Industrial Hydraulics | Electric Drives and Controls | Linear Motion and Assembly Technologies | Pneumatics | Service Automation | Mobile Hydraulics

Rexroth
Bosch Group

Rexroth OptiFeed-FS EcoDrive 03 with Integrated NC Control FLP04VRS

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Edition 01

Functional Description

Title Rexroth OPTIFEED-FS
ECODRIVE03
with Integrated NC Control

Type of Documentation Functional Description

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Purpose of Documentation This documentation is a functional description for the firmware FWA-ECODR3-FLP-04VRS-MS.

This documentation:

- describes the functional characteristics

Record of Revisions

Description	Release Date	Notes
FWA-ECODR3-FLP-04VRS-MS	8/2003	First release

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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

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

FWA-ECODR3-CRP-0xVRS-MS

- OPTIFEED-CS
  Single-axis solution package for Feed-to-length mechanisms

FWA-ECODR3-SMT-xxVRS-MS

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

FWA-ECODR3-SGP-xxVRS-MS

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

FWA-ECODR3-FGP-xxVRS-MS

- drive for general automation tasks with fieldbus 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.

SH5040X1.BMP

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

1.4 Function Overview: FWA-ECODR3-FLP-04VRS-MS

Command Communications Interface

The following interfaces are supported:

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

Supported Motor Types

- MKD
- MKE
- LSF (linear synchronous kit motor)
- MHD

Supported Measuring Systems

Motors

- 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.

Measuring Wheel

- Incremental encoder with square wave signals, by Heidenhain

Master Encoder (PLS, Press Encoder)

- Absolute Encoder SSI Format (8 – 24 bit)

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
- indexed variables

Logic Task

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

PLS

- 8 outputs (with lead time)
- 10 PLSs

RS Interface

- RS 232 C / RS 485 serial interface

Programming 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 diagnostic options
- basic parameters that can be called up to set the parameters to their default settings
- operation time counter
- three-language support for parameter and command names, as well as for diagnostic messages
  - German
  - English
  - French
- optional encoders
  - evaluation of optional (load-side) encoder for position and/or velocity control
  - measuring wheel encoder
  - master encoder (PLS, press encoder)
- 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 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 feedforward

  velocity precontrol
- velocity control loop monitoring
- position control loop monitoring

- homing
- set absolute distance
- analog output
- analog inputs
- probe function
- detect marker position
- piece counter
- encoder emulation
  - incremental encoder emulation

2 Important directions for use

2.1 Appropriate use

Introduction

All Rexroth controls and drives are developed and tested according to the state-of-the-art of technology.

As it is impossible to follow the continuing development of all materials (e.g. lubricants in machine tools) which may interact with our controls and drives, it cannot be completely ruled out that any reactions with the materials used by Bosch Rexroth might occur.

For this reason, before using the respective material a compatibility test has to be carried out for new lubricants, cleaning agents etc. and our housings/our housing materials.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Areas of use and application

For ECODR3-FLP Rexroth defines appropriate use as for precision motion control of one axis.

Control and monitoring of (the) Ecodrive03 may require additional sensors and actors.

Note: ECODR3-FLP may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

The ECODR3-FLP has to be programmed before starting it up, making it possible for the motor to execute the specific functions of an application.

The ECODR3-FLP has been developed for use in single axis drives and control tasks.

Typical applications of ECODR3-FLP are:

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

The ECODR3-FLP may only be operated under the assembly, installation and ambient conditions as described here (temperature, system of protection, humidity, EMC requirements, etc.) and in the position specified.

2.2 Inappropriate use

Using the ECODR3-FLP outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as “inappropriate use".

ECODR3-FLP may not be used if

- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Rexroth has not specifically released them for that intended purpose. Please note the specifications outlined in the general Safety Guidelines!

3 Safety Instructions for Electric Drives and Controls

3.1 Introduction

Read these instructions before the initial startup of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times.

Do not attempt to install or start up this equipment without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation of the equipment prior to working with the equipment at any time. If you do not have the user documentation for your equipment, contact your local Bosch Rexroth representative to send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the equipment is resold, rented or transferred or passed on to others, then these safety instructions must be delivered with the equipment.

WARNING

Improper 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 material damage, bodily harm, electric shock or even death!

3.2 Explanations

The safety instructions describe the following degrees of hazard seriousness in compliance with ANSI Z535. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions.

Warning symbol with signal word	Degree of hazard seriousness according to ANSI
DANGER	Death or severe bodily harm will occur.
WARNING	Death or severe bodily harm may occur.
CAUTION	Bodily harm or material damage may occur.

Fig. 3-1: Hazard classification (according to ANSI Z535)

3.3 Hazards by Improper Use

DANGER

High voltage and high discharge current! Danger to life or severe bodily harm by electric shock!

DANGER

Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

WARNING

High electrical voltage due to wrong connections! Danger to life or bodily harm by electric shock!

WARNING

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

CAUTION

Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

CAUTION

Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock or incorrect handling of pressurized systems!

CAUTION

Risk of injury due to incorrect handling of batteries!

3.4 General Information

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this equipment.
- Only persons who are trained and qualified for the use and operation of the equipment may work on this equipment or within its proximity.
  - The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and equipment on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use 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 industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Use only safety features and applications that are clearly and explicitly approved in the Project Planning Manual.
  For example, the following areas of use are not permitted: construction cranes, elevators used for people or freight, devices and vehicles to transport people, medical applications, refinery plants, transport of hazardous goods, nuclear applications, applications sensitive to high frequency, mining, food processing, control of protection equipment (also in a machine).
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
  The machine and installation manufacturer must
  - make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  - make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Startup of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.

- Operation is only permitted if the national EMC regulations for the application are met.
  The instructions for installation in accordance with EMC requirements can be found in the documentation "EMC in Drive and Control Systems".
  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

3.5 Protection Against Contact with Electrical Parts

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

Touching live parts with voltages of 50 Volts and more with bare hands or conductive tools or touching ungrounded housings can be dangerous and cause electric shock. In order to operate electrical equipment, certain parts must unavoidably have dangerous voltages applied to them.

DANGER

High electrical voltage! Danger to life, severe bodily harm by electric shock!

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

⇒ Follow general construction and safety regulations when working on high voltage installations.

⇒ Before switching on power the ground wire must be permanently connected to all electrical units according to the connection diagram.

⇒ Do not operate electrical equipment at any time, even for brief measurements or tests, if the ground wire is not permanently connected to the points of the components provided for this purpose.

⇒ Before working with electrical parts with voltage higher than 50 V, the equipment must be disconnected from the mains voltage or power supply. Make sure the equipment cannot be switched on again unintended.

⇒ The following should be observed with electrical drive and filter components:

⇒ Wait five (5) minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to 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.

⇒ Install the covers and guards provided with the equipment properly before switching the equipment on. Prevent contact with live parts at any time.

⇒ A residual-current-operated protective device (RCD) must not be used on electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

⇒ Electrical components with exposed live parts and uncovered high voltage terminals must be installed in a protective housing, for example, in a control cabinet.

To be observed with electrical drive and filter components:

DANGER

High electrical voltage on the housing!
High leakage current! Danger to life, danger of injury by electric shock!

⇒ Connect the electrical equipment, the housings of all electrical units and motors permanently with the safety conductor at the ground points before power is switched on. Look at the connection diagram. This is even necessary for brief tests.

⇒ Connect the safety conductor of the electrical equipment always permanently and firmly to the supply mains. Leakage current exceeds 3.5 mA in normal operation.

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

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

3.6 Protection Against Electric Shock by Protective Low Voltage (PELV)

All connections and terminals with voltages between 0 and 50 Volts on Rexroth products are protective low voltages designed in accordance with international standards on electrical safety.

WARNING

High electrical voltage due to wrong connections! Danger to life, bodily harm by electric shock!

⇒ Only connect equipment, electrical components and cables of the protective low voltage type (PELV = Protective Extra Low Voltage) to all terminals and clamps with voltages of 0 to 50 Volts.

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

3.7 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of the connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

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

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily injury and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

DANGER

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

⇒ Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. Unintended machine motion is possible if monitoring devices are disabled, bypassed or not activated.

⇒ Pay attention to unintended machine motion or other malfunction in any mode of operation.

⇒ Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:

- use safety fences
- use safety guards
- use protective coverings
- install light curtains or light barriers

⇒ Fences and coverings must be strong enough to resist maximum possible momentum, especially if there is a possibility of loose parts flying off.

⇒ Mount the emergency stop switch in 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 starting lockout to prevent unintentional start.

⇒ Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone. Safe standstill can be achieved by switching off the power supply contactor or by safe mechanical locking of moving parts.

⇒ Secure vertical axes against falling or dropping after switching off the motor power by, for example:

- mechanically securing the vertical axes
- adding an external braking/ arrester/ clamping mechanism
- ensuring sufficient equilibration of the vertical axes

The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!

⇒ Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:

- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

⇒ Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such equipment cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

3.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated near 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, hearing aids and metal implants are not permitted to enter the following areas:

- Areas in which electrical equipment and parts are mounted, being operated or started up.
- Areas in which parts of motors with permanent magnets are being stored, operated, repaired or mounted.

⇒ If it is necessary for a person with a heart pacemaker to enter such an area, then a doctor must be consulted prior to doing so. Heart pacemakers that are already implanted or will be implanted in the future, have a considerable variation in their electrical noise immunity. Therefore there are no rules with general validity.

⇒ Persons with hearing aids, metal implants or metal pieces must consult a doctor before they enter the areas described above. Otherwise, health hazards will occur.

3.9 Protection Against Contact with Hot Parts

CAUTION

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

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

⇒ After switching the equipment off, wait at least ten (10) minutes to allow it to cool down before touching it.

⇒ Do not touch hot parts of the equipment, such as housings with integrated heat sinks and resistors. Danger of burns!

3.10 Protection During Handling and Mounting

Under certain conditions, incorrect handling and mounting of parts and components may cause injuries.

CAUTION

Risk of injury by incorrect handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock!

⇒ Observe general installation and safety instructions with regard to handling and mounting.

⇒ Use appropriate mounting and transport 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.

⇒ For safe protection wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.

⇒ Never stand under suspended loads.

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

3.11 Battery Safety

Batteries contain reactive chemicals in a solid housing. Inappropriate handling may result in injuries or material damage.

CAUTION

Risk of injury by incorrect handling!

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

⇒ Never charge non-chargeable batteries (danger of leakage and explosion).

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

⇒ Do not damage electrical components installed in the equipment.

Note: Be aware of environmental protection and disposal! The batteries contained in the product should be considered as hazardous material for land, air and sea transport in the sense of the legal requirements (danger of explosion). Dispose batteries separately from other waste. Observe the legal requirements in the country of installation.

3.12 Protection Against Pressurized Systems

Certain motors and drive controllers, corresponding to the information in the respective Project Planning Manual, must be provided with pressurized media, such as compressed air, hydraulic oil, cooling fluid and cooling lubricant supplied by external systems. Incorrect handling of the supply and connections of pressurized systems can lead to injuries or accidents. In these cases, improper handling of external supply systems, supply lines or connections can cause injuries or material damage.

CAUTION

Danger of injury by incorrect handling of pressurized systems !

⇒ Do not attempt to disassemble, to open or to cut a pressurized system (danger of explosion).

⇒ Observe the operation instructions of the respective manufacturer.

⇒ Before disassembling pressurized systems, release pressure and drain off the fluid or gas.

⇒ Use suitable protective clothing (for example safety glasses, safety shoes and safety gloves)

⇒ Remove any fluid that has leaked out onto the floor immediately.

Note: Environmental protection and disposal! The media used in the operation of the pressurized system equipment may not be environmentally compatible. Media that are damaging the environment must be disposed separately from normal waste. Observe the legal requirements in the country of installation.

Notes

4 General Instructions for Start-Up

4.1 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 of the unit. Distinctions are made between:

- operating modes
- warnings
- errors

Errors can be acknowledged using the S1 key located below 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 has two options available:

- PC programming using MotionManager
- BTV04 display unit with FWA-BTV04*-ELC firmware

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 20 seconds. 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.

Note: When the basic parameters are set using switch settings 98 and 99, parameters that were previously set are overwritten. Switch settings 98 and 99 only accepted in parameter mode.

The "temporarily" set interface parameters are reset to the parameter values (B001/B002/B009/B010) after an error is cleared or after exiting Parameter Mode.

	Address S3	S2	Function	Parameter B001	Parameter B002	Para. B009	Para. B010
temporary	**9**	**0**	ASCII-Protocol 9600 Baud NO Parity (**MotionManager**)	09600 1 05	1 1 0 1 0 004	0 200	0
temporary	**9**	**1**	SIS-Protocol 9600 Baud EVEN Parity (BTV04)	09600 2 05	0 1 0 0 0 000	0 200	0
temporary	**9**	**2**	RS on drive 9600 Baud No Parity (DriveTOP possible)	09600 2 05	not programmable		
temporary	**9**	**3**	SIS Protocol 9600 Baud No Parity (for **BTV04,** for **Dolfi Firmware Upgrade)**)	09600 1 05	0 1 0 0 0 000	0 200	0
temporary	**9**	**4**	SIS Protocol 9600 Baud EVEN Parity (BTV04 with BTV keys and BTV I/O)	09600 2 05	0 1 0 0 0 000	1 200	1
temporary	**9**	**5**	SIS Protocol 9600 Baud EVEN Parity (BTV04 with BTV keys and BTV I/O)	09600 1 05	0 1 0 0 0 000	1 200	1
Default	**9**	**7**	Load parameter with default values Programs, Variables, Marker Flags are cleared SIS Protocol 9600 Baud NO Parity **(BTV04)**	09600 1 05	0 1 0 0 0 000	0 200	0
Default	**9**	**8**	Load parameter with default values ASCII Protocol 9600 Baud NO Parity (**MotionManager**)	09600 1 05	1 1 0 1 0 004	0 200	0
Default	**9**	**9**	Load parameter with default values SIS Protocol 9600 Baud NO Parity (**BTV04**)	09600 1 05	0 1 0 0 0 000	0 200	0

Fig. 4-1: Interface Settings Using the S2/S3 Switches

All functions will set the serial interface to 1 stopbit.

Diagnostic "E- 01 09" is issued at address 97, 98 or 99.

Note: The "temporarily" set interface parameters are reset to the parameter values (B001/B002/B009/B010) after an error is cleared or after exiting Parameter Mode.

Data Storage

Non-Volatile Memory

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

The following operating data are stored there:

- 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 DKC21.3 inputs, via the fieldbus for DKC3.3, or via the BTV04 (Parameters B009-B013).

Parameters

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
- PLS

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
- PLS

The following function is possible:

- interrupt vector

Inputs / Outputs / Marker Flags

Designation

The designation of the inputs, outputs and marker flags.

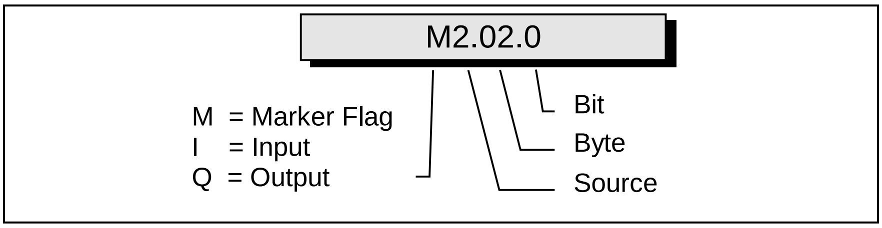


Fig. 4-2: Structure of the Inputs / Outputs / Marker Flags

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 6

First user-programmable input

See also: "Inputs, Outputs, Marker Flags" Chapter 10.1.

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. 4-3: Warning Classes

Warnings can not be externally cleared.

Faults

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 limit	F6xx F- 03xx	velocity command value set to zero
Interface	F4xx	per setting for “Best possible deceleration,” Parameter A119
non-fatal	F2xx F- 02xx	per setting for “Best possible deceleration,” Parameter A119

Fig. 4-4: 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 deceleration**. 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
- pressing the **"S1"** key
- the fieldbus
- the serial interface

If the error condition is still present, the error will be immediately detected again.

Clear errors with controller enable 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 re-enable the drive:

- the error must be cleared

Basic Parameter/Basic Load

Basic Parameters

When the drive is ready for delivery, the factory-set basic values are written to the parameters. The **Load Basic Parameters During Active Parameter Mode** function can be invoked using the S1 key and the address setting 98 or 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
- limit values for velocity and acceleration are set to low values
- Address 98 ASCII Protocol 9600 Baud No Parity
  Address 99 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.

4.2 Quick Setup Instructions

For safety reasons, the drive should be disconnected from the mechanical components for initial startup. If this is not possible, before the initial startup of the individual components, it must be insured that the E-STOP sequence functions completely and without problems. Any danger to persons or machines because of erroneous drive movements must be eliminated.

- Check to see that devices and cables are of the correct type.
- Connect the power supply, the control voltage and the drive with its encoder according to the information provided in the documentation: Project Planning Manual DOK-ECODR3-DKC**.****-PRxx-EN-P. The connections between cables and clamps should also be checked.
- Check wiring of inputs X3 and
DKC21.3 X210
DKC3.3 Profibus Interface
- Check wiring of the interface to the operator panel (PC or BTV).
- Adjust the interface parameters using the S1 key
see Chapter 4.1 Communication
- Match the parameters to the equipment
- Test motor brake control
- Turn on the power
- Check cooling systems for the drive, amplifier and control cabinet.
- Use ‘Jog’ to move the axis in Manual Mode
- Check the system safety devices
(E-Stop, travel limit switches X3/2 and X3/3, Best possible deceleration A119, Ready for Operation contacts X1/7 and X1/8, etc.)

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

- Set or home Absolute distance (Parameter C010)
- Set the position-limit parameters
- Load the programs
- Test sequence controls
- 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.

4.3 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 determined 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

- diagnostic message number
- diagnostic message text

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

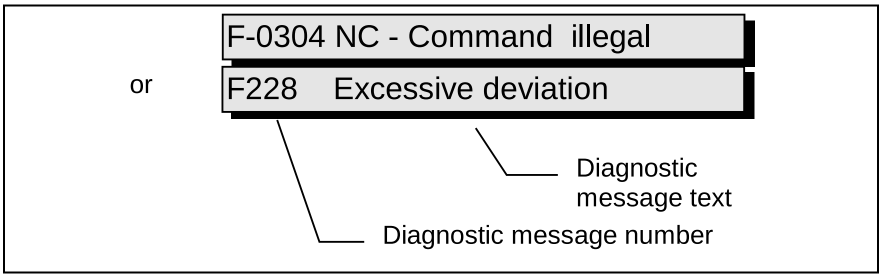


Fig. 4-5: Composition of Diagnostic Message with Diagnostic Message Number and Text

In this example, "F-," "03" and "04," or "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 " Diagnostic Message Priority Diagram ".

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 shown on the H1 display. If the drive complies with the operating mode and no command was activated, "HA," "AU" or "PA" appear on the display.

- PA – Parameter Mode
- HA – Manual Mode
- AU – Automatic Mode

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.

4.4 Language Selection

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

- parameter names
- description of commands
- diagnostic message text strings

Currently, the following languages are implemented:

Value of B000:	Language:
0	German
1	English
2	French

Fig. 4-6: Language Selection

4.5 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 Rexroth 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.

Firmware Update of ECODRIVE

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

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

Options → Com-Port	Connect baud rate	9600
	Download baud rate	115200
Options → Address	Receiver	xx

Notes for Firmware Upgrade

For a firmware upgrade, the following basic points must be observed:

1. Turn on the drive controller.
   for the DKC3.3, without turning on the master. (If the Profibus connector is not plugged in, the DKC3.3 automatically switches to Parameter Mode)
2. Secure current parameters and programs.
   (Normally, the programs and parameters remain intact)
3. Switch the drive controller to Parameter Mode. (DKC21.3 only)
4. Using switches S2, S3 and the S1 key on the firmware module, the relevant transfer parameters can be temporarily set in the drive controller.

S3/S2 = 00	Press S1	(Enable the functions) Display "Ad"
S3/S2 = 93	Press S1	(Setting the Interface)
S3/S2 = xx	(Default 05)	(Setting the Address)

Firmware Upgrade Process

1. Start Dolfi.
2. Under **Options**, set up the following:
   - **COM Port** Register Card
   - Under **COM Port**, select the interface to the PC.
   - Under **Baudrate connect**, set ’9600.’
   - Under **Baudrate download**, set baud rate for download (recommended: ’115200’).

Address Register Card

- Enter the address set with the S2 and S3 dials on the drive controller.

Language Register Card

- Select language.

3. Press **Connect** button and wait for connection to be made.
   If no connection is made, the baud rate and address can be determined by using **Serial/Scan**. If no device is found that way, check the serial cable.
4. Using Serial/Firmware Info the four headers of the programmed module are read. (You can view the headers that were read by selecting the **Header** register card.)
5. Press **Transmit** button.

   → The standard Windows dialog for opening a file is shown.
6. Select the *.ibf file to be updated and open file.
7. Press **Send** button.

   → If "Modules - all" is selected, the entire IBF file is programmed without asking for confirmation (normally, the firmware FWA-ECODRIVE03-FLP has four firmware modules). If Modules "Module - Single" is selected, you must press Send again after each firmware module has been programmed.
8. After successful update, press the **Disconnect** button.

   → The drive firmware is started.
9. Close Dolfi.

   → If the number of parameters to be buffered has changed, "PL" is displayed. (If errors are present, they must first be cleared). If the S1 key is pressed, all buffered parameters are re-set to their default values. During this time, "C8 Load Default Parameters" is displayed.

   If the command "C8 Load Default Parameters" is started or the motor type is changed, "UL" is displayed. (If Parameter Mode is pre-set, it must first be exited.) Press the S1 key or initialize the Clear Errors command. Then, the controller default settings are loaded from the motor feedback to the drive controller.
10. Setting the correct address for the drive controller
11. Load the desired parameter/program file.

Firmware Update in BTV04/05

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

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

Options → Com-Port	Connect baud rate	9600
	Download baud rate	38400
Options → Address	Receiver	03

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.
- OR by pressing Shift + F6

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

Set to

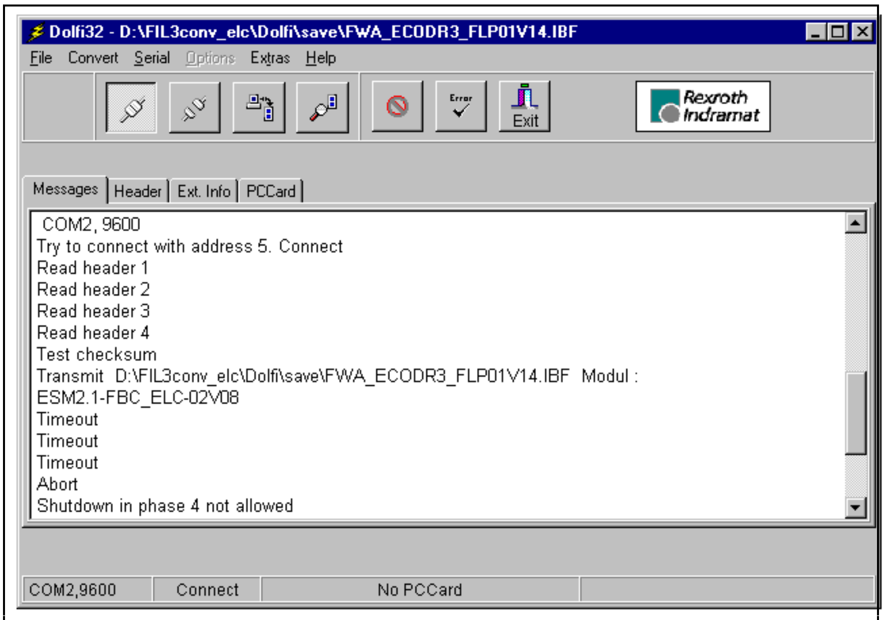
Address:	3
Baud Rate:	9600
Parity:	off
Protocol:	ASCII +SIS
Answer Delay:	1 ... 4
Timeout (ms):	400
Retry:	2
Group No.:	0
Max Unit:	0

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

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_AE.bmp

Fig. 4-7: 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. 4-8: 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 the Error: 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

<u>Baud rates possible [baud]</u>

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:

<u>Windows 95:</u>

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

Activate FIFO buffer using standard setting

<u>Windows NT:</u>

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 kBaud. 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 / kBaud
2	115.2
5	57.6
10	57.6
15	38.4

Fig. 4-9: Maximum Baud Rate Depending on Cable Length

Notes

5 Motor Configuration

5.1 Characteristics of the Motor Types

The following motor types can be used:

MKD	MHD
MKE	
	LSF

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
LSF	no	synchronous	param.	param.	no	PTC

Fig. 5-1: 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**
- **CM02, Peak/Standstill motor current**
- **CM03, Maximum velocity of motor**
- **CM04, Number of pole pairs/pole pair distance**
- **CM05, Torque/force constant**
- **CM06, Rotor moment of inertia**
- **CM08, Holding brake current**

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, 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.”

5.2 Setting the Motor Type

The setting of the motor type is either:

- dependent on the motor type used
- performed automatically by reading the motor feedback memory or
- via input of parameter **CM00, Motor type**

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, encoder 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.

5.3 Synchronous Motors

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

- MHD
- MKD and MKE motors

plus rotary and linear synchronous kit motors, types MBS and LSF. Rexroth 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 Rexroth 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). Rexroth 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.

5.4 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 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 deceleration**
- **CM07, Holding brake type**
- **Holding brake delay time (always 150 msec)**

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.

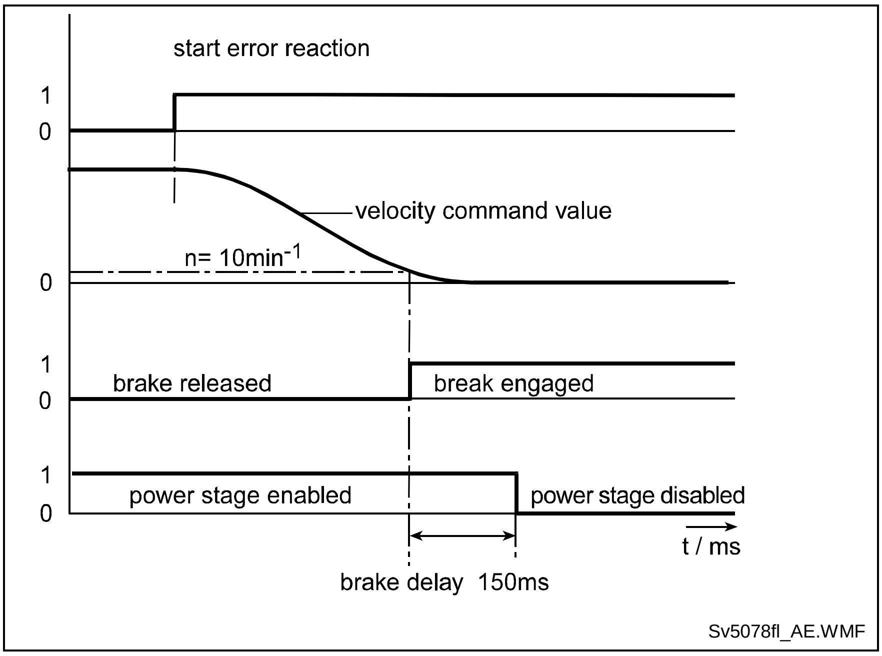


Fig. 5-2: Timing Diagram for Command Value Reset and CM07, Holding Brake Type (Spindle Brake)

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:

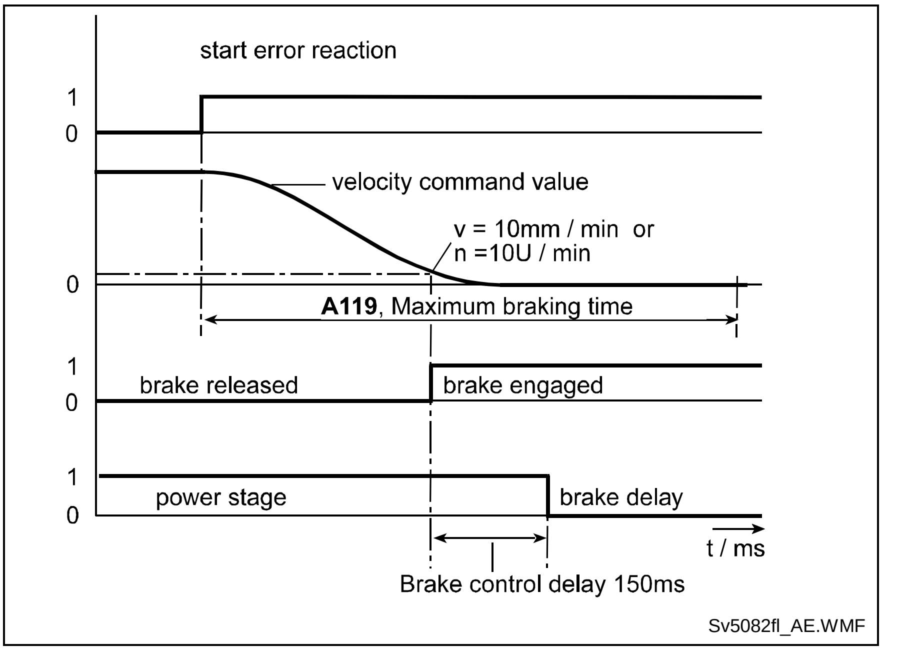


Fig. 5-3: Timing Diagram for Command Value Set to Zero and CM07, Holding Brake Type (Servo Brake) and Actual Braking Time < A119

Behavior with Servo Brake

CM07, Holding brake type

Braking time > A119

Incorrectly set braking time:

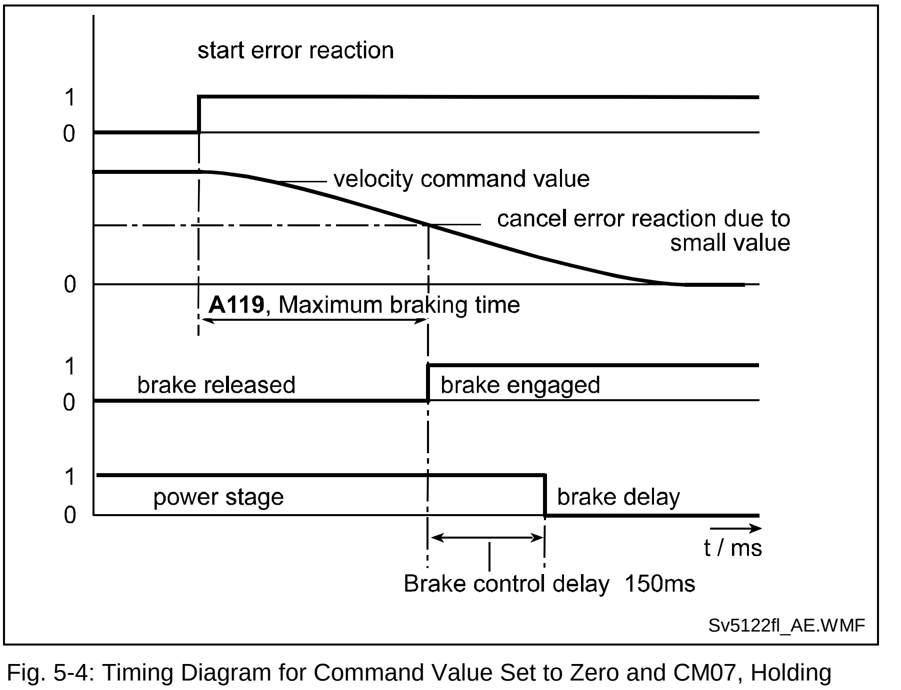


Fig. 5-4: Timing Diagram for Command Value Set to Zero and CM07, Holding Brake Type (Servo Brake) and Actual Braking Time > A119

Setting Maximum Braking Time

The **Maximum Braking time** 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 deceleration**) since the start of the error reaction has elapsed.

Note: The value in **A119, Best possible deceleration** 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 deceleration** 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

See also Project Planning Specifications ECODRIVE 03

6 Writing the User Program

6.1 Overview of All User Commands

6.2 General Information

The basic programming is pre-set, 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 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.

6.3 Program Input

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 port. 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 10.2.

6.4 Starting the User Program

The user program can be started only in Automatic 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 is 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.

6.5 Stopping the User Program

The running program can be stopped 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 9 - Parameter A116

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

6.6 Variables

The commands contain data which are subsets of 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 for using constants. 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 IU

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 V601.

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.

User-Programmable Variables

The following variables can be used for programming in the NC user programs:

V600 to V999

General 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 standardized to +/1
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 ‰
V019	Hour Counter
V020	Hour Counter, Automatic Mode
V021	Actual Position 2 Optional Encoder
V022	Actual Position 3 SSI Encoder (PLS)
V023	Actual Position of Master Encoder (Cam) [Degrees]
V024	Actual Velocity of the Optional Encoder [IU/s]
V027	Actual Velocity of the SSI Encoder
V028	Length Counter for the Optional Encoder
V030	Time Measurement Counter 1 (current value)
V031	Time Measurement Counter 1 (buffered measured value)
V032	Time Measurement Counter 2 (current value)
V033	Time Measurement Counter 2 (buffered measured value)
V034	Length Measurement Encoder 1 (current value)
V035	Length Measurement Encoder 1 (stored measured value)
V036	Length Measurement Encoder 2 (current value)
V037	Length Measurement Encoder 2 (stored measured value)
V038	Length Measurement Encoder 3 (current value)
V039	Length Measurement Encoder 3 (stored measured value)
V044	Actual Position Virtual Encoder

Fig. 6-1: System Variables

Axis-Related System Variables

The axis variables are read-only.

No.	Definition
V100	Absolute position of motor encoder (actual coordinate system)
V101	Position Command Value
V102	Reserved (Free)
V103	Lag Distance
V104	Actual Velocity in IU/s
V105	Processed Material Length [meters]
V106	Average Velocity in IU/s (see FUN command)
V107	Slip in Measuring Wheel Mode [%]
V108	Target Velocity in IU/s
V113	Distance from home position to processing location

Fig. 6-2: Axis System Variables

System Variable V000 "Cycle Counter 1":

The counter is incremented by 1 for each NC cycle. The value is output as modulo-100000000 in NC cycles (1 NC cycle = 2 ms). The counter cannot be cleared.

System Variable V001 "Cycle Counter 2“:

When the NC program has been started in Automatic Mode, the counter is incremented by 1 for each NC cycle. The value is output as modulo-100000000 in NC cycles. The counter cannot be cleared.

System Variable V002 "Current Program Instruction in Task 1":

The current status of the program instruction counter for Task 1.

System Variable V003 "Current Program Instruction in Task 2":

The current status of the program instruction counter for Task 2.

System Variable V004 "Current Program Instruction in Task 3":

The current status of the program instruction counter for Task 3.

System Variable V007 "Analog Input 1":

The input voltage (+/- 10 Volts) at the analog input is made available as a standardized value of +/- 1in this variable.

System Variable V013 "Strokes per Minute":

With every positive change in the leading edge of the signal bit feed angle monitoring (Parameter A116), the length of time since the previous change in the leading edge is output. This time was available to the previous positioning operation (stroke). This time is converted to positioining operations (strokes) per minute. The result is output without decimal places. The value is cleared only when restarting the system.

Note: The function "Feed Angle Monitoring" (Parameter A116) must be enabled.

System Variable V014 "Feed Angle Load":

The time required by a positioning operation is set as a ratio with the time that is available for the positioining operation. (Signal bit for Feed Angle Monitoring – Parameter A116 = 1) The result is output as a percent (without decimal places). The value is cleared only when restarting the system.

Note:	The function "Feed Angle Monitoring" (Parameter A116) must be enabled.

System Variable V015 "Feed length of the IDS1.1-1":

Current feed length of the IDS1.1 in IU (input units). Interpretation of the 6 decades with 5 places before the decimal and 1 place after the decimal as for an IDS1.1-**1**.

Note:	The interface protocol for IDS must be enabled in **B002 "Interface Parameters."**

System Variable V016 "Feed length of the IDS1.1-2":

Current feed length of the IDS1.1 in IU (input units). Interpretation of the 6 decades with 4 places before the decimal and 2 places after the decimal as for an IDS1.1-**2**.

Note:	The interface protocol for IDS must be enabled in **B002 "Interface Parameters."**

System Variable V017 "Feed length of the IDS1.1-3":

Current feed length of the IDS1.1 in IU (input units). Interpretation of the 6 decades with 3 places before the decimal and 3 places after the decimal as for an IDS1.1-**3**.

Note:	The interface protocol for IDS must be enabled in **B002 "Interface Parameters."**

System Variable V018 "Velocity of the IDS1.1-x":

Current velocity of the IDS1.1. The read value in percent is multiplied by a factor of 10 and is made available to the variable. Thus, it can be directly transferred into a positioning command as a per mil value.

Note:	The interface protocol for IDS must be enabled in **B002 "Interface Parameters."**

System Variable V019 "Hour counter“**:**

Start-up time of the unit.
The value is output as modulo 100,000 hours.

System Variable V020 "Hour Counter, Automatic Mode":

Start-up time of the unit in Automatic Mode.
The value is output as modulo 100,000 hours.

System Variable V021 "Actual Position Value 2 [IU]":

Output of the Actual Position Value for the optional encoder.

System Variable V022 "Actual Position Value, SSI Encoder [degrees]":

Output of the Actual position value for an SSI encoder at Connector X9.

System Variable V023 " Actual Position Value, Master Encoder (Cam)“:

Output of the Actual position value of the active master encoder for cams [degrees].

System Variable V024 "Actual Velocity of the Optional Encoder":

Output of the actual velocity of the optional encoder 2 [IU/s]

System Variable V027 "Actual Velocity of the SSI Encoder":

Output of the actual velocity of the SSI encoder [IU/s]

System Variable V028 "Length counter for the Optional Encoder":

Output of the length counter of the optional encoder 2 [IU]

Note: System Variable V028 can be changed with the commands **SET** and **MAT**.

System Variable V030 "Time Measurement Counter 1, current value":

Output of the current value of the Time Measurement Counter 1 [ms]

System Variable V031 "Time Measurement Counter 1, buffered measured value":

Output of the buffered measured value of the Time Measurement Counter 1 [ms]

System Variable V032 "Time Measurement Counter 2, current value":

Output of the current value of the Time Measurement Counter 2 [ms]

System Variable V033 "Time Measurement Counter 2, buffered measured value":

Output of the buffered measured value of the Time Measurement Counter 2 [ms]

System Variable V034 "Length Measurement Encoder 1, current value":

Output of the current value of the Length Measurement Encoder 1 [IU]

System Variable V035 "Length Measurement Encoder 1, stored measured value":

Output of the stored measured value of the Length Measurement Encoder 1 [IU]

System Variable V036 "Length Measurement Encoder 2, current value":

Output of the current value of the Length Measurement Encoder 2 [IU]

System Variable V037 "Length Measurement Encoder 2, stored measured value":

Output of the stored measured value of the Length Measurement Encoder 2 [IU]

System Variable V038 "Length Measurement Encoder 3, current value":

Output of the current value of the Length Measurement Encoder 3 [IU]

System Variable V039 "Length Measurement Encoder 3, stored measured value":

Output of the stored measured value of the Length Measurement Encoder 3 [IU]

System Variable V044 "Actual Position Value Virtual Encoder [Degrees]":

Output of the Actual Position Value of the Virtual Encoder.

System Variable V100 "Current Position Value, Motor Encoder":

Output of the current position value for the motor encoder [IU].

System Variable V101 "Target Position Value":

Output of the Target position value [IU].

System Variable V103 "Position Lag":

Output of the position lag (target position value – actual position value) [IU].

System Variable V104 "Actual Velocity":

Actual velocity of the axis in IU/s

System Variable V105 "Processed Material Length" [meters]:

All movements of the active encoder in Automatic Mode and Manual Mode are counted. It can be cleared by the command “Clear NC Variables”. (Serial Interface or Profibus)

System Variable V106 "Average Velocity" :

The average velocity in IU/s (only positive values) determined by the NC program with the FUN command.

System Variable V107 "Slip in Measuring Wheel Mode":

The slip between the optional Encoder 2 and Motor Encoder [%] (only in Measuring Wheel Mode) is issued.

$$Slip\,[\%] = \frac{\text{Encoder Difference after 1 Rev. of Measuring Wheel}}{\text{Measuring Wheel Feed Rate Constant}}$$

Fig. 6-3: Calculation of the Slip

System Variable V108 "Target Velocity [IU/s]":

Output of the target velocity, not averaged.

System Variable V113 „Distance from home position to processing location [IU]“:

All movements of the active measurement wheel are counted.

(only for application "Flying Cutoff“)

Indexed Variables

In order to address variables with indexes in program loops, two variable fields of the same type have been defined. Eight indexed variables are available. The function within the variable field is assigned and enables a calculation of a variable address using the formula:

$$calculated\ Variable\ Number = [V50x] + [V509] * [V508]$$

$$calculated\ Variable\ Number = [V51x] + [V519] * [V518]$$

L: [ ] Contents
L: [V50x] = Contents of V500 – V507
L: [V51x] = Contents of V510 – V517

Fig. 6-4: Formula for Calcualating Indexed Variables

The contents of variables V509 and V508 (or V519 and V518) are multiplied and added to the contents of Variable 50x (or V51x). The resulting value is the variable number that is then processed in the called function.

Variables	Definition
500	# of Basis Variable 1
501	# of Basis Variable 2
502	# of Basis Variable 3
503	# of Basis Variable 4
504	# of Basis Variable 5
505	# of Basis Variable 6
506	# of Basis Variable 7
507	# of Basis Variable 8
508	Offset Factor 1
509	Variable Index 1

Fig. 6-5: Variable Block 1

Variables	Definition
510	# of Basis Variable 1
511	# of Basis Variable 2
512	# of Basis Variable 3
513	# of Basis Variable 4
514	# of Basis Variable 5
515	# of Basis Variable 6
516	# of Basis Variable 7
517	# of Basis Variable 8
518	Offset Factor 2
519	Variable Index 2

Fig. 6-6: Variable Block 2

Variables	Definition
520	<V500> + <V508> * <V509>
521	<V501> + <V508> * <V509>
522	<V502> + <V508> * <V509>
523	<V503> + <V508> * <V509>
524	<V504> + <V508> * <V509>
525	<V505> + <V508> * <V509>
526	<V506> + <V508> * <V509>
527	<V507> + <V508> * <V509>
528	508
529	509

Fig. 6-7: Variable Block 1: Contents of the indexed variables with actual Offset Factor V508 and actual Index V509

Variables	Definition
530	<V510> + <V518> * <V519>
531	<V511> + <V518> * <V519>
532	<V512> + <V518> * <V519>
533	<V513> + <V518> * <V519>
534	<V514> + <V518> * <V519>
535	<V515> + <V518> * <V519>
536	<V516> + <V518> * <V519>
537	<V517> + <V518> * <V519>
538	518
539	519

Fig. 6-8: Variable Block 2: Contents of the indexed variables with actual Offset Factor V518 and actual Index V519

All NC commands using Variables V500-V507 or V510-V517, are executed in their indexed form.

If access to a variable outside of the range V600 to V999 is made, (besides system variables), the error message **"F- 02 23 – Wrong variable index"** is issued.

If these variables are written via the serial interface, fieldbus or using the SET command, they are written **without an index** (directly).

Additional Variable Definitions

Variable Fields in Parameters:

AA11 Tool Wear

Variable Fields in Commands:

BAC Counter

COU Counter

If the target piece count is programmed through a variable for the COU and BAC commands, the current piece count is automatically assigned to the variable with the number higher by 1.

SRP Registration Marks

6.7 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.

Exception: The new deceleration value is only transferred after a deceleration phase has been completed!

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 (Parameter A111)
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. 6-9: Example of Programming an Acceleration Change

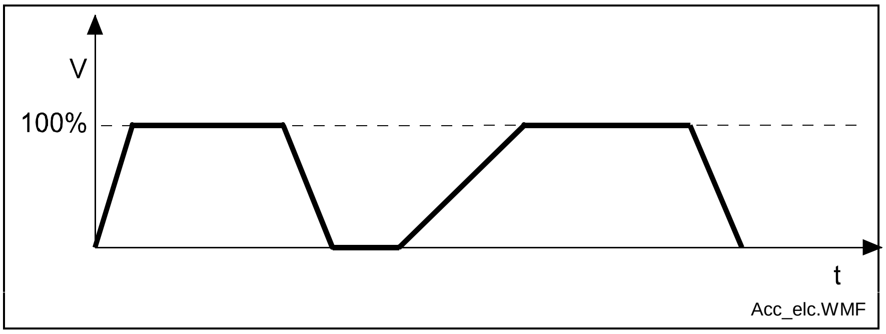


Fig. 6-10: Example Showing Acceleration Change

The program proceeds to the next instruction following the time period of one 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 ,M8
	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.

Hardware outputs are set at the beginning of the following cycle. Commands in the current instruction of a task with a higher task number directly affect the changing of this bit.

The program proceeds to the next instruction following the time period of one cycle.

AKN - Acknowledge Bit

AKN M2.02.2 V600 or
AKN M2.02.2 1

0 = Wait until status of the bit is at ’0’
1 = Wait until status of the bit is at ’1’

Bit: M0 – M5, M8
I0 - I4
Q0 - Q2

The status of the programmed bit 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 - Acknowledge Byte

AKP M2.02 11022001

Bit Field

Byte: M0 – M5, M8
I0 - I4
Q0 - Q2

This command represents an extension of the 'AKN' command. It can be used to verify that conditions have been met for a particular byte. The program proceeds to the next instruction if all bytes have met their conditions. 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_M0.05_ _	**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 only 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 ,M8

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 7 are not changed.

The program proceeds to the next instruction following the time period of one cycle.

APZ - Byte Set / Clear and Count

APZ 21022001

Bit Field (see Parameter AA11)

Using this command, the status of up to 8 bits of the byte defined in Parameter AA11 (Tool Wear) can be controlled. For each of up to 8 bits, a separate counter is incremented by one whenever the bit status changes from ’0’ to ’1.’ This enables the number of uses for a tool, and therefore also its wear, to be determined.

Otherwise, this command operates like the APE command.

The program proceeds to the next instruction following the time period of one cycle.

BAC - Branch Conditional on Count

BAC V600 +1234 V603 or

BAC 0345 +1234 12345

- 12345: Preset Count
- +1234: Actual Quantity Offset
- 0345: Target Instruction

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 desired target quantity. If the programmed target quantity is not reached, the program jumps to the target location. If the target quantity is reached, 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 = Jump when status is '0'
1 = Jump when status is '1'

Bit: M0 – M5, M8
I0 - I4
Q0 - Q2

Target Instruction

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 the time period of one cycle.

BIC - Branch Conditional on Bit Field Value

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

Mode
0 = Evaluate as binary
1 = Evaluate BCD

Number of Bits:	1 to 8
Start Bit (Low Bit):	M0 – M5, M8, 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 instruction is >0999, the error message "**F- 03 02 – NC-Block Nr.illegal**." is issued.

If digits >9 result from the BCD evaluation, the error message "**F- 02 14 – Input Not BCD**" is issued.

The target location is calculated as follows:

$$Target\,Instruction = Instruction\,Offset + (Total\,Scaling \times Jump\,Length)$$

Fig. 6-11: Calculation of the Target Instruction, BIC Command

The program proceeds to the target location following the time period of one cycle.

Binary Evaluation Examples:

	M2.03			M2.02							
Start 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 Scaling:	2^4	2^3	2^2	2^1	2^0
Equiv. decimal value:	16	8	4	2	1

Total Scaling: (16 + 0 + 4 + 2 + 0) = 22
Target Instruction: 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 Scaling :	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Equiv. decimal value:	128	64	32	16	8	4	2	1

Total Scaling: (128 + 64 + 0 + 16 + 8 + 0 + 2 + 0) = 218
Target Instruction: 218 * 02 + 300 = 0736

BCD Evaluation Examples:

	M2.03			M2.02							
Start Bit :	2	1	0	7	6	5	4	3	2	1	0
Current Status :	1	0	1	0	1	1	0	0	1	1	1

1) Input : BIC 0500 11 M2.02.4 5 1

Selected Bits :	1	0	1	1	0
Decimal Scaling:	10	8	4	2	1

Total Scaling : 10 + 0 + 4 + 2 + 0 = 16
Target Instruction : 16 * 11 + 500 = 0676

2) Input : BIC 0300 02 M2.02.2 8 1

Selected Bits :	0	1	0	1	1	0	0	1
Decimal Scaling :	80	40	20	10	8	4	2	1

Total Scaling : 0 + 40 + 0 +10 + 8 + 0 + 0 + 1 = 59
Target Instruction : 59 * 02 + 300 = 0418

BIO - Branch Conditional on Byte Compare

BIO V600 M2.02 Q1,01 01201201 or
BIO 0123 M0.12 Q1.01 01201201

Assigned Bit Field
Compare Byte 2 : M0 – M5, M8, I0 - I4, Q0 - Q2
Compare Byte 1 : M0 – M5, M8, I0 - I4, Q0 - Q2
Target Instruction

The 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 the time period of one cycle.

BPA - Branch Conditional on Byte

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

Assigned Bit Field
Compare Byte : M0 – M5, M8, I0 - I4, Q0 - Q2
Target Instruction

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 the time period of one cycle.

CAN - Cam Shaft: Feed Angle

CAN 01 V600 V601 or
CAN 01 0000.00 0000.00

Off Angle in IU, Master Axis [degrees] (editable on-line)
On Angle in IU, Master Axis [degrees] (editable on-line)
Master Axis 01 = Optional Encoder
02 = SSI Encoder
03 = Virtual Encoder

This command determines in which area of the master axis encoder value the cam is processed. (Changes are considered outside of the feed angle)

The following conditions are valid:

- Off Angle >= On Angle
- Both Values <= 360 degrees

The program proceeds to the next instruction after the time period of at least 2 cycles.

CID - Change Variable Value

CID V600 0 + V601 or

CID V600 1 +000000.100

Operand

Operational Sign:
+ = Operand is added to target variable
- = Operand is subtracted from target variable

Assignment:
0 = Addition or subtraction
1 = Addition or subtraction; however the result must be positive following the operation or the operation will not be executed.
2 = Addition or Subtraction; however the result must be negative following the operation, or the operation will not be executed.
3 = Place information and its operational sign in variable.
4 = Addition or subtraction; however the result must be positive following the operation or the operation will not be executed.
5 = Addition or Subtraction; however the result must be negative following the operation, or the variable is set = 0

Target Variable

This command adds/subtracts a value to/from a variable. Unlike the MAT command, the result is limited according to 'Assignment.'

The program continues after the time period of one cycle.

CIO - Copy Bit Field

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

Number of bits to be copied: (0 – 16)

Copy Target : Start Bit : M2, M3, M4 ,M8
DKC21.3 : Q0.00.4-Q0.01.3
DKC 3.3 : Q2.02.0-Q2.05.7

Copy Source : Start Bit : M0 – M5, M8, 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.

Input Bit	7	6	5	4	3	2	1	0
Status	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**1**

Marker Bit	7	6	5	4	3	2	1	0
Status Before	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**
Status After	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**

The program proceeds to the next instruction following the time period of one cycle.

CLC - Clear Counter

CLC V661 or
CLC 0123

Instruction 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 the time period of one cycle.

CLG - Cam Shaft: Stroke

CLG 1 +V700 or
CLG 1 +000010.000

+000010.000 — Stroke, Feed Length in IU (editable on-line)

Cam: Curve stroke
Synchronization by Precise Positioning: Acceleration path
If 000000.000 is input, the acceleration path is automatically calculated (=A106^2 / 2*A109)

1 — Axis = 1 (always 1)

The default for stroke or length must be programmed before turning on the slave axis.

If this command is used during operation, the new length is transferred after exiting the feed angle. This dynamic change of length does not make sense for all applications!

The program continues after the time period of one cycle.

CMM - Cam Shaft: Assignment

CMM 1 01 01 0 0

- Reserved
- Mode
  - 0 = Slave Axis
  - 1 = Synchronization by Precise Positioning
  - 2 = Pxx Command with Cam
  - 3 = Cyclic Cam
  - 4 = Cam Start/Stop
- Master Axis
  - 01 = Optional Encoder
  - 02 = SSI Encoder
  - 03 = virtual Encoder
- Cams:
  - 0 = Quadratic Parabola (Velocity Triangle)
  - 1 = Sloping Sine Cam
  - 2 = Modified Sine Cam
  - 3 = Grade 5 Polynomial Cam
  - 4 = Sloping Sine Cam (Change velocity, no jerk)
  - 5 = User-Programmable Cam (see Cam Transfer)

  Cam: Selecting the Law of Movement 0-5 (editable on-line)
- Axis = 1 (always 1)

The program continues after the time period of one cycle.

Note:	The error message **"F- 03 25 – Mode unauthorized"** is issued if a different mode is active than the one pre-set here!

Note:	For Mode 1, the cam shapes 2 and 3 (standardized Law of Movement "notch-in-notch") are not usable.

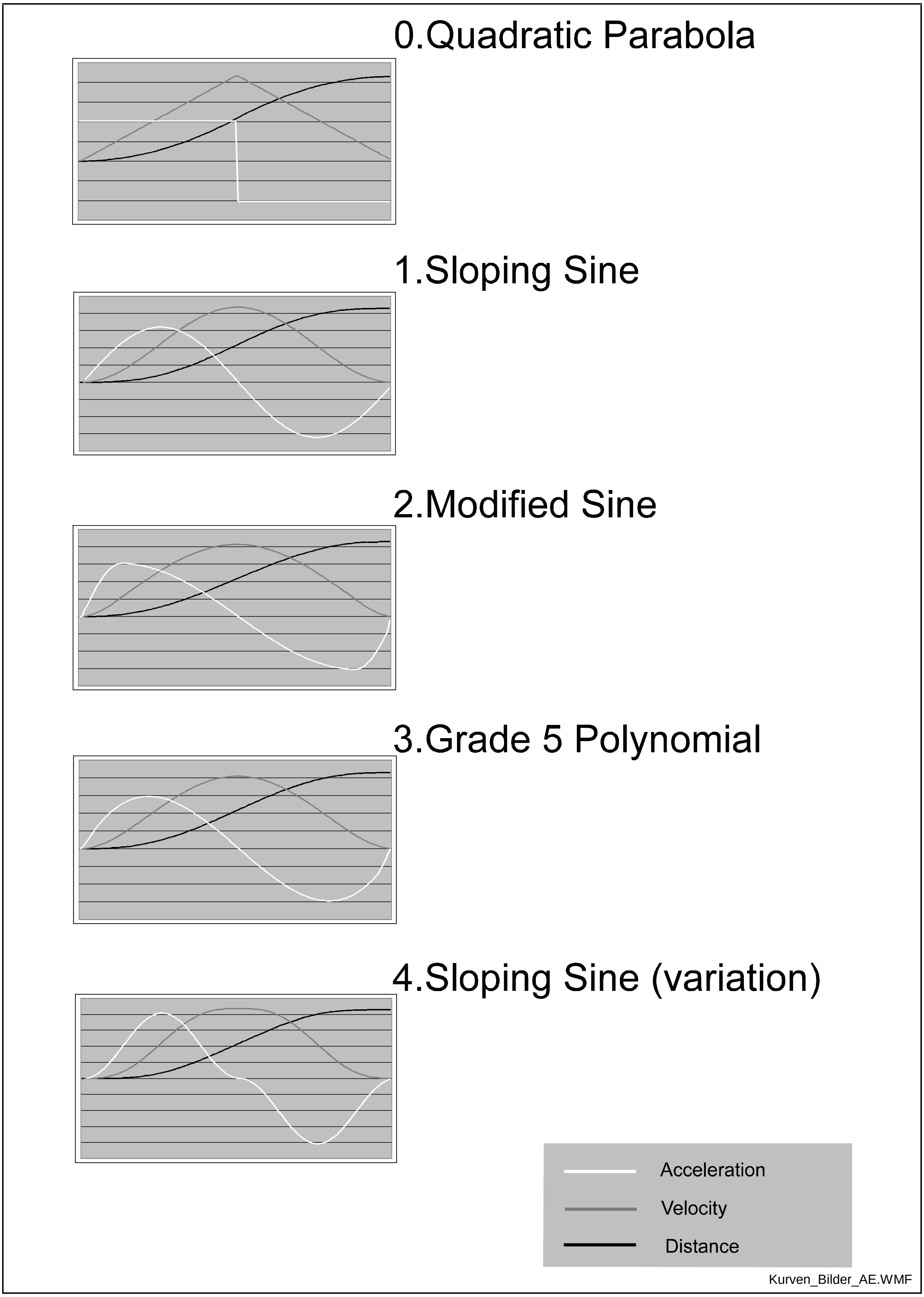


Fig. 6-12: Pre-Defined Cams

CON - Continuous Operation

CON 1 V601 +V602 or
CON 1 1 +999

Velocity in ‰ (001 to 999) of the programmed maximum velocity (parameter A106)

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

0 = continuous operation OFF
1 = 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 A103** and **A104**) 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 the time period of one 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 ,M8
DKC21.3 : Q0.00.4-Q0.01.3
DKC 3.3 : Q2.02.0-Q2.05.7

Actual Quantity 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. If the target quantity is reached, the programmed bit is turned on.

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   0002  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!

Note: If the target piece count is programmed through a variable for the COU and BAC commands, the current piece count is automatically assigned to the variable with the number higher by 1.

The program proceeds to the next instruction following the time period of one cycle.

CPJ - Compare and Jump

CPJ V600 >= + 601 V602 V603 or

CPJ V600 >= +12345.123 1234.12 0400

Target Instruction

Tolerance Range

Compare Operand 2

Operational Sign for Compare Operand 2

Compare Conditions

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

Compare 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. For the compare conditons ’same’ and ’different,’ the condition is met when the difference between the two operands lies within the tolerance range.

Example: CPJ V600 >= +V601 0000.00 0400

V600 = 100.000

V601 = 090.000

The command branches to instruction 400

The program proceeds to the next instruction following the time period of one cycle.

CPL - Clear Position Lag

CPL 1

Axis: 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.

CAUTION

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.

The program proceeds to the next instruction following the time period of one cycle.

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 , M8

DKC21.3 : Q0.00.4-Q0.01.3

DKC 3.3 : Q2,020,0-Q2,050,7

Tolerance Range

Compare Operand 2

Operational Sign for Compare Operand 2

Compare Conditions

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

Compare Operand 1

The result bit is set when the comparison has been made. Otherwise, the result bit is deleted. For the compare conditons ’same’ and ’different,’ the comparison is met when the difference between the two operands lies within the tolerance range.

The program proceeds to the next instruction following the time period of one cycle.

CST - Clear Subroutine Stack

CST 1 1

Second parameter:
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

First parameter:
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 accessed within one program cycle, a direct return across 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 across several levels.

Note: If all the subroutine stacks are cleared, no ’RTS’ command may follow the ’CST’ command, or the error message "**F- 02 06 - St. underflow RTS**" is displayed.

Example:

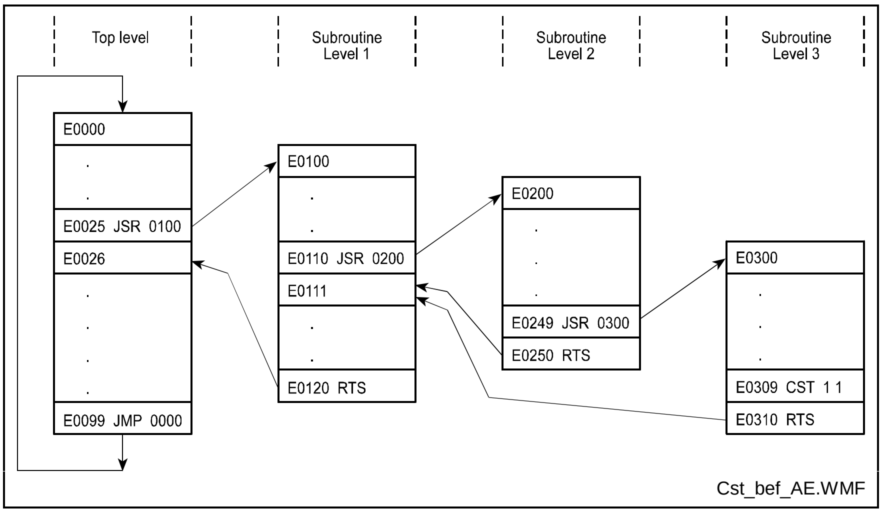


Fig. 6-13: Example Overview of Subroutine Stack Levels

CSY - Cam Shaft: Activation

CSY 1 0 0 0 00.00.0

- 00.00.0: Reserved (Free)
- fourth digit (0): Reserved (Free)
- third digit (0): Reserved (Free)
- second digit (0): Reserved (Free)
- first digit (1):
  0 = Off
  1 = On (real master axis)
  2 = Activation status unchanged
  3 = Shutoff when the cam passes the zero point

The program continues after the time period of one cycle.

CVT - Convert Variable <-> Marker

CVT V601 M2.02 1 1

- last digit (1):
  0 = Convert from a variable to a bit pattern
  1 = Convert from a bit pattern to a variable
- first digit (1):
  0 = BCD conversion
  1 = Binary conversion
- M2.02: Lowest byte of the bit pattern :
  Starting with this byte, the 8 following bytes are always converted.
  (Input only M2.00 – M2.12)
- V601: Variables

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

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)

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

The program proceeds to the next instruction following the time period of one cycle.

CVT Example:

Convert the content of a variable to a BCD bit pattern

V600 = -87654321.654321

CVT V600 M2.00 0 0

Marker Flag	Bit Number 7654 3210	Value	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. 6-14: Marker Use After Executing the CVT Command

<u>Example: Loading the Decade Switch</u>

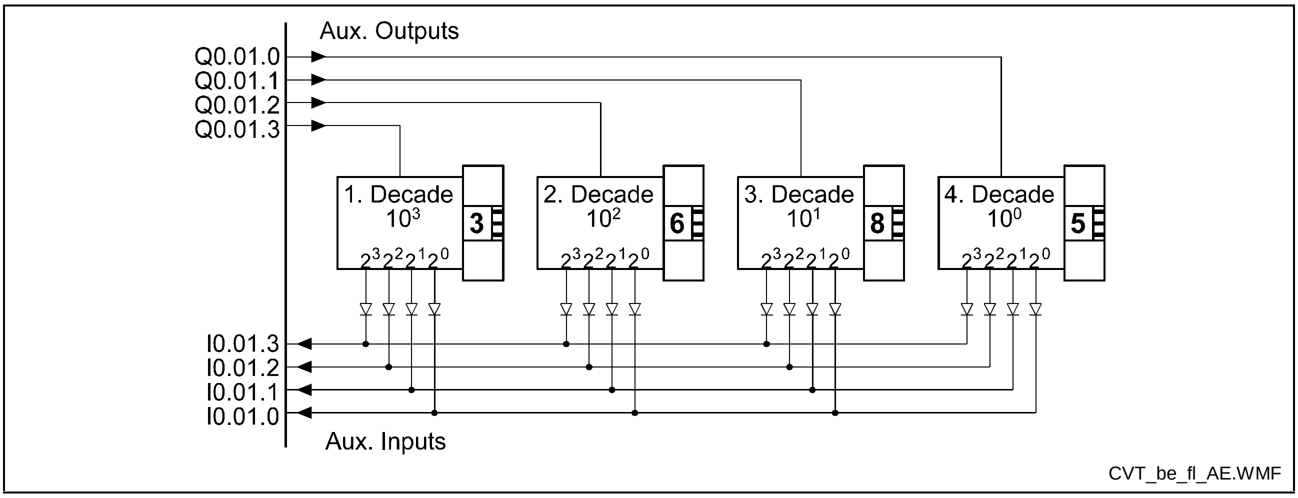


Fig. 6-15: Loading the Decade Switch

Instruction No.	Commands	Comment
0000	SET V600 = +00000000.000000	Initial Value for Marker
0001	CVT V600 M2.00 0 0	Initialize Marker with 0
0002	APE Q0.01 22220001	4. Select Decade Switch 10^0
0003	WAI 00.02	Wait Until Level is Stable
0004	CIO I1.01.0 M2.03.0 04	Load Value of the Decade Switch
0005	APE Q0.01 22220010	3. Select Decade Switch 10^1
0006	WAI 00.02	Wait Until Level is Stable
0007	CIO I1.01.0 M2.03.4 04	Load Value of the Decade Switch
0008	APE Q0.01 22220100	2. Select Decade Switch 10^2
0009	WAI 00.02	Wait Until Level is Stable
0010	CIO I1.01.0 M2.04.0 04	Load Value of the Decade Switch
0011	APE Q0.01 22221000	1. Select Decade Switch 10^3
0012	WAI 00.02	Wait Until Level is Stable
0013	CIO I1.01.0 M2.04.4 04	Load Value of the Decade Switch
0014	CVT V600 M2.00 0 1	Write Decade Switch Value after V600
0015	JMP 0002	Read Decade Switch Again

Fig. 6-16: Programming Example: Loading the Decade Switch

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:

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

Fig. 6-17: Calculation of Incremental Positioning

The formula below applies for absolute positioning:

$$\boxed{Target\ Position = Preselected\ absolute\ Position \times Multiplication\ Factor}$$

Fig. 6-18: 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 (Manual/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. 6-19: Example of Multiplication Factor for Positioning Motions

The program proceeds to the next instruction following the time period of one cycle.

FOL - Follow Master

FOL 1 V600 – V601 or
FOL 1 1 –01.123456

Slave Factor
Input of 0.000000 to 99.999999

Direction, with reference to Master Axis
+ or ` ´= in the same direction
- = in the opposite direction

Slave Axis Mode
0 = Slave Axis OFF
1 = Slave Axis ON, without ramp
2 = Slave Axis ON with acceleration ramp
Dynamic Synchronization

Slave Axis = 1

Using this command, the axis follows a master encoder as a slave axis. The master is the optional encoder 2.

The 'FOL' command can be used to enable or disable the slave axis function (with or without an acceleration ramp). The behavior of the slave axis can also be changed by using a slave factor.

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

$$\boxed{\textit{Positioning Travel Master}\,[IU]\times \textit{Slave Factor}}$$

L: IU = input units

Fig. 6-20: Calculation of Positioning Travel of Slave Axis

In calculating the positioning travel in IU for the slave and master axes, the IU 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.

To synchronize with a rotating master encoder, the slave axis can be accelerated or decelerated (when switching off equipment) using a ramp. The acceleration ramp can also be activated when changing the slave factor. The acceleration is determined in Parameter A108/A109 or with the ACC command. It is also possible to synchronize without using a ramp.

An additional positioning motion (e.g., using the POI or PSI commands) is additive to the positioning of the slave axis. The velocity is therefore limited, so that the maximum velocity (Parameter A106) is not exceeded.

With the POA/PSA commands, the slave axis is deactivated and it is positioned to the set absolute position using the set velocity. If a velocity of 0 is set in the POA/PSA command, positioning is accomplished using the retrieved current master velocity.

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

Each time a switch from Parameter Mode to Manual or Automatic Mode occurs, and after an error, the slave axis must be reactivated using the command.

The master encoder can be selected using the CMM command. If the CMM command was not invoked, the optional encoder is automatically set as the default master.

Start/Stop and Interrupt are only active in Mode 2 when the slave axis is switched on. When an E-STOP occurs, the axis is no longer synchronized. The equipment is stopped using "Best possible deceleration.“

See also Section 8, 'Slave Axis.'

The program proceeds to the next instruction following the time period of one cycle.

FUN - Functions

FUN 1 0 0 0 0 0 0

- Reserved
- Length Measurement, Encoder 3 (SSI Encoder) (only when the master axis is **not** programmed in Parameter A100)!
- Length Measurement, Encoder 2 (optional encoder)
- Length Measurement, Encoder 1 (motor encoder)
- Time Measurement 2
- Time Measurement 1
- Measuring the Average Velocity [IU/s]

Inputs for Controlling the Measurements:

0 = Buffer the measured value, then clear counter and re-start measurement.

1 = Clear counter and re-start measurement. The buffered value remains intact.

2 = No change.

3 = Buffer measured value. Leave counter unchanged.

4 = Turn off Measuring.

The buffered values can be found in system variables:

System Variables:

V106 = Average velocity [IU/s] (positive values only)

V030 = Time Measurement Counter 1 – current value [ms]
V031 = Time Measurement Counter 1 – buffered measured value [ms]
V032 = Time Measurement Counter 2 – current value [ms]
V033 = Time Measurement Counter 2 – buffered measured value [ms]

V034 = Length Measurement Encoder 1 – current value [IU]
V035 = Length Measurement Encoder 1 – stored measured value [IU]
V036 = Length Measurement Encoder 2 – current value [IU]
V037 = Length Measurement Encoder 2 – stored measured value [IU]
V038 = Length Measurement Encoder 3 – current value [degrees]
V039 = Length Measurement Encoder 3 – stored measured value [degrees]

The system variables V030 to V039 are not monitored for overflow
The following values should not be exceeded

for length measurement:	±214748 or ± 11796479 for Encoder 3
for time measurement:	±99999999

The program continues after the time period of one 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.
In ’rotary’ motion type, (see Parameter A100), this command is not permitted.

In both cases, the error message "**F- 02 17 – HOM not allowed**" is issued.

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’ bit 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 8.3.

The program proceeds to the next instruction following the time period of one cycle.

JMP - Jump Unconditional

JMP V601 or
JMP 0123

Target Instruction

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, otherwise the error message "**F- 03 02 - NC-Block Nr. illegal**" erfolgt.

The program proceeds to the target location following the time period of one 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 16 subroutine levels are possible. For more than 16 levels, the error message "**F- 02 05 - St. overflow. JSR**" is issued.

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 control generates the error message "**F- 02 06 - St. overflow. RTS**."

The program proceeds to the start instruction following the time period of one cycle.

JST - Jump and Stop

JST V611 or
JST 0123

Target Instruction

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 measurement, as long as there was no change of operating mode or error message.
Continuous operation using the 'CON' command is disabled!

The output states are not changed by a 'JST' command. In multitasking (see Section 8.7), 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 - Jump in Task

JTK V611 1 or
JTK 0123 1

1 = Target Task 1
2 = Target Task 2
3 = Target Task 3
Target Instruction

This command can be used to influence program execution in one of the other tasks. The program stops processing in the specified target task, and the target task branches to the specified target instruction.

The command 'JTK_0100_2' that is called in Task 1 causes execution of the Task 2 program to continue at instruction 100.

The command \`JTK 0100 1´ in Task 1 has the same meaning as the 'JMP 0100' command.

The program proceeds to the next instruction following the time period of one cycle.

LAE - End: for Synchronization by Precise Positioning

LAE 1

End Synchronization

Slave Axis: 1

Synchronization is disabled and decelerated using the current deceleration value (Parameter A109 or ACC Command). Proceeding to the next instruction occurs when the axis has stopped.

LAL - Length: for Synchronization by Precise Positioning

LAL 1 000100.000 00.00.0 or
LAL 1 V600 I0.01.0

Inputs ee:
ee = Immediate Cut (Immediate Synchronization)
ee+1 = Cut Inhibit (Inhibit Synchronization)

Product Length [IU]

Slave Axis: 1

Proceeding to the next instruction occurs as soon as the axis begins synchronizing. Therefore, outputs (for example) can be set, even before the synchronization is complete. The "rising edge" at Input "ee“ is queried until synchronization begins. Input "ee+1“ is always queried when a function is activated. A detected rising edge of Input "ee+1“ is immediately recognized and confirmed with Marker Flag M1.02.1.

No synchronization occurs if the length read from the Master Position Counter is too short. (shorter than 2 x Acceleration Distance). In this case, the marker flag "Synchronization not possible" is set and proceeding to the next instruction is delayed until **"Immediate Synchronization"** is initiated.

See also Section 8, ‘ Flying Cutoff.'

LAR - Raster: for Synchronization by Precise Positioning

LAR 1 000100.000 00.00.0 00.00.0 oder

LAR 1 V600 I0.01.0 00.00.0

Raster Input "Start Synchronization“:

Bit: M0 – M5
I0 - I4
Q0 - Q2

I4.00.3 / I4.00.4 = Fast Inputs (are currently evaluated just like standard inputs!)

00.00.0 = Immediate Synchronization occurs

Inputs ee:
ee = Immediate Cut (Immediate Synchronization)
ee+1 = Cut Inhibit (Inhibit Synchronization)

Offset Dimension [IU]

Slave Axis: 1

The raster input may only occur when the carriage is in its initial position. The raster detection device must be placed in the direction of the material from the initial position. The offset dimension is determined by the distance between the initial position and the processing location to be reached, when the raster is located precisely under the raster detection device.

Proceeding to the next instruction occurs as soon as a rising edge is recognized at the input **"Start Synchronization"** or **"Immediate Synchronization."**

No synchronization occurs if the length read from the Master Position Counter is too short. (shorter than 2 x Acceleration Distance). The error message **"F- 02 30 – Offset Dimension too small"** is issued.

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 addition and subtraction functions require an NC cycle (2ms).

The multiplication and division operations are transferred to a calculating unit. This unit functions independently from the cycle time. Furthermore, this calculating unit can be used by the other program tasks. Therefore, this command can endure over the time period of multiple 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

- V602 / 100: Continuous torque limit in %. (100% corresponds to motor current level at standstill; Parameter CM02)
  input range of 000%…500%
  Warning: The Parameter A115 monitoring function remains active.
  500% = torque limiting is turned off.
- M2.02.3: Bit: Torque limiting is only active when the selected bit is set to 1.
  M0 – M5, M8, I0 -I4, Q0 - Q2
  00.00.0 = torque limiting is always active
- V601 / 456: Maximum torque at positive stop in % (**<u>only</u>** valid with an active PFA/PFI command)
- V600 / 123: Maximum torque during movement to positive stop in % (**<u>only</u>** valid with an active PFA/PFI command)
- 1: 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 500 percent.

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

Note: When the MOM command is used, error messages may be generated if the torque limit is set too low ('**F228 – Excessive Deviation,' 'F878 – Velocity loop error**'). 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: The parameter CM01 "Bipolar Torque/Force Limit Value" limits all previous settings via the MOM command. The smaller of the two limit values in the MOM command and Parameter CM01 is always used.
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.

The program proceeds to the next instruction following the time period of one cycle.

NOP - No Operation

NOP

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

The program proceeds to the next instruction following the time period of one cycle.

PBK - Stop Motion

PBK 1

Axis 1

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

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

If continuous operation has been enabled (using ’CON’ command) it is disabled.

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

Example:

0000	CON	1 1 +999
0001	WAI	02.000
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 IU from the previous ’POI’ command. There is, however, a continuous transition from V = 99.9% to V = 10%.

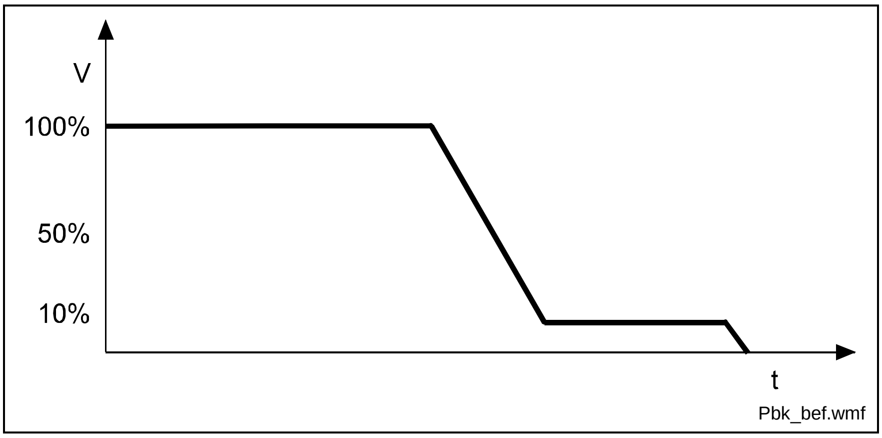


Fig. 6-21: Example of Positioning Break

The program proceeds to the next instruction following the time period of one cycle.

PFA - Positioning, Absolute to Positive Stop

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

- 010: Standstill window in ‰ (001 to 999) of the maximum velocity (Parameter A106).
- 123: Feedrate in ‰ (001 to 999) of the maximum velocity.
- +123456.789: Absolute position given in IUs
- 1: Axis 1

For functioning of the command, see PFI command.

See also Section 8 function 'Movement to Positive Stop.'

PFI - Positioning, Incremental to Positive Stop

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

- 010: Standstill window in ‰ (001 to 999) of the maximum velocity (Parameter A106).
- 123: Feedrate in ‰ (001 to 999) of the maximum velocity.
- +123456.789: Feed distance in IUs
- 1: 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.

So that the motor is not overloaded, the torque values should be set by the MOM command. The start of the positioning move generally occurs 150 ms after the command is loaded.

Note: Before invoking commands PFA and PFI, the torque limit values must be set by invoking the MOM command.

See also Section 8 function 'Movement to Positive Stop.'

Example:

0100	MOM	1 020 040 00.00.0 400	Torque Reduction: 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 +000300.000 100 002	Movement to positive stop until position +300 is reached.
0104	JMP	0200	Jump if positive stop was not recognized.
0105	BCE	0120 I0.00.7 1	Positive stop was 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. 6-22: PFA Command Program Example

POA - Positioning, Absolute

POA 1 + V600 V601 or
POA 1 +123456.789 999

- Feedrate in ‰ (001 to 999) of the maximum velocity given in the parameter (Parameter A106)
- Absolute position given in IUs
- 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.

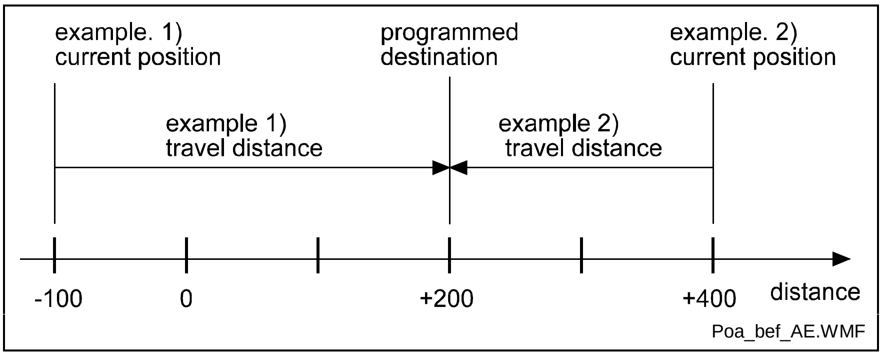


Fig. 6-23: Example of Position, Absolute

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 Section 8.3, Homing). Otherwise, the error message "**F- 03 05 - n. referenced**" is issued. For the application type "rotary" the absolute relationship between Parameter A100 and the SAC command can be established.

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 the time period of one cycle.

POI - Positioning, Incremental

POI 1 +V600 V601 or
POI 1 +123456,789 999

Feedrate in ‰ (001 to 999) of the maximum velocity given in the parameter (Parameter A106)

Feed length in IU (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:

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

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

The program proceeds to the next instruction following the time period of one cycle.

PSA - Positioning, Absolute with In-Position

PSA 1 + V600 V601 or
PSA 1 +123456.789 999

- 999: Feedrate in ‰ (001 to 999) of the maximum velocity given in the parameter (Parameter A106)
- 123456.789: Absolute position given in IUs
- +: Operational sign of the position (+/-)
- 1: 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 threshold’) for the programmed position.

Example:

+ 100,00	= current position
0,20	= switching threshold, 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 - Positioning, Incremental with In-Position

PSI 1 + V600 V601 or
PSI 1 +123456.789 999

- Feedrate in ‰ (001 to 999) of the maximum velocity given in the parameter (Parameter A106)
- Feed length in IU
- 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 threshold’ (Parameter 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 threshold).

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 Q0.00.6 is activated.

REP - Registration Position Limit

REP V600 1 V601 or
REP 0100 1 123456.789

Maximum search path for 'SRM' command in IU
Axis 1
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.
Otherwise, the program proceeds to the following instruction immediately.

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 IU is programmed in the 'REP' command.

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

RTM - Rotary Table Mode

RTM 1 V600 or
RTM 1 0

Rotary table mode:
0 = mode is accepted from **Parameter A105**
1 = shortest distance
2 = programmed direction
>2 = no change in mode
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 described for the ’JSR’ command, a subroutine must be concluded with an ’RTS’ return command.

If several subroutine levels have been accessed 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.

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 control generates the error message "**F- 02 06 - St. overflow. RTS**."

Example:

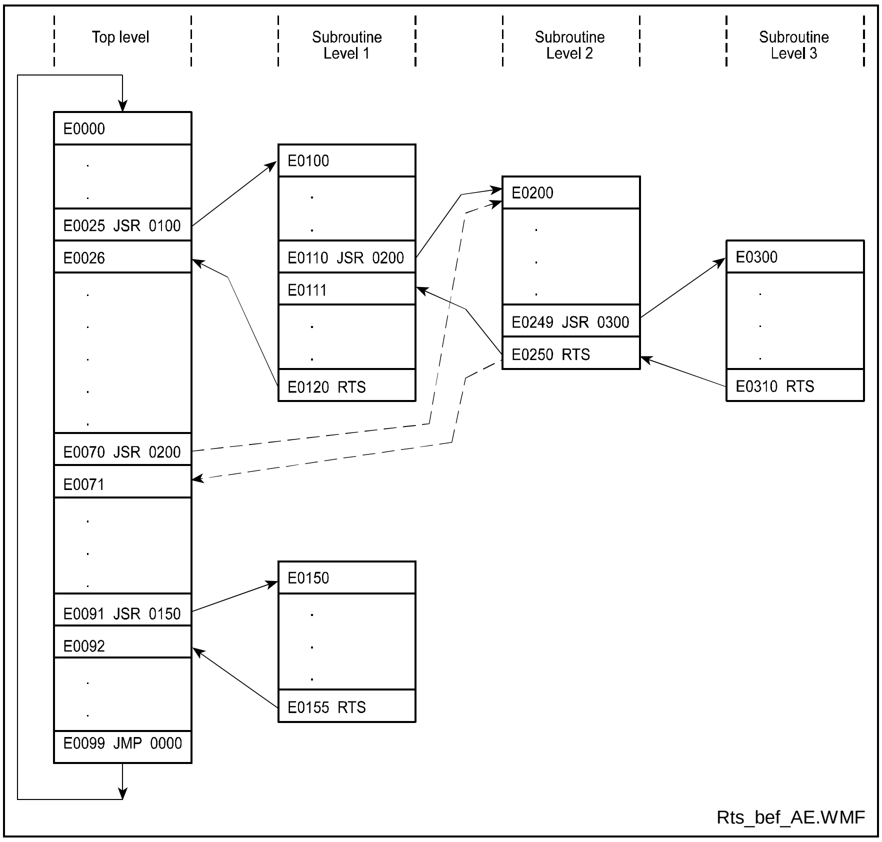


Fig. 6-24: Example of Return from Subroutine Levels

The program continues after the time period of one cycle.

SA1 - Set Analog Output 1

SA1 0 +V600 V601 V602 M2.12 or
SA1 0 +9.999 0 1000 M2.12

Marker Flag Field (M2)
Startup Time in ms
Time for stroke voltage to go from 0 to 10V
Scaling factor (Variables V600 – V999, only for Mode 2 !)
Output value (Volt)
Mode: 0 = off
1 = one-time output.
2 = continuous output with scaling factor.

The analog output channel AK1 (Connector X3, Pin 16/18) can be affected by this command. The conversion of the digital programmed value occurs via an 8-bit digital-analog converter. The max. output voltage is +/-10V.
The output occurs during each NC cycle.

The program proceeds to the next instruction following the time period of one cycle.

Output Value:

Value to be output.

Values over +/- 10 are output as +/- 10V.

Mode:

0. Disabling the analog output.
   The output value ramps up to the value = 0 using the set startup time. The marker flags in the marker flag field are set (i.e. bit 4) and are then no longer processed by this function.
1. The output voltage can be input directly as a constant or a variable. The data range is from -9.999 to +9.999. The input of the scaling factor is ignored.
   Input variations:
   SA1 1 +9.999 0 1000 M2.00
   SA1 1 +V600 0 V601 M2.00
   The output value and the startup time are processed once while skipping the command.
2. This way, the data that originates in a different place (i.e. system variables) can be output at the analog output.
   The output value is multiplied by the scaling factor in every NC cycle and is output as output voltage while maintaining the startup time. If the startup time is to be altered, the command must be changed to contain the new value.
   Input variations:
   SA1 2 +V104 V600 1000 M2.00
   SA1 2 +V104 V600 V601 M2.00
   The startup time is processed once, while the command is skipped.

Startup Time:

This time is always expressed in relation to the stroke voltage of the output from 0 to 10V and is input in ms.

Marker Flag Field:

In the specified marker flag field, the following information is available, with reference to Analog Output 1:

M2.xx.4 Output value = 0

M2.xx.5 Acceleration in the positive direction.

M2.xx.6 Acceleration in the negative direction.

M2.xx.7 Output value is constant but not equal to zero.

Notes:

- If errors or a mode change from Automatic to Manual occur, the analog output ramps to 0 using the actual data.
- In Parameter Mode, the value is kept at 0 signal.
- In Parameter B003, "S 0 0000" must be input and in Parameter B004, "00000000" must be input. If this is not the case, the error message "**F- 02 22 - SA1 not allowed**"is output.

Example:

	SA1	1 0.000 0 0200 M2.13	Startup Voltage 0 Volts
	AKN	M2.13.4 1	Is the analog output = 0?
	AEA	Q0.00.6 1	Set enable signal.
	WAI	0.2	Wait until enable takes effect.
	SA1	1 5.000 0 0200 M2.13	Analog output 5 Volts
	AKN	M2.13.7 1	Wait until constant velocity is reached.
	SA1	1 0.000 0 0400 M2.13	Analog output 0 Volts
	AKN	M2.13.4 1	Is the analog output = 0?
	AEA	Q0.00.6 0	Clear enable signal.

Fig. 6-25: SA1 Command Example

SAC - Set Absolute Position Counter

SAC V601 0 +V600 or

SAC 1 0 +123456.789

Absolute position or offset in IU

Mode:

0 = Absolute zero offset relative to the home position.
1 = Set new absolute position.
9 = Clear ‘Homed’ entry (only if Parameter A100 = 0 x).

Axis 1

Using this command, the coordinate system is offset or set to a particular value.
The changes made using the 'SAC' command are temporarily valid. After a system restart, switch to Parameter Mode or clearing an error, the initial coordinate system becomes valid again.

The command is executed correctly only when the axis signals ‘Position reached.' (Parameter A111)
The program proceeds to the next instruction following the time period of one cycle.

Motion type = 0 (rotary)

Parameters "**A103, Negative travel limit**" and "**A104, Positive travel limit**" are not valid.

Axis is not homed:

- Modes 0 and 1:
  The actual position is set to the value found in the SAC command. This way, the axis is homed.
- Mode 9 :
  No function. The program proceeds to the next instruction.

Axis is homed:

- Mode 0 :
  The target position is offset by the value in the SAC command. (referenced to the initial coordinate system)
- Mode 1 :
  The target position is set to the value found in the SAC command.
- Mode 9 :
  The absolute position reference is canceled and the actual position is set to the value 0. The axis is no longer homed.

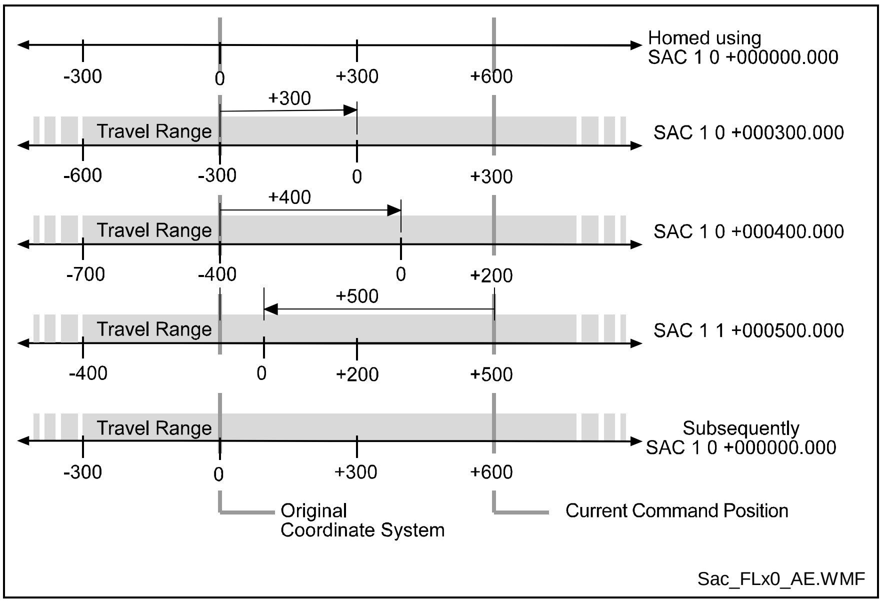


Fig. 6-26: How the SAC command works (rotary)

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Motion Type = 1 (linear)

Axis is not homed:

- Modes 0 and 1:
  The axis cannot be homed using the SAC command. Beforehand, the axis must be homed using the HOM command. The error message "**F- 03 05 - n. referenced**" is issued. See also Section 8, Functions/Homing.
- Mode 9 :
  No function. The program proceeds to the next instruction.

Axis is homed:

Parameters "**A103, Negative travel limit**" and "**A104, Positive travel limit**" are valid. They remain in the initial coordinate system.

- Mode 0 :
  The target position is offset by the value in the SAC command. (referenced to the initial coordinate system)
- Mode 1 :
  The target position is set to the value found in the SAC command.
- Mode 9 :
  No function. The program proceeds to the next instruction.

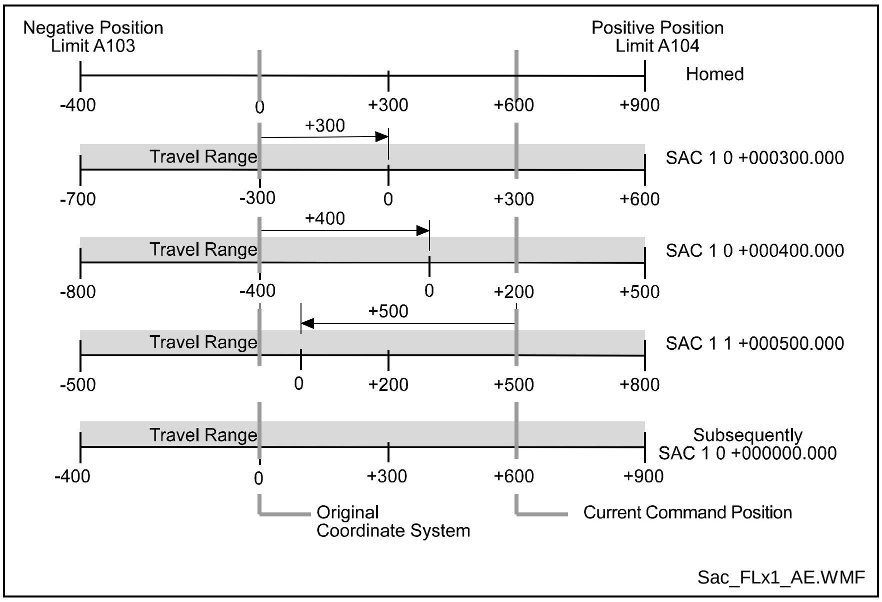


Fig. 6-27: How the SAC command works (linear)

Motion Type = 2 (Rotary Table)

Parameters "**A103, Negative travel limit**" and "**A104, Positive travel limit**" are not valid.
An offset of the initial coordinate system by a particular value > **Parameter A105; Modulo value** can lead to erroneous positioning moves.

Axis is not homed:

- Modes 0 and 1:
  The axis cannot be homed using the SAC command. Beforehand, the axis must be homed using the HOM command.
  The error message "**F- 03 05 - n. referenced**" is issued.
- Mode 9 :
  No function. The program proceeds to the next instruction.

Axis is homed:

- Mode 0 :
  The target position is shifted by the value in the SAC command. (referenced to the initial coordinate system)
- Mode 1 :
  The target position is set to the value found in the SAC command.
- Mode 9 :
  No function. The program proceeds to the next instruction.

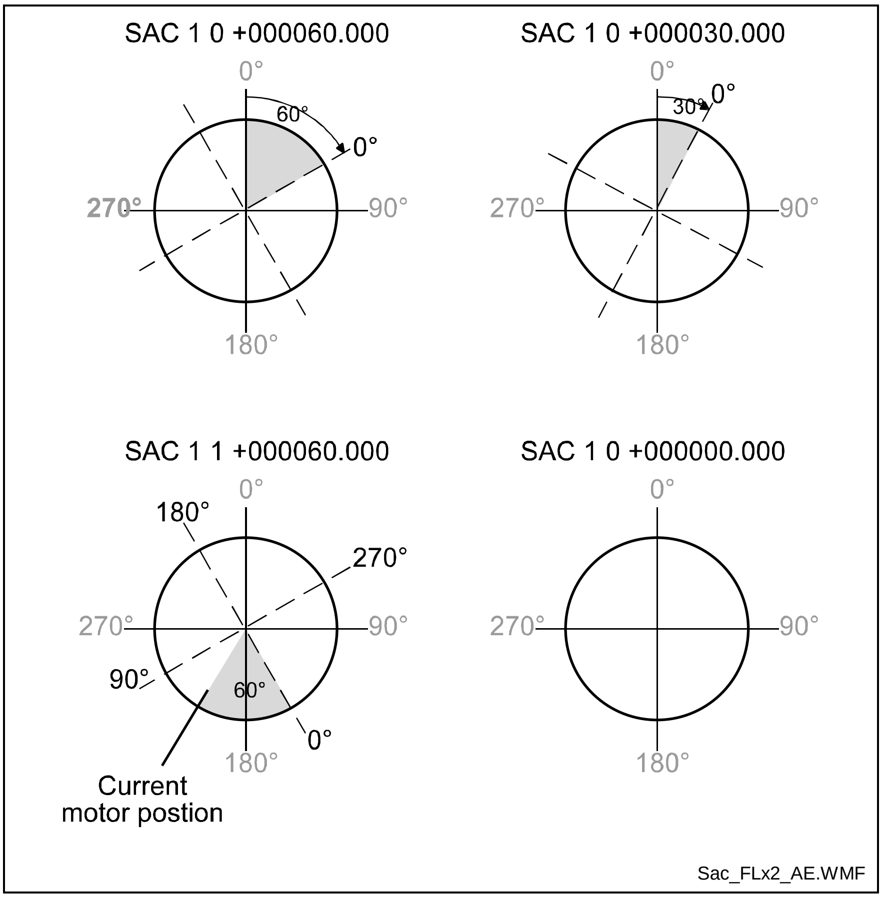


Fig. 6-28: How the SAC command works (rotary table)

SET - Set Variable Value

SET V600 = + V601 or
SET V600 = +12345678.123456

Value
Operational Sign
Target Variable

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

Valid inputs for '**Target Variable**' and the corresponding limit values:

Variable Type	Number	Minimum Value	Maximum Value
User-programmable	V600 to V999	-99999999.999999	+99999999.999999
Indicated Basis	V500 to V507 V510 to V517	+600	+999
Indicated Offset Factor	V508, V518	+0	+399
Indicated Index	V509, V519	+0	+399

Fig. 6-29: Set Command: Valid Target Variable

Valid Inputs for '**Value**':

Variable Type	Value	Access	Comment
User-programmable	V600 to V999	Direct	
Indicated Basis	V500 to V507 V510 to V517	Indicated	
Indicated Offset Factor	V508, V518	Direct	
Indicated Index	V509, V519	Direct	
System	V000 to V199	Direct	Only variable, according to Fig. 6-1 and Fig. 6-2
No Variable		Value	

Fig. 6-30: Set Command: Valid Target Variable

See also Section 6.6 – Variables.

The program proceeds to the next instruction following the time period of one cycle.

SRM - Search for Registration Mark

SRM 1 + V600 +V601 I0.01.0 or

SRM 1 +123456.123 + 123 I0.01.0

Input Bit Reference Mark (Input:Probe1 when 00.00.0 is input)
M0...M5 , I0...I4, Q0...Q2

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

Search Direction (The operational sign of the variable helps determine the direction)

Offset in IU

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 selected by the user. 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. Via this input, the reference mark position is determined, with a precision of 1 µs.

Offset Dimension:

The move to an offset dimension (referenced to the reference mark position) is accomplished immediately after detection of the reference point.

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 8.3).

Detection of the reference marker 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:

$$Search\ Velocity\ [IU/s] * 2 * CycleTime[s]$$

L: IU = Input Units
s = seconds

Fig. 6-31: Calculation of the Search Velocity

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

0000	SRM 1 +000000.000 +500 I0.01.0

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

With the Probe1 input (Connector X3 / Pin 4), there is no debouncing time and the detection occurs within a time frame of 1µs.
The accuracy is > 0.01 IU.

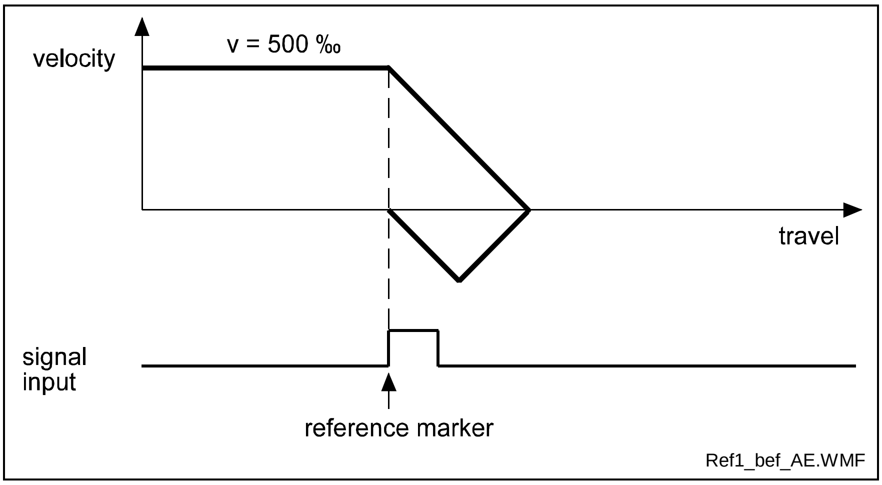


Fig. 6-32: Example of Movement to a Reference Mark

Example of moving to a reference mark with offset programming:

0000	SRM 1 +000200.000 +500 I0.01.0

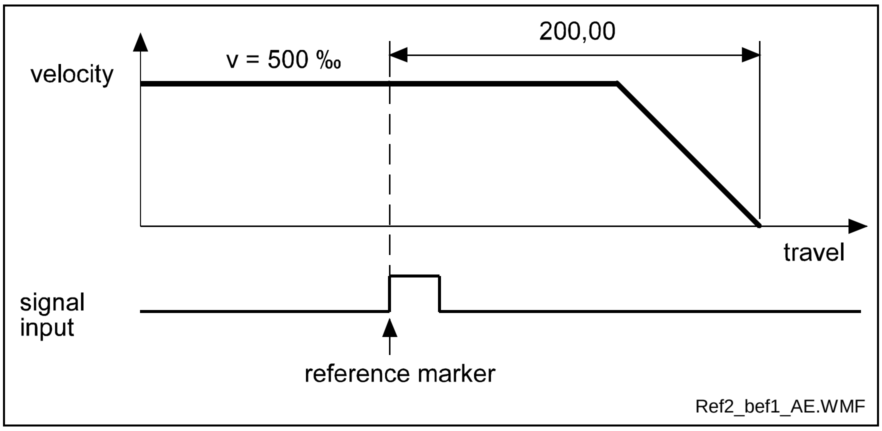


Fig. 6-33: Example of Moving to a Reference Mark with Offset Programming

SRP - Print Mark Registration

SRP 1 1 0 V600 M2.13

Marker Flag Byte (M2)

Start Point of the Variable Field (V600-V990)

0 = Evaluation of rising edge

Mode:
- 0 = disable the functionality
- 1 = automatic correction with following movement
- 2 = automatic correction in current movement
- 3 = detect raster position

Axis 1

Raster detection is accomplished using the SRP command. The command is invoked at the beginning of the automatic program and it thus enables the functionality. The beginning of the measurement occurs with the following feed command PSI. Depending on the assignment, the result can be processed immediately or in the next positioning operation. For Assignment 1, no correction is made in the first PSI command after the SRP.

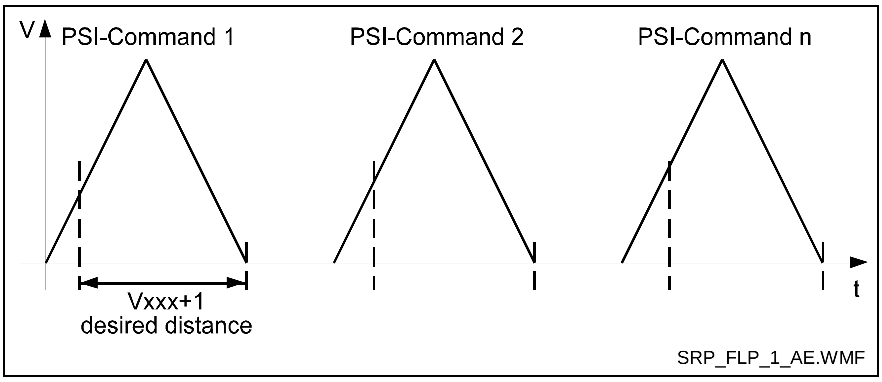


Fig. 6-34: Registration Marks

Marker Flag Byte:

M2.xx.4 Raster detected (read only)

Raster Input:

X3 Pin 4 This is a fast input.

Variable Field:

Different data is required for the various assignments. This data is input into a common variable field, where each assignment does not use every variable. The lowest address of the variable field is determined in the command.

Vxxx+0 = **measured distance** to the end position of the positioning operation in IUs (read only).

Vxxx+1 = **desired distance** to the end position of the positioning operation in IUs (read only).

Vxxx+2 = **maximum correction value** in IUs. (positive values only)
The difference between Vxxx+0 and Vxxx+1 can be limited to a maximum measurement with these variable.

Vxxx+3 = **Beginning of search** in IUs
(measured from the start position of the command)

Vxxx+4 = **End of search** in IUs
(measured from the start position of the command)
Vxxx+4 = 000 (no monitoring of search distance)

Vxxx+5 = **target instruction**, when end of search is exceeded

Vxxx+6 (Reserved)

Mode:

0 = disabling the functionality "Raster detection"

1 = automatic correction with following movement
The difference between the desired and the measured distance is output. The feed length of the next feed command is corrected by this value. To avoid a large correction, and therefore a movement which is too small, a maximum correction value can be set in the variable Vxxx+2.
The beginning and end of the search can be set in variables Vxxx+3 and Vxxx+4. If there is no raster signal in this area, the program branches to the instruction number set in variable Vxxx+5. The positioning operation is completed. If search monitoring is not enabled and no raster signal is detected, the next positioning movement is executed without correction.

2 = automatic correction in the current positioning operation
this function corresponds to Assignment 1. The correction is performed immediately after detection of the raster signal.

3 = Raster position detection
This function corresponds to Assignment 1. However, no correction is made. The information is entered in variable Vxxx+0 and marker flag M2.xx.4. This data is cleared only when the next positioning command is started.

Note: The execution of the SRP command can take up to 100ms.

Examples:

	SET	V601 = 20	Distance to End Position
	SET	V602 = 10	Maximum Correction
	SET	V604 = 0	No Search Monitoring
	SRP	1 1 0 V600 M2.02	
	WAI	0.1	
Start	PSI	1 +100 999	Feed Command
	JSR	Processing	
	JMP	Start	

Fig. 6-35: Example for Mode = 1

	SET	V601 = 20	Distance to End Position
	SET	V602 = 10	Maximum Correction
	SET	V604 = 0	No Search Monitoring
	SET	V700 = +100	Desired Positioning
	SET	V701 = +V700	Calculated Positioning
	SET	V702 = 0	Interim Value
	SRP	1 3 0 V600 M2.02	
	WAI	0.1	
Start	PSI	1 +V701 999	Feed Command
	BCE	Corr M2.02.4 1	
	SET	V701 = V700	
	JMP	Prog	
Corr	MAT	V702 = V602 – V601	
	MAT	V701 = V700 + V702	
Prog	JSR	Processing	
	JMP	Start	

Fig. 6-36: Example for Mode = 3

TXT - Text Row

TXT 0 ABCDEFGHIJKLMNOP

Text with 16 characters

Mode:
- 0 = Text can be requested via Status 63.
- 1 = Text can be requested via Status 53 (diagnostic).
- 2 = Text is no longer output as a diagnostic (Status 53).
- 3 = Text can be requested via Status 25.
- 4 = Text is no longer output as a diagnostic (Status 25).

Using the TXT command, text that can be read via Status Messages 53 or 63 across the serial interface can be prepared as defined in a program. The character set includes ASCII characters from ASCII code 32 to 95 (from the space character, numbers and capital letters to the underscore character).

Note: ASCII characters from ASCII code 32 to 95
except $ and \.

Output via Status 63:

Up to 64 characters can be used for the description in this status. This is achieved by using 4 TXT commands that must be written successively in the program. These are executed in one cycle (2ms). If less than 4 TXT commands are used, the Status 63 output has a length of n * 16 characters.

Example:

```
0001  TXT  0  W A I T _ F O R _ _ _ _ _ _ _ _
0001  TXT  0  F E E D _ A N G L E _ _ _ _ _ _
```

Status 63

Xs63_WAIT_FOR_ _ _ _ _ _ _ _ FEED_ANGLE_ _ _ _ _ _ _$ h h CR LF

Output via Status 53:

Using Status 53, the current diagnostic can be requested. In place of the diagnostics ’Manual’ and ’Automatic,’ the one-line text is output when calling the TXT command with Mode 1. All other diagnostics are dominant and are output in place of the text.

The program text in Status 53 is enabled only in Manual and Automatic modes, and it is deleted when switching from Automatic to Manual or Manual to Parameter.

Example:

Program is in Automatic Mode

```
0000  TXT  1  S T O P _ P R E S E N T _ _ _ _
0001  TXT  0  W A I T _ F O R _ _ _ _ _ _ _ _
0002  TXT  0  F E E D _ A N G L E _ _ _ _ _ _
0003  AEA  Q0.00.6  1
```

Status 53

? s X_ _5 3 _ CR LF

Xs53_AU_ _ _ _ _ STOP_PRESENT_ _ _ _ _ $hh CR LF

Status 63

? s X_ _63 _12_CR LF

Xs63_WAIT_FOR_ _ _ _ _ _ _ _FEED_ANGLE_ _ _ _ _ _ _$ h h CR LF

VCC - Velocity Change

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

Mode: 0 = Start of the velocity change
1 = Velocity reached

Switching Point:0 = Distance traveled (based on startposition)
1 = Absolute Position

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

Distance traveled in IUs up to switching point

Axis 1

Mode 0 : **Start of the Velocity Change at the Switching Point**

a) Switching Point = Distance Traveled:

Velocity changes are always relative to the most recently initiated positioning move before the VCC command. 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 IU, then proceed to next instruction
0001	VCC	1 000050.000 250 0 0	After 50 IU, change to 25% velocity
0002	VCC	1 000075.000 500 0 0	After 75 IU, change to 50% velocity
0003	VCC	1 000090.000 100 0 0	After 90 IU, change to 10% velocity
0004	AKN	M2.00.0 1	Wait until target position is reached
0005	WAI	01.000	End of cycle, wait 1 second
0006	JMP	0000	Repeat program

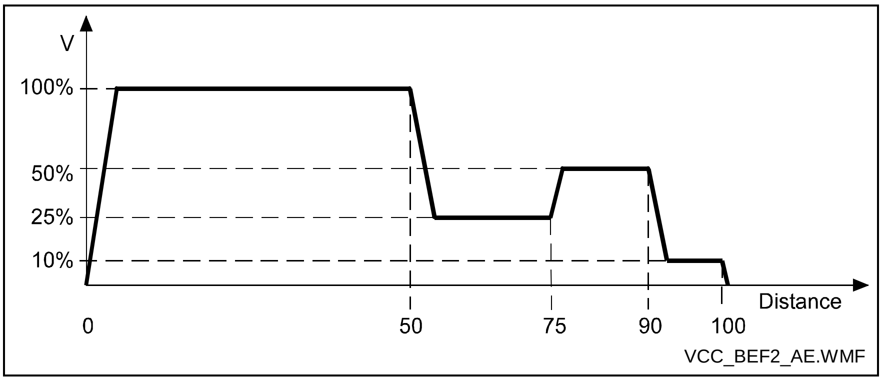


Fig. 6-37: Change Velocity (Distance Traveled)

b) Switching Point = Absolute Position

The switching point is referenced to the actual coordinate system.

Note: The axis must be homed to zero! Otherwise, the error message "**F- 03 05 – n. referenced**" is issued.

Mode 1 :

Velocity Change at the Switching Point

a) Switching Point = Distance Traveled:

Always referenced to the most recently initiated positioning function.

b) Switching Point = Absolute Position

The new velocity of the positioning move in process is reached at the absolute position indicated.

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.

Note: The axis must be homed to zero! Otherwise, the error message "**F- 03 05 – n. referenced**" is issued.

Example:

0000	PSA	1 +000100.000 999	Movement to Absolute Start Position +100 IU
0001	WAI	01.000	Wait
0001	POA	1 +000300.000 999	Movement to Absolute Position +300 IU
0002	VCC	1 +000200.000 500 1 1	At position +200 IU, V = 50%
0003	VCC	1 +000280.000 100 1 1	At position +280 IU, V = 10%
0004	AKN	M2.00.1 1	Wait until target position is reached
0005	WAI	01.000	End of cycle, wait 1 second
0006	JMP	0000	Repeat program

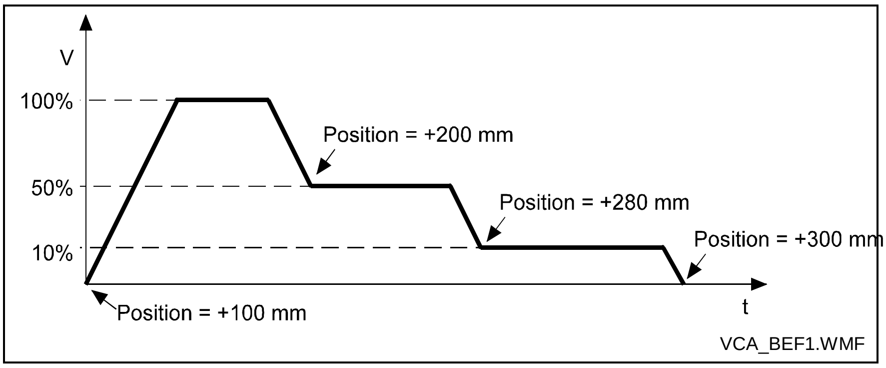


Fig. 6-38: Change Velocity (Absolute Position)

VEO - Velocity Override

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

Function
0 = Override as factor
1 = Override as limit

Override value in ‰ (from 001 to 999)
This value is significant only in mode 4

0 = Read in new override value in each controller cycle
(2 milliseconds)
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 analog input
2 = Binary value at inputs I0.00.6 to I0.01.4
3 = Gray code value at inputs I0.00.1 to I0.01.4
4 = Override value from VEO command (see above)

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 velocity from the parameter Vmax (**Param. A106**), and therefore limits the velocity. 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 ‘Manual' cancels the override function invoked by the 'VEO' command. The values can be changed again in Task 3.

See also Section 8.4 – Velocity Override.

The program proceeds to the next instruction following the time period of one cycle.

Examples: 'VEO' - Velocity Override

0000	BPA	0004 M2.02 22222201	Program Selection ; Jump to Program A
0001	BPA	0006 M2.02 22222210	Program Selection ; Jump to Program B
0002	BPA	0008 M2.02 22222211	Program Selection ; Jump to Program C
0003	JMP	0000	Wait Loop
0004	VEO	1 4 1 999 1	Program A; velocity unchanged
0005	JMP	0009	Execute positioning move
0006	VEO	1 4 1 700 1	Program B; velocity limited
0007	JMP	0009	Execute positioning move
0008	VEO	1 4 1 500 0	Program C; reduce velocity
			Execute positioning move
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 80mm, change to 20% velocity
0014	AKN	M2.02.4 1	Wait until switching threshold is reached
0015	WAI	01.000	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

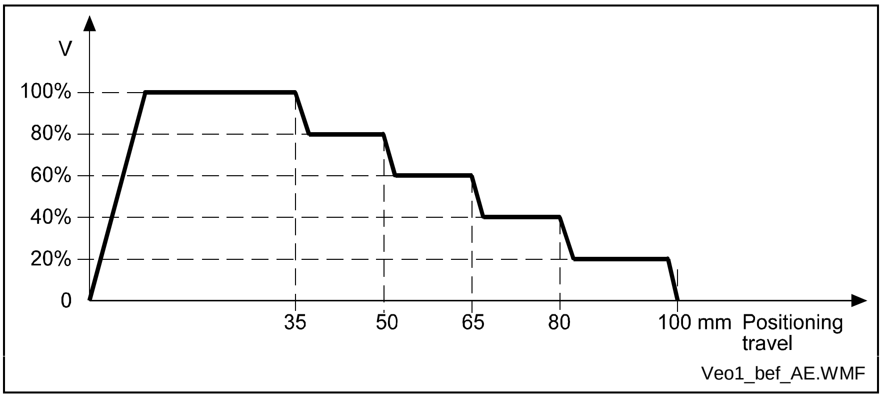


Fig. 6-39: VEO Command – Change Velocity

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

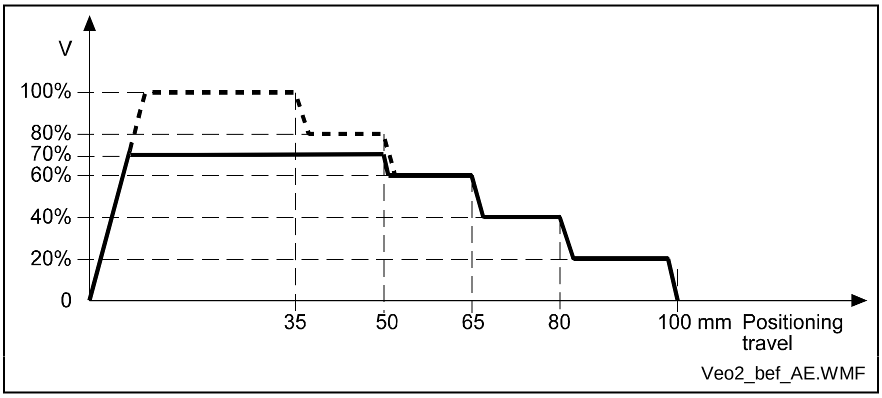


Fig. 6-40: VEO Command – Limit Velocity to 70%

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

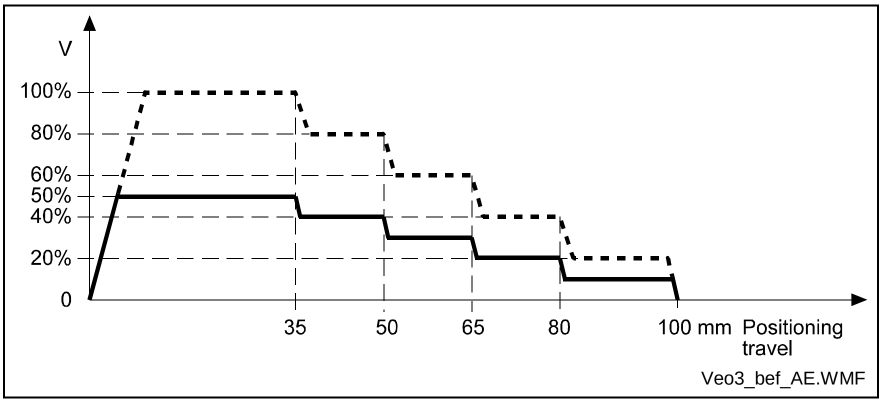


Fig. 6-41: VEO Command - Multiplication by a Factor

VMC - Virtual Master (Test Mode)

VMC 1 +999 999 or
VMC 1 +V600 V601

Acceleration:

Acceleration of the virtual Master in per mil (‰) from Parameter A109. This value is retrieved when the command is read.

Velocity:

Velocity of the virtual Master in per mil (‰) of the maximum velocity (Parameter A106).

Constants:
The value is retrieved once each time the command is read.

Variable:
Each time the command is read, the specified variable number is retrieved. The contents of this variable is then permanently read and evaluated by the function.

Slave Axis: 1

The virtual axis must be set using the CMM command. Before the function selected in the CMM command is activated using the CSY command, the VMC command must be executed.

WAI Wait (Time Delay)

WAI V600 or
WAI 00.500

Wait 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. (Resolution 2ms)

7 Logic Task

7.1 General Information

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/s is reached, where a minimum cycle time of 4 ms is present.

Logic- Task End of Program

Reading the program begins with program instruction 0000 and ends with the first "END“ command found.

Deactivate Logic Task

To deactivate the Logic Task, an "END" command must be programmed into program instruction 0000.

In the following cases, the error message **"F- 02 21 – Logic Task Program Error"** is issued:

- No valid Logic Task program or a valid program in the Logic Task without the "END" command.
- A Logic Task command uses an output or marker that is already being used in a Parameter, and therefore has been assigned to a function.

7.2 Overview of All Commands

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

Fig. 7-1: Logic Task Commands

7.3 Description of Commands

Terminology Definitions:

"TRUE“ describes the logical condition "1.“
"FALSE“ describes the logical condition "0.“
All operands are bit operands.

Load and Save Commands:

LD Loads the value of the operand

LDN Loads the negated value of the operand

ST Assigns the current value to the operand

STN Assigns the negated value to the operand

Set and Reset Commands:

SET Setting the bit operand, unconditional

SETC or **S** Setting the bit operand, if the previous result is TRUE, otherwise no change

SETCN Setting the bit operand, if the previous result is FALSE, otherwise no change

RES Resetting the bit operand, unconditional

RESC or **R** Resetting the bit operand, if the previous result is TRUE, otherwise no change

RESCN Resetting the bit operand, if the previous result is FALSE, otherwise no change

AND Logic:

AND AND logic of the current value with the value of the operand

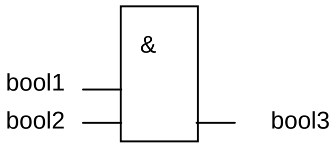
ANDN AND logic of the current value with the negated value of the operand

AND(AND logic of the current value with the logical value of the following term

ANDN(AND-logic of the current value with the negated logical value of the term that follows.

Examples: AND Logic

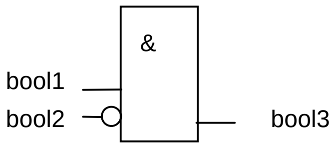
FBS



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:

OR OR logic of the current value with the value of the operand

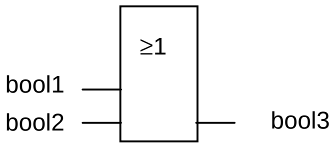
ORN OR logic of the current value with the negated value of the operand

OR(OR logic of the current value with the logical value of the following term

ORN(OR logic of the current value with the negated logical value of the term that follows.

Examples: OR Logic

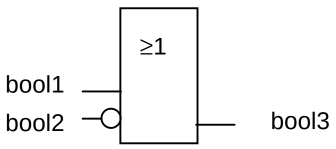
FBS



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:

XOR Exclusive OR logic of the current value with the value of the operand

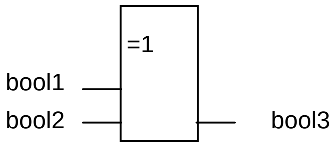
XORN Exclusive OR logic of the current value with the negated value of the operand

XOR(Exclusive OR logic of the current value with the logical value of the following term

XORN(Exclusive OR logic of the current value with the negated logical value of the term that follows.

Examples: XOR Logic

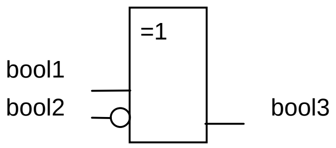
FBS



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

Other Assignments:

NOP No Command (can be used as a placeholder)

END End of the assignment list

) End of a term

Operands:

Source Operand For the load assignments and the logical assignments, the bits of Groups M0, M1, M4 - M6, M8, Q0 - Q3, I0 - I4 and C0 and C1 are allowed as operands.

Target Operand For the save, set and re-set assignments, the bits of Groups M5, M6, and Q0 - Q3 are allowed as operands.

Target operands, which have already been assigned to a function by a parameter, cannot be used. Otherwise, the error message "**F- 02 21 – Logic Task Program Error"** is issued.

Likewise, no output bit in the NC Program may be written if it has already been used as a target operand in the logic task.

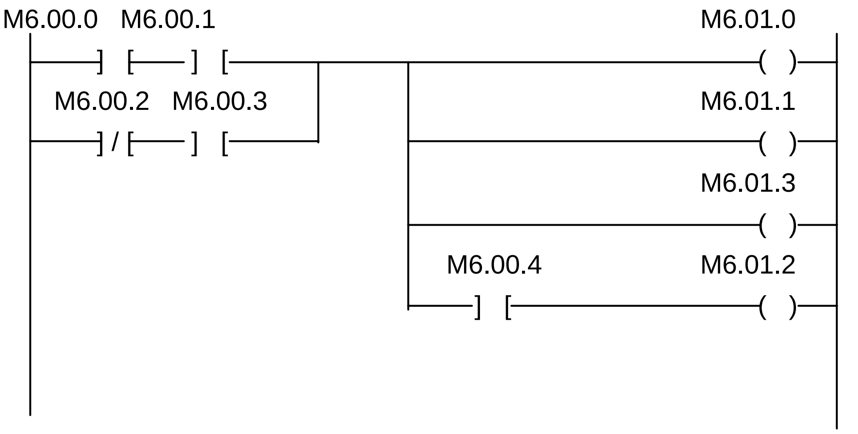
Constants:

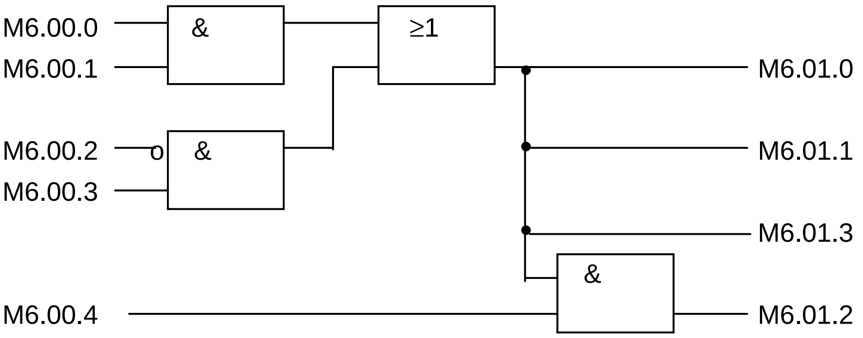
Constant 0 Source bits C0.00.0 to C0.01.7
All bits have a defined status of FALSE.

Constant 1 Source bits C1.00.0 to C1.01.7
All bits have a defined status of TRUE.

7.4 Program Examples

Example 1:





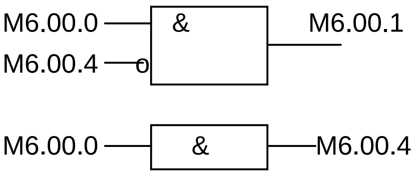

```
LDN    M6.00.2
AND    M6.00.3
OR(    M6.00.0
AND    M6.00.1
)
ST     M6.01.0
ST     M6.01.1
ST     M6.01.3
AND    M6.00.4
ST     M6.01.2
```

Example 2: Spurious pulse, positive starting edge

M6.00.0 = Input

M6.00.1 = Result

M6.00.4 = Intermediate flag



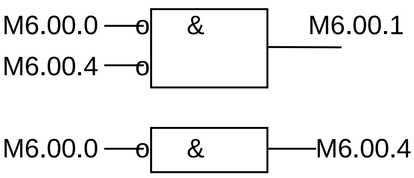

```
LD     M6.00.0
ANDN   M6.00.4
ST     M6.00.1
LD     M6.00.0
ST     M6.00.4
```

Example 3: Spurious pulse, negative starting edge

M6.00.0 = Input

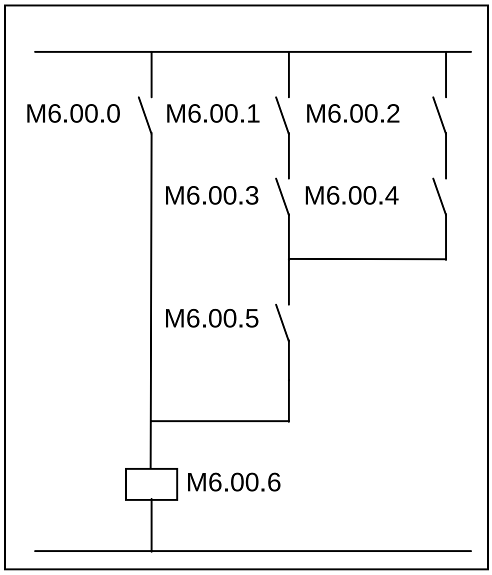
M6.00.1 = Result

M6.00.4 = Intermediate flag

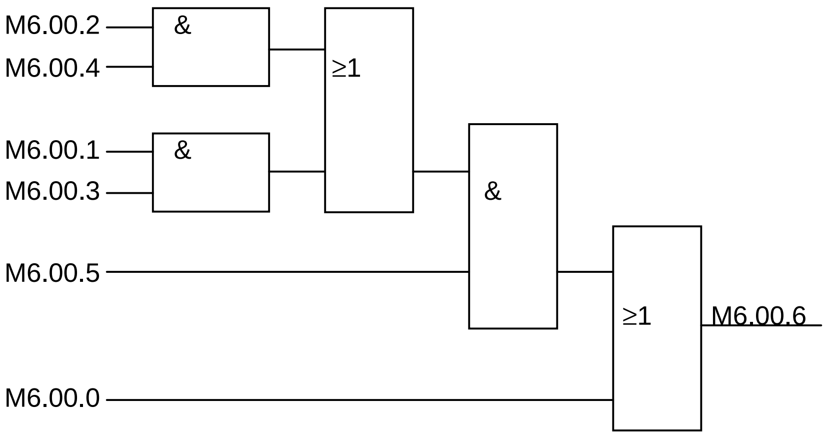



```
LDN    M6.00.0
ANDN   M6.00.4
ST     M6.00.1
LDN    M6.00.0
ST     M6.00.4
```

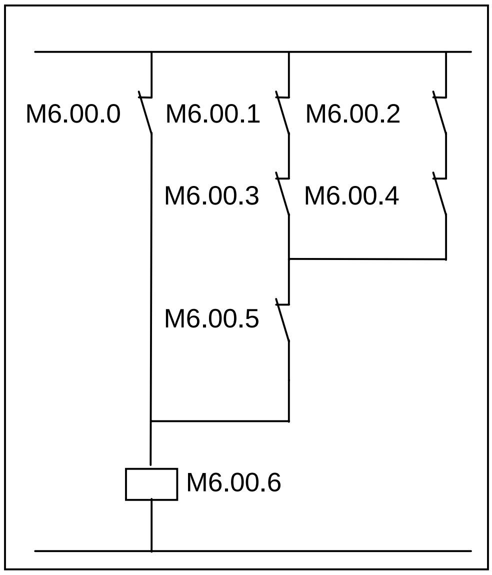
Example 4:



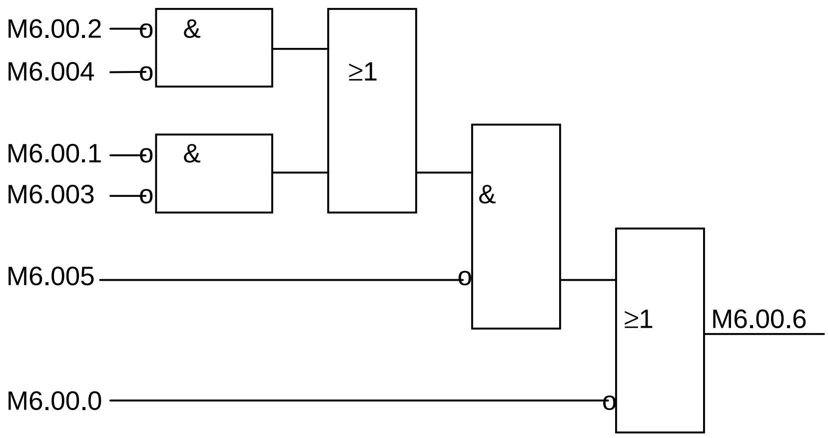
LD	M6.00.2
AND	M6.00.4
OR(	M6.00.1
AND	M6.00.3
)	
AND	M6.00.5
OR	M6.00.0
ST	M6.00.6



Example 5:




```
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
```



8 Functions

8.1 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 following functions are active:

- NC Task 3
- Logic Task
- PLS

The following functions can also be called up.

- Homing
- Manual Vector
- Interruption
- 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.

8.2 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 of encoder 2**
- **AA07, Measuring wheel mode**
- **CR10, Actual position filter time constant for measuring wheel mode**

Functioning

Requirements

- The optional encoder must be set in Parameter **A100, Function of encoder 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 of encoder 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 mode**.

Drive in Position Control Mode

The drive switches over to Position Control Mode with motor encoder and 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, Actual position filter-time constant for measuring wheel mode**.

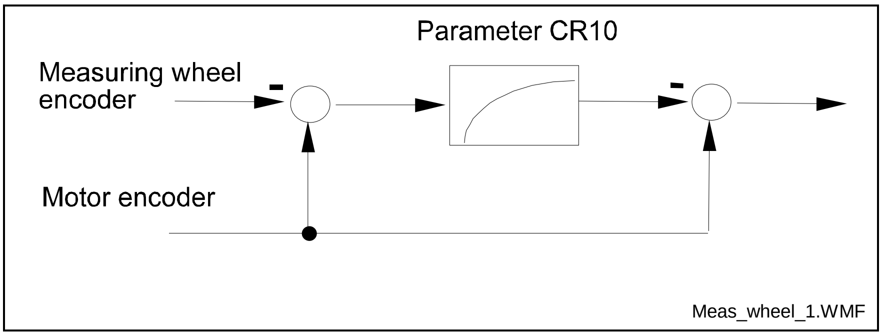


Fig. 8-1: Generation of Position Feedback Value in Measuring Wheel Mode

Manual Mode

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

Open Feed Roll

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 (Parameter AA07). 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, Encoder difference monitoring**.

The following parameters are set for the measuring wheel encoder:

- **C007, Feed rate constant 2**
- **C005, Feedback 2: type**
- **C006, Feedback 2: resolution**

Diagnostic Messages

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

- **D801 Measuring wheel mode not possible**

Systemvariable

V107 "Slip in Measuring Wheel Mode [%]".

8.3 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, Homing configuration**
- **C010, Homing**
- **C011, Reference distance**
- **C012, Home switch offset**
- **C013, Distance-coded reference offsets**

In addition, the following parameter is used:

- **A011, Switching threshold**

Setting the Homing Parameter

The basic sequence is dependent on how the **C009, Homing configuration** 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 Homing Configuration

1 0 0 12 34

- 34 – Homing Acceleration in % of amax (A108)
- 12 – Homing Velocity in % of Vmax (A106)
- 0 – Reference Mark Measurement:
  0 = yes
  1 = no
- 0 – Home Switch, Evaluate:
  0 = yes
  1 = no
- 1 – Home 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, Feedback 1 type** (for motor encoders) or **C005, Feedback 2 type** (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 Position Feedback 1 Type

01 0 0 0

Encoder Type
0 = rotary
1 = linear

Distance-Coded Measurement System:
0 = no distance-coded measurement system
1 = distance-coded reference marks

Direction:
0 = not inverted
1 = inverted

Absolute Measurement:
x0 = no absolute measurement possible
01 = absolute measurement possible and active
Encoder is treated as absolute
11 = Absolute measurement 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 distance**. 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 distance**.
- 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 distance**.

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 parameter:

- **C009, Homing configuration**

The following diagram explains this:

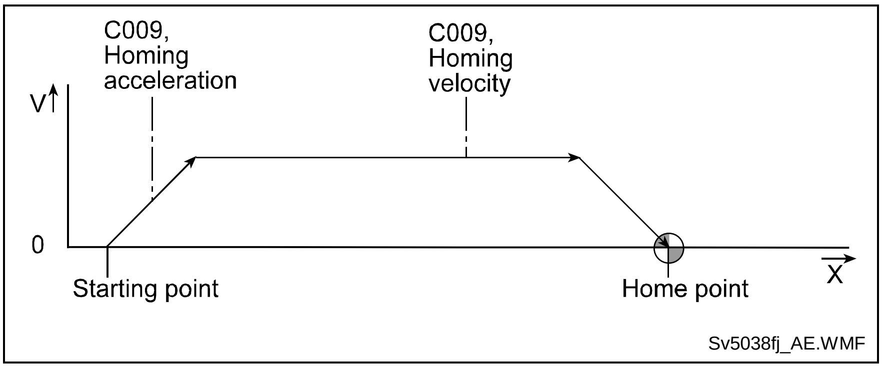


Fig. 8-2: Position Command Value Profile for Homing Velocity and Homing Acceleration

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, Homing configuration** select 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.

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

⇒ setting the following parameter to 0

- **C011, reference distance**

⇒ Set parameter **C009, Homing configuration** to low values (e.g., velocity = 1% , acceleration = 10 %)

⇒ 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 distance** 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 distance**.

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

Homing velocity and **Homing acceleration** in **Parameter C009** 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 revolution

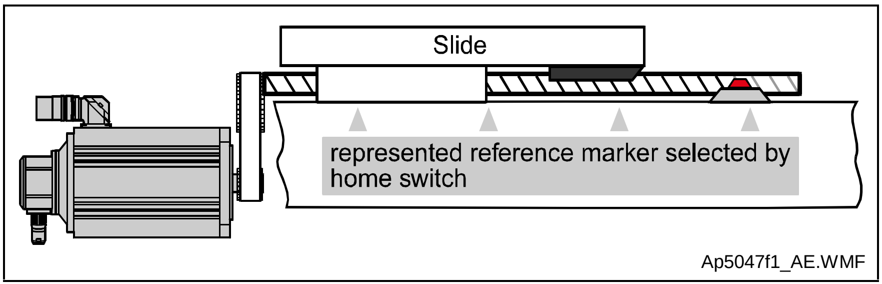


Fig. 8-3: Selection of a Reference Mark Depending on the Homing Direction

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.

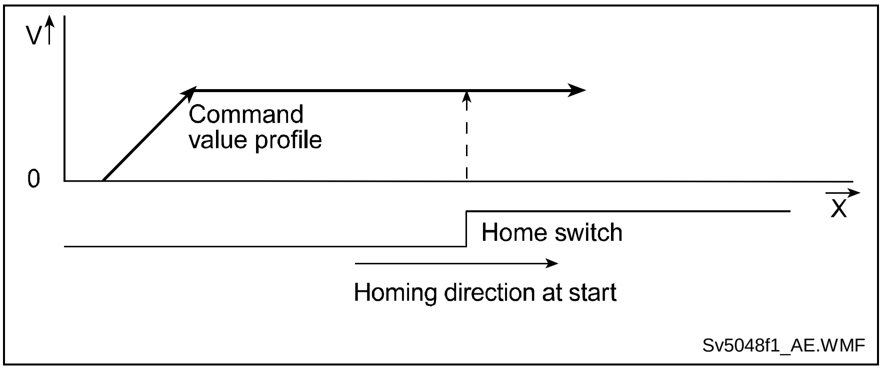


Fig. 8-4: Correct Setting of Homing Direction

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!

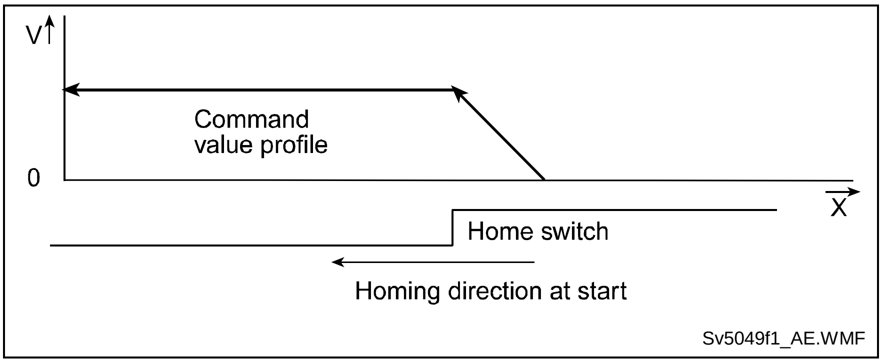


Fig. 8-5: Incorrectly Set Homing Direction

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.

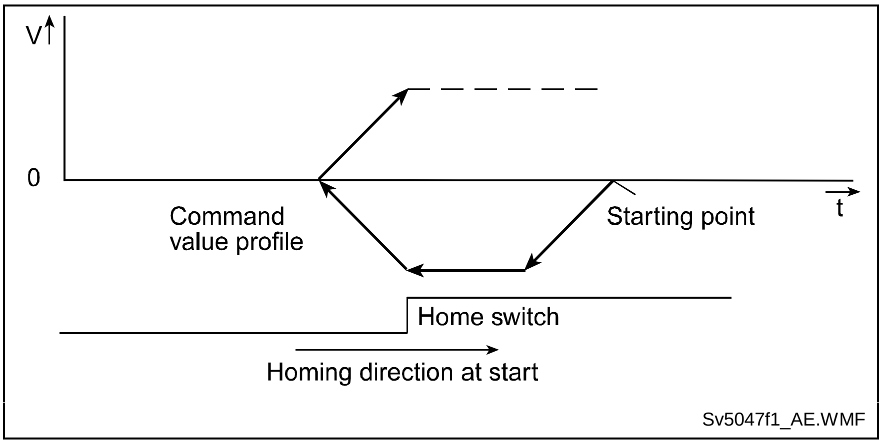


Fig. 8-6: Command Value Profile with Start Position at the Home Switch

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.

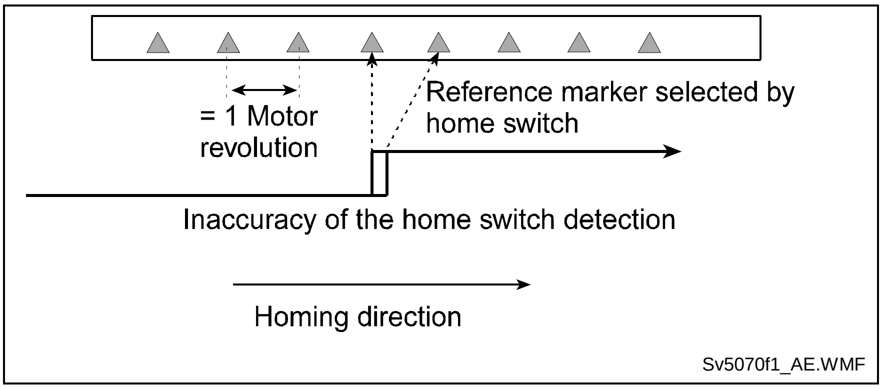


Fig. 8-7: Inaccurate Selection of Reference Marks when Distance Between Home-switch Signal Edge and Reference Mark is too Small

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 Distance home switch** - reference mark erroneous will be generated.

The Critical Range for this distance is:

0.25 * distance between reference marks

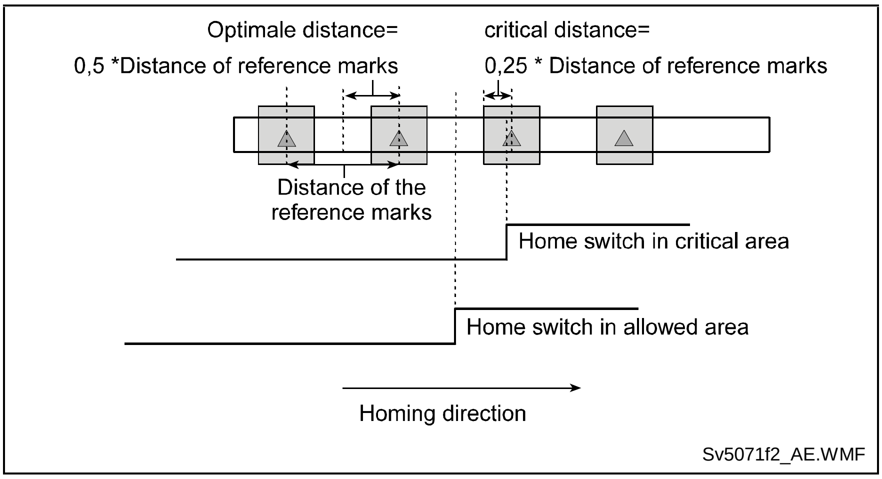


Fig. 8-8: Critical and Optimal Distance Between Home Switch and Reference Mark

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, Home switch offset**.

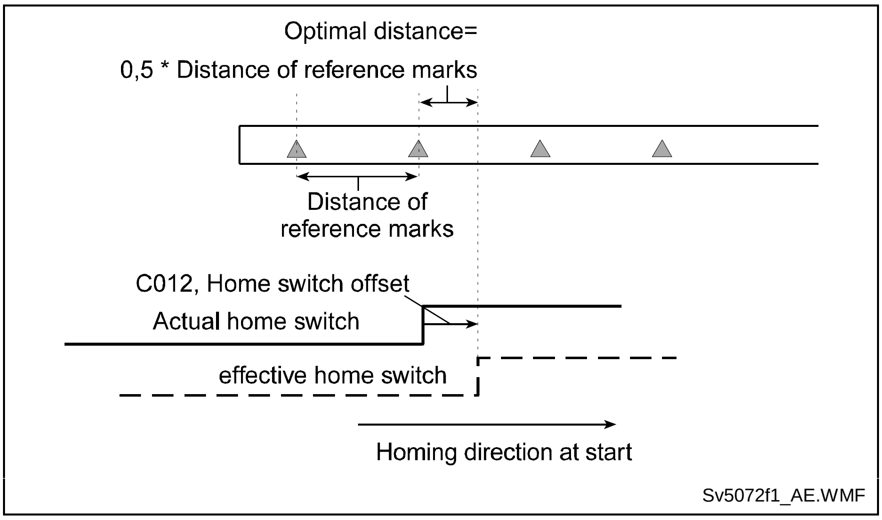


Fig. 8-9: How Parameter **C012, Home switch offset** works

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

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

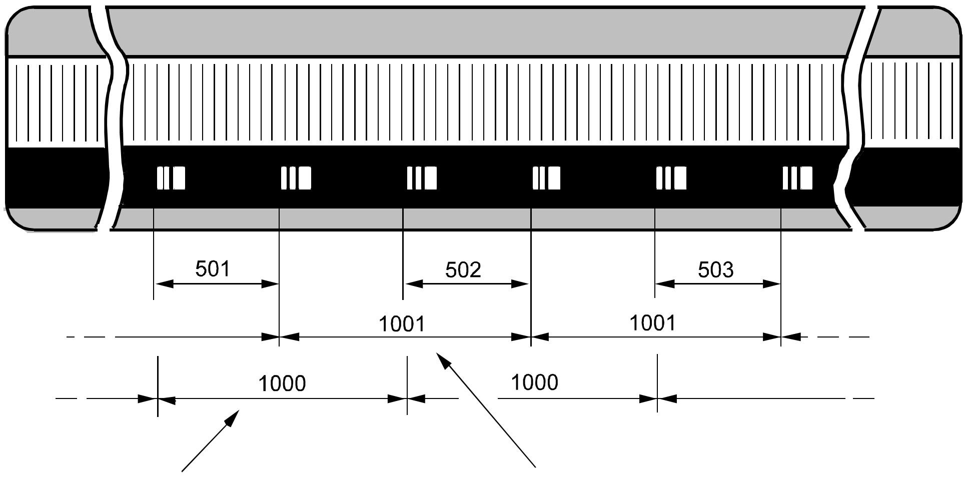
If the encoder has distance-coded reference marks (type 4), **C009, Homing configuration** must be set to determine the following:

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

In parameter:

- **C013, Distance-coded reference offsets**

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. 8-10: 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 distances 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 parameter (C002/C005) for the correct settings

⇒ Set parameter **C011, Reference distance** to 0.

⇒ Set parameter **C009, Homing velocity** and **C009, Homing 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 distance** 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 distance**.

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

Parameters **C009, Homing velocity** and **C009, Homing 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

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

C013: Value in parameter C013 Distance-coded reference distance 1
v: Value in C009 Homing velocity (in IU/s)
a: Value in C009 Homing acceleration (in IU/s^2)
$s_{\mathrm{Re}\,f\,\max}$ maximum travel distance for homing with distance-coded reference marks
C003: encoder 1 resolution
C006: encoder 2 resolution

Fig. 8-11: 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.

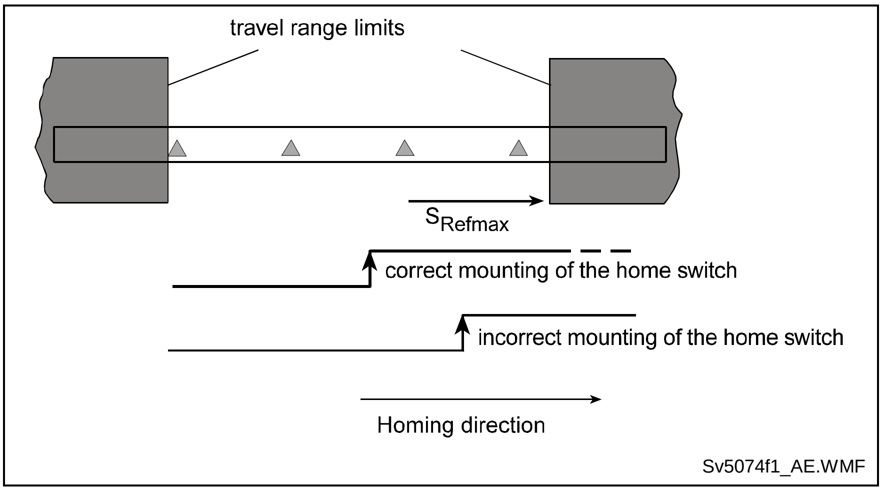


Fig. 8-12: Placement of the Home Switch with Distance-coded Reference Marks

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-coded reference offsets**.

    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-coded reference offsets**
  - **F-0217**, **HOM command not allowed**
    Parameter A100 Type of motion = 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 !

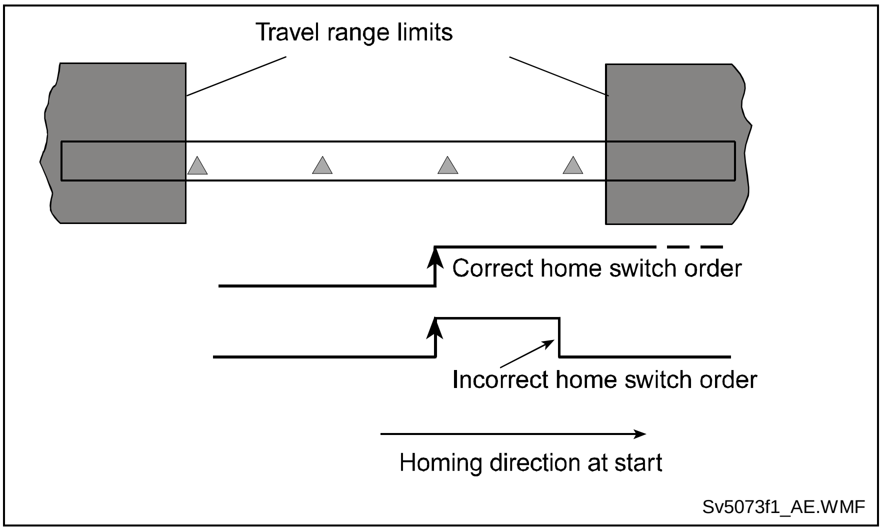


Fig. 8-13: Placement of the Home Switch in Reference to the Travel Range

8.4 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.

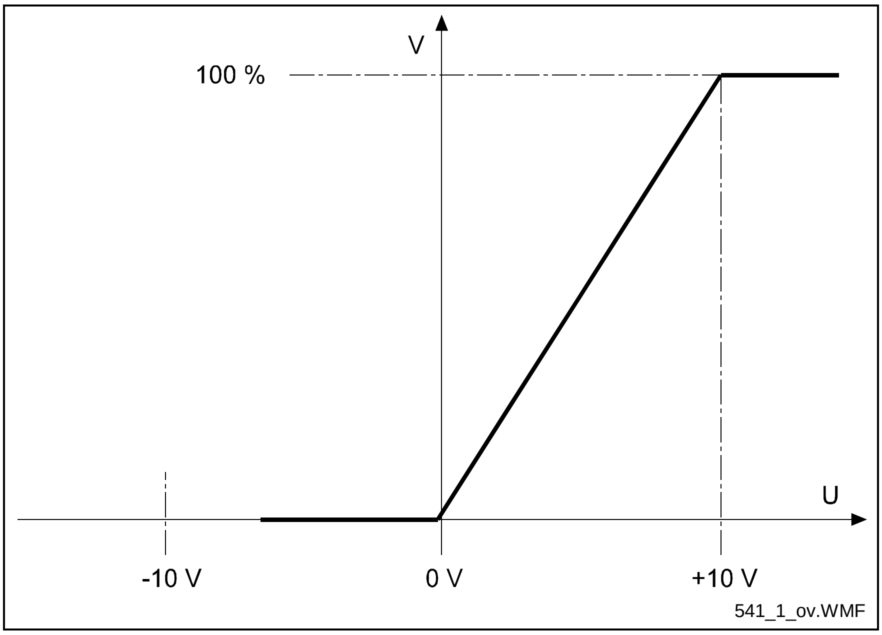


Fig. 8-14: Analog Override

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. 8-15: 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, velocity = 0** diagnostic warning 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 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 A106 .

```
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 I0.01.4. This function is activated 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:

$$Vo = Vp \times \frac{Sum\ of\ all\ decimal\ value}{127}$$

L: Vo = Velocity
Vp = Traversing Velocity

Fig. 8-16: Velocity Calculation

8.5 Rotary Table

Description in preparation

8.6 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 9/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	00000000
0401	APE	M2.03	00000000
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 9/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 9/Parameter AA02).

Note: The interrupt vector is available only in Task 1.

8.7 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 of 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 AA00

AA00	0200 0000 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 AA00

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: Task 1 and 2 are equivalent. Within the NC cycle, the task are completed in numerical order (1, 2, 3).

8.8 Master Encoder and motion type Cam

Overview

Slave Axis

The axis follows the positions pre-set by the master axis encoder exactly.

Positioning Command Pxx with Pre-Set Cam

The motion path of the axis is determined by a cam for motion commands POI, PSI, POA and PSA.

Relative Synchronization According to Exact Position

For ’flying cutoff or rotary processing.’

Axis Motion with Cam
Absolute Master Encoder (SSI)

The cams set in the user program are now used during one master rotation.

Axis Motion with Cam
Incremental Master Encoder (optional Encoder 2)

The master axis is re-homed each time this function is activated in the CSY command.

The cams set in the user program are now used during one master rotation.

	Slave Axis FOL 1 1 xxxxxx	Dynamic Synchronization FOL 1 2 xxxxxx	Synchronization by Precise Positioning	Positioning Commands Pxx	Positioning with Cam, Real Master with SSI Encoder	Positioning with Cam, Real Master (with Opt. Encoder)
Incremental SSI Encoder Evaluation	N	N	N	-	N	N
Absolute SSI Encoder Evaluation	N	N	N	-	Y	N
Incremental Optional Encoder Evaluation	Y	Y	Y	-	N	Y
Absolute Optional Encoder Evaluation	N	N	N	-	N	N
A100 Motion Type = Continuous	Y	Y	Incr.	Y	Y	Y
A100 Motion Type = Rotary	Y	Y	Y	Y	Y	Y
A100 Motion Type = Rotary Table	Y	Y	Y	Y	Y	Y
A100 Function of Encoder 2 = 0	Y	Y	Y	Y	Y	Y
A100 Function of Encoder 2 = 1 or 3	N	N	N	Y	Y	N
AA09 Feed-To-Length Monitoring	Y	Y	Y	Y	Y	Y
Modulo Value					=VK=360	= VK
FOL Command	Y	Y	N	N	N	N
CSY Command	N	N	Y	Y	Y	Y
CMM Command	Y	Y	Y	Y	Y	Y
CLG Command	N	N	Y	N	Y	Y
CAN Command	N	N	N	N	Y	Y
LAL Command	N	N	Y	N	N	N
LAR Command	N	N	Y	N	N	N
LAE Command	N	N	Y	N	N	N
V0xx – Position Counter for Master 1 (opt. enc.)	N	N	Y	N	N	N
V0xx – Position Counter for Master 2 (SSI)	N	N	N	N	N	N
System Marker Flag – Axis is synchronized	Y	Y	Y	N	In Cam	In Cam
System Marker Flag – Synch. not poss.	N	N	Y	N	N	N
Immediate Stop of Motion	N	Y	Y	Y	N	N
Immediate Stop Program	Y	Y	Y			
Interrupt	N	Y	N	Y	N	N
E-Stop (Best Possible Deceleration)	Y	Y	Y	Y	Y	Y
A109 Acceleration / Deceleration	N	Y	Decel.	Y	N	N
ACC Command	N	Y	Decel.	Y	N	N
Position Offset using POI/PSI	Y	Y	Y	N	N	N
Positioning using POA/PSA	N	Y	Y	N	N	N

Fig. 8-17: Functions with Master Encoder

Slave Axis

The axis follows the positions pre-set by the master axis encoder exactly. With the FOL command, this function can be turned on or off. In addition, a gear can be edited with this command, even during operation, by changing a factor value. Dynamic synchronization (acceleration or deceleration) is possible.

The activation of this function occurs in the user program with the FOL command.

See also Section 6, 'NC Commands.'

Positioning Command Pxx with Pre-Set Cam

The positioning commands POI, PSI, POA, PSA are executed with a ramp generator.
The process can be influenced by the values for acceleration, deceleration and jerk. If this shape does not meet customer needs, the axis can be positioned using a cam. Five pre-programmed cams (triangle) and one user-programmable cam are available.

Cam startup and selection are executed using the CMM command. With this command, it is possible to select cam/ramp generator in the program. When the following Pxx commands are called, they provide the detection velocity of the cam, based on the motion length and the maximum velocity pre-set in the command. With this pre-calculation, positioning is delayed by one cycle (2 ms).

Note: Limiting of the acceleration does not take place.

Note: After a started Pxx command with a cam, the positioning distance and the velocity may no longer be changed. Interrupt and Stop are only possible when the axis is stopped.

Commands:

CSY: Turn this function on.
CMM: Select the cam shape and select this function. (using Mode = 2)

Marker Flags

Velocity and acceleration greater than 90% of the maximum values. (Parameter AA09)

Program Example: Positioning Commands with Pre-Set Cams

	Syntax		Description
Loop	**CMM**	**1 01 03 2 0**	Assignment of curve shape, function
	CSY	**1 0 0 0 00.00.0**	Turn function on
	PSI	**1 10.000 999**	Positioning with virtual master
	WAI	**2.000**	
	CSY	**0 0 0 0 00.00.0**	Turn function off
	PSI	**1 -10.000 999**	Positioning with standard ramp
	WAI	**2.000**	
	JMP	**Loop**	

Synchronization by Precise Positioning

This function is for synchronizing the slave axis for a material sequence that is moving in one direction. The motion of the material sequence is detected with a relative master encoder. Using the LAL and LAR commands, the synchronization location on the material can be defined.

In the LAL command, the distance between two synchronization locations is set. When the function is turned on using the CSY command, the position of the slave axis is defined as the synchronization location and, therefore, as the start position (home position) for the slave axis. Before each synchronization operation, the slave axis must be in this home position. In Variable V113, the actual distance between the next or actual processing location and the home position is displayed.

Synchronization is executed with a cam function. This cam can be selected using the CMM command. The acceleration distance is set in the CLG command, or, if this does not occur, it is set as the default value.

Acceleration Distance > Parameter A106^2 / (2 x Parameter A109)

- This function can be turned on and off using the CSY command.
- During the synchronization phase, a position offset can be set using the POI/PSI commands. The indicated velocity is therefore limited, so that the maximum velocity (Parameter A106) is not exceeded.
- With the POA/PSA commands, the synchronization function is deactivated and it is positioned to the set absolute position using the set velocity. If a velocity of 0 is set in the POA/PSA command, positioning is accomplished using the retrieved current master value.
- Immediate Stop is active. The axis stops using a ramp. The function is closed.
- When the operating mode is switched from Automatic→Manual, decelerative synchronization, using the current deceleration value (Parameter A109 or ACC command), and deactivation of this function occurs.
- The interrupt function is not activated.
- Calling an Interrupt Vector program is possible. However, because of the program sequence for this function, caution is advised!
- With the system synchronized, if the master position is less than the start position because of a reversal of the direction of the master, the axis remains synchronized. However, the position value may be less than the "Min. Position Limit"!
- Behavior during an E-Stop:
  The axis is no longer synchronized. The equipment is stopped using "Best possible deceleration.“
- Current reduction (possible using the MOM command)

The following functions can also be set in the LAL/LAR command:

"Immediate Cut"

Under the following conditions, synchronization can be immediately initiated with a rising edge at the **"Immediate Synchronization"** input, during processing of the LAL or LAR command:

1. During processing of the LAL/LAR command, as long as the starting point has not yet been reached.
2. When synchronization inhibit is active.

"Cut Inhibit"

With a rising edge at the **"Inhibit Synchronization"** input in Automatic Mode, an inhibiting of the next synchronization is requested. This request causes an inhibiting of the beginning of synchronization in the next LAL or LAR command. In this case, the direction to proceed to the next instruction does not occur in these commands. **"Synchronization Inhibit"** can only be canceled using an "Immediate Synchronization" (or by switching to Manual Mode).

"Test Mode"

This mode can be set in the program by selecting the virtual encoder as a master in the CMM command. The parameters for the master are set in the VMC command.

Process 1: Start with Signal

Using the LAR command, the system waits for an input signal. When a rising edge is present, synchronization is started immediately or after an offset measurement occurs for the master.
Synchronization begins when the offset measurement becomes smaller than the acceleration distance.

The offset measurement must be at least 2 x the acceleration distance. Otherwise, synchronization cannot occur because of acceleration values that are too high, and the error message
"F- 02 30 – Offset Measurement too large" is issued.

Process 2: Start from Position

The programmed length is subtracted from the master position counter value using the LAL command. The program then proceeds to the next instruction. As soon as the master reaches the start position (synchronous position – 2 x acceleration distance), synchronization begins and the program proceeds to the next instruction. The first LAL command after activating the function sets the master position counter to the negative value of the "Product Length."

Commands:

- CSY: Activating and defining the home position
- CMM: Selecting the master, the cam shape and this function.
- CLG: Determine the acceleration distance.
- LAL: Calculate new product length. Synchronization occurs, as soon as the start position is reached.
- LAR: When a rising edge occurs at the synchronization input, a new product length is set.
  Synchronization occurs as soon as the start position is reached.
- LAE: End synchronization.
- VMC: Control of the virtual master. (Test Mode)

Parameters:

Set parameters for master encoder.
When selecting "Function of Encoder 2" equal to Direct Measurement or Measuring Wheel Mode, it is only possible to use an SSI encoder!

System Marker Flags:

M1.02.0 = "Axis is synchronized"

M1.02.1 = "Synchronization not possible."
This marker flag is set if the synchronized position is not located at least 2x the acceleration distance before the home position, when reading the production length using the LAL command. Synchronization does not occur.

M1.02.2 = "Cam active"

System Variables:

V113 Master Position Counter 1 "Optional Encoder"

Program Example: Synchronization from Starting Point

	Syntax		Description
	HOM	**1**	Home slave
	CMM	**1 00 01 1 0**	Assign master / Cam shape
	CLG	**1 10.000**	Set acceleration path
	CSY	**1 2 2 2 00.00.0**	Turn function on
Loop	**LAL**	**1 50.000 I0.00.6**	Product length
	AKN	**Axis_Synchron. 1**	System marker flags
	JSR	**Tools**	
	LAE	**1**	Turn synchronization off
	AKN	**Sw. Threshld. 1**	Wait until axis stops
	AKN	**Reverse_enable 1**	
	PSA	**1 +0.000 999**	Return to home position
	JMP	**Loop**	

Program Example: Start with Signal

Label	Syntax		Description
	Syntax		Description
	HOM	**1**	Home slave
	CMM	**1 00 01 1 0**	Assign master / Cam shape
	CLG	**1 10.000**	Set acceleration path
	CSY	**1 2 2 2 00.00.0**	Turn function on
Loop	**LAR**	**1 50.000 I0.00.6 I4.00.3**	Wait for starting point
	AKN	**Axis_Synchron. 1**	System marker flags
	JSR	**Tools**	
	LAE	**1**	Turn synchronization off
	AKN	**Sw. Threshld. 1**	Wait until axis stops
	AKN	**Reverse_enable 1**	
	PSA	**1 +0.000 999**	Return to home position
	JMP	**Loop**	

Axis Motion with Cam Absolute Master Encoder (SSI)

Moving a particular length using a cam in a defined angle range for the SSI encoder. Processing the cam occurs each time the angle range is entered, in case this function is not deactivated using the CSY command. Outside of this range, it is possible to move the axis using normal positioning commands.

Multiple cams can also be processed within one master rotation. If the master axis is within the current angle range, the next angle range can be determined using the CAN command. The cam stroke and type can also be pre-set in commands.

Velocity and acceleration of the slave axis are defined using the master velocity, length of movement and angle range.

Commands:

CAN	Angle range
CLG	Movement length
CMM	Activating this function with mode = 3
CSY	Activating a function

Program Example for Positioning of Mechanical Hand:

In the 50°-150° range for the master encoder (SSI), a mechanical hand is to push the material 10mm forward. After reaching 200°, the open hand moves back again, without using a cam.

	Syntax		Description
	CMM	**1 01 02 3 0**	Activate this function
	CLG	**1 +10.000**	Stroke for cam
	CAN	**02 50 150**	Set angle range
	CSY	**1 0 0 0 00.00.0**	Turn function on
W_End	**CPJ**	**V023 < +200 0 W_Endt**	Wait until cam complete
	PSA	**1 +0 999**	Return
W_360	**CPJ**	**V023 < 40 0 W_360**	Wait until over 360 degrees
	JMP	**W_End**	

Axis Motion with Cam (Incremental Master Encoder (optional Encoder 2))

Movement over a length from a start signal, using a cam. With each activation of this function using the CSY command, the position counter for the master is set to 0. The movement over the length then occurs within a defined angle range. Processing the cam occurs each time the angle range is entered, in case this function is not deactivated using the CSY command. Feed Constant 2 (optional encoder Parameters C004-C007) is to be set to a value of 360. The modulo value for the encoder evaluation corresponds to Feed Constant 2.

To re-start, the function must first be deactivated and then reactivated using CSY.

Multiple cams can also be processed within one master rotation. If the master axis is within the current angle range, the next angle range can be determined using the CAN command. The cam stroke and type can also be pre-set in commands.

Commands:

CAN	Angle range
CLG	Movement length
CMM	Activating this function with mode = 4
CSY	Activating a function

Program Example:

	Syntax		Description
	CMM	**1 01 01 4 0**	Function selection
	CLG	**1 +10.000**	Stroke
	CAN	**01 20 170**	Start and end of angle
Wait	**BCE**	**Wait I0.01.7 0**	Machine start signal
	CSY	**1 0 0 0 00.00.0**	Turn function on
WaiEnd	**CPJ**	**V023 <= 170 0 WaiEnd**	Wait until end angle reached
	CSY	**0 0 0 0 00.00.0**	Turn function off
	PSA	**1 +0 050**	Return
	JMP	**Wait**	

8.9 Application: Flying Cutoff

With the "Synchronization" function, "Flying Cutoff" can be programmed into the user program.

The following functions can be implemented:

- Processing of lengths
- Cut inhibit with messaging output
- Immediate cut
- Moving away using the PSI/POI command
- Reverse inhibit
- Reduction of the reverse velocity/acceleration
- Shift home position

The following function cannot be implemented

Short length (between two processing operations, the carriage does not move back to the original position).

Parameters

The parameters for the motion axis are normally input according to the mechanical and dynamic assignments.

In addition, the input of measuring wheel data into the parameters occurs: C004 – C007.

All further indications for this function are issued in the command structure in the user program.

User Program

Automatic Program

	Main Functions	Possible Additional Functions	Description
		HOM 1	Home Axis This is not necessary when using an absolute encoder
	CMM 1 00 01 1 0		Assign master / Cam shape for Master Encoder
		BCE TestM M2.002.0 1 CMM 1 00 03 1 0 VMC 1 +V600 V601	Test Mode: (Virtual Axis) Setting: Virtual axis V600 : Velocity in per mil (‰)
Test M	CLG 1 10.000		Set acceleration path
		ACC 1 V608 V609	Setting the acceleration when braking to standstill or when moving to home position
	CSY 1 2 2 2 00.00.0		Turn function on
Loop	LAL 1 50.000 I0.00.6		Product Length Program stays in this instruction until synchronization begins.
	AKN M1.02.0 1		Wait until synchronization point is reached
	JSR Tools	PSI 1 0.5 999	Initialize Processing Program. In the processing program "Moving away" is possible using a POI/PSI command.
		LAE 1 AKN Reverse Motion 1	Turn off synchronization and stop axis. Wait until reverse motion is enabled
	PSA 1 +0.000 999	 ACC 1 V606 V607 PSA 1 +0.000 V605 ACC 1 V608 V609	Return to home position using parameter data or using product-specific data. Moving to another home position is possible. The difference value must be calculated with the production length.
	JMP Loop		

Fig. 8-18: Flying Cutoff Program

Immediate Cut / Cut Inhibit

The following functions can be activated in the LAL command:

"Immediate Cut"

Under the following conditions, synchronization can be immediately initiated with a rising edge at the **"Immediate Synchronization"** input, during processing of the LAL or LAR command:

- During processing of the LAL/LAR command, as long as the starting point has not yet been reached.
- When cut inhibit is active.

"Cut Inhibit"

With a rising edge at the **"Inhibit Synchronization"** input in Automatic Mode, an inhibiting of the next synchronization is requested. This request causes an inhibiting of the beginning of synchronization in the next LAL or LAR command. In this case, the direction to proceed to the next instruction does not occur in these commands. **"Synchronization Inhibit"** can only be canceled using an **"Immediate Synchronization"** (or by switching to Manual Mode).

Marker Flag **M1.02.1** signals this status.

Functions

Default Length

LAL 1 000100.000 00.00.0 or
LAL 1 V600 I0.01.0

Inputs ee:
ee = Immediate Cut (Immediate Synchronization)
ee+1 = Cut Inhibit (Inhibit Synchronization)

Product Length [IU]

Slave Axis: 1

Proceeding to the next instruction occurs as soon as the axis begins synchronizing. Therefore, outputs (for example) can be set, even before the synchronization is complete. The "rising edge" at Input "ee“ is queried until synchronization begins. Input "ee+1“ is always queried when a function is activated. A detected rising edge of Input "ee+1“ is immediately recognized and confirmed with Marker Flag M1.02.1.

Part Length with Raster Pulse

LAR 1 000100.000 00.00.0 00.00.0 or
LAR 1 V600 I0.01.0 00.00.0

Raster Input "Start Synchronization“:
Bit: M0 – M5
I0 - I4
Q0 - Q2

I4.00.3 / I4.00.4 = Fast Inputs (are currently evaluated just like standard inputs!)
00.00.0 = Immediate Synchronization occurs

Inputs ee:
ee = Immediate Cut (Immediate Synchronization)
ee+1 = Cut Inhibit (Inhibit Synchronization)

Offset Dimension [IU]

Slave Axis: 1

The raster input may only occur when the carriage is in its initial position. The raster detection device must be placed in the direction of the material from the initial position. The offset dimension is determined by the distance between the initial position and the processing location to be reached, when the raster is located precisely under the raster detection device.

Proceeding to the next instruction occurs as soon as a rising edge is recognized at the input **"Start Synchronization"** or **"Immediate Synchronization."**

Synchronization Path

The acceleration path of the axis from standstill to synchronization is set by the user in the CLG command.

$$s = \frac{V_{Material}^{2}}{2 * a}$$

Fig. 8-19: Acceleration Path

If the acceleration path is set as a smaller value, the acceleration set in Parameter A108/109 can be exceeded. The acceleration can be monitored using Parameter AA09.

CLG 1 000050.000 or
CLG 1 V600

Acceleration Distance [IU]
Slave Axis: 1

Note: Before calling this command, the mode must be defined using the CMM command!

Processing Program with Movement Away

If the tool is to be moved to the processing location during processing, this can be done using a POI/PSI command. There, the velocity can also be entered. The acceleration can be changed using the ACC command. The switching threshold, Parameter A111, indicates when the additional movement is finished.

If the sum of the velocities ($V_{Material}$ + V_{POI}) becomes larger than the maximum velocity (ParameterA106), an error occurs. If a very large negative distance is entered in the POI/PSI command, the axis can also move backward. (even beyond the home position).

Leaving a Synchronized State

- **Braking the Axis:**

  The axis is braked using the LAE command with the default deceleration.

LAE 1

Slave Axis: 1

Synchronization is disabled and decelerated using the current deceleration value (Parameter A109 or ACC Command). Proceeding to the next instruction occurs when the axis has stopped. Subsequently, the axis must be returned to the home position using the POA or PSA command.

- **Positioning the Axis:**

  Using the POA/PSA commands, the axis can move to a defined position. Synchronization is canceled with the commands. If the velocity is set to 000 in this command, the current master (material) velocity is retrieved.

Reverse Inhibit

See programming example for Flying Cutoff

Virtual / Real Master

Using the CMM command, the assignments for the master axis are made. In production, this is always the measuring wheel as a real master. For Test Mode, it is possible to activate a virtual master in the CMM command. The velocity data and the acceleration for the virtual master can be entered in the VMC command.

CMM 1 00 01 1 0

Reserved

Mode:

0 = Slave Axis (On/Off in the FOL Command)
1 = Synchronization by Precise Positioning
2 = Cam with Pxx Command and Virtual Master
3 = Feed-To-Length Commands with Real Master
4 = Feed-To-Length Commands with Real Master

Master m:

01 = Optional Encoder
02 = SSI Encoder
03 = Virtual Encoder

Cam k:
0 = Quadratic Parabola
1 = Sloping Sine
2 = Modified Sine
3 = Grade 5 Polynomial
4 =
5 = User-Programmable Cam

Slave Axis: always 1

Note: The error message **"F- 03 25 – Mode unauthorized"** is issued if a different mode is active than the one pre-set here!

VMC 1 +999 999 or

VMC 1 +V600 V601

Acceleration a:

Acceleration of the virtual Master in per mil (‰) from Parameter A109. This value is retrieved when the command is read.

Velocity v:

Velocity of the virtual Master in per mil (‰) of the maximum velocity (Parameter A106).

- Constants:
  The value is retrieved once each time the command is read.
- Variable:
  Each time the command is read, the specified variable number is retrieved. The contents of this variable is then permanently read and evaluated by the function.

Slave Axis: 1

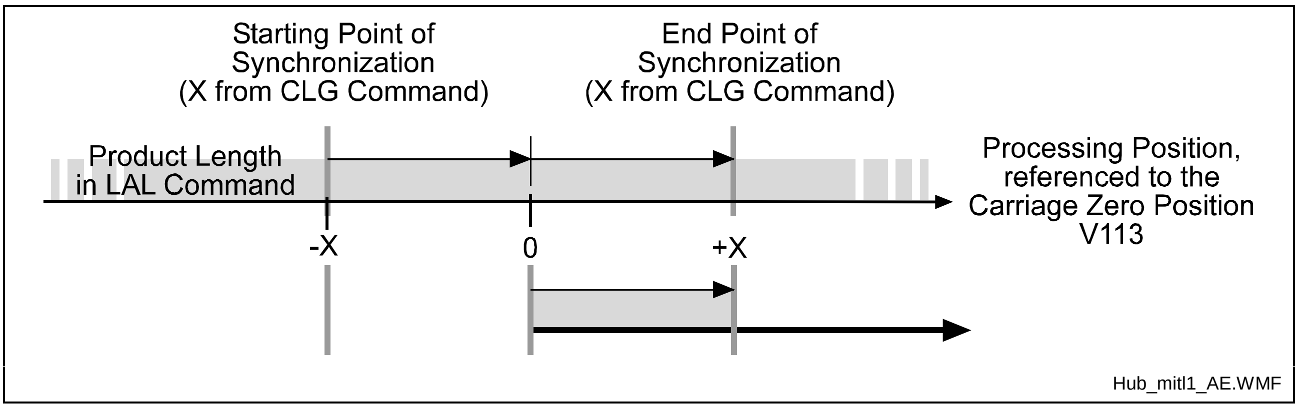
Shifting the Home Position

After synchronization has ended, the axis must not be positioned to a particular home position using the POA/PSA command.

If the old home position is not being used, the difference between the "old home position" and the "new home position" must be added to the production length once and activated using the LAL command.

Variables

In Variable V113, the actual distance between the next or actual processing location and the home position is displayed.



L: X = Acceleration Path using CLG Command

Fig. 8-20: Variable V113

When a negative value is set in Variable V113, the processing location comes before the axis. At the location –X, the axis begins to accelerate and at the location +X, the axis has reached the same material velocity and the axis is at the processing location.

Jerk

Using jerk, the material pulses and the axis movement are smoothed at the same time.

Therefore, the axis position is shifted to the position of the processing location. It consists of:

$$s = V_{current}\,[IU/s] * (Parameter\ A110 + 0.002)$$

Fig. 8-21: Shifting the Position using Jerk

Monitoring

When re-loading the length using the LAL command, it is subtracted from the value in Variable V113. If the value is not more negative than the negative acceleration path (see Fig. 8-20 –X), it is no longer possible for the axis to synchronize to the processing location using the default parameters. In this case, the error marker flag M1.02.1 is set, the axis no longer synchronizes and remains in the LAL command.

If the system is to continue operating, this is possible by setting the negated acceleration path in Variable V113.

```
SET   V113 = -xxxx
```

Caution: The length of the processed part will always be larger than the length programmed in the LAL command!

Presignaling

Using the content of Variable V113 (distance from home position to next processing location), a presignal can be programmed.

8.10 Control Loop Settings

The control loop settings in a digital drive controller are important in terms of the characteristics of the servo axis.

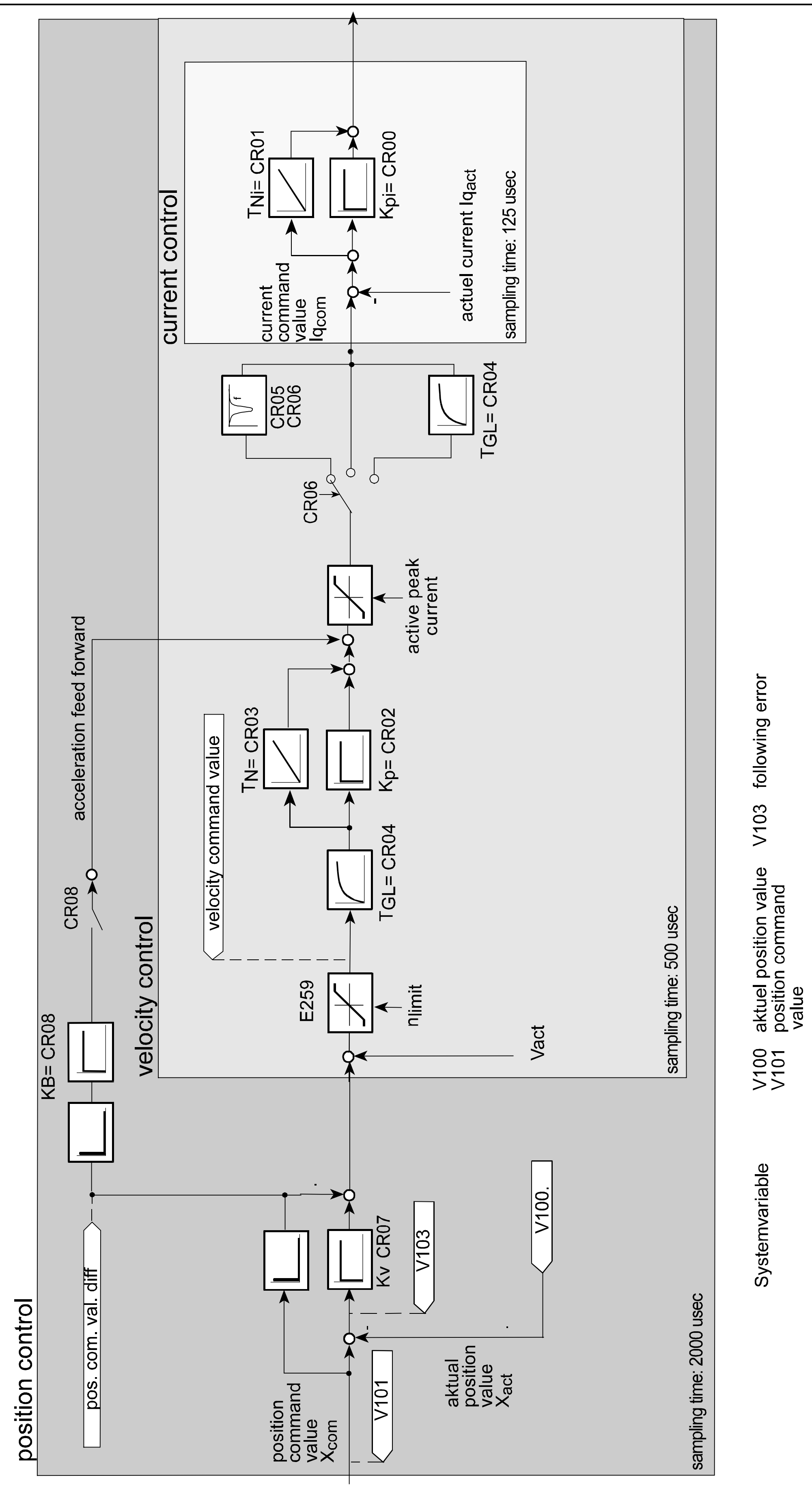
"Optimizing" the controller settings is generally not necessary!

Determining the control loop settings requires expert knowledge. For this reason, application-specific controller parameters are available for all Rexroth 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:



fp5007fj_AE.WMF

Fig. 8-22: Control Loop

Setting the Current Controller

The parameters for the current loop are set by Rexroth 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 loop proportional gain 1**
- **CR01, Current loop integral action time 1**

WARNING

Changing the values defined by Rexroth

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, Velocity loop proportional gain**
- **CR03, Velocity loop integral action time**
- **CR04, Velocity loop smoothing time constant**

as well as the parameters

- **CR05, Rejection frequency velocity loop**
- **CR06, Rejection bandwidth velocity loop**

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, Velocity loop proportional gain = default value of the connected motor.

CR03, Velocity loop integral action time = 6500 ms (no integral gain)

CR04, Smoothing time constant = minimum value (= 500 µs)

CR06, Rejection bandwidth velocity loop = 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, Velocity loop-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, Smoothing time constant** until the oscillation ends. Then increase the **CR02, Velocity loop proportional gain** until it becomes unstable again.
- **Reduce the CR02, Velocity loop 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, Velocity loop proportional gain** = 0.5 times the critical proportional gain
- Reduce the **CR03, Velocity loop integral action time** until unstable behavior results.
- Increase the **CR03, Velocity loop 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.

Mode:	Velocity Loop Proportional Gain:	Velocity Loop Integral Action Time:	Remarks:
Feed axis on standard machine tool	Kp = 0.5 x • Kpcrit	Tn = 2 • Tncrit	Good rigidity and good command response
Feed axis on perforating press or turret punch presses	Kp = 0,8 x • 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. 8-23: 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, Rejection frequency velocity loop**
- **CR06, Rejection bandwidth velocity loop**

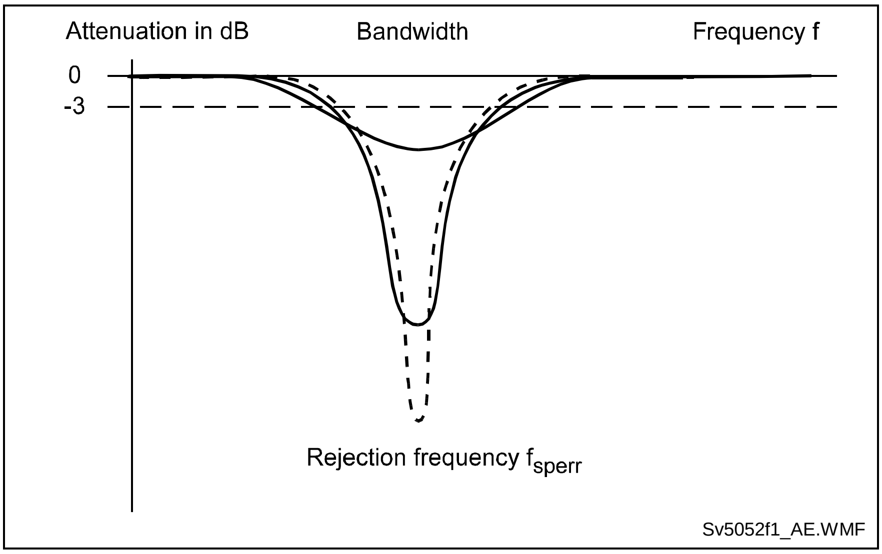


Fig. 8-24: Amplitude Response of the Rejection Filter as a Function of Bandwidth (Qualitative)

To set the bandpass filter, we recommend proceeding as follows:

Presets

First set rejection filter to inactive

⇒ Set parameter **CR06, Rejection bandwidth Velocity loop** 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 selection** "B004" and in **B004, Analog output 1 scaling** 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, Rejection frequency velocity loop.**

⇒ Enter a minimum bandwidth in parameter **CR06, Rejection bandwidth velocity loop,** 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, Rejection bandwidth velocity loop** produces additional improvement.

- or -

⇒ Check whether a change in the value of **CR05, Rejection frequency velocity loop** produces additional improvement.

If the step response displays the same behavior, then:

⇒ Check the resonance frequency analysis.

- or -

⇒ Increase the value of **CR06, Rejection bandwidth velocity loop** by a much larger amount.

Optimize Rejection Filter or Velocity Loop

⇒ Using the pre-optimized values for **CR05, Rejection frequency velocity loop** and **CR06, Rejection bandwidth velocity loop,** optimize the velocity loop again (see above).

The step response defined above must have a similar appearance with higher values for **CR02, Velocity loop proportional gain** and/or smaller values for **CR03, Velocity loop integral action time.**

⇒ Any additional optimization cycles for **CR05, Rejection frequency velocity loop** and **CR06, Rejection bandwidth velocity loop** 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, Rejection bandwidth velocity loop** to **"-1."** The notch filter and the associated parameter **CR05, Rejection frequency velocity loop** 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 Velocity loop 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, Velocity loop smoothing time constant**.

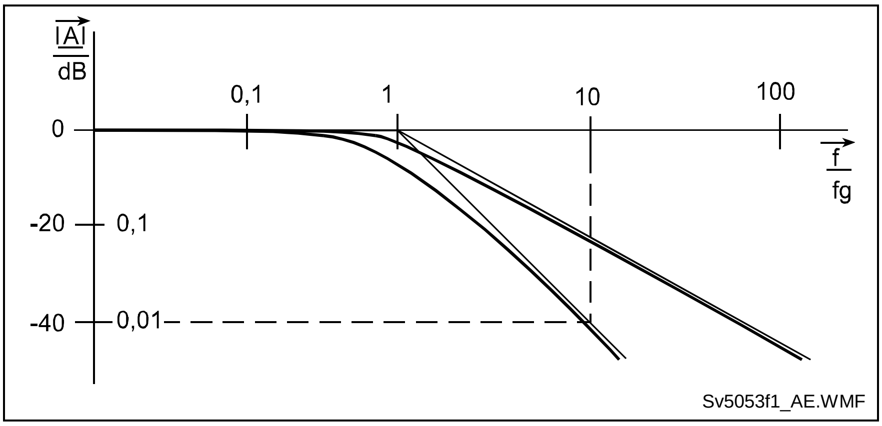


Fig. 8-25: Frequency Response of Low Pass Filters with 1 Pole and with 2 Poles

Note: This setting is made as described in the section entitled: "Determination of the critical proportional gain and parameter CR04, Velocity loop 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 of 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, Position Loop 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. (Kv = 1)
- For the determination of the position loop parameters, no compensation function should be activated.

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, Position loop 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

A parameter are used for setting the monitoring function:

- **A115, Monitoring position loop**

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, Monitoring position loop** for more than 8 ms, error message **F228 Excessive deviation** will be generated.

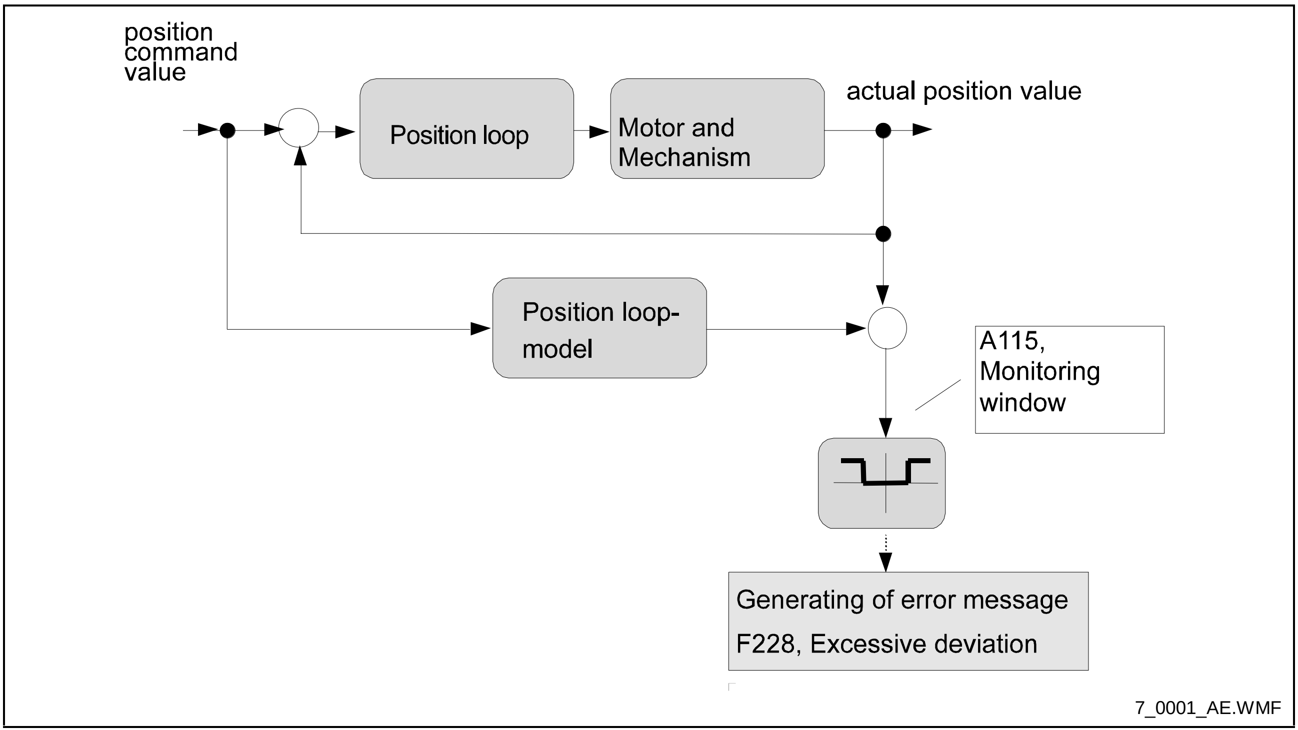


Fig. 8-26: Operating Principle of Position Loop Monitor

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, Monitoring position loop**.

Note: By default, the position control loop monitor is active.

Setting the Acceleration Feedforward

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, Acceleration feedforward gain**

Requirements for a Correct Setting for Acceleration Feedforward

- Velocity and position loops must be set properly.

Setting the Acceleration Feedforward

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:

$$Acceleration\ Feedforward = \frac{J_{\text{Motor}} + J_{\text{Load}}}{Kt} \times 1000$$

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. 8-27: Approximate Value for Acceleration Feedforward

Enter the approximate value calculated in parameter **CR08, Acceleration feedforward gain.**

- Verification of the effect of the acceleration feedforward and fine tuning of parameter **CR08, Acceleration Feedforward Proportional Gain** 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.

8.11 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, Gear, input revolutions**
- **A102, Gear, output revolutions**

The parameters for the ratio between gear input and output are set here.

Example:

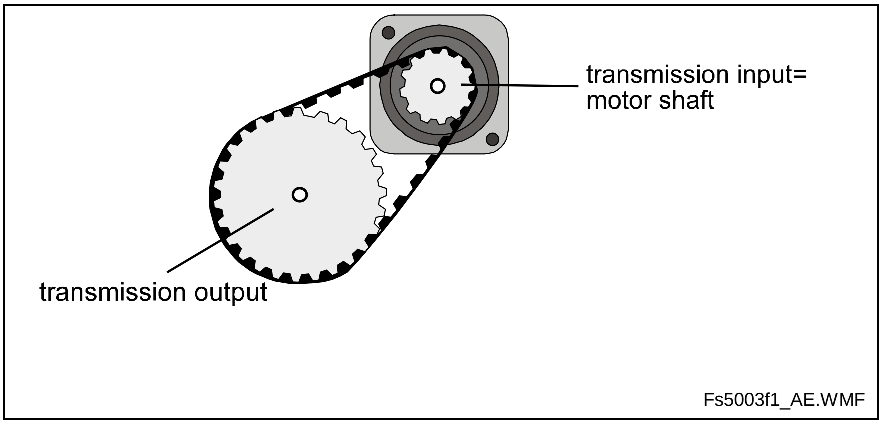


Fig. 8-28: Setting the Gear Ratio Parameters

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 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:

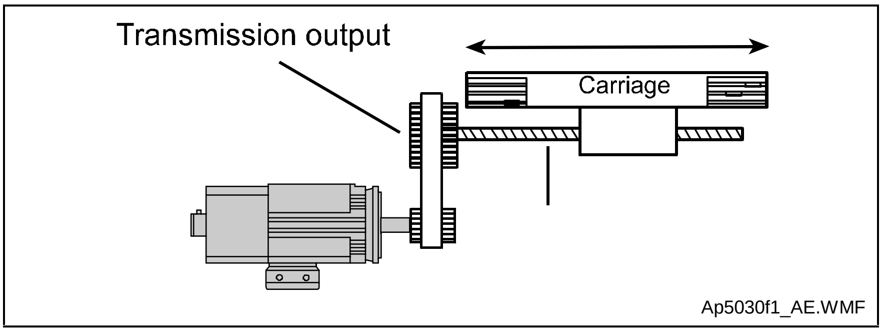


Fig. 8-29: Feed Constant Parameters

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 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:

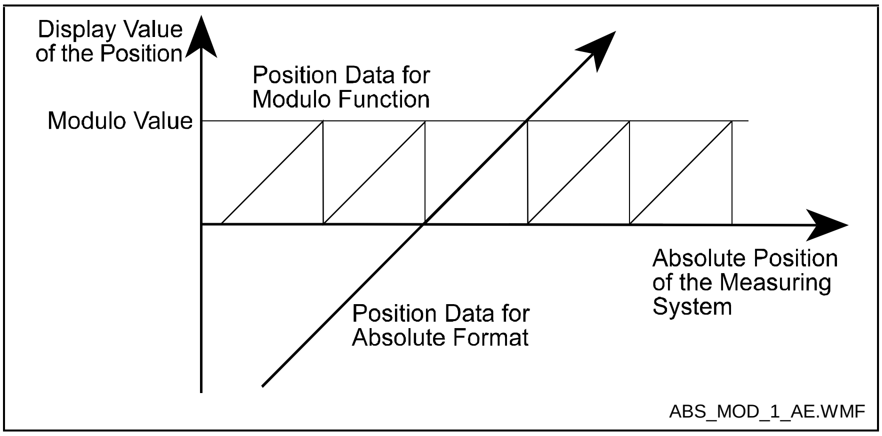


Fig. 8-30: Display Value of Positions in Absolute Format and Modulo Format

8.12 Movement to Positive Stop

The assignment 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 redirect 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 clamping, a POI command with travel distance of zero can be used.

The movement to positive stop function is triggered by the commands **"PFA"** and **"PFI."**

Remarks:

- When the command is initialized, the feedrate is set first. (Requires approx. 80 ms.) Next, the logic is enabled for detecting the positive stop. Then, finally, the positioning operation 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 standstill window 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.

Further explanation can be found in the descriptions for the "MOM," "PFA" and "PFI" commands.

For correct function standstill window must be lower than feedrate in PFA/PFI command!

Example Program:

Instruction	Command	Command Contents	Comment
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. 8-31: PFA Command Example

8.13 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 (Connector X9) 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 type**
- **C015, Encoder emulation resolution**
- **C010, Homing, set absolute position**

For **incremental encoder emulation,** the following parameter is also used:

- **C016, Marker pulse offset**

With absolute encoder emulation, the following parameter is used:

C011, Reference distance

Activating Encoder Emulation

It is possible to control the behavior of the function with the help of parameter **C014, Encoder emulation type.**

C014 Encoder Emulation Configuration

0 0 0

Select Emulation (third digit)
- 0 = no output
- 1 = incremental encoder emulation
- 2 = absolute encoder emulation

Dead-Time Compensation (second digit)
- 0 = is deactivated
- 1 = is activated

Select Actual Position Source (first digit)
- 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 unambiguous 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**, **Marker pulse 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..359.9 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. 8-32: 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 type**, 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.

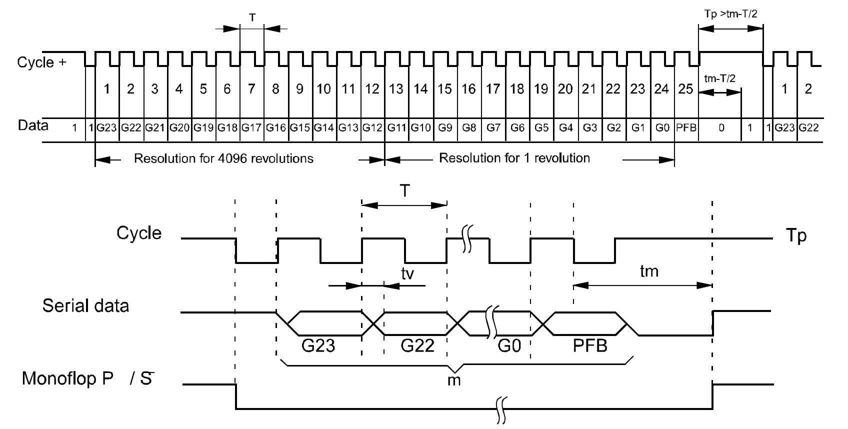
Remedy:

- 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.



G0 = lowest value bit in the Gray-Code
G23 = highest value bit in the Gray-Code
m = saved parallel information
T = cycle signal period duration
tm = monoflop time 15µs to 25µs
Tp = cycle rest
tv = delay time for the first cycle max. 540ns, for all others max. 360ns
PFB = Power Failure Bit (is not used and is logically always... "0")

Ap5002d1_AE.WMF

Fig. 8-33: SSI Format as Pulse Diagram

Note: 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 encoder,** the absolute position output by the absolute encoder emulator can be homed.

When the absolute encoder is set, the value from parameter **C011, Reference distance** 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.

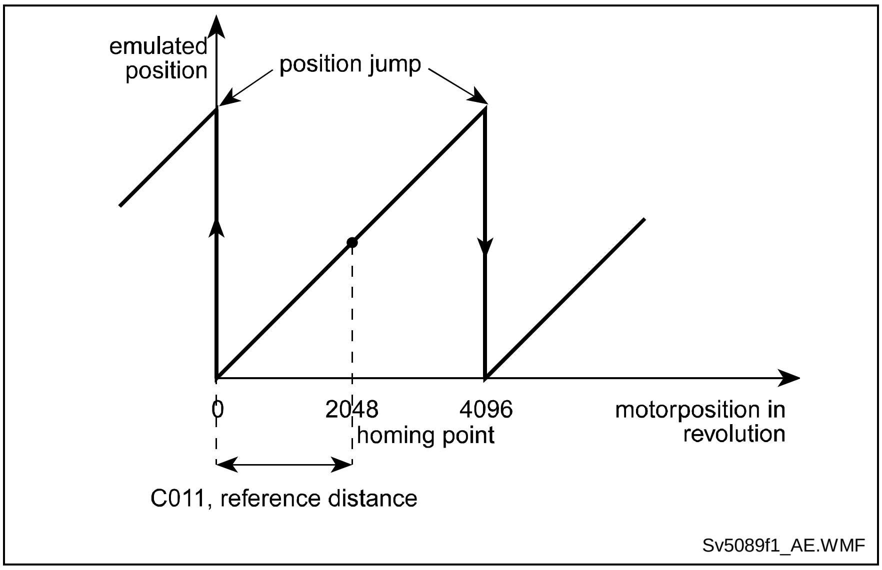


Fig. 8-34: SSI Display Limits

To prevent this effect, the SSI position value must be moved using parameter

C010 Homing, Set absolute position.

It is recommended that parameter **C011, Reference distance** 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.

8.14 Indexed Variables in NC Commands

Two variable fields of the same type have been assigned, to communicate indexes to variables, even within program loops. Eight indexed variables are available. The function within the variable field is assigned and enables a calculation of a variable address using the formula:

$$\textit{calculated variable number} = [V50x] + [V509] * [V508]$$

$$\textit{calculated variable number} = [V51x] + [V519] * [V518]$$

L: [ ] Contents
L: [V50x] = Contents of V500 – V507
L: [V51x] = Contents of V510 – V517

Fig. 8-35: Formula for Calculating Indexed Variables

The contents of variables V509 and V508 (or V519 and V518) are multiplied and added to the contents of Variable 50x (or V51x). The resulting value is the variable number that is then processed in the called function.

Variable	Definition
500	# of Basic Variable 1
501	# of Basic Variable 2
502	# of Basic Variable 3
503	# of Basic Variable 4
504	# of Basic Variable 5
505	# of Basic Variable 6
506	# of Basic Variable 7
507	# of Basic Variable 8
508	Offset Factor 1
509	Variable Index 1

Fig. 8-36: Variable Block 1

Variable	Definition
510	# of Basic Variable 1
511	# of Basic Variable 2
512	# of Basic Variable 3
513	# of Basic Variable 4
514	# of Basic Variable 5
515	# of Basic Variable 6
516	# of Basic Variable 7
517	# of Basic Variable 8
518	Offset Factor 2
519	Variable Index 2

Fig. 8-37: Variable Block 2

All NC commands using Variables V500-V507 or V510-V517, are executed in their indexed form.

If access to a variable outside of the range V600 to V999 is made, (besides system variables), the error message **"F- 02 23 – Wrong variable index"** is issued.

If these variables are written via the serial interface, fieldbus or using the SET command, they are written **without an index** (directly).

Example 1:

SET	V500	=	600	Basic Variable 1 "Length“	
SET	V501	=	601	Basic Variable 2 "Velocity“	
SET	V502	=	602	Basic Variable 3 "Acceleration“	
SET	V503	=	603	Basic Variable 4 "Preset Count“	
SET	V504	=	604	Basic Variable 5 "Actual Quantity“	
SET	V508	=	5	Number of variables per product	
SET	V600	=	15	Product 1	Length
SET	V601	=	800	Product 1	Velocity
SET	V602	=	750	Product 1	Acceleration
SET	V603	=	120	Product 1	Preset Count
SET	V605	=	20	Product 2	Length
SET	V606	=	700	Product 2	Velocity
SET	V607	=	600	Product 2	Acceleration
SET	V608	=	150	Product 2	Preset Count
SET	V610	=	10	Product 3	Length
SET	V611	=	990	Product 3	Velocity
SET	V612	=	400	Product 3	Acceleration
SET	V613	=	100	Product 3	Preset Count

Index V509	Length V500	Velocity V501	Acceleration V502	Preset Count V503	Actual Count V504
0	V600	V601	V602	V603	V604
1	V605	V606	V607	V608	V609
2	V610	V611	V612	V613	V614
3	V615	V616	V617	V618	V619

Fig. 8-38: Product Table, Example 1

The quantity of product-specific data is limited to 8, and the number of products is limited by the variable field V600 – V999.

SET V509 = 2	Select Product 3
ACC 1 V502 999	→ ACC 1 V612 999 → ACC 1 400 999
PSI 1 +V500 V501	→ PSI 1 V610 V611 → POI 1 +010 990
COU +00000 Q0.01.3 V503	→ COU +00000 Q0.01.3 V613 → COU +00000 Q0.01.3 100

It follows that:

The value for acceleration is calculated from Variable # 602+2*5 = 612.

The value for length is calculated from Variable # 600+2*5 = 610.

The value for velocity is calculated from Variable # 601+2*5 = 611.

The value for the target quantity is calculated from Variable # 603+2*5 = 613.

The current actual quantity can be found in Variable # 604+2*5 = 614.

Example 2:

SET	V500	=	600	Basic Variable 1 "Length"	
SET	V501	=	610	Basic Variable 2 "Velocity"	
SET	V502	=	620	Basic Variable 3 "Acceleration"	
SET	V508	=	1		
SET	V600	=	15	Product 1	Length
SET	V610	=	500	Product 1	Velocity
SET	V620	=	800	Product 1	Acceleration
SET	V601	=	20	Product 2	Length
SET	V611	=	700	Product 2	Velocity
SET	V621	=	550	Product 2	Acceleration
SET	V602	=	10	Product 3	Length
SET	V612	=	999	Product 3	Velocity
SET	V622	=	400	Product 3	Acceleration

Index V509	**Length V500**	**Velocity V501**	**Acceleration V502**
0	V600	V610	V620
1	V601	V611	V621
2	V602	V612	V622
3	V603	V613	V623

Fig. 8-39: Product Table, Example 2

SET	V509 = 2	Select Product 3
ACC	1 V502 999	➔ ACC 1 V620 999 ➔ ACC 1 400 999
PSI	1 +V500 V501	➔ PSI 1 V600 V610 ➔ POI 1 +010 999

It follows that:

V509 is used to access data for Product 3.

The value for acceleration is calculated from Variable # 620+2*1 = 622.

The value for length is calculated from Variable # 600+2*1 = 602.

The value for velocity is calculated from Variable # 610+2*1 = 612.

8.15 Logic Task Controlled Diagnostics for Status Message 25

The issuance of Status Message 25 can be affected by the Logic Task program, if the drive diagnostic is "HA" or "AU."

For control of this output, marker flags M6.37.0 to M6.39.7 are used, with which 24 different messages can be output.

The diagnostic text is written to NC instructions using the TXT command. The text appears in a block of 96 NC instructions. This block begins at instruction number 900.

24 diagnostics with 4 TXT commands each are available; this communication occurs via 24 diagnostic marker bits. If more than one diagnostic marker bit is activated, the text of the higher-priority bit is displayed.

If the text strings are written using Mode 3 (TXT 3 xxxxx), they can be queried using Status 25.

high

Error Messages
Warnings
Diagnostics besides "HA“ / "AU“
Logic Task Diagnostic
NC Diagnostic per TXT Command
"HA“ / "AU“ Diagnostics

Fig. 8-40: Diagnostic Priority

low

Summary of DLC-R Error Messages:

<u>Status Messages:</u>

```
"02M: Feed Forward                 "
"0EPARAMETER MODE                  "
"17M: Feed Reverse                 "
"18Initializing System             "
"1AA: C.Stop Active                "
"3AFeed Rolls Open                 "
"48Stop Due To Interrupt Input!    "
"99Control Error, See H1 Display!  "
```

<u>Minor Error:</u>

```
"13Both Jogs High                  "
```

<u>Soft Fault:</u>

```
"66Feed Angle Lost During Feed!    "
"6AInvalid Mode Selection!         "
```

<u>Hard Fault:</u>

```
"77Parameter Invalid! Select P-mode! "
"81Parameters Lost! Clear to Cont  "
"86Parameters Lost! Select P-mode! "
```

<u>DLC-R Drive Errors:</u>

```
"00System is Ready                 "
"3DA: Stop/Wait for start          "
"3ES: Stop active                  "
"3FM: Stop active                  "
"44Drive is not enabled!           "
"7DMotor Overtemp Warning          "
"7EAmp Overtemp Warning            "
"82Axis 1 Drive Runaway!           "
```

```
    "88EMERGENCY STOP!                         "
    "8BMotor Has Overheated!                   "
    "8CDrive Stalled!                          "
    "93Drive Watch Dog Error                   "
    "96Drive Error, See H1 Display!            "
```

If a marker is set, but there are no text commands written to the corresponding instruction area, the text "No text block nn" (’nn’ = text field number) is displayed.

Examples:

```
Xs25 88EMERGENCY STOP!                        $hh<cr><lf>
Xs25 13Both Jogs High                         $hh<cr><lf>
Xs25 02M: Feed Forward                        $hh<cr><lf>
Xs25 NC Customer-Text                         $hh<cr><lf>
Xs25 Logic Task Customer Text                 $hh<cr><lf>
Xs25 00System is Ready                        $hh<cr><lf>
```

Note: If Status 25 is active, the first 40 characters of the selected text block are displayed.

high

Text Field No.	NC Instruction Numbers	Diagnostic Marker Bit
Text-Field 1	xxxx+00 TXT 0 ABC.. xxxx+01 TXT 0 EFG xxxx+02 TXT 0 HIJ.. xxxx+03 TXT 0 KLM	M6.39.7
Text-Field 2	xxxx+04 ... xxxx+07	M6.39.6
Text-Field 3	xxxx+08 ... xxxx+11	M6.39.5
Text-Field 4	xxxx+12 ... xxxx+15	M6.39.4
Text-Field 5	xxxx+16 ... xxxx+19	M6.39.3
Text-Field 6	xxxx+20 ... xxxx+23	M6.39.2
Text-Field 7	xxxx+24 ... xxxx+27	M6.39.1
Text-Field 8	xxxx+28 ... xxxx+31	M6.39.0
Text-Field 9	xxxx+32 ... xxxx+35	M6.38.7
Text-Field 10	xxxx+36 ... xxxx+39	M6.38.6
Text-Field 11	xxxx+40 ... xxxx+43	M6.38.5
Text-Field 12	xxxx+44 ... xxxx+47	M6.38.4
Text-Field 13	xxxx+48 ... xxxx+51	M6.38.3
Text-Field 14	xxxx+52 ... xxxx+55	M6.38.2
Text-Field 15	xxxx+56 ... xxxx+59	M6.38.1
Text-Field 16	xxxx+60 ... xxxx+63	M6.38.0
Text-Field 17	xxxx+64 ... xxxx+67	M6.37.7
Text-Field 18	xxxx+68 ... xxxx+71	M6.37.6
Text-Field 19	xxxx+72 ... xxxx+75	M6.37.5
Text-Field 20	xxxx+76 ... xxxx+79	M6.37.4
Text-Field 21	xxxx+80 ... xxxx+83	M6.37.3
Text-Field 22	xxxx+84 ... xxxx+87	M6.37.2
Text-Field 23	xxxx+88 ... xxxx+91	M6.37.1
Text-Field 24	xxxx+92 TXT 0 ABC.. xxxx+93 TXT 0 EFG xxxx+94 TXT 0 HIJ.. xxxx+95 TXT 0 KLM	M6.37.0

low

Fig. 8-41: Priority of the Logic Task Diagnostics

8.16 PLS

A maximum of 11 PLS positions that are output over 8 PLS outputs can be programmed. Multiple PLS positions can be assigned to each output. The outputs can be controlled within the entire PLS range, or set only as a timer. For each output, hysteresis spacing in the forward and reverse directions can be assigned. To balance switching times for controlled peripherals, a lead time for turning on/off each PLS output can be set. These outputs are then controlled for correct positioning, depending on the press velocity. The outputs of groups Q0 to Q3 are available as physical outputs. The PLS function must be enabled in Parameter N100 and the PLS outputs, PLS positions and desired functions must be correctly input in Parameters N101-N131. The encoder type and the encoder reference position are recorded in Parameters C017 – C019.

Parameter Number	**Definition**
C017	SSI Encoder Type (Press Encoder)
C018	Home SSI Encoder
C019	SSI Encoder Reference Distance
N100	Enable and Feed Constant
N101 - N131	PLS Parameters

Fig. 8-42: Parameters Required for the PLS

The PLS gets its positions from an absolute encoder. This encoder is attached at connector X9 and must support the SSI format.

The PLS outputs are set every 2ms and can also be evaluated by the NC Program or the logic task.

9 Parameters

9.1 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 CRxx Parameters and PLS Parameters N111 - N131, the parameters can only be modified in Parameter Mode via the serial interface. To configure the system parameters, the MomaNT startup software and the BTV04 operator console are available. Once the system is no longer in Parameter Mode, the parameters are monitored and a diagnostic message is issued if incorrect parameters are found. (Chapter entitled "Serial Interface," Heading "Status 60")

To provide a better overview, the parameters are divided into 7 groups:

Parameter Blocks	Block Identifier	Parameter Number
System Parameters	A1	00 to 19
Function Parameters	AA	00 to 19
General Parameters	B0	00 to 14
Encoder Parameters	C0	00 to 19
Controller Parameters	CR	00 to 10
Motor Parameters	CM	00 to 12
PLS Switch Press Encoder	N1	00 to 31

Fig. 9-1: Parameter Groups

System Parameters A1

The machine type, the maximum move data and the mechanical data are recorded here.

Function Parameters AA

Program execution structures can be activated here.

General Parameters B0

Determination of the Interfaces and their Function Parameters.

Encoder Parameters C0

The encoder type, direction of movement and resolutions.

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.

PLS Parameters N1

N1 Parameters are needed only when an external absolute encoder is connected for the PLS.

PLS Parameters N111 to N131 can also be written when the system is not in Parameter Mode. In this case, however, they must be initialized using a command.

Online Changeable Parameters

Changeable Parameters

• A110	Bipolar Jerk Limiting Time Constant
• AA15 ... AA18	Signal Controlbit 1 ... 4
• B006 ... B008	Analog Output 2
• CRxx	All Controller Parameters

Conditionally Changeable Parameters

Can be changed, if no SA1 command is active in the program:

• B003 ... B005	Analog Output 1

Can be changed, if no program is running:

• C019	SSI Encoder Reference Distance

The following parameters should only be changed at idle PLS encoder in Manual Mode. Each modification will cause a dead time of 10ms in which the outputs of the PLS stay unchanged.

• N111 ... N118	Function of Output Channel 1
• N121 ... N131	Switch 1

Input Unit

The input unit is defined in Parameter A101 Feed Constant. The feed constant is defined as the linear displacement of the load during one revolution of the gear output 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. IU [mm]

In this case, the velocity is entered or shown as IU/s, hence mm/s.

IU [inch]

In this case, the velocity in entered or shown as IU/s, hence inches/s.

9.2 System Parameters

A100 Application Type

1 0

Function of Encoder 2 (optional):

0 = None

1 = Direct Measurement

3 = Measuring Wheel

Motion Type:

0 = rotary (continuously rotating)

1 = linear (finite travel)

2 = Rotary Table

Motion Type:

For **rotary** motion, the drive unit normally turns continuously in one direction. The product is brought to its relative position using rolls and is then processed. Feed-to-length mechanisms are typically used. There are no travel limit switches.

For **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 of **Parameter A105, Modulo Value**. There are no travel limit switches.

Function of Encoder 2:

none: There is no second encoder

Direct Measurement: In addition to the motor encoder, an externally mounted encoder provides position detection.

Measuring Wheel: At times, an external encoder takes over position detection. It is possible to switch back and forth between the motor encoder and the measuring wheel encoder. Only relative distances are traversed.

A101 Feed Constant

0100.0000

Feed Constant in IU

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 output shaft.

Input min.:	0.1000	IU
Input max.:	5000.0000	IU

A102 Gearing

0001 0001

Output Revolutions of the Load Gear

Input Revolutions of the Load Gear

A mechanical gear is often employed between the motor and the load.

The **gear ratio** is defined as:

$$i = \frac{\textit{Input Revolutions of Load Gear}}{\textit{Output Revolutions of Load Gear}}$$

Fig. 9-2: Gear Ratio

See also functional description for: "Gear Ratio" and "Modulo Function"

Example:

Five turns of the motor shaft equal two turns of the output shaft.

$\Rightarrow$ Input Revolutions: 5

Output Revolutions: 2

Input min.:	1
Input max.:	9999

A103 Negative Position Limit

±000100.000

Negative Position Limit in IU

The negative position 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 outside of the negative position limit is stipulated for the drive, the error message "**F- 02 03 – Target pos. < Min."** (Target position < Negative position limit) is generated.

If this programmed position is exceeded in Automatic Mode, the error message **F630 Negative position travel exceeded** is generated.

Input min.: -200000.000

Input max.: +200000.000

A104 Positive Position Limit

±000100.000

Positive Position Limit in IU

The positive position 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 outside of the positive position limit is stipulated for the drive, the error message "**F- 02 04 – Target pos. > Max."** (Target position > Positive position limit) is generated.

If this programmed position is exceeded in Automatic Mode, the error message **F629 Positive travel limit exceeded** is generated.

Input min.: -200000.000

Input max.: +200000.000

A105 Modulo Value

000000.000 0

Rotary Table Mode:
0 = direction programmed within command
1 = shortest distance

Modulo value in IU

When the modulo format is set, the modulo value determines the numeric 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	IU
Input max.:	200000.000	IU

A106 Maximum Velocity

001000.000

Maximum velocity of the axis in IU/s

The maximum velocity defines the maximum permissible velocity and applies symmetrically in both directions.

The maximum value that can be entered is limited by **Parameter CM03** "Maximum Motor Speed" and by the amplifier output.

$$\textit{For rotary encoder:}$$

$$A106_{\mathrm{max}} = \frac{\textit{Max. possible speed} \times FC(A101)}{60 \times i}$$

$$\textit{Bei Linear motor:}$$

$$A106_{\mathrm{max}} = CM03$$

L: FC = Feed Constant
i = Gear Ratio

Fig. 9-3: Calculation of Maximum Velocity

The velocity given in per thousand in the feed commands is referenced to this value.

Input min.: 0.010

Input max.: 200000.000
depending on the drive and the amplifier output

A107 Jog Velocity

000100.000

Jog velocity in IU/s

With the velocity entered here, the drive motion is
‘Jog forward‘ or ‘Jog reverse.'
Additionally: A107 ≤ A106

Input min.: 0.001
Input max.: 200000.000
depending on the drive and the amplifier output

A108 Bipolar Acceleration

001000

Acceleration in IU/s^2

The maximum possible bipolar acceleration defines the maximum permissible acceleration symmetrically in both directions (acceleration and deceleration) and is programmed in this parameter.

Acceleration or deceleration limits are possible in Parameter A109 and/or using the ACC command.

Input min.: 1
Input max.: 200000

A109 Acceleration / Deceleration

000 000

Deceleration in ‰ (per thousand)
Acceleration in ‰ (per thousand)

In both of these values, the ‰ indication refers to the maximum acceleration in **Parameter A108**. If 000 is entered, the program retrieves the 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 clearing, and after exiting Parameter Mode. The ‰ values shown in the ACC command refer to this parameter.

Input min.: 0 ‰
Input max.: 999 ‰

A110 Bipolar Jerk Limiting Time Constant

0.000

Time Constant for acceleration [s]

Min. = 0 (no jerk)
Max. = 1.024 s

The time constant is processed only in 2^n values

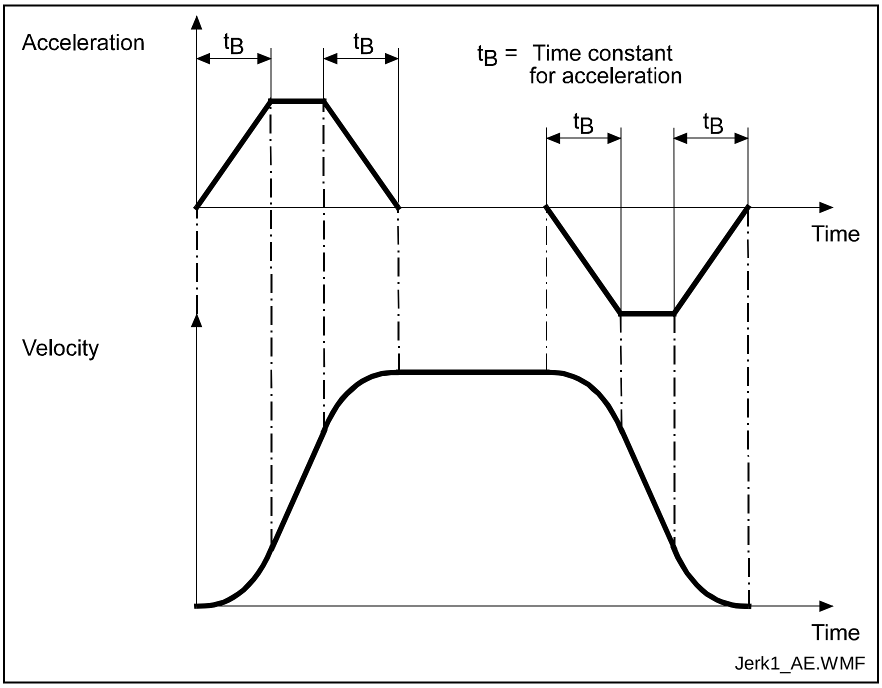


Fig. 9-4: Jerk

Parameter A110 can be written in all operating modes.

CAUTION

Bei nicht stehender Achse kann es bei Änderung dieses Parameters zu ruckartigen Bewegungen kommen.

⇒ Value should be changed preferably in standstill.

A111 Switching Threshold

M2.02.2 000.100

Switching Threshold in IU

Output Bit: Position Reached

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

Output Bit: This bit is set when the remaining distance to travel from the last feed command is within the monitoring window (switching threshold) range. If the motor does not remain within this ± switching threshold range, or if a new feed command is detected, the output bit is turned off. If 00.00.0 is entered, the function is not active.

Switching Threshold: This value is used to establish a monitoring window. The last progression is considered completed when the remaining distance is less than the switching threshold. Depending on the friction and external forces acting on the feed rolls, and depending on the control loop parameter settings, a small untraveled distance remains at the end of each progression. This distance does not accumulate for more than one progression. If this remaining distance (position deviation) is greater than the switching threshold that has been set, the feed angle monitoring function (if activated in Parameter A116) reacts, or program processing is stopped. The typical values for the switching threshold for feed-to-length progressions are 0.05 to 0.5 IU (IU = mm).

When the stop function is executed, the “Position reached” message is no longer referenced to the previously stipulated target position.

| Remaining Travel Distance | + | Position Deviation | < Switching Threshold →Output = 1

| Remaining Travel Distance | + | Position Deviation | > Switching Threshold →Output = 0

Switching Threshold Input Min.:	0.001
Switching Threshold Input Max.:	999.999

A112 Reserved

A113 In-Position Window

M2.02.2 0001.000

"In Position" - Window in IU

Output Bit: Axis in Last Programmed Position
00.00.0 = function not active

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

The last target position specified via a feed command or homing is stored and then continually compared with the actual position value. If the actual position value is within this window, the output bit is set.

| Programmed Position – Actual Position | < In Positioning Window → Output = 1

| Programmed Position – Actual Position | > In Positioning Window → Output = 0

This function is active in Manual and Automatic Mode.

Position Input Min.:	0.001
Position Input Max.:	9999.999

A114 Presignaling

M2.02.2 1.5 0050

Distance from the Target Position in IU,
Min.: 1 Max.: 9999

Time in s (pulse)
0.0 = Output as continuous signal

Presignaling Output
00.00.0 = Presignaling function not active

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

The presignaling function programmed in this parameter applies for every positioning command (POI, PSI, POA, PSA, PFI, PFA).

As soon as the remaining travel distance becomes less than the programmed presignaling distance, the output is enabled. The output bit remains enabled continuously or for the programmed time period. When a new positioning move is issued, the output bit is deactivated.

A115 Monitoring

0 010 M2.02.2

Output Bit:
Position Deviation > max. Position Deviation

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

00.00.0 = Output bit inactive

max. Position Deviation [%] max. = 300

8 = Position Loop Monitoring = OFF
<> 8 = Position Loop Monitoring = ON

The position loop is continuously monitored. This is done by calculating a sample actual position value and comparing it with the actual position value.

The maximum deviation tolerated between the measured and calculated actual positions is set using **Parameter A115, Monitoring**. At maximum velocity, the position deviation is assumed to be at 100%.

If the position deviation exceeds this monitoring window, the error message "**F228, Excessive deviation**" is issued.

$$\max.Deviation[IU] = \frac{A106}{CR07} \times \frac{60}{1000} \times \frac{\max.Position\ Deviation[\%]}{100}$$

L: A106 Maximum Velocity
CR07 Kv Factor

Fig. 9-5: Monitoring Window

DANGER

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

Turning off Position Loop Monitoring is only intended for initial start-up or for verifying the motion sequence.

⇒ In any case, activate Position Loop Monitoring with its value = 0.

A116 Feed Angle Monitoring

M2.02.1 M2.02.2 0

Mode in Manual Mode:

0 = Feed Angle Monitoring active
1 = Feed Angle Monitoring inactive

Input Bit : Interruption
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

Input Bit : Feed Angle Monitoring
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

Feed Angle Monitoring (Feed Angle):

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 bit, 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 bit.

If the signal drops out during feed, feed is aborted and the error message **"F-02 10 – Feed Angle Loss"** is generated.

Interruption:

Enter whether or not a positioning function in progress can be interrupted. Entering 00.00.0 means there is no interrupt.

If the signal at the specified input bit 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 bit.

If the other operating conditions have been retained, execution or continuation of the positioning function takes place as soon as the signal is present.

Mode in Manual Mode:

Deactivate Feed Angle Monitoring in Manual Mode

This value can also be edited outside of Parameter Mode, via the serial port.

A117 Encoder Difference Monitoring

000

000 = no monitoring
Monitoring window in ‰ (per thousand) referencing C007 (Function of Encoder 2 (A100) Measuring Wheel Mode)
Monitoring window in ‰ (per thousand) referencing A101 (Function of Encoder 2 (A100) Direct Measurement)

If Measuring Wheel Mode is active, the motion of the motor and the measuring wheel is monitored. As soon as the difference between the two encoders during one measuring wheel revolution is greater than the monitoring window entered, the drive is shut down and the error message **"F- 02 13 – Measuring Wheel Difference"** or **"F- 02 36 – Excessive Position Feedback Difference"** is issued.

DANGER

Dangerous movements! Risk of death, serious bodily injury or equipment damage due to unintentional motor movements!
When the measuring wheel is activated, turning off Measuring Wheel Difference is only intended for initial start-up or for verifying the motion sequence.

⇒ In any case, activate Measuring Wheel Difference Monitoring with a value > 0.

A118 Absolute Encoder Monitoring Window

0001.000

Window Size in IU

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 set in **Parameter A118**, Absolute Encoder Monitoring Window, the error message **"F276 – Absolute Encoder out of allowed Window"** 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 Encoder Monitoring Window' is set to 0, the absolute encoder monitoring function is deactivated. 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 IU)

$$Window\ Size[IU] = \frac{Degrees(Motor\ Shaft) \times FC\,(A101)}{i\ \ (Gear\ ratio)\ \times\ 360}$$

Fig. 9-6: Absolute Encoder Monitoring Window

Input min.:	0	[IU]
Input max.:	9999.999	[IU]

A119 Best Possible Deceleration

0 0 000 — **Reserved**

Maximum Braking Time in s
0 = 5 s (Default value)

Reaction:
0 = Velocity (rotary) command value set to zero
1 = Switch to torque-free state
2 = Velocity (linear) command value set to zero

This parameter specifies how the drive will be decelerated in the event of

- a non-fatal error
- an interface error
- a phase regression
- clearing the drive enable signal

A119:	Reaction:
0	**Velocity Command Value Set to Zero** The motor decelerates, with consideration of the torque limit. The **max. braking time** is 5 seconds. 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), 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 deceleration and filter. The deceleration value, i.e., the maximum acceleration, is set in **Parameter A108**, the jerk filter is set in **Parameter A110**.

Fig. 9-7: Deceleration Mode for the Drive

The drive enable signal can be applied only after the drive has finished its error reaction.

9.3 Function Parameters

AA00 Tasks 2 & 3

0100 0200 1

Reserved

Task 3 - Start Block
If '0000' appears here, Task 3 is not enabled.
max.: 0999

Task 2 – Start Block
If '0000' appears here, Task 2 is not enabled.
max.: 0999

For further details, see Section 8.7, 'Multitasking.'

AA01 Manual Vector

M2.02.2 0 0 0100

Program Start Block

Reserved

0 = Start only via Input Bit
1 = Jump to vector program, even when switching from Automatic to Manual

Input Bit : Input number, program start at leading edge of pulse
00.00.0 = no input selected
M0 – M5 ; M8 ; I0 -I4; Q0 - Q3

For further information, see Section 8.6 'Vector Programming.'

AA02 Interrupt Vector

M2.02.2 1 0 0200

Start Block Interrupt Vector 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 active (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 Bit : Activate interrupt function
00.00.0 = Interrupt function inhibited
M0 – M5 ; M8 : I0 - I4 ; Q0 - Q3

For further information, see Section 8.6 'Vector Programming.'

AA03 Reserved

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 (Connector X3/12 X3/13)

For further information, see Section 8.4, 'Override.'

AA05 Open Feed Roll I

M2.02.1 M2.02.2 M2.02.3 000 0

0 = Open mechanically
1 = Open electrically (in preparation)

Delay in ms (0 - 999)
Open Feed Roll OFF → Meas. Wheel ON

Input Bit : Rolls Closed
(Acknowledgement)

00.00.0 = Delay Activated
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

Input Bit : Rolls Open (Automatic)

M0 – M5; M8 ; I0 – I4 ; Q0 – Q3

Output Bit: Rolls Open

	M2, M3, M4
DKC21.3	: Q0.00.4-Q0.01.3
DKC 3.3	: Q2.02.0-Q2.05.7
EMD	: Q3.00.0-Q3.03.7

Open Feed Roll in Automatic Mode

If pilot pins are used for precise positioning, the feed rolls must be open while engaging the pilot pins. This can be accomplished by opening the feed rolls (mechanically), or by preventing a connection from making contact (electrically). For the latter, positioning is disabled and the power to the motor is cut. (In preparation)

The pilot pins must hold the material in place before, and position it after opening the rolls. The material must also be held in place at all times while closing the rolls.

If a measuring wheel is used for positioning in conjunction with this function, a motor encoder is used after the initial signal is received. Switching back to Measuring Wheel Encoder occurs after the acknowledgement signal "Rolls closed" or after the programmed delay has expired. If a positioning command is called while the rolls are open, the positioning move does not occur until after the acknowledgement signal, at the earliest.

If an E-Stop, Fault, Immediate Stop, switch to Parameter Mode, or switch to Manual Mode occurs, the programmed output is immediately cleared.

Diagnostic Message: **„A- 00 11 – Feed Rolls Open“**

System Marker Flags: M1.03.2 Rolls Open

AA06 Open Feed Roll II

This function is only valid in conjunction with Parameter AA05.

M2.02.1 M2.02.2

M2.02.2 — Input Bit : Open Feed Roll in Manual Mode
00.00.0 = no opening possible in Manual Mode
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

M2.02.1 — Input Bit : Enable Function (only in Automatic Mode)
00.00.0 = No separate enable possible
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

Open Feed Roll in Manual Mode

If the input for opening the feed rolls is high, the output for opening the feed rolls is set (independently of the enable bit). Jogging is always possible.

Enable Function

This function can also be enabled from the NC Program, Logic Task or from an external input. Removing the enable signal while the function is active has no effect on the output.

In Manual Mode, this function is always enabled.

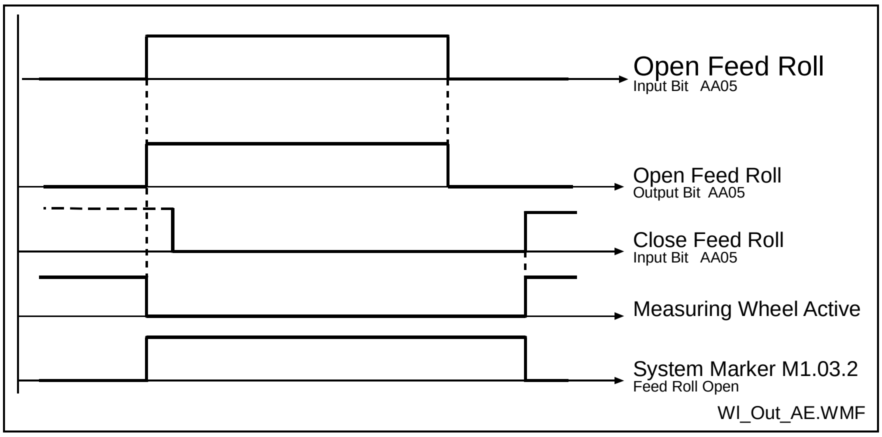


Fig. 9-8: Open Feed Roll with Acknowledgement Signal

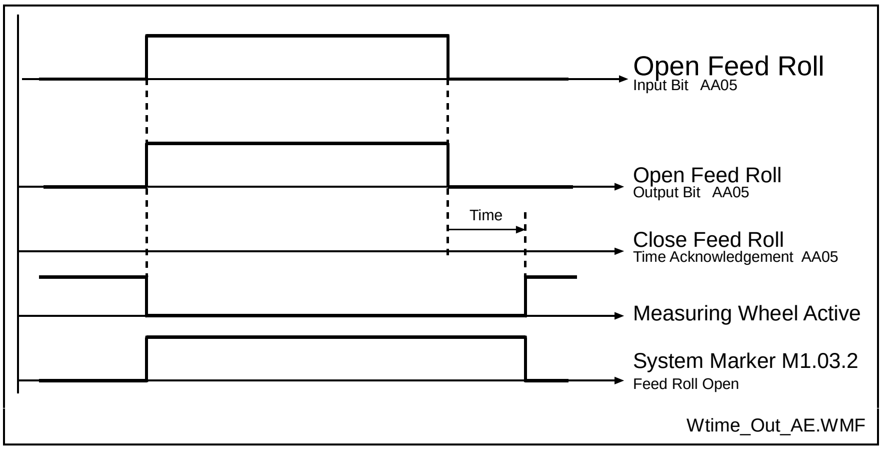


Fig. 9-9: Open Feed Roll with Time Acknowledgement

AA07 Measuring Wheel Mode

Only in Automatic Mode

M2.02.3

“Activate Measuring Wheel” Input Bit
Input status = 0 : Control using motor encoder
Input status = 1 : Control using measuring wheel encoder

M0 – M5; M8 ; I0 - I4 ; Q0 - Q3

00.00.0 = no input programmed.
The measuring wheel is always active in Automatic Mode if programmed in **Parameter A100.**

This parameter applies only if Measuring Wheel Mode has been preselected in **Parameter A100**. The measuring wheel is always active in Automatic Mode or can be disabled using the programmed input.

See also Parameter A117, Encoder Difference Monitoring.

AA08 Various Functions

M2.02.2 M2.02.3

M2.02.3: Output Bit: Parameter Mode activated

M2.02.2: Output Bit: Target velocity reached

The following is valid for both output bits:

M2, M3, M4

DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3:	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

00.00.0 = Function Deactivated

Target Velocity Reached

As long as the roll moves the material at the pre-set velocity, the output bit is set.

Parameter Mode active

This output indicates whether Parameter Mode is active.

If 00.00.0 is entered here, no output bit is selected.

AA09 Feed-To-Length Monitoring

00.00.0 00.00.0

Output Bit: Acceleration > 90% of A108

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

Output Bit: Velocity > 90% of A106

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

00.00.0 = no output programmed

The output bits programmed in this parameter are set when the velocity or the acceleration reach 90% of their maximum possible values.

AA10 Setup Mode

M2.00.2 I0.00.4 M2.02.0

Output Bit: In Start Position
Bit+1 In End Position
M2, M3, M4
DKC21.3 : Q0.00.4-Q0.01.3
DKC 3.3 : Q2.02.0-Q2.05.7
EMD: Q3.00.0-Q3.03.7

Input Bit :"Jog forward"
Bit+1 "Jog reverse"
M0 – M5; M8 ; I0 - I4 ; Q0 - Q3

Input Bit :Setup Mode active
00.00.0 = no Setup Mode
M0 – M5; M8 ; I0 - I4 ; Q0 - Q3

In Setup Mode, the programmed feed length is traversed using jog inputs.

Setup Mode input bit active:

The function is activated via this input or marker. If this signal drops off, the system exits Setup Mode and the remaining positioning move is aborted.

"Jog Forward" Input Bit:

As long as this input bit is set, a feed progression is executed in the positive direction. The next higher input bit causes a feed progression in the opposite direction. The feed progressions stop when the programmed feed distance or the start position has been reached.

"In Start Position" Output Bit

This bit signals that the feed length has not yet been processed. The next higher bit signals that the entire distance of the feed length has been traversed.

Notes:

- POI and PSI are possible positioning commands.
- Setup Mode is deactivated when there is a change in the operating mode.
- Immediate Stop, Interrupt and Feed Angle Monitoring are possible.
- "In Position“ is not signalled (Parameter A111).

AA11 Tool Wear

Q3.00 M8.02 8 630

630 – Number of the first variable of the "Counter" variable field

8 – Number of output bits to be counted

M8.02 – Marker Byte, degree of wear reached M2-M4, M8

Q3.00 – Output Byte

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

00.00.0 = Function Deactivated

The wear on a tool, corresponding with a defined number of times the tool is activated, shall be output.

The switching operations (0 to 1 transition) of the output bits in the output byte recorded here, are counted. For each output bit, the corresponding bit of the marker group with the same number is assigned. In the variable field, the number of counters is defined along with the number of outputs. After reaching the command piece count, the corresponding marker bit is set.

Vnnn	→	Output bit 0 (Command number of times activated)
Vnnn+1	→	Output bit 0 (Actual number of times activated)
. . .		
Vnnn +14	→	Output bit 7 (Command number of times activated)
Vnnn +1+14	→	Output bit 7 (Actual number of times activated)

After reaching the command piece count, the corresponding marker bit is set and the counter continues to count. The markers and the variables with the actual piece count must be cleared by the user.

The output byte can only be changed using **Command APZ**.

To do this, the function in Parameter AA11 must be activated, otherwise the error message **"F-02 24 – APZ not allowed"** is issued.

AA12 Press: Signal Offset

M2.02.2 M2.02.3 00

00 = Press off for feed angle falling edge
01 = Press off for feed angle rising edge

Output Bit: Press (Continuous Operation)

		M2, M3, M4
EMD	:	Q3.00.0-Q3.03.7
DKC21.3	:	Q0.00.4-Q0.01.3
DKC 3.3	:	Q2.02.0-Q2.05.7

Input Bit : Press: 0 = off
1 = on

00.00.0 = Function Off
Parameter Function AA13 Off
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

This parameter allows the definition of the output used to control the press and when this output is cleared.

The press marker must be turned off in the program when the feed angle edge is falling. Via this parameter, it is possible to offset the shutoff signal of the feed angle rising edge. The signal to turn on the press is always immediate.

This parameter must also be programmed when the function in Parameter AA13 is used.

If an E-Stop, Fault, Immediate Stop, Interruption (parameter A116), switch to Parameter Mode, or switch to Manual Mode occurs, the programmed press output is immediately cleared.

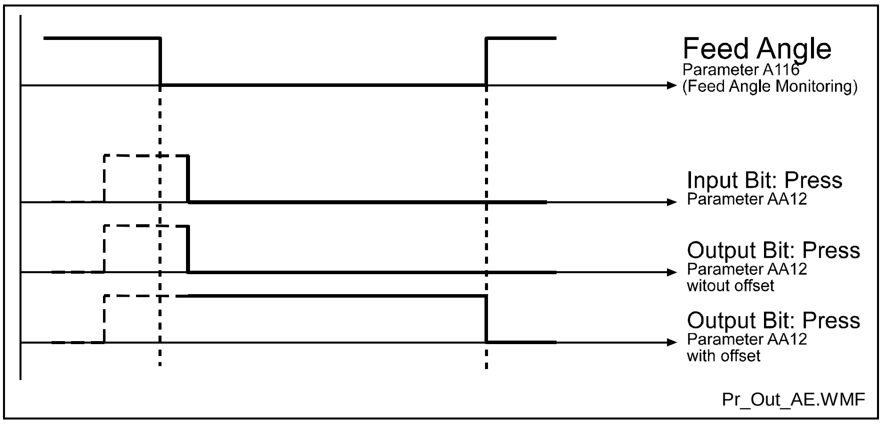


Fig. 9-10: Signal Sequence for the Press

AA13 Press: Signal, Intermittent

M2.02.2 M2.02.3

Output Bit: Press (Intermittent)

		M2, M3, M4
EMD	:	Q3.00.0-Q3.03.7
DKC21.3	:	Q0.00.4-Q0.01.3
DKC 3.3	:	Q2.02.0-Q2.05.7

Input Bit :
Press, Intermittent/Continuous (0/1)
00.00.0 = Function Off
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

This function is only valid as an option when Parameter AA12 is programmed. Here, a second output can be set when the press is run intermittently. If this parameter is not activated, the output from Parameter AA12 is used for the press in continuous operation or in intermittent operation.

In addition to the output Press in Parameter AA12, a second press output can be programmed.

Depending on the input/marker Press Intermittent/Continuous operation, one of the two outputs is processed.

Input Press On/Off	**Input Intermittent/ Continuous**		**Output Press (Intermittent Operation AA13)**	**Output Press (Continuous Operation AA12)**		**Output Press AA12 Without Parameter AA13**
0	0		0	0		0
1	0		1	0		1
0	1		0	0		0
1	1		0	1		1

Fig. 9-11: Output Press Intermittent / Continuous

AA14 Signal Control: Enable

M2.02.2 M2.02.3

Output Bit: Output Fault (Warning)

	M2, M3, M4
DKC21.3:	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

Input Bit : Enable Signal Control

M0 – M5; M8 ; I0 – I4 ; Q0 – Q3

With this input, each signal that is programmed to be monitored is activated at the next rising edge of the test range. For Assignments 1 and 2, all the rising edges that are outside the test range are not tested for the first cycle after enabling.

In case of a fault, the drive is stopped and the following error message is issued:

"F- 02 26 – SIC 1 Signal Fault"

"F-0 2 27 – SIC 2 Signal Fault "

"F-0 2 28 – SIC 3 Signal Fault "

"F- 02 29 – SIC 4 Signal Fault "

If the output bit 'Fault' is programmed, when a fault occurs the output bit is set without stopping the drive. The following diagnostics are issued:

"A- 00 26 – SIC 1 Signal Invalid"

"A- 00 27 – SIC 2 Signal Invalid "

"A- 00 28 – SIC 3 Signal Invalid "

"A- 00 29 – SIC 4 Signal Invalid "

The bit can be cleared by pressing 'Clear.' It is also cleared when power is lost or Parameter Mode is turned on.

AA15 Signal Control Bit 1

AA15 Signal Control Bit 2

AA15 Signal Control Bit 3

AA15 Signal Control Bit 4

M2.02.2 M2.02.3 00

Signal change test assignment
can be edited on-line via RS

Input Bit : Signal to be tested
M0 – M5; M8 ; I0 – I4 ; Q0 – Q3

Input Bit : Test Range
(00.00.0 Function deactivated)
M0 – M5; M8 ; I0 – I4 ; Q0 – Q3

Assignment: Signal Change Test:

00 = No test is done.
01 = Test for signal level 0
when not enabled, tests for a change in the leading edge
The input must be at '0' during the entire test range
02 = Test for signal level 1
when not enabled, tests for a change in the leading edge
The input must be at '1' during the entire test range

03 = Test for rising edge within the test range
04 = Test for falling edge within the test range
05 = Test for signal level 0 when leaving the test range
06 = Test for signal level 1 when leaving the test range
07 = Test for a rising edge within the test range.
08 = Test for a falling edge within the test range.

Note: Parameters AA15 to AA18 are also writable in Manual and Automatic Modes!

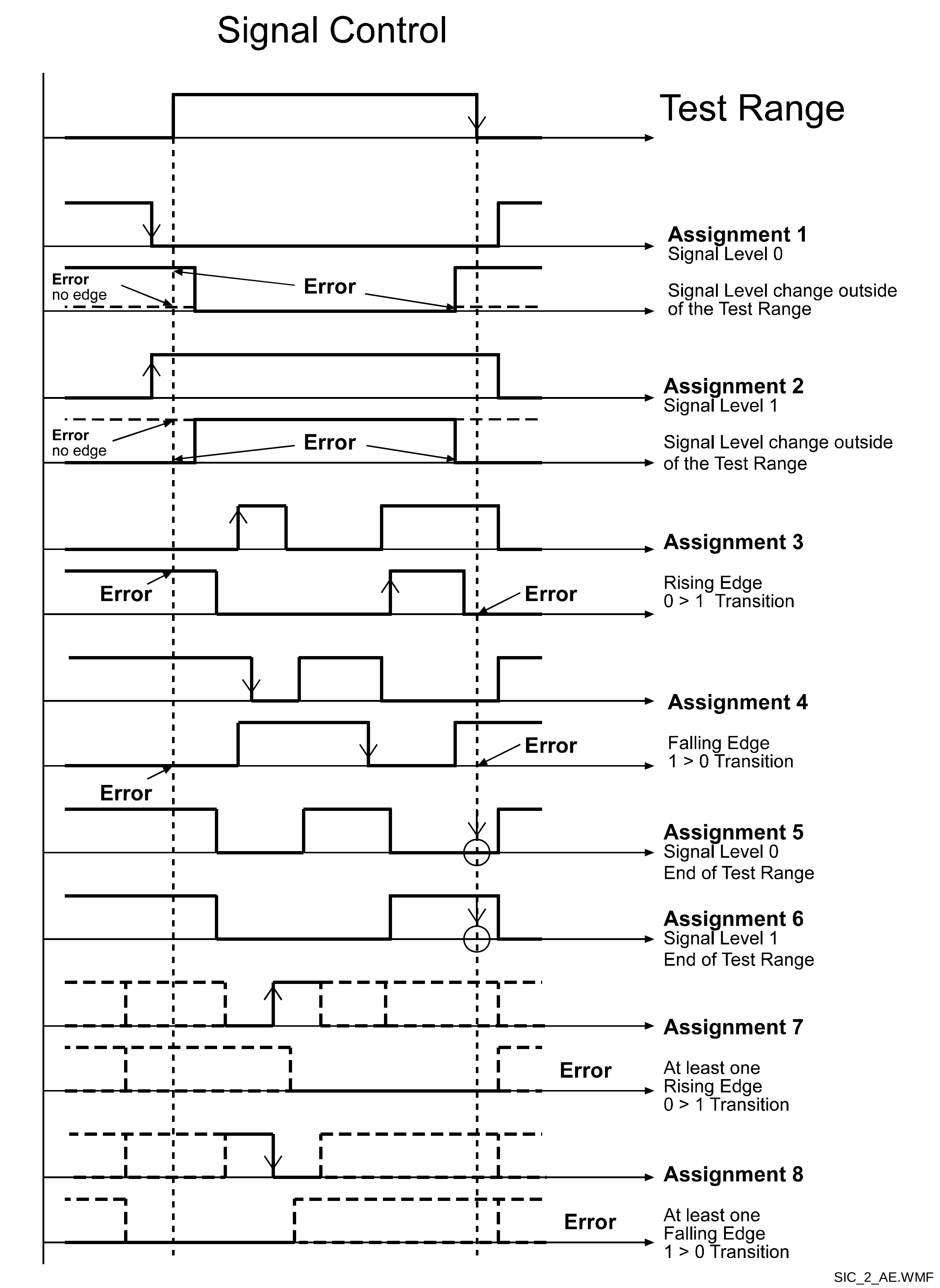


Fig. 9-12: Signal Control

AA19 Press: Time Monitoring

99 M2.02.2

- M2.02.2 – Output Bit: "Timeout – Time expired."
  - M2, M3, M4
  - EMD : Q3.00.0-Q3.03.7
  - DKC21.3 : Q0.00.4-Q0.01.3
  - DKC 3.3 : Q2.02.0-Q2.05.7
- 99 – Timeout in min.
  - 00 = function inactive

Note: The input bit "Press" in Parameter AA12 must be programmed.

The press motion is tested using the falling edge of the feed angle (A116 Feed Angle Monitoring). In Automatic Mode and for the input bit "Press" (AA12) = 1, the 1 → 0 edge is monitored. If this edge does not transition during the timeout preselected in the parameter, the following diagnostic is issued: **"A- 00 12 – Press Timeout"** and the output bit programmed in Parameter AA19 is set.

Via the function "Clear Error," the diagnostic and the output bit are cleared. Thereafter, time monitoring restarts.

The following conditions clear the diagnostic and the output bit:

Fault, Manual Mode, NC Stop

9.4 General Parameters

B000 Display

1 0 00 0

reserved
reserved
Write Protection: 9 = for NC and Logic Task
Language 0 = German
1 = English
2 = French

Language

All texts are output in the selected language. The language selection becomes active immediately after saving these parameters.

Write Protection

NC Program and Logic Task are no longer programmable.

If a write command is sent via the serial interface anyway, **Status Message 01** is issued**: "26- Write Protected"**

B001 Serial Interface Parameter 1

09600 1 05

Station number
00 = the set address (S3/S2) of the module is valid.
xx = 1 – 32 fixed station number
Parity Check
1 = none
2 = even
3 = odd
Baud Rate: 02400 Baud
04800 Baud
09600 Baud
19200 Baud

For further details, see Section 10.2, `Serial Interface´

B002 Serial Interface Parameter 2

0 0 0 0 0 000

Response Delay Time in ms in RS485 Mode
000 = no delay (0 – 200)

1 = in the event of a fault, an error message is sent automatically via the interface **(in preparation)**.
0 = function deactivated

0 = SIS protocol
1 = ASCII protocol
2 = IDS-01 (SIS protocol in Parameter Mode)
3 = IDS-01 (ASCII protocol in Parameter Mode)

0 = no checksum error message
1 = checksum error message

write confirmation (Y CR LF)
0 = off
1 = on

Checksum
0 = checksum validation on
1 = checksum validation off

For further details, see Section 10.2, `Serial Interface´

Response Delay:

In RS485 Mode, once the serial interface receives the last character of an 'LF' request (Line feed: ASCII Code 10), it immediately switches to Send Mode. With various RS 485 PC driver cards, this leads to problems if the cards are unable to switch to Receive Mode quickly 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.

Note: If you want to use the SA1-command, this parameter have to be unassigned with S 0 0000.

Input	Definition	B005 Input Value	Value at 10V
S 0 0036	Command Velocity	Contents of Parameter A106 x 6	Contents of Parameter A106 [IU/s]
S 0 0040	Actual Velocity	Contents of Parameter A106 x 6	Contents of Parameter A106 [IU/s]
S 0 0047	Command Position	IU with 4 Decimal Places	Value from B005 [IU]
S 0 0051	Actual Position, Encoder 1	IU with 4 Decimal Places	Value from B005 [IU]
S 0 0053	Actual Position, Encoder 2	IU with 4 Decimal Places	Value from B005 [IU]
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	IU with 4 Decimal Places	Value from B005 [IU]
S 0 0347	Velocity Control Deviation	Contents of Parameter A106 x 6	Contents of Parameter A106 [IU/s]
S 0 0383	Motor Temperature	0000.1000	100° C
P 0 0098	Max. Model Deviation	IU with 4 Decimal Places	Value from B005 [IU]
P 0 0141	Thermal Controller Load	0000.0100	100%
P 0 4044	Braking Resistor Load	0000.0100	100%

Fig. 9-13: Signal Selection

B004 Analog Output 1, Expanded Signal Select

00000000

Hex Value

Expanded signal selection is possible for representing signals as an analog voltage, a function which is not included in the B003 list. This function is activated if no parameter is assigned to the analog output via **B003, Analog Output 1, Signal Select**.

Note: If you want to use the SA1-command, this parameter have to be unassigned with 00000000.!

The following expanded signal selection options are defined:

- Expanded signal selection with permanently defined signals
- Byte output
- Bit output
- output via SA1 command

1) Expanded 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, Scaling per 10V Full Scale**. 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	Optional Sine Signal Encoder	0.5V/10V
0x00000004	Optional Cosine Signal Encoder	0.5V/10V
0x00000005	Position Loop Command Value Difference	rotary => 1000 Rpm/10V linear => 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	rotary => 1000 Rpm/10V linear => 100 m/min/10V

Fig. 9-14: 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 location as an analog voltage. However, this is only useful if the data storage structure is known. Since this structure differs from version to version, this function can only be used by developers. The function is activated by setting Bit 28 in **Parameter B004, Analog Output 1, Expanded Signal Select**. The address of the storage location is defined in the 24 least significant bits of the expanded signal selection.

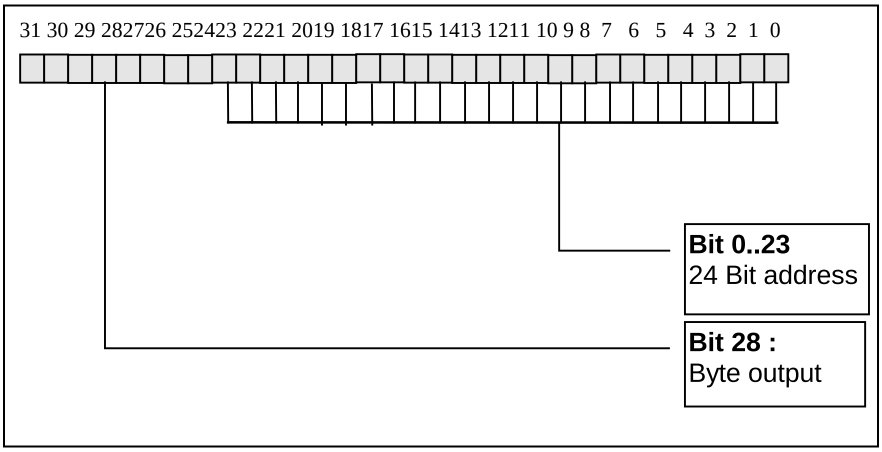


Fig. 9-15: Definition of **B004, Analog Output 1, Expanded Signal Select** with Byte Output

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, Expanded Signal Select**.

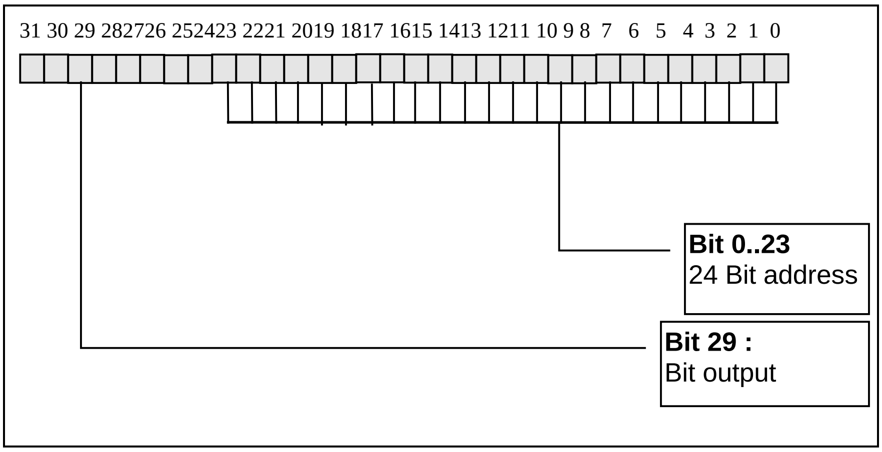


Fig. 9-16: Definition of **B004, Analog Output 1, Expanded Signal Select** with Bit Output

4) Output using SA1 Command

To be able to output analog data using the SA1 command, Parameters B003 to B005 must be set so that no analog output occurs.

B005 Analog Output 1, Scaling per 10V Full Scale

00001.0000

Scaling / Bit Number

The resolution of the selected signal can be varied using **Parameter B005, Analog Output 1 Scaling per 10V Full Scale**. 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 a 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 [IU/s]
S 0 0040	Actual Velocity	Contents of Parameter A106 x 6	Contents of Parameter A106 [IU/s]
S 0 0047	Command Position	IU with 4 Decimal Places	Value from B005 [IU]
S 0 0051	Actual Position, Encoder 1	IU with 4 Decimal Places	Value from B005 [IU]
S 0 0053	Actual Position, Encoder 2	IU with 4 Decimal Places	Value from B005 [IU]
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	IU with 4 Decimal Places	Value from B005 [IU]
S 0 0347	Velocity Control Deviation	Contents of Parameter A106 x 6	Contents of Parameter A106 [IU/s]
S 0 0383	Motor Temperature	0000.1000	100° C
P 0 0098	Max. Model Deviation	IU with 4 Decimal Places	Value from B005 [IU]
P 0 0141	Thermal Controller Load	0000.0100	100%
P 0 4044	Braking Resistor Load	0000.0100	100%

Fig. 9-17: Signal Selection

B007 Analog Output 2, Expanded Signal Select

00000000

Hex Value

Expanded signal selection is possible for representing signals as an analog voltage, a function which is not included in the B006 list. This function is activated if no parameter is assigned to the analog output via **B006, Analog Output 2, Signal Select**.

The following expanded signal selection options are defined:

- Expanded signal selection with permanently defined signals
- Byte output
- Bit output

1) Expanded 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, Scaling per 10V Full Scale**. 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	Optional Sine Signal Encoder	0.5V/10V
0x00000004	Optional Cosine Signal Encoder	0.5V/10V
0x00000005	Position Loop Command Value Difference	rotary => 1000 Rpm/10V linear => 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	rotary => 1000 Rpm/10V linear => 100 m/min/10V

Fig. 9-18: 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 location as an analog voltage. However, this is only useful if the data storage structure is known. Since this structure differs from version to version, this function can only be used by developers. The function is activated by setting Bit 28 in **Parameter B007, Analog Output 2, Expanded Signal Select**. The address of the storage location is defined in the 24 least significant bits of the expanded signal selection.

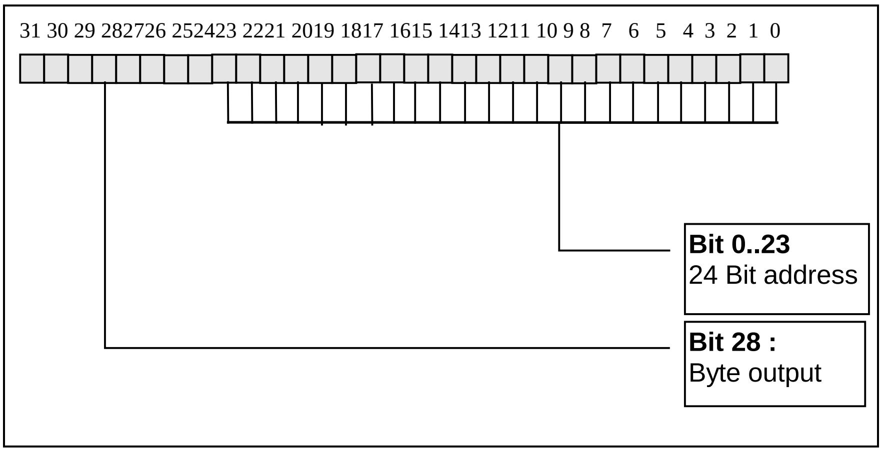


Fig. 9-19: Definition of **B007, Analog Output 2, Expanded Signal Select** with Byte Output

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, Expanded Signal Select**.

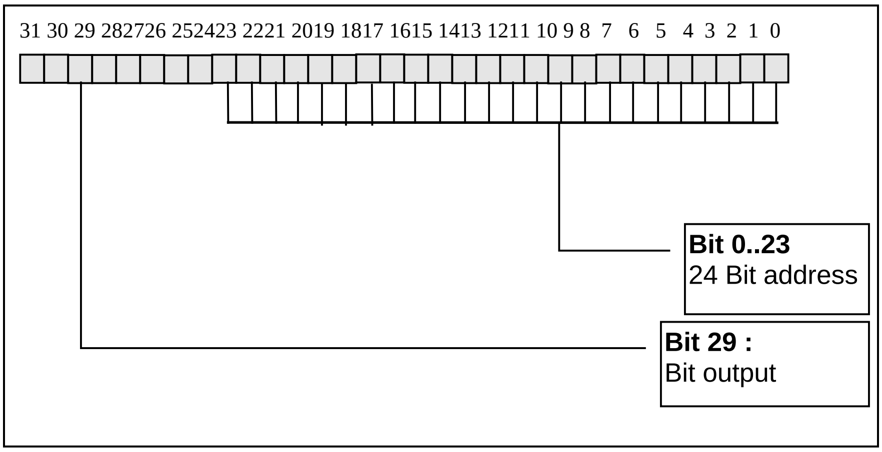


Fig. 9-20: Definition of **B007, Analog Output 2, Expanded Signal Select** with Bit Output

B008 Analog Output 2, Scaling per 10V Full Scale

00001.0000

Scaling / Bit Number

The resolution of the selected signal can be varied using **Parameter B008, Analog Output 2 Scaling per 10V Full Scale**. If a signal number is assigned via **B006, Analog Output 1, Signal Selection**, 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 a 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 I/O Control for BTV04

0 200

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 the following warning or error message:

- **"E- 01 05 – Serial I/O offline"**
- **"F- 03 17 – Serial 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
10 Keys	I1.00.0 / I1.00.1 and I1.01.0 to I1.01.7

Note: The BTV04 inputs and outputs can only be accessed with Adress 5 when using the BTV04 and FWA-BTV04*-ELC firmware!

Note: If only the X4 inputs are used, the zero potentional for the inputs on connector X5/12 must be conrected!

B010 System Control

1

Mode:
0 – Standard – System control
1 – Serial system control
2 – System control via the EMD module
4 – System control via the Logic Task

Note: The serial system control can only be accessed with Adress 5 when using the BTV04 and FWA-BTV04*-ELC firmware.

Mode = 1 : System control can also be handled via the serial interface. Cyclic transmission of the system inputs via the serial interface is then monitored. If no new message is received within the maximum cycle time, the control unit generates the following warning or error message:

- **"E- 01 04 – Systemctrl. Offline"**
- **"F- 03 16 – Systemctrl. Error“**

The **"E- 01 04"** warning is generated whenever system control takes place via the serial interface and the control unit is in Parameter Mode. The **"F- 03 16"** warning is generated whenever system control takes place via the serial interface and the control unit is in Manual or Automatic Mode.

Note: The serial inputs/outputs in Parameter B009 must also be activated.

Mode = 2 : The system inputs and outputs are no longer on connector X210 or on the assigned fieldbus markers.

Mode = 4 : In this case, the system inputs are set by the Logic Task.

One exception is the ’Parameter’ input. It always remains on the input designated by the hardware.

Marker Flag	Function	Logic Task
M6.19.0	Parameters	RES M6.19.0
M6.19.1	$\overline{\text{Manual}}$/Automatic	User-controllable
M6.19.2	Start	User-controllable
M6.19.3	$\overline{\text{Stop}}$	User-controllable
M6.19.4	Jog forward	User-controllable
M6.19.5	Jog reverse	User-controllable
M6.19.6	Clear errors (X3/7)	User-controllable
M6.19.7	No function	

Fig. 9-21: System Control by the Logic Task

B011 Fieldbus Cycle Time

Valid only for DKC3.3 with Profibus

05000

Maximum Cycle Time [ms]

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- 01 04 – No Systemctrl."**
- **"F- 03 16 – Systemctrl. Error“**
- **"F- 03 17 – User I/O Error"**

The "E- 01 04" warning is generated whenever communication takes place via the fieldbus and the control unit is in Parameter Mode. The "F-03 16" error message is generated whenever communication takes place via the fieldbus and the control unit is in Manual or Automatic Mode. The "F- 03 17" 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 the Profibus Command Communication chapter.

B012 Fieldbus Baudrate

Valid only for DKC3.3 with Profibus

000019.2

Baud Rate [kBaud]

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: Profibus Command Communication.

B013 Fieldbus Format

Valid only for DKC3.3 with Profibus

0 1 0 0

Profile:
0 = Standard
1 = Expanded (with drive enable in the control word)

0 = Word Evaluation
1 = Byte Evaluation (in preparation)

0 = Intel
1 = Motorola

Format:
0 = Process Data channel with I/O diagnostic and variable channel
1 = Process Data channel with I/O diagnostic
2 = Process Data channel with I/O, diagnostic, variable channel and service data channel

For further information, see Section 11.2 Profibus Command Communication.

B014 EMD Configuration

0 0 0 0

Reserved

Reserved

Number of EMD Modules (max. 2)
The connected module must have the same Address as the drive

Reserved

See the chapter entitled "EMD Module"

9.5 Encoder Parameters

C000 Working Polarity

0

0 = Motor turns clockwise
1 = Motor turns counterclockwise

'Right-hand motor rotation = motor turns in clockwise direction'
(viewed facing the motor shaft end)

C001 Interface Feedback 1 (Motor)

01

Measurement System

In motors with feedback memory, these parameters are 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 9-22 Measurement System Ports

C002 Position Feedback 1 Type

00 0 0 0

- Encoder Type
  - 0 = rotary
  - 1 = linear
- Distance-Coded Measurement System:
  - 0 = no distance-coded measurement system
  - 1 = distance-coded reference marks
- Direction:
  - 0 = not inverted
  - 1 = inverted
- Absolute Measurement:
  - x0 = no absolute measurement possible
  - 01 = absolute measurement possible and active (Encoder is treated as absolute)
  - 11 = Absolute measurement 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 measurement is automatically set to x1.

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.

C003 Feedback 1 Resolution (Motor)

00005000

Pulses/Revolution (rotary encoders)

000,05000

mm / Graduation Mark (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, position encoder 1** 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 Interface Feedback 2

Applicable for

- master axis encoders
- measuring wheel encoder
- direct measurement

05

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. 9-23: Measurement System Connections

C005 Position Feedback 2 Type

00 0 0 0

- Encoder Type
  - 0 = rotary
  - 1 = linear
- Distance-Coded Measurement System:
  - 0 = no distance-coded measurement system
  - 1 = distance-coded reference marks
- Direction:
  - 0 = not inverted
  - 1 = inverted
- Absolute Measurement:
  - x0 = no absolute measurement possible
  - 01 = absolute measurement possible and active (Encoder is treated as absolute)
  - 11 = Absolute measurement possible, but not active

This parameter is used to set the most important properties of the interface encoder (position encoder 2).

Remark:

In absolute measuring systems with memory, absolute measurement is automatically set to x1.

C006 Feedback 2 Resolution

00005000

Pulses/Revolution (rotary encoders)

00005000

mm / Graduation Mark (linear encoders)

Input is in 0.0000001 mm

See also Parameter C003.

C007 Feed Constant 2

0500.0000

Feed Constant in IU

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 measuring wheel encoder shaft.

Input min.:	0.1000	IU
Input max.:	5000.0000	IU

C008 Reserved

C009 Homing Configuration

1 0 0 10 20

- 20: Homing Acceleration in % of amax (A108)
- 10: Homing Velocity in % of Vmax (A106)
- 0: Reference Mark Measurement:
  - 0 = yes
  - 1 = no
- 0: Home Switch, Evaluate:
  - 0 = yes
  - 1 = no
- 1: Homing Direction
  - 0 = positive
  - 1 = negative

C010 Homing

I0.01.1 Q0.00.6 00

76 = Set Absolute Position
The command is executed after exiting Parameter Mode.

Output Bit: Homed
M2, M3, M4
DKC21.3 : Q0.00.4-Q0.01.3
DKC 3.3 : Q2.02.0-Q2.05.7
EMD : Q3.00.0-Q3.03.7

Input Bit : Start Homing in Manual Mode
M0 – M5 ; M8 ; I0 – I4 ; Q0 – Q3

00.00.0 = no input or output set

Set Absolute Distance: If 76 is entered in this parameter, the absolute position is set to the value stored in Reference distance, 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.

"Set absolute encoder" is not possible in this parameter in "rotary" mode. In this case, this can only be set using the SAC command:

C011 Reference Distance

±000000.000

Reference Distance in IU

Input min.: -200000.000

Input max.: +200000.000

C012 Home Switch Offset

±000.000

Offset in IU

Input min.: -999.999

Input max.: +999.999

C013 Distance-Coded Reference Offsets

1001 1000

Distance-Coded Reference Offset 2
the smaller distance between 2 reference markers

Distance-Coded Reference Offset 1
the larger distance between 2 reference marks

This parameter is used for inputting the encoder-specific distances between two reference marks for measuring systems with distance-coded reference marks.

See also functional description for: "Homing"

C014 Encoder Emulation Configuration

0 0 0

Select Emulation
0 = no output
1 = incremental encoder emulation
2 = absolute encoder emulation

Dead-Time Compensation
0 = is deactivated
1 = is activated

Select Actual Position Source
0 = position output of motor encoder
1 = position output of optional encoder
2 = output of position command value

Select between incremental/absolute encoder emulation.

Select the source of the signal to emulate.

Note: If an second optional encoder with an SSI interface is to be connected to Connector X9, the encoder emulation in this parameter must be disabled.

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 functional description for: "Encoder Emulation."

Input min.:	1	or	8
Input max.:	65536	or	24

C016 Marker Pulse Offset

000.0

Offset 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

C017 SSI Encoder (Press Encoder)

2 0 00 12 0

PFB (Encoder monitoring)
0 = off
1 = on

Resolution in Bits:
9 - 12 for multi-turn format (tree)
9 - 24 for single-turn format

Number of Revolutions in Bits: (0 to 12)

Direction: 0 = forward
1 = reverse

Encoder Type:
0 = no press encoder
1 = multi-turn encoder (tree format)
2 = single-turn encoder

For encoder type <>0, the encoder emulation according to Parameter C014 - C016 is turned off. An absolute encoder with SSI format can be hooked up to connector X9. This encoder then outputs the data for the PLS.

Note: In Manual and Automatic Mode, the SSI encoder is monitored. If an error is detected in the SSI files, the following error message is generated:
"F- 03 22 – SSI Encoder Error"

Note: The sum of **Resolution in Bits** and **Number of Revolutions in Bits** must be lower or equal 24.

C018 SSI Encoder Homing

00.00.0 00.00.0 76

76 = Set Absolute Encoder
The command is executed after exiting Parameter Mode.

Reserved :

Reserved :

Set Absolute Position: If 76 is entered in this parameter, the absolute value is set to the value stored in Reference distance, Parameter C019, 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.

C019 SSI Encoder Reference Distance

+000000.000

Reference distance in IU

9.6 Control Parameters

The CRxx Parameters, except für CR09, can also be edited in Manual/Automatic Mode. Thus, it is possible to change the settings while the machine is running.

WARNING

Changing the values defined by Rexroth or the machine builder

can result in damage to the motor, the drive controller, or the machine mechanics.

⇒ Changes are to be made only by trained personnel.

CR00 Current Loop Proportional Gain 1

010.00

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 Action Time 1

0002.5

[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 s/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•s/rad
Linear motor:	A•min/m

Fig. 9-24: Units for the Velocity Loop Proportional 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 s/rad (A min/m)

Input max.: 6553.5 A s/rad (A min/m)

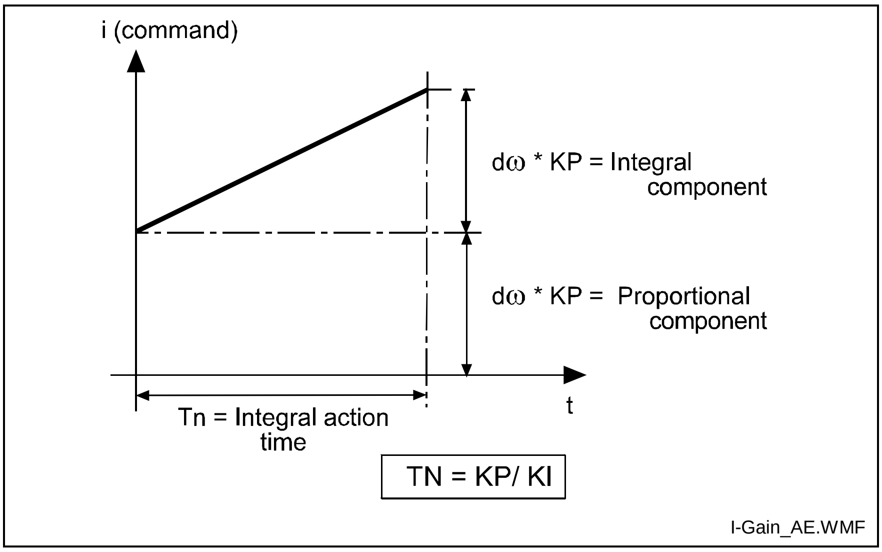
CR03 Velocity Loop Integral Action Time

0015.0
[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 [ms]
KP : veloc. contr. prop. gain [A*sec/rad]
KI : integral gain [A/rad]
dω : speed regulation deviation

Fig. 9-25: Integral Action Time

The integral action time is defined as that value on the time axis 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 Controller"

Input min.: 0 µs
Input max.: 65500 µs

CR05 Rejection Frequency Velocity Loop

600

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, Rejection Frequency Velocity Loop and

CR06, Rejection Bandwidth Velocity Loop

In **CR05, Rejection Frequency Velocity Loop**, 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 velocity loop. The parameters for this function are **CR05, Rejection Frequency Velocity Loop** and **CR06, Rejection Bandwidth Velocity Loop**.

CR06, Rejection Bandwidth Velocity Loop sets the frequency range on either side of the notch frequency in which the attenuation is less than -3dB.

Example:

CR05 = 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 notch filter

Fig. 9-26: CR06, Velocity Loop Bandwidth Rejection Filter

See also functional description for: “Filtering Oscillations from Mechanical Resonance.”

Input min.: -1
Input max.: 950

CR07 Kv Factor

001.00

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

0000.0

[mA/rad/s^2]

The acceleration feedforward helps to reduce the following error during the acceleration in lagless mode. 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.

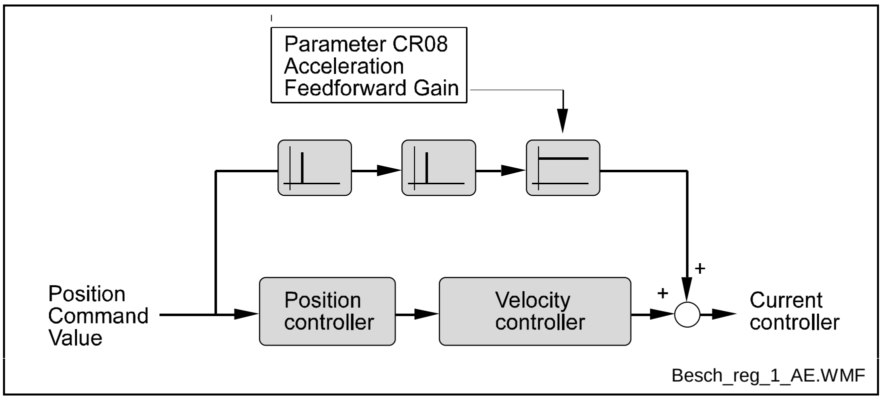


Fig. 9-27: Acceleration Feedforward

Activation:

Writing a value greater than 0 to this parameter activates the acceleration feedforward.

Note: The loop also functions without feedforward! (The standard value equals 0.) Acceleration feedforward is only possible in lagless mode.

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** (proportional to velocity). This means that at constant speed, the position deviation is 0. Nevertheless, a lag results, during acceleration (and deceleration).

The **acceleration feedforward** is activated by entering a value greater than 0 for this parameter. It creates (from the standpoint of the position loop), a **feedforward of the 2nd order** (proportional to acceleration). The position deviation is 0, as long as the correct gain is set and the acceleration is constant.

Recommended Input Value:

$$CR08 = \frac{\text{Moment of Inertia}\,[\text{kgm}^2]}{\text{Torque Cinstand}\,[\text{Nm/A}]} * 1000$$

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. 9-28: 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 Constant for Measuring Wheel Mode

000.00
└── 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 determines the time constant of the filter used.

The differences in actual position are attenuated in order to minimize 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

9.7 Motor Parameters

CM00 Motor Type

5
└──── Motor Type

The motor type can be selected with this parameter. The following motor types are supported:

- 1: MHD
- 2: Not allowed (2AD / 1MB with NTC temperature sensor)
- 3: LSF
- 4: LAR / LAF
- 5: MKD / MKE
- 6: Not allowed (2AD / 1MB with PTC temperature sensor)
- 7: Synchronous kit motor

Input min.:	1
Input max.:	7

CM01 Bipolar Torque/Force Limit Value

400
└──── [%]

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 Peak Current / Stall Current

0023.0 0005.1

Stall Current [A]

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 Stall Current**" 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 stall current 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 motor speed should not be exceeded. It also limits Parameter **A106, Maximum Velocity**.

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 to 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 (rotary motor)

0750

Pole Pair Distance (linear motor)

Input is in 0,1 mm

For rotary motors, the number of **pole pairs** per motor revolution is indicated here.

For **linear motors**, the **length of a pole pair** is to be entered 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 Holding Brake Type

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
after maximum braking time, the brake is activated.
1 = Main spindle brake
Brake is applied only at < 10 RPM

If a holding brake is used, this parameter specifies whether it is **a self-holding or self-releasing** brake. If an **MHD** or **MKD** motor is used, the holding brake, if there is one, is a self-holding one. Bit 0 is automatically set to 0. When other motor types are used, this bit must be input at initial startup.

CM08 Holding Brake Current

000.000

[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

Motor Shutdown Temperature [°C]
Motor Warning Temperature [°C]

CM10 Motor Inductance

003.70

[mH]

CM11 Commutation Setting

+0000.0000

Probe Value [mm]

In preparation

CM12 Commutation Offset

00100

Commutation Offset

9.8 PLS Parameters

See also functional description for PLS.

N100 PLS

0 360.00

Feed Constant

0 = PLS Off
1 = PLS On

The PLS must be activated, and a feed constant that references one encoder revolution must be programmed. Currently, the only possible input is 360.00.

N101 Output Channel 1

Q0.00.7 020 000

Hysteresis Spacing, Negative Direction

Hysteresis Spacing, Positive Direction

Output Bit

DKC21.3 :	Q0.00.4-Q0.01.3
DKC 3.3 :	Q2.02.0-Q2.05.7
EMD:	Q3.00.0-Q3.03.7

The PLS position is issued via the displayed output bit. If the PLS position is only to be used internally as a marker (e.g. for feed angle), outputs that are not physically present in the hardware, like outputs in group Q1.00 can be used. Multiple PLS positions can be assigned to each output.

For all outputs, hysteresis spacing can be assigned separately for both encoder directions.

Example: The programmed PLS position can be between 60 and 120 degrees, and the hysteresis spacing for the forward direction is input as 20 degrees. The output is turned on between 80 and 140 degrees, when the encoder moves in the positive direction. If hysteresis spacing of 20 degrees is programmed for the negative direction and the encoder turns in that direction, the output is set between 100 and 40 degrees.

Note: **Parameters N102 to N108 have the same function for output channels 2 through 8.**

N109 SSI Encoder Monitoring

3000 04 000 000

- 000 (last): Hysteresis Spacing All Negative Direction
- 000: Hysteresis Spacing All Positive Direction
- 04: Filter Time [4ms]
- 3000: Maximum Encoder Velocity
  Input 0-9999 [1/min]

Encoder Velocity:

If a maximum velocity not equal to 0 is pre-set, the encoder velocity is monitored. When the velocity is exceeded, the error message **"F- 03 23 – PLS Speed > N109"** is issued.

Filter Time:

To prevent bounce in the output for an encoder speed that is not constant, a filtering time in milliseconds can be set for all inputs. The input value is multiplied by 4 internally.

Hysteresis Spacing:

Hysteresis spacing for both directions of movement, which is valid for all PLS outputs, can also be programmed here.

Note: Parameters N100 - N109 can only be written in Parameter Mode.

N110 Reserved

N111 Function of Output Channel 1

1 00 00 000

- 000 – Timer Run Time
- 00 (second) – Switch Off Lead Time in ms
- 00 (first) – Switch On Lead Time in ms
- 1 – Output Function
  - 0 = Output 1 off
  - 1 = Output 1 on
  - 2 = Output 1 set as timer

Output Function:

The output function determines whether or not the output is used, and how it is used.

Lead Time:

To balance switching hystereses for connected peripherals, a lead time for turning on/off the output can be set. Depending on the encoder speed, the corresponding output is turned on/off earlier.

Run Time:

If the output is programmed as a timer, it is set when the PLS position is reached and cleared again after the programmed time has expired.

Note: Parameters N112 – N118 have the same function for output channels 2 through 8.

N119 Reserved

N120 Reserved

N121 Switch 1

1 270 090

- 090 — Off Position
- 270 — On Position
- 1 — Number of the Output Channel (1 – 8)

Number of the Output Channel:

The number determines which output (Parameter N101 – N108) is assigned to the PLS position.

On Position:

The point at which the output is turned on is defined by the on position. If a hysteresis or lead time has been input in the corresponding parameters, the on position is automatically calculated and adjusted.

Off Position:

The point at which the output is turned off is defined by the off position. If a hysteresis or lead time has been input in the corresponding parameters, the off position is automatically calculated and adjusted.

Note: **Parameters N122 to N131 have the same function for output channels 2 through 11.**

Note: Parameters N111 to N131 can also be edited outside of Parameter Mode.

9.9 List of FLP Parameters

Software : _ _ _ _ _ _ _ _ _ _ _ _ Com. No. : _ _ _ _ _ _ _ _ _ _ _ _
Date : _ _ _ _ _ _ _ _ _ _ _ _ Client/End Cl.: _ _ _ _ _ _ _ _ _ _ _ _
Prep. by : _ _ _ _ _ _ _ _ _ _ _ _ Serial No. : _ _ _ _ _ _ _ _ _ _ _ _

Designation	**Parameters**	**Data**
Application Type	A100	
Feed Constant	A101	
Gearing	A102	
Negative Position Limit	A103	
Positive Position Limit	A104	
Modulo Value	A105	
Maximum Velocity	A106	
Jog Velocity	A107	
Bipolar Acceleration	A108	
Acceleration / Deceleration	A109	
Bipolar Jerk Limiting, Time Constant	A110	
Switching Threshold	A111	
Reserved	A112	
In-Position Window	A113	
Presignaling	A114	
Monitoring	A115	
Feed Angle Monitoring	A116	
Encoder Difference Monitoring	A117	
Absolute Encoder Monitoring Window	A118	
Best Possible Deceleration	A119	

Tasks 2 & 3	AA00	
Manual Vector	AA01	
Interrupt Vector	AA02	
Reserved	AA03	
Override	AA04	
Open Feed Roll I	AA05	
Open Feed Roll II	AA06	
Measuring Wheel Mode	AA07	
Various Functions	AA08	
Feed-To-Length Monitoring	AA09	
Setup Mode	AA10	
Tool Wear	AA11	
Press: Signal Offset	AA12	
Press: Signal, Intermittent	AA13	
Signal Control: Enable	AA14	
Signal Control: Bit 1	AA15	
Signal Control: Bit 2	AA16	
Signal Control: Bit 3	AA17	
Signal Control: Bit 4	AA18	
Press: Time Monitoring	AA19	

Display	B000	
Serial Interface Parameter 1	B001	
Serial Interface Parameter 2	B002	
Analog Output 1, Signal Select	B003	
Analog Output 1, Expanded Signal Select	B004	
Analog Output 1, Scaling per 10V Full Scale	B005	
Analog Output 2, Signal Select	B006	
Analog Output 2, Expanded Signal Select	B007	
Analog Output 2, Scaling per 10V Full Scale	B008	
Serial I/O Control for BTV04	B009	
System Control	B010	
Fieldbus Cycle Time	B011	
Fieldbus Baudrate	B012	
Fieldbus Format	B013	
EMD Configuration	B014	

Working Polarity	C000	
Interface Feedback 1 (Motor)	C001	
Position Feedback 1 Type	C002	
Feedback 1 Resolution (Motor)	C003	
Interface Feedback 2	C004	
Position Feedback 2 Type	C005	
Feedback 2 Resolution	C006	
Feed Constant 2	C007	
Reserved	C008	
Homing Configuration	C009	
Homing	C010	
Reference Distance	C011	
Home Switch Offset	C012	
Distance-Coded Reference Offsets	C013	
Encoder Emulation Configuration	C014	
Encoder Emulation, Resolution	C015	
Marker Pulse Offset	C016	
SSI Encoder (Press Encoder)	C017	
SSI Encoder Homing	C018	
SSI Encoder Reference Distance	C019	

Current Loop Proportional Gain 1	CR00	
Current Loop Integral Action 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	
Kv Factor	CR07	
Acceleration Feedforward Gain	CR08	
Switching Frequency	CR09	
Actual Position Filter, Time Constant for Measuring Wheel Mode	CR10	

Motor Type	CM00	
Bipolar Torque/Force Limit Value	CM01	
Motor Peak Current / Stall 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	
Holding Brake Type	CM07	
Holding Brake Current	CM08	
Motor Temperature	CM09	
Motor Inductance	CM01	
Commutation Setting, Probe Value	CM11	
Commutation Offset	CM12	

PLS	N100	
Output Channel 1	N101	
Output Channel 2	N102	
Output Channel 3	N103	
Output Channel 4	N104	
Output Channel 5	N105	
Output Channel 6	N106	
Output Channel 7	N107	
Output Channel 8	N018	
SSI- Encoder Monitoring	N109	
Reserved	N110	
Function of Output Channel 1	N111	
Function of Output Channel 2	N112	
Function of Output Channel 3	N113	
Function of Output Channel 4	N114	
Function of Output Channel 5	N115	
Function of Output Channel 6	N116	
Function of Output Channel 7	N117	
Function of Output Channel 8	N118	
Reserved	N119	
Reserved	N120	
PLS , Switch 1	N121	
PLS , Switch 2	N122	
PLS , Switch 3	N123	
PLS , Switch 4	N124	
PLS , Switch 5	N125	
PLS , Switch 6	N126	
PLS , Switch 7	N127	
PLS , Switch 8	N128	
PLS , Switch 9	N129	
PLS , Switch 10	N130	
PLS , Switch 11	N131	

10 Interface

10.1 Inputs / Outputs / Marker Flags

Designation

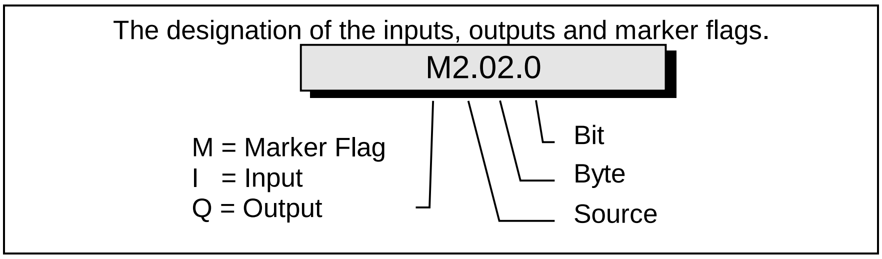


Fig. 10-1: Structure of the Inputs / Outputs / Marker Flags

e.g.

I0.00.6

I	Input
I0	Input, Connector X210
I0.00	Input, Connector X210, Group 0 (Byte 00)
I0.00.6	Input, Connector X210, Group 0 (Byte 00, Bit 6)

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.

Source	Bytes	Functions
0	00...01	DSUB Connector X210 DKC21.3
1	00...04	BTV04 (can be enabled via Parameter B009 / B010)
2	00...05	Fieldbus : Profibus DKC3.3
3	00...03	EMD Enhancement
4	00. .01	Hardware Inputs X1, X3

Fig. 10-2: Source Numbers of the Inputs

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 enabled in the parameters.

Source	Bytes	Functions
0	00...01	DSUB Connector X210 DKC21.3
1	00...04	BTV04 (can be enabled via Parameter B009 / B010)
2	00...05	Fieldbus : Profibus DKC3.3
3	00...03	EMD Enhancement

Fig. 10-3: Source Numbers of the Outputs

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 marker flags handle the exchange of information between the NC Task and the Logic Task.

Source	Bytes	Function
0	00...05	System Marker Flags (Inputs)
1	00...03	System Marker Flags (Outputs)
2	00...19	NC Marker Flags
3	00...07	Saved NC Marker Flags
4	00...09	NC Transfer Marker Flags → Logic Task
4	10...13	NC Transfer Marker Flags → Logic Task cleared after processing of the Logic Task
5	00...09	Logic Task Transfer Marker Flags → NC
6	00...18	Saved Logic Task Marker Flags
6	19	System Byte (Parameter B010 = 4) Saved
6	20...36	Logic Task Marker Flags
6	37...39	Logic Task Marker Flags for Command TXT 3 and Serial Interface Status 25
8	00...19	Command Marker Flags via Serial Interface

Fig. 10-4: Source Numbers for the Marker Flags

Source

Origin or category

Bytes

8 inputs, outputs or marker flags are grouped together (to form bytes).

Bit

The bit designates in individual input, output or marker flag within a byte. Numbering is from 0 to 7.

System Inputs

Connector X210 or Fieldbus

Parameter

DKC21.3	**X210 / 1**	**(I0.00.0)**
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:

Drive Enable (Reglerfreigabe - RF)
Stop
Jog

Other functions can be assigned to inputs via programming:

Homing
Manual Vector
Interrupt
Feed Angle Monitoring

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
Interrupt
Feed Angle Monitoring

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**	**(I0.00.3)**
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, in Manual Mode the drive moves forward at the velocity entered in Parameter A107. When entering Manual Mode for the first time, a rising edge is required at the input.

Position limit monitoring is active only if the axis has been homed. In this case, the drive moves only to the 'Positive Position Limit.'

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**	**(I2.00.5)**

If a signal is present at the “Jog reverse” input, in Manual Mode the drive moves in reverse at the velocity entered in Parameter A107. When entering Manual Mode for the first time, a rising edge is required at the input.

Position limit monitoring is active only if the axis has been homed. In this case, the drive moves only to the 'Negative Position Limit.'

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 deceleration mode” (**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.

(This Signal has no function.)

Connector X3

Ref **X3 /1** **(I4.00.6)**

Home position switch

The rising edge of the home position switch signal is always read when homing.

Limit + **X3 /2** **(I4.00.7)**

Position Limit +

This limit switch must always be a normally-closed contact.

Limit - **X3 /3** **(I4.01.0)**

Position Limit -

This limit switch must always be a normally-closed contact.

Probe 1 **X3 / 4** **(I4.00.3)**

Measurement of positions using the SRM command.
Used with SRP Command (Registration Marks).

Probe 2 **X3 / 5** **(I4.00.4)**

No function

$\overline{\text{E-Stop}}$ **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 deceleration mode” (**Parameter A119**).

Clear Errors **X3 / 7** **(I4.00.2)** **or**

DKC3.3 **Control Word (I2.00.6)** **or**

S1 Key, Prog. Module **(I4.01.2)**

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.

System Outputs

Connector X210 or Fieldbus

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.

$\overline{\text{Fault}}$

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.

Run

DKC21.3 X210 / 20 (Q0.00.3)

DKC3.3 Status Word (Q2.00.3)

If Automatic Mode is selected and NC Tasks 1 and 2 have been started, this output is set.

Connector X3

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 < (0.75 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 high.

See also Project Planning Guide: X3, Digital Inputs/Outputs

Parallel Interface DKC21.3 Programmable Inputs/Outputs

Inputs

Inputs I0.00.6 through I0.01.7 Connector X210 / Pin No.: 07 to 16

There are, therefore, 10 available inputs.

The inputs are user-programmable within all NC Tasks and in the Logic Task. Moreover, these programmable inputs can be used for various functions which have been activated in the parameters.

Outputs

Outputs Q0.00.4 to Q0.01.3 Connector X210 / Pin No.: 21 to 28

There are 8 available outputs.

The outputs are user-programmable within all NC Tasks and in the Logic Task. Moreover, these user-programmable outputs can be used for different functions that are programmable via parameters.

Note: If an output is used from the logic task, the error message "**F- 03 00 – I/O-No. illegal**" is issued as soon as this output is used by an NC task.

EMD Programmable Inputs/Outputs

Two input/output modules with 16 inputs/outputs each can be connected.

Inputs

Module 1 Inputs I3.00.0 to I3.01.7
Module 2 Inputs I3.02.0 to I3.03.7

There are, therefore, up to 32 available inputs.

The inputs are user-programmable within all NC Tasks and in the Logic Task.

Moreover, these programmable inputs can be used for various functions which have been activated in the parameters.

Outputs

Module 1 Outputs Q3.00.0 to Q3.01.7
Module 2 Outputs Q3.02.0 to Q3.03.7

There are, therefore, up to 32 available outputs.

The outputs are user-programmable within all NC Tasks and in the Logic Task.

Note: If an output is used from the logic task, the error message "**F- 03 00 – I/O-No. illegal**" is issued as soon as this output is used by an NC task.

Profibus Interface DKC 03.3 Programmable Inputs/Outputs

Profibus Inputs

32 inputs, I2.02.0 to I2.05.7, are available.

Profibus Outputs

32 outputs, Q2.02.0 to Q2.05.7, are available.

See also Section 11.2 Profibus

BTV04 Programmable Inputs/Outputs

These inputs and outputs 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 inputs and outputs are transferred serially to the BTV04. The transfer time can take up to 500ms.

BTV04 X4 Inputs

10 inputs, I1.03.0 to I1.04.1 are available.

BTV04 X5 Outputs

11 outputs, Q1.03.0 to Q1.04.2, are available.

Some keys can be queried from the user programs.

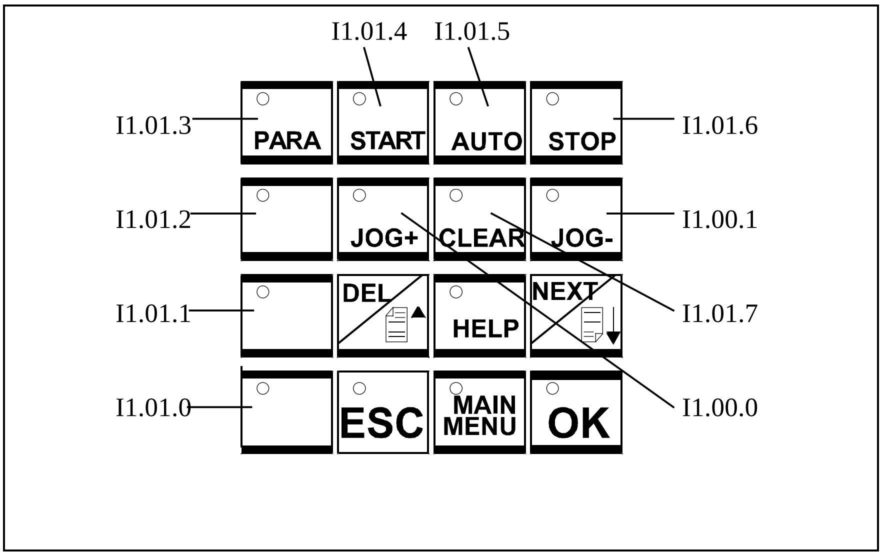


Fig. 10-5: BTV04 Key Inputs

Following LED can be switched on and off:

	Q1.01.0
	Q1.01.1
	Q1.01.2
PARA	Q1.01.3
START	Q1.01.4
AUTO	Q1.01.5
STOP	Q1.01.6
CLEAR	Q1.01.7

Accessing System Inputs and Outputs from the BTV04

If Parameter B010 is set to 1, serial system control becomes active via the BTV04 keys.

Caution: **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 nevertheless to be assigned to a hardware output (Connector X210), this can be programmed in the Logic Task.

The BTV04 Keys:

PARA
START
AUTO
STOP
JOG+
JOG-

are activated.

Marker Flags

The marker flags can be distinguished as follows:

Source	Bytes	Function
0	00...05	System Marker Flags (Inputs)
1	00...03	System Marker Flags (Outputs)
2	00...19	NC Marker Flags
3	00...07	Saved NC Marker Flags
4	00...09	NC Transfer Marker Flags → Logic Task
4	10...13	NC Transfer Marker Flags → Logic Task cleared after processing of the Logic Task
5	00...09	Logic Task Transfer Marker Flags → NC
6	00...18	Saved Logic Task Marker Flags
6	19	System Byte (Parameter B010 = 4) saved
6	20...36	Logic Task Marker Flags
6	37...39	Logic Task Marker Flags for Command TXT 3 and Serial Interface Status 25
8	00...19	Command Marker Flags via Serial Interface

Fig. 10-6: Marker Flag Categories

System Marker Flags (Inputs)

Here, the requirements are mirrored.

These marker flags are read-only using the Logic Task and the NC Task.

M0.00

Bit	Function	Source
0	Parameter	Input or Fieldbus
1	$\overline{\text{Manual}}$/Automatic	Input or Fieldbus
2	Start	Input or Fieldbus
3	$\overline{\text{Stop}}$	Input or Fieldbus
4	Jog forward	Input or Fieldbus
5	Jog reverse	Input or Fieldbus
6	Clear errors	Input or Fieldbus
7	Drive Enable	Input or Fieldbus

Fig. 10-7: 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 enabled in the designated parameter.

Status of the Function Inputs

Bit	Function	Source
0	Interrupt	Parameter A116
1	Feed Angle Monitoring	Parameter A116
2	Manual Vector	Parameter AA01
3	Interrupt vector	Parameter AA02
4	Reserved (Free)	
5	Reserved (Free)	
6	Reserved (Free)	
7	Measuring Wheel Control enabled	Parameter AA07

Fig. 10-8: Marker Flags - Programmable System Inputs

Note: If the functions for bits 0 and 1 are not set in the parameters, these bits are initialized by setting them to ’1.’

M0.03

All bits in this byte are reserved.

M0.04

All bits in this byte are reserved.

M0.05

All bits in this byte are reserved.

System Marker Flags (Outputs)

Here, the conditions are mirrored.

These marker flags are read-only using the Logic Task and the NC Task.

M1.00

Bit	Function	Source
0	Manual Mode	Status
1	Automatic	Status
2	$\overline{\text{Fault}}$	Status
3	Run	Status
4	Ready	Status
5	Warning	Status
6	Parameter	Status
7	In Position (Switching Threshold)	Status

Fig. 10-9: Marker Flags - System Outputs

M1.01

Status of Generating Position Command Values

Bit	Function
0	Position Command Value: Command Position reached and Command Velocity = 0
1	Position Command Value: Acceleration Phase
2	Position Command Value: Deceleration Phase
3	Position Command Value: Constant Velocity
4	Position Command Value: Negative Velocity
5	Inhibited Movement: Stop, Interrupt, Feed Angle Monitoring, Movement to Positive Stop
6	Axis in Home Position of the last Positioning Command (dependent on Parameter A113 "Positioning Window").
7	Reserved (Free)

Fig. 10-10: Marker Flags Generating Command Values

M1.02

Bit	Function	Source
0	Axis is synchronized	Status
1	Synchronization not possible	Status
2	Cam is active	Status
3	Reserved (Free)	
4	Reserved (Free)	
5	Reserved (Free)	
6	Reserved (Free)	
7	Reserved (Free)	

Fig. 10-11: Marker Flags - System Outputs

M1.03

Bit	Function	Source
0	EMD Module 1 enabled	Status
1	EMD Modules 1 and 2 enabled	Status
2	Open feed roll enabled	Status
3	Reserved (Free)	
4	Reserved (Free)	
5	Reserved (Free)	
6	Drive is ready	Status
7	Power on	Status

Fig. 10-12: Marker Flags - System Outputs

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.

Transfer Marker Flags NC → 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.

M4.10 - M4.13

These marker flags are written from the NC tasks, but are cleared immediately after the Logic Task is processed.

Transfer Marker Flags Logic Task → 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.

Marker flag **M6.19** can also be used for system control. See also Parameter B010.

Logic Task Marker Flags

M6.20 - M6.39

These marker flags can be read and written only 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.

Marker flags **M6.37 to M6.39** can be used for user diagnostic functions that are controlled by the Logic Task. See also 'Logic- Task- Controlled Diagnostics for Status Message 25' in the Functions Chapter and the description for the TXT command.

Communication Marker Flags

M8.00 - M8.19

These marker flags can be written using a command from the serial interface. These can also be read and written from the Logic and NC Tasks.

Note: Because these marker flags are saved, the last written status remains active. A safety-related function like "jogging" is only allowed when the master interface monitors the transmission cyclically and can ensure that the function or system will be shut down by an external source in case of an interface fault.

10.2 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:

- **Parameter**
- **Programs**
- **Logic Task**
- **Cam**
- **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

The precise structure is outlined in the following section.

- **IDS protocol (RS232)**

In conjunction with the Indramat IDS01 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 32, and for Profibus from 2 to 32.

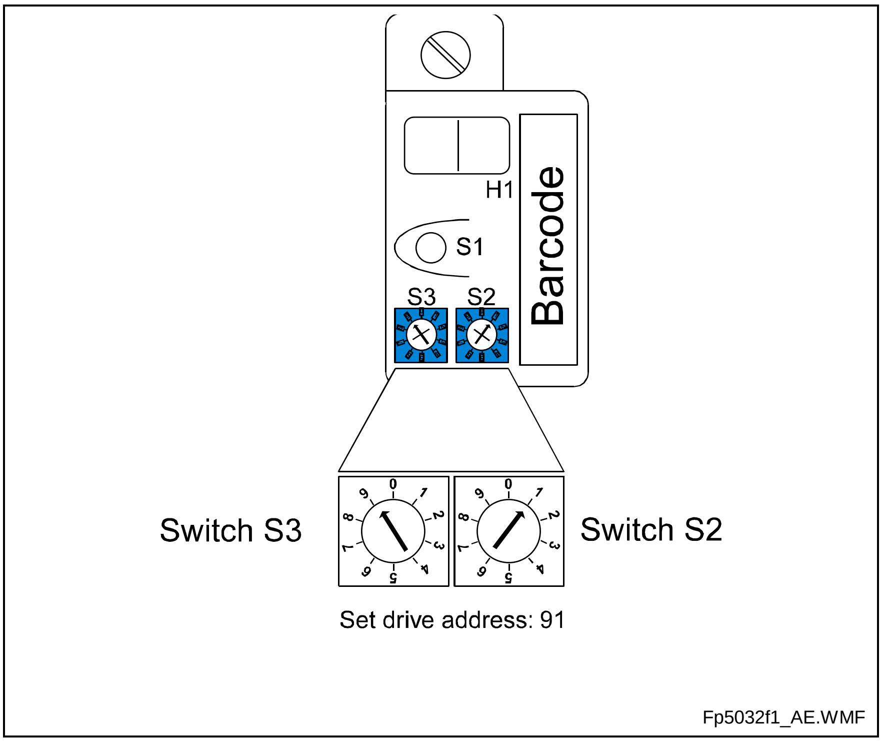


Fig. 10-13: Setting the Address via the Address Switch on the Programming Module

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

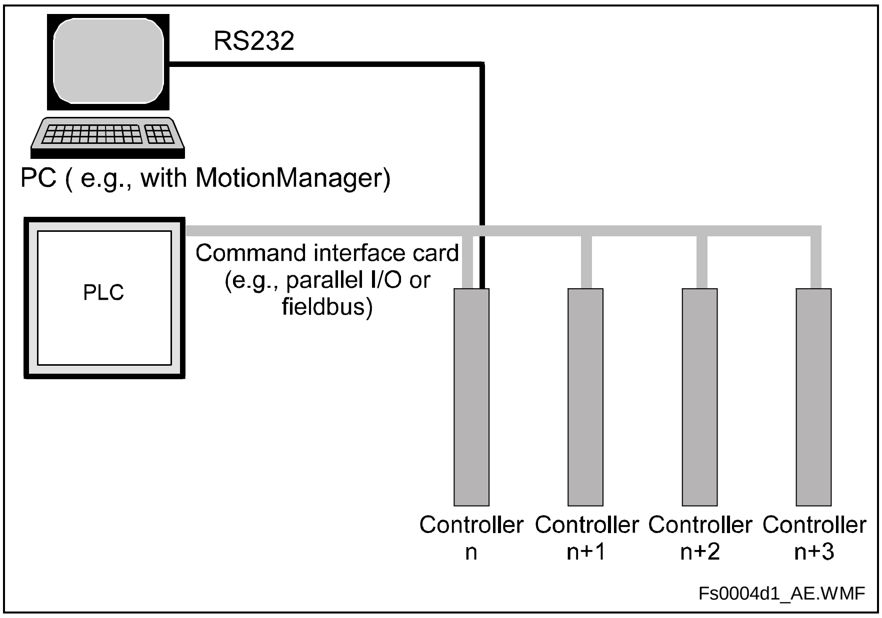


Fig. 10-14 Communications via RS232 interface

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

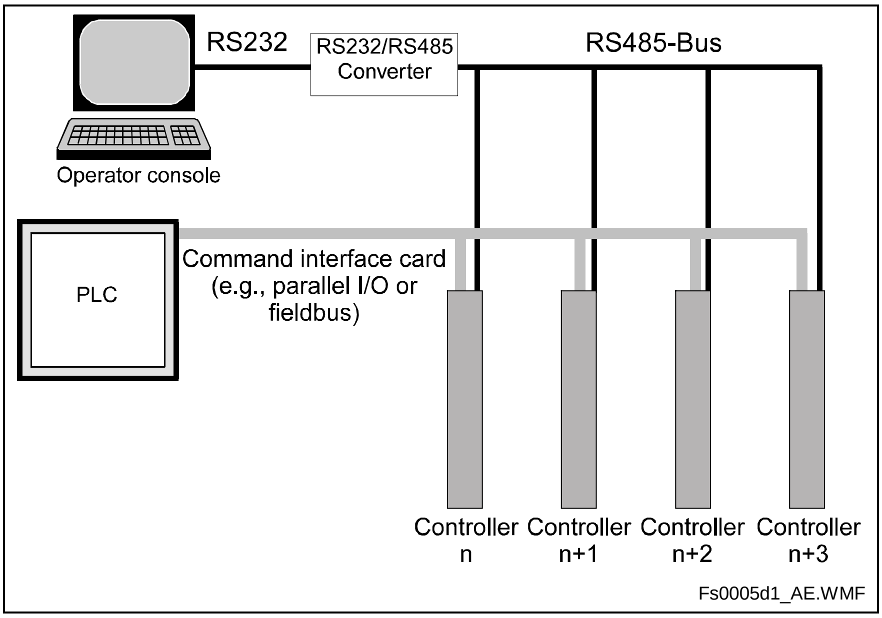


Fig. 10-15 Data Exchange of Drive Groups from an Operator Console

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: "Initial Startup" Chapter, 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, Variable, Logic Task, Cam) is output.

2) **#** Hexadecimal 23 / character for transmission of data

If the control receives a '#,' the following characters are saved into the control (NC, Parameters, Logic Task, Variables, Cam).

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 to be replaced by an appropriate character, depending on the operating mode.

1) In RS232C operating mode, the 's' is replaced by a blank space. However, the responses always contain the station number.
2) In RS485 mode, the 's' is replaced by the respective station number (1 - 9 ; A...W for No. 10 to 32). 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 NC instruction.

The information following the 'N' is interpreted as an NC 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 a command.

The information following the 'C' is interpreted as a command.

7) **T** Hexadecimal 54 / character for a table value.

The information following the ’T’ is interpreted as a table value.

Other Control Characters:

1) **$** Hexadecimal 24 / character for checksum.

The two characters that follow are interpreted as a 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 numeric values are sent, a decimal point is always used.

Generating the Checksum

Examples: 1. #_N0000_POI _ 1_ _ _ _ +123456,789_123_ $

2. #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. 10-16: Generating the Checksum

- The sum of all 'ASCII' characters is calculated, from the first control character to the last character before the '$.'
- Then, the 'High Byte' is added to the 'Low Byte.' A transmission occurring during this time is ignored.
- The Two's Complement of the 'Low Byte' of this sum results in the checksum

Example 1: #_N0000_ 1_ _ _ _ +123456,789_123_ $**C4**

Sum: 636 ➔ 06 + 36 = 3C. The Two's Complement of 3C is **C4**.

Example 2: #5N0123_NOP _ _$**45**

Sum: 2B9 ➔ 02 + B9 = BB. The Two's Complement of BB is **45**.

Interface Confirmation

Data transmission via the serial interface is monitored. If erroneous data are present, an error message (Status 01) is sent via the serial interface.

If the interface confirmation feature is activated in Parameter B002 and if the control has completely and correctly received and processed the data, a confirmation is sent:

Format:

```
Y CR LF
```

Note: The MoMaNT PC Program always expects a response from the control.
The interface confirmation feature must be activated!

NC Program Instructions

Write Program Instructions:

A new instruction is read in as shown in the example below.

The character sequence ’# s N’ always comes first.

An input must always end with ’CR LF’ or ’$ h h CR LF’

Format:

```
#sNbbbb_ccc_dddddddddddddddd_$hh CR LF
```

Meaning of the characters used:

b = Instruction number
c = Command code
d = Instruction information (data field with up to 32 characters)

Examples of data transmissions to the FLP:

```
#5N0100_POI_1____+123456.786_123__$hh CR LF
#5N0101_AEA_Q0.00.3_1____$hh CR LF
#5N0102_BPA_0123_M2.02______22112212_$hh CR LF
```

The data formats are stipulated for each command and must be complied with!

Command	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_
APZ	APZ_01201201_	APZ_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_
CAN	CAN_01_1234.56 _1234.56_	CAN_01_V678_ _ _ _V789_
CID	CID_V600_1_ _ _ _ _ _ _ _ _ _ +123456.789_	CID_V600_1_ _ _ _ _ _ _ _ _ _ +V601_ _ _ _ _ _ _
CIO	CIO_M2.02.3_Q0.01.1_45_ _ _	CIO_M2.02.3_Q0.01.1_V600 _
CLC	CLC_0234_	CLC_V600_
CLG	CLG_1_ _ _ _+123456.789_	CLG_1_ _ _ _+V600_ _ _ _ _ _ _
CMM	CMM_1_ _ _ _02_01_3_0_	CMM_1_ _ _ _02_01_3_0_
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_
CST	CST_1_2_	CST_1_2_
CSY	CSY_1_0_0_0_00.00.0_	CSY_1_0_0_0_00.00.0_
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_ _ _ _V600_ _ _ _ _ _ _ _+V600_ _ _ _ _ _
FUN	FUN_0_0_0_0000_	FUN_0_0_0_0000_
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_
LAE	LAE_1_ _ _ _	LAE_1_ _ _ _
LAL	LAL_1_ _ _ _123456.123_I0.00.6_	LAL_1_ _V600_ _ _ _ _ _ _I0.00.6_
LAR	LAR_1_ _ _ _123456.123_I0.00.6_I0.01.3_	LAR_1_ _V600_ _ _ _ _ _ _I0.00.6_I0.01.3_
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 1	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_ _ _ _ _ _ _
RTM	RTM_1_ _ _ _1_ _ _ _	RTM_1_ _ _ _V600_
RTS	RTS_	RTS_
SA1	SA1_0_+9.876_0_ _ _ _1234_M2.12_	SA1_0_+V600_ _V601_V602_M2.12_
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_
SRP	SRP_1_ _ _ _1_0_V600_M2.12_	SRP_1_ _ _ _1_0_V600_M2.12_
TXT	TXT_1_YESTHISISTEXT_ _ _ _	TXT_1_YESTHISISTEXT_ _ _ _
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_
VMC	VMC_1_ _ _ _234_ _567_ _	VMC_1_ _ _ _V600 _V601_
WAI	WAI_12.345_	WAI_V600_ _

Fig. 10-17: Transmission Formats of the Commands

Read Out Program Instructions: Example of querying an instruction:

Format:

```
?sNbbbb_$hh 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' are sent.

```
#sNbbbb_ccc_dddddddddddddddd_$hh CR LF
```

Meaning of the characters used:

b = Instruction number
c = Command code
d = Instruction information (number dependent on command)

Parameter

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' are sent.

```
Ksxxyy_dddddddd_$hh CR LF
```

Meaning of the characters used:

x = Block identifier
y = Parameter number
d = Instruction information (number dependent on parameter)

Write Parameters:

Writing a parameter

```
#sK_xxyy_dddddddd_$hh CR LF
```

Meaning of the characters used:

x = Block identifier
y = Parameter number
d = Instruction information (number dependent on parameter)

Parameter Blocks	Block Identifier	Parameter Number
System Parameters	A1	00 to 19
Function Parameters	AA	00 to 19
General Parameters	B0	00 to 14
Encoder Parameters	C0	00 to 19
Controller Parameters	CR	00 to 10
Motor Parameters	CM	00 to 12
PLS Switch Press Encoder	N1	00 to 31

Fig. 10-18: Parameter Groups

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 (Free)
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_0_
A117	A117_123_
A118	A118_1234.567_
A119	A119_0_0_000_

AA00	AA00_0100_0200_1_
AA01	AA01_M2.02.0_1_0_0100_
AA02	AA02_M2.02.2_1_0_0100_
AA03	Reserved (Free)
AA04	AA04_1_
AA05	AA05_M2.02.1_M2.02.2_M2.02.3_000_0_
AA06	AA06_M2.02.1_M2.02.2_
AA07	AA07_M2.02.0_
AA08	AA08_M2.02.0_M2.02.1_
AA09	AA09_00.00.0_00.00.0_
AA10	AA10_00.00.0_00.00.0_00.00.0_
AA11	AA11_Q3.00_M8.02_8_630_
AA12	AA12_M2.02.2_M2.02.3_00_
AA13	AA13_M2.02.2_M2.02.3_
AA14	AA14_M2.02.2_M2.02.3_
AA15	AA15_M2.02.2_M2.02.3_00_
AA16	AA16_M2.02.2_M2.02.3_00_
AA17	AA17_M2.02.2_M2.02.3_00_
AA18	AA18_M2.02.2_M2.02.3_00_
AA19	AA19_99_M2.02.2_

B000	B000_1_0_00_0_
B001	B001_09600_1_05_
B002	B002_0_0_0_0_0_000_
B003	B003_S_0_0001_
B004	B004_12345678_
B005	B005_00001.0000_
B006	B006_S_0_0001_
B007	B007_12345678_
B008	B008_00001.0000_
B009	B009_0_123_
B010	B010_0_
B011	B011_12345_
B012	B012_123456.7_
B013	B013_0_1_0_0_
B014	B014_0_0_0_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 (Free)
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_
C017	C017_1_0_00_12_0_
C018	C018_00.00.0_00.00.0_76_
C019	C019_+000090.000_

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_0003_
CM05	CM05_000.20_
CM06	CM06_0.00003_
CM07	CM07_0_0_
CM08	CM08_010.000_
CM09	CM09_123_123_
CM01	CM10_000.00_
CM11	CM11_+0000.0000_
CM12	CM12_00000_

N100	N100_0_360.00_
N101	N101_Q0.00.6_010_020_
through	...
N108	N108_Q0.00.7_010_020_
N109	N109_3000_04_003_005_
N110	Reserved (Free)
N111	N111_1_02_03_000_
N119	Reserved (Free)
N120	Reserved (Free)
N121	N121_2_180_270_
through	...
N131	N131_2_180_270_

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: Write

```
#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 disabled, even though Parameter B002 has been overwritten, until Parameter Mode is exited.

Variables

Read Out Variables:

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 'xxx' are sent.

```
Vsxxx_+dddddddd.dddddd_$hh CR LF
```

Meaning of the characters used:

x = Variable number
d = Variable information

Variable Type		Access	Comment
User-programmable	V600 to V999	Direct	
System	V000 to V199	Direct	Variable only, according to list in Section 'General System Variables' and 'Axis-Related System Variables.'
Indicated Basis	V500 to V507 V510 to V517	Direct	Value = 0 or 600 to 999
Indicated Offset Factor	V508, V518	Direct	Value = 0 to 399
Indicated Index	V509, V519	Direct	Value = 0 to 399
Indicated Basis	V520 to V527 V530 to V537	Indicated	See Fig. 10-21: Determining the Target Variable by Accessing the Index Variable

Fig. 10-19: Allowed Variables for Selection

Write Variables:

```
#sVxxx_+dddddddd.dddddd _$hh CR LF
```

Meaning of the characters used:

x = Variable number
d = Variable information

Variable Type		Access	Comment
User-programmable	V600 to V999	Direct	
System	V000 to V199		Write not possible !
Indicated Basis	V500 to V507 V510 to V517	Direct	Value = 0 or 600 to 999
Indicated Offset Factor	V508, V518	Direct	Value = 0 to 399
Indicated Index	V509, V519	Direct	Value = 0 to 399
Indicated Basis	V520 to V527 V530 to V537	Indicated	See Fig. 10-21: Determining the Target Variable by Accessing the Index Variable

Fig. 10-20: Allowed Variables for Writing

Notes About the Index Variables:

Access to the indicated variables (V500 to V519) is direct.

Via a variable number that is higher by 20 allows access to the same variables, but also to the contents of the indicated target variable.

Displayed Index Variable	Number of the Target Variable
500 to 507	500 to 507
508	508
509	509
510 to 517	510 ... 517
518	518
519	519
520	<V500> + <V508> * <V509>
527	<V507> + <V508> * <V509>
528	508
529	509
530	<V510> + <V508> * <V509>
537	<V517> + <V508> * <V509>
538	518
539	519

Fig. 10-21: Determining the Target Variable by Accessing the Index Variable

Logic Task

Read Out Logic Task

Logic Task instructions can be read out in any operating mode.

Format:

```
?sPxxxx_$hh CR LF
```

In response to this query, the contents stored in the queried Logic Task instruction 'xxxx' is sent.

```
Psxxxx_bbbbb_ddddddd_$hh CR LF
```

Meaning of the characters used:

x = Instruction number
b = Logic task assignment
d = Operand (Length up to 7 characters)

Write Logic Task

Writing Logic Task instructions is only possible in 'Parameter' Mode !

Format:

```
#sPxxxx_bbbbb_ddddddd_$hh CR LF
```

Meaning of the characters used:

x = Instruction number
b = Logic task assignment
d = Operand (Length up to 7 characters)

Command	Data
LD	LD_ _ _ _M2.02.0_
LDN	LDN_ _ _M2.02.0_
ST	ST_ _ _ _M2.02.0_
STN	STN_ _ _M2.02.0_
S	S _ _ _ _ _M2.02.0_
SET	SET _ _ _M2.02.0_
SETC	SETC _ _M2.02.0_
SETCN	SETCN _M2.02.0_
R	R_ _ _ _ _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: Readout

Query	Response
?5P0006_$hh CR LF	P50006_ORN(__M2.02.0_$hh CR LF
?5P0101_$hh CR LF	P50101_AND___M2.02.1_$hh CR LF

Examples: Transmission

```
#5P0103_SET___M2.02.3_$hh CR LF
#5P0600_RESCN_M2.02.5_$hh CR LF
```

If no checksum validation function has been programmed prior to entering Parameter Mode, this function remains disabled, even though Parameter B002 has been overwritten, until Parameter Mode is exited.

Cam

The cam data for the user-programmable cam are stored in the programming module.

Using the "FLPCAM" program, a CSV file can be transferred to the control. The number of points on the cam may not exceed 1024. If the number of points is smaller, the cam is automatically expanded to contain 1024 points. The FLPCAM program can be found on the "MotionManager" CD and must be installed on a PC.

Read out Table Values

Table Values can be read out in any operating mode.

Format:

```
?sTnn_eeee$hh CR LF
```

In response to this request, the control returns the information saved in the table index.

```
Tsnn_eeee_pppppppp$hh CR LF
```

Meaning of the characters used:

s = Station Number

n = Table Number (00 only)

e = Table Element No. (from 0000 to 1023)

p = Standardized Positions [Hexadecimal Value] (standardized to 2^31)

Note: An invalid position (>$7FFFFFFF) returns the value '????????'.

Write Table Values

It is not possible to transfer table values in Automatic Mode.

The cam must begin with the value $00000000 in Element 0000, and the last value in Element 1023 must be $7FFFFFFF.

Format:

```
#sTnn_eeee_pppppppp$hh CR LF
```

Meaning of the characters used:

s = Station Number

n = Table Number (00 only)

e = Table Element No. (from 0000 to 1023)

p = Standardized Positions [Hexadecimal Value]
(standardized to 2^31)

Note: Only table values <=$7FFFFFFF may be transferred.

Readout of Status Information

The following status messages can be queried via the serial data interface:

Status ’00’	=	Actual Position in IU
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, Measuring Wheel and Actual Position of the Motor Encoder
Status ’10’	=	Position Lag in IU
Status ’19’	=	Hardware and firmware version
Status ’25’	=	Two-digit diagnostic code with text output
Status ’48’	=	Actual Velocity in 1/min
Status ’53’	=	Diagnostic / Error Message
Status ’60’	=	Output of first erroneous instruction number (Parameter, NC Task, Logic Task)
Status ’61’	=	Output of a byte for the Markers / Inputs / Outputs
Status ’62’	=	Controller Type or Motor Type
Status ’63’	=	Text output (TXT command)
Status ’64’	=	Two-digit diagnostic code
Status ’66’	=	Output of a word for the Markers / Inputs / Outputs

Status 00

Actual Position in IU

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 IU

Status 01

Transmission error, interface

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 = Fault (error) number
t = Fault (error) text (always 20 characters)

Below is a list of the fault (error) numbers and their meanings:

Faults No.	Fault Text	Description
01	RS Instruction # Wrong	Incorrect characters 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	Invalid Mode	Attempt was made to transmit parameter data. The control was not in \`Parameter´ operating mode at the time.
06	Wrong RS Param #	The transmitted parameter number is not a decimal number.
07	Param. # too large	The transmitted parameter number is too large.
08	Wrong RS Status #	The number given in a status request is not a decimal number.
09	Status # illegal	An attempt was made to query status information that was not present.
11	Invalid Param. Block	Incorrect parameter instruction identifier.
12	Instruction # too large	The transmitted instruction number is greater than 999.
13	Invalid Prg Command	An illegal command was transmitted.
16	Value too large	Some of the data is too large. Please note the maximum values in the description
17	Value too small	Some of the data is too small. Please note the minimum values in the description
18	Not accepted!	a) No digit for writing NC commands or parameters. b) Incorrect data for writing variables. c) Incorrect source type for Status 61. d) Unknown interface command.
20	RS system error #1	
21	RS system error #2	
22	MF para. Read only	**M**otor **F**eedback Parameter is not writable
23	Var. No. incorrect	The variable number is not enabled (e.g. unknown system variable)
24	RS system error #3	
25	Invalid Operand	Illegal Source/Target Operand in the Logic Task Command
26	Write disabled	Write Protection Active for NC / Logic Task Instructions
28	Indicated Variables No.	Access to Invalid Target Variables Using Index Variables

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 = Preset count

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 BTV display)

e.g. ECODR3-FLP-04V02

Status 08

Current Instructions and Return Instruction Numbers for Tasks 1 to 3

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 enabled, 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: Current Measuring Wheel Position and Current Motor Encoder Position

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 IU. The sums of all Measuring wheel encoder movements are added
n = Actual position of the motor encoder in IU (incremental encoder 1)

Status 10

Position Lag in IU

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 IU

Status 19

Hardware and firmware 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 25

Two-digit diagnostic code with text output

see also TXT Command, Markers M6.37 – M6.39 and
Functional Description for 'Logic Task Controlled Diagnostic for Status Message 25.'

The status query:

```
? s X _ _ 2 5 _CR LF
```

produces the message:

```
Xs25_cc--------40 characters information-----$hh CR LF
```

cc = Current diagnostic code

Examples:

```
Xs25_8BAxis 1 Motor Has Overheated          $hh CR LF
Xs25_02M: Feed Forward                      $hh CR LF
```

Overview of Error Messages:

Status Messages:

```
"02M: Feed Forward                         "
"0EPARAMETER MODE                          "
"17M: Feed Reverse                         "
"18Initializing System                     "
"1AA: C.Stop Active                        "
"3AFeed Rolls Open                         "
"48Stop Due To Interrupt Input!            "
"99Control Error, See H1 Display           "
```

Minor Error:

```
"13 Both Jogs High                         "
```

Soft Fault:

```
"66Feed Angle Lost During Feed!          "
"6AInvalid Mode Selection!               "
```

Hard Fault:

```
"77Parameter Invalid! Select P-mode!     "
"81Parameters Lost! Clear to Cont        "
"86Parameters Lost! Select P-mode!       "
```

Drive Error:

```
"00System is Ready                       "
"3DA: Stop/Wait for start                "
"3ES: Stop active                        "
"3FM: Stop active                        "
"44Drive is not enabled!                 "
"7DMotor Overtemp Warning                "
"7EAmp Overtemp Warning                  "
"82Axis 1 Drive Runaway!                 "
"88EMERGENCY STOP!                       "
"8BMotor Has Overheated!                 "
"8CDrive Stalled!                        "
"93Drive Watch Dog Error                 "
"96Drive Error, See H1 Display!          "
```

Status 48

Actual Velocity in 1/min.

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 Revolutions/Min.
g	=	0 = Axis deactivated
		1 = Axis activated

Status 53

Diagnostic / Error Message

The status query:

```
?sX__53_CR LF
```

produces the message:

```
Xs53_xxxxxx_tttttttttttttttt $hh CR LF
```

t = Fault message in plain text (max. 40 characters)

x = error code / diagnostic number

If the TXT command was called with Mode 1 (TXT 1 tttttttttttttttt), the text from this text command is output with Status 53.

t = 16 characters of the TXT command.

For fault texts and codes, see Chapter 12, Diagnostics.

Status 60

Output of first erroneous instruction number (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 for the Markers / Inputs / Outputs

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 7...0

Rexroth Bosch Group

Status 62

Controller Type or Type of Connected Motor

The status query:

```
?sX_ _62_a_CR LF
```

produces the message:

```
Xs62_an...n_$hh CR LF
```

a = selection 0 = Controller type
1 = Reserved
2 = Motor type

n...n = character string with variable length and max. 40 characters.

Example:

?5X 62 0 → X562 0DKC21.3-040-7 $DC

?5X 62 2 → X562 2MKD025B-144-KG0-KN$84

Status 63

Text output (TXT command)

The status query:

```
? s X _ _63_vb_CR LF
```

v = 1-4 : from line
b = 1-4 : to line

produces the message:

```
Xs63_tttttttt . . . tttttttt _ $ h h CR LF
```

t = 16, 32, 48 or 64 characters of the TXT command with mode greater than 0

See also TXT command

Status 64

Two-digit diagnostic code

Current two-digit diagnostic code.

The status query:

```
? s X _ _ 6 4 _ CR LF
```

produces the message:

```
Xs64_cc$hh CR LF
```

cc = Current diagnostic code (see Status 25)

Examples:

```
X s 6 4 _ 8 B $ h h CR LF
X s 6 4 _ 0 2 $ h h CR LF
```

For diagnostic code see Status 25, TXT command, M2.37 to M2.39

Status 66

Output of a word for the Markers / Inputs / Outputs

Two bytes at a time are output. The display of the data can be set to binary, decimal or hexadecimal.

The status query:

```
? s X _ _ 6 6 _ q t . n n m _ CR LF
```

produces the message:

```
X s 6 6 _ q t . n n _ Datum $ h h CR  LF
```

q	=	Source type I, Q or M		
t	=	Source number		
nn	=	Byte number of the high byte		
m	=	Display: '_' or 'b' or 'B'		= Binary
			'h' or 'H'	= hexadecimal
			'd' or 'D'	= decimal

For binary display, the datum is output at 16 bits, for hexadecimal, 4 digits, and for decimal, variable with 1-5 digits.

Examples:

```
e.g.   M4.03 =  0 0 1 0 0 1 0 1
       M4.02 =  1 1 0 0 1 0 1 0
```

Binary:

```
Xs66 _ M4.03 _ 0010010111001010 $hh CR LF     always 16 bits
               |              |
  Bit Field:  15   ... 76543210
        Byte: nn          nn-1
```

Decimal:

```
Xs66 _ M4.03 _ 9674 $hh CR LF     variable 1...5 characters
```

Hexadecimal:

```
Xs66 _ M4.03 _ 25CA $hh CR LF     always 4 characters
```

Interface Commands

Note:	**For all commands, it is necessary for the checksum to transmitted independently from Parameter B002!**

Clear Fault Message:

```
!sCLEAR_$hh CR LF
```

or

```
!sCCLEAR_$hh CR LF
```

Clears a fault message.

Clear Position Counter:

```
!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 interface responds with "**Status-01: 18 Not accepted!**"

This is only possible if motion type = 0 (Parameter A100). If the control is not in Manual or Automatic Mode, the interface responds with "**Status 01: 05-Operating Mode Error**."

Set Default Values: Default parameters can be set via the interface.

```
!sCSETPA_$hh CR LF
```

Note:	All parameter values are overwritten with the default values. This command is only accepted in Parameter Mode.

Note:	The command is accepted only in Parameter Mode.

Write NOP to NC Instructions

The NOP command is written to all NC program instructions.

Format:

! s C N O P N C $ h h CR LF

Write NOP command to NC program instructions.

Format:

! s C N O P N C v v v v b b b b $ h h CR LF

vvvv = beginning with NC instruction number (0000...0999)

bbbb = up to and including NC instruction number (0000...0999)

Note: These commands are only accepted in Parameter Mode.

A Yes response follows, and the command is successfully completed.

Write NOP to Logic Task Instructions

All Logic Task program instructions are written to with NOP commands.

Format:

! s C N O P L T $ h h CR LF

Note: 'END' is written to instruction 0000 !

Write NOP command to Logic Task program instructions.

Format:

! s C N O P L T v v v v b b b b $ h h CR LF

vvvv = starting with logic task instruction number (0000...0999)

bbbb = up to and including logic task instruction number (0000...0999)

Note: If instruction 0000 is the first instruction, 'END' is written to it !

Note: These commands are only accepted in Parameter Mode.

A Yes response follows, and the command is successfully completed.

Clear NC Variables: Variables V600 to V999 and the indexed Variables V500 to V519 are cleared.

Format:

```
! s C C L V A R $ h h CR LF
```

Clear a variable range.

Format:

```
! s C C L V A R v v v v b b b b $ h h CR LF
```

vvvv = starting with variable number (0600...0999)

bbbb = up to and including variable number (0600...0999)

Clear system variables.

Format:

```
! s C C L V A R n n n n $ h h CR LF
```

nnnn = Number of the system variables
0019, 0020 and 0105 are allowable

Note: These commands are only accepted in Parameter Mode.

A Yes response follows, and the command is successfully completed.

Clear Saved Marker Flags: All saved marker flags (M3, M6 and M8) are cleared.

Format:

```
! s C C L M _ _ $ h h CR LF
```

A particular group of saved NC marker flags is cleared.

Format:

```
! s C C L M _ _ m n $ h h CR LF
```

m = "M" for marker flag

n = Group number

The saved NC marker flags are groups M3, M6 M8.

Note: These commands are only accepted in Parameter Mode.

A Yes response follows, and the command is successfully completed.

Write Saved Marker Flags:

Change a byte from a saved marker flag group.

Format:

```
! s C S E T M B _ M g . n n _ x x x x x x x x _ $ h h CR LF
                              Bit7          Bit0
```

With g: Marker Flag Group (3, 6 or 8)

nn : Byte Number 00 to 19 (depending on group)

x: 0 = Clear bit
1 = Set bit
2 = Leave bit unchanged
3 = Invert bit

Note: For marker flag groups M3 and M6, the command is accepted only in Parameter Mode.

Note: There is no time monitoring of the data transmission!.
The marker flags are saved.

A Yes response follows, and the command is successfully completed.

Change a Bit in Marker Flag Group M8:

Change a bit in marker flag group M8.

```
! s C S E T M _ M 8 . n n . b _ x _ $ h h CR LF
```

With nn : Byte number 00 to 19

b: Bit number of the selected byte.

x: 0 = Clear bit

1 = Set bit

2 = Leave bit unchanged

3 = Invert bit

Note: There is no time monitoring of the data transmission!.
The marker flags are saved.

A Yes response follows, and the command is successfully completed.

Re-Initialize PLS The PLS is initialized using the current PLS parameter data.

Format:

```
! s C I N I T N $ h h CR LF
```

Note: The command is accepted only in Manual or Automatic Mode.

An answer of Yes occurs immediately after acceptance of the command.

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
```

is answered with:

```
:snnnn CR LF
```

Meaning of the characters used:

nnnn = Diagnostic Error Number (Hexadecimal)

See also Diagnostics, Chapter 12.

SIS Protocol

In preparation

11 Command Communications

11.1 Parallel Interface

DKC21.3

Three connectors serve as the parallel interface.

X1, X3 and X210

See also the Project Planning Manual and Section 13.

Diagnostic LED for Parallel Interface

For diagnosing the parallel interface, four LEDs are available on the front of the card. These LEDs signal the status of the control.

H211	H210	H213	Definition
green	off	- -	Status Diagnostic
red	green	- -	Warnings E-01xx
red	orange	- -	Error Message F-02xx
red	red	- -	Error Message F-03xx
- -	- -	off	Command communications not working
any	any	orange blinking	Initialization active
any	any	green blinking	System is working

Fig. 11-1: Diagnostic LED for Parallel Interface

The LEDs H212, H214 and H215 have no function

Note: If all 6 LEDs turn orange approximately 10 seconds after start-up, the parallel interface is not working. The firmware on the programming module is either a wrong or defective version.

11.2 Profibus

Rexroth provides advanced drive technology with a user-friendly interface. For example, jogging was defined as an individual function. Rexroth 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 ... 32 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.

Any change to the slave address takes effect only after startup of the drive controller.

Unit Source File

For each PROFIBUS-DP unit, a unit source file (*.GSD), in which the data for the operation on the bus are stored, must be executed. This file is required for each unit when configuring the bus master.

The unit source file for the ECODRIVE03 with FLP firmware is an ASCII file named:

IN2_04eb.gsd

This unit source file also contains the following information, issued for this configuration by the PNO (PROFIBUS user organization):

Ident Number = 04eb hex

Additionally, it is possible to set the transmission length. This is dependent on the data to be transmitted. See Fig: 11-5.

Data Channel

The maximum data channel size is 32 bytes.

Service Data Channel (only format 2)	**Process Data Channel**
6 Words	8 (7) Words

Fig. 11-2: Transmission

The length of the process data channel is dependent on the format set in Parameter B013.

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. 11-3: Receive Channel DKC3.3 → Master

I Channel (DKC Input)	**Variable Channel**
3 Words	4 Words

Fig. 11-4: Transmission Channel Master → DKC3.3

Parameter B013	**Process Data Channel**	
	Receive Length Profibus Master	**Send Length Profibus Master**
Format 0	8 Words	7 Words
Format 1	4 Words	3 Words
Format 2	8 Words	7 Words

Fig. 11-5: Transmission Length, Process Data Channel

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.

Profile 0

I/O Status Word (DKC Output)

Bit	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	Parameter	Q2.00.6
7	In Position (Switching Threshold)	Q2.00.7
8	Reserved (Free)	Q2.01.0
9	Reserved (Free)	Q2.01.1
10	Reserved (Free)	Q2.01.2
11	Reserved (Free)	Q2.01.3
12	Reserved (Free)	Q2.01.4
13	Reserved (Free)	Q2.01.5
14	Drive is ready	Q2.01.6
15	Power on	Q2.01.7

Fig. 11-6: Status Word DKC3.3 → Master

I/O Control Word (DKC Input)

Bit	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 (Free)	I2.00.7
8	Reserved (Free)	I2.01.0
9	Reserved (Free)	I2.01.1
10	Reserved (Free)	I2.01.2
11	Reserved (Free)	I2.01.3
12	Reserved (Free)	I2.01.4
13	Reserved (Free)	I2.01.5
14	Reserved (Free)	I2.01.6
15	Reserved (Free)	I2.01.7

Fig. 11-7: Control Word Master → DKC3.3

Profile 1

I/O Status Word (DKC Output)

Bit	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	Parameter	Q2.00.6
7	In Position	Q2.00.7
8	Reserved (Free)	Q2.01.0
9	Reserved (Free)	Q2.01.1
10	Reserved (Free)	Q2.01.2
11	Reserved (Free)	Q2.01.3
12	Reserved (Free)	Q2.01.4
13	Reserved (Free)	Q2.01.5
14	Drive is ready	Q2.01.6
15	Power on	Q2.01.7

Fig. 11-8: Status Word DKC3.3 → Master

I/O Control Word (DKC Input)

Bit	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	Drive Enable (RF)	I2.00.7
8	Reserved (Free)	I2.01.0
9	Reserved (Free)	I2.01.1
10	Reserved (Free)	I2.01.2
11	Reserved (Free)	I2.01.3
12	Reserved (Free)	I2.01.4
13	Reserved (Free)	I2.01.5
14	Reserved (Free)	I2.01.6
15	Reserved (Free)	I2.01.7

Fig. 11-9: Control Word Master → DKC3.3

Profibus: User-Configurable I/O

DKC Input

I2.02, I2.03 – in one word when received

I2.04, I2.05 – in one word when received

are the addresses of the available words

DKC Output

Q2.02, Q2.03 – in one word when sent

Q2.04, Q2.05 – in one word when sent

are the addresses of the available words

Diagnostic Channel

The diagnostic (Status, Warning, Error Message) is made available in a word as a hexadecimal number. The content represents the diagnostic numbers assigned in the description.

Error Description	F276 or E257	= Diagnostic F276 (E257)
Warning	E-01xx	= Diagnostic 01xx
Error Message	F-02xx	= Diagnostic 02xx
Error Message	F-03xx	= Diagnostic 03xx

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. 11-10: Variable Channel Master → DKC3.3

1 Word: Read Control Word

1 Word: Write Control Word

1 Long-Word: Write Variable Datum

From DKC to Master

Read Status Word	Write Status Word	Variable Datum
1 Word	1 Word	1 Long-Word

Fig. 11-11: DKC3.3 Variable Channel → Master

1 Word: Read Status Word

1 Word: Write Status Word

1 Long-Word: Read 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. 11-12: Status Word for Variable

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. 11-13: Control Word for Variable

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. 11-14: Handshake Process

The variables have a fixed format:

+99999999.999999

While transmitting the variables via the Profibus interface, a signed 32-bit number (1 Long) with an operational sign, that is interpreted according to its **Format** selection, is transmitted. The data capacity of the variable is reduced. For the two types of fixed point formats, the places after the decimal are always rounded. For the integer format, only the places before the decimal are used. The transmission formats must correspond to the application of the variable in the NC program.

Format:

- The following data formats are defined:
  0 (0000) = Integer (+/-99999999)
  1 (0001) = Fixed point (3) (+/-99999.999)
  2 (0010) = Fixed point (6) (+/- 99.999999)
  3 (0011) = IEEE Floating point (in preparation)
  4 (0100) = Integer, not rounded (+/-99999999)

Fault (Error) Number:

- 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:
  0 (0000) = Variable number too large
  1 (0001) = Variable number illegal
  2 (0010) = Unknown format
  3 (0011) = Data too large
  4 (0100) = Data too small
  5 (0101) = Data not displayable
  6 (0110) = Variable not writable
  7 (0111) = Bit 14 in the control word is ‘1’
  8 (1000) = Indexed variable number too large
  9 (1001) = Indexed variable number too small

Variable Number:

Read

- System variable
- V500 – V519 (direct access)
- V520 – V539 (indexed access)
- V600 – V999

Write

- System variable
- V500 – V519 (direct access)
- V520 – V539 (indexed access)
- V600 – V999

See also Section 6.6 Writing the User Program 'Variable.'

Service Data Channel

All the programs, parameters, variables and status information can be sent to the slave or read out via this channel.

The data exchange occurs after the ASCII Data Protocol of the 'Serial Interface.' The checksum and 'CR LF' at the end of the protocol were disregarded. The station number is not checked.

Reading a Datum

1. Read request (e.g. ? N0000) → Write
2. Readout of the requested datum → Read

Writing a Datum

1. Write request → Write
2. Readout of the response telegram → Read

Handling the Service Data Channel

Structure of the Control Word in the Service Data Channel

The control word is sent in the direction of master to slave. It is 16 bits wide and the individual bits are defined as follows:

Control Word

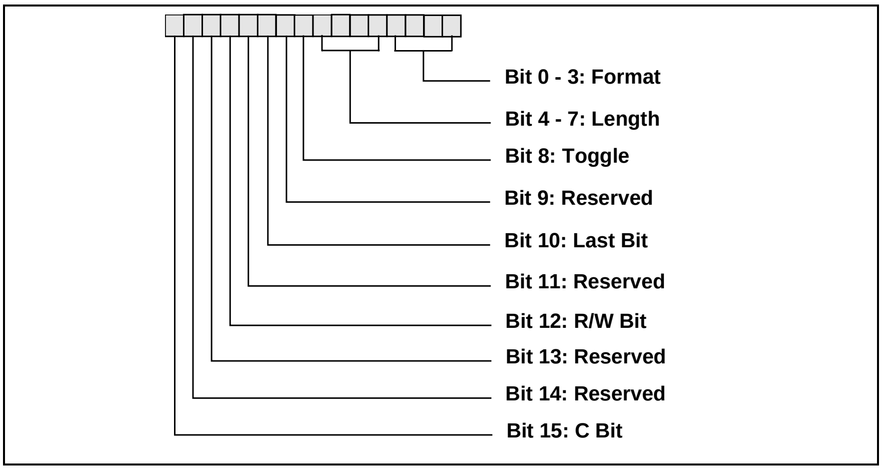


Fig. 11-15: Structure of the Control Word in the Service Data Channel

The individual bits are defined as follows:

Format: These bits indicate the meaning of the transmitted data. Currently, only one format (B) exists.

Length: These four bits indicate the length of the valid data byte in the Service Data Channel, not including the control word. The content of the invalid data is not defined.

Toggle: This bit changes its status for each new cycle. It is used for a software handshake between master and slave. The master may only send this bit if the toggle bit in the status word has the same status as in the control word that was just sent.

Last: Last Bit: This bit is set when the last fragment of a data set is sent. This way, the slave can recognize that it can assemble and edit the previously collected fragments.

R/W: Read/Write; Read = 1, The master sets this bit when it would like to read data.

C: Reserved. (Always 0)

Note: Reserved Bits are to be set to 0.

Status Word

The status word is sent in the direction of slave to master. It is 16 bits wide and the individual bits are defined as follows:

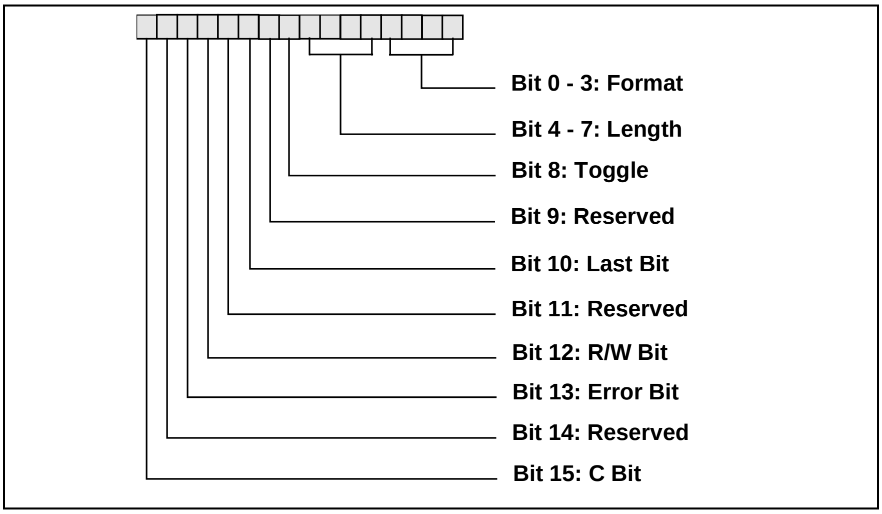


Fig. 11-16: Structure of the Status Word in the Service Data Channel

The individual bits are defined as follows:

Format: These bits indicate the meaning of the transmitted data. Currently, only one format (B) exists.

Length: These four bits indicate the length of the valid data byte in the Service Data Channel, not including the control word. The content of the invalid data is not defined.

Toggle: This bit changes its status for each new cycle. It is used for a software handshake between master and slave. The slave recognizes new data when the received toggle bit (control word) is not equal to the sent toggle bit.

Last: Last Bit: This bit is set when the last fragment of a data set is sent. This way, the slave can display to the master that it is sending the last fragment.

R/W: Read/Write; Read = 1, The slave sets this bit.
(Copy of the master bit)

Error Bit: This bit indicates an error that has occurred in the slave. The following data indicate the reason for the error.

C: Reserved.

Note: Reserved Bits are to be set to 0.

Communication Between Master and Slave

A general description of the communication relationships is illustrated in the following graphic. The following two services are shown from the perspective of the master:

- Read Request (Readout of the requested data)
  (Readout of the response telegram)
- Write Request (Read request)
  (Write request)

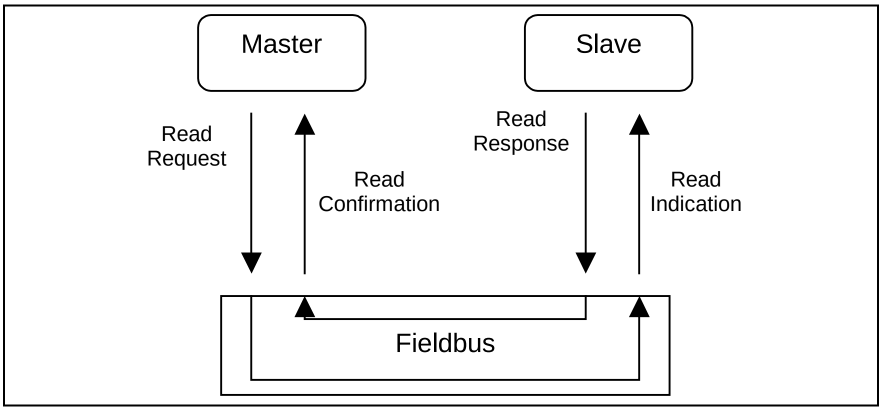


Fig. 11-17: Master Reads Datum

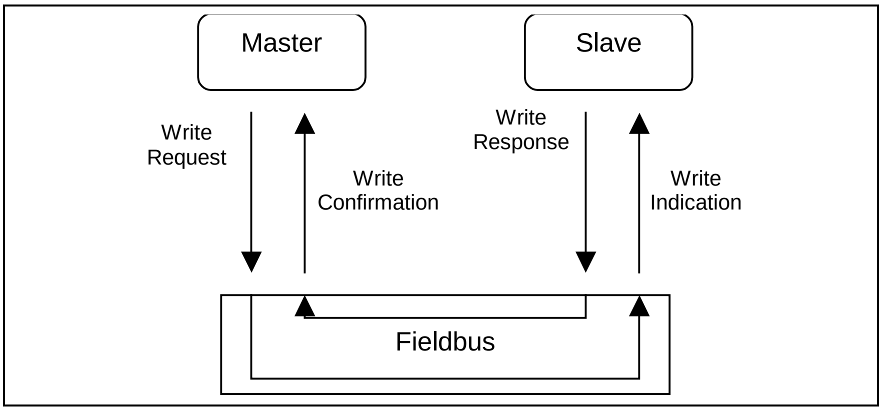


Fig. 11-18: Master Writes Read or Write Request

The "Request" and "Indication" services contain the same data; the difference is in the perspective ("Request' from the master's perspective, "Indication" from the slave's perspective).

If the master sends a service to the slave, the first word is the control word. If, however, an answer is sent from the slave to the master, the first word is the status word. Both words control the sequence of the Service Data Channel.

If the data to be transmitted are longer than the length of the Service Data Channel, they must be fragmented. The required information is also contained in the control/status word. The total length that may be transmitted via the Service Data Channel is 128 bytes.

Reading a Value

The master clears the R-Bit to signal a request. In this example, an NC instruction is read out. The length of the control word is set to 8, which indicates the valid length of the data in bytes, not counting the control word. The toggle bit is set to 1, assuming it was set to 0 before. The L-Bit is also set, because all the data is sent in one block and therefore, the last fragment is transmitted.

	Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	0	0	1	0	1	1	0	0	0	1	0	1	1	3F	20	4E	30	30	30	30	20	x	x
																	?	_	N	0	0	0	0	_		

Fig. 11-19: The Master Sends a "Write Request"

The slave responds with a "Write Response" that contains no data.

	Status Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
S	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x

Fig. 11-20: The Slave Sends a "Write Response"

The master now wants to read out the requested datum with a "Read Request."

	Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x

Fig. 11-21: The Master Sends a "Read Request"

The slave responds with a "Read Response," which contains the requested data (total length = 14 bytes). The length indication was set to 10 and the toggle bit was also set to 1. The L-Bit is not set, because the data is fragmented and cannot all be transmitted at once. An additional fragment is required to receive the rest of the data.

	Status Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
S	0	0	0	1	0	0	0	0	1	0	1	0	1	0	1	1	23	20	4E	30	30	30	30	20	4E	4F
																	#	_	N	0	0	0	0	_	N	O

Fig. 11-22: "Read Response" From the Slave (First Fragment)

Now, the master must switch the toggle bit to show the slave that it is ready to receive new data. The R/W-Bit, the L-Bit, the length and the data are not of interest, and are therefore not considered by the slave. However, the master should set the bits as shown below.

	Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	1	0	1	0	1	0	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x

Fig. 11-23: The Master Sends a "Read Request" for the Second Fragment

The slave responds with the second fragment, which contains the remaining 4 bytes. The L-Bit is set, because the system is processing the last fragment. In addition, the length is set accordingly.

	Status Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
S	0	0	0	1	0	1	0	1	0	1	0	0	1	0	1	1	50	20	20	20	x	x	x	x	x	x
																	P	_	_	_						

Fig. 11-24: "Read Response" From the Slave (Last Fragment)

Writing a Value

In this example, an NC instruction is written:

- # N0000 NOP

The master clears the R-Bit to signal a write operation. In this example, the length of the operating datum is 12 bytes. Because only 5 data words are available in the Service Data Channel, the request cannot be sent all at once, but must be fragmented. Therefore, the L-Bit is not set; the toggle bit was switched opposite of the previous state.

	Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	0	0	0	0	1	1	0	1	0	1	0	1	1	23	20	4E	30	30	30	30	20	4E	4F
																	#	_	N	0	0	0	0	_	N	O

Fig. 11-25: "Write Request" From the Master (First Fragment)

The slave responds with a "Read Response" that contains no data. This response indicates to the master that the slave is again ready to receive additional data. Each time, the status word is a copy of the control word, for which the length was set to 0 and the L-Bit was set.

	Status Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
S	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x

Fig. 11-26: "Write Response" From the Slave

Now, the master can send the rest of the data in the next "Write Request." The master must change the status of the toggle bit again and the length must be indicated accordingly. The L-Bit is set, because the system is processing the last fragment.

	Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	1	50	20	x	x	x	x	x	x	x	x
																	P	_								

Fig. 11-27: "Write Request" From the Master (Second Fragment)

The slave now has all the information to process the master's request. To confirm successful execution of the service to the master, the slave sends a "Write Response," which consists of the status word, to the master.

	Status Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
S	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x

Fig. 11-28: "Write Response" From the Slave

If the error bit is not active, the transmission is completed successfully. However, as for the "Serial Interface," it is still possible to request a transmission confirmation.

	Status/Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	1	0	1	0	1	0	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x
S	0	0	0	1	0	1	0	1	0	0	1	0	1	0	1	1	59	20								
																	Y	_								

Fig. 11-29: Transmission Confirmation

Error Messages

If the slave detects an erroneous message, it generates an error message. This message contains an error code as a 16-bit value that indicates the source of the error. The error message has the following structure:

	Status Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
S	0	0	1	d	0	1	0	d	0	0	1	0	1	0	1	1	y	y	x	x	x	x	x	x	x	x

Fig. 11-30: Structure of the Slave's Error Message

The error bit is set and the R and toggle bits have the same value as the bit set in the master. The error code indicates an internal error code. The definition of the error code for internal errors is described as follows.

Error Code yy (Hex)	**Description**
0x0085	The sum of the data in all of the collected fragments is too large.
0x0088	An internal error occurred during communication between the fieldbus card and the drive controller.
0x008A	The index sent by the master is not present.
0x008B	The format is unknown.
0x008C	The length of the valid data indicated in the status word is longer than the parameter channel length.
0x008D	Communication is not possible because the parameter channel was configured with only 1 word.
0x0090	The format changed during collection of individual fragments.
0x0095	Additional data besides the index and subindex is present in a read request.
0x0096	The internal SIS communication returned an error.
0x009A	This functionality has not been implemented.
0x009B	Switching between the "old" and "new" parameter channel is occurring for sending / receiving data.
0x009C	The indicated subindex does not exist.
0x009D	The subindex is write-protected.
0x00F0	A timeout occurred during communication between the fieldbus card and the drive controller.
0x01nn	nn = Error code for the "serial interface"
0x01FF	The length indicated by the slave for the data to be transmitted is incorrect. (>128)

Fig. 11-31: Error Codes

If a 0x01nn error is present, this error can be read out again as "plain text."

	Status/Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	0	0	1	0	1	1	0	0	0	1	0	1	1	3F	20	4E	33	30	30	30	20	x	x
																	?	_	N	3	0	0	0	_		
S	0	0	1	0	0	1	0	1	0	0	1	0	1	0	1	1	01	0C								
																		12								
M	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x
S	0	0	0	1	0	1	0	0	1	0	1	0	1	0	1	1	58	20	30	31	20	31	32	20	42	6C
																	X	_	0	1	_	1	2	_	B	l
M	0	0	0	1	0	1	0	1	1	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x
S	0	0	0	1	0	0	0	1	1	0	1	0	1	0	1	1	6F	63	6B	20	2C	20	74	6F	6F	20
																	o	c	k	_	#	_	t	o	o	_
M	0	0	0	1	0	1	0	0	1	0	0	0	1	0	1	1	x	x	x	x	x	x	x	x	x	x
S	0	0	0	1	0	1	0	0	1	0	0	0	1	0	1	1	6C	61	72	67	65					
																	l	a	r	g	e					

Fig. 11-32: Error Output With Plain Text

Termination of the Data Exchange

In some cases, it can make sense to terminate the data exchange (the slave sends no more data). The master can indicate the termination of the data exchange to the slave by using the format 0xF in the control word and setting the length, the L-Bit and the R-Bit to zero. The toggle bit must be switched according to the previous state. The slave then terminates the data exchange and waits for a new service.

	Control Word																Service Data									
	C		E	R		L		T	Length				Format				Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
M	0	0	0	0	0	1	0	d	0	0	0	0	1	1	1	1	x	x	x	x	x	x	x	x	x	x
S	0	0	0	0	0	1	0	d	0	0	0	0	1	1	1	1	x	x	x	x	x	x	x	x	x	x

Fig. 11-33: Termination of the Data Exchange During Fragmenting

Inputs X1 and X3

The following hardware inputs must be assigned to the DKC3.3:

- $\overline{\text{E-Stop}}$ X3/6
- Limit + X3/2
- Limit - X3/3
- $\overline{\text{AH}}$ X1/3

Additionally only when using Profile 0:

- RF X1/4

Assignment of Profibus Connector X30

Signal Assignment for X30 Profibus Connector

X 30	RS 485 Reference	Rexroth Signal Name	Signal according to EN50170 Volume 2	Definition
1		PE	Shield	Shield or Protective Ground
2		Free		
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		Free		
8	A / A´	A	RxD / TxD-N	Receive/Transmit Data - N
9		CNTR-N	CNTR-N	Repeater - Control Signal N

Fig. 11-34: X30 Signal Assignment. Profibus Connection

Diagnostic LED for Profibus

For diagnosing the Profibus interface, four LEDs are available on the front of the fieldbus card. These LEDs signal the status of the synchronization between the fieldbus interface and the control, as well as the bus activity for the cyclic data exchange.

LED Designation	LED Status	Definition
H30	ON	Cyclic Process Data channel is active.
H31		
H32/33	alternately blinking	synchronization established between the fieldbus card and the control
H32/33	blinking simultaneously	synchronization not established between the fieldbus card and the control
all LEDs	blinking simultaneously	serious error in the fieldbus card Turn unit off / on

Fig. 11-35: Diagnostic LEDs for Profibus X30

Notes

12 Diagnostic Message Descriptions

12.1 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**

Composition of a Diagnostic Message

A diagnostic message consists of:

- a **diagnostic message number** and a
- Diagnostic Message Text

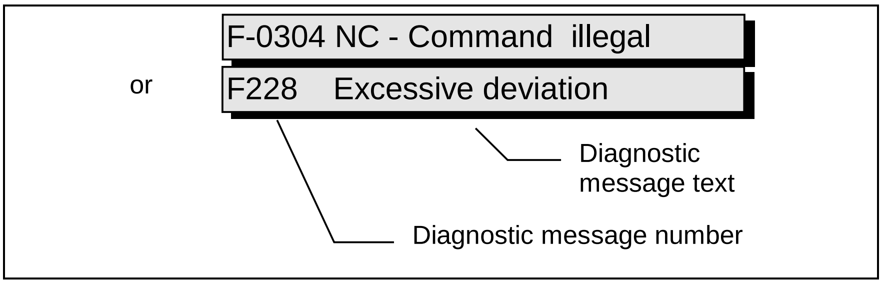


Fig. 12-1: Composition of Diagnostic Message with Diagnostic Message Number and Text

For the example shown in the above graphic, "F-," "03" and "04" or "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.

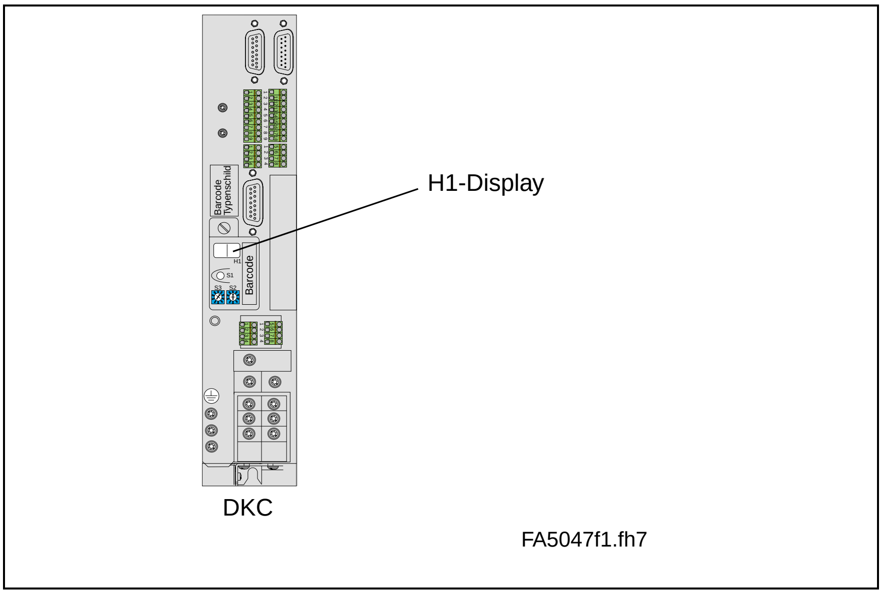


Fig. 12-2: H1 Display

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 apparent from the H1-Display. If the drive complies with the operating mode and no error is present, following appears on the display:

"AU" = Automatic

"HA" = Manual Mode

"PA" = Parameter

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.

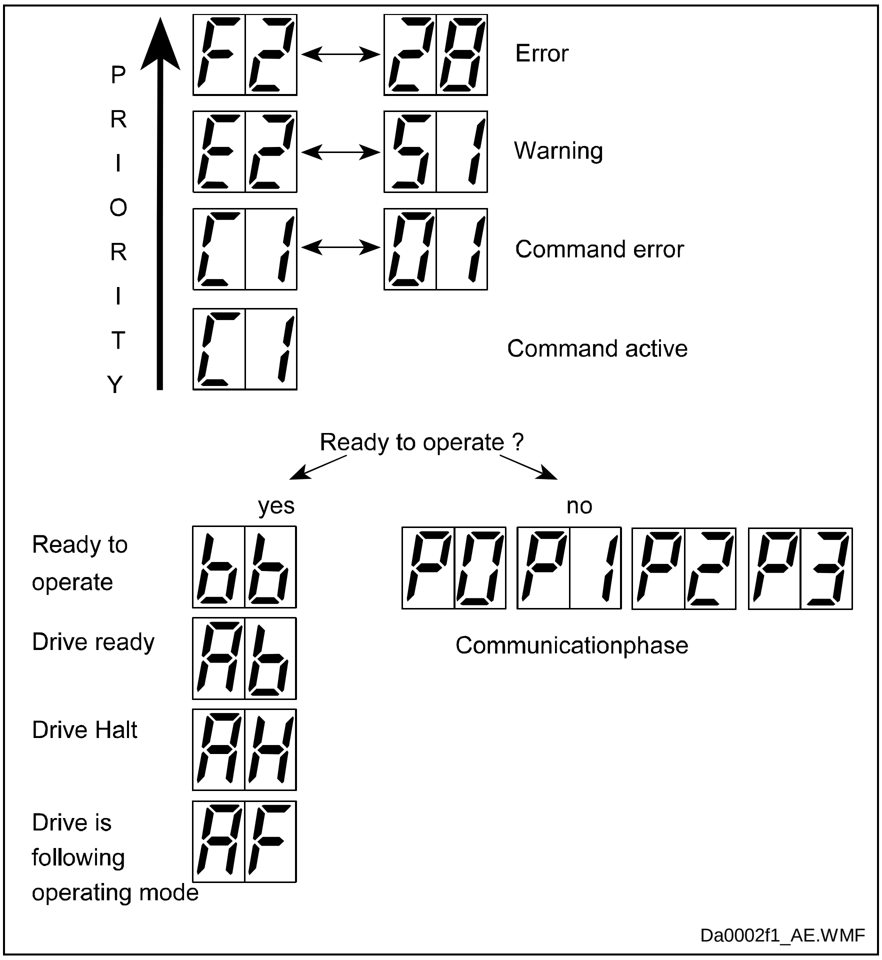


Fig. 12-3: Diagnostic Message Priority Diagram

The plain-text diagnostic message contains the diagnostic message number followed by the diagnostic message text, as shown in the example, "Excessive deviation" (Fig. 12-1).
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, depending on the language selection (Parameter B000).

12.1 Error Diagnostics for Amplifier F. ..

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.

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.

F217 Blower not connected

For the 100A and 200A drive controllers, the blower must always be connected.

Cause:

- Blower is not connected or is incorrectly connected

Remedy:

- Connect or replace blower

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.

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 deceleration).

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."

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.

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."

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.

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, Monitoring**, 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, Monitoring** 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, Monitoring**.

See also functional description for: "Position Control Loop Monitoring."

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. Electromagnetic 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.

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.

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.

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, Encoder difference Monitoring**. 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, Homing**) of both encoders are cleared.

The monitoring function is inactive if a value of 0 is entered in **Parameter A117, Encoder difference Monitoring**.

Possible Causes:

1. Wrong parameter for encoder 2
   (Parameter C005, Position Feedback 2 Type,
   Parameter C006, Feedback 2 Resolution)
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, Position Feedback 2 Type** and **Parameter C006, Feedback 2 Resolution**.

For 2. Check **Parameter A102, Gearing**.

For 3. Increase **A117, Encoder Difference Monitoring**.

For 4. Replace encoder cable.

For 5. Reduce the velocity.

For 6. Set **Parameter A117, Encoder Difference Monitoring** to 0 (turn monitoring off).

For 7. execute **Parameter C010, Set Absolute Encoder**.

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 Velocity**, the position command value monitoring function is activated.

F242 Encoder 2 failure: Signal amplitude wrong

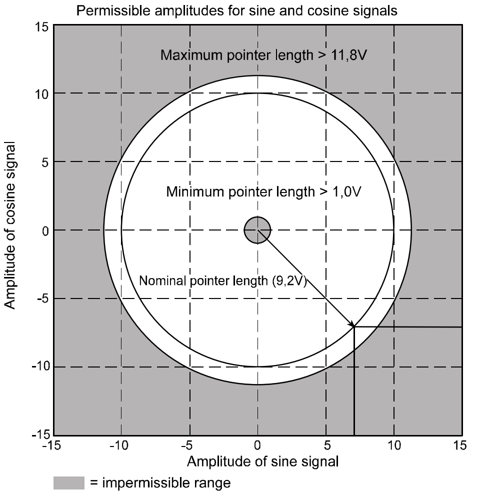
Cause:

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.

$$\text{pointerlength} = \sqrt{\sin^2 + \cos^2}$$

Fig. 12-4: Pointer Length



Dg5004a1_AE.WMF

Fig. 12-5: Correct Signal Amplitude

Example:

Ucos = -6.5 V
Usin = 6.5 V

$$Pointerlength = \sqrt{(\ \ 6,5V)^2 + 6,5V^2}\quad 9,2V$$

Remedy:

1. Check the measurement system cable.
2. Check the measurement system.

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)

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.

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 (Mat. No. 257101)

CAUTION

Malfunction in the control of motors and moving elements

Equipment damage can occur.
Turn off the power supply. Make sure the equipment is not 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 encoder**“ 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.

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.”

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.

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 Encoder Monitoring 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 encoder monitoring 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 Customer Service.

F277 Current measurement trim wrong

This error can occur only when the drive controller is tested at the Rexroth factory.

Measurement of the current within the drive controller is precisely calibrated in the Rexroth 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.

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.

F288 Error during firmware update of EMD Module firmware

Description:

An error occurred during the Firmware update for the EMD Module. After checking the remedy in the drive controller, clear the error and switch from Parameter to Manual Mode again and check if the error recurs.

Cause:

- Error while clearing the flash memory
- Error during flash memory programming
- Error during flash memory checksum
- Address switch on the EMD Module is set incorrectly.
- Communication Timeout
- The supply voltage for the EMD Module was turned off

Remedy:

Please check the following:

1. the EcoX bus
2. the position of the address switches at the EMD module (to accept the new address please cut off the supply voltage at the EMD module and switch it on again)
3. the correct supply voltage of the EMD modules

Then proceed as follows:

1. Clear the error message in the drive controller.
2. Switch form phase 2 to phase 3.
3. Make a test to see whether the error is generated again. If yes, the electronic module may be damaged and will have to be replaced.

F291 Timeout in EMD Module

The EMD Modules send the inputs to the base unit in a cyclic telegram. If this telegram is not sent for 2 cycles, Error F291 is generated. The telegram cycle time is dependent on the number of slaves on the EcoX-Bus.

The following is valid:

Cycle Time = (Number of Slaves +1) ms.

Cause:

1. Address switch on the EMD Module is set incorrectly.
2. Faults on the EcoX Bus.
3. EcoX Bus is incorrectly wired.
4. The supply voltage for the EMD Module was turned off

Remedy:

1. Check the address switch on the EMD Module (for the new address to be accepted, the supply voltage must be turned on and then off at the EMD Module).
2. Check EcoX Bus
3. Check the wiring of the EcoX bus
4. Check the supply voltage for the EMD Modules.

F292 Overtemperature in EMD Module

The temperature of the EMD Module has risen to an unacceptable level. As soon as the temperature error threshold is exceeded, the outputs are immediately turned off and the error is generated in the base unit.

Cause:

- The EMD Module ventilation is inadequate.
- The specifications for the EMD Module are not adhered to; therefore, an overload occurs.

Remedy:

- Ensure adherence to the specifications.

F294 Timeout in EcoX Slave

The EcoX Slave sends a cyclic telegram to the EcoX Master. If this telegram is not sent for 2 cycles, and the controller is enabled, Error F294 is generated in the Master. The telegram cycle time is dependent on the number of slaves on the EcoX-Bus. The following is valid:

Cycle Time = (Number of Slaves +1) ms.

When the error is cleared, the EcoX Bus is re-scanned. If the EcoX Slave is still not present, Warning E296 is entered.

Cause:

1. EcoX Bus is incorrectly wired.
2. The EcoX Bus parameters are not set in the EcoX Slave/Master.
3. Faults on the Bus.
4. The supply voltage for the EcoX Slaves was turned off

Remedy:

1. Check the wiring of the EcoX bus
2. Check EcoX Bus
3. Check parameter settings.
4. Check the supply voltage for the EMD Modules.

F296 Number of EcoX Slaves incorrect

In Parameter **B014, EMD Configuration** the number of EcoX slaves has to be entered. If the master notices that the number of EcoX slaves does not correspond with the parameterized value when scanning the slaves, warning **E296 Number of EcoX slaves incorrect** is generated.

The EcoX master cyclically scans the EcoX slaves until their number corresponds with the parameterized number of EcoX slaves. If **warning E296** is activated and you try to set the controller enable signal, **error F296** is generated.

Cause:

1. The EcoX bus has not been correctly wired
2. The EcoX bus has not been parameterized in an EcoX slave and/or master
3. The EcoX bus is disturbed
4. The supply voltage of the EcoX slaves was cut off

Remedy:

1. Check the wiring of the EcoX bus
2. Check parameterization
3. Check the EcoX bus
4. Check supply voltage of the EMD modules

F297 Error in EcoX Slave

If an error (e. g. **F292 Overtemperature in EMD module**) occurs in an EcoX slave, this is communicated to the EcoX master via the EcoX interface. Error **F297** is then generated in the EcoX master.

Cause:

- An error occurred in an EcoX slave.

Remedy:

- Remedy the cause of the error in the EcoX slave. Then delete the error message in the EcoX slave and in the EcoX master.

F386 No ready signal from supply module

Cause:

Input BbN "Power supply ready“ on the drive controller is at 24V, i.e., the connected power supply is not issuing a ready signal.

F407 Error during initialization of master communication

An error occurred during initialization and verification of command communications card (DIO1.1/PBK2).

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

F408 Fatal error of the interface card

Communication with the DIO1.1 parallel interface card of the DKC21.3 respectively with the Profibus interface card of the DKC03.3 has been disrupted.

Cause:

- DIO/PBK2 Card not properly seated
- Impermissible memory access occurs.

Remedy:

- Check card seating
- Switch unit off and on. If error still pending, replace hardware.

F411 Double SST failure shutdown

Description:

The EcoX master cyclically sends the synchronization and command value telegram (SST). If it fails for 2 cycles, warning **E411** is generated. The cycle time for the SST is 500 µs. If controller enable has been set and the SST fails for 2 cycles, error **F411** is generated instead of warning **E411**.

Cause:

1. The EcoX master has been switched to phase 2
2. The EcoX bus has not been correctly wired
3. The EcoX bus is disturbed
4. The EcoX bus has not been parameterized in the EcoX master
5. The supply voltage of the EcoX master has been cut off

Remedy for...:

1. Switch EcoX master to phase 3 or phase 4
2. Check the wiring of the EcoX bus
3. Check the EcoX bus
4. Check parameterization
5. Check supply voltage of the EcoX master

F434 Emergency-Stop

Actuating the emergency stop switch has caused the drive to execute the emergency stop function set via **Parameter A119, Best possible deceleration**.

Cause:

The emergency stop switch was detected.

Remedy:

Eliminate the malfunction that has caused the emergency switch to be activated, and clear the error.

See also functional description for: "Emergency stop function."

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, Positive travel limit** exceeded.

Remedy:

1. Verify **Parameter A104, Positive travel limit**.
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 threshold** is used to implement a hysteresis function.

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, Negative travel limit** exceeded.

Remedy:

1. Verify Parameter **A103, Negative travel limit**.
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 threshold** is used to implement a hysteresis function.

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.

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.

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.

F822 Encoder 1 failure: Signal amplitude wrong

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.

$$\mathrm{pointerlength} = \sqrt{\sin^2 + \cos^2}$$

Fig. 12-6: : Pointer Length

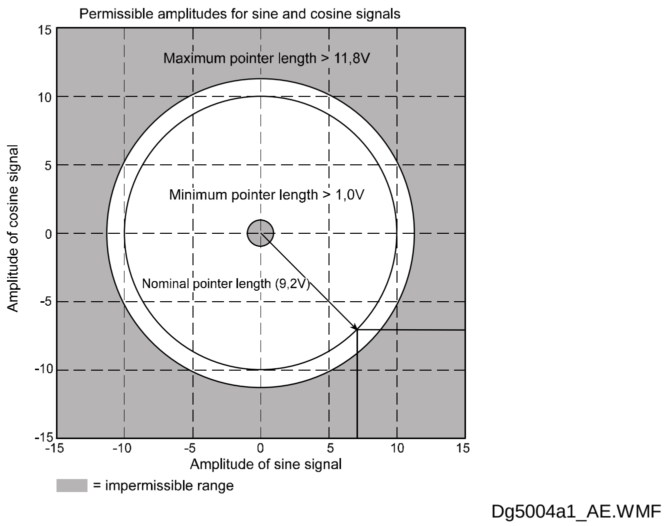


Fig. 12-7: Correct Signal Amplitude

Example:

Ucos = -6.5V

Usin = 6.5V

$$Pointerlength = \sqrt{(-6{,}5V)^2 + (6{,}5V)^2} = \quad 9{,}2V$$

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.

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.

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.

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.

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.

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.

12.2 Warning Diagnostics for Amplifier E. ..

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.

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 stall current, 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.

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 deceleration** 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.

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).

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.

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.

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

E259 Command velocity limit active

The velocity command value is limited to the value present in Parameter **A106, Maximum velocity**.

Cause:

Parameter **A106, Maximum velocity** set too low.

Remedy:

Check parameter and program.

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

E263 Velocity command value > limit S-0-0091

Cause:

The **maximum velocity** stipulated was greater than the permissible value.

Remedy:

The value is limited to that given in Parameter **A106, Maximum velocity**.

E267 Hardware synchronization defective

Drive control in the EcoX slave is synchronized to the EcoX bus via a phase control loop. In order to enable the EcoX slave to synchronize to the master, the master has to be in phase 3 or 4. The correct synchronization function is monitored in the EcoX slave as of phase 4. If the average divergence is greater than 5 µs, warning **E267** is generated. If controller enable has been set, error **F267** is generated.

Cause:

1. The EcoX-Bus has not been parameterized in the EcoX master
2. The EcoX master is in phase 2
3. The EcoX bus is disturbed
4. The supply voltage of the EcoX master was cut off

Remedy:

1. Check parameterization
2. Switch EcoX master to phase 3 or phase 4
3. Check EcoX bus
4. Check supply voltage of the EcoX master

E288 Firmware update of EMD Module active

If the Firmware of the drive controller has been replaced and the Firmware of the EMD module has changed, the Firmware is automatically updated when progressing from phase 2 to phase 3. During this time **warning E288** is displayed.

Note: If an error occurs during the Firmware update, the message. **F288, Error during firmware update of EMD module** is displayed.

Cause:

The Firmware in the EMD module does not match the Firmware in the drive controller.

Remedy:

After the Firmware update the warning is automatically cleared.

E289 Waiting for scan by EcoX Master

During the command to transition from Phase 3 to Phase 4, the EcoX Slave is tested to determine whether or not it was scanned by the EcoX Master. The warning is automatically reset after the scan takes place.

Cause:

1. The EcoX bus has not been parameterized in the EcoX slave and/or master
2. The EcoX master is in phase 2
3. The EcoX bus is disturbed
4. The EcoX bus has not been correctly wired
5. The supply voltage of the EcoX slaves has been cut off

Remedy for:

1. Check parameterization(s)
2. Switch EcoX master to phase 3 or phase 4
3. Check the EcoX bus
4. Check the wiring of the EcoX bus
5. Check supply voltage of the EMD modules

E291 Timeout in EMD Module

Description:

The EMD Modules send the inputs to the base unit in a cyclic telegram. If this telegram is not sent for 2 cycles, Warning **E291** is generated.

The following is valid:

Cycle Time = (number of slaves +1) ms.

If drive enable is set, Error **F291** is generated in place of the warning.

Cause:

1. Address switch on the EMD Module is set incorrectly.
2. Faults on the EcoX Bus.
3. EcoX Bus is incorrectly wired.
4. The supply voltage for the EMD Module was turned off.

Remedy:

1. Check the address switch on the EMD Module (for the new address to be accepted, the supply voltage must be turned on and then off at the EMD Module).
2. Check EcoX Bus
3. Check the wiring of the EcoX bus
4. Check the supply voltage for the EMD Modules.

E293 Undervoltage in EMD Module

Cause:

The EMD modules of the EcoX bus have a supply voltage of 24 V. If this voltage drops below 17 V, the undervoltage is signaled at the EMD module by a red LED (H2) and the warning **E293** is generated.

Remedy:

Check the power supply or increase the voltage to the rated voltage of 24 V.

E296 Number of EcoX Slaves incorrect

The number of EcoX Slaves must be entered in **Parameter B014, EMD Configuration** for the EcoX Master. If the master notices that the number of EcoX slaves does not correspond with the parameterized value when scanning the slaves, warning **E296** is generated. The EcoX master cyclically scans the EcoX slaves until their number corresponds with the parameterized number of EcoX slaves. If warning **E296** is activated and you try to set the controller enable signal, error **F296** is generated.

Cause:

1. The EcoX bus has not been correctly wired
2. The EcoX bus has not been parameterized in an EcoX slave and/or master
3. The EcoX bus is disturbed
4. The supply voltage of the EcoX slaves was cut off

Remedy for...:

1. Check the wiring of the EcoX bus
2. Check parameterization
3. Check EcoX bus
4. Check supply voltage of the EMD modules

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 occurred?

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 Customer Service. Explain precisely under what circumstances the error occurred. The firmware should be replaced.

"E3 " Display

E408 Invalid addressing of MDT Data container A

During data communication within the system, an error has occurred. If the error continues to occur after the system has been shut down and restarted several times, the parameter default values must be reset. (see also Startup chapter). The default values can then be overwritten with the specific system parameters.

E411 Double SST Failure

The EcoX master cyclically sends the synchronization and command value telegram (SST). If it fails for 2 cycles, warning **E411** is generated. The cycle time for the SST is 500 µs. If controller enable has been set and the SST fails for 2 cycles, error **F411** is generated instead of warning **E411**.

Cause:

1. The EcoX master has been switched to phase 2
2. The EcoX bus has not been correctly wired
3. The EcoX bus is disturbed
4. The EcoX bus has not been parameterized in the EcoX master
5. The supply voltage of the EcoX master has been cut off

Remedy for...:

1. Switch EcoX master to phase 3 or phase 4
2. Check the wiring of the EcoX bus
3. Check the EcoX bus
4. Check parameterization
5. Check supply voltage of the EcoX master

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.

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.

12.3 Command Diagnostics C.. ., D. ..

C100 Communication phase 3 transition check

The **C100 Communication phase 3 transition check** command has been activated.

C200 Communication phase 4 transition check

Definition

The **C200 Communication phase 4 transition check** command has been activated. A switch from Parameter Mode to Manual or Automatic.

"C2" Display

C201 Invalid Parameters

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.

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.

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.

C204 Motor type Parameter CM00 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.

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.

C210 Feedback 2 required

Cause:

Values were entered in **Parameter A100, Type of application** which make an optional encoder necessary. However, a 0 (for not available) is entered in **Parameter C004, Interface, feedback 2**.

Remedy:

Correct Parameter **A100, Type of application**

Correct Parameter **C004, Interface, feedback 2**

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

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.

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.

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.

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.

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.

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.

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 message is generated if an additional optional encoder (encoder 2) is present and being evaluated (Parameter **C004, Interface, feedback 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 measurement system.

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
- 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 the complete drive controller.

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
- Error in the measurement system micro-controller
- with DAG 1.2: error, external 24V set for SSI interface

Cause:

1. Defective opt. encoder cable
2. Defective encoder
3. Defective measurement system interface

Remedy:

For 1. Check opt. encoder cable.

For 2. Replace encoder.

For 3. Replace the measurement system interface (module).

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.

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.

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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.

C234 Encoder combination not possible

Cause:

The encoder interface that has been selected in Parameter **C004, Interface feedback 2**, cannot be supported by the drive; since it has already been allocated to the motor encoder.

Remedy:

Select another **optional** encoder.

C235 Load-side motor encoder with inductance motor only

Cause:

The functionality of the optional encoder can be defined in Parameter **A100, Type of application**. 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, Type of application**.

C300 Set absolute measuring

The **Set absolute encoder** function was activated via **Parameter C010, Homing**.

"C3" Display

C301 Setting absolute encoder not possible when RF set

Cause:

The “C3 Command, set absolute encoder emulator“ was initiated in response to the current drive enable signal.

Remedy:

Terminate the command and deactivate the drive enable signal.

C302 Absolute measuring system not installed

The command in **Parameter C010, Homing "Set absolute encoder"** 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.

C400 Switch to Parameter Mode

Parameters can be written only in Parameter Mode, so switch to Parameter Mode prior to editing parameters.

"C4" Display

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.

"C5" Display

C600 Drive-controlled homing procedure command

The **homing command** is activated via a command or an input.

See also functional description for: "Homing."

"C6" Display

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."

C602 Distance home switch – reference mark erroneous

Cause:

The 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, Home switch offset**.

See also functional description for: "Configuration of the home switch"

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 encoder for Homing**.

If the encoder was homed using the "**Set absolute encoder**" command, the homing command can be used to initiate a return to the reference point.

Remedy:

Home the absolute encoder using the **"Set absolute encoder"** command.

See also functional description for: "Possible error messages with drive-controlled homing."

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:

In Parameter **C009, Homing Configuration**, reduce the homing velocity.

See also functional description for: "Homing."

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.

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"

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 Customer Service, and enter the parameters.

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.

C704 Parameters not copyable

Cause:

The existing default parameters are not compatible with this software version.

Remedy:

Please contact Rexroth. Explain which software version, which device and which motor type you have.

C705 Locked with password

Set default parameters.

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."

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.

C802 Locked with password

Remedy:

Load basic parameters.

See also Section 4: "System Startup"

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.

"d3" Display

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.

D302 Torque/force too small for movement

The command **D3 Commutation Setting** was initialized. 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 Parameter **CM01, Bipolar Torque/Force Limit Value** until the motor can overcome the mechanical resistance and turn. Check, using a **MOM command**, if the Torque/Force Limit Value is too small.
2. Release pinched cables/wires. If necessary, also check the brake.

D400 Command Move to Positive Stop

Using the "**PFA**“ or "**PFI**“ commands, the move to positive stop command is activated. In this process, encoder monitoring is turned off, which would result in a drive error message if the drive were blocked because of a positive stop.

Cause:

The movement to positive stop was activated using the "PFA" or "PFI" commands.

See also Section "Movement to Positive Stop."

"d4" Display

D500 Command Detect Marker Position

An unknown command was invoked.

Cause:

Firmware malfunction.

D501 No incremental measuring system

Cause:

The command was initialized for a measuring system that does not have any real reference marks. Examples are measuring systems like DSF, EnDat, SSI or resolver measuring systems.

Remedy:

Check if the correct encoder is set in Parameter **C009, Homing configuration**.

Implement an encoder system with real reference marks.

D800 Command Measuring Wheel Mode

Definition:

The command is active.

The position loop is closed using Encoders 1 and 2.

Control loop monitoring is deactivated.

Cause:

Measuring Wheel Mode was activated.

See also "Measuring Wheel Mode" in the Chapter entitled Functions.

"d8" Display

D801 Measuring Wheel Mode not possible

Cause:

Measuring Wheel Encoder not connected.

12.4 Diagnostic Status Messages for Amplifier A. ..

A002 Communication phase 2

Parameter Mode.

A003 Communication phase 3

Preparation for communications phase 4 (manual/automatic)

A010 Drive HALT

The input Drive HALT is for stopping an axis using a defined **acceleration** and a defined **jerk**.

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.

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."

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."

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).

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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).

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).

12.5 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.

If an error occurs, E2 is shown in the display.

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

Initializing parameters from non-volatile memory and calculation of the corresponding data, depending on the parameter contents.

Diagnostic Message Display: -4

Initializing and testing **command communications**.

Diagnostic Message Display: -5

Initializing the system control.

Diagnostic Message Display: -6

Starting the system controls.

Diagnostic Message Display: Watchdog ● ● (2 Dots)

Causes:

1. Programming Mode.
2. The processor does not run at all, due to hardware errors.

Remedies:

For 1. Re-load firmware program with the help of REXROTH Customer Service.

For 2. Replace the hardware.

Diagnostic Message Display: E1

Cause:

Processor fault caused by voltage surge, programming error or hardware fault. More information is available via a terminal connected to the RS232 port.

Remedy:

Switch amplifier off and on again; if error is still present, replace hardware. In any case, inform REXROTH Customer Service. Please describe the exact conditions, under which the error occurred.

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 REXROTH 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 REXROTH 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.

12.6 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" (betriebsbereit)

See also: **A013 Ready for power on**

Ab

"Drive is ready" (Antrieb bereit)

See also diagnostic message: **A012 Control and power sections ready for operation.**

Ad

"Input Address" (Adresse eingeben)

Basic Settings via S1, S2, S3. Duration of Display, approximately 20 seconds.
Diagnostic number: 0010

AF

"Drive enable" (Antrieb Freigabe)

The operation mode display HA or AU replaces this one.

AU

“Automatic” (Automatik)

See also: **Automatic**
Diagnostic number : 0004

HA

“Manual” (Hand)

See also: **Manual**
Diagnostic number : 0003

PA

"Parameters" (Parameter)

See also: **Parameter**
Diagnostic number : 0002

Jb

"Jog reverse" (Joggen backward)

Diagnostic number : 0006

JF

"Jog forward" (Joggen forward)

Diagnostic number : 0005

P2

"**<u>P</u>hase <u>2</u>**"

The control is in parameter mode and is checking the parameter data. The power cannot be switched on. See also status message A002.

P3

"**<u>P</u>hase <u>3</u>**"

The control is transitioning from Phase 2 to Phase 4 (Manual or Automatic Mode).
See also status message A003.

P4

"**<u>P</u>hase <u>4</u>**"

The control is in manual or automatic mode.

Normally, this display appears only very briefly.

PL

"Basic Parameter Load" (<u>P</u>arameter <u>L</u>aden mit Basiswerten)

See also: **F209 PL Load parameter default values**

UL

"Basic Load" (<u>U</u>r<u>l</u>aden)

See also: **F208 UL The motor type has changed**

12.7 NC Error Diagnostics F- .. ..

F- 0200 Parameter and automatic input simultaneously

If the 'Parameters' input is activated in Automatic Mode, the following error message is issued. The 'Automatic' input is not monitored in Parameter Mode.

F- 0201 Wrong phase transition

The phase transition in the drive, which is initiated through a mode change from Manual/Automatic Mode to Parameter Mode or vice versa, failed.

Cause:

There is a software error.

Remedy:

Please contact REXROTH Customer Service.

F- 0203 Target position < negative position limit

The target position pre-set in an NC feed command (POA, POI, PFA, PFI, PSA or PSI) is less than the **negative position limit**.

F- 0204 Target position > positive position limit

The target position pre-set in an NC feed command (POA, POI, PFA, PFI, PSA or PSI) is greater than the **positive position limit**.

F- 0205 Stack overflow with JSR command

The nesting for subroutine programming exceeds 16 levels.

Remedy:

- Check program. Every program containing the JSR command that is called must end with an RTS command.
- It is possible that a JSR command was programmed without an RTS.

F- 0206 Stack overflow with RTS command

The nesting for subroutine programming is less than 0 levels.

Remedy:

- Check program. Every program containing the JSR command that is called must end with an RTS command.
- It is possible that an RTS command was programmed without a JSR.

F- 0207 Invalid destination task number

The number of the destination task in the JTK command is not within the range 1 to 3.

F- 0208 Per mil value in ACC command > 999

The value for acceleration and/or deceleration is greater than 999 per mil.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0209 Invalid value in FAK command

The value for the multiplication factor in the FAK command is not within the range 0 to +1.999999.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large or negative. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0210 Feed angle loss

The signal at the input 'Feed angle monitoring' dropped off during a move. See Parameter A116.

F- 0211 Torque > 500%

The value for at least one torque value in the MOM command is greater than 500 percent.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large or negative. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0212 Program run without power

Power is not on!

- In Automatic Mode, a start is triggered without the power being turned on.
- While the program is running in Automatic Mode, the power was switched off.

F- 0213 Measuring Wheel Difference

When Measuring Wheel Mode is active, the slip between the motor encoder and the measuring wheel encoder is greater than the monitoring window set in the parameters. See Parameter A117, 'Encoder Difference Monitoring.'

F- 0214 Wrong BCD information

The bit pattern for the programmed bits is not in BCD-F format for:

- BIC command
- CVT command: changes in bit pattern according to variable

F- 0215 FOL Factor > Max.

The value of the slave factor in the FOL command is greater than 99.999999.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0216 V > 999 Per Mil

The value for the velocity in the commands CON, POA, POI, PFA, PFI, PSA, PSI, SRM, VCC or VMC is greater than 999 per mil.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large or negative. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0217 HOM not allowed

Calling the HOM command is not permitted.

Cause:

1. The motion type "continuous" is set in Parameter A100.
2. The motor encoder is evaluated as an absolute encoder (value "01“ in Parameter C002 Position Encoder Type 1).
3. For the "direct measurement“ function of encoder 2, the optional encoder is evaluated as an absolute encoder (value "01“ in Parameter C005 Position Encoder Type 2).

Remedy:

For 1. Select "linear" or "rotary table“ motion type.

For 2. Enter the value "11" in Parameter C002 for absolute evaluation.

For 3. Enter the value "11" in Parameter C005 for absolute evaluation.

F- 0218 RTM not allowed

Calling the RTM command is not permitted, because the motion type "rotary table" is programmed in Parameter A100.

F- 0219 Wrong variable value

The variable value in an NC command is too large or too small.

F- 0220 Wrong constant value

The constant value in an NC command is too large or too small.

Cause:

- The value is not permitted in the command.
- Data error.

F- 0221 Logic Task Program error

Reading the Logic Task program failed.

Cause:

- No valid program in the Logic Task or the Logic Task was not closed with the "END" command. If the Logic Task is not to be used, an "END" must be in program instruction 0000.
- A Logic Task command uses an output or marker that already exists in a parameter, and therefore has been assigned to a function.

Remedy:

Pre-select Parameter Mode and clear the error message. Check and correct the Logic Task program.

F- 0222 SA1 not allowed

The output of an analog value with the SA1 command via the analog channel AK1 is not possible, because the channel was already set for one output signal of the drive. See Parameters B003 to B005.

Remedy:

Use either the 'SA1' command or the analog output of the drive.

F- 0223 Wrong variable index

In an NC command, an indexed variable (V500...V507, V510...V517) is programmed. However, an invalid variable is accessed.

Cause:

The variables 'Offset Factor' and/or 'Variable Index' are incorrect. The following formulas must be followed:

$$600 \le \left([V50x] + [V509] * [V508] \right) \le 999$$

$$600 \le \left([V51x] + [V519] * [V518] \right) \le 999$$

L: [ ] Contents
L: [V50x] = Contents of V500 – V507
L: [V51x] = Contents of V510 – V517

Fig. 12-8: Limits for indexed variable access

See Chapter 6 'Indexed Variables.'

F- 0224 APZ not allowed

Using the 'APZ' command is not permitted, because Parameter AA11 is not correctly set.

F- 0225 No curve data

For processing an NC function with cams (activation using the 'CSY' command), required data like stroke, angle range or curve shape are still missing. These data must be available to the function **before** activation.

Cause:

The required commands 'CMM,' 'CLG' and 'CAN' were not called in the 'CSY' command before activation.

F- 0226 Control signal bit 1 fault

The function was activated in Parameters AA14 and AA15, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA15 did not correspond to the PLS position. Check input signal and PLSs.

F- 0227 Control signal bit 2 fault

The function was activated in Parameters AA14 and AA16, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA16 did not correspond to the PLS position. Check input signal and PLSs.

F- 0228 Control signal bit 3 fault

The function was activated in Parameters AA14 and AA17, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA17 did not correspond to the PLS position. Check input signal and PLSs.

F- 0229 Control signal bit 4 fault

The function was activated in Parameters AA14 and AA18, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA18 did not correspond to the PLS position. Check input signal and PLSs.

F- 0230 Offset dimension too small

The offset dimension in the ’LAR’ command is too small. It must be longer than twice the distance:

- $A106^2$ / (2*A109)
- resp. indicated in the ’CLG’ command

F- 0300 Invalid I/O number in command instruction

Cause:

An NC command for setting one (or more) output bit(s) uses an output bit that has already been occupied by a parameter or the Logic Task. Double assignment of output bits in the NC program, Logic Task or parameters is not possible.

Remedy:

Use a different available output bit.

F- 0301 I/O status illegal

The bit status indicated in the ’AEA,’ ’AKN’ or ’BCE’ command is not ’0’ or ’1.’

Cause:

- Wrong variable content.
- Data error.

F- 0302 NC instruction number illegal

The destination instruction number indicated in an NC instruction does not fall within the programmed range (instruction 0 to 999).

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large or negative. Possibly caused by access to an incorrect destination variable when using indexed variables.
- The formula for calculating the destination variable is not fulfilled in the 'BIO' command.

Remedy:

Re-save the command with valid values. Check the contents of the variable.

F- 0304 NC command illegal

Invalid NC command, or command not supported by this firmware was processed in the program or manual vector.

Cause:

Data loss.

Remedy:

Check program.

F- 0305 not homed

Calling the commands 'POA,' 'PFA,' 'PSA,' 'SAC,' or 'VCC' is not allowed, because the axis is not homed.

F- 0307 Data loss parameter

The checksums via the parameters are invalid.

Cause:

- Data loss.
- Firmware update was executed. Previously, a different firmware or a different version was loaded.

Remedy:

Pre-select Parameter Mode and clear the error message. Check and correct all parameters. When exiting Parameter Mode, the checksums are recalculated.

F- 0308 AT Failure

The initialization of communication between the drive and NC is not o.k.

Cause:

- Data loss.
- Firmware update was executed. Previously, a different firmware or a different version was loaded.

Remedy:

If possible, pre-select Parameter Mode and clear the error message. Using S1, S2, and S3 on the programming module, execute a 'Load parameters with default values.' (See Chapter 4 'S1 Key on Programming Module.')

If the error continues to occur:

Please contact REXROTH Customer Service. Explain precisely under what circumstances the error occurred. The firmware should be replaced.

F- 0309 NC cycle error

The initialization of communication between the drive and NC is not o.k.

Cause:

- Data loss.
- Firmware update was executed. Previously, a different firmware or a different version was loaded.

Remedy:

If possible, pre-select Parameter Mode and clear the error message. Using S1, S2, and S3 on the programming module, execute a 'Load parameters with default values.' (See Chapter 4 'S1 Key on Programming Module.')

If the error continues to occur:

Please contact REXROTH Customer Service. Explain precisely under what circumstances the error occurred. The firmware should be replaced.

F- 0310 Parameter error

1. A parameter contains invalid data.
2. The contents of a parameter element is too large or too small.
3. The contents of a combination of parameters is not permitted.

Incorrect parameter combinations:

- **A100**: The motion type 'continuous' or 'rotary table' is programmed and in Parameter CM00, a linear motor is pre-selected.
- **A107:** The 'setup velocity' is greater than A106 'Maximum Velocity.'
- **A111**: The 'switching threshold' is greater than A105 'Modulo Value' for A100 Motion Type 'Rotary Table.'
- **AA19**: The 'timeout duration' is set in the parameters, but the press function is not activated in AA12.
- **B009**: 'Serial inputs/outputs' are set in the parameters, but no SIS protocol is pre-selected in B002.

- **B009**: No ’Serial inputs/outputs’ are set in the parameters, but ’serial system control’ is pre-selected in B010.
- **B014:** No ’EMD modules’ are set in the parameters, but ’system control via EMD module’ is pre-selected in B010.
- **C011:** The reference distance is greater than A105 ’Modulo Value’ for A100 Motion Type ’Rotary Table.’
- **C006:** The ’timeout duration’ is set in the parameters, but the press function is not activated in AA12.

F- 0311 Stack correction value > 9

The value for the correction of the subprogram stack level in the ’CST’ command is greater than 9.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large or negative. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0312 Select Parameter Mode

The error message "F- 03 10 – Parameter Error“ was acknowledged. Parameter Mode was not pre-selected.

Remedy:

Activate Parameter Mode and clear the error again. Then correct the incorrect parameters.

F- 0313 Jump interval > 99

The value for the jump interval in the 'BIC' command is greater than 99.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large or negative. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0314 Instruction offset greater than 999

The value for the instruction offset in the 'BIC' command is greater than 999.

Cause:

- For constants: Data loss.
- For variables: Value of the destination variable is too large or negative. Possibly caused by access to an incorrect destination variable when using indexed variables.

Remedy:

Re-save the command with valid values.

F- 0315 BCD selection incorrect

The value for the mode in the 'BIC' command is not within the range 0 to 1.

F- 0316 Systemcontrol Error

The real-time communication to the Fieldbus / BTV04 is interrupted.

Cause:

System control via the fieldbus or via the BTV04 is interrupted in 'Manual' or 'Automatic' Mode.

Remedy:

- **BTV04:**
  - Check grounding of all cables on the DKC.
  - Ground BTV04 housing.
  - Use shielded cables (Motor / Serial Interface).
  - Increase maximum cycle time in Parameter B009.
  - Possibly reduce the 'Answer Delay Time' value (Default = 4ms) in the BTV04.
- **Fieldbus :**
  - Ensure that the fieldbus card connector is correctly inserted.
  - Check the fieldbus cable for errors.
  - Check master.

F- 0317 Serial I/O Error

The cyclic communication to the Fieldbus / BTV04 is interrupted for:

BTV04: In '**Manual**' or '**Automatic**' Mode, and Standard system control (B010), if only the 'serial inputs/outputs' in Parameter B009 are activated.

Fieldbus: In '**Automatic**' Mode with serial system control or via the EMD module (Parameter B010).

Remedy:

- **BTV04:**
  - Check grounding of all cables on the DKC.
  - Ground BTV04 housing.
  - Use shielded cables (Motor / Serial Interface).
  - Increase maximum cycle time in Parameter B009.
  - Possibly reduce the 'Answer Delay Time' value (Default = 4ms) in the BTV04.
- **Fieldbus:**
  - Ensure that the fieldbus card connector is correctly inserted.
  - Check the fieldbus cable for errors.
  - Check master.

F- 0319 NC cycle time exceeded

Too many functions have been activated in parameters or using NC commands. Check all parameters and NC commands.

F- 0320 FW Err. No. nnnn (System Error)

Programming error in the firmware.

Remedy:

Upgrade firmware. In any case, inform REXROTH Customer Service. Please describe the exact conditions under which the error occurred.

F- 0321 NC Variable Number illegal

Wrong variable number in NC command.

See Chapter '6.6 – Variable' or description of the related NC command.

F- 0322 SSI-Encoder Error (PLS)

The PLS has been enabled in Parameter N100, but no encoder is attached, or the encoder type was incorrectly input in Parameter C017.

Remedy:

Check parameters, check encoder, check wiring.

F- 0323 PLS speed > N109

The velocity of the absolute encoder for the PLS is greater than input in Parameter N109.

Remedy:

Check parameter and encoder velocity.

F- 0324 Function terminated

- NC program was stopped during an active cam.
- Mode change was executed during an active cam.

F- 0325 Mode unauthorized

Calling the ’CMM’ command is not permitted, because

- a function is already active in a different mode.
- an invalid master axis is selected for the chosen function.
- an invalid curve profile is selected.

12.8 NC Warning Diagnostics E- .. ..

E- 0100 Velocity = 0

"Jog forward" or "Jog reverse" is active.

Cause:

Using Velocity Override, a velocity of 0 is pre-set by:

- Override activation in Parameter AA04.
- VEO command or positioning command with velocity = 0 in NC Task 3.

E- 0102 'Jog+' & 'Jog-'

Both inputs "jog forward" and "jog reverse" are activated. Jogging occurs, when only one of the two signals is activated.

E- 0103 Outputs overloaded

At least one output at connector X210 of the DKC21.3 is overloaded or shorted.
See project planning information.

E- 0104 System control offline

The real-time communication to the BTV04 is interrupted in

'**Parameter**' Mode

Remedy:

- Check grounding of all cables on the DKC.
- Ground BTV04 housing.
- Use shielded cables (Motor / Serial Interface).
- Increase maximum cycle time in Parameter B009.
- Possibly reduce the 'Answer Delay Time' value (Default = 4ms) in the BTV04.

E- 0105 No serial I/O

The cyclic communication to the BTV04 is interrupted in '**Parameter**' Mode for standard system control (B010), if only the 'serial inputs/outputs' in Parameter B009 are activated.

Remedy:

- Check grounding of all cables on the DKC.
- Ground BTV04 housing.
- Use shielded cables (Motor / Serial Interface).
- Increase maximum cycle time in Parameter B009.
- Possibly reduce the 'Answer Delay Time' value (Default = 4ms) in the BTV04.

E- 0106 Jog, Position < Limit

Reverse jogging is not possible. The 'negative position limit value' has been reached or exceeded.

Remedy:

Move the axis with the signal 'jog forward' into the motion range.

E- 0107 Jog, Position > Limit

Forward jogging is not possible. The 'positive position limit value' has been reached or exceeded.

Remedy:

Move the axis with the signal 'jog reverse' into the motion range.

E- 0108 IDS01 – Timeout

The Interface to the IDS-01 decade switch is interrupted.

Cause:

- IDS-01 Power Supply.
- Cable Connection.
- Parameter settings for the Interface.

E- 0109 Load default values

Default values are loaded. Triggered by S1 probe with the Address 97-99 or via an interface command.

E- 0110 Jog, no power

In Manual Mode, one of the inputs 'Jog forward' or 'Jog reverse' was applied when the power was off.

12.9 NC- Status Diagnostics A- .. ..

A- 0007 Stop is active

No voltage at the Stop input X210/4 or the automatic program was stopped using a Stop command (JST).

A- 0008 Manual vector program is active

The Manual Vector program in Parameter AA01 is currently being processed.

A- 0009 Function interrupt is active

24V not present at input programmed in Parameter A116.

A- 0011 Feed rolls open

In Parameters AA05 and AA06, the function ’Open feed rolls’ was activated and the output for opening the feed rolls is currently active, based on the PLS position or the input state.

A- 0012 Press Timeout

In Parameter AA19, press monitoring is active. No signal change for the feed area (Parameter A116) occurred during the set time (Parameter AA19).

A- 0013 Waiting for Feed Angle

The signal at input ’Feed angle monitoring’ (feed angle) is not present. See Parameter A116.

A- 0026 Control signal bit 1 invalid

The function was activated in Parameters AA14 and AA15, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA15 did not correspond to the PLS position. Check input signal and PLSs.

A- 0027 Control signal bit 2 invalid

The function was activated in Parameters AA14 and AA16, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA16 did not correspond to the PLS position. Check input signal and PLSs.

A- 0028 Control signal bit 3 invalid

The function was activated in Parameters AA14 and AA17, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA17 did not correspond to the PLS position. Check input signal and PLSs.

A- 0029 Control signal bit 4 invalid

The function was activated in Parameters AA14 and AA18, to compare PLS positions with a particular state of an input signal. The state of the input signal from Parameter AA18 did not correspond to the PLS position. Check input signal and PLSs.

13 Connectors

13.1 DKC21.3

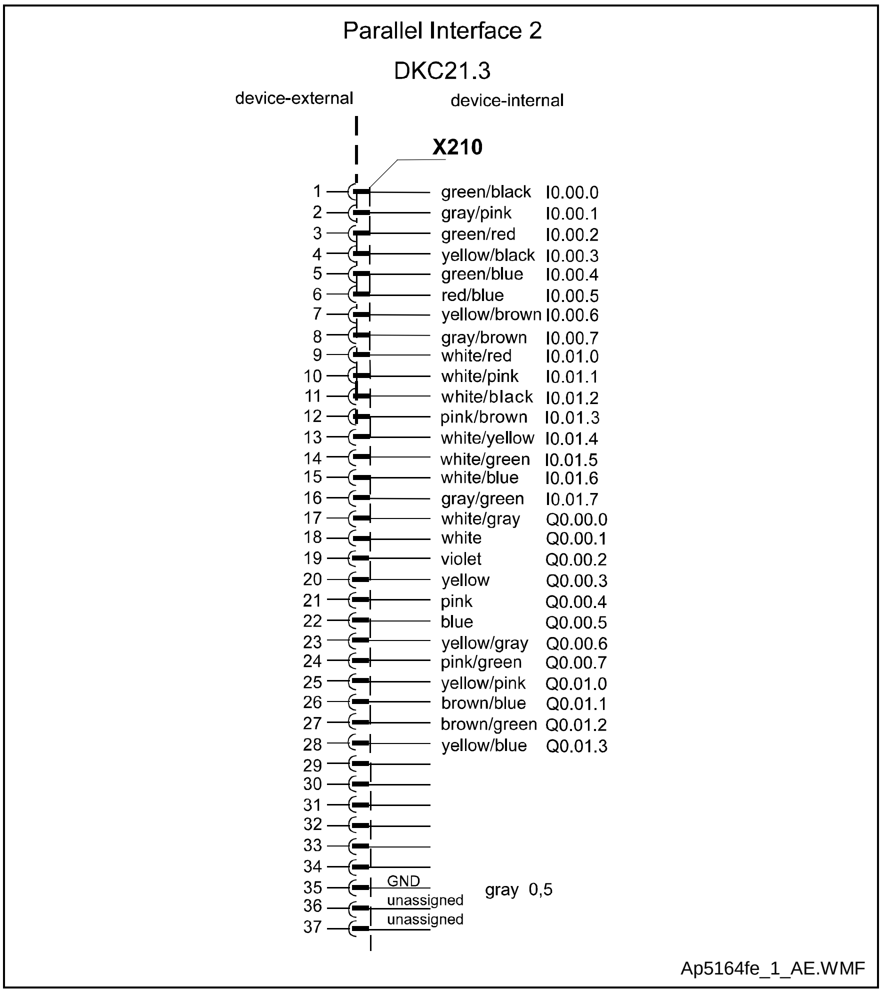


Fig. 13-1: X210 Connector for DKC21.3 with IKS4037 Cable Colors

Pin		Inputs	Pin		Outputs
1	I0.00.0	Parameters	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			

13.2 DKC21.3 and DKC3.3

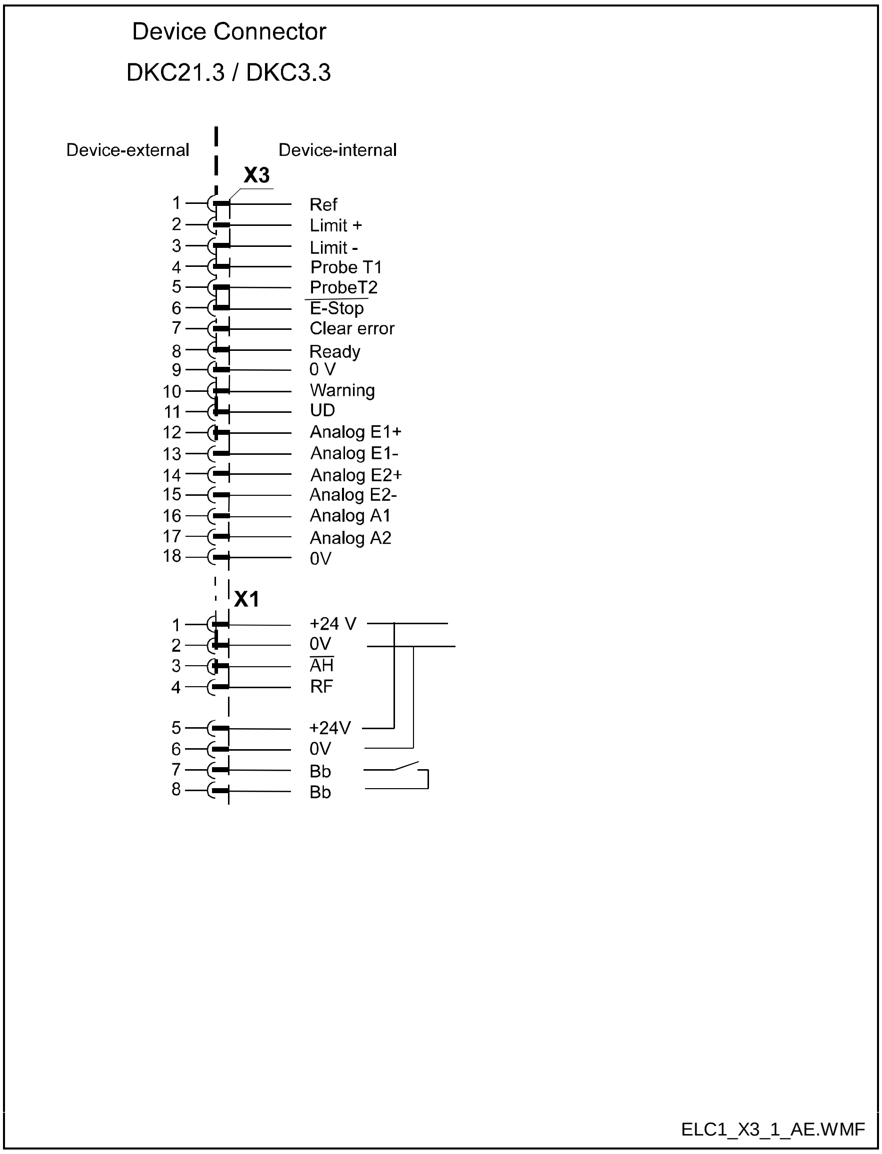


Fig. 13-2: Connector X3

13.3 Press Encoder

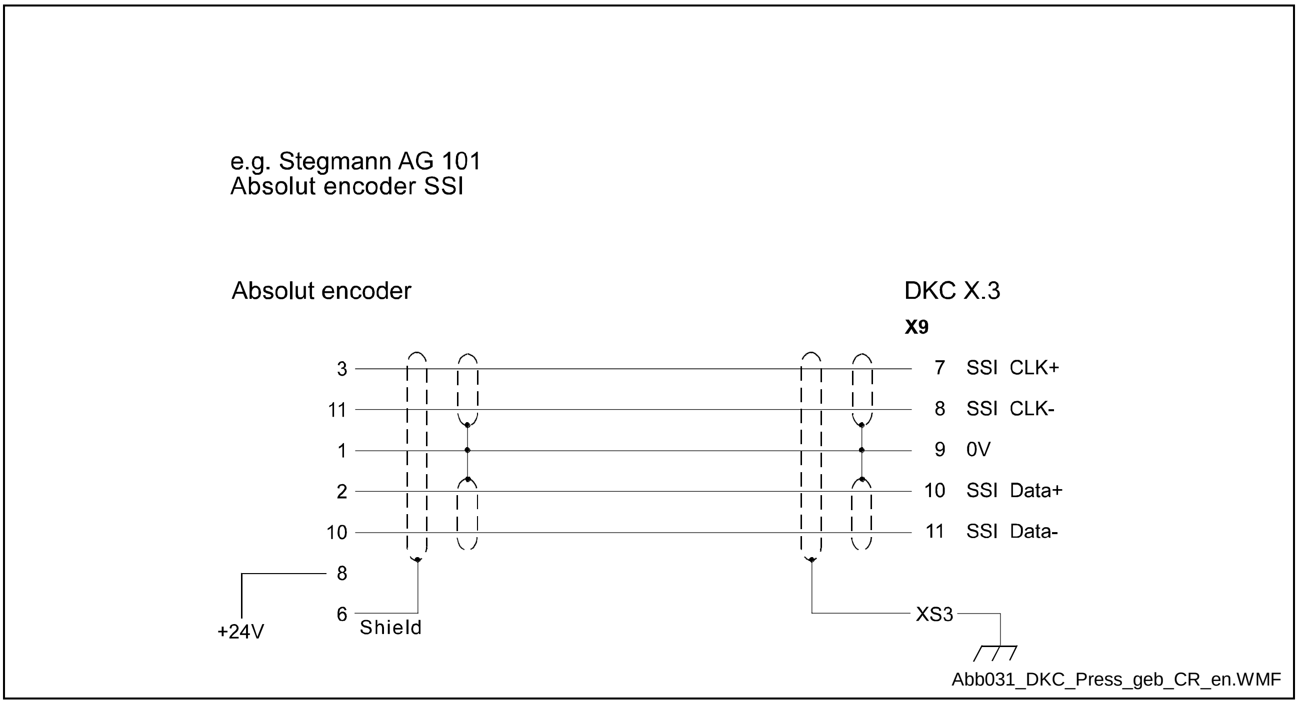


Fig. 13-3: Press Encoder

Notes

14 Display

14.1 BTV04

The control will be programmed using the serial interface. For this purpose, two different accessories are available.

MotionManager PC-Windows Program

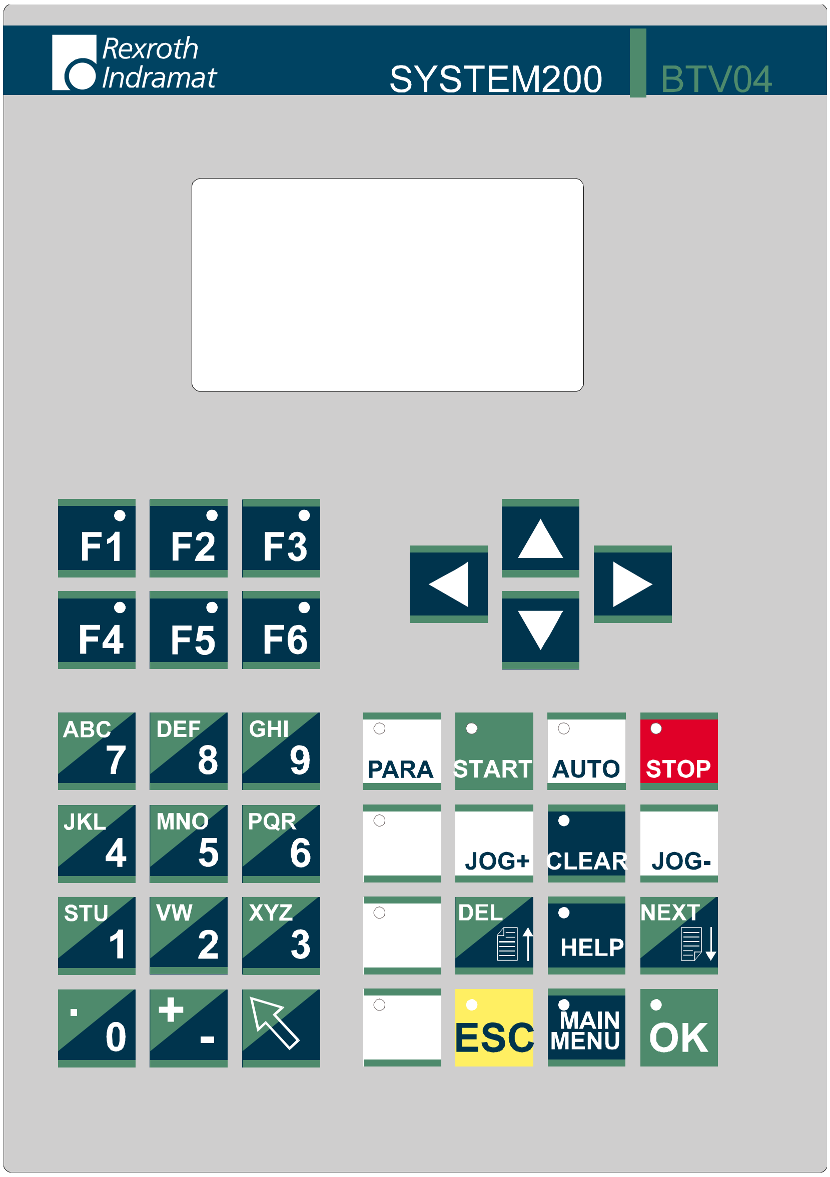
or

BTV04 – Operator Console

A specific user program can be created, or a BTV04 preconfigured with the firmware

FWA-BTV-ELC-01VRS

and the functions described below can be used.



btv04_COL.WMF

Fig. 14-1:Front Panel

Parameter Settings

BTV04 Basic Settings

Pressing "Shift + F6" enters the parameter setting function of the BTV04. Pressing F1 sets the serial interface parameters.

F2 Serial Port X2 (RS 485)	
Baud Rate	9600 (19200)
Parity	off
Protocol	SIS Master
F3 Serial Port X3 (RS 232)	
Address	3
Baud Rate	9600
Parity	off
Protocol	ASCII + SIS

Fig. 14-2: BTV04 Interface

PC->BTV04->DKC Push-Through Operation

It is possible to push the serial communication from the PC and DKC through to the BTV04 via the second interface connection. For this type of operation, hard-wiring of the interface between the BTV04 and the DKC can remain intact. In such a case, no changes are required to the interface settings, as long as the communication between the BTV04 and the DKC is already functioning.

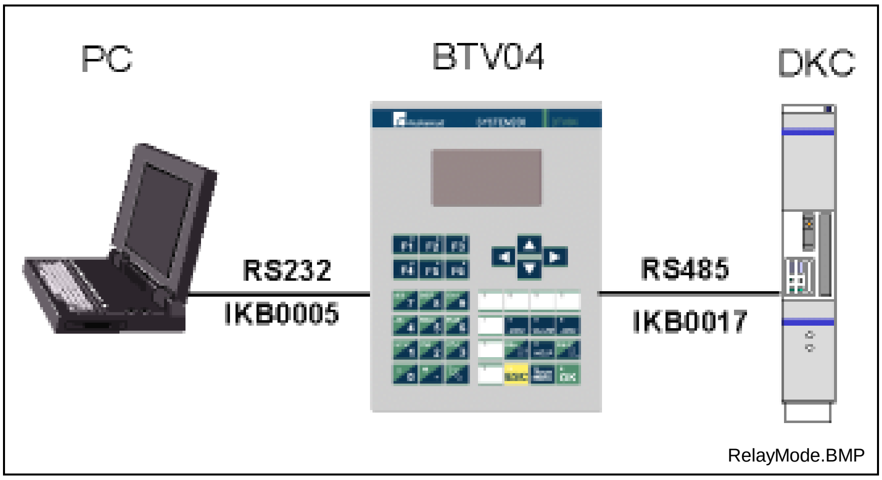


Fig. 14-3: Connection

Switching Between the User Interface and the Programming Displays

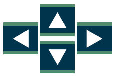
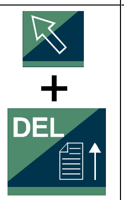
User Interface → Programming Displays

SHIFT-HELP

Programming Displays → User Interface

Press this key twice MAIN MENU

BTV04 Key Descriptions

Keys	
Symbol	**Definition**
	F1 to F6 are function keys which are used to select menus or display levels.
	The arrow keys enable navigation inside a screen or activation of input fields. When inputting parameters, they also perform additional functions for scrolling through parameter groups.
	The page keys allow paging through screen contents. This function significantly simplifies working in nested menus. In the windows where NC instructions, parameters, logic task instructions or variables are displayed, the running selection number is incremented by one when a key is pressed.
	The alphanumeric keypad allows data input and loading/saving products in the BTV04 Product Administration. To compose the character "B," for example, the character key must be pressed twice while holding the SHIFT key; to compose the character "C," the character key must be pressed 3 times, etc. When releasing the Shift key, the cursor moves one space to the right.
	CLEAR – Using the CLEAR key, error messages are cleared. To clear an error, it must first have been eliminated, otherwise the error screen will continue to be displayed.
	While in the DELETE function, holding down SHIFT and pressing the DEL key at the same time leads to deleting the entire entry.
	HELP – If an 'H' is shown on the display, a help screen can be called up.
	ESC – Jump to previous menu. Cancel functions or data input.
	MAIN MENU – Leave the current screen and return to the Main Menu.
	OK – Data input is accepted and saved only by pressing the OK key. Switching to another screen does not automatically save data. Note: As long as a data input has not been saved, it is shown in italics.

Key Combinations with SHIFT	
Symbol	**Definition**
SHIFT+F6	Calls the BTV Parameter Menu. For details, see "BTV Parameters“
SHFIT+ESC	Causes a re-boot of the BTV04. This key combination is equivalent to turning the BTV04's 24V power supply off and then on again.

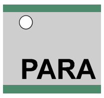
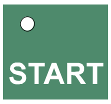
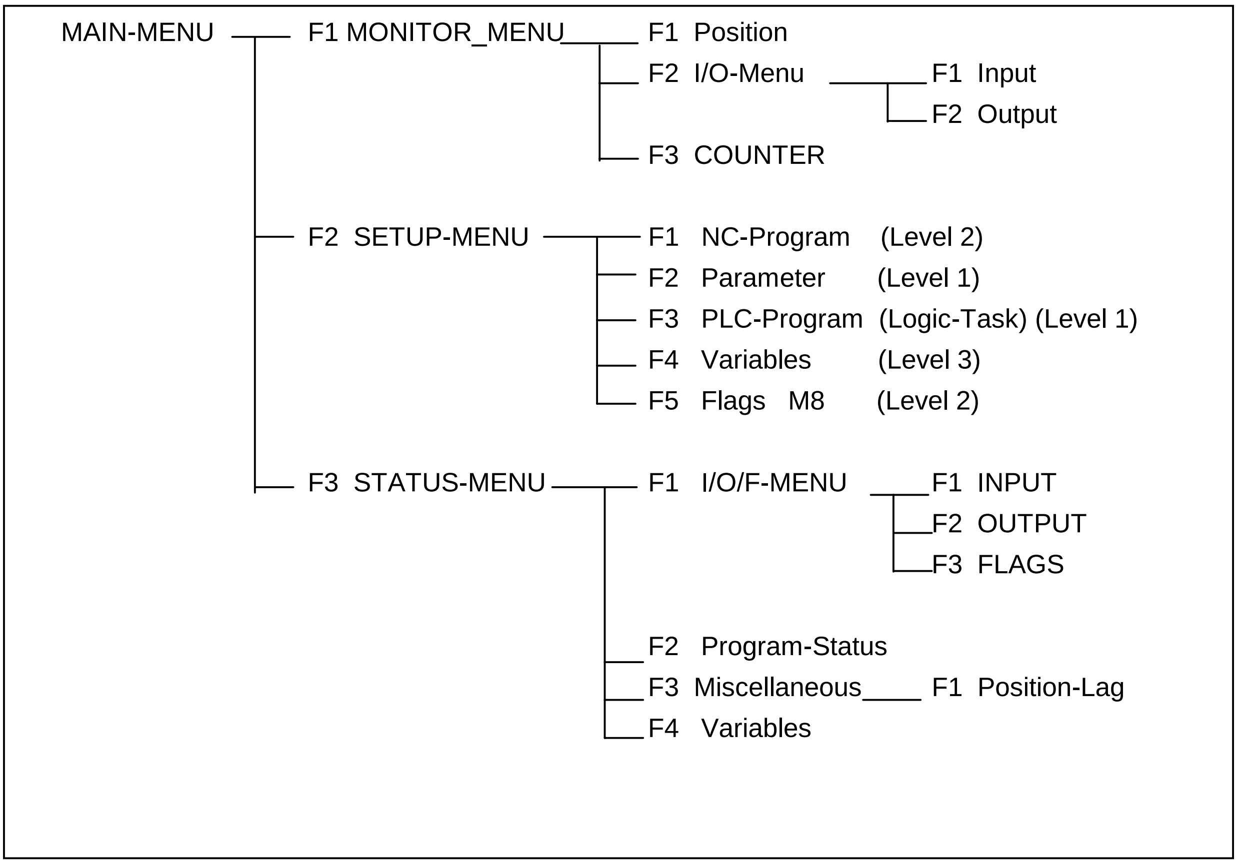
The following keys are active only when "Serial System Control" (Parameter B010) is active.	
	PARA – The controller switches to Parameter Mode. Pressing the key again closes Parameter Mode. The controller then has a status of "Ready" or "Manual."
	START – When the system is in "Automatic" Mode, pressing this key starts the program. In Manual and Parameter Modes, this key has no function.
	AUTO – The system switches to "Automatic" Mode. Pressing the key again cancels Automatic Mode.
	STOP – Causes an immediate stop of the system The equipment is stopped as soon as possible, without completing the current movement. The system may only be restarted when the error source has been eliminated.
 	JOG-/JOG+ - In Manual Mode, a movement in the positive or negative direction takes place. Movement occurs by pressing the keys and is stopped by releasing the keys.

Fig. 14-4: Key Labels

14.2 Programming Displays

BTV04 Display Menu



Main Menu

```
 FWA-BTV04 ELC 01V08

     ELC/FLP ADDRESS

           5


MAIN-MENU          (OK)
```

After startup, the BTV04 always first asks for Control Address 5. If it is detected, this menu is not shown.

If the address is not preselected, the BTV04 issues a transmission error. This message must be cleared by repeatedly pressing the ESC key. Then, this menu is displayed, and the controller address must be entered. After confirming by pressing OK, the display switches back to the main menu.

```
Manual                    .
    MAIN MENU
    DKCxx.x–xxx-x
 ECODR3–XXX–xxVxx

MONITOR-MENU       (F1)
SETUP MENU         (F2)
STATUS-MENU        (F3)
```

Status Line

e.g. DKC3.3-040-7

e.g. ECODR3-FLP-04V03

Monitor - Menu

```
Manual                    .
    MONITOR-MENU



POSITION           (F1)
I/O-MENU           (F2)
COUNTER            (F3)
```

Status Line

selected menu

Position

```
Manual                      .
        VELOCITY:
        +0000.09

   RELATIVE POSITION
      +084225.090

CLEAR POSITION          (0)
```

Axis position

I/O Menu

```
Manual                      .
      I/O MENU




INPUT                   (F1)
OUTPUT                  (F2)
```

```
Manual                      .
      INPUTS
 I0.00   00000000
 I0.01   00000000
 I1.00   00000000
 I1.01   00000000
 I1.02   00000000
```

Bit 7 Bit 0

By pressing the Cursor key, the next input bit can be displayed and by pressing the Page keys, the next 4 input bytes can be displayed.

```
Manual                    .
        OUTPUTS
 Q0.00    00000000
 Q0.01    00000000
 Q1.00    00000000
 Q1.01    00000000
 Q1.02    00000000
```

Bit 7 Bit 0

Counter

```
Manual                    .
        COUNTER

LINE NUMBER : 0

TOTAL COUNT :
ACT.COUNT   :
```

If an NC instruction number that contains a counter command (COU, BAC) is entered here, the target and actual counts are shown.

Setup Menu

```
Manual                              .
       SETUP - MENU


NC-PROGRAM              (F1)
PARAMETER               (F2)
PLC-PROGRAM             (F3)
VARIABLES               (F4)
FLAGS M8                (F5)
```

NC Program

```
Manual                              .
       NC-PROGRAM    'H'
 0     NOP






        No Operation
```

Instruction number
and Command

or

```
Manual                              .
       NC-PROGRAM    'H'
999    PSA
1      +000500.000
 999

Positioning, Absolute
 with In–Position
```

Command Contents

Command
Description

If the cursor is positioned

- on the command, the “up” and “down” cursor 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" cursor keys. In addition, the description of this input field is shown in the last two lines.
- at the beginning of the input field, and a variable should be programmed, which can occur by directly entering the letter "V."

Parameters

```
Manual                 .
     PARAMETER      'H'
A1   0
0  1


     Application Type

```

Parameter Number

Parameter Description

```
Manual                 .
     PARAMETER      'H'
A1   0
0  1


     Motion Type

```

Parameter Number

Description 1st element

```
Manual                 .
     PARAMETER      'H'
A1   0
0  1


     Function of Encoder2

```

Description 2nd element

If the cursor is positioned on

- the parameter block (A1, AA, B0; C0, CR, CM, N1), the “up” and “down” cursor keys scroll through the block.
- the parameter number, the “up” and “down” cursor keys increment or decrement the number. In addition, the description of the parameter function is shown in the last two lines.
- 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" cursor keys. In addition, the description of this input field is shown in the last two lines.

PLC Program (Logic Task)

```
Manual                         .
   PLC-PROGRAM          'H'

 0000   LD___ I4.00.1
>0001   ST___ Q2.01.1
 0002   END__
```

Any input or changes to the program can only be made in Parameter Mode.

The instruction numbers of the logic task can be directly entered or scrolled using the cursor keys or the page keys.

The definitions are input using the alphanumeric keypad. For inputting letters, the cursor moves to the next space as soon as the Shift key is released. After editing the text, it is saved by pressing OK.

The required input format must be observed and it is tested when exiting Parameter Mode.

Variable

```
Manual                         .
      VARIABLES


V600 +00000000.000000


      V600 ... V999
```

Selecting the variables can be done by directly inputting the variable number or by scrolling using the Cursor keys.

The variables can also be edited in Automatic Mode. When calling up the variable, the current value is read and displayed once. After editing the contents, the new value is saved by pressing OK.

Marker Flag M8

```
Manual                         .
 FLAGS INPUT M8

   M8.01   01010101

  0:  x=0   |  1:  x=1
  2:  x=x   |  3:  x=x̄
     M8.00... M8.19
```

Marker flags 8.xx can be edited "online" using this display.

Selecting the marker flags can be done by directly inputting the marker flag number or by scrolling using the Cursor keys. When calling up the marker flag, the current value is read and displayed once.

The following editing methods are available per bit:

0 = The marker bit is set to the value ’0’

1 = The marker bit is set to the value ’1’

2 = the marker bit is not changed

3 = the marker bit is inverted

Diagnostic Messages

The current system status and the current data are displayed. It is not possible to change the data.

```
Manual                .
    STATUS - MENU



I/O/F MENU          (F1)
PROGRAM-STATUS      (F2)
VARIOUS             (F3)
VARIABLES           (F4)
```

I / O / F - Menu

```
Manual                .
    I/O/F MENU




INPUT               (F1)
OUTPUT              (F2)
FLAGS               (F3)
```

```
Manual                .
    INPUTS
 I0.00   00000000
 I0.01   00000000
 I1.00   00000000
 I1.01   00000000
 I1.02   00000000
```

Bit 7 Bit 0

By pressing the Cursor key, the next input bit can be displayed and by pressing the Page keys, the next 4 input bytes can be displayed.

```
Manual                    .
      OUTPUTS
Q0.00   00000000
Q0.01   00000000
Q1.00   00000000
Q1.01   00000000
Q1.02   00000000
```

Bit 7 Bit 0

```
Manual                    .
        FLAGS
M0.00   00000000
M0.01   00000000
M0.02   00000000
M0.03   00000000
M0.04   00000000
```

Bit 7 Bit 0

By pressing the Cursor key, the next marker byte can be displayed and by pressing the Page keys, the next 4 input bytes can be displayed.

Program Status

```
Manual                    .
    PROGRAM-STATUS



TASK1:   0000   NOP
TASK2:   0100   POI
TASK3:   0300   AKN
```

Various Functions

```
Manual                     .
     MISCELLANEOUS




POSITION-LAG          (F1)
```

```
Manual                     .
     POSITION LAG
        +000000.001

   RELATIVE POSITION
      +084225.089

CLEAR POSITION        (0)
```

In Mode 0, the 'Relative Position' can be deleted

Variables

```
Manual                     .
     VARIABLES


V600 +00000000.000000


     V600 ... V999
```

Special Displays

This display is called up when the Help key is pressed from the Parameter menu.

```
Manual                     .
      PARAMETER–HELP


PAR.- ERROR           (F1)
DEFAULT-VALUE         (F2)
ACTIVATE N1           (F3)
START–ADR TEXT        (F4)
```

If a parameter error is present, the parameter number of the erroneous parameter is displayed when the **F1** key is pressed.

Pressing **F2** allows default values to be set.

Note: All parameters are overwritten!

As a precaution, another query is performed.

In addition, the system must be in Parameter Mode.

```
Parameter                  .
      !  CAUTION    !
PARAMETERS WILL BE
OVERWRITTEN


OVERWRITE        (OK)
BACK            (ESC)
```

After pressing the OK key, the default parameters are set and the display returns to the Parameter Menu.

Activate N1 **F3**

This way, the PLS positions that were edited during operation can be transferred.

Start Adr. Text **F4**

On the first line, the start instruction of the user interface is defined. (Default value is 500).

On the second line, the index for the following screens is shown, e.g.: INDEX = 20

F1 = NC Instruction Number 500
F2 = NC Instruction Number 520
F3 = NC Instruction Number 540
etc.

14.3 User Interface

Introduction

Using the TXT command, one simple user screen/interface can be created in the NC program.

To do this, the BTV04 hardware with the BTV04-ELC-01V08 firmware or higher is required.

Example:

Manual .	Status Line
MAIN-MENU	Line 1
MACHINE 2345	Line 2
ACT POS: +00000123.123	Line 3
LENGTH: 0001.000 MM	Line 4
VELOCITY: 999	Line 5
PIECES : 0000	Line 6

Fig. 14-5: Text

On each line, text or variable contents can be displayed, and variable contents can be edited.

The NC lines are used as display specifications, beginning with NC instruction 500 (default setting). This start instruction number can be edited in "Start Adr Text" (see Special Displays). Up to 6 different display specifications can be written. In the user interface, the displays are called up by pressing function keys F1 - F6.

The TXT 0 command is used as an identifier for the display specification.

The NC instructions are read in sequence, until another command is reached.

Note: For any erroneous entries in the format specification, the data is erroneously displayed, or not displayed at all.

Note: The specifications are processed in the order in which they were programmed. The following definitions can overwrite other definitions on the display!

Note: Variables must be programmed for the associated NC program.

Definition	Assignment	Function	Example:
Display Text	0	--	N0500 TXT 0 0-0-2-00-20-ABCD N0501 TXT 0 EFGHIJKLMNOPQRST
Display Variable	1	0	N0500 TXT 0 1-0-2-00-100-183
Display Marker	1	1	N0500 TXT 0 1-1-2-00-M2.00.0
Variable Value Editable	2	--	N0500 TXT 0 2-0-2-00-600-183
Draw Line	3	--	N0500 TXT 0 3-100-50-120-30
Draw Box	4	--	N0500 TXT 0 4-100-50-120-30
	5	--	
	6	--	
	7	--	
	8	--	
Number of Lines	9	0	N0500 TXT 0 9-0-6

Fig. 14-6: Specification

Using Assignments 1 and 2, a total of 10 definitions can be programmed.

Text Programming

N0500 TXT 0 0-0-2-00-04-ABCD

The TXT command and the following 0 are always hard-coded.

Parameters	Description	min.	max.
0	Assignment: Text	--	--
0	Reserved	0	0
2	Line	1	6(7)
00	Position	00	21
04	Number of Text Characters	01	20
ABCD	Text	--	--

Fig. 14-7: Text

In the 16-character writable portion of the TXT command, the display specification is entered.

If more than 4 characters are to be shown as the text output, the next NC instruction is used with this one as the text input.

Only characters which are permitted by the text command can be used as text. (Capital Letters). In addition, the 5th text position may not be a space.

Permitted Characters

!"#%&()*+,-./:;<=>?@[]_

ABCDEFGHIJKLMNOPQRSTUVWXYZ

1234567890

Programming the Text for Example Fig 14-5

Text Main Menu

N0500	TXT	0	0-0-1-05-10-MAIN
	TXT	0	-MENU

Text Machine 2345

	TXT	0	0-0-2-04-12-MACH
	TXT	0	INE 2345

Text : Actual Position:

	TXT	0	0-0-3-00-07-ACTP
	TXT	0	OS:

Text : Length:

	TXT	0	0-0-4-00-07-LENG
	TXT	0	TH:

Text : mm

	TXT	0	0-0-4-19-02-MM

Text : Velocity:

	TXT	0	0-0-5-00-09-VELO
	TXT	0	CITY:

Text : Pieces:

	TXT	0	0-0-6-00-08-PIEC
	TXT	0	ES:

Data Display

Display Variable

The contents of the programmed variable are written to the display cyclically.

The contents of all variables can be displayed.

The number of places before and after the decimal can be designated.

N0500 TXT 0 1-0-2-00-100-183

Display of the Actual Position with Places Before the Decimal

Parameter	Description	min.	max.
1	Assignment: Displays	--	--
0	0 = Display Variable	--	--
2	Display Line	1	6(7)
00	Display Position	00	21
100	Variable Number	000	999
183		--	--
1xx	0 = Without operational sign 1 = With operational sign	0	1
x8x	Number of Places Before Decimal	1	8
xx3	Number of Places After Decimal	0	6

Fig. 14-8: Variable Display

Display: Actual Position

TXT 0 1-0-3-08-100-183

V100 = Actual Value, Axis1

Display Markers

N0500 TXT 0 1-1-2-00-M2.00.0

Parameter	Description	min.	max.
1	Assignment: Displays	--	--
1	Display Marker Bit	--	--
2	Line	1	6(7)
00	Position	00	21
M2.02.0	Complete Identifier M = Marker I = Input Q = Output	000	999

Fig. 14-9: Marker Display

Variable Value Editable

N0500 TXT 0 2-0-2-00-600-183

Parameter	Description	min.	max.
2	Assignment: Variable Contents	--	--
0	Reserved	0	0
2	Line	1	6(7)
00	Position	00	21
600	Variable Number	000	999
183	Format	--	--
1xx	0 = Without operational sign 1 = With operational sign	0	1
x8x	Number of Places Before Decimal	1	8
xx3	Number of Places After Decimal	0	3

Fig. 14-10: Variable Value Editable

The contents of the programmed variable are written to the display cyclically.

The current input position is shown as a negative value: To change the value, it is possible to place the cursor in the field. Edited values are shown in italics and are then no longer updated. By pressing OK, the value is transferred and by pressing ESC, the old value is reestablished.

Display and Edit Parts of a Variable

The entire variable format : +00000000.000000

Depending on the format indicated, part of the variable value can be displayed and edited. The invisible locations for the variables are not changed and therefore remain intact.

Example:

V600 = + 00010000.000111

Display: 0000.000 Format: 043

Change: 0022.222

V600 = + 00010022.222111

Example: Display and Editing of Three Variables

TXT 0 2-0-4-10-600-043

TXT 0 2-0-5-15-601-030

TXT 0 2-0-6-14-602-040

Graphic Elements

Draw Line

N0500 TXT 0 31-100-50-120-30

Parameter	Description	min.	max.
3x	Assignment: Draw Line	--	--
X	0 = White Line 1 = Black Line 2 = Dotted Line	0	2
100	X Starting point of the line	0	128
50	Y Starting point of the line	0	64
120	X End point of the line	0	128
30	Y End point of the line	0	64

Fig. 14-11: Draw Line

Draw Box

A rectangular shape is drawn. Later write instructions overwrite these shapes (or their content).

N0500 TXT 0 41-010-10-020-20

Parameter	Description	min.	max.
4x	Assignment: Draw Box	--	--
X	0 = No fill, with frame 1 = Bold (black) 2 = No fill	0	2
100	X Top left point of the rectangle	0	128
50	Y Top left point of the rectangle	0	64
120	X Width	0	128
30	y Height	0	64

Fig. 14-12: Draw Box

Draw Circle

N0500 TXT 0 51-050-30-10

Parameter	Description	min.	max.
5x	Assignment: Draw circle	--	--
X	0 = White 1 = Black 2 = Dotted	0	2
050	X Center of the circle	0	128
30	Y Center of the circle	0	64
10	Radius	0	64

Fig. 14-13: Draw Circle

Number of Lines

In the default settings, the number of available lines is set to 6.

Using this command, the number can be increased to 7.

Note: With 7 preselected lines, for fields with an editing function, the topmost pixels of the following line are overwritten!

Note: The number of lines should always be programmed first.

N0500 TXT 0 9-0-6

Parameter	Description	min	max
9	Assignment:	--	--
0	Number of Lines	0	0
6	Number of Lines	6	7

Fig. 14-14: Number of Lines

Display Example

```
Manual                                  .
           MAIN-MENU
        MACHINE    2345
ACTPOS: +00000123.123
LENGTH:     0001.000 MM
VELOCITY:         999
PIECES :         0000
```

N0500	TXT	0	0-0-1-05-09-MAIN
	TXT	0	-MENU
	TXT	0	0-0-2-04-12-MACH
	TXT	0	INE 2345
	TXT	0	0-0-3-00-07-ACTP
	TXT	0	OS:
	TXT	0	0-0-4-00-07-LENG
	TXT	0	TH:
	TXT	0	0-0-4-18-02-MM
	TXT	0	0-0-5-00-09-VELO
	TXT	0	CITY:
	TXT	0	0-0-6-00-07-PIEC
	TXT	0	ES:
	TXT	0	1-0-3-08-100-183
	TXT	0	2-0-4-09-600-043
	TXT	0	2-0-5-14-601-030
	TXT	0	2-0-6-13-602-040
	NOP		
	NOP		

15 EMD Module (EcoX-Bus)

15.1 Digital Input/Output Module

System Setup

Functionality and Communication

Using the digital input/output module described in this documentation, the number of digital inputs (16 per module) and outputs (16 per module) can be increased for drive controllers in the ECODRIVE03 family. Input/Output modules and the drive controller are connected via the EcoX Bus. Via this bus, signals and the firmware required for the modules are transmitted.

Physical Characteristics

The input/output module consists of two parts:

- the base module
- the electronic module (shown in detail in the following drawing). A description plate that allows the user to add information is attached to the electronic module.

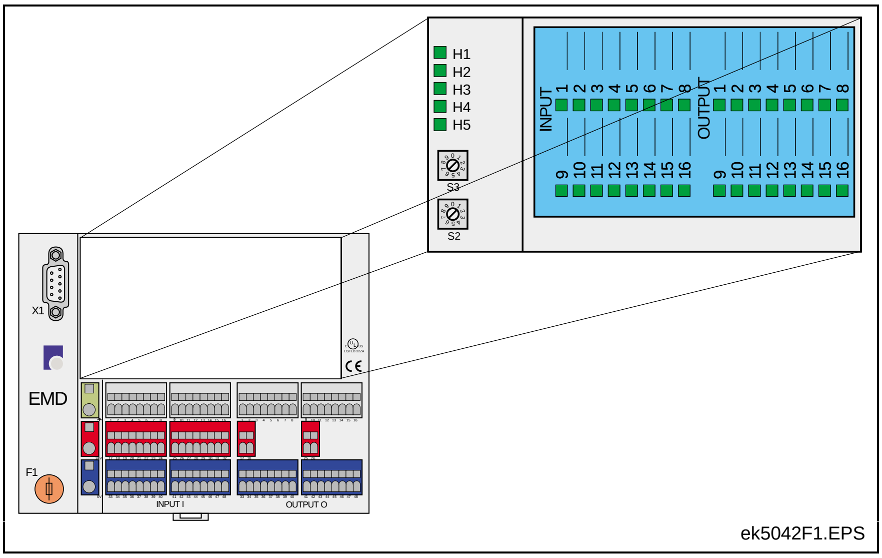


Fig. 15-1: EMD Digital Input/Output Module

The **base module** is designed for mounting on a top-hat rail. The power supply, EcoX Bus, sensors and actors must be connected to this rail. The electronic module connector must be inserted into the base module.

Rexroth
Bosch Group

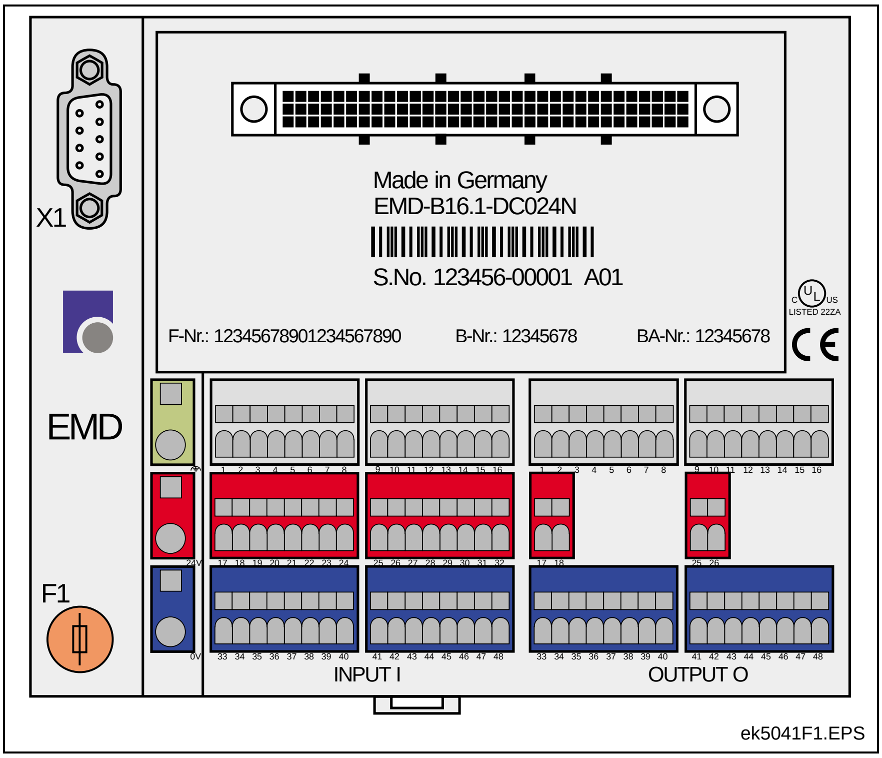


Fig. 15-2: Base Module

The **electronic module** contains the processing unit, the fieldbus connection and the input and output connections.

Diagnostic and status LEDs, as well as address switches are also on this module.

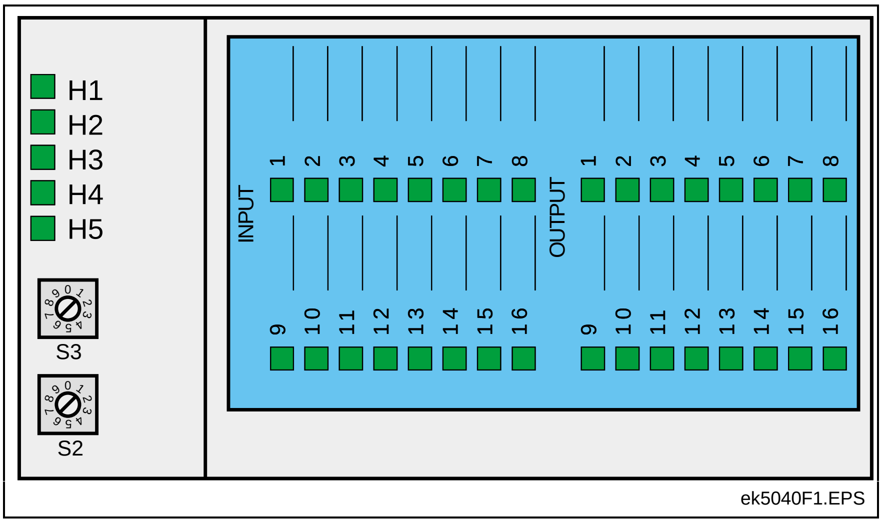


Fig. 15-3: Electronic Module (With Description Plate)

15.2 Technical Data

EcoX Bus System Data

max. number of drive controllers	1
max. number of input/output modules	2
bus conductor	Rexroth cable assembly Type IKB 0036
maximum conductor length	2 m
bus connection	9-pole D-SUB connector
transmission rate	1 MBaud

Fig. 15-4: EcoX Bus Data

Input/Output Module Data

Designation	Symbol	Unit	Value / Description
Supply			
Supply Voltage	U_{DC}	V [DC]	24 (± 20 %)
Current Consumption (Module without Load at U_{DC}=24 V)	I	A	0.1 (± 20 %)
Rated Current at 24 V / 0 V	I_B	A	8
Total Power Loss	P_V	W	< 4.5
Protection for sensor power supply	F1		TR5 250 V / 6.3 A T
Inputs			
Number			16
Connections			dual- or triple-conductor, depending on whether the sensor requires power supply
Signal Voltage (low or 0)	U_{E0}	V [DC]	0 ... 5
Signal Voltage (high or 1)	U_{E1}	V [DC]	11 ... 30
Time Constant (no bus)		ms	< 0.5
Electronic Isolation – Circuit Side			no

Outputs			
Number			16
Connections			triple-conductor
External Power Supply total by group			 with power supply clamps 24 V, 0 V and ground clamp with power supply clamps for each group of 8 outputs
Rated Voltage	U_B	V [DC]	24
Rated Current maximum per output maximum per group maximum per module (16 DO)	I_B	A	 0.5 4.0 8.0
Leakage Current		mA	< 0.2
Maximum Switching Frequency with Ohm load with inductive load			
Short-Circuit Diagnostic			no short-circuit diagnostic possible
Short-Circuit Protection			electronic, automatic re-start
Electronic Isolation – Circuit Side			no
Conditions for Use			
Ambient Temperature Allowed		°C	0° ... +55°
Storage and Transport Temperature		°C	-25° ... +70°
max.		m over NN	2000
Max. Allowable Relative Humidity		%	10 - 45, no condensation
Air Pressure during Operation		hPa	86 ... 106
Protection Type			IP 20 according to EN 60529 /IEC 529
Special Requirements for Operation			The unit can be used in locations where dust, caustic steam, caustic gases or ionized radiation can be present, only if additional measures are undertaken!

Fig. 15-5: EMD Input/Output Module Data

15.3 Important Notes

Appropriate Use

Introduction

Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Areas of Use and Application

The equipment described in this documentation is intended for use while connected to a digital drive controller with a corresponding interface. Using this equipment, additional digital inputs/outputs are added to a drive controller.

To use this equipment, additional sensors and actors need to be connected.

Note: The input/output modules may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

The input/output modules may only be operated under the specified conditions of mounting and installation, in the specified area of use and according to the specified environmental requirements (temperature, type of protection, humidity, EMV, etc.).

Inappropriate Use

Using the input/output modules outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as “inappropriate use."

Input/Output modules may not be used if:

- ... they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures.
- Rexroth has not specifically released them for that intended purpose. Please note the specifications outlined in the general Safety Guidelines!

15.4 Installation

Dimensions and Installation Measurements

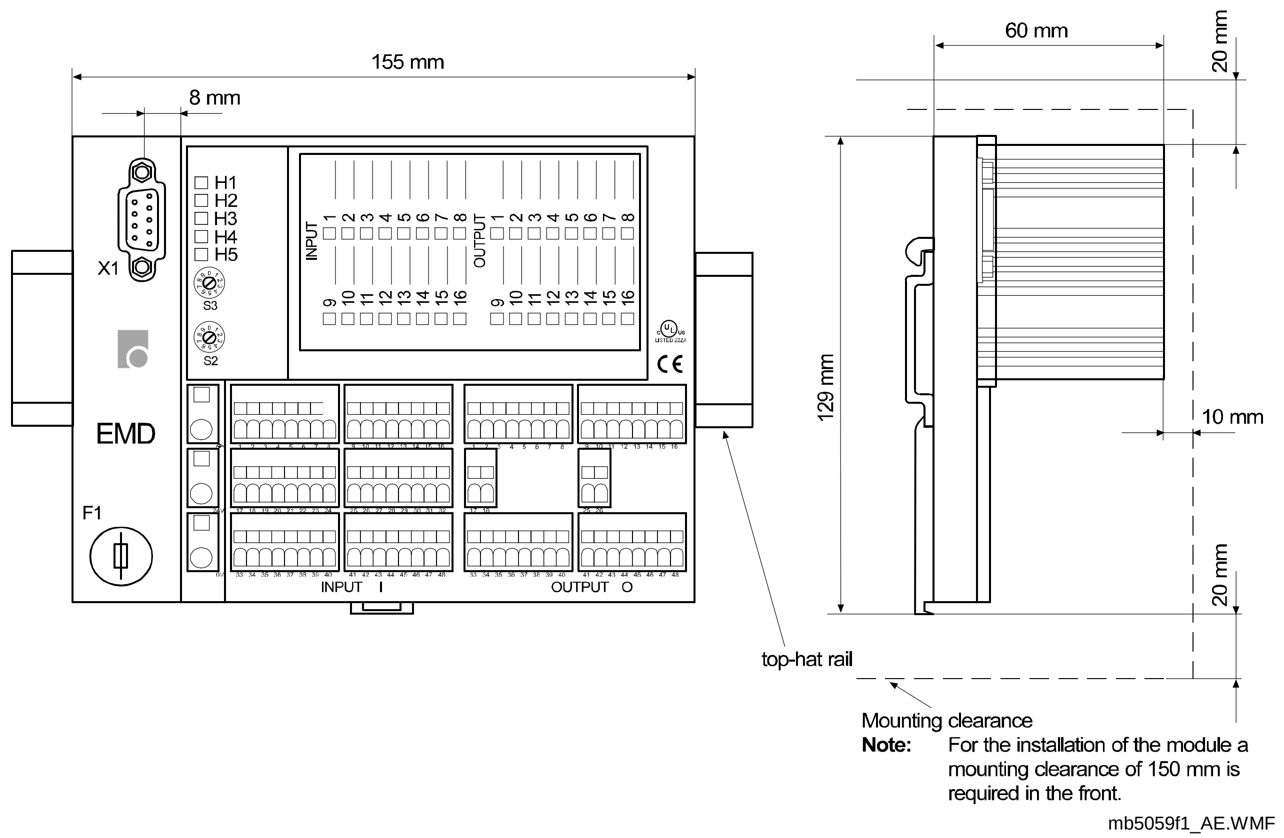


Fig. 15-6: EMD Unit Dimensions and Installation Space

Note: To ensure adequate ventilation of the input/output module and to avoid overheating, please adhere to the required installation space shown in Fig 15-6.

Please also note that the required installation space of 150 mm is required at the front. Additionally, the D-SUB connector for the bus connection may protrude beyond the unit!

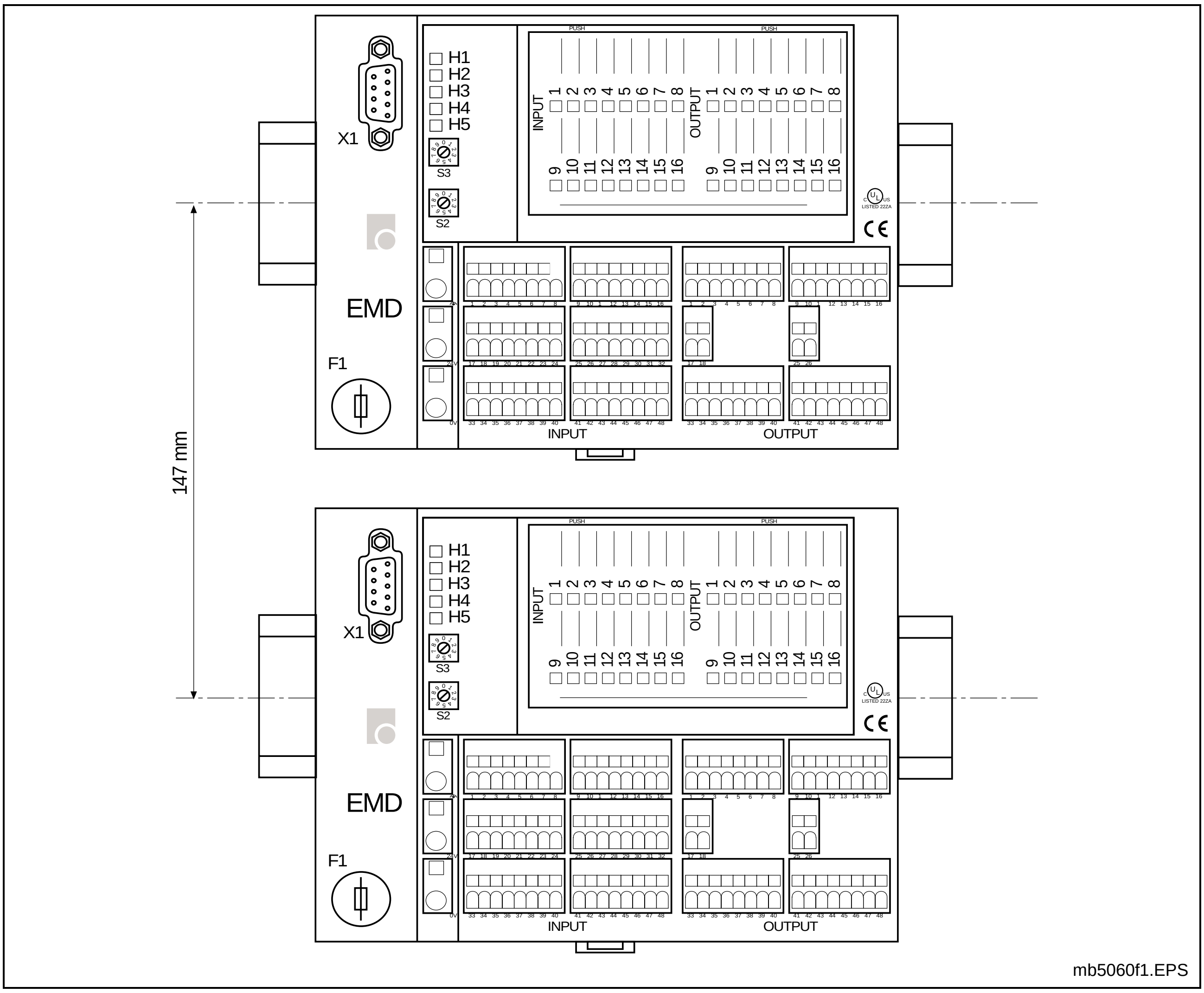


Fig. 15-7: Distance Between Two Stacked Input/Output Modules

Installation/Removal

Required Installation Space and Measurements

The required installation space and the unit dimensions can be found in the Section "Dimensions and Installation Measurements"

Mounting Materials

The input/output module is designed for mounting on a top-hat or mounting rail. The following drawing contains the dimensions of the top-hat rail.

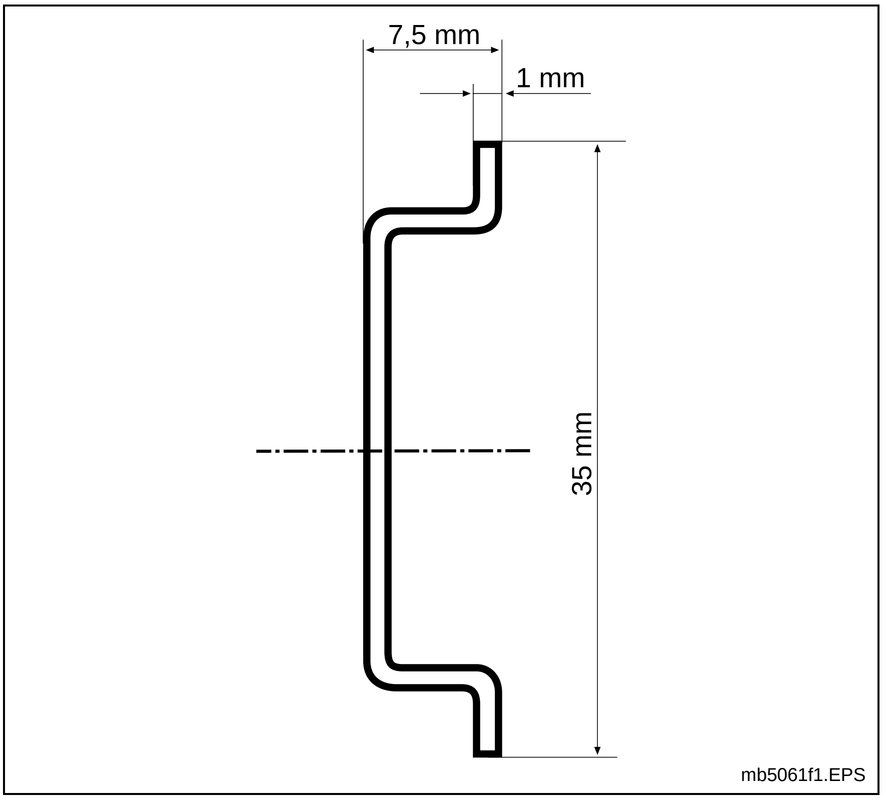


Fig. 15-8: Dimensions of the Top-Hat Rail

The base module and the electronic module together make up the input/output module.

Installing the Base Module

No tools are required to install the base module. It must be hooked into the top-hat rail and latched into place, as shown in the following drawing.

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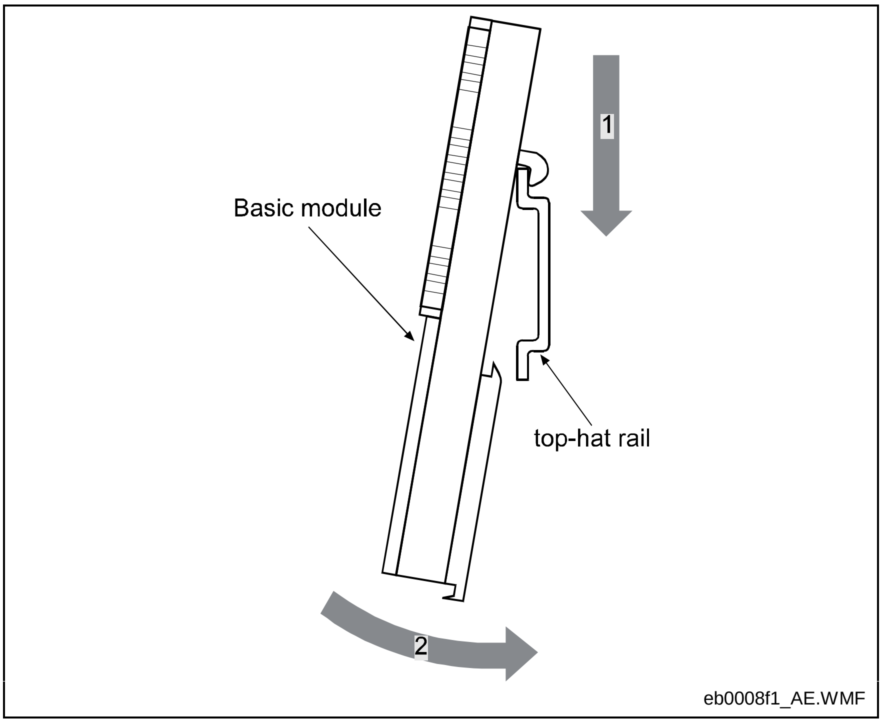

Fig. 15-9: Installing the Base Module

Removing the Base Module

Removing the base module requires a 6 mm x 1 mm screwdriver.

Remove the base module by placing the tip of the screwdriver on the release clip of the base module. Proceed as shown in the following drawing.

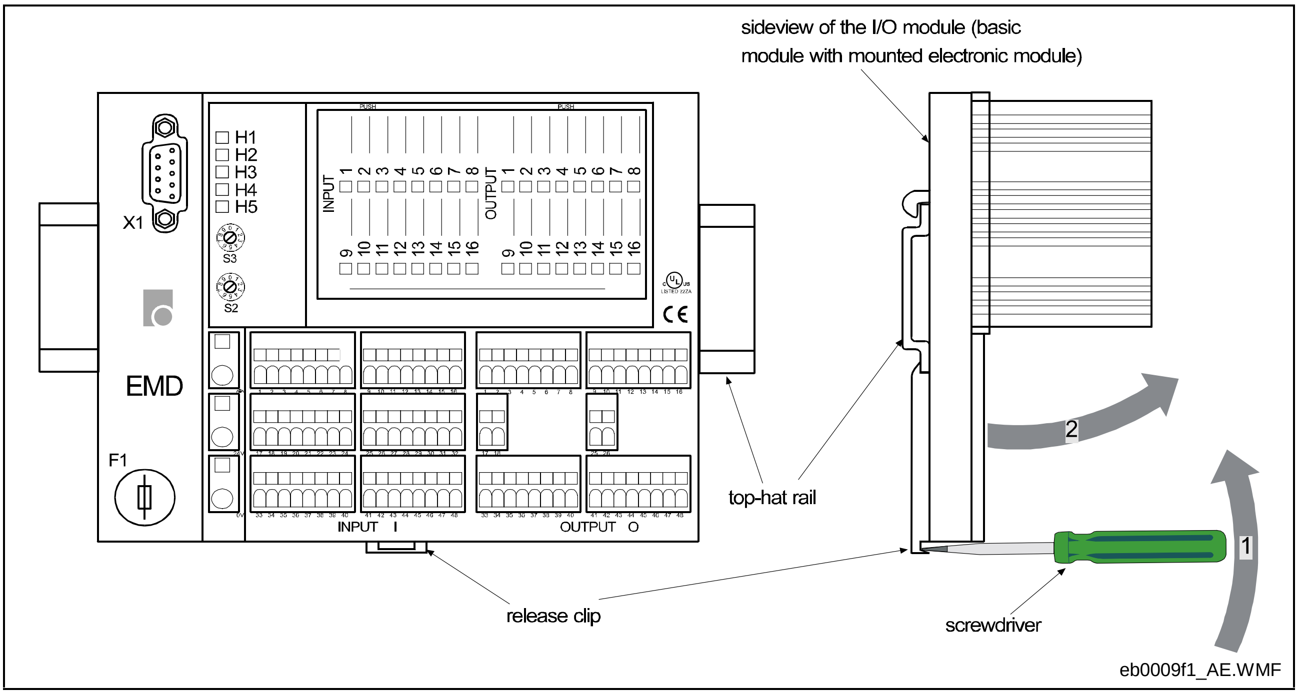

Fig. 15-10: Removing the Base Module

Installation and Removal of the Electronic Module

Damage by live parts!

⇒ Turn off the power to the base module before installing or removing the electronic module, so the electronic module is not damaged.

CAUTION

No tools are required to install or remove the electronic module. It must be inserted in the required slot on the base module and pressed in place, until an audible click is heard for each of the four latches.

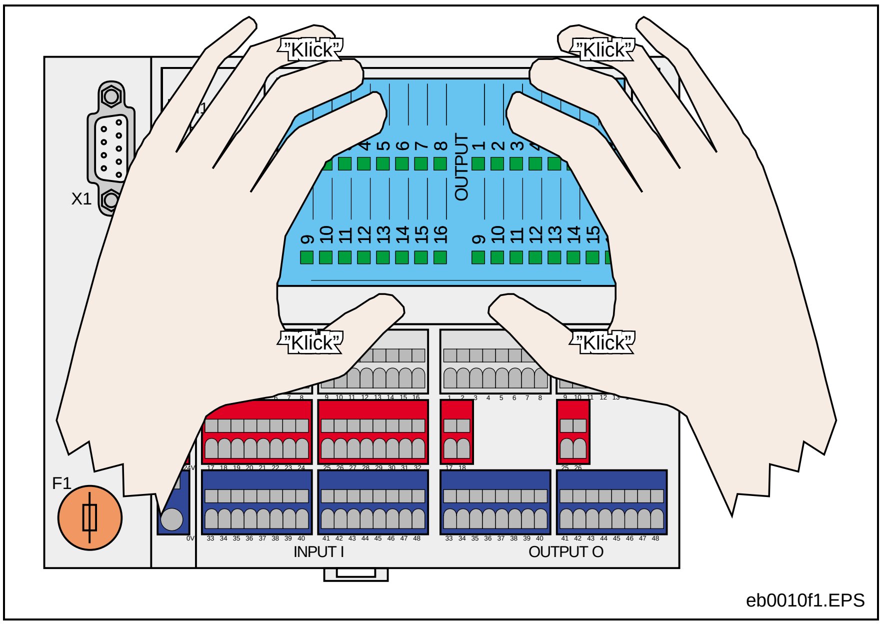

Fig. 15-11: Installing the Electronic Module

To remove the electronic module, press all four latches simultaneously, hold them down and pull the electronic module away from the base module.

Installation and Removal of the Description Plate

The description plate is plastic. It can be removed for replacement or to place on a flat surface for labeling. (For labeling we recommend a water proofed felt-tip pen).

To install or remove the description plate, no tools are required. To remove it, use fingers to slightly bend it free of the latch points. Installation is accomplished in the opposite order.

15.5 Electrical Connection

Before You Begin

For operation, an input/output module must be supplied with power.

In addition, note the following:

CAUTION

Electrical components will be damaged by electrostatic discharge!

⇒ When handling electrical components, ensure that you and any equipment are appropriately grounded.

CAGE CLAMP® Connections

General Information

All connector clamps for supply lines as well as sensor and actor connections are made with CAGE CLAMP connections.

The CAGE CLAMP® connections are appropriate for fine or single-conductor wiring. Generally, only **one** conductor can be connected to each clamp.

The CAGE CLAMP® connection is structured so that, with proper handling, a fine conductor can be fed through without splicing and can be securely clamped. Under normal operating conditions, this direct clamping, e.g. direct contact between the conductor and the clamp's busbar, achieves optimal contact quality.

Note: If structural characteristics or ambient conditions require splicing protection in the form of ferrules, the smaller conductor diameter should be selected.

Clamp Handling A 2.5 mm x 0.5 mm screwdriver is required for connecting a conductor shows where the screwdriver is to be placed and Fig. 15-13 shows how to attach a conductor with CAGE CLAMP® connectors.

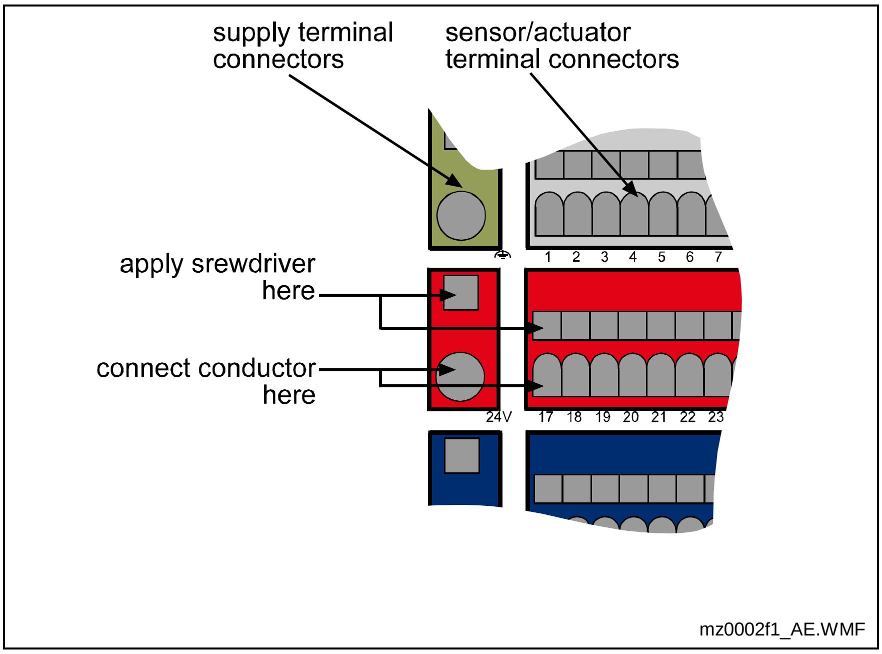

Fig. 15-12: CAGE CLAMP® Connections

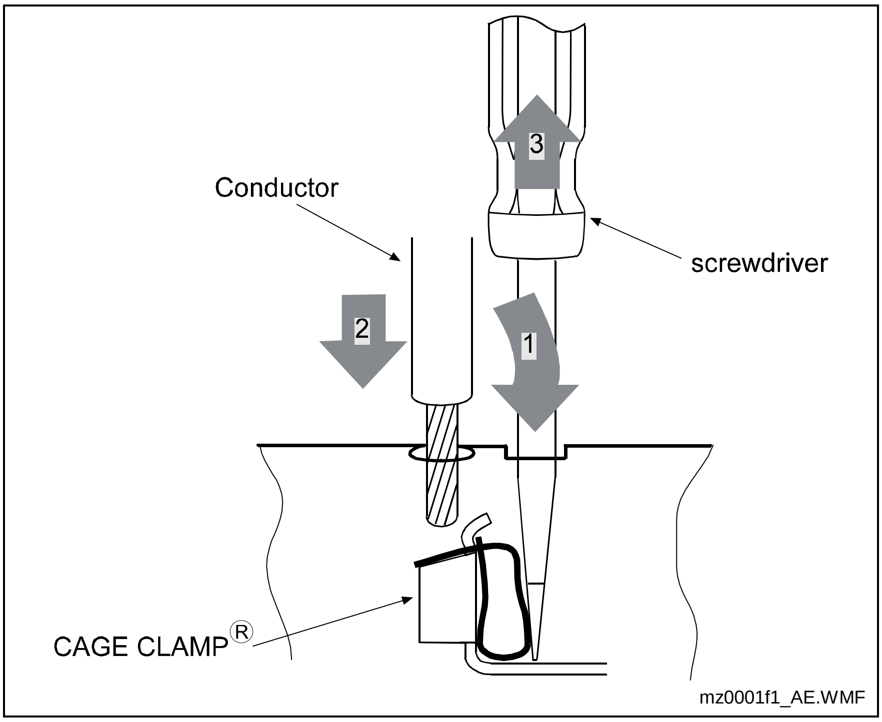

Fig. 15-13: CAGE CLAMP® Handling / Attaching a Conductor

Position of Connections

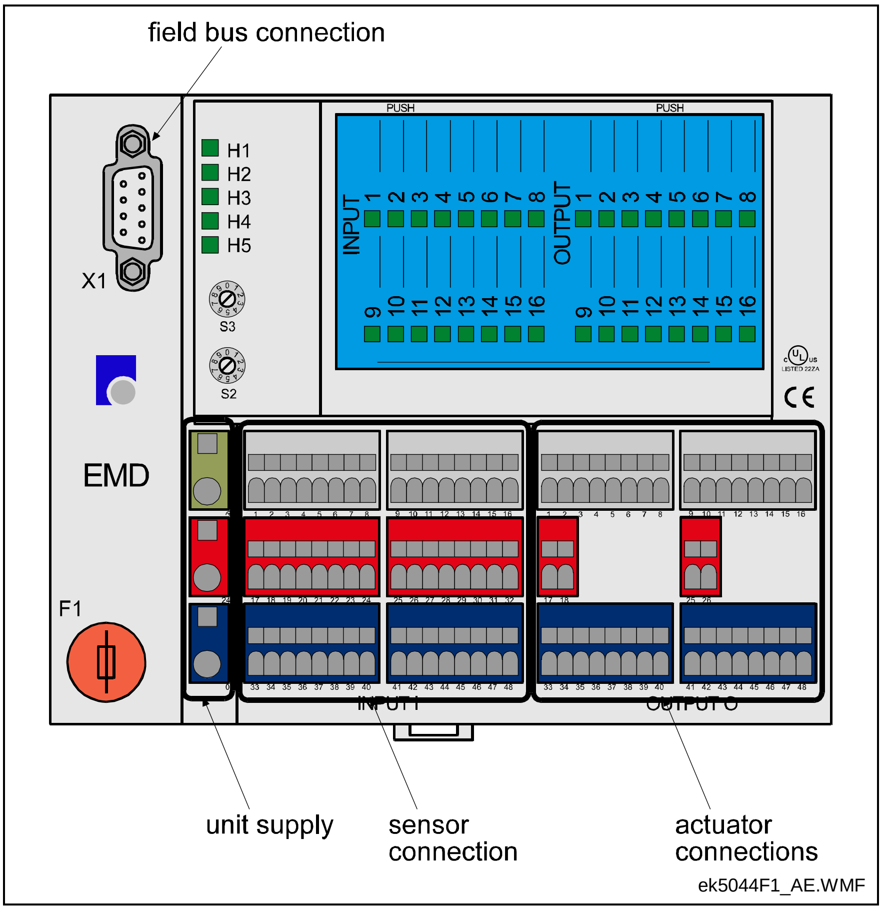

Fig. 15-14: Position of Connections

Power Supply, Protection and Grounding

Power Supply

The input/output module must be supplied with 24 Volts DC power using the clamps labeled as "unit supply" in Fig 15-14:

Green clamp:	Grounding
Red clamp:	24 Volts
Blue clamp:	0 Volts

With the appropriate layout, the external power supply can be used as the power source that is also used to supply the drive controller.

The actors (digital outputs) can be supplied in two ways:

- via the unit supply
- externally

Power for the sensors is supplied via the unit supply.

Protection

The electronic module is protected from short circuiting by the F1 plug-in fuse on the base module.

Note: Please take note of the technical data for the plug-in fuse.

Actors When power is supplied via the input/output module, the electrical protection of the actors is ensured by the F1 plug-in fuse on the module. When power is supplied externally, protection must be provided according to the appropriate technical data.

Sensors Power supply to the sensors is protected against short-circuiting by the F1 plug-in fuse on the module.

Grounding

The base module is set up to be grounded via the top-hat rail: At the rear of the base module, two contacts are present that establish the electrical connection to the top-hat rail when the base module is correctly mounted.

The contacts at the rear of the base module are, in turn, connected to the grounding clamp (front of unit).

Note: Ensure that the top-hat rail is grounded!

Input Signals

Position of the Connector Clamps The sensor connection clamps are labeled as "sensor connections" in Fig. 15-14. For each of the 16 sensors that can be connected, three clamps are available. The connectors for a sensor are arranged vertically. (Example: Clamps 3, 19 and 35 form the group for connecting one sensor.)

Connecting the Sensors Dual-conductor sensors (e.g. switches) must be connected to the gray and red clamps.

Sensors with a connection to the power supply receive the 24 V power supply by connection to the red and blue clamps. The output signal of the sensor must be connected to the gray clamp.

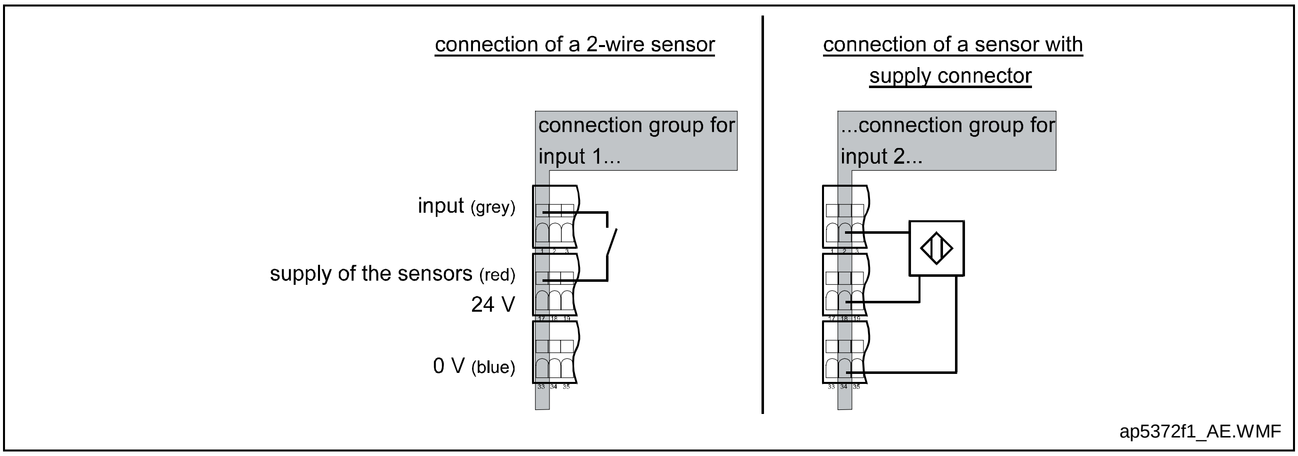

Fig. 15-15: Connecting the Sensors

Power Supply of the Outputs

For power supply to the outputs, four red clamps are available in the area labeled "actuator connections" in Fig. 15-14. Each set of 2 clamps is assigned for the power supply to 8 outputs. The left clamp in each pair connects the 24 V input voltage, and the right clamp is connected to the outputs.

As already mentioned, the outputs can be supplied either via the unit supply of the input/output module or via an external power source.

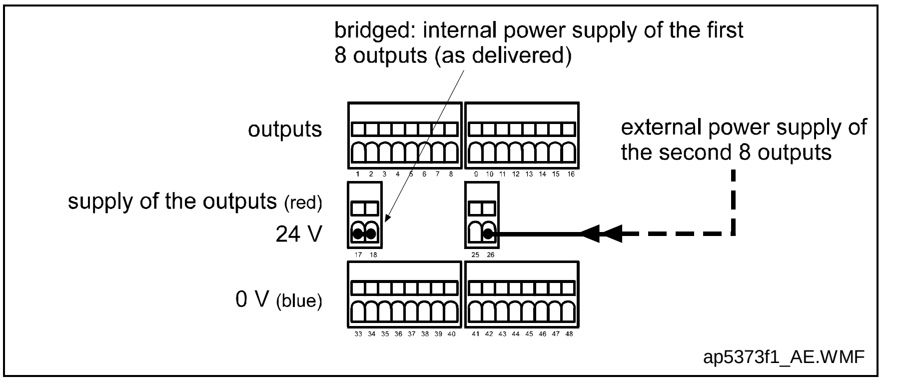

Fig. 15-16: Clamp Positions for Power Supply to the Outputs, and Power Supply Options

Using the Internal Power Supply

If the outputs are to be supplied via the unit supply to the input/output module, the left clamp (24 V) must be bridged with the right clamp (connection to the outputs).

Note: At the factory, the bridges between the two clamps for both output groups (1 group = 8 outputs) are placed.

Connecting an External Power Supply

The connection of an external power supply must be wired via the correct supply clamp. Make sure that the output voltage can also flow in reverse to the power supply. To ensure that this is possible, an external connection between the 0 V potential of the input/output module (blue clamp) and the 0 V potential of the external power supply must be established.

Note: The entire load voltage flows across the connection between the 0 V potential of the input/output module and the 0 V potential of the external power supply. Because a connector clamp is approved for a maximum of 6 A load in the field, the 0 V potentials of the power supply units must be combined and wired to the 0 V unit supply clamp.

Output Signals

The actuator connection clamps are labeled as "actuator connections" in Fig. 15-14. For each of the 16 actuators that can be connected, two clamps are available. The connectors for an actuator are arranged vertically. (Example: Clamps 14 and 46 form the group for connecting one actuator.)

The positive connection of a load must be connected to the gray connection clamp and the negative connection must be connected to the blue connection clamp.

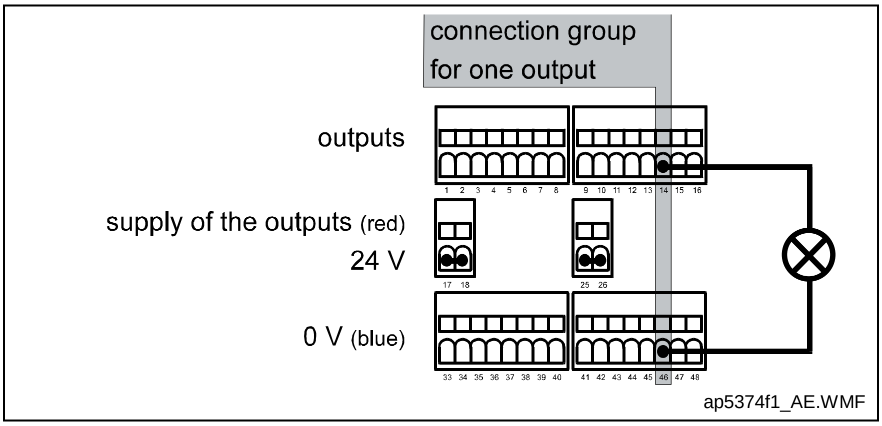

Fig. 15-17: Connection of the Actuators

Fieldbus Connectors

Note: For the first and the last unit along an EcoX bus, a bus terminationmust be attached to the end of the conductor. The IKB0036 (Connection between Input/Output Module and drive controller) and IKB0037 (Connection from Input/Output Modules) cable assemblies have an integrated bus termination in the connectors.

Connection Between Input/Output Module and Drive Controller

The fieldbus input/output modules (EMD Module) are galvanically isolated from each other.

The input/output module must be connected to the drive controller. On the EMD side, a 9-pole D-Sub connector with a maximum housing width of 16 mm and a twisted conductor with a diameter of 0.25 mm^2 must be used. The maximum allowed cable length is 2 m.

Note: A pre-assembled cable IKB0036 is provided for the connection between Input/Output module and drive controller.

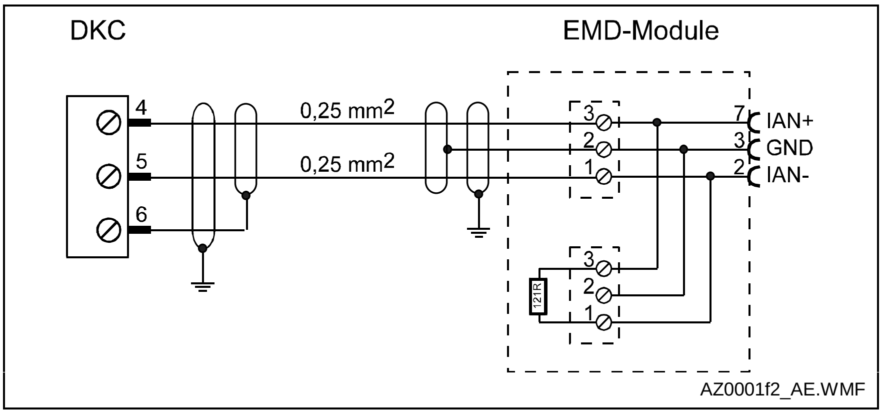

Fig. 15-18: Assignment of the Pre-Assembled Cable (IKB0036), for the Connection Between Drive Controller and EMD Module

Note: Switching between input/output module 1 (inputs/outputs 0 to 15) and module 2 (inputs/outputs 16 to 31) is done via a bridge in the EcoX connector on the input/output module. For more information, see Chapter 15.6 Assigning the Input/Output numbers.

Connection of Input/Output Modules

Note: A pre-assembled cable IKB0037 is provided for the connection from the Input/Output modules.

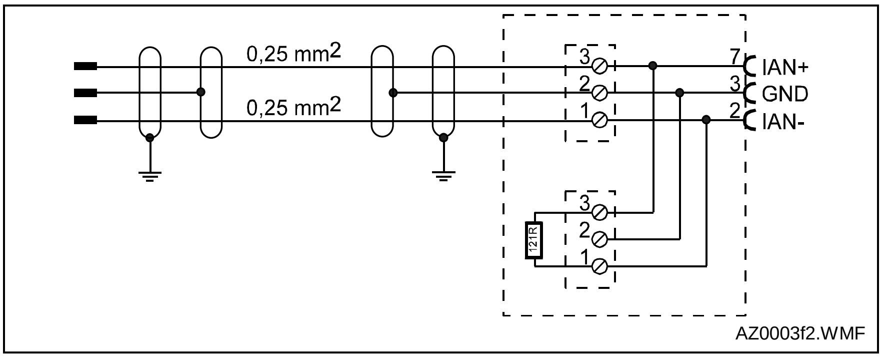

Fig. 15-19: Connection from Input/Output Modules

Example for the Structure of an EcoX-Bus

The following examples should clarify the basic structure of an EcoX bus.

Note: Please note the types of cable assemblies used and the requirements for the bus termination resistance!

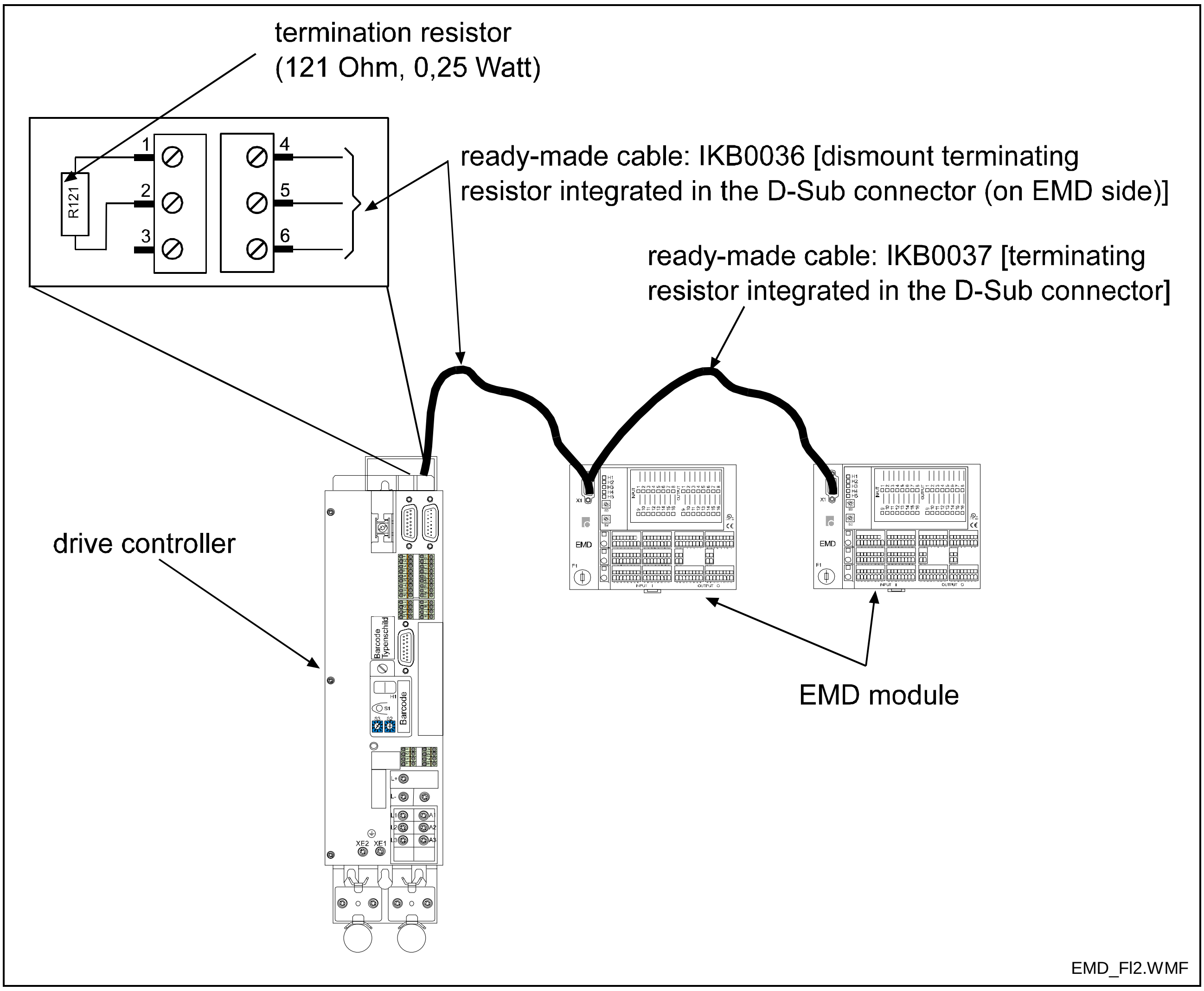

Fig. 15-20: Bus with a Drive Controller and EMD Module

15.6 Initial Startup

Setting the Module Address

For an input/output module and a drive controller to be able to communicate, identical (unit) addresses must be set for both units.

The input/output module address is set using address switches S2 and S3. The address switches can be found on the electronic module of the input/output module. The S2 switch sets the one's place and the S3 switch sets the ten's place of the module address.

Assigning the Input/Output Numbers

Two input/output modules with 16 inputs/outputs each can be connected to one drive controller.

Switching between the input/output modules [Module 1 (inputs/outputs 0 to 15) and Module 2 (inputs/outputs 16 to 31)] is done via a bridge in the connector on the input/output module.

How to do it:

To define a module as Module 2, thereby defining the inputs/outputs on this module as Input 16, 17, 18,…, 31 or Output 16, 17, 18,…, 31, a bridge must be placed across Pin 9 (SUB-ADR) and Pin 6 (GND) of the connector.

No bridge may be placed on the connector for Module 1!

Setting the Drive Controller Parameters

The modules are activated in parameter **B014, EMD Configuration**.

After each startup of the supply voltages to the input/output module and the drive controller, a firmware test and an update are executed. This process is automatically executed, e.g. you must periodically check the status display to determine whether the firmware test resulted in any errors.

Note: The firmware test is also executed automatically when exiting the parameter mode.

15.7 Faults and Messages

Display

Position of the Displays

Display of general status messages and input/output status messages is integrated on the electronic module. The following figure shows the electronic module and the position of all its displays.

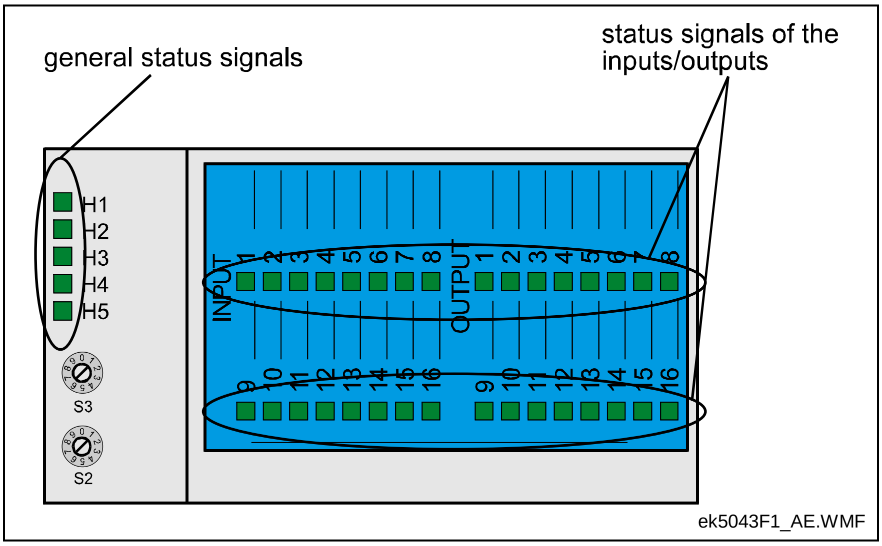

Fig. 15-21: Position of the Electronic Module Displays

General Status Displays

LED	Color	Status	Definition	Error-Clearing
H1	green	on	input/output module is synchronous to master drive, synchronous data exchange with the assigned drive	
H1	orange	on	input/output module is synchronous to master drive, no data exchange with the assigned drive	
H1	-	off	input/output module is asynchronous to master drive, asynchronous data exchange with the assigned drive	
H1	red	on	no communication with a drive	check if... • ...the bus cable is correctly connected. • …the address switches on the input/output module are correctly set. • … the assigned drive controller is turned on. • …the parameters for the input/output module assigned to the drive controller are set correctly.

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LED	Color	Status	Definition	Error-Clearing
H2	-	off	correct power supply for the input/output module	
H2			Undervoltage in the input/output module	Check of the 24V power supply
H3	-	off	input/output module is configured as Module 1 (I/O 0...15)	
H3	green	on	input/output module is configured as Module 2 (I/O 16…32)	
H3	red	blinking	watchdog, error executing firmware	Turn power supply off and on If the error occurs again, contact Customer Service.
H4	-	off	firmware test in process	
H4	green	on	firmware tested and o.k.	
H4	red	on	firmware tested and contains errors, or firmware update in process	Wait for firmware update to be executed. If the error is still occurring, switch from Phase 2 to Phase 3 again.
H5	green	blinking	normal operation	
H5	red	on	overtemperature	Check load on input/output module. Check ambient temperature, ventilation and installation.

Fig. 15-22: Definitions of General Status Displays and Error-Clearing

Status Displays for the Inputs:

The status displays for the inputs are ready for operation as soon as supply voltage is applied to the input/output module.

The following table shows the relationship between input voltage, input value and LED status.

Input Voltage	Input Value	LED Status
DC –3 V - 5 V	"0"	OFF
DC 5 V - 11 V	not defined	not defined
DC 11 V - 30 V	"1"	ON

Fig. 15-23: Switching Threshold of the Inputs

Status Displays for the Outputs

If an output is set to "1," the LED assigned to that output is on.

If an output is set to "1" and the LED is not on, check the following:

- Is the power supply to the outputs connected?
- Is there a short-circuit at the output?
- Is the output turned off in the input/output module because of overtemperature?

15.8 Replacement of a Unit

CAUTION

Damage by live parts!

⇒ Turn off the power to the input/output module before installing or removing it, so it is not damaged.

Following is a short list of items that must be considered when a unit is replaced.

First, please note that the replacement of a unit in a drive control system – consisting of a drive controller and an input/output module – always also affects the unit that is not replaced.

Replacement of the Electronic Module

The electronic module is plugged into the base module. The Removal/Installation has already been described. The wiring of the input/output module is not affected by replacing the electronic module.

For (re-)startup instructions for the electronic module, please see the corresponding section.

Replacement of the Base Module

For (re-)startup of the base module, the same description is valid as for the electronic module.

Replacement of the Drive Controller

A physical connection to the drive controller exists via the EcoX interface. It is also necessary to set the parameters for the drive controller, so it can communicate with the input/output module. Setting the parameters is not necessary if the programming module is transferred to the replacement unit.

15.9 Factory Settings and Identifying the Components

Identifying the Components

The base module and the electronic module are clearly marked with a typecode.

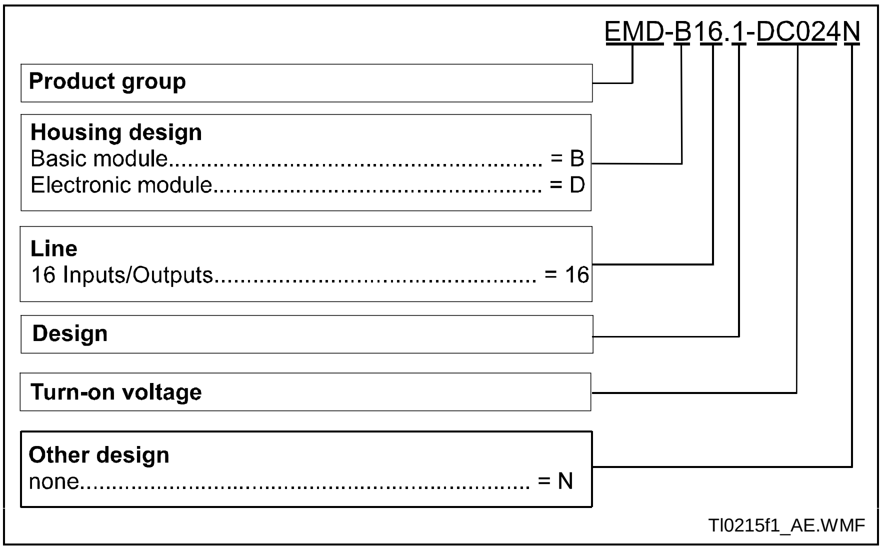

Fig. 15-24: Typecode for the Electronic or Base Module

16 IDS Accessories

16.1 INDRAMAT Decade Switch IDS1.1

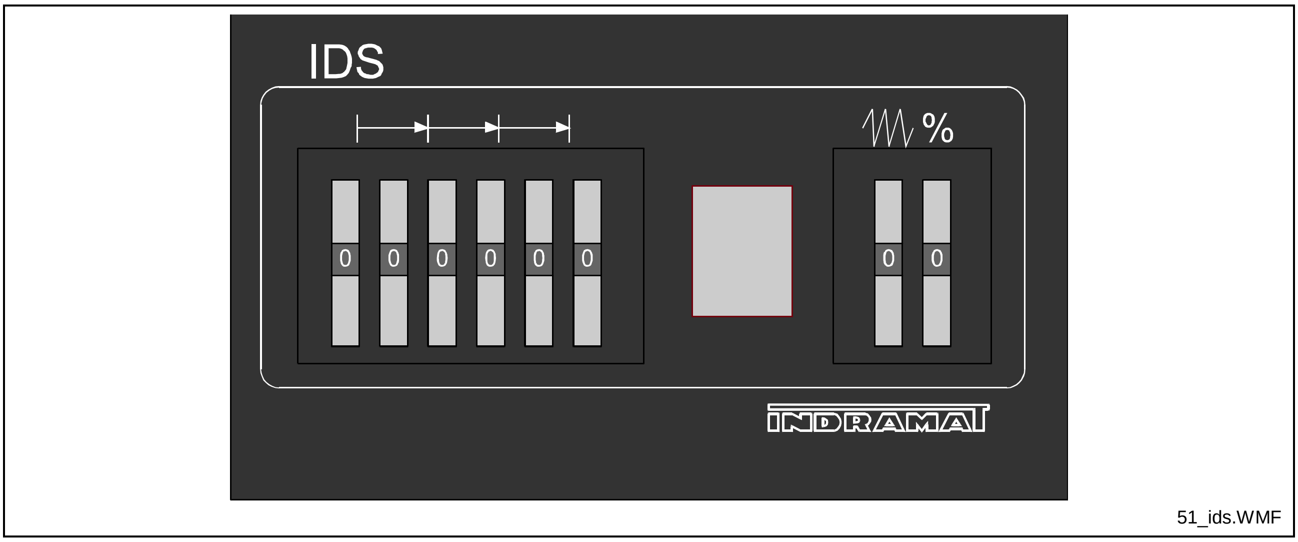

Fig. 16-1: IDS Indramat Serial Decade Switch

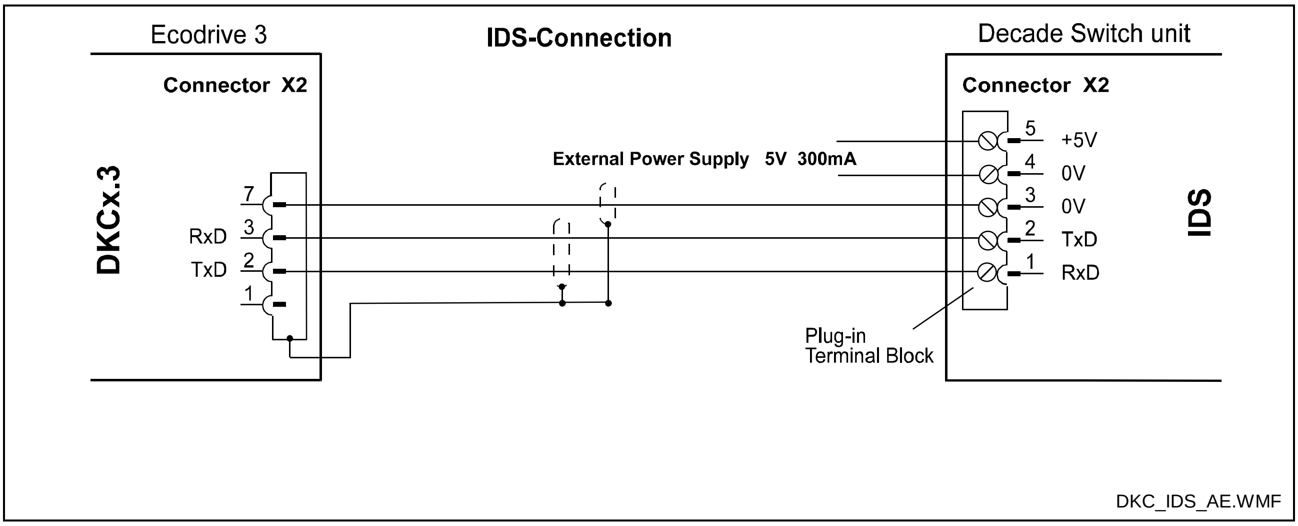

Fig. 16-2: IDS Connection to DKC

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 or a PC (e.g. MotionManager).

- Die IDS1.1 operates with the following transmission parameters:
- RS232, 2400 Baud, 1 Start Bit, 8 Data Bits, 1 Stop Bit, no parity check.
- 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. 16-3: 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.

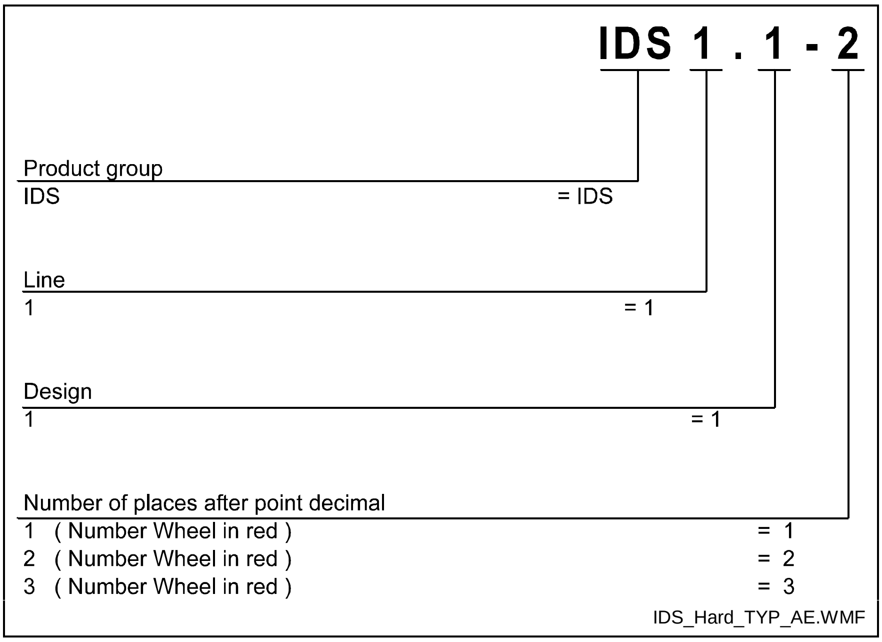

Fig. 16-4: IDS Typecode

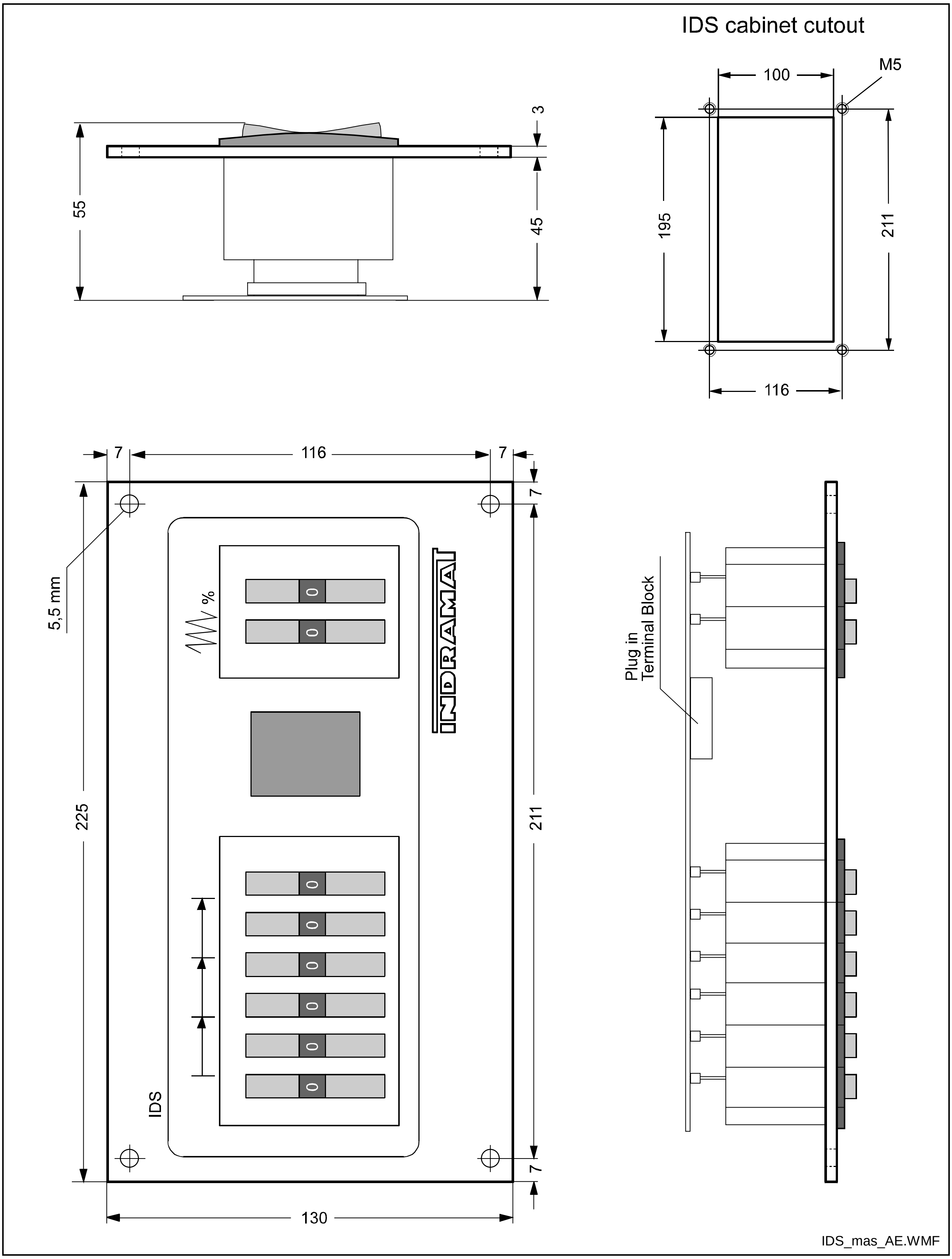

Fig. 16-5: :IDS Dimensions

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18 Service & Support

18.1 Helpdesk

Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns

Our service helpdesk at our headquarters in Lohr am Main, Germany can assist you in all kinds of inquiries. Contact us

- telefonisch - by phone: **49 (0) 9352 40 50 60**
  über Service Call Entry Center Mo-Fr 07:00-18:00
  - via Service Call Entry Center Mo-Fr 7:00 am - 6:00 pm
- per Fax - by fax: **+49 (0) 9352 40 49 41**
- per e-Mail - by e-mail: **service.svc@boschrexroth.de**

18.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

After helpdesk hours, contact our service department directly at

+49 (0) 171 333 88 26

oder - or **+49 (0) 172 660 04 06**

18.3 Internet

Unter **www.boschrexroth.com** finden Sie ergänzende Hinweise zu Service, Reparatur und Training sowie die **aktuellen** Adressen *) unserer auf den folgenden Seiten aufgeführten Vertriebs- und Servicebüros.

- ☐ Verkaufsniederlassungen
- ☐ Niederlassungen mit Kundendienst

Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit unserem für Sie nächstgelegenen Ansprechpartner auf.

*) Die Angaben in der vorliegenden Dokumentation können seit Drucklegung überholt sein.

At **www.boschrexroth.com** you may find additional notes about service, repairs and training in the Internet, as well as the **actual** addresses *) of our sales- and service facilities figuring on the following pages.

- ☐ sales agencies
- ☐ offices providing service

Please contact our sales / service office in your area first.

*) Data in the present documentation may have become obsolete since printing.

18.4 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. Tel.-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

For quick and efficient help, please have the following information ready:

1. Detailed description of the failure and circumstances.
2. Information on the type plate of the affected products, especially type codes and serial numbers.
3. Your phone/fax numbers and e-mail address, so we can contact you in case of questions.

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18.5 Kundenbetreuungsstellen - Sales & Service Facilities

Deutschland – Germany

vom Ausland: (0) nach Landeskennziffer weglassen!
from abroad: don't dial (0) after country code!

Vertriebsgebiet Mitte Germany Centre Bosch Rexroth AG Bgm.-Dr.-Nebel-Str. 2 / Postf. 1357 97816 Lohr am Main / 97803 Lohr **Kompetenz-Zentrum Europa** Tel.: +49 (0)9352 40-0 Fax: +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.svc@boschrexroth.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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