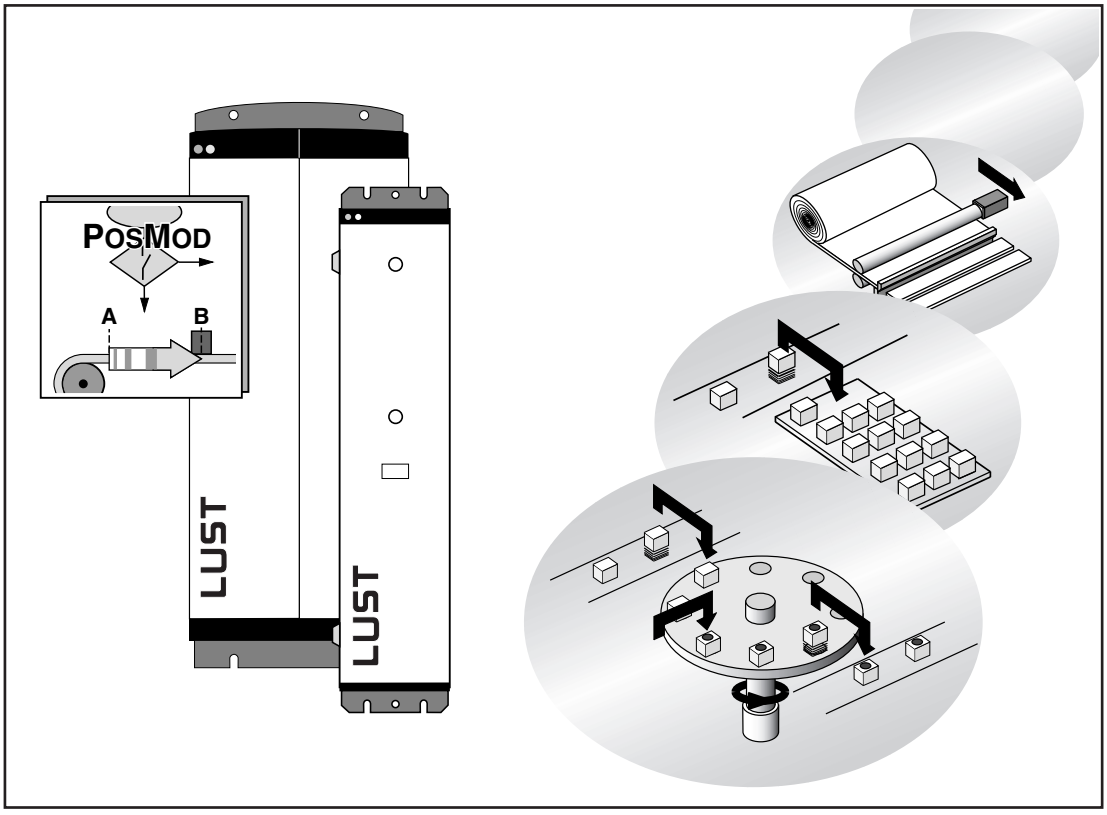
LUST
ANTRIEBSTECHNIK

MASTERCONTROL MC7000 POSMOD

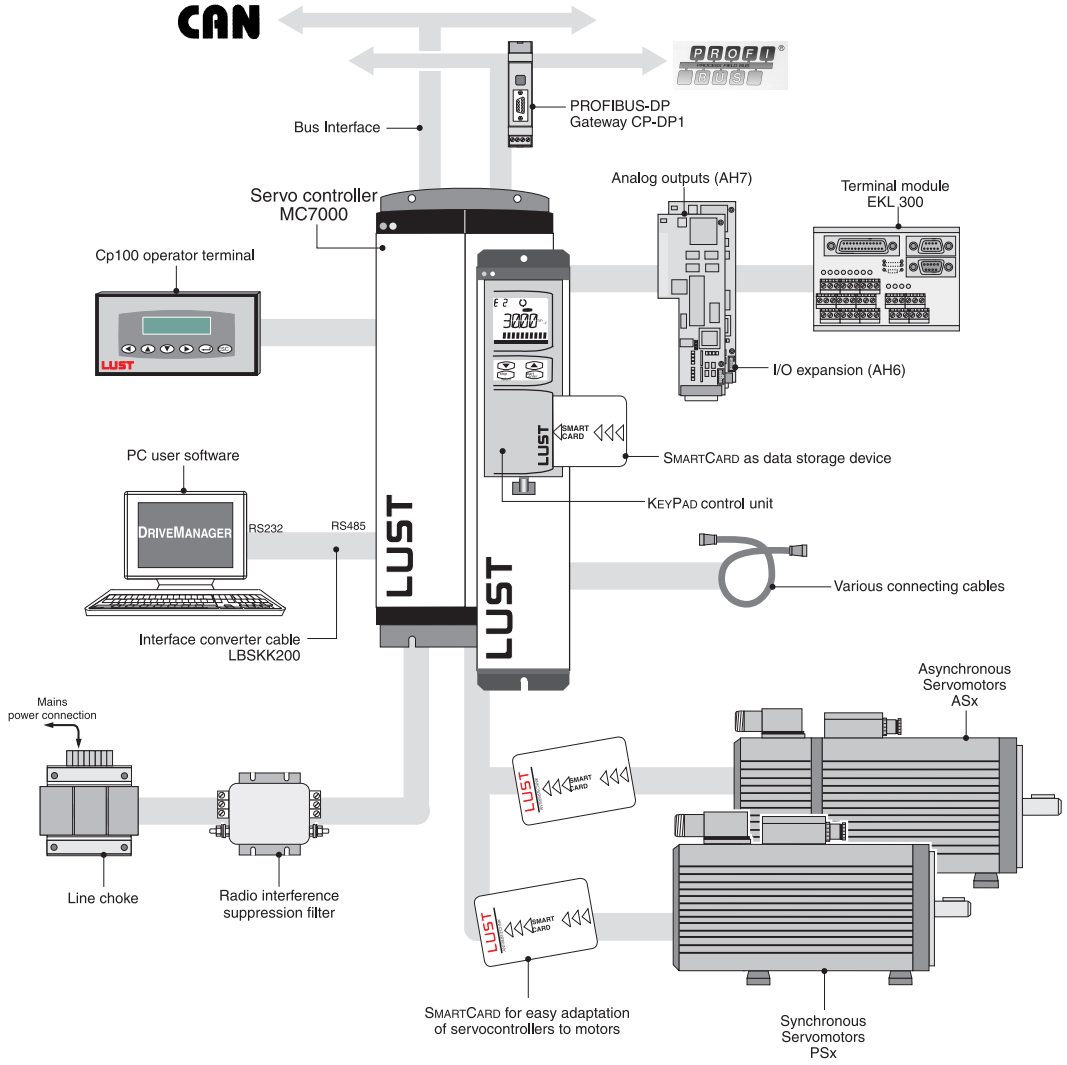
EN

Position controllers from 2 to 64 A

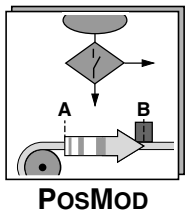


Operation Manual

The MASTERDRIVE Drive system



Operation Manual
for position controllers
MC7000, POSMOD series



POSMOD

Valid as of software version: V3.35

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Version: June 2001

Dear Customer!

Thank you for the trust you have placed in us by purchasing the LUST MASTERDRIVE DRIVE system.

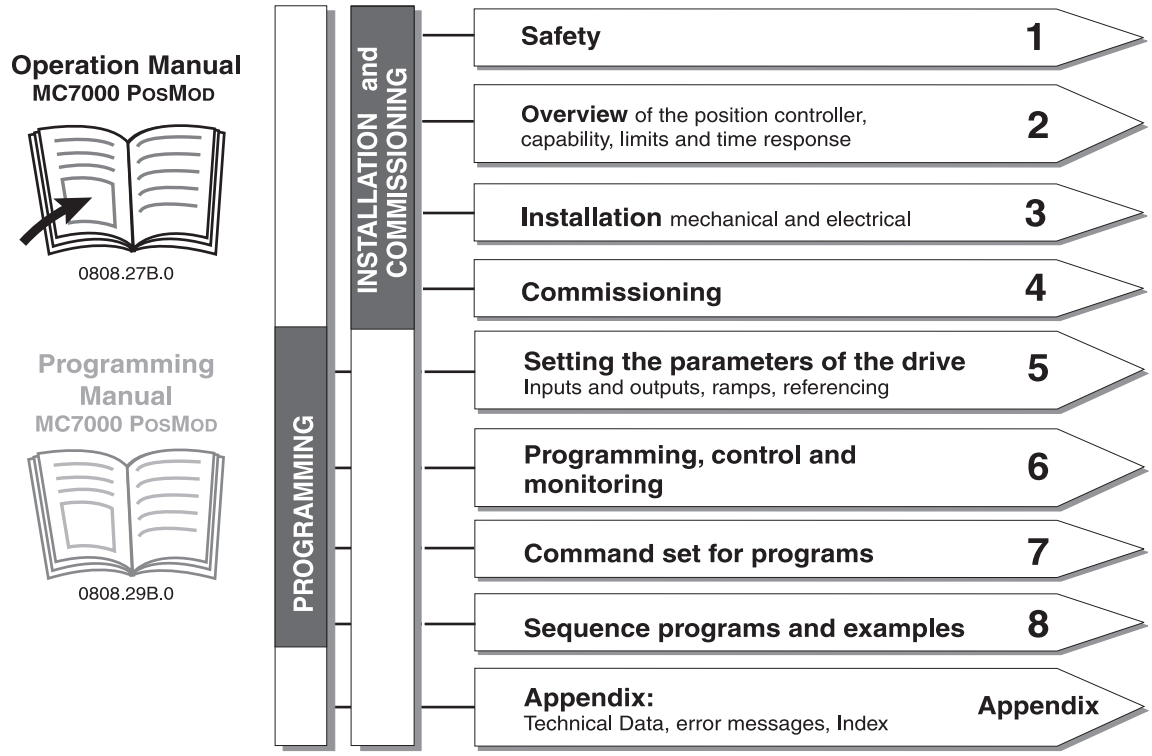
Installation and commissioning should be carried out by trained personnel. Please take the time to read these instructions carefully and in advance. If you follow all the instructions, you will save yourself much time and many questions at the commissioning stage.

It is also essential to read the Operation Manual because incorrect use of the equipment can damage both the servo drive as weel as other parts of the system. There is, in addition, a danger of physical injury from the rotating parts of the drive and the high operating voltage present!

If, after reading the instructions, you still have questions, do please contact us:

Lust Antriebstechnik GmbH
Gewerbestr. 5-9
D-35633 Lahnau
Telephone: +49 6441 966 -0Internet:http://www.lust-tec.de
Fax: +49 06441 966 -137e-Mail:lust@lust-tec.de

How to use this manual:



Pictograms and their meanings

⇒ Danger! Risk to human life from electric shock.

⇒ Danger! Risk to human life through rotation of the drive.

⇒ Danger! It is essential to observe these points.

⇒ Prohibited! Incorrect operation may cause damage to equipment.

⇒ Useful note or tip.

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1 For your safety

1.1 Safety instructions

While in operation, servo drives may have conductive, uninsulated, and sometimes also moving or rotating parts, and hot surfaces. This means that a servo drive presents a danger to human life.

To prevent serious physical injury or major material damage, only qualified persons familiar with electrical drive equipment may work on the devices. Only those persons who are familiar with mounting, installing, commissioning and operating servo drives and have appropriate professional qualifications are considered qualified. Those persons must read the Operation Manual carefully before installation and commissioning, and follow the safety instructions.

(cf. IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC Report 664 or VDE 0110 and national accident prevention regulations or VBG 4)

Repairs to the components of the servo drive may only be carried out by the manufacturer or by a repair workshop approved by the manufacturer. Unauthorized opening and incorrect intervention could lead to physical injury or material damage.

1.2 Intended use

Servo drives are components that are intended for installation in electrical systems or machines. The servo drive may not be commissioned (i.e. it may not be put to its intended use) until it has been established that the machine complies with the provisions of EC Directive 89/392/EEC (Machinery Directive); EN60204 is to be observed.

Commissioning (i.e. putting the device to its intended use) is only permitted in compliance with the EMC Directive (89/336/EEC).

In addition to the Low Voltage Directive 73/23/EEC, the harmonized standards of the series prEN 50178/DIN VDE 0160 in conjunction with EN 60439-1/DIN VDE 0660 part 500 and EN 60146/DIN VDE 0558 are applicable to the servo drives.

The technical data and the instructions concerning connection conditions are given on the name plate and in the documentation, and are to be observed under all circumstances.

Servo drives are to be protected against **i**mpermissible istress. In particular, components may not be bent, nor may insulation distances be altered, during transport and use. Servocontrollers and servomotors contain components that are vulnerable to electrostatic accumulation and can therefore easily be damaged if incorrectly handled. Ensure that electrical components are not mechanically damaged or destroyed.

When work is being carried out on live servo drives, the applicable national accident prevention regulations (e.g. VBG 4) are to be observed.

Electrical installation is to be carried out in accordance with the relevant regulations (e.g. wire cross-section, fuses, grounding lead connection). Other details are contained in the documentation.

Electronic devices are fundamentally not fail-safe. Users are themselves responsible for ensuring that the drive is rendered safe if the device fails.

If the servo drive is used for special applications (e.g. in areas subject to explosion hazard), the required standards and regulations (e.g. EN50014 and EN50018) must always be observed.

2 Overview of functions

2.1 Position controller MC7000 PosMod

The MasterControl MC7000 PosMod servocontrollers have an integrated single-axle positioning and sequence control. This results in major advantages over the conventional split between a servocontroller with torque and speed control and a separate, higher-level position control with Position control.

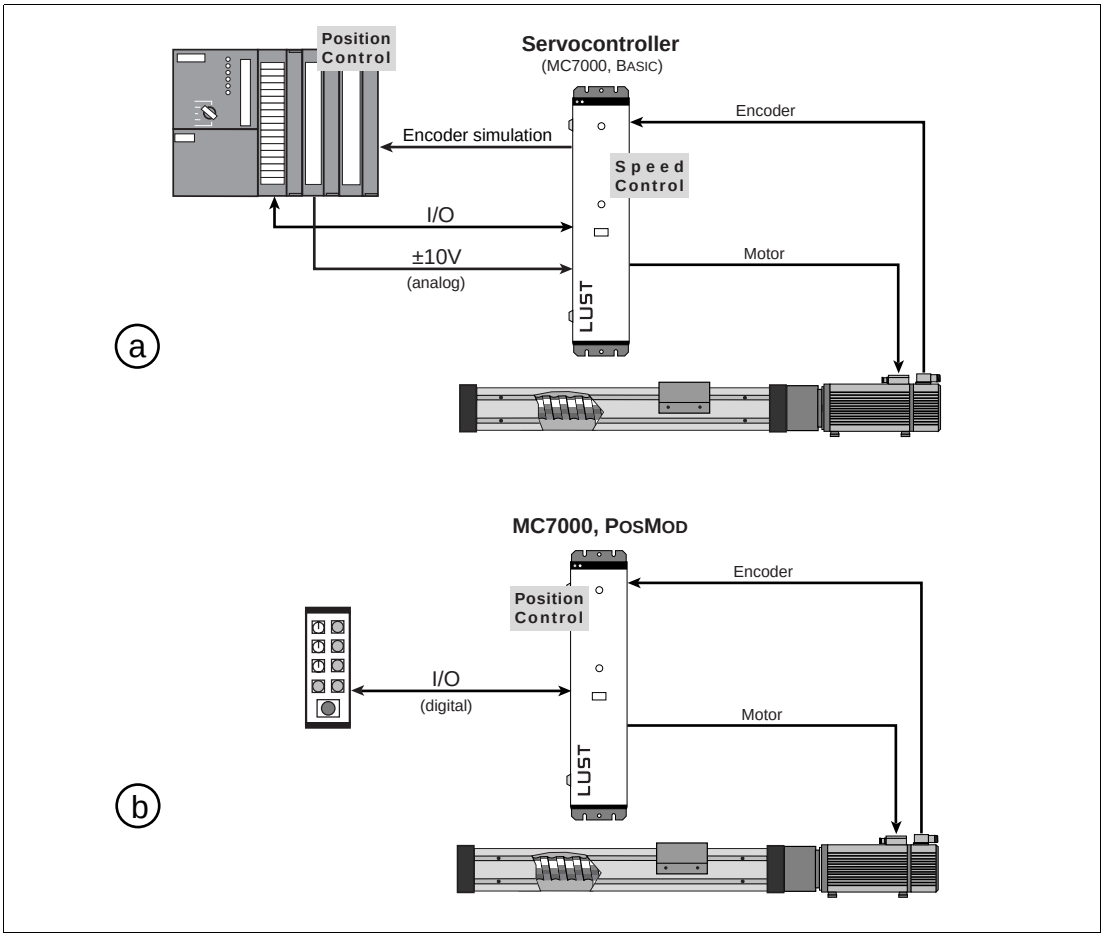
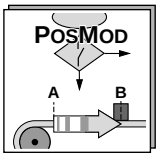


Diagram: Layout of a positioning system: a) Conventional split between external position control and analog reference input, and b) with integrated MC7000 PosMod single-axle position control, operator control terminal for selection of the positions

Properties of the position controller MC7000 PosMod

- → Reduced wiring based on integrated position control
- → Single-axle, slim design
- → Same termination technique across the entire power range from 750 W to 30 kW
- → Standalone operation
- → Optimum balancing of the position control with direct access to the system variables of the servocontroller and reference value input in a 1 ms cycle, resulting in higher positioning accuracy
- → Standard resolution 16 bits (65536 increments) per revolution
- → 9 different kinds of reference run



Programming offers the following facilities

- Simple, easy-to-understand programming language
- High degree of flexibility in writing sequence programs
- 100 positioning program with up to 700 program sets
- Absolute and relative positioning, endless travel (e.g. conveyor belts)
- Time-optimized or non-bucking positioning (linear or sinusoidal ramps)
- Variables, timers and flags can be used and simple programmable logic control functions can be simulated

Areas of application

Based on its high degree of flexibility and programming, the single-axle position controller can provide high-precision positioning and time/path-optimized speed profiles in many different applications.

Common areas of application are:

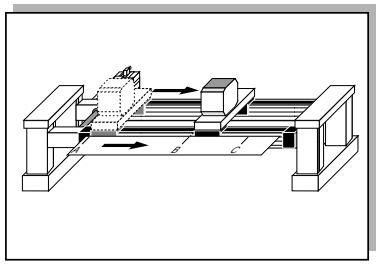
→ Handling equipment (parts positioning, mounting, sorting, palletizing, etc.)

→ Presses

→ Feed drives, stop positioning

→ Indexing tables

→ Special machines, e.g. for cutting to length and metering

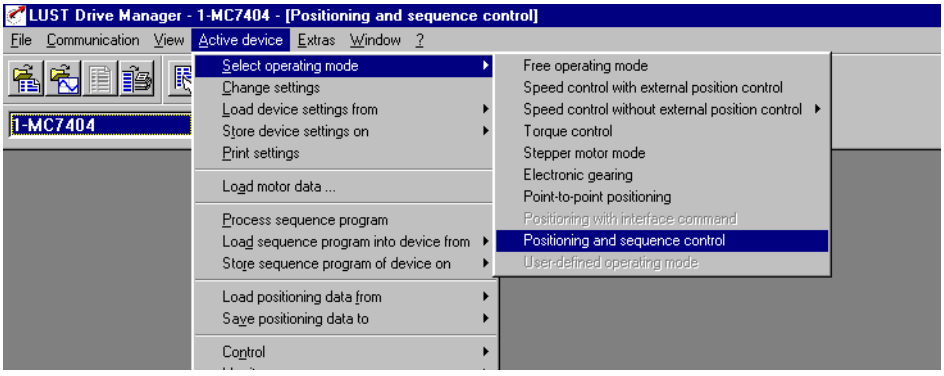


2.2 DriveManager user interface

The servocontroller is commissioned and programmed using the PC user interface DriveManager :

- **Commissioning:** Parameter-setting, control and monitoring, transfer of ready-to-use sequence programs → DriveManager (standard license)
- **Programming:** Write, edit and administer sequence programs → DriveManager (programming license for PosMod)

The position controller must be set to **Positioning and sequence control** mode, to make those functions available in the DriveManager. This is done under **Active device - Select operation mode**.



2.3 Submodes of the position controller

In **Positioning and sequence control** mode there are the following submodes:

1. **Manual mode**

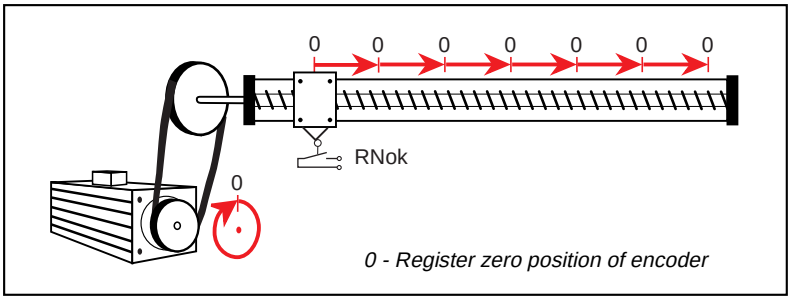
   Prerequisite: Input IS00 'Automatic' = Low level

   1. Setup mode: Positioning and control commands are transmitted from the PC via the serial interface and executed directly by the servocontroller (under the **Active device - Control - Manual mode Positioning and sequence control** menu).
   2. Jog mode: The axle can be positioned in creep feed or rapid feed mode. This can also be activated under the **Manual mode Positioning and sequence control** or menu or by way of two inputs ('Jog+' or 'Jog-' function).

2. **Automatic mode**

   The EPS works through the selected positioning program. Automatic mode is selected by way of the input IS00 'Automatic' = High level.

3. **Referencing**
   - In manual and in automatic mode
   - In the reference run the axle runs until the reference cam (mechanical, inductive or capacitive proximity switch) is detected at the input IE00 'Reference cam' and a zero position of the encoder is reached.
   - The object of the reference run is to establish an absolute position reference (referred to the entire axle), and it must usually be executed once after power-up, because normal encoders only register the position within one revolution.



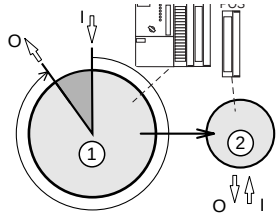
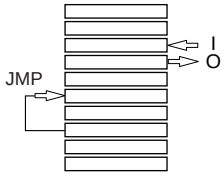
   Exceptions: Endless-loop axes (e.g. conveyor belts, indexing tables) not requiring an absolute position reference across several revolutions; or use of Multiturn encoders which are able to register the position across a large number of revolutions (type G3).

Note:

The operation modes of the BASIC and MOTION application packages can also be used, e.g. speed control over ±10V, electronic gearing, stepper motor operation. Refer to the MC7000 BASIC/MOTION Operation Manual, ident. no. 0808.22B.0-00.

2.4 Time response of the position controller

For greater clarity: The comparison with the programmable logic control shows the different mode of functioning and the differing time response.

Comparison:	**PLC**	**MC7000 PosMod**
Principle of function	Fixed cycle: Read inputs, run through complete program, set outputs 	Sequence is determined by program. Next command is usually only executed when the preceding one has been completed (e.g. destination position reached). 
Programming	With statement list, ladder diagram or function chart. Flags indicate the current status	Similar to BASIC programming language with step commands and subroutines
Processing speed	Typically 0.5 ms/ 1 K instructions (e.g. S7-300)	5 ms / command, so-called “set-to-set execution time“ (for simple commands the same time is reserved as for complex positioning commands)
Response time to an input	Depending on the time slot, typically approx. 10 to 20 ms (exception: interrupt input)	depending on the program length (e.g. 5 ms if an input is requested in the next data set)
Sampling time of position control	Typically 1 to 5 ms for PLC with positioning card (without fine interpolation), speed reference input analog via ±10V	250 µs position control, 4 x times fine interpolation (new position references every 1 ms) [1)], speed reference input digital

① *- PLC cycle;* ② *- Positioning core*

[1)] *At 4 kHz switching frequency: 500 µs position control*

Accuracy and time response

The data determine the achievable positioning accuracy of the drive and the time sequence of a program in advance. This delivers information, for example, as to how long a signal must be applied to an input as a minimum, or how long it takes until an output is set.

Correct time sequencing of a positioning program must always be checked!

Accuracy and time response			
Position resolution on the motor shaft	16	bits	= 360°/65,536 increments
Position accuracy on the motor shaft [1)]	≤ ± 0.5' ≤ ± 10'	arc min	Optical encoders (sin/cos) Resolvers
Set-to-set execution time	5	ms	
Read inputs / Set outputs	5	ms	
Positioning commands GO (program editing is immediately resumed)	5	ms	
Positioning commands GOW (program editing is resumed only when the destination position is reached)	10	ms	Plus positioning time
Read status	5 ... 10	ms	
Change acceleration values in program (SET K15 ... K24)	≤ 90	ms	
Time between selection of automatic mode and subsequent start command	≥ 20	ms	

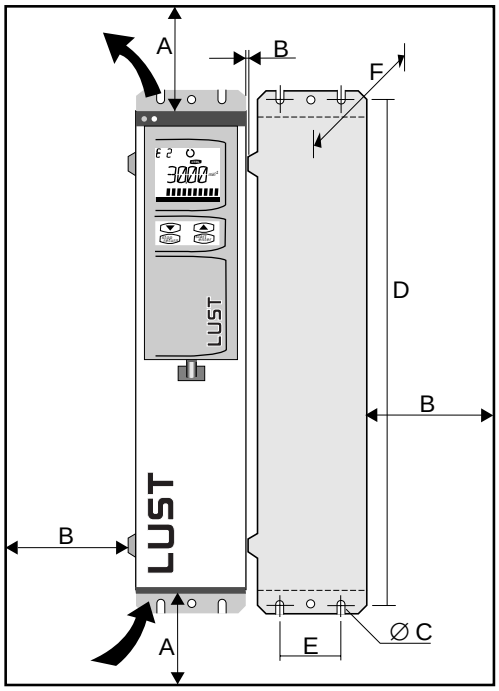
1) *Please pay attention to additional inacurracies caused by the mechanism such as elasticities and play.*

3 Installation of the drive system

Installation and commissioning must only be carried out by qualified electricians who have undergone instruction in the necessary accident prevention measures!

3.1 Mechanical installation of the servocontroller

■ **Mount the servocontroller vertically in a switch cabinet.**



EMC

The servocontroller must be mounted on a **metal mounting plate**. The rear panel of the device must have **good, wide-area contact** with the mounting plate; otherwise use scratchy disks. Use of a HF-screened cabinet with a chrome-plated or galvanized mounting plate offers the best means of EMC installation.

Cooling

The **size of cabinet** required depends, among other factors, on the power loss of the servocontrollers (see Appendix A.3).

The **top and bottom clearances** must always be maintained.

It is permitted to arrange a number of devices **adjacent to each** other without mounting clearances (for exception see table below).

Mounting clearances (for full dimensional drawing see Appendix A.3):

	MC7402	MC7404	MC7408	MC7412	MC7416	MC7432	MC7464
A	≥ 100 mm			≥ 150 mm			
B	0 mm			0 mm / 20 mm[1)]			
C	Ø 4.8			Ø 5.8		Ø 7	
D	315			345		425	
E	40			100		150	240
F	260			260		290	

[1)] *Exceptions B = 20 mm: to other devices or to servocontrollers with other power outputs, e.g. 1 x MC7412, 1 x MC7416*

Make sure that

- no moisture gets into the device;
- no aggressive or conductive materials are in the immediate vicinity;
- no foreign matter such as metal swarf or screws fall into the device;
- the vent openings on the top are never covered over.

The device may otherwise be destroyed.

3.2 Mechanical installation of the motor

■ **Mount the servomotor in your system or machine.**

You should, where possible, wait until after commissioning before mounting the output elements (toothed wheels, pulleys, couplings etc.), in order to be able to carry out tests without having to move parts of the system or machine.

Note:

Suitable devices should be used to mount and remove the output elements - the support elements should be installed on the drive end of the shaft.

Observe the permissible axial and lateral forces for the motor shaft according to the " MASTERDRIVE Technical Data" specification.

Caution! The motor contains sensitive mechanical components!

Never strike the motor shaft or the drive-side shaft end with a hammer or any similar implement!

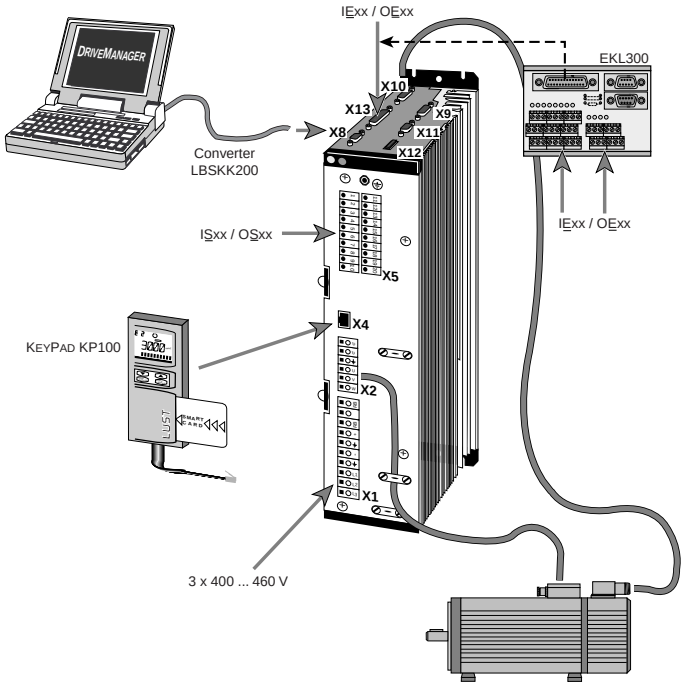
3.3 Preparing electrical installation

Installation andand commissioning must only be carried out by qualified electricians!

Safety instructions:
Caution - Danger to life! • Never wire or disconnect electrical connections while they are live! • Before working on the device disconnect the power. Wait for the DC-link capacitors to discharge. Work may only be carried out on the device when the residual voltage (between terminals X 1 + and X 1 -) is below 42 V! In the MC7000,SN2 (external supply of the control section with 24 V) the discharge time may be as long as 30 minutes.

■ What components do I need from LUST for the installation?

- ✔ MC7000 servo-controller, POSMOD
- ✔ Synchronous or asynchronous servomotor
- ✔ Ready made-up encoder cable for connection of the rotary encoder built into the motor
- ✔ PC or notebook with DRIVEMANAGER user software
- ✔ Interface converter cable LBSKK200 to convert the signals of the interference-immune RS485 interface to the PC's RS232 level.



Connections

- ❑ The KEYPAD control unit for storing and transferring parameters by chipcard ("SMARTCARD") is useful.
- ❑ Other components depending on requirements, such as external mains filter, line choke and/or external braking resistor.

Also:

- Screened cables for motor and power connection (see Section Appendix A)
- Screened cables for control terminals via terminals or sub-D connector

■ Matching motor – Matching motor-encoder cable – servocontroller

Compare the name plates of the components. Make absolutely sure you are using the right components according to the chosen variant A, B or C!

	Motor (with built-in encoder)	Encoder cable	Servocontroller
➔ **A**	With **resolver** R1, R2, R8, K1, K2 or K8 xxx - xx - xxRxx or - xxKxx	KRX-xxxxx	Encoder interface standard (no D2)
➔ **B**	With **encoder G1** (incremental) xxx - xx - xxG1x	KG1-xxxxx	MC7000, D2
➔ **C**	With **encoder G3** or **G5** (absolute value) xxx - xx - xxG3x or - xxG5x	KG2/3-xxxxx	MC7000, D2

3.4 Electrical installation of the drive system

■ **Remove the front guard by unscrewing the screw on the front of the unit (bottom right).**

■ **Wire up the drive system in accordance with the system connection diagram.**

■ **For proper EMC installation and compliance with European EMC interference immunity regulations to EN50082-2 and interference emission regulations to EN50081-2 and EN55011 we recommend:**

- a matching mains filter (as per specification)
- screened control and motor cables
- original encoder cable, and
- a good, point-to-point grounding.
- Further information on EMC measures is given in the general Operation Manual.

Procedure:

1. **Grounding the servocontroller**
   - VDE 0160 stipulates a good point-to-point grounding of the unit via a connection between the unit center point (see System connection diagram) and the central center point of the cabinet by means of a grounding wire cross-section of at least 10 mm or by means of two wires with the same thickness as the mains connecting lead cross-section.

2. **Wire up the motor (including thermistor and – where needed – holding brake and external ventilator)**
   - Be sure to follow the instructions given in section 3.4.2.

3. **Wire up the mains lead, but do not switch on yet!**
   - Be sure to follow the instructions given in section 3.4.3.

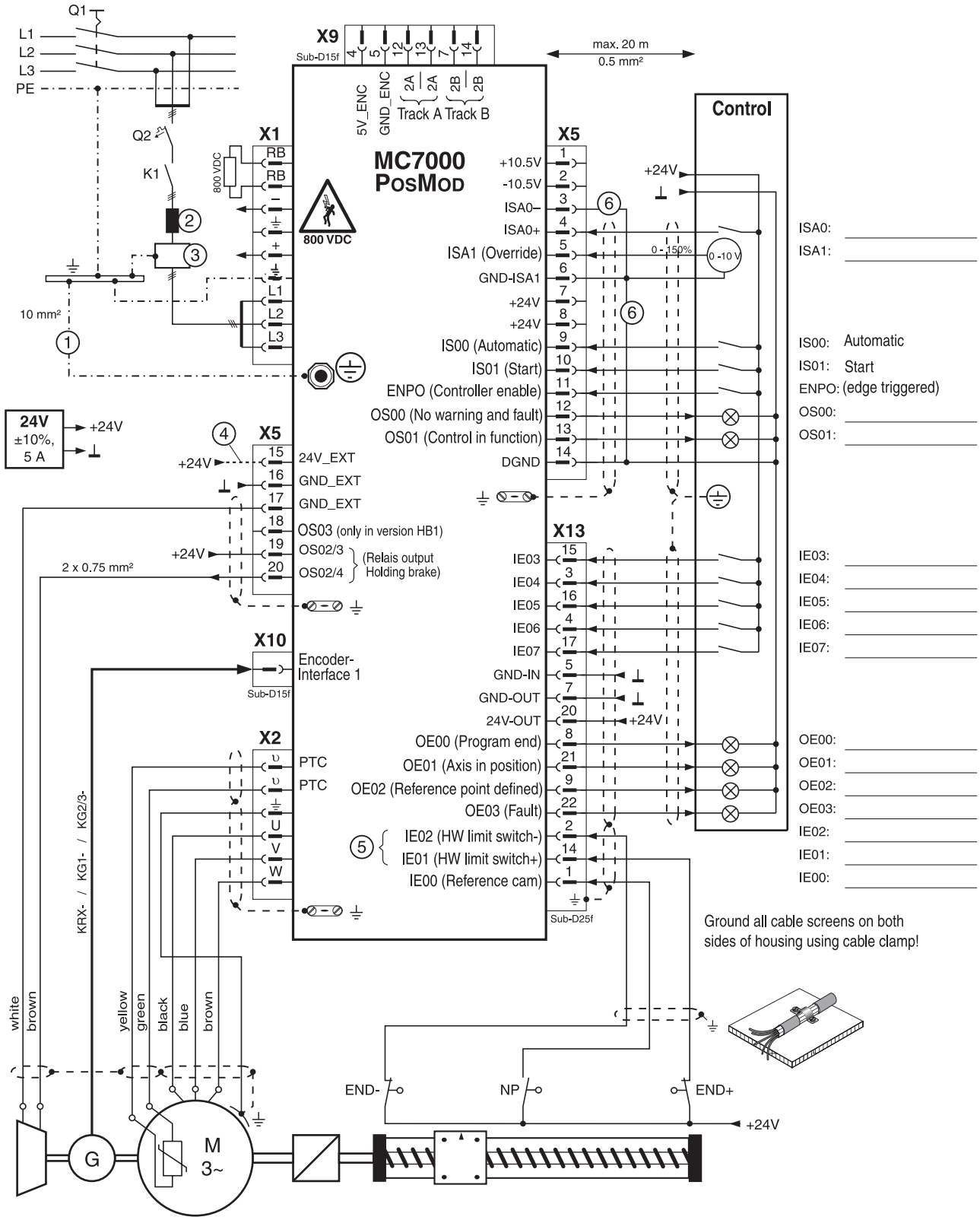
4. **Wire up the control terminals according to the selected operation mode.**
   - Don't forget power stage enable ENPO.

5. **Connect the master encoding cable.**
   - (Only if you want to use the synchronous function of the MC7000 PosMod, see Programming Manual, section 7.5)

6. **Connect the encoder cable to the motor and servocontroller.**
   - Be sure to follow the instructions given in section 3.4.6.

■ **Check the electrical installation. Inspect all connections! Then screw the front guard of the MC7000 back on.**

System connection diagram



① *Grounding lead min. 10 mm or 2 wires with same cross-section as mains connection (prEN50178, DIN VDE0160)*

② *Line choke to reduce supply system load (recommended above approx. 5 kVA rated power)*

③ *External mains filter, not required for devices with internal mains filter (MC7000, **FA**), see 3.4.3*

④ *Use 24 V control voltage connection only in version MC7000, **SN2** (external supply to control section), see Appendix A.4*

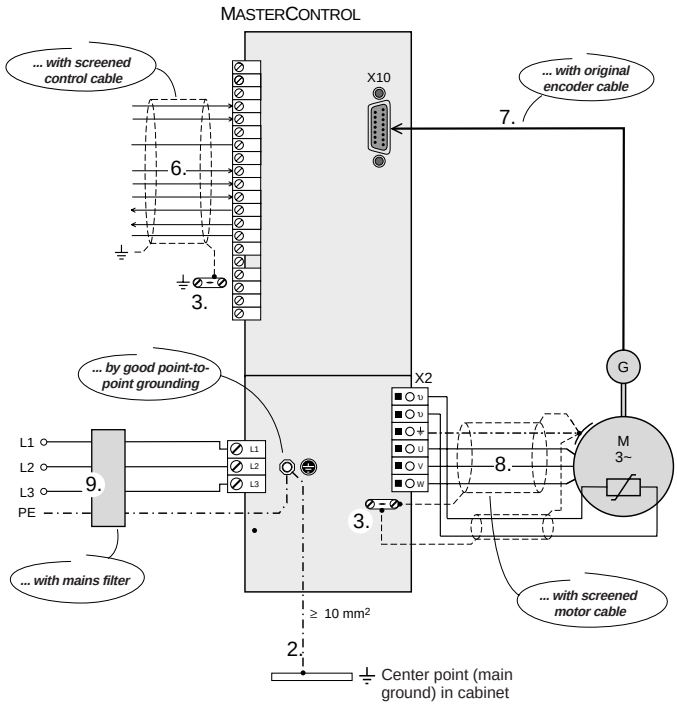
⑤ *No factory setting; programmable*

⑥ *Bridge only required if ISA0 or ISA1 used as digital input.*

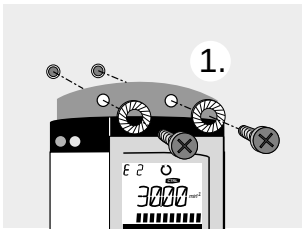
3.4.1 Electromagnetic compatibility (EMC)

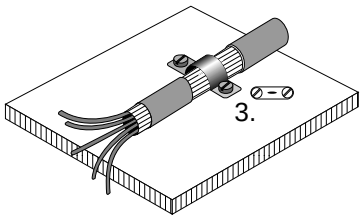
The servocontrollers of the MC7000 series meet the European requirements of EMC interference suppression in accordance with EN50082-2 and relating to interference emission in accordance with EN50081-2 and EN55011. The following steps must be taken to comply with the standards.

	Action	Effect/reason
1.	Screw servocontroller onto mounting board using toothed washers.	Highly conductive, full-area contact.
2.	Set up grounding lead connection over at least 10 mm² on PE rail in cabinet.	Good point-to-point grounding due to leakage currents > 3.5 mA.
3.	Ground all cable screens flat over entire area using cable clamps (both sides).	Screening effect lost if the screen is pigtailed.
4.	Ensure power cable and control cable are laid out completely separate.	Prevent mutual interference.
5.	Ensure mains cable and motor cable are laid out completely separate.	Prevent mutual interference.
6.	Use screened control cable.	Prevent interference on control signals.
7.	Use original encoder cable.	Prevent interference on encoder signals.
8.	Use screened motor cable.	Prevent spread of interference and injected interference via the motor connection.
9.	Screw mains filter onto mounting plate immediately adjacent to servocontroller using toothed washers.	Prevent spread of interference and injected interference via mains connection; highly conductive, full-area contact.



Mounting with toothed washers:





Ground all cable screens on both sides on housing using cable clamps!

3.4.2 Motor connection

The motor is connected via terminals U, V, W and ⏚ on the servocontroller (X2); cross-section see Mains connection.

In the interest of interference reduction, the motor connecting cable is screened. The screen is mounted over a large surface, and without reduction of cross-section, on on both sides of the housing ⏚. The screen can be connected optimally to the unit over a large area by way of the cable clamp.

The motor cable should not be separated (e.g. at terminals in the cabinet), as this would cause the screening effect to be lost!

Caution – Danger to life!

Do not confuse the motor and unit ends of the motor phases U, V and W! If the motor phases are incorrectly connected, the servocontroller will lose control over the motor and the motor may buck or accelerate uncontrollably (“run away“). The entire system may be damaged as a result! There may consequently also be danger to human life.

Explanation:

If working with an open-loop drive (frequency inverter), interchanged motor phases will merely lead to an inversion of the rotary field and thus to a reversal of the direction of rotation of the motor.
If working with a closed-loop drive, the same mistake would cause an error in the control loop of the control circuit!

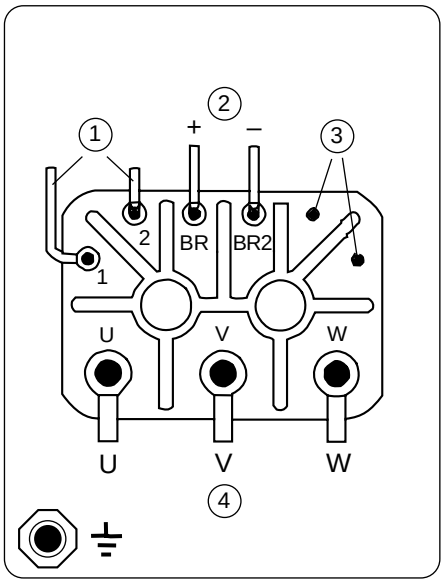
Caution – Danger to life!

Do not touch the motor terminals! There may also be dangerously high induction voltages present on motor terminals U, V and W during coasting!

Motors with terminal boxes

Correct EMC wiring of the motor requires the use of screw glands with a large-area screen contact, e.g. TOP-T-S type made by Lütze. The terminal box can be turned to allow the setting of different outgoing cable directions (square terminal boxes can be turned by 90°, rectangular ones by 180°).

Ensure that the outgoing cables are properly sealed, as otherwise IP65 protection can no longer be guaranteed!

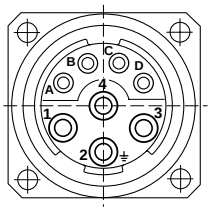


No.	Function
1	PTC thermistor
2	Holding brake (option)
3	not assigned
4	Motor

Motors with plug-in power terminals

Protection class IP65 can only be attained using mating connectors which are wired as authorized and properly tightened.

Suitable mating connector:
e.g. Interconnectron, type LPNA 08B NN



Contact no.	Assignment	Color of cores
1	U	black
2	⏚	yellow / green
3	W	brown
4	V	blue
A	Brake+	brown
B	Brake–	white
C	PTC	green
D	PTC	yellow

Long motor lines

When working with screened motor cables, in particular, leakage currents are prevalent which cannot be ignored. The level of leakage current depends on the line length, the cable structure, the cable route and the motor type. The rated output currents apply up to a line length of 10 meters.

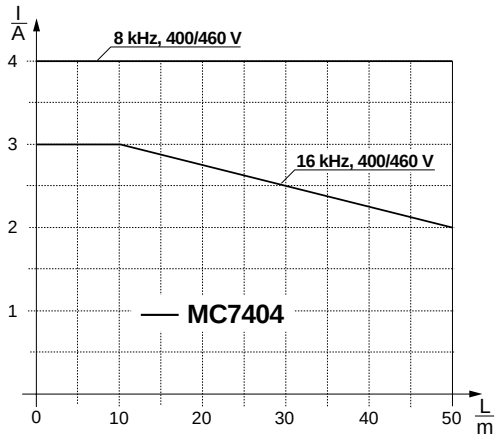


Diagram: Output current as a function of motor cable length; here as an example for the MC7404. Power reduction for servocontrollers MC7402 to MC7464 - see Appendix A.3

Connection of the thermistor

Temperature monitoring of the motor requires connection to the servocontroller of the thermistor (PTC) integrated in the motor housing. This involves connecting contacts 1 and 2 in the motor terminal box to the two υ (X2) terminals (X2) in the MC7000.

The connection of the PTC is **screened, and executed by a two-ended interface to** ⏚ via a separate cable (wire cross-section 0.75 mm).

The resistance of the PTC at the nominal response temperature is > 3 kΩ (cf. DIN44081 and 44082). When this resistance value is reached, the servocontroller reacts with the error message Motor overtemperature (E-OTM).

If the thermistor is not connected, the two PTC terminals on the servocontroller must be bridged. This bridge is factory-fitted, and should be removed when the thermistor is connected.

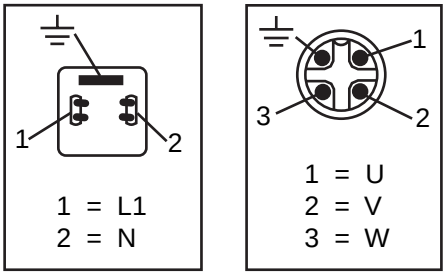
When using motors from other manufacturers, note that the PTC when installed is electrically isolated to DIN VDE 0530 part 1.

Cooling the motors / Motors with external ventilation

The permissible ambient temperature for the motors is between -5 and 40°C. The motors must be installed to guarantee sufficient heat discharge by convection and radiation. Where motors have internal cooling devices, ensure that they are not installed too close together (e.g. in narrow frames or shafts) in order to prevent excessive heat build-up.

If the motor has an **external ventilator unit**, connect it as instructed (wire cross-section 0.75 mm^2) and check that the direction of rotation is correct (note arrow on ventilator housing indicating direction of rotation)!

A sufficient quantity of cooling air is required to ensure perfect cooling.

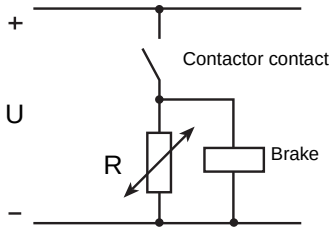


Holding brake (if installed)

The backlash-free, permanent-field single-disc holding brake works on the closed circuit principle, meaning that the brake is operative without power supply. Actuation of the holding brake is described in Section 5.

Due to the inductance of the holding brakes, a voltage spike which may be over 1000 V will arise when the field current is switched off. To avoid this voltage spike,a protection device with a varistor (recommended type Q69-X3022) should be used.

Motors with a built-in holding brake require a reduction of the maximum speed where appropriate (see MASTERDRIVE data specification).



Suggested switching option for protection of the brake with third-party motors

Motors with shaft seal IP65 (option)

If working with motors with an IP65 built-in shaft seal (option), observe the permissible maximum speed (see MASTERDRIVE data specification). Functional safety can only be guaranteed if sufficient lubrication is applied. Sealing lips may be destroyed by speeds of rotation which are too high.

Refer to the MASTERDRIVE data specification for further important instructions relating to the motors.

Motor maintenance

Maintenance of the motors is limited to cleaning of the motor surfaces. The radial deep groove ball bearings in the motors are lifetime lubricated and designed for 20.000 operating hours. Motors in the ASx and PSx series must not be disassembled!

3.4.3 Mains connection

The mains connection to the MASTERCONTROL is made via terminals L1, L2, L3 and ⏚. Use of a screened mains cable is only necessary as from cable lengths > 20 cm.

The fuses listed in the following table are to be inserted in series upstream of the servocontroller in accordance with VDE 636, part 1. Adapt the wire cross-section of the connecting cable to the current load.

The servocontroller MC7000 is built for the operation at TN and TT-mains. Using an IT-mains (with isolated center point) is not allowed (see Engineering Guide CDA3000, chapter 3.2.1)!

	Dim.	MC7402	MC7404	MC7408	MC7412	MC7416	MC7432	MC7464
Recommended wire cross-section	mm^2	1.0		1.5	4		10	25
Maximum possible wire cross-section	mm^2	2.5		2.5	4		10	35
Recommended mains fuse (time-lag)	A	10		10	25		50	80

Automatic circuit-breakers with tripping characteristic C or fuses of utilization category gL may be used.

Mains filters

The following mains filters are required in order to comply with the EMC directives:

Servocontrollers	Order ref.	Cable length	Limit curve	Rated current at 40°C	Leakage current	Terminal [mm^2]
MC7402	NFD10.3	50 m	Class B	10 A	< 116 mA	0.2 ... 4
MC7404	NFD10.3	50 m	Class B	10 A	< 116 mA	0.2 ... 4
MC7408	NFD10.3	50 m	Class A	10 A	< 116 mA	0.2 ... 4
MC7408	NFD10.4	100 m	Class B	10 A	< 24 mA	0.2 ... 4
MC6404	NFD10.3	50 m	Class B	10 A	< 116 mA	0.2 ... 4
MC6408	NFD16.2	100 m	Class A/B*	16 A	< 178 mA	0.2 ... 4
MC6412 + MC7412	NFD25.1	100 m	Class A/B*	25 A	< 127 mA	0.2 ... 4
MC6416 + MC7416	NFD25.1	100 m	Class A	25 A	< 127 mA	0.2 ... 4
		25 m	Class B			
MC6432 + MC7432	NFD50.1	100 m	Class A	50 A	< 140 mA	0.5 ... 16
		25 m	Class B			
MC6464 + MC7464	NFD80.0	100 m	Class A	80 A	< 305 mA	10 ... 25
		50 m	Class B			

** Attained with additional use of a line choke of type DNDxx*
Rated voltage: 3 x 480 V AC ±10 %
The figures relate to a clock frequency of 8 kHz.

Specifications for other types of mains filter are available on request. For mains filter and line choke dimensions see mains MASTERDRIVE data specification.

Notes:

- The servocontroller may only be connected to and disconnected from the mains after an interval higher than 120 seconds. Direct reactivation of the supply voltage is permitted during commissioning or after an emergency shutdown (“Emergency Off“).
- The use of fault current breakers alone is prohibited, due to the high leakage currents (> 3.5 mA). Protective grounding is therefore mandatory (see Section 3.4, “Grounding the servocontroller“).

3.4.4 Use of line chokes

Use of line chokes is necessary:

- When using the drive controller in applications involving interference as per environment class 3 to EN 61000-2-4 and above (hostile industrial environments)
- When several drive controllers are interconnected by DC links

The features of environment class 3 include:

- Mains voltage fluctuations > ± 10% U_N
- Short-time outages between 10 ms and 60 s
- Voltage asymmetry > 3%

Environment class 3 typically applies where:

- A major portion of the load is supplied by power converters (DC choppers or soft-start units)
- Welding machines are operated
- Induction or arc furnaces are operated
- Large motors are frequently started up
- Loads fluctuate rapidly

Benefits:

Using line chokes with 4% U_K ...

- ... reduces the amplitude of the mains charging current by around 50%
- ... reduces the effective value of the mains charging current by around 27%
- ... reduces the harmonic distortion (THD) by around 67%
- ... extends the useful life of the DC-link capacitors by around 300%.

The data demonstrate that the benefits of line chokes are many and varied, and consequently they should not be omitted from any machine or plant system.

3.4.5 Connection of the braking resistor

During regenerative operation, e.g. when applying the brake to the drive, the motor returns energy to the servocontroller. This raises the voltage in the DC-link. If the voltage exceeds a value of 745 V DC, the internal braking transistor is switched on and the regenerative energy is converted into heat by an internal or external braking resistor.

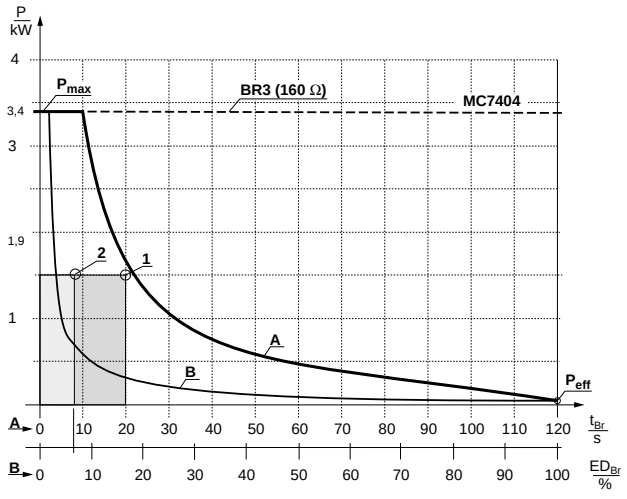
If the DC-link voltage exceeds the maximum permissible value of 780 V DC, the servocontroller will register an overvoltage error (E-OV) and disable the power stage. Overvoltage can occur when the brake is applied to large masses and/or short braking durations have been set. Then an external braking resistor or braking chopper should be used.

The servocontroller is not short-circuit-proof or ground-fault-proof at the R_B terminals!

■ **If you want to compile a precise project plan, the Operation Manual to the MC7000 servocontroller provides useful formulae. The following variables from your application will be needed:**

- Moment of inertia of the motor and the load
- Speed before and after braking
- Braking duration.

■ **You can get a rough estimate using the diagram below and the braking power data (see Appendix A.3). It is essential to check the dimensioning during commissioning!**



Standard version:
(with braking resistor in heat sink)

A - Single braking action (waiting period ≥ 15 min.

B - Cyclic braking (continuous braking power) with continuous duty factor ED.

BR3:
(with braking chopper power electronics for direct connection of an external braking resistor)

The diagram shows the characteristic of the internal electronics; the continuous output power of the external resistor must be rated accordingly!

Operation points (examples):

1 - Permissible operation for single braking action

2 - Impermissible operation for cyclic braking in standard version; use BR3.

Diagram: Permissible braking power as a function of continuous duty factor ("ED"; in s or %) as an example for MC7404 servocontrollers

Note:

The braking power data table is given in Appendix A.3.

Braking the drive is important to the safety of the machine or system

Commissioning should include a test for safe functioning of the braking system! Incorrect dimensioning (overload) could lead to destruction of the braking resistor or the braking electronics, and damage to the machine or system. Overload (failure of the braking device) can also lead to serious or fatal physical injury to human beings, for example in lifting applications!

Note:

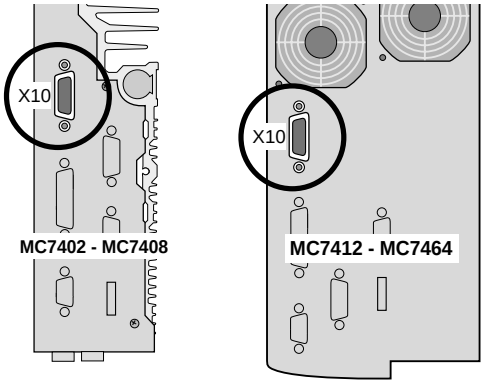
Electronic devices are fundamentally not fail-safe. Users are themselves responsible for ensuring that the drive is rendered safe if the device fails.

3.4.6 Encoder connection

The encoder cable is supplied in ready made-up form. This cable is used to make a direct connection (as in the system connection diagram) between the round connector on the motor housing and the 15-pin sub-D socket (X10) in the device cover.

The encoder cable must not be separated, for example to route the signals to the switch cabinet via the terminals. Ensure that the knurled screws on the sub-D connector housing are secured!

The MASTERCONTROL servocontroller detects the connected encoder by reading-in the SMARTCARD belonging to the motor or by reading the motor data set into the servocontroller by means of DRIVEMANAGER.



Caution!

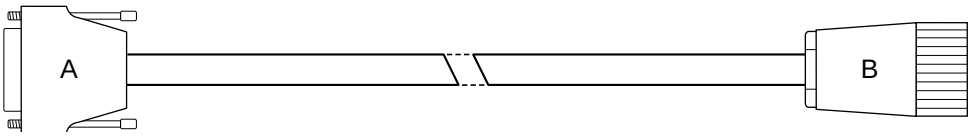
Make absolutely sure that the encoder interface, encoder type and encoder cable match (see Section 3.3), otherwise proper functioning cannot be guaranteed!

Caution!

The encoder cable should under no circumstances be detached during operation, as the servo-controller will otherwise lose all control over the motor! The resulting uncontrolled rotation of the drive may lead to damage to the motor and the system, and pose a danger to human beings!

Resolver cables KRX-Nxx, KRX-KSxx

xx = length of cable in meters; standard lengths: xx = 05, 10, 15, 20, 25, 30 m



A	B	Function	Color
1		n. c.	
2		n. c.	
3		n. c.	
4	5	REF+ (R1)	yellow
5	7	REF- (R2)	green
6		n. c.	
7	2	COS+ (S1)	pink
8		n. c.	
9		n. c.	
10		n. c.	
11		n. c.	
12	10	SIN+ (S2)	white
13	1	SIN- (S4)	brown
14	11	COS- (S3)	gray
15		n. c.	

Outer and inner screens on housing

Material:

KRX-Nxx Cable not festoon compatible,
Lapp Unitronic CY Pi CY 3x2x0.25

KRX-KSxx Cable festoon compatible,
Lapp Unitronic FD CP TP 3x2x0.25

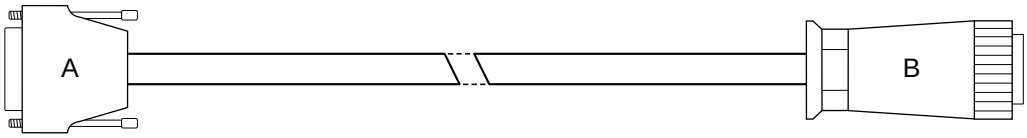
Connector A Sub-D 15-pin terminals,
metallic housing

Connector B Signal connector, 12-pin socket,
Interconnectron
SPNA12B NNNN 169 (for KRX-Nxx)
PLD121 NV 171187 (for KRX-KSxx)

Encoder cables KG1-KSxx and KG2/3-KSxx

xx = length of cable in meters

Standard lengths: xx = 05, 10, 15, 20, 25, 30 m; maximum 50 m (longer lengths on request)



KG1-KSxx			
A	**B**	**Function**	**Color**
1		Bridge pin 6	
2		1 K Pin 4	
3		5 V	blue
4	C	5 V, 1 K Pin 2	brown/green
5	A	0 V	white/green
6		Bridge pin 1	
7	J	B+	gray
8	H	R-	black
9		n. c.	
10		n. c.	
11		0 V	white
12	E	A+	brown
13	F	A-	green
14	K	B-	pink
15	G	R+	red

KG2/3-KSxx			
A	**B**	**Function**	**Color**
1	T	DATA+	gray
2	U	DATA-	pink
3	D	5 V	blue
4	C	5 V	brown/green
5	A	0 V	white/green
6	V	Inner screen	
7	J	B+	blue/black
8		n. c.	
9	S	CLK-	yellow
10	R	CLK+	purple
11	B	0 V	white
12	E	A+	green/black
13	F	A-	yellow/black
14	K	B-	red/black
15		n. c.	

Material:

KG1-KSxx Cable festoon compatible,
Heidenhain 244 957 01

KG2/3-KSxx Cable festoon compatible,
Heidenhain 266 306 01

Connector A Sub-D 15-pin terminals,
metallic housing

Connector B Connector, 19-pin socket,
Schaltbau München MT1

Technical data of the encoder cables

	Dim.	KRX-N0xxx	KRX-KSxxx	KG1-KSxxx	KG2/3-KSxxx
Servocontroller type		All (not version D2)		MC6000, D2 MC7000, D2	
Motors with encoder system		R1, R2, R8, K1, K2, K8		G1	G3, G5
Festoon compatible		no	yes	yes	
Minimum bending radius: in fixed installation in flexible use	 mm mm	 60 not permitted	 60 120	 40 100	
Temperature range: in fixed installation in flexible use	 °C °C	 - 30 ... + 70 not permitted	 - 10 ... + 70 - 10 ... + 70	 - 35 ... + 80 - 10 ... + 80	
Cable diameter approx.	mm	9.9	9.4	8.0	
Material of outer sheath		PVC	PUR	PUR	
Resistance		Flame retardant	Flame retardant, resistant to hydrolysis and microbic attack	Resistant to oil, hydrolysis and microbic attack (VDE0472)	

Encoder wire break detection

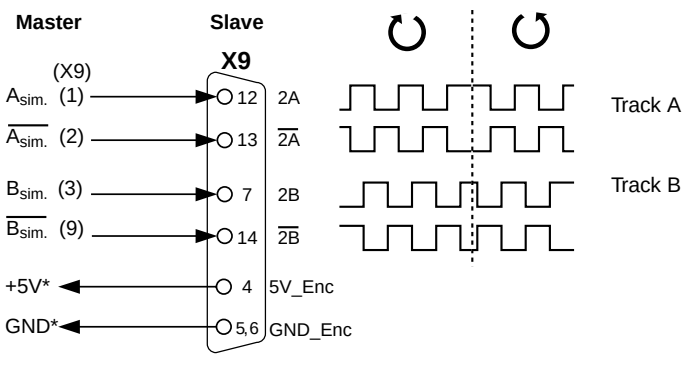
The encoder signals are continuously monitored before the drive is started up and during operation. If the signals fail, such as due to a wire break, the error E-ENC with error location 1 is triggered (the motor can no longer be controlled and spins out of true).

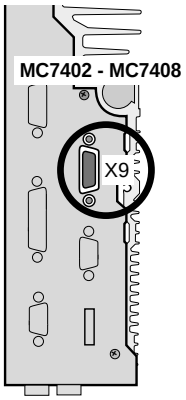
The monitoring function is operative for all resolvers (R1, R2 and R8) as well as for optical encoders with sin/cos signals (G1, G2, G3 and G5). Incremental encoders with square signals and the absolute position information (DATA and CLK) of encoders G2 to G5 are not monitored.

3.4.7 Connection of the master encoder

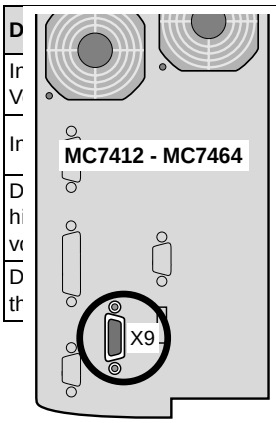
The master encoder must deliver incremental signals with RS422 level. The encoder simulation of a MC6000 or MC7000 servocontroller may also be used, for example. The maximum count frequency is 500 kHz.

Incremental encoder signals

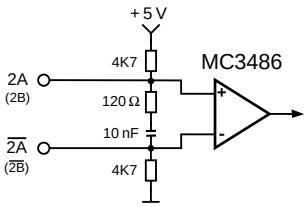




* *use only, when an incremental encoder is used as the master encoder*

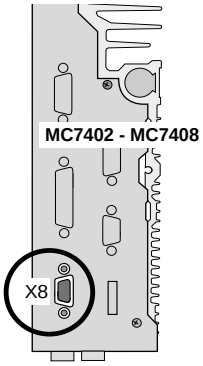


D	max.	Circuit diagram
Ir V	± 6 V	
Ir	500 kHz	
D hi ve	0.2 V	
D th	–	



3.4.8 Serial interface RS485

The standard fitted RS485 interface (X8) is the operator control and diagnostic interface for the DRIVEMANAGER Windows-based user interface.



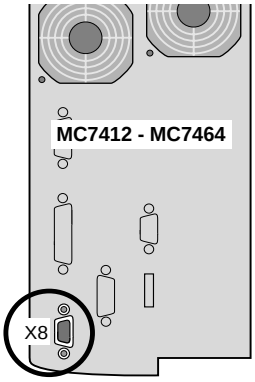
To connect to your PC you will need:

For a single drive:

- Interface converter cable LBSKK200 to convert the signals of the drive's interference-immune RS485 interface to the PC's RS232 level, or
- For an industrial PC with RS485 just a 1:1 interface cable (sub-D 9-pin, male-female).

For several interconnected drives:

- One T-coupler per drive unit, e.g. LUST LB TK101, B&R INT101 and a 1:1 interface cable (sub-D 9-pin, male-female) for the link from the PC to the first T-coupler.



Assignment of the RS485 interface

Power is supplied to the optocouplers:

a) by feed-in of 24 V (floating) or

b) by the internal 5 V (non-floating).

Pin no. X8	Assignment RS485	Variant a) (external 24 V)	Variant b) (internal 5 V)
1	n.c.	n.c.	n.c.
2	GND_B	GND	GND, bridge pin 8
3	+5V_B	Bridge pin 7	Bridge pin 9
4	RS485-	RS485-	RS485-
5	RS485+	RS485+	RS485+
6	24V_IN	feed + 24 V	n.c.
7	+5V_B*	Bridge pin 3	n.c.
8	GND	n.c.	GND, bridge pin 2
9	+5V	n.c.	Bridge pin 3

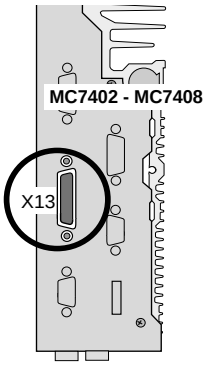
Screening: Connect a screened cable to the grounding lead via both sides of the connector housing

Note:

If bus operation is to continue even when the mains power fails, the +24 V voltage for the control section must be externally supplied (only possible for MC7000, **SN2**).

3.4.9 CAN connection

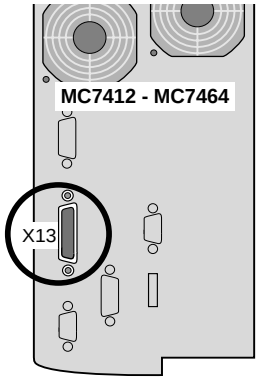
The bus is connected via X13 (sub-D 25-pin). The EKL300 terminal module is available for conventional connection via 2 x 9-pin sub-D connectors.



The device address is assigned using a parameter (addresses 0 ... 29).

Screening:

The CAN bus is to be wired using a screened cable, the screen being mounted on both sides of the connector housing and connected to the grounding lead.



No.	Assignment	Function
10	24V-CAN	Supply to CAN bus 1)
11	GND-CAN	Ground for CAN bus 1)
12	GND-CAN	Ground for CAN bus 1)
13	CAN+	CAN signal+
25	CAN-	CAN signal-

1) External +24 V feed required!

Comments: Housing is at grounding lead potential.

Notes:

- Uninterrupted duty of the CAN bus independent of the mains power supply to the MC7000 requires use of the servocontroller version SN2 with an external +24 V supply voltage.
- More information on installation is given in the description: “Correct EMC installation of bus systems“.

Technical data	
Supply to control section:	24 V DC ± 20 % for MC7000, SN2 max. 3 A, typ. 0.5 A
Supply to CAN bus:	24 V DC ± 10 % for CAN bus, pin 10 (X13) 100 mA per station
Transmission speeds:	Adjustable from 50 kBit/s (1 km cable length) to 1 Mbit/s (40 m cable length)
Transmission medium:	CAN bus to ISO11898

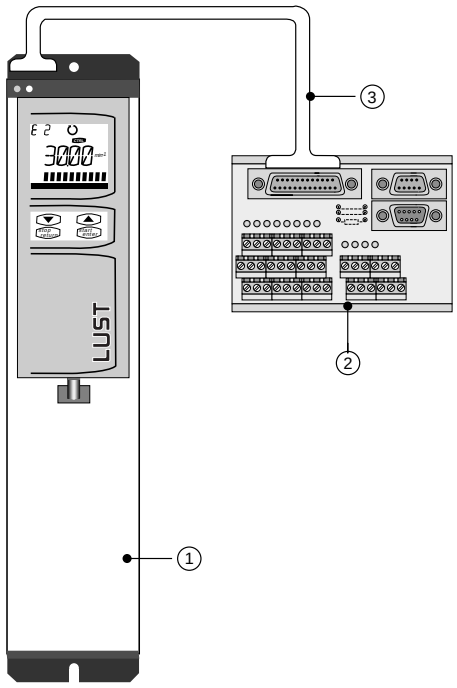
3.4.10 EKL300

The external terminal module EKL300 facilitates direct wiring of the external inputs and outputs and of the CAN bus on the 25-pin sub-D connector X13 in the cabinet. LEDs signal the status of the inputs and outputs.

The EKL300 execution is three-wire. Initiators can be conveniently connected using the three leads for +24 V, signal and ground. The terminal module is simply mounted on a Z-rail.

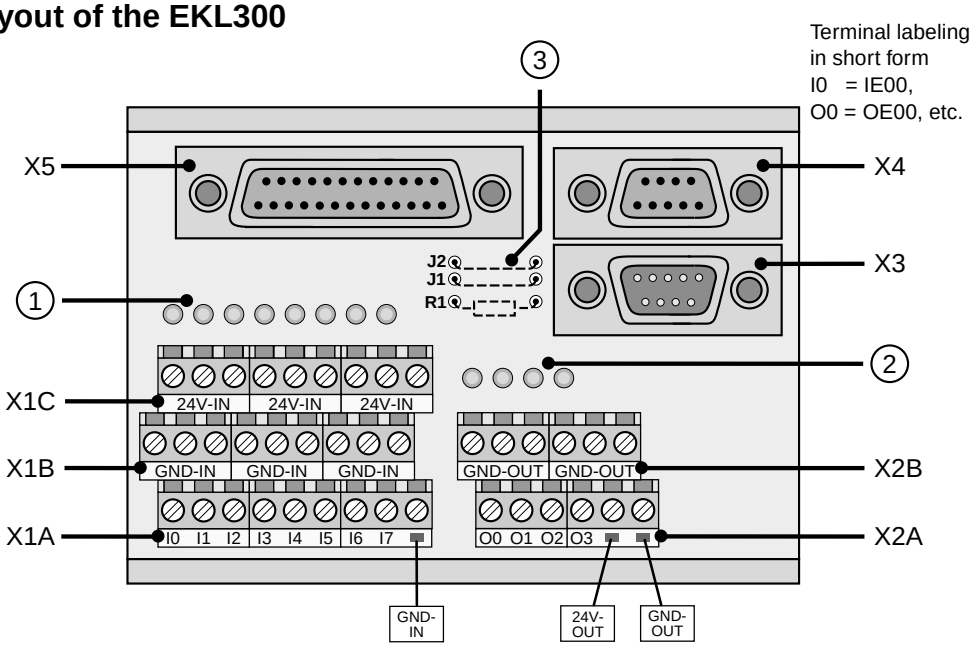
Features of the EKL300 in summary:

- For direct wiring of inputs and outputs (IExx + OExx) in the cabinet
- For CAN bus connection via 2 x 9-pin sub-D connectors
- Three-wire execution (signal, +24 V and ground) for convenient connection of initiators
- LEDs as status indicators for inputs and outputs
- Mounting of terminal module on Z-rail
- Dimensions (W x H x D): 113 x 78 x 72 mm²
- Max. connecting cable cross-section 2.5 mm²



No.	Function
1	Servocontroller MC7000
2	Terminal module EKL300
3	Connecting cable KSS252 (25-pin, 1.8 m long)

Layout of the EKL300



No.	Function	No.	Function
1	LEDs for inputs	X2A	Output terminals OExx
2	LEDs for outputs	X2B	Ground for output terminals (GND-OUT)
3	Mounting options for CAN bus (R1 = 120 Ω, J1 + J2 with jumper)	X3	CAN bus input
X1A	Input terminals IExx	X4	CAN bus output
X1B	Ground for input terminals (GND-IN)	X5	Link to PosMod [1]
X1C	+24V for input terminals (+24V-IN)		

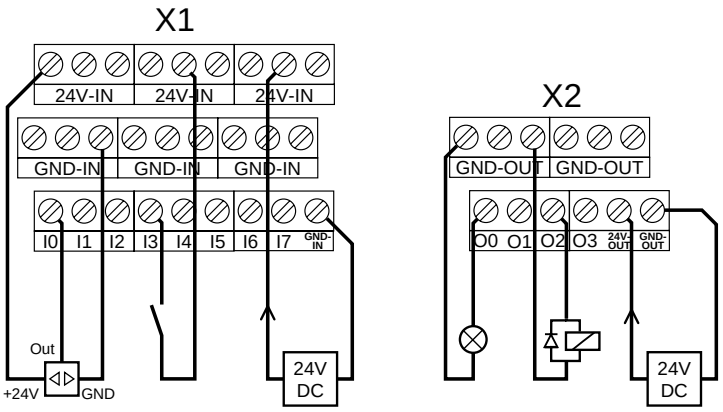
1) X5 pin assignment corresponds to X13 on MC7000 (25-pin sub-D connection)

CAN: Connectors X3, X4

If the servocontroller with the EKL300 is at the end of a CAN network, the necessary termination can be provided by fitting resistor R1 = 120 Ω.

No.	Assignment	Function
2	CAN-	CAN signal-
3	GND-CAN	Ground for CAN bus [1]
7	CAN+	CAN signal+
9	24V-CAN	Supply to CAN bus [1]

1) External +24 V feed required here



Block diagram of the circuit

External +24 V feed required (floating). Inputs and outputs can be supplied separately.

Load capacity:

- max. 50 mA per output

4 Commissioning

1. Preparing for commissioning: inspect connections and follow safety instructions
2. Switch on power and perform function test
3. Set basic setup of servocontroller (operation modes and functions)
4. Test run
5. Adapt drive to machine and optimize drive response
6. Commission the position controller

4.1 Preparing for commissioning

Commissioning must only be carried out by qualified electricians who have undergone instruction in the necessary accident prevention measures!

The servocontroller must be correctly connected in accordance with section 4.4. Inspect all connections.

Safety instructions:

Caution – Danger to life!

- Never wire or disconnect electrical connections while they are live!
- Before working on the device disconnect the power. Wait for the DC-link capacitors to discharge. Work may only be carried out on the device when the residual voltage (between terminals X 1+ and X 1-) is below 42 V! In the MC7000,SN2 (external supply of the control section with 24 V) the discharge time may be as long as 30 minutes.

Caution – Danger to life from uncontrolled rotation!

- The brake (if installed) should be checked for fault-free functioning before installation of the motor.
- Before motors with a feather key at the shaft end are commissioned, the feather key should be secured against being ejected, if this cannot be prevented by output elements such as pulleys, couplings etc.

Additional safety instructions relating to the servomotors

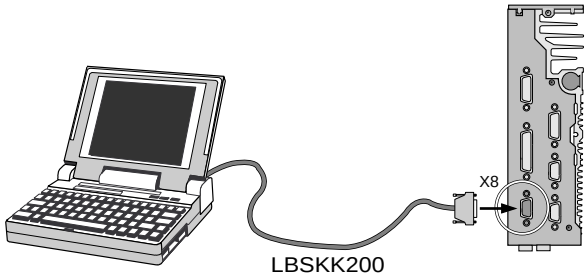
- The motors are intended for service on the servocontroller. Direct connection to the mains may lead to destruction of the motor.
- The motors may be subject to surface temperatures of over 100 °C. Temperature-sensitive items should therefore not be placed on top of or attached to the motors. Protective measures may be needed to prevent touching.
- The standstill holding brake (installation optional) is only designed for a limited number of emergency brakings. Use as a working brake is prohibited.
- The temperature sensor (PTC) installed in the winding is to be connected to the servocontroller in order to prevent overheating in the motor.

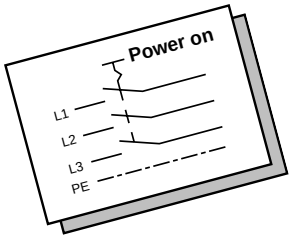
4.2 Startup and function test

You will need:

- Laptop or PC with DRIVEMANAGER user software. For installation and basic operation of the user interface refer to the description of the DRIVEMANAGER.
- Interface converter cable LBSKK200 to convert the signals of the drive's interference-immune RS485 interface to the PC's RS232 level.
- KEYPAD control unit.
- SMARTCARD with motor data set or motor data set on floppy disk.

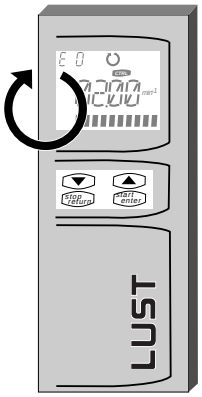
1. Connect the interface converter cable between the PC and the servocontroller.





2. Switch on the power to the servocontroller.

- Input ENPO = Low level at terminal 11 (X5) to prevent unintentional startup of the motor (power stage disabled).
- The MC7000 performs a self-test. If the KEYPAD is connected, the display lights up red and shows the “TEST“ message.
- Once the self-test has been completed correctly, the display lights up green and the current reference value (REFV parameter in the VAL menu) is displayed in the VAL menu.
- If the unit detects a fault during the self-test, the display lit up red indicates the cause of the error (see Appendix).



3. Check the direction of rotation

- With KEYPAD: The top section of the KEYPAD display shows the symbols for the direction of rotation when the motor shaft is turned by hand (for clockwise and for counter-clockwise).
- With DRIVEMANAGER: The direction of rotation is displayed in graphical form.
- Check that the symbol appears when you rotate the motor shaft clockwise by hand while looking onto the shaft end (flange).
- If the symbol fails to appear, check:

  Is the encoder cable plugged into the motor and the servocontroller?

  Is the encoder cable in use the correct one for the type of encoder?

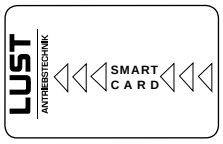
  If using self-made encoder cables: Is the cable correctly wired?

4. Start the DRIVEMANAGER.

- Make the connection to the servocontroller, if not already made automatically (see DRIVEMANAGER description).
- If the DRIVEMANAGER displays no error message the function test has been performed successfully and the connection to the PC is OK.

4.3 Basic setup of the servocontroller

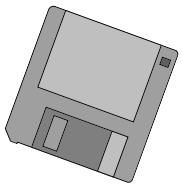
In closed-loop controlled drive systems it is of fundamental importance for the motor data to be set in the servocontroller. In LUST servocontrollers this is done with the aid of the motor-specific SMARTCARD (up to device version V1.65) or with a floppy disk containing the relevant motor data set (as from device software version V3.0).



1. **Read the SMARTCARD with the motor data into the KEYPAD:**
   - Exit the VAL menu by choosing Stop/Return.
   - Use the cursor keys to select the CARD menu and choose Start/Enter to open it.
   - Switch to READ and confirm with Start/Enter.
   - Use the cursor keys to select the DRIVE area (motor data) on the card and confirm with Start/Enter.
   - The motor data are read-in. The display indicates “READY“. Exit the CARD menu again by choosing Stop/Return.

     General use of the KEYPAD is described in Appendix B.

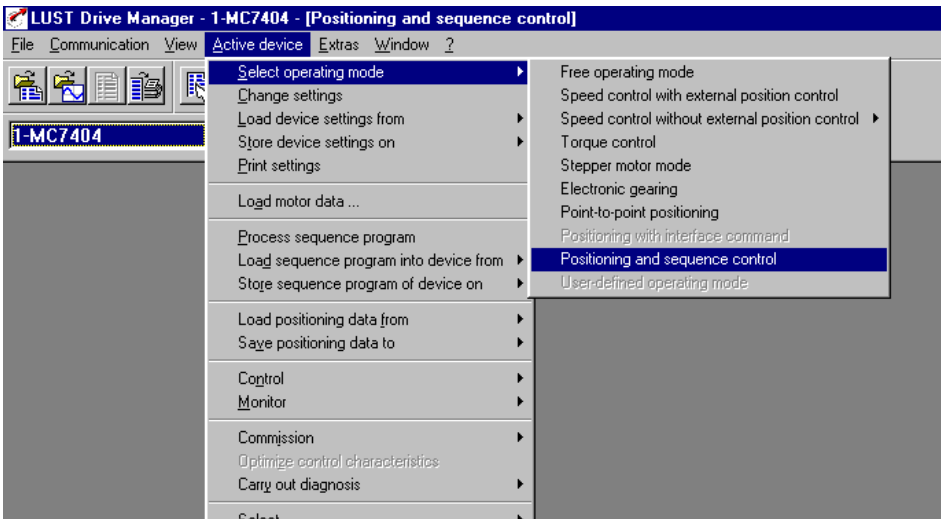
or:

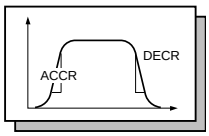


1. **Transfer the motor data using the DRIVEMANAGER (as from V3.0):**
   - First install the floppy disks containing the motor data, if they have not already been installed. To do so, open the SETUP.EXE file on the first disk, by double-clicking on its icon under Windows Explorer for example.
   - To transfer the data to the servocontroller select the right data set for the motor under the **Active device - Load motor data** menu.

   → **The MC7000 servocontroller is now set up for the connected motor.**

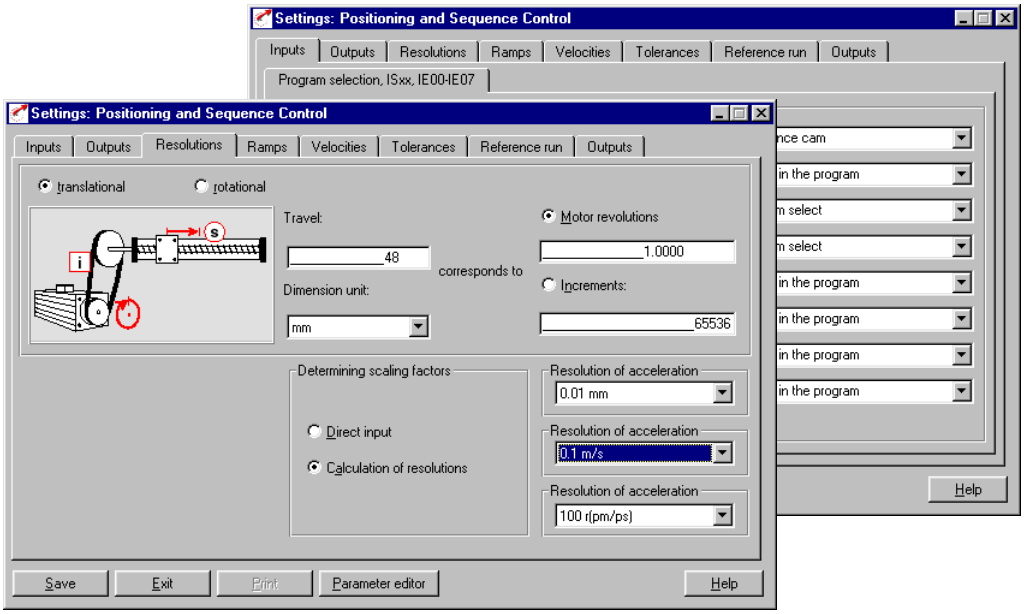
2. **Select 'Positioning and sequence control' mode**
   - The **Active device - Select operation mode** menu lists the available modes, depending on the application package. You can also use the operation modes of the BASIC and MOTION application packages. Refer to the MC7000 BASIC/MOTION Operation Manual, ident. no. 0808.02B.2-00.
   - When you have activated an operation mode the DRIVEMANAGER prompts you to confirm your selection.





3. Program functions

- Program the functions from see Section 5 of the programming manual which you will need - for example for the inputs and outputs, for monitoring by limit switches, for the jog speed or for actuation of the holding brake - by way of the **Active device - Change settings** menu (all tabs) or by choosing the  icon.



A note on changing parameters:

When the drive is at a standstill (ENPO input not set): Changes to parameters take effect in the servocontroller when you choose the “Save“ button in the DRIVEMANAGER.

When the drive is running (ENPO input set): Changes to parameters only take effect in the servocontroller when the program, or manual mode, has been restarted. One exception to this is the speed controller gain parameter SCGFA, which is updated online.

4.4 Test run

It is now possible to test the drive with no mechanical components coupled to it.

Safety instructions:
If the motor is already connected to the system, you must ensure that the system is not damaged by the test! In particular, pay attention to positioning range limits. In such cases the safety instructions as given for positioning (see Section 4.7) apply accordingly. **Please note that you yourself are responsible for safe operation. Lust Antriebstechnik GmbH cannot be held responsible for any damage incurred.**

4.4.1 The first axle movement

Caution!

1. **Set power stage enable ENPO (High level at terminal 11 (X5)).**
   - This activates the position control. **The axle must not move!**

   → **If the axle does move:**

   Shut off ENPO immediately

   Switch off power and wait until the unit is no longer live (see Section 4.1). Check the cabling.

2. **Jog via inputs or Jog in the DRIVEMANAGER menu**
   - **Inputs:** Wire two inputs with pushbuttons. Choose the **Active device - Change settings** menu from the **Inputs** tab and assign the inputs the functions 'Jog+' and 'Jog-' respectively.
     Make sure the pre-set speed for the jog mode is permitted under the **Speeds** tab.

     or:
   - **Menu:** Start the **Active device - Control - Manual mode POSMOD** menu. Make sure the pre-set speed for the jog mode is permitted.
   - **Test whether the axle can be moved.**

   → **If the axle does not move:**

   Shut off ENPO immediately

   Switch off power and wait until the unit is no longer live (see Section 4.1), check the cabling

   Check the settings of the MC7000 in terms of the torque limit

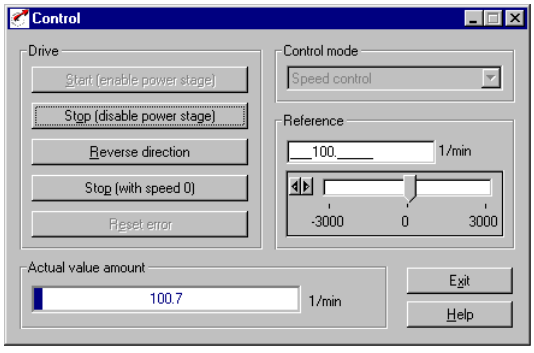
Test in speed-controlled operation

3. **Reset power stage enable ENPO**
   - Low level at terminal 11 (X5).

4. **Control with DRIVEMANAGER:**
   - Select **Active device - Control - Basic operation modes** or

     choose the  icon.

     Select “Speed control“ as the operation mode.



5. **Set power stage enable ENPO - High level at terminal 11 (X5). Then start the drive, e.g. with reference 0 rpm or 100 rpm, provided your drive permits it.**

Caution!

Limit switch monitoring is not active in “Speed control“ mode. Make sure you observe the limits of the positioning range!

6. Check the drive response

- Now you can assess the drive response with the aid of step responses, which can be recorded using the DRIVEMANAGER's digital scope function. Select **Active device - Monitor - Quickly changing digital scope values** or choose the  icon.

- The following three values are recorded using the digital scope:

  Speed reference (n*f)

  Actual speed (n)

  Torque reference (m*).

- Start the drive with a reference value of 100 rpm for example.

  Compare the step response of your drive with the diagram. With resolvers the overshoot of the actual speed should be around 20 %; with sin/cos incremental encoders around 30 % (referred to the reference value). The scaling of the x-axis may be allowed to deviate significantly (depending on the size of motor).

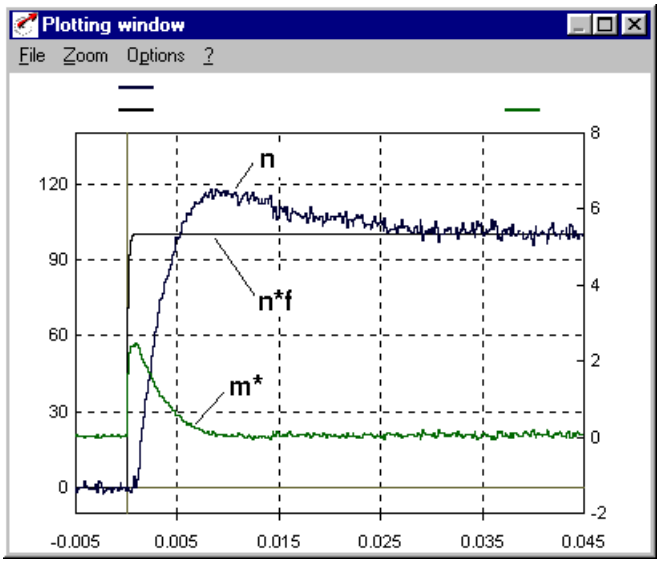


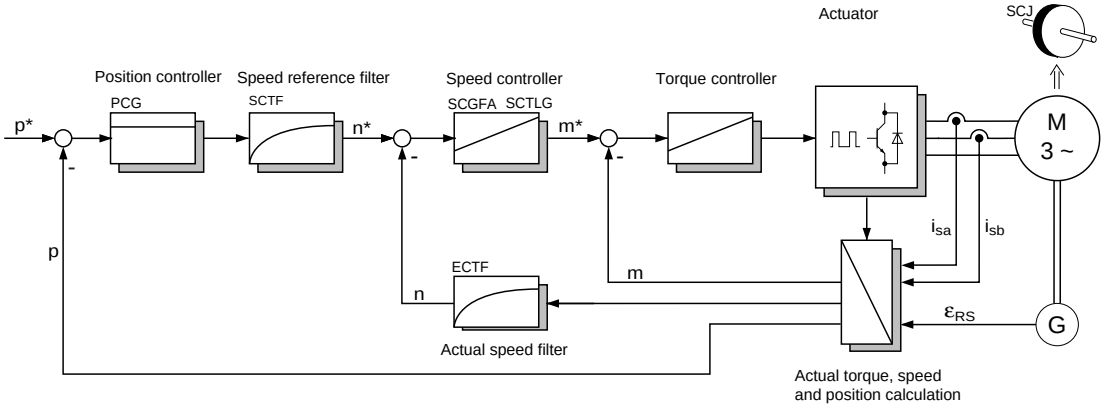
Diagram: Typical step response recorded with the DRIVEMANAGER (without load and without elasticities in the mechanical system)

→ **Result:**

- If the step response of your drive more or less matches the diagram, you can be sure that the motor phases are correctly wired, the encoder is correctly connected, and the MC7000 parameters are set to the correct motor.
- If the step response deviates significantly from the diagram, it must be assumed that the motor data are incorrect or the cabling is faulty. Check the individual steps as set out in sections 3.4, 4.2 and 4.3 and then repeat the test run.

4.5 The control structure of the MC7000

The MC7000 has a classic cascade control system with torque, speed and position controllers. The torque controller is always optimized first, then the speed controller, and finally the position controller.



Des.	Meaning
p*	Position reference
p	Actual position
n*	Speed reference
n	Actual speed
m*	Torque reference
m	Actual torque
ε_{RS}	Angle of revolution
$i_{sa,isb}$	Phase currents

Parameter	Meaning
SCTF	Speed reference filter
SCGFA	Speed controller gain
SCTLG	Speed controller lag time
SCJ	Moment of inertia of mechanism
ECTF	Actual speed filter

Important notes:

The **torque controller** is is already optimally attuned to the motor data by the read operation from the SMARTCARD . As a result, torque control mode requires no further adjustment.

The **speed controller** must be adapted to the mechanism coupled to the motor.
The following influencing variables are decisive in this:

- The reduced moment of inertia of the mechanism
- The elasticities of the mechanism (toothed belts, plastic couplings, torsion of shafts)
- Play (gear backlash).

The **position controller** is only active in “electronic gearing“, “stepper motor“ and “point-to-point positioning“ modes. The higher the dynamics of the speed controller, the more dynamically the position controller can be set.

Note:

If the MC7000 BASIC or MOTION is used in conjunction with motor data sets from earlier software versions, the value of the speed reference filter parameter SCTF must be set manually to the value of the lag time SCTLG in order to obtain the same control response.

4.6 Adaptation to the machine and optimization of the speed controller

1. **Install the drive into the machine or system.**

2. **Adapt to the moment of inertia of the mechanism.**
   - If you know the exact moment of inertia of the mechanism reduced onto the motor shaft, you can enter it in the relevant box.
   - If you do not know the exact moment of inertia, enter 0 in the box and use the following steps to optimize the speed controller.

Rule of thumb:

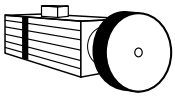
The higher the moment of inertia,
the higher the gain.

Controller setup

To set the speed controller's basic settings, the existing mechanism must first be divided roughly into three categories:

Very rigid mechanism

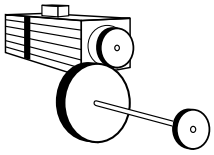
The mechanism has only very low elasticities and no play.



⇒ **Hard controller setup**

Rigid mechanism

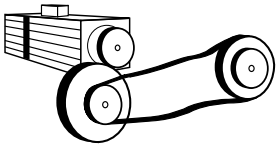
The mechanism has low elasticities and/or play.



⇒ **Medium controller setup**

Less rigid mechanism

The mechanism has higher elasticities and/or play.



⇒ **Soft controller setup**

By selecting the controller setup you can decide on a compromise between control dynamics and smooth running.

A note on dimensioning:

- **Hard controller setup** ⇒ **High control dynamics, rough running**
- **Soft controller setup** ⇒ **Low control dynamics, smoother running**

Useful tip: Use a soft controller setup wherever possible, and only switch to a harder setup if the required dynamics are not attained.

Please note:

If the controller setup is too hard, the drive will tend to vibrate.

If the controller setup is too soft, the control dynamics are too low.

Note:

If you use linear acceleration and speed ramps, and if you want to avoid overshoot beyond the destination position, the speed controller setup must be soft.

Actual speed filter

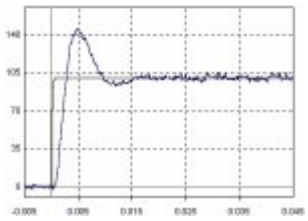
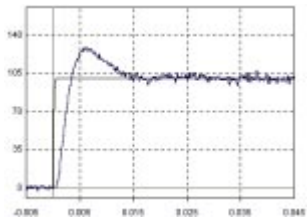
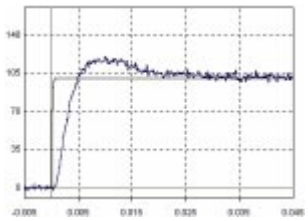
The MC7000 has an actual speed filter which reduces the torque fluctuations and so makes the drive run smoother. The actual speed filter should only be increased in response to high moments of inertia (above 200 kg cm^2 with resolvers and 10000 kg cm^2 with sin/cos incremental encoders).

A note on dimensioning:

- **Low actual speed filter** ⇒ **High control dynamics, rough running**
- **High actual speed filter** ⇒ **Low control dynamics, smoother running**

3. Control parameter settings (speed controller sampling time ECTS = 8 kHz):

- First select just the controller setup – hard, medium or soft – and then set the gain and lag time according to the following table in the DRIVEMANAGER.

Controller setup		Actual speed filter ECTF [µs]	Gain SCGFA [%]	Lag time SCTLG [ms]
	**Hard**	300	208	3.4
		600	156	4.6
		900	127	5.9
		2000	75	10.3
	**Me-dium**	1) → 300	143	4.7
		600	106	8.4
		900	102	10.8
		2000	60	19.1
	**Soft**	300	138	8.6
		2) → 600	100	12.8
		900	79	17.0
		2000	46	32.4

1) Factory setting for sin/cos incremental encoders
2) Factory setting for resolvers

Note:

The moment of inertia of the load SCJ is pre-set to the rotor moment of inertia of the motor MOJNM (inertia adjustment 1:1).

4. Check the drive response

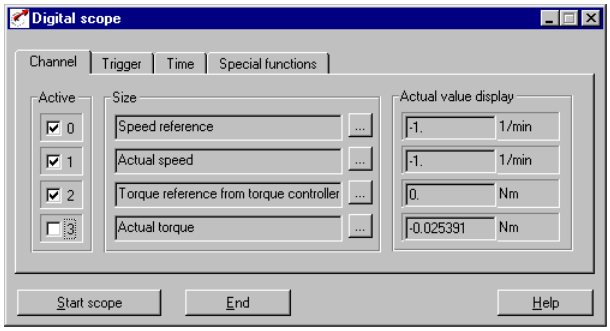
- Now you can optimize the speed controller with the aid of step responses, which can be recorded using the DRIVEMANAGER's digital scope function. Select **Active device - Monitor - Quickly changing digital scope values** or choose the  icon.
- The following three values are recorded using the digital scope:

  Speed reference (n*f)

  Actual speed (n)

  Torque reference (m*).

- Start the drive again with a reference value of 100 rpm, for example. Compare the step response of your drive with the diagrams on the next page.



Note:

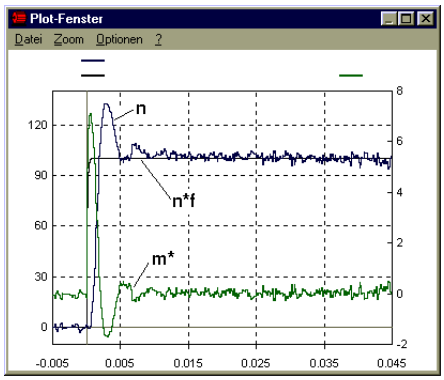
When recording step responses, make sure the selected step is small enough to ensure the torque reference does not reach the maximum value TCMMX. If it does (indicated by constant torque at the level of the maximum torque), start the drive with lower reference values, such as 50 rpm or less.

5. Optimization of the speed controller

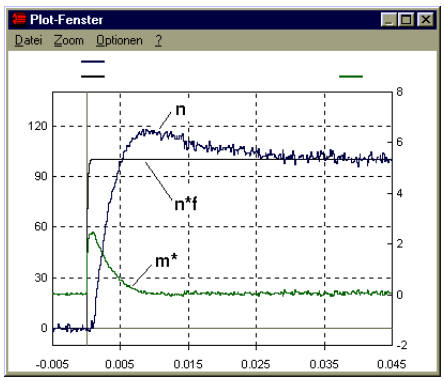
- Now change the gain SCGFA in increments of 10 % (or larger), so that the speed controller is set to its optimum and the drive responds as you want it to.

How to change SCGFA correctly:

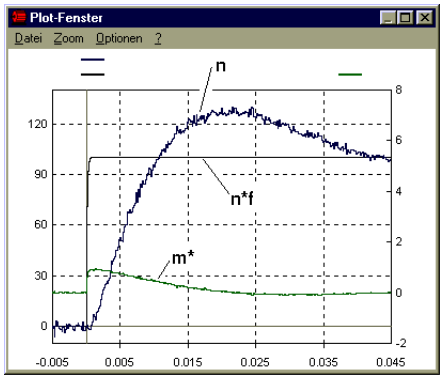
❶ Reduce gain SCGFA



❷ Gain SCGFA OK, overshoot approx. 20 %, usually the desired response



❸ **Increase gain SCGFA**



The speed curves shown apply only to low elasticities and play.

6. **Adaptation of the speed controller to the machine is now completed!**
   - If the response of the drive is satisfactory, commissioning of the speed control is concluded. Go to see Section 4.7.
   - We recommend that you log the optimum setup and keep a copy of the step response printout in your records.

4.7 Optimization of the position controller

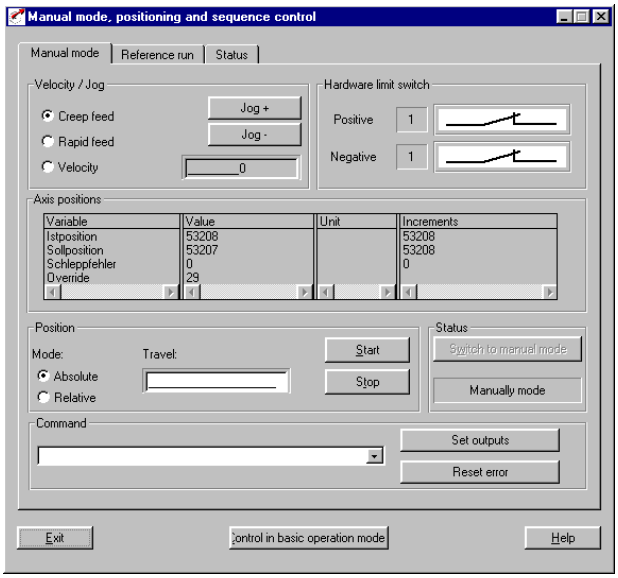
The higher the dynamics of the speed controller, the more dynamically the position controller can be set. Consequently, for optimization of the position controller the speed controller must first have been optimized as detailed in see Section 4.6.

Safety notes for commissioning of the position controller:

- **The drive may start up unintentionally!**
- **Make sure no one is in the hazardous area of the machine!**
- **Check that the Emergency Off device is functioning properly.**
- **Adjust the limit switches before the mechanical stop so that the speed of the axle is at least reduced such that no damage results from the impact (often the available braking distance is insufficient to stop the axle completely). The limit switches must also be operated when the mechanical stop is reached (and the rubber buffers are pressed in)!**
- **Check that the limit switches are functioning properly by operating them manually. The MC7000 must respond with the error E-POS with location number 210 (+) or 211 (-).**
- **Set the axle to the mid position.**
- **If necessary, dismount expensive machine tools.**

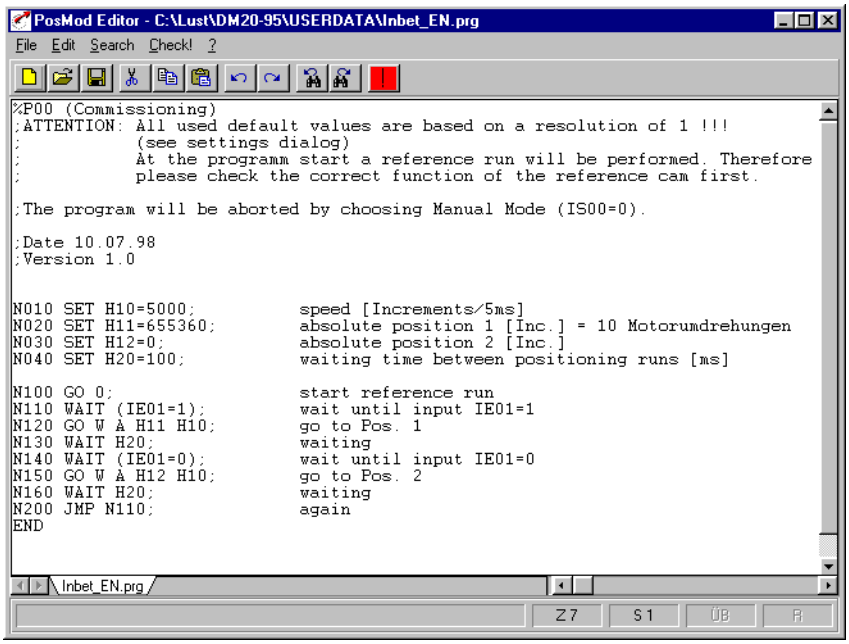
Commissioning of the position controller

1. **Check the drive response**
   - **Positioning and sequence control** mode must be active.
   - Reset power stage enable ENPO and 'Automatic' input (Low level).
   - Select **Active device - Control - Manual mode PosMod**. Set ENPO.
   - Move the axle in jog mode slowly toward the positive limit switch. The axle must stop with error E-POS 210. Repeat the attempt in negative direction.



   - Perform a reference run (`GO 0`) or set the current position as the zero (`SET 0`).
   - Set positioning operations at low speed, but with the highest possible acceleration and bucking, without allowing the MC7000 to reach the torque limit TCMMX.
   - Record the positioning operation with the DriveManager's scope function.
   - Exit the **Control** menu.

2. **Check the drive response with a short sequence program**
   - Reset power stage enable ENPO - Low level at terminal 11 (X5).
   - Start the program editor by choosing Active device - Edit sequence program. Open the “Commissioning“ sequence program.



- **Make sure the values set in the variables for the destination position (positioning travel), the velocity and the acceleration are permitted for your machine, so that the possibility of damage is fully eliminated!**

- Load the program into the servocontroller (**File - Save - Servo** menu). Input 'Automatic' = High level.
- Set the input ENPO (controller enable – position control active) and input 'Automatic' = High level. Start the positioning program with the 'Start' input.
- Record the positioning operation with the DRIVEMANAGER's scope function.

3. Optimization of the position controller

- Now change the position controller gain parameter PCG to set an optimum balance between low overshoot at the destination position and minimized tracking error (see diagram).
- The higher the **position controller gain** parameter PCG is set, the more rigid will be the drive, and the smaller will be the tracking errors during positioning. If the position controller gain is set too high, it will cause overshoot at the destination position or even control instabilities.

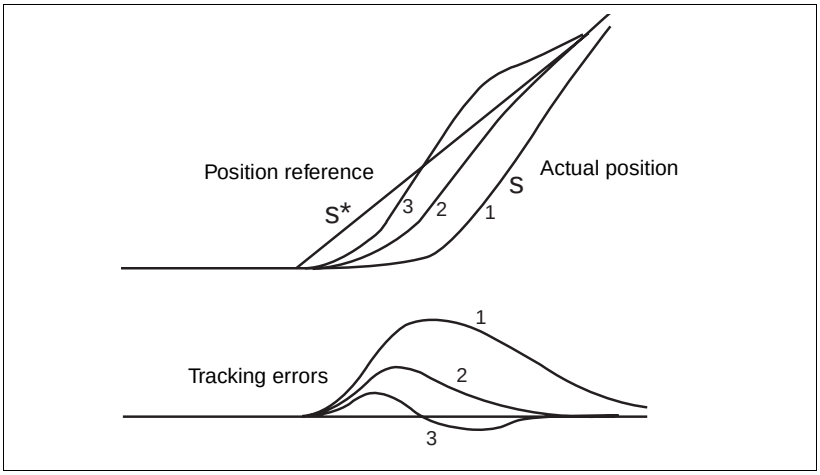


Diagram: Actual position and tracking errors where:
1 position controller gain too low (large tracking error)
2 position controller gain optimum
3 position controller gain too high (overshoot)

4. Write the positioning program for your application.

- Write the program (for command set see POSMOD Programming Manual)
- Check the syntax of the program by selecting **Check!** menu option or button
- Make sure you select the right program (**Inputs** tab)
- Start the porgram - **Be careful, the axle will move!**

Hardware enable input:	ENPO = 1
Select automatic mode:	IS00 = 1
Start program:	IS0 = 1

5. **Test the drive with the positioning program in all possible operating states:**
   - Test the functionality of the program. In the “Monitor positioning and sequence control“ window, selected from the **Active device** menu, the states of the inputs and outputs and the edited line number can be read.
   - Response to power-off, faults and heat-up after continuous duty
   - Check running and optimize as necessary

⇒All done! Congratulations!

4.8 Saving and transferring data

What kinds of data are there and how are they saved?

Save ...	**with KEYPAD on SMARTCARD**	**with DRIVEMANAGER in file**
Parameter data (= “Settings“) (device settings and motor data), cf. Section 5 or Section 4.3	**X**	**X (*.00d)**
Sequence programs cf. Section 6, 7 and 8	**–**	**X (*.prg)**
Positioning data (variables, flags, table positions) cf. Section 6	**–**	**X (*.00d)**
Display data CP100 (selection of parameters, display texts)	**–**	**X *.mmi)**

Transfer settings to other position controllers

with same hardware components (servocontroller and motor)	**with different hardware components (servocontroller and motor)**
1. Load settings (motor data included)	1. Load parameter data
	2. Load motor data (for this motor)
2. Load positioning data as necessary	3. Load positioning data as necessary
3. Load sequence program	4. Load sequence program
4. Load display data CP100	5. Load display data CP100
5. Back up data in device	6. Back up data in device

“Load“ = from file into active device

For comparison:

Initial commissioning (cf. Sections 4.1 to 4.7)
1. Load motor data
2. Activate mode
3. Change settings (adapt to application)
4. Create sequence program
5. Save settings to file (backup copy of device settings and motor data)
6. Save sequence program to file (backup copy)
7. Back up data in device

Appendix

A Technical data

B KEYPAD operation

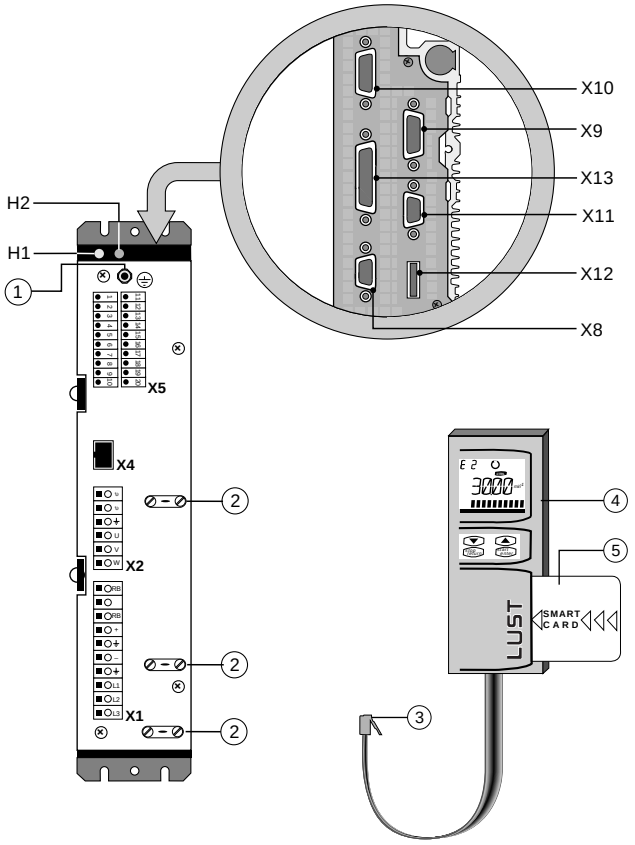
C Diagnosis and fault rectification

D Index

Appendix A Technical data

Appendix A.1 Layout, MC7402-MC7408

Schematic layout!

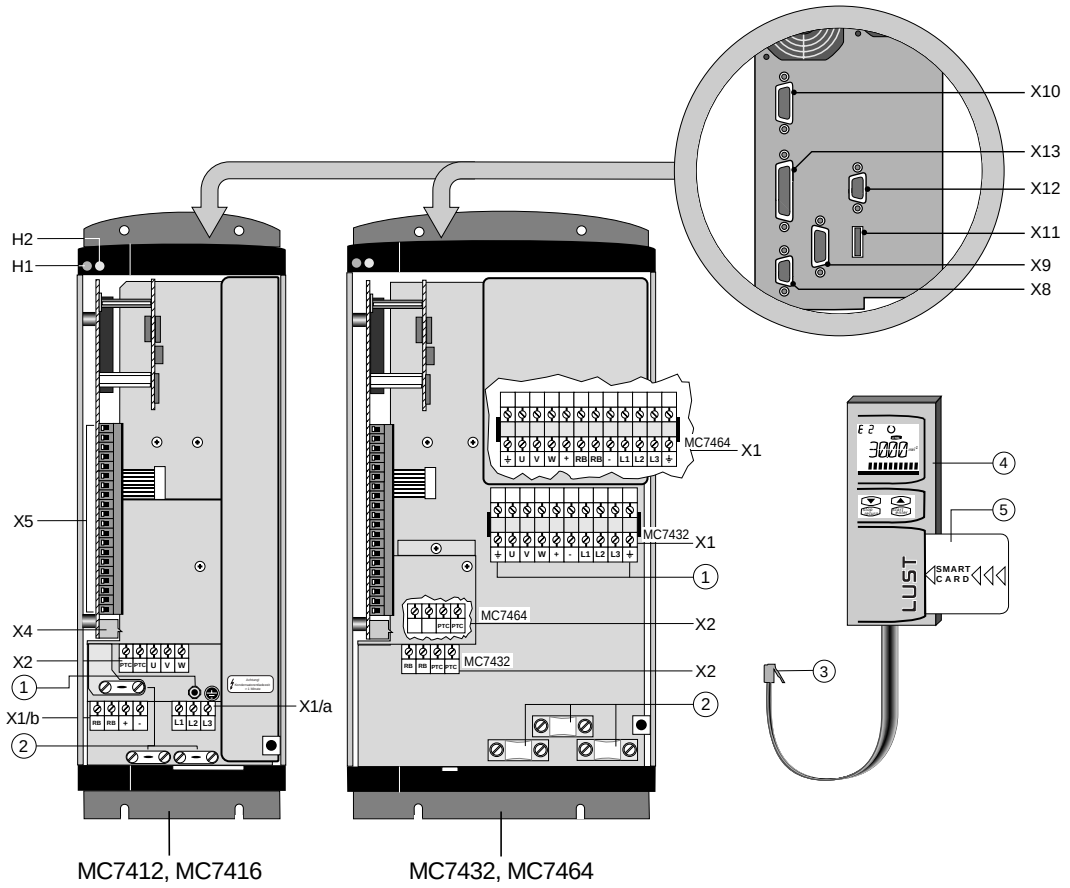


No.	Function	No.	Function
H1	Green LED, ON indicator	X10	Encoder interface 1, for connection of encoder built into motor
H2	Yellow LED, fault indicator	X11* X12*	Connection for application hardware 2 (e.g. for CANopen connection via two 9-pole Sub-D connectors)
X1	Connection for mains input, DC-link and braking resistor	X13*	Connection for application hardware (8 inputs IExx, 4 outputs OExx) and also for CAN bus
X2	Connection for motor and PTC	1	Center point for grounding lead connection
X4	Socket for KEYPAD	2	Cable clamps for correct EMC screening and cable strain relief
X5	Control terminals	3	KEYPAD connector
X8	Serial interface RS485	4	KEYPAD KP100 control unit
X9	Encoder interface 2: encoder simulation and pulse input	5	SMARTCARD data storage card

** Depending on device version.*

Appendix A.2 Layout, MC7412-MC7464

Schematic layout!



No.	Function	No.	Function
H1	Green LED, ON indicator	X10	Encoder interface 1, for connection of encoder built into motor
H2	Yellow LED, fault indicator	X11* X12*	Connection for application hardware 2 (e.g. for CANopen connection via two 9-pole Sub-D connectors)
X1	Connection for mains input, DC-link and braking resistor	X13*	Connection for application hardware (8 inputs IExx, 4 outputs OExx) and also for CAN bus
X2	Connection for motor and PTC	1	Center point for grounding lead connection
X4	Socket for KEYPAD	2	Cable clamps for correct EMC screening and cable strain relief
X5	Control terminals	3	KEYPAD connector
X8	Serial interface RS485	4	KEYPAD KP100 control unit
X9	Encoder interface 2: encoder simulation and pulse input	5	SMARTCARD data storage card

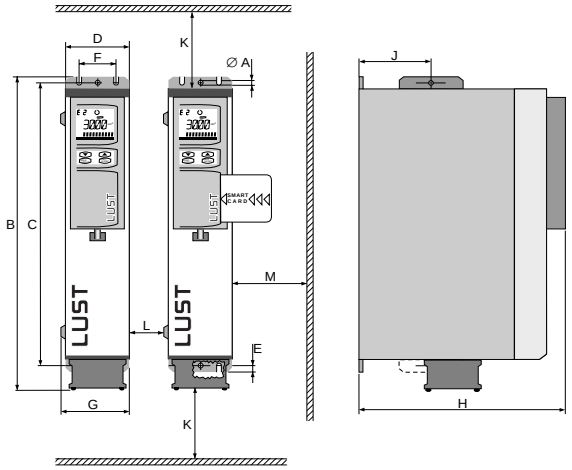
** Depending on device version.*

Appendix A.3 Technical data

		Des.	Dim.	MC7402	MC7404	MC7408	MC7412	MC7416	MC7432	MC7464
Output, motor side	Rated power (400V mains) [1]	S	kVA	1.4	2.8	5.5	8.3	11	22	44
	Rated power (460V mains) [1]	S	kVA	1.6	3.2	5.2	9.5	11	22	50
	Voltage, effective	U	V	3 x 0 ... 400 (460)						
	Continuous current, effective (400V/460V)[1]	IN	A	2 / 2	4 / 4	8 / 6,5	12 / 12	16 / 14	32 / 32	64 / 64
	Continuous current, effective (400V/460V)[2]	IN	A	1.5 / 1.5	2.5 / 2	4 / 2.5	7.5 / 6	9 / 7	32 / 28	60 / 56
	Pulse current for 10 s	I_{max}	A	$2 \cdot I_N$					[6]	
	Switching frequency of power stage	f_s	kHz	4, 8, 16 (factory setting 8 kHz[3])						
	Motor system			asynchronous or synchronous						
	Protection against short and ground fault			yes, but not at terminals for braking resistor						
Input, mains side	Mains voltage [5]	U	V	3 x 400 ... 460 ± 10%						
	Asymmetry of mains voltage		%	≤ 3						
	Frequency	f	Hz	48 ... 62						
	Power factor of fundamental	$\cos\varphi_1$		> 0.97						
	Efficiency [1] [4]	η	%	> 95						
	Power loss	P_V	W	70	110	200	250	310	600	1000
Braking chopper	Peak braking power with internal braking resistor [max. duration]	P_{SP}	kW	1.9 [17 s]	3.4 [10 s]	6 [3 s]	6 [8 s]	6 [8 s]	– –	
	Continuous braking power (internal)	P_{eff}	W	80	80	40	90	30	–	
	Minimum ohmic resistance of external braking resistors (design code BR3)	R_{min}	Ω	280	160	90	33		13	10
	Peak braking power with external resistor R_{min}	P_{SPex}	kW	1.9	3.4	6.0	16.8		42	55
Encoder simulation	Pulses per revolution with encoder version G1, G3, G5 (sin/cos encoders)	G1		2048						
		G3								
		G5								
	Standard pulses per revolution with encoder version R1, R2, R8 (resolvers)	R1		1024 (128, 256, 512, 1024, 2048, 4096)						
		R2		2048 (256, 512, 1024, 2048, 4096, 8192)						
		R8		3072 (384, 768, 1536, 3072, 6144, 12288)						
	Zero pulses per revolution with encoder version G1, G3, G5 (sin/cos encoders)	G1		1						
		G3 G5		0						
	Zero pulses per revolution with encoder version R1, R2, R8 (resolvers)	R1		1						
		R2		2						
		R8		3						

1) *At a factory-set power stage switching frequency of 8 kHz (4 kHz for MC7432 and MC7464). All other data apply irrespective of switching frequency of power stage!*
2) *Based on a switching frequency of 16 kHz (8 kHz for MC7432 and MC7464).*
3) *Servocontroller MC7432 and MC7464: factory setting 4 kHz.*
4) *At rated voltage and rated current.*
5) *The usage at an IT mains supply is not permitted (IT = insulated transformer / grounded body).*
6) *Pulse current: MC7432 at 4 kHz: 2.0 · I_N (at 8 kHz: 1.3 · I_N), for MC7464 at 4 kHz: 1.5 · I_N (at 8 kHz: 1.0 · I_N).*

	Des.	Dim.	MC7402	MC7404	MC7408	MC7412	MC7416	MC7432	MC7464
Cooling air temperature (1000 m above sea level)	T_N	°C	0 ... 40						
Type of cooling			Forced cooling						
Relative air humidity	rF	%	15 ... 85, non-condensing (VDE0160)						
Power reduction depending on mounting height	ΔP_H	%	5 % per 1000 m above 1000 m above sea level, max. 2000 m above sea level						
Motor line length	L_{ML}	m	0 ... 10 m, with power reduction 10 ... 50 m						
Power reduction depending on motor line length (4 and 8 kHz / 16 kHz)	ΔP_{ML}	mA/m	0 / 25		25 / 40	50 / 70		100 / 150	
Storage temperature	T_L	°C	-25 ... +55 (VDE0160)						
Transport temperature	T_T	°C	-25 ... +70 (VDE0160)						
Vibration			2g (IEC 68-2-6)						
Protection			IP20 , VBG4						
Mounting type			Vertical wall-mounting						
Mass	m	kg	3.7			7.5		10	15
Dimensions	ØA	mm	Ø 4.8			Ø 5.8		Ø 7	
	B	mm	347			360		440	
	C	mm	315			345		425	
	D	mm	65			142.5		190	285
	E	mm	7.5						
	F	mm	40			100		150	240
	G	mm	69					– (G = D)	
	H	mm	260			260		290	
	J	mm	112			–			
Minimum mounting clearances	K	mm	100			150			
	L	mm	0			0 / 20 6)			
	M	mm	0			0 / 20 6)			



Ambient conditions

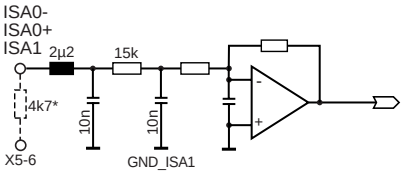
Mechanism

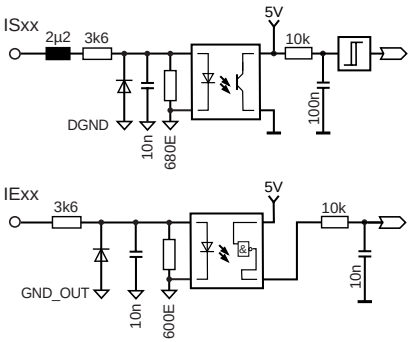
6) Distance 20 mm to other devices or to servocontrollers with other power outputs, e.g. 1 x MC7412, 1 x MC7416.

Appendix A.4 Specification of control terminals

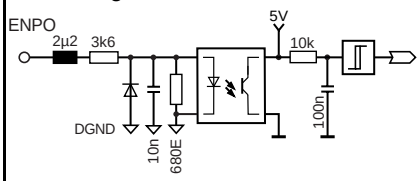
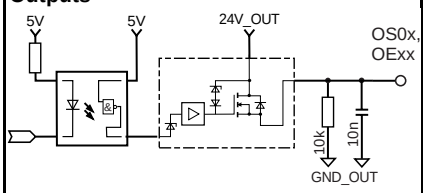
<table>
<tr><th></th><th>No.</th><th>Terminal</th><th>Specification</th></tr>
<tr><td rowspan="3">Auxiliary voltages</td><td>X5-1
X5-2
X5-6</td><td>+10V
-10V
GND_ISA1</td><td>±10.5 V DC ±5%, short-circuit-proof, load capacity: max. 10 mA
Ground for input ISA1, isolated from DGND</td></tr>
<tr><td>X5-7
X5-8
X5-14</td><td>+24V
+24V
DGND</td><td>+24V DC ±10%, short-circuit-proof, isolated,
load capacity: max. 200 mA
Digital ground, isolated from GND_ISA1 and GND_EXT</td></tr>
<tr><td>X5-15

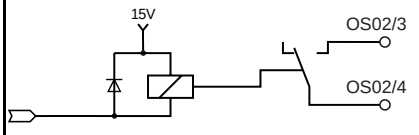
X5-
16,17</td><td>24V_EXT

GND_EXT</td><td>+24V DC ±20%, external supply
• To supply the control section (SN2):
Power consumption: typically 35 W for MC7402 - MC7408,
65 W for MC7412 - MC7464 (PosMod, C11, AH7)
On startup 50% more power for 150 ms!
Ground for externally supplied voltage</td></tr>
<tr><td>Reference inputs
 

* For a contact current of 5 mA
use a resistor bridge</td><td>X5-3
X5-4
X5-5</td><td>ISA0-
ISA0+
ISA1</td><td>For generation of reference values with voltage
<table>
<tr><td></td><td></td><td>ISA0</td><td>ISA1</td></tr>
<tr><td>Ref. values</td><td>U</td><td>-10 ... +10 V</td><td>0 ... +10 V</td></tr>
<tr><td>Input impedance</td><td>U</td><td>≥ 100 kΩ</td><td>≥ 100 kΩ</td></tr>
<tr><td>Resolution</td><td></td><td>12 bits</td><td>11 bits</td></tr>
<tr><td>Accuracy</td><td></td><td colspan="2">1% ± 1 LSB</td></tr>
<tr><td>Switching level, digital</td><td>Low=
High=</td><td colspan="2">< 4.8 V
> 8 V</td></tr>
</table>
Offset calibrated at factory
Also usable as 24 V digital input,
freely programmable
Sampling time 1 ms, plus < 1 ms operating delay
or 8 kHz scan cycle (124 µs) in "speed control with external position control" mode</td></tr>
<tr><td>Digital inputs
 
</td><td>X5-9
X5-10

X13-1
...
X13-17</td><td>IS00
IS01

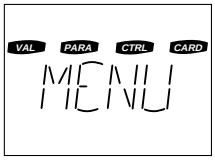
IE00
...
IE07</td><td>Freely programmable control inputs
Sampling time 1 ms
Inputs IS00, IS01: plus < 2 ms operating delay
Inputs Iexx: plus < 1 ms operating delay
PLC-compatible, +24 V logic isolated from DGND
Switching level HIGH = 19.2 ... 26.8 V DC
LOW = 0 ... 4.8 V DC
(no other voltage states are permissible)
Contact current 6.4 mA (24 V), 8 mA (30 V)
Input impedance 4.3 kΩ</td></tr>
<tr><td>Power stage enable
 
</td><td>X5-11</td><td>ENPO</td><td>Hardware-linked enable of power stage
< 2 ms operating delay
PLC-compatible, +24 V logic isolated from DGND
High level = power stage enabled
Edge triggered. If function AUTO-Start is activated: state dependent, that means that after power-on with ENPO=ON the drive is active.</td></tr>
<tr><td rowspan="2">Outputs
 

 
</td><td>X5-12
X5-13

X13-8
...
X13-22</td><td>OS00
OS01

OE00
...
OE03</td><td>Digital +24 V outputs, high-active, short-circuit-proof
Freely programmable
Sampling time 1 ms, practically no operating delay
Internal freewheeling diode
Max. load capacity per output: 50 mA
Driver protected against overheating</td></tr>
<tr><td></td><td></td><td>OS00 also usable as a PWM output:
As a quasi-analog signal for display instruments
Pulse width modulated output signal (f=200 Hz)
Minimum load: 1 kΩ</td></tr>
<tr><td></td><td>X5-19
X5-20</td><td>OS02/3
OS02/4</td><td>Relay contacts (make contacts)
Max. 42 V AC or 63 V DC, max. 3 A
Freely programmable
Operating delay of relay 10 ms
Sampling time 1 ms</td></tr>
</table>

Appendix B KEYPAD operation



Menu in KEYPAD:	VAL	PARA	CTRL	CARD
Abbreviation for:	Value	Parameter	Control	SMARTCARD
Function:	Display values	Edit parameters	Control the drive	Read from/write to SMARTCARD

In conjunction with the position controller MC7000 POSMOD only the VAL and CARD menus can be used; editing and control is provided via the DRIVEMANAGER.

Appendix B.1 The VAL menu

To display the value of a parameter select the parameter name by scrolling with the ▲ and ▼ **keys** and confirm with the **Start/Enter key**.

When the servocontroller starts up the KEYPAD DISPLAY shows this menu, indicating the value of the parameter selected as the permanent actual value DISP. The factory default for this is the control reference, parameter REFV (Reference Value).

No.	Name	MODE	Unit	Designation	Description
75	CURNT	1	A	Current	Output current (effective phase current)
76	TORQE	1	Nm	Torque	Torque (actual)
77	SPEED	1	rpm	Speed	Speed (actual)
78	POS	1	U	Position	Position (actual)
86	TSYS	1	min	System Time	System time (time since last power-on)
87	TOP	1	h	Time of Operation	Operating hours meter
90	SREV	1		Standard Revision	For modified software, gives reference to standard software
91	TYPE	1		Type	Device type
92	REV	1		Revision	Software version
94	TERR	1	min	Time Error	System time on occurrence of last error
95	ERR1	1		Error 1	Last error 1)
347	DCV	1	V	DC-(Link-)Voltage	DC-link voltage
400	ACTV	1	Nm, rpm, revs	Actual Value	Actual value of control variable
427	TEMP	1	°C	Temperature	Temperature of servocontroller
447	REFV	1	Nm, rpm, revs	Reference Value	Control variable reference value
96	ERR2	3		Error 2	Second-last error 1)
97	ERR3	3		Error 3	Third-last error 1)
98	ERR4	3		Error 4	Fourth-last error 1)
483	ISA0	4	V	Voltage on ISA0	Voltage at analog input
484	ISA1	4	V	Voltage on ISA1	Voltage at analog input
115	CSXOR	4	Hex	Checksum XOR	Software checksum (XOR)
116	CSADD	4	Hex	Checksum ADD	Software checksum (UND)

1) The error E-OFF is only stored in the event of short-time power outages. The time since the last power-on (system time) is also displayed.

Appendix B.2 The CARD menu

This menu is used for reading from and writing to SMARTCARDS in order to store device settings and to adapt automatically to the motor in use.

The CARD menu comprises four functions:

- READ: Read all or some of the parameters from the SMARTCARD
- WRITE: Store all parameters on the SMARTCARD
- LOCK: Write-protect the SMARTCARD
- UNLOCK: Cancel write protection

Reading and storing (READ and WRITE functions)

The parameters are grouped into areas on the SMARTCARD according to activity. The areas do not correspond to the subject areas in the PARA menu! In every storage operation all parameters are always saved to the SMARTCARD.
For read operations, select the desired area after accessing the READ function. It is possible to read just one area from a SMARTCARD containing the entire parameter set.

Setting	Designation	Store/Read ...
ALL	All	All parameters
APPLI	Application	Application-specific parameters
SYSTM	System	General system configuration
REFRC	Reference	Parameters of reference generation and function selectors
DRIVE	Drive	Drive parameters

Notes:

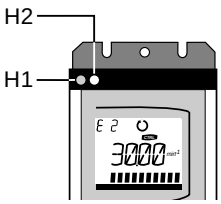
1. The CARD menu can only be selected when the controller is not active!
2. Control cannot be started while you are still in the CARD menu.
3. The system therefore switches automatically to the VAL menu after 10 minutes.
4. In bus system mode: The bus is not active while the SMARTCARD is being read or written to. The bus watchdog may therefore be triggered if switched on.

Appendix C Diagnosis and fault rectification

Appendix C.1 Operation and fault diagnosis

On the servocontroller

The current status of the servocontroller is indicated by two LEDs on the front panel of the cover.

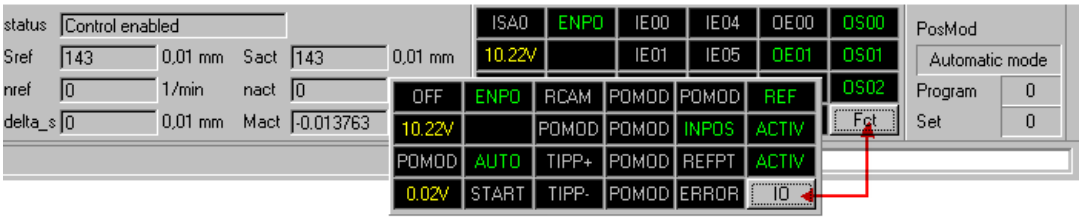


Green LED (H1)			Yellow LED (H2)			Status
Off	On	Flashing	Off	On	Flashing	
X			X			Device is off
	X		X			Servocontroller ready
	X			X		Servocontroller ready and warning
		X	X			Control enabled
		X		X		Control enabled and warning
		X			X	Reference limitation active (RLIM1, RLIM2) 1)
X				X		Fault
X					X	Precharge relay not operated or ENPO open

1) The direction symbol ↻ or ↺ on the KEYPAD display also flashes.

In the DRIVEMANAGER

Shown at the footnote in the DRIVEMANAGER (menu **VIEW, from DriveManager Version V2.1**)



Faults are indicated by:

- Display on device: LED (H2) lit yellow
- In DRIVEMANAGER: Menu: **Active device - Monitor - Device status**
- In KEYPAD: Display lit red

KEYPAD shows:		Section
E-xxx	Servocontroller fault	Appendix C.4
ATTx	KEYPAD USER ERROR	Appendix C.5
ERRxx	SMARTCARD error	Appendix C.6

x, xx, xxx - Wildcards for any letters or numbers

Appendix C.2 Resetting faults

Resetting faults (after eliminating the cause):

• Control via terminals:	Rising edge at **ENPO input IS01 "Automatic"**
• or:	Rising edge at **ENPO input, Caution: Control is shut off! (not permitted in all applications)**
• or:	Reset Error with input Ixxx (therefore set parameter FIxxx = RSERR (_CONF menu)
• Control via DRIVEMANAGER:	Choose "Reset error" button in **Active device - Control menu**
• Control via CAN bus:	Set 'Reset fault' bit in CAN bus control word

Starting the drive after an error

When an error occurs the current program is aborted. Restart the program after eliminating the error.

- **Cancel start signal and reapply it.**

Appendix C.3 Fault responses

When a fault occurs the servocontroller responds with one of the responses listed below. The "Response no." column in the fault table indicates the response of the servocontroller to the respective fault type.

Response no.	Function
0	Signal error only, no further response (warning)
1	Signal error and disable power stage
2	Signal error, quick-stop and wait for cancellation of start signal
3	Signal error, disable power stage and secure against restarting [1)]
4	Signal error, quick-stop, wait for cancellation of start signal and secure against restarting [1)]
5	Signal error, disable power stage, wait for error reset; then software reset.

[1)] *Only relevant with programmed autostart function.*

Appendix C.4 Fault table

In the event of a fault, a plain text message and an error location number (at the top left of the KEYPAD display) appear. The error location number facilitates more detailed definition of the cause.

No.	Error	Error location no.	Cause	Response no.	Remedy
0	–	–	No error		
1	E-CPU	–	Processor faulty or wrong software version	5	1)
2	OFF	1	Undervoltage, i.e. DC-link voltage < 425 V (also displayed on normal power-off)	1	Repair mains failure or connect higher mains voltage
3	E-OC	18	Overcurrent due to:	3	
			incorrectly set parameters		Check parameters of control circuits 1)
			short-circuit, ground-fault or insulation error		Check installation
			internal device fault		1)
4	E-OV	1	Overvoltage due to:	3	1)
			overload of the braking chopper (braking too long or too heavy)		Set DECR ramp parameter slower (_REF), use ext. braking resistor or chopper
			mains voltage surge		Adjust mains voltage
5	E-OLI	1	I x t shutdown to protect the servo-controller (permissible current/time area exceeded)	3	Reduce load, reduce maximum torque TCMMX(_TCON)
6	E-OTM	18	Overheating in motor (PTC in motor tripped):	3	Allow motor to cool down
			PTC not connected		Connect PTC or bridge terminals with 100 Ω
			Motor overload		Use a higher-power motor 1)
7	E-OTI	1	Overheating in servocontroller:	3	
			ambient temperature too high		Improve ventilation
			load too high (power stage or braking chopper)		Use a higher-power servocon-troller and ext. braking resistor or chopper 1)
8	E-EEP	3, 12	Error in EEPROM	5	1) EEPROM faulty
		6, 100...116	Error accessing parameters	5	1)
9	E-OLM	1	I^2 x t shutdown to protect the motor	3	Reduce load, use a higher-power motor
10	E-PLS	xxx	Plausibility check detected invalid param-eter or impermissible program sequence	5	1)
11	E-PAR	2	Reference generation limits incorrect (RLIM1 > RLIM2)	5	Set RLIM1 < RLIM2 (_REF)
		7	Faulty parameter detected. Before the error message appears the display indicates the number of the faulty parameter.	5	Find faulty parameter based on number from parameter list and correct faulty parameter.
		8	Error in first initialization	5	1)
		13	Function and reference selector settings contradictory	5	Check selectors and change set-ting (_CONF,_REF)
		16	Parameter for output OS00 incorrectly set	5	Exchange OA0MN and OA0MX (_CONF) values
		58	Invalid operation mode	5	Change operation mode
		101	Impermissible number of pole pairs in resolver (not equal to number of pole pairs of motor and not equal to 1)	5	Set parameter ECNPP (_ENCD) Check resolver
		150	Range limits of D/A module (AH7) incor-rectly selected	5	Check DAxMN, DAxMX
12	E-FLT	0	Global error in floating point calculation	5	1)
13	E-PWR	6	Power pack not correctly detected	5	1) Send in device
14	E-EXT	1	Error in an external device	2	Rectify error in other device

1) A hardware or software error has occurred which should not occur in normal operation.

No.	Error	Error location no.	Cause	Response no.	Remedy
15	E-ENC	1	Encoder signals faulty	5	Check cable; check encoder
		6	Encoder interface not correctly detected or cable not connected	5	1) Check cable
16	E-OP1	6	Error on module in slot 1 (X11/ X12)	2	1) Check module and ID
17	E-OP2	6	Error on module in slot 2 (X9)	2	1) Check module and ID
18	E-TIM	18	Runtime monitor triggered	5	1)
19	E-FLW		Tracking error, See section 5.7	0 (0 ... 2)	Reduce load or acceleration
20	E-WDG	111	Watchdog for RS485 triggered	2	Check bus master or increase SWDGT (_SIO)
21	E-CAN	1	CAN watchdog timeout	2	Check bus master or increase BUTWD (_CONF)
		6	CAN module not detected	2	Module wrong or faulty 1)
22	E-IO1	6	Input module not detected	5	Module wrong or faulty 1)
23	E-IO2	6	Output module not detected	5	Module wrong or faulty 1)
24	E-VEC	19	Error initializing VeCon data RAM	5	1)
		20	Error initializing VeCon program RAM	5	1)
25	E-BRK		Error at output OS03:	3	Check output OS03
		1	- Open circuit		- Brake connected?
		6	- Short	3	- Check installation
			- Overheating		
			- No protective circuit, or protective circuit inadequate		- Check protective circuit
26	E-POS	210	Pos. hardware limit switch approached	2	
		211	Neg. hardware limit switch approached		
		212	Pos. software limit switch approached		
		213	Neg. software limit switch approached		
		214	Reference point not defined		
		216	Selected program not available		
		217	Jump to non-existent set no.		
		218	Called subroutine not available		
		219	Destination position outside positioning range		
		220	Division by zero		
		221	Max. nesting depth exceeded		
		222	Timeout in manual mode		
		223	Destination position not reached		
		224	No feed hold		
		225	Selection (Automatic/Ref.run/Jog mode) not permitted, conflict of control location		
		226	Index overflow (indexed addressing)		
		230	Max. servo speed exceeded		
		232	No controller enable (ENPO)		
		235	Impermissible command during axle movement		
		236	Hardware limit switches interchanged		
27	E-FLH	50...53	Error in Flash memory or delete operation running	5	1)

1) A hardware or software error has occurred which should not occur in normal operation.

Re 1): Ascertain a) the error, b) the error location number and c) the software version (parameter REV in the KEYPAD VAL menu or in the DRIVEMANAGER parameter editor) and contact:

Lust Service Center
Gewerbestr. 7
35633 Lahnau
Phone: (+49 6441) 966 -136; Fax: -211

To acknowledge errors press the **Stop/Return** key on KEYPAD for at least 3 seconds!

(See section Appendix C.2)

Appendix C.5 KEYPAD user errors

The following user errors can occur in operation:

Error	Cause	Remedy
ATT1	Parameter cannot be changed at current user level or is not editable	Select higher MODE user level 1)
ATT2	Motor must not be controlled online via the CTRL menu	Cancel start signal from a different control location
ATT3	Motor must not be controlled via the CTRL menu because of error state	Reset error
ATT4	New parameter value impermissible	Change value of parameter
ATT5	New parameter value too high	Reduce value of parameter
ATT6	New parameter value too low	Increase value of parameter
ATT7	Card must not be read in current state	Stop control (cancel start signal)
ATT8	Permissible speed limit SCSMX too high for selected control mode or motor	Reduce SCSMX (_SCON) to permissible values
ATT9	CTRL menu cannot be used with POSMOD1	Choose a different menu or remove POSMOD1
ERROR	Invalid password	Enter correct password for user level 1)

1) A higher user level can only be selected by users who are familiar with the device and have the appropriate access permission. They will know the password required for access to the user level.

Reset errors by choosing the **Start/Enter** key.

Appendix C.6 Errors in SMARTCARD operation

Error	Meaning
ERR91	SMARTCARD write-protected
ERR92	Error in plausibility check
ERR93	SMARTCARD not readable, wrong servo or inverter type
ERR94	SMARTCARD not readable, parameter not compatible
ERR96	Connection to SMARTCARD broken
ERR97	SMARTCARD data invalid (CS test)
ERR98	Insufficient memory on SMARTCARD
ERR99	Selected area not present on SMARTCARD, no parameters transferred to SMARTCARD

These errors occur when impermissible - and usually unintentional - actions are executed such as writing to a backup copy of parameter data or reading a SMARTCARD for inverters. We therefore recommend using a different SMARTCARD as a generally applicable remedy.

Reset errors by choosing the **Stop/Return** key.

Appendix D Index

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Hinweis zur EN 61000-3-2
(rückwirkende Netzbelastung durch Oberwellen)

Unsere Frequenzumrichter und Servoregler sind im Sinne der EN61000 "professionelle Geräte", so dass sie bei einer Nennanschlußleistung ≤1kW in den Geltungsbereich der Norm fallen.
Beim direkten Anschluß von Antriebsgeräten ≤1kW an das öffentliche Niederspannungsnetz sind entweder Maßnahmen zur Einhaltung der Norm zu treffen oder das zuständige Energieversorgungsunternehmen muß eine Anschlußgenehmigung erteilen.
Sollten Sie unsere Antriebsgeräte als eine Komponente in ihrer Maschine/ Anlage einsetzen, dann ist der Geltungsbereich der Norm für die komplette Maschine/ Anlage zu prüfen.

Notes on EN 61000-3-2
(limits for harmonic current emissions)

Our frequency inverters and servocontrollers are "professional devices" in the sense of the European Standard EN 61000, and with a rated power of ≤1kW obtained in the scope of this standard.
Direct connection of drive units ≤1kW to the public low-voltage grid only either by means of measurements for keeping the standard or via an authorization of connection from the responsible public utility.
In case our drive units are used as a component of a machinery/plant, so the appropriate scope of the standard of the machinery/plant must be checked.

Remarque concernant EN 61000-3-2
(valeurs limites pour courants d'harmonique)

Dans l'esprit de EN61000, nos convertisseurs de fréquence et régulateurs automatiques sont des "appareils professionnels". Par conséquent ils tombent sous l'application de la norme lorsque la puissance de raccordement nominale ≤1kW.
Lorsque des appareils d'entraînement sont raccordés directement au réseau public basse tension, il convient de prendre des mesures pour respecter la norme ou l'entreprise de distribution d'électricité compétente doit délivrer une autorisation de branchement.
Si vous deviez utiliser nos appareils de branchement comme composants dans votre machine ou votre installation, il convient dans ce cas de vérifier le domaine d'application de l'ensemble de la machine ou de l'installation.

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Lust Antriebstechnik GmbH * Gewerbestr. 5-9 * D-35631 Lahnau * Tel. +49 (0)6441 / 966 -0 * Fax +49 (0)6441 / 966 -137
Internet: http://www.lust-tec.de * e-Mail: lust@lust-tec.de