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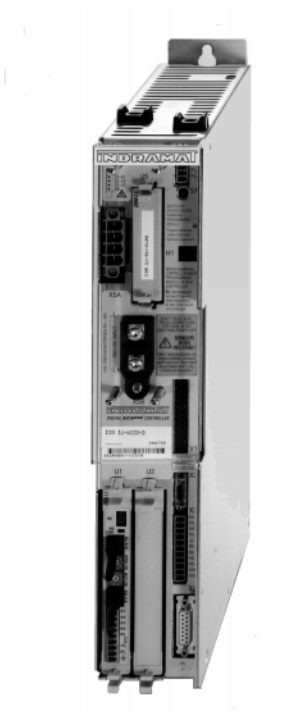

DDS 2.1/3.1 and MDD
Digital intelligent AC servo drives with SERCOS interface

Application Manual

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This documentation is used: This documentation is intended for trained commissioning personel and serves
- as a practical instruction manual for commissioning the digital AC servo drive via a SERCOS-compatible NC control unit.
- to parametrize the drive controller.
- to save drive parameter data.
- as an aid in diagnosing and clearing errors and faults in the digital AC servo drive.

This document is intended for trained maintenance personnel and serves
- as an aid in identifying fault sources.
- as a practical instruction manual for rapid fault clearance.
- for effective consulting with the machine manufacturer or INDRAMAT customer service department.

Meaning of the symbols used in this documentation

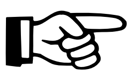
Symbol	Meaning	Explanation
	**Risk of injury to persons and damage to machinery**	Instructions or DOs and DON'Ts for the prevention of accidents and damage to equipment.
	**Note:**	Text passages marked with this symbol contain special notes or DOs and DON'Ts relating to accident prevention.

Fig. 1: Risk of injury to persons and damage to machinery

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1. The digital intelligent AC servo drive

Digital intelligent AC servo drives are microprocessor-controlled brushless three-phase AC drives with outstanding servo control characteristics in terms of dynamic response and precision.

Excellent performance data, flexible operating modes and applications-orientated functions offer the ideal pre-requisites for:

- CNC machine tool axes
- Electronic transmissions, e.g. for gear milling machines
- Grinding machines
- Robots
- Handling systems
- Assembly equipment
- Woodworking machines
- Packaging machines
- Textile machines
- Printing machines

All drive control, monitoring, parametrizing and diagnostics functions are digital - employing a signal processor - with an extremely high-resolution measurement of the rotor position over the entire speed range.

INDRAMAT digital intelligent AC servo drives can be supplied with either of two interfaces:

- SERCOS interface
- ANALOG interface
- Single-axis positioning module

SERCOS interface

Series DDS 2.1 drive controllers with SERCOS interface enable the operation of digital intelligent AC servo motors using control units equipped with a SERCOS interface. The SERCOS interface is a serial real-time communication system. The control unit and the drives are connected in a ring by means of fibre-optics cables which serve as paths for serial data exchange between the control unit and the drives.

The SERCOS interface has been proposed for standardization in a draft standard (DIN IEC/TC 44) drawn up by a joint workgroup made up of representatives from the Verein Deutscher Werkzeugfabriken e.V. (VDW) [Association of German Machine Tool Factories] and of the trade association for Electrical Drives of the Zentralverband Elektrotechnik und Elektroindustrue e.V. (ZVEI) [Central Association of Electrical Engineering and the Electrical Industry].

The possible operating modes are:

- position loop
- velocity loop
- torque loop

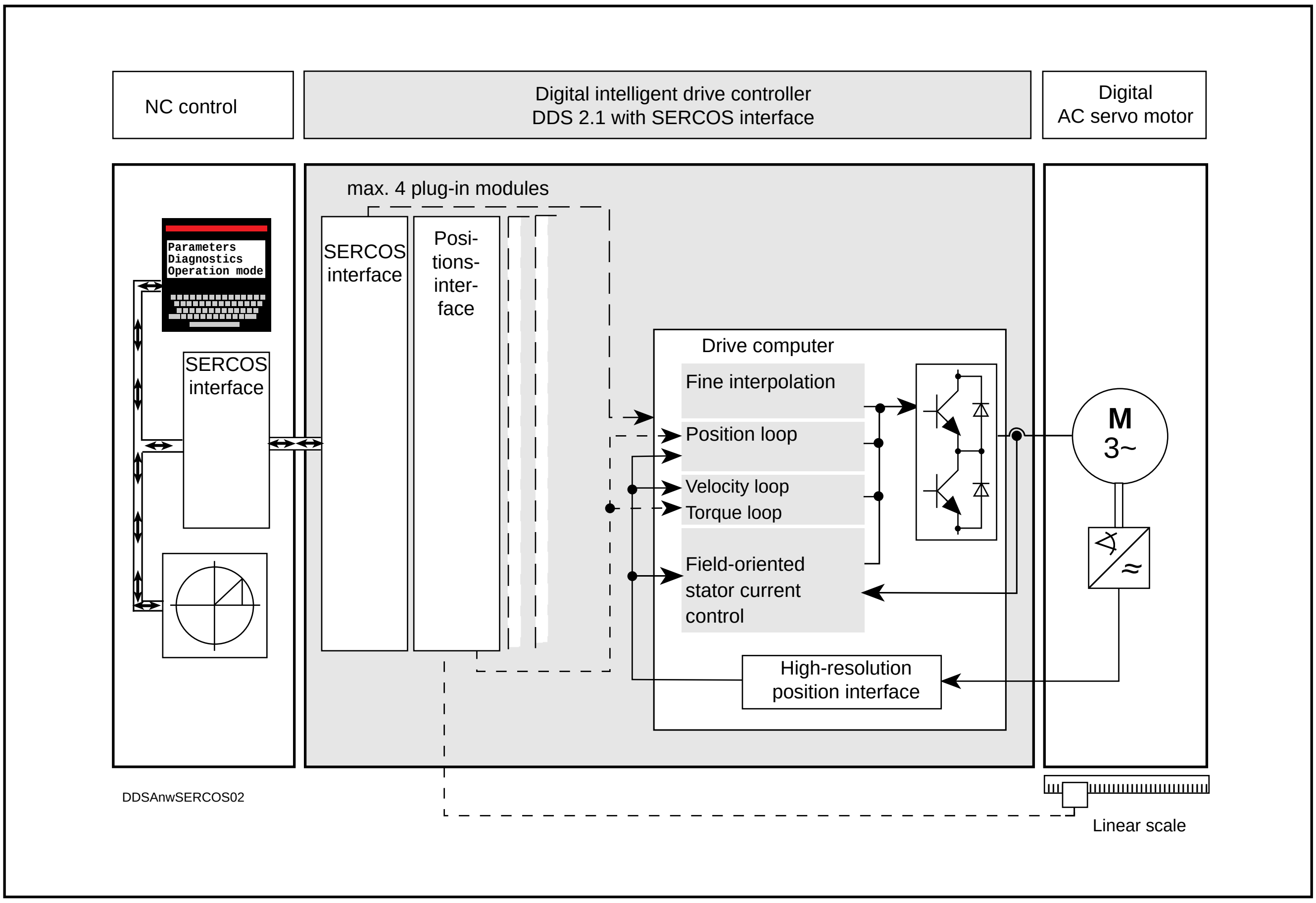


Fig. 1.3: CNC axis with digital three-phase AC servo drive and SERCOS interface

The full range of possibilities and benefits of digital intelligent drives can only be exploited through the SERCOS interface.

These include:

- Display and entry of all internal drive data, parameters and diagnoses via the SERCOS terminal of compatible NC controls.
- Exploitation of the high speed resolution of 0.0001 rpm up to maximum speed.
- Exploitation of the drive's internal fine interpolation and position control loop (cycle time 0.250 ms, resolution 0.00001 mm to 180 m/min with linear scales with a graticule constant of 20 μm free of following error) for positioning, contouring and C-axis mode including the high-velocity range.
- Normalization of position, velocity, acceleration and load data as well as adaptation of machine parameters, such as gearbox, spindle pitch, etc.
- Reducing the complexity of NC controls, wiring and position encoders.

ANALOG interface

DDS 2.1 Series drive controllers with ANALOG interface allow digital intelligent AC servo drives to be operated by conventional NC controls with a ±10V analog interface.

The possible operating modes are:

- velocity control loop
- torque control loop (for master/slave mode)

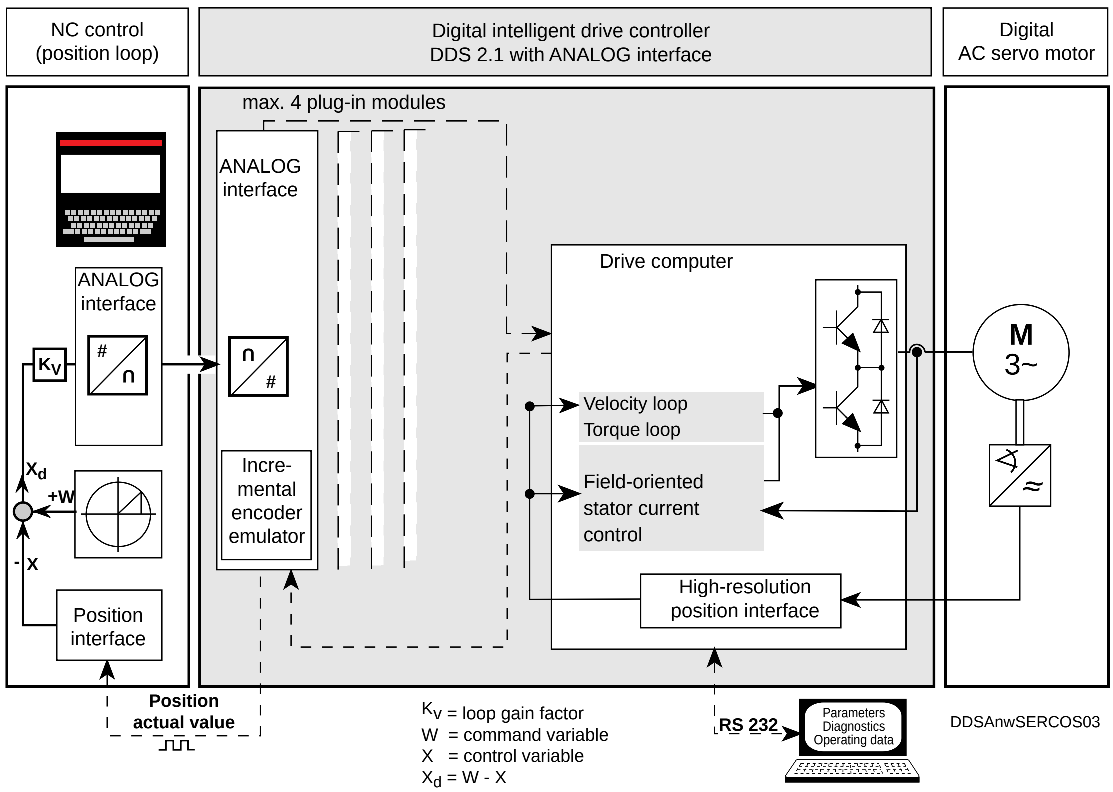


Fig. 1.4: CNC axis with digital three-phase AC servo drive and ±10V ANALOG interface

Digital servo drives with ANALOG interface differ from analog drives by the following functional features:

- Output of the rotor position either as an incremental encoder signal or an absolute position encoder signal for use as a position actual value in the NC control, thus providing benefits such as:
  – elimination of an additional measuring system with wiring.
  – shortening the overall dimensions of the motor.
- Effortless matching of the resolution of the position encoder signal to different machine and NC control configurations due to parametrization.
- Drift-free positioning after stopping of the digital AC servo drive via a switching input. The stopping position is maintained by the drive's internal velocity loop as long as the drive controller is active.
- Control and monitoring of the holding brake through the drive controller.

Single-axis positioning control

The drive controllers can be turned into intelligent digital single-axis positioning controls by equipping them with the DLC 1.1 positioning module.

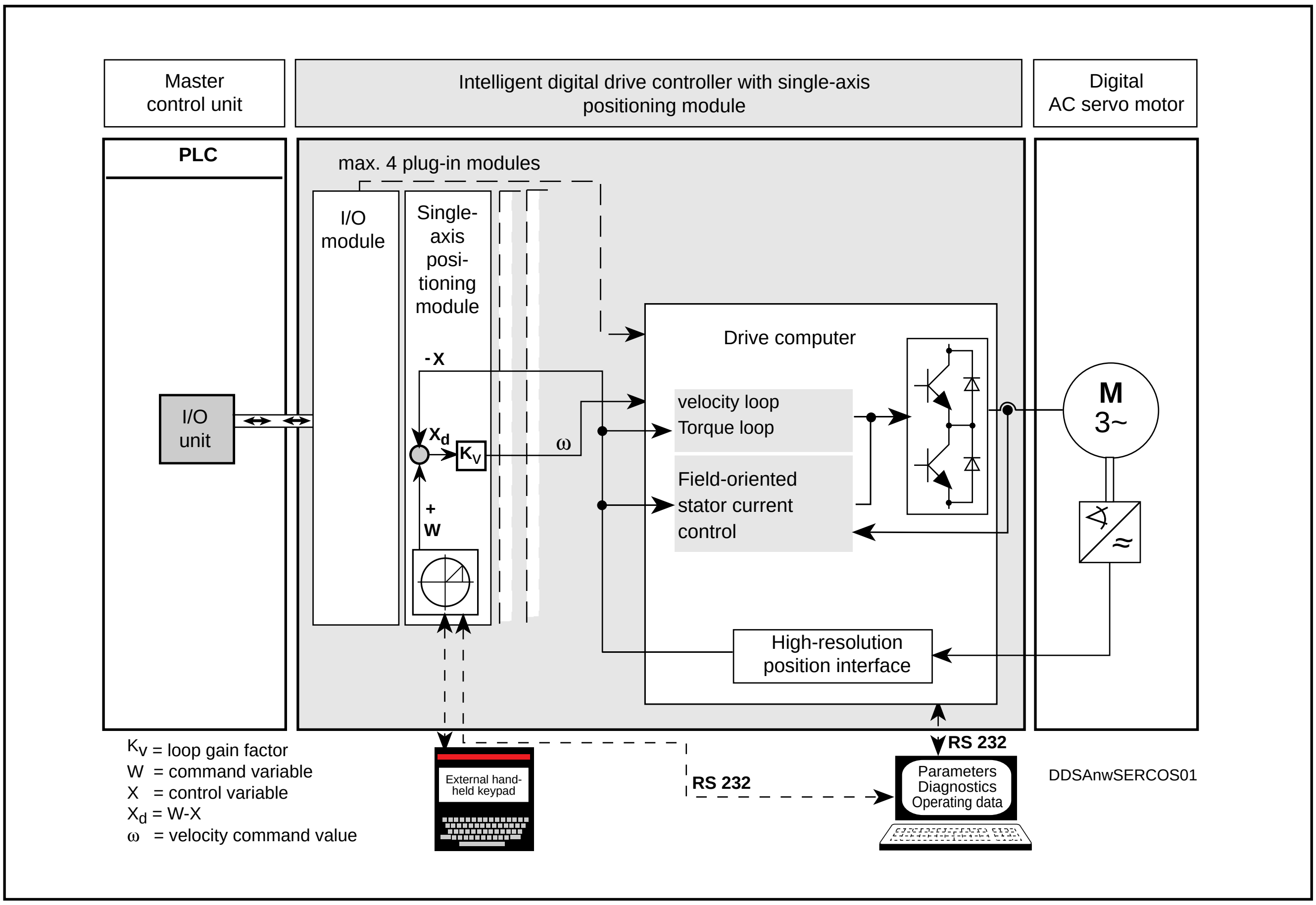


Fig. 1.5: CNC axis with digital AC servo drive and DLC 1.1 positioning module (single-axis positioning control)

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

- user-oriented programming language
- simple input of up to 3000 programming command sets, e.g.
  – target position
  – velocity
  – input monitoring
  – output setting commands
  – motion sequences
- Monitoring of the current motion sequence while executing the next programmed command set
- Adaptation of the drive to the mechanical and electrical machine configuration through parameter input
- Monitoring of the parameter sets entered as to errors and adherence to the specified system limit values
- Various parametrizing/programming options provided by
  – CTA programming keyboard
  – IDS decade switch unit
  – Master PC
  – SOT programming terminal
  – Master PLC

2. The digital intelligent AC servo drive with SERCOS interface

Digital intelligent AC servo drives are of modular construction.

The modular principle allows flexible combination of AC servo drives and AC main spindle drives of different power ratings to form compact drive packages with one common power supply module.

A digital intelligent AC servo drive consists in each case of a carefully matched combination of AC servo motor MDD and a DDS drive controller.

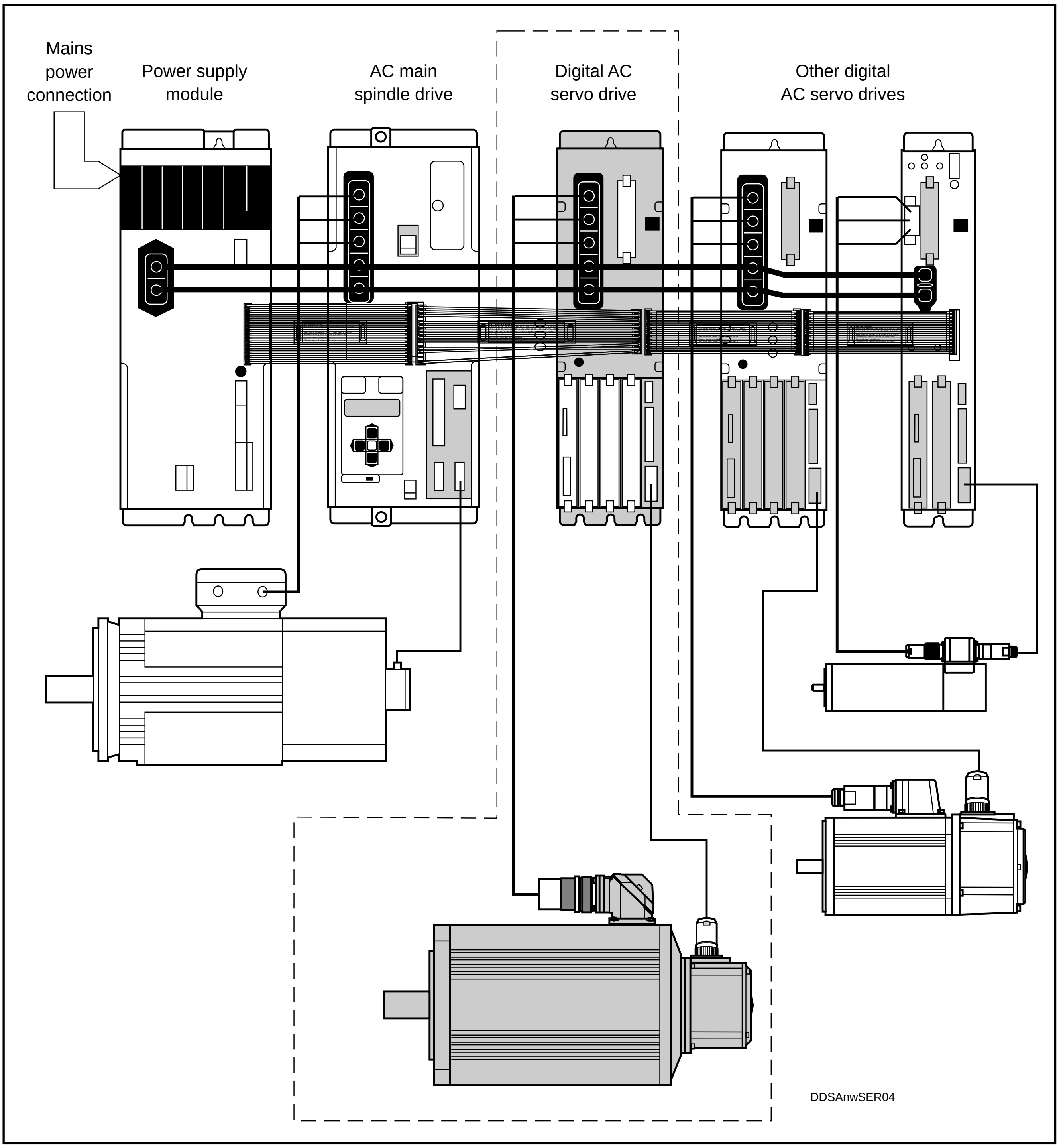


Fig. 2.1: Digital AC servo drives combined to form a modular drive package

2.1. Components of the digital AC servo drive

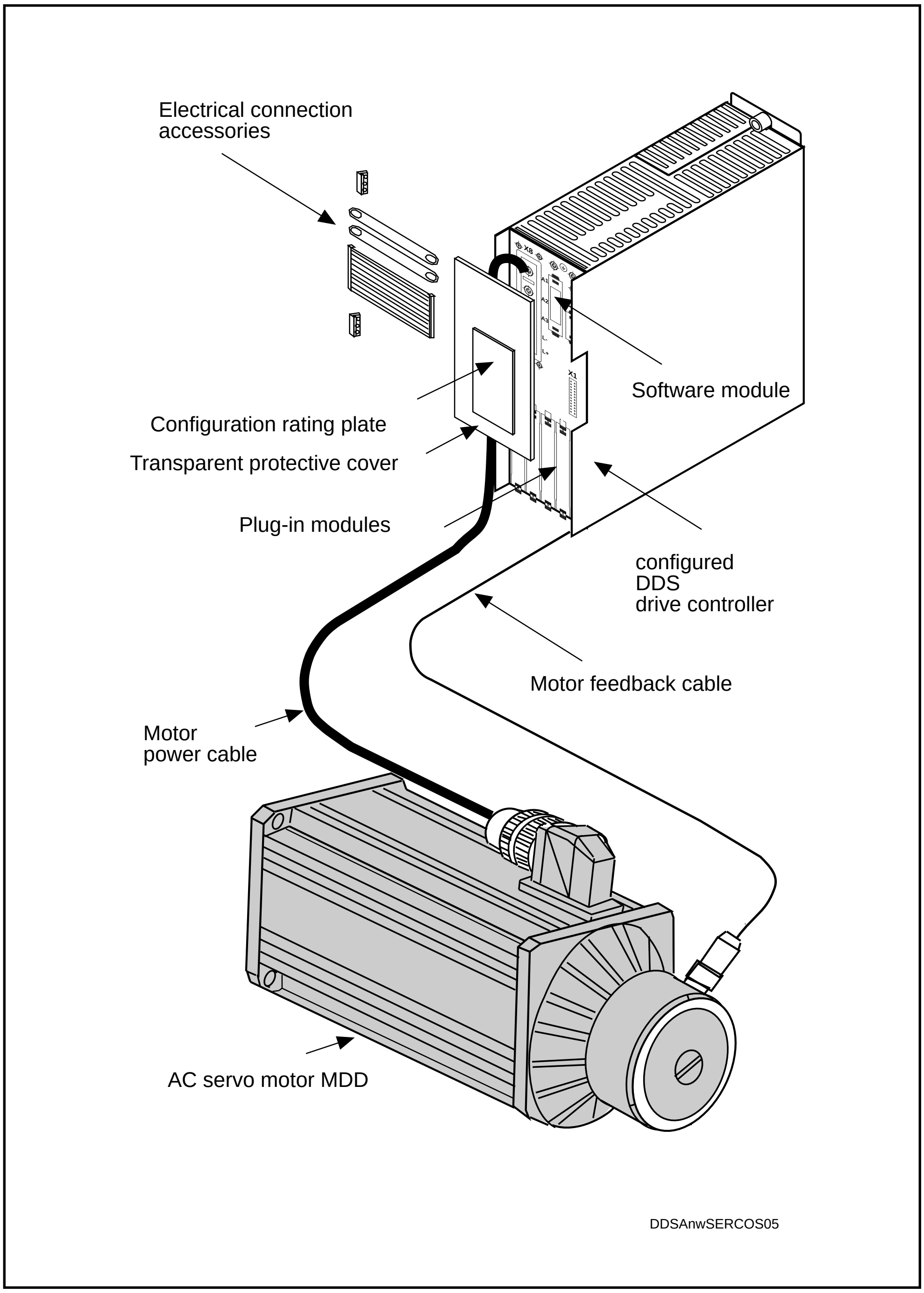


Fig. 2.2: Individual components of a digital AC servo drive with their designations

2.2. Function schematic of the digital AC servo drive

The interaction of an NC control with an analog command output and the digital AC servo drive with SERCOSinterface is illustrated in Figure 2.3.

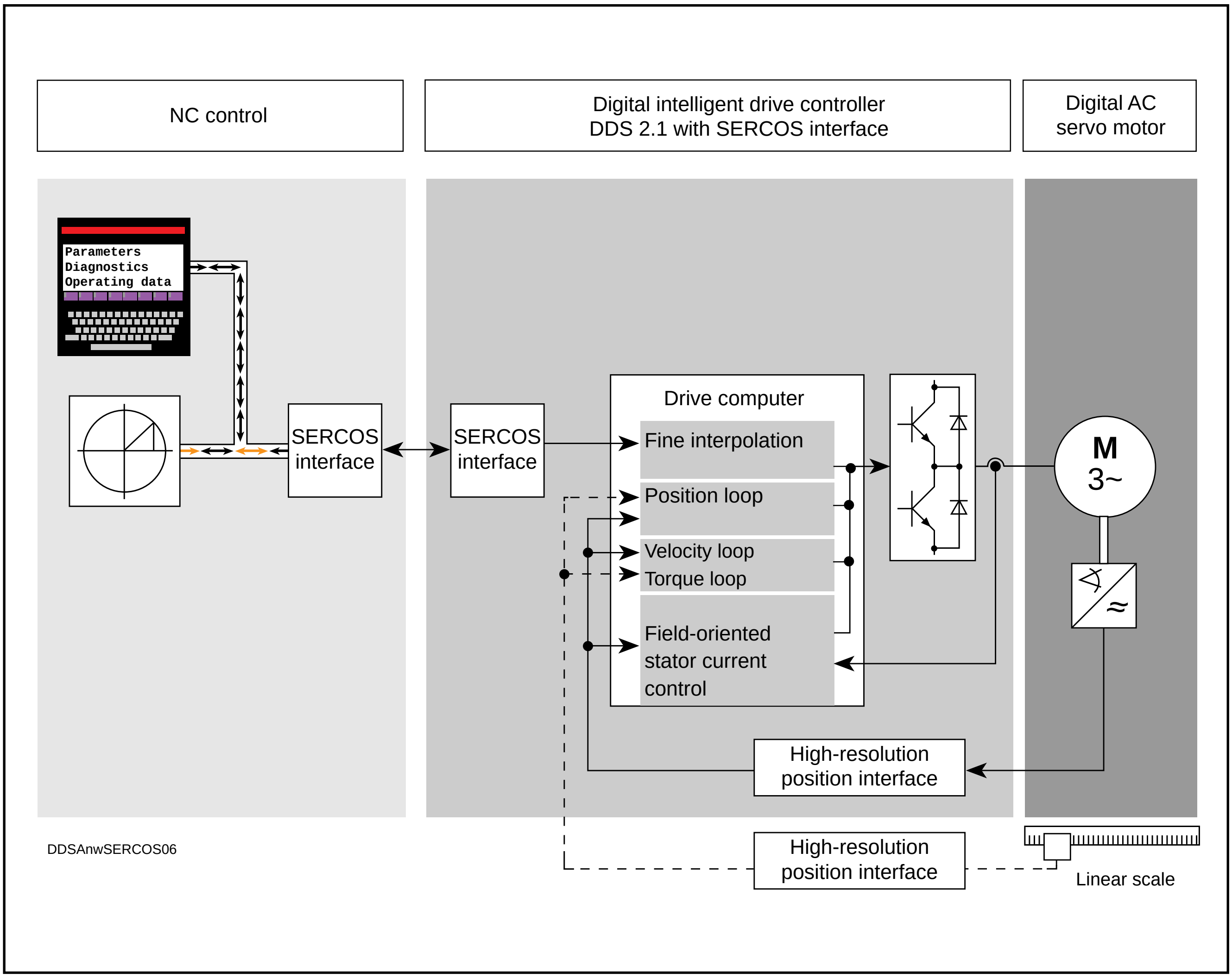


Fig. 2.3: Interaction of NC control, digital drive controller and digital servo motor

2.3. System configuration of the digital AC servo drive

To fulfil a given task, the drive controller, basic unit and individual components are combined together to form a configured drive controller.

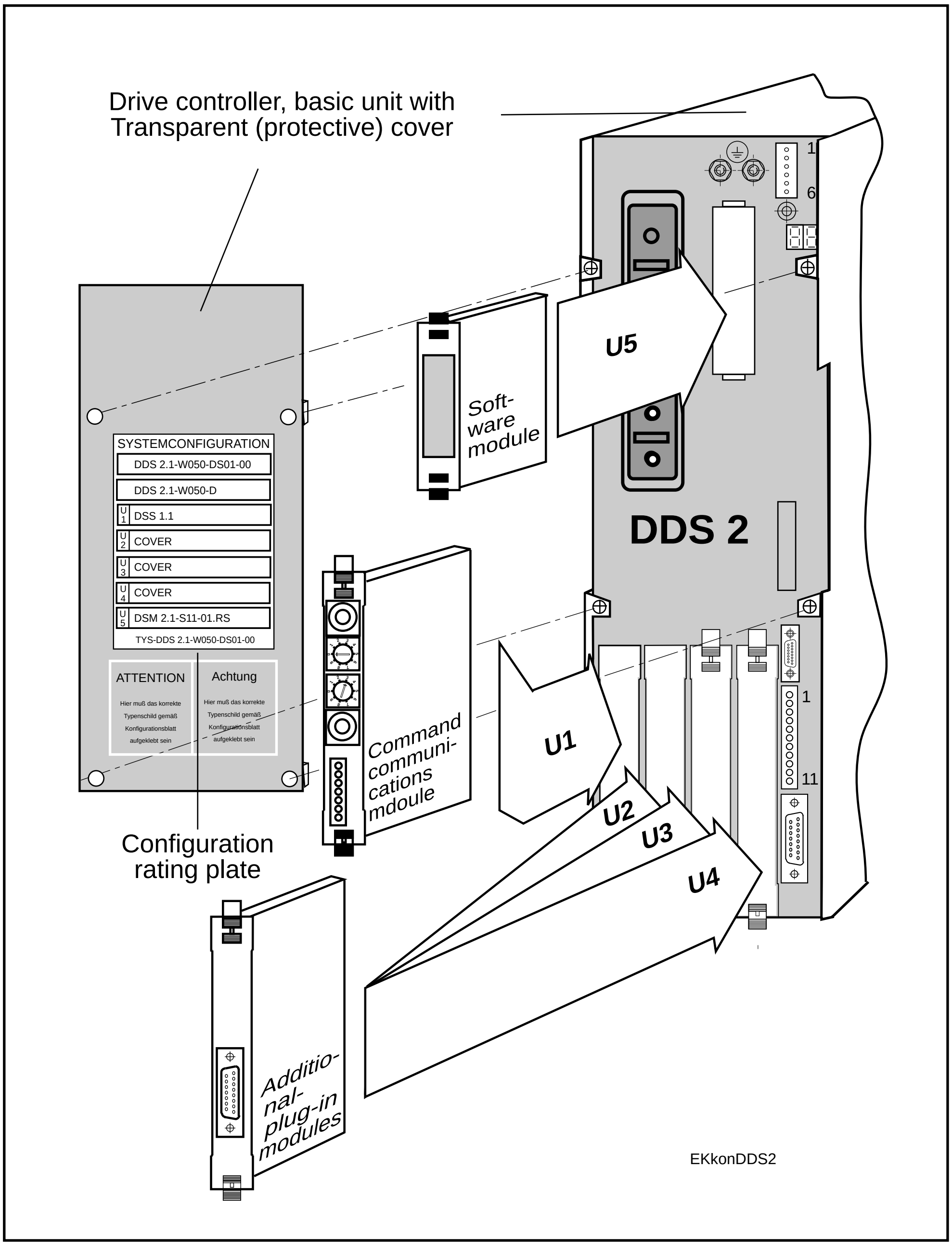


Fig. 2.4: Components of a configured drive controller

The constituent parts of a configured drive controller are:

- Drive controller (basic unit)
- Software module
- Command communication module
- Additional plug-in module
- Transparent (protective) cover
- Configuration rating plate

The individual components are described in Section 2.4.

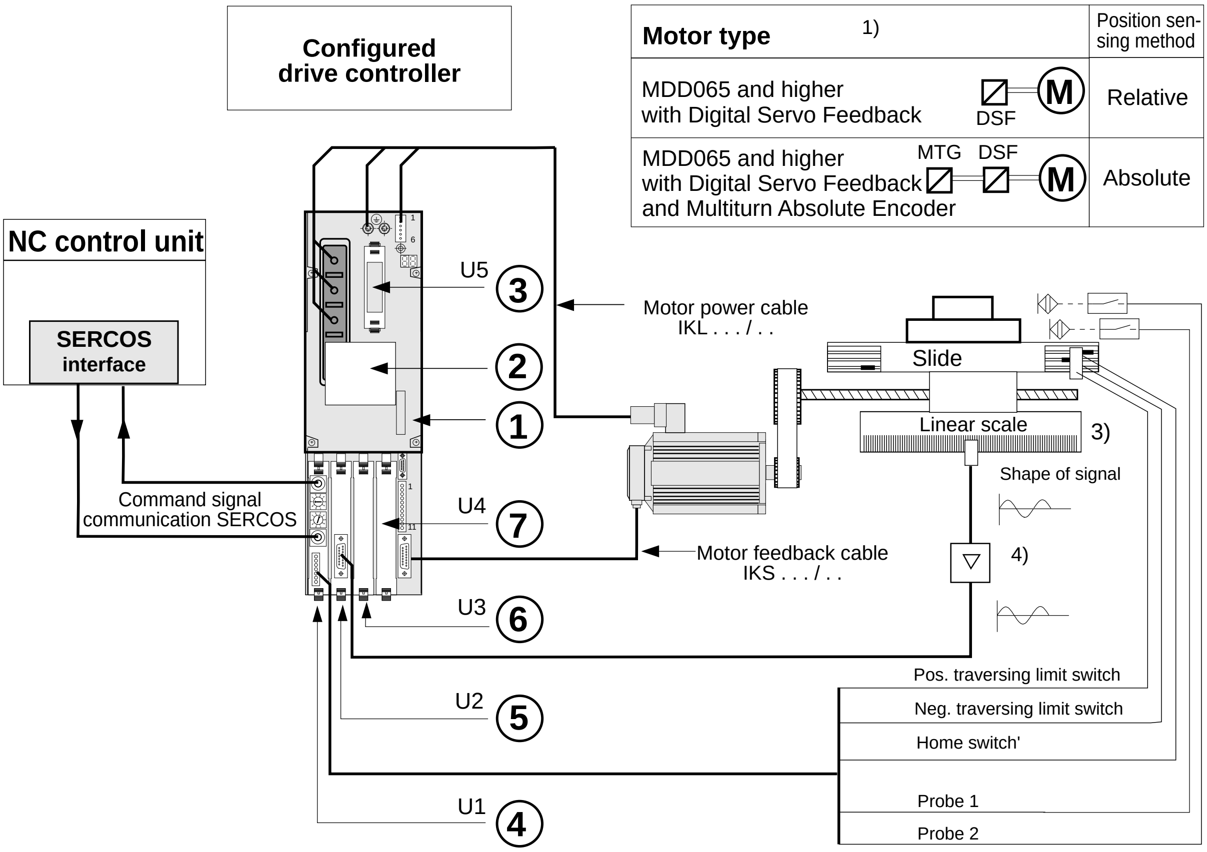
1. A configured drive controller used in combination with an AC servo motor and a particular method of position sensing is termed a system configuration. Each type of system configuration is documented in a configuration data sheet and assigned an alphanumerical code (e.g. DS 04).

DS 04 is the name used for a digital intelligent AC servo drive with SERCOS interface and direct position sensing (see Fig. 2.5).

INDRAMAT supplies drive controllers completely equipped according to the desired function.

The complete range of tried and tested system configurations (drive controllers) is given in the documentation „DDS 2 digital intelligent AC servo drives / System Configurations“, Doc. No. 209-0069-4312-00.

Digital intelligent AC servo drive with SERCOS interface and direct position sensing	System configuration Configuration sheet	DDS DS04-01



A drive controller will only deliver the desired function when it has been completely assembled according to the configuration parts list!

Type designation of the completely configured drive controller: DDS 2.1 - . . . .[2)] - DS04 - 01

Cooling method — Current rating

Configuration parts list:

Item	Description	Type designation	Slot No.
1	Drive controller / basic unit [2)]	DDS 2.1- . . . . -D	-
2	Configuration plate (sticker)[2)]	TYS-DDS 2.1 - . . . . - DS04 - 01	-
3	Software module	DSM 2.1-S11-01.RS	U5
4	SERCOS interface	DSS3.1	U1
5	High-resolution position interface	DLF1.1	U2
6	-	-	U3
7	-	-	U4

1) The type of motor is chosen among those in the Selection List

2) The type of drive controller is chosen among those in the Selection List.
Enter the cooling method and the current rating in the type designation.
These data are also given on the configuration plate.

3) For appropriate types of linear scales see Doc. No. ...

4) The Line Driver type DGV 1.1 is required for line lengths over 30 m only.

DDSAnwSERCOS08

Fig. 2.5: Example of a system configuration

Name plate Configured drive controller

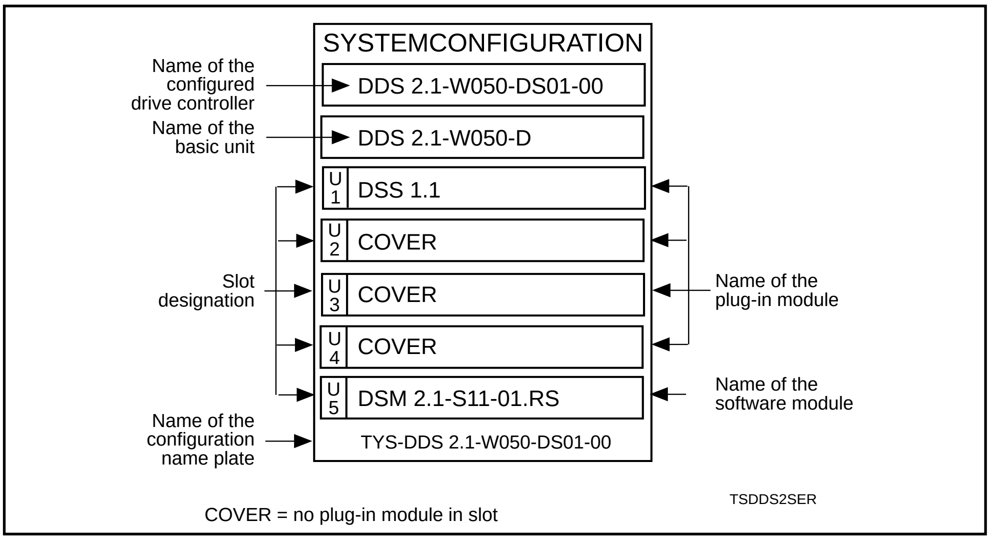


Fig. 2.6: Example: Name plate of a configured drive controller

Type code Configured drive controller

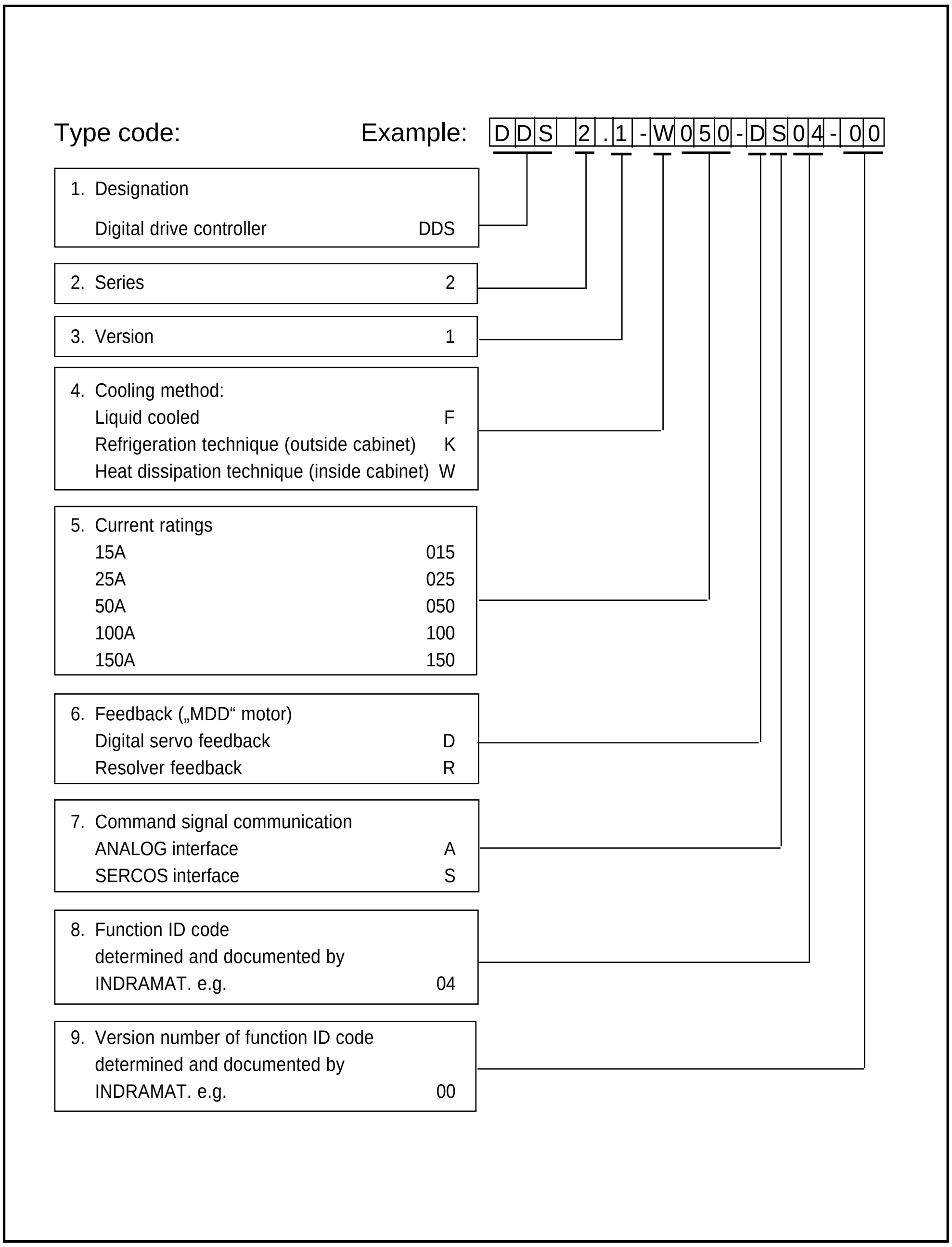


Fig. 2.7: Type code explaining a configured drive controller

2.4. System configuration components

A system configuration consists of a "configured drive controller" and an "MDD servo motor".

Drive controller, basic unit

The basic unit is equipped with different modules to make up a configured drive controller.

The basic unit is available in two different unit widths and with different current ratings:

- 70 mm for DDS 3
  - Current rating: 30 A, 50 A
  - two slots for plug-in modules
- 105 mm for DDS 2
  - Current rating: 15 A, 25 A, 50 A, 100 A, 150 A, 200 A
  - four slots for plug-in modules

Designations of DDS 3 basic unit features

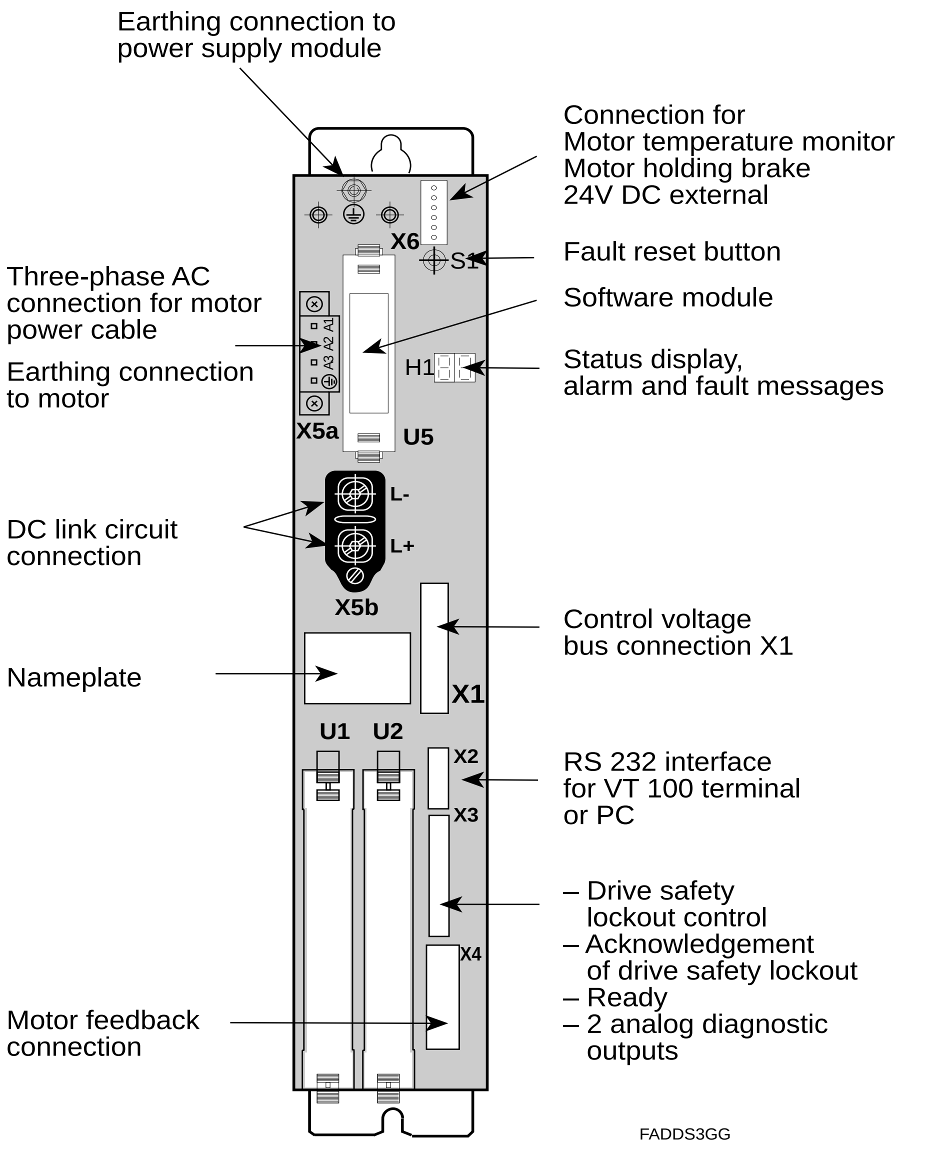


Fig. 2.8: Designations of DDS 3 basic unit features

Designations of DDS 2 basic unit features

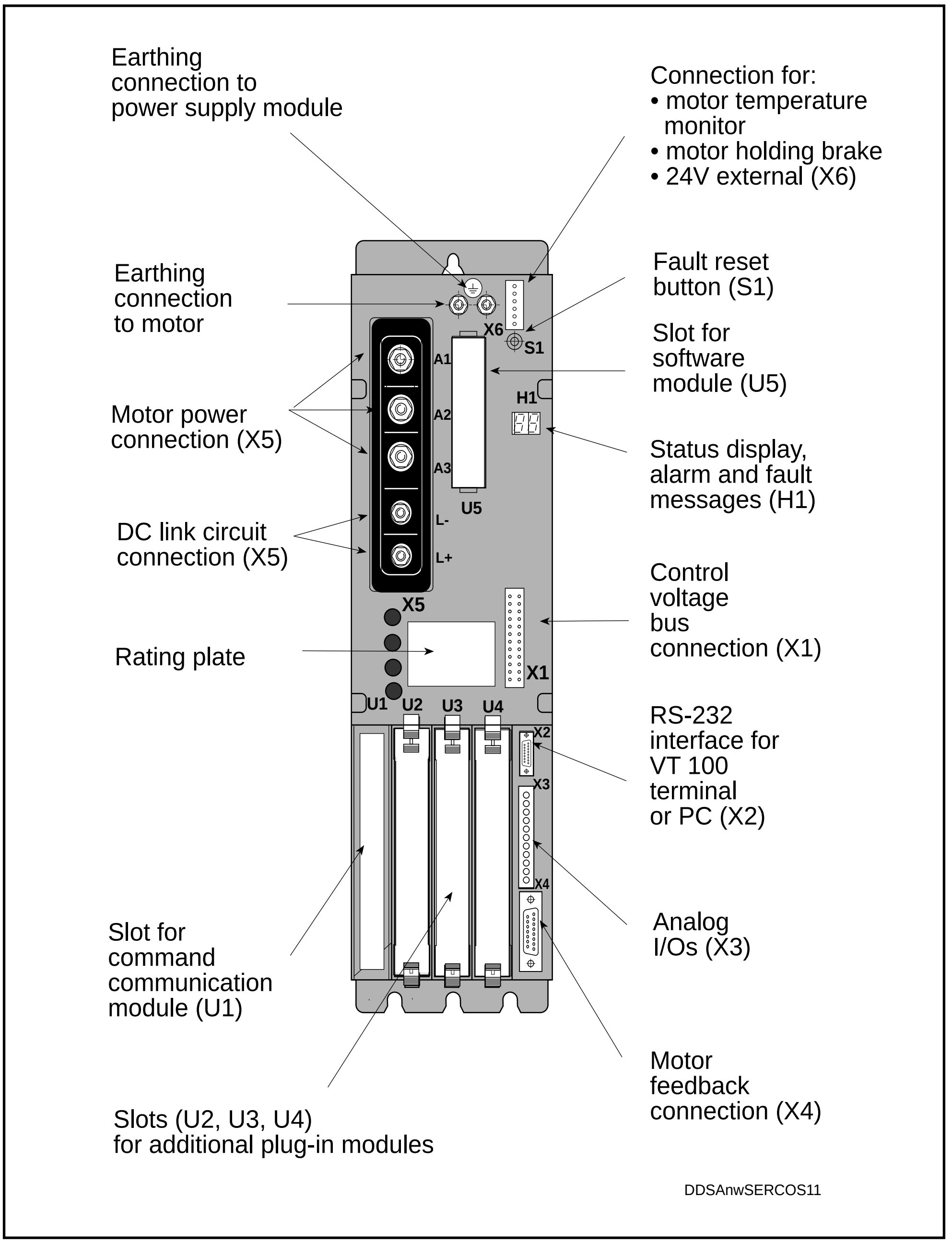


Fig. 2.9: Designations of DDS2.1 basic unit features

Name plate Drive controller Basic unit

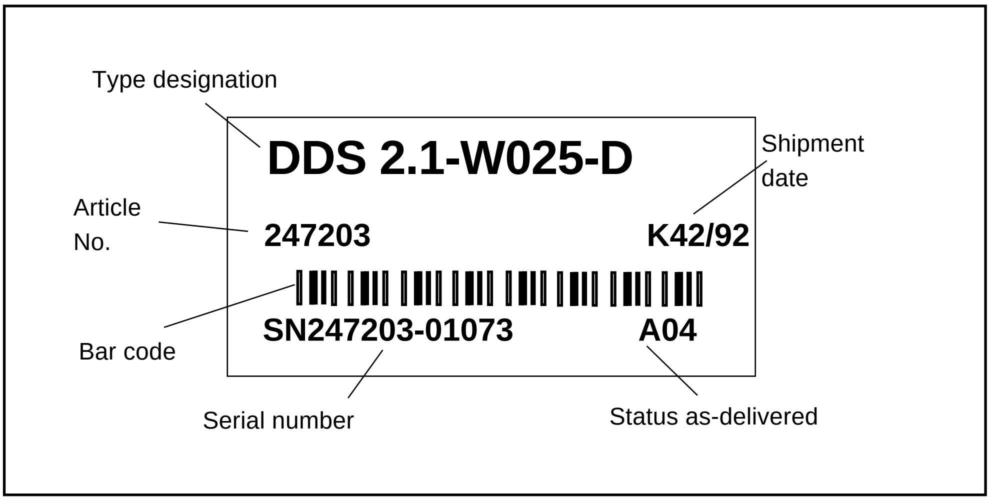


Fig. 2.10: Name plate of a drive controller, basic unit

The name plate is located on the front panel of the basic unit (Fig. 2.8/2.9).

Type code Drive controller Basic unit

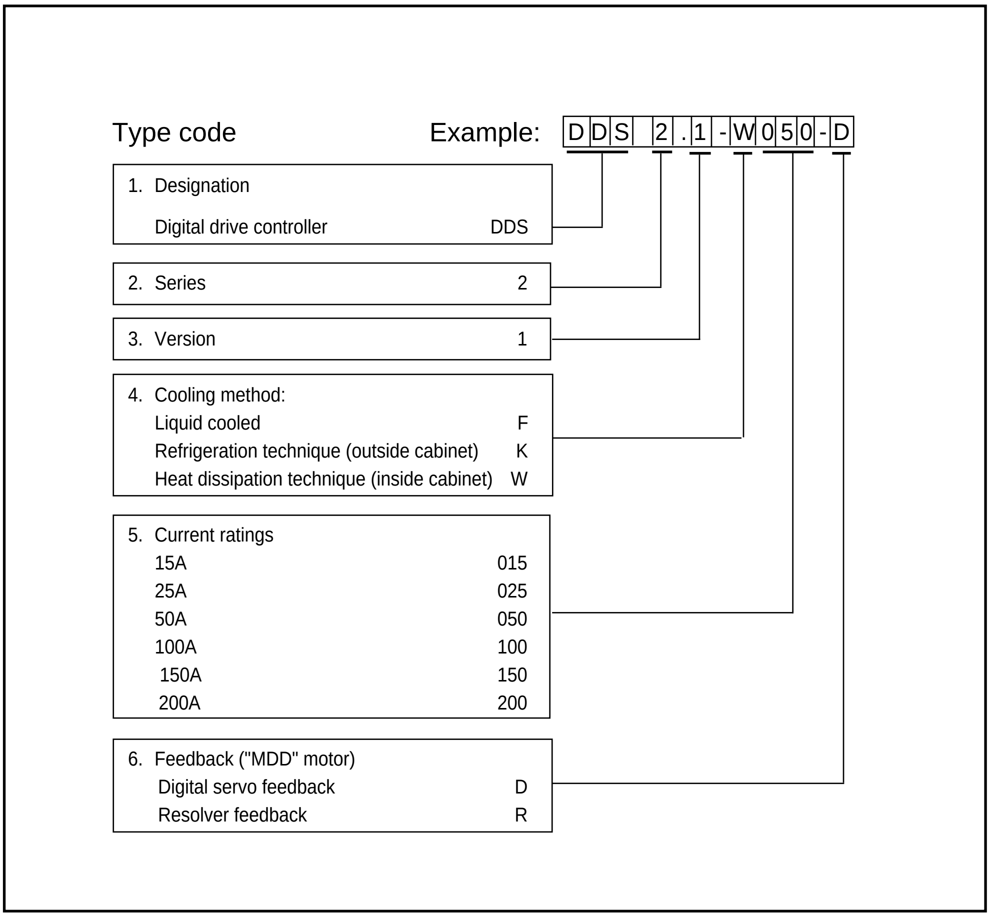


Fig. 2.11: Type code explaining the drive controller basic unit.

Software module

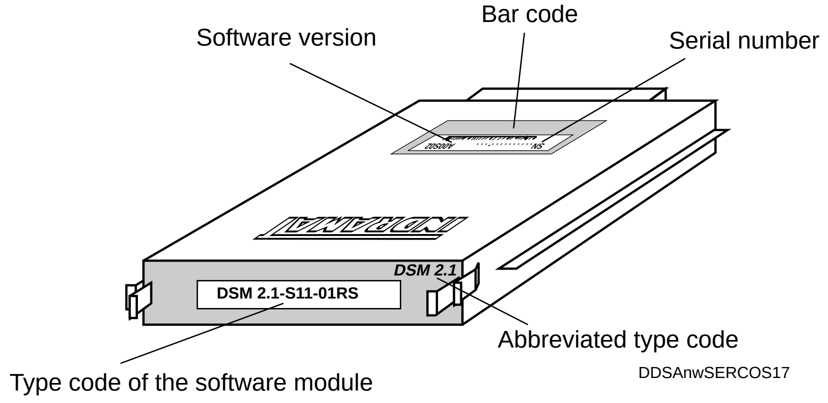


Fig. 2.12: Designations of software module features

Matching of the drive controller to the motor and of the AC servo drive to the machine mechanics is done by means of parameters stored in the software module.

Benefit in the event of unit replacement

The software module stores the operating software and the parameters. If a unit has to be replaced, the new drive controller does not require to be matched to the motor or the machine. This is done automatically by plugging in the old software module into the new drive controller.

Duplication

Software modules can be duplicated for use on other identical machines or for security purposes. Duplication is done using the serial interface.

Standard software modul

The **drive-related parameter values** calculated by INDRAMAT are stored in the motor feedback and are activated on request during commissioning. **Application-related parameters** are set on site to machine-dependent values.

The documentation and management of application-related parameters is the responsibility of the customer.

Compatibility of software modules

The latest state of the art (software module update) for operation of the drive is supplied without any change being made to the ordering code (type designation) of the software module. Updated software modules are compatible with software modules already in the field.

Name plate
Software module

DSM 2.1-S11-01.RS

Fig. 2.13: Name plate, software module

Type code
Software module

Type code fields: Example: D S M 2 . 1 - S 1 1 - 0 1 . R S

1. Designation	
DSM	DSM
2. Series	2
3. Version	1
4. Software type	
ANALOG interface (asynchronous motors)	ASM
ANALOG absolute (DAA1.1)	A11
Single-axis positioning control (DLC 1.1)	C11
SERCOS (el. transmission, asynchronous motors)	ELA 1)
SERCOS (el. transmission, MDD)	ELS 2)
ANALOG incremental (DAE1.1)	E11
SERCOS (linear drive)	LNS
SERCOS (el. transmission LAF, LAR)	LSA 3)
SCARA direct drive	SDA
SERCOS (Twin-axis alternation)	SZU
SERCOS (Standard)	S11
5. Software-Version	
01	01
6. Software release (up-date) (the latest update is automatically supplied)	RS

1) Electronic transmission, standard gears for asynchronous motors „1MB“, „2AD“ and „MBW“.

2) Electronic transmission, standard transmission for „MDD“ servo motor

3) Standard transmissions for „LAF“ and „LAR“

Fig. 2.14: Type code explaining the software module

Command communication module SERCOS interface

The SERCOS interface module in the DDS 2.1 drive controller enables communication in the fibre-optics ring between the NC control unit (master), the drive controllers (slave) and the machine axis.

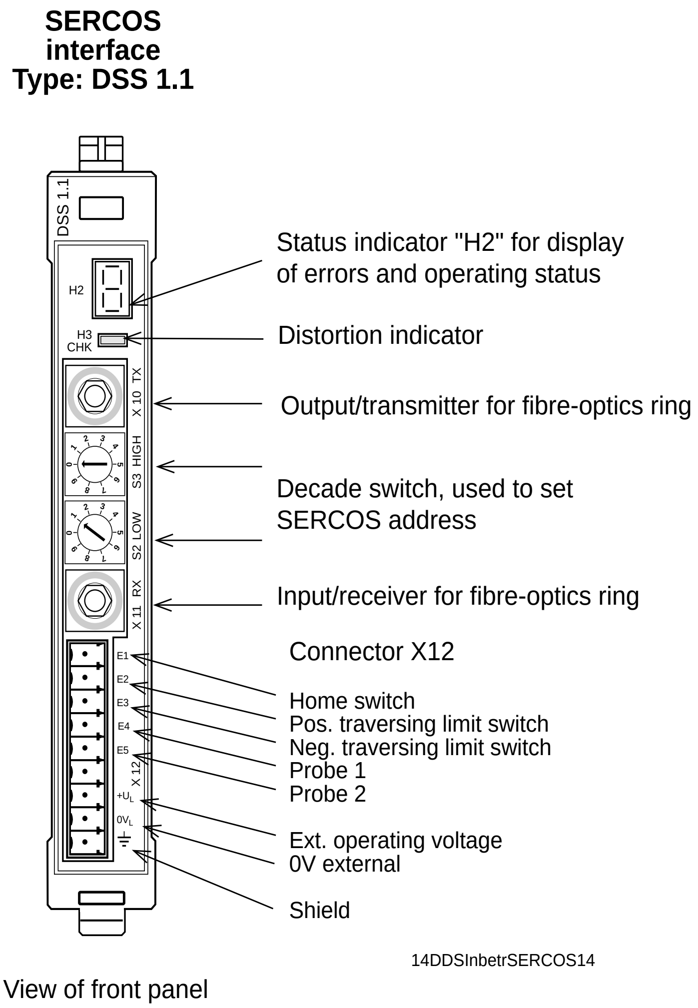


Fig. 2.15: Designations of SERCOS interface features

Type code Command communication module

Type code fields: Example: D S S 1 . 1

1. Designation

Digital ANALOG interface with absolute encoder emulator	= DAA
Digital ANALOG interface with incremental encoder emulator	= DAE
Digital SERCOS interface..	= DSS
Single-axis positioning module	= DLC
Control card =	CLC-D

2. Series 1

3. Version 1

Fig. 2.16: Type code explaining the command communication module (for current status see Project Planning document Doc. No. 209-0069-4356-00).

Plug-in extension modules Excerpt from the range of plug-in extension modules.

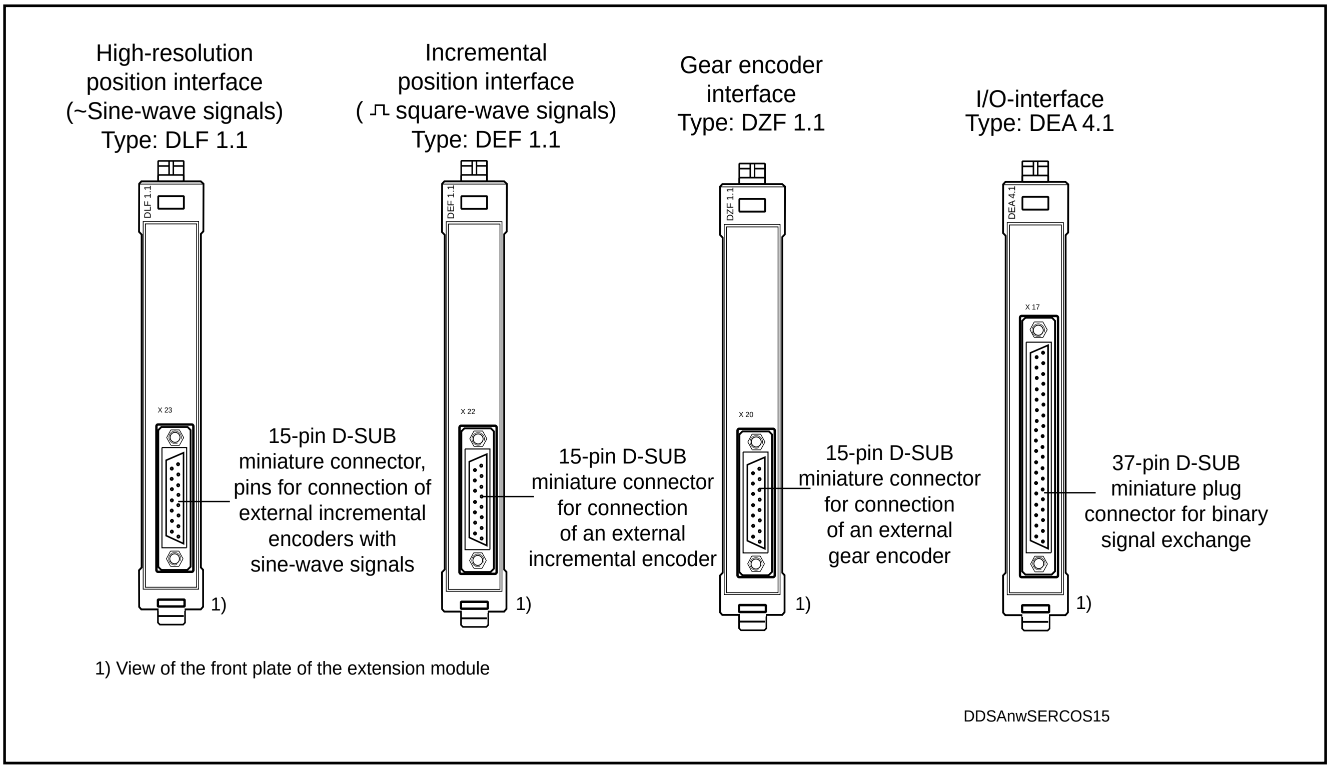


Fig. 2.17: Additional plug-in modules for DDS 2.1 with SERCOS interface

DLF 1.1. The extension module "High-resolution positioning interface DLF 1.1." serves as the link-up to the drive controller for sine signals for the acquisition of data from an external measuring system installed directly on the moving machine element.

DEF 1.1.
DEF 2.1. Extension modules "Inkremental positioning interface DEF 1.1. and DEF 2.1." serve as the link-up to the drive controller for square-wave signals for the acquisition of data from an external measuring system installed directly on the moving machine element. The difference between them is the set address range, which allows both modules to be plugged into a drive controller to give the DS05 system configuration (dual-axis changeover).

DZF 1.1. The extension module "Gear encoder interface DZF 1.1" is used to evaluate position feedback values from an external gear encoder.

DEA 4.1. The extension module "I/O interface DEA 4.1" is a parallel input/output card (15 inputs, 16 outputs) that enables the drive to exchange binary signals with a PLC. This allows setting of drive operating conditions or accessing of jog inputs. The signals applied to this card are transmitted to the NC control unit via the SERCOS fiber-optics conductor circuit.

Technical data and connector pin allocations can be found in the project planning documentation, Doc. No.: 209-0069-4317-00.

Type code Additional plug-in module

Type code fields: Example: D L F 1 . 1

1. Designation

Designation		
Interbus-Slave (I/O) interface	=	DBS
I/O interface	=	DEA
Incremental position interface (square-wave signals)	=	DEF
Digital servo feedback encoder interface	=	DFF
High-resolution position interface (sine wave signals)	=	DLF
Communication module for anti-backlash drive	=	DQM
Analog signal interface (for resolver connection/analog inputs)	=	DRF
Summation input interface	=	DSE
Gear encoder interface	=	DZF
Plug-in control for digital drive controllers	=	CLC-D

2. Series 1

3. Version 1

Fig. 2.18: Type code explaining the additional plug-in modules (for current status see Project Planning document Doc. No. 209-0069-4356-00)

Digital AC servo motors

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

- Motors with "digital servo feedback" (DSF)
- Motors with "digital servo feedback and multi-turn encoder" (DSF + MTG)
- Motors with "resolver feedback" (RSF)
- Motors with "resolver feedback and multi-turn encoder" (RSF + MTG)

Motors are used for different applications in accordance with their properties:

Properties

Description	**Digital servo feedback**	**Resolver feedback**
Sensor principle	Optical scanning of a code disk	Three-phase transformer with angle-dependent coupling ratio
Maximum position resolution	256 x 2^{13} = 2 097 152 increments/revolution	MDD ≤ 041 ⇒ 2x2^{13} = 16384 MDD ≥ 065 ⇒ 3x2^{13} = 24576 increments/revolution
System accuracy	± 0,5 angular minutes	± 7 angular minutes
Home switch	1x per 360°	1x per 180°
Home switch offset	0 ... 360°	0 ... 180°
Multi-turn version, sensing range	4096 rotor revolutions	4096 rotor revolutions
Available on motor series:	MDD 065 to MDD 117	MDD 021 to MDD 117
Suitable for applications with:	High demands on dynamic control response, synchronism, absolute accuracy	- Low demands on synchronism, absolute accuracy; - Extreme impact and vibration stresses
Range of applications:	Servo applications in: - machine tool axes - robot applications - handling systems - assembly equipment - wood-working machines - packaging machines - textile machines - printing machines	Handling applications, feed axes, low-cost applications etc.

Fig. 2.19: Properties of available feedback versions

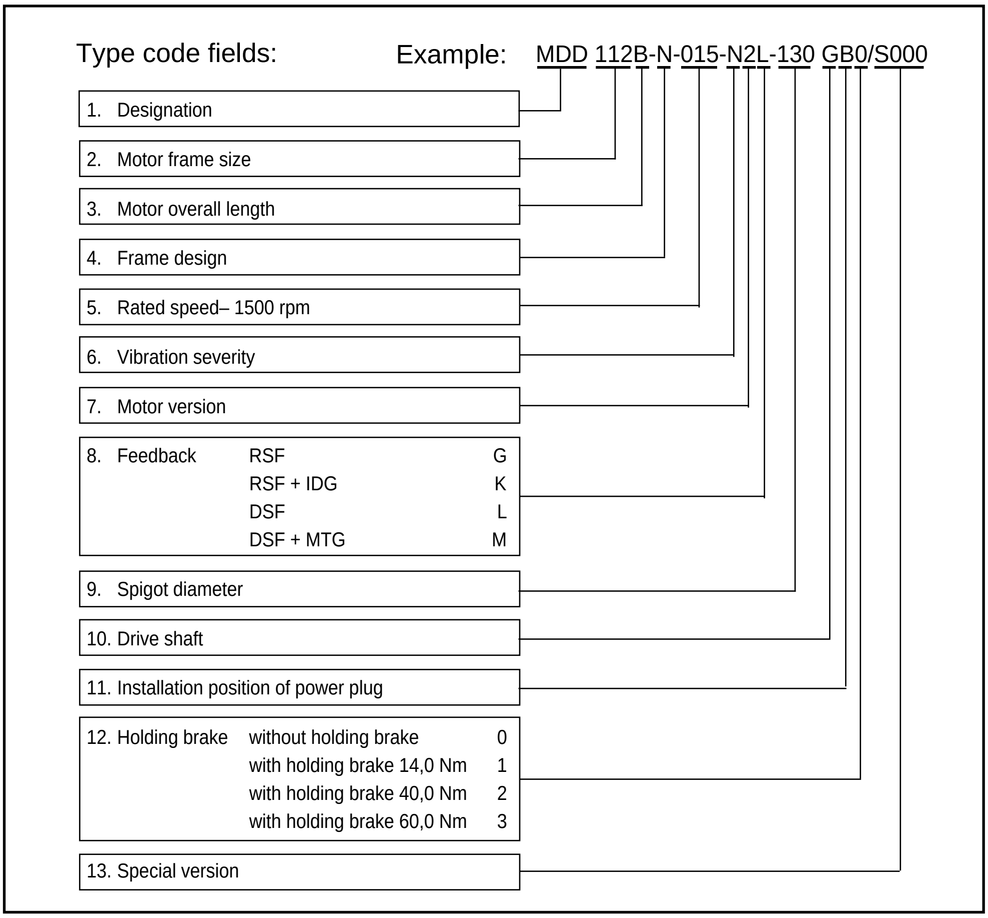
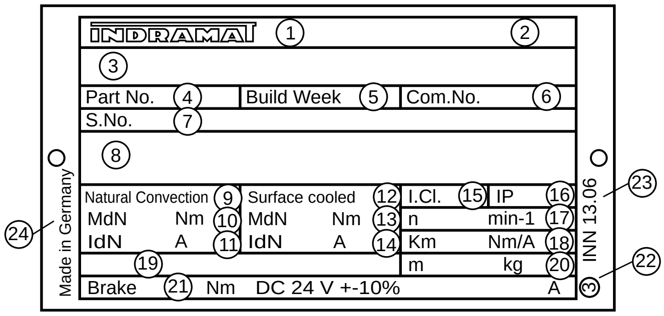


Fig. 2.20: Type code explaining MDD servo motors in terms of feedback and holding brake version

For further details please refer to the relevant motor documentation.

Rating plate MDD servo motors



1	**INDRAMAT-Logo**	
2		Type of machine
3		Motor type
4	**Part.No.**	Serial number
5	**Build Date**	Week and year of manufacture
6	**Com.No.**	Job number
7	**S.No.**	Serial number
8		Bar code
9	**Natural convection**	Cooling method: natural convection
10	**MdN**	Continuous zero-speed torque for natural convection in Nm
11	**IdN**	Continuous zero-speed current for natural convection in A
12	**surface cooled bzw. liquid cooled**	Cooling method: surface cooled or liquid cooled
13	**MdN**	Continuous zero-speed torque for surface cooling or
14	**IdN**	liquid cooling in Nm Continuous zero-speed current for surface cooling or liquid cooling in A
15	**I.Cl.**	Insulation class
16	**IP**	Protection class
17	**n**	Motor rated speed in rpm
18	**Km**	Torque constant in Nm/A
19		Blank field
20	**m**	Mass in Kg
21	**Brake**	Holding brake Holding torque in Nm, Rated voltage in V, (with indication of tolerance range) Rated current in A
22 23 24		Internal index numbers

DDSAnwSERCOS22

Fig. 2.21: Example of an MDD servo motor rating plate

3. Fundamental safety notes

3.1. Use as prescribed

Digital intelligent AC servo drives are built to the state of the art and to recognized regulations. Nevertheless, their use may still involve risks to life and limb of the user or third parties or of damage to the machine and other equipment.

Digital AC servo drives are installed in machinery and plant. It is imperative that they be used as prescribed.

Use as prescribed can only be guaranteed when:

- the machine/plant is in flawless technical condition and used as prescribed with due attention to safety and risk considerations and according to the relevant technical instructions for use.
- any necessary work on the electrical installation or the machine/plant is done exclusively by a trained electrician or trained personnel under the supervision of a trained electrician and according to technical regulations.
- the instructions for handling the drives as contained in the technical documentation and in this Application Manual in particular are known and adhered to.

3.2. Safety notes for commissioning

When commissioning a servo drive problems may arise that increase the risk of accidents and damage to the drive and machine. These are:

- errors in wiring up the motor, drive controller and feedback
- errors in the NC control
- errors putting monitoring equipment out of action

To reduce the accident risk commissioning must always be carried out by trained and qualified personnel only.

3.3. Notes on protection of personnel

INDRAMAT drives operate as components in machinery and plant. They cannot, in themselves, ensure the safety of personnel for each machine/plant in which they are installed.

INDRAMAT drives must always be included in the global safety concept for each application.

The drives provide certain functions which may be incorporated into the safety concept. This Application Manual indicates such possibilities.

Risks due to axis motions

Risks to human safety may occur through:

- unintentional start-up of servo axes due to faults and errors in the machine or drive.
- operation of servo axes in unsecured working areas of a machine.

Unintentional start-up can be prevented by:

- disconnecting the power contactor (E-STOP)
- disconnecting the master switch when operation is interrupted for any length of time. Appropriate measures must be taken to protect the master switch against accidental reconnection, e.g. by hanging up a suitable warning notice or removing the key from lockable master command equipment. For activation of the starting lockout (drive interlock open) see Section 7.2.

Risks through contact with electrical parts

The following connections may carry dangerous voltage levels:

- **on the drive controller: motor power connection X5**
  (see Fig. 2.8/2.9), terminals
  - L+, L- DC link circuit voltage
    After power has been switched off wait for the link circuit to discharge (approx. 5 min.) and check that the voltage level is under 50 V before beginning to work. If in doubt, short-circuit.
  - A1, A2, A3 motor voltage;
    Even after power has been disconnected, dangerous voltage levels may appear on the terminals when the motors rotate (runout). Check that the drives are at a complete standstill.
- **on the power supply module**
  - L1, L2, L3 mains power connection.
  - L+, L- DC link circuit connection (refer also to the applications manual for the installed power supply)

Accident risk through lethal voltage levels!

Never operate drive controllers without the transparent protective plate in place (see. Fig. 3.1). All connections on terminal block X5 carry lethal voltage levels when power is switched on. The same applies to the power and DC link circuit terminals of the power supply module.

Protection against indirect contact with power-conducting parts: Earth linkage circuit-breaker systems cannot be used on INDRAMAT equipment. The mains protection for indirect contact must be achieved by other means, e.g. by overcurrent protective devices with multiple earthing.

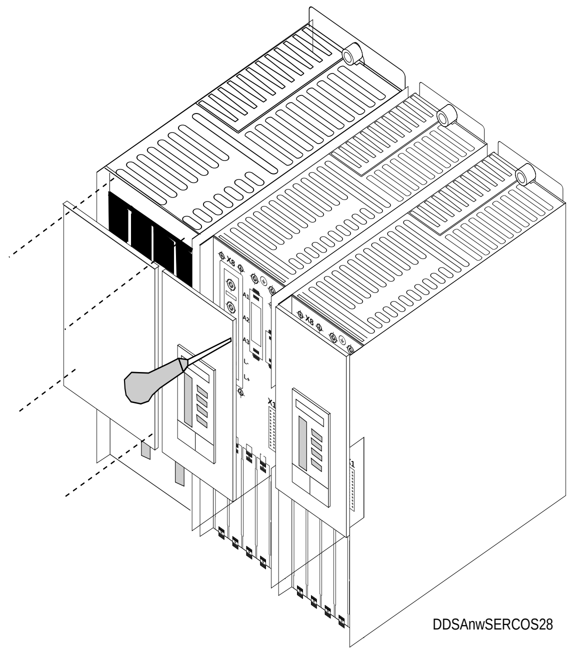


Fig. 3.1: Power supply module and DDS 2.1 drive controller with screwed-down transparent protective plates.

3.4. Notes on protection of equipment

INDRAMAT electronic drive components are provided with comprehensive protective circuitry and protected against overloading.

Risk of damage through wrong connection

Nevertheless, the following precautions must still be taken:

- Voltage levels applied to inputs must always be in accordance with prescribed data.
- Do not connect outputs to external power sources.
- Do not connect mains power, DC link circuit and motor conductors to the low-voltage ± 15 V and +24 V supplies. These conductors must also be provided with adequate insulation against each other.

INDRAMAT drive components are 100% h.v. tested according to VDE standard 0160.

Risk of damage through external or high-voltage power sources

If an h.v. or separate-source voltage-withstand test is to be carried out on a machine's electrical equipment, all component connections must be disconnected in order not to damage the components' electronic modules (permissible acc. to VDE 0113).

Our Sales Department will provide additional information on request.

Risk of damage through electrostatic charges

Electrostatic charges represent a danger to electronic equipment. Bodies liable to come into contact with components and circuit cards must be discharged by earthing:

- discharge your own body by touching a conductive, earthed object.
- when carrying out soldering work, first discharge the soldering iron.
- discharge parts and tools by laying them on a conductive substrate.
- Parts at risk, such as software modules, must always be stored or shipped in conductive packaging.

3.5. Notes on protection of machinery

If the position control loop of the NC control is opened during commissioning and the drives are operated in a velocity loop, the machine will be at risk due to the limited stroke lengths of linear axes.

To avoid damage to the machine, please ensure the following:

- Enabling of the drives and injection of a velocity command must always be carried out by properly qualified personnel.
- Make sure the emergency stop function will be triggered by limit switch or E-STOP button.

4. Commissioning equipment

The following equipment is needed for commissioning:

- Measuring instruments
- Selection Data List Doc. No. 209-0069-4302 for input of the short-term operating torque „MKB“ and for checking the drive
- Project Planning Manual to check the wiring
  Doc. No. 209 0069-4356 for plug-in modules
  Doc. No. 209-0069-4317 - for DDS 2
  Doc. No. 209-0069-4362 - for DDS 3

4.1. Measuring instruments

The following measuring instruments are required:

- multimeter for voltage measurement
- oscilloscope or plotter
  required only to produce test records for prototype commissioning and as an aid in fault locating.

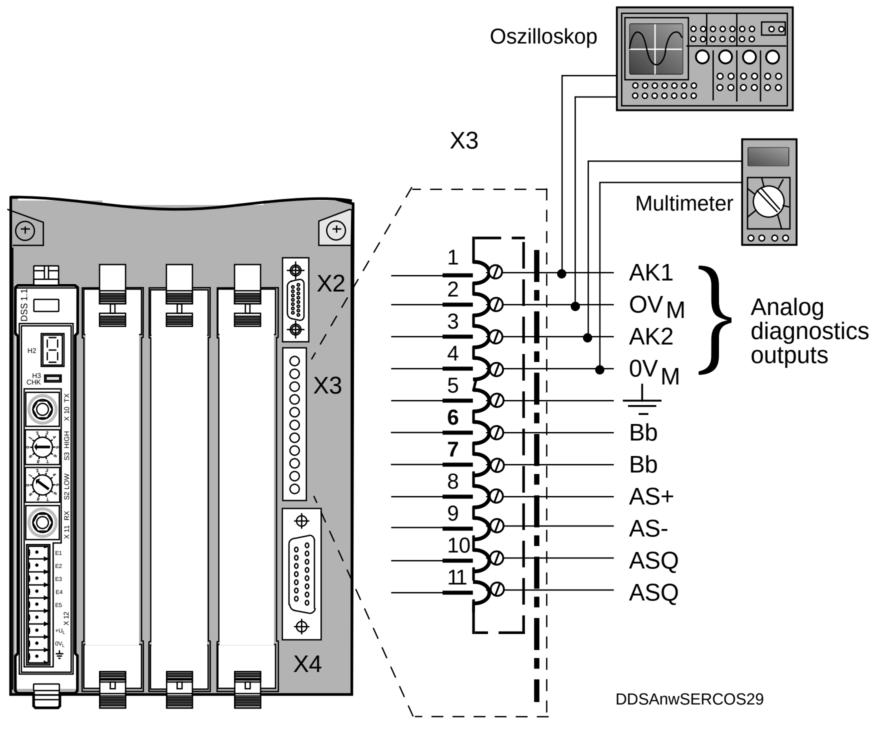


Fig. 4.1: Connection of voltage measuring instruments to the analog diagnostics outputs on the drive controller

4.2. SERCOS/PC interface

Digital drives are usually commissioned using the terminal on a SERCOS-compatible NC control unit. If this is not possible, the servo drives may be commissioned via the INDRAMAT SERCOS/PC interface.

The SERCOS/PC interface „SYSDA 1.1“ permits the following:

- Menu-driven commissioning
- Traversing axes in velocity loop mode
- Diagnostics for fault clearance purposes
- Parameter management
- Performance of commands
- Oscilloscope function for recording test logs

This commissioning aid for Digital Intelligent AC Servo Drives with SERCOS Interface comes complete with the following items:

- 1 plug-in card for IBM-compatible AT computers (SERCOS/PC interface DPS 3)
- 1 disk with the „ISYS“ operating program“
- 1 hand-held operating control HT4
- 1 Documentation, Doc. No. 209-0069-4322

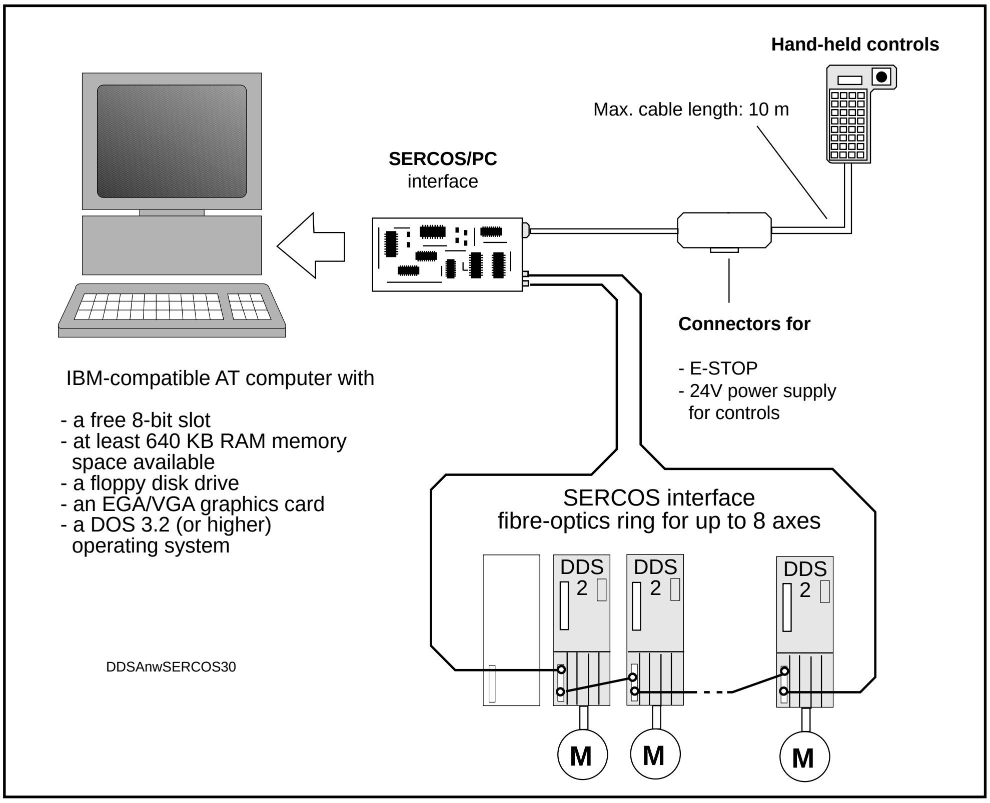


Fig. 4.2: Overview: Commissioning aid for digital intelligent AC drives

5. Commissioning procedure up to initial start-up of the drive controller

5.1. Entering parameters

Before DDS 2.1 drive controllers can be commissioned for the first time they must be supplied with the necessary operating data. These data are stored in various parameters.

For the sake of clarity, INDRAMAT distinguishes these parameters according to the following function categories which are listed in Section 10:

- Communication parameters (Section 10.1)
- Control-related application parameters (Section 10.2)
- Machine-related application parameters (Section 10.3)
- Drive parameters (Section 10.4)

Communication parameters:
These are parameters required for communication between the installed NC control unit and the drive controller via the SERCOS interface, e.g. transfer times.

Control-related application parameters:
These parameters are used to set-up and match the installed NC control unit and the drive controller, e.g. setting the dimensional reference of the data to be transferred via the SERCOS ring.

Machine-related application parameters:
These parameters serve to match the drive to the machine mechanics by means of mechanical constants.

Drive parameters:
The purpose of this these parameters is to match the drive controller and the AC servo motor to the machine dynamics.

Parameter contents

The parameter contents are supplied to the controller via the SERCOS interface.

Communication parameters (such as the SERCOS cycle time) and control-related application parameters (e.g. main operating mode) are determined by the control itself or at initial start-up of the control. They are therefore not described in this documentation. For more information, see the SERCOS interface manual or the manual for the NC control unit. The control unit automatically transmits the data via the SERCOS interface to the drive.

Machine-related application parameters (e.g. linear encoder resolution) and drive parameters not initially present in the drive (e.g. loop gain factor) must be entered manually if they have not already been determined at initial start-up of the NC control unit.

As a rule, data entry and command activation are performed using the terminal of the SERCOS-compatible control unit. It is also possible to use the INDRAMAT SERCOS/PC interface provided for this purpose.

Procedure for entering parameters

1. First select the appropriate operating mode on NC control unit, which will allow the missing parameters to be entered (see control unit manual).
2. Enter the parameters.
3. Repeat this procedure until the parameters have been entered for each of the installed drives. The drives are selected via the control unit.

A parameter consists of:

ID No.	Description	Value	Unit
S-0-0091	Bipolar velocity limit value	20,000	[mm/min]

The unit of the parameter to be entered will be displayed. Depending on the type of control unit, parameters may be set automatically. For a precise description of the parameters, consult the following documents:

- SERCOS interface manual
- description of product-specific parameters in DDS 2.1 (see Section 10.5).

5.2. Command handling

Commands are instructions issued by the control unit which trigger a series of operations in the drive, e.g. homing cycle. A command is initiated by a message via the service channel. The information concerning the sequence of operations to be executed on receipt of a command is stored in the drive's command block. For more details refer to the description in Chapter 5 of the SERCOS interface manual.

The handling of commands is specified in SERCOS. Instructions on how to activate commands are contained in the control unit manual.

6. Commissioning procedure up to initial start-up of the AC servo drive

6.1. Checks to be run with power disconnected

Mains power requirements

Before starting any commissioning work check that the mains power supply is suitable for the installed power supply module (see power supply module documentation).

Drive components

The installed drive components must be suitable for the connection voltages used.

See Project Planning Manuals:

- Doc. No. 209-0069-4317 - for DDS 2 basic unit
- Doc. No. 209-0069-4362 - for DDS 3 basic unit
- Doc. No. 209-0069-4356

Check the configuration of the drive controller. The data on the configuration rating plate must correspond to the components installed in the drive controller.

If this is not the case, the AC servo drive and the machine mechanics may be destroyed or damaged!

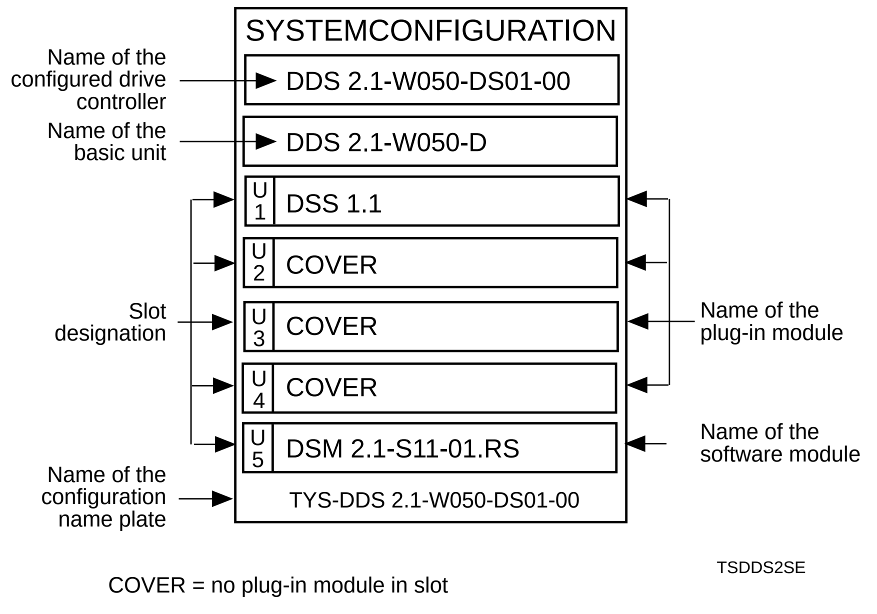


Fig. 6.1: Configuration rating plate

Wiring

Check all wiring for short circuits, interruptions, reverse polarity and conductor cross-sections.

Earth connections

- Earth the components exactly as prescribed in the specific INDRAMAT connection diagrams.
- Observe the valid safety precautions for the machine.
- Earth each motor to its drive module.
- Earth each drive module separately to the power supply module.
- Connect up the common reference point of the power supply module to the source earth.

The earth connections described above are operational earths and have a protective function. Do not disconnect them!

The earthable point of the power supply module is the common reference point for all drive components.

- Make an electrically conductive connection between the frames of the drive controllers and the rear wall of the cabinet (electromagnetic compatibility)).

Power cables

- Twist the power cables leading from the drive controllers to the motor or lay a four-core cable (3x phase, 1x earth).
- Check the conductor cross-sections for compliance with VDO 0113.

Power connections to additional modules

Power conductors leading to additional modules or other buffers should be twisted and kept short.

Power connections between servo drive modules

Normally, the units are installed adjacent to each other and the power connection is made using two conductor rails. If this is not possible, use two 16 mm^2 twisted conductors with a maximum length of 1 m.

Terminals and plug connectors

Check that:

- proper contact has been made
- terminals are firmly connected
- sub-miniature connectors are tightly screwed down.

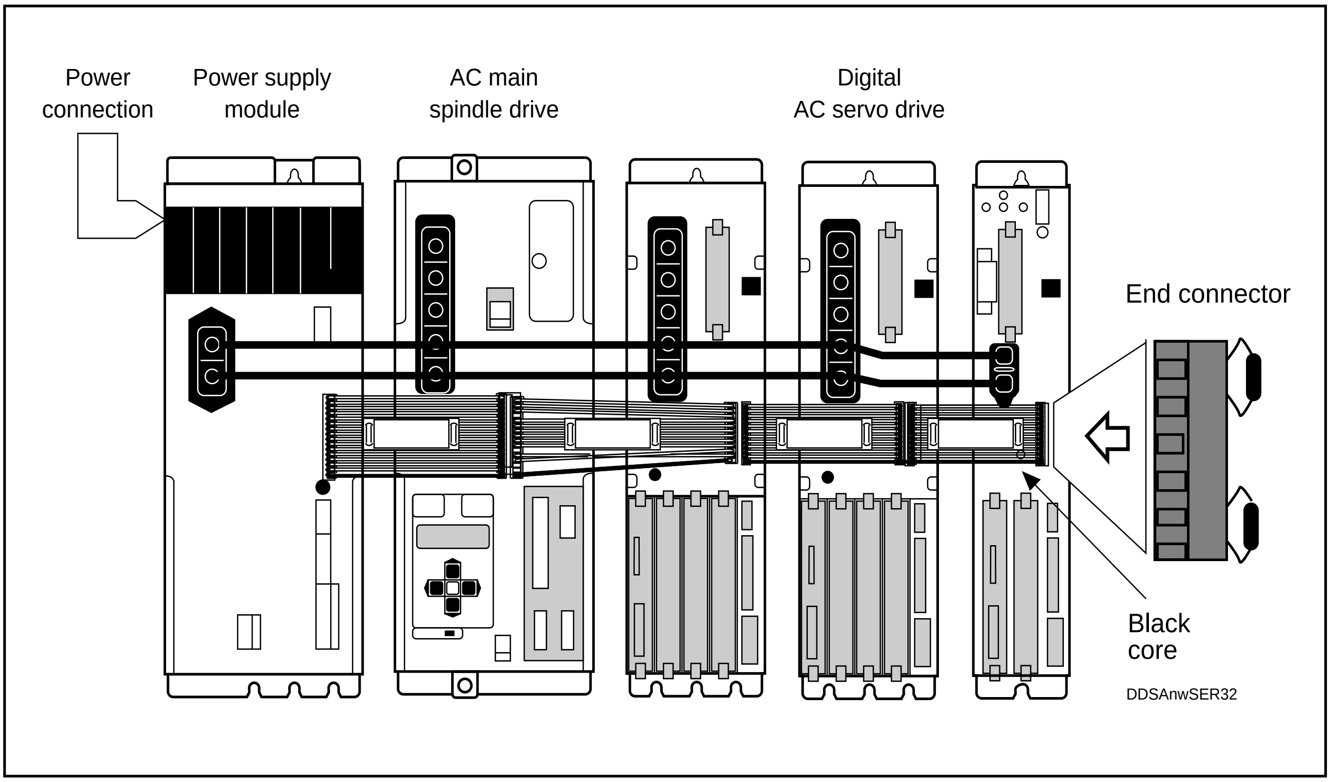


Fig. 6.2: Arrangement of bus connecting cable and end connector

Bus connecting cable, end connector

A bus connecting cable is used for control voltage supply and the coordination of monitoring devices.

- Connect up the bus connecting cable with the black core at the bottom.
- For control voltage monitoring, plug in the end connector to the drive controller furthest away from the power supply module.

The end connector is an integral part of the accessories supplied along with the power supply module.

Screening

Shields for the motor feedback cable and the conductors to the thermistor must be connected up to the frame earth terminal of the drive controller.

Connection of a power transformer

If a power transformer is to be installed, check that the transformer output voltage and the connection voltage on the power supply module match.

E-STOP

If the plant is shut down by an E-STOP command, malfunction of the servo drive cannot be totally excluded and the circuit must therefore be broken (see documentation on the installed power supply module). Until the servo drive has come to a halt, uncontrolled drive motions will have to be reckoned with. The extent of these will depend on the type of fault and the operating status of the servo drive at the time the fault occurred. All precautions must therefore be taken at the higher plant level to exclude any risks of injury to persons.

Machine axes requiring immobilization of the axis after the servo drive has been stopped must be equipped with a holding brake. MDD servo motors can be supplied with an optional holding brake.

Power circuit ON/OFF switching sequence

The correct switching sequence is given when the „Ready“ contact in the power supply module has been installed according to INDRAMAT diagrams. Do not power up until the power supply module’s „Ready“ (Bb1) contact is closed (see documentation on the installed power supply module).

Set drive addresses on the SERCOS interface module

The addresses assigned to individual drives are always determined by the NC control unit. Refer to the control unit manual or control unit configuration data for the relevant addresses.

The SERCOS interface module (Fig. 6.3) has been provided with two decade switches. Use decade switch „S3 - HIGH“ to set the first digit and „S2 - LOW“ to enter the second digit of a two-digit SERCOS address.

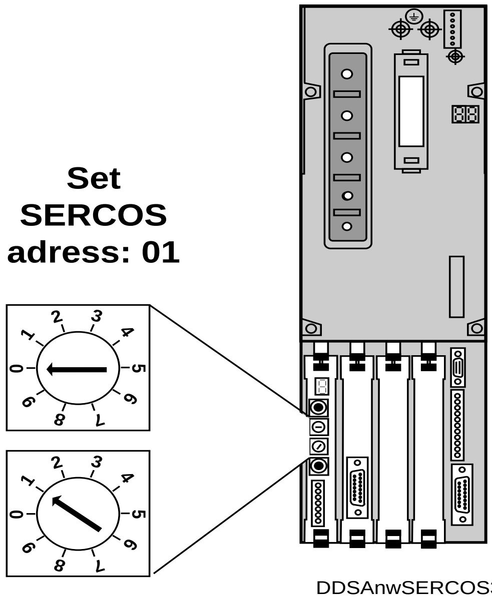


Fig. 6.3: Setting a drive address using the decade switches on the front panel of the SERCOS interface module.

6.2. Checks to be run with control voltage applied

Before running the following checks switch on the signal conditioning voltage supply at the power supply module. The power supply module provides the voltage for signal conditioning in the drive controller.

Make sure the main contactor K1 for powering up is switched off. Take the necessary precautions to ensure that it cannot be switched on involuntarily.

„H1“ status indicator messages

The drive controller is in working order when the status indicator H1 displays „Bb“ , i.e. „Ready“ for powering up. If the indicator shows any other message, see Section 9 „Diagnostics and fault clearance“.

„H2“ status indicator messages

The „H2“ status indicator on the SERCOS interface module (Fig. 2.15) must display 2, 3 or 4 once the communication link has been established. The value displayed depends on the drive’s level of parametrization at this point. If the status indicator shows any other value than 2, 3 or 4, proceed according to Section 9, diagnostics for the SERCOS status indicator.

6.3. Entering parameters for initial start-up

Language selection

All texts, e.g. parameter designations and diagnostic and error messages are stored in different languages in the DDS 2.1. To select the desired language, use the parameter:

P-0-005 Language selection
0: German
1: English
further languages in preparation

Input of machine-specific data

The following parameters are used to input the machine-specific data. These data can be found in the machine documentation (manual, design documents). The parameters listed below are required for every drive linked up to the SERCOS ring:

	Id.-No.	Description	See Section
Setting of scaling parameters in the AC servo drive	S-0-0076 S-0-0044 S-0-0160 S-0-0086	Scaling method for position data Scaling method for velocity data Scaling method for acceleration data Scaling method for torque/force data	7.6 P. 58
Error reaction	P-0-0007	Error reaction	7.1. P. 45
Polarity parameters	S-0-0055 S-0-0043 S-0-0085 S-0-0159	Position polarity parameters Velocity polarity parameters Torque polarity parameters Monitoring window	7.8. P. 81 7.7. P. 77
Limit parameters	S-0-0049 S-0-0050 S-0-0091 S-0-0092	Positive position limit value Negative position limit value Bipolar velocity limit value Bipolar torque limit value	7.9. P. 82
Mechanical transmission elements	S-0-0121 S-0-0122 S-0-0123	Input revolutions of load gear Output revolutions of load gear Feed constant	7.10. P. 84
External measuring system	S-0-0115 S-0-0118 S-0-0117 S-0-0165 S-0-0166 P-0-0120	Position feedback type parameter Resolution of linear feedback Resolution of rotational feedback 2 Distance-coded reference dimension 1 Distance-coded reference dimension 2 External Encoder Monitoring Window	7.11. P. 86 7.7. P. 78
To set controller parameters	S-0-0262	Activate „initial loading sequence“ command	7.23. P. 129
Short-time operation torque	P-0-0006	Overload factor	7.14. P. 94
Homing cycle parameters	S-0-0041 S-0-0042 S-0-0147	Homing velocity Homing acceleration Homing parameter	7.16. P. 97

Fig. 6.4: List of parameters to be entered on commissioning

6.4. Checking status indicators before powering up

When the parameters are put in, switch the SERCOS ring to cyclic operation (communication phase 4) via the control.

- The status indicators of all SERCOS interface modules must display the number 4.
  If this is not the case, proceed according to Section 9.5 (Diagnostics for SERCOS status indicators).
- The status indicators of all controllers in the drive package must show „bb“ (Ready for powering up). If this is not the case, proceed according to Section 9 (Diagnostics and fault clearance).

Control voltage	Power	Status indicators	
		H1	H2
ON	OFF	bb	4

Fig. 6.5: Checking the status indicators before powering up.

- Switch on the power at the power supply module.

Check the status indicators:

- The status indicators of all SERCOS interface modules must show the number 4.
- The status indicators of all controllers must show „Ab“ („Control and power sections ready“) or „AF“ („Drive enable“). If this is not the case, proceed according to Section 9 (Diagnostics and fault clearance).

Control voltage	Power	Status indicators	
		H1	H2
ON	OFF	AF / Ab	4

Fig. 6.6: Checking the status indicators after powering up.

6.5. AC servo drive initial start-up

- Check that safety devices are functioning
  Prior to starting up the servo drive for the first time, check that all safety devices are functioning properly and that the safety limit switches are far enough away from the dead stops on the machine.
- Check the holding brake function
  The servo drive module will apply the signal to release the holding brake at the same time as the controller enable signal. Check that the axis locking function is cancelled once the signal has been emitted (see Section 7.3).

Operate the drive using the jog key

- First select „manual mode“ on the NC control unit.
- Use the jog key to select the appropriate axis.
- The axis should now move.
  (If it does not, refer to Section 9, „Diagnostics and fault clearance“.)
- Repeat the procedure with all other axes.

Checking the traversing direction

- Check that the axes are moving in the right direction. If they do not, correct the parameters S-0-0055, S-0-0043 and S-0-0085 as described in Section 7.8.

Cancel the velocity limitation

Set the parameter „Bipolar velocity limit value“ ID No. S-0-0091 to the desired rapid traverse velocity +10%.

Set „Monitoring Window“ S-0-0159 to the axis-specific value

A drive model is calculated in the drive to monitor the drive’s internal position loop. Error „28“ is generated when the position actual feedback value deviates from the model actual value. The threshold value for generation of the error reaction is stored as a percentage value in Parameter S-0-0159. The error reaction will only be triggered when this value has been exceeded for 50 msec.

For parameter entry purposes, 100% has been normalized as 360° at the motor shaft.

The parameter „Maximum Model Deviation“ P-0-0098 serves to parametrize the „Monitoring Window S-0-0159“ parameter.

To determine the input value for the monitoring window, proceed as follows:

1. Set the monitoring window (S-0-0159) to 50%.
2. Traverse the axis at a predetermined speed and acceleration (predetermined operating cycle)
3. Read off the value in parameter „Maximum Model Deviation P-0-098“.
4. Multiple this value by 2 and enter the result in the „Monitoring Window“ Parameter.

7. Commissioning the digital AC servo drive with SERCOS interface

7.1. Error reaction

Digital intelligent AC servo drives offer the possibility of preselecting different error reactions for each drive in a drive package. Error reactions 1, 2 and 3 make it possible to complete machining operations on workpieces even in the event of errors occurring in other axes not involved in the machining process (e.g. loading axes).

INDRAMAT classifies errors according to:

- Errors causing an error reaction in the entire drive package.
- Errors causing individual drive-specific error reactions.

Errors causing an error reaction in the entire drive package

Errors causing an error reaction in all drives connected up to one power supply module are:

22 „Motor encoder error“

24 „Overcurrent“

25 „Overvoltage“

60 „Bridge fuse“

61 „Earth-fault fuse“

69 „± 15 Volt error“

70 „± 24 Volt error“

71 „± 10 Volt error“

72 „+ 8 Volt error“

73 „Voltage supply driver stage“

(For more details on errors, see Section 9)

Danger of uncontrolled drive movements!

The errors stated above prevent the drive being stopped under controlled conditions.

Error reaction in the drive package

1. The drive affected by the error sends an error signal to the power supply module.
2. The power supply module cuts the power.
3. The error signal „undervoltage“ sent by the power supply module to the drives is ignored by the unaffected drives. These can then be brought to a standstill in under normal process conditions via the NC control. However, stopping under normal process conditions will depend on the residual energy available in the DC link circuit. If the drive can no longer follow the NC control’s commands, error message No. „28“ „Excessive Deviation“ will be generated.
4. The deceleration path can be shortened via the power supply module by activating the „plug braking“ function (see documentation on the installed power supply module).

Activating the „plug braking“ function affects all AC servo drives in one drive package, irrespective of their preset error reactions.

Errors causing drive-specific error reactions

With all other types of errors it is possible to select any desired error reaction for each servo axis. Unaffected axes in the drive package will remain operative.

Accident hazard in the event the servo axis is not halted in keeping with the process!
Disconnect the NCB jumper on the supply module.

If digital Ac servo drives with SERCOS interface are used together with supply modules equipped with an NCB jumper, the latter must be disconnected (see applications manual for the installed supply module).

If the NCB jumper remains connected the undervoltage error signal sent from the supply module to the AC servo drive will be suppressed and the error message 26 (undervoltage error) will not be generated (see Section 9.3). There will be no error reaction in the AC servo drive.

Setting error reactions

Error reaction	Drive reaction in the presence of an error
0	– Automatic switch to velocity loop regulation – Braking at maximum acceleration – Torque disable signal for the drive after 500 ms – Opening of the „bb“ Ready contact X3-6/7 on the drive controller (see Section 7.4) – Error signal to the power supply module • The power supply module cuts the power
1	– The drive reacts the same as in error reaction **0** – No error signal to the power supply module – Other unaffected drives connected up to the same power supply module remain operative.
2	**Error reaction „2“ is not to be recommended for motors equipped with a holding brake. Upwards of 20,000 revolutions against a closed holding brake will wear the brake out.** – Undelayed torque disable signal (axis coasts to a halt) – Undelayed braking through motor holding brake (if fitted) – No error signal to power supply module – Unaffected drives connected up to the same power supply module remain operative – „Ready“ contact Bb X3-6/7 on drive controller open (Section 7.4)

3	– Immediate reaction
	  • Error signal to the NC control unit
	  • No further error reaction for 30 s (gives the NC control time to carry out error reactions under normal process conditions)
	– Delayed reaction (after 30 s)
	  • Switch-over to torque loop
	  • Braking at maximum acceleration
	  • Drive torque de-activated after 500 ms
	  • Ready contact Bb X3/6/7 on the drive controller opens (Section 7.4.)
	  • No error message to the supply module

Fig. 7.1: Input codes for error reactions in the DDS 2.1

Error reaction and holding brake control

The reaction of the holding brake under different preset error reactions is shown in Fig. 7.2.

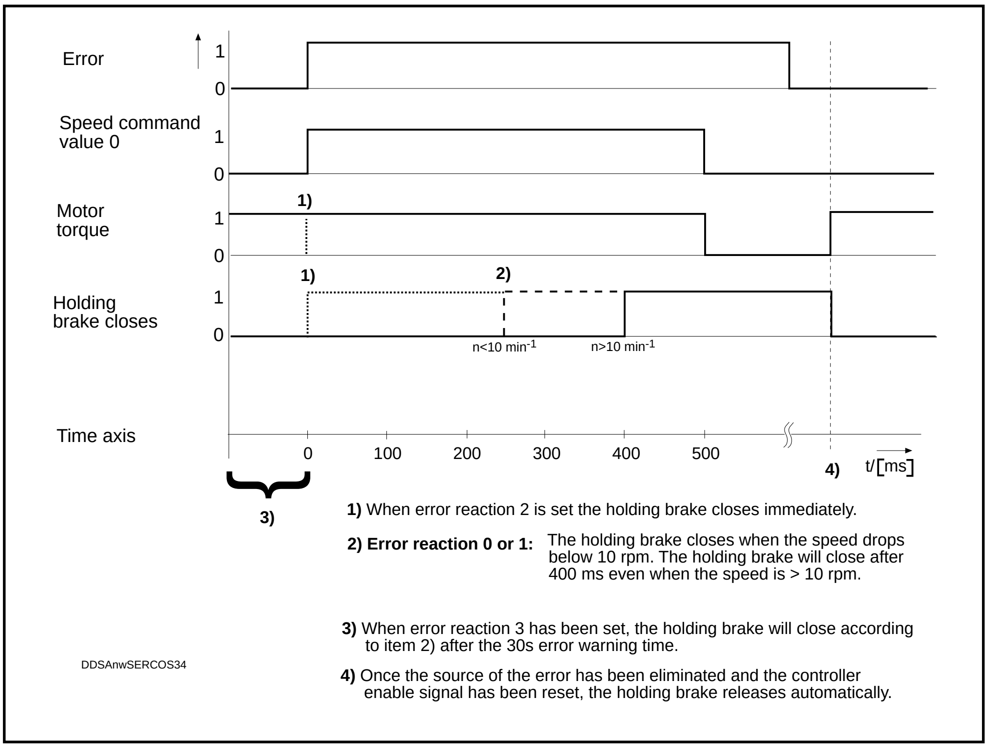


Fig. 7.2: Reaction of the holding brake under different error reactions.

7.2. Safety lockout (drive interlock)

Production facilities, transfer lines and machine tools often consists of physically separate operational units such as machining stations, transport, handling and storage systems.

Personnel often have to perform work in a danger zone on one of these units while the other units on the machine are still running. If a person has to enter the working area of an axis, this must first be stopped and secured against involuntary start-up.

The safety lockout is such a feature intended to prevent an installed motor starting up again in the presence of an error. It provides safe shutdown of separate working areas in a machine or a plant.

Series DDS 2.1 drive controllers are equipped with a safety lockout to stop a servo axis starting up accidentally. When this lockout is activated, the control electronics for the power output stage are disconnected from the latter by means of a relay contact.

Risk of injury or damage due to uncontrolled axis movements!

The safety lockout is NOT intended to stop a moving axis.

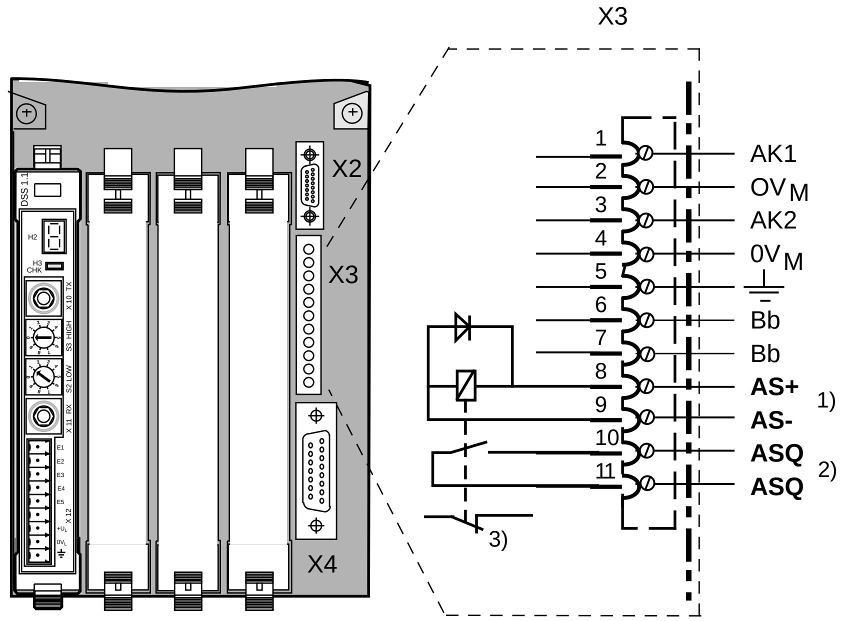
When the lockout is active, the drives can no longer be operated via the NC control. The motor torque signal is immediately disabled and the axis can no longer be brought to a halt under controlled conditions.

Vertical axes must always be immobilized using a mechanical brake before the safety lockout is activated.

For motors with holding brakes, this function is executed by cancelling the controller enable signal. Only then may the safety lockout be switched on.

Activating the safety lockout

Activate the safety lockout by applying a + 24 V signal to the pins AS+; AS- on connector X3. Switching of the safety lockout relay in the drive controller is signalled to the NC control when the potential-free feedback contacts (output ASQ - ASQ) close (Fig. 7.3).



1) AS+, AS- - control input for relay coil, voltage 20-30V DC, power 1.5 kW

2) ASQ, ASQ - potential-free feedback contact 24V, 1A

DDSAnwSERCOS35

3) Control contact for power electronics

Fig. 7.3: Control inputs and signal outputs of the safety lockout on a DDS 2.1 drive controller

Time sequence for safety lockout activation

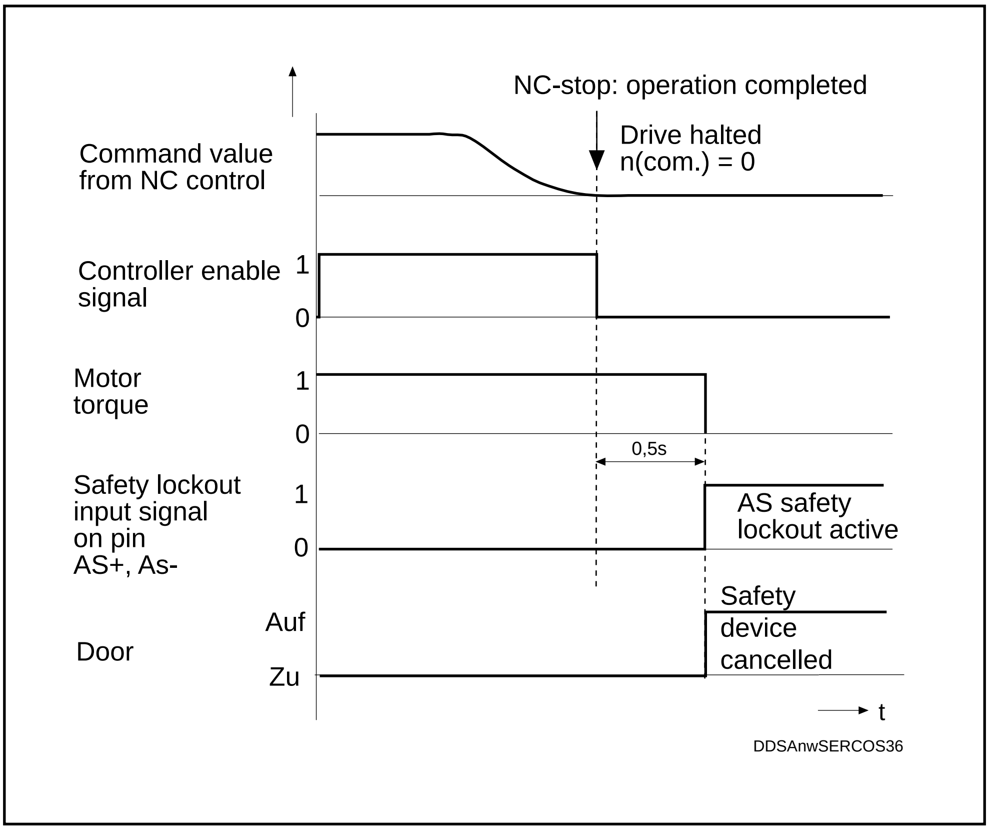


Fig. 7.4: Time sequence for safety lockout activation

Status diagnosis AS

When the safety lockout has been activated, the status indicator H1 on the drive controller will display the message „AS“.

Additional information

Application examples explaining how to use of the safety lockout are contained in the documentation „Safety lockout for DDS 2 drive controllers“ (Doc. No. 209-0069-4313).

7.3. Holding brake function

When shut down, servo axes must be secured against uncontrolled start-up if such a movement could cause injury to personnel or damage to machinery. INDRAMAT supplies protection of this type in the form of an optional holding brake.

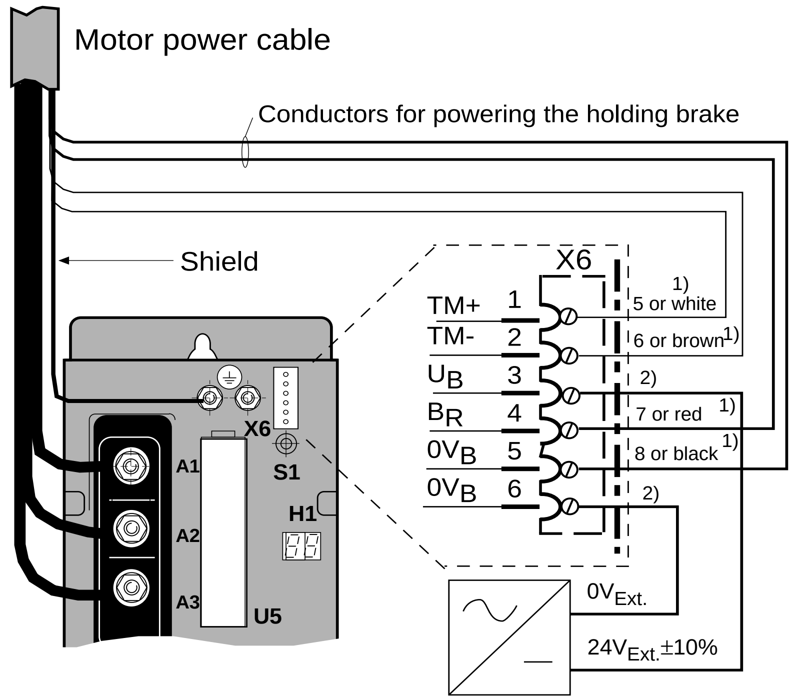
The holding brake for MDD motors is not designed as a service brake. If applied with the motor running, it will wear out after approx. 20,000 motor revolutions.

When the holding brake is de-energized a force acts on the braking/armature disc of the servo motor, thus safely immobilizing the axis. The holding brake is activated by the drive controller according to the status of the controller enable signal sent by the NC control via the „drive on“ bit in the „MDT“ (Master Data Telegram), and in accordance with the preset error reaction (see Fig. 7.7).

When the "Drive Enable" bit changes from 1–>0 (undelayed torque cut-out) the holding brake closes immediately. This signal may only be generated when the speed n = 0 rpm as the holding brake could otherwise be damaged.

Electrical connections for the holding brake

To power up the holding brake, apply an DC voltage from an external source to the terminal block X6 on the drive controller (see Fig. 7.5).



1) The cores in the motor power cable are identified by figures.
Exception: Cable IN 253 has colour-coded cores.

2) The external power supply for the holding brake is: 24 V DC ± 10%
The recommended conductor cross-section is 0.75 mm².

DDSAnwSERCOS37

Fig. 7.5: Connecting up the holding brake to Connector X6

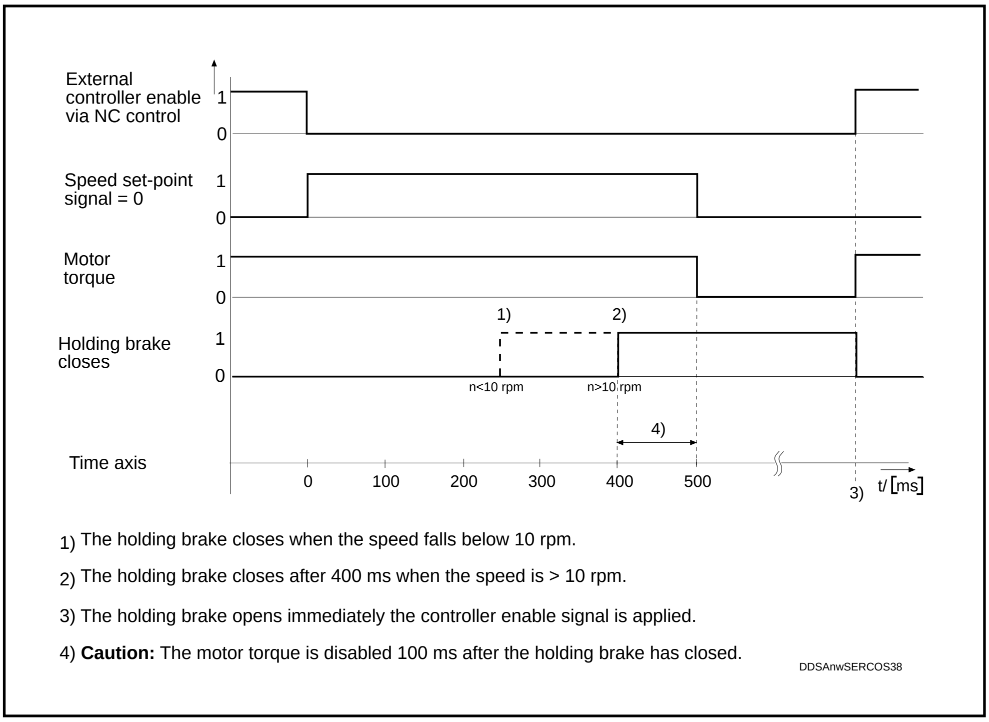


Fig. 7.6: Time sequence of holding brake status corresponding to controller enable status

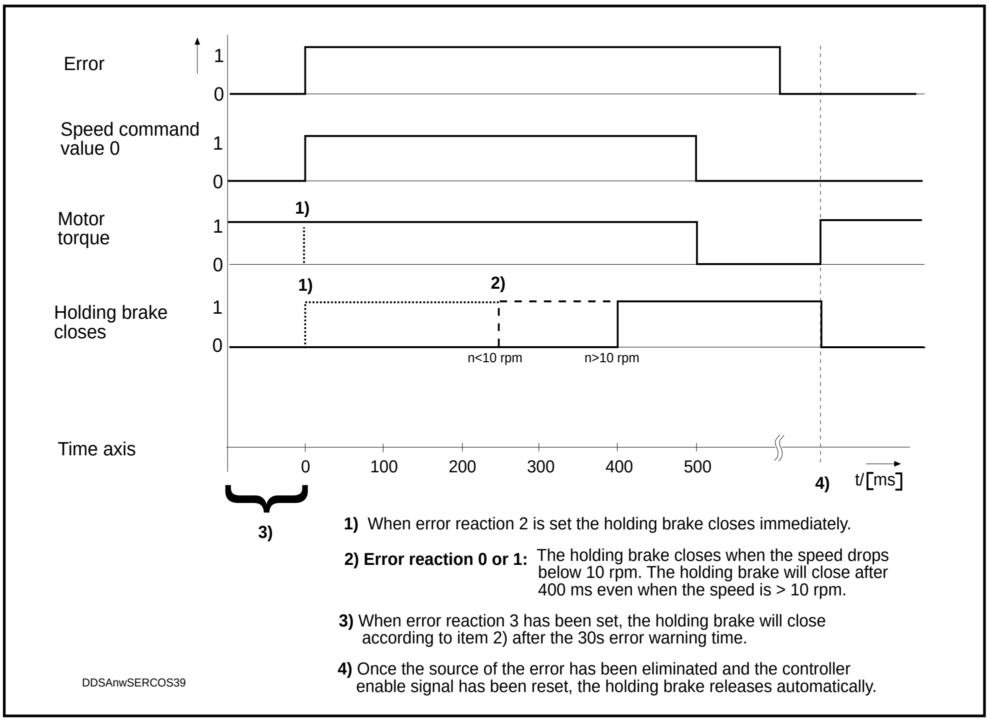


Fig. 7.7: Reaction of the holding brake under different error reactions.

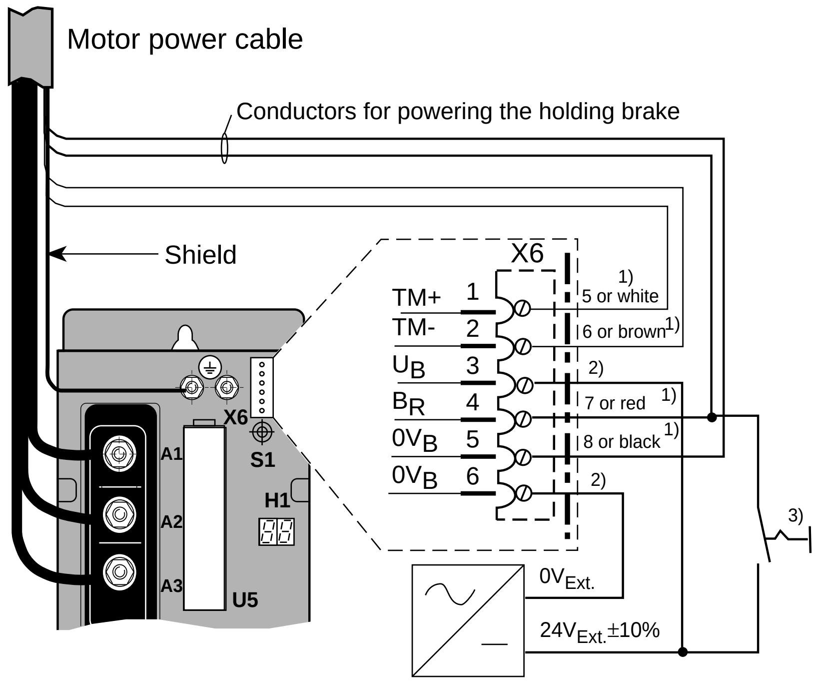
Holding brake, manual release

In cases where the controller enable signal cannot be set and it is necessary to move the servo axis by hand, the holding brake can be released as described below.

Secure vertical axes against accidental movement!
Danger of injury to persons and damage to machinery.

Procedure:

1. Apply an external +24 V DC signal to the core marked „7“ or „rt“ (red).
2. Apply 0 V to the core marked „8“ or „sw“ (black).
3. The brake is released.
4. Move the axis to the desired position.
5. Disconnect or switch off the external DC voltage supply.



1) The cores in the motor power cable are identified by figures.
Exception: Cable IN 253 has colour-coded cores.

2) The external power supply for the holding brake is: 24V DC ±10%.
The recoomended conductor cross-section is 0.75 mm²

3) To release the brake manually, apply +24V
to the core marked „7“ or the colour „red“ on connector X6/4

DDSAnwSERCO39.5

Fig. 7.8: Manual release of holding brake.

Check that the brake has opened

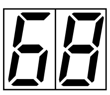
When the holding brake opens, this produces an audible sound in the servo motor. To check this, activate the holding brake briefly several times and listen for a synchronous knocking sound in the motor!

Check that the holding brake is correctly dimensioned

During commissioning, measure the mass moment of inertia of the axis acting on the motor (see Section 8.1)

The figure given in the motor data sheet for the brake’s holding moment must be greater than the mass moment of inertia of the axis. Vibrations liable to occur when the machine is in operation require an oversizing factor of 30% on account of dynamic moment combinations.

Error diagnosis



Error in the holding brake and its control signals (see Section 9.3)

7.4. Operational status (Ready)

In order to avoid unnecessary down time, machinery and plant require continuous monitoring. The DDS 2.1 drive controller caters to this need with a signal contact.

The potential-free signal contact „Bb“ (Ready) on connector X3 pin 6/7 makes it possible to pinpoint the affected machine in the event of a drive error in the associated NC control or signalling device (see Fig. 7.9).

The signal issued by the drive controller can be indicated through an NC control or a signalling device.

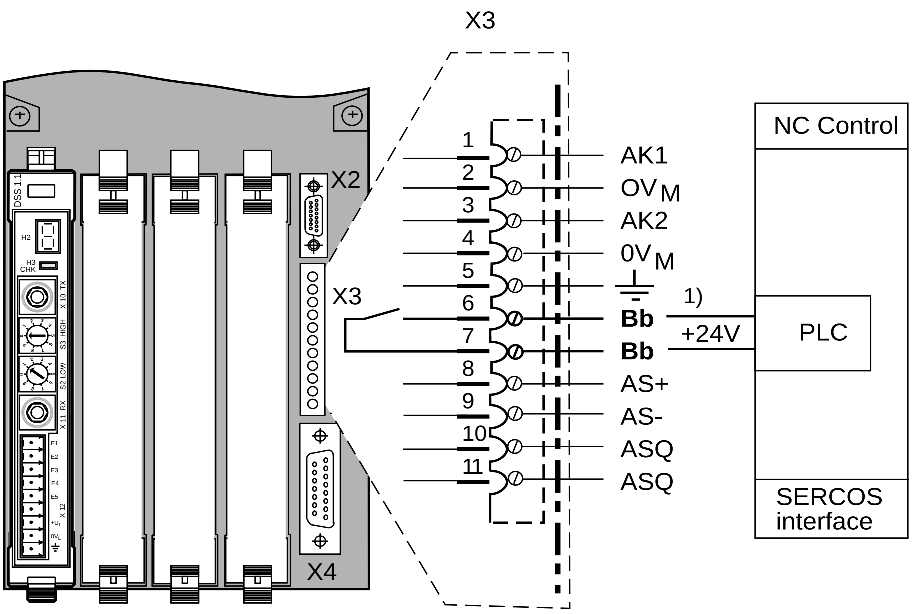
Switching status

The Bb contact opens whenever:

- there is an interruption in the control voltage
- the control voltage is applied, but there is an error in the AC servo drive

The Bb contact remains closed when:

- the servo drive is free of errors in Communication Phase 4



1) Potential-free signal contact 24 V, 1A

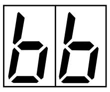
Fig. 7.9: „Ready“ signal contact for external evaluation

It is not permissible to connect up a protective coil via the relay contacts Bb, etc., as the relay contacts will overloaded by frequent switching at high transient current levels and can therefore fail.

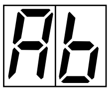
It is not permissible to use varistors as protective circuitry as these consume ever higher current levels in the course of their useful life, which can lead to premature failure of the adjacent components and thus the entire unit.

Status diagnoses

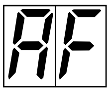
Status diagnoses are signals referring to the operational readiness of the drive. They are listed as follows:



When the control voltage has been applied and the drive is free of errors, the status indicator „H1“ on the drive controller will display the message „bb“ „Ready“ (drive ready for powering up).



Once the mains power has been switched on the status indicator „H1“ will switch to „Ab“ (drive ready for power output).



„Drive enable“: Application of the controller enable signal will enable the internal control circuits. The drive will follow the command value.

7.5. Temperature monitoring

Inadmissibly high temperatures will damage drive controllers and MDD servo motors. Defective drives can cause production stoppages on the machines in which they are installed. To avoid such stoppages, INDRAMAT AC servo drives are continuously monitored as to the temperature of drive controllers and MDD AC servo motors.

The causes of overheating may be:

- Contamination of heat transfer points
- Overloading due to the machine’s work cycle
- Failure of the cooling system in the drive controller
- Failure of the cooling system on the AC servo motor

Working principle

The temperature of both the drive controller and the servo motor are monitored continuously and separately. When the temperature rises above the permissible limit an overtemperature warning signal is emitted for 30 s.

The following temperature warnings are emitted as flashing messages:

Warning displayed on the status indicator „H1“

Status indicator **H1**	Significance	Duration of signal	Remarks
50 flashing	Amplifier overtemperature warning	30s	Error warning signalled to NC control to allow shut down under normal process conditions according to set error reaction
51 flashing	Motor overtemperature warning	30s	Error warning signalled to NC control to allow shut down under normal process conditions according to set error reaction

Fig. 7.10: Error warning on overheating

Drive reaction once temperature warning signal has run

Status indicator **H1**	Significance	Duration of signal	Remarks
18	Amplifier overtemperature shutdown	Until error is reset via NC control unit	The AC servo drive reacts according to the set error reaction (Section 9.3)
19	Motor overtemperature shutdown	Until error is reset via NC control unit	The AC servo drive reacts according to the set error reaction (Section 9.3)

Fig. 7.11: Error message after overtemperature shutdown

Electrical connections for motor temperature monitoring

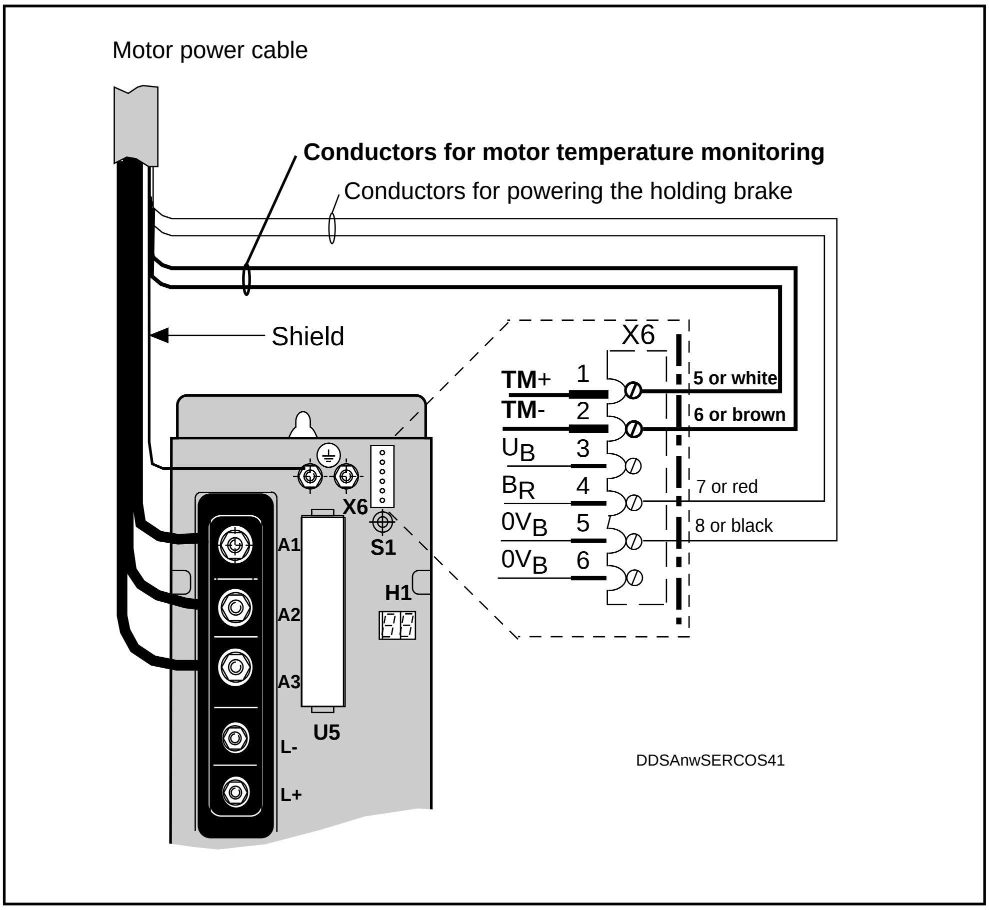


Fig. 7.12: Input on the drive controller for motor temperature monitoring

7.6. Setting the scaling parameters in the SERCOS interface

The reference dimension in the servo axis is set by determining the scaling parameters.

The following parameters must be set:

- Position Data Scaling Method
  ID. No. S-0-0076 siehe Abb. 7.14 bis 7.17
- Scaling Factor for Velocity Data
  ID. No. S-0-0044 siehe Abb. 7.20 oder 7.21
- Scaling Method for Torque-Force Data
  ID. No. S-0-0086 siehe Abb. 7.24
- Wichtungsart für Beschleunigungsdaten
  ID. No. S-0-0160 siehe Abb. 7.29 oder 7.30

Position Data Scaling Method, ID No. S-0-0076

The position data scaling method is determined by setting the definition bits as shown in Fig. 7.13. Figures 7.14 to 7.17 show the appropriate input examples.

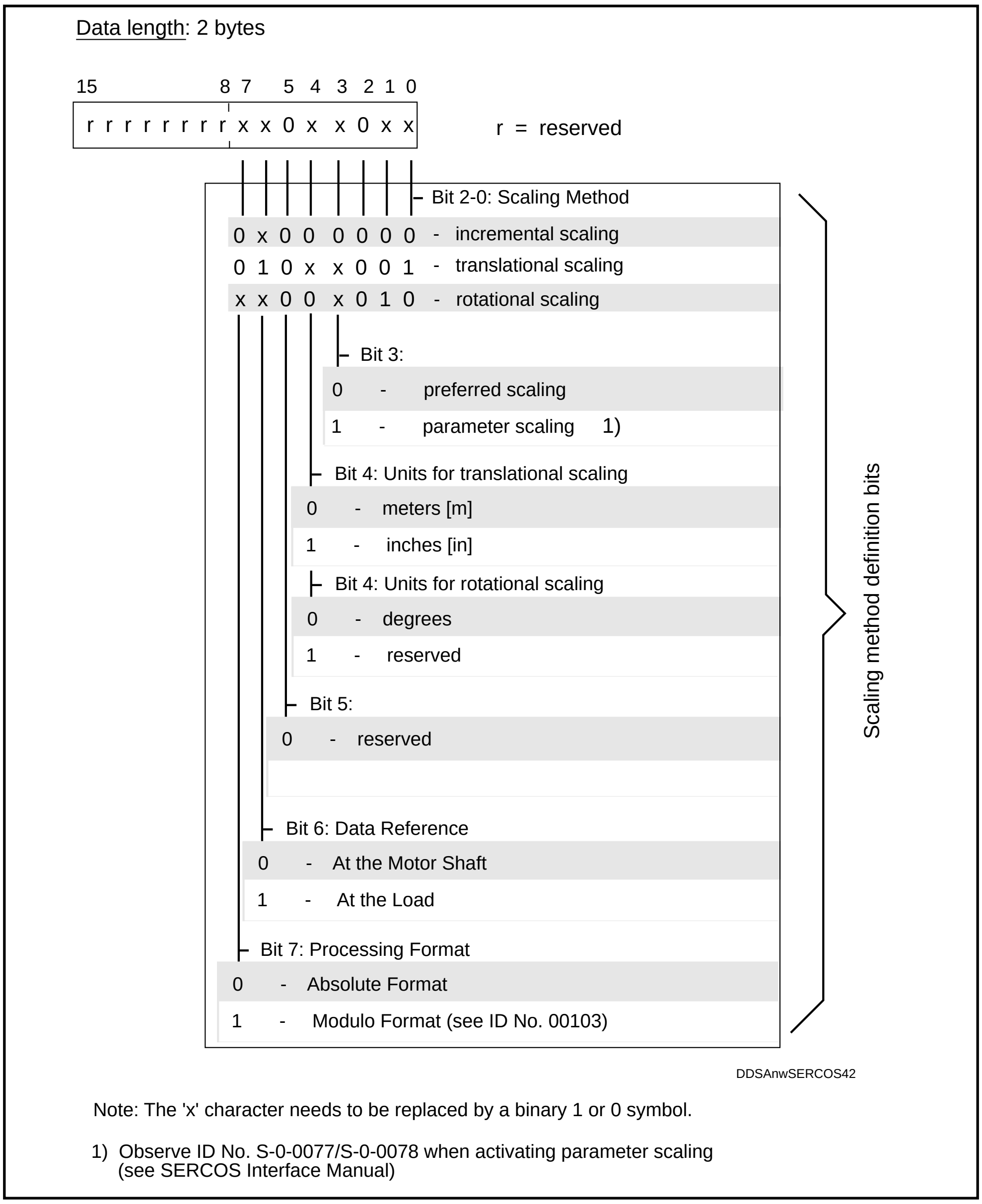


Fig. 7.13: Input of definition bits to determine the scaling method for position data

Input for translational servo axes

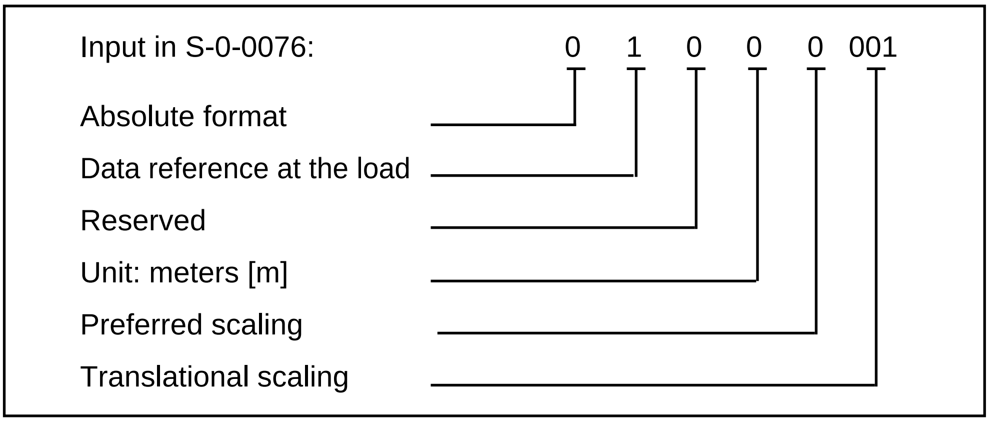


Fig. 7.14: Example of input in the „Position Data Scaling Method“ parameter for a translational servo axis

Input for translational servo axes modulo format

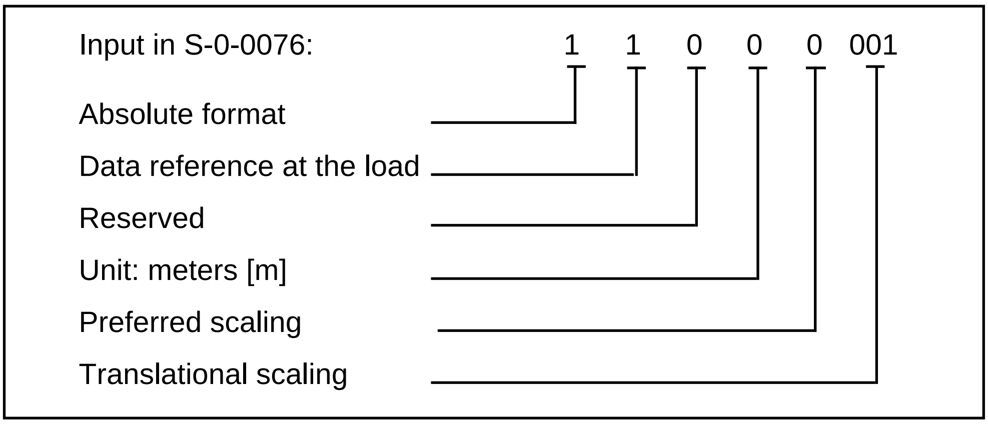


Fig. 7.15: Example of input in the „Position Data Scaling Method“ parameter for a translational servo axis in modulo format

Input for rotational servo axes, modulo format

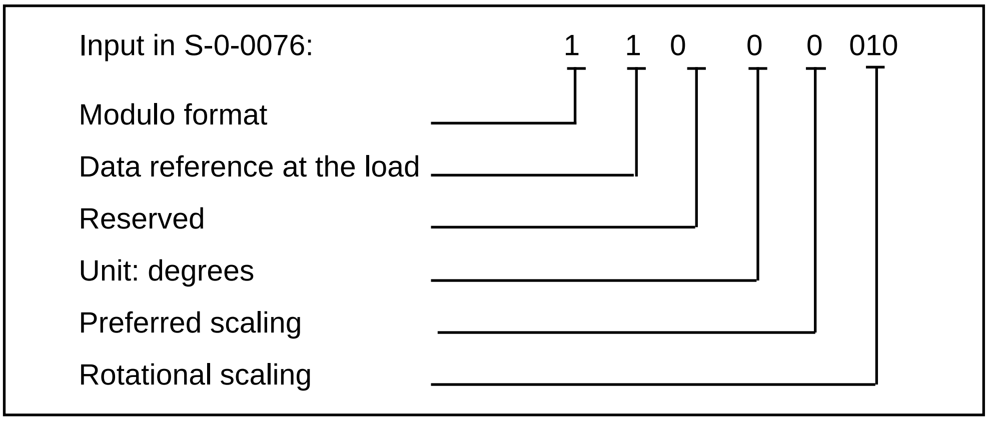


Fig. 7.16: Example of input in the „Position Data Scaling Method“ parameter for a rotational servo axis (revolving round axis).

Input for rotational servo axes, absolute format

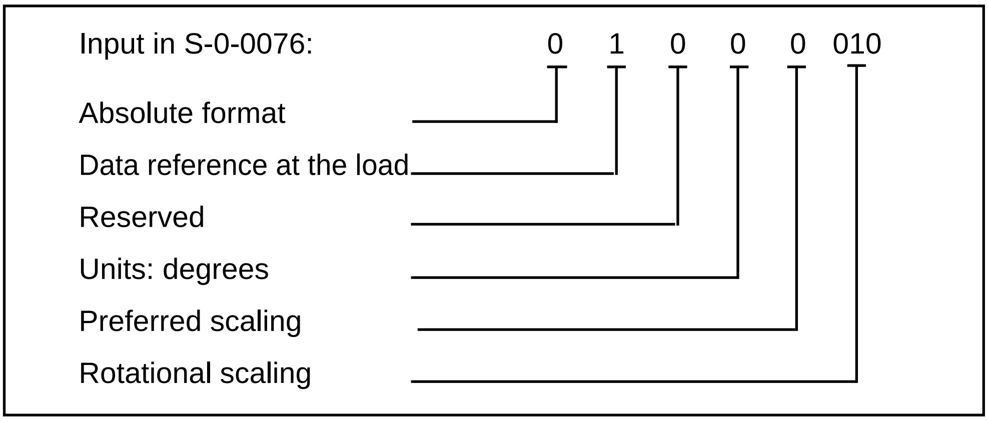


Fig. 7.17: Example of input in the „Position Data Scaling Method“ parameter for a rotational servo axis

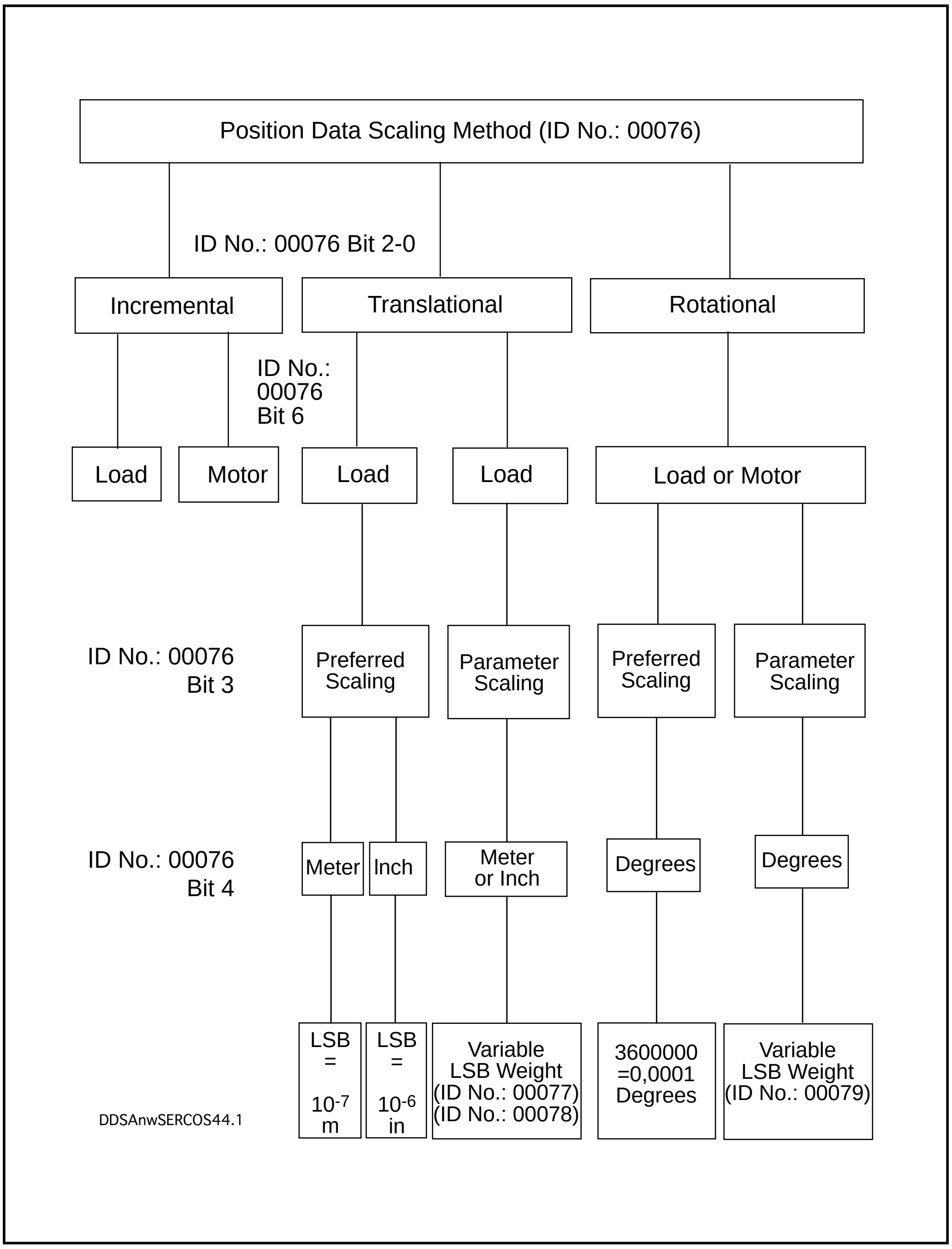
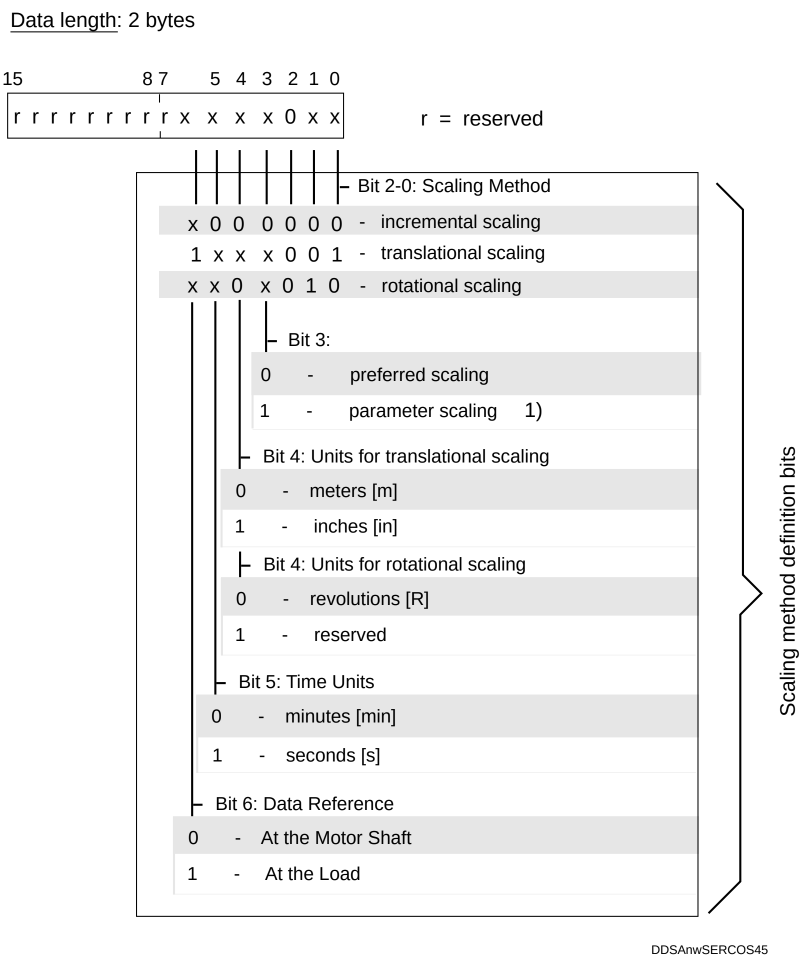


Fig. 7.18: Position Data Scaling Method diagram

Scaling of velocity data, ID No. S-0-0044

The velocity data scaling method is determined by setting the definition bits as shown in Fig. 7.19. For the input, see Fig. 7.20 or 7.21 depending on the type of axis.



Note: The 'x' character needs to be replaced by a binary 1 or 0 symbol.

1) Observe ID No. S-0-0045/S-0-0046 when activating parameter scaling (see SERCOS Interface Manual)

Fig. 7.19: Input of definition bits to determine the scaling method for velocity data

Input for translational servo axes

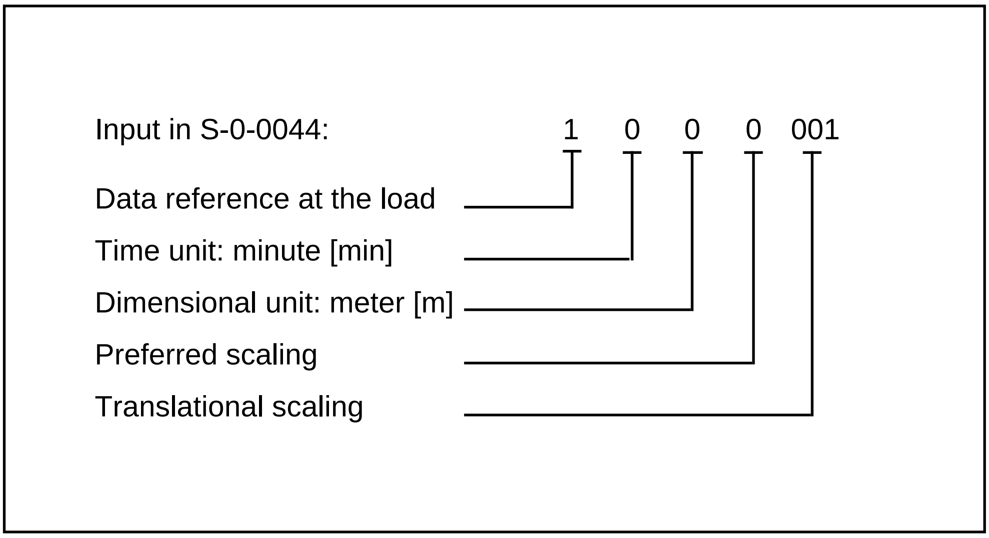


Fig. 7.20: Example of input in the „Scaling Method for Velocity Data“ parameter for a translational servo axis

Input for rotational servo axes

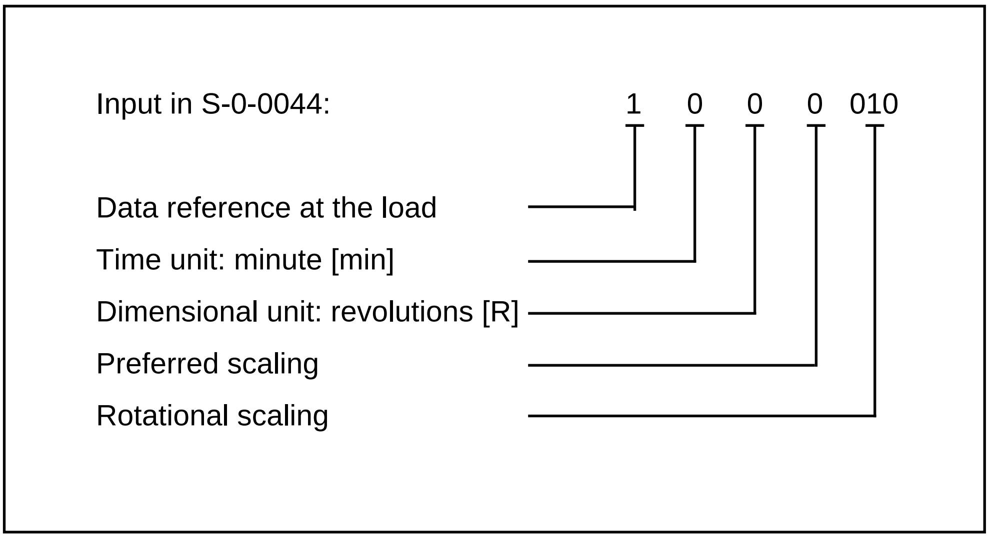


Fig. 7.21: Example of input in the „Scaling Method for Velocity Data“ parameter for a rotational servo axis

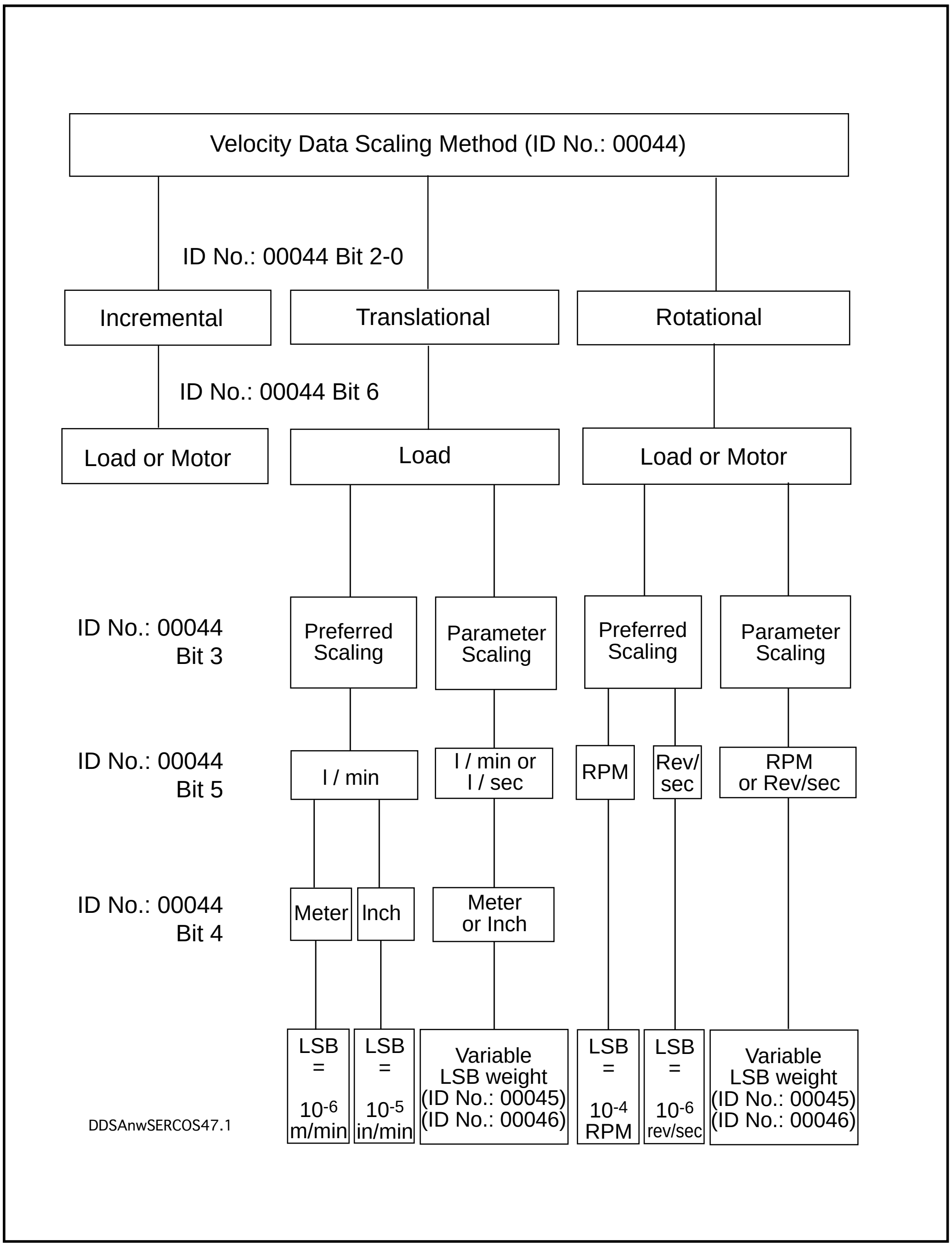
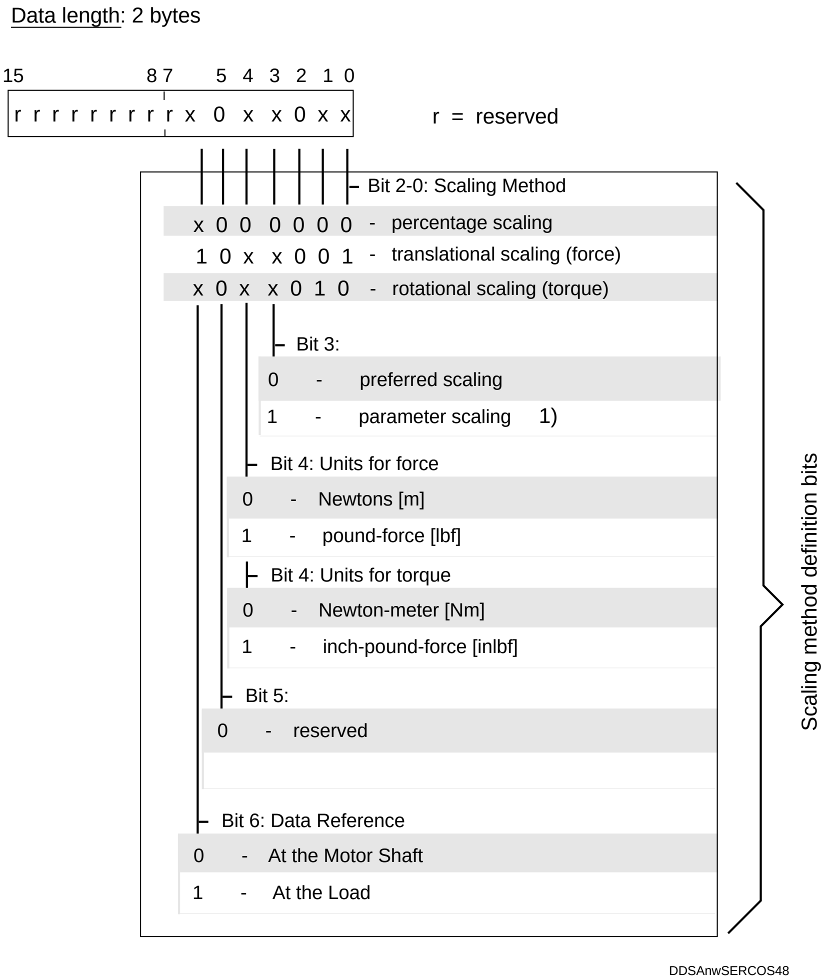


Fig. 7.22: Velocity Data Scaling Method diagram

Scaling Method for Torque-Force Data, ID No. S-0-0086

The torque-force data scaling method is determined by setting the definition bits as shown in Fig. 7.23.

At present, percentage scaling only is settable, see Fig. 7.24. The other scaling methods are in preparation.



Note: The 'x' character needs to be replaced by a binary 1 or 0 symbol.

1) Observe ID No. S-0-0087/S-0-0088 when activating parameter scaling (see SERCOS Interface Manual)

Fig. 7.23: Input of definition bits to determine the scaling method for torque-force data, ID No. S-0-0086

Input for percentage scaling

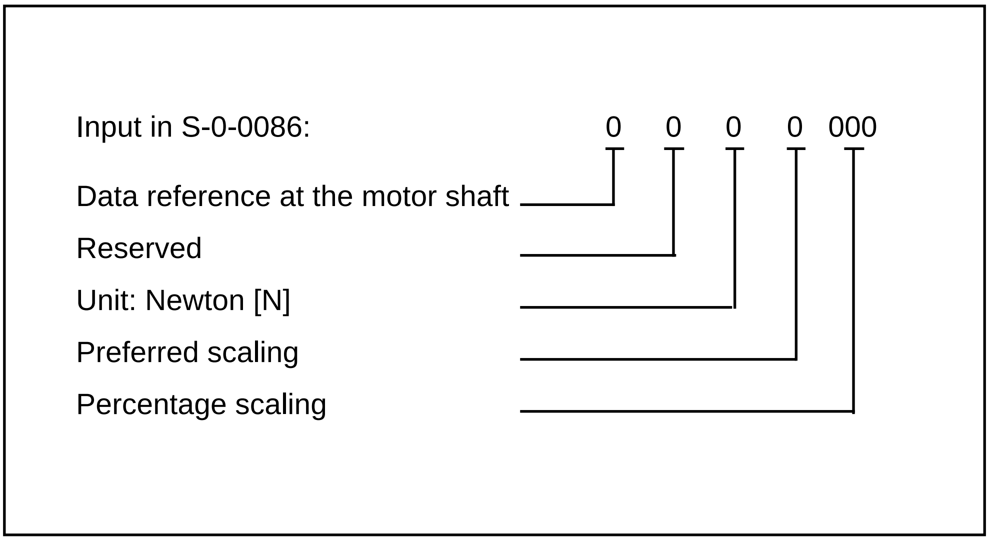


Fig. 7.24: Example of input in the „Scaling Torque-Force Data“ parameter

Input for translational servo axes

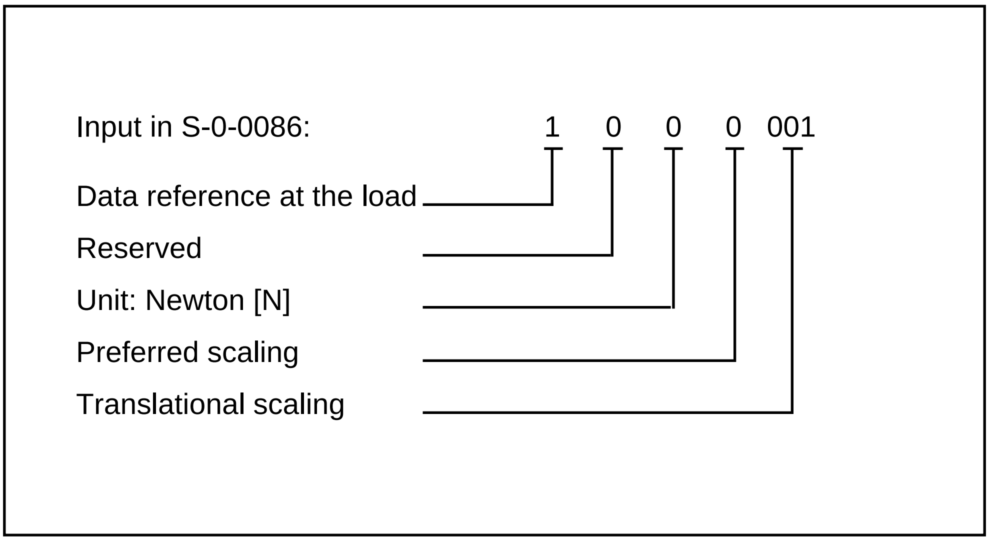


Fig. 7.25: Example of input in the „Scaling Torque-Force Data“ parameter for a translational servo axis

Input for rotational servo axes

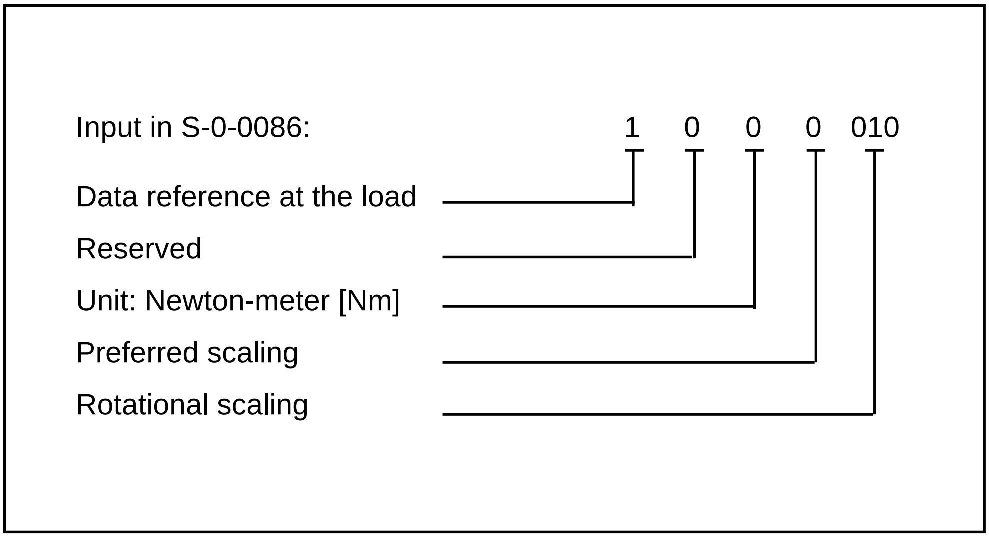


Fig. 7.26: Example of input in the „Scaling Torque-Force Data“ parameter for a rotational servo axis

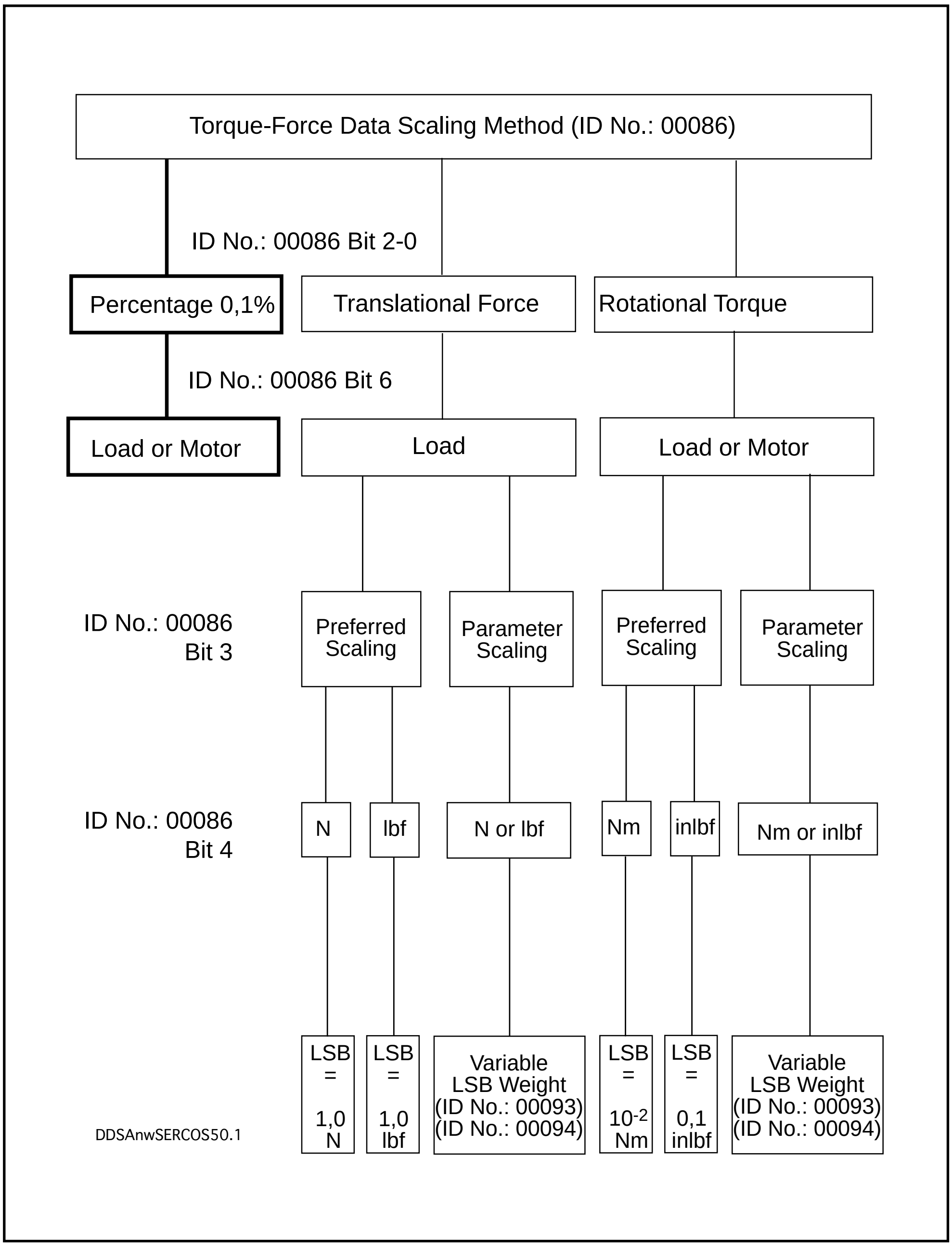
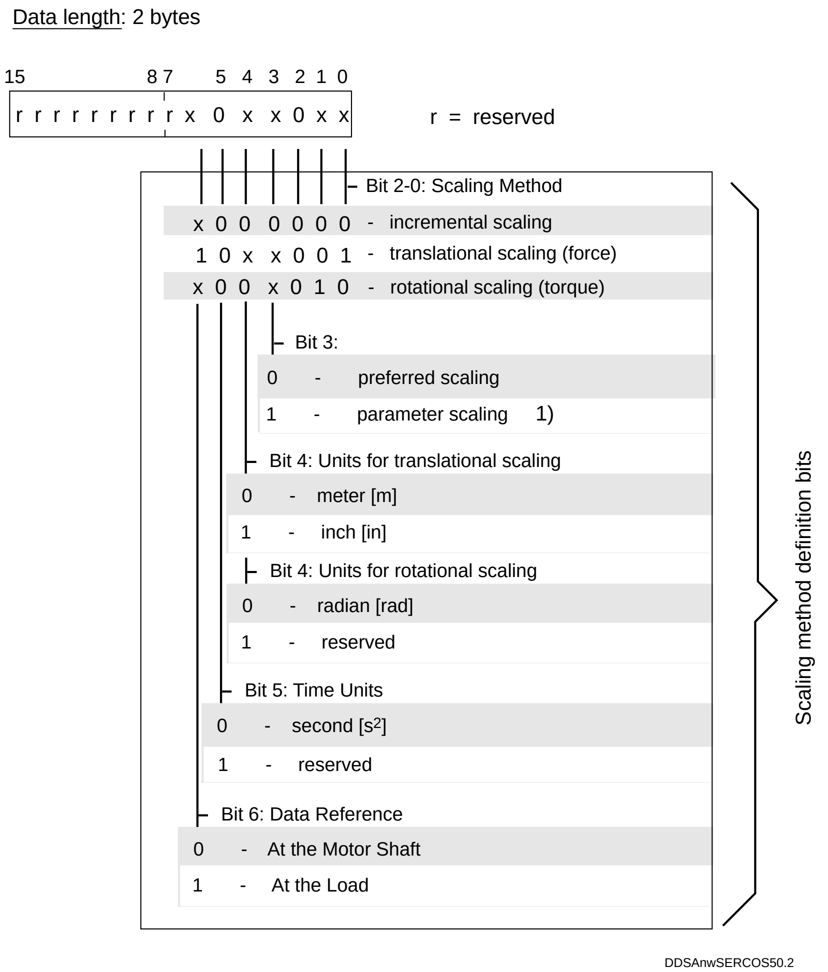


Fig. 7.27: Torque-Force Data Scaling Method diagram

Scaling of acceleration data, ID No.: S-0-0160

The acceleration data scaling method is determined by setting the definition bits as shown in Fig. 7.28. For the input, see Fig. 7.29 or 7.30 depending on the type of axis.



Note: The 'x' character needs to be replaced by a binary 1 or 0 symbol.

1) Observe ID No. S-0-0045 / S-0-0046 when activating parameter scaling (see SERCOS Interface Manual)

Fig. 7.28: Input of definition bits to determine the scaling method for acceleration data

Input for translational servo axes

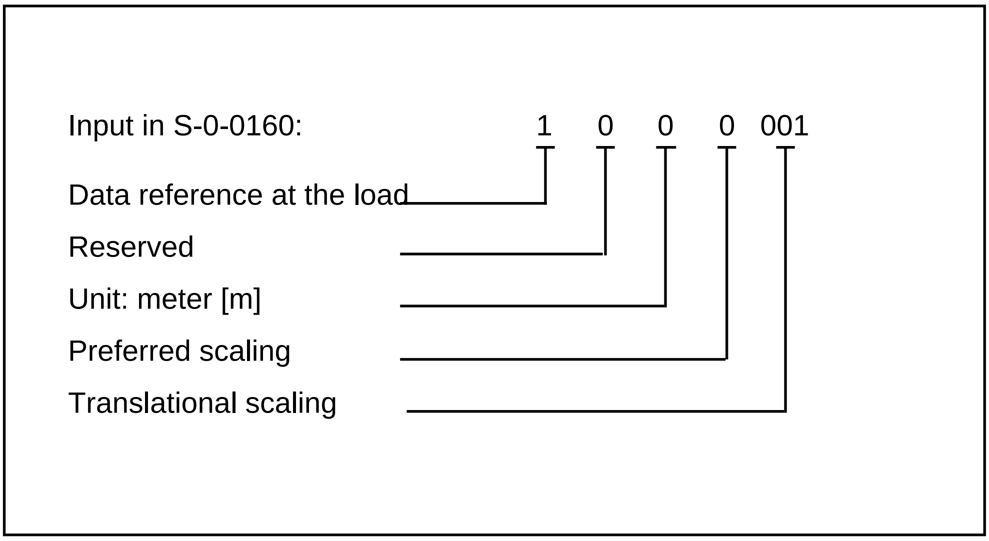


Fig. 7.29: Example of input in the „Scaling of Acceleration Data“ parameter for a translational axis

Input for rotational servo axes

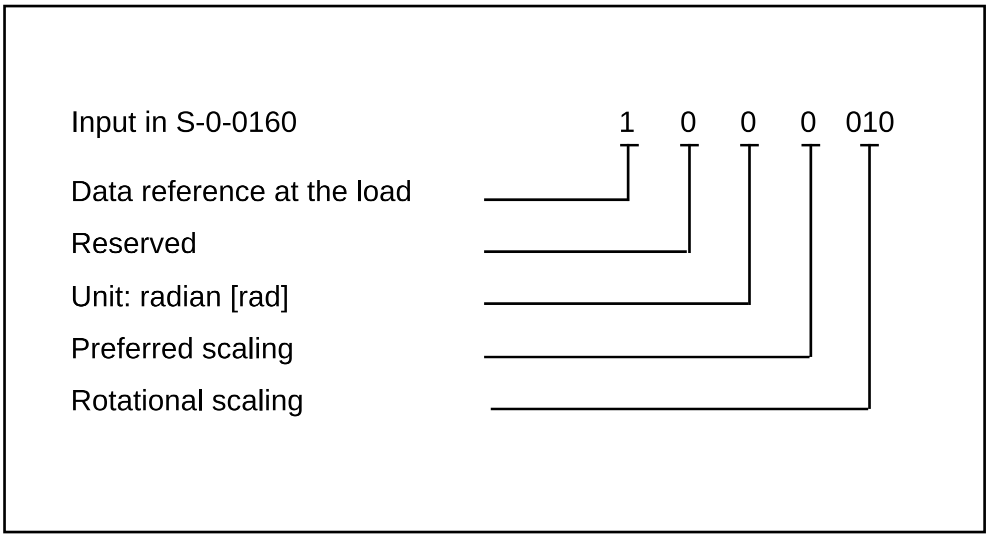


Fig. 7.30: Example of input in the „Scaling of Acceleration Data“ parameter for a rotational axis

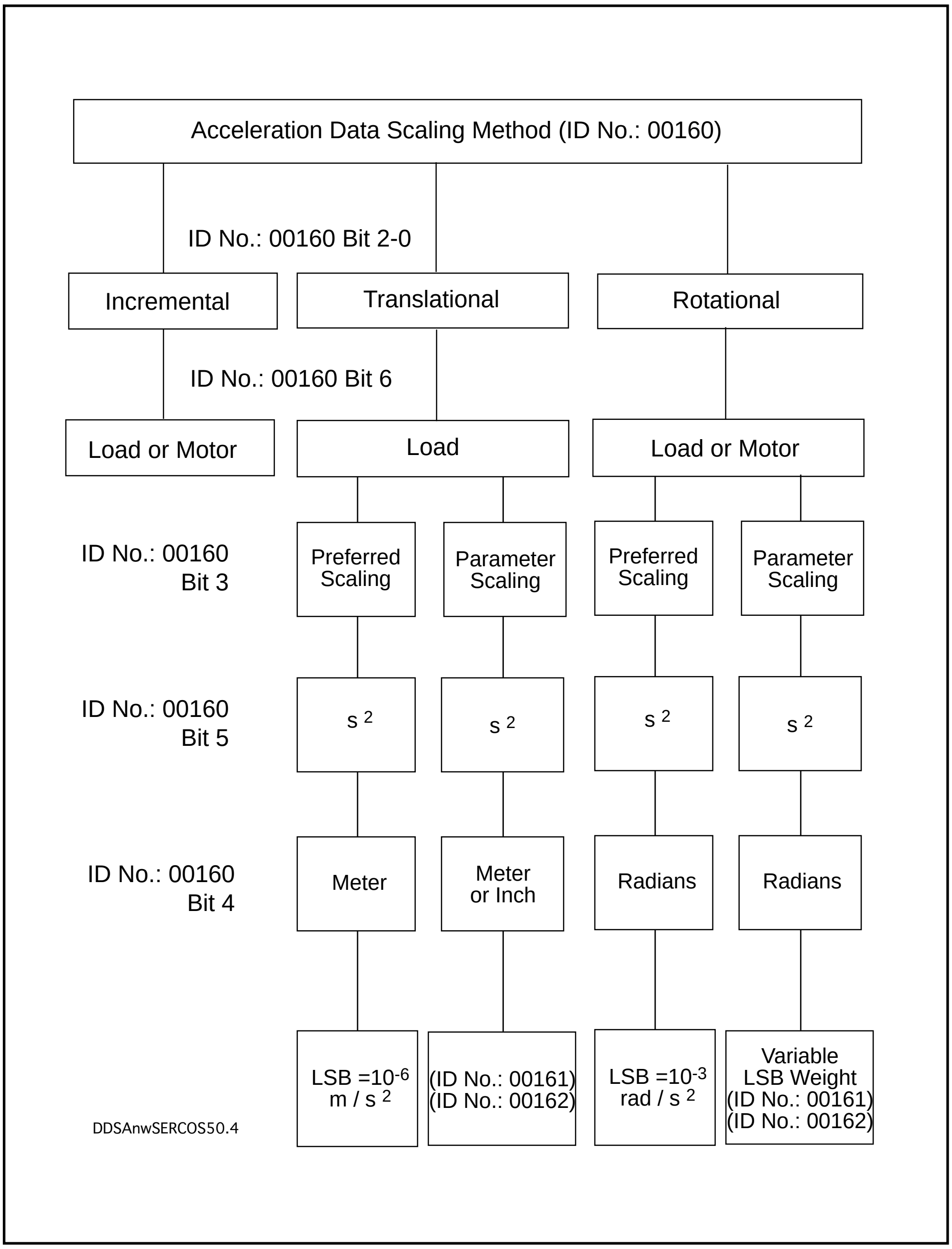


Fig. 7.31: Acceleration Data Scaling Method diagram

7.7. Modes of operation /loop monitoring

INDRAMAT digital AC servo drives with SERCOS interface can be run in the following operation modes:

1) Position loop
   - Position loop with actual feedback value 2
     for evaluation of external position measuring systems (direct position feedback acquisition)

     in the variants:
     lagless
     with lag

   - Position loop with actual feedback value 1
     for evaluation of the drive’s internal position measuring system (indirect position feedback acquisition)

     in the variants:
     lagless
     with lag

2. Position loop with command filter

3. Velocity loop

4. Torque loop

The desired mode of operation can be activated via the NC control system (see control system manual).

1. Position loop mode

The purpose of the position loop is to achieve synchronous position feedback values in all drives in response to valid position command signals emitted by the NC control for the target point in time according to the time reference.

The drive’s internal computing capacity, the high-resolution position data, the short scanning times (250 µs) and the minimization of delays in the entire control loop all combine to give a drive with high-resolution internal position control .

Lagless position loop

The lagless position loop can be used without restriction as long as the NC control generates position command values that always remain within the acceleration capacity of the axes over the entire traversing sequence. Lagless traversing has no buffer zone (lag) for acceleration or deceleration.

Parameter P-0-0099 "Position Command Smoothing Filter Time Constant" offers restricted use of this mode in a control system that does not support the lagless mode.

P-0-0099 Position command smoothing filter time constant

Parameter P-0-0099 allows a time constant to be set in the position command filter in order to create a lag as a buffer zone. This lag should be set so as to avoid rapid changes in acceleration. Entering a zero in parameter P-0-0099 will deactivate the filter.

Parameter P-0-0050 "Proportional Gain Acceleration Feed Forward" permits matching of the position loop to the maximum obtainable dynamic machine response.

P-0-0050 Proportional gain - acceleration feed forward

In the position loop mode, parameter P-0-0050 permits an acceleration feed forward to achieve a minor control deviation in the event of rapid changes in acceleration in the position command function.

Precondition:

- the velocity loop must set up accordingly (see Section 7.23.)

The input values are:

$$K_B = \frac{Jm + JL}{Km} \cdot 100$$

K_B	=	Proportional gain acceleration feed forward	in $\left[\frac{mAsec^2}{rad}\right]$
Jm	=	Rotor mass moment or inertia (see project planning manual „Digital AC servo motors“)	in $[kgm^2]$
JL	=	Reduced external mass moment of inertial	in $[kgm^2]$
Km	=	Torque constant (see project planning manual „Digital AC servo motors“)	in $\left[\frac{Nm}{A}\right]$

If the installed NC control does not support the above precondition, a position command filter can be activated in the drive controller.

Precondition:

- the velocity loop must be set up accordingly (see Section 7.23.)
- the position loop must be set to the correct gain. This is done using parameter S-0-0104 „Position loop KV factor“:

  The KV factor determines the position loop gain. In lagless mode, the KV factor does not affect the position loop’s response to commands, it determines the speed at which disturbance variables are compensated for (e.g. torque reactions stemming from a machining process). The setting of the KV factor depends on the machine mechanics.

Parameter S-0-0058 „Backlash Magnitude“ is used to compensate for the mechanical backlash on reversal of a gear.

S-0-0058
Backlash Magnitude

This parameter permits correction of load-related position actual values as a function of the direction of rotation. For positive direction of rotation the position actual value is not corrected. For negative direction of rotation the backlash magnitude is added to the position actual value.

The polarity of the speed (velocity) command value is used to sense the direction of rotation. The detected direction of rotation is change when the value of the speed command value is greater than the „Zero Velocity Window“ (S-0-0124) (hysteresis).

The backlash magnitude compensation is used to correct position actual feedback value 2 when the homing parameter (S-0-0147) has been parametrized for homing cycle with external encoder (Bit3 = 1), otherwise position actual feedback value 1 will be corrected. Correction will only be performed when the relevant encoder is referenced.

S-0-0155
Friction Torque
Compensation

This parameter is used to compensate the friction torque when accelerating from zero velocity and on reversal of direction. The value is to be entered as a percentage of the zero velocity continuous torque M_{dN} of the uncooled AC servo motor (see Selection Data List Doc. No. 209-0069-4363).

Position loop with actual feedback value 2

This mode of operation is provided to evaluate signals from a position measuring system installed directly on the moving machine element.

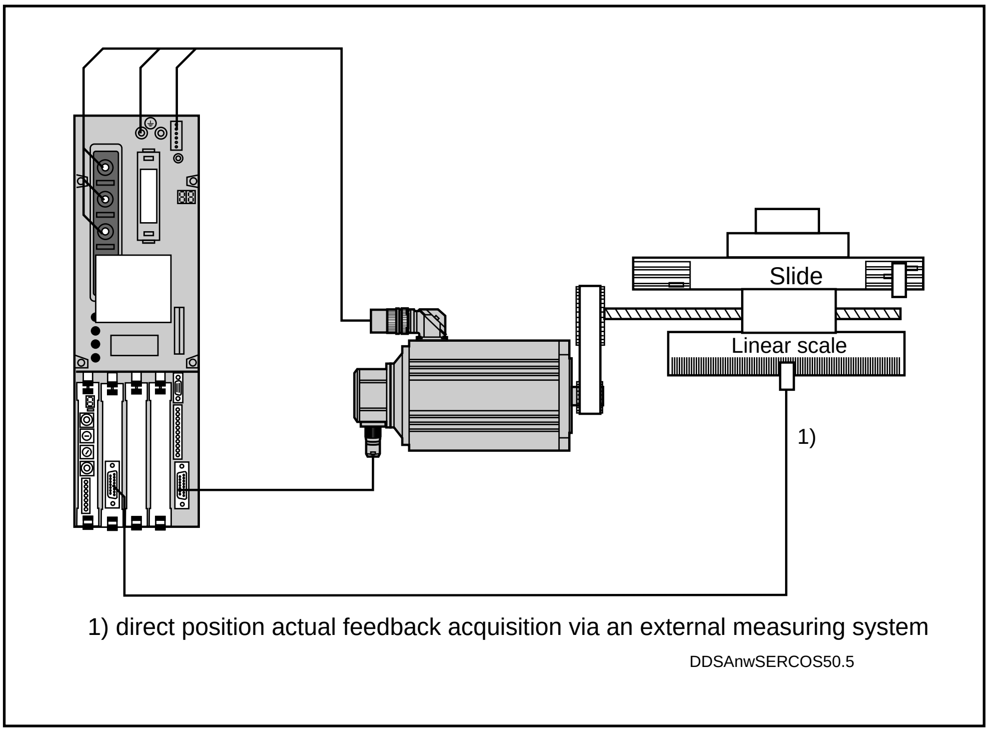


Fig. 7.32: Position loop with actual feedback value 2 for a linear servo axis

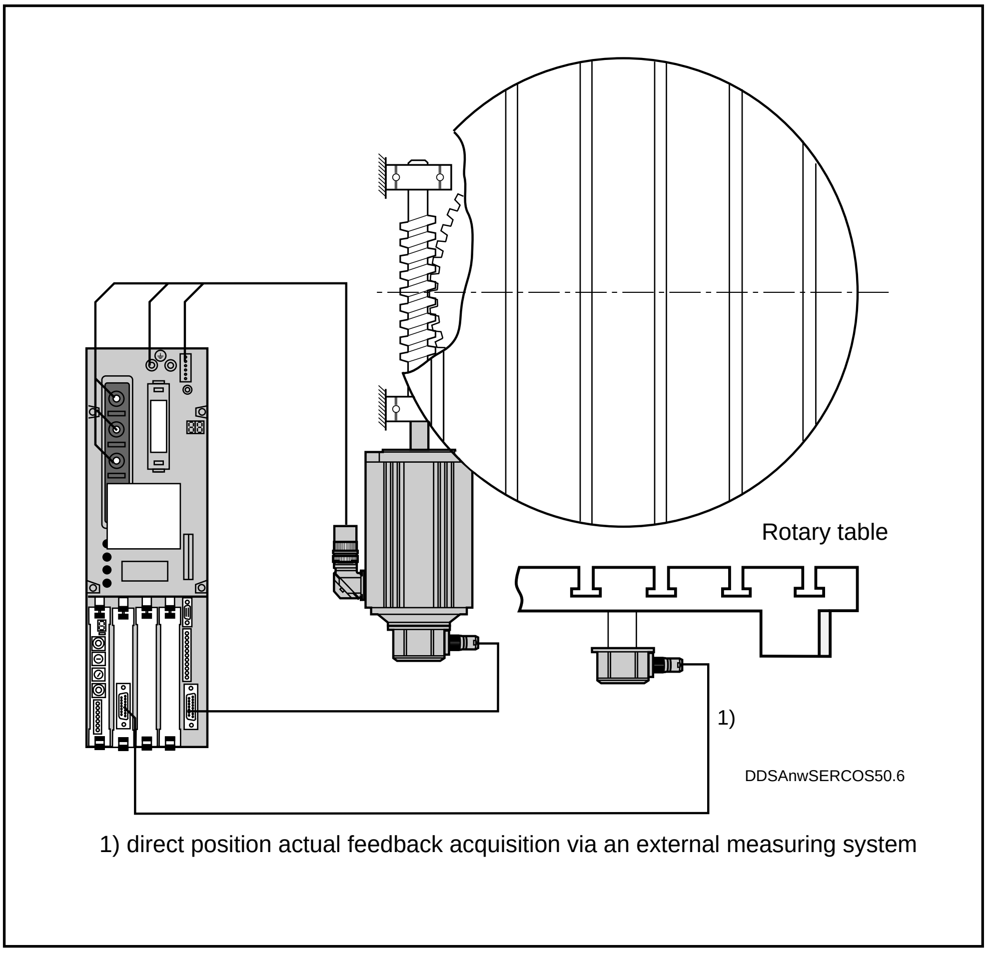
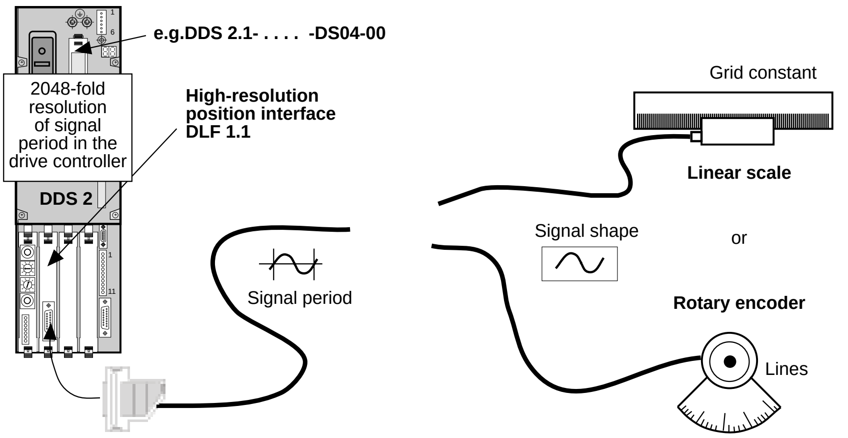


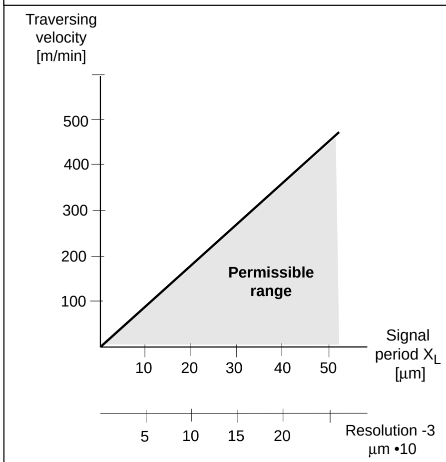
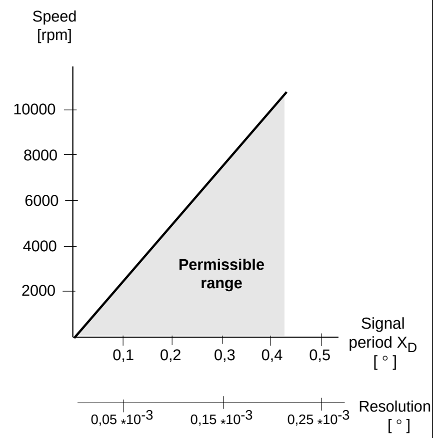
Fig. 7.33: Position loop with actual feedback 2 for a rotational servo axis

Depending on the required resolution, either sine or square-wave signals can be processed. System configuration DS04 is capable of evaluating sinusoidal signals from an external encoder at high resolution for precision shaping of the workpieces to be processed or for highly accurate positioning tasks.

This is achieved by:

- the drive's internal fine interpolation feature with a resolution of 0.00001 mm for linear scales with a signal period (grid constant) of 20µm (multiplication factor of 2048) up to a traversing velocity of 180 m(min.
- a cycle time of 250 µs in the drive's internal control loop.



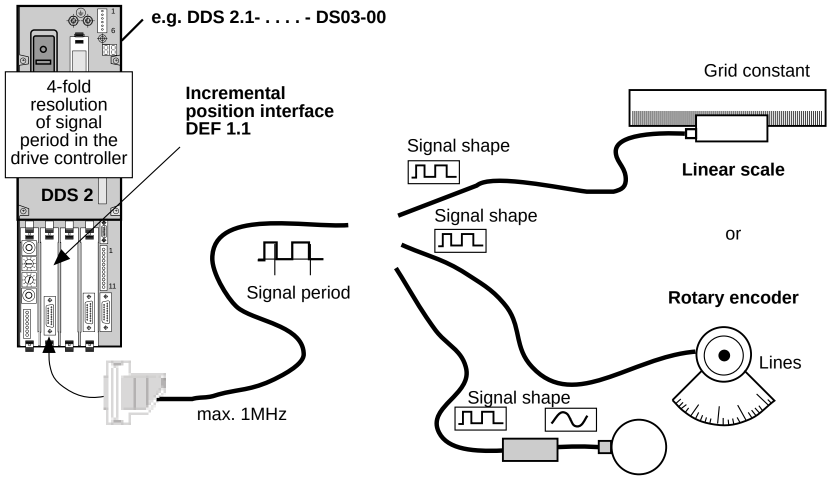
	Linear scale	Rotary encoder
Signal period	**corresponds to a traversing distance of . . . X_L µm**	**corresponds to an angle of . . . X_D °**
Position feedback resolution in the drive controller	**Resolution [µm] = $\frac{X_L\ [\mu m]}{2048}$**	**Resolution [°] = $\frac{X_D\ [\,°\,]}{2048}$**
Maximum speed or traversing velocity for a max. evaluation unit input frequency of DLF 1.1 von f_E = 150 kHz	**Max. traversing velocity** V_{max} **/ m/min = 0.06 • X_L / µm • f_E / kHz**	**Max. speed** n_{max} **/ U/min = 166.67 • X_D / ° • f_E / kHz**
	Observe the permissible mechanical traversing velocity or speed of the encoder!	
		

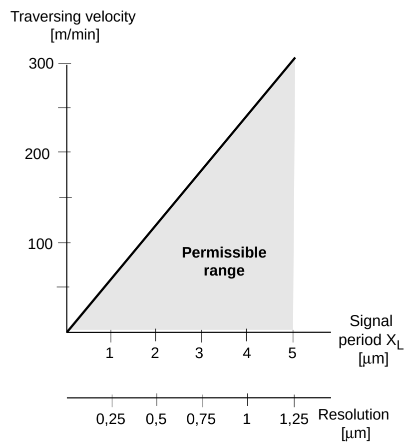
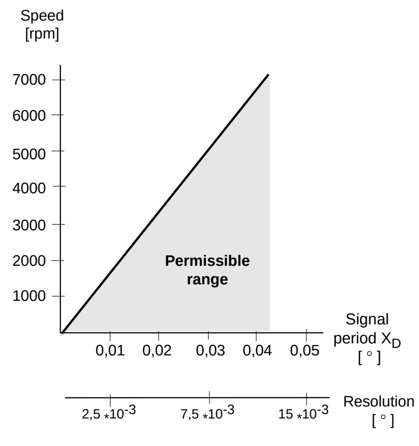
DDSAnwSERCOS50.7

Fig. 7.34: Evaluation of an external encoder supplying sinusoidal signals

Evaluation of square-wave encoder signals

System configuration DS03 has been provided for the evaluation of square-wave signals supplied by an external encoder.



	Linear scale	Rotary encoder
Signal period	**corresponds to a traversing distance of . . . X_L µm**	**corresponds to an angle of . . . X_D °**
Lageistwert-auflösung im Antriebs-regelgerät	**Resolution [µm] = $\frac{X_L\,[\mu m]}{4}$**	**Resolution [°] = $\frac{X_D\,[°]}{4}$**
Maximum speed or traversing velocity for a max. evaluation unit input frequency of DEF 1.1 of f_E = 1 MHz	**Max. traversing velocity** V_{max} / m/min = 60 • X_L / µm • f_E / MHz	**Max. speed** n_{max} / U/min = 166.67 • X_D / ° • f_E / MHz • 10^3
	Observe the permissible mechanical traversing velocity or speed of the encoder!	
		

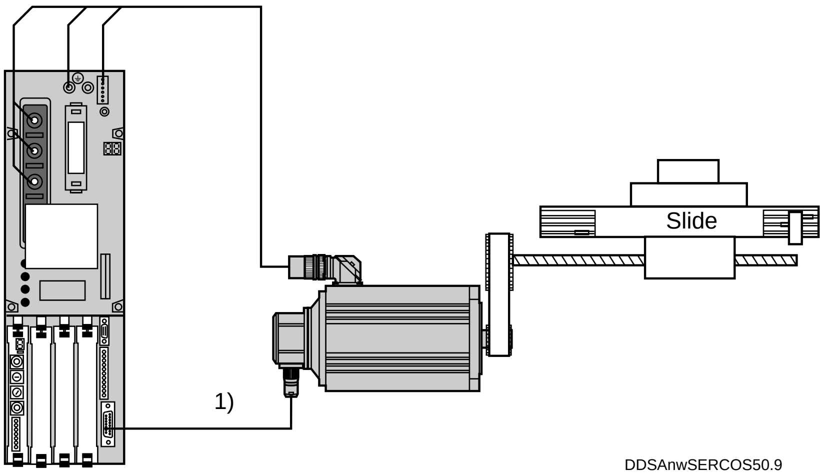
DDSAnwSERCOS50.8

Fig. 7.35: Evaluation of an external encoder supplying square-wave signals

Position loop with actual feedback value 1

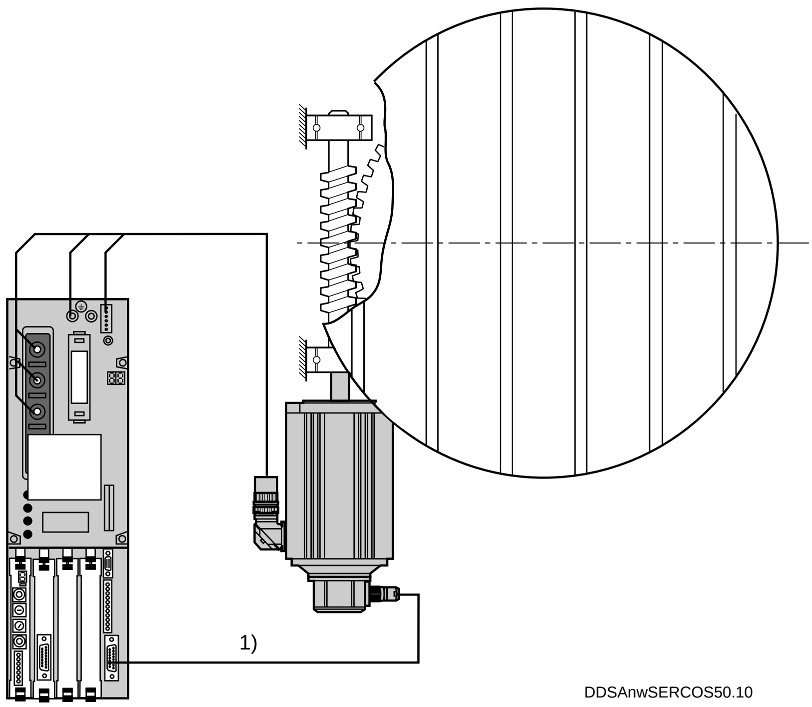
This mode of operation, implemented in system configuration DS01, offers a resolution of 2,000,000 increments per motor revolution via the drive's internal position measuring system, a powerful and cost-effective (elimination of an external sensor with associated wiring) version providing the prerequisites for driving a servo axis.

Leadscrew and gear errors that cannot be compensated for by this indirect position actual feedback acquisition can be accounted for in the „Axis Error Compensation“ function (see Section 7.22).



1) Indirect position actual feedback acquisition via the drive's internal position measuring system

Fig. 7.36: Position loop with actual feedback value 1 for a translational servo axis



1) Indirect position actual feedback acquisition via the drive's internal position measuring system

Fig. 7.37: Position loop with actual feedback value 1 for a rotational servo axis

Monitoring of position command values 37

Excessive position command difference

When the drive is running in position loop position command values coming in through the SERCOS interface are monitored . If the velocity fed forward to the drive by two successive position commands is equal to or greater than the „Bipolar Velocity Limit Value“ ID No. S-0-0091, the position command value monitoring feature will respond. The excessive position command value is stored in parameter P-0-0010. The last valid position command value is stored in parameter P-0-0011 (see Section 7.9. Limit Values).

Remedy:
Compare the „Bipolar Velocity Limit Valve“ (ID No. S-0-0091) with the velocity programmed in the parts program and adjust if necessary.

P-0-0010 Excessive command value

All cyclical position command values reaching the drive through the SERCOS interface are checked for validity against the previous value. A position command is valid when the difference from the previous command is smaller than or equal to the calculated velocity limit value (refer also to S-0-0091 Bipolar velocity limit value).

If the drive detects an excessive command value, this is written to the parameter „Excessive command value“. The drive will react to this error in accordance with the error reaction programmed in parameter P-0-0007. The last valid position command is written to parameter P-0-0011. This allows complete reconstruction of the scenario in the event of a position command error.

P-0-0011 Last valid position command value

In the event of an excessive position command value, the last valid position command is stored in this parameter (see P-0-0010 Excessive command value).

Monitoring of position feedback values in parameter S-0-0159 „Monitoring Window“

The drive concurrently runs a drive model calculation for the purpose of monitoring its internal position loop. If the actual position feedback value deviates from the model’s feedback value, error no. „28“ will be generated, however, not until the threshold value prompting the error reaction has been exceeded for more than 50 ms. The threshold is determined by entering a percentage value in parameter S-0-0159 „Monitoring Window“.

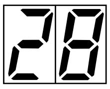
This has been standardized as: 100% = 360° at the motor shaft.

Parameter P-0-0098 „Model Deviation“ serves to parametrize S-0-0159 „Monitoring Window“.

To determine the input value for the monitoring window:

1. Set the monitoring window (S-0-0159) to 50%
2. Move the axis at the set velocity and acceleration (prescribed working cycle).
3. Read off the parameter P-0-0098 „maximum model deviation“.
4. Multiply this value by 2 and enter the result in the „monitoring window“ parameter.

Excessive Deviation Error



The drive was not able to follow the incoming command value and reacted according to the set error reaction.

Cause:
1. The drive's acceleration capacity was exceeded.
2. The axis jammed.
3. Error in the drive parameters
4. Monitoring window S-0-0159 wrongly parametrized.
5. Loose connections at the DC link circuit connector X5 or on the motor power cable.

Remedy:
1. Check parameter S-0-0092 „Bipolar Velocity Limit Value“ and set to the maximum permissible value for the application (see Section 7.9).
2. Reduce the acceleration feed forward in the NC control (see NC control manual).
3. Check the drive parameters, see Section 7.23 - Velocity loop
4. Reset the monitoring window.
5. Check that all contacts are firmly connected.

Danger due to lethal voltage levels

Before checking the equipment, first:
- **Switch off the power supply.**
- **Wait for the circuits to discharge (approx. 5 min.)**
- **Measure the DC link circuit voltage. Wait for the voltage to fall below 50 V before attempting any inspection work.**

„Monitoring Window for External Encoders“ P-0-0120

Parameter P-0-0120 „Monitoring Window for External Encoders“ is used to monitor the machine mechanics and the link-up to an external encoder.

Function

The command for preparing to switch to Communication Phase 4 sets the position actual feedback value 2 to position actual feedback value 1 and starts cyclical evaluation of the two encoders. During cyclical operation (Phase 4), the difference in the position actual feedback value emitted by the two encoders is compared with the monitoring window. If the difference value is outside the monitoring window, Error 36 „ Excessive position feedback value difference“ is diagnosed and the parametrized error reaction (P-0-007) executed.

Input

The value to be entered in Parameter P-0-0120 depends on the application. As a rough guide, the value to enter is the distance travelled for one motor revolution.

2. Position loop with command filter

INDRAMAT digital AC servo drives feature a „Position Loop with Command Filter“ mode. This permits operation of automation equipment, e.g. positioning axes, with controls of minimal complexity.

In this mode, the AC servo drive can approach a pre-set target position in compliance with the prescribed velocity, acceleration and stutter values.

The working principle of the position loop with command filter is illustrated in Fig. 7.38.

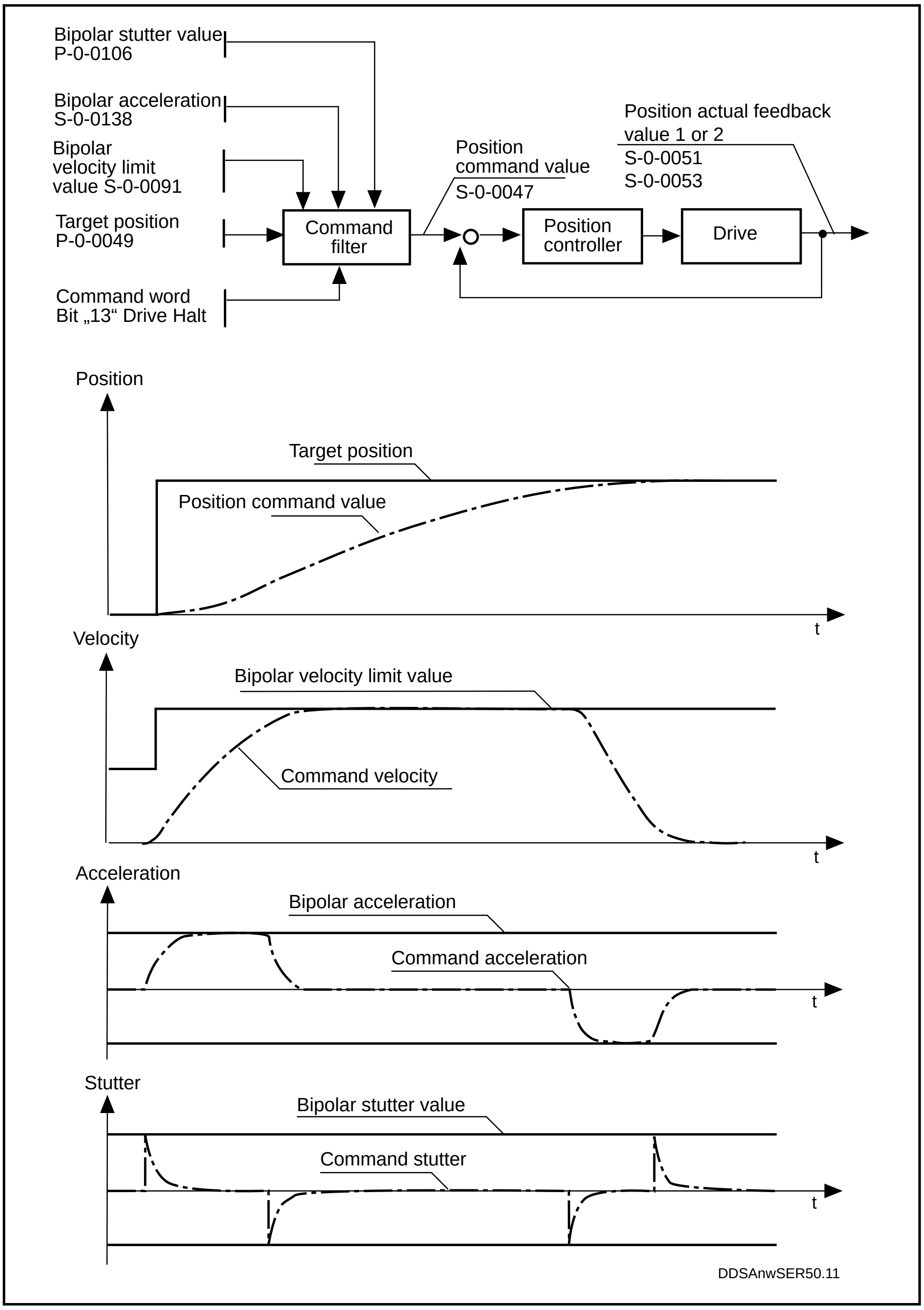


Fig. 7.38: Working principle, „Position loop with command filter“ mode

Parameter input for the „Position loop with command filter“ mode:

P-0-0106 Bipolar stutter limit value

When the manufacturer-specific operating mode „position loop with command filter“ is active, the value to be entered in this parameter is the maximum permissible change in acceleration while the axis is in motion.

S-0-0138
Bipolar acceleration

This parameter is used to limit the drive's maximum acceleration, symmetrically in both directions, to the programmed value.

S-0-0091
Bipolar velocity limit value

The drive limits the velocity to the amount fixed by the „Bipolar Velocity Limit Value“ parameter. In this mode the parameter contents serve as the velocity command.

P-0-0049
Target Position

When the manufacturer-specific „Position loop with command filter“ mode is active, this parameter serves to enter the target position that the drive is to approach automatically.

All further parametrizing is identical to that for the position loop mode.

S-0-00182
Manufacturer Class 3 diagnostics

In addition to the SERCOS definition, the following manufacturer-specific operating conditions have been defined for diagnostics purposes:

Bit 4: Target position outside position limit values
[Target position (P-00049) > positive position limit value (S-00049) or
target position (P-00049) > negative position limit value (S-00050)]
and limit values are active (bit 4 in S-00055)

Bit 5: Excessive bipolar velocity limit value
| Bipolar velocity limit value (S-00091) | > |
| converted* maximum motor speed (S-00113) |
* converted with feed constant (S-00123), load gear input revolutions (S-00121) and load gear output revolutions (S-00122).

Bit 6: At target position
Target position - actual position is within position window (S-0057) and
Command position - actual position is within position window (S-0057) and
| |actual velocity | < zero velocity window (S-00124)

Bit 11: Drive has halted
Bit 13 in control word = 0 and
| actual velocity | < zero velocity window (S-00124)

3. Velocity loop

The velocity loop mode can be used for applications requiring a constant velocity. Such applications may be:

- main spindle applications of MDD motors
- driven tools
- metering equipment

If the velocity loop is employed as a minor control loop with a major position loop, e.g. in contouring applications, the inevitable delays will lead to less accurate contours compared with those achievable with the drive's internal position control.

4. Torque loop

The drive controller's torque loop mode can be used for applications requiring a force control loop

7.8. Servo axis traversing direction

S-0-0055 Position Polarity Parameters

These parameters determine the polarity of individual position command and feedback values exchanged between the NC control unit and the drives

In the case of position-controlled digital drives, changing the polarity is only effective if all command and feedback values are changed with to either positive or negative polarity.

In addition, the position polarity parameters permit deactivation of the position limit value parameters S-0-0049 and S-0-0050. However, in the interests of operational safety, this option should preferably not be used.

The following coding applies:

	4 3210 Bit	
Positive polarity:	1 0000	position limit values active
	0 0000	position limit values deactivated
	4 3210 Bit	
Negative polarity	1 1111	position limit values active
	0 1111	position limit values deactivated
Positive polarity means:		clockwise direction of rotation when looking at the motor shaft

S-0-0043 Velocity Polarity Parameters

These parameters determine the polarity of individual velocity command and feedback values exchanged between the NC control unit and the drives. These should be set to the same polarity as the position polarity parameters.

	210 Bit
Positive polarity	000
Negative polarity	111

S-0-0085 Torque Polarity Parameters

These parameters determine the polarity of individual torque command and feedback values exchanged between the NC control unit and the drives. These should be set to the same polarity as the position polarity parameters.

	210 Bit
Positive polarity	000
Negative polarity	111

7.9. Position/Velocity/Torque Limit Values

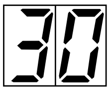
The parameters „Positive/negative position limit value“ are used to limit the working range (see Section 7.13 Limitation of working range).

Position limit values are only active when the axis has been referenced.

If these position limit values are exceeded, the drive will be shut down. Parameter S-0-0055 „Position Polarity Parameters“ allows deactivation of the position limit values.

Shut-down is achieved by:

- Shut-down of main power
- Cancellation of torque command value, (i.e. zero torque). This causes the drive to brake at maximum torque.



The status indicator „H1“ displays the following error message:

Travel limit value is exceeded

Activating the axis after an error reaction

Procedure

- Clear the error (see NC unit manual)
- Switch on power
- Move the axis to within the permissible working range

Only position command values lying within the permissible working range will be accepted. Any other command values will cause the drive to shut down again.

Danger due to uncontrolled axis movements!
Before deactivating position limit values, activate the higher-level safety devices.

Deactivating the position limit values

The position limit values can be deactivated via the parameter S-0-0055 „Position Polarity Parameters“

	4 3210 Bit
Input for positive polarity	0 0000
Input for negative polarity	0 1111

S-0-0091 Bipolar velocity limit values

The drive limits the velocity to the value set by the „Bipolar Velocity Limit Value“ parameter. If the velocity command value reaches this value the drive will be shut down after the set error reaction. For safety reasons, the parameter should be set to 10% of the max. useful NC speed during commissioning. For normal operation, set the „Bipolar Velocity Limit Value“ parameter to a value 10% higher than the useful NC speed.

In order to avoid internal computer overflows, the value entered for the bipolar velocity limit value must be below the following limits:

for rotational scaling:

$$\text{Bipolar velocity limit value} < \left[20000\ \text{rpm} \cdot \frac{\text{S-0-0122 (Load gear output revolutions)}}{\text{S-0-0121 (Load gear input revolutions)}} \right]$$

for translational scaling

$$\text{Bipolar velocity limit value} < \left[20000\ \text{rpm} \cdot \text{Feed constant} \ \frac{\text{S-0-0122 (Load gear output revolutions)}}{\text{S-0-0121 (Load gear input revolutions)}} \right]$$

S-0-0092 Bipolar Torque Limit Value

If peak torque has to be reduced for certain machine operating modes, this is possible via the DDS 2.1 servo drive module. The drive limits the motor torque to the amount set in the „Bipolar Velocity Limit Value“. The velocity limit value is given in % of the continuous torque at standstill M_{dN} for the uncooled motor. See the Selection Data List Doc. No. 209-0069-4302 of the relevant motor/ drive controller combination.

7.10. Matching of mechanical transmission elements

Command and feedback values are interchanged between the NC control unit and the drives. If the data exchanged refers to the load, all mechanical constants of the respective machine axis must be parametrized in the drive controller.

These are:

- feed constants (for translational axes)
- gears

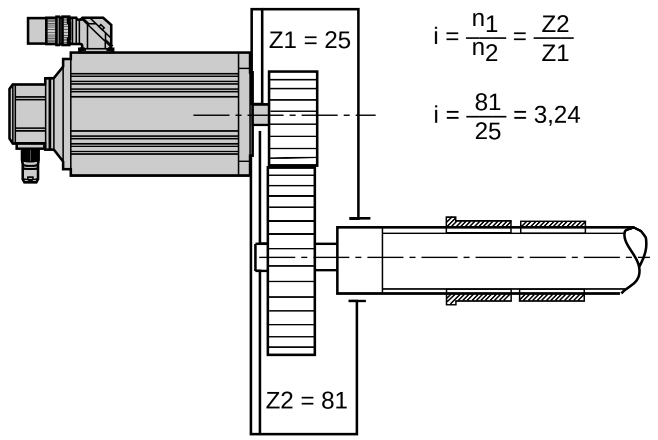
Parametrizing gears

Gear matching on digital AC servo drives is achieved by entering the gear transmission ratio in the parameters:

- „Input Revolutions of Load Gear“ ID No. S-0-0121
- „Output Revolutions of Load Gear“ ID No. S-0-0122

The entry should be made in whole numbers without decimal places. If no gear is installed, enter 1 in both parameters.

Example



i = transmission ratio
n_1 = input revolutions
n2 = output revolutions
Z1 = number of teeth on the input pinion
Z2 = number of teeth on the output pinion

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Fig. 7.39: Example of a single stage gear

Input into the parameters:

- "Input Revolutions of Load Gear"
  ID No. S-0-0121
  Z2 = 81
- "Output Revolutions of Load Gear"
  ID No. S-0-0122
  Z1 = 25

Parametrizing feed constants

The parameter „Feed constant“ ID No. S-0-0123 describes the machine elements which converts a rotational motion into a translational motion (e.g. recirculating ball screw, rack and pinion). The feed constant gives the traversed translational dimension for one output revolution of the gear.

Example: recirculating ball screw

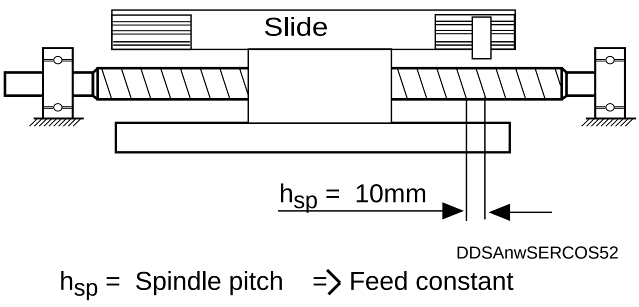

Fig. 7.40: Feed constant for a recirculating ball screw

Input in parameter „Feed constant“ ID No. S-0-0123: 10.000 [mm]

Example:
Rack and pinion

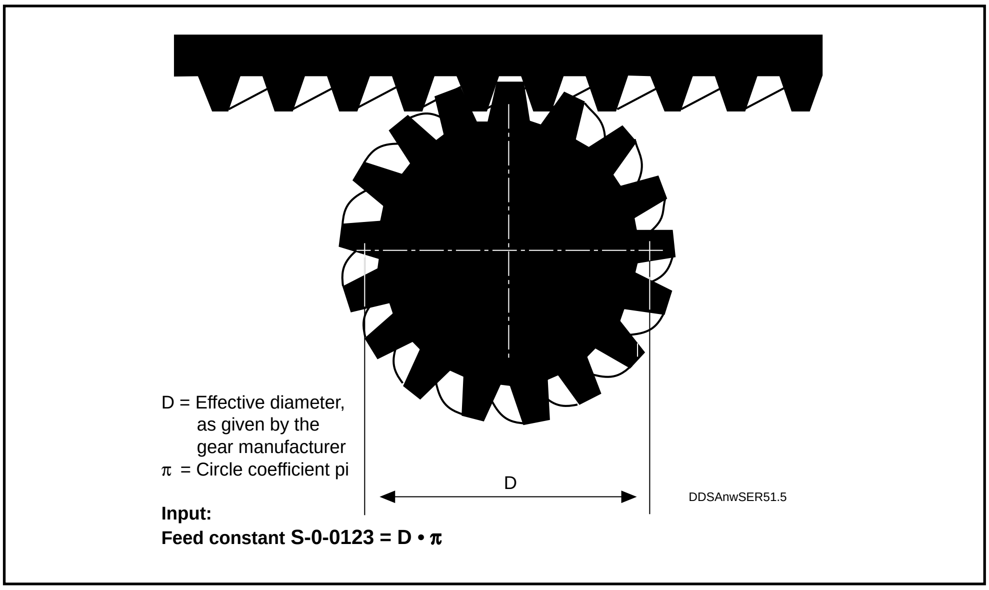

Fig. 7.41: Feed constant by rack and pinion transmission

Maximum travel!

The maximum travel for a translational servo axis is limited to a range of ± 2048 motor shaft revolutions after referencing.

$$S = [\text{S-0-0123 (feed constant)} \bullet \frac{\text{S-0-0122 (Load gear output revolutions)}}{\text{S-0-0121 (Load gear input revolutions)}} \bullet 2048]$$

S = max. travel

7.11. Matching external measuring systems

External measuring systems can be matched using the „Position Feedback Type Parameter“ ID No. S-0-0115.

The following items must be entered:

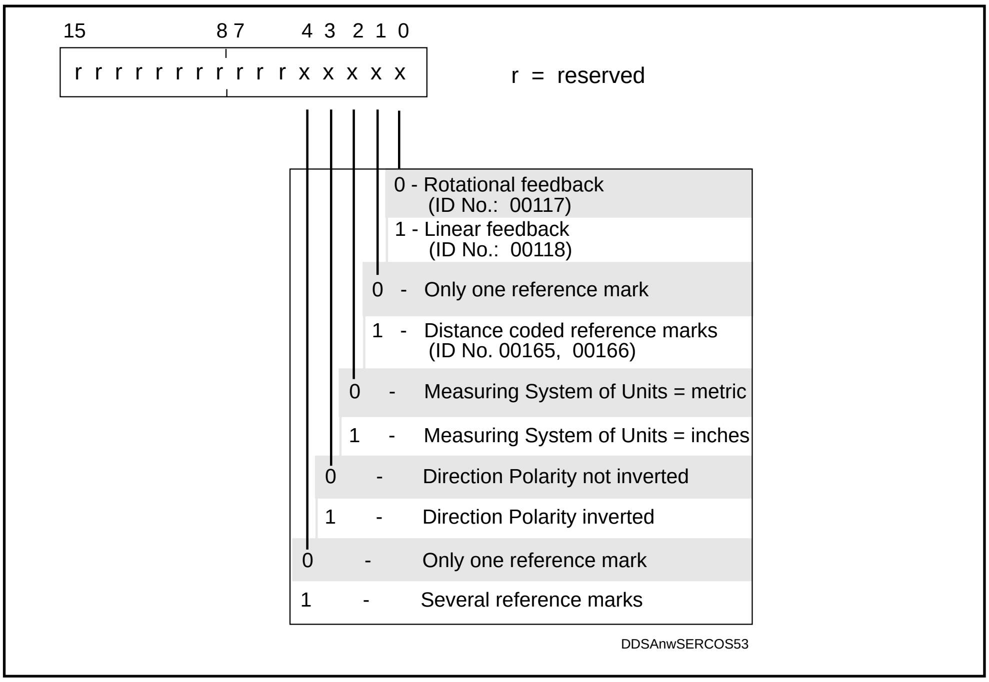

Fig. 7.42: Input coding for S-0-0115 „Position Feedback Type Parameter“

When using an external measuring system for direct position measurement, the count direction for position feedback values 1 and 2 is to be set in the same way.

Positive direction of travel in an axis equals positing count direction of position feedback values 1 and 2.

In the following input combinations, please note the additional position feedback parameters:

Type of external measuring system	Input in ID No.:S-0-0115	Additional feedback parameter inputs
Rotational feedback with one reference mark	X 0 X X X 0	S-0-0117
Linear feedback with one reference mark	X 0 X X X 1	S-0-0118
Linear feedback with distance-coded reference marks	X X X X 1 1	S-0-0118 / S-0-0165 / S-0-0166
Rotational feedback with distance-coded reference marks	X X X X 1 0	S-0-0117 / S-0-0165 / S-0-0166

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Fig. 7.43: Input combinations for external measuring systems with indication of additional mandatory position parameter inputs

S-0-0117 Resolution of Rotational Feedback 2 (ext. feedback)

For drive controllers, the resolution of external feedback types is given as:

- Evaluation of square-wave feedback signals without external evaluation electronics, i.e.

Resolution of Rotational Feedback 2 = number of lines per revolution

- Evaluation of square-wave feedback signals without external evaluation electronics, i.e.

Resolution of Rotational Feedback 2 = number of lines per revolution x external multiplication

- Evaluation of sinusoidal feedback signals, i.e.

Resolution of rotational feedback 2 = number of lines per revolution

S-0-0118 Resolution of Linear Feedback (ext. feedback)

For drive controllers, the resolution of external linear feedback types is given as

- Evaluation of sinusoidal feedback signals, i.e.

Resolution of linear feedback = grid constant

- Evaluation of square-wave feedback signals, i.e.

$$\text{Resolution of linear feedback} = \frac{\text{grid constant}}{\text{external multiplication}}$$

Maximum position detection range

The maximum position detection range of drive controllers depends on the resolution of the encoder used and the type of signal transmission. This range can be calculated as follows:

Detection range when using an encoder with square-wave signals

Detection range: $\pm 2^{29}$ *pitch unit*

Example: rotary encoder 9000 lines/revolution

$$\text{Detection range} = \frac{\pm 2^{29}}{9000} = \pm 59652 \text{ revolutions}$$

Example: linear scale 20 µm pitch unit

$$\text{Detection range} = \pm 2^{29} \cdot 20\ \mu\text{m} = \pm 10737\ \text{m}$$

Detection range when using an encoder with sine-wave signals

Detection range: $\pm 2^{18}$ *pitch unit*

Example: rotary encoder 9000 lines/revolution

$$\text{Detection range} = \frac{\pm 2^{18}}{9000} = \pm 29 \text{ revolutions}$$

Example: linear scale 20 µm pitch unit

$$\text{Detection range} = \pm 2^{18} \cdot 20\ \mu\text{m} = \pm 5{,}24\ \text{m}$$

Linear scale with distance-coded reference marks

For an external measuring system with distance-coded reference marks, the following parameters must be entered:

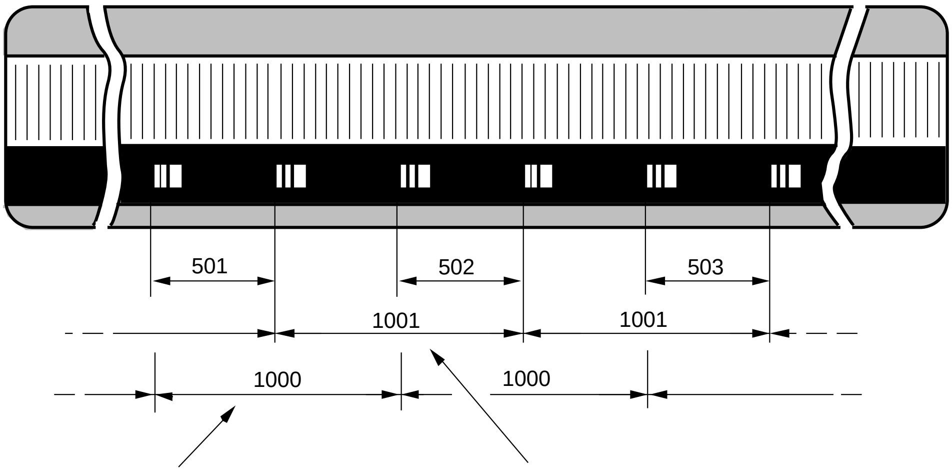
"Distance-coded Reference Dimension 1"   ID No. S-0-0165

and

"Distance-coded Reference Dimension 2"   ID No. S-0-0166

(See Fig. 7.44)

Example of inputs for Heidenhain products



„Distance-coded reference dimension 2“ (smaller value) SERCOS-**ID No.:S-0-0166**; Input unit: pitch

The manufacturer of the length measuring system indicates:
distance travelled up to the absolute position value: 20 mm
pitch unit: 20 µm (0-02 mm)

20 mm: 0.02 mm = 1000 pitch units

This value (**1000** pitch units) is to be entered in parameter ID No. S-0-0166.

„Distance-coded reference dimension 1“ (larger value) SERCOS **ID No. S-0-0165.** Input unit: pitch unit

For Heidenhein length measuring system the larger value is the product of:
(distance travelled + pitch unit):
pitch unit, therefore:
20.02 mm: 0.02 mm = 1001 pitch units

This value (**1001** pitch units) is to be entered in parameter ID No. S-0-0165.

Setting up of distance-coded Heidenhain length measuring systems
(taken from: Catalog for NC length measuring systems, September 1993):

Length measuring system Type	Distance travelled: in mm	Pitch unit: in µm	Input in: ID No.: S-0-0166	Input in: ID No.: S-0-0165
LS 403C LS 406C LS 323C LS 623C LS 106C ULS 300C	20	20	1000	1001
LS 103C LS 405C ULS 300C	10	10	1000	1001
LID 311C LID351C	20	10	2000	2001

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Fig. 7.44: Configuration of a distance-coded linear scale

7.12. Absolute encoder function

Drives with an integral absolute encoder function are always at the reference dimension immediately the plant is powered up. There is no need to carry out a homing cycle. The reference dimension only has to be set once on commissioning for an axis fitted with an absolute encoder function.

Benefits of absolute position acquisition

- No need to carry out new homing cycle when position data has been lost (time-saving).
- No risk to machine and workpiece through homing cycles.
- Elimination of reference cams with switches and wiring.

Working principle

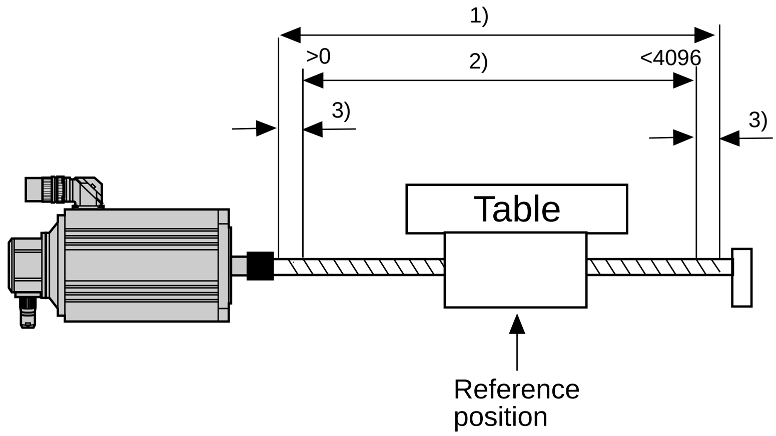
In motor feedback types with multiturn encoder option, the position of the servo motor's rotor is acquired cyclically in absolute terms and processed at high resolution within the drive controller.

The multiturn encoder option enables absolute position feedback acquisition over 4096 motor revolutions.

Setting reference positions

To set the reference dimension for interaction between the measuring system and the machine mechanics, the procedure is as follows:

1. Use the manual jog mode to move the axis to a specific (already measured) reference position. (The jog function can be initiated via the NC control unit or the PC SERCOS interface.) Fig. 7.45 shows an example with the reference position located at mid traversing stroke.
2. Enter the desired position actual value (axis position) in parameter S-0-0052 „Actual Position Feedback Value 1 - Reference Dimension"
3. Trigger the command „Set absolute dimension" via the NC control unit.
4. Deactivate the axis by cancelling the controller enable signal (switch off power). This causes the reference dimension to be set when the plant is restarted.



1) The maximum travel range for absolute indirect position feedback acquisition on the motor is 4096 motor revolutions

2) Useful travel range = 4096 revs. - 2 * max. braking path

3) Max. braking path

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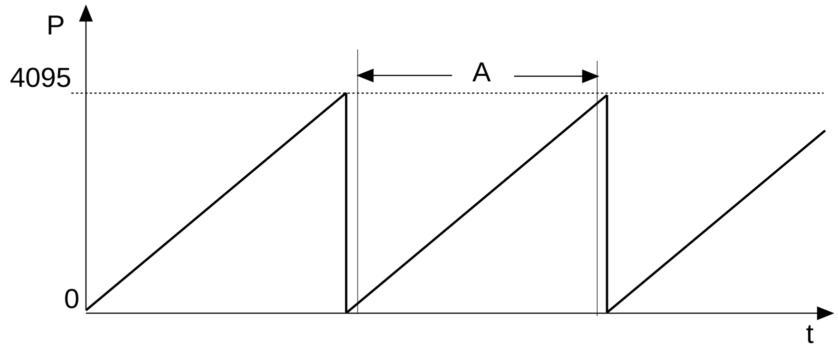
Fig. 7.45: Example for setting the reference (homing) point in a digital servo motor with multiturn encoder option.

Travel command signals exceeding the permissible travel range mean a high accident risk for operating personnel and can lead to extensive machine damage.

Exceeding the maximum travel range causes the absolute actual position feedback value to be lost.



P = Absolute position feedback evaluation in revolutions

A = Travel range limited by absolute position feedback evaluation of >0 to < 4096 motor revolutions

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Fig. 7.46: Absolute position feedback evaluation

Absolute encoder monitoring

When a DDS with absolute encoder motor (multiturn) is switched off, the actual position feedback value is stored. When the unit is restarted, the position detected by the absolute encoder evaluation is compared with the stored value. If the deviation is greater than permitted in the parametrized absolute encoder monitoring window P-0-0097, error „76“ „Absolute Encoder Error“ is generated and signalled to the NC control unit.

The value in Parameter P-0-0097 "Absolute Encoder Monitoring Window" is application-related. If necessary, this must be determined and entered separately in each case.

Remedy:

1.

Danger!
The axis has been moved while shut down and is outside the position parametrized in the „Absolute Encoder Monitoring Window“. Check whether a new travel command will cause any damage.

- Reset the error via the NC control unit

2. If the current axis position is within the monitoring window after Error 76 has been signalled, there is a feedback error.

Remedy:

- Replace motor
- Reset absolute reference dimension

7.13. Limitation of Working Range

Extensive safety measures have been taken to avoid accidents and damage to machinery. Some of these safety measures relate to the limitation of the permissible working range.

These are:

- Software limit switches
  These are set and evaluated via the NC control and the drive controller. They only become active once the reference dimension has been set between the measuring system and the machine mechanics.
- Hardware limit switches

  These are
  – safety limit switch
  – travel range limit switch

Safety limit switches are linked to the master E-STOP circuit. They become active as soon as the machine has been switched on. In the event of a fault, the safety limit switches activate the E-STOP circuit. They must be of the normally closed type.

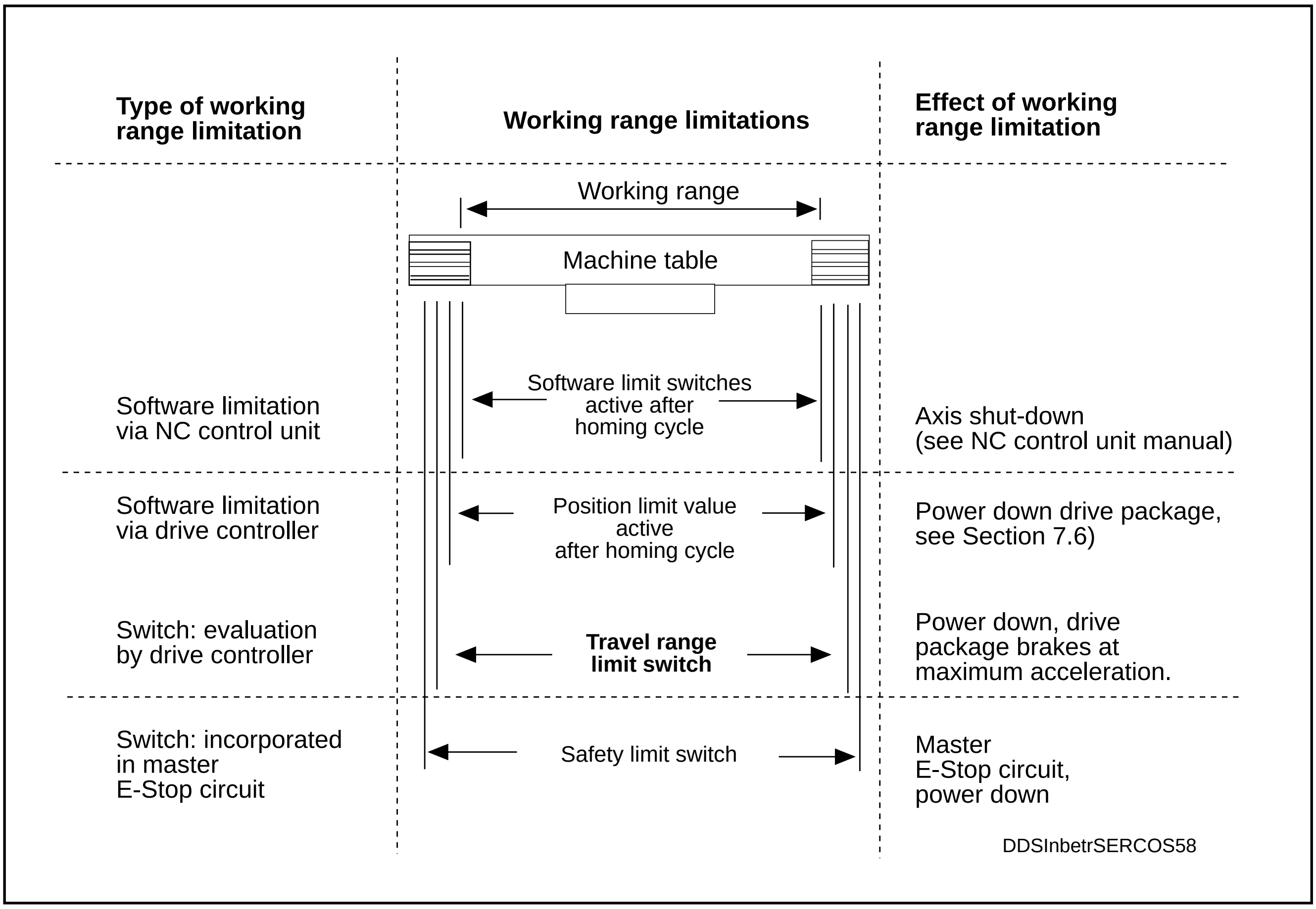


Fig. 7.47: Working principle and types of working range limitation

Evaluation of travel range limit switches by the DDS 2.1 drive controller

Travel range limit switches are fixed to moving machine elements. These serve to limit the working range when

- the reference dimension has been lost
- the software limit switches are not active

Benefits

- Elimination of malfunctions due to wrong command value inputs after an axis has been shut down. Command values will only be accepted when they move the axis back into the working range.
- There is no need to install devices to short-circuit safety limit switches.
- The E-STOP circuit is not activated.

Logical processing of travel range limit switches

1. A positive flank at the working range limit switch input on the drive controller is signalled to the NC control unit.

   X12/E2 (input 2) positive travel limit
   X12/E3 negative travel limit
2. The power supply to the respective drive package is cut.
3. The drive diagnostics display H1 shows the Error message 44 „Travel limit switch detected!“
4. Even if one of the limit switches is still active, the error can be reset via the NC control system (see NC control unit manual).
5. After the error has been cleared, the drive package can be powered up again.
6. If the axis is still positioned over one of the travel limit switches, the drive will only accept such position, velocity or torque command value as will move the axis back into the working range. Command values outside the permissible working range will be rejected. If these are input to the drive, it will react in the same way as described in items 1-3 above. The permissible direction of travel depends on which of the two travel limit switches was activated.

Cable break monitoring of working range limit switch

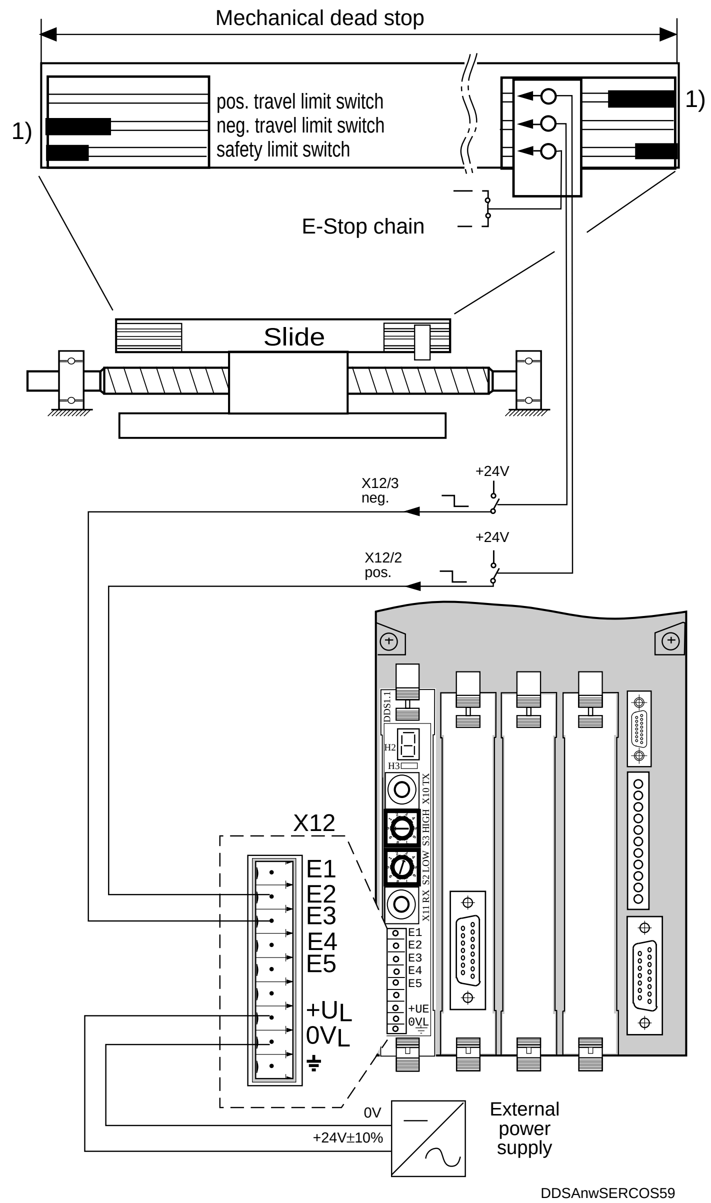
Monitoring of the working range limit switch can be provided with a cable break detection feature.

Preconditions:

- Drive is provided with software version higher than or equal to DSM 2.1-S01.10.
- Working range limit switch must be of the N/C type.
- Parameter P-0-0114 „Negation of working range limit switch“: Bit 0 must be set to 1.

Example of a working range limitation

Two normally open contacts are installed on the machine bed (see Fig. 7.48), thus producing a positive flank at the travel limit switch input X12/E2 for the positive travel limit or X12/E3 for the negative travel limit when the respective travel limit has been reached. This makes it possible to shut down the respective drive prior to breaking the E-Stop chain and also ensures that a return to within the permissible travel range can be executed more safely.



1) The cams for the travel limit switches must always be long enough to ensure that the switches have been operated before the mechanical dead stop is reached.

Fig. 7.48: Example of a working range limitation as given in the DDS 2.1 drive controller.

7.14. Setting the short-time operation torque „M_{KB}“

The short-time operation torque M_{KB} is entered in the parameter „overload factor“ (P-0-0006). Consult the selection data list Doc. No. 209.0069.4302-00 IDE for the value corresponding to the installed motor/controller combination.

If a value other than that given above for the relevant motor/controller combination is required, this can be changed in the parameter „overload factor“.

For the „overload factor in the following approximation applies:

Overload factor

$$\text{Overload factor}^{1)} = \frac{M_{KB}}{M_{dN}} \times 100\ [\%]$$

M_{KB} = Short-time operation torque [Nm]
M_{dN} = Nominal torque [Nm]
1) = Settable range = 0 ... 400 [%]

The short-time operating torque for intermittent operation can be selected according to the „duty cycle“ column of the selection data list (Doc. No. 209-0069-4302-00) (load condition S6 to DIN 57530/VDE0530). The maximum cycle time depends on the size of the motor and is indicated in the operating characteristics of the relevant motor documentation. For lower short-time torque levels, the duty cycle can be calculated as follows:

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

ED = Duty cycle [%]
M_{dN} = Nominal torque [Nm]
M_{KB} = Short-time operation torque [Nm]

When in continuous operation, the AC servo motor can sustain the nominal torque M_{dN} as follows:

– up to 25% of n_{max} (max. NC useful velocity)

– up to an ambient temperature of 45°C.

A corresponding thermal time constant representing an overtemperature of 60 K will develop on the motor frame. The nominal torque for higher speeds can be found in the relevant motor documentation.

7.15. Torque reduction

Depending on the type of machine and its design, certain operation conditions may call for torque reduction of the drive.

The DDS 2.1 drive controller allows you to set different torque reductions. These are entered via the parameter „Bipolar Torque Limit Value“ ID No. S-0-0092.

Entering a reduced torque level

Enter the desired torque reduction in %. Entering the figure 100 will produce a torque identical to the continuous zero-speed torque M_{dN} of the uncooled motor.

Upper and lower limits for entries: 0 to 400.

Calculating the input values for torque reduction

$$\text{Reduced torque [\%]} = \frac{100 \cdot M_{max.\ desired}}{M_{dN}}$$

$M_{max.\ desired}$ = desired torque in [Nm]

M_{dN} = Nominal (zero-speed) torque in [Nm]

Example of a torque reduction calculation

The desired torque reduction is $M_{max.}$ = 20 Nm.

The installed motor/drive controller combination is:

MDD112B.-N-030
DDS 2.1-050
Mains power supply
with stabilized DC link circuit

Procedure:

1. For the above motor/controller combination, the following figures can be found in the selection data list:
   - Nominal torque
     M_{dN} = 17.5 Nm (uncooled motor)
   - Maximum torque M_{max} = 35.2 Nm
2. Putting these figures into the equation, we obtain:

$$\frac{100 \cdot 20\ [Nm]}{17{,}5\ [Nm]} = 114\ [\%]$$

3. Input value for entry in the parameter „Bipolar Torque Limit Value“
   ID No. S-0-0092: 114

Torque/speed characteristic for a torque reduction to 20 Nm

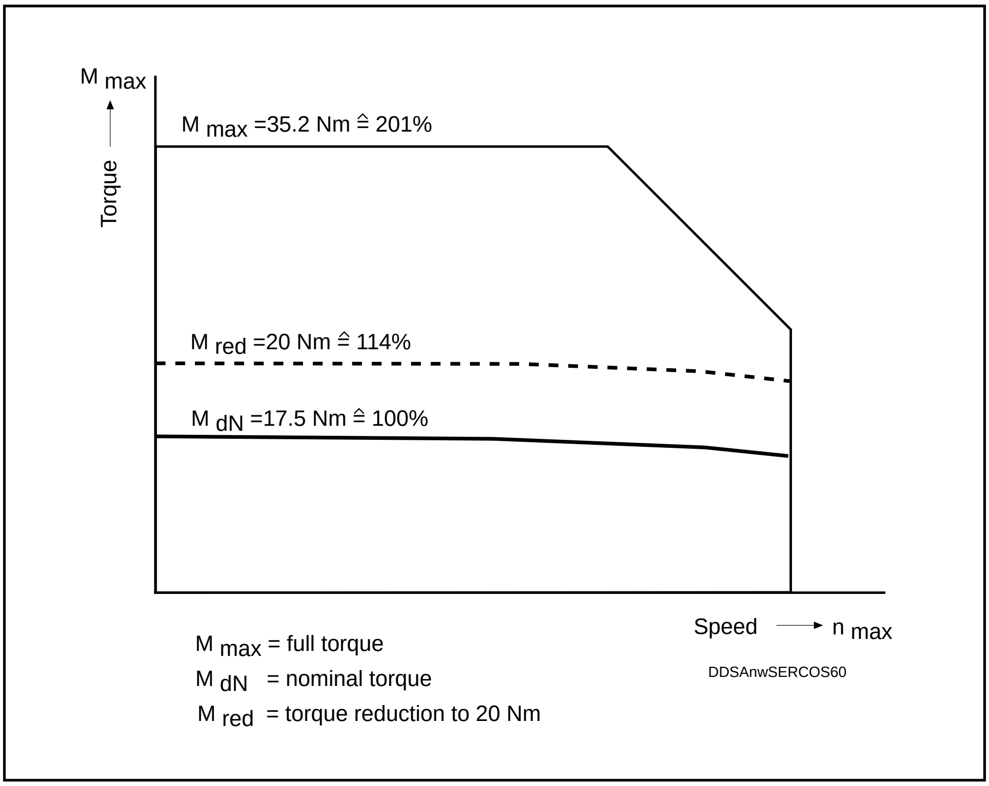


Fig. 7.49: Torque reduction to 20 Nm

The full torque for this motor/controller combination is $M_{max.}$ = 32.5 [Nm]. Referred to the nominal torque, this corresponds to (M_{dN}) 201%. Entering a higher value than 201 in the „Bipolar Torque Limit Value“ parameter would limit the drive controller to the full torque $M_{max.}$ of the motor.

Activating the torque reduction

See NC control unit manual

The value entered in the „Bipolar Torque Limit Value“ parameter ID No. S-0-0092 is immediately active on powering up.

Before recording the step response, deactivate the torque reduction. Assessing the velocity loop circuit while the torque reduction is active will lead to wrong evaluation.

7.16. Drive-controlled homing cycle

Machine axes which do not have any absolute position reference on powering up must have their measuring system matched up to the machines homing point before the plant will operate satisfactorily. This matching operating is done by drive-controlled homing (see Fig. 7.52).

If position measuring systems are used that allow several markers to be passed before reaching the machine reference point, one reference marker must be selected for absolute position referencing. This is done using the home switch.

For drive-controlled homing with a home switch the preconditions are:

- The home switch must be connected up to the drive
- The home switch is of the normally open type. The switching status of the home switch must not change between activation of the home switch by the reference cam and theoretical arrival at the safety limit switch, i.e. the home switch cam must overlap with the safety limit switch cam (see Fig. 7.50).
- The first reference mark is located behind the positive flank of the home switch.
- With rotational servo axes, the quotient of S-0-0121 "Load gear input revolutions" und S-0-0122 "Load gear output revolutions" must not have any places after the decimal point. It must be an integer.

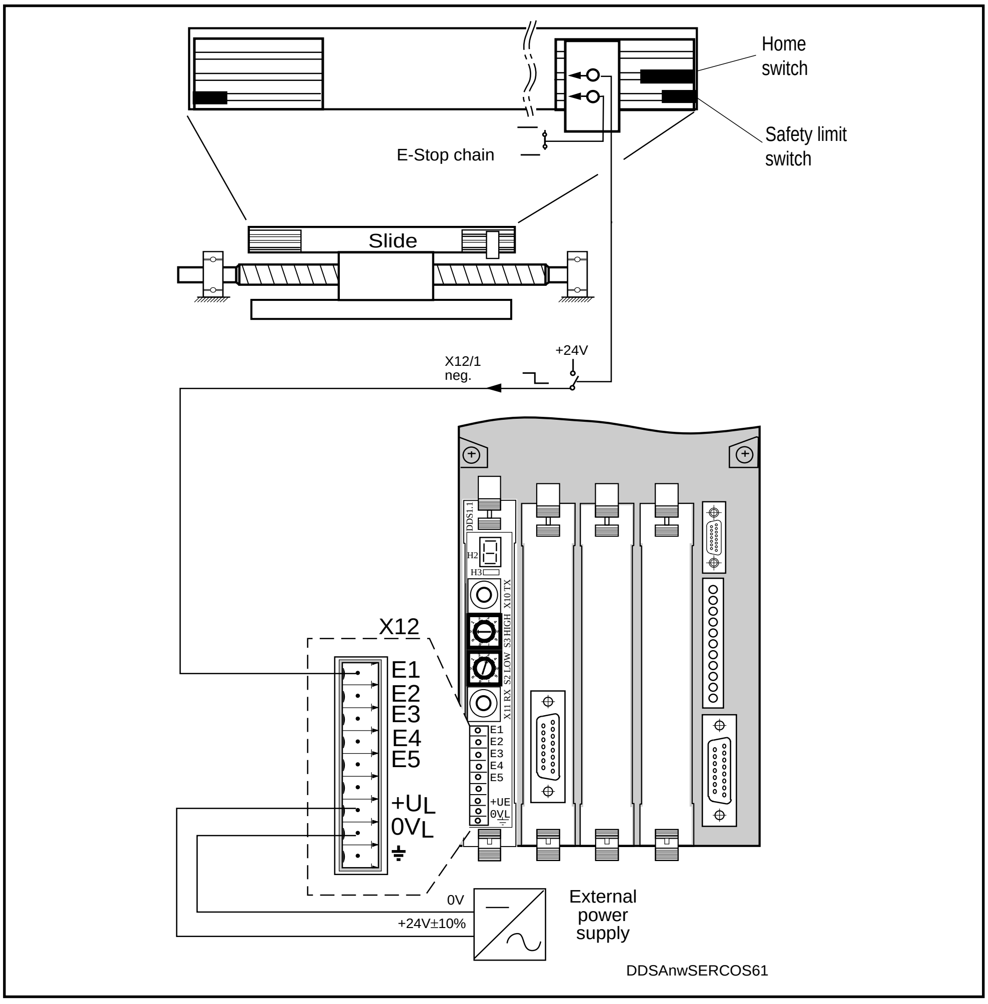


Fig. 7.50: Integration of the home switch in the DDS 2.1 circuitry.

Procedure for function check of home switches

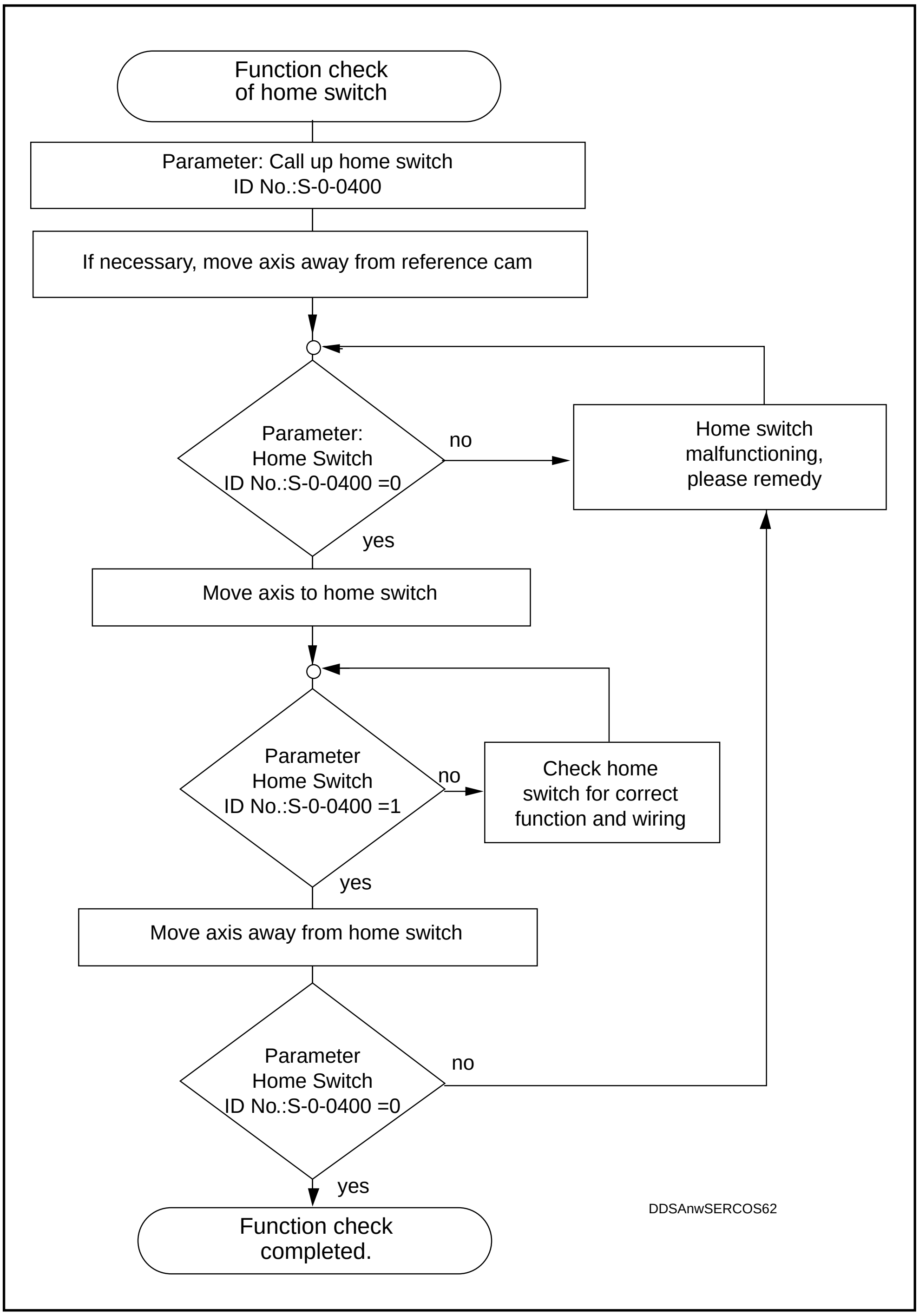


Fig. 7.51: Home switch function check

Parametrizing for drive-controlled homing cycle

The input values for homing parameters are contained in Fig. 7.52.

The homing parameters must always be entered even when the axis to be parametrized does not require to be set for homing.

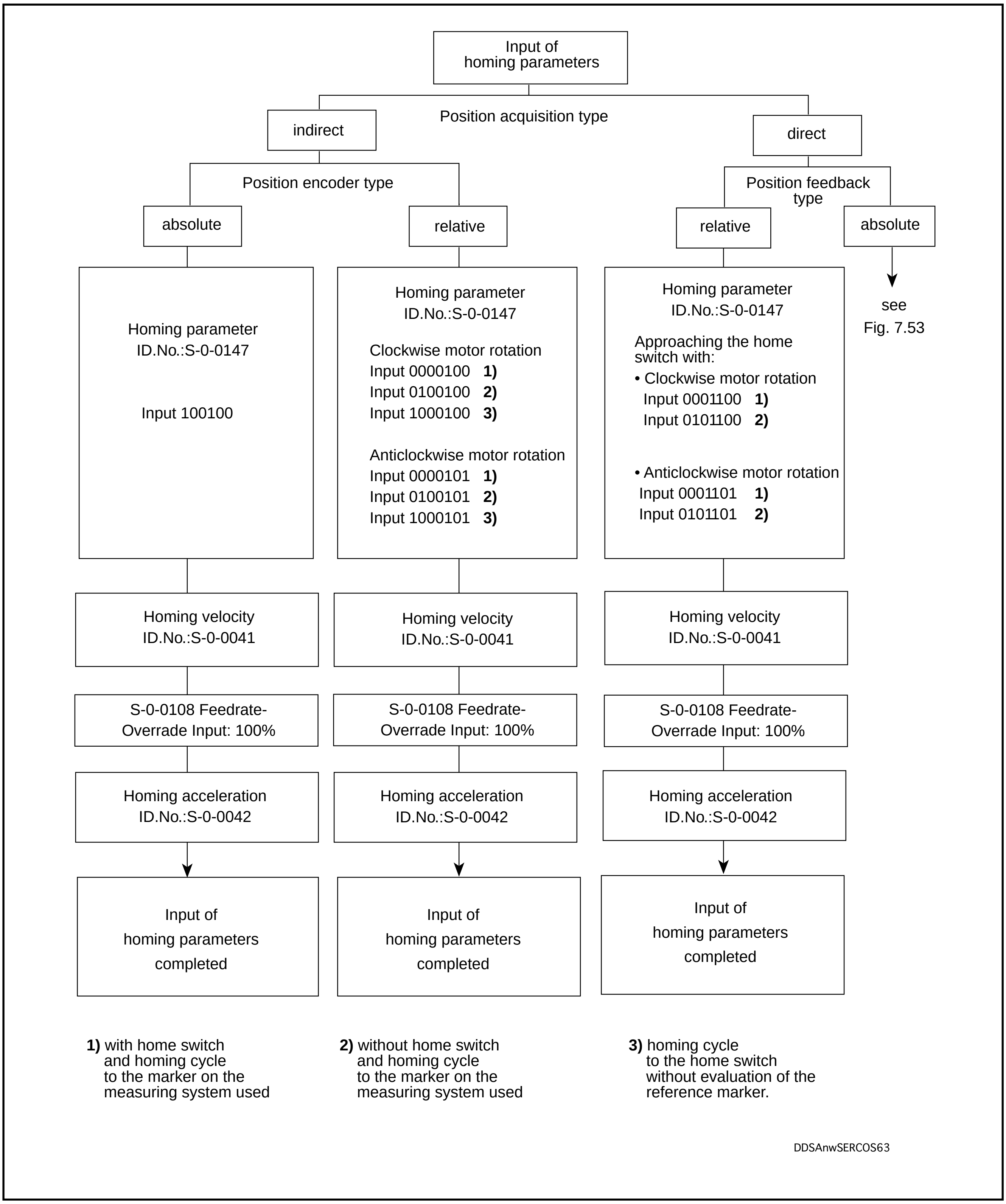


Fig. 7.52: Parameter input values for drive-controlled homing cycle

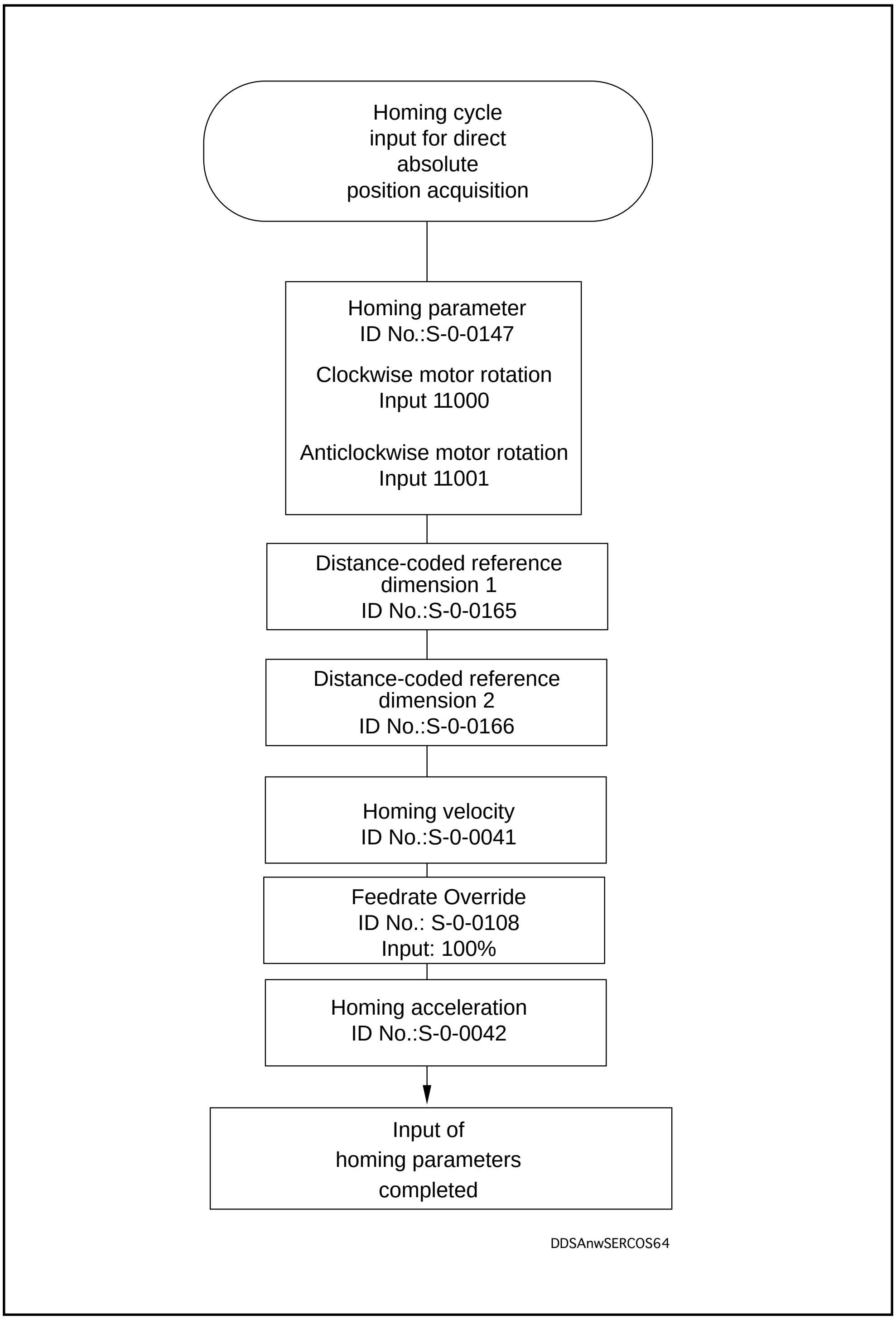


Fig. 7.53: Input of parameters for drive-controlled homing cycle

Significance of homing parameters

S-0-0147 „Homing Parameters“

This parameter is used to set the sequences for the homing cycle as referred to the plant, NC and drive installation, e.g. the homing cycle polarity, i.e. the direction in which the machine axis travels to reach the reference cam.

S-0-0041 „Homing velocity“

This parameter determines the homing velocity for a drive-controlled homing cycle. For safety reasons, the homing velocity selected at initial start-up should be kept at a level (e.g. 1m/min) which will allow the servo axis to be shut down safely in the event of a malfunction.

The parameter can be set to a higher level once initial start-up has been successfully completed.

S-0-0042 „Homing acceleration“

This parameter limits the acceleration of a drive-controlled homing cycle.

For safety reasons, the homing acceleration selected at initial start-up should be kept at a level (e.g. $1m/s^2$) which will allow the servo axis to be shut down safely in the event of a malfunction.

The parameter can be set to a higher level once initial start-up has been successfully completed, but should not exceed the acceleration capability of the machine axis.

Input values for reference dimension parameters

- The assignment of the reference dimension parameter is shown in Fig. 7.54 for indirect position measurement using the motor encoder and in Fig. 7.55 for direct position measurement using an external position feedback. These figures also illustrate the homing cycle as such.
- Before attempting any homing cycle check that the home switch is functioning correctly. Proceed according to the flow chart in Fig. 7.51.
- The procedure for entering the reference dimension parameters is given in the following illustrations:

Fig. 7.56	for „indirect relative“ position measurement
Fig. 7.58	for „direct relative“ position measurement without evaluation of the home switch
Fig. 7.59	for „direct relative“ position measurement with evaluation of the home switch
Fig. 7.61	for „direct absolute“ position measurement with home switch

The parameters are described below:

S-0-0150 „Reference Offset 1“

„Reference Offset 1“ contains the difference in distance travelled between the reference point and the position feedback reference mark of the indirect measuring system (motor encoder).

S-0-0051 „Position Feedback Value 1 (motor feedback)“

This parameter contains the actual motor position feedback for indirect position acquisition.

S-0-0151 „Reference Offset 2“

This parameter contains the difference in distance between the reference point and the position feedback reference mark of the direct measuring system (external feedback, e.g. glass scale).

S-0-0053 „Position Feedback Value 2 (ext. feedback)“

This parameter contains the actual position feedback value of the external feedback for direct position acquisition.

S-0-0052 „Actual Position Feedback Value 1 - Reference Dimension“

This parameter serves to refer the position command and feedback values to the machine’s fixed zero point. In the case of indirect position measurement using the motor position encoder, the difference in distance between the reference point in the automatic homing cycle and the machine zero point is entered in this parameter.

S-0-0054 „ Actual Position Feedback Value 2 - Reference Dimension“

This parameter serves to refer the position command and feedback values to the machine’s fixed zero point. In the case of direct position measurement using an external feedback, the difference in distance between the reference point in the automatic homing cycle and the machine zero point is entered in this parameter.

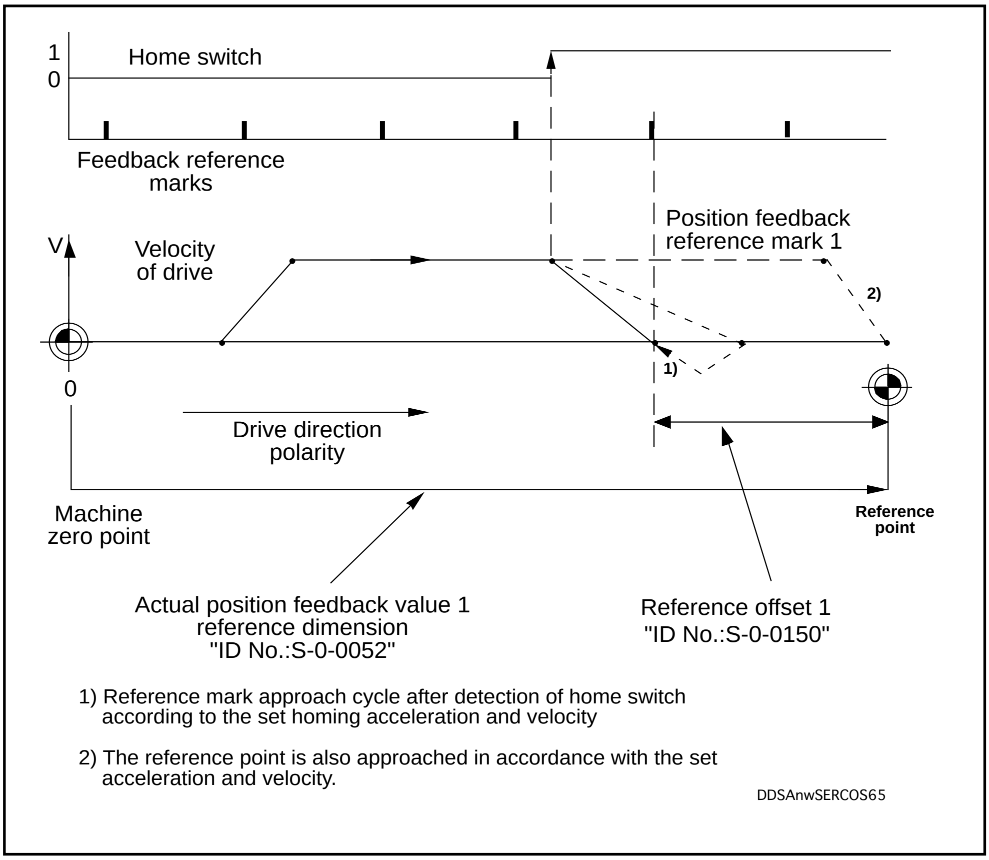


Fig. 7.54: Designation of reference dimension parameters for indirect position measurement

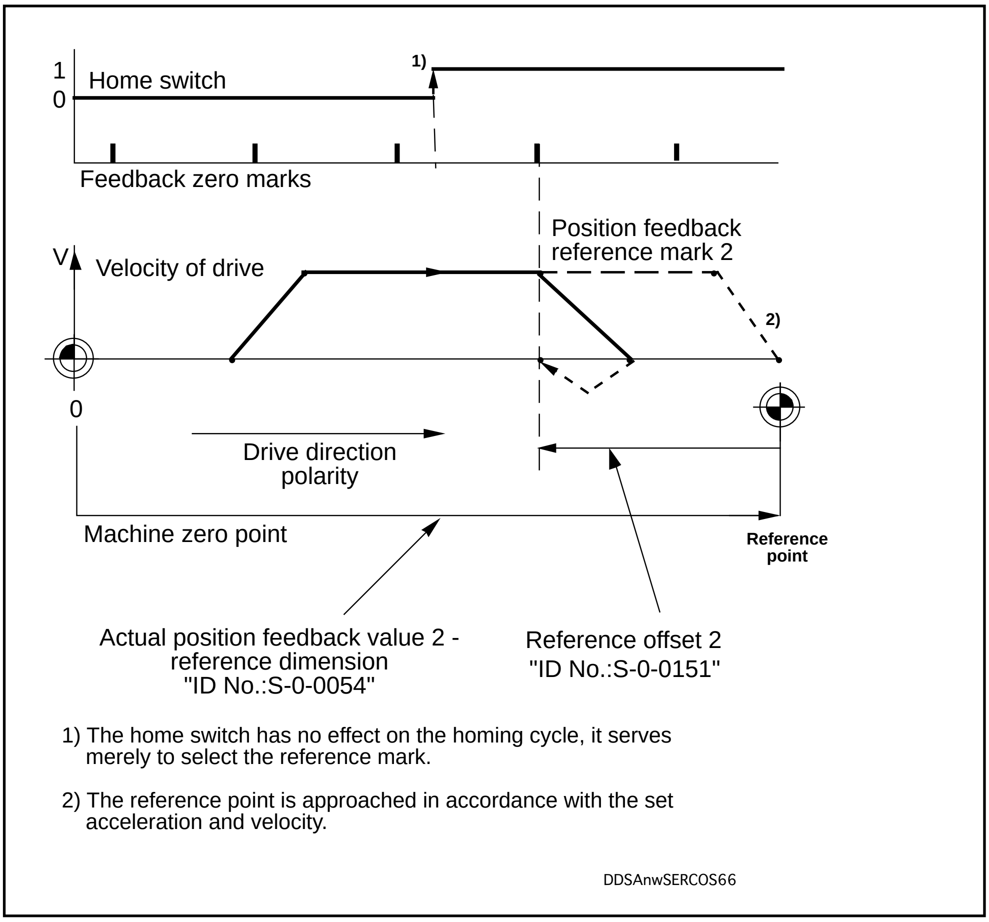


Fig. 7.55: Designation of reference dimension parameters for direct position measurement

S-0-0400 „Home Switch“

This parameter is used to display whether the home switch has been activated or not.

Switch detected: Bit 0 = 1

Switch not detected: Bit 0 = 0

P-0-0020 „Reference Cam Shifting“

In the drive-controlled homing procedure, the home switch is evaluated by the drive. There is an optimum setting for the position of the home switch relative to the zero mark of the motor encoder. In order to simplify set-up procedures for the operator on initial start-up, this parameter shows the distance between the reference cam and the ideal point.

S-0-0299 „Home Switch Offset“

This parameter saves mechanical shifting of a home switch cam after the home switch signal position monitor has responded. Shifting is done by entering the distance shown in S-0-0299 in the parameter P-0-0020 „Home switch cam shift“.

The position of the home switch as detected during the next homing cycle is then added to the home switch offset, so that the position of the home switch is shifted within the encoder cycle.

When home switch cams have already been preset, the value to enter in the home switch offset parameter is 0.

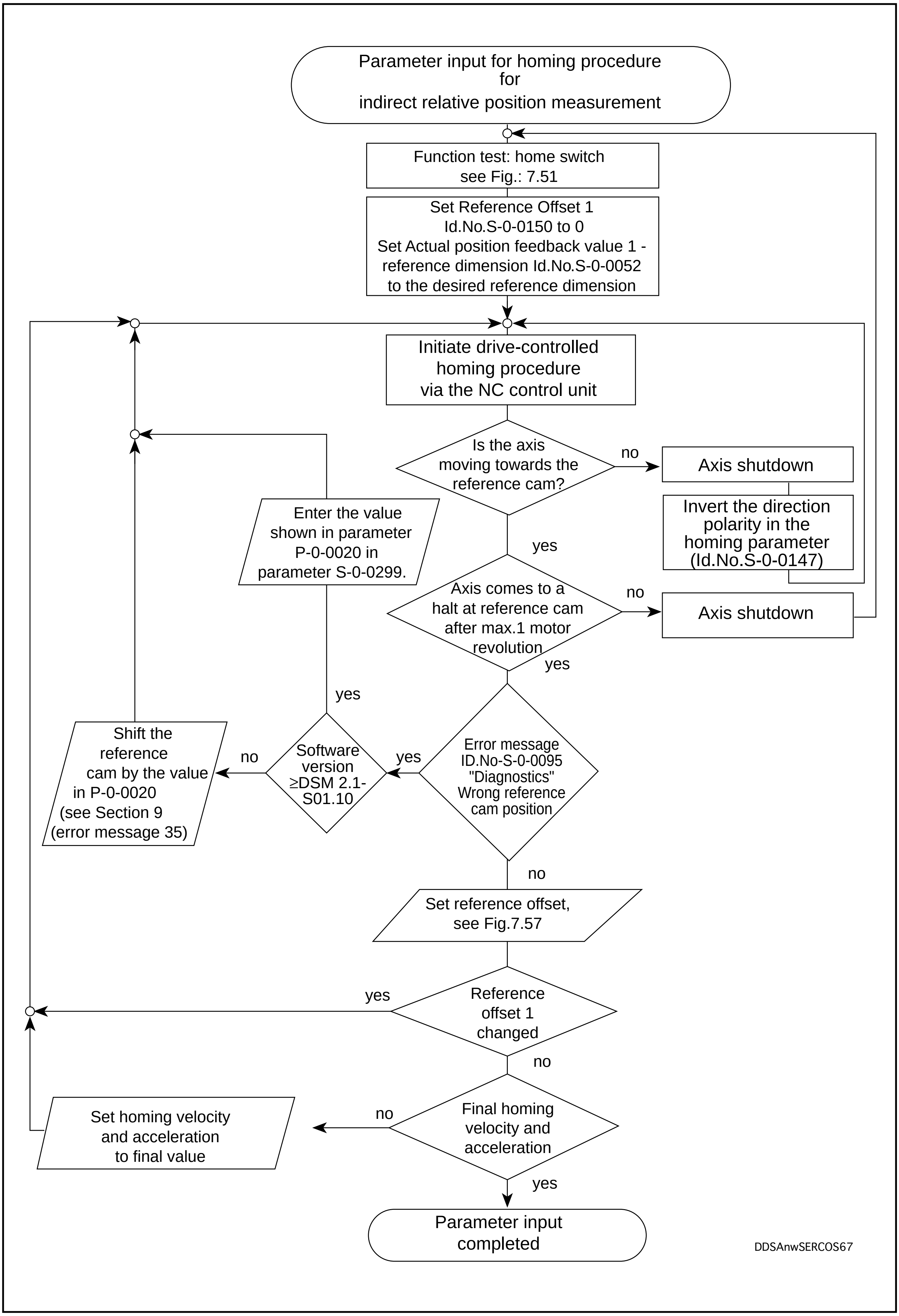


Fig. 7.56: Parameter input for homing procedure with home switch

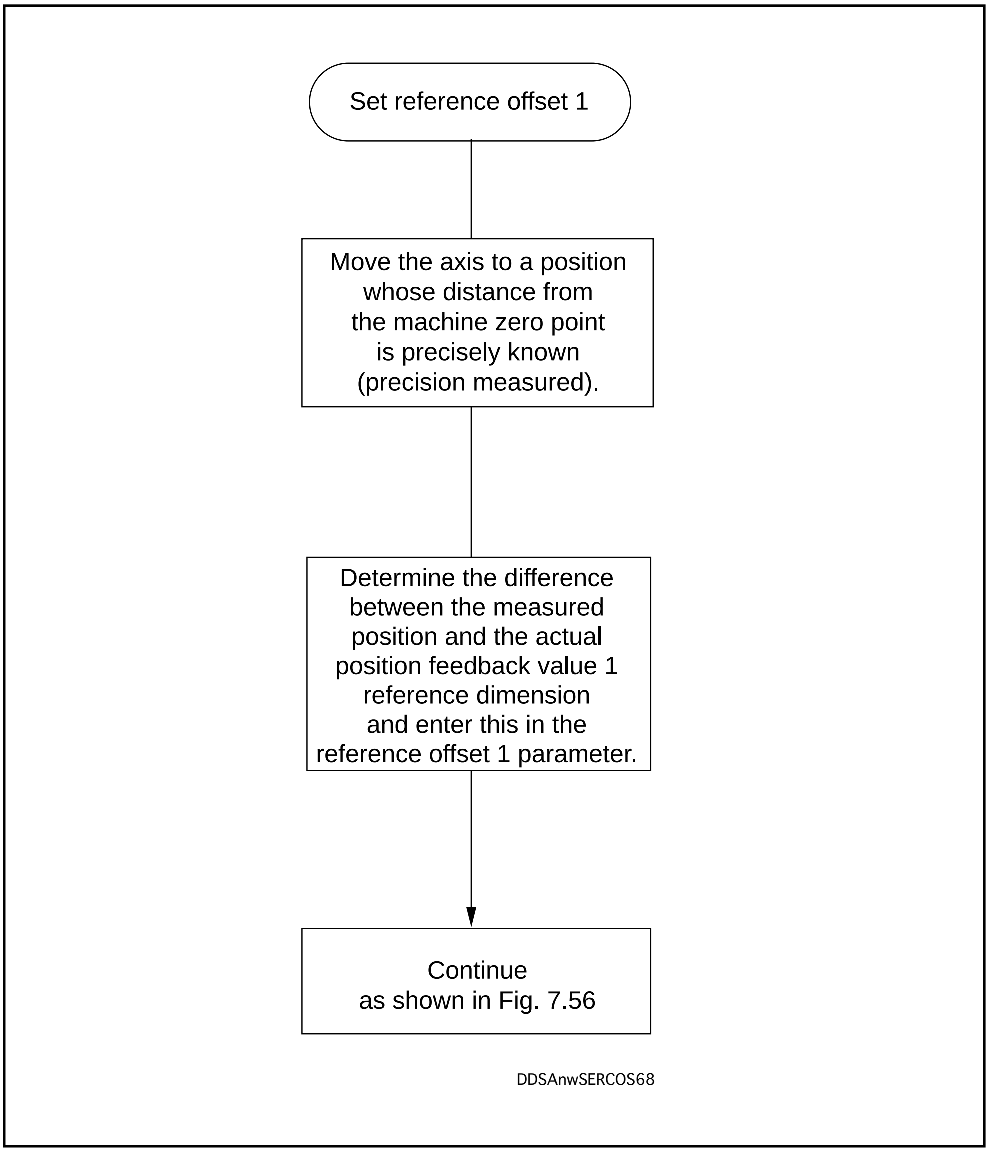


Fig. 7.57: Determining the reference offset

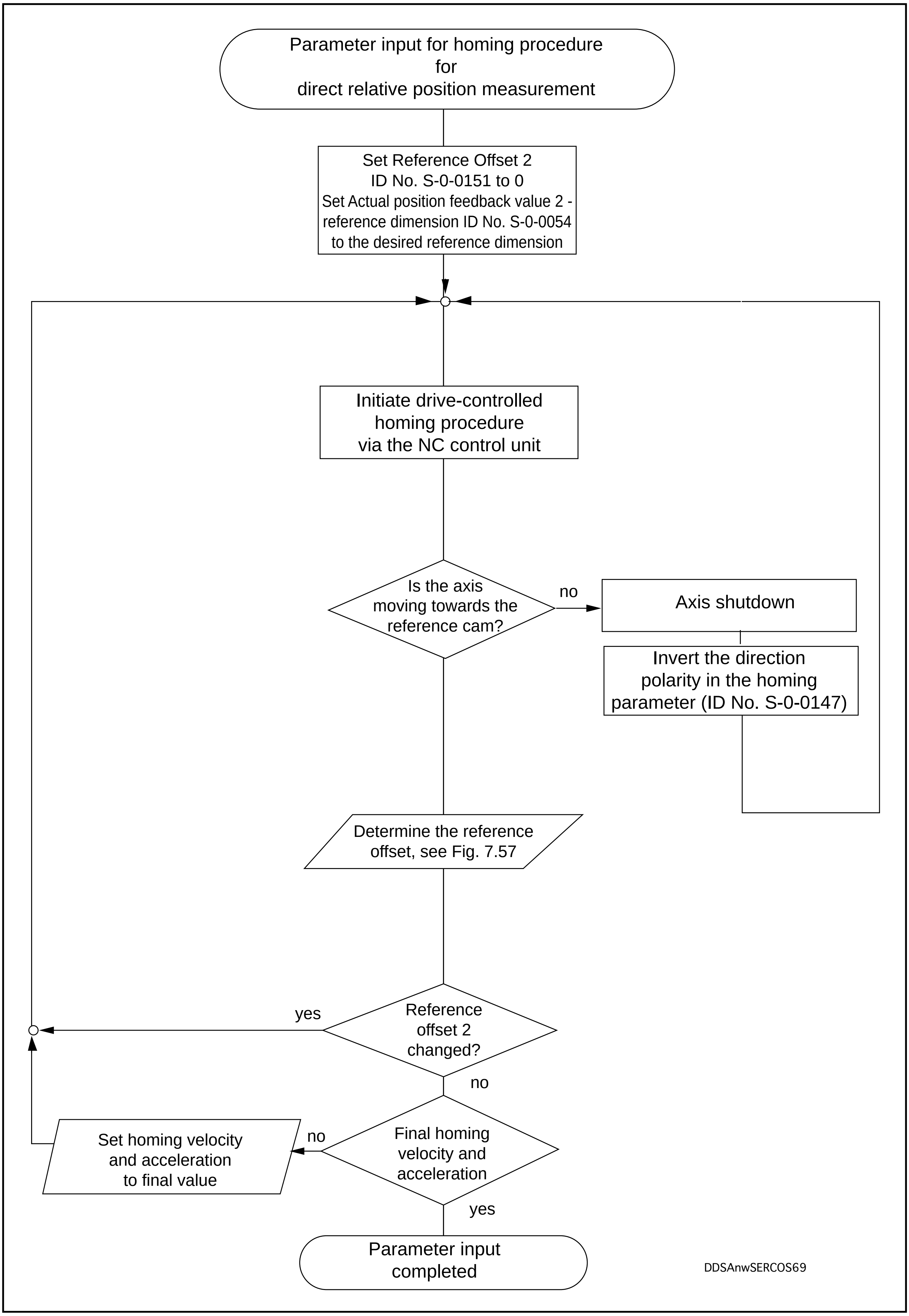


Fig. 7.58: Parameter input for homing procedure with direct relative position measurement without home switch

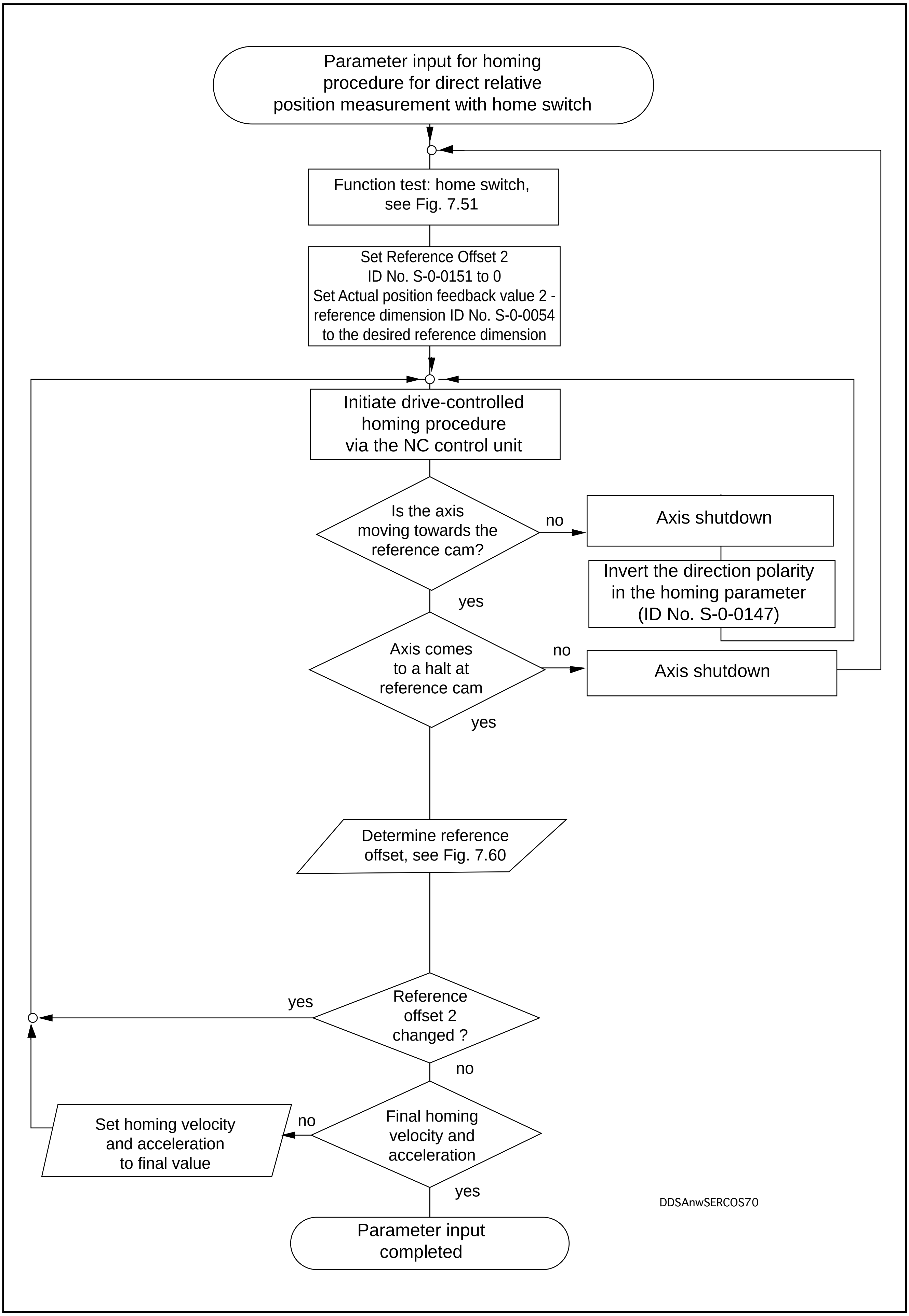


Fig. 7.59: Parameter input for homing procedure with direct relative position measurement with home switch

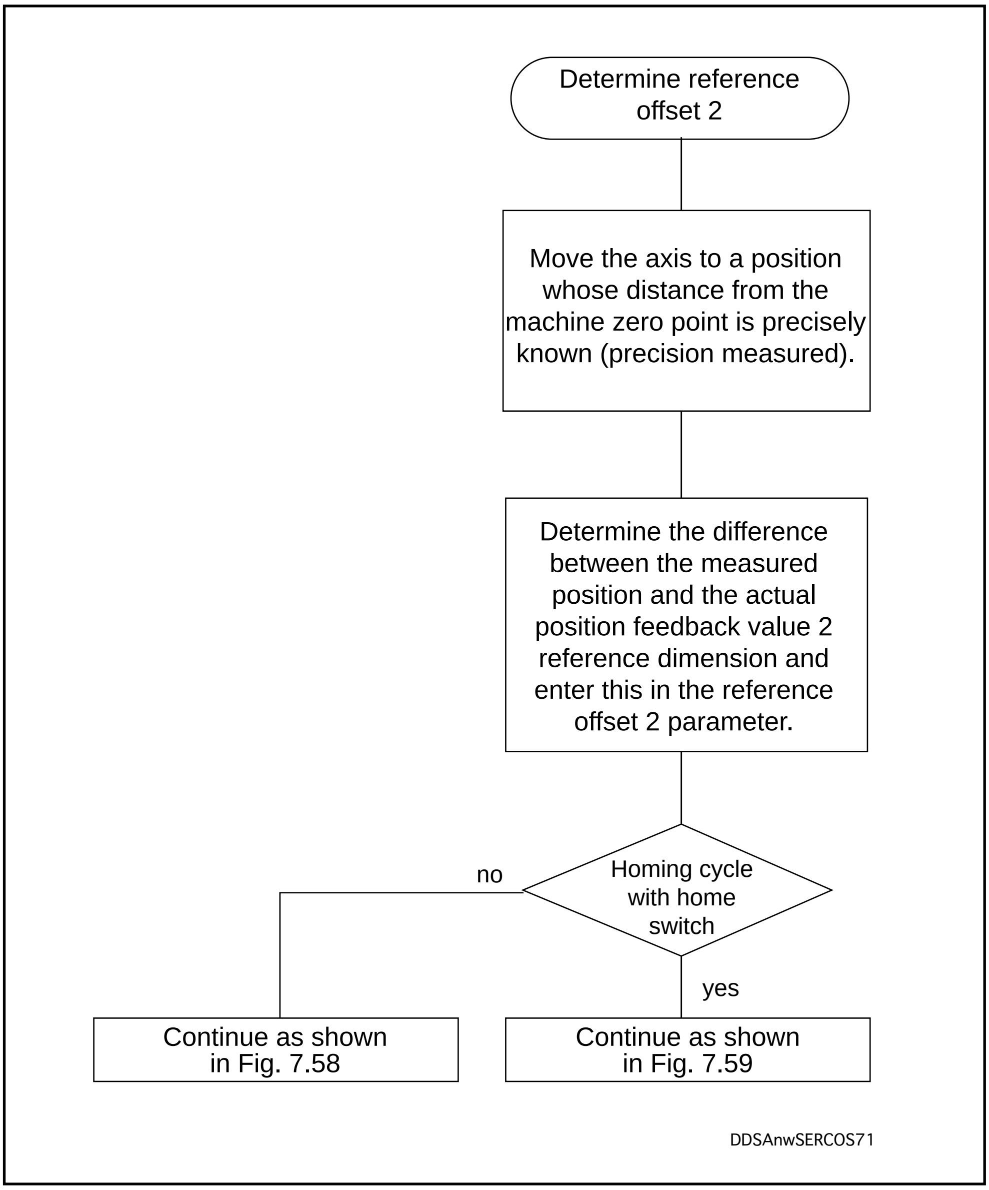


Fig. 7.60: Determining the reference offset

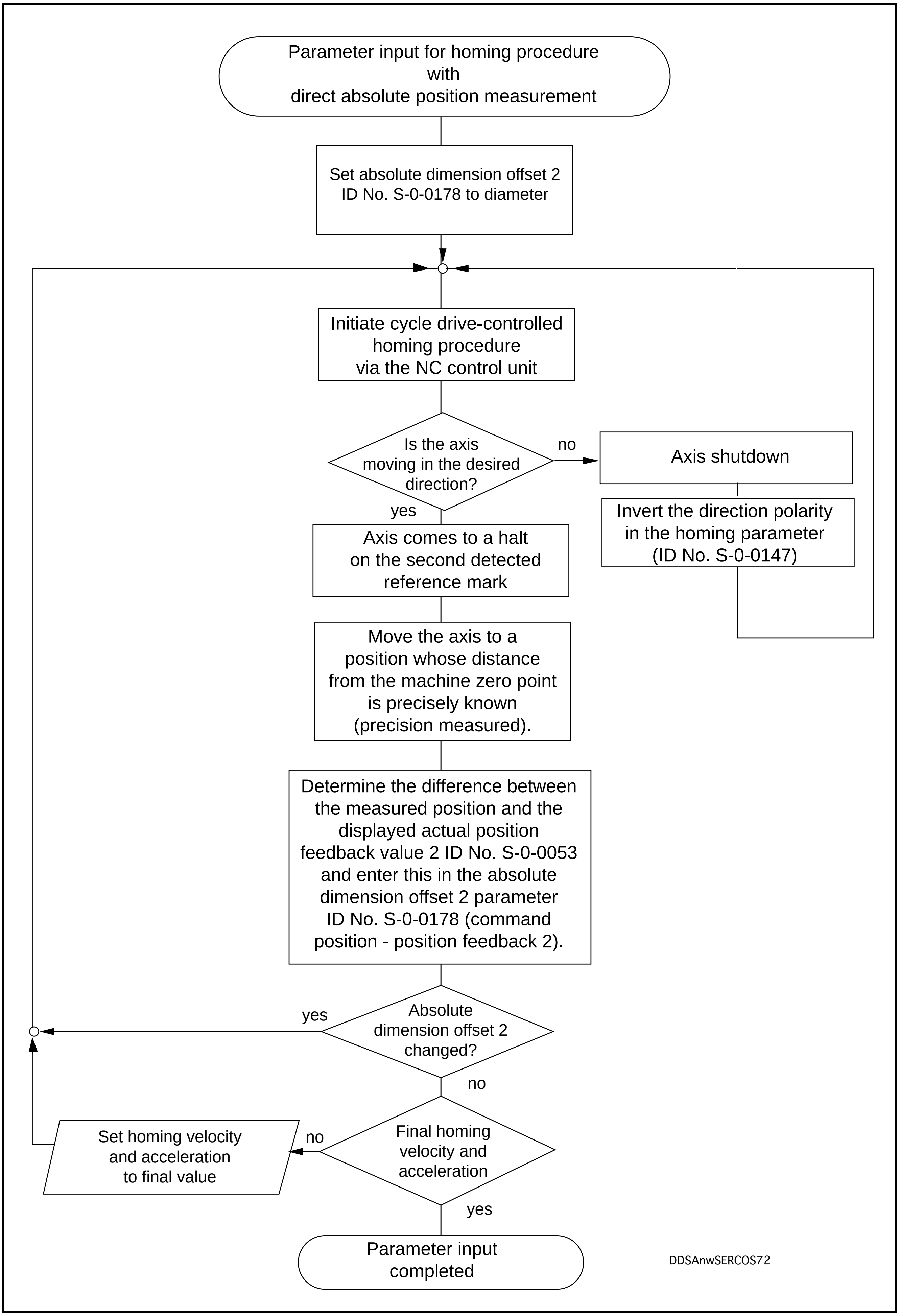


Fig. 7.61: Parameter input for homing procedure with direct absolute position measurement

7.17. Probe function

In machines with automatic workpiece changing, inaccuracies in workpiece clamping are unavoidable. In order to avoid production errors, the precise position within the clamping equipment is checked before the start of processing in order to correct any clamping errors.

For this purpose INDRAMAT offers the option of evaluating probes using the servo drive module DDS 2.1 with SERCOS interface.

On the SERCOS interface DSS 1.1 connector X12 features probe inputs „Probe 1 = X12/E4“ and „Probe 2 = X12/E4“. When a signal edge is detected at the relevant probe input, the actual position value is stored without delay in the drive. Edge detection is signalled to the SERCOS interface, thus enabling the NC control unit to initiate reactions in keeping with the process.

The maximum error to be expected in connection with position measuring is:

$$S_{max} = 200\ \mu s * V_{meas}$$

V_{meas} = starting velocity of the probe
S_{max} = distance covered

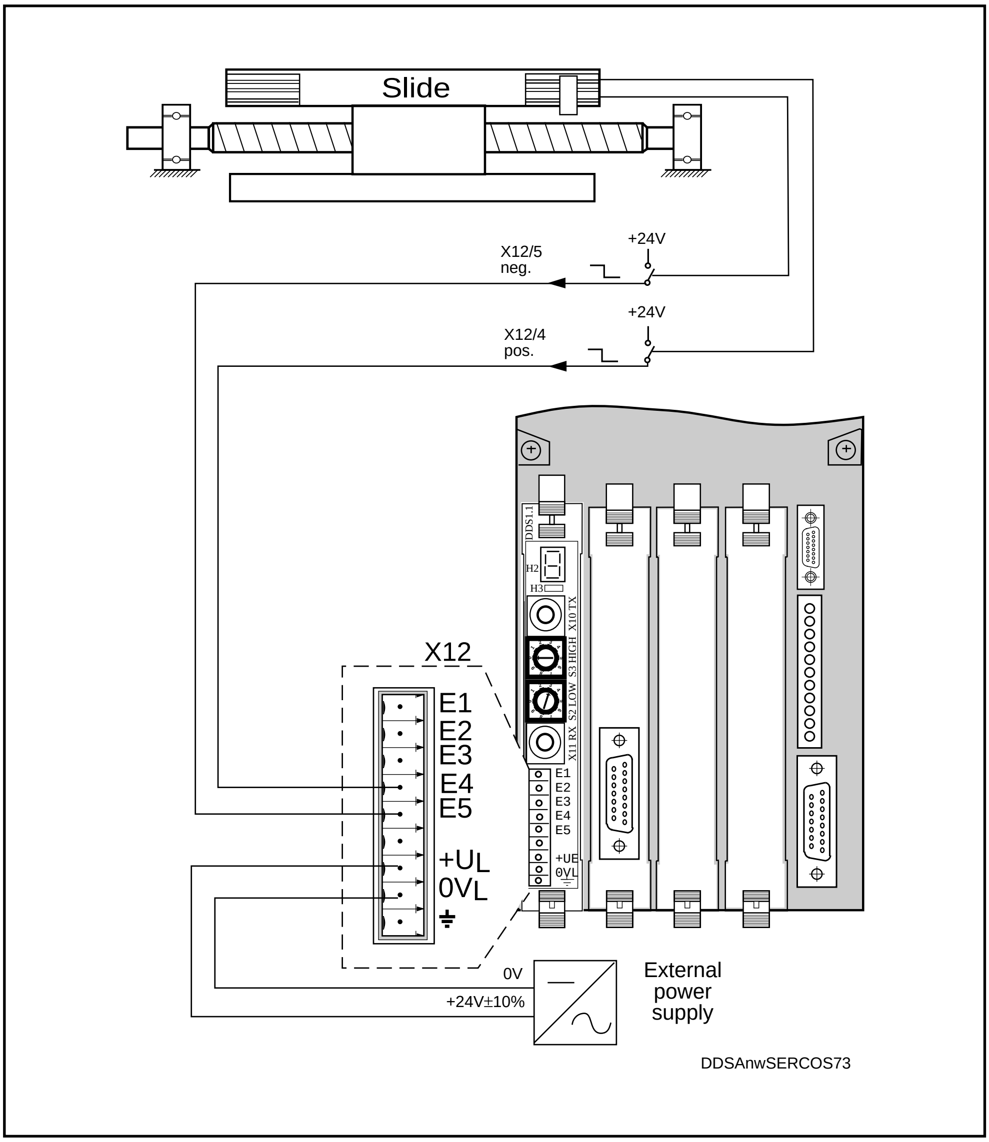


Fig. 7.62: Connection of probes to SERCOS interface DSS 1.1

Parametrizing for probe evaluation

The „Probe Control Parameter“ ID No. S-0-00169 is used to select the edge of the probe signal for storage of the measured data.

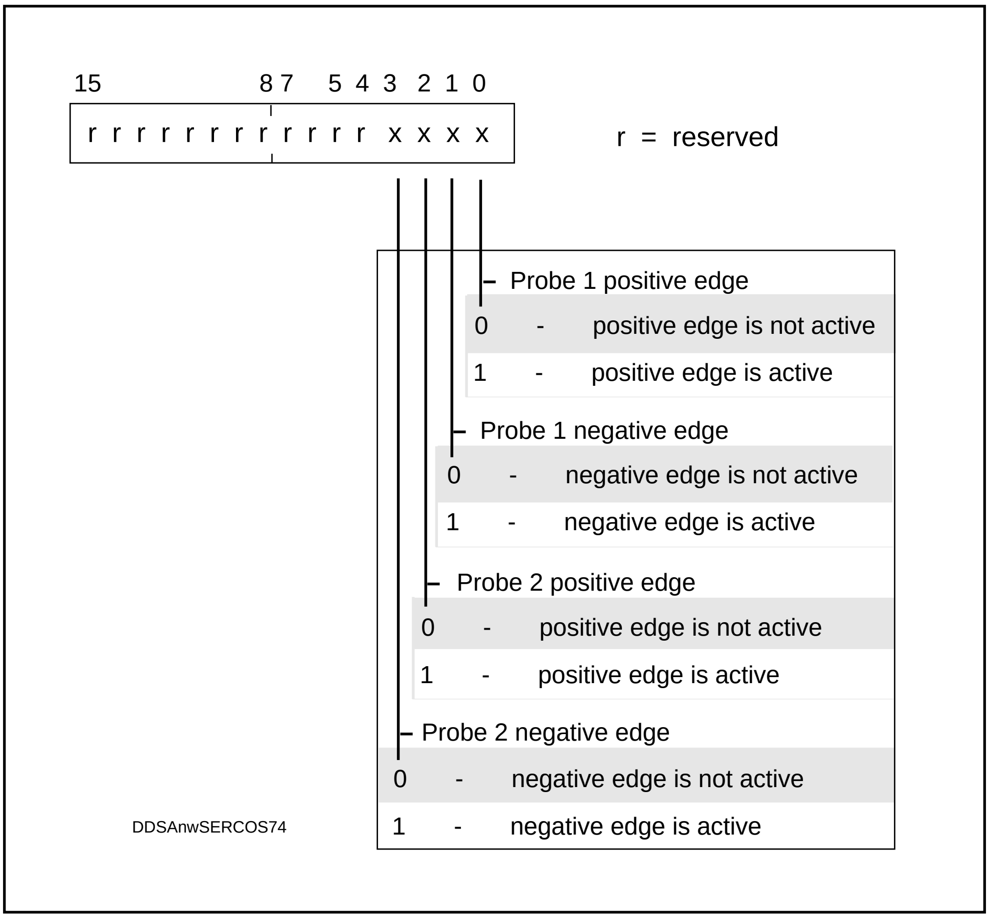
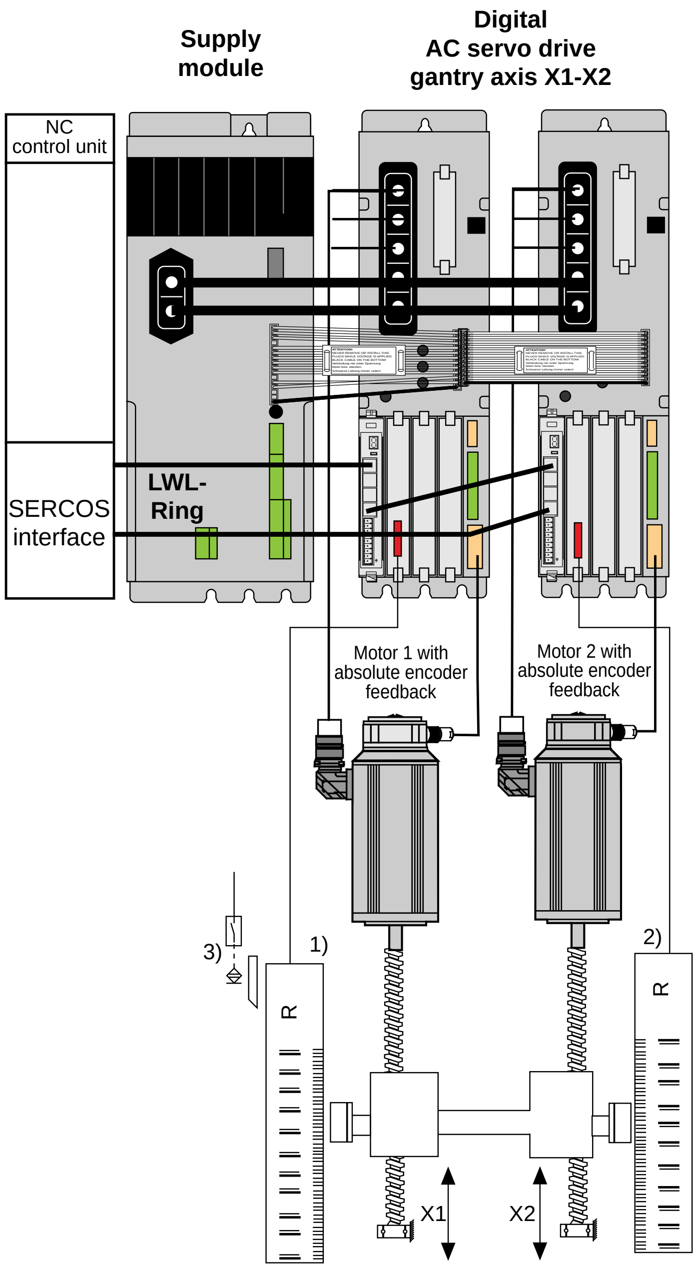


Fig. 7.63: Structure of the Probe Control Parameter

7.18. Gantry axes

Gantries are used for to process workpieces with large surfaces. The digital AC servo drive with SERCOS interface is equipped with a „Gantry Axis“ function allowing gantries to be traversed without danger of skewing.



1), 2) Optional direct position measurement using external measurement systems for high-precision positioning

3) Evaluation of the reference cam

DDSAnwSERCOS75

Fig. 7.64: Schematic of the „Gantry Axis“ with intelligent digital INDRAMAT AC servo drives

Gantry axes have an inherent „skewing“ problem. This skewing must always be taken up by the mechanical machine structure in such a way as to ensure that the machine will never under any circumstances be damaged

Before gantry axes can be safely operated, the following conditions must be fulfilled:

- The two gantry axes are registered as single axes in the NC control unit.
- The axes have identical parametrization.
- The gantry drives must be fitted with absolute encoders
- The guide rails of the gantry axes (X1;X2) must be parallel.

Setting up gantry axes

Procedure:

1. Align the gantry axis at right angles to the traversing direction. This can be done manually or by moving the axis in jog mode (Fig. 7.65).

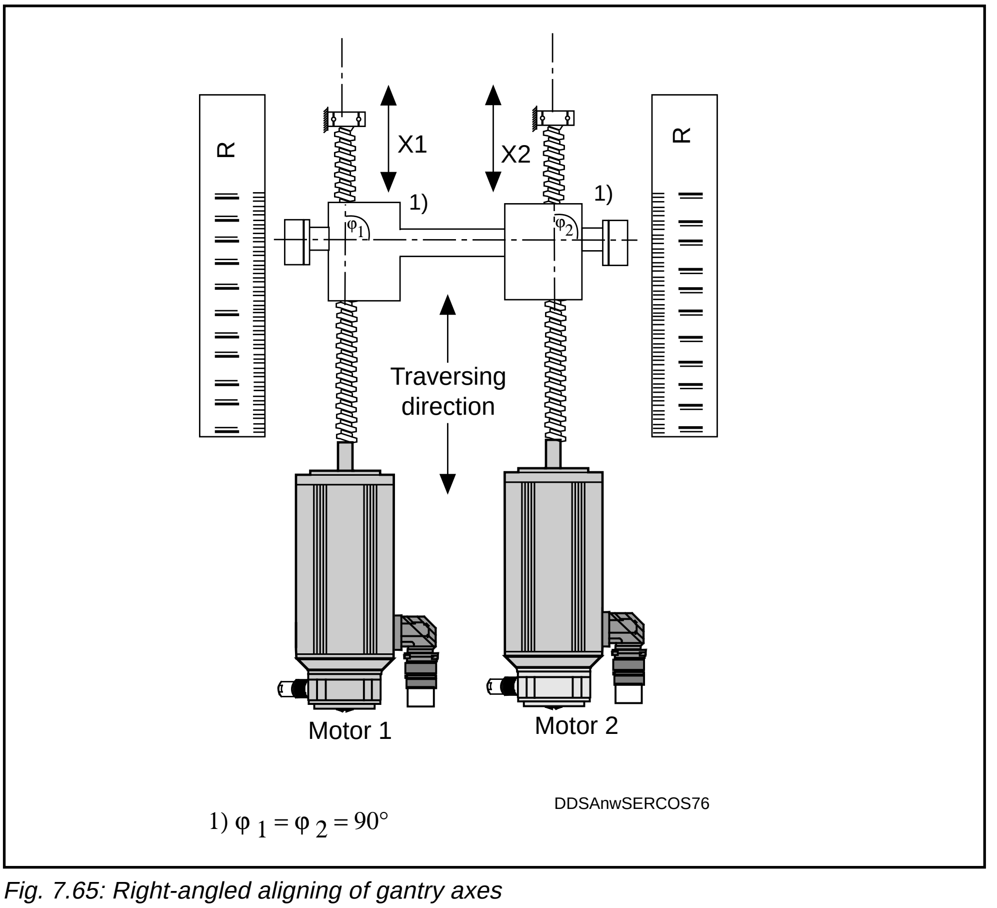


Fig. 7.65: Right-angled aligning of gantry axes

2. Set the absolute reference dimension

   1) Record the distance from the gantry axis to the machine zero point.

   2) Enter distance A (see Fig. 7.66) to the machine's zero point in Parameter "Position feedback value - reference dimension 1" eintragen.

   3) Trigger the command "Set absolute dimension", ID. Nr. P-0-0012.

   4) Cancel the drive enable signal:
      The value entered in Parameter "Position feedback value - reference dimension 1" is transferred to the Parameter "Feedback value 1" S-0-0051".

   5) Reset the command

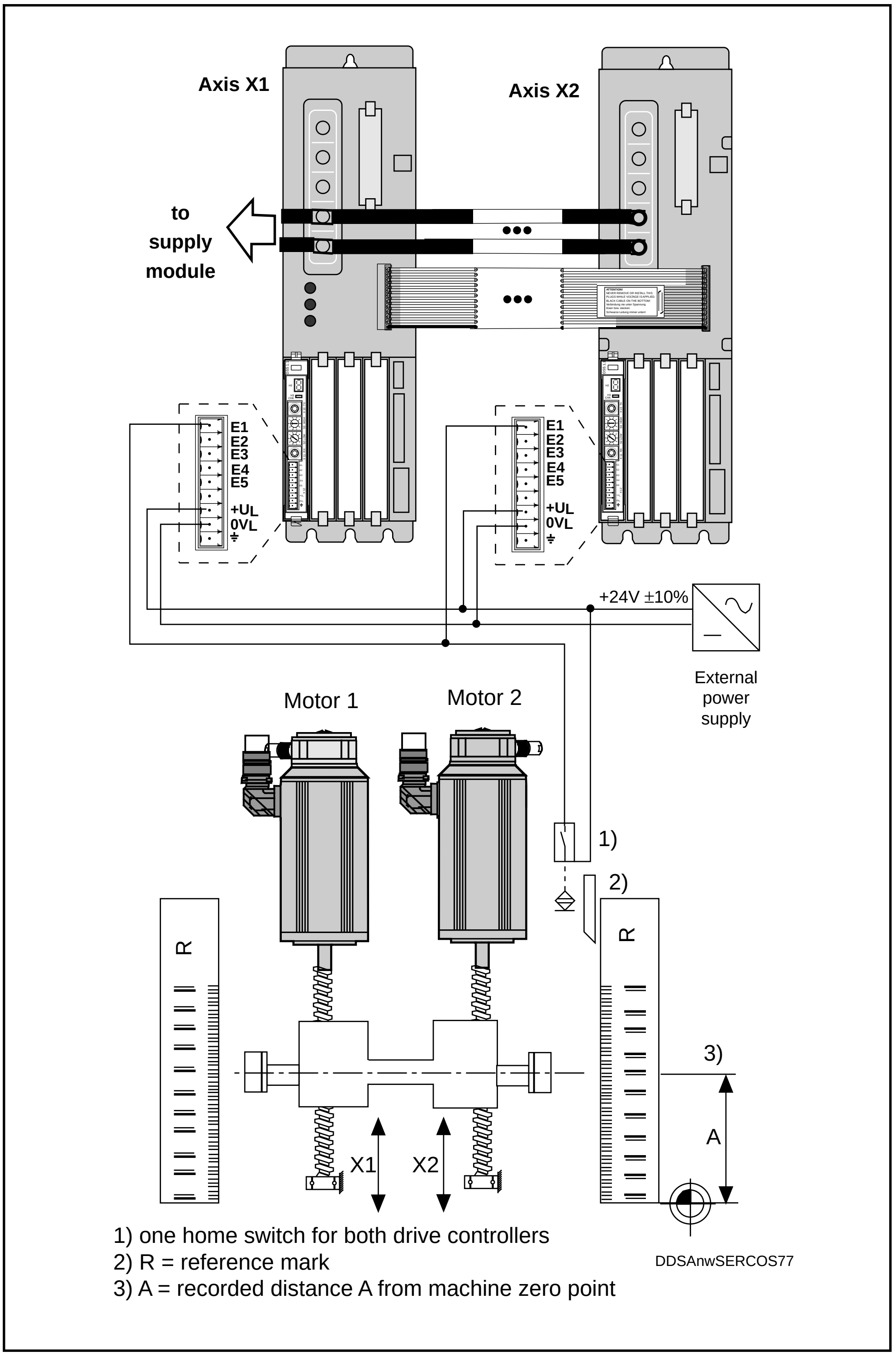


Fig. 7.66: Connection of home switch to the drive controllers of gantry axis X1/X2.

3. Set the dimension reference of the direct position measuring system (if installed).

Procedure:

- Set the homing procedure parameters
  „Homing Velocity“ ID No. S-0-0041
  „Homing Acceleration“ ID No. S-0-0042
  „Homing Parameter“ ID No. S-0-0147
  „Feedrate Override“ ID No. S-0-0108

  of both axes to the same values (see Section 7.16 Homing parameters). Check the connection of the home switch as shown in Fig. 7.66.
- Check that the home switch is functioning correctly

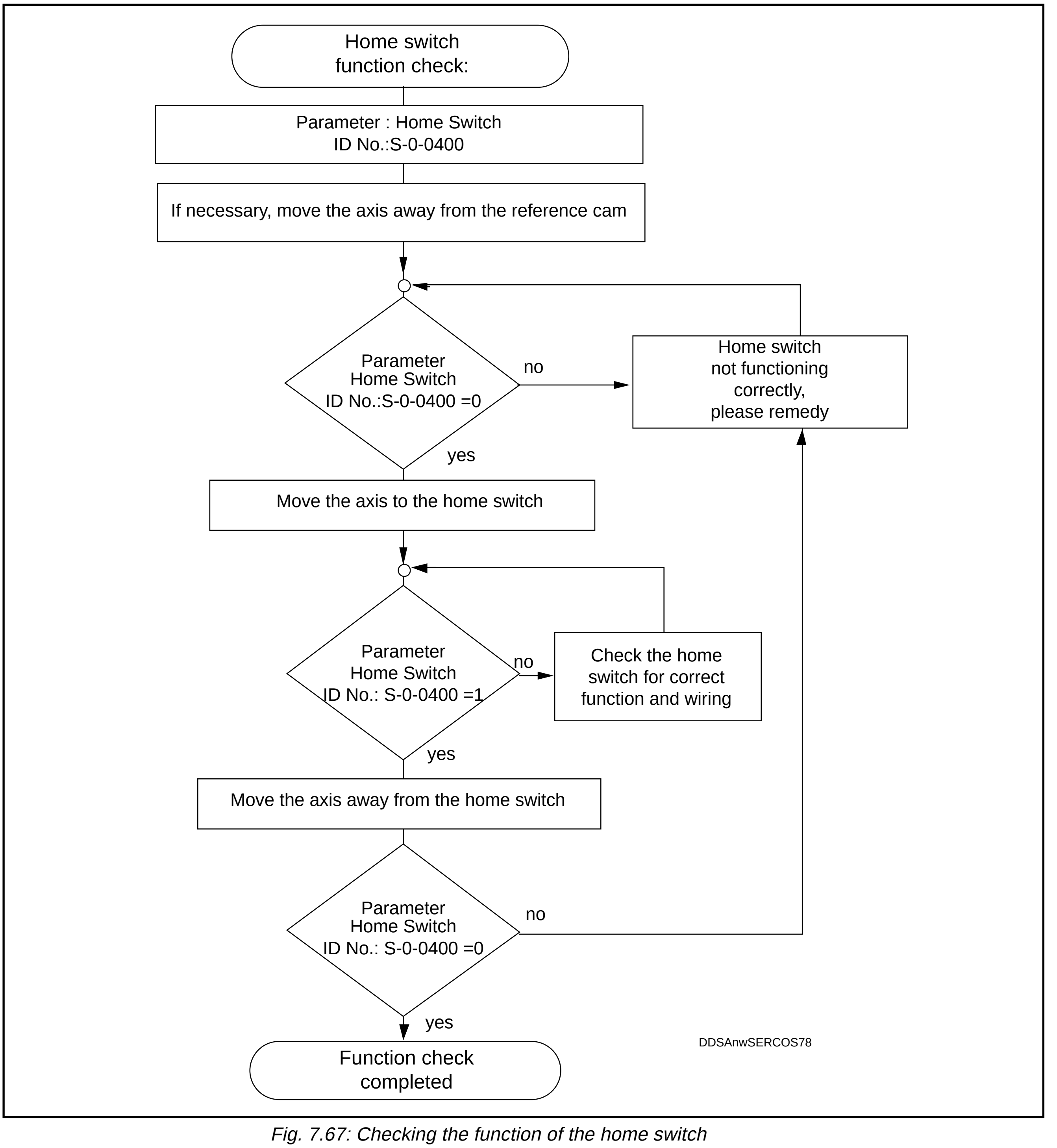
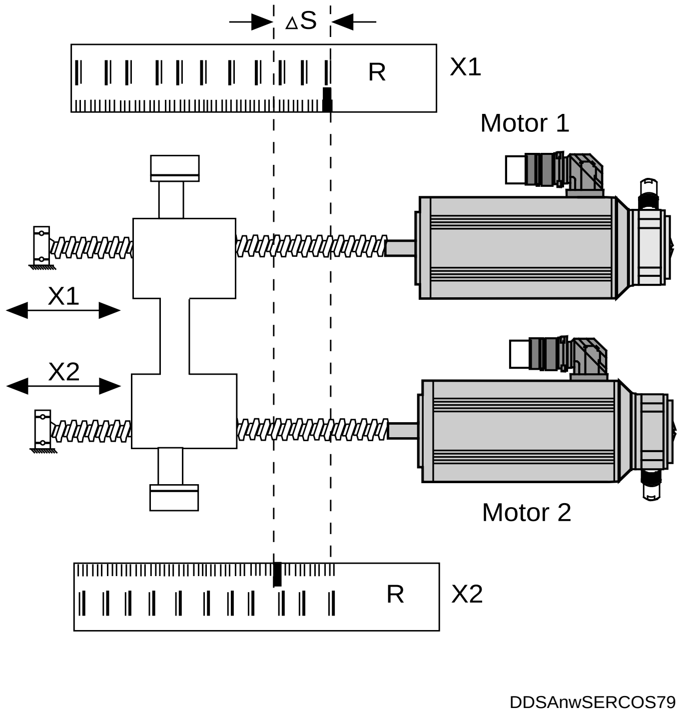


Fig. 7.67: Checking the function of the home switch

- Detecting the reference mark positions of external feedback systems



ΔS = Position offset of reference marks in the direct measuring systems of gantry axes X1/X2

Fig. 7.68: Position offset of reference marks in the direct measuring systems of gantry axes X1/X2

Procedure:

1. Trigger the command „Get Mark Position“ ID No. P-0-0014 (see NC control unit manual).
2. Move both axes towards the reference marks by forward feeding the same position command values through the NC control unit.

The direction of travel must be the same as that of the subsequent homing cycle

On reaching the respective reference mark of the linear scale, each of the two drives stores the instantaneous actual position feedback value 2 in the corresponding marker position (ID No. S-0-0173). Once the reference marks have been acquired, the relevant drive acknowledges the command „Get Mark Position“. When both gantry axes have acknowledged the command, the NC control unit must brake the drives to a standstill.

3. Determining the marker offset (Δs):

Δs =	Marker position Axis X1 (ID No. S-0-0173)	–	Marker position Axis X2 ID No. S-0-0173)

- Calculate Reference Offset 2 for the respect axis and enter the value.

For the axis whose reference mark occurs first, the following applies:

$$\text{Reference Offset 2 (ID No. S-0-0151)} = \frac{V_{ref}^2}{2 \times a_{ref}} + \text{Marker offset}$$

V_{ref} = homing velocity
a_{ref} = homing acceleration

For the axis whose reference mark occurs last, the following applies:

$$\text{Reference Offset 2 (ID No. S-0-0151)} = \frac{V_{ref}^2}{2 \times a_{ref}}$$

V_{ref} = homing velocity
a_{ref} = homing acceleration

Danger: a reversal of the direction of travel of one of the two drives may lead to an accident. This will happen when the values entered in the Reference Offset 2 parameter are lower than the calculated ones.

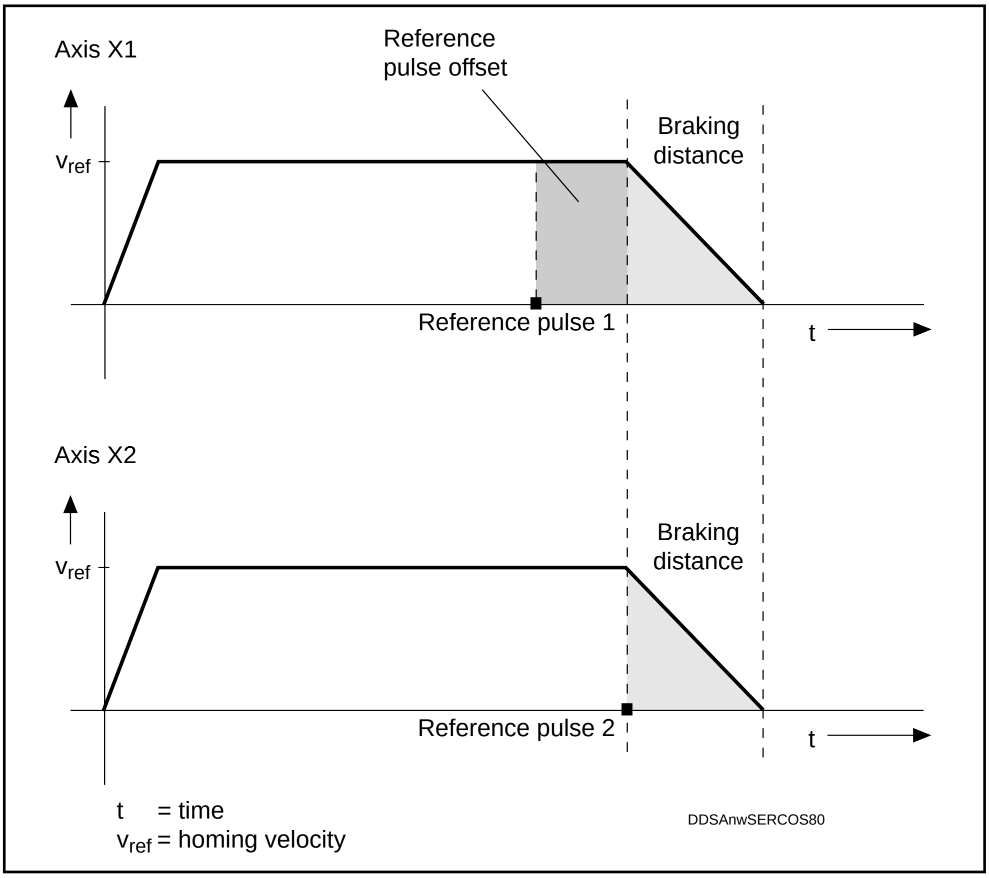


Fig. 7.69: Velocity profile of gantry axes during the homing procedure

7.19. Two-axis alternation

For applications requiring two mechanical axes to be driven in alternation, INDRAMAT offers a cost-effective solution involving only one servo drive in the shape of the DS05 „Two-axis alternation" system configuration.

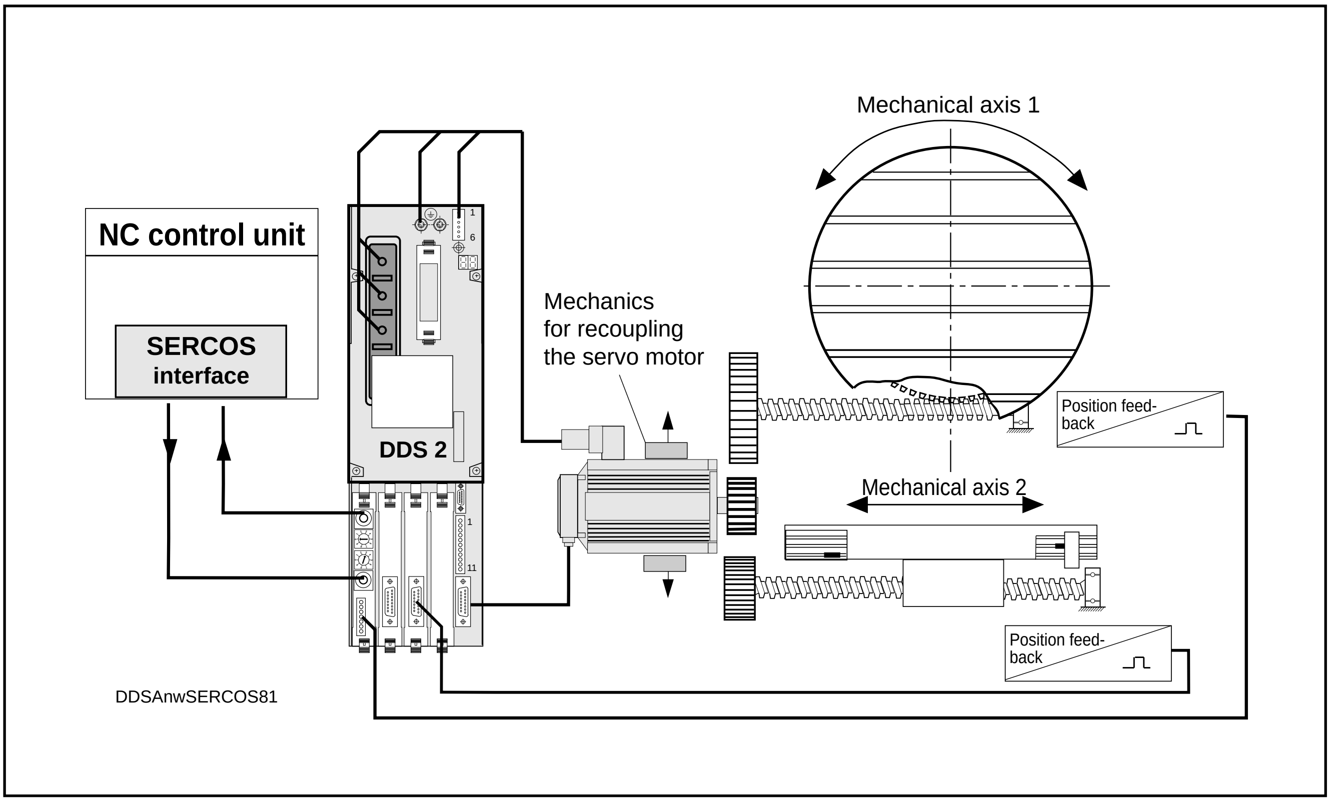


Fig. 7.70: Schematic of a two-axis circuit: System Configuration DS05 (see System Configurations Doc. No. 209-0069-4312)

Working principle

The DS05 drive configuration allows two mechanical axes to be driven alternately by one single drive. Each mechanical axis may have a separate external measuring system installed. The two measuring systems are evaluated by the drive controller DDS 2.1. Either 2 rotary axes, 2 linear axes or a combination of rotary and linear axis can be driven.

Accident risk
Secure vertical axes against uncontrolled motion.

Before this option can be implemented, the following conditions must be met:

- The digital AC drive has been equipped a two-axis alternation DS05 according to the system configuration
- A mechanism has been provided for recoupling the mechanical axes.
- The control inputs and signal outputs must be capable of switching over to the respective driven axis.
- The assignment of the driven axis to the parameter set provided for this purpose must be ensured by the NC control unit.

When the drive controller has been powered up and the SERCOS initialization has reverted to Phase 2 (parametrizing mode), parameter set 0 is always active.

Procedure for starting up the separate servo axes

1. Connect up the servo motor to mechanical axis 1.
2. Activate the relevant SERCOS parameter set through the NC control unit.
3. Start up Axis 1 (see Sections 6 and 7)
4. Halt the servo motor, cancel the controller enable signal, if necessary immobilize mechanical axis 1.
5. Connect up the servo motor to mechanical axis 2.
6. Activate the relevant SERCOS parameter set through the NC control unit.
7. Start up Axis 2 (see Sections 6 and 7).

Danger: accident risk due to uncontrolled axis movements.
When the drives are powered up of when the SERCOS interface switches from the parametrizing phase (Phase 2) to the operating mode (Phase 4), both axes lack any dimensional reference.
For servo axes which require a reference, set the reference dimension.

Setting the reference dimension in the two mechanical axes:

Mechanical axis 1
1. Connect up the motor
2. Activate parameter set 0
3. Activate the drive
4. Trigger the „Drive Controlled Homing Procedure“ command
5. Deactivate the drive.

Mechanical axis 2
1. Connect up the motor
2. Activate parameter set 1
3. Activate the drive
4. Trigger the „Drive Controlled Homing Procedure“ command

7.20. Use of the E-STOP function

The E-STOP function is used to monitor the readiness of the installed NC control system.

The SERCOS interface offers all the necessary prerequisites for safe operation. Even a total failure of communication between the NC control system and the drive has been catered for and generates a defined error reaction in each drive.

For applications

- where safety measures have to be provided in the event of a failure of communication between the NC part of the control system and the SERCOS master module (see 1) in Fig. 7.71),
- where the E-STOP circuit of the installed PLC is not sufficiently monitored and will therefore not trigger a drive reaction in time (see 2) in Fig. 7.71)

it is necessary to ensure that the drive will go into error reaction mode as quickly as possible.

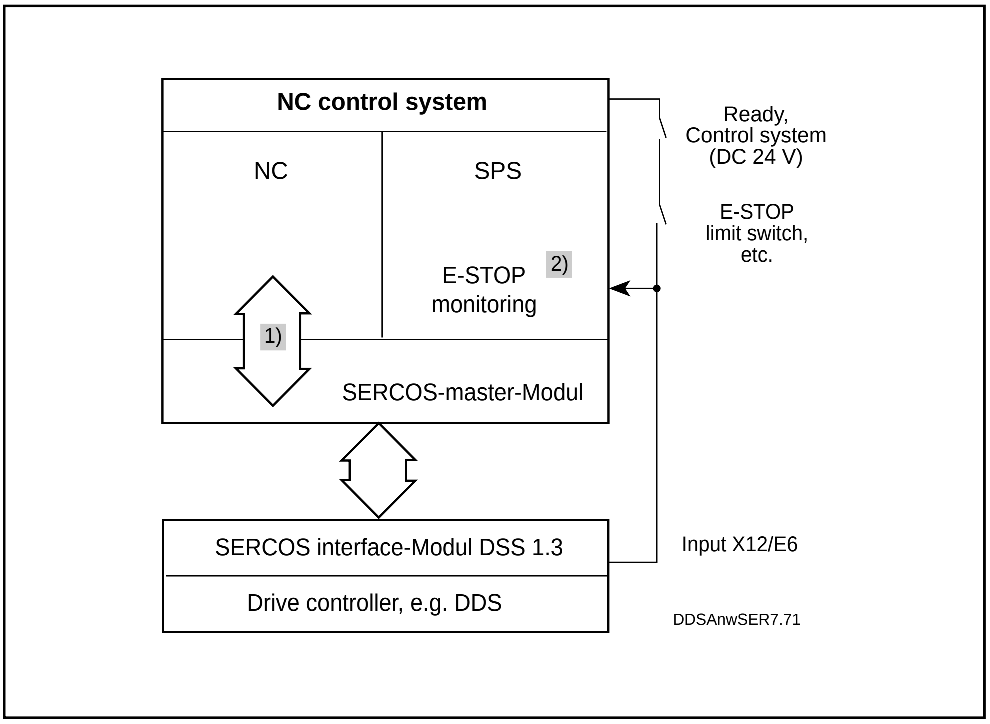


Fig. 7.71: E-STOP function on the DDS 1.3

Drive reaction with „E-STOP“ active

Activation of the E-STOP function triggers the following drive reaction:

- the AC servo drive performs the set error reaction (see Section 7.1 error reaction)
- Bit 15 of Diagnostics Class 1 and the related change bit in the drive status are set
- The AC servo drive remains inactive until the E-STOP function has been deactivated.
- The status indicator „H1“ shows the message ES.

Preconditions for using the E-STOP input

The following modules must be slotted into the drive controller:

- Software module ≥ DSM 2.1-S11-01.10
- Command communication module ≥ DSS 1.3
- The E-STOP input X12/E6 on the DSS module must be connected up to via the E-STOP chain and/or a Ready contact on the NC control system (+24 V DC).

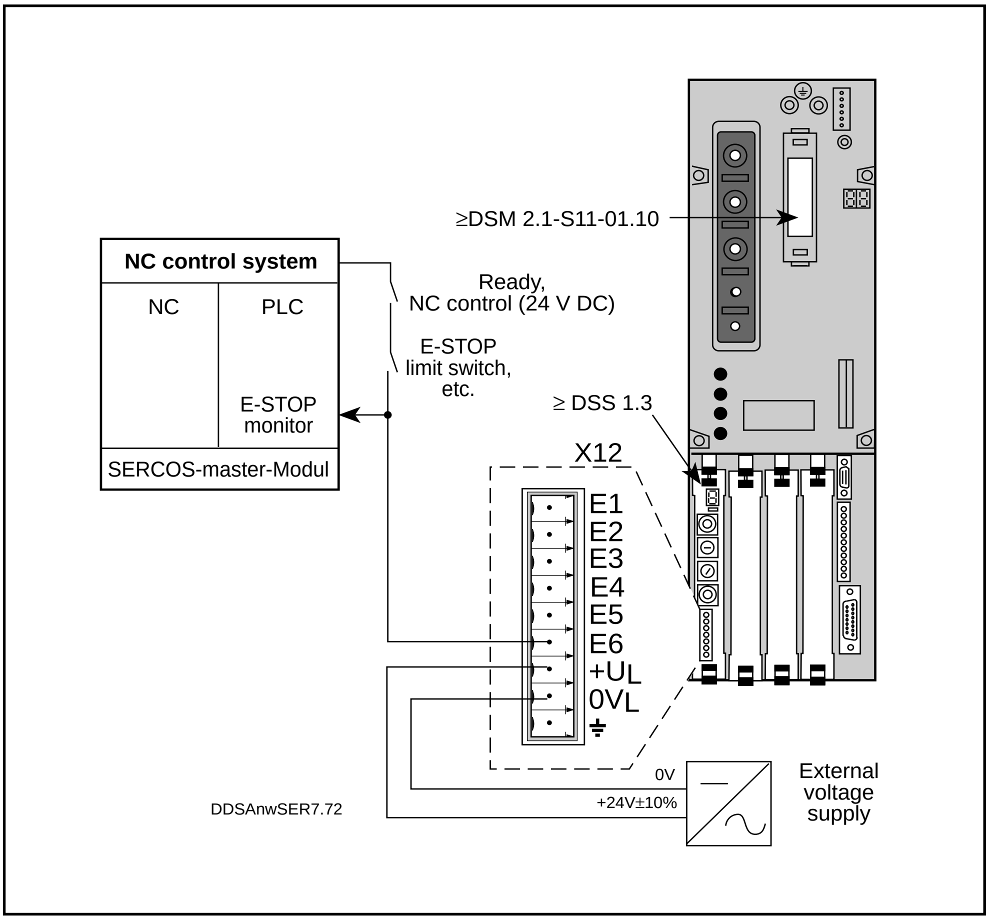


Fig. 7.72: Conditions for activation of the E-STOP function

Activating the E-STOP function

- Parameter P-0-0008 „Activation of E-STOP function“, Set BIT 0 to 1.
- Disconnect the +24 V DC signal voltage on the E-STOP input X12/E6

Deactivating the E-STOP function

- Reconnect the +24 V DC to the E-STOP input X12/E6
- Reset the error via the installed NC control system

Diagnosis

When the E-STOP function is active, the status indicator „H1“ shows the message: ES.

7.21 Park Axis Command

The „Park Axis“ function is provided to allow the servo axis to be decoupled from the machine in orderly conditions.

Activating the ID No.: S-0-0139 „Park Axis Command“ allows digital AC servo motors to be decoupled from a drive package by disconnecting the cables. When the command is active, error messages will be suppressed and not transmitted to the NC control system or the power supply module. All other servo drives in a drive package therefore remain operable.

Risk due to lethal voltage levels.

Before disconnecting power lines, the power must be switched off and secured against accidental switching on.

The „Park Axis Command“ is supported by the drive from software version DSM2.1-S01-.10 and higher.

Procedure for decoupling a servo axis

1. Bring the relevant servo axes to a halt.
2. Deactivate the drives using the „Drive On“ bit (bit 15 in the command word of the master data telegram).
3. Via the NC control, switch the relevant SERCOS ring into communication phase 2.
4. Once in communication phase 2, use the NC control to activate the „Park Axis Command“ ID No. S-0-0139.
5. Switch off the power supply to the drives or activate the safety lockout.
6. Remove the servo axis.
7. Switch the remaining drives back into communication phase 4.
8. Activate the drives
9. Restart the operating cycles.

When servo axes have been decoupled, the „Park Axis Command“ must be activated in communications phase 2 before any phase progression is undertaken in the NC control.

Status indicator H1

When the „Park Axis Command“ is active, the status indicator „H1“ shows the symbol PA.

When this symbol appears, the drive controller is deactivated.

7.22. Axis error compensation

In machine axes operated in position loop control there are systematic errors in position acquisition. These errors are caused by:

- gear and spindle pitch errors in indirect position acquisition.
- errors in the installed measuring system in both direct and indirect position acquisition.

To compensate these errors, INDRAMAT offers an „axis error compensation“ function in the drive controller.

Preconditions/ mechanics

The correct position feedback values have been recorded using a suitable measuring procedure (e.g. laser interferometer).

Conditions for implementing the axis error compensation

1. There are two tables of correction values for each direction of travel. These contain 500 correction values x_c (n) each. The permissible bit length of the correction values is 16. The first x_c (1) and the last x_c (500) correction value in each table must be initialized with the value 0 in order to avoid a jump in actual feedback and subsequent stability problems in the control loop. To ensure that the control loop remains stable, there is a theoretical limit to the interpolation factor of $|m| < 1$, i.e. the difference between two adjacent correction values may not be larger than the distance between two compensation points.

Table 1 for positive direction of travel.

Table 2 for negative direction of travel.

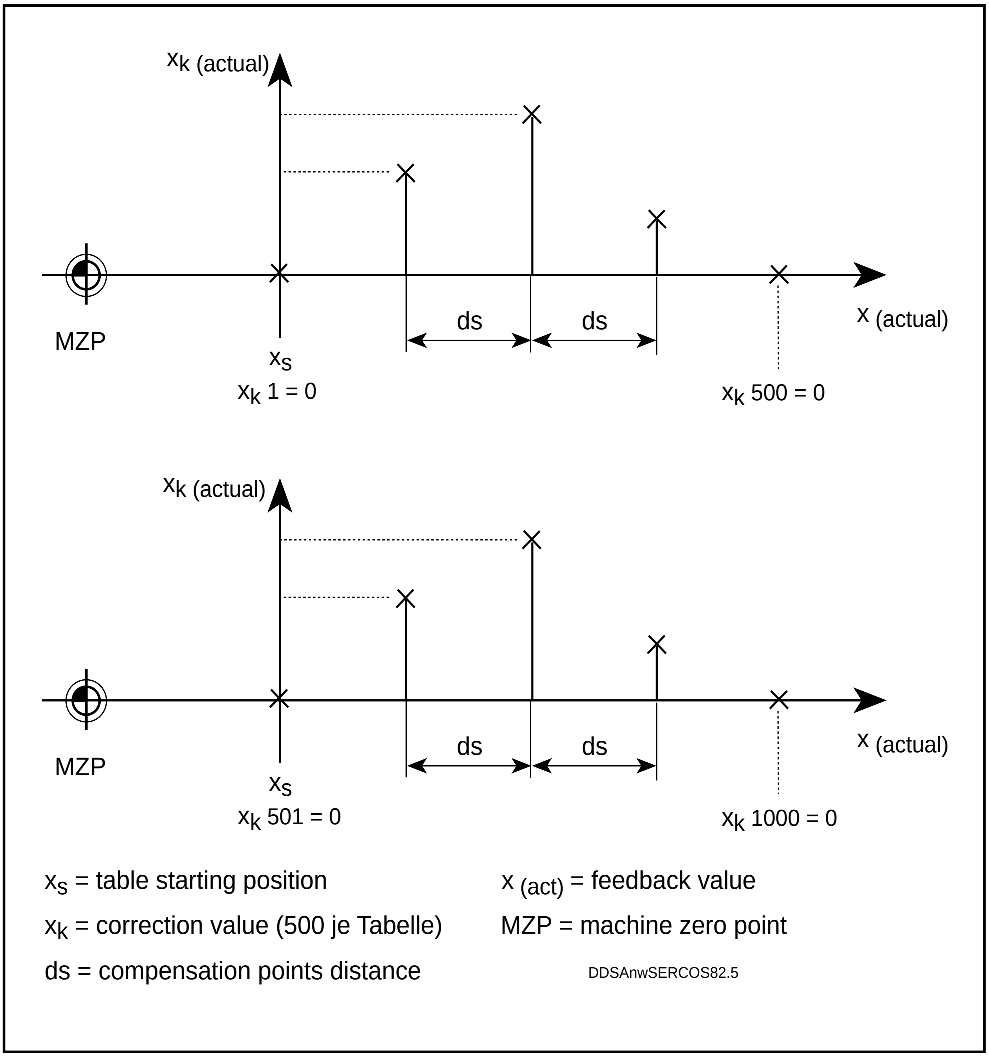


Fig. 7.73: Designations of axis error compensation

2. The correction range comprises 500 values and can be applied to any section of the traversing range, though it is advisable to situate the correction range in the working range. To do this, the table starting position X_s must first be defined. This determines the negative end of the compensation range with reference to the machine's zero point.
3. The distance between compensation points „ds" defines the distance between two actual feedback values to which a correction value is assigned. This distance is constant throughout the correction range.

The maximum distance between compensation points „ds" is 1450° referred to the motor shaft.

4. Access to the relevant correction value table depends on the polarity of the command velocity d(Xcom)/dt.
5. Actual feedback values lying outside the compensation range defined by the starting position and the compensation points distance will not be corrected.
6. The correction value tables are loaded via the SERCOS interface. The tables are stored as resident in the programming module so that they are easily transferable to replacement controllers by simple replacement of the programming module.
7. All position data in the axis error compensation can only be entered in the **preferred scaling method**. This gives maximum correction values of ± 3.27 mm.
8. If less than 500 compensation points are required, enter a "0" for the rest (unused) values in the table.
9. The "Drive-controlled Homing Cycle" cannot be executed in the correction range.

Procedure for activating the axis error compensation

1. Determine the correction table starting position.
2. Enter the difference between the start position and the machine's zero point in the parameter „Correction table starting position“ P-0-0056. Input format: preferred scaling method (see Section 7.6).
3. Determine the „correction table compensation points distance“ and enter this in parameter P-0-0057.

$$ds\,[mm] = \frac{A\,[mm]}{499}$$

ds = compensation points distance [mm]
A = working range [mm]

4. Call up the parameter „Tables of correction values“ P-0-0058 and enter the appropriate correction value table.

Danger risk due to uncontrolled axis movements

1. To avoid instability in the control loop, enter „0“ for the first and last correction values.

2. The difference between two adjacent correction values X_k may not be larger than the distance between compensation points.

positive polarity

Datum 1 = 0
|Datum 2-499| = < 3,2700 mm
Datum 500 = 0

negative polarity

Datum 501 = 0
|Datum 502-999| = < 3,2700 mm
Datum 1000 = 0

5. Call up parameter P-0-0055 „Axis Error Compensation“. Activate the axis error compensation by setting Bit 0 to 1.

Axis error compensation status

The parameter for compensation status is P-0-0055. All necessary initialization signals are stored in this parameter and can be interrogated by the NC control unit. The parameter also contains the control bit for activating axis error compensation. This must be set if the compensation function is to be used. SSF parameters are checked during initialization. If a parameter is erroneous, the corresponding status bit is set and the control bit reset.

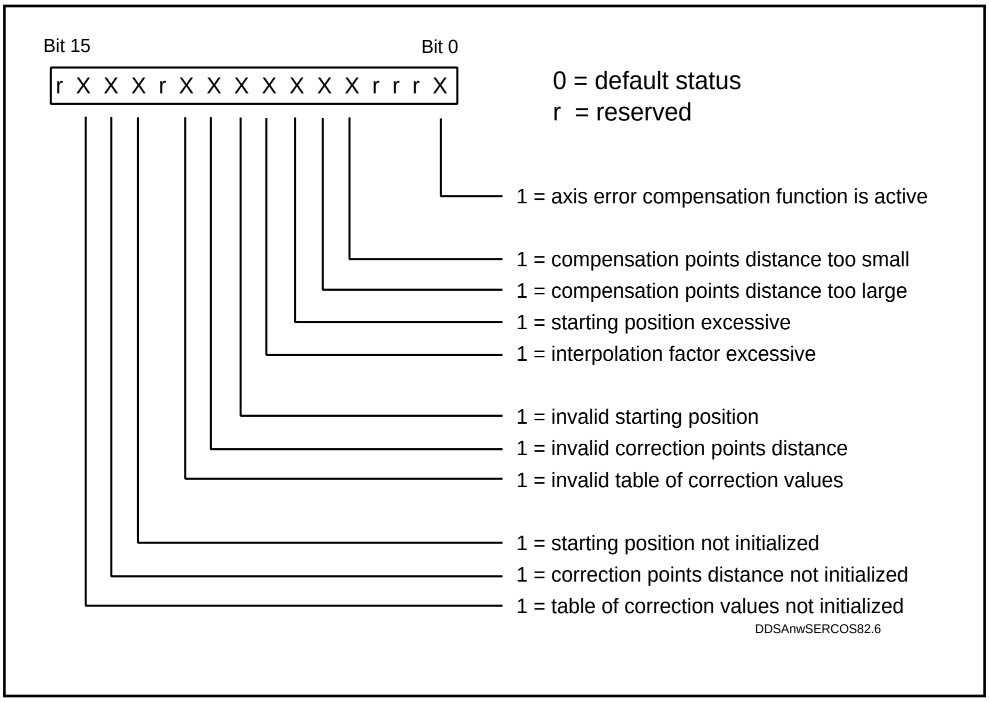


Fig. 7.74: Status indication for axis error compensation, parameter P-0-0055

Description of parameters for axis error compensation

Table of correction values P-0-0058

This parameter contains the correction values for the two tables. These are given in the form of a list of variable length with 2-byte operation data. The correction values 1-500 are reserved for positive command velocities, the correction values 501-1000 for negative command velocities.

Risk of machine damage due to instability of the servo axis.
The correction values for the first and last compensation point must be initialized in each case with 0.

Correction table compensation points distance P-0-0057

The „compensation points distance“ parameter defines the distance between two adjacent values in the table. The compensation points distance is constant over the entire correction range. It can only be entered in the preferred scaling method (32 bits) and must match the corresponding starting position and the table of correction values.

Correction table starting position P-0-0056

This parameter defines the distance between the table starting position x_s and the machine’s zero point (MZP). The table starting position is always the smallest feedback value in the correction range (see Fig. 7.73). This data can only be entered in the preferred scaling method (32 bits) and the starting position must always match the corresponding table of correction values.

Parameter input

Parameter input is simple to handle using the IMPORT function of the commissioning aid „SYSDA 1.1“

The IMPORT function enables the integration of externally prepared parameter sets in the ISYS file system. This option has been provided for special applications, thus allowing machine-related correction value tables, for example, which have been compiled by the user to be entered in a drive.

The parameter file must be a simple ASCII file that has been created using an editor that does not insert any control characters (word processing).

A parameter file may also contain comments in addition to the parameters. Comment lines do not have to be identified in any way, but must be written at the beginning of the file.

The following format is mandatory for parameters:

Line 1: **Starting identification |**
Line 2: **Ident. no.**
Line 3: Parameter name
Line 4: **Parameter attribute**
Line 5: Unit
Line 6: Min. input value
Line 7: Max. input value
Line 8...n: **Operation datum**

The items in bold print must always be entered. For items that are not know or do not occur in the corresponding parameter the mandatory entry is '—'.

It is not permissible to omit lines. If, for example, no unit has been determined for a parameter, Line 5 must be completed by entering '—'.

ISYS file manager has a prescribed file name format:

ANTxxyyy.**ASC**

The letter combinations in bold type are mandatory.
The xx and yyy combinations can be replaced by arbitrary consecutive numbering.

To ensure that an existing file is not overwritten when importing another file, the file to be imported should be assigned a name that has not already been allocated by the ISYS file manager.
All parameter sets are listed in the ISYS/PARAM file system.

The IMPORT function can be found in the PARAMETERS menu item.

Example:

Comment
...
...
Comment
Date: 13.04.93

| Block starting identification
P-0-0056 ID No.
Compensation points distance;
00000000000000000000 32-bit attribute
µm Date unit
-- Min input value
-- Max input value
Date (4 bytes) Parameter value
|
P-0-0057
Table starting position
00000000000000000000
µm
--
--
Date (4 bytes)
|
P-0-0058
Table of correction values
0000000000000101010000000000001
--
--

2000	Number of bytes in the list
2000	Max. length of the list

Date 1 (2 bytes)
Date 2 (2 bytes)
Date 3
.
.
.
Date 1000

7.23. Velocity loop

Velocity loop parameters stored in the motor feedback are used to match the machine mechanics to the digital AC servo drive.

Procedure:

- Select the parametrizing mode on the NC control unit
- Activate the „Initial Default Parameter Command“ ID No. S-0-0062.

This completes default setting of the servo drive. If the machine axis still tends to become unstable despite loading of default parameters, this can be due to the following causes:

- Backlash between the motor shaft and the machine
- The machine construction is not rigid enough
- Unfavourable matching of mass moments of inertia
  (The ideal case is a 1:1 ratio for rotor mass moment of inertia to external mass moment of inertia)

These factors can lead to

- poor surface quality of the workpieces
- increased wear on machine mechanics

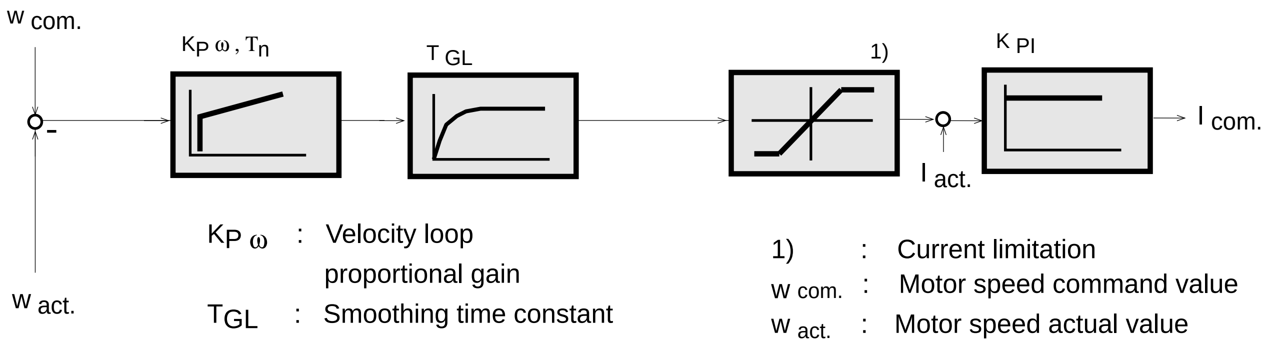
and must therefore be avoided.

In cases where the above factors cannot or can only partially be eliminated, INDRAMAT digital AC servo drives offer a matching function in the controller set-up. The functions of the controller parameters is shown in the block diagram in Fig. 7.75 and 9.4.

Default settings in the velocity loop should only be edited by personnel well versed in control engineering technology.

If the editing of default parameters has not produced the desired result, please contact INDRAMAT’s technical service department.

Functions of velocity loop parameters



KP ω : Velocity loop proportional gain
TGL : Smoothing time constant
Tn : Velocity loop integral action time
KPI : Current regulator proportional gain

1) : Current limitation
w com. : Motor speed command value
w act. : Motor speed actual value
I act. : Motor current actual value
I com. : Motor current command value

DDSAnwSERCOS83

Fig. 7.75: Block diagram of the velocity loop

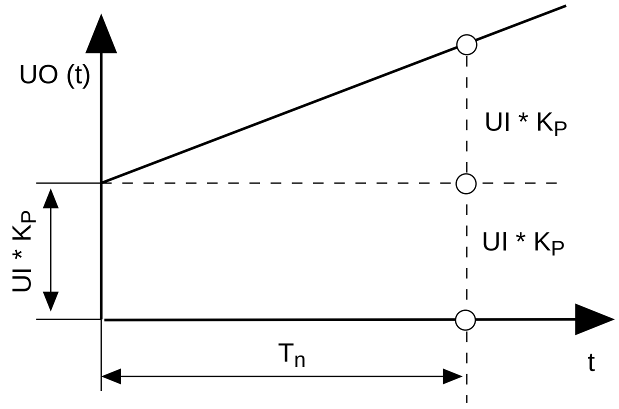
Velocity loop proportional gain "Kpω"

The „Velocity Loop Proportional Gain“ parameter, ID No. S-0-0100 sets the proportional component of the velocity loop.

Velocity loop integral action time "T_N"

The definition of the Velocity Loop Integral Action Time ID No. S-0-0101 can be seen in Fig. 7.76.

This representation of the PI regulator transition function assumes a step change of the input variable „UI“ to a constant value and shows the gradient of the output variable „UO“.



$$T_n = \frac{K_P}{K_I}$$

T_n = Velocity loop integral action time [ms]
K_P = Proportional gain [mA/rad/s]
h (t) = Transition function
K_I = Integral gain [A/rad/s]
UO = output variable
UI = input variable

DDSAnwSERCOS84

Fig. 7.76: Transition function of the PI regulator

Smoothing time constant"T_{GL}"

A time constant parameter, the Smoothing Time Constant ID No. P-0-0004 can be activated in the proportional component of the velocity loop to suppress quantization effects and to limit the band width of the velocity loop.

The filter can be deactivated by entering the smallest input value of 250 µs.

Current regulator proportional gain

The proportional component of the current regulator is set using the parameter „Proportional Gain 1 Current Regulator“ ID No. S-0-0106.

Risk of damage to machines due to instability of the servo axis. The „Proportional Gain 1 Current Regulator“ parameter ID No. S-0-0106 has been set specifically for each motor by INDRAMAT and must never be changed.

7.24. Language selection

All texts, e.g. parameter names and diagnostics and error messages, have been stored in several languages in the DDS 2.1. The desired language can be selected using the parameter:

P-0-0005 Language Selection

0: German

1: English

Other languages in preparation

7.25. What to do in the event of mains power failure or E-STOP shutdown

When there is a mains power failure or an E-STOP shutdown, machinery and workpieces risk being damaged due to abrupt and uncontrolled braking of servo axes. INDRAMAT power supplies are fitted with monitoring and signalling devices permitting safe return movements in the presence of faults (exception: TVM and KDV). For more details see the Applications Manual of the installed power supply.

7.26. Continuously rotating servo axis (Modulo Axis)

The absolute reference dimension of a servo axis cannot be registered indefinitely. To do this, the modulo axis function is required. With this function, the position feedback value is reset to zero after a number of increments that can be set in the Parameter "Modulo Value" S-0-0103.

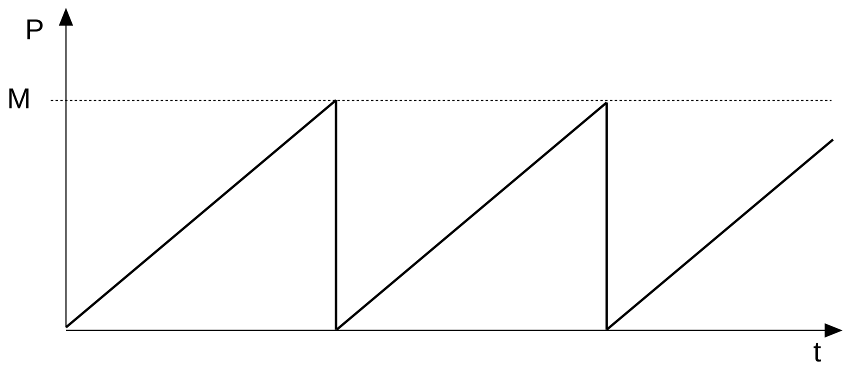


Fig. 7.72: Input for the Parameter S-0-0103 "Modulo Value"

Input limits

The following input limits must be adhered to:

1.

$$\frac{\text{S-0-0103 (Modulo value)}}{360°} \cdot \frac{\text{S-0-0121 (Load gear input revolutions)}}{\text{S-0-0122 (Load gear output revolutions)}} \mathbf{< 2048}$$

2.

The product of 1. multiplied by 2^{20} must not have any places after the decimal point.

Accident hazard due to uncontrolled axis movements!
When the input limits are exceeded the position feedback values will be wrongly evaluated.

Modulo rotational axis with multiturn absolute encoder

The quotient of S-0-0121 (Load gear input revolutions) and S-0-0122 (Load gear output revolutions) multiplied by 2^{20} must be an integer.

7.27 Detecting analog measurement values

Drive controllers equipped with the extension plug-in module „Analog signal interface „ Type DRF, are provided with two differential inputs for detection of analog measurement variables.

The voltage present at the respective differential input is converted at a resolution of 12 bits and supplied to the parameter P-0-0115" Analog Input 1" and P-0-0116 „Analog Input 2“.

The values corresponding to the input voltage can now be read out via the NC control system or configured as cyclical data in the drive telegram (see NC control manual).

Use incremental position measuring systems with square-wave signals for direct position feedback value acquisition.

The high-resolution position interface DLF cannot be evaluated in addition.

Connection diagram for measurement variable transducer

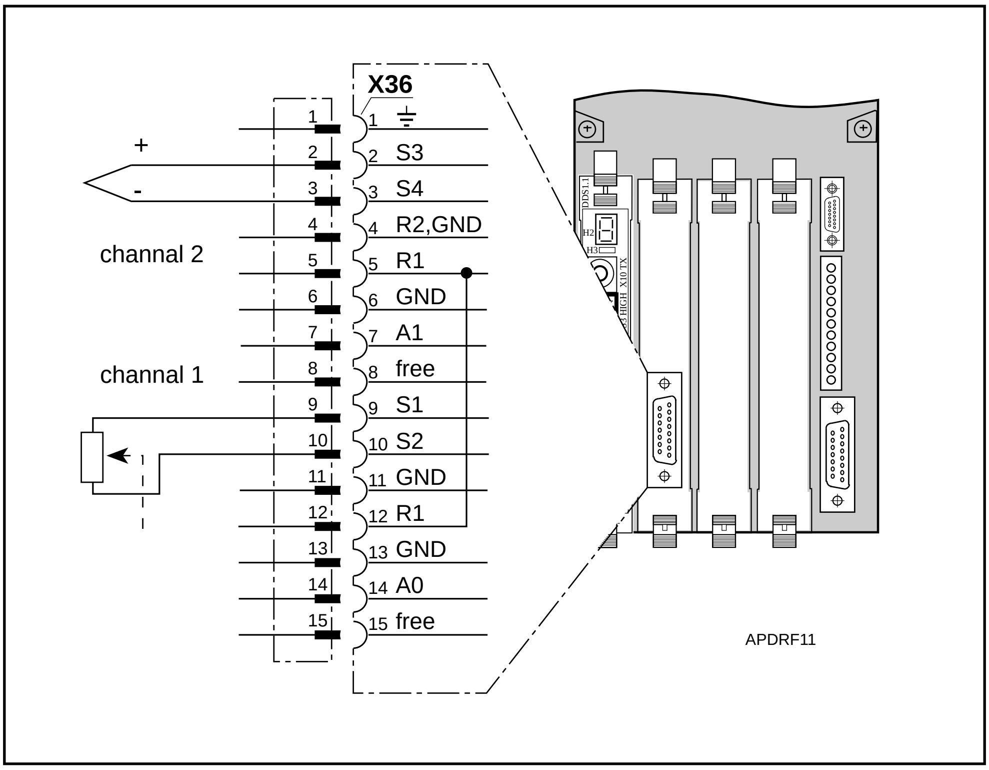


Fig. 7.78: Connection diagram of the Analog Signal Interface DRF 1.1 for measurement variable acquisition

Matching of different measurement variable transducers

Depending on their design, measurement variable transducers supply different signal voltage levels. The analog inputs on the DRF 1.1 are equipped with signal amplification options.

Setting the desired maximum input voltage levels

Max. input voltage	**Input voltage**	**12-bit resolution**	**Amplification**
±10 V ±10 V	S1, S2 S3, S4	4,88 mV/Bit	1
±5 V ±5 V	S1, S2 S3, S4	2,44 mV/Bit	2
±2,5 V ±2,5 V	S1, S2 S3, S4	1,22 mV/Bit	3
±1 V ±1 V	S1, S2 S3, S4	0,49 mV/Bit	10

Fig. 7.79: Permissible voltage levels and resolution of the input signals for the respective amplification setting

The amplification level is set by altering the circuitry of Pin 6 (GND) to Pins 7 and 14 in the connector.

If Pins 7 and 14 are open, amplification level 2 (for resolver connection) is selected.

Desired amplification level	**Connector on X36**	
	Pin 7	**Pin 14**
2 (default)	free	free
1	free	GND
4	GND	free
10	GND	GND

Fig. 7.80: Circuitry of connector X36 for setting the desired amplification level.

8. Final commissioning work on the servo axis

8.1. Checking the servo drive

Setting the safety limit switch

Set the safety limit switch of the axis at an adequate distance from the dead stop. (check that the cams are of sufficient length!). Traverse the axis at maximum velocity until it passes the safety limit switch and measure the stopping distance. For vertical axes, measure the distance in both traversing directions. The stopping distance is the minimum distance between the machine's dead stop and the safety limit switch.

Checking the drive set-up matches the power requirements

The torque levels output by the AC servo motor are used to check whether the drive set-up matches the power requirements. These torque levels can be determined as follows:

Option 1:

Parameter „Torque feedback value" ID No. S-0-0084 shows the instantaneous torque as a percentage of the zero velocity continuous torque M_{dN} of the uncooled motor (see motor nameplate or Selection Data List Doc. No. 209-0069-4302).

Option 2:

Determine the current command value by measuring the DC voltage on connectors X3.3 and X3.4 against 0VM (see Fig. 4.1).

Procedure:

1. Apply the current command value to the output via Channel 2 (see Section 9.6).
2. Connect up a multimeter or oscilloscope.
   - Move the axis
   - Measure the DC voltage signal at the analog diagnostic output
   - Calculate the current command value I_{com} as follows:

Calculating the current command value

$$I_{com} = \frac{U_{AKmax}}{U_{AK}} I_{Type}$$

U_{AK} = voltage in V measured at the diagnostic output AK

U_{AKmax} = 10V = maximum output voltage in V at the diagnostic output AK

I_{Type} = unit current rating in A

I_{com} = current command value in A

Calculating the torque output by the servo motor

- the torque output by the servo motor can be calculated from the current command value as follows:

$$M_{load} = I_{com} K_m$$

I_{com} = current command value in A

M_{load} = load moment in Nm

K_m = torque constant in Nm/A at 20°C

The torque constant K_m of the respective motor can be found:

- on the motor nameplate
- in the motor documentation
- in parameter P-0-0051 „Torque Constant“

Check the motor torque

In order to ensure sufficient control reserves in the drive controller, it is recommended to check the following torque levels output by the AC servo motor:

- torque level at maximum operating velocity
- torque level in rapid traverse
- torque level during acceleration

Recording the torque at minimum and maximum operating velocity

Record the torque output by the servo motor in the feed range at minimum and maximum operating velocity. This should not exceed 60% of the zero velocity continuous torque „M_{dN}“ !

Reasons for excessive base torque levels:

- Axis immobilization not released
- insufficient lubrication
- excessive static friction on the slide guideways
- mechanical jamming of the drive axis
- holding brake not released (24 V DC not applied)
- drive underdimensioned

Record the torque during rapid traverse

The torque output by the servo motor in the rapid traverse mode (feed motions) should not exceed 75% of the zero velocity continuous torque „M_{dN}“.

Reasons for higher torque levels:

- insufficient hydraulic weight compensation (pressure changes dependent on velocity)
- fluid collecting in the toothing of an oil-flooded gear
- overtensioned toothed belt
- break in the lubrication film
- poor ball circulation in the screw spindle nut
- drive underdimensioned

Checking the torque level during acceleration

The torque to be output by the AC servo motor during acceleration should not exceed 80% of the maximum torque M_{max} of the installed motor/drive controller combination. (Refer to the Selection Data List for M_{max} for the relevant motor/ drive controller combination).

Check the torque level as follows:

1. Apply the current command value to diagnostic output 1 or 2 and record the value.
2. Accelerate the servo axis to maximum velocity via the NC control system and record the acceleration ramp.
3. Increase the acceleration until the current command value is limited by the drive controller.
4. Reduce the acceleration thus measured by 20%.

If this setting is insufficient for the operating cycle, the drive has been underdimensioned.

In interpolating servo axes the acceleration should be set at the same level. The value to set is that if the servo axis with the lowest acceleration.

Adjusting the weight compensation

Adjust the weight compensation so that the motor current consumption shows a steady minimum value during both upward and downward motion. This check must be carried out in the feed range and in rapid traverse.

Monitor the recovered energy

Peak energy recovery:
Operate all axes simultaneously in rapid traverse mode via the NC control and brake them using the E-STOP function. This must happen with the power supply module cutting out with error message „bleeder overload“ or the DDS 2.1 with error message 25 „overvoltage“.

Continuous energy recovery:
Run the axes of the drive package to be checked for at least 15 minutes in the load cycle for which the highest energy recovery (braking energy) is to be expected. The test phase must run without the supply module cutting out with the error message „bleeder overload“.

If the system does cut out in either of the above cases, the power supply dimensioning must be corrected (see power supply manual). It may be necessary to change the power supply module or install an extension module (TBM or TCM).

8.2. Saving data

Saving data using the "specific axis data list"

The "specific axis data list" is intended as an additional data saving option for axis-related parameter contents and should be stored in the machine file. This list is to be completed by commissioning personnel on initial start-up.

If necessary, the blank "specific axis data list" can be photocopied for documenting the parameter contents of other axes. The form is included in the appendix to this documentation.

Saving data using electronic data carriers

Saving the set parameters on electronic data carriers external to the system should preferably be done via the installed NC control unit.

The INDRAMAT SERCOS-PC interface offers a comfortable parameter manager function that can be used for saving data (see Section 4.2).

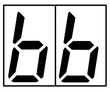
9. Diagnostics and fault clearance

Faults and warning signals recognized by the drive as well as operating status messages are displayed on the two-digit, seven-segment „status indicator H1" (see Fig. 2.8).

Warning messages emitted by the controller and command errors are indicated by a flashing display. The operating status and the error messages are simultaneously indicated via the diagnostics text in the parameter „Diagnostic messages" ID No. S-0-0095.

9.1. Diagnosing the operating status of the controller using its status display

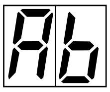
The relevant operating status of the drive is indicated by a two-letter message.



„Ready"

The drive is ready for powering up.

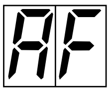
Diagnosis text:
Ready for main power (Bb closed)



„Drive ready"

The control and power section of the drive is ready.

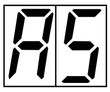
Diagnosis text:
Control and power section ready (drive ready)



„Drive enable"

The drive enable signal has been emitted and activates the drive which will then follow the command value.

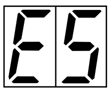
Diagnosis text:
according to the selected mode of operation (see Section 7.7).



„Starting lockout"

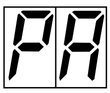
The power output stage has been locked. This signal ensures safe torque disabling of the drive independently of the current operating status of the drive package (see Section 7.2).

Diagnosis text:
Drive interlock open



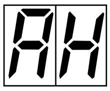
„E-Stop"

E-STOP was activated. The AC servo drive shuts down according to the set error reaction (see Section 7.20).



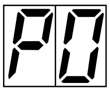
Command „Park axis"

This command was given by the control. The drive controller is deactivated (see Section 7.21).



„Drive halt“

The drive has been stopped at the parametrized acceleration (ID no 00136) and remains under control.

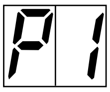


Phase 0

The drive is in Phase 0 and is waiting for switch-over from Phase 0 to Phase 1.

Diagnosis text: Phase 0

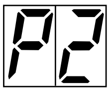
Status display on the SERCOS interface:
0 or 6 (for meaning see Section 9.5).



Phase 1

Switch-over from Phase 1 to 2 has not yet been triggered by the control unit.

Remedy:
Refer to the control unit manual.

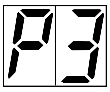


Phase 2

Before the control unit switches over to Communications Phase 3, the drive controller checks the parameters entered for completeness and for compliance with the input limits. If the controller detects any invalid parameter values, it will prevent progression of the communications phase.

The parameters are not checked for correctness.

Remedy:
The „ID No. List of Invalid Operation Data for Comm. Phase 2“, ID No. S-0-0021 contains parameters that are recognized as invalid prior to transition to Communications Phase 3. These parameters must be run through before any progression to Phase 3 is possible.



Phase 3

Before the control unit switches over to Communications Phase 4, the drive controller checks the parameters entered for completeness and for compliance with the input limits. If the controller detects any invalid parameter values, it will prevent progression of the communications phase.

The parameters are not checked for correctness

Remedy:
The „ID No. List of Invalid Operation Data for Comm. Phase 3“, ID No. S-0-0022 contains parameters that are recognized as invalid prior to transition to Communications Phase 4. These parameters must be run through before any progression to Phase 4 is possible.

9.2. Status indications during drive initialization

If the drive controller stalls in one of the status displays during the initialization phase, the controller requires to be changed.

-1 Clearing of data RAM

-2 Checking and, if necessary, automatic clearing of the parameter memory (EEPROM) in the software module.
Note: For new software modules, this status display will be indicated for about 15 seconds.

-3 Loading program (EPROM -> RAM)

-4 Checking hardware (data RAM)

-5 Initializing hardware

-6 Initializing software (EEPROM data -> RAM; input limitations)

-7 Initializing software (oscillation function, feedback code)

-8 Initializing software (reading DSF data)

-9 Initializing SERCOS

9.3. Fault diagnostics and clearance using the drive controller status display

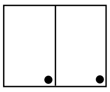
Once a fault has been cleared, the fault message must also be cleared, otherwise the controller will remain inoperative.

To clear fault messages in the SERCOS interface, proceed as follows:

- via the control unit (see control unit manual)

Precondition for fault diagnosis via the controller DDS 2.1:

- Power supply must be ready.

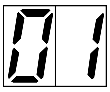


"Watchdog"

Processor in the drive controller not working

Cause:
1. Software module not plugged in or defective
2. Processor defective

Remedy:
1. Plug in or replace the software module
2. Replace the drive controller



Double MST error shutdown

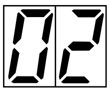
The master sync telegram was not received by the drive for two consecutive SERCOS cycles.

Cause:
1. Fault in the optical fibre transmission line
2. Excessive damping of optical signals
3. Fault in the SERCOS interface (general)

Remedy:
1. Check all optical fibre cable connections in the SERCOS ring.
2. Check the optical cable damping

The maximum damping level between TX and RX is 12.5 dB

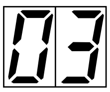
3. Replace the SERCOS interface module in the drive.



Double MDT error shutdown

The drive has not received the master data telegram for two successive SERCOS cycles.

Cause:
See 01 „Double MST error shutdown“



Invalid communication phase shutdown

The SERCOS master module has commanded an invalid communication phase (Phase > 4).

Cause:
Fault in the control unit’s SERCOS master module.

Remedy:
Consult the control unit manufacturer.

04

Error during phase progression

Phase progression did not comply with the prescribed sequence.

Cause:
See error message 03 „Invalid communication phase shutdown“

05

Error during phase regression

The phase did not revert to Phase 0 during regression.

Cause:
See error message 03 „Invalid communication phase shutdown“

06

Phase switching without Ready signal

The SERCOS master attempted to switch phases without waiting for the drive’s „Ready“ signal.

Cause:
See error message 03 „Invalid communication phase shutdown“

07

Switching to uninitialized operation mode

No operation mode defined in the activated operation mode parameter.

Remedy:
Enter the desired operation mode in the activated operation mode parameter.

Permissible modes of operation are:

- Torque loop
- Velocity loop
- Position loop with position feedback value 1
- Position loop with position feedback value 2
- Position loop with position feedback value 1, lagless
- Position loop with position feedback value 2, lagless
- Position loop with command filter, with lag error.
- Position loop with command filter, lagless.

To set the required operation mode, refer to Parameter S-0-0032 Primary Mode of Operation and S-0-0033 to S-0-0035 Secondary Operation Mode 1 to 3 in the control unit manual and the SERCOS interface manual.

18

„**Drive overtemperature shutdown**“

Overtemperature was detected in the power output stage of the DDS 2.1 drive controller. The controller then emitted a 30 second warning: 50 „Amplifier overtemperature warning“, and shut itself down according to the selected error reaction, while signalling the above error message.

Cause:
1. Failure of the unit’s internal cooling system.
2. Failure of the cabinet air conditioning.
3. Incorrectly dimensioned heat dissipation of the cabinet air conditioning

Remedy:
1. If the cooling system is defective, change the controller.
2. Restore the cabinet air conditioning function.
3. Check the cabinet dimensioning.

19

„**Motor overtemperature shutdown**“

The motor temperature has risen above the permissible level. The drive controller then emitted a 30-second warning: 51 „Motor overtemperature warning“. The drive then shut down according to the selected error reaction, while signalling the above error message (see selection options for error reactions, Section 7.1 „Error Reaction“).

Cause:
1. The motor has been overloaded. The effective torque demanded from the motor was above the permissible nominal torque for too long.
2. Earthing or short-circuit in the conductor for motor temperature monitoring.

Remedy:
1. Check the motor dimensioning. For plants which have been in operation for some time, check whether the drive conditions have changed (e.g. contamination, friction, moved masses, etc.).
2. Check the motor temperature monitor for earthing or short-circuiting.

22

„Motor encoder error“

The signals emitted by the motor encoder are monitored. If the signals lie outside the tolerance window, this message will be signalled and the main power cut out.

Cause:
1. Defective or disconnected encoder cable
2. Defective motor feedback.

Remedy:
Check the feedback cable. If no error can be found, replace the motor (feedback defective).

Danger of uncontrolled axis movements

For drives with absolute encoder functions, make sure to set the right absolute reference point when changing the motor (refer to Section 7.9. „Absolute encoder parameters“).

24

„**Overcurrent**“

Cause:
One of the three phase currents has risen to a level higher than 1.5 times the unit’s rated current.

Remedy:
1. Check the motor cable.
2. Check the current regulator parameters. Consult INDRAMAT Service Department.

25

„**Overvoltage error**“

The DC link circuit voltage has risen above the permissible level. (Ud>475 V). The drive torque has been disabled in order not to risk damaging the power output stage of the controller.

Cause:
The energy of a braking main spindle motor could not be converted quickly enough by the installed bleeder resistors.

Remedy:
Reduce the gradient of the braking ramp for the main spindle or increase the bleeder resistance by installing an additional bleeder.

See Section 8.1 „Monitoring the recovered energy“.

„Undervoltage error“

The DC link circuit voltage is monitored in the supply module. It signals to the controller via the control voltage bus whether the link circuit voltage is above the minimum permissible level of +200 V. If the voltage falls below this level, the drive will be shut down according to the selected error reaction.

Precondition: The NCB jumper on the supply module is not connected (see Section 7.1).

Cause:
1. Mains power shutdown without first deactivating the drive by cancelling the controller enable (RF) signal.
2. Malfunction of the supply unit.

Remedy:
1. Check the NC control logics for activating the drive.
2. Remedy the malfunction in the power supply unit.

Excessive deviation

The drive could not follow the given command value and reacted according to the selected error reaction.

Cause:
1. The command signal exceeded the acceleration potential of the drive.
2. The axis has jammed.
3. Error in the drive parameters
4. S-0-0159 monitoring window wrongly parametrized.
5. Main power was switched off without the controller enable signal having been cancelled. Possible cause: error in one AC servo drive in the common supply module.

Remedy:

1. Check the parameter for S-0-0092 „Bipolar Torque Limit Value“ and set to the maximum permissible value for the application (see Section 7.9).

1.1 Reduce the acceleration command in the control unit (see the control unit manual).

2. Check the mechanics and remedy any jamming.

3. Check the drive parameters. Refer to Section 7.23, „Velocity Loop“.

4. To set parameter S 0-0159, see Section 7.7.

5. Check the AC servo drive for other errors than denoted by message „28“.

30

Travel limit value is exceeded

Cause:
The drive has received a command value which would move the axis outside the permitted travel range.

Remedy:
1. Check the position limit parameters S-0-0049 and S-0-0050
2. Check the software limits in the control unit.

See Section 7.9, „Limit Values“

32

Command error

Error messages occurring while a command is being executed are displayed as a collective diagnostic message on the status indicator H1 (32, flashing). The exact error message can be called up via the SERCOS parameter S-0-0095 „Diagnostic message“ (see Section 9.4).

33

„External power supply error“

Different optional plug-in modules have DC-decoupled inputs and outputs. An external power supply must be applied for proper operation of these inputs and outputs. If this voltage lies above the permissible level, the above error message will be signalled.

Remedy:
Check the external power supply.

Description	Unit	min.	typ.	max.
External operating voltage $+U_L$	V	18	24	32
External current consumption I_L	mA			100

Fig. 9.1: Extract from the specification sheet for the SERCOS interface DSS

35

Invalid reference cam position

The position of the reference cam relative to the null point of the motor encoder is outside the permissible range.

Remedy:
Parameter P-0-0020 gives the offset of the home switch flank to the optimum point. Shift the reference cam by this amount, then initiate a drive-generated homing procedure.

For the tolerance range of the permissible home switch flank positions in the encoder cycle, see Fig. 106.

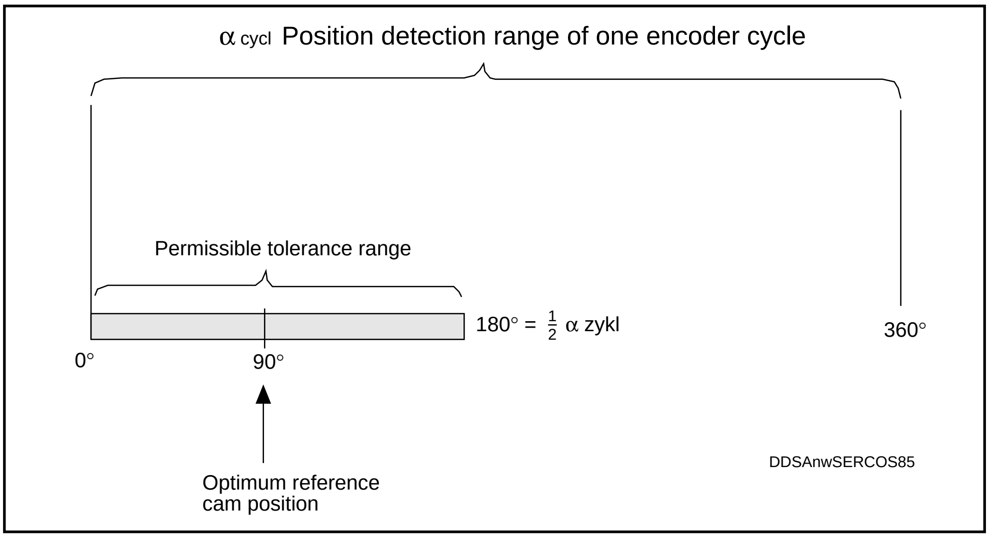
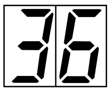


Fig. 9.2: Positioning the reference cam.

2. Software update ≥ DSM 2.1-S01.10
   - Enter the value shown in parameter P-0-0020 in parameter S-0-0299.



Excessive position feedback difference

The command for preparation of progression to communication phase 4 sets the position actual feedback value 2 is set to position actual feedback value 1 and starts up the cyclical evaluation of the two encoders. During cyclical operation (Phase 4), the difference in the position actual feedback value emitted by the two encoders is compared with the monitoring window every 8 msec. If the difference value is outside the monitoring window, Error 36 „ Excessive position feedback value difference“ is diagnosed and the parametrized error reaction (P-0-007) executed.

Causes

1. Wrong parameter for external encoder (S-0-0115, S-0-0117, S-0-0118).
2. Wrong parametrization of mechanics between motor shaft and external encoder (S-0-0121, S-0-0122, S-0-0123).
3. Mechanics between motor shaft and external encoder not stiff (e.g. gear backlash)
4. Encoder cable defective
5. DEF 1.1 defective
6. Maximum input frequency of the encoder interface exceeded
7. External encoder not mounted on driven axis

Remedy:

1. Check the position encoder type parameter (S-0-0115) and the encoder resolution (S-0-0117 or S-0-0118).
2. Check the load gear input and output revolutions (S-0-0121, S-0-0122) and the feed constant (S-0-0123).
3. Increase the monitoring window for external encoders (P-0-0120)
4. Replace the encoder cable
5. Replace the DEF 1.1
6. Reduce the velocity
7. Set the monitoring window for external encoders (P-0-0120) to 0. (Deactivate the monitoring function.

37

Excessive position command difference

When the drive is working in position loop mode, position command signals arriving through the SERCOS interface are monitored. If the velocity demanded of the drive by two successive position command signals is equal to or greater than the „Bipolar Velocity Limit Value“, the position command monitoring function will be activated. The excessive position command is stored in parameter P-0-0010. The last valid position command is stored in parameter P-0-0011 (see Section 7.9 Limit Values).

Remedy:
Compare the „Bipolar Velocity Limit Value“ (ID No. S-0-0091) with the velocity stored in the parts program and adapt if necessary.

42

External encoder failure: signals too small

For high-resolution evaluation, an external measuring system will use its analog signals. This error message appears when the signal amplitudes are below a permissible limit.

Remedy:
Check the cable to the measuring system.

43

Invalid feedback data -> Phase 2

Error 22 (motor encoder failure) has occurred during cyclic operation (Phase 4). This error message is generated by the drive controller once the first message has been cleared in Phase 4.

Cause:
1. Defective feedback or feedback cable

Remedy:
1. Check feedback and feedback cable and repair/replace if necessary.
2. Clear the error in Phase 2.

44

Working range limit switch detected

Cause:

1. The working range limit switch was detected and the power supply to the corresponding drive package shut down. The AC servo drive was halted at maximum acceleration.

Remedy:

- Reset the error via the NC control system
- Switch on the power supply again
- Move the axis back into the permissible working range

Commands that would move the axis still further out of range will not be accepted by the drive. If it receives another such command, it will emit the same error message

45

External encoder failure: quadrant error

A hardware fault has been detected on the „DLF 1.1“ high-resolution position interface for sine signals in the external measuring system.

Cause:

1. Defective encoder cable
2. Interference in the encoder cable
3. Defective DLF 1.1 module

Remedy:

1. Replace encoder cable
2. Lay encoder cable away from power-carrying cables
3. Replace DLF 1.1 module

47

Error in detecting the marker of the external encoder

Cause:

1. Defective DLF 1.1 module
2. Error in detecting the marker of the external encoder.

Remedy:

1. Replace DLF 1.1 module.
2. Consult INDRAMAT Service Department as the installed encoder is not compatible with the evaluation electronics.

48

Absolute encoder battery low

A function is provided to monitor the voltage of absolute encoders with a battery back-up in the feedback. A message is signalled when the voltage falls below 2.8 V. The absolute encoder function will only be ensured for another 4 weeks (approx.).

Danger risk due to uncontrolled axis motion. After the above time, the absolute reference dimension may be lost.

Cause: low battery voltage

Remedy: change the battery as soon as possible. Procedure:

Tools and equipment

- Torx screw driver, size 10
- Pointed pliers
- Torque wrench

Danger risk due to uncontrolled axis motion.
- **Switch off the power supply and secure against accidental reactivation.**
- **The control voltage must be switched on during battery replacement. If the control voltage is switched off when the battery is removed, the absolute reference dimension will be lost and will have to be reset.**

Removing the battery

- Unscrew the 4 Torx screws ① using the screwdriver
- Remove the cover of the resolver feedback RSF with its protective cap.
- Remove battery connector ② from the pcb
- Use the pointed pliers to remove the battery ③ from the housing.

Fitting the new battery

- Insert the preassembled battery (mat. no. 257101) by hand into the housing. **Caution!** Do not pinch the battery cable.
- Plug the battery connector ② into the pcb.
- Insert the resolver feedback RSF with its protective cover into the housing. **Caution!** Only one orientation possible.
- Rescrew the 4 Torx screws ① and tighten them with the torque wrench to 1.8 Nm.

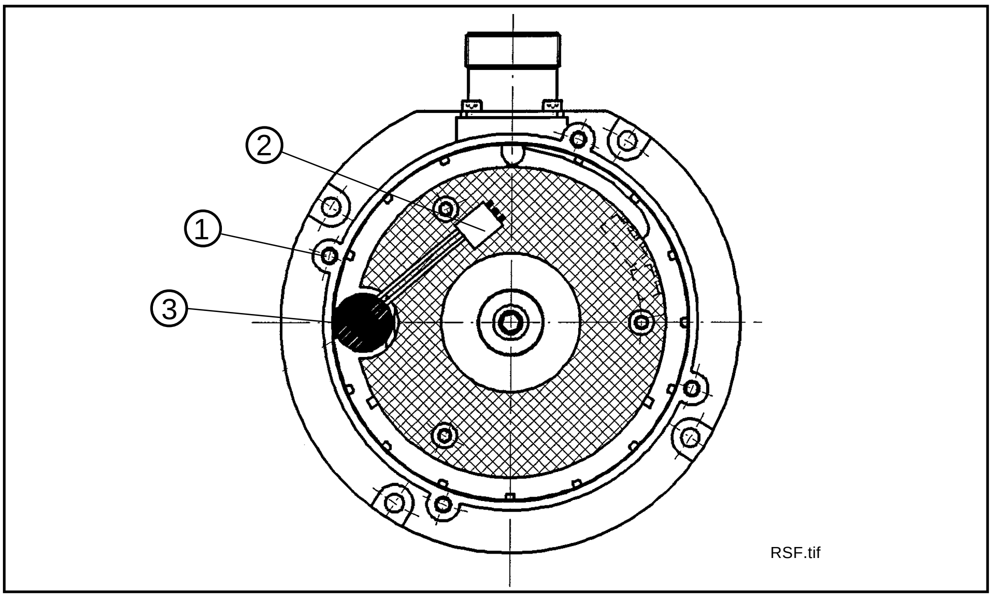


Fig. 9.3: Resolver feedback with back-up battery.

50

„Drive overtemperature warning“

The temperature of the heatsink in the drive controller has reached the maximum permissible level. The drive will follow the command value for 30 seconds. This permits the axis to be brought to a halt by the NC control unit without endangering the process (e.g. completing a machining operation, retreating from an area where collisions might occur, etc.)

After 30 seconds, the drive will react according to the parameter „error reaction“ (P-0-0007), see Section 7.1.

Cause:
1. Failure of the unit’s internal cooling system
2. Failure of the cabinet air conditioning system
3. Insufficiently dimensioned cabinet air conditioning.

Remedy:
1. If the cooling system is defective, change the controller.
2. Restore the cabinet air conditioning function.
3. Check the cabinet dimensioning.

51

„Motor overtemperature warning“

The motor has risen above the permissible temperature. The drive will follow the given command value for 30 seconds. This permits the axis to be brought to a halt by the NC control unit without endangering the process (e.g. completing a machining operation, retreating from an area where collisions might occur, etc.)

After 30 seconds, the drive will react according to the parameter „error reaction“ (see Section 7.1).

Cause:
The motor was overloaded. The effective torque demanded from the motor was above the permissible nominal torque for too long.

Remedy:
Check the motor dimensioning. For plants which have been in operation for some time, check whether the drive conditions have changed (e.g. contamination, friction, moved masses, etc.)

60

„Overcurrent: short in the power stage“ (bridge fuse)

The current in the power transistor bridge has risen to more than twice the unit’s rated current. The drive torque function is immediately disabled.

Cause:
1. Short-circuit in the motor cable
2. Power section of the drive controller defective.

Remedy:
1. Check the motor cable for short-circuits
2. If necessary, replace the drive controller.

61

„Overcurrent: 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.

Cause:
1. Defective motor cable
2. Earth short in the motor.

Remedy:
1./2. Check motor cable and motor for shorting to earth and replace if necessary.

67

„Erroneous internal hardware synchronization“

Cause:
1. 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.
2. Error in MST from master (NC control unit).

Remedy:
1. Replace the unit and send in for checking
2. Check transmission starting time (consult NC control unit manufacturer).

68

„Brake error“

For MDD motors with integral 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.

Cause:
1. The supply voltage for the holding brake has not been properly connected or lies outside the tolerance window (24 V +/- 10%).
2. The motor cable is incomplete or wrongly connected (reverse polarity).
3. Defective holding brake
4. Defective drive controller.

Remedy:
1. Check the supply voltage.
2. Check the motor cable.
3. Replace the motor.
4. Replace the controller.

69

„± 15 V error“

The controller has detected a fault in the ± 15 V supply.

Cause:
1. Defective control voltage bus cable
2. Defective supply module

Remedy:
1. Check and, if necessary, replace the control voltage bus cable or plug connector.
2. Check the power supply module (see Application Manual for supply module).

70

„+ 24 V error“

The controller has detected a fault in the +24 V supply.

Cause:
1. Defective control voltage bus cable
2. Overload in the 24 V voltage supply
3. Defective supply module.

Remedy:
1. Check and, if necessary, replace the control voltage bus cable or plug connector.
2. Check the 24 V voltage supply in the power supply module
3. Check the power supply module (see Application Manual for supply module).
4. Check the E-stop circuit for shorting.

71

„± 10 V error“

The supply voltage to the current sensors is faulty.

Cause:
Defect in the drive controller

Remedy:
Replace the drive controller.

72

„+ 8 V error“

The supply voltage to the encoder systems is faulty.

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

Remedy:
Check cables and replace if necessary.

73

„Power supply to driver stage“

The voltage supply to the driver stages is faulty.

Cause:
Defect in the drive controller

Remedy:
Replace drive controller.

76

„Absolute encoder error“

When a DDS with absolute encoder motor (multiturn) is switched off the instantaneous actual position is stored. When the unit is powered up again, this position is compared with the position detected by the absolute encoder evaluation. If the deviation is outside the parametrized absolute encoder monitoring window P-0-0097, the error message „76“ „Absolute encoder error“ is generated and signalled to the NC control unit.

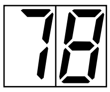
Cause:
1. First start-up (stored position invalid)
2. The axis was moved while switched off and is outside the absolute encoder monitoring window P-0-0097.
3. Erroneous position initialization.

Remedy:
1. Clear error (reset reference dimension)
2.

> **The axis was moved while switched off and is outside the permissible limits.**
>
> **Check whether a new move command will cause any damage. Then clear the error.**

3.

> **Danger risk due to uncontrolled axis movements.**
>
> **Check the reference dimension. If this is wrong, the feedback is defective and the motor has to be replaced.**

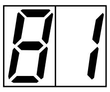


Velocity loop error

If, when the velocity loo is active, the difference between the velocity command and the velocity feedback values exceeds 10% of the maximum motor speed, the velocity feedback value should approach the command value. If this does not happen within 20 msec, the drive is shut down and an error message sent to the supply module.

Cause:
1. Motor cable wrongly connected
2. Power section of the drive controller defective
3. Feedback defective
4. Velocity loop wrongly parametrized

Remedy:
1. Check the motor cable connections
2. Replace the drive controller
3. Replace the motor
4. Check the velocity loop according to the application instructions (see Section 7.23)

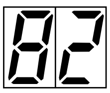


„Program RAM error“

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

Cause:
Hardware error in the controller.

Remedy:
Replace the controller.

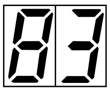


„Data RAM error“

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

Cause:
Hardware error in the controller.

Remedy:
Replace the controller.

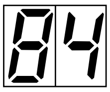


„Error reading drive data“

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

Cause:
Hardware error in the controller.

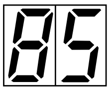
Remedy:
Replace the controller.



„Drive data invalid“

Cause:
Hardware error

Remedy:
Replace the controller.

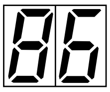


„Error writing drive data“

An error was detected while writing data to the drive’s internal EEPROM.

Cause:
Defective hardware

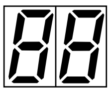
Note:
This error message can only occur during factory test runs.



„Error while writing to parameter memory“

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

Remedy:
1. Save the parameter set in the programming module.
2. Replace the software module.
3. Transfer the parameter set to the new module.

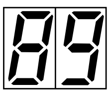


„Error reading motor data“

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

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

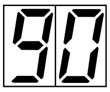
Remedy:
1. Check motor feedback cable.
2. Replace motor.



„Motor data invalid“

Cause:
Defective motor feedback

Remedy:
Replace motor (see related documentation, page 3).

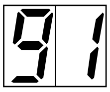


„Error while writing motor data“

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

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

Remedy:
1. Check cable and replace if necessary.
2. Replace motor.



„Configuration error“

Cause:
1. Software and hardware configurations do not match.
2. Plug-in module defective, not installed or not properly inserted.

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

9.4. Command errors

Error messages generated while commands are being executed are displayed as a collective diagnostic message on the status indicator H1 (32, flashing). The respective error message can be called up via the SERCOS parameter „Diagnostic message“ S-0-0095.

The various error messages are listed below:

200 Parameter Lost

A checksum is stored in the software module for each parameter. When the drive is initialized, the check sum is calculated again for each parameter and compared with the stored checksum. In the event of a discrepancy, the above message will be signalled.

Cause:
Hardware error in the software module or the drive controller.

Remedy:
Save drive parameters, replace the software module and transfer the parameters to the new software module.

201 Parameter set incomplete

The parameters stored in the software module are partly invalid.

Cause:
The installed software module has not been completely parametrized.

Remedy:
Enter the full parameter set. The ID Nos. of the invalid operation data for communication phase 2 and 3 are listed in List ID No. S-0-0021 and S-0-0022.

202 Ram error

The drive controller’s read/write memory is not ready.

Cause:
Hardware error in the drive controller

Remedy:
Replace the controller.

209 T1 too small: T1<T1min

The value entered for the parameter „AT transmission starting time“ (ID No. S-0006) was less than T1min. (ID No. S-0-0003)

Remedy:
Enter a value that matches the installed NC control unit. (For the significance of T1, refer also to the SERCOS interface manual.)

210 T2 too large: T2 + TMTSG > TSCYC

The value entered in the parameter „Master data telegram transmit starting time“ (ID No. S-0-0089) is too large.

Remedy:
Enter a value that matches the installed NC control unit. (For the significance of T2, refer also to the SERCOS interface manual).

211 MDT too long

The value entered in the parameter „Length of master data telegram“ (ID No. S-0-0010) is too long.

Remedy:
Enter a value that matches the installed NC control unit (refer also to the SERCOS interface manual).

212 T1 too large: T1 + TATMT + AT > T2

The value entered in the parameter „AT transmission starting time“ (ID No. S-0-0006) is too large.

Remedy:
Enter a value that matches the installed NC control unit (refer also to the SERCOS interface manual).

213 T4 too large: T4 + T4min > TSCYC

The value entered in the parameter „Feedback acquisition starting time“ (ID No. S-0-0007) is too large.

Remedy:
Enter a value that matches the installed NC control unit (refer also to the SERCOS interface manual).

214 T3 too large: T3 > TSCYC

The value entered in the parameter „Command valid time“ (ID No. S-0-0008) is too large.

Remedy:
Enter a value that matches the installed NC control unit (refer also to the SERCOS interface manual).

215 Starting address in MDT too large

The value entered in the parameter „Starting address in master data telegram“ (ID No. S-0-0009) is too large.

Remedy:
Enter a value that matches the installed NC control unit (refer also to the SERCOS interface manual).

216 SERCOS cycle time incorrect

The value entered in the parameter „SERCOS cycle time“ (ID No. S-0-0002) is invalid.

Remedy:
Only whole multiples of 1 ms are valid for the SERCOS cycle time. Enter a value that matches the installed NC control unit.

219 Starting address in MDT incorrect

The contents of the parameter „Starting address in master data telegram“ (ID No. S-0-0009) are incorrect.

Remedy:
Consult the NC control unit manufacturer.

243 - 244 Position initialization error

The position of the motor encoder is calculated when the drive is initialized. If an error occurs during this calculation, this message will be generated.

Remedy:
Check that the motor feedback cable is correctly connected. If there is no error in the feedback cable, replace the motor.

250 No absolute encoder available

On attempting to trigger the command „Set absolute dimension“, the drive has detected that the installed motor has no absolute encoder.

Remedy:
If necessary, install a motor with an absolute value encoder, otherwise suppress the trigger for the command „Set absolute dimension“.

260 Command error „Travel to dead stop“

An error occurred while the command „Travel to dead stop“ was being executed. This caused the drive to shut down.

Remedy:
Look up the error messages to locate the exact error.

270 RF missing during drive-generated move command

The NC control unit has triggered a drive-generated move command (e.g. drive-controlled homing cycle), without the drive having been activated prior to this.

Cause:
Software error in the NC control unit, since it must first activate the drive before triggering a drive-controlled move command.

Remedy:
Consult the NC control unit manufacturer.

271 No reference available

The command „Drive-controlled homing cycle“ has been sent to a motor with absolute encoder without any marker having been set.

Remedy:
See Section 7.12 „Setting absolute dimensions in drives with integral absolute encoders“

Status displays under the SERCOS interface parameter „Diagnostic messages“ ID No. S-0-0095

300 Drive in torque mode

301 Drive in velocity mode

302 Position mode/Encoder 1

303 Position mode/Encoder 1/lagless

304 Position mode/Encoder 2

305 Position mode/Encoder 2/lagless

320 Communications Phase 3 transition check

321 Communications Phase 4 transition check

322 Set absolute measuring command (P-0-0012)

323 Dead stop drive command

330 Drive-generated homing command

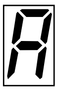
9.5. Status and fault diagnosis for communication link via SERCOS interface

The communication link is set up in four phases. The communication partners are identified during Phases 0 and 1. Phase 2 is used to set up the time and data for the protocols required for Phases 3 and 4.

Initialization is conducted in ascending order. The communication phases are successively triggered by the NC control unit, ending with Phase 4. This completes initialization and enables the drive to be powered up.

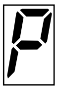
During phase progression the operational status is displayed on the SERCOS interface module's indicator „H2" (see Fig. 2.15). If phase progression is interrupted, the indicator will stall at the last successfully completed communication phase.

Diagnostic messages displayed by the SERCOS status indicator „H2" after control voltage has been applied.



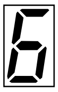
Meaning:
The address 0 has been set on the SERCOS interface module. This is invalid according to the SERCOS specification.

Remedy:
Set a valid drive address (see NC control unit manual)



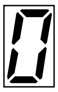
Invalid communication parameter

Remedy:
• Consult the NC control system manufacturer
  – Reset the parameter (see SERCOS Interface Manual or NC control system manual)



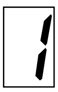
Meaning:
The „Master Sync. Telegram" signalling Communication Phase 0 has not yet been received.

Remedy:
Check that optical-fibre cables and all terminals are properly connected.



Meaning:
The NC control unit has not yet triggered switching from Phase 0 to 1.

Remedy:
Refer to NC control unit manual.



Meaning:
The NC control unit has not yet triggered switching from Phase 1 to 2.

Remedy:
Refer to NC control unit manual.

Diagnostic messages on the SERCOS status indicator before main power is switched on

2

Before the NC control unit switches to Communications Phase 3, the drive controller checks the input parameters for completeness and compliance with input limits. If any invalid parameters are detected, the controller will prevent any further phase progression.

The parameters are not checked for correctness.

Remedy:
The „ID No. List of invalid operation data for Comm. Phase 2“ ID No. S-0-0021 contains parameters which the drive recognizes as invalid prior to progression to Communications Phase 3. These parameters must be run through before any further phase progression is possible.

3

Before the NC control unit (master) switches to Communications Phase 4, the drive controller checks the input parameters for completeness and compliance with input limits. If any invalid parameters are detected, the controller will prevent any further phase progression.

The parameters are not checked for correctness.

Remedy:
The „ID No. List of invalid operation data for Comm. Phase 3“ ID No. S-0-0022 contains parameters which the drive recognizes as invalid prior to progression to Communications Phase 4. These parameters must be run through before any further phase progression is possible.

4

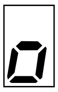
The SERCOS ring is in cyclical operation. The communication link within the SERCOS ring has been successfully established.

5

Static display: no communication with drive processor
Flashing display: communication with the drive processor not possible.

Hardware fault

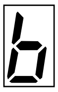
Remedy:
1. Replace the SERCOS interface module.
2. Replace the drive controller.



Double Master Synchronization Telegram (MST) error. This is monitored from Communication Phase 3 onwards.

Cause:
1. Defective optical-fibre cable.
2. Defective SERCOS interface in the NC control unit or in one of the drives.

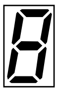
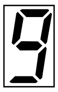
Remedy:
1. Check that the optical-fibre cable is correctly connected.
2. Replace the SERCOS interface.



Double Master Data Telegram (MDT) error. This is monitored from Communication Phase 3 onwards.

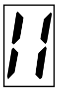
Cause:
1. The telegram sent was of the wrong length.
2. Checksum error.

Remedy:
1. Check that the optical-fibre cable is correctly connected.
2. Replace the SERCOS interface.

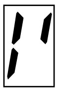
 or 

The SERCOS interface is in test mode.

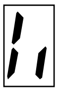
Remedy:
Consult INDRAMAT Service Department



Invalid communications phase

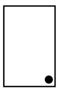


Error during phase progression



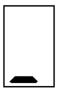
Error during phase regression

Remedy:
Check the SERCOS master module on the NC control unit.



Decimal point on: high transmission rate
off: low transmission rate

The transmission rate is set to the maximum value on shipment. This can be changed, if required, using switch S1.1 on the pcb of the SERCOS module DSS.



EPROM checksum error

Remedy:
Replace the command communication module DSS.

9.6. Selecting signals for diagnostics outputs

The DDS 2.1 is equipped with two analog diagnostics outputs. These may be used to emit internal drive variables for test purposes (see Section 4.1).

The parameter „Analog output to Channel 1“ ID No. P-0-0038 offers the possibility of selecting one of a number of signals for analog output via the diagnostics output AK1 on connector X3.1 and X3.2 (for the significance of these signals see Figure 9.4). Similarly, parameter „ Analog output to Channel 2“ ID No. P-0-0039 permits output of these signals through diagnostics output AK2 on connectors X3.3 and X3.4.

The following signals can be selected for output by entering their code numbers:

Code No.	Output via the diagnostics outputs
0	No analog output on Channel 1
1	Current command value (10 V = controller’s rated current)
2	Velocity actual value Parameter P-0-0040 is used to determine the scaling of velocity data signalled through analog output channel 1. The unit is [rpm/10V]. This also applies to parameter P-0-0041 and analog output channel 2.
3	Velocity command value Scaling as per code no. 2
4	Position command value difference between two control cycles Scaling as per code no. 2
5	Position feedback value 1 Parameter P-0-0042 serves to determine the scaling of position data at the analog output channel 1. The unit is [°/ 10V] (voltage range + 10V to -10V). This also applies to parameter P-0-0043 and analog output channel 2.
6	Position feedback value 2 Scaling as per code no. 5
7	Lag error Scaling as per code no. 5
8	Sine signal from motor encoder
9	Cosine signal from motor encoder
10	Sine signal from external encoder
11	Cosine signal from external encoder

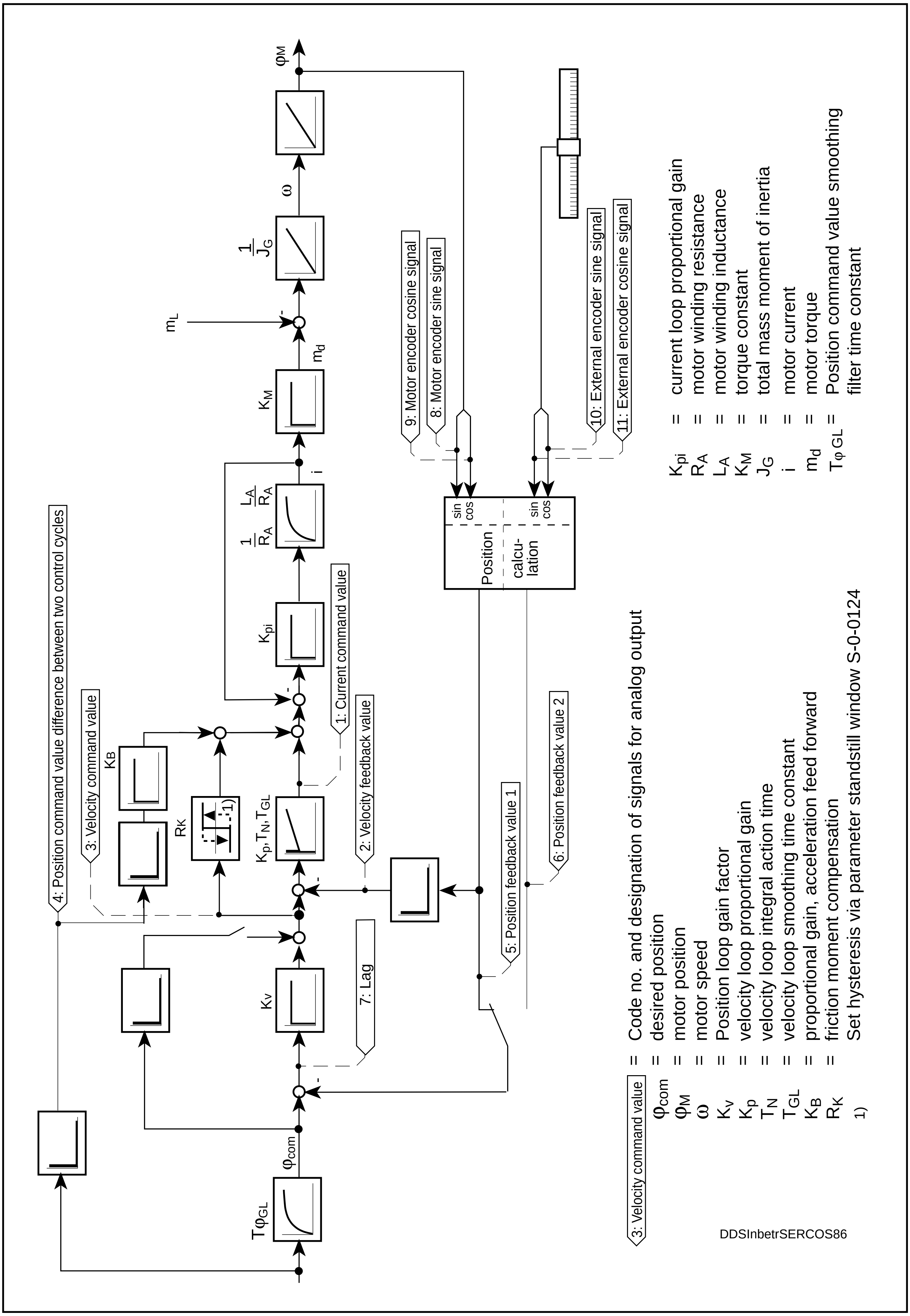


Fig. 9.4: Coding and designation of signals for analog output, indicated on the block diagram of the digital AC servo drive.

9.7. Notes on component replacement

Lengthy fault locating on several different units and repairing of units on the machine should be avoided due to the associated loss of production time.

The diagnostics display and the message signals on the DSS drive controller enable methodical and effective fault location.

Simple replacement of defective drive components guarantees the fastest possible clearance of the fault and resumption of operation without any lengthy assembly and readjustment work.

When replacing components, please bear the following in mind:

- The new unit, motor or cable (preassembled by INDRAMAT) must carry exactly the same type designation as the part it is to replace (see Fig. 9.5).
- The type designation has to be stated when ordering replacement parts from INDRAMAT:

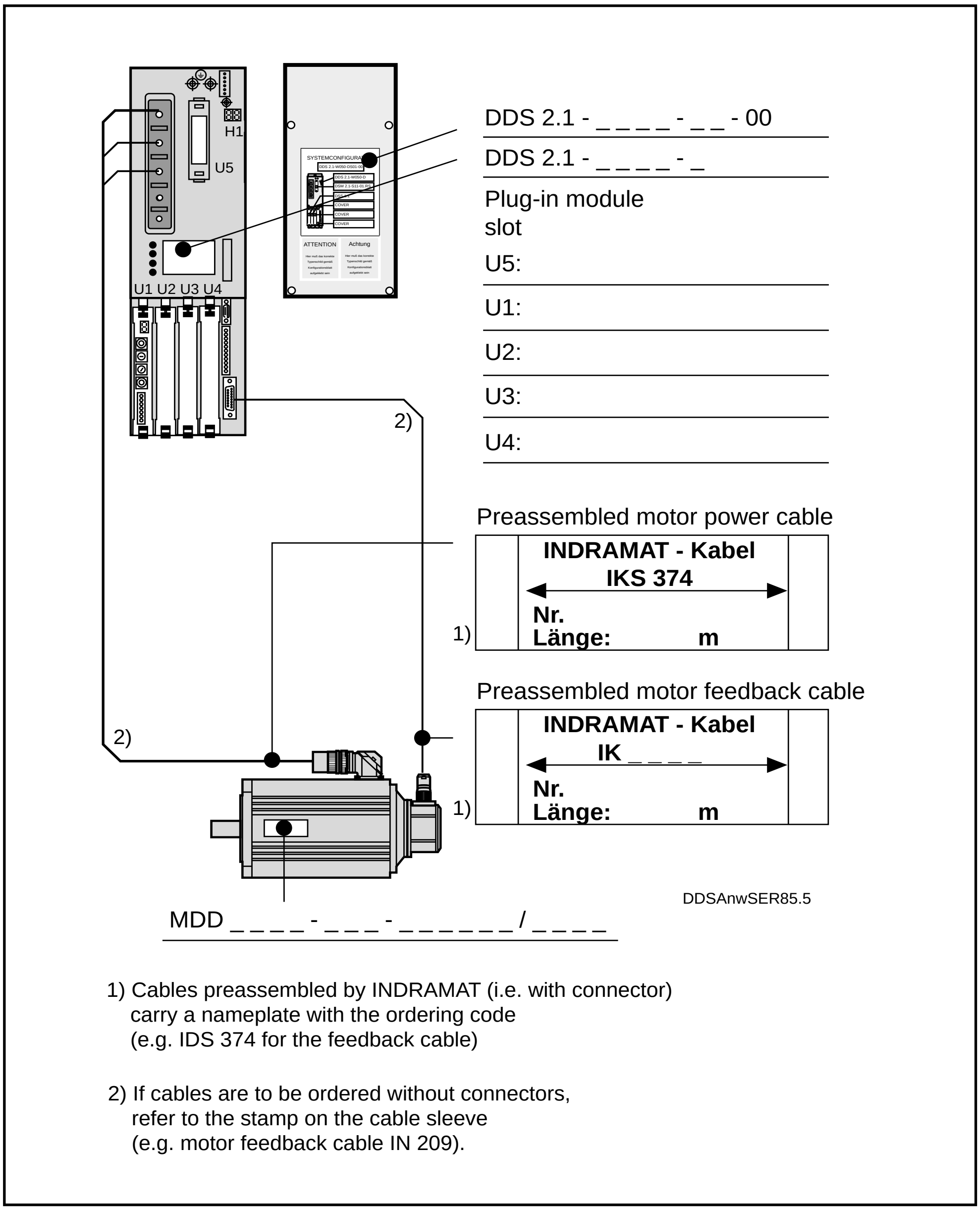


Fig. 9.5: Type designation of drive components.

- When returning a defective unit to INDRAMAT Service Department, please send in the completed „Fault Report" as shown in Section 11.4 along with the unit. This will ensure that repairs are carried out promptly and correctly or prompt further support from INDRAMAT.

Procedure for unit replacement

Danger risk due to lethal voltage levels!

1. Prior to any work on electrical equipment, open the master switch and secure it against reconnection. The drives must be at a standstill, otherwise voltage will appear on the motor cables when the motors rotate.

2. Wait for the link circuit (L+, L-) to discharge (>= 1 min) and check that the voltage level is under 50 V.

3. Switch off the power before you pull out any plug-connectors.

Drive controller

- Open the master switch
- Secure against reconnection
- Unscrew the protective cover (transparent plate) of the DDS 2 and the neighbouring units in the drive package.
- Check that the voltage in the DC link circuit is under 50V
- Remove the rails of the link circuit bus and disengage all other connections.
- Loosen the screws at the top and bottom of the housing and remove the drive controller from the drive package.
- Insert the new drive controller and retighten the screws.

Always disconnect the power supply before removing or plugging in the software module!

- Remove the software module DSM ... from the defective drive controller and plug it into the new one (this eliminates the need for any adjustment work).
- Connect up the new drive controller according to the machine circuit diagram!
- Replace and screw down the protective cover with configuration nameplate
- Restart the installation.

AC servo motor

- Open master switch
- Secure against reconnection
- Observe the machine manufacturer's instructions concerning the mechanical aspects of replacing the AC servo motor.

Danger risk due to uncontrolled axis motion

In servo axes with indirect position measuring systems via the motor encoder, the reference dimension will be lost when the motor is replaced.

- For servo axes with indirect position feedback value acquisition via the motor's own measuring system, reset the reference dimension. See Section 7.16 Drive-controlled homing cycle, or - for motors with absolute position measuring systems - see Section 7.12 Absolute encoder function.

Replacing cables

- Open the master switch
- secure against reconnection

Replacement

Danger risk due to lethal voltage levels.

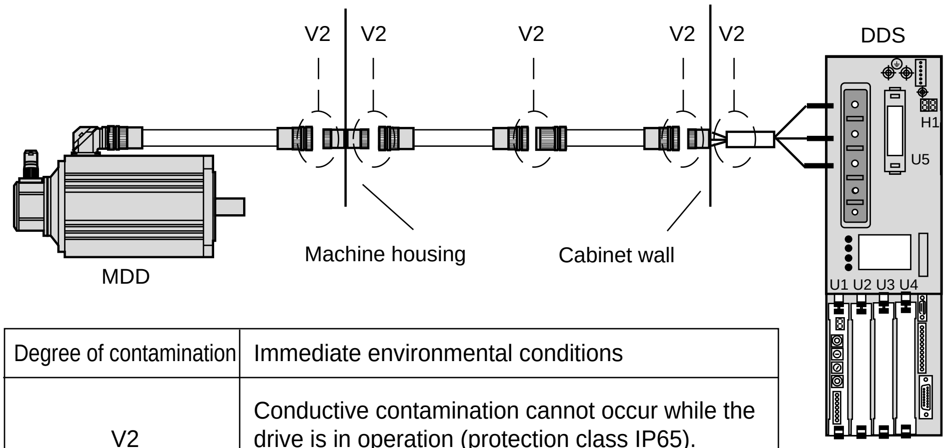
Always disconnect the power supply before disconnecting and connecting power cable plugs!

Splashing and contamination

When replacing cables or motors, protect any open power points with caps if there is any risk of their being splashed with coolant/ lubricant or otherwise contaminated (permissible contamination level V2).

Ensure that all power connecting points are dry and clean before connecting plugs!

Environmental conditions for open power connection points



Degree of contamination	Immediate environmental conditions
V2	Conductive contamination cannot occur while the drive is in operation (protection class IP65). However, when drive components are installed or replaced, non-conductive contamination may occur or condensation form on the parts.

IZschmutz

Fig. 9.6: Degree of contamination to DIN VDE 0160

Preassembled INDRAMAT cables

Easy cable replacement. The replacement cable will function immediately.

Customer-assembled cables

Check the cable according to the machine manufacturer’s circuit diagram!

10. Overview of parameters Parameter handling DDS 2.1

Sections 10.1 to 10.4 contain lists of the parameters implemented in the DDS 2.1, sorted according to function groups. The parameter status is indicated in Fig. 108 to assist with SERCOS programming in NC control units. For a precise description of the SERCOS parameters, please refer to the SERCOS manual.

Parameter status	Significance
a	Datum is fixed
b	Datum can be changed in Phase 2
c	Datum can be changed in Phase 3
d	Datum can be changed in Phase 4
e	Datum is fixed in the respective preferred scaling (position, velocity, torque or acceleration)
f	Datum required for Phase 3 (verified during Communication Phase 3 transition check)
g	Datum required for Phase 4 (verified during Communication Phase 4 transition check)
h	Datum required for Phase 4 in the case of position loop with encoder 1
i	Datum required for Phase 4 in the case of position loop with encoder 2
j	Datum required for Phase 4 in the case of velocity loop
k	Datum is read out from feedback
l	Datum is read out from drive controller
m	Datum read from feedback on triggering of initial default parameter command
n	Datum is backed up (stored in parameter EEPROM)
o	Datum is scaling-related
p	Datum (configuration lists for AT and MDT) write protected in preferred telegram
q	Parameters may be configured in cyclical data

Fig. 10.1: Parameter status

10.1. Communication parameters

These are parameters, e.g. transfer times, required for communication by means of the SERCOS interface between the installed NC control unit and the drive controller. The parameters must be set on the NC control unit side.

ID No.	Designation	Parameter status
S-0-0001	NC Cycle Time (NCcyc)	b, f, n
S-0-0002	SERCOS Cycle Time (TScyc)	b, f, n
S-0-0089	Master Data Telegram Transmit Starting Time (T2)	b, f, n
S-0-0006	AT Transmission Starting Time (T1)	b, f, n
S-0-0007	Feedback Acquisition Starting Time (T4)	b, f, n
S-0-0008	Command Valid Time (T3)	b, f, n
S-0-0009	Beginning Address in Master Data Telegram	b, f, n
S-0-0010	Length of Master Data Telegram	b, f, n
S-0-0015	Telegram Type Parameter	b, f, n
S-0-0016	Custom Amplifier Telegram Configuration List	b, f, n
S-0-0024	Configuration List of the Master Data Telegram	b, f, n, p
S-0-0003	Minimum AT Transmit Starting Time (T1min)	b, f, n, p
S-0-0004	Transmit/Receive Transition Time (TATMT)	a
S-0-0185	Length of the Configurable Data Record in the AT	a
S-0-0187	List of Configurable Data in the AT	a
S-0-0021	ID No. List of Invalid Operation Data for Comm. Phase 2	a
S-0-0022	ID No. List of Invalid Operation Data for Comm. Phase 3	a
S-0-0186	Length of the Configurable Data Record in the MDT	a
S-0-0188	List of Configurable Data in the MDT	a
S-0-0030	Manufacturer Version	a

Fig. 10.2: Communication Parameters

ID No.	Designation	Parameter status
S-0-0005	Minimum Feedback Acquisition Time (T4min)	a
S-0-0017	ID No. List of All Operation Data	a
S-0-0088	Receive to Receive Recovery Time (TMTSY)	a
S-0-0090	Command Value Transmit Time (TMTSG)	a
S-0-0096	Slave Arrangement (SLKN)	a
S-0-0143	SERCOS Interface Version	a
S-0-0095	Diagnostic Message	a
P-0-0107	Slave Version	a
Diagnostic Parameters		
S-0-0011	Class 1 Diagnostics	a
S-0-0012	Class 2 Diagnostics	a
S-0-0013	Class 3 Diagnostics	a
S-0-0014	Interface Status	a
S-0-0028	MST Error Count	b, c, d, n
S-0-0029	MDT Error Count	b, c, d, n
S-0-0134	Master Control Word	a
S-0-0135	Drive Status	a
S-0-0182	Manufacturer Class 3	a, q
P-0-0009	Error number	a
P-0-0005	Language selection	b, c, d, n
Commands		
S-0-0127	Communications Phase 3 Transition Check	b, f
S-0-0128	Communications Phase 4 Transition Check	c, g
S-0-0099	Reset Class 1 Diagnostics	b, c, d
S-0-0148	Drive-Controlled Homing Procedure Command	d
S-0-0149	Dead Stop Drive Command	d
P-0-0012	Set Absolute Dimension Command	d
P-0-0014	Get Marker Position Command	d
S-0-0262	Initial Default Parameter Command	b, c, d
S-0-0170	Probing Cycle Procedure Command	d

Fig. 10.3: Communication parameters

10.2. NC Control-related application parameters

These parameters are used for set-up and to match the installed NC control unit and the drive controller, e.g. determining the dimensional reference for the data to be transmitted via the SERCOS ring.

ID No.	Designation	Parameter status
P-0-0005	Language Selection	b, c, d, n
S-0-0032	Primary Mode of Operation	b, f, n
S-0-0033	Secondary Operation Mode 1	b, n
S-0-0034	Secondary Operation Mode 2	b, n
S-0-0035	Secondary Operation Mode 3	b, n
S-0-0076	Position Data Scaling Method	b, f, n
S-0-0077	Translational Position Data Scaling Factor	b, e, f, n
S-0-0078	Rotational Position Data Scaling Exponent	b, e, f, n
S-0-0044	Scaling of Velocity Data	b, f, n
S-0-0045	Scaling Factor for Velocity Data	b, e, f, n
S-0-0046	Scaling Exponent for Velocity Data	b, e, f, n
S-0-0160	Scaling Method for Acceleration Data	b, f, n
S-0-0161	Scaling Factor for Acceleration Data	b, e, f, n
S-0-0162	Scaling Exponent for Acceleration Data	b, e, f, n
S-0-0086	Scaling Method for Torque-Force Data	b, f, n
S-0-0093	Scaling factor for Torque-Force Data	b, e, f, n
S-0-0094	Scaling Exponent for Torque-Force Data	b, e, f, n
S-0-0079	Rotational Position Resolution	
S-0-0108	Feedrate Overdrive	b, c, d, f, n
S-0-0301	Allocation of Real-Time Control Bit 1	b, c, d, n
S-0-0303	Allocation of Real-Time Control Bit 2	b, c, d, n
S-0-0305	Allocation of Real-Time Control Bit 1	b, c, d, n
S-0-0307	Allocation of Real-Time Control Bit 2	b, c, d, n

Fig. 10.4: NC control-related application parameters

10.3. Machine-related application parameters

Parameters that require to be set (machine operating manual)
These parameters serve to match the drive to the machine mechanics by means of mechanical constants.

ID No.	Designation	Parameter status
S-0-0049	Positive Position Limit Value	b,c,d,n,o
S-0-0050	Negative Position Limit Value	b,c,d,n,o
S-0-0091	Bipolar Velocity Limit Value	b,c,d,h,i,n,o
S-0-0092	Bipolar Torque Limit Value	b,c,d,h,i,n,o
S-0-0055	Position Polarity Parameters	b,f,n
S-0-0043	Velocity Polarity Parameters	b,f,n
S-0-0085	Torque Polarity Parameters	b,f,n
S-0-0115	Position Feedback Type Parameter	b,i,n
S-0-0118	Resolution of the Linear Feedback (external feedback)	b,i,n
S-0-0041	Homing Velocity	b,c,d,f,n,o
S-0-0042	Homing Acceleration	b,c,d,f,n,o
S-0-0121	Input Revolutions of Load Gear	b,f,n
S-0-0122	Output Revolutions of Load Gear	b,f,n
S-0-0123	Feed Constant	b,f,n,o
S-0-0147	Homing Parameter	b,f,n
S-0-0150	Reference Offset 1	b,c,d,h,n,o
S-0-0151	Reference Offset 2	b,c,d,i,n,o
S-0-0052	Actual Position Feedback 1 - Reference Dimension	b,c,d,h,n,o
S-0-0117	Resolution of Rotational Feedback 2 (ext. feedback)	b,i,n
S-0-0103	Modulo Value	b,f,n,o
S-0-0178	Absolute Dimension Offset 2	b,c,d,i,n,o
S-0-0054	Actual Position Feedback 2 - Reference Dimension	b,c,d,i,n,o
P-0-0007	Error Reaction	b,n
P-0-0018	Starting Position Value	b,o
S-0-0189	Lag	a,o
S-0-0173	Marker Position A	a,o
S-0-0057	Position Window	b,c,d,h,i,n,o
S-0-0124	Zero Velocity Window	b,c,d,n,o
P-0-0097	Absolute Encoder Monitoring Window	b,c,d,h,i,n,o
P-0-0049	Target Position	d,o
S-0-0138	Bipolar Acceleration	b,c,d,n,o
P-0-0106	Bipolar stutter limit value	b,c,d,n,o
S-0-0159	Monitoring Window	b,c,d,h,i,n
P-0-0098	Maximum Model Deviation	b,c,d

Fig. 10.5: Machine-related application parameters

ID No.	Designation	Parameter status
S-0-0130	Probe 1 Positive Edge	a,o,q
S-0-0131	Probe 1 Negative Edge	a,o,q
S-0-0132	Probe 2 Positive Edge	a,o,q
S-0-0133	Probe 2 Negative Edge	a,o,q
S-0-0401	Probe 1	a
S-0-0402	Probe 2	a
S-0-0169	Probe Control Parameter	b,c,d,n
S-0-0405	Probe 1 Enable	b,c,d
S-0-0406	Probe 2 Enable	b,c,d
S-0-0409	Probe 1 Positive Latched	a
S-0-0410	Probe 1 Negative Latched	a
S-0-0411	Probe 2 Positive Latched	a
S-0-0412	Probe 2 Negative Latched	a
P-0-0081	Parallel Output	b,c,d,q
P-0-0082	Parallel Input	a,q
S-0-0192	ID No. List of Required Operation Data	a
P-0-0045	ID No. List of NC Parameters	a
P-0-0046	ID No. List of Machine Parameters	a
P-0-0047	ID No. List of Drive Parameters	a
P-0-0048	ID No. List of Controller Parameters	a
P-0-0008	Activation of E-STOP function	b, c, d, n
P-0-0114	Negation of working range limit switch inputs	b, c, d, n
P-0-0005	Position command value interpolation after MDT error	b, c, d, n

Fig. 10.6: Machine-related application parameters

10.4. Drive Parameters

Parameters to be entered:
These parameters serve to match the drive controller and the AC servomotor to the machine's dynamic response.

ID No.	Designation	Parameter status
S-0-0142	Type of Application	b,c,d
S-0-0104	Position Loop KV Factor (closed-loop control)	b,c,d,h,i,n
S-0-0100	Velocity Loop Proportional Gain	b,c,d,h,i,j,m,n
S-0-0101	Velocity Loop Integral Action Time	b,c,d,h,i,j,m,n
P-0-0004	Smoothing Time Constant	b,c,d,h,i,j,m,n
S-0-0106	Proportional Gain 1 Current Regulator	b,c,d,g,m,n
P-0-0006	Overload Factor	b,f,n
S-0-0199	Position Command Value Smoothing Filter Time Constant	b,c,d,h,i,n
S-0-0155	Friction Torque Compensation	b,c,d,h,i,j,n
P-0-0050	Proportional Gain Acceleration Feed Forward	b,c,d,h,i,n
S-0-0113	Maximum Motor Speed (nmax)	a,k
S-0-0109	Motor Peak Current	a,k
S-0-0111	Motor Current at Standstill	a,k
S-0-0141	Motor Type	a,k
P-0-0051	Torque constant	a, e
S-0-0110	Amplifier Peak Current	a,l
S-0-0112	Amplifier Nominal Current	a,l
S-0-0140	Controller Type	a,l
P-0-0015	Memory Address	b,c,d,n
P-0-0016	Contents of Memory Address	a
P-0-0021	List of Scope Data 1	a,o
P-0-0022	List of Scope Data 2	a,o
P-0-0023	Signal Select Channel 1	b,c,d,n

Fig. 10.7: Drive Parameters

ID No.	Designation	Parameter status
P-0-0024	Signal Select Channel 2	b, c, d, n
P-0-0025	Trigger Source	b, c, d, n
P-0-0026	Trigger Signal Selection	b, c, d, n
P-0-0027	Trigger Level for Position Data	b, c, d, n, o
P-0-0028	Trigger Level for Velocity Data	b, c, d, n, o
P-0-0029	Trigger Level for Torque Data	b, c, d, n, o
P-0-0030	Trigger Mode	b, c, d, n
P-0-0031	Time Division	b, c, d, n
P-0-0032	Size of Memory	b, c, d, n
P-0-0033	Number of Samples after Trigger	b, c, d, n
P-0-0035	Delay from Trigger to Start	d
P-0-0036	Trigger Control Word	d
P-0-0037	Trigger Status Word	d
P-0-0038	Signal Select Analog Output Channel 1	b, c, d, n
P-0-0039	Signal Select Analog Output Channel 2	b, c, d, n
P-0-0040	Scaling Factor for Velocity Data Analog Output Channel 1	b, c, d, n
P-0-0041	Scaling Factor for Velocity Data Analog Output Channel 2	b, c, d, n
P-0-0042	Scaling Factor for Position Data Analog Output Channel 1	b, c, d, n
P-0-0043	Scaling Factor for Position Data Analog Output Channel 2	b, c, d, n
S-0-0011	Class 1 Diagnostics	a
S-0-0012	Class 2 Diagnostics	a
S-0-0013	Class 3 Diagnostics	a
S-0-0099	Reset Class 1 Diagnostics	b, c, d
S-0-0036	Velocity Command Value	d, o, q
S-0-0040	Velocity Feedback Value	a, o, q
S-0-0047	Position Command Value	d, o, q
S-0-0051	Position Feedback Value 1 (motor feedback)	a, o, q
S-0-0053	Position Feedback Value 2 (ext. feedback)	q
S-0-0080	Torque Command Value	d, o, q
S-0-0084	Torque Feedback Value	a, o, q
S-0-0400	Home Switch	a
S-0-0403	Status Actual Position Value	a
P-0-0010	Excessive Position Command	a, o
P-0-0011	Last Valid Position Command Value	a, o
P-0-0020	Reference Cam Shifting	a, o

Fig. 10.8: Drive Parameters

10.5. Overview of DDS 2.1 product-specific parameters

P-0-0004	Smoothing Time Constant	see Section 7.23
P-0-0005	Language Selection	see Section 7.24
P-0-0006	Overload Factor	see Section 7.14
P-0-0007	Error Reaction	see Section 7.1

P-0-0-008 „Activating the E-STOP function

See Section 7.20

P-0-0009 „Error number“

If an error occurs during cyclical operation, this is diagnosed by the drive and signalled on the seven-segment display. At the same time, one bit in Diagnostics Class 1 and the change bit for this diagnostics class in the drive status word will be set. The „Error Number“ parameter permits NC control systems to output the error code as a decimal figure (1 to 99) on the display and, in conjunction with the application manual, to display customer-specific diagnostics and execute different types of error reaction. If no error is present, the status of this parameter is 0.

P-0-0011 Last Valid Position Command Value

see Section 7.7

P-0-0012 Set Absolute Dimension Command

see Section 7.12

P-0-0014 Get Marker Position Command

When this command is triggered and a zero pulse received from an external measuring system the actual position feedback value 2 is stored in the parameter S-0-0173 Marker Position.

P-0-0015 Memory Address

For in-plant purposes, this parameter allows a memory address to be accessed in the DDS 2.1, whose contents are then indicated via the parameter P-0-0016 Contents of the Memory Address.

P-0-0016 Contents of the Memory Address

This parameter displays the contents of the memory address stored in the parameter P-0-0015 Memory Address (for in-plant use only!).

P-0-0019 Position Starting Value

An NC control, which is linked up via the SERCOS interface, can on start-up write the last valid actual position value into this parameter. The drive will then accept this position starting value as the actual position feedback value, thus allowing the machine to be traversed to initial position at reduced accuracy, if this is so desired.

P-0-0020 Reference Cam Shifting

If the drive is equipped with an integral absolute encoder function, this parameter will have no effect as such a drive will always have precise absolute position data at its disposal.

In the case of a drive-controlled homing cycle, the homing switch is evaluated by the drive. There is an optimum position for the homing switch signal relative to the zero marker of the motor encoder. In order to simplify the procedure for the person commissioning the plant, this parameter shows the homing switch offset relative to the ideal point. The display is governed by the set Position Data Scaling Method (see S-0-0076) and may be in [mm] or [°] (see Section 9.3 error message 30 and Section 7.16).

Oscilloscope Function Parameters

P-0-0021 List of Scope Data 1

Parameter P-0-0021 is where the data acquired for oscilloscope channel 1 are stored. The data are governed by the set scaling factors.

P-0-0022 List of Scope Data 2

P-0-0021 contains the data acquired for oscilloscope channel 2. These data are in SERCOS format.

P-0-0023 Signal Select Channel 1

To select the signal to be logged on channel 1 a number has to be entered in this parameter. The code numbers and their related signals are given below:

Selection list:
0 -> no signal recording
1 -> actual position
2 -> actual velocity
3 -> velocity deviation
4 -> position deviation
5 -> torque command value

P-0-0024 Signal Select Channel 2

To select the signal to be logged on channel 2 a number has to be entered in this parameter. The code numbers and their related signals are given below:

Selection list:
0 -> no signal recording
1 -> actual position
2 -> actual velocity
3 -> velocity deviation
4 -> position deviation
5 -> torque command value

P-0-0025 Trigger Source

The „Trigger Source“ parameter determines whether an external or an internal signal triggers the start of logging. The selection options are given below:

Selection list:
0 -> Internal triggering of logging via the „Start logging“ bit in the trigger command word (see ID No. P-0-0035).
2 -> Internal triggering with the drive’s internal start logging signal

The trigger function can be activated by different signals

P-0-0026 Trigger Signal Selection

Selection List:
1 -> actual position
2 -> actual velocity
3 -> velocity deviation
4 -> position deviation
5 -> torque command value

P 0-0027 Trigger Level for Position Data

If a position signal has been selected as the trigger signal (actual position, position deviation), the trigger mechanism will be activated when the signal is at this level.

Trigger Level for Velocity Data

If a velocity signal has been selected as the trigger signal (actual velocity, velocity deviation), the trigger mechanism will be activated when the signal is at this level.

Trigger Level for Torque Data

If a torque signal has been selected as the trigger signal (torque command value) the trigger mechanism will be activated when the signal is at this level.

P-0-0030 Trigger Mode

This parameter determines the circumstances under which the signal will activate the trigger. The following options are provided:

1. Triggering when approaching the trigger level in positive direction
2. Triggering when approaching the trigger level in negative direction
3. Triggering when approaching the trigger level in either positive or negative direction.

P-0-0031 Time Division

The digital working principle of the oscilloscope function means that signals can only be detected at discrete points in time. The gap between these acquisition times can be varied by means of the „Time division“ parameter. This is restricted in that only whole multiples of the basic scanning time of 250 µs can be selected. This means that the minimum input value is 250µs and the maximum value is 8,192 sec.

P-0-0032 Size of Memory

The „Size of Memory“ parameter allows selection of identified signal values. The memory size can be set between 1 and 2048.

P-0-0035 Delay from Trigger to Start

This parameter serves to store the number of samples between the occurrence of the triggering event and the start of logging.

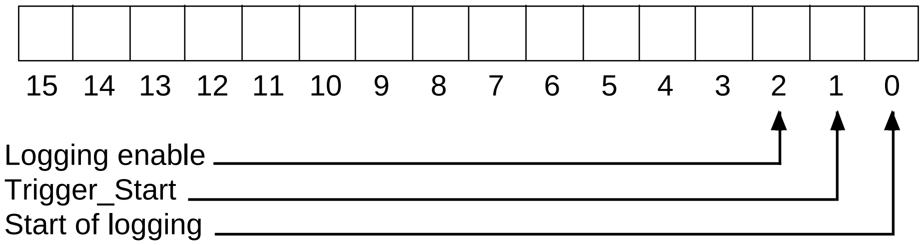
P-0-0036 Trigger Command Word

Logging Enable:
When this bit is activated, data logging will start without delay.

Trigger_Start:
The trigger mechanism is activated when the Trigger_Start Bit changes to „1“.

Logging enable:
In order to be able to acquire data before the occurrence of the triggering event even in those cases where a trigger delay has been set, the „logging enable“ bit must be active for a sufficient length of time at the beginning of a data acquisition sequence.

The Trigger Command Word has the following bit allocation:



P-0-0037 Trigger Status Word

In the event that several drives are required to acquire data synchronously (see trigger mode), the drive that is to activate joint data acquisition transmits the „Triggering Activated“ status signal to the NC control. The NC control must in turn initiate data acquisition by activating the „Start of Logging“ bit for all drives.

P-0-0038

Signal Select Analog Output Channel 1 — see Section 9.6

P-0-0039

Signal Select Analog Output Channel 2 — see Section 9.6

P-0-0040

Scaling Factor for Velocity Data Analog Output Channel 1 — see Section 9.6

P-0-0041

Scaling Factor for Velocity Data Analog Output Channel 2 — see Section 9.6

P-0-0042

Scaling Factor for Position Data Analog Output Channel 1 — see Section 9.6

P-0-0043

Scaling Factor for Position Data Analog Output Channel 2 — see Section 9.6

P-0-0045 ID No. List of NC Parameters

This list serves to classify parameter groups and can be used in an NC control for group representation of parameters.

P-0-0046 ID No. List of Machine Parameters

This list serves to classify parameter groups and can be used in an NC control for group representation of parameters.

P-0-0047 ID No. List of Drive Parameters

This list serves to classify parameter groups and can be used in an NC control for group representation of parameters.

P-0-0048 ID No. List of Controller Parameters

This list serves to classify parameter groups and can be used in an NC control for group representation of parameters.

P-0-0049 Target Position

If the manufacturer-specific mode of operation „position loop with command filter“ has been activated, this parameter must be completed with the target position that the drive is to traverse to automatically.

P-0-0050 Proportional Gain Acceleration Feed Forward

see Section 7.7

P-0-0051 Torque Constant

The torque constant of the installed motor is stored in the relevant feedback and indicated in this parameter.

P-0-0055 Axis error compensation

see Section 7.22

P-0-0056 Correction table starting position

see Section 7.22

P-0-0057 Correction tables, distance between compensation points

see Section 7.22

P-0-0058 Correction value table

see Section 7.22

P-0-0081 Parallel Output

If the DDS is equipped with a parallel I/O board DEA 4.1, this parameter indicates the status of the output channels, which may also be modified.

P-0-0082 Parallel Input

If the DDS is equipped with a parallel I/O board DEA 4.1, this parameter indicates the status of the input channels.

P-0-0097 Absolute encoder monitoring window

see Section 7.12

P-0-0098 Maximum model deviation

see Section 7.7

P-0-0099 Position Command Value Smoothing Filter Time Constant

In the position loop mode, it is possible to activate a position command value filter. This parameter is used to set the time constant of the filter. A time constant of 0 means that the filter is deactivated. In application cases where the dragging effect of a control loop with lag is to be used in order to limit stutter, the drive can still be operated without lag by means of this filter. It is possible to set an arbitrary lag error via the position command value filter to meet the machine requirements regarding the stutter factor without this having any effect on the position control loop.

P-0-0106 Bipolar Stutter Limit Value

If the manufacturer-specific mode of operation „Position Loop with Command Value Filter“ is active, this parameter is used to enter the maximum acceleration change that is permitted while the axis is in motion.

P-0-0095 „Position command value interpolation after MDT error“

This parameter activates the interpolation of a position command value when an MDT error has occurred.

Possible input values: 1 = interpolation active
0 = no interpolation

If the position command value interpolation has been activated, the position command values are delayed by one NC cycle. For this reason, all axes involved in interpolation in one controlled system must be given the same value for this parameter.

P-0-0107 „Slave Version“

This parameter indicates the software version of the Sercos Interface Module DDS

P-0-0110 „Parallel Output 2“

P-0-0111 „Parallel Input 2“

Input/output signals of the DEA 5 are contained in the new parameters P-0-0110 „Parallel Output 2“ and P-0-0111 „Parallel Input 2“. The DEA 6 signals are contained in Parameters P-0-0112 „Parallel Output 3“ and P-0-0113 „Parallel Input 3“.

All parameters for the parallel outputs can be configured in the MDT and the inputs in the AT. All parallel outputs are set to 0 during communication phase 0.

P-0-0114 „Negation of working range limit switch inputs“

see Section 7.13

P-0-0115 „Analog input 1“

see Section7.27

P-0-0116 „Analog input 2“

11. Appendix

11.1. DDS 2.1/3.1 drive controller connection diagram for motors with resolver feedback

The machine manufacturer's connection diagram is the main specification for inclusion of the drive controller in the wiring circuits of the control cabinet.

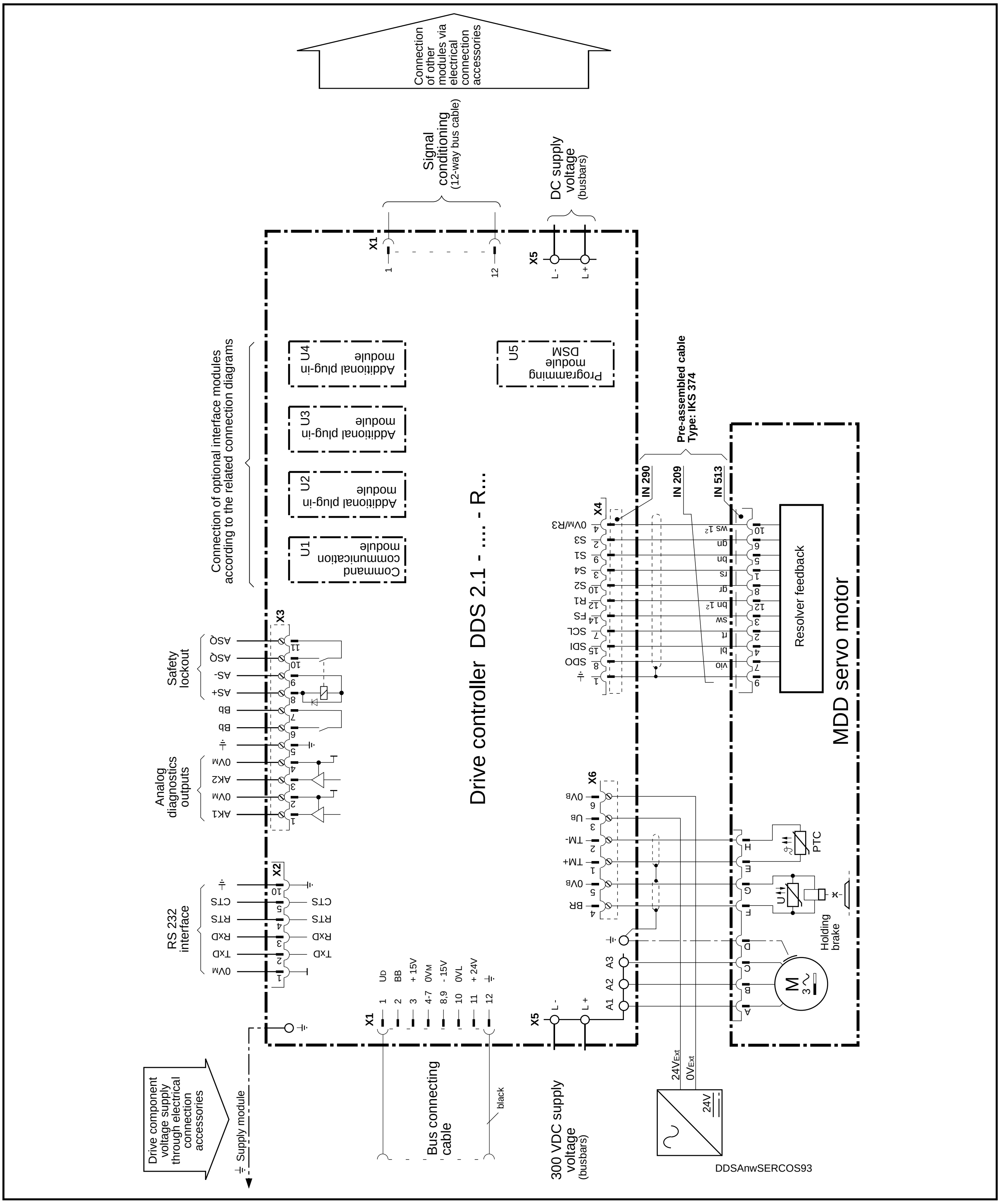


Fig. 11.1: Connection diagram for DDS 2.1-...-R– drive controller for motors with resolver feedback.

11.2. DDS 2.1/3.1 drive controller connection diagram for motors with digital servo feedback

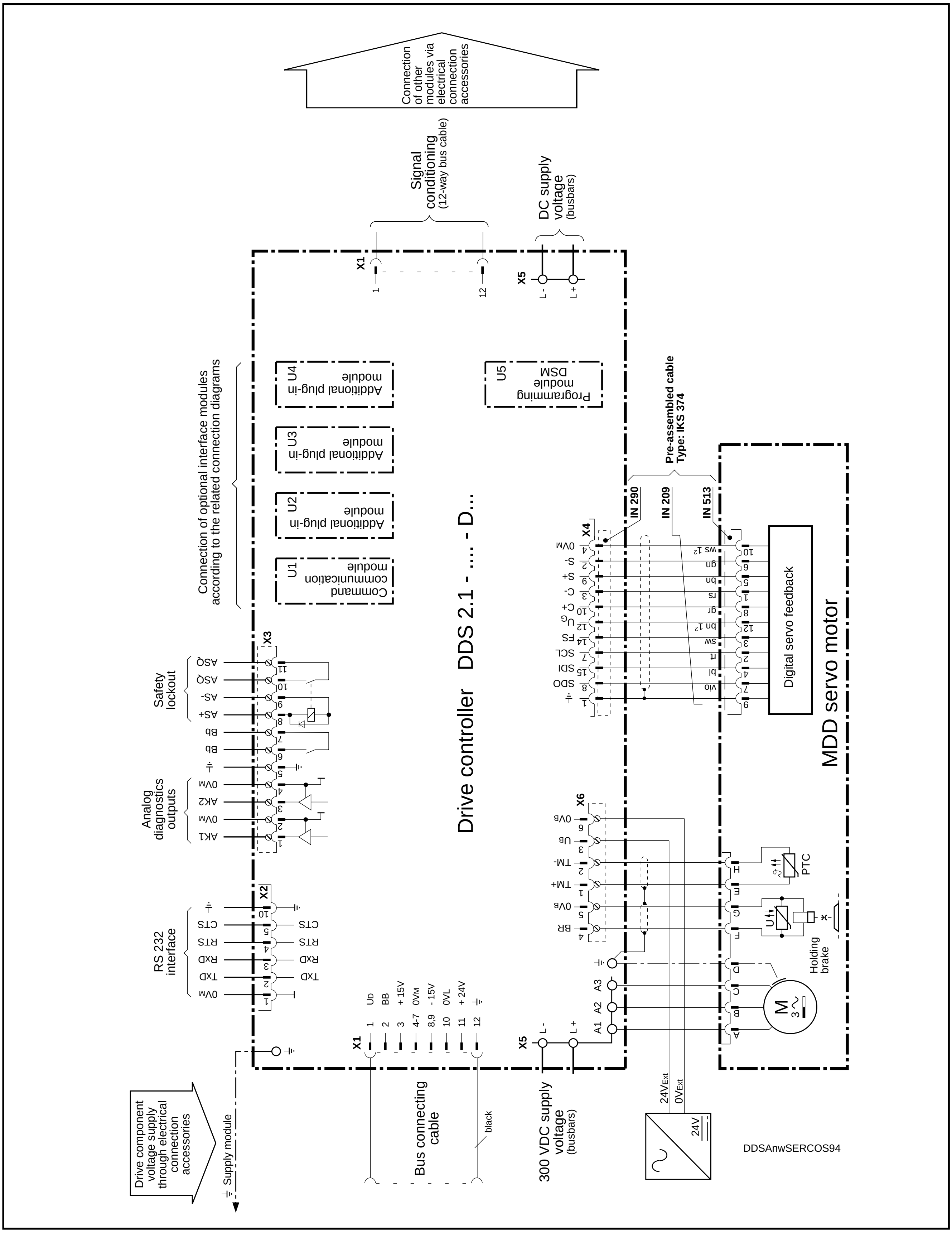


Fig. 11.2: Connection diagram for DDS 2.1-...-D– drive controller for motors with digital feedback.

11.3. Pin allocations/abbreviations on the DDS 2.1/3.1 drive controller

Connector X1

Pin	Signal	Meaning
X1/1	UD	Error message from supply module
X1/2	BB	Ready message from drive controller to supply module
X1/3	+15V	15 V supply voltage
X1/4 to X1/7	0VM	0 Volt test voltage
X1/8 to X1/9	-15V	-15V supply voltage
X1/10	0VL	0V load voltage
X1/11	+24V	+24V supply voltage
X1/12	⏚	Earth

Fig. 11.3: Control voltage bus on the DDS 2.1

Connector X2

Pin	Signal	Meaning
X2/1	0VM	0V test voltage
X2/2	TXD	Transmit data
X2/3	RXD	Receive data
X2/4	RTS	Request to send
X2/5	CTS	Clear to send
X2/10	⏚	Earth

Fig. 11.4: RS 232 interface on the DDS 2.1

Connector X3

Pin	Signal	Meaning
X3/1	AK1	Analog output channel 1
X3/2	0VM	0V test voltage
X3/3	AK2	Analog output channel 2
X3/4	0VM	0 V test voltage
X3/5	⏚	Earth
X3/6, X3/7	Bb	Potential-free signal contact "Ready"
X3/8	AS+	Safety lockout
X3/9	AS-	Safety lockout
X3/10	ASQ	Accept safety lockout
X3/11	ASQ	Accept safety lockout

Fig. 11.5: Analog inputs and outputs on the DDS 2.1

Plug-in terminal strip X4
Digital feedback

Pin	Signal	Meaning
X4/1	⏚	Earth
X4/2	S-	Signal conductor
X4/3	C-	Signal conductor
X4/4	0VM	0V test voltage
X4/7	SCL	Signal conductor
X4/8	SDO	Signal conductor
X4/9	S+	Signal conductor
X4/10	C+	Signal conductor
X4/12	UG	Signal conductor
X4/14	FS	Signal conductor
X4/15	SDI	Signal conductor

Fig. 11.6: Connections of the digital servo feedback on the DDS 2.1

Connector X4
Resolver feedback

Pin	Signal	Meaning
X4/1	⏚	Earth
X4/2	S3	Signal conductor
X4/3	S4	Signal conductor
X4/4	0VM/R3	0V test voltage
X4/5	not used	
X4/6	not used	
X4/7	SCL	Data conductor
X4/8	SDO	Data conductor
X4/9	S1	Signal conductor
X4/10	S2	Signal conductor
X4/11	not used	
X4/12	R1	Signal conductor
X4/13	not used	
X4/14	FS	Data conductor
X4/15	SDI	Data conductor

Fig. 11.7: Connections of the resolver feedback on the DDS 2.1

Connector X5

Pin	Signal	Meaning
X5/1	A1	Phase 1 motor connection
X5/2	A2	Phase 2 motor connection
X5/3	A3	Phase 3 motor connection
X5/4	L-	Negative DC link circuit voltage
X5/5	L+	Positive DC link circuit voltage

Fig. 11.8: Mains power connections on the DDS 2.1

Connector X6

Pin	Signal	Meaning
X6/1	TM+	Positive temperature sensing conductor
X6/2	TM-	Negative temperature sensing conductor
X6/3	UB	External +24V operating voltage
X6/4	BR	+24V connection for brake
X6/5	0VB	0V connection for brake
X6/6	0VB	External 0V operating voltage

Fig. 11.9: Connections for motor temperature monitoring, holding brake on the DDS 2.1

Connector X15, X16

Pin	Signal	Meaning
X15/1	E1 NEGIN	Analog input 1 (-10V)
X15/2	E2 POSIN	Analog input 2 (+10V)
X15/3	TVW	Overtemperature warning
X15/4	RF	Controller enable
X15/5	AH	Drive halt
X15/6	Ired1	Current reduction 1 (Torque reduction 1)
X15/7	Ired2	(Torque reduction 2)
X15/8	+UI, ext	External +24V operating voltage
X15/9	0VI, ext	
X15/10	shield	Shield
X16/1	not used	
X16/2	not used	
X16/3	not used	
X16/4	not used	
X16/5	DATA(+)	
X16/6	DATA(-)	
X16/7	not used	
X16/8	not used	
X16/9	not used	
X16/10	0Vext	Supply voltage
X16/11	+Uext	Supply voltage +24V
X16/12	not used	
X16/13	clock pulse (+)	Clock line
X16/14	clock pulse (-)	Clock line
X16/15	shield	Shield

Fig. 11.10: Command communication module DAA 1.1

Connector X10

Pin	Signal	Meaning
X10	TX	Data output

Fig. 11.11: SERCOS interface, optical fibre cable

Connector X11

Pin	Signal	Meaning
X11	RX	Data input

Fig. 11.12: SERCOS interface, optical fibre cable

Connector X12

Pin	Signal	Meaning
X12/1	E1	Home switch
X12/2	E2	Pos. travel limit switch
X12/3	E3	Neg. travel limit switch
X12/4	E4	Probe 1
X12/5	E5	Probe 2
X12/6		Not used
X12/7	+UL	External operating voltage
X12/8	0VL	External 0V
X12/9	⏚	Shield
X12/14	FS	Signal line
X12/15	SDI	Signal line

Fig. 11.13: SERCOS interface

11.4. Fault Report

	Fault Report for Digital AC Servo Drives DDS and MDD	Mat. No. 256 520

This fault report serves to identify faults and their causes. It is essential, particularly for detection and elimination of hidden, sporadic or application-related problems.

- When sending in units for repair, please always send in a completed fault report with them.
- Otherwise, send the report to the appropriate INDRAMAT office or to the INDRAMAT Quality Assurance Department at the address printed on the reverse.

In return for your trouble, INDRAMAT will process your report with all due speed and care.

Fault Report completed by:	Company:	Place:	Date:
	Department:	Name:	Tel.:

Details of faulty drive:

Software module data:

DSM _._ - _ _ _

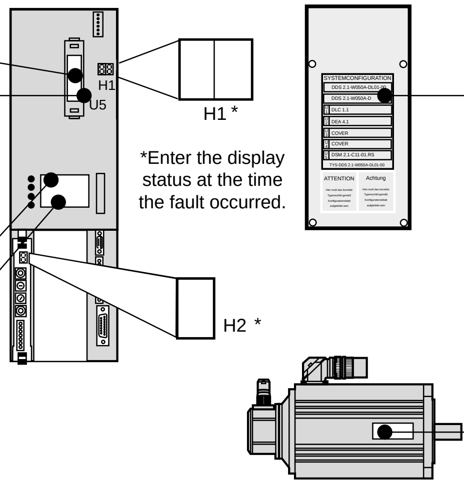
S.No.: _ _ _ _ _ _ -

_ _ _ _ _ A _ _ S _ _

Basic unit nameplate data:

DDS _._ - _ _ _ _ - _

Serial No.



Configuration nameplate data

DDS _._ - _ _ _ _ - _ _ - 00

U5:

U1:

If installed:

U2:

U3:

U4:

Motor data:

Motor type:

Serial No.:

Details of the machine on which the fault occurred:

Machine manufacturer: ____________ Model: ____________ Hours in service: ____________

Machine number: ____________ Commissioning date: ____________

Manufacturer and type of machine controls: ____________

Designation of axis on which the fault occurred: ____________

Please give a short description of the fault:

Additional details:

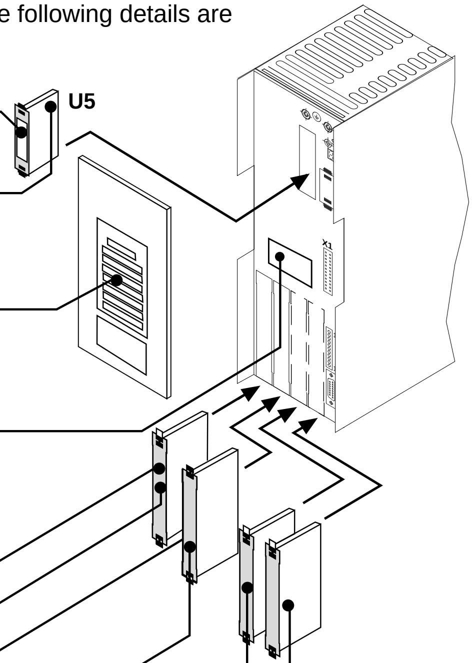
Fault status:	Causes:	Related phenomena:	
☐ always present ☐ during commissioning ☐ occurs sporadically ☐ occurs after ☐ hrs ☐ occurs on impact/vibration ☐ is temperature-dependent	☐ not known ☐ faulty connections ☐ external causes ☐ mechanical damage ☐ loose cable connections ☐ dampness in the unit ☐ foreign bodies in the unit	☐ mechanical problems ☐ failure of power supply unit ☐ failure of NC control system ☐ motor failure ☐ cable break ☐ defective fan ☐ defective feedback	Is the cabinet equipped with a cooling system? Y / N ☐ Have such faults occurred previously on the same axis? How often: ____________
☐ Additional information: ____________			Did the faults always occur on particular days or at particular times of the day?

StörDDS1

Fig. 11.14: Fault Report

Specific details of faulty controllers:

The function of digital drive controllers is determined by their configuration including the software module and plug-in modules.
Faults may be due to defective modules or inadmissible configurations.
If the unit is not sent in complete with all plug-in modules, the following details are necessary for thorough investigation.



Slot no.

U5
Software- Modul: DSM _._ - _ _ _
S.No.: _ _ _ _ _ _ - _ _ _ _ _ A _ _ S _ _

Plexiglas cover with configuration nameplate

Unit nameplate

Plug-in modules:

Error diagnosis:
Enter the display status at the time the fault occurred.

H2: if provided

U1
Type:
SN:
Software:

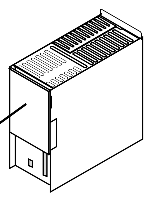
If installed

U2
Type:
SN:
Software, if any:

U3
Type:
SN:
Software, if any:

U4
Type:
SN:
Software, if any:

Associated power supply unit:
Type:
SN:



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

D-97816 Lohr am Main

StörDDS2

Fig. 11.15: Specific details of faulty controllers

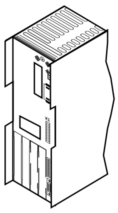
11.5. Specific axis data list, to be completed by hand

Specific Axis Data List/Sheet 1

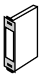
The specific axis data list serves as an additional measure to ensure security of axis-specific parameter contents and should be stored in the machine file.

Machine manufacturer :...
Plant No. :...
Machine Model :...
Axis designation :...

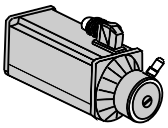
Axis equipment



Drive controller :DDS ....



Software module :DSM 2.1-..



MDD servo motor :MDD ....

Date :...
Completed by :....................................
Approved by :......................................
Company :...

FBdatenDDS

Fig. 11.16: Specific Axis Data List

Application parameters

ID No.	Designation	Present value	Unit
S-0-0049	Positive Position Limit Value		
S-0-0050	Negative Position Limit Value		
S-0-0091	Bipolar Velocity Limit Value		[mm/min]
S-0-0092	Bipolar Torque Limit Value		%
S-0-0055	Position Polarity Parameter		÷
S-0-0043	Velocity Polarity Parameter		÷
S-0-0085	Torque Polarity Parameter		÷
S-0-0115	Position Feedback Type Parameter		÷
S-0-0118	Resolution of Linear Feedback (ext. feedback)		÷
S-0-0041	Homing Velocity		[mm/min]
S-0-0042	Homing Acceleration		[mm/s^2]
S-0-0121	Input Revolutions of Load Gear		÷
S-0-0122	Output Revolutions of Load Gear		÷
S-0-0123	Feed Constant		[mm]
S-0-0147	Homing Parameter		÷
S-0-0150	Reference Offset 1		[mm]
S-0-0151	Reference Offset 2		[mm]
S-0-0052	Actual Position Feedback 1 - Reference Dimension		[mm]
S-0-0117	Rotational Encoder Resolution-2		
S-0-0103	Modulo Value		
S-0-0178	Absolute Reference Dimension Offset 2		
S-0-0054	Actual Position Feedback 2 - reference Dimension		[mm]
P-0-0007	Error Reaction		÷
S-0-0173	Marker Position A		
S-0-0057	Positioning Window		
S-0-0124	Standstill Window		
P-0-0097	Absolute Encoder Monitoring Window		
P-0-0049	Target Position		
S-0-0138	Bipolar Acceleration		
P-0-0106	Bipolar Stutter Limit Value		
S-0-0159	Monitoring Window		
P-0-0098	Maximum model deviation		
S-0-0169	Probe Control Parameter		
S-0-0405	Probe-1 Enable		
S-0-0406	Probe-2 Enable		
P-0-0081	Parallel Output		
P-0-0095	Position Command Interpolation with MDT Failure		
P-0-0114	Negation of Working Range Limit Switch Inputs		
S-0-0058	Backlash on Reversal		

Fig. 11.17: Drive parameters

Drive Parameters

ID No.	Designation	Present value	Unit
S-0-0142	Type of Application		÷
P-0-0050	Proportional Gain - Acceleration Feed Forward		[mAsec^2/rad]
S-0-0104	Position Loop KV factor (loop gain)		[(m/min)/mm]
S-0-0100	Velocity Loop Proportional Gain		[mAs/rad]
S-0-0101	Velocity Loop Integral Action Time		[ms]
P-0-0004	Smoothing Time Constant		[µsec]
S-0-0106	Proportional Gain 1 - Current Regulator		[V/A]
P-0-0006	Overload Factor		[%]
S-0-00113	Maximum Motor Speed (nmax)		[rpm]
S-0-0109	Motor Peak Current		[A]
S-0-0111	Motor Current at Zero Velocity		[A
P-0-0099	Position Command Smoothing Filter Time Constant		ms
S-0-0155	Friction Torque Compensation		%

Fig. 11.18: Drive parameters

11.6. Overview of INDRAMAT companies, subsidiaries and agencies

GERMANY

Lohr:

Indramat GmbH
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr am Main
☎ 0 93 52/40-0
Telex 6 89 421
Telefax 0 93 52/40-4885

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Indramat GmbH
c/o Rexroth Vertriebs- und Servicegesellschaft mbH
Beckerstraße 31
09120 Chemnitz
☎ 03 71/355-0
Telefax 03 71/355-230

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Technisches Büro Ratingen
Harkortstraße 25
Postfach 32 02
40880 Ratingen 1
☎ 0 21 02/44 20 48 /-49
Telefax 0 21 02/41 315

Stuttgart:

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Technisches Büro
Liststraße 1/2
71229 Leonberg 1
☎ 0 71 52/25 076/-77
Telefax 0 71 52/25 034

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G.L. Rexroth GmbH
Geschäftsbereich Indramat
Randlstraße 14
A - 4061 Pasching
☎ 07 229/44 01-72
Telefax 07 229/44 01-80

DENMARK

BEC Elektronik AS
Zinkvej 6
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Telefax 086/44 71 60

ENGLAND

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Indramat Division
4 Esland Place, Love Lane
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4, Place du Village
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☎ 1/47 98 44 66
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Telefax 03/718 98 62

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División Indramat
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Indramat Division
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Telefax 064/ 67 150

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Telefax 416/335-41 84

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80/83 94 34 5

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44 - 35 Yeouido-Dong
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Seoul, Korea
☎ 02/780 - 82 07 ~9
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Australasian Machine Tool Co. Pty. Ltd.
9 Webber Parade,
East Keilor (Melbourne)
Victoria, 30 33, Australia
☎ 03/336 78 22
Telefax 03/336 17 52

11.7. Related Documentation

Digital intelligent AC servo drives with modular drive controllers

Information Pre-selection

Digital intelligent AC main spindle and AC servo drives with SERCOS interface

Digital intelligent
AC main spindle and
AC servo drives
with SERCOS interface
Doc. No.: 71800

Digital AC servo drive

Digital intelligent
AC servo drives
Doc. No.: 71801

Selection Dimensioning

DDS 2 and MDD

DDS 2.1 and MDD
Digital intelligent
AC servo drives
System configuration manual
– List of proven and available system configurations
Doc. No.: 209-0069-4312

DDS and MDD

DDS and MDD
Digital intelligent AC servo drives with modular drive controllers
Selection data list
– Power-related selection of motor/ controller combination
– for stabilized DC link circuit voltage
– for unstabilized DC link circuit voltage
Doc.-No.: 209-0069-4363

Project planning (design, assembly, installation)

DDS 2

DDS 3

DDS 2.1
Digital AC servo drive controller
Project planning manual
– technical, design data
– assembly, installation
– interfaces
– available equipment/options/ accessories
– connection requirements
Doc. No.: 209-0069-4317

DDS 3
Doc.-No.: 209-0069-4362

Plug-in modules

Plug-in modules for digital intelligent drive controllers
Project planning manual

Doc.-No.: 209-0069-4356

Application (commissioning, operation, diagnostics)

this is the documentation in front of you

DDS 2.1 and MDD ANALOG interface

SERCOS interface

DDS 2.1/3.1 and MDD
Digital intelligent AC servo drives
with SERCOS interface
Application manual
– commissioning
– diagnostics, fault clearance
– overview of parameters
Doc.-No.: 209-0069-4315

with SERCOS interface
Doc.-No.: 209-0069-4321

DDS,DKS,DDC and MDD

DDS, DKS, DDC and MDD
digital intelligent AC servo drives
Notes on Fault Clearance

Doc.-No.: 209-0069-4357

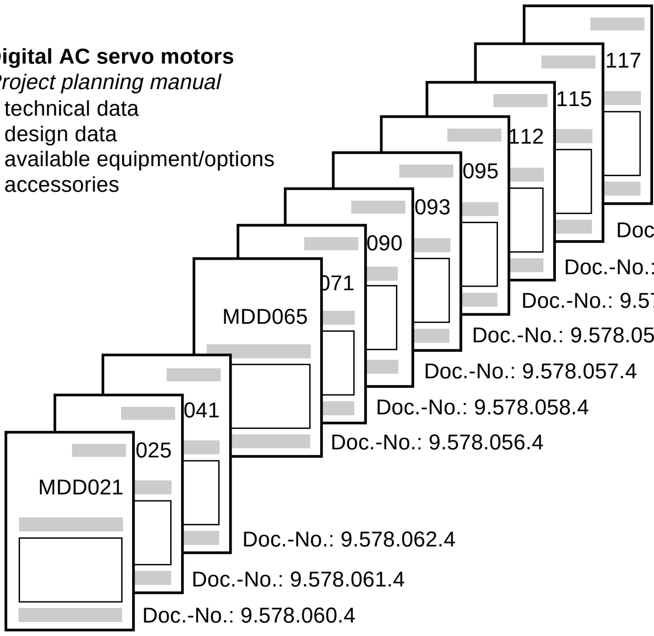
Abb. 11.19: Documentation overview

Information
Pre-selection

Selection
Dimensioning

Project planning
(design, assembly, installation)

Digital AC servo motors
Project planning manual
– technical data
– design data
– available equipment/options
– accessories



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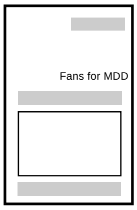
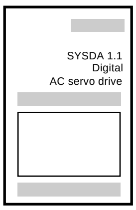
Doc.-No.: 9.578.054.4
Doc.-No.: 9.578.057.4
Doc.-No.: 9.578.058.4
Doc.-No.: 9.578.056.4
Doc.-No.: 9.578.062.4
Doc.-No.: 9.578.061.4
Doc.-No.: 9.578.060.4

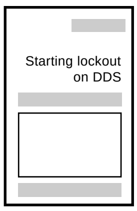


Fans for mounting on MDD servo motors
Project planning manual
– technical data
– design data
– assembly
– fan types for MDD motors
Doc.-No.: 9.578.003.4

Application
(commissioning, operation, diagnostics)



SYSDA 1.1 commissioning equipment for digital intelligent AC drives with SERCOS interface
Application manual
– technical data
– components
– operation
– commissioning
Doc.-No.: 209-0069-4322



Starting lockout on DDS 2 drive controllers
Application manual
– protecting persons against unintentional start-up of servo motors
– plant reliability
Doc.-No.: 209-0069-4313

12. Glossary, Explanations

Absolute encoder

Absolute value encoder, multiturn encoder, absolute position encoder

Position encoders which supply a position signal, referred to a reference point set at initial start-up, as soon as the power supply is switched on. No homing cycle necessary during operation or after a power failure.

Absolute encoder emulator

The absolute encoder emulation is an integral part of ANALOG interfaces with absolute encoder emulator DAA 1.1. It allows the output of the drive's internal absolute position or angle information via the SSI (synchronous serial interface) common to all absolute encoders for the purposes of external use as a position actual value.

Drive enable, SERCOS

Controller enable

Signal in the SERCOS interface to activate the drive when in powered up condition.

Drive controller

Servo amplifier, servo control amplifier, servo drive module

Unit required to operate a digital AC servo motor.

Axial surface cooling

Axial cooling

Forced cooling of the frame of a digital AC servo motor by means of a fan installed axially on the motor axis to increase the nominal torque.

Bleeder

Load resistor, bleeder resistor, chopper resistor

Electronically controlled braking resistor which dissipates as heat the excess energy generated when a motor is braked.

Digital servo feedback

DSF

Position encoder in AC servo motors for digital intelligent drives for high-resolution measurement of the rotor position (resolution 1/2 000 000 revolutions). The measurement is absolute within one revolution.

Bipolar torque limit value

Limitation of the maximum torque, symmetrically in both directions

Torque loop

Force control loop, torque control loop

Operating mode in which the drive sets the torque according to the applied torque command value. This mode is recommended

- as a secondary operation mode when the drive is operated in position or velocity loop in the primary mode of operation
- for master/slave applications. The slave servo motor is then run in a torque loop.

Velocity loop proportional gain

This parameter determines the velocity loop derivative/proportional gain (see Section 7.23)

Velocity loop integral reaction time

T_N

The reaction time T_N is the time required with a step response to produce a change in the adjustment variable due to the I derivative that is equal to that produced by the P derivative (see Section 7.23).

Real time

Determined processing of inputs without the time being affected by any other events.

Emulator

Hardware extensions or programs allowing the emulation of the characteristics of another system.

Excessive Position Command

Error message no. 37 emitted by the drive controller
This happens when
- the drive is being run in position loop, and
- the NC control feeds forward invalid position commands (Section 7.7)

Velocity control loop

Speed control loop

Drive operating mode in which the drive sets the motor speed or the velocity of the moved machine part with a high dynamic response as a function of the applied velocity command.

Smoothing time constant

Time constant in the velocity loop proportional gain
It serves
- to suppress quantizing effects
- to limit the band width of the velocity loop

Base torque

Idling torque, friction torque

The torque required to move the drive and the attached mechanical construction.

Holding brake, closed-circuit current

An electromagnetic brake built into the servo motor as an option. It serves to protect the AC servo motor (servo axis) against involuntary movement when shut down. The brake is closed when de-energized.

High-resolution position interface

This is an optional interface for slotting into the drive controller (slot U2 to U4). It conditions sinusoidal signals from an external encoder at high resolution (multiplication factor 2048).

Pulse wire absolute encoder

IDG

Alternative to the resolver feedback on digital AC servo motors for absolute measurement of the rotor position over 4096 revolutions.

Incremental encoder

Position encoder, relative position encoder

Incremental encoders supply a defined number of measuring cycles per revolution or stroke. Position measurement referred to a homing point is achieved by running a homing cycle after switching on the supply voltage, with continuous direction-biased counting of the measurement cycles in the NC control or the drive.

Incremental encoder emulator

The incremental encoder emulation is an integral part of „ANALOG interfaces with incremental encoder emulator DAA 1.1“. It allows the output of the drive's internal position or angle information. This information is used by the related NC control as a position actual value signal.

Interface

Plug-in card

The transition point for signal interchange between drives, NC controls, encoders, etc. Digital intelligent drive controllers have permanently installed standard interfaces. If desired, the units may also be equipped with optional, variable application-related interfaces. These can be fitted into slots U2, U3, U4.

Natural air cooling

The heat generated by the power section of the drive controller is not dissipated inside, but outside the control cabinet. This is achieved by a special arrangement for directing the flow of the cooling air. Though it dispenses with the need for cooling systems, it means that the control cabinet cannot be completely closed and the protection class is consequently low.

Multiturn encoder

Multiturn absolute encoder, MTG

Absolute position measurement over several revolutions. Digital AC servo motors may optionally be fitted with multiturn encoders (absolute measurement of the rotor position over 4092 revolutions).

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