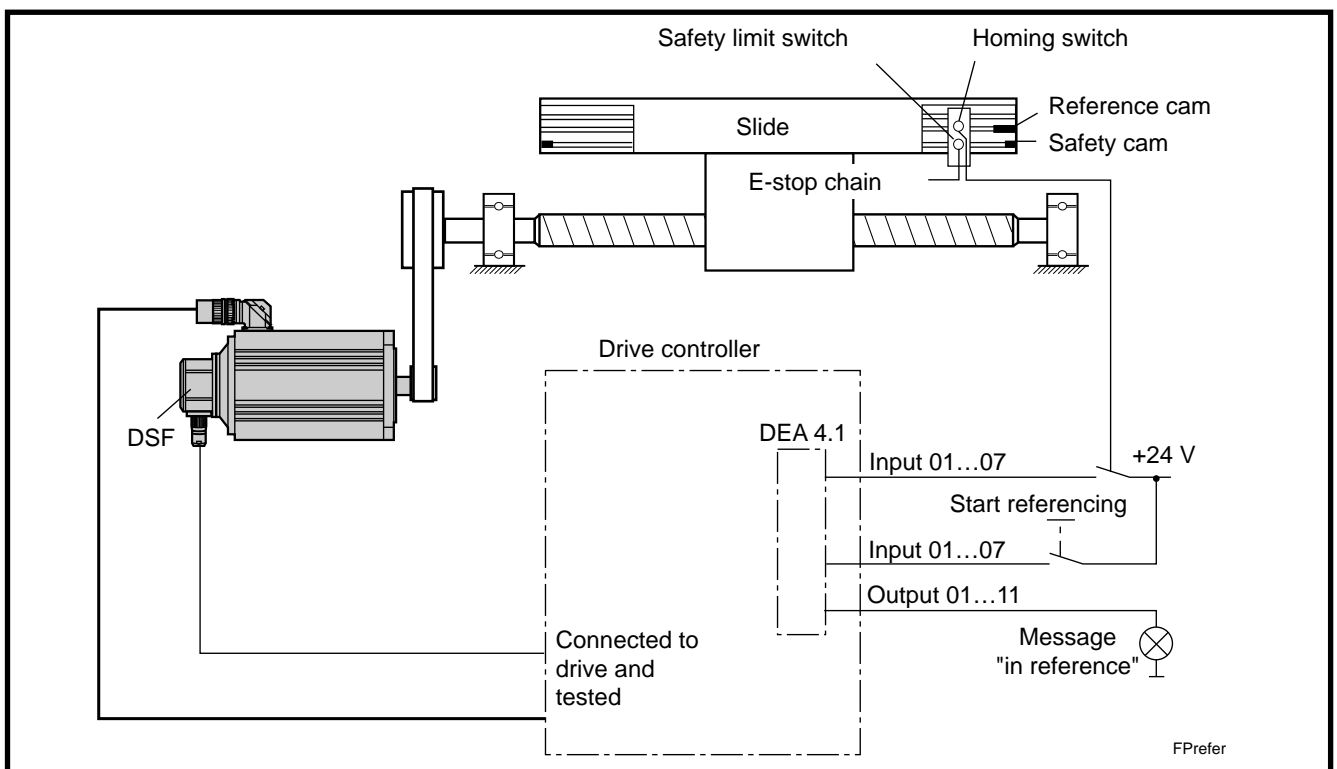
Fig 8.1: Referencing prerequisites

Start referencing   A referencing cycle is started in setup mode if a "1" is applied to the input specified in parameter A 112. With an automatic program in progress, it is started with a HOM or G 74 command.

⚠️
Warning

Source of danger:	**The axis can move in the wrong direction during referencing.**
Possible consequences:	**Personnel could be injured and machine damage is possible.**
How to avoid:	**Personnel may not remain within the danger zone of the machine.**
	There must be sufficient distance to the dead stop.
	The machine operator must be readily able to actuate the E-stop sequence.

Referencing velocity   The homing velocity is programmed in parameter A 110.

Referencing cycle

1) If speed and set acceleration permit, then the homing point will be directly approached. If speed is too high or acceleration too low (parameter A102) then the reference marker is ignored and the drive reversed.

2) The distance between the positive edge of the homing switch and the reference marker must be greater than 1/16 motor revolution ($\hat{=}$ 23°) and smaller than 15/16 motor revolution ($\hat{=}$ 337°).

FPzykl

Fig 8.2: Referencing cycle of a linear axis with DSF digital servo feedback

Reference cam   The reference cam must be sufficiently long so as to prevent the opening of the reference switch, once actuated, to the end limit. Only then is it possible for the DLC to recognize in what direction to look for the reference marker once the reference marker has been overshot.

Referencing cycle flow process diagram
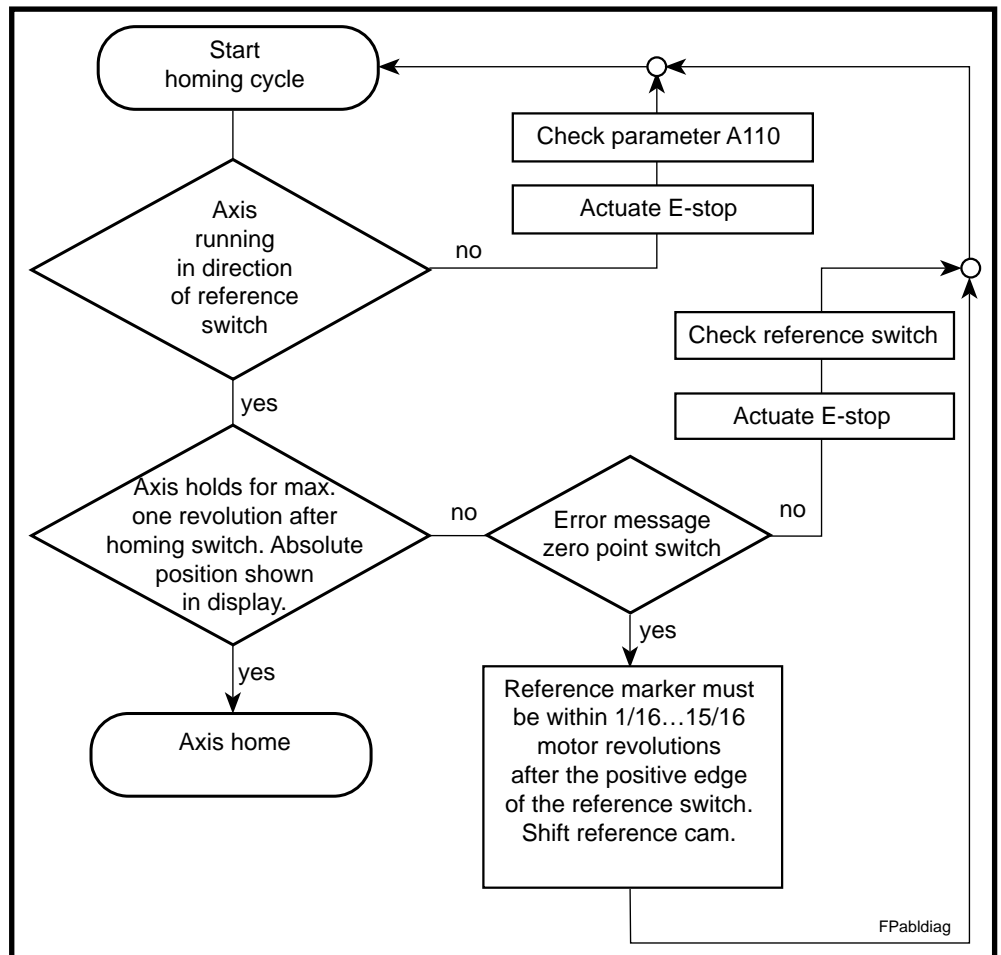
Fig 8.3: Referencing cycle - flow process diagram

☞ **The permissible working range of the feed axis can still be overshot. Enter travel range limits in parameter A 113 und A 114.**

8.2. Referencing a Linear Axis with Direct Position Detection (e.g., Linear Scale)

Axes with direct position detection and relative position measuring systems must be equilibrated to a machine reference point once distribution voltage is on.

Referencing prerequisites

- The safety limit switch must be switched into the E-stop sequence
- Reference switch connected to DFA 4 and checked
- Connect position masuring system to the DEF and check it
- Parameters must be programmed as per Section 6
- No interference contour (workpiece) between current position and reference switch
- Conduct drive start-up as outlined in section 7

Fig 8.4: Referencing prerequisites

Homing start A referencing cycle is started in setup mode if a "1" is applied to the input specified in parameter A 112. With an automatic program in progress, it is started with a HOM or a G74 command.

⚠ Warning	**Source of danger:**	**The axis can move in the wrong direction when homing.**
	Possible consequences:	**Personnel could be injured and machine damage is possible.**
	How to avoid:	**Personnel may not remain within the danger zone of the machine.**
		There must be sufficient distance to the dead stop.
		The machine operator must be readily able to actuate the E-Stop sequence.

Homing velocity The homing velocity is programmed in parameter A 110.

Maximum traverse rate   If an external measuring system is being evaluated, then do not exceed maximum input frequency of the DEF position interface (1MHz).

	Linear scale	**Rotary encoder**
Signal duration	**equals the distance from . . .** X_L **in** μm $X_L = \dfrac{\text{increments}}{\text{pulse repetition}}$	**equals an angle of . . .** X_D **in** $^\circ$ $X_D = \dfrac{360\,^\circ}{\text{number of hairlines}}$
actual position value in drive controller	**resolution in** μm $= \dfrac{X_L \text{ in } \mu m}{4}$	**resolution in** $^\circ = \dfrac{X_D \text{ in } ^\circ}{4}$
maximum speed or traversing speed with maximum input frequency of the DEF 1.1 of $f_E = 1$ **MHz**	**maximum traversing range** $V_{max} / \text{m/min} = 60 \cdot X_L / \mu m \cdot f_E / \text{MHz}$	**maximum speed** $n_{max} / \text{U/min} = 166.67 \cdot X_D / ^\circ \cdot f_E / \text{MHz} \cdot 10^3$
	Note the mechanically permissing traversing range or the speed of the encoder	

Fig 8.5: Maximum traverse rate with external position measuring systems

Referencing cycle
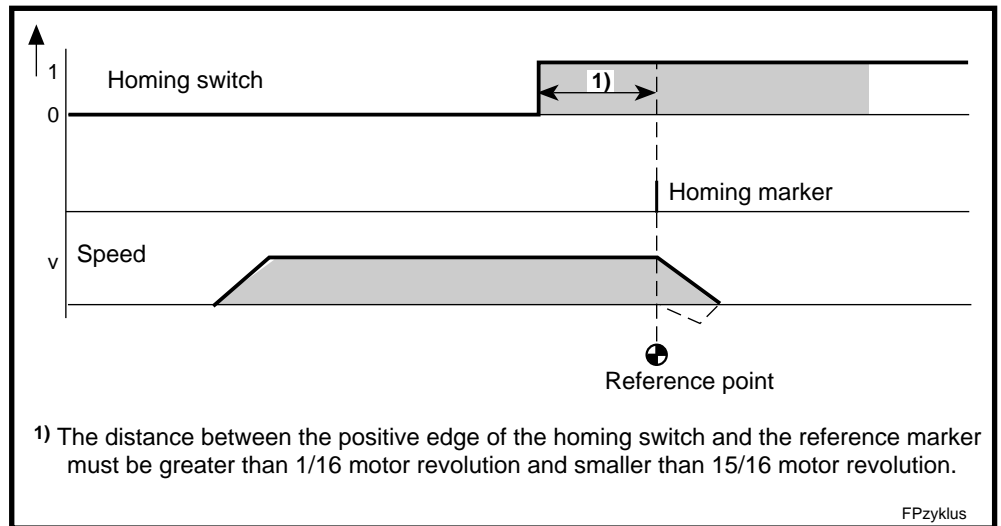
Fig 8.6: Referencing with direct position detection

Reference cam
The reference cam must be sufficiently long so as to keep the reference switch, once actuated, from opening all the way to dead stop. Only then is it possible for the DLC to recognize in what direction to look for the reference marker once the reference marker has been overshot.

Reference cycle - flow diagram
See section 8.1 for the flow diagram of referencing cycle.

The permissible working range of the feed axis can still be overshot. Enter working range limit in parameters A 113 and A 114.

8.3. Establishing the Dimensional Reference of a Linear Axis with Multiturn Encoder (MTG)

A reference dimension must be established once when commissioning an axis equipped with a multiturn encoder (MTG). It is not necessary to run a homing cycle each time the control voltage is switched on.

Function principle
Rotor position is detected cyclically and absolute and then processed in the drive controller with high resolution. Within one motor revolution, there is a resolution of 4096 positions.

The multiturn encoder makes absolute actual position detection over 4096 motor revolutions possible.

Prerequities for setting the reference dimension
- Saftey limit switch switched into the E-stop sequence.
- Parameters have been programmed as described in section 6.
- There is no imperfect contour (workpiece) between the actual and the homing position.
- The drive has been started up as per the procedure described in section 7.

Using the multiturn encoder to limit the working range

1) The maximum working range with absolute indirect actual position evaluation at the motor equals 4096 revolutions.

2) Usable working range = 4096 rev. - 2 • max. braking path in motor revolutions.

3) Maximum braking path in motor revolutions   FPfahrbe
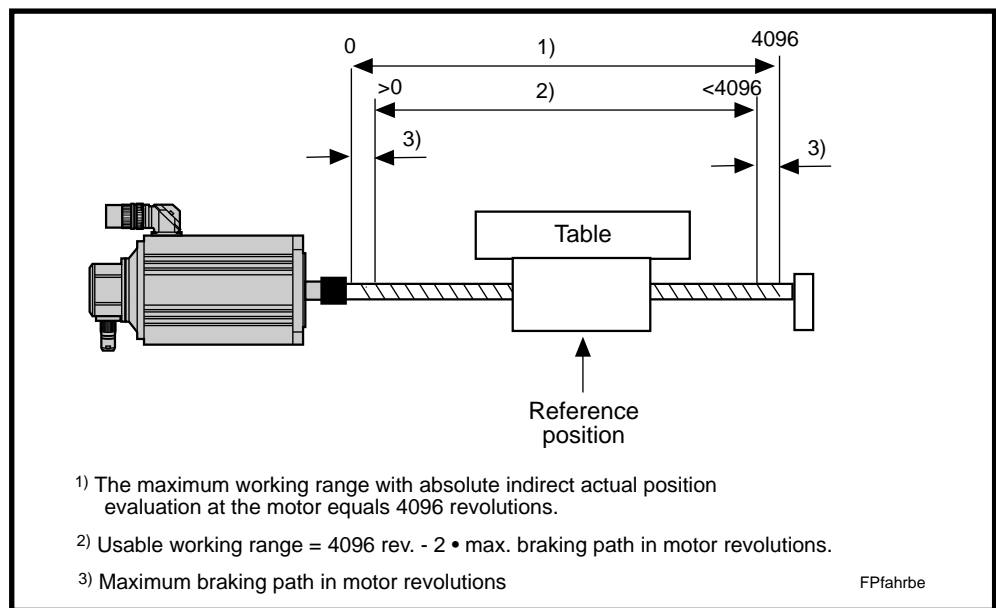
Fig 8.7: Using the multiturn encoder to limit the working range

Caution

Source of danger:	**If the maximum working range is exceeded, then the absolute reference dimension is lost.**
Possible consequences:	**Damage to the machine can result.**
How to avoid:	**Program parameter A 113 and A 114 (travel range minimum/maximum) with a sufficient clearance to the traversing range limit.**

P = position in revolutions

A = absolute reference dimension within working range limitations

>0 through <4096 motor revolutions   DGgrenz
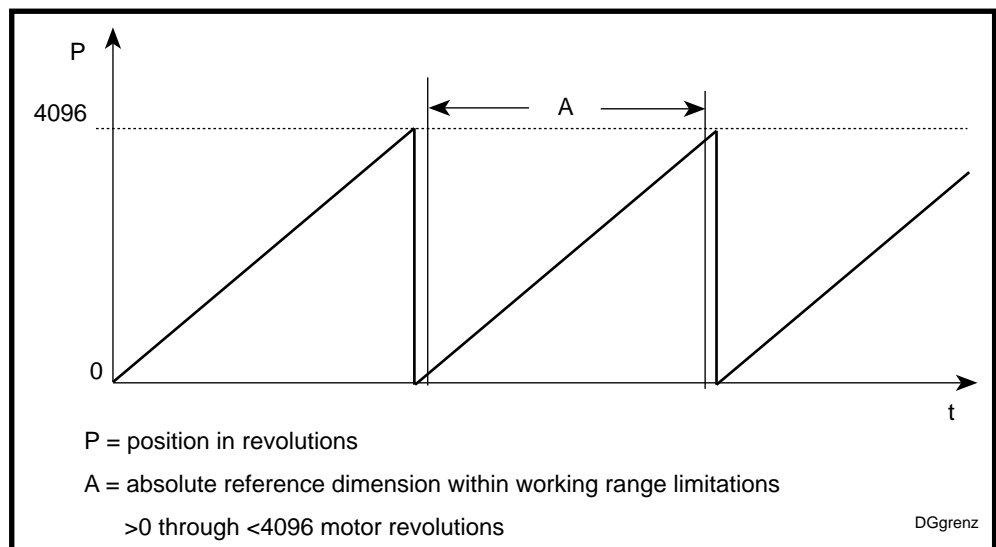
Fig 8.8: The limits of the absolute reference dimension

Setting the absolute reference dimension

- Bring the feed axis to a measured position by jogging it there in setup mode (match parameter A114 "Travel range maximum", if necessary).
- Switch operating mode parameter on
- Check parameter A 109
- Call up parameter C 007 absolute encoder homing position.
- Input C 007

A 109 = 0 0 000 000	A 109 = 0 1 000 000
$C007 = \dfrac{\text{position measured}}{\text{feedconstant}}$	$C007 = 4096 + \dfrac{\text{position measured}}{\text{feedconstant}}$

Example: In Figure 6.6 of section 6.6 the measured position (+600 mm) is located in the center of the working range.

Parameter A 109 reads 0 1 000 000

Feed constant = 6.25 mm

$$C007 = 4096 - \frac{600 \text{ mm}}{6.25 \text{ mm}} = 4000$$

Input value : 4000.0000

- hit ⬡ !
- switch operating mode off
- hit ⬡ until the position appears in the CTA display. The measured position is displayed, e.g., + 000600.00.

Absolute encoder-activate monitor

The current actual position is stored in the drive controller once control voltage is off. Stored position and actual position are compared once it is switched back on.

The permissible deviation is programmed in parameter C 006.

> **The permissible working range of the feed axis can still be overshot. Enter working range limit in parameters A 113 and A 114.**

8.4.   Setting Position Offset (Zero Point Offset)

If the reference point of the machine does not agree with machine zero point, then an offset can be programmed. The positioning commands in the user program, in this case, then relate to the machine zero point.
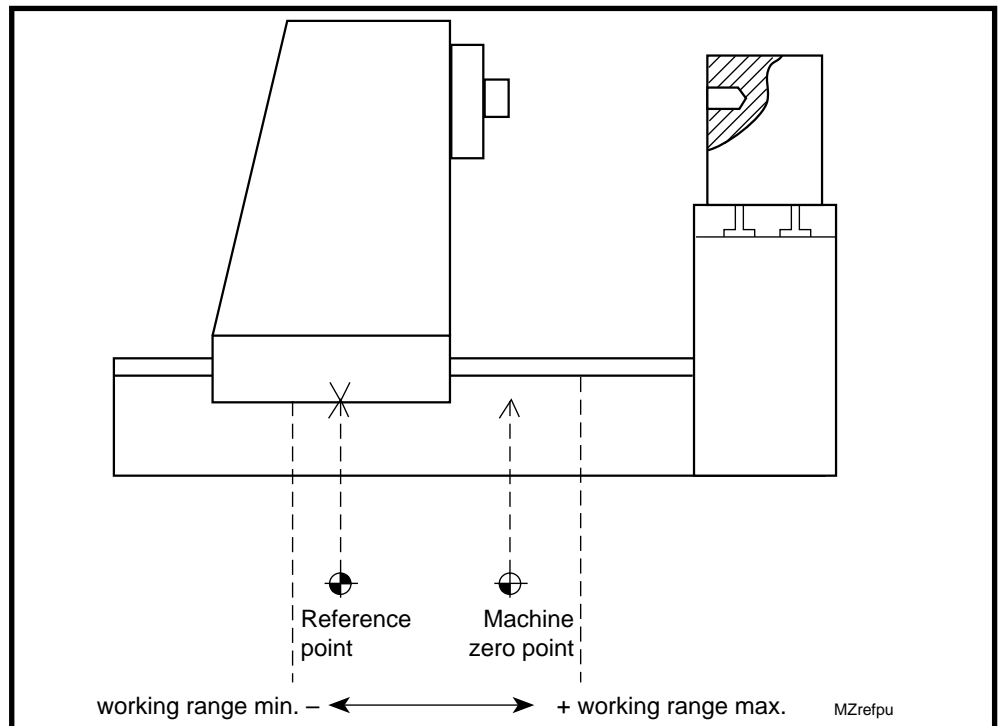
Fig 8.9: Position of reference point, machine zero point and working range limit in a forward feed unit.

Inputting position offset
- Call up parameter A 111
- Enter the difference between the machine zero point and the reference point.

S S a a a a a a a a

Offset in input units (2 or 3 decimal places depending on parameter B 007)

0 = machine zero point in a positive direction from the reference point
1 = machine zero point in a negative direction from the reference point

If the drive is equipped with a multiturn encoder, then the zero point can only be moved in a positive direction.

Source of danger: A zero point offset is not possible with a rotary axis.

Possible consequences: There is the risk that the reference dimension will be lost and there will be damage to the machine.

How to avoid: Program parameter A 111 to read 0 000000.00.

Traversing range limits   The traversing or working range limits (parameters A 113 and A 114) always reference the reference point or the encoder zero point as is the case with multiturn encoders. If an offset is programmed, then the working range limits must be adjusted accordingly. The programmable working range is then correspondingly displaced.

Example: Figure 8.9 gives the minimum working range with - 200 and the maximum working range with + 1000.

Parameter			programmable working range
A 113	A 114	A 111	
-000200.00	+001000.00	0 00000.00	- 200 ... + 1000
-000200.00	+001000.00	0 00150.00	- 350 ... + 850

Fig 8.10: Parameters and programmable working range

Programmable working range = A 113 ± A 111 … A 114 ± A 111

+ if zero point is moved in a negative direction

- if zero point is moved in a positive direction

8.5.   Positioning Against a Dead Stop

With the DLC single-axis positioning module it is possible to run forward feed units in a controlled manner against a dead stop. To do so, it is necessary to program a torque limit and a corresponding positioning command in the user program.
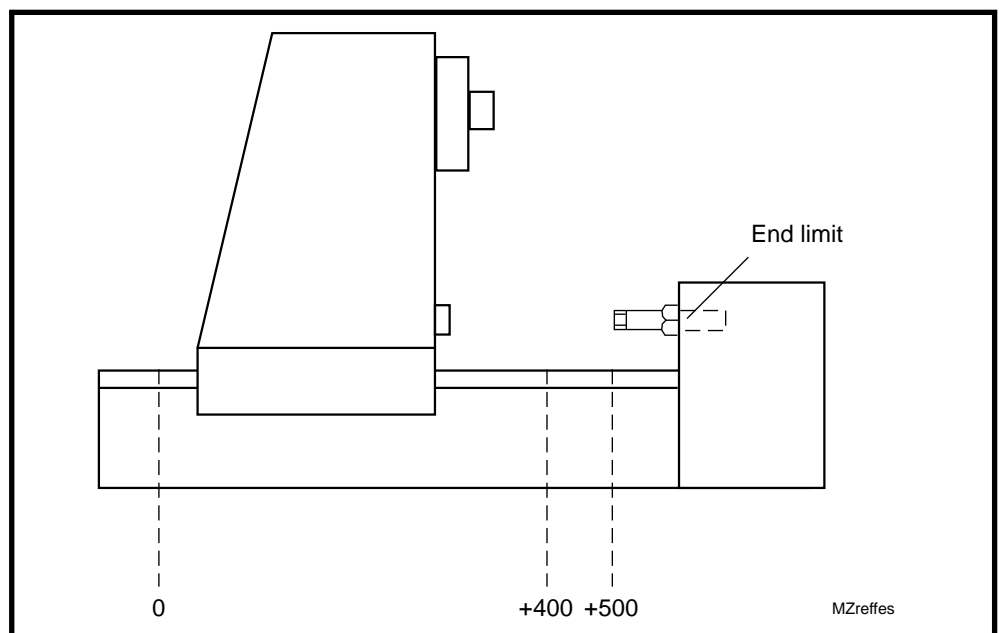
Fig 8.11: Forward feed unit with dead stop

Torque limit   A command limiting drive torque (MOM command) must precede the positioning command in the user program. With this command, the torque is limited **during the run** to the dead stop and **at** the dead stop.

Example:

```
program      block no.    command
  input          |           |
    |            |           |
    E           150         MOM
    1           060         020  00  400
    |
  axis 1
```

constant torque limit 400 = max. drive torque

input to activate constant torque limit
00 = constant torque limit always active

torque limit at the dead stop with PFI and PFA command;
Input range 0 ... 100;
100 = 25 % of maximum drive torque.

Torque limit up to dead stop with PFI and PFA command; Input range 0 ... 400, 400 = 100 % of maximum drive torque.

Positioning command   Path information can be programmed either absolute or incremental, i.e., relative. The programmed traversing distance must be greater than the remaining distance to the dead stop. The dead stop must be located within the working range limit.

Example:

```
program      offset no.     positioning command
  input          |                  |                    PFA = absolute
    |            |                  |                    PFI = incremental
    E          0151              PFA
    1        +000501.00         100
    |
  axis 1
```

traversing speed in per thousands of maximum speed.

position > position of the dead stop with PFA.
path traversed > remainder of
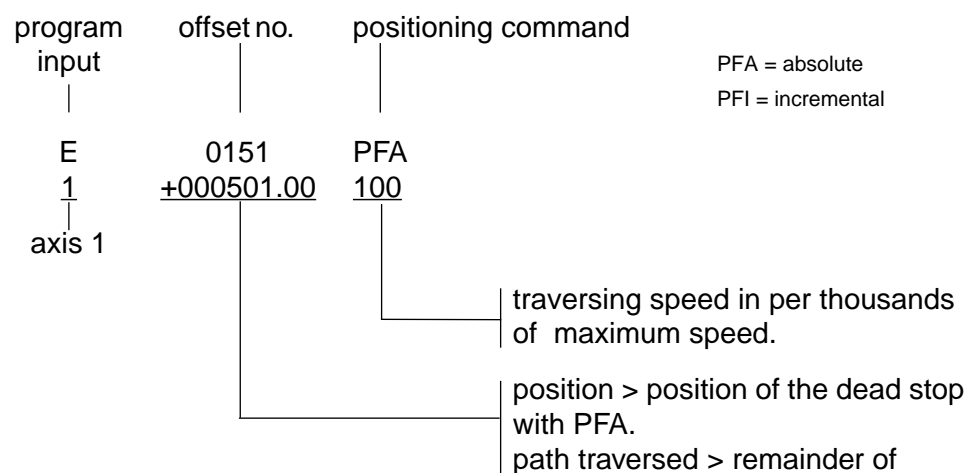
Offset incrementing   Once the dead stop is reached, then there is switching to the **next after** program block.

If the dead stop is not reached, then there is switching to the **next** program block. It is possible to branch to an error routine in the program.

Recognizing the dead stop

The dead stop is recognized if the lag distance has grown to fourfold the usual value (lag distance = speed/KV factor).

If the dead stop is not recognized within the programmed path plus fivefold the lag distance, then there is a switching to the next program block.

The dead stop can only be recognized 20 ms after reading the PFI or PFA.

Program example

0100 MOM 1 060 020	• torque limit: 60% to dead stop; 20% at dead stop
	• start run with 30% of vmax
0101 POA 1 +000450.00 300	• speed at +400 reduce to 10%
0102 VCA 1 +000400.00 100	• run against dead stop to Pos.510 with v=10%.
0103 PFA 1 +000510.00 100 *)	• jump to error routine
0104 JMP 0200	• jump to block 0120, if inut 02 is set (work completed).
0105 BCE 0120 02 1	• loop
	• return to Pos. 0 with maximum speed
0106 JMP 105	• jump to stop after block 0100 (wait for next cycle).
0120 PSA 1 +000000.00 999	• set error output 07
0121 JST 0100	• return to Pos.0 at maximum speed
	• jump with stop after block 0000
0200 AEA 07 1	
0201 PSA 1 +000000.00 999	
0202 JST 0000	

*) Jump to next after block if dead stop is recognized. If dead stop is not recognized, then the program jumps to the next block.

Fig 8.12: Program example

Warning

Source of danger:	**The speed with which the dead stop is being approached is too high.**
Possible consequences:	**Machine damage can result despite torque limit.**
How to avoid:	**Program speed appropriate to ambient conditions.**

As a result of the torque limit, errors can occur when running to the dead stop. The following table lists several typical errors and the remedial actions to take to clear them.

Error	Cause	Remedial action
Drive error 78 is signalled when running to the dead stop	Drive cannot follow	Reduce speed; Increase torque to dead stop
Drive does not run. Program jumps to next after block	Torque is limited to below the friction torque	Increase torque to dead stop
Error 78 is signalled after reaching the dead stop	Monitoring Speed controller actuated	Decrease torque at dead stop, possibly torque to dead stop as well
Dead stop not reached. Program jumps to next block.	Traversing path too short	Program a longer traversing path

Fig 8.13: Errors when running against the dead stop

8.6. Interrupt Vector (Jump on Event)

An automatic program in progress can be interrupted by means of a switching signal and then continued at the interrupt program address. This can be used to initiate an automatic return in the event a tool should break (tool monitoring required). The interrupt function is released via parameter B 012.

Example: Parameter B 012

0 7 1 1 1 1 0 0

Start block for the interrupt program

Feed interrupt yes/no
0 = Feed in progress is not interrupted (do not program feed in the interrupt program).
1 = Feed in progress is interrupted.

Interrupt in subprogram
0 = subprogram not interrupted
1 = subprogram interrupted

A positive edge at this input (01 ... 37) starts the interrupt program;
00 = interrupt function not active

1. **There is no automatic return to the interrupted main program.**

2. **The interrupt vector is only available in Task 1.**

3. **Jumping is not possible in a subprogram that is concluded with RTS.**

8.7. Speed Override

The speed can be reduced to increase the control of the program sequence whilst setting up the machine.

Override active   Speed override can generally be activated via a parameter or in the program by means of a command.

Source of danger: **Speed override is not in effect during referencing.**

Possible consequences: **Machine damage is possible.**

How to avoid: **If necessary, reduce homing speed in parameter A 110.**

Caution

Override via parameter A general speed override can be activated via parameter B 013. Speed value input is binary or Gray-Code and a step switch mechanism is used.

Parameter B013

6 0 0 0 0 0 0 0 0

5 = binary code
6 = Gray-Code input 04 ... 07
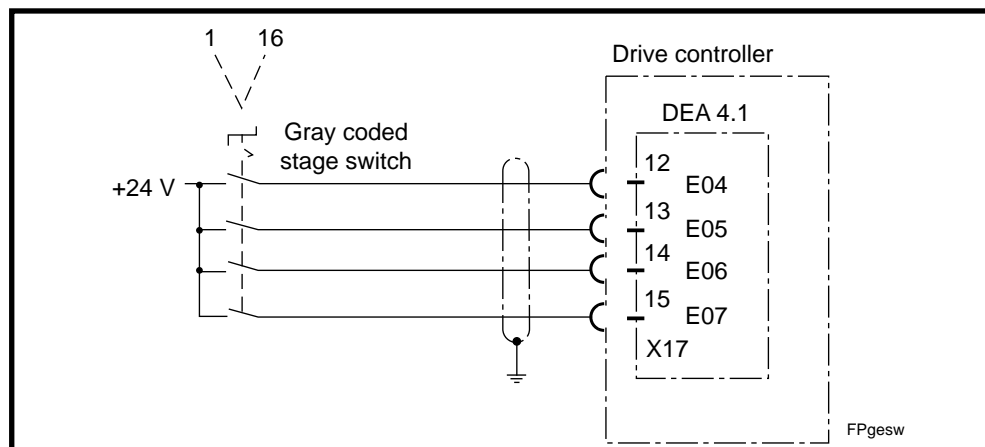
Fig 8.14: Speed overrride via a Gray-Code switch

Table of values with Gray-Code speed override

Input				Speed in %
04	05	06	07	
0	0	0	0	0
1	0	0	0	1
1	1	0	0	2
0	1	0	0	4
0	1	1	0	6
1	1	1	0	8
1	0	1	0	10
0	0	1	0	20
0	0	1	1	30
1	0	1	1	40
1	1	1	1	50
0	1	1	1	60
0	1	0	1	70
1	1	0	1	80
1	0	0	1	90
0	0	0	1	100

Fig 8.15: Table of values with Gray-Code speed override

Speed reduction relates to the speed which has been programmed.

Override in program via command
The VEO command can be used to reduce the speed in the program. A VEO command has priority over a speed override from parameter B 013. A VEO command remains valid until a different VEO command replaces it or the automatic operating mode is switched off.

Example:

```
program      block no.     command
 input        |            |
   E          0180         VEO
   1          3  0         999  0
   |
 axis 1
```

0 = Override in % of programmed speed
1 = Override as % of vmax (A100).

0.1 .... 99.9 % = Override value with parameter entry 4

0 = Override is read in anew after each control cycle (1 ms)

1 = Override read in only once

Parameter entry:
0 = Override off or as in parameter B 113
1 = not used
2 = binary at inputs 01...07
3 = Gray-Code at inputs 04 ... 07
4 = Override from VEO command

8.8.   Setup Mode

Setup mode is switched on if the automatic operating mode and parameter input are switched off.

DEA 4 inputs		Operating mode
Parameter (X17/1)	Automatic / setup (X17/2)	
1	0	Parameter input
0	1	Automatic
0	0	Setup

Fig 8.16: Operating modes

If there is no error pending and if the power source is switched on (UD contact), then setup mode is possible.

Signal sequence   Condition:
- E-stop input of a DEA 4 must be 1.
- The UD contact must be closed.
- Immediate stop input of DEA 4 must be 1.
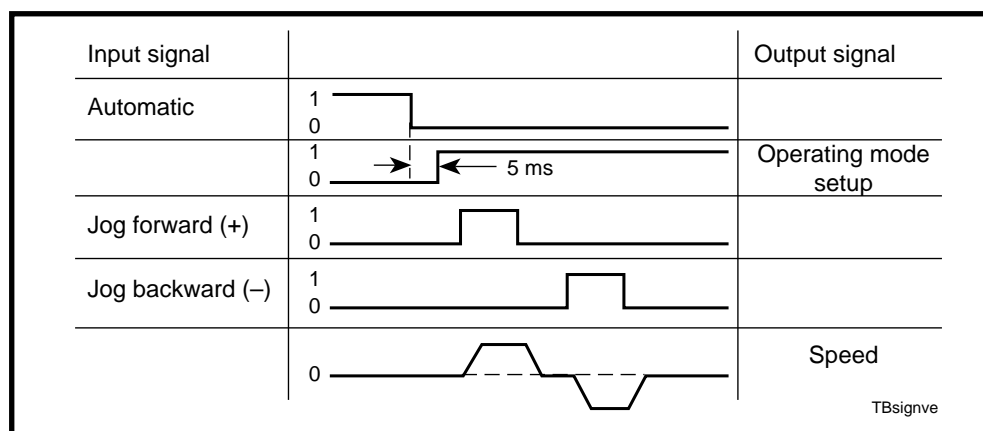
Fig 8.17: Signal sequence in setup mode

8.9.   Automatic Mode

The following conditions must be met before an automatic program can be started.

Signal	Connection	
E-stop input	DEA 4 - X17/3	1
Immediate stop input	DEA 4 - X17/4	1
UD contact	X3 / 9-10	closed
Fault signal	DEA 4 - X17/16	1
Parameter	DEA 4 - X17/1	0
Automatic	DEA 4 - X17/0	1

Fig 8.18: Preconditions for an automatic program

Signal sequence   If the output "automatic operating mode" of the DLC is set, then the automatic program can be started.
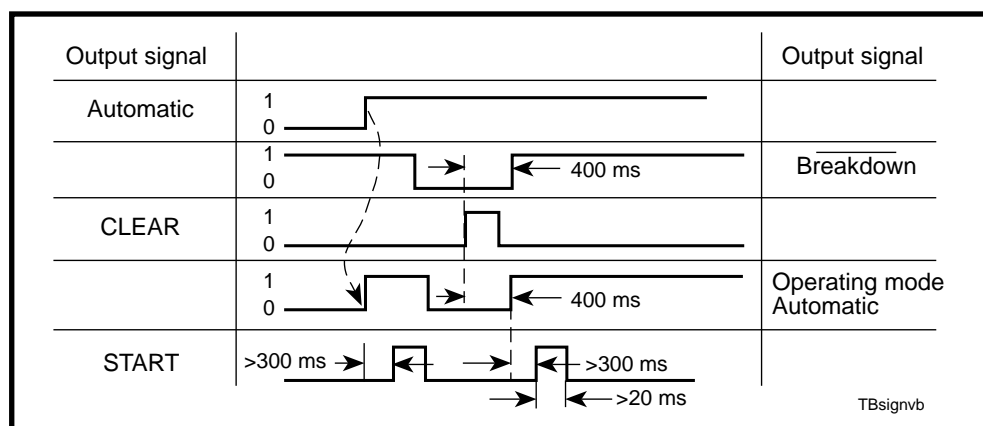
Fig 8.19:   Signal sequence in automatic mode

Program Example If commissioning has been completed as outlined in section 7, then a simple program can be input to check drive controller functions. To program extensive programs, see „DLC 1-A single-axis positioning modules for digital drive control" - Programming Instructions; doc. no. 109-0852-4102-00.

The positions programmed in the following example specifically apply to this example. They must be adapted to the specific machine conditions as otherwise the machine could be damaged.

Example:

The following program sequence is to be programmed:
- Positioning to + 300 in rapid traverse
- with feed speed to + 360
- dwell time of 1s
- return to 10 in rapid traverse
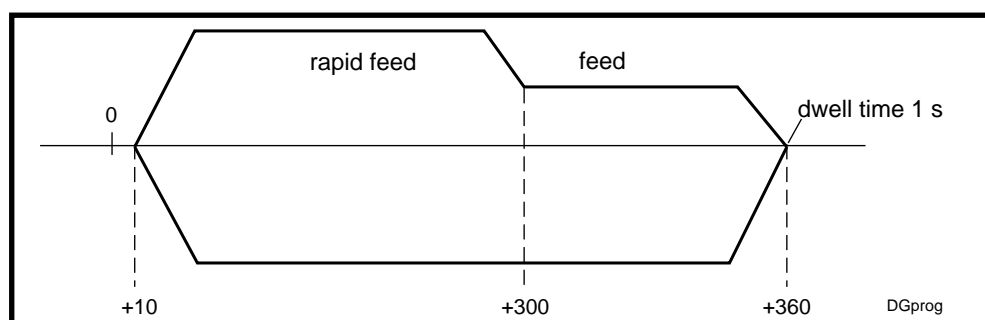
Fig 8.20: A simple processing program

INDRAMAT Programming Language

Command	Comment
E 000 JMP 0100	jump to block no. 100.
E 0100 POA 1 +000360.00 999	run to +360 with 99.9% of maximum speed Note: block incrementing after 1 ms.
E 0101 VCA 1 +000300.00 100	reduce speed to +300 to 10% of maximum speed
E 0102 PSA 1 +000360.00 100	run to +360 with 10% of maximum speed. Note: blocking incrementing when position reached.
E 0103 WAI 01.00	dwell time 1s
E 0104 PSA 1 +000010.00 999	return to position +10 with 99.9% of maximum speed
E 105 JST 0000	jump to block no. 0000 with program stop

Fig 8.21: Program

G-Code   With the appropriate software it is possible to write processing programs in G-Code as well. G-Code programming is possible with systems configuration DG . . - . ..

Program

Command	Comments
E 000 JMP 0100	jump to block no. 100.
E 0100 G90	absolute dimensional notation
E 0101 G62	speed optimized block transitions
E 0102 F== 018000.00	rapid traverse speed 18 m/min
E 0103 G01 1 +000300.00 99	position to +300
E 0104 F== 002000.00	feed speed 2 m/min
E 0105 G01 1 +000360.00 99	position to +360
E 0106 F== 002000.00	target speed anticipated with G62 in 1st or 2nd block after the positioning block
E 0107 G60	exact positioning on
E 0108 G04 01.00	dwell time 1s
E 0109 F== 018000.00	rapid traverse speed 18 m/min
E 0110 G01 1 +000010.00 99	Position to +10
E 0111 JST 0000	jump to block no. 0000 with program stop

Fig 8.22: Program

9. Diagnostics and Fault Clearance

Extensive fault finding and the repair of drive components in the machine are not acceptable because of the production downtime that such represents.

As a result of their design, INDRAMAT AC drives make it possible to completely exchange, without problems or difficulties, the individual functional units and without requiring any necessary follow-up adjustments.

The service thus is limited to locating the fault, in the event of a breakdown, either on the motor or in the drive controller, or, in some cases, the plug-in module which means simply replacing the component.

Due to the interplay of DLC single-axis positioning modules, drive controllers, the mechanical system and position measurements, faulty drive movements can result either from a fault within the aforementioned equipment or incorrect adjustments of the individual components as they relate to each other. For a quick localization of faults, the single-axis positioning module and the drive controller have been equipped with an extensive diagnostics system.

Danger	Source of danger:	**Increased risk of accidents in the event of faults.**
	Possible consequences:	**Severe injury of personnel and damage to the plant.**
	How to avoid:	• **Problems and faults should only be corrected by trained personnel.**
		• **Personnel may not remain within the hazardous area of the machine.**
		• **Such protective measures as protective fences, light barriers and so on must always be in use.**
		• **When working within the hazardous area and on electrical equipment, make sure that the power to the machine has been switched off and it has been secured against being switched back on.**
		• **Wait the discharge time of the DC bus capacitors which equals about five minutes.**

9.1. Operating Status Display of the Drive Controller

The operating status, i.e., operating mode, of the drive controller is displayed in the 7-segement display H1. Operating states are displayed in terms of letters and numbers < 10. Numbers > 10 are error messages.
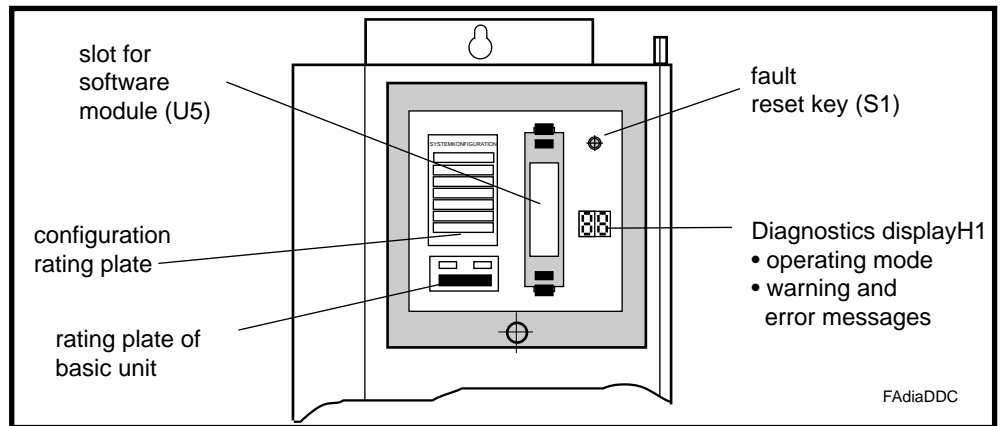
Fig 9.1: Diagnostics display and reset button on a DDC

Supply voltage applied During initialization of the drive controller, the numbers 1 ... -9 were displayed.

UL

If an error is detected during initialization, then a corresponding error number is generated.
UL is displayed if the motor type stored in the drive controller does not agree with the type of motor actually connected.
This message is generally only displayed if motor (MDD) and drive controller are operated together for the first time.

Actions:
Press reset key S1. The standard speed controller parameters are now loaded into the drive controller out of the motor feedback.

bb

Ready signal
No error was detected during the intialization phase. The drive is ready to switch power on.

Power contactor switched on

Ab

Drive ready
The power contactor is switched on. The DC bus voltage is built up.

AF

Drive enable
The control (DLC) has set the drive enable signal. The drive can now comply with the command value entry.
Drive enable is issued by a single-axis positioning module if no error is present and if either "setup" or "automatic" modes are switched on.

AH

Drive halt
The drive is holding its position without drift. It will not follow a command value. The drive is holding its position drift-free. It will not follow a command value.

9.2. Fault Displays of the Drive Controller

Fault messages and warnings are signalled via the diagnostics display H1. Warnings are flashed. If there is no response to a warning, the drive controller shuts down and an error message is displayed. Errors are stored. Once the error has been cleared, then it can be cancelled by pressing the fault reset button S1, by a positive edge at the CLEAR input of the DEA 4.1 or by the CL key of the CTA (optional).

•• *Watchdog*
Processor in drive controller not working.

1. There is no software module or it is defective.
2. Processor defective

Remedy
1. Plug-in software module or replace it.
2. Replace drive controller.

18 *Drive overtemperature shutdown*
An unacceptably high temperature was detected in the power stage of the drive controller. The message "amplifier overtemperature warning" was generated for 30 seconds (warning 50). Depending on the error reaction, the drive was brought to a standstill.

Remedy
1. Machine blower break down
2. Blower mesh dirty
3. Heatsink dirty

1. Replace the drive controller if the blower has broken down.
2. Clean blower mesh and/or heatsink.

19 *Motor overtemperature shutdown*
The motor has overheated to an unacceptable level. For 30 seconds, warning 51 was generated. The drive is brought to a standstill in terms of the error reaction selected.

1. The motor was overloaded. The effective torque which the motor required exceeded the permissible continuous torque at standstill for too long a period.

Remedy *2. Earth short or short circuit in the lead to the motor temperature monitor.*

1. Check motor layout. In those plants which have been running for an extensive period it is advisable to check whether the drive conditions have changed in terms of dirt contamination, friction, moving masses and so on.
2. Check the lead to the motor temperature monitor for earth short or short circuits.

20 *Bleeder overtemperature*

Continuous regenerative power too high

Remedy
1. Adjust working cycle
2. Use a drive controller with higher continuous bleeder power.

22 *Motor encoder error*

There are no motor encoder signals or they are outside of the tolerance.

1. Motor encoder cable break or incorrectly poled.
2. Motor feedback is defective.

Remedy
1. Check motor encoder cable.

2. Replace motor (feedback defective)

⚠️ **Warning**

Source of danger:	**Displacement of dimensions if motor replaced!**
Possible consequences:	**Risk of damage to machine and workpiece.**
How to avoid:	**Check reference dimension after motor is replaced.**

24 *Overcurrent*

One of the three phase currents has reached a level that is greater than 1.5 times the rated current of the unit.

Remedy
1. Check motor cable.

2. Check current regulator parametrization. Contact INDRAMAT Customer Service in this case.

25 *Overvoltage*

The DC bus voltage has reached an unacceptably high level (UD > 475V). So as not to endanger the power stage of the drive controller, the drive was switched torque-free.

1. Peak regenerative power too high
2. Bleeder switch defective

Remedy
1. Use a drive controller with higher peak bleeder output.

2. Check application.

3. Replace drive controller.

26 *Undervoltage error*

The DC bus voltage is monitored in the drive controller. If it should exceed a threshold of + 200 V then the drive will be brought to a standstill as per the error reaction set.

Fault in the power source (Phase failure)

Remedy
1. Clear the fault in the power supply.

33 *External voltage supply fault*

Auxiliary plug-in module (e.g., DEA 4) with galvanically isolated inputs and outputs must be supplied with 24 V DC.

The external 24 V DC are lacking or outside of the tolerance.

Remedy
1. Check external voltage source. Voltage width and tolerances are listed in the Project Planning Manual. See plug-in module for digital intelligent drive controllers, Project Planning Manual, doc. no. 209-0069-4356-XX.

46 *External encoder fault: maximum frequency exceeded*

The interface module for connecting the external measuring system may be operated up to a maximum input frequency. This error indicates that this maximum frequency has been exceeded.

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

Remedy 1. Reduce speed.

47 *Reference marker of the external encoder not correctly detected*
1. Plug-in module (DLF) defective.
2. Reference marker of the external encoder not correctly detected.

3. Reference marker must be located within 1/16th to15/16th motor revolutions after the postive flank of the reference switch.

Remedy 1. Replace plug-in module.

2. Contact INDRAMAT Customer Service because the mounted encoder is not compatible with the evaluating electronics.

3. Shift reference cam.

48 **Absolute encoder - battery undervoltage**

Applies to absolute encoders with a battery in the feedback, e.g., the RSF feedback. If the voltage level drops below 2.8 volts, then this message is generated. The absolute encoder function will only be available for approximately four more weeks.
This error is generated each time the supply voltage is switched on.

⚠ Caution

Source of danger:	**Reference dimension will be lost!**
Possible consequences:	**Machine damage possible.**
How to avoid:	**Replace battery as soon as possible.**

50 *Drive overtemperature warning* (flashing)

The heatsink of the drive controller has reached maximum permissible temperature. The drive can still maintain the command value for another 30 seconds. This means that it is possible to bring the axis via the control to a standstill appropriate to the procedure being performed. In other words, finishing can be completed, removal out of the area of possible collision and so on.
The drive is brought to a standstill as per the error reaction set after 30 thirty seconds.

1. Machine blower break down.
2. Blower mesh dirty.
3. Heatsink dirty.

Remedy 1. Replace the drive controller if the blower was defunct.

2. Clean blower grid and heatsink.

51 Motor overtemperature warning *(flashing)*

The motor has reached maximum permissible temperature. The drive can still maintain the command value for another 30 seconds. This means that it is possible to bring the axis via the DLC to a standstill appropriate to the procedure being performed. In other words, finishing can be completed, removal out of the area of possible collision and so on.

The drive is brought to a standstill as per the error reaction set after 30 seconds.

The motor was overloaded. The effective torque required by the motor exceeded the permissible continuous standstill torque for too long a period.

Remedy
1. Check motor layout. In those plants that have been in operation for an extended period it is advisable to check drive conditions in terms of dirt contamination, moving masses and so on.

2. Check the lead to the motor temperature monitor for earth shorts or short circuits.

52 Bleeder overtemperature warning (flashing)

The bleeder prewarn contact (BVW) opens and can be evaluated. The continous regenerative power is then greater than 75% of the continuous bleeder output. If the bleeder load continues to climb, there will a shutdown and error 20 will be generated.

60 Overcurrent: short in the power stage (bridge fuse)

The current in the power transistor bridge has exceeded twice the value of the peak current of the machine. The drive was immediately switched torque free as a result.

1. Short circuit in motor cable.
2. Power section of the drive controller defective.
3. Short circuit in motor.

Remedy
1. Check motor cable and motor for short circuit. Replace with short circuit.

2. Replace drive controller.

61 Short to ground (earth connection)

The sum of the phase currents is monitored. During normal operation, the sum = 0. The earth connection fuse will react when the sum of the currents rises above 0.5 x I_N

1. Motor cable defective.
2. Short to ground in motor.

Remedy
1. Check motor cable and motor for short to ground and replace, if necessary.

67 Erroneous internal hardware synchronization

The pulse width modulator of the drive controller is synchronized by a phase control loop. The synchronization is monitored and the above error message signalled when a fault is detected.

Remedy
1. Replace drive controller and send it for a check.

68 *Brake error*

For MDD motors with integrated brakes, the drive controller pilots the brake. The brake current is monitored. If it lies outside the permissible range, the above error message will be signalled.

1. The holding brake connection is interrupted, incorrectly poled or short circuited.
2. The holding brake is defective.
3. The drive controller is defective.

Remedy
1. Check holding brake connection.

2. Replace the motor.

3. Replace the drive controller.

69 *± 15-Volt error*

Fault in the ± 15 Volt supply.

External short circuit, drive controller defective.

Remedy
1. Clear the short circuit, replace the drive controller.

70 *± 24-Volt error*

Fault in the ± 24 Volt supply.

External consumer has a short circuit, drive controller defective.

Remedy
1. Clear short circuit, replace drive controller.

71 *± 10-Volt error*

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

Defect in the drive controller.

Remedy
1. Replace drive controller.

72 *± 8-Volt error*

There is a problem in the voltage supply to the encoder system.

Short circuit in the motor encoder cable or in the external encoder cable.

Remedy
1. Check cable and replace, if necessary.

73 *Voltage supply - driver stage*

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

A defect in the drive controller.

Remedy
1. Replace drive controller.

76 *Absolute encoder error*

When a motor with absolute encoder (multiturn) is switched off, the actual position is stored. When the motor is switched back on again, that position is then compared to the stored one. If the deviation is greater than the parametrized absolute encoder monitor window (C006) then error 76 „Absolute encoder error" is signalled.

1. Initial powering up (stored position not valid).
2. During the time the machine was switched off, the axis was moved more than the path parametrized in the absolute value encoder monitoring window (C006) and now stands outside of the permissible position.
3. Faulty position initialization (feedback defective).

Remedy
1./2. Check whether another run command could cause damage. If not, cancel the error.

3. Check reference dimension. If incorrect, replace motor.

Caution

Source of danger:	**Uncontrolled movements of the axes.**
Possible consequences:	**Damage to the machine is possible.**
How to avoid:	**Check whether the actual axis position agrees with that transmitted to the DLC (CTA connected, axis position measured). Check encoder function. Re-establish reference dimension, if necessary. Operate axis with reduced speed only.**

---

78 *Speed controller- monitoring (Runaway)*

Speed controller-monitoring has actuated.

1. Feedback mechanically twisted or defective.
2. Feedback lead incorrectly poled.
3. Drive blocked.
4. Drive accelerating to current limit.

Remedy
1. Call INDRAMAT Customer Service

2. Check feedback lad

3. Clear the jam

4. Reduce acceleration (Parameter A 102)

---

81 *Program RAM defective*

The storage subassemblies are checked in the drive controller during drive initialization. If an error occurs during the course of this check, then this error message is generated.

Hardware fault in drive controller.

Remedy
1. Replace drive controller.

---

82 *Data RAM error*

The memory blocks in the drive controller are checked during initialization. If an error is detected, the above message will be signalled.

Hardware error in the controller

Remedy   1. Replace the drive controller.

83 *Error reading drive data*

The operating software reads data from an EEPROM in the drive controller during initialization. If this is not successful, the above messge will be generated.

Hardware error in the controller.

Remedy   1. Replace the drive controller.

84 *Drive data invalid*

No values in the EEPROM or invalid values have been loaded.

Remedy   1. Rewrite EEPROM, contact INDRAMAT Customer Service.

85 *Error writing drive data*

An error was detected while writing data to the drive's internal EEPROM. *Hardware defective.*

This error message can only occur during factory test runs.

86 *Error while writing to parameter memory*

The parameter memory in the programming module will not accept data.

1. Save the parameter set in the programming module.

Remedy   2. Replace the software module.

3. Transfer the parameter set to the new module.

87 *Parameter data invalid*

During the controller initialization phase, one or more parameters in the software module were found to be invalid.

1. The software module has not been previously initialized.
2. The operating software EEPROMs in the software module have been changed.
Remedy   *3. Hardware fault in the software module.*

1. Start the operator interface and call up each of the submenus in the „PARAMETER" menu. Invalid parameters are indicated by „***„. Enter new parameters for these items.

2. Replace the software module.

88

Error reading motor data

All motor data are stored in a data memory in the motor feedback. An error has occurred while reading these data.

1. Defective motor feedback cable.
2. Defective motor feedback.

Remedy

1. Check motor feedback cable and replace, if necessary.

2. Replace motor.

89

Motor data invalid

No data or invalid data in EEPROM .

Remedy

1. Rewrite EEPROM, contact INDRAMAT Customer Service.

90

Error while writing motor data

An error has been detected while writing data to the motor feedback.

1. .Defective motor feedback cable.
2. Defective motor feedback.

Remedy

1. Check motor feedback cable and replace, if necessary.

2. Replace motor.

91

Configuration error

1. Software and hardware configurations do not match.
2. Plug-in module defective, not installed or not properly inserted.
3. Break in feedback lead.

Remedy

1. Check the drive controller against its configuration data sheet and, if necessary, replace the software or hardware.

2. Check plug-in module.

3. Check feedback lead.

92

Absolute encoder not calibrated

Parameter "homing position" and/or "counting direction" in the menu "ABSO-LUTE ENCODER PARAMETER" could not be read.

1. These parameters have not yet been entered.
2. Feedback defective.

Remedy

1. Enter or confirm parameters.

2. Replace motor.

93 *DLC Watchdog error*

The drive controller monitors that the DLC is operating correctly. If the processor system of the DLC is out of synchronization with the drive controller's processors, error no. 93 will be generated in the DKS.

DLC card or drive controller defective.

Remedy
1. Replace the DLC card. If the error is still present after the DLC card has been replaced, replace the drive controller.

94 *Unacceptable software combination*

The software for the drive controller in the DSM software module and in the single-axis positioning module DLC do not match.

Remedy
1. Contact INDRAMAT Customer Service.

9.3. Diagnostics Possibilities with a CTA Programming and Display Unit

With the use of a CTA programming and display unit it is possible to access the high-performance display system of the DLC.
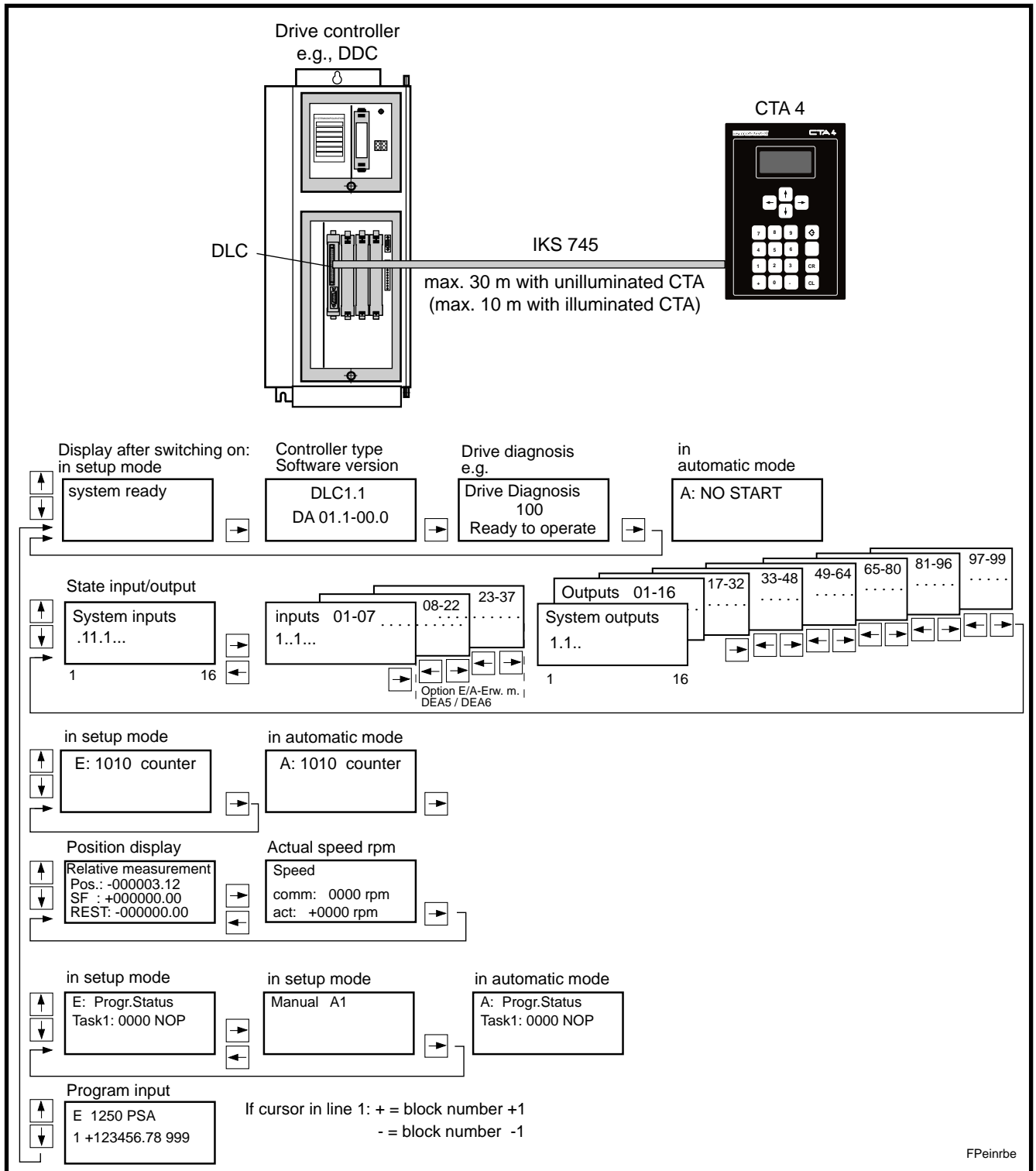
Fig 9.2: Display system of the DLC

9.4. Error Displays of a CTA Programming and Display Unit

If the DLC 1 detects an error, then this error will be signalled in the CTA display. All system outputs and outputs 01 through 72 are cleared.
Errors are stored. Once the fault has been cleared, the error message must then be cancelled with the CL key or by a 1-signal at the CLEAR input of the DEA 4.

Error Display	Error Description	Notes
Failure absolute encoder error 1	No longer in the measuring range of the absolute encoder of axis 1	• check the machine • reduce the distance to be covered
Failure axis shutdown 1	An axis not yet released has been called up in the program	Check the program; ⬆ press until „F: Progr. Status" appears; faulty set is displayed
Failure incorrect axis number	An axis not yet released has been called up in the program	Check program; ⬆ press until „F: Progr. Status" appears; faulty set is displayed
Failure drive watchdog	Synchronization of DLC and drive controller is faulty	Replace DLC. If fault not cleared - replace drive controller
Failure battery empty	Back up battery for RAM storage is almost empty -- data could be lost	Replace battery!
Failure operating mode	Input parameters and automatic are on 1	Place input parameter or automatic to 0.
Failure division error	Parameter not valid	Check parameters!
Failure DPR not legible	Data exchange between DLC and drive interrupted during intialization	Replace DLC. If fault still present, replace drive.
Failure storage set no.	The previously programmed program set is faulty.	Check the respective program.
Failure external encoder	Signals of the external path measuring systems are faulty	• Check encoder lead • Lag between motor and external encoder • DEF defective
input error Parameter A100	The parameter indicated was incorrectly programmed	Check parameters!
Failure HOM command A1	HOM command not possible. Go to zero not released.	Parameter A110 und A112 prüfen (Achse 1)
Failure IDS break error	Verbindung zu den Dekadenschaltern ist unterbrochen oder gestört.	Check lead (interruption, max. length 15m)
Failure IDS format length	DLC receiving faulty data format.	Check lead, max. length 15m; Check shield.
Failure IDS format symbol	DLC receiving faulty data format.	Check lead, max. length 15m; Check shield
Failure IDS checksum error	DLC receiving faulty data format.	Check lead, max. length 15m; Check shield
Failure Illegal command	User program contains illegal command, e.g., REP without REF command.	check program ⬆ press until „F: Progr. Status" appears; faulty set is displayed
Failure JSR nesting	nesting depth of subprogram > 127.	• check program • jump to subprogram without return jump (JSR without RTS)
Failure no BCD Input	the value for a jump command at inputs 1 through 8 is not in BCD format	check inputs 1 through 8 input 8 7 6 5 | 4 3 2 1 value 80 40 20 10 | 8 4 2 1 input <100 | <10
Failure configuration	configuration of the interface assembly in the drive controller is not permitted	Contact INDRAMAT Customer Service
Continued on next page		
Failure no zero impulse 1	the zero impulse of an external position encoder cannot be recognized	• check the position of the reference switch • check the connection to the external position encoder

Error Display	Error Description	Notes
Failure no power	The attempt was made to start an automatic program with power off.	Switch the power on.
Failure maximum limit switch 1	Es wurde eine Position außerhalb der Maximum traversing range limit programmiert.	• Check program • Check traversing range limit
Failure maximum override A1	With speed override via external encoder speed entry > value in A100	Reduce the speed of the external encoder
Failure minimum limit switch 1	A position outside of the minimum traversing range limit was programmed	• Check program • Check traversing range limit
Failure coupling in	The actual position exceeds the command value position.	• Axis is moving without position command • The value in parameter A122 is too small
Failure not setup 1	Positioning command in automatic program with an axis which has not yet been setup.	Home the axis
E-stop	The E-stop signal at the DLC input was switched off.	• Check E-stop loop • Check connections
Failure zero point switch 1	The zero point of the position encoder is less than 1/16th of an encoder revolution to the reference cam.	Move the reference cam
Parameter loss	Parameters were erased.	• Check all parameters • Replace battery at the DLC, if necessary
Position monitoring 1	The drive is outside of the position window according to the time set in parameter A122.	• Check weighted torque • Check position window in A106
Program loss	Die Programme wurden gelöscht	• Check all program sets • Replace battery at the DLC, if necessary
Failure RTS nesting	A program is concluded with RTS which was not called up with JSR or it has been programmed with CST*0.	Check program
Failure SAC command	SAC command was called up with a non setup axis.	• Check program • Reference axis
Failure lag error 1	The drive cannot comply with the command value.	• Reduce acceleration • Check weighted torque • Check whether torque reduction is active
Failure software combination	The software of the drive controller and the DLC do not match.	Contact INDRAMAT Customer Service.
Failure illegal set	In a BCB or BCD command, the target set > 2999 was calculated.	Check BCB or BCD command • offset • jump width
Failure forward feed monitoring 1	The signal was rekeased at the input specified in A120 during forward feed.	• Check control • Check connections
Failure WRITE command	Error during execution of a WRITE command.	Check program; a position must be programmed into the target set.
Failure Zielpos < limit 1	Target position of a forward feed command lies outside of the minimum traversing range limit.	• Check program • Check traversing range limits
Failure target position > limit 1	Target position of a forward feed command lies outside of the maximum traversing range limit.	• Check program • Check traversing range limits
Failure target position < limit 2	Target position of a forward feed command for axis 2 is outside the minimum traversing range limit.	• Check program • Check traversing range limits
Failure target position > limit 2	Target position of a forward feed command for axis 2 is outside the maximum traversing range limit.	• Check program • Check traversing range limits
System error! ******	Internal error	Contact INDRAMAT Customer Service.

Fig 9.3: Error display of the programming and display unit CTA

9.5.   Replacing the Battery

The parameters and the user program are both stored on the DLC in RAM memory with battery back up.

The 3.6 volt lithium battery can generally be used for and has a lifespan of approximately ten years.

Monitoring the battery
The battery is tested each time the DLC is switched on and then every four hours thereafter during operations. Once the power of the battery has reached the stage where only approximately 30 days of use remain, then the message "battery empty" will appear on the CTA display each time the power supply is switched on. Output „fault NOT" of the DLC remains at „0". If the error message is cancelled, then it will still appear every ten minutes. Output „fault NOT" remains at „1". The DLC can still function.

Replacing the battery
With power off, pull the DLC plug-in module out of the drive controller.

⚠️ Caution	**Source of danger:** **Data loss**
	Possible consequences: Extensive machine downtimes
	How to avoid: **Parameter and user program should be secured on an external data carrier or in hardcopy form.**

If the connections at connector X32 on the DLC are re-plugged from old to new within 30 seconds, then the data will not be lost. In conclusion, fix the new battery on the DLC plug-in module tightly into place.

9.6. Replacing the Forward Feed Motor

In the case of forward feed axes with indirect path measurements (path measuring system mounted to the motor), changes in the reference dimension can go unnoticed when replacing the forward feed motor.

⚠️ **Caution**	**Source of danger:** **When replacing the motor dimensions can be shifted unnoticed.** **Possible consequences:** **Damage to the machine.** **How to avoid:** • **Make note of the danger at the machine.** • **At the machine and in the machine file, make a note of markings at the geears, the machine slide or similar.**

Motors with relative position detection and keyways

The position of the zero point in INDRAMAT AC servo motors with keyways and relative position detection has been standardized. If the construction of the machine **excludes** any other type of coupling (e.g., direct coupling to the ball screw spindle), then it is possible to couple motor and ball screw spindle to each other in the same angular position.
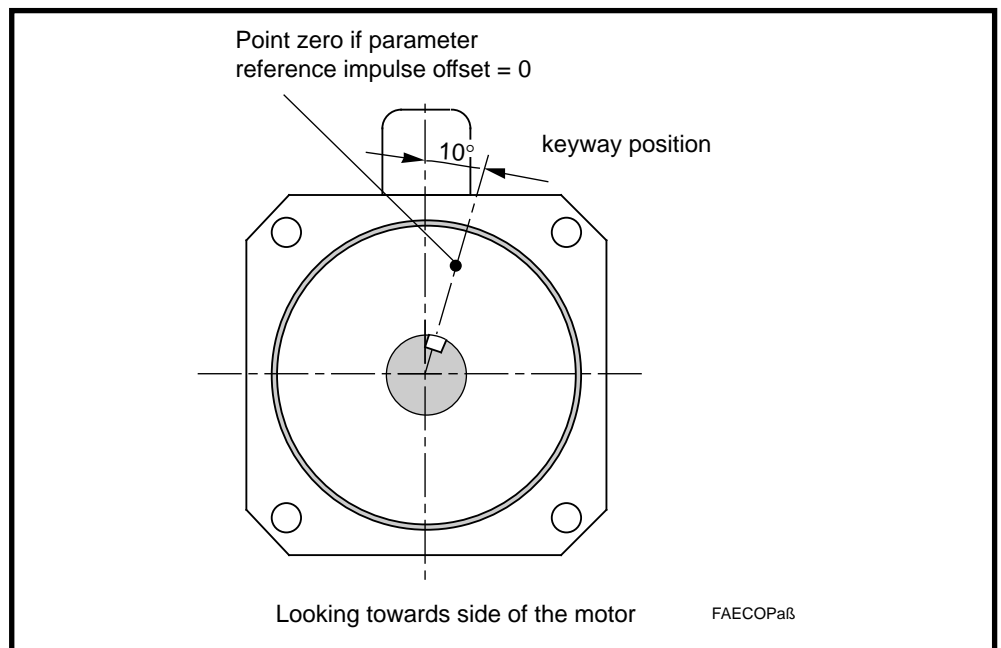
Fig 9.4: Zero point in motors with keyways

Motors with relative position detection without keyway

When replacing a motor, the reference dimensions shift within one motor revolution. This can cause damage to the workpiece, the tool or the machine. Gauging is, therefore, advisable each time a motor is replaced. Gauging is simplest if the machine is marked at specific reference points, i.e., the reference point is the first zero marker of the position encoder after the postive flank of the reference switch, or at any point with a known position.

A PC and the emulation software DDS2PC are needed for this gauging procedure. The reference offset can be read. No calculations are needed.

Gauging:
- Connect the RS 232 interface of the drive controller (X2) with the PC. Call up the DDS 2 PC emulation software.
- Reference the axes.

Source of danger:	**danger of collision**
Possible consequences:	**Damage to the machine is possible.**
How to avoid:	**Remove all obstacles between the actual and the reference position.**

After referencing, the reference dimensions are still shifted within one motor revolution (1 x feed constant).
- Move the axis in jog mode or manually to the marking.
- Switch parameter mode on at the DLC.
- Start the user interface of the drive controller at the PC and in menu 2 (parameter) call up submenu 2 (position evaluation).
- In submenu 2, degrees must be indicated in parameter return offset 0. Enter 0, if necessary.
- Read rotor position and enter the current angle (e.g., 215.0313 degrees) as the reference offset.
- Switch on setup mode at the DLC and reference the axis again.
- The axis should be located at the marker.

Measure the first workpiece after the motor has been replaced. Fine adjustment may be necessary.

Marking any point The position of the marker must be known. A CTA programming and display unit must be connected to the drive controller. It is now possible to calculate the reference offset.

Gauging:
- Reference axis

Source of danger:	**Danger of collision**
Possible consequences:	**Damage to the machine is possible.**
How to avoid:	**Remove all obstacles between the actual and the reference position.**

A reference cycle is described in section 8.1 in detail.

After the referencing, the reference dimensions remain shifted within one motor revolution (1 x feed constant).

- In jog mode, move the axis to a measured position and read the actual position from the CTA display.
- Select parameter A111 and enter the difference between the actual and command position.

  Input = A111 + (actual position - command value position)

  Note the qualifying signs!

  A111 is positive with   0*****.**

  A111 is negative with 1*****.**

  Example: A111= 1 0 0 1 0 0 . 0 0

                            command value position =400

                            actual position =   402.43

                            A111 = -00100.00 + [(+) 400 - (+) 402.43]

                            A111 = -00102.43

- Switch on setup mode and reference again.
- Run the axis to the measured position. The position in the CTA must agree with the command value position.

> **Measure the first workpiece after the motor is replaced as fine adjustment may be necessary.**
>
> **The value determined for parameter A111 should be documented outside of the control as well.**

Motors with absolute position determination

As a result of replacing a motor it is possible that the reference dimensions are inaccurate within the entire position detection range. To reestablish this reference dimension it is necessary to bring the forward feed axis to a measured position (note markings on the machine carriage).

Set the relevant dimension in parameter absolute encoder reference position (C007). See section 8.3 for details.

9.7.   Fault Report
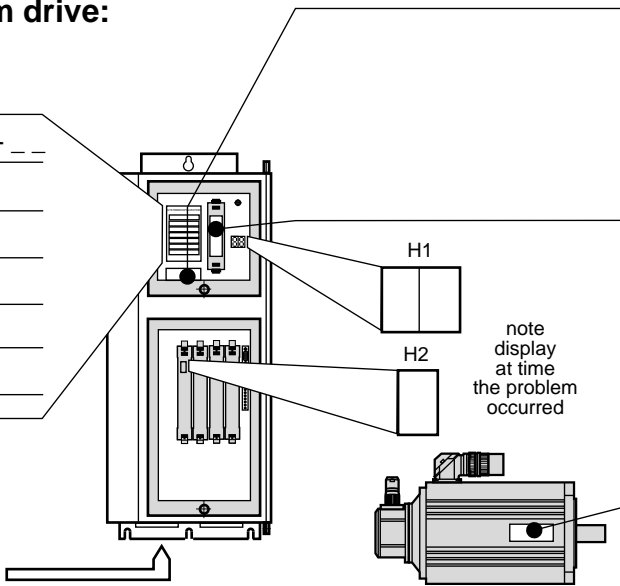
INDRAMAT	**Fault Report** **for digital AC Servo Dives DDC and MDD**	Part no. 259 355

This fault report must be used to locate and eliminate faults and their causes. It must be filled out in order to find and eliminate hidden, sporadic or application-specific problems.

- Include a fault report when sending in any repairs.

- Fault reports must otherwise be sent to the respective INDRAMAT office or to the INDRAMAT Quality Assurance address printed on the reverse side.

INDRAMAT would like to express its appreciation with a quick and thorough processing.

Fault report from:	Co.:	Location:	Date:
	Dept.:	Name:	Tele.:

Data on the problem drive:

Data on configuration rating plate:

DDC _._ - _ _ _ _ - _ _ - _ _

U5:

U1:

U2:

U3:

U4:

Input conn.:
one-phase ☐
two-phase ☐

Data on rating plate of basic unit:

DDC _._ - _ _ _ _ - _

S.No.: _ _ _ _ _ _ -

_ _ _ _ _ A _ _ S _ _

Software module data:

DSM _._ - _ _ _

S.No.: _ _ _ _ _ _ -

_ _ _ _ _ A _ _ S _ _

H1

H2

note display at time the problem occurred

Motor data:

Motor type:

Serial no.:

Data on the machine with breakdown:

Machine manuf.: _____ Type: _____ Hrs. operated: _____

Machine no.: _____ Comm. date: _____

Machine manuf. and type: _____

Designation of machine with breakdown: _____

Describe problem: _____

Additional info: _____

Problem:	Causes	Accompanying problems:	
☐ always present	☐ unknown	☐ problem in mech. sys.	Is there an air conditioner in control enclosure? Y/ N ☐
☐ present with commissioning	☐ connection error	☐ controller breakdown	
☐ occurs sporadically	☐ external causes	☐ motor breakdown	Have there been previous problems with this axis?
☐ occurs after ☐ hrs. approx.	☐ mechanical damage	☐ cable break	
☐ occurs with vibrations	☐ loose cable conn.	☐ blower defective	
☐ is temperature dependent	☐ moisture in unit	☐ feedback defective	How often: _____
	☐ extrinsic object in unit		
☐ Additional information: _____			Have the problems always occurred on certain days or times of the day? _____

PRStörDDCS1

Fig 9.5: DDC and MDD - fault report

Details on faulty controllers:

The function of digital drive controllers is determined by the configuration of software module and plug-in modules.
Problems can be caused by faulty modules or unpermitted configurations.
The following information is needed for a complete check in the event that the unit is not sent in with all its plug-in modules.

Configuration rating plate

Unit rating plate

Slot	
U5	Software module: DSM _._ - _ _ _ **U5** S.No.: _ _ _ _ _ _ - _ _ _ _ _ A _ _ S _ _
	Plug-in module: Error diagnosis: enter display at time problem occurred **H2:** **if given**
U1	**Type:** **SN:** **Software:**
U2	**Type:** **SN:** **Poss. software:**
U3	**Type:** **SN:** **Poss. software:**
U4	**Type:** **SN:** **Poss. software:**

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Dept. QSP
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GERMANY

PRStörDDCS2

Fig 9.6: Fault report

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Indramat