ECODRIVE03
Drive With Integrated NC-Control And Profibus / Parallel Interface

Functional Description FLP-01VRS

DOK-ECODR3-FLP-01VRS**-FK01-AE-P

Title
ECODRIVE03
Drive With Integrated NC-Control
And Profibus / Parallel Interface

Type of Documentation
Functional Description

Document Typecode
DOK-ECODR3-FLP-01VRS**-FK01-AE-P

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Purpose of Documentation
The following documentation describes the function of the firmware FWA-ECODR3-FLP-01VRS
- for description of all functional features

Record of Revisions

Description	Release Date	Notes
DOK-ECODR3-FLP-01VRS**-Fk01-AE-P	03.01	first release

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Note
This document has been printed on chlorine-free bleached paper.

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1 System Overview

1.1 ECODRIVE03 - The Universal Drive Solution for Automation

The ECODRIVE03 universal automation system is an especially cost-effective solution for open- and closed-loop control tasks.

The ECODRIVE03 servo drive system features:

- a very broad range of applications
- many different integrated functions
- a highly favorable price/performance ratio

The **ECODRIVE03** also features ease of assembly and installation, high system availability, and a reduced number of system components.

The **ECODRIVE03** can be used to implement many different kinds of functions in a number of applications.

Typical applications are:

- metalworking
- printing and paper processing machines
- automatic handling systems
- packaging and food processing machines
- handling and assembly systems

1.2 ECODRIVE03 – A Family of Drives

FWA-ECODR3-FLP-0xVRS-MS

In addition to the firmware documented here (FWA-ECODR3-FLP-0xVRS-MS, **Drive with integrated NC control and Profibus / parallel interface**), three other application-specific firmware versions exist:

FWA-ECODR3-SMT-0xVRS-MS

- drive for machine tool applications with SERCOS, analog and parallel interfaces

FWA-ECODR3-SGP-0xVRS-MS

- drive for general automation tasks with SERCOS, analog and parallel interfaces

FWA-ECODR3-FGP-0xVRS-MS

- drive for general automation tasks with field bus interfaces

1.3 Drive Controllers and Motors

Available controllers

The **ECODRIVE03** family of drives is at present made up of eight different units. They differ primarily in terms of which interface is used for machine control (e.g. SPS, CNC). The drive controllers are available in three different rating classes with peak currents of 40A, 100A and 200A.

For the FLP, two different interfaces are supported:

- DKC21.3 Parallel interface 2
- DKC03.3 Profibus-DP interface

For other application-specific firmware versions:

- DKC11.3 Analog interface
- DKC01.3 Parallel interface
- DKC02.3 SERCOS interface
- DKC03.3 Profibus-DP interface
- DKC04.3 InterBus interface
- DKC05.3 CANopen interface
- DKC06.3 DeviceNet interface

Supported Motor Types

The following motor types **can be operated using ECODRIVE03** firmware:

- synchronous motors for standard applications up to 48 Nm.
- synchronous motors for more stringent demands up to 64 Nm.

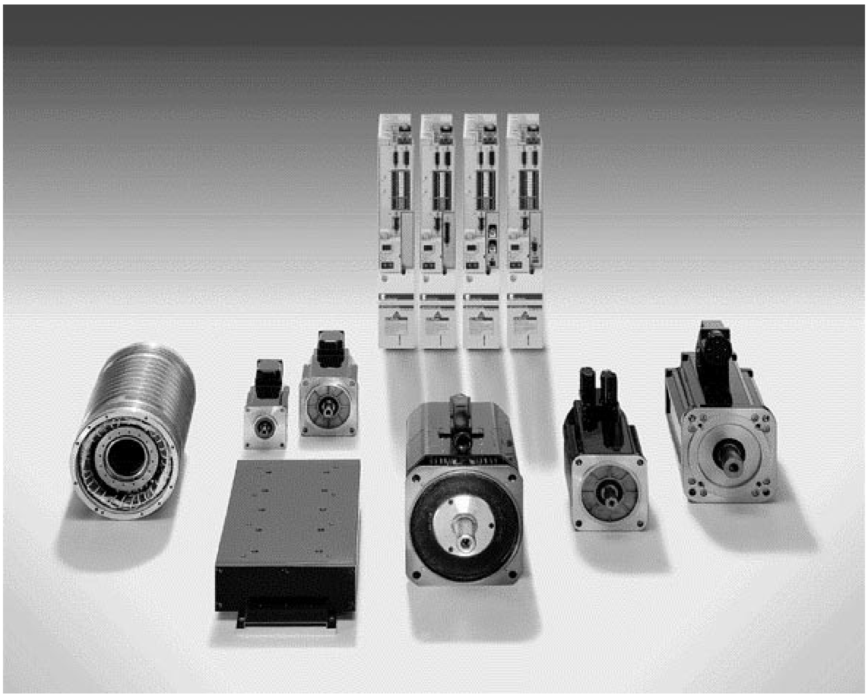


Fig. 1-1: The ECODRIVE03 Family of Drives and the Motors Supported

1.4 Function Overview: FWA-ECODR3-FLP-01VRS-MS

Command Communications Interface

The following interfaces are supported:

- Profibus-DP (DKC 3.3)
- Parallel interface 2 (DKC 21.3)

Supported Motor Types

- MKD
- 2AD
- 1MB
- LAF
- MKE
- MBS (rotary synchronous kit motor)
- MHD
- ADF
- MBW
- LAR
- LSF (linear synchronous kit motor)

Supported Measuring Systems

- HSF/LSF
- resolver
- sine encoder with 1Vp-p signals
- encoder with EnDat interface
- resolver without feedback data memory
- Resolver without feedback data memory, with incremental sine encoder
- gearwheel encoder with 1Vp-p signals
- Hall encoder with square-wave encoder
- Hall encoder with sine encoder
- ECI encoder

Parameters C001 and C004 describe which combinations are possible.

Firmware Functions

Data

- 1 NC axis
- units can be defined in mm, inches and degrees
- dimensions can be programmed as incremental or absolute
- preselection of velocity in ‰ of Vmax

Operating Modes

- Parameter
- Manual
- Automatic

Program Data

NC

- 1000-line sequential program
- 3 NC tasks (quasi parallel)
- processing of subroutines
- System variables
- 400 variables
- 224 marker flags

Logic task

- 1000 assignments
- Processing speed: 5000 assignments/sec
- Cycle time 4ms
- System flags
- 320 marker flags

RS Interface

RS 232 C / RS 485 serial interface

Programing via this interface is possible using the following:

- **ASCII** protocol
- **SIS** protocol
- IDS connection (Indramat Decade switch)

Data Security

The user programs and parameters are stored in a NOVRAM (non-volatile memory).

Functions

- extensive diagnostics options
- basic parameters that can be called up to set the parameters to their default settings
- dual language support for parameter and command names, as well as for diagnostic messages
- German
- English
- evaluation of optional (load-side) encoder for position and/or velocity control
- evaluation of absolute measurement systems
- modulo function
- torque/force limit can be set via parameters
- current limiting
- travel limiting:

  via travel limit switch and/or

  position limit values
- drive-side error responses:

  best possible deceleration "velocity command value set to zero"

  best possible deceleration "torque free"

  best possible deceleration "velocity" command value set to zero with ramp and filter"

  power shutdown in the event of a fault

  E-Stop function
- control loop settings

  base load function (feedback memory readout)

  acceleration precontrol

  velocity precontrol
- velocity control loop monitoring
- position control loop monitoring
- drive halt

- homing
- set absolute distance
- analog output
- analog inputs
- oscilloscope function
- probe input function
- detect marker position
- encoder emulation
    - absolute encoder emulation (SSI format)
    - incremental encoder emulation

2 Safety Instructions for Electric Servo Drives and Controls

2.1 Introduction

Read these instructions before the equipment is used in order to prevent bodily injury and/or property damage. Follow these safety instructions at all times.

Do not attempt to install, use or service this equipment without first carefully reading all documentation provided with the product. Read these safety instructions and all user documentation prior to working with the equipment at any time. If you do not have user instructions for the equipment, contact your Rexroth Indramat sales representative. Request that this documentation be sent immediately to the person or persons responsible for safe operation of the equipment.

If the product is resold, rented and transferred to others, then these safety instructions must be delivered with the product.

WARNING

Inappropriate use of this equipment, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in product damage, bodily injury, severe electric shock or even death!

2.2 Explanations

The safety warnings in this documentation describe individual degrees of hazard seriousness in compliance with ANSI:

Warning symbol with signal word	**Degree of hazard seriousness per ANSI** The degree of hazard seriousness describes the consequences resulting from non-compliance with the safety instructions:
DANGER	Death or serious bodily injury will occur.
WARNING	Death or serious bodily injury may occur.
CAUTION	Bodily injury or equipment damage may occur.

Fig. 2-1: Degree of hazard seriousness (per ANSI)

Rexroth Indramat

2.3 Hazards Due to Incorrect Use

DANGER	**High electrical voltage and high discharge current! Risk of death or serious bodily injury by electric shock!**

DANGER	**Dangerous movements! Risk of death, serious bodily injury or equipment damage due to unintentional motor movements!**

WARNING	**High electrical voltage due to wrong connections! Risk of death or bodily injury by electric shock!**

WARNING	**Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!**

CAUTION	**Housing surfaces could be extremely hot! Danger of injury! Danger of burns!**

CAUTION	**Risk of injury due to improper handling! Bodily injury caused by crushing, shearing, cutting and mechanical shock or improper handling of pressurized lines!**

CAUTION	**Risk of injury due to improper handling of batteries!**

2.4 General Information

- Rexroth Indramat GmbH is not liable for damage resulting from failure to observe the warnings given in this documentation.
- Read the operating, maintenance and safety instructions before starting up the machine. If you find that you can not completely understand the documentation for your product in the language provided, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation, as well as due care in operation and maintenance, are prerequisites for optimal and safe operation of this equipment.
- The handling of electrical equipment requires trained and qualified personnel:
  Only trained and qualified personnel may work on this equipment or within its proximity. Personnel are qualified if they have sufficient knowledge of the assembly, installation and operation of the product, as well as an understanding of all warnings and precautionary measures noted in these instructions.
  Furthermore, they should be trained, instructed or qualified to switch electrical circuits and equipment on and off, to ground them and to label them according to the requirements of safe work practices and common sense. They must have adequate safety equipment and be trained in first aid.
- Use only spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The equipment is designed for installation in commercial machinery.

European countries: see directive 89/392/EEC (machine guideline).

- The ambient conditions stipulated in the product documentation must be complied with.
- Applications relevant to safety are not permitted unless expressly and specifically stipulated in the project planning specifications.
  For example, the following uses and applications are not permitted: Cranes, passenger and freight elevators, facilities and vehicles for passenger transport, the medical industry, refineries, transport of hazardous substances, the nuclear sector, areas sensitive to high frequencies, mining, processing of foodstuffs, control of safety devices (even within machines).
- Start-up is permitted only after it has been determined that the machine in which the product is installed complies with the national requirements and safety regulations pertinent to the application.
- Operation is only permitted if the national EMC regulations are complied with for the application in question.

  The instructions for installation in accordance with EMC requirements can be found in the INDRAMAT document "EMC in Drive and Control Systems”.

  The manufacturer of the machine or system is responsible for compliance with the limit values as prescribed in the national regulations and specific EMC regulations for the application.

European countries: see Directive 89/336/EEC (EMC Guideline).

U.S.: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must comply with the above noted items at all times.

- Technical data, connections and installation conditions are specified in the product documentation and must be followed at all times.

2.5 Protection Against Contact with Electrical Parts

Note: This section refers only to equipment and drive components with voltages above 50 volts.

Making contact with parts conducting voltages above 50 volts can be dangerous to personnel and can cause electric shock. When operating electrical equipment, it is unavoidable that some parts of the unit conduct dangerous voltages.

DANGER

High electrical voltage! Risk of death or injury by electric shock, or serious bodily injury!

⇒ Only personnel trained and qualified to work with or on electrical equipment are permitted to operate, maintain or repair this equipment.

⇒ Observe general construction and safety regulations when working on electrical power installations.

⇒ Before the power is switched on, the ground wire must be permanently connected to all electrical units in accordance with the connection diagram.

⇒ Do not operate electrical equipment at any time if the ground wire is not permanently connected, even for brief measurements or tests.

⇒ Before working with electrical parts with voltages higher than 50 V, the equipment must be disconnected from the grid or power supply. Make sure it isn’t switched back on.

⇒ With electrical drive and filter components, do the following:

Wait five (5) minutes after switching off power to allow capacitors to discharge before beginning work. Measure the voltage on the capacitors before beginning work to make sure that the equipment is safe to touch.

⇒ Never touch the electrical connection points of a component while power is turned on.

⇒ Properly install the covers and guards provided with the equipment before switching the equipment on. Prevent contact with live parts at all times. ⇒ A residual-current-operated protective device (r.c.d.) must not be used on an electric drive! Indirect contact must be prevented by other means, for example, by an overcurrent protective device in accordance with the relevant standards.

⇒ Equipment that is built into machines must be secured against direct contact. Use appropriate housings such as a control cabinet, for example.

European countries: according to EN 50178/1998, section 5.3.2.3.

U.S.: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must comply with the above noted items at all times.

With electrical drive and filter components, do the following:

DANGER

High electrical voltage on housing and high leakage current! Risk of death or injury by electric shock!

⇒ Before switching on power for electrical units, all housings and motors must be permanently grounded according to the connection diagram. This applies even for brief tests.

⇒ Therefore, the protective conductor of the electrical equipment and units must always be securely connected to the supply network. Leakage current exceeds 3.5 mA.

⇒ Use a copper conductor with at least 10 mm² cross section over its entire length for this protective conductor connection!

⇒ Prior to startup, even for brief tests, always connect the protective conductor or connect with ground wire. Otherwise, high voltage levels can occur on the housing that could lead to severe electric shock.

European countries: EN 50178/1998, section 5.3.2.1.

U.S.: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must comply with the above noted items at all times.

2.6 Protection Against Electrical Shock by Protective Extra-Low Voltage (PELV)

All connections and terminals with voltages between 5 and 50 volts on INDRAMAT products are rated for protective extra-low voltages in accordance with the following standards on contact safety:

- International: IEC 60364-4-41
- EU countries: EN 50178/1998, section 5.2.8.1.

WARNING

High electrical voltage due to wrong connections! Risk of death or injury by electric shock!

⇒ Only equipment, electrical components and cables of the protective extra-low voltage type (PELV) may be connected to all connectors and terminals with 0 to 50 volts.

⇒ Only safely isolated voltages and electrical circuits may be connected. Safe isolation is achieved, for example, with an isolating transformer, an opto-electronic coupler or when battery-operated.

2.7 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of the connected motors. The causes can be as follows:

- unclean or faulty wiring or cable connections
- improper or incorrect operation of equipment
- malfunction of sensors, encoders and monitoring circuits
- defective components
- software errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified period of trouble-free operation.

The monitoring systems in the drive components make malfunctions in the connected drives very unlikely. With regard to personnel safety, especially the risk of bodily injury and/or equipment damage, reliance on these systems alone is not enough. Until the built-in monitoring systems become active and effective, it must always be assumed that some faulty drive movements will occur. The extent of these faulty drive movements depends upon the type of control and the operating state.

DANGER

Dangerous movements! Risk of death or injury, serious bodily injury or equipment damage!

⇒ For the above reasons, personnel safety must be ensured by means of monitoring or measures implemented at the facility in which the drives are used.

These monitoring systems or measures undergo a risk and fault analysis by the builder of the facility in accordance with the specific conditions of the facility. All the safety regulations that apply to this facility are included therein. Random machine movements or other types of faults can occur when safety devices are deactivated, circumvented or not activated in the first place.

Prevention of accidents, bodily injury and/or equipment damage:

⇒ Keep free and clear of the machine's range of motion and moving parts. Prevent people from accidentally entering the machine's range of movement:

- use protective fences
- use protective screens
- install protective coverings
- install light curtains or light barriers

⇒ Fences must be strong enough to withstand maximum possible momentum.

⇒ Mount the emergency stop switch (E-stop) within the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the machine if the emergency stop is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a start-inhibit system to prevent unintentional start-up.

⇒ Make sure that the drives are brought to standstill before accessing or entering the danger zone.

⇒ Provide additional safeguards to prevent vertical axes from dropping or descending after shutdown, e.g., using:

- a mechanical interlock on the vertical axis
- an external braking/capture/clamping element or
- a sufficient axis counterweight

By itself, the standard holding brake supplied with the motor or an external motor holding brake controlled by the drive controller is not suitable for personnel protection!

⇒ Disconnect electrical power to the equipment using a master switch and provide safeguards to prevent unintentional restarts when:

- performing maintenance and repair work
- cleaning the equipment
- there are long periods of discontinued equipment use

⇒ Avoid operating high-frequency, remote control and radio equipment near electronic circuits and supply leads. If use of such equipment cannot be avoided, check the system and the facility in which it is installed for possible malfunctions at all possible positions of normal use before the first start-up. If necessary, perform a special electromagnetic compatibility (EMC) test on the facility.

2.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious health hazard to persons with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

⇒ Persons with heart pacemakers, metal implants and hearing aids are not permitted to enter the following areas:

- Areas in which electrical equipment and parts are being mounted, are in operation or are being started up.
- Areas in which motor parts containing permanent magnets are being stored, repaired or mounted.

⇒ If it is necessary for a person with a pacemaker to enter such an area, then a physician must be consulted prior to doing so. Pacemakers that are already implanted or will be implanted in the future vary greatly in terms of their resistance to interference, and thus there are no generally valid rules regarding their use.

⇒ Persons with hearing aids, metal implants or embedded metal fragments must consult a doctor before they enter the areas described above, since health hazards are present.

2.9 Protection Against Contact with Hot Parts

CAUTION

Housing surfaces could be extremely hot! Danger of injury! Danger of burns!

⇒ Do not touch housing surface near sources of heat! Danger of burns!

⇒ Wait ten (10) minutes before you access any hot unit. Allow the unit to cool down.

⇒ Do not touch hot parts of the equipment, such as equipment housings containing heatsinks or resistors. Danger of burns!

2.10 Protection During Handling and Installation

Under unfavorable conditions, improper handling and installation of parts and components may cause injuries.

CAUTION

Risk of injury due to improper handling! Bodily injury caused by crushing, shearing, cutting and mechanical shock!

⇒ Observe general instructions and safety regulations regarding handling and installation.

⇒ Use only appropriate lifting or moving equipment.

⇒ Take precautions to avoid pinching and crushing.

⇒ Use only appropriate tools. If specified by the product documentation, special tools must be used.

⇒ Use lifting devices and tools correctly and safely.

⇒ Wear appropriate protective gear, e.g. safety glasses, safety shoes and safety gloves.

⇒ Never linger under suspended loads.

⇒ Clean up liquids from the floor immediately to prevent the risk of slipping.

2.11 Battery Safety

Batteries contain reactive chemicals in a solid housing. Improper handling may result in injuries or equipment damage.

CAUTION

Risk of injury due to improper handling!

⇒ Do not attempt to reactivate discharged batteries by heating or other methods (danger of explosion and release of corrosive substances).

⇒ Never charge batteries (danger from leakage and explosion).

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

⇒ Do not damage electrical components installed in the devices.

Note: Environmental protection and waste disposal! In terms of the legal requirements, the batteries contained in the product must be considered a hazardous material for land, air and sea transport (danger of explosion). Dispose of batteries separately from other refuse. Observe the legal requirements in the country of installation.

2.12 Safeguards with Pressurized Lines

Depending on what is specified in the project planning specifications, certain motors (ADS, ADM, 1MB, etc.) and drive controllers can sometimes be supplied externally with pressurized media, such as compressed air, hydraulic oil, liquid coolants and cooling lubricants. In such cases, improper handling of external supply systems, supply lines or connections can lead to injury or equipment damage.

CAUTION

Risk of injury due to improper handling of pressurized lines!

⇒ Do not attempt to disconnect, open or cut pressurized lines (danger of explosion).

⇒ Follow the operating instructions provided by the respective manufacturers.

⇒ Before lines are disconnected, the pressure must be relieved and the medium (air or liquid) must be drained.

⇒ Wear appropriate protective gear, e.g. safety glasses, safety shoes and safety gloves.

⇒ Immediately clean up spilled liquids from the floor.

Note: Environmental protection and waste disposal! Under certain circumstances, the media used to operate the product may not be environmentally compatible. Dispose of environmentally harmful media separately from other refuse. Observe the legal requirements in the country of installation.

3 General Instructions for Start-Up

3.1 Explanation of Terms

So that the terms used in this document will be better understood, some explanations are provided below.

Communication

Display

The 2-digit, 7-segment H1 display on the programming module indicates the current status. Distinctions are made between:

- operating mode
- warnings
- errors

Errors can be acknowledged using the S1 key located next to the display on the programming module.

Serial Interface

Parameters and programs must be entered into the control in order for it to conform to the system-specific requirements. This input is handled exclusively via the serial interface (X2).

Rexroth Indramat has two options available:

- PC programming using MotionManager
- BTV04 display unit

Fieldbus

The following can be transmitted via the fieldbus:

- cyclic I/O
- variables

S1 Key on Programming Module

The S1 key and the address switch located below it can be used to control various basic settings.

The subsequent function is enabled by pressing the S1 key with the address set to 00. The function enable signal is present for 1 minute. This is indicated by “Ad” on the display. After selecting the function number and confirming it with the S1 key, the display disappears if the function was completed.

1 stop bit applies for all

Address 90 ASCII protocol 9600 Baud NO parity
(MotionManager)
Address 91 SIS protocol 9600 Baud EVEN Parity
Address 92 RS at drive 9600 Baud No Parity
Address 93 SIS protocol 9600 Baud No Parity
(BTV04)
Address 94 SIS protocol 9600 Baud EVEN
(BTV04 with BTV keys and BTV I/O)
only change to Parameter Mode possible

Address 95 SIS protocol 9600 Baud No Parity
(BTV04 with BTV keys and BTV I/O)
only change to Parameter Mode possible

Address 98 Load parameter with default values (Basic parameter load)
ASCII protocol 9600 Baud NO Parity

Address 99 Load parameter with default values (Basic parameter load)

The resulting RS interface parameter setting is not retained.

It is again set to the parameter values (B001/B002/B009/B010) after a fault is cleared or after parameter mode is exited.

The invoked settings correspond to the following parameter settings:

Address 90	B001	09600 1
	B002	1 1 0 1 0 004
	B009	0 200
	B010	0
Address 91	B001	09600 2
	B002	0 1 0 0 0 000
	B009	0 200
	B010	0
Address 92	Cannot be entered in the parameters	
Address 93	B001	09600 1
	B002	0 1 0 0 0 000
	B009	0 200
	B010	0
Address 94	B001	09600 2
	B002	0 1 0 0 0 000
	B009	1 200
	B010	1
Address 95	B001	09600 1
	B002	0 1 0 0 0 000
	B009	1 200
	B010	1
Address 98	B001	09600 1
	B002	1 1 0 1 0 004
	B009	B010: -
Address 99	The default interface values are the same as for Address 93	

Note: When the basic parameters are set, any parameters that have already been entered are overwritten.

Data Storage

Non-volatile Memory

Various non-volatile data storage registers are contained in the drive.

The following operating data are stored there

- The configuration setting
- Parameters
- Programs
- Stored marker flags and variables.

The data are stored to the corresponding operating data after each instance of write access.

The following modules contain non-volatile memory:

- Drive controller
- Motor encoder (optional)
- Programming module
- Plug-in module (Profibus Card, DIO Card)

Operating Modes

There are three operating modes:

- Manual
- Automatic
- Parameter

They are specified via system inputs for DKC21.3, via the fieldbus for DKC3.3, or via the BTV04.

Parameter

The drive displays **"PA"** on the H1 display.

You must switch to parameter mode to change parameters and to operate the Logic Task program. When you exit parameter mode, the parameters and the Logic Task program are checked, and for any errors, an error message is displayed.

Manual

The drive displays **"HA"** on the H1 display.

In manual mode and with the drive enabled, the following functions are in operation:

- Task 3
- Logic Task

The following functions are possible:

- Jog forward
- Jog reverse
- Manual Vector
- Homing via programmable input
  (Parameter C010)

Automatic

The drive displays **"AU"** on the H1 display.

In automatic mode and with the drive enabled, the following functions are in operation:

- Task 1
- Task 2
- Task 3
- Logic Task

The following function is possible:

- Interrupt vector

Inputs / Outputs / Marker Flags

Designation:

Die designation of the inputs, outputs and marker flags.

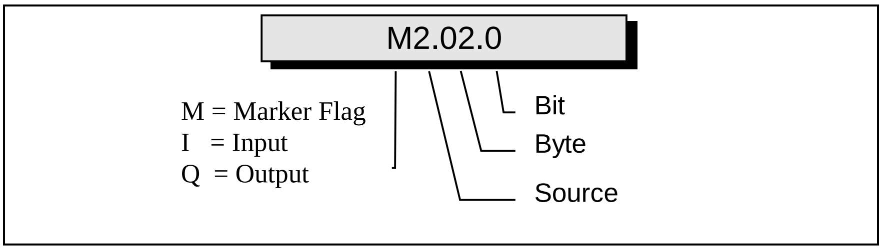


Fig. 3-1: Structure of the Inputs / Outputs / Marker Flags

e.g.

I0.00.6

	Input:
I0	Input, Connector X210
I0.00	Input, Connector X210, Group 0 (Byte)
I0.00.6	Input, Connector X210, Group 0, Bit 0

First user-programmable input

See also: “Inputs, outputs, marker flags,” Section 9.1.

Warning

Warnings do not lead to an automatic shutdown

A number of monitoring functions are performed depending on the operating modes and parameter settings. If a state is detected which allows proper operation for the time being, but eventually generates an error and leads to a shutdown of the drive, a warning will be generated if this state continues.

Warning Classes

Warning Class:	**Diagnostic Message:**	**Drive Reaction:**
Without drive reaction	E2xx E- 01xx	--

Fig. 3-2: Warning Classes

Warnings can not be externally cleared.

Errors

A number of monitoring functions are performed depending on the operating modes and parameter settings. An error message is generated if a condition is discovered which no longer allows proper operation.

Error Classes

The error class is apparent from the diagnostic error message.

Errors can be divided into four error classes. The error class determines the drive error reaction.

Error Class:	Diagnostic Message:	Drive Reaction:
Fatal	F8xx	Switch to torque-free state
Travel range	F6xx F- 03xx	Velocity Command Value Set to Zero
Interface	F4xx	per setting for “Best possible halt,” Parameter A119
Non-fatal	F2xx F- 02xx	per setting for “Best possible halt,” Parameter A119

Fig. 3-3: Error Classes

Drive Error Reaction

If an error condition is detected in the drive, execution of the drive's error reaction starts automatically as long as the drive is ready. The H1 display flashes Fx / xx. The drive's reaction to interface and non-fatal errors can be set in Parameter A119, Best possible halt. The drive switches to torque-free operation at the end of each error reaction.

Clear Errors

Errors must be cleared externally

Errors are not cleared automatically; they must be cleared externally via:

Input X3/7

or

by pressing the **"S1"** key.

or

via the fieldbus

If the error condition is still present, the error will be immediately detected again.
The **positive edge of a controller enable signal** is required to restart the drive.

Clearing Errors When Controller Enable Is Set

If a drive error is discovered while operating with the controller enable set, the drive will execute an error reaction. The drive automatically deactivates itself at the end of each error reaction; in other words, the power stage is switched off and the drive switches from an energized to a de-energized state.

To reenable the drive:

- the error must be cleared

Basic Parameter/Basic Load

Basic Parameter

When the drive is ready for delivery, the factory-set basic values are written to the parameters. The **load basic parameters** function can be invoked using the S1 key and the address setting 99.
The basic parameter set is structured such that

- all optional functions are deactivated
- limit values for position are deactivated
- limit values for torque/force are set to high values
- and limit values for velocity and acceleration are set to low values
- SIS protocol 9600 Baud No parity

Note:	If machine parameters have already been set prior to invoking this function, they will be overwritten.

Note:	The basic parameter load does not guarantee that the drive will be matched to the machine, and only in certain instances will it be matched to the connected motors and measuring systems. The relevant settings must be made when first starting up the axis.

Automatic execution of the "Load basic parameter " function

The drive firmware is on the programming module. If the firmware is replaced with a different, non-compatible version of the firmware, the drive controller will detect this the next time the control voltage is switched on. In this case, the message "**PL**" appears on the 7-segment display. The basic parameter block is activated by pressing the "**S1**" key.

Note:	Any previous parameter settings are lost upon replacement of the firmware followed by "Load basic parameter." To prevent the loss of these settings when a new version is loaded, save the parameters prior to replacement and then reload them following the replacement of the firmware and loading of the basic parameter block.

Note:	As long as the drive displays "PL" and the command is active, no communication is possible via the serial interface.

3.2 Initial Startup Guidelines

During initial startup, the drive should be disconnected from the mechanical system.

- Check to see that devices and cables are of the correct type
- The power supply, the control voltage and the drive with its encoder must be connected according to the information provided in the documentation:
  Project Planning Manual DOK-ECODR3-DKC**.****-PRxx-EN-P.
- Hardwire inputs X3 and
  DKC21.3 X210
  DKC3.3 Profibus Interface
- Match the interface parameter using the S1 key
- Hardwire the interface to the operator panel (PC or BTV)
- Match the parameters to the equipment
- Turn on the power
- Use ‘Jog’ to move the axis in manual mode
- Check the safety devices
  (emergency STOP, travel limit switches, etc.)

If the drive works as expected, the power can be turned off and the motor can be connected to the machine. After that, the following work must be performed if required by the application in question:

- Set the absolute distance or home the drive
- Set the position-limit parameters
- Load the programs
- Test the dynamic motion reaction and match up the control parameters (CRxx) if necessary.
- Save parameters and program.

Downloading the Firmware

The firmware is already included in a new unit when it is delivered.
The firmware version which the unit contains can be read sequentially via Status Message 19.
If the unit contains the wrong firmware version, the correct firmware can be downloaded using DOLFI software.

Once a new firmware version has been downloaded, the H1 display will indicate **PL** the next time the control voltage is turned on. The basic parameter load is activated by pressing the "**S1**" key.

3.3 Diagnostic Message Options

Overview of Diagnostic Message Options

The diagnostic message options are divided into 2 groups:

- Options for generating priority-based, drive-internal diagnostic messages for identifying the current operating state
- Collective messages for diverse status messages

Additionally, there are parameters for all important operating data that can be transmitted via both the command communications hardware (Profibus, ...) and the parameter-entry interface (RS-232/485 using the ASCII protocol or SIS [serial Indramat protocol]).

Drive-internal Diagnostic Message Generation

The actual operating state of the drive is determined from the presence of any errors, warnings, commands and controller enable signals, as well as the active operating mode. It can be ascertained from

- the 2-part seven-segment display (H1 display)
- status message 53
- system outputs

Diagnostic Message Composition

Each operating state is identified by a diagnostic message which consists of

- a diagnostic message number and a
- diagnostic message text

For example, the diagnostic message for the non-fatal error "Excessive Deviation" is displayed as follows.

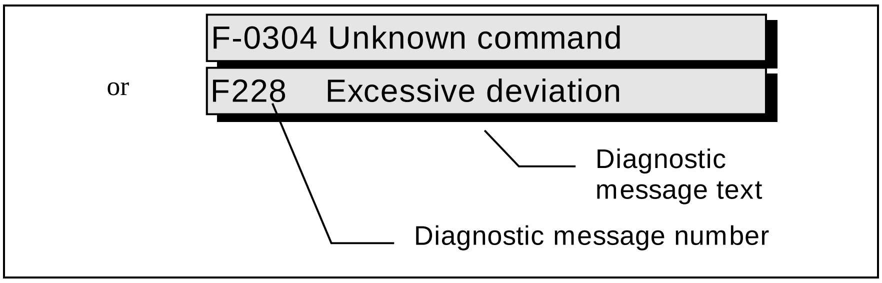


Fig. 3-4: Diagnostic Message Composition with a Diagnostic Message Number and Text

In this example, "F2" and "28" appear alternately on the H1 display.

H1 Display

The diagnostic message number appears in the two-digit seven-segment display. The display format is shown in the graphic "Priority-Based Display of the Diagnostic Message".

With the help of this display, it is possible to quickly determine the current operating state without using a communication interface.

The operating mode is not shown on the H1 display. If the drive complies with the operating mode and no command was activated, "AF" appears on the display.

Plain Text Diagnostic Message, Status Message 53

The plain-text diagnostic message contains the diagnostic message number followed by the diagnostic message text, as shown in the “Excessive Deviation” example.
It can be read out via the status message and is used for direct display of the drive status at a user interface.

The language of the plain-text diagnostic message can be changed.

3.4 Language Selection

The language for the following items can be changed using **Parameter B000, Language selection** :

- Parameter names
- Description of commands
- Diagnostic message texts

Currently, the following languages are implemented:

Value of B000:	**Language:**
0	German
1	English

Fig. 3-5: Language Selection

3.5 Firmware Update using the DOLFI Program

With the help of the DOLFI program it has become possible to update the firmware for a drive controller via the serial interface.

This program can be ordered from Indramat with the designation:

-SWA-DOL*PC-INB-01VRS-MS-C1,44-COPY

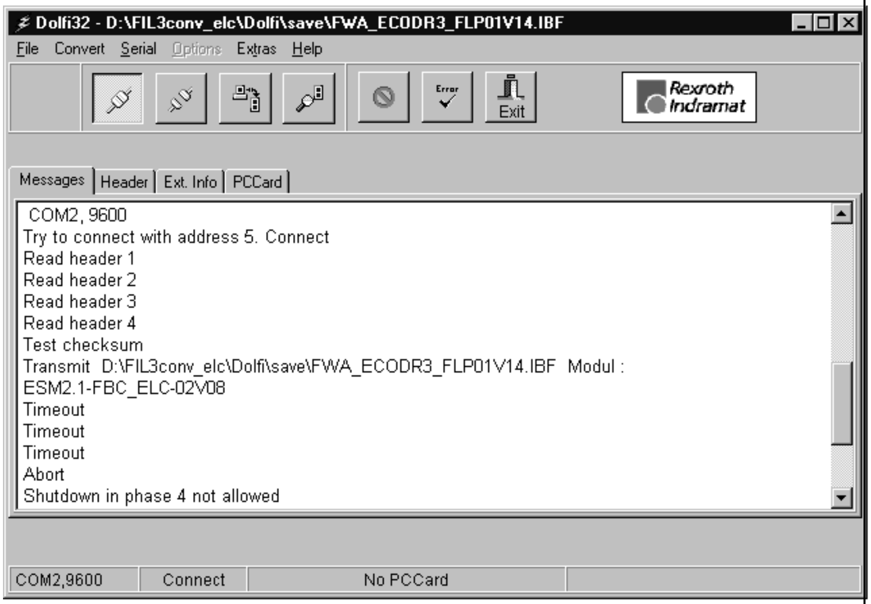
or with the Material Number: 279804

A detailed description of the program is also included.

Error Message in the Firmware Loader

If a firmware update is performed via the serial interface (using the SIS protocol), it is possible that the drive will generate error messages.

These messages are displayed both by DOLFI, as shown in the figure below, and by the drive on its 7-segment display:



Dolfi_FLx.bmp

Fig. 3-1: Example: An illustration of a “Firmware was cleared” error

The table below lists the error messages:

SIS error message number	7 segment display	Error message:
0x9002	dL / 00	Firmware was cleared
0x9003	-	Loading not allowed in phase 3.
0x9004	-	Loading not allowed in phase 4
0x9102	dL / 03	Firmware was cleared
0x9103	-	Restart not allowed in phase 3
0x9104	-	Restart not allowed in phase 4
0x9200	dL / 06	Read error
0x9400	dL / 07	Timeout during delete
0x9402	dL / 0F	Address range not in flash memory
0x940A	dL / 08	Deletion possible only in loader
0x960A	-	Programming possible only in loader
0x96E0	dL / 0b	Error during flash memory verification
0x96E1	dL / 0C	Timeout when programming flash memory
0x96FF	dL / 09	Error when writing to RAM
0x9701	dL / 0d	Wrong checksum
0x9702	dL / 0E	Wrong CRC32 checksum

Fig. 3-6: SIS errors in the firmware loader

Note: While the firmware is being updated, the 7-segment display of the drive reads "**dL**".

0x9002 (dL / 00) Firmware was cleared

Description: a) The FBC boot kernel module or FIL firmware loader is to be programmed.

The FIL firmware is running, and it or the boot kernel must be replaced. To do so, the command "Drive firmware shutdown“ must be sent, i.e., the controller must changeover from the FIL module to the ELC (FLP), FGP, SGP or SMT module. During the transition, a check is made to see whether the checksum of the ELC (FLP), FGP, SGP or SMT module is correct in order to ensure that the module was correctly programmed and that the program can be executed. This checksum validation went wrong.

b) The ELC (FLP), FGP, SGP or SMT module must be programmed.

The ELC (FLP), FGP, SGP or SMT firmware is running and must be replaced. To do so, the command "Shutdown, Loader“ must be sent. This means that the controller must change over from module ELC (FLP), FGP, SGP or SMT to module FIL: During the transition, a check is made to see whether the checksum of the FIL module is correct in order to ensure that the module was correctly programmed and that the program can be executed. This checksum validation went wrong.

Clearing Errors: For a) The ELC (FLP), FGP, SGP or SMT module must be programmed prior to programming the FIL module.

For b) The FIL module must be programmed prior to programming the ELC (FLP), FGP, SGP or SMT module.

0x9003 Loading not allowed in phase 3

Description: The drive is in manual or automatic mode and switchover to the firmware loader for replacement of the firmware is required. This operation is possible only in parameter mode.

Clearing the Error: Switch the drive to parameter mode.

0x9004 Loading not allowed in phase 4

Description: The drive is in manual or automatic mode and switchover to the firmware loader for replacement of the firmware is required. This operation is possible only in parameter mode.

Clearing the Error: Switch the drive to parameter mode.

0x9102 (dL / 03) Firmware was cleared

Description: The drive firmware is to be restarted after replacement of the firmware. The programming of the ELC (FLP), FGP, SGP or SMT module was incomplete (checksum validation went wrong).

Clearing the Error: The ELC (FLP), FGP, SGP or SMT module must be reprogrammed.

0x9103 Restart not allowed in phase 3

Description: The drive is in phase 3 and the drive firmware must be restarted. This operation is possible only in parameter mode.

Clearing the Error: Switch the drive to parameter mode.

0x9104 Restart not allowed in phase 4

Description: The drive is in phase 4 (manual/automatic) and the drive firmware must be restarted. This operation is possible only in parameter mode.

Clearing the Error: Switch the drive to parameter mode.

0x9200 (dL / 06) Read error

Description: A memory module is to be read. An error occurred while making the attempt.

Clearing the Error: Check address range in the *.ibf file. If the address range is in order, i.e., a memory module is actually present at that address, then the error can be cleared only by replacing the ESF02.1 firmware module.

0x9400 (dL / 07) Timeout during reset

Description: An error occurred while trying to delete a flash memory.

Clearing the Error: Repeat the delete command. If the error continues to appear, it can only be cleared by replacing the ESF02.1 firmware module.

0x9402 (dL / 0F) Address range not in flash memory

Description: An address range not in the flash memory must be cleared.

Clearing the Error: Correct the address range in the SIS service or check the address range in the *.ibf file.

0x940A Reset only possible in loader

Description: Drive firmware is running and a flash memory is to be cleared.

Clearing the Error: Change over to the firmware loader.

0x96E0 (dL / 0b) Error verifying the flash memory

Description: An error occurred during programming. Write access to a memory cell in the flash memory was unsuccessful.

Clearing the Error: The flash memory must be deleted prior to the programming command. If the error continues to appear, it can only be cleared by replacing the ESF02.1 firmware module.

0x96E1 (dL / 0C) Timeout programming the flash memory

Description: A timeout occurred during programming. Write access to a memory cell in the flash memory was unsuccessful.

Clearing the Error: Programming command repeated. If the error continues to appear, it can only be cleared by replacing the ESF02.1 firmware module.

0x96FF (dL / 09) Error during write access to RAM

Description: An error occurred during programming. Write access to a memory cell in the RAM was unsuccessful.

Clearing the Error: Check whether the target address is actually in the RAM. If the error continues to appear, it can only be cleared by replacing the ESF02.1 firmware module.

0x9701 (dL / 0d) Wrong checksum

Description: The programmed checksum is validated once the firmware module has finished updating. This validation check went wrong.

Clearing the Error: Reprogram the module; validate the checksum of the source file (*.ibf).

0x9702 (dL / 0e) Wrong CRC32 checksum

Description: The programmed CRC32 checksum is validated once the firmware module has finished updating. This validation check went wrong.

Clearing the Error: Reprogram the module; validate the checksum of the source file (*.ibf).

Additional Problems when Loading Firmware

The programming of a module was terminated

Problems on the serial interface can lead to the termination of a transmission.

If the loading procedure for the FBC module was terminated, the unit must not be switched off. This module is responsible for starting the firmware and is therefore absolutely necessary.

A module that has not been completely programmed can simply be reprogrammed (open *.ibf file, press transmit key, select *Modules, single* in the "Send" window, and then press the "*Skip*" key to find the right module. After that, press the send key).

After switching the unit on, the display reads dL

The last programming procedure with DOLFI was not completed correctly.

To exit the firmware loader, one or all of the modules of an *.ibf file must be programmed with DOLFI. The drive firmware is then started by pressing the "*Abort*" key.

DOLFI Cannot Establish a Connection

a) A baud rate other than that in DOLFI was set in Parameter B001.

B001, Baud rate RS-232/485

Baud rates possible [baud]

09600

19200

It is recommended that Parameter B001 be set to 09600 baud for the "Connect" process. The baud rate for the download can be set to a different value in DOLFI.

If the programming of a module was terminated, (e.g., due to interference at a serial interface), the baud rate for the download still remains set in the DKC. For DOLFI to be able to re-establish a connection, it is necessary to set the connect baud rate to the same value used for the most recent download.

If the unit has been switched back on and the display reads dL, then a baud rate of 9600 is always set.

b) The receiver and unit addresses are not identical to the addresses set at the controller via switches S2 and S3.

c) Parity check in Parameter B001: Parity must be set to NO or EVEN.

DOLFI Cannot Open the *.ibf File

DOLFI signals "Wrong *.ibf format“ when opening the *.ibf file.

The *.ibf file was generated using a different release and the *.ibf format has changed from that used in the DOLFI version.

To open the file, the correct DOLFI version must be used. This version can be obtained from the manufacturer.

DOLFI Signals Timeout

Timeout messages appear while the *.ibf file is being transmitted. Interference at the serial connections could be the problem or a deactivated COM interface FIFO buffer.

This function can be activated as follows:

Windows 95:

Start Settings → Control Panel → System → Device Manager
Ports (COM and LPT) → COM port (COMx) → Port Settings → Advanced

Activate FIFO buffer using standard setting

Windows NT:

Start → Settings → Control Panel → Ports → COMx → Settings → Advanced

Activate FIFO buffer

Select the Download Baud Rate

Depending on the length of the serial interface cable, there is a physical limit to the maximum baud rate at which serial communications will proceed without errors.

The factory recommends a maximum download baud rate of 19.2 kBd. The baud rate can be increased considerably in some applications, however, which helps achieve a reduction in the time needed for a firmware update.

The following baud rates can be implemented at the specified cable lengths.

Cable length / m	**max. baud rate / kBd**
2	115,2
5	57,6
10	57,6
15	38,4

Fig. 3-7: Maximum Baud Rate Depending on Cable Length

3.6 Firmware Update of ECODRIVE

The previous description also applies to the downloading of new firmware to the ECODRIVE.

Serial transmission to X2 takes place via the RS 232 port.

The communications parameters of the DOLFI program must be set as follows:

Settings	**COM-Port**	Connect baud rate	9600
		Download baud rate	115200
Settings	**Address**	Receiver	x

3.7 Firmware Update in BTV04/05

The previous description also applies to the transmission of new firmware to the BTV04/05 display unit.

Serial transmission to X3 takes place via the RS 232 port.

The communications parameters of the DOLFI program must be set as follows:

Settings	**COM-Port**	Connect baud rate	9600
		Download baud rate	38400
Settings	**Address**	Receiver	3

Caution: The **BTV04*-DOL-01Vxx** module must never be overwritten.

Setup Menu in the BTV

Enter the Setup Menu by

- pressing the F2 key while the BTV is in the initialization phase.
- pressing Shift + F6

Enter the Setup Menu for Port 2 by pressing F1 (Serial Port Parameter) and then F3 (Serial Port 2)

Set to

Address:	3
Baud rate:	9600
Parity:	off
Protocol:	ASCII +SIS
Answer Delay:	1 4
Timeout (ms):	400
Retry:	2
Group No.:	0
Max Unit:	0

Once these data are set, exit this input level by pressing ESC. These data are stored by pressing F3 (Save Values and Reboot).

4 Motor Configuration

4.1 Characteristics of the Different Motor Types

The following motor types can be used.

MKD	MHD
2AD	ADF
1MB	MBW
MKE	LAR
MBS	LSF
	LAF

The individual motor types all have one characteristic in common.

- The presence of data memory in the motor encoder for all motor-specific parameters

The individual motor types have the following characteristics

Motor type	Motor Feedback Data Memory	Sync./Async.	Temp. Check	Motor-Encoder Interface	”Basic Load”	Temp. Sensor
MHD/MKD/MKE	yes	synchronous	fixed	fixed (1)	possible	PTC
2AD/ADF	no	asynchronous	param.	param.	no	NTC
1MB	no	asynchronous	param.	param.	no	NTC
LAF/LAR	no	asynchronous	param.	param.	no	PTC
LSF	no	synchronous	param.	param.	no	PTC
2AD with PTC	no	asynchronous	param.	param.	no	PTC
MBS	no	synchronous	param.	param.	no	PTC

Fig. 4-1: Characteristics of Motor Types, Part 1

Motor-Feedback Data Memory

The motor-feedback data memory contains all motor-specific parameters

MHD, MKD and MKE motors have a motor feedback data memory in which all motor-specific parameters are stored. The drive controller automatically detects this data memory and reads the parameters from it following power up and exiting of parameter mode.

The data memory contains values for the following parameters:

- **CM00, Motor type**
- **CM01, Motor peak current**
- **CM02, Motor current at standstill**
- **CM03, Maximum speed Motors**
- **CM04, Pole pair number/pole width**
- **CM05, Torque-/Force-constant**
- **CM06, Rotor inertia**
- **CM08, Holding brake current [A]**

Temperature Monitoring

The power-off threshold of the motor-temperature monitoring system is fixed for MHD, MKD, MKE motors.

The following parameters are used to monitor the motor temperature :

Motor warning temperature

Motor shutdown temperature

For MHD, MKD and MKE motors, the parameter default values are fixed at the following values:

Motor warning temperature = 145.0°C

Motor shutdown temperature = 155.0°C

The drive controller checks for proper functioning of the motor temperature monitoring system. If discrepancies occur (temperature drops below –10° Celsius), the warning **E221 Warning, Motor temp. surveillance defective** will be displayed for 30 seconds. After that, the error message **F221 Error, Motor temp. surveillance defective** is generated.

Load Default

MHD, MKD and MKE motors have data memory circuits in their encoders. The memory contains a set of default control parameters in addition to all motor-dependent parameters.

These parameters are activated with “load default.”

4.2 Setting the Motor Type

The setting of the motor type is either:

- dependent on the motor type used or
- performed automatically by reading the motor feedback memory

The motor type should be set before start-up because the motor type affects the drive functions:

Automatic Setting of the Motor Type for Motors with Feedback Memory

MHD, MKD and MKE motors have a motor feedback data memory in which the motor type is stored (along with other information). The drive controller recognizes these motor types automatically, and the following actions are taken:

- The value of parameter **CM00, Motor type** is set to its proper value and is write-protected.
- The value of parameter **C001, Interface fbk. device 1** is set to the defined value for the corresponding motor type.
- All motor-specific parameters are read from the motor feedback memory.
- The value for **Motor warning temperature** is set to 145.0°C and for **Motor shutdown temperature** is set to 155.0°C.
- The value of **Parameter CM07, Holding brake type** is set to "0". The value for the **Holding brake delay period** is set to 150 msec.

This process is executed immediately after the unit is switched on. The command error message, **C204 Motor type incorrect**, will be generated if an MHD, MKD and MKE motor is selected in parameter CM00, **Motor type**, but the corresponding character string cannot be found in the motor feedback data memory.

4.3 Synchronous Motors

This drive firmware can be used to run the following Rexroth Indramat housing motors

- MHD
- MKD and MKE motors

plus rotary and linear synchronous kit motors, types MBS and LSF. Indramat housing motors have the stator, rotor, bearings and encoder factory-installed in the housing. They are equipped with a motor feedback data memory containing

- motor parameters
- motor feedback parameters
- synchronous motor-specific parameters and
- default control parameters

Automatic Detection and Parameter Loading of INDRAMAT Housing Motors (MHD and MKD Motors)

These motors are recognized by the firmware and the correct settings for them are made automatically. In these motors, the adjustment between the physical rotor position and the position supplied by the encoder has already been performed at the factory. The resulting offset is stored in the **Commutation offset** parameter in the motor feedback data memory (synchronous-motor-specific parameter). INDRAMAT housing motors are configured ready for operation at the factory, meaning that they can be placed in service without having to make any additional motor-specific settings.

4.4 Motor Holding Brake

A motor holding brake can be mounted via a potential-free contact built into the drive controller . It prevents unwanted axis movements when the drive enable signal is off. (e.g. for vertical axes without counterweights)

Note: The holding brake for Rexroth Indramat motor types MHD and MKD is not designed to halt operation of the drive. After about 20,000 motor revolutions with the brake applied, it is worn down.

Pertinent Parameters

To set the motor holding brake, use the following parameters

- **A119, Best possible halt**
- **CM07, Holding brake type**
- **Holding brake delay time (always 150 ms)**

The parameters for the motor holding brake are automatically set in motors with motor feedback data memory

With MHD, MKD and MKE motors, **Parameter CM07** is set automatically.

Setting the Motor Holding Brake Type

The motor holding brake type can be set using **Parameter CM07, Holding brake type**.

The following are stipulated:

- self-releasing or self-holding brake
- Spindle brake or servo brake

0 0

0 = self-holding brake
0V at the brake, brake applied

1 = self-releasing brake
24V at the brake, brake applied

0 = Servo brake
brake is applied after reaching the max. braking time.
1 = Main spindle brake
Brake is applied only at < 10 RPM

Behavior with Spindle Brake

CM07 Holding brake type

The motor holding brake is always activated when the actual velocity of the motor is less than 10 RPM.

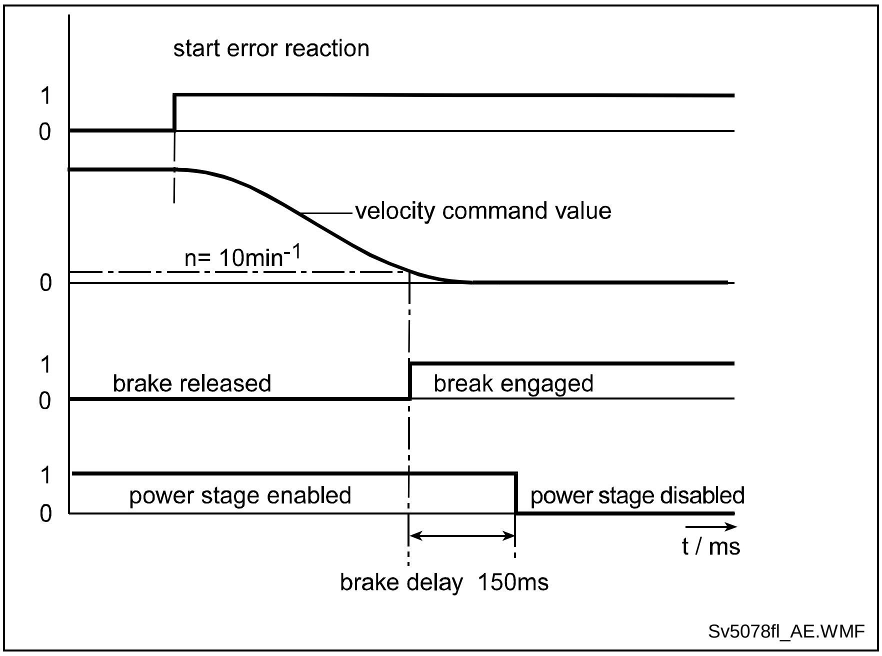


Fig. 4-2: Timing Diagram for Command Value Reset and CM07, Holding Brake Type (Spindle Brake)

Behavior with Servo Brake

CM07, Holding brake type

Braking time < A119

Activation of the brake takes place

- as soon as the velocity drops below 10 RPM during the error reaction or
- after the maximum deceleration time has elapsed at the latest.

Correctly set braking time

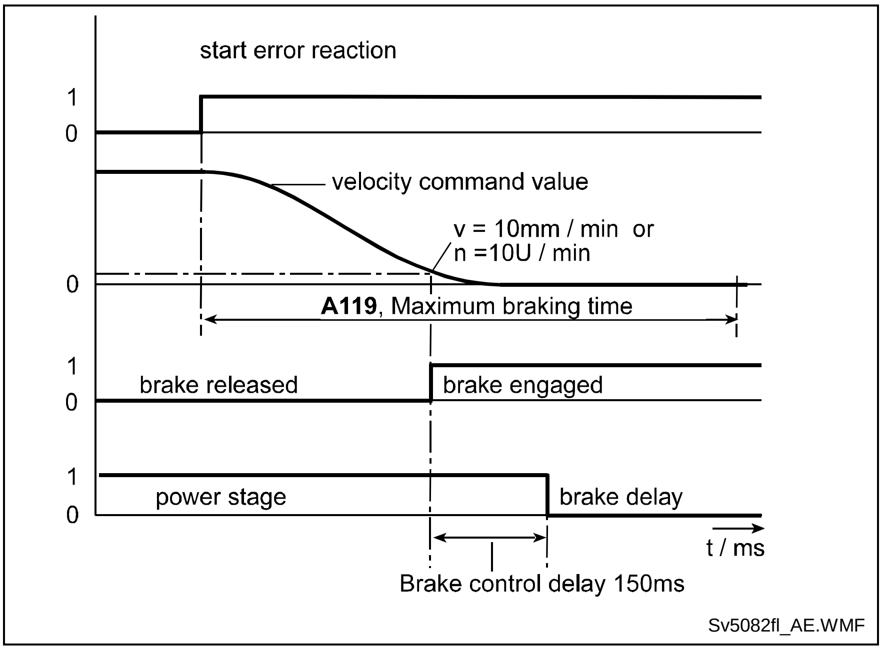


Fig. 4-3: Timing Diagram for Command Value Set to Zero and CM07, Holding Brake Type (Servo Brake) and Actual Braking Time < A119

Incorrectly set braking time

Behavior with Servo Brake

CM07, Holding brake type

Braking time > A119

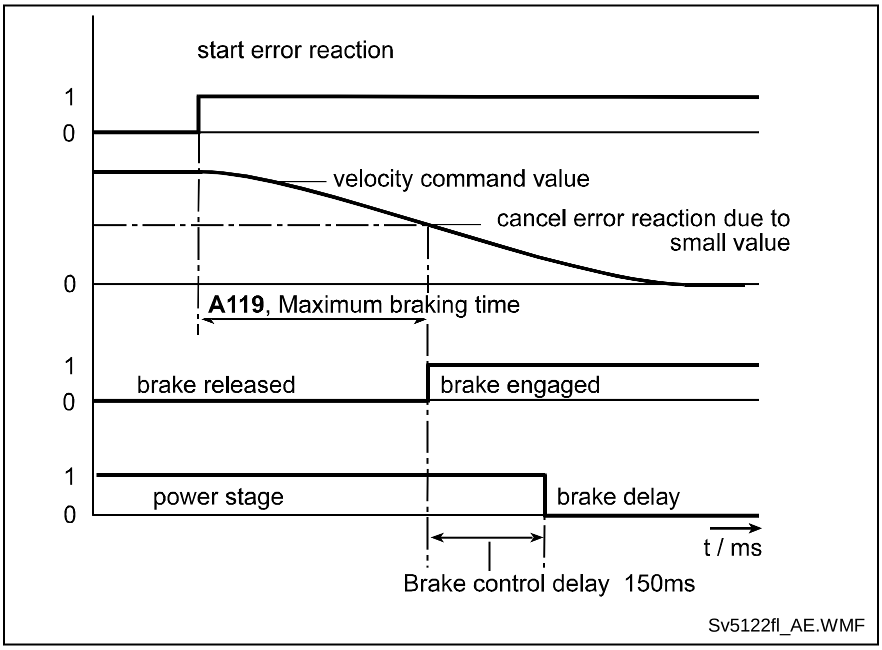


Fig. 4-4: Timing Diagram for Command Value Set to Zero and CM07, Holding Brake Type (Servo Brake) and Actual Braking Time > A119

Setting Maximum Decel Time

The **Best possible decel time parameter** is used to monitor the braking time and activate the motor holding brake if the theoretical braking time is exceeded due to an error.

The motor holding brake is activated once the time (set in **A119, Best possible halt)** since the start of the error reaction has elapsed.

Note: The value in **A119, Best possible halt** must be set so that the drive can come safely to a standstill from the maximum speed at the maximum moment of inertia and greatest load forces.

CAUTION

If the value in **A119, Best possible halt** is set too low, then the error reaction is terminated and the motor holding brake is activated at a speed greater than 10 RPM. Over time, this will damage the brake !

Connecting the Motor Holding Brake to the ECO03

See also Project Planning Specifications

5 Writing the User Program

5.1 Overview of All User Commands

5.2 General Information

The basic programming is preprogrammed, and the user has no external access to it.

The programming language for the user program is a code similar to the BASIC programming language and was developed especially for use with this program.

The user program can have a maximum size of 1000 instructions or lines. Only one command is stored within each program instruction.

In programming, any four-digit program number between 0000 and 0999 is allowed.

The user program can be loaded via the serial port.

Program input can take place in any operating mode. A running program should not be interrupted.

With most commands, the processing time for an instruction is exactly the same as the CPU cycle time of 2 ms.

After that, the instruction with the next higher sequence number is processed (unless a jump instruction is given). In the descriptions that follow, this action is called ‘proceed immediately to next instruction.’

In the case of commands involving wait states for receipt of an outcome, the process time is always extended by the CPU cycle time required for the outcome to arrive.

In most commands, both constants and variables can be used. For clearer understanding, command examples are shown with variables and with constants. If both example lines contain a variable or a constant in the same location, only this type of value is allowed.

5.3 Loading the Program

The program can be loaded via the serial port of any computer having an RS232C or RS485 interface.

Parameters B001 and B002 control the activation and setting of the serial interface. The programming module can be used to provide a default setting to ensure establishment of a reliable communications link.

Handling of the interface and the transmission format used are described in Section 9.2.

5.4 Starting the User Program

The user program can be started only in the ‘Automatic’ operating mode. One exception is the ‘manual vector’

The program start address for Task 1 is reset to '0000' after each change of operating mode or system restart. The start addresses for Task 2 and Task 3 are set in **Parameter AA00**.

In Task 3, the program runs as a higher-level program in every operating mode (except parameter mode) and is not affected by the ‘Start’ or ‘Immediate Stop’ input variables.

The program start command is received via the ‘Start’ input.

5.5 Stopping the User Program

The running program can be stopped again at any time. There are two ways to accomplish this:

1) Stop the program externally using the ‘Immediate Stop’ input
2) Stop the program using the JST user command

If the operating mode was not changed after such a stop, the program continues from the point of interruption once the start command is received.

There are also two ways to interrupt the user program. Unlike a program stop, no start command is required once the cause of the interrupt is removed, i.e., the program continues from the point of the interrupt.

1) Program interrupt caused by signal at input 'Interrupt'
2) Program interrupt caused by signal at input 'Feed angle monitoring'

See also Section 8, Parameter A116

In the event of an error message, the user program is always stopped in Tasks 1, 2. Continuation of the program following correction of the problem is possible only at instruction 0000 for Tasks 1 and 2 for the instruction defined in **Parameter AA00**.

5.6 Variables

The commands contain data which are contained in the instruction.

These constants can also be changed on-line via the serial interface, but not from the user program.

Using variables is an alternative. They can be programmed in place of the constants, so that this data can also be edited from the user program.

The variables are retained and all have the same format:

+12345678.123456

If a variable is used in a command, only the size of the constant that has been placed here is used. If the content of the variable is greater or less than the size of the constant, an error message is generated.

Note: The variable's operational sign is always taken into account!

---

e.g.

For a travel command POI, several inputs are shown.

With Constants:

POI 1 +123456.123 111

Velocity in ‰

Feed length in IUs

Axis 1

For feed length, the following data size is assigned	min.: -200000,000 max: +200000.000
For velocity, the following data size is assigned	min.: 000 max: 999

V600 = +00123456.123456

V601 = +999.9999

V602 = +01234567.123456

V603 = -999.99999

V604 = -1234.123456

POI 1 +V600 V601

The value +123456.123 is picked up from the variable V600.

The value 999 is picked up from the variable V603.

POI 1 +V602 V603

The value of variable V602 is too large. An error message is generated.

The value of variable V603 is negative. An error message is generated.

POI 1 -V604 V601

The content of variable V604 is negative. With the operational sign from the command, the feed length becomes positive.

Available Variables

The following variables are available for NC user programs:

V600 to V999

System Variables

The system variables can only be read.

No.	Definition
V000	Cycle counter 1 Data size 0 - 99999999
V001	Cycle counter 2 only in Automatic Mode 0 - 9999999
V002	Actual instruction, Task1
V003	Actual instruction, Task2
V004	Actual instruction, Task3
V007	Analog input 1 +/- 1
V011	Actual velocity of measuring wheel in IU/sec
V013	Strokes per minute
V014	Feed angle load
V015	IDS01: Length of IDS 00000.0
V016	IDS01: Length of IDS 0000.00
V017	IDS01: Length of IDS 000.000
V018	IDS01: Velocity ‰

Fig. 5-1: System Variables

Axis Variables

The axis variables can only be read.

No.	Definition
V100	Absolute position value of motor encoder
V101	Position command value
V102	Reserved
V103	Lag distance

Fig. 5-2: Axis System Variables

5.7 Description of Commands

ACC - Acceleration Change

ACC 1 V600 V601 or
ACC 1 999 999

Deceleration in ‰ of the value programmed in Parameter A109

Acceleration in ‰ of the value programmed in Parameter A109

Axis: 1

Acceptance of the new acceleration and deceleration value is immediate.

The new acceleration and deceleration value is retained until changed by a new ACC command.

After switching from Automatic to Manual Mode, following an error or start-up, the valid acceleration and deceleration value is always the value programmed in Parameter A109.

If the value 000 is input, it represents 1000‰

Example of how to change the acceleration value:

0000	ACC	1 999 999	- Set acceleration to 100%
0001	POI	1 +000200.000 999	- Position, then proceed immediately to next instruction
0002	AKN	MX.xx.x	- Wait until position is reached
0003	ACC	1 500 999	- Reduce acceleration to 50%
0004	WAI	00.100	- Wait (time delay)
0005	PSI	1 +000300.000 999	- Positioning at 50% acceleration without proceeding to next instruction
0006	WAI	02.000	- Wait 2 seconds
0007	JST	0000	- Program end in instruction 0000

Fig. 5-3: Example of Programming an Acceleration Change

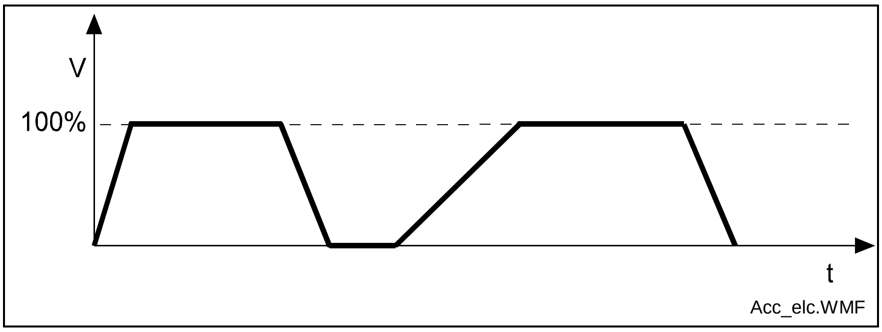


Fig. 5-4: Example Showing Acceleration Change

The program proceeds to the next instruction following one CPU cycle.

AEA – Bit set/clear

AEA Q1.02.3 V600 or
AEA Q1.02.3 1

0 = Off - Clear bit (for variables, the variable value must be 0)
1 = On - Set bit (for variables, the variable value must be <> 0)

Bit:		M2, M3, M4
	DKC21.3 :	Q0.00.4-Q0.01.3
	DKC 3.3 :	Q2.02.0-Q2.05.7

This command affects the status of the bit.

The program proceeds to the next instruction following one CPU cycle.

AKN – Compare bit

AKN M2.02.2 V600 or
AKN M2.02.2 1

0 = Off - Wait until status of the bit is at '0'
1 = On - Wait until status of the bit is at '1'

Bit:	M0 – M5
	I0 - I4
	Q0 - Q2

This is where the status of the programmed bits is verified. The program proceeds to the next instruction as soon as the bit assumes the desired status.

For inputs not present in the hardware, the signal level is always set to '0.'

AKP – Compare byte

AKP M2.02 11022001

Bit field

Byte: M0 – M5
I0 - I4
Q0 - Q2

This command represents an extension of the 'AKN' command. It can be used to verify that conditions have been for a particular byte. The program proceeds to the next instruction if all bytes have met their conditions simultaneously. If not, the program waits at this instruction until all conditions for proceeding on to the next instruction have been met.

Three different conditions are possible:

0 = The bit is checked to see if it is set to '0'
1 = The bit is checked to see if it is set to '1'
2 = The bit is not checked

Example:

```
0008_AKP_M_0_._0_5_ _2 1 0 0 1 2 2 0
                     7 6 5 4 3 2 1 0
```

Bits 0, 4 and 5 are checked to see if they are set to '0.'
Bits 3 and 6 are checked to see if they are set to '1.'
Bits 1, 2 and 7 are not checked.

The program proceeds to the next instruction once all bits are in the correct state.

APE – Byte set/clear

APE M2.02 21022001

Bit field

Byte: M2, M3, M4

DKC21.3 : Q0.00.4-Q0.01.3

DKC 3.3 : Q2.02.0-Q2.05.7

This command represents an extension of the 'AEA' command. It can be used to switch the bits in a byte. At the same time, each of the bits can be controlled independently.

Three different conditions are possible:

0 = The bit is set to \`0´
1 = The bit is set to \`1´
2 = The status of the bits remains unchanged

Example: a)

```
0008_APE_M2.02 _2 1 0 0 2 2 1 0
                7 6 5 4 3 2 1 0
```

Bits 0, 4 and 5 are set to \`0.´
Bits 1 and 6 are set to \`1.´
Bits 2, 3 and 7 are not changed.

Example: b)

```
0008_APE_M2.02 _2 1 1 1 0 0 0 2
                7 6 5 4 3 2 1 0
```

Bits 1, 2 and 3 are set to \`0.´
Bits 4, 5 and 6 are set to \`1.´
Bits 0 and 07 are not changed.

The program proceeds to the next instruction following one CPU cycle.

BAC – Branch conditional on count

BAC V600 +1234 V603 or
BAC 0345 +1234 12345

- 12345: Preset count
- +1234: Counter offset
- 0345: Target location

Like the COU command, this command allows the program to count events, process cycles, quantities, etc.

First the quantity is incremented. Then the actual quantity is compared with the target quantity. If the programmed target quantity is not reached, the program jumps to the target location. If the target quantity is reached, the actual quantity is reset to zero and the program proceeds to the next instruction.

Examples: a) Count following the event

0000	WAI	01.000
0001	PSI	1 +000050.000 250
0002	BAC	0000 +0000 00010
0003	JST	0000

Positioning is executed 10 times, and then the program waits for a new start signal.

Examples: b) Count prior to the event

0000	BAC	0002 +0000 00010
0001	JST	0000
0002	PSI	1 +000050.000 250
0003	WAI	01.000
0004	JMP	0000

Positioning is executed 9 times, and then the program waits for a new start signal.

For additional information on this command, see the explanation below under the COU command.

BCE – Branch Conditional on bit

BCE V602 M0.02.3 V600 or
BCE 0100 M0.02.3 1

0 = Low - Jump when status is '0'
1 = High - Jump when status is '1'

Bit: M0 – M5
I0 - I4
Q0 - Q2

Target location

The jump is executed if the programmed bit has met the preselected condition.

If the condition is not met, the program continues at the instruction with the next higher number.

The program continues after one CPU cycle.

BIC – Branch Conditional on bitfield value

BIC V600 V601 M2.02.3 2 1 or
BIC 0234 10 M2.02.3 2 1

Mode
0 = Evaluate as binary (input values 2 through 9 for future expansions, e.g., BCD, Gray code, etc.)
1 = evaluate BCD

Number of bits: 1 to 8

Starting bit : M0 – M5, I0 - I4, Q0 - Q2

Jump length : Maximum value = 99

Jump offset

This command executes a jump to a calculated target location. The destination depends on the state of the programmed bits. Up to 8 bits are considered. If a target location of >0999 is produced, the error message ‘illegal instruction’ is generated.

The target location is calculated as follows:

$$\boxed{Target\,location = JumpOffset + (Overall\ Evaluation \times Jump\ Length)}$$

Fig. 5-5: Calculation of Target Location with Binary Input Logic

Examples:

		M2.03			M2.02							
Starting bit :	:	2	1	0	7	6	5	4	3	2	1	0
Current status	:	0	1	1	0	1	1	0	1	0	1	1

1) Input	: BIC 0500 11 M2.02.4 5 0					
Selected bits:		1	0	1	1	0
Binary value	:	2^4	2^3	2^2	2^1	2^0
corresponds to decimal value	:	16	8	4	2	1
Target location	: (16 + 0 + 4 + 2 + 0) = 22 22 * 11 + 500 = 0742					

2) Input	: BIC 0300 02 M2.02.2 8 0								
Selected bits:		1	1	0	1	1	0	1	0
Binary value	:	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
corresponds to decimal value	:	128	64	32	16	8	4	2	1
Target location	: (128 + 64 + 0 + 16 + 8 + 0 + 2 + 0) = 218 218 * 02 + 300 = 0736								

The program proceeds to the target location following one CPU cycle.

BIO – Branch conditional on byte compare

BIO V600 M0.02 Q1.01 01201201 or
BIO 0123 M0.12 Q1.01 01201201

Assigned bit field
Compare byte 2 : M0 – M5, I0 - I4, Q0 - Q2
Compare byte 1 : M0 – M5, I0 - I4, Q0 - Q2
Target location

In assigned bit field is to designate which bits of the two compare bytes are to be checked for which states.

0 = The bit is checked to see if it is set to `0´.
1 = The bit is checked to see if it is set to '1'
2 = The bit is not checked

The condition is met when the state of all selected bits in both compare bytes matches the state of the assigned bit field.

The jump is executed when all conditions are met.

Example:

```
0032_BIO_0123_M2.02_Q1.00  1 1 1 1 0 0 0 0
      Compare byte 1       1 1 1 0 0 0 1 0
      Compare byte 2       1 1 0 0 0 0 1 1
      Result               1 1 X X 0 0 X X
                           7 6 5 4 3 2 1 0
```

For results places with a content of 0 or 1, the condition is met. For results places with a content of X, the conditions are not met, and therefore the overall condition is not met.

The program continues after one CPU cycle.

BPA – Branch conditional on byte

BPA V600 M2.02 21112212 or
BPA 0123 M2.02 21112212

Assigned bit field
Compare byte : M0 – M5, I0 - I4, Q0 - Q2
Target location

Here, the byte is checked for a met condition. At the same time, the condition can be stipulated separately for each bit. The jump to the target location is executed only if all programmed conditions are met. Otherwise, the program proceeds to the next instruction.

Three different conditions are possible:

0 = The condition is true if the bit is set to `0.´
1 = The condition is true if the bit is set to `1.´
2 = The bit is not checked.

The program continues after one CPU cycle.

CIO – Copy bitfields

CIO M2.02.3 Q0.01.3 V123 or
CIO M2.02.3 Q0.01.3 07

Quantity (Number of bits to be copied): (0 – 16)

Copy target : Starting bit : M2, M3, M4
DKC21.3 : Q0.00.4-Q0.01.3
DKC 3.3 : Q2.02.0-Q2.05.7

Copy source : Starting bit : M0 – M5, I0 - I4, Q0 - Q2

This command can be used to copy bit states. This command is particularly important for security programs. Regularly saving the data ensures that it may be possible to continue the program with the proper state settings following a fault.

Example:

```
0456 CIO I1.01.0 M2.02.0 5
```

The status of inputs I1.01.0 to I1.01.4 is copied to markers M2.02.0 to M2.02.4.

```
Status of the Input Bits = 7 6 5 4 3 2 1 0
                           1 0 1 0 1 0 1 1
```

```
Status of the Marker Bits = 7 6 5 4 3 2 1 0
             before       = 1 1 0 1 0
             after        = 0 0 1 0 1
```

The program proceeds to the next instruction following one CPU cycle.

CLC – Clear counter

CLC V661 or
CLC 0123

Block number of the counter to be set to zero

At the specified instruction number, this command resets the current value of a counter to zero. If the specified instruction contains no BAC or COU count command, this instruction is skipped.

The program proceeds to the next instruction following one CPU cycle.

CON – Steady state speed

CON 1 V601 +V602 or
CON 1 1 + 999

Speed in ‰ (001 to 999) of the programmed maximum speed (parameter AX00)

Direction**:** + = forward / - = back (variable value with operational sign)

0 = Inactive - continuous operation OFF
1 = Active - continuous operation ON

Axis: 1

The CON command can also be used in the ‘Homed’ state. In that case, however, the position limit values (**Parameters A113** and **A114**) must be noted.

Within the program, continuous operation can be switched off only using the commands CON, JST or PBK.

A change in the operating mode (e.g., from automatic to manual) switches continuous operation off.

Acceleration and deceleration are always executed using the current values.

The program proceeds to the next instruction following one CPU cycle.

COU - Count

COU +12345 Q0.01.3 V601 or
COU +12345 Q0.01.3 123456

Preset count

‘Preset count reached’ bit : M2, M3, M4
DKC21.3 : Q0.00.4-Q0.01.3
DKC 3.3 : Q2.02.0-Q2.05.7

Counter value offset

In the same way as the BAC command, this command allows the program to count events, process cycles, quantities, etc.

The quantity is incremented each time the instruction is processed with the COU command. Then, the actual quantity is compared with the desired target quantity. Once the target quantity is reached, the programmed output is activated and the actual quantity is set to zero.

The programmed bit is only enabled here. If it is necessary for this bit to be disabled, this action must take place at another location within the user program.

Counters can be set at any digit position as often as desired within the user program.

Example:

```
0000 CLC 0002
0001 AEA Q0.00.4 0
0002 COU +00000  Q0.00.4  000010
0003 PSI 1 +000050.000  999
0004 WAI 01.000
0005 BCE 0001 Q0.00.4 0
0006 JST 0001
```

Positioning is executed ten times. Then, output Q0.00.4 is set and the system waits for a new start signal.

Note on actual count offset for COU (Count) and BAC (Branch and count):

The counter display on the BTV04 or Status 4 via the serial interface can be used to check the counter status. The actual quantity is not apparent within the command itself. Once a COU command (BAC command) has been read in, the actual quantity can be manipulated. To accomplish this, the actual quantity offset must be entered. With the BAC command, the offset has one less digit.

Actual quantity offset	Effect
+00000 or -00000	No effect on the actual quantity
+02345 or -02345	The actual quantity offset, with its operational sign, is added to the actual quantity
000000	When the operational sign is a '0,' the actual quantity is set to zero

The actual quantity offset is significant only if the COU command (BAC command) has been read in (even via the RS interface). When the program is running, the offset has no meaning. In the user program, the actual quantity can be reset to zero using the **CLC command**.

During a production cycle, it may be necessary to change the desired target quantity. This can be accomplished by overwriting the quantity within the command and then resaving.

In order to prevent unintentional repetition of a one-time correction every time the program is read in, the offset within the command itself is reset to '+00000' once the actual quantity offset has been accepted. This prevents unintentional changes from being made to the actual quantity.

Note: The current actual quantity of every counter is retained even in the event of a fault, emergency stop, change of operating mode or shutdown!

The program proceeds to the next instruction following one CPU cycle.

CPJ – Compare and jump

CPJ V600 >= + 601 V602 V603 or
CPJ V600 >= +12345.123 1234.12 0400

Target location
Tolerance window
Operand 2
Operational sign of Operand 2
Compare condition

=	equal to	(with tolerance field)
>	greater than	
<	less than	
>=	greater than or equal to	
<=	less than or equal to	
<>	not equal to	(with tolerance field)

Operand 1

The jump to the target location is executed when the comparison has been made.

If the condition is not met, the program continues at the instruction with the next higher number.

The program continues after one CPU cycle.

Example: CPJ V600 >= +V601 0000.00 0400
V600 = 100.000
V601 = 090.000
The command branches to instruction 400

CPL – Clear position error

CPL 1

Axis nr.: 1

The position lag of the axis is set to zero on a one-time basis. Normally, this action is useful only for special tasks such as moving to a positive stop. When this task is performed, buildup of a substantial position lag is possible because the monitoring systems are deactivated and the performance of the drive has been affected.

The program proceeds to the next instruction following one CPU cycle.

Note: This command directly accesses the position control circuit. It is therefore possible for unauthorized changes to be made in the values for length, position and acceleration.

CPS – Compare and set a bit

CPS V600 >= + V601 V602 M2.02.0 or

CPS V600 >= +12345.123 1234.12 M2.02.0

Result bit M2, M3, M4

DKC21.3	:	Q0.00.4-Q0.01.3
DKC 3.3	:	Q2.02.0-Q2.05.7

Tolerance field

Compare operand 2

Operational sign of compare operand 2

Compare conditions

=	equal to	(with tolerance field)
>	greater than	
<	less than	
>=	greater than or equal to	
<=	less than or equal to	
<>	not equal to	(with tolerance field)

Compare operand 1

The result bit is set when the comparison has been made.

The program continues after one CPU cycle.

CST – Change Subroutine stack level

CST 1 1

0 = Clear the subroutine stack
1 = Correct the subroutine stack by 1 level
2 = Correct the subroutine stack by 2 levels
and so on until
9 = Correct the subroutine stack by 9 levels

0 = Task 1 and Task 2
1 = Task 1
2 = Task 2

This command can be used to correct the subroutine stack.

If several subroutines are opened within one program cycle, a direct return over several levels is not possible with the RTS command. If the subroutine stack has been corrected using the CST command, a subsequent RTS command will execute a direct return over several levels.

Note: If all subroutine stacks have been cleared, issuing an RTS command after the CST X 0 command will result in an RTS nesting 'error.'

Example:

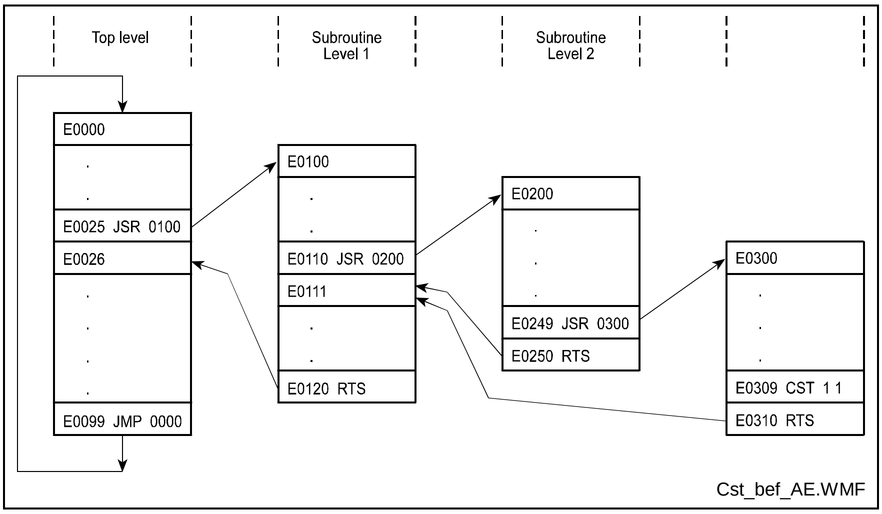


Fig. 5-6: Example Overview of Subroutine Stack Levels

CVT – Convert Variable <- -> Marker

CVT V601 M2.02 1 1

0 = BCD conversion
1 = Binary conversion

0 = Convert from a variable to a bit pattern
1 = Convert from a bit pattern to a variable

Lowest byte of the bit pattern : M2.00 – M2.12
Starting with this byte, the 8 following bytes are always converted.

Variable

This command converts a binary or BCD bit pattern to a variable or converts a variable to a binary or BCD bit pattern.

Binary : 1 x operational sign bit (1 = negative 0 = positive)
highest bit in the highest byte before the decimal point
4 x bytes before the decimal point
4 x bytes after the decimal point

BCD : 1 x byte before the decimal point
(1-FF = negative 0 = positive)
4 x bytes before the decimal point (8 decimal places)
3 x bytes after the decimal point (6 decimal places)

The program proceeds to the next instruction following one CPU cycle.

Example:

Convert the content of a variable to a BCD bit pattern

V600 = -87654321.654321

CVT V600 M2.00 0 0

Marker Flags	**Bit Number 7654 3210**	**Valu e**	**Comment**
M2.00	0010 0001	2 1	After decimal point
M2.01	0100 0011	4 3	After decimal point
M2.02	0110 0101	6 5	After decimal point
M2.03	0010.0001	2 1	Before decimal point M2.03.0 indicates if value is even or odd.
M2.04	0100 0011	4 3	Before decimal point
M2.05	0110 0101	6 5	Before decimal point
M2.06	1000 0111	8 7	Before decimal point
M2.07	1111 1111		Operational sign

Fig. 5-7: Marker Use According to CVT Command

FAK – Length scaling factor

FAK 1 V601 or
FAK 1 1.234567

Multiplication factor
Input: from 0.000000 to 1.999999

Axis: 1

Positioning travel of the POA, POI, PSI and PSA commands is **always** the result of a preselected linear value or position and a multiplication factor.

The formula below applies for incremental positioning:

$$\boxed{\textit{Positioning Path} = \textit{Preselected Length} \times \textit{Multiplication Factor}}$$

Fig. 5-8: Calculation of Incremental Positioning

The formula below applies for absolute positioning:

$$\boxed{\textit{Target Position} = \textit{Preselected Abs.Pos.} \times \textit{Multiplication Factor}}$$

Fig. 5-9: Calculation of Absolute Positioning

Each change in the factor applies to all subsequent positioning motions. A positioning motion already in progress is no longer affected by changes in this factor.

To make a change in the operating mode (homing/automatic), the multiplication factor is preset to a value of 1.000000.

0000	PSI	1 +000100.000 999	- Positioning = 100
0001	JSR	0100	
0002	FAK	1 1.234500	
0003	PSI	1 +000100.000 999	- Positioning = 123.45
0004	JSR	0100	
0005	FAK	1 1.000300	
0006	PSI	1 +000100.000 999	- Positioning = 100.03

Fig. 5-10: Example of Multiplication Factor for Positioning Motions

The program proceeds to the next instruction following one CPU cycle.

FOL – Slave axis

FOL 1 V600 – V601 or
FOL 1 1 –01.123456

Slave factor
Input of 0.000000 to 99.999999

Gearing Factor
+ or \` ´= in the same direction
- = in the opposite direction

Status of the slave axis - in preparation !
0 = slave axis OFF
1 = slave axis ON

Axis: 1

This command assigns the parameter for the axis to be used as a slave axis. The master is Encoder 2

The FOL command can be used to enable or disable the slave axis function. The behavior of the slave axis can also be changed by using a multiplication factor.

The positioning travel of the slave axis in IUs is calculated as follows:

$$\boxed{Pos.Travel\,Master\,Axis\,in\,IU \times Multiplication\,Factor}$$

L: IUs = input units

Fig. 5-11: Calculation of Positioning Travel of Slave Axis

In calculating the positioning travel in IUs for the slave and master axes, the IUs shall be considered in terms of the feed constant for the relevant axis (slave or master). Any differences in the values calculated for the input units shall also be taken into account.

An additional positioning motion (e.g., using the POI or PSI commands) is additive to the positioning of the slave axis.

When the operating mode is changed from Homing to Automatic, or vice versa, the status (enabled or disabled) and the current value of the multiplication factor are retained.

Each time the operating mode is changed from Parameter Mode to Manual or Automatic mode, the slave axis defaults to a multiplication factor of 1.000000.

Note: Currently, deactivating operation of the slave axis in Slave or Synchronous Mode is possible only by setting the multiplication factor to zero!

See also Section 7.8, Slave Axis

The program proceeds to the next instruction following one CPU cycle.

HOM – Home Axis

HOM 1

Axis 1

This command produces an absolute measurement reference. What occurs basically corresponds to homing in Manual Mode. To accomplish this, **Parameters C009 through C012** must be programmed accordingly.

This command is not needed when the position is detected using multi-turn encoders, since they already generate an absolute measurement reference.

Otherwise, the error message ‘Illegal command’ is generated.

Significance of entries:

During homing, make sure that no command is processed which executes a drive motion.

A query within the program to determine whether homing has been successfully completed is accomplished by polling the ‘Homed’ output in **Parameter C010**.

Note: In general, completion of the homing routine following each HOM command should be verified using an AKN command.

Example:

Entry in Parameter C010 = 00.00.0 M2.02.0 00

0011	HOM	1	- Home Axis 1
0012	AKN	M2.02.0 1	- Wait until homing is completed
0013	POA	1 +000010.000 999	- Positioning absolute

A detailed description of the homing function is provided in Section 7.3.

The program proceeds to the next instruction following one CPU cycle.

JMP – Jump Unconditional

JMP V601 or
JMP 0123

Target location

When it reaches this user command the program jumps to the specified target location.

This allows the programmer to jump directly to another part of the program. This enables the main program to be divided up into fixed program blocks, which can be of great help when making changes or additions.

An unconditional jump from the end of the program to the beginning produces an endless loop. Such a program continues to run without interruption.

A valid command must be present in the target location, otherwise the error message ‘Illegal command’ will be generated.

The program proceeds to the target location following one CPU cycle.

JSR – Jump to Subroutine

JSR V601 or
JSR 0123

Start instruction of the subroutine

In programs containing several identical functions, the programming can be simplified by entering repeat functions into a subroutine.

A program structure is thus clearer and shorter.

The return from a subroutine is always automatically to the instruction with the next sequential number following the instruction which initiated the jump to the subroutine.

A maximum of 127 subroutine levels are possible. At more than 127 levels, the error message ‘JSR nesting’ is generated.

Note: The last instruction in each subroutine must be an RTS (Return From Subroutine) command. If this command is invoked without first jumping to a subroutine, the error message ‘RTS nesting’ is generated.

The program proceeds to the start instruction following one CPU cycle.

JST – Jump and Halt

JST V611 or
JST 0123

Target location

With this command, the program jumps to the specified target location. However, program execution stops there. The program continues only when the voltage changes from 0 to 1 at the system input 'Start.' With the new start signal, the program continues at the target location.

This command is used frequently to end a machining cycle.

If the drive is in motion, it is brought to a standstill by the programmed acceleration/deceleration values. The remaining travel distance is stored and executed after the next start. There is no loss of dimensions. Continuous operation using the CON command is disabled!

The output states are not changed by a JST command. In multitasking (see Section 7.7), a JST command results in a programmed stop in all running tasks. Task 3 is not affected.

This corresponds to the system input: Stop.

JTK – Program jump in parallel Task

JTK V611 1 or
JTK 0123 1

1 = Task 1
2 = Task 2
3 = Task 3
Target location

This command can be used to influence program execution in one of the other tasks. Program execution within the programmed task is aborted and the task jumps to the specified target location.

- The command JTK_0100_2 in Task 1 causes execution of the Task 2 program to continue at instruction 100.
- The JTK command can also be programmed in Task 3.
- The command JTK_0100_1 in Task 1 does the same thing as the JMP_0100 command

The program proceeds to the next instruction following one CPU cycle.

MAT - Mathematics

MAT V600 = V601 - + V602 or
MAT V600 = V601 - +123456.987654

2nd operand
Operational sign of the 2nd operand
Operation :

-	Subtract
+	Add
*****	Multiply
/	Divide

1st operand (is always a variable)
Result (is always a variable)

The calculation is transferred to a calculating unit. This unit functions independently from the cycle time. Furthermore, this calculating unit can be used by the other tasks. Therefore, this command can endure over multiple CPU cycles.

The program proceeds to the next instruction when the calculation is completed.

MOM – Torque Limitation

MOM 1 V600 V601 M2.02.3 V602 or
MOM 1 123 456 M2.02.3 100

Continuous torque limit in %. (100% corresponds to continuous current level with motor at idle) input range of 000%…400%
Warning: The Parameter A115 monitoring function remains active.
500% = torque limiting is turned off.

Bit: Torque limiting is only active when the selected bit is set to 1. M0 – M5, I0 - I4, Q0 - Q2
00.00.0 = torque limiting is always active

Maximum torque at positive stop in % (**only** valid with an active PFA/PFI command)

Maximum torque during movement to positive stop in % (**only** valid with an active PFA/PFI command)

Axis 1

This command is used to preselect the maximum torque values in % for the drive unit.

Torque limiting remains in effect until the next MOM command is invoked or as long as automatic mode is activated. When reactivating Automatic Mode, the limit is set to 400 percent.

It is also possible to overwrite the torque limiting command while the drive is running.

The program proceeds to the next instruction following one CPU cycle.

Note: When the MOM command is used, error messages may be generated if the torque limit is set too low (F228, F878). To prevent these error messages, position control circuit monitoring in Parameter A115 can be deactivated.
Caution: If this monitoring function is disabled, a malfunction may result in unmonitored acceleration of the drive unit!

Note: Parameter CM01, Bipolar torque/force limit value, limits all previous settings using the MOM command. The smaller of the two limit values in the MOM command and in Parameter CM01 is active.
Please make appropriate data selections!.

When using continuous torque limiting via the MOM command, 100% corresponds with the motor current at standstill. The peak current, which can reach four times the continuous current level depending on the motor type, is also limited to this value.

NOP – No Operation (Blank Block)

NOP

This command has no function and functions like a blank block. While executing the program in Automatic Mode, this command is processed like any other command.

The program proceeds to the next instruction following one CPU cycle.

PBK – Stop motion

PBK 1

Axis Number: 1

This command can be used to interrupt positioning motions in progress.

The relevant axis is brought to a standstill using the current deceleration value. Following deceleration, any remaining positioning travel is ignored.

If continuous operation has been enabled using CON, it is disabled.

After the PBK command has been executed, other positioning commands can follow immediately.

Example:

0000	CON	1 1 +999
0001	WAI	02.00
0002	PBK	1
0003	POI	1 +000050.000 100

After the PBK command has been read in, the axis still moves over the deceleration distance from V = 99.9% to V = 0 plus 50 IUs. There is, however, a continuous transition from V = 99.9% to V = 10%.

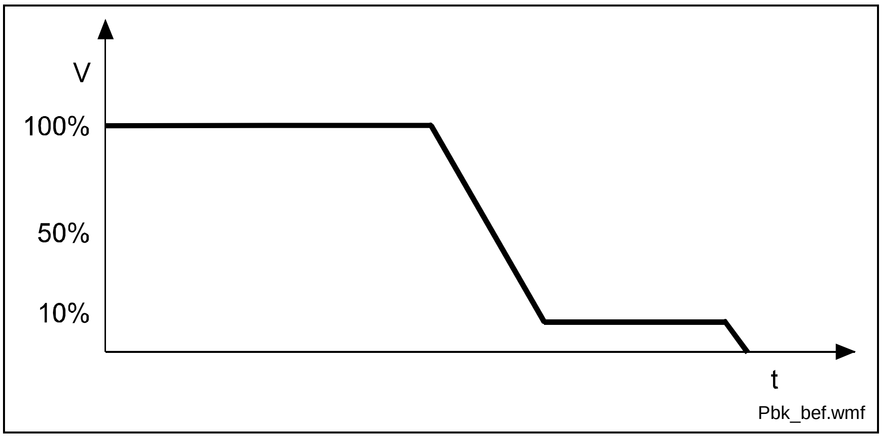


Fig. 5-12: Example of Positioning Break

The program proceeds to the next instruction following one CPU cycle.

PFA – Position absolute against end-stop

PFA 1 +V600 V601 010
PFA 1 +123456.789 123 010

Feedrate in ‰ (001 to 999) of the maximum speed (Parameter A106)

Feedrate in ‰ (001 to 999) of the maximum velocity.

Absolute position given in IUs

Axis (1).

see also PFI command and Chapter 7

PFI – Position incremental against end-stop

PFI 1 +V600 V601 010
PFI 1 +123456.789 123 010

Feedrate in ‰ (001 to 999) of the maximum speed (Parameter A106).

Feedrate in ‰ (001 to 999) of the maximum velocity.

Feed length in IUs

Axis (1).

Using the PFA/PFI commands, movement to a positive stop occurs.

The positive stop must be between the position limit values (A103, A104).

The programmed distance to a positive stop must always be larger than the exact travel distance to the positive stop, otherwise the positive stop may not be reached.

Proceeding to the next program instruction occurs immediately after fulfilling one of the following two conditions:

- Proceeding to the next program instruction if the positive stop is not reached.
- Skipping the next program instruction and proceeding to the following one if the positive stop is reached.

If the positive stop is not reached, Continuous Torque Reduction (MOM command) becomes active again.

For movement to a positive stop and standstill at the positive stop, the torque limits in the MOM command are active (see MOM command).

So that no motor overload occurs, torque settings should always be set via the MOM command. The start of a positioning movement usually occurs 150 ms after reading in the command.

POA – Position absolute

POA 1 + V600 V601 or
POA 1 +123456.789 999

- Feedrate in ‰ (001 to 999) of the maximum speed in the assigned parameter A106
- Absolute position given in IUs (input units)
- Operational sign of the position (+/-)
- Axis 1

From its current position, the drive is moved to the programmed absolute position referenced to the zero point.

Example: 1) current position = -100.00

0000	POA	1 +000200.000 999

The drive unit is moved 300 mm forward to the +200 position.

Example: 2) current position = +400 mm

0011	POA	1 +000200.000 999

The drive unit is moved 200 mm backward to the +200 position.

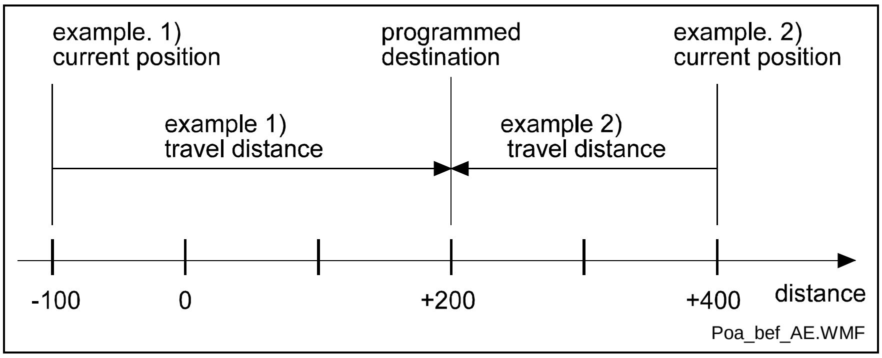


Fig. 5-13: Example of Positioning Absolute

[Callouts for Fig. 5-13]

Beisp. 1) momentane Position = example 1) current position

programmierte Zielposition= programmed destination

Beisp. 2) momentane Position = example 2) current position

Beisp. 1) Fahrweg = example 1) travel distance

Beisp. 2) Fahrweg = example 2) travel distance

This command may be used only if an absolute measurement reference is present. This is the case when an absolute multi-turn encoder is used for position detection or for position detection following a return to zero (homing), (see also Chapter 7.3, Homing). Otherwise the error message ‘Not homed’ is generated.

Example:

0000	POA	1 +00010.005 999
0001	JSR	0100
0002	POA	1 +000020.003 999
0003	JSR	0100
0004	POA	1 +000030.000 500
0005	JSR	0100

The program proceeds to the next instruction following one CPU cycle.

POI – Position Incremental

POI 1 + V600 V601 or
POI 1 +123456.789 999

Feedrate in ‰ (001 to 999) of the maximum speed given in the parameter (Parameter A106)
Feed length in IUs (input units)
Direction of movement (+ = forward / - = back)
Axis 1

The position setpoint is incremented or decremented by the amount of the programmed value.

This feed length is adjusted to account for any remaining travel distance.

Example: The drive unit traverses the distance: -100 +200 = +100

0000	POI	1 –000100.000 999
0001	PSI	1 +000200.000 999
0002	JSR	0555
0003	JMP	0000

The program proceeds to the next instruction following one CPU cycle.

PSA – Position absolute with in-Position

PSA 1 + V600 V601 or
PSA 1 +123456.789 999

- Feedrate in ‰ (001 to 999) of the maximum speed in the assigned parameter A106
- Absolute position given in IUs (input units)
- Operational sign of the position (+/-)
- Axis 1

This command corresponds to the POA command. However, the program proceeds to the next instruction only if the programmed absolute position has been reached.

The drive unit is considered to have reached the correct position as soon as it reaches the 'Position window' (see Parameter A111 'Switching level') for the programmed position.

Example:

+ 100,00	= current position
0,20	= switching level, Parameter A111
± 0,20	= position window

```
0000    PSA    1 +000200.000 999
```

The program proceeds to the next instruction when the drive unit has reached position +199.80 to +200.20.

Note: Adjustment for the highest accuracy naturally takes place even after the program has gone on to the next instruction. The adjustment accuracy is therefore not dependent on the size of the position window.

PSI – Position incremental with in-position

PSI 1 + V600 V601 or
PSI 1 +123456.789 999

- Feedrate in ‰ (001 to 999) of the maximum speed in the assigned parameter A106
- Feed length in IUs (input units)
- Direction of movement (+ = forward / - = back)
- Axis 1

This command corresponds to the POI command. However, the program proceeds to the next instruction only after the positioning procedure has been completed (position acknowledgement). This procedure is completed as soon as the drive unit has traversed the programmed feed length within the ‘Switching level’ (A111). Adjustment for the highest accuracy takes place even after the program has gone on to the next instruction.

The size of the ‘Positioning window’ is stipulated in parameter A111 (Switching level).

Example:

0000	PSI	1 +000100.000 999
0001	WAI	00.500
0002	AEA	Q0.00.6 1
0003	JSR	0666
0004	JMP	0000

First, Axis 1 is started up. Once the final position has been reached and an additional waiting time of 0.5 seconds has elapsed, output 02 is activated.

REP – Jump on max. search limit reached

REP V600 1 V601 or
REP 0100 1 123456.789

- 123456.789: Max. search path for SRM command in IUs
- 1: Axis 1
- 0100: Jump to target location if search distance is exceeded

This command is a supplement to the SRM command. It permits limits to be placed on the search distance needed to find a reference marker.

If the maximum search distance entered here is exceeded without finding a reference marker, the program executes a jump to the specified target location. At the same time, the drive unit decelerates to a complete stop.

The REP command must be executed immediately after the SRM command. A REP command alone will result in the error message 'Illegal command' when the program is executed.

The following command combinations are permissible:

1) Moving to a reference point without search distance limitation.

0020	SRM	1 +000000.000 +050 I0.01.0

2) Moving to the reference point is programmed in the SRM command.
A limit of max. 500 IUs is programmed in theREP command.

0030	SRM	1 +000000.000 +050 I0.01.0
0031	REP	0900 1 000500.000

.

RTM – Round table-Modus

RTM 1 V600 or
RTM 1 0

- 0: Rotary table mode:
  0 = mode is accepted from **Parameter A105**
  1 = shortest distance
  2 = programmed direction
  >2 = no change in mode
- 1: Axis 1

Rotary table must be preselected under the type of motion in **Parameter A100** and the axis must be homed.

The **parameter setting A105** is active after each restart or error acknowledgement, or after termination of Parameter Mode. Changing between Manual and Automatic Modes does not change the current Rotary Table Mode.

RTS – Return from Subroutine

RTS

As already described for the JSR command, a subroutine must be concluded with an RTS return command.

If several subroutine levels have been opened in one program cycle, a return from a higher subroutine level leads first to the next lower subroutine level rather than directly back to the main program.

Example:

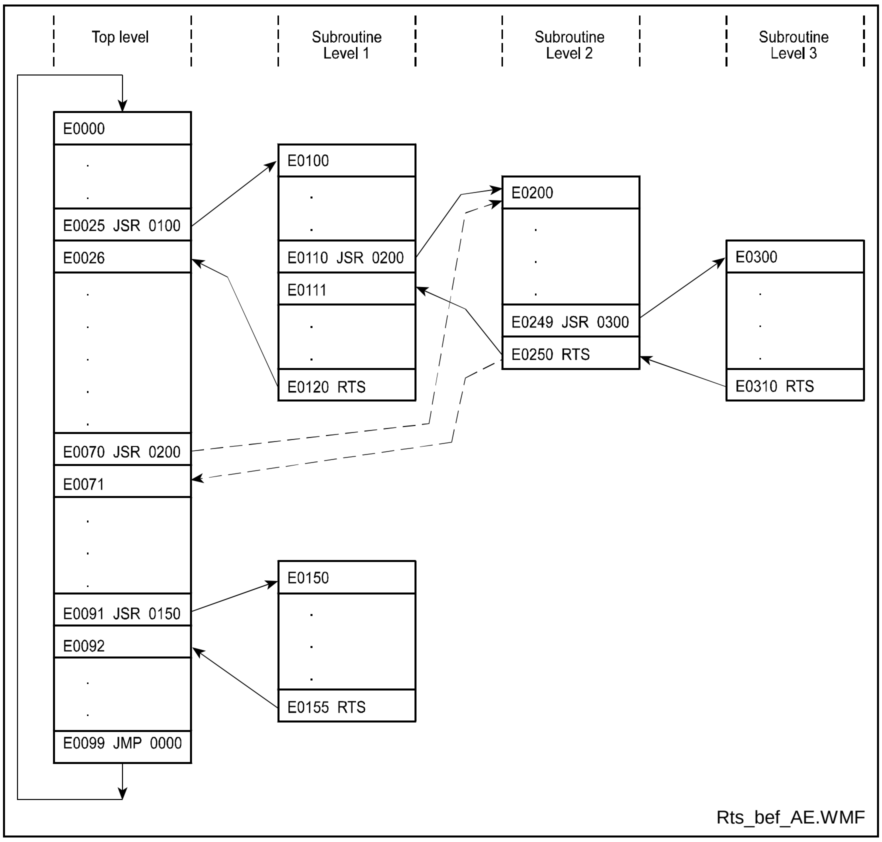


Fig. 5-14: Example of Return from Subroutine Levels

The program proceeds to the next instruction following one CPU cycle.

SAC - Set Abs. position Counter

SAC 1 V601 + V601 or
SAC 1 1 + 123456.789

Absolute position or offset in IUs
Operational sign
0 = Absolute zero offset relative to the zero position after homing
1 = Set new absolute position relative to the target position
9 = Clear 'Homed‘ (only for Parameter A100 = 0 x)

Axis 1

The command is executed correctly only when the axis signals ‘Position reached’.

Example for incremental encoders:

Min. travel limit = - 400 IU (Parameter A103)
Max. travel limit: = +900 IU (Parameter A104)

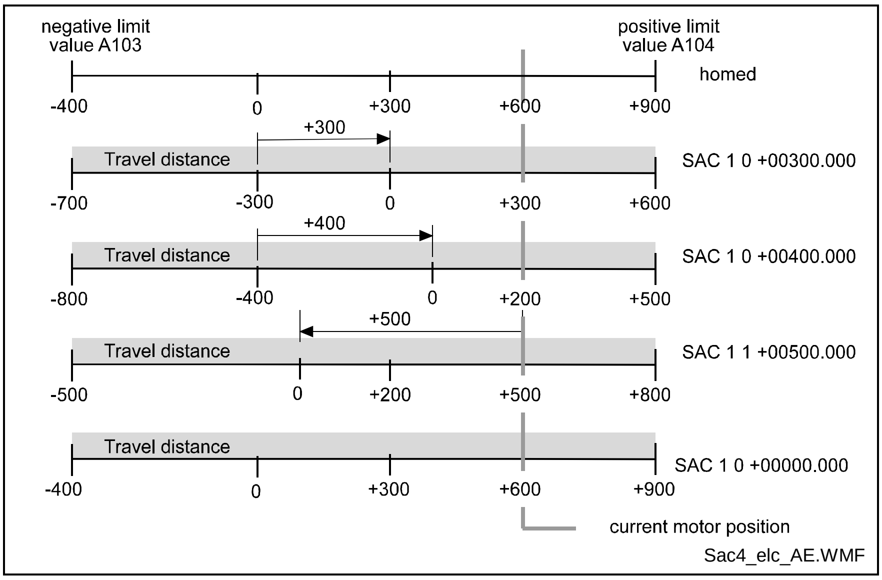


Fig. 5-15: SAC Command

For motion types 1 and 2 (Parameter A100), the coordinate system in the user program can be shifted using the SAC command.

For motion type 0 (Parameter A100), an absolute reference can be established using the SAC command. **Parameters A103, Max Position negative** and **A104, Max Position positive**) are also valid in this case. The first time this command is used, the actual axis position is set to the offset value of the SAC command. For further uses of the SAC command while the drive is homed, the offset is processed as shown in the figure. The absolute reference can be cleared using SAC 1 0 +000000.000.

The program proceeds to the next instruction following one CPU cycle.

SET – Set variable

SET V600 = + V601 or
SET V600 = +12345678.123456

New value
Operational sign
Target variable

Using this command, variables can be set from the program or copied from another variable.

The program proceeds to the next instruction following one CPU cycle.

SRM – Drive to registration mark

SRM 1 + V600 +V601 I0.01.0 or
SRM 1 +123456.123 + 123 I0.01.0

Input Reference mark (Input:Probe1 when 00.00.0 is input)
M0...M5 , I0 I4, Q0 Q2
Feedrate in ‰ (001 to 999) of the maximum speed in the assigned parameter (A106)
Search direction (0 = forward / 1 = back) (Operational sign of variable helps determine the direction)
Offset in IUs
Axis 1

This command can be used to search for a reference marker at any time. The axes, the search direction, the search velocity and the reference signal input can be freely selected. Once the command is invoked, the search for the reference marker proceeds at the preselected velocity. The reference marker is detected by means of the rising edge of a pulse (from 0V to 24V) at the programmed input.

As soon as the reference marker is detected, the program proceeds to the next instruction.
(The command did not wait for the offset to be executed.)

If a value of 00.00.0 is programmed for the reference marker input, then that input (probe 1, connector X3 / pin 4) is selected as the reference marker input. This input has no hardware debouncing. This input can also initiate an interrupt. This input is therefore able to detect the reference marker substantially more accurately (within a time frame of approx. 100 microseconds).

Offset dimension:

The move to an offset dimension (referenced to the reference point) is accomplished by means of an incremental positioning command immediately following the SRM command.

It is also possible to limit and monitor the search travel until the reference marker is found (see also the REP command).

Note: No new absolute measurement reference (zero point) is created using the SRM command. This is possible only through the homing function. (see also Section 7.3).

Detection of the reference point occurs within a time frame of 2 to 4 ms (controller cycle time). If a highly accurate reference point is required, the search velocity must be reduced. The achievable accuracy is determined as follows:

$$SearchVelocity in\, IU/s * 2 * CycleTime\,[s]$$

L: IUs = Input Units
s = seconds

Fig. 5-16: Calculation of the Search Velocity

Example: The maximum velocity is 200 IUs/s. The cycle time is 2 ms. A normal input with a debouncing time of a cycle time is selected.

0000	SRM	1 +000000.000 +500 I0.01.0

The search velocity is 200 IUs/s * 500 ‰ = 100 IUs/s. The accuracy is > 0.4 mm.

With the system input Probe1, Connector X3 / Pin 4, there is no debouncing time and the detection time is approx. 0.1 ms. The accuracy is > 0.01 IU

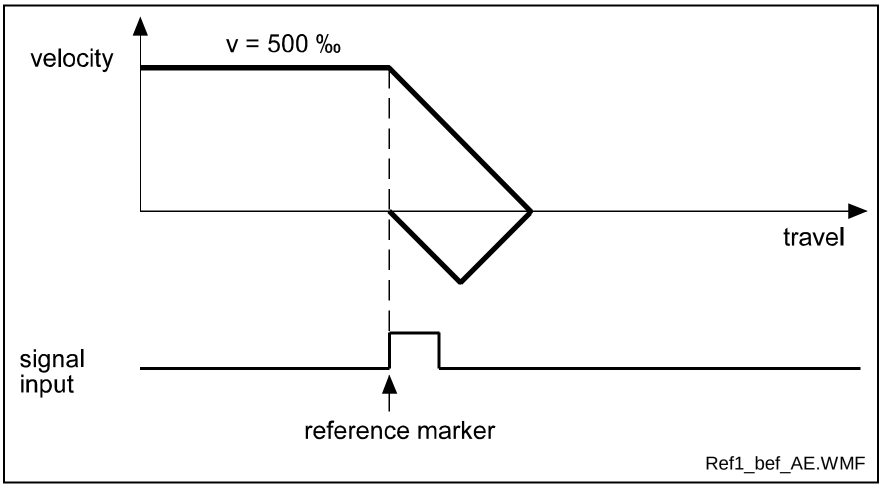


Fig. 5-17: Example of Movement to a Reference Mark

Example of moving to a reference mark with offset programming:

```
0000    SRM   1 +000200.000 +050 I0.01.0
```

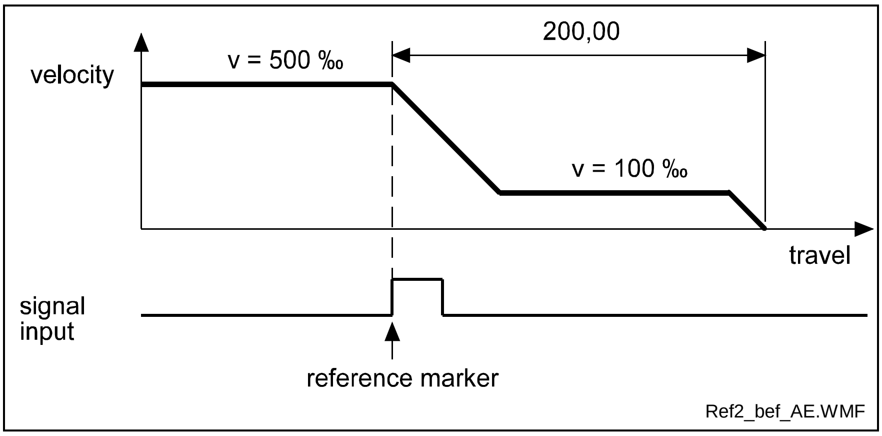


Fig. 5-18: Example of Moving to a Reference Mark with Offset Programming

VCC – Velocity change command

VCC 1 + V600 V601 0 V602 or
VCC 1 +123456.789 999 0 1

Assignment
0 = Start of the velocity change
1 = Velocity reached

0 = Distance traveled (incremental measurement input)
1 = Absolute switching point (axis must be homed)

New velocity in ‰ (001 to 999) of the maximum speed in the assigned parameter (A106)

Distance traveled in IUs up to switching point

Axis 1

Assignment 0 : Start of velocity change

Velocity changes are always referenced to the most recently initiated positioning function.

The program proceeds to the next instruction immediately after the distance programmed in the VCC command, referenced to the start position of the most recent positioning function, has been traversed.

A change in velocity can take place only when the positioning functions do not include position acknowledgement (POI, POA).

The position portion in the last VCC value must be smaller than the previously started positioning function, otherwise that VCC command is not executed and the program proceeds to the next instruction.

Example:

The actual start position is 0 mm.

0000	POI	1 +000100.000 999	- Move 100 IUs, then proceed to next instruction
0001	VCC	1 000050.000 250 0 0	- after 50 IUs, change to 25% velocity
0002	VCC	1 000075.000 500 0 0	- after 75 IUs, change to 50% velocity
0003	VCC	1 000090.000 100 0 0	- after 90 IUs, change to 10% velocity
0004	AKN	M3.00.0 1	- Wait until target position is reached
0005	WAI	01.000	- End of cycle, wait 1 second
0006	JMP	0000	- Repeat program

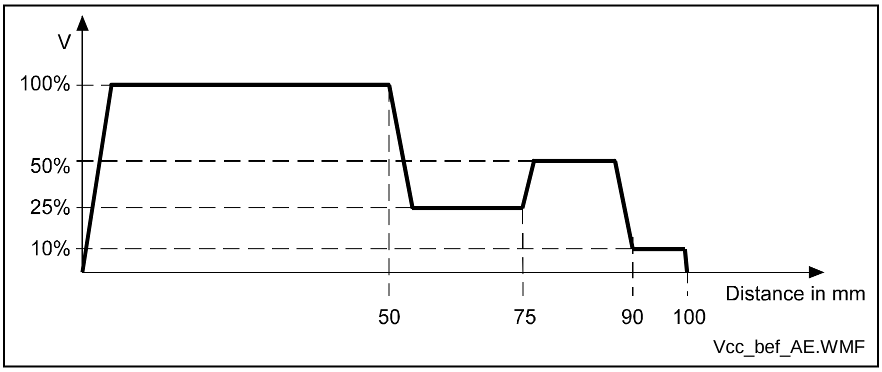


Fig. 5-19: Change Velocity

Assignment 0 : Start of velocity change

New velocity in ‰ (001 to 999) of the maximum speed in the assigned parameter (A106)

Absolute position in IUs at which the new velocity is achieved

This command changes the velocity of a positioning move in progress such that the desired velocity is reached at the specified absolute position.

The program proceeds to the next instruction immediately after the drive unit begins changing its velocity. This point depends on the acceleration, the difference in velocity and the position lag.

If this point has already been reached or exceeded when the VCC command arrives, the program proceeds immediately to the next instruction, accepting the new velocity.

The axis must be homed to zero.

Example:

The actual start position is 0 mm.

0000	POA	1 +000200.000 999	- Move to absolute position +200 IUs
0001	VCC	1 +000100.000 500 1 1	- at position +100 IUs, V = 50%
0002	VCC	1 +000180.000 100 1 1	- at position +180 IUs, V = 10%
0003	AKN	M3.00.1 1	- Wait until target position is reached
0004	WAI	01.00	- End of cycle, wait 1 second
0005	JMP	0000	- Repeat program

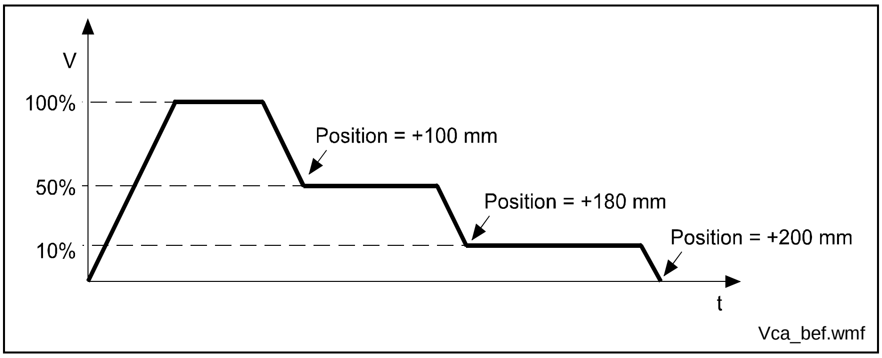


Fig. 5-20: Change Velocity (Absolute Position)

VEO – Velocity Override Command

VEO 1 1 0 V600 1 or
VEO 1 1 0 500 1

Function
0 = Override as factor
1 = Override as limit

This value is significant only in modes 4 and 6
Override value in ‰ (from 001 to 999)

0 = Read in new override value in each controller cycle (2 to 4 milliseconds)
read in
1 = Read override value only once when command is invoked

Override mode defaults
0 = Override disabled, or as programmed in **Parameter AA04**
1 = Analog value of 0...+10 volts at the corresponding analog input
2 = Binary value at inputs (weighted value, see Chp. 7)
3 = Gray code at inputs (weighted value, see Chp. 7)
4 = Override value from VEO command (see above)
5 = Default value via measuring wheel encoder (in preparation)
6 = Analog input 1 * Override value from the VEO command

Axis 1

This command produces a reduction in the velocity of all of the programmed traversing commands.

With the ‘Override as factor’ function, the override value is multiplied by the programmed velocity from the commands.

With the ‘Override as limit' function, the override value is multiplied by the programmed speed from the parameter Vmax (**Param. A106**), and therefore limits the speed. Activation of an override function using the VEO command has priority over activation of any function within **Parameter AA04**.

Once a VEO command has been invoked, it applies to all subsequent motions until it is canceled. See also the examples on the following pages.

Any change in operating mode between ‘Automatic’ and ‘Homing’ cancels the override function invoked by the VEO command. The values can be changed again in Task 3.

The program proceeds to the next instruction following one CPU cycle.

Description of Override Mode 5 (in Preparation)

This function can only be activated using the VEO command if Encoder 2 is designated as a Slave Axis in Parameter A100. Additionally, Encoder 2 must be set up correctly in the parameters (Parameter B016, B017 and B018). Otherwise, the program proceeds to the following instruction immediately.

The following relationship applies:

$$Override\,Value = \frac{MeasureWheelVel\left[IUs\,MeasureWheel\,/\,Sec.\right]}{Max.Vel.\left[IUs\,Motor\,/\,Sec.\right]} \times Multiplier$$

L: IUs - Input Units

Fig. 5-21:Formula for Default Values via Measuring Wheel Encoder

The maximum speed is taken from **Parameter A106**.

The multiplier is always equal to 1 after a change in operating mode (from Manual to Automatic or from Automatic to Manual). Using the FOL command, the multiplier can be changed and this value remains until another change in operating mode or changed input using the FOL command is executed.

If the axis reaches a speed of more than 1.25 times Vmax (Parameter A106), because of a programming error or excessive velocity of the measuring wheel encoder, the error message ` max. Override ´ is issued.

However, the velocity of the drive is limited to Vmax in any case, for measuring wheel encoder speeds > Vmax.

Examples: VEO – Velocity Override

0000	BPA	0004 M2.02 21022222	Input 1 selected; jump to program-A
0001	BPA	0006 M2.02 20122222	Input 2 selected; jump to program B
0002	BPA	0008 M2.02 21122222	Input 3 selected; jump to program C
0003	JMP	0000	Input 0 selected; wait loop
0004	VEO	1 4 1 999 1	Progr. A; velocity unchanged
0005	JMP	0009	Execute positioning function
0006	VEO	1 4 1 700 1	Progr. B; velocity limited
0007	JMP	0009	Execute positioning function
0008	VEO	1 4 1 500 0	Progr. C; reduce velocity
			Execute positioning function
0009	POI	1 +000100.000 999	Move 100 mm and proceed to next instruction
0010	VCC	1 +000035.000 800 0 0	after 35mm, change to 80% velocity
0011	VCC	1 +000050.000 600 0 0	after 50mm, change to 60% velocity
0012	VCC	1 +000065.000 400 0 0	after 65mm, change to 40% velocity
0013	VCC	1 +000080.000 200 0 0	after 80 mm, change to 20% velocity
0014	AKN	M02.02.4 1	Wait until switching threshold is reached
0015	WAI	01.000	At end of cycle, wait 1 second
0016	JMP	0000	Jump to program selection

The above example from the program generates the following velocity profiles:

1) Program A – unaffected velocity profile

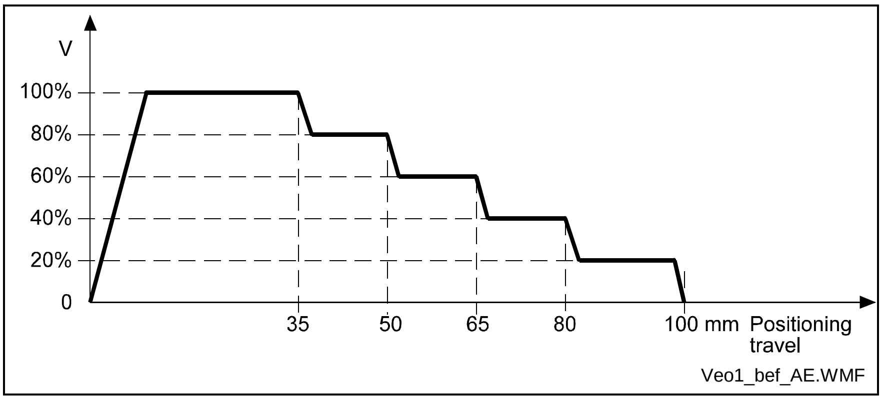


Fig. 5-22: VEO Command – Change Velocity

2) Program B – velocity limited to 70% from instruction number 0006

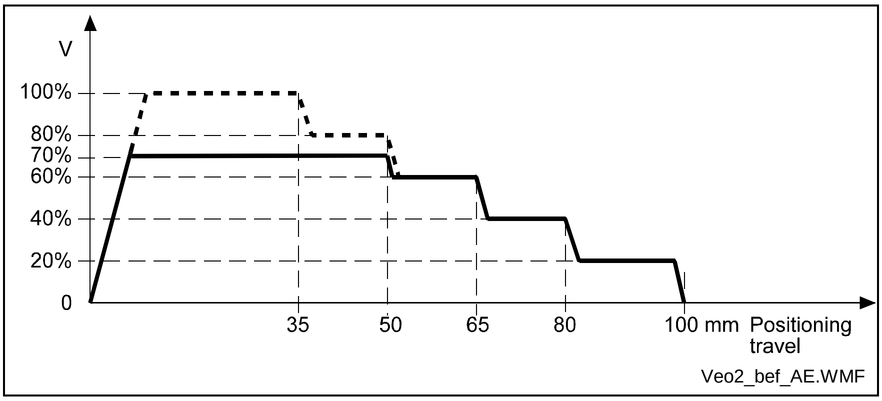


Fig. 5-23: VEO Command – Limit Velocity to 70%

3) Program C - Multiplication by factor of 500 from instruction number 0008

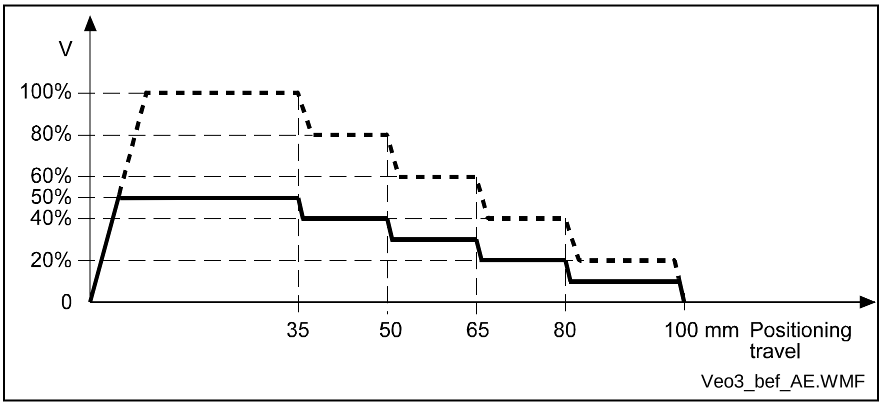


Abb. 5-24: VEO Command - Multiplication by a Factor

WAI – Wait (Time Delay)

WAI V600 or
WAI 00.500

Waiting time in seconds

Execution of the next instruction is delayed until the programmed time has elapsed, i.e., the program proceeds to the next instruction after the waiting time has elapsed. Execution of the next instruction is delayed until the programmed time has elapsed, i.e., the program proceeds to the next instruction after the waiting time has elapsed.

6 The Logic Task

6.1 Overview

The Logic Task program is written into a line-by-line memory that contains 1000 lines. It is saved in a buffered area and it can be edited via the serial interface. After turning on the unit, the program is interpreted by the built-in compiler and processed without a start signal. For programming and for stopping the Logic Task, the system must be switched to Parameter Mode. When leaving Parameter Mode, the program is recompiled and it is started immediately (only if no errors are present). If an error is present, the system cannot be started up, and must be switched to Parameter Mode again.

An average processing speed of 5000 assignments/sec is reached, where a minimum cycle time of 4 ms is present.

Load, Save, Set and Reset Assignments		**Logical Assignments**	
LD	SET	AND	XOR
LDN	SETC	AND(	XOR(
ST	SETCN	ANDN	XORN
STN	RES	ANDN(	XORN(
)	RESC	OR	
NOP	RESCN	OR(	
END		ORN	
		ORN(	

Fig. 6-1: Table of Commands

Processing Commands

NOP	No Command (can be used as a placeholder)
END	End of the assignment list
)	End of a partial term

Loading Commands

LD Q.0.11.1	Loads the value of the operand
LDN I0.00.1	Loads the negative value of the operand

Save Commands

ST M0.00.2	Assigns the current value to the operand
STN Q0.01.4	Assigns the bit-by-bit negated value to the operand

Allowed data type: BOOL

Setting Commands

SET M0.01.3	Setting the bit operand, unconditional
SETC M0.01.5	Setting the bit operand, if the previous result is TRUE; otherwise no change
SETCN M0.01.6	Setting the bit operand, if the previous result is FALSE; otherwise no change

Reset Commands

RES M0.006	Resetting the bit operand, unconditional
RESC M.01.1	Resetting the bit operand, if the previous result is TRUE; otherwise no change
RESCN M0.01.6	Resetting the bit operand, if the previous result is FALSE; otherwise no change

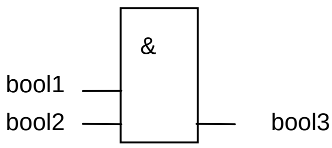
AND Logic

The ´**AND Logic**´ functions bit-by-bit.

AND	AND logic of the current value with the value of the operand
ANDN	AND logic of the current value with the bit-by-bit negated value of the operand
AND(	AND logic of the current value with the logical value of the bracket.
ANDN(	AND logic of the current value with the bit-by-bit negated value of the operand

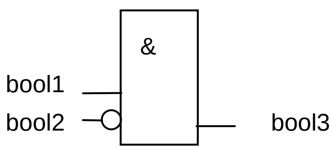
Examples: AND Logic

FBS	AWL		Type	
	LD	bool1	bool1:	BOOL
	AND	bool2	bool2:	BOOL
	ST	bool3	bool1:	BOOL



bool1	1	0	1	0
bool2	1	1	0	0
bool3	1	0	0	0

FBS	AWL		Type	
	LD	bool1	bool1:	BOOL
	ANDN	bool2	bool2:	BOOL
	ST	bool3	bool1:	BOOL



bool1	1	0	1	0
bool2	1	1	0	0
bool3	0	0	1	0

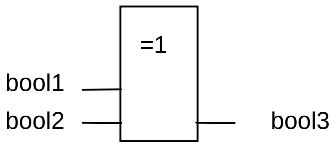
OR Logic

The ´**OR Logic**´ functions bit-by-bit.

OR	OR logic of the current value with the value of the operand
ORN	OR logic of the current value with the bit-by-bit negated value of the operand
OR(	OR logic of the current value with the logical value of the bracket.
ORN(	OR logic of the current value with the bit-by-bit negated value of the operand

Examples: OR Logic

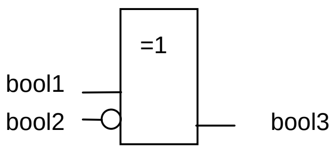
FBS



AWL		Type	
LD	bool1	bool1:	BOOL
OR	bool2	bool2:	BOOL
ST	bool3	bool1:	BOOL

bool1	1	0	1	0
bool2	1	1	0	0
bool3	1	1	1	0

FBS



AWL		Type	
LD	bool1	bool1:	BOOL
ORN	bool2	bool2:	BOOL
ST	bool3	bool1:	BOOL

bool1	1	0	1	0
bool2	1	1	0	0
bool3	1	0	1	1

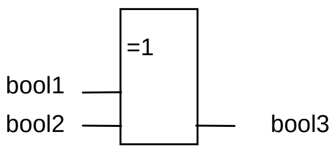
XOR Logic

The ´**XOR Logic**´ functions bit-by-bit.

XOR	Exclusive OR logic of the current value with the value of the operand
XORN	Exclusive OR logic of the current value with the bit-by-bit negated value of the operand
XOR(	Exclusive OR logic of the current value with the logical value of the bracket
XORN(	Exclusive OR logic of the current value with the bit-by-bit negated value of the operand

Examples: XOR Logic

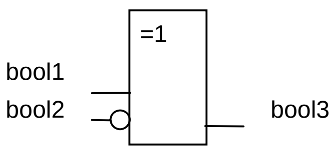
FBS | AWL | Type



LD	bool1	bool1:	BOOL
XOR	bool2	bool2:	BOOL
ST	bool3	bool1:	BOOL

bool1	1	0	1	0
bool2	1	1	0	0
bool3	0	1	1	0

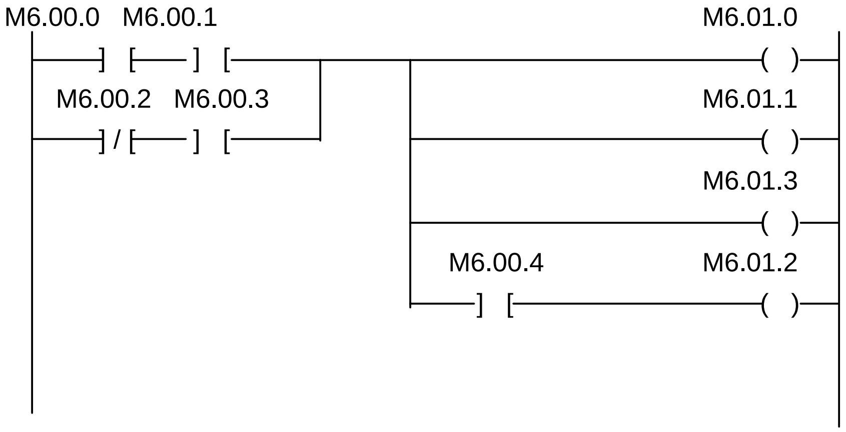
FBS | AWL | Type

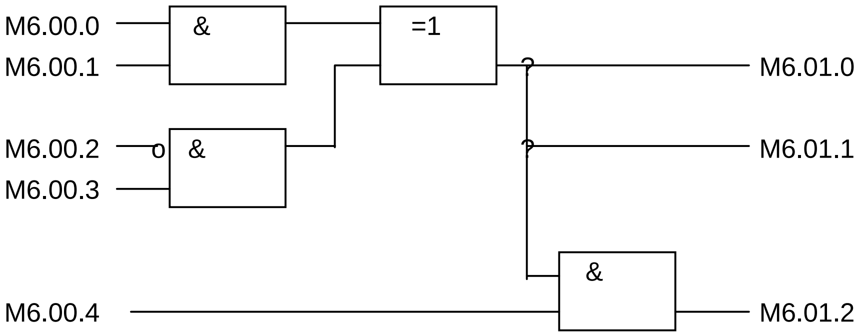


LD	bool1	bool1:	BOOL
XORN	bool2	bool2:	BOOL
ST	bool3	bool1:	BOOL

bool1	1	0	1	0
bool2	1	1	0	0
bool3	1	0	0	1

Examples:

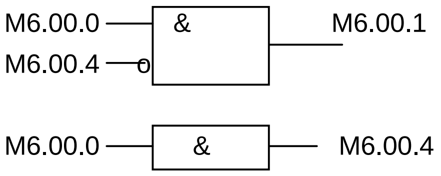





```
LDN   M6.00.2
AND   M6.00.3
OR(   M6.00.0
AND   M6.00.1
)
ST    M6.01.0
ST    M6.01.1
ST    M6.01.3
AND   M6.00.4
ST    M6.01.2
```

Spurious Pulse Positive Starting Edge

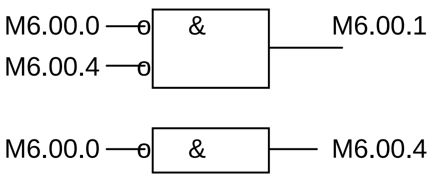
M6.00.0 = Input
M6.00.1 = Result
M6.00.4 = Intermediate flag



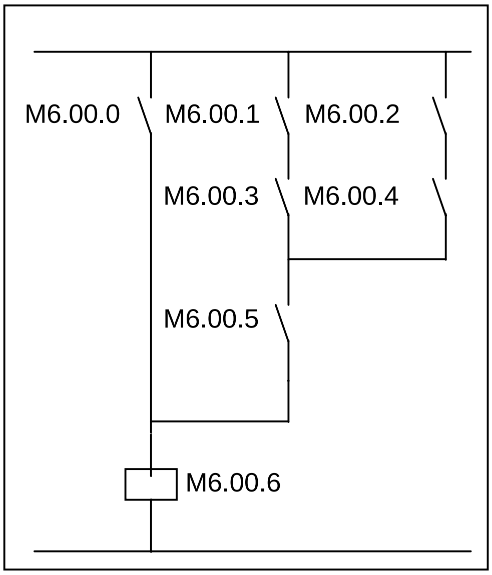

```
LD     M6.00.0
ANDN   M6.00.4
ST     M6.00.1
LD     M6.00.0
ST     M6.00.4
```

Spurious Pulse Negative Starting Edge

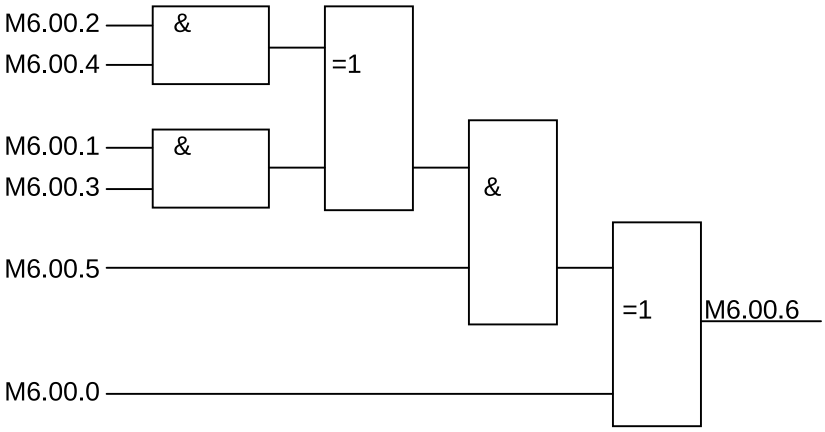
M6.00.0 = Input
M6.00.1 = Result
M6.00.4 = Intermediate flag

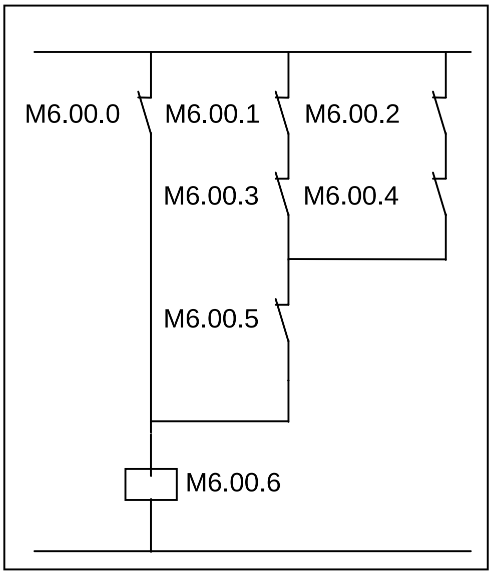



```
LDN    M6.00.0
ANDN   M6.00.4
ST     M6.00.1
LDN    M6.00.0
ST     M6.00.4
```

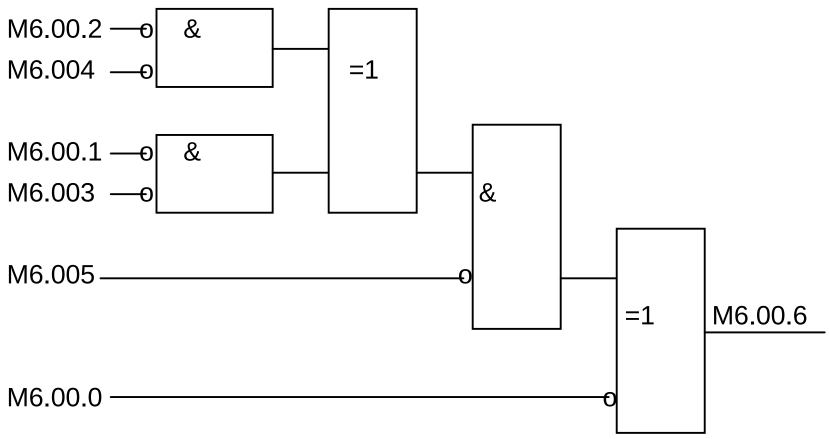



```
LD      M6.00.2
AND     M6.00.4
OR(     M6.00.1
AND     M6.00.3
)
AND     M6.00.5
OR      M6.00.0
ST      M6.00.6
```






```
LDN     M6.00.2
ANDN    M6.00.4
OR (    M6.00.1
LDN     M6.00.1
ANDN    M6.00.3
)
ANDN    M6.00.5
ORN     M6.00.0
ST      M6.00.6
```


M6.00.2
M6.004
M6.00.1
M6.003
M6.005
M6.00.0
&
&
=1
&
=1
M6.00.6

Notes

7 Functions

7.1 Operating Modes

Parameter Mode

Programming the parameters and the logic task is possible only in this operating mode. When this mode is exited, the parameter interactions are reviewed and the logic task program is tested.

In Parameter Mode, the power is turned off and all tasks are halted. The outputs and non-retained marker flags are cleared.

Manual Mode

The unit is in Manual Mode when there is no error, and it is not in parameter or automatic mode. It is used primarily to move the axis using the Jog+ (forward) or Jog- (backward) functions.

The two tasks

NC task 3

Logic Task

are functioning. The following functions can also be called up.

Homing

Manual vector

Interrupt

Feed angle monitoring

Automatic Mode

In Automatic Mode, both NC tasks 1 and 2 can be activated using the start command.

All functions are possible except for the jog and manual vector functions.

7.2 Measuring Wheel Mode

Roll-feed drives are used to feed material that is processed downstream (for example, sheet-metal cutting). The motor encoder cannot be used to measure the material length if there is slip between the material and the drive. In such cases, an optional encoder (the measuring wheel encoder) can be used. Ideally, there is no slip between this encoder and material, and the individual lengths can be measured accurately.

CAUTION

If the measuring wheel encoder has no contact with the material:

The position control circuit via encoder 2 is open, i.e. the motion of the drive is uncontrolled.

⇒ only start the measuring wheel mode command if encoder 2 is in contact with the material.

Pertinent Parameters

- **A100, Function Feedback device 2**
- **AA07, Measuring wheel operation**
- **CR10, Smoothing filter for measuring wheel**

Functioning

Requirements

- The optional encoder must be set in Parameter **A100, Function Feedback device 2** as a measuring wheel encoder.
- The material is in feed rollers and under the measuring wheel.
- The feed rollers are closed.
- The measuring wheel encoder is pressed up against the material.

Activation

The measuring wheel function is possible only in Automatic Mode. In Manual Mode, the motor encoder always handles positioning control.

It is activated in Parameter
A100, Function Feedback device 2. It is possible to deactivate the measuring wheel function via an input or marker flag in Automatic Mode by programming **Parameter AA07, Measuring wheel operation**.

Drive in Position Control Mode

The drive switches over to Position Control Mode with motor encoder <u>and</u> measuring wheel encoder.

Any negative effects produced by poor coupling between the measuring wheel encoder and the motor shaft (only those due to material properties) shall be alleviated by attenuating the differences in the position feedback value. The differences are smoothed out using a first-order filter. The filter time constants are set in **Parameter CR10, Smoothing filter for measuring wheel**.

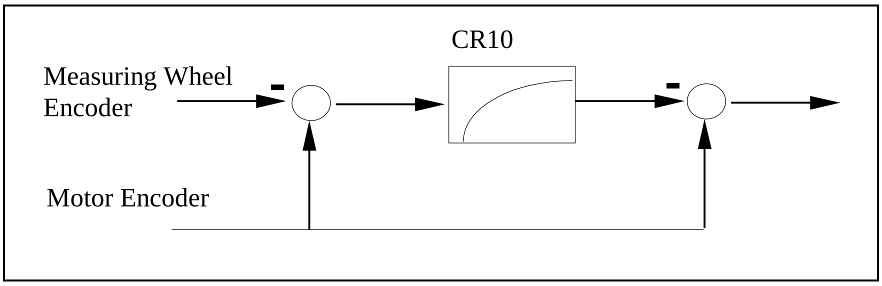


Fig. 7-1: Generation of Position Feedback Value in Measuring Wheel Mode

Drive Not in Position Control Mode

The position of the measuring wheel encoder is detected correctly. However, automatic control is handled by the motor encoder.

Position Loop Reset

If position loop reset is required in conjunction with ‘measuring wheel mode,’ the ‘measuring wheel mode’ signal must be removed via the signal input while resetting the position loop. Care must be taken not to exceed switching times.

Setting the Measuring Wheel Encoder Parameters

Note: Difference monitoring can be activated when a measuring wheel is used. This occurs using Parameter **A117, Monitor Feedback difference**.

The following parameters are set for the measuring wheel encoder:

- **C007 Feedrate constant 2**
- **C005 Pos. measurement device type 2**
- **C006 Resolution 2**

Diagnostic Messages

The following error messages can be generated in conjunction with the measuring wheel mode command:

- **D801 Measuring wheel mode not possible**

7.3 Homing

The position feedback value of the measuring system to be referenced forms a coordinate system referencing the machine axis. If absolute encoders are not used, this coordinate system does not correspond to the machine coordinate system after the drive has been initialized.

Therefore, homing is used to:

- establish agreement between the drive measuring system and the machine coordinate system in incremental measuring systems
- move to the reference point in absolute measuring systems.

Homing means that the drive independently generates the position command values for initiating the necessary drive motions in accordance with the homing velocity and acceleration settings.

Note: It is possible to perform this function for either the motor encoder or the optional encoder.

Pertinent Parameters

The following parameters are available for execution of this function:

- **C009, Reference move-configure**
- **C011, Reference point**
- **C009, Reference speed**
- **C009, Reference acceleration**
- **C013, Distance encoded Reference point 1**

In addition, the following parameter is used:

- **A011, Switching threshold**

Setting the Homing Parameter

The basic sequence is dependent on how the **C009, Reference move-configure** parameter has been set.

The following settings are made in this parameter:

- homing direction positive/negative (depending on A100)
- homing using motor/optional encoder (depending on A100)
- readout of home switch yes/no
- readout of reference mark yes/no

The parameter is structured as follows:

C009 Reference move-configure

1 0 0 12 34

- 34: Homing acceleration in % of amax (A108)
- 12: Homing velocity in % of Vmax (A106)
- 0: Reference marker readout:
  0 = yes
  1 = no
- 0: Home position switch readout:
  0 = yes
  1 = no
- 1: Homing direction
  0 = positive
  1 = negative

Note: The sequence also depends on the type and arrangement of the reference marks of the encoder to be used for homing. (see next section).

Overview of the Type and Configuration of Reference Marks of Incremental Measuring Systems

For better understanding, the measuring systems can be divided into 4 different groups according to the type and configuration of their reference marks.

- **Type 1**: Measuring systems with an absolute single-turn range, such as the single-turn DSF or resolver. These measuring systems have an absolute range of one encoder revolution or fractions of one encoder revolution (resolver).
  Typical applications are
- the encoders for the MHD, MKD and MKE motors
- the GDS measurement system
- the single-turn encoder with EnDat interface by Heidenhain
- **Type 2**: Incremental rotary measuring systems with a reference mark for each encoder rotation, such as the ROD or RON types by Heidenhain.
- **Type 3**: Incremental linear measuring systems with one or more reference marks, such as the LS linear scales by Heidenhain.
- **Type 4**: Incremental measuring systems with distance-coded reference marks, such as the LSxxxC linear scales by Heidenhain.

Drive-internal detection of the configuration of the reference marks is based on the settings in the relevant parameter — **C002, Fbk. device type 1** (for motor encoders) or **C005, Pos. measurement device type 2** (for optional encoders).

In these parameters, bit 0 determines whether a rotary or a linear measurement system is set, and bit 1 determines whether the measurement system has distance-coded reference marks.

C002 Fbk device type 1

01 0 0 0

Encoder type
0 = rotary
1 = linear

Distance-coded measuring system:
0 = no distance-coded measuring system
1 = distance-coded reference marks

Direction of movement:
0 = not inverted
1 = inverted

Absolute readout:
x0 = no absolute readout possible
01 = absolute readout possible and active
>encoder is treated as absolute
11 = Absolute readout possible, but not active

Note:	For measuring systems with their own data memory (type 1), these settings are automatic.

How Drive-controlled Homing Works in Incremental Measuring Systems

To establish congruency between the coordinate systems of the drive (measuring system) and machine, it is necessary for the drive to have precise information about its relative position within the machine coordinate system. The drive receives this information by detecting the home-switch signal edge and/or the reference mark.

Note: Evaluation of the home switch alone is not recommended, since detecting the position of the home-switch signal edge is less precise than detecting the reference mark!

The coordinate systems are matched by comparing the desired feedback position at a specific point within the machine coordinate system with the actual feedback position ("old" drive coordinate system). A distinction must be made in this case between "Evaluation of a reference mark/**home-switch** signal edge" (type 1 .. 3) and "Evaluation of distance-coded reference marks".

Definition of the Reference Point

- With "Evaluation of a reference mark/home-switch signal edge," the "specific" point within the coordinate system is the so-called reference point. The desired feedback position at this point is stipulated in parameter **C011, Reference point 1**. The physical position of the reference point is the result of the position of the reference mark. After detecting the reference mark, the drive knows the position of this marker and, thus, also the position of the reference point in the “old” drive coordinate system. The desired position in the new coordinate system based on the machine zero point is provided in parameter **C011, Reference point 1**.
- With "**Evaluation of distance-coded reference marks**" the "specific" point is the zero point (position of the first reference mark) of the distance-coded measuring system. By detecting the position difference between two adjacent reference marks, it is possible to determine the position of the first reference mark in the "old" drive coordinate system. The desired feedback position at this point is defined by the position of the first reference mark in the machine coordinate system at this point, plus the value in **C011, Reference point.**

In both cases, the difference between the two coordinate systems is added to the "old" drive coordinate system. The two coordinate systems will then conform to one another.

Sequence Control for "Homing"

The command value profile depends on the following parameters:

- **C009, Reference speed**
- **C009, Reference acceleration**

The following diagram explains this:

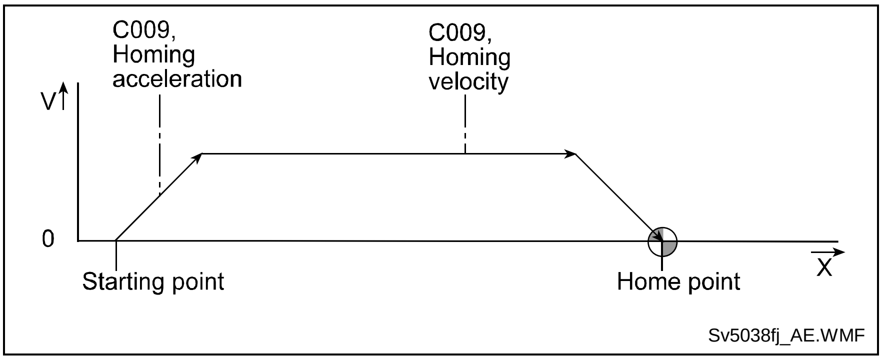


Fig. 7-2: Position Command Value Profile for Homing Velocity and Homing Acceleration

Executing Movement

Executing the movement required for homing incremental encoders can consist of up to three subprocesses:

- If the home switch evaluation process has been activated and there are no distance-coded reference marks, then the drive accelerates to the homing velocity and travels in the selected homing direction (Parameter C009) until the positive home-switch signal edge is detected. If the drive is already at the home switch when homing starts (**REF X3/1**), the drive first accelerates in the opposite homing direction until the negative home switch signal edge is detected, and then reverses the direction of travel. If a distance-coded measuring system is being homed, the drive travels in the set homing direction when the home switch is not activated. However, if the home switch has been activated when the command is invoked, the drive travels in the opposite direction.

WARNING

⇒ Make sure that the home switch signal edge lies within the reachable travel range.

- If reference marks are present (types 2 to 4, see above), and if the reference mark evaluation is activated, then the drive travels in the homing direction until it detects a reference mark. In distance-coded measuring systems (type 4), two sequential reference marks must be passed.
- After the necessary movements have been executed to detect the home switch or reference mark, the drive is positioned at the reference point.

Initial Startup with "Evaluation of Reference Mark/Home-switch Signal Edge"

If the encoder does not have distance-coded reference marks (types 1 to 3), then in **C009, Reference move-configure** select whether

- whether the home switch should be evaluated and/or
- the reference marks should be evaluated.

The following must also be stipulated:

- the direction in which the drive is to move when the **"Homing"** command is started, along with

⇒ verification of the corresponding position encoder type parameters (C002/C005) for the correct settings

⇒ setting the following parameter to 0

- **C011, Reference point 1, and/or**

⇒ Set parameter **C009, Reference speed** and
C009, Reference acceleration to low values (e.g.,

⇒ Execute the homing function

Result of Homing

The command should have been completed without error. The machine zero point is at the position of the home switch or the reference point, since the reference distance for the position feedback value was set to "0" in parameter C011. The actual position value should now be absolute as referenced to this preliminary machine zero point. To set the correct machine zero point, the following steps can now be taken:

⇒ Move the axis to the desired machine zero point and enter the position feedback value indicated there in **C011, Reference point** with the inverse operational sign.

or:

⇒ Move the axis to position feedback value = 0 and measure the distance between the current position and the desired machine zero point. Enter this distance in **C011, Reference point**.

After once again executing the drive-controlled homing command, the position feedback value should be referenced to the desired machine zero point.

Parameters **C009, Reference speed** and **C009, Reference acceleration** can now be set to their final values.

Evaluation of the Home Switch

If there is no clear-cut match with the reference marks of the measuring system to be homed, the home switch can be used to identify a specific mark.

Home Switch Evaluation

If reference mark evaluation was selected in parameter C009, the reference mark evaluated is the one that comes right after the leading edge of the home switch signal in the homing direction.

Note: The home switch input is mapped as input I4.00.6.

Example: Homing of a motor encoder with 1 reference mark per

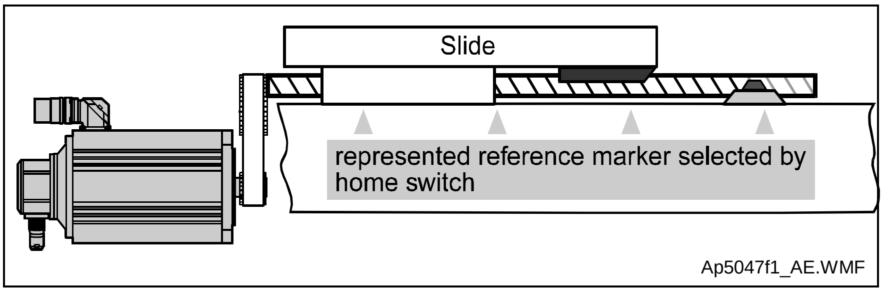


Fig. 7-3: Selection of a Reference Mark Depending on the Homing Direction

If **home switch evaluation is activated**, the drive searches first for the positive edge of the home switch signal. If the home switch has not been actuated when the command is invoked, the drive moves in the preset homing direction.

Note: The homing direction must be set so that the positive edge of the signal pulse can be found.

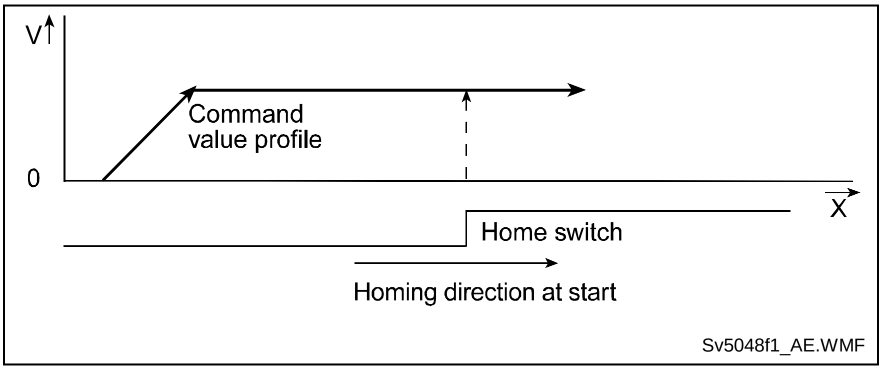


Fig. 7-4: Correct Setting of Homing Direction

WARNING

If the homing direction setting is incorrect, the drive generates command values away from the positive edge of the home switch signal. In such a case, the drive runs the risk of reaching its travel range limits. This may result in damage to the system!

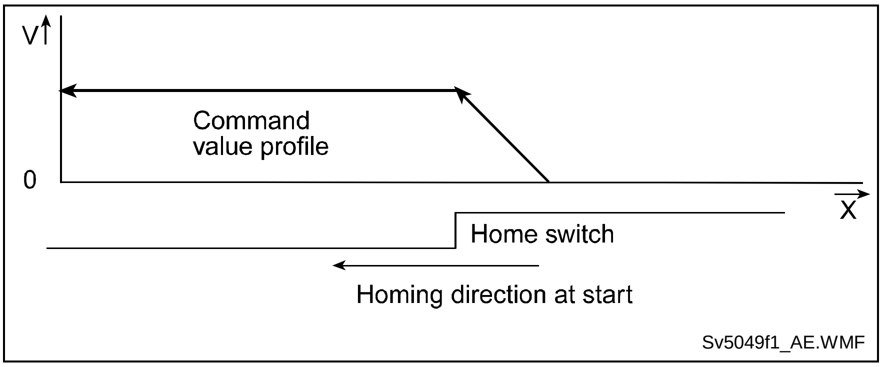


Fig. 7-5: Incorrectly Set Homing Direction

Command Value Profile with Home Switch Actuated

If the home switch has already been activated when the command is started, the drive generates command values in the opposite direction to move away from the home switch. As soon as a 1-0 edge of the home switch signal is detected, the drive reverses its direction and continues as if the starting point were outside the home switch range.

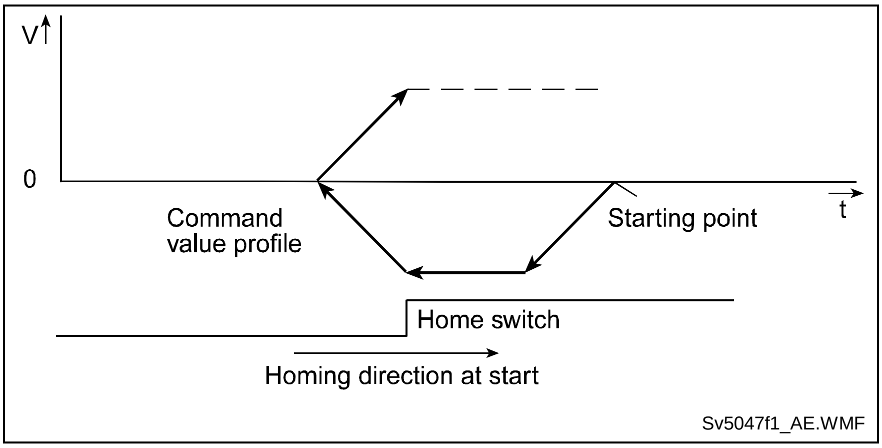


Fig. 7-6: Command Value Profile with Start Position at the Home Switch

Monitoring the Distance Between Home Switch and Reference Mark

If the distance between the home-switch signal edge and the reference mark is too small, it is possible that sometimes the home-switch signal edge will be detected only after the reference mark has already been passed. As a result, the next reference mark after that is then evaluated. The reference mark selection is no longer uniquely defined.

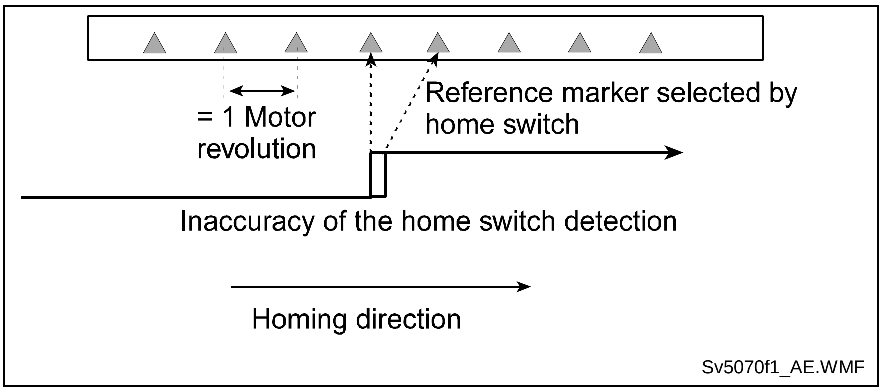


Fig. 7-7: Inaccurate Selection of Reference Marks when Distance Between Home-switch Signal Edge and Reference Mark is too Small

The distance between the home-switch signal edge and the reference mark is therefore monitored.

If the distance between the home-switch signal edge and the reference mark is smaller than a certain value, the command error **C602 Wrong home switch -** reference mark distance will be generated.

The Critical Range for this distance is:

0.25 * distance between reference marks

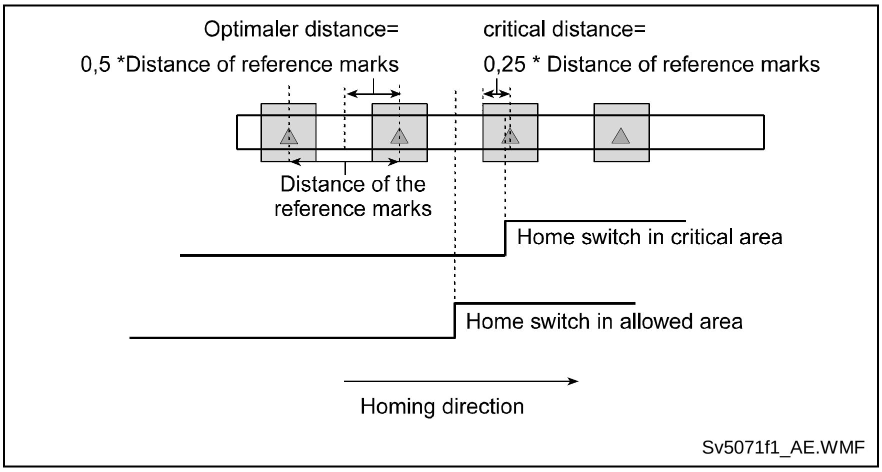


Fig. 7-8: Critical and Optimal Distance Between Home Switch and Reference Mark

The optimum distance between the home-switch signal edge and the reference mark is:

0.5 * distance between reference marks

To avoid having to mechanically shift the home-switch signal edge, this procedure can be taken over by the software in parameter **C012, Reference switch**.

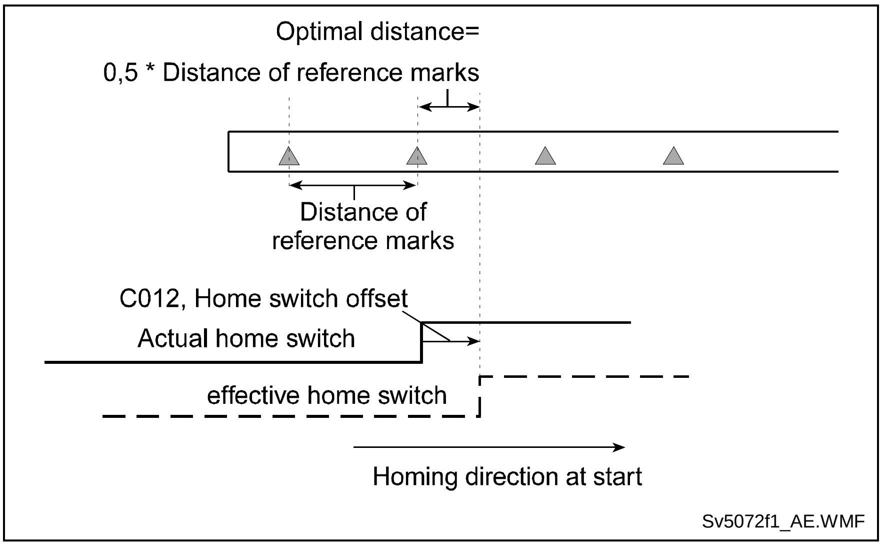


Fig. 7-9: How Parameter **C012, Reference switch** Works

When setting parameter **C012, Reference switch,** always enter 0 the first time.

Initial Startup with "Evaluation of Distance-coded Reference Marks"

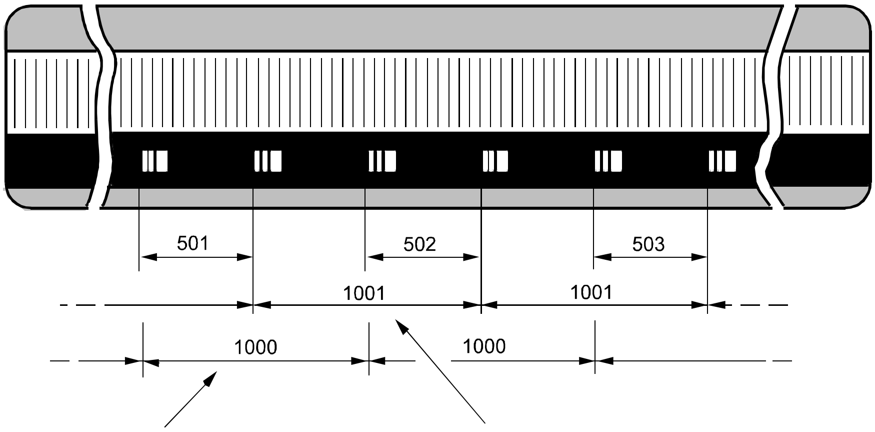
If the encoder has distance-coded reference marks (type 4), **C009, Reference move-configure** must be set to determine the following:

- whether the home switch should be evaluated and/or
- in what direction the drive should move during "Homing"

In the following parameters:

- **C013, Distance encoded Reference point 1**, and
- **C013, Distance encoded Reference point 2**

enter the greater and lesser distances between the reference marks. These values can be found in the encoder specification.



„Distance-coded reference dimension 2“
(smaller value) parameter C013;
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 C013.

„Distance-coded reference dimension 1“
(larger value) parameter C013**.**
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 C013.

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: Parameter C013	Input in: Parameter C013
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

Pi5005fj_AE.WMF

Fig. 7-10: Distance-coded Measuring System Specified with Greater and Lesser Distances

The greater distance is entered in **C013, Distance-coded reference offset 1**, the lesser distance in **C013, Distance-coded reference offset 2**. The unit for these two parameters is the grating period. Typical values for a linear scale with distance-coded reference marks are 20.02 mm for the greater distance and 20.00 mm for the lesser distance with a resolution of 0.02 mm. The numerical values 1001 or 1000 are then entered in parameter C013.

The further steps are outlined below.

⇒ Verify the corresponding position encoder type parameters (C002/C005) for the correct settings

⇒ Set parameter **C011, Reference point (absolute distance offset 1)** to 0.

⇒ Set parameter **C009, Reference speed** and **C009, Reference acceleration** to low values.

⇒ Execute the homing function

Result of the Homing Command

The command should have been completed without error. The machine zero point is at the position of the first reference mark of the distance-coded measuring system, since the reference distance was set to "0" in parameter C011. The actual position value should now be absolute as referenced to this preliminary machine zero point. To set the correct machine zero point, the following steps can now be taken:

⇒ Move the axis to the desired machine zero point and enter the actual position value indicated there in **C011, Reference point** with the inverse operational sign.

or:

⇒ Move the axis to position feedback value = 0 and measure the distance between the current position and the desired machine zero point. Enter this distance in **C011, Reference point**.

After once again executing the homing command, the position feedback value should be referenced to the desired machine zero point.

Parameters **C009, Reference speed** and **C009, Reference acceleration** can now be set to their final values.

Home Switch Evaluation with Distance-Coded Reference Marks

Evaluating a home switch in conjunction with homing of a distance-coded measuring system serves only one purpose: staying within the allowed travel range.

Increased Reliability with a Home Switch

If the home switch is not evaluated, the drive always traverses the distance in the selected homing direction which is needed to detect 2 adjacent marker positions.

This distance is

$$s_{\mathrm{Re}\,f\,\max} = (\,\mathrm{C013} * \mathit{Encoder\ Resolution}) + \frac{v^2}{2 \times a}$$

C013:	Value in parameter C013 Distance encoded Reference point 1
v:	Value in C009 Reference speed (in IUs/s)
a:	Value in C009 Reference acceleration (in IUs/s^2)
$s_{\mathrm{Re}\,f\,\max}$	maximum travel distance for homing with distance-coded reference marks
C003:	Resolution Fbk. Device 1 (Motor)
C006:	Resolution 2

Fig. 7-11: Travel distance for homing with distance-coded reference marks

If the distance between the drive and the limit of the travel range in the homing direction is smaller than the necessary travel distance S_{Refmax}, the drive can leave the allowed travel range and do mechanical damage to the machine. To prevent such an occurrence, do the following

- make sure that the distance of the axis from the travel limit at start of the **homing command** is greater than the max. necessary travel distance S_{Refmax}, or
- evaluate the home switch.

Home Switch Evaluation

If the home switch is evaluated, the drive automatically starts traveling in the opposite homing direction as long as the home switch has already been activated when the command is invoked.

Therefore, the home switch must be mounted in such a way that it covers at least the max. necessary travel distance S_{Refmax} until reaching the travel range limit in the homing direction.

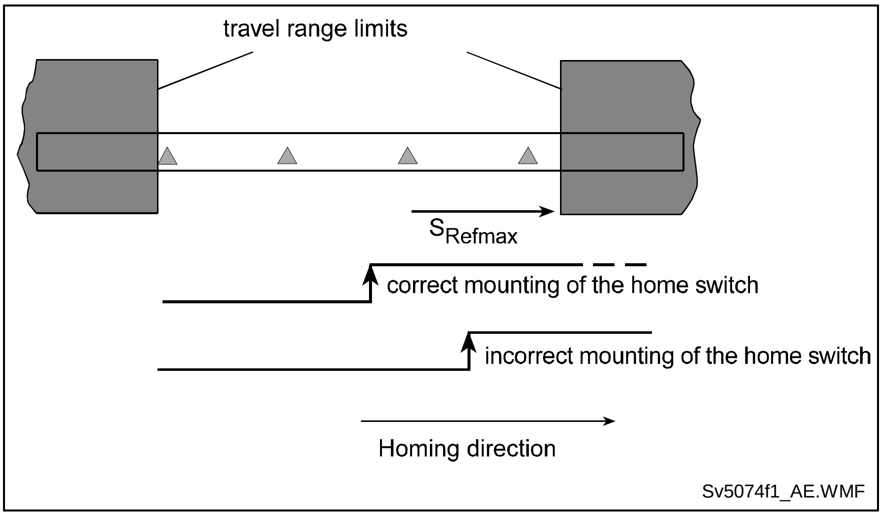


Fig. 7-12: Placement of the Home Switch with Distance-coded Reference Marks

Starting, Interrupting and Completing the "Homing" Function

Homing can be started as follows:

- in Manual Mode via the programmed input in parameter C010
- in Automatic Mode via the HOM command

If a stop, interrupt, feed monitoring or mode change command is received in Manual Mode, the cycle is terminated and must be reinvoked.

In Automatic Mode, homing restarts immediately after the interrupt or stop is cleared and the start button is pressed.

Following an error or a change in operating mode during homing, the homing function must be invoked all over again.

Possible Error Messages During "Homing"

The following command errors can occur during execution of the homing function:

- **C601 Homing only possible with drive enable**
  When the command was started, the drive enable parameter was not set.
- **C602 Distance home switch - reference mark erroneous**
  The distance between the home switch and reference mark is too small,
  see Section entitled ”Monitoring the Distance Between the Home Switch and the Reference Mark." Monitoring the Distance Between Home Switch and Reference Mark"

- **C604 Homing of absolute encoder not possible**
  The encoder to be homed is an absolute encoder. "Homing" was started without first starting the "Set absolute dimension" command. (see Parameter C010 "Set absolute dimension")
- **C606 Reference mark not detected**
  With incremental encoders, the actual position value is determined through detection of the reference mark. During the search for the reference mark during homing, the distance traversed is monitored. If the distance traversed is greater than the calculated max. distance necessary to detect a reference mark, the error message **C606 Reference mark not detected** is generated. Monitoring is performed with the following encoder types:
- Rotary incremental encoder: The maximum travel distance is 1 revolution of the encoder.
- Distance-coded measuring systems: The maximum travel distance is defined by **C013, Distance encoded Reference point 1**.

The cause for this error message can be:

- no detection of the reference marks possible (due to cable break, defective encoder, etc.).
- wrong parameter set in **C013, Distance encoded Reference point 1**
- **F-0217**, HOM command not allowed
  Parameter A100 Motion type = 0
  or
  Parameter C002/C005 Absolute readout = 01

Placement of the Home Switch

Note: The home switch should be set up so that its “activated” range extends over the permissible travel range of the axis. Otherwise, it can overrun the permissible travel range if it is in an unfavorable position when the command is started. Damage to the system is possible !

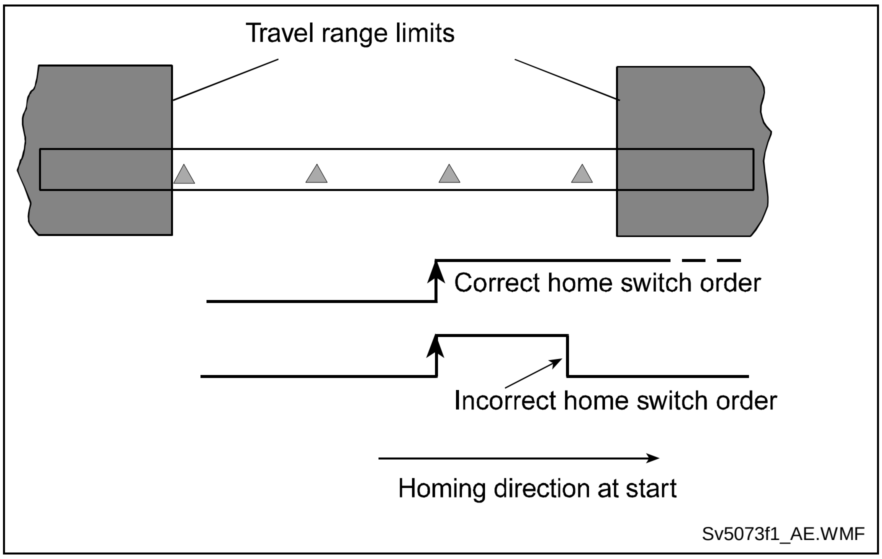


Fig. 7-13: Placement of the Home Switch in Reference to the Travel Range

7.4 Velocity Override

The override function permits an infinitely variable reduction in the currently programmed velocity in Manual and Automatic Modes (exception: homing).

Override via Analog Input

The override is controlled by applying a voltage to E1 (X3/12 and X3/13).

The graph below shows the relationship between the applied voltage and the override factor.

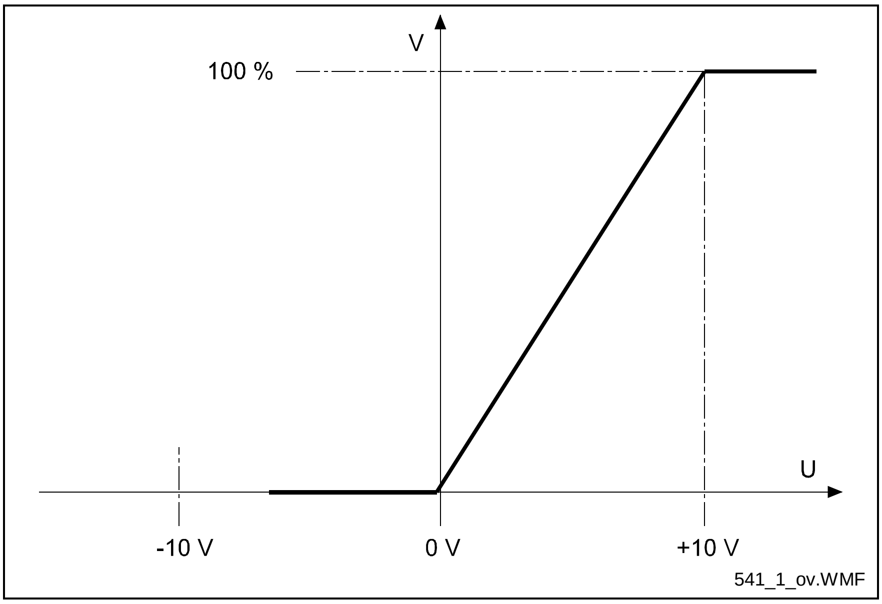


Fig. 7-14: Analog Override

The velocity \`Vo´ is produced by multiplying the programmed traversing velocity \`Vp´ by the override factor \`F´ (F = 0 - 1 corresponds to 0V - 10V):

$$Vo = Vp \times F$$

L:	Vo	=	velocity
	Vp	=	traversing velocity
	F	=	override factor

Fig. 7-15: Velocity Calculation with Override

This function can be activated in Parameter AA04 or using the VEO command.

If a voltage = 0V is applied, the E-0100 diagnostic error message is generated.

Override via Gray-code Inputs

The override velocity can also be set using a step switch programmed with Gray code. This switch must be connected to I0.01.1 – I0.01.4. This function is activated individually per axis in Parameter AA04 or using the `VEO´ program command.

The set velocity always references the currently programmed velocity.

Input No.	**I0.01.1**	**I0.01.2**	**I0.01.3**	**I0.01.4**	**Velocity**
Weighted Value	**2^0**	**2^1**	**2^2**	**2^3**	**in %**
	0	0	0	0	0
	1	0	0	0	1
	1	1	0	0	2
	0	1	0	0	4
	0	1	1	0	6
	1	1	1	0	8
	1	0	1	0	10
	0	0	1	0	20
	0	0	1	1	30
	1	0	1	1	40
	1	1	1	1	50
	0	1	1	1	60
	0	1	0	1	70
	1	1	0	1	80
	1	0	0	1	90
	0	0	0	1	100

Example:

The max. velocity is entered in parameter A100 .

```
A106          000500.000
```

The following program instruction is processed.

```
0000   PSI     1 +001000.000 500
```

Input I0.01.1 = weighted value of 1
Input I0.01.2 = weighted value of 1
Input I0.01.3 = weighted value of 0
Input I0.01.4 = weighted value of 0

The max. velocity is 500 mm/sec.

In the sample instruction, the velocity is reduced to 50%. The result is 250 mm/sec.

If the override has also been activated in Parameter AA04, the velocity is 0.02 x 250 = 5 mm/sec.

Override via Binary-code Inputs

The evaluation is handled via inputs I0.00.6 through I0.1.4. This function is activated individually for each axis in parameter AA04 or using the VEO program command.

Input Number	:	I0.01.4				I0.00.6		
binary value	:	2^6	2^5	2^4	2^3	2^2	2^1	2^0
decimal value	:	64	32	16	8	4	2	1

The decimal values of all of the above inputs set to 1 are added together.

The resulting velocity is obtained as follows:

$$Vo = Vp \times \frac{Sum\,of\;\; all\; decimal\; values}{127}$$

L: Vo = velocity
Vp = traversing velocity

Fig. 7-16: Velocity Calculation

7.5 Rotary Table

Description in preparation

7.6 Vector Programming

Manual Vector

This makes it possible to run a user program in Manual Mode. The vector program must be concluded with an RTS command (the stack is not changed).

Note: In the manual vector program, no feeds can be programmed.

When the operating mode is changed from `Manual´ to `Parameter,´ the manual vector program is terminated. While the manual vector program is running, any attempt to change the operating mode to `Automatic´ is suppressed until the program has concluded.

The manual vector program is started by detection of the rising edge of a signal pulse at the programmed input (see Chapter 8/Parameter AA01). If '00.00.0' is programmed in this parameter, the manual vector program is to be started only via a change in operating mode (Automatic → Manual). The start instruction for the manual vector program must not be within the main program.

During jogging or homing in Manual Mode, no manual vector is accepted. No jogging or homing is possible while the manual vector program is running. Any such command is ignored.

Example: Input in Parameter AA01

AA01	I0.00.7 1 0 0400

Input in the programming instruction

0400	APE	M2.02 0000000
0401	APE	M2.03 0000000
0402	RTS	

Bytes M2.02 and M2.03 are cleared when the manual vector is invoked.

The manual vector program can be halted with a `Stop´ command. When the immediate stop input changes from '0' to '1,' the program continues to run from the point at which it was stopped.

Interrupt Vector

With the interrupt vector, a program running in Automatic Mode in Task 1 can be interrupted externally at any time. The program sequence then continues at the interrupt program address (see Chapter 8/Parameter AA02). There is no return to the interrupted main program.

The interrupt vector can be invoked only in Automatic Mode. Therefore, the `Start´ or `Stop´ actions remain in effect. The subroutine stack (JSR, RTS) is cleared each time the interrupt vector is invoked.

Invoking the interrupt vector during a subroutine can wait until the subroutine has ended (see Chapter 8/Parameter AA02).

The interrupt vector is available only in Task 1.

7.7 Multitasking

The control can process 3 cycles simultaneously (Task). The user can enter a program in each of these 3 tasks. In each task, one instruction (command) is processed within the NC cycle time.

When programming Tasks 1 through 3, take note of the following:

The same subroutine may not be called up by more than one task at the same time!

Movements in a given axis may not be initiated by more than one task at the same time!

Prior to activation of Task 3, make sure that a program is present at its start instruction!

Task 1

Task 1 runs only in Automatic Mode. Program execution begins after a \`Start´ and ends with a \`Stop´ command. After re-entering Automatic Mode, the program counter resets to 0000 with each start command. If the start command follows execution of a prior immediate stop, the program continues from the point of interruption.

Normally, only Task 1 is in operation.

Example:

0000	AKN	M2.02.0 1
0001	PSI	1 +000100.000 999
0002	AEA	Q0.00.4 1
0003	WAI	00.250
0004	AEA	Q0.00.4 0
0005	COU	+00000 Q0.00.5 000100
0006	JMP	0000

Task 2

Task 2 is activated only if it has been enabled in parameter AA00. That is also where the start instruction that begins the program in Task 2 is entered for each start following re-entry into Automatic Mode.

Example: Input in Parameter B006

AA00	0200 0800 1

Input in the programming instruction

0200	AKN	I0.00.7 1
0201	AEA	Q0.00.4 0
0202	PSI	1 +000500.000 999
0203	APE	M2.02 00111100
0204	WAI	00.500
0205	APE	M2.02 22111111
0206	WAI	00.800
0207	APE	M2.02 00000000
0208	WAI	02.000
0209	COU	+00000 M2.03.1 000010
0210	JMP	0200

Task 3

Task 3 is also enabled in Parameter AA00, as is the start instruction. Program execution of Task 3 begins automatically immediately after power-up (even in Manual Mode).

Task 3 is deactivated only in Parameter Mode. Task 3 continues to run in the event of a fault or emergency stop.

Lockouts can therefore also be monitored via this cycle.

Note: Axis movements may not be processed in Task 3.

Example: Input in Parameter B006

AA00	0000 0800 1

Input in the programming instruction

0800	AKN	I0.00.7 1
0801	APE	Q0.00 00000000
0802	WAI	02.000
0803	AEA	Q0.00.4 1
0804	AKN	I0.00.6 1
0805	AEA	Q0.00.4 0
0806	AEA	Q0.00.6 1
0807	WAI	00.100
0808	AEA	Q0.00.6 0
0809	JMP	0802

Note: Tasks 1 and 2 are equivalent. Within the NC cycle, the tasks are completed in numerical order (1, 2, 3).

7.8 Slave Axis

Description in preparation

7.9 Control Loop Settings

The control loop settings in a digital drive controller are important in terms of the characteristics of the servo axis.

"Optimizing" the controller settings is generally not necessary!

Determining the control loop settings requires expert knowledge. For this reason, application-specific controller parameters are available for all Rexroth Indramat digital drives. These parameters are either located in the motor feedback data memory and can be activated through the **Basic load** command (with MHD, MKD and MKE motors), or they must be entered via the parameter input interface. (See also chapter on: "Basic Load")

In isolated instances, it may nevertheless be necessary to adjust the control loop settings for a specific application. The following section gives a few simple but important basic rules for setting the control loop parameters in such cases.

The methods indicated should always be viewed only as guidelines for producing a stable control setting. Specific aspects of some applications may require settings that deviate from these guidelines.

The control loop structure is made up of a cascaded (nested) position, velocity and torque/force loop. Depending on the operating mode, sometimes only the torque control loop or the torque and velocity control loops become operative. The control is structured as depicted below:

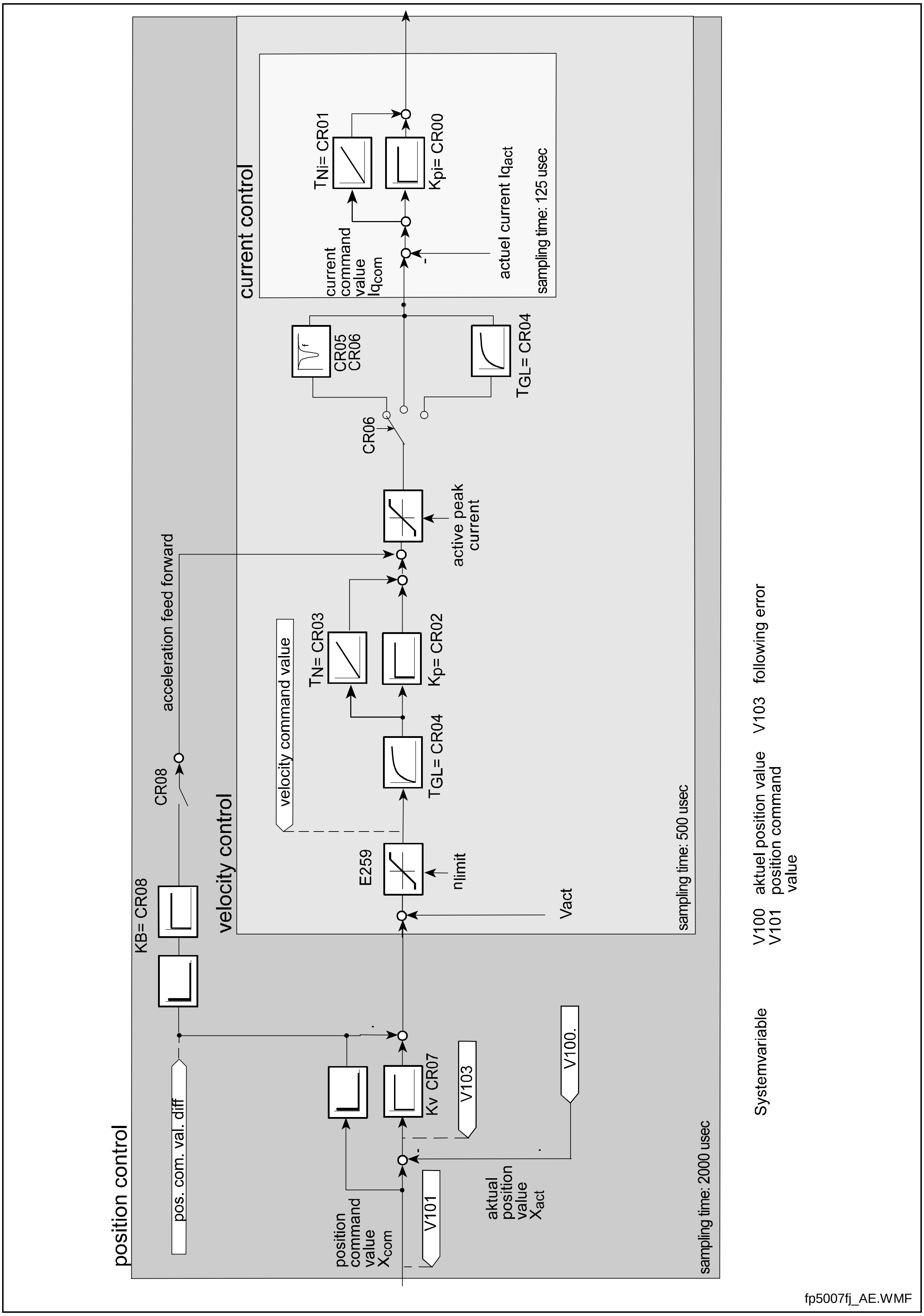


Fig. 7-17: Control Loop

Rexroth Indramat

Setting the Current Controller

The parameters for the current loop are set by Rexroth Indramat and cannot be adjusted for specific applications. The parameter values set at the factory are activated by the **Basic Load** command for MKD/MHD motors or can be found on the motor data sheet.
The settings for the current controller are made via the parameters.

- **CR00, Current controller – Proportional gain 1**
- **CR01, Current controller – Time constant 1**

WARNING

Changing the values defined by Rexroth Indramat
can result in damage to the motor and the drive controller.
⇒ Changes to the current controller parameters are not permitted.

Setting the Velocity Loop

Requirements:

The current loop must be set correctly.

The velocity loop is set via the parameters

- **CR02, Speed controller – Proportional gain**
- **CR03, Speed controller – integral action time**
- **CR04, Speed controller – smoothing time constant**

as well as the parameters

- **CR05, Notch filter speed-controller**
- **CR06, Bandwidth Notch-Filter Speed-controller**

The setting can be made by:

- one-time execution of the “Basic Load” function
- in accordance with the procedure described below

Preparations for Programming the Velocity Loop A series of preparations must be made in order to be able to set the velocity loop:

- The mechanical system must be completely assembled and ready for operation, so that the original conditions are present for determining the parameters.
- The drive controller must be properly connected as described in the user manual.
- The safety limit switches (if present) must be checked for correct operation.

Start Settings

The controller settings must be selected for the start of parameterization as follows:

CR02, Speed controller – Proportional gain = default value of the connected motor.

CR03, Speed controller – integral action time = 6500 ms (no integral gain)

CR04, Speed controller – smoothing time constant = minimum value (= 500 µs)

CR06, Bandwidth Notch-Filter Speed-controller = 0 Hz (deactivated)

Definition of the Critical Proportional Gain and Smoothing Time Constant

- Allow the drive to move at low velocity after activating the controller enable signal. (Rotary motors: 10...20 rpm, linear motors: 1...2 m/min)
- Increase the **CR02, Speed controller – Proportional gain** until unstable behavior (sustained oscillation) begins.
- Determine the frequency of the oscillation using an oscilloscope to view the actual velocity signal (see also section entitled "Analog Output"). If the frequency of the oscillation is much higher than 500 Hz, raise the **CR04, Speed controller – smoothing time constant** until the oscillation ends. Then increase the **CR02, Speed controller – Proportional gain** until it becomes unstable again.
- **Reduce the CR02, Speed controller – Proportional gain** until the oscillation ends by itself.

The value found using this process is called the "**critical velocity loop proportional gain."**

Determining the Critical Integral Action Time

- Set the **CR02, Speed controller – Proportional gain** = 0.5 times the critical proportional gain
- Reduce the **CR03, Speed controller – integral action time** until unstable behavior results.
- Increase the **CR03, Speed controller – integral action time** until sustained oscillation ends.

The value found using this process is called the "**Critical Integral Action Time."**

Determining the Velocity Loop Setting

The critical values found can be used to derive a control setting that is:

- independent of changes to the axis, since there is a sufficient safety margin with respect to the stability limits
- able to reliably reproduce the characteristics in series-produced machines

The following table shows some of the most frequently used application types and the corresponding control loop settings.

Application Type:	Velocity Loop Proportional Gain	Velocity Loop Integral Action Time:	Remarks:
Feed axis on standard machine tool	Kp = 0.5 • Kpcrit	Tn = 2 • Tncrit	Good stiffness and good command response
Feed axis on perforating press or turret punch presses	Kp = 0.8 • Kpcrit	Tn = 0	High proportional gain; no integral gain, to achieve short transient recovery times.
Feed drive for flying shear devices	Kp = 0.5 x • Kpcrit	Tn = 0	Relatively non-dynamic control setting without integral gain, to prevent structural tension between the material and the shearing device.

Fig. 7-18: Identification of Velocity Loop Settings

Filtering of Mechanical Resonance Oscillations

Within a narrow band, the drives are able to suppress oscillations caused by the drive train (gear) between the motor and the axis or spindle mechanism. As a result, increased drive dynamics with good stability can be achieved.

With torsionally rigid drive mechanisms, mechanical oscillations are induced in the mechanical system (comprising the rotor—drive train—load) as a result of position/velocity feedback within a closed control loop. This behavior, called "two mass oscillation," is generally within the 400 to 800 Hz range depending on the rigidity (or elasticity) of the mechanism and spatial volume of the system.

This "two mass oscillation" usually has a distinct resonance frequency which can be suppressed selectively by a notch filter (band suppressor) provided in the drive.

By suppressing the mechanical resonance frequency, the dynamics of both the velocity and position control loops can be significantly improved compared to control loops without a band suppression filter.

This results in greater contour accuracy and shorter cycle times for positioning processes, leaving a sufficient stability margin.

The filter rejection frequency and bandwidth can be adjusted. The rejection frequency is the one that is attenuated the most, while the bandwidth determines the frequency range within which the attenuation is less than -3 dB. A larger bandwidth results in less attenuation of the rejection frequency! The following parameters can be used to set both:

- **CR05, Notch filter speed-controller**
- **CR06, Bandwidth Notch-Filter Speed-controller**

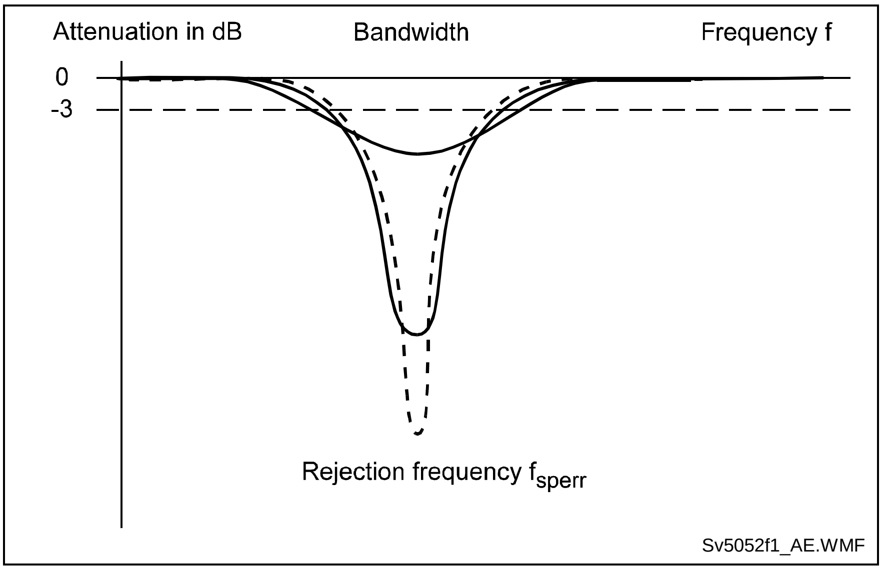


Fig. 7-19: Placement of the Home Switch in Reference to the Travel

To set the bandpass filter, we recommend proceeding as follows:

Pre-settings

First set rejection filter to inactive

⇒ Set parameter **CR06 Bandwidth Notch-Filter Speed-controller** to 0.

Determining the Resonance Frequency

⇒ Connect oscilloscope to analog output channels. Assign velocity feedback value to analog output 1 (in **B003, Analog-Output 1 Signal select** "B004" and in **B004, Analog-Output 1 exp. Signal select** enter the scaling, e.g., 100 rpm / 10 volts.

- or -

⇒ Induce oscillation in the drive mechanics, e.g., tap lightly with a rubber mallet.

⇒ Record the time history of the velocity oscillation with the oscilloscope and analyze this record for salient frequencies.

Determining the Initial State of the Control Loop

⇒ Set the drive enable signal and optimize the velocity loop with the rejection filter deactivated (see Chapter entitled “Setting the Velocity Loop).”

⇒ Record the step response (high acceleration) of the velocity feedback value and the torque/force generating command current for a small velocity command step (the torque-generating command current must not reach the limits during this process.)

Turn Rejection Filter On and Check the Effect

⇒ Enter the most salient frequency in Hz in parameter **CR05, Notch filter speed-controller.**

⇒ Enter a minimum bandwidth in parameter **CR06, Bandwidth Notch-Filter Speed-controller,** e.g., 25Hz).

⇒ Record the previous step response again.

If the step response shows less overshoot and shorter oscillation periods, then:

⇒ Check whether increasing the value of **CR06, Bandwidth Notch-Filter Speed-controller** produces additional improvement.

- or -

⇒ Check whether a change in the value of **CR05, Notch filter speed-controller** produces additional improvement.

If the step response displays the same behavior, then:

⇒ Check the resonance frequency analysis.

- or -

⇒ Increase the value of **CR06, Bandwidth Notch-Filter Speed-controller** by a much larger amount.

Optimize Rejection Filter or Velocity Loop

⇒ Using the pre-optimized values for **CR05, Notch filter speed-controller** and **CR06, Bandwidth Notch-Filter Speed-controller,** optimize the velocity loop again (see above).

The step response defined above must have a similar appearance with higher values for **CR02, Speed controller – Proportional gain** and/or smaller values for **CR03, Speed controller – integral action time.**

⇒ Any additional optimization cycles for **CR05, Notch filter speed-controller** and **CR06, Bandwidth Notch-Filter Speed-controller** must be based on the step response.

Filtering with Two Smoothing Filters

⇒ Using a notch (band suppression) filter for optimization of the control loop does not always produce enough improvement in the control quality. This can happen, for example, when the closed loop has no salient resonance frequencies. In some situations, activation of a second smoothing filter (with low pass response) can nevertheless produce the desired improvement in the control quality.

⇒ To activate this second filter, set parameter **CR06, Bandwidth Notch-Filter Speed-controller** to **"-1."** The notch filter and the associated parameter **CR05, Notch filter speed-controller** are deactivated. Instead of the notch filter, a smoothing filter is activated in the control loop. This filter has the same smoothing time constant (T_{gl}) as the smoothing filter in **CR04, Speed controller – smoothing time constant**. Together with the smoothing filter at the velocity loop input, a low pass filter of the 2nd order (2 poles) is produced. Frequencies greater than the cut-off frequency ($f_g = 1/2\pi T_{gl}$) are much more heavily suppressed and can no longer induce oscillations in the control loop.
The parameter for the filter is set via **CR04, Speed controller – smoothing time constant**.

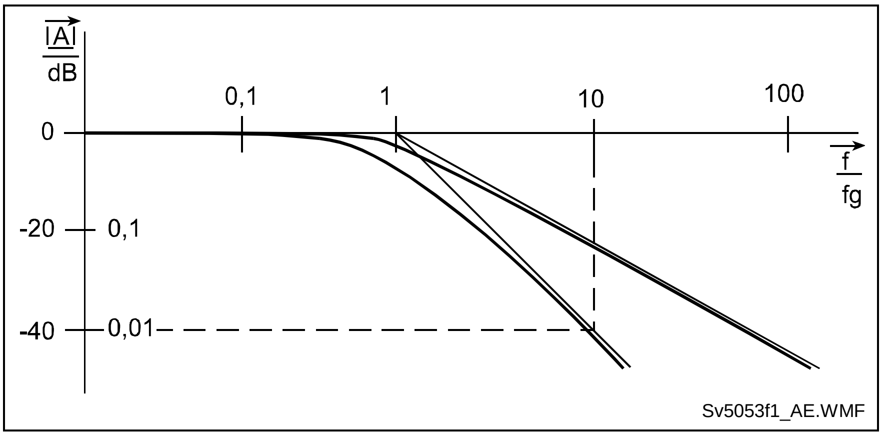


Fig. 7-20: Frequency Response of Low Pass Filters with 1 Pole and with 2 Poles

Note: This setting is made as described in the section entitled: "Determination of the critical proportional gain and parameter CR04, Speed controller – smoothing time constant."

Velocity Control Loop Monitoring

If the velocity control loop monitor detects an error in the velocity control loop,, the error message

- **F878 Velocity loop error**

is entered.

Reasons for Triggering the Monitor

The velocity control loop monitor is designed to monitor for those faults that could lead the motor to begin turning in the wrong direction. Basically, the following are possible:

- reversed polarity when motor is connected
- wrong commutation angle
- faults in the velocity encoder

Note: The purpose is to prevent the "runaway effect" in the motor.

Criteria for Triggering the Monitor

The following criteria must be met for the velocity control loop monitor to be triggered :

- the command value for current is limited to the **effective peak current**.
- the motor is accelerating in the wrong direction
- the actual velocity value is > $0.0125*n_{Max}$

Setting the Position Controller

Requirements: Current and velocity loops must be correctly set.

The position loop can be set using the following parameter

- **CR07, Kv-Factor**

This loop can be set by either executing the “Basic load” function or by following the procedure below.

Preparations for Setting the Position Control Loop

A number of preparations must be made in order to be able to set the position loop properly:

- The mechanical system must be completely assembled and ready for operation, so that the original conditions are present for determining the parameters.
- The drive controller must be properly connected as described in the user manual.
- The safety limit switches (if present) must be checked for correct operation.
- Operate the drive in a mode that closes the position loop in the drive (Operating Mode: Position Control").
- The subordinate velocity loop must be properly tuned. The start value chosen for the K_v-factor should be relatively small. ($K_v = 1$)
- For the determination of the position loop parameters, no compensation function should be activated.

Rexroth Indramat

Determining the Critical Position Loop Gain

- Move axis slowly, i.e., using jog function on connected NC control (rotary motors: 10...20 rpm, linear motors: 1...2 m/min).
- Raise the K_v-factor until instability appears.
- Reduce the K_v-factor until the sustained oscillation ends by itself.

The Kv factor determined through this process is the "**Critical position control loop gain".**

Determining the Position Loop Setting

In most applications, an appropriate position loop setting will lie between 50% and 80% of the critical position loop gain.
This means:

CR07, Kv-Factor = 0.5 … 0.8 x K_{vkrit}

Position Control Loop Monitoring

The position control loop monitor helps to diagnose errors in the position control loop.

Reasons for triggering the position control loop monitor can be:

- Exceeding the torque or acceleration capability of the drive
- Blocking of the axis mechanism
- Disruptions in the position encoder

Two parameters are used for setting and diagnosing the monitoring function:

- **A115, Monitor**

If the drive detects an error in the position control loop, the error message

- **F228 Excessive deviation**

is generated.

General Operating Characteristics of Position Control Loop Monitoring

To monitor the position control loop, the drive calculates a model position value within the closed position loop which is a function only of the specified position command value profile and the set position loop parameters. This model position value is compared continuously to the actual position that is fed back to the control.

If the deviation exceeds **A115, Monitor** for more than 8 msec, error message **F228 Excessive deviation** will be generated.

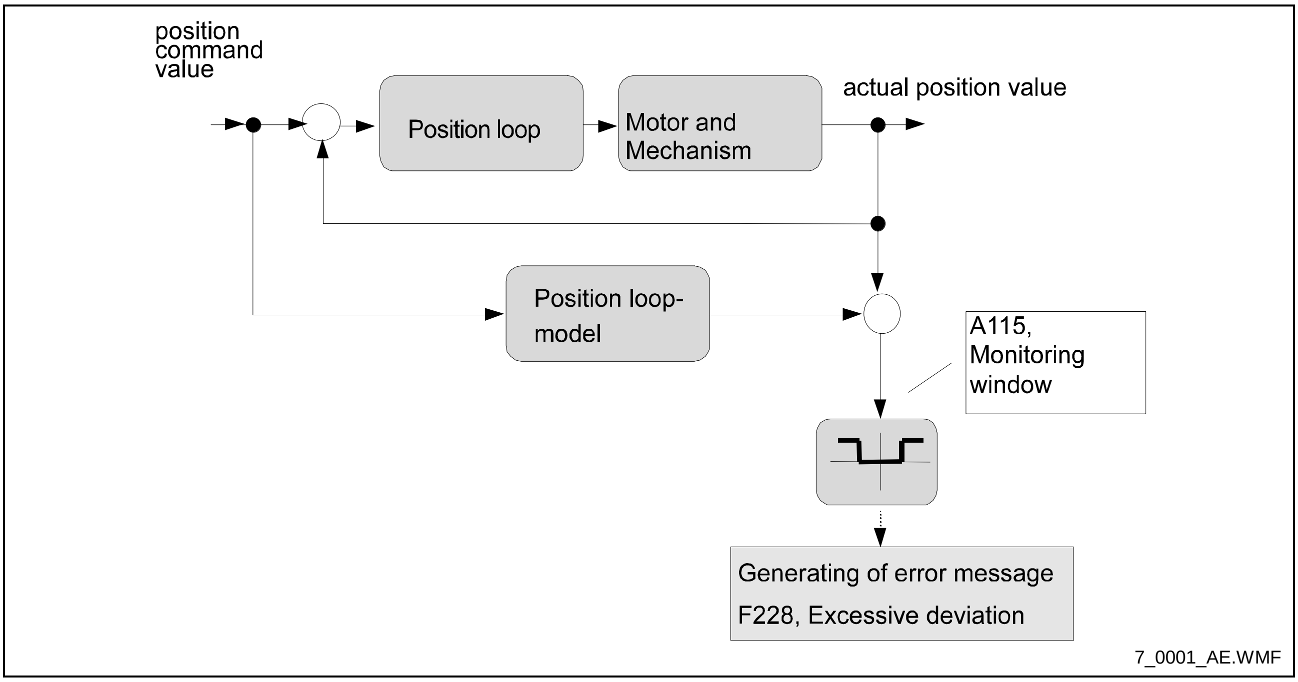


Fig. 7-21: Operating Principle of Position Loop Monitor

Note: For accurate monitoring, the actual feedback value from the position loop is always used. This means that for position control with the motor encoder, position feedback value 1 is used; and for position control with the external encoder, position feedback value 2 is used.

Setting the Position Control Loop Monitor

Requirements

Requirements for setting the position loop monitor are as follows

- Check the velocity and position control loops for their appropriate settings prior to setting the position loop monitor.
- The axis in question should be checked mechanically and should be in its final state.

Deactivation of the Position Control Loop Monitor

It is strongly recommended that the position loop monitor be activated.

However, there are exceptions when the position loop monitor must be deactivated. This action can be taken in Parameter **A115, Monitor**.

Note: By default, the position control loop monitor is active.

Setting the Acceleration Feed Forward

For servo applications requiring high precision at high speeds, it is possible to greatly improve the precision of an axis during the acceleration and deceleration phases by activating the acceleration feed forward.

Typical applications for the use of the acceleration feed forward:

- Free-form surface milling
- Grinding

To set the acceleration feed forward, use the following parameter

- **CR08, Amplification Accel.-pre-set**

Requirements for a Correct Setting for Acceleration Feed Forward

- Velocity and position loops must be set properly.

Setting the Acceleration Feed Forward

Since it is dependent on the moment of inertia, the correct acceleration feedforward can only be set by the user.

Setting this value involves two steps:

- Calculation of an approximate value for acceleration feedforward. To make this calculation, take the total moment of inertia transferred from the axis to the motor shaft ($J_{Motor}+J_{Load}$). This approximate value is known from the size and set-up of the axis. Then take the torque constant of the motor used. This data can be retrieved from the motor data sheet or parameter **CM05, Torque-/Force-constant**. The approximate value is calculated as follows:

$$Acceleration\ feedforward = \frac{J_{\mathrm{Motor}} + J_{Load}}{Kt} \times 1000$$

Acceleration feedforward [mA\rad\s²)]
J_{Motor}: Moment of inertia of the motor [kg m²]
J_{Load}: Moment of inertia of the load [kg m²]
Kt: Torque constant of the motor [Nm/A]

Fig. 7-22: Approximate Value for Acceleration Feedforward

Enter the approximate value calculated in parameter **CR08, Amplification Accel.-pre-set.**

- Verification of the effect of the acceleration feedforward and fine tuning of parameter **CR08, Amplification Accel.-pre-set** if necessary. The deviation between the actual feedback value and the position command can be displayed via the analog diagnostic outputs of the drive controller or using the oscilloscope function. To verify the effect of the acceleration feedforward, this signal must be viewed on an oscilloscope while the axis traverses the desired operating cycle. In the acceleration and deceleration phases, the acceleration feedforward must reduce the dynamic control deviation significantly.

7.10 Mechanical Data

Mechanical Transmission Elements

Mechanical transmission elements are gearboxes and feed mechanisms between the motor shaft and the load. These data must be entered in order to perform the load-side conversion of the physical parameters for position, velocity and acceleration. To see if these parameters have been entered correctly, move the shaft and compare the path followed with the position feedback value and the path actually taken.

Gear Ratio

The gear ratio can be set using the following parameters

- **A102, Gearing, Load gear Input rev's**
- **A102, Gearing, Load gear Output rev's**

The parameters for the ratio between gear input and output are set here.

Example:

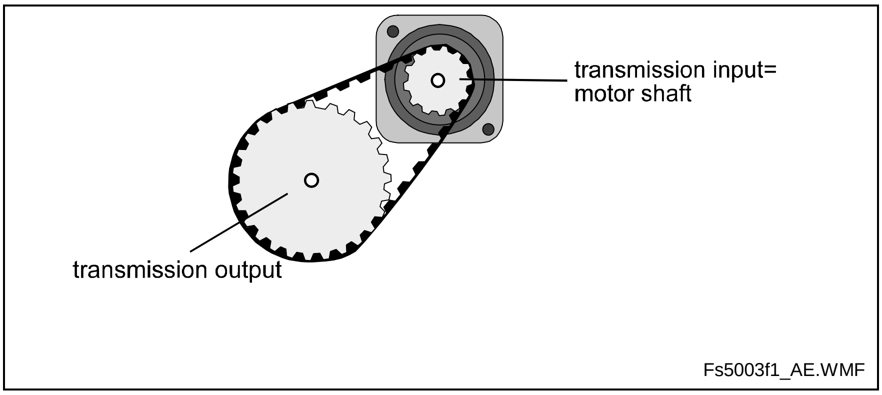


Fig. 7-23: Setting the Gear Ratio Parameters

In the illustration above, 5 gear input revolutions (= motor revolutions) were equivalent to 2 gear output revolutions. The proper parameter settings for this would be :

Input revolutions of load gear = 5

Output revolutions of load gear = 2

Feed Constant

The feed constant defines how far the load moves linearly per output revolution of the gear. It is stipulated in Parameter **A101, Feed rate constant**.

The value programmed here is used along with the gear ratio for converting the position, velocity, and acceleration data from motor reference to load reference.

Example:

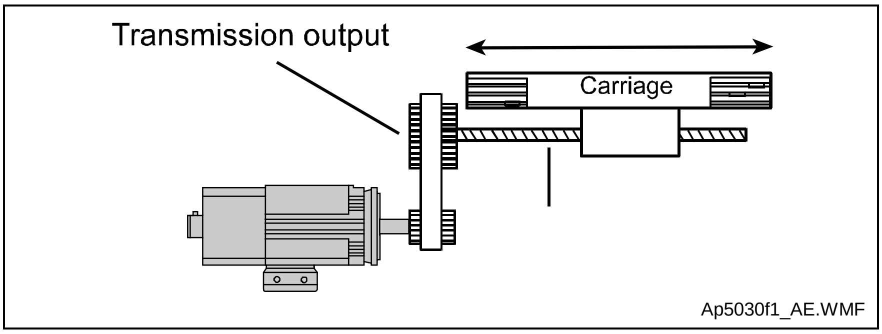


Fig. 7-24: Feed Constant Parameters

Example:

In the illustration above, the feed module would cover 10 mm per output revolution of the gear. The proper parameter settings for this would be :

A101, Feed rate constant = 10 mm/rev

Modulo Function

If Parameter A100 is programmed for a rotary table, the modulo function is activated and all position data in the vicinity of the 0..modulo value are displayed. Thus it is possible to implement an axis which can move infinitely in one direction. There is no overrunning of the position data.

The modulo value is set via parameter **A105, Modulo value**.

Note: Modulo processing of position data is allowed only with rotary motors. The motor type is verified when parameter mode is exited, and error message **C213 Position data scaling error** is issued if necessary.

The following illustration shows the difference in displaying the position data in absolute format and modulo format:

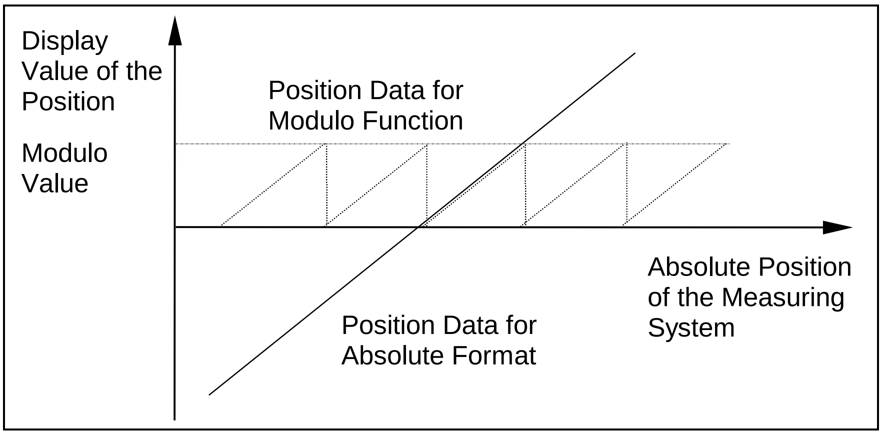


Fig. 7-25: Display Value of Positions in Absolute Format and Modulo Format

INDRAMAT Decade Switch IDS1.1

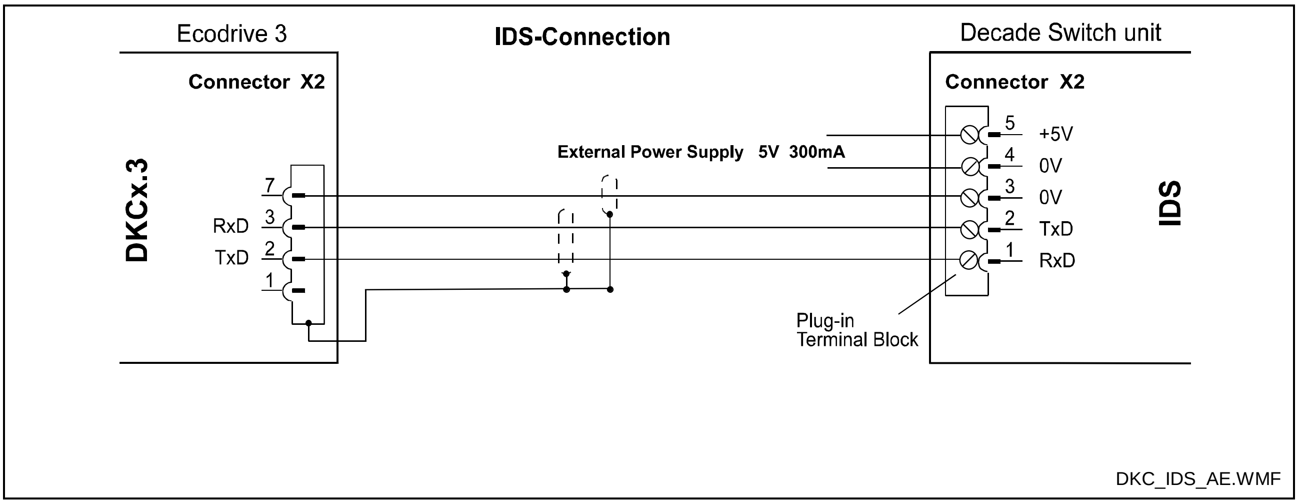


Fig. 7-26: IDS Connection to DKC

The INDRAMAT Decade Switch "IDS1.1“ enables inputting a feed length with 6 decimal places and a velocity with 2 decimal places. Communications with the IDS1.1 are activated by increasing the input value to 2 or 3 for the protocol in Parameter B002. With this setting, the interface is always set to the IDS setting in Manual/Automatic Mode. In Parameter Mode, the protocol setting is set back to the original protocol, according to the driver selection in Parameter B002. This reestablishes communication with the BTV04.

Die IDS1.1 operates with the following transmission parameters:

RS232, 2400 Baud, 1 Start bit, 8 Data bits, 1 Stop bit, no parity checking.

A timeout is effective in Automatic Mode. If more than 2 seconds pass without receiving a valid IDS1.1 telegram, the following message is displayed: "**E- 01 08 IDS01 timeout**." Any positioning function in process is terminated and the NC user program is subsequently stopped.

B002, Protocol	Parameter Mode:	Manual Mode	Automatic Mode
0	SIS	SIS	SIS
1	ASCII	ASCII	ASCII
2	SIS	**IDS**	**IDS**
3	ASCII	**IDS**	**IDS**

Fig. 7-27: B002, Protocol Setting

The IDS information that has been read is made available in system variables V015 to V018 and can be accessed there by the user NC program.

The distance between the DKC and the IDS1.1 can be up to 15 m. If power is available directly on the IDS, longer cables can sometimes be used.

7.11 Movement to Positive Stop

The goal is to move a particular distance, within which a positive stop is expected.

If the positive stop is reached within that distance, the torque defined in the user program (refer to MOM command) is applied at the positive stop.

The torque, which should be valid until reaching the positive stop (during movement of the carriage), is also defined in the user program (refer to MOM command).

If the positive stop is not reached within the programmed distance, the movement is equal to the programmed distance. In this case, it is possible to switch the program flow into a user-defined error routine.

When the positive stop is reached, the position is held using the programmed torque, until new motion is initiated using another travel command.

If you only want to turn off the voltage, a POI command with travel distance of zero can be used.

Following are the criteria for recognizing the positive stop:

- Motion is started.
- The positive stop is recognized as soon as:

  a) The current torque/force actual value >= torque/force limit value, is defined in the MOM command.

  and

  b) a drive movement occurs that is smaller than the feedrate set in the PFA/PFI command.

Only one PFI/PFA command can be active at one time.

During an active movement to positive stop, the execution of any other PFI/PFA command in a different program task is impeded until the movement to positive stop is completed.

0100	MOM	1 020 040 00.00.0 400	Torque Limitation To positive stop 20%At positive stop 40%
0101	POA	1 000250.000 999	Initiate movement at maximum speed.
0102	VCC	1 +000200 100 1 1	- Wait until position +200 with v=10% is reached.
0103	PFA	1 +000300.000 100 010	Movement to positive stop until position +300 is reached.
0104	JMP	0200	Jump if positive stop not recognized.
0105	BCE	0120 I0.00.7 1	Positive stop recognized. Jump if input is 1.
0106	JMP	0105	Wait until input becomes 1.
0120	PSA	1 +000000.000 999	Return to position +0
0121	JST	0100	Jump with stop according to instruction 0100 (wait for next cycle)
0200	AEA	Q0.01.2 1	Set output.
0201	PSA	1 +000000.000 999	Return to position +0
0202	JST	0000	Jump with stop according to instruction 0000.

Fig. 7-28: PFA Command Example

7.12 Encoder Emulation

It is possible, with the help of encoder emulation, to generate positions in both of the standard formats

- **TTL format** with incremental encoder emulation
- **SSI format** with absolute encoder emulation.

Using these formats, encoder signals can be sent to other devices.

Incremental Encoder Emulation

Incremental encoder emulation means the simulation of a real incremental encoder by a driver controller.

The emulated **incremental encoder signals** are used to relay information about the traversing velocity of the motor that is connected to the controller to a higher-ranking numeric control (NC) device.

Absolute Encoder Emulation

"Absolute encoder emulation" means that the drive controller has the option of simulating a real absolute encoder in **SSI data format**. The drive controller thus offers the possibility of transmitting the position in **SSI data format** to a higher-level device. Pertinent Parameters

- **C014, Encoder emulation**
- **C015, Encoder-Emulation Resolution**
- C010, Reference, set absolute dimension

For **incremental encoder emulation,** the following parameter is also used:

- **C016, Reference impulse-offset**

With absolute encoder emulation, the following parameter is used:

C011, Reference point

Activating Encoder Emulation

It is possible to control the behavior of the function with the help of parameter **C014, Encoder emulation.**

C014 Encoder emulation

0 0 0

Selection of emulation type
0 = no output
1 = incremental encoder emulation
2 = absolute encoder emulation

Dead-time compensation
0 = is deactivated
1 = is activated

Selection of the position to be emulated
0 = position output of motor encoder
1 = position output of optional encoder
2 = output of position command value

Operating principle: Incremental Encoder Emulation

Number of Graduation Marks

The **number of graduation marks** of the emulated incremental encoder is set in parameter **C015, Encoder-Emulation Resolution**:

- **1 to 65536 (=2^16) graduation marks / revolution**

Note: If a motor with resolver feedback is mounted, then the emulator generates as many zero pulses per mechanical revolution as the resolver has pairs of poles. Therefore, make sure that the input for **C015**, **Encoder-Emulation Resolution** is divisible by the number of resolver pole pairs with no remainder, since otherwise the zero pulse will "run away".

Unit

The parameter unit depends on the motor type, i.e.,

- rotary motors: **graduation marks / revolution**
- linear motors: **graduation marks / mm**

Position of the Zero Pulse Relative to the Motor Position

Absolute Encoder

With motor encoders that achieve an **absolute**, **unambiguous** position **within** one **motor revolution** after initialization, or within one **electrical revolution** with resolvers, the zero pulse is always generated at the **same motor position** each time the unit is switched on.

Incremental Encoder

Incremental encoders **do not have an automatic method of determining an umambiguous position** after powering up and must be homed. Homing uses the incremental encoder emulator zero pulse.

With incremental encoders (e.g., sine encoders, gearwheel encoders), the following occurs automatically each time manual or automatic mode is **engaged** (in other words, each time the drive controller is powered up):

- Detection of the motor encoder internal reference point is activated.
- The zero pulse output of the incremental encoder emulator is blocked.
- The increment output is activated.

Homing

As soon as the motor encoder internal reference point is detected, the following takes place:

- general release of the zero pulse output
- immediate output of a zero pulse by the emulator
- initialization of the zero pulse so that in the future it is always output at this absolute motor position.

Note: Output of the zero pulse occurs after homing has been successfully completed. It is then always output at the same position (reference mark).

Zero Pulse Offset

With **rotary motors,** it is possible to offset the zero pulse using **C016**, **Reference impulse-offset** within one (electrical or mechanical) rotation in a clockwise direction.

The **unit** used in C016 is the **degree.** For motor encoders which provide an absolute, unambiguous position within **one motor revolution** after their initialization, the input range is **0..3590.9 degrees.**

The input range for resolvers which provide an absolute, unambiguous position within one **electrical revolution** is

359.9 degrees /number of pole pairs.

Limits on Incremental Encoder Emulation

In contrast to the conventional incremental encoder in which the pulse output frequency is virtually infinitely adjustable in very fine increments (i.e., the pulse edges are always assigned to fixed positions), emulated incremental encoder signals are subject to certain restrictions. These restrictions are primarily the result of how the digital process of the drive controller works.

Maximum Output Frequency

The maximum pulse frequency is 1024 kHz. If this frequency is exceeded, pulses can be lost. The non-fatal error **F253 Incremental encoder emulator: Pulse frequency too high** is generated. The emulated position is then offset with respect to the real position.

$$I_{max} = \frac{f_{max} * 60}{n_{max}}$$

I_{max}: maximum number of graduation marks
n_{max}: allowable maximum speed in rpm

Fig. 7-29: Computing the maximum number of graduation marks

Compensation for Delay (Deadtime) Between Real and Emulated Positions

Between position measurement and pulse output, there is a deadtime (delay) of about 1 ms. If the deadtime compensation is set to 1 in parameter **C014, Encoder emulation**, then this time is compensated for in the drive.

Pulse Breaks at the End of the Pulse Output Cycle

At the end of each time interval, the **signal levels** can **remain constant** for a certain period of time. During the time interval T_A, the output frequency cannot be changed . This effect is especially noticeable at high frequencies, i.e., when the number of graduation marks is great and/or at high speeds.

Diagnostic Messages with Incremental Encoder Emulation

The following diagnostic messages are generated with incremental encoder emulation:

- **F253 Incremental encoder emulator: Pulse frequency too high**

Cause: The output frequency for the set number of graduation marks exceeds the value of 1024 kHz.

Remedy:

- Decrement number entered for **C015, Encoder-Emulation Resolution.**
- Reduce travel velocity

Cause: output of all graduation marks detected in the interval is monitored and was incorrect in this case, leading to a position offset. This error occurs only during extremely long interrupt periods.

Remedy:

- All software options not absolutely required are disabled, e.g., processing of the second analog input, signal output via the two analog outputs, etc.

Operating principle: Absolute Encoder Emulation

SSI Format

The following illustration shows the format for SSI data transmission.

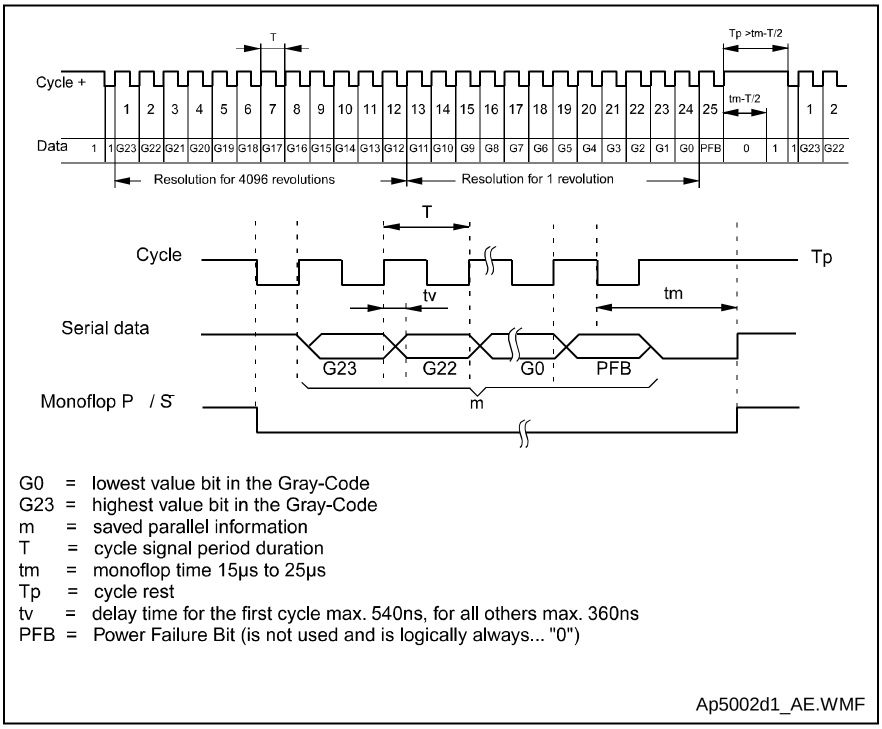


Fig. 7-30: SSI Format as Pulse Diagram

Notes: The **Power Failure Bit** is not evaluated in the drive!

Emulated position reference

Emulation of the signals for "Position of the motor encoder," "Position of the optional encoder" and "Position command value" is based on the “feed constant” and “gear” parameters.

The values produced by the emulator are load-dependent.

Resolution with Absolute Encoder Emulation

The data output format for the emulated SSI position is stipulated in parameter **C015**, **Encoder-Emulation Resolution**.

- **4 .. 24** bit / mm

The output direction depends on parameter C000, Working Polarity.

Homing with Absolute Encoder Emulation

Using parameter **C010, Set absolute dimension,** the absolute position output by the absolute encoder emulator can be homed .

When the absolute encoder is set, the value from parameter **C011, Reference point** is processed.

Position Jumps at the Display Limits of Absolute Encoder Emulation

Using SSI emulation, it is possible to represent **4096 revolutions** as an absolute measurement . When the display limits are reached with SSI emulation, small position fluctuations will lead to large **jumps in the emulated SSI position**.

This is the case with position 0 followed by 4096 revolutions.

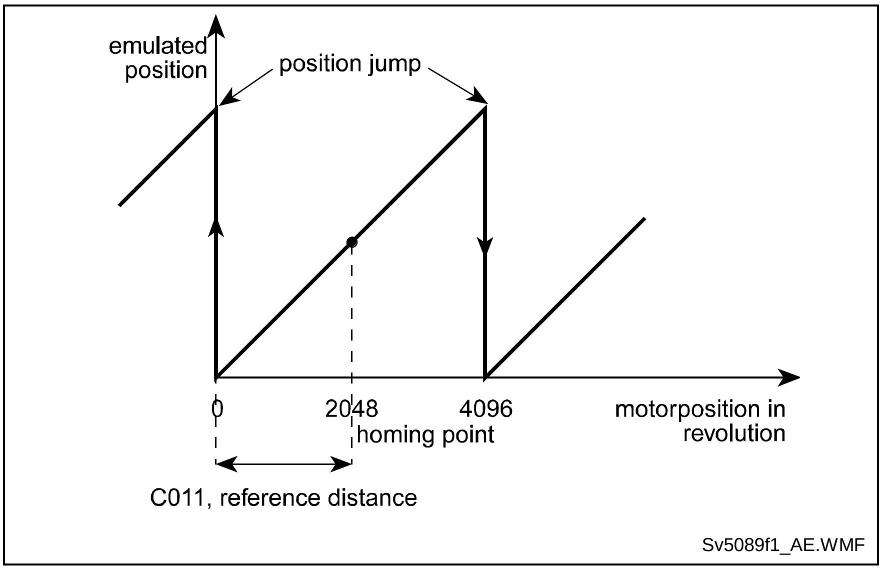


Fig. 7-31: SSI Display Limits

To prevent this effect, the SSI position value must be moved using parameter

C010, Set absolute dimension.

It is recommended that parameter **C011, Reference point** be used to move the position to the middle of the SSI display range. Then it is possible to travel 2048 revolutions to the left and right.

8 Parameters

8.1 Basic Information

In this chapter, the parameters are described. They are used to define and adjust the system components and to activate hard-coded operations. Except for the CR parameters, they can only be modified in parameter mode via the serial interface. Once the system is no longer in Parameter Mode, the parameters are monitored and a diagnostic message is issued if incorrect parameters are found.

To provide a better overview, the parameters are divided into 7 groups:

Parameter Group	Group Identifier	Parameter Number
System Parameters	A1	00 to 19
Function Parameters	AA	00 to 08
General Parameters	B0	00 to 13
Encoder Parameters	C0	00 to 16
Controller Parameters	CR	00 to 10
Motor Parameters	CM	00 to 09
Asynchronous Motor Parameters	CA	00 to 08

Fig. 8-1: Parameter Groups

Controller Parameters (CR)

These parameters can be changed via the serial interface, both in Manual and Automatic Mode.

Motor Parameters (CM)

In motors with feedback memory, these parameters are set when the program is initially loaded.

Asynchronous Motor Parameters (CA)

In motors with feedback memory, these parameters are meaningless.

Input Units

The input unit is defined in Parameter **A101 Feed rate constant**. The feed constant is defined as the linear displacement of the load during one revolution of the gear drive shaft. Input can be in any desired dimension and is referred to below as the input unit (IU).

It is important that all other measurements entered be referenced to this same unit.

e.g. IUs [mm]

In this case, the velocity is entered or shown as IUs/sec., hence mm/sec.

IUs [inch]

In this case, the velocity in entered or shown as IUs/sec, hence inches/sec.

8.2 System Parameters

A100 Application type

1 1

Function, encoder 2 (optional):

0 = none
1 = direct measurement
2 = master/slave axis
3 = measuring wheel

Type of motion:

0 = rotary (continuous rotating)
1 = linear (finite travel)
2 = rotary table

Type of motion: With **rotary** motion, the drive unit normally turns continuously in one direction. The product is brought to its relative position using rollers and is then processed. Roll feed mechanisms are typically used.

There are no travel limit switches.

With **linear** motion, the drive unit moves a mechanical system only a specified distance. Normally, absolute positioning is performed and travel limit switches monitor the distance traversed.

The **rotary table** normally turns continuously.

Positioning is absolute within one revolution (modulo value). There are no travel limit switches.

Function, encoder 2:

none: There is no second encoder

Direct measurement: In addition to the motor encoder, an externally mounted encoder provides position detection.

Master/slave axis: Encoder signals are transferred from a master axis. Depending on the task definition, these are interpreted in the parameters or in the user program.

Measuring wheel: In this function, an external encoder at times detects the position. It is possible to switch back and forth between the motor encoder and the measuring wheel encoder. Only relative distances are traversed.

A101 Feed rate constant

1234.5678

Feed constant in IUs

Note:	This is where the IU is defined

IU = input unit

This parameter describes the conversion from rotary to linear motion. It is defined as the linear displacement of the load during one revolution of the gear drive shaft.

Input min.:	0.1000	IUs
Input max.:	5000.0000	IUs

A102 Gearing

1000 2000

Output revolutions of load gear
Input revolutions of load gear

A mechanical gear is often employed between the motor and the load.

The **gear ratio** is defined as:

$$i = \frac{Load\ Gear - Input\ Revolutions}{Load\ Gear - Output\ Revolutions}$$

Fig. 8-2: Gear Ratio

See also function description for: "Gear Ratio" and "Modulo Function"

Example:

5 turns of the motor shaft produce 2 turns of the output gear shaft.

⇒ Input revolutions: 5
Output revolutions: 2

Input min.:	1
Input max.:	9999

A103 Max Position negative

±123456.789

Negative travel limit in IUs

The negative travel limit defines the maximum travel distance in the negative direction whenever the type of motion is 1 ("linear motion," **Parameter A100**) and all position data have been referenced to the home position, i.e., the drive unit has been **homed**.

If a target position beyond the negative travel limit is stipulated for the drive, **error message E-0203** (target position < negative travel limit) is generated.

If this programmed position is exceeded in automatic mode, the **F629** error message (positive travel limit exceeded) is generated.

Input min.: -200000.000

Input max.: +200000.000

A104 Max position positive

±123456.789

Positive travel limit in IUs

The positive travel limit defines the maximum travel distance in the positive direction.

The position limit is only active when the type of motion is 1 ("linear motion," **Parameter A100**) and all position data have been referenced to the home position, i.e., the drive unit has been **homed**.

If a target position beyond the positive travel limit is stipulated for the drive, **error message E-0204** (target position > positive travel limit) is generated.

If this programmed position is exceeded in automatic mode, the following error message is generated: **F630** (Negative travel limit exceeded)

Input min.: -200000.000

Input max.: +200000.000

A105 Modulo value

123456.789 0

0 = direction programmed within command
1 = shortest distance
modulo value in IUs

When the modulo format is set, the modulo value determines the numerical value at which the position data overflow to 0.

This parameter is used only with motion type 2 (rotary table, **Parameter A100**) and normally indicates the circumference of the table.

Input min.:	0.000	IUs
Input max.:	200000.000	IUs

A106 Maximum-Speed

123456.789

Maximum velocity of the axis in IUs/sec

The maximum speed defines the maximum permissible speed and applies symmetrically in both directions.

The maximum value that can be entered is limited by **Parameter CM03** “Maximum speed Motors” and by the amplifier output.

$$\textit{For rotary encoders:}$$

$$A106_{\max} = \frac{\textit{Max. possible speed} \times \mathrm{VK}\,(\mathrm{A101})}{60 \times \mathrm{i}}$$

$$\textit{For linear motors:}$$

$$A106_{\max} = CM\,03$$

L: FC = feed constant
i = gear ratio

Fig. 8-3: Calculation of Maximum Speed

The speed given in per mille in the feed commands is referenced to this value.

Input min.: 0.010

Input max.: depending on the drive and the amplifier output
200000.000

A107 Setup-Speed

123456.789

Jog velocity in IUs/sec.

With the velocity entered here, the drive motion is
‘Jog forward‘ or ‘Jog reverse'.
Additionally: A107 =< A106

Input min.: 0.001
Input max.: depending on the drive and the amplifier output
200000.000

A108 Acceleration bipolar

123456

Acceleration in IUs/sec^2

The maximum possible bipolar acceleration defines the maximum permissible acceleration symmetrically in both directions (acceleration and deceleration) and is stipulated in this parameter.

Acceleration or delay limits are possible in Parameter A109 and/or using the ACC/DEC command.

Input min.: 1
Input max.: 200000

A109 Acceleration / Delay

123 456

Deceleration in ‰
Acceleration in ‰

In both of these values, the ‰ indication refers to the maximum acceleration in **Parameter A108**. If 000 is entered, the program retrieves the acceleration value from **Parameter A108**.

Acceleration and deceleration can be set to different values using this parameter. These values are always valid following a restart, after error messages are received, and after parameter mode is exited. The ‰ indications given in the ACC and DEC commands are referenced to this parameter.

Input min.: 0 ‰
Input max.: 999 ‰

A110 Jerk bipolar, Time constant

In preparation

1.024

Time constant for acceleration [in sec]

Min. = 0 (no jerk)
Max. = 1.024 s

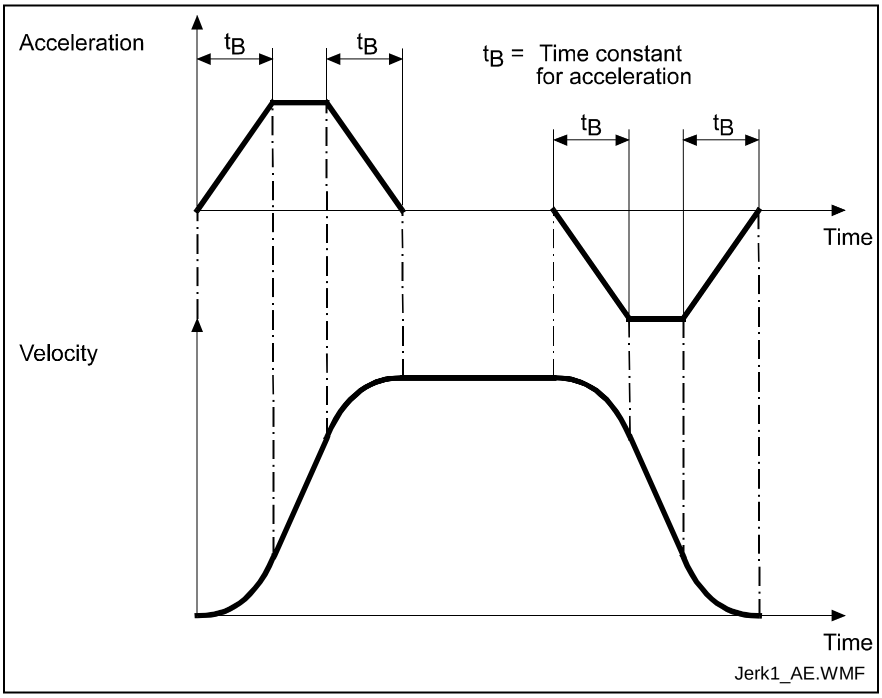


Fig. 8-4: Jerk

A111 Switching level/Positioning window

M2.02.2 123.456

Switching level in IUs

Output: Position reached

		M2, M3, M4
DKC21.3		Q0.00.4-Q0.01.3
DKC 3.3	:	Q2.02.0-Q2.05.7

Output: This parameter is set when the current distance to travel from the last feed command is less than the switching level. If the motor does not remain within this ± switching level range or if a new feed command is detected, the output is canceled. If 00.00.0 is entered, the function is not enabled.

Switching level: How close the approach must be to the stipulated target position for the 'Position reached' message to be generated is entered here. In response to feed commands, this message also tells the program to proceed to the next instruction.

When the stop function is executed, the "Position reached" message is no longer referenced to the previously stipulated target position.

In case of an interrupt, the target position is retained.

| Current distance to travel | + | position lag | < switching threshold → Output = 1

| Current distance to travel | + | position lag | < switching threshold → Output = 0

Switching threshold input min.: 0.001

Switching threshold input max: 999.999

A112 Reserved

A113 Positioning window

M2.02.2 1234.567

"In Position" – window in IUs

Output: Axis in last programmed target position
00.00.0 = function not enabled

	M2, M3, M4
DKC21.3 :	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7

The last target position specified by means of a feed command or by homing is stored and then continually compared with the actual position value. If the actual position value is within this window, the output is set.

| Target position – actual position | < positioning window → Output = 1

| Target position – actual position | < positioning window → Output = 0

This function is enabled in Manual and Automatic Mode.

Position input min.: 0,001

Position input max.: 9999.999

A114 Registration signal

M2.02.2 1.5 0050

- 0050 — Distance from the target position in IUs,
  Min: 1 Max: 9999
- 1.5 — Time in sec. (pulse)
  0.0 = Output as continuous signal
- M2.02.2 — Presignaling output
  00.00.0 = Presignaling function not enabled

	M2, M3, M4
DKC21.3 :	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7

The presignaling function programmed in this parameter applies for every positioning command (POI, PSI, POA, PSA).

As soon as the distance from the target position becomes less than the programmed presignaling distance, the output is enabled. The output remains enabled continuously or for the programmed time period. The output is disabled each time a new feed instruction is received.

A115 Monitor

1 100 M2.02.2

- M2.02.2 — Output:
  Position lag > max. position deviation

	M2, M3, M4
DKC21.3 :	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7

  00.00.0 Function not active
- 100 — max. position deviation [%] max. = 300
- 1 — 8 = position control circuit monitoring = OFF
  <> 8 = position control circuit monitoring = ON

The position control circuit is continuously monitored. This is done by calculating an actual position value model and comparing it with the actual position value.

The maximum deviation tolerated between the measured and calculated actual positions is set using **Parameter A115, Monitor.** At maximum velocity, the position lag is assumed to be at 100%. If the position deviation exceeds this monitoring window, the error message **F228, Excessive deviation** is issued.

$$\max.\mathit{Deviation}[\mathit{EGE}] = \frac{A106}{CR07} \times \frac{60}{1000} \times \frac{\max.\mathit{Position\,Deviation}}{100}$$

L: A106 Maximum Speed
CR07 Kv factor

Fig. 8-5: Monitoring Window

A116 Feed monitoring

M2.02.2 M2.02.3

Input: Interrupt
M0 – M5 ; I0 - I2 ; Q0 - Q2

Input: Feed Angle Monitoring
M0 – M5 ; I0 - I2 ; Q0 - Q2

Feed angle monitoring

Whether or not the feed is to be monitored is entered at this point. If 00.00.0 is entered, there is no monitoring.

If no signal is present at the specified input, no feed takes place. Then all of the NC instructions which do not contain feed distances are executed. As soon as the NC encounters an instruction containing a feed distance, it stops at this instruction until a signal is applied at the input.

If the signal drops out during feed, feed is aborted and the following **error message** is generated. **E-0210** (Feed angle monitoring)

Interrupt:

Whether or not a positioning function in progress can be interrupted is entered at this point. If 00.00.0 is entered, there is no interruption.

If the signal at the specified input is lost, any initiated positioning functions are not executed, or those already in progress are stopped. All instructions containing **no** feed distances continue to be processed as usual.

As soon as an instruction containing a feed distance is invoked, the program waits to process the instruction until a signal is present at the input.

If the other operating conditions have been retained, execution or continuation of the positioning function takes place as soon as the signal is present.

A117 Monitor Feedback difference

123

000 = no monitoring
Monitoring window in ‰ referencing C007
(only for measuring wheel applications)

A118 Absolute Feedback device Monitor window

1234.567

Window size in IUs

Following a restart or after exiting Parameter Mode, the actual position stored the last time the control voltage was switched off is compared with the current initialized actual position of the absolute measuring system by the absolute encoder monitoring function.

If the difference is greater than the value given in **Parameter A118** (absolute feedback device monitor window parameter input), the error message **F276, 'Absolute encoder error'** is generated. This can happen when the axis has been **moved with the power off**, or after a motor has been replaced.

If the parameter entered in A118, 'Absolute Feedback device Monitor window' is a 0, the absolute encoder monitoring function is disabled. As a standard value, 0.1 motor revolutions (= 36 degrees in reference to the motor shaft) can be programmed if the axis has a holding brake or is self-locking.

Window size: Conversion of motor shaft data (in degrees) to load-referenced window size (in IUs)

$$Window\,size[IU] = \frac{Degrees\,(Motor\ shaft) \times VK\,(A101)}{i\,(Gear\ ratio) \times 360}$$

Fig. 8-6: Absolute Feedback device Monitor window

Input min.:	0	[IUs]
Input max.:	9999.999	[IUs]

A119 Best possible halt

0 0 000 — Reserved

Maximum braking time in sec
0 = 5 s (Default value)

0 = zero the speed command value
1 = Switch to torque-free state
2 = zero the velocity command value

This parameter specifies how the drive will be stopped by setpoint zeroing in the event of

- a non-fatal error
- an interface error
- a phase regression
- clearing the drive enable signal

A119:	Reaction type:
0	**Velocity command value set to zero** The motor decelerates, allowing for the torque limit. The **max. braking time** is 5 sec.. The holding brake is activated 100 ms prior to expiration of the braking time. If the velocity has previously fallen below 10 RPM (rotary motors) or below 10 mm/min (linear motors), then the motor holding brake will be engaged immediately. The motor is torque free 100 ms after the mechanical brake is engaged.
1	**Switch to torque-free state**
2	**Velocity command value to zero** with command ramp and filter The ramp value, i.e., the maximum acceleration, is set via **Parameter A108**, the jerk filter via **Parameter A110**.

Fig. 8-7: Deceleration Mode for the Drive

The drive enable signal can be applied only after the drive has finished its error reaction.

8.3 Function Parameters

AA00 Task 2 & 3

0100 0200 1

- **1** – Number of commands in Task 3 per NC cycle
  only 1 is possible
- **0200** – **Task 3** _ Start instruction
  If 0000 appears here, Task 3 is not enabled
  max: 0999
- **0100** – **Task 2** – Start instruction
  If 0000 appears here, Task 2 is not enabled
  max: 0999

For further details, see Section 7.7, Multitasking.

AA01 Manual-Vector

M2.02.2 1 0 0100

- **0100** – Start instruction of the manual vector program
- **0** – reserved
- **1** – 0 = start only via input
  1 = jump to vector program even when changing from automatic to manual mode
- **M2.02.2** – Input number, program start at leading edge of pulse
  00.00.0 = no input selected
  M0 – M5 ; I0 - I2 ; Q0 - Q2

For further information, see Section 7.6 `Vector Programming.´

AA02 Interrupt vector

M2.02.2 1 0 0100

Start instruction for the interrupt program

0 = a positioning motion in progress is not interrupted
1 = a positioning motion in progress is interrupted (the drive decelerates to a complete stop)

0 = the vector is inhibited during a subroutine (JSR). (leading edge of pulse)
1 = the vector is always enabled (leading edge of pulse)
2 = the vector is inhibited during a subroutine (JSR). (falling edge of pulse)
3 = the vector is always active (falling edge of pulse)

Input, Activate interrupt function
00.00.0 = Interrupt function inhibited
M0 – M5 ; I0 - I2 ; Q0 - Q2

For further information, see Section 7.6 `Vector Programming.´

AA03 Restart

AA04 Override

1

0 = override is off
1 = inputs I0.00.6...I0.01.4 in binary format
2 = inputs I0.01.1...I0.01.4 in Gray code
3 = analog input 0-10V E1 (X3/12 X3/13)

For further information, see Section 7.4, `Override.´

AA05 Reserved

AA06 Reserved

AA07 Measuring wheel operation

Only in Automatic Mode

M2.02.3

"Activate measuring wheel" input
Input status = 0 : Control using motor encoder
Input status = 1 : Control using measuring wheel encoder

00.00.0 = no input programmed.
The measuring wheel function is always active in Automatic Mode if programmed in **Parameter A100.**

M0 – M5 ; I0 - I2 ; Q0 - Q2

This parameter applies only if Measuring Wheel Mode has been preselected in **Parameter A100**. The measuring wheel function is always active in Automatic Mode or can be disabled using the programmed input.

AA08 Various

M2.02.2 M2.02.3

Output: Parameter enabled

Output: Programmed velocity reached
M0 – M5 ; I0 - I2 ; Q0 - Q2

00.00.0 = no output programmed

This output indicates whether Parameter Mode is enabled.

If 00.00.0 is entered here, no output is selected.

8.4 General Parameters

B000 Display

1 0

- 0: Reserved
- 1: Language
  - 0 = German
  - 1 = English

B001 Interface Para. 1

09600 1

- 1: Parity check
  - 1 = no parity
  - 2 = even
  - 3 = odd
- 09600: Baud rate: 02400 baud rate
  - 04800 baud rate
  - 09600 baud rate
  - 19200 baud rate

For further details, see Section 9.2, `Serial Interface.´

B002 Interface Para. 2

0 0 0 0 0 000

- 000: response delay in ms in RS485 Mode
  - 000 = no delay (0...200)
- 0: 1 = in the event of a fault, an error message is sent automatically via the interface.
  0 = function disabled
- 0: 0 = SIS protocol
  1 = ASCII protocol
- 0: 0 = no checksum error message
  1 = checksum error message
- 0: interface confirmation (Y CR LF)
  - 0 = off
  - 1 = on
- 0: checksum
  - 0 = checksum validation on
  - 1 = checksum validation off

Explanation of the term 'Response Delay' (0...200ms)

In RS485 Mode, once the serial interface receives the last character of a request (an LF or "Linefeed": ASCII Code 10), it immediately switches over to Send Mode. With various RS 485 PC driver cards, this leads to problems if the cards are unable switch to Receive Mode fast enough.

The interface can delay the switch from Receive to Send Mode by a defined amount of time (response delay).

The PC driver should be able to switch reliably from Send to Receive Mode within this time limit.

B003 Analog-Output 1 Signal select

S 0 0001

Signal number
S 0 0000 = unassigned

The B003 parameter can be used to assign a signal number to the analog AK1 output channel of the drive controller.
The content of these signals can be viewed using an oscilloscope.

Input:	Definition	B005 Input Value	Value at 10V
S 0 0036	Command Velocity	Contents of Parameter A106 x 6	Contents of Parameter A106
S 0 0040	Actual Velocity	Contents of Parameter A106 x 6	Contents of Parameter A106
S 0 0047	Command Position		
S 0 0051	Actual Position, Encoder 1		
S 0 0053	Actual Position, Encoder 2		
S 0 0080	Command torque/force	0.500 = 500%	Current at standstill, Parameter CM02
S 0 0084	Actual torque/force	0.500 = 500%	Current at standstill, Parameter CM02
S 0 0189	Lag distance		
S 0 0347	Velocity control deviation		
S 0 0383	Motor temperature		
P 0 0098	Max. model deviation		
P 0 0141	thermal controller load		

Fig. 8-8: Signal Selection

B004 Analog-Output 1 ext. Signal select

12345678

Hex value

Extended signal selection is possible for also representing signals as an analog voltage, which is not included in the B003 list. This function is enabled if no parameter is assigned to the analog output via **B003, Analog-Output 1 Signal select**.

The following extended signal selection options are defined:

- Extended signal selection with:
- permanently defined signals
- byte output
- bit output

1) Extended signal selection with permanently defined signals

Internal signals are assigned numbers. These signals have fixed reference units so that they can be scaled via **B005, Analog-Output 1 Evaluation [1/10V]**. A scaling factor of 1.0 equals the fixed reference unit.

The following permanently defined signals are possible:

Signal number B004	Output signal	Reference unit: Scaling factor = 1.0
0x00000001	motor encoder sine signal	0.5V/10V
0x00000002	motor encoder cosine signal	0.5V/10V
0x00000003	opt. sine signal Encoder	0.5V/10V
0x00000004	opt. cosine signal Encoder	0.5V/10V
0x00000005	position loop command value difference	rot. => 1000 RPM/10V lin. => 100 m/min/10V
0x00000006	DC bus power	1kW/10V
0x00000007	absolute DC bus power amount	1kW/10V
0x00000008	effective current (Iq)	peak current amplifier/10V
0x00000009	relative current (Id)	peak current amplifier/10V
0x0000000a	thermal load	100%/10V no scaling possible
0x0000000b	motor temperature	150°C/10V
0x0000000c	magnetizing current	peak current amplifier/10V
0x0000000d	velocity loop command value	rot. => 1000 RPM/10V lin. => 100 m/min/10V

Fig. 8-9: Signal Selection List with Predefined Signal Selection

The outputs are not scaling dependent and are always referenced to the motor shaft for the position and velocity data.

2) Byte output

With this option, it is possible to directly output data memory storage locations as an analog voltage. It is only useful, however, if the data storage structure is known. Since this structure differs from version to version, this function can only be used by the respective developer. The function is activated by setting bit 28 in parameter **B004, Analog-Output 1 ext. Signal select**. The address of the storage location is defined in the 24 least significant bits of the extended signal selection.

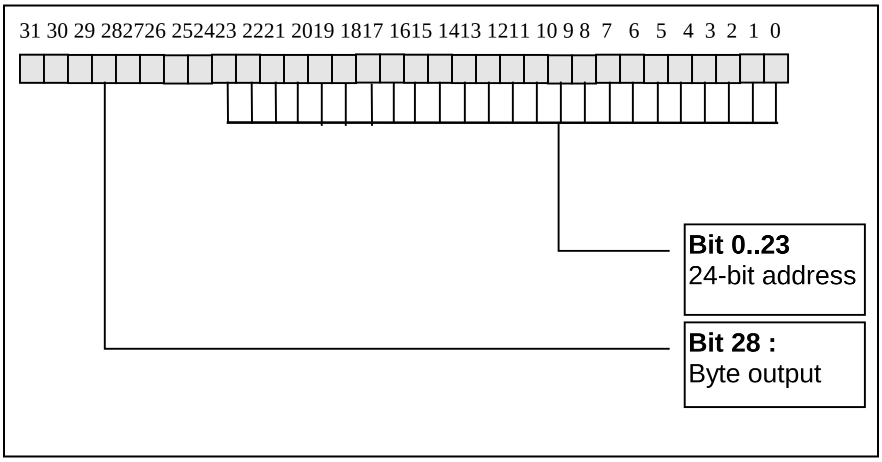


Fig. 8-10: Definition of **B004, Analog-Output 1 ext. Signal select** with Byte Output

3) Bit output

With this option, individual bits of the data memory can be represented as an analog voltage. If the bit in question is set, 10 volts are output at the analog output. In response to a reset bit, -10 volts are output. The function is activated by setting bit 29 and inputting the desired memory address in **Parameter B004, Analog-Output 1 ext. Signal select**.

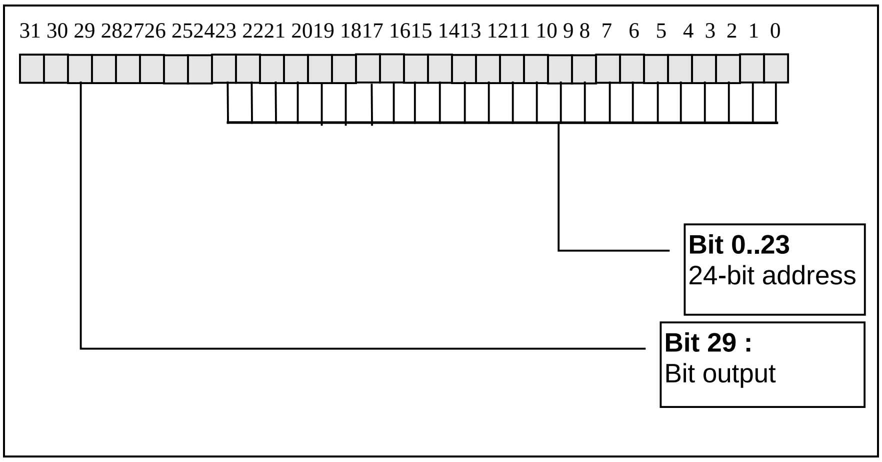


Fig. 8-11: Definition of **B004, Analog-Output 1 ext. Signal select** with Bit Output

B005 Analog-Output 1 Evaluation [1/10V]

0001.0000

Scaling /bitnumber

The resolution of the selected signal can be varied using parameter **B005, Analog-Output 1 Evaluation [1/10V]**. If a number is assigned via **B003, Analog-Output 1 Signal select**, scaling always uses the same **unit** as the parameter with the assigned ID number. When pre-defined signals are output, scaling is defined as a factor having 4 decimal places. It has a permanent reference with fixed unit. Scaling defines the least significant bit for bit and byte output. The input is an integer value without decimal places.

B006 Analog-Output 2 Signal select

S 0 0001

Signal number
S 0 0000 = unassigned

The B006 parameter can be used to assign a signal number to the analog AK2 output channel of the drive controller.
The content of these signals can be viewed using an oscilloscope.

Input:	**Definition**	**B008 Input Value**	**Value at 10V**
S 0 0036	Command Velocity	Contents of Parameter A106 x 6	Contents of Parameter A106
S 0 0040	Actual Velocity	Contents of Parameter A106 x 6	Contents of Parameter A106
S 0 0047	Command Position		
S 0 0051	Actual Position, Encoder 1		
S 0 0053	Actual Position, Encoder 2		
S 0 0080	Command torque/force	0.500 = 500%	Current at standstill, Parameter CM02
S 0 0084	Actual torque/force	0.500 = 500%	Current at standstill, Parameter CM02
S 0 0189	Lag distance		
S 0 0347	Velocity control deviation		
S 0 0383	Motor temperature		
P 0 0098	Max. model deviation		
P 0 0141	thermal controller load		

Fig. 8-12: Signal Selection

B007 Analog-Output 2 Extended Signal select

12345678

Hex value

Extended signal selection is possible for also representing signals as an analog voltage, which is not included in the B006 list. This function is enabled if no parameter is assigned to the analog output via **B006, Analog-Output 2 Signal select**.

The following extended signal selection options are defined:

- extended signal selection with permanently defined signals
- byte output
- bit output

1) Extended signal selection with permanently defined signals

Internal signals are assigned numbers. These signals have fixed reference units so that they can be scaled via **B007, Analog-Output 2 Evaluation [1/10V]**. A scaling factor of 1.0 equals the fixed reference unit.

The following permanently defined signals are possible:

Signal number B007	Output signal	Reference unit: Scaling factor = 1.0
0x00000001	motor encoder sine signal	0.5V/10V
0x00000002	motor encoder cosine signal	0.5V/10V
0x00000003	opt. sine signal Encoder	0.5V/10V
0x00000004	opt. cosine signal Encoder	0.5V/10V
0x00000005	position loop command value difference	rot. => 1000 RPM/10V lin. => 100 m/min/10V
0x00000006	DC bus power	1kW/10V
0x00000007	absolute DC bus power amount	1kW/10V
0x00000008	effective current (Iq)	peak current amplifier/10V
0x00000009	relative current (Id)	peak current amplifier/10V
0x0000000a	thermal load	100%/10V no scaling possible
0x0000000b	motor temperature	150°C/10V
0x0000000c	magnetizing current	peak current amplifier/10V
0x0000000d	velocity loop command value	rot. => 1000 RPM/10V lin. => 100 m/min/10V

Fig. 8-13: Signal Selection List with Predefined Signal Selection

The outputs are not scaling dependent and are always referenced to the motor shaft for the position and velocity data.

2) Byte output

With this option, it is possible to directly output data memory storage locations as an analog voltage. It is only useful, however, if the data storage structure is known. Since this structure differs from version to version, this function can only be used by the respective developer. The function is activated by setting bit 28 in parameter **B007, Analog-Output 2 Extended Signal select**. The address of the storage location is defined in the 24 least significant bits of the extended signal selection.

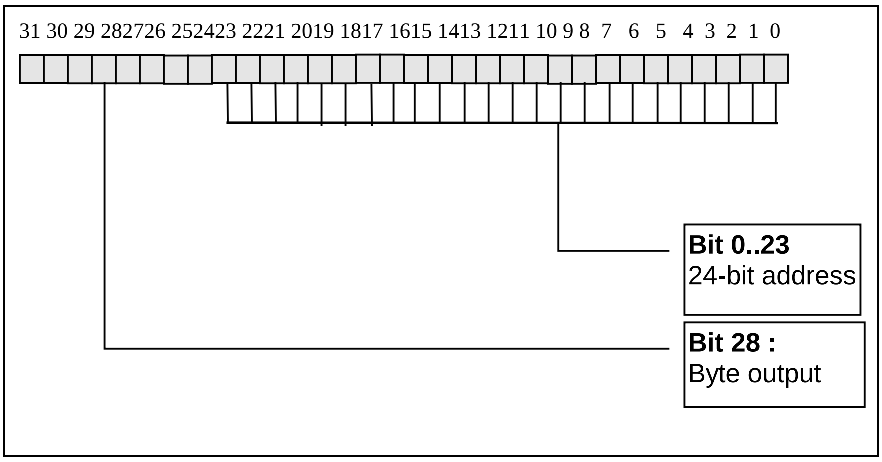


Fig. 8-14: Definition of **B007, Analog-Output 1 Extended Signal select** with Byte Output

3) Bit output

With this option, individual bits of the data memory can be represented as an analog voltage. If the bit in question is set, 10 volts are output at the analog output. In response to a reset bit, -10 volts are output. The function is activated by setting bit 29 and inputting the desired memory address in **Parameter B007, Analog-Output 2 Extended Signal select**.

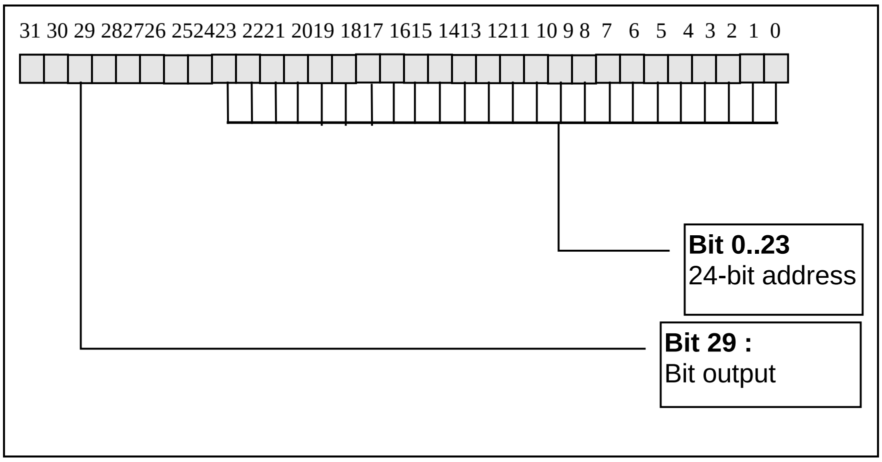


Fig. 8-15: Definition of **B007, Analog-Output 1 Extended Signal select** with Bit Output

B008 Analog-Output 2 Evaluation [1/10V]

0001.0000

Scaling /bit number

The resolution of the selected signal can be varied using parameter **B008, Analog-Output 2 Evaluation [1/10V]**. If a signal number is assigned via **B006, Analog-Output 1 Signal select**, scaling always uses the same **unit** as the parameter with the assigned ID number.

When pre-defined signals are output, scaling is defined as a factor having 4 decimal places. It has a permanent reference with fixed unit. The scaling defines the least significant bit for bit and byte output. The input is an integer value without decimal places.

B009 Serial IO control

0 123

maximum cycle time [ms] (200-500 ms)

0 – no serial inputs/outputs active

1 – serial inputs/outputs active

The system reads the X4 inputs and writes to the X5 outputs on the BTV04 via the serial interface. The transmission rate depends on the type of transmission and the baud rate. Cyclic transmission is monitored by the control unit. If no new message is received within the maximum cycle time, the control unit generates a warning or error message:

- E-0105 Serial I/O offline
- F-0317 User I/O error

The following can be transmitted:

11 inputs, I1.03.0 to I1.04.1

12 outputs, Q1.03.0 to Q1.04.2

The keys can be read when the inputs/outputs are activated.

B010 System control

```
1
└──────── 0 – Standard system control
          1 – serial system control
```

System control can also be handled via the serial interface. Cyclic transmission of the system inputs and outputs via the serial interface is then monitored. If no new message is received within the maximum cycle time, the following warning or error message is generated:

- E-0104 Systemctrl. offline
- F-0316 Systemctrl. Error

The E-0104 warning is generated whenever system control takes place via the serial interface and the control unit is in Parameter Mode. The F-0316 warning is generated whenever system control takes place via the serial interface and the control unit is in Manual or Automatic Mode.

B011 Fieldbus Cycle Time

Valid only for DKC3.3 with Profibus

```
12345
 └──────── maximum cycle time
```

Cyclic transmission of the process data via the fieldbus is monitored. If no new message is received within the maximum cycle time, the control unit generates one of the following warning or error messages:

- E-0104 Systemctrl. offline
- F-0316 Systemctrl. Error
- F-0317 User I/O Error

The E-0104 warning is generated whenever communication takes place via the fieldbus and the control unit is in Parameter Mode. The F-0316 error message is generated whenever communication takes place via the fieldbus and the control unit is in Manual or Automatic Mode. The F-0317 error message is generated whenever communication does **not** take place via the fieldbus and the control unit is in Automatic Mode.

If the cycle time is predetermined by the fieldbus master, the actually used value is written to this parameter and can be read out for diagnostic purposes.

Note: A value of 0 means that monitoring is turned off!

For further information, see Section 10.2 `Vector Programming.´

B012 Fieldbus Baudrate

Valid only for DKC3.3 with Profibus

123456.7

Baud rate

Here, the desired baud rate in increments of 1 kBaud can be set, if the fieldbus does not automatically detect the baud rate.If the set baud rate is not allowed, a default baud rate for the particular fieldbus is used. The actually used value is written to this parameter and can be read out for diagnostic purposes.

For further information, see Section 10.2 `Vector Programming.´

B013 Fieldbus Format

Valid only for DKC3.3 with Profibus

0 1 0

0 = Word evaluation
1 = Byte evaluation (in preparation)

0 = Intel
1 = Motorola

0 = Process Data Channel with I/O , Diagnostic and Variable Channel
1 = Process Data Channel with I/O and Diagnostic

For further information, see Section 10.2 `Vector Programming´.

8.5 Encoder Parameters

C000 Position Polarity

1

0 = motor turns in clockwise direction
1 = motor turns in counterclockwise direction

‘Right-hand motor rotation = motor turns in clockwise direction‘
(viewed facing the motor shaft end)

C001 Feedback 1 Type

01

Measurement System

In motors with feedback memory, this parameter is written automatically.

This parameter determines the encoder interface to which the motor encoder is connected. The number of the corresponding interface module should be entered in this parameter.

C000:	Interface	Measurement System
1	X4	Digital servo feedback or resolver
2	X8	Incremental encoder with sine signals, by Heidenhain; 1V signals
5	X8	Incremental encoder with square wave signals, by Heidenhain
8	X8	Encoder with EnDat interface
9	X8	Gearwheel encoder with 1Vp-p signals
10	X4	Resolver encoder without feedback memory
11	X4+X8	Resolver without feedback memory plus incremental encoder with sine signals
12	X4+X8	Hall encoder with square-wave encoder
13	X4	ECI encoder
14	X4+X8	Hall encoder with sine encoder

Table 8-16 Measurement System Ports

C002 Position feedback 1 type

01 0 0 0

Encoder type
0 = rotary
1 = linear

Distance-coded measuring system:
0 = no distance-coded measuring system
1 = distance-coded reference marks

Direction of movement:
0 = not inverted
1 = inverted

Absolute readout:
x0 = no absolute readout possible
01 = absolute readout possible and active
>encoder is treated as absolute
11 = Absolute readout possible, but not active

This parameter is used to stipulate the most important properties of the motor encoder (position encoder 1).

Remark:

In absolute measuring systems with memory, absolute readout is automatically set.

For MHD, MKD and MKE motors, the encoder type, distance-coded measuring system, and direction of movement are set by the drive and are write-protected.

Note: Only the bits listed here are supported by the software.

C003 Resolution Feedback 1 (Motor)

00005000

Pulses/revolution (rotary encoders)

000,05000

mm / Graduation marks (linear encoders)
Input is in 0.00001 mm

In motors with feedback memory, these parameters are written automatically.

Depending on parameter **CM00, Motor type** (rotary or linear motors), **C003, Resolution Fbk. device 1 (Motor)** stipulates the motor encoder resolution.

For rotary motors, this value reflects the number of pulses (number of graduation marks) or cycles per motor revolution, and with linear motors, the number of graduation marks per mm.
For motors with a resolver feedback, the number of pole pairs is stored here.

C004 Feedback 2 type

Applicable for

- master axis encoders
- measuring wheel encoders
- direct measurement

01

Measurement System:
00 = no optional encoder

This parameter determines the encoder interface to which the optional encoder is connected. The number of the corresponding interface module should be entered in this parameter.

C004:	Interface	Measurement System
1	X4	Digital servo feedback or resolver
2	X8	Incremental encoder with sine signals by Heidenhain; 1V signals
5	X8	Incremental encoder with square wave signals, by Heidenhain
8	X8	Encoder with EnDat interface
9	X8	gearwheel encoder with 1Vp-p signals

Fig. 8-17: Measurement System Connections

C005 Position feedback 2 type

01 0 0 0

Encoder type
0 = rotary
1 = linear

Distance-coded measuring system:
0 = no distance-coded measuring system
1 = distance-coded reference markers

Direction of movement:
0 = not inverted
1 = inverted

Absolute readout:
x0 = no absolute readout possible
01 = absolute readout possible and active
>encoder is treated as absolute
11 = Absolute readout possible, but not active

This parameter is used to stipulate the most important properties of the interface encoder (position encoder 2).

Remark:

In absolute measuring systems with memory, absolute readout is automatically set to x1.

C006 Resolution Feedback 2

00005000

Pulses/revolution (rotary encoders)

00005000

mm / Graduation mark (linear encoders)
Input is in 0.0000001 mm

See C003.

C007 Feedrate constant 2

1234.5678

Feed constant in IUs

Encoder 2 is used as an optional encoder, measuring wheel axis or master axis.

This parameter is read out only with rotary encoders.

This parameter describes the conversion from rotary to linear motion. It is defined as the linear displacement of the load during one revolution of the encoder shaft.

Input min.:	0.1000	IUs
Input max.:	5000.0000	IUs

C008 Reserved

C009 Homing configuration

1 0 0 12 34

- 34: Homing acceleration in % of amax (A108)
- 12: Homing velocity in % of Vmax (A106)
- 0: Reference marker readout:
  - 0 = yes
  - 1 = no
- 0: Home position switch readout:
  - 0 = yes
  - 1 = no
- 1: Homing direction
  - 0 = positive
  - 1 = negative

C010 Homing

I0.01.1 Q0.00.6 00

76 = Set absolute dimension
The command is executed after Parameter Mode is exited.

Output: Homed

Input: Start homing in Manual Mode

00.00.0 = no input or output set

set absolute dimension If 76 is entered in this parameter, the absolute value is set to the value stored in Reference point, Parameter C011, upon exiting Parameter Mode. After that, the 76 is cleared. If a parameter error occurs, the 76 is cleared automatically, and the function must be reprogrammed.

C011 Reference distance 1

±123456.678

Reference distance in IUs

Input min.: -200000.000

Input max.: +200000.000

C012 Home switch offset

±123.456

Offset in IUs

Input min.: -999.999

Input max.: +999.999

C013 Distance coded reference offset

1234 4567

Distance encoded reference distance 1
the smaller distance between 2 reference markers

Distance encoded reference distance 2
the larger distance between 2 reference markers

With this parameter, the smaller distance between two reference marks is programmed if a measuring system with distance-coded reference marks is used.

See also functional description for: "Reference"

C014 Encoder emulation type

0 0 0

Selection of emulation type
- 0 = no output
- 1 = incremental encoder emulation
- 2 = absolute encoder emulation

Dead-time compensation
- 0 = is deactivated
- 1 = is activated

Selection of the position to be emulated
- 0 = position output of motor encoder
- 1 = position output of optional encoder
- 2 = output of position command value

Selection between incremental/absolute encoder emulation.

Selection of the source of the signal to emulate.

See also functional description for: "Encoder emulation."

C015 Encoder emulation, resolution

02500

Resolution: For incremental encoder emulation up to 65536
For absolute encoder emulation 8 ... 24 bits

If incremental encoder emulation is selected as the actual position output, the number of graduation marks used by the emulated incremental encoder must be entered here.

See also function description for: "Encoder emulation."

Input min.:	1	or	8
Input max.:	65536	or	24

C016 Marker pulse-offset

000.0

Shift in degrees

For the emulated incremental encoder, this parameter can shift the position of the marker pulse (zero pulse) within one (electrical or mechanical) revolution.

See also functional description for: "Encoder emulation."

Input min.: 0

Input max.: 359.9

8.6 Control Parameters

CR00 Current loop proportional gain 1

655.35

V/A

The current loop proportional gain is fixed for every motor-drive combination. It depends on the type of motor and should not be changed. It is loaded from the motor feedback memory when the initial connection is made (UL is displayed) or when the "Basic load" command is issued.

Note: The values set at the factory should not be changed!

See also functional description for: Setting the current loop

Input min.:	0	V/A
Input max.:	655.35	V/A

CR01 Current loop integral time 1

6553.5

[ms]

The current loop integral action time is fixed for every motor-drive combination. It depends on the type of the motor. The factory setting may not be changed. The basic setup for all loops is loaded after the initial connection is made (UL is displayed) or with the command "Basic load.“ For motors without feedback memory, the value can be found in the motor data sheet.

See also functional description for: Setting the current loop

Input min.:	0	ms
Input max.:	6553.5	ms

CR02 Velocity loop proportional gain

6553.5

A sec/rad (A min/m)

This parameter contains the value for the velocity loop proportional gain of the velocity loop.

The proportional gain **unit** depends on the motor type of the connected motor.

Unit:

Motor type:	**Unit:**
Rotary motor:	A•sec/rad
Linear motor:	A•min/m

Fig. 8-18: Units for the Veloc. Loop Prop. Gain Depending on Motor Type

It is possible to load a default value for this parameter using the "Basic load" command if the current motor has a feedback memory. (**CM00, motor type:** 1 or 5).

See also functional description for: “Setting the velocity loop.”

Input min.: 0 A sec/rad (A min/m)

Input max.: 6553.5 A sec/rad (A min/m)

CR03 Velocity loop integral action time

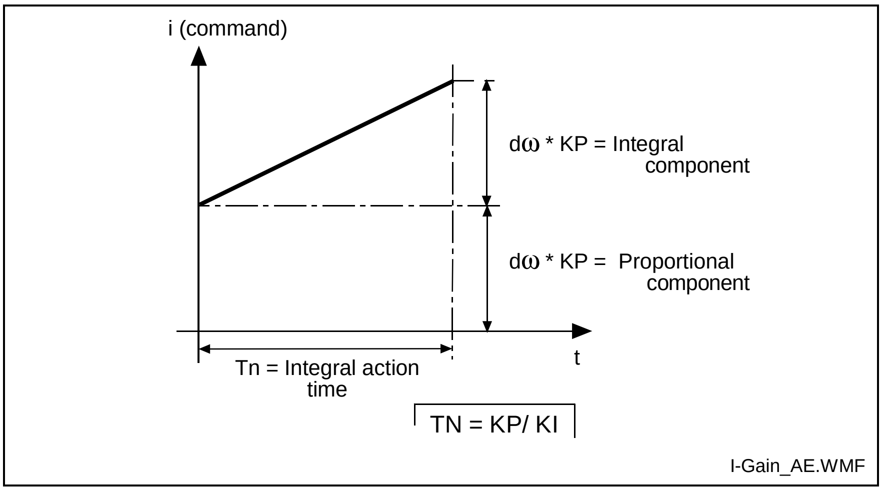
6553.5

[ms]

The velocity loop forms a current command value from the difference between the velocity command value and the velocity feedback value (= speed regulation deviation).

This current command value consists of a proportional component and an integral component. The Velocity Loop Integral Action Time corresponds to the time in which the integral component of the current command value is increasing on the value of the proportional component.

Definition of the Integral Action Time:



L: Tn : velocity integral action time
KP : veloc. contr. prop. gain [A'sec/rac]
KI : integral gain [A/rad]
dω : speed regulation deviation

Fig. 8-19: Integral Action Time

The integral action time is defined as that value on the time base at which the integral component is equal to the proportional component. This represents the time that a pure I-controller would need until the controller output variable y is equal to the output variable of a P-controller at time t=0.

Entering a value of 0 deactivates the integral component. See also functional description for: "Setting the velocity loop"

Input min.:	0	ms
Input max.:	6553.5	ms

CR04 Velocity loop smoothing time constant

00500

[µs]
00000 = function disabled

The time constant that can be activated in this parameter affects the output of the velocity loop. It can be used to suppress quantization effects and limit the bandwidth of the velocity loop. The limit frequency is derived from smoothing time constant T resulting from the relationship

$$\boxed{f_g = \frac{1}{2 \cdot \pi \cdot \mathrm{T}}}$$

Inputting the minimum input value or ‘0’ turns the filter off.

See also functional description for: “Setting the velocity loop”

Input min.: 0 µs
Input max: 65500 µs

CR05 Rejection frequency velocity loop

900

Frequency [Hz]

To suppress the mechanical resonance frequency, a band-pass filter can be activated at the output of the velocity loop.

It can be set using the following parameters:

CR05, Notch filter speed-controller and **CR06, Bandwidth Notch-Filter Speed-controller**

Velocity loop parameter set.

In **CR05, Notch filter speed-controller**,

the most attenuated frequency is set.

See also functional description for: “Filtering oscillations from mechanical resonance.”

Input min.: 50 Hz
Input max.: 950 Hz

CR06 Rejection bandwidth velocity loop

±000

Bandwidth [Hz]

To suppress the mechanical resonance frequency, a band-pass filter can be activated at the output of the speed controller. The parameters for this function are **CR05, Notch filter speed-controller** and **CR06, Bandwidth Notch-Filter Speed-controller**.

CR06, Bandwidth Notch-Filter Speed-controller sets the frequency range on either side of the rejection frequency in which the attenuation is less than -3dB.

Example:

CR06 = 500 Hz,

CR06 = 200 Hz;

then: attenuation < -3dB in range of 400..600 Hz.

Parameter value	Action of CR06
-1	VZ1 filter with CR04 time constant
0	filter is off
>0	bandwidth for rejection filter

Fig. 8-20: CR06, Bandwidth Notch-Filter Speed-controller

See also functional description for: “Filtering oscillations from mechanical resonance.”

Input min.: 50 Hz
Input max.: 950 Hz

CR07 Position loop Kv-factor

056.78

Kv factor

This parameter contains the value for the proportional gain of the position loop. The Kv factor must be matched to the given mechanical conditions.

Input min.: 00.01

Input max.: 30.00

CR08 Acceleration feedforward gain

6553.5

[mA/rad/s^2]

The amplification acceleration (acceleration feedforward) helps to reduce the following error during the acceleration in operation modes without following error. To do this, the current acceleration command value is multiplied by the "acceleration feedforward gain" and added to the current command value of the velocity loop.

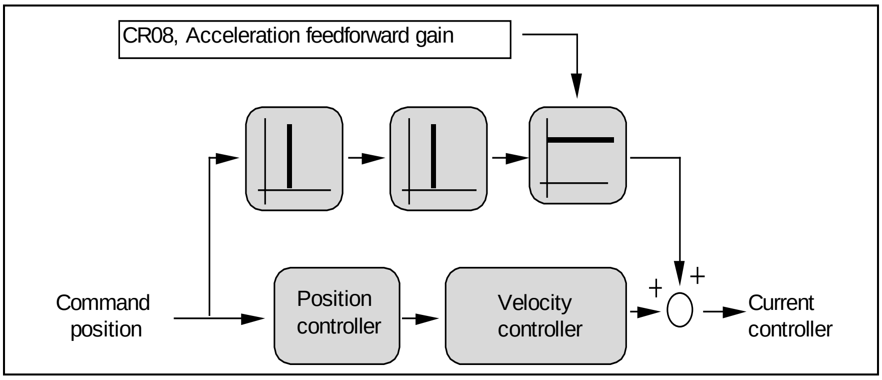


Fig. 8-21: Acceleration precontrol

Activation:

Writing a value greater than 0 to the parameter activates the acceleration feedforward.

Note: The loop also functions without feedforward! (The standard value equals 0.) Acceleration feedforward is only possible in modes without following error.

Comparison between the different types of feedforward

The **velocity feedforward** is activated by selecting an operating mode with no **position lag** (following error). This creates (from the standpoint of the position loop) a **feedforward of the 1st order** (prop. to velocity). This means that at constant speed, the position deviation is 0. A lag results, nevertheless, during acceleration (and deceleration).

The **acceleration feedforward** is activated by entering more than 0 for this parameter. It creates (from the standpoint of the position loop), a **feedforward of the 2nd order** (prop. to acceleration). The position deviation is 0, as long as the correct gain is set and the acceleration is constant.

Recommended input value:

$$\mathrm{CR08} = \frac{\mathit{Moment\,of\ Inertia}\left(\mathrm{kgm}^2\right)}{\mathit{Torque\,Constant}\left(\mathrm{Nm/A}\right)} * 1000$$

The moment of inertia is the total sum of the rotor and the reflected load inertia.

The factor 1000 is needed because of the unit mA.

Fig. 8-22: Acceleration feedforward proportional gain

See also functional description for: "Setting the Acceleration Feedforward."

Input min.: 0 mA/rad/s^2
Input max: 6553.5 mA/rad/s^2

CR09 Switching frequency

4

[kHz]

This parameter is used to set the switching frequency of the pulse width modulation controller to **4 kHz or 8 kHz**.

This parameter cannot be changed online.

Input min.: 4 kHz

Input max.: 8 kHz

CR10 Actual position filter time const. for measuring wheel mode

056.78

Smoothing time constant in ms

•

When measuring wheel mode is active, the position control loop is closed using the sum of

- actual position 1 (motor encoder) and the
- filtered difference between actual position 2 and actual position 1

This parameter stipulates the time constant of the filter used.

The differences in actual position are attenuated in order to mitigate any negative effects caused by poor coupling between encoder 2 and the motor shaft (e.g., due to the measuring wheel becoming disengaged from the material).

Actual position 2 by itself stipulates the end position.

See also functional description for: Measuring wheel operating mode.

If the input value = 0, only the measuring wheel is operable.

Input min.: 000.00

Input max.: 327.67

8.7 Motor Parameters

CM00 Motor type

1
└ Motor type

The motor type can be selected with this parameter. The following motor types are supported:

- 1: MHD
- 2: 2AD / 1MB with NTC temperature sensor
- 3: LSF
- 4: LAR / LAF
- 5: MKD / MKE
- 6: 2AD /1MB with PTC temperature sensor
- 7: synchronous kit motor

Input min.:	1
Input max.:	7

CM01 Torque/force peak limit

100
└ [%]

This parameter specifies the maximum permissible torque and applies symmetrically in both directions. It ensures that the maximum permissible peak torque for the given application is not exceeded, regardless of how high the torque/force is set in the MOM command.

The evaluation is based on the percentage of the motor current at standstill:

Input min.:	1	%
Input max.:	500	%

CM02 Motor current, Peak current

0010.0 0010.0

Motor current at standstill [A]
Amplifier peak current [A]

The “Motor peak current” specifies the maximum current which may flow through the motor for a short period without damaging it.

If the motor's peak current is less than the amplifier's peak current, the maximum output current will be automatically limited to the motor's peak current.

This value is stored in the motor feedback memory of MHD, MKD and MKE motors and is loaded from there when the drive controller is turned on for the first time. For other motor types, the value must be taken from the data sheet.

Input min.:	0.1	A
Input max.:	500.0	A

The “continuous motor current at standstill” is the current at which the motor continuously generates standstill torque according to the motor data sheet. This value is stored in the motor feedback memory for MHD, MKD and MKE motors and is loaded from there when the drive controller is turned on for the first time. For other motor types, the value must be taken from the data sheet.

All **torque/force data** are based on this **motor current at standstill being equal to 100%** .

Input min.:	0.1	A
Input max.:	500.0	A

CM03 Maximum motor speed

10500.000

in RPM for rotary motors
m/min for linear motors

The maximum speed of the motor must not be exceeded. It also limits the parameter **A106, Bipolar velocity limit**.

This value is stored in the motor feedback memory of MHD, MKD and MKE motors and is loaded from there when the drive controller is turned on for the first time. For other motor types, the value must be taken from the data sheet.

In torque regulation, the drive will be switched into a torque-free state and the error message **F879 Velocity limit exceeded** will be issued if the maximum motor speed is exceeded by more than 12.5%.

Input min.:	0
Input max.:	99999.999

CM04 Number of pole pairs/pole pair distance

0003
Number of pole pairs

With rotary motors, the number of **pole pairs** per motor revolution is specified here. For **linear motors**, the **length of a pole pair** must be indicated here. In motors with **motor feedback memory**, e.g., MKD motors, this value is stored in memory and need not be specified. See also functional description for: "Motor feedback memory.”

CM05 Torque-/force-constant

000.20
[Nm/A]

The torque/force constant indicates how much torque or force the motor delivers at a certain effective current. For synchronous motors, this value depends entirely on the design of the motor.

In asynchronous motors, this value is valid as long as the motor is not operated in the field-weakening range.

For MHD, MKD and MKE motors, this value is stored in the feedback memory and cannot be changed.

Input min.:	0,01	Nm/A
Input max:	655,35	Nm/A

CM06 Moment of inertia of the rotor

0.00003
[Kgm^2]

This parameter indicates the moment of inertia of the rotor without load. For motors with feedback memory (e.g. MKD), it is saved in the feedback memory.

Input min.:	0.00001
Input max.:	1.00000

CM07 Type of motor brake

0 0

- Second digit:
  - 0 = self-holding brake
    0V at the brake, brake applied
  - 1 = self-releasing brake
    24V at the brake, brake applied
- First digit:
  - 0 = Servo brake
    brake is applied after reaching the max. braking time.
  - 1 = Main spindle brake
    Brake is applied only at < 10 RPM

This parameter specifies whether an electrically released or electrically engaged brake is being used. If an MHD or MKD motor is used, then the brake will be electrically released, if there is one. The bit 0 will be set automatically to 0. If other motor types are used, this bit must be entered during the start-up procedure.

CM08 Brake current [A]

010.000

- [A]

This parameter indicates how much current is drawn by the holding brake in the in-circuit motor.

Input min.:	0
Input max.:	500.000

CM09 Motor temperature

145 155

- 155: Motor shutdown temperature
- 145: Motor warning temperature

8.8 Asynchronous Motor Parameters

CA00 Magnetizing current

010.000

[A]

This parameter indicates the nominal or servo-magnetization current set by Indramat **for asynchronous motors**. The magnetizing current actually flowing is also dependent on the pre-magnetization factor.

In synchronous motors, e.g., MKD motors, this parameter is automatically set to 0.

Input min.: 0 A

Input max.: 500,000 A (maximum, but peak, current amplifier)

CA01 Premagnetization factor

100

[%]

The pre-magnetization factor is used for application-dependent decreases in the servo magnetization current. Together with parameter **CA00, Magnetising current,** it determines the magnetization current of the motor.

Effective magnetization current =

magnetization current • pre-magnetization factor

With a pre-magnetization factor of 100%, the servo magnetization current flowing in the motor in the base speed range produces a torque proportional to the torque-producing current.

Input min.: 25 %

Input max.: 100 %

CA02 Slip factor

010.00

[Hz/100A]

The slip factor is the most important parameter for asynchronous motors. It indicates the rotor frequency as a function of the torque-producing current. The lower the rotor time constant, the higher the slip factor.

This parameter is set differently by Indramat for each motor.

Input min.:	1	Hz/100A
Input max.:	500,00	Hz/100A

CA03 Slip increase

1.50

[1/100K]

In an asynchronous motor, the rotor resistance and, consequently, the rotor time constant changes with the temperature. The slip increase compensates for this change.

The slip increase per 100K(elvin) is motor-specific and is specified by Indramat for each individual motor.

Input min.:	1.00	1/100K
Input max.:	3.00	1/100K

CA04 Stall current factor

01000

[A/Vmin]

The stall current limit is used to limit the peak current of the motor to reasonable values when operating at high velocities. Higher currents lead only to higher losses, not to more shaft output power.

The stall current limit is set by Indramat. If 0 is entered, the limit is inactive.

Input min.:	0	A/Vmin
Input max.:	65535	A/Vmin

CA05 Flux loop prop. gain

00.500

[A/V]

The flux loop controls the magnetization current in the field-weakening range.

The parameter value is set by Indramat.

Input min.:	0.100	A/V
Input max.:	65.535	A/V

CA06 Flux loop integral action time

0600.0

[ms]

The flux loop controls the magnetization current in the field-weakening range.

The parameter value is set by Indramat.

Input min.:	0	ms
Input max.:	6553.5	ms

CA07 Motor voltage at no load

080.0

[% DC bus voltage]

The motor voltage in the field-weakening range is set so that it reaches a value less than or equal to the DC bus voltage.

Under load, the motor voltage will be raised to the maximum motor voltage.

Input min.:	50.0	% DC bus voltage
Input max.:	100.0	% DC bus voltage

CA08 Motor voltage maximum

090.0

[% DC bus voltage]

The motor voltage in the field-weakening range is set so that it reaches a value less than or equal to the DC bus voltage.

At full load, the motor voltage will rise to the maximum motor voltage. The output voltage will remain sinusoidal up to a value of 90% .

Input min.:	50,0	% DC bus voltage
Input max.:	100,0	% DC bus voltage

8.9 List of FLP Parameters

Software : _ _ _ _ _ _ _ _ _ _ _ _ Com. No. : _ _ _ _ _ _ _ _ _ _ _ _
Date : _ _ _ _ _ _ _ _ _ _ _ _ Client/end c.: _ _ _ _ _ _ _ _ _ _ _ _
Prep. by : _ _ _ _ _ _ _ _ _ _ _ _ Serial No. : _ _ _ _ _ _ _ _ _ _ _ _

Designation	Parameter	Data
Application type	A100	
Feed rate constant	A101	
Gearing	A102	
Max Position negative	A103	
Max position positive	A104	
Modulo value	A105	
Maximum-Speed	A106	
Setup-Speed	A107	
Acceleration bipolar	A108	
Acceleration / Delay	A109	
Jerk bipolar, Time constant	A110	
Switching level/Positioning window	A111	
Reserved	A112	
Positioning window	A113	
Registration signal	A114	
Monitor	A115	
Feed monitoring	A116	
Monitor Feedback difference	A117	
Absolute Feedback device Monitor window	A118	
Best possible halt	A119	

Task 2 & 3	AA00	
Manual-Vector	AA01	
Interrupt vector	AA02	
Restart	AA03	
Override	AA04	
Open position loop	AA05	
Motor brake	AA06	
Measuring wheel operation	AA07	
Various	AA08	

Display	B000	
Interface Para. 1	B001	
Interface Para. 2	B002	
Analog-Output 1 Signal select	B003	
Analog-Output 1 ext. Signal select	B004	
Analog-Output 1 Evaluation [1/10V]	B005	
Analog-Output 2 Signal select	B006	
Analog-Output 2 Extended Signal select	B007	
Analog-Output 2 Evaluation [1/10V]	B008	
Serial IO control	B009	
System control	B010	
Fieldbus Cycle Time	B011	
Fieldbus Baudrate	B012	
Fieldbus Format	B013	

Position Polarity	C000	
Feedback 1 Type	C001	
Position feedback 1 type	C002	
Resolution Feedback 1 (Motor)	C003	
Feedback 2 type	C004	
Position feedback 2 type	C005	
Resolution Feedback 2	C006	
Feedrate constant 2	C007	
Reserved	C008	
Homing configuration	C009	
Homing	C010	
Reference distance 1	C011	
Reference switch offset	C012	
Distance coded reference offset	C013	
Encoder emulation type	C014	
Encoder emulation , resolution	C015	
Marker pulse-offset	C016	

Current loop proportional gain 1	CR00	
Current loop integral time 1	CR01	
Velocity loop proportional gain	CR02	
Velocity loop integral action time	CR03	
Velocity loop smoothing time constant	CR04	
Rejection frequency velocity loop	CR05	
Rejection bandwidth velocity loop	CR06	
Position loop Kv-factor	CR07	
Acceleration feedforward gain	CR08	
Switching frequency	CR09	
Actual position filter time const. for measuring wheel mode	CR10	

Motor type	CM00	
Torque/force peak limit	CM01	
Motor current, Peak current	CM02	
Maximum motor speed	CM03	
Number of pole pairs/pole pair distance	CM04	
Torque-/Force-constant	CM05	
Moment of inertia of the rotor	CM06	
Type of motor brake	CM07	
Brake current [A]	CM08	
Motor temperature	CM09	

Magnetizing current	CA00	
Premagnetization factor	CA01	
Slip factor	CA02	
Slip increase	CA03	
Stall current factor	CA04	
Flux loop prop. gain	CA05	
Flux loop integral action time	CA06	
Motor voltage at no load	CA07	
M Motor voltage maximum	CA08	

9 Interface

9.1 Inputs / Outputs / Marker Flags

Designation

Die designation of the inputs, outputs and marker flags.

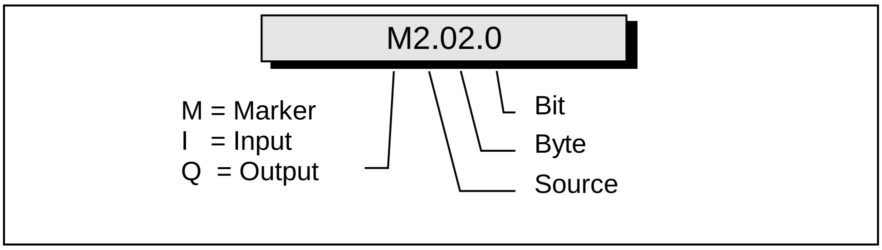


Fig. 9-1: Structure of the Inputs / Outputs / Marker Flags

e.g. I0.00.6

I	Input:
I0	Input, Connector X210
I0.00	Input, Connector X210, Group 0 (Byte)
I0.00.6	Input, Connector X210, Group 0, Bit 0

First user-programmable input

Inputs

The inputs are designated with 'I.' They can be programmed and processed in the parameters, commands, and in the Logic Task. They are read at the beginning of each cycle (every 2 ms) or at the start of the Logic Task.

Outputs

The outputs are designated with 'Q.' They can be programmed and processed in the parameters, commands, and in the Logic Task. They are processed at the beginning of each cycle (every 2 ms) or at the start of the Logic Task. If an output is designated in the Logic Task, this output can no longer be processed in one of the NC Tasks or via the functions activated in the parameters.

Marker Flags

The marker flags are designated with 'M.' They can be programmed and processed in the parameters, commands, and in the Logic Task. They are processed at the beginning of each cycle (every 2 ms) or at the start of the Logic Task. To avoid confusion, the NC Task and the Logic Task have different marker flags. Transfer flags handle the exchange of information between the NC Task and the Logic Task.

Source

Origin or category

Byte

8 inputs, outputs or marker flags are grouped together (to form bytes).

BIT

The bit designates an input, output or marker flag. Numbering is from 0 to 7.

System Inputs

Parameter

DKC21.3	**X210 / 1**	**(I0.00.6)**
DKC3.3	**Control Word**	**(I2.00.0)**

In this mode, users can program the parameters .

When calling up this mode, power is shut down.

$\overline{\text{Manual}}$/Automatic

DKC21.3	**X210 / 2**	**(I0.00.1)**
DKC3.3	**Control Word**	**(I2.00.1)**

Manual Mode is possible if neither of the other two operating modes is active and all other preconditions have been met.

The following inputs are acceptable: RF
Stop
Jog

Other functions can be assigned to inputs via programming:

Homing
Manual vector

Automatic Mode is possible when a signal is present at this input, no error is present, and the RF signal is present.

The following inputs are acceptable: Stop
Start

Other functions can be assigned to inputs via programming:

Homing
Interrupt vector

Start

DKC21.3	**X210 / 3**	**(I0.00.2)**
DKC3.3	**Control Word**	**(I2.00.2)**

When the leading edge of this input is detected, the start instructions for tasks 1 and 2 initiate these two tasks. If both tasks have already been started, the input is ignored.

$\overline{\text{Stop}}$

DKC21.3	**X210 / 4**	**(I1.00.3)**
DKC3.3	**Control Word**	**(I2.00.3)**

If the signal at the STOP input is lost , execution of both tasks 1 and 2 stops immediately. If the drive is in motion, it immediately decelerates to a standstill via the programmed acceleration command. The remaining distance to travel is stored.

If the system remains in automatic mode, the remaining distance to travel is executed following a new START input, and the program continues to execute the task from the stopping point.

Jog forward

DKC21.3 X210 / 5 (I0.00.4)

DKC3.3 Control Word (I2.00.4)

If a signal is present at the “Jog forward” input, the drive moves forward at the velocity entered in Parameter A107.

Position limit monitoring is active only if the axis has been homed.

Note: There is no movement if a STOP, interrupt or feed monitoring signal is active.

Jog reverse

DKC21.3 X210 / 6 (I0.00.5)

DKC3.3 Control Word (I0.00.5)

If a signal is present at the “Jog reverse” input‘ , the drive moves in reverse at the velocity entered in Parameter A107.

Position limit monitoring is active only if the axis has been homed.

Note: There is no movement if a STOP, interrupt or feed monitoring signal is active.

Connector X1

RF (Drive Enable) **X1 / 4 (I4.00.0)**

The RF (Drive Enable) input RF activates the drive via a 0-1 (rising) signal edge. If the signal drops out, the “Best possible halt” (**Parameter A119**) is activated. The BB contact remains closed.

$\overline{\text{AH}}$ (Drive Stop) **X1 / 3 (I4.00.1)**

A signal must always be present

Ref **X3 / 1 (I4.00.6)**

Home position switch

The rising edge of the home position switch signal is always read.

Connector X3

Limit + **X3 / 2 (I4.00.7)**

Travel limit switch + .

This limit switch must always be a normally-closed contact.

Limit - **X3 / 3 (I4.01.0)**

Travel limit switch - .

This limit switch must always be a normally-closed contact.

Probe 1 **X3 / 4 (I4.00.3)**

Measurement of positions using the SRM command

Probe 2 **X3 / 5 (I4.00.4)**

No function

E-Stop **X3 / 6** **(I4.01.1)**

In the operating state, +24V must be present at this input. If this signal is not present, contact Bb opens. The axis is stopped via the “Best possible halt” (**Parameter A119**).

Clear errors **X3 / 7 or** **(I4.00.2)**

DKC3.3 **Control Word (I2.00.6)**

When the rising edge of the pulse is present at the “Clear errors” input, all existing errors are cleared. Pressing the S1 button (on the firmware module) clears the currently displayed error and shows the next one.

S1 Button **(I4.01.2)**

System Outputs

Manual

DKC21.3 **X210 / 17** **(Q0.00.0)**

DKC3.3 **Status Word** **(Q2.00.0)**

If manual mode is preselected and there are no faults, this output is set.

Automatic

DKC21.3 **X210 / 18** **(Q0.00.1)**

DKC3.3 **Status Word** **(Q2.00.1)**

If automatic mode is preselected and there are no faults, this output is set.

Fault

DKC21.3 **X210 / 19** **(Q0.00.2)**

DKC3.3 **Status Word** **(Q2.00.2)**

In the event of a fault , the output is immediately deactivated. The fault can be cleared using the “Clear errors” input, X3 / 7.

Run

DKC21.3 **X210 / 20** **(Q0.00.3)**

DKC3.3 **Status Word** **(Q2.00.3)**

If automatic mode is selected and the tasks have been started, this output is set.

Ready

DKC21.3 **X3 / 8**

DKC3.3 **Status Word** **(Q2.00.4)**

When the unit is ready to receive the drive enable signal, the “Ready” output is set.

The output is turned off:

- if an error is present
- if DC bus voltage is <80.75 X line voltage
- if control voltage is not present

Warning **DKC21.3** **X3 / 10**

DKC3.3 **Status Word (Q2.00.5)**

Many types of monitoring are performed depending on the operating mode and parameter settings. If a state is detected which still permits proper operation but leads to generation of an error message as the program continues, the warning output is set to 1.

U_D Message **X3 / 11**

When a minimum voltage is reached in the DC bus, the U_D_output is set to 1.

See also Project Planning information: X3, digital inputs/outputs

DKC21.3 Programmable Inputs/Outputs

Inputs

Inputs I0.06.0 through I0.01.7 Connector X210 / Pin No.: 07 to 16

There are, therefore, 10 available inputs.

The inputs are user-definable.

Moreover, these programmable inputs can be used for various functions which have been activated in the parameters.

Outputs

Outputs Q0.00.6 to Q0.01.7 Connector X210 / Pin No.: 21 to 28

There are 8 available outputs.

All outputs are user-programmable within all NC Tasks and in the Logic Task.

Note: If an output is used by the Logic Task, an error message is generated as soon as the same output is also used by an NC Task.
F-0300 Invalid I/O number in command instruction

Moreover, these user-programmable outputs can be used for different functions.

DKC3.3 Programmable Inputs/Outputs

Profibus Inputs

32 inputs, I2.02.0 through I2.05.7, are available.

Profibus Outputs

32 outputs, Q2.02.0 through Q2.05.7 are available.

See also Section 10.2 Profibus

BTV04 Programmable Inputs/Outputs

These I/Os are only available if a BTV04 is being used as an operator console. The parameters must be designated as:

- B002 0 1 0 0 0 000
- B009 1 xxx (xxx = 200 – 500)

The I/Os are transferred serially to the BTV04. The transfer time can take up to 500ms.

BTV04 X4 Inputs

11 inputs, I1.03.0 through I1.04.1 are available.

BTV04 X5 Outputs

12 outputs, Q1.03.0 through Q1.04.2, are available.

Some keys can be queried from the user programs.

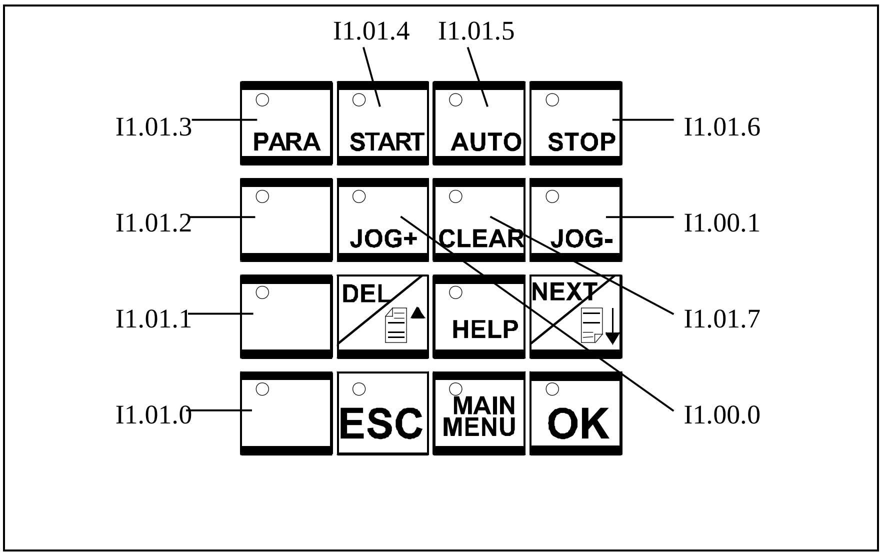


Fig. 9-2: BTV04 Key Inputs

Accessing System Inputs and Outputs from the BTV04

If Parameter B010 is set to 1 the operating modes and jog buttons are valid.

Caution: The system outputs on the DKC21.3 no longer execute the functions!

The system inputs and outputs of the DKC21.3 on connector X210 are no longer queried or set. They can be used freely from the user programs.

If a fault output or the operating modes are to be assigned to a hardware output, this can be programmed in the Logic Task.

The following keys are now active:

PARA
START
AUTO
STOP
JOG+
JOG-

Marker Flags

The marker flags can be distinguished as follows:

Source	Byte	Function
0	00...05	System Flags (Inputs)
1	00...03	System Flags (Outputs)
2	00...19	NC Marker Flags
3	00...07	Saved NC Marker Flags
4	00. .09	NC Transfer Flags Logic Task
5	00...09	Logic Task Transfer Flags NC
6	00...19	Saved Logic Task Marker Flags
6	20...39	Logic Task Marker Flags

Fig. 9-3: Marker Flag Categories

System Flags (Inputs)

Here, the requirements are mirrored.
These marker flags can only be read by the programs.

M0.00

Bit	Function	Source
0	Parameter	Inputs or Fieldbus
1	Manual/Automatic	Inputs or Fieldbus
2	Start	Inputs or Fieldbus
3	Stop	Inputs or Fieldbus
4	Jog forward	Inputs or Fieldbus
5	Jog reverse	Inputs or Fieldbus
6	Clear errors	Inputs or Fieldbus
7	reserved	

Fig. 9-4: Marker Flag System Inputs

M0.01

All bits in this byte are reserved.

M0.02

These marker flags are only valid if the function is activated in the designated parameter.

Bit	Function	Source
0	Interrupt	Parameter A116
1	Feed monitoring	Parameter A116
2	Manual-Vector	Parameter AA01
3	Interrupt vector	Parameter AA02
4	reserved	
5	reserved	
6	reserved	
7	Control using measuring wheel	Parameter AA07

Fig. 9-5: Marker Flags - Programmable System Inputs

M0.03

All bits in this byte are reserved.

M0.04

Bit	Function	Source
0	reserved	
1	reserved	
2	reserved	
3	reserved	
4	reserved	
5	reserved	
6	reserved	
7	reserved	

Fig. 9-6: Marker Flags - Programmable System Inputs

M0.05

All bits in this byte are reserved.

System Flags (Outputs)

M1.00

Bit	Function	Source
0	Manual Mode	Status
1	Automatic	Status
2	Fault	Status
3	Run	Status
4	Ready	Status
5	Warning	
6	In Position	
7	reserved	

Fig. 9-7: Marker Flags - System Outputs

M1.01

All bits in this byte are reserved.

M1.02

These marker flags are only valid if the function is activated in the designated parameter.

Bit	Function	Source
0	Axis is in the last position	Parameter A113
1	Registration signal	Parameter A114
2	Position lag monitoring	Parameter A115
3	reserved	
4	reserved	
5	reserved	
6	Parameter Mode	Parameter AA08
7	Programmed Velocity reached	Parameter AA08

Fig. 9-8: Marker Flags - Programmable System Status

M1.03

All bits in this byte are reserved.

NC Marker Flags

M2.00 - M2.19

These marker flags can be read and written via NC commands. These marker flags are cleared when exiting Automatic Mode, losing power or when a fault occurs.

Saved NC Marker Flags

M3.00...M3.07

These marker flags can be read and written via NC commands. They are not cleared, even when power is lost.

NC ? Transfer Flags Logic Task

M4.00...M4.09

These marker flags are only for signal transfers between the NC Tasks and the Logic Task. They can be read and written by the NC Tasks. The Logic Task can only read these marker flags. These marker flags are cleared when power is lost.

Logic Task Transfer Flags NC

M5.00...M5.09

These marker flags are only for signal transfers between the Logic Task and the NC Tasks. They can be read and written by the Logic Task. The NC Tasks can only read these marker flags. These marker flags are cleared when entering Parameter Mode, when a fault occurs in the Logic Task, or when power is lost.

Saved Logic Task Marker Flags

M6.00...M6.19

These marker flags can be read and written by the Logic Task. They are not cleared, even when power is lost.

Logic Task Marker Flags

M6.20 M6.39

These marker flags can be read and written by the Logic Task. These marker flags are cleared when entering Parameter Mode, when a fault occurs in the Logic Task, or when power is lost.

9.2 Serial Interface

Overview

The drive controller is equipped with a serial interface. This interface is used to program the drive. The following can be exchanged via this interface:

- **Parameters**
- **Programs**
- **the Logic Task**
- **Status information**
- **Commands**

These data are numbers-oriented and a single transfer occurs.

Interface Mode

The interface can operate optionally in either

- **RS232 Mode** or
- **RS485 Mode**

Interface Protocol

Three different protocols are supported:

- Indramat **SIS Protocol**
  user data transmitted in INTEL format
- **ASCII** Protocol

Their precise structure is outlined in the following section.

- **IDS protocol (RS232)**

transmission from the Indramat decade switch

Setting the Drive Address

Setting the drive address using the S2 button and the S3 button is only required when communicating via the RS485 bus (e.g. BTV04).

The addresses can be set from 1 to 36, and for Profibus from 2 to 36.

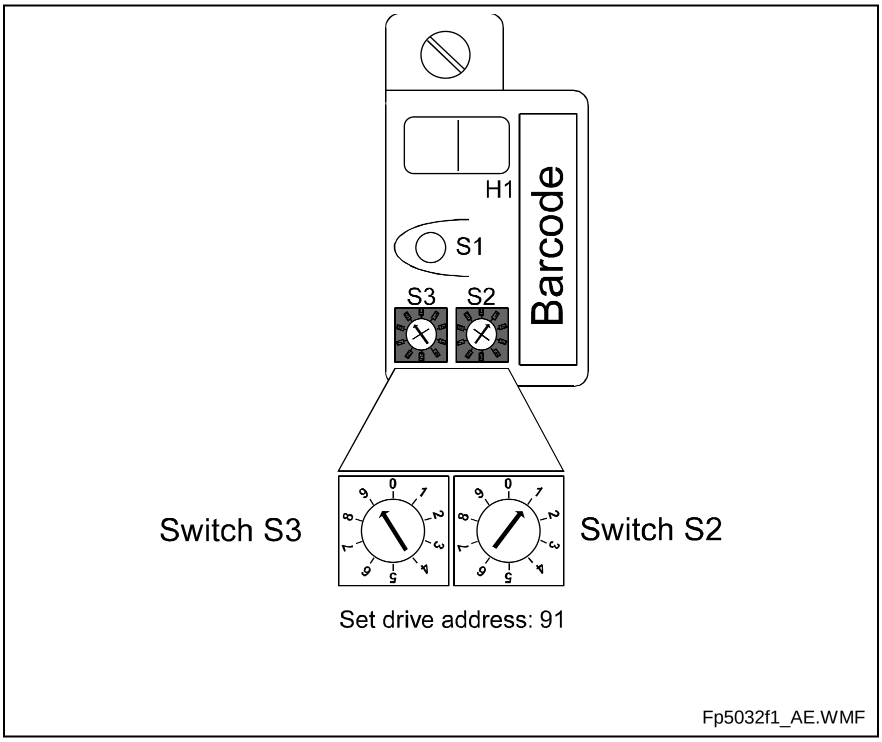


Fig. 9-9: Setting the Address via the Address Switch on the Programming Module

RS232 Mode

In this mode, it is not necessary to set the drive address, since only one user is connected (peer-to-peer connection).

Communications via RS232 Interface

Features:

The RS232 interface is intended for use when connecting a PC with the **MotionManager** startup program.

- Transmission rates of:

2400	baud	ASCII
4800	baud	ASCII
9600	baud	ASCII / SIS
19200	baud	ASCII / SIS

- Maximum transmission path: 15m
- 8-bit **ASCII** protocol or 8-bit **SIS** protocol
- Parity bit: none, even, odd
- one stop bit

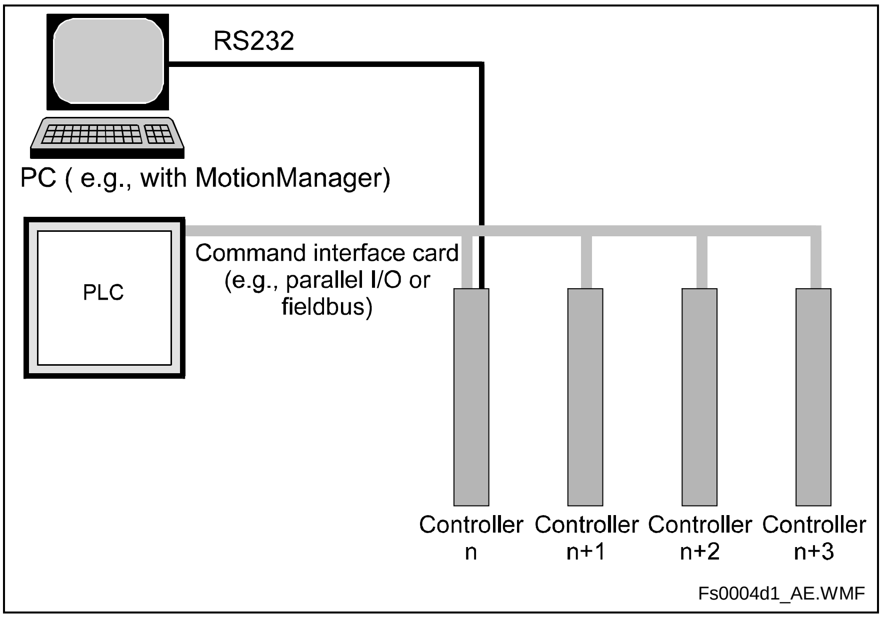


Fig. 9-10: Communications via RS232 Interface

Communications via RS485 Interface

Features

Communication via the RS485 interface makes it possible to implement a **serial bus** with the following data:

- Up to **8 drives** can be connected to one bus master.
- Transmission rates of: 2400 baud ASCII
  4800 baud ASCII
  9600 baud ASCII / SIS
  19200 baud ASCII / SIS

- Maximum transmission path: **500m**
- **Half duplex** mode over a **2-wire** line
- 8-bit **ASCII** protocol or 8-bit **SIS** protocol
- Parity bit: none, even, odd
- one stop bit

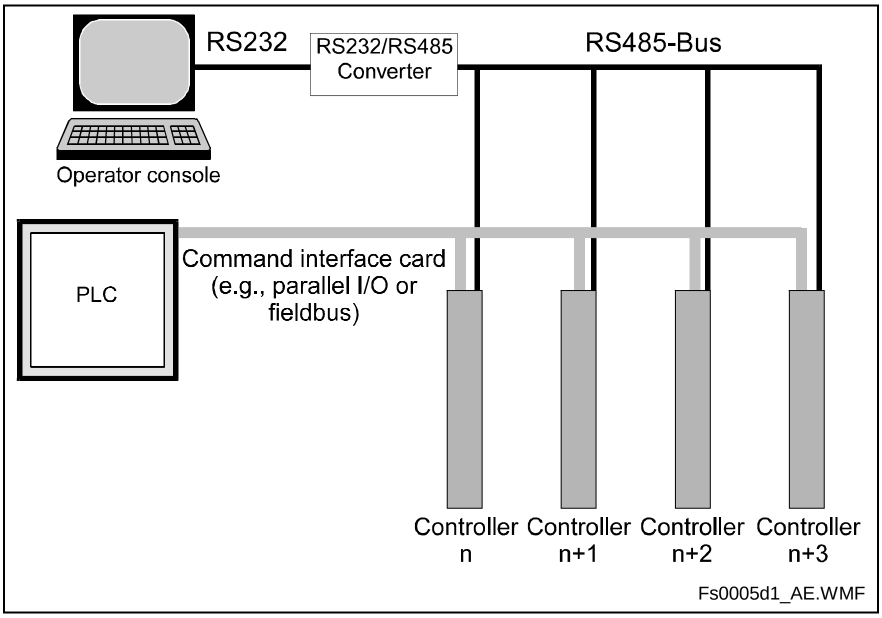


Fig. 9-11: Data Exchange of Drive Groups from an Operator Console

Transmission Protocols

When the 24V supply voltage is switched on, the data set in Parameters B001, B002, B009 and B010 are used as the communications parameters. If these settings do not correspond to the data in the programming unit, the S1 button on the programming module can be used to set the default transmission parameters. See also: Chapter 7, S1 Button.

ASCII Protocol

First Control Character in the Data String:

The first control character indicates the beginning of a data transmission:

1) **?** hexadecimal 3F / character for data query

If the control receives a `?´, requested information (program instruction, parameter, status message) is output.

2) **#** hexadecimal 23 / character for transmission of instruction NC, Parameters, Logic Task, Variables

If the control receives a `#´, the following characters are read into the corresponding instruction number of the program memory.

3) **!** hexadecimal 21

If the control receives a `!´, the following characters are picked up as the control command.

4) **:** hexadecimal 3A Colon for polling query.

Second Control Character in the Data String:

s This character identifies the station number. The `s´ is replaced by an appropriate character depending on the operating mode.

1) In RS232C operating mode, the `s´ is replaced by a blank space. No other character is accepted.

2) In RS485 mode, the `s´ is replaced by the respective station number (1 ... 9; A ...W). If this number does not correspond to the number set in the programming module, there is no response to the received data.

   If `s´ is a blank space, this information is relevant for all users on the bus.

Third Control Character:

The third character identifies the information type:

1) **N** hexadecimal 4E / character for instruction number

The information following the `N´ is interpreted as a program instruction.

2) **K** hexadecimal 4B / character for parameter

The information following the `K´ is interpreted as a parameter.

3) **X** hexadecimal 58 / character for status

4) **P** hexadecimal 50 / character for Logic Task

The information following the `P´ is interpreted as a Logic Task instruction.

5) **V** hexadecimal 56 / character for variable

The information following the `V´ is interpreted as a variable.

6) **C** hexadecimal 43 / character for commands

The information following the `C´ is interpreted as a command.

Other Control Characters:

1) **$** hexadecimal 24 / character for checksum

2) **hh** hexadecimal value / checksum

These two characters represent the result of the checksum for a piece of information. The checksum is sent along with each type of information. When data is received, the checksum can be disregarded (see Parameter B002).

3) **CR** hexadecimal 0D / character for carriage return

LF hexadecimal 0A / character for linefeed

The characters \`CR´ and \`LF´ together form the end of each transmission. (transmission of instruction)

Information Characters:

All information characters are coded in hexadecimal format in accordance with the ASCII code table. The following characters are used to exchange information:

1) **0** through **9** hexadecimal 30 through 39

A through **Z** hexadecimal 41 through 5A

The numerals \`0´ through \`9´ and the letters \`A´ through \`Z´ are available for command and data input.

2) **__** hexadecimal 20 / space (space bar)

To produce the desired format, the space is used at various points within the data string.

3) **+** hexadecimal 2B / operational sign for data

- hexadecimal 2D / operational sign for data

4) **.** hexadecimal 2E

, hexadecimal 2C

When numerical values are received, both a period and a comma are accepted. Both are recognized as the decimal point. When numerical values are sent, a decimal point is always used.

Checksum

#_N0000_ 1_ _ _ _ 123456.789_123_ $
#5N0123_NOP _$

character	hex	∑ hex		character	hex	∑ hex
#	23	23		#	23	23
_	20	43		5	35	58
N	4E	91		N	4E	A6
0	30	C1		0	30	D6
0	30	F1		1	31	107
0	30	121		2	32	139
0	30	151		3	33	16C
_	20	171		_	20	18C
P	50	1C1		N	4E	1DA
O	4F	210		O	4F	229
I	49	259		P	50	279
_	20	279		_	20	299
1	31	2AA		_	20	2B9
_	20	2CA				
_	20	2EA				
_	20	30A				
_	20	32A				
+	2B	355				
1	31	386				
2	32	3B8				
3	33	3EB				
4	34	41F				
5	35	454				
6	36	48A				
.	2E	4B8				
7	37	4EF				
8	38	527				
9	39	560				
_	20	580				
1	31	5B1				
2	32	5E3				
3	33	616				
_	20	636				

Fig. 9-1: Checksum

Using the Two's Complement to Generate the Checksum

#_N0000_ 1_ _ _ _ 123456.789_123_ $C4
Callout: 636 ➔ 06 + 36 = 3C
The two's complement of 3C = C4

#5N0123_NOP _ _$45
Callout: 2B9 ➔ 02 + B9 = BB
The two's complement of BB = 45

Transmit Program Instructions:

A new instruction is read in as shown in the example below.

The character sequence `# s N´ always comes first.

An entry must always be concluded with `CR LF´.

Format:

```
#sNbbbb_ccc_dddddddddddddddd_$hh CR LF
```

Meaning of the characters used:

s = blank space for RS232C or station number for RS485
b = instruction number
c = command code
h = checksum
d = instruction information

Examples of data transmissions to the FLP:

```
#5N0100_POI_1_+123456.786_123_$30 CR LF
#5N0101_AEA_Q0.00.3_1____$C9 CR LF
#5N0102_BPA_0123_M2.02_21112212_$1C CR LF
```

The data formats are stipulated for each command and must be complied with!

Com	Data	Data
ACC	ACC_1_ _ _ _234_ _567_	ACC_1_ _ _ _V600 _V601_
AEA	AEA_Q1.01.1_1_ _ _ _	AEA_Q1.01.0_V600_
AKN	AKN_M1.02.3_1_ _ _ _	AKN_M2.02.3_V600_
AKP	AKP_M2.02_01201201_	AKP_M2.02_01201201_
APE	APE_Q0.01_01201201_	APE_Q0.01_01201201_
BAC	BAC_1234_-5678_98765_	BAC_V600_-5678_V601_ _
BCE	BCE_0234_I0.12.3_ _ _ _ 1_ _ _ _	BCE_V601_I1.01.3_ _ _ _ V600_
BIC	BIC_0234_56_ _ _ _ _ _ _ _ _M0.12.3_0_1_	BIC_V601_V600 _ _ _ _ _ _ _M0.12.3_0_1_
BIO	BIO_0234_M2.03_Q0.56_01201201_	BIO_V600_M2.03_Q0.01_01201201_
BPA	BPA_0234_M2.02_ _ _ _ _ _01201201_	BPA_V600_M2.02_ _ _ _ _ _01201201_
CIO	CIO_M2.02.3_Q0.01.1_45_ _ _	CIO_M2.02.3_Q0.01.1_V600 _
CLC	CLC_0234_	CLC_V600_
CON	CON_1_ _ _ _1_ _ _ _+234_ _	CON_1_ _ _ _V600 _+V601_
COU	COU_+12345_Q0.01.1_ _654321_	COU_+12345_Q0.01.1_ _V600_ _ _
CPJ	CPJ_V600>=+12345.678_1234.56_1234_	CPJ_V604_=+V600_ _ _ _ _ _V601_ _ _ _V603_
CPL	CPL_1_ _ _ _	CPL_1_ _ _ _
CPS	CPS_V602<=+12345.678 1234.56_Q0.01.1_	CPS_V602_<+V600_ _ _ _ _ _V601_ _ _ _Q0.01.1_
CID	CID_V600<=_1_ _ _ _ _ _ _ _ _ _ +12345.678_	CID_V600<=_1_ _ _ _ _ _ _ _ _ _ +V601_
CST	CST_1_2_	CST_1_2_
CVT	CVT_V600_M2.02_3_1_	CVT_V600_M2.02_3_1_

FAK	FAK_1_ _ _ _1.654321_	FAK_1_ _ _ _V600_ _ _ _ _
FOL	FOL_1_ _ _ _1_ _ _ _ _ _ _ _ _ _+12.654321_	FOL_1_ _ _ _1_ _ _ _ _ _ _ _ _ +V600 _ _ _ _ _ _
HOM	HOM_1_ _ _ _	HOM_1_ _ _ _
JMP	JMP_0234_	JMP_0234_
JSR	JSR_0234_	JSR_0234_
JST	JST_0234_	JST_0234_
JTK	JTK_0234_3_	JTK_V600_3_
MAT	MAT_V600_=_V656_-_ _ _+123456.987654_	MAT_V123_=_V456_-_ _ +V600 _ _ _ _ _ _ _ _ _
MOM	MOM_1_ _ _ _123_ _456_ _ _M0.12.3_789_ _	MOM_1_ _ _ _V600_V601 _ _M2.02.3_V602_
NOP	NOP_	NOP_
PBK	PBK_1_ _ _ _	PBK_1_ _ _ _
PFA	PFA_1_ _ _ _+123456.789_123_ _	PFA_1_ _ _ _+V600_ _ _ _ _ _ _V601_
PFI	PFI_1_ _ _ _+123456.789_123_ _	PFI_1_ _ _ _+V600_ _ _ _ _ _ _V601_
POA	POA_1_ _ _ _+123456.789_123_ _	POA_1_ _ _ _+V600_ _ _ _ _ _ V601_
POI	POI_1_ _ _ _-123456.789_123_ _	POI_1_ _ _ _- V600_ _ _ _ _ _ V601_
PSA	PSA_1_ _ _ _+123456.789_123_ _	PSA_1_ _ _ _+ V600_ _ _ _ _ _ V601_
PSI	PSI_1_ _ _ _+123456.789_123_ _	PSI_1_ _ _ _+ V600_ _ _ _ _ _ V601_
REP	REP 0234 1_ _ _ _ _ _ _ _ _ _123456.789_	REP 0234 1_ _ _ _ _ _ _ _ _ _V600_ _ _ _ _ _ _
RSV	RSV_1_ _ _ _0234_12345_	RSV_1_ _ _ _V600_12345_
RTM	RTM_1_ _ _ _1_ _ _ _	RTM_1_ _ _ _V600_
RTS	RTS_	RTS_
SAC	SAC_1_ _ _ _1_ _ _ _ _ _ _ _ _ _+123456.789_	SAC_1_ _ _ _V600 _ _ _ _ _ _ _+V601_ _ _ _ _ _ _
SET	SET_V600_ = _ _ _ _ _ _ _ _ _ _ _ +12345678.123456_	SET V601_ = _ _ _ _ _ _ _ _ _ _ _ +V600_ _ _ _ _ _ _ _ _ _ _ _
SRM	SRM_1_ _ _ _+123456.123_+123_ _I0.00.6_	SRM_1_ _ _ _+V600_ _ _ _ _ _ _+V601 _I0.00.6_
VCC	VCC_1_ _ _ _+123456.789_123_ _0_1_ _ _ _	VCC_1_ _ _ _+V600_ _ _ _ _ _ _V601_0_V602_
VEO	VEO_1_ _ _ _1_1_123_ _1_	VEO_1_ _ _ _1_1_V600 _1_
WAI	WAI_ 1 2 . 3 4 _	WAI_V600_ _

Fig. 9-12: Transmission Formats of the Commands

Read Out Program Instructions:

Example of querying an instruction:

Format:

```
? s N b b b b _ $ h h  CR  LF
```

The character sequence `? s N´ always comes first. An entry must always be concluded with `CR LF´.

In response to this query, the contents stored in the queried program instruction `bbbb´ is sent.

```
#sNbbbb_ccc_dddddddddddddddd_$hh CR LF
```

Meaning of the characters used:

s = blank space for RS232C or station number for RS485
b = instruction number
c = command code
d = instruction information (number dependent on command)

Read Out Parameters: Parameters can be read out in any operating mode.

Format:

```
?sK_xxyy_$hh CR LF
```

In response to this query, the contents stored in the queried parameter \`xxyy´ is sent.

```
Ksxxyy_dddddddd_$hh CR LF
```

Meaning of the characters used:

x = Parameter number
y = Block Identifier
d = Instruction information (number dependent on parameter)

Writing a parameter

```
!sKxxyy_dddddddd_$hh CR LF
```

Meaning of the characters used:

x = Parameter number
y = Block Identifier
d = Instruction information (number dependent on parameter)

Parameter Block	Block Identifier	Parameter Number
System parameters	A1	00 to 19
Function parameters	AA	00 to 08
General parameters	B0	00 to 13
Encoder parameters	C0	00 to 16
Controller parameters	CR	00 to 10
Motor parameters	CM	00 to 09
Asynchronous motor parameters	CA	00 to 08

Fig. 9-13: Parameter Blocks

Parameter	Data
A100	A100_1_1_
A101	A101_1234.5678_
A102	A102_1000_2000_
A103	A103_+123456.789_
A104	A104_+123456.789_
A105	A105_123456.789_0_
A106	A106_123456.789_
A107	A107_123456.789_
A108	A108_123456_
A109	A109_123_456_
A110	A110_1.024_
A111	A111_M2.02.2_123.456_
A112	Reserved
A113	A113_M2.02.0_1234.567_
A114	A114_M2.02.2_1.5_0050_
A115	A115_1_100_M2.02.0_
A116	A116_M2.02.0_M2.02.1_
A117	A117_123_
A118	A118_1234.567_
A119	A119_0_0_

AA00	AA00_0100_0200_1_
AA01	AA01_M2.02.0_1_0_0100_
AA02	AA02_M2.02.2_1_0_0100_
AA03	Restart
AA04	AA04_1_
AA05	Open position loop
AA06	Reserved
AA07	AA07_M2.02.0_
AA08	AA08_M2.02.0_M2.02.1_

B000	B000_1_0_
B001	B001_09600_1_
B002	B002_0_0_0_0_0_000_
B003	B003_S_0_0001_
B004	B004_12345678_
B005	B005_0001.0000_
B006	B006_S_0_0001_
B007	B007_12345678_
B008	B008_0001.0000_
B009	B009_0_123_
B010	B010_0_
B011	B011_12345_
B012	B012_123456.7_
B013	B013_0_1_0_

C000	C000_1_
C001	C001_01_
C002	C002_01_0_0_0_
C003	C003_00005000_
C004	C004_01_
C005	C005_01_0_0_0_
C006	C006_00005000_
C007	C007_1234.5678_
C008	Reserved
C009	C009_1_0_0_12_34_
C010	C010_I0.00.6_Q0.00.6_03_
C011	C011_+123456.789_
C012	C012_+123.456_
C013	C013_1234_4567_
C014	C014_0_0_0_
C015	C015_02500_
C016	C016_000.0_

CR00	CR00_655.35_
CR01	CR01_6553.5_
CR02	CR02_6553.5_
CR03	CR03_6553.5_
CR04	CR04_00500_
CR05	CR05_900_
CR06	CR06_+000_
CR07	CR07_056.78_
CR08	CR08_6553.5_
CR09	CR09_4_
CR10	CR10_056.78_

CM00	CM00_1_
CM01	CM01_040_
CM02	CM02_0100.0_0070.0_
CM03	CM03_10500.000_
CM04	CM04_003_
CM05	CM05_000.20_
CM06	CM06_0.00003_
CM07	CM07_0_0_
CM08	CM08_010.000_
CM09	CM09_123_123_

CA00	CA00_010.000_
CA01	CA01_100_
CA02	CA02_010.000_
CA03	CA03_1.50_
CA04	CA04_01000_
CA05	CA05_00.500_
CA06	CA06_0600.0_
CA07	CA07_080.0_
CA08	CA08_090.0_

Examples:

Query	Response
?5K_B006_$hh CR LF	K5B006_S_0_0001_$05 CR LF
?5K_A101_$hh CR LF	K5A101_1234.5678_$B8 CR LF

Examples: Writing

```
!5K_A103_+123456.789_$11 CR LF
!5K_CR00_655.35_$F1 CR LF
```

If no checksum validation function has been programmed prior to entering Parameter Mode, this function remains deactivated, even though Parameter B002 has been overwritten, until Parameter Mode is exited.

Variables

Readout of a Variable

Variables can be read out in any operating mode.

Format:

```
?sVxxx_$hh CR LF
```

In response to this query, the contents stored in the queried variable \`xxxx´ is sent.

```
Vsxxx_+12345678.123456_$hh CR LF
```

Meaning of the characters used:
x = Variable Number
h = checksum

Writing a Variable

```
#sVxxx_+dddddddd.dddddd _$hh CR LF
```

Meaning of the characters used:
x = Variable Number
h = checksum
d = Variable Information

Logic Task: Logic Task instructions can be read out in any operating mode.

Format:

```
?sP_xxxx_$hh CR LF
```

In response to this query, the contents stored in the queried Logic Task instruction \`xxxx´ is sent.

```
Psxxxx_dddddddd_$hh CR LF
```

Meaning of the characters used:
x = Parameter Number
d = Instruction Information

Writing a Logic Task assignment

```
#sPxxyy_dddddddd_$hh CR LF
```

Meaning of the characters used:

x = Parameter Number
y = Block Identifier
d = Instruction information (number dependent on parameter)

Command	Data
LD	LD_ _ _ _M2.02.0_
LDN	LDN _ _ _M2.02.0_
ST	ST _ _ _ _M2.02.0_
STN	STN _ _ _M2.02.0_
SET	SET _ _ _M2.02.0_
SETC	SETC _ _M2.02.0_
SETCN	SETCN _M2.02.0_
RES	RES_ _ _M2.02.0_
RESC	RESC_ _M2.02.0_
RESCN	RESCN _M2.02.0_
AND	AND _ _ _M2.02.0_
ANDN	ANDN _ _M2.02.0_
AND(	AND(_ _M2.02.0_
ANDN(	ANDN(_M2.02.0_
OR	OR_ _ _ _M2.02.0_
ORN	ORN_ _ _M2.02.0_
OR(	OR(_ _ _M2.02.0_
ORN(	ORN(_ _M2.02.0_
XOR	XOR_ _ _M2.02.0_
XORN	XORN_ _M2.02.0_
XOR(	XOR(_ _M2.02.0_
XORN(	XORN(_M2.02.0_
)	)_
NOP	NOP_
END	END_

Examples:

Query	Response
?_P_0006_$hh CR LF	P_0006_ORN(__M2.02.0_$hh CR LF
?_P_0101_$hh CR LF	P_0101_AND___M2.02.1_$hh CR LF

Examples: Transmission

```
#_P_0103_SET___M2.02.3_$hh CR LF
#_P_0600_RESCN_M2.02.5_$hh CR LF
```

If no checksum validation function has been programmed prior to entering Parameter Mode, this function remains deactivated, even though Parameter B002 has been overwritten, until Parameter Mode is exited.

Readout of Status Information

The following status messages can be queried via the serial data interface:

Status \`00´	=	Actual position of axis 1 in IUs
Status \`01´	=	Transmission error, interface
Status \`04´	=	Counter
Status \`05´	=	Firmware version
Status \`08´	=	Current instructions and return instruction numbers of tasks 1 through 3
Status \`09´	=	Measuring wheel mode: Actual position of axis 1 and position of motor encoder
Status \`10´	=	Position lag (following error) of axis 1 in IUs
Status \`19´	=	Hardware and firmware version
Status \`48´	=	Actual velocity of axis 1 in RPM
Status \`53´	=	Fault indication
Status 60	=	Output of first erroneous instruction number (Parameter, Task, Logic Task)
Status 61	=	Output of a byte M/I/Q

Status 00

Actual position of axis 1 in IUs

The status query:

```
?sX__00_ CR LF
```

produces the message:

```
Xs00_evmmmmmmm.mmm__+000000.000$hh CR LF
```

Meaning of the characters used:

e = \`_´ stands for relative position (not homed)
\`A´ stands for absolute position (axis homed)
v = Operational sign of the actual position
m = Actual position of axis 1 in IUs

Status 01

Transmission errors

The control sends this status information automatically if an error occurs in the transmission. Status 01 can *not* be queried.

In the event of a transmission error, the control delivers the following message:

```
Xs01_ff_tttttttttttttttttt_$hh CR LF
```

Meaning of the characters used:

f = Error number
t = Error text (always 20 characters)

Below is a list of the error numbers and their meanings:

Error No.	Error Text	Explanation
01	RS instruction no. incorrect	Incorrect character in the instruction number. The transmitted instruction number is not a decimal number.
02	RS format error	The format of the transmitted data is incorrect
03	RS instruction data error	The transmitted instruction data are incorrect.
04	RS checksum error	The transmitted checksum is incorrect.
05	Operating mode error	Attempt was made to transmit parameter data. The control was not in `Parameter´ operating mode at the time.
06	RS parameter no. incorrect	The transmitted parameter number is not a decimal number.
07	Param. no. too large	The transmitted parameter number is too large.
08	RS status no. incorrect	The number given in a status request is not a decimal number.
09	Status no. illegal	An attempt was made to query status information that was not present.
11	Invalid param. block	Incorrect parameter instruction identifier.
12	Instr. no. too large	The transmitted instruction number is greater than 2999.
13	Illegal command	An illegal command was transmitted to the DKC.
16	Value too large	One of the values is too large See description for max. values
17	Value too small	One of the values is too small See description for min. values
18	Not accepted!	
19	Group no. illegal	
20	RS system error #1	
21	RS system error #2	
22	MF para. Read only	Motor feedback parameter
23	Var. No. incorrect	The variable number is not enabled.

Status 04

Counter

The status query:

?sX__04_nnnn_CR LF

produces the message:

Xs04_nnnn_iiiiii_zzzzzz______$hh CR LF

Meaning of the characters used:

n = Block number
i = Actual quantity
z = Target quantity

If the requested instruction contains no counter, blank spaces `_´ are output for `i´ and `z´.

Status 05

Firmware version

The status query:

?sX__05_CR LF

produces the message:

Xs05__vvvvvvvvvvvvvvvv_$hh CR LF

Meaning of the characters used:

v = firmware version (also appears on the display of the BTV)

e.g. ECODR3-FLP-01Vxx

Status 08

Current instruction number and return instruction number to the main program of the 3 tasks

The status query:

?sX__08_CR LF

produces the message:

Xs08_aaaa_bbbb_cccc_dddd_eeee_ffff_$hh CR LF

Meaning of the characters used:

a = Task 1 - Current instruction number
b = Task 1 - Instruction number of the main program
c = Task 2 - Current instruction number
d = Task 2 - Instruction number of the main program
e = Task 3 - Current instruction number
f = Task 3 - Instruction number of the main program

In the case of tasks that have not been activated, an appropriate number of blank spaces is output.

If a task is not located in a subroutine, only the current instruction number is output.

Status 09

Measuring wheel mode: Actual position of axis 1 and position of motor encoder

The status query:

```
?sX__09_CR LF
```

produces the message:

```
Xs09__evmmmmmmm.mmm_vnnnnnn.nnn$hh CR LF
```

Meaning of the characters used:

e = `_´ stands for relative position (not homed)
`A´ stands for absolute position (axis homed)

v = Operational sign of the actual position

m = Actual position of axis 1 in IUs. The sums of all measuring wheel encoder movements are added

n = Actual position of the motor encoder in IUs (incremental encoder 1)

Status 10

Axis 1 Position Lag (Following Error)

The status query:

```
?sX__10_CR LF
```

produces the message:

```
Xs10_vmmmmmmm.mmm__+000000.000$hh CR LF
```

Meaning of the characters used:

v = Operational sign for position lag (following error)
m = Position lag (following error) of axis 1 in IUs

Status 19

Hardware and software version

The status query:

```
?sX__19_CR LF
```

produces the following message, e.g.,:

```
Xs19DKC21.3_ _ _ _ _ _ _ _ _ ECODR3-FLP-xxVxx$hh CR LF
```

Firmware version
max. 16 characters

Hardware version
max. 16 characters

Status 48

Actual velocity of axis 1

The status query:

```
?sX__48_CR LF
```

produces the message:

```
Xs48_g_vmmmm.mm_0_0000.00_$hh CR LF
```

Meaning of the characters used:

v	=	Operational sign
m	=	Velocity of axis 1 in RPM
g	=	0 Axis deactivated
		1 Axis activated

Status 53

Fault indication

The status query:

```
?sX__53_CR LF
```

produces the message:

```
Xs53_xxxxxx_tttttttttttttttt $hh CR LF
```

t = fault description in plain text (max 40 characters)

x = error code / diagnostic number

For error texts and codes, see Chapter 11.

Status 60

Output of erroneous

- Parameter number
- NC instruction number
- Logic Task instruction number

The status query:

```
?sX__60_a_CR LF
```

produces the message:

```
Xs60_a_nnnn_$hh CR LF
```

a = source	0 = parameter
	1 = NC
	2 = Logic Task

nnnn = instruction number or parameter number

If no error is present, blank spaces are transmitted

Status 61

Output of a byte M/I/Q

The status query:

```
?sX_61_mt.nn_CR LF
```

produces the message:

```
Xs61_mt.nn_bbbbbbbb_$hh CR LF
             Bit 7. . . . . 0
```

m = Source type I / Q / M

t = Source number

n = Byte number

b = Bits

Interface Commands

For all commands, it is necessary for the checksum to transmitted independently of Parameter B002!

Clear Fault

```
!sCLEAR_$hh CR LF
```

or

```
!sCCLEAR_$hh CR LF
```

Clears an error message

Clear Position Counter

The position counter can be cleared via the interface.

```
!sCRPOS0_$hh CR LF
```

With this transmission, the relative position counter is set to 0. This counter also represents the position that is transmitted with status 00 when the type of motion = 0 (Parameter A100). If another type of motion is activated, the command is followed by error message 18 “Not accepted.”

This is possible only when the type of motion = 0 (Parameter A100). If the control is not in manual or automatic mode, the interface responds with error message 05 “Incorrect operating mode.”

Set Default Values

Default parameters can be set via the interface.

```
!sCSETPA_$hh CR LF
```

Note: All parameters are overwritten

Polling Query

A query, in the shortest possible format, which cyclically polls all of the controls connected to the RS485 bus.

The query:

```
:s CR LF
```

produces the DLC message:

```
:snnnn CR LF
```

Meaning of the characters used:

nnnn = error code (hexadecimal)
error list

SIS Protocol

In preparation

10 Command Communications

10.1 Parallel Interface

DKC21.3

Three connectors serve as the parallel interface.

X1, X3 and X210

See also the Project Planning Manual and Section 12.

10.2 Profibus

Rexroth Indramat provides advanced drive technology with a user-friendly interface. For example, jogging was defined as an individual function. Rexroth Indramat has provided this functionality (as also defined in the ProfiDrive) as bits in the control word, and thus can now offer an interface that is easier to use.

Setting the Slave Address

The slave address is set on the plug-in module.

Status at Delivery:

The DKC3.3 address is set to 99 at delivery.

settable Addresses:

Slave addresses 1-99 (decimal) are supported.

Depending on the fieldbus type, however, the following limitations exist:

Profibus DP address: **2 ... 36 permitted**

Note: Slave address 0 does not exist and cannot be used in applications.

Slave Address

The address is read from the programming module when starting up the DKC3.3, and it is used to set the parameters for the fieldbus. Parameter input X3/1 is used.

Any change to the slave address takes effect only after startup of the drive controller.

The data channel size is 32 bytes.

Service Data Channel	Process Data Channel
6 Words	8 (7) Words

Fig. 10-1: Transmission

Fieldbus Parameters

Several parameters must be programmed for the fieldbus. The parameters are part of the group B0xx.

B011 Fieldbus Cycle Time

B012 Fieldbus Baudrate

B013 Fieldbus Format

The following information is supplied by the Profibus

- Watchdog Time: is displayed in Parameter B011
- Baud rate: is displayed in Parameter B012

Process Data Channel

O Channel (DKC Output)	**Diagnostic Channel**	**Variable Channel**
3 Words	1 Word	4 Words

Fig. 10-2: Transmission Channel DKC3.3 → Master

I Channel (DKC Input)	**Variable Channel**
3 Words	4 Words

Fig. 10-3: Receive Channel Master → DKC3.3

I/O Channel

The I/O Channel consists of 3 words. The Status Word and the Control Word are concretely defined. The other two words are not defined. Their function is assigned via the user program or the parameters.

I/O Status Word (DKC Output)

Bit field	Definition	Designation
0	Manual Mode	Q2.00.0
1	Automatic Mode	Q2.00.1
2	$\overline{\text{Fault}}$	Q2.00.2
3	Run	Q2.00.3
4	Ready	Q2.00.4
5	Warning	Q2.00.5
6	Parameters	Q2.00.6
7	In Position	Q2.00.7
8	Reserved	Q2.01.0
9	Reserved	Q2.01.1
10	Reserved	Q2.01.2
11	Reserved	Q2.01.3
12	Reserved	Q2.01.4
13	Reserved	Q2.01.5
14	Reserved	Q2.01.6
15	Reserved	Q2.01.7

Fig. 10-4: Status Word DKC3.3 → Master

I/O Control Word (DKC Input)

Bit field	Definition	Designation
0	Parameter Mode	I2.00.0
1	$\overline{\text{Manual}}$/Automatic	I2.00.1
2	Start	I2.00.2
3	$\overline{\text{Stop}}$	I2.00.3
4	Jog forward	I2.00.4
5	Jog reverse	I2.00.5
6	Clear errors	I2.00.6
7	Reserved	I2.00.7
8	Reserved	I2.01.0
9	Reserved	I2.01.1
10	Reserved	I2.01.2
11	Reserved	I2.01.3
12	Reserved	I2.01.4
13	Reserved	I2.01.5
14	Reserved	I2.01.6
15	Reserved	I2.01.7

Fig. 10-5: Control Word Master → DKC3.3

User-configurable I/O

DKC Input

I2.02

I2.03

I2.04

I2.05 are the addresses of the unused words

DKC Output:

Q2.02

Q2.03

Q2.04

Q2.05 are the addresses of the unused words

Diagnostic Channel

Diagnostics (Status, Warnings, Error Messages) are made available in a word as a hexadecimal Number. The content represents the diagnostic numbers assigned in the description.

Variable Channel

The length is 4 words, and all variables can be transmitted in 4 different formats.

From Master to DKC

Read Control Word	Write Control Word	Variable Datum
1 Word	1 Word	1 Long Word

Fig. 10-6: Variable Channel Master → DKC3.3

1 Word: Read Control Word

1 Word: Write Control Word

1 Long: Variable Datum

From DKC to Master

Read Status Word	Write Status Word	Variable Datum
1 Word	1 Word	1 Long Word

Fig. 10-7: Variable Channel DKC3.3 → Master

1 Word: Read Status Word

1 Word: Write Status Word

1 Long: Variable Datum

Write Status Word / Read Status Word

Bits	Function
0..9	Variable Number
10..13	Format / Error Number
14	Error Bit
15	Handshake Bit toggles to the Status Word

Fig. 10-8: Variable Status Word

Write Control Word / Read Control Word

Bits	Function
0..9	Variable Number
10..13	Format
14	Reserved (always 0)/ Version Number: 0
15	Handshake Bit toggles to the Status Word

Fig. 10-9: Variable Control Word

Handshake

When restarting the DKC, the handshake bits are the same.

When the master makes a read or write request, the respective handshake bit must be toggled in the control word. After the DKC has processed the request, it toggles the respective handshake bit in the status word.

Handshake Bit Control Word	Handshake Bit Status Word	Status
0	0	No function
1	0	Request from the Master
1	1	Request processed by the Slave (DKC)
1	1	No function
0	1	Request from the Master
0	0	Request processed by the Slave (DKC)
0	0	No function

Fig. 10-10: Handshake Process

- The following data formats are defined
  Format 0 = Integer (+/- 99999999)
  Format 1 = Fixed point (3) (+/-99999.999)
  Format 2 = Fixed point (6) (+/- 99.999999)
  Format 3 = IEEE Floating point (in development)

- When the error bit (Bit 14) is set in the status word, error numbers are assigned to the format bits (Bits 10-13). The following error numbers are assigned:
  Error 0 = Variable number too large
  Error 1 = Variable number illegal
  Error 2 = Unknown format
  Error 3 = Datum too large
  Error 4 = Datum too small
  Error 5 = Datum not displayable (IEEE)
  Error 6 = Variable not writable
  Error 7 = Bit 14 = 1

Variable Number:

Assignment of the variables as in the description

Variables V600 – V999 are unused.

Service Data Channel

In preparation

In the future, instructions, parameters and the logic task will be transmitted via this channel.

Parallel Interface

The following hardware inputs must be assigned to the DKC3.3:

- E-Stop X3/6
- Limit + X3/2
- Limit - X3/3
- RF X1/4
- $\overline{\text{AH}}$ X1/3

Assignment of Profibus Connector X30

Signal Assignment for X30 Profibus Connector

X 30	RS 485 Referen ce	Rexroth Indramat Signal Name	Signal according to EN50170 Volume 2	Definition
1		PE	Shield	Shield or Protective Ground
2		unused		
3	B / B´	B	RxD / TxD-P	Receive/Transmit Data - P
4		CNTR-P	CNTR-P	Repeater – Control Signal P
5	C / C´	BUSGND	DGND	Data Ground
6		VP	VP	Supply Voltage –Plus (P5V)
7		unused		
8	A / A´	A	RxD / TxD-N	Receive/Transmit Data - N
9		CNTR-N	CNTR-N	Repeater – Control Signal N

Fig. 10-11: X30 Signal Assignment. Profibus-DP

Notes

11 Diagnostic Message Descriptions

11.1 Overview of the Diagnostic Message Descriptions

Diagnostic Message Types

Each operating state of the drive controller is identified with a diagnostic message.

Distinctions are made between:

- **Diagnostic Error Messages**
- **Diagnostic Warning Messages**
- **Command Diagnostic Messages**
- **Diagnostic Status Messages**
- **Operation Status Messages**

Composition of a Diagnostic Message

A diagnostic message consists of:

- a **diagnostic message number** and a
- **diagnostic message text**

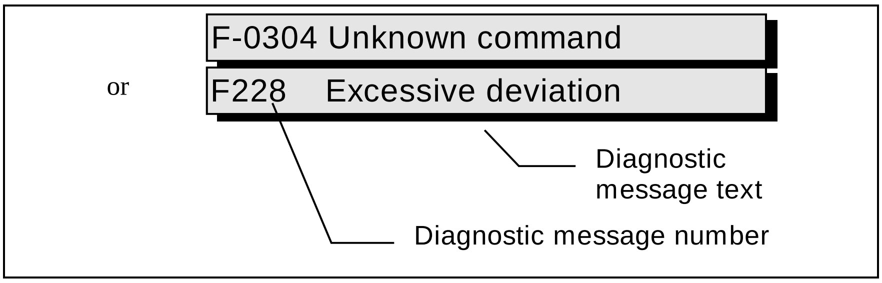


Fig. 11-1: Diagnostic Message Composition with a Diagnostic Message Number and Text

For the example shown in the above graphic, "F2" and "28" alternate in the H1 display.

Using status 53, the control can read the **diagnostic message number** and the diagnostic message text as **F228, Excessive deviation**.

H1 Display

The H1 display visually displays the diagnostic message on the drive controllers.

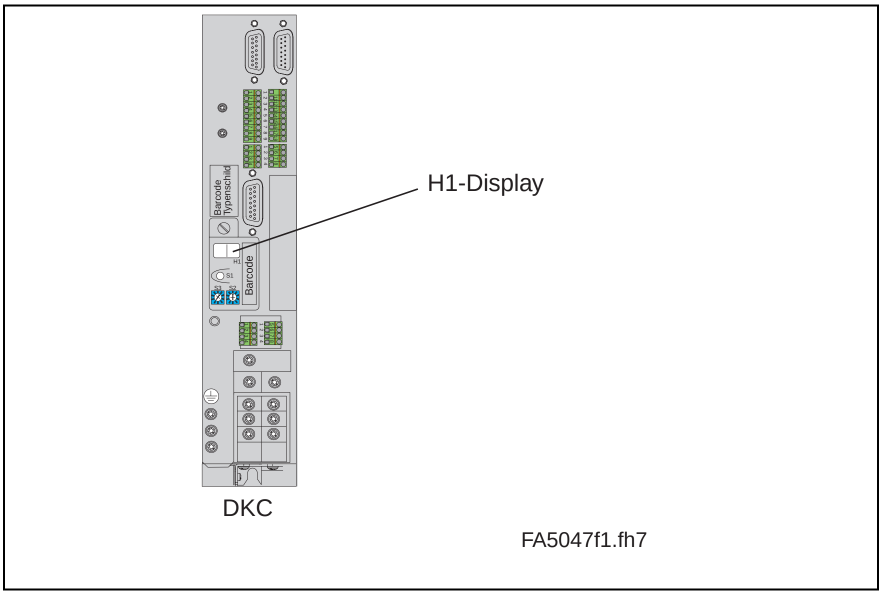


Fig. 11-2: H1 Display

The diagnostic message number appears in the two-digit seven-segment display. See the "Diagnostic Message Priority Diagram" for the display format.

This display quickly shows the current operating state without the use of a communications interface.

The operating mode is not apparent from the H1-Display. If the drive complies with the operating mode and no command was activated, then "AF" appears on the display.

Diagnostic Message Output Priority

If more than one diagnostic message is active, then the message with the highest priority will be displayed. If more than one diagnostic message is active, then the message with the highest priority will be displayed.

The following graphic classifies the operating states in order of importance.

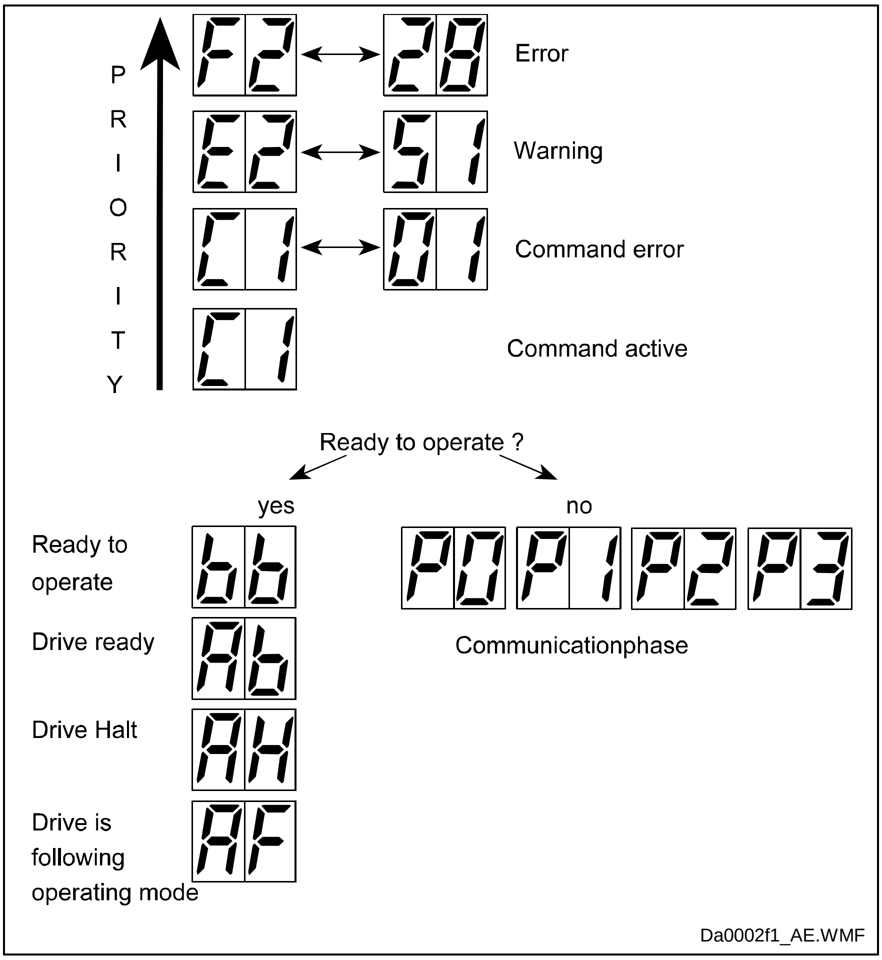


Abb. 11-3: Message Priority Diagram

Plain Text Diagnostic Message

The plain-text diagnostic message contains the diagnostic message number followed by the diagnostic message text, as shown in the example, "Excessive deviation" (Fig. 11-1).
It can be read out via Status 53, **Diagnostic**, and is used for direct display of the drive status on a user interface.

The language of the plain-text diagnostic message can be changed.

11.1 Diagnostic Error Messages

F208 UL The motor type has changed

This message is displayed when the unit is powered up for the first time with a new motor.

The regulator settings for the current, velocity and position loops are stored in the feedback memory on the motor. After powering up, the controller compares the motor type stored in the parameter with the connected motor type. If the two do not match, the basic control loop setting must also be adjusted.

With the Basic Load command, the default control loop settings are loaded from the feedback memory into the drive controller. The previous control loop settings are overwritten. The Basic Load command is started by pressing the S1 key on the controller.

Causes:

- The motor has been replaced.
- A parameter file was loaded in which the motor type is different from the motor type present.

Remedy:

Press the S1 key.

F208 - Attributes

SS display:	UL
Message no.:	F208 (hex)
Error no.:	208
Class:	Non-fatal

F209 PL Load parameter default values

After replacing the firmware version, the drive displays “**PL**” if the parameters have been changed compared to the old firmware. Pressing the S1 key on the controller clears all of the parameters and sets them to the default values.

Cause:

The firmware has been replaced; the number of parameters in the new firmware has changed compared to the old version.

Remedy:

Press the S1 key on the controller. All parameters will be cleared and preset with the parameters assigned at the factory.

CAUTION

Following acknowledgement of the S1 key, a save query is also issued. The parameters can then be saved via the serial interface, or the function for presetting the parameters can be suppressed.

F209 - Attributes

SS display:	PL
Message no.:	F209 (hex)
Error no.:	209
Class:	Non-fatal

F218 Amplifier overtemp. shutdown

The temperature of the amplifier's heatsink is monitored. If the heatsink is too hot, the drive will power down in order to protect against damage.

Cause:

1. Ambient temperature is too high. The specified performance data apply up to an ambient temperature of 45°C.
2. The amplifier's heatsink is dirty.
3. Air flow is prevented by other assembly parts or the control cabinet assembly.
4. Blower is defective

Remedy:

For 1. Reduce the ambient temperature, e.g. through cooling of the control cabinet.

For 2. Clean heatsink.

For 3. Install the device vertically and clear a large enough area for proper heatsink ventilation.

For 4. Replace drive.

F218 - Attributes

SS display:	F2/18
Message no.:	F218 (hex)
Error no.:	218
Class:	Non-fatal

F219 Motor overtemp. shutdown

The motor temperature has risen to an unacceptable level.

As soon as the **temperature error threshold** of 155°C is exceeded, the drive will immediately be brought to a standstill in accordance with the type of error response selected (A119, Best possible halt).

The following applies:

temperature warning threshold < temperature error threshold

See also **E251 Motor overtemperature prewarning**.

Cause:

1. The motor is **overloaded**. The effective torque demanded by the motor has been above its allowable continuous torque level for too long.
2. **Wire break**, ground fault or short circuit in the motor temperature monitoring line
3. **Instability** in the velocity loop

Remedy:

For 1. Check the motor rating. If the system has been in operation for a long time, check to see if the operating conditions have changed. (with regard to contamination, friction, moved components, etc.)

For 2. Check the motor temperature monitoring line for wire breaks, ground faults and short circuits.

For 3. Check velocity loop parameter settings.

See also functional description for: "Temperature Monitoring."

F219 - Attributes

SS display:	F2/19
Message no.:	F219 (hex)
Error no.:	219
Class:	Non-fatal

F220 Bleeder overload shutdown

The regenerative energy coming from the machine mechanism via the motor has overloaded the braking resistor (bleeder). When the maximum braking energy is exceeded, the drive shuts down after braking. The bleeder is thus protected against destruction due to overheating.

Cause:

The regenerative energy coming from the machine mechanism via the motor is too great.

Remedy:

If demand is too great → reduce the acceleration values.

If too much power is supplied → reduce the velocity.

Check the drive rating.

Install additional bleeder module if necessary.

F220 - Attributes

SS display:	F2/20
Message no.:	F220 (hex)
Error no.:	220
Class:	Non-fatal

F221 Motor temp. surveillance defective

Cause:

Wire break or improper connection in motor temperature monitoring line.

Remedy:

Check motor temperature monitoring line (signals MT(emp)+ and MT(emp)-) for breaks/interruptions and short circuits.

See also functional description for: "Temperature Monitoring."

F221 - Attributes

SS display:	F2/21
Message no.:	F221 (hex)
Error no.:	221
Class:	Non-fatal

F226 Undervoltage in power section

The level of the DC bus voltage is monitored by the drive controller. If the DC bus voltage falls below a minimal threshold, the drive independently shuts down according to the set error response.

Cause:

1. Power is turned off without first deactivating the drive using the drive enable (RF) signal.
2. Disturbance in the power supply

Remedy:

For 1. Check the drive activation logic in the connected controller.

For 2. Check the power supply.

The error disappears in the DKC03 when the drive enable signal is cleared.

F226 - Attributes

SS display:	F2/26
Message no.:	F226 (hex)
Error no.:	226
Class:	Non-fatal

F228 Excessive deviation

When the position loop is closed, the drive monitors whether it is able to follow the specified command value. This is done by calculating a model position value in the drive and comparing that value with the actual feedback value. If the difference between the theoretical and actual position values continually exceeds the value in **Parameter A115, Monitor**, the drive obviously cannot comply with the given command value. This error is then generated.

Cause:

1. The drive's **acceleration capacity** has been exceeded.
2. The axis is **locked**.
3. Incorrect parameter values set in the drive parameters.
4. **Parameter A115, Monitor** set incorrectly.

Remedy:

For 1. Check program to see whether a value that is too low has been entered in a MOM_command.

For 2. Check the mechanical system and eliminate jamming of the axis.

For 3. Check the drive parameters (control loop settings).

For 4. Set **Parameter A115, Monitor**.

See also functional description for: "Position Control Loop Monitoring."

F228 - Attributes

SS display:	F2/28
Message no.:	F228 (hex)
Error no.:	228
Class:	Non-fatal

F229 Encoder 1 failure: Quadrant error

On the basis of faulty signals detected during the encoder evaluation, a hardware error has been discovered in the interface being used for encoder 1.

Cause:

1. Defective encoder cable
2. Disruptive electro-magnetic interference on the encoder cable
3. Defective encoder interface
4. Defective drive controller

Remedy:

For 1. Replace the encoder cable.

For 2. Keep the encoder cable well away from power cables. Use shielded motor and encoder cables.

For 3. Replace the encoder interface.

For 4. Replace the drive controller.

F229 - Attributes

SS display:	F2/29
Message no.:	F229 (hex)
Error no.:	229
Class:	Non-fatal

F230 Max. Signal frequency of encoder 1 exceeded

The signal frequency of encoder 1 (motor encoder) is checked to see whether the max. permissible frequency of the encoder interface has been exceeded.

If the frequency is higher than allowed, error **F230, Max. signal frequency of encoder 1 exceeded** is generated. The “homed” output in **Parameter C010** is turned off.

F230 - Attributes

SS display:	F2/30
Message no.:	F230 (hex)
Error no.:	230
Class:	Non-fatal

F234 Emergency-Stop

Cause:

The emergency stop function was initiated by switching off the +24V present at the emergency stop input. The drive controller was brought to a standstill according to the set error response.

Remedy:

1. Correct the problem that caused the +24V signal present at the emergency stop input to be switched off.
2. Execute the “Reset class 1 diagnostics“ command, e.g., via the control or the S1 key on the drive controller.

F234 - Attributes

SS display:	F2/34
Message no.:	F234 (hex)
Error no.:	234
Class:	Non-fatal

F236 Excessive position feedback difference

Cause:

After the system is restarted, actual position values 1 and 2 are set to the same value, and the cyclic evaluation of both encoders is started. In cyclic mode, the difference in the actual position values of both encoders is compared using **Parameter A117, Monitor Feedback difference**. If the amount of the difference is greater than the parameter value, the diagnostic error message **F236 Excessive position feedback difference** is generated, the error response set in the parameter is executed and the reference bits (**Parameter C010**) of both encoders are cleared.

The monitoring function is inactive if a value of 0 is entered in **Parameter A117, Monitor Feedback difference**.

Possible causes:

1. Wrong parameter for encoder 2
   (**Parameter C005, Pos. measurement device type 2, Parameter C006, Resolution 2**)

2. Incorrect parameter setting of mechanical system between motor shaft and encoder 2: (**Parameter A102 Gearing**, **Parameter A101, Feed rate constant**)
3. Mechanical system between motor shaft and encoder 2 is not rigid (e.g., gear play).
4. Defective encoder cable
5. Maximum input frequency of the encoder interface exceeded
6. Encoder 2 is not mounted to the driven axis.
7. Reference point of an absolute encoder is incorrect

Remedy:

For 1. Check **Parameter C005, Pos. measurement device type 2** and **Parameter C006, Resolution 2**.

For 2. Check **Parameter A102, Gearing**.

For 3. Increase **A117, Monitor Feedback difference**.

For 4. Replace encoder cable.

For 5. Reduce the velocity.

For 6. Set **Parameter A117, Monitor Feedback difference** to 0 (turn monitoring off).

For 7. Execute **Parameter C010, Set absolute dimension**.

F236 - Attributes

SS display:	F2/36
Message no.:	F236 (hex)
Error no.:	236
Class:	Non-fatal

F237 Excessive position command difference

Cause:

The position command values created by the position loop must be monitored. If two position command values received in succession request the drive to produce a velocity that is greater than or equal to the value in **Parameter A106, Maximum Speed**, the position command value monitoring function is activated.

F237 - Attributes

SS display:	F2/37
Message no.:	F237 (hex)
Error no.:	237
Class:	Non-fatal

F242 Encoder 2 failure: Signal amplitude wrong

Cause:

The analog signals of an optional measurement system are used for high resolution analysis of that measurement system. These signals are monitored according to two criteria:

1. The pointer length, determined from the sine and cosine signals, must be greater than 1 V.
2. The maximum pointer length resulting from the sine and cosine signals must not exceed 11.8 V.

$$Pointer\ \ Length = \sqrt{\sin^2 + \cos^2}$$

Fig. 11-4: Pointer Length

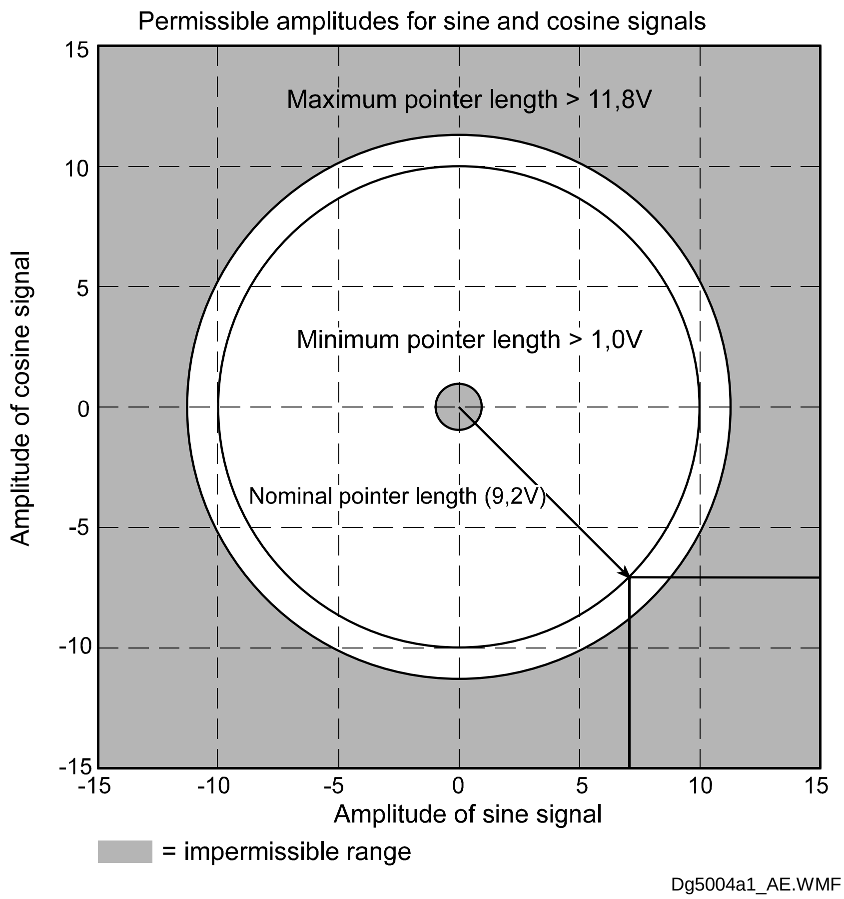


Fig. 11-5: Correct Signal Amplitude

Example:

Ucos = -6.5V

Usin = 6.5V

$$Pointer\ Length = \sqrt{(-6{,}5V)^2 + (6{,}5V)^2} = 9{,}2V$$

Remedy:

1. Check the measurement system cable.
2. Check the measurement system.

F242 - Attributes

SS display:	F2/42
Message no.:	F242 (hex)
Error no.:	242
Class:	Non-fatal

F245 Encoder 2 failure: Quadrant error

The evaluation of the additional optional encoder (encoder 2) is active. In the evaluation of the sinusoidal input signals of the optional encoder, a plausibility check is performed between these signals and the counter fed by these signals. In so doing, an error has been encountered.

Cause:

1. Defective encoder cable
2. Electromagnetic interference on the encoder cable
3. Defective encoder interface

Remedy:

For 1. Replace the encoder cable

For 2. Keep the encoder cable well away from power cables.

For 3. Replace unit (ECODRIVE)

F245 - Attributes

SS display:	F2/45
Message no.:	F245 (hex)
Error no.:	245
Class:	Non-fatal

F246 Max. signal frequency of encoder 2 exceeded

The signal frequency of encoder 2 (optional encoder) is checked to see whether the allowed max. frequency of the encoder interface has been exceeded.

If the frequency is higher than allowed, error **F246, Max. signal frequency of encoder 2 exceeded** is generated. The “homed” output in **Parameter C010** is turned off.

F246 - Attributes

SS display:	F2/46
Message no.:	F246 (hex)
Error no.:	246
Class:	Non-fatal

F248 Low battery voltage

Cause:

For model MKD and MKE motors, the absolute position information is stored in the motor encoder electronics with battery backup. The battery is rated for a 10-year service life. If the battery voltage goes below 2.8 V, this message is displayed. Encoder functioning is ensured for approximately another 2 weeks.

CAUTION

Malfunction in the control of motors and moving elements

Equipment damage can occur.
Replace battery immediately.

Instructions for replacing batteries

Have the following tools and accessories ready:

- Torx screwdriver size 10
- Needle-nose pliers, torque wrench
- New battery pack (Part No. 257101)

CAUTION

Malfunction in the control of motors and moving elements

Equipment damage can occur.

Turn off the power supply. Make sure it isn't switched back on. Replace the battery while the control voltage is turned on.

If the control voltage is turned off while the battery is out, the absolute **reference** point will be lost. Then, the reference point must be reestablished using the "**Set absolute dimension**" command.

Removing the Battery

- Unscrew Torx screws (1) using size 10 screwdriver.
- Pull out the resolver feedback (RSF) lid by hand.
- Remove battery connector (2)
- Undo battery clamp (3) and remove battery
- Place the battery pack in the housing and screw on the clamp. **Attention!** Do not kink or crimp the battery cable.
- Attach battery connector (2)

Close the resolver feedback lid, screw in the 4 Torx screws (1) and tighten to 1.8 Nm with the torque wrench.

F248 - Attributes

SS display:	F2/48
Message no.:	F248 (hex)
Error no.:	248
Class:	Non-fatal

F253 Incr. encoder emulator: Frequency too high

Cause:

The incremental encoder emulator can process a maximum of 1023 graduation marks per 250-µs sampling period; this value was exceeded.

Remedy:

1. Decrease the **number of lines** to be used by the incremental encoder emulator (Parameter C015).

or

2. Reduce the travel **velocity**.

See also functional description for: "Encoder emulation."

F253 - Attributes

SS display:	F2/53
Message no.:	F253 (hex)
Error no.:	253
Class:	Non-fatal

F267 Erroneous internal hardware synchronization

Cause:

The drive control is synchronized to the bus interface (DIO, Profibus,). Synchronization is monitored to check for proper functioning. If the average value of the deviation exceeds 5 µs, this error message is generated.

Remedy:

Replace the drive controller.

F267 - Attributes

SS display:	F2/67
Message no.:	F267 (hex)
Error no.:	267
Class:	Non-fatal

F276 Absolute encoder out of allowed window

When turning off the drive controller with an absolute encoder motor (multiturn), the actual feedback position will be stored. When powered up, the absolute position determined by the encoder evaluation is compared with this stored position. If the deviation is greater than the value set in parameter **A118, Absolute Feedback device Monitor window**, error **F276** is generated and the control is notified.

Cause:

1. Controller is turned on for the first time (stored position is invalid)
2. While the controller was turned off, the axis was moved further than allowed by **Parameter A118, Absolute Feedback device Monitor window**.
3. Incorrect position initialization

Remedy:

For 1. Clear error (establish absolute reference point).

For 2. The axis was moved with the motor turned off and is outside of its permissible position. Check to see if the displayed position is correct in relation to the machine zero point. Then clear the error.

For 3. **Unintentional movement of the axis may cause accidents.** Check absolute reference point. If the absolute reference point is incorrect, the encoder is defective. The motor should be replaced and sent to Rexroth Indramat Customer Service.

F276 - Attributes

SS display:	F2/76
Message no.:	F276 (hex)
Error no.:	276
Class:	Non-fatal

F277 Current measurement trim wrong

This error can occur only when the drive controller is tested at the INDRAMAT factory.

Measurement of the current within the drive controller is precisely calibrated in the INDRAMAT test bay using a compensation current. During this calibration, the correction values are found to be outside the intended tolerances.

Cause:

1. Defective hardware in the drive controller.
2. The correct compensation current for this measurement is not flowing.

Remedy:

1. Repair the control card.
2. Check the compensation current.

F277 - Attributes

SS display:	F2/77
Message no.:	F277 (hex)
Error no.:	277
Class:	No. 1

F281 Mains fault

Cause:

The power supply voltage was not present during operation for at least 3 power periods. As a result, the drive controller was brought to a standstill according to the set error response (**Parameter A119**).

Remedy:

Check the power connections to ensure that they are as specified in the project planning specifications.

F281 - Attributes

SS display:	F2/81
Message no.:	F281 (hex)
Error no.:	281
Class:	Non-fatal

F386 No ready signal from supply module

Cause:

Input BbN "Power supply readyl“ on the drive controller is at 24V, i.e., the connected power supply is not issuing a ready signal.

F386 - Attributes

SS display:	F3/86
Message no.:	F386 (hex)
Error no.:	386
Class:	Non-fatal

F407 Error during initialization of master communication

An error has occurred during initialization and check testing of the command communications card (DIO1.1 or Fieldbus).

Cause:

- No command communications card is inserted
- Wrong command communications card is inserted
- Wrong firmware is loaded

Remedy:

- Insert correct command communications card
- Replace firmware

F407 - Attributes

SS display:	F4/07
Message no.:	F407 (hex)
Error no.:	407
Class:	Interface

F408 Fatal error of the interface card

Communication with the DIO1.1 parallel interface card of the DKC21.3 has been disrupted.

Cause:

- DIO card not properly seated
- Impermissible memory access occurs.

Remedy:

- Check card seating
- Switch unit off and on. If error still pending, replace hardware.

F408 - Attributes

SS display:	F4/08
Message no.:	F408 (hex)
Error no.:	408
Class:	Interface

F434 Emergency-Stop

Actuating the emergency stop switch has caused the drive to execute the emergency stop function set via **Parameter A119, Best possible halt**.

Cause:

The emergency stop switch was detected.

Remedy:

Eliminate the malfunction that has caused the emergency switch to be activated, and clear the error.

F434 - Attributes

SS display:	F4/34
Message no.:	F434 (hex)
Error no.:	434
Class:	Interface

F629 Positive travel limit exceeded

A command was executed which resulted in an axis position outside the negative travel range. The axis has been brought to a standstill with the error response "Set velocity command value to zero."

Cause:

Parameter A104, Max position positive exceeded.

Remedy:

1. Verify **Parameter A104, Max position positive**.
2. Check program.

Procedure:

- Clear error
- If the power supply was turned off, turn it back on.
- Move the axis into the permissible working range.

Note: Only those command values which lead back into the allowed working range will be accepted. With other command values, the drive will stop again. **Parameter A111, Switching level** is used to implement a hysteresis function.

F629 - Attributes

SS display:	F6/29
Message no.:	F629 (hex)
Error no.:	629
Class:	No. 1

F630 Negative travel limit exceeded

A command was executed which resulted in an axis position outside the negative travel range. The axis has been brought to a standstill with the error response "Set velocity command value to zero."

Cause:

Parameter A103, Max Position negative exceeded.

Remedy:

1. Verify **Parameter A103, Max Position negative**.
2. Check program.

Procedure:

- Clear error
- If the power supply was turned off, turn it back on.
- Move the axis into the permissible working range.

Note: Only those command values which lead back into the allowed working range will be accepted. With other command values, the drive will stop again. **Parameter A111, Switching level** is used to implement a hysteresis function.

F630 - Attributes

SS display: F6/30

Message no.: F630 (hex)

Error no.: 630

Class: Travel range

F634 Emergency-Stop

Actuating the emergency stop (E-Stop) switch has caused the drive to stop by setting the velocity setpoint value to zero.

Cause:

The emergency stop switch was detected.

Remedy:

Eliminate the malfunction that has caused the emergency switch to be activated, and clear the error.

F634 - Attributes

SS display: F6/34

Message no.: F634 (hex)

Error no.: 634

Class: Travel range

F643 Positive travel limit switch detected

The positive travel limit switch has been activated. The axis has been brought to a standstill with the error response "Set velocity command value to zero."

Cause:

The positive travel limit switch has been detected.

Remedy:

1. Reset the error.
2. Turn the power supply back on.
3. Move the axis into the permissible travel range.

Note: Command values which would move the axis outside the permissible range are not accepted, and this error message is generated again.

F643 - Attributes

SS display: F6/43

Message no.: F643 (hex)

Error no.: 643

Class: No. 1

F644 Negative travel limit switch detected

The negative travel limit switch has been activated. The axis has been brought to a standstill with the error response "Set velocity command value to zero."

Cause:

The negative travel limit switch has been activated.

Remedy:

1. Reset the error.
2. Turn the power supply back on.
3. Move the axis into the permissible travel range.

Note: Command values which would move the axis outside the permissible range are not accepted, and this error message is generated again.

F644 - Attributes

SS display:	F6/44
Message no.:	F644 (hex)
Error no.:	644
Class:	Travel range

F822 Encoder 1 failure: Signal amplitude wrong

The analog signals of a position measurement system are used for high-resolution analysis of that measurement system. These signals are monitored according to two criteria:

1. The pointer length, determined from the sine and cosine signals, must be greater than 1 V.
2. The maximum pointer length resulting from the sine and cosine signals must not exceed 11.8 V.

$$\boxed{Pointer\ Length = \sqrt{\sin^2 + \cos^2}}$$

Fig. 11-6: : Pointer Length

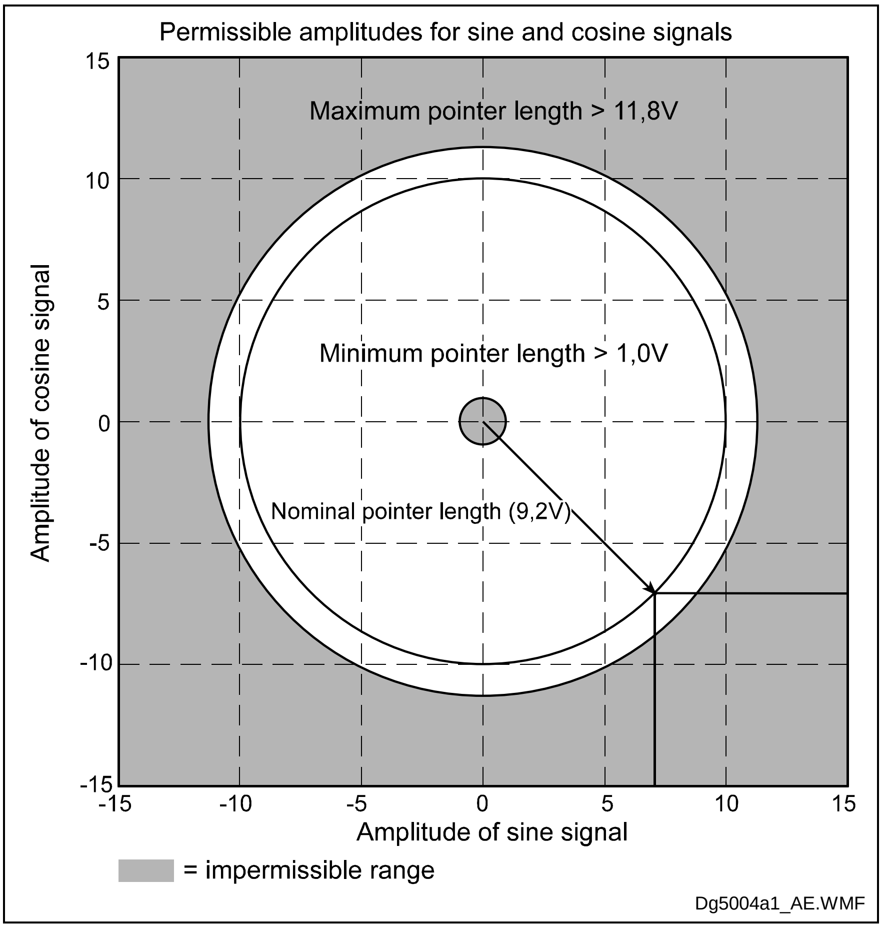


Fig. 11-7: Correct Signal Amplitude

Example:

Ucos = -6.5V

Usin = 6.5V

$$Pointer\ Length = \sqrt{(-6{,}5V)^2 + (6{,}5V)^2} = 9{,}2V$$

Note: The error cannot be cleared in the (manual/automatic) operating mode. Switch to parameter mode before clearing the error.

Causes:

1. Defective encoder **cable**
2. **Disruption** of feedback signal transmission
3. Defective **encoder**

Remedy:

1. Check the measurement system cable.
2. Keep the cable well away from motor power cables . Shielding must be placed on the drive controller.
3. Check the measurement system and replace if necessary.

F822 - Attributes

SS display:	F8/22
Message no.:	F822 (hex)
Error no.:	822
Class:	Fatal

F860 Overcurrent: short in power stage

The current in the power transistor bridge is more than twice as high as the equipment's peak current. The drive is immediately switched to a torque-free state. An optional holding brake, if present, engages immediately.

Cause:

1. Short circuit in motor cable
2. Defective power section of the drive controller
3. The current-loop parameters were set incorrectly.

Remedy:

For 1. Check motor cable for short circuit.

For 2. Replace the drive controller.

For 3. The current-loop parameters must not deviate from the initial values received from the encoder.

F860 - Attributes

SS display:	F8/60
Message no.:	F860 (hex)
Error no.:	860
Class:	Fatal

F870 +24Volt DC error

The drive controller requires a 24-V control voltage. The drive is immediately switched to a torque-free state when the maximum permissible tolerance of +-20% is exceeded. An optional holding brake, if present, engages immediately.

Cause:

1. Defective **cable** for the control voltages.
2. 24-V power supply **overload**.
3. Defective power **supply unit**.
4. **Short-circuit** in the emergency stop circuit.

Remedy:

For 1. Check cables for control voltages and/or connections and replace if necessary.

For 2. Check the 24-V supply voltage at the power supply unit.

For 3. Check the power supply unit.

For 4. Check the emergency stop circuit for a short-circuit.

Note: The error can be reset only in Parameter Mode. As a result of this error, the encoder emulation is switched off.

F870 - Attributes

SS display:	F8/70
Message no.:	F870 (hex)
Error no.:	870
Class:	Fatal

F873 Power supply driver stages fault

The power supply for the driver stages is monitored. If the voltage is too low, the drive is turned off.

Cause:

The voltage supplied to the driver stages is too low.

Remedy:

Replace drive controller.

F873 - Attributes

SS display:	F8/73
Message no.:	F873 (hex)
Error no.:	873
Class:	Fatal

F878 Velocity loop error

The velocity loop monitoring function is activated when the following conditions occur simultaneously:

- The current command value is at the peak current limit.
- The difference between the actual velocity and the target velocity is more than 10% of the maximum motor velocity.
- Actual velocity > 1.25% of the maximum velocity
- Target and actual acceleration values have different operational (+/-) signs.

Cause:

1. Motor cable is connected incorrectly.
2. Power circuit of the drive controller defective.
3. Defective encoder.
4. Velocity loop parameters set incorrectly.
5. Incorrect commutation offset.

Remedy:

For 1. Check motor cable connection.

For 2. Replace the drive controller.

For 3. Replace the motor.

For 4. Check the velocity loop to see whether it is within operational parameters.

For 5. Replace the motor.

F878 - Attributes

SS display:	F8/78
Message no.:	F878 (hex)
Error no.:	878
Class:	Fatal

F895 4-kHz signal wrong

The 4-kHz signal for generating the resolver signals is synchronized with the processing of the software. This error message is generated if there is a lack of synchronization.

Cause:

1. The error can be caused by an electrostatic discharge.
2. Synchronization between the resolver excitation voltage and the software is not correct.

Remedy:

For 1. Turn everything off and then on again. If this does not solve the problem: Replace the drive controller and send the old one in for inspection

For 2. Replace the drive controller and send the old one in for inspection.

F895 - Attributes

SS display:	F8/95
Message no.:	F895 (hex)
Error no.:	895
Class:	Fatal

11.2 Diagnostic Warning Messages

E221 Warning, Motor temp. surveillance defective

The temperature monitoring system checks to see if the measured motor temperature is within reasonable bounds. If it finds that the temperature is lower than -10°C, then it is assumed that the measuring unit is defective. The warning message **E221 Warning, Motor temp. surveillance defective** will appear for 30 seconds. Afterwards the drive is brought to a standstill according to the selected error response and message **F221 Error, motor temp. surveillance defective** will be generated.

Cause:

1. Motor temperature sensor not connected.
2. Broken cable.
3. Defective sensor.
4. Broken cable in drive controller.

Remedy:

For 1. Connect the sensor to the drive controller and to the motor (see project planning specifications for the motor).

For 2. Replace the lead between the drive controller and the motor.

For 3. Replace the motor.

For 4. Replace the drive controller.

E221 - Attributes

SS display:	E2/21
Message no.:	E221 (hex)
Class:	Non-fatal

E225 Motor overload

The maximum possible motor current is reduced in order to prevent damage to the motor.

If the current flowing in the motor is more than 2.2 times the **Motor current at standstill, Parameter CM02**, the maximum possible motor current (**Motor peak current, Parameter CM02**) is reduced. The reduction begins after 400 ms at 4 times the motor current at standstill. At 5 times the current, it begins earlier; at 3 times the current, later.

If the limitation causes the motor peak current to be reduced, the **E225 Motor overload** warning is issued.

E225 - Attributes

SS display:	E2/25
Message no.:	E225 (hex)
Class:	Non-fatal

E250 Drive overtemp. prewarning

The temperature of the heatsink in the drive controller has reached the maximum permissible temperature. The drive controller complies with the command value input for a period of 30 seconds. This makes it possible to bring the axis to a standstill via the control system without disruption of the process (e.g., close the operation, leave the collision area, etc.).

After 30 seconds, the response set in parameter **Parameter A119, Best possible halt** will be performed by the drive controller.

Cause:

1. Failure of the drive's internal blower.
2. Failure of the control cabinet's climate control.
3. Incorrect control cabinet sizing in regards to heat dissipation.

Remedy:

For 1. If the blower fails, replace the drive controller.

For 2. Restore climate control feature in the cabinet.

For 3. Check the sizing of the control cabinet.

E250 - Attributes

SS display:	E2/50
Message no.:	E250 (hex)
Class:	Non-fatal

E251 Motor overtemp. prewarning

As soon as the temperature **warning threshold** (145°C) is exceeded, the E251 warning is output, and the drive continues to follow the setpoint specification.

This state can last for a long time without the drive powering down. Only when the temperature **error threshold** is exceeded, will the drive immediately power down.

See also **F219 Motor overtemp. shutdown**.

Cause:

The motor is overloaded. The effective torque required by the motor has been above its allowable continuous torque level at standstill for too long.

Remedy:

Check the motor rating. For systems which have been in use for a long time, check to see if the drive conditions have changed (in regards to contamination, friction, moving components, etc).

E251 - Attributes

SS display:	E2/51
Message no.:	E251 (hex)
Class:	Non-fatal

E252 Bleeder overload prewarning

Cause:

The braking resistor (bleeder) in the drive controller is charged with regenerative energy from the motor by about 90%. The bleeder overload prewarning indicates that an overload of the bleeder is expected if the regenerative energy continues to increase.

Remedy:

Reduce the acceleration values or velocity and check the drive rating if necessary.

E252 - Attributes

SS display:	E2/52
Message no.:	E252 (hex)
Class:	Non-fatal

E256 Torque limit = 0

Cause:

1. For protection against mechanical overloading, the MOM command can be used to limit the maximum torque. If the current value is equal to 0, the motor does not develop torque and does not comply with the stipulated command values.
2. Torque reduction is set via an analog channel, and the applied voltage amounts to 10 V.

Remedy:

For 1. Set the torque limit to a value greater than 0.

For 2. Apply an analog voltage of less than 10 V.

E256 - Attributes

SS display:	E2/56
Message no.:	E256 (hex)
Class:	Non-fatal

E257 Continuous current limit active

The drive controller supplies peak current for 400 ms. Afterward, the continuous current limit becomes active and dynamically limits the peak current until it reaches the value of the continuous current.

Cause:

More continuous torque was required than was available.

Remedy:

1. Check the drive rating.
2. For systems which have been in use for a long time, check to see whether the drive conditions have changed with regard to

- contamination
- friction
- moved mass

E257 - Attributes

SS display:	E2/57
Message no.:	E257 (hex)
Class:	Non-fatal

E259 Command velocity limit active

The velocity command value is limited to the value present in **Parameter A106, Maximum Speed**.

Cause:

Parameter A106, Maximum Speed set too low.

Remedy:

Check parameter and program.

E259 - Attributes

SS display:	E2/59
Message no.:	E259 (hex)
Class:	Non-fatal

E261 Continuous current limit prewarning

Digital drives are monitored via a continually operating temperature model. Continuous current limiting is activated shortly after the thermal load capacity reaches 100%.

At 90%, the continuous-current-limiting prewarning is issued prior to this torque reduction.

Cause:

The drive controller was overloaded.

Remedy:

1. Check the amplifier rating.
2. Reduce acceleration.
3. With systems which have been in use for long periods of time, check to see if drive controller conditions have changed in regards to:
   - friction
   - moved mass
   - feed during processing.

E261 - Attributes

SS display:	E2/61
Message no.:	E261 (hex)
Class:	Non-fatal

E263 Velocity command value > limit A106

Cause:

The **maximum velocity** stipulated was greater than the permissible value.

Remedy:

The value is limited to that given in **Parameter A106, Maximum Speed**.

E263 - Attributes

SS display:	E2/63
Message no.:	E263 (hex)
Class:	Non-fatal

E300 Processor watchdog timer

The processor in the drive controller is equipped with a **watchdog timer**. The processor must regularly signal it internally.

What has happened?

The watchdog timer has timed out without receiving a signal from the processor. Reliable running of the firmware program is no longer assured.

Cause:

An **overload** or a serious error in the **firmware** has caused the processor to no longer service interrupts.

Remedy:

Please contact Rexroth-INDRAMAT Customer Service. Explain precisely under what circumstances the error occurred. The firmware should be replaced.

E300 - Attributes

SS display:	E3
Message no.:	E300 (hex)
Class:	Fatal

E825 Overvoltage in power stage

The **DC bus voltage** is too high.

Cause:

1. During **braking** (decelerating): the regenerative energy received from the machine mechanism via the motor was briefly so high that the bleeder resistor was unable to convert enough of it to heat. The regenerative current could not be bled off and therefore charged the DC bus, causing the voltage on the bus to get too high.
2. The **supply voltage** (AC voltage input) is too high.

Result:

If an overvoltage is present, the motor is switched to a **torque-free** state. Once the DC bus voltage again drops below the maximum allowable value, the controller will again be switched on.

Remedy:

For 1. Reduce the **acceleration** values. Check the drive rating if necessary.
Install an additional bleeder if necessary.

For 2. Check the **supply voltage** (AC voltage/3phase).

WARNING

Danger! High voltage!
Protect against accidental contact.

E825 - Attributes

SS display: E8/25

Message no.: E825 (hex)

Class: Fatal

E826 Undervoltage in power section

Undervoltage is handled as a "fatal warning“ and the motor is switched off. If the drive enable signal is present and the DC bus voltage status signal is lost, the drive displays this warning.

Cause:

Power supply unit is switched off or power grid failure occurs when the drive enable signal is set.

Remedy:

Switch off the drive enable signal before switching off the power supply unit.

E826 - Attributes

SS display: E8/26

Message no.: E826 (hex)

Class: Fatal

11.3 Command Diagnostic Messages

C100 Communication phase 3 transition check

The **C100 Communication phase 3 transition check** command has been activated.

C100 - Attributes

SS display: C1

Message no.: C100 (hex)

C200 Communication phase 4 transition check

Definition

The **C200 Communication phase 4 transition check** command has been activated.

C200 - Attributes

SS display: C2

Message no.: C200 (hex)

C201 Invalid parameter(s)

Cause:

Parameters needed to operate the drive in communications phase 4 (operating mode) are invalid.

Remedy:

- Check parameters and make corrections
- Turn unit off and on
- Check for correct firmware

C201 - Attributes

SS display: C2/01

Message no.: C201 (hex)

Class: Command error

C202 Parameter limit error

Cause:

Parameters needed to operate the drive in communications phase 4 mode (manual/automatic) exceed the minimum or maximum input values, or the entered value cannot be processed.

Remedy:

- Check parameters and make corrections
- Check for correct firmware
- Turn off and then on again. If this does not solve the problem:
- Replace the unit.

C202 - Attributes

SS display: C2/02

Message no.: C202 (hex)

Class: Command error

C203 Parameter calculation error

Cause:

Parameters needed for phase 4 (operating mode) cannot be processed as they are.

Remedy:

- Check parameters and make corrections
- Check for correct firmware
- Turn off and then on again. If this does not solve the problem:
- Replace the unit.

C203 - Attributes

SS display: C2/03

Message no.: C203 (hex)

Class: Command error

C204 Motor type P-0-4014 incorrect

An MHD, MKD or MKE motor is installed, however the corresponding abbreviation ("MHD," "MKD" or "MKE") was not found in the motor feedback memory.

Cause:

1. Incorrect parameter set for type of motor.
2. The motor feedback memory cannot be read.

Remedy:

For 1. Enter the correct motor type in **Parameter CM00, Motor type**.

For 2. Check encoder feedback connection. If encoder is defective, replace motor.

C204 - Attributes

SS display: C2/04

Message no.: C204 (hex)

Class: Command error

C207 Load error LCA

Cause:

Defective unit.

Remedy:

1. Turn off and then on again. If this does not solve the problem:
2. Replace the unit.

C207 - Attributes

SS display: C2/07

Message no.: C207 (hex)

Class: Command error

C210 Feedback 2 required

Cause:

Values were entered in **Parameter A100, Application type** which make an optional encoder necessary. However, a 0 (for not available) is entered in **Parameter C004, Interface Fbk. device 2**.

Remedy:

- Correct **Parameter A100, Application type**
- Correct **Parameter C004, Interface Fbk. device 2**

C210 - Attributes

SS display: C2/10

Message no.: C210 (hex)

Class: Command error

C211 Invalid feedback data

Invalid data have been encountered when the parameters stored in the motor feedback memory were read, or an error has occurred when the data were read.

Causes:

1. Motor feedback cable not connected or defective
2. Motor encoder defective
3. Drive controller defective

Remedy:

For 1. Check motor feedback cable; connect both ends

For 2. Replace the motor.

For 3. Replace amplifier

C211 - Attributes

SS display:	C2/11
Message no.:	C211 (hex)
Class:	Command error

C212 Invalid amplifier data

During drive initialization, the operating software accesses data from an EEPROM in the drive controller. This error message is generated if the attempt to read the data has failed.

Cause:

Defective hardware in the drive controller.

Remedy:

Replace the drive controller.

C212 - Attributes

SS display:	C2/12
Message no.:	C212 (hex)
Class:	Command error

C213 Position data scaling error

Cause:

The drive-internal format of the position data is dependent on the motor encoder and the encoder resolution. The factor for converting the position data from the drive-internal format to the display format and vice versa is outside of the possible range, because one of the following is true:

- linear motor and rotary position scaling with respect to the motor, or
- rotary motor and linear position scaling with respect to the motor, or
- linear motor and modulo scaling is set, OR
- the detected factor for converting the position data from display format to internal format or vice versa is not displayable.

Remedy:

- Check parameters and make corrections.
- Check for correct firmware.

- Turn off and then on again. If this does not solve the problem:
- Replace the unit.

C213 - Attributes

SS display: C2/13
Message no.: C213 (hex)
Class: Command error

C214 Velocity data scaling error

Cause:

The drive-internal format of the velocity data is dependent on the motor encoder and the encoder resolution. The factor for converting the velocity data from the drive-internal format to the display format and vice versa is outside of the possible range.

Remedy:

- Check parameters and make corrections.
- Check for correct firmware.
- Turn off and then on again. If this does not solve the problem:
- Replace the unit.

C214 - Attributes

SS display: C2/14
Message no.: C214 (hex)
Class: Command error

C215 Acceleration data scaling error

Cause:

The drive-internal format of the acceleration data is dependent on the motor encoder and the encoder resolution. The factor for converting the acceleration data from the drive-internal format to the display format and vice versa is outside of the possible range.

Remedy:

- Check parameters and make corrections.
- Check for correct firmware.
- Turn off and then on again. If this does not solve the problem:
- Replace the unit.

C215 - Attributes

SS display: C2/15
Message no.: C215 (hex)
Class: Command error

C216 Torque/force data scaling error

Cause:

The factor for converting the torque/force data from the drive-internal format to the display format and vice versa is outside of the possible range.

Remedy:

- Check parameters and make corrections.
- Check for correct firmware.
- Turn off and then on again. If this does not solve the problem:
- Replace the unit.

C216 - Attributes

SS display:	C2/16
Message no.:	C216 (hex)
Class:	Command error

C217 Feedback 1 data reading error

All MKD and MHD motors have a feedback memory. From this memory, the settings for the encoder are read.

Cause:

An error has occurred while the values from the feedback memory were being read.

Remedy:

Check feedback cable.

Replace the motor.

C217 - Attributes

SS display:	C2/17
Message no.:	C217 (hex)
Class:	Command error

C218 Feedback 2 data reading error

If the measurement system to be initialized has an intrinsic memory, this memory is read when the manual/automatic operating mode is switched on. The **C218 Feedback 2 data reading error** error message is generated if an additional optional encoder (encoder 2) is present and being evaluated (**Parameter C004, Interface, Fbk. device 2** is not set to 0), and if an error is discovered while reading the data.

Measurement systems with intrinsic data memory are :

- DSF/HSF/LSF and resolvers, as well as
- measurement systems with the EnDat interface (from Heidenhain)

Cause:

1. Defective measurement system cable.
2. Defective measurement system.

Remedy:

For 1. Check the measurement system cable.

For 2. Replace the measurement system.

C218 - Attributes

SS display: C2/18

Message no.: C218 (hex)

Class: Command error

C220 Feedback 1 initializing error

A number of tests are performed when the motor encoder is initialized. An error was detected during this process. This error may be:

- an error reading the angle rectification data
- an error copying the angle rectification data
- interruption of communications with the encoder
- an assembly error regarding the position of an initialization track
- an error reading the analog signals of an initialization track
- an error in the pointer length for the analog signals of an initialization track
- an invalid offset between the high- and low-resolution tracks
- an error in the measurement system micro-controller

Cause:

1. Defective motor feedback **cable**.
2. Motor encoder defective.
3. Defective measurement system interface.

Remedy:

For 1. Check the motor feedback cable.

For 2. Replace the motor.

For 3. Replace the measurement system interface if it is a module, or else the complete drive controller.

C220 - Attributes

Message no.: C220 (hex)

Class: Command error

C221 Feedback 2 initializing error

Several checks are performed during the initialization of an optional encoder. An error was detected during this process. This error may be:

- an error reading the angle rectification data
- an error copying the angle rectification data
- interruption of communications with the encoder
- an assembly error regarding the position of an initialization track
- an error reading the analog signals of an initialization track
- an error in the pointer length for the analog signals of an initialization track
- an invalid offset between the high- and low-resolution tracks
- an error in the measurement system micro-controller
- with DAG 1.2: error, external 24V set for SSI interface

Cause:

1. opt. Defective encoder cable
2. Defective encoder
3. Defective measurement system interface

Remedy:

For 1. opt. Check encoder cable.

For 2. Replace encoder.

For 3. Replace the measurement system interface (module).

C221 - Attributes

SS display: C2/21

Message no.: C221 (hex)

Class: Command error

C223 Input value for max. range too high

Cause:

An internal position resolution was set which no longer ensures correct commutation of the motor.

Remedy:

- Check parameters and make corrections.
- Check for correct firmware.
- Turn off and then on again. If this does not solve the problem:
- Replace the unit.

C223 - Attributes

SS display: C2/23

Message no.: C223 (hex)

Class: Command error

C227 Modulo range error

Cause:

The modulo value entered is larger than half of the position display range of the drive.

Remedy:

Select a smaller modulo value, Parameter A105.

C227 - Attributes

SS display:	C2/27
Message no.:	C227 (hex)
Class:	Command error

C228 Wrong controller type

In preparing for the communications phase 4 transition check, first check whether the heat-sink temperature model data stored in the resident memory of the amplifier are valid. If an error is detected, the drive responds with the error message **C228 Wrong controller type**.

Cause:

Amplifier EEPROM defective.

Remedy:

Replace/repair controller.

C228 - Attributes

SS display:	C2/28
Message no.:	C228 (hex)
Class:	Command error

C234 Encoder combination not possible

Cause:

The encoder interface that has been selected in **Parameter C004, Optional encoder interface** cannot be supported by the drive; since it has already been allocated to the motor encoder.

Remedy:

Select another **optional** encoder.

C234 - Attributes

SS display:	C2/34
Message no.:	C234 (hex)
Class:	Command error

C235 Load-side motor encoder with inductance motor only

Cause:

The functionality of the optional encoder can be defined in **Parameter A100, Application type**. If 'load-side motor encoder' has been selected as the function of the optional encoder, that function will be supported only for asynchronous motors.

Remedy:

Set **Parameter CM00, Motor type** in accordance with the type of motor used.

Check **Parameter A100, Application type**.

C235 - Attributes

SS display:	C2/35
Message no.:	C235 (hex)
Class:	Command error

C236 Feedback 1 required

Cause:

If a load-side motor encoder was set in **Parameter A100, Application type,** no motor encoder is required **(Parameter C001** = 0). However, values have been entered in the **Homing parameter** which do require a motor encoder.

Remedy:

Change **Homing parameter** to reflect use of the optional encoder.

Activate the motor encoder by entering a value other than 0 in **Parameter C001, Interface fbk. device 1**.

C236 - Attributes

SS display:	C2/36
Message no.:	C236 (hex)
Class:	Command error

C300 Command set absolute measuring

The **Set absolute dimension** function was activated via **Parameter C010, Reference**.

C300 - Attributes

SS display:	C3
Message no.:	C300 (hex)

C301 Setting absolute encoder not possible when RF set

Cause:

The “C3 Command, set absolute dimension emulator“ was initiated in response to the current drive enable signal.

Remedy:

Terminate the command and deactivate the drive enable signal.

C301 - Attributes

SS display:	C3/01
Message no.:	C301 (hex)
Class:	Command error

C302 Absolute measuring system not installed

The command in **Parameter C010, Reference "Set absolute dimension"** was initiated with no absolute measurement system installed.

The command can be executed only if an absolute measurement system is installed.

Cause:

1. The command should not have been activated.
2. The connected motor or the optional measurement system is not implemented as an absolute encoder.

Remedy:

For 1. Stop execution of the command.

For 2. Equip the motor or optional measurement system with an absolute encoder function.

C302 - Attributes

SS display: C3/02

Message no.: C302 (hex)

Class: Command error

C400 Switching to Parameter Mode

Parameters can be written only in Parameter Mode, so switch to Parameter Mode prior to editing parameters.

C400 - Attributes

SS display: C4

Message no.: C400 (hex)

C500 Reset class 1 diagnostic, error reset

The input for clearing the errors was activated. All drive internal errors are cleared. However, the cause of the errors must first have been eliminated.

C500 - Attributes

SS display: C5

Message no.: C500 (hex)

C600 Drive-controlled homing procedure command

The **homing command** is activated via a command or an input.

See also functional description for: "Homing"

C600 - Attributes

SS display: C6

Message no.: C600 (hex)

C601 Homing only possible with drive enable

Cause:

The drive enable signal was not active when the **drive-controlled homing command** was initiated. This is not permitted.

Remedy:

1. Switch on the drive enable signal.
2. Initiate the command again.

See also functional description for: "Homing"

C601 - Attributes

SS display: C6/01

Message no.: C601 (hex)

Class: Command error

C602 Distance home switch – reference mark erroneous

Cause:

Evaluation of the home switch signal has been activated. The distance between the positive edge of the home-switch signal and the reference mark to be interpreted is outside the valid range.

Remedy:

Change the value in **Parameter C012, Reference switch**.

See also functional description for: "Configuration of the home switch"

C602 - Attributes

SS display: C6/02

Message no.: C602 (hex)

Class: Command error

C604 Homing of absolute encoder not possible

Cause:

With the absolute encoder, this error cancels the homing command if it was invoked without having first executed the command in **Parameter C010, Set absolute dimension**.

If the encoder was homed using the "**Set absolute dimension**" command, the homing command can be used to initiate a return to the reference point.

Remedy:

Home the absolute encoder using the **"Set absolute dimension"** command.

See also functional description for: "Possible error messages with drive-controlled homing."

C604 - Attributes

SS display:	C6/04
Message no.:	C604 (hex)
Class:	Command error

C605 Homing velocity too high

Cause:

If the velocity is too high, it is not possible to achieve precise coordination between a reference mark and the zero switch because the zero switch is only evaluated every 2 ms.

Remedy:

Reduce **Parameter C009, Reference speed**.

See also functional description for: "Homing"

C605 - Attributes

SS display:	C6/05
Message no.:	C605 (hex)
Class:	Command error

C700 Basic load

With motors of the MHD, MKD and MKE series, activating the controller parameters stored in the motor feedback memory sets the default parameters in the controller for the connected motor. The C7 message signals the drive controller that the C700 “Basic load” command has been activated.

Cause:

The **C700 Basic load** command has been activated.

C700 - Attributes

SS display:	C7
Message no.:	C700 (hex)

C701 Basic load not possible with drive enable

Cause:

Basic load cannot be executed if the drive enable function is set.

Remedy:

1. Turn off drive enable.
2. Reinitiate command.

See also functional description for: "Causes of error in executing the 'Basic load' function"

C701 - Attributes

SS display:	C7/01
Message no.:	C701 (hex)
Class:	Command error

C702 Default parameters not available

With motors of the MHD, MKD and MKE series, the control loops are adapted to the connected digital drive by activating the speed controller parameters stored in the motor feedback memory. Via message C702, the drive controller signals that "**Basic load"** has been activated; however, **no data memory** is present in the connected motor.

Remedy:

Order the parameter sheet for the motor from REXROTH INDRAMAT Customer Service, and enter the parameters.

C702 - Attributes

SS display:	C7/02
Message no.:	C702 (hex)
Class:	Command error

C703 Default parameters invalid

Cause:

The default parameters are read from the motor feedback memory. At least one of these parameters is invalid.

Remedy:

Check the connection to the motor feedback memory. Replace the motor if necessary.

C703 - Attributes

SS display:	C7/03
Message no.:	C703 (hex)
Class:	Command error

C704 Parameters not copyable

Cause:

The existing default parameters are not compatible with this software version.

Remedy:

Please contact Indramat. Explain which software version, which device and which motor type you have.

C704 - Attributes

SS display:	C7/04
Message no.:	C704 (hex)
Class:	Command error

C705 Locked with password

Set default parameters.

C705 - Attributes

SS display:	C7/05
Message no.:	C705 (hex)
Class:	Command error

C800 Default parameter load

Initiating the command:

This command can be initiated in 2 ways:

1. By pressing the **S1 key** when **"PL"** is displayed on the drive controller (appears after a change in firmware version).
2. By initiating the **C8 Load basic parameters command** via the serial interface

Result:

All the **parameters** are cleared and preset with their respective default (initial) values. Positioning blocks and control loop settings are also **overwritten**.

See also functional description for: "Basic parameter load."

C800 - Attributes

SS display:	C8
Message no.:	C800 (hex)

C801 Parameter default value erroneous

Cause:

During execution of the **C800 Command, Load basic parameters,** a default value stored in the drive was recognized as incorrect.

C801 - Attributes

SS display:	C8/01
Message no.:	C801 (hex)
Class:	Command error

C802 Locked with password

Remedy:

Load basic parameters.

See also Section 3: "System Startup"

C802 - Attributes

SS display:	C8/02
Message no.:	C802 (hex)
Class:	Command error

D300 Command adjust commutation

A correctly adjusted commutation offset is mandatory for the operation of synchronous motors. The "D3“ message indicates that the command for determining the commutation offset has been activated.

Cause:

The adjust commutation command has been activated.

D300 - Attributes

SS display:	d3
Message no.:	D300 (hex)

D301 Drive not ready for commutation command

Cause in linear motors:

No drive enable signal can be present when the command is initiated, however, it must be present in communications phase 4 mode ("bb“ or "Ab“ is displayed).

Cause in rotary synchronous motors:

The drive must be in torque mode when the "D3“ command is initiated.

If these conditions are not met, this error message is generated.

Remedy for linear motors:

Depending on the motor type, turn off the drive enable signal and initiate the command again.

Remedy for rotary synchronous motors:

Activate torque mode and initiate the command again.

D301 - Attributes

SS display:	d3/01
Message no.:	D301 (hex)
Class:	Command error

D302 Torque/Force too small to move

The command **D3 Command adjust commutation** has been started. For this to occur, the **motor must be moving**. However, it is not moving.

Cause:

1. The torque is too small to overcome the mechanical resistance (friction or weight load).
2. The motor is mechanically **locked**.

Remedy:

1. Raise the value of **CM01 torque/force limit value** until the motor can overcome the mechanical resistance and turn.
2. Release pinched cables/wires. If necessary, also check the brake.

D302 - Attributes

SS display: d3/02

Message no.: D302 (hex)

Class: Command error

D500 Command Get mark position

An unknown command was invoked.

Cause:

Firmware malfunction.

D500 - Attributes

SS display: d5

Message no.: D500 (hex)

D501 Incremental encoder required

An unknown command was invoked.

Cause:

Firmware malfunction.

D501 - Attributes

SS display: d5/01

Message no.: D501 (hex)

Class: Command error

11.4 Diagnostic Status Messages

A002 Communication phase 2

Parameter Mode.

A002 - Attributes

SS display: P2

Message no.: A002 (hex)

A003 Communication phase 3

Preparation for communications phase 4 (manual/automatic)

A003 - Attributes

SS display: P3

Message no.: A003 (hex)

A010 Drive HALT.

The input Drive HALT is for stopping an axis using a defined **acceleration** and a defined **jerk**.

A010 - Attributes

SS display: AH

Message no.: A010 (hex)

A012 Control and power sections ready for operation.

The drive is supplied with control voltage, and the power is on. The drive is ready to have the power turned on.

A012 - Attributes

SS display: Ab

Message no.: A012 (hex)

A013 Ready for power on

The drive is supplied with control voltage, and there are no errors on the drive. The drive is ready to have the power turned on.

See also functional description for: "Parameter Mode - Operating Mode."

A013 - Attributes

SS display: bb

Message no.: A013 (hex)

A102 Position mode with encoder 1

The drive is in **position control mode**. Within the drive, the position control loop is closed via a position encoder. The control system only sets the position command value sequence; the drive complies with the command value with a systematic **lag** (following error).

Encoder 1 indicates that the position encoder is installed on the motor shaft (indirect measurement of the axis position).

See also functional description for: “Position control."

A102 - Attributes

SS display: AF

Message no.: A102 (hex)

A103 Position mode with encoder 2

The drive is in **position control mode**. Within the drive, the position control loop is closed via a position encoder. The control system only sets the position command value sequence; the drive complies with the command value with a systematic **lag** (following error).

Encoder 2 indicates that the position encoder is installed on the machine axis (direct axis position measurement).

A103 - Attributes

SS display: Diag. mess. name: AF

Message no.: A103 (hex)

A104 Position mode without position lag (following error), encoder 1

The drive is in **position control mode**. Within the drive, the position control loop is closed via a position encoder. The control system only sets the position command value sequence; the drive complies with the command value without a systematic **lag** (following error).

Encoder 1 indicates that the position encoder is installed on the motor shaft (indirect measurement of the axis position).

A104 - Attributes

SS display: AF

Message no.: A104 (hex)

A105 Position mode without lag, encoder 2

The drive is in **position control mode**. Within the drive, the position control loop is closed via a position encoder. The control system only sets the position command value sequence; the drive complies with the command value without a systematic **lag** (following error).

Encoder 2 indicates that the position encoder is installed on the machine axis (direct axis position measurement).

A105 - Attributes

SS display: AF

Message no.: A105 (hex)

A800 Unknown operating mode

No diagnostic messages exist for the active operating mode.

A800 - Attributes

SS display: AF

Message no.: A800 (hex)

11.5 Diagnostic Messages for Basic Initialization and Fatal System Errors

Diagnostic Message Display: -0

The writable **data storage** area of the drive controller is tested for functionality.

Diagnostic Message Display: -1

- The hardware of the amplifier is being initialized.

Diagnostic Message Display: -2

Cause:

The control voltage of the encoder power supply is not present.

Remedy:

Replace the hardware.

Diagnostic Message Display: -3

Initialization of the parameters retrieved from NovRam and calculation of the relevant data depending on the parameter content.

Diagnostic Message Display: -4

Initializing and testing of command communications.

Diagnostic Message Display: -5

Initializing the system control.

Diagnostic Message Display: -6

Starting the system controls.

Diagnostic Message Display: Diagnostic Message Display: E1

Cause:

Processor fault caused by voltage surge, programming error or hardware fault. More information available via a terminal connected to the RS232 port.

Remedy:

Turn amplifier on and off. If error persists, replace hardware. In any case, inform Customer Service.

Diagnostic Message Display: Diagnostic Message Display: E2

Cause:

Test of the RAM on the programming module has shown an error.

RAM defective or programming module not properly seated.

Remedy:

Turn off, check connector and turn on again.

If the error message appears again, replace the firmware module.

Diagnostic Message Display: E3

Cause:

The 1st watchdog timer of the amplifier has been triggered in response to a hardware fault or a high-voltage discharge.

Remedy:

Turn amplifier off and then on again. If E3 recurs, replace amplifier. In any case, inform Customer Service.

Diagnostic Message Display: E4

Cause:

The 2nd watchdog timer of the amplifier has been triggered in response to a hardware fault or a high-voltage discharge.

Remedy:

Turn amplifier off and then on again. If E4 recurs, replace amplifier. In any case, inform Customer Service.

Diagnostic Message Display: E5

Cause:

Testing of the dual-port RAM for command communications has shown an error.

The command communications hardware may not be properly seated.

Remedy:

Check the connector; if OK, replace the amplifier.

11.6 Operation Status

The possible operating states are listed alphabetically below. These states are displayed on the H1 display of the unit.

bb

"Ready for operation"

See also: **A013 Ready for power on**

Ab

"Drive is ready"

See also diagnostic message: **A012 Control and power sections ready for operation**

AF

"Drive enable"

Depending on the operating state used, you will find a more exact description of the "AF" display under the respective diagnostic status message (A101 - A800).

AH

"Drive Halt"

See also: **A010 Drive HALT**

AU

“Automatic”

See also: **Automatic**
Diagnostic number : 0004

HA

“Manual”

See also: **Manual**
Diagnostic number : 0003

PA

"Parameter Mode"

See also: **Parameter**
Diagnostic number : 0002

Jb

"Jog negative"

See also:
A218 Jog negative
Diagnostic number :
0006

JF

"Jog positive"

See also: **A208 Jog positive**
Diagnostic number : 0005

P2

"Phase 2"

The control is in parameter mode and is checking the parameter data. The power cannot be switched on. See also status message A002.

P3

"Phase 3"

The control is transitioning from Phase 2 to Phase 4 (manual or automatic mode). See also status message A003.

P4

"Phase 4"

The control is in manual or automatic mode.

Normally, this display appears only very briefly.

PL

"Basic Parameter Load"

See also: **F209 PL Load parameter default values**

UL

"Basic Load"

See also: **F208 UL The motor type has changed**

F- 0300 Invalid I/O number in command instruction

F- 0301 Wrong I/O status in command

F- 0302 Command instruction number too large

F- 0304 Unknown command

F- 0305 Drive not homed to absolute value

F- 0306 Feed distance overrun

F- 0307 Data loss parameter

F- 0308 Drive message not sent

F- 0309 Master data message not processed

F- 0310 Input error in parameter

F- 0311 Stack correction value > 9

F- 0312 Acknowledgement of an initialization error and not in Parameter-Mode

F- 0313 Interval too great, BCB/BCD command

F- 0314 Instruction offset too large for BIC command

F- 0315 BCB command: Wrong selection

F- 0316 Field bus real-time communication interrupted

F- 0317 Field bus cyclic communication interrupted

F- 0318 Wrong axis number in NC command

F- 0319 NC cycle time exceeded

F- 0320 System error (firmware error)

F- 0321 Wrong axis number in NC command

F-0200 Parameter and automatic input simultaneously

F-0201 Wrong phase transition

F-0203 Target position < negative position limit

F- 0204 Target position > positive position limit

F- 0205 Stack overflow with JSR command

F- 0206 Stack overflow with RTS command

F- 0207 Invalid destination task number

F- 0208 Per mille value in ACC command > 999

F- 0209 Invalid value in FAK command

F- 0210 Feed monitoring

F- 0211 Torque > 500%

F- 0212 Program run without power

E- 0213 Max. difference between motor and measuring wheel encoder too large

F- 0214 Wrong BCD information

F- 0215 Wrong slave factor input

F- 0216 Per mille value in command > 999

F- 0217 HOM command not allowed

F- 0218 RTM command not allowed

F- 0219 Variable in NC command > permissible input value

F- 0220 Constant in NC command > permissible input value

F- 0221 Logic Task Program error

E- 0100 Velocity = 0

E- 0102 Both jog inputs read simultaneously

E- 0103 Hardware outputs overloaded

E- 0104 System control using BTV interrupted

E- 0105 Real-time communication with BTV interrupted

E- 0106 Jog reverse not possible

Negative position limit value exceeded

E- 0107 Jog forward not possible

Positive position limit value exceeded

E- 0108 IDS-01 timeout

A- 0007 Stop is active

A- 0008 Manual vector program is active

A- 0009 Function interrupt is active

11.7 Diagnostic-LED

LED for Parallelinterface

H211	H210	H213	Meaning
green	off	- -	ready
red	green	- -	Minor-error E-01xx
red	orange	- -	Soft-Fault F-02xx
red	red	- -	Hard-Fault F-03xx
- -	- -	off	no NC-Task are working
		orange blink	initialize System
		green blink	System is working

Fig. 11-1: Diagnostic LEDs for Parallelinterface

The LEDs H212, H214 and H215 have no function

Note: All LEDs are orange > 10second
The Firmware or the Hardwareare wrong

LEDs for PROFIBUS

There are four LEDs on the front of the fieldbus module used in fieldbus interface diagnoses. These signal the synchronization state between fieldbus interface and drive as well as the bus activity for cyclical data exchange.

LED designation	LED state	Definition
H30	ON	cyclical process data channel active
H31	Impulse	Parameter access
H32/H33	alt. flashing	fieldbus module and drive synchronized
H32/H33	steady flashing	fieldbus module and drive not synchronized
All LEDs	flashing regularly	severe error on fieldbus module; switch unit off and on

Fig. 11-2: Diagnostic LEDs for PROFIBUS X30

12 Connectors

12.1 DKC21.3

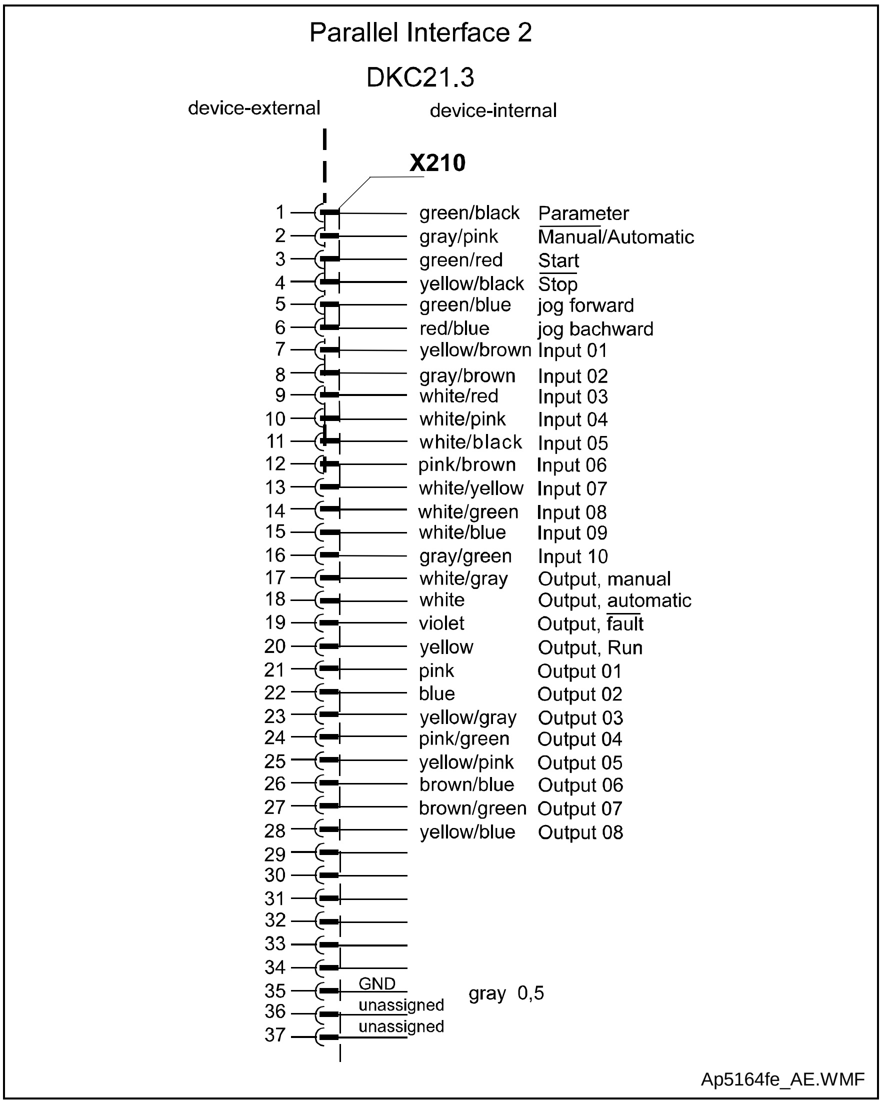


Fig. 12-1: X210 Connector for DKC21.3 with Cable Colors

Pin		Inputs:	Pin		Outputs
1	I0.00.0	Parameter	17	Q0.00.0	Manual
2	I0.00.1	Manual/Automatic	18	Q0.00.1	Automatic
3	I0.00.2	Start	19	Q0.00.2	Fault
4	I0.00.3	*Stop*	20	Q0.00.3	Run
5	I0.00.4	Jog forward	21	Q0.00.4	Output 1
6	I0.00.5	Jog reverse	22	Q0.00.5	Output 2
7	I0.00.6	Input 1	23	Q0.00.6	Output 3
8	I0.00.7	Input 2	24	Q0.00.7	Output 4
9	I0.01.0	Input 3	25	Q0.01.0	Output 5
10	I0.01.1	Input 4	26	Q0.01.1	Output 6
11	I0.01.2	Input 5	27	Q0.01.2	Output 7
12	I0.01.3	Input 6	28	Q0.01.3	Output 8
13	I0.01.4	Input 7			
14	I0.01.5	Input 8			
15	I0.01.6	Input 9			
16	I0.01.7	Input 10			

12.2 DKC21.3 and DKC3.3

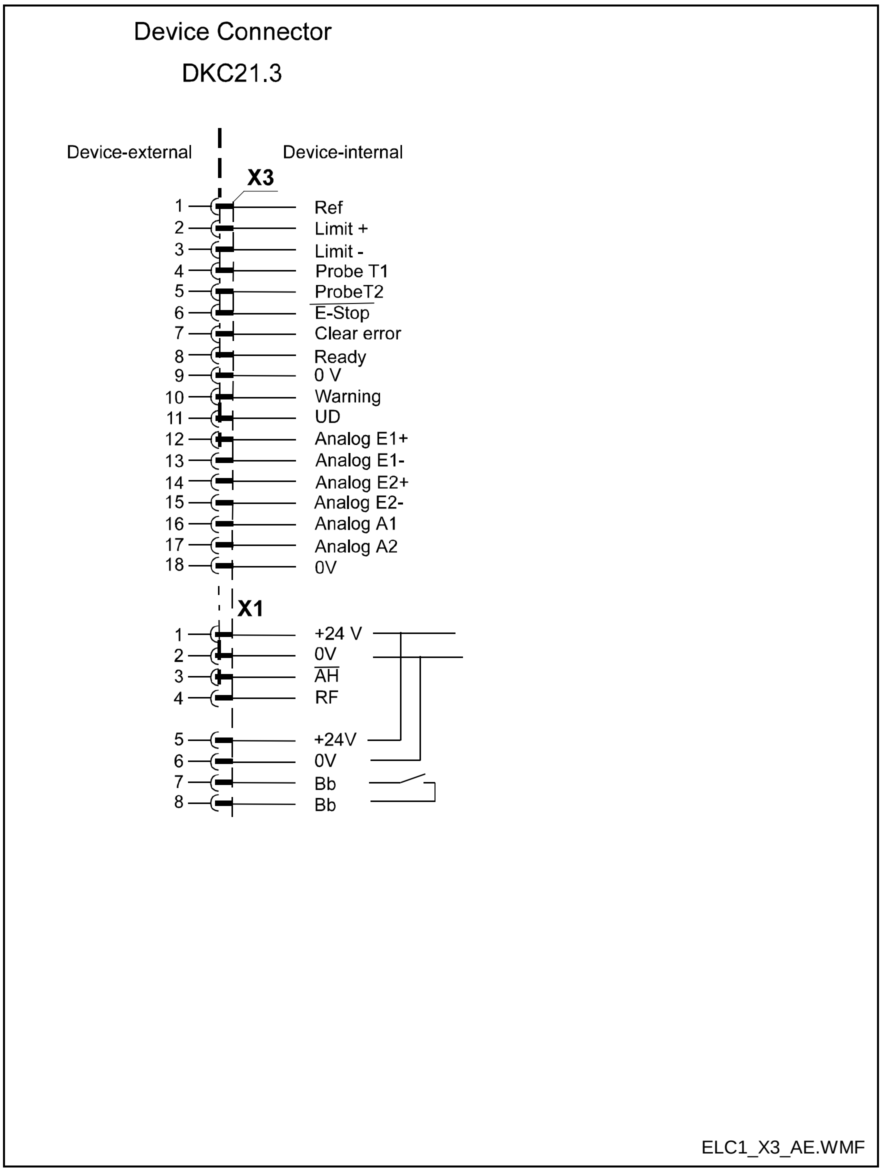


Fig. 12-2: X3 Connector

Assignment of Profibus Connector X30

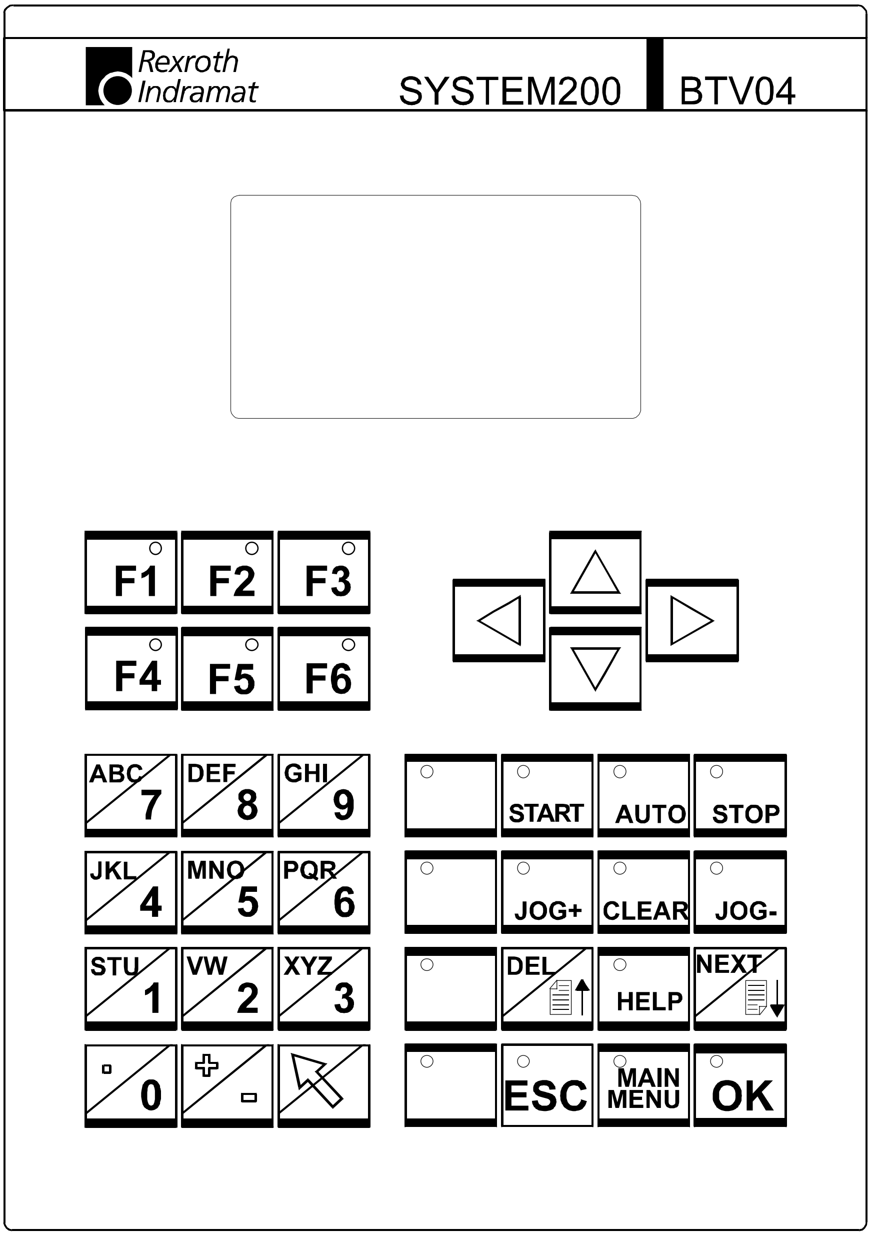
Signal Assignment for X30 Profibus Connector

X 30	RS 485 Reference	Rexroth Indramat Signal Name	Signal according to EN50170 Volume 2	Definition
1		PE	Shield	Shield or Protective Ground
2		unused		
3	B / B´	B	RxD / TxD-P	Receive/Transmit Data - P
4		CNTR-P	CNTR-P	Repeater – Control Signal P
5	C / C´	BUSGND	DGND	Data Ground
6		VP	VP	Supply Voltage –Plus (P5V)
7		unused		
8	A / A´	A	RxD / TxD-N	Receive/Transmit Data - N
9		CNTR-N	CNTR-N	Repeater – Control Signal N

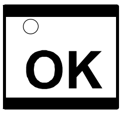
Fig. 12-3: X30 Signal Assignment. Profibus-DP

13 Display

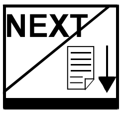
13.1 BTV04



BTV04 Key Descriptions



Store when programming NC or parameters

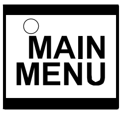


Scroll:

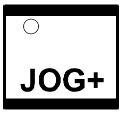
When this key is pressed, the instruction or parameter number which appears in the NC and parameter programming windows is incremented by one.

Next:

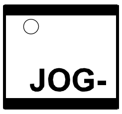
When this key is pressed, the next display block is flagged in the NC and parameter programming windows.



The program jumps immediately to the main menu.

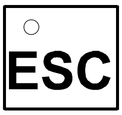


Jog forward



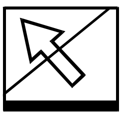
Jog reverse

Parameter help

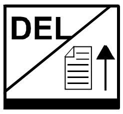


If data are changed, the changes can be canceled by pressing the ESC key.

Otherwise, the program jumps back one level in the menu.



Second key level (hold key down)

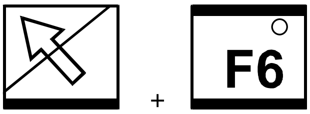


Scroll:

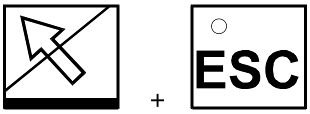
When this key is pressed, the instruction or parameter number which appears in the NC and parameter programming windows is decremented by one.

DEL:

No function

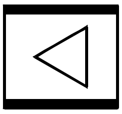


BTV04 Parameter Setup



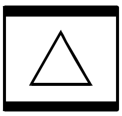
Resetting the BTV04

This function is equivalent to switching the BTV on again. The BTV04 parameters are not changed.



Move cursor down

The cursor moves to the left block by block and into a new line. If the entry block has a border around it, the cursor moves to the left character by character.



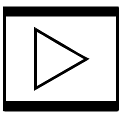
Cursor movement

Parameters:
If the cursor is positioned on the parameter block identifier, the preceding parameter block is invoked.

NC programming:

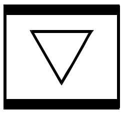
If the cursor is positioned on the command, the user can scroll through the commands. If the cursor is positioned at a position that can contain Q,M,I, the user can scroll through these letters.

In all other cases, the cursor jumps to the preceding line.



Cursor movement

The cursor moves to the right, character by character. A block which contains multiple characters is surrounded by a border.



Move cursor down

Parameters:
If the cursor is positioned on the parameter block identifier, the next parameter block is invoked.

NC programming:

If the cursor is positioned on the command, the user can scroll through the commands. If the cursor is positioned at a position that can contain Q,M,I, the user can scroll through these letters.

In all other cases the cursor jumps to the preceding line.

BTV04 Display Menu

- OK Main Menu
  - F1 Monitor Menu
    - F1 Position
    - F2 I/O Menu
      - F1 Inputs
      - F2 Outputs
    - F3 Counter
  - F2 Setup Menu
    - F1 NC Program
    - F2 Parameter
    - F3 Logic Task
    - F4 Variable
  - F3 Status Menu
    - F1 I/O/F Menu
      - F1 Inputs
      - F2 Outputs
      - F3 Flags
    - F2 Program Status
    - F3 Variable
    - F4 Miscellaneous
      - F1 Position Lag

Main Menu

```
  BTV04 ESA xxVxx

      ELC ADDRESS

           1


MAIN MENU          (OK)
```

The BTV04 uses an English interface when it is switched on. If either F1 or F2 is pressed, display specifications and texts in different languages are read from the DKC21.3 or DKC3.3.

The program then branches to the preselected function.

If the user moves back to the initial screen, it is displayed in the preselected language.

Initial screen in English

```
  BTV04 ESA xxVxx

      ELC ADDRESS

           1


MAIN MENU          (OK)
```

The software version number of the BTV04 is displayed in the status message.

The ELC address must agree with the address on the DKC programming module.

Manual Mode	status line
MAIN MENU	
DKC21.3	or DKC3.3
ECODR3–ELC–xxVxx	or ECODR3-FLP
SETUP MENU (F1)	
INPUT MENU (F2)	
DIAGNOSTIC (F3)	

Machine Menu

```
Manual Mode
      SETUP MENU



POSITION              (F1)
I/O MENU              (F2)
COUNTER               (F3)
```

status line
selected menu

Position

```
Manual Mode                .

        +084225.090

             RPM:
             +0000.09
```

Axis position

I/O Menu

```
Manual Mode
      I/O MENU




INPUT                 (F1)
OUTPUT                (F2)
```

```
Manual Mode                .

SYSTEM INPUT
000100

INPUTS 01–10
1000000000
```

Ascending
bit sequence from left to right

«

System inputs: Parameters, Automatic, Start, Stop, Jog+, Jog-

```
Manual Mode

SYSTEM OUTPUT
1010

OUTPUTS 01–08
00000001
```

System outputs: Manual Mode, Automatic, Error, Run

Counter

```
Manual Mode
       COUNTER

BLOCK NUMBER: 0

TOTAL COUNT  :
ACT: COUNT   :
```

Setup Menu

```
Manual Mode
     SETUP MENU


NC-PROGRAM          (F1)
PARAMETER           (F2)
PLC-PROGRAM         (F3)
VARIABLE            (F4)
```

NC Program

```
Manual Mode
     NC-PROGRAM
 0   NOP





          LEERZEICHEN
```

or

```
Manual Mode
     NC-PROGRAM
999  PSA
1    +000500.000
 999

Vorschub  absolut  mit
 Positionsquittung
```

If the cursor is positioned on

- the command, the “up” and “down” arrow keys scroll through the command list. In addition, the description of the command function is shown in the last two lines.
- on the first space of the input fields, depending on the meaning of the command input field, the user can scroll through 'M'=marker flag, 'I'=input, 'Q'=output, or '0'=no meaning using the "up" and "down" arrow keys. In addition, the description of this input field is shown in the last two lines.

Parameters

```
Manual Mode
      PARAMETER    H
A1    00
0  0


      Motion Type
```

```
Manual Mode
      PARAMETER    H
A1    01
0  1


      Funktion  Geber 2
```

If the cursor is positioned on

- the parameter block (A1,AA,B0;C0,CR,CM,CA), the “up” and “down” arrow keys scroll through the block.
- the parameter number, the “up” and “down” arrow keys increment or decrement the number. In addition, the description of the parameter function is shown in the last two lines.
- on the first space of the input fields, depending on the meaning of the command input field, the user can scroll through 'M'=marker flag, 'I'=input, 'Q'=output, or '0'=no meaning using the "up" and "down" arrow keys. In addition, the description of this input field is shown in the last two lines.

Diagnostic Messages

```
Manual Mode
      DIAGNOSEMENUE



I/O/F MENU             (F1)
PROGRAM-STATUS         (F2)
MISCELLANEOUS          (F3)
```

I / O / F - Menu

```
Manual Mode
      I/O/F MENU



INPUT                  (F1)
OUTPUT                 (F2)
FLAGS                  (F3)
```

```
Manual Mode

SYSTEM–INPUT
000100

INPUTS 01–10
1000000000
```

System inputs: Parameters, Automatic, Start, Stop, Jog+, Jog-
Ascending bit sequence from left to right

```
Manual Mode

SYSTEM OUTPUT
1010

OUTPUTS 01–08
00000001
```

System outputs: Manual Mode, Automatic, Error, Run
Ascending bit sequence from left to right

```
Manual Mode

Flags
```

System outputs: Manual Mode, Automatic, Error, Run

Program Status

```
Manual Mode
      PROGRAM-STATUS



TASK1:    0000   NOP
TASK2:    0100   POI
TASK3:    0300   AKN
```

Other

```
Manual Mode
      MISCELLANEOUS





SCHLEPPABSTAND    (F1)
```

Manual Mode SCHLEPPABSTAND +000000.001   +084225.089

Special Displays

```
Manual Mode
     PARAMETER–HELP



PAR.–ERROR           (F1)
DEFAULT VALUE        (F2)
```

Pressing F1 displays the incorrect parameter number.

14 Index

Rexroth Indramat

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15 Service & Support

15.1 Helpdesk

Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns

- telefonisch: **+49 (0) 9352 40 50 60**
  über Service-Call Entry Center Mo-Fr 07:00-18:00
- per Fax: **+49 (0) 9352 40 49 41**
- per e-Mail: **service@indramat.de**

Our service helpdesk in the head factory Lohr am Main is assisting you in all kind of queries. You may contact us

- by phone: **+49 (0) 9352 40 50 60**
  via Service-Call Entry Center Mo-Fr 07:00-18:00
- by fax: **+49 (0) 9352 40 49 41**
- by e-mail: **service@indramat.de**

15.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

+49 (0) 171 333 88 26
oder **+49 (0) 172 660 04 06**

Beyond the helpdesk hours, our service is directly contactable under

+49 (0) 171 333 88 26
or **+49 (0) 172 660 04 06**

15.3 Internet - Worldwide Web

Weitere Hinweise zu Service, Reparatur und Training finden Sie im Internet unter

www.indramat.de

Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit Ihrem lokalen Ansprechpartner auf. Die Adressen sind im Anhang aufgeführt.

Further hints about service, repairs and training are available in the worldwide web under

www.indramat.de

Please don't hesitate to contact first the sales & service agencies in your area. Refer to the addresses are on the following pages.

15.4 Vor der Kontaktaufnahme... ...before contacting us

Wir können Ihnen schnell und effizient helfen wenn Sie folgende Informationen bereithalten:

1. detaillierte Beschreibung der Störung und der Umstände.
2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Telefon-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

To enable us for quick and efficient help, please prepare the following information:

1. most detailed description of the failure appearance.
2. Indications on the typelabel of the concerned products, especially typecodes and serialnumbers.
3. Telephone-/faxnumbers and e-mail address by which we can attend you in case of queries.

15.5 Kundenbetreuungsstellen Sales & Service Facilities

☐	Verkaufsniederlassungen	☐	sales agencies
▒	Niederlassungen mit Kundendienst	▒	agencies providing service

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Vertriebsgebiet Mitte Germany Centre Rexroth Indramat GmbH Bgm.-Dr.-Nebel-Str. 2 97816 Lohr am Main **Kompetenz-Zentrum Europa** Telefon: +49 (0)9352 40-0 Telefax: +49 (0)9352 40-4885	**SERVICE** **CALL ENTRY CENTER** **MO – FR** **von 07:00 - 18:00 Uhr** **from 7 am – 6 pm** **Tel. +49 (0) 9352 40 50 60** service@indramat.de	**SERVICE** **HOTLINE** **MO – FR** **von 17:00 - 07:00 Uhr** **from 5 pm - 7 am** + SA / SO **Tel.: +49 (0)172 660 04 06** **oder / or** **Tel.: +49 (0)171 333 88 26**	**SERVICE** **ERSATZTEILE / SPARES** verlängerte Ansprechzeit - extended office time - ♦ nur an Werktagen - only on working days - ♦ von 07:00 - 18:00 Uhr - from 7 am - 6 pm - **Tel. +49 (0) 9352 40 42 22**
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Czech Republic Mannesmann-Rexroth, spol.s.r.o. Hviezdoslavova 5 627 00 Brno Telefon: +420 (0)5 48 126 358 Telefax: +420 (0)5 48 126 112	England Mannesmann Rexroth Ltd. Rexroth Indramat Division Broadway Lane, South Cerney Cirencester, Glos GL7 5UH Telefon: +44 (0)1285 863000 Telefax: +44 (0)1285 863030	Finland Rexroth Mecman Oy Rexroth Indramat division Ansatie 6 017 40 Vantaa Telefon: +358 (0)9 84 91-11 Telefax: +358 (0)9 84 91-13 60	France Mannesmann Rexroth S.A. Division Rexroth Indramat Parc des Barbanniers 4, Place du Village 92632 Gennevilliers Cedex Telefon: +33 (0)141 47 54 30 Telefax: +33 (0)147 94 69 41 Hotline: +33 (0)608 33 43 28
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