

Operating instructions Compax3 T30

Programmable motion control according to IEC61131-3



192-120104N13 C3lxxT30

Release R08-0

June 2008

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Production site:



Reg. Nr. 36 38

Parker Hannifin GmbH & Co. KG
Electromechanical Automation Europe [EME]
Robert-Bosch-Strasse 22
77656 Offenburg (Germany)
Tel.: + 49 (0781) 509-0
Fax: + 49 (0781) 509-98176
Internet: **www.parker-automation.com** <http://www.parker-automation.com>
E-mail: **sales.automation@parker.com** <mailto:sales.automation@parker.com>

Parker Hannifin GmbH & Co. KG - registered office: Bielefeld - Amtsgericht: Bielefeld HRA 14808
Personally liable shareholder: Parker Hannifin Management GmbH - Amtsgericht: Bielefeld HRB 35489
executive board: Dr. Gerd Scheffel, Günter Schrank, Christian Stein, Kees Veraart, Hans Wolfs - Chairman of the board: Hansgeorg Greuner

Headquarters:

England:

Parker Hannifin plc
Electromechanical Automation
Arena Business Centre
Holy Rood Close
Poole, Dorset BH17 7FJ UK
Tel.: +44 (0)1202 606300
Fax: +44 (0)1202 606301
E-mail:
sales.automation@parker.com
<mailto:sales.automation@parker.com>
Internet:
www.parker-automation.com
<http://www.parker-automation.com>

USA:

Parker Hannifin Corporation
Electromechanical Automation
5500 Business Park Drive
Rohnert Park, CA 94928
Phone #: (800) 358-9068
FAX #: (707) 584-3715
E-mail:
CMR_help@parker.com
mailto:emn_support@parker.com
Internet:
www.compumotor.com
<http://www.compumotor.com>

Worldwide sales

http://apps.parker.com/divapps/eme/EME/Contact_sites/Sales%20Channel_Parker-EME.pdf

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1. Introduction

In this chapter you can read about:

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Type specification plate	14
Packaging, transport, storage	15
Safety Instructions	16
Warranty conditions	18
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1.1 Device assignment

This manual applies to the following devices:

- ◆ Compax3S025V2 + supplement
- ◆ Compax3S063V2 + supplement
- ◆ Compax3S100V2 + supplement
- ◆ Compax3S150V2 + supplement
- ◆ Compax3S015V4 + supplement
- ◆ Compax3S038V4 + supplement
- ◆ Compax3S075V4 + supplement
- ◆ Compax3S150V4 + supplement
- ◆ Compax3S300V4 + supplement
- ◆ Compax3H050V4 + supplement
- ◆ Compax3H090V4 + supplement
- ◆ Compax3H125V4 + supplement
- ◆ Compax3H155V4 + supplement
- ◆ Compax3M050D6 + supplement
- ◆ Compax3M100D6 + supplement
- ◆ Compax3M150D6 + supplement
- ◆ Compax3M300D6 + supplement
- ◆ Compax3MP10D6
- ◆ Compax3MP20D6

With the supplement:

- ◆ F10 (Resolver)
- ◆ F11 (SinCos®)
- ◆ F12 (linear and rotary direct drives)
- ◆ I11 T30
- ◆ I20 T30
- ◆ I21 T30
- ◆ I22 T30
- ◆ I30 T30
- ◆ I31 T30

1.2 Type specification plate

You will find the exact description of the device on the type specification plate, which can be found on the device:

Compax3 - Type specification plate:



Explanation:

1	Type designation The complete order designation of the device (2, 5, 6, 9, 8).
2	C3: Abbreviation for Compax3 S025: Single axis device, nominal device current in 100mA (025=2.5A) M050: Multi-axis device, nominal device current in 100mA (050=5A) H050: High power device, nominal device current in 1A (050=50A) MP10: Mains module 3AC230...480V, nominal power in 1kW (10=10kW) D6: Nominal supply voltage (6=560VDC) V2: Mains supply voltage (2=230VAC/240VAC, 4=400VAC/480VAC)
3	Unique number of the particular device
4	Nominal supply voltage Power Input: 1AC = single phase, 3AC = three phase / input current
5	Designation of the feedback system F10: Resolver F11: SinCos® / Single- or Multiturn F12: Feedback module for direct drives
6	Device interface I10: Analog, step/direction and encoder input I11 / I12: Digital Inputs / Outputs and RS232 / RS485 I20: Profibus DP / I21: CANopen / I22: DeviceNet / I30: Ethernet Powerlink / I31: EtherCAT C10: integrated controller C3 <i>powerPLmC</i> C13: integrated controller C3 <i>powerPLmC</i> with Profibus
7	Date of factory test
8	Options Mxx: I/O extension, HEDA Sx: optional safety technology on the C3M
9	Technology function T10: Servo controller T11: Positioning T30: Motion control programmable according to IEC61131-3 T40: Electronic cam generation
10	CE compliance
11	Certified safety technology
12	UL certification

1.3 Packaging, transport, storage

Packaging material and transport

Caution! *The packaging material is inflammable, if it is disposed of improperly by burning, lethal fumes may develop.*

The packaging material must be kept and reused in the case of a return shipment. Improper or faulty packaging may lead to transport damages.

Make sure to transport the drive always in a safe manner and with the aid of suitable lifting equipment (**Weight** (see page 523, see page 513)). Do never use the electric connections for lifting. Before the transport, a clean, level surface should be prepared to place the device on. The electric connections may not be damaged when placing the device.

First device checkup

- ◆ Check the device for signs of transport damages.
- ◆ Verify, if the indications on the **Type identification plate** (see page 14) correspond to your requirements.
- ◆ Check if the consignment is complete.

Storage

If you do not wish to mount and install the device immediately, make sure to store it in a dry and clean **environment** (see page 525). Make sure that the device is not stored near strong heat sources and that no metal chippings can get into the device.

Disposal

This product contains materials that fall under the special disposal regulation from 1996, which corresponds to the EC directory 91/689/EEC for dangerous disposal material. We recommend to dispose of the respective materials in accordance with the respectively valid environmental laws. The following table states the materials suitable for recycling and the materials which have to be disposed of separately.

Material	suitable for recycling	Disposal
Metal	yes	no
Plastic materials	yes	no
Circuit boards	no	yes

Please dispose of the circuit boards according to one of the following methods:

- ◆ Burning at high temperatures (at least 1200°C) in an incineration plant licensed in accordance part A or B of the environmental protection act.
- ◆ Disposal via a technical waste dump which is allowed to take on electrolytic aluminium condensers. Do under no circumstances dump the circuit boards at a place near a normal waste dump.

1.4 Safety Instructions

In this chapter you can read about:

General hazards	16
Safety-conscious working	16
Special safety instructions	17

1.4.1. General hazards

General Hazards on Non-Compliance with the Safety Instructions

The device described in this manual is designed in accordance with the latest technology and is safe in operation. Nevertheless, the device can entail certain hazards if used improperly or for purposes other than those explicitly intended. Electronic, moving and rotating components can

- ◆ constitute a hazard for body and life of the user, and
- ◆ cause material damage

Usage in accordance with intended purpose

The device is designed for operation in electric power drive systems (VDE0160). Motion sequences can be automated with this device. Several motion sequences can be combined by interconnecting several of these devices. Mutual interlocking functions must be incorporated for this purpose.

1.4.2. Safety-conscious working

This device may be operated only by qualified personnel.

Qualified personnel in the sense of these operating instructions consists of:

- ◆ Persons who, by virtue to their training, experience and instruction, and their knowledge of pertinent norms, specifications, accident prevention regulations and operational relationships, have been authorized by the officer responsible for the safety of the system to perform the required task and in the process are capable of recognizing potential hazards and avoiding them (definition of technical personnel according to VDE105 or IEC364),
- ◆ Persons who have a knowledge of first-aid techniques and the local emergency rescue services.
- ◆ Persons who have read and will observe the safety instructions.
- ◆ Those who have read and observe the manual or help (or the sections pertinent to the work to be carried out).

This applies to all work relating to setting up, commissioning, configuring, programming, modifying the conditions of utilization and operating modes, and to maintenance work.

This manual and the help information must be available close to the device during the performance of all tasks.

1.4.3. Special safety instructions

- ◆ Check the correct association of the device and its documentation.
- ◆ Never detach electrical connections while voltage is applied to them.
- ◆ Safety devices must be provided to prevent human contact with moving or rotating parts.
- ◆ Make sure that the device is operated only when it is in perfect condition.
- ◆ Implement and activate the stipulated safety functions and devices.
- ◆ Operate the device only with the housing closed.
- ◆ Make sure that all axes are sufficiently fixed.
- ◆ Attention during configuration downloads with master - slave couplings (electronic gear, cam)
Deactivate the drive before starting the configuration download: Master and Slave axis
- ◆ Check that all live terminals are secured against contact. Fatal voltage levels of to 850V occur.
- ◆ Do not bypass power direct current



Due to movable machine parts and high voltages, the device can pose a lethal danger. Danger of electric shock in the case of non-respect of the following instructions. The device corresponds to DIN EN 61800-3, i.e. it is subject to limited sale. The device can emit disturbances in certain local environments. In this case, the user is liable to take suitable measures.

- ◆ The device must be permanently grounded due to high earth leakage currents.
- ◆ The drive motor must be grounded with a suitable protective lead.
- ◆ The devices are equipped with high voltage DC condensers. Before removing the protective cover, the discharging time must be awaited. After switching off the energy, it may take up to 5 minutes to discharge the capacitors. Danger of electric shock in case of non respect.
- ◆ Before you can work on the device, the supply voltage must be switched off at the L1, L2 and L3 clamps. Wait at least 3 minutes so that the power direct current may sink to a secure value (<50V). Check with the aid of a voltmeter, if the voltage at the DC+ and DC- clamps has fallen to a value below 50V (not possible on the Compax3M).
- ◆ Do never perform resistance tests with elevated voltages (over 690V) on the wiring without separating the circuit to be tested from the drive.
- ◆ In the event of a device exchange it is absolutely necessary to transfer the configuration determining the correct operation of the drive to the device, before the device is put into operation.
- ◆ The device contains electrostatically sensitive components. Please heed the electrostatic protection measures while working at/with the device as well as during installation and maintenance.



Attention hot surface!

The heat dissipator can reach very high temperatures (>70°C)

Protective covers

The user is responsible for protective covers and/or additional safety measures in order to prevent damages to persons and electric accidents.

1.5 Warranty conditions

- ◆ The device must not be opened.
- ◆ Do not make any modifications to the device, except for those described in the manual.
- ◆ Make connections to the inputs, outputs and interfaces only in the manner described in the manual.
- ◆ Fix the devices according to our **mounting instructions**. (see page 78)
We cannot provide any guarantee for any other mounting methods.

Note on exchange of options

Compax3 options must be exchanged in the factory to ensure hardware and software compatibility.

- ◆ When installing the device, make sure the heat dissipators of the device receive sufficient air and respect the recommended mounting distances of the devices with integrated ventilator fans in order to ensure free circulation of the cooling air.
- ◆ Make sure that the mounting plate is not exposed to external temperature influences.

1.6 Conditions of utilization

In this chapter you can read about:

Conditions of utilization for CE-conform operation	19
Conditions of utilization for UL certification Compax3S	22
Conditions of utilization for UL certification Compax3M	24
Current on the mains PE (leakage current)	25
Supply networks	25

1.6.1. Conditions of utilization for CE-conform operation

- Industry and trade -

The EC guidelines for electromagnetic compatibility 2006/95/EC and for electrical operating devices for utilization within certain voltage limits 2004/108/EC are fulfilled when the following boundary conditions are observed:

Operation of the devices only in the condition in which they were delivered, i.e. with all housing panels.

In order to ensure contact protection, all mating plugs must be present on the device connections even if they are not wired.

Mains filter: A mains filter is required in the mains input line if the motor cable exceeds a certain length. Filtering can be provided centrally at the plant mains input or separately at the mains input to each device or with C3M for each axis combination.

Devices in a commercial and residential area (limit values of Class C2 in accordance with EN 61800-3)

The following mains filters are available for independent utilization:

Device: Compax3	Order No.:	Condition:
S0xxV2	NFI01/01	Only for motor lines > 10m
S1xxV2, S0xxV4, S150V4	NFI01/02	Only for motor lines > 10m
S300V4	NFI01/03	independent of the length of the motor cable (always required)
Device: Compax3	Order No.:	Condition:
H050V4	NFI02/01	Only for motor lines > 10m
H090V4	NFI02/02	Only for motor lines > 10m
H1xxV4	NFI02/03	Only for motor lines > 10m

Industrial area (limit values class C3 in accordance with EN 61800-3)

Longer motor cable lengths are possible in industrial areas.

Devices in the industrial area (limit values class C3 in accordance with EN 61800-3)

The following mains filters are available for independent utilization:

Device: Compax3	Order No.:	Condition:
MP10	NFI03/01	Reference axis combination 6x10m
MP10	NFI03/02	Reference axis combination 6x50m
MP20	NFI03/03	Reference axis combination 6x50m

Connection length: Connection between mains filter and device:

unshielded: < 0.5m
 shielded: < 5m (fully shielded on ground – e.g. ground of control cabinet)

Motor and Feedback cable:

Operation of the devices only with motor and feedback cables whose plugs contain a special full surface area screening.

Requirements for Compax3S motor cable

<100 m (the cable must not be rolled up!)
 A **motor output filter** (see page 471) is required for motor cables >20m :
 ♦ MDR01/04 (max. 6.3A rated motor current)
 ♦ MDR01/01 (max. 16A rated motor current)
 ♦ MDR01/02 (max. 30A rated motor current)

Requirements for Compax3H motor cable

A motor output filter is required for motor cables >50m. Please contact us.

Requirements for Compax3M motor cable

<80m per axis (the cable must not be rolled up!)
 The entire length of the motor cable per axis combination may not exceed 300m.
 A **motor output filter** (see page 471) is required for motor cables >20m :
 ♦ MDR01/04 (max. 6.3A rated motor current)
 ♦ MDR01/01 (max. 16A rated motor current)
 ♦ MDR01/02 (max. 30A rated motor current)

Shielding connection of the motor cable

The cable should be fully screened and connected to the Compax3 housing. We offer a special Shield connecting terminal as accessory item (ZBH./...). The shield of the cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.

Requirements for encoder cable Compax3:

<100m

Requirements for Compax3M encoder cable:

<80m

Requirements for other cables

Corresponding to the specifications of the terminal clamp with a temperature range of up to 60°C.

Motors: Operation with standard motors.

Control: Use only with aligned controller (to avoid control loop oscillation).

Grounding: Connect the filter housing and the Compax3 to the cabinet frame, making sure that the contact area is adequate and that the connection has low resistance and low inductance.
 Never mount the filter housing and the device on paint-coated surfaces!

Cable installation: Signal lines and power lines should be installed as far apart as possible. Signal leads should never pass close to excessive sources of interference (motors, transformers, contactors etc.).

Accessories: Make sure to use only the accessories recommended by Parker

Connect all cable shields at both ends, ensuring large contact areas!

Warning:

This is a product in the restricted sales distribution class according to EN 61800-3. In a domestic area this product can cause radio frequency disturbance, in which case the user may be required to implement appropriate remedial measures.

1.6.2. Conditions of utilization for UL certification Compax3S

UL certification for Compax3S

conform to UL:	◆ according to UL508C
Certified	◆ E-File_No.: E235 342

The UL certification is documented by a "UL" logo on the device (type specification plate).

"UL" logo



Conditions of utilization

- ◆ The devices are only to be installed in a degree of contamination 2 environment (maximum).
- ◆ The devices must be appropriately protected (e.g. by a switching cabinet).
- ◆ The X2 terminals are not suitable for field wiring.
- ◆ Tightening torque of the field wiring terminals (green Phoenix plugs)
 - ◆ C3S0xxV2 0.57 - 0.79Nm 5 - 7Lb.in
 - ◆ C3S1xxV2, 0.57 - 0.79Nm 5 - 7Lb.in
 - C3S0xxV4, C3S150V4
 - ◆ C3S300V4 1.25 - 1.7Nm 11 - 15Lb.in
- ◆ Temperature rating of field installed conductors shall be at least 60°C Use copper lines only
Please use the cables described in the **accessories chapter** (see page 458, see page 460), they do have a temperature rating of at least 60°C.
- ◆ Maximum ambient temperature: 45°C.
- ◆ Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes and 480 volts maximum.



ATTENTION

Danger of electric shock.

Discharge time of the bus capacitor is 5 minutes.

- ◆ The drive provides internal motor overload protection.
This must be set so that 200% of the motor nominal current are not exceeded.
- ◆ Cable cross-sections
 - ◆ Mains input: corresponding to the recommended fuses.
 - ◆ **Motor cable:** (see page 477) corresponding to the **nominal output currents** (see page 516, see page 515)
 - ◆ Maximum cross-section limited by the terminals mm² / AWG
 - ◆ C3S0xxV2 2.5mm² AWG 12
 - ◆ C3S1xxV2, 4.0mm² AWG 10
 - C3S0xxV4, C3S150V4
 - ◆ C3S300V4 6.0mm² AWG 7

◆ Fuses

In addition to the main fuse, the devices must be equipped with a S 201 K or S 203 K fuse made by ABB.

- ◆ C3S025V2: ABB, nominal 480V 10A, 6kA
- ◆ C3S063V2: ABB, nominal 480V, 16A, 6kA
- ◆ C3S100V2: ABB, nominal 480V, 16A, 6kA
- ◆ C3S150V2: ABB, nominal 480V, 20A, 6kA
- ◆ C3S015V4: ABB, nominal 480V, 6A, 6kA
- ◆ C3S038V4: ABB, nominal 480V, 10A, 6kA
- ◆ C3S075V4: ABB, nominal 480V, 16A, 6kA
- ◆ C3S150V4: ABB, nominal 480V, 20A, 6kA
- ◆ C3S300V4: ABB, nominal 480V, 25A, 6kA

1.6.3. Conditions of utilization for UL certification Compax3M

UL certification for Compax3M

conform to UL:	◆ according to UL508C
Certified	◆ E-File_No.: E235 342

The UL certification is documented by a "UL" logo on the device (type specification plate).



Conditions of utilization

- ◆ The devices are only to be installed in a degree of contamination 2 environment (maximum).
- ◆ The devices must be appropriately protected (e.g. by a switching cabinet).
- ◆ Tightening torque of the field wiring terminals (green Phoenix plugs)

Device	X40: Braking Resistor	X41: Mains connector	X9: 24VDC
C3MP10	0.5 (4.43Lb.in)	1.2Nm (10.62Lb.in)	1.2Nm (10.62Lb.in)
C3MP20	0.5 (4.43Lb.in)	1.7Nm (15Lb.in)	1.2Nm (10.62Lb.in)

Device	X43: Motor connector	X15: Temperature monitoring
C3M050-150	0.5 (4.43Lb.in)	0.22Nm (1.95Lb.in)
C3M300	1.2Nm (10.62Lb.in)	0.22Nm (1.95Lb.in)

- ◆ Temperature rating of field installed conductors shall be at least 60°C Use copper lines only
Please use the cables described in the **accessories chapter** (see page 458, see page 460), they do have a temperature rating of at least 60°C.
- ◆ Maximum ambient temperature: 40°C.
- ◆ Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes and 480 volts maximum.



ATTENTION

Danger of electric shock.
Discharge time of the bus capacitor is approx. 5 minutes.

- ◆ The drive provides internal motor overload protection.
This must be set so that 200% of the motor nominal current are not exceeded.
- ◆ Cable cross-sections
 - ◆ Mains input: corresponding to the recommended fuses.
 - ◆ **Motor cable:** (see page 477) corresponding to the **nominal output currents** (see page 516, see page 515)
- ◆ Maximum cross-section limited by the terminals mm² / AWG

Line cross-sections of the power connections (on the device bottoms)

Compax3 device:	Cross-section: Minimum... Maximum[mm ² with contactor sleeve]
M050, M100, M150	0,25 ... 4 (AWG: 23 ... 11)
M300	0,5 ... 6 (AWG: 20 ... 10)
MP10	Mains supply: 0,5 ... 6 (AWG: 20 ... 10) Braking resistor: 0,25 ... 4 (AWG: 23 ... 11)
MP20	Mains supply: 0,5 ... 16 (AWG: 20 ... 6) Braking resistor: 0,25 ... 4 (AWG: 23 ... 11)

1.6.4. Current on the mains PE (leakage current)



This product can cause a direct current in the protective lead. If a residual current device (RCD) is used for protection in the event of direct or indirect contact, only a type B (all current sensitive) RCD is permitted on the current supply side of this product. On the other hand a different protective measure must be taken, such as for example separation from the environment by double or enforced insulation or separation from the supply network by a transformer.

Please heed the connection instructions of the RCD supplier.

Mains filters do have high leakage currents due to their internal capacity. An internal mains filter is usually integrated into the Compax3 servo controllers.

Additional leakage currents are caused by the capacities of the motor cable and of the motor windings. Due to the high clock frequency of the power output stage, the leakage currents do have high-frequency components. Please check if the FI protection switch is suitable for the individual application.

If an external mains filter is used, an additional leakage current will be produced.

The figure of the leakage current depends on the following factors:

- ◆ Length and properties of the motor cable
- ◆ Switching frequency
- ◆ Operation with or without external mains filter
- ◆ Motor cable with or without shield network
- ◆ Motor housing grounding (how and where)

Remark:

- ◆ The leakage current is important with respect to the handling and usage safety of the device.
- ◆ A pulsing leakage current occurs if the supply voltage is switched on.

Please note:

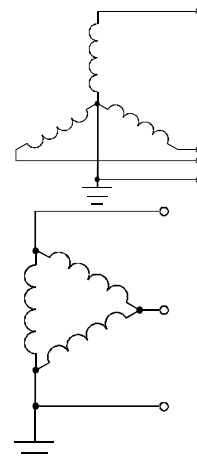
The device must be operated with effective grounding connection, which must comply with the local regulations for high leakage currents (>3.5mA).

Due to the high leakage currents it is not advisable to operate the servo controller with an earth leakage circuit breaker.

1.6.5. Supply networks

The Compax3 servo controller series is designed for fixed connection to TN networks (TN-C, TN-C-S or TN-S). Please note that the line-earth voltage may not exceed 300VAC.

- ◆ When grounding the neutral conductor, mains voltages of up to 480VAC are permitted.
- ◆ When grounding an external conductor (delta mains, two-phase mains), mains voltages (external conductor voltages) of up to 300VAC are permitted.



Servo controllers which are to be connected to an IT network must be provided with a separating transformer. Then the Compax3 device is operated locally like in

a TN network. The secondary sided center of the separating transformer must be grounded and connected to the PE connector of the Compax3.

2. IEC 61131-3 - Positioning with function modules based on PLCopen

IEC 61131-3 Programming

Due to its high functionality, Compax3 in the version “IEC 61131-3 - Positioning with function modules based on PLCopen” forms an ideal basis for many applications in high-performance motion automation.

A standard with general applicability was created with Standard IEC 61131-3. The programming system is equipped with a series of functions in addition to the compliant editor. The Motion Control functions specified in PLCopen are also provided by Parker as a library with the device and control software.

The graphical program editor supports the following functions:

- ◆ Ladder diagram
- ◆ Function block diagram (structurally-guided)
- ◆ Function block diagram (free graphical editor)

The text-oriented editor supports programming in

- ◆ Instruction list
- ◆ Structured text

Programming of Compax3 based on IEC 61131-3 is also made considerably easier by a series of additional functions. This includes in particular Syntax Coloring, multi-level undo/redo and context-sensitive input help.

Interfaces with superordinate controllers

Independent of your motion automation you can access Compax3 externally via different interfaces (e.g. with the superordinate control):

- ◆ via RS232 / RS485
- ◆ via digital Inputs/Outputs (Interface I11)
- ◆ via Profibus (Interface I20)
- ◆ via CANopen (Interface I21)

Profibus (I20 - functions)

The higher-level control system communicates with Compax3 via Profibus.

A number of different cyclic transfer telegrams (which can be conveniently adjusted with the Compax3 ServoManager) can be used to adjust bus communication to the requirements of specific applications.

In addition to the cyclic data channel, parameter access is also possible via a DPV1 master or using the parameter channel with a DPV0 master.

CANopen (I21 - functions)

The higher level control system communicates with Compax3 via CANopen.

Via various cyclic process data objects (which can be comfortably set with the Compax3 ServoManager) the bus communication can be adapted to the application requirements.

Apart from the cyclic process data objects, acyclic parameter access is possible via service data objects.

DeviceNet (I22 functions)

The higher level control system communicates with Compax3 via DeviceNet.

Cyclic I/O messages (which can be conveniently adjusted with the Compax3 ServoManager) can be used to adjust bus communication to the requirements of specific applications.

Besides the cyclic data, acyclic access to objects is possible via Explicit Messages.

Compax3 control technology

High-performance control technology and openness for various sender systems are fundamental requirements for a fast and high-quality automation of movement.

Model / standards / auxiliary material

The structure and size of the device are of considerable importance. High-quality electronics are a fundamental requirement for the particularly small and compact form of the Compax3 devices. All connectors are located on the front of the Compax3S.

Partly integrated mains filters permit connection of motor cables up to a certain length without requiring additional measures. EMC compatibility is within the limits set by EN 61800-3, Class A. The Compax3 is CE-conform.

The intuitive user interface familiar from many applications, together with the oscilloscope function, wizards and online help, simplifies making and modifying settings via the PC.

The optional **Operator control module (BDM01/01)** (see page 495)) for Compax3S/F makes it possible to exchange devices quickly without requiring a PC.

**Configuration**

Configuration is made on a PC using the Compax3 ServoManager.
General proceeding (see page 113)

3. Compax3 device description

In this chapter you can read about:

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Meaning of the status LEDs - Compax3MP (mains module)	30
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Compax3M with safety option S1: Safe torque off	98

3.1 Meaning of the status LEDs - Compax3 axis controller

Device status LEDs	Right LED (red)	Left LED (green)
Voltages missing	off	off
During the booting sequence	alternately flashing	
No configuration present. SinCos® feedback not detected. Compax3 IEC61131-3 program not compatible with Compax3 Firmware. no Compax3 IEC61131-3 program For F12: Hall signals invalid.	Flashes slowly	off
Axis without current excitation	off	Flashes slowly
Power supplied to axis; commutation calibration running	off	Flashes quickly
Axis with current excitation	off	on
Axis in fault status / fault present / axis energized (error reaction 1)	Flashes quickly	on
Axis in fault status / fault present / axis deenergized (error reaction 2)	on	off
Compax3 faulty: Please contact us.	on	on

Note on Compax3H: The **internal** device status LEDs are only connected to the **external** housing LEDs, if the RS232 jumper at X10 is fitted to the control and the upper dummy cover is fitted.

3.2 Meaning of the status LEDs - Compax3MP (mains module)

C3MP Status LEDs	Left LED (green)	Right LED (red)
Control voltage 24 VDC iss missing**	off	off
Error of mains module*	off	on
DC power voltage is built up	-	Flashes quickly
Phase failure / mains power supply undervoltage	on	Flashes slowly
Address assignment CPU active	Flashes quickly	-
Address assignment CPU completed	Flashes slowly	-
C3MPxx Ready - State	on	off
Incorrect wiring of internal communication X30/31	Flashes slowly	Flashes quickly

*can be read out in each axis controller



Caution!

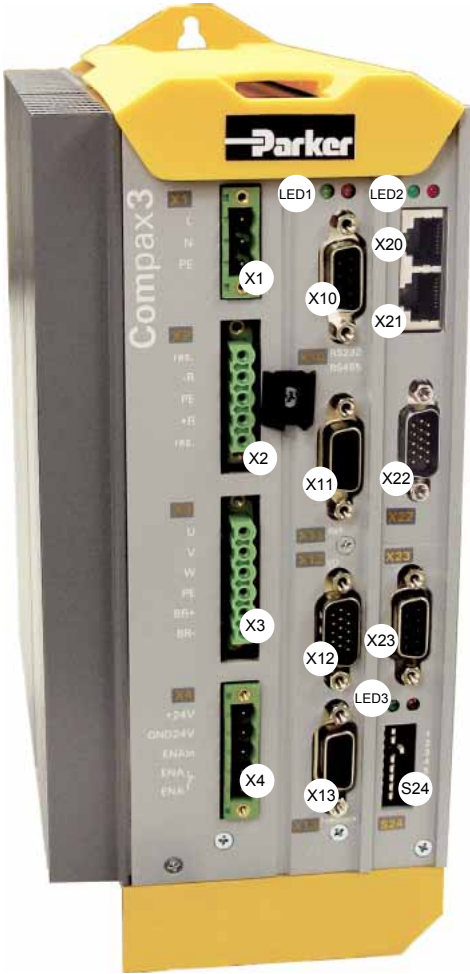
When the control voltage is missing there is no indication whether or not high voltage supply is available.

3.3 Connections of Compax3S

In this chapter you can read about:

Compax3S connectors	31
Connector and pin assignment C3S.....	32
Control voltage 24VDC / enable connector X4 C3S.....	34
Motor / Motor brake (C3S connector X3)	35
C3Sxxx V2.....	36
C3Sxxx V4.....	39

3.3.1. Compax3S connectors



X1	AC Supply	X20	HEDA in (Option)
X2	Ballast / DC power voltage	X21	HEDA out (Option)
X3	Motor / Brake	X22	Inputs Outputs (Option M10/12)
X4	24VDC / Enable	X23	Bus (Option) connector type depends on the bus system!
X10	RS232/RS485	S24	bus settings
X11	Analog/Encoder	LED1	Device status LEDs
X12	Inputs/Outputs	LED2	HEDA LEDs
X13	Motor position feedback	LED3	Bus LEDs



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!



Caution!

When the control voltage is missing there is no indication whether or not high voltage supply is available.



PE connection

The PE connection is made with 10mm² via a grounding screw at the bottom of the device.



Attention hot surface!

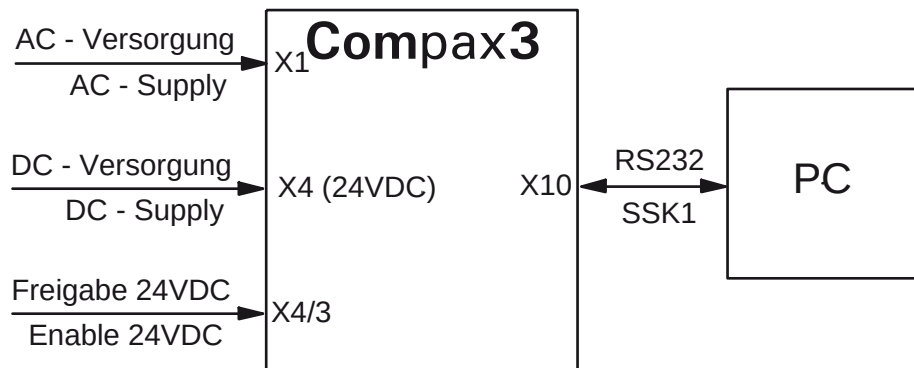
The heat dissipator can reach very high temperatures (>70°C)

Line cross sections of the line connections X1, X2, X3

Compax3 device:	Cross-section: Minimum... Maximum[mm ²]
S025V2, S063V2	0,25 ... 2.5 (AWG: 24 ... 12)
S100V2, S150V2 S015V4, S038V4, S075V4, S150V4	0,25 ... 4 (AWG: 24 ... 10)
S300V4	0,5 ... 6 (AWG: 20 ... 7)

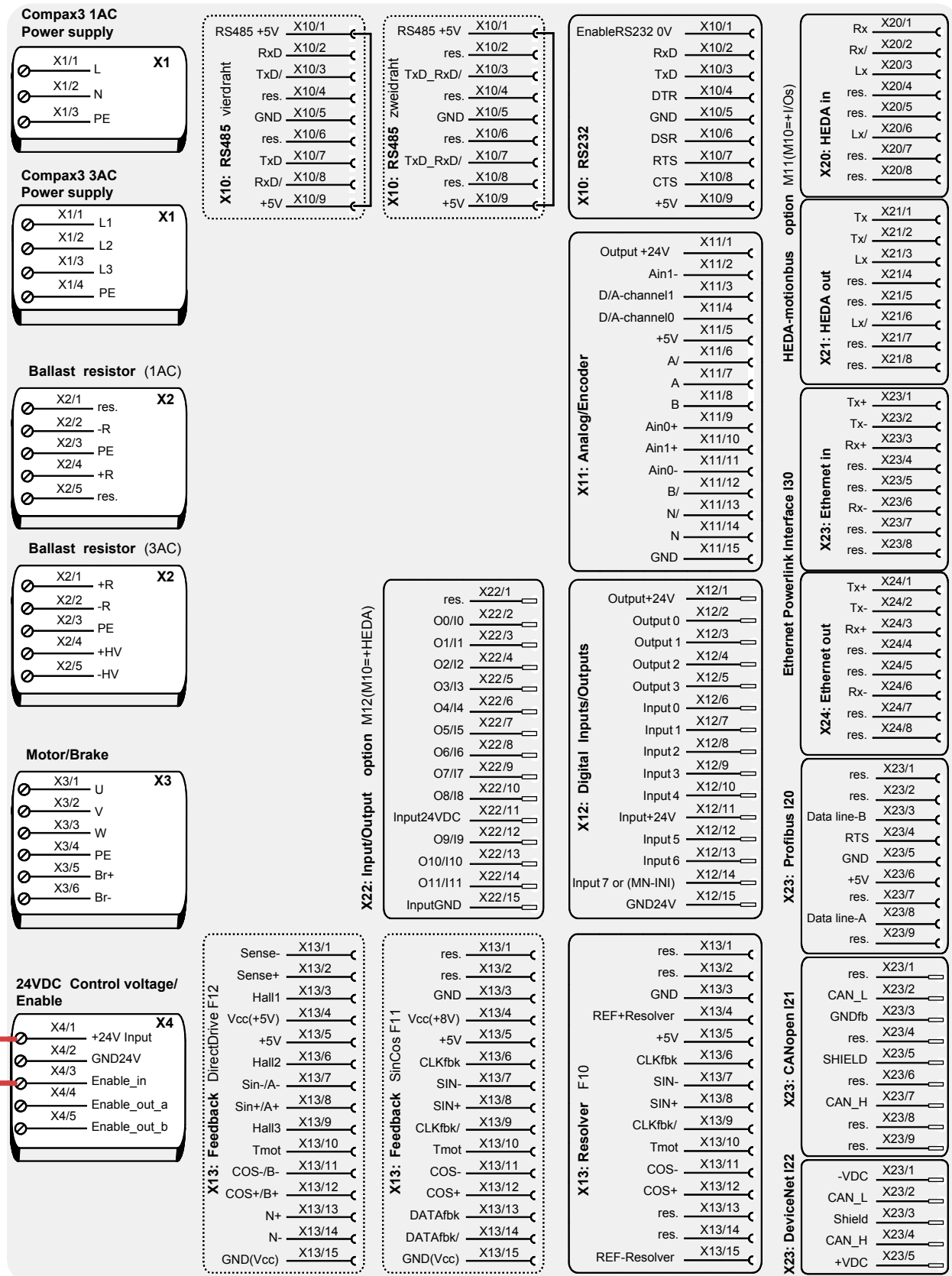
3.3.2. Connector and pin assignment C3S

Overview:



Further information on the assignment of the plug mounted at the particular device can be found below!

In detail: The fitting of the different plugs depends on the extension level of Compax3.
In part, the assignment depends on the Compax3 option implemented.



The jumper drawn in at X4 (at the left side in red) is used to enable the device for testing purposes.

During operation, the enable input is in most cases switched externally.

3.3.3. Control voltage 24VDC / enable connector X4 C3S



PIN	Description
1	+24V (supply)
2	Gnd24 V
3	Enable_in
4	Enable_out_a
5	Enable_out_b

Line cross sections:
 minimum: 0.25mm²
 maximum: 2.5mm²
 (AWG: 24 ... 12)

Control voltage 24VDC Compax3S and Compax3H

Controller type	Compax3
Voltage range	21 - 27VDC
Mains module	with switch-on current limitation, due to capacitive load
Fuse	MCB miniature circuit breaker or "delayed action fuse", due to capacitive load
Current drain of the device	0.8A
Total current drain	0.8 A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

Hardware - enable (input X4/3 = 24VDC)

This input is used as safety interrupt for the power output stage.
 Tolerance range: 18.0V - 33.6V / 720Ω

Safe standstill (X4/3=0V)

For implementation of the "Safe standstill" safety feature in accordance with the "protection against unexpected start-up" described in EN1037. Observe instructions in the corresponding **section** (see page 87) with the circuitry examples!

The energy supply to the drive is reliably shut off, the motor has no torque. A relay contact is located between X4/4 and X4/5 (normally closed contact)

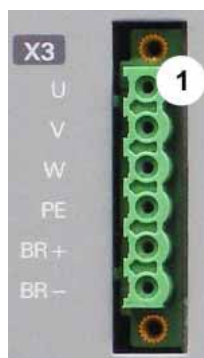
Enable_out_a - Enable_out_b	Power output stage is
Contact opened	activated
Contact closed	disabled

Series connection of these contacts permits certain determination of whether all drives are de-energized.

Relay contact data:

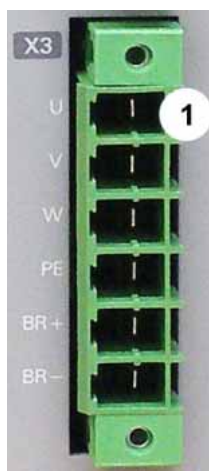
Switching voltage (AC/DC): 100mV -60V
 Switching current: 10mA - 0.3A
 Switching power: 1mW...7W

3.3.4. Motor / Motor brake (C3S connector X3)



PIN	Designation
1	U (motor)
2	V (motor)
3	W (motor)
4	PE (motor)
5	BR+ Motor holding brake *
6	BR- Motor holding brake *

*** Please note that Compax3 will report error "open circuit at holding brake" (5481h / 2163d) if the current is < 150mA.**
If needs be, use a parallel resistor of 150Ohm for relay control!



Requirements for motor cable

<100 m (the cable must not be rolled up!)

A **motor output filter** (see page 471) is required for motor cables >20m :

Shielding connection of the motor cable

The cable should be fully screened and connected to the Compax3 housing. We offer a special Shield connecting terminal as accessory item (ZBH./...). The shield of the cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.



Motor holding brake!

Connect the brake only on motors which have a holding brake!
 Otherwise make no brake connections at all.

Requirements cables for motor holding brake

If a motor holding brake is present, **a cable** of the motor holding brake must be fed on the device side through the toroidal core ferrite provided as accessory ZBH0x/xx (63Ω @1MHz, di=5.1mm), in order to ensure error-free switching on and off of the motor holding brake.

Motor holding brake output

Motor holding brake output	Compax3
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A
Minimum output current	150 mA

Motor cable (see page 477)

3.3.5. C3Sxxx V2

In this chapter you can read about:

Main voltage supply C3S connector X1	36
Braking resistor / high voltage DC C3S connector X2.....	37

3.3.5.1 Main voltage supply C3S connector X1

In this chapter you can read about:

Power supply plug X1 for 1 AC 230VAC/240VAC devices.....	36
Power supply plug X1 for 3AC 230VAC/240VAC devices.....	36

Device protection

By cyclically switching on and off the power voltage, the input current limitation can be overloaded, which will cause a device error.

Therefore please wait at least 2 minutes after switching off before you switch the device on again!



Power supply plug X1 for 1 AC 230VAC/240VAC devices

PIN	Designation
1	L
2	N
3	PE

Mains connection Compax3S0xxV2 1AC

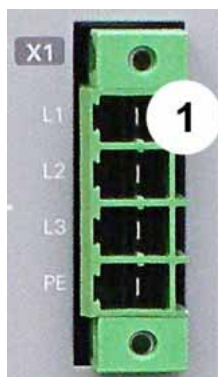
Controller type	S025V2	S063V2
Supply voltage	Single phase 230VAC/240VAC 80-253 VAC/50-60Hz	
Input current	6Aeff	13Aeff
Maximum fuse rating per device (=short circuit rating)	10 A (MCB miniature circuit breaker)	16 A (MCB miniature circuit breaker)



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!

Power supply plug X1 for 3AC 230VAC/240VAC devices



PIN	Designation
1	L1
2	L2
3	L3
4	PE

Mains connection Compax3S1xxV2 3AC

Controller type	S100V2	S150V2
Supply voltage	Three phase 3* 230VAC/240VAC 80-253 VAC/50-60Hz	
Input current	10Aeff	13Aeff
Maximum fuse rating per device (=short circuit rating)	16 A (MCB miniature circuit breaker)	20 A (MCB miniature circuit breaker)

Caution!

The 3AC V2 – devices must only be operated with three phases!



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!

3.3.5.2

Braking resistor / high voltage DC C3S connector X2

In this chapter you can read about:

Braking resistor / high voltage supply plug X2 for 1AC 230VAC/240VAC devices..... 37

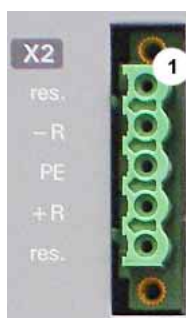
Braking resistor / high voltage supply plug X2 for 3AC 230VAC/240VAC devices..... 38

Connection of a braking resistor..... 38

The energy generated during braking operation is absorbed by the Compax3 storage capacity.

If this capacity is too small, the braking energy must be drained via a braking resistor.

Braking resistor / high voltage supply plug X2 for 1AC 230VAC/240VAC devices



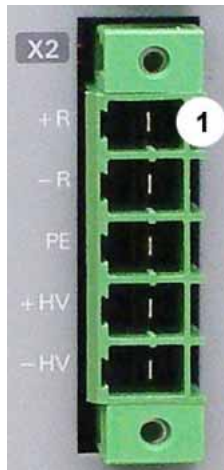
PIN	Designation
1	Reserved
2	- braking resistor (not short-circuit protected!)
3	PE
4	+ braking resistor (not short-circuit protected!)
5	Reserved

Braking operation Compax3S0xxV2 1AC

Controller type	S025V2	S063V2
Capacitance / storable energy	560μF / 15Ws	1120μF / 30Ws
Minimum braking- resistance	100Ω	56Ω
Recommended nominal power rating	20 ... 60W	60 ... 180W
Maximum continuous current	8A	15A

Caution!

The power voltage DC of two Compax3 1AC V2 devices (230VAC/240VAC devices) must not be connected.

**Braking resistor / high voltage supply plug X2 for 3AC
230VAC/240VAC devices**


PIN	Description	
1	+ Braking resistor	no short-circuit protection!
2	- Braking resistor	
3	PE	
4	+ DC high voltage supply	
5	- DC high voltage supply	

Braking operation Compax3S1xxV2 3AC

Controller type	S100V2	S150V2
Capacitance / storable energy	780 μ F / 21Ws	1170 μ F / 31Ws
Minimum braking- resistance	22 Ω	15 Ω
Recommended nominal power rating	60 ... 450W	60 ... 600W
Maximum continuous current	20A	20A

Connection of a braking resistor

Minimum line cross section: 1.5mm²
 Maximum line length: 2m
 Maximum output voltage: 400VDC

3.3.6. C3Sxxx V4

In this chapter you can read about:

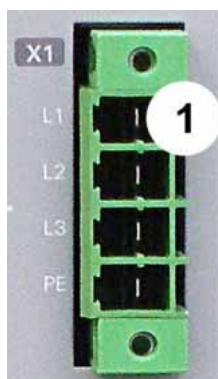
Power supply connector X1 for 3AC 400VAC/480VAC-C3S devices	39
Braking resistor / high voltage supply connector X2 for 3AC 400VAC/480VAC_C3S devices	40
Connection of the power voltage of 2 C3S 3AC devices.....	41

3.3.6.1 Power supply connector X1 for 3AC 400VAC/480VAC-C3S devices

Device protection

By cyclically switching on and off the power voltage, the input current limitation can be overloaded, which will cause a device error.

Therefore please wait at least 2 minutes after switching off before you switch the device on again!



PIN	Designation
1	L1
2	L2
3	L3
4	PE

Mains connection Compax3SxxxV4 3AC

Controller type	S015V4	S038V4	S075V4	S150V4	S300V4
Supply voltage	Three phase 3*400VAC/480VAC 80-528VAC / 50-60Hz				
Input current	3Aeff	6Aeff	10Aeff	16Aeff	22Aeff
Maximum fuse rating per device(=short circuit rating)	6A	10A	16A	20A	25A
	MCB miniature circuit breaker				D*

* for UL conform operation (see page 22): MCB miniature circuit breaker S273-K.

Caution!

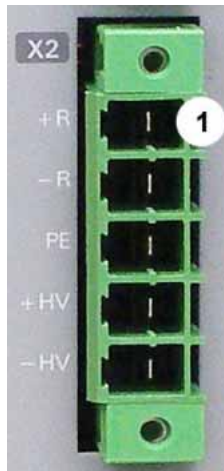
The 3AC V4 – devices must only be operated with three phases!



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!

3.3.6.2 Braking resistor / high voltage supply connector X2 for 3AC 400VAC/480VAC_C3S devices



PIN	Description	
1	+ Braking resistor	no short-circuit protection!
2	- Braking resistor	
3	PE	
4	+ DC high voltage supply	
5	- DC high voltage supply	

Braking operation Compax3SxxxV4 3AC

Controller type	S015V4	S038V4	S075V4	S150V4	S300V4
Capacitance / storable energy	235μF / 37Ws	235μF / 37Ws	470μF / 75Ws	690μF / 110Ws	1100μF / 176Ws
Minimum braking-resistance	100Ω	100Ω	56Ω	33Ω	15Ω
Recommended nominal power rating	60 ... 100W	60 ... 250W	60 ... 500 W	60 ... 1000 W	60 ... 1000 W
Maximum continuous current	10A	10A	15A	20A	30A

Connection of a braking resistor

Minimum line cross section: 1.5mm²
 Maximum line length: 2m
 Maximum output voltage: 800VDC

3.3.6.3 Connection of the power voltage of 2 C3S 3AC devices

Caution!

The power voltage DC of the single phase Compax3 servo axes must not be connected!

In order to improve the conditions during brake operation, the DC power voltage of 2 servo axes may be connected.

The capacity as well as the storable energy are increased; furthermore the braking energy of one servo axis may be utilized by a second servo axis, depending on the application.



It is not permitted to connect the power voltage in order to use one brake circuit for two servo axes, as this function cannot be ensured reliably.

Note the following:

Caution! In case of non-compliance with the following instructions, the device may be destroyed!

- ◆ You can only connect two similar servo axes (same power supply; same rated currents)
- ◆ Connected servo axes must always be fed separately via the AC power supply. If the external pre-fuse of one of the servo axes takes action, the second servo axis must also be disconnected automatically.

Please connect as follows:

Servo axis 1 X2/4 to servo axis 2 X2/4

Servo axis 1 X2/5 to servo axis 2 X2/5

3.4 Installation instructions Compax3M

General introductory notes

- ◆ Operation of the Compax3M multi-axis combination is only possible in connection with a Compax3MP (mains module).
- ◆ Axis controllers are aligned at the right of the mains module.
- ◆ Alignment within the multi-axis combination sorted by power (with the same device types according to device utilization), the axis controller with the highest power directly at the right of the mains module.
e.g. first the device type with high utilization, at the right of this the same device type with a lower utilization.
- ◆ Max. 15 Compax3M (axis controllers) per Compax3MP (mains module) are permitted (please respect the total capacity of max. 2400μF).
- ◆ The continuation of the current rail connection outside the axis combination is not permitted and will lead to a loss of the CE and UL approbation.
- ◆ External components **may not** be connected to the rail system.

Required tools:

- ◆ Allen key M5 for fixing the devices in the control cabinet.
- ◆ Crosstip screwdriver M4 for connection rails of the DC rail modules.
- ◆ Crosstip screwdriver M5 for grounding screw of the device.
- ◆ Flat-bladed screwdriver 0.4x2.5 / 0.6x3.5 / 1.0x4.0 for wiring and mounting of the phenix clamps.

Order of installation

- ◆ Fixing the devices in the control cabinet.
 - ◆ Predrilling the mounting plate in the control cabinet according to the specifications. dimensions. Fit M5 screws loosely in the bores.
 - ◆ Fit device on the upper screws and place on lower screw. Tighten screws of all devices. The tightening torque depends on the screw type (e.g. 5.9Nm for M5 screw DIN 912 8.8).
- ◆ Connection of the internal supply voltage.
The Compax3M axis controllers are connected to the supply voltages via the rail modules. **Details** (see page 45).
 - ◆ Deblocking the yellow protective cover with a flat-bladed screwdriver on the upper surface (click mechanism). Remove the closing devices (contact protection) that are not required from between the devices.
 - ◆ Connecting the rail modules, beginning with the mains module.
For this, loosen crossheadscrews (5 screws at the right in the mains module, all 10 screws in the next axis controller), push the rails one after the other against to the left and tighten screws. Proceed accordingly for all adjacent axis controllers in the combination.
Max. tightening torque: 1.5Nm.
 - ◆ Close all protective covers. The protective covers must latch audibly.

Please Note:

Insufficiently fixed screw connections of the DC power voltage rails may lead to the destruction of the devices.

Protective covers

In order to secure the contact protection against the alive rails, it is absolutely necessary to respect the following:

- ◆ Insert the yellow plastic device at the left or right of the rails.
Make sure that the yellow plastic device is placed at the left of the first device and at the right of the last device in the combination and have not been removed.
- ◆ Setup of the devices only with closed protective covers.
- ◆ Connect protective earth to mains module (M5 crossheadscrew on front of device bottom).
- ◆ Connecting the internal communication. **Details** (see page 64).
- ◆ Connecting the signal and fieldbus connectors. **Details** (see page 73).
- ◆ Connection of mains power supply **Details** (see page 48) ballast resistor **Details** (see page 50) and motor **Details** (see page 51).
- ◆ Connecting the configuration interface to the PC. **Details** (see page 64).

3.5 Compax3MP/Compax3M connections

In this chapter you can read about:

Front connector	43
Connections on the device bottom	43
Connections of the axis combination	45
Connector and pin assignment	46
Control voltage 24VDC Compax3MP (mains module)	48
Mains supply Compax3MP (mains module)	48
Braking resistor / temperature switch Compax3MP (mains module)	50
Motor / motor brake Compax3M (axis controller)	51

3.5.1. Front connector



MP	Power module
LED1	Status LEDs Mains module
S1	Basic address
X3	Configuraiton interface (USB)
X9	Supply voltage 24VDC
M	Axis controller
LED2	Status LEDs of the axis
S10	Function
X11	Analog/Encoder
X12	Inputs/Outputs
X13	Motor position feedback
X14	Safety technology (option)
X15	Motor temperature monitoring
LED3	HEDA LEDs
X20	HEDA in (Option)
X21	HEDA out (Option)
X22	Inputs Outputs (Option M10/12)
X23	Bus (option) connector type depends on the bus system!
X24	Bus (option) depends on the bus system!
LED4	Bus LEDs
S24	bus settings
1	Behind the yellow protective covers you can find the rails for the supply voltage connection. Supply voltage 24VDC DC power voltage supply

3.5.2. Connections on the device bottom



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!

**Caution!**

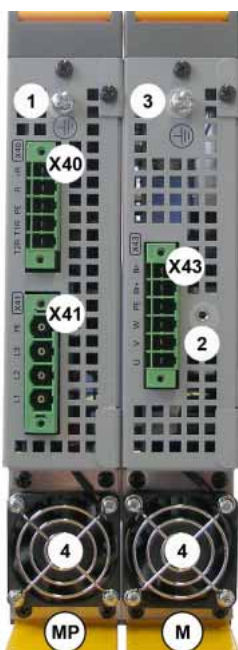
When the control voltage is missing there is no indication whether or not high voltage supply is available.

**PE connection**

The PE connection is made with 10mm² via a grounding screw at the bottom of the device.

Attention hot surface!

The heat dissipator can reach very high temperatures (>70°C)



MP	Power module
X40	Braking Resistor
X41	Mains supply VAC/PE
1	Central ground connection for the axis combination, with 10mm ² to the ground screw on the housing.
4	Fan*
M	Axis controller
X43	Motor / Brake
2	Fixing for motor shield clamp
4	Fan*
3	optionally, the axis controller features a ground screw on the housing, if the grounding is not possible via the back plate.

* is internally supplied.

Line cross-sections of the power connections (on the device bottoms)

Compax3 device:	Cross-section: Minimum... Maximum[mm ² with contactor sleeve]
M050, M100, M150	0,25 ... 4 (AWG: 23 ... 11)
M300	0,5 ... 6 (AWG: 20 ... 10)
MP10	Mains supply: 0,5 ... 6 (AWG: 20 ... 10) Braking resistor: 0,25 ... 4 (AWG: 23 ... 11)
MP20	Mains supply: 0,5 ... 16 (AWG: 20 ... 6) Braking resistor: 0,25 ... 4 (AWG: 23 ... 11)

3.5.3. Connections of the axis combination

The Compax3M axis controllers are connected to the supply voltages via rails.

- ◆ Supply voltage 24VDC
- ◆ DC power voltage supply

The rails are located behind the yellow protective covers. In order to connect the rails of the devices, you may have to remove the yellow plastic device inserted at the side.

CAUTION: Risk of Electric Shock



Please respect before opening:

◆ **Warning** - RISK OF SHOCK - Disconnect Power Before Removing Cover.



◆ **Caution** - Risk of Electric Shock! Energy for 5 minutes after "Power Off"!



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!



Caution!

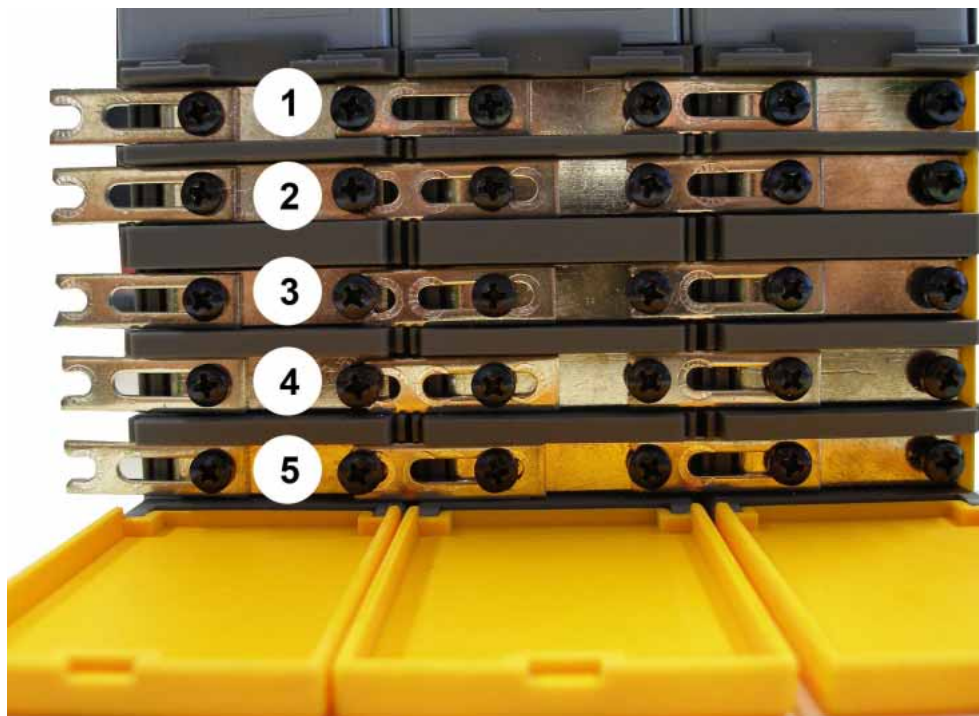
When the control voltage is missing there is no indication whether or not high voltage supply is available.

Protective covers



In order to secure the contact protection against the alive rails, it is absolutely necessary to respect the following:

- ◆ Insert the yellow plastic device at the left or right of the rails.
Make sure that the yellow plastic device is placed at the left of the first device and at the right of the last device in the combination and have not been removed.
- ◆ Setup of the devices only with closed protective covers.



- 1 24VDC
- 2 Gnd 24 V
- 3 -HV DC
- 4 PE
- 5 +HV DC

Note: External components **may not** be connected to the rail system.

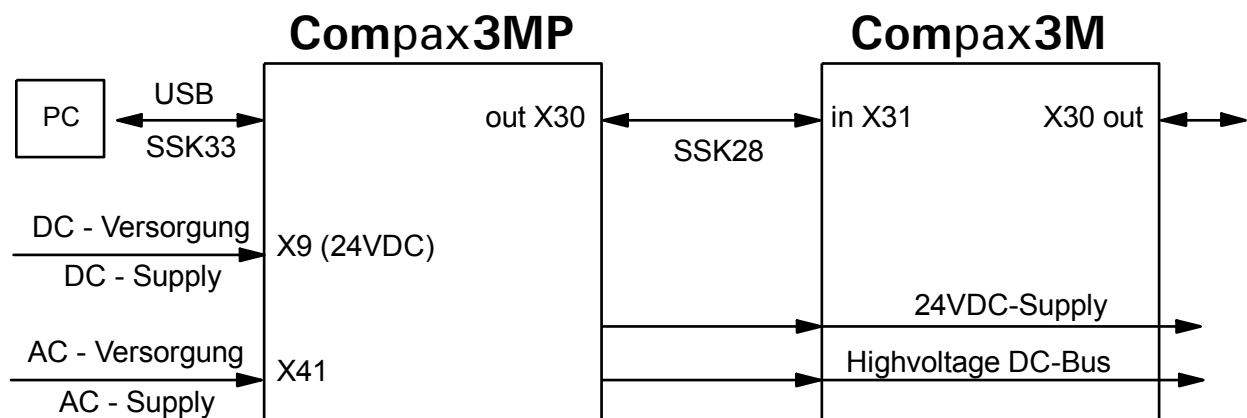
Protective covers



The user is responsible for protective covers and/or additional safety measures in order to prevent damages to persons and electric accidents.

3.5.4. Connector and pin assignment

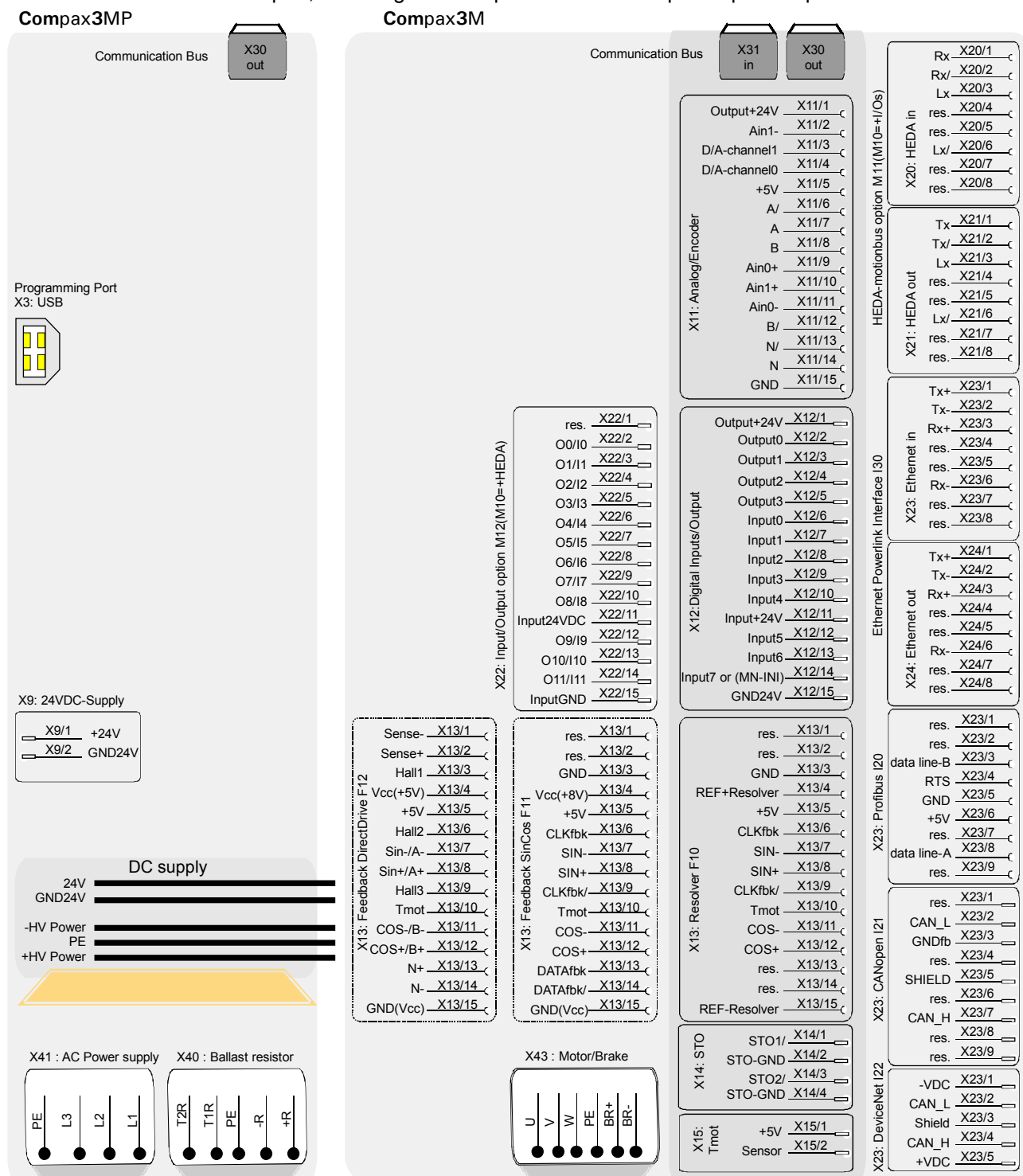
Overview:



Maximum no. of C3M axes in a combination: 15 axes (max. 2400µF)

Further information on the assignment of the plug mounted at the particular device can be found below!

In detail: The fitting of the different plugs depends on the extension level of Compax3.
In part, the assignment depends on the Compax3 option implemented.



Protective covers



The user is responsible for protective covers and/or additional safety measures in order to prevent damages to persons and electric accidents.

3.5.5. Control voltage 24VDC Compax3MP (mains module)

connector X9



PIN	Designation
1	+24V
2	Gnd 24 V

Line cross sections:
 minimum: 0.5mm² with contactor sleeve
 maximum: 6mm² with contactor sleeve
 (AWG: 20 ... 10)

Control voltage 24VDC Compax3MP / Compax3M

Device type	Compax3MP / Compax3M
Voltage range	21 - 27VDC
Mains module	with switch-on current limitation, due to capacitive load
Fuse	MCB miniature circuit breaker or "delayed action fuse", due to capacitive load
Current drain of the device	C3MP10D6: 0.2A C3MP20D6: 0.3A
Total current drain	C3M050D6: 0.85A C3M100D6: 0.85A C3M150D6: 0.85A C3M300D6: 1.0A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

3.5.6. Mains supply Compax3MP (mains module)

Device protection

By cyclically switching on and off the power voltage, the input current limitation can be overloaded, which may cause damage to the device.

Wait at least one minute between two switching on processes!

Connector X41



Pin designation
PE
L3
L2
L1

Mains connection Compax3MP10D6

Device type Compax3MP10	230V	400V	480V
Supply voltage	230VAC $\pm 10\%$ 50-60Hz	400VAC $\pm 10\%$ 50-60Hz	480VAC $\pm 10\%$ 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	22Aeff	22Aeff	18Arms
Output voltage	325VDC $\pm 10\%$	565VDC $\pm 10\%$	680VDC $\pm 10\%$
Output power	6kW	10 kW	10 kW
Maximum fuse rating per device (=short circuit rating)	MCB miniature circuit breaker according to DIVQ.GuideInfo Recommendation: (ABB) S203 UP-25K (480VAC)		

Mains connection Compax3MP20D6

Device type Compax3MP20	230V	400V	480V
Supply voltage	230VAC $\pm 10\%$ 50-60Hz	400VAC $\pm 10\%$ 50-60Hz	480VAC $\pm 10\%$ 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	44Arms	44Arms	35Arms
Output voltage	325VDC $\pm 10\%$	565VDC $\pm 10\%$	680VDC $\pm 10\%$
Output power	12kW	20kW	20kW
Maximum fuse rating per device (=short circuit rating)	MCB miniature circuit breaker 50A according to DIVQ.GuideInfo Recommendation: (ABB) S203-U50K (440VAC) Fuses 80A / 660VAC per supply leg according to UL-Guide JFHR2 Recommendation: Bussmann 170M		

Caution!

The Compax3MPxxD6 devices must only be operated with three phases!



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!

3.5.7. Braking resistor / temperature switch Compax3MP (mains module)

The energy generated during braking operation must be dissipated via a braking resistor.

Connector X40



PIN	Description	
+R	+ Braking resistor	no short-circuit protection!
-R	- Braking resistor	
PE	PE	
T1R	Temperature Switch	
T2R	Temperature Switch	

Braking operation Compax3MPxxD6 (mains module)

Device type Compax3	MP10	MP20
Capacitance / storable energy	550μF/ 92Ws at 400V 53Ws at 480V	1175μF/ 197Ws at 400V 114Ws at 480V
Minimum braking- resistance	27Ω	15Ω
Recommended nominal power rating	500 ... 1500W	500 ... 3500W
Pulse power rating for 1s	22kW	40kW
Maximum permissible continuous current	13A	15A

Braking operation Compax3MxxxD6 (axis controller)

Device type Compax3	M050	M100	M150	M300
Capacitance / storable energy	110μF/ 18Ws at 400V 10Ws at 480V	220μF/ 37Ws at 400V 21Ws at 480V	220μF/ 37Ws at 400V 21Ws at 480V	440μF/ 74Ws at 400V 42Ws at 480V

Maximum capacity in the axis combination: 2400μF

Connection of a braking resistor on Compax3MP (mains module)

Mimimum line cross section:	1.5mm ²
Maximum line length:	2m
Maximum intermediate circuit voltage:	810VDC
Switch-on threshold:	780VDC

3.5.7.1 Temperature switch Compax3MP (mains module)

Connector X40 Pin T1R, T2R

Temperature monitoring:

The temperature switch (normally closed contact) must be connected, unless an error message will be issued.

Temperature switch/relay

No galvanic separation, the temperature sensor (normally closed contact) must comply with the safe separation according to EN 60664.

If there is no temperature monitoring due to the connected braking resistor, the T1R and T2R connections must be connected by a jumper.

Without temperature monitoring, the braking resistor might be destroyed.



3.5.8. Motor / motor brake Compax3M (axis controller)

Connector X43



PIN	Designation
BR+	Motor holding brake *
BR-	Motor holding brake *
PE	PE (motor)
W	W (motor)
V	V (motor)
U	U (motor)

*** Please note that Compax3 will report the error "open circuit at holding brake" (5481h / 2163d) if the current is < 150mA.**

**Requirements for
Compax3M motor
cable**

<80m per axis (the cable must not be rolled up!)

The entire length of the motor cable per axis combination may not exceed 300m.

A **motor output filter** (see page 471) is required for motor cables >20m :

- ◆ MDR01/04 (max. 6.3A rated motor current)
- ◆ MDR01/01 (max. 16A rated motor current)
- ◆ MDR01/02 (max. 30A rated motor current)

Shielding connection of the motor cable

The cable should be fully screened and connected to the Compax3 housing. We offer a special Shield connecting terminal as accessory item (ZBH./...).

The shield of the cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.

Motor cables (see page 477) can be found in the accessories chapter of the device description.

Motor holding brake output

Motor holding brake output	Compax3
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A
Minimum output current	150 mA
Securing of brake Compax3M	3.15A

**Motor holding brake!**

Connect the brake only on motors which have a holding brake!
Otherwise make no brake connections at all.

Requirements cables for motor holding brake

If a motor holding brake is present, **a cable** of the motor holding brake must be fed on the device side through the toroidal core ferrite provided as accessory ZBH0x/xx (63Ω @1MHz, di=5.1mm), in order to ensure error-free switching on and off of the motor holding brake.

3.5.8.1**Measurement of the motor temperature of Compax3M (axis controller)****Connector X15**

The acquisition of the motor temperature by the axis controller can either take place via the connection of X15 (Tmot) or via the feedback cable and the corresponding connection on X13 PIN10.



PIN	Description
1	+5V
2	Sensor

The temperature acquisition on X15 Tmot can not be connected at the same time as X13 Pin 10.

3.6 Connections of Compax3H

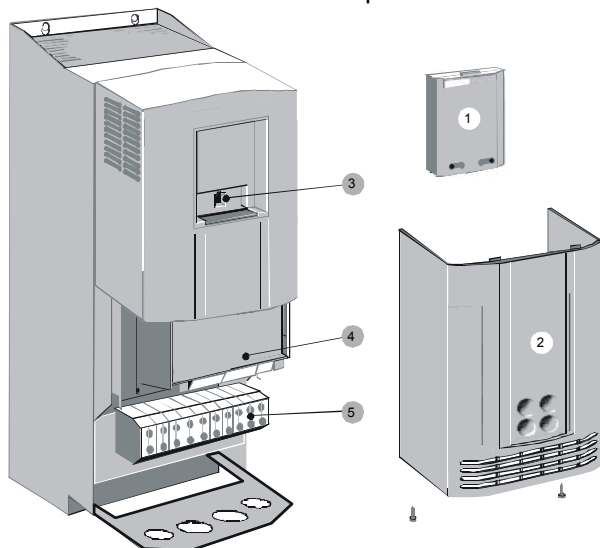
In this chapter you can read about:

Compax3H plugs/connections.....	53
Terminal clamps – max. line cross section C3H	54
Plug and pin assignment C3H	56
Motor / Motor brake C3H.....	58
Control voltage 24 VDC C3H.....	59
Mains connection Compax3H.....	60
Braking resistor / supply voltage C3H	60

3.6.1. Compax3H plugs/connections

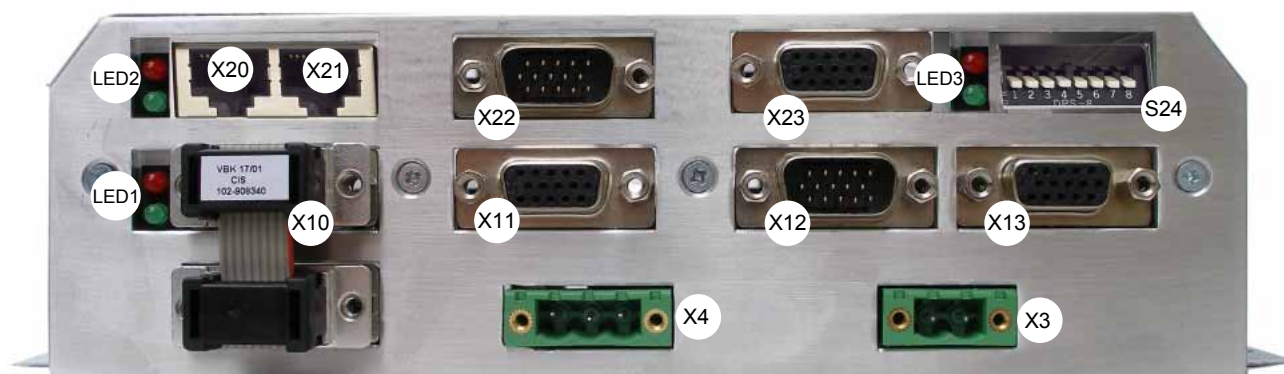
The following figure is an example for all sizes.

The fitting of the different controller plugs depends on the extension level of Compax3.



- (1): Dummy cover with display of the **external** device status LEDs.
- (2): lower clamp cover, fixed by 2 screws at the device bottom.
- (3): RS232 programming interface
Connection to the PC via adapter cable SSK32/20 (furnished with the device) and standard RS232 cable SSK1.
- (4): Controlling
- (5): Power connections

Controller front plate



X3	Motor brake	X20	HEDA in (Option)
X4	24VDC	X21	HEDA out (Option)
X10	RS232/RS485 with jumper to the programming interface	X22	Inputs Outputs (Option M10/12)
X11	Analog/Encoder	X23	Bus (Option) connector type depends on the bus system!
X12	Inputs/Outputs	S24	bus settings
X13	Motor position feedback	LED1	Device status LEDs
		LED2	HEDA LEDs
		LED3	Bus LEDs

Note on Compax3H: The **internal** device status LEDs are only connected to the **external** housing LEDs, if the RS232 jumper at X10 is fitted to the control and the upper dummy cover is fitted.

The RS232 programming interface under the upper dummy cover is only available if the X10 jumper at the controller is fitted.



Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!



Caution!

If the control voltage is missing and if the X10-X10 jumper is not fitted (VBK17/01) on the control part, the availability of power voltage is not displayed.



PE connection

The PE connection is made with 10mm² via a grounding screw at the bottom of the device.



Attention hot surface!

Metal parts can heat up to a temperature of 90°C during operation.

3.6.2. Terminal clamps – max. line cross section C3H

Terminal clamps – max. line cross section

The line cross sections must correspond to the locally valid safety regulations. The local regulations have always priority.

	Power clamps (minimum/maximum section)	Control lines

C3H050V4	2.5 / 16mm ²		2.5mm ²
	massive	multiwire	
C3H090V4	16 / 50mm ²	25 / 50mm ²	2.5mm ²
C3H1xxV4	25 / 95mm ²	35 / 95mm ²	2.5mm ²

The standard connection clamps of Compax3H090V4 and Compax3H1xxV4 are not suitable for flat line bars.

Cover plate for cable feedthrough

The cable feedthrough holes have the following dimensions:

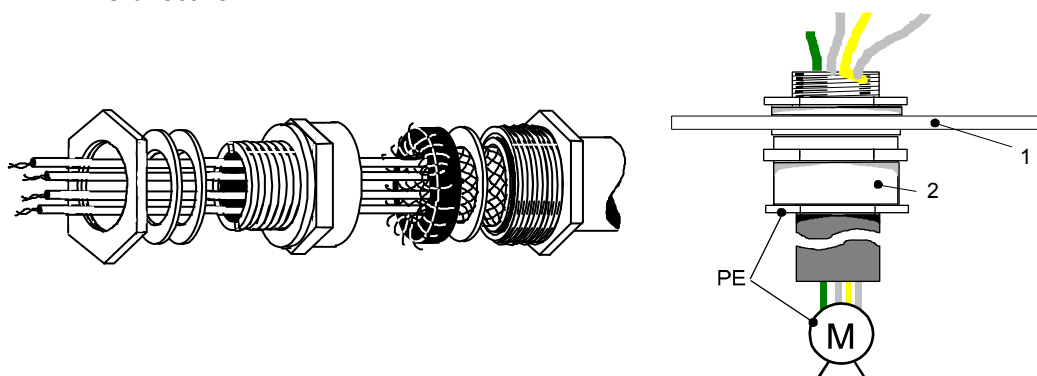
C3H050V4	28.6mm for M20, PG16 and ½" NPT (America). 37.3mm for M32, PG29 and 1" NPT (America).
C3H090V4	22.8mm for M20, PG16 and ½" NPT (America). 28.6mm for M25, PG21 and ¾" NPT (America). 47.3mm for M40, PG36 and 1¼" NPT (America). 54.3mm for M50, PG42 and 1½" NPT (America).
C3H1xxV4	22.8mm for M20, PG16 and ½" NPT (America). 28.6mm for M25, PG21 and ¾" NPT (America).

Recommended tightening torques

	High voltage supply	Braking Resistor	Grounding
C3H050V4	4Nm / 15.88kg-in	4Nm / 15.88kg-in	4.5Nm / 18.14kg-in
C3H090V4	6-8Nm / 53-70lb-in	6-8Nm / 53-70lb-in	6-8Nm / 53-70lb-in
C3H1xxV4	15-20Nm / 132-177lb-in	0.7Nm / 2.77kg-in	42Nm / 375lb-in

Cable joints

Use metallic cable joints permitting a 360° shielding in order to comply with the EMC directive.



1: Cable feedthrough plate

2: metallic joint with 360° shielding for EMC compliant design

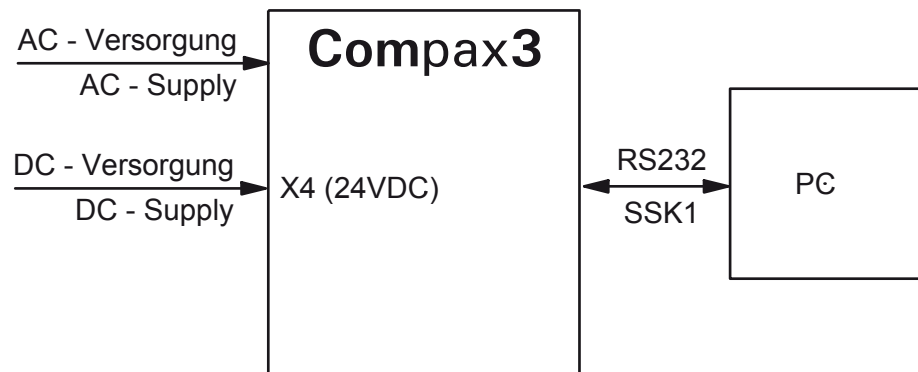
The device must be grounded without interruption according to EN 61800-5-1. The mains supply lines must be protected with a suitable fuse or a circuit breaker (FI switches or earth fault fuses are not recommended).

For installation in accordance with EN 61800-5-1 mm Europe:

- ◆ For grounding without interruption, two separate protective leads (<10mm² cross-section) or one lead (>10mm² cross-section) are required. Each protective lead must meet the requirements according to EN 60204.

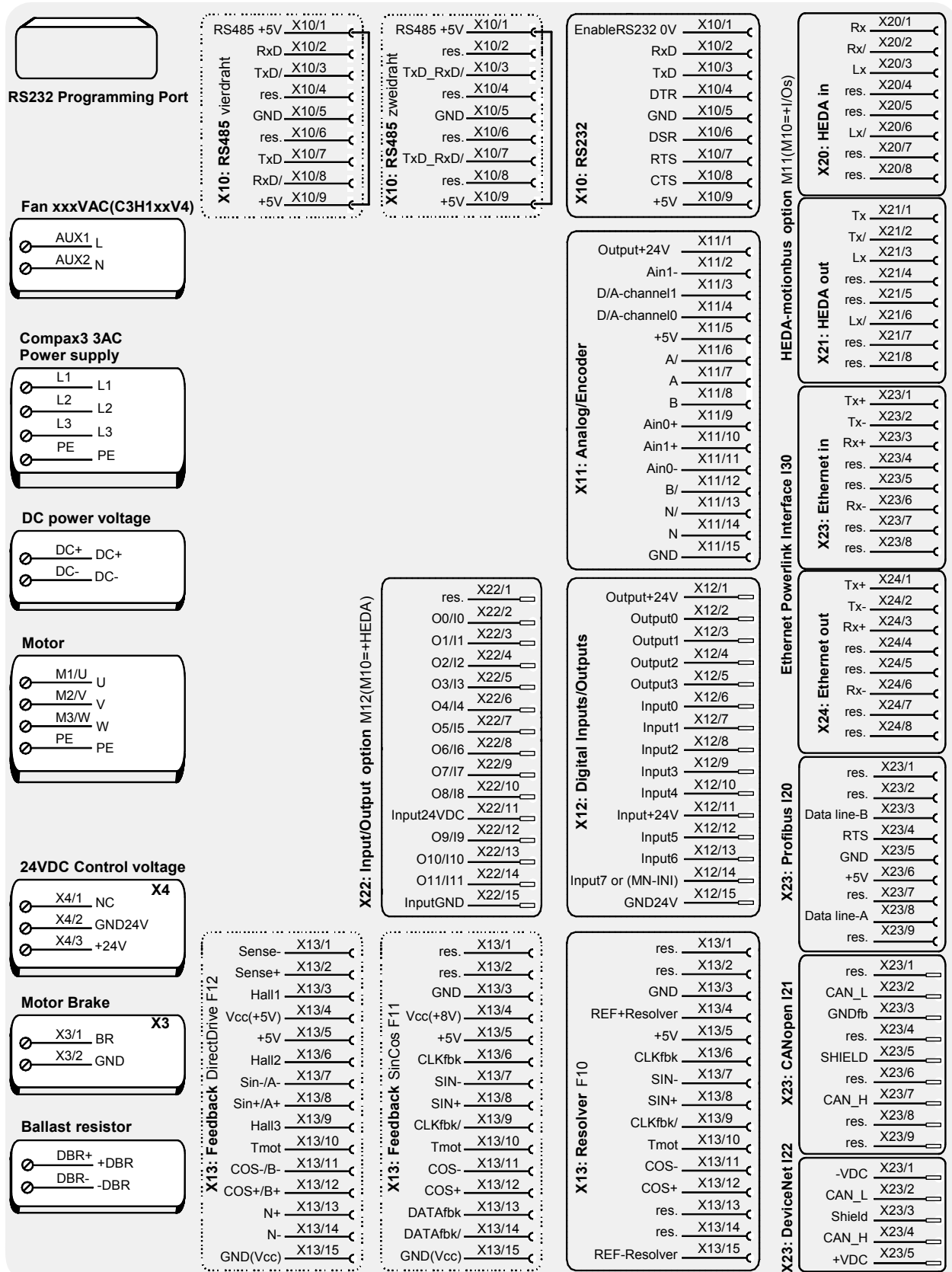
3.6.3. Plug and pin assignment C3H

Overview



Further information on the assignment of the plug mounted at the particular device can be found below!

In detail: The fitting of the different plugs depends on the extension level of Compax3.
In part, the assignment depends on the Compax3 option implemented.



The RS232 programming interface under the upper dummy cover is only available if the X10 jumper at the controller is fitted.

Please note

C3H1xxV4 uses a ventilator fan which must be externally supplied via separate connections. The ventilator fan is available in two versions for single phase feed: 220/240VAC; 110/120VAC

3.6.4. Motor / Motor brake C3H

Motor connection clamps

PIN	Designation
M1/U	U (motor)
M2/V	V (motor)
M3/W	W (motor)
PE	PE (motor)

Requirements for Compax3H motor cable

A motor output filter is required for motor cables >50m. Please contact us.

Shielding connection of the motor cable

The motor cable should be fully screened and connected to the Compax3 housing. The shield of the motor cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.



Motor holding brake!

Connect the brake only on motors which have a holding brake! Otherwise make no brake connections at all.

Requirements cables for motor holding brake

If a motor holding brake is present, **a cable** of the motor holding brake must be fed on the device side through the toroidal core ferrite provided as accessory ZBH0x/xx (63Ω @1MHz, di=5.1mm), in order to ensure error-free switching on and off of the motor holding brake.



Connection of motor brake X3

PIN	Designation
1	BR
2	GND

Motor holding brake output

Motor holding brake output	Compax3
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A
Minimum output current	150 mA

3.6.5. Control voltage 24 VDC C3H



Connector X4 Pin	Description	
1	NC	NC
2	Gnd 24 V	GND
3	+24V	24 VDC (power supply)

Control voltage 24VDC Compax3S and Compax3H

Controller type	Compax3
Voltage range	21 - 27VDC
Mains module	with switch-on current limitation, due to capacitive load
Fuse	MCB miniature circuit breaker or "delayed action fuse", due to capacitive load
Current drain of the device	0.8A
Total current drain	0.8 A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

3.6.6. Mains connection Compax3H

Device protection

Avoid permanent switching on and off so that the charging connection is not overloaded.

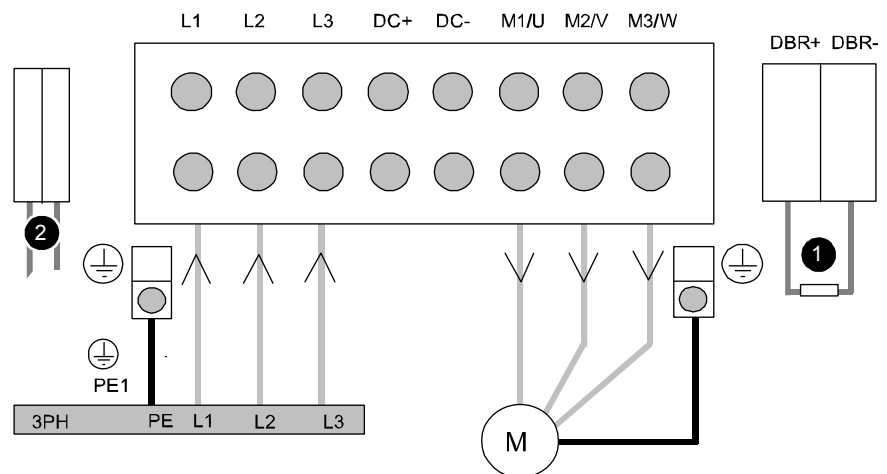
Mains connection Compax3HxxxV4

Controller type	H050V4	H090V4	H125V4	H155V4
Supply voltage	Three phase 3*400VAC/480VAC 350-528VAC / 50-60Hz			
Input current	54Aeff	93Aeff	118Aeff	140Aeff
Maximum fuse rating per device(=short circuit rating)	60A JDDZ class K5, JDRX class H	100A JDDZ class H5, JDRX class H	125A	150A

The terminal block of the drive can be found under the front cover. It is secured with 2 screws at the bottom of the device. Remove the bottom cover in order to access the connection clamps.

Make sure that all live parts are covered by the housing after installation.

Illustration of the connection clamps exemplarily for all sizes:



L1, L2, L3: 3 phase mains connection

M1, M2, M3: Motor connections

DC+, DC-: DC link voltage

(1) DBR+ und DBR-: Connection of external braking resistor

(2) AUX1, AUX2: only with C3H1xxV4 external supply (AC) for device ventilator L, N

- ◆ All shields must be connected via a cable joint to the cable feedthrough plate.
- ◆ Braking resistor and cable must be shielded if they are not installed in a control cabinet.
- ◆ The standard connection clamps of C3H090V4 and C3H1xxV4 are **not** suitable for flat line bars.

3.6.7. Braking resistor / supply voltage C3H

The energy generated during braking operation is absorbed by the Compax3 storage capacity.

If this capacity is too small, the braking energy must be drained via a braking resistor.

3.6.7.1 Connect braking resistor C3H

Connecting the braking resistor:

PIN	Designation
DBR+	+ Braking resistor
DBR-	- Braking resistor

Braking operation of Compax3HxxxV4

Controller type	H050V4	H090V4	H125V4	H155V4
Capacitance / storable energy	2600 μ F / 602Ws	3150 μ F / 729Ws	5000 μ F / 1158Ws	5000 μ F / 1158Ws
Minimum braking-resistance	24 Ω	15 Ω	8 Ω	8 Ω
Maximum continuous current	30A	45A	83A	83A

Mimimum line cross section: 2.5mm²
 Maximum line length: 2m
 Maximum output voltage: 830VDC

3.6.7.2 Power supply voltage DC C3H

DC high voltage supply

PIN	Description
DC+	+ DC high voltage supply
DC-	- DC high voltage supply



Warning!

*Do not connect any **braking resistor** on DC+/DC- .*

3.6.7.3 Connection of the power voltage of 2 C3H 3AC devices

In order to improve the conditions during brake operation, the DC power voltage of 2 servo axes may be connected.

The capacity as well as the storable energy are increased; furthermore the braking energy of one servo axis may be utilized by a second servo axis, depending on the application.



It is not permitted to connect the power voltage in order to use one brake circuit for two servo axes, as this function cannot be ensured reliably.

Note the following:

Caution! In case of non-compliance with the following instructions, the device may be destroyed!

- ◆ You can only connect two similar servo axes (same power supply; same rated currents)
- ◆ Connected servo axes must always be fed separately via the AC power supply.
- ◆ If the external pre-fuse of one of the servo axes takes action, the second servo axis must also be disconnected automatically.

Please connect as follows:

Servo axis 1 DC+ with servo axis 2 DC+
Servo axis 1 DC- with servo axis 2 DC-

3.7 Communication interfaces

In this chapter you can read about:

RS232 / RS485 interface (plug X10)	63
Communication Compax3M	64
Profibus connector X23 with Interface I20	66
CANopen connector X23 Interface I21	67
DeviceNet connector X23	69
Ethernet Powerlink (Option I30) / EtherCAT (option I31) X23, X24	70

3.7.1. RS232 / RS485 interface (plug X10)



Interface selectable by contact functions assignment of X10/1:

X10/1=0V RS232

X10/1=5V RS485

PIN X10	RS232 (Sub D)
1	(Enable RS232) 0V
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	+5V

RS485 2-wire

PIN X10	RS485 two wire (Sub D) Pin 1 and 9 jumpered externally
1	Enable RS485 (+5V)
2	res.
3	TxD_RxD/
4	res.
5	GND
6	res.
7	TxD_RxD
8	res.
9	+5V

RS485 4-wire

PIN X10	RS485 four wire (Sub D) Pin 1 and 9 externally jumpered
1	Enable RS485 (+5V)
2	RxD
3	TxD/
4	res.
5	GND
6	res.
7	TxD
8	RxD/
9	+5V

USB - RS232/RS485 converter

The following USB - RS232 converters were tested:

- ◆ ATEN UC 232A
- ◆ USB GMUS-03 (available under several company names)
- ◆ USB / RS485: **Moxa Uport 1130** http://www.moxa.com/product/UPort_1130.htm
- ◆ Ethernet/RS232/RS485: **NetCom 113** <http://www.vscom.de/666.htm>

3.7.2. **Communication Compax3M**

In this chapter you can read about:

PC - Compax3MP (mains module).....	64
Communication in the axis combination (connector X30, X31).....	64
Adjusting the basic address	65
Setting the axis function	65

3.7.2.1 PC - Compax3MP (mains module)

Connector X3

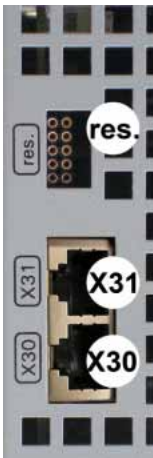


USB2.0
Connect your PC to the USB sleeve X3 of the mains module via an USB cable (SSK33/03).

3.7.2.2 Communication in the axis combination (connector X30, X31)

The communication in the axis combination is implemented via a SSK28 cable and double RJ45 sleeves on the device top.
Beginning with the Compax3MP (mains module) the connection is always made from X30 to X31 of the next device. On the first device (X31) and the last device (X30) in the multi-axis combination, a bus termination plug (BUS07/01) is required.

Orientation to the back
side



Orientation to the front
plate

	Compax3MP (mains module)
X30	out
X31	in
res.	Reserved
	Compax3M (axis)
X30	out
X31	in
res.	Reserved

3.7.2.3 Adjusting the basic address

On the mains module, the basic address of the device combination is set in steps of 16 with the aid of the first three dip switches.

The mains module contains the set basic address while the axes placed at the right in the combination contain the following addresses.

Switch S1



Address setting

Basic addresses

Switch	Value upon ON
1	16
2	32
3	64

Settings:

left: OFF

right: ON

Settable value range: 0, 16, 32, 48, 64, 80, 96, 112

Address of the 1st Compax3M = basic address+1

The addresses of the axis controllers are newly assigned after PowerOn.

Example:

Basic address = 48; mains module with 6 Compax3M axes in the combination.

1. Axis right: Address = 49

2. Axis right: Address = 50

...

6. Axis right: Address = 54

3.7.2.4 Setting the axis function

Switch S10



Function settings for T30 and T40

The value of switch S10 on the axis controller is stored in object O110.1

C3plus.Switch_DeviceFunction and can be evaluated with the aid of a program.

This helps realize a more simple function selection.

3.7.3. Profibus connector X23 with Interface I20



Pin X23	Profibus (Sub D)
1	Reserved
2	Reserved
3	Data line B
4	RTS
5	GND
6	+5V
7	Reserved
8	Data line A
9	Reserved

The assignment corresponds to Profibus standard EN 50170.

Wiring (see page 510).

3.7.3.1 Adjusting the bus address



Address setting

Values:

1: 2^0 ; 2: 2^1 ; 3: 2^2 ; ... 7: 2^6 ; 8: reserved

Settings:

left: OFF

right: ON

(The address is set to 0 in the illustration to the left)

Range of values: 1 ...127

Address 0 is set internally to address 126.

3.7.3.2 Function of the Bus LEDs

Meaning of the LEDs (under X23)

Green LED (left)	Red LED (right)	Description
alternately flashing		Field bus program missing
off	flashing	Device is not initialized
on	flashing	Bus operation mode (no DATA exchange)
on	off	Bus operation mode (DATA exchange)
on	on	Bus error

3.7.4. CANopen connector X23 Interface I21



Pin X23	CANopen (Sub D)	
1	Reserved	
2	CAN_L	CAN Low
3	GNDfb	Opto-isolated GND-supply
4	Reserved	
5	SHIELD	Shield optional
6	Reserved	
7	CAN_H	CAN High
8	Reserved	
9	Reserved	

The assignment corresponds to CANopen DS301.

At the beginning and end of the device chain a terminating resistor of 120Ω is required between CAN_L and CAN_H

Wiring (see page 511).

3.7.4.1 Setting baud rate and Node-ID



Proceeding:

- ◆ Switch off 24VDC
- ◆ Switch 8 must be set to ON
- ◆ Set **Baud rate** with switches 1...7:
 - 0:= 20kbits/s
 - 1:= 50kbit/s
 - 2:= 100kbit/s
 - 3:= 125kbit/s
 - 4:= 250kbit/s
 - 5:= 500kbit/s
 - 6:= 800kbit/s
 - 7...127:= 1Mbit/s
- ◆ switch on 24VDC and wait until both LEDs above the DIP switch are blinking simultaneously
- ◆ **Set Node-ID** with switches 1...7:
 - Values: **1:** 2⁰; **2:** 2¹; **3:** 2²; ... **7:** 2⁶;
 - Value range: 1 ...127
- ◆ **Switch 8:** = OFF
- ◆ Compax3 is now ready to operate

Position of the switch

left: OFF
right: ON

Note:

The baud rate can also be set in the C3 ServoManager. After switching on, the last setting made is valid!

3.7.4.2 Function of the Bus LEDs

LED red

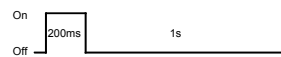
No.	Signal	Status	Description
1	off	No Error	The bus is operating
2	Single flash	Warning	at least one of the error counters of the CAN controller has reached the warning level.
3	Double flash	Error	Node Guarding Error
4	Triple flash	Error	Sync Error Buffer overflow (0x8110)
5	on	Bus not active	

If several errors occur at once, the error with the most significant number is reported.

LED green

Signal	Status	Description
Single flash	Stop	The bus is in STOPPED state
blinks (permanently)	pre-operational	The bus is ready to operate (Pre-Operational)
on	operational	The bus is operating (operational)

Single flash



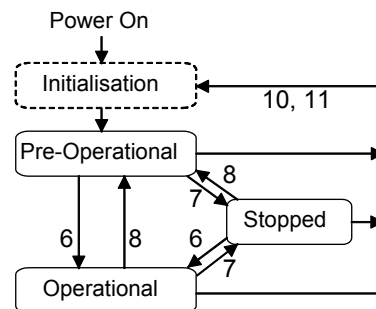
Double flash



Triple flash



CANopen states



6: Start Remote Node

7: Stop Remote Node

8: Enter Pre-Operational State

10: Reset Node

11: Reset Communication

The "Initialization" state is no fixed state but only a transition state.

3.7.5. DeviceNet connector X23



Pin X23	DeviceNet (Open Plug Phoenix MSTB 2.5/5-GF5.08 ABGY AU)	
1	V-	Mass
2	CAN-	CAN Low
3	Shield	Shield
4	CAN+	CAN High
5	V+	not required, internal supply

A mating plug is included in the delivery.

If Compax3 is used as first or last device in the fieldbus network, a terminal resistance of 121 Ω is required. This is integrated between Pin 2 and Pin 4.

Additional information on the DeviceNet wiring can be found under www.odva.org <http://www.odva.org>

Please do also heed the instructions in the DeviceNet master manual.

3.7.5.1 Adjusting the bus address



Address setting (NA: Node Address)

Values:

1: 2⁰; 2: 2¹; 3: 2²; ... 6: 2⁵reserved

Settings:

left: OFF

right: ON

(The address is set to 2 in the illustration)

Range of values: 1 ... 63

Address 0 is set internally to address 63.

Data Rate setting (DR):

Data Rate [kBit/s]	S24_7	S24_8
125	left: OFF	left: OFF
250	left: ON	right: OFF
500	right: OFF	left: ON
Reserved	right: ON	right: ON

Bear in mind that the maximum cable length depends on the Data rate:

Data Rate	Maximum length
500kbit/s	100m
250kbit/s	250m
125kbit/s	500m

3.7.5.2 Function of the Bus LEDs

LED (red)

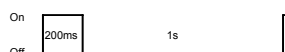
No.	Signal	Status	Description
1	off	No Error	The bus is operating
2	Single flash	Warning	at least one of the error counters of the CAN controller has reached the warning level.
3	Double flash	Error	Communication Fault
4	Triple flash	Error	Double Mac ID
5	on	Error	Bus Off

If several errors occur at once, the error with the most significant number is reported.

LED green

Signal	Status	Description
Single flash	On-line Not Connected	Online, not at the master (not allocated)
blinks (permanently)	On-line Connected	Online, at the master (allocated)
on	On-line I/O Connected	I/O Messages allocated

Single flash



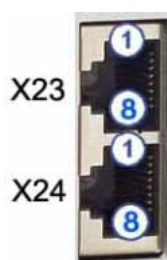
Double flash



Triple flash



3.7.6. Ethernet Powerlink (Option I30) / EtherCAT (option I31) X23, X24



	RJ45 (X23)	RJ45 (X24)
PIN	in	out
1	Tx +	Tx +
2	Tx -	Tx -
3	Rx +	Rx +
4	-	Reserved
5	-	Reserved
6	Rx -	Rx -
7	-	Reserved
8	-	Reserved

Wiring with Ethernet Crossover cable Cat5e (from X24 to X23 of the next device without termination); for this, we recommend our **SSK28** (see page 462, see page 504) interface cable.

Meaning of the RJ45 LEDs (only for Ethernet Powerlink, I30)

Green LED (top): connection established (RPT_LINK/RX)

Yellow LED (bottom): Traffic (exchange of data) (Transmit / Receive Data) (RPT_ERR)

3.7.6.1 Set Ethernet Powerlink (option I30) bus address

Automatic address assignment with EtherCAT



Address setting

Values:

1: 2^0 ; 2: 2^1 ; 3: 2^2 ; ... 7: 2^6 ; 8: 2^7

Settings:

left: OFF

right: ON

(The address is set to 0 in the illustration)

Range of values: 1 ... 239

3.7.6.2 Meaning of the Bus LEDs (Ethernet Powerlink)

Red LED (right): Ethernet Powerlink error

LED is influenced by the transitions of the NMT - status diagram (for further details, please refer to the **Ethernet Powerlink Specification**

http://www.parker.com/euro_emd/EME/downloads/compax3/EPL/epl2.0-ds-v-1-0-0.pdf

Error LED	Transition
off => on	NMT_CT11, NMT_GT6, NMT_MT6
on => off	NMT_CT6, NMT_GT2, NMT_CT3, NMT_MT5

Green LED (left): Ethernet Powerlink Status

LED indicates the states of the NMT - status diagram (for further details, please refer to the **Ethernet Powerlink Specification**

http://www.parker.com/euro_emd/EME/downloads/compax3/EPL/epl2.0-ds-v-1-0-0.pdf

Status LED		status
off	off	NMT_GS_OFF, NMT_GS_INITIALISATION, NMT_CS_NOT_ACTIVE / NMT_MS_NOT_ACTIVE
flickering	flickering	NMT_CS_BASIC_ETHERNET
single flash	Single flash	NMT_CS_PRE_OPERATIONAL_1 / NMT_MS_PRE_OPERATIONAL_1
double flash	Double flash	NMT_CS_PRE_OPERATIONAL_2 / NMT_MS_PRE_OPERATIONAL_2
triple flash	Triple flash	NMT_CS_READY_TO_OPERATE / NMT_MS_READY_TO_OPERATE
on	on	NMT_CS_OPERATIONAL / NMT_MS_OPERATIONAL
blinking	flashing	NMT_CS_STOPPED

3.7.6.3 Meaning of the Bus LEDs (EtherCAT)

Red LED (right): EtherCAT error

LED is influenced by the transitions of the status diagram

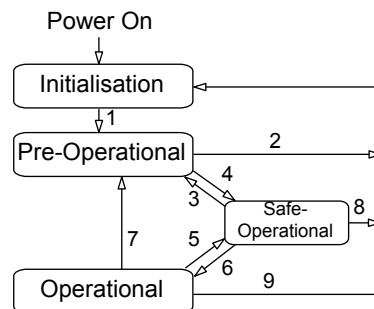
Error LED	Error:	Description
Off	No Error	
Flickering	Boot error	Error during initialization
Blinking	Invalid configuration	
Single Flash	Unsolicited change of status	Slave changed the status independently
Double Flash	Application Watchdog Timeout	Watchdog
On	PDI Watchdog Timeout	

Green LED (left): EtherCAT Status

LED shows the states of the status diagram

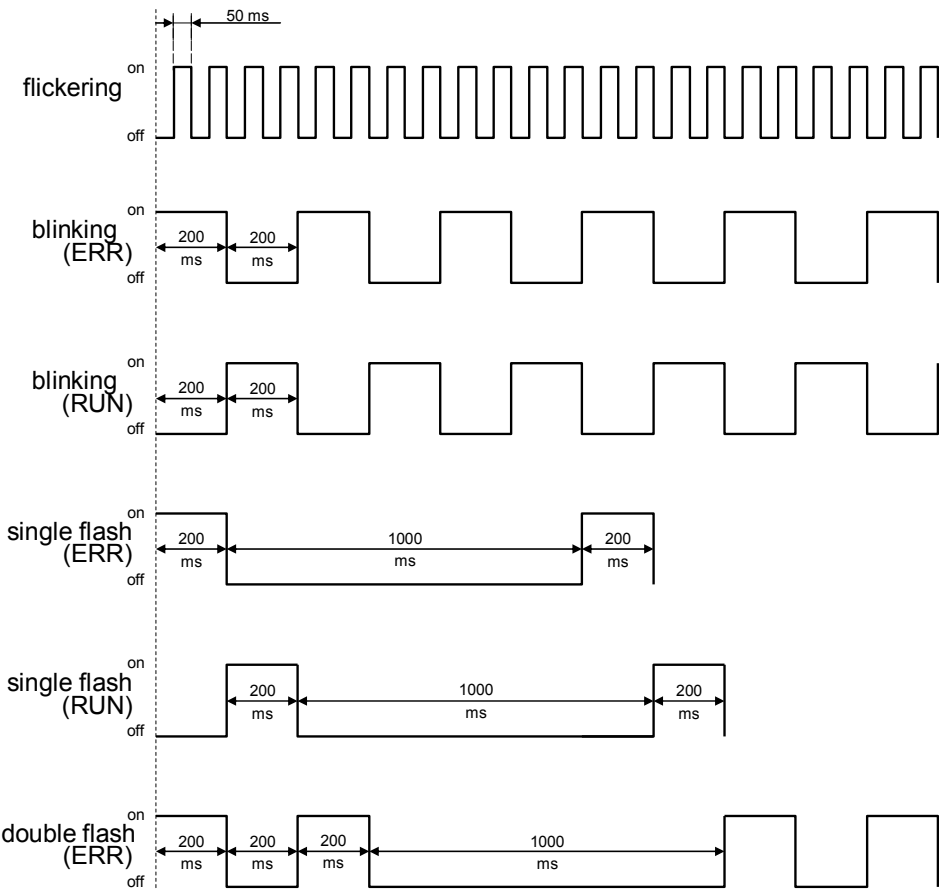
Status LED	status	Description
Off	INITIALIZATION	Initialisation
Blinking	PRE-OPERATIONAL	Ready
Single Flash	SAFE-OPERATIONAL	Master reads values
On	OPERATIONAL	Operation

Status diagram



Transition	Action
1	Start mailbox communication
2	Stop mailbox communication
3	Start input update
4	Stop input update
5	Start output update
6	Stop output update
7	Stop output update, stop input update
8	Stop input update, stop mailbox communication
9	Stop output update, stop input update, stop mailbox communication

Meaning of the LED states



3.8 Signal interfaces

In this chapter you can read about:

Resolver / Feedback (connector X13)	74
Analog / Encoder (plug X11)	75
Digital inputs/outputs (plug X12)	76

3.8.1. Resolver / Feedback (connector X13)



PIN X13	Feedback /X13 High Density /Sub D (depending on the Feedback module)		
	Resolver (F10)	SinCos (F11)	EnDat 2.1 (F12)
1	Reserved	Reserved	Sense -*
2	Reserved	Reserved	Sense +*
3	GND	GND	Reserved
4	REF-Resolver+	Vcc (+8V)	Vcc (+5V) * max. 350mA load
5	+5V (for temperature sensor)		
6	Reserved	Reserved	CLKfbk
7	SIN-	SIN-	SIN- / A- (Encoder)
8	SIN+	SIN+	SIN+ / A+ (Encoder)
9	Reserved	Reserved	CLKfbk/
10	Tmot*	Tmot*	Tmot*
11	COS-	COS-	COS- / B- (Encoder)
12	COS+	COS+	COS+ / B+ (Encoder)
13	Reserved	DATAfbk	DATAfbk
14	Reserved	DATAfbk/	DATAfbk/
15	REF-Resolver-	GND (Vcc)	GND (Vcc)

*X13 Pin10 Tmot may not be connected at the same time as X15 (on Compaxx3M).

Resolver cables (see page 474) can be found in the accessories chapter of the device description.

SinCos® - cables (see page 475) can be found in the accessories chapter of the device description.

EnDat cable GBK38 (see page 476) can be found in the accessories chapter of the device description

PIN X13	Feedback /X13 High Density /Sub D	
	Direct drives (F12)	
1	Sense -*	
2	Sense +*	
3	Hall1 (digital)	
4	Vcc (+5V) * max. 350mA load	
5	+5V (for temperature and Hall Sensors)	
6	Hall2 (digital)	
7	SIN-, A- (Encoder) or analog Hall sensor	
8	SIN+, A+, (Encoder) or analog Hall sensor	
9	Hall3 (digital)	
10	Tmot*	
11	COS-, B- (Encoder) or analog Hall sensor	
12	COS+, B+ (Encoder) or analog Hall sensor	
13	N+	
14	N-	
15	GND (Vcc)	

*X13 Pin10 Tmot may not be connected at the same time as X15 (on Compaxx3M).

Note on F12:

*+5V (Pin 4) is measured and controlled directly at the end of the line via Sense – and Sense +.

Maximum cable length: 100m

Caution!

- ◆ Pin 4 and Pin 5 must under no circumstances be connected!
- ◆ Plug in or pull out feedback connector only in switched off state (24VDC switched off).

3.8.2. Analog / Encoder (plug X11)



PIN X11	Reference High Density Sub D	Encoder	
		Encoder	SSI (see page 154)
1	+24V (output) max. 70mA		
2	Ain1 -: analog input - (14Bit; max. +/-10V)		
3	D/A monitor channel 1 ($\pm 10V$, 8-bit resolution)		
4	D/A monitor channel 0 ($\pm 10V$, 8-bit resolution)		
5	+5V (output for encoder) max. 150mA		
6	- Input: steps RS422 (5V - level)	A/ (Input / simulation)	Clock-
7	+ Input: steps RS422 (5V - level)	A (Input / simulation)	Clock+
8	+ Input: direction RS422 (5V - level)	B (Input / simulation)	
9	Ain0 +: analog input + (14Bit; max. +/-10V)		
10	Ain1 +: analog input + (14Bit; max. +/-10V)		
11	Ain0 -: analog input - (14Bit; max. +/-10V)		
12	- Input: direction RS422 (5V - level)	B/ (Input / simulation)	
13	Reserved	N/ (Input / simulation)	DATA-
14	Reserved	N (Input / simulation)	DATA+
15	GND		

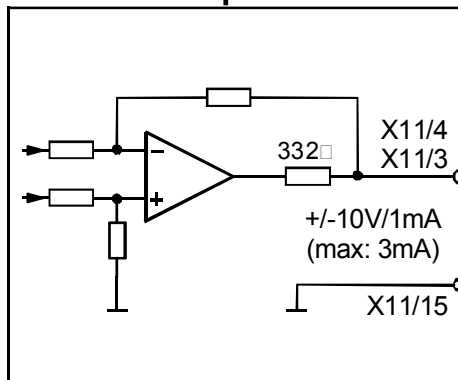
Technical data X11 (see page 521)

3.8.2.1 Wiring of analog interfaces

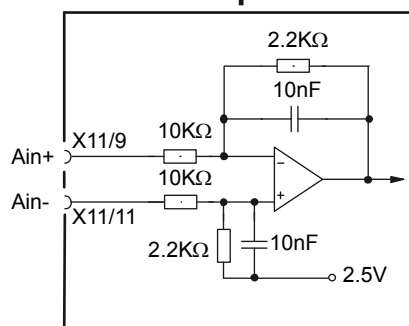
Output

Input

Compax3



Compax3

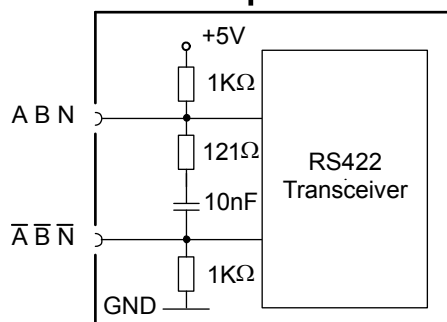


Please note: with Ain- on earth and Ain+ open, 2.02V are read in.

Structure image of the internal **signal processing of the analog inputs**, Ain1 (X11/10 and X11/2) has the same wiring!

3.8.2.2 Connections of the encoder interface

Compax3



The input connection is available in triple (for A & /A, B & /B, N & /N)

3.8.3. Digital inputs/outputs (plug X12)



PIN X12/	Input/output	I/O /X12 High density/Sub D
1	Output	+24VDC output (max. 400mA)
2	O0	Output 0 (max. 100mA)
3	A1	Output 1 (max. 100mA)
4	A2	Output 2 (max. 100mA)
5	O3	Output 3 (max. 100mA)
6	I0	Input 0
7	I1	Input 1
8	I2	Input 2
9	I3	Input 3
10	I4	Input 4
11	E	24V input for the digital outputs Pins 2 to 5
12	I5	Input 5 or limit or direction reversal switch
13	I6	Input 6 or limit or direction reversal switch
14	I7	Input 7 or home switch
15	Output	Gnd 24 V

All inputs and outputs have 24V level.

Maximum capacitive loading of the outputs: 30nF (max. 2 Compax3 inputs)

Note:

The inputs and outputs are freely programmable using an IEC61131-3 program. Input 7 is planned as home switch, the inputs 5 and 6 as limit switches or direction reversal switches.

If no limit switches are used and these are switched off (in the C3 ServoManager under configuration), the inputs 5 and 6 can be freely assigned.

The same applies for input 7: A machine zero mode without home switch allows to freely assign input 7.

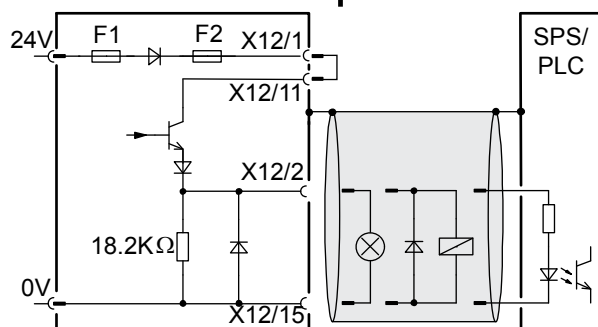
Optimization window display

The display of the digital inputs in the optimization window of the C3 ServoManager does not correspond to the physical status (24Volt=on, 0Volt=off) but to the logic status: If the function of an input or output is inverted (e.g. limit switch, negatively switching), the corresponding display (LED symbol in the optimization window) is OFF with 24Volts at the input and ON with 0 Volts at the input.

3.8.3.1 Connection of the digital Outputs/Inputs

Wiring of digital outputs

Compax3



The circuit example is valid for all digital outputs!
The outputs are short circuit proof; a short circuit generates an error.

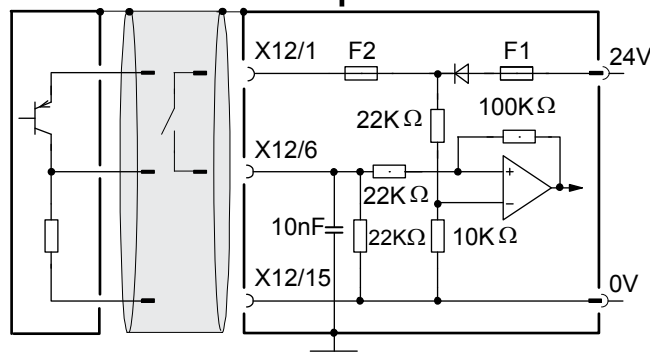
F1: delayed action fuse

F2: quick action electronic fuse; can be reset by switching the 24VDC supply off and on again.

Status of digital inputs

SPS/PLC

Compax3



The circuit example is valid for all digital inputs!
Signal level:

- ◆ > 9.15V = "1" (38,2% of the control voltage applied)
- ◆ > 8.05V = "0" (33.5% of the control voltage applied)

3.9 Installation and dimensions Compax3

In this chapter you can read about:

Mounting and dimensions Compax3S.....	78
Mounting and dimensions C3MP/C3M.....	81
Mounting and dimensions C3H.....	84

3.9.1. Mounting and dimensions Compax3S

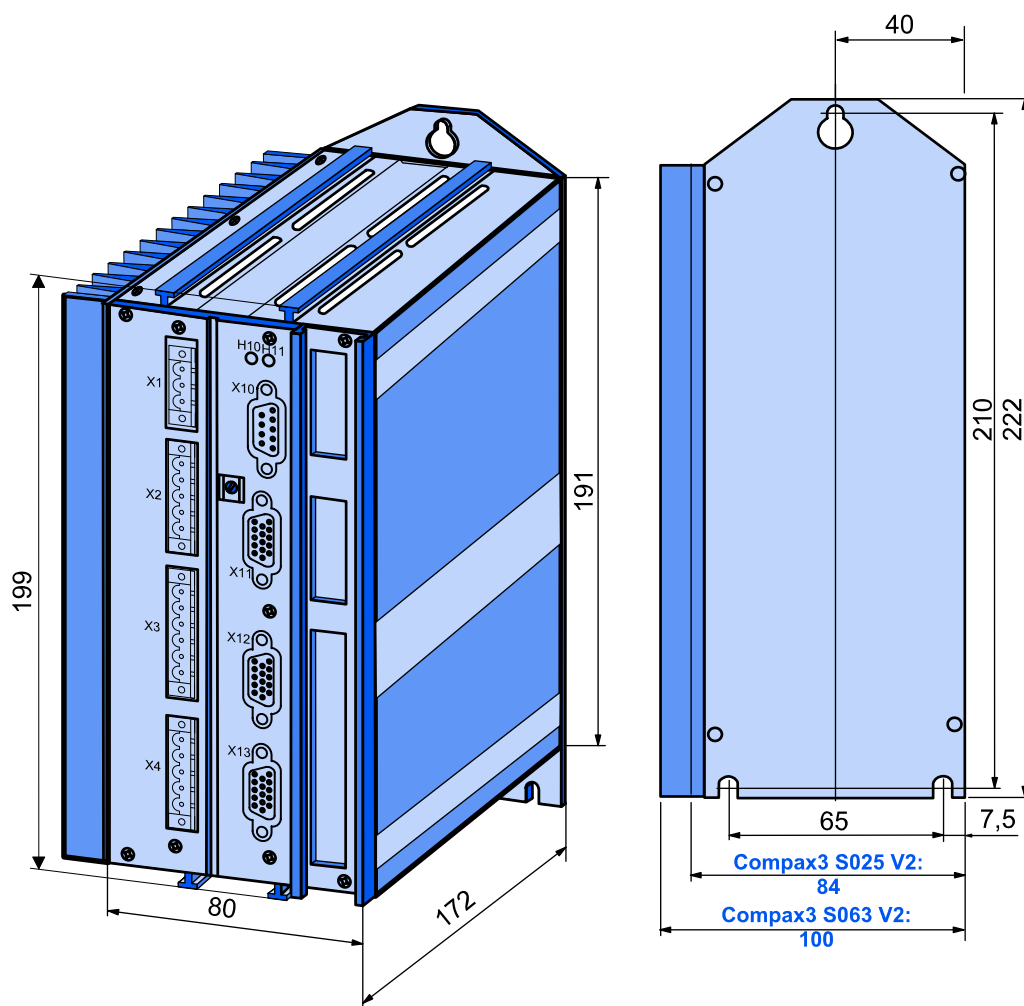
In this chapter you can read about:

Mounting and dimensions Compax3S0xxV2.....	78
Mounting and dimensions Compax3S100V2 and S0xxV4.....	79
Mounting and dimensions Compax3S150V2 and S150V4.....	80
Mounting and dimensions Compax3S300V4.....	81

3.9.1.1 Mounting and dimensions Compax3S0xxV2

Mounting:

3 socket head screws M5



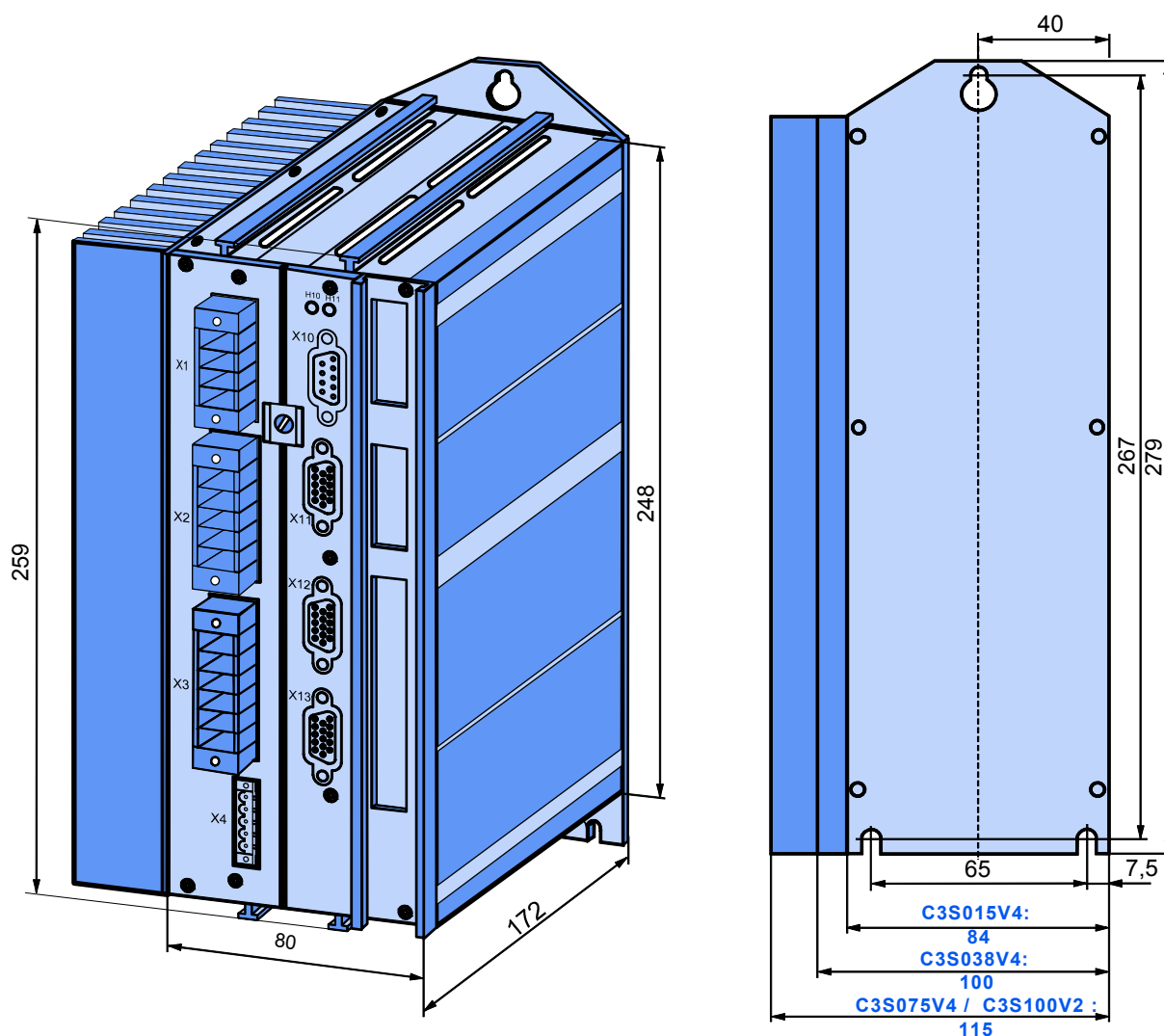
Please respect an appropriate mounting gap in order to ensure sufficient convection:

- ◆ At the side: 15mm
- ◆ At the top and below: at least 100mm

3.9.1.2 Monting and dimensions Compax3S100V2 and S0xxV4

Mounting:

3 socket head screws M5



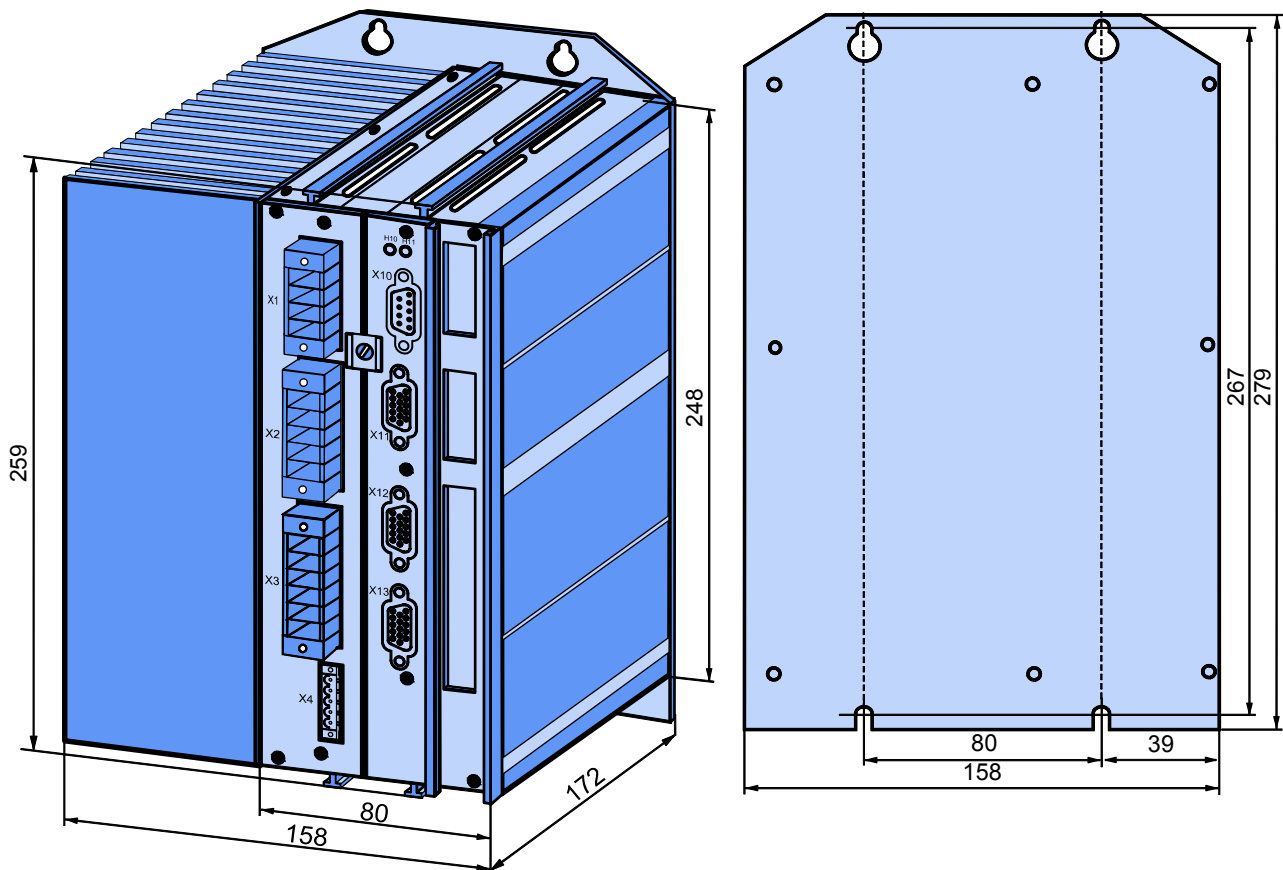
Please respect an appropriate mounting gap in order to ensure sufficient convection:

- ◆ At the side: 15mm
- ◆ At the top and below: at least 100mm

3.9.1.3 Mounting and dimensions Compax3S150V2 and S150V4

Mounting:

4 socket head screws M5



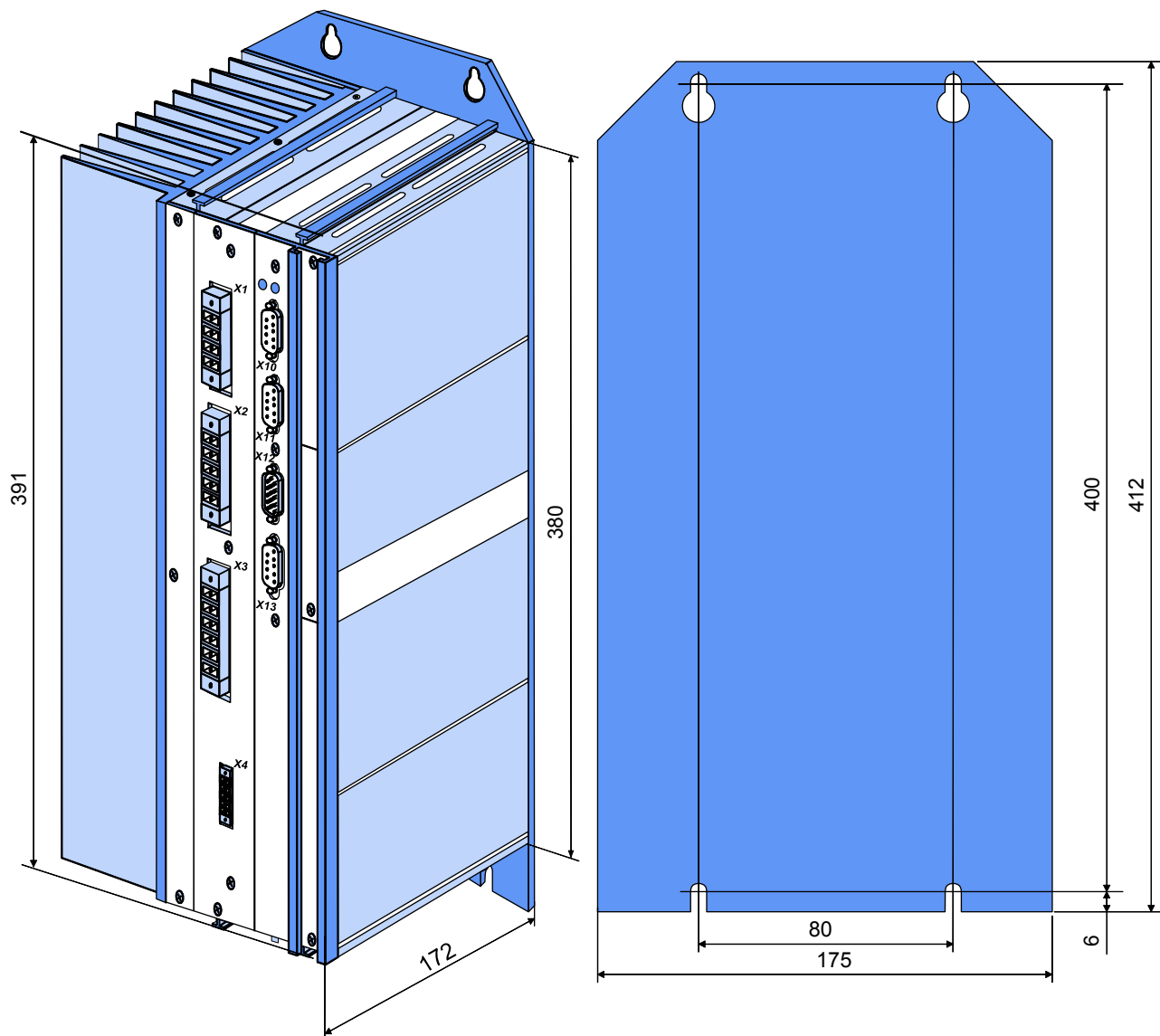
Please respect an appropriate mounting gap in order to ensure sufficient convection:

- ◆ At the side: 15mm
- ◆ At the top and below: at least 100mm

3.9.1.4 Mounting and dimensions Compax3S300V4

Mounting:

4 socket head screws M5



Please respect an appropriate mounting gap in order to ensure sufficient convection:

- ◆ At the side: 15mm
- ◆ At the top and below: at least 100mm

Compax3S300V4 is force-ventilated via a fan integrated into the heat dissipator!

3.9.2. Mounting and dimensions C3MP/C3M

Ventilation: During operation, the device radiates heat (power loss). Please provide for a sufficient mounting distance below and above the device in order to ensure free circulation of the cooling air. Please do also respect the recommended distances of

other devices. Make sure that the mounting plate is not exhibited to other temperature influences than that of the devices mounted on this very plate. The devices must be mounted vertically on a level surface. Make sure that all devices are sufficiently fixed.

3.9.2.1 Mounting and dimensions Compax3MP10/M050-150

Compaxa3MP and Compax3M are force-ventilated via a ventilator fan fixed to the lower part of the heat dissipator!

Mounting spacing: At the top and below: at least 100mm

Information on

C3MP (mains module)

C3MP10D6

C3M (axis)

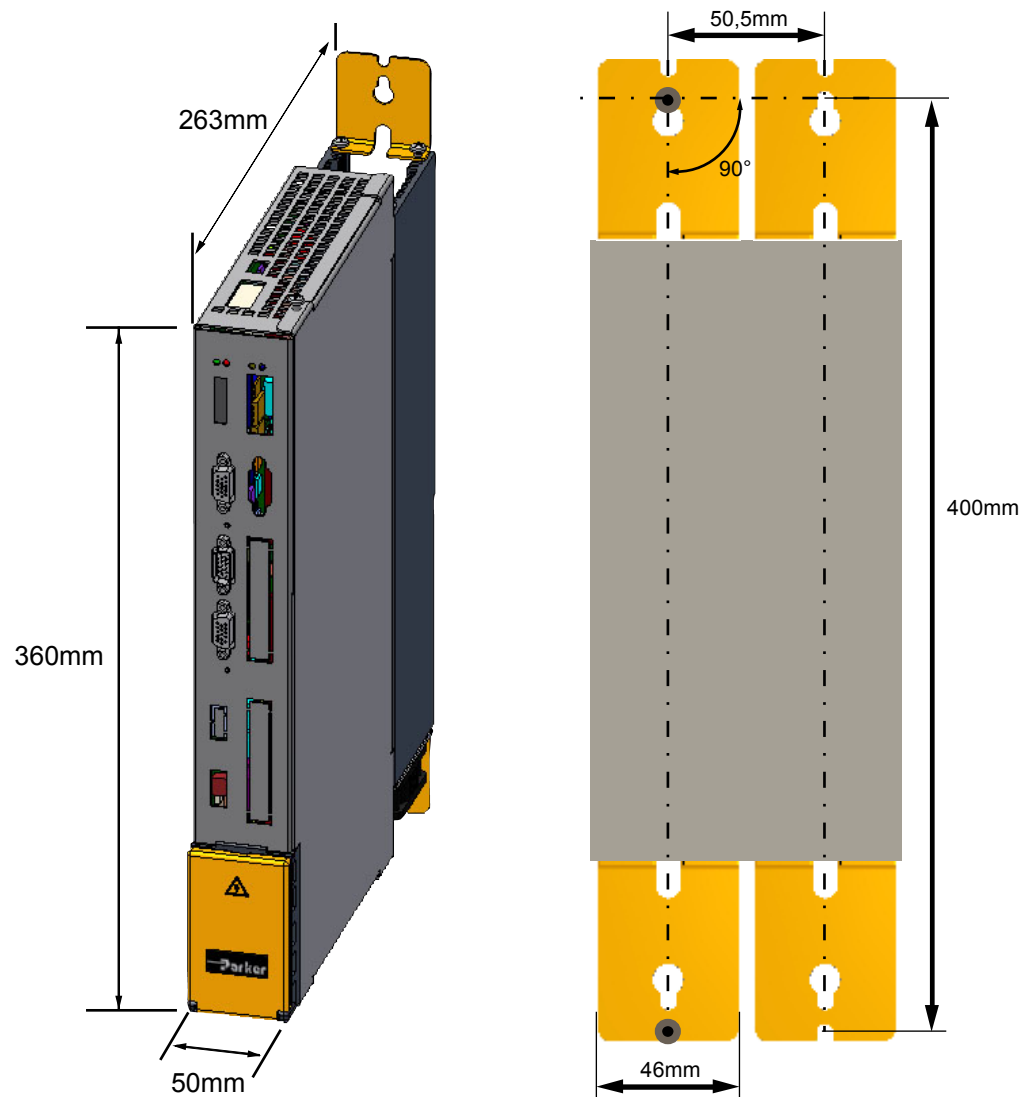
C3M050D6

C3M100D6

C3M150D6

Mounting:

2 socket head screws M5



Tolerances: DIN ISO 2768-f

3.9.2.2 Installation and dimensions Compax3MP20/M300

Information on

C3MP (mains module)

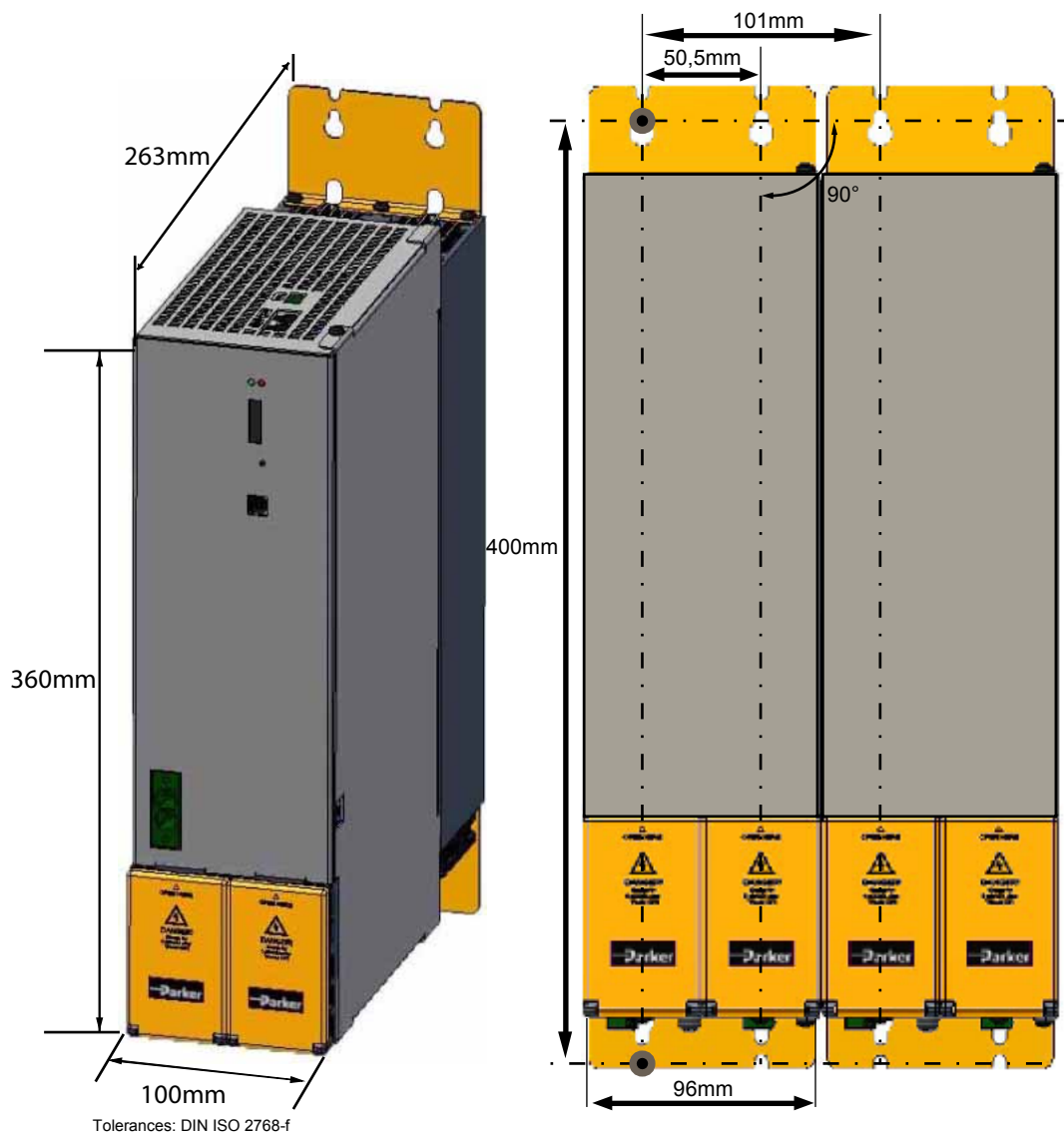
C3M (axis)

C3MP20D6

C3M300D6

Mounting:

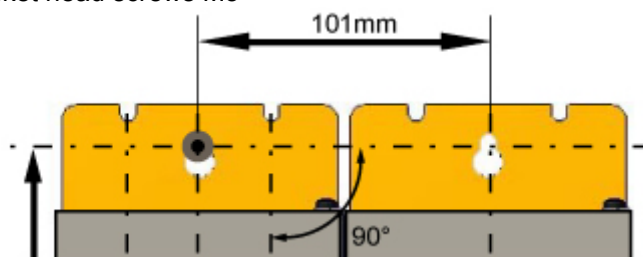
4 socket head screws M5



3.9.2.3 With upper mounting, the housing design may be different.

Mounting:

3 socket head screws M5



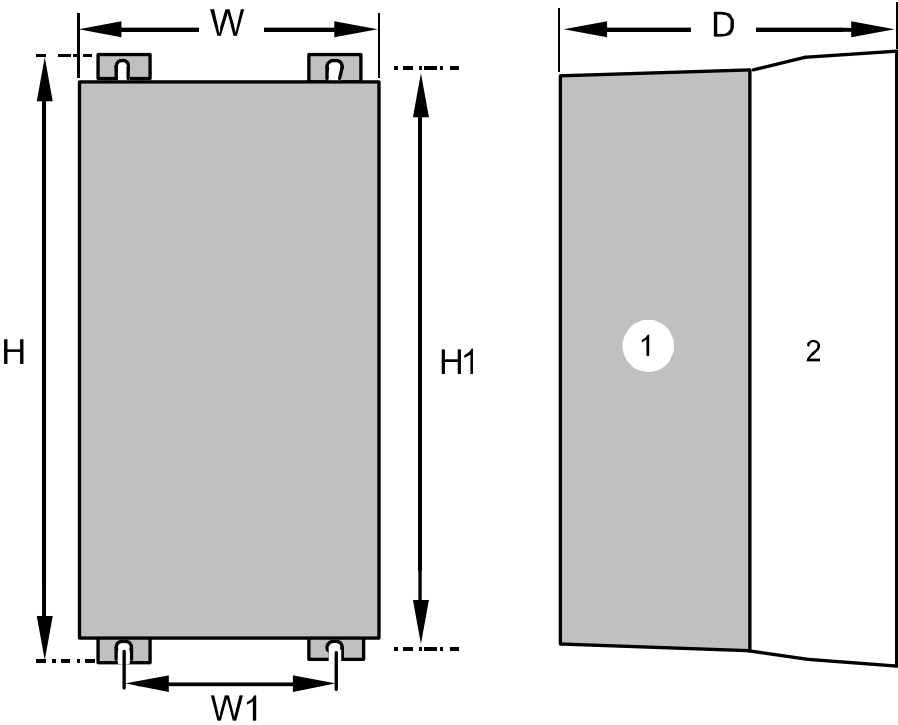
3.9.3. Mounting and dimensions C3H

In this chapter you can read about:

Mounting distances, air currents Compax3H050V4	85
Mounting distances, air currents Compax3H090V4	85
Mounting distances, air currents Compax3H1xxV4	86

The devices must be mounted vertically on a level surface in the control cabinet.

Dimensions:



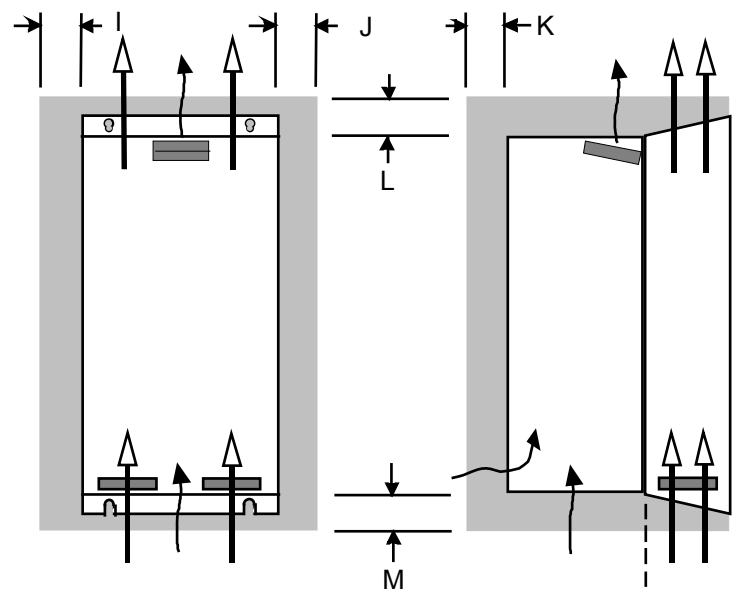
(1): Electronics
(2): Head dissipator

	H	H1	D	W	W1
C3H050V4	453mm	440mm	245mm	252mm	150mm
C3H090V4	668.6mm	630mm	312mm	257mm	150mm
C3H1xxV4	720mm	700mm	355mm	257mm	150mm

Mounting: 4 screws M6

Ventilation: During operation, the device radiates heat (power loss). Please provide for a sufficient mounting distance below and above the device in order to ensure free circulation of the cooling air. Please do also respect the recommended distances of other devices. Make sure that the mounting plate is not exhibited to other temperature influences than that of the devices mounted on this very plate. If two or more devices are combined, the mounting distances are added.

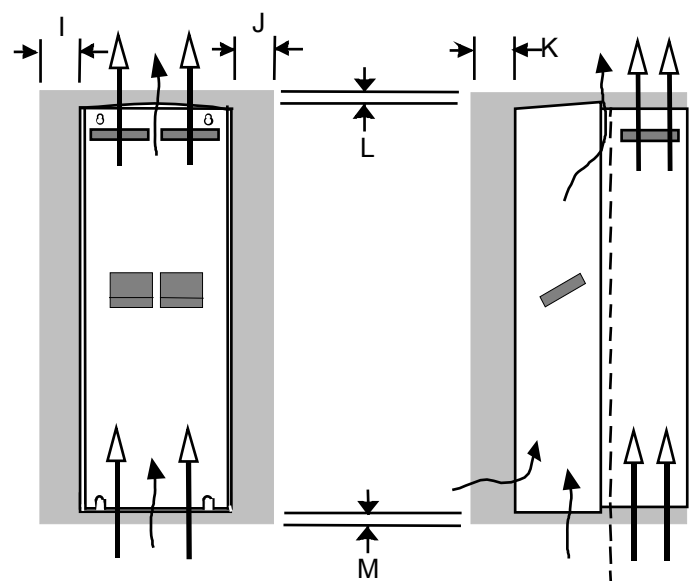
3.9.3.1 Mounting distances, air currents Compax3H050V4



in mm

	I	J	K	L	M
C3H050V4	15	5	25	70	70

3.9.3.2 Mounting distances, air currents Compax3H090V4

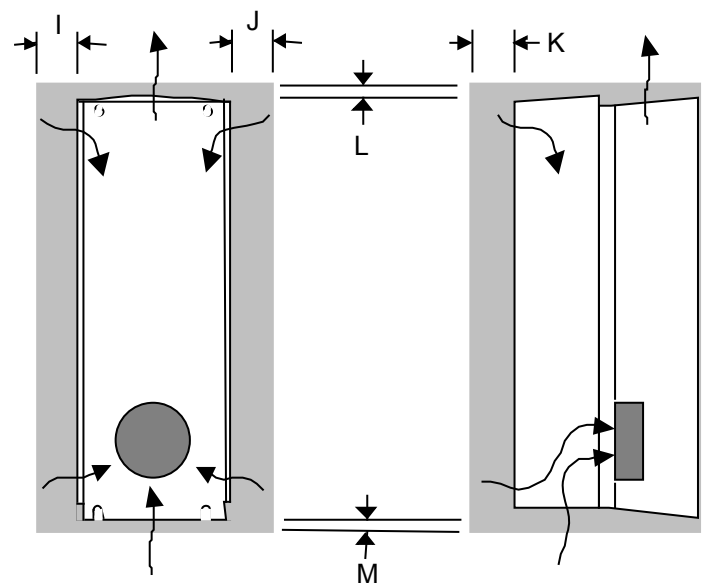


in mm

	I	J	K	L	M
C3H090V4	0	0	25	70	70

3.9.3.3

Mounting distances, air currents Compax3H1xxV4



in mm

	I	J	K	L	M
C3H1xxV4	0	0	25	70	70

3.10 Safety function – safety torque off – Compax3S

In this chapter you can read about:

Safe standstill with Compax3 principle	87
Devices with the "Safe Standstill" safety function	88
Safety instructions for the "safety torque off" function	89
Application example for "safe standstill"	90

Compax3S is equipped with the "safety torque off" safety feature.
The "protection against unexpected start-up" described in EN1037 can be implemented with this feature.

3.10.1. Safe standstill with Compax3 principle

To ensure safe protection against a motor starting up unexpectedly, the flow of current to the motor and thus to the power output stage must be prevented. This is accomplished for Compax3 with two measures independent of each other (Channel 1 and 2), without disconnecting the drive from the power supply:

Channel 1:

Activation of the power output stage can be disabled in the Compax3 controller by means of a digital input or with a fieldbus interface (depending on the Compax3 device type) (deactivation of the energize input).

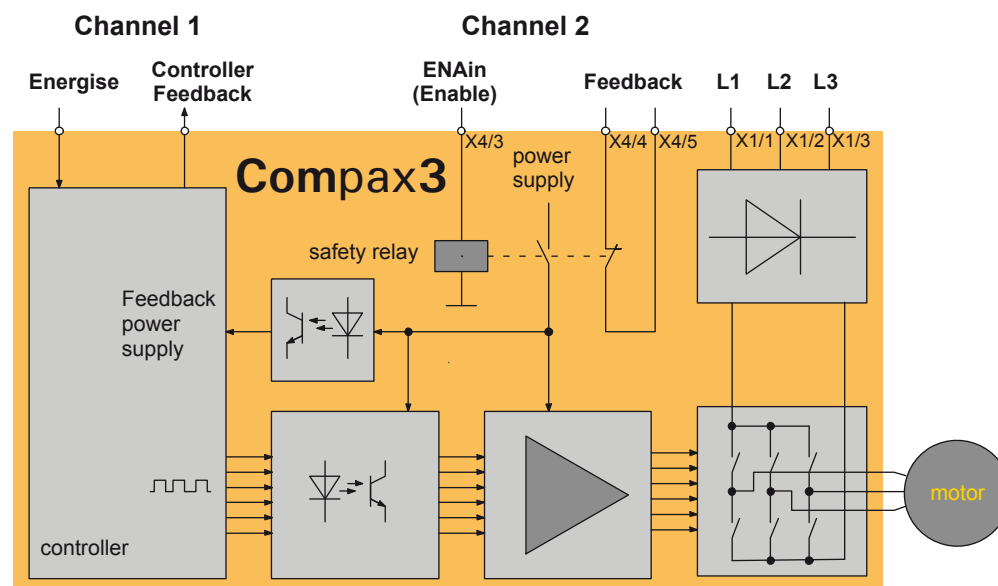
Channel 2:

The power supply for optocouplers and drivers of power output stage signals is disconnected by a safety relay activated by the enable input "ENAIN"(X4/3) and equipped with force-directed contacts. This prevents control signals from being transferred to the power output stage.



The "Safe Standstill" safety function as defined by EN 954-1 Category 3 is only possible if both channels are used.

Circuit diagram illustrating working principle:



Notes

- ◆ In normal operation of Compax3, 24 V DC of power is supplied to the "Enable" input (X4/3). The drive is then controlled by the digital inputs/outputs or the fieldbus.

When used properly, the "Safe standstill" safety function is only used when the motor is at a standstill, since it is not capable of braking a motor or bringing it to a standstill by itself.

3.10.2. Devices with the "Safe Standstill" safety function

The "safety torque off" safety function is implemented in the following devices:

Compax3 technology function

- ◆ I10T10, I11T11
- ◆ I11T30, I20T30, I21T30, I22T30, I30T30, I31T30, I11T40, I20T40, I21T40, I22T40, I30T40, I31T40
- ◆ I12T11, I20T11, I21T11, I22T11, I30T11, I31T11
- ◆ C10T11, C10T30, C10T40, C13T11, C13T30, C13T40

with the device power

S025V2, S063V2, S100V2, S150V2, S015V4, S038V4, S075V4, S150V4, S300V4

and does apply only for the safety switching devices used in the application examples.

3.10.3. Safety instructions for the "safety torque off" function

- ◆ Safety functions must be tested 100%.
- ◆ Only qualified staff members are permitted to install the "Safe Standstill" feature and place it in service.
- ◆ For all applications in which the first channel of the "Safe Standstill" is implemented by means of a PLC, care must be taken that the part of the program that is responsible for current flowing to or not flowing to the drive is programmed with the greatest possible care. The "Safe Standstill" application example of Compax3 with fieldbus should be considered.
The designer and operator responsible for the system and machine must refer programmers who are involved to these safety-related points.
- ◆ Terminal X4/2 (GND 24 V and at the same time the reference point for the safety relay bobbin) must be connected with the PE protective lead. This is the only way to ensure protection against incorrect operation through earth faults (EN60204-1 Section 9.4.3)!
- ◆ All conditions necessary for **CE conform operation** (see page 19) must be observed.
- ◆ It should be noted in connection with the "Safe Standstill" application example illustrated here that after the Emergency Power-off switch has been activated, no galvanic isolation in accordance with EN 60204-1 Section 5.5 is guaranteed. This means that the entire system must be disconnected from the mains power supply with an additional main switch or mains power contactor for repair jobs. Please note in this regard that even after the power is disconnected, dangerous electrical voltages may still be present in the Compax3 drive for about 5 minutes.
- ◆ When using an external Emergency power-off module with adjustable delay time, (as illustrated in the "Safe Standstill" application example), it must be ensured that the delay time cannot be adjusted by persons not authorized to do so (for example by applying a lead seal).
The adjustable delay time on the Emergency Power-off module must be set to a value greater than the duration of the braking ramp controlled by the Compax3 with maximum load and maximum speed.
If the setting range for the specified Emergency power-off module is not sufficient, the Emergency power-off module must be replaced by another comparable module.
- ◆ All safety-related external leads (for example the control lead for the safety relay and feedback contact) must absolutely be laid so they are protected, for example in a cable duct. Short circuits and crossed wires must be reliably excluded!
- ◆ If there are external forces operating on the drive axes, additional measures are required (for example additional brakes). Please note in particular the effects of gravity on suspended loads!
- ◆ If the power fails, the possibility must be considered that for the application with stop category K1, such as is described in the application example, it will no longer be possible to execute the braking ramp controlled to speed 0.
- ◆ It is important to note that if the drive is being activated (Energize) by the RS232 (RS485) interface, it may not be possible to execute switch-off by a controlled braking ramp. For example, this is true when the set-up window of the C3 ServoManager is used. If set-up mode is turned on, the digital I/O interface and fieldbus interface are automatically disabled.

3.10.4. Application example for "safe standstill"

In this chapter you can read about:

Note:	90
Safe standstill without bus option	90
Safe standstill with bus option	94

The application example described here corresponds to Stop Category 1 as defined by EN60204-1.

A Stop Category 0 in accordance with EN 60204-1 can be implemented, for example by setting the delay time on the Emergency power-off switch to 0. The Compax3 drive will then be turned off immediately in 2 channels and will not be able to generate any more torque. Please take into consideration that the motor will not brake and a coasting down of the motor may result in hazards. If this is the case, a "Safe Standstill" in the stop category 0 is not permitted.

3.10.4.1 Note:



If the "safe standstill" function of Compax3 is required or used for a machine or system, the errors:

- ◆ "Motor_Stalled" and
- ◆ "Tracking"

is not to be switched off (**see page 335, see page 150, see page 334, see page 148).**

3.10.4.2 Safe standstill without bus option

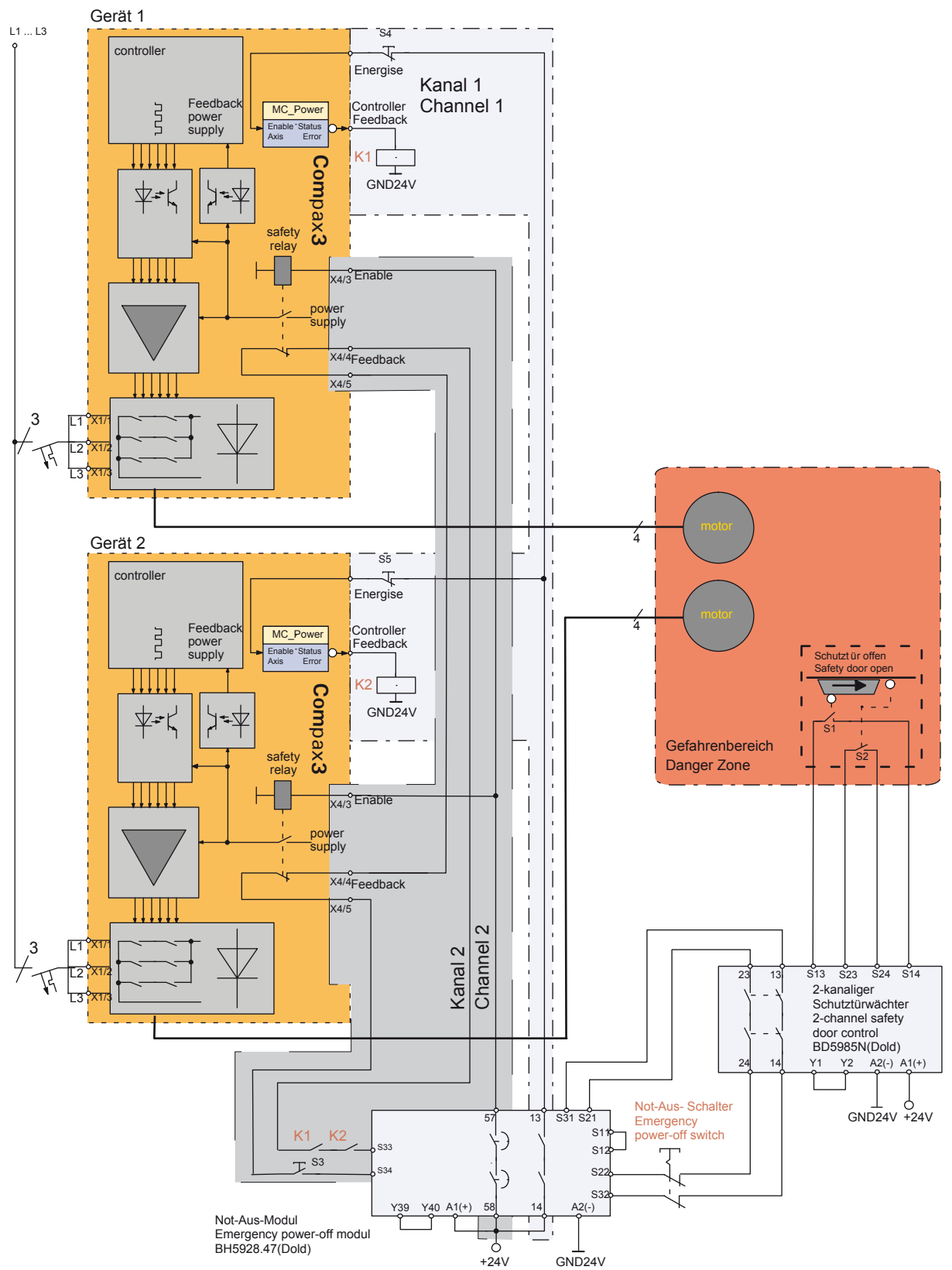
In this chapter you can read about:

Layout:	91
Circuit:	92
Description	93

Layout:

- ◆ 2 Compax3 devices (the circuit example is also valid for one or multiple devices, if it is adapted accordingly)
- ◆ 1 Emergency Power-off module (BH5928.47 manufactured by Dold)
With adjustable delayed deactivation of the Compax3 enable input.
The time must be set so that all axes are at a standstill before the Compax3 controllers are deactivated.
- ◆ 1 safety door monitor (BD5985N made by Dold)
Note: With safety door monitor BD5985N, the safety door must be opened and closed again every time after turning on the 24 V power supply so that the Emergency power-off module can be acknowledged and reset. To avoid this, safety door monitors with an additional simulation entry or a corresponding reset circuit can also be used.
- ◆ 1 Emergency power-off switch
- ◆ Hazardous area accessible via a safety door with safety door switch S1 and S2
- ◆ 3 buttons (S3, S4, S5)
- ◆ 1 relay per Compax3

Circuit:



Switches and buttons:

S1:	Closed when the safety door is closed
S2:	Closed when the safety door is closed
S3:	Activate Emergency power-off module
S4:	Guide Device 1 to a currentless state (error acknowledge)
S5:	Guide Device 2 to a currentless state (error acknowledge)

Description

In this chapter you can read about:

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Access to the hazardous area	96

In this chapter you can read about:

Basic function	93
Access to the hazardous area	94

Basic function

Compax3 devices disabled by:

Channel 1: Energize input to "0" through open contacts of Emergency power-off module (13 -14)

Channel 2: Enable input to "0" through open contacts of Emergency power-off module (57 -58)

Activate Emergency power-off module

Before the Compax3 can be placed in operation, the Emergency power-off module must be activated by a pulse to Input S33/S34.

Prerequisite:

- ◆ S3 closed
- ◆ Safety door closed: only in this case the safety door monitor enables the emergency power off module via two channels.
- ◆ K1 and K2 energized
 - ◆ K1: receives current if Compax3 Device 1 is currentless (output = "1" in currentless state) = Channel 1 feedback
 - ◆ K2: receives current if Compax3 Device 2 is currentless (output = "1" in currentless state) = Channel 1 feedback
- ◆ The feedback contact of all Compax3 devices must be closed (channel 2).
If S33 & S34 of the Emergency power-off module are briefly connected (pulse) the contacts will be closed (between 13 & 14 and between 57 & 58)

Energize Compax3 (Motor and power output stage)

- ◆ Compax3 devices are enabled by the Energize input and the Enable input via the Emergency power-off module. (If an error is still pending on Compax3, it must previously be reset. The acknowledge/reset function depends on the type of the Compax3 device).
- ◆ The motors are energized with current.

Summary: Compax3 is only energized if the feedback functions are capable of functioning via two channels.

Access to the hazardous area

Activate Emergency power-off switch

The two-channel disconnecting at the emergency power-off switch deactivates the emergency power-off module – the contacts 13 – 14 will open immediately.

Channel 1: Compax3 devices receive the command via the Energize input to guide the drive to a currentless state (using the ramp configured in the C3 ServoManager for "drive disable").

Channel 1 feedback: The "Controller Feedback" Compax3 outputs supply current to Relays K1 and K2.

Channel 2: After the delay time set in the Emergency power-off module, (this time must be set so that all drives are stopped after it has elapsed) the contacts between 57 & 58 open, which in turn deactivates the Enable inputs of the Compax3 devices.

Channel 2 feedback: Via the series circuit of all feedback contacts, the "Safe Standstill" status (all Compax3 devices without current) is reported.

Only if the drives are all at a standstill, the safety door may be opened and the hazardous area may be accessed.

If the safety door is opened during operation and the emergency-power-off switch was not triggered before, the Compax3 drives will also trigger the stop ramp.



Caution! The drives may still move.

If danger to life and limb of a person entering cannot be excluded, the machine must be protected by additional measures (e.g. a safety door locking).

3.10.4.3 Safe standstill with bus option

In this chapter you can read about:

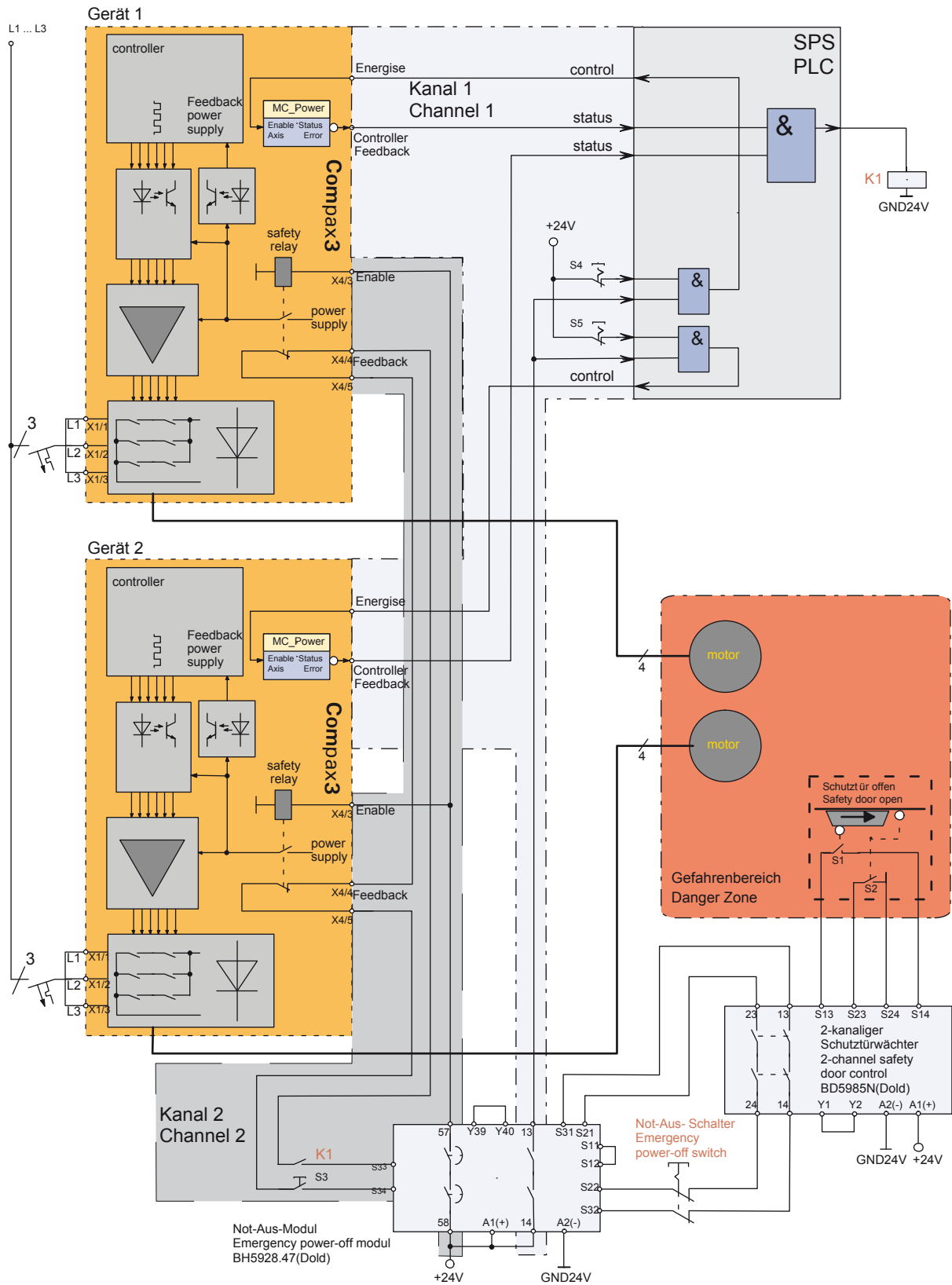
Layout:	94
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Description	96

Layout:

- ◆ 2 Compax3 devices (the circuit example is also valid for one or multiple devices, if it is adapted accordingly)
- ◆ 1 Emergency Power-off module (BH5928.47 manufactured by Dold)
 - With adjustable delayed deactivation of the Compax3 enable input.
 - The time must be set so that all axes are at a standstill before the Compax3 controllers are deactivated.
- ◆ 1 safety door monitor (BD5985N made by Dold)
 - Note: With safety door monitor BD5985N, the safety door must be opened and closed again every time after turning on the 24 V power supply so that the Emergency power-off module can be acknowledged and reset. To avoid this, safety door monitors with an additional simulation entry or a corresponding reset circuit can also be used.
- ◆ 1 Emergency power-off switch
- ◆ Hazardous area accessible via a safety door with safety door switch S1 and S2
- ◆ 3 buttons (S3, S4, S5)
- ◆ 1 Relay (K1)

Circuit:

control: Control word
status: Status word



Switches and buttons:

S1:	Closed when the safety door is closed
S2:	Closed when the safety door is closed
S3:	Activate Emergency power-off module
S4:	Guide Device 1 to a currentless state (error acknowledge)
S5:	Guide Device 2 to a currentless state (error acknowledge)

Description

Basic functions:

Compax3 devices disabled by:

Channel 1: Energize deactivated by PLC due to open contacts of the Emergency power-off module (13 -14)

Channel 2: Enable input to "0" through open contacts of Emergency power-off module (57 - 58)

Activate Emergency power-off module

Before the Compax3 can be placed in operation, the Emergency Power-off module must be activated by a pulse to Input S33/S34.

Prerequisite:

- ◆ S3 closed
- ◆ Safety door closed: only in this case the safety door monitor enables the emergency power off module via two channels
- ◆ K1 energized via PLC (feedback channel 1: motor not energized)
- ◆ The feedback contact of all Compax3 devices must be closed (channel 2).

If S33 & S34 of the Emergency power-off module are briefly connected (pulse) the contacts will be closed (between 13 & 14 and between 57 & 58).

Energize Compax3 (Motor and power output stage)

- ◆ The PLC enables the Compax3 devices by means of the control word and the Emergency power-off module enables the Compax3 devices by means of the Enable input. (if an error is still pending on Compax3, it must be previously acknowledged/reset)
- ◆ The motors are energized with current.

Summary: Compax3 is only energized if the feedback functions are capable of functioning via two channels.

Access to the hazardous area

Activate Emergency power-off switch

The two-channel disconnecting at the emergency power-off switch deactivates the emergency power-off module – the contacts 13 – 14 will open immediately.

The PLC evaluates this and responds as follows:

Channel 1: The Compax3 devices receive via the control word the command to guide the drive to currentless state (vi the ramp for "deenergizing" configured in the C3 ServoManager).

Channel 1 feedback: The Compax3 feedback via the status word is evaluated by the PLC and passed on to the emergency power-off module via K1.

Channel 2: After the delay time set in the Emergency power-off module, (this time must be set so that all drives are stopped after it has elapsed) the contacts

between 57 & 58 open, which in turn deactivates the Enable inputs of the Compax3 devices.

Channel 2 feedback: Via the series circuit of all feedback contacts, the "Safe Standstill" status (all Compax3 devices without current) is reported. Only if the drives are all at a standstill, the safety door may be opened and the hazardous area may be accessed.

If the safety door is opened during operation and the emergency-power-off switch was not triggered before, the Compax3 drives will also trigger the stop ramp.



Caution! The drives may still move.

If danger to life and limb of a person entering cannot be excluded, the machine must be protected by additional measures (e.g. a safety door locking).

3.11 Compax3M with safety option S1: Safe torque off

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3.11.1. General Description

In this chapter you can read about:

Important terms and explanations	98
Intended use	99
Advantages of using the "safe torque off" safety function.	100

The present documentation assumes a basic knowledge of our drive controllers as well as an understanding of safety-oriented machine design. References to standards and other regulations are only rudimentarily expressed.

For complementary information, we recommend the respective technical literature, e.g.:

BIA Report 6/97 and BIA Report 5/2003 (Information issued by the german government safety organization)

Download under: <http://www.hvbg.de/d/bia/pub/rep/index.html>

<http://www.hvbg.de/d/bia/pub/rep/index.html>

3.11.1.1 Important terms and explanations

Term	Explanation
Safety category 3 according to EN 954-1 or EN ISO 13849-1:2007	Definition according to standard: Circuit with safety function against individual faults Some, but not all faults are detected. An accumulation of faults may lead to a loss of the safety function. The remaining risk is accepted. The determination of the safety category required for an application (risk analysis) lies within the responsibility of the machine manufacturer. It can take place according to the method described in EN ISO 13849-1:2007, appendix A.
"Safe torque off" or abbreviated: STO=Safe torque off	With the "safe torque off", the energy supply of the drive is safely interrupted according to EN 1037, paragraph 4.1. The drive is not to be able to produce a torque and thus dangerous movements (see EN 1037, paragraph 5.3.1.3). The standstill position must not be monitored. If an external force effect, e.g. a drop of hanging loads, is possible with the "safe torque off", additional measures to safely prevent those must be provided (e.g. additional mechanical brakes). The following measures are appropriate for a "safe torque off": Contactor between mains and drive system (mains contactor) Contactor between power section and motor (motor contactor) Safe blocking of the power semiconductor control (start inhibitor)
Start inhibitor	Safe blocking of the power semiconductor control. With the aid of this function, you can obtain a "safe torque off".

Stop categories according to EN60204-1 (9.2.2)

Stop category	Safety function	Requirement	System behaviour	Remark
0	Safe torque off (STO)	Stopping by immediately switching off the energy supply of the machine drive elements	Uncontrolled stop	Uncontrolled stop is the stopping of a machine movement by switching off the energy of the machine drive elements. Available brakes and/or other mechanical stopping components are applied.
1	Safe stop 1 (SS1)	Stop where the energy of the machine drive elements is maintained in order to reach a stop. The energy supply is only interrupted, if the standstill is attained.	Controlled stop	Controlled stop is the stopping of a machine movement by for instance resetting the electrical command signal to zero, as soon as the stop signal has been detected by the controller, the electrical energy for the machine drive elements remains however during the stopping procedure.
2	Safe stop 2 (SS2)	Stop where the energy to the machine drive elements is maintained.	Controlled stop	This category is not covered.

3.11.1.2 Intended use

The Compax3M drive controller supports the "safe torque off" (STO) safety function, with protection against unexpected startup according to the requirements of EN 954-1 category 3, EN ISO 13849-1 PL=d and EN 1037.

Together with the external safety control device, the "safe stop 1" (SS1) safety function according to the requirements of EN 954-1 category 3 can be used. As the function is however realized with the aid of an individually settable time delay on the safety switching device, you must take into account that, due to a fault in the drive system during the active braking phase, the axis trundles to a stop unguidedly or may even accelerate actively in the worst case until the expiry of the preset switch-off time.

According to a risk evaluation which must be carried out according to the machine standard 98/37/EG or EN ISO 12100, EN ISO 13849-1 and EN ISO 14121-1, the machine manufacturer must project the safety system for the entire machine including all integrated components. This does also include the electrical drives.

When using the S1 option, a protocol describing the orderly working of the safety function must be made upon the setup and in defined maintenance intervals (see protocol proposal).

Qualified personnel

Projecting, installation and setup require a detailed understanding of this description.

Standards and accident prevention regulation associated with the application must be known and respected as well as risks, protective and emergency measures.

3.11.1.3 Advantages of using the "safe torque off" safety function.

Safety category 3 according to EN 954-1 and EN ISO 13849-1:

Requirements performance feature	Use of the safe torque off function	Conventional solution: Use of external switching elements
Reduced switching overhead	Simple wiring, certified application examples Grouping of drive controllers on a mains contactor is possible.	Two safety-oriented power contactors in series connection are required.
Use in th production process High operating cycles, high reliability, low wear	Extremely high operating cycles thanks to almost wear-free technology (low-voltage relay and electronic switch). The "safe torque off" status is attained due to the use of wear-free electronic switches (IGBTs).	This performance feature cannot be reached with conventional technology.
Use in th production process High reaction speed, fast restart	Drive controller remains performance- and control-oriented in connected state. No significant waiting times due to restart.	When using power contactors in the supply, a long waiting time for the energy discharge of the DC link circuit is required. When using two power contactors on the motor side, the reaction times may increase, you must however take into consideration other disadvantages: a) Securing that switching takes only place in powerless state (Direct current! Constant electric arcs must be prevented). b) Increased overhead for EMC conform wiring.
Emergency-stop function	According to the german version of the standard: Permitted without control of mechanical power switching elements 1)	Switch-off via mechanical switching elements is required

1) According to the preface of the german version of the EN 60204-1/11.98, electronic equipment for emergency-stop devies are also permitted, if they comply with the safety categories as described in EN954-1.

3.11.2. STO function on the Compax3M

In this chapter you can read about:

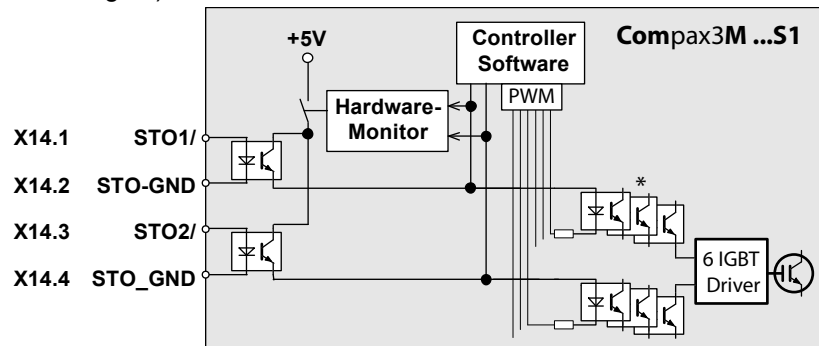
Safety switching circuits	101
Safety notes and limitations of the STO function in the Compax3M	102
Technical details of the Compax3M S1 option	103

3.11.2.1 Safety switching circuits

The current flow in the motor windings is controlled by a power semiconductor bridge (6-fold IGBT). A processor circuit and PWM circuit will switch the IGBT with rotary field orientation. Between control logic and power module, optocouplers or pulse transmitters are used for potential separation

On the Compax3M drive controller with S1 option, the X14 (STO) connector can be found on the front plate. 2 optocouplers are controlled on two channels via the STO1/ and STO2/ terminals of this connector. When requesting the STO via an external safety switching device, the two auxiliary voltage supply channels of the power stage control circuits are switched off on two channels. Therefore the power transistors (IGBTs) for the motor current can not longer be switched on.

The hardware monitor detects a failure of the optocoupler circuit of a channel by always checking both channels for similarity. If the hardware monitor detects a discrepancy for a defined time (max. 20s), the error will be stored in the hardware latch. The processor signals this error externally via the 0x5493 error code. An activation of the coupler supply can then only take place via a hardware reset (switching off and on again) of the device.



* Potential separation with optocoupler.

3.11.2.2 Safety notes and limitations of the STO function in the Compax3M

- ◆ The STO safety function must be tested and protocolled **as described** (see page 109). The safety function must be requested at least once a week. In safety door applications, the weekly testing interval must not be observed, as you can assume that the safety doors will be opened several times during the operation of the machine.
- ◆ The CompaxM with integrated STO safety function as well as the utilized safety control devices must be mounted protectedly (IP54 control cabinet).
- ◆ Only qualified staff members are permitted to install the STO function and place it in service.
- ◆ The X9/2 (GND24V) terminal on the Compax3MPxx mains module must be connected to the PE protective lead. This is the only way to ensure protection against incorrect operation through earth faults (EN60204-1 Section 9.4.3)!
- ◆ All conditions necessary for **CE conform operation** (see page 19) must be observed.
- ◆ It should be noted in connection with the STO application examples illustrated here that after the Emergency Power-off switch has been activated, no galvanic isolation in accordance with EN 60204-1 Section 5.5 is guaranteed. This means that the entire system must be disconnected from the mains power supply with an additional main switch or mains power contactor for repair jobs. Please note in this regard that even after the power is disconnected, dangerous electrical voltages may still be present in the Compax3 drive for about 5 minutes.
- ◆ When using an external Emergency power-off module with adjustable delay time, (as illustrated in the STO application example), it must be ensured that the delay time cannot be adjusted by persons not authorized to do so (for example by applying a lead seal). With the UE410-MU3T5 safety control, this is not necessary, if the anti manipulation measures are respected.
The adjustable delay time on the Emergency Power-off module must be set to a value greater than the duration of the braking ramp controlled by the Compax3 with maximum load and maximum speed.
- ◆ If there are external forces operating on the drive axes, additional measures are required (for example additional brakes). Please note in particular the effects of gravity on suspended loads! This must be respected above all for vertical axes without self-locking mechanical devices or weight balance.
- ◆ During the active braking phase of Stop category 1 (controlled bringing to a stop with safely monitored delay time according to EN60204-1) or safe stop 1, faulty function must be expected. If a fault in the drive system occurs during the active braking phase, the axis may trundle to a stop unguidedly or might even actively accelerate until the expiry of the defined switch-off time.
- ◆ When using synchronous motors, a short movement over a small angle is possible, if two faults occur simultaneously in the power section. This depends on the number of pole pairs of the motor (rotary types: 2 poles = 180°, 4 poles = 90°, 6 poles = 60°, 8 poles = 45°, Linear motors: 180° electrically).
- ◆ For synchronous motors operated in the field weakening range, the operation of the STO function may lead to overspeed and destructive, life-threatening overvoltages as well as explosions in the servo controller. Therefore, NEVER use the STO function with synchronous drives in the field-weakening range.
- ◆ It is important to note that if the drive is being activated (Energize) by the USB / RS485 interface, it may not be possible to execute switch-off by a controlled braking ramp. For example, this is true when the set-up window of the C3 ServoManager is used. If set-up mode is turned on or with the input simulator, the digital I/O interface and fieldbus interface are automatically disabled.

3.11.2.3 Technical details of the Compax3M S1 option

Compax3M S1 Option: Signal inputs for connector X14

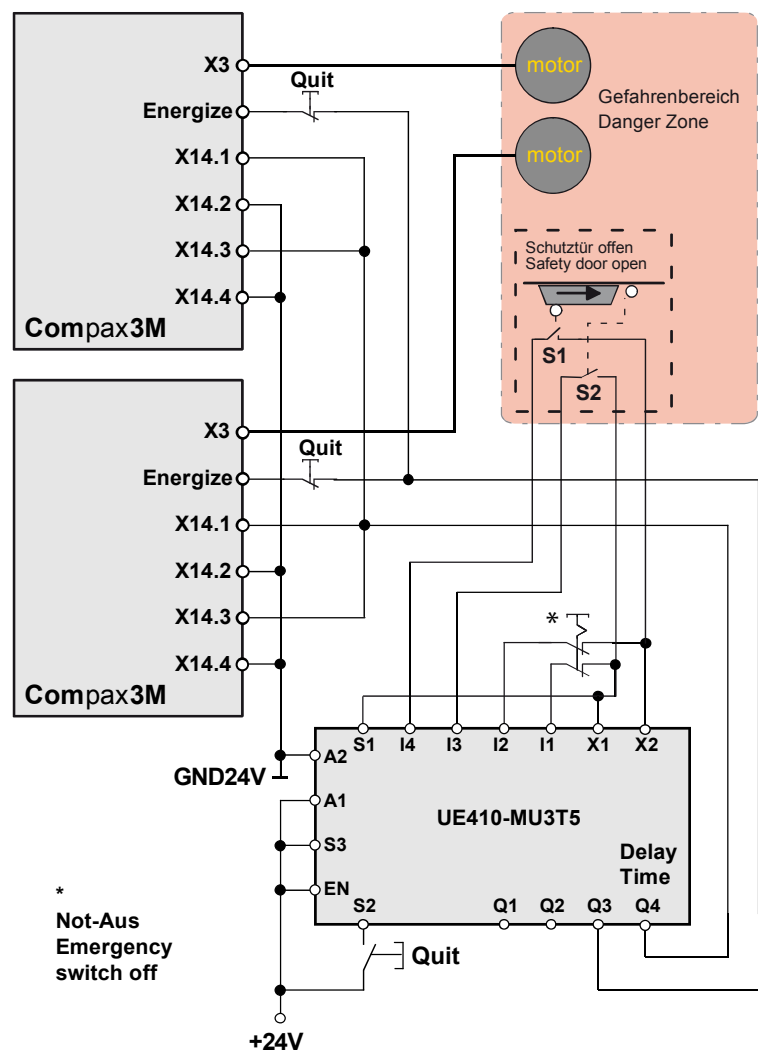
Nominal voltage of the inputs	24V
Required isolation of the 24V control voltage	Grounded protective extra low voltage, PELV
Protection of the STO control voltage	1A
Number of inputs Signal inputs via optocoupler	2 Low = 0...7V DC or open High = 15...30V DC I_{in} at 24V DC: 8mA
STO1/	Low = STO activated High = STO deactivated
STO2/	Low = STO activated High = STO deactivated
Switch-off time with unequal input statuses (max. reaction time)	20 seconds
Grouping of safety level	Category 3 PL=d PFH=1.01 x 10 ⁻⁷ h ⁻¹

3.11.3. Compax3M STO application description

In this chapter you can read about:

STO function with safety control device via Compax3M inputs.....	104
STO function description	104
STO function with safety switching device for applications with fieldbuses.....	106
Emergency power-off and protective door monitoring without safety switching devices..	108

3.11.3.1 STO function with safety control device via Compax3M inputs



The acknowledgement via the safety control UE410-MU3T5 is only necessary, if after the disabling of the STO function, a danger to any person or to the machine could arise. During the **Configuration des Compax3M** (see page 145) you must see to a debouncing time >3ms being configured. The operating instructions of the UE410-MU3T5 safety control must be observed. The Compax3M devices and the UE410-MU3T5 safety control must be mounted in the same control cabinet.

3.11.3.2 STO function description

When opening the protective door or after actuating the emergency power-off switch, the signal of the "energize" input of the Compax3M drive modules is

interrupted via the Q3 output on the UE410-MU3T5 safety control. This triggers an immediate braking ramp on the drives. Then after the delay time set on the UE410-MU4T5 safety control, the STO function in the drives is triggered via the Q4 output. The servo drives are then in safe torqueless state. The delay time must be set on the safety control so that the braking ramp in the drives has run off and the drives are at standstill when the delay time has elapsed.

The described application example corresponds to the stop category 1 according to EN 60204-1. Together with the external safety switching device, the "Safe Stop 1" safety function can also be implemented.

A Stop Category 0 in accordance with EN 60204-1 can be implemented, for example by setting the delay time on the Emergency power-off module to 0. The Compax3M will then be turned off immediately in 2 channels and will not be able to generate any more torque. Please take into consideration that the motor will not brake and a coasting down of the motor may result in hazards. If this is the case, the STO function in stop category 0 is not permitted.

Depending on the interface Ixx or technology function Txx of the Compax3M, the "energize" input can be a digital input or for instance a defined bit of a fieldbus control word (see the overview table below).

Interface/Technology	"Energize"
I10T10	Digital input X12.6
I11T11	Digital input X12.8
I12T11	Digital input X12.6
I2xT11	Applications with fieldbusses (see page 106)
I1xT30 and I1xT40	Debounced digital input defined in the IEC program, which leads to the enable input of the MCpower function module
I2xT30, I2xT40, I3xT30 and I3xT40	Bit defined in the IEC program which is linked to the enable input of the MCpower function module
C1xT30 and C1xT40	Debounced digital input defined in the IEC program, which leads to the enable inputs of several MCpower function modules for different axes. The information is passed on via the CANbus.

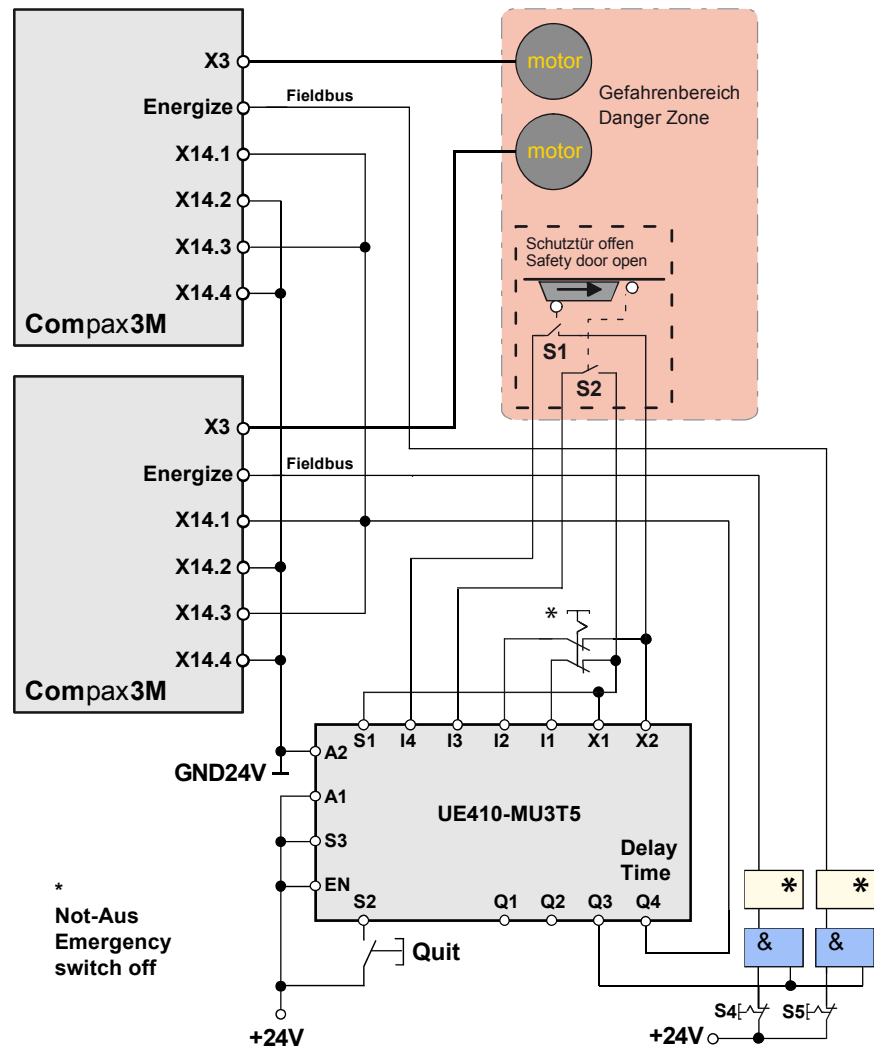
The acknowledgement via the safety control UE410-MU3T5 is only necessary, if after the disabling of the STO function, a danger to any person or to the machine could arise.

3.11.3.3 STO function with safety switching device for applications with fieldbusses

In this chapter you can read about:

Energize and deenergize circuitry	106
Function description for fieldbus applications:	107

Energize and deenergize circuitry



* With Profibus:

Status change in:	
0 -> 1	SB1 SC1
1 -> 0	SA2

* with CANopen, Devicenet, Ethernet Powerlink and Ethercat:

Status change in:	
0 -> 1	Operation enable
1 -> 0	Switched On Disabled

The operating instructions of the UE410-MU3T5 safety control must be observed. The Compax3M devices and the UE410-MU3T5 safety control must be mounted in the same control cabinet.

Function description for fieldbus applications:

When opening the safety door or after actuating the emergency power-off switch, it is ensured via output Q3 and the external control that the Compax3M servo drives will enter the following state immediately:

- ◆ "SA2"
(for Profibus) or (braking ramp followed by software switch-off)
- ◆ "Switched On Disabled"
for fieldbuses based on the CANopen profile

In the programmable Compax3 devices (T30, T40), this switch-off is realized with the MC_power function module. Then after the delay time set on the UE410-MU4T5 safety control, the STO function in the drives is triggered via the Q4 output. The servo drives are afterwards in safe torqueless state. The delay time must be set on the safety control so that the braking ramp in the drives has run off and the drives are at standstill when the delay time has elapsed.

The described application example corresponds to the stop category 1 according to EN 60204-1. Together with the external safety switching device, the "Safe Stop 1" safety function can also be implemented.

A Stop Category 0 in accordance with EN 60204-1 can be implemented, for example by setting the delay time on the Emergency power-off module to 0. The Compax3M will then be turned off immediately in 2 channels and will therefore not be able to generate any more torque. Please take into consideration that the motor will not brake and a coasting down of the motor may result in hazards. If this is the case, the STO function in stop category 0 is not permitted.

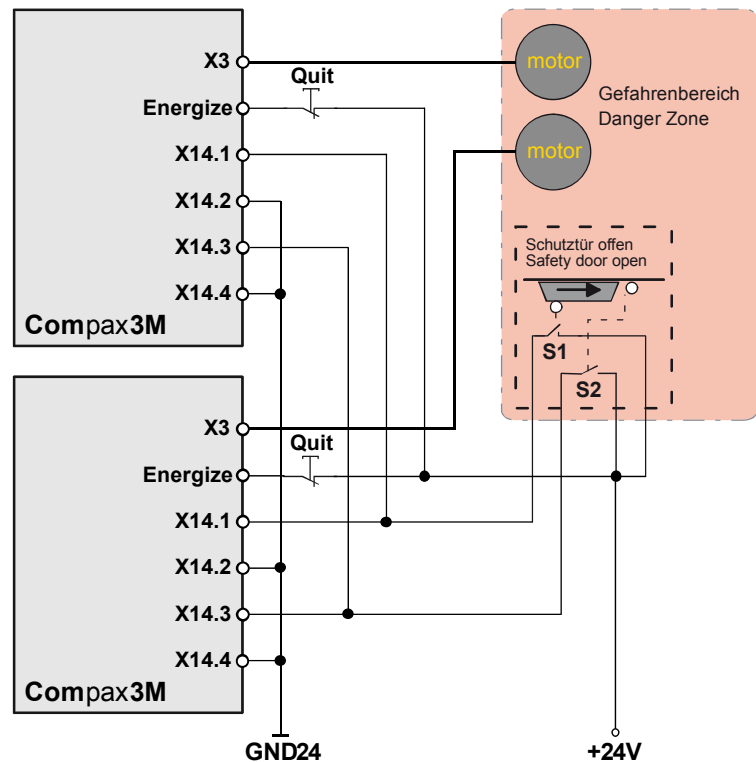
The acknowledgement via the safety control UE410-M is only necessary, if after the disabling of the STO function, a danger to any person or to the machine could arise.

3.11.3.4 Emergency power-off and protective door monitoring without safety switching devices

With Compax3M, a 2-channel protective door monitoring switch or a 2 channel emergency power-off switch can be directly connected. The figure below visualizes an application with 2 channel protective door monitoring switch.

The Compax3M drive modules with Compax3MPxx mains rectifier must be located in a protected area (IP54 control cabinet). Outside this protected area, the line guiding to the external switches must be separated channelwise or must be especially protected (screened).

It is also permitted to use one acknowledgement switch for both servo drives at a time. In both cases the acknowledgement does only correspond to category B (no longer category 3), therefore this acknowledgement should not be used if there is any possibility of stepping in the dangerous area. In this case, an external acknowledgement device must be used.



3.11.4. STO function test

The STO function must be checked in the event of:

- ◆ Commissioning
 - ◆ After each exchange of any equipment within the system
 - ◆ After each intervention into the system wiring
 - ◆ In defined maintenance intervals (at least once per week) and after a longer standstill of the machine
- If the STO function was triggered by opening a protective door and if this door is opened several times a week, the weekly testing interval is not required.
- The check must be made by qualified personnel adhering to all necessary safety precautions.

The following testing steps must be performed:

STO test	Action, activity	Expected reaction and effect
1	24V DC voltage on terminal X14.1 and X14.3	
2	Switch on power and 24V supply voltage	No error must be present
3	Configuring the device	No error must be present
4	Testing active STO on terminal X14.1 and X14.3: Remove 24V DC on terminal X14.1 and X14.3 at the same time	Error message 0x5492 must be present 1)
5	Re-apply 24V DC voltage on terminals X14.1 and X14.3 and then acknowledge error	No error must be present
6	Then switch off and on again 24V voltage supply	No error must be present

1) In order to automatize the test, it is sufficient here to monitor the general error output with an external logic.

A manual check of the torqueless drive is here also sufficient.

The triggering of the STO can also be made by actuating the emergency power-off switch. During the automated test, the STO can also be triggered via the contacts of an external relay

Following the test steps

The performance of the individual test steps of the STO function must be logged. A protocol specimen can be found in the following section.

Depending on the machine version, additional or other test steps may be required.

3.11.4.1 STO test protocol specimen

General information:

Project/machine:

Servo axis:

Name of the tester:

STO function test:

Test specification
according to the
Compax3 release:

STO function test steps 1- o successfully tested
6:

Acknowledgement safety o successfully tested
switching device: o is not used

Safe stop 1: o successfully tested
o is not used

Initial acceptance on:

Repeat check on:

Signature of the tester

Signature of the tester

4. Setting up Compax3

In this chapter you can read about:

Configuration	111
Configuring the signal source	152
Load control	157
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4.1 Configuration

In this chapter you can read about:

Test commissioning of a Compax3 axis	113
Selection of the supply voltage used	113
Motor Selection	113
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Braking Resistor	117
General Drive	118
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Configuration name / comments	151

The general proceeding in order to operate an empty-running motor is described **here** (see page 113).

Configuration sequence:**Installation of the C3
ServoManager**

The Compax3 ServoManager can be installed directly from the Compax3 DVD. Click on the appropriate hyperlink or start the installation program "C3Mgr_Setup_V.... .exe" and follow the instructions.

PC requirements**Recommendation:**

Operating system:	MS Windows XP SP2 / MS Windows 2000 as from SP4 / (MS Vista)
Browser:	MS Internet Explorer 6.x
Processor:	Intel Pentium 4 / Intel Core 2 Duo / AMD Athlon class as from >=2GHz
RAM memory:	>= 1024MB
Hard disk:	>= 20GB available memory
Drive:	DVD drive
Monitor:	Resolution 1024x768 or higher
Graphics card:	on onboard graphics (for performance reasons)
Interface:	USB

Minimum requirements:

Operating system:	MS Windows XP SP2 / MS Windows 2000 as from SP4
Browser:	MS Internet Explorer 6.x
Processor:	>= 1.5GHz
RAM memory:	512MB
Hard disk:	10GB available memory
Drive:	DVD drive
Monitor:	Resolution 1024x768 or higher
Graphics card:	on onboard graphics (for performance reasons)
Interface:	USB

Note:

- ◆ For the installation of the software you need administrator authorization on the target computer.
- ◆ Several applications running parallelly, reduce the performance and operability.
- ◆ especially customer applications, exchanging standard system components (drivers) in order to improve their own performance, may have a strong influence on the communication performance or even render normal use impossible.
- ◆ Operation under virtual machines such as Vware Workstation 6/ MS Virtual PC is not possible.
- ◆ Onboard graphics card solutions reduce the system performance by up to 20% and cannot be recommended.
- ◆ Operation with notebooks in current-saving mode may lead, in individual cases, to communication problems.

- Connection between PC - Compax3** Your PC is connected with Compax3 via a RS232 cable (**SSK1** (see page 500)). Cable **SSK1** (see page 500) (COM 1/2-interface on the PC to X10 on the Compax3 or via adapter SSK32/20 on programming interface of Compax3H). Start the Compax3 servo manager and make the setting for the selected interface in the menu "**Options Communication settings RS232/RS485...**".
- Device Selection** In the menu tree under device selection you can read the device type of the connected device (Online Device Identification) or select a device type (Device Selection Wizard).
- Configuration** Then you can double click on "Configuration" to start the configuration wizard. The wizard will lead you through all input windows of the configuration.

Input quantities will be described in the following chapters, in the same order in which you are queried about them by the configuration wizard.

4.1.1. Test commissioning of a Compax3 axis

In the device online help, we show you at this place an animation of a test setup with the aim to move an unloaded motor.

- ◆ Simple and independent of the Compax3 device variant*
- ◆ Without overhead for configuration
- ◆ Without special knowledge in programming

* for device specific functions, please refer to the corresponding device description.

Due to continuous optimization, individual monitor displays may have changed. This does however hardly influence the general proceeding.

4.1.2. Selection of the supply voltage used

Please select the mains voltage for the operation of Compax3. This influences the choice of motors available.

4.1.3. Motor Selection

The selection of motors can be broken down into:

- ◆ Motors that were purchased in Europe and
- ◆ Motors that were purchased in the USA.
- ◆ You will find non-standard motors under "Additional motors" and
- ◆ Under "User-defined motors" you can select motors set up with the C3 MotorManager.

For motors with holding brake SMHA or MHA brake delay times can be entered. For this see also **Brake delay times** (see page 290).

Please note the following equivalence that applies regarding terms to linear motors:

- ◆ Rotary motors / linear motors
- ◆ Rotations = Pitch
- ◆ rotational speed = speed
- ◆ torque = force
- ◆ moment of inertia = load

Notes on direct drives (see page 465) (Linear and Torque – Motors)

4.1.4. Optimize motor reference point and switching frequency of the motor current

Optimization of the motor reference point

The motor reference point is defined by the reference current and the reference (rotational) speed.

Standard settings are:

- ◆ Reference current = nominal current
- ◆ Reference (rotational) speed = nominal (rotational) speed

These settings are suitable for most cases.

The motors can, however, be operated with different reference points for special applications.

- ◆ By reducing the reference (rotational) speed, the reference current can be increased. This results in more torque with a reduced speed.
- ◆ For applications where the reference current is only required cyclically with long enough breaks in between, you may use a reference current higher than I_0 . The limit value is however reference current = max. $1.33 \cdot I_0$. The reference (rotational) speed must also be reduced.

The possible settings or limits result from the respective motor characteristics.



Caution!

Wrong reference values (too high) can cause the motor to switch off during operation (because of too high temperature) or even cause damage to the motor.

Optimization of the switching frequency

The switching frequency of the power output stage is preset to optimize the operation of most motors.

It may, however, be useful to increase the switching frequency especially with direct drives in order to reduce the noise of the motors. Please note that the power output stage must be operated with reduced nominal currents in the case of increased switching frequencies.

The switching frequency may only be increased.



Caution!

By increasing the motor current switching frequency, the nominal current and the peak current are reduced.

This must already be observed in the planning stage of the plant!

The preset motor current switching frequency depends on the performance variant of the Compax3 device.

The respective Compax3 devices can be set as follows:

Resulting nominal and peak currents depending on the switching frequency

Compax3S0xxV2 at 1*230VAC/240VAC

Switching frequency*		S025V2	S063V2
16kHz	I _{nominal}	2.5A _{eff}	6.3A _{eff}
	I _{peak} (<5s)	5.5A _{eff}	12.6A _{eff}
32kHz	I _{nominal}	2.5A _{eff}	5.5A _{eff}
	I _{peak} (<5s)	5.5A _{eff}	12.6A _{eff}

Compax3S1xxV2 at 3*230VAC/240VAC

Switching frequency*		S100V2	S150V2
8kHz	I _{nominal}	-	15A _{eff}
	I _{peak} (<5s)	-	30A _{eff}
16kHz	I _{nominal}	10A _{eff}	12.5A _{eff}
	I _{peak} (<5s)	20A _{eff}	25A _{eff}
32kHz	I _{nominal}	8A _{eff}	10A _{eff}
	I _{peak} (<5s)	16A _{eff}	20A _{eff}

Compax3S0xxV4 at 3*400VAC

Switching frequency*		S015V4	S038V4	S075V4	S150V4	S300V4
8kHz	I _{nominal}	-	-	-	15A _{eff}	30A _{eff}
	I _{peak} (<5s)	-	-	-	30A _{eff}	60A _{eff}
16kHz	I _{nominal}	1.5A _{eff}	3.8A _{eff}	7.5A _{eff}	10.0A _{eff}	26A _{eff}
	I _{peak} (<5s)	4.5A _{eff}	9.0A _{eff}	15.0A _{eff}	20.0A _{eff}	52A _{eff}
32kHz	I _{nominal}	1.5A _{eff}	2.5A _{eff}	3.7A _{eff}	5.0A _{eff}	14A _{eff}
	I _{peak} (<5s)	3.0A _{eff}	5.0A _{eff}	10.0A _{eff}	10.0A _{eff}	28A _{eff}

Compax3S0xxV4 at 3*480VAC

Switching frequency*		S015V4	S038V4	S075V4	S150V4	S300V4
8kHz	I _{nominal}	-	-	-	13.9A _{eff}	30A _{eff}
	I _{peak} (<5s)	-	-	-	30A _{eff}	60A _{eff}
16kHz	I _{nominal}	1.5A _{eff}	3.8A _{eff}	6.5A _{eff}	8.0A _{eff}	21.5A _{eff}
	I _{peak} (<5s)	4.5A _{eff}	7.5A _{eff}	15.0A _{eff}	16.0A _{eff}	43A _{eff}
32kHz	I _{nominal}	1.0A _{eff}	2.0A _{eff}	2.7A _{eff}	3.5A _{eff}	10A _{eff}
	I _{peak} (<5s)	2.0A _{eff}	4.0A _{eff}	8.0A _{eff}	7.0A _{eff}	20A _{eff}

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3HxxxV4 at 3*400VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I_{nominal}	50A _{eff}	90A _{eff}	125A _{eff}	155A _{eff}
	$I_{\text{peak}} (<5\text{s})$	75A _{eff}	135A _{eff}	187.5A _{eff}	232.5A _{eff}
16kHz	I_{nominal}	33A _{eff}	75A _{eff}	82A _{eff}	100A _{eff}
	$I_{\text{peak}} (<5\text{s})$	49.5A _{eff}	112.5A _{eff}	123A _{eff}	150A _{eff}
32kHz	I_{nominal}	19A _{eff}	45A _{eff}	49A _{eff}	59A _{eff}
	$I_{\text{peak}} (<5\text{s})$	28.5A _{eff}	67.5A _{eff}	73.5A _{eff}	88.5A _{eff}

Compax3HxxxV4 at 3*480VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I_{nominal}	43A _{eff}	85A _{eff}	110A _{eff}	132A _{eff}
	$I_{\text{peak}} (<5\text{s})$	64.5A _{eff}	127.5A _{eff}	165A _{eff}	198A _{eff}
16kHz	I_{nominal}	27A _{eff}	70A _{eff}	70A _{eff}	84A _{eff}
	$I_{\text{peak}} (<5\text{s})$	40.5A _{eff}	105A _{eff}	105A _{eff}	126A _{eff}
32kHz	I_{nominal}	16A _{eff}	40A _{eff}	40A _{eff}	48A _{eff}
	$I_{\text{peak}} (<5\text{s})$	24A _{eff}	60A _{eff}	60A _{eff}	72A _{eff}

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3MxxxD6 at 3*400VAC

Switching frequency*		M050D6	M100D6	M150D6	M300D6
8kHz	I_{nominal}	5A _{eff}	10A _{eff}	15A _{eff}	30A _{eff}
	$I_{\text{peak}} (<5\text{s})$	10A _{eff}	20A _{eff}	30A _{eff}	60A _{eff}
16kHz	I_{nominal}	3.8A _{eff}	7.5A _{eff}	10A _{eff}	20A _{eff}
	$I_{\text{peak}} (<5\text{s})$	7.5A _{eff}	15A _{eff}	20A _{eff}	40A _{eff}
32kHz	I_{nominal}	2.5A _{eff}	3.8A _{eff}	5A _{eff}	11A _{eff}
	$I_{\text{peak}} (<5\text{s})$	5A _{eff}	7.5A _{eff}	10A _{eff}	22A _{eff}

Compax3MxxxD6 at 3*480VAC

Switching frequency*		M050D6	M100D6	M150D6	M300D6
8kHz	I_{nominal}	$4A_{\text{eff}}$	$8A_{\text{eff}}$	$12.5A_{\text{eff}}$	$25A_{\text{eff}}$
	$I_{\text{peak}} (<5s)$	$8A_{\text{eff}}$	$16A_{\text{eff}}$	$25A_{\text{eff}}$	$50A_{\text{eff}}$
16kHz	I_{nominal}	$3A_{\text{eff}}$	$5.5A_{\text{eff}}$	$8A_{\text{eff}}$	$15A_{\text{eff}}$
	$I_{\text{peak}} (<5s)$	$6A_{\text{eff}}$	$11A_{\text{eff}}$	$16A_{\text{eff}}$	$30A_{\text{eff}}$
32kHz	I_{nominal}	$2A_{\text{eff}}$	$2.5A_{\text{eff}}$	$4A_{\text{eff}}$	$8.5A_{\text{eff}}$
	$I_{\text{peak}} (<5s)$	$4A_{\text{eff}}$	$5A_{\text{eff}}$	$8A_{\text{eff}}$	$17A_{\text{eff}}$

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

4.1.5. Braking Resistor

If the regenerative brake output exceeds the amount **storable energy of the servo controller** (see page 521), an error will be generated. To ensure safe operation, it is then necessary to either

- ◆ reduce the accelerations resp. the decelerations,
- ◆ or you will need an **external braking resistor** (see page 481) .

Please select the connected braking resistor or enter the characteristic values of your braking resistor directly.

Please note that with resistance values greater than specified, the power output from the servo drive can no longer be dissipated in the braking resistor.

4.1.6. General Drive

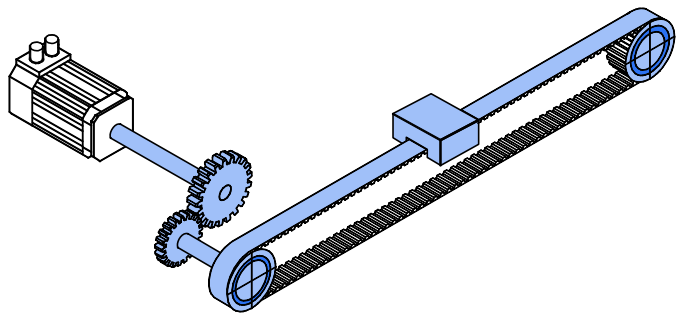
External moment of inertia / load

The external moment of inertia is required for adjusting the servo controller. The more accurately the moment of inertia of the system is known, the better is the stability and the shorter is the settle-down time of the control loop.

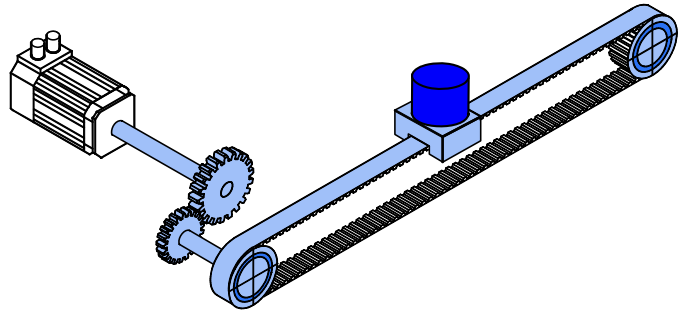
It is important to specify the minimum and maximum moment of inertia for best possible behavior under varying load.

If you do not know the moment of inertia, click on "Unknown: using default values". You have then the possibility to determine the moment of inertia by means of automatic **load identification** (see page 247).

Minimum moment of inertia / minimum load



Maximum moment of inertia / maximum load



Enter minimum = maximum moment of inertia when the load does not vary.

4.1.7. Defining the reference system

The reference system for positioning is defined by:

- ◆ a unit,
- ◆ the travel distance per motor revolution,
- ◆ a machine zero point with true zero,
- ◆ positive and negative end limits.

4.1.7.1 Measure reference

In this chapter you can read about:

You can select from among the following for the unit:

Unit of Travel

- ◆ mm,
- ◆ increments *
- ◆ angle degrees or
- ◆ Inch.

The unit of measure is always [mm] for linear motors.

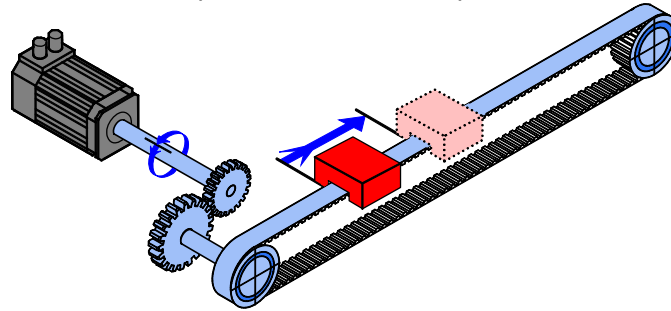
*

The unit "increments" is valid only for position values!

speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s² and revolutions/s³ (resp. pitch/s, pitch/s², pitch/s³).

Travel distance per motor revolution / pitch

The measure reference to the motor is created with the value: "travel distance per motor revolution / pitch" in the selected unit.

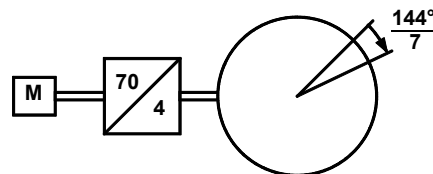


Input as numerator and denominator

You can enter the "travel distance per motor revolution" as a fraction (numerator divided by denominator). This is useful in the case of continuous operation mode or in reset mode if the value cannot be specified as a rational number. This makes it possible to avoid long-term drifts.

Example 1:

Rotary table control



Unit: Degrees

Gear transmission ratio 70:4 => 4 load revolutions = 70 motor revolutions

Travel distance per motor revolution = $4/70 * 360^\circ = 20.571\ 428\ 5\ \dots^\circ$ (number cannot be represented exactly)

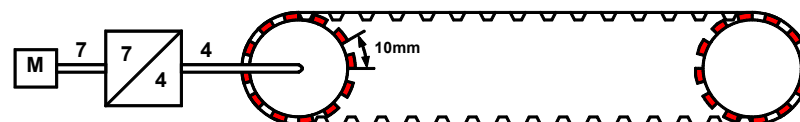
Instead of this number, you have the option of entering it exactly as a numerator and denominator:

Travel distance per motor revolution = $144/7$

This will not result in any drift in continuous operation mode or in reset mode, even with relatively long motion in one direction.

Example 2:

Conveyor belt



Unit: mm

Gear transmission ratio 7:4 => 4 load revolutions = 7 motor revolutions

Number of pinions: 12

Tooth separation: 10mm

Travel path per motor revolution = $4/7 * 12 * 10\text{mm} = 68.571\,428\,5 \dots \text{mm}$ (this number cannot be expressed exactly)

Instead of this number, you have the option of entering it exactly as a numerator and denominator:

Travel distance per motor revolution = $480/7 \text{ mm}$

For "travel distance per motor revolution" that can be represented exactly, enter 1 as the denominator.

Travel distance per motor revolution / pitch

Numerator

Unit: Unit of Travel	Range: depending on the chosen unit	Standard value: depending on the chosen unit
Resolution: 0.000 000 1 (7 decimal places)		
Unit of Travel	Division	Standard value
Increments*	10 ... 1 000 000	1024
mm	0,010 000 0 ... 2000,000 000 0	1,000 000 0
Degrees	0,010 000 0 ... 720,000 000 0	360,000 000 0
Inch	0,010 000 ... 2000,000 000	1,000 000

Denominator

Unit: -	Range: 1 ... 1 000 000	Standard value: 1
Integer value		

*

The unit "increments" is valid only for position values!

speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s² and revolutions/s³ (resp. pitch/s, pitch/s², pitch/s³).

Invert Motor Rotation/Direction Polarity

Unit: -	Range: no/yes	Standard value: no
Reverse direction inverts the sense of rotation, i.e. the direction of movement of the motor is reversed in the case of equal setpoint.		

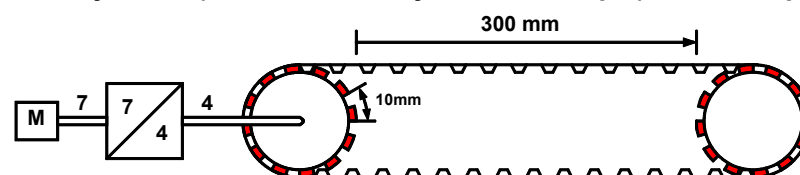
Reset mode

Reset mode is available for applications in which the positioning range repeats; some examples are: Rotary table applications, belt conveyor, ...

After the reset travel distance (can be specified exactly as **numerator and denominator** (see page 119))) the position values in Compax3 are reset to 0.

Example:

Conveyor belt (from the "Conveyor belt" example) with reset path



A reset path of 300 mm can be entered directly with numerator = 300 mm and denominator = 1.

Reset mode is not possible for linear motors.

Reset distance**Numerator**

Unit: Unit of Travel	Range: depending on the chosen unit	Standard value: depending on the chosen unit
Unit of Travel	Division	Standard value
Increments	10 ... 1 000 000	0
mm	1 ... 2000	0
Degrees	1 ... 720	0

Denominator

Unit: -	Range: 1 ... 1 000 000	Standard value: 0
Integer value		

Turn off reset mode

Reset mode is turned off for numerator = 0 and denominator = 0.

4.1.7.2 Machine Zero

In this chapter you can read about:

Positioning after homing run	123
Absolute encoder	124
Operation with MultiTurn emulation	124
Store absolute position in the feedback	125
Machine zero modes overview	126
Homing modes with home switch (on X12/14)	128
Machine zero modes without home switch	135
Adjusting the machine zero proximity switch	139
Machine zero speed and acceleration	139

The Compax3 machine zero modes are adapted to the CANopen profile for Motion Control CiADS402.

Position reference point

Essentially, you can select between operation with or without machine reference. The reference point for positioning is determined by using the machine reference and the machine reference offset.

Machine reference run

In a homing run the drive normally moves to the position value 0 immediately after finding the home switch. The position value 0 is defined via the homing offset.

A machine reference run is required each time after turning on the system for operation with machine reference.



Please note:

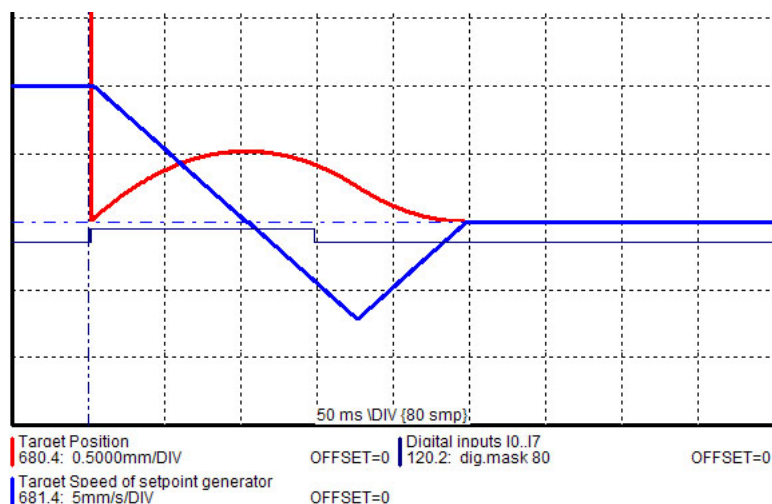
During homing run the software end limits are not monitored.

Positioning after homing run

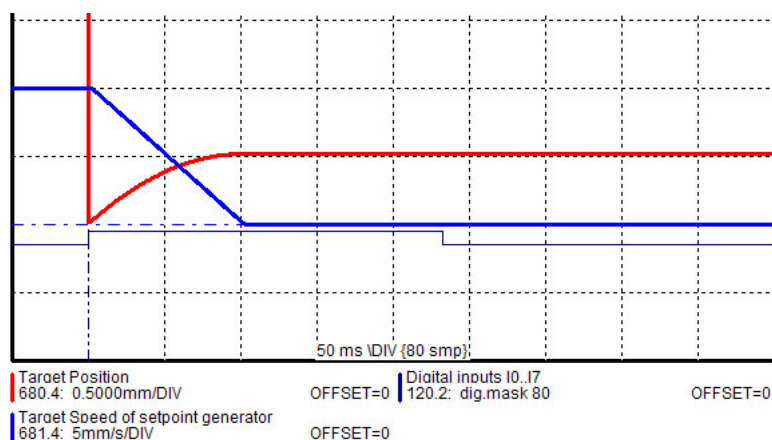
The positioning made after the home switch has been found can be switched off. For this enter in the "machine zero" window in the configuration wizard "no" under "approach MN point after MN run".

Example Homing mode 20 (Home on homing switch) with T40 by homing offset 0

With positioning after homing run The motor stands then on 0:



Without positioning after homing run The position reached is not exactly on 0, as the drive brakes when detecting the home and stops:



Absolute encoder

Using a SinCos® or EnDat Multiturn absolute value sensor as feedback system, the absolute position can be read in over the entire travel range when switching on the Compax3. This means that a machine zero run is not necessary after the switching on (feedback may not be shifted by the absolute range while switched off).

In this case the reference only needs to be established once

- ◆ at initial commissioning time
- ◆ after an exchange of motor / feedback system
- ◆ after a mechanical modification and
- ◆ after an exchange of device (Compax3); does not apply for the "Store absolute position in feedback" function.
- ◆ after a configuration download

by carrying out a machine zero run.

The homing mode 35 "**MN at the current position**" (see page 135) is appropriate for this, because it is therewith possible to operate without proximity switch, but any other homing mode is possible too - if the hardware prerequisites are fulfilled.

When you have once re-established the reference, reset the homing mode to "without homing run".

Operation with MultiTurn emulation

You can simulate the function of a Multiturn over the entire travel distance by the aid of a Multiturn emulation. A resolver or a SinCos® / EnDat Singleturn feedback is sufficient as a feedback signal from the motor.

It differs from the physical Multiturn in the way that the motor may not be moved by more than half a turn if Compax3 (24VDC) is switched off – unless the absolute position is lost.

Besides that, the Multiturn emulation offers the same function as the physical Multiturn feedback.

You can switch on the Multiturn emulation directly in the wizard.

You can assign the maximum permissible motor angle via the Multiturn validity window

If Compax3 states after switching on that this value is not exceeded, then the "Referenced" is set status word Bit 12 or output M.O8).

Compax3 restores nevertheless the absolute position, the motor angle is correct, the absolute position is however not correct, if the motor was moved by more than the validity window while currentless.

Machine reference run

For a unique machine zero run the same conditions apply as for the use of an absolute encoder (Multiturn).

Store absolute position in the feedback

SinCos® or EnDat feedback systems can store the absolute position, this allows a change of the Compax3 device without position loss.

The function is possible with Multiturn absolute value feedback systems and in combination with the "Multiturn emulation" function and is activated by selecting "Store absolute position: in the position feedback" (configuration wizard: Reference system).

The standard setting valid up to now is "Store absolute position: in the device"

Read / write position value

The writing process into the position feedback takes place upon a successful machine zero run.

After PowerON of Compax3, the position value of the position feedback is read out.

Please note:

Other data stored in the feedback are overwritten!

Machine zero modes overview

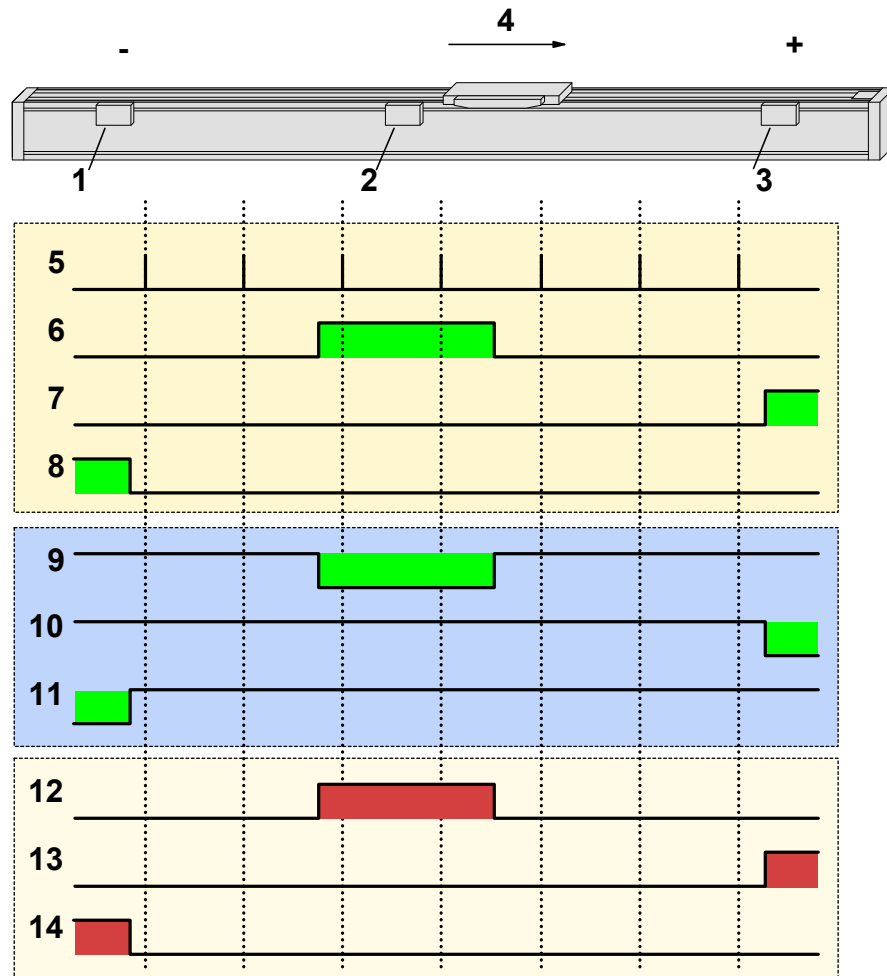
Selection of the machine zero modes (MN-M)

Machine home switch on X12/14: MN-M 3 ... 14, 19 ... 30	Without motor reference point MN-M 19 ... 30	without direction reversal switches: MN-M 19, 20 (see page 128), MN-M 21, 22 (see page 129)
		with reversal switches: MN-M 23, 24, 25, 26 (see page 130), MN-M 27, 28, 29, 30 (see page 131)
	With motor reference point MN-M 3 ... 14	without direction reversal switches: MN-M 3, 4 (see page 132), MN-M 5, 6 (see page 133)
		with reversal switches: MN-M 7, 8, 9, 10 (see page 134), MN-M 11, 12, 13, 14 (see page 134)
Without machine zero initiator on X12/14: MN-M 1, 2, 17, 18, 33 .. 35, 128, 129, 130 ... 133	Without motor reference point MN-M 17, 18, 35, 128, 129	MN-M 35: at the current Position (see page 135) MN-M 128, 129: while moving to block (see page 135)
		With limit switch as machine zero: MN-M 17, 18 (see page 136)
	With motor reference point MN-M 1, 2, 33, 34, 130 ... 133	Only motor reference: MN-M 33, 34 (see page 137), MN-M 130, 131 (see page 137) With limit switch as machine zero: MN-M 1, 2 (see page 138), MN-M 132, 133 (see page 139)

Definition of terms / explanations:

Motor zero point	Zero pulse of the feedback Motor feedback systems such as resolvers or SinCos® / EnDat give one pulse per revolution. Some motor feedback systems of direct drives do also have a zero pulse, which is generated once or in defined intervals. By interpreting the motor zero point (generally in connection with the machine zero initiator) the machine zero can be defined more exactly.
Machine zero initiator:	For creating the mechanical reference Has a defined position within or on the edge of the travel range.
Direction reversal switches:	Initiators on the edge of the travel range, which are used only with a machine zero run in order to detect the end of the travel range. In some cases, the function "direction reversal via Current threshold" is also possible, then you will need no initiator, Compax3 detects the end of the travel range via the threshold. Please observe the respective notes. During operation, the direction reversal switches are often used as limit switches.

Example axis with the initiator signals



- 1: Direction reversal / end switch on the negative end of the travel range (the **assignment of the reversal / end switch inputs** (see page 145) to travel range side can be changed).
- 2: Machine zero initiator (can, in this example, be released to 2 sides)
- 3: Direction reversal / end switch on the positive end of the travel range (the **assignment of the reversal / end switch inputs** (see page 145) to travel range side can be changed).
- 4: Positive direction of movement
- 5: Signals of the motor zero point (zero pulse of the motor feedback)
- 6: Signal of the machine zero initiator (**without inversion of the initiator logic** (see page 145)).
- 7: Signal of the direction reversal resp. end switch on the positive end of the travel range (without inversion of the initiator logic).
- 8: Signal of the direction reversal / resp. end switch on the negative end of the travel range (without inversion of the initiator logic).
- 9: Signal of the machine zero initiator (**with inversion of the initiator logic** (see page 145)).
- 10: Signal of the direction reversal / resp. end switch on the positive end of the travel range (with inversion of the initiator logic).
- 11: Signal of the direction reversal / resp. end switch on the negative end of the travel range (with inversion of the initiator logic).
- 12: Logic state of the home switch (independent of the inversion)
- 13: Logic state of the direction reversal resp. end switch on the positive end of the travel range (independent of the inversion)
- 14: Logic state of the direction reversal resp. end switch on the negative end of the travel range (independent of the inversion)

The following principle images of the individual machine zero modes always refer to the logic state (12, 13, 14) of the switches.

Homing modes with home switch (on X12/14)

In this chapter you can read about:

Without motor reference point	128
With motor reference point	132

Without motor reference point

In this chapter you can read about:

Without direction reversal switches	128
With direction reversal switches	130

Without direction reversal switches

In this chapter you can read about:

MN-M 3.4: MN-Initiator = 1 on the positive side	132
MN-M 5.6: MN initiator = 1 on the negative side	133

In this chapter you can read about:

MN-M 19.20: MN-Initiator = 1 on the positive side	128
MN-M 21.22: MN initiator = 1 on the negative side	129

MN-M 19.20: MN-Initiator = 1 on the positive side

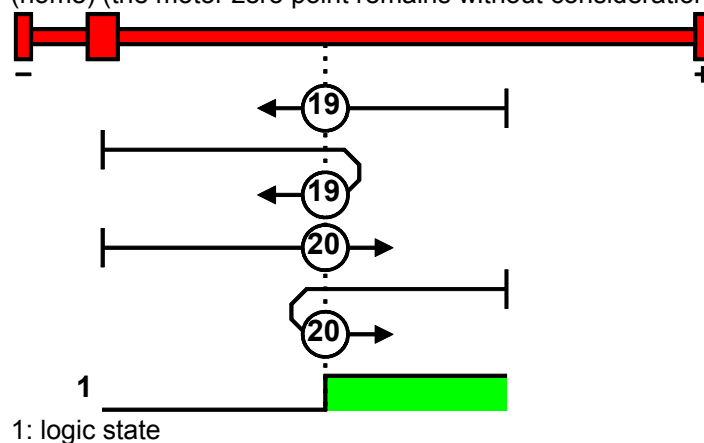
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (left of the MN initiator) and one range with activated MN initiator (right of the MN initiator).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the positive travel direction.

Without motor zero point, without direction reversal switches

MN-M 19: The negative edge of the MN proximity switch is used directly as MN (home) (the motor zero point remains without consideration).

MN-M 20: The positive edge of the MN proximity switch is used directly as MN (home) (the motor zero point remains without consideration).



MN-M 21.22: MN initiator = 1 on the negative side

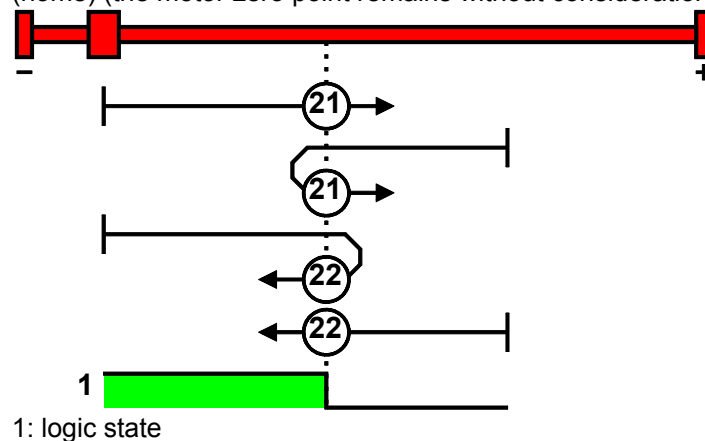
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (positive part of the travel range) and one range with activated MN initiator (negative part of the travel range).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the negative travel direction.

Without motor zero point, without direction reversal switches

MN-M 21: The negative edge of the MN proximity switch is used directly as MN (home) (the motor zero point remains without consideration).

MN-M 22: The positive edge of the MN proximity switch is used directly as MN (home) (the motor zero point remains without consideration).



With direction reversal switches

In this chapter you can read about:

MN-M 1, 2: Limit switch as machine zero	138
MN-M 132, 133: Determine absolute position via distance coding with direction reversal switches	139

In this chapter you can read about:

MN-M 7...10: Direction reversal switches on the positive side	134
MN-M 11...14: With direction reversal switches on the negative side	134

In this chapter you can read about:

MN-M 23...26: Direction reversal switches on the positive side 130
 MN-M 27...30: With direction reversal switches on the negative side 131
 Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.
 The **assignment of the direction reversal switches** (see page 145) can be changed.

Function Reversal via Current threshold

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function "direction reversal via Current threshold"

Here the drive runs towards the mechanical limit mounted at the end of the travel range.

When the settable Current threshold is reached, the drive is braked and changes the travel direction.



Caution!

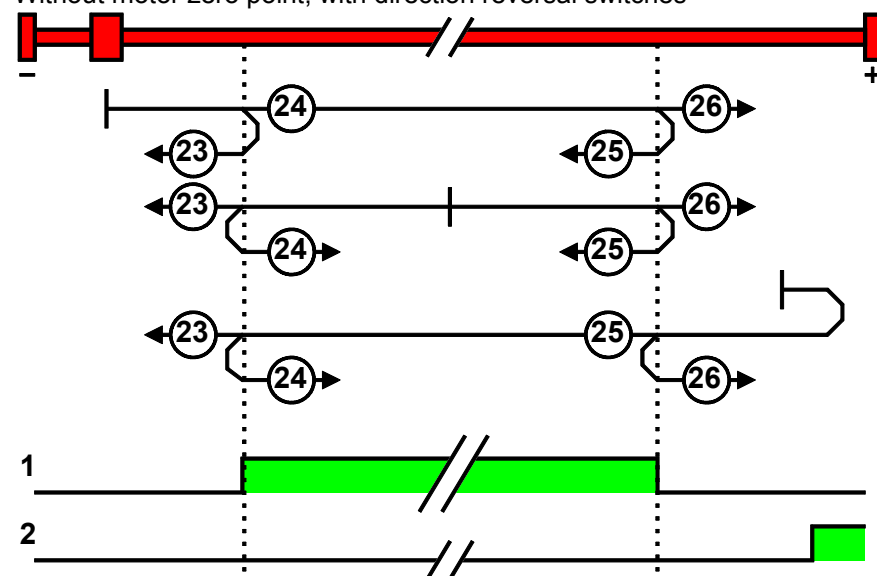
Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

- ◆ Choose a low machine zero speed.
- ◆ Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- ◆ The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.

MN-M 23...26: Direction reversal switches on the positive side

Without motor zero point, with direction reversal switches

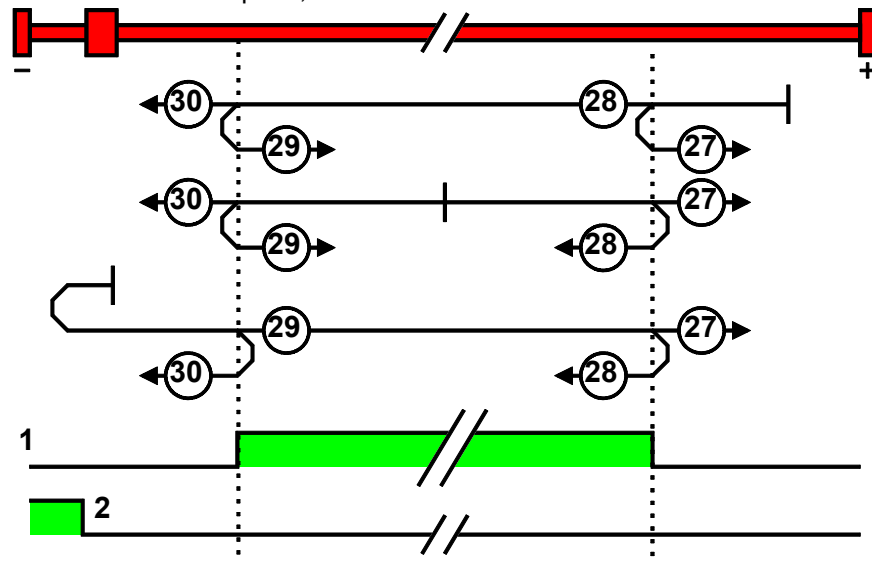


1: Logic state of the home switch

2: Logic state of the direction reversal switch

MN-M 27...30: With direction reversal switches on the negative side

Without motor zero point, with direction reversal switches



1: Logic state of the home switch

2: Logic state of the direction reversal switch

With motor reference point**In this chapter you can read about:**

Without direction reversal switches	132
With direction reversal switches	133

Without direction reversal switches**MN-M 3.4: MN-Initiator = 1 on the positive side**

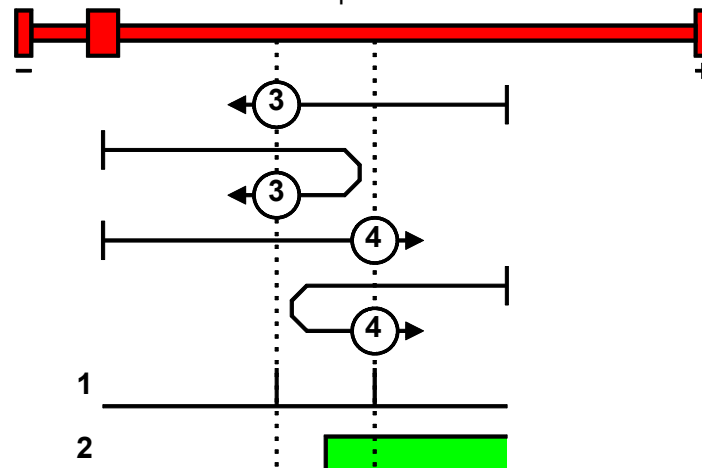
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (left of the MN initiator) and one range with activated MN initiator (right of the MN initiator).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the positive travel direction.

With motor zero point, without direction reversal switches

MN-M 3: The 1st motor zero point with MN initiator = "1" is used as MN.

MN-M 4: The 1st motor zero point with MN initiator = "1" is used as MN.



- 1: Motor zero point
2: Logic state of the home switch

MN-M 5.6: MN initiator = 1 on the negative side

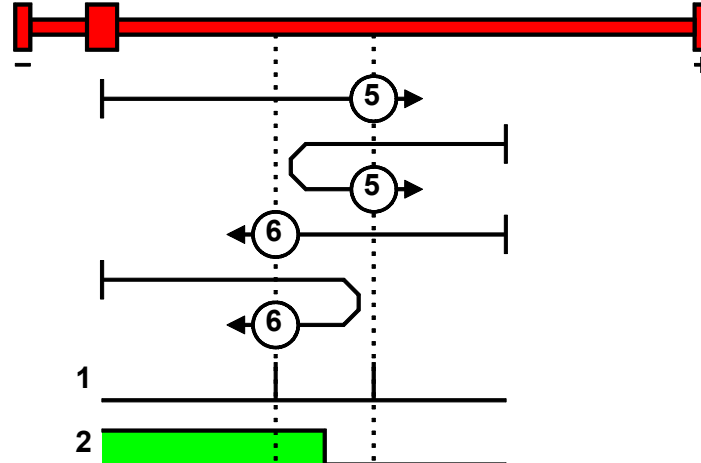
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (positive part of the travel range) and one range with activated MN initiator (negative part of the travel range).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the negative travel direction.

With motor zero point, without direction reversal switches

MN-M 5: The 1st motor zero point with MN proximity switch = "0" is used as MN.

MN-M 6: The 1st motor zero point with MN initiator = "1" is used as MN.



1: Motor zero point

2: Logic state of the home switch

With direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.

The **assignment of the direction reversal switches** (see page 145) can be changed.

Function Reversal via Current threshold

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function "direction reversal via Current threshold"

Here the drive runs towards the mechanical limit mounted at the end of the travel range.

When the settable Current threshold is reached, the drive is braked and changes the travel direction.

**Caution!**

Wrong settings can cause hazard for man and machine.

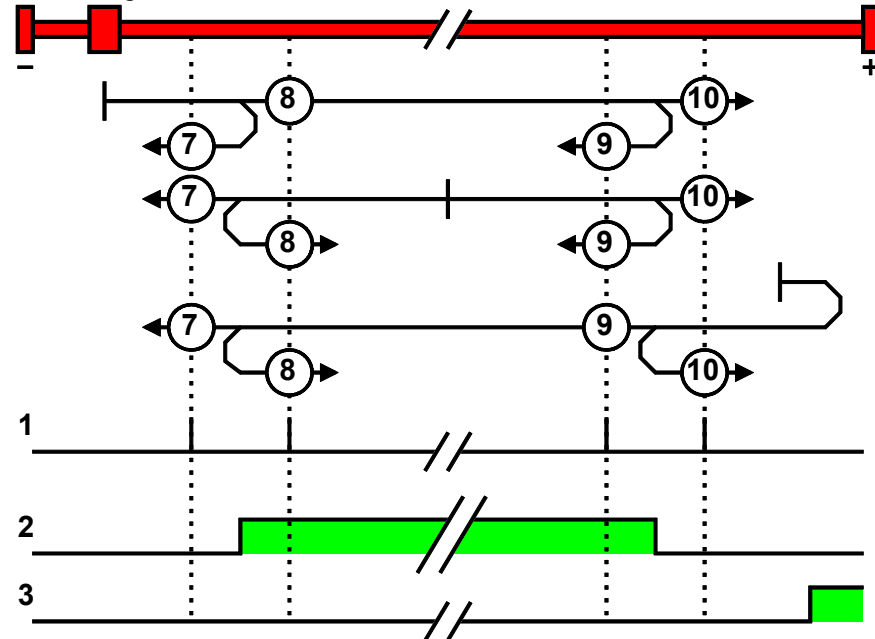
It is therefore essential to respect the following:

- ◆ Choose a low machine zero speed.
- ◆ Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- ◆ The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.

MN-M 7...10: Direction reversal switches on the positive side

With motor zero point, with direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.

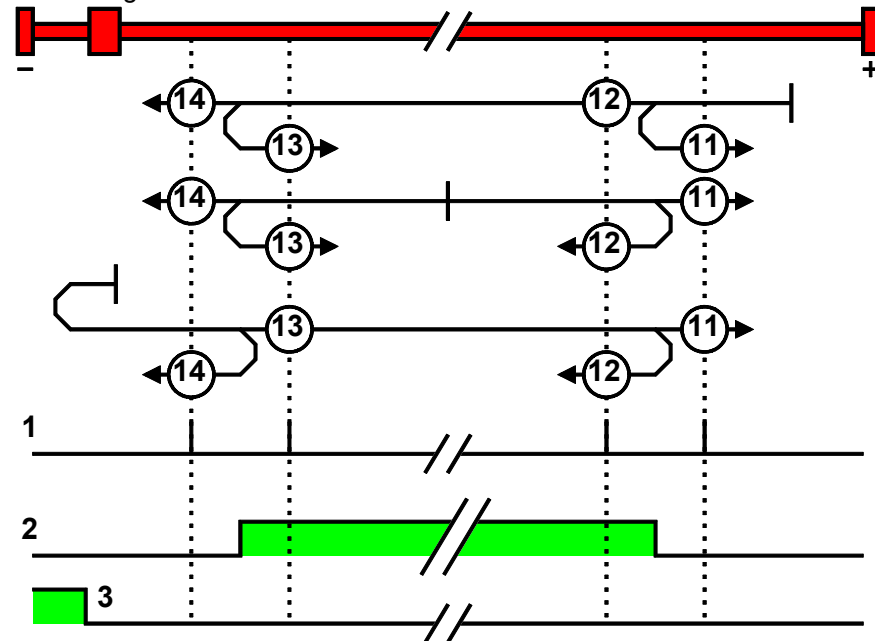


- 1: Motor zero point
- 2: Logic state of the home switch
- 3: Logic state of the direction reversal switch

MN-M 11...14: With direction reversal switches on the negative side

With motor zero point, with direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.



- 1: Motor zero point
- 2: Logic state of the home switch
- 3: Logic state of the direction reversal switch

Machine zero modes without home switch

In this chapter you can read about:

Without motor reference point	135
With motor reference point	137

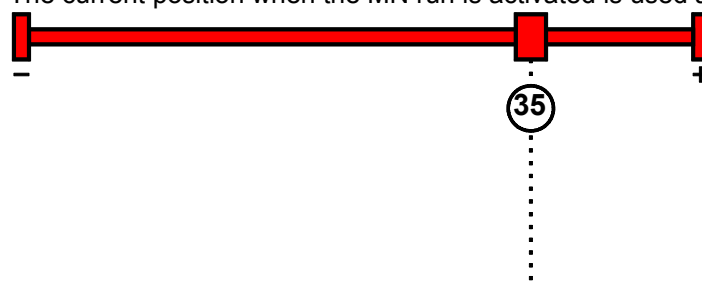
Without motor reference point

In this chapter you can read about:

MN-M 35: MN at the current position	135
MN-M 128/129: Current threshold when moving to block	135
MN-M 17.18: Limit switch as machine zero	136

MN-M 35: MN at the current position

The current position when the MN run is activated is used as an MN.



MN-M 128/129: Current threshold when moving to block

Without a MN (machine zero) initiator, an end of travel region (block) is used as MN (machine zero).

For this the Current threshold is evaluated if the drive pushes against the end of the travel region. If the limit is exceeded, the MN is set. During the homing run (MN), the error reaction "following error" is deactivated.

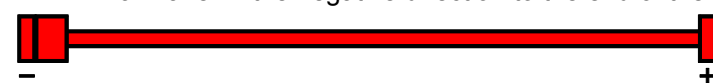
Please observe:

The homing offset must be set so that the home (reference point) for positioning lies within the travel range.

MN-M 128: Travel in the positive direction to the end of the travel region



MN-M 129: Travel in the negative direction to the end of the travel region

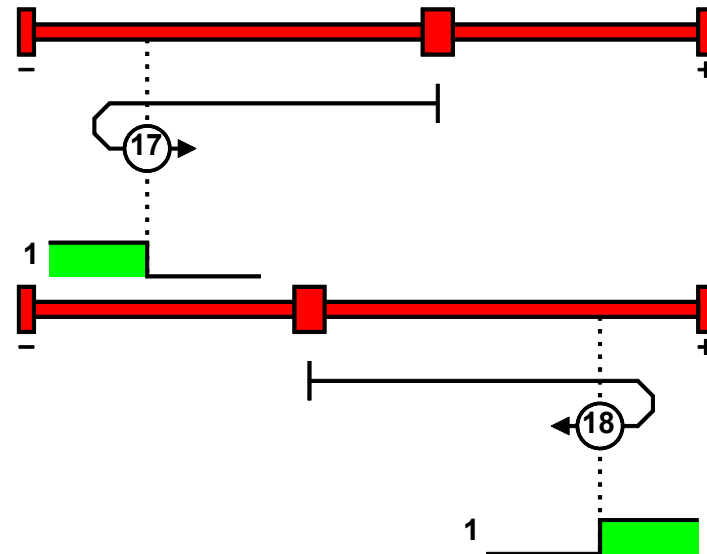


Caution!

Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

- ◆ Choose a low machine zero speed.
- ◆ Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- ◆ The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.

MN-M 17.18: Limit switch as machine zero

1: Logic state of the direction reversal switch

Function Reversal via Current threshold

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function "direction reversal via Current threshold"

Here the drive runs towards the mechanical limit mounted at the end of the travel range.

When the settable Current threshold is reached, the drive is braked and changes the travel direction.

**Caution!**

Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

- ◆ Choose a low machine zero speed.
- ◆ Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- ◆ The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.

With motor reference point

In this chapter you can read about:

Machine zero only from motor reference	137
With direction reversal switches	138

Machine zero only from motor reference

In this chapter you can read about:

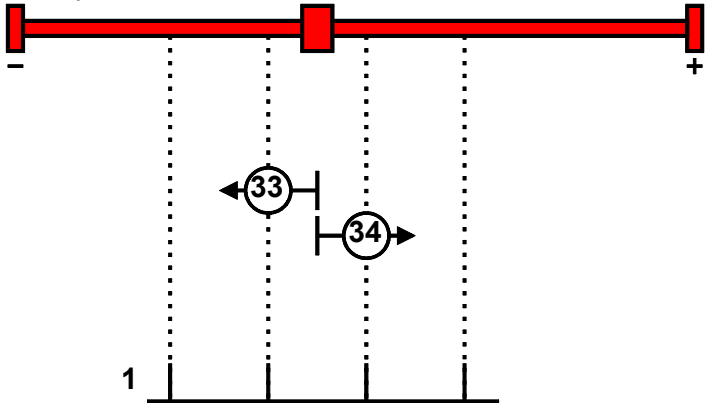
MN-M 33,34: MN at motor zero point	137
MN-M 130, 131: Determine absolute position via distance coding	137

MN-M 33,34: MN at motor zero point

The motor reference point is now evaluated (no MN initiator):

Without home switch

MN-M 33:For a MN run, starting from the current position, the next motor zero point in the negative travel direction is taken as the MN.
MN-M 34:For a MN run, starting from the current position, the next motor zero point in the positive travel direction is taken as the MN.



1: Motor zero point

MN-M 130, 131: Determine absolute position via distance coding

Only for motor feedback with distance coding (the absolute position can be determined via the distance value).
Compax3 determines the absolute position from the distance of two signals and then stops the movement (does not automatically move to position 0).



1: Signals of the distance coding

With direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.

The **assignment of the direction reversal switches** (see page 145) can be changed.

Function Reversal via Current threshold

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function "direction reversal via Current threshold"

Here the drive runs towards the mechanical limit mounted at the end of the travel range.

When the settable Current threshold is reached, the drive is braked and changes the travel direction.



Caution!

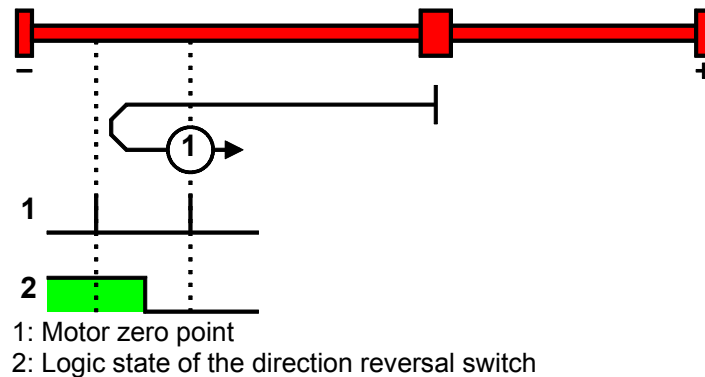
Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

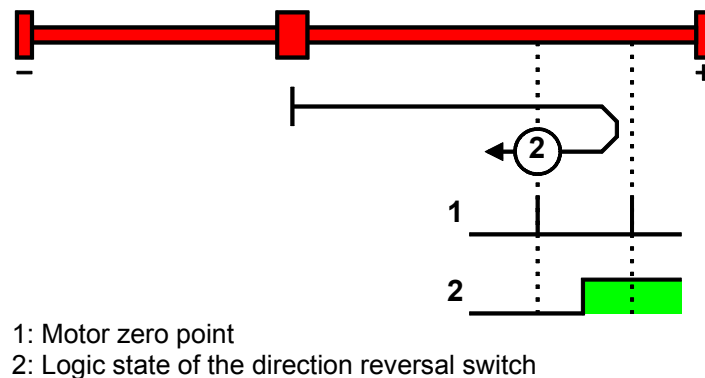
- ◆ Choose a low machine zero speed.
- ◆ Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- ◆ The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.

MN-M 1, 2: Limit switch as machine zero

End switch on the negative side



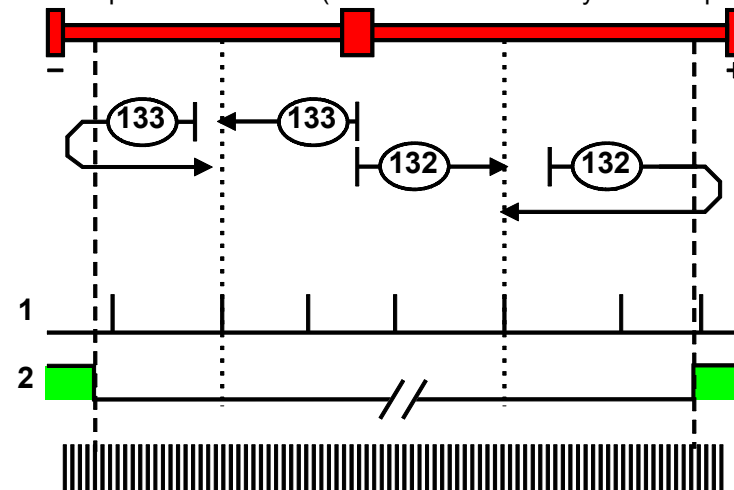
End switch on the positive side:



MN-M 132, 133: Determine absolute position via distance coding with direction reversal switches

Only for motor feedback with distance coding (the absolute position can be determined via the distance value).

Compax3 determines the absolute position from the distance of two signals and then stops the movement (does not automatically move to position 0).



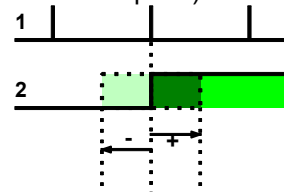
1: Signals of the distance coding

2: Logic state of the direction reversal switches

Adjusting the machine zero proximity switch

This is helpful in some cases with homing modes that work with the home switch and motor reference point.

If the motor reference point happens to coincide with the position of the MN initiator, there is a possibility that small movements in the motor position will cause the machine reference point to shift by one motor revolution (to the next motor reference point).



1: Motor zero point

2: Logic state of the home switch

A solution to this problem is to move the MN initiator by means of software. This is done using the value initiator adjustment.

Initiator adjustment

Unit: Motor angle in degrees	Range: -360 ... 360	Standard value: 0
Move the machine reference initiator using software		

Machine zero speed and acceleration

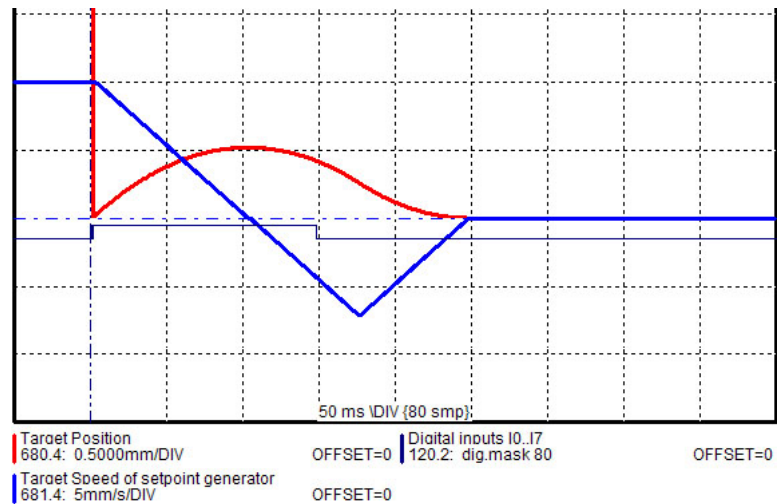
With these values you can define the motion profile of the machine zero run.

4.1.7.3 Positioning after homing run

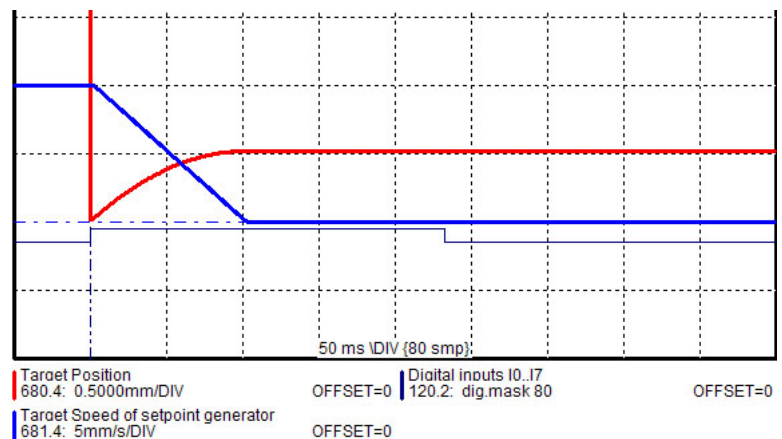
The positioning made after the home switch has been found can be switched off. For this enter in the "machine zero" window in the configuration wizard "no" under "approach MN point after MN run".

Example Homing mode 20 (Home on homing switch) with T40 by homing offset 0

With positioning after homing run The motor stands then on 0:



Without positioning after homing run The position reached is not exactly on 0, as the drive brakes when detecting the home and stops:



4.1.7.4 Travel Limit Settings

Software end limits

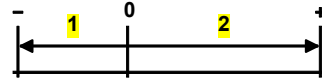
The error reaction when reaching the software end limits can be set:
Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

If "no reaction" was set, no software limits must be entered.

Software end limits:

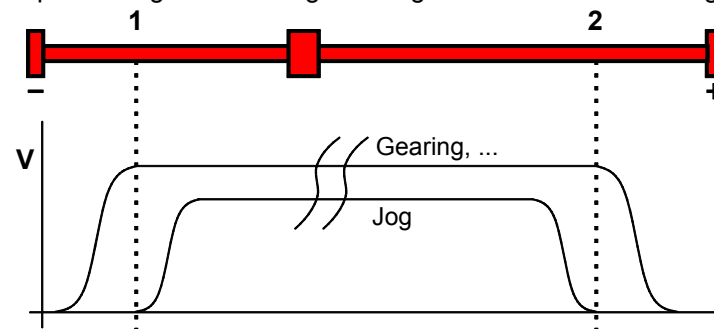
The travel range is defined via the negative and positive end limits.



- 1: negative end limit
2: positive end limit

Software end limit in absolute operating mode

The positioning is restricted to the range between the travel limits.
A positioning order aiming at a target outside the travel range is not executed.



- 1: negative end limit
2: positive end limit

The reference is the position reference point that was defined with the machine reference and the machine reference offset.

Software end limits in reset mode

The reset mode does not support software end limits

Software end limit in continuous mode

Each individual positioning is confined within the travel limits.
A positioning order aiming at a target outside the software end limits is not executed.
The reference is the respective current position.

Error when disregarding the software end limits

A software end limit error is triggered, if the position value exceeds an end limit.
For this, the position setpoint value is evaluated in energized state; in currentless state, the actual position value is evaluated.

Hysteresis in disabled state:

If the axis stands currentless at an end limit, another error may be reported due to position jitter after acknowledging the end limit error. To avoid this, a hysteresis surrounding the end limits was integrated (size corresponds to the size of the positioning window).
Only if the distance between axis and the end limits was larger than the positioning window, another end limit error will be detected

Error codes (see page 457) of the end limit errors:

0x7323 Error when disregarding the positive software end limit.
0x7324 Error when disregarding the negative software end limit.

Activating / deactivating the end limit error:

In the C3 ServoManager under configuration: End limits, the error can be (de)activated.
For IEC-programmable devices with the "C3_ErrorMask" module.

Behavior after the system is turned on

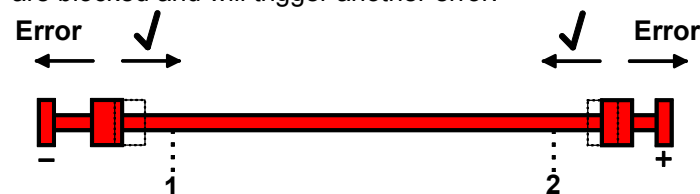
The end limits are not active after switching on. The end limits do not refer to the position reference point until after a machine reference run.
During homing run the end limits are not monitored.
With a Multiturn encoder or with active Multiturn emulation, the limit is valid immediately after switching on.

Behavior outside the travel range

1. If the software end limit errors are deactivated, all movements are possible.

2. If the software end limit errors are activated:

After disregarding the software end limits, an error is triggered. First of all, this error must be acknowledged.
Then a direction block is activated: only motion commands in the direction of the travel range are executed. These will not trigger another error.
Motion commands inciting a movement in the opposite direction of the travel range are blocked and will trigger another error.



1: negative end limit
2: positive end limit

Notes on special feedback systems (Feedback F12)

During automatic commutation, the end limit monitoring is deactivated!

Behavior with software end limits of a referenced axis

	Position within target outside	Position outside target outside and aiming in the opposite direction of the travel range	Position outside target within and aiming in the direction of the travel range
JOG +/-	◆ Positioning up to the end limits ◆ No Error	◆ No positioning ◆ No Error	◆ Positioning
MC_MoveAbsolute, MC_MoveRelative, MC_MoveAdditive, MC_MoveSuperImposed	◆ No positioning ◆ Error	◆ No positioning ◆ Error	◆ Positioning
MC_GearIn, MC_Cam..., C3_Cam...	◆ Positioning up to the end limits, from these on braking with the error ramp. The end limit is exceeded ◆ Error	◆ No positioning ◆ Error	◆ No positioning ◆ Error
MC_MoveVelocity	◆ Positioning up to the end limits ◆ Error	◆ No positioning ◆ Error	◆ Positioning
MC_Home	◆ No monitoring of the software end limits		

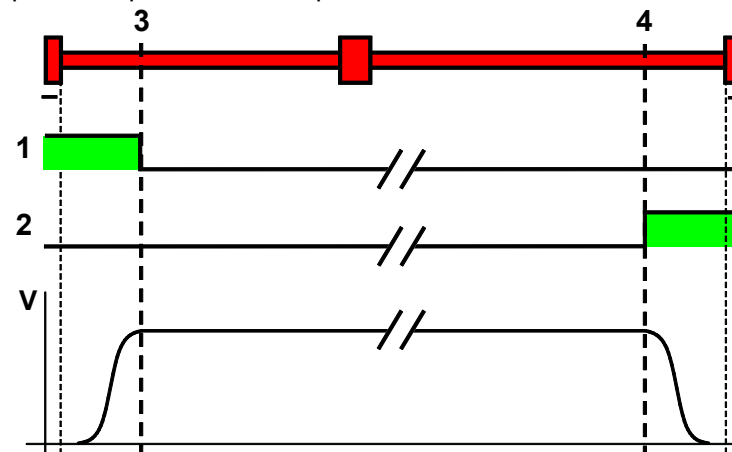
The software end limit error can be deactivated in general via the configuration or separately for each end limit via the **C3_Error_Mask** (see page 335) f module.

Hardware end limits

The error reaction when reaching the hardware end limits can be set:
Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

Hardware end limits are realized with the aid of end switches.
These are connected to X12/12 (input 5) and X12/13 (input 6) and can be (de)activated separately in the C3 ServoManager under Configuration: End limits.
After a limit switch has been detected, the drive decelerates with the ramp values set for errors (error code 0x54A0 at X12/12 active, 0x54A1 at X12/13 active) and the motor is switched to currentless.
Please make sure that after the detection of the end switch there is enough travel path left up to the limit stop.



- 1: Limit switch E5 (X12/12)
- 2: Limit switch E6 (X12/13)
- 3: Limit switch position E5 (X12/12)
- 4: Limit switch position E6 (X12/13)

The **assignment of the end switches** (see page 145) can be changed!

Please note: The limit switches must be positioned so that they cannot be released towards the side to be limited.

Limit switch / direction reversal switch
Behavior in the case of an active limit switch

Limit switches functioning as direction reversal switches during homing run, will not trigger a limit switch error.

The error can be acknowledged with activated limit switch.
The drive can then be moved out of the end switch range with a normal positioning.
Both directions of movement are possible.
A direction block can be programmed in the IEC program with the aid of the limit switch bits or the error message.

(De)activate limit switch errors

The end limit error can be deactivated in general via the configuration or separately for each end limit via the **C3_Error_Mask** (see page 335) module.

Debouncing: Limit switch, machine zero and input 0

A majority gate is used for debouncing.

The signal is sampled every 0.5ms

The debounce time determines the number of scans the majority gate will perform. If the level of more than half of the signals was changed, the internal status will change.

The debounce time can be set in the configuration wizard within the range of 0 ... 20ms.

The value 0 deactivates the debouncing.

If the debouncing time is stated, the input I0 can be debounced as well (checkbox below).

4.1.7.5 Change assignment direction reversal / limit switches

If this function is not activated, the direction reversal / end switches are assigned as follows:

Direction reversal / limit switch on E5 (X12/12): negative side of the travel range

Direction reversal / limit switch on E6 (X12/13): Direction reversal / limit switch on E6 (X12/13):

Change assignment of direction reversal / limit switch is activated

If this function is activated, the direction reversal / limit switches are assigned as follows:

Direction reversal / limit switch on **E5** (X12/12): **positive side** of the travel range

Direction reversal / limit switch on **E6** (X12/13): **negative side** of the travel range

4.1.7.6 Change initiator logic

The initiator logic of the limit switches (this does also apply for the direction reversal switches) and the machine zero initiator can be changed separately.

◆ Limit switch E5 low active

◆ Limit switch E6 low active

◆ Home switch E7 low active

In the basic settings the inversion is deactivated, so that the signals are "high active".

With this setting the inputs I5 to I7 can even be switched within their logic, if they are not used as direction reversal/limit switches or machine zero.

Possible settings for the error reaction are:

◆ No response

◆ downramp / stop

◆ Downramp / switch to currentless (standard setting)

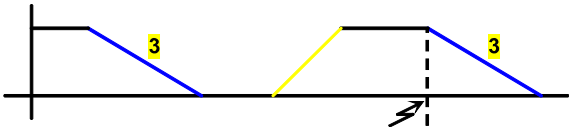
4.1.8. Defining jerk / ramps

In this chapter you can read about:

Ramp upon error and switch to currentless.....	146

4.1.8.1 Ramp upon error and switch to currentless

Ramp (deceleration) upon error and "switch to currentless"



3: Deceleration upon error and upon deactivation of **MC_Power** (see page 302)

Please observe:
The configured error ramp is limited. The error ramp will not be smaller than the deceleration set in the last motion set.

4.1.9. Limit and Monitoring Settings

In this chapter you can read about:

Current (Torque) Limit	146
Positioning window - Position reached	147
Following error limit	148
Maximum operating speed	148

4.1.9.1 Current (Torque) Limit

The current required by the speed controller is limited to the current limit.

4.1.9.2 Positioning window - Position reached

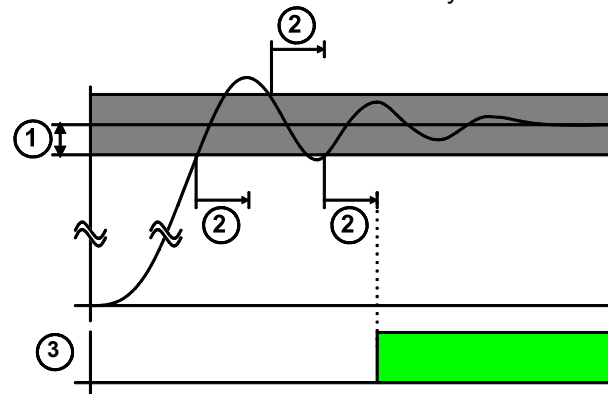
Position reached indicates that the target position is located within the position window.

In addition to the position window, a position window time is supported. If the actual position goes inside the position window, the position window time is started. If the actual position is still inside the position window after the position window time, "Position reached" is set.

If the actual position leaves the position window within the position window time, the position window time is started again.

When the actual position leaves the position window with Position reached = "1", Position reached is immediately reset to "0".

Position monitoring is active even if the position leaves the position window because of measures taken externally.



1: Positioning window

2: positioning window time

3: Setpoint position reached (== object 420.6
C3.PositioningAccuracy_PositionReached)

4.1.9.3 Following error limit

The error reaction upon a following error can be set:

Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

The following error is a dynamic error.

The dynamic difference between the setpoint position and the actual position during a positioning is called the following error. Do not confuse this with the static difference which is always 0; the target position is always reached exactly.

The change of position over time can be specified exactly using the parameters jerk, acceleration and speed. The integrated Setpoint value generator calculates the course of the target position. Because of the delay in the feedback loop, the actual position does not follow the setpoint position exactly. This difference is referred to as the following error.

Disadvantages caused by a following error

In joint operation of several servo controllers (e.g. master controller and slave controller), following errors lead to problems due to the dynamic position differences, and a large following error can lead to positioning overshoot.

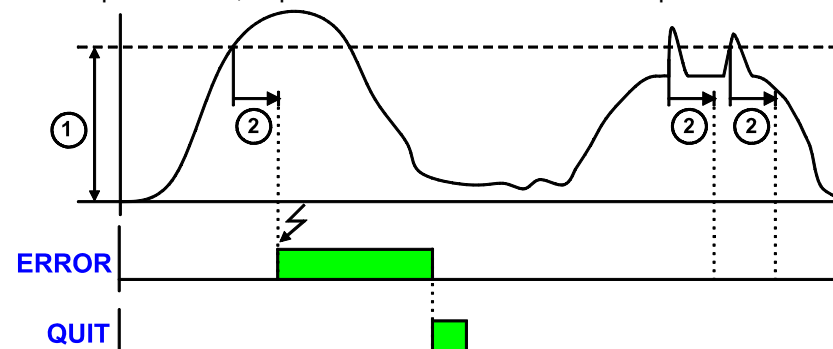
Error message

If the following error exceeds the specified following error limit, the "following error time" then expires. If the following error is even greater than the following error limit at the end of the following error time, an error is reported.

If the following error falls short of the following error limit, a new following error time is then started.

Minimizing the following error

The following error can be minimized with the help of the extended (advanced) control parameters, in particular with the feed forward parameters.



1: Following error limit [parameterized unit]

2: Tracking error time

ERROR:Error output of positioning modules

QUIT:Ackn with MC_Reset module

4.1.9.4 Maximum operating speed

The speed limitation is derived from the maximum operating speed. In order to ensure control margins, the speed is limited to a higher value.

The speed setpoint value is actively limited to 1.1 times the given value.

If the speed actual value exceeds the preset maximum speed by 21% (= "switching off limit speed"), error 0x7310 is triggered.

4.1.10. Encoder Simulation

You can make use of a permanently integrated encoder simulation feature to make the actual position value available to additional servo drives or other automation components.

Caution!

- ◆ The encoder simulation is not possible at the same time as the encoder input resp. the step/direction input or the SSI interface.
The same interface is used here.
- ◆ A direction reversal configured in the C3 ServoManager does not affect the encoder simulation.
The direction of rotation of the encoder simulation can, however, be changed via the feedback direction in the MotorManager.

Simulated Encoder Output Resolution

Unit: Increments per revolution / pitch	Range: 4 - 16384	Standard value: 1024
Any resolution can be set Limit frequency: 620kHz i. e. for:		
Increments per revolution	Max. speed	
1024	36000 min ⁻¹	
4096	9000 min ⁻¹	
16384	2250 min ⁻¹	

4.1.10.1 Encoder bypass with Feedback module F12 (for direct drives)

If the feedback module F12 is used, the encoder signals can be placed directly (Bypass) to the encoder interface (X11: same assignment as encoder simulation) for further use. Sine/Cosine signals are directly converted into encoder signals, however without zero pulse.

The advantage is, that the limit frequency is 5MHz instead of 620kHz.

The direction of rotation is only defined via the encoder wiring; a direction inversion configured in the C3 ServoManager does not have any consequence.

4.1.11. Recipe table

If you would like to work with the **recipe array** (see page 296), (e.g. for the storage of variable machine data) you can make preassignments in it with Compax3 ServoManager.

Note:

The recipe array can also be loaded separately into the device (>button on the right side).

Row	Column 1 REAL	Column 2 REAL	Column 3 INT	Column 4 INT	Column 5 INT	Column 6 DINT	Column 7 DINT	Column 8 DINT	Column 9 DINT
1	0.000000	0.000000	0	0	0	0	0	0	0
2	0.000000	0.000000	0	0	0	0	0	0	0
3	0.000000	0.000000	0	0	0	0	0	0	0
4	0.000000	0.000000	0	0	0	0	0	0	0
5	0.000000	0.000000	0	0	0	0	0	0	0
6	0.000000	0.000000	0	0	0	0	0	0	0
7	0.000000	0.000000	0	0	0	0	0	0	0
8	0.000000	0.000000	0	0	0	0	0	0	0
9	0.000000	0.000000	0	0	0	0	0	0	0
10	0.000000	0.000000	0	0	0	0	0	0	0
11	0.000000	0.000000	0	0	0	0	0	0	0
12	0.000000	0.000000	0	0	0	0	0	0	0
13	0.000000	0.000000	0	0	0	0	0	0	0
14	0.000000	0.000000	0	0	0	0	0	0	0
15	0.000000	0.000000	0	0	0	0	0	0	0
16	0.000000	0.000000	0	0	0	0	0	0	0
17	0.000000	0.000000	0	0	0	0	0	0	0
18	0.000000	0.000000	0	0	0	0	0	0	0
19	0.000000	0.000000	0	0	0	0	0	0	0
20	0.000000	0.000000	0	0	0	0	0	0	0
21	0.000000	0.000000	0	0	0	0	0	0	0

4.1.12. Error response

Under "configuring: Under "configuration: error reaction" you can change the error reaction for individual **errors** (see page 457) (the error no. which can be influenced is displayed).

Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

Note on Compax3H:

The error reaction upon the "low voltage DC" error (0x32229 is fixed to "downramp/deenergize" for Compax3H.

4.1.13. Configuration name / comments

Here you can name the current configuration as well as write a comment.
Then you can download the configuration settings or, in T30 or T40 devices,
perform a complete Download (with IEC program and curve).

**Caution!**

Deactivate the drive before downloading the configuration software!

N.B.!

Incorrect configuration settings entail danger when activating the drive.
Therefore take special safety precautions to protect the travel range of
the system.

**Mechanical limit values!**

Observe the limit values of the mechanical components!
Ignoring the limit values can lead to destruction of the mechanical
components.

4.2 Configuring the signal source

In this chapter you can read about:

Physical Source.....	152
Internal virtual master.....	155
HEDA Master signal source	156

Possible master signal sources

Under the tree entry "Configuring the signal source" of the C3 ServoManager you can configure 3 signal sources for Master – Slave applications.

The master signal source can then be selected in the IEC program with the aid of the C3_MasterControl module via the input "Master".

3 signal sources are available:

- ◆ Physical Source
 - ◆ analog value above +/-10V
 - ◆ Encoder signal A/B (5V)
 - ◆ Step/Direction signal (5V)
 - ◆ SSI Feedback
- ◆ Internal virtual master (IEC program) (only T40)
- ◆ HEDA

the "use as current signal source" CheckBox can be found in the signal source configuration wizards.

This CheckBox is only relevant for the Compax3 firmware versions < V2.05; it is used to define the signal source for the CoDeSys program.

Otherwise, the signal source is directly selected at the IEC module.

Signal source of the load feedback system

Configuration of the load control (Dual Loop Option)

4.2.1. Physical Source

In this chapter you can read about:

Encoder A/B 5V, step/direction or SSI feedback as signal source.....	152
+/-10V Master speed	155

4.2.1.1 Encoder A/B 5V, step/direction or SSI feedback as signal source

Caution!

- ◆ The encoder simulation is not possible at the same time as the encoder input resp. the step/direction input or the SSI interface.
The same interface is used here.
- ◆ A direction reversal configured in the C3 ServoManager does not affect the encoder simulation.
The direction of rotation of the encoder simulation can, however, be changed via the feedback direction in the MotorManager.

The dimensional reference to the master is established via the following settings:

- ◆ Travel path per motor revolution (or pitch for linear motors) master axis numerator
With denominator = 1 the value can be entered directly.
Long-term drift can be avoided by entering non-integral values integrally as a fraction with numerator and denominator.
- ◆ Travel per motor revolution (or pitch ofr linear motors) master axis denominator
- ◆ Increments per revolution of the master axis
If required the direction of rotation of the master axis read in can be changed.

Example: Electronic gearbox with position detection via encoder

Reference to master axis

The reference to the master axis is established via the increments per revolution and the travel path per revolution of the master axis (corresponds to the circumference of the measuring wheel).

That is:

$$\text{MasterPos} = \frac{\text{Master\_I}}{\text{I\_M}} * \frac{\text{Travel Distance per Master Axis revolution (M\_Units/rev)}}{\text{Travel Distance per Master Axis revolution - Denominator}} \quad (1)$$

MasterPos: Master Position

Master_I: master increments read in

I_M: Increments per revolution of the master axis

External signal source

Encoder with 1024 increments per master revolution and a circumference of the measuring wheel of 40mm.

Settings:

Travel path per revolution of the master axis numerator = 40
Travel path per revolution of the master axis denominator = 1
Increments per revolution of the master axis = 1024

Configuration wizard:

Reference system of Slave axis: Unit of measure [mm]
Travel path per revolution numerator = 1
Travel path per revolution denominator = 1

Gearing:

Gearing numerator = 2
Gearing denominator = 1

This results in the following interrelations:

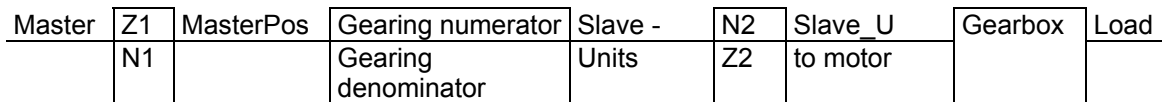
If the measuring wheel moves by 40mm (1 master revolution), the slave axis will move by 80mm.

$$\text{Slave unit} = \text{MasterPos} * \frac{\text{Gearing numerator}}{\text{Gearing denominator}} \quad (2)$$

(1) set into (2) and with numerical values results with 1024 increments read in (=1 Master revolution):

$$\text{Slave unit} = 1024 * \frac{1}{1024} * \frac{40\text{mm}}{1} * \frac{2}{1} = 80\text{mm}$$

Master - Position = +40mm => Slave - Position = +80mm

Structure:**Detailed structure image** (see page 326)

with:

$$MD = \frac{Z1}{N1} * \frac{\text{Travel Distance per Master Axis revolution (M_Units/rev)}}{\text{Travel Distance per Master Axis revolution - Denominator}}$$

Entry in the "configuration of the signal source" wizard

$$SD = \frac{Z2}{N2} * \frac{\text{Travel path per revolution slave axis numerator}}{\text{Travel path per revolution slave axis denominator}}$$

Entry in the "configuration of the signal source" wizard

MD: Feed of the master axis**SD:** Feed of the slave axis**SSI configuration****Notes on the SSI sensor (see page 154)**

- ◆ With Multiturn: Number of sensor rotations with absolute reference
- ◆ Word length: Gives the telegram length of the sensor.
- ◆ Baud rate/step: Max. transmission rate of the path measurement system.
- ◆ Gray code: Sensor gray code coded yes/no (if no binary coded).

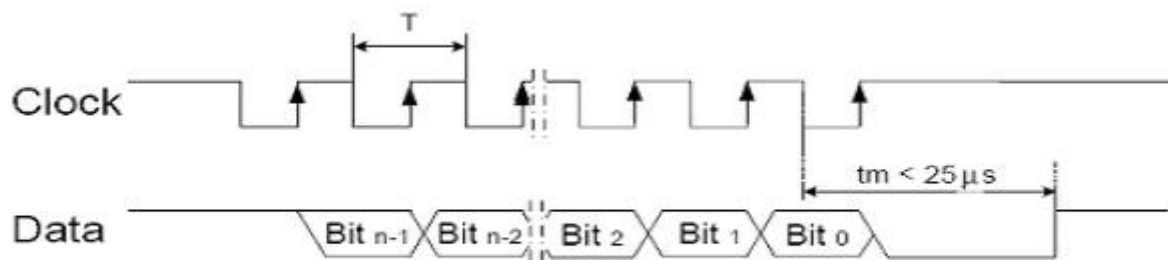
Note:

The absolute position is not evaluated!

It is available in the objects 680.24 (load position) and 680.25 (master position) (C3T30, C3T40).

General requirements for supported SSI feedbacks

- ◆ Baud rate: 350k ... 5MBaud
- ◆ Word length: 8 ... 32 Bit
- ◆ Binary or gray code (start value = 0)
- ◆ Initialization time after PowerOn: < 1.1s
- ◆ Signal layout:



The most significant bit must be transmitted the first!

Caution! Feedback systems, transmitting data containing error or status bits are not supported!

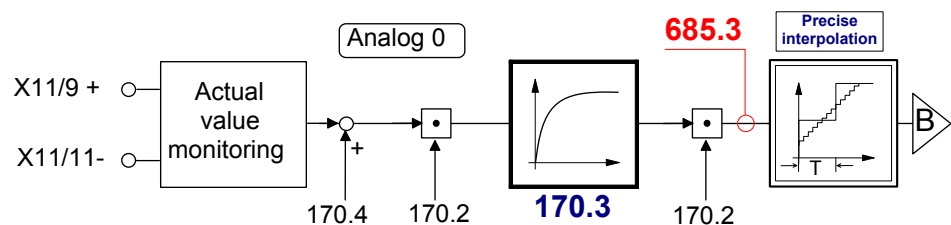
◆ Examples of supported SSI feedback systems:

- ◆ IVO / GA241 SSI;
- ◆ Thalheim / ATD 6S A 4 Y1;
- ◆ Hübner Berlin / AMG75;
- ◆ Stegmann / ATM60 & ATM90;
- ◆ Inducoder / SingleTurn: EAS57 & Multiturn: EAMS57

4.2.1.2 +/-10V Master speed

Via Analog channel0 (X11/9 and X11/11) the speed of the master is read in. From this value a position is internally derived.

Signal processing of the analog input 0



B: **Continuative structure image** (see page 240)

The reference to the master is established with the velocity at 10V.

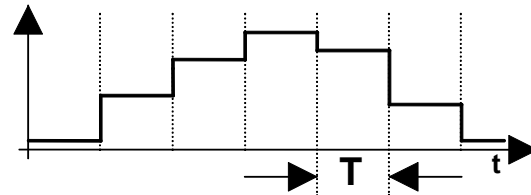
If required the direction of rotation of the master axis read in can be changed.

Time grid of master signal source

Averaging and a following filter (interpolation) can help to avoid steps caused by discrete signals.

If the external signal is analog, there is no need to enter a value here (Value = 0).

For discrete signals e.g. from a PLC, the scanning time (or cycle time) of the signal source is entered.



This function is only available if the analog interface +/-10V is used!

4.2.2. Internal virtual master

In this chapter you can read about:

The reset distance of the virtual master is only used for resetting the displayed value (Object680.2).

The travel per motor revolution of the master axis (numerator/denominator) is set to 1 for a virtual master.

If required the direction of rotation of the master axis read in can be changed.

4.2.3. HEDA Master signal source

Please choose if the virtual master of the HEDA master is transmitted via the HEDA.

If yes, the input "travel per revolution" is not necessary, as a positioning signal is already present.

The dimensional reference to the master is established via the following settings:

- ◆ Travel path per motor revolution (or pitch for linear motors) master axis numerator

With denominator = 1 the value can be entered directly.

Long-term drift can be avoided by entering non-integral values integrally as a fraction with numerator and denominator.

- ◆ Travel per motor revolution (or pitch ofr linear motors) master axis denominator

If required the direction of rotation of the master axis read in can be changed.

4.3 Load control

In this chapter you can read about:

Configuration of load control	159
Error: Position difference between load mounted and motor feedback too high.....	160
Load control signal image.....	160

The load control can be activated via an additional feedback system for the acquisition of the actual position of the load.

This helps for example compensate the slip between material and roller or non-linearities of the mechanic parts.

The load position is set to the demand position.

Please note:

- ◆ This function is not available in the C3I10T10 and C3I11T11 devices.
- ◆ As a sensor signal, **Encoder** (see page 527) with A/B track, Step/Direction signal or SSI - sensor is supported.
- ◆ This controller structure improves the stationary precision at the load after the decay of all control movements.
An increase of the dynamic precision (faster transient response) can in general not be reached with the "load control" structure variant.

Notes on the SSI sensor (see page 154)

- ◆ With Multiturn: Number of sensor rotations with absolute reference
- ◆ Word length: Gives the telegram length of the sensor.
- ◆ Baud rate/step: Max. transmission rate of the path measurement system.
- ◆ Gray code: Sensor gray code coded yes/no (if no binary coded).

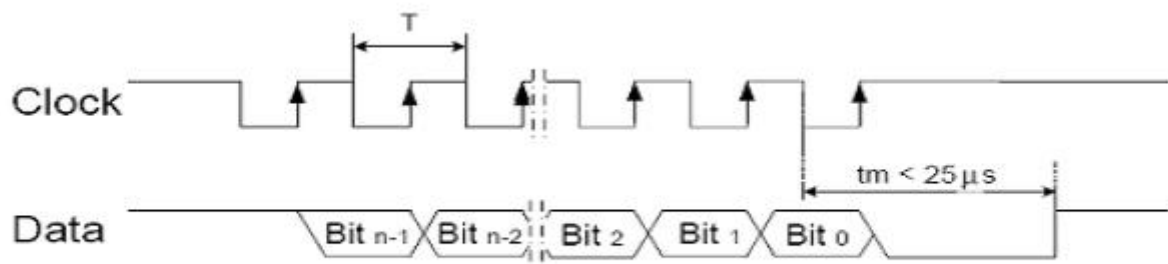
Note:

The absolute position is not evaluated!

It is available in the objects 680.24 (load position) and 680.25 (master position) (C3T30, C3T40).

General requirements for supported SSI feedbacks

- ◆ Baud rate: 350k ... 5MBaud
- ◆ Word length: 8 ... 32 Bit
- ◆ Binary or gray code (start value = 0)
- ◆ Initialization time after PowerOn: < 1.1s
- ◆ Signal layout:



The most significant bit must be transmitted the first!

Caution! Feedback systems, transmitting data containing error or status bits are not supported!

◆ Examples of supported SSI feedback systems:

- ◆ IVO / GA241 SSI;
- ◆ Thalheim / ATD 6S A 4 Y1;
- ◆ Hübner Berlin / AMG75;
- ◆ Stegmann / ATM60 & ATM90;
- ◆ Inducoder / SingleTurn: EAS57 & Multiturn: EAMS57

4.3.1. Configuration of load control

Configuration in the "configure signal source" wizard under "load feedback system":

- ◆ The selection of the feedback signal activates the acquisition and the signals are available as **Status values** (see page 160).
- ◆ Rotatory or linear feedback systems are supported.
- ◆ Input values for rotatory feedback systems:
 - ◆ Increments per feedback revolution (physical, without quadruplication)
 - ◆ Direction reversal

Attention! With wrong sense of direction and active load control, you will get a positive feedback; the motor will accelerate in an uncontrolled way
Solution: Before the load control is activated, the signals must be checked with the aid of the **status values** (see page 160) and secure against a wrong sense of direction with the aid of a "maximum difference to motor position.
 - ◆ Load travel per feedback revolution: Is used for establishing the measure reference between load- and motor position.
The value can be configured very precisely by entering numerator and denominator.
- ◆ Input values for linear feedback system
 - ◆ Feedback resolution (physical, without quadruplication)
Position difference, which corresponds to a cycle duration of the feedback signal.
 - ◆ Direction reversal

Attention! With wrong sense of direction and active load control, you will get a positive feedback; the motor will accelerate in an uncontrolled way
Solution: Before the load control is activated, the signals must be checked with the aid of the **status values** (see page 160) and secure against a wrong sense of direction with the aid of a "maximum difference to motor position.
 - ◆ Scaling factor for an additional adaptation of the feedback signal (is normally not required = 1)
 - ◆ Maximum difference to the motor position
Upon exceeding this value, Compax3 will report **error 7385hex** (see page 160) (29573dez)
 - ◆ Activate / Deactivate load control

Attention!

**The load control is active immediately after the configuration download!
Therefore do only activate if the load position signal (scaling, direction, value) was verified before.**

Alignment of the load control:

There is an **Alignment of the position values** of motor and load under the following operating conditions (Load position = Motor position):

- ◆ During a **Machine zero run** the load control is deactivated until the position value 0 (defined via the machine zero offset) was approached.
Then an alignment of the position values is performed and the load control is activated.
- ◆ After switching on Compax3.
- ◆ When writing "1" into object 2201.2
- ◆ When activating the load control.

Continuous mode

In continuous operation (object 1111.8 $\neq 0$) an alignment of the position values of motor and load (load position = motor position) takes place upon each new positioning command.

Application: e.g. roller feed

4.3.2. Error: Position difference between load mounted and motor feedback too high

The (unfiltered) position difference between motor feedback and load feedback has exceeded the "maximum difference to motor position" value (O410.6)

The load position in the position controller is deactivated.

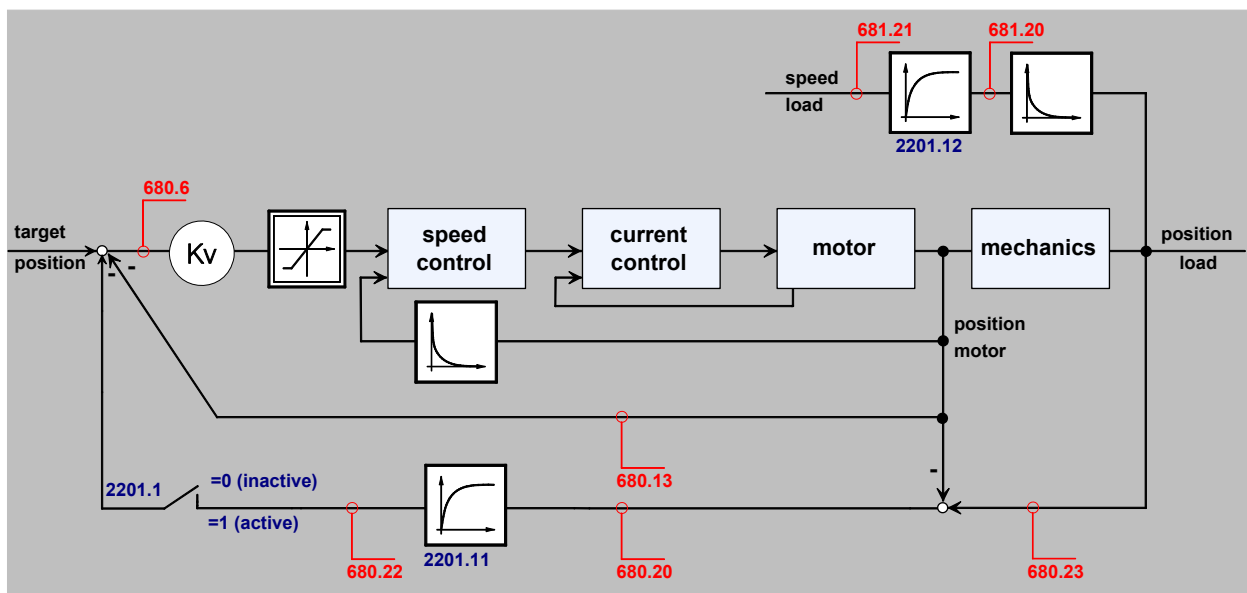
In order to re-activate the function (after eliminating the cause of the error), you have the following possibilities:

- ◆ Activate function in configuration and perform configuration download or write 1 into O2201.1
- ◆ Perform Ackn and/or Homing (function becomes effective after homing run).

Caution!

The position difference is aligned to zero when switched on again, i.e. the original position reference is lost. Therefore it is advisable to approach the reference point again in this case (Machine zero run or Homing)

4.3.3. Load control signal image



4.3.3.1 Object for the load control (overview)

No.	Object name	Object	Format	PD	Valid beginning
410.6	C3.LimitPosition_LoadControlMaxPosDiff	Position difference load-motor (error threshold)	C4_3	no	VP
680.23	C3.StatusPosition_LoadControlActual	Actual position of the load	C4_3	no	-
680.20	C3.StatusPosition_LoadControlDeviation	Position difference load-motor (unfiltered)	C4_3	no	-
680.22	C3.StatusPosition_LoadControlDeviationFiltered	Position difference load-motor (filtered)	C4_3	no	-
680.21	C3.StatusPosition_LoadControlDeviationMax	Maximum position difference load-motor	C4_3	no	-
681.20	C3.StatusSpeed_LoadControl	Speed of the load feedback (unfiltered)	C4_3	no	-
681.21	C3.StatusSpeed_LoadControlFiltered	Speed of the load feedback (filtered)	C4_3	no	-
2201.2	C3Plus.LoadControl_Command	Load control command mode	I16	no	Immediately
2201.1	C3Plus.LoadControl_Enable	Enable load control	I16	no	Immediately
2201.11	C3Plus.LoadControl_FilterDenominator	Time constant of position difference filter	U32	no	VP
2201.3	C3Plus.LoadControl_Status	Load control status bits	I16	no	-
2201.12	C3Plus.LoadControl_VelocityFilter	Time constant of the load-speed filter for the load feedback	I16	no	VP

4.3.3.2 Objects for load control

Detailed information on the topic of "objects for load control" can be found in the online help of the device.

4.4 Optimization

In this chapter you can read about:

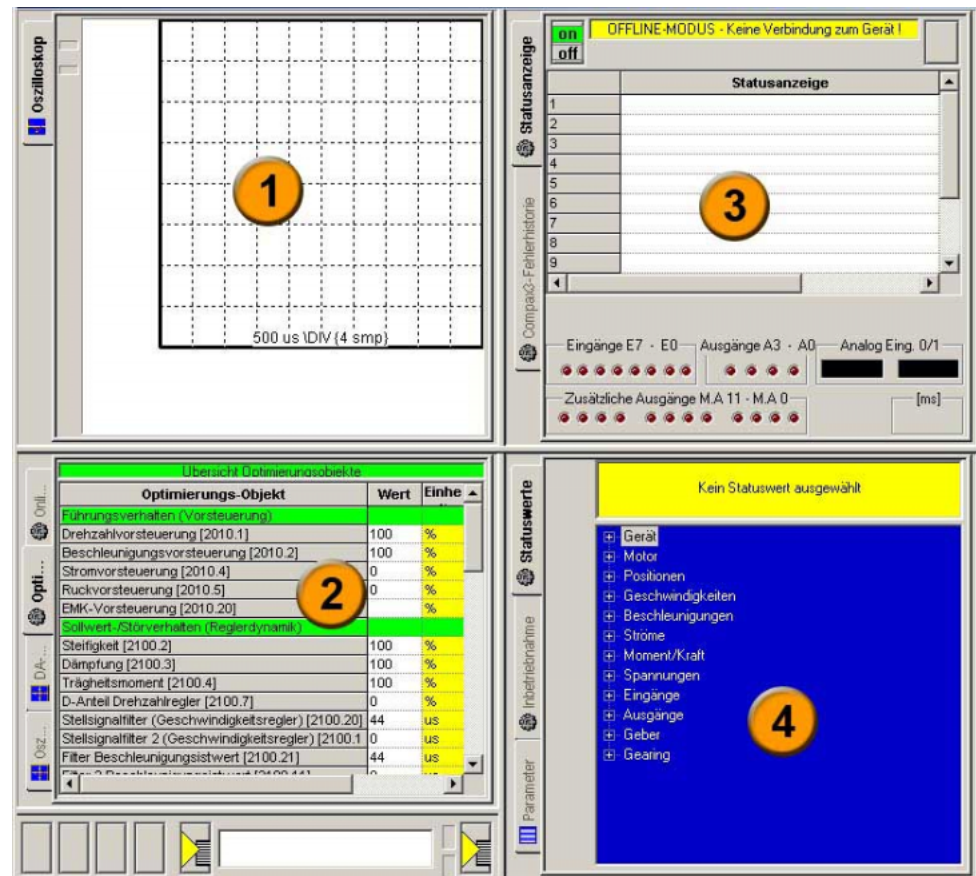
Optimization window.....	163
Scope	164
Controller optimization.....	172
Signal filtering with external command value	240
Input simulation	243
Setup mode	245
Load identification.....	247
Alignment of the analog inputs	249
C3 ServoSignalAnalyzer.....	251
ProfileViewer for the optimization of the motion profile	288
Turning the motor holding brake on and off	290

- ◆ Select the entry "**Optimization**" in the tree.
- ◆ Open the optimization window by clicking on the "**Optimization Tool**" button.

4.4.1. Optimization window

Layout and functions of the optimization window

Segmentation	Functions (TABs)
Window 1:	◆ Scope (see page 164)
Window 2:	◆ Optimization: Controller optimization
	◆ D/A Monitor (see page 456): Output of status values via 2 analog outputs
	◆ Scope Settings
Window 3:	◆ Status Display
	◆ Compax3 Error History
Window 4:	◆ Status values
	◆ Commissioning: Setup mode (see page 245) with load identification (see page 247)
	◆ Parameters for commissioning, test movements (relative & absolute) and for load identification.



4.4.2. Scope

In this chapter you can read about:

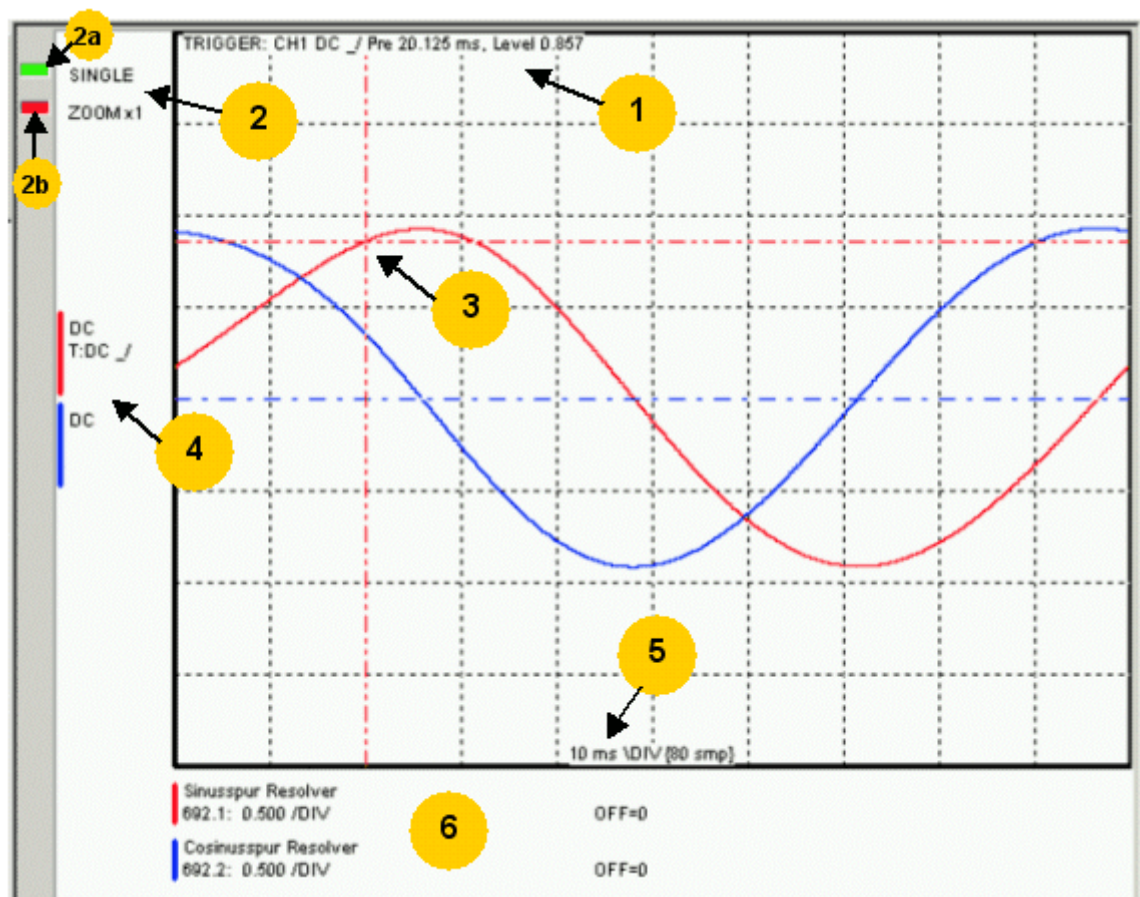
Monitor information.....	164
User interface.....	165
Example: Setting the Oscilloscope.....	170

The integrated oscilloscope function features a 4-channel oscilloscope for the display and measurement of signal images (digital and analog) consisting of a graphic display and a user interface.

Special feature:

in the single mode you can close the ServoManager after the activation of the measurement and disconnect the PC from Compax3 and upload the measurement into the ServoManager later.

4.4.2.1 Monitor information

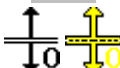


- 1: Display of the trigger information
- 2: Display of the operating mode and the zoom setting
 - ♦ 2a: Green indicates, that a measurement is active (a measurement can be started or stopped by clicking here).
 - ♦ 2b: Active channel: the active channel can be changed sequentially by clicking here (only with valid signal source).
- 3: Trigger point for Single and Normal operating mode
- 4: Channel information: Type of display and trigger setting
- 5: X-DIV: X deviation set
- 6: Single channel sources

Cursormodes/ -functions

Depending on the operating mode, different cursor functions are available within the osci monitor.

The functions can be changed sequentially by pressing on the right mouse button.

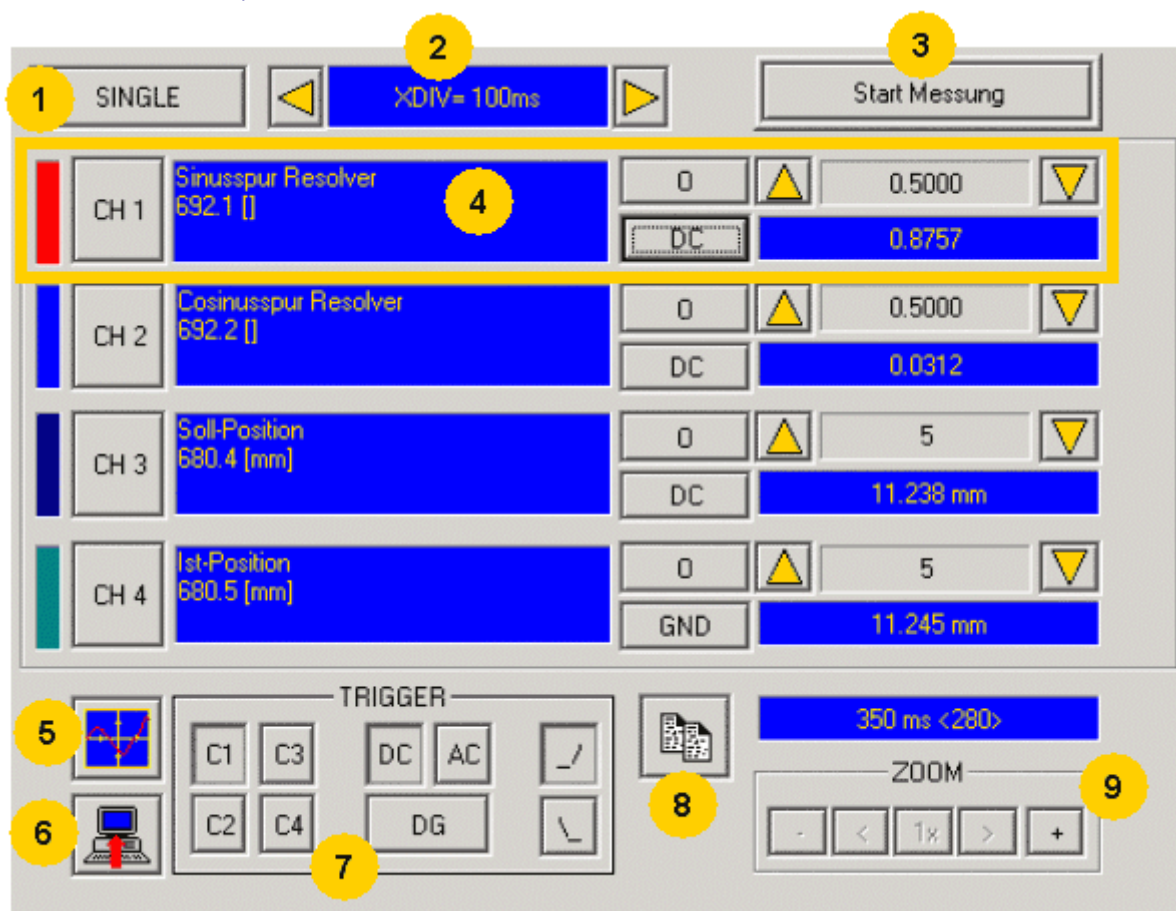
Cursor Symbol	Function
	Set Marker 1 the measurement values of the active channel as well as the y difference to marker 2 are displayed
	Set Marker 2
	Delete and hide marker
	Move offset of the active channel. The yellow symbol indicates that the scrolling is active.
	Set trigger level and pretrigger

In the ROLL operating mode, marker functions and set trigger level positions are not available.

4.4.2.2 User interface

In this chapter you can read about:

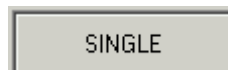
Oscilloscope operating mode switch:	166
Setting the time basis XDIV	166
Settings for channels 1..4	167
Trigger settings	168
Special functions	168



- 1: **Operating mode switch** (see page 166) (Single / Normal / Auto / Roll)
- 2: **Setting the time basis** (see page 166)
- 3: Starting / Stopping the measurement (prerequisites are valid channel sources and if necessary valid trigger settings.)
- 4: **Setting channel** (see page 167) (Channels 1 ...4)
- 5: **Special functions** (see page 168) (Color settings; memorizing settings and measurement values)
- 6: Loading a measurement from Compax3: in the single mode you can close the ServoManager after the activation of the measurement and disconnect the PC from Compax3 and upload the measurement later.
- 7: **Setting triggering** (see page 168)
- 8: Copy osci display to clipboard
- 9: Zoom of the osci display (1, 2, 3, 8, 16 fold) with the possibility to move the zoom window (<,>)

Oscilloscope operating mode switch:

Oscilloscope operating mode switch:



Selection of the desired operating mode: SINGLE, NORMAL; AUTO and ROLL by clicking on this button.

Changing the operating mode is also permitted during a measurement. The current measurement is interrupted and started again with the changed settings.

The following operating modes are possible:

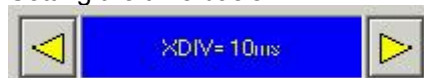
Operating mode	Short description
SINGLE	Single measurements of 1-4 channels with trigger on a freely selectable channel
NORMAL	Like Single, but after each trigger event, the measurement is started again.
AUTO	No Trigger. Continuous measuring value recording with the selected scanning time or XDIV setting
ROLL	Continuous measuring value recording of 1 .. 4 channels with selectable scanning time and a memory depth of 2000 measuring values per channel.

With SINGLE / NORMAL / AUTO, the measurement is made in Compax3 and is then loaded into the PC and displayed.

With ROLL, the measuring values are loaded into the PC and displayed continuously.

Setting the time basis XDIV

Setting the time basis XDIV



Depending on the selected operating mode, the time basis can be changed via the arrow keys.

For the operating modes **SINGLE**, **NORMAL** and **AUTO**, the following **XDIV** time settings are possible:

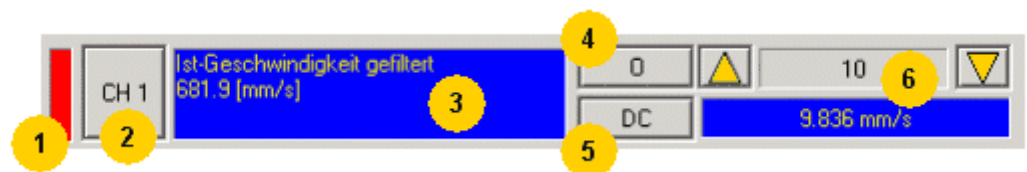
XDIV	Mode	Scanning time	Samples DIV/TOTAL	Measuring time
0.5ms	1	125us	4/40	5ms
1.0ms	2	125µs	8/80	10ms
2.0ms	3	125µs	16/160	20ms
5.0ms	4	125µs	40/400	50ms
10.0ms	5	125µs	80/800	100ms
20.0ms	6	250µs	80/800	200ms
50.0ms	7	625µs	80/800	500ms
100.0ms	8	1.25ms	80/800	1s
200.0ms	9	2.50ms	80/800	2s
500.0ms	10	6.25ms	80/800	5s
1s	11	12.50s	80/800	10s
2s	12	25.00ms	80/800	20s
5s	13	62.50ms	80/800	50s
10s	14	125.00ms	80/800	100s

For the operating **ROLL**, the following **XDIV** time settings are possible:

XDIV	Mode	Scanning time	Samples DIV/TOTAL
2 ms	54	125us	200/2000
2ms	54	125µs	200/2000
4ms	55	125µs	200/2000
10ms	56	125µs	200/2000
20ms	57	125µs	200/2000
40ms	58	125µs	200/2000
100ms	59	250µs	200/2000
200ms	60	625µs	200/2000

Changing the time basis is also permitted during an OSCI measuring sequence. This means, however, that the current measurement is interrupted and started again with the changed settings.

Settings for channels 1..4



1: Select channel color

2: Open menu for channel-specific settings

- ◆ **Reset Channel CH 1..4** all channel settings are deleted.
Please note: Channels can only be filed with sources one after the other. It is, for example, not possible to start a measurement which has only a signal source for channel 2!
- ◆ **Select channel color:** Here you can change the color of the channel..
- ◆ **show/hide channel:** Hide/show display of the channel.
- ◆ **Change logic display mask:** Mask bits in logic display.
- ◆ **auto scaling** Calculation of YDIV and Offset: The program calculates the best settings for YDIV and channel offset in order to display the complete signal values optimally.

3: Set signal source with object name, number and if necessary unit

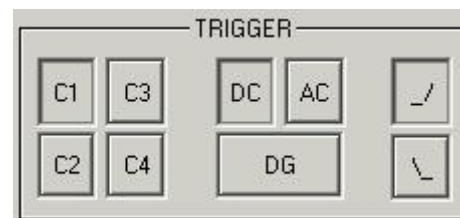
- ◆ Define source: Draw the desired status object with the mouse (drag & drop) from the "Status value" window (right at the bottom) into this area.

4: Set Channel offset to 0**5: Select channel display (GND, DC, AC, DIG)**

- ◆ **DC:** Display of the measurement values with constant component
- ◆ **AC:** Display of the measurement values without constant component
- ◆ **DIG:** Display of the individual bits of an INT signal source.
The displayed bits can be defined via the logic display mask.
- ◆ **GND:** A straight line is drawn on the zero line.

6: Set Y-amplification (YDIV)

Change of the Y amplification YDIV in the stages 1,2,5 over all decades.
Arrow upwards increases YDIV, arrow downwards diminishes YDIV.
the standard value is 1 per DIV.
The measurement value of the channel at the cursor cross is displayed.

Trigger settings

Select trigger channel: Buttons C1, C2, C3, C4

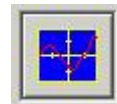
Select trigger mode: DC, AC, DG

Select trigger edge: rising_/_/ or falling_

the pretrigger as well as the trigger level are set by clicking on the trigger cursor



() directly in the OSCI display.

Special functions

Menu with special oscilloscope functions such as memorizing or loading settings.

Functions:

- ◆ **Select background color:** Adapt background color to personal requirements.
- ◆ **Select grid color:** Adapt grid color to personal requirements.
- ◆ **Memorize OSCI settings in file:** The settings can be memorized in a file on any drive. The file ending is *.OSC.
- ◆ The format corresponds to an INI file and is presented in the appendix.
- ◆ **open OSCI settings from file.** Loading a memorized set of settings. The file ending is *.OSC.
- ◆ **Memorizing OSCI settings in the project:** Up to four sets of OSCI settings can be memorized in the current C3 ServoManager project. .
- ◆ **open OSCI settings from project.** If settings were memorized in the project, they can be read in again.
- ◆ **Memorize OSCI measurement in file:** Corresponds to memorizing the setting; the measurement values of the measurement are stored in addition. Thus it is possible to memorize and read measurements completely with settings. The file ending is *.OSM.
- ◆ **Exporting measurement values into a CSV file:** e.g. for reading into Excel.

4.4.2.3 Example: Setting the Oscilloscope

SINGLE measurement with 2 channels and logic trigger on digital inputs

The order of the steps is not mandatory, but provides a help for better understanding.

As a rule, all settings can be changed during a measurement. This will lead to an automatic interruption of the current measurement and to a re-start of the measurement with the new settings:

Assumption: A test movement in the commissioning mode is active.

1.) Select OSCI operating mode



2.) Select Time basis XDIV



3.) Select channel 1 signal source digital inputs 120.2 from status tree with the aid of Drag & Drop

4.) Select channel 2 (filtered actual speed) via "Drag and drop" from the status tree

5.) Set trigger to channel 1 and DG.

Input of the mask in HEX

Triggering a rising edge to input I1.

BIT 0 (value 1) = I0

BIT 1 (value 2) = I1

BIT 2 (value 4) = I2 etc.

Trigger to input	I0	I1	I2	I3	I4	I5	I6	I7
Trigger mask in hex	1	2	4	8	10	20	40	80

The masks can also be combined so that the trigger is only active, if several inputs are active. Example: Triggering to I2 and I5 and I6 -> 4h + 20h + 40h = 64h

The mask for input I1 is in this case 2.

select rising edge.

Note: If the trigger mask DG (digital) is selected for a channel, the display mode of the trigger channel is automatically set to DIG display.

6.) Start measurement

7.) Set pretrigger in the OSCI window

Note: There is no level for the DIG trigger. The event limit determines the mask. If a trigger event occurs, the measurement values are captured until the measurement is completed.

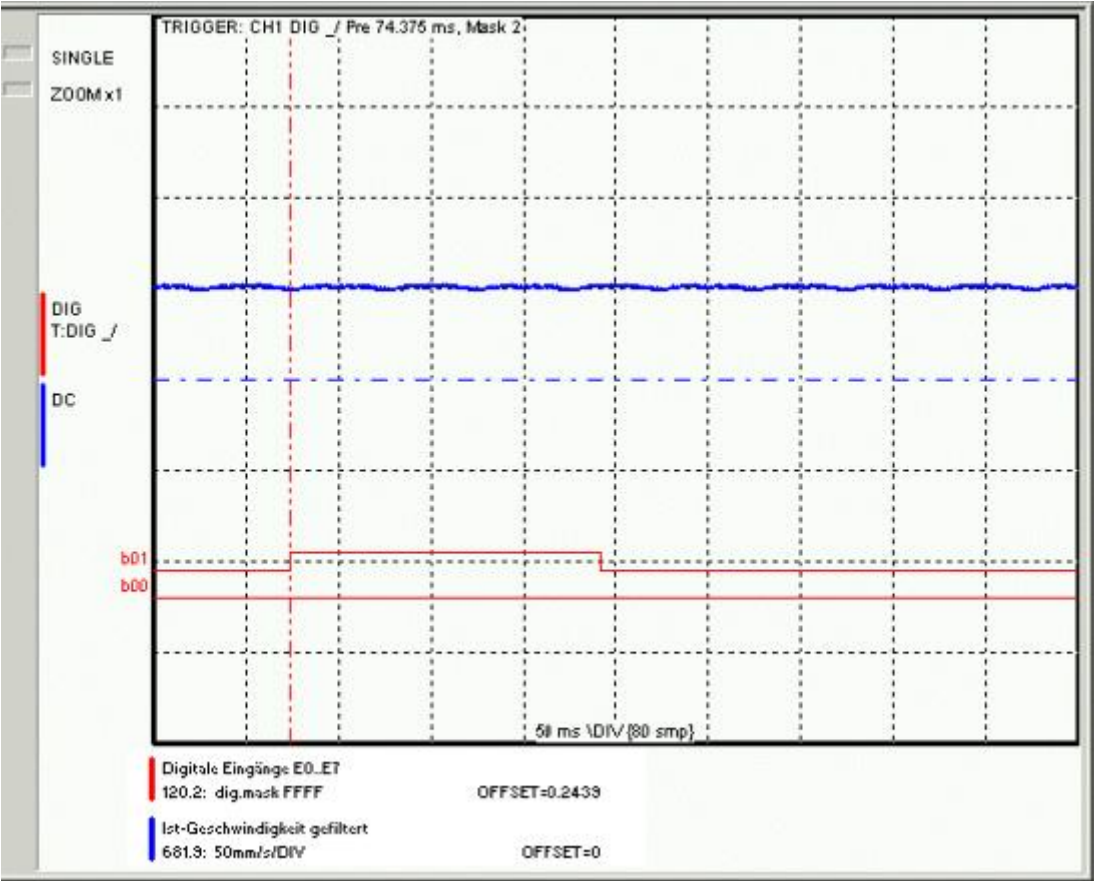
Afterwards, the measurement values are read from the Compax3 and displayed.

The display mask of trigger channel 1 was not yet limited, therefore it shows all 16 bit tracks (b0...b15). In order to limit it to 8 bit tracks, you must call up the menu for channel 1 via [CH1] and select "change logic of display mask [H].

Limit the display mask to 8 bit tracks with Mask FFh.

In the display the bit tracks b0 to b7 are now shown:

Example: Only b0 and b1 are to be displayed: Set display mask to 03



4.4.3. **Controller optimization**

<u>In this chapter you can read about:</u>	
Introduction	173
Configuration	176
Automatic controller design	194
Setup and optimization of the control	207

4.4.3.1 Introduction

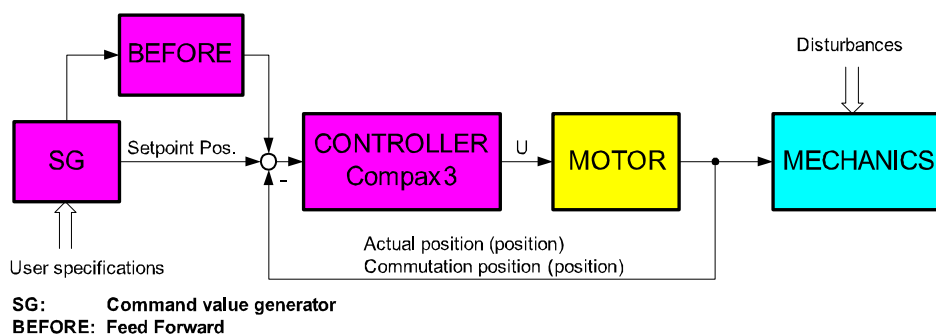
In this chapter you can read about:

Basic structure of the control with Compax3	173
Proceeding during configuration, setup and optimization	173
Software for supporting the configuration, setup and optimization	174

Basic structure of the control with Compax3

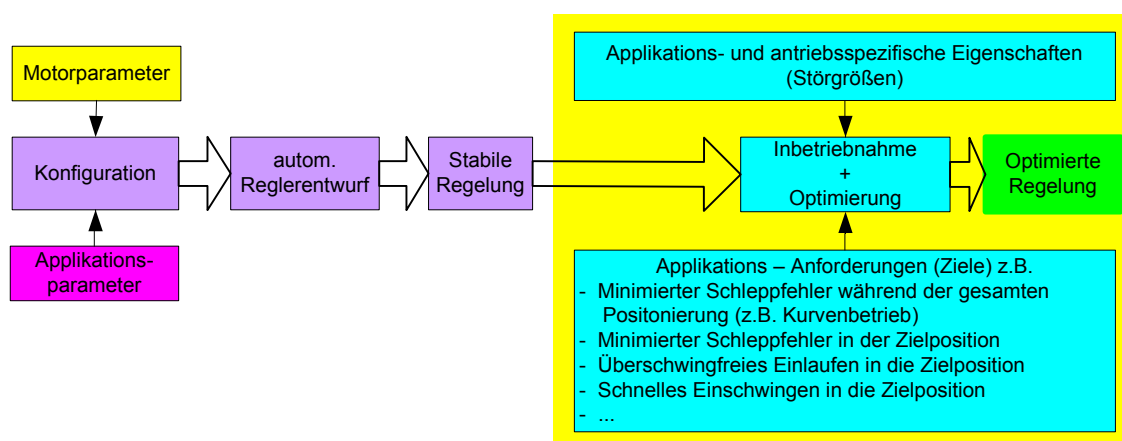
Compax3 is an intelligent servo drive for different applications and dynamic motion sequences.

Basic structure of a control with the Compax3 servo drive



As shown in the above figure, the programmed motion sequences are generated by the internal Compax3 setpoint generator. The setpoint position as well as the other status values of the feedforward control are made available to the position controller in order to keep the following error as small as possible. For the control, Compax3 requires on the one hand the actual position and on the other hand the commutation position, which represents the reference between the mechanic feedback position and the motor magnet.

Proceeding during configuration, setup and optimization



Overview of the processes during configuration and setup of the Compax3 drive system

The controller default settings are calculated from the configured motor and application parameters with the aid of the automatic controller design which runs in the background.

These controller presettings provide normally for a stable and robust control. Due to continually rising application requirements, this presetting is often not sufficient, so that further optimization of the control behavior is necessary.

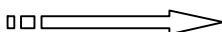
This manual describes the setup and optimization procedure for Compax3.

In order to better understand the correlations and interactions, we will describe in the first step the individual correlations and physical values, that are required for the configuration and the prespecification of the control loops. In the following, the manual will then describe the function blocks for the optimization implemented in the servo controller as well as the setup tool.

Software for supporting the configuration, setup and optimization

In this chapter you can read about:

Application parameters 175



The entry of the motor and application parameters is made with the C3 ServoManager2 (C3Mgr2.exe):

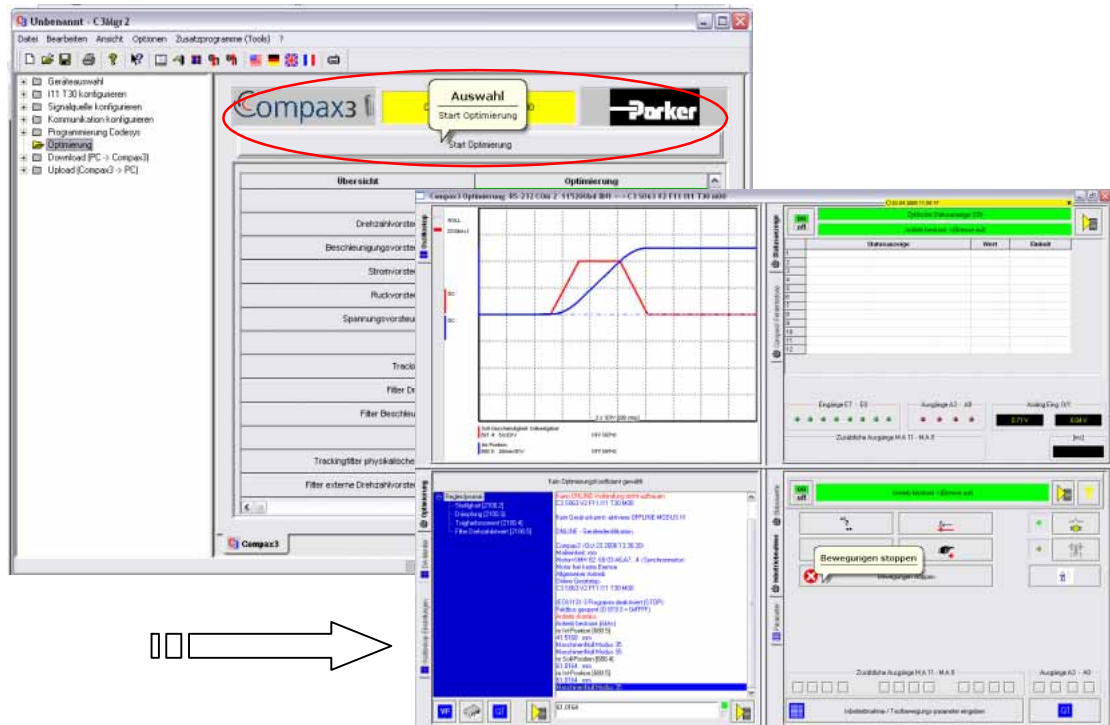
The configuration requires:

Application parameters

The wizard guided entry of the application parameters takes place directly in the ServoManager.

Carefully verify the entries and default values in order to detect entry errors in the run-up.

After the configuration download, the drive can be set up and be optimized if needs be. For this, please open the optimization window of the ServoManager:



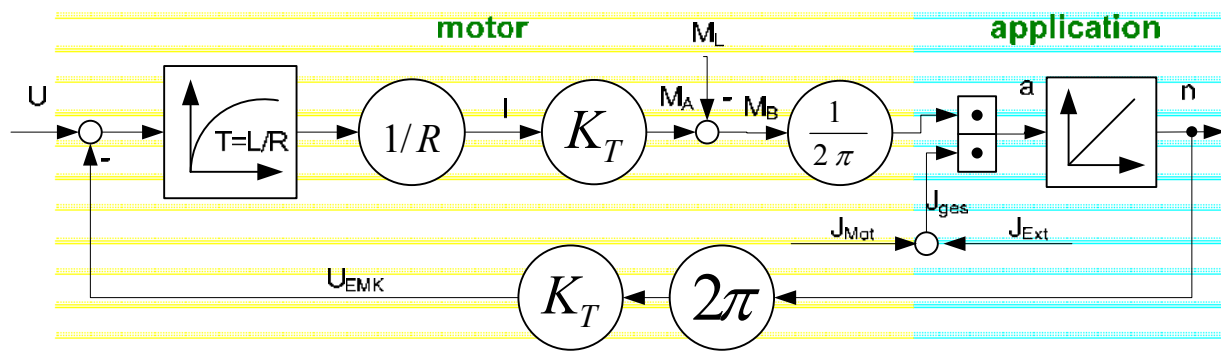
4.4.3.2 Configuration

In this chapter you can read about:

Control path	176
Motor parameters relevant for the control	177
Mass inertia	177
Nominal point data	177
Saturation values	179
Quality of different feedback systems	179
Typical problems of a non optimized control	180
Feedback error compensation	181
Commutation settings	183
I ² t - monitoring of the motor	183
Relevant application parameters	186
Asynchronous motors	190

Control path

For the motors, the knowledge of the mathematical model is a prerequisite.
Mathematically idealized model of the control path:



U:	Control voltage
U_{EMK} :	electromagnetically generated voltage in the motor
T:	electric time constant of the motor winding
L:	Winding Inductance
R:	Winding Resistance
M_A :	Drive torque of the motor
M_L :	Load torque
M_B :	Acceleration torque
I:	Actual current r.m.s. (torque-producing)
K_T :	Torque constant
J_{mot} :	Motor mass moment of inertia
J_{ext} :	External mass moment of inertia
J_{total} :	Total mass moment of inertia
a:	Acceleration
n:	Velocity

Explanation:

The motor is controlled by the servo drive with control voltage U . During motion of the motor, an internal back e.m.f U_{EMC} is induced. This antagonizes the control voltage and is therefore deduced in the motor model. The difference is available for the acceleration of the motor.

The first order delay component represents the delaying property of the motor winding with the time constant $T=L/R$. According to Ohm's Law, a current $I=U/R$ results.

The drive torque of the motor is calculated by multiplying the current with the motor torque constant K_T . This is antagonized by the load torque of the machine.

The remaining acceleration torque accelerates the motor.

The resulting acceleration depends on the total mass moment of inertia (= motor + load moment of inertia).

The integration of the acceleration (sum of the acceleration over time) results in the velocity of the motor, which influences the amplitude of the induced EMC voltage.

Motor parameters relevant for the control

All motor parameters relevant for the control quality will be explained below. Wizard guided entry of the motor parameters in the MotorManager.

Electromotoric countercheck EMC

A non-energized synchronous motor induces an induction voltage, the so-called EMC voltage during an armature movement.

The EMC constant (motor EMC) states the value of the induced voltage subject to velocity.

The EMC constant corresponds to the motor torque constant K_T , which represents the correlation between the torque-producing current and the drive torque, however in a different unit.

The EMC voltage antagonizes the control voltage of the servo drive.

As the control voltage of the drive is not unlimited, it must be taken into consideration that the drive may approach the voltage limit at high velocities and therefore high EMC voltages.

The EMC constant is important with respect to the velocity control design.

The motor EMC is entered in the "motor characteristics" wizard window of the MotorManager. You may choose between different units. Please note the information on the motor type specification plate.

Mass inertia

The mass moment of inertia (moment of inertia) is also an important motor parameter for the design of the velocity control loop. For the velocity control design, this parameter is effective in correlation with the external mass moment of inertia of the load. The external load is entered in the C3 ServoManager. With the "load identification" function of the C3 ServoManager, the mass inertia can be determined, if it is not yet known.

Nominal point data**In this chapter you can read about:**

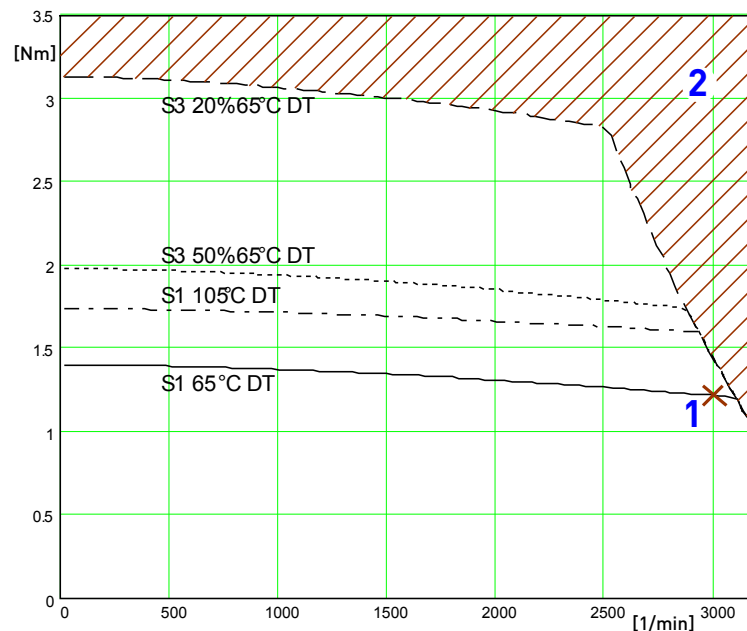
Motor characteristic line of a synchronous servo motor (torque via velocity) 178

Calculation of the reference current from the characteristic line 178

The nominal point data can be found in the velocity characteristic line of the motor. the prespecified nominal point can be changed in the 2nd wizard page of the C3 ServoManager configuration with the aid of "activate change of reference point" via the reference velocity and the reference current.

Motor characteristic line of a synchronous servo motor (torque via velocity)

SMH 60 30 1,4 ...2ID...4: 3000rpm at 400VAC



[Motorkennlinie.emf /.jpg]

1: Nominal point

2: Forbidden range

Calculation of the reference current from the characteristic line.

$$I = \frac{M[Nm]}{EMK} \cdot 85,5 = \frac{M[Nm]}{K_T}$$

or for linear motors

$$I = \frac{M[Nm]}{EMK_v} \cdot \frac{\sqrt{2}}{\sqrt{3}} = \frac{M[Nm]}{K_f}$$

In the MotorManager, a motor can be defined for different operating modes (230V, 400V and 480V) without having to create several entities.

Additional parameters of a motor are:

◆ Standsill current [mA_{r.m.s.}]

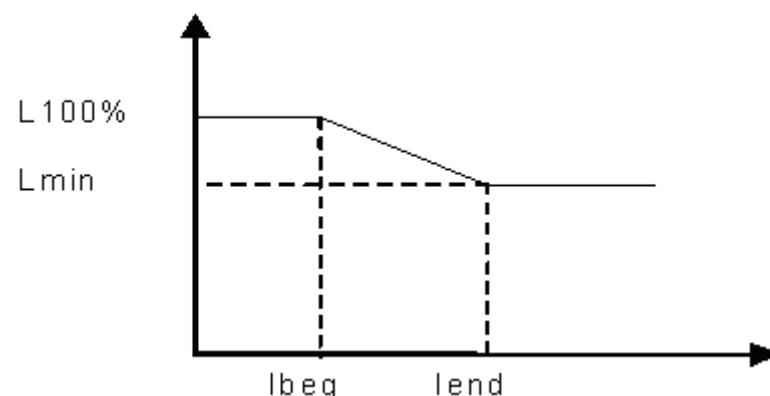
◆ Pulse current [in % of the nominal current]

The pulse current can be provided by the Compax3 for the duration of the pulse current time (as far as the device current permits). The thermal pulse load of the motor rises due to the pulse current. This pulse load is monitored by the i^2t monitoring in the Compax3.

Saturation values

A motor may show a saturation behavior at higher currents due to iron saturation. This results in the reduction of the winding inductance at higher currents. As the inductance value of the winding enters directly into the P term of the current controller, the saturation at higher currents will result in too fast current control. This behavior can be countersteered with saturation values (entered in the "motor characteristics" wizard window of the MotorManager).

Consideration of the saturation values with the aid of a linear characteristic line



L 100%	Entered value of the nominal inductance
Lmin	Minimum winding inductance [% of the nominal inductance]. Value to which the inductance of the winding sinks at Ifinal.
Ibeg	End of the saturation [% of the nominal inductance].
Ifinal	Beginning of the saturation [% of the nominal inductance].

For the determination of the saturation values please see chapter 0.

Quality of different feedback systems

In this chapter you can read about:

Interface	179
Resolution	180
Noise	180

The controller quality depends to a great extent on the signal quality of the position feedback and its signal acquisition. It is therefore important to select a suitable measurement system for the individual application.

In the rotary range, a resolver is mostly used for reasons of economics. The single pole resolver provides one sine/cosine period per revolution. In very demanding applications, the performance of the resolver is often not satisfactory, so that a SinCos feedback with a higher resolution must be used. The typical resolution of a SinCos feedback is 1024 periods/revolution.

Other position feedbacks which are often used in the linear range, differ with respect to the reading principle. High-quality optical position measuring systems offer the highest resolution and accuracy.

Interface

An additional distinctive feature is the electric interface between servo controller and feedback. Analog sine/cosine signals or digital encoder signals (RS422 standard) are used to transmit the incremental position information. Due to the high interpolation rate (approx. 14 bits) of the Compax3 servo controller, an analog sine/cosine signal is in most cases preferable to digital encoder signals.

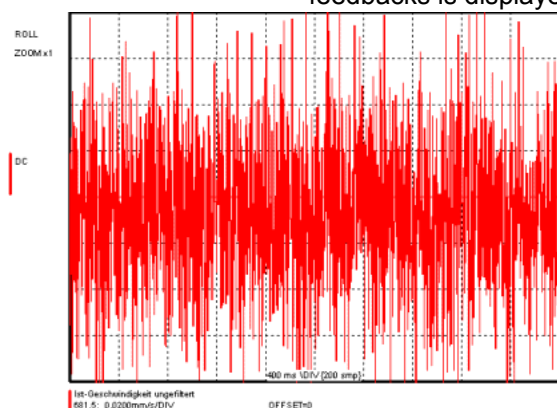
Resolution

The less precise the resolution, the higher the quantization noise on the velocity signal.

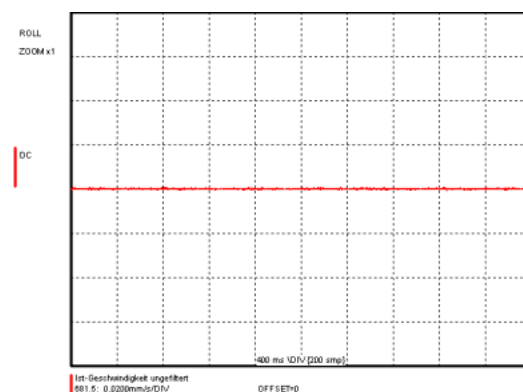
Noise

The feedbacks have different levels of analog noise, which have a negative effect on the control. The noise can be dampened with the aid of filters in the actual value acquisition, however at the cost of the controller bandwidth.

For comparison, the noise of the actual velocity value at standstill of two different feedbacks is displayed.



Resolver: 1 period/revolution



SinCos: 1024 periods/revolution

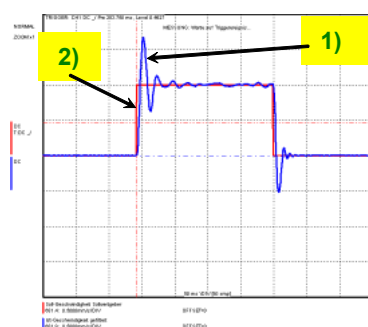
Typical problems of a non optimized control

In this chapter you can read about:

Too high overshoot on velocity	180
Increased following error	181
Instable behavior	181

Upon first setup of a control, the controller is normally not able to meet all application requirements at once. Typical problems may be:

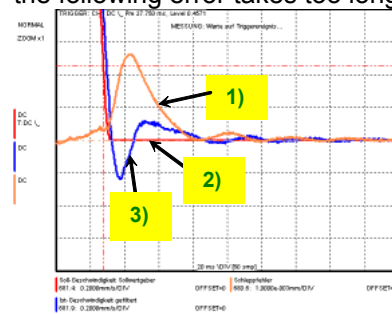
Too high overshoot on velocity



- 1) Actual velocity
- 2) Setpoint velocity

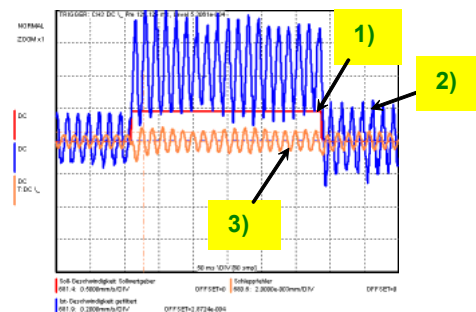
Increased following error

Increased following error when approaching the target position or the reduction of the following error takes too long



- 1) Following error
- 2) Setpoint velocity
- 3) Actual velocity

Instable behavior



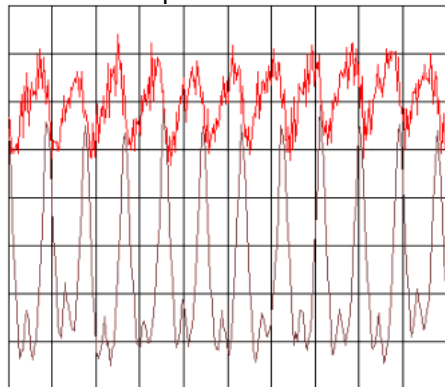
- 1) Setpoint velocity
- 2) Actual velocity
- 3) Following error

Feedback error compensation

Feedbacks with sine/cosine tracks may have different errors. The feedback error compensation supported by Compax3 eliminates offset and gain errors on both tracks online.

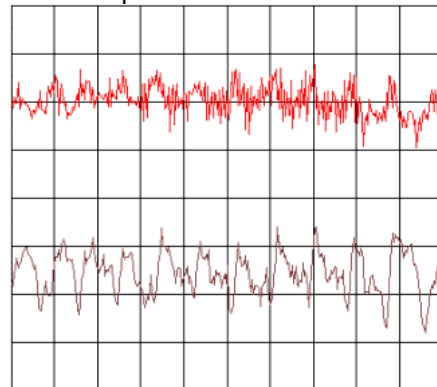
The feedback error compensation is activated in the MotorManager: "Feedback system" wizard under "feedback error compensation".

Without compensation



top:
bottom:

With compensation



Scale:
Current = 50mA/Div
Speed = 0.2mm/s/Div
Time = 3.8ms/Div

Type of motor: Parker LMDT 1200-1 ironless linear motor
Linear encoder: Renishaw RGH 24B with 20 μ m resolution
Servo controller: Compax3

In order to accept the changes in the MotorManager in the project, the individual configuration pages must be clicked through. In order to make the changes made in the MotorManager effective in the device, the configuration download in the C3Manager must be executed.

In the event of formal errors, the feedback error compensation may however be disadvantageous; therefore it is switched off as a default.

Commutation settings

Another prerequisite for a good control quality is the correct motor commutation. This comprises several settings.

- ◆ The commutation angle describes the relation of the feedback position with respect to the motor pole pair position.
- ◆ Commutation direction reversal describes the correlation between the position of the feedback and the commutation position.
- ◆ Feedback direction reversal describes the direction correlation between the defined positive direction of the drive and the feedback position.
- ◆ If the commutation direction does not match the defined direction of rotation, this will result in a subsequent error with the error message "following error" or "motor stalled".
- ◆ A faulty commutation angle value results in increased current and following error. Therefore the voltage limit is reached faster. If the value of the commutation error exceeds 90°, the motor will spin due to the positive feedback effect.

These 3 settings can be automatically acquired with the MotorManager. With the aid of the automatic commutation acquisition, the commutation settings can be determined and plausibility checks can be made. You will be guided through the individual wizard pages and the MotorManager will issue a prompt to define the positive direction of the drive. The wizard pages supporting the user depend on the feedback system as well as from the motor type (linear or rotary).

This function is activated in the MotorManager:
"Feedback system" wizard under "automatic commutation settings".

Hint The motor should be operated without load (=> no load torque e.g. weight force of a z-axis).

Additional setting of the commutation for incremental feedback:
This function is activated in the MotorManager:
"Feedback system" wizard under "feedback resolution".

In the event of an incremental feedback (Sine/cosine or RS424 encoder) the commutation must be defined in addition, in order to find the position reference to the winding.

- ◆ Automatic commutation with movement
- ◆ Commutation with digital hall sensors

I²t - monitoring of the motor

In this chapter you can read about:

Motor continuous usage	184
Motor pulse usage	185
Reference point 2: Increased torque thanks to additional cooling	186

With the I²t - monitoring, the motor is protected against overload or thermal destruction. For this, knowledge on the load bearing capacity of the motor is required. This information can be taken from the manufacturer documentation (motor parameters). Compax3 monitored:

- ◆ Continuous usage of the motor (motor usage)
- ◆ Pulse usage of the motor (motor pulse usage)

Motor continuous usage

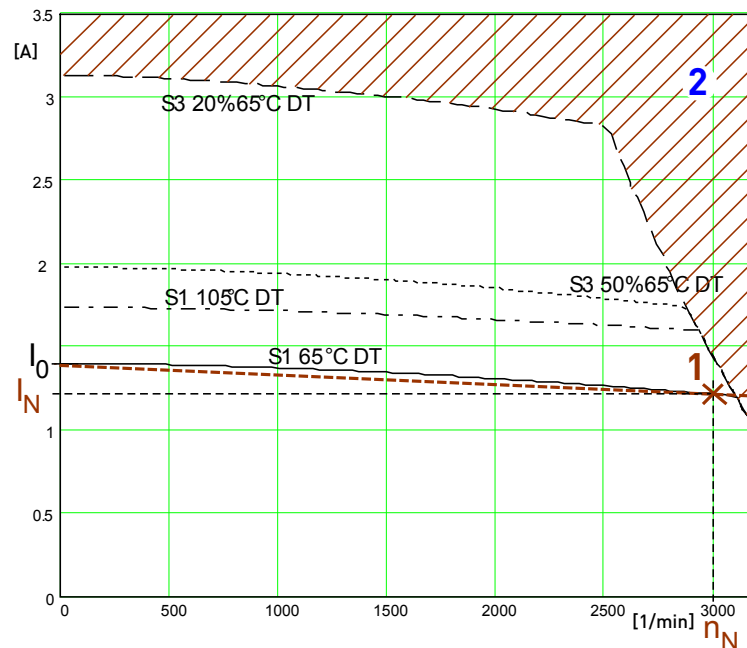
In this chapter you can read about:

Linearized motor characteristic line for different operating points 184

This kind of monitoring watches over the continually deliverable torque (continuous current). This continuous current depends on the velocity and is acquired online from the linearization of the motor characteristic line.

Linearized motor characteristic line for different operating points

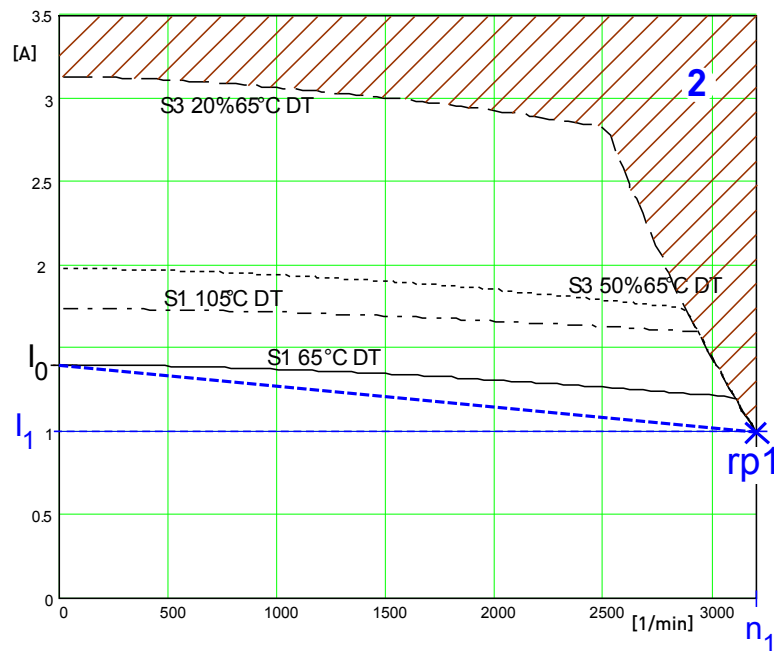
Nominal point



- I_0 : Continual stall current
- 1: Nominal point
- I_N : Nominal current (defined in the MotorManager)
- n_N : Nominal speed
- 2: Forbidden range

For monitoring the continuous usage, the linearized characteristic line between I_0 and I_N / n_N is used as a threshold.

Reference point 1: higher velocity at reduced torque



I_0 Continual stall current

rp1: Reference point 1 (defined in the C3 ServoManager)

I_1 : Reference current to reference point 1

n_1 : Reference velocity to reference point 1

2: Forbidden range

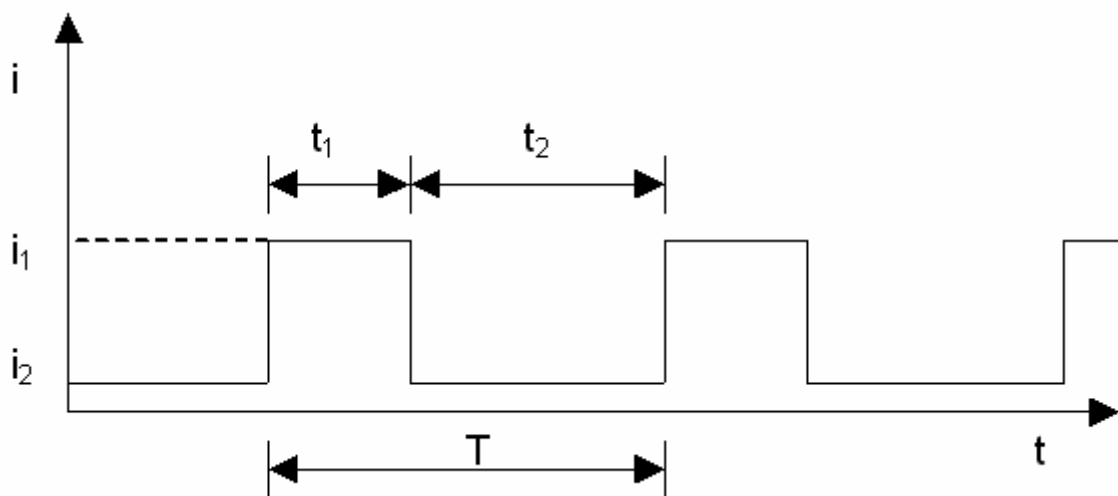
For monitoring the continuous usage, the linearized characteristic line between I_0 and I_1 / n_1 is used as a threshold.

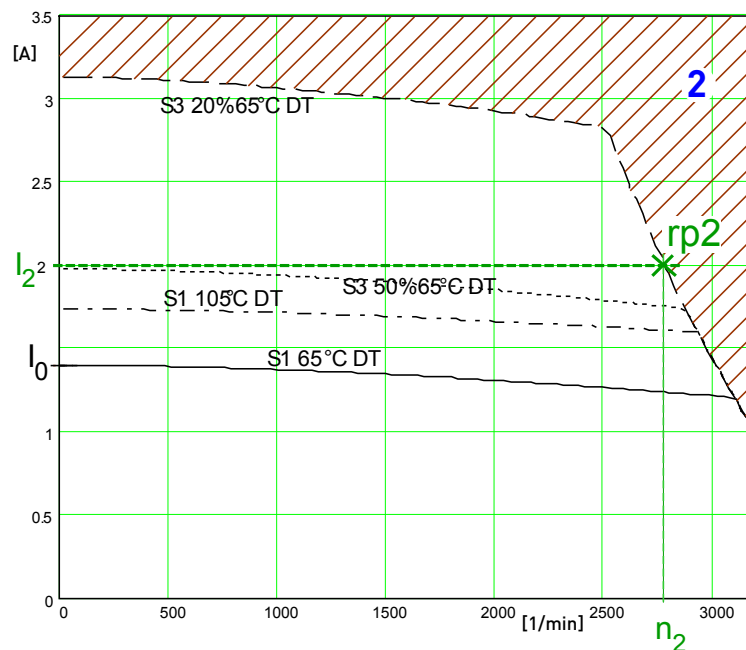
Motor pulse usage

This monitoring watches over the duration of the defined pulse current. The permitted duration for the pulse current is defined by the pulse current time constant.

If the acceleration current exceeds the nominal current for a defined time t_1 , a sufficient break time t_2 is required. If the current remains in average above the nominal current, the "monitoring motor pulse usage" [0x7180] error is triggered. Upon a high pulse usage, the error will occur almost without delay.

Current cycle:



Reference point 2: Increased torque thanks to additional cooling

- I_0 : Continual stall current
 1: Nominal point
 rp2: Reference point 2 (defined in the C3 ServoManager)
 I_2 : Reference current to reference point 2
 n_2 : Reference velocity to reference point 2
 2: Forbidden range

In order to monitor the continuous usage, the velocity-independent current limit I_2 is used.

If a r.m.s. current over the valid straight flows continually in the motor, the I^2t monitoring will issue the "effective motor current monitoring" error message [0x5F48]. The period of time until the error occurs depends on the thermal time constant of the motor defined in the motor parameters. The electronic temperature monitoring simulates approximately the temperature behavior of the motor. By defining a reference point different from the motor nominal data, the I^2t monitoring of the motor can be adapted to changed thermal ambient conditions (e.g. air stream caused by a ventilator fan).

Relevant application parameters**In this chapter you can read about:**

Switching frequency of the motor current / motor reference point.....	186
External Moment of Inertia.....	189
Limit and Monitoring Settings	190

Application parameters relevant for the control (C3 ServoManager)

Compax3 is configured with the aid of the C3 ServoManager. Here you can make application dependant settings. Among these are also parameters, that are relevant for the control. They will be explained below.

Switching frequency of the motor current / motor reference point**In this chapter you can read about:**

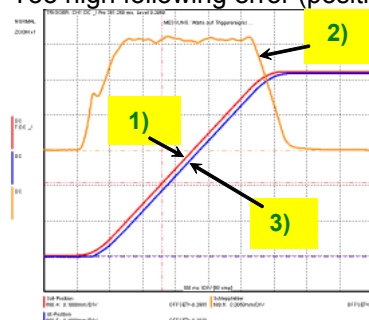
Following Error (Position Error)	187
Reduction of the current ripple.....	187
Motor parameters	187
Changing the switching frequency and the reference point.....	189

The higher the switching frequency, the better the quality of the current control. The higher switching frequency reduces the dead time of the current control path as

well as the current control noise. Furthermore, thermal losses caused by current ripple are reduced at higher switching frequencies.

Following Error (Position Error)

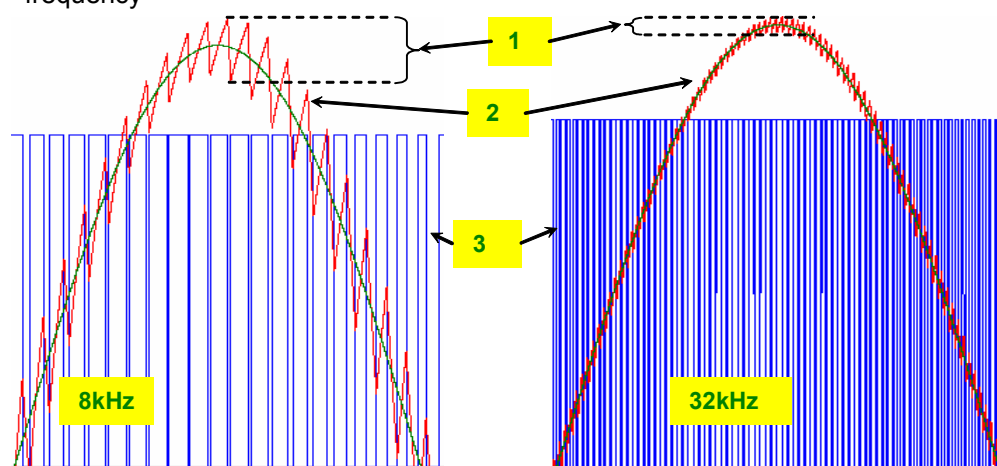
Too high following error (position error) during a movement



- 1) Setpoint Position
- 2) Position deviation = following error
- 3) Actual position

Reduction of the current ripple

Reduction of the current ripple of the phase current due to the higher switching frequency



- 1: Current ripple
- 2: Phase current
- 3: PWM control

Hint Please note that a high switching frequency means also high switching losses in the power output stage of the controller. For this reason, you must consider derated data of the servo controller for the drive design with higher switching frequencies.

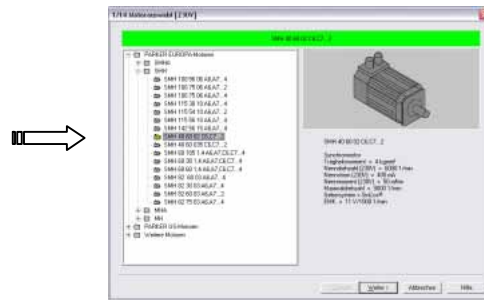
Motor parameters

In this chapter you can read about:

Parker Motor	188
Other motor	188
Motor types supported	189

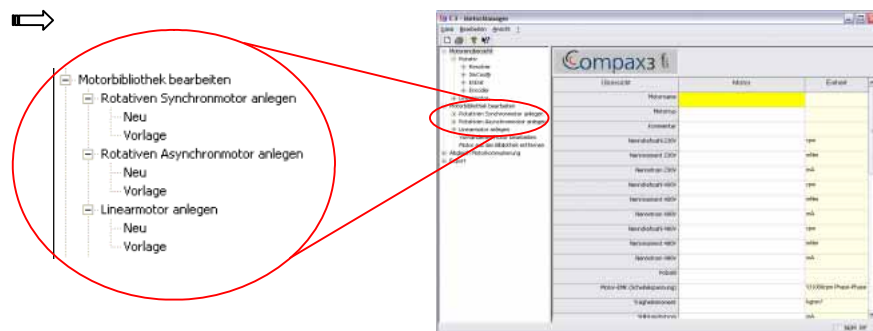
Parker Motor

If a Parker motor is used for the application, the parameters are already contained in the installed software. You can just select one of the available motors from the first configuration page.



Other motor

When using a motor from a different manufacturer, you will have to enter the relevant data. This process is supported by the MotorManager software tool, which can be called up from the ServoManager:



After doubleclicking on "new", the individual motor parameters are queried by the MotorManager.

Be careful to respect the units of the individual parameters when making your entries!

Furthermore you can use the MotorManager to edit motors already available. In addition, the import and export of motor data entities in XML format is supported.

Motor types supported

Compax3 supports the following motor types:

- ◆ Permanently excited synchronous rotary motors
- ◆ Permanently excited synchronous linear motors
- ◆ Asynchronous rotary motors

In general, rotary and linear motors do have the same signal flow chart. The difference consists solely in the basic physical values, which refer to circular movement resp. the linear motion laws of physics. For this, the following analogies can be established:

Rotary drive [unit]		Linear drive [unit]	
Travel x	[rev]	Path x	[m]
Mass moment of inertia J	[kgm ²]	Mass m	[kg]
Velocity n	[rps]	Velocity v	[m/s]
Angular velocity ω	[1/s]		
Torque constant K _t	[Nm/Arms]	Force constant K _F	[N/Arms]
Torque M	[Nm]	Force F	[N]

For reasons of clarity, we will in the following refer to the rotary motor, which will represent both drive types.

An asynchronous motor is set up in the same way as a synchronous motor. The only differences are varying motor parameters.

Changing the switching frequency and the reference point

The switching frequency and the reference point are activated in the ServoManager: "Motor reference point" wizard

A reference point differing from the nominal data may also be entered on the wizard page displayed above.

Please activate "activate changing the reference point", then you may enter the new reference velocity as well as the new reference current.

Motor reference point

A reference point differing from the nominal data may also be entered on the wizard page displayed above.

Please activate "activate changing the reference point", then you may enter the new reference velocity as well as the new reference current.

External Moment of Inertia

The external mass moment of inertia is set against the moment of inertia of the rotor to form the total moment of inertia. The total moment of inertia is used for the controller design.

If you do not know or have only a vague knowledge of the external mass moment of inertia, the mass inertia can be determined via the load identification.

Configuration of an unknown external mass inertia:

The load identification is activated in the ServoManager:

Wizard "External moment of inertia" "unknown: using default values".

The correct values can be determined later via the load identification!

Limit and Monitoring Settings

On the "limit and monitoring settings" wizard page, you can set among others the current and velocity limits in % of the nominal values. The nominal values are motor parameters resulting from the motor library or from shifting the reference point on the "motor reference point" wizard page.

Limit and Monitoring Settings wizard page:

Funktion	Wert	Einheit
Strom-Begrenzung	200	% In (= 5400 mA)
Positionsfenster	0.1	mm (10 % Umd)
Positionsfensterzeit	0	ms
Fehlerreaktion Schleppfehler (0x7320)	Abrampen, Stromlos schalten	
Schleppfehler (+/-)	1	mm (100 % Umd)
Schleppfehlerzeit	0	ms
Max. Betriebsdrehzahl	100	% von nN = 3000.0 (1/min)

1: Current (Torque) Limit

2: Velocity limit

Asynchronous motors

In this chapter you can read about:

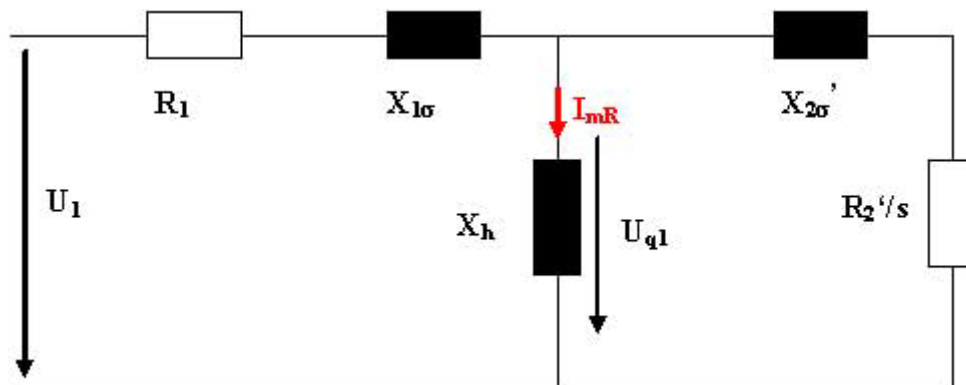
Type specification plate data	190
Replacement switching diagram - data for a phase.....	191
Slip Frequency.....	191
Saturation behavior.....	192
Cut-off frequency for the field weakening range	192
Rotor time constant.....	193
Determination of the commutation settings	193
Asynchronous motors: Extension of the controller structure	193

Type specification plate data

On the 2nd. wizard page of the Compax3 MotorManager, the type specification plate data must be entered.

Replacement switching diagram - data for a phase

This data can be obtained from the manufacturer or be determined by measurement.



U1:	Nominal phase voltage
R1:	Stator leg resistance
$X1\sigma=2\pi fL1\sigma$:	Leak reactance (for f=50Hz mains frequency)
$L1\sigma$:	Stator leakage inductance
$Xh=2\pi fLh$:	Main reactance (for f=50Hz mains frequency)
LH:	Main field inductance
$X2\sigma'=2\pi fL2\sigma$:	Referenced leak reactance (for f=50Hz mains frequency)
$L2\sigma$:	Rotor leak inductance
$R2'$:	Referenced carriage resistance
I_{mR} :	Magnetization Current

Slip Frequency

The slip frequency is stated in [Hz electrical] or in [%] and can be determined as follows

$$f_2[\text{mHz (electrical)}] = (f_s \cdot 60 - N_{\text{Nenn}} \cdot \frac{P}{2}) / N$$

$$f_2[\text{mHz}(el.)] = \frac{f_s \cdot 60 - N_{\text{Nenn}} \cdot \frac{P}{2}}{f_s \cdot 60} \cdot f_s \cdot 1000 = \left(f_s - N_{\text{Nenn}} \cdot \frac{P}{120} \right) \cdot 1000$$

$$f_2[\text{Promille}] = \frac{f_s \cdot 60 - N_{\text{Nenn}} \cdot \frac{P}{2}}{f_s \cdot 60} \cdot 1000$$

$$\frac{f_s \cdot 60 \cdot 2}{N_{\text{Nenn}}}$$

Whereas P = value before the point of the term è

f_s : Synchronous nominal frequency (dimensioning base)

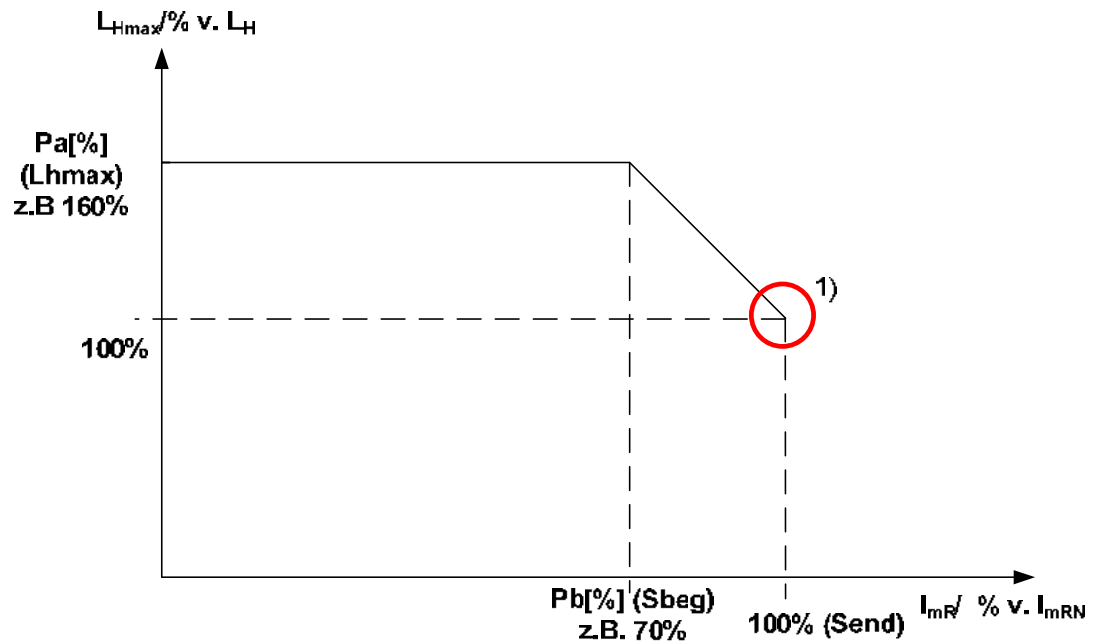
N_{Nominal} : Nominal speed in rpm

f_2 : Slip frequency in mHz (electrical)

Saturation behavior

The saturation of the main field inductance can be considered with the help of the following characteristic.

Activate the "consider saturation values" checkbox.



1) Nominal point in the basic speed range

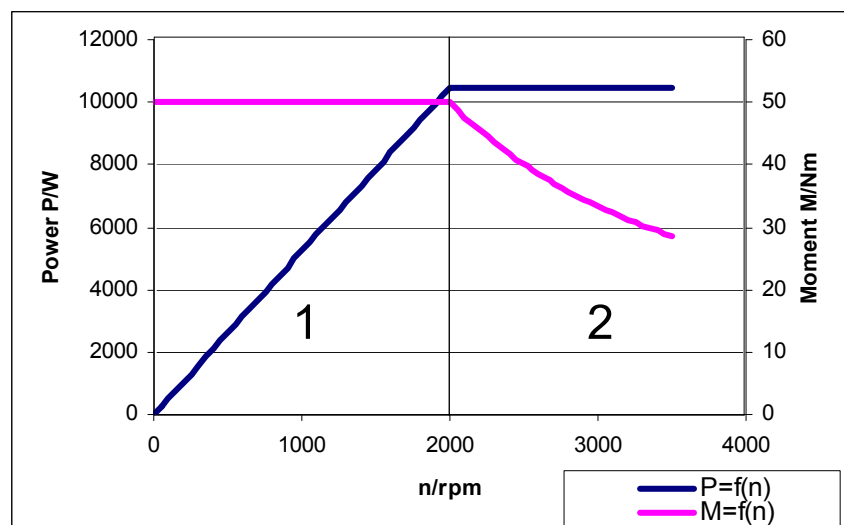
L_{hmax} : max. main field inductance

S_{beg} : Beginning of Saturation

S_{end} : End of Saturation

Cut-off frequency for the field weakening range

The statement of the cut-off speed defines the beginning of the field weakening operation. From the cut-off speed on, the magnetization current and thus the force constant of the motor are reduced inversely proportional to the speed; the motor is operated in the field weakening range. In the field weakening range, the shaft power produced remains constant.



1: Basic speed range

2: Field weakening range

Rotor time constant

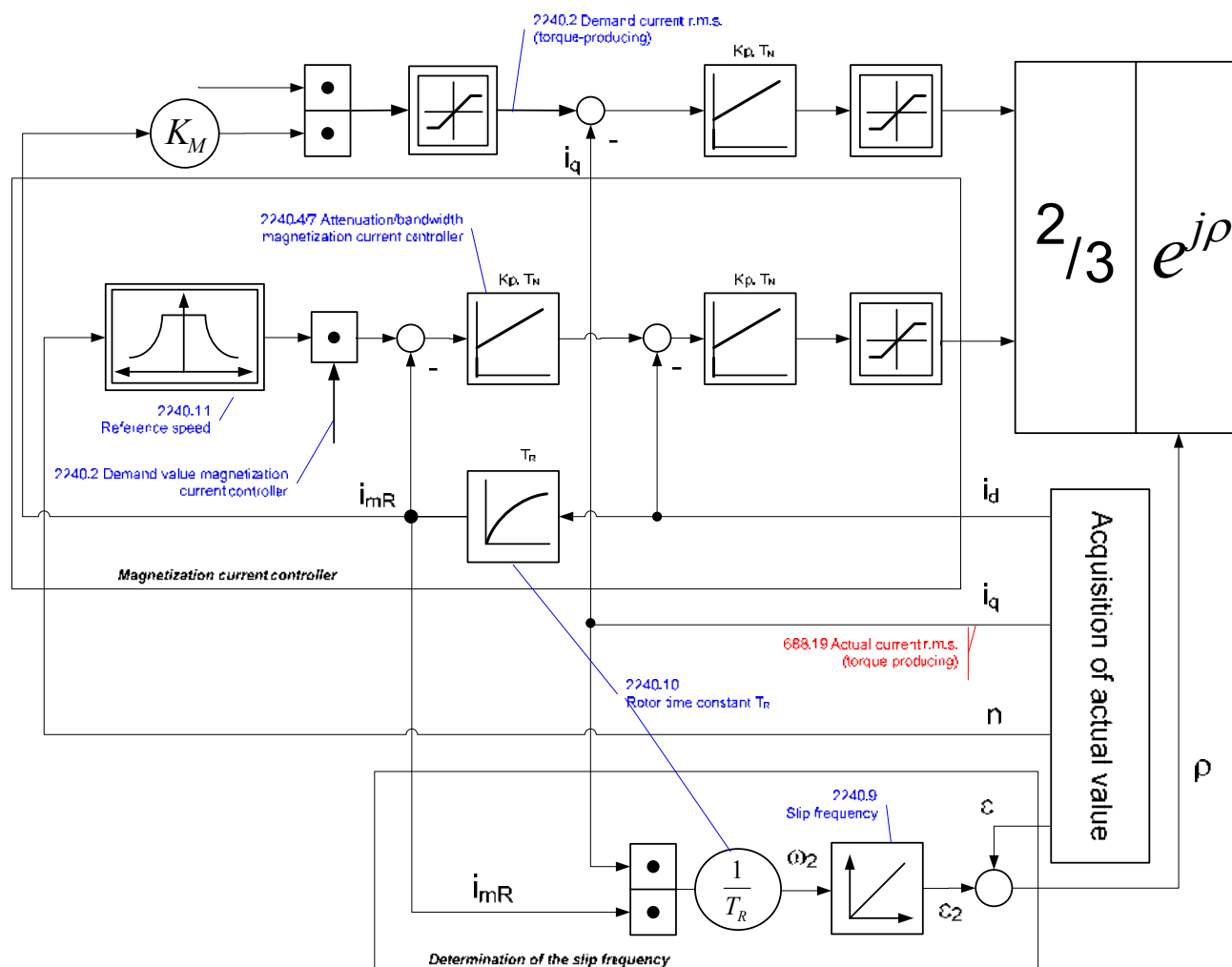
If the value of the rotor time constant is not known, it can be approximated automatically.

Determination of the commutation settings

On the last wizard page of the Compax3 MotorManager, the commutation settings (feedback direction reversal and commutation direction reversal) can be determined automatically.

Asynchronous motors: Extension of the controller structure

Structure of the magnetization current controller and determination of the slip frequency:



4.4.3.3 Automatic controller design

In this chapter you can read about:

Dynamics of a control	194
Cascade control	200
Stiffness	201
Automated controller design	204
Controller coefficients	205

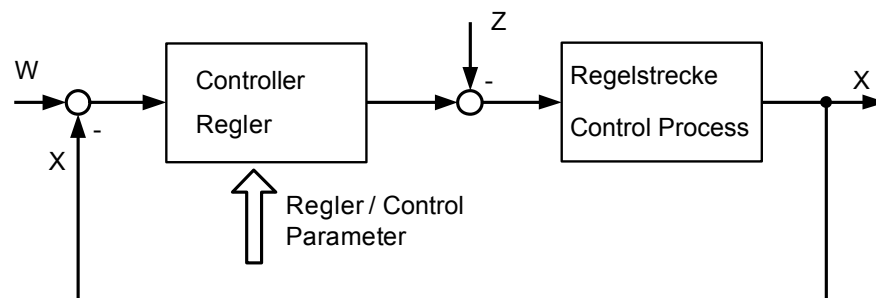
Dynamics of a control

In this chapter you can read about:

Structure of a control	194
Oscillating plant	194
stability, attenuation	195
Velocity, bandwidth	196
Setpoint and disturbance behavior of a control loop	198
response	200
Limitation behavior	200

A change in the input value of a dynamic transmission element causes a change of its output value. The change of the output value is however not immediately effective, but takes a certain time, the transient response. The course of the transient response is characteristic for certain kinds of transmission behavior. For this reason, a complete description of the transmission properties of a control comprises the stationary behavior (all setpoint, actual and disturbance values in settled state), as well as the dynamic behavior.

Structure of a control



The basic task of a control is the generation and maintaining of a desired state or sequence in spite of interfering disturbances. It is essential that the effects of the disturbances are balanced with the correct force and at the correct time. In the above figure, the setpoint value W represents the desired state and the disturbance value Z represents the interfering disturbance. The actual value X represents the generated and maintained state.

Oscillating plant

Oscillating control paths are control paths that respond with attenuated or unattenuated oscillation to an abrupt change in the setpoint value. Part of this class are for instance:

- ◆ Linear actuators with toothed belts, as a toothed belt represents an elasticity.
- ◆ A mechanic shaft with an external mass moment of inertia, as the shaft represents an elasticity due to its torsional properties.

In general this kind of elasticity is due to a high ratio between $J_{\text{Load}}/J_{\text{Motor}}$, as the shaft is normally not designed for this high external load and which may lead to a considerable distortion.

stability, attenuation

In this chapter you can read about:

Stability problem in the high-frequency range: 195

Stability problem in the low-frequency range: 195

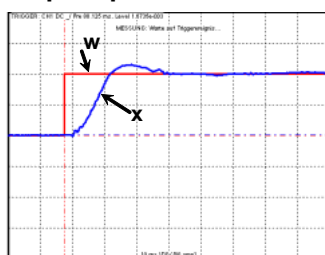
In general, two stability problems may occur in a servo drive control:

Stability problem in the high-frequency range:

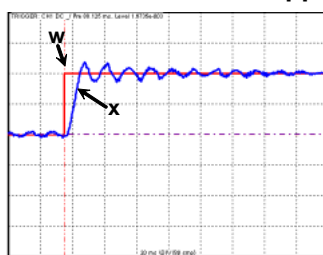
The "control structure" figure shows that the reverse effect in the control loop (negative feedback) is a prerequisite for the functioning of a control system. Due to the delay in signal transmission, the effect of the negative feedback is diminished or even compensated. The reason is that the corrective measures of the controller are also delayed in the event of delayed signal transmission. This results in a typical oscillating course of the control variable. In the worst case, the deviation of the control variable and the effect of the corrective measures get in phase, if the delays reach a defined value. The negative feedback passes into positive feedback. If the product of the gain factors of all control loop components is higher than 1, the oscillation amplitude will continually rise.

In this case the control loop is unstable. In the total gain of 1 the oscillation keeps its amplitude and the control loop is within the limits of stability. The transient response can be characterized by the attenuation and the transient time (velocity).

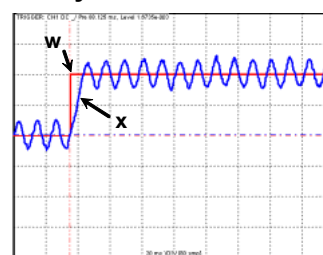
Step response of a stable controller and of a controller approaching the stability limit



Stable
Well attenuated



Stable
Poorly attenuated



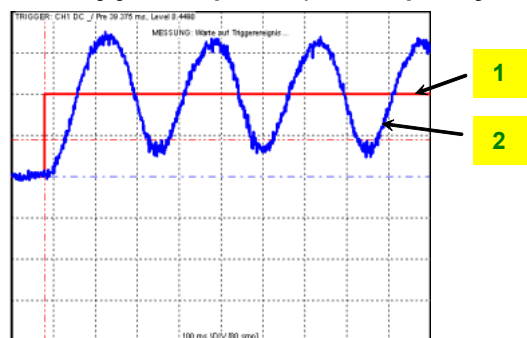
Stability limit
not attenuated

W: Setpoint value
x: Actual value

Stability problem in the low-frequency range:

In this case the controller was set for a very inert control path, while the actual control path is much more dynamic. The controller reacts to a disturbance variable with a much too strong corrective measure so that the disturbance variable is overcompensated and even an increasing oscillation may be the result. In this case the mechanic system of the control path may be destroyed.

Velocity jerk response (low-frequency stability limit)



1: Setpoint speed value
2: Actual speed value

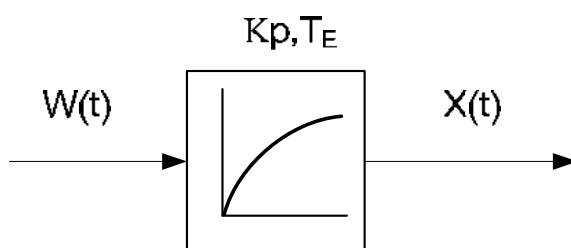
Velocity, bandwidth

In this chapter you can read about:

P-TE - Symbol	196
Jerk response of a delay component	196
Approximation of a well-attenuated control loop	196
Frequency response of the P-TE component (value and phase)	198

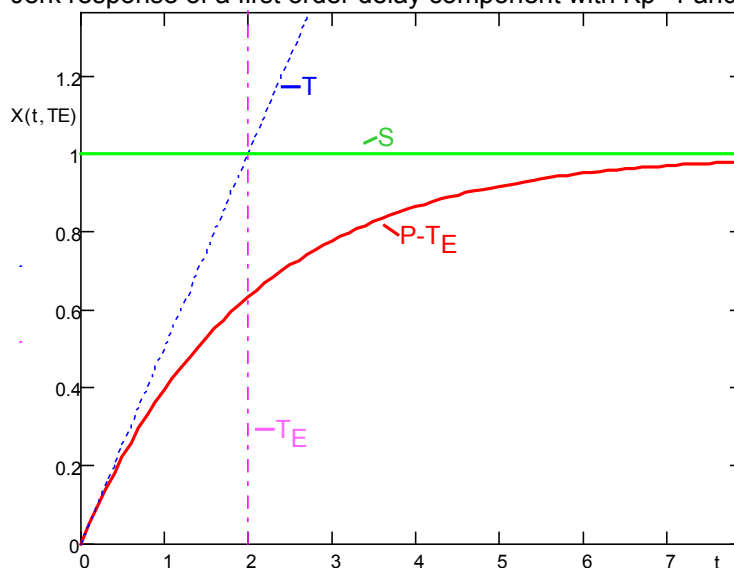
A well attenuated control loop can, under certain conditions, be approximated in order to simplify the controller design with a first order delay component (P-TE component) with the replacement time constant T_E and the total gain K_p . A P-TE component represents a first order delay component and is a simple dynamic basic component.

P-TE - Symbol



Jerk response of a delay component

Jerk response of a first order delay component with $K_p=1$ and $T_E=2.0s$



T: Tangent

S: Input jerk

P-TE: Output value of the P-TE component

T_E : Time constant of the P-TE component

The definition of the delay time constant is displayed in the above figure. The time of intersection of the tangent and the jerk function itself is by definition the delay time constant (called filter time constant for filters) of a P-TE component. At this point in time the value of the jerk response is approx. 63% of the final value. In practice the jerk response corresponds, for instance, to the voltage charge curve of a capacitor.

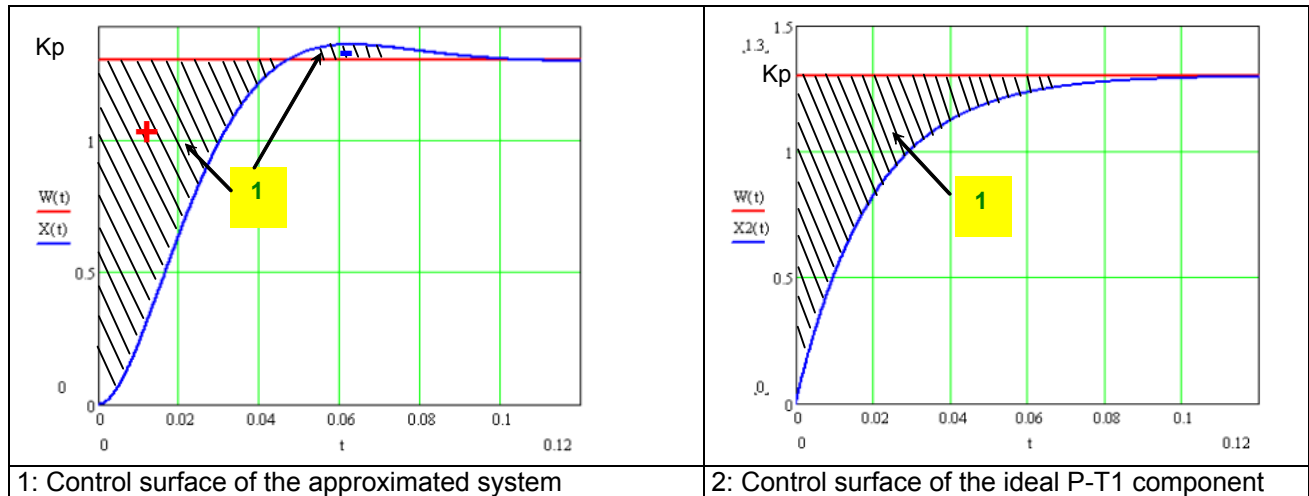
Approximation of a well-attenuated control loop

The approximation of a well-attenuated control loop is based on the sameness of the control surface of the ideal first order delay component (P-T1 component) and the approximated system (P-TE component).

The control surface is a measure for the velocity of a system and is defined in the following figure. If the surface of the approximated system corresponds to the

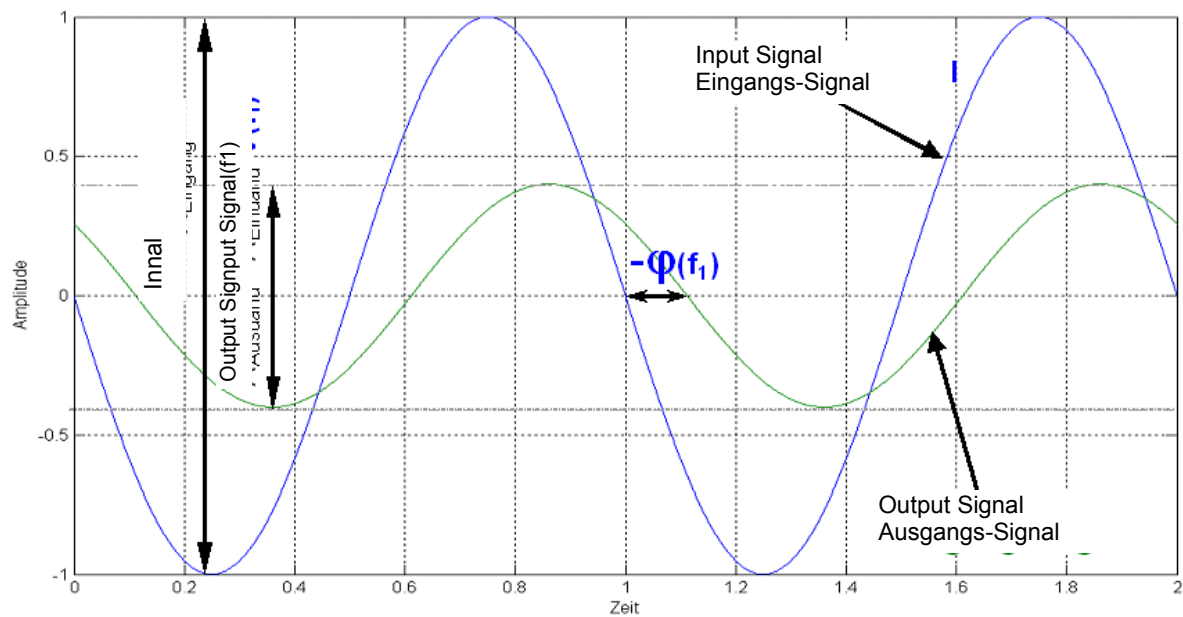
surface of the ideal system, the approximated system can be described, up to a certain frequency, with the transmission function of the P-T1 component.

Determination of the control surface from the transmission behavior of a P-TE component.



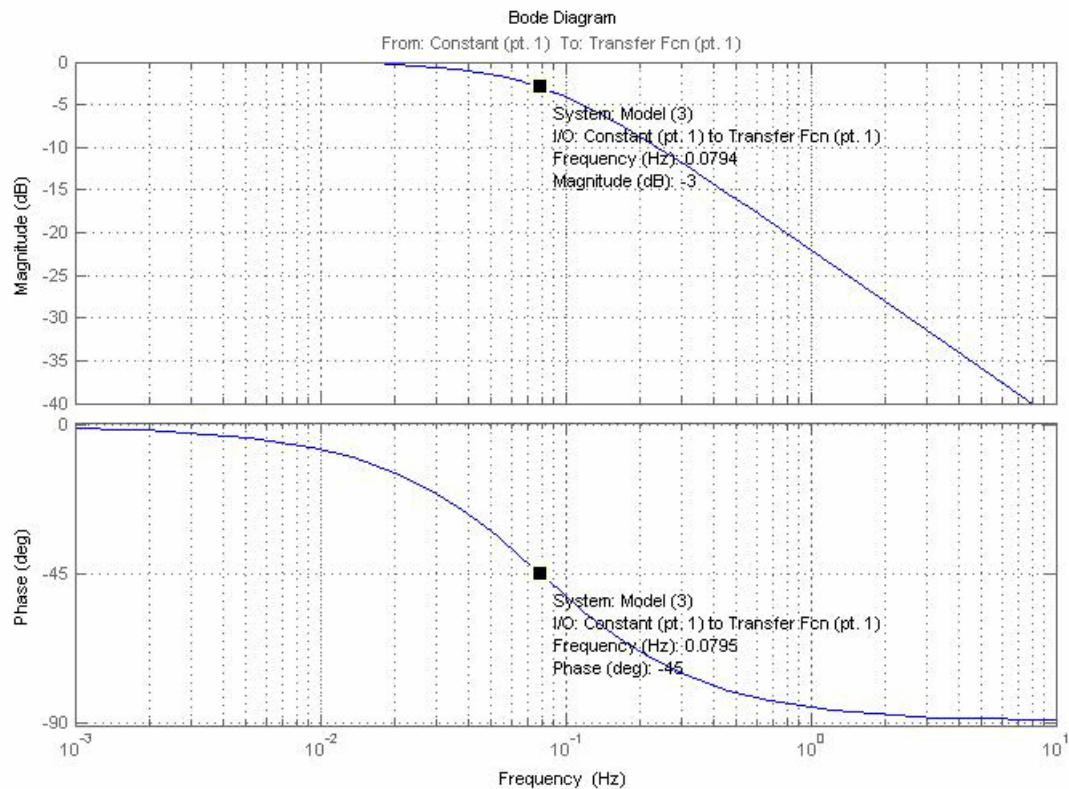
The velocity of a dynamic system can also be described in the frequency range. In the frequency range, the system behavior is analyzed to sinusoidal inputs signals of different frequencies (frequency response).

Input and output signals of a dynamic transmission component at a defined frequency $f=f_1$



The bode diagram represents the behavior of a dynamic system (in our case of the P-TE component) against the input signal frequency with respect to amplitude and phase.

Frequency response of the P-TE component (value and phase)



$$f_0 = \frac{1}{2\pi \cdot T_E} = 0,0795 \text{ Hz}$$

The cut-off frequency is the frequency where the input signal is attenuated by 3dB (-3dB attenuation). The phase shift between the output and the input is -45° at this frequency. Precisely this cut-off frequency is called the bandwidth of a control loop.

Setpoint and disturbance behavior of a control loop

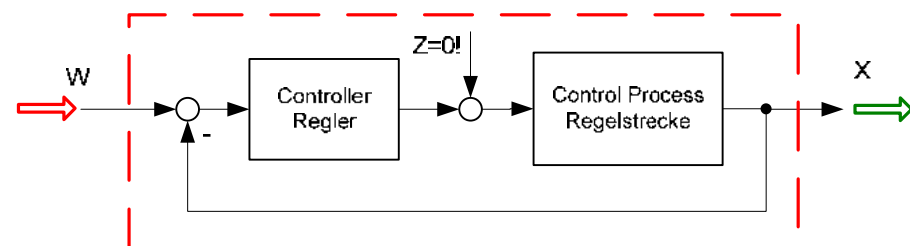
In this chapter you can read about:

Demand behavior	198
Disturbance behavior	199
Test functions	199
Characteristics of a control loop setpoint response	199

The setpoint behavior is the behavior of the control loop for the setpoint variable W . We assume that the disturbance variable $Z=0$.

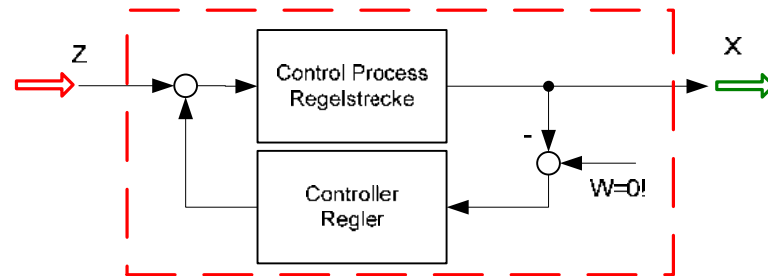
The disturbance behavior describes the behavior of the control loop for disturbance variable Z . In this case, we assume, in analogy to the setpoint behavior, that the setpoint variable $W=0$.

Demand behavior



W: Setpoint value
 X: Actual value
 Z: Disturbance variable

Disturbance behavior

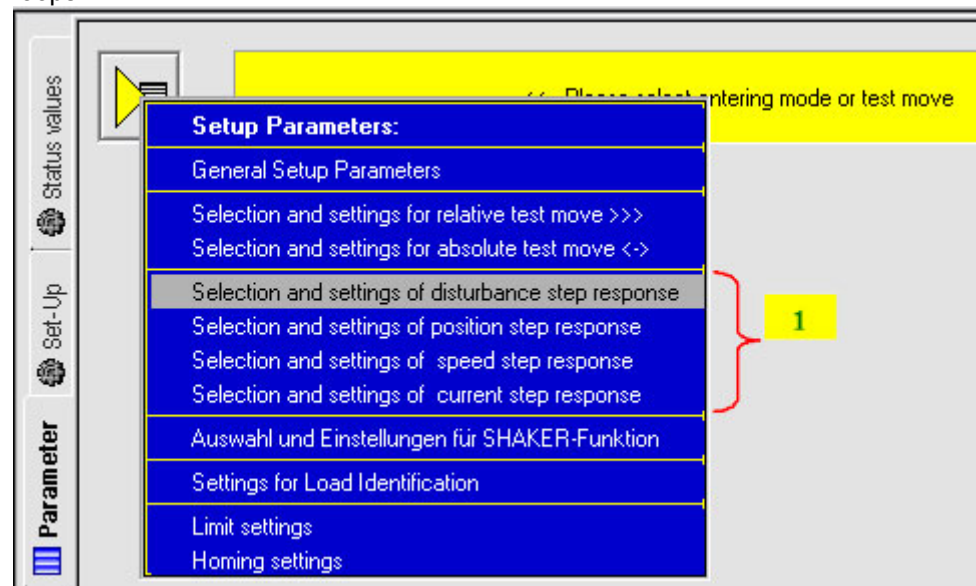


W: Setpoint value
 X: Actual value
 Z: Disturbance variable

In order to examine the disturbance and setpoint behavior, the Compax3 setup software offers 4 jerk functions.

Test functions

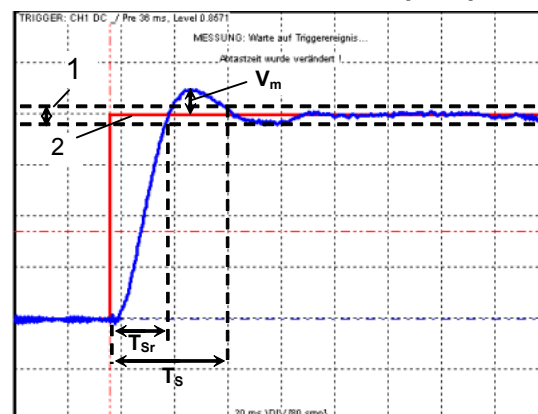
Test functions for the analysis of disturbance and setpoint behavior of the control loops



1: 4 jerk functions

The properties of the setpoint behavior of the velocity controller can be acquired from the velocity jerk response.

Characteristics of a control loop setpoint response

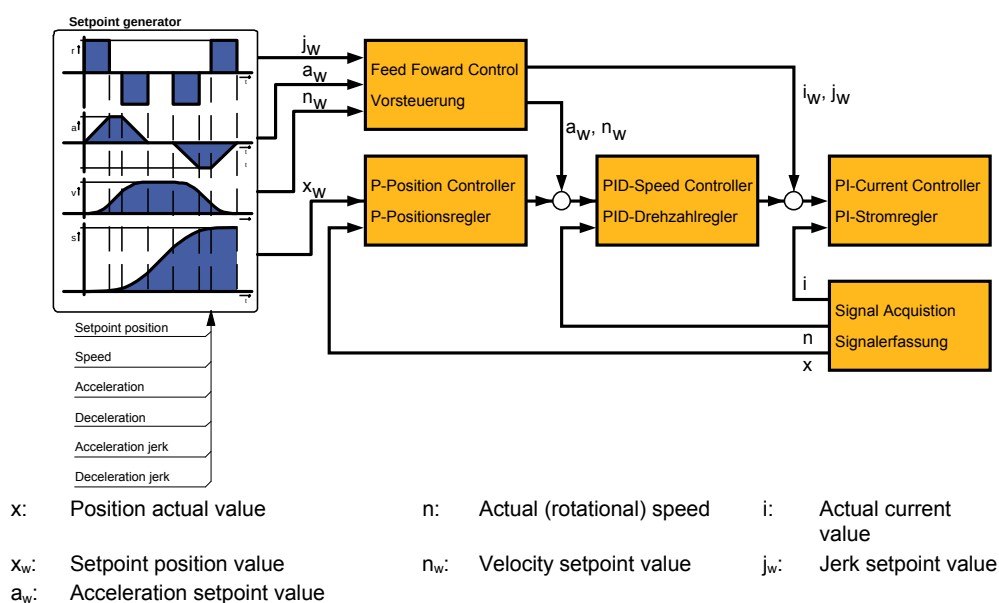


T_{sr} :	Response time. (Time elapsing until the control variable reaches one of the $\pm 5\%$ tolerance limits for the first time)
T_s :	Settling time. (Time elapsing until the control variable ultimately enters the $\pm 5\%$ range)
V_m :	maximum overshoot width
1	Tolerance range $\pm 5\%$
2	Setpoint value

response

The response of the controller is the behavior of the actual value with respect to the calculated profile of the setpoint generator. the kinematic status variables, speed, acceleration and jerk are fed into the cascade as feedforward signals. The feedforward signals work with calculated factors and contribute to an improved contour constancy due to the minimization of the following error.

Compax3 servo controller structure



Limitation behavior

Each control variable is limited by the control (actuating) element. If the control variable demanded by the controller is within the linear range (without limitation), the control loop shows the behavior defined by the design. If the controller demands however a higher control variable than permitted by the limitation, the control variable is limited and the controller slows down.

Hint You should therefore make sure that the control variable (output) of the controller does not remain within the limitation or only for a very short time.

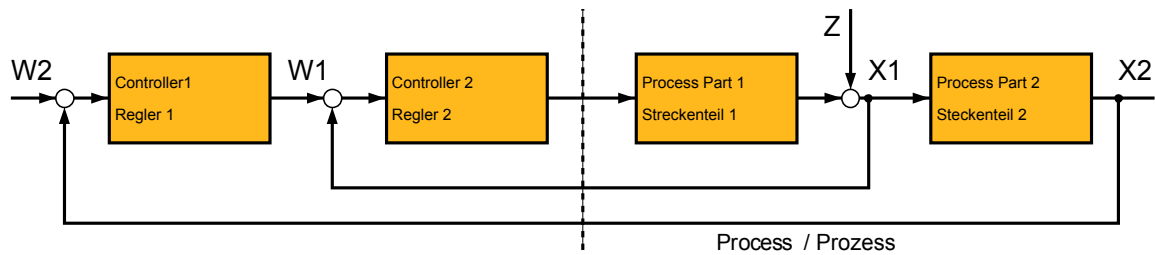
Cascade control

In this chapter you can read about:

Structure of a cascade control	201
Cascade structure of Compax3	201

In drive technology, a cascading structure with several controllers (normally 3) is often used. This improves the control behavior. For this, additional sensors must be fixed within the control path. You will get the structure of a cascade control.

Structure of a cascade control



W1 Setpoint value (setpoint) for the superposed controller 2

W2 Setpoint value (setpoint) for the subordinate controller 1

X2: Actual variable (actual value) for controller 2

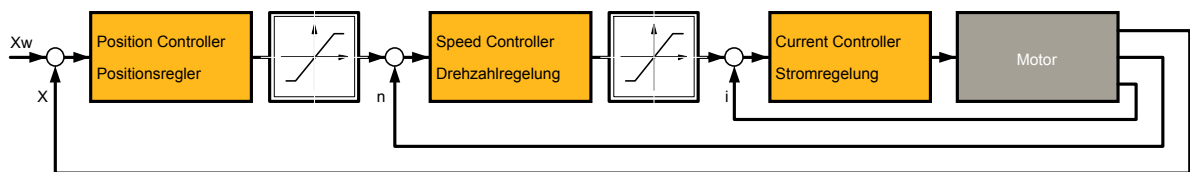
X1: Actual variable (actual value) for controller 1

The cascade control offers the following advantages:

- ◆ Disturbances occurring within the control path, can be compensated in the subordinate control loop. Therefore they must not pass through the entire control path and are therefore compensated earlier.
- ◆ The delay times within the path can be reduced for the superposed controller.
- ◆ The limitation of the intermediate variables can be made by the control variable limitation of the superposed controller rather easily.
- ◆ The effects of the non-linearity for the superposed controllers can be reduced by the subordinate control loops.

In the Compax3 servo controller, a triple cascade control is implemented with the following controllers - position controller, velocity controller and current controller.

Cascade structure of Compax3



Stiffness

In this chapter you can read about:

Static stiffness.....	201
Dynamic stiffness.....	202
Correlation between the terms introduced.....	203

The stiffness of a drive represents an important characteristic. The faster the disturbance variable can be compensated in the velocity control path and the smaller the oscillation caused, the higher the stiffness of the drive. With regard to stiffness, we distinguish static and dynamic stiffness.

Static stiffness

The static stiffness of a direct drive is comparable with the spring rate D of a mechanical spring, and indicates the excursion of the spring in the event of a constant interference force. It is the ratio between the constant force F_{Dmax} of the motor and a position difference. Due to the I term in the velocity controller, the static stiffness is therefore infinitely high in theory, as the I term is integrated until the control difference vanishes. In a digital control the static stiffness is above all limited by the finite resolution of the position signal (the error must be at least one quantization step, so that it can be detected by the reading system) and by numerical resolution. Additional effects are for instance mechanical stiffness of the mechanic components in the control path (e.g. load connection, guiding system) as well as measurement errors of the measurement system.

Dynamic stiffness

In this chapter you can read about:

Traditional generation of a disturbance torque/force jerk	202
Electronic simulation of a disturbance torque jerk with the disturbance current jerk	202
Disturbance jerk response	203

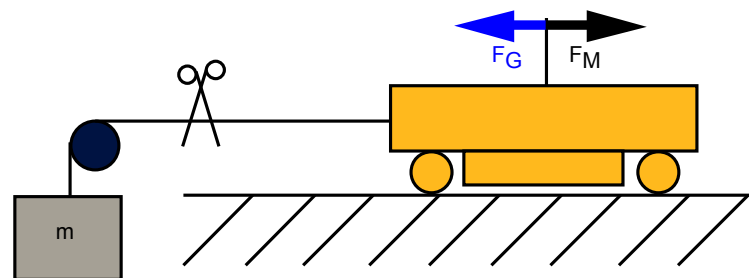
The dynamic stiffness is described by the ratio between the change in load torque or in load force and the resulting position deviation (following error):

$$\frac{-\Delta M_L}{\Delta x}$$

The higher this ratio (=dynamic stiffness), the higher the necessary change in load torque in order to generate a defined following error.

The dynamic stiffness can be acquired from the disturbance jerk response.

Traditional generation of a disturbance torque/force jerk

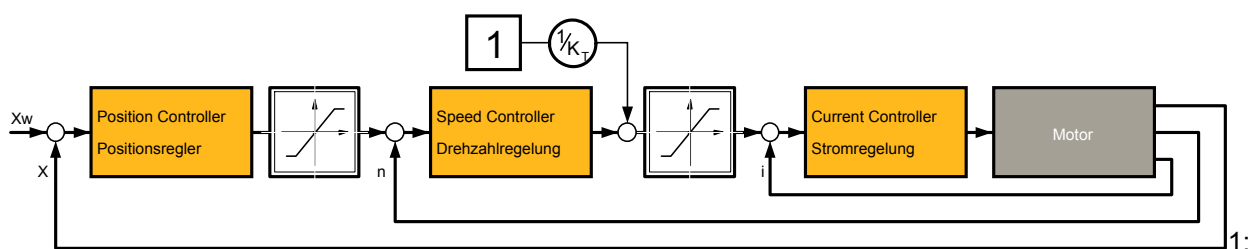


In settled state of the control, the motor force F_M corresponds exactly to the load force $F_G = m \times g$.

If the cord is cut through, the load force is eliminated abruptly and the controller must first of all settle to the new situation.

In order to simulate this load jerk electronically, a disturbance current jerk is fed to the Compax3 as a variable proportional to the disturbance torque at the velocity controller output.

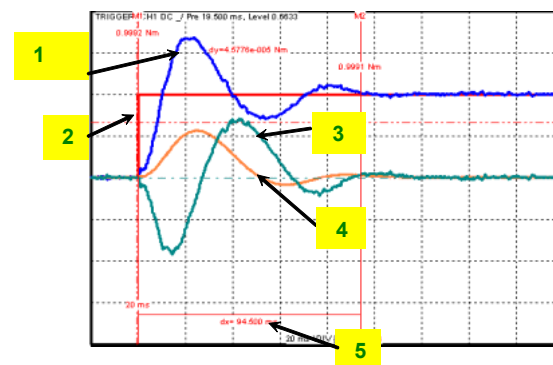
Electronic simulation of a disturbance torque jerk with the disturbance current jerk



Feeding in of a disturbance current jerk, which corresponds to a disturbance torque jerk.

The maximum amplitude and the settling time of the following error decline with rising dynamic stiffness. The settling behavior of the following error is furthermore a measure for the attenuation and the bandwidth of the control.

Disturbance jerk response



- 1: Compensation torque of the controller
- 2: Simulated disturbance torque
- 3: Actual speed
- 4: Following error
- 5: Settling time

Correlation between the terms introduced

The introduced terms:

- ◆ stability
- ◆ Attenuation
- ◆ velocity
- ◆ bandwidth
- ◆ setpoint and disturbance behavior
- ◆ Control variable limitation
- ◆ Replacement time constant
- ◆ Stiffness

are related as follows:

- ◆ A well-attenuated control features a stable control behavior.
- ◆ The velocity of a control loop is a measure for the reaction rate of the controller to the disturbance variable (disturbance behavior) as well as to the setpoint variable (setpoint behavior).
- ◆ The faster the control, the higher its bandwidth.
- ◆ The term replacement time constant is an approximation and is only valid in a defined scope¹. In this scope, the control is always stable and well-attenuated.
- ◆ If the controller does not work in the linear range, but the control variable of the controller is within the limitation, the control slows down and the control difference rises.
- ◆ The stiffness represents the bandwidth of the velocity control. The higher the stiffness value of the velocity control, the higher the bandwidth of the velocity controller and the stiffer the drive.

Automated controller design

In this chapter you can read about:

Jerk response of the velocity loop depending on the optimization parameter "attenuation" and "stiffness"	204
D-term	205
Position loop	205

The controller design takes place after the configuration immediately before the configuration download into the device. The controller coefficients are preassigned according to the design method of cross-ratios so that a stable control is achieved. The automatic, robust controller design calculates the P and I terms of the individual controllers (current, velocity, position) on the basis of the configured motor and application parameters.

Please observe: Faulty motor and application parameters may lead under certain circumstances to instable controllers.

The controller parameters are not directly available for the optimization. Instead, they can be changed with the aid of the following optimization parameters:

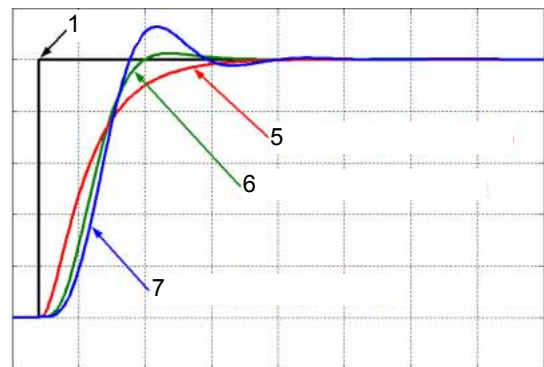
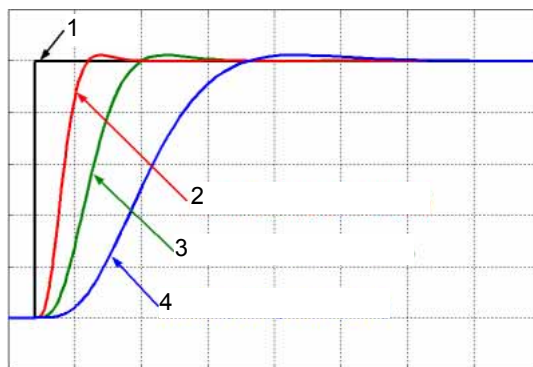
Optimization of the current controller dynamics:	◆ Current loop bandwidth in % ◆ "Attenuation of current loop" in %
Optimization of the velocity loop dynamics:	◆ "Stiffness" in % ◆ "Attenuation" in % ◆ Velocity loop - "D" term in %

The bandwidth parameter states the actually effective % of the calculated default velocity. The default bandwidth of the controller is fixed to approx. $f_{GR}=531\text{Hz}$. In reverse this signifies that each motor delivers the same jerk response. The prerequisite is, of course, that you keep out of the control signal limitation (voltage limitation). The attenuation characterizes the controller's tendency to oscillate with respect to an excitation signal (see below). The stiffness (of the velocity loop, corresponds to the bandwidth of the current loop) describes the velocity of the velocity loop (see below).

Jerk response of the velocity loop depending on the optimization parameter "attenuation" and "stiffness"

Attenuation = 100%

Stiffness = 100%



- 1: Setpoint value
- 2: Actual value (stiffness = 200%)
- 3: Actual value (stiffness = 100%)
- 4: Actual value (stiffness = 50%)
- 5: Actual value (attenuation = 500%)
- 6: Actual value (attenuation = 100%)
- 7: Actual value (attenuation = 50%)

D-term

The D-term parameter (of the velocity loop) activates existing control oscillations of drives with elastic coupling (e.g. toothed belt drives). The D-term is not automatically designed and must therefore be set manually.

Position loop

The position controller is automatically adapted depending on the stiffness of the velocity loop.

Controller coefficients**In this chapter you can read about:**

Velocity Loop "P" Term 205

D-term of the KD velocity controller 205

P-term KV position loop 205

Dependence of the controller coefficients from the optimization objects

The controller coefficients are influenced by the optimization objects such as "stiffness" and/or "attenuation". The dependency is displayed below.

I-term KI in the velocity loop

$$K_I = \frac{St[\%]}{100 \cdot T_{EGD}}$$

$$\Rightarrow K_I \sim St$$

T_{EGD} : the replacement time constant of the closed velocity loop.

St Stiffness

Velocity Loop "P" Term

$$K_{PV} = \frac{St[\%]}{100 \cdot T_{EGD}} \cdot \frac{Tm[\%]}{100} \cdot T_N \cdot \frac{100}{EMK[\%]} \cdot \frac{30 + 0,14 \cdot Dp[\%]}{20}$$

$$\Rightarrow K_{PV} \sim St \wedge K_{PV} \sim Tm / EMK \wedge K_{PV} = f_{LIN}(Dp)$$

T_{EGD} : the replacement time constant of the closed velocity loop.

T_N : The mechanical integration time constant of the motor.

$f_{LIN}()$: Linear function (straight) between attenuation and KPV

Tm Moment of Inertia

St Stiffness

Dp Attenuation

D-term of the KD velocity controller

$$K_D = \frac{Dterm[\%]}{100} \cdot K_{D\_100\%}$$

$$\Rightarrow K_D \sim Dterm$$

$KD\_100\%$ The defined 100% coefficient

:

Dterm D-term

P-term KV position loop

$$K_V = \frac{St[\%]}{100 \cdot T_{EGD}} \cdot \frac{20}{30 + 0,14 \cdot Dp[\%]} \cdot T_x$$

$$\Rightarrow K_V \sim St[\%] \wedge K_V = f_{LIN}(1/Dp[\%])$$

T_{EGD} :	the replacement time constant of the closed velocity loop.
T_X :	The position integration time constant of the motor.
St	Stiffness
Dp	Attenuation
$f_{LIN}()$:	Linear function (straight) between 1/attenuation and KV

4.4.3.4 Setup and optimization of the control

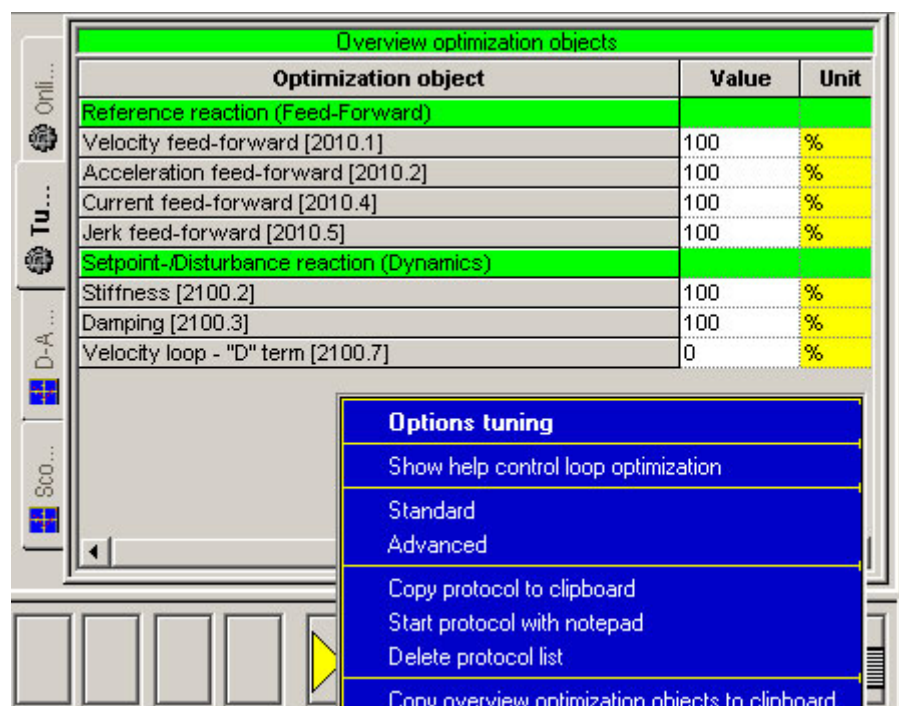
In this chapter you can read about:

Standard	207
Advanced	214
Commissioning window	229
Proceeding during controller optimization	231

For the setup and optimization of the control loops, the optimization window is available.

The Compax3 control functionality is divided into 2 sections, standard and advanced; the advanced functionality does however incorporate the entire standard functionality. The switching can be made in the optimization window.

Switching between standard and advanced

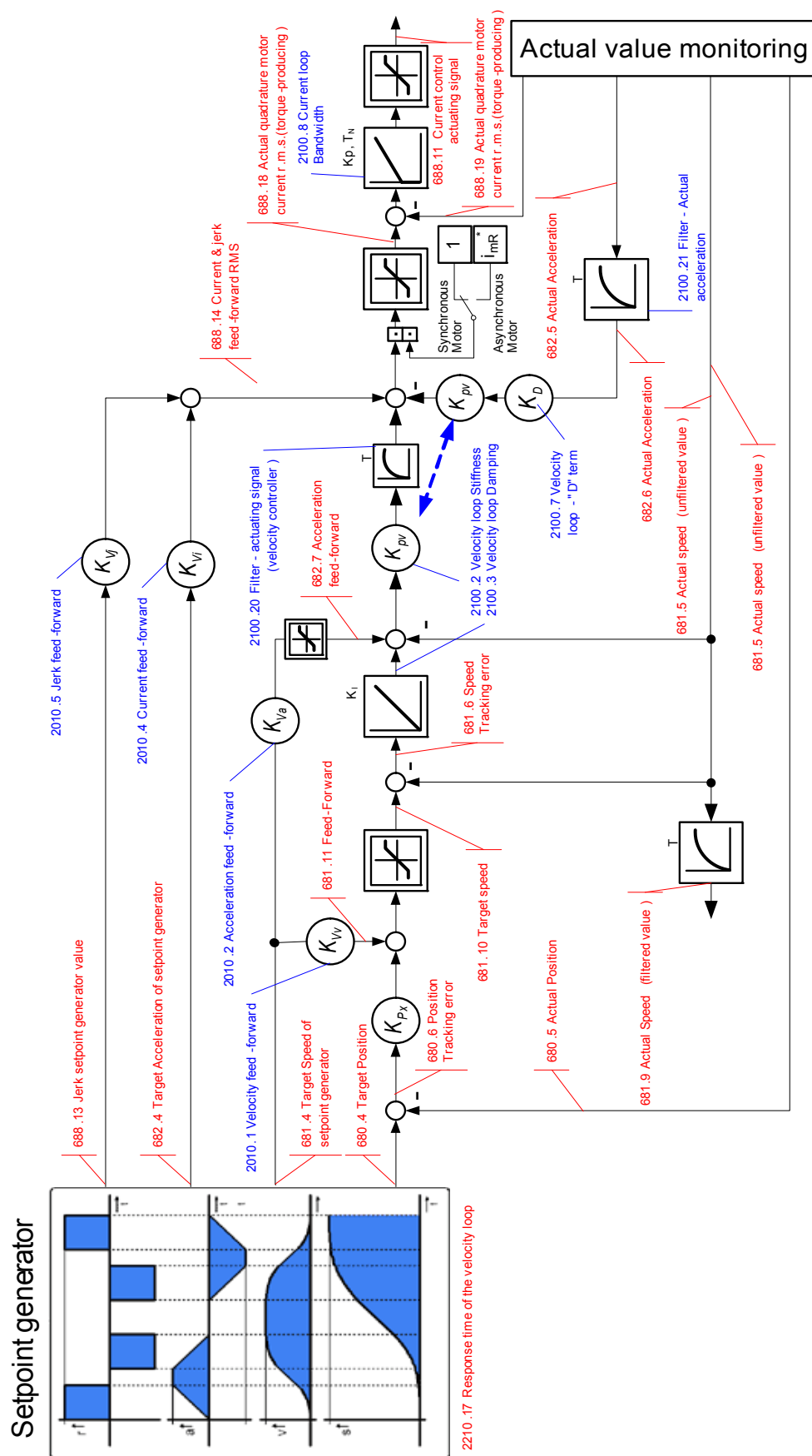


Standard

In this chapter you can read about:

standard cascade structure	208
Standard optimization parameters	209
Control signal limitations	209
Feedforward channels	211
Control signal filter / filter of actual acceleration value	213

standard cascade structure



During external setpoint specification, please respect the structure images for electronic cams or gearboxes for **signal filtering with external setpoint specification** (see page 240) !

Symbol	Description
	Proportional term signal is multiplied with K_p
	First order delay component (P-T1 component)
	Integration block (I-block)
	PI-block
	Limitation block (signal limitation)
	Notch filter (band elimination filter)
	Addition block
blue description	Optimization objects (simple pointer line)
red description	Status objects (pointer line with vertical stroke)

Standard optimization parameters

Overview optimization objects		
Optimization object	Value	Unit
Reference reaction (Feed-Forward)		
Velocity feed-forward [2010.1]	100	%
Acceleration feed-forward [2010.2]	100	%
Current feed-forward [2010.4]	100	%
Jerk feed-forward [2010.5]	100	%
Setpoint-/Disturbance reaction (Dynamics)		
Stiffness [2100.2]	100	%
Damping [2100.3]	100	%
Velocity loop - "D" term [2100.7]	0	%

The above figure shows the parameters for the standard group. With the aid of these parameters, you can optimize the standard cascade structure.

Control signal limitations

In this chapter you can read about:

Limitation of the setpoint velocity	210
Limitation of the setpoint current	210
Limitation of the control voltage	210

The cascade structure shows that a limitation block is available in the control signal sector of each controller. The limitations of the position and velocity loops are calculated from the set limitations in the configuration and the motor parameters of the selected motor.

Limitation of the setpoint velocity

Limitation of the setpoint velocity in the control signal sector of the position loop:
This limitation value is calculated from the maximum mechanical velocity of the motor and the set value in the configuration in % of the nominal velocity. The smaller of the two values is used for the limitation.

Example

MotorManager

maximum mechanical velocity of the motor:	$n_{\max}=3100\text{rpm}$
Rated speed of the motor:	$n_N=2500\text{rpm}$

C3 ServoManager

Maximum Operating Speed:	$n_{b\max}=200\%$ of n_N $\Rightarrow 5000\text{rpm}$

Velocity limitation value = **3100rpm**
 $\text{MIN}(n_{\max}, n_{b\max} * n_N / 100) =$

Limitation of the setpoint current

Limitation of the setpoint current in the control signal sector of the velocity loop:
This limitation value is calculated from the device peak current, the pulse current of the motor and the set value in the configuration in % of the nominal current. The smaller of the three values is used for the current limitation.

Example

Device

C3 S063 V2 F10 T30 M00 device peak current:	$I_{G\max}=12.6\text{A}_{\text{rms}}$

MotorManager

Rated current of the motor:	$I_N=5.5\text{Arms}$
Peak Current:	$I_{\text{imp}}=300\%$ I_N $\Rightarrow 16.5\text{A}_{\text{rms}}$

C3 ServoManager

Current (Torque) Limit:	$I_{b\max}=200\%$ of I_N $\Rightarrow 11\text{A}_{\text{rms}}$

Current limitation value = **11A_{eff}**
 $\text{MIN}(I_{G\max}, I_{\text{imp}} * I_N / 100, I_{b\max} * I_N / 100) =$

Limitation of the control voltage

Limitation of the control voltage in the control signal sector of the current loop:
This limitation is fixed and cannot be influenced by the user. The limitation value depends on the DC voltage of the device.

Please note!

In the event of highly dynamic motion cycles it is necessary to make sure not to enter the control signal limitation (or, if so only for a very short time) as the drive is then not in the position to follow the set dynamics due to the slow drive physics and the limited control signal range.

Feedforward channels

In this chapter you can read about:

Influence of the feedforward measures	211
Motion cycle without feedforward control	212
Motion cycle with feedforward measures	212

The feedforward channels are used for the specific influence of the guiding behavior of a control. The calculated and evaluated status variables are coupled into the corresponding places within the controller cascade. In practice, the feedforward control offers the following advantages:

- ◆ Minimal following error
 - ◆ Improves the transient response
 - ◆ Gives greater dynamic range with lower maximum current
- The Compax3 servo controller disposes of four feedforward measures (see in the standard cascade structure):

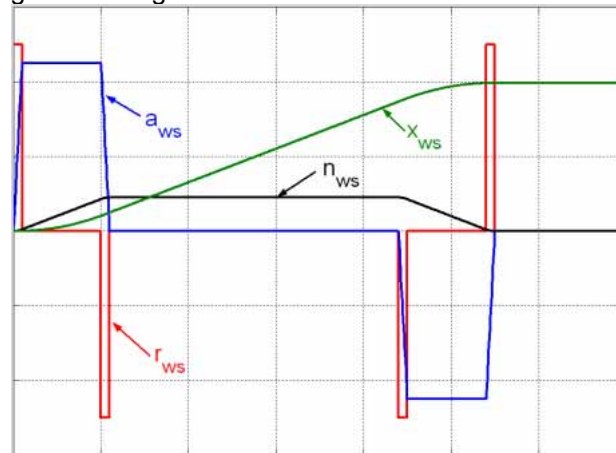
- ◆ Velocity feed-forward
- ◆ Acceleration feed-forward
- ◆ Current feed-forward
- ◆ Jerk feed-forward

The above order represents at the same time the effectiveness of the individual feedforward measures. The influence of the jerk feedforward may be, depending on the profile and the motor, negligibly small.

Please note! But the principle of feedforward control fails in limiting the motor current or the motor speed during the acceleration phase!

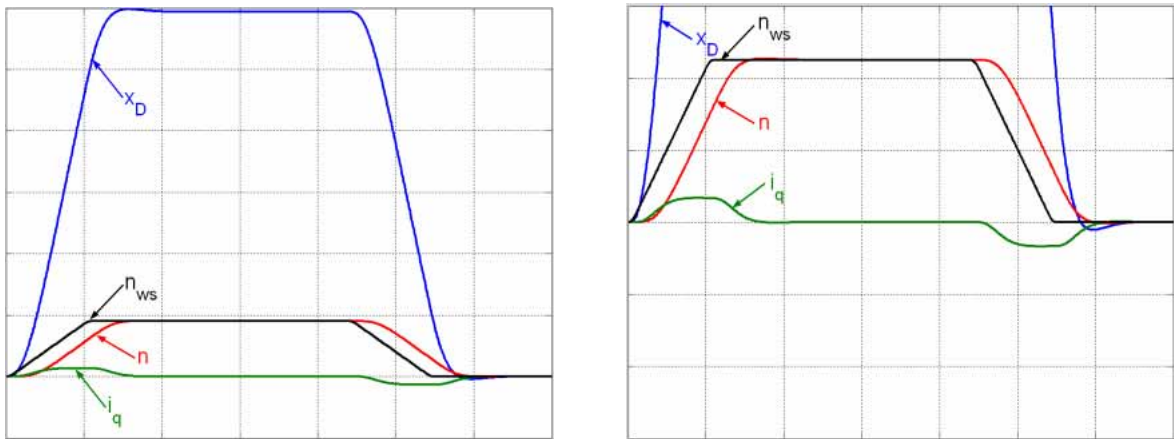
Influence of the feedforward measures

Following error minimization by feedforward control / course of the setpoint generator signals



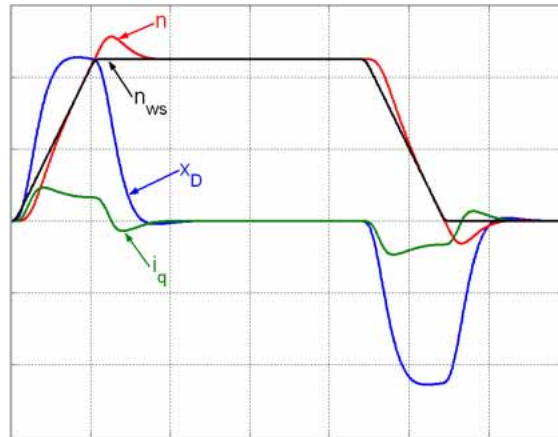
xws:	Position setpoint value of the setpoint generator
nws:	Velocity setpoint - setpoint generator
aws:	Acceleration setpoint value setpoint generator
rws:	Jerk setpoint value setpoint generator

Motion cycle without feedforward control

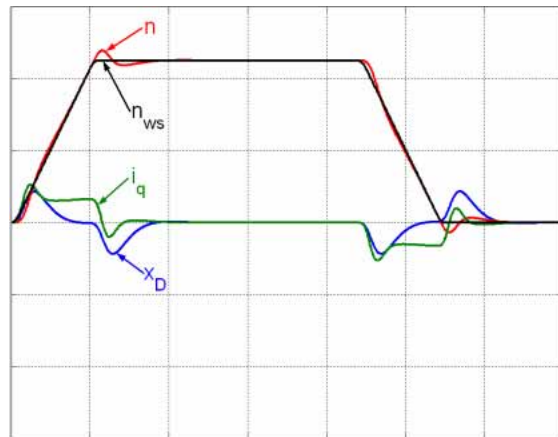


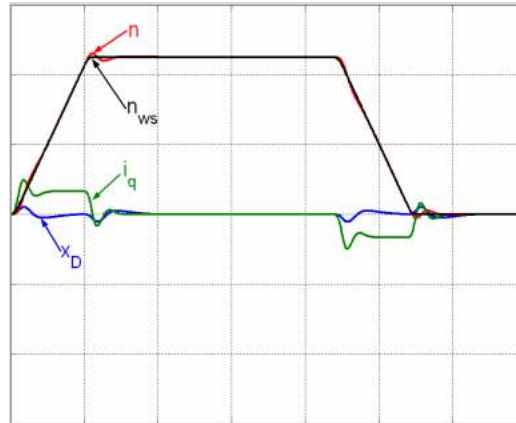
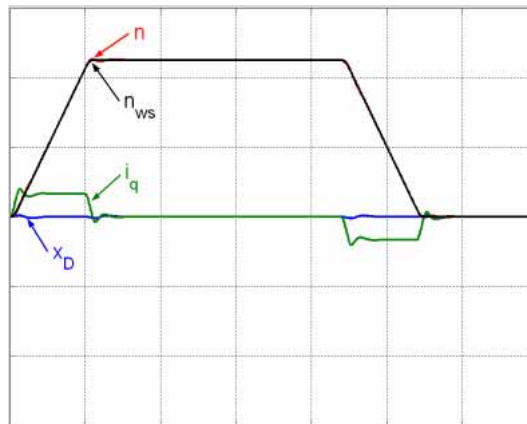
Motion cycle with feedforward measures

Velocity feedforward



Velocity and acceleration feedforward



Velocity, acceleration and current feedforward**Velocity, acceleration, current and jerk feedforward****Control signal filter / filter of actual acceleration value**

The filters in the Compax3 firmware are implemented as P-T1 filters (first order delay component see chapter 0)

The two "control signal filter (velocity loop)" (Object 2100.20) and "acceleration value filter" (Object 2100.21) are set in μs . The value range for these filters is 63... 8 300 000 μs . Depending on the replacement time constant of the closed velocity loop, we can make recommendations for the setting.

Setting recommendation for "control signal filter (velocity loop)":

$$O2100.20 = O2210.17[\mu\text{s}] / 5 \quad \text{for } O2210.17 \geq 10\,000\mu\text{s}$$

$$O2100.20 = O2210.17[\mu\text{s}] / 3 - 1333\mu\text{s} \quad \text{for } 4000\mu\text{s} \geq O2210.17 < 10\,000$$

$$O2210.20 = 0 \quad \text{for } O2210.17 < 4000\mu\text{s}$$

O2210.17: Object replacement time constant of the velocity loop in μs .

O2100.20: Object control signal filter (velocity loop) in μs .

Please note!

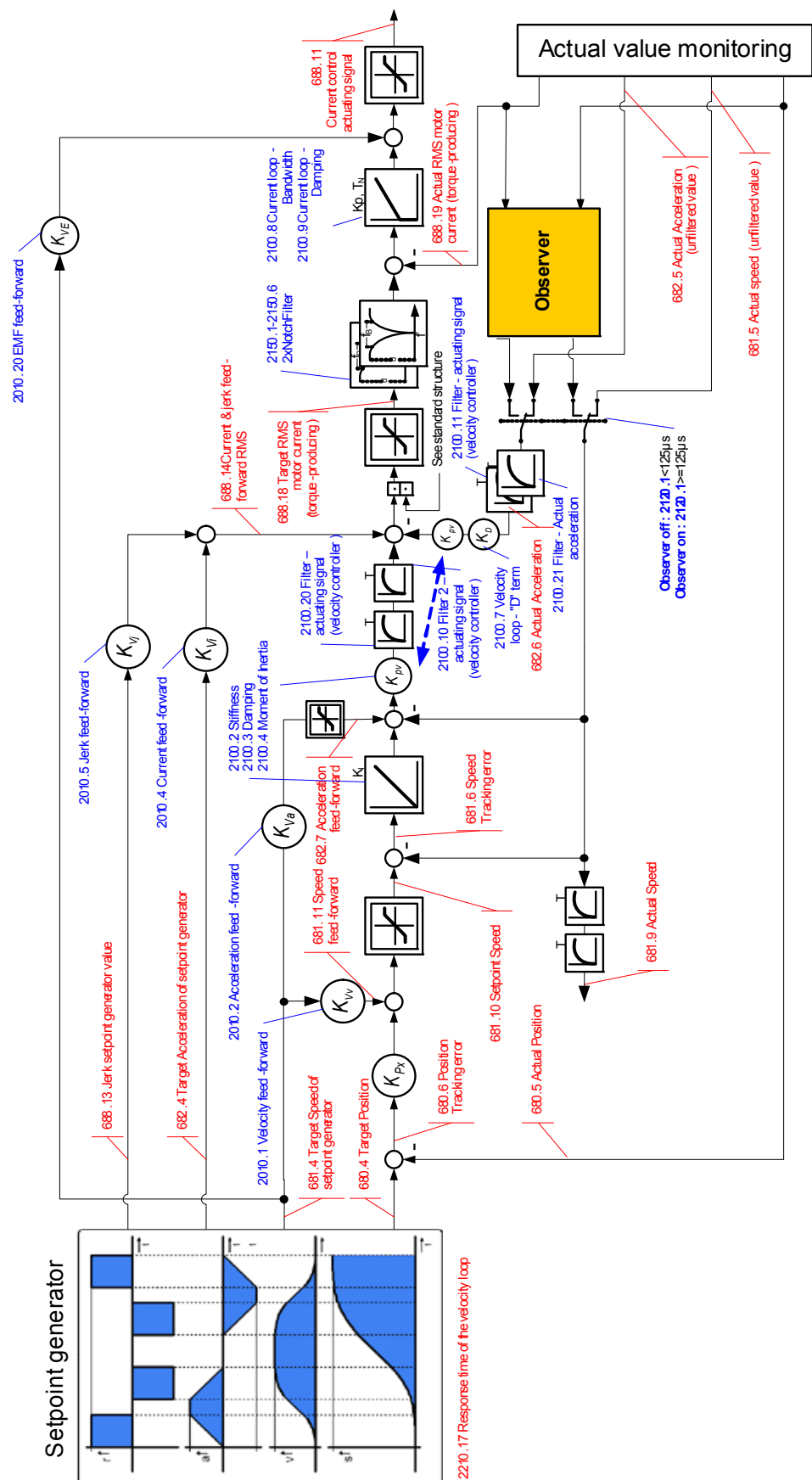
It cannot be excluded that the filter may have a destabilizing effect even though set according to the above recommendation. In this case the filter time constant must be reduced.

Advanced

In this chapter you can read about:

Extended cascade (structure variant 1)	215
Extended cascade structure (structure variant 2 with disturbance variable observer)	217
Optimization parameter Advanced	218
EMC feedforward	219
Motor parameters	219
Filter "External Command Interface"	219
Voltage decoupling	219
Load control	219
Luenberg observer	219
Commutation settings of the automatic commutation	221
Notch filter	225
Saturation behavior	227
Control measures for drives involving friction	228

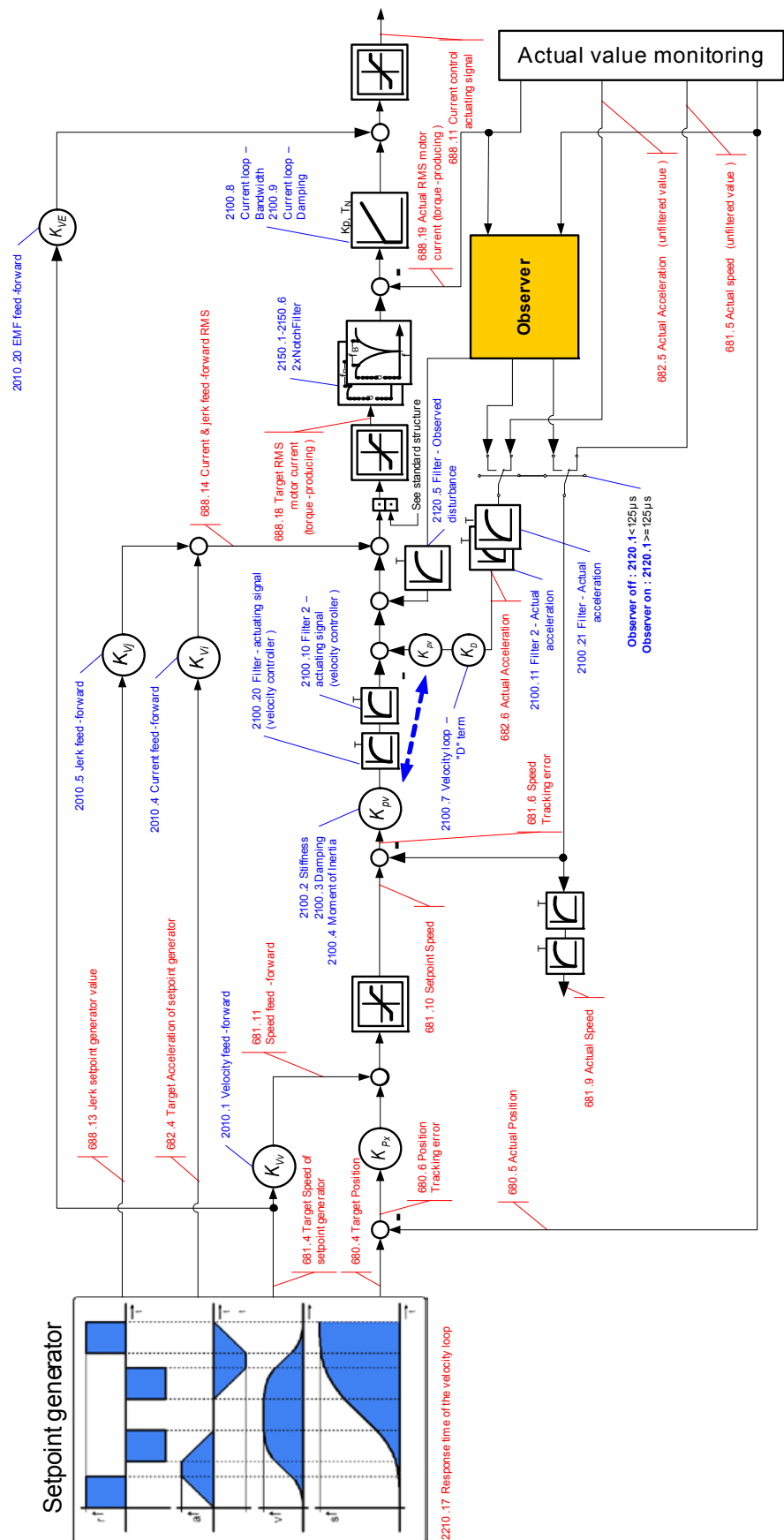
Extended cascade (structure variant 1)



During external setpoint specification, please respect the structure images for electronic cams or gearboxes for **signal filtering with external setpoint specification** (see page 240) !

Symbol	Description
	Proportional term signal is multiplied with K_p
	First order delay component (P-T1 component)
	Integration block (I-block)
	PI-block
	Limitation block (signal limitation)
	Notch filter (band elimination filter)
	Addition block
blue description	Optimization objects (simple pointer line)
red description	Status objects (pointer line with vertical stroke)

Extended cascade structure (structure variant 2 with disturbance variable observer)



During external setpoint specification, please respect the structure images for electronic cams or gearboxes for **signal filtering with external setpoint specification** (see page 240) !

Symbol	Description
	Proportional term signal is multiplied with K_p
	First order delay component (P-T1 component)
	Integration block (I-block)
	PI-block
	Limitation block (signal limitation)
	Notch filter (band elimination filter)
	Addition block
blue description	Optimization objects (simple pointer line)
red description	Status objects (pointer line with vertical stroke)

Optimization parameter Advanced

Overview optimization objects		
Optimization object	Value	Unit
Reference reaction (Feed-Forward)		
Velocity feed-forward [2010.1]	100	%
Acceleration feed-forward [2010.2]	100	%
Current feed-forward [2010.4]	100	%
Jerk feed-forward [2010.5]	100	%
Setpoint-/Disturbance reaction (Dynamics)		
Stiffness [2100.2]	100	%
Damping [2100.3]	100	%
Moment of Inertia [2100.4]	100	%
Velocity loop - "D" term [2100.7]	0	%
Filter - Actual velocity [2100.5]	100	%
Filter 2 - actuating signal (velocity controller) [2100.10]	0	us
Filter - Actual acceleration [2100.6]	0	%
Filter 2 - Actual acceleration [2100.11]	0	us
Current loop - Bandwidth [2100.8]	50	%
Current loop - Damping [2100.9]	100	%
Observer		
Time Constant [2120.1]	0	us
Filter - Observed disturbance [2120.5]	1000	us
Enable Disturbance Compensation [2120.7]	0	
Filter external signal source		
Filter - Ext. velocity feed-forward [2011.1]	500	%
Filter - Ext. accel. feed-forward [2011.2]	500	%
Trackingfilter HEDA [2109.1]	0	500us
Filter setpoints		
Trackingfilter [2110.1]	1	500us
Filter velocity [2110.3]	0	%
Filter acceleration [2110.4]	0	%
Analog Input		
Offset [170.4]	0	
Gain [170.2]	1	

EMC feedforward

The EMC feedforward compensates the electromagnetically generated back e.m.f. of the motor U_{EMC} . This signal is proportional to velocity and is deduced from the setpoint velocity of the setpoint generator.

Motor parameters

Furthermore you can re-optimize the motor parameters inductance, resistance and EMC (or K_t) in the advanced mode. The $LdLqRatio$ parameter is the ratio of the smallest and the highest inductance value of the winding, measured during one motor revolution.

Filter "External Command Interface"

For explanations on this group of parameters please see chapter 0

Voltage decoupling

In the current control path there is a velocity and current proportional voltage disturbance variable, which must be compensated by the current loop. Due to limited controller dynamics, this disturbance variable can not always be entirely compensated by the current loop. The influence of this disturbance variable may however be minimized by activating the voltage decoupling.

Load control

If a second position feedback is available for the acquisition of the load position, the load control can be activated.

For more detailed information on the load control see device help for T30/T40 devices in the setup chapter Compax3\load control.

Luenberg observer

In this chapter you can read about:

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Signal flow chart Luenberg observer	220

Introduction observer

A high signal quality of the actual signal value is of high significance in the control of the motor velocity n or the motor speed v . By means of oversampling and transmitter error compensation, a high-quality position signal can be produced for speed determination. As a rule the motor speed is determined by numeric differentiation of the motor position. In this case the quantisation noise Q_vD of the digital speed signal depends on the quantisation Q_x of the position signal and the sampling time T_{AR} of the digital control loop:

Quantisation – speed signal Q_vD

$$Q_{vD} = \frac{Q_x}{T_{AR}}$$

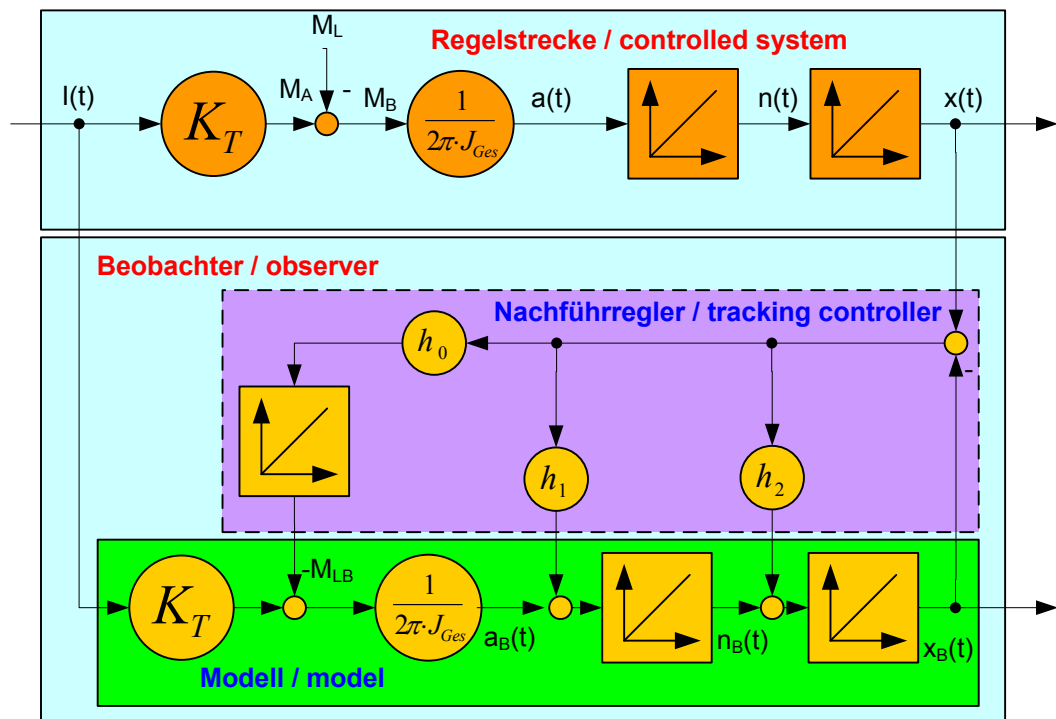
The quantisation of the speed signal is inversely proportional to the sampling time T_{AR} . Hence the demands for the lowest possible sampling time and the minimum quantisation noise oppose each other in the determination of speed by numeric differentiation. The noise superimposed by the digital speed signal may be reduced by the low-pass filter, however this is always at the cost of the stability margin of the digital control loop. An alternative method is to determine the speed by integration of the acceleration. The dependence of the quantisation noise Q_vD of the digital speed signal on the quantisation Q_x of the position signal and the sampling time T_{AR} of the digital control loop is shown by the following correlation.

Quantisation – speed signal Q_vI

$$Q_{vI} = Q_a \cdot T_{AR}$$

The observer technology offers the advantage that the velocity can be calculated with the aid of integration. The idea of the observer principle is to connect a mathematical model of the control path parallel to the section observed and with the same transfer behaviour. In this case, the controller also has the intermediate variables (state variables) of the control path available. However in the presence of model deviations (in structure or parameters), different signal values occur between the model and the control path. For this reason, the technique cannot be employed in this way in practice. However, the model contains the measurable output signal of the control section as a redundant quantity. By comparing the two variables, a tracking control can be used to adapt the model state variables to the state variables of the control path. As the model deviations have become minor in this case due to the simple mechanical drive train, the observer now has an efficient aid available to increase the signal quality. Increase in signal quality in the observer means that the noise components decrease, and the dynamics improve as the observed speed is feedforward-controlled undelayed by the current and is not just calculated delayed from the position signal using simple differentiation.

Signal flow chart Luenberg observer



$I(t)$:	Torque-forming motor current
K_t :	Torque constant
$M_L(t)$:	External disturbance torque
J_{total} :	Total mass moment of inertia (motor + load)
$a(t)$:	Acceleration
$n(t)$:	Velocity
$x(t)$:	Position
Index b:	Observed signal quantities
$h_0 \dots h_2$:	Controller coefficients of the tracking controller

The figure shows that an additional I element is connected for interference compensation to correct external disturbance forces in the observer. Therefore the speed and the acceleration observed are statically precise. The same applies to the output of the integrator in the tracking controller which is a statically precise determination of an external interference torque M_L . For this reason, the I component is not required in the speed controller, and the entire control can be set up as a state cascade control, which increases the bandwidth of the speed and position controlled member by factor 2. As a consequence, the interference stiffness of the drive and the tracking error behavior improve.

Here the quantisation of the speed signal is proportional to the sampling time TAR , hence there is no longer any conflict between the requirements for minimum sampling time and minimum quantisation noise. For the integral velocity acquisition, the motor current variable, which is proportional to the acceleration, can be used. This approach is particularly advantageous in direct drive engineering; due to the absence of a mechanical drive train, there is a very good match between the mathematical model of the observer and the real physical control section in the fundamental frequency range of the control. This applies in particular to direct drive systems with fixed moving masses, as otherwise the mismatch between model and the physical drive system has a destabilising influence on the transfer behaviour of the speed control. A remedy is to increase the observer dynamics, however this increases the noise of the observed signals. Therefore in the case of variable moving masses a compromise has to be found between the dynamics of the observer and the maximum stiffness of the drive.

Commutation settings of the automatic commutation

In this chapter you can read about:

Display of the commutation error in incremental feedback systems.....	222
Prerequisites for the automatic commutation	223
Course of the automatic commutation function	223
Other	225

Permanently excited synchronous motors can only be operated with an absolute feedback system (at least for electric motor rotation). The reason is the necessary commutation information (position assignment of the magnet field generated by the motor to the motor magnets). Without the commutation information, there is inevitably the possibility of a positive feedback between position and velocity loop ("running away" of the motor) or of bad motor efficiency (reduced force constant). Digital hall sensors are the most common aid to prevent this. Due to the mechanical design it is however impossible or very hard to integrate these sensors in some motors. The Compax3 automatic commutation function (in the F12 direct drive device) described below allows however to use incremental feedback systems without hall sensors.

The functionality implemented in the servo controller establishes the necessary reference between motor stator field and permanent magnetic field without additional aids.

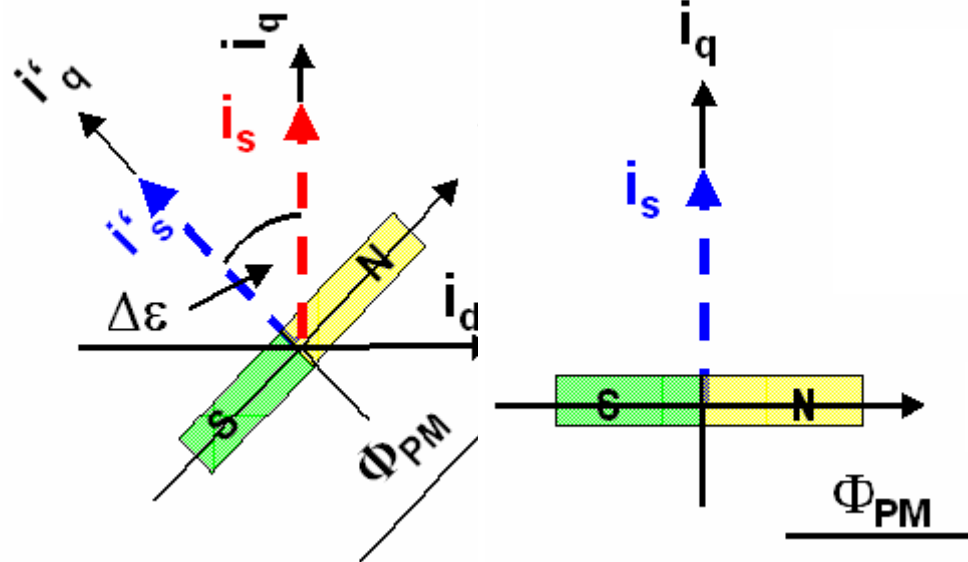
The incremental feedback devices are, in contrast to absolute feedback devices, able to acquire relative distances. It is true that any position can be approached from a starting point, there would be however no consistency between these position values and a fixed virtual absolute system. Other than with an absolute feedback, the correlation between rotor and stator is lost if the position acquisition is switched off ("the position acquisition zero is lost"). When switching on, the actual position is randomly taken as zero. A commutation angle error can therefore

absolutely not be excluded. Even a system adjusted before, would show an angular error, for example after a current failure. Therefore the angular error occurring randomly upon each new switching on must always be compensated in an incremental system.

Display of the commutation error in incremental feedback systems

$\Delta\epsilon = 0$ (adjusted)

$\Delta\epsilon \neq 0$ (not adjusted)



blue: ideal position
 red: unfavourable position
 PM: magnetic flux of the permanent magnets
 i_s : Current pointer
 $\Delta\epsilon$: Commutation error
 i'_s : ideal position
 i_q : Quadrature current (torque forming)

The automatic commutation function (AK) in Compax3 uses the position dependent sinusoidal torque course of permanently excited AC synchronous motors. If the motor windings are energized with DC voltage for instance, the motor develops a sinusoidal torque depending on the rotor position, which can be used for example by evaluating the resulting movement in order to determine the correct motor commutation.

The automatic commutation with movement in the Compax3 has the following properties:

- ◆ The motor movement occurring during the commutation is, with correctly parameterized function, very small. It is typically in the range smaller than 10° electrical revolution ($=10^\circ/\text{motor poles physically or } 10^\circ/360^\circ \cdot \text{motor pitch for a linear motor}$).
- ◆ The precision of the acquired commutation angle depends on the external conditions, however lies normally in the range better than 5° electrical revolution.
- ◆ The time until the termination of the commutation acquisition is typically below 10s.

Prerequisites for the automatic commutation

- ◆ A movement of the motor must be permitted. The movement actually occurring depends greatly on the motor (friction conditions) itself, as well as on the load moved (inertia).
- ◆ Applications requiring a motor brake, i.e. applications where active load torques are applied at the motor (e.g. vertical actuator, slope) are not permitted.
- ◆ Due to the function principle, high static friction or load torques will deteriorate the result of automatic commutation.
- ◆ When performing automatic commutation, a motion of at least $\pm 180^\circ$ must be electrically possible (no mechanic limitation)! The implemented automatic commutation function with motion cannot be used for applications with limit or reversal switches.
- ◆ With the exception of missing commutation information, the controller/motor combination is configured and ready for operation (parameters correctly assigned for the drive/linear motor). Feedback direction and effective direction of the field of rotation must be identical (automatic commutation performed in the MotorManager).

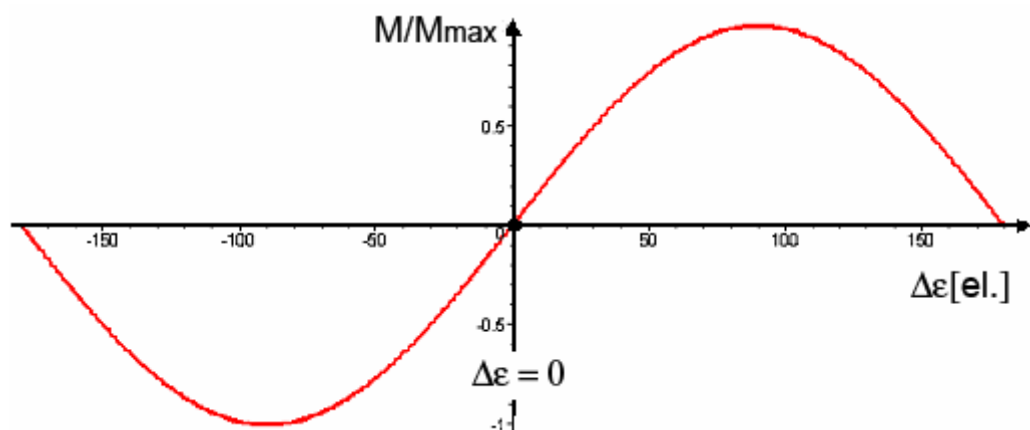
Course of the automatic commutation function

If "automatic commutation with movement" is selected as source of commutation, the automatic commutation sequence runs once if the power stage is enabled. If the power stage is enabled or disabled afterwards, the automatic commutation will be left out. If an error occurs during the execution, the automatic commutation is aborted. A new "attempt to enable" the power stage will trigger a new automatic commutation.

Function principle of the automatic commutation with movement

The implemented method with movement is based on the sinusoidal dependence of the provided motor currents and the resulting movement on the effective commutation error. The acceleration performed by the motor ($\rightarrow$ movement) in the event of constantly maintained current is a measure for the actual change in the commutation angle in the way that it disappears upon a change of exactly 0° and is, for other angles, the acceleration and its direction in dependence of the sign and value of the angular error ($-180^\circ \dots 180^\circ$).

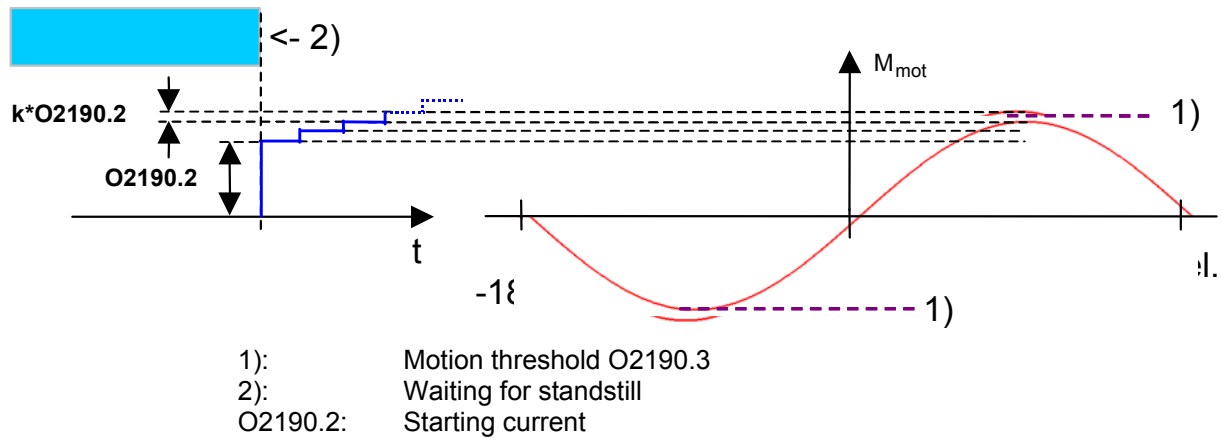
Acceleration torque depending on the commutation error.



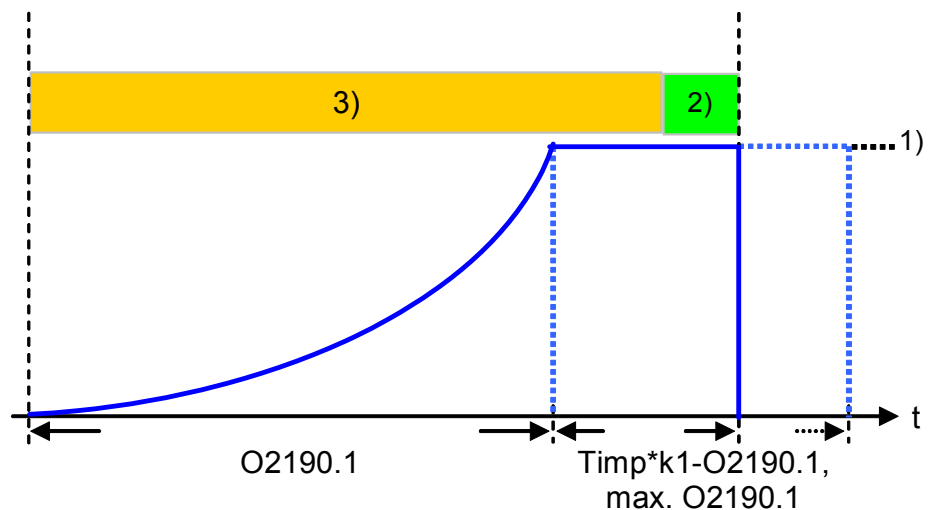
$\Delta\epsilon$:	Commutation error
$M/M_{\mu\alpha\xi}$	normalized acceleration torque

Searching for the torque maxima (phase 1)

If the sum of the actual and the estimated error angle is $\pm 90^\circ$ electrically, the motor torque is maximal for the provided current. If you gradually increase the provided motor current, the motor will, from a defined value on, surpass its friction torque and exceed a motion threshold defined by O2190.3:

Illustration of the first phase**Latching of the motor (phase 2)**

Here, the drive is brought to the position with the provided motor torque=0, where the angular error is either $\pm 180^\circ$ or 0° .

Current rise in the second phase.**Motion reduction:**

It is possible, to considerably reduce the motor movement occurring during the fine angle search with the aid of the "motion reduction" parameter (O2190.4). Please respect also that the acquired commutation result may be slightly worse than without this measure.

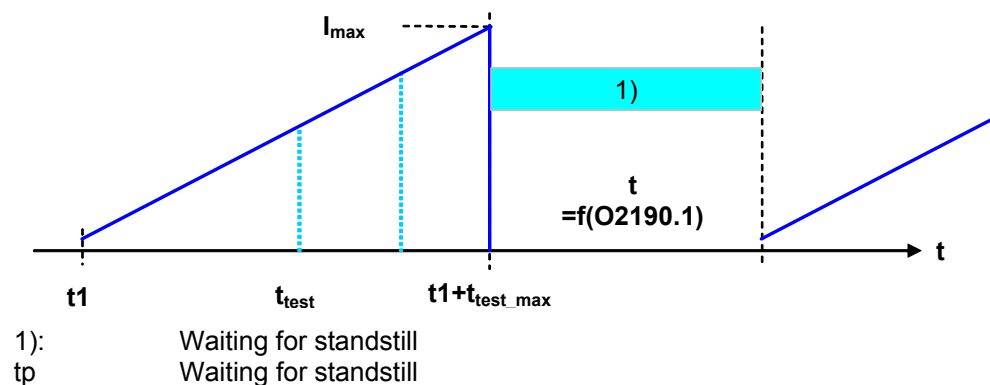
Hint As a current well above the nominal motor current is provided here, there may be saturation effects on ironcore motors, which might lead to an instable current loop (-> highly frequent "creaking noises" during the automatic commutation). This can be avoided by activating the saturation characteristic line in the motor data.

Test for positive feedback (phase 3)

Here it is verified, if the motor performs a motion in the expected positive direction in the event of positive current in the torque maximum. The same motion threshold (defined via O2190.3) as in phase 1 is valid. The test is repeated several times.

A current course in ramp form is specified (target: minimum movement). The break between the tests varies with the current rise time O2191.1.

Illustration of the third phase



Other

- ◆ During the sequence (time according to parameterization >> 1s) the automatic commutation is externally visualized by a LED blinking code (green permanent and red blinking).
- ◆ Device errors will lead to an abort of the automatic commutation.
- ◆ During automatic commutation, no motion commands are accepted.
- ◆ The controller cascade entirely deactivated during automatic commutation, with the exception of the current loop.
- ◆ In multi-axis applications, the axes to be automatically commutated must be awaited (output of the MC_Power block must deliver "True")!
- ◆ The automatic commutation is only started if the drive is at standstill.
- ◆ After the occurring and acknowledgement of a feedback error or a configuration change of the feedback system, the automatic commutation must be performed again, as it might be that the position entrainment in the servo controller is interrupted (commutation information is lost).

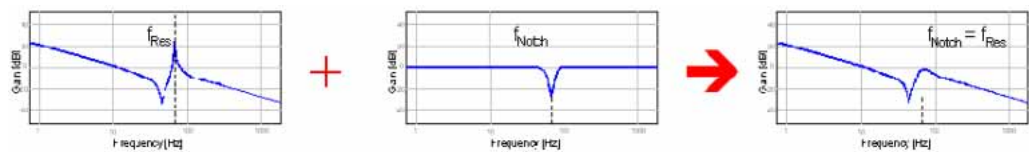
Notch filter

In this chapter you can read about:

Effect of the notch filter	226
Wrongly set notch filter	226
Frequency response of the notch filter.	226
Parameterization by 3 objects.	226

Notch filters are small-band band elimination filters which slope in a wedge form towards the center frequency. The attenuation of this center frequency is extremely high in most cases. With the aid of the notch filters it is possible to purposefully eliminate the effects of mechanical resonance frequencies. With this, the mechanical resonance point is not activated itself, but the excitation of this point of resonance is avoided by the control.

Effect of the notch filter



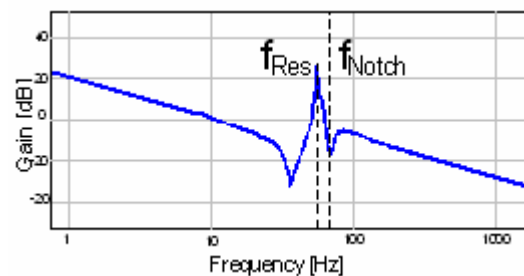
Resonance

Notch filter

Result

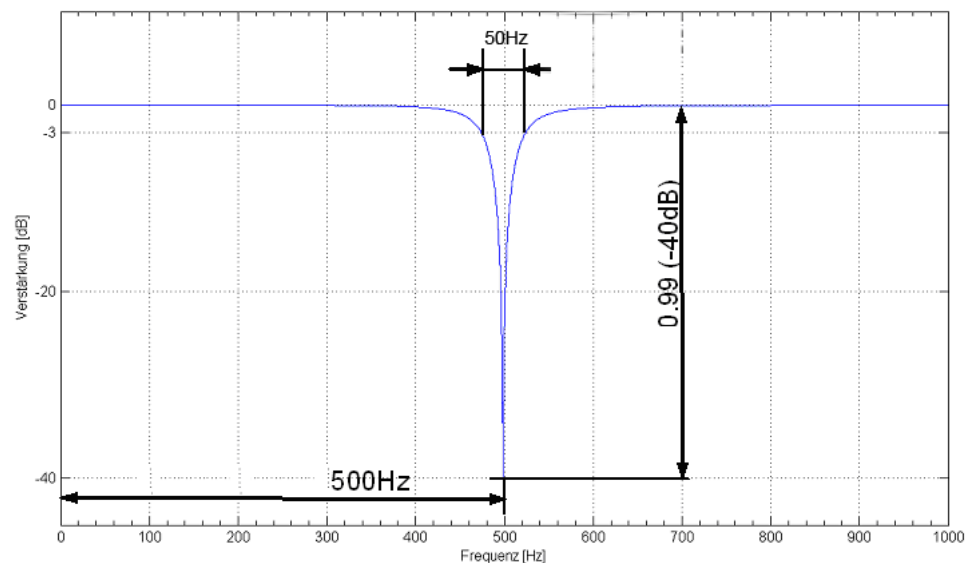
As can be seen in the figure, the notch filter is only useful in cases where the set frequency of the notch filter is exactly the same as the disturbing frequency. The notch filter as well as the resonance point are very narrowband. If the resonance point does only minimally change (e.g. by changing the masses involved), it is not sufficiently activated by the notch filter.

Wrongly set notch filter



In the Compax3, two notch filters which are independent of each other are implemented.

Frequency response of the notch filter.



Center frequency = 500Hz

Bandwidth = 50Hz

Depth = 0.99 (-40dB)

Parameterization by 3 objects.

In this chapter you can read about:

Frequency filter 1 (O2150.1) / frequency filter 2 (O2150.4)	226
Bandwidth filter 1 (O2150.2) / bandwidth filter 2 (O2150.5)	227
Depth filter 1 (O2150.3) / depth filter 2 (O2150.6)	227

Frequency filter 1 (O2150.1) / frequency filter 2 (O2150.4)

This defines the frequency at which the notch filter attenuation is highest. In practice it shows that notch filters can only sensibly be used if the distance

between the controller bandwidth (velocity loop) and the center frequency is long enough (at least factor 5). This permits to deduce the following recommendation:

$$O2150.x \geq \frac{5000000}{2\pi \cdot O2210.17[\mu s]}$$

x = 1 or x = 4

Obj2210.17: Replacement time constant of the velocity loop in μs .

Note: If this distance is too small, the stability of the control can be very negatively influenced!

Bandwidth filter 1 (O2150.2) / bandwidth filter 2 (O2150.5)

This defines the width of the notch filter.

The value refers to the entire frequency band, where the attenuation of the filter is higher than (-)3dB.

In practice it shows that even if there is enough distance towards the control, it can be negatively influenced by too high bandwidths (higher than 1/4 of the center frequency).

$$O2150.x \leq \frac{O2150.1/4}{4}$$

x = 2 or x = 5

Depth filter 1 (O2150.3) / depth filter 2 (O2150.6)

With this the size of the attenuation of the filter must be at the position of the center frequency. One stands here for complete attenuation ($-\infty$ dB) and zero for no attenuation.

$$O2150.x = 1 - 10^{-\left(\frac{D[dB]}{20}\right)}$$

x = 3 or x = 6

D [dB]: The desired attenuation at the center frequency in dB

Saturation behavior

In this chapter you can read about:

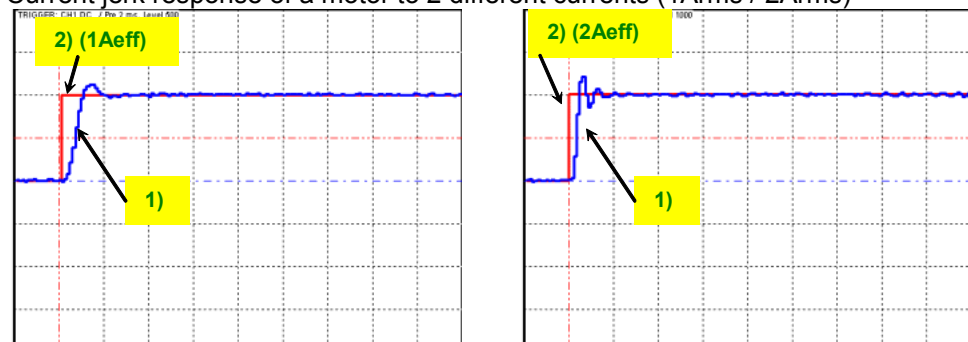
Current jerk response 227

Current jerk response with the activated saturation characteristic line 228

Saturation can be stated with the aid of current jerk responses at different current height.

Current jerk response

Current jerk response of a motor to 2 different currents (1Arms / 2Arms)



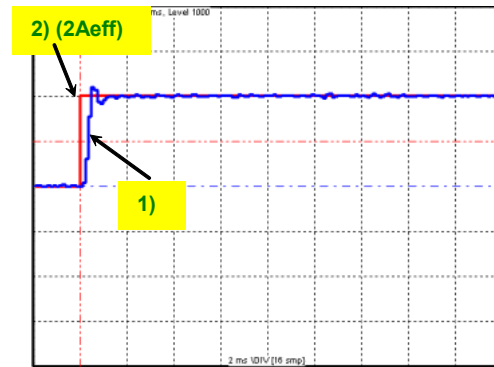
1) Actual current

2) Setpoint current

In the above figure we can see from the settling response that the drive shows a distinctive tendency to oscillate at doubled current. The saturation characteristic line, which is used to linearly reduce the P-term of the current loop depending on the current, helps against such a saturation behavior.

If you respect the saturation for the above example with the aid of the saturation characteristic line, the tendency to oscillate of the current loop can again be activated.

Current jerk response with the activated saturation characteristic line



The parameterization of the characteristic line is made in the MotorManager.

Note:

- ◆ In order to accept the changes in the MotorManager in the project, the entire configuration must be confirmed.
- ◆ In order to make the changes from the MotorManager effective in the device, the configuration download must be executed.

Control measures for drives involving friction

In this chapter you can read about:

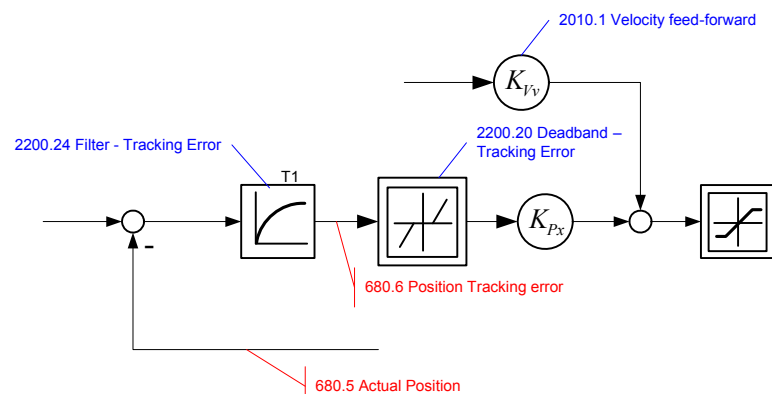
Deadband following error.....	228
Friction compensation.....	229

Some drives, which involve much friction due to their guiding system, may show permanent oscillation at standstill. The transition between static friction (standstill) and kinetic friction (very low speed) is very steep. The controller can no longer follow the friction characteristic line at this position. The I-term integrates until the control variable pulls free the drive and the drive moves too far. This procedure is repeated in the opposite direction and a control oscillation occurs (so-called limit cycle). In order to eliminate this control oscillation, the following control functions were implemented:

- ◆ Deadband following error (Obj. 2200.20)
- ◆ Filter following error (Obj. 2200.24)
- ◆ Friction compensation (Obj. 2200.20)

Deadband following error

Deadband/filter following error in the position loop



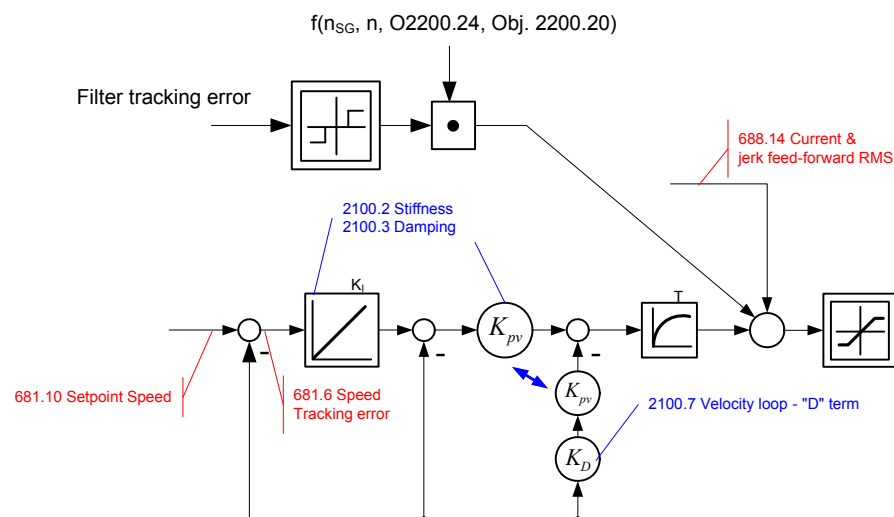
The deadband does no longer supply a velocity setpoint value (zero) for the subordinate velocity loop at small following error. The integrator of the velocity loop stops integrating and the system comes to a standstill.

In order to prevent that the velocity loop is excited by the noise on the following error, the following error should be filtered before the deadband, which will lead, however, to delays in the position loop. The deadband to be set depends on the

friction behavior (amplitude of the limit cycle) and on the noise on the following error (the noise must remain within the deadband).

Friction compensation

The activation of the friction compensation (end of the velocity loop)



The friction compensation helps the control to surmount static friction at low setpoint speeds. The non linear characteristic line is partly compensted by this and a smaller deadband can be chosen, which will increase the position accuracy. The amplitude of the friction compenstion depends on the application and must be calculated if needed. If the value is set too high, corrective movements may result and the tendency to oscillate is increased.

Commissioning window

In this chapter you can read about:

Load identification.....	229
Setpoint generation.....	229
Commissioning window	

With the aid of the setup window, the drive can be set up in a simple way.

Load identification

If you do not know the mass moment of inertia, it can be determined. For this, you click on the corresponding button (see setup window no. 13). After the following parameter entry, the identification can be started via the same button.

- ◆ For more detailed information on the load identification, see the device help, chapter "load identification".
- ◆ This measurement requires the correct EMC or torque constant value K_t .

Setpoint generation

In this chapter you can read about:

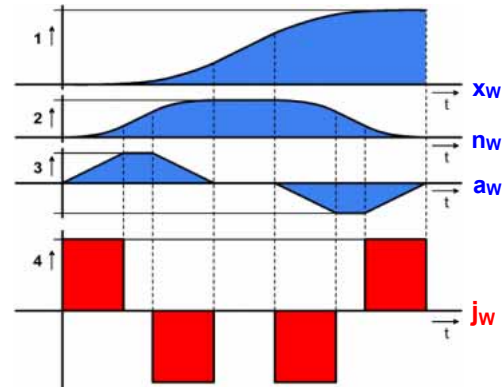
Internal setpoint generation	230
External setpoint generation	231

The setpoints for the control loops are provided in two different ways - internally or externally. The setpoint generation depends on the technology option of the device.

Internal setpoint generation

The internal setpoint generation can be used for the technology option s>T10. In this case, the internal setpoint generator generates the entire motion profile with position, velocity, acceleration and jerk.

Motion profile at jerk-controlled setpoint generation



x_w Position
 n_w Velocity
 a_w Acceleration
 j_w Jerk

The drive cannot move randomly through hard profiles, as certain physical limits exist for the acceleration ability due to the motor physics and the limitation of the control variable. You must therefore make sure that the set movement corresponds to the real physics of the motor and of the servo drive.

As a support you can take the following physical correlation.

The calculation of the physically possible acceleration

rotary drives

$$a[\text{rps}^2] = \frac{M_A[\text{Nm}] - M_L[\text{Nm}]}{2\pi \cdot J_{\text{ges}}[\text{kgm}^2]}$$

M_A : Drive torque of the motor
 M_L : Load torque of the motor
 J_{total} : entire mass moment of inertia
 a : possible acceleration

Linear drives

$$a\left[\frac{\text{m}}{\text{s}^2}\right] = \frac{F_A[\text{N}] - F_L[\text{N}]}{m_{\text{ges}}[\text{kg}]}$$

F_A : Drive force of a linear motor
 F_L : Load force of a linear motor
 m_{ges} : Total mass of a linear motor

The generation of the setpoint profile is jerk-controlled and jerk-limited by the specification of the jerk.

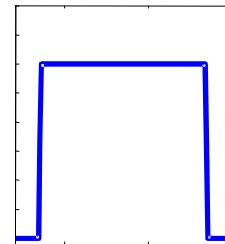
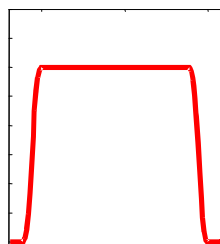
In practice, jerk-limited setpoint generation is important if the items to be moved must be handled gently. In addition, the service life of the mechanical guiding system will be extended. A separate setting of jerk and slope of the deceleration phase also permits overshoot-free positioning in the target position. For this reason, it is common practice to use higher values for acceleration and jerk in the acceleration phase than in the deceleration phase. In consequence a higher cycle rate can be achieved.

An additional important reason for the jerk limitation is the excitation of higher frequencies due to the too high jerk in the power density spectrum of the velocity function.

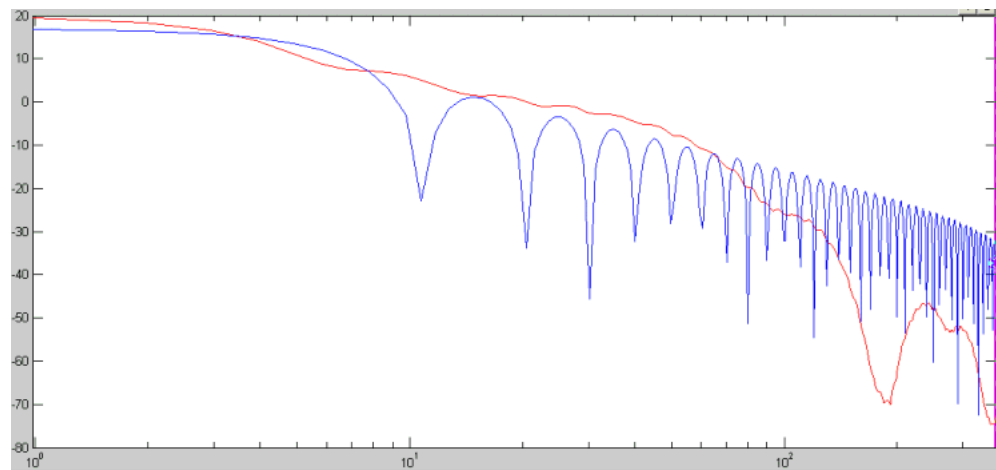
Jerk=10000°/s³

Jerk=1000000°/s³

Time function:



Time function and power density spectrum of Compax3 setpoint generator with different jerk settings



Power density over the frequency

The profile can be simply calculated and displayed for control purposes.

External setpoint generation

During external setpoint generation, the necessary feedforward signals are calculated from the external setpoint with the aid of numerical differentiation and final filtering.

Hint For more detailed information on the external setpoint generation see device help for T11/T30/T40 devices in the "setup" chapter Compax3\optimization\controller dynamics\signal filtering at external setpoint specification"

Test Move

In order to evaluate the behavior of the drive, test movements can be defined. For this you jump into the parameter entry either with the aid of the "enter setup/test movement parameters" or by selecting the parameter tab. Via the "setup settings" menu you access the settings for the desired test movement. The desired motion profile can be set via the parameters in the following window.

Proceeding during controller optimization

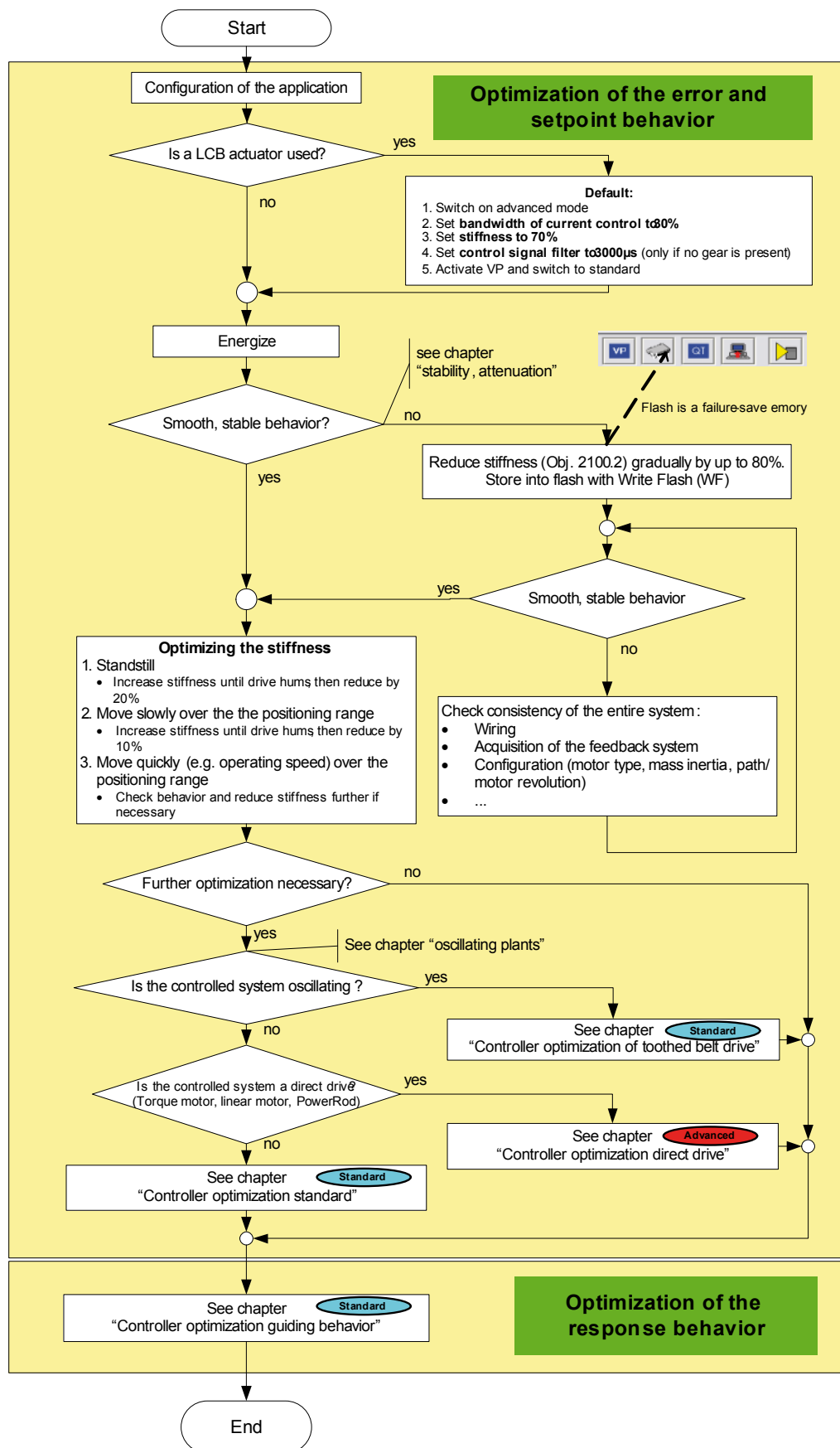
In this chapter you can read about:

Main flow chart of the controller optimization.....	232
Controller optimization disturbance and setpoint behavior (standard).....	233
Controller optimization disturbance and setpoint behavior (advanced).....	236

If the control behavior is not sufficient for the present application, an optimization is required. We recommend the following approach:

Overview on the approach to setup a+optimization

- ◆ At first, the disturbance and setpoint behavior of the velocity loop at standstill and at different displacement velocities is optimized (stiffness, attenuation, filter).
- ◆ After that, the necessary motion profiles are set via the setup tool and the desired guiding behavior in the entire velocity range is set via the feedforward control (motion profiles, feedforward).

Main flow chart of the controller optimization

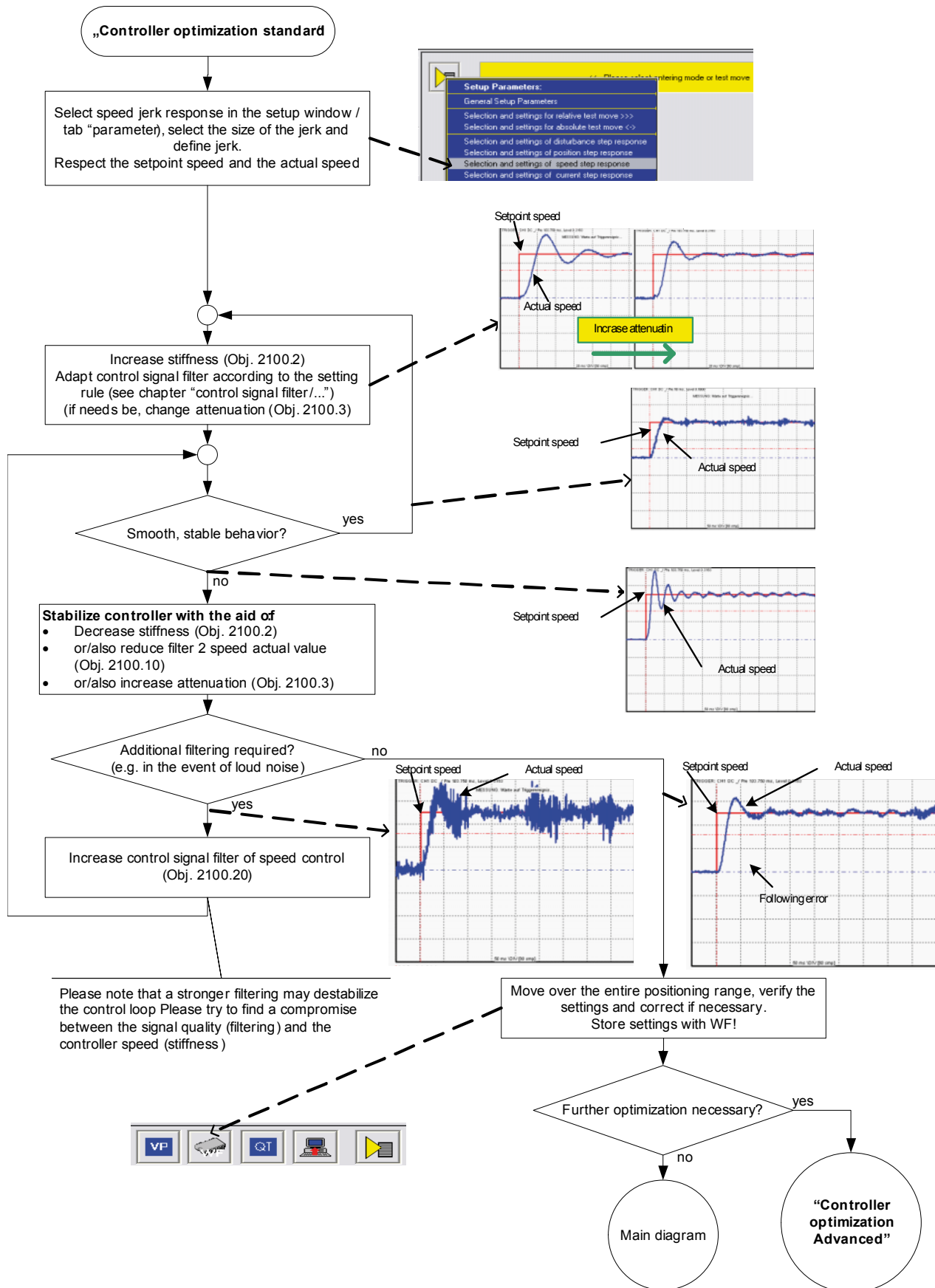
Controller optimization disturbance and setpoint behavior (standard)

In this chapter you can read about:

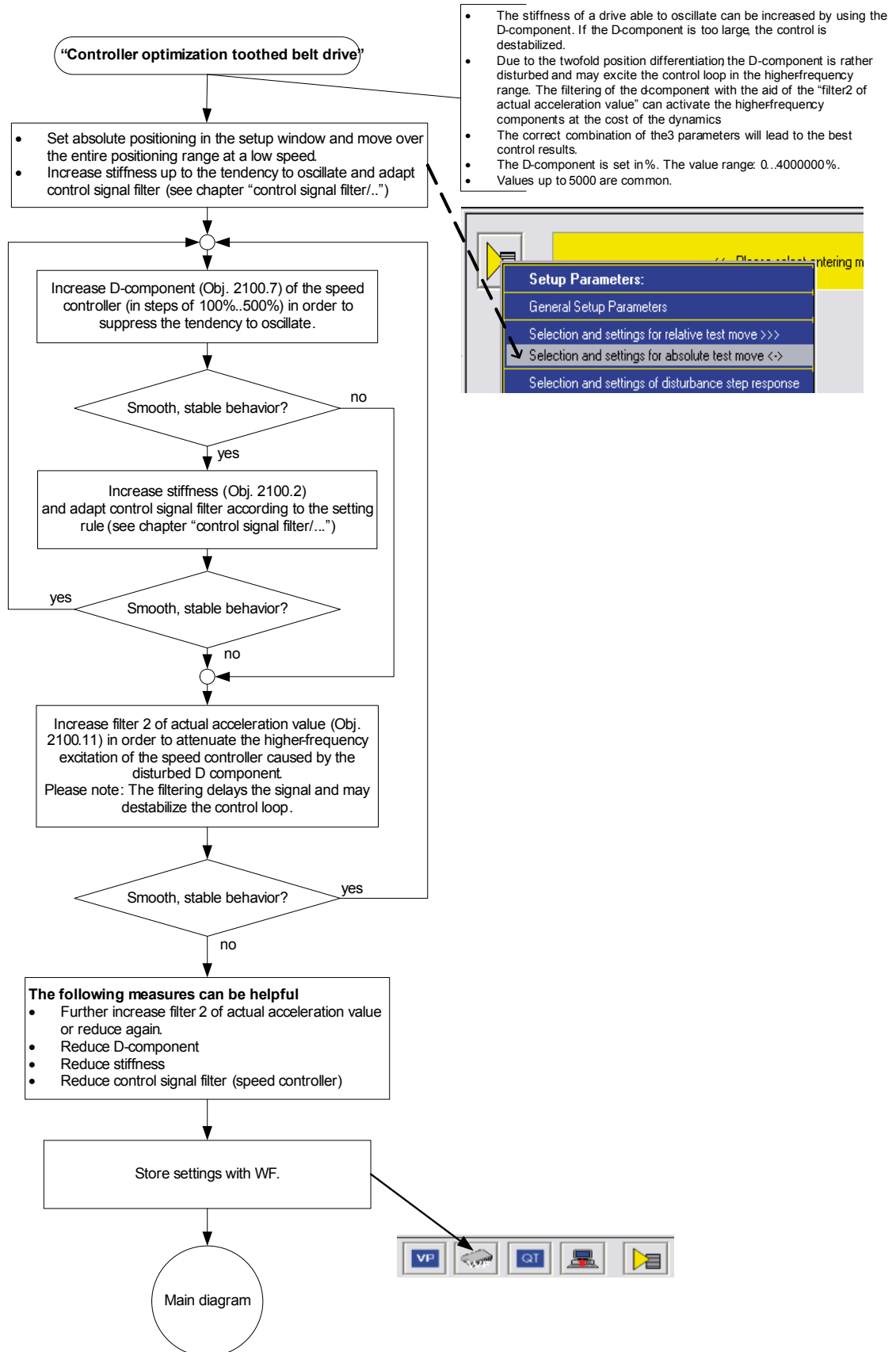
Controller optimization standard 234

Controller optimization of toothed belt drive 235

Controller optimization standard



Controller optimization of toothed belt drive

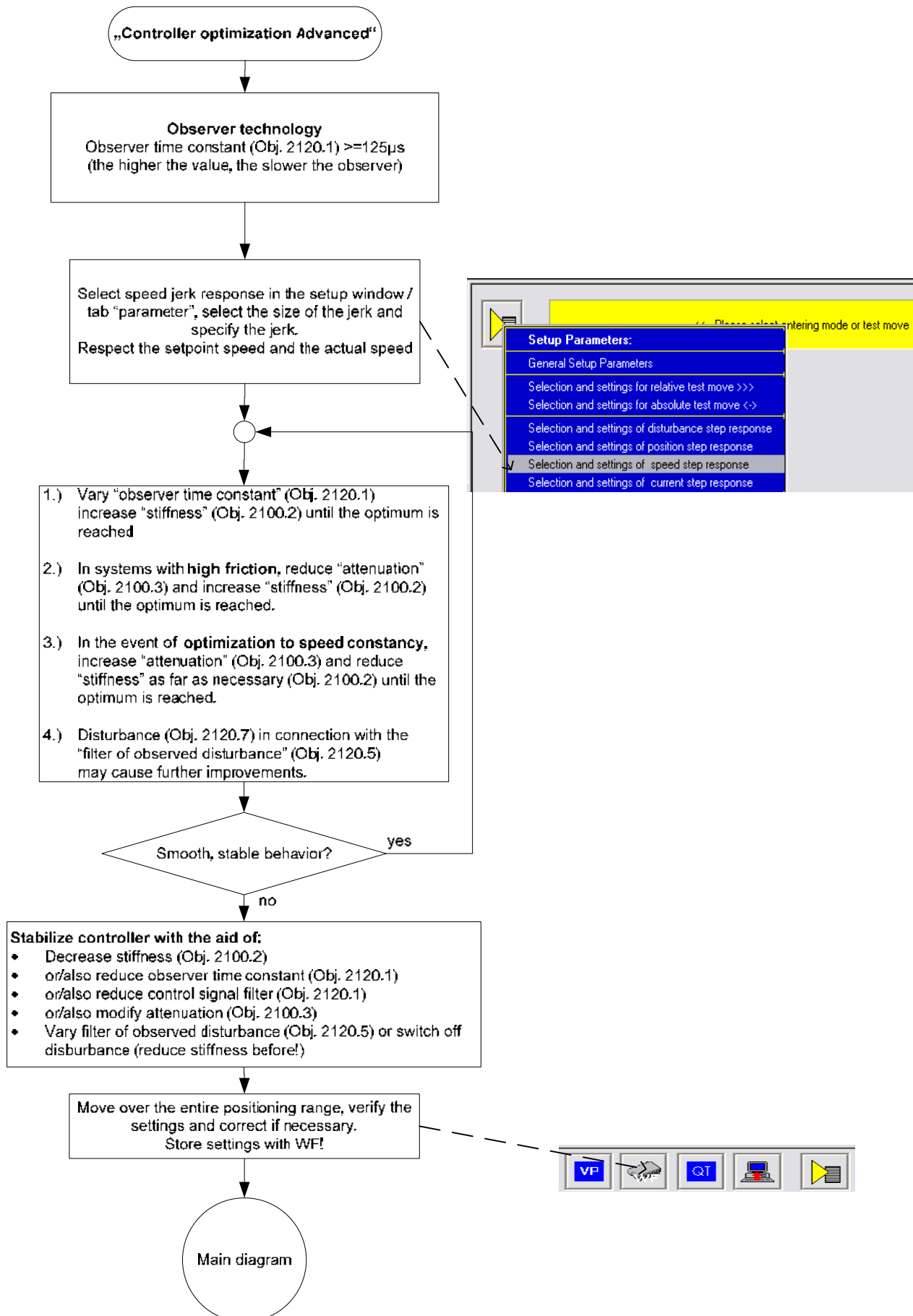


Controller optimization disturbance and setpoint behavior (advanced)

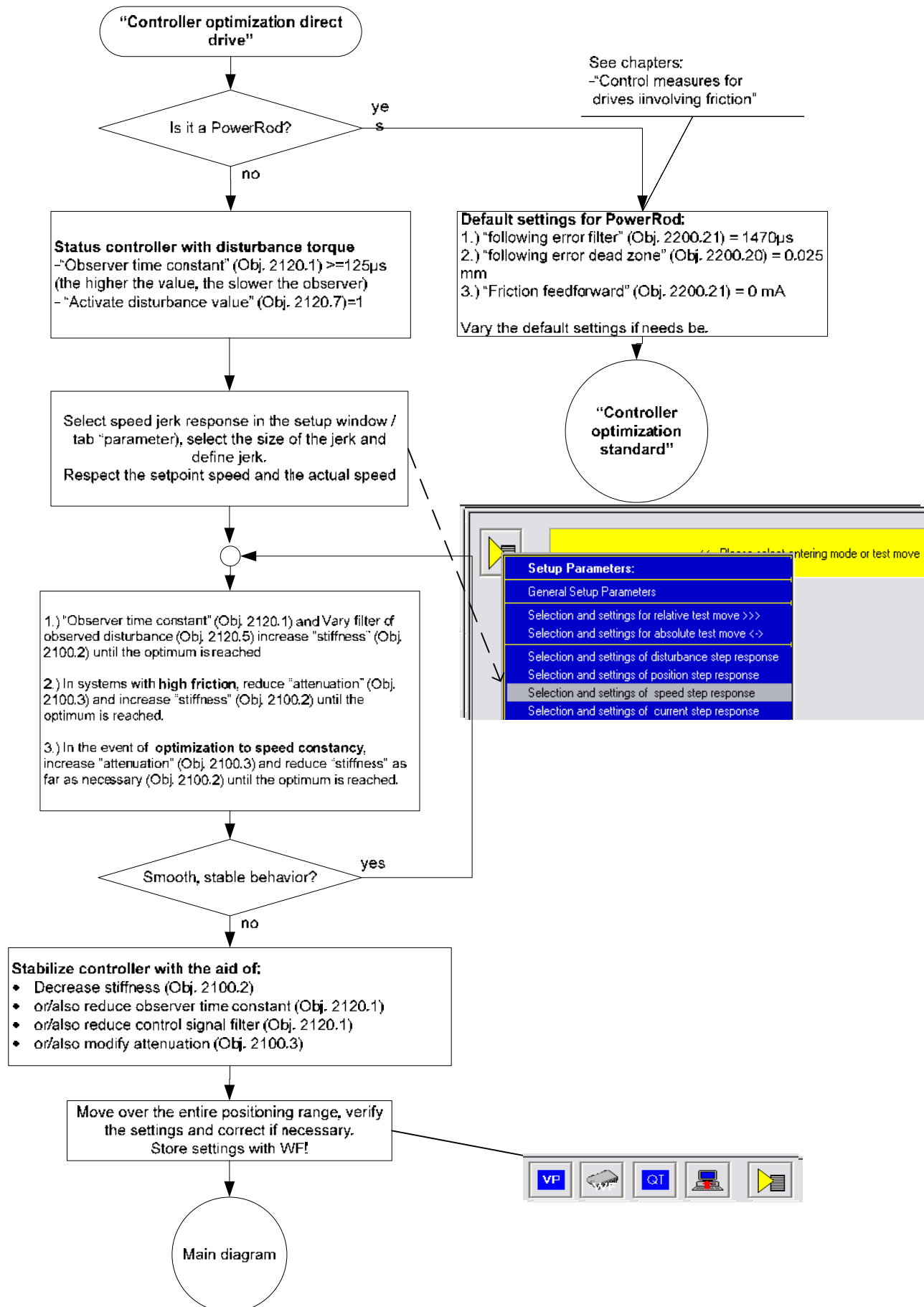
In this chapter you can read about:

Controller optimization Advanced	237
Flow chart controller optimization of a direct drive.....	238
Controller optimization guiding transmission behavior	239

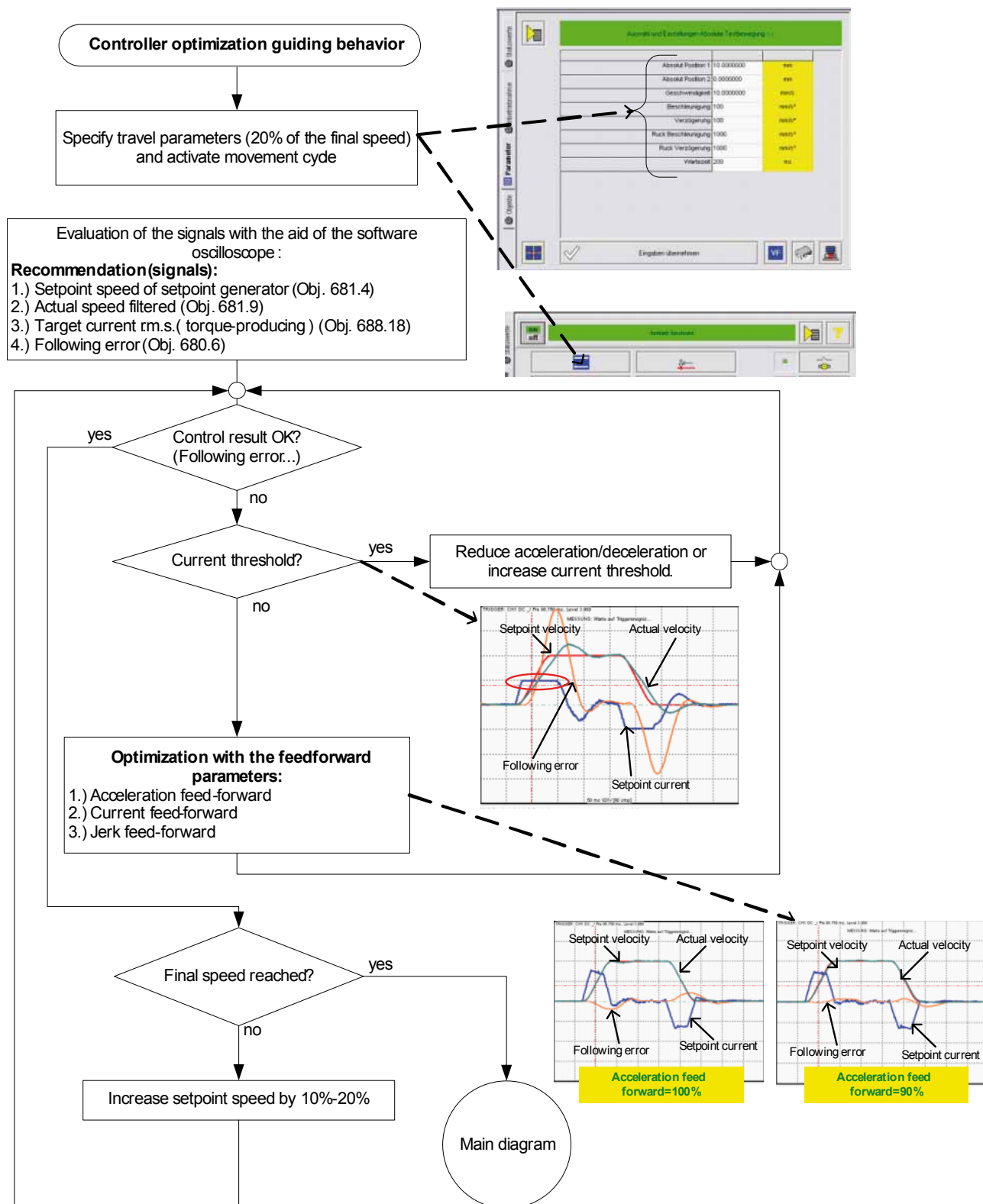
Controller optimization Advanced



Flow chart controller optimization of a direct drive



Controller optimization guiding transmission behavior



4.4.4. Signal filtering with external command value

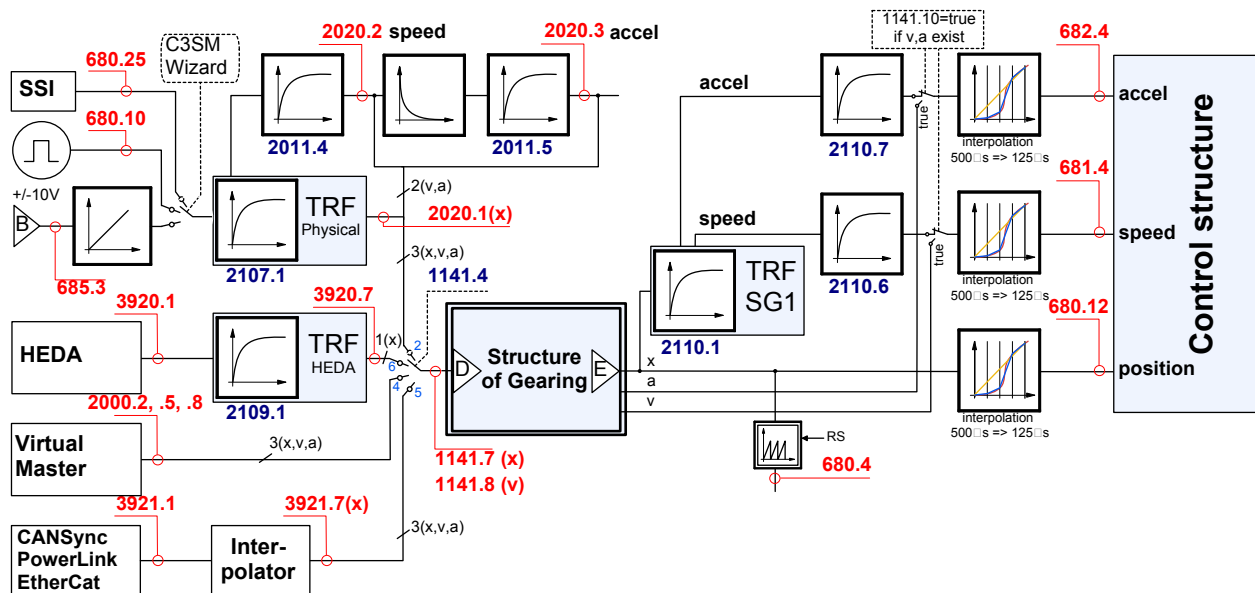
In this chapter you can read about:

Signal filtering for external setpoint specification and electronic gearbox	240
Signal filtering for external setpoint specification and electronic cam	241

The command signal read in from an external source (via HEDA or physical input) can be optimized via different filters.
For this the following filter structure is available:

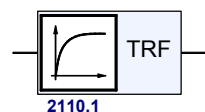
4.4.4.1 Signal filtering for external setpoint specification and electronic gearbox

Does not apply for Compax3I11T11!



B: **Structure image of the signal processing**,
 D/E: **Structure of Gearing** (see page 327)
Control structure (see page 215, see page 217, see page 208)

Symbols



Trackingfilter

The displayed filter influences all outputs of the tracking filter.

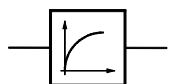
Number: Object number of the filter characteristic



Differentiator

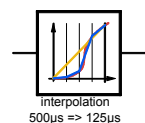
Output signal = $d(\text{input signal})/dt$

The output signal is the derivation (gradient) of the input signal



Filter

Number: Object number of the filter characteristic



Interpolation

Linear Interpolation.

Values in the 500µs grid are converted into the more exact time grid of 125µs.

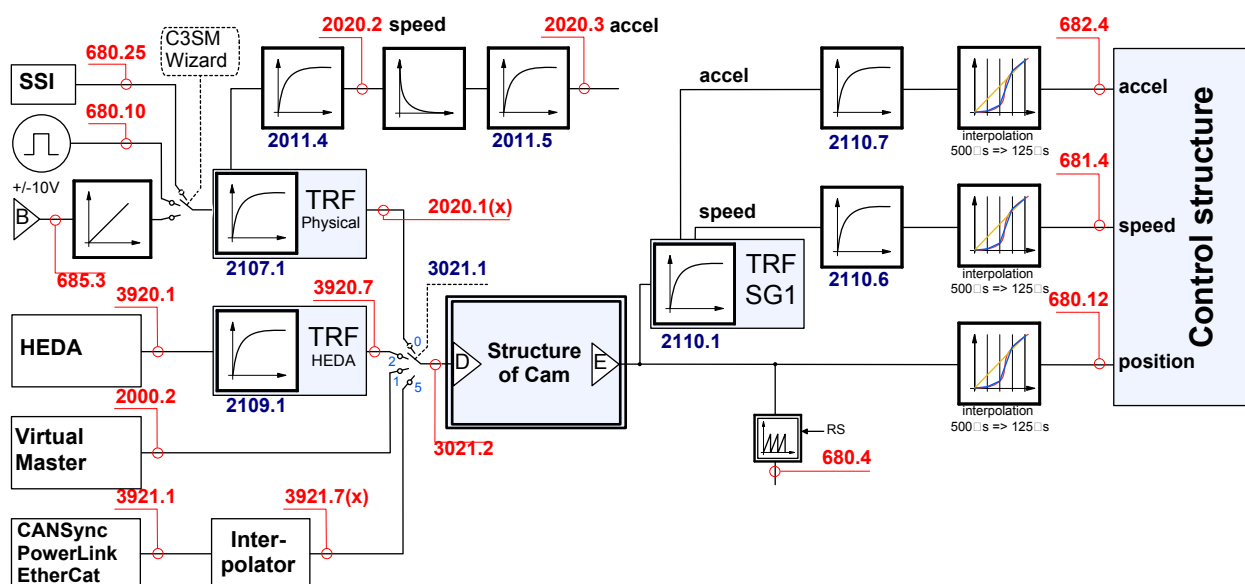
Note:

- ◆ A setpoint jerk setpoint feedback is not required for external setpoint specification.
- ◆ The description of the objects can be found in the **object list** (see page 446).

4.4.4.2

Signal filtering for external setpoint specification and electronic cam

Only Compax3 T40!

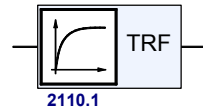


B: **Structure image of the signal processing,**

D/E: Structure of Cam

Control structure (see page 215, see page 217, see page 208)

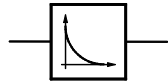
Symbols



Trackingfilter

The displayed filter influences all outputs of the tracking filter.

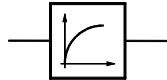
Number: Object number of the filter characteristic



Differentiator

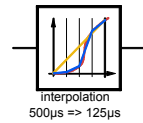
Output signal = $d(\text{input signal})/dt$

The output signal is the derivation (gradient) of the input signal



Filter

Number: Object number of the filter characteristic



Interpolation

Linear Interpolation.

Values in the 500µs grid are converted into the more exact time grid of 125µs.

Note:

- ◆ A setpoint jerk setpoint feedback is not required for external setpoint specification.
- ◆ The description of the objects can be found in the **object list** (see page 446).

4.4.5. Input simulation

In this chapter you can read about:

Calling up the input simulation	243
Functionality	244

Function The input simulation is used for the performance of tests without the complete input/output hardware being necessary.
 The digital inputs (standard and inputs of M10/M12 option) as well as the analog inputs are supported.
 The following operating modes are available for digital inputs:

- ◆ The physical inputs are deactivated, the digital inputs are only influenced via the input simulation.
- ◆ The digital inputs and the physical inputs are logically or-linked.
 This necessitates very careful action, as the required function is, above all with low-active signals, no longer available.

The pre-setting of an analog input value is always made in addition to the physical analog input.

the function of the inputs depends on the Compax3 device type; please refer to the respective online help or the manual.

The input simulation is only possible if the connection with Compax3 is active and if the commissioning mode is deactivated!

4.4.5.1 Calling up the input simulation

Open the optimization window (double click in the C3 ServoManager tree entry: Optimization).
 Activate the Tab "Setup" in the right lower window.
 Clicking on the following button will open a menu; please select the input simulation.



4.4.5.2 Functionality

Window Compax3 InputSimulator:

1st series: Standard inputs I7 ... I0 = "0" button not pressed; = "1" switch pressed

2nd series: Optional digital inputs (M10 / M12)

Green field: port 4 is defined as input

Red field: port 4 is defined as output

the least significant input is always on the right side

3rd series: if the button "deactivating physical inputs" is pressed, all physical, digital inputs are deactivated; only the input simulation is active.

If both sources (physical and simulated inputs) are active, they are or-linked!



Caution!

Please consider the effects of the or-linking; above all on low-active functions.

4th series: Simulation of the analog inputs 0 and 1 in 100mV – steps.

The set value is added to the value on the physical input.

After the input simulation has been called up, all simulated inputs are on "0".

When the input simulation is left, the physical inputs become valid.

4.4.6. Setup mode

The setup mode is used for moving an axis independent of the system control
The following functions are possible:

- ◆ Machine reference run
- ◆ Jog+ / Jog-
- ◆ Activation / deactivation of the motor holding brake.
- ◆ Acknowledging errors
- ◆ Defining and activating a test movement
- ◆ Activating the digital outputs.
- ◆ **Automatic determination of the load characteristic value** (see page 247)
- ◆ **Setup** (see page 246) of the **load control** (see page 157)

Activating the setup mode



By activating the setup mode, the the control program (IEC program) is deactivated; the system function of the device is no longer available. Access via an interface (RS232/RS485, Profibus, CANopen,...) and via digital inputs is deactivated.

Attention! The safety functions are not always guaranteed during the setup mode!

- ◆ In the Commissioning window (left at the bottom) the commissioning mode is activated.
- ◆ Then parameterize the desired test movement in the Parameter window. You can accept changed configuration settings into the current project.
- ◆ Now energize drive in the commissioning window and start the test movement.



Caution! Safeguard the travel range before energizing!

Deactivating the setup mode



If the setup mode is left, the drive is deactivated and the the control program (IEC program) is re-activated.

Note:

- ◆ The parameters of the setup window are saved with the project and are loaded into Compax3 if the setup mode is activated (see below).

4.4.6.1 Motion objects in Compax3

The motion objects in Compax3 describe the active motion set.
The motion objects can be influenced via different interfaces.
The following table describes the correlations:

Source	active motion objects		Compax3 device
	==>	describe	
	<==	read	
Set-up (working with the commissioning window)	==>	◆ With the "accept entry" button. ◆ The current project gets a motion set. Download by activating the motion	Active motion objects ◆ Position [O1111.1] ◆ Speed [O1111.2] ◆ Acceleration [O1111.3] ◆ Deceleration [O1111.4] ◆ jerk* [O1111.5] (Acceleration) ◆ Jerk* [O1111.6] (Deceleration) * for lxxT11 - devices, both jerk values are identical
	<==	◆ When opening the commisisoning window of a new project for the first time. ◆ Activated via the "Upload settings fromdevice" button (bottom at the left side).	
Compax3 ServoManager project	==>	◆ C3lxxT11: via an activated motion set ◆ C3l2xT11: via a configuration download	
	<==	For Compax3 l2xT11: ◆ via a configuration upload ◆ in the commissioning window via "accept configuration"	
Fieldbus (Compax3 l2xTxx)	==>	◆ Changing the motion objects directly	
	<==	◆ Reading the motion objects	
IEC61131-3 program (Compax3 lxxT30, lxxT40)	==>	◆ via positioning modules	

4.4.6.2 Commissioning the load control

If a load control was configured, the following buttons are displayed in the Commissioning window :



- 1 Status of the load control - yellow ==> off; green ==> on
- 2 Activate / Deactivate load control
- 3 **Alignment of the position values** of motor and load
(Load position = Motor position)
Only if the load control is deactivated!

Please note the explanations for the load control (see page 157)!

4.4.7. Load identification

In this chapter you can read about:

Principle.....	247
Boundary conditions	247
Process of the automatic determination of the load characteristic value (load identification)	248
Tips.....	249

Automatic determination of the load characteristic value:

- ◆ of the mass moment of inertia with rotary systems
- ◆ of the mass with linear systems

4.4.7.1 Principle

The load characteristic value is automatically determined.

For this it is necessary to excite the system additionally with a signal (excitation signal = noise).

The excitation signal is fed into the control loop. The control loop dampens the excitation signal. Therefore, the superimposed control loop is set so slowly by reducing the stiffness, that the measurement is not influenced.

A superimposed test movement is additionally possible. This helps to eliminate possible mechanical effects such as rubbing caused by friction.

4.4.7.2 Boundary conditions

If the control is instable before the beginning of the measurement, please reduce the stiffness (in the optimization window at the left bottom)

The following factors can disturb a measurement:

- ◆ Systems with high friction (e.g. linear actuators with sliding guide)
Here, the systems where the static friction is considerably higher than the kinetic friction (slip-stick effect) are especially problematic.
- ◆ Systems with significant slack points (play)
- ◆ Systems with "too light" or susceptible to oscillation bearing of the total drive (rack).
Formation of rack resonances. (e.g. with gantries,...)
- ◆ Non constant disturbance forces which influence the speed development. (e.g. extremely strong slot moments)

The effects of the factors one to three on the measurement can be reduced by using a test movement.

caveat emptor (exclusion of warranty)

Due to multiple possibilities for disturbing influences of a real control path, we cannot accept any liability for secondary damages caused by faultily determined values. Therefore it is essential to verify all values automatically determined before loading them into the control loop.

4.4.7.3 Process of the automatic determination of the load characteristic value (load identification)

- ◆ Please click on "unknown: default values are used" in the configuration wizard in the "External moment of inertia" window.
- ◆ After the configuration download, you can enter directly, that the optimization window is to be opened.
- ◆ In the Commissioning window (left at the bottom) change to commissioning mode.
- ◆ Finally enter the values of the excitation signal and of the test movement in the parameter window.
Parameters of the excitation signal:
 - ◆ Amplitude of the excitation signal in % of the motor reference current
Only an amplitude value causing a distinct disturbance can give a usable result.
 - ◆ Permissible following error
In order to avoid a following error caused by the excitation signal, the permissible following error must be increased for the measurement if necessary.
 - ◆ Selection of the test movement: inactive, reverse, continuous
 - ◆ Parameterizing of the test movement if necessary
- ◆ Now energize drive in the commissioning window and open load identification window.



Caution! Safeguard the travel range before energizing!

- ◆ Starting the load identification.



Caution! The drive will perform a jerky movement during load identification!

- ◆ After the measurement, the values can be accepted. Depending on the application, 2 measurements for minimum external load and maximum external load are recommended.

4.4.7.4 Tips

Tip	Problem	Measures
1	Speed too low (with reverse operation)	Increase maximum speed and adapt travel range*
2	Speed too low (with continuous operation)	Increase maximum speed
3	Test movement missing	A test movement is important for drives with high friction or with mechanical slack points (play).
4	No error detected	Please note the boundary conditions . (see page 247)
5	Speed too low and amplitude of the excitation signal too small (with reverse operation)	Increase amplitude of the excitation signal; increase maximum speed and adapt travel range*
6	♦ Speed too low and ♦ amplitude of the excitation signal too small (with continuous operation)	Increase amplitude of the excitation signal; increase maximum speed.
7	♦ Test movement missing ♦ amplitude of the excitation signal too small	♦ Increase amplitude of the excitation signal or / and ♦ activate an appropriate test movement
8	amplitude of the excitation signal too small	Increase the amplitude of the excitation signal.
9	Following error occurred	Increase the parameter "permissible following error" or decrease the amplitude of the excitation signal.

*if the travel range is too short, the speed is not increased, as the drive does not reach the maximum speed.

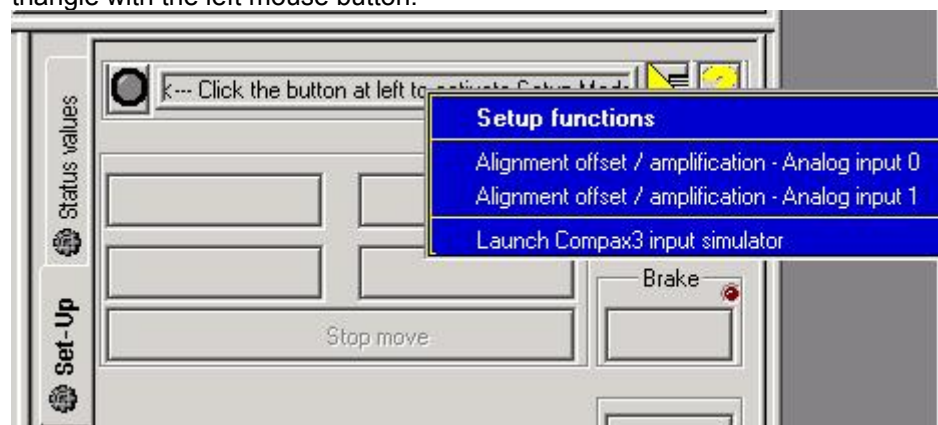
4.4.8. Alignment of the analog inputs

In this chapter you can read about:

Signal processing of the analog inputs.....	250
Offset alignment	250
Gain alignment	250

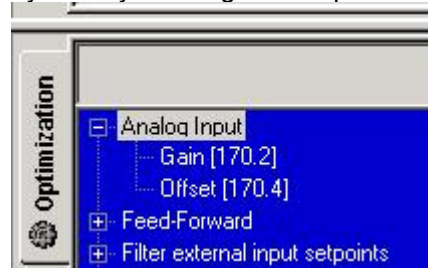
There are two possibilities to align the analog inputs in the optimization window:

- ♦ wizard-guided under commissioning: commissioning functions (click on the yellow triangle with the left mouse button:

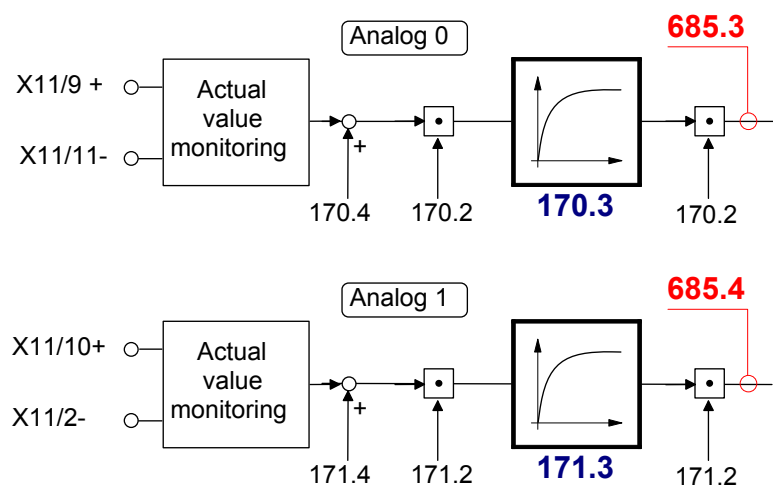


or

◆ by directly entering under optimization: Analog Input



4.4.8.1 Signal processing of the analog inputs



B: Continuable structure image (see page 240)

4.4.8.2 Offset alignment

Performing an offset alignment when working with the $\pm 10V$ analog interface in the optimization window under optimization: Analog input Offset [170.4].

Enter the offset value for 0V input voltage.

The currently entered value is shown in the status value "analog input" (optimizing window at the top right) (unit: 1 $\equiv$ 10V). Enter this value directly with the same sign as offset value.

The status value "analogue input" shows the corrected value.

4.4.8.3 Gain alignment

Performing an offset alignment when working with the $\pm 10V$ analog interface in the optimization window under optimization: Analog Input: Gain [170.2].

A gain factor of 1 has been entered as default value.

The currently entered value is shown in the status value "analogue input" (optimising window at the top right).

The status value "analogue input" shows the corrected value.

4.4.9. C3 ServoSignalAnalyzer

In this chapter you can read about:

ServoSignalAnalyzer – function range	251
Signal analysis overview	252
Installation enable of the ServoSignalAnalyzer	253
Analyses in the time range	255
Measurement of frequency spectra	258
Measurement of frequency responses	261
Overview of the user interface	268
Basics of frequency response measurement	282
Examples are available as a movie in the help file.....	287

4.4.9.1 ServoSignalAnalyzer – function range

The function range of the ServoSignalAnalyzer is divided into 2 units:

Analysis in the time range

This part of the function is freely available within the Compax3 ServoManager.
The Compax3 ServoManager is part of the Compax3 servo drive delivery range.

Analysis in the frequency range

This part of the function requires a licence key which you **can buy** (see page 253)
.
The licence is a company licence and must only be bought once per company.
For each PC you need however an individual key, which you can request individually.

4.4.9.2 Signal analysis overview

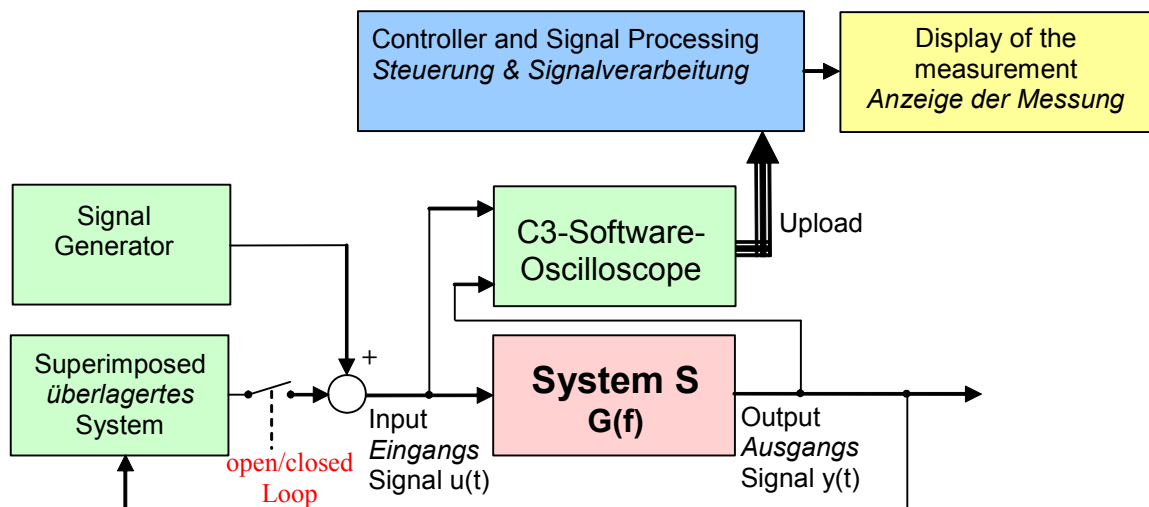
The ServoSignalAnalyzer offers three basic methods of analyzing systems:

- ◆ Analysis in the time range by measuring the step response
- ◆ Spectral analysis of individual signals
- ◆ Measurement of frequency response (Bode diagram) of the position control or of individual parts of the control as well as of the control path

These functions are available in the Compax3 ServoManager after the **activation** (see page 253) with the aid of a system-dependent key.

You do not require expensive and complex measurement equipment -> a Compax3 device and a PC will do!

Basic structure of the signal analysis



Systems / signals

Depending on the kind of measurement, the SignalAnalyzer can help analyze the most different signals and systems.

Signal generator

This allows to inject different excitation signals (step, sine and noise signals) into the control loop.

Superposed system

For different analyses, superposed systems must be manipulated in order to allow a measurement. After the measurement, the changes made for this purpose are reset

C3 software oscilloscope

With the aid of the software oscilloscope, the contents of different objects can be registered and be loaded into the PC for further analysis.

Control and signal processing

The control of the entire measurement as well as the processing of the uploaded sample data are made in the PC.

4.4.9.3 Installation enable of the ServoSignalAnalyzer

In this chapter you can read about:

Prerequisites	253
Installation	253
Activation	253

Prerequisites

- ◆ Compax3 with up-to-date controller board (CTP 17)
- ◆ Firmware version R06-0 installed

Installation

- ◆ Execution of the C3 ServoManager Setup (on CD)
- ◆ If the firmware is too old => update with the aid of the firmware from the CD

Activation

In order to being able to use the analysis functions in the frequency range (for example frequency response measurement), a software activation is required.

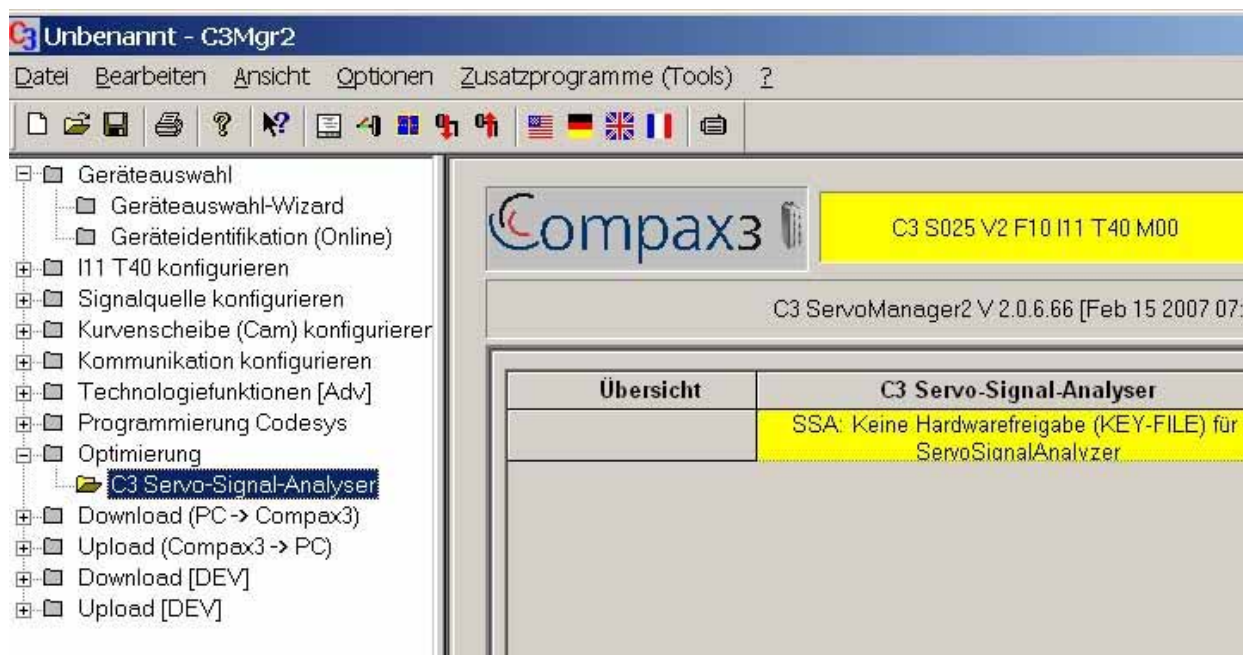
Please observe:

The activation is only valid for the PC on which it was performed!

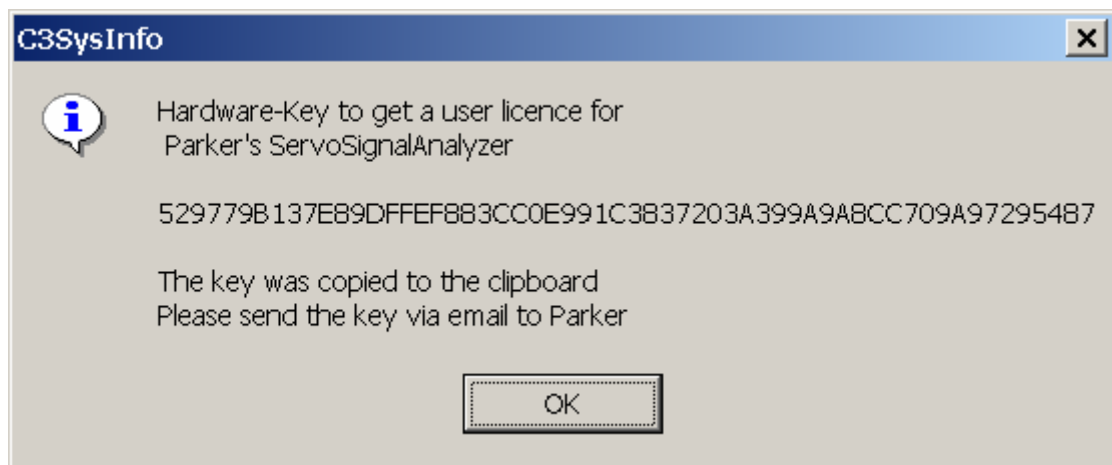
Caution! : If the PC disposes of network adapters which are removed at times (e.g. PCMCIA cards or notebook docking stations), these adapters should be removed before generating the key!

In order to activate the ServoSignalAnalyzer, please follow these steps:

- ◆ Start the Compax3 ServoManager.



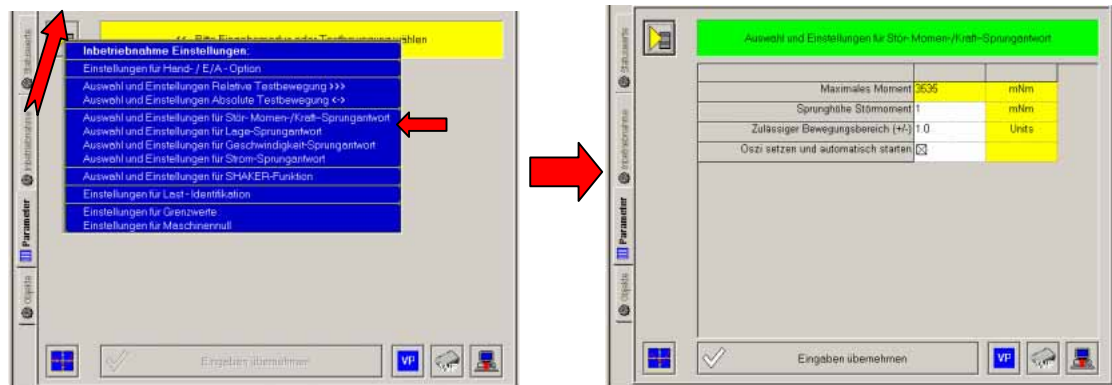
- ◆ Select the C3 ServoSignalAnalyzer in the function tree under optimization. In the right part of the window you can see the note that no key file was found.
- ◆ A double click on the preselected C3 ServoSignalAnalyzer will generate a system-dependent key.



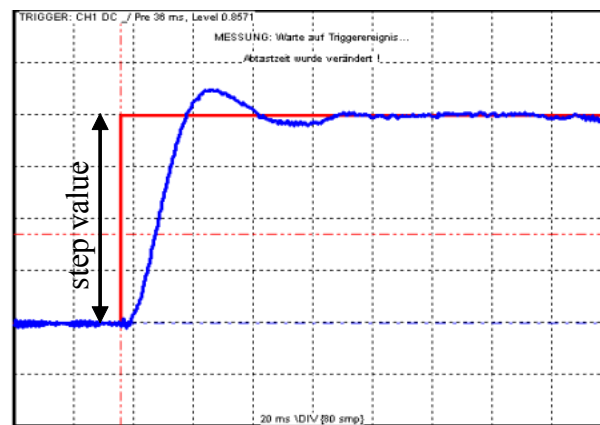
- ◆ Acknowledge with OK and enter the key, which is on your clipboard, into an e-mail, which you please send to **eme.ssalicence@parker.com** (mailto:eme.ssalicence@parker.com).
- ◆ After receipt of the reply, copy the attached file "C3_SSA.KEY" into the C3 ServoManager directory (C:\Programs\Parker Hannifin\C3Mgr2\).
- ◆ => the software is activated.

4.4.9.4 Analyses in the time range

Selection and parameterization of the desired analysis function



Exemplary step function



The following functions are available:

Position demand value step: For analysis of the demand value behavior of the position control

Step value < (admissible motion range / 2)

=> even a 100% overshoot does not incite an error message

Speed demand value step: For analysis of the demand value behavior of the speed control

The position control is switched off during the measurement, this might lead in exceptional cases to a slow drift of the position.
Furthermore you should make sure that the selected speed step value corresponds to the parameterized admissible motion range.

Step value < (admissible motion range / time of measurement)

with time of measurement > 2s

Current demand value step: For analysis of the demand value behavior of the current control

The current setpoint jerk is set at the end of the oscilloscope recording time, but is reset to 0 after max. 50mS.



Caution!

- ◆ Many systems are not stable without control!
- ◆ Position as well as speed control are switched off during measurement ==>
no measurement on z-axes!

disturbance torque- / force step response: For analysis of the disturbance value behavior of the control

The step of an external disturbance force is simulated and the reaction of the controller is registered.

Shaker function

For this, a sine signal is injected to the current which is used to excite the mechanic system. This allows to analyze the oscillation behavior - what oscillates at which frequency.

Basic settings of the analysis functions:

Maximum torque / maximum current / maximum speed (display):

This is used as a lead for the selection of a suitable step value and indicates which maximum step value is possible.

Step value:

Gives the value of a step.

permissible motion range (+/-):

- ◆ Indication, in which position window the axis may move during the analysis.
- ◆ This range is not left even in the event of an error.

- ◆ If the drive approaches the limits of the motion range, the controller will decelerate so that the drive will come to a standstill within the permitted motion range. The maximum permitted velocity is used to calculate the deceleration ramp, therefore the drive stops even before reaching the range limits and reports an error.
- ◆ Please make sure that a sufficiently large movement is set for the measurement and that it will be reduced by a high maximum permitted velocity.
- ◆ The motion range monitoring is especially important during current step responses, as position as well as speed control are deactivated during the measurement.

Max permitted speed

When exceeding this value, an error is triggered, the controller decelerates and reports an error.

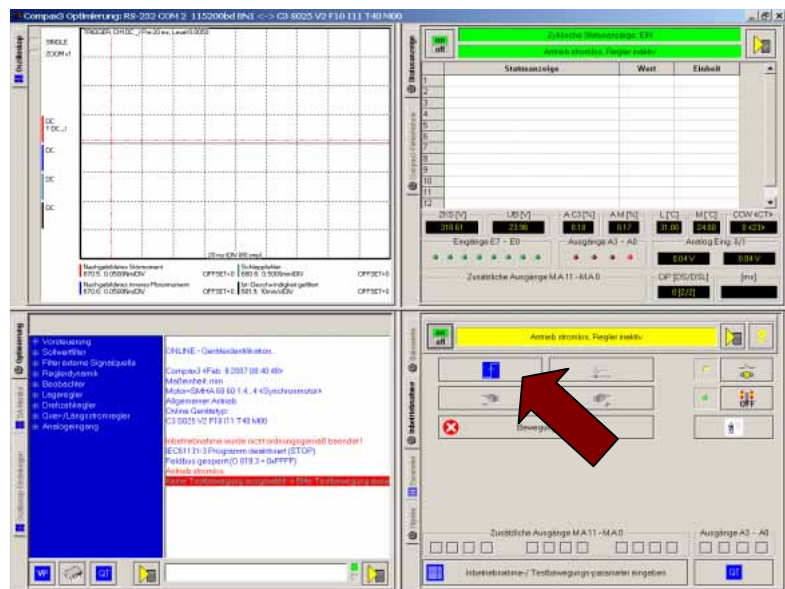
When measuring the velocity setpoint jerk, the maximum permitted velocity is set to twice the step height.

Setting and automatic start of the oscilloscope:

After pressing "accept entries", the parameters of the oscilloscope (such as scanning time and the assignment of the individual channels) are automatically set to default values according to the respective step value.

When starting the step function, the oscilloscope is automatically started.

Start of the measurement



The start of the step function is made with the aid of the highlighted button.

4.4.9.5 Measurement of frequency spectra

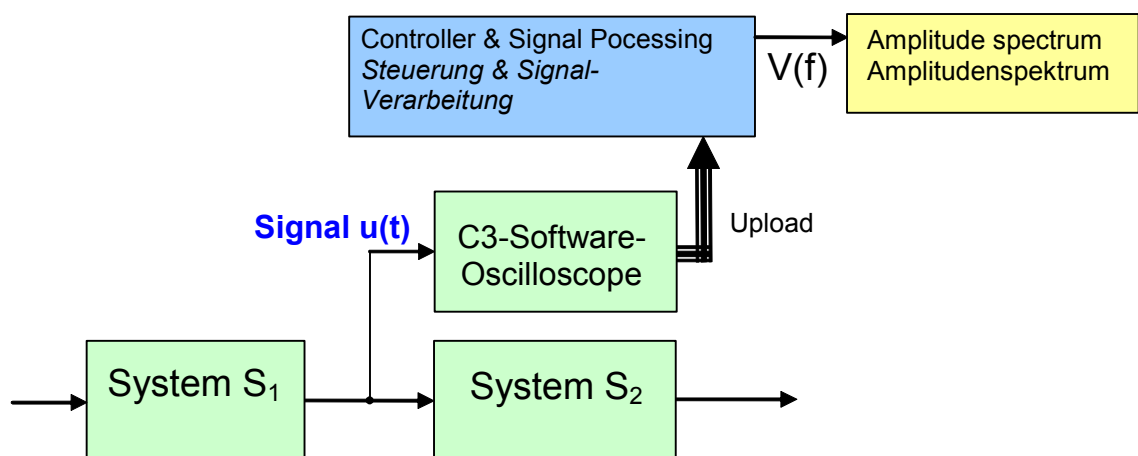
In this chapter you can read about:

Functionality of the measurement.....	258
Leak effect and windowing	259

Please note that you require a licence key (see page 253, see page 251) for this application!

Functionality of the measurement

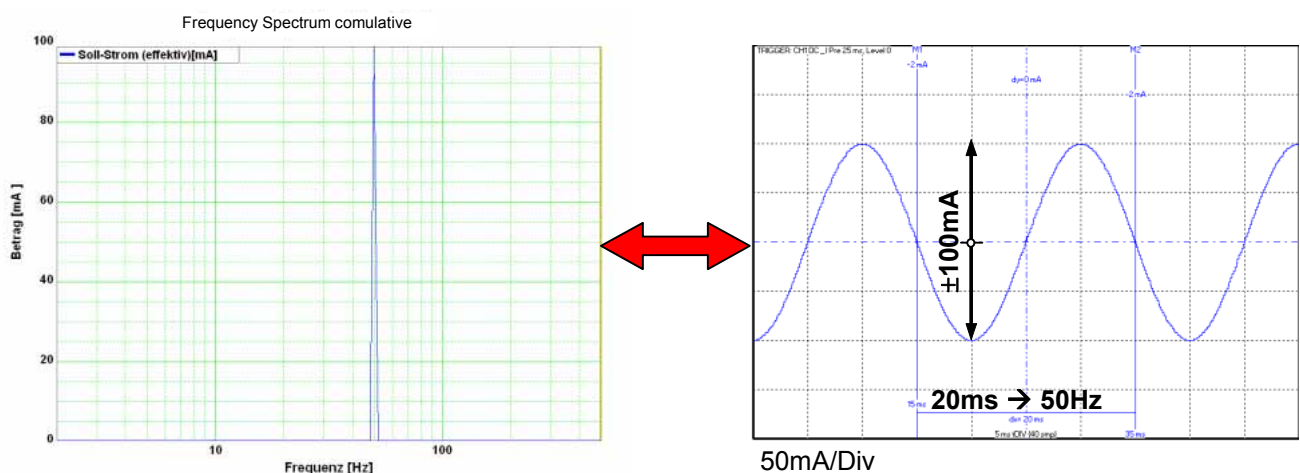
Measurement of the spectral analysis



During the spectral analysis of scanned signals with the aid of the discrete Fourier transformation, a so-called frequency resolution (Δf) results, Δf being $=fA/N$, independently of the scanning frequency (fA) and of the number of measurement values used (N).

The spectra of scanned signals are only defined for frequencies, which are an integer multiple of this frequency resolution.

Interpretation of the frequency spectrum

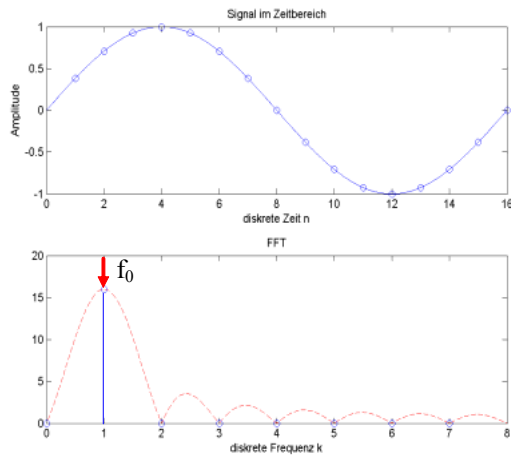


Leak effect and windowing

If frequencies not corresponding to the frequency resolution are present in the analyzed spectrum, the so-called leak effect can be caused.

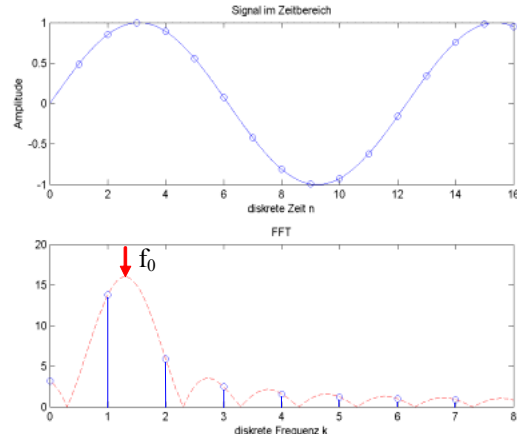
Display of the leak effect with the aid of a 16 point discrete Fourier transformation

Complete oscillation period in the scanning period



Envelope without leak effect

Non complete oscillation period in the scanning period



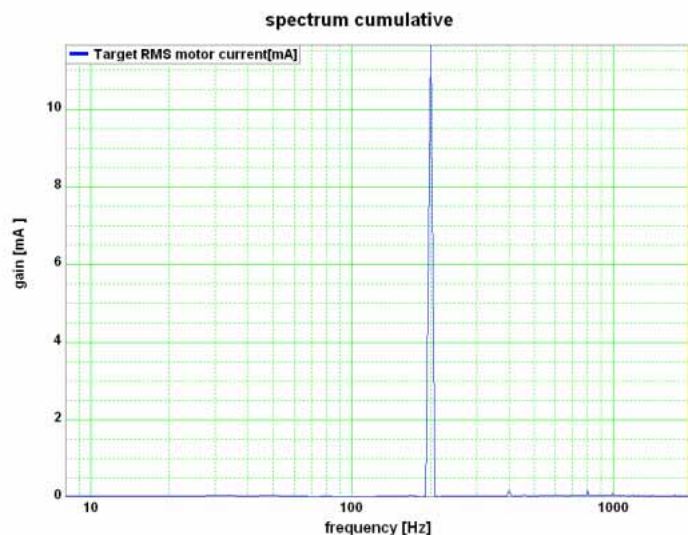
Envelope with leak effect

Sine at 200Hz without windowing

Consequence of the leak effect shown at the example of a sine signal.

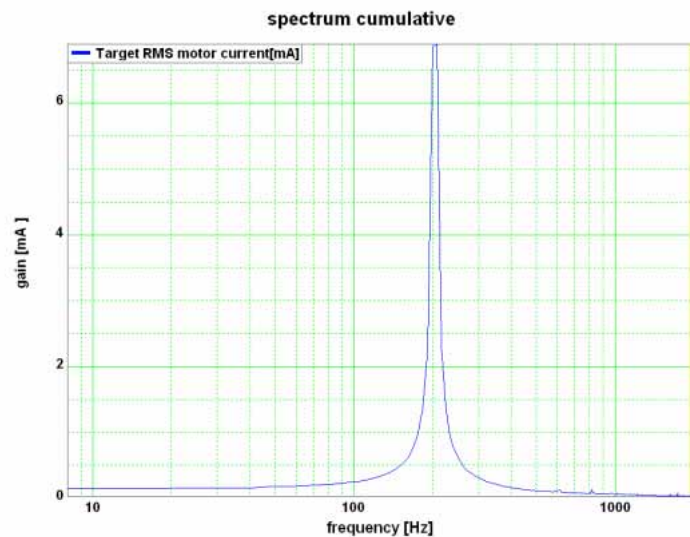
($f_A=4000\text{Hz}$; $N=500$; $\Rightarrow \Delta f=8\text{Hz}$)

$f_0=200\text{Hz} = 25 \cdot \Delta f$ frequency corresponds to the frequency-resolution



The sine frequency is exactly on a multiple of the frequency resolution ($200\text{Hz} / 8\text{Hz}=25$). The spectre is clearly separated and there are no leak effects visible.

Sine at 204Hz



$\Delta f = 8\text{Hz} / f_0 = 204\text{Hz} = 25,5 \cdot \Delta f$ / frequency does not correspond to the frequency resolution!

The sine frequency has only minimally changed, due to which it does, however, no longer match the frequency resolution ($204\text{Hz}/8\text{Hz}=25,5$) => leak effect

Two consequences are visible:

The spectre is faded in the ranges at the right and at the left of the sine frequency. In this range, an amplitude is displayed, even though these frequencies are not contained in the real signal.

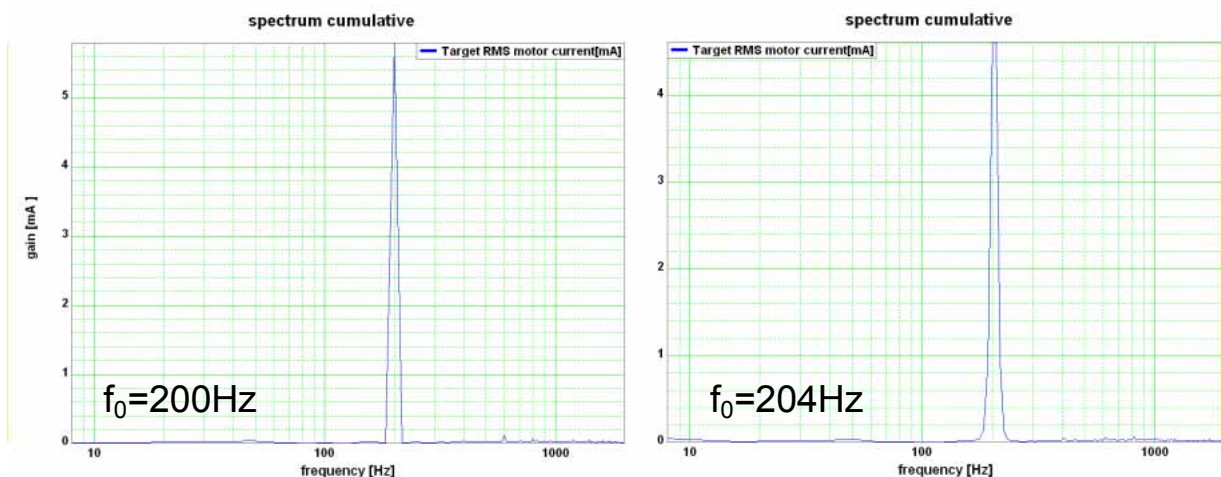
- ◆ The height of the peak of the sine frequency is reduced, => it seems as if the signal energy is leaking out and distributing over the spectre. This explains the term leak effect.

Windowing

With the aid of the windowing, leak effects can be avoided. There are many different kinds of windowing, who do all have the same restrictions.

- ◆ windowing reduces the total energy of the analyzed signal, which results in a reduced amplitude of all measured frequencies.
- ◆ Individual frequency peaks do not appear so sharp and narrow as with measurements without windowing.

Sine at 200Hz and 204Hz with Hanning windowing



4.4.9.6 Measurement of frequency responses

In this chapter you can read about:

Safety instructions concerning the frequency response measurement	261
Functionality of the measurement.....	261
Open/Closed Loop frequency response measurement	263
Excitation Signal	264
Non-linearities and their effects	265

Please note that you require a licence key (see page 253, see page 251) for this application!

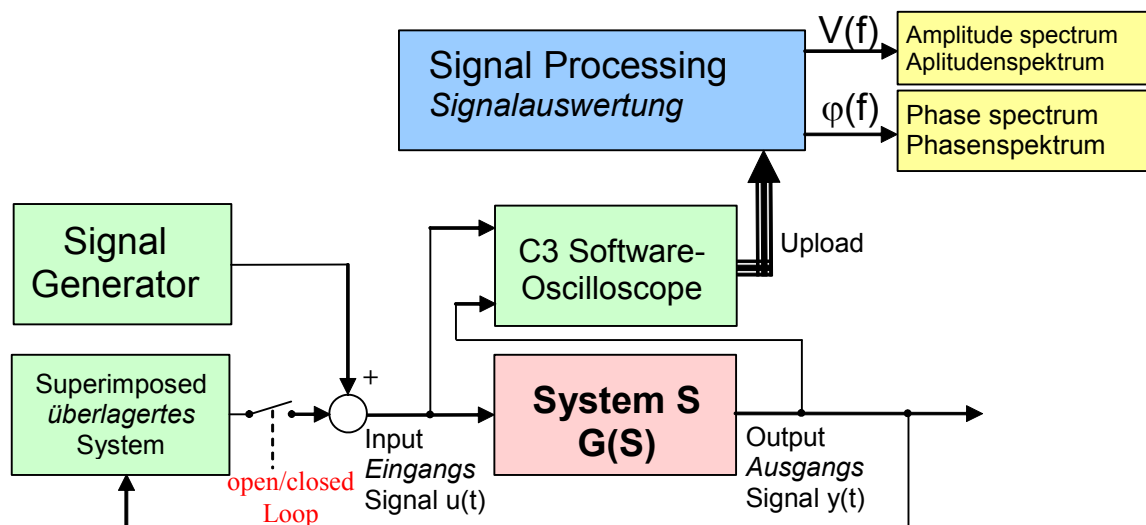
Safety instructions concerning the frequency response measurement

During the measurement of the frequency response, the control is changed and influenced in multiple ways. You should therefore respect the following notes:

- ◆ During the measurement, the entire system is excited via a broad frequency spectrum. This might damage especially sensitive components (such as lenses). The risk increases with the extent of the excitation. In addition, natural mechanical frequencies may cause an increased excitation of individual components.
- ◆ The measurement of the frequency response can only be made in the setup mode with energized controller.
- ◆ During the current measurement (between start and stop of the measurement), no write flash may be executed.
- ◆ In the event of a break in communication during the measurement, the controller must be switched off and then on again in order to reestablish the original status.
- ◆ Changes of the controller parameters during the measurement are not permitted. Those may be overwritten by standard values when the measurement is terminated.

Functionality of the measurement

Basic structure of a frequency response measurement



In general, the analysis of the dynamic behavior of a system is made by analyzing the input and output signals.

If you transform the input signal as well as the output signal of a system into the range (Fourier transformation) and then divide the output signal by the input signal, you get the complex frequency response of the system.

$$G(s) = \frac{Y(s)}{U(s)} \quad \text{with} \quad \begin{array}{l} y(t) \xrightarrow{F} Y(s) \\ u(t) \xrightarrow{F} U(s) \end{array}$$

A problem are, however, superimposed systems (the control)
Course of the measurement

- ◆ superimposed controls are switched of (open Loop) or attenuated
- ◆ The excitation signal is injected in front of the system to be measured with the aid of the signal generator. Wait, until the system settled.
- ◆ Execution of the measurement: Registration of input and output signal with the aid of the oscilloscope.
- ◆ Upload of the measurement values from the controller into the PC.
- ◆ Processing of the measurement values into a frequency response
- ◆ If a cumulated measurement is configured: Averaging over several frequency responses.

During cumulated measurement, an average is taken over all measurements in the result memory and the result is then put out.

Open/Closed Loop frequency response measurement

In order to be able to analyze the transmission behavior of subordinate systems (such as for example speed control, current control or mechanical system), the influence of the superposed controls on the measurement must be avoided.

Influence of a superposed system on the frequency response measured

In the simplest case, the superposed controls are switched off completely (Open Loop) This provides the best measurement results due to the elimination of any influence caused by the superposed controls.

This is, however, rarely possible for reasons of safety or feasibility.



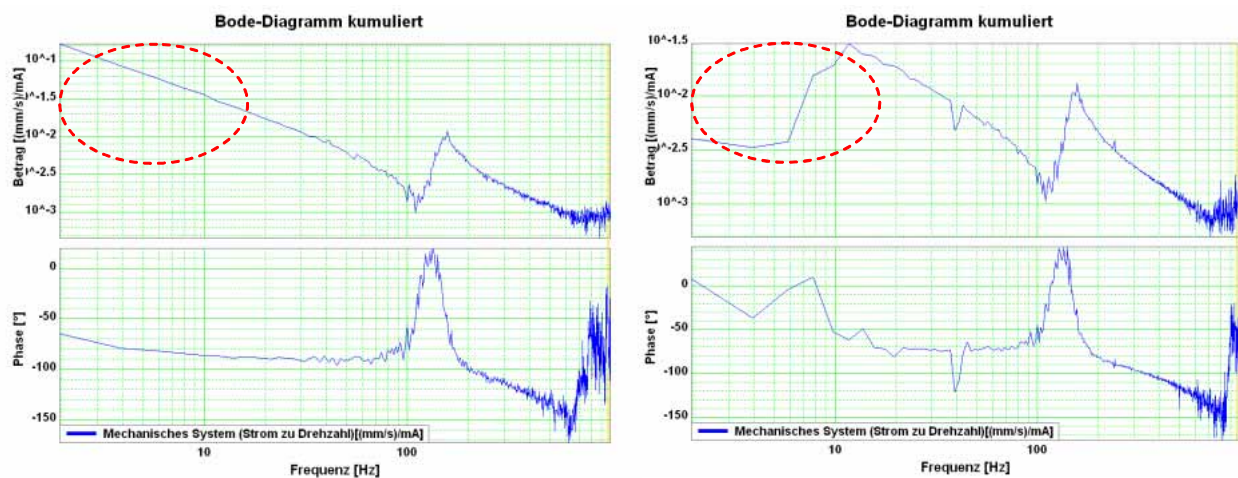
Caution!

- ◆ Many systems are not stable without control!
- ◆ Position as well as speed control are switched off during measurement ==>
no measurement on z-axes!

If you want to analyze for example the mechanic system of a z-axis, the position control as well as the speed control must remain active.

In systems subject to friction it may be necessary in order to improve the quality of the measurement, to **move the system with a superimposed speed** (see page 266), which is however only possible with a closed loop measurement.

Influence of an active superposed control on the result of the measurement



At the left without, at the right with the influence of the superposed control

In order to attenuate the influence of the superposed controls, the controller bandwidth is reduced to such an extent, that their influence on the measurement is negligible.

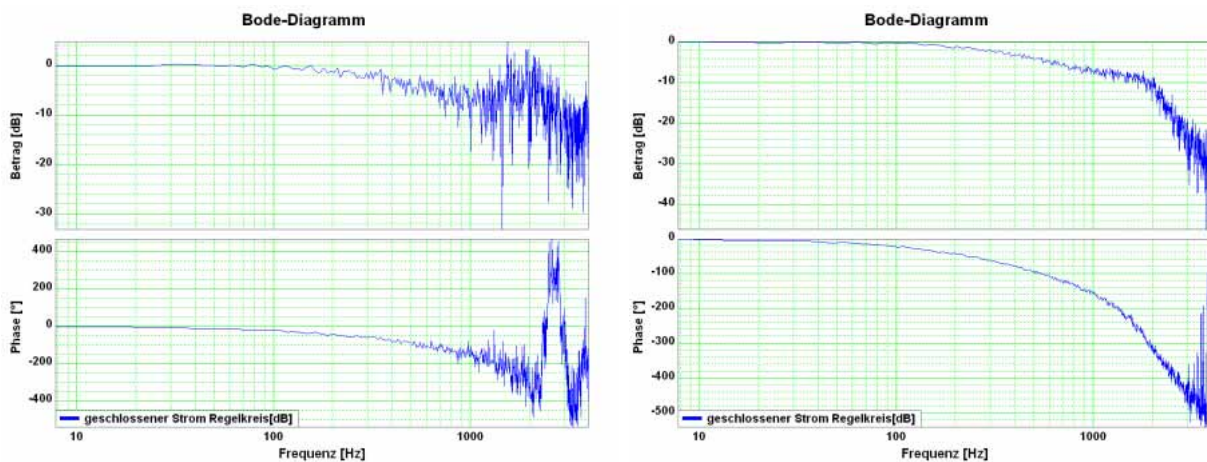
Excitation Signal

In order to be able to analyze the behavior of the system at individual frequencies, it is necessary that these frequencies can be measured in the input signal as well as in the output signal. For this, a signal generator excites all frequencies to be measured. For this applies, that the signal noise distance of the measurement is the larger, the larger the excitation of the system.
High noise distance => low influence of disturbances on the measurement.

For this, an excitation signal is injected in front of the system to be measured.

The power (amplitude) of the excitation signal can be set.
Start with a small amplitude and increase the amplitude slowly during the current measurement until the result of the measurement shows the desired quality.

Influence of the excitation amplitude on the quality of the measurement results



left: too small amplitude of the excitation signal (7.3mA)

right: suitable amplitude of the excitation signal (73mA)

In the case of non-linearities in the system, an increase in the excitation may however lead to a **decline of the quality of the measurement** (see page 265)

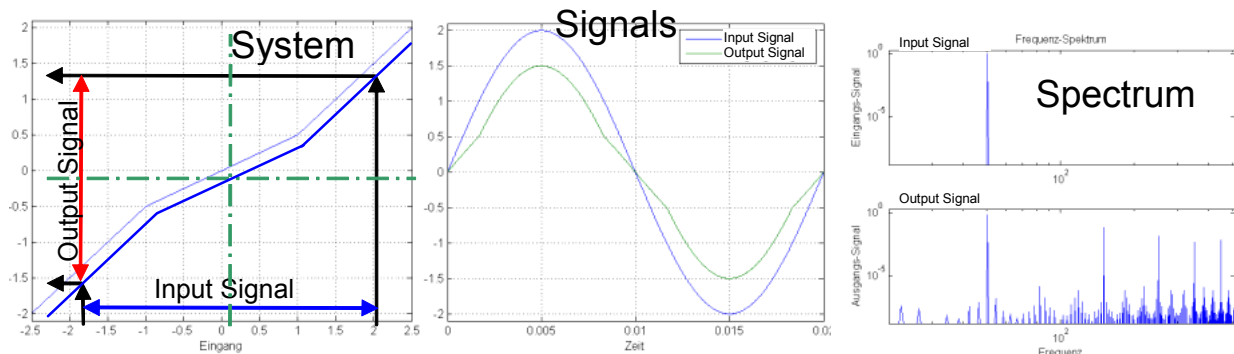
Non-linearities and their effects

In this chapter you can read about:

Attenuation of the excitation amplitude..... 265
 Shifting the working point into a linear range..... 266

Non-linearities in mechanical systems are for example due to friction, backlash or position-dependent transmissions (cams and crankshaft drives). In general, the frequency response is only defined for linear systems (see **Linear Systems 7.2** (see page 283)). What happens in the frequency range in the event of a non-linear system, is shown below.

Signal amplitude too high => non-linearity in the signal range



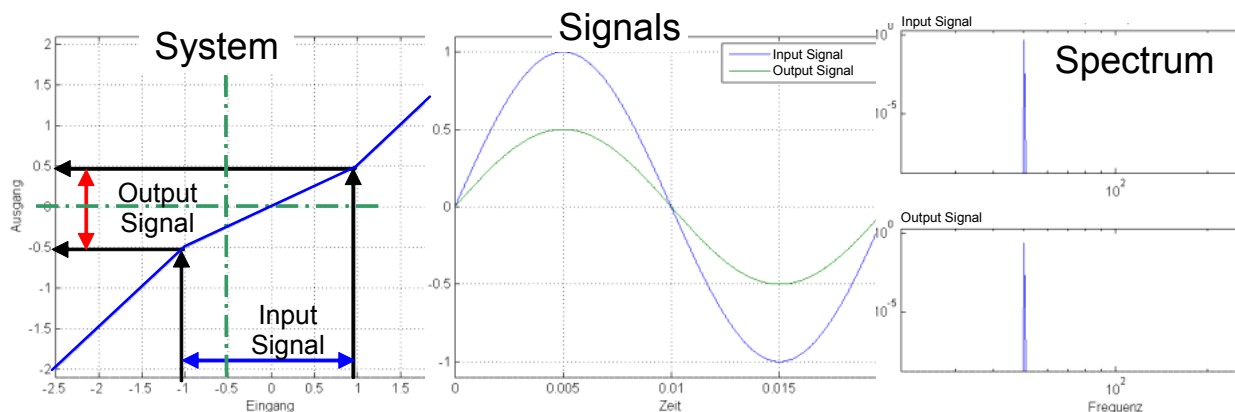
Due to the non-linear transmission behavior of the system, many "new" frequencies were generated in the output signal. In the frequency response, only one change of the frequency present in the input signal can be displayed meaningfully.

=> The frequencies generated in the spectre of the output signal lead to a deterioration of the measured frequency response.

There are however two possibilities to make successful measurements of frequency responses in spite of non-linearities present:

Attenuation of the excitation amplitude

Signal amplitude too small => no non-linearity in the signal range



The signal range is reduced so that approximately linear conditions are valid. The results of the measurement will then display the dynamic behavior at the working point.

Example cam drive:

If the drive moves considerably (e.g. 180°) during the measurement, the behavior of the system will change greatly over this range => caused by non-linearities in the signal range.

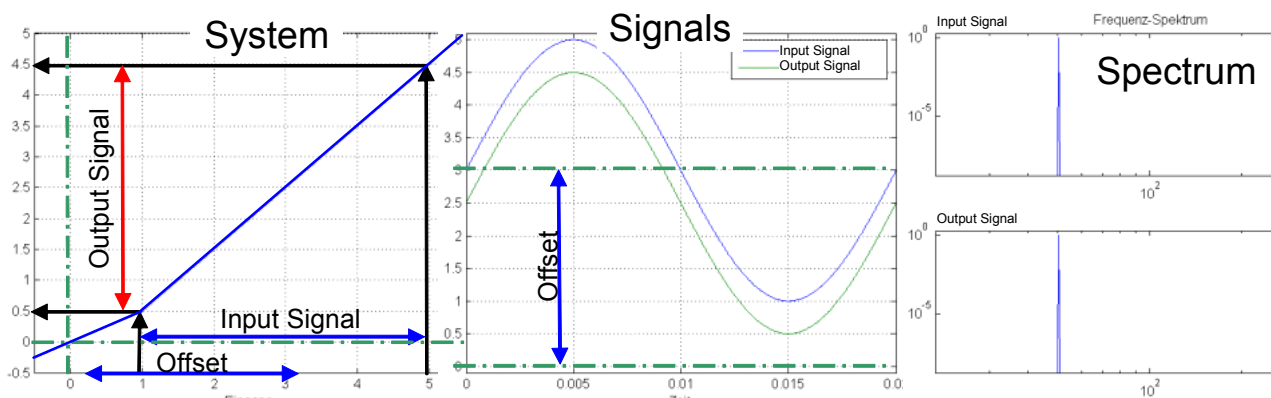
An inexact measurement is the result.

If the excitation is reduced so that the drive will move only by a few degrees, the behavior of the system at this working point will be approximately constant.

An exact measurement is the result.

Shifting the working point into a linear range

Signal amplitude large with offset => no non-linearity in the signal range



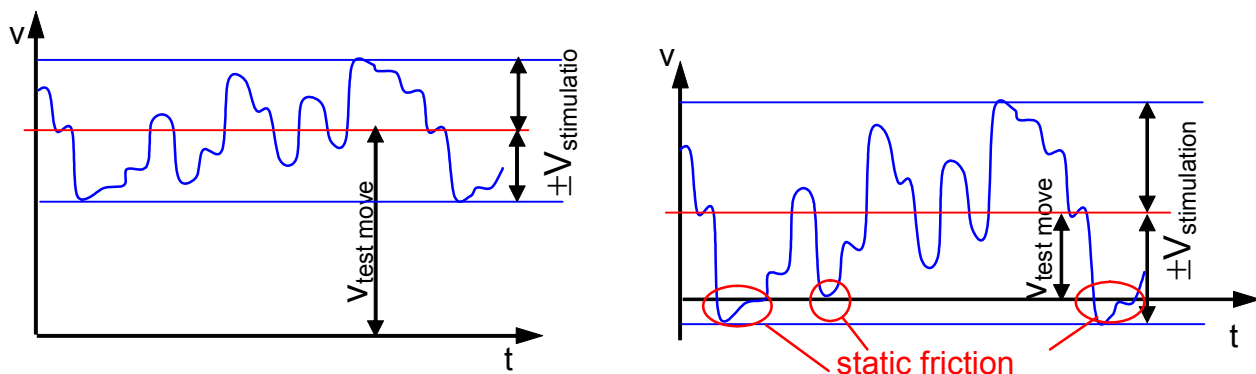
For this, the signal range is shifted so that approximately linear conditions are valid => the results of the measurement show the dynamic behavior at the working point.

Example rubbing caused by friction:

In systems subject to a distinct transition between rubbing caused by friction and sliding friction, the rubbing force will reduce abruptly as soon as the drive is moved ($v > 0$). With a motor at standstill, the excitation signal will cause a multiple passing through the range of rubbing friction during measurement. Due to the non-linearity in the signal range, the resulting measurement will be inexact.

If the drive moves, however, fast enough during the measurement, so that the speed will not become zero during the measurement, the system remains in sliding friction and a precise measurement can be obtained.

Optimal measurement with rubbing friction



$V_{\text{test move}}$: Speed of the test movement

$V_{\text{stimulation}}$: Speed of the excitation signal

Example backlash: (for example in gearboxes)

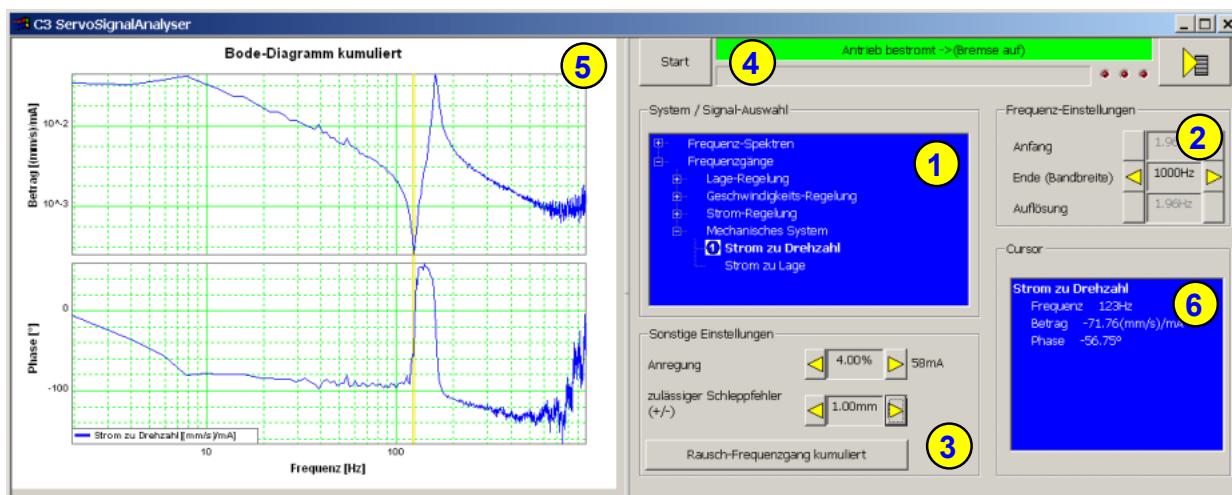
Here, non-linearities are caused, if the tooth edges will turn from one side to the other during measurement. The reason for this is a change of the sign of the force transmitted by the gearbox.

In order to avoid this, you can try to transmit a constant torque by keeping a constant speed and to avoid a change of the sign during the measurement by choosing a relatively small excitation amplitude.

4.4.9.7 Overview of the user interface

In this chapter you can read about:

Selection of the signal or system to be measured	268
Frequency settings	273
velocity control	273
Other settings	275
Operating and status field	277
Display of the measurement result	280
Display of the measurement point at the cursor position	281



- (1) Selection of the signal or system to be measured (see page 268)
- (2) Frequency settings (see page 273)
- (3) Other settings (see page 275)
- (4) Operating and status field (see page 277)
- (5) Display of the measurement result (see page 280)
- (6) Display of the measurement point at the cursor position (see page 281)

Selection of the signal or system to be measured.

In this chapter you can read about:

Current control	269
Mechanical system	269
Position control	271

With the aid of the tree structure, you may select what you want to measure. Here, the selection is made, if a frequency spectrum or a frequency response is to be measured.

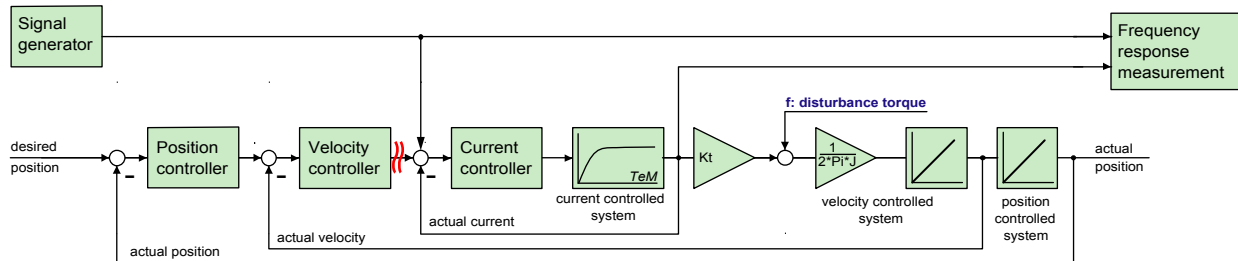
The shown structures are simplified in such as all feedbacks are displayed without special transmission behavior. This is surely not the case in reality, serves however a better overview.

Current control

Closed current control

Shows the dynamic behavior of the closed current control.

=> How a signal on the current demand value is transmitted to the current actual value.
(response)



Signal Generator

Position controller

actual position

desired position

Velocity controller

actual velocity

Current controller

actual current

current controlled system

disturbance torque

velocity controlled system

position controlled system

Frequency response measurement

Signal Generator

Actual position value

Geschwindigkeitsregler

Actual speed value

Actual current value

Current controlled system

Disturbance torque

Speed controlled system

Position controlled system

Frequency response measurement

Application:

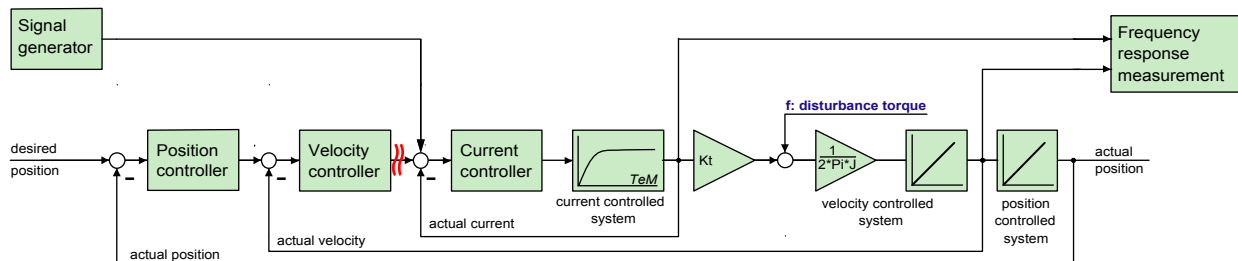
During the optimization of the current control for verification

♦ for the design of superposed controllers.

Mechanical system

Current to velocity

Shows the dynamic behavior between the measured current actual value and the velocity actual value



Signal Generator	Signal Generator
Position controller	
actual position	Actual position value
desired position	
Velocity controller	Geschwindigkeitsregler
actual velocity	Actual speed value
Current controller	
actual current	Actual current value
current controlled system	Current controlled system
disturbance torque	Disturbance torque
velocity controlled system	Speed controlled system
position controlled system	Position controlled system
Frequency response measurement	Frequency response measurement

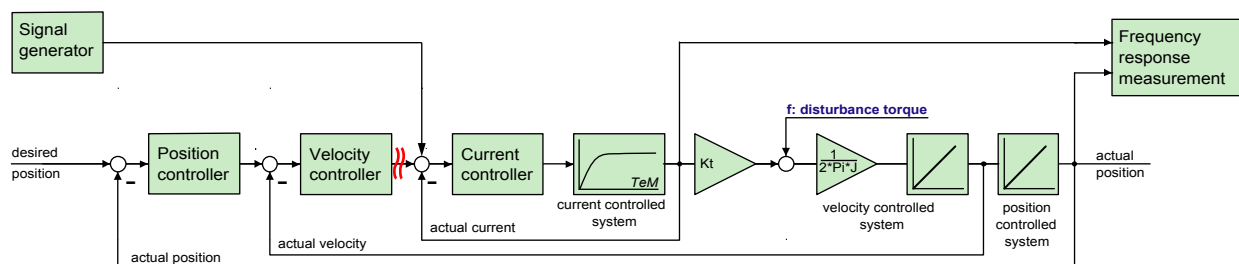
Reflects the transmission behavior between the acceleration at the motor and the acceleration at the load to be moved.

Application:

- ◆ for the analysis of the dynamic behavior of the mechanic system

Current to position

Shows the dynamic behavior between current actual value and position actual value.



Signal Generator	Signal Generator
Position controller	
actual position	Actual position value
desired position	
Velocity controller	Geschwindigkeitsregler
actual velocity	Actual speed value
Current controller	
actual current	Actual current value
current controlled system	Current controlled system
disturbance torque	Disturbance torque
velocity controlled system	Speed controlled system
position controlled system	Position controlled system
Frequency response measurement	Frequency response measurement

use:

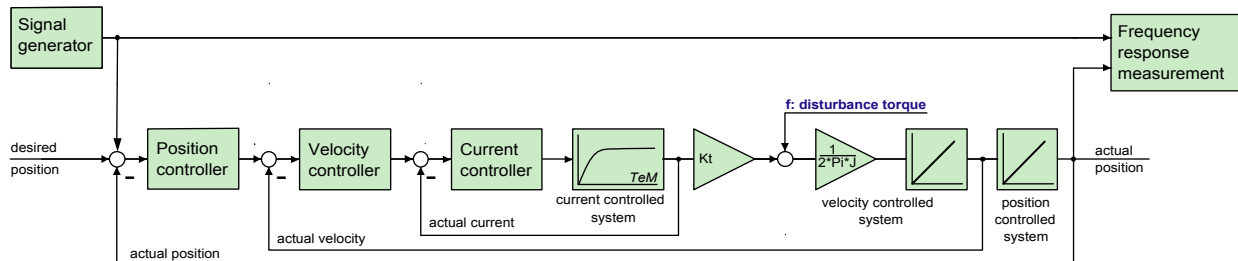
- ◆ for the analysis of the dynamic behavior of the mechanic system

Position control

Closed position control

Shows the dynamic behavior of the closed position control.

=> How a signal on the position demand value is transmitted to the position actual value.



Signal Generator

Position controller

actual position

desired position

Velocity controller

actual velocity

Current controller

actual current

current controlled system

disturbance torque

velocity controlled system

position controlled system

Frequency response measurement

Signal Generator

Actual position value

Geschwindigkeitsregler

Actual speed value

Actual current value

Current controlled system

Disturbance torque

Speed controlled system

Position controlled system

Frequency response measurement

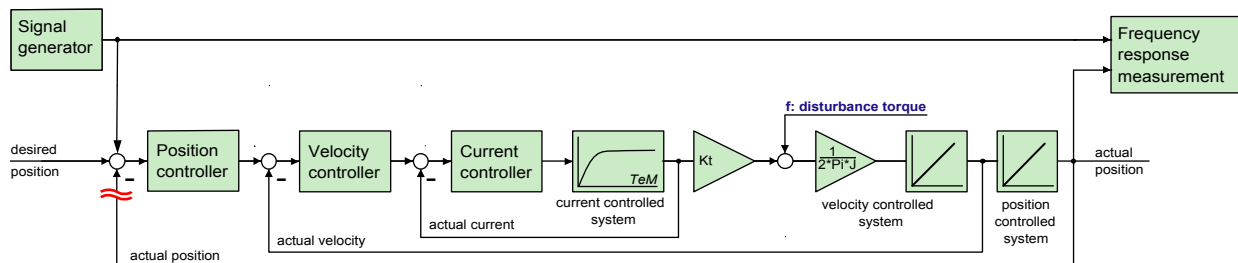
Application:

for the design of superposed controllers or systems.

- ◆ For the verification of the obtained controller speed during optimization
- ◆ for the revision of the controller design of the position control

open position control

Shows the dynamic behavior of all components in the position control loop, but without closing it.



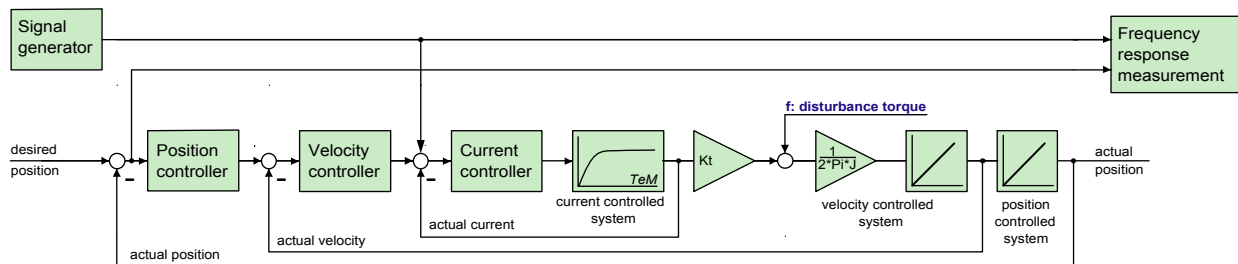
Signal Generator	Signal Generator
Position controller	
actual position	Actual position value
desired position	
Velocity controller	Geschwindigkeitsregler
actual velocity	Actual speed value
Current controller	
actual current	Actual current value
current controlled system	Current controlled system
disturbance torque	Disturbance torque
velocity controlled system	Speed controlled system
position controlled system	Position controlled system
Frequency response measurement	Frequency response measurement

use:

- ◆ For the graphic design of the position control.

Compliance of Position control

Shows the dynamic disturbance value behavior of the position control.
 => which dynamic influence does a disturbance torque have on the following error.
 The disturbance torque is injected as disturbance current => this corresponds to the effect of a disturbance torque f

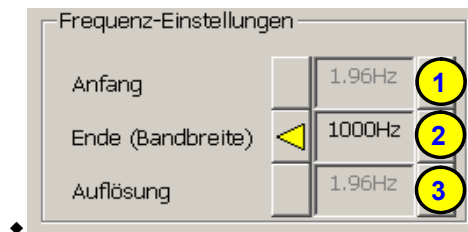


Signal Generator	Signal Generator
Position controller	
actual position	Actual position value
desired position	
Velocity controller	Geschwindigkeitsregler
actual velocity	Actual speed value
Current controller	
actual current	Actual current value
current controlled system	Current controlled system
disturbance torque	Disturbance torque
velocity controlled system	Speed controlled system
position controlled system	Position controlled system
Frequency response measurement	Frequency response measurement

use:

- ◆ Verification of the dynamic disturbance value behavior of the position control.
- ◆ Which following error generates a sinusoidal disturbance torque / disturbance current with the frequency f ?
- ◆ The frequency response of the compliance corresponds to the disturbance step response in the time range

Frequency settings



(1) start frequency

- ◆ This is the smallest frequency at which is still measured. During the measurement of frequency spectrum and noise frequency response this results automatically from the bandwidth and is only displayed as an information.

(2) End (bandwidth)

- ◆ This corresponds to the highest frequency which is measured. Start frequency as well as the frequency resolution can be varied with the aid of the bandwidth for frequency spectrum and noise frequency response.

(3) Frequency resolution (see page 258)

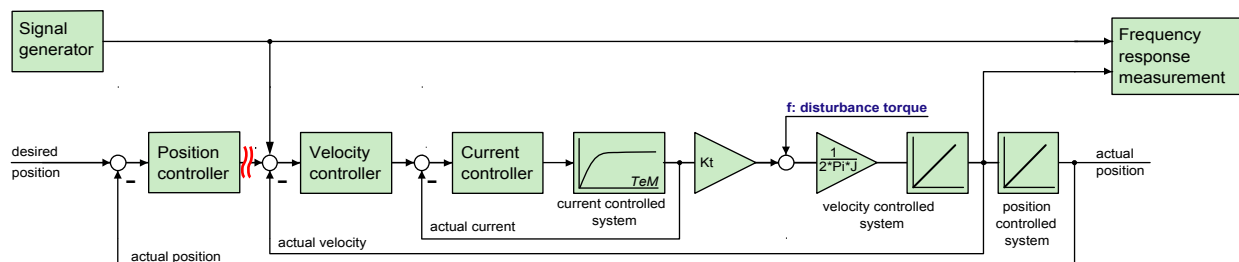
- ◆ During the measurement of frequency spectrum and noise frequency response this results automatically from the bandwidth and is only displayed as an information.

velocity control

Closed velocity control

Shows the dynamic behavior of the closed velocity control.

=> How a signal on the velocity demand value is transmitted to the velocity actual value.



Signal Generator
Position controller
actual position
desired position
Velocity controller
actual velocity
Current controller
actual current
current controlled system
disturbance torque
velocity controlled system
position controlled system
Frequency response measurement

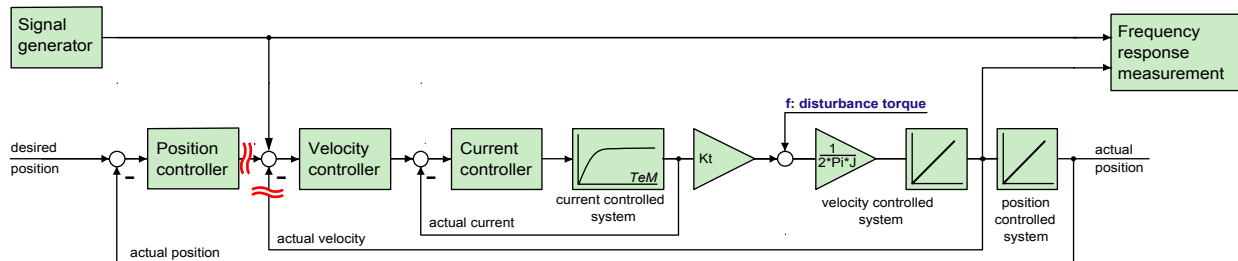
Signal Generator
Actual position value
Geschwindigkeitsregler
Actual speed value
Actual current value
Current controlled system
Disturbance torque
Speed controlled system
Position controlled system
Frequency response measurement

use:

- ◆ During the optimization of the velocity control for verification
- ◆ for the design of superposed controllers.

Open velocity control

Shows the dynamic behavior of all components in the velocity control loop, but without closing it.



Signal Generator

Position controller

actual position

desired position

Velocity controller

actual velocity

Current controller

actual current

current controlled system

disturbance torque

velocity controlled system

position controlled system

Frequency response measurement

Signal Generator

Actual position value

Geschwindigkeitsregler

Actual speed value

Actual current value

Current controlled system

Disturbance torque

Speed controlled system

Position controlled system

Frequency response measurement

use:

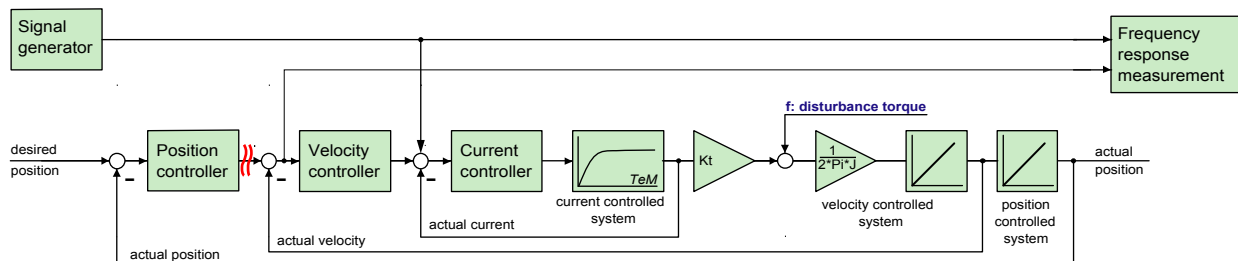
For the graphic design of the velocity control.

Compliance of velocity control

Shows the dynamic disturbance value behavior of the velocity control.

=> which dynamic influence does a disturbance torque have on the control deviation of the velocity control.

The disturbance torque is injected as disturbance current => this corresponds to the effect of a disturbance torque f



Signal Generator	Signal Generator
Position controller	
actual position	Actual position value
desired position	
Velocity controller	Geschwindigkeitsregler
actual velocity	Actual speed value
Current controller	
actual current	Actual current value
current controlled system	Current controlled system
disturbance torque	Disturbance torque
velocity controlled system	Speed controlled system
position controlled system	Position controlled system
Frequency response measurement	Frequency response measurement

Application:

- ◆ Verification of the disturbance value behavior of the velocity control
- ◆ Which velocity deviation generates a sinusoidal disturbance torque / disturbance current with the frequency fZ ?
- ◆ The frequency response of the compliance corresponds to the disturbance step response in the time range

Other settings

Sonstige Einstellungen

Anregung 4.00% 58mA 1

zulässiger Schleppfehler (+/-) 1.00mm 2

Rausch-Frequenzgang kumuliert 3

(1) Excitation

Serves to set the excitation signal of the frequency response measurement.

(2) Permissible following error (only for frequency response measurement)

The resulting following error is increased by the injection of the excitation signal during the frequency response measurement. In order to allow for this, the permissible following error window can be enlarged so that the measurement can be made. After the end of the measurement, this is reset to the original value.

(3) Selection of the kind of analysis of the measurement results

Depending on the fact whether frequency spectra or frequency responses are measured, the following types of analyses are available:

For frequency spectra:

- ◆ (a) Spectrum
- ◆ (b) Spectrum cumulated
- ◆ (c) cascade diagram

For frequency responses:

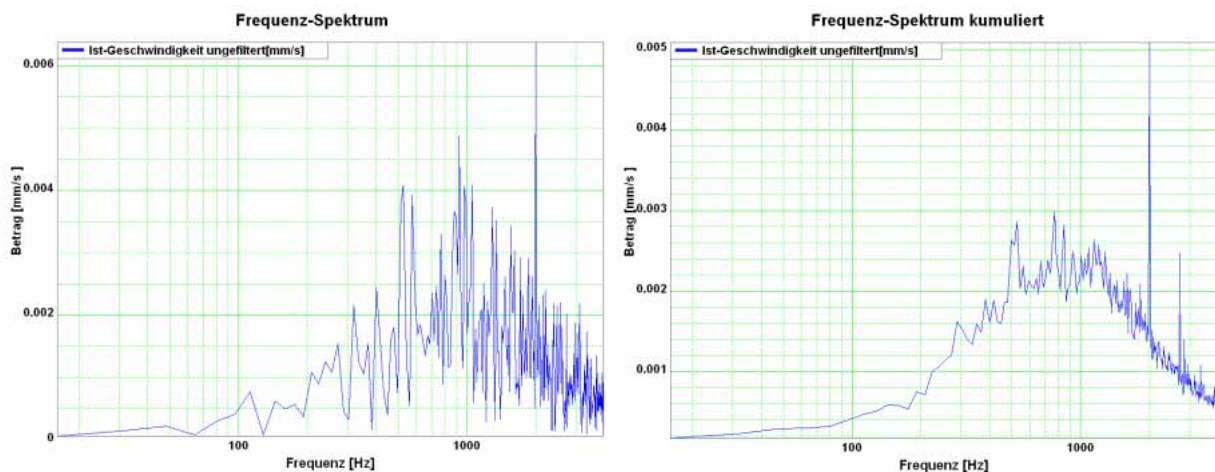
- ◆ (d) noise frequency response
- ◆ (d) noise frequency response cumulated

Non cumulated measurement (a & d)

The measured data are displayed directly. This is especially suitable if you wish to analyze the effects of changes on the measurement results directly and promptly. The disadvantage is however a smaller noise distance (quality) and an increased sensitiveness of the measurement towards unique disturbances.

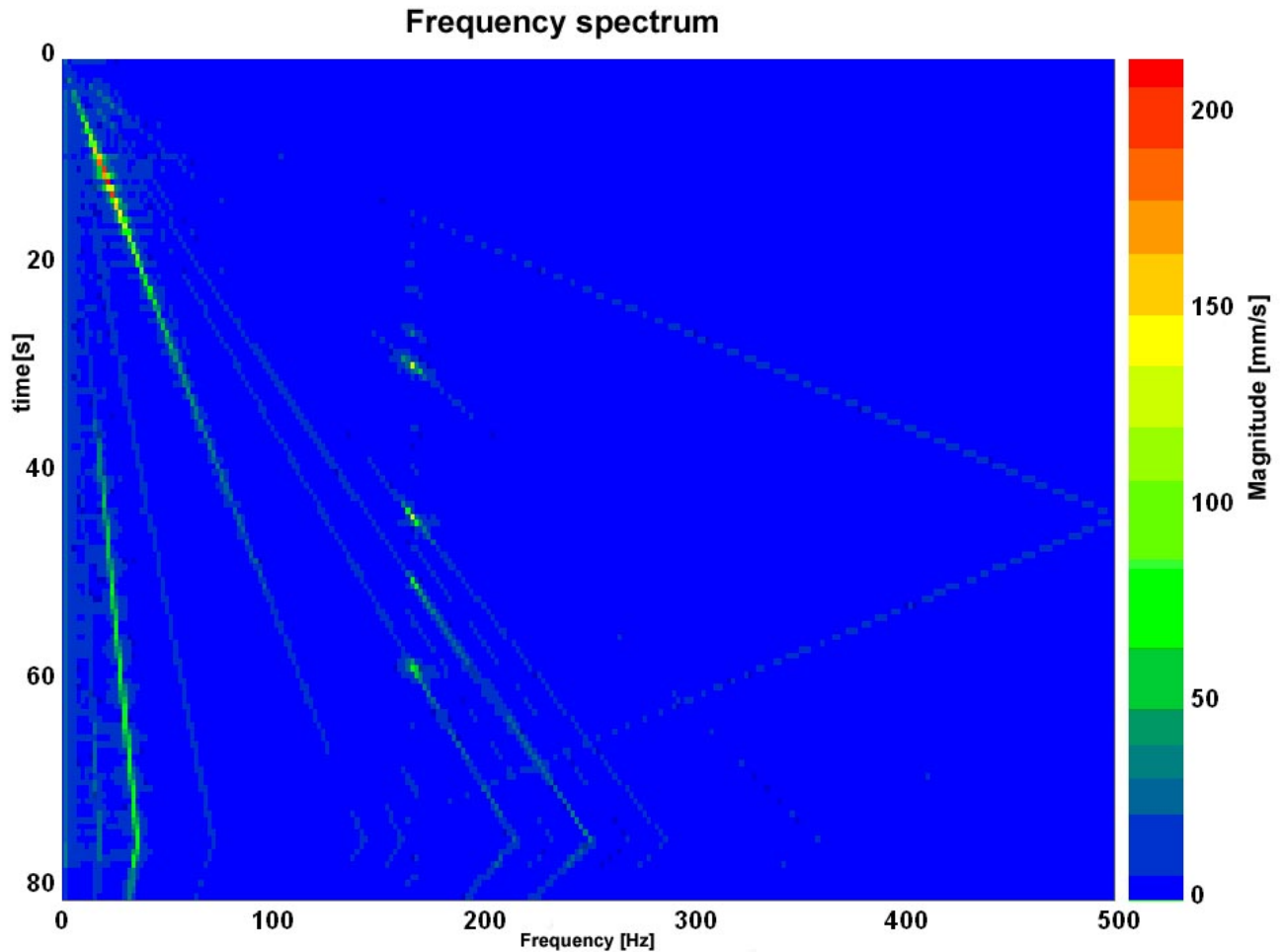
Cumulated measurement (b & e)

An average is taken from all measurements in the result memory. This reduces the influence of random signals and disturbances extremely (improvement of the quality). The number of measurements from which the average is taken, is set with the **Size of the result memory** (see page 277).

Comparison of two frequency spectra without and with cumulation

cascade diagram (c)

Frequency spectra are displayed subject to time. The information on the value of the signal is color-coded.

Cascade diagrams of the velocity signal during an acceleration process

This kind of display is suitable for the analysis of temporal changes in the measured spectrum.

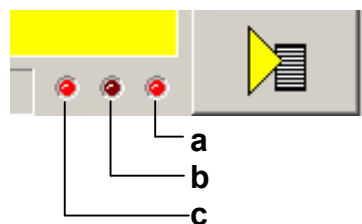
Operating and status field

(1) Start and Stop of the measurement**(2) Status display**

Current status of the measurement or of the controller (if no measurement is taking place).

(3) Progress of the registration of the signals in the controller

The time of registration of the signals in the controller itself can, depending on the bandwidth and the kind of measurement, take up to one minute.

(4) status of the activity of the different partitions of the measurement

- a: Registration of the measurement in the controller
- b: Upload of the measurement from the controller to the PC
- c: Processing the measurement in the PC

(5) Different settings and options

Functions available in a pull-down menu:

Open superposed control loops (see page 263)

accept load force

This serves, when opening the velocity controller, to accept the load which the controller has provided at the time of switching off => a z-axis does not drop down abruptly.

Measurement synchronous to the test movement

if this option is selected, it is ensured during the measurement, that the sampling does not take place in the turning point during a movement.

Unless frequencies are generated due to the deceleration/acceleration of the drive, which influence the measurement.

Result memory

In the result memory, the results of the N last measurements are kept. This is important for the display of the cumulated measurement and for the cascade diagram. The larger the memory, the "older" the results still used. When the contents is deleted, all old measurements are discarded and do no longer influence the new results.

Windowing (see page 259)

Here you can select different windowing modes for the measurement of frequency spectra. As default, no window is used.

Save measure to file

The currently displayed measurement result is stored and can be uploaded later into the ServoSignalAnalyzer. This does, however, not apply to the cascade diagram display.

Open measure from file

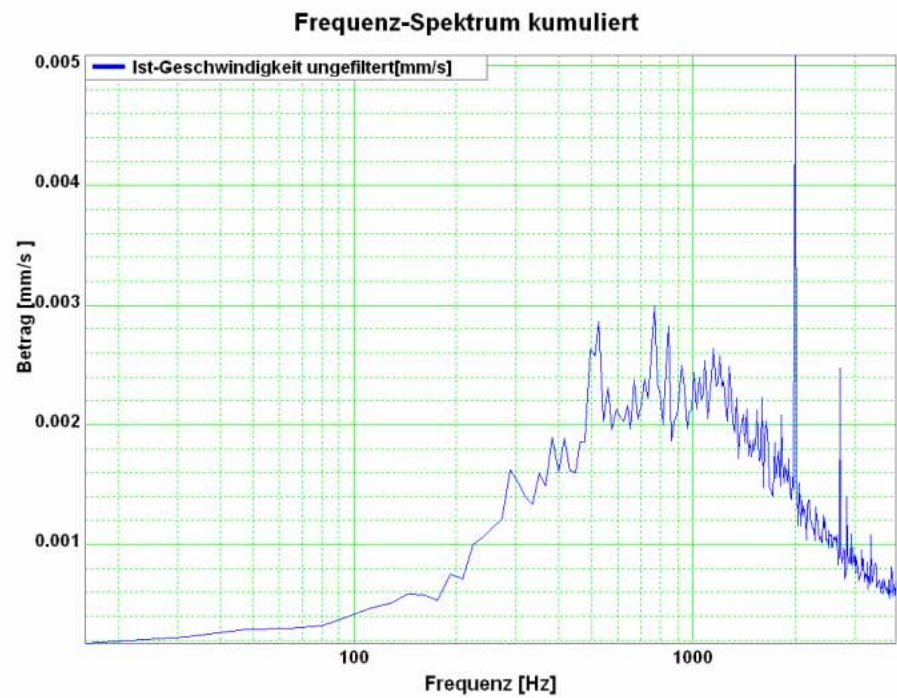
Here you can reload the measurements memorized before. You have the possibility to load up to four measurements subsequently and display them together in a graphic display.

Copy measurement to clipboard as graphic display.

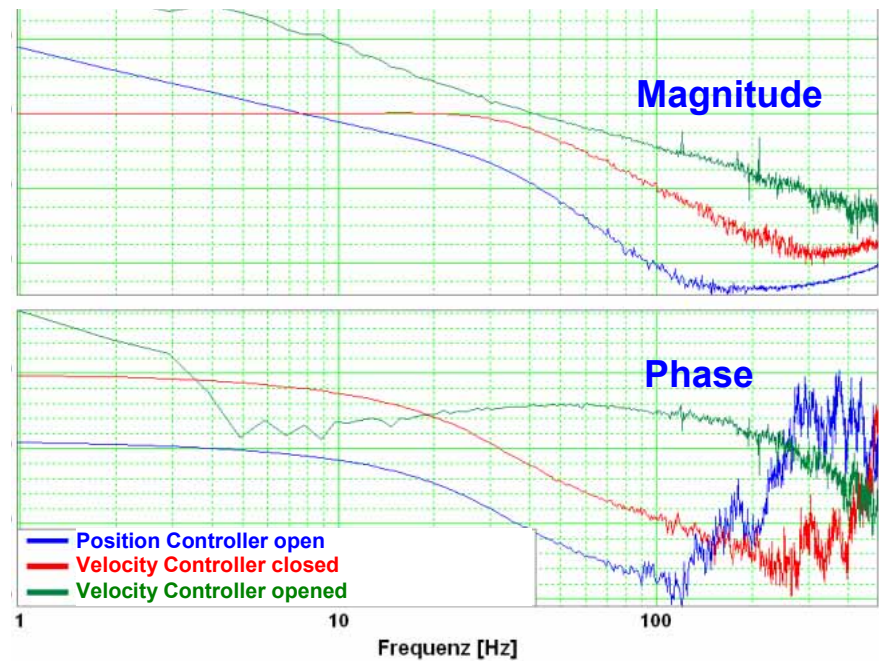
The currently displayed measurement result is copied as pixel graphic (e.g. BMP) to the clipboard.

Display of the measurement result

Frequency spectra

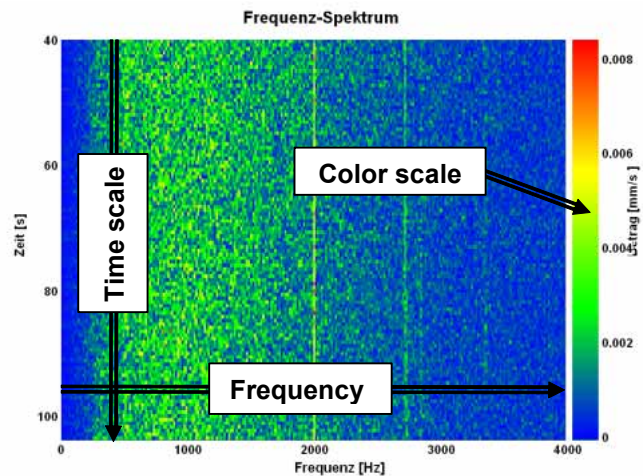


Bode diagrams: Value and phase



By clicking with the left mouse button on the legend, this can be shifted by 90°. By clicking on the color bar, the color of the respective graph can be modified.

Cascade diagrams



By clicking with the left mouse button on the color scale, you can change between autoscale mode and fixscale mode.

AutoScaleMode:

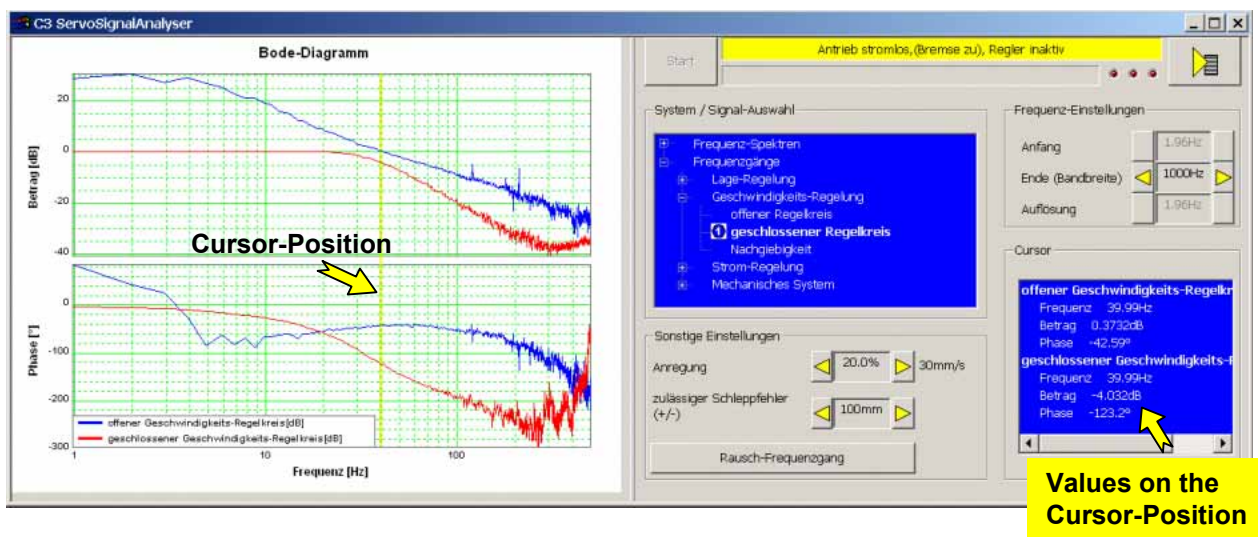
In this mode, the scaling of the color scale is adapted automatically so that all values can be displayed.

FixScaleMode:

Here, the scaling is fixed.

=> If, for instance, a considerably higher value than before is to be displayed, it is simply displayed like the former maximum (red).

Display of the measurement point at the cursor position



The cursor is set by clicking on the left mouse button. All measurement data of the selected cursor position (frequency) are displayed in the "cursor" operating field.

4.4.9.8 Basics of frequency response measurement

In this chapter you can read about:

Distinction between signals and systems	282
Linear Systems (LTI System)	283
Mechanical system	284
Resonance points and their causes.....	285

In the drive and control technology, the display of signals and systems in the frequency range is often the best possibility to solve different tasks.

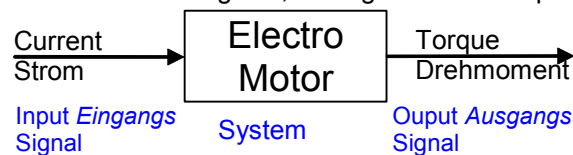
Distinction between signals and systems

Defined objects and their interactions that can be combined to a whole by a plausible distinction from their environment (i.e. the complex reality) are called a system.

Example electric motor

This consists of a multitude of different components, but the function and the behavior of a motor can be described as a whole without describing each individual component and their interactions separately.

If the motor is energized, it will generate a torque at the motor shaft.



Current is therefore a signal, which causes at the input of the system motor a change of its output signal torque.

In order to register and process such signals in the controller, they are digitized and read in with the so-called scanning frequency (fA). Thus the physical signal was converted into a finite sequence of numbers, which can be processed in the controller.

Linear Systems (LTI System)

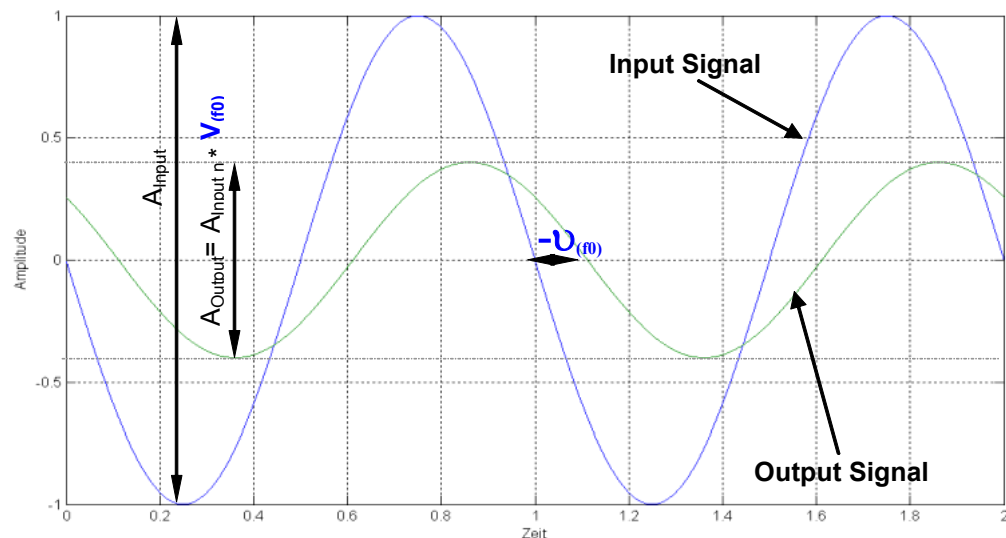
Further explanations are based on the concept of so-called linear systems. This means that doubling the input value means that the portion of the output value influenced by it is also doubled. this, for instance, is not the case in the event of influence due to limitations, friction and backlash.

=> those are called non-linear systems, which can not be analyzed with the methods described here (or only with difficulties).

One of the most important properties of linear systems is that a sine signal, which is put through a linear system, is still a sine signal at the output, which differs from the input signal only in value and phase.

When a signal passes a LTI system, no new frequencies are generated.

Input and output signals of a linear system

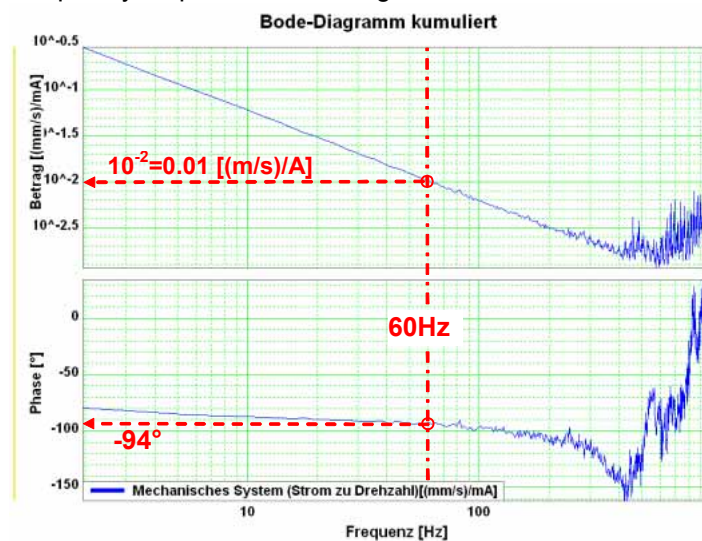


If you know the value ($V(f_0)$) as well as the phase position ($u(f_0)$) for all frequencies, the LTI system is completely defined.

Such a graph of value and phase position in dependence of the frequency, is called frequency response or bode diagram.

=> only LTI systems can be analyzed with the aid of frequency responses.

Frequency response / bode diagram



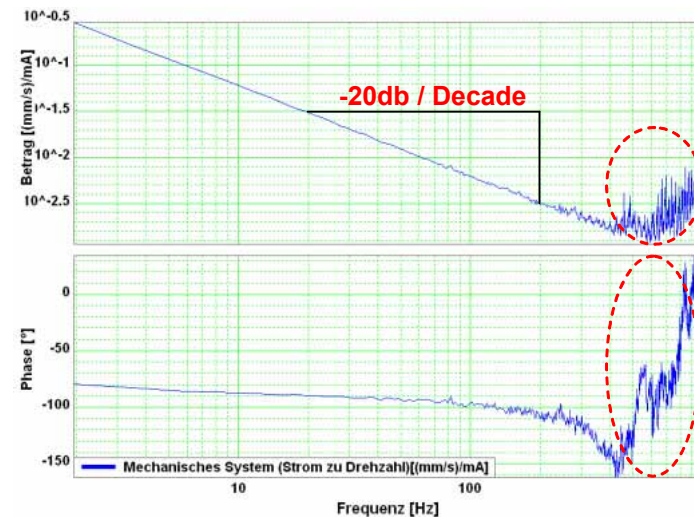
The frequency response shows the amplification (value) and the phase shift (phase), which a signal is submitted to when passing through a system.

The displayed bode diagram allows the following conclusions:

If a sine with 60Hz and an amplitude of 1A is present at the input, a sine delayed by 94° and an amplitude of 0.01m/s will result at the output.

Mechanical system

Frequency response of a mechanic system: Current - velocity of a motor



The outlined course at the end of the measurement range does not permit statements on the system measured due to disturbances. Due to the attenuation of the signals increasing with the frequency, the sensitiveness of the measurement to disturbances (signal to noise ratio) increases with a rising frequency. The value as well as the phase response of the displayed frequency response are "disturbed" at the same intensity, this shows, that disturbances are the reason.

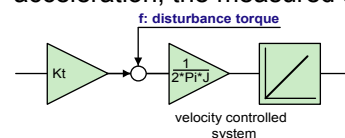
The value response consists basically of a straight, which declines with a slope of -20dB/decade (-20dB/decade => per tenfold increase of the frequency, the value decreases also by factor ten.)

the phase response remains however almost constantly at -90° over a relatively large range.

In control technology, this is called integrating behavior (I-behavior).

the I-behavior can be explained as follows.

The measured current is proportional to the motor force and thus also to the acceleration of the driven mass. As the velocity is calculated from the integrated acceleration, the measured system looks as follows:



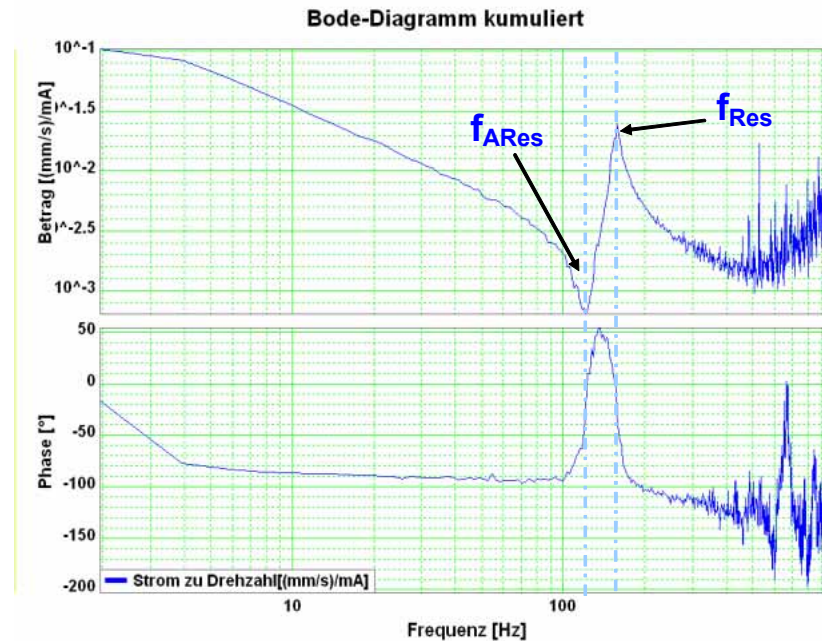
Input value is the current actual value, output value is the velocity actual value

Resonance points and their causes

In this chapter you can read about:

Rotary two mass system.....	285
Linear two mass system	286
Toothed belt drive as two mass system.....	287

Mechanical system with a resonance point



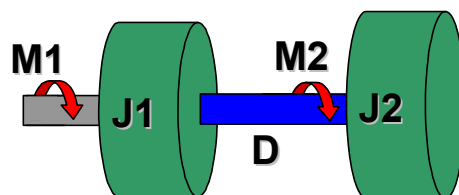
f_{ARes} : Anti resonance frequency

f_{Res} : Resonance frequency

The displayed change of the frequency response (resonance point), has its cause in a so-called two mass system (caused by the elastic coupling of two masses).

Hint As, upon closer examination, each mechanic coupling shows a certain elasticity, it is no the question if there is a resonance point, but at which frequency it is and how well it is attenuated.

Rotary two mass system



The shown system corresponds for instance to a motor with a flywheel coupled via a shaft. Hereby J1 corresponds to the motor moment of inertia and J2 to the moment of inertia of the flywheel.

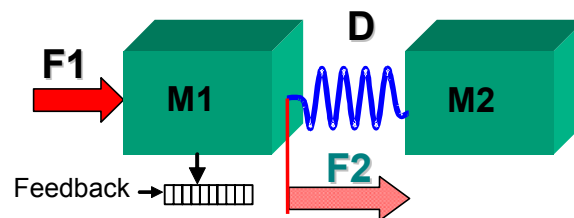
Calculation of the resonance frequencies in the rotary system with a hollow shaft as elastic coupling element

$$D = \int_{r_I}^{r_A} \frac{2 \cdot \pi \cdot G}{l} \cdot r^3 \cdot dr = \frac{G \cdot \pi \cdot (r_A^4 - r_I^4)}{2 \cdot l}$$

$$f_{A\text{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{D}{J_2}} \quad f_{\text{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{D \cdot \left(\frac{1}{J_1} + \frac{1}{J_2} \right)}$$

G	Shear modulus of the material used [N/m²] (e.g. approx. 80750N/mm² for steel)
D	Torsional rigidity in [m/rad]
rA	Outer radius of the hollow shaft
rI	Inner radius of the hollow shaft
l	Length of the hollow shaft

Linear two mass system



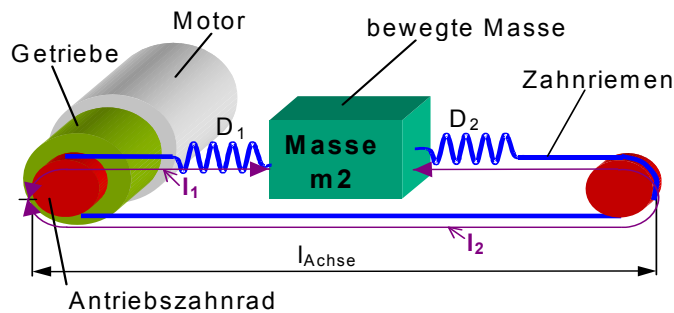
Resonance frequencies in the linear system

$$f_{A\text{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{D}{m_2}}$$

$$f_{\text{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{D \cdot \left(\frac{1}{m_1} + \frac{1}{m_2} \right)}$$

D	Rigidity in [N/m]
m1	e.g. motor mass
m2	e.g. load mass

Toothed belt drive as two mass system



In toothed belt drives, the toothed belt is the elastic coupling element. Its rigidity depends directly on the lengths l_1 and l_2 and changes in dependence of the position of the moved mass.

$$D_{spez} = \frac{F_{max}}{0,004}; \quad l_2 = 2 \cdot l_{Achse} - l_1$$

$$D_1 = \frac{D_{spez}}{l_1}; \quad D_2 = \frac{D_{spez}}{l_2}; \quad D = D_1 + D_2 = \frac{2 \cdot D_{spez}}{l_1 \cdot \left(2 - \frac{l_1}{l_{Achse}}\right)}$$

$$f_{ARes} = \frac{1}{2\pi} \cdot \sqrt{\frac{D}{m_2}} \quad f_{Res} = \frac{1}{2\pi} \cdot \sqrt{D \cdot \left(\frac{1}{m_2} + \frac{(r_{Zahnrad})^2}{J_1 \cdot (i_{Getriebe})^2} \right)}$$

D	Total spring constant of the toothed belt drive
Dspez	Specific spring constant of the toothed belt used
D1	Spring rate of the belt length l_1
D2	Spring rate of the belt length l_2
iGearbox	Transmission ratio of the gearbox
lAxis	Length of the axis
J1	Moment of inertia of motor and gearbox
m2	translatory moved mass
rToothed wheel	Radius of the drive pinion

4.4.9.9

Examples are available as a movie in the help file

Here you can find examples as a movie in the help file.

4.4.10. ProfileViewer for the optimization of the motion profile

In this chapter you can read about:

Mode 1: Time and maximum values are deduced from Compax3 input values.....	288
Mode 2: Compax3 input values are deduced from times and maximum values	289

You will find the ProfileViewer in the Compax3 ServoManager under the "Tools" Menu:



4.4.10.1 Mode 1: Time and maximum values are deduced from Compax3 input values

- ◆ The motion profile is calculated from Position, Speed, Acceleration, Deceleration, Acceleration Jerk and Deceleration Jerk
- ◆ As a result you will get, besides a graphical display, the following characteristic values of the profile:
 - ◆ Times for the acceleration, deceleration and constant phase
 - ◆ Maximum values for acceleration, deceleration and speed

4.4.10.2 Mode 2: Compax3 input values are deduced from times and maximum values

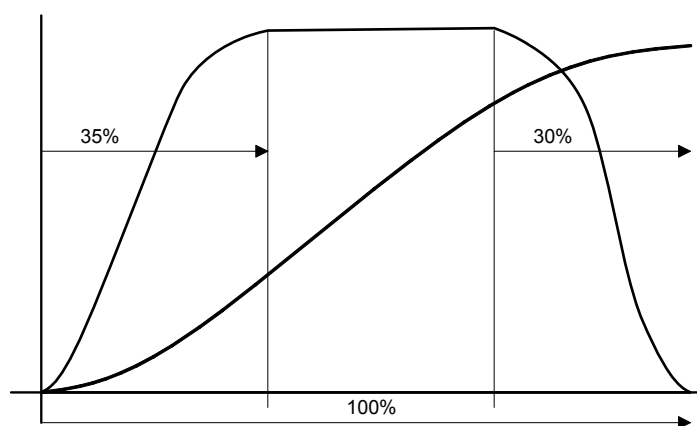
- ◆ A jerk-limited motion profile is calculated from the positioning time and the maximum speed / acceleration
- ◆ As a result you will get, besides a graphical display, the following characteristic values of the profile:
 - ◆ the parameters Position, Speed, Acceleration, Deceleration, Acceleration Jerk and Deceleration Jerk
 - ◆ Times for the acceleration, deceleration and constant phase
 - ◆ Maximum values for acceleration, deceleration and speed

Set deceleration and acceleration phase

The profile can be defined more exactly by entering the segmentation into deceleration and acceleration phase.

When setting 50% and 50%, a symmetrical design will result, the values for triangular operation are calculated, which is limited by the maximum speed. The total of the percentage values may not exceed 100.

The percentage entries refer to the total positioning time.

Example:

4.4.11. Turning the motor holding brake on and off

Compax3 controls the holding brake of the motor and the power output stage. The time behavior can be set.

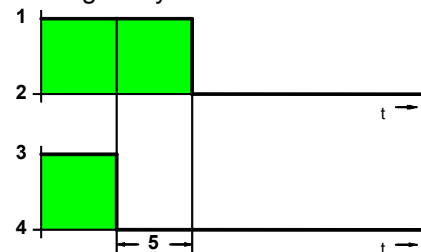
Application:

For an axis to which torque is applied in the stationary state (e.g. for a z-axis) the drive can be switched on and off in a manner such that no load movement takes place. The drive thereby remains energized during the holding brake response time. This is adjustable.

The power output stage current is de-energized by:

- ◆ Error or
- ◆ by deactivating the MC_Power module
- ◆ the ServoManager

Thereafter the motor is braked to zero rotation speed on the set ramp. When zero speed is reached, the motor is de-energized with the delay "brake closing delay time".

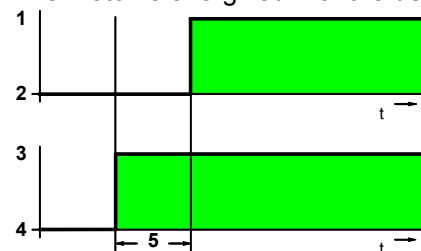


- 1: Motor powered
- 2: Motor de-energized
- 3: Brake open
- 4: Engage the brake
- 5: brake closing delay time

The power output stage is enabled by:

- ◆ Quit (acknowledge) (after error) with the MC_Reset module
- ◆ by activating the MC_Power module
- ◆ the ServoManager

The motor is energized with the delay "delay time for brake release".



- 1: Motor powered
- 2: Motor de-energized
- 3: Brake open
- 4: Engage the brake
- 5: Delay time for brake release

5. Motion control

In this chapter you can read about:

Programming based on IEC61131-3	291
Status diagram based on PLCopen	301
Control functions	302
Reading values	306
Positioning functions (standard)	310
Error handling	332
Process image	336
Interface to C3 powerPLmC	347
IEC examples	355
Profibus: Simulate Profidrive profile (C3_ProfiDrive_StateMachine)	362

5.1 Programming based on IEC61131-3

In this chapter you can read about:

Prerequisites	291
CoDeSys / Compax3 target system (Target Package)	292
Languages supported	293
Function range supported	293
Data types supported	296
Retain Variables	296
Recipe table with 9 columns and 32 lines	296
Maximum program size	297
Cycle time	297
Access to the Compax3 object directory	297
Compilation, debugging and down/upload of IEC61131 programs	298
General rules / timing	299
Library constants	300

5.1.1. Prerequisites

- ◆ Installation of the CoDeSys programming tool.
- ◆ Installation of necessary Target Packages (target systems):
 - ◆ Bring up the "InstallTarget" program (program group "3S Software": "CoDeSys V2.3")
 - ◆ From "Open", select the target file; file name: "Compax3.tnf".
 - ◆ The selected target can be installed with "Install".

5.1.2. CoDeSys / Compax3 target system (Target Package)

Targets for Compax3 servo axes

Beginning with Compax3 software version V2.0, two Compax3 targets are included with delivery (containing module and object descriptions).

- ◆ **CoDeSys for C3 T30:** for Compax3 T30 (beginning with Compax3 software version V2.0)
- ◆ **CoDeSys for C3 T40:** for Compax3 T40 (beginning with Compax3 software version V2.0)

The old target is still available for programs that were created earlier (created with Compax3 software version < V2.0).

- ◆ **CoDeSys for Compax3:** for Compax3 T30
- This programs are thus still capable of running.

When migrating to a new target, you must be certain that the module and object names have been changed.
Edit the appropriate parts of the IEC program accordingly.

Targets for Compax3F hydraulic axes

- CoDeSys for C3F T30:** for Compax3 T30
- CoDeSys for C3F T40:** For Compax3 T40

5.1.2.1 Program development and test

Program development

CoDeSys is the development environment for control systems which will help you develop Compax3 IEC61131 programs. CoDeSys is called up from the Compax3 ServoManager (under "programming: IEC61131-3 development environment")
The IEC program can be integrated into the C3 ServoManager project or exported again from the project as required.
When CoDeSys is brought up, the IEC program stored in the project is opened. If the project does not contain an IEC program, a selection dialog appears.

Download to Compax3

After the IEC61131 program has been developed and compiled with CoDeSys, it is downloaded to Compax3 by means of the ServoManager (in "Download: IEC61131-3").

Program test

For testing your program directly with Compax3, you may use the Compax3 IEC61131-3 debugger (the debug functions of CoDeSys are not supported in conjunction with Compax3). The debugger is called up from the ServoManager (under Programming: IEC61131-3 debugger). It automatically accesses the last IEC61131-3 program in the ServoManager to be loaded into Compax3 with "Download: IEC61131-3" and makes its modules and variables available in the project tree.
The data from Compax3 are read via the instruction "log in". Please note in this regard that the interface to Compax3 can only be assigned once: Online functions in the ServoManager such as Upload, Download, Status display in the Optimization window or oscilloscope functions are not possible simultaneously. These functions interrupt the connection between debugger and Compax3 automatically.

5.1.2.2 Recipe management

The recipe management function in CoDeSys is not supported in conjunction with Compax3. Please use the recipe table available in Compax3 (also see in the configuration wizard).

5.1.3. Languages supported

- ◆ IL (Instruction List)
- ◆ ST (Structured Text)
- ◆ FBD (Function block diagram)
- ◆ CFC (continuous function chart editor)
- ◆ LD (Ladder diagram)

5.1.4. Function range supported

In this chapter you can read about:

Operators supported.....	293
Standard functions supported	294
Standard function modules supported.....	295

5.1.4.1 Operators supported

IL	FBP / CFC / SFC	ST
LD(N)		
ST(N)		
R		
S		
AND(N)	AND	AND(N)
OR(N)	OR	OR(N)
XOR(N)	XOR	XOR(N)
NOT	NOT	NOT
ADD	ADD	+
SUB	SUB	-
MUL	MUL	*
DIV	DIV	/
GT	GT	>
GE	GE	>=
EQ	EQ	=
NE	NE	<>
LE	LE	<=
LT	LT	<
RET	RET	RETURN
	MOVE	
		:=

CAL(C/N)		
JMP(C/N)		
		CASE
		DO
		ELSE
		ELSIF
		END_CASE
		END_FOR
		END_IF
		END_REPEAT
		END_WHILE
		EXIT
		FOR
		IF
		REPEAT
		THEN
		TO
		UNTIL
		WHILE

5.1.4.2 Standard functions supported

Bit manipulation functions

SHL, SHR, ROL, ROR

Numeric functions

ABS, SQRT, SIN, COS

Functions for type conversion

Type conversions x_TO_y	X=Source data type, Y=Target data type
TRUNC	

Functions for selection

MIN	Not for BOOL /WORD / DWORD
MAX	Not for BOOL /WORD / DWORD
LIMIT	Not for BOOL /WORD / DWORD
SEL	Not for BOOL /WORD / DWORD

5.1.4.3 Standard function modules supported**FlipFlops**

RS, SR,

Trigger

R_TRIG, F_TRIG,

Numerator

CTU, CTD, CTUD,

Timer

TON, TOF, TP,
max. 8 pcs., time resolution 0.5ms
(the number of timers required is displayed in the CoDeSys output window during compilation)

PID Controller function block

5.1.5. Data types supported

The following data types are available for IEC61131-3 programming:

Name	Division	Format
BOOL	Status values: TRUE or FALSE	Logical variable.
INT	-32768...32767	16-bit integer: Fixed point number without places after the decimal
DINT	-2147483648...2147483647	32-bit integer: Fixed point number without places after the decimal
REAL		32-bit floating point: 16 bits before the decimal and 16 bits after the decimal
WORD	0...65535	16-bit bit sequence (no range of values)
DWORD	0...4294967295	32-bit bit sequence (no range of values)
TIME	0...4194,3035s	32 Bit - Format (resolution: 0.5 ms)
ENUM	User-defined type of enumeration (local enumerations are not supported)	

Altogether 500 16-bit variables are available. These include BOOL, INT, and WORD.

Altogether 150 32-bit variables are available. These include DINT, DWORD, TIME, REAL.

The number of the required variables is displayed in the CoDeSys output window during compilation.

5.1.6. Retain Variables

6 retain variables (variables that are safe from power failure) are available

- ◆ 3x16-bit retain-variables
- ◆ 3x32-bit retain-variables

5.1.7. Recipe table with 9 columns and 32 lines

An array, i.e. a table with 9 columns and 32 rows, is available to store values.

This table is freely assignable and can be used for example to store position sets or for recipe management.

In addition, this table can be used to exchange data with an external control system or a POP, for example.

The layout of the table is as follows:

Column 1 Type: REAL Objects O1901	Column 2 Type: REAL Objects O1902	Column 3 Type: INT Objects O1903	Column 4 Type: INT Objects O1904	Column 5 Type: INT Objects O1905	Column 6 Type: DINT Objects O1906	Column 7 Type: DINT Objects O1907	Column 8 Type: DINT Objects O1908	Column 9 Type: DINT Objects O1909
Row 1 "C3Array_Col 1_Row1" (1901.1)	Row 1 "C3Array_Col 2_Row1" (1902.1)	Row 1 "C3Array_Col 3_Row1" (1903.1)	Row 1 "C3Array_Col 4_Row1" (1904.1)	Row 1 "C3Array_Col 5_Row1" (1905.1)	Row 1 "C3Array_Col 6_Row1" (1906.1)	Row 1 "C3Array_Col 7_Row1" (1907.1)	Row 1 "C3Array_Col 8_Row1" (1908.1)	Row 1 "C3Array_Col 9_Row1" (1909.1)
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
Row 32 "C3Array_Col 1_Row32" (1901.32)	Row 32 "C3Array_Col 2_Row32" (1902.32)	Row 32 "C3Array_Col 3_Row32" (1903.32)	Row 32 "C3Array_Col 4_Row32" (1904.32)	Row 32 "C3Array_Col 5_Row32" (1905.32)	Row 32 "C3Array_Col 6_Row32" (1906.32)	Row 32 "C3Array_Col 7_Row32" (1907.32)	Row 32 "C3Array_Col 8_Row32" (1908.32)	Row 32 "C3Array_Col 9_Row32" (1909.32)

In addition to direct access to every individual field in the table, direct access is also possible through pointer addressing.

To do this, the table pointer "C3ArrayPointer_Row" (Object 1900.1) must be set to the desired rows.

This makes access to Columns 1 through 9 of the referenced rows possible through "C3Array_Indirect_Col1" to "C3Array_Indirect_Col9" (objects 1910.1 to 1910.9).

5.1.8. Maximum program size

Up to 6000 (IL) instructions are possible

Note! Please note, that integrated function modules do also require program memory. The required program memory can therefore increase due to a Targets update, even without any program changes.

The number of instructions generated is displayed in the CoDeSys output window by the Compax3 compiler during interpretation.

5.1.9. Cycle time

Minimal cycle time: 1ms.

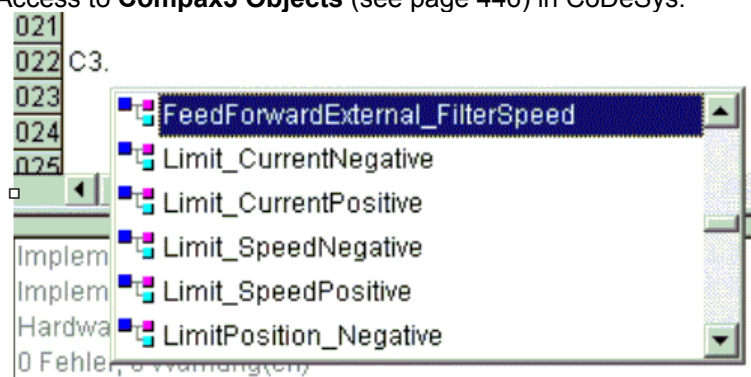
The cycle time can be adjusted with the Compax3 ServoManager when downloading IEC61131-3 programs.

It is possible to optimize later in the optimization display of the Compax3 Servomanager. The cycle time is displayed there in increments of 500 μ s (2 = 1 ms; 3 = 1.5 ms; etc.).

The IEC61131-3 program is stopped cycle time of 0.

5.1.10. Access to the Compax3 object directory

All Compax3 objects are encapsulated in the "C3" program module. Access to **Compax3 Objects** (see page 446) in CoDeSys:



Compax3 objects are divided into groups:

C3.	Compax3 - Objects
C3Array.	Variable (Recipe) List
C3Pop.	Objects for the Parker Operator Panel Pop.
C3Cam.	Objects for the T40 cam control. Do only use the objects described in this help; the additional objects are for internal use only!
C3Plus.	Additional objects that are generally not required.
C3Scope.	Objects for programming the oscilloscope function. For internal use only!

The object name reveals the group assignment.

In general, it applies:

Objects that are not described here are reserved objects!

5.1.11. Compilation, debugging and down/upload of IEC61131 programs

- ◆ Compiling IEC61131-3 programs in CoDeSys
- ◆ Downloading or uploading of IEC61131-3 programs with the Compax3 ServoManager.
- ◆ The debugger is called up from the C3 ServoManager under "Programming: IEC61131-3 debugger" called up.

Note:

Before compiling you have to enter for which Compax3 versions the compilation is to be executed.

Please note that when selecting "all versions" not all functions are available, only the minimal range of functions is supported.

Only if the latest firmware version was selected (and the corresponding firmware is loaded in the target Compax3) all functions described here are supported.

5.1.12. General rules / timing

General rules

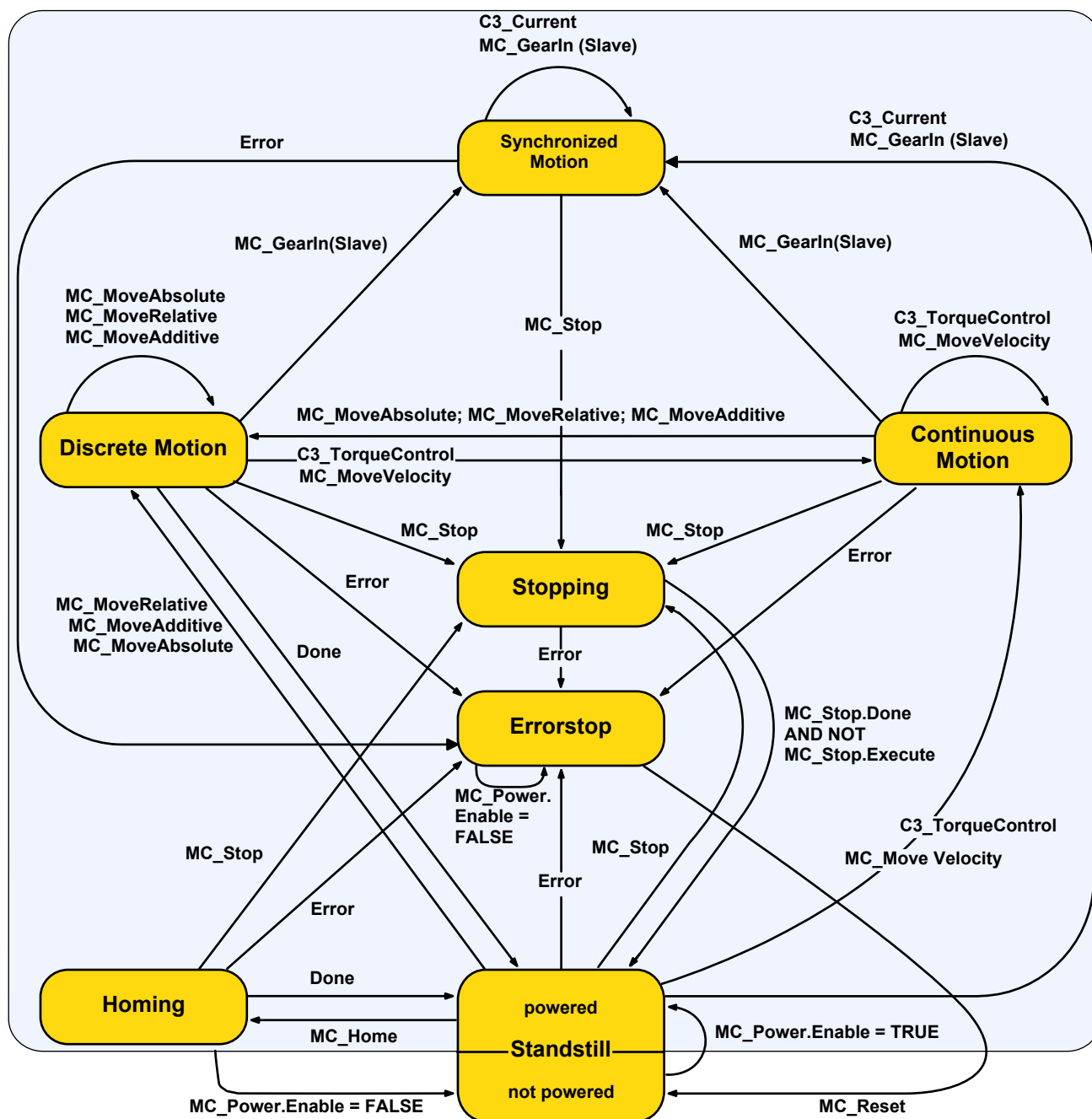
Positioning	Within an IEC cycle, only one positioning module may be activated! If 2 positioning modules are activated within one IEC cycle, it is not defined which one is executed.
Status of the outputs	◆ The outputs "Done", "InVelocity", "Error", "ErrorID" and "CommandAborted" reset with the falling edge of the "Execute" input. ◆ If the "Execute" input goes back to FALSE again before the module action (for example positioning) has been completed ("pulse to Execute"), the corresponding outputs (for example "Done") will still be set for exactly ONE cycle upon termination. ◆ The outputs "Done" and "Error" are never simultaneously TRUE. ◆ If the instance of a function module receives a new "Execute" signal before the function ends, the module will not show any response (no "Done" and no "Command Aborted") in reference to the previous action.
Input parameters	◆ Parameters are accepted with the rising edge of the "Execute" signal. ◆ To be able to accept modified parameters, the module must be triggered again with an "Execute" signal.
Missing input parameters	◆ If an input parameter is missing, the previous value of this instance will be used in accordance with IEC61131-3. ◆ The default value is used the first time a call is made.
Position and distance	◆ "Position" is a value that is defined for a reference system, i.e. a specific position value is a fixed location in the reference system. ◆ "Distance" is the difference between 2 positions.
Sign	◆ "Velocity", "Acceleration", "Deceleration" and "Jerk" are always positive variables. ◆ "Position" and "Distance" may be positive or negative.
Error handling	◆ All function modules have an "Error" output that can be activated by a module during a module sequence. ◆ The ErrorID (error number) can be read by an axis error with the "MC_ReadAxisError" module.
Behavior of the "Done" - output	The "Done" output is set if the function module has been successfully executed. If one positioning process is interrupted by a second before it is complete, the first function module will not set "Done".
Behavior of the "CommandAborted" output	"CommandAborted" is set if a positioning process is interrupted by a second positioning process, by "MC_Stop" or MC_Power. The reset behavior of "CommandAborted" is the same as "Done". If "CommandAborted" occurs, the other outputs will be reset.
Value range of the movement parameters	Please note that the limits are specified in revolutions. To convert to the configured unit, multiply the min/max values by the "travel distance per motor revolution".
Linear motors	With a configured linear motor, all revolution data must be replaced by pitch. To convert to the configured unit, the min/max values must be multiplied by the pitch length (see the technical data for the motor).

5.1.13. Library constants

The following global constants are declared in the PLCopen function module library:

For the selection of the master signal source:		
AXIS_REF_Physical	C3_AXIS_Ref	for +/-10V analog input, step / direction input 5V or Encoder A/B input 5V (depending on the configuration of the physical source under signal source)
Axis_REF_HEDA	C3_AXIS_Ref	HEDA
General constants		
MC_Direction_Positive	INT	For supply of the Direction input of the MC_MoveVelocity module (for positive rotational direction)
MC_Direction_Negative	INT	For supply of the Direction input of the MC_MoveVelocity module (for negative rotational direction)
MC_Direction_Current	INT	For supply of the Direction input of the MC_MoveVelocity module (retaining the last rotational direction to be selected)
Direction_Memory	INT (Variable)	The MC_MoveVelocity modules instances store the last direction parameter in this variable. This variable can only be used by Motion Control modules and must not be overwritten!
Reset positioning mode		
All directions	INT	C3_all_direction
Positive direction	INT	MC_positive_direction
Shortest path	INT	MC_shortest_way
Negative direction	INT	MC_negative_direction
Actual direction	INT	MC_current_direction
For power supply of the axis inputs/outputs of modules:		
Axis_Ref_LocalAxis	INT	Local axis (physically present axis)
Reset positioning mode		
All directions	INT	C3_all_direction
Positive direction	INT	MC_positive_direction
Shortest path	INT	MC_shortest_way
Negative direction	INT	MC_negative_direction
Actual direction	INT	MC_current_direction

5.2 Status diagram based on PLCopen



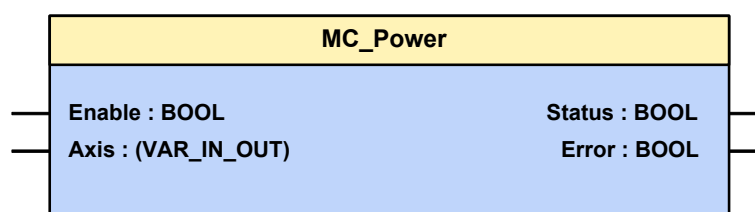
5.3 Control functions

In this chapter you can read about:

Activation of the drive (MC_Power)	302
Stop (MC_Stop)	303
Opening the brake (C3_OpenBrake)	305

5.3.1. Activation of the drive (MC_Power)

FB name		MC_Power
Transition into the status "Standstill: disable" or "Standstill: powered"		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Enable	BOOL	Activates the module; as long as Enable=TRUE, the drive is activated. With Enable=FALSE, the drive stops with the ramp defined for the error (see page 146). Please observe: The configured error ramp is limited. The error ramp will not be smaller than the deceleration set in the last motion set.
VAR_OUTPUT		
Status	BOOL	State of the power output stage (TRUE=drive activated, FALSE=drive deactivated)
Error	BOOL	Error when deactivating the drive
Notes:		
◆ If the input parameter "Enable" = TRUE, all enables of the drive will be set. ◆ All enables will be reset if the input parameter "Enable" = FALSE, the axis decelerates with the configured error ramp to speed = 0. ◆ Note on Compax3 Servo: During automatic commutation, the output "Status" is not set to TRUE for activation, but rather not until after automatic commutation has been successfully completed. ◆ An enable is denied until the intermediate circuit is loaded, this may take up to 2s when switching on Compax3H for the first time. ◆ If the drive is in error state (see page 334) (error reaction 1: controller active) and the enable of the MC_Power is deactivated, the drive is deactivated (error reaction 2). ◆ C3 powerPLmC Note: This module is also available as group function block. You can then trigger this function for the entire Compax3 group.		

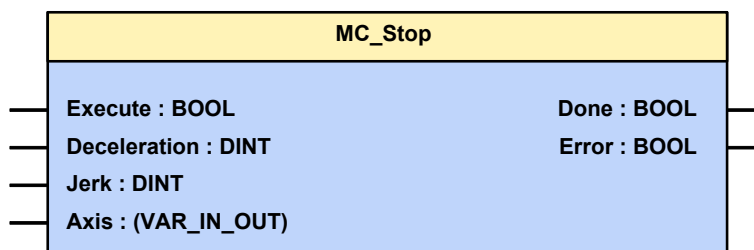


5.3.2. Stop (MC_Stop)

In this chapter you can read about:

MC_Stop: Example 1.....	303
MC_Stop: Example 2.....	305

FB name		MC_Stop
Stops the current movement		
Please note: Only one instance of MC_Stop is permitted per axis!		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Stops the movement
Deceleration	DINT	The value of deceleration (always positive) [units/s ²] Value range: 0.24 rev/s ² ... 1000000 rev/s ² Please observe: The configured STOP ramp is limited. The STOP ramp will not be smaller than the deceleration set in the last motion set.
Jerk	DINT	Value of the deceleration jerk [units/s ³] (always positive) Value range: 30 rev/s ³ ... 125,000,000 rev/s ³
VAR_OUTPUT		
Done	BOOL	Stop move
Error	BOOL	Error while stopping positioning
Note: As long as the "Execute" input is set, the axis remains in the "Stopping" status (as long the axis is activated) and is unable to execute any additional movement commands! If the axis is deactivated by setting the Enable signal of the "MC_Power" module to FALSE, the Stopping state will then be exited. If the enable signal of the "MC_Power" module is set to TRUE again, the axis goes back to the "Stopping" state again if the Execute input of the "MC_Stop" module is still TRUE. C3 powerPLmC Note: This module is also available as group function block. You can then trigger this function for the entire Compax3 group.		

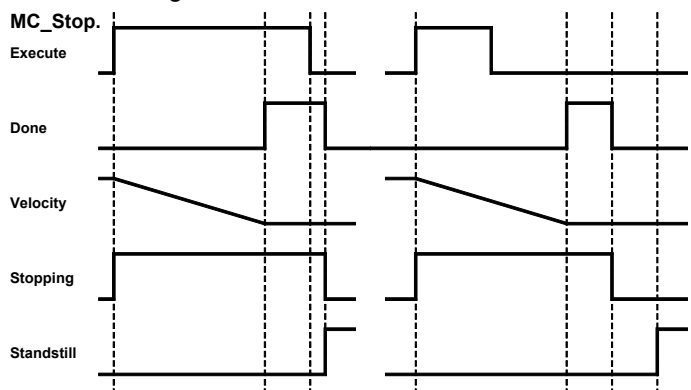


5.3.2.1 MC_Stop: Example 1

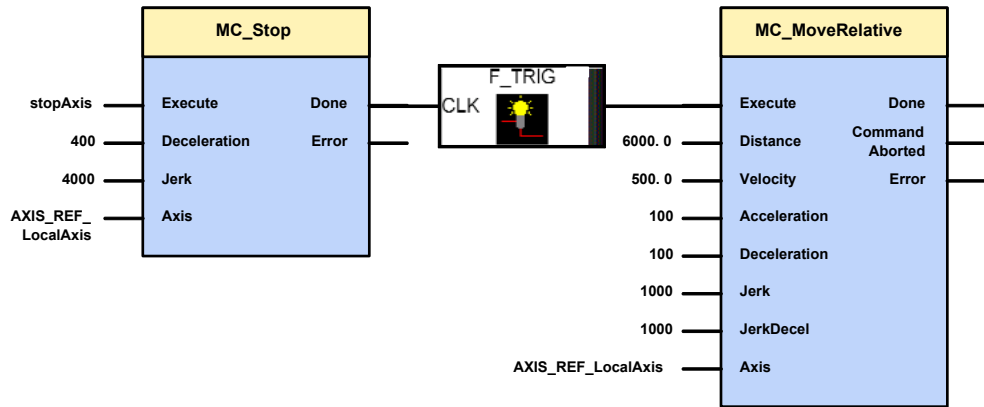
The following illustration shows an example of how the MC_Stop module interrupts and stops a movement that is in progress.
If a positioning module is interrupted by the MC_Stop module, it reports "Command Aborted" and can no longer be executed as long as the MC_Stop module is active.

If the MC_Stop module is inactive (no "Execute" signal), the function module can be executed again.

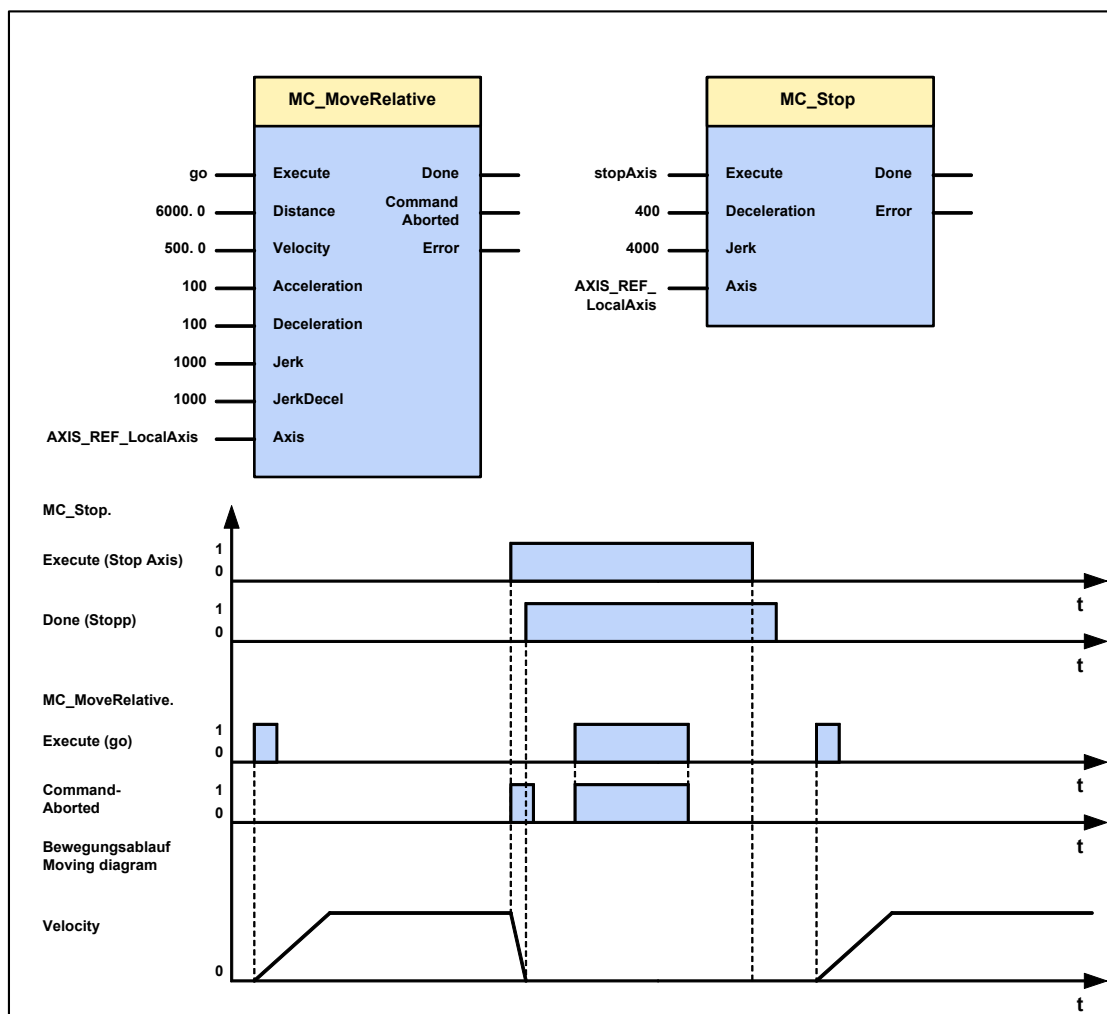
Timing Diagram:



Note: If a positioning is to follow immediately after the stop, this can take place with the falling edge of the done output at the earliest:

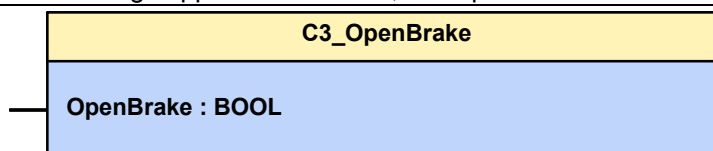


5.3.2.2 MC_Stop: Example 2



5.3.3. Opening the brake (C3_OpenBrake)

FB name		
C3_OpenBrake		
Opening the motor holding brake – works only with no current (standstill - not powered)		
VAR_INPUT		
OpenBrake	BOOL	"TRUE" opens the motor holding brake
When current is being supplied to the drive, the input has no function.		



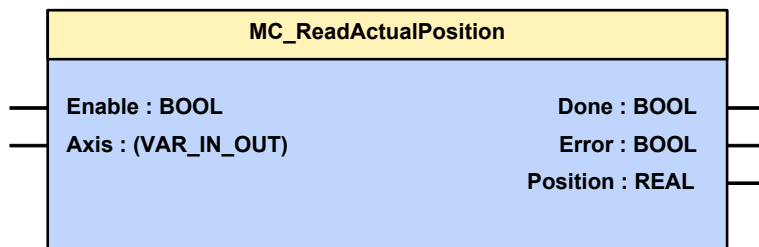
5.4 Reading values

In this chapter you can read about:

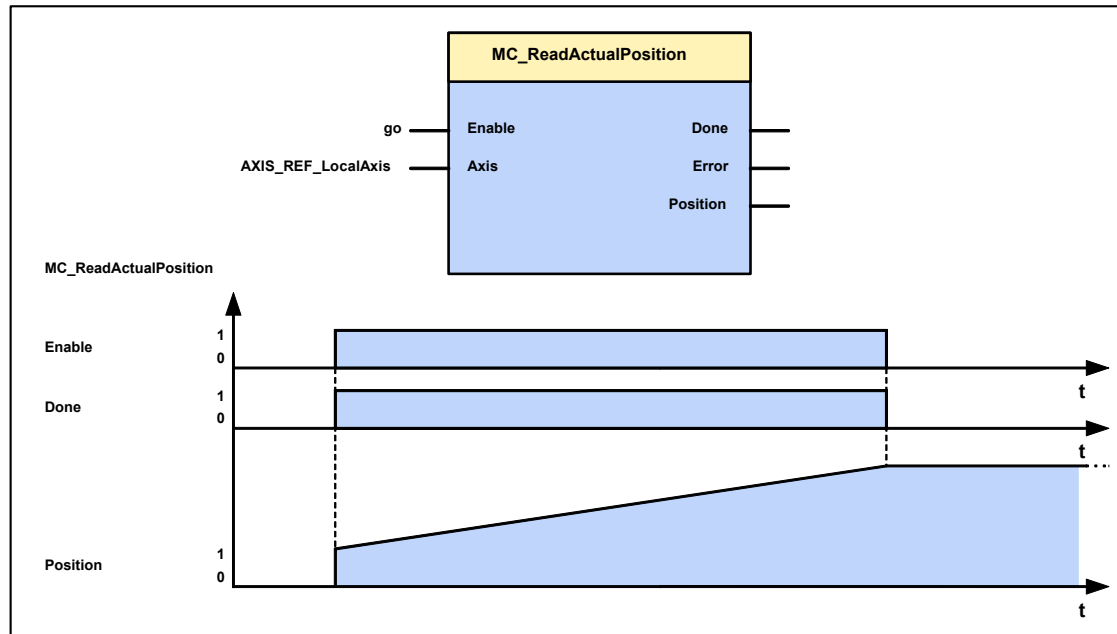
Reading the current position (MC_ReadActualPosition)	306
Read access to the (C3_ReadArray) array	308
Reading the device status (MC_ReadStatus)	309

5.4.1. Reading the current position (MC_ReadActualPosition)

FB name		MC_ReadActualPosition
Reading the current axis position		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Enable	BOOL	Activates the module, continuous reading of the axis position as long as Enable=TRUE
VAR_OUTPUT		
Done	BOOL	Position value available
Error	BOOL	Error while reading the position
Position	REAL	Axis position
Note: -		

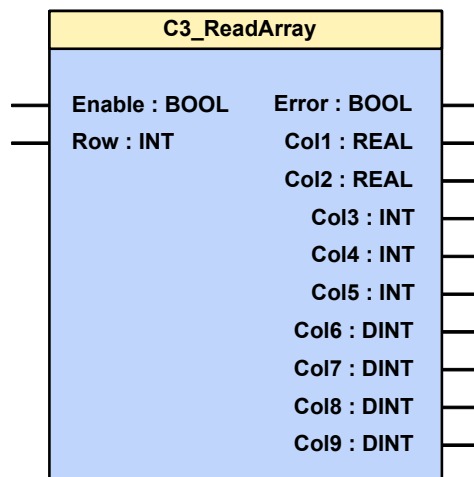


You can read the current position of the axis with this module.
As long as the input parameter "Enable" = TRUE, the current parameter value will be supplied **cyclically** (see page 350) to the output parameter "Position".
The status of the input parameter must be present for at least one module call.
The following illustration shows the behavior of parameters in the MC_ReadActualPosition function module.



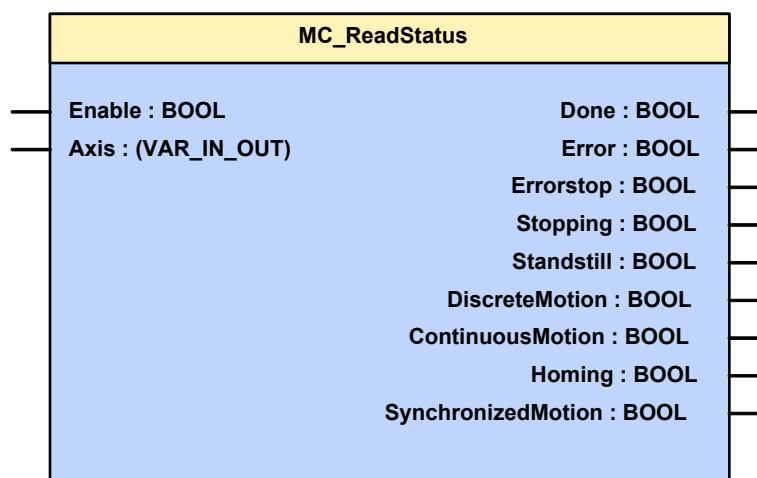
5.4.2. Read access to the (C3_ReadArray) array

FB name		C3_ReadArray
This module is used for simplified read access to the array (recipe table).		
VAR_INPUT		
Enable	BOOL	The desired rows can be read with the Enable input (after selecting "Row").
Row	INT	The desired row in the table must be created at the end of the Row module input. this input works with object 1900.1; please take this into consideration, if you directly access the object 1900.1 in addition.
VAR_OUTPUT		
Error	BOOL	Error as an output indicates that an error was encountered while reading the array (a row that does not exist selected on the Row input).
Col1 – Col9	REAL INT DINT	The individual columns of the array can be accessed through outputs Col1 through Col9.
Notes: Rows will be read cyclically as long as Enable = TRUE.		



5.4.3. Reading the device status (MC_ReadStatus)

FB name		MC_ReadStatus
Specifies the current status according to the PLCopen status machine		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Enable	BOOL	Activates the module; continuous outputs of output parameters as long as Enable=TRUE
VAR_OUTPUT		
Done	BOOL	Status values available
Error	BOOL	Error while executing module
Errorstop	BOOL	Error stop function. The motor brakes as specified by the stop ramp and is de-energized;
Stopping	BOOL	The motor is stopped;
Standstill	BOOL	The motor is stopped;
DiscreteMotion	BOOL	Individual movement;
ContinuousMotion	BOOL	Continuous positioning;
Homing	BOOL	Machine home is approached;
SynchronizedMotion	BOOL	Synchronous motion
Note: See also in the status diagram.		



5.5 Positioning functions (standard)

In this chapter you can read about:

Dynamic positioning	310
Value range for positioning parameters	310
Absolute positioning (MC_MoveAbsolute)	311
Relative positioning (MC_MoveRelative)	316
Additive positioning (MC_MoveAdditive)	318
Continuous positioning (MC_MoveVelocity)	320
Manual operation (C3_Jog)	322
Homing (MC_Home)	324
Electronic gearbox (MC_GearIn)	326
Current setting operation (C3_Current)	329
Torque / force control (C3_TorqueControl)	330

5.5.1. Dynamic positioning

Dynamic positioning processes can be performed with the modules MC_MoveAbsolute, MC_MoveRelative and MC_MoveAdditive. The speed can be altered dynamically with MC_MoveVelocity.

In the state: "Discrete Motion"

If another, second positioning process is activated in the "Discrete Motion" state, the 1st positioning process will be interrupted. The transition to the new destination occurs dynamically, i.e. without any intervening stop.

In "Continuous Motion" state

If a positioning process (MC_MoveAbsolute, MC_MoveRelative or MC_MoveAdditive) or a MC_MoveVelocity is activated in the "Continuous Motion" state, the active function module will then be interrupted. All input variables of the new positioning process will then be taken over.

5.5.2. Value range for positioning parameters

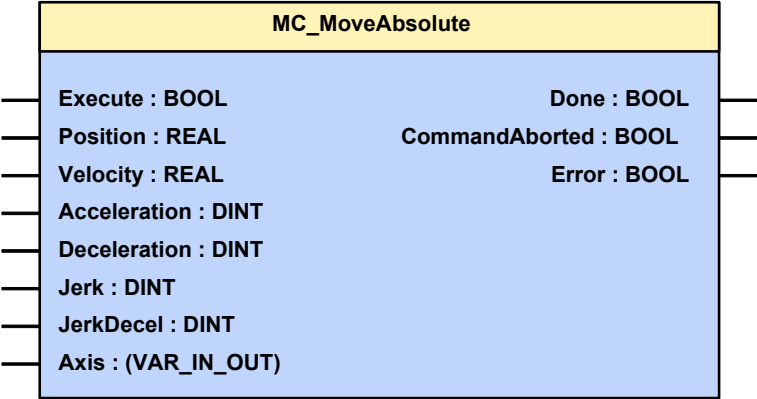
Target position:	Min: -4000000 rev	Max: 4000000 rev
Speed for positioning:	Min: 0.00001157 rev/s	Max: 2000 rev/s
Acceleration for positioning	Min: 0.24 rev/s ²	Max: 100000 rev/s ²
Acceleration jerk for positioning:	Min: 30 rev/s ³	Max: 125,000,000 rev/s ³
Deceleration for positioning:	Min: 0.24 rev/s ²	Max: 1000000 rev/s ²
Deceleration jerk for positioning:	Min: 30 rev/s ³	Max: 125,000,000 rev/s ³

The unit "increments" is valid only for position values!

speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s² and revolutions/s³ (resp. pitch/s, pitch/s², pitch/s³).

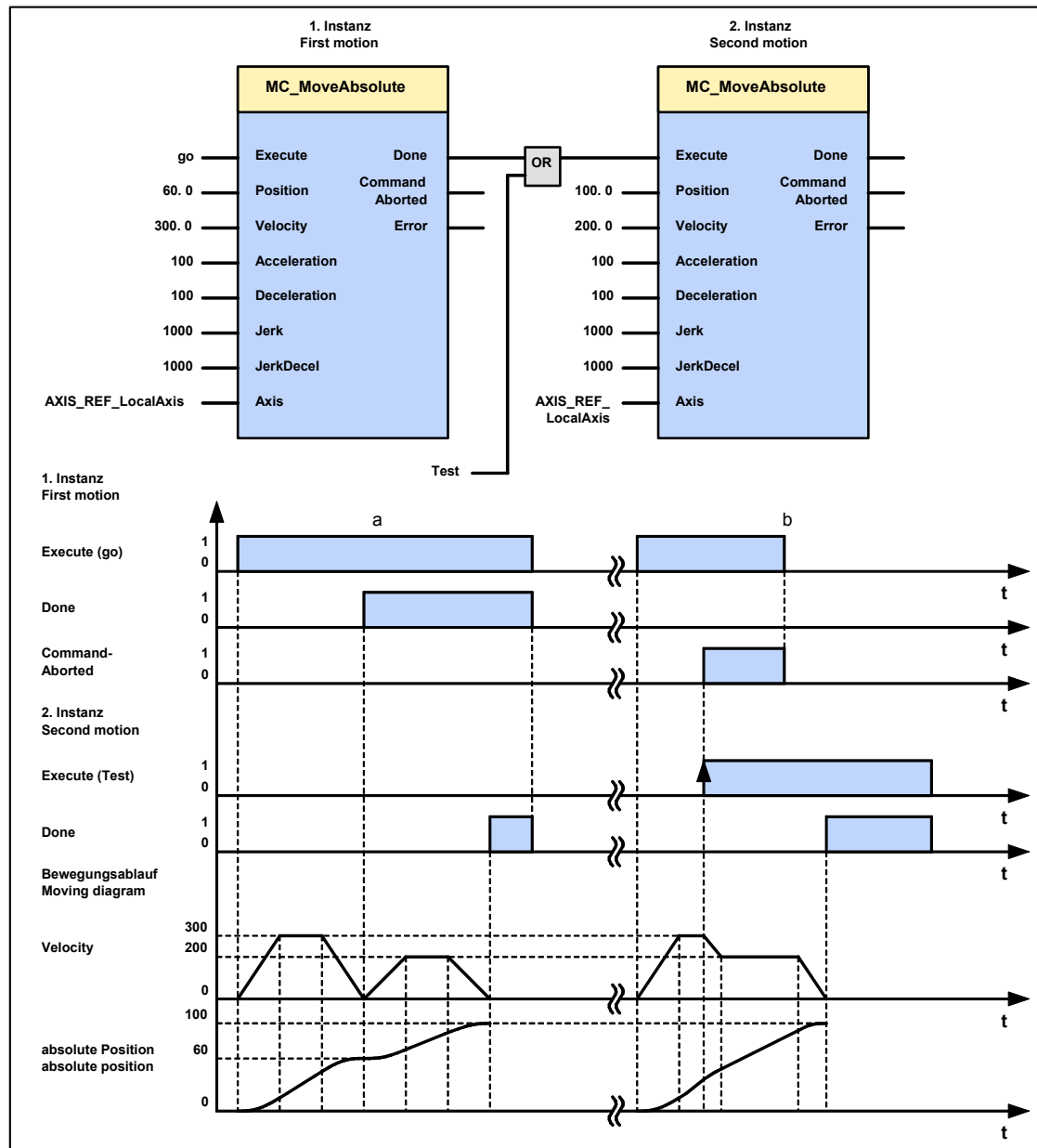
5.5.3. Absolute positioning (MC_MoveAbsolute)

FB name		MC_MoveAbsolute
Absolute positioning to a specified position.		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Position	REAL	Absolute target position of the movement to be executed (configured unit [Units]) (positive and negative direction) <value range> (see page Fehler! Textmarke nicht definiert.)
Velocity	REAL	Value of the maximum speed (always positive) (not necessarily reached) <value range> (see page Fehler! Textmarke nicht definiert.) [Units/s]
Acceleration	DINT	Value of acceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Deceleration	DINT	Value of deceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Jerk	DINT	Value of the acceleration jerk (see page 315) [Units/s ³] (always positive) <value range> (see page Fehler! Textmarke nicht definiert.)
JerkDecel	DINT	Value of deceleration jerk [Units/s ³] (always positive) <value range> (see page Fehler! Textmarke nicht definiert.)
VAR_OUTPUT		
Done	BOOL	Specified setpoint position on the setpoint generator output is reached
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error while executing module
Note: - ◆ If a SuperImposed movement is started during an absolute movement, the absolute position is not accessed, but the absolute position plus the position entered in the SuperImposed. ◆ The same applies if a SuperImposed movement is already being executed and an absolute movement is started, then the absolute position is not accessed but the sum of both values. ◆ After the SuperImposed movement has been finished, the absolute position is accessed with the next absolute movement. ◆ Continuous operation can be selected via object 1111.8 "C3Plus.Position_restposition_mode" <> 0; setpoint value and actual value are then set to 0 before each positioning. ◆ You can optimize the motion profile data with the "ProfilViewer" (see page 288) software tool!		



The following illustration shows two examples of the combination of two MC_MoveAbsolute modules.

- ◆ The left part (a) of the time diagram shows a case in which the second function module (FB) is executed after the first function module..
When the first function module has reached Position 60, the "Done" output gives the execution command to the second function module, which then moves to Position 100.
- ◆ The right part (b) of the diagram shows a case in which the second function module is activated while the first function module is being executed. The first function module is automatically interrupted..
The second function module moves directly to position 100 whether or not position 60 of the first function module has already been reached.



5.5.3.1 Position mode in reset operation

In this chapter you can read about:

Setting the positioning mode in reset mode.....	314
Examples in the help file.....	314

In reset operation (activated by the configured reset distance), additional positioning functions are possible for absolute positionings:

All directions	Standard positioning mode
Positive direction	Positioning only in positive direction
Shortest path	Positioning on the shortest path
Negative direction	Positioning only in negative direction
Actual direction	Positioning by keeping the actual direction of travel

Dynamic positioning

In dynamic positioning, a decision concerning the positioning travel is not taken on the basis of the actual position, but on the basis of the braking position resulting from the motion parameters.

Please observe:

- ◆ In the event of positioning specifications below zero and higher than or equal to the reset distance, this function is deactivated.
- ◆ The positioning functions are neither effective in test movements nor in a positioning after homing travel.
- ◆ In the event of "shortest path" the motion is not defined for a positioning by half the reset distance.

Setting the positioning mode in reset mode

The positioning modes in reset operation are configured via object 1111.13 [=C3Plus.POSITION_direction:=MC_Direction_Positive]:

Mode	Value	IEC constant
All directions	0	C3_all_direction
Positive direction	1	MC_positive_direction
Shortest path	2	MC_shortest_way
Negative direction	3	MC_negative_direction
Actual direction	4	MC_current_direction

Setting the desired value must take place in the IEC initialization routine, as a configuration download by the C3 ServoManager would reset the value to 0 (due to downwards compatibility).

Examples in the help file

In the help file you can find here examples for the functioning of the individual positioning modes.

5.5.3.2 Description of jerk

Jerk

The jerk (marked with "4" in the drawing below) describes the change in acceleration (derivation of the acceleration)

The maximum change in acceleration is limited via the jerk limitation. A motion process generally starts from a standstill, accelerates constantly at the specified acceleration to then move at the selected speed to the target position. The drive is brought to a stop before the target position with the delay that has been set in such a manner as to come to a complete stop at the target position. To reach the set acceleration and deceleration, the drive must change the acceleration (from 0 to the set value or from the set value to 0).

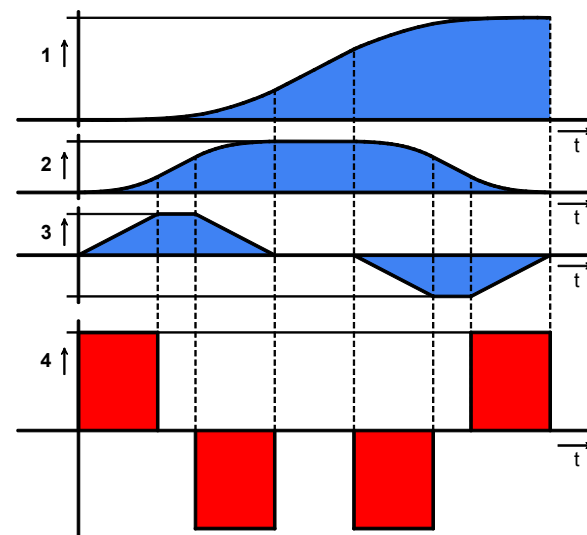
This change in speed is limited by the maximum jerk.

**Without jerk
according to
VDI2143**

According to VDI2143 the jerk is defined (other than here) as the jump in acceleration (infinite value of the jerk function).

This means that positionings with Compax3 are without jerk according to VDI2143, as the value of the jerk function is limited.

Motion sequence

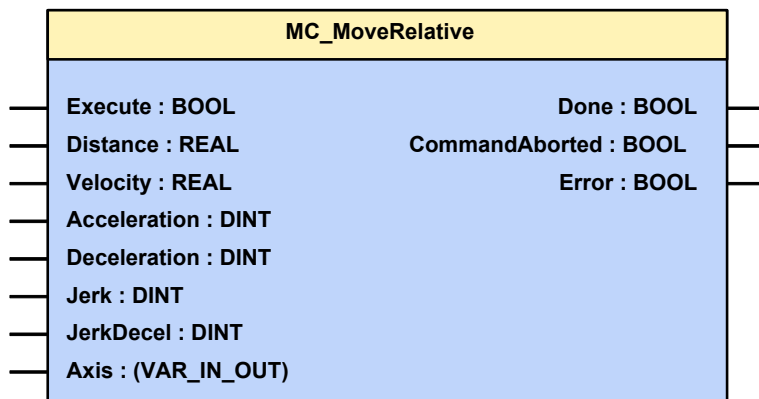


- 1: Position
- 2: Velocity
- 3: Acceleration
- 4: Jerk

High changes in acceleration (high jerks) often have negative effects on the mechanical systems involved. There is a danger that mechanical resonance points will be excited or that impacts will be caused by existing mechanical slack points. You can reduce these problems to a minimum by specifying the maximum jerk.

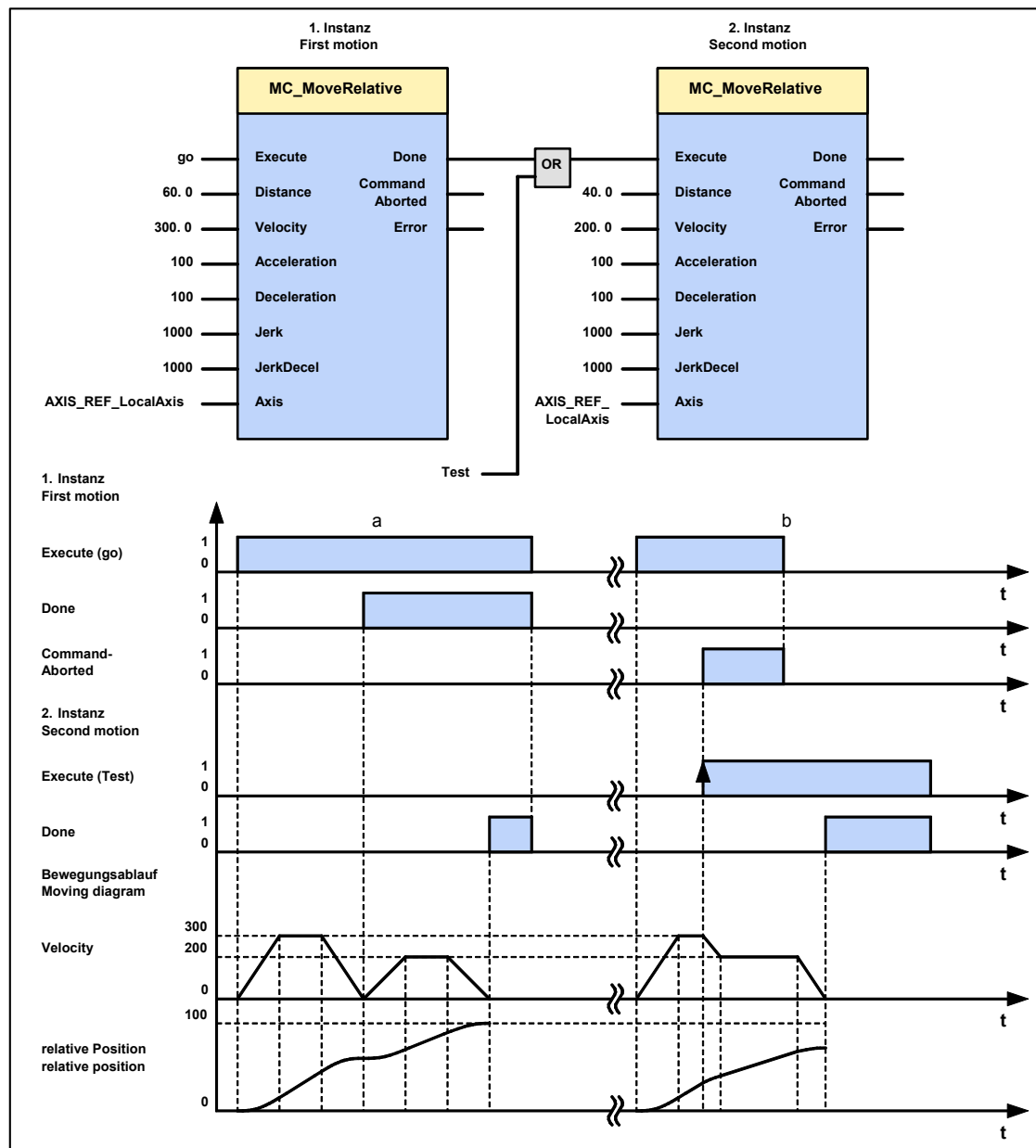
5.5.4. Relative positioning (MC_MoveRelative)

FB name		MC_MoveRelative
Relative positioning by a specified distance.		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Distance	REAL	Relative distance of the movement to be executed (configured unit [Units]) <value range> (see page Fehler! Textmarke nicht definiert.)
MoveVelocity	REAL	Value of maximum speed (always positive) (not necessarily reached) [Units/s] <value range> (see page Fehler! Textmarke nicht definiert.)
Acceleration	DINT	Value of acceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Deceleration	DINT	Value of deceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Jerk	DINT	Value of the acceleration jerk (see page 315) [Units/s ³] (always positive) <value range> (see page Fehler! Textmarke nicht definiert.)
JerkDecel	DINT	Value of deceleration jerk [Units/s ³] (always positive) <value range> (see page Fehler! Textmarke nicht definiert.)
VAR_OUTPUT		
Done	BOOL	Specified setpoint distance on the setpoint generator output is reached
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error while executing module
Note:		
◆ In the case of dynamic positioning (module is called during a positioning process) the specified position is added to the current actual position. ◆ Continuous operation can be selected via object 1111.8 "C3Plus.Position_restposition_mode" <> 0; setpoint value and actual value are then set to 0 before each positioning. ◆ You can optimize the motion profile data with the "ProfilViewer" (see page 288) software tool!		



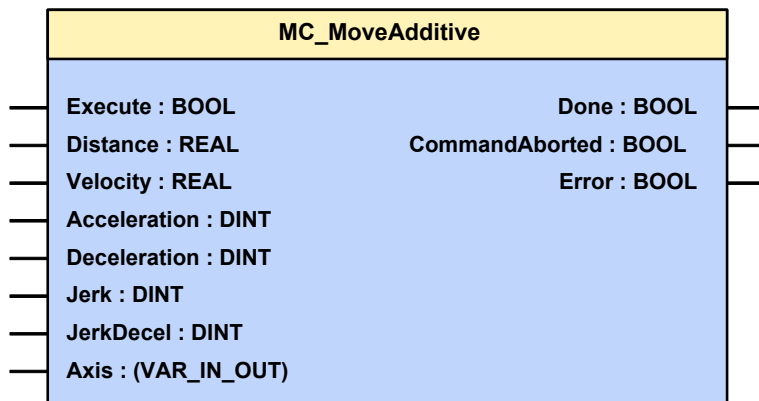
The following illustration shows two examples of the combination of two MC_MoveRelative modules.

- ◆ The left part (a) of the time diagram shows a case in which the second function module is executed after the first function module..
If the first function module has reached 60 units, the "Done" output gives the execution command to the second function module, which then moves an addition 40 units.
- ◆ The right part (b) of the diagram shows a case in which the second function module is activated while the first function module is being executed. Because the second module is started during the execution of the first function module, the first function module is automatically interrupted.
The second function module immediately moves an additional 40 units whether or not the 60 units of the first function were already reached.



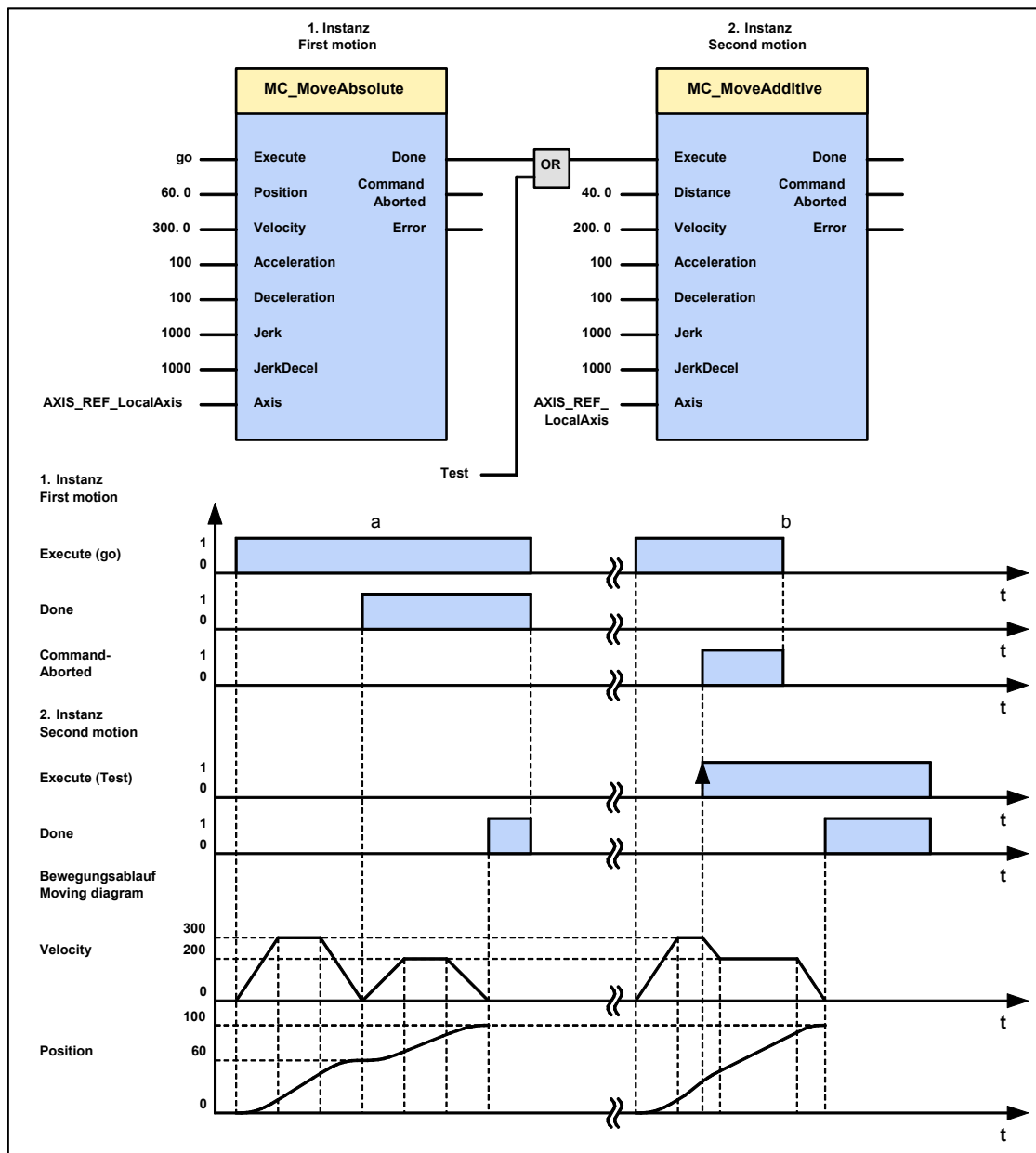
5.5.5. Additive positioning (MC_MoveAdditive)

FB name		MC_MoveAdditive
Adds a relative distance to the target position of a positioning process in progress.		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Distance	REAL	Relative distance <Value range> (see page Fehler! Textmarke nicht definiert.)
MoveVelocity	REAL	Value of maximum speed (always positive) (not necessarily reached) [Units/s] <value range> (see page Fehler! Textmarke nicht definiert.)
Acceleration	DINT	Value of acceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Deceleration	DINT	Value of deceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Jerk	DINT	Value of the acceleration jerk (see page 315) [Units/s ³] (always positive) <value range> (see page Fehler! Textmarke nicht definiert.)
JerkDecel	DINT	Value of deceleration jerk [Units/s ³] (always positive) <value range> (see page Fehler! Textmarke nicht definiert.)
VAR_OUTPUT		
Done	BOOL	Specified distance has been reached
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error during positioning
Note: In the case of dynamic positioning (module is called during a positioning process) the specified position is added to the current target position.		



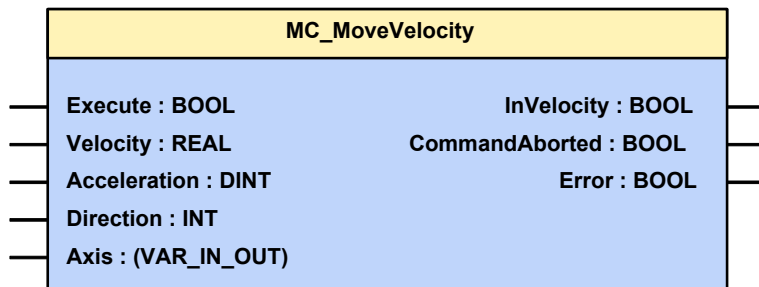
The following illustration shows two examples of the combination of a MC_MoveAbsolute and an MC_MoveAdditive module.

- ◆ The left part (a) of the time diagram shows a case in which the second function module is executed after the first function module.
After the first function module has traveled to Position 60, the "Done" output gives the execution command to the second FB, which then moves on another 40 units
- ◆ The right part (b) of the diagram shows a case in which the second function module is activated while the first FB is being executed. Because the second module is started during the execution of the first FB, the first FB is automatically interrupted.
The second function module adds the missing units that are still lacking for the first module and the moves an additional 40 units with the new predefined settings.



5.5.6. Continuous positioning (MC_MoveVelocity)

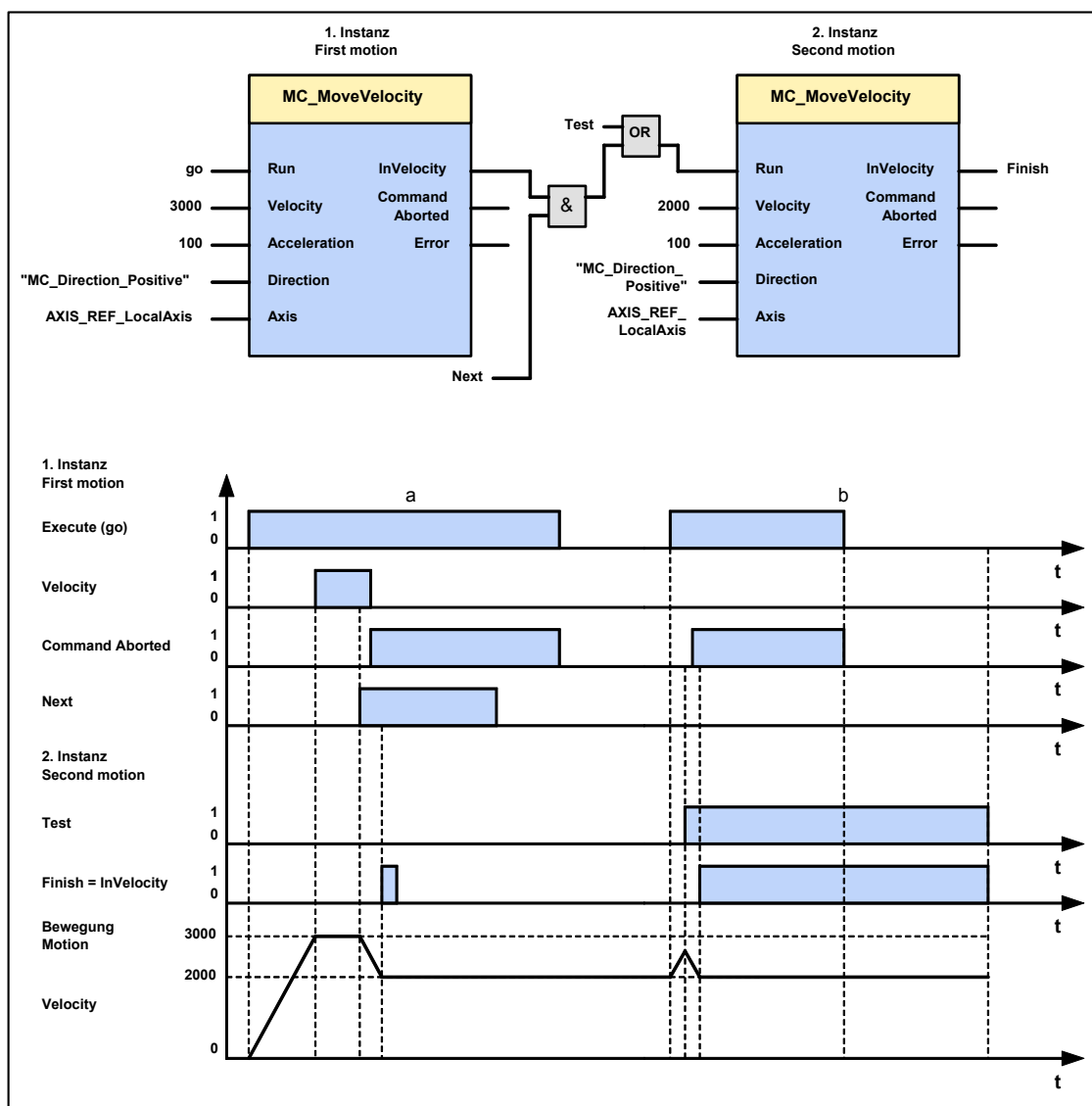
FB name		MC_MoveVelocity
Continuous controlled positioning with adjustable speed		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
MoveVelocity	REAL	Value of maximum speed (always positive) (not necessarily reached) [Units/s] Value range: 0 rev/s ... 2000 rev/s
Acceleration	DINT	Value of the acceleration and deceleration (always positive) [Units/s ²] Value range: 0.24 rev/s ² ... 1000000 rev/s ²
Direction	INT	Selection: positive direction, negative direction, current direction; library constants (see page 300)
VAR_OUTPUT		
InVelocity	BOOL	Specified target speed on the setpoint output is reached
CommandAborted	BOOL	Execution interrupted
Error	BOOL	Error during positioning
Note: ◆ To be able to stop the drive, the function module must be interrupted by another positioning function module or positioning must be stopped by calling the MC_Stop function module. ◆ A positioning to the end limit follows.		



Example

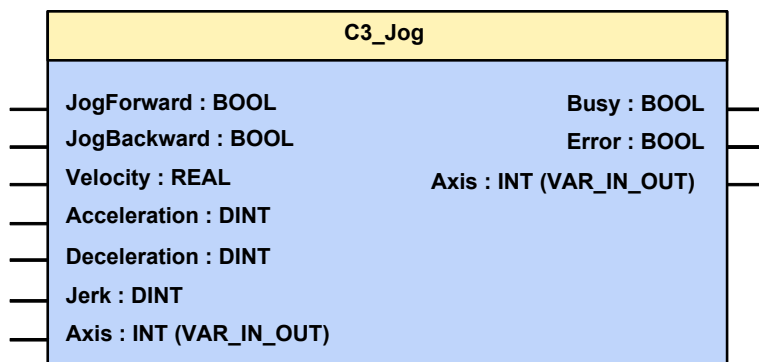
The following illustration shows two examples of the combination of two MC_MoveVelocity modules.

- ◆ The left part (a) of the time diagram shows a case in which the second function module is executed after the first function module.
After the first function module has accelerated to a speed of 3000, the "InVelocity" output, AND-linked with the "Next" signal gives the execution command to the second FB, which then slows to a speed of 2000.
- ◆ The right part (b) of the diagram shows a case in which the second FB is activated while the first function module is being executed. Because the second module is started during the execution of the first FB, the first FB is automatically interrupted.
During the acceleration of the first module, the second module slows again similarly to a speed of 2000 without the speed of the first module having been reached.

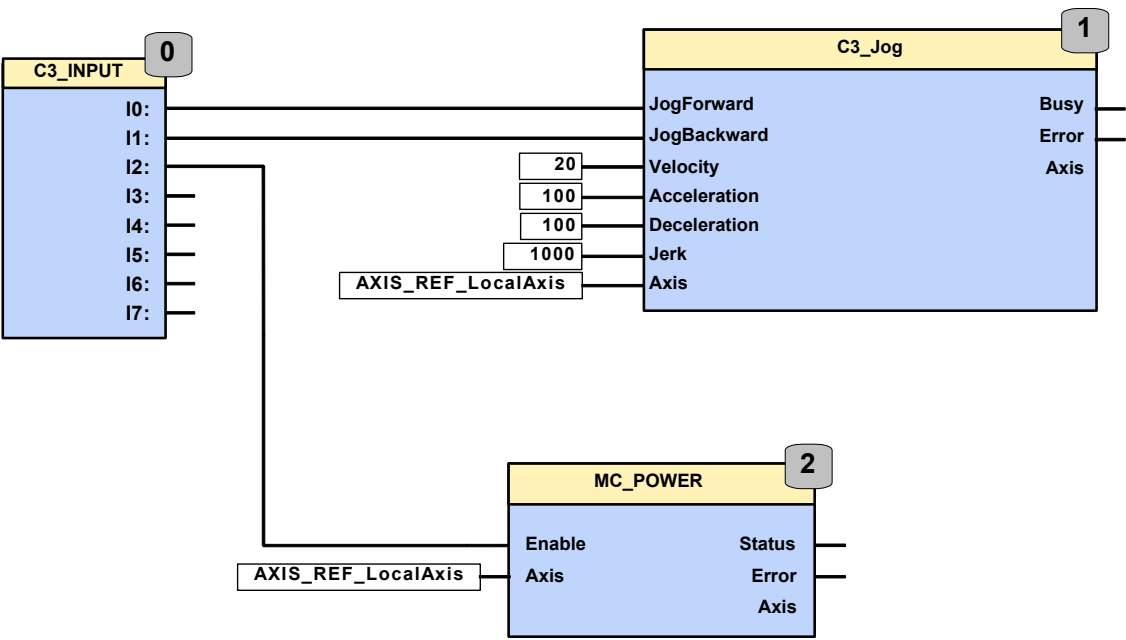


5.5.7. Manual operation (C3_Jog)

FB name		C3_Jog
Traveling along the axis in manual mode (in the "standstill" state)		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
JogForward	BOOL	JogForward = TRUE makes the axis move in positive direction.
JogBackward	BOOL	JogBackward = TRUE makes the axis move in negative direction. <Value range> (see page Fehler! Textmarke nicht definiert.)
Velocity	REAL	Speed value [Units/s] <value range> (see page Fehler! Textmarke nicht definiert.)
Acceleration	DINT	Value of the acceleration [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Deceleration	DINT	Value of deceleration during stop [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Jerk	DINT	Value of the acceleration and deceleration jerk (see page 315) [Units/s ³] <value range> (see page Fehler! Textmarke nicht definiert.)
VAR_OUTPUT		
Busy	BOOL	Module is active (manual operation in progress)
Error	BOOL	Error during manual operation or faulty parameter when starting manual operation
Note: ◆ The axis must be in the "standstill" state in order to start manual operation (Jogging Mode). ◆ Start: When starting manual operation, the output "Busy" is set to TRUE. ◆ Stop: The axis is brought to a standstill if the respective input (JogForward or JogBackward) is set to FALSE again ◆ As soon as manual operation is stopped, the output "Busy" is set to FALSE. Further commands can only be executed after this feedback.		

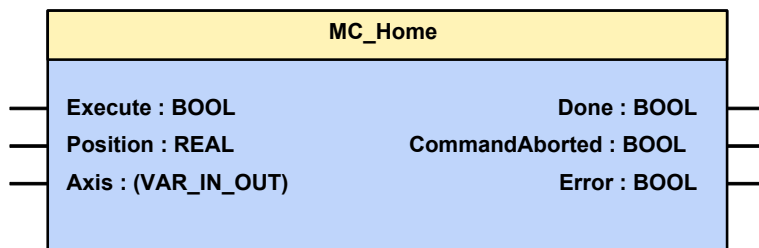


Example: Manual movement via digital inputs.



5.5.8. Homing (MC_Home)

FB name		MC_Home
Predefined search for the machine reference point		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Position	REAL	Position on the machine zero point (configured unit [units]) = Machine zero Offset
VAR_OUTPUT		
Done	BOOL	Referencing process completed
CommandAborted	BOOL	Referencing process aborted
Error	BOOL	Error while searching for machine reference point
Note: This module gives the command to search for the machine reference point; not for "zero" position. The type of search function (machine reference mode) can be adjusted with the configuration or with the object "HOMING_mode" (Object 1130.4). Objects that are connected with the machine reference point: ◆ C3Plus.HOMING_speed (Object 1130.3) ◆ C3Plus.HOMING_accel (Object 1130.1) - C3Plus.HOMING_mode (Object 1130.4) ◆ C3Plus.HOMING_edge_sensor_distance (Object 1130.7)		



The Compax3 machine zero modes are adapted to the CANopen profile for Motion Control CiADS402.

Position reference point

Essentially, you can select between operation with or without machine reference. The reference point for positioning is determined by using the machine reference and the machine reference offset.

Machine reference run

In a homing run the drive normally moves to the position value 0 immediately after finding the home switch. The position value 0 is defined via the homing offset.

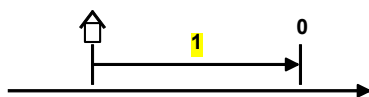
A machine reference run is required each time after turning on the system for operation with machine reference.



Please note:

During homing run the software end limits are not monitored.

Machine reference offset



1: machine zero point

The machine reference offset is used to determine the actual reference point for positioning.

The rule for this is: Machine zero point = - Machine zero Offset

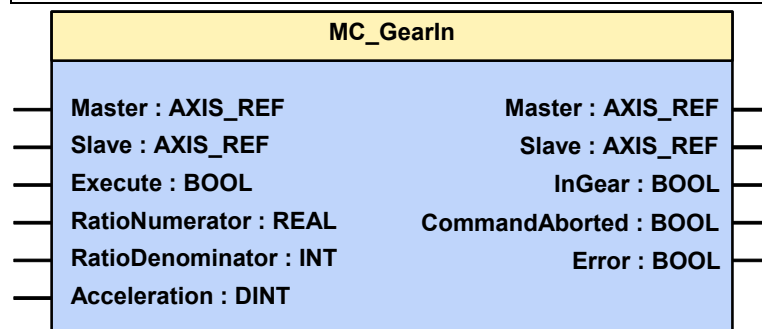
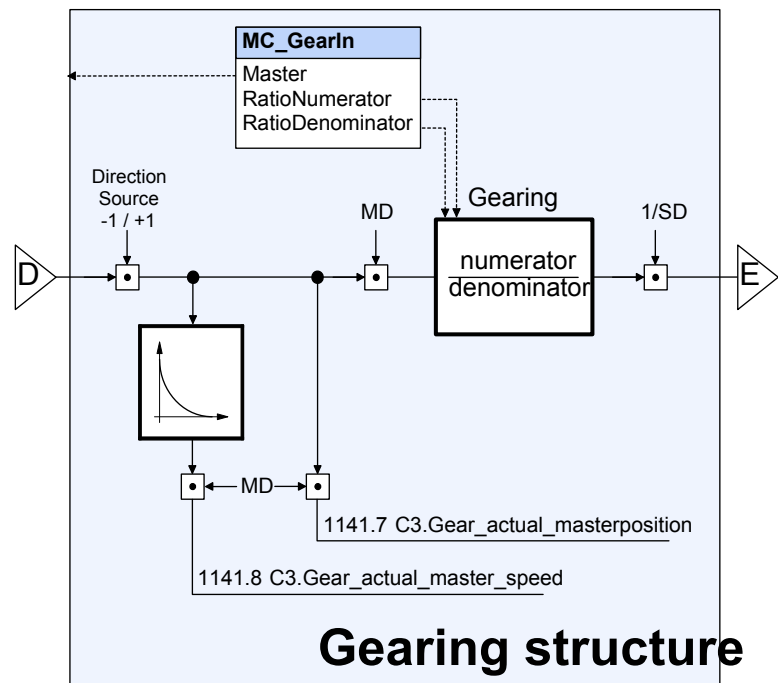
A change in the machine reference offset does not take effect until the next machine reference run.

5.5.9. Electronic gearbox (MC_GearIn)

FB name		MC_GearIn
Controlled speed and position synchronicity with adjustable transmission ratio		
VAR_IN_OUT		
Master	INT	Constant for the master signal source (see page 300) Configuration (see page 152) of the signal sources
Slave	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
RatioNumerator	REAL	Transmission ratio of numerator
RatioDenominator	INT	Transmission ratio of denominator
Acceleration	DINT	Value of acceleration / deceleration (always positive) until the synchronism is reached [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
VAR_OUTPUT		
InGear	BOOL	Synchronicity achieved
CommandAborted	BOOL	Command aborted ◆ The device is not ready to operate when the Execute is issued ◆ Another module of the MC_GearIn has interrupted (in gear operation or quasi parallelly in the same IEC cycle) ◆ The gear command was not accepted by the setpoint generator because ◆ The selected master source was not configured (signal source) ◆ The command cannot be accepted in the current device status (not "standstill powered", "Discrete Motion", "Continuous Motion" or "Synchronized Motion") ◆ The nominator of the gear factor (O1141.1) equals zero
Error	BOOL	Error while executing module: ◆ Input Slave unequal AXIS_REF_LocalAxis ◆ Input Acceleration smaller than or equal to zero ◆ Input RatioDenominator equals zero ◆ Input Master unequal to AXIS_REF_Physical, AXIS_REF_HEDA or AXIS_REF_Virtual (only T40) ◆ The device changes to "Error Stop" error status while gearing is running

Note:

- ◆ Behaviour: the drive accelerates (with Acceleration) until the master speed is reached - the module will report synchronicity with "InGear". Position losses during acceleration to master speed are not made up.
- ◆ The transmission ratio can be changed at any time with a positive edge on Execute. InGear is reset until synchronicity is achieved again.
- ◆ For example, if speed synchronicity is not achieved because of limiting effects, the position difference that arises will be made up (by the active position controller).
- ◆ Acceleration / deceleration to the set transmission ratio takes place without a jerk limit.
- ◆ If the master and slave units do not correspond, this fact must be considered for the transmission ratio.
- ◆ **Example;** (see page 153)

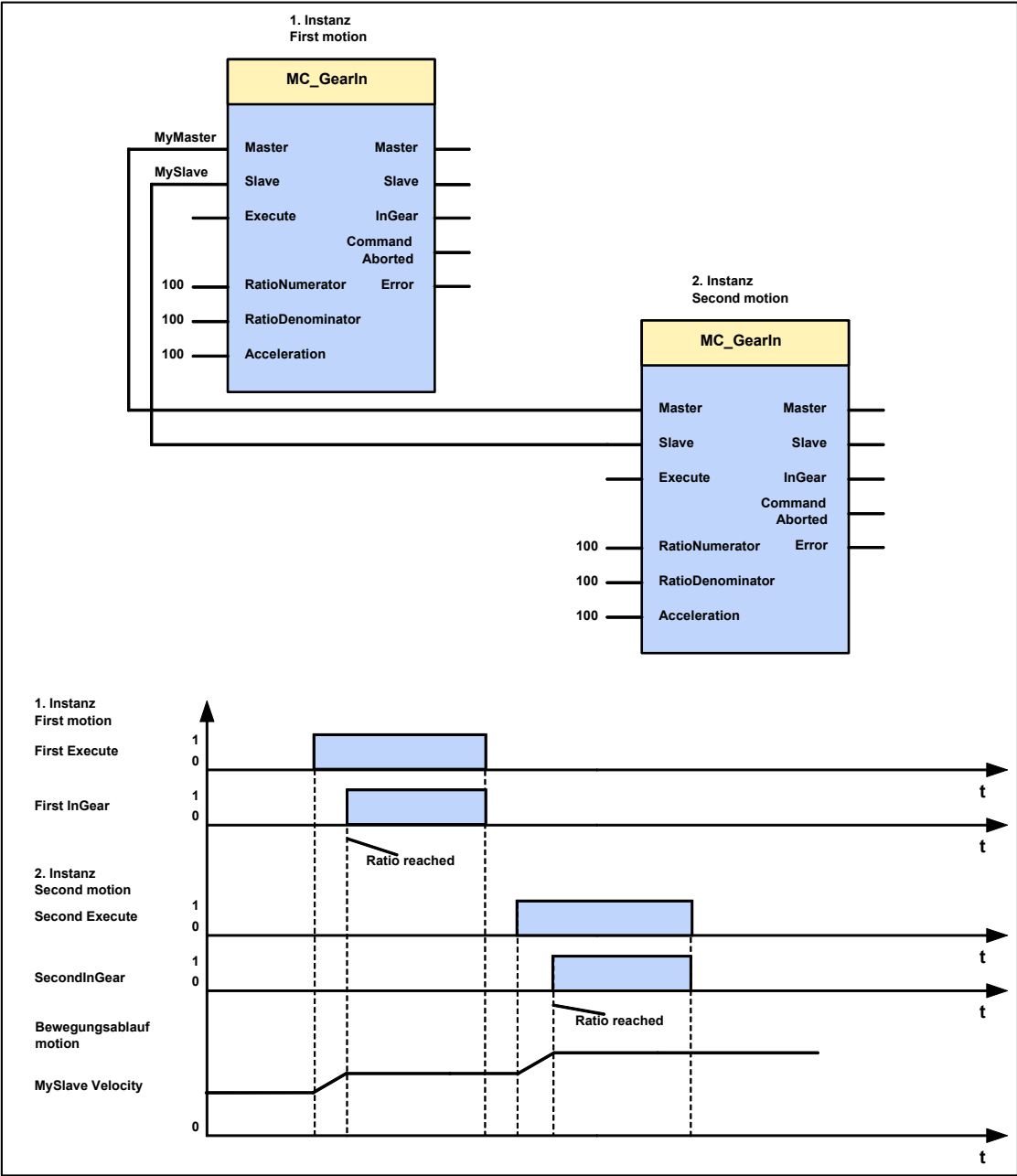
**Structure of the "electronic cam" function**

D: / E: **additional structure** (see page 240)

Note:

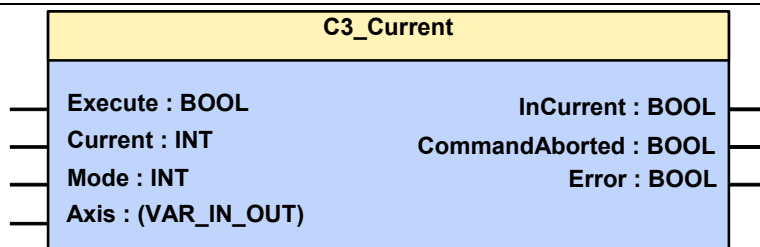
- ◆ Direction -1 / +1: with direction reversal (under configuration of signal sources) factor -1 is applied.
- ◆ The "virtual master" source is not available with Compax3 T30.

Example:



5.5.10. Current setting operation (C3_Current)

FB name		C3_Current
Current control. Speed and position controllers are switched off. The system controls to the specified current. The current setting can be made with the module input or with an analog input.		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Current	INT	Current to be set in [mA]
Mode	INT	0 = The current read during Execute on the Current input is set. 3 = After Execute, the Current input is read again in each cycle and the corresponding current is set (Execute must be permanently present for this mode).
VAR_OUTPUT		
InCurrent	BOOL	Specified current set
CommandAborted	BOOL	Command aborted
Error	BOOL	Error
Note: ◆ The current feedforward (optimization parameter) is set to 100% to operate C3_Current. ◆ The status "current control" must be aborted with MC_Stop before new positionings are possible.		



5.5.11. Torque / force control (C3_TorqueControl)

FB name		C3_TorqueControl
Torque / force control with speed limitation The module can be started from the "Discrete Motion" and "Continuous Motion" states. The position control is deactivated during this operating mode.		
VAR_IN_OUT		
Axis	INT	
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Torque	DINT	Command torque [mNm] or command force [mN]
TorqueRamp	DINT	Value of the torque-force ramp [mNm/s] [mN/s]
Velocity	REAL	Value of maximum speed (always positive) (not necessarily reached) [Units/s] <value range> (see page Fehler! Textmarke nicht definiert.) If the command torque or the command force is not reached, the drive will move with this speed.
Acceleration	DINT	Value of the maximum acceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Deceleration	DINT	Value of the maximum deceleration (always positive) [Units/s ²] <value range> (see page Fehler! Textmarke nicht definiert.)
Direction	INT	Selection of the permitted direction (positive direction or negative direction) (library constant) The movement into the other direction is blocked, a speed of 0 is commanded!
VAR_OUTPUT		
InTorque	BOOL	Specified torque is reached
CommandAborted	BOOL	Module sequence is interrupted
Error	BOOL	Error while executing module
Note: ◆ The movement is limited by the set maximum speed or by the command torque/command force. ◆ The actual speed value is always positive. The direction of movement depends on the Direction Input. ◆ There is no torque/force acquisition. Actual torque or actual force is acquired from the quadrature current and the motor parameters. ◆ Behaviour on ◆ Stop: (MC_Stop) => immediate switching to position control; this means entire torque (or entire force)! ◆ C3 error => depending on the error reaction (1) switching to position control, this means entire torque (or entire force)! ◆ The module can also be used for defined braking, e.g. for unwinders. ◆ The command torque or the command force has then the opposite sign than the direction ◆ If there is no counter torque or no counter force, so that braking is not possible, the drive will decelerate to 0 in a torque/force controlled manner.		



5.6 Error handling

In this chapter you can read about:

Acknowledging errors (MC_Reset).....	332
Reading axis errors (MC_ReadAxisError).....	333
Set error reaction (C3_SetErrorReaction).....	334
Switching off error messages (C3_ErrorMask)	335

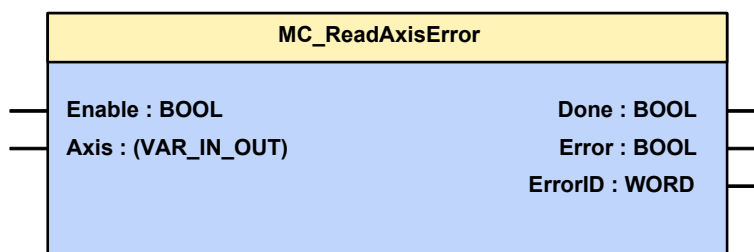
5.6.1. Acknowledging errors (MC_Reset)

FB name		MC_Reset
Acknowledges errors (transition from "Errorstop" status to "Standstill" status).		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Execute	BOOL	Activates the module if there is a positive edge
VAR_OUTPUT		
Done	BOOL	Error successfully acknowledged, axis is in the "Standstill" state again
Error	BOOL	Acknowledge failed /not possible
ErrorID	WORD	Error description, according to error history
Note: After the error is successfully acknowledged, the power must be supplied to the power output stage again by a rising edge on the enable input of the MC_Power power module. C3 powerPLmC Note: This module is also available as group function block. You can then trigger this function for the entire Compax3 group.		



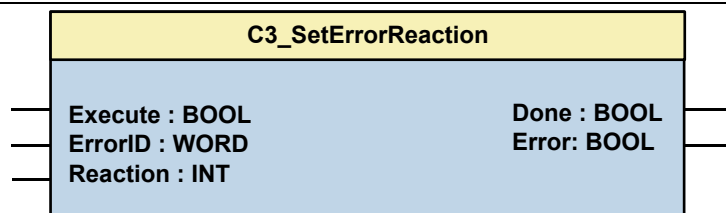
5.6.2. Reading axis errors (MC_ReadAxisError)

FB name	MC_ReadAxisError	
This function module displays axis errors.		
VAR_IN_OUT		
Axis	INT	Axis-ID (library constants)
VAR_INPUT		
Enable	BOOL	Activates the module
VAR_OUTPUT		
Done	BOOL	Output values available
Error	BOOL	Compax3 in error state
ErrorID	WORD	Current error description
Note: -		



5.6.3. Set error reaction (C3_SetErrorReaction)

FB name		C3_SetErrorReaction
This module is used to define the error reaction. Note: The error reaction (see page 457) cannot be changed for errors with standard reaction 5 (switch immediately to currentless (without ramp), close brake).		
VAR_INPUT		
Execute	BOOL	The defined error reaction is set for the selected error
ErrorID	WORD	Error number [hexadecimal] for which the error reaction should be set, e.g. 0x6281
Reaction	INT	Error response: 0: no reaction, error is deactivated. 1: Downramp actual speed; remain in position control state 2: Downramp the actual speed; then switch off controller
VAR_OUTPUT		
Done	BOOL	The defined error reaction was set
Error	BOOL	Error while executing module
Note: Error list (see page 457) ◆ The error reaction settings from the configuration wizard are overwritten. ◆ The setting of the error mask is made internally via a C3 object. If the objects are saved permanently, the setting is memorised after Power off. Please note: ◆ The C3_ErrorMask overwrites (depending on the calling-up order) the settings. ◆ The corresponding error reaction is valid for both axes (of Compax3F) as the case may be. ◆ The module will overwrite the settings made via the C3 ServoManager. ◆ If the ErrorID has an invalid error number, no change is effected.		



5.6.3.1 Error reaction of IEC61131-3 modules with Release < R5-0

A changed **error reaction** (see page 150, see page 334) of the errors with reaction 2 (to reaction 1 or 0) is only considered at the "ERROR" output of the IEC61131-3 modules from targets of the Compax3 - Release R5-0.
Install the new targets and recompile your IEC program.

5.6.4. Switching off error messages (C3_ErrorMask)

FB name		C3_ErrorMask
This module is used to switch off error messages. Selection between error reactions 2 and 0		
VAR_INPUT		
Execute	BOOL	The selected error mask is activated
Disable_PLC	BOOL	TRUE is used to switch off error 0x6281.
Disable_HEDA	BOOL	TRUE is used to switch off HEDA errors.
Disable_Fieldbus	BOOL	TRUE is used to switch off the errors 0x8120 and 0x8121.
Disable_MotorStalled	BOOL	TRUE is used to switch off error 0x7121.
Disable_Tracking	BOOL	TRUE is used to switch off error 0x7320.
Disable_IOShortCircuit	BOOL	TRUE is used to switch off error 0x5380.
Disable_IOAddSupply	BOOL	TRUE is used to switch off error 0x5117.
Disable_BusVoltageLow	BOOL	Error 0x3222 is switched off with TRUE. Switch off only for commissioning! Note on Compax3H: always on FALSE, as operation <420VDC is not possible.
Disable_E5LimitSwitch	BOOL	TRUE is used to switch off error 0x54A0.
Disable_E6LimitSwitch	BOOL	TRUE is used to switch off error 0x54A1.
Disable_SoftwareLimit_Pos	BOOL	TRUE is used to switch off error 0x7323.*
Disable_SoftwareLimit_Neg	BOOL	TRUE is used to switch off error 0x7324.*
Error list (see page 457) Notes: ◆ The setting of the error mask is made internally with a C3 object. If the objects are saved permanently, the setting is memorised after Power off. Please note: ◆ In the active module, the given errors can no longer be changed to error reaction 1. ◆ With open inputs, the respective error is active, therefore you should assign the error messages you wish to eliminate with TRUE. ◆ The module will overwrite the settings made via the C3 ServoManager. ◆ * During operation with reset distance, these errors are active with a limit of 8 000 000; you should therefore switch off the errors in this operating mode by assignment to TRUE (with open input, a corresponding error is active).		

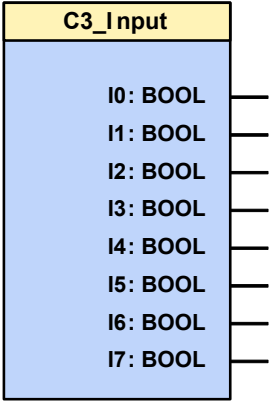
5.7 Process image

In this chapter you can read about:

Reading digital inputs (C3_Input).....	336
Write digital outputs (C3_Output).....	336
Reading/writing optional inputs/outputs.....	337
Memorizing the signals with the trigger event (C3_TouchProbe).....	339
Integration of Parker I/Os (PIOs).....	342

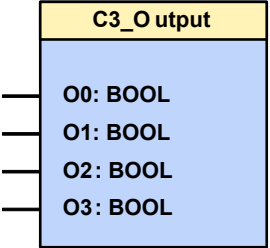
5.7.1. Reading digital inputs (C3_Input)

FB name	C3_Input	
Used to generate a process image of the digital inputs.		
VAR_INPUT		
I0 ... I7	BOOL	Displays the logic status of the respective input (with low active inputs, the physical statuses are negated).
Notes: the module should always be brought up at the beginning of the processing cycle.		



5.7.2. Write digital outputs (C3_Output)

FB name	C3_Output	
Used to generate a process image of the digital outputs.		
VAR_OUTPUT		
O0 ... O3	BOOL	Displays the status of the respective output.
Notes: the module should always be brought up at the end of the processing cycle.		



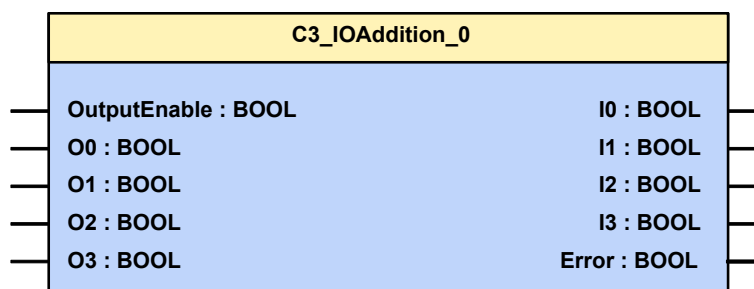
5.7.3. Reading/writing optional inputs/outputs

In this chapter you can read about:

C3_IOAddition_0	337
C3_IOAddition_1	337
C3_IOAddition_2	338

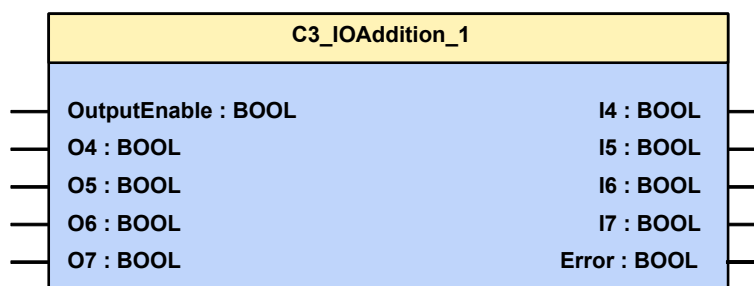
5.7.3.1 C3_IOAddition_0

FB name		C3_IOAddition_0
Is used to create a process image of the optional digital inputs/outputs.		
VAR_INPUT		
I0 ... I3	BOOL	Displays the status of the respective input.
O0 ... O3	BOOL	Displays the status of the respective output.
Please note that the group of 4 may be assigned as inputs or as outputs (see page 506). You may only use either inputs or outputs exclusively. Notes: The module should always be brought up at the beginning (inputs) or end (outputs) of the processing cycle.		



5.7.3.2 C3_IOAddition_1

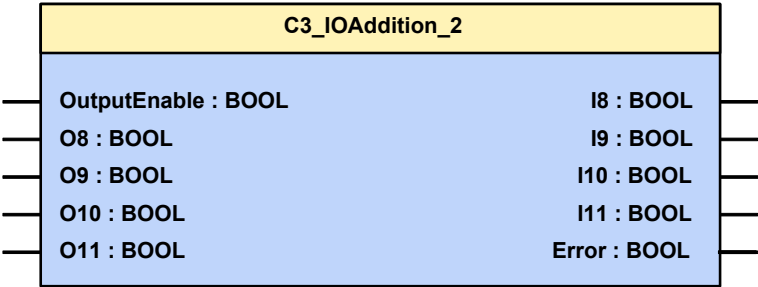
FB name		C3_IOAddition_1
Is used to create a process image of the optional digital inputs/outputs.		
VAR_INPUT		
I4 ... I7	BOOL	Displays the status of the respective input.
O4 ... O7	BOOL	Displays the status of the respective output.
Please note that the group of 4 may be assigned as inputs or as outputs (see page 506). You may only use either inputs or outputs exclusively. Notes: the module should always be brought up at the beginning of the processing cycle.		



5.7.3.3

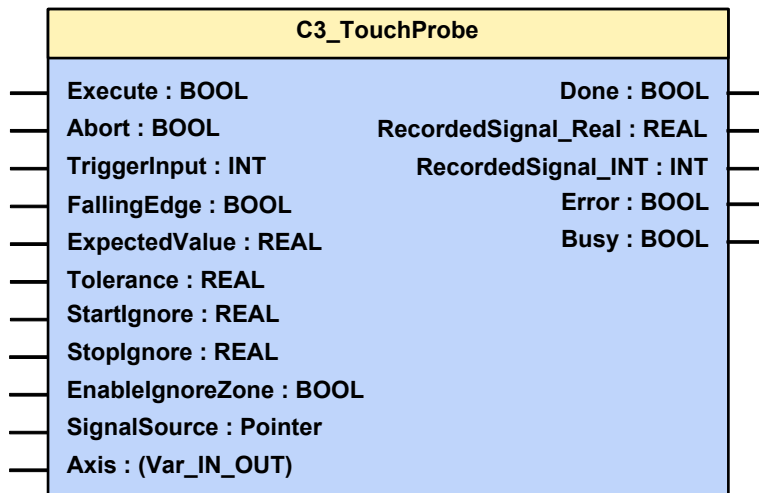
C3_IOAddition_2

FB name		C3_IOAddition_2	
Is used to create a process image of the optional digital inputs/outputs.			
VAR_INPUT			
I8 ... I11	BOOL	Displays the status of the respective input.	
O8 ... O11	BOOL	Displays the status of the respective output.	
Please note that the group of 4 may be assigned as inputs or as outputs (see page 506). You may only use either inputs or outputs exclusively. Notes: the module should always be brought up at the beginning of the processing cycle.			

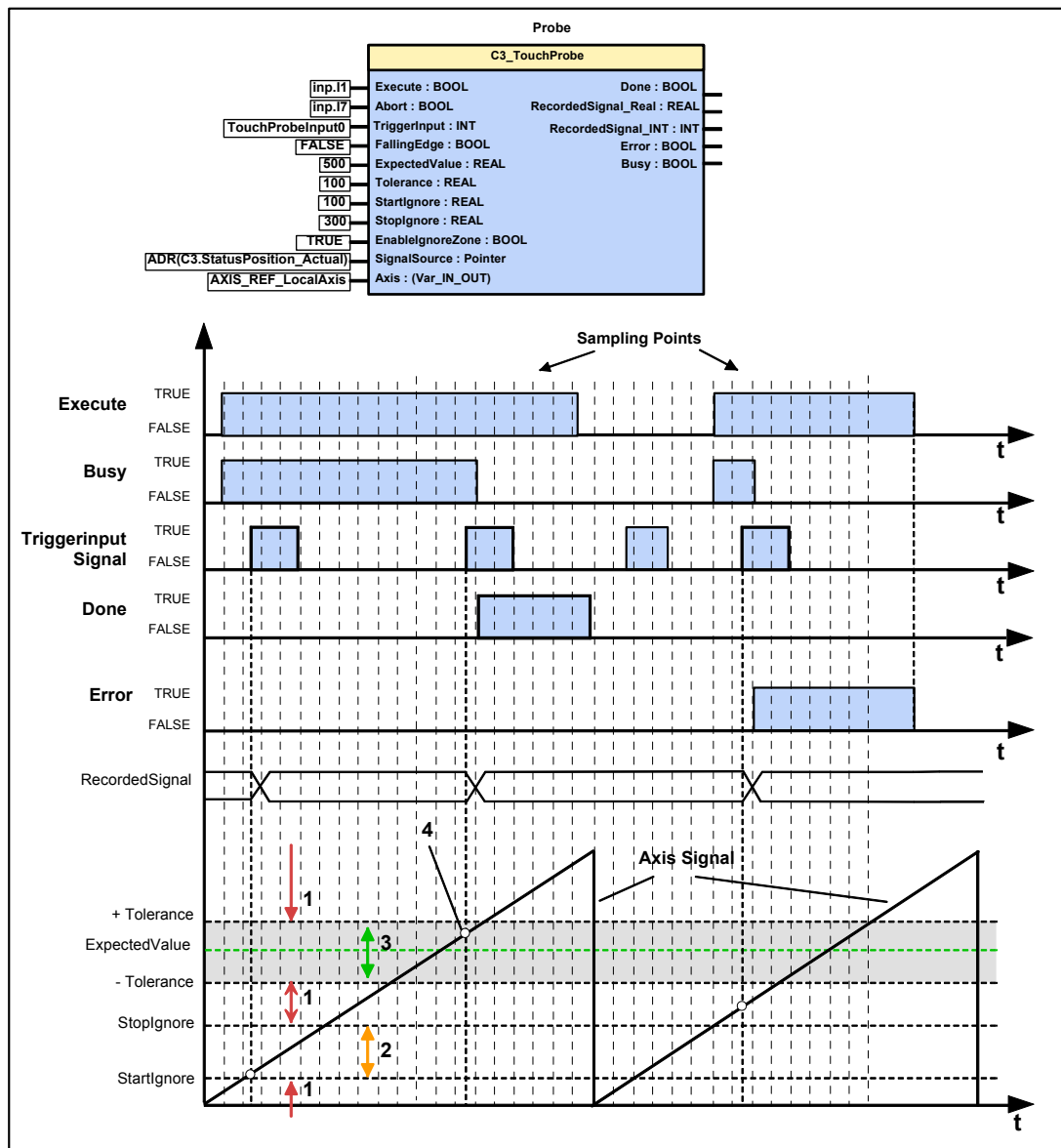


5.7.4. Memorizing the signals with the trigger event (C3_TouchProbe)

FB name		C3_TouchProbe
Memorizing signals / objects with the trigger event - replaces the MC_TouchProbe module -		
VAR_IN_OUT		
Axis	INT	Axis ID (Library constants)
VAR_INPUT		
Execute	BOOL	Activates the module if there is a rising edge
SignalSource	Pointer	Selects the signal to be scanned. The <address operator> must be used imperatively. The signal scanned must be in the REAL or the INT format.
FallingEdge	BOOL	If TRUE, it is triggered in the falling edge. The logical status after a possible input inversion is respected.
TriggerInput	INT	Selects the trigger input. Constant TouchProbeInputx (see note)
ExpectedValue	REAL	Value at which the trigger event is expected.
Tolerance	REAL	Tolerance interval around ExpectedValue, where the trigger event is accepted (always positive) (with reference to the signal source).
StartIgnore	REAL	The beginning of the range in which the trigger event will not be acknowledged with Done or Error (with reference to the signal source).
StopIgnore	REAL	The end of the range in which the trigger event will not be acknowledged with Done or Error (with reference to the signal source).
EnableIgnoreZone	BOOL	Activate IgnoreZone.
Abort	BOOL	Deactivate module.
VAR_OUTPUT		
Done	BOOL	Trigger event occurred within the tolerance interval and the signal was detected.
RecordedSignal_ Real	REAL	Value scanned at the time of the trigger event, if the source is available in the coDeSys "REAL" format. Please respect the format information of the signal source (SignalSource)
RecordedSignal_ INT	INT	Value scanned at the time of the trigger event, if the source is available in the coDeSys "INT" format. Please respect the format information of the signal source (SignalSource)
Busy	BOOL	Module active and no scanning signal occurred outside the IgnoreZone.
Error	BOOL	Error while executing module.
Note: ◆ Temporal precision of signal recording: <1µs ◆ TriggerInput Trigger-input: via the constants "TouchProbeInput0" ... "TouchProbeInput7" (X12/6 - X12/14) the trigger signal input is selected. ◆ Attention! Max. one entity of the module can be active as the hardware resources are only available once! Several entities being activated one after the other are permitted.		



Example: Scanning the actual position, triggered via Input I0



- 1: Area where a **module error** is generated.
- 2: Ignore Zone: Area where **no module error** and **no Done** is generated. The ranges 2 and 3 may not overlap. If they do, the ignore zone in range 3 is not effective.
- 3: ExpectedValueZone: Trigger signal in the permissible value range; this is confirmed with Done=TRUE.
- 4: RecordedSignal; is updated with every active edge of the TriggerInput signal upon Execute = TRUE.

- ◆ If the value of the signal (SignalSource) during the Trigger event is in the permissible value range between (ExpectedValue - Tolerance) and (ExpectedValue + Tolerance), this is confirmed with Done = TRUE; the RecordedSignal is updated.
- ◆ If the value of the signal (SignalSource) during the Trigger Event is between StartIgnore and StopIgnore (Ignore zone), the module will report neither error nor Done, the RecordedSignal is however updated.
- ◆ If the value of the signal (SignalSource) during the Trigger Event is outside the permissible value range and outside the zone between StartIgnore and StopIgnore (Ignore zone), the module will report an error, the RecordedSignal is updated.
- ◆ Within this range, the signals are read in with a temporal exactitude of $<1\mu\text{s}$ (determined by linear interpolation).
- ◆ If a Trigger Signal occurs at Execute = False, the RecordedSignal is not updated.
- ◆ If **no** Trigger Signal comes up, Busy remains active until the module is reset to the original state with Abort.
- ◆ More examples with C3_Touchprobe (example 7 and example 8).

5.7.5. Integration of Parker I/Os (PIOs)

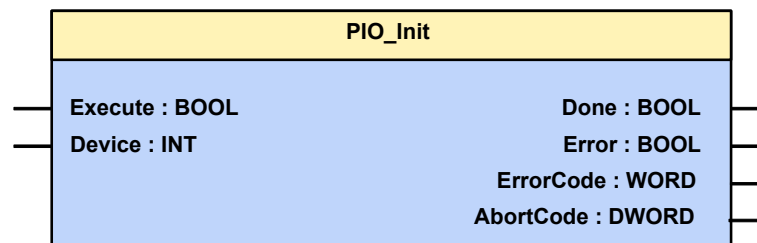
In this chapter you can read about:

Initializing the PIOs (PIO_Init)	342
Reading the PIO inputs 0-15 (PIO_Inputx...y)	343
Writing the PIO outputs 0-15 (PIO_Outputx...y)	344
Example: Compax3 as CANopen Master with PIOs	345

In order to integrate PIOs via CANopen, the CANopen operating mode "**Master for PIOs** (see page 400, see page 399)" must be configured.

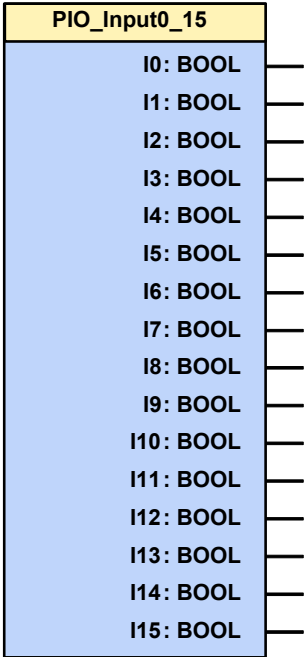
5.7.5.1 Initializing the PIOs (PIO_Init)

FB name		PIO_Init
Initialization of the PIOs		
VAR_IN_OUT		
Device	INT	PIO - ID (Address)
VAR_INPUT		
Execute	BOOL	Activates the module if there is a positive edge
VAR_OUTPUT		
Done	BOOL	Initialization executed
Error	BOOL	An error occurred during initialization
ErrorCode	WORD	1 = no Parker device Additional errors can be found in the error list (see page 457).
AbortCode	DWORD	SDO abort code (see page 415)
Note: Please execute this module at the beginning of the IEC program.		



5.7.5.2 Reading the PIO inputs 0-15 (PIO_Inputx...y)

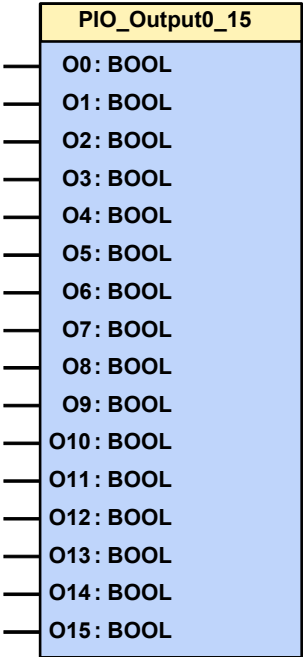
FB name	PIO_Input0_15	
Is used for reading the respective inputs		
VAR_INPUT		
I0 ... I15	BOOL	Displays the status of the respective input.
Note: For the additional inputs, the following modules are available PIO_Input16_31 PIO_Input32_47and PIO_Input48_63. Please execute this module at the beginning of the IEC program (After PIO_INIT).		



5.7.5.3

Writing the PIO outputs 0-15 (PIO_Outputx...y)

FB name	PIO_Output0_15	
Is used for writing on the respective outputs		
VAR_INPUT		
O0 ... O15	BOOL	Displays the status of the respective output.
Note: For the additional outputs, the following modules are available PIO_Output16_31 PIO_Output32_47and PIO_Output48_63. Please execute this module at the end of the IEC program.		



5.7.5.4 Example: Compax3 as CANopen Master with PIOs

- ◆ Compax3 control via PIOs.
- ◆ Configuration of the PIO connection with the C3 ServoManager.
- ◆ Initializing the PIO connection with the PIO_Init module
- ◆ Control of Compax3 via the digital PIOs and
- ◆ setpoint assignment via the analog PIOs

Related programs:

- ◆ ..\Examples\C3_mit_PIOs\T30_MasterPIO_ID2.C3P
- ◆ ..\Examples\C3_mit_PIOs\C3_PIO_CONNECTION_TEST.pro

Test setup:

- A PIO-347 for CANopen with:
- ◆ 1 PIO-602 (24V DC feed)
 - ◆ 2 PIO-402 (8 digital inputs) for operation wired to a switch box
 - ◆ 6 PIO-504 (24 digital outputs)
 - ◆ 1 PIO-468 (4 analog inputs)
 - ◆ 1 PIO-550 (2 analog outputs) analog output 0 is wired with analog input 0 for setpoint definition
 - ◆ 1 PIO-600 (Bus terminal)
 - ◆ a 24V power supply unit
 - ◆ a C3 S025 F10 I21 T30 M11 with power- and 24V-cable
 - ◆ a motor SMH 60 60 1,4...4 with motor- and resolver cable
 - ◆ a CAN-bus cable for the connection of the Compax3 with the PIO coupler.
 - ◆ a serial cable for the connection of the Compax3 with the PC
 - ◆ a switch box for the operation of the 8 digital inputs of the PIOs.

Settings:

- ◆ Baud rate = 1Mbit
- ◆ Node address of the PIO = 5 (setting via the address switch on the device)
- ◆ Node address of the C3 = 2 (setting via the address switch on the device)

Control interface:

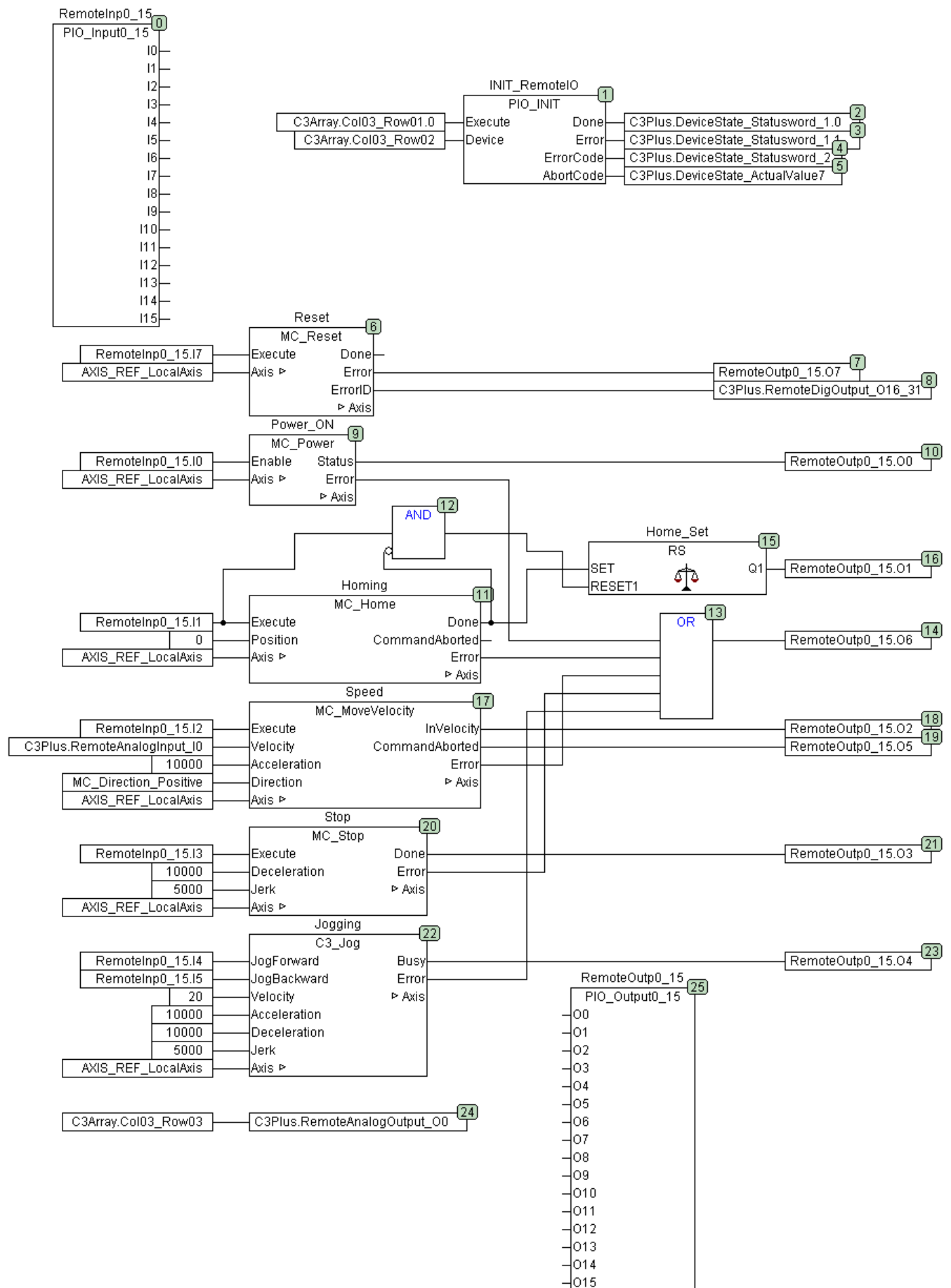
Digital input	Function	Digital output	Function
0	Energize axis	0	Axis is energized
1	Travel to MN (home)	1	MN (home) is accessed
2	Start MoveVelocity	2	Setpoint speed reached
3	Stop	3	Stop is present
4	JOG +	4	Manual function active
5	JOG -	5	MoveVelocity aborted
6	Free	6	Global module error display
7	Error reset	7	Error is present
Analog input		Analog output	
0	Setpoint speed		Setpoint speed specification

Additional Compax3 settings:

- ◆ Array_Col03_Row01=1; activates the PIO_Init module
- ◆ Array_Col03_Row02=5; address of the PIO
- ◆ Array_Col03_Row03=10; Specification for analog output0 => setpoint speed specification

If these values are stored in the Compax3, the PIO will be automatically initialized after Power On and started for PDO data exchange with Compax3.

Solution:



5.8 Interface to C3 powerPLmC

In this chapter you can read about:

Interface module "PLmC_Interface"	348
Cyclic data channel for C3T30 and C3T40	350
Example: C3 powerPLmC Program & Compax3 Program.....	352

5.8.1. Interface module "PLmC_Interface"

The interface between a central IEC61131-3 user program on C3 powerPLmC and a local IEC61131-3 user program on a Compax3 servo axis T30 or T40 is created with the program module "PLmC_interface".

The " PLmC_Interface" module must be called up in each Compax3 T30 which is operated as a slave on a C3 powerPLmC.

With Compax3 T40 this is only necessary, if the slave axis is programmed directly (not with **operating mode: "Slave on C3 powerPLmC (Cam programming on C3 powerPLmC)"**)

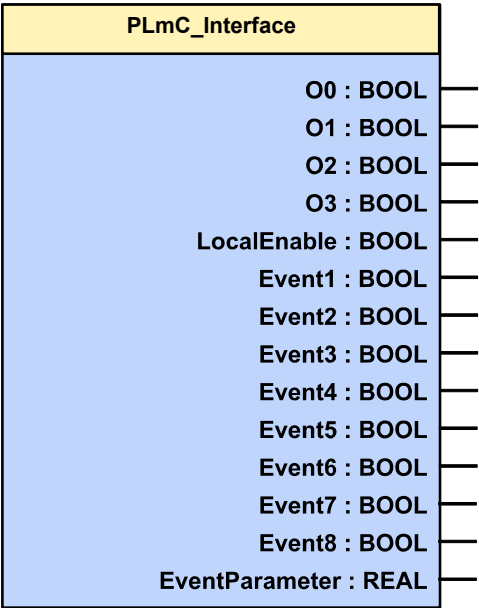
The call-up must take place cyclically!

The module can be found in the "C3_PLmC_interface.lib" library, which must be integrated manually via the library manager, if required.

FB name		PLmC_Interface
		Interface module for the control of C3 powerPLmC
VAR_OUTPUT		
O0	BOOL	Status of the digital output O0 on the C3 powerPLmC side
O1	BOOL	Status of the digital output O1 on the C3 powerPLmC side
O2	BOOL	Status of the digital output O2 on the C3 powerPLmC side
O3	BOOL	Status of the digital output O3 on the C3 powerPLmC side
LocalEnable	BOOL	Enable for the local IEC61131-3 program LocalEnable switches to FALSE for one cycle, if a command for this axis is activated on the C3 powerPLmC. This helps to avoid that the axis will receive different commands at a time.
Event1 ... Event8		Reserved
EventParameter		Reserved
Note: ◆ The execution of all local motion functions should be coupled with the LocalEnable output. ◆ Via the outputs O0...O3, the outputs set by C3 powerPLmC can be set out via the physical outputs with the aid of C3_Output.		

**Recipe array line
17... 32 assigned**

Please note that the last 16 lines of the recipe array (C3Array.ColXX_Row17 to C3Array.ColXX_Row32) are reserved for the communication with C3 powerPLmC.



5.8.2. Cyclic data channel for C3T30 and C3T40

An additional communication channel (besides the one established by the Drive Interface which is not freely assignable) can be established between the programs of the C3 powerPLmC and a Compax3 axis via a freely usable cyclic data channel. To do this, the assignment of the channel is defined on the side of the C3 powerPLmC in the controller configuration for the respective axis. The assignment is always bidirectional.

The following options are available for the communication between the two programs.

2x INT:

Assignment of the cyclic channel with 2 INT variables

Mapping to Compax3 objects

C3.PLmCToC3_INT1 / C3.PLmCToC3_INT2	from PLmC to Compax3
C3.C3ToPLmC_INT1 / C3.C3ToPLmC_INT2	from Compax3 to PLmC

Mapping to power PLmC variables

"Axis name".PLmCToC3_INT1	from PLmC to Compax3
"Axis name".PLmCToC3_INT2	from PLmC to Compax3
"Axis name".C3ToPLmC_INT1	from Compax3 to PLmC
"Axis name".C3ToPLmC_INT2	from Compax3 to PLmC

1x DINT:

Assignment of the cyclic channel with one DINT variable

Mapping to Compax3 objects

C3.PLmCToC3_DINT	from PLmC to Compax3
C3.C3ToPLmC_DINT	from Compax3 to PLmC

Mapping to power PLmC variables

Axis name".PLmCToC3_DINT	from PLmC to Compax3
"Axis name".C3ToPLmC_DINT	from Compax3 to PLmC

1x REAL:

Assignment of the cyclic channel with one REAL variable

Mapping to Compax3 objects

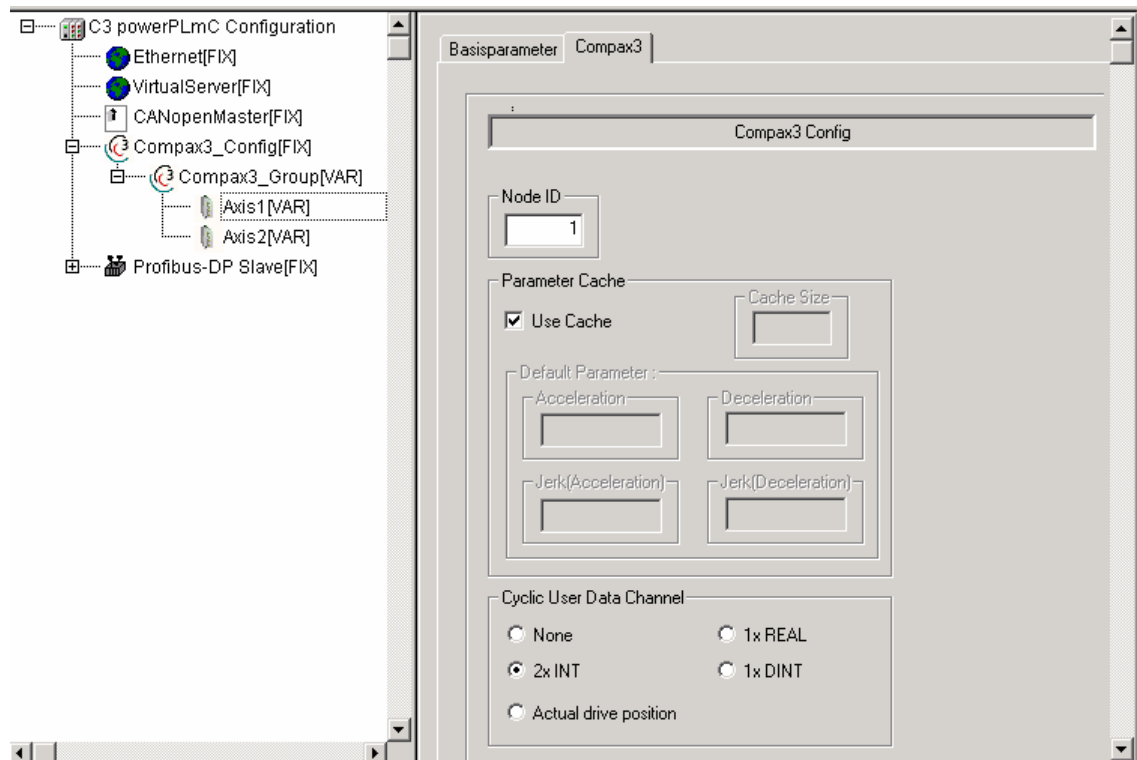
C3.PLmCToC3_REAL	from PLmC to Compax3
C3.C3ToPLmC_REAL	from Compax3 to PLmC

Mapping to power PLmC variables

"Axis name".PLmCToC3_REAL	from PLmC to Compax3
"Axis name".C3ToPLmC_REAL	from Compax3 to PLmC

Note: The use of INT or DINT variables is especially suitable for implementing a user-defined control word / status word between C3 powerPLmC IEC61131-3 program and Compax3 IEC61131-3 program.

Configuration of the data channel



Note: If the cyclic data channel is not required, it can also be assigned to the actual position of the axis. This is then provided by the "**MC_ReadActualPosition** (see page 306)" module. Therefore the value must not be continually read via the acyclic channel if the module is used; this reduces the bus load and the IEC cycle time.

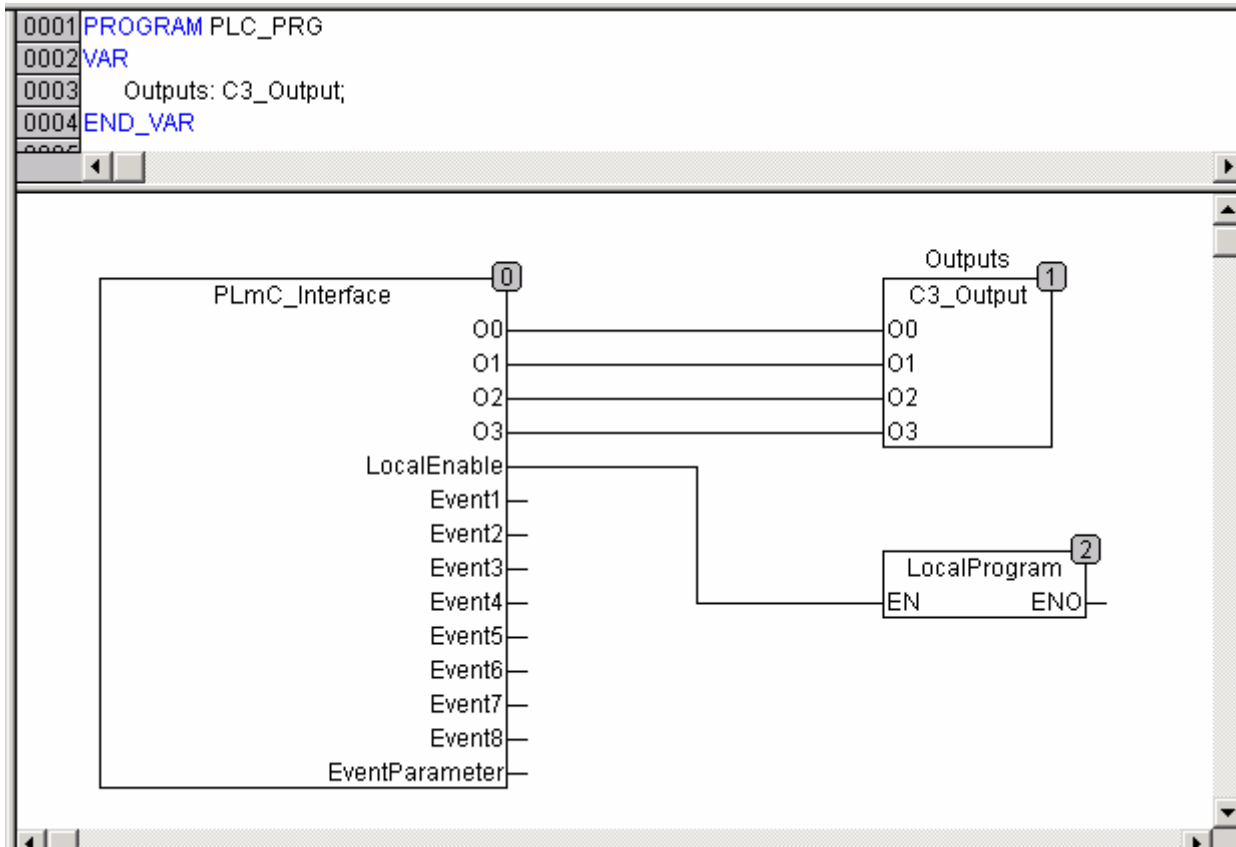
5.8.3. Example: C3 powerPLmC Program & Compax3 Program

- Task:**
- ◆ Implementation of a mark synchronization in a Compaxa3 servo axis.
 - ◆ Control of the program via the C3 powerPLmC via a user-defined control word / status word.

Main program on Compax3 (module PLC_PRG)

Cyclic call-up of the interface to powerPLmC in the PLC_PRG module

In CFC:



In ST:

```

0001 PROGRAM PLC_PRG
0002 VAR
0003   Outputs : C3_Output;
0004 END_VAR
0005
0001 PLmC_Interface(O0=>Outputs.O0,O1=>Outputs.O1,O2=>Outputs.O2,O3=>Outputs.O3);
0002 Outputs();
0003 IF PLmC_Interface.LocalEnable THEN
0004   LocalProgram();
0005 END_IF
0006

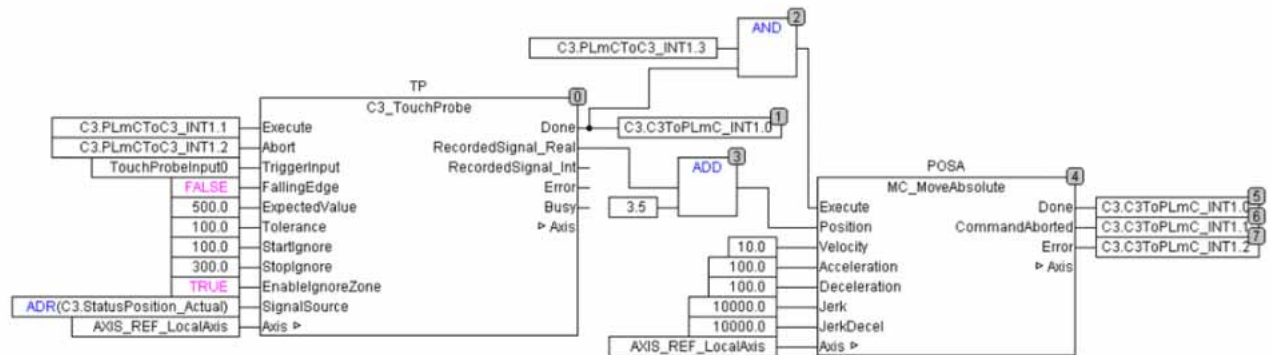
```

Local Compax3 Program in the LocalProgram module

```

1001 PROGRAM LocalProgram
1002 VAR
1003   TP: C3_TouchProbe;
1004   POSA: MC_MoveAbsolute;
1005 END_VAR

```



Program on C3 powerPLmC

```

0001 PROGRAM PLC_PRG
0002 VAR
0003     Inputs : C3_Input;
0004     Power : MC_Power;
0005     MoveAbs : MC_MoveAbsolute;
0006     Status : MC_ReadStatus;
0007     TouchProbeDone: BOOL;
0008 END_VAR
0009
0010 DriveExecuteStart(ADR(Compax3_Group));
0011
0012 Inputs(Axis := Axis1);
0013 Status(Axis := Axis1);
0014
0015 IF (Inputs.I0 AND NOT Inputs.I3) THEN
0016     Power.Enable := TRUE;
0017 ELSE
0018     Power.Enable := FALSE;
0019 END_IF
0020
0021 IF (Inputs.I4) THEN
0022     MoveAbs.Position := Position1;
0023     MoveAbs.Velocity := Velocity1;
0024     MoveAbs.Acceleration := 100;
0025     MoveAbs.Deceleration := 100;
0026     MoveAbs.Jerk := 10000;
0027     MoveAbs.JerkDecel := 10000;
0028     MoveAbs.Execute := TRUE;
0029 END_IF
0030
0031 IF (Inputs.I4 AND Status.DiscreteMotion) THEN
0032     (* set control bit to start C3_TouchProbe in local program *)
0033     Axis1.PLmCtoC3_INT1.1 := TRUE;
0034 END_IF
0035
0036 IF (Axis1.C3ToPLmC_INT1.0) THEN
0037     (* C3_TouchProbe in local program is done *)
0038     TouchProbeDone := TRUE;
0039 END_IF
0040
0041 Power(Axis := Axis1);
0042 MoveAbs(Axis := Axis1);
0043
0044 DriveExecuteEnd(ADR(Compax3_Group));
0045

```

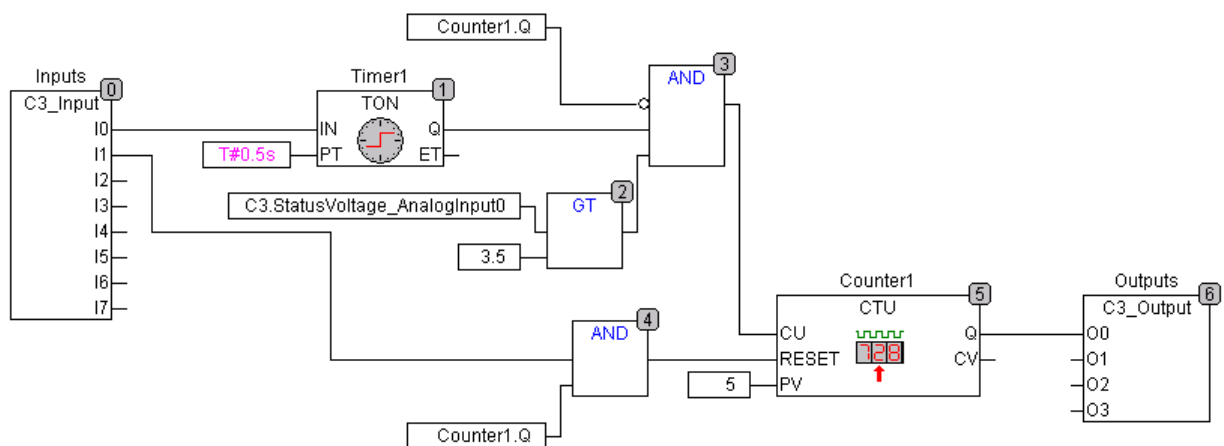
5.9 IEC examples

In this chapter you can read about:

Example in CFC: Using Compax3-specific function modules and Compax3 objects	355
Example in CFC: Positioning 1	356
Example in CFC: Positioning 2	357
Example in CFC: Positioning with set selection	358
Example in CFC: Cycle mode	359
Example in ST: Cycle mode with a Move module	360

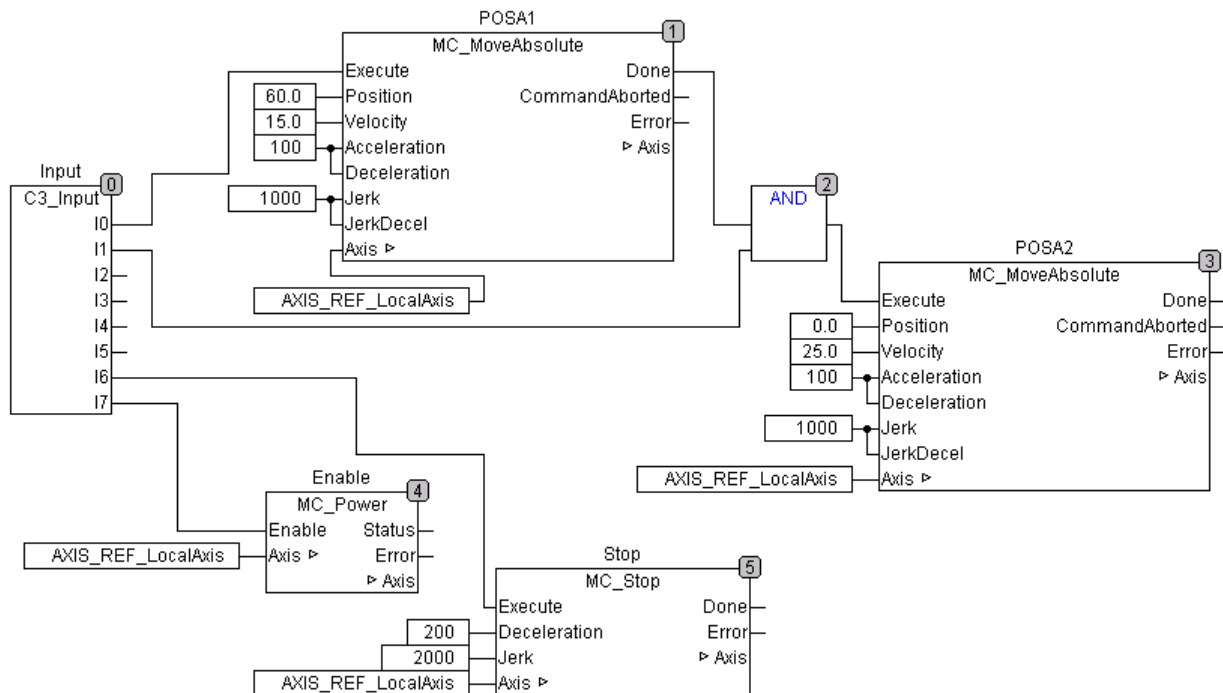
5.9.1. Example in CFC: Using Compax3-specific function modules and Compax3 objects

- ◆ Read in the process image of the digital inputs with the InputStatus module.
- ◆ Generate a process image of the digital outputs with the OutputStatus module.
- ◆ Digital input I0, used for counting an external event. The event is only detected as an event if
 - ◆ The I0 input is at TRUE for at least 0.5 seconds and
 - ◆ The voltage on analog input 0 exceeds the threshold value of 3.5 volts.
- ◆ When 5 of these events have been counted, the digital output is set to O0. At the same time, the program prevents additional events on the I0 from being counted. The counter state can be reset again with Input I1 as soon as it reaches a value of 5.



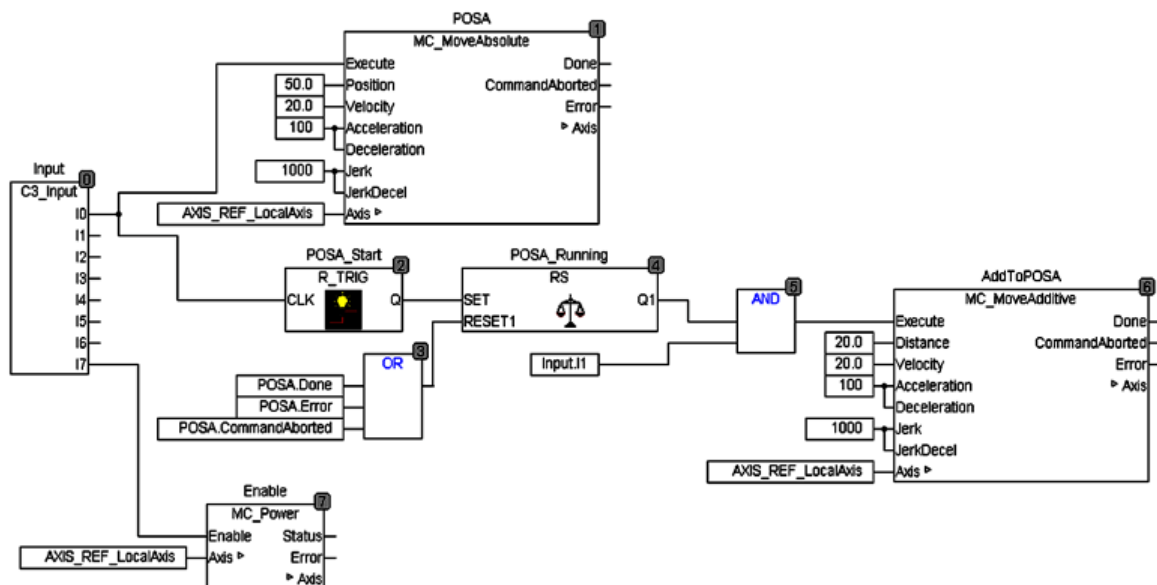
5.9.2. Example in CFC: Positioning 1

- ◆ Input I7 enables the power output stage
- ◆ Input I0 starts an absolute positioning process with fixed parameters
- ◆ Input I6 is used to stop the movement
- ◆ After positioning is complete, there will be a return to Position 0 as soon as Input I1 has been activated



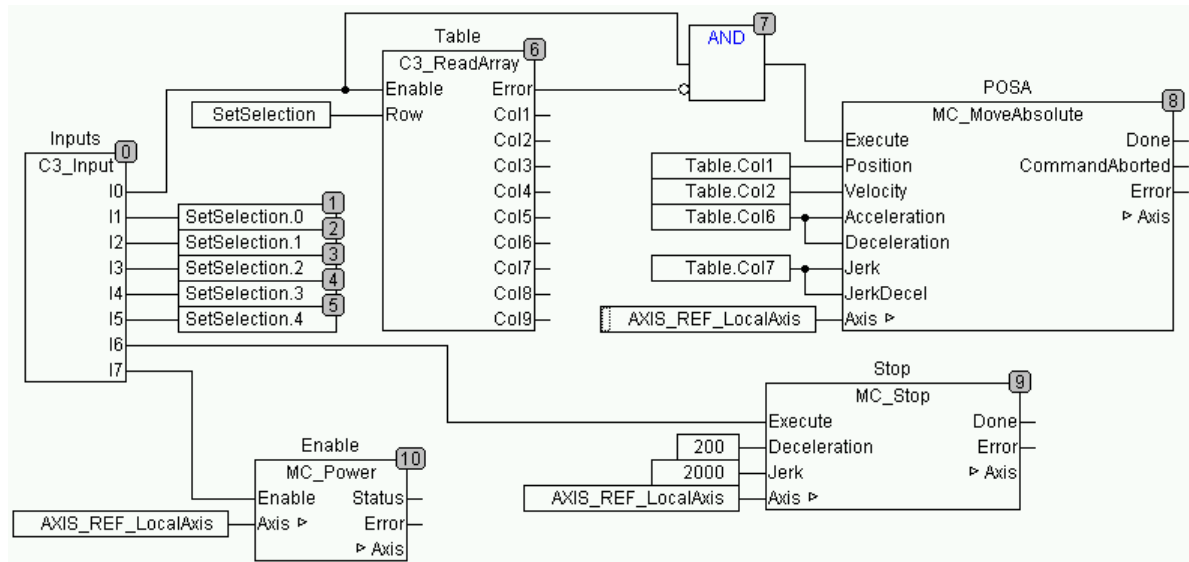
5.9.3. Example in CFC: Positioning 2

- ◆ Input I7 enables the power output stage
- ◆ Input I0 starts an absolute positioning process
- ◆ If an event (I1) occurs during the positioning, the target position will be moved back by 20 ("MoveAdditive")
- ◆ If an event occurs while positioning is not in progress, it has no effect



5.9.4. Example in CFC: Positioning with set selection

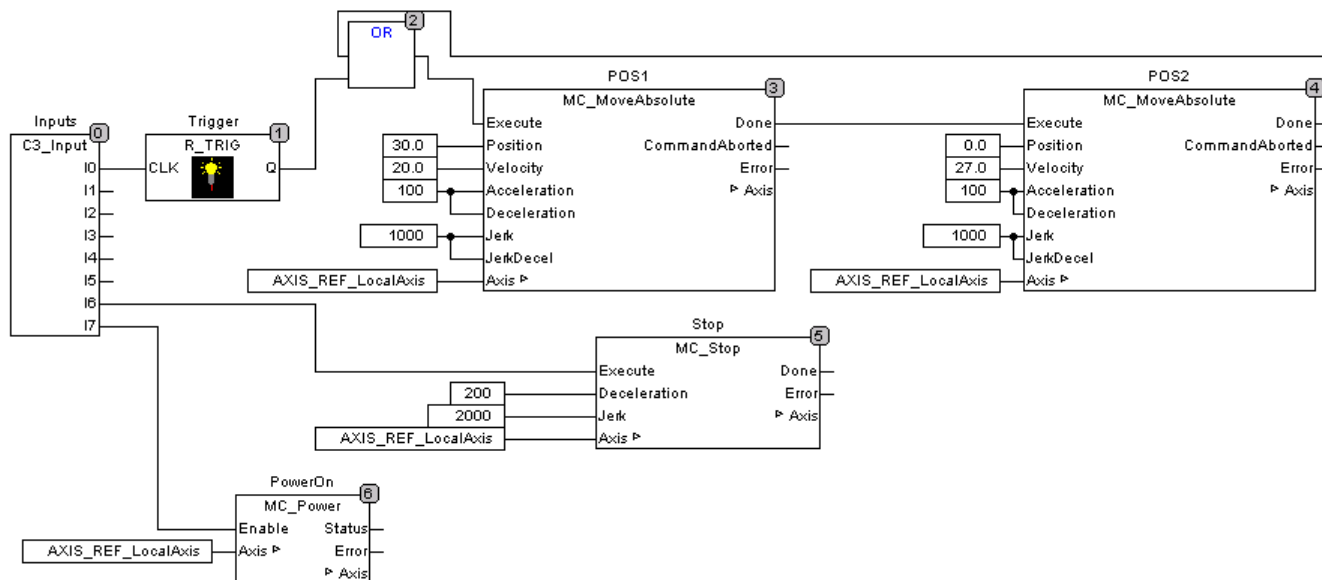
- ◆ Input I7 enables the power output stage
- ◆ The position, speed and ramps can be stored in the array (table) (for example input with the Compax3 ServoManager)
- ◆ The desired set can be selected with inputs I1 through I5 (binary coded)
- ◆ Input I0 starts the positioning (absolute positioning)
- ◆ Positioning that is in progress can be stopped with Input I6



5.9.5. Example in CFC: Cycle mode

Example a: Cycle mode

- ◆ Input I7 enables the power output stage
- ◆ Input I0 starts cyclical positioning. During this process, two positions are approached in alternation.
- ◆ Input I6 stops cycle mode



5.9.6. Example in ST: Cycle mode with a Move module

Input I2 enables the power output stage.

- ◆ Input I0 starts cycle mode. Two positions are approached alternately.
- ◆ There is a pause of 1 second after the first position is reached.
- ◆ There is a pause of 1.5 seconds after the second position is reached.
- ◆ Input I1 stops cycle mode.

```

0001 PROGRAM PLC_PRG
0002 VAR
0003   Inputs: C3_Input;
0004   Outputs: C3_Output;
0005   StartTrigger: R_TRIG;
0006   POSA: MC_MoveAbsolute;
0007   Timer1: TON;
0008   Stop: MC_Stop;
0009   Power: MC_Power;
0010   State: INT;
0011 END_VAR
0012
0001 Inputs(); (* Read Input process image *)
0002
0003 (* Enable Power stage *)
0004 Power(Enable:=Inputs.I2 , Axis:= AXIS_REF_LocalAxis, Status=>Outputs.O0);
0005
0006 (* State machine Start *)
0007 StartTrigger(CLK:=Inputs.I0); (* detect a rising edge on Input I0 *)
0008 IF(StartTrigger.Q) THEN (* Rising Edge ? *)
0009   State:=1; (* -> Start State machine *)
0010 END_IF
0011
0012 (* State machine *)
0013 CASE State OF
0014 1: (* Prepare first Move command *)
0015   POSA.Execute:=FALSE;
0016   POSA.Position:=30.0;
0017   POSA.Velocity:=15.0;
0018   State:=2;
0019 2: (* Start first Move command *)
0020   POSA.Execute:=TRUE;
0021   State:=3;
0022 3: (* Wait until position 1 reached *)
0023   IF(POSA.Done) THEN
0024     State:=4;
0025   END_IF

```

```

0026 4: (* 1 Sekunde Pause *)
0027   Timer1(IN:=TRUE , PT:=T#1.0s);
0028   IF(Timer1.Q) THEN
0029       Timer1(IN:=FALSE);
0030       Zustand:=5;
0031   END_IF
0032 5: (* Positionierung 2 vorbereiten *)
0033   POSA.Execute:=FALSE;
0034   POSA.Position:=0.0;
0035   POSA.Velocity:=25.0;
0036   Zustand:=6;
0037 6: (* Positionierung 2 Start *)
0038   POSA.Execute:=TRUE;
0039   Zustand:=7;
0040 7: (* Warten bis Position 2 erreicht *)
0041   IF(POSA.Done) THEN
0042       Zustand:=8;
0043   END_IF
0044 8: (* 1.5 Sekunden Pause *)
0045   Timer1(IN:=TRUE , PT:=T#1.5s);
0046   IF(Timer1.Q) THEN
0047       Timer1(IN:=FALSE);
0048       Zustand:=1; (* Schrittkette erneut starten *)
0049   END_IF
0050 END_CASE
0051 (* Positionierbaustein aufrufen *)
0052 POSA(Acceleration:=100, Deceleration:=100, Jerk:=10000, JerkDecel:=10000, Axis:=AXIS_REF_LocalAxis);
0053 (* Stop Eingang *)
0054 Stop(Execute:=Inputs.I1 , Deceleration:=200 , Jerk:=20000 , Axis:=AXIS_REF_LocalAxis);
0055 IF(Inputs.I1) THEN (* Stop Eingang = TRUE *)
0056     Zustand:=0; (* Schrittkette zurücksetzen *)
0057     Timer1(IN:=FALSE); (* Timer zurücksetzen *)
0058     POSA.Execute:=FALSE;
0059 END_IF
0060 Outputs(); (* PA Ausgänge schreiben *)

```

5.10 Profibus: Simulate Profidrive profile (C3_ProfiDrive_Statemachine)

The function module can be found in the "C3_Profiles_lib" library and must be integrated via the library manager before use.

Notes on the use:

- ◆ The input values coming from the master control via the Profibus can be changed before they are transmitted to the Statemachine (e.g. I/Os).
- ◆ In the simplest case, the control word and the motion parameters (which may come from the Profibus) are manipulated by the IEC program.
- ◆ If the Statemachine is active, all motions must be executed via the Statemachine. Motions such as for example MoveAbsolut, MoveRelativ, MoveAdditiv, MoveVelocity, Gearing, Reg-related positioning are possible. Or with Compax3F: Force/pressure regulating.
- ◆ With the "control via PLC" bit (CW1 bit 10 = 1), the Statemachine takes the control for the drive (is active). This means that no functions concerning the device status (such as Power, MoveX) by other function/program modules are permitted. If "no control" is selected (CW1 bit 10 = 0), the device status can be changed via function/program modules.
- ◆ The Profidrive Statemachine works independently of the Profibus. I.e. it can also be used in connection with other busses.
- ◆ The Profidrive Statemachine contains states, which cannot be mapped to the PLCopen status machine.

FB name		C3_ProfiDrive_Statemachine
With the aid of the Profibus function module, the PROFIdrive profile can be simulated. The profile is described in the help of the Compax3 I20T11 technology function (set operation is however not possible). The inputs of the module can be assigned as required.		
VAR_IN_OUT		
--	--	--
VAR_INPUT		
CW1	WORD	Control word according to Profidrive (see below)
STWadd	INT	additional control word: the following functions can be triggered in the positioning mode 0: no action 1: NOP (No Operation) 2: Stop 3: Homing Execution takes place with the "activate motion order" of CW1. The value must be reset to zero after the execution!
OperationMode	INT	Operating mode after Profidrive 1: Speed control 2: Positioning
Position	REAL	Position setpoint value for all positioning commands (MoveAbs, MoveRel, MoveAdd, RegSearch, RegMove preparation)
Velocity	REAL	Setpoint speed in operating mode 1 (speed control) and for MoveVelocity (not for positioning)
VelocityForPosition	REAL	Setpoint travel speed for positioning
VelocityForJog	REAL	Speed for JOG
Acceleration	DINT	Commanded acceleration
Deceleration	DINT	Setpoint deceleration

DecelerationForStop	DINT	Deceleration for Stop
Jerk	DINT	Setpoint jerk
Master	INT	Source for Gearing - AXIS_REF_Physical (T30, T40) [e.g. encoder input X11] - AXIS_REF_HEDA (T30, T40) - AXIS_REF_Virtual (T40)
RatioNumerator	INT	Numerator for Gearing
RatioDenominator	INT	Denominator for Gearing
PositionForRegMove	REAL	Position for RegMove, necessary if RegSearch is executed and registration is detected. Note: The input is connected to the PositionOfRegMove output in the simplest case.
VelocityForRegMove	REAL	Speed for RegMove, necessary if RegSearch is executed and registration is detected. Note: The input is connected to the VelocityOfRegMove output in the simplest case.
CStatus1ForRegMove	WORD	- do not use - Command status 1 for RegMove end; necessary if RegSearch is executed and registration is detected
CStatus2ForRegMove	WORD	reserved!
ShortRampForRegMove	BOOL	Permits the Compax3 to calculate individual parameters for the RegMove positioning, if the set parameters would not reach the target.
RegMoveMode	INT	reserved!
IgnoreZoneStart	REAL	Registration mark-related positioning: Beginning of Registration lock-out zone (StartIgnore)
IgnoreZoneStop	REAL	Registration mark-related positioning: End of Registration lock-out zone (StopIgnore)
PositionReachedMode	BOOL	Mode for the generation of the PositionReached in the status word (CW1.10). TRUE: link to setpoint value
DisablePositiveDirection	BOOL	Block for positive direction
DisableNegativeDirection	BOOL	Block for negative direction
LimitErrorExtern	BOOL	reserved!
Override	REAL	reserved!
CStatus1In	WORDW	reserved!
CStatus2In	WORD	reserved!
VAR_OUTPUT		
ZSW1	WORD	Status word after Profidrive
OperationModeActual	INT	Active operating mode
PositionOfRegMove	REAL	Position transmitted to the RegMove command (cache memory) Note: The output is connected to the PositionForRegMove input in the simplest case.
VelocityOfRegMove	REAL	Velocity transmitted to the RegMove command (cache memory) Note: The input is connected to the VelocityForRegMove output in the simplest case.
CStatus2OfRegMove	WORD	reserved!
StatusMotor_off	BOOL	Motor is currentless (TRUE)
StatusMotor_standstill	BOOL	Status motor is energized at standstill (setpoint value) (TRUE)
CStatus1	WORD	reserved!
CStatus2	WORD	reserved!

Notes:

- ◆ You can call up directly the help for the Compax3 Profidrive device (I20T11) via the help intaller (C3 ServoManager "?" Start C3 ServoManager Help Installer...) (select and open in the left window).
- ◆ On the Compax3 DVD you will find an application example with additional explanations for the use of this module:
C3 DVD directory\\Examples\\Profidrive with T30T40\\

6. Communication

In this chapter you can read about:

Compax3 communication variants	365
COM port protocol	377
Remote diagnosis via Modem	382
Profibus	386
CANopen - Node Settings	399
DeviceNet	417
Ethernet Powerlink	420
HEDA Bus	422
Normalization factors	445

Here you will find the description of the fieldbus interfaces, which can be configured in the Compax3 ServoManager under the tree entry "configuring the communication".

Please note: The configuration of the process data (Mapping) is made wizard-guided with the Compax3 ServoManager.
If you perform the mapping directly via the master, you must go through this fieldbus wizard once; the Compax3 ServoManager will perform the necessary initializations.

6.1 Compax3 communication variants

In this chapter you can read about:

PC <-> Compax3 (RS232)	366
PC <-> Compax3 (RS485)	367
PC <-> C3M device combination (USB)	368
USB-RS485 Moxa Uport 1130 adapter	369
ETHERNET-RS485 NetCOM 113 adapter	370
Modem Westermo TD-36 485	372
C3 settings for RS485 two wire operation	375
C3 settings for RS485 four wire operation	376

Overview of all possible communication modes between Compax3 deviecs and a PC.

6.1.1. PC <-> Compax3 (RS232)

PC <-> Compax3 (RS232): Connections to a device

PC (RS232 COM)



115kb



PC (Virtueller ComPort)



USB/RS232



115kb



PC (Virtueller ComPort)



10/100/1000Mb



Ethernet (LAN)

Ethernet/RS232



115kb



PC (RS232 COM)



115kb



Modem

TelefonNetz

Max
33.6kb

Modem

115kb



PC (Virtueller ComPort)



10/100/1000Mb



Ethernet (LAN)



WLAN/RS232

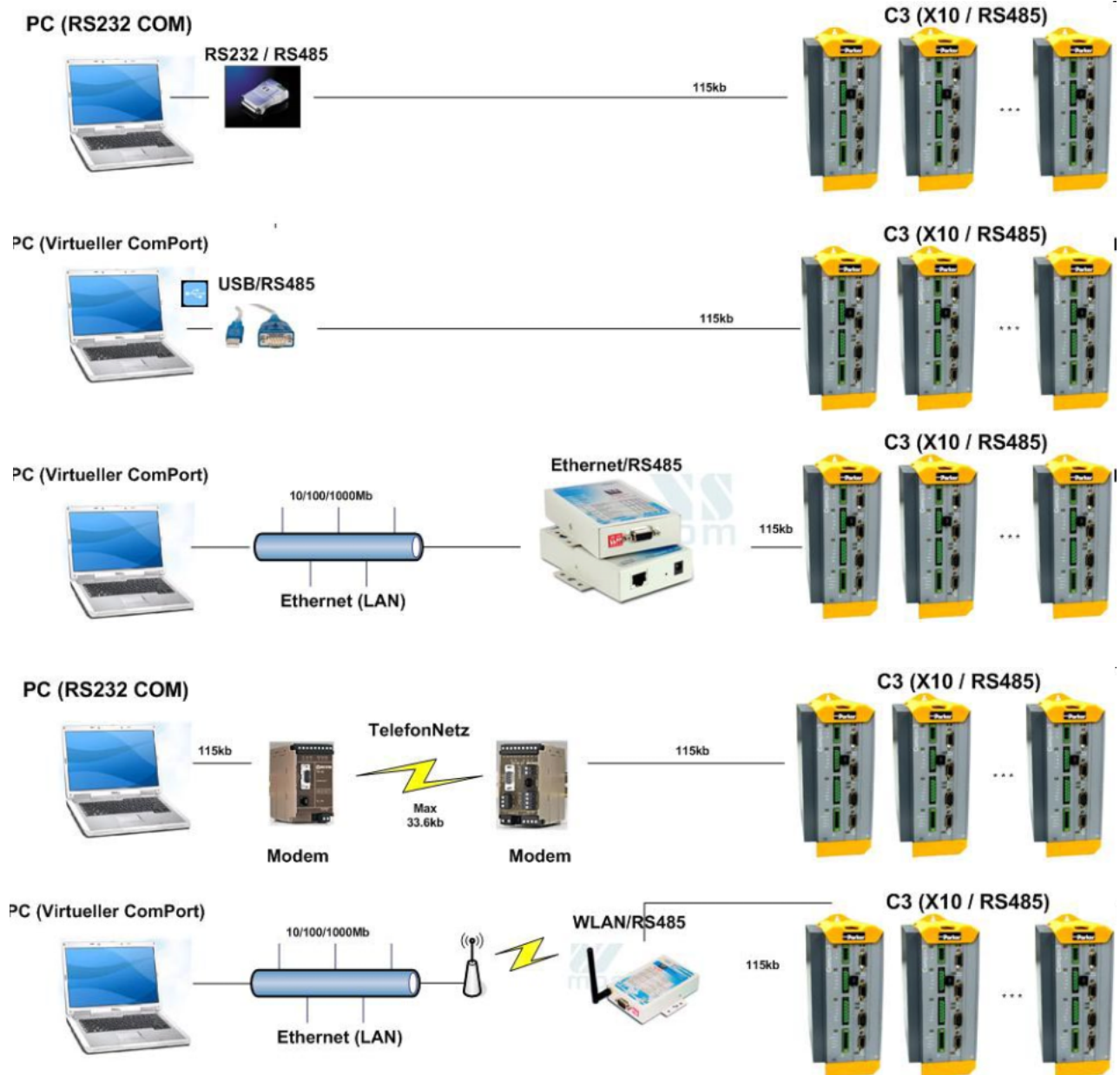


115kb



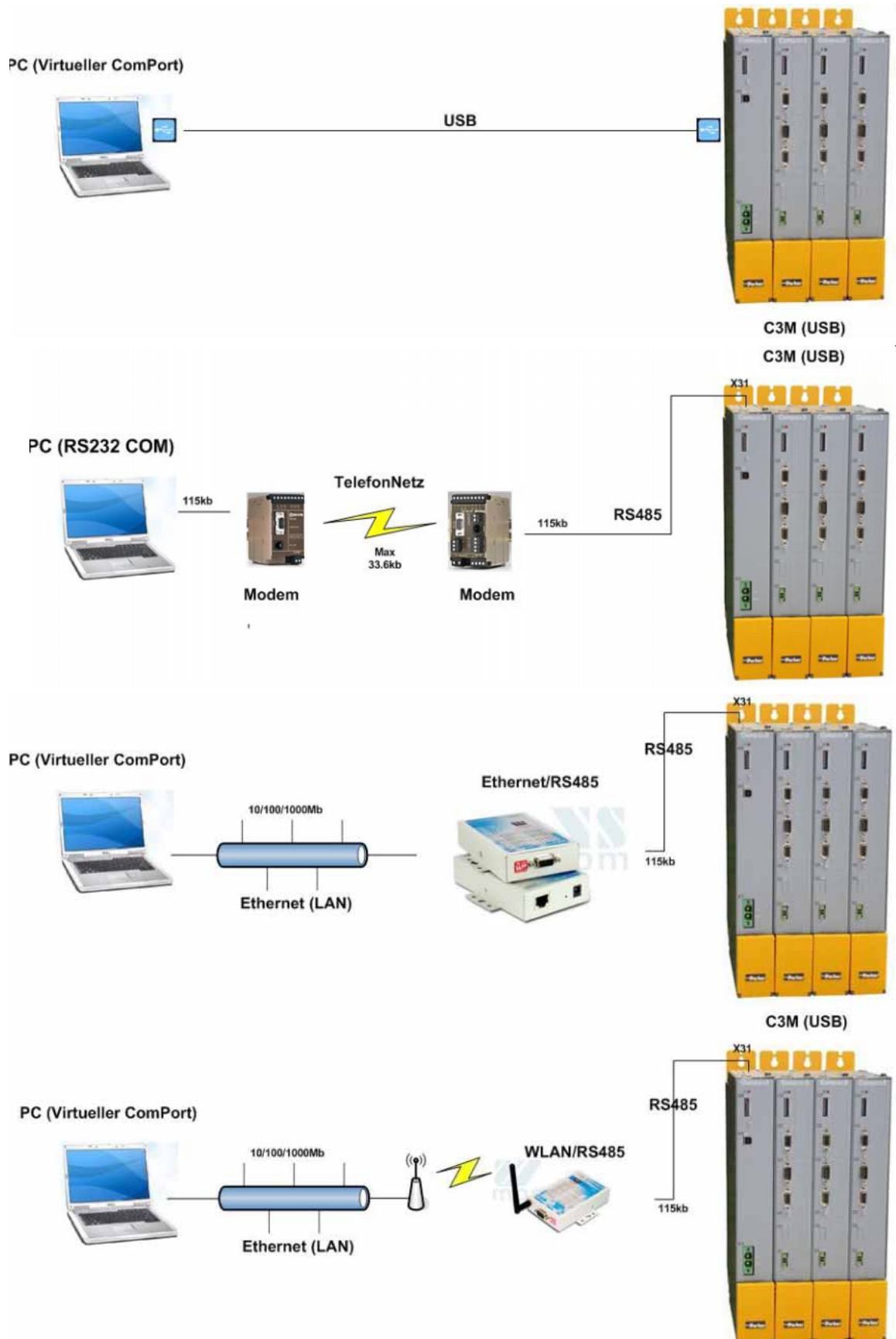
6.1.2. PC <-> Compax3 (RS485)

PC <-> Compax3 (RS485)



6.1.3. PC <-> C3M device combination (USB)

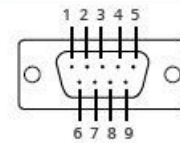
PC <-> C3M device combination



6.1.4. USB-RS485 Moxa Uport 1130 adapter



Male DB9



PIN	RS-422/4-wire RS-485	2-wire RS-485
1	TxD-(A)	–
2	TxD+(B)	–
3	RxD+(B)	Data+(B)
4	RxD-(A)	Data-(A)

PIN	RS-422/4-wire RS-485	2-wire RS-485
5	GND	GND
6	–	–
7	–	–
8	–	–

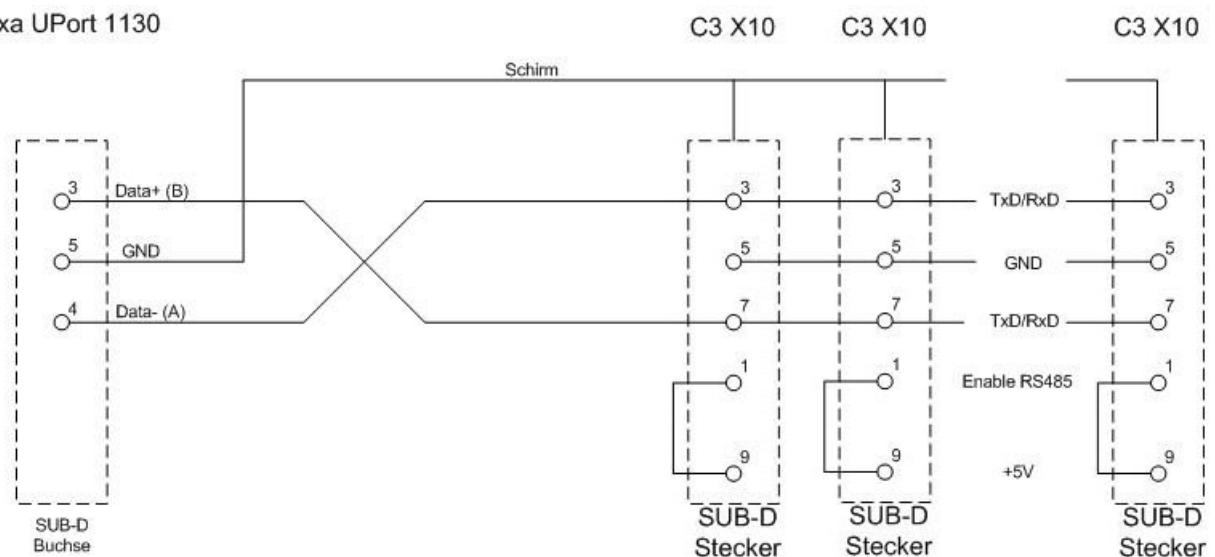
The serial UPort 1130 USB adapter offers a simple and comfortable method of connecting an RS-422 or RS-485 device to your laptop or PC. The UPort 1130 is connected to the USB port of your computer and complements your workstation with a DB9 RS-422/485 serial interface. For simple installation and configuration, Windows drivers are already integrated. The UPort 1130 can be used with new or legacy serial devices and supports both 2- and 4-wire RS-485. It is especially suited for mobile, instrumentation and point-of-sale (POS) applications.

Herstellerlink: http://www.moxa.com/product/UPort_1130.htm

http://www.moxa.com/product/UPort_1130.htm

Connection plan for Compax3S:

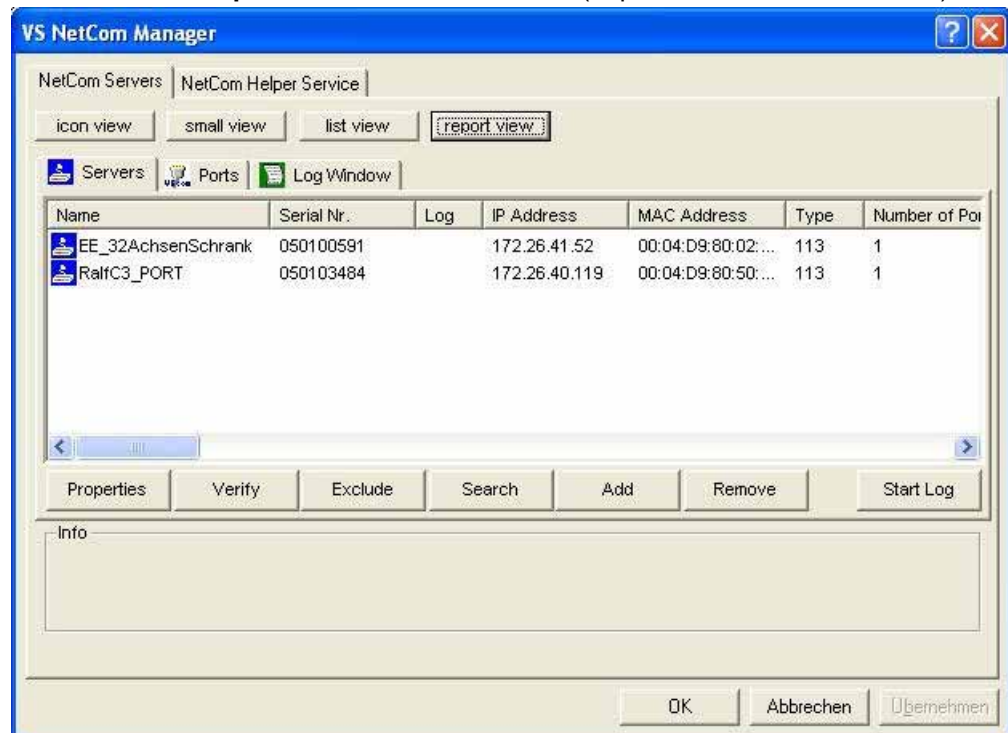
Moxa UPort 1130



6.1.5. ETHERNET-RS485 NetCOM 113 adapter



Herstellerlink: <http://www.vscom.de/666.htm> (<http://www.vscom.de/666.htm>)

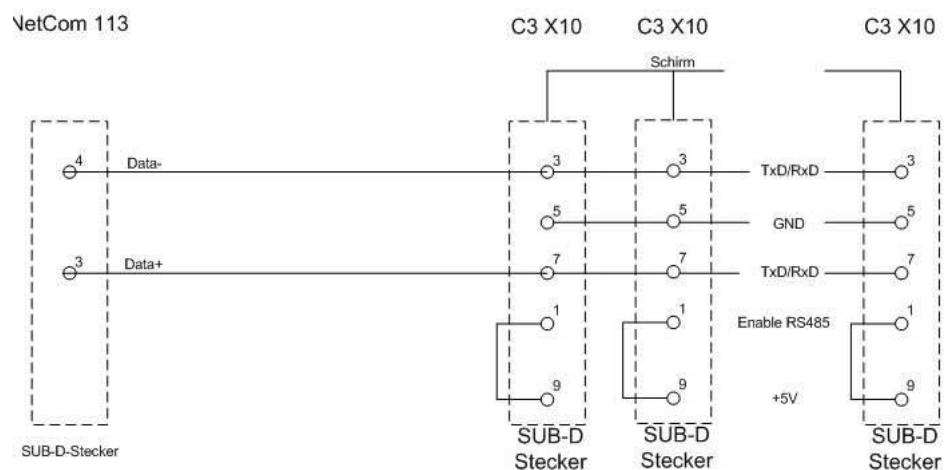
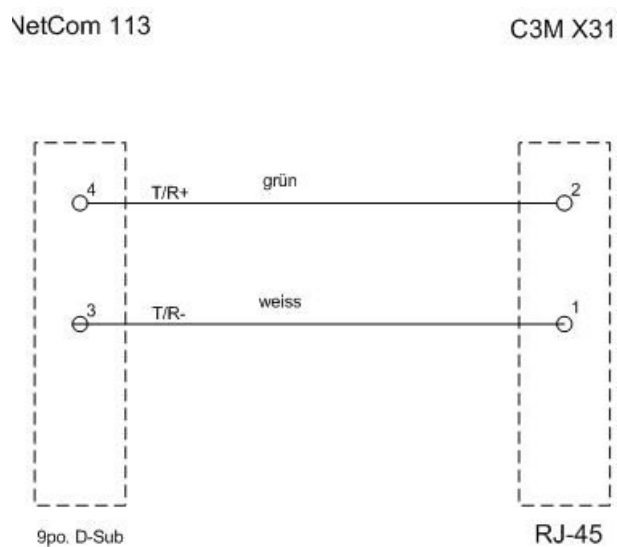


DIP Switch settings NetCom 113 for two-wire operation:

1ON 2ON 3off 4off (Mode: RS485 by ART (2 wire without Echo))

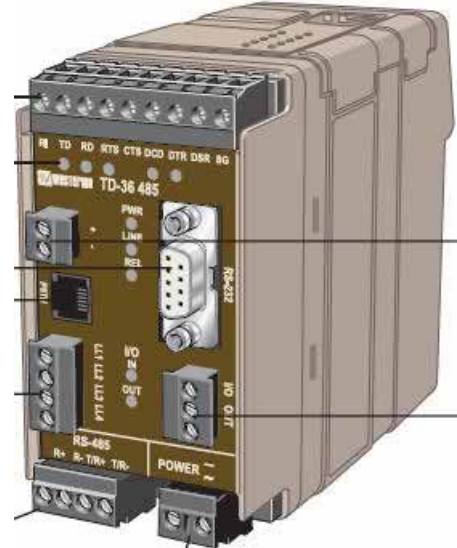
Communication settings C3S/C3M:

Object	Function	Value
810.1	Protocol	16 (two wire)
810.2	Baud rate	115200
810.3	NodeAddress	1..254
810.4	Multicast Address	

Connection plan NetCom113<-> C3S:**Connection plan NetCom113<-> C3M X31:**

6.1.6. Modem Westermo TD-36 485

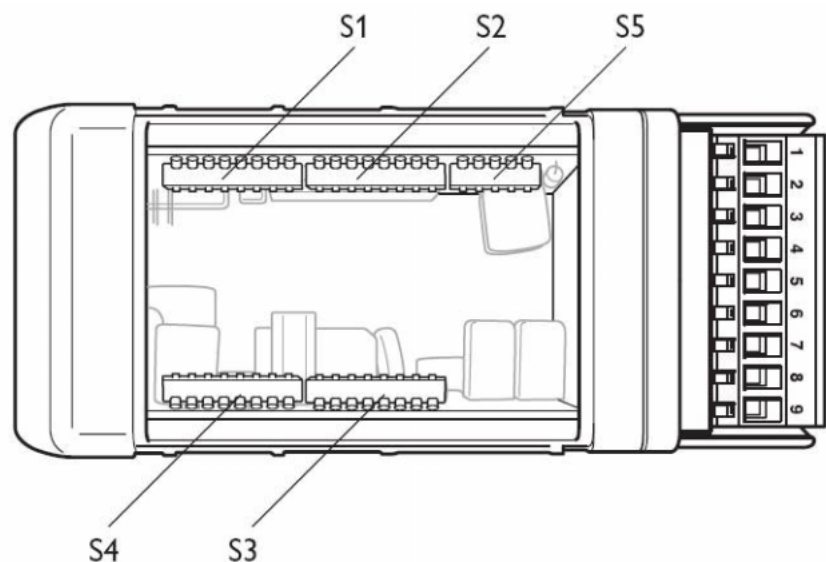
Modem Westermo TD-36 485 (Remote maintenance C3S /C3M)

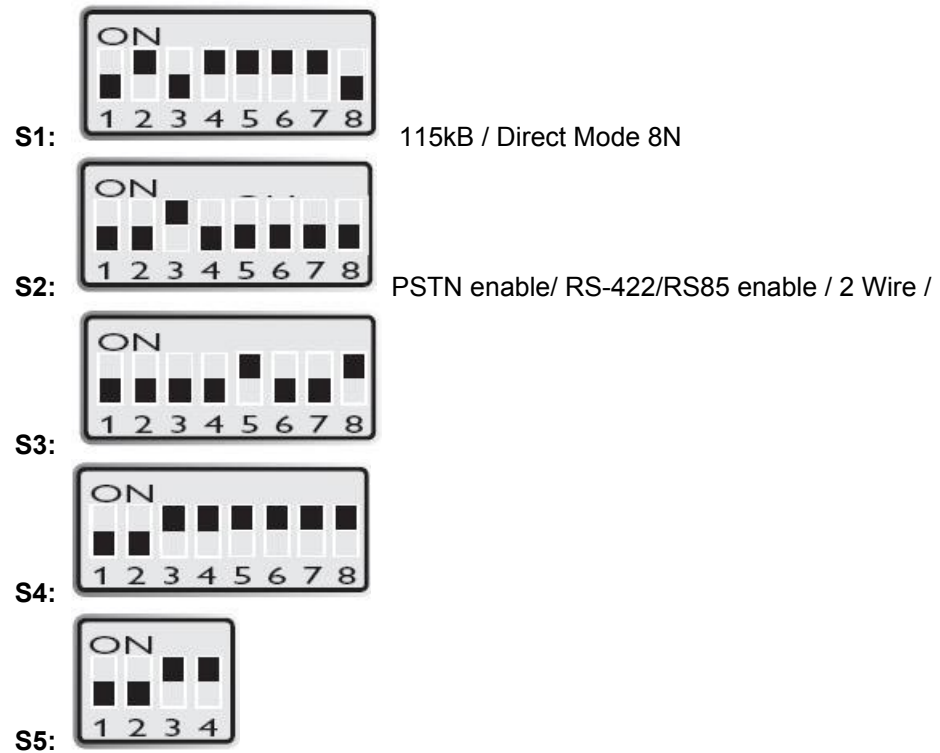


DIP Switch - settings TD-36 (RS485 two wire)

For operation , all settings must be reset to factory settings!
All other settings must be made via the DIP switches.

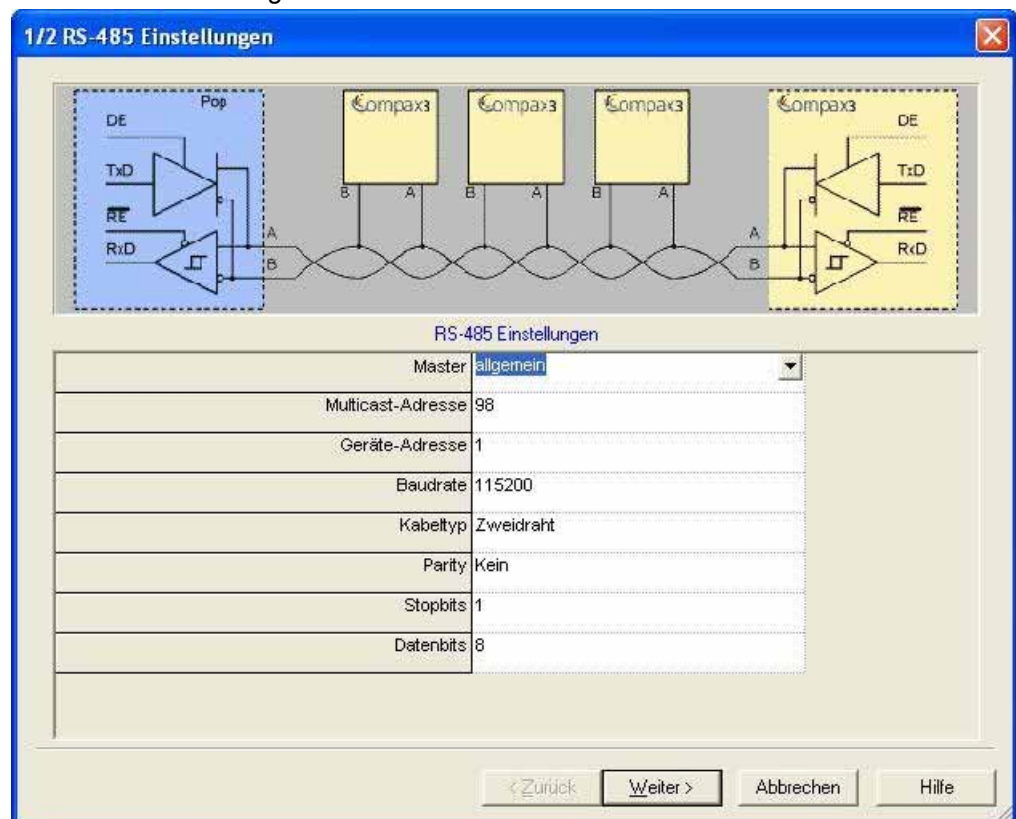
**IMPORTANT: The changes of the DIP switches are only accepted after
POWER ON!**





C3 ServoManager RS485 wizard settings:

download with configuration in RS232 mode°!



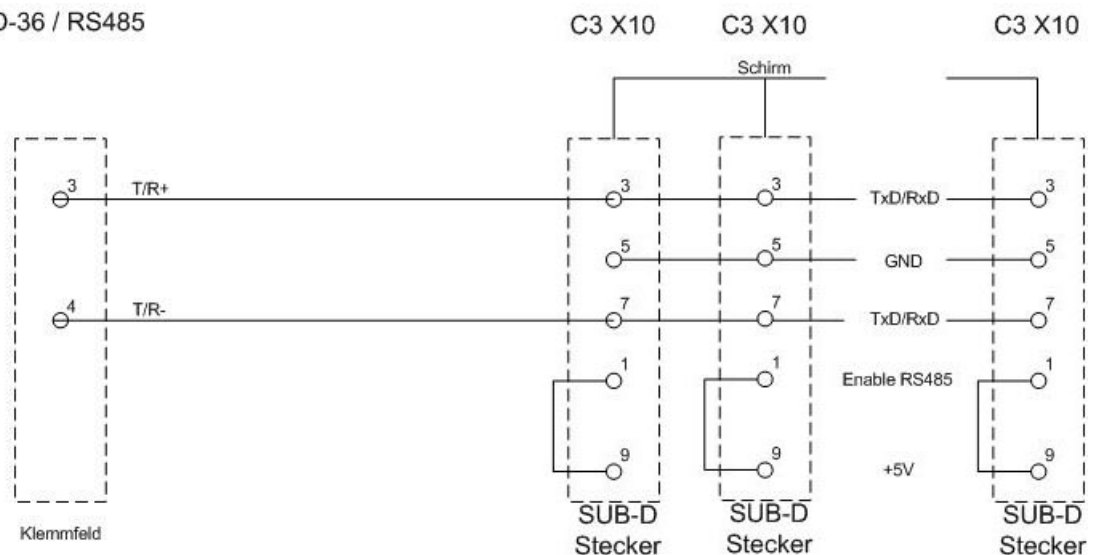
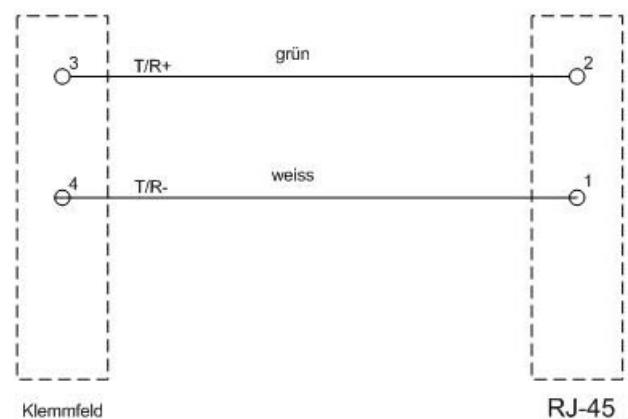
Communication settings C3S/C3M:

Object	Function	Value
810.1	Protocol	16 (two wire)
810.2	Baud rate	115200
810.3	NodeAddress	1..254
810.4	Multicast Address	

Connection plan TD-36 / Compax3 S**RS-422/485**

Position	Direction*	Description		Product marking
No. 1	In	R+ (A') Receive	RS-422/485 4-wire	R+
No. 2	In	R- (B') Receive	RS-422/485 4-wire	R-
No. 3	Out	T+ (A) Transmit	RS-422/485 4-wire	T/R+
	In/Out	T+ (A/A') Transmit/Receive	RS-485 2-wire	
No. 4	Out	T- (B) Transmit	RS-422/485 4-wire	T/R-
	In/Out	T+ (A/A') Transmit/Receive	RS-485 2-wire	

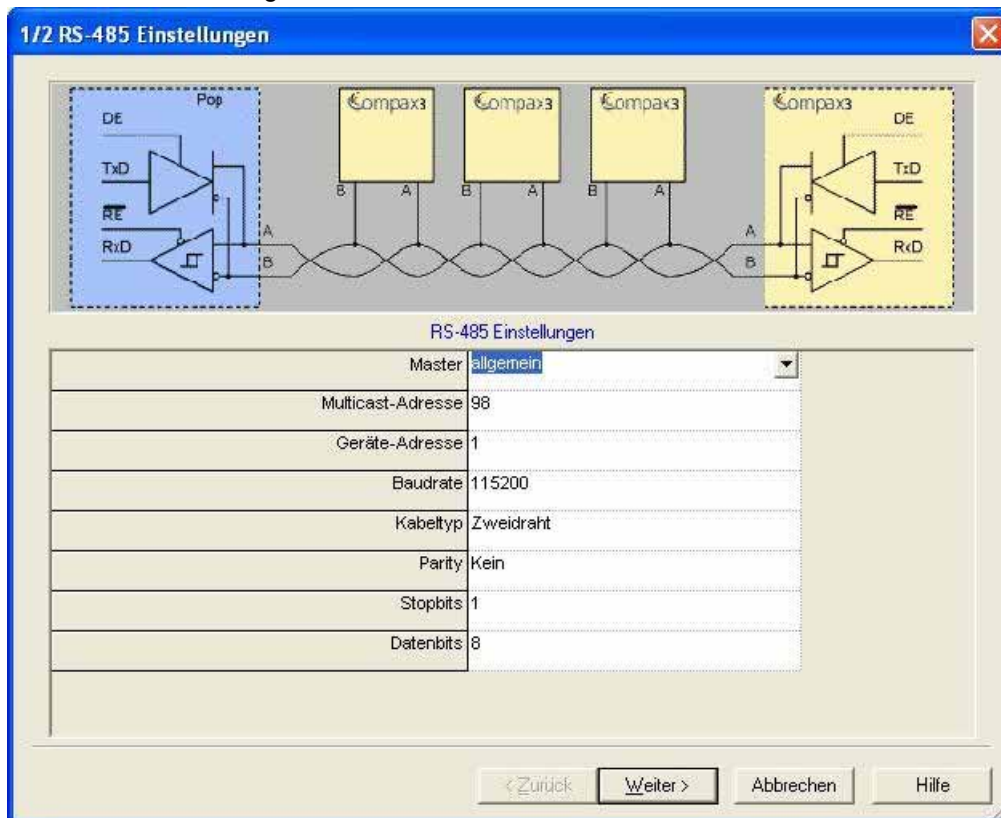
* Direction relative to this unit

TD-36 / RS485**Connection plan TD-36 / Compax3 M****TD-36/RS485****C3M X31**

6.1.7. C3 settings for RS485 two wire operation

C3 ServoManager RS485 wizard settings:

download with configuration in RS232 mode°!



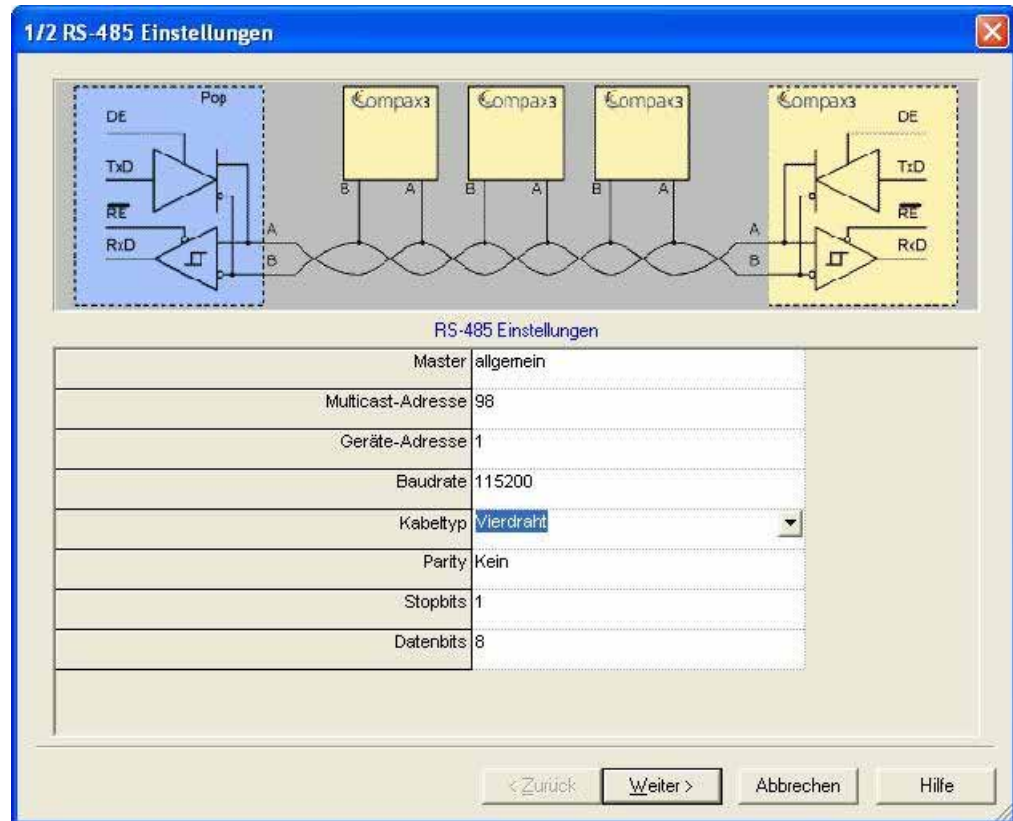
Communication settings C3S/C3M:

Object	Function	Value
810.1	Protocol	16 (two wire)
810.2	Baud rate	115200
810.3	NodeAddress	1..254
810.4	Multicast Address	

6.1.8. C3 settings for RS485 four wire operation

C3 ServoManager RS485 wizard settings:

download with configuration in RS232 mode



Communication settings C3S/C3M:

Object	Function	Value
810.1	Protocol	0 (four wire)
810.2	Baud rate	115200
810.3	NodeAddress	1..254
810.4	Multicast Address	

6.2 COM port protocol

In this chapter you can read about:

RS485 setting values.....	377
ASCII - record.....	378
Binary record.....	379

You can communicate with Compax3 in order to read or write objects via plug X10 (or X3 on the mains module of Compax3M) on the front via a COM port (max. 32 nodes).

As a rule 2 records are possible:

- ◆ ASCII record simple communication with Compax3
- ◆ Binary record: fast and secure communication with Compax3 by the aid of block securing.

Switching between the ASCII and the binary record via automatic record detection.

interface settings (see page 526)

Wiring RS232: **SSK1** (see page 500)
 RS485: like **SSK27** (see page 501) / RS485 is activated by +5V on X10/1.
 USB: SSK33/03 (only for Compax3M)

6.2.1. RS485 setting values

If "Master=Pop" was selected, only the settings compatible with the Pops (Parker Operator Panels) made by Parker are possible.

Please note that the connected Pop has the same RS485 setting values.

You can test this with the "PopDesigner" software.

"Master=General" makes all Compax3 settings possible.

Multicast Address You can use this address to allow the master to access multiple devices simultaneously.

Device Address The device address of the connected Compax3 can be set here.

Baud rate Adjust the transfer speed (baud rate) to the master.

Connection Type Please choose between **two-wire and four-wire RS485** (see page 63).

Protocol Adjust the protocol settings to the settings of your master.

6.2.2. ASCII - record

The general layout of a command string for Compax3 is as follows:

[Adr] command CR

Adr	RS232: no address RS485: Compax3 address in the range 0 ... 99 Address settings can be made in the C3 ServoManager under "RS485 settings"
Command	valid Compax3 command
CR	End sign (carriage return)

Command

A command consists of the representable ASCII characters (0x21 .. 0x7E). Lower cases are converted automatically into capitals and blanks (0x20) are deleted, if they are not placed between two quotation marks.
Separator between places before and after the decimal is the decimal point (0x2E).
A numeric value can be given in the Hex-format if it is preceded by the "\$" sign.
Values can be requested in the Hex-format if the CR is preceded additionally by the "\$" sign.

Answer strings

All commands requesting a numeric value from Compax3 are acknowledged with the respective numeric value in the ASCII format followed by a CR without preceding command repetition and following statement of unit. The length of these answer strings differs depending on the value.
Commands requesting an Info-string (e.g. software version), are only acknowledged with the respective ASCII character sequence followed by a CR, without preceding command repetition. The length of these answer strings is here constant.
Commands transferring a value to Compax3 or triggering a function in Compax3 are acknowledged by:

>CR

if the value can be accepted resp. if the function can be executed at that point in time.
If this is not the case or if the command syntax was invalid, the command is acknowledged with

!xxxxCR

The 4 digit error number **xxxx** is given in the HEX format; you will find the meaning in the **appendix** (see page 457).

RS485 answer string

When using RS485, each answer string is preceded by a "*" (ASCII - character: 0x2A).

Compax3 commands

Read object

RS232: O [\$] Index , [\$] Subindex [\$]

RS485: Address O [\$] Index , [\$] Subindex [\$]

The optional "\$" after the subindex stands for "hex-output" which means that an object value can also be requested in hex;
e.g. "O \$0192,2\$": (Object 402.2)

Write object

RS232: O [\$] Index , [\$] Subindex = [\$] Value [; Value2 ; Value3 ; ...]

RS485: Address O [\$] Index , [\$] Subindex = [\$] Value [; Value2 ; Value3 ; ...]

The optional "\$" preceding Index, Subindex and value stands for "Hex-input" which means that Index, Subindex and the value to be transferred can also be entered in hex (e.g. O \$0192,2=\$C8).

6.2.3. Binary record

The binary record with block securing is based on 5 different telegrams:

- ◆ 2 request telegrams which the control sends to Compax3 and
- ◆ 3 response telegrams which Compax3 returns to the control.

Telegram layout

Basic structure:

Start code	address	Number of data bytes - 1	Data				block securing	
SZ	A	L	D0	D1	...		Crc(Hi)	Crc(Lo)

The start code defines the frame type and is composed as follows:

Bit	7	6	5	4	3	2	1	0
Frame type	Frame identification				PLC		Gateway	address
RdObj Read object	1	0	1	0	x	1	x	x
WrObj Write object	1	1	0	0	x	1	x	x
Rsp Answer	0	0	0	0	0	1	0	1
Ack Positive command acknowledgement	0	0	0	0	0	1	1	0
Nak Negative command acknowledgement	0	0	0	0	0	1	1	1

Bits 7, 6, 5 and 4 of the start code form the telegram identification; Bit 2 is always "1".

Bits 3, 1 and 0 have different meanings for the request and response telegrams. The address is only necessary for RS484.

Request telegrams

-> Compax3

- ◆ the address bit (Bit 0 = 1) shows if the start code is followed by an address (only for RS485; for RS232 Bit 0 = 0)
- ◆ the gateway bit (Bit 1 = 1) shows if the message is to be passed on. (Please set Bit 1 = 0, as this function is not yet available)
- ◆ the PLC bit (Bit 3 = 1) allows access to objects in the PLC/Pop format
 U16, U32: for integer formats (see bus formats: Ix, Ux, V2)
 IEEE 32Bit Floating Point: for broken formats (bus formats: E2_6, C4_3, Y2, Y4; without scaling)
 With Bit 3 = 0 the objects are transmitted in the DSP format.
 DSP formats:
 24 Bit = 3 Bytes: Integer INT24 or Fractional FRACT24
 48 Bit = 6 Bytes: Real REAL48 (3 Byte Int, 3 Byte Fract) / Double Integer DINT48 / Double Fractional DFRACT48

Response telegram Compax3>

- ◆ Bits 0 and 1 are used to identify the response
- ◆ Bit 3 is always 0

The maximum number of data bytes in the request telegram is 256, in the response telegram 253.

The block securing (CRC16) is made via the CCITT table algorithm for all characters.

After receiving the start code, the timeout monitoring is activated in order to avoid that Compax3 waits in vain for further codes (e.g. connection interrupted) The timeout period between 2 codes received is fixed to 5ms (5 times the code time at 9600Baud)

Write object – WrObj telegram

SZ	Adr	L	D0	D1	D2	D3 ... Dn	Crc(Hi)	Crc(Lo)
0xCX		n	Index(Hi)	Index(Lo)	Subindex	Value	0x..	0x..

Describing an object by a value.

Positive acknowledgement – Ack-telegram

SZ	L	D0	D1	Crc(Hi)	Crc(Lo)
0x06	1	0	0	0x..	0x..

Answer from Compax3 if a writing process was successful, i.e. the function could be executed and is completed in itself.

Negative acknowledgement – Nak - telegram

SZ	L	D0	D1	Crc(Hi)	Crc(Lo)
0x07	1	F-No.(Hi)	F-No.(Lo)	0x..	0x..

Answer from Compax3 if access to the object was denied (e.g. function cannot be executed at that point in time or object has no reading access). The error no. is coded according to the DriveCom profile resp. the CiA Device Profile DSP 402.

Read object – RdObj - telegram

SZ	Adr	L	D0	D1	D2	D3	D4	D5	...	Dn	Crc(Hi)	Crc(Lo)
0xAX		n	Index1(Hi)	Index1(Lo)	Subindex1	Index2(Hi)	Index2(Lo)	Subindex2	...	...	0x..	0x..

Reading one or several objects

Answer – Rsp - telegram

SZ	L	D0 ... Dx-1	Dx ... Dy-1	Dy-D..	D ... D..	D ... Dn	Crc(Hi)	Crc(Lo)
0x05	n	Value1	Value 2	Value 3	Value ..	Value n	0x..	0x..

Answer from Compax3 if the object can be read.

If the object has no reading access, Compax3 answers with the Nak – telegram.

Example:**Reading object "StatusPositionActual" (o680.5):**

Request: A5 03 02 02 A8 05 E1 46

Response: 05 05 FF FF FF FF FE 2D 07 B4

Writing into an Array (o1901.1 = 2350)

Request: C5 02 08 07 6D 01 00 09 2E 00 00 00 95 D5

Response: 06 01 00 00 BA 87

Block securing:**Checksum calculation for the CCITT table algorithm**

The block securing for all codes is performed via the following function and the corresponding table:

The "CRC16" variable is set to "0" before sending a telegram.

Function call:

```
CRC16 = UpdateCRC16(CRC16, Character);
```

This function is called up for each Byte (Character) of the telegram.

The result forms the last two bytes of the telegram

Compax3 checks the CRC value on receipt and reports CRC error in the case of a deviation.

```
Function  const unsigned int _P_CRC16_table[256] = {
    0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
    0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
    0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
    0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
    0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
    0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
    0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
    0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
    0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
    0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
    0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
    0xdbfd, 0xcdbc, 0xfbfb, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
    0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
    0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
    0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
    0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
    0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
    0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
    0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
    0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
    0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
    0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
    0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
    0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
    0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
    0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
    0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
    0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
    0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
    0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
    0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
    0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
};

unsigned int UpdateCRC16(unsigned int crc,unsigned char value) {

unsigned int  crc16;

crc16 = (CRC16_table[(crc >> 8) & 0x00FF] ^ (crc << 8)
^ (unsigned int) (value));

return crc16;

}

```

You will find this function on the Compax3 CD under RS232_485\Function UpdateCRC16.txt!

6.3 Remote diagnosis via Modem

In this chapter you can read about:

Structure	382
Configuration of local modem 1	383
Configuration of remote modem 2	384
Recommendations for preparing the modem operation	385

Caution!

As the transmission via modem may be very slow and interference-prone, the operation of the Compax3 ServoManager via modem connection is on your own risk!

The function setup mode as well as the ROLL mode of the oscilloscope are not available for remote diagnosis!

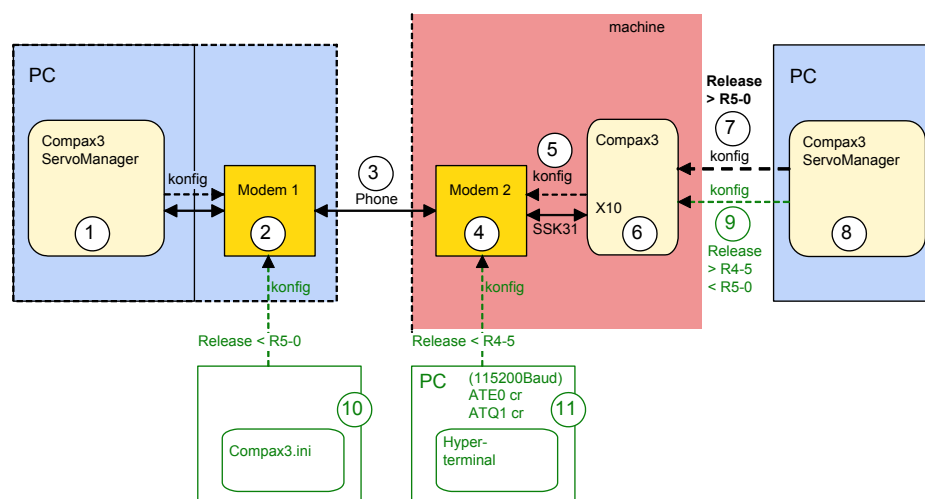
It is not recommended to use the logic analyzer in the Compax3 IEC61131-3 debugger due to the limited bandwidth.

Requirements:

For modem operation, a direct and stable telephone connection is required. Operation via a company-internal telephone system is not recommended.

6.3.1. Structure

Layout and configuration of a modem connection ServoManager - Compax3:



The green part of the drawing shows the proceeding for Compax3 release versions < R5-0!

The proceeding for Compax3 release versions < R5-0 is described in an application example (.../modem/C3_Appl_A1016_language.pdf on the Compax3 CD).

Connection Compax3 ServoManager <=> Compax3

The Compax3 ServoManager (1) establishes a RS232 connection with modem 1 (PC internal or external).

Modem 1 dials modem 2 via a telephone connection (3).

Modem 2 communicates with Compax3 (6) via RS232.

Configuration

Modem 1 is configured via the Compax3 ServoManager (1)

Modem 2 can be configured via Compax3 (on place), triggered by putting **SSK31** (see page 505) on X10. For this, the device must be configured before. This can be made locally before the system / machine is delivered with the aid of the Compax3 ServoManager (8).

The transmission was tested with a TD33 modem made by "**Westermo** <http://www.westermo.com>". The configuration with this standard modem is especially simple.

Other modem types are also possible.

6.3.2. Configuration of local modem 1

- ◆ Menu "Options: Communication settings RS232/RS485..." must be opened
- ◆ Select "Connection via Modem"
- ◆ Under "name" you can enter a name for the connection
- ◆ Enter the target telephone number.
Note: If an ISDN telephone system is operated within a company network, an additional "0" may be required in order to get out of the local system into the company network before reaching the outside line with an additional "0".
- ◆ The timeout periods are set to reasonable standard values according to our experience.
- ◆ Select the modem type: "Westermo TD-33" or "user-defined modem"
 - ◆ For "Westermo TD-33", no further settings are required.
 - ◆ For "user-defined modem", additional settings are only required, if the modem does not support standard AT commands.
Then you can enter special AT commands.
 - ◆ **Note:** When operating the local modem on a telephone system, it may be necessary to make a blind dialling. Here, the modem does not wait for the dialling tone. For the Westermo TD33, the additional command sequence is ATX3.
- ◆ Select the COM interface where the modem is connected.
- ◆ Close the window and establish the connection with button  (open/close COM port).
- ◆ The connection is interrupted when the COM port is closed.

- ◆ Select the modem type: "Westermo TD-33" or "user-defined modem"
 - ◆ For "Westermo TD-33", no further settings are required.
 - ◆ For "user-defined modem", additional settings are only required, if the modem does not support standard AT commands.
Then you can enter special AT commands.
- ◆ **Note:** When operating the local modem on a telephone system, it may be necessary to make a blind dialling. Here, the modem does not wait for the dialling tone. For the Westermo TD33, the additional command sequence is ATX3.

6.3.3. Configuration of remote modem 2

Settings in Compax3 under "configure communication: Modem settings":

- ◆ Modem initialization = "ON": After the SSK31 modem cable has been connected, Compax3 initializes the modem
- ◆ Modem initialization after Power On = "ON": After Power on of Compax3, the device initializes the modem
- ◆ Modem check = "ON": a modem check is performed
- ◆ The timeout periods are set to reasonable standard values according to our experience.
- ◆ Select the modem type: "Westermo TD-33" or "user-defined modem"
 - ◆ For "Westermo TD-33", no further settings are required.
 - ◆ For "user-defined modem", additional settings are only required, if the modem does not support standard AT commands.
Then you can enter special AT commands.
- ◆ **Note:** When operating the local modem on a telephone system, it may be necessary to make a blind dialling. Here, the modem does not wait for the dialling tone. For the Westermo TD33, the additional command sequence is ATX3.
- ◆ in the following wizard window, a specific download of the modem configuration can be made.

Note:

If a configuration download is interrupted, the original settings in the non volatile memory of the Compax3 are still available.
You have to finish the communication on the PC side and to reset the Compax3 via the 24V supply before you can start a new trial.

Reinitialization of the remote modem 2

Remove cable on Compax3 X10 and connect again!

6.3.4. Recommendations for preparing the modem operation

Preparations:

- ◆ Settings in Compax3 under "configure communication: Modem settings":
 - ◆ Modem initialization: "ON"
 - ◆ Modem initialization after Power On: "ON"
 - ◆ Modem check: "ON"
- ◆ Deposit SSK31 cable in the control cabinet.
- ◆ Install modem in the control cabinet and connect to telephone line.

Remote diagnosis required:

- ◆ On site:
 - ◆ Connect modem to Compax3 X10 via SSK31
 - ◆ Modem is automatically initialized
- ◆ Local:
 - ◆ connect modem to telephone line
 - ◆ Establish cable connection to modem (COM interface)
 - ◆ Select "connection via modem" under "options: communication settings RS232/RS485...".
 - ◆ Select modem under "selection"
 - ◆ Enter telephone number
 - ◆ Select COM interface (PC - modem)
 - ◆ Establish connection with button  (open/close COM port).

6.4 Profibus

In this chapter you can read about:

Typical application with fieldbus and IEC61131	386
Profibus configuration.....	386
Cyclic process data channel.....	388
Acyclic parameter channel	389
Simatic S7 -300/400 - modules	398

I20 Function

The Profibus option is available with the Compax3 devices C3I20Txx!

Notes on the configuration of the Profibus master

Before configuring the Profibus master (e.g. S7), you will have to configure the Compax3 axis.

In the **Profibus window** (see page 386) of the configuration wizard you will receive the status message "Profibus Telegram" with the information on the telegram which can be set in the master (PPO type).

6.4.1. Typical application with fieldbus and IEC61131

We recommend the following procedure to control the IEC61131-3 program via Profibus:

- ◆ Use the control word (DeviceControl_Controlword_1) to control the PLCOpen function modules (Execute, Enable) to activate the modules via Profibus.
- ◆ The logical module outputs can be placed on the status word (DeviceState_Statusword_1).
- ◆ Place the control word and the status word on the cyclic process data channel.
- ◆ Connect variable module outputs of your IEC61131-3 program with the recipe array.
 - ◆ For rapid access, the values from the first 5 rows of the recipe array can be placed in the cyclic channel.
 - ◆ Additional values of the recipe array can be written acyclically.

Now you can use the bus to assign values, to activate function modules with the control word and to read the current status with the control word.

6.4.2. Profibus configuration

In this chapter you can read about:

Configuration of the process-data channel.....	387
PKW parameter channel	388
Error reaction to a bus failure	388

Following are described the input windows of the Profibus configuration wizard. Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.4.2.1 Configuration of the process-data channel

You can use the Process Data Channel (PZD) to exchange actual and Setpoint values cyclically between the Compax3 and the Profibus master.

Adjusting the cyclic PZD:

The PZD is adjusted separately for the following transfer directions:

- ◆ Profibus-Master $\Rightarrow$ Compax3 (PAD)
- ◆ Compax3 $\Rightarrow$ Profibus-Master (PED)

Maximum size of the process-data channel:

8 words (16 bytes) PAD and

8 words (16 bytes) PED

The objects that can be put on the process data channel can be found in the "Compax3 Objects (see page 446)"!

Assignment of the process data channel

Assignment of the process data channel is automated in Compax3 ServoManager. You select the objects which you want to put one after the other to the process input data (PED: Compax3 $\Rightarrow$ PLC) and to the process output data (PAD: PLC $\Rightarrow$ Compax3).

ServoManager continuously checks areas of the PZD that are free and enables additional input options correspondingly.

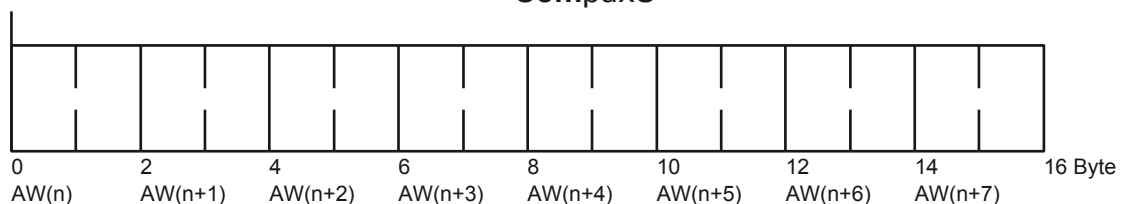
PPO type Depending on the configuration that is set, the resulting PPO type is displayed in the "Profibus telegram" wizard window (in the status line of the wizard window). You can use this value for the configuration of the Profibus master.

Assignment of the PZD When data is read out of the Process Data Channel (PZD), the word width of the individual objects must be carefully noted.

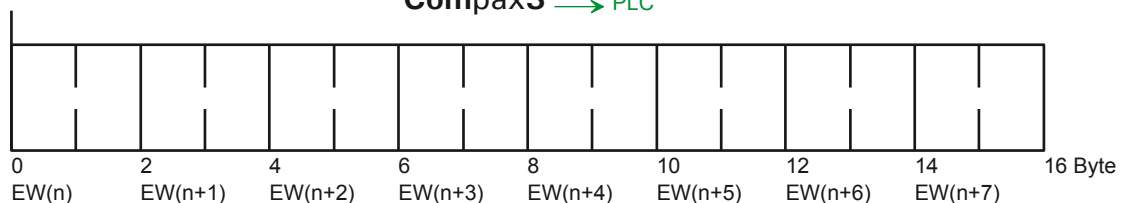
Example: Assignment:

Object	Word width	Assignment	address
POSITION_position	2	AW(n) & AW(n+1)	AD(n)
POSITION_speed	2	AW(n+2) & AW(n+3)	AD(n+2)
AnalogOutput0_DemandValue	1	AW(n+4)	AW(n+4)
AnalogOutput1_DemandValue	1	AW(n+5)	AW(n+5)
Array_Col1_Row1	2	AW(n+6) & AW(n+7)	AD(n+6)

PLC $\longrightarrow$ Compax3



Compax3 $\longrightarrow$ PLC



6.4.2.2 PKW parameter channel

Parameter access with DPV0

In addition to cyclic data exchange, you can use the PKW mechanism for acyclic access to parameters.

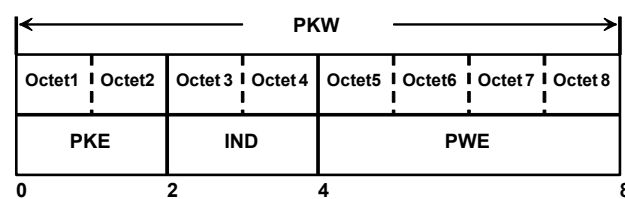
The PKW mechanism is implemented for Profibus masters without DPV1 functionality.

PKW:Parameter identification value

You can select between:

- ◆ **no PKW** - without acyclic parameter access.
- ◆ **PKW** - parameter access via a PKW length of 8 bytes.

PKW structure



Additional information on the **structure of the PKW** (see page 389)

6.4.2.3 Error reaction to a bus failure

Here you can adjust how Compax3 will respond to a **fieldbus error** (see page 457):

Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

6.4.3. Cyclic process data channel

The structure of the PZD is defined in the configuration menu: "Profibus Telegram" of the Servomanager.

6.4.3.1 Control and status word

The cyclic process data channel contains a control word and a status word both, freely available and 16 bits in size:

Control word: Profibus-Master ⇒ Compax3

Status word: Compax3 ⇒ Profibus-Master

6.4.4. Acyclic parameter channel

In this chapter you can read about:

Parameter access with DPV0: Required data channel	389
Data formats of the bus objects	395

Compax3 supports parameter access with DPV1.

6.4.4.1 Parameter access with DPV0: Required data channel

You can use the PKW mechanism for acyclic access to parameters in cyclic data exchange as well. This is made available to make it possible for the master to have access to the important device parameters without DPV1 functionality. The master formulates an order in the PKW mechanism. Compax3 processes the order and formulates the response.

PKW structure:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
PKE		IND		PWE			

PKW: Parameter identification value

PKE: Parameter identification (1. and 2. octet) (see below)

IND: Subindex* (3. Octet), 4. byte is reserved

PWE: Parameter value (5th to 8th byte resp. 5th to 12th byte with extended PKW)

PKE structure:

Byte 1								Byte 2							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AK				SPM		PNU									

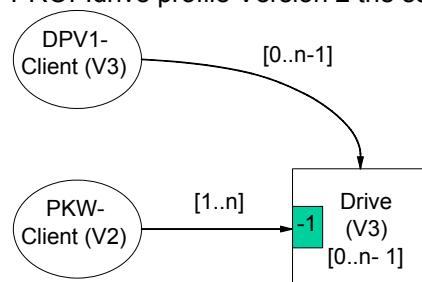
AK: Order /response identification (value range 0 ... 15)

SPM: Reserved

PNU: Parameter number

*Reference to the subindex

The information for PNU subindex (parameter number) also applies to PROFIdrive profile Version 3, i.e., that the subindex is counted starting at 0, while for PROFIdrive profile Version 2 the subindex is counted starting at 1:



The result of this is as follows:

Profibus master based on PROFIdrive profile Version 3

The subindex of the Profibus No. (PNU) specified in the object list is directly valid. Example: Example: PNU object forward speed control = 400.1 (as specified).

Profibus master based on PROFIdrive profile Version 2

The subindex of the Profibus No. (PNU) specified in the object list must be incremented by 1.

Example: PNU object forward speed control = 400.2

Order and response processing

Order/response identifications are defined so that it is apparent from the identification which fields of the PKW interface (IND, PWE) also need to be evaluated. To this may be added the distinction between parameter value and parameter description.

Order identification	Order Master → Compax3	response identification Compax3 → Master
0	No order	0
1	Request parameter value	1,2
2	Change parameter value (word)	1
3	Change parameter value (double word)	2
6	Request parameter value (array)	4,5
7	Change parameter value (array of word)	4
8	Change parameter value (array of double word)	5
9	Request number of array elements	6
14	Change object	14
15	Request object	15

Response identifications 7 and 8 are used for negative acknowledgements for problems.

Sequence

- ◆ The master transfers an order to a Compax3.
- ◆ The master repeats this order at least until a response is received from Compax3. This procedure ensures the transfer of orders /responses on the user level.
- ◆ Only one order is ever being processed at a time.
- ◆ Compax3 continues to make the response available until the master formulates a new order.
- ◆ For responses containing parameter values, Compax3 always responds upon repetition with the current value (cyclic processing). This applies to all responses to the orders "Request parameter value", "Request parameter value (Array)" and "Request object".
- ◆ The PWE transfer of word sizes takes place with byte 7 and 8, while the transfer of double word sizes takes place with byte 5 through 8.

Explanation of response identification

Response identification	Response Compax3 → Master
0	No response
1	Transfer value (word)
2	Transfer parameter value (double word)
4	Transfer parameter value (array of word)
5	Transfer parameter value (array of double word)
7	Order cannot be executed (with error no. (see page 457).)
8	No user level for PKW interface
9	Reserved
10	Reserved
14	Object value transferred
15	Object value transferred

Example: Changing the stiffness

Task:

Parameter / object change via PKW (DPV0)

The object "stiffness" will be set to 200%

Object stiffness: PNU 402.2; valid after VP

Format UNSIGNED 16 == 1 word == order identification = 2 == "Change parameter value (word)"

The master sends to Compax3:

PLC - Compax3

Octet 1											Octet 2											Octet 3				Octet 4				Octet 5				Octet 6				Octet 7				Octet 8							
PKE															IND															PWE																			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex				-				MSB												LSB													
AK															PNU																																		
2											0				402											3				0				200															
0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	1	0																																	
0x21											0x92											0x3				0x0				0x0				0x0				0x0				0xC8							

Compax3 responds with the same content, except with response identification = 1:

Compax3 - PLC

Octet 1					Octet 2					Octet 3		Octet 4		Octet 5		Octet 6		Octet 7		Octet 8					
PKE										IND				PWE											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex		-		MSB				LSB	
AK						PNU																			
1				0		402										3		200							
0	0	0	1	0	0	0	1	1	0	0	1	0	0	1	0										
0x11					0x92					0x3		0x0		0x0		0x0		0x0		0x0		0xC8			

If no additional object needs to be changed, the new value can be set to valid with VP:

Object: Set objects to valid PNU 338.10 (because of DPV0, the **Subindex must be incremented by 1** (see page 389))

PLC - Compax3

Octet 1											Octet 2											Octet 3				Octet 4				Octet 5				Octet 6				Octet 7				Octet 8			
PKE															IND															PWE															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex				-				MSB								LSB													
AK								PNU																																					
2				0				338												11				1																					
0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	0																													
0x21											0x52											0xB				0x0				0x0				0x0				0x0				0x1			

Compax3 responds with the same content, except with response identification = 1:

Compax3 - PLC

Octet 1											Octet 2											Octet 3				Octet 4				Octet 5				Octet 6				Octet 7				Octet 8			
PKE															IND								PWE																						
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex				-				MSB								LSB													
AK							PNU																																						
1					0		338											11				1																							
0	0	0	1	0	0	0	1	0	1	0	1	0	0	1	0																														
0x11											0x52											0xB				0x0				0x0				0x0				0x0				0x1			

Reading back the object set objects to valid makes it possible to check whether the command was performed. Byte 8 will contain the value 0.

The change can be stored and will not be lost even with a power failure by using the object "Save objects permanently".

Object: Save objects permanently PNU 339

PLC - Compax3

Octet 1											Octet 2											Octet 3				Octet 4				Octet 5				Octet 6				Octet 7				Octet 8			
PKE																IND								PWE																					
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex				-				MSB												LSB									
AK						PNU																																							
2				0		339										0												1																	
0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	1																													
0x21											0x53											0x0				0x0				0x0				0x0				0x0				0x1			

Compax3 responds with the same content, except with response identification = 1:

Compax3 - PLC

Octet 1										Octet 2										Octet 3		Octet 4		Octet 5		Octet 6		Octet 7		Octet 8	
PKE																IND				PWE											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex		-		MSB				LSB							
AK						PNU																									
1				0		339										0				1											
0	0	0	1	0	0	0	1	0	1	0	1	0	0	1	1																
0x11										0x53										0x0		0x0		0x0		0x0		0x0		0x1	

Upload/download objects via the Profibus

All settings of Compax3 can be read using the Profibus and written back to Compax3. This makes it easy to replace a device, for example.

Condition: Compax3 must be configured (once running through the configuration wizard followed by a download is enough; the configuration settings are, however, not relevant)
To implement this, the PKW mechanism has been changed.

Structure of modified PKW:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
PKE		IND		PWE			

PKW: Parameter identification value

PKE: Parameter identification (1. and 2. octet) (see below)

IND: Object index (3. octet high 4. octet low)

PWE: Parameter value (5. to 8. octet)

Structure of modified PKE:

Byte 1								Byte 2							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AK=14 or 15				SPM	DF	DPZ		SI							

AK: Order/response identification

SPM: Reserved

DF: Data format (DF=1 constant)

DPZ: Data buffer access

SI: Object subindex

Data buffer access:

For each object, 16 bytes must be read or written. Since the size of the PWE channel is 4 bytes, each object must be read or written 4 times.

Sequence for reading / writing and object:

DPZ=0: Object byte 1 ... 4 can be read / is being written

Order executed

DPZ=1 Object byte 5 ... 8 can be read / is being written

DPZ=2 Object byte 9 ... 12 can be read / is being written

DPZ=3 Object byte 13 ... 16 can be read / is being written

The data will either be read from the PWE or written into the PWE.

Access algorithm for reading objects

◆ Object 20.2 written with value 0 (object 20.2 is a counter that specifies the next object to be read; the starting value is 0).

◆ Read object index and subindex in object 20.5.

Format I32 of Object 20.5:

Not assigned	Index (high byte)	Index (low byte)	Subindex

◆ Read the object with the index and subindex read in object 20.5 and save it in a table with the following structure: Index (2Byte), Subindex(1Byte), Contents (16Byte).

◆ Read the next object-Index and subindex in object 20.5.

◆

This must be performed until index = 0xFFFF and until subindex = 0xFF.

Writing objects

Write the entire table to Compax3. Each index and subindex is written with the value stored in the table.

It should be noted in this regard that each time an object is written, the internal buffer must first be written with DPZ=1, 2, 3 and then the entire order is written with DPZ0.

6.4.4.2 Data formats of the bus objects

In this chapter you can read about:

Integer formats.....	395
Unsigned - Formats	395
Fixed point format E2_6.....	395
Fixed point format C4_3	396
Bus format Y2 and Y4.....	396
Bit sequence V2.....	397
Byte string OS.....	397

Integer formats

Twos complement representation;

The highest order bit (MSB) is the bit after the sign bit (VZ) in the first octet.

VZ == 0: positive numbers and zero; VZ == 1: negative numbers

Type	Bit	8	7	6	5	4	3	2	1
Integer 8 length: 1 Byte		VZ	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Integer 16	MSB	VZ	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
Length: 1 Word	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Integer 32	MSB	VZ	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
Length: 2 Words		2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Unsigned - Formats

Type	Bit	8	7	6	5	4	3	2	1
Unsigned 8 Length: 1 Byte		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Unsigned 16	MSB	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
Length: 1 Word	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Unsigned 32	MSB	2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
Length: 2 Words		2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Fixed point format E2_6

Linear fixed point value with six binary places after the decimal point. 0 corresponds to 0, 256 corresponds to 2^{14} (0x4000).

Twos complement representation;

MSB is the bit after the sign bit

VZ == 0: positive numbers and zero;

VZ == 1: negative numbers

Type	Bit	8	7	6	5	4	3	2	1
E2_6	MSB	VZ	2^8	2^7	2^6	2^5	2^4	2^3	2^2
Length: 1 Word	LSB	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}

Fixed point format C4_3

Linear fixed point value with three decimal places after the decimal point. 0 corresponds to 0 and 0,001 corresponds to 2^0 (0x0000 0001).
Structure like data type Integer32, value of the bits reduced by a factor of 1000.
Length: 2 Words

Bus format Y2 and Y4**Layout:**

- ◆ Y2 like data type Integer16
- ◆ Y4 like data type Integer32

The values can be adjusted by a scaling factor.
The following rules apply:

- ◆ Scaling factor for Y2: Object 200.1, ... 200.5
- ◆ Scaling factor for Y4: Object 201.1, ... 201.5

There are different scaling factors for individual values

1. Y2 scaling factors

- ◆ Object 200.1: NormFactorY2_Speed: Scaling factor for Y2 speeds
- ◆ Object 200.2: NormFactorY2_Position: Scaling factor for Y2 positions
- ◆ Object 200.3: NormFactorY2_Voltage: Scaling factor for Y2 voltages
- ◆ Object 200.5: NormFactorY2_Array_Col2: Scaling factor for Column 2 of the recipe array

2. Y4 scaling factors

- ◆ Object 201.1: NormFactorY4_Speed: Scaling factor for Y4 speeds
- ◆ Object 201.2: NormFactorY4_Position: Scaling factor for Y4 positions
- ◆ Object 201.3: NormFactorY4_Voltage: Scaling factor for Y4 voltages
- ◆ Object 201.4: NormFactorY4_Array_Col1: Scaling factor for Column 1 of the recipe array

Meaning of scaling factors

◆ Bit 5: Meaning of scaling factor:

◆ Bit 5 = "0": decimal factors 1, 1/10, 1/100, ..

Bit 0 .. Bit 4: Scaling factor

#	Bit 0...4	Factor dec (Bit 5 = 0) yy0x xxxx	
0	00000	10^0	1
1	00001	10^{-1}	0,1
2	00010	10^{-2}	0,01
3	00011	10^{-3}	0,001
4	00100	10^{-4}	0,0001
5	00101	10^{-5}	0,00001
6	00110	10^{-6}	0,000001
7	00111	10^{-7}	0,0000001
8	01000	10^{-8}	0,00000001
9	01001	10^{-9}	0,000000001

◆ Bit 5 = "1": binary factors 1, 1/2, 1/4, 1/8, ...

Bit 0 ... Bit 4: Scaling factor

#	Bit 0...4	Factor bin (Bit 5 = 1) yy1x xxxx	
32	00000	2^0	1
33	00001	2^{-1}	0,5
34	00010	2^{-2}	0,25
35	00011	2^{-3}	0,125
36	00100	2^{-4}	0,0625
37	00101	2^{-5}	0,03125
38	00110	2^{-6}	0,015625
39	00111	2^{-7}	0,0078125
40	01000	2^{-8}	0,00390625
41	01001	2^{-9}	0,001953125
42	01010	2^{-10}	0,0009765625
43	01011	2^{-11}	0,00048828125
44	01100	2^{-12}	0,000244140625
45	01101	2^{-13}	0,0001220703125
46	01110	2^{-14}	0,00006103515625
47	01111	2^{-15}	0,000030517578125
48	10000	2^{-16}	0,0000152587890625
49	10001	2^{-17}	0,00000762939453125
50	10010	2^{-18}	0,000003814697265625
51	10011	2^{-19}	0,0000019073486328125
20	10100	2^{-20}	0,00000095367431640625
21	10101	2^{-21}	0,000000476837158203125
22	10110	2^{-22}	0,0000002384185791015625
23	10111	2^{-23}	0,00000011920928955078125
24	11000	2^{-24}	0,000000059604644775390625

◆ Bit 6 ... Bit 15: Reserved

Bit sequence V2

The V2 bus format is a bit sequence with a length of 16 bits.

Byte string OS

Octet string OS: String with variable length.

6.4.5. Simatic S7 -300/400 - modules

You can find the modules on the Compax3 DVD or in the internet under **<http://www.compax3.info/startup>** <http://www.compax3.info/startup>.
You will find a description of these function modules in the help file !

6.5 CANopen - Node Settings

In this chapter you can read about:

CANopen - configuration	399
Supporting IEC modules.....	401
CANopen communication profile	409
Acyclic parameter channel	414

I21 Function

The CANopen option is available with the Compax3 devices C3I21Txx!

6.5.1. CANopen - configuration

In this chapter you can read about:

CANopen Operating Mode	399
Error reaction to a bus failure	400
Baud rate	400
Possible PDO assignment.....	401
Transmission cycle time	401

Following are described the input windows of the CANopen configuration wizard. Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.5.1.1 CANopen Operating Mode

CANopen Operating Modes:

- ◆ **Slave on C3 powerPLmC:**
Compax3 as Slave on C3 powerPLmC integrated via the DriveInterface
Note for C3I21T40: The cam programming is made in the slave axis
- ◆ **Slave**
Compax3 is Slave of a CANopen Master; the CANopen configuration is made via the ServoManager
- ◆ **Slave with configuration via Master**
Compax3 is Slave of a CANopen Master; the CANopen configuration is made via the Master
- ◆ **Master for PIOs**
Compax3 as CANopen Master only for the operation of external digital and analog PIOs (Parker Input and Output modules).
Please note: The device cannot be operated with an additional CANopen Master!
- ◆ **Slave on C3 powerPLmC (Cam programming on C3 powerPLmC)**
Operating mode only available with I21T40!
The programming of the device (C3I21T40) is only made on the C3 powerPLmC.

C3 Master PIO

In the "C3 Master PIO" operating mode, the input window for the CANopen PIO mapping is following:

Please state, how many words the process image of the PIOs will need, 1.. 4 words are possible.

The process image is transmitted via the process data objects as follows:

Digital Inputs: RPDO1

Analog Inputs: RPDO2

Digital Outputs: TPDO1

Analog Outputs: TPDO2

The inputs and outputs are stored in objects (O150.x ... O153.x).

Object 150.x: Digital Inputs

Object 151.x: Digital Outputs

Object 152.x: Analog Inputs

Object 153.x: Analog Outputs

The digital inputs and outputs can be read or written into in the IEC program via

modules (see page 342) in order to get an exact process image. Modules:

PIO_Input0_15, PIO_Input16_31, PIO_Input32_47, PIO_Input48_63,

PIO_Output0_15, PIO_Output16_31, PIO_Output32_47, PIO_Output48_63.

Before that, you must execute some initializations; this can be made with the aid of the **PIO_INIT** (see page 342) module.

6.5.1.2 Error reaction to a bus failure

Here you can adjust how Compax3 will respond to a **fieldbus error** (see page 457):

Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

6.5.1.3 Baud rate

Selecting the Baud rate.

Bear in mind that the maximum cable length depends on the Baud rate:

Baud rate	Maximum length
1Mbit/s	25m
800kbit/s	50m
500kbit/s	100m
250kbit/s	250m
125kbit/s	500m
100kbit/s	700m
50kbit/s	1,000m
20kbit/s	2,500m

6.5.1.4 Possible PDO assignment

Via the process data objects (PDOs) actual values and Setpoint values are continually exchanged between Compax3 and the CANopen client.

4 cyclic PDOs are possible, they are configured with the help of the Compax3 ServoManager:

The PDOs are set separately for the transmission directions

- ◆ CANopen - Client ⇒ Compax3 (**RPDO**) (max. 16 words)
- ◆ Compax3 ⇒ CANopen - Client (**TPDO**) (max. 16 words)

The objects that can be put on the process data channel can be found in the "**Compax3 Objects** (see page 446)"!

6.5.1.5 Transmission cycle time

For the TPDOs a transmission cycle time can be set in each case.

This time specifies the time intervals at which Compax3 applies the cyclic data new to the respective PDO.

The minimum value is thereby 1ms.

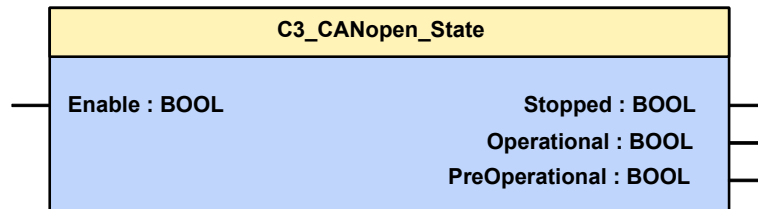
6.5.2. Supporting IEC modules

In this chapter you can read about:

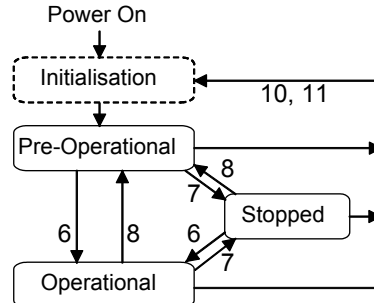
C3_CANopen_State	402
C3_CANopen_GuardingState	403
C3_CANopen_AddNode	404
C3_CANopen_ConfigNode	405
C3_CANopen_NMT	406
Reading an object in another node (C3_CANopen_SDO_Read4)	407
Writing an object in another node (C3_CANopen_SDO_Write4)	408

6.5.2.1 C3_CANOpen_State

FB name		
C3_CANOpen_State		
This module is used to determine the status of the CANopen NMT status machine		
VAR_INPUT		
Enable	BOOL	Activating the module
VAR_OUTPUT		
Stopped	BOOL	CANopen node is in "Stopped" state
Operational	BOOL	CANopen node is in the "Operational" state (communication via process data and service data objects is possible)
PreOperational	BOOL	CANopen node is in the "PreOperational" state (communication via process data and service data objects is possible)



CANopen states



6: Start Remote Node

7: Stop Remote Node

8: Enter Pre-Operational State

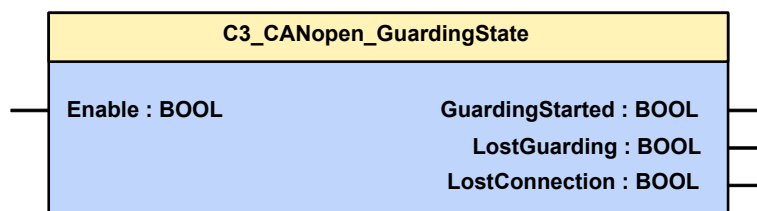
10: Reset Node

11: Reset Communication

The "Initialization" state is no fixed state but only a transition state.

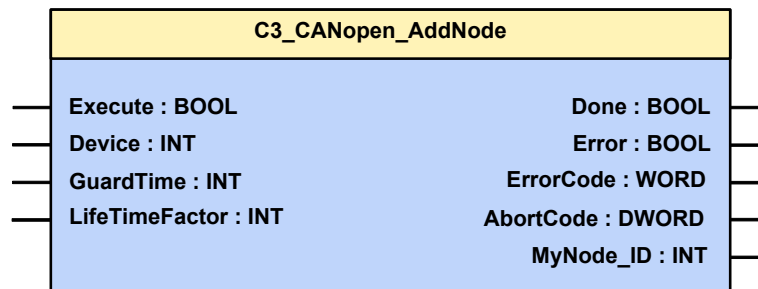
6.5.2.2 C3_CANopen_GuardingState

FB name		C3_CANopen_GuardingState
This module is used to determine the status during Nodeguarding		
VAR_INPUT		
Enable	BOOL	Activating the module
VAR_OUTPUT		
GuardingStarted	BOOL	The NMT master started the Nodeguarding procedure
LostGuarding	BOOL	The node did not receive a Nodeguarding RTR telegram from the NMT master during the Guarding time.
LostConnection	BOOL	The node did not receive a RTR telegram from the NMT Master during the "Node Life Time" (GuardingTime * LifeTimeFactor) and therefore considers the connection as interrupted.



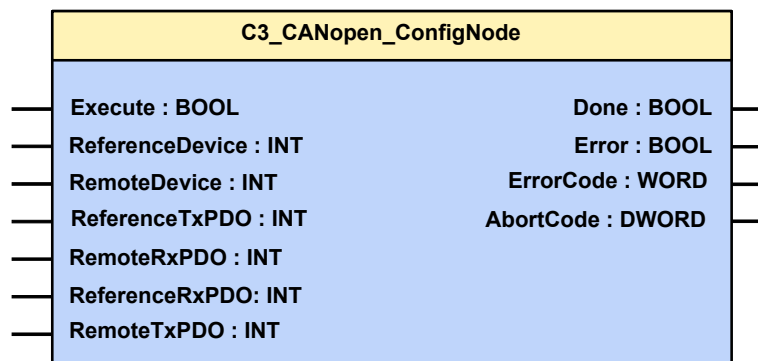
6.5.2.3 C3_CANopen_AddNode

FB name		C3_CANopen_AddNode
This module inserts a new CANopen node into the management list of the NMT master with the stated Node Guarding parameters and the current CANopen status PRE_OPERATIONAL.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node-ID (1 ... 127)
GuardTime	INT	Guard time = 0
LifeTimeFactor	INT	Life Time Factor = 0
VAR_OUTPUT		
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	You will find the error code in the Compax3 error list (see page 457).
AbortCode	DWORD	CANopen SDO abort code (see page 415) upon error 65377 C3 CANopen stack error (see page 406) no. upon error 65376
MyNode_ID	INT	Own Node_ID (NMT master)
Note: Compax3 must be CANopen master.		



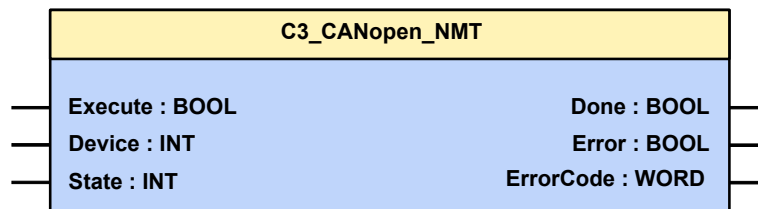
6.5.2.4 C3_CANopen_ConfigNode

FB name		C3_CANopen_ConfigNode
This module establishes a PDO connection between two CANopen nodes. To do this, the module changes the COB-Ids of the 2nd node (RemoteDevice) to the COB-Ids of the 1st node (ReferenceDevice).		
VAR_INPUT		
Execute	BOOL	Activating the module
ReferenceDevice	INT	Node ID of the 1st node (1 ... 127)
RemoteDevice	INT	Node ID of the 2nd node (1 ... 127)
ReferenceTxPDO	INT	TxPDO number of the 1st node (1 ... 4)
RemoteRxPDO	INT	TxPDO number of the 2nd node (1 ... 4)
ReferenceRxPDO	INT	RxPDO number of the 1st node (1 ... 4)
RemoteTxPDO	INT	TxPDO number of the 2nd node (1 ... 4) "0" do not establish connection
VAR_OUTPUT		
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	You will find the error code in the Compax3 error list (see page 457).
AbortCode	DWORD	CANopen SDO abort code (see page 415) upon error 65377 C3 CANopen stack error (see page 406) no. upon error 65376
Note: Compax3 must be CANopen master.		



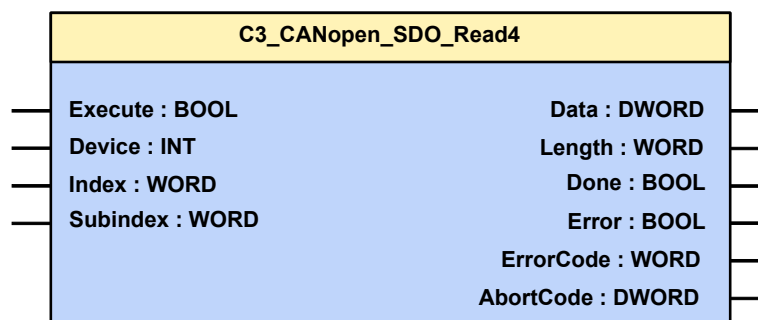
6.5.2.5 C3_CANopen_NMT

FB name		C3_CANopen_NMT
This module allows to send NMT messages.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node ID (0 ... 127) 0 = NMT-message is valid for all nodes
State	INT	State which the node must take on: START_REMOTE_NODE STOP_REMOTE_NODE ENTER_PRE_OPERATIONAL RESET_NODE RESET_COMMUNICATION (these are no constants; please enter therefore directly)
VAR_OUTPUT		
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	CANopen-Stack error no. 1 = not sufficient memory 2 = node is not in the management list 3 = node is already in the management list 4 = nodes are in the wrong state 11 = network object not available 12 = node 0 was selected 65378 = C3 has no master functionality
Note: Compax3 must be CANopen master.		



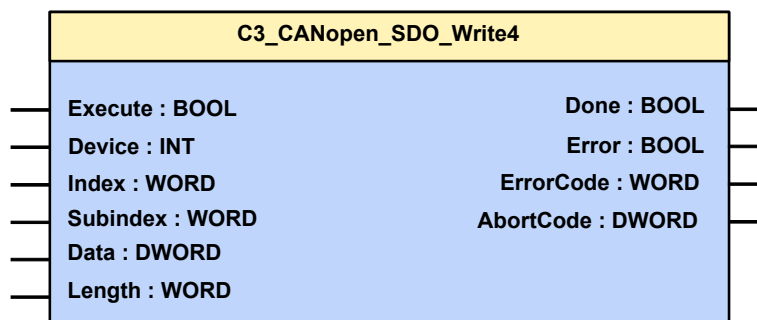
6.5.2.6 Reading an object in another node (C3_CANopen_SDO_Read4)

FB name		C3_CANopen_SDO_Read4
This module allows to read an object with a max. length of 4 bytes in another node via SDO.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node ID of the other node (1 ... 127)
Index	WORD	Object Index (CAN-No.)
Subindex	WORD	Object Subindex (CAN-No.)
VAR_OUTPUT		
Data	DWORD	Object data read in
Length	WORD	Data length in Byte
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	You will find the error code in the Compax3 error list (see page 457).
AbortCode	DWORD	CANopen SDO abort code (see page 415) upon error 65377 C3 CANopen stack error (see page 406) no. upon error 65376
Note: Compax3 must be CANopen master.		



6.5.2.7 Writing an object in another node (C3_CANopen_SDO_Write4)

FB name		C3_CANopen_SDO_Write4
This module allows to write an object with a max. length of 4 bytes in another node via SDO.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node ID of the other node (1 ... 127)
Index	WORD	Object Index
Subindex	WORD	Object subindex
Data	DWORD	Object data which must be written
Length	WORD	Data length in Byte
VAR_OUTPUT		
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	You will find the error code in the Compax3 error list (see page 457).
AbortCode	DWORD	CANopen SDO abort code (see page 415) upon error 65377 C3 CANopen stack error (see page 406) no. upon error 65376
Note: Compax3 must be CANopen master.		



6.5.3. CANopen communication profile

The CANopen communication objects described in this chapter are either set to sensible standard values or they are set under menu control with the help of the ServoManager.

The communication objects described below must be modified only for special deviating settings.

- ◆ CAN is an open system which has been standardised in the ISO 11898 and OSI reference model ISO 7498.
- ◆ CAN is Multi-Master compatible.
- ◆ Data transmission takes place with up to 8 Bytes useful data.
- ◆ The CAN objects are designated with an 11 Bit identifier (ID or COB-ID: CAN Object identifier). The identifier specifies the priority of the objects (the smaller the value of the object ID is, the higher is the priority level of the object).
- ◆ The COB-ID consists of the function code and the node ID:

Structure of the COB-ID

Bit 10	9	8	7	6	5	4	3	2	1	0
Function code				NodeID (1 ... 127)						

NodeID: The Compax3 device address is used here as standard value

I21 Function

CANopen ratings

Baud rate [kBit/s]	◆ 20, 50, 100, 125, 250, 500, 800, 1000
EDS file	◆ C3.EDS
Service data object	◆ SDO1
Process data objects	◆ PDO1, ... PDO4

6.5.3.1 Object types

The following table shows the preset COB-IDs:

Communication on object type	Function code	COB - Identifier (dec)	COB - Identifier (hex)	Defined in Index...	Description	
Broadcast objects						
NMT	0000b	0	0h	-	Network management and identifier assignment	
SYNC	0001b	128	80h	1005h	CANSYNC	
TIME	0010b	256	100h	1012h	TIME is not implemented in Compax3.	
Point to point objects						
EMCY	0001b	129-255	81h-FFh	1014h	Error messages	
T-PDO1	0011b	385-511	181h-1FFh	1800h	Assignment via Index 1A00h	Transmit process data object (Compax3) max. 8 Bytes
T-PDO2	0101b	641-767	281h-2FFh	1801h	Assignment via Index 1A01h	
T-PDO3	0111b	897-1023	381h-3FFh	1802h	Assignment via Index 1A02h	
T-PDO4	1001b	1153-1279	481h-1279h	1803h	Assignment via Index 1A03h	
R-PDO1	0100b	513-639	201h-27Fh	1400h	Assignment via Index 1600h	Receive process data objects (Compax3) max. 8 Bytes
R-PDO2	0110b	769-895	301h-37Fh	1401h	Assignment via Index 1601h	
R-PDO3	1000b	1025-1151	401h-47Fh	1402h	Assignment via Index 1602h	
R-PDO4	1010b	1281-1407	501h-57Fh	1403h	Assignment via Index 1603h	
T-SDO1	1011b	1409-1535	581h-5FFh	1200h	Transmit service data object 1	
T-SDO2	-*	-*	-	1201h	Transmit service data object 2	
R-SDO1	1100b	1537-1663	601h-67Fh	1200h	Receive service data object 1	
R-SDO2	-*	-*	-	1201h	Receive service data object 2	
Node guard	1110b	1793-1919	701h-77Fh	100Eh	Check bus subscribers.	

* The SDO2 are not activated.

The standard value of the COB-ID for an object is calculated as follows: COB-ID = (Function code * 128) + Device address

The standard values of the COB-Ids can be changed via communication objects via SDOs.

Application of the communication object types

Transmission of real time data (faster transmission because higher priority)

T-PDO Transmit process data object: Compax3 reply.

R-PDO Receive process data object: send to Compax3.

Once only transmission, e. g. of parameters or programme lines

T-SDO Transmit service data object: Compax3 reply.

R-SDO Receive service data object: send to Compax3.

6.5.3.2 Communication objects

General note:

Every CAN object which is created as array (with subindex) contains the number of entries in subindex 0.

CAN communication objects overview sorted according to CAN No.

CAN-No	Name	Bus format	Standard value	Minimum value	Maximum value	Access
0x1000	Device Type	Unsigned32	0x00020192	0x00000000	0xFFFFFFFF	const
0x1001	Error Register	Unsigned8	0x00	0x00	0xFF	ro
0x1005	COB-ID SYNC	Unsigned32	0x80000080	0x00000001	0xFFFFFFFF	rw
0x1006	Communication Cycle Period	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1007	Synchronous Window Length	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1008	Manufacturer Device Name	Visible_String	C3xxxxxxxxxxxxxxxxx			const
0x1009	Manufacturer Hardware Version	Visible_String	CTPxxxxxxxxLElxxxx			const
0x100A	Manufacturer Software Version	Visible_String	Vxxxxxxxxxxxxxxxxx			const
0x100C	Guard Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x100D	Life Time Factor	Unsigned8	0x00	0x0	0xFF	rw
0x1014	COB-ID EMCY	Unsigned32	0x000000FF	0x00000001	0xFFFFFFFF	rw
0x1015	Inhibit Time Emergency	Unsigned16	0x0	0x0	0xFFFF	rw
0x1018	Identity Object (see page 413)	-				
0x1018.1	Vendor Id	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1018.2	Product Code	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1018.3	Revision number	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1018.4	Serial number	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1200	Server SDO1 Parameter	-				
0x1200.1	SDO1: COB-ID Client -> Server	Unsigned32	0x0000067F	0x00000001	0xFFFFFFFF	ro
0x1200.2	SDO1: COB-ID Server -> Client	Unsigned32	0x000005FF	0x00000001	0xFFFFFFFF	ro
0x1200.3	Node ID of the SDO1 client	Unsigned8	0x00	0x00	0xFF	rw
0x1201	Server SDO2 Parameter	-				
0x1201.1	SDO2: COB-ID Client -> Server	Unsigned32	0x800006E0	0x00000001	0xFFFFFFFF	rw
0x1201.2	SDO2: COB-ID Server -> Client	Unsigned32	0x800006E0	0x00000001	0xFFFFFFFF	rw
0x1201.3	Node ID of the SDO2 Client	Unsigned8	0x00	0x00	0xFF	rw
0x1400	Receive PDO1 communication parameters	-				
0x1400.1	RPDO1: COB-ID	Unsigned32	0x0000027F	0x00000001	0xFFFFFFFF	rw
0x1400.2	RPDO1: Transmission type	Unsigned8	0xFE	0x00	0xFF	rw
0x1400.3	RPDO1: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1400.5	RPDO1: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1401	Receive PDO2 communication parameters	-				
0x1401.1	RPDO2: COB-ID	Unsigned32	0x0000037F	0x00000001	0xFFFFFFFF	rw
0x1401.2	RPDO2: Transmission type	Unsigned8	0xFE	0x00	0xFF	rw
0x1401.3	RPDO2: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1401.5	RPDO2: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1402	Receive PDO3 communication parameter	-				
0x1402.1	RPDO3: COB-ID	Unsigned32	0x0000047f	0x0	0xFFFFFFFF	rw
0x1402.2	RPDO3: Transmission type	Unsigned8	0xFE	0x0	0xFF	rw
0x1402.3	RPDO3: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1402.5	RPDO3: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1403	Receive PDO4 communication parameter	-				
0x1403.1	RPDO4: COB-ID	Unsigned32	0x0000057f	0x0	0xFFFFFFFF	rw
0x1403.2	RPDO4: Transmission type	Unsigned8	0xFE	0x0	0xFF	rw
0x1403.3	RPDO4: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1403.5	RPDO4: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1600	Receive PDO1 mapping parameter	-				
0x1600.1	RPDO1 mapping entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1600.2	RPDO1 mapping entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1600.3	RPDO1 mapping entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw

0x1600.4	RPDO1 mapping entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1600.5	RPDO1 mapping entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601	Receive PDO2 mapping parameter	-				
0x1601.1	RPDO2 mapping entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.2	RPDO2 mapping entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.3	RPDO2 mapping entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.4	RPDO2 mapping entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.5	RPDO2 mapping entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1602	Receive PDO3 mapping parameter	-				
0x1602.1	RPDO3 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.2	RPDO3 mapping entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.3	RPDO3 mapping entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.4	RPDO3 mapping entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.5	RPDO3 mapping entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603	Receive PDO3 mapping parameter	-				
0x1603.1	RPDO4 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.2	RPDO4 mapping entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.3	RPDO4 mapping entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.4	RPDO4 mapping entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.5	RPDO4 mapping entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1800	Transmit PDO1 communication parameter	-				
0x1800.1	TPDO1: COB-ID	Unsigned32	0x000001FF	0x00000001	0xFFFFFFFF	rw
0x1800.2	TPDO1: Transmission type	Unsigned8	0xFE	0x00	0xFF	rw
0x1800.3	TPDO1: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1800.5	TPDO1: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1801	Transmit PDO2 communication parameter	-				
0x1801.1	TPDO2: COB-ID	Unsigned32	0x000002FF	0x00000001	0xFFFFFFFF	rw
0x1801.2	TPDO2: Transmission type	Unsigned8	0xFE	0x00	0xFF	rw
0x1801.3	TPDO2: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1801.5	TPDO2: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1802	Transmit PDO3 communication parameter	-				
0x1802.1	TPDO3: COB-ID	Unsigned32	0x000003ff	0x0	0xFFFFFFFF	rw
0x1802.2	TPDO3: Transmission type	Unsigned8	0xFE	0x0	0xFF	rw
0x1802.3	TPDO3: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1802.5	TPDO3: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1803	Transmit PDO4 communication parameter	-				
0x1803.1	TPDO4: COB-ID	Unsigned32	0x000004ff	0x0	0xFFFFFFFF	rw
0x1803.2	TPDO4: Transmission type	Unsigned8	0xFE	0x0	0xFF	rw
0x1803.3	TPDO4: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1803.5	TPDO4: Event timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1A00	Transmit PDO1 mapping parameter	-				
0x1A00.1	TPDO1 mapping entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.2	TPDO1 mapping entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.3	TPDO1 mapping entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.4	TPDO1 mapping entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.5	TPDO1 mapping entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01	Transmit PDO2 mapping parameter	-				
0x1A01.1	TPDO2 mapping entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.2	TPDO2 mapping entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.3	TPDO2 mapping entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.4	TPDO2 mapping entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.5	TPDO2 mapping entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A02	Transmit PDO3 mapping parameter	-				
0x1A02.1	TPDO3 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A02.2	TPDO3 mapping entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A02.3	TPDO3 mapping entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A02.4	TPDO3 mapping entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw

0x1A02.5	TPDO3 mapping entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03	Transmit PDO4 mapping parameter	-				
0x1A03.1	TPDO4 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.2	TPDO4 mapping entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.3	TPDO4 mapping entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.4	TPDO4 mapping entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.5	TPDO4 mapping entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw

Identity Object (0x1018)

This object is composed as follows:

Vendor-ID (0x1018.1)

Is stored in the FBI-EEPROM binarily from addr. 56...59 (low...high). Current value = 0x02000089.

Product-Code (0x1018.2)

Is composed of the part of the order code "Faa lbb Tcc Mdd" to 0xaabbccdd, i.e. the device with the order code C3S025V2F10I21T40M11 has the product code 0x10214011.

The product code is hex coded, but can be read decimally.

Revision number (0x1018.3)

Is composed of 5 digits of the software version no. of the DSP software and 3 digits of the SV no. of the FBI softwre, i.e. the device with the DSP SV no. 01.08.02 and the FBI SV no. 1.21 has the revision no. 0x10802121.

Serial number (0x1018.4)

Is stored in the CTP-EEPROM as a 10 digit ASCII string from addr. 56...65 (series number of the device). A C3 with the series number 1423440001 has the serial number 0x54D7F881.

Communication objects

The description of the CANopen communication objects can be found in the corresponding help file.

6.5.4. Acyclic parameter channel

In this chapter you can read about:

Service Data Objects (SDO).....	414
Object up-/download via RS232 / RS485	416
Data formats of the bus objects.....	416

6.5.4.1 Service Data Objects (SDO)

Asynchronous access to the object directory of Compax3 is implemented with the help of the SDOs. The SDOs serve for parameter configuration and status interrogation. Access to an individual object takes place via the RS232 / RS485 index and subindex of the object directory.

Attention!

A SDO is a confirmed service, therefore the SDO reply telegram must always be awaited before a new telegram may be transmitted.

CiA405_SDO_Error (Abort Code): UDINT

In the case of an incorrect SDO transmission, the error cause is returned via the "abort code".

Abort Code	Description
0x0503 0000	" Toggle Bit" was not alternated
0x0504 0000	SDO protocol "time out"
0x0504 0001	Client/server command designator invalid or unknown
0x0504 0002	Unknown block size (block mode only)
0x0504 0003	Unknown block number (block mode only)
0x0504 0004	CRC error (block mode only)
0x0504 0005	Outside of memory
0x0601 0000	Access to this object is not supported
0x0601 0001	Attempted read access to a write only object
0x0601 0002	Attempted write access to a read only object
0x0602 0000	The object does not exist in the object directory
0x0604 0041	The object cannot be "mapped" in a PDO
0x0604 0042	The size and number of the "mapped" objects exceeds the maximum PDO length
0x0604 0043	General parameter incompatibility
0x0604 0047	General incompatibility in the device
0x0606 0000	Access infringement due to a hardware error
0x0607 0010	Data type does not fit, length of the service parameter does not fit
0x0607 0012	Data type does not fit, length of the service parameter too large
0x0607 0013	Data type does not fit, length of the service parameter too small
0x0609 0011	Subindex does not exist
0x0609 0030	Outside parameter value range (only for write access operations)
0x0609 0031	Parameter value too large
0x0609 0032	Parameter value too small
0x0609 0036	Maximum value smaller than minimum value
0x0800 0000	General error
0x0800 0020	Date cannot be transmitted or saved
0x0800 0021	Date cannot be transmitted or saved due to local device management
0x0800 0022	Date cannot be transmitted or stored due to device status
0x0800 0023	Dynamic generation of the object directory is impossible or no object directory exists (the object directory is created from a file and an error occurs due to a defective file)

6.5.4.2 Object up-/download via RS232 / RS485

The up-/download takes place via the RS232 / RS485 objects C3_Request (Index 0x2200) and C3_Response (Index 0x2201). These have the data type data type octet string with a length of 20 bytes (octets). Write/read of a C3 object is carried out by writing of C3_Request with the corresponding data. When a C3 object is read, the data appear in the C3_Response object .

Meaning of the data from C3_Request

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	...	...	Byte 19	Byte 20
Request header				C3 object data (write)					
AK	Subindex	Index		D1	D2	...	...	D15	D16

AK: Job identifier; 3=read, 4= write

OD1..OD16: Object data; OD1 = High, OD16 = Low

Meaning of the data from C3_Response

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	...	...	Byte 19	Byte 20
Reply header				C3 object data (read)					
-	-	-	-	OD1	OD2	...	...	OD15	OD16

OD1..OD16: Object data; OD1 = High, OD16 = Low

Upload

RS232 / RS485		O 1	O 2	O 3	O 4	O 5	O 6	O 7	O 8	...	O 20
Access	Object	C3 object request/reply				C3 object data					
1. Write C3 object 20.2 with the value 0											
Write	0x2200.0	4	2	0	20	0	0	0	x	...	x
2. read next C3 object index/subindex in C3 object 20.5											
Write	0x2200.0	3	5	0	20	x	x	x	x	...	x
Read	0x2201.0	x	x	x	x	I_hi	I_lo	Subi	x	...	x
3. read the C3 object with the in index/subindex read in the C3 object 20.5											
Write	0x2200.0	3	Subi	I_hi	I_lo	x	x	x	x	...	x
Read	0x2201.0	x	x	x	x	D1	D2	D3	D4	...	D16
4. Store C3 object index, subindex and data D1...D16 in table											
5. Repeat steps 2 to 4 until I_hi = I_lo = Subi = 0xFF											

Download: Write the entire table of C3 objects.

RS232 / RS485		O 1	O 2	O 3	O 4	O 5	O 6	O 7	O 8	...	O 20
Access	Object	C3 object request/reply				C3 object data					
1. Write C3 object from the table											
Write	0x2200.0	4	Subi	I_hi	I_lo	D1	D2	D3	D4	...	D16
2. Repeat step 1 until the end of the table											

6.5.4.3 Data formats of the bus objects

Data formats of the bus objects (see page 395)

6.6 DeviceNet

In this chapter you can read about:

DeviceNet Configuration.....	417
DeviceNet object classes	418
Data formats of the bus objects.....	419

I22-Function

Please note:

A changed assignment (mapping) of the Input/Output Message is accepted with Power off / Power on!

The length of the Input / Output Message is adapted to the real assignment (mapping) (2...32).

Statement of Conformance

http://www.compax3.de/C3_DeviceNet_Statement_of_Conformance.pdf (in the Internet)

Address or Baud rate settings (see page 69)

Connector assignment (see page 69)

6.6.1. DeviceNet Configuration

In this chapter you can read about:

Error reaction to a bus failure	417

Following are described the input windows of the configuration wizard.
Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.6.1.1 Error reaction to a bus failure

Here you can adjust how Compax3 will respond to a **fieldbus error** (see page 457):

Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

6.6.2. DeviceNet object classes

In this chapter you can read about:

Overview of the DeviceNet object classes	419
Object classes	419

The DeviceNet object classes described in this chapter are either set to sensible standard values or they are set under menu control with the help of the ServoManager.

The communication objects described below must be modified only for special deviating settings.

DeviceNet characteristic data

DeviceNet	◆ Predefined Master/Slave Connection Set ◆ Standard 2.0 Group-2-Slave ◆ Fieldbus I/O Data or Process Data (Polled, COS/Cyclic I/O and Bit Strobe)
Implemented object classes	◆ Identify, Message Router, DeviceNet, Assembly, Connection, Acknowledge Handler
Baud rate [kBit/s]	◆ 125, 250, 500
permissible cable length	◆ up to 500m on 125Bit/s, ◆ up to 200m on 250Bit/s, ◆ up to 100m on 500Bit/s,
Max. number of nodes	◆ 63 Slave
Insulation	◆ Isolated Device Physical Layer
EDS file	◆ C3_DeviceNet.EDS
Conformance (file in the Internet)	◆ Statement of Conformance http://www.compax3.de/C3_DeviceNet_Statement_of_Conformance.pdf
Further information:	◆ Application example (C3I22_DeviceNet.ZIP) on the Compax3 CD in the "\Examples" directory

6.6.2.1 Overview of the DeviceNet object classes

Object name	Class ID	Instance ID	Description
Identify	0x01	1	Mandatory
Message Router	0x02	1	Mandatory
DeviceNet	0x03	1	Mandatory
Assembly	0x04	101-103	I/O Messages
Connection	0x05	1	Explicit Messages
		2	Polled I/O Data
		3	Bit Strobe
		4	Change of State (COS), Cyclic I/O Data
Acknowledge Handler	0x2B	1	Necessary for connection class ID 05hex, instance ID 04
Image of I/O Data	0x64	1	Manufacturer-specific object class image of I/O data
C3 object	0x65	20-3300	Manufacturer-specific object class C3 object

6.6.2.2 Object classes

Detailed information on the topic of "object classes" can be found in the online help of the device.

6.6.3. Data formats of the bus objects

Data formats of the bus objects (see page 395)

6.7 Ethernet Powerlink

In this chapter you can read about:

Configuring Ethernet Powerlink / EtherCAT 420

The Ethernet Powerlink option is available with the Compax3 devices C3I30Txx!

The EtherCAT option is available with the Compax3 devices C3I31Txx!

6.7.1. Configuring Ethernet Powerlink / EtherCAT

In this chapter you can read about:

CN Controlled Node (Slave) 420
 Slave with configuration via master 420
 Error reaction to a bus failure 420
 Possible PDO assignment 421

Following are described the input windows of the Ethernet Powerlink / EtherCAT configuration wizard.

Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.7.1.1 CN Controlled Node (Slave)

Compax3 is the slave of an Ethernet / EtherCAT master; the bus configuration is made via the ServoManager

6.7.1.2 Slave with configuration via master

Select "Slave with configuration via master". for operating mode and mapping via master.

Then run through the wizard completely.

6.7.1.3 Error reaction to a bus failure

Here you can adjust how Compax3 will respond to a **fieldbus error** (see page 457):

Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

6.7.1.4 Possible PDO assignment

Via the process data objects (RPDO and TPDO), actual values and Setpoint values are cyclically exchanged between Compax3 and the Ethernet Powerlink Controlled Nodes (Slaves).

The cyclic PDOs are configured with the aid of the Compax3 ServoManager:

The PDOs are set separately for the transmission directions

- ◆ Slave ⇒ Compax3 (**RPDO**)
- ◆ Compax3 ⇒ Slave (**TPDO**)

The objects that can be put on the process data channel can be found in the "**Compax3 Objects** (see page 446)"!

6.8 HEDA Bus

In this chapter you can read about:

HEDA standard mode.....	423
HEDA expansion (HEDA advanced)	425
Coupling objects	444

HEDA: **H**igh **E**fficiency **D**ata **A**ccess: Option M10 or M11

- ◆ Real-time data transfer
- ◆ High-stage axis synchronization
- ◆ fixed transfer rate of 10MBit/s
- ◆ Jitter < 300ns (Bus) which results in a high synchronicity
- ◆ Peer-to-Peer communication
- ◆ maximum cable length 50m (greater lengths on request)
- ◆ 1 Master / 31 Slave: Individual HEDA axis address in the range between 1...32
- ◆ fixed cycle time of 0.5ms
- ◆ Synchronization of the scanning grid of the digital control loops and of the setpoint generation
- ◆ cyclic data exchange
- ◆ acyclic data exchange of time-uncritical values

HEDA wiring (see page 507)

Function of the HEDA LEDs

Green LED (left)

HEDA module energized

Red LED (right)

Error in the receive area

Possible causes:

- ◆ at the Master
 - ◆ no slave sending back
 - ◆ Wrong cabling
 - ◆ Terminal plug is missing
 - ◆ several masters are sending in the same slot
- ◆ at the slave
 - ◆ several masters in the system
 - ◆ no master active
 - ◆ Terminal plug is missing
 - ◆ no transmission from one or several receive slots (neither by the master nor by another slave)

The configuration may take place in two different ways:

- ◆ HEDA standard: Simple Master -> Slave communication
- ◆ HEDA advanced: Communication Master <-> Slave and Slave <-> Slave.

6.8.1. HEDA standard mode

In this chapter you can read about:

Error reaction to a bus failure	423
HEDA-Master	424
HEDA-Slave	424

The HEDA option (option M10 or M11) can be used to send 4 process values in the "HEDA standard" operating mode from master to slave. A return transmission from Slave to Master is possible with "HEDA advanced".

First choose, if Compax3 is HEDA Master or HEDA Slave:

- ◆ HEDA master: in order to send process values
- ◆ HEDA slave: in order to receive process values

Please respect that only 1 HEDA station can be Master.

- ◆ Error reaction (from Compax3) at bus failure:
 - ◆ activated: Compax3 switches to error state in the case of a bus error. (Error reaction 2: Downramp / apply brake / de-energize.)
 - ◆ deactivated: Compax3 will ignore a bus error.

6.8.1.1 Error reaction to a bus failure

Here you can adjust how Compax3 will respond to a **fieldbus error** (see page 457):

Possible settings for the error reaction are:

- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

6.8.1.2 HEDA-Master

You can transmit 4 process values with max. 7 words (one process value per channel).

The 1st process value (takes 3 words) is reserved for the axis synchronization. You may choose between:

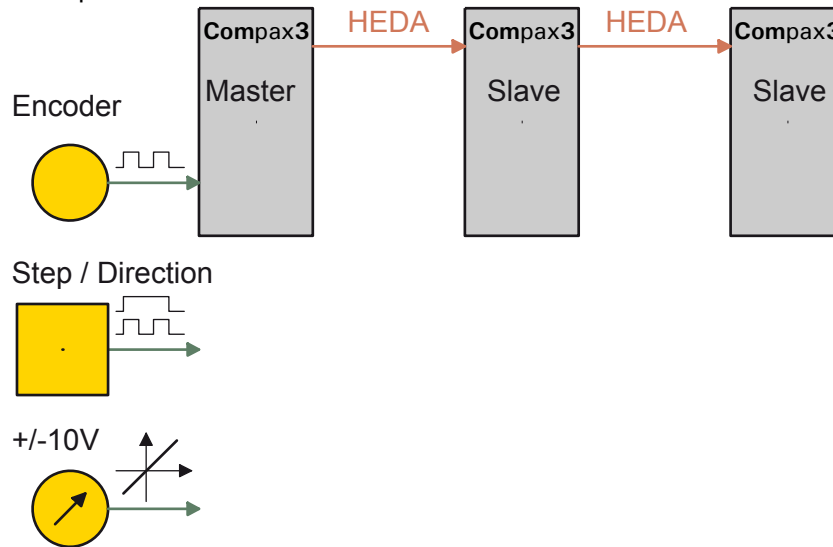
◆ Process - setpoint position (Object 2000.1)

◆ Process - actual position (Object 2200.2)

◆ Position from external setpoint (object 2020.1)

Signal read in via Analog channel0 (X11/9 and X11/11), encoder input or step / direction input in the master.

Principle:



Attention in the case of a configuration download with master-slave coupling (electronic gearbox, cam)

Switch Compax3 to currentless before starting the configuration download: Master and Slave axis

◆ Position from virtual Master (object 2000.2)

You can transmit 3 additional process values with 4 words data max. You can make your choice between the **Compax3 PD objects** (see page 454).

Note: Please use the **coupling objects** (see page 444) for axis coupling.

6.8.1.3 HEDA-Slave

The transferred process values can be read and assigned to objects in the configuration wizard (e.g. array objects) in the HEDA slave.

Objects with appropriate data width (corresponding to the process values read in) must be assigned.

The 1st process value is used as input process value (object 3920.1: HEDA SignalProcessing Input) for axis synchronization. The target for the process values 2, 3, 4 can be selected from a list in the configuration wizard.

6.8.2. HEDA expansion (HEDA advanced)

In this chapter you can read about:

The possibilities of the HEDA expansion	425
Technical data of the HEDA interface / overview	426
Definitions.....	427
Calling up the HEDA wizard in the C3 ServoManager	427
Configuration of the HEDA communication	427

6.8.2.1 The possibilities of the HEDA expansion

The HEDA option (option M10 or M11) can be used to exchange process values in the "HEDA advanced" operating mode.

- ◆ from Slave to Master
- ◆ from Slave to Master and
- ◆ from Slave to Slave.

6.8.2.2 Technical data of the HEDA interface / overview

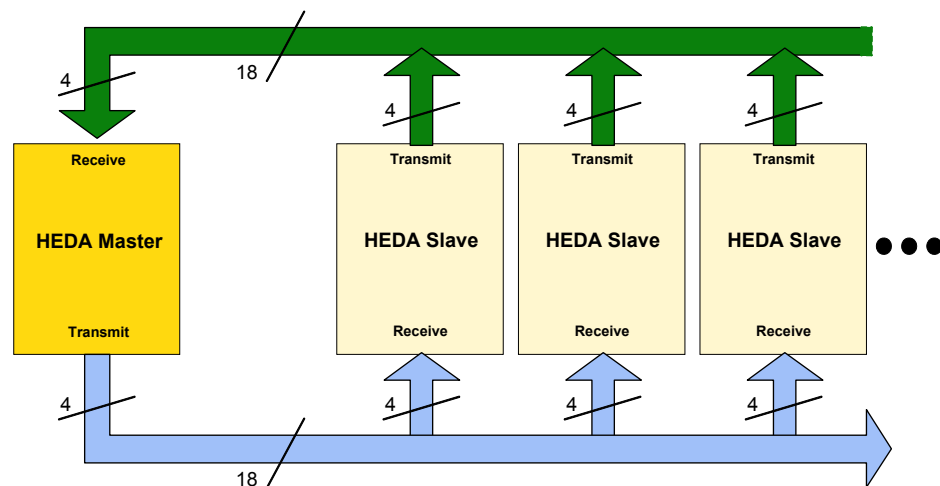
General HEDA data

- ◆ Synchronous, bidirectional, deterministic real-time bus.
- ◆ Bus access via time sharing (slots), Master/Slave, Producer/Consumer. (synchronization exactitude $<1\mu\text{s}$).
- ◆ Bus cycle time $500\mu\text{s}$, distributed into 20 time slots à $25\mu\text{s}$.
- ◆ 18 slots cyclic transmitting and receiving data channels (Slot 0 .. 17).
- ◆ 2 slots reserved for acyclic communication.
- ◆ Telegrams (frames) with max. 7 words à 16 bit can be sent and received in a slot.
- ◆ Freely configurable assignment of the cyclic transmit(Tx)/receive(rx)-slots to the stations.
- ◆ The transmitting and receiving data are freely definable via mapping tables.
- ◆ Master-Slave as well as Slave-Slave communication (cross-communication) are possible.
- ◆ A master=>slave frame in slot x can be received by every slave.
- ◆ A slave=>slave frame (cross-communication) in slot x can be received by every bus node.

Compax3-specific HEDA data:

- ◆ The Compaxa3 system cycle time is synchronized with the bus cycle time.
- ◆ System cycle time $500\mu\text{s}$, distributed into 4 position control cycles à $125\mu\text{s}$.
- ◆ For system-immanent reasons, only one slot is able to send and receive during the same position control cycle (every $125\mu\text{s}$).
- ◆ Transmit- and receive slot can differ within one position controller cycle.
- ◆ The Master can receive frames from 4 slaves max.

Principle:



Displayed are the number of the possible telegrams (Frames).

6.8.2.3 Definitions

DSP Format	Objects with this format: ◆ are not reset ◆ are unlimited: you have a value range between 2^{23} and $2^{23}-1$ ◆ are suitable as coupling objects If the DSP Format is not selected, the objects are transmitted into the described formats (see page 446). Please note that the Bus formats Y2 and Y4 (see page 396) are set against the scaling factors.
Frame	Telegram of process values with a data width of 7 words.
Mapping	Image of process data on a communication channel (slot)
Mapping Table	Overview of process values that can be put on a communication channel (slot).
Coupling objects	Are suitable as master signals for electronic coupling and must be in the DSP format.
Receive	Received:
Slot	communication channel
Transmit	Send:
Process data	Objects, which are suitable for use in the cyclic data channel.

6.8.2.4 Calling up the HEDA wizard in the C3 ServoManager

The "HEDA Advanced" wizard can be found in the C3 ServoManager tree under communication.
Please observe:

The "HEDA advanced" wizard settings overwrite the settings of the HEDA standard wizard!

6.8.2.5 Configuration of the HEDA communication

In this chapter you can read about:

Error reaction to a bus failure	427
Data transfer Master – Slave and back	428
Example: Communication Master – Slave and back	435
Data transfer from Slave to Slave	439

Error reaction to a bus failure

Here you can adjust how Compax3 will respond to a **fieldbus error** (see page 457):

Possible settings for the error reaction are:

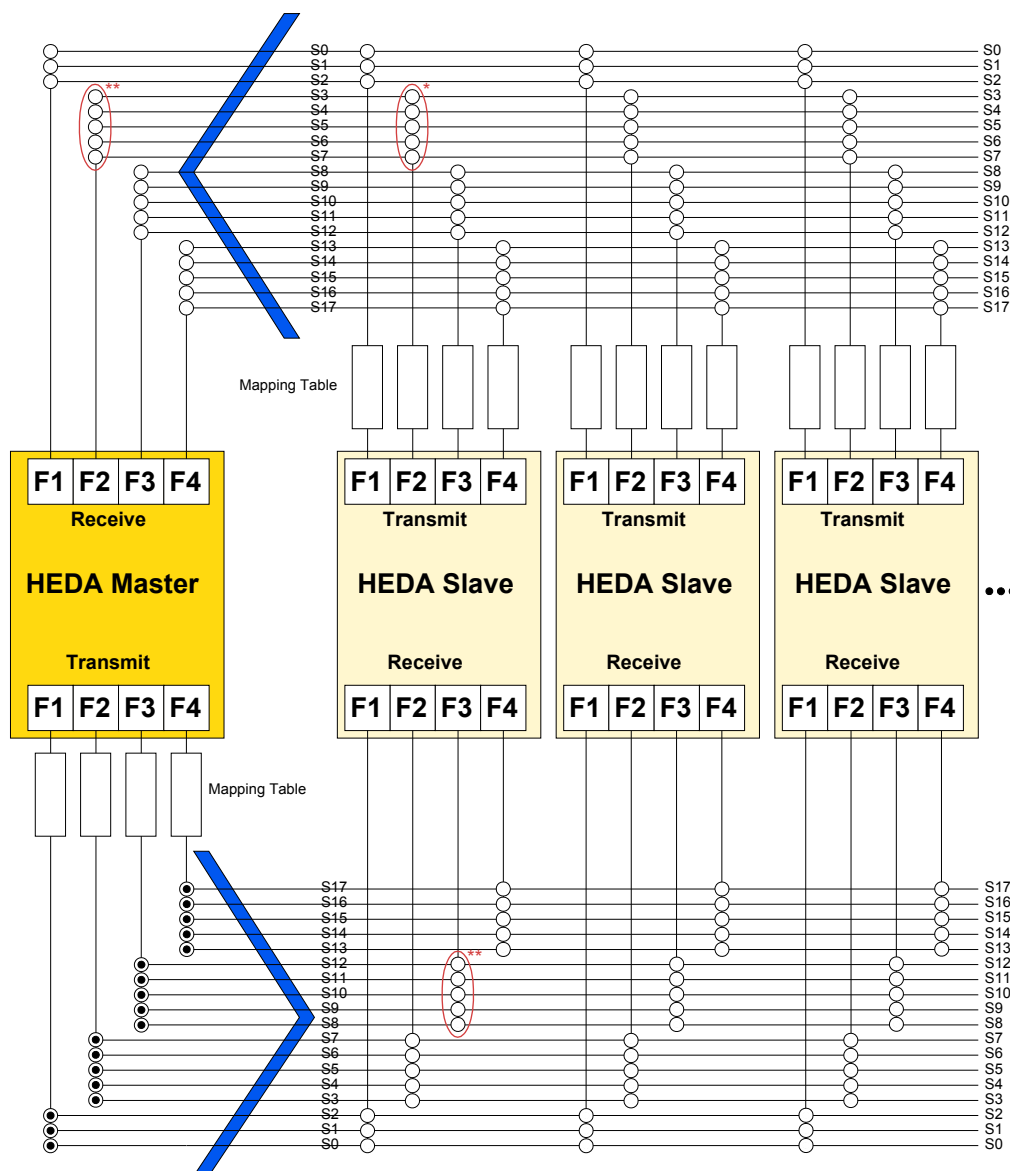
- ◆ No response
- ◆ downramp / stop
- ◆ Downramp / switch to currentless (standard setting)

Data transfer Master – Slave and back

In this chapter you can read about:

Setting the HEDA master.....	430
Setting the HEDA slave	433

In standard applications the master sends process values to the slaves and reads the answers from the slaves.

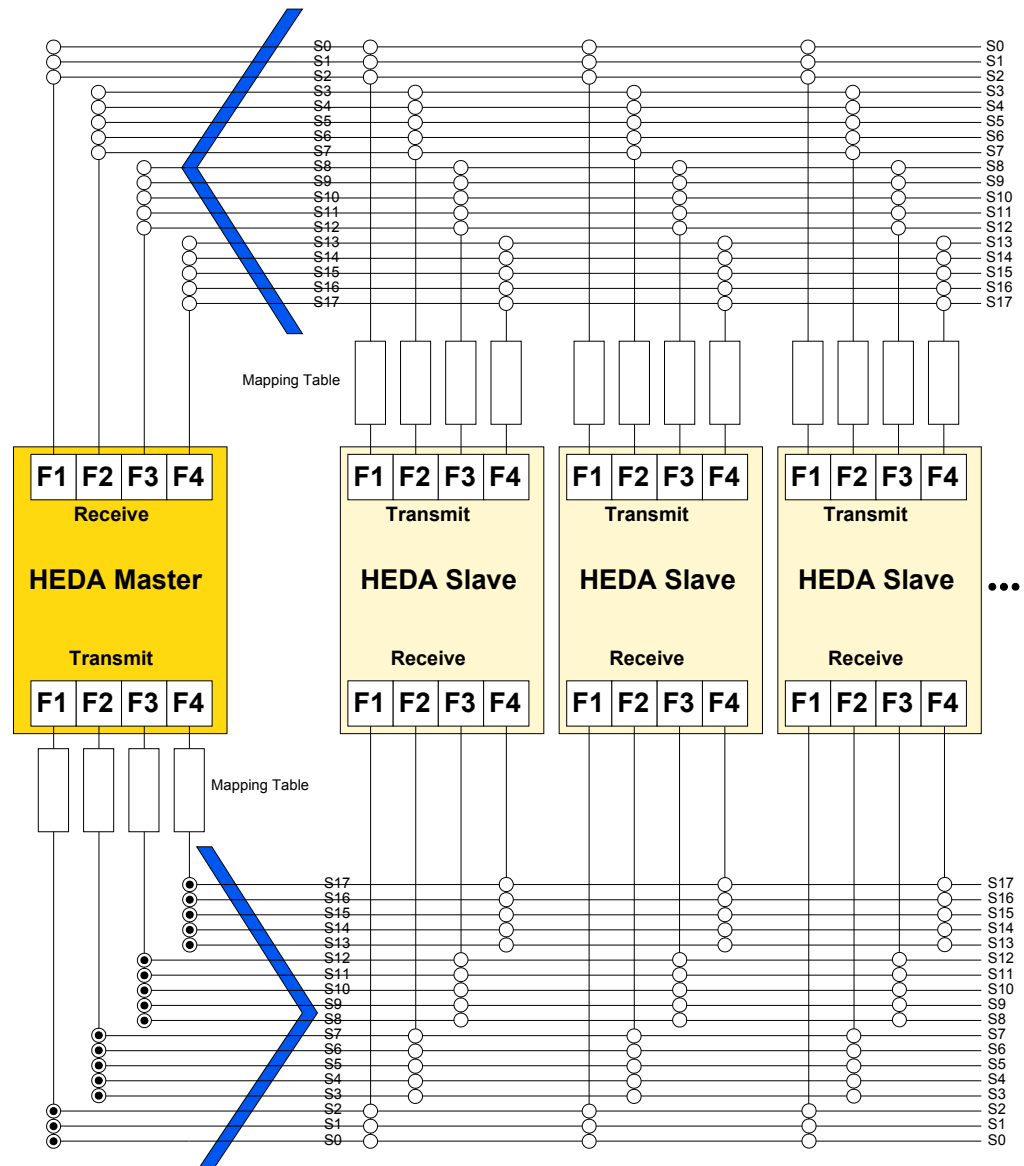


* only one of the assigned slots per frame group may be activated on the slave transmit side (this is blocked by the C3 ServoManager)

* only one of the assigned slots per frame group may be activated on the master or slave receive side (this is blocked by the C3 ServoManager)

Print version available in the Internet

http://apps.parker.com/euro_emd/EME/downloads/compax3/HEDA-Formulare/HEDA-Standard.pdf

**Functionality:**

The master can send 4 different frames (F1,... F4). A frame can be sent from several slots:

Frame:	F1	F2	F3	F4
possible slots:	0 ... 2	3 ... 7	8 ... 12	13 ... 17

Each frame is assigned a mapping table number.

The individual slaves read in the slot from where their relevant data are sent.

It is necessary to define a mapping table in the slave, stating where the individual process data are to be written (e.g. into an array-object).

The assignment of the mapping table is made via the mapping table number which is transferred via HEDA.

For this reason, the receive mapping table number and the transfer mapping table number must always be the same.

Important: **Receive-Mapping-Tablen-Number = Transmit-Mapping-Table-Number**

Setting the HEDA master

HEDA master settings:

- ◆ activate HEDA Master
- ◆ Axis address = 0
- ◆ Setting the error reaction (from Compax3) at bus failure:
 - ◆ activated: Compax3 switches to error state in the case of a bus error.
 - ◆ deactivated: Compax3 will ignore a bus error.

Master transmission slots (Transmit Slots)

Important:

For standard applications (data transfer master – slave and back) all slots in the master must be transmitting.

- ◆ for this reason you should activate all transmit slots (0...17, in the lower area of the wizard window).
- ◆ Please assign, according to your requirements, a mapping table to each of the 4 transmit frames.

The contents of the transmit mapping table is defined in the next wizard window.

Master receive slots

Activate the receive slots from which the slave sends data (corresponding to the settings in the slave).

In each of the 125µs cycles (slot 0...2, slot 3...7, slot 8...12, slot 13...17) data can be received only via one slot, see also the **HEDA communication structure** (see page 428).

The assignment of the data is made via the mapping table number (which was defined in the slave), this number is also received.

In the Wizard window "Receive Mapping table", it is defined under this mapping table number where the data received are to be written to.

Master Transmit Mapping Table (max. 4)

Here the transmit mapping tables, which were assigned to the max. 4 transmit 125µs slots, are defined.

Procedure:

- ◆ Selection of the corresponding transmit mapping table.
- ◆ Selection of the Compax3 objects to be transmitted.
 - ◆ The assignment of the mapping table is permanently identified and displayed.
 - ◆ Up to 7 words are possible.
 - ◆ How many words are used by an **object** (see page 446) depends on the **bus format** (see page 395) / DSP format

Note: For axis coupling, please use the **coupling objects** (see page 444) in the **DSP format** (see page 427) (selected by clicking on the DSP switch). Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Master Receive Mapping Table (max. 4)

Please select the mapping table number, which was defined in the slave (under transmit mapping table).

Please enter where the data received shall be written (e.g. into an array object).

Please use the data formats as defined in the mapping table of the slave.

Note: For axis coupling, please use the **coupling object** (see page 444) O3920.1 in the **DSP format** (see page 427) as an input (selection by clicking on the DSP switch). Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Setting the HEDA slave

HEDA slave settings:

- ◆ Activating the HEDA Slave
- ◆ Assigning the axis address = 0 (can be changed by clicking)
- ◆ Setting the error reaction (from Compax3) at bus failure:
 - ◆ activated: Compax3 switches to error state in the case of a bus error.
 - ◆ deactivated: Compax3 will ignore a bus error.

Slave receive slots

Activate the receive slots, from where the slave is to receive the data.

In each of the four 125µs cycles (slot 0...2, slot 3...7, slot 8...12, slot 13...17) data can be received only via one slot, see also the **HEDA communication structure** (see page 428).

The assignment of the data is made via the mapping table number (which was defined in the master), this number is also received.

In the Wizard window "Receive Mapping table", it is defined under this mapping table number where the data received are to be written to.

Slave transmission slots (Transmit Slots)

Activate the transmit slots, from where the slave is to send the data.

In each of the four 125µs cycles (slot 0...2, slot 3...7, slot 8...12, slot 13...17) data can be transmitted only via one slot, see also the **HEDA communication structure** (see page 428).

Please make sure, that no other slave can send on this slot.

Now you can assign a mapping table to each individual activated slot.

Please consider, that transmit mapping table numbers are only used once in one transmit/receive range.

The contents of the transmit mapping table is defined in the next wizard window.

Slave Transmit Mapping table

Here the transmit mapping tables, which were assigned to the transmit slots activated before, are defined.

Procedure:

- ◆ Selection of the corresponding transmit mapping table.
- ◆ Selection of the Compax3 objects to be transmitted.
 - ◆ The assignment of the mapping table is permanently identified and displayed.
 - ◆ Up to 7 words are possible.
 - ◆ How many words are used by an **object** (see page 446) depends on the **bus format** (see page 395).

Note: For axis coupling, please use the **coupling objects** (see page 444) in the **DSP format** (see page 427) (selected by clicking on the DSP switch). Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Slave Receive Mapping table

Please select the mapping table number, which was defined in the master (under transmit mapping table).

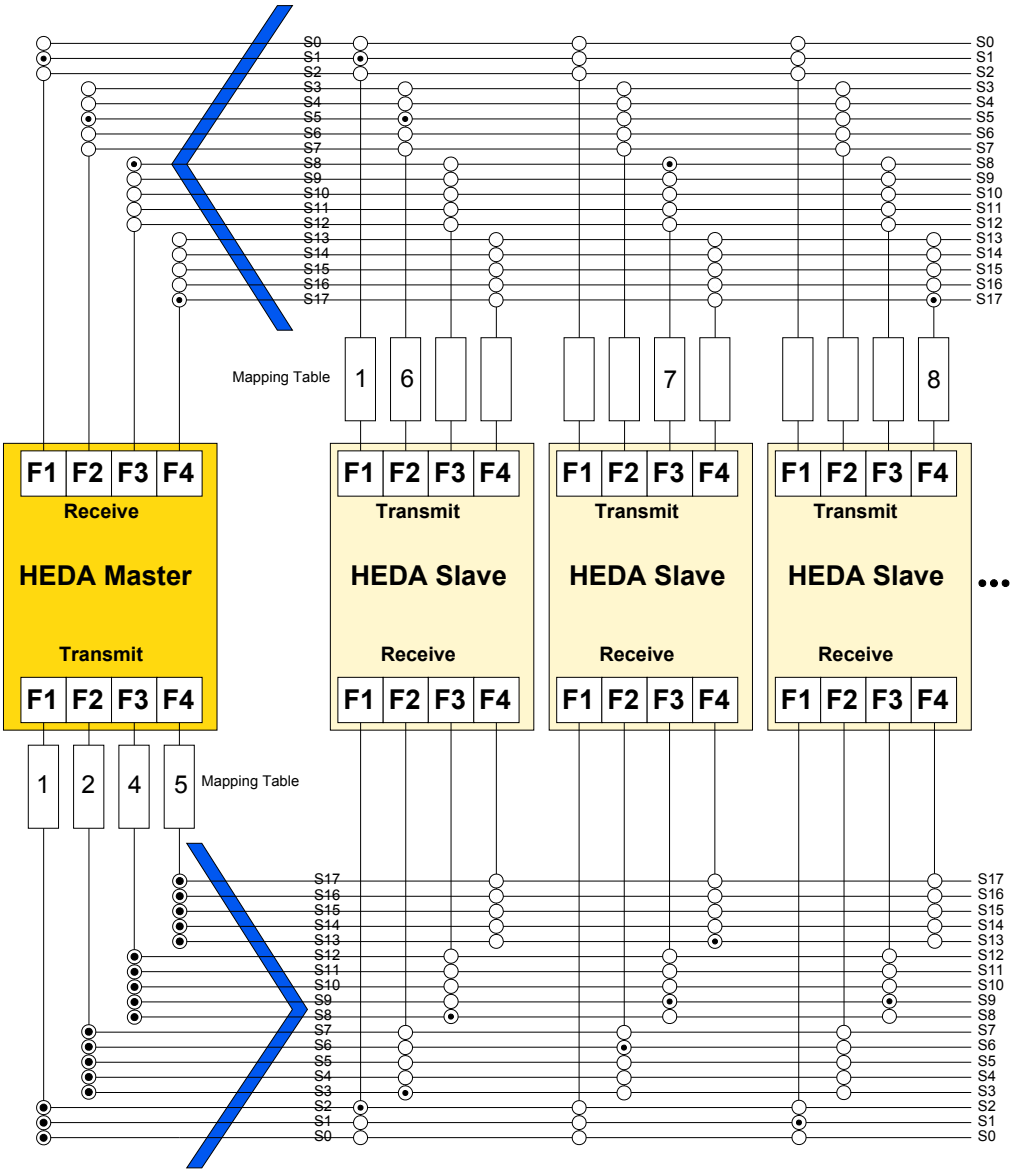
Please enter now, where the received data are to be written.

Please use the data formats as defined in the mapping table of the master.

Note: For axis coupling, please use the **coupling object** (see page 444) O3920.1 in the **DSP format** (see page 427) as an input (selection by clicking on the DSP switch). Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Example: Communication Master – Slave and back

HEDA communication structure:



Master and Slave 1 to 3 (from left to right).

Task:**Master Transmit**

- ◆ Master sends on:
 - ◆ Slot 0...2: Mapping table 1
 - ◆ Slot 3..0.7: Mapping table 2
 - ◆ Slot 8..0.12: Mapping table 4
 - ◆ Slot 13..0.17: Mapping table 5

Slave Receive

- ◆ Slave 1 reads on:
 - ◆ Slot 2: Mapping table 1
 - ◆ Slot 3: Mapping table 2 and
 - ◆ Slot 8: Mapping table 4
- ◆ Slave 2 reads on:
 - ◆ Slot 6: Mapping table 2
 - ◆ Slot 9: Mapping table 4 and
 - ◆ Slot 13: Mapping table 5.
- ◆ Slave 3 reads on
 - ◆ Slot 1: Mapping table 1 and
 - ◆ Slot 9: Mapping table 4.

Slave Transmit

- ◆ Slave 1 sends on:
 - ◆ Slot 1: Mapping table 1
 - ◆ Slot 5: Mapping table 6
- ◆ Slave 2 sends on:
 - ◆ Slot 8: Mapping table 7
- ◆ Slave 3 sends on:
 - ◆ Slot 17: Mapping table 8

Master Receive

- ◆ Master receives on:
 - ◆ Slot 1: Mapping table 1
 - ◆ Slot 5: Mapping table 6
 - ◆ Slot 8: Mapping table 7
 - ◆ Slot 17: Mapping table 8

C3 ServoManger settings:**Slot - settings Master:**

Receive Slot : \$20122 {131362}

#	#	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

0 .. 125 us 125 .. 250 us 250 .. 375 us 375 .. 500 us

Transmit Slot : \$3FFFF {262143}

#	#	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Mapping Table 1 Mapping Table 2 Mapping Table 4 Mapping Table 5

Example for transmit mapping table 1 on the master or slave

Transmit Mapping Table 1

TxPD Obj 1.1	PositionController_ActualValue [2200.2] 3w DSP
TxPD Obj 1.2	Array_Col07_Row01 [1907.1] 3w DSP
TxPD Obj 1.3	leer
TxPD Obj 1.4	leer
TxPD Obj 1.5	leer
TxPD Obj 1.6	leer
TxPD Obj 1.7	leer

1 Worte frei

Slot settings slave 1:

Receive Slot : \$10C {268}

#	#	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

0 .. 125 us 125 .. 250 us 250 .. 375 us 375 .. 500 us

Transmit Slot : \$22 {34}

#	#	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

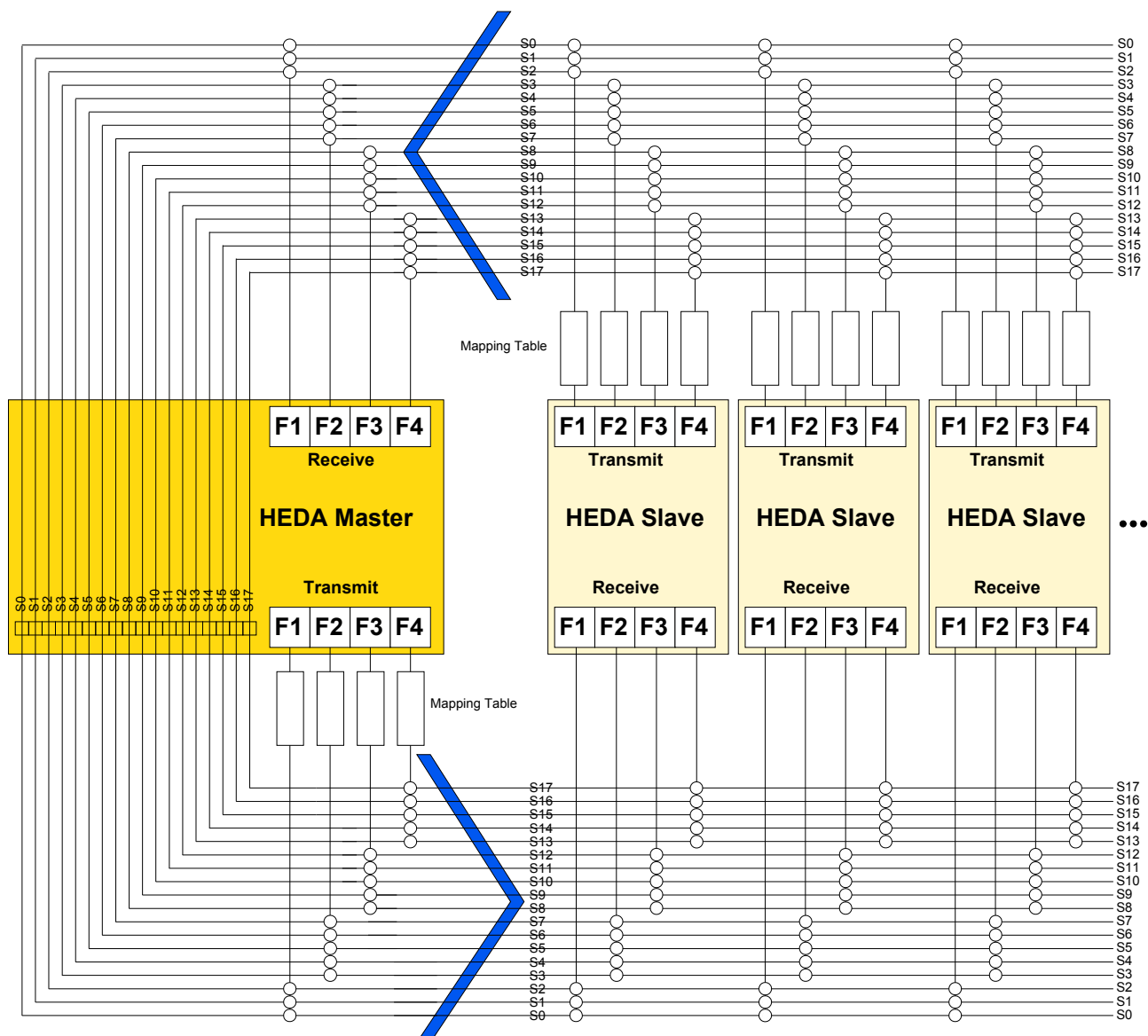
Mapping Table 1 Mapping Table 6 Mapping Table 1 Mapping Table 1

Example for receive mapping table 1 at slave 1 (is also valid for slave 3, master)

RECEIVE MAPPING TABLE 1	
RxPD Obj 1.1	HEDA_SignalProcessing_Input [3920.1] 3w DSP
RxPD Obj 1.2	leer
RxPD Obj 1.3	leer
RxPD Obj 1.4	leer
RxPD Obj 1.5	leer
RxPD Obj 1.6	leer
RxPD Obj 1.7	leer
4 Worte frei	

Data transfer from Slave to Slave.

HEDA communication structure with data transfer from Slave to Slave:



Print version available in the Internet

http://apps.parker.com/divapps/eme/EME/downloads/compax3/HEDA-Formulare/HEDA_adv.pdf

If a transmit slot of the HEDA master is not assigned, the master will pass the received data directly on to the slaves (independent of his reading from this slot or not).

I.e. if a transmit slot of the master where a slave is sending is disabled, the data will be passed on and can be received from any slave on this slot.

It is, however, valid:

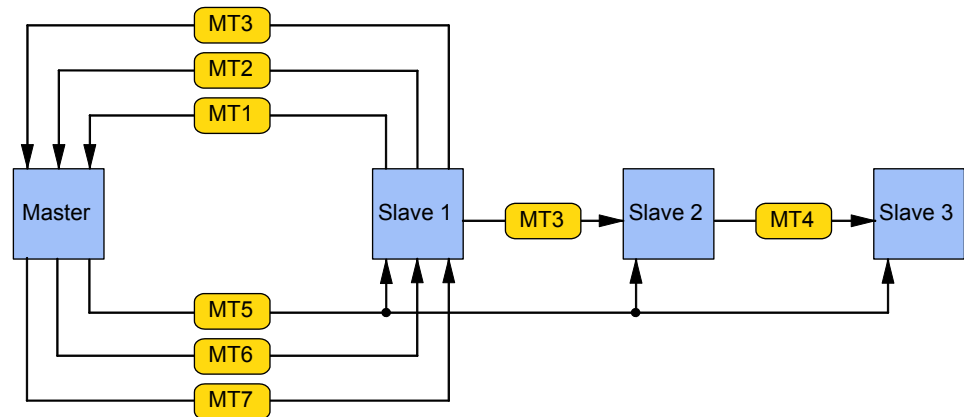
All transmit slots must send!

This is also true, if a slave sends on this slot.

Please note:

Please ensure that all slots are used for transmission, the C3 ServoManager cannot verify this fact!

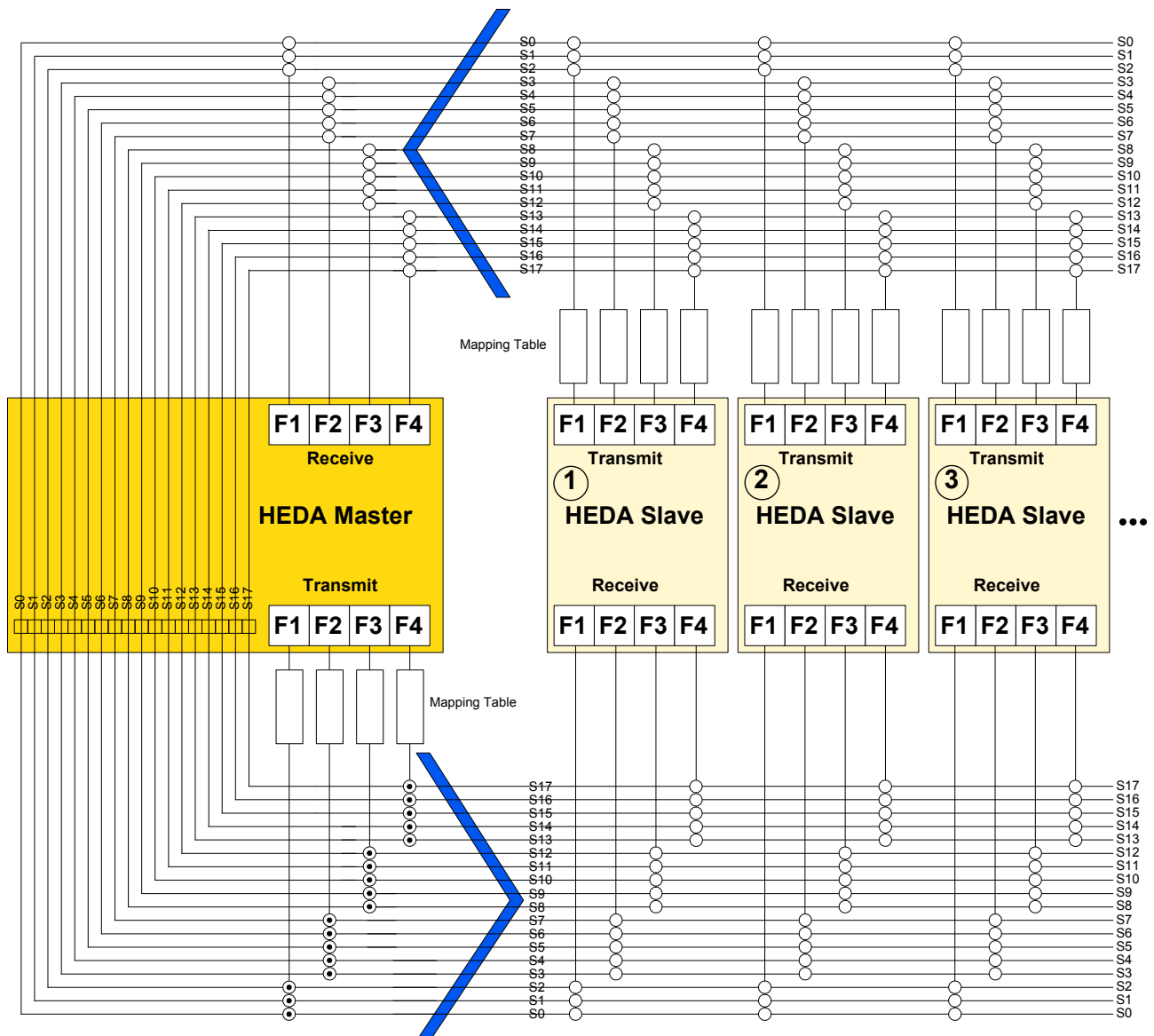
In order to verify this, please use the HEDA communication structure.

Example 1: Communication Master - Slave and Slave - Slave.**Task:**

MT1 ... MT7: Mapping table 1... 7

Step-by-step setting of the HEDA communications:

Firstly, activate all transmit slots of the master in order to ensure that all transmit slots of the master are sending:

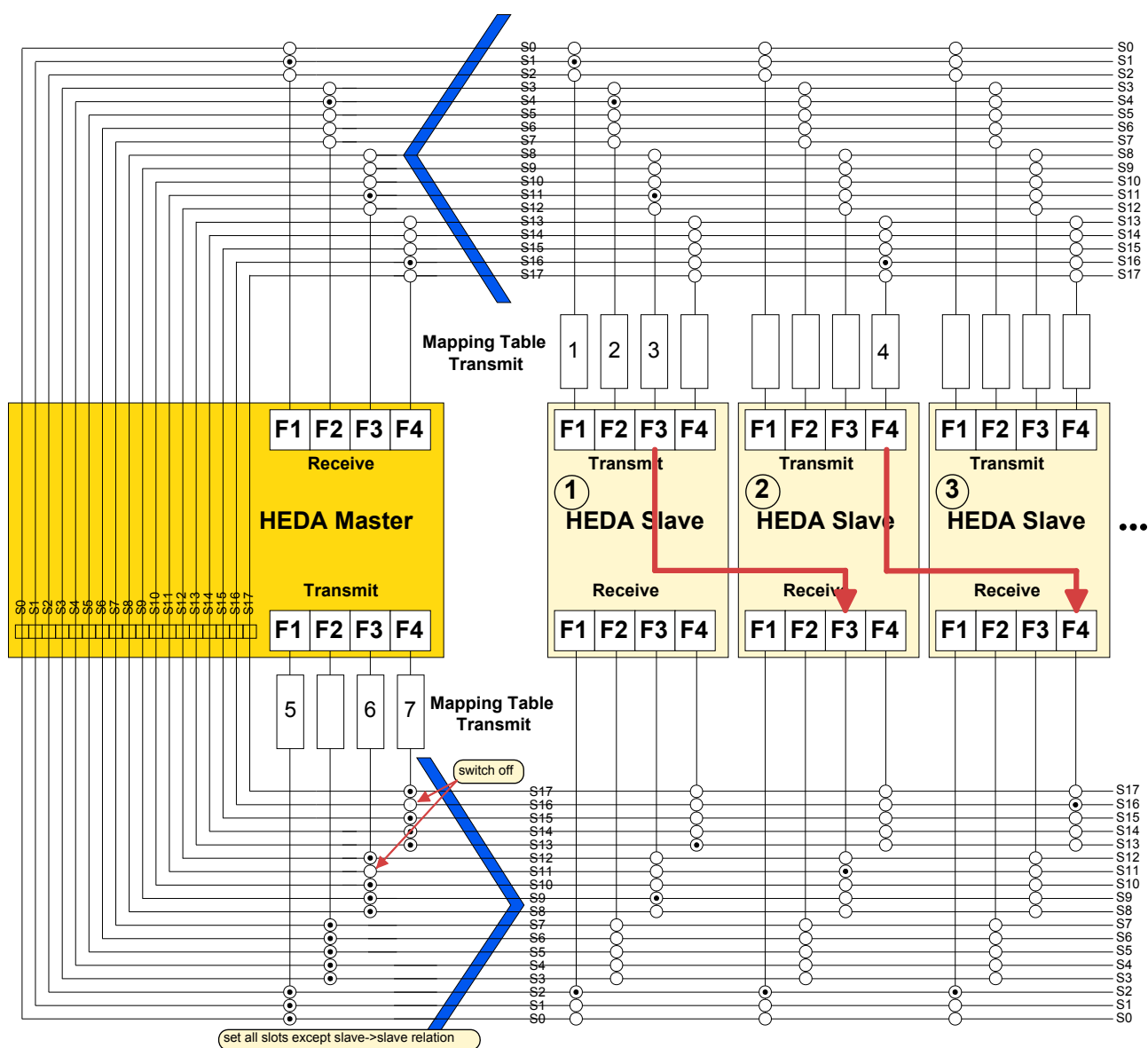


The mapping tables are now distributed to different slots:

Mapping Table	Slot	
MT1	1	Slave transmit range
MT2	4	
MT3	11	
MT4	16	
MT5	2 (& 0, 1)	Master transmit range
MT6	9 (& 8, 10, 12)	
MT7	13 (& 14, 15, 17)	

Note: The transmit slots where a slave-slave communication is taking place (Slot 11 & 16), must be deactivated in the master! Otherwise, the master would overwrite the data of the slave.

This results in the following image:



The following objects are transmitted:

TRANSMIT (send)		RECEIVE		RECEIVE
Mapping Table	Source	Objects	Target	
1	S1	C3Array.Col01Row01 (1901.1)	M	C3Array.Col01Row01 (1901.1)
2	S1	C3Plus.DeviceState_Statusword1 (1000.3)	M	C3Array.Col03Row01 (1903.1)
3	S1	C3Plus.ProfileGenerators_SG1Position (2000.1)	M S2	C3Array.Col01Row02 (1902.1) C3Plus.HEDA_SignalProcessing_Input (3920.1)
4	S2	C3Plus.PositionController_DemandValue (2200.1)	S3	C3Plus.HEDA_SignalProcessing_Input (3920.1)
5	M	C3Plus.ProfilGenerators_PG2Position (2000.2)	S1 S2 S3	C3Plus.HEDA_SignalProcessing_Input (3920.1) C3Array.Col01Row05 (1901.5) C3Array.Col01Row05 (1901.5)
6	M	C3Plus.DeviceControl_Controlword1 (1100.3)	S1	C3Plus.DeviceControl_Controlword1 (1100.3)
7	M	C3Array.Col06Row01 (1906.1)	S1	C3Array.Col06Row01 (1906.1)

M: Master

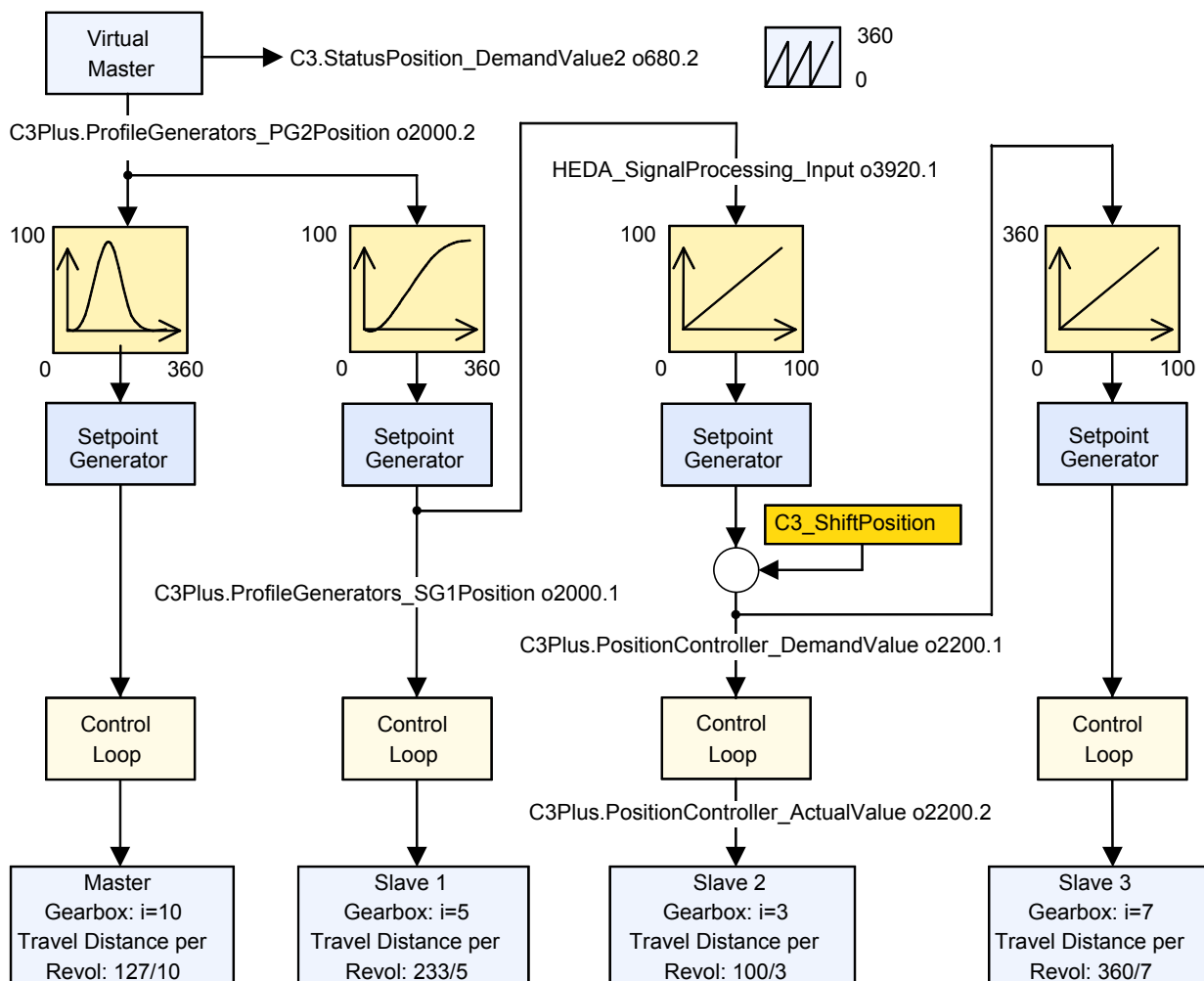
S1, S2, S3: Slave 1 ... 3

Word form for the objects to be transmitted in the internet

http://apps.parker.com/euro_emd/EME/downloads/compax3/HEDA-Formulare/communications-table.doc.

Example 2: 4-axis application with HEDA**Task:**

- ◆ four-axis processing machine
- ◆ Setting the steps via virtual master
- ◆ Forwards and backwards movement with the master (closed curve)
- ◆ Linearized feed movement with Slave 1 = rotating blade (open curve)
- ◆ Position synchronous operation of slave 2 with respect to slave 1 with slip correction (use of C3_Shift_Position)
- ◆ Fixed position assignment of a turning axis slave 3 to slave 2 with consideration of the correction movement of slave 2



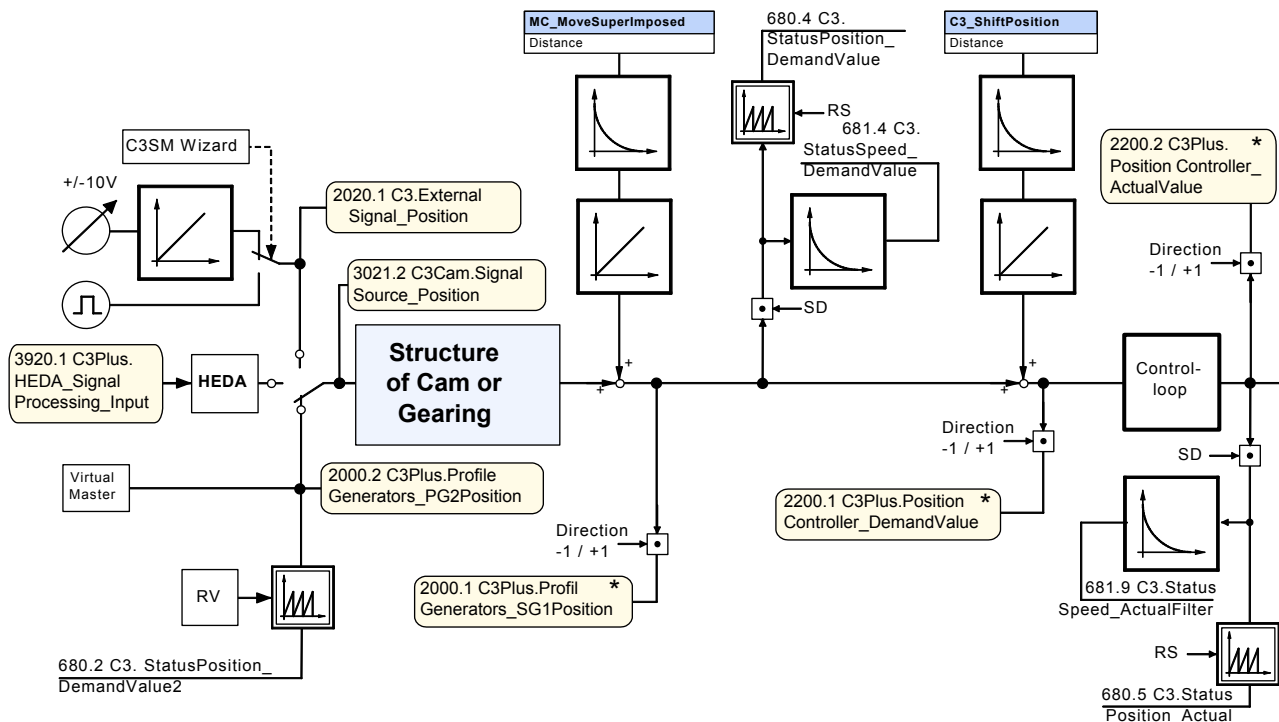
Master / Slave Configuration of the reference system

Configuration	Master	Slave 1	Slave 2	Slave 3
Travel distance per motor revolution				
◆ Numerator	127	233	100	360
◆ Denominator	10	5	3	7
Reset distance				
◆ Numerator	100	100	100	360
◆ Denominator	1	1	1	1
Signal source (Master axis)				
◆ Virtual Master				
◆ Reset distance	360			
◆ Use as current signal source	yes			
Source HEDA (Slave axis)				
◆ "Virtual master" as HEDA Master		yes	no	no
◆ Path per motor revolution of the HEDA Master		not required		
◆ Numerator			233	100
◆ Denominator			5	3
◆ Create cams with the CamDesigner				
◆ Distance Counter Reset Position - Numerator	360	360	100	100
◆ Distance Counter Reset Position - Denominator	1	1	1	1

The C3 ServoManager projects (configuration) can be found on the Compax3 CD: ...\\Examples\\HEDA\\Master.c3p, slave1.c3p, slave2.c3p, slave3.c3p

6.8.3. Coupling objects

Coupling objects (framed objects) are suitable as master signal for electronic coupling and should be in the **DSP Format** (see page 427).



Input value for HEDA couplings is object 3920.1.

Note: * This values are not even reset by a home run.
Direction -1 / +1: with direction inversion (in the configuration wizard) these coupling values are inverted, relative to the drive direction (factor -1).

6.9 Normalization factors

Under "configure communication: normalization factors Y2/Y4", you can change the validation for individual objects (objects in the Y2 and Y4 format) via scaling factors.

In the wizard window, the object numbers that can be influenced are displayed at the right side of the factors.

7. Compax3 - Objects

In this chapter you can read about:

Object overview sorted by object name (T30).....	446
T30 Objects for the process data channel / the message	454
Detailed object list	455

Compax3 objects are encapsulated in the "C3, C3Array, ..." modules in the IEC61131-3 programming environment (CoDeSys).

Enter the object names before the "." and the corresponding list of objects will appear.

Objects that are not described here are reserved objects!

Note on searching objects:

- ◆ If the object number is known, you can enter it directly in the index.
- ◆ In addition you can find the CoDeSys name of the objects in the index.

Note on bus numbers (PNU, CAN-No.):

The bus numbers of the array can be found in the description on column 1, line 1 (Object 1901.1)

Set objects to valid

Please note that certain objects are not valid (read by Compax3) immediately after a change. This is described in the heading "Valid after". These objects are converted to internal variables the Compax3 "VP" command (write in object 210.10 with value <> 0).

Save objects permanently

It should also be noted that modified objects are not permanently stored in the Compax3, i.e. the changes are lost after the power (24 VDC) is turned off. The object "Save objects permanently" (write in object 20.11 with value <> 0) can be used to save objects in a flash memory so they are retained even if the power fails.

7.1 Object overview sorted by object name (T30)

No.	Object name	Object	PNU	CAN No.	Format	PD	Valid beginning	Device assignment		
								I11	I20	I21
2120.1	C3.SpeedObserver_TimeConstant	Rapidity of the speed monitor			U32	no	VP	X	X	X
420.7	C3.PositioningAccuracy_WindowTime	In Position Window Time	329	0x6068	U16	no	Immediately	X	X	X
2220.22	C3.Q_CurrentController_BackEMF	Parameter motor force constant			I16	no	VP	X	X	X
2220.20	C3.Q_CurrentController_Inductance	Parameter motor inductance			I16	no	VP	X	X	X
2220.4	C3.Q_CurrentController_Q_ActualValue	Manual Quadrature Current Command Value			I16	yes	-	X	X	X
2220.1	C3.Q_CurrentController_Q_DemandValue	Quadrature Current CommandValue			I16	yes	-	X	X	X
2220.2	C3.Q_CurrentController_Q_DemandValueAdditive	Manual Quadrature Current Command Value			I16	yes	Immediately	X	X	X
2220.21	C3.Q_CurrentController_Resistance	Parameter motor resistance			I16	no	VP	X	X	X
2210.17	C3.SpeedController_ActualBandwidth	Replacement time constant for the velocity control			I32	no	-	X	X	X
688.31	C3.StatusCurrent_DecouplingVoltageUd	Signal decoupling of direct current controller			C4_3	no	-	X	X	X
2120.5	C3.SpeedObserver_DisturbanceFilter	Time constant disturbance filter			U32	no	VP	X	X	X
420.2	C3.PositioningAccuracy_FollowingErrorWindow	Following error limit	330	0x6065	C4_3	no	VP	X	X	X
682.5	C3.StatusAccel_Actual	Status of actual acceleration unfiltered			I32	no	-	X	X	X
682.6	C3.StatusAccel_ActualFilter	Status of filtered actual acceleration			I32	no	-	X	X	X
682.4	C3.StatusAccel_DemandValue	Status demand acceleration	325	0x200E	I32	no	-	X	X	X
682.7	C3.StatusAccel_FeedForwardAccel	Status acceleration feed forward			C4_3	no	-	X	X	X
690.5	C3.StatusAutocommutation_Iterations	Current increase steps automatic commutation			U16	no	-	X	X	X
688.2	C3.StatusCurrent_Actual	Status of actual current RMS (torque producing)			E2_6	yes	-	X	X	X
688.19	C3.StatusCurrent_ActualDINT	Actual current r.m.s.			I32	no	-	X	X	X
170.2	C3.AnalogInput0_Gain	Gain analog input 0			C4_3	no	VP	X	X	X
2120.7	C3.SpeedObserver_DisturbanceAdditionEnable	Switch to enable disturbance compensation			BOOL	no	VP	X	X	X
201.6	C3.NormFactorY4_DemandValue2	Normalization factor for 1100.7	356.6	0x2021.6	V2	no	Immediately	-	X	X
200.9	C3.NormFactorY2_DemandValue2_Y2	Normalization factor for 1100.14 1100.14			V2	no	Immediately	-	X	X
200.4	C3.NormFactorY2_DemandValue3	Normalization factor for 1100.8	355.4	0x2020.4	V2	no	Immediately	-	X	X
200.6	C3.NormFactorY2_DemandValue4	Normalization factor for 1100.9	355.6	0x2020.6	V2	no	Immediately	-	X	X
200.1	C3.NormFactorY2_Speed	Scaling factor for Y2 speeds	355.1	0x2020.1	V2	no	Immediately	-	X	X
200.3	C3.NormFactorY2_Voltage	Scaling factor for Y2 voltages	355.3	0x2020.3	V2	no	Immediately	-	X	X
201.7	C3.NormFactorY4_ActualValue1	Normalization factor for 1000.6	356.7	0x2021.7	V2	no	Immediately	-	X	X
201.8	C3.NormFactorY4_ActualValue2	Normalization factor for 1000.7	356.8	0x2021.8	V2	no	Immediately	-	X	X
201.13	C3.NormFactorY4_ActualValue8	Normalization factor for 1000.13	356.13	0x2021.13	V2	no	Immediately	-	X	X
420.1	C3.PositioningAccuracy_Window	Positioning window for position reached	328	0x6067	C4_3	no	VP	X	X	X
201.5	C3.NormFactorY4_DemandValue1	Normalization factor for 1100.6	356.5	0x2021.5	V2	no	Immediately	-	X	X
420.6	C3.PositioningAccuracy_PositionReached	Position reached			I32	no	-	X	X	X
201.12	C3.NormFactorY4_DemandValue8	Normalization factor for 1100.13	356.12	0x2021.12	V2	no	Immediately	-	X	X
201.11	C3.NormFactorY4_FBI_SignalProcessing	Normalization factor for bus interpolation CANSync/EthernetPowerLink	356.11	0x2021.11	V2	no	Immediately	-	-	X
201.1	C3.NormFactorY4_Speed	Scaling factor for Y4 speeds	356.1	0x2021.1	V2	no	Immediately	-	X	X
201.3	C3.NormFactorY4_Voltage	Scaling factor for Y4 voltages	356.3	0x2021.3	V2	no	Immediately	-	X	X
20.1	C3.ObjectDir_Objekte-->FLASH	Store objects permanently (bus)	339	0x2017	I16	no	Immediately	-	X	X
20.10	C3.ObjectDir_ReadObjects	Read objects from Flash			I16	no	Immediately	X	X	X
20.11	C3.ObjectDir_WriteObjects	Save objects permanently			I16	no	Immediately	X	X	X
420.3	C3.PositioningAccuracy_FollowingErrorTimeout	Following Error Time	331	0x6066	U16	no	Immediately	X	X	X
688.32	C3.StatusCurrent_FeedForwardbackEMF	Signal EMC feedforward			C4_3	no	-	X	X	X
201.4	C3.NormFactorY4_Array_Col1	Scaling factor recipe arrays column 1	356.4	0x2021.4	V2	no	Immediately	-	X	X
680.21	C3.StatusPosition_LoadControlDeviationMax	Maximum position difference load-motor			C4_3	no	-	X	X	X
680.18	C3.StatusPosition_ActualNotReset	Status actual position (not reset)			C4_3	yes	-	X	X	X
680.12	C3.StatusPosition_DemandController	Status demand position without absolute reference			C4_3	no	-	X	X	X
680.4	C3.StatusPosition_DemandValue	Status demand position	323	0x60FC	C4_3	yes	-	X	X	X
680.1	C3.StatusPosition_DemandValue1	Position command value of Profile transmitter1	0	0x2052	Y4	yes	-	X	X	X
680.11	C3.StatusPosition_EncoderInput24V	Status of encoder input 0 (24V)			C4_3	yes	-	X	X	X
680.10	C3.StatusPosition_EncoderInput5V	Status of encoder input 0 (5V)		0x2095.2	C4_3	yes	-	X	X	X
680.6	C3.StatusPosition_FollowingError	Status of tracking error	100	0x60F4	C4_3	yes	-	X	X	X
680.23	C3.StatusPosition_LoadControlActual	Actual position of the load			C4_3	no	-	X	X	X
688.8	C3.StatusCurrent_ControlDeviationIq	Status of control deviation of current control RMS			C4_3	no	-	X	X	X
680.22	C3.StatusPosition_LoadControlDeviationFiltered	Position difference load-motor (filtered)			C4_3	no	-	X	X	X

No.	Object name	Object	PNU	CAN No.	Format	PD	Valid beginning	Device assignment		
								I11	I20	I21
692.5	C3.StatusFeedback_FeedbackVoltage[Vpp]	Status of feedback level			C4_3	no	-	X	X	X
680.30	C3.StatusPosition_Referenced	Status of axis referenced			I16	no	-	X	X	X
681.5	C3.StatusSpeed_Actual	Status actual speed unfiltered	8	0x606C/0x6069	C4_3	yes	-	X	X	X
681.9	C3.StatusSpeed_ActualFiltered	Status actual speed filtered			C4_3	yes	-	X	X	X
681.7	C3.StatusSpeed_ActualFiltered_Y2	Status of the actual filtered speed in the Y2 format	6	0x2023	Y2	yes	-	-	X	X
681.8	C3.StatusSpeed_ActualFiltered_Y4	Status of the actual filtered speed in the Y4 format	117	0x2024	Y4	yes	-	-	X	X
681.12	C3.StatusSpeed_ActualScaled	Filtered actual speed			C4_3	no	-	X	X	X
681.13	C3.StatusSpeed_DemandScaled	Setpoint speed of the setpoint generator			C4_3	no	-	X	X	X
681.10	C3.StatusSpeed_DemandSpeedController	Status demand speed controller input			C4_3	yes	-	X	X	X
680.20	C3.StatusPosition_LoadControlDeviation	Position difference load-motor (unfiltered)			C4_3	no	-	X	X	X
683.1	C3.StatusDevice_ActualCurrent	Status of actual current value	112	0x6077	E2_6	yes	-	X	X	X
688.14	C3.StatusCurrent_FeedForwardCurrentJerk	Status of current & jerk feedforward			C4_3	no	-	X	X	X
688.9	C3.StatusCurrent_PhaseU	Status of current phase U			C4_3	no	-	X	X	X
688.10	C3.StatusCurrent_PhaseV	Status of current phase V			C4_3	no	-	X	X	X
688.1	C3.StatusCurrent_Reference	Status of setpoint current RMS (torque forming)			E2_6	no	-	X	X	X
688.18	C3.StatusCurrent_ReferenceDINT	Target current r.m.s.			I32	no	-	X	X	X
688.13	C3.StatusCurrent_ReferenceJerk	Status of demand jerk setpoint generator			I32	no	-	X	X	X
688.11	C3.StatusCurrent_ReferenceVoltageUq	Status of current control control signal			C4_3	no	-	X	X	X
688.22	C3.StatusCurrent_ReferenceVoltageVector	Provided voltage pointer			C4_3	no	-	X	X	X
680.13	C3.StatusPosition_ActualController	Status actual position without absolute reference			C4_3	no	-	X	X	X
688.29	C3.StatusCurrent_VoltageUq	Provided voltage of quadrature current controller			C4_3	no	-	X	X	X
680.5	C3.StatusPosition_Actual	Status actual position	28	0x6064	C4_3	yes	-	X	X	X
683.2	C3.StatusDevice_ActualDeviceLoad	Status of device load	334	0x2011	E2_6	no	-	X	X	X
683.3	C3.StatusDevice_ActualMotorLoad	Status of long-term motor load	335	0x2012	E2_6	no	-	X	X	X
683.4	C3.StatusDevice_DynamicMotorLoad	Status of short-term motor load			E2_6	no	-	X	X	X
683.5	C3.StatusDevice_ObservedDisturbance	Status of observed disturbance			C4_3	no	-	X	X	X
692.4	C3.StatusFeedback_EncoderCosine	Status of analog input cosine			I32	no	-	X	X	X
692.3	C3.StatusFeedback_EncoderSine	Status of analog input sine			I32	no	-	X	X	X
692.2	C3.StatusFeedback_FeedbackCosineDSP	Status of cosine in signal processing			I32	yes	-	X	X	X
692.1	C3.StatusFeedback_FeedbackSineDSP	Status of sine in signal processing			I32	yes	-	X	X	X
200.7	C3.NormFactorY2_ActualValue3	Normalization factor for 1000.8	355.7	0x2020.7	V2	no	Immediately	-	X	X
688.30	C3.StatusCurrent_VoltageUd	Provided voltage of direct current controller			C4_3	no	-	X	X	X
550.2	C3.ErrorHistory_1	Error (n-1) in the error history	947.1	0x201D.2	U16	no	-	-	X	X
84.5	C3.DeviceSupervision_OperatingTime	Hours of operation of the C3MP in s			U32	no	-	X	X	X
84.2	C3.DeviceSupervision_ThisDevice	Device number in the C3M combination			U16	no	-	X	X	X
85.1	C3.Diagnostics_DeviceState	C3MP operating status			V2	no	-	X	X	X
120.3	C3.DigitalInput_DeouncedValue	Status of digital inputs	21	0x6100.1	V2	yes	-	X	X	X
120.2	C3.DigitalInput_Value	Status of digital inputs			V2	yes	-	X	X	X
121.2	C3.DigitalInputAddition_Value	Input word of I/O option	175	0x6100.2	V2	yes	-	X	X	X
133.4	C3.DigitalOutputAddition_Enable	Activate input/output option M10/M12	350	0x6300.3	V2	no	Immediately	X	X	X
133.2	C3.DigitalOutputAddition_Error	Error in I/O option	351	0x6300.4	V2	no	-	X	X	X
200.5	C3.NormFactorY2_Array_Col2	Scaling factor recipe arrays column 2	355.5	0x2020.5	V2	no	Immediately	-	X	X
140.3	C3.DigitalOutputWord_DemandState	Command value of the digital outputs	22	0x6300.1	V2	yes	Immediately	-	X	X
1.15	C3.Device_ProfileID	Profibus profile number	965		OS	no	-	-	X	-
87.1	C3.ErrorHistoryNumber_1	Error 1			U16	no	-	X	X	X
86.1	C3.ErrorHistoryPointer_LastEntry	Pointer to current error			U16	no	-	X	X	X
88.1	C3.ErrorHistoryTime_1	Error point in time 1			U32	no	-	X	X	X
2020.1	C3.ExternalSignal_Position	Position from external signal source		0x2095.1	C4_3	yes	-	X	X	X
2020.2	C3.ExternalSignal_Speed	Speed from external signal source			C4_3	yes	-	X	X	X
3925.23	C3.FBI_Interpolation_AccelStatus	Input value of the acceleration of Q3925.21			C4_3	no	-	-	-	X
3925.1	C3.FBI_Interpolation_SubModeSelect	Interpolation method		0x60C0	I16	no	Immediately	-	-	X
3925.22	C3.FBI_Interpolation_VelocityStatus	Input speed of the differentiated input position Q2121.1			C4_3	no	-	-	-	X
133.3	C3.DigitalOutputAddition_Value	Output word for I/O option	176	0x6300.2	V2	yes	Immediately	X	X	X
2100.5	C3.ControllerTuning_FilterSpeed	Filter - Actual velocity	402.5	0x2100.5	U16	no	VP	X	X	X
170.4	C3.AnalogInput0_Offset	Analog input Offset 0			I16	no	Immediately	X	X	X
634.4	C3.AnalogOutput0_DemandValue	Setpoint for analog output 0	24	0x2019	I16	yes	Immediately	X	X	X
635.4	C3.AnalogOutput1_DemandValue	setpoint for analog output 1	103	0x201A	I16	yes	Immediately	X	X	X
2100.20	C3.ControllerTuning_ActuatingSpeedSignalFilter_us	Control signal filter of velocity control			U16	no	VP	X	X	X
2100.8	C3.ControllerTuning_CurrentBandwidth	Current regulator bandwidth	402.8	0x2100.8	U16	no	VP	X	X	X
2100.9	C3.ControllerTuning_CurrentDamping	Current loop - Damping	402.9	0x2100.9	U16	no	VP	X	X	X
2100.3	C3.ControllerTuning_Damping	Damping (rotation speed controller)	402.3	0x2100.3	U16	no	VP	X	X	X
2100.6	C3.ControllerTuning_FilterAccel	Filter - Actual acceleration	402.6	0x2100.6	U16	no	VP	X	X	X
84.3	C3.DeviceSupervision_DeviceCounter	Number of devices in the C3M combination			U16	no	-	X	X	X
2100.11	C3.ControllerTuning_FilterAccel2	Filter actual acceleration 2			U16	no	VP	X	X	X
84.4	C3.DeviceSupervision_DeviceAdr	Current RS485 address of the C3M			U16	no	-	X	X	X
2100.10	C3.ControllerTuning_FilterSpeed2	Filter actual velocity 2			U16	no	VP	X	X	X
2100.4	C3.ControllerTuning_Inertia	Moment of Inertia	402.4	0x2100.4	U16	no	VP	X	X	X

No.	Object name	Object	PNU	CAN No.	Format	PD	Valid beginning	Device assignment		
								I11	I20	I21
2100.7	C3.ControllerTuning_SpeedDFactor	D-component of speed controller	402.7	0x2100.7	U16	no	VP	X	X	X
2100.2	C3.ControllerTuning_Stiffness	Stiffness (speed controller)	402.2	0x2100.2/0x2100.1	U16	no	VP	X	X	X
2230.20	C3.D_CurrentController_Ld_Lq_Ratio	Ratio direct to quadrature inductance			U16	no	VP	X	X	X
2230.24	C3.D_CurrentController_VoltageDecouplingEnable	Activation of the voltage decoupling			I16	no	VP	X	X	X
990.1	C3.Delay_MasterDelay	Setpoint delay for bus master			I16	no	Immediately	X	X	X
1.21	C3.Device_FirmwareRelease	Version of firmware package		0x20FF	I32	no	Immediately	-	-	X
950.3	C3.FBI_RxPD_Mapping_Object_3	3. object of the Setpoint value PZD	915.2		U16	no	Immediately	-	X	-
2100.21	C3.ControllerTuning_FilterAccel_us	Filter - Actual acceleration			U16	no	VP	X	X	X
402.4	C3.Limit_CurrentNegative	Maximum permissible negative current	320	0x200C	I16	no	VP	X	X	X
950.1	C3.FBI_RxPD_Mapping_Object_1	1. Object of the setpoint PZD (Profibus)	915.0		U16	no	Immediately	-	X	-
2010.1	C3.FeedForward_Speed	Velocity feed-forward	400.1	0x2101.1	U16	no	VP	X	X	X
2010.23	C3.FeedForward_Speed_FFW	Speed feedforward (A1)			C4_3	no	VP	X	X	X
2010.21	C3.FeedForward_Valve	Valve feedforward			U16	no	VP	X	X	X
2011.2	C3.FeedForwardExternal_FilterAccel	External Acceleration Feed Forward Filter Time Constant	401.2	0x2102.2	U16	no	VP	X	X	X
2011.5	C3.FeedForwardExternal_FilterAccel_us	Filter time constant ext. Acceleration			U16	no	VP	X	X	X
2011.1	C3.FeedForwardExternal_FilterSpeed	External Speed Feed Forward Filter Time Constant	401.1	0x2102.1	U16	no	VP	X	X	X
2011.4	C3.FeedForwardExternal_FilterSpeed_us	Filter time constant ext. Velocity			U16	no	VP	X	X	X
2010.20	C3.FeedForward_EMF	EMC feedforward			U16	no	VP	X	X	X
1141.7	C3.GEAR_actual_masterposition	Position input value for Gearing		0x2058	C4_3	no	-	X	X	X
2010.4	C3.FeedForward_Current	Current feed-forward	400.4	0x2101.4	U16	no	VP	X	X	X
402.3	C3.Limit_CurrentPositive	Maximum permissible positive current	319	0x200B	I16	no	VP	X	X	X
402.2	C3.Limit_SpeedNegative	Maximum permissible negative speed	318	0x200A	I16	no	VP	X	X	X
402.1	C3.Limit_SpeedPositive	Maximum permissible positive speed	317	0x2009	I16	no	VP	X	X	X
410.6	C3.LimitPosition_LoadControlMaxPosDiff	Position difference load-motor (error threshold)			C4_3	no	VP	X	X	X
410.3	C3.LimitPosition_Negative	negative end limit	322	0x607D.1	C4_3	no	Immediately	X	X	X
410.2	C3.LimitPosition_Positive	positive end limit	321	0x607D.2	C4_3	no	Immediately	X	X	X
3310.1	C3.Multiturnemulation_Status	Status of the Multiturn emulation			I16	no	-	X	X	X
200.10	C3.NormFactorY2_ActualValue2_Y2	Normalization factor for 1000.14			V2	no	Immediately	-	X	X
681.6	C3.StatusSpeed_Error	Status control deviation of speed	101	0x2027	C4_3	yes	-	X	X	X
1141.8	C3.GEAR_actual_master_speed	Master speed for Gearing			C4_3	no	-	X	X	X
951.4	C3.FBI_TxPD_Mapping_Object_4	4. object of actual value PZD	916.3		U16	no	Immediately	-	X	-
200.8	C3.NormFactorY2_ActualValue4	Normalization factor for 1000.9	355.8	0x2020.8	V2	no	Immediately	-	X	X
950.4	C3.FBI_RxPD_Mapping_Object_4	4. object of the Setpoint value PZD	915.3		U16	no	Immediately	-	X	-
950.5	C3.FBI_RxPD_Mapping_Object_5	5. object of the Setpoint value PZD	915.4		U16	no	Immediately	-	X	-
950.6	C3.FBI_RxPD_Mapping_Object_6	6. object of the Setpoint value PZD	915.5		U16	no	Immediately	-	X	-
950.7	C3.FBI_RxPD_Mapping_Object_7	7. object of the Setpoint value PZD	915.6		U16	no	Immediately	-	X	-
950.8	C3.FBI_RxPD_Mapping_Object_8	8. object of the Setpoint value PZD	915.7		U16	no	Immediately	-	X	-
3921.1	C3.FBI_SignalProcessing0_Input	Interpolation input CanSync, PowerLink		0x2050	I32	yes	Immediately	-	-	X
951.1	C3.FBI_TxPD_Mapping_Object_1	1. object of actual value PZD	916.0		U16	no	Immediately	-	X	-
2010.5	C3.FeedForward_Jerk	Jerk feed-forward	400.5	0x2101.5	U16	no	VP	X	X	X
951.3	C3.FBI_TxPD_Mapping_Object_3	3. object of actual value PZD	916.2		U16	no	Immediately	-	X	-
950.2	C3.FBI_RxPD_Mapping_Object_2	2. object of the Setpoint value PZD	915.1		U16	no	Immediately	-	X	-
951.5	C3.FBI_TxPD_Mapping_Object_5	5. object of actual value PZD	916.4		U16	no	Immediately	-	X	-
951.6	C3.FBI_TxPD_Mapping_Object_6	6. object of actual value PZD	916.5		U16	no	Immediately	-	X	-
951.7	C3.FBI_TxPD_Mapping_Object_7	7. object of actual value PZD	916.6		U16	no	Immediately	-	X	-
951.8	C3.FBI_TxPD_Mapping_Object_8	8. object of actual value PZD	916.7		U16	no	Immediately	-	X	-
2050.10	C3.FeedForward_2_Accel_FFW	Acceleration feedforward (A2)			C4_3	no	VP	X	X	X
2050.9	C3.FeedForward_2_Speed_FFW	Speed feedforward (A2)			C4_3	no	VP	X	X	X
2050.8	C3.FeedForward_2_Valve	Valve feedforward auxiliary axis			U16	no	VP	X	X	X
2010.2	C3.FeedForward_Accel	Acceleration feed-forward	400.2	0x2101.2	U16	no	VP	X	X	X
2010.24	C3.FeedForward_Speed_FFW	Acceleration feedforward (A1)			C4_3	no	VP	X	X	X
951.2	C3.FBI_TxPD_Mapping_Object_2	2. object of actual value PZD	916.1		U16	no	Immediately	-	X	-
1111.13	C3Plus.POSITION_direction	Manipulation of the motion direction in reset mode			I32	no	Immediately	X	X	X
2150.3	C3Plus.NotchFilter_DepthFilter1	Depth of notch filter 1			I32	no	VP	X	X	X
2150.6	C3Plus.NotchFilter_DepthFilter2	Depth of notch filter 2			I32	no	VP	X	X	X
2150.1	C3Plus.NotchFilter_FrequencyFilter1	Center frequency of notch filter 1			I16	no	VP	X	X	X
2150.4	C3Plus.NotchFilter_FrequencyFilter2	Center frequency of notch filter 2			I16	no	VP	X	X	X
1211.13	C3Plus.PG2POSITION_direction	Manipulation of the motion direction in reset mode			I32	no	Immediately	X	X	X
50.3	C3Plus.PLC_ActualCycleTime	Status of cycle time of the control program	353	0x201F.2	U16	no	-	-	X	X
50.4	C3Plus.PLC_ActualCycleTimeMax	Status of maximum cycle time	354	0x201F.3	U16	no	Immediately	-	X	X

No.	Object name	Object	PNU	CAN No.	Format	PD	Valid beginning	Device assignment		
								I11	I20	I21
50.1	C3Plus.PLC_DemandCycleTime	Cycle time specification	352	0x201F.1	U16	no	Immediately	-	X	X
550.1	C3Plus.ErrorHistory_LastError	Current error (n)	115/947.0	0x603F/ 0x201D.1	U16	yes	-	X	X	X
1111.4	C3Plus.POSITION_decel	Deceleration for positioning	312	0x6084	U32	yes	Immediately	X	X	X
201.2	C3Plus.NormFactorY4_Position	Scaling factor for Y4 positions	356.2	0x2021.2	V2	no	Immediately	-	X	X
1111.5	C3Plus.POSITION_jerk_accel	Acceleration jerk for positioning	313	0x2005	U32	no	Immediately	X	X	X
1111.6	C3Plus.POSITION_jerk_decel	Deceleration jerk for positioning	314	0x2006	U32	no	Immediately	X	X	X
1111.1	C3Plus.POSITION_position	Target position	27		C4_3	yes	Immediately	X	X	X
1111.8	C3Plus.POSITION_resetposition_mode	Continuous mode	0	0	U16	no	Immediately	X	X	X
1111.2	C3Plus.POSITION_speed	Speed for positioning	111		C4_3	yes	Immediately	X	X	X
1111.17	C3Plus.POSITION_turnaround	Direction inversion - lock			U16	no	Immediately	X	X	X
2200.2	C3Plus.PositionController_ActualValue	Position actual value (sequentially)			C4_3	yes	-	X	X	X
2200.20	C3Plus.PositionController_DeadBand	Deadband of position controller			C4_3	no	VP	X	X	X
1111.3	C3Plus.POSITION_accel	Acceleration for positioning	114	0x6083	U32	yes	Immediately	X	X	X
1130.2	C3Plus.HOMING_jerk	Jerk for machine reference run	357	0x201E	U32	no	Immediately	X	X	X
681.4	C3.StatusSpeed_DemandValue	Status demand speed of setpoint generator	324	0x606B	C4_3	yes	-	X	X	X
2020.6	C3Plus.ExternalSignal_Speed_Munits	Speed value of the external signal source			C4_3	yes	-	X	X	X
3921.7	C3Plus.FBI_SignalProcessing0_OutputGreat	Interpolation output of the Position CanSync, PowerLink			Y4	no	-	-	-	X
1141.10	C3Plus.GEAR_FFW_mode	Control bits for feedforward with source CANSync/EthernetPowerLink		0x2097	U16	no	Immediately	-	-	X
1141.4	C3Plus.GEAR_mode	Source selection Gearing		0x2055	U16	no	Immediately	X	X	X
3920.1	C3Plus.HEDA_SignalProcessing_Input	Process input signal Slave			C4_3	yes	Immediately	X	X	X
3920.7	C3Plus.HEDA_SignalProcessing_OutputGreat	Output of the Heda Tracking Filter			C4_3	no	-	X	X	X
1130.1	C3Plus.HOMING_accel	Acceleration / deceleration homing run	300	0x609A	U32	no	Immediately	X	X	X
2150.5	C3Plus.NotchFilter_BandwidthFilter2	Bandwidth of notch filter 2			I16	no	VP	X	X	X
1130.7	C3Plus.HOMING_edge_sensor_distance	Initiator adjustment	304	0x2000	C4_3	no	Immediately	X	X	X
2150.2	C3Plus.NotchFilter_BandwidthFilter1	Bandwidth of notch filter 1			I16	no	VP	X	X	X
1130.4	C3Plus.HOMING_mode	Adjusting the machine reference mode	302	0x6098	U16	no	Immediately	X	X	X
1130.3	C3Plus.HOMING_speed	Speed for machine reference run	301	0x6099.1	C4_3	no	Immediately	X	X	X
402.6	C3Plus.Limit_CurrentFine	Factor for the current limits		0x2093	I16	yes	Immediately	-	-	X
2201.2	C3Plus.LoadControl_Command	Load control command mode			I16	no	Immediately	X	X	X
2201.1	C3Plus.LoadControl_Enable	Enable load control			I16	no	Immediately	X	X	X
2201.11	C3Plus.LoadControl_FilterLaggingPart	Time constant of position difference filter			U32	no	VP	X	X	X
2201.3	C3Plus.LoadControl_Status	Load control status bits			I16	no	-	X	X	X
2201.12	C3Plus.LoadControl_VelocityFilter	Time constant of the load-speed filter			I16	no	VP	X	X	X
2200.11	C3Plus.PositionController_TrackingErrorFilter	Following error filter of the position controller			U16	no	VP	X	X	X
1130.13	C3Plus.HOMING_edge_position	Distance MN (zero) initiator - motor zero			C4_3	no	Immediately	X	X	X
670.2	C3Plus.StatusTorqueForce_ActualTorque	Status of actual torque			I32	no	-	X	X	X
2200.1	C3Plus.PositionController_DemandValue	Position setpoint value (sequentially)			C4_3	yes	-	X	X	X
151.2	C3Plus.RemoteDigOutput_O16_31	Digital PIO outputs 16...31		0x2081.2	V2	yes	Immediately	-	-	X
151.3	C3Plus.RemoteDigOutput_O32_47	Digital PIO outputs 32...47		0x2081.3	V2	yes	Immediately	-	-	X
151.4	C3Plus.RemoteDigOutput_O48_63	Digital PIO outputs 48...63		0x2081.4	V2	yes	Immediately	-	-	X
1127.3	C3Plus.SPEED_speed	Target speed in speed control operating mode	7		C4_3	yes	Immediately	X	X	X
683.8	C3Plus.StatusDevice_MotorCurrent	Motor current in per thousand of the actual current limit		0x2094	I16	yes	-	-	-	X
680.8	C3Plus.StatusPosition_Actual_Y4	Status position actual value in the bus format Y4	119	0x2022	Y4	yes	-	-	X	X
680.24	C3Plus.StatusPosition_SSI_AbsolutPosition_LoadUnits	AbsolutPosition of the SSI-feedback load unit			C4_3	no	-	X	X	X
150.4	C3Plus.RemoteDigInput_I48_63	Digital PIO inputs 48...63		0x2080.4	V2	yes	Immediately	-	-	X
670.4	C3Plus.StatusTorqueForce_ActualForce	Status of actual force			I32	no	-	X	X	X
150.3	C3Plus.RemoteDigInput_I32_47	Digital PIO inputs 32...47		0x2080.3	V2	yes	Immediately	-	-	X
670.3	C3Plus.StatusTorqueForce_SetpointForce	Status of setpoint force			I32	no	-	X	X	X
670.1	C3Plus.StatusTorqueForce_SetpointTorque	Status of setpoint torque			I32	no	-	X	X	X
110.1	C3Plus.Switch_DeviceFunction	Value of the function switch on C3M			U16	no	-	X	X	X
2109.1	C3Plus.TrackingfilterHEDA_TRFSpeed	Time constant tracking filter HEDA-process position			I16	no	VP	X	X	X
2107.1	C3Plus.TrackingfilterPhysicalSource_TRFSpeed	Time constant tracking filter physical source			U16	no	VP	X	X	X
2110.4	C3Plus.TrackingfilterSG1_AccelFilter	Filter effect of acceleration filter setpoint encoder			U16	no	VP	X	X	X
2110.7	C3Plus.TrackingfilterSG1_AccelFilter_us	Filter time constant acceleration setpoint generator			U16	no	VP	X	X	X

No.	Object name	Object	PNU	CAN No.	Format	PD	Valid beginning	Device assignment		
								I11	I20	I21
2110.3	C3Plus.TrackingfilterSG1_FilterSpeed	Filter effect of speed filter setpoint encoder			U16	no	VP	X	X	X
2110.6	C3Plus.TrackingfilterSG1_FilterSpeed_us	Filter time constant velocity setpoint generator			U16	no	VP	X	X	X
680.25	C3Plus.StatusPosition_SSI_AbsolutPosition_MasterUnits	AbsolutPosition of the SSI-feedback master unit			C4_3	no	-	X	X	X
152.1	C3Plus.RemoteAnalogInput_I0	PIO analog input 0		0x2082.1	I16	yes	Immediately	-	-	X
85.4	C3Plus.Diagnostics_TemperatureHeatSink	C3MP temperature of heat dissipator			I16	no	-	X	X	X
2200.24	C3Plus.PositionController_TrackingErrorFilter_us	Time constant following error filter of position controller			U16	no	VP	X	X	X
830.2	C3Plus.Profibus_Baudrate	Baud rate			U32	no	-	-	X	-
830.3	C3Plus.Profibus_NodeAddress	Station address	918		U16	no	-	-	X	-
830.1	C3Plus.Profibus_Protocol	PPO-type selection switch			U16	no	Immediately	-	X	-
830.6	C3Plus.Profibus_StandardSignalTable	List of Profidrive standard signals	923.x		U16	no	-	-	X	-
830.4	C3Plus.Profibus_TelegramSelect	Telegram selection switch	922		U16	no	Immediately	-	X	-
2000.1	C3Plus.ProfilGenerators_SG1Position	Position value of the setpoint encoder		0x2060	C4_3	yes	-	X	X	X
151.1	C3Plus.RemoteDigOutput_O0_15	Digital PIO outputs 0...15		0x2081.1	V2	yes	Immediately	-	-	X
2220.3	C3Plus.Q_CurrentController_Scaling_Q_DemandValueAdditive	Scaling for manual current command value			I16	no	Immediately	X	X	X
2200.21	C3Plus.PositionController_FrictionCompensation	Friction compensation			I32	no	VP	X	X	X
152.2	C3Plus.RemoteAnalogInput_I1	PIO analog input 1		0x2082.2	I16	yes	Immediately	-	-	X
152.3	C3Plus.RemoteAnalogInput_I2	PIO analog input 2		0x2082.3	I16	yes	Immediately	-	-	X
152.4	C3Plus.RemoteAnalogInput_I3	PIO analog input 3		0x2082.4	I16	yes	Immediately	-	-	X
153.1	C3Plus.RemoteAnalogOutput_O0	PIO analog output 0		0x2083.1	I16	yes	Immediately	-	-	X
153.2	C3Plus.RemoteAnalogOutput_O1	PIO analog output 1		0x2083.2	I16	yes	Immediately	-	-	X
153.3	C3Plus.RemoteAnalogOutput_O2	PIO analog output 2		0x2083.3	I16	yes	Immediately	-	-	X
153.4	C3Plus.RemoteAnalogOutput_O3	PIO analog output 3		0x2083.4	I16	yes	Immediately	-	-	X
150.1	C3Plus.RemoteDigInput_I0_15	Digital PIO inputs 0...15		0x2080.1	V2	yes	Immediately	-	-	X
150.2	C3Plus.RemoteDigInput_I16_31	Digital PIO inputs 16...31		0x2080.2	V2	yes	Immediately	-	-	X
2000.4	C3Plus.ProfilGenerators_SG1Speed	Speed of the setpoint encoder		0x2063	I32	yes	-	X	X	X
1905.2	C3Array.Col05_Row02	Variable Column 5 Row 2	151/345.2	0x2305.2	I16	yes	Immediately	X	X	X
1903.2	C3Array.Col03_Row02	Variable Column 3 Row 2	141/343.2	0x2303.2	I16	yes	Immediately	X	X	X
1903.3	C3Array.Col03_Row03	Variable Column 3 Row 3	142/343.3	0x2303.3	I16	yes	Immediately	X	X	X
1903.4	C3Array.Col03_Row04	Variable Column 3 Row 4	143/343.4	0x2303.4	I16	yes	Immediately	X	X	X
1903.5	C3Array.Col03_Row05	Variable Column 3 Row 5	144/343.5	0x2303.5	I16	yes	Immediately	X	X	X
1904.1	C3Array.Col04_Row01	variable Column 4 Row 1	145/344.1	0x2304.1	I16	yes	Immediately	X	X	X
1904.2	C3Array.Col04_Row02	Variable Column 4 Row 2	146/344.2	0x2304.2	I16	yes	Immediately	X	X	X
1904.3	C3Array.Col04_Row03	Variable Column 4 Row 3	147/344.3	0x2304.3	I16	yes	Immediately	X	X	X
1904.4	C3Array.Col04_Row04	Variable Column 4 Row 4	148/344.4	0x2304.4	I16	yes	Immediately	X	X	X
2020.7	C3Plus.ExternalSignal_Accel_Munits	Acceleration of the external signal source			I32	yes	-	X	X	X
1905.1	C3Array.Col05_Row01	variable Column 5 Row 1	150/345.1	0x2305.1	I16	yes	Immediately	X	X	X
1902.4	C3Array.Col02_Row04	Variable Column 2 Row 4	138/342.4	0x2302.4	Y2	yes	Immediately	X	X	X
1905.3	C3Array.Col05_Row03	Variable Column 5 Row 3	152/345.3	0x2305.3	I16	yes	Immediately	X	X	X
1905.4	C3Array.Col05_Row04	Variable Column 5 Row 4	153/345.4	0x2305.4	I16	yes	Immediately	X	X	X
1905.5	C3Array.Col05_Row05	Variable Column 5 Row 5	154/345.5	0x2305.5	I16	yes	Immediately	X	X	X
1906.1	C3Array.Col06_Row01	variable Column 6 Row 1	155/346.1	0x2306.1	I32	yes	Immediately	X	X	X
1906.2	C3Array.Col06_Row02	Variable Column 6 Row 2	156/346.2	0x2306.2	I32	yes	Immediately	X	X	X
1906.3	C3Array.Col06_Row03	Variable Column 6 Row 3	157/346.3	0x2306.3	I32	yes	Immediately	X	X	X
1906.4	C3Array.Col06_Row04	Variable Column 6 Row 4	158/346.4	0x2306.4	I32	yes	Immediately	X	X	X
1906.5	C3Array.Col06_Row05	Variable Column 6 Row 5	159/346.5	0x2306.5	I32	yes	Immediately	X	X	X
1904.5	C3Array.Col04_Row05	Variable Column 4 Row 5	149/344.5	0x2304.5	I16	yes	Immediately	X	X	X
210.10	C3.ValidParameter_Global	Set objects to valid	338.10	0x2016.10	U16	no	Immediately	X	X	X
2110.1	C3Plus.TrackingfilterSG1_TRFSpeed	Time constant tracking filter setpoint encoder		0x2096	I16	no	VP	X	X	X
681.11	C3.StatusSpeed_FeedForwardSpeed	Status speed feed forward			C4_3	no	-	X	X	X
681.20	C3.StatusSpeed_LoadControl	Speed of the load feedback (unfiltered)			C4_3	no	-	X	X	X
681.21	C3.StatusSpeed_LoadControlFiltered	Speed of the load feedback (filtered)			C4_3	no	-	X	X	X
684.2	C3.StatusTemperature_Motor	Status of motor temperature	336	0x2013	U16	no	-	X	X	X

No.	Object name	Object	PNU	CAN No.	Format	PD	Valid beginning	Device assignment		
								I11	I20	I21
684.1	C3.StatusTemperature_PowerStage	Status of power output stage temperature	337	0x2014	U16	no	-	X	X	X
685.3	C3.StatusVoltage_AnalogInput0	Status of analog input 0	23	0x2025	Y2	yes	-	X	X	X
685.4	C3.StatusVoltage_AnalogInput1	Status of analog input 1	102	0x2026	Y2	yes	-	X	X	X
1903.1	C3Array.Col03_Row01	variable Column 3 Row 1	140/343.1	0x2303.1	I16	yes	Immediately	X	X	X
685.2	C3.StatusVoltage_BusVoltage	Status DC bus voltage	327	0x6079	E2_6	no	-	X	X	X
1902.5	C3Array.Col02_Row05	Variable Column 2 Row 5	139/342.5	0x2302.5	Y2	yes	Immediately	X	X	X
1901.1	C3Array.Col01_Row01	variable Column 1 Row 1	130/341.1	0x2301.1	Y4	yes	Immediately	X	X	X
1901.2	C3Array.Col01_Row02	Variable Column 1 Row 2	131/341.2	0x2301.2	Y4	yes	Immediately	X	X	X
1901.3	C3Array.Col01_Row03	Variable Column 1 Row 3	132/341.3	0x2301.3	Y4	yes	Immediately	X	X	X
1901.4	C3Array.Col01_Row04	Variable Column 1 Row 4	133/341.4	0x2301.4	Y4	yes	Immediately	X	X	X
1901.5	C3Array.Col01_Row05	Variable Column 1 Row 5	134/341.5	0x2301.5	Y4	yes	Immediately	X	X	X
1902.1	C3Array.Col02_Row01	variable Column 2 Row 1	135/342.1	0x2302.1	Y2	yes	Immediately	X	X	X
1902.2	C3Array.Col02_Row02	variable Column 2 Row 2	136/342.2	0x2302.2	Y2	yes	Immediately	X	X	X
1902.3	C3Array.Col02_Row03	variable Column 2 Row 3	137/342.3	0x2302.3	Y2	yes	Immediately	X	X	X
1907.3	C3Array.Col07_Row03	Variable Column 7 Row 3	162/347.3	0x2307.3	I32	yes	Immediately	X	X	X
685.1	C3.StatusVoltage_AuxiliaryVoltage	Status of auxiliary voltage	326	0x200F	E2_6	no	-	X	X	X
1100.1	C3Plus.DeviceControl_CommandOnRequest	Control command	108	0x2028	I16	yes	Immediately	X	X	X
1907.1	C3Array.Col07_Row01	variable Column 7 Row 1	160/347.1	0x2307.1	I32	yes	Immediately	X	X	X
170.3	C3Plus.AnalogInput0_FilterCoefficient	Filter of analog input 0			I16	no	VP	X	X	X
171.3	C3Plus.AnalogInput1_FilterCoefficient	Filter of analog input 1			I16	no	VP	X	X	X
2190.2	C3Plus.AutoCommutationControl_InitialCurrent	Start current of automatic commutation			U16	no	VP	X	X	X
2190.4	C3Plus.AutoCommutationControl_MotionReduction	Motion reduction Automatic commutation			U16	no	VP	X	X	X
2190.8	C3Plus.AutoCommutationControl_PeakCurrent	Reduction of the peak current			U16	no	VP	X	X	X
2190.3	C3Plus.AutoCommutationControl_PositionThreshold	Motion limit for automatic commutation			U16	no	VP	X	X	X
2190.1	C3Plus.AutoCommutationControl_Ramptime	Ramp slope current slope AK			U16	no	VP	X	X	X
1910.9	C3Array.Indirect_Col09	Indirect table access Column 9	189	0x2319	I32	yes	Immediately	X	X	X
2190.7	C3Plus.AutoCommutationControl_StandstillThreshold	Optimization of the standstill threshold			U16	no	VP	X	X	X
1910.8	C3Array.Indirect_Col08	Indirect table access Column 8	188	0x2318	I32	yes	Immediately	X	X	X
1100.3	C3Plus.DeviceControl_Controlword_1	Control word CW	1	0x6040	V2	yes	Immediately	-	X	X
1100.4	C3Plus.DeviceControl_Controlword_2	Control word 2	3	0x201B	V2	yes	Immediately	-	X	X
1100.5	C3Plus.DeviceControl_OperationMode	Operating mode	127/930	0x6060	I16	yes	Immediately	-	X	X
1000.5	C3Plus.DeviceState_ActualOperationMode	Operating mode display	128	0x6061	I16	yes	Immediately	-	X	X
1000.3	C3Plus.DeviceState_Statusword_1	Status word SW	2	0x6041	V2	yes	Immediately	-	X	X
1000.4	C3Plus.DeviceState_Statusword_2	Status word 2	4	0x201C	V2	yes	Immediately	-	X	X
85.3	C3Plus.Diagnostics_DCbus_Current	C3MP DC intermediate current			I16	no	-	X	X	X
85.2	C3Plus.Diagnostics_DCbus_Voltage	C3MP DC intermediate voltage			I16	no	-	X	X	X
85.5	C3Plus.Diagnostics_RectifierLoad	C3MP usage in %			I16	no	-	X	X	X
2190.10	C3Plus.AutoCommutationControl_Reset	Reset automatic commutation			U16	no	Immediately	X	X	X
1909.3	C3Array.Col09_Row03	Variable Column 9 Row 3	172/349.3	0x2309.3	I32	yes	Immediately	X	X	X
681.1	C3.StatusSpeed_DemandValue1	Speed command value of profile transmitter1	337	0x2053	Y4	yes	-	X	X	X
1907.4	C3Array.Col07_Row04	Variable Column 7 Row 4	163/347.4	0x2307.4	I32	yes	Immediately	X	X	X
1907.5	C3Array.Col07_Row05	Variable Column 7 Row 5	164/347.5	0x2307.5	I32	yes	Immediately	X	X	X
1908.1	C3Array.Col08_Row01	variable Column 8 Row 1	165/348.1	0x2308.1	I32	yes	Immediately	X	X	X
1908.2	C3Array.Col08_Row02	Variable Column 8 Row 2	166/348.2	0x2308.2	I32	yes	Immediately	X	X	X
1908.3	C3Array.Col08_Row03	Variable Column 8 Row 3	167/348.3	0x2308.3	I32	yes	Immediately	X	X	X
1908.4	C3Array.Col08_Row04	Variable Column 8 Row 4	168/348.4	0x2308.4	I32	yes	Immediately	X	X	X
1908.5	C3Array.Col08_Row05	Variable Column 8 Row 5	169/348.5	0x2308.5	I32	yes	Immediately	X	X	X
1900.1	C3Array.Pointer_Row	Pointer to table row	180	0x2300	U16	yes	Immediately	X	X	X
1909.2	C3Array.Col09_Row02	Variable Column 9 Row 2	171/349.2	0x2309.2	I32	yes	Immediately	X	X	X
1907.2	C3Array.Col07_Row02	Variable Column 7 Row 2	161/347.2	0x2307.2	I32	yes	Immediately	X	X	X
1909.4	C3Array.Col09_Row04	Variable Column 9 Row 4	173/349.4	0x2309.4	I32	yes	Immediately	X	X	X
1909.5	C3Array.Col09_Row05	Variable Column 9 Row 5	174/349.5	0x2309.5	I32	yes	Immediately	X	X	X
1910.1	C3Array.Indirect_Col01	Indirect table access Column 1	181	0x2311	Y4	yes	Immediately	X	X	X

No.	Object name	Object	PNU	CAN No.	Format	PD	Valid beginning	Device assignment		
								I11	I20	I21
1910.2	C3Array.Indirect_Col02	Indirect table access Column 2	182	0x2312	Y2	yes	Immediately	X	X	X
1910.3	C3Array.Indirect_Col03	Indirect table access Column 3	183	0x2313	I16	yes	Immediately	X	X	X
1910.4	C3Array.Indirect_Col04	Indirect table access Column 4	184	0x2314	I16	yes	Immediately	X	X	X
1910.5	C3Array.Indirect_Col05	Indirect table access Column 5	185	0x2315	I16	yes	Immediately	X	X	X
1910.6	C3Array.Indirect_Col06	Indirect table access Column 6	186	0x2316	I32	yes	Immediately	X	X	X
1910.7	C3Array.Indirect_Col07	Indirect table access Column 7	187	0x2317	I32	yes	Immediately	X	X	X
1909.1	C3Array.Col09_Row01	variable Column 9 Row 1	170/349.1	0x2309.1	I32	yes	Immediately	X	X	X

7.2 T30 Objects for the process data channel / the message

No.	Object name	Object	PNU	PZD	CAN No.	PD	Bus format	Word width
634.4	Setpoint for analog output 0	C3.AnalogOutput0_DemandValue	24	PED/PAD	0x2019	R/TPDO	I16	1
635.4	setpoint for analog output 1	C3.AnalogOutput1_DemandValue	103	PED/PAD	0x201A	R/TPDO	I16	1
120.3	Status of digital inputs	C3.DigitalInput_DebouncedValue	21	PED	0x6100.1	TPDO	V2	1
121.2	Input word of I/O option	C3.DigitalInputAddition_Value	175	PED	0x6100.2	TPDO	V2	1
133.3	Output word for I/O option	C3.DigitalOutputAddition_Value	176	PED/PAD	0x6300.2	R/TPDO	V2	1
140.3	Command value of the digital outputs	C3.DigitalOutputWord_DemandState	22	PED/PAD	0x6300.1	R/TPDO	V2	1
2020.1	Position from external signal source	C3.ExternalSignal_Position		PED	0x2095.1	TPDO	C4_3	2
3921.1	Interpolation input CanSync, PowerLink	C3.FBI_SignalProcessing0_Input		PED/PAD	0x2050	R/TPDO	I32	2
683.1	Status of actual current value	C3.StatusDevice_ActualCurrent	112	PED	0x6077	TPDO	E2_6	1
680.5	Status actual position	C3.StatusPosition_Actual	28	PED	0x6064	TPDO	C4_3	2
680.4	Status demand position	C3.StatusPosition_DemandValue	323	PED	0x60FC	TPDO	C4_3	2
680.1	Position command value of Profile transmitter1	C3.StatusPosition_DemandValue1	0	PED	0x2052	TPDO	Y4	2
680.10	Status of encoder input 0 (5V)	C3.StatusPosition_EncoderInput5V		PED	0x2095.2	TPDO	C4_3	2
680.6	Status of tracking error	C3.StatusPosition_FollowingError	100	PED	0x60F4	TPDO	C4_3	2
681.5	Status actual speed unfiltered	C3.StatusSpeed_Actual	8	PED	0x6069	TPDO	C4_3	2
681.9	Status actual speed filtered	C3.StatusSpeed_ActualFiltered		PED	0x606C	TPDO	C4_3	2
681.7	Status of the actual filtered speed speed in the Y2 format	C3.StatusSpeed_ActualFiltered_Y2	6	PED	0x2023	TPDO	Y2	1
681.8	Status of the actual filtered peed in the Y4 format	C3.StatusSpeed_ActualFiltered_Y4	117	PED	0x2024	TPDO	Y4	2
681.4	Status demand speed of setpoint generator	C3.StatusSpeed_DemandValue	324	PED	0x606B	TPDO	C4_3	2
681.1	Speed command value of profile transmitter1	C3.StatusSpeed_DemandValue1	337	PED	0x2053	TPDO	Y4	2
681.6	Status control deviation of speed	C3.StatusSpeed_Error	101	PED	0x2027	TPDO	C4_3	2
685.3	Status of analog input 0	C3.StatusVoltage_AnalogInput0	23	PED	0x2025	TPDO	Y2	1
685.4	Status of analog input 1	C3.StatusVoltage_AnalogInput1	102	PED	0x2026	TPDO	Y2	1
1901.1	variable Column 1 Row 1	C3Array.Col01_Row01	130/341.1	PED/PAD	0x2301.1	R/TPDO	Y4	2
1901.2	Variable Column 1 Row 2	C3Array.Col01_Row02	131/341.2	PED/PAD	0x2301.2	R/TPDO	Y4	2
1901.3	Variable Column 1 Row 3	C3Array.Col01_Row03	132/341.3	PED/PAD	0x2301.3	R/TPDO	Y4	2
1901.4	Variable Column 1 Row 4	C3Array.Col01_Row04	133/341.4	PED/PAD	0x2301.4	R/TPDO	Y4	2
1901.5	Variable Column 1 Row 5	C3Array.Col01_Row05	134/341.5	PED/PAD	0x2301.5	R/TPDO	Y4	2
1902.1	variable Column 2 Row 1	C3Array.Col02_Row01	135/342.1	PED/PAD	0x2302.1	R/TPDO	Y2	1
1902.2	variable Column 2 Row 2	C3Array.Col02_Row02	136/342.2	PED/PAD	0x2302.2	R/TPDO	Y2	1
1902.3	variable Column 2 Row 3	C3Array.Col02_Row03	137/342.3	PED/PAD	0x2302.3	R/TPDO	Y2	1
1902.4	Variable Column 2 Row 4	C3Array.Col02_Row04	138/342.4	PED/PAD	0x2302.4	R/TPDO	Y2	1
1902.5	Variable Column 2 Row 5	C3Array.Col02_Row05	139/342.5	PED/PAD	0x2302.5	R/TPDO	Y2	1
1903.1	variable Column 3 Row 1	C3Array.Col03_Row01	140/343.1	PED/PAD	0x2303.1	R/TPDO	I16	1
1903.2	Variable Column 3 Row 2	C3Array.Col03_Row02	141/343.2	PED/PAD	0x2303.2	R/TPDO	I16	1
1903.3	Variable Column 3 Row 3	C3Array.Col03_Row03	142/343.3	PED/PAD	0x2303.3	R/TPDO	I16	1
1903.4	Variable Column 3 Row 4	C3Array.Col03_Row04	143/343.4	PED/PAD	0x2303.4	R/TPDO	I16	1
1903.5	Variable Column 3 Row 5	C3Array.Col03_Row05	144/343.5	PED/PAD	0x2303.5	R/TPDO	I16	1
1904.1	variable Column 4 Row 1	C3Array.Col04_Row01	145/344.1	PED/PAD	0x2304.1	R/TPDO	I16	1
1904.2	Variable Column 4 Row 2	C3Array.Col04_Row02	146/344.2	PED/PAD	0x2304.2	R/TPDO	I16	1
1904.3	Variable Column 4 Row 3	C3Array.Col04_Row03	147/344.3	PED/PAD	0x2304.3	R/TPDO	I16	1
1904.4	Variable Column 4 Row 4	C3Array.Col04_Row04	148/344.4	PED/PAD	0x2304.4	R/TPDO	I16	1
1904.5	Variable Column 4 Row 5	C3Array.Col04_Row05	149/344.5	PED/PAD	0x2304.5	R/TPDO	I16	1
1905.1	variable Column 5 Row 1	C3Array.Col05_Row01	150/345.1	PED/PAD	0x2305.1	R/TPDO	I16	1
1905.2	Variable Column 5 Row 2	C3Array.Col05_Row02	151/345.2	PED/PAD	0x2305.2	R/TPDO	I16	1
1905.3	Variable Column 5 Row 3	C3Array.Col05_Row03	152/345.3	PED/PAD	0x2305.3	R/TPDO	I16	1
1905.4	Variable Column 5 Row 4	C3Array.Col05_Row04	153/345.4	PED/PAD	0x2305.4	R/TPDO	I16	1
1905.5	Variable Column 5 Row 5	C3Array.Col05_Row05	154/345.5	PED/PAD	0x2305.5	R/TPDO	I16	1
1906.1	variable Column 6 Row 1	C3Array.Col06_Row01	155/346.1	PED/PAD	0x2306.1	R/TPDO	I32	2
1906.2	Variable Column 6 Row 2	C3Array.Col06_Row02	156/346.2	PED/PAD	0x2306.2	R/TPDO	I32	2
1906.3	Variable Column 6 Row 3	C3Array.Col06_Row03	157/346.3	PED/PAD	0x2306.3	R/TPDO	I32	2
1906.4	Variable Column 6 Row 4	C3Array.Col06_Row04	158/346.4	PED/PAD	0x2306.4	R/TPDO	I32	2
1906.5	Variable Column 6 Row 5	C3Array.Col06_Row05	159/346.5	PED/PAD	0x2306.5	R/TPDO	I32	2
1907.1	variable Column 7 Row 1	C3Array.Col07_Row01	160/347.1	PED/PAD	0x2307.1	R/TPDO	I32	2
1907.2	Variable Column 7 Row 2	C3Array.Col07_Row02	161/347.2	PED/PAD	0x2307.2	R/TPDO	I32	2
1907.3	Variable Column 7 Row 3	C3Array.Col07_Row03	162/347.3	PED/PAD	0x2307.3	R/TPDO	I32	2
1907.4	Variable Column 7 Row 4	C3Array.Col07_Row04	163/347.4	PED/PAD	0x2307.4	R/TPDO	I32	2
1907.5	Variable Column 7 Row 5	C3Array.Col07_Row05	164/347.5	PED/PAD	0x2307.5	R/TPDO	I32	2
1908.1	variable Column 8 Row 1	C3Array.Col08_Row01	165/348.1	PED/PAD	0x2308.1	R/TPDO	I32	2
1908.2	Variable Column 8 Row 2	C3Array.Col08_Row02	166/348.2	PED/PAD	0x2308.2	R/TPDO	I32	2
1908.3	Variable Column 8 Row 3	C3Array.Col08_Row03	167/348.3	PED/PAD	0x2308.3	R/TPDO	I32	2
1908.4	Variable Column 8 Row 4	C3Array.Col08_Row04	168/348.4	PED/PAD	0x2308.4	R/TPDO	I32	2
1908.5	Variable Column 8 Row 5	C3Array.Col08_Row05	169/348.5	PED/PAD	0x2308.5	R/TPDO	I32	2
1909.1	variable Column 9 Row 1	C3Array.Col09_Row01	170/349.1	PED/PAD	0x2309.1	R/TPDO	I32	2
1909.2	Variable Column 9 Row 2	C3Array.Col09_Row02	171/349.2	PED/PAD	0x2309.2	R/TPDO	I32	2
1909.3	Variable Column 9 Row 3	C3Array.Col09_Row03	172/349.3	PED/PAD	0x2309.3	R/TPDO	I32	2
1909.4	Variable Column 9 Row 4	C3Array.Col09_Row04	173/349.4	PED/PAD	0x2309.4	R/TPDO	I32	2
1909.5	Variable Column 9 Row 5	C3Array.Col09_Row05	174/349.5	PED/PAD	0x2309.5	R/TPDO	I32	2
1910.1	Indirect table access Column 1	C3Array.Indirect_Col01	181	PED/PAD	0x2311	R/TPDO	Y4	2
1910.2	Indirect table access Column 2	C3Array.Indirect_Col02	182	PED/PAD	0x2312	R/TPDO	Y2	1
1910.3	Indirect table access Column 3	C3Array.Indirect_Col03	183	PED/PAD	0x2313	R/TPDO	I16	1
1910.4	Indirect table access Column 4	C3Array.Indirect_Col04	184	PED/PAD	0x2314	R/TPDO	I16	1
1910.5	Indirect table access Column 5	C3Array.Indirect_Col05	185	PED/PAD	0x2315	R/TPDO	I16	1
1910.6	Indirect table access Column 6	C3Array.Indirect_Col06	186	PED/PAD	0x2316	R/TPDO	I32	2
1910.7	Indirect table access Column 7	C3Array.Indirect_Col07	187	PED/PAD	0x2317	R/TPDO	I32	2
1910.8	Indirect table access Column 8	C3Array.Indirect_Col08	188	PED/PAD	0x2318	R/TPDO	I32	2
1910.9	Indirect table access Column 9	C3Array.Indirect_Col09	189	PED/PAD	0x2319	R/TPDO	I32	2
1900.1	Pointer to table row	C3Array.Pointer_Row	180	PED/PAD	0x2300	R/TPDO	U16	1
1100.1	Control command	C3Plus.DeviceControl_CommandOnRequest	108	PED/PAD	0x2028	R/TPDO	I16	1
1100.3	Control word CW	C3Plus.DeviceControl_Controlword_1	1	PED/PAD	0x6040	R/TPDO	V2	1
1100.4	Control word 2	C3Plus.DeviceControl_Controlword_2	3	PED/PAD	0x201B	R/TPDO	V2	1
1100.5	Operating mode	C3Plus.DeviceControl_OperationMode	127/930	PED/PAD	0x6060	R/TPDO	I16	1
1000.5	Operating mode display	C3Plus.DeviceState_ActualOperationMode	128	PED/PAD	0x6061	R/TPDO	I16	1
1000.3	Status word SW	C3Plus.DeviceState_Statusword_1	2	PED/PAD	0x6041	R/TPDO	V2	1
1000.4	Status word 2	C3Plus.DeviceState_Statusword_2	4	PED/PAD	0x201C	R/TPDO	V2	1
550.1	Current error (n)	C3Plus.ErrorHistory_LastError	115/947.0	PED	0x603F/0x201D.1	TPDO	U16	1

No.	Object name	Object	PNU	PZD	CAN No.	PD	Bus format	Word width
402.6	Factor for the current limits	C3Plus.Limit_CurrentFine		PED/PAD	0x2093	R/TPDO	I16	1
1111.3	Acceleration for positioning	C3Plus.POSITION_accel	114	PED/PAD	0x6083	R/TPDO	U32	2
1111.4	Deceleration for positioning	C3Plus.POSITION_decel	312	PED/PAD	0x6084	R/TPDO	U32	2
1111.1	Target position	C3Plus.POSITION_position	27	PED/PAD		R/TPDO	C4_3	2
1111.2	Speed for positioning	C3Plus.POSITION_speed	111	PED/PAD		R/TPDO	C4_3	2
2000.1	Position value of the setpoint encoder	C3Plus.ProfilGenerators_SG1Position		PED	0x2060	TPDO	C4_3	2
2000.4	Speed of the setpoint encoder	C3Plus.ProfilGenerators_SG1Speed		PED	0x2063	TPDO	I32	2
152.1	PIO analog input 0	C3Plus.RemoteAnalogInput_I0		PED/PAD	0x2082.1	R/TPDO	I16	1
152.2	PIO analog input 1	C3Plus.RemoteAnalogInput_I1		PED/PAD	0x2082.2	R/TPDO	I16	1
152.3	PIO analog input 2	C3Plus.RemoteAnalogInput_I2		PED/PAD	0x2082.3	R/TPDO	I16	1
152.4	PIO analog input 3	C3Plus.RemoteAnalogInput_I3		PED/PAD	0x2082.4	R/TPDO	I16	1
153.1	PIO analog output 0	C3Plus.RemoteAnalogOutput_O0		PED/PAD	0x2083.1	R/TPDO	I16	1
153.2	PIO analog output 1	C3Plus.RemoteAnalogOutput_O1		PED/PAD	0x2083.2	R/TPDO	I16	1
153.3	PIO analog output 2	C3Plus.RemoteAnalogOutput_O2		PED/PAD	0x2083.3	R/TPDO	I16	1
153.4	PIO analog output 3	C3Plus.RemoteAnalogOutput_O3		PED/PAD	0x2083.4	R/TPDO	I16	1
150.1	Digital PIO inputs 0...15	C3Plus.RemoteDigInput_I0_15		PED/PAD	0x2080.1	R/TPDO	V2	1
150.2	Digital PIO inputs 16...31	C3Plus.RemoteDigInput_I16_31		PED/PAD	0x2080.2	R/TPDO	V2	1
150.3	Digital PIO inputs 32...47	C3Plus.RemoteDigInput_I32_47		PED/PAD	0x2080.3	R/TPDO	V2	1
150.4	Digital PIO inputs 48...63	C3Plus.RemoteDigInput_I48_63		PED/PAD	0x2080.4	R/TPDO	V2	1
151.1	Digital PIO outputs 0...15	C3Plus.RemoteDigOutput_O0_15		PED/PAD	0x2081.1	R/TPDO	V2	1
151.2	Digital PIO outputs 16...31	C3Plus.RemoteDigOutput_O16_31		PED/PAD	0x2081.2	R/TPDO	V2	1
151.3	Digital PIO outputs 32...47	C3Plus.RemoteDigOutput_O32_47		PED/PAD	0x2081.3	R/TPDO	V2	1
151.4	Digital PIO outputs 48...63	C3Plus.RemoteDigOutput_O48_63		PED/PAD	0x2081.4	R/TPDO	V2	1
1127.3	Target speed in speed control operating mode	C3Plus.SPEED_speed	7	PED/PAD		R/TPDO	C4_3	2
683.8	Motor current in per thousand of the actual current limit	C3Plus.StatusDevice_MotorCurrent		PED	0x2094	TPDO	I16	1
680.8	Status position actual value in the bus format Y4	C3Plus.StatusPosition_Actual_Y4	119	PED	0x2022	TPDO	Y4	2

7.3 Detailed object list

A detailed object list can be found in the corresponding online help.

8. Status values

In this chapter you can read about:

D/A-Monitor	456
Status values	456

A list of the status values supports you in optimization and commissioning. Open the optimization function in the C3 ServoManager (double-click on optimization in the tree)

You will find the available status values in the lower right part of the window under selection (TAB) "Status values"

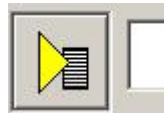
You can pull them into the oscilloscope (upper part of the left side) or into the status display (upper part of the right side) by the aid of the mouse (drag and drop). The status values are divided into 2 groups (user levels):

standard: here you can find all important status values

advanced: advanced status values, require a better knowledge

Switching of the user level

The user level can be changed in the optimization window (left hand side lower part under selection (TAB) "optimization") with the following button.



8.1 D/A-Monitor

A part of the status values can be output via the D/A monitor channel 0 (X11/4) and channel 1 (X11/3). In the following status list under D/A monitor output: possible / not possible).

The reference for the output voltage can be entered individually in the reference unit of the status value.

Example: Output Object 2210.2: (actual position unfiltered)

In order to get an output voltage of 10V at 3000min^{-1} , please enter 50Umd/s ($=3000\text{min}^{-1}$) as "value of the signal at 10V".

Hint

The unit of measurement of the D/A monitor values differs from the unit of measurement of the status values.

8.2 Status values

Additional information on the topic of "status values" can be found in the online help of the device.

9. Error

Standard error reactions:

Reaction 2: Downramp with "de-energize" then **apply brake** (see page 290) and finally de-energize.

For errors with standard reaction 2 the **error reaction can be changed** (see page 150, see page 334).

Reaction 5: switch-off of the current immediately (without ramp), application of the brake.

Caution! A Z-axis may drop down due to the brake delay times

Most pending errors can be acknowledged with Quit!

The following errors must be acknowledged with Power on:

0x7381, 0x7382, 0x7391, 0x7392, 0x73A0

Object 550.1 displays error:
value 1 means "no error".

The errors as well as the error history can be viewed in the C3 ServoManager under optimization (at the top right of the optimization window).

9.1 Error list

Detailed information on the topic of the "error list" can be found in the online help of the device.

10. Order code

<u>In this chapter you can read about:</u>	
Order code device: Compax3.....	459
Order code for mains module: Compax3MP	460
Accessories order code	460

10.1 Order code device: Compax3

Example: C3S025V2F10I10T10M00

Device model: Compax3

Single axis

Highpower

Multi-axis device

Device currents static/dynamic; supply voltage

2.5A / 5A ; 230VAC (single phase)

6.3A / 12.6A ; 230VAC (single phase)

10A / 20A ; 230VAC (three phase)

15A / 30A ; 230VAC (three phase)

1.5A / 4.5A ; 400VAC (three phase)

3.8A / 7.5A ; 400VAC (three phase)

7.5A / 15.0A ; 400VAC (three phase)

15.0A / 30.0A ; 400VAC (three phase)

30.0A / 60.0A ; 400VAC (three phase)

50A / 75A ; 400VAC (three phase)

90A / 135A ; 400VAC (three phase)

125A / 187.5A ; 400VAC (three phase)*

155A / 232.5A ; 400VAC (three phase)*

5.0A / 10.0A ; 400VAC (three phase)

10A / 20A ; 400VAC (three phase)

15A / 30A ; 400VAC (three phase)

30A / 60A ; 400VAC (three phase)

Feedback:

Resolver Feedback

SinCos® (Hiperface)

Encoder, Sine-cosine with/without hall

Interface:

Step/direction / analogue input

Positioning with inputs/outputs

Positioning via I/Os or RS232 / RS485/USB

Profibus DP V0/V1/V2 (12Mbaud)

CANopen

DeviceNet

Ethernet Powerlink

EtherCAT

C3 powerPLmC (Multi-axis control)

C3 powerPLmC (Multi-axis control) with Profibus

Technology functions:

Positioning

Motion control programmable according to IEC61131-3

Motion control programmable according to IEC61131-3 & electronic cam extension

Options:

no additional supplement

Expansion 12 digital I/Os & HEDA (Motionbus)

HEDA (Motionbus)

Expansion, 12 digital I/Os

Safety technology only C3M:

no safety technology

Safe torque off

*external voltage supply for ventilator fan required. Available in two versions for single phase feed:

Standard: 220/240VAC: 140W, on request: 110/120VAC: 130W

10.2 Order code for mains module: Compax3MP

Example: C3MP10D6USBM00

Device model: Compax3M

Power module

Nominal power; supply voltage

10kW; 400VAC (3-phase)

20kW; 400VAC (3-phase)

Interface:

USB connection

Options:

no additional supplement

C3M	P		D6	USB	M00
	P				
		10	D6		
		20	D6		
				USB	
					M00

10.3 Accessories order code

Order Code connection set for Compax3S

for C3S0xxV2	ZBH 02/01	ZBH	0	2	/	0	1		
for C3S0xxV4 / S150V4 / S1xxV2	ZBH 02/02	ZBH	0	2	/	0	2		
for C3S300V4	ZBH 02/03	ZBH	0	2	/	0	3		

Order Code connection set for Compax3MP/Compax3M

for C3M050D6, C3M100D6, C3M150D6	ZBH 04/01	ZBH	0	4	/	0	1		
for C3M300D6	ZBH 04/02	ZBH	0	4	/	0	2		
for C3MP10	ZBH 04/03	ZBH	0	4	/	0	3		
C3MP20	ZBH 04/03	ZBH	0	4	/	0	4		

Order code for feedback cables

for Resolver ⁽²⁾	for MH / SMH motors	REK	4	2	/	...	...	⁽¹⁾	
for Resolver ⁽²⁾	for MH / SMH motors (cable chain compatible)	REK	4	1	/	...	...	⁽¹⁾	
for SinCos® – Feedback devices ⁽²⁾	for MH / SMH motors (cable chain compatible)	GBK	2	4	/	..	...	⁽¹⁾	
for EnDat 2.1 ⁽²⁾	for MH / SMH motors (cable chain compatible)	GBK	3	8	/	..	...	⁽¹⁾	
Encoder – Compax3		GBK	2	3	/	...	...	⁽¹⁾	
for LXR linear motors	(cable chain compatible)	GBK	3	3	/	...	...	⁽¹⁾	
for BLMA linear motors	(cable chain compatible)	GBK	3	2	/	...	...	⁽¹⁾	

^(x) **Note on the cable** (see page 463)

Order code for motor cables⁽²⁾

for SMH / MH56 / MH70 / MH105 ⁽³⁾	(1.5mm ² ; up to 13.8A)		MOK	5	5	/	...	...	⁽¹⁾
for SMH / MH56 / MH70 / MH105 ⁽³⁾	(1.5mm ² ; up to 13.8A)	(cable chain compatible)	MOK	5	4	/	...	...	⁽¹⁾
for SMH / MH56 / MH70 / MH105 ⁽³⁾	(2.5mm ² ; up to 18.9A)		MOK	5	6	/	...	...	⁽¹⁾
for SMH / MH56 / MH70 / MH105 ⁽³⁾	(2.5mm ² ; up to 18.9A)	(cable chain compatible)	MOK	5	7	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(1.5mm ² ; up to 13.8A)		MOK	6	0	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(1.5mm ² ; up to 13.8A)	(cable chain compatible)	MOK	6	3	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(2.5mm ² ; up to 18.9A)		MOK	5	9	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(2.5mm ² ; up to 18.9A)	(cable chain compatible)	MOK	6	4	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(6mm ² ; up to 32.3A)	(cable chain compatible)	MOK	6	1	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(10mm ² ; up to 47.3A)	(cable chain compatible)	MOK	6	2	/	...	...	⁽¹⁾

^(x) Note on the cable (see page 463)

Order Code braking resistors

for C3S063V2 or C3S075V4	56Ω / 0.18kW _{cont}		BRM	0	5	/	0	1	
for C3S075V4	56Ω / 0.57kW _{cont}		BRM	0	5	/	0	2	
for C3S025V2 or C3S038V4	100Ω / 60W _{cont}		BRM	0	8	/	0	1	
for C3S150V4	47Ω / 0.57kW _{cont}		BRM	1	0	/	0	1	
for C3S150V2, C3S300V4 and C3MP20D6	4/01:15Ω / 0.57kW _{cont} 4/02:15Ω / 0.74kW _{cont}		BRM	0	4	/	0	...	
for C3S300V4 and C3MP20D6	4/03:15Ω / 1.5kW _{cont}								
for C3S100V2	22Ω / 0.45kW _{cont}		BRM	0	9	/	0	1	
for C3H0xxV4	27Ω / 3.5kW _{cont}		BRM	1	1	/	0	1	
for C3MP10D6 and with C3MP20D6 (2x30Ω parallel)	30Ω / 0.5kW _{cont}		BRM	1	3	/	0	1	
for C3MP10D6, (2x15Ω in series) CeMP20D6	15Ω / 0.5kW _{cont}		BRM	1	4	/	0	1	
for C3H1xxV4	18Ω / 4.5kW _{cont}		BRM	1	2	/	0	1	

Order code mains filter Compax3S

for C3S025V2 or S063V2			NFI	0	1	/	0	1	
for C3S0xxV4, S150V4 or S1xxV2			NFI	0	1	/	0	2	
for C3S300V4			NFI	0	1	/	0	3	

Order code mains filter Compax3H

for C3H050V4			NFI	0	2	/	0	1	
for C3H090V4			NFI	0	2	/	0	2	
for C3H1xxV4			NFI	0	2	/	0	3	

Order code mains filter Compax3MP

for C3MP10	Reference axis combination 3x480V 25A 6x10m motor cable length		NFI	0	3	/	0	1	
for C3MP10	Reference axis combination 3x480V 25A 6x50m motor cable length		NFI	0	3	/	0	2	
for C3MP20	Reference axis combination 3x480V 50A 6x50m motor cable length		NFI	0	3	/	0	3	

Order code for motor output filter (for Compax3S, Compax3M >20m motor cable)

up to 6,3 A rated motor current	MDR	0	1	/	0 4
Up to 16 A rated motor current	MDR	0	1	/	0 1
up to 30 A rated motor current	MDR	0	1	/	0 2

Order code for interface cables and plugs

PC – Compax3 (RS232)	SSK	0	1	/	... ⁽¹⁾
PC - Compax3MP (USB)	SSK	3	3	/	... ⁽¹⁾
on X11 (Ref/Analog) and X13 at C3F001D2	SSK	2	1	/	... ⁽¹⁾
on X12 / X22 (I/Os digital)	SSK	2	2	/	... ⁽¹⁾
on X11 (Ref/Analog)	SSK	2	3	/	... ⁽¹⁾
on X12 / X22 (I/Os digital)	SSK	2	4	/	... ⁽¹⁾
PC ⇔ POP (RS232)	SSK	2	5	/	... ⁽¹⁾
Compax3 ⇔ POP (RS485) for several C3H on request	SSK	2	7	/	... ⁽⁶⁾
Compax3 HEDA ⇔ Compax3 HEDA or PC ⇔ C3powerPLmC	SSK	2	8	/	... ⁽⁵⁾
Compax3 I30 ⇔ Compax3 I30 or C3M-multi-axis communication					
Compax3 X11 ⇔ Compax3 X11 (encoder coupling of 2 axes)	SSK	2	9	/	... ⁽¹⁾
Compax3 X10 ⇔ Modem	SSK	3	1	/	...
Compax3H adapter cable ⇔ SSK01 (length 15cm, delivered with the device)	SSK	3	2	/	2 0
Compax3H X10 RS232 connection control ⇔ Programming interface (delivered with the device)	VBK	1	7	/	0 1
Bus terminal connector (for the 1st and last Compax3 in the HEDA Bus/or multi-axis system).	BUS	0	7	/	0 1
Profibus cable ⁽²⁾	SSL	0	1	/	... ⁽¹⁾
Profibus plug	BUS	0	8	/	0 1
CAN-Bus cable ⁽²⁾	SSL	0	2	/	... ⁽¹⁾
CANbus connector	BUS	1	0	/	0 1

(x) **Note on the cable** (see page 463)**Order Code operating module**

Operating module (for Compax3S and Compax3F)	BDM	0	1	/	0 1

Order Code terminal block

for I/Os without luminous indicator	for X11, X12, X22	EAM	0	6	/ 0 1
for I/Os with luminous indicator	for X12, X22	EAM	0	6	/ 0 2

Order Code decentralized input terminals

PIO 2DI 24VDC 3.0ms	2-channel digital input terminal	PIO	4	0	0
PIO 4DI 24VDC 3.0ms	4-channel digital input terminal	PIO	4	0	2
PIO 8DI 24VDC 3.0ms	8-channel digital input terminal	PIO	4	3	0
PIO 2AI DC ± 10V differential input	2 channel analog input terminal (± 10V differential input)	PIO	4	5	6
PIO 4AI 0-10VDC S.E.	4 channel analog input terminal (0-10V signal voltage)	PIO	4	6	8
PIO 2AI 0 -20mA differential input	2 channel analog input terminal (0 -20mA differential input)	PIO	4	8	0

Order Code decentralized output terminals

PIO 2DO 24VDC 0.5A	2 channel digital output terminal (output voltage 0.5A)	PIO	5	0	1
PIO 4DO 24VDC 0.5A	4 channel digital output terminal (output voltage 0.5A)	PIO	5	0	4
PIO 8DO 24VDC 0.5A	8 channel digital output terminal (output voltage 0.5A)	PIO	5	3	0
PIO 2AO 0-10VDC	2 channel analog output terminal (0-10V signal voltage)	PIO	5	5	0
PIO 2AO 0 -20mA	2 channel analog output terminal (0-20mA signal voltage)	PIO	5	5	2
PIO 2AO DC ± 10V	2 channel analog output terminal (± 10V signal voltage)	PIO	5	5	6

Order Code CANopen Fieldbus Coupler

CANopen Standard	max. vectorial sum current for bus terminals 1650mA at 5V
CANopen ECO	max. vectorial sum current for bus terminals 650mA at 5V

PIO	3	3	7	
PIO	3	4	7	

⁽¹⁾ Length code 1

Length [m]	1,0	2,5	5,0	7,5	10,0	12,5	15,0	20,0	25,0	30,0	35,0	40,0	45,0	50,0
Order code	01	02	03	04	05	06	07	08	09	10	11	12	13	14

Example:

SSK01/09: length 25m

⁽²⁾ Colours according to DESINA⁽³⁾ with motor plug⁽⁴⁾ with cable eye for motor terminal box⁽⁵⁾ Length code 2 for SSK28

Length [m]	0,17	0,25	0,5	1,0	3,0	5,0	10,0
Order code	23	20	21	01	22	03	05

⁽⁶⁾ Order code: SSK27/nn/..

Length A (Pop - 1. Compax3) variable (the last two numbers according to the length code for cable, for example SSK27/nn/01)

Length B (1. Compax3 - 2. Compax3 - ... - n. Compax3) fixed 50 cm (only if there is more than 1 Compax3, i.e. nn greater than 01)

Number n (the last two digits)

Examples:

SSK27/05/.. for connecting from Pop to 5 Compax3.

SSK27/01/.. for connection from Pop to one Compax3

MOK55 and MOK54 can also be used for linear motors LXR406, LXR412 and BLMA.

^(x) Note on the cable (see page 463)

11. Compax3 Accessories

In this chapter you can read about:

Parker servo motors	465
EMC measures	467
Connections to the motor	473
External braking resistors	481
Connection set for Compax3S	494
Connection set for Compax3MP/Compax3M	495
Operator control module BDM	495
EAM06: Terminal block for inputs and outputs	496
Interface Cables	499
Options M1x	506
Profibus plug BUS08/01	510
CAN - plug BUS10/01	511
PIO: Inputs/Outputs	512

11.1 Parker servo motors

In this chapter you can read about:

Direct drives.....	465
Rotary servo motors	466

11.1.1. Direct drives

In this chapter you can read about:

Feedback systems for direct drives	465
Linear motors.....	466
Torque motors	466

11.1.1.1 Feedback systems for direct drives

The Feedback option F12 makes it possible to operate linear motors as well as torque motors. Compax3 supports the following feedback systems:

Special encoder systems for direct drives	Option F12
Analog hall sensors	◆ Sine - cosine signal (max. 5Vss; typical 1Vss) 90° offset ◆ U-V Signal (max. 5Vss; typical 1Vss) 120° offset.
Encoder (linear or rotatory)	◆ Sine-cosine (max. 5Vss; typical 1Vss) (max. 400kHz) or ◆ TTL (RS422) (max. 5MHz) with the following modes of commutation: ◆ automatic commutation (see page 465) or ◆ Digital hall sensors (e.g. DiCoder®)
Digital, bidirectional interface	◆ All EnDat 2.1 or EnDat 2.2 feedback systems with incremental track (sine-cosine track) ◆ linear or rotary ◆ max. 400kHz Sine-Cosine
Distance coded feedback systems	◆ Distance coding with 1VSS - Interface ◆ Distance coding with RS422 - Interface (Encoder)

The motor performs automatic commutation after:

- ◆ Power on,
- ◆ A configuration download or
- ◆ An IEC program download

The time duration (typically 5-10 sec) of automatic commutation can be optimized with the start current (see in the optimization display of the C3 ServoManager; given as a percentage of the reference current). Note that values that are too high will cause Error 0x73A6 to be triggered.

Typically the motor moves by 4% of the pitch length or, with rotary direct drives 4% of 360°/number of pole pairs - maximum 50%.

Note the following conditions for automatic commutation

- ◆ During automatic commutation the end limits are not monitored.
- ◆ Actively working load torques are not permitted during automatic commutation.
- ◆ Static friction deteriorates the effect of automatic commutation.
- ◆ With the exception of missing commutation information, the controller/motor combination is configured and ready for operation (parameters correctly assigned for the linear motor/drive). The feedback and the direction of the field of rotation in effect must match.
- ◆ The auto-commutating function must be adapted to fit the mechanics if necessary during commissioning.

11.1.1.2 Linear motors

Parker offers you a number of systems of linear motor drives:

<u>Linear motors</u>	Feed force (continuous/dynamic)	Stroke length:
LMDT ironless linear servo motors:	26 ... 1,463N	almost any
LMI iron-cored linear servo motors:	52 ... 6,000N	64 ... 999mm
Linear motors of the LXR series:	315N / 1,000N	up to 3m
Linear motor module BLMA:	605N / 1,720N	up to 6m

11.1.1.3 Torque motors

Parker offers you an extensive range of torque motors that can be adapted to your application. Please contact us for information.
Additional information can be found on the **Internet** <http://www.parker-automation.com> in the direct drives section.

11.1.2. Rotary servo motors

Parker offers you an extensive range of servo motors that can be adapted to your application. Please contact us for information.
Additional information can be found on the **Internet**
(http://apps.parker.com/divapps/eme/EME/Literature_List/dokumentationen/SMH_MH_Kat%20dt.pdf, ,
http://apps.parker.com/divapps/eme/EME/Literature_List/dokumentationen/SMH_MH_Cat%20fra.pdf, ,
http://apps.parker.com/divapps/eme/EME/Literature_List/dokumentationen/SMH_MH_Cat%20engl.pdf,)
or on the CD supplied in the documentations file:
Catalogue = SMH_MH_Kat engl.pdf
User guide = SMH_MH-Manual engl.pdf

Suitable servo motors for Compax3H are available on request!

11.2 EMC measures

In this chapter you can read about:

Mains filter	467
Motor output filter.....	471
Mains filter	472

11.2.1. Mains filter

For radio disturbance suppression and for complying with the emission limit values for **CE conform operation** (see page 19) we offer mains filters:

Observe the maximum permitted length of the connection between the mains filter and the device:

- ◆ unshielded < 0.5m;
- ◆ shielded < 5m (fully shielded on ground – e.g. ground of control cabinet)

Order code mains filter Compax3S

				/					
for C3S025V2 or S063V2	NFI	0	1	/	0	1			
for C3S0xxV4, S150V4 or S1xxV2	NFI	0	1	/	0	2			
for C3S300V4	NFI	0	1	/	0	3			

Order code mains filter Compax3MP

				/					
for C3MP10	Reference axis combination 3x480V 25A 6x10m motor cable length	NFI	0	3	/	0	1		
for C3MP10	Reference axis combination 3x480V 25A 6x50m motor cable length	NFI	0	3	/	0	2		
for C3MP20	Reference axis combination 3x480V 50A 6x50m motor cable length	NFI	0	3	/	0	3		

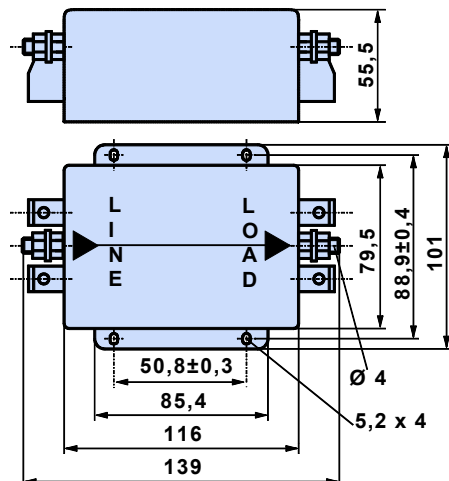
Order code mains filter Compax3H

				/					
for C3H050V4	NFI	0	2	/	0	1			
for C3H090V4	NFI	0	2	/	0	2			
for C3H1xxV4	NFI	0	2	/	0	3			

11.2.1.1 Mains filter NFI01/01

for Compax3 S025 V2 and Compax3 S063 V2

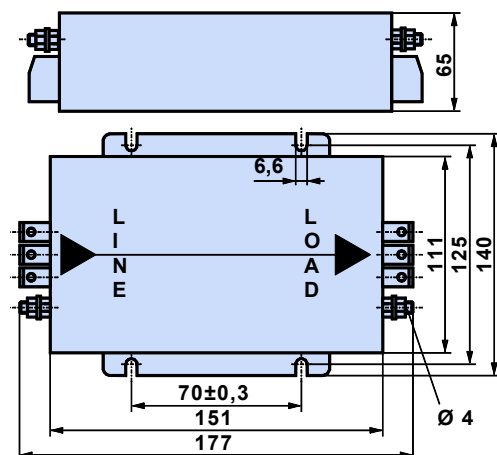
Dimensional drawing:



11.2.1.2 Mains filter NFI01/02

for Compax3 S0xx V4, Compax3 S150 V4 and Compax3 S1xx V2

Dimensional drawing:



for Compax3 S300

Technical drawing of the 'LINE LOAD' device, showing front and side views with dimensions.

Front View Dimensions:

- Overall width: 240
- Overall height: 159
- Internal width (between mounting holes): 217
- Internal height (between mounting holes): 145 ± 0,5
- Mounting hole diameter: Ø 4
- Distance from top edge to top mounting hole: 6,6
- Distance from bottom edge to bottom mounting hole: 6,6
- Distance from left edge to left mounting hole: 115 ± 0,3
- Distance from right edge to right mounting hole: 115 ± 0,3

Side View Dimensions:

- Overall height: 64

Labels:

- LINE (Left side)
- LOAD (Right side)

Filter for mounting below the Compax3 Hxxx V4 housing

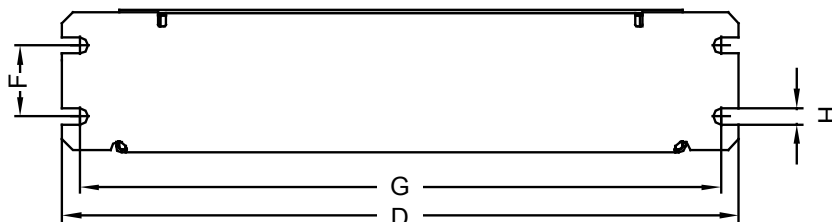
192-120104N13 C3lxxT30 June 2008

11.2.1.5 Mains filter NFI03/01 & NFI03/03

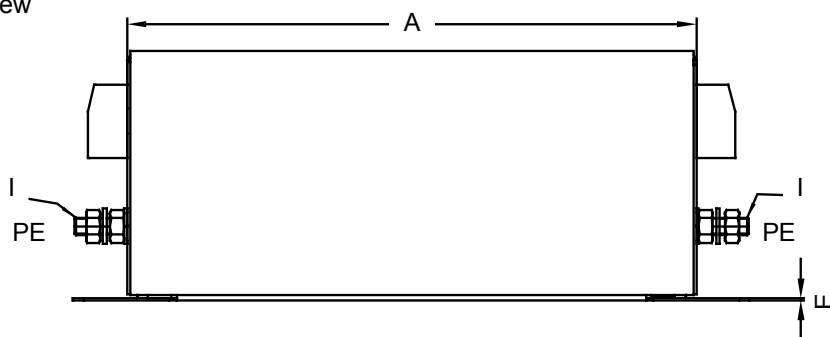
for Compax3MP10D6 and Compax3MP20D6

Dimensional drawing:

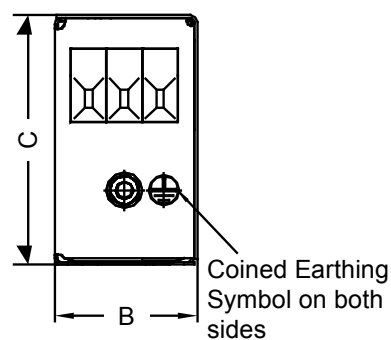
Bottom view



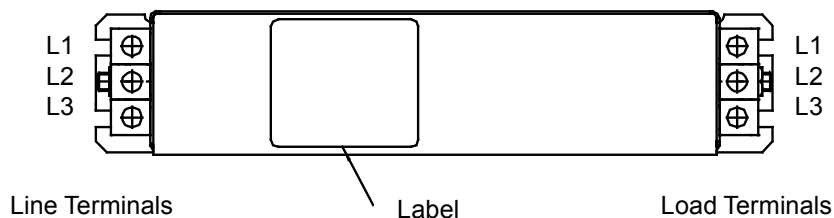
Side view



Front view



Top view



Filter type	A	B	C	D	E	F	G	H	Weight	GND(I)	Connection clamp
NFI03/01	240	50	85	270	0,8	30	255	5,4	1,5	M5	10mm ²
NFI03/03	220	85	90	250	1,0	60	235	5,4	2,4	M6	16mm ²

Stated in mm

11.2.1.6 Mains filter NFI03/02

for Compax3MP10D6

Dimensional drawing:

On request

11.2.2. Motor output filter

In this chapter you can read about:

Motor output filter MDR01/04	471
Motor output filter MDR01/01	471
Motor output filter MDR01/02	472
Wiring of the motor output filter	472

We offer motor output filters for disturbance suppression when the motor connecting cables are long (>20m):

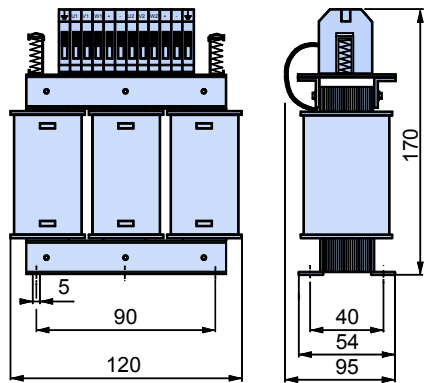
Order code for motor output filter (for Compax3S, Compax3M >20m motor cable)

				/		
up to 6,3 A rated motor current	MDR	0	1	/	0	4
Up to 16 A rated motor current	MDR	0	1	/	0	1
up to 30 A rated motor current	MDR	0	1	/	0	2

11.2.2.1 Motor output filter MDR01/04

up to 6.3A nominal motor current (3.6mH)

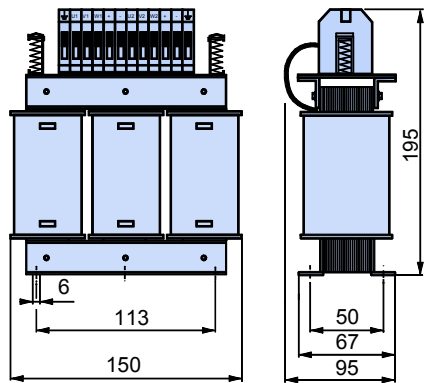
Dimensional drawing:



11.2.2.2 Motor output filter MDR01/01

Up to 16 A nominal motor current (2mH)

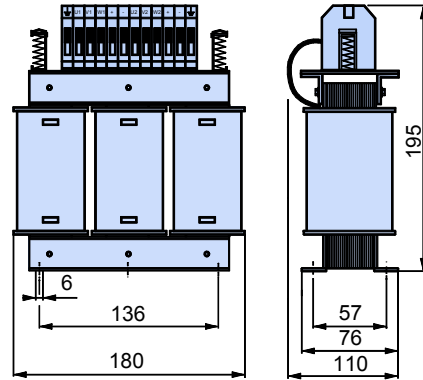
Dimensional drawing:



11.2.2.3 Motor output filter MDR01/02

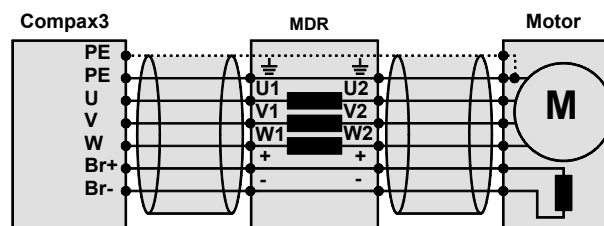
up to 30A nominal motor current (1.1mH)

Dimensional drawing:



Weight: 5.8kg

11.2.2.4 Wiring of the motor output filter



11.2.3. Mains filter

Mains filters serve for reducing the low-frequency interferences on the mains side. Further information on request.

11.3 Connections to the motor

In this chapter you can read about:

Resolver cable.....	474
SinCos© cable.....	475
EnDat cable.....	476
Overview of motor cables.....	476
Motor cable with plug.....	477
Motor cable for terminal box.....	478
Encoder cable.....	480

Under the designation "REK.." (resolver cables) and "MOK.." (motor cables) we can deliver motor connecting cables in various lengths to order. If you wish to make up your own cables, please consult the cable plans shown below:

Order code for motor cables⁽²⁾

for SMH / MH56 / MH70 / MH105 ⁽³⁾	(1.5mm ² ; up to 13.8A)		MOK	5	5	/	...	...	⁽¹⁾
for SMH / MH56 / MH70 / MH105 ⁽³⁾	(1.5mm ² ; up to 13.8A)	(cable chain compatible)	MOK	5	4	/	...	...	⁽¹⁾
for SMH / MH56 / MH70 / MH105 ⁽³⁾	(2.5mm ² ; up to 18.9A)		MOK	5	6	/	...	...	⁽¹⁾
for SMH / MH56 / MH70 / MH105 ⁽³⁾	(2.5mm ² ; up to 18.9A)	(cable chain compatible)	MOK	5	7	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(1.5mm ² ; up to 13.8A)		MOK	6	0	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(1.5mm ² ; up to 13.8A)	(cable chain compatible)	MOK	6	3	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(2.5mm ² ; up to 18.9A)		MOK	5	9	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(2.5mm ² ; up to 18.9A)	(cable chain compatible)	MOK	6	4	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(6mm ² ; up to 32.3A)	(cable chain compatible)	MOK	6	1	/	...	...	⁽¹⁾
for MH145 / MH205 ⁽⁴⁾	(10mm ² ; up to 47.3A)	(cable chain compatible)	MOK	6	2	/	...	...	⁽¹⁾

^(x) **Note on the cable** (see page 463)

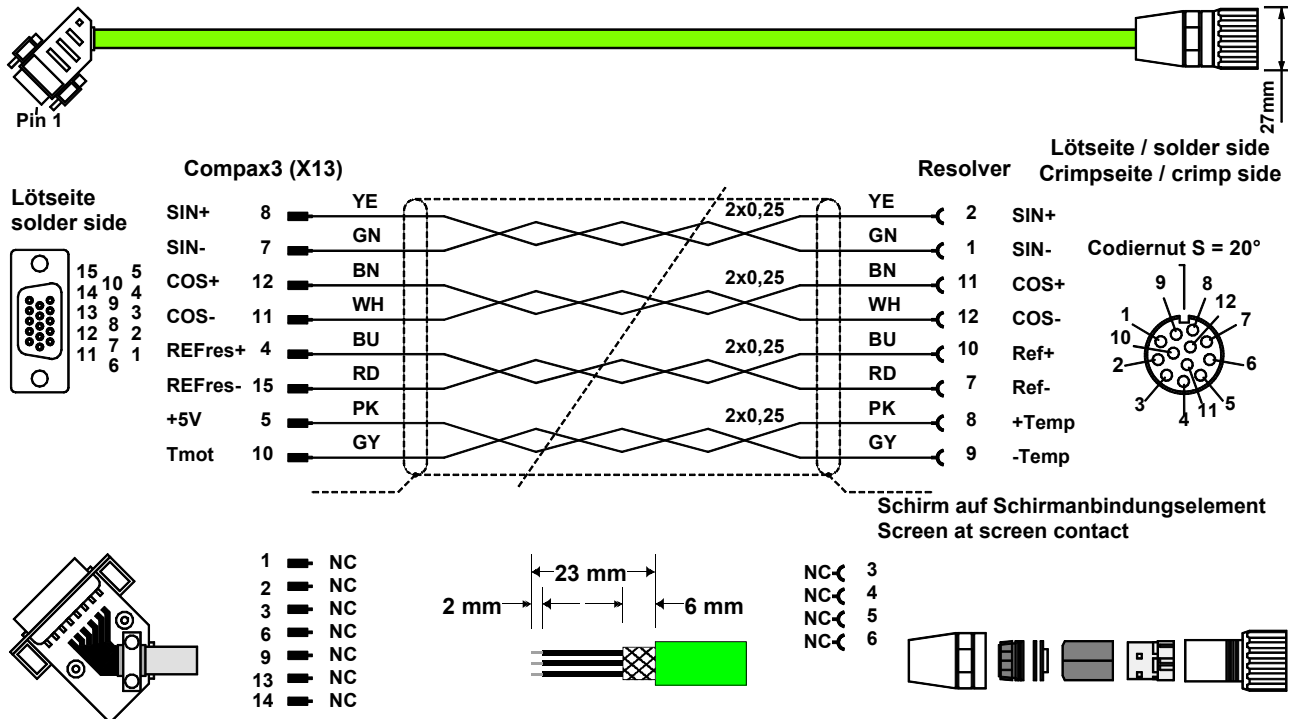
Order code for feedback cables

for Resolver ⁽²⁾	for MH / SMH motors		REK	4	2	/	...	...	⁽¹⁾
for Resolver ⁽²⁾	for MH / SMH motors	(cable chain compatible)	REK	4	1	/	...	...	⁽¹⁾
for SinCos© – Feedback devices ⁽²⁾	for MH / SMH motors	(cable chain compatible)	GBK	2	4	/	..	...	⁽¹⁾
for EnDat 2.1 ⁽²⁾	for MH / SMH motors	(cable chain compatible)	GBK	3	8	/	..	...	⁽¹⁾
Encoder – Compax3			GBK	2	3	/	...	...	⁽¹⁾
for LXR linear motors		(cable chain compatible)	GBK	3	3	/	...	...	⁽¹⁾
for BLMA linear motors		(cable chain compatible)	GBK	3	2	/	...	...	⁽¹⁾

^(x) **Note on the cable** (see page 463)

11.3.1. Resolver cable

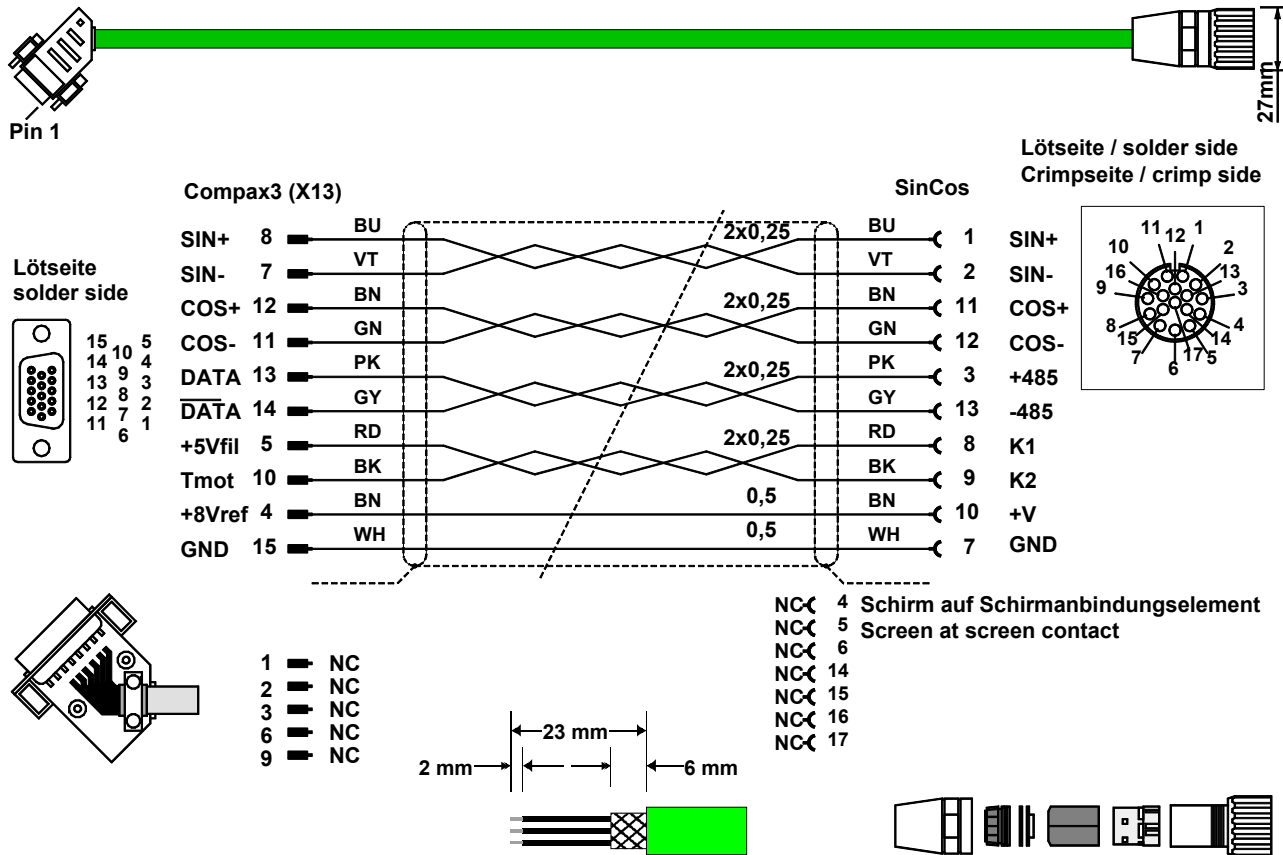
REK42/..



The same cable (with changed conductor coloring) is available under the designation REK41/.. in a version which is suitable for cable chain systems. You will find the length code in the **accessories order code** (see page 460).

11.3.2. SinCos© cable

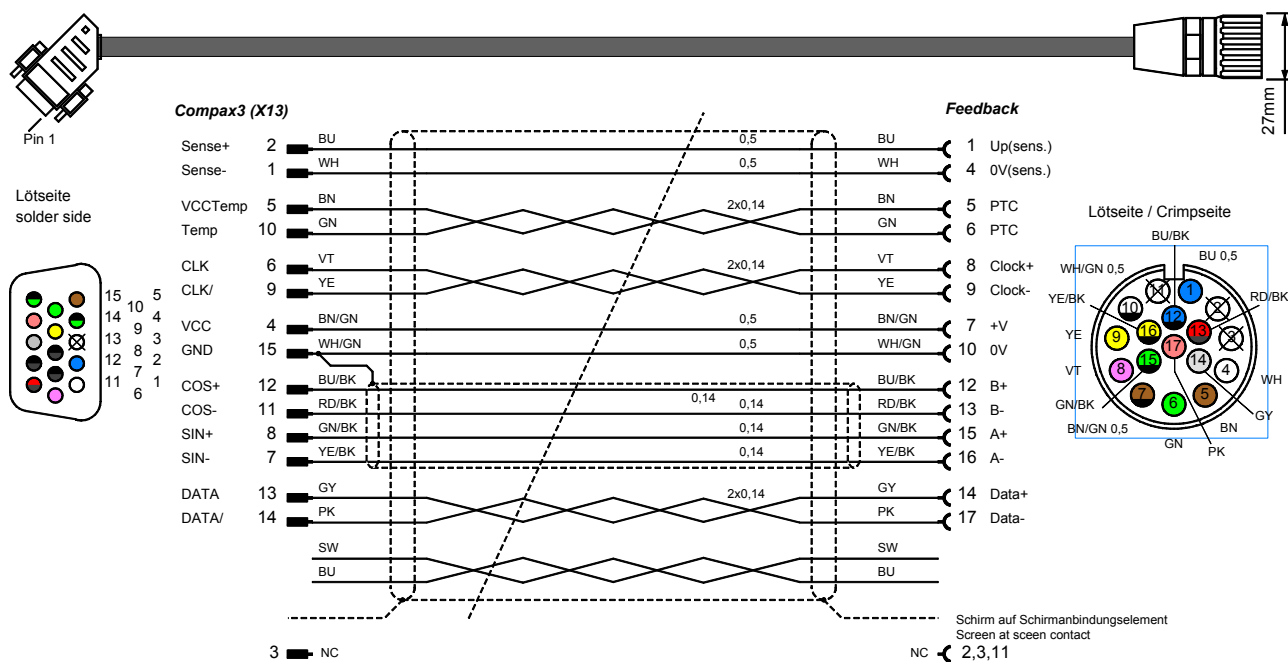
GBK24/...: Cable chain compatible



You will find the length code in the **accessories order code** (see page 460).

11.3.3. EnDat cable

GBK38/...: (cable chain compatible)

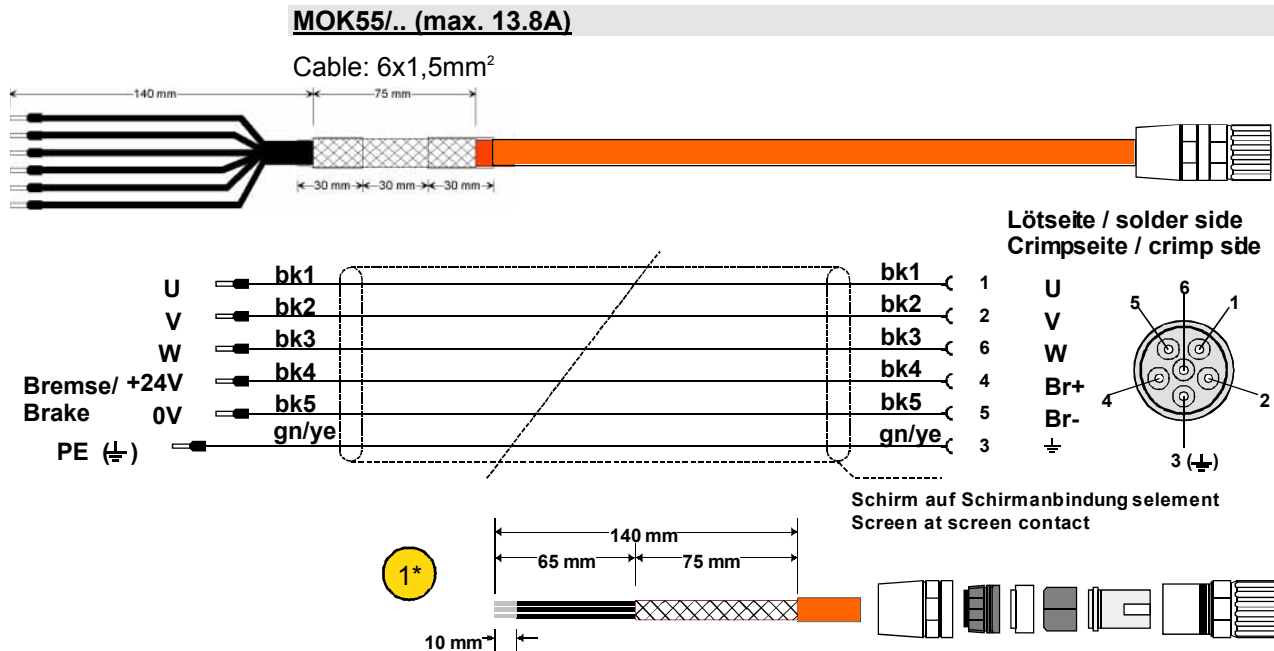


You will find the length code in the **accessories order code** (see page 460).

11.3.4. Overview of motor cables

Cross-section / max. permanent load	Motor connector SMH motors MH56, MH70, MH105		Motor terminal box MH145, MH205	
	standard	cable chain compatible	standard	cable chain compatible
1.5mm ² / up to 13.8A	MOK55	MOK54	MOK60	MOK63
2.5mm ² / up to 18.9A	MOK56	MOK57	MOK59	MOK64
6mm ² / up to 32.3A	-	-	-	MOK61
10mm ² / up to 47.3A		--	-	MOK62

11.3.5. Motor cable with plug



- 1* ♦ Strip cable on 140mm
- ♦ Cut off shield for about 65mm, loosen, fold back over external cover (for about 75mm) and fix with insulating tape.
- ♦ Fix 2x approx. 30mm shrinking hose (adhesive)
- ♦ Strip ends of lines for 10mm and fix terminal sleeves 1.5

MOK54/... (max. 13.8A) cable chain compatible

Same structure (conductor coloring may be changed) as MOK55/.. available in cable chain compatible version.

MOK56/... (max. 18.9A)

Same structure (conductor coloring/designations may be changed) as MOK55/.. but with 6x2.5mm².

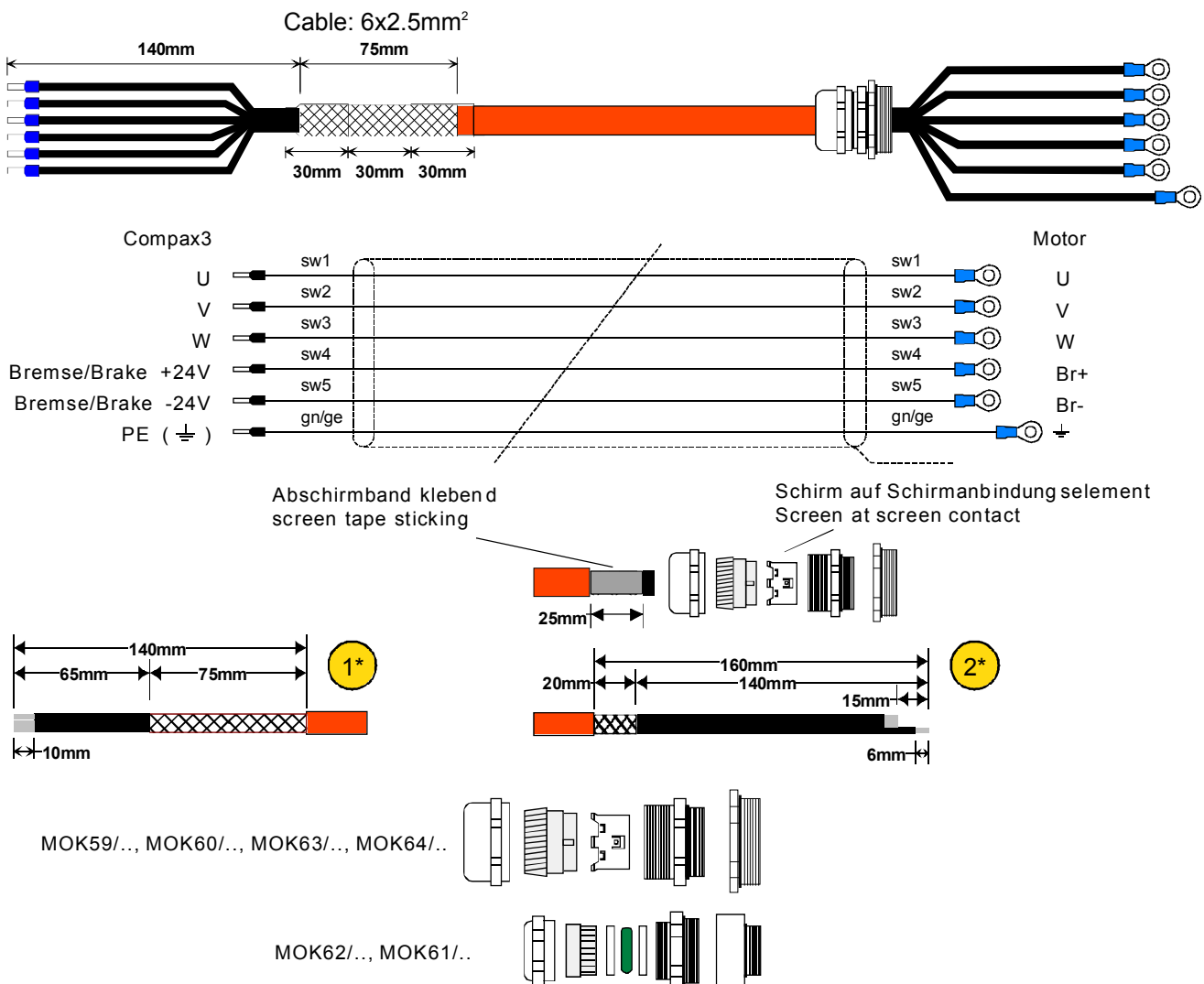
MOK57/... (max. 18.9A) cable chain compatible

Same structure (conductor coloring / designation may be changed) as MOK55, but with 4x2.5 + 2x1mm² and cable chain compatible.

You will find the length code in the **accessories order code** (see page 460).

11.3.6. Motor cable for terminal box

Design on the example of MOK59/... (max. 18.9A) standard



- 1* ♦ Strip cable on 140mm
- ♦ Cut off shield for about 65mm, loosen, fold back over external cover (for about 75mm) and fix with insulating tape.
 - ♦ Fix 2x approx. 30mm shrinking hose (adhesive)
 - ♦ Strip ends of lines for 10mm and fix terminal sleeves 2.5
- 2* ♦ Strip cable on 160mm
- ♦ Cut off shield for 140mm, fix rest on a length of 20mm with isolating tape (width 25mm, length 80mm)
 - ♦ Cut off bck1, bck2, bck3, bck4, bck5 by approx. 15mm (gn/ye about 15mm longer)
 - ♦ Strip end of lines for about 6mm and fix with cable eyes M6

Please note the two different shield connection elements!

Additional motor cables for the terminal box with similar layout:

MOK62/.. (max. 47.3A) cable chain compatible with $4 \times 10 \text{mm}^2 + 2 \times 1 \text{mm}^2$

MOK61/... (max. 32.3A) cable chain compatible with $4 \times 6 \text{mm}^2 + 2 \times 1 \text{mm}^2$

MOK60/.. (max. 13.8A) standard with $6 \times 1,5 \text{mm}^2$

MOK63/.. (max. 13.8A) cable chain compatible with $6 \times 1.5 \text{mm}^2$

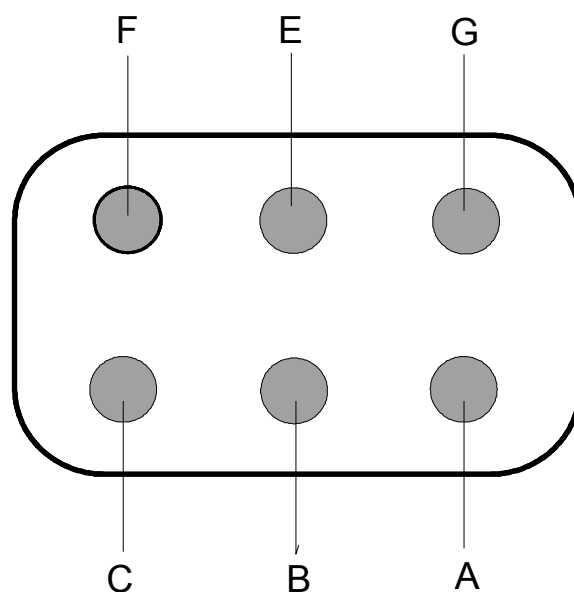
MOK64/.. (max. 18.9A) cable chain compatible with $6 \times 2.5 \text{mm}^2$

Designation of the conductors

The designations of the conductors varies according to the cable type:

U	U1	sw1	black
V	V2	sw2	Brown
W	W3	sw3	blue
BR+	BR1	sw4	red
BR-	BR2	sw5	green

You will find the length code in the **accessories order code** (see page 460).

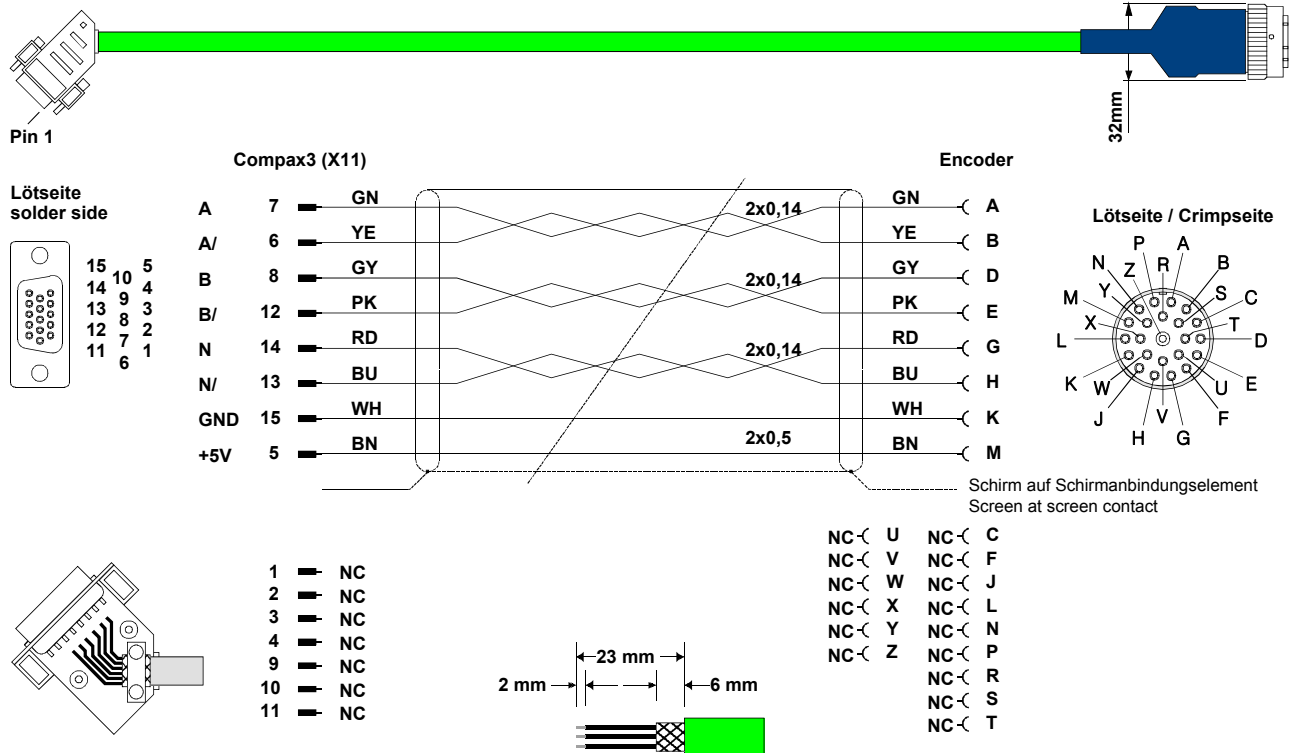
11.3.6.1 Connection of terminal box MH145 & MH205

Terminal	Assignment
A	Phase U
B	Phase V
C	Phase W
E	PE
F	Brake (+ red for MH205)
G	Brake (- blue for MH205)

Additional designations can be found on the connection cable clamping board - motor (internal).

11.3.7. Encoder cable

GBK23/...: Connection Encoder - Compax3



You will find the length code in the **accessories order code** (see page 460).

11.4 External braking resistors

In this chapter you can read about:

Permissible braking pulse powers of the braking resistors	482
Dimensions of the braking resistors	491

Danger!	Hazards when handling braking resistors!
	Housing temperature up to 200°C!
	Dangerous voltage!
	The device may be operated only in the mounted state!
	The external braking resistors must be installed such that contact with the human body is prevented. Install the connecting leads at the bottom. Observe the instructions on the resistors (warning plate).

Please note that the length of the supply cable must not exceed 2m!

Ballast resistors for Compax3

Braking Resistor (see page 481)	Device	Rated Power
BRM08/01 (100Ω)	Compax3S025V2	60W
	Compax3S015V4	
	Compax3S038V4	
BRM05/01 (56Ω)	Compax3S063V2	180W
	Compax3S075V4	
BRM05/02 (56Ω)	Compax3S075V4	570W
BRM10/01 (47Ω)	Compax3S150V4	570W
BRM04/01 (15Ω)	Compax3S150V2	570W
	Compax3S300V4	
	Compax3MP20D6	
BRM04/02 (15Ω)	Compax3S150V2	740W
	Compax3S300V4	
	Compax3MP20D6	
BRM04/03 (15Ω)	Compax3S300V4	1500W
	Compax3MP20D6	
BRM09/01 (22Ω)	Compax3S100V2	570W
BRM11/01 (27Ω)	Compax3H0xxV4	3500W
BRM13/01 (30Ω)	Compax3MP10D6	500 W
	Compax3MP20D6**	
BRM14/01 (15Ω)	Compax3MP10D6*	500 W
	Compax3MP20D6	
BRM12/01 (18Ω)	Compax3H1xxV4	4500W

*for Compax3MP10D6 2x15Ω in series

**for Compax3MP20D6 2x30Ω parallel

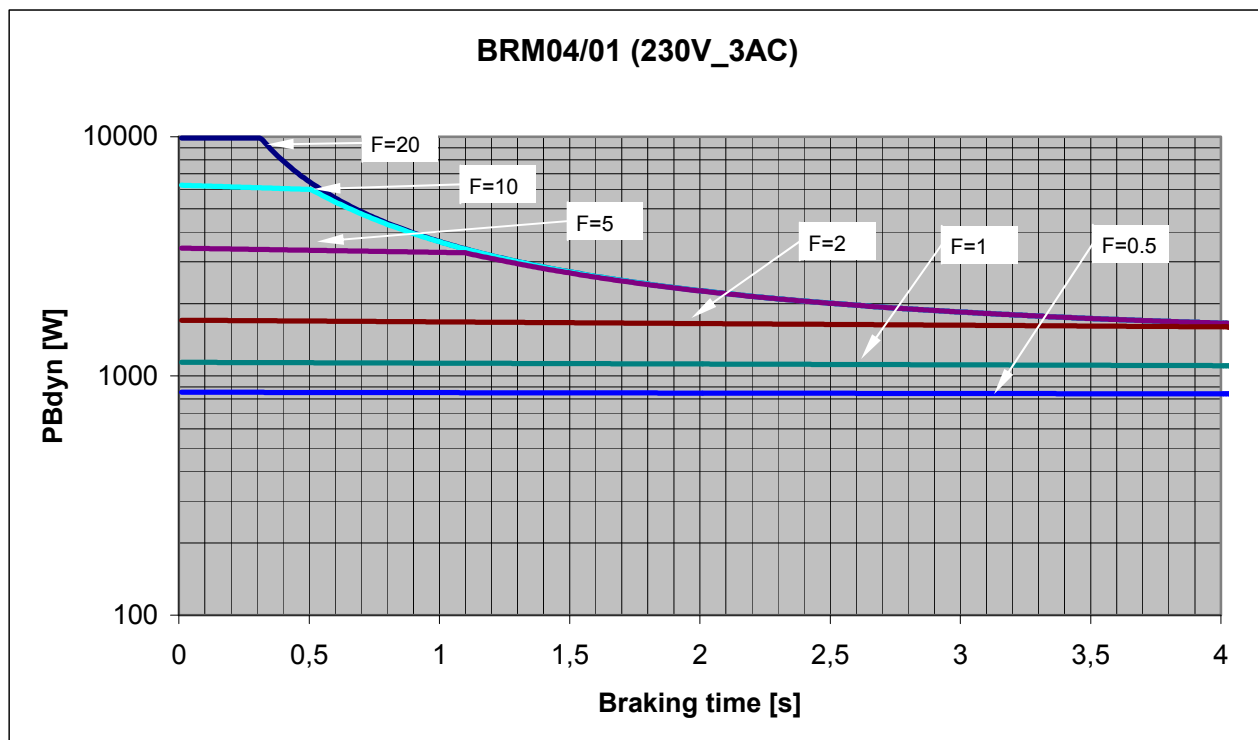
11.4.1. Permissible braking pulse powers of the braking resistors

In this chapter you can read about:

Calculation of the BRM cooling time	483
Permissible braking pulse power: BRM08/01 with C3S015V4 / C3S038V4	484
Permissible braking pulse power: BRM08/01 with C3S025V2	484
Permissible braking pulse power: BRM09/01 with C3S100V2	485
Permissible braking pulse power: BRM10/01 with C3S150V4	485
Permissible braking pulse power: BRM05/01 with C3S063V2	486
Permissible braking pulse power: BRM05/01 with C3S075V4	486
Permissible braking pulse power: BRM05/02 with C3S075V4	487
Permissible braking pulse power: BRM04/01 with C3S150V2	487
Permissible braking pulse power: BRM04/01 with C3S300V4	488
Permissible braking pulse power: BRM04/02 with C3S150V2	488
Permissible braking pulse power: BRM04/02 with C3S300V4	489
Permissible braking pulse power: BRM04/03 with C3S300V4	489
Permissible braking pulse power: BRM11/01 with C3H0xxV4	490
Permissible braking pulse power: BRM12/01 with C3H1xxV4	490
Permissible braking pulse power: BRM13/01 with C3MP10D6	491
Permissible braking pulse power: BRM14/01 with C3MP10D6	491

The diagrams show the permissible braking pulse powers of the braking resistors in operation with the assigned Compax3.

11.4.1.1 Calculation of the BRM cooling time



F = Factor

Cooling time = F * braking time

Example 1: For a braking time of 1s, a braking power of 1kW is required. The Diagram shows the following:

The required values can be found in the range between characteristic F = 0.5 and F = 1. In order to achieve operating safety, please select the higher factor, this means that the required cooling time is 1s.

F * Braking time = cooling time

1 * 1s = 1s

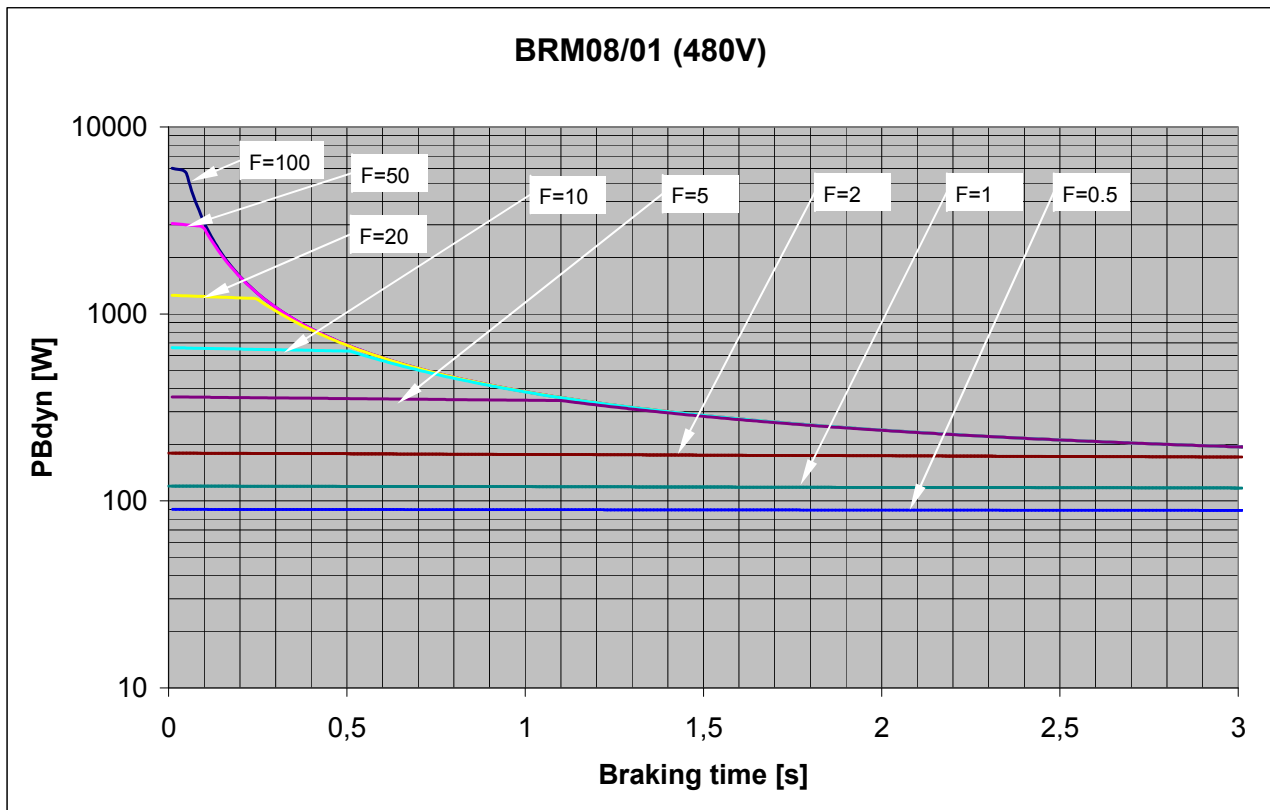
Example 2: For a braking time of 0.5s, a braking power of 3kW is required. The Diagram shows the following:

The required values can be found in the range between characteristic F = 2 and F = 5. In order to achieve operating safety, please select the higher factor, this means that the required cooling time is 2.5s.

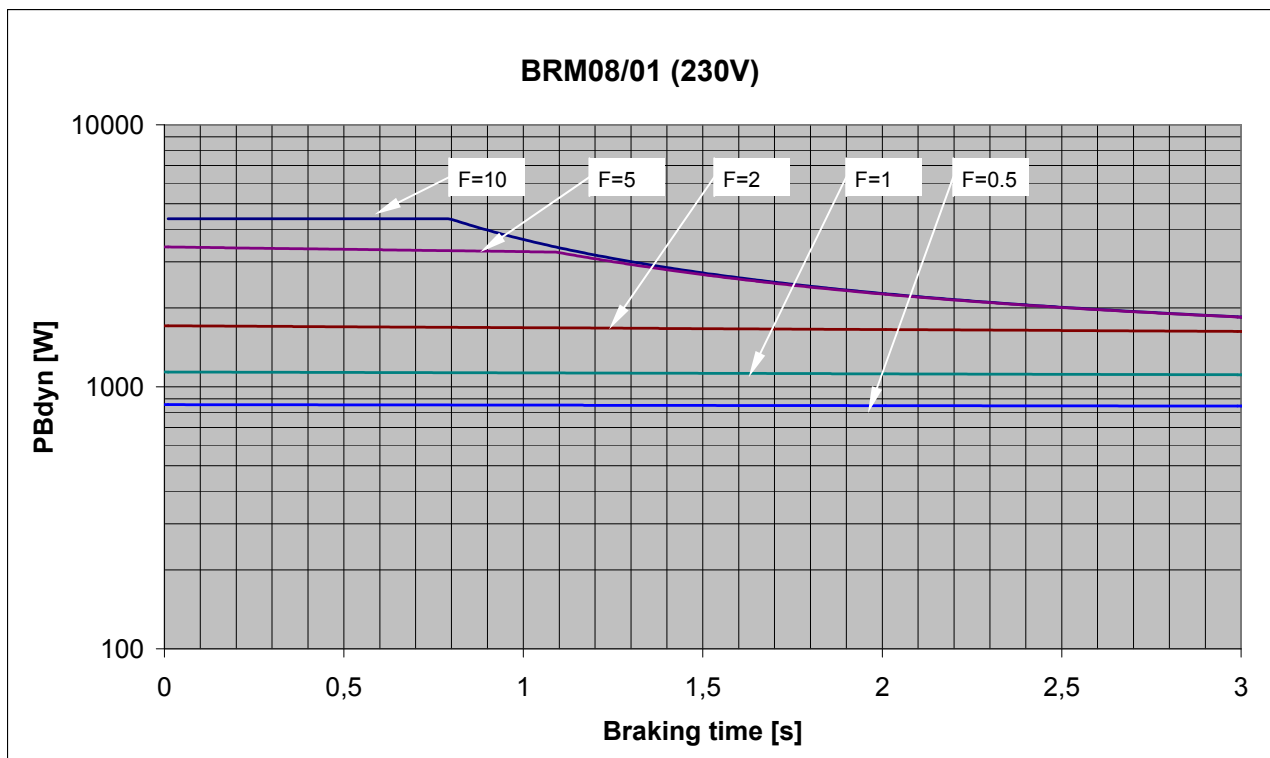
F * Braking time = cooling time

5 * 0.5s = 2.5s

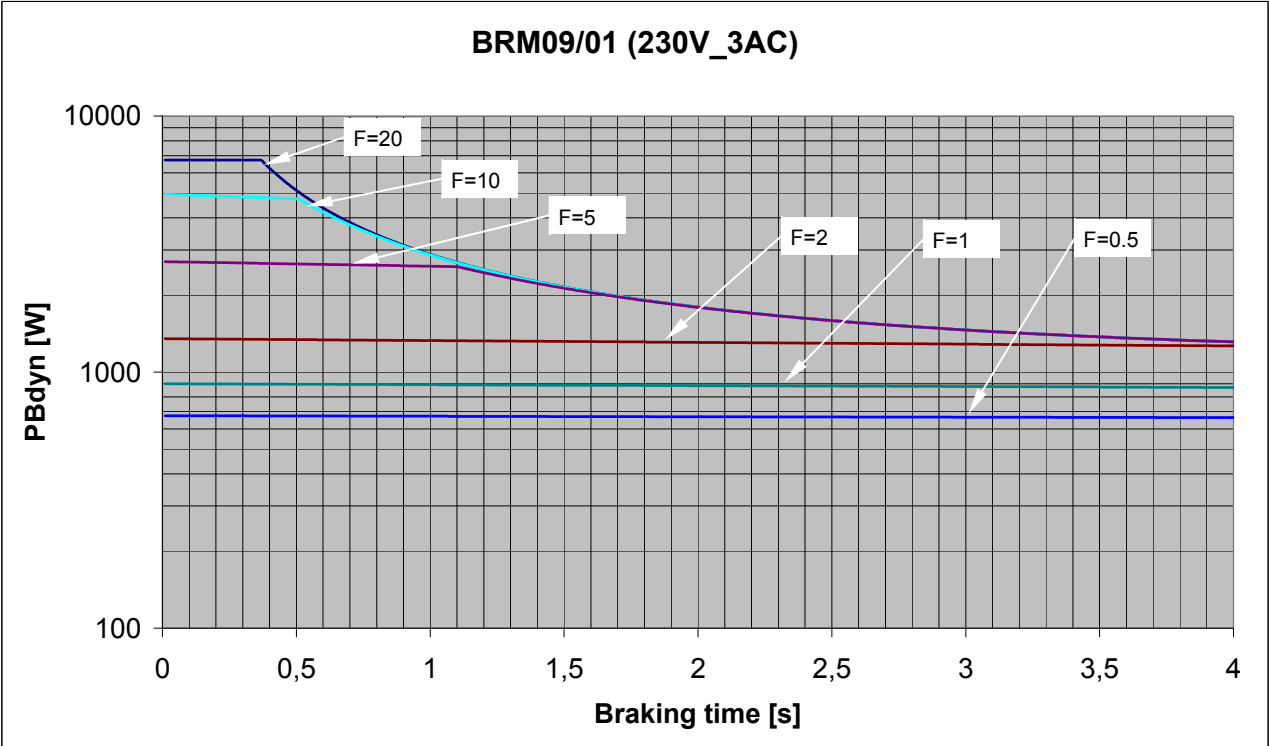
11.4.1.2 Permissible braking pulse power: BRM08/01 with C3S015V4 / C3S038V4



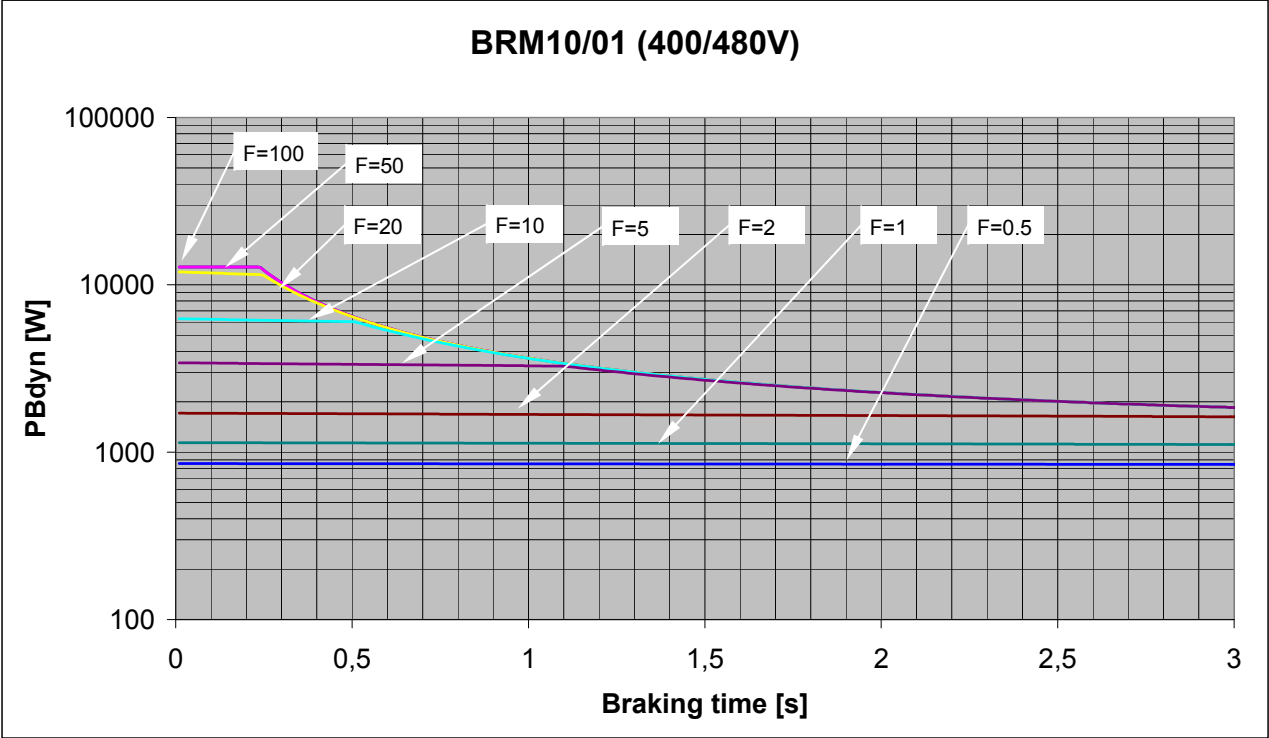
11.4.1.3 Permissible braking pulse power: BRM08/01 with C3S025V2



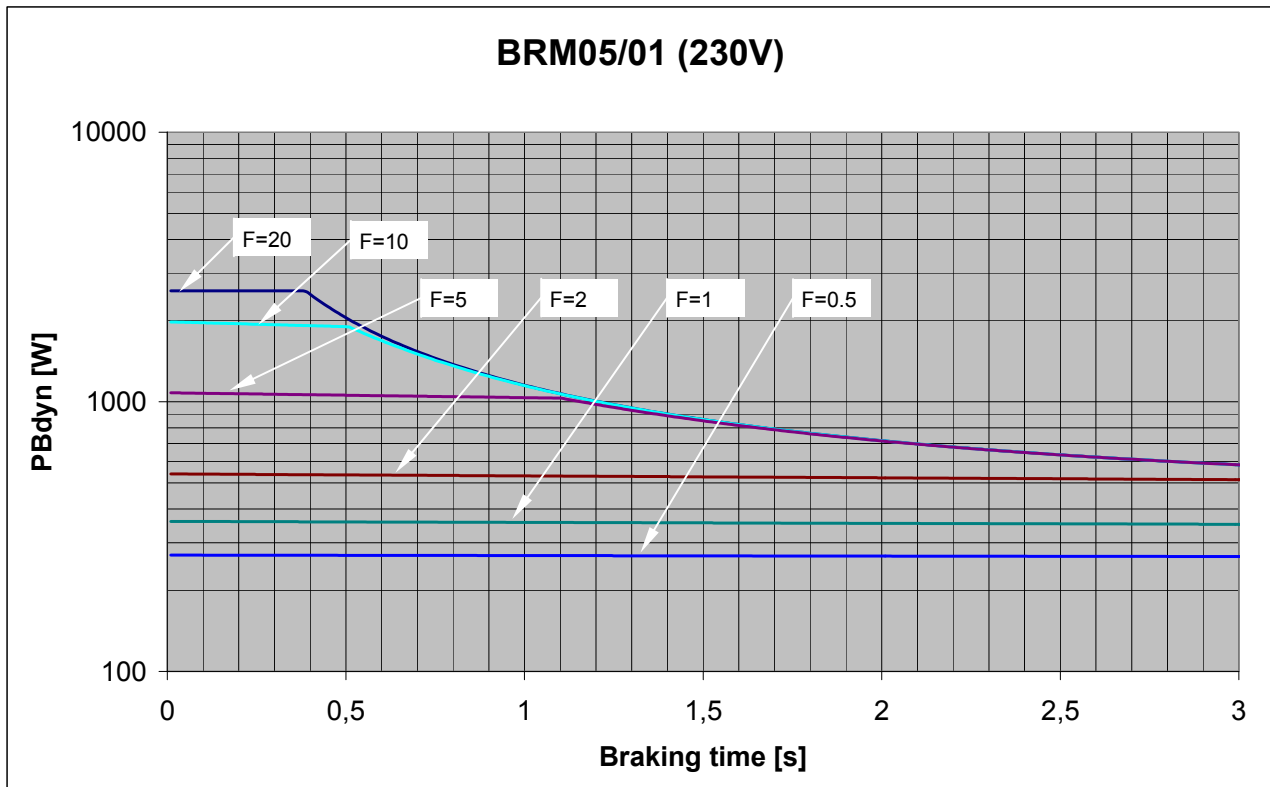
11.4.1.4 Permissible braking pulse power: BRM09/01 with C3S100V2



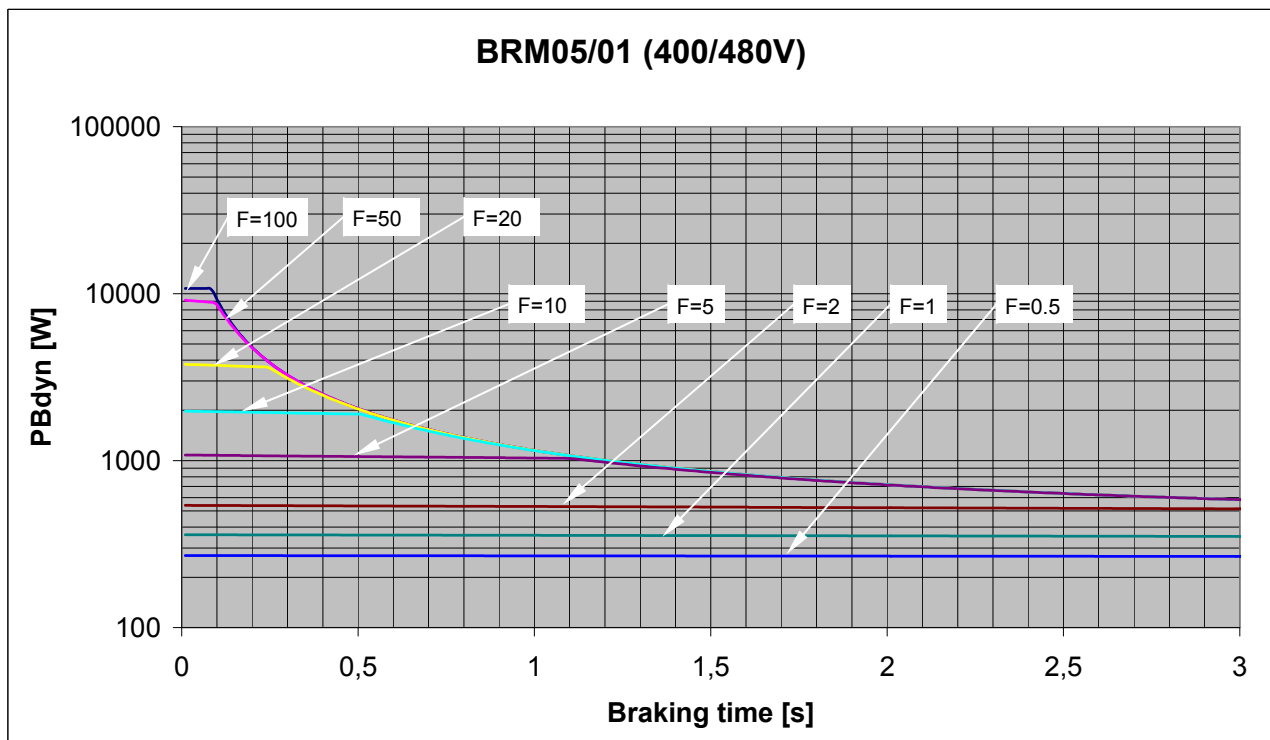
11.4.1.5 Permissible braking pulse power: BRM10/01 with C3S150V4

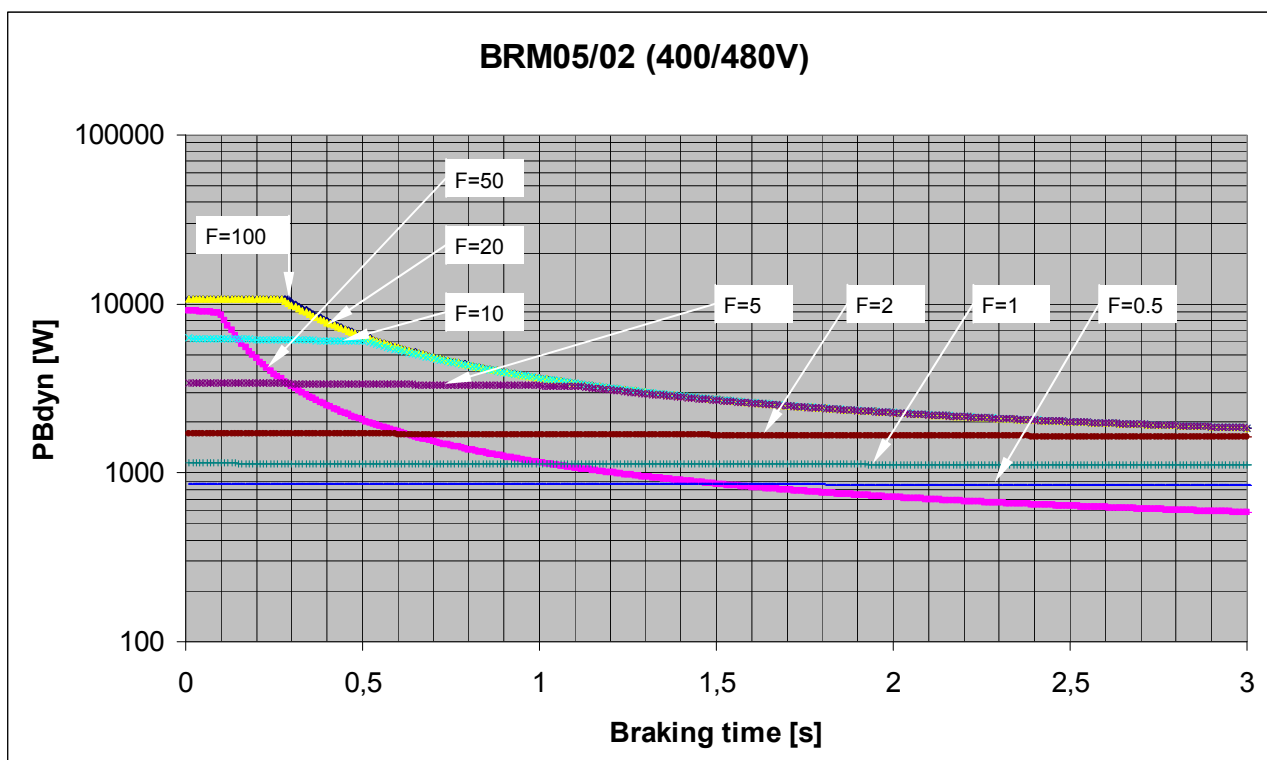
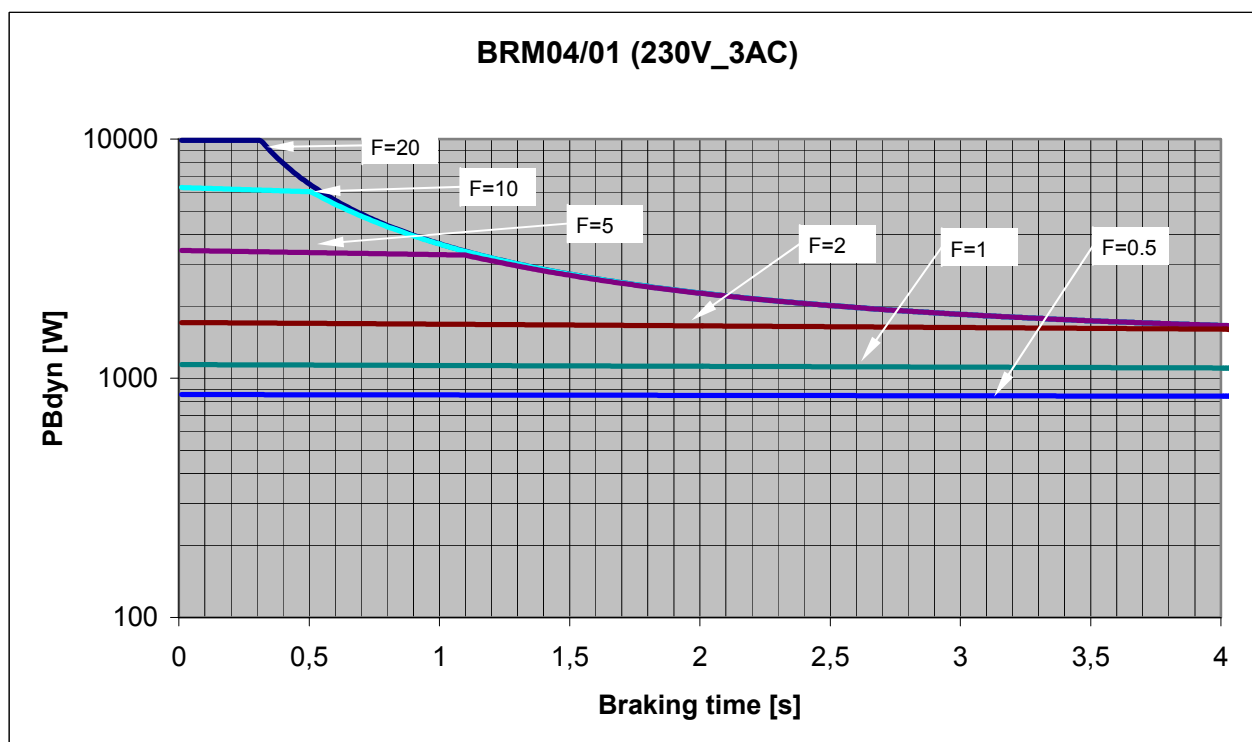


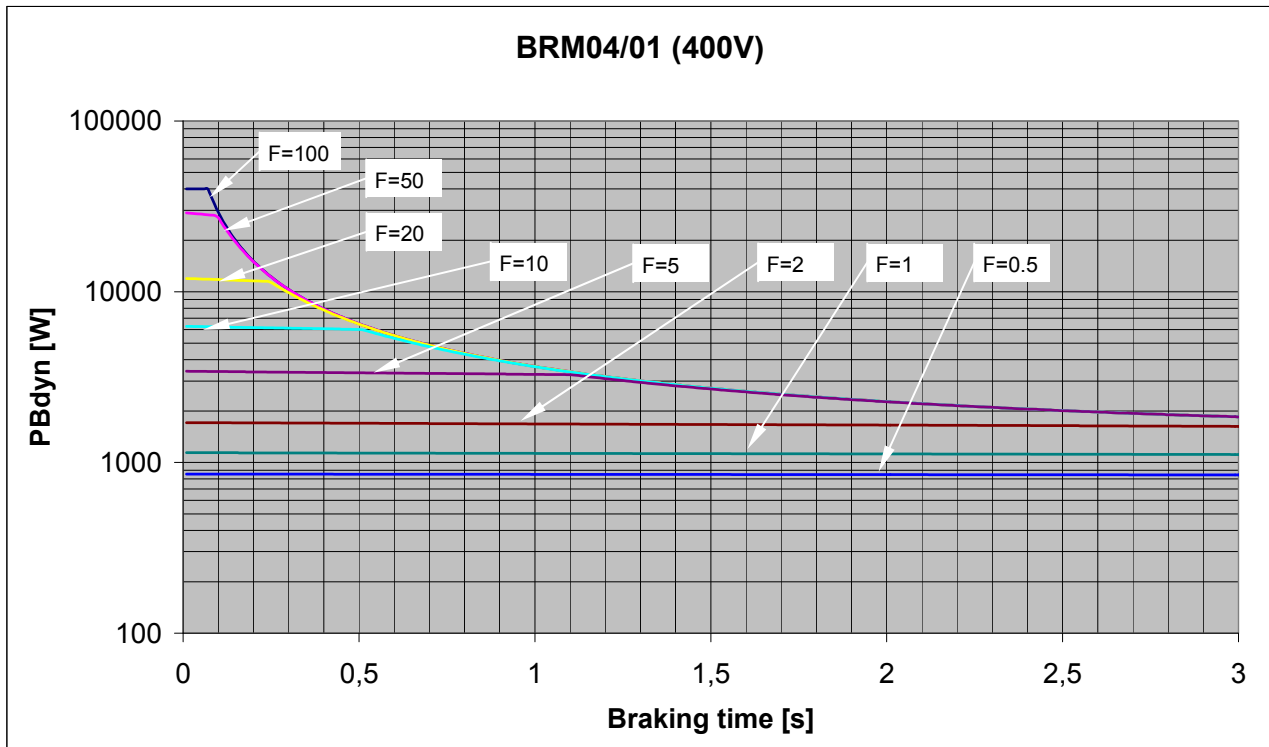
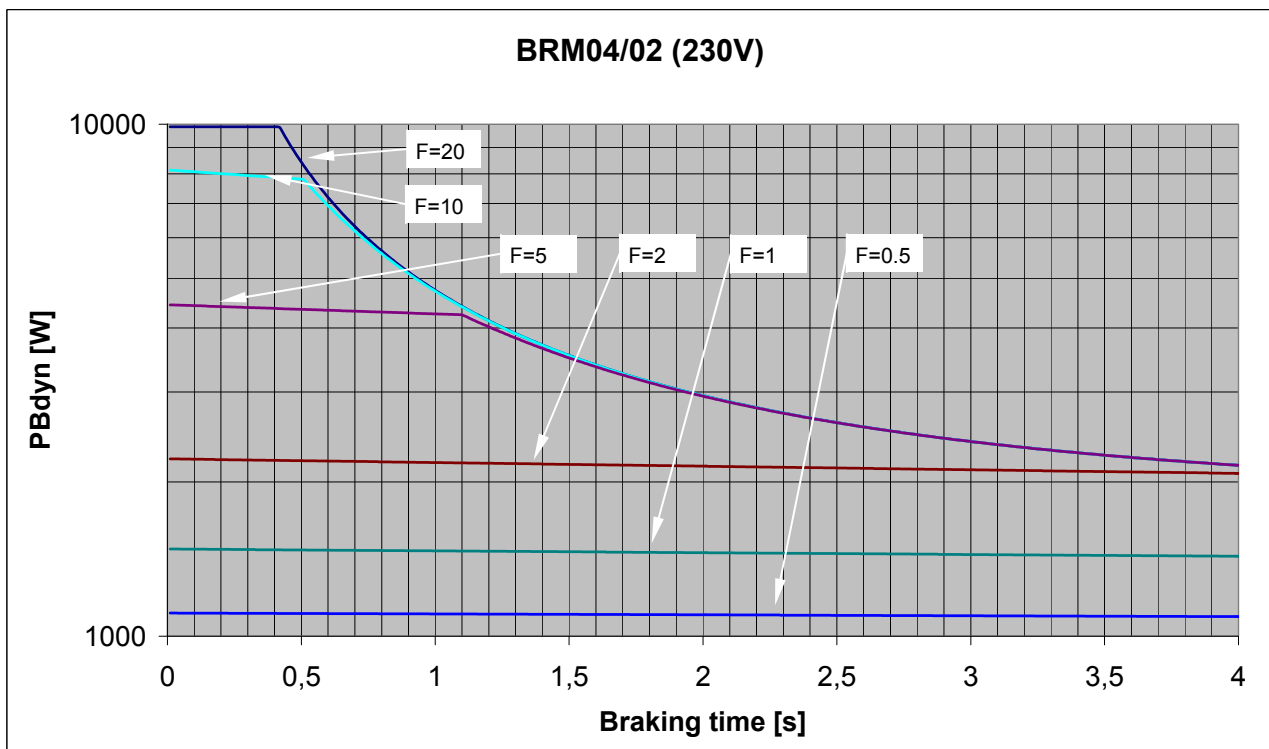
11.4.1.6 Permissible braking pulse power: BRM05/01 with C3S063V2

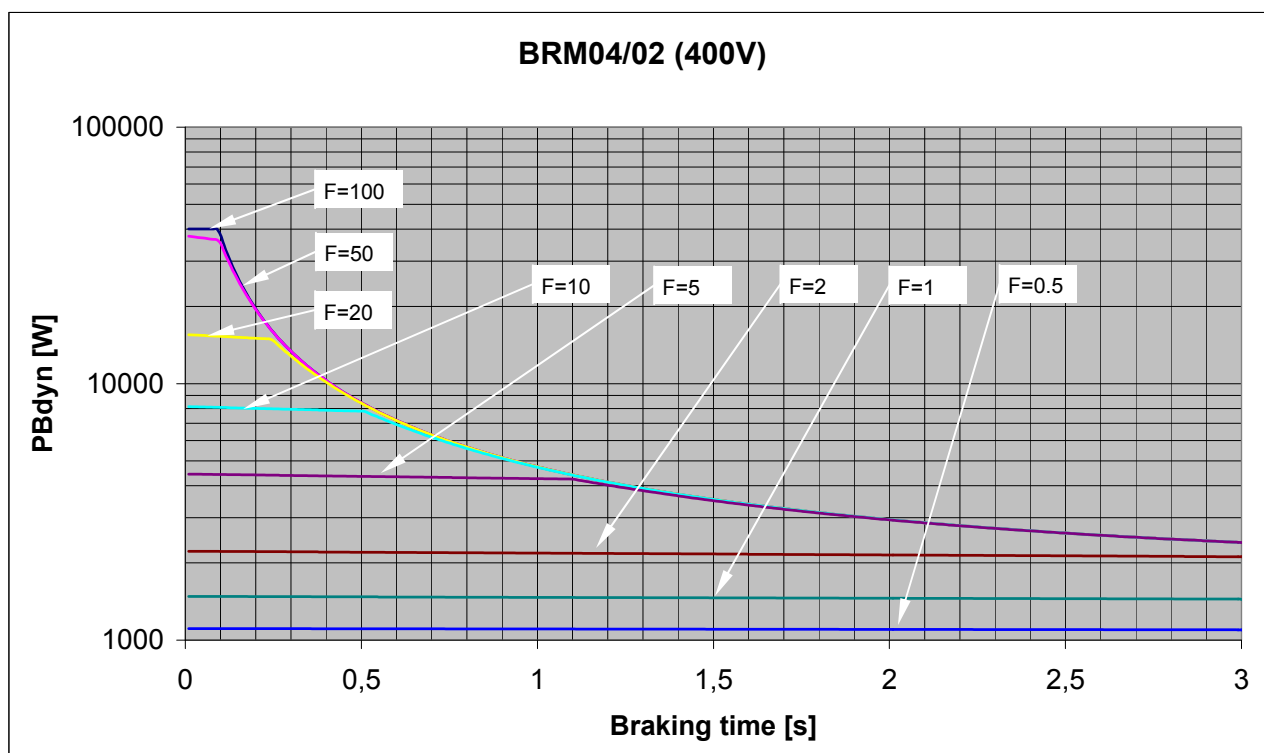
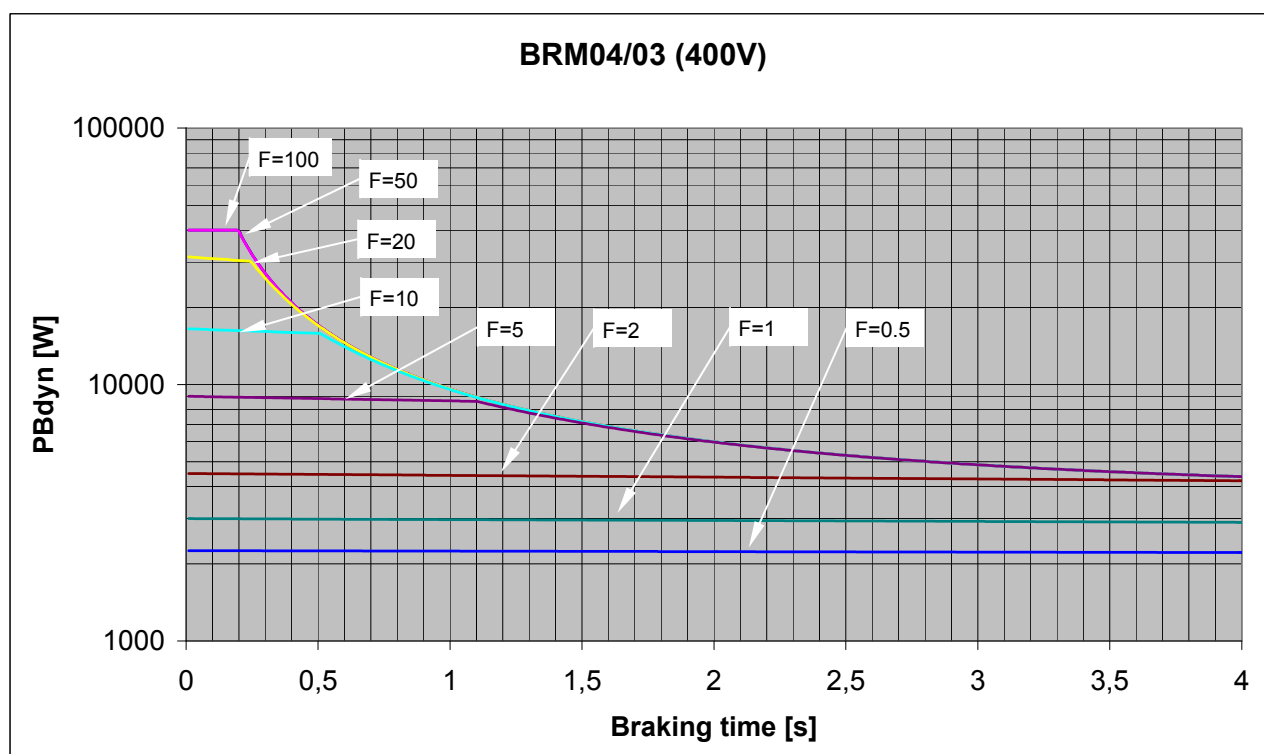


11.4.1.7 Permissible braking pulse power: BRM05/01 with C3S075V4

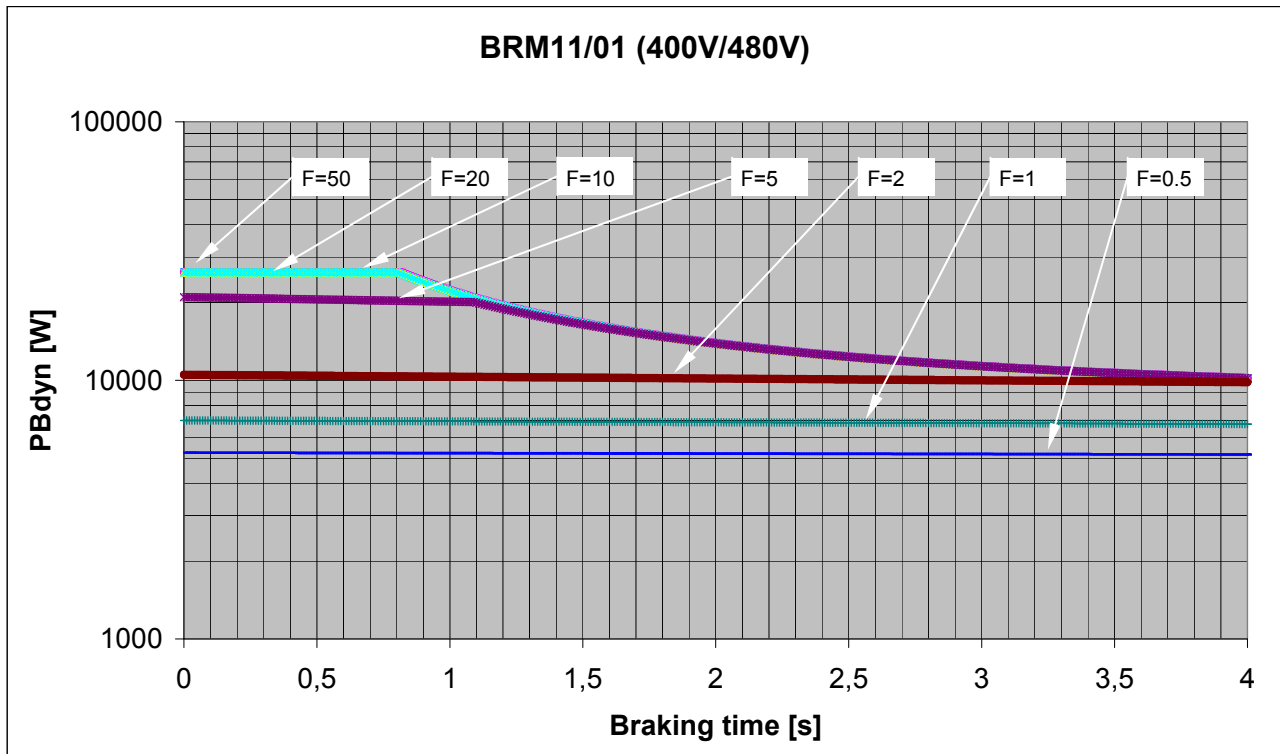


11.4.1.8 Permissible braking pulse power: BRM05/02 with C3S075V4**11.4.1.9 Permissible braking pulse power: BRM04/01 with C3S150V2**

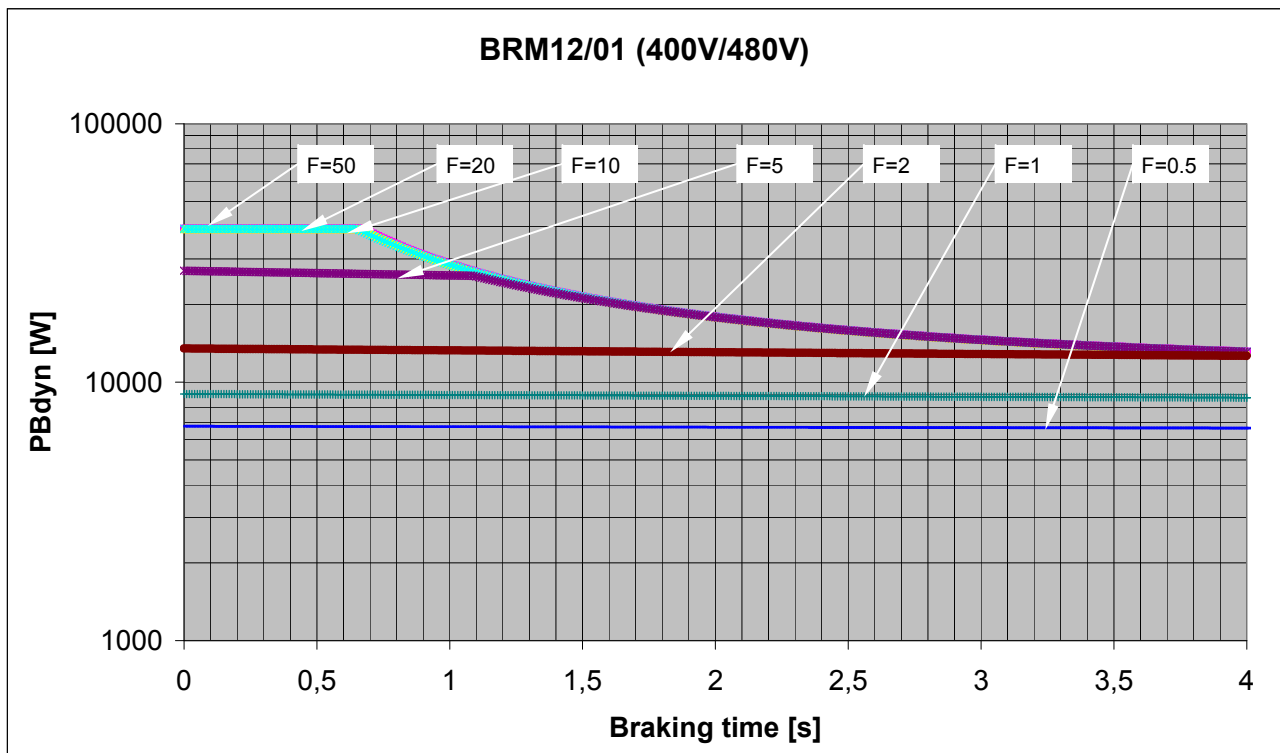
11.4.1.10 Permissible braking pulse power: BRM04/01 with C3S300V4**11.4.1.11 Permissible braking pulse power: BRM04/02 with C3S150V2**

11.4.1.12 Permissible braking pulse power: BRM04/02 with C3S300V4

11.4.1.13 Permissible braking pulse power: BRM04/03 with C3S300V4


11.4.1.14 Permissible braking pulse power: BRM11/01 with C3H0xxV4



11.4.1.15 Permissible braking pulse power: BRM12/01 with C3H1xxV4



11.4.1.16

Permissible braking pulse power: BRM13/01 with C3MP10D6

On request

11.4.1.17

Permissible braking pulse power: BRM14/01 with C3MP10D6

On request

11.4.2. Dimensions of the braking resistors

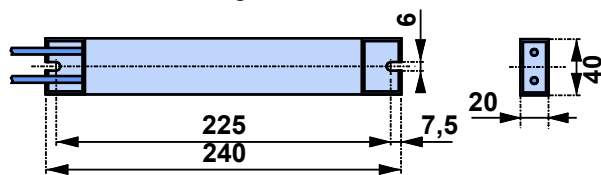
In this chapter you can read about:

BRM8/01braking resistors	491
BRM5/01 braking resistor	491
Braking resistor BRM5/02, BRM9/01 & BRM10/01	492
Braking resistor BRM4/0x	492
Braking resistor BRM11/01 & BRM12/01	493
Braking resistor BRM13/01 & BRM14/01	493

11.4.2.1

BRM8/01braking resistors

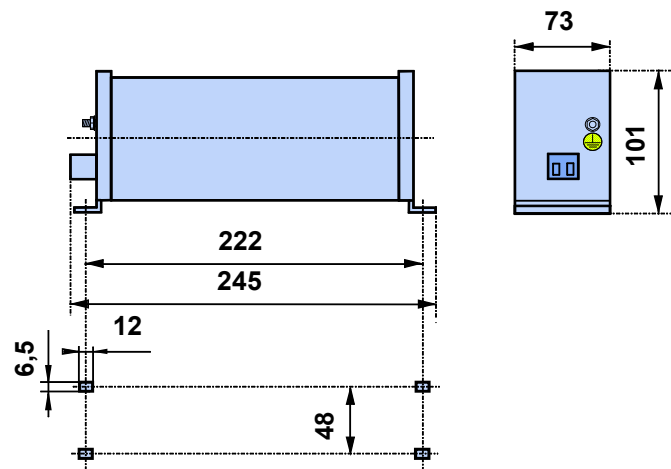
Dimensional drawing:



11.4.2.2

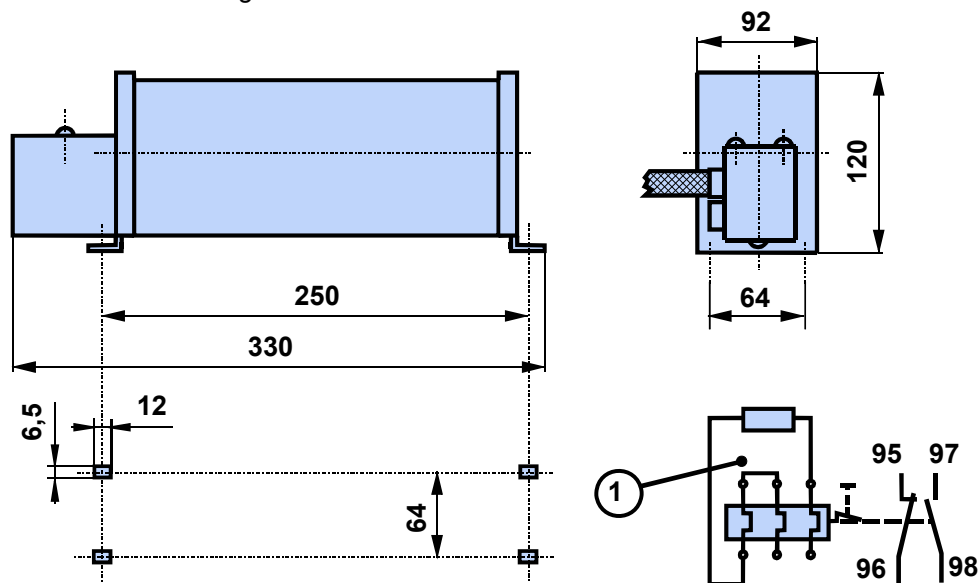
BRM5/01 braking resistor

Dimensional drawing:



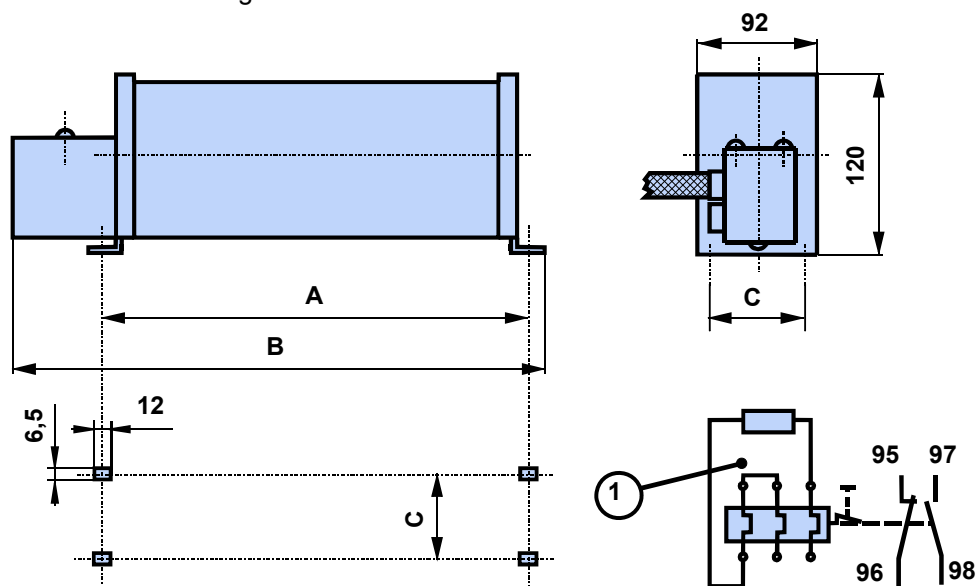
11.4.2.3 Braking resistor BRM5/02, BRM9/01 & BRM10/01

Dimensional drawing:



11.4.2.4 Braking resistor BRM4/0x

Dimensional drawing:



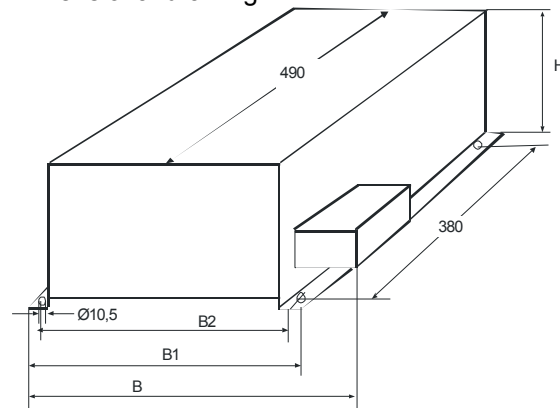
1: thermal current overload cut-off

Dimensions in mm:

Size:	BRM4/01	BRM4/02	BRM4/03
A	250	300	540
B	330	380	620
C	64	64	64

11.4.2.5 Braking resistor BRM11/01 & BRM12/01

Dimensional drawing:

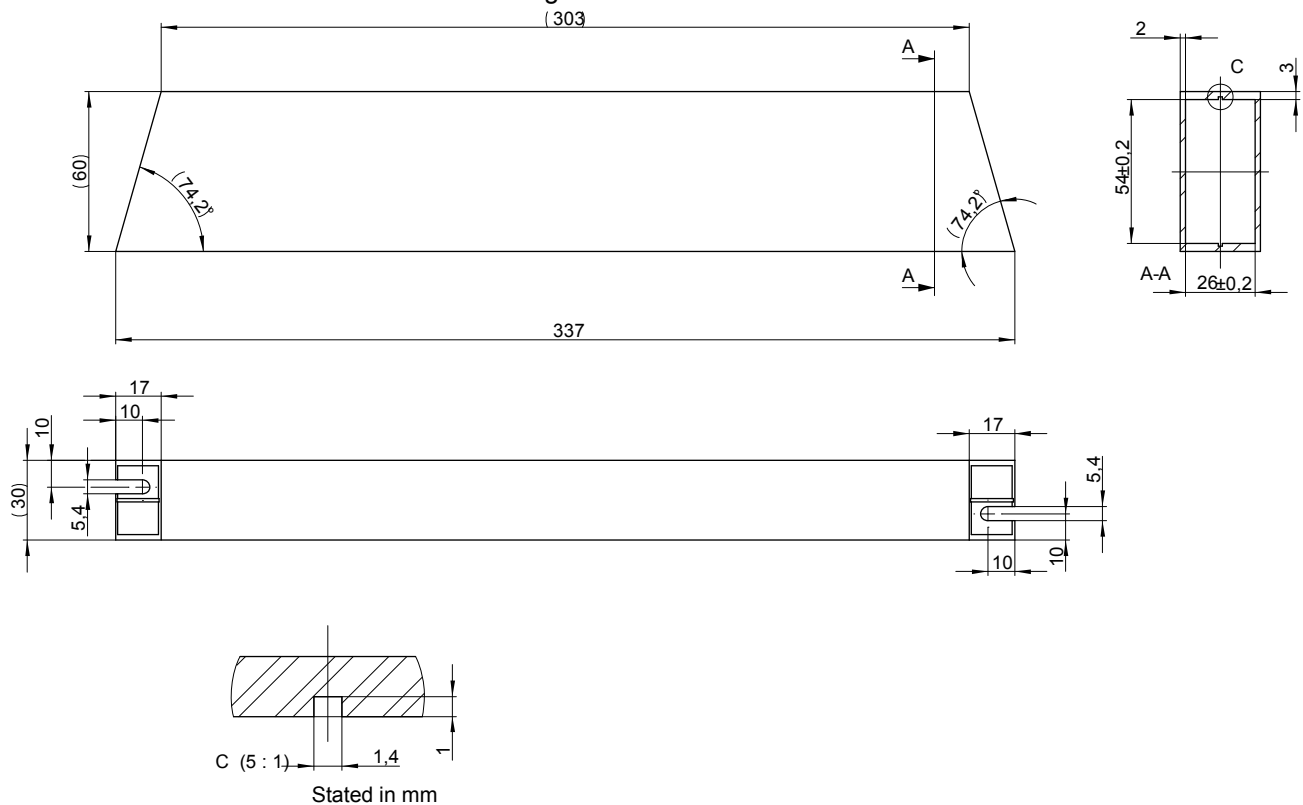


Dimensions in mm:

	BRM11/01	BRM12/02
B	330	
B1	295	
B2	270	
H	260	
Weight	6,0	7,0

11.4.2.6 Braking resistor BRM13/01 & BRM14/01

Dimensional drawing:



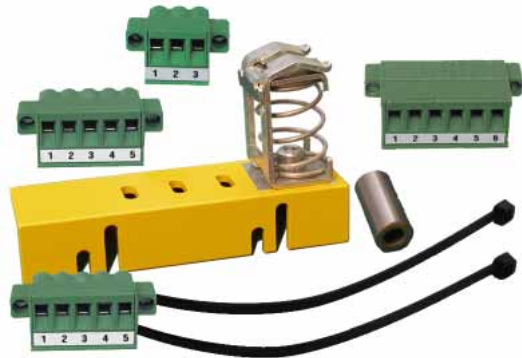
11.5 Connection set for Compax3S

- The connection set which is available as accessory comprises:
- ◆ a shield terminal with large contact area for the motor cable shield, and
 - ◆ the mating plug connectors for the Compax3 plug connectors X1, X2, X3, and X4
 - ◆ a toroidal core ferrite for a cable of the motor holding brake
 - ◆ Lacing cord

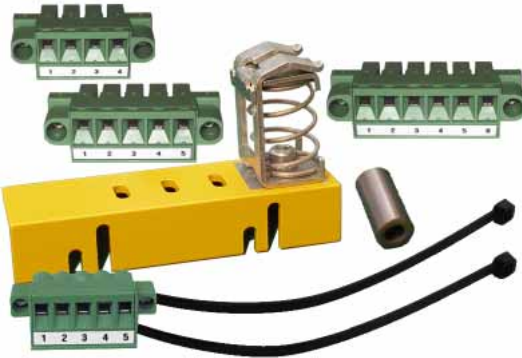
Order Code connection set for Compax3S

for C3S0xxV2	ZBH 02/01	ZBH	0	2	/	0	1		
for C3S0xxV4 / S150V4 / S1xxV2	ZBH 02/02	ZBH	0	2	/	0	2		
for C3S300V4	ZBH 02/03	ZBH	0	2	/	0	3		

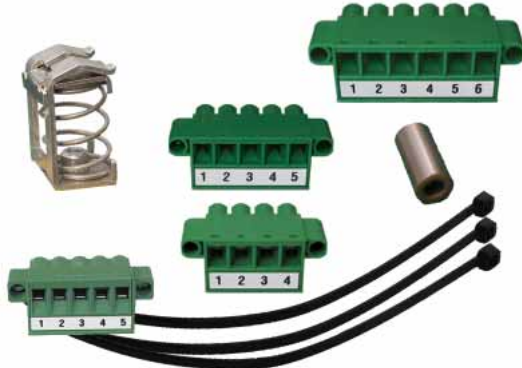
ZBH02/01: for Compax3 S0xx 1AC V2



ZBH02/02: for Compax3 S0xx 3AC V4, Compax3 S150 3AC V4 and Compax3 S1xx 3AC V2



ZBH02/03: for Compax3 S300 3AC V4



11.6

Connection set for Compax3MP/Compax3M

The connection set which is available as accessory comprises:

for Compax3M

- ◆ Cable clamps in different sizes for large area shielding of the motor cable, the screw for the cable clamp as well as
- ◆ the matching plug for the Compax3M connectors X14, X15, X43
- ◆ a toroidal core ferrite for a cable of the motor holding brake
- ◆ an interface cable (SSK28/23) for communication within the axis combination

for Compax3MP

- ◆ the matching plug for the Compax3MP connectors X9, X40, X41
- ◆ 2 bus terminal connectors (BUS07/01) for mains module and the last axis controller in the combination
- ◆

Order Code connection set for Compax3MP/Compax3M

for C3M050D6, C3M100D6, C3M150D6	ZBH 04/01	ZBH	0	4	/	0	1		
for C3M300D6	ZBH 04/02	ZBH	0	4	/	0	2		
for C3MP10	ZBH 04/03	ZBH	0	4	/	0	3		
C3MP20	ZBH 04/03	ZBH	0	4	/	0	4		

ZBH04/01: for Compax3M050-150D6

ZBH04/02: for Compax3M300D6

ZBH04/03: for Compax3MP10D6

ZBH04/04: for Compax3MP20D6

11.7 Operator control module BDM

Order Code operating module

Operating module (for Compax3S and Compax3F)

			/		
BDM	0	1	/	0	1

Flexible service and maintenance



Functions:

- ◆ Mobile or stationary handling: can remain on the unit for display and diagnostic purposes, or can be plugged into any unit.
- ◆ Can be plugged in while in operation
- ◆ Power supply via Compax3 servo control
- ◆ Display with 2 times 16 places.
- ◆ Menu-driven operation using 4 keys.
- ◆ Displays and changing of values.
- ◆ Display of Compax3 messages.
- ◆ Duplication of device properties and IEC61131-3 program to another Compax3 with identical hardware.
- ◆ Additional information can be found in the BDM manual. This can be found on the Compax3 CD or on our Homepage: **BDM-manual** (http://apps.parker.com/divapps/EME/EME/Literature_List/dokumentationen/BDM.pdf).

11.8

EAM06: Terminal block for inputs and outputs

Order Code terminal block

for I/Os without luminous indicator	for X11, X12, X22	EAM	0	6	/ 0 1
for I/Os with luminous indicator	for X12, X22	EAM	0	6	/ 0 2

The terminal block EAM06/.. can be used to route the Compax3 plug connector X11 or X12 for further wiring to a terminal strip and to a Sub-D plug connector.

Via a supporting rail (Design:  or ) the terminal block can be installed on a mounting rail in the control cabinet.

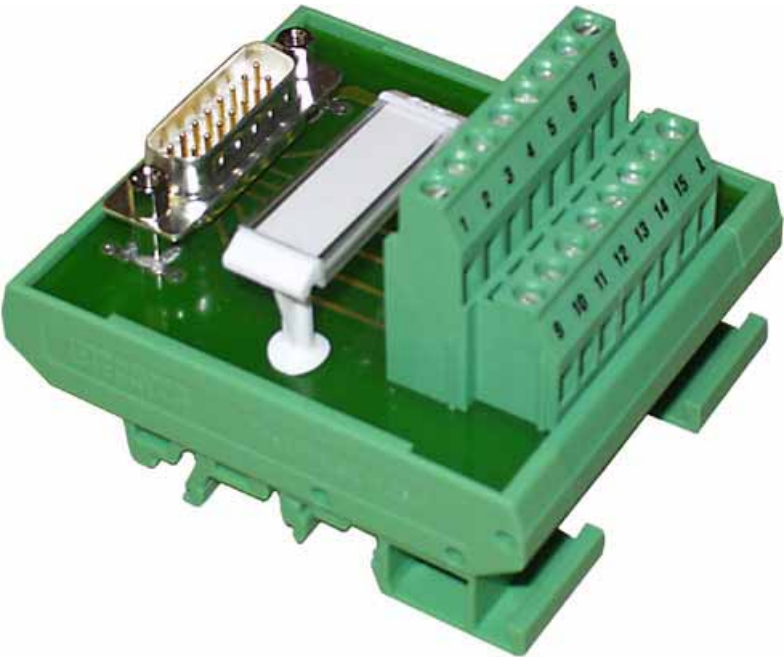
EAM06/ is available in 2 variants:

- ◆EAM06/01: Terminal block for X11, X12, X22 without luminous indicator
- ◆EAM06/02: Terminal block for X12, X22 with luminous indicator

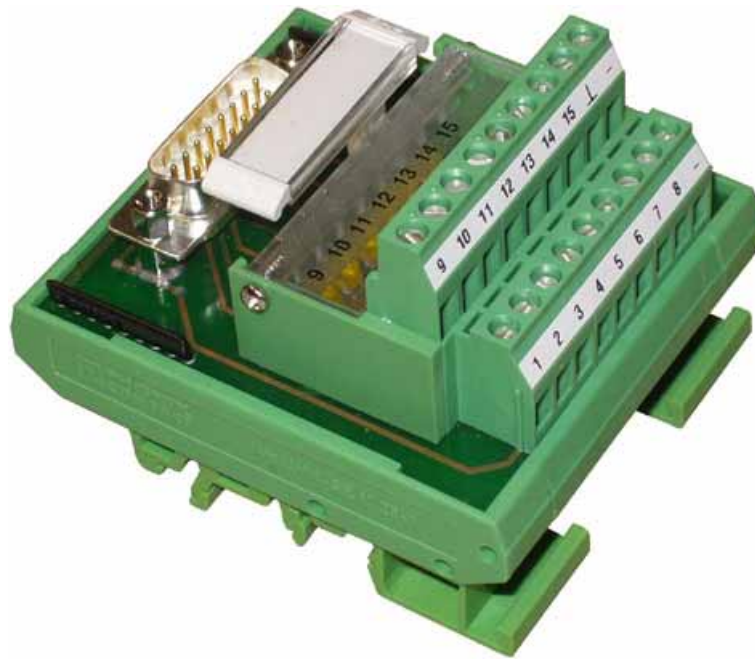
Corresponding connecting cables EAM06 - Compax3 are available:

- ◆from X11 - EAM06/01: SSK23/..
- ◆from X12, X22 - EAM06/xx: SSK24/..

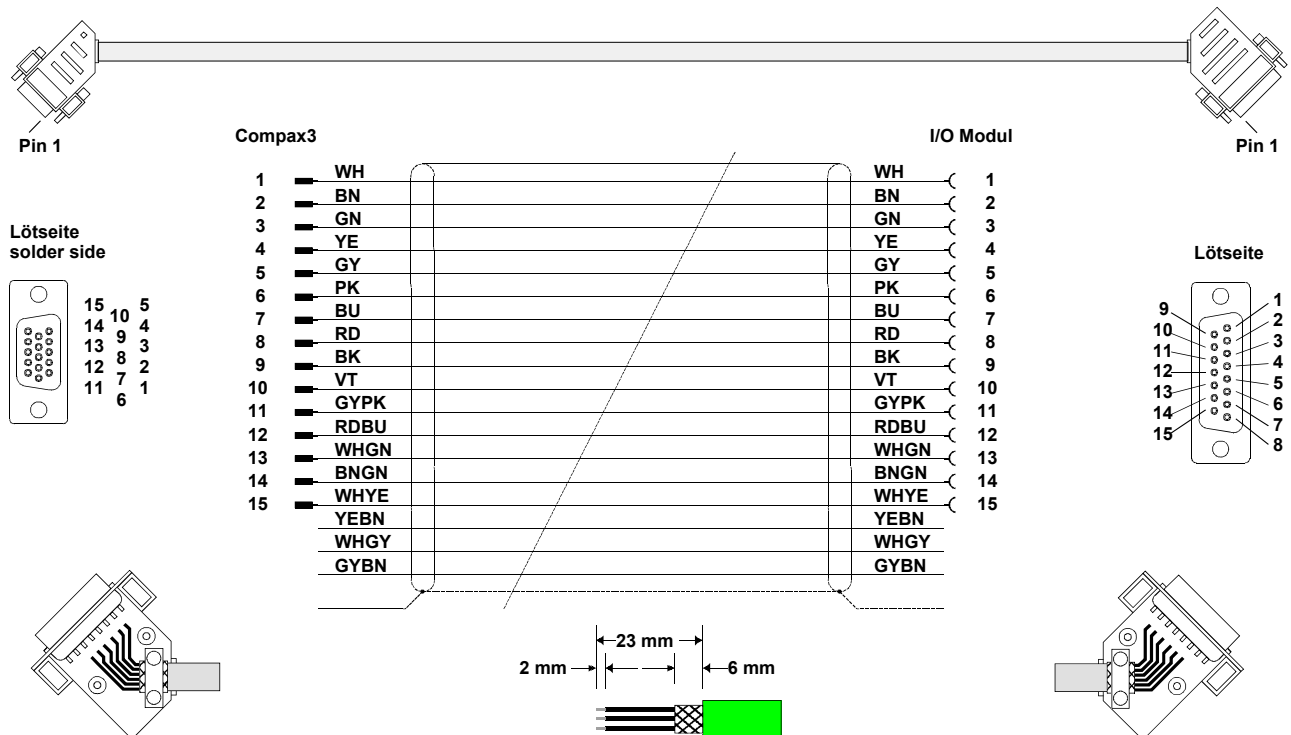
EAM6/01: Terminal block without luminous indicator for X11, X12 or X22



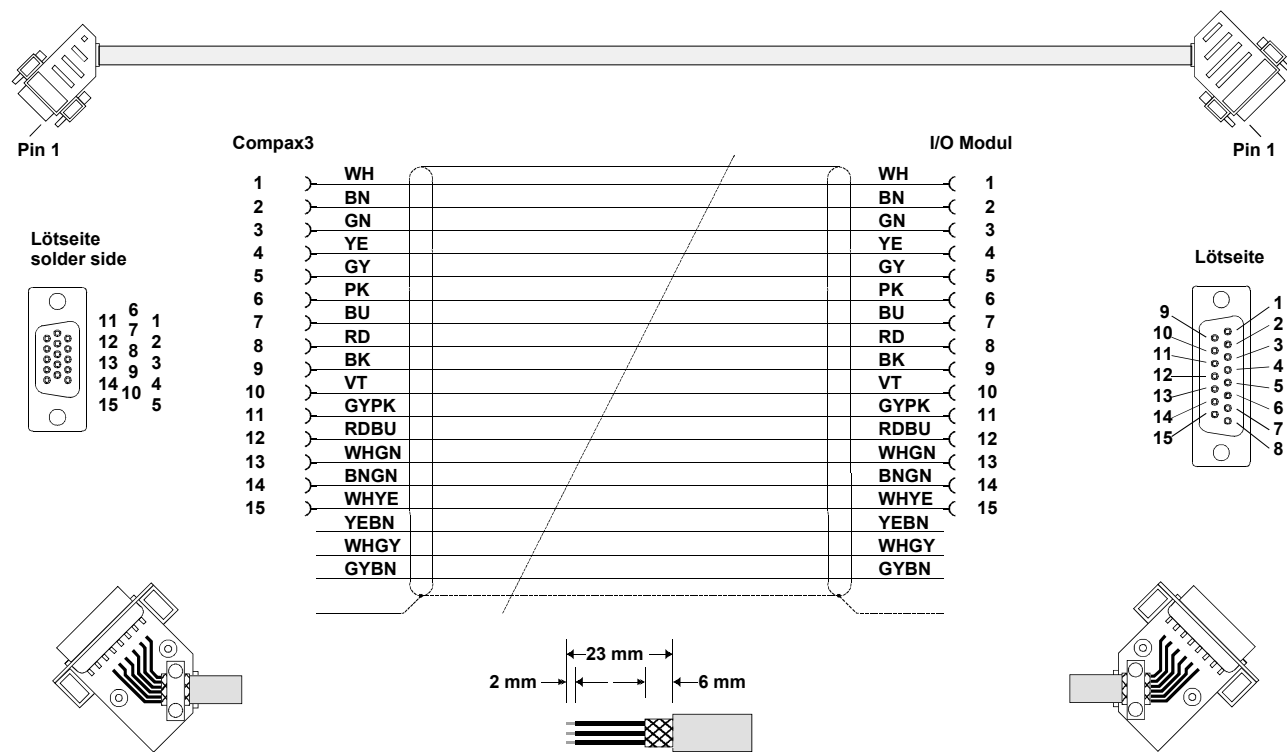
Width: 67.5mm

EAM6/02: Terminal block with luminous indicator for X12, X22

Width: 67.5mm

Cable plan SSK23/...: X11 to EAM 06/01

Cable plan SSK24/...: X12 to EAM 06/xx



11.9 Interface Cables

In this chapter you can read about:

RS232 cable	500
RS485 cable to Pop.....	501
I/O interface X12 / X22	502
Ref X11.....	503
Encoder coupling of 2 Compax3 axes.....	504
Modem cable SSK31.....	505

Order code for interface cables and plugs

		/		

PC – Compax3 (RS232)	SSK	0	1	/	...	...	⁽¹⁾
PC - Compax3MP (USB)	SSK	3	3	/	...	...	
on X11 (Ref/Analog) and X13 at C3F001D2	SSK	2	1	/	...	...	⁽¹⁾
on X12 / X22 (I/Os digital)	SSK	2	2	/	...	...	⁽¹⁾
on X11 (Ref /Analog)	SSK	2	3	/	...	...	⁽¹⁾
on X12 / X22 (I/Os digital)	SSK	2	4	/	...	...	⁽¹⁾
PC ⇔ POP (RS232)	SSK	2	5	/	...	...	⁽¹⁾
Compax3 ⇔ POP (RS485) for several C3H on request	SSK	2	7	/	..	...	⁽⁶⁾
Compax3 HEDA ⇔ Compax3 HEDA or PC ⇔ C3powerPLmC	SSK	2	8	/	..	...	⁽⁵⁾
Compax3 I30 ⇔ Compax3 I30 or C3M-multi-axis communication							
Compax3 X11 ⇔ Compax3 X11 (encoder coupling of 2 axes)	SSK	2	9	/	...	...	⁽¹⁾
Compax3 X10 ⇔ Modem	SSK	3	1	/	...	...	
Compax3H adapter cable ⇔ SSK01 (length 15cm, delivered with the device)	SSK	3	2	/	2	0	
Compax3H X10 RS232 connection control ⇔ Programming interface (delivered with the device)	VBK	1	7	/	0	1	
Bus terminal connector (for the 1st and last Compax3 in the HEDA Bus/or multi-axis system).	BUS	0	7	/	0	1	
Profibus cable ⁽²⁾	SSL	0	1	/	...	...	⁽¹⁾
Profibus plug	BUS	0	8	/	0	1	
CAN-Bus cable ⁽²⁾	SSL	0	2	/	...	...	⁽¹⁾
CANbus connector	BUS	1	0	/	0	1	

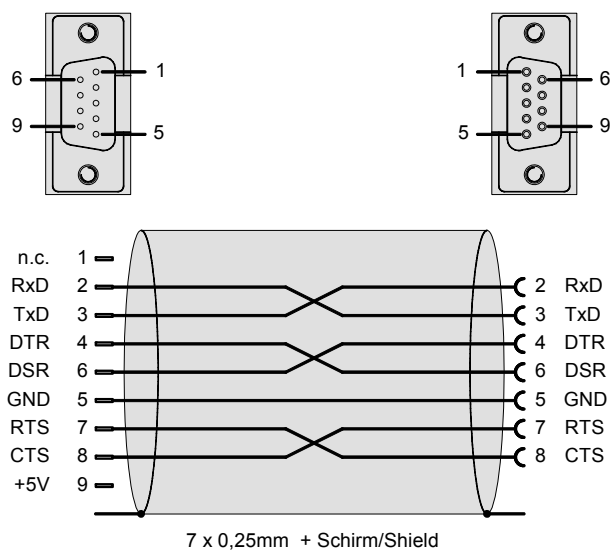
^(x) **Note on the cable** (see page 463)

11.9.1. RS232 cable

SSK1/..

X10 <---

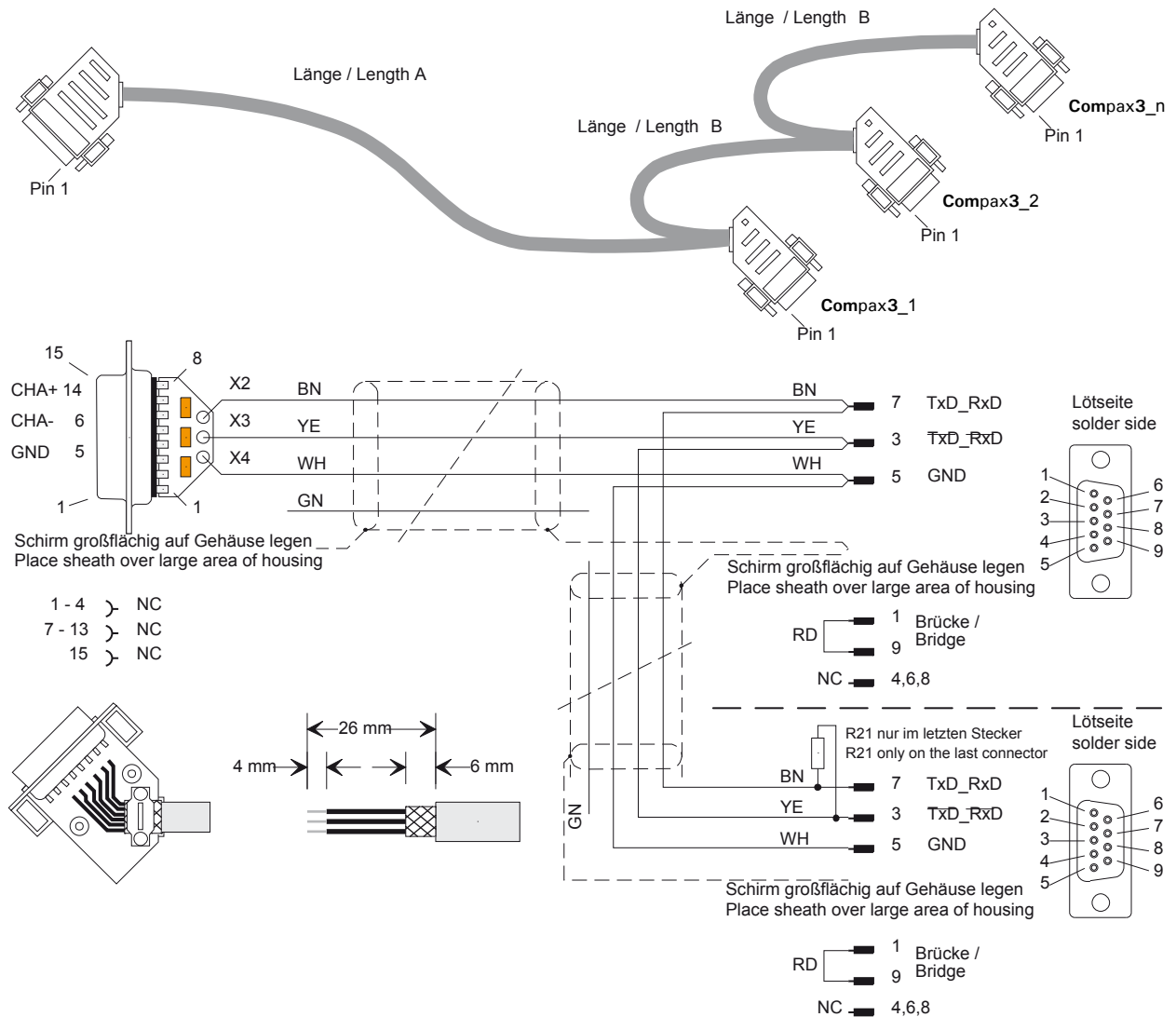
--->PC



You will find the length code in the **accessories order code** (see page 460).

11.9.2. RS485 cable to Pop

SSK27: Connection Pop - Compax3 - Compax3 - ...



R21 = 220 Ohm

⁽⁶⁾ Order code: SSK27/nn/..

Length A (Pop - 1. Compax3) variable (the last two numbers according to the length code for cable, for example SSK27/nn/01)

Length B (1. Compax3 - 2. Compax3 - ... - n. Compax3) fixed 50 cm (only if there is more than 1 Compax3, i.e. nn greater than 01)

Number n (the last two digits)

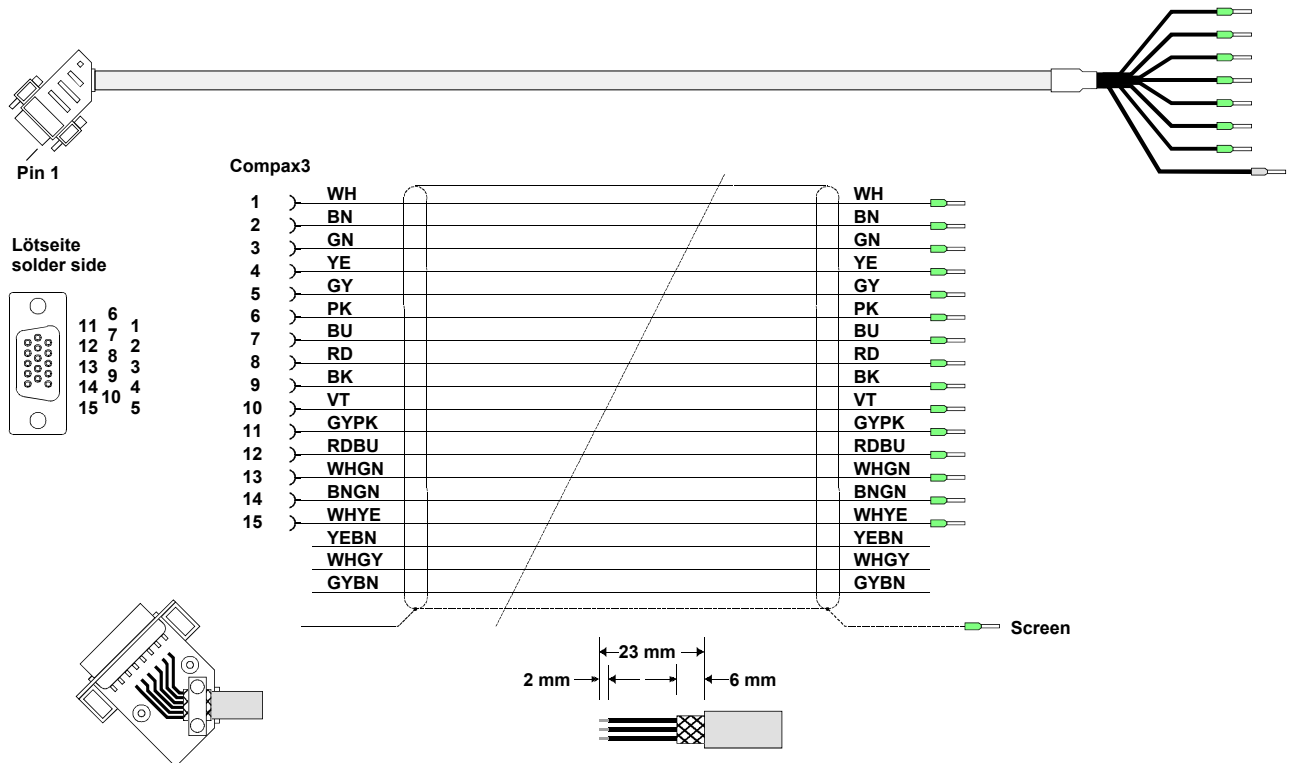
Examples:

SSK27/05/.. for connecting from Pop to 5 Compax3.

SSK27/01/.. for connection from Pop to one Compax3

11.9.3. I/O interface X12 / X22

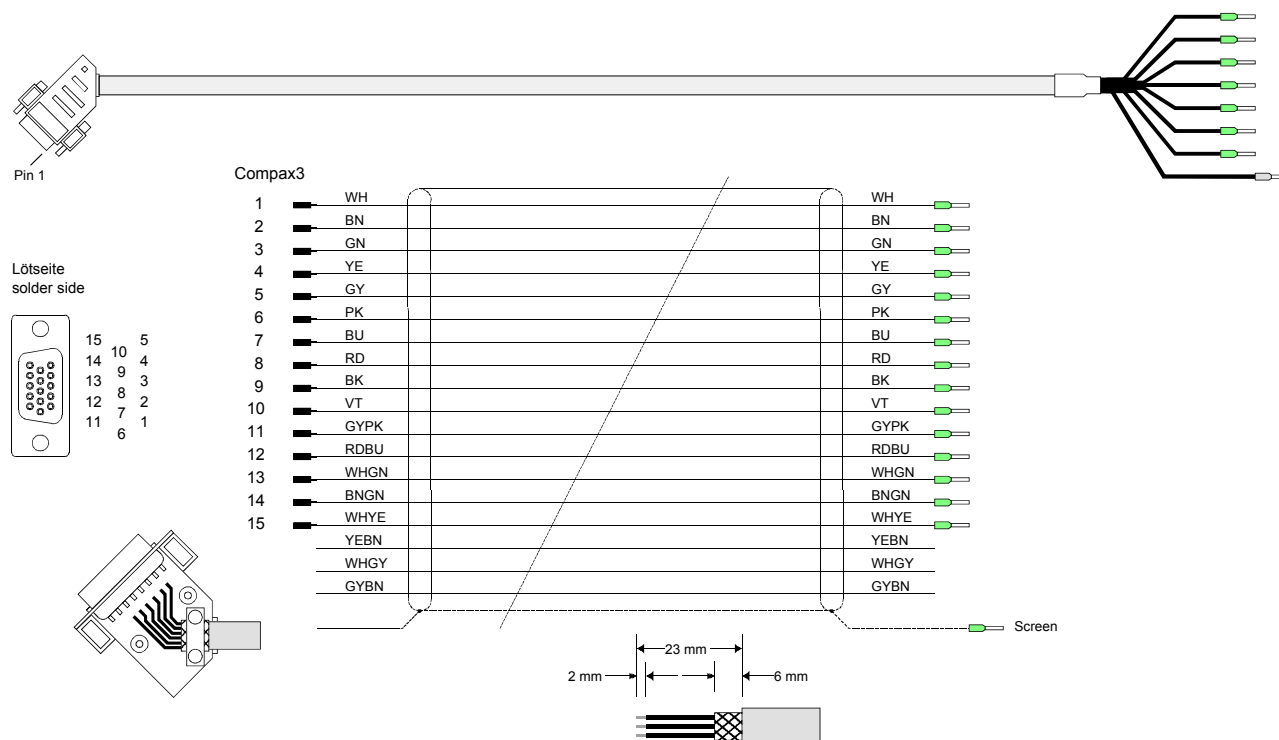
SSK22/...: Cable for X12 / X22 with flying leads



You will find the length code in the **accessories order code** (see page 460).

11.9.4. Ref X11

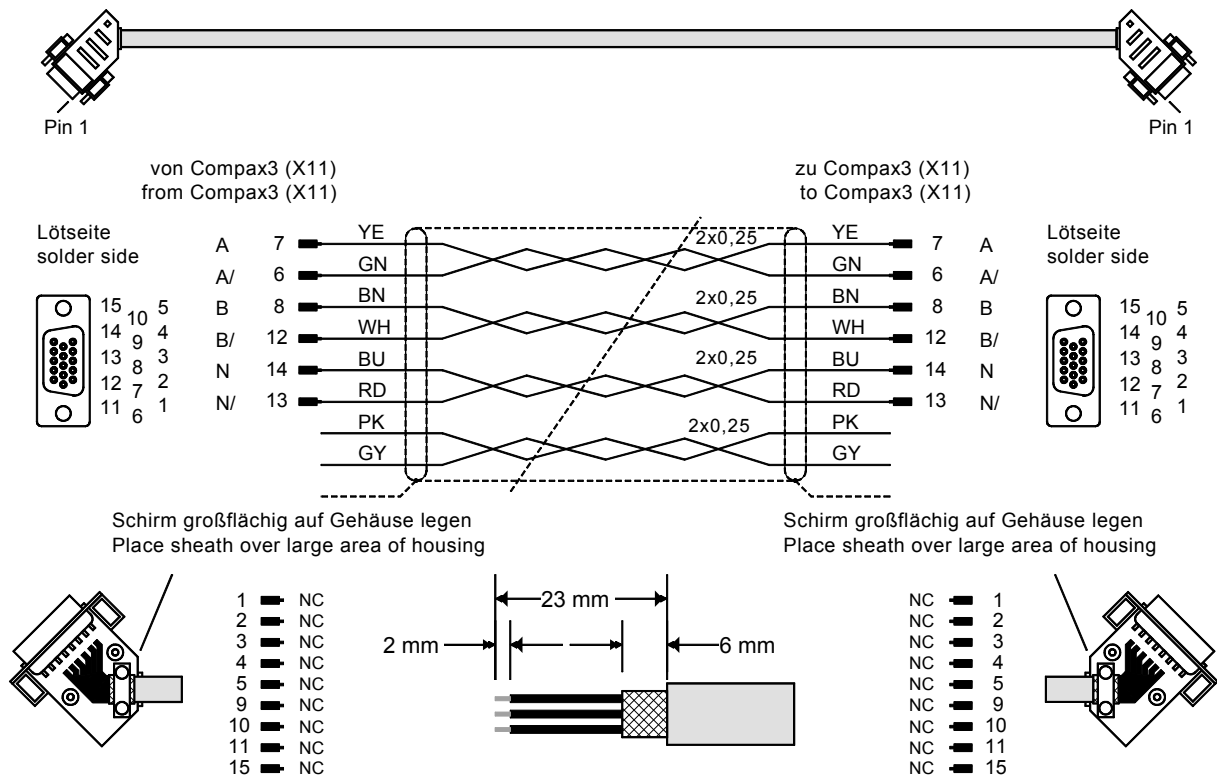
SSK21/...: Cable for X11 with flying leads



You will find the length code in the **accessories order code** (see page 460).

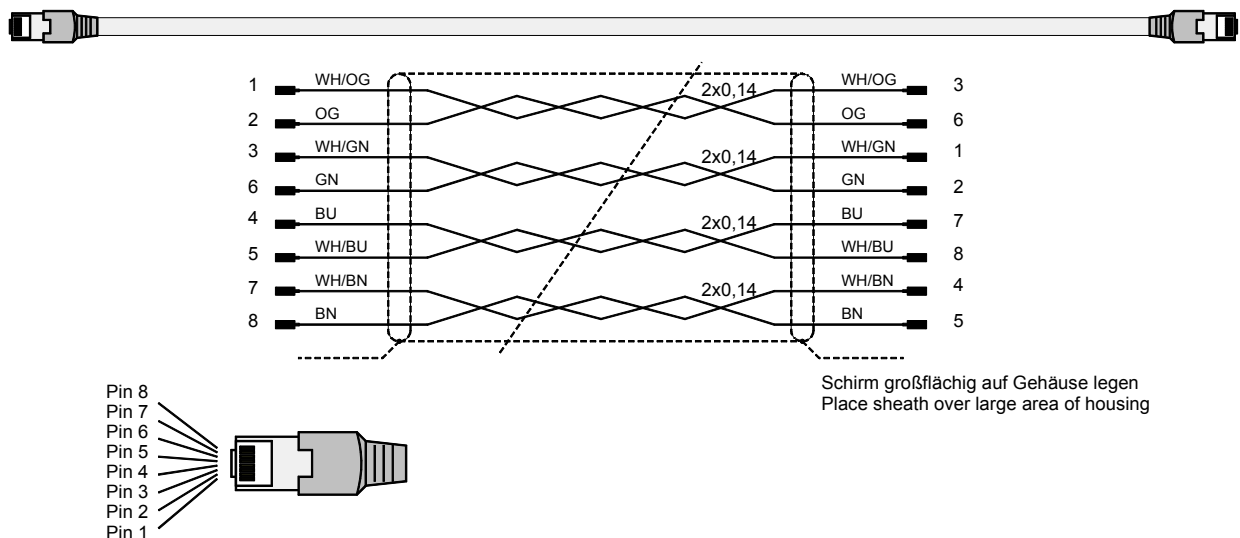
11.9.5. Encoder coupling of 2 Compax3 axes

SSK29/...: Cable from Compax3 X11 to Compax3 X11



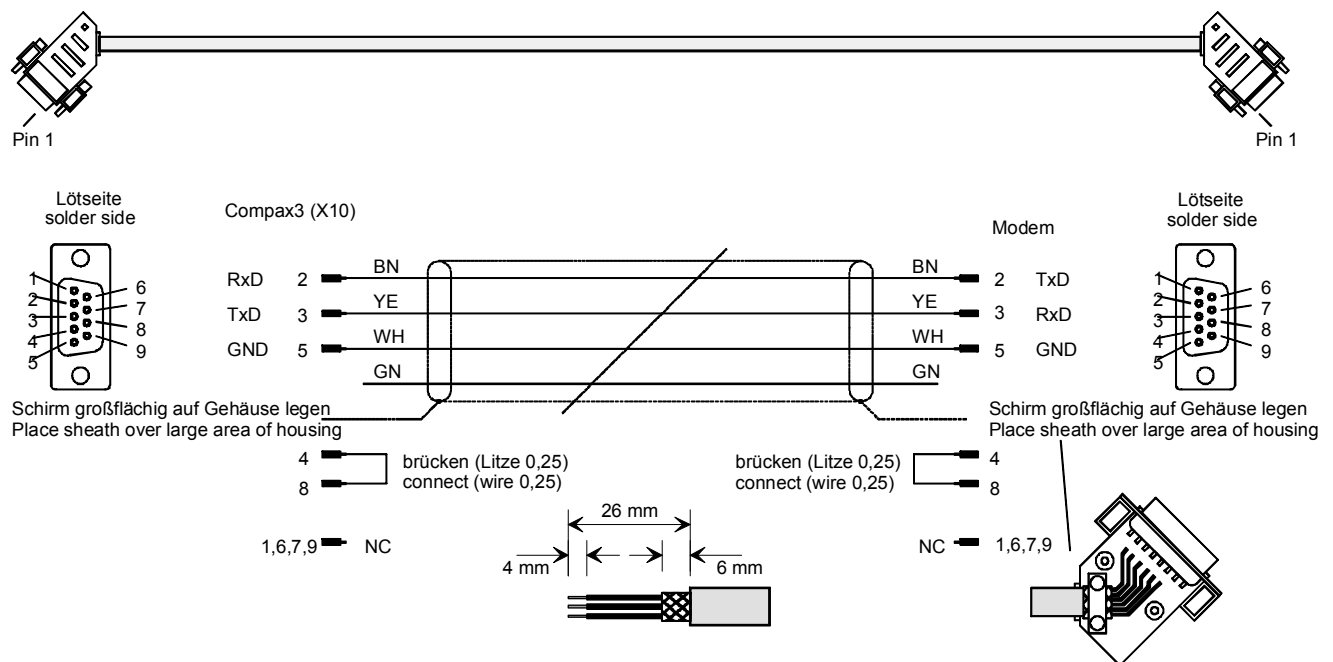
You will find the length code in the **accessories order code** (see page 460).

Layout of SSK28:



11.9.6. Modem cable SSK31

SSK31/..



You will find the length code in the **accessories order code** (see page 460).

11.10 Options M1x

In this chapter you can read about:

Input/output option M12.....	506
HEDA (motion bus) - Option M11.....	507
Option M10 = HEDA (M11) & I/Os (M12).....	509

11.10.1. Input/output option M12

An optional input/output extension is available for Compax3. This option is named M12 and offers 12 digital 24V inputs/outputs (Ports) on X22.

The use of the option as inputs or outputs is programmable in groups of 4 (via the object 133.4).

The outputs are written via the object 133.3 "Output word for the I/O option"; this applies only for the ports defined as output.

The inputs are read via the object 121.2 "Input word for the I/O option"; all ports are being read, also the outputs.

11.10.1.1 Assignment of the X22 connector



PIN X22/	Input/output	I/O /X22 High density/Sub D	Access via IEC module:
1	n.c.	Reserved	
2	O0/I0	Output 0 / Input 0 - adjustable	C3_IOAddition_0 (see page 337)
3	O1/I1	Output 1 / Input 1 - adjustable	
4	O2/I2	Output 2 / Input 2 - adjustable	
5	O3/I3	Output 3 / Input 3 - adjustable	
6	O4/I4	Output 4 / Input 4 - adjustable	C3_IOAddition_1 (see page 337)
7	O5/I5	Output 5 / Input 5 - adjustable	
8	O6/I6	Output 6 / Input 6 - adjustable	
9	O7/I7	Output 7 / Input 7 - adjustable	
10	O8/I8	Output 8 / Input 8 - adjustable	C3_IOAddition_2 (see page 338) (not 24VDC)
11	E	24 VDC power supply	
12	O9/I9	Output 9 / Input 9 - adjustable	
13	O10/I10	Output 10 / Input 10 - adjustable	
14	O11/I11	Output 11 / Input 11 - adjustable	
15	E	Gnd 24 V	

The assignment can be adjusted.

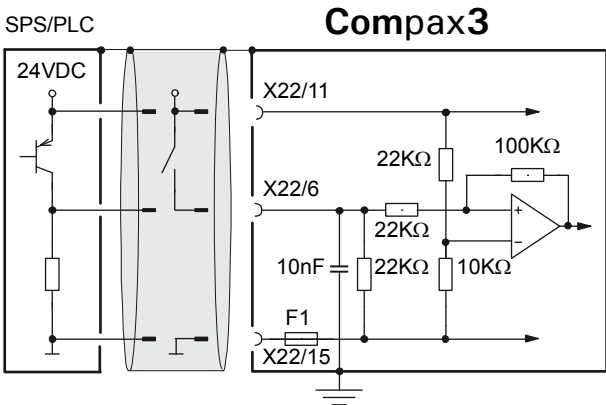
All inputs and outputs have 24V level.

Maximum load on an output: 100mA

Maximum capacitive load: 50nF (max. 4 Compax3 inputs)

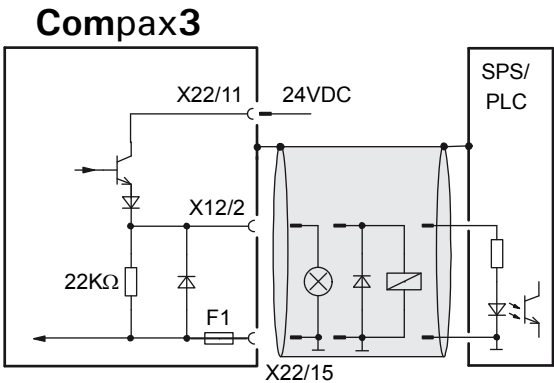
Caution! The 24VDC power supply (X22/11) must be supplied from an external source and must be protected by a 1.2A delayed fuse!

Input wiring of digital inputs



The circuit example is valid for all digital inputs!
F1: quick action electronic fuse; can be reset by switching the 24VDC supply off and on again.

Output wiring of digital outputs



The circuit example is valid for all digital outputs!
The outputs are short circuit proof; a short circuit generates an error.
F1: quick action electronic fuse; can be reset by switching the 24VDC supply off and on again.

11.10.2. HEDA (motion bus) - Option M11



	RJ45 (X20)	RJ45 (X21)
PIN	HEDA in	HEDA out
1	Rx	Tx
2	Rx/	Tx/
3	Lx	Lx
4	-	Reserved
5	-	Reserved
6	Lx/	Lx/
7	-	Reserved
8	-	Reserved

Function of the HEDA LEDs

Green LED (left)

HEDA module energized

Red LED (right)

Error in the receive area

Possible causes:

- ◆ at the Master
 - ◆ no slave sending back
 - ◆ Wrong cabling
 - ◆ Terminal plug is missing
 - ◆ several masters are sending in the same slot
- ◆ at the slave
 - ◆ several masters in the system
 - ◆ no master active
 - ◆ Terminal plug is missing
 - ◆ no transmission from one or several receive slots (neither by the master nor by another slave)

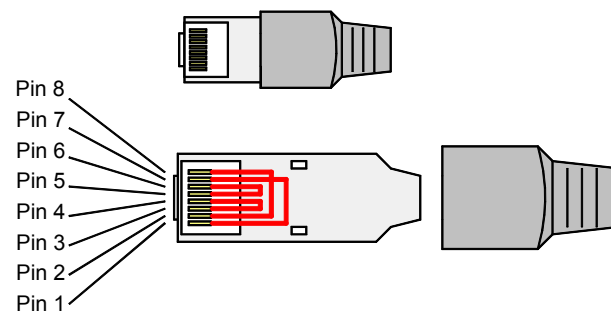
HEDA-wiring:

HEDA-Master



Layout of SSK28 (see page 462, see page 504)

Design of the HEDA bus terminator BUS 07/01:



Jumpers: 1-7, 2-8, 3-4, 5-6

Function of the HEDA LEDs**Green LED (left)**

HEDA module energized

Red LED (right)

Error in the receive area

Possible causes:

- ◆ at the Master
 - ◆ no slave sending back
 - ◆ Wrong cabling
 - ◆ Terminal plug is missing
 - ◆ several masters are sending in the same slot
- ◆ at the slave
 - ◆ several masters in the system
 - ◆ no master active
 - ◆ Terminal plug is missing
 - ◆ no transmission from one or several receive slots (neither by the master nor by another slave)

11.10.3. Option M10 = HEDA (M11) & I/Os (M12)

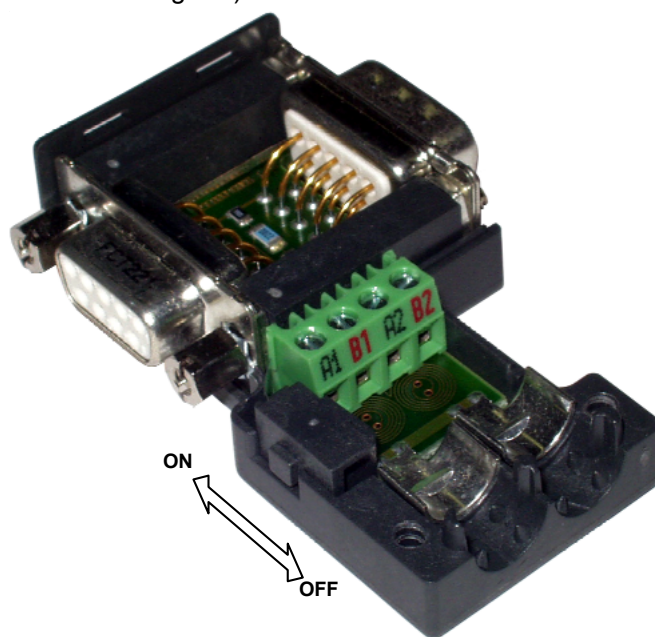
The M10 option includes the M12 input/output option and the HEDA M11 option.

11.11 Profibus plug BUS08/01

We offer a Profibus plug and special cable as meterware for Profibus wiring:

- ◆ Profibus cable: SSL01/.. not prefabricated (color according to DESINA).
- ◆ Profibus plug: BUS08/01 with 2 cable inputs (for one incoming A1, B1 and one continuing Profibus cable- A2, B2 -) and screw terminals as well as a switch for activating the terminal resistor.

The terminal resistor must be activated on the first and on the last station (= switch setting ON).



11.12 CAN - plug BUS10/01

We offer a CAN plug and special cable in any length to order for the CAN-bus wiring:

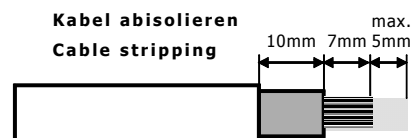
- ◆ CAN cable: SSL02/.. not prefabricated (colour according to DESINA).
- ◆ CAN plug: BUS10/01 with 2 cable inputs and screw terminals as well as a switch for activating the terminal resistor.
The terminal resistor must be activated on the first and on the last station (=switch setting ON).

Note for integrated C3 powerPLmC (Compax3 interface designation "C1x")

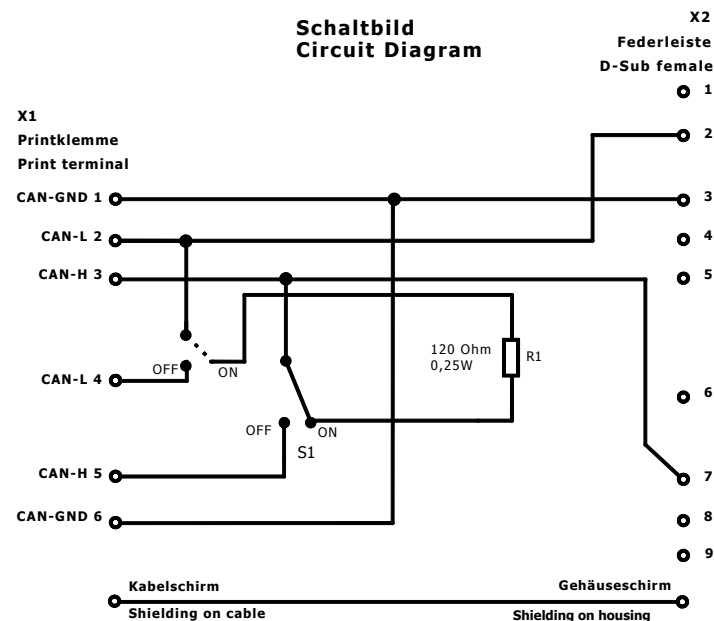
- ◆ The CAN bus of the C3 powerPLmC does already contain a terminal resistor.
- ◆ Therefore it applies for the **C3 powerPLmC**:
Put switch to OFF
wire C3 powerPLmC always at the end of the CAN bus!



CAN wiring



Schaltbild Circuit Diagram



11.13 PIO: Inputs/Outputs

Additional external digital and analog inputs and outputs can be integrated via CANopen.

For this purpose we offer the Parker I/O system (PIO).

PIO offers the convenience of exceptionally simple installation. The individual modules can be installed and removed without any tools.

Available modules:

Order Code decentralized input terminals

PIO 2DI 24VDC 3.0ms	2-channel digital input terminal	PIO	4	0	0
PIO 4DI 24VDC 3.0ms	4-channel digital input terminal	PIO	4	0	2
PIO 8DI 24VDC 3.0ms	8-channel digital input terminal	PIO	4	3	0
PIO 2AI DC $\pm$ 10V differential input	2 channel analog input terminal ($\pm$ 10V differential input)	PIO	4	5	6
PIO 4AI 0-10VDC S.E.	4 channel analog input terminal (0-10V signal voltage)	PIO	4	6	8
PIO 2AI 0 -20mA differential input	2 channel analog input terminal (0 -20mA differential input)	PIO	4	8	0

Order Code decentralized output terminals

PIO 2DO 24VDC 0.5A	2 channel digital output terminal (output voltage 0.5A)	PIO	5	0	1
PIO 4DO 24VDC 0.5A	4 channel digital output terminal (output voltage 0.5A)	PIO	5	0	4
PIO 8DO 24VDC 0.5A	8 channel digital output terminal (output voltage 0.5A)	PIO	5	3	0
PIO 2AO 0-10VDC	2 channel analog output terminal (0-10V signal voltage)	PIO	5	5	0
PIO 2AO 0 -20mA	2 channel analog output terminal (0-20mA signal voltage)	PIO	5	5	2
PIO 2AO DC $\pm$ 10V	2 channel analog output terminal ($\pm$ 10V signal voltage)	PIO	5	5	6

Order Code CANopen Fieldbus Coupler

CANopen Standard	max. vectorial sum current for bus terminals 1650mA at 5V	PIO	3	3	7
CANopen ECO	max. vectorial sum current for bus terminals 650mA at 5V	PIO	3	4	7

For additional information please refer to our **catalog**

http://www.parker.com/euro_emd/EME/Literature_List/dokumentationen/PIO_catalogue%20eng.pdf.

12. Specifications

Mains connection Compax3S0xxV2 1AC

Controller type	S025V2	S063V2
Supply voltage	Single phase 230VAC/240VAC 80-253 VAC/50-60Hz	
Input current	6Aeff	13Aeff
Maximum fuse rating per device (=short circuit rating)	10 A (MCB miniature circuit breaker)	16 A (MCB miniature circuit breaker)

Mains connection Compax3S1xxV2 3AC

Controller type	S100V2	S150V2
Supply voltage	Three phase 3* 230VAC/240VAC 80-253 VAC/50-60Hz	
Input current	10Aeff	13Aeff
Maximum fuse rating per device (=short circuit rating)	16 A (MCB miniature circuit breaker)	20 A (MCB miniature circuit breaker)

Mains connection Compax3SxxxV4 3AC

Controller type	S015V4	S038V4	S075V4	S150V4	S300V4
Supply voltage	Three phase 3*400VAC/480VAC 80-528VAC / 50-60Hz				
Input current	3Aeff	6Aeff	10Aeff	16Aeff	22Aeff
Maximum fuse rating per device(=short circuit rating)	6A	10A	16A	20A	25A
	MCB miniature circuit breaker				D*

* for UL conform operation (see page 22): MCB miniature circuit breaker S273-K.

Mains connection Compax3MP10D6

Device type Compax3MP10	230V	400V	480V
Supply voltage	230VAC ±10% 50-60Hz	400VAC ±10% 50-60Hz	480VAC ±10% 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	22Aeff	22Aeff	18Arms
Output voltage	325VDC ±10%	565VDC ±10%	680VDC ±10%
Output power	6kW	10 kW	10 kW
Maximum fuse rating per device (=short circuit rating)	MCB miniature circuit breaker according to DIVQ.GuidelInfo Recommendation: (ABB) S203 UP-25K (480VAC)		

Mains connection Compax3MP20D6

Device type Compax3MP20	230V	400V	480V
Supply voltage	230VAC ±10% 50-60Hz	400VAC ±10% 50-60Hz	480VAC ±10% 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	44Arms	44Arms	35Arms
Output voltage	325VDC ±10%	565VDC ±10%	680VDC ±10%
Output power	12kW	20kW	20kW
Maximum fuse rating per device (=short circuit rating)	MCB miniature circuit breaker 50A according to DIVQ.GuidelInfo Recommendation: (ABB) S203-U50K (440VAC) Fuses 80A / 660VAC per supply leg according to UL-Guide JFHR2 Recommendation: Bussmann 170M		

Mains connection Compax3HxxxV4

Controller type	H050V4	H090V4	H125V4	H155V4
Supply voltage	Three phase 3*400VAC/480VAC 350-528VAC / 50-60Hz			
Input current	54Aeff	93Aeff	118Aeff	140Aeff
Maximum fuse rating per device(=short circuit rating)	60A	100A	125A	150A
	JDDZ class K5, JDRX class H	JDDZ class H5, JDRX class H		

Control voltage 24VDC Compax3S and Compax3H

Controller type	Compax3
Voltage range	21 - 27VDC
Mains module	with switch-on current limitation, due to capacitive load
Fuse	MCB miniature circuit breaker or "delayed action fuse", due to capacitive load
Current drain of the device	0.8A
Total current drain	0.8 A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

Control voltage 24VDC Compax3MP / Compax3M

Device type	Compax3MP / Compax3M
Voltage range	21 - 27VDC
Mains module	with switch-on current limitation, due to capacitive load
Fuse	MCB miniature circuit breaker or "delayed action fuse", due to capacitive load
Current drain of the device	C3MP10D6: 0.2A C3MP20D6: 0.3A
Total current drain	C3M050D6: 0.85A C3M100D6: 0.85A C3M150D6: 0.85A C3M300D6: 1.0A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

Output data Compax3S0xx at 1*230VAC/240VAC

Controller type	S025V2	S063V2
Output voltage	3x 0-240V	3x 0-240V
Nominal output current	2.5Arms	6.3Aeff
Pulse current for 5s	5.5Aeff	12.6Aeff
Power	1kVA	2.5kVA
Switching frequency	16kHz	16kHz
Power loss for In	30W	60W

Output data Compax3S1xx at 3*230VAC/240VAC

Controller type	S100V2	S150V2
Output voltage	3x 0-240V	3x 0-240V
Nominal output current	10Aeff	15Aeff
Pulse current for 5s	20Aeff	30Aeff
Power	4kVA	6kVA
Switching frequency	16kHz	8kHz
Power loss for In	80 W	130W

Output data Compax3Sxxx at 3*400VAC

Controller type	S015V4	S038V4	S075V4	S150V4	S300V4
Output voltage	3x 0-400V				
Nominal output current	1.5Aeff	3.8Aeff	7.5 Aeff	15Aeff	30Aeff
Pulse current for 5s	4.5Aeff	9.0Aeff	15Aeff	30Aeff	60Aeff
Power	1kVA	2.5kVA	5kVA	10kVA	20kVA
Switching frequency	16kHz	16kHz	16kHz	8kHz	8kHz
Power loss for In	60W	80 W	120W	160W	350W

Output data Compax3Sxxx at 3*480VAC

Controller type	S015V4	S038V4	S075V4	S150V4	S300V4
Output voltage	3x 0-480V				
Nominal output current	1.5Aeff	3.8Aeff	6.5Aeff	13.9Aeff	30Aeff
Pulse current for 5s	4.5Aeff	7.5 Aeff	15Aeff	30Aeff	60Aeff
Power	1.25kVA	3.1kVA	6.2kVA	11.5kVA	25kVA
Switching frequency	16kHz	16kHz	16kHz	8kHz	8kHz
Power loss for In	60W	80 W	120W	160W	350W

Output data Compax3Mxxx at 3*230VAC

Device type Compax3	M050D6	M100D6	M150D6	M300D6
Power Input	325VDC $\pm 10\%$			
Output voltage	3x 0-230V (0...500Hz)			
Nominal output current	5Aeff	10Aeff	15Aeff	30Aeff
Pulse current for 5s *	10Aeff	20Aeff	30Aeff	60Aeff
Power	2kVA	4kVA	6kVA	12kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	70W+**	90W+**	120W+**	270W+**

*Turning frequency for pulse current: $f > 5\text{Hz}$

** Maximum additional losses with option card 5W.

Output data Compax3Mxxx at 3*400VAC

Device type Compax3	M050D6	M100D6	M150D6	M300D6
Power Input	565VDC $\pm 10\%$			
Output voltage	3x 0-400V (0...500Hz)			
Nominal output current	5Aeff	10Aeff	15Aeff	30Aeff
Pulse current for 5s *	10Aeff	20Aeff	30Aeff	60Aeff
Power	3.33kVA	6.66kVA	10kVA	20kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	70W+**	90W+**	120W+**	270W+**

*Turning frequency for pulse current: $f > 5\text{Hz}$

** Maximum additional losses with option card 5W.

Output data Compax3Mxxx at 3*480VAC

Device type Compax3	M050D6	M100D6	M150D6	M300D6
Power Input	680VDC $\pm 10\%$			
Output voltage	3x 0-480V (0...500Hz)			
Nominal output current	4Aeff	8Arms	12.5Arms	25Arms
Pulse current for 5s *	8Arms	16Arms	25Arms	50Aeff
Power	3.33kVA	6.66kVA	10kVA	20kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	70W+**	90W+**	120W+**	270W+**

*Turning frequency for pulse current: $f > 5\text{Hz}$

** Maximum additional losses with option card 5W.

Output data Compax3Hxxx at 3*400VAC

Controller type	H050V4	H090V4	H125V4	H155V4
Output voltage	3x 0-400V			
Nominal output current	50A _{eff}	90A _{eff}	125A _{eff}	155A _{eff}
Pulse current for 5s *	75A _{eff}	135A _{eff}	187.5A _{eff}	232.5A _{eff}
Power	35kVA	62kVA	86kVA	107kVA
Switching frequency	8 kHz	8 kHz	8 kHz	8 kHz
Power loss for I _n	880W	900W	1690W	1970W

* during low speeds, the overload time is reduced to 1s. Limit:

< 2.5 electric rev/s (= actual revolutions/s * number of pole pairs) resp. > 2.5 Pitch/s

Output data Compax3Hxxx at 3*480VAC

Controller type	H050V4	H090V4	H125V4	H155V4
Output voltage	3x 0-480V			
Nominal output current	43A _{eff}	85A _{eff}	110A _{eff}	132A _{eff}
Pulse current for 5s *	64.5A _{eff}	127.5A _{eff}	165A _{eff}	198A _{eff}
Power	35kVA	70kVA	91kVA	109kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for I _n	850W	1103W	1520W	1800W

* during low speeds, the overload time is reduced to 1s. Limit:

< 2.5 electric rev/s (= actual revolutions/s * number of pole pairs) resp. > 2.5 Pitch/s

Resulting nominal and peak currents depending on the switching frequency**Compax3S0xxV2 at 1*230VAC/240VAC**

Switching frequency*		S025V2	S063V2
16kHz	I _{nominal}	2.5A _{eff}	6.3A _{eff}
	I _{peak} (<5s)	5.5A _{eff}	12.6A _{eff}
32kHz	I _{nominal}	2.5A _{eff}	5.5A _{eff}
	I _{peak} (<5s)	5.5A _{eff}	12.6A _{eff}

Compax3S1xxV2 at 3*230VAC/240VAC

Switching frequency*		S100V2	S150V2
8kHz	I _{nominal}	-	15A _{eff}
	I _{peak} (<5s)	-	30A _{eff}
16kHz	I _{nominal}	10A _{eff}	12.5A _{eff}
	I _{peak} (<5s)	20A _{eff}	25A _{eff}
32kHz	I _{nominal}	8A _{eff}	10A _{eff}
	I _{peak} (<5s)	16A _{eff}	20A _{eff}

Compax3S0xxV4 at 3*400VAC

Switching frequency*		S015V4	S038V4	S075V4	S150V4	S300V4
8kHz	I _{nominal}	-	-	-	15A _{eff}	30A _{eff}
	I _{peak} (<5s)	-	-	-	30A _{eff}	60A _{eff}
16kHz	I _{nominal}	1.5A _{eff}	3.8A _{eff}	7.5A _{eff}	10.0A _{eff}	26A _{eff}
	I _{peak} (<5s)	4.5A _{eff}	9.0A _{eff}	15.0A _{eff}	20.0A _{eff}	52A _{eff}
32kHz	I _{nominal}	1.5A _{eff}	2.5A _{eff}	3.7A _{eff}	5.0A _{eff}	14A _{eff}
	I _{peak} (<5s)	3.0A _{eff}	5.0A _{eff}	10.0A _{eff}	10.0A _{eff}	28A _{eff}

Compax3S0xxV4 at 3*480VAC

Switching frequency*		S015V4	S038V4	S075V4	S150V4	S300V4
8kHz	I _{nominal}	-	-	-	13.9A _{eff}	30A _{eff}
	I _{peak} (<5s)	-	-	-	30A _{eff}	60A _{eff}
16kHz	I _{nominal}	1.5A _{eff}	3.8A _{eff}	6.5A _{eff}	8.0A _{eff}	21.5A _{eff}
	I _{peak} (<5s)	4.5A _{eff}	7.5A _{eff}	15.0A _{eff}	16.0A _{eff}	43A _{eff}
32kHz	I _{nominal}	1.0A _{eff}	2.0A _{eff}	2.7A _{eff}	3.5A _{eff}	10A _{eff}
	I _{peak} (<5s)	2.0A _{eff}	4.0A _{eff}	8.0A _{eff}	7.0A _{eff}	20A _{eff}

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3MxxxD6 at 3*400VAC

Switching frequency*		M050D6	M100D6	M150D6	M300D6
8kHz	I _{nominal}	5A _{eff}	10A _{eff}	15A _{eff}	30A _{eff}
	I _{peak} (<5s)	10A _{eff}	20A _{eff}	30A _{eff}	60A _{eff}
16kHz	I _{nominal}	3.8A _{eff}	7.5A _{eff}	10A _{eff}	20A _{eff}
	I _{peak} (<5s)	7.5A _{eff}	15A _{eff}	20A _{eff}	40A _{eff}
32kHz	I _{nominal}	2.5A _{eff}	3.8A _{eff}	5A _{eff}	11A _{eff}
	I _{peak} (<5s)	5A _{eff}	7.5A _{eff}	10A _{eff}	22A _{eff}

Compax3MxxxD6 at 3*480VAC

Switching frequency*		M050D6	M100D6	M150D6	M300D6
8kHz	I _{nominal}	4A _{eff}	8A _{eff}	12.5A _{eff}	25A _{eff}
	I _{peak} (<5s)	8A _{eff}	16A _{eff}	25A _{eff}	50A _{eff}
16kHz	I _{nominal}	3A _{eff}	5.5A _{eff}	8A _{eff}	15A _{eff}
	I _{peak} (<5s)	6A _{eff}	11A _{eff}	16A _{eff}	30A _{eff}
32kHz	I _{nominal}	2A _{eff}	2.5A _{eff}	4A _{eff}	8.5A _{eff}
	I _{peak} (<5s)	4A _{eff}	5A _{eff}	8A _{eff}	17A _{eff}

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3HxxxV4 at 3*400VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I _{nominal}	50A _{eff}	90A _{eff}	125A _{eff}	155A _{eff}
	I _{peak} (<5s)	75A _{eff}	135A _{eff}	187.5A _{eff}	232.5A _{eff}
16kHz	I _{nominal}	33A _{eff}	75A _{eff}	82A _{eff}	100A _{eff}
	I _{peak} (<5s)	49.5A _{eff}	112.5A _{eff}	123A _{eff}	150A _{eff}
32kHz	I _{nominal}	19A _{eff}	45A _{eff}	49A _{eff}	59A _{eff}
	I _{peak} (<5s)	28.5A _{eff}	67.5A _{eff}	73.5A _{eff}	88.5A _{eff}

Compax3HxxxV4 at 3*480VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I _{nominal}	43A _{eff}	85A _{eff}	110A _{eff}	132A _{eff}
	I _{peak} (<5s)	64.5A _{eff}	127.5A _{eff}	165A _{eff}	198A _{eff}
16kHz	I _{nominal}	27A _{eff}	70A _{eff}	70A _{eff}	84A _{eff}
	I _{peak} (<5s)	40.5A _{eff}	105A _{eff}	105A _{eff}	126A _{eff}
32kHz	I _{nominal}	16A _{eff}	40A _{eff}	40A _{eff}	48A _{eff}
	I _{peak} (<5s)	24A _{eff}	60A _{eff}	60A _{eff}	72A _{eff}

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resolution of the motor position

For option F10: Resolver	◆ Position resolution: 16Bit (= 0.005°) ◆ Absolute accuracy: ±0,167°
For option F11: SinCos®	◆ Position resolution: 13.5Bit/Encoder sine period => 0.03107°/encoder resolution
For option F12:	◆ Maximum position resolution ◆ Linear: 24 Bits per motor magnet spacing ◆ Rotary: 24 bits per motor revolution ◆ Resolution for analog hall sensors with 1Vss signal (e.g. EnDat): 13.5 bits / graduation of the scale of the encoder ◆ For RS 422 encoders: 4x encoder resolution ◆ Accuracy of the feedback zero pulse acquisition = accuracy of the feedback resolution ◆ Resolution for analog hall sensors with 1Vss signal: 13.5 bits / motor magnet spacing

Precision

The exactitude of the position signal is above all determined by the exactitude of the feedback system used.

Motors and feedback systems supported

Motors Direct drives ♦ Linear motors ♦ Torque motors	♦ Sinusoidal commutated synchronous motors ♦ Maximum rotating field frequency: 1,000Hz ♦ Max. velocity at 8 pole motors: 15000min ⁻¹ . ♦ General max. speed: 60*1000/number of pole pairs in [min ⁻¹]. ♦ Max. number of poles = 600 ♦ Sinusoidal commutated asynchronous motors ♦ Maximum rotating field frequency: 1,000Hz ♦ Max. speed: 60*1000/number of pole pairs - slip in [min ⁻¹]. ♦ Field suppression: typically up to triple (higher on request). ♦ Temperature sensor: KTY84-130 (insulated according to EN60664-1 or IEC60664-1) ♦ 3 phase synchronous direct drives
Position encoder (Feedback)	<u>Option F10: Resolver Feedback</u>
LTN:	♦ JSSBH-15-E-5 ♦ JSSBH-21-P4 ♦ RE-21-1-A05 ♦ RE-15-1-B04
Tamagawa:	♦ 2018N321 E64
Siemens:	♦ 23401-T2509-C202
	<u>Option F11: SinCos®</u>
	♦ Singleturn (SICK Stegmann) ♦ Multiturn (SICK Stegmann) Absolute position up to 4096 motor revolutions. ♦ Rotary feedback with HIPERFACE® interface: e.g.: SRS50, SRM50, SKS36, SKM36, SEK52

Special encoder systems for direct drives	Option F12
Analog hall sensors	◆ Sine - cosine signal (max. 5Vss; typical 1Vss) 90° offset ◆ U-V Signal (max. 5Vss; typical 1Vss) 120° offset.
Encoder (linear or rotatory)	◆ Sine-cosine (max. 5Vss; typical 1Vss) (max. 400kHz) or ◆ TTL (RS422) (max. 5MHz) with the following modes of commutation: ◆ automatic commutation (see page 465) or ◆ Digital hall sensors (e.g. DiCoder®)
Digital, bidirectional interface	◆ All EnDat 2.1 or EnDat 2.2 feedback systems with incremental track (sine-cosine track) ◆ linear or rotary ◆ max. 400kHz Sine-Cosine
Distance coded feedback systems	◆ Distance coding with 1VSS - Interface ◆ Distance coding with RS422 - Interface (Encoder)

Feedback error compensation

Feedback error compensation	◆ Automatic feedback error compensation (offset & amplification) for analog hall sensors and sine-cosine encoder can be activated in the MotorManager.

Motor holding brake output

Motor holding brake output	Compax3
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A
Minimum output current	150 mA
Securing of brake Compax3M	3.15A

Braking operation Compax3S0xxV2 1AC

Controller type	S025V2	S063V2
Capacitance / storable energy	560µF / 15Ws	1120µF / 30Ws
Minimum braking- resistance	100Ω	56Ω
Recommended nominal power rating	20 ... 60W	60 ... 180W
Maximum continuous current	8A	15A

Braking operation Compax3S1xxV2 3AC

Controller type	S100V2	S150V2
Capacitance / storable energy	780µF / 21Ws	1170µF / 31Ws
Minimum braking- resistance	22Ω	15Ω
Recommended nominal power rating	60 ... 450W	60 ... 600W
Maximum continuous current	20A	20A

Braking operation Compax3SxxxV4 3AC

Controller type	S015V4	S038V4	S075V4	S150V4	S300V4
Capacitance / storable energy	235µF / 37Ws	235µF / 37Ws	470µF / 75Ws	690µF / 110Ws	1100µF / 176Ws
Minimum braking-resistance	100Ω	100Ω	56Ω	33Ω	15Ω
Recommended nominal power rating	60 ... 100W	60 ... 250W	60 ... 500 W	60 ... 1000 W	60 ... 1000 W
Maximum continuous current	10A	10A	15A	20A	30A

Braking operation Compax3MxxxD6 (axis controller)

Device type Compax3	M050	M100	M150	M300
Capacitance / storable energy	110µF / 18Ws at 400V 10Ws at 480V	220µF / 37Ws at 400V 21Ws at 480V	220µF / 37Ws at 400V 21Ws at 480V	440µF / 74Ws at 400V 42Ws at 480V

Braking operation of Compax3HxxxV4

Controller type	H050V4	H090V4	H125V4	H155V4
Capacitance / storable energy	2600µF / 602Ws	3150µF / 729Ws	5000µF / 1158Ws	5000µF / 1158Ws
Minimum braking-resistance	24Ω	15Ω	8Ω	8Ω
Maximum continuous current	30A	45A	83A	83A

Ballast resistors for Compax3

Braking Resistor (see page 481)	Device	Rated Power
BRM08/01 (100Ω)	Compax3S025V2 Compax3S015V4 Compax3S038V4	60W
BRM05/01 (56Ω)	Compax3S063V2 Compax3S075V4	180W
BRM05/02 (56Ω)	Compax3S075V4	570W
BRM10/01 (47Ω)	Compax3S150V4	570W
BRM04/01 (15Ω)	Compax3S150V2 Compax3S300V4 Compax3MP20D6	570W
BRM04/02 (15Ω)	Compax3S150V2 Compax3S300V4 Compax3MP20D6	740W
BRM04/03 (15Ω)	Compax3S300V4 Compax3MP20D6	1500W
BRM09/01 (22Ω)	Compax3S100V2	570W
BRM11/01 (27Ω)	Compax3H0xxV4	3500W
BRM13/01 (30Ω)	Compax3MP10D6 Compax3MP20D6**	500 W
BRM14/01 (15Ω)	Compax3MP10D6* Compax3MP20D6	500 W
BRM12/01 (18Ω)	Compax3H1xxV4	4500W

*for Compax3MP10D6 2x15Ω in series

**for Compax3MP20D6 2x30Ω parallel

Size / weight of Compax3S

Controller type	Dimensions HxWxD [mm]	Weight [kg]
Compax3S025V2	191 x 84 x 172	2.0
Compax3S063V2	191 x 100 x 172	2.5
Compax3S015V4	248 x 84 x 172	3.1
Compax3S100V2	248 x 115 x 172	4.3
Compax3S150V2	248 x 158 x 172	6.8
Compax3S038V4	248 x 100 x 172	3.5
Compax3S075V4	248 x 115 x 172	4.3
Compax3S150V4	248 x 158 x 172	6.8
Compax3S300V4	380 x 175 x 172	10.9

Minimum mounting distance: 15mm at the sides, above & below 100mm

Protection type IP20

Drawings, Mounting (see page 78)

Size / weight of Compax3MP/Compax3M

Device type	Dimensions HxWxD [mm]	Weight [kg]
Compax3MP10D6	360 x 50 x 263	3,95
Compax3MP20D6	360 x 100 x 263	
Compax3M050D6	360 x 50 x 263	3,5
Compax3M100D6	360 x 50 x 263	3,6
Compax3M150D6	360 x 50 x 263	3,6
Compax3M300D6	360 x 100 x 263	

Protection type IP20

Size / weight of Compax3H

Controller type	Dimensions HxWxD [mm]	Weight [kg]
Compax3H050V4	453 x 252 x 245	17,4
Compax3H090V4	668.6 x 257 x 312	32,5
Compax3H125V4	720 x 257 x 355	41
Compax3H155V4	720 x 257 x 355	41

Protection class IP20 when mounted in a control cabinet (not for Compax3H1xxxV4)

Drawings, Mounting (see page 78)

Safety technology Compax3S

Safe torque-off as per EN954-1, category 3 Certified: (BG-PRÜFZERT certification number: 0403005)	◆ For implementation of the "protection against unexpected start-up" function described in EN1037. ◆ Note the circuit examples circuit examples (see page 87).

Safety technology Compax3MP / Compax3M

Safety technology as an option State-of-the-art safety technology EN ISO 13849	◆ Please respect the stated safety technology on the type designation plate (see page 14) and the circuitry examples

Compax3M S1 Option: Signal inputs for connector X14

Nominal voltage of the inputs	24V
Required isolation of the 24V control voltage	Grounded protective extra low voltage, PELV
Protection of the STO control voltage	1A
Number of inputs Signal inputs via optocoupler	2 Low = 0...7V DC or open High = 15...30V DC I_{in} at 24V DC: 8mA
STO1/	Low = STO activated High = STO deactivated
STO2/	Low = STO activated High = STO deactivated
Switch-off time with unequal input statuses (max. reaction time)	20 seconds
Grouping of safety level	Category 3 PL=d PFH=1.01 x 10 ⁻⁷ h ⁻¹

UL certification for Compax3S

conform to UL:	◆ according to UL508C
Certified	◆ E-File_No.: E235 342

The UL certification is documented by a "UL" logo on the device (type specification plate).

"UL" logo



UL certification for Compax3M

conform to UL:	◆ according to UL508C
Certified	◆ E-File_No.: E235 342

The UL certification is documented by a "UL" logo on the device (type specification plate).



Insulation requirements

Protection class	Protection class I according to EN60664-1
Protection against human contact with dangerous voltages	According to En 61800-5-1
Overvoltage category	Voltage class III according to EN 60664-1
Degree of contamination	Degree of contamination 2 according to EN 60664-1 and EN 61800-5-1

Environmental conditions Compax3S and Compax3H

General ambient conditions	According to EN 60 721-3-1 to 3-3 Climate (temperature/humidity/barometric pressure): Class 3K3	
Permissible ambient temperature:		
Operation Storage Transport	0 to +45 C Class 3K3 -25 to +70 C Class 2K3 -25 to +70 C Class 2K3	
Tolerated humidity:	No condensation	
Operation Storage Transport	<= 85% class 3K3 <= 95% class 2K3 <= 95% class 2K3	(Relative humidity)
Elevation of operating site	<=1000m above sea level for 100% load ratings <=2000m above sea level for 1% / 100m power reduction Please inquire for greater elevations	
Mechanic resonances:	EN 60068-2-6 (sinusoidal excitation)	
Sealing	IP20 protection class according to EN 60 529	

Cooling Compax3S and Compax3H

Cooling mode:	C3S025V2 ... S150V4: Convection C3S300V4 & C3H: Forced air ventilation with fan in the heat dissipator Air flow rate: 459m³/h (C3H)
Supply:	C3S300V4, C3H050, C3H090 internal C3H125, C3H155 external 220/240VAC: 140W, 2.5µF, Stator - 62Ω Optionally on request: 110/120VAC: 130W, 10µF, Stator - 16Ω Circuit breaker: 3A

EMC limit values Compax3S and Compax3H

EMC interference emission	Limit values according to EN 61 800-3, Limit value class C3/C4 without additional mains filter: Information on C2 limit value classes (see page 19)
EMC disturbance immunity	Industrial area limit values in accordance with EN 61 800-3

Environmental conditions Compax3MP / Compax3M

General ambient conditions	According to EN 60 721-3-1 to 3-3 Climate (temperature/humidity/barometric pressure): Class 3K3	
Permissible ambient temperature:		
Operation Storage Transport	0 to +40 C -25 to +70 C -25 to +70 C	Class 3K3
Tolerated humidity:	No condensation	
Operation Storage Transport	<= 85% class 3K3 <= 95% <= 95%	(Relative humidity)
Elevation of operating site	<=1000m above sea level for 100% load ratings <=2000m above sea level for 1% / 100m power reduction Please inquire for greater elevations	
Sealing	IP20 protection class according to EN 60 529	
Mechanic resonances:	Class 2M3, 20m/s ² ;8-200Hz	

Cooling Compax3MP / Compax3M

Cooling mode:	Forced air ventilation with fan in the heat dissipator

EMC limit values Compax3MP/Compax3M

EMC interference emission	Limit values according to EN 61 800-3, Limit value class C3 with mains filter.
EMC disturbance immunity	Industrial area limit values in accordance with EN 61 800-3

EC directives and harmonised EC norms

Low voltage directive 2006/95/EC	EN 61800-5-1, Standard for electric power drives with settable speed; requirements to electric safety EN 60664-1, isolation coordinates for electrical equipment in low-voltage systems EN 60 204-1, machinery standard partly applied
EC-EMC-directive 2004/108/EC	EN 61 800-3, EMC norm Product standard for variable speed drives

COM ports

RS232	♦ 115200 baud ♦ Word length: 8 bits, 1 start bit, 1 stop bit ♦ Hardware handshake XON, XOFF
RS485 (2 or 4-wire)	♦ 9600, 19200, 38400, 57600 or 115200 baud ♦ Word length 7/8 bit, 1 start bit, 1 stop bit ♦ Parity (can be switched off) even/odd ♦ 2 or 4-wire
USB (Compax3M)	♦ USB 2.0 Full Speed compatible

Load position control

Dual Loop Option	◆ 2. Feedback system for the control of the load position (see page 157) is possible.

Signal interfaces

Signal inputs / signal sources	◆ Encoder – input track A/B (RS422) ◆ up to max. 10MHz ◆ internal quadrature of the resolution ◆ Step / direction input (24V-level) Max. 300kHz at $\geq 50\Omega$ source impedance and minimum pulse width of 1,6µs. ◆ +/-10V analog input 14Bit; 62.5µs scanning rate. ◆ SSI Feedback (see page 154)
Signal outputs	◆ Encoder simulation ◆ 1...16384 increments/revolution or pitch ◆ Limit frequency 620kHz ◆ Bypass function with encoder feedback with feedback module F12.(Limit frequency 5MHz).
Signal transmission	HEDA (option M10 or M11) Exchange of process values: ◆ from Slave to Master ◆ from Slave to Master and ◆ from Slave to Slave.

IEC6113-3 functions

General	◆ Programming based on IEC61131-3 ◆ Up to 6000 instructions ◆ 650 16 bit variables ◆ 200 32 bit variables ◆ Recipe table with 288 variables ◆ 3x16-bit retain-variable ◆ 3x32-bit retain-variable
PLCOpen function modules	◆ Positioning: absolute, relative, additive, endless ◆ Electronic Gearbox (Gearing) ◆ Machine Zero ◆ Stop, activating the drive, quit ◆ Position, device status, reading axis error
IEC61131-3 standard modules	◆ Up to 8 timers (TON, TOF, TP) ◆ Triggers (R_TRIG, F_TRIG) ◆ Flip-flops (RS, SR) ◆ Counters (CTU, CTD, CTUD)
Device-specific function modules	◆ generates an input process image ◆ generates an output process image ◆ access to recipe table
Inputs/Outputs	◆ 8 digital inputs (24V level) ◆ 4 digital outputs (24-V level) ◆ Optional addition of 12 inputs/outputs

I20 Function**Profibus ratings**

Profile	◆ PROFIdrive Profile drive system V3
DP Versions	◆ DPV0/DPV1
Baud rate	◆ up to 12MHz
Profibus ID	◆ C320
Device master file	◆ PAR_C320.GSD (can be found on the Compax3 - CD)
Communication Simatic <-> Compax3	◆ Simatic S7-300/400 - modules for Compax3 I20 and a corresponding help file can be found on the Compax3 CD in the folder: ..\Profibus\S7-modules\

I21 Function**CANopen ratings**

Baud rate [kBit/s]	◆ 20, 50, 100, 125, 250, 500, 800, 1000
EDS file	◆ C3.EDS
Service data object	◆ SDO1
Process data objects	◆ PDO1, ... PDO4

I22 Function**DeviceNet characteristic data**

DeviceNet	◆ Predefined Master/Slave Connection Set ◆ Standard 2.0 Group-2-Slave ◆ Fieldbus I/O Data or Process Data (Polled, COS/Cyclic I/O and Bit Strobe)
Implemented object classes	◆ Identify, Message Router, DeviceNet, Assembly, Connection, Acknowledge Handler
Baud rate [kBit/s]	◆ 125, 250, 500
permissible cable length	◆ up to 500m on 125Bit/s, ◆ up to 200m on 250Bit/s, ◆ up to 100m on 500Bit/s,
Max. number of nodes	◆ 63 Slave
Insulation	◆ Isolated Device Physical Layer
EDS file	◆ C3_DeviceNet.EDS
Conformance (file in the Internet)	◆ Statement of Conformance http://www.compax3.de/C3_DeviceNet_Statement_of_Conformance.pdf
Further information:	◆ Application example (C3I22_DeviceNet.ZIP) on the Compax3 CD in the "Examples" directory

Ethernet Powerlink / EtherCAT characteristics

Baud rate	◆ 100Mbits (FastEthernet)
Bus file	◆ ◆ C3_EPL_cn.EDS ◆ C3_EtherCAT_xx.XML
Service data object	◆ SDO
Cycle time	◆ 1ms
Synchronicity accuracy	◆ maximum jitter: +/-25µs

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+

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