Device description V1.1

motion control Series motion control FU3-022

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This document was carefully created, in order to ensure the correctness and completeness of the documentation.
Since, in spite of all the care taken, errors can never be completely avoided, we are always grateful for advice and suggestions.

Table of contents

1 General

1.1 Preface

This manual contains texts, illustrations and explanations for the correct installation and operation. This manual must be read and considered before installation and employment of the devices.

This documentation is mainly directed towards qualified personnel to control and automation technology. They must be well acquainted with the current standards and guidelines.

If you have any questions about the installation, application and operation, please contact the *elrest* customer hotline:

Phone: 07021/92025-33

Fax: 07021/92025-59

E-Mail: hotline@elrest.de

or contact your responsible agency.

This manual is published subject to any changes. Changes can be made without reference.

1.2 Liability

The documentation was carefully compiled.

All examples and illustrations in this manual serve only as assistance for understanding the text. Changes without references can be made. We do not assume any liability for the correctness of the represented operations. No claims for the modification of products that have already been supplied may be made on the base of the texts, explanations and illustrations in this documentation. elrest Automationssysteme GmbH takes on no responsibility for an application of products, which refers to the represented examples (e.g. in eStudio demo).

elrest Automationssysteme GmbH assumes under no circumstances the liability or responsibility for damage, which resulted from an inappropriate installation, respectively an application of the devices or the accessories.

The staff must ensure that the installation and the application of the products according all of the safety requirements, laws, regulations and standards

In each case the national regulations and the valid safety regulations have to be considered.

Interferences and changes in the devices automatically render the warranty void.

1.3 Security regulations and safty precautions

This manual was provided for trained and competent personnel. The qualification is defined by the European guidelines for machines, low-voltages and EMV. The connection and the assembly of the devices can be carried out only via an electrical specialist, if the voltages are higher than the Safety Extra Low Voltage (SELV).

In each case the national regulations and the valid safety regulations have to be considered. Interferences and changes in the devices automatically render the warranty void.

Due to the large number of different applications for these devices, you must adapt yourself for your particular application.

If circuit components should fail, appropriate safety devices must ensure that the attached periphery is stopped.

Do not try to repair the devices themselves or exchange electrical parts. Please turn exclusively to the elrest service department. You can contact us on the elrest-hotline.

Consider the local, national standards and regulations during the installation and the employment of the devices.

The relevant regulations (VDE etc.) while handling electrical system are to be considered:

- To activate
- Prevent unintentional restart
- The unit must be deenergized
- Ground and short-circuiting
- No ground-loops.
- Cover or shield the nearby live electric parts.

1.4 Copyright

All parts of the software and the documentation are subject to copyright. The software described in this manual must be used exclusively in the context of the license terms.

No part of the documentation and software may be reproduced or assimilated by use an electronic data processing system, reproduced or spreaded in any form without a written permission of the company elrest (pressure, photocopy, microfilm or another procedure). The expressly exceptional cases, named in the paragraphs 53 und 54 UrhG, are not affected.

All measures have been taken to ensure the correctness and completeness of the information in this documentation. Nevertheless errors cannot be excluded. The company elrest cannot assume legal responsibility or any liability for damage, which results from the use of information from this manual or from the use of the program described in this documentation.

The product names mentioned in this manual are trade marks or registered trade marks of the respective manufacturing firms and are hereby accepted.

The information, contained in this document, may be changed without advance notice and represents no

obligation on the part of elrest.

1.5 Symbols

In this manual different symbols are used for the emphasis of certain information. Hereby the service personnel receive necessary references to the safety and preventive measures. With each occurrence of the symbols the associated reference has to be read.

Indicates a directly threatening danger situation which may result in damage to persons or property.

Indicates a possibly arising danger, which may result in damage to persons or property.

Indicates notes, thereby the handling gets easier.

DANGER

Personal injury caused by electric current!

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

DANGER

Personal injury caused by electric current!

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Warning of damage to persons

Indicate a possible danger with moderate risk that can result in death or (severe) bodily injury if it is not avoided.

CAUTION

Warning of damage to persons

Indicates a low-risk, potentially hazardous situation which, if not avoided, could result in slight to moderate injury.

CAUTION

Warning of damage to material

Indicates a possible danger which can result in material damage, when it cannot be avoided.

ESD

Damage to Property Caused by Electrostatic Discharge (ESD)!

Indicates a potentially hazardous situation which, if not avoided, may result in damage to property

NOTICE

Important Note!

Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

INFORMATION Further information

Refers to further information, which is not a substantial component of this documentation (e.g. Internet

ST

```
(* comment to CODESYS code lines *)
a := a+1;
```

1.6 Safety instructions

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:

DANGER Don’t assembly the devices under voltage!

Always switch off the power supply before assembling the device, eradicating defaults or carrying out maintenance operations.

DANGER Take note of the general regulations on prevention of accidents!

Take note of the relevant regulations on prevention of accidents, e.g. the regulations during installation and commissioning of BGV A 3 "electrical installations and equipment" for mounting, installation and eradicating defaults.

DANGER Take note of connection in compliance with the standard!

To avoid risks of the staff and the disturbances on the device, install the data- and the supply line conforming to standards. Take note of the correct assignment of connections.Observe the relevant EMC directives for your application.

ATTENTION Replace defective or damaged device!

Replace defective or damaged device/module (e.g., in the event of deformed contacts), since the long-term functionality of fieldbus station involved can no longer be ensured.

ATTENTION Shield the devices from creeping and isolating materials!

The components are not resistant against materials which have creeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If it cannot be excluded that this substances are in the environment of the device, incorporate the device in a cage which is resistant against the above-named substances. Always use proper tools and materials for the maintenance.

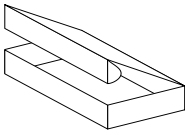
1.7 Before you start…

Before switching- on the supply voltage, please check definitely:

- The wiring
- Possible interference
- Free circulation around the heatsink

1.8 Storage, transport and packaging

The delivery has to be checked for completeness after the receipt. Possibly determined transport damages shall be notified to the shipping company and the manufacturer immediately. In the case of a possible temporary storage it is recommended to use the original packaging. The storage must be clean and dry. According the §BGB §446 and §448, the transfer of perils of the purchased product will pass to the buyer from invoicing. elrest does not assume any liability for the transport risk.If the carrier's liability of the transport enterprise does not cover the commodity value, it is incumbent on the buyer to conclude an additional transport insurance.



The devices are delivered in a suitable packing. To avoid damages please remove the packing before using the device. If the packing includes further accessories or descriptions, consider and keep them absolutely.

1.9 Warranty

A warranty claim presupposes a professional assembly and start-up, based on a valid assembly-, commissioning instruction and the operating instructions. The necessary assembly, start-up and maintenance work may be accomplished only by adept and authorized persons. See our EULA regulations too.

Manufacturer	**Trademark**	**Country of origins**
elrest Automationssysteme GmbH D-73230 Kirchheim unter Teck Leibnizstraße 10 Phone:+49 (0) 7021/92025-0 Fax: +49 (0) 7021/92025-29		Germany

1.10 Application area

The speed control ensures a quite low vibration of running pumps and other aggregates. This assures a longer lifetime of the mechanical components. The drives can be actuated always in the optimum speed range. By using an elrest inverter, the application is significantly more energy efficient than other conventional drive solutions.

Typical applications for frequency converter with sensorless speed control are the price sensitive applications with higher requirements, regarding to the speed accuracy.
Due to the control mode, the frequency inverter is particularly suitable for high-speed applications, which could be operated currently by controlling.

The frequency inverter has a wide range of applications:

- Pumps, vans and compressors (particularly in the upper speed range)
  - Air conditioners e.g. in the building services
  - Extraction units
  - Air blower
  - Hydraulic systems
  - Compressors
  - Sewage technology
  - Subsurface water pumps
  - Heat pumps
- simple feed drives
- Presses
- Belts

They can be used optimally for continuous movements, e.g.:

- belts
- Lifting- and locomation applications
- Pumps and ventilation applications

1.10.1 Intended usage

The devices are intended for the use in the ranges of the regulation, control and automatic control engineering.

Within all ranges, particularly when using inductive loads (e.g. engines and relay etc.), it must be guaranteed that arising voltage peaks don't exceed the maximum input voltages of the entrances and exits. If necessary, external protecting circuit parts must be installed.

The devices are exclusively intended for the installation in machines and plants. Start-up is forbidden until the conformity of the final product with the guideline 2006/42/EG „machine guideline "is determined.

External measures (e.g. a special power supply) can be necessary for certain devices, in order to achieve the requiered interference immunity against surge. In this case, it will be pointed out at the respective device.

If external measures are necessary for the minimization of the radiated interference, it will be referenced accordingly to the appropriate device Further the environment can be affected the radiated interference.

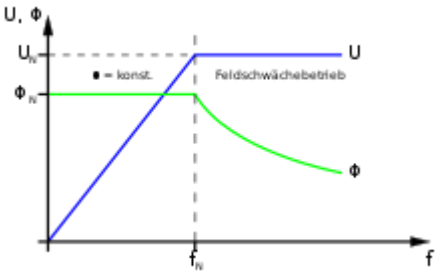
Fulfils a device the "higher" standards (e.g. EN 61000-6-3:2007 generic standard emission: Living quarters, business and industrial areas and small enterprises), it will be applied accordingly to the appropriate device), see chapter „data sheets ".

Warning!

This is a Class A product. In a domestic environment it may cause radio interference, in which case the user may be required to take adequate measures.
Designates a possibly arising danger, which can lead to a damage to property or person

Assessment of risk:
With the identification of hazards it must be involved the device, the opertator and the environment of the device. After identifying the hazards, each risk of a hazard has to be individual assessed.

1.11 Construction of the Frequency converter



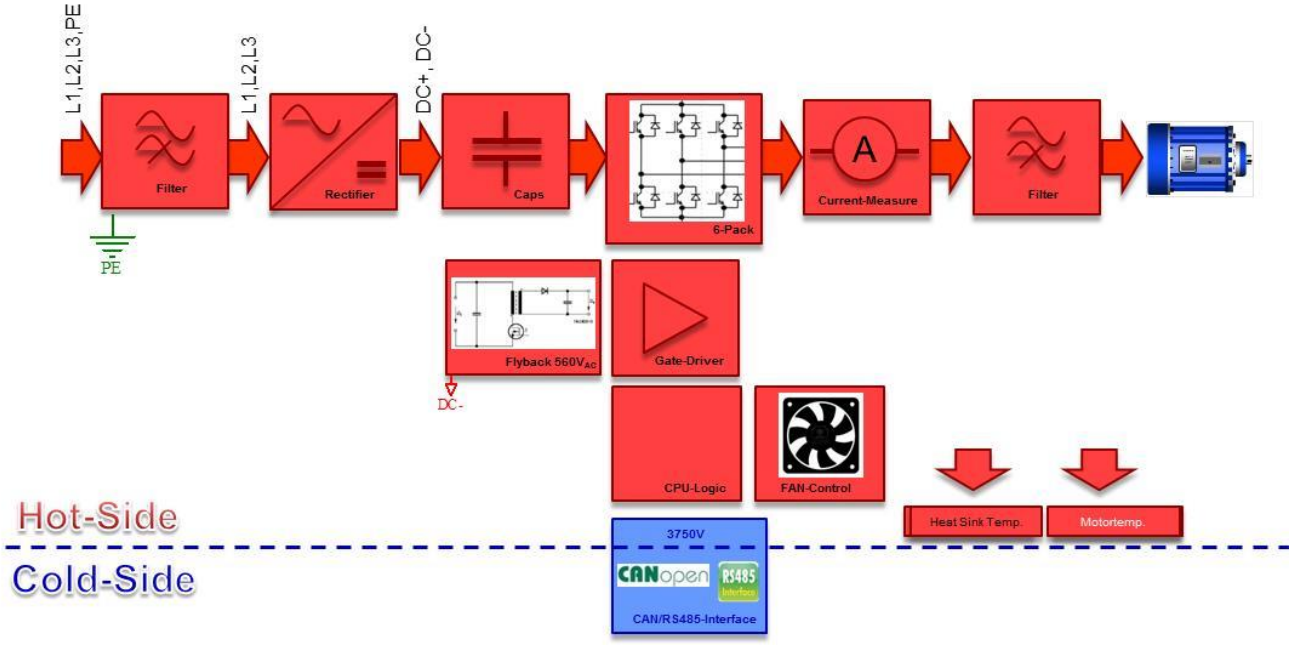
A frequency converter is an electronic motor controller, which converts a power input - in a variable output current with AC wave form. A convetional frequency converter controls the frequency and the voltage from the output current and thereby the motor rotation speed and the engine torque.

The definition frequency converter means, inverter the output current is generated depending on the linear voltage/frequency (U/F-characteristic). The generated frequency corresponds proportional to the engine speed.

This kind of control is easily applicable for unasynchronous engines.

For synchronous motors, the control of the speed may leads to oscillations in certain load cases and speed ranges.

Therefore the elrest FU is armed with a sensorless speed control. This allows a speed- controlled opration for the synchronous motors. The speed is undependend of the load and can be adjusted continuously.The max. engine torque is completely available for every power point above 5% of the nominal number.



The frequenty converter consists of an input filter and a rectifier, which supplies a DC link. The DC link consists of several caps for smooting the d.c. voltage. The 6 Pack IGBT's will be supplied from this DC link.

The control- and feedback control system are designated by an integrated drive controller. This monitors the system status, the condition of the engine, supplies warnings or signals on fault conditions, starts and stops the engine, optimizes the energy efficiency. Furthermore it offers many other functions for control, regulation, control and improvement of the effectiveness. Operation- and control functions are available for status displays of an external control system or a serial communications network.

Power supply X6 (See chapter 4)	Three-phase power supply of the frequency
Rectifier	The rectifier bridge converts AC into DC for the supply of the frequency converter.
Caps	The DC-bus leads the DC. The Capacitors store the DC.For a short time they bridge voltage breakdowns or -drops
B6 bridge (Inverter)	The inverter generates DC voltage in pulse-width AC voltage on the motor terminals and sinusoidal motor currents for a variable engine control.
Motor terminals X7 (See chapter 4)	Connection of the motor cable for the supply on the motor with the 3-phase motor voltage.
Control unit • CPU-Logic • CAN/RS485 interfaces • Heat sink temp. • Motor temp.	The control unit monitors the internal processing, the motor exit and the motor current. This ensures an efficient operation and controlling. It monitors the user interface, as well as external signals and executes the resulting commands.It provides the status messages and the control functions.

A output filter is integrated for the motor.

- The industrial standard for interference emissions will be fulfilled without an additional external filter erfüllt.
- For the household standard interference emissions are additional external filters necessary.
  see chapter 2.2 „electrical iInstallation“.

2 Implementing

2.1 Mechanical installation

Safety notes at the workplace:

Before installating and starting up, the manual must be read and followed carefully. The relevant EN and VDE regulations are valid.

Before starting up, adapt the device to the room temperature.By condensation you are allowed to switch on the device only after it is completely dry.

To prevent the device from overheating:

- avoid direct sun contact to the device,

- do not cover the vents

- ensure sufficient air circulation.

- all devices must be dimensioned on the same mains voltage

2.1.1 Required space

During installation, please ensure sufficient access to the device for the operator and maintenance work. Care must be taken for sufficient air ventilation.
The frequency inverter uses the surrounding air for cooling; therefore the particulate limit values for the ambient temperature (-20°C…50°C) have to be considered.

2.1.2 Installation / Assembly

The valid local, and in particular, electrical safety regulations must be kept.

Safety notes at the workplace:

- The devices are intended for installation in switching cabinets;
  (in general switching cabinets made of steel)
- The protection rating IP20 has to be warranted;
- Unless otherwise indicated, the devises may only be installed perpendicular.
- The installation point has to be in a solid position with low vibration

Please observe sufficient distance to the neighbor devices during assembly, so the convection heat ensures adequate cooling.

Only staff qualified and trained in electrical engineering are allowed to install the frequency converter

The procedure of installation is described as an example. A different method may be appropriate or necessary, depending on the application of the equipment.

We provide further know-how through **training courses** (on request).

The ground symbol"_", found in all connection diagrams shows a request for an electro conductive and with as large a surface area as possible connection between servo drive and mounting plate.
This connection is to suppress HF interference and must not be confused with the PE _ (protective earth) symbol (protective measure to EN 60204).

2.1.3 Mounting for the FU03-22 with aluminium plate

Mounting of the cold plate:

On the rear of the frequency converter are 4 tapped holes (M5). The cold plate is mounted there. See dimension drawing of the rear The cut-out is marked **red**.

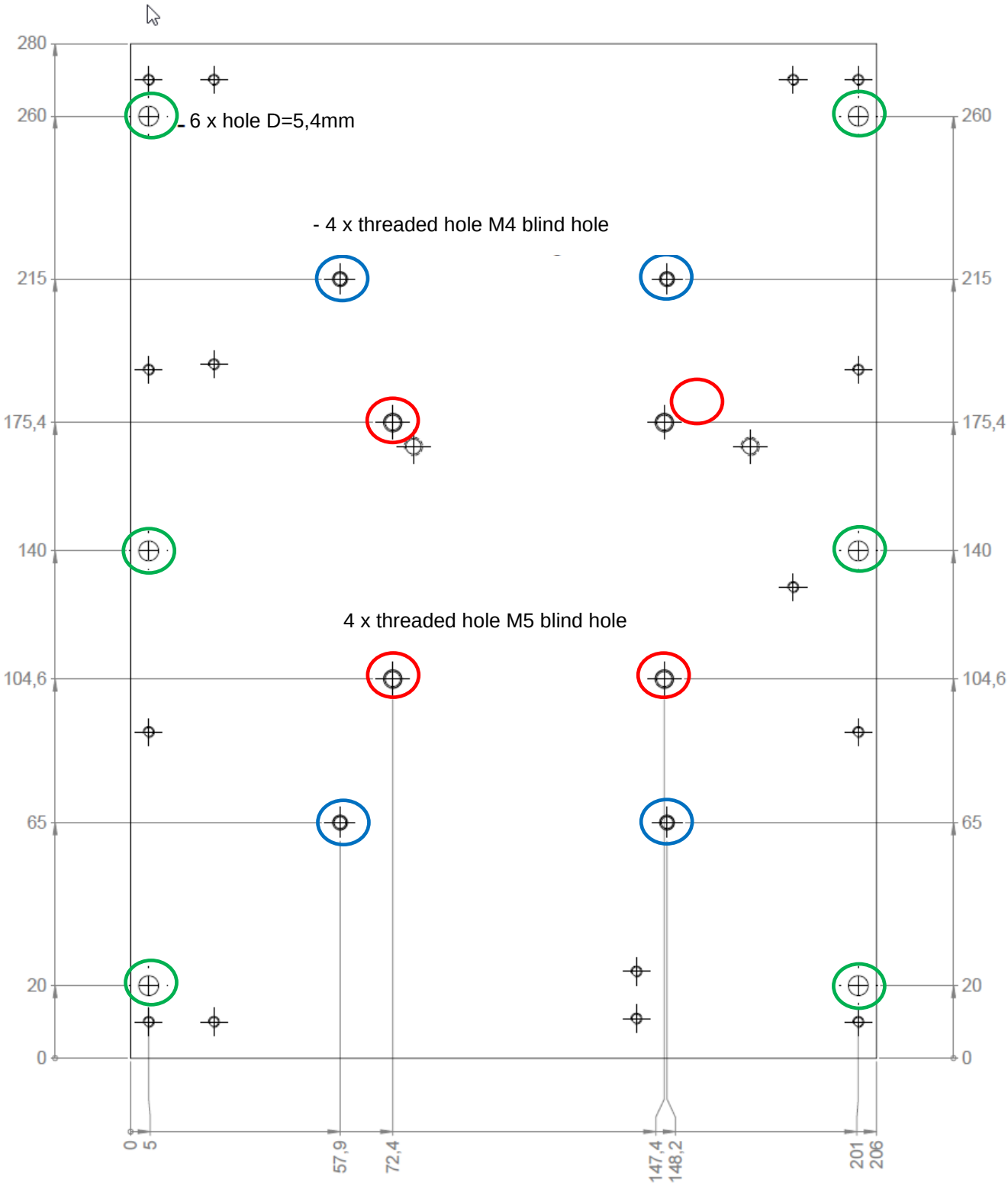
Installation for an additional heat sink:

On the rear of the frequency converter are 4 tapped holes (M4). The heat sink is installed there. < See dimension drawing of the rear view. The cut-out is marked **blue**.

Mounting of the FU3-022:

On each side of the frequency converter are 3 tapped holes (Ø = 5,4) for mounting.
See dimension drawing of the rear view. The cut-out is marked **green**.

2.1.3.1 Dimension drawing of the rear view aluminium plate

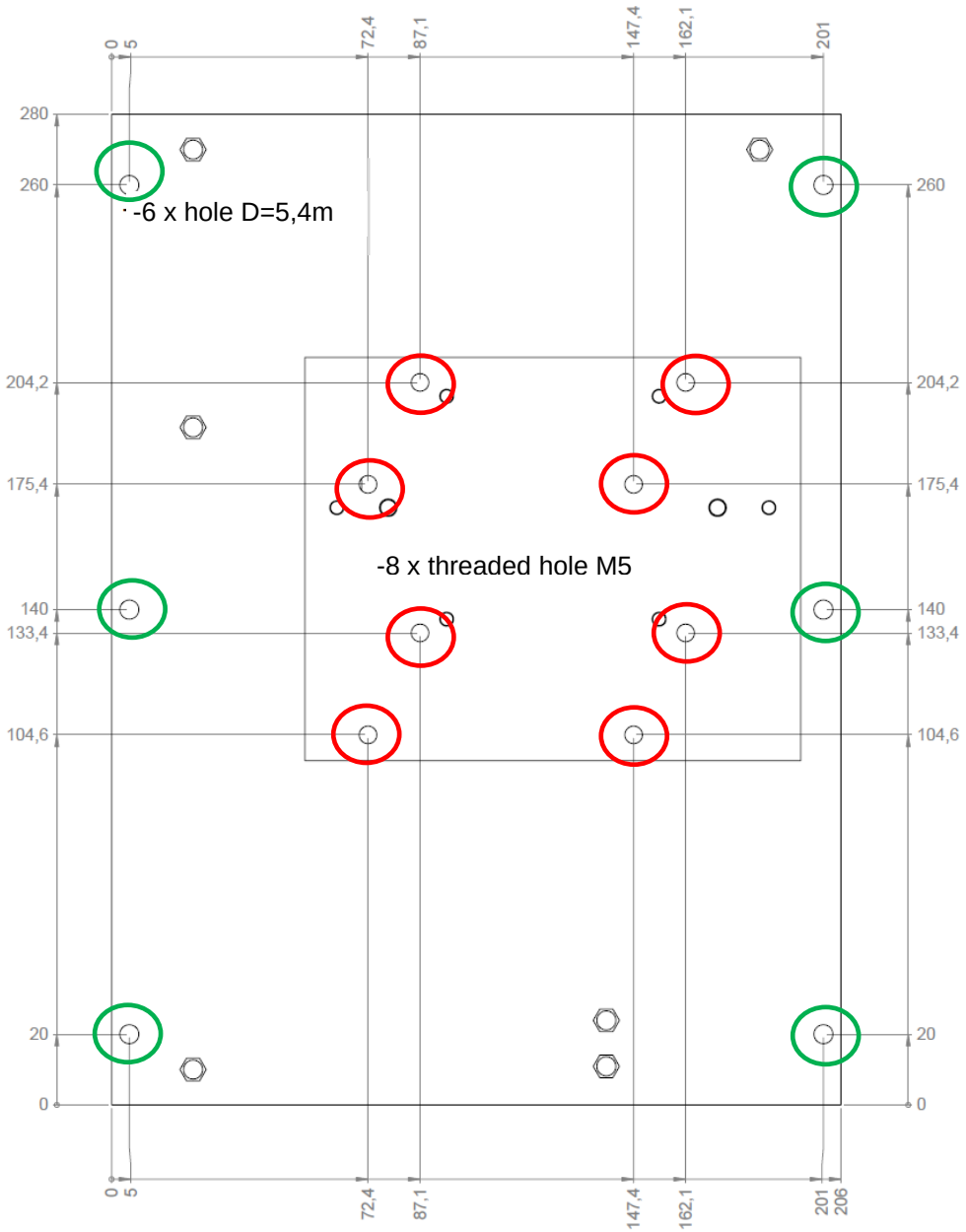


2.1.4 Mounting FU03-22 with steel plate

Mounting of the cold plate:
On the rear of the frequency converter are 8 tapped holes (M5). The cold plate is mounted there.
See dimension drawing of the rear viewThe cut-out is marked red.

Mounting of the FU3-022:
On each side of the frequency converter are 6 tapped holes (Ø = 5,4) for mounting .The cut-out is marked
See dimension drawing of the rear view green.

2.1.4.1 Dimension drawing of the rear view- steel plate



2.1.5 Cooling

Cooling occurs of a cold plate or a heat sink

2.1.5.1 Cold Plate

For operating with the maximum continuous current of 19,6 A at an ambient temperature of 50°C, the cold plate must not exceed 60°C. We recommend to use a cold plate with the following specifications:

- Rth = 0.05 K/W
- T_ha <= 10,65 °C

To exclude a condensation of the converter-electronic, the minimum temperature of the cold plate has to be 5 K above dew point of the surrounding air.

The figure is only symbolic

2.1.5.2 Heat sink KP2559:

When using a heat sink and a natural convection, the converter can only be run with the maximum continuous current of 19,6 A with a maximum ambient temperature of 20°C.
With forced-air cooling (van) can be achieved higher currents.

Following derating has to be adapted with natural convection:

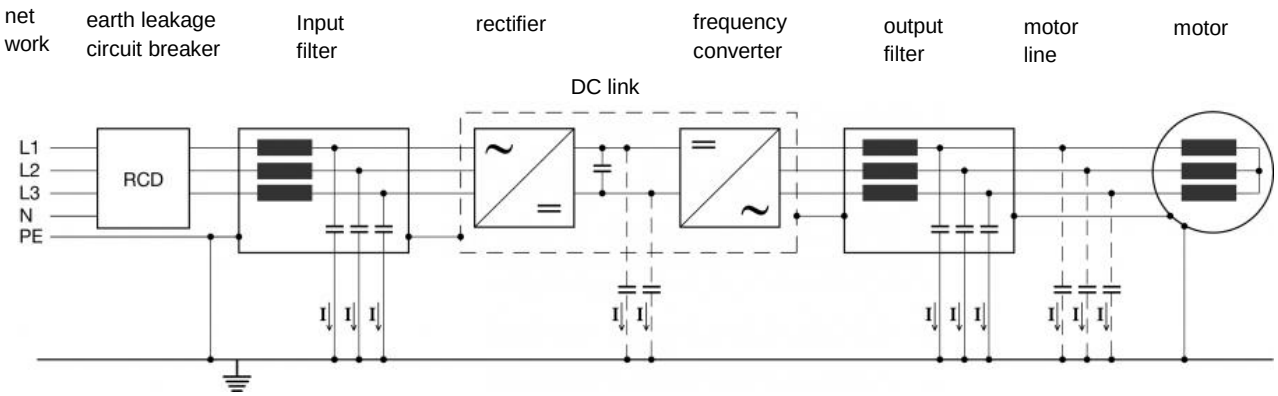
Ambient temperature	Continous current
50°C	10,3 A
40°C	12,1 A
30°C	17,0 A

The continous current between the values are interpolated lineary.

2.2 Electrical Installation

2.2.1 Mains filter

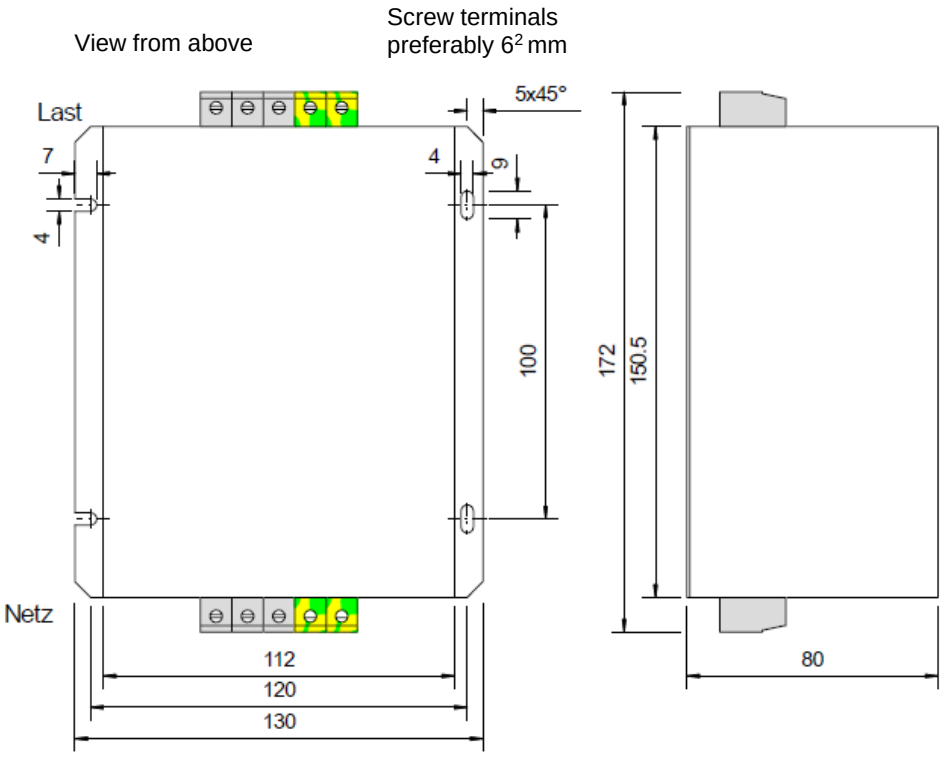
To ensure the household standard class B, the FU03-22 has to be connect with a mains filter and a motor cable filter. Depending on space requirements there are two versions possible:



2.2.1.1 Mains filter - version 1 for standard space

NKL F-XLLXYR-B150

F-XXX-B150



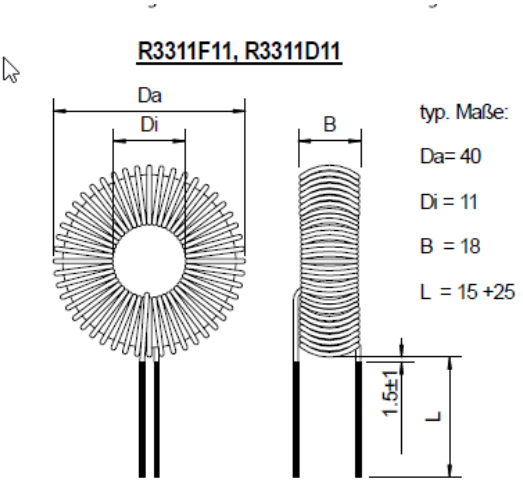
Filter element 15011080

2.2.1.2 Mains filter - version 2 (limited space)

Mains filter Schaffner FN3270H-20-44 with additional integrated 3 x 10µH/16A in the phase-circuit L1, L2, L3 between filter and FU03-22

Schaffner FN3270H-20-44

NKL phase- circuit



2.2.2 Motor cable filter

To ensure the household standard class B, the FU03-22 has to be connect with a output filter:

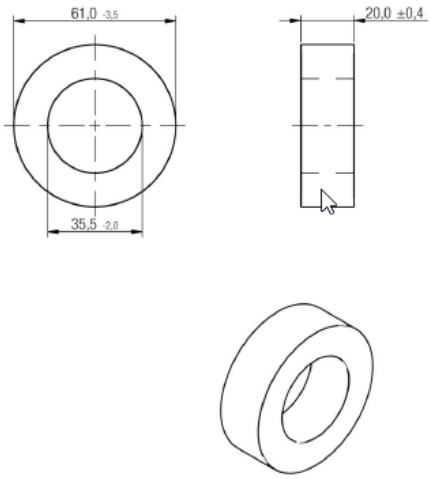
This consists of three loops

cylinder ferrit

winding

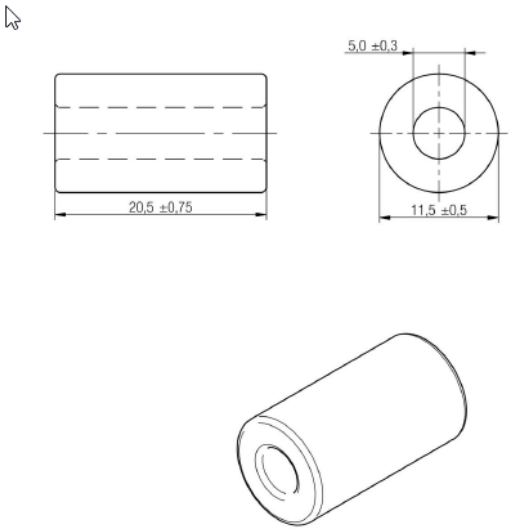
Directly at the frequency converter the three windings will be mounted via a toroidal coret.
The shield is connected with the shield connection/ motor-PE on the FU0-22 after the toroidal core.

Würth Elektronik (742 701 91)



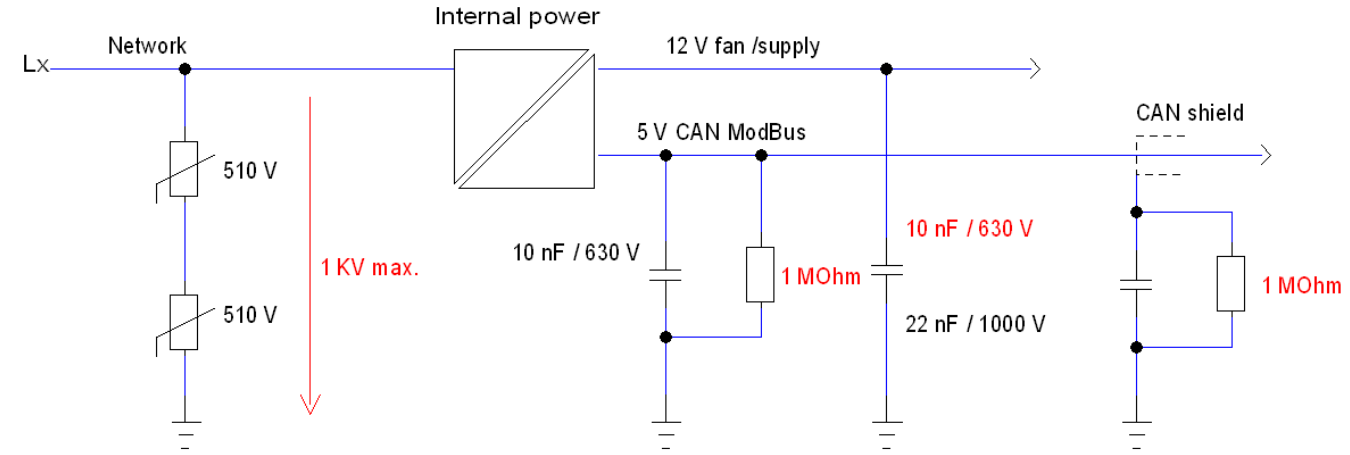
A cylinder ferrit is put over each of the three motor phases U, V, W.

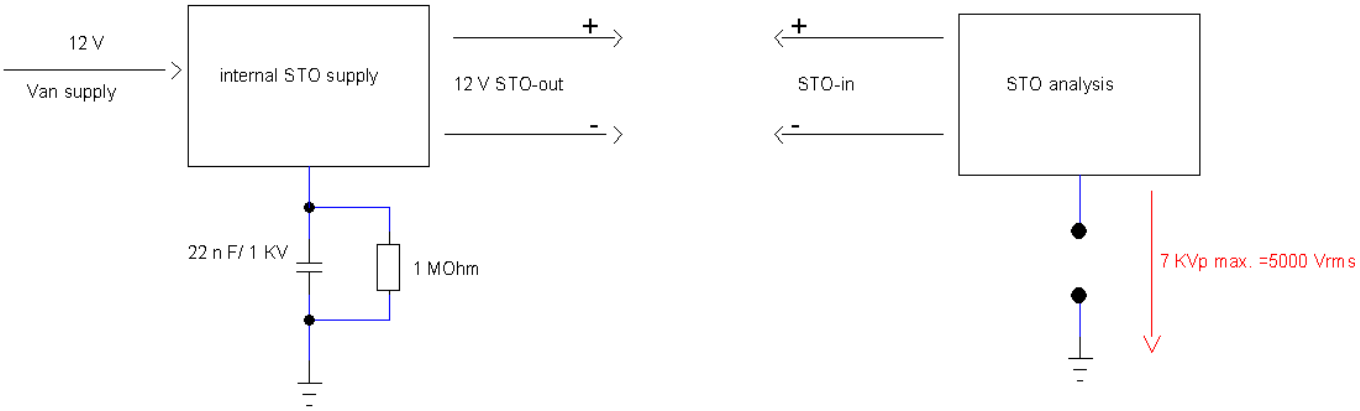
Würth (742 700 31)



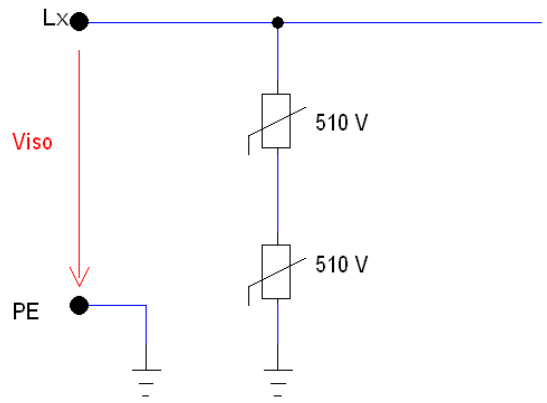
2.2.3 Isolation structure FU3-22

2.2.3.1 Circuit diagramms for measuring of the isolation resistances





Isolation test Phase ↔ Ground



Maximum test voltage:

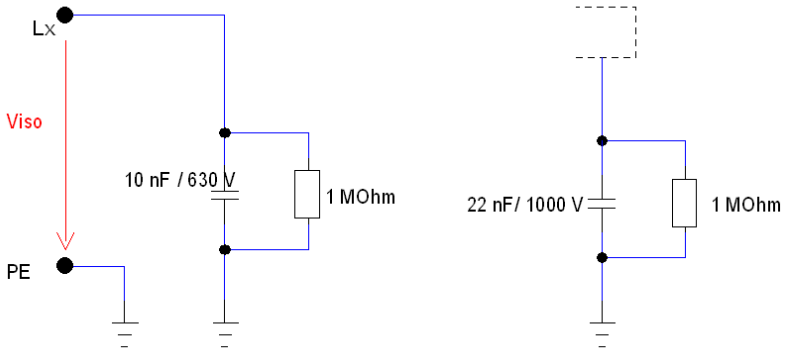
1 kV DC / 1 sec.

Beginning arround 1KV-DC the varistor distance gets conductively.

Possible cosequences:

- Test abort, because leakage flow is to high
- Overload / damage of the varistors in use from an old isolation test equipment without current limitation.

Isolation test CAN/Modus ↔ Ground

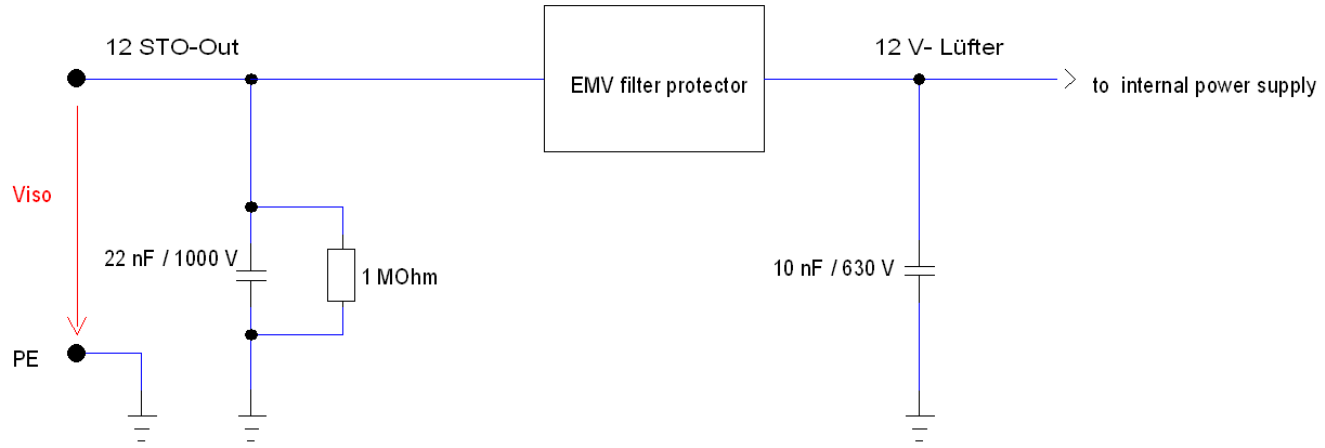


Maximum test voltage:
500 V DC / 1 sec.

A higher test voltage against ground / PE results in:

- Thermal overload of the leak resistors
- Demage of the leakage capacitor

Isolation test STO-supply↔ground

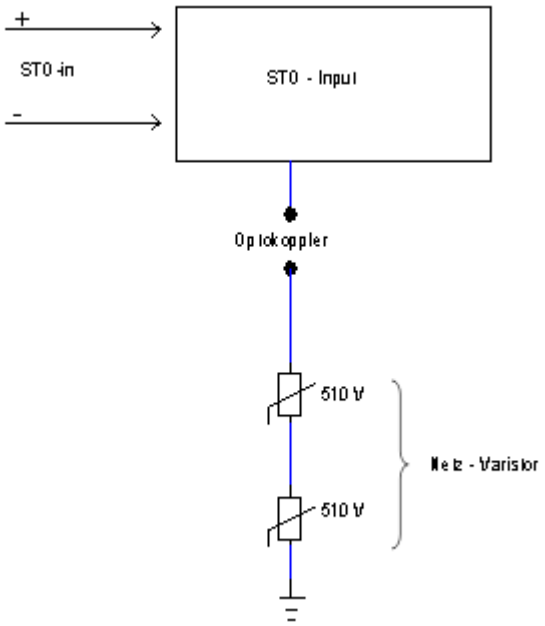


Maximum test voltage:
500 V / 1 sec.

A higher test voltage against ground / PE results in:

- Thermal overload of the leak resistors
- Demage of the leakage capacitor 10 nF /630 V

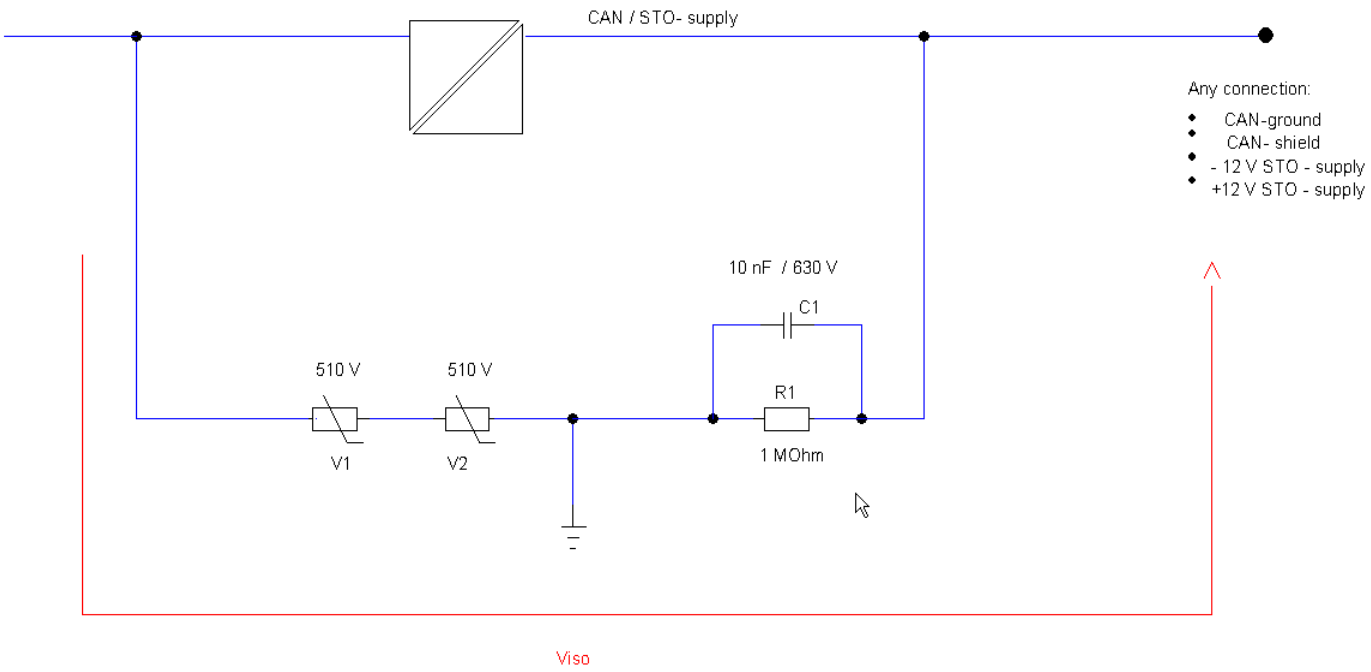
Isolation test STO- input↔ground



Maximum test voltage:
500 V / 1 sec.

The isolation distances are designed for very short pulses in the µ- second range.
Higher loading with DC-or 50Hz AC –voltage overloads the clearance and creepage on the board!

Phase ↔ STO – supply / CAN/ ModBus:



The breakdown voltage of both varistors can vary in the range of 900 - 1100 V. If a test voltage of 1.500 V is applied, voltages > 500 V can be present on the leakage resistance R_1 and on the leakage capacitor C_1. The components can be overloaded and damaged. Therefore the maximum test voltage will be 1.000 V DC.

2.2.3.2 Measurement of insulation resistances

- When measuring the insulation resistance, it has to be observe and adhere the current valid versions (VDE 0100) relating to electric shock.
- The measurement may only be carried out by trained personnel and in a perfect condition of the measuring device acc. DIN VDE 0100-630 bzw. EN60204-1.
- The measurement of the isolation resistances can only be carried out with a DC voltage from max. 500V. Higher test voltages leads to actuation of overvoltage protecton components or to damage/overloading of components (on the lower-voltage side CAN/Mod-Bus/STO in- and outputs).

The following schematic diagrams show the measurements of the insulation resistance of the converter units.

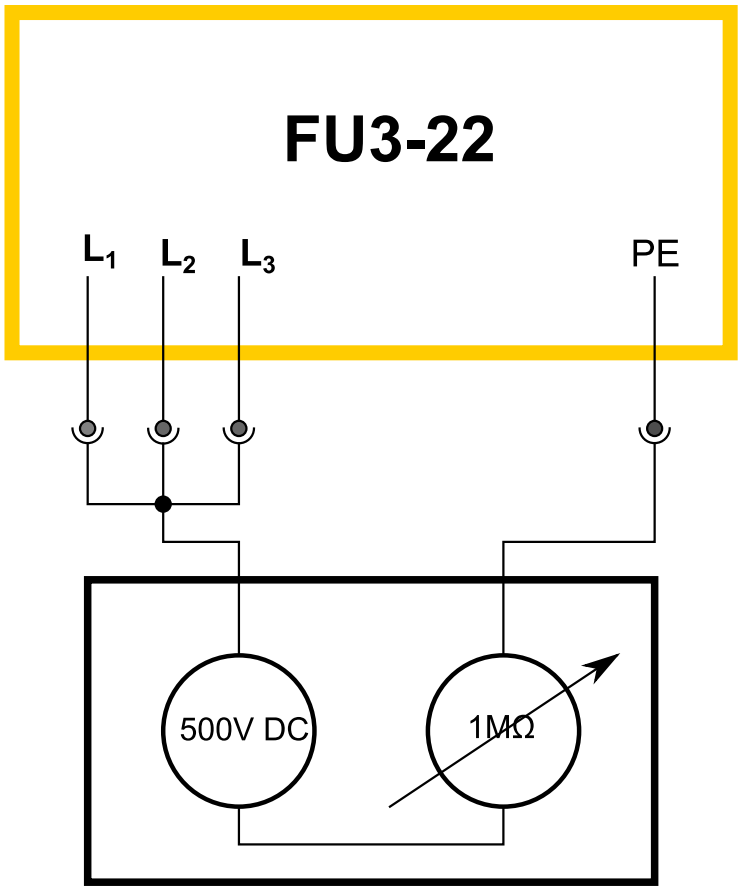


Figure 1: Measurement insulation resisrtance power input - PE

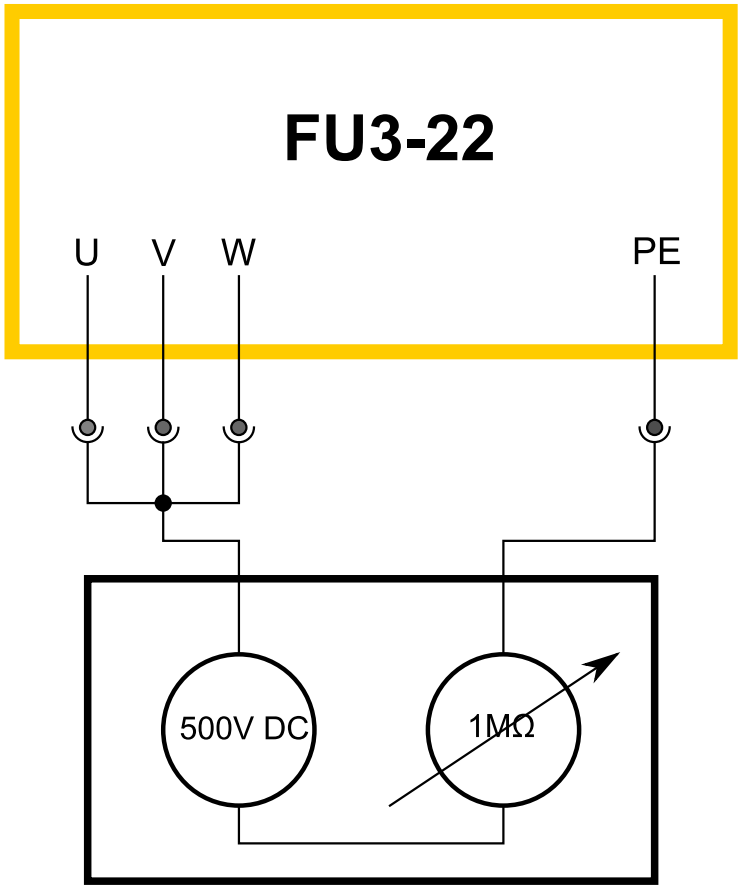


Figure 2: Measurment insulation resistance motor- outputs – PE

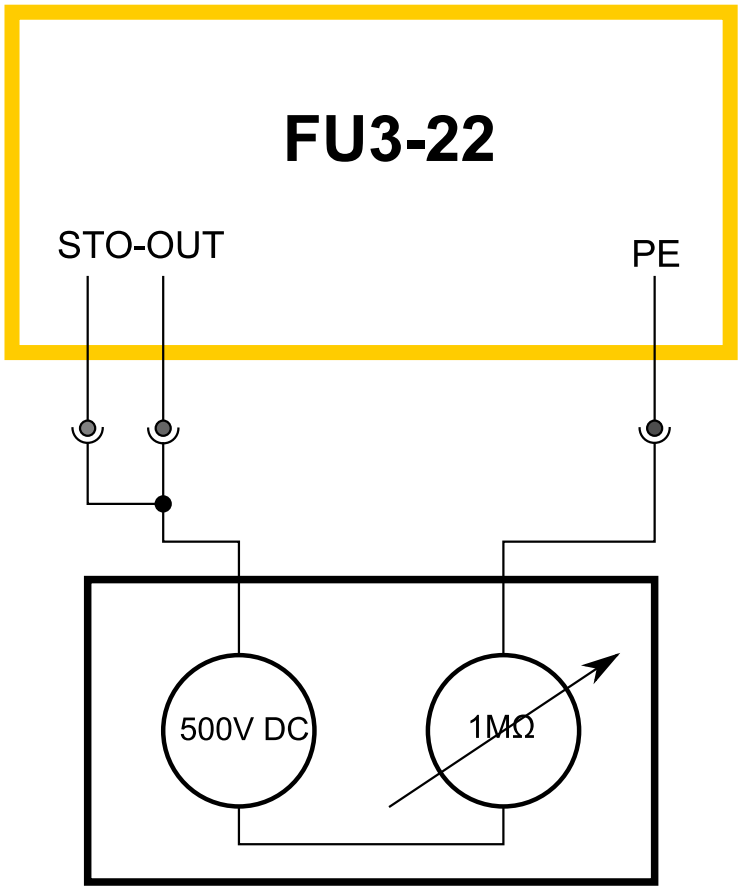


Figure 3: Measurement insulation resistance STO- output / STO supply - PE

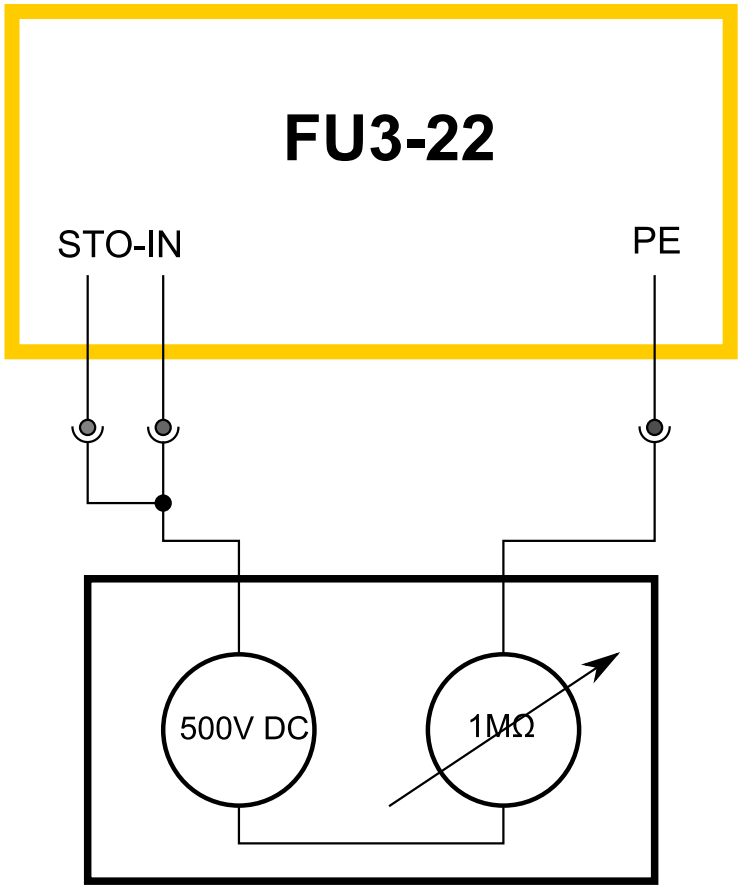


Figure 4: Measurement insulation resistance STO- input – PE

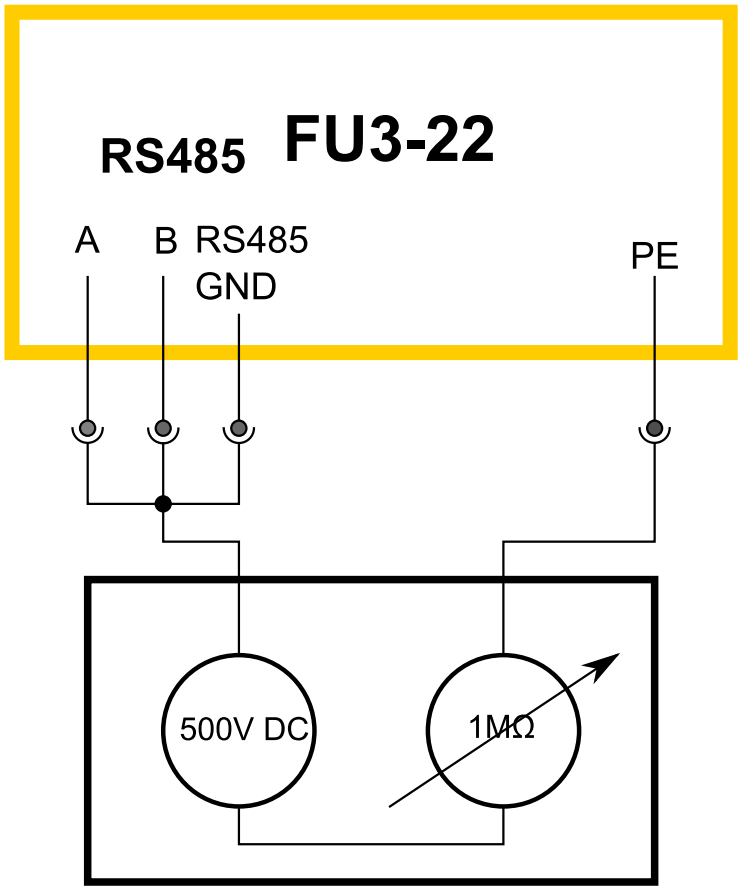


Figure 5: Measurement insulation resistance RS485- Modbus -PE

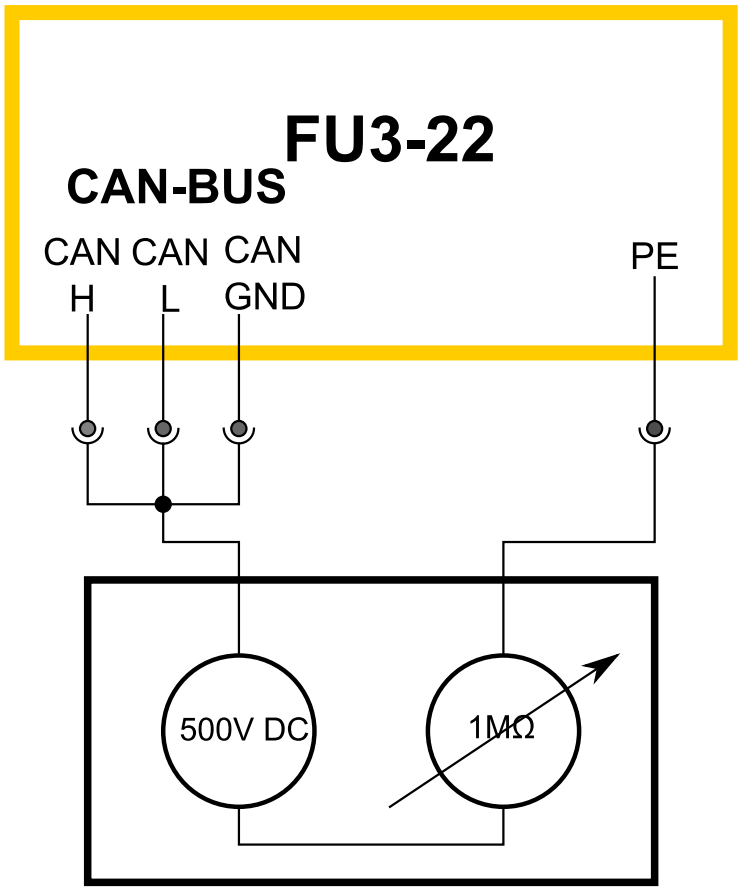


Figure 6: Measurement insulation resistance CAN-Bus – PE

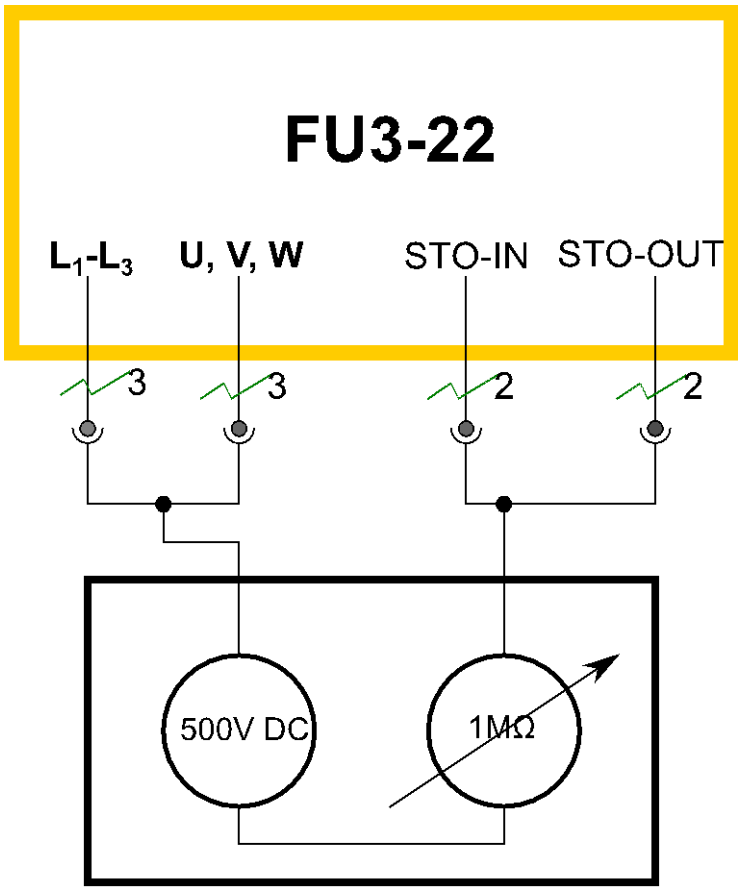


Figure 7: Measuremnt insulation resistance net / motor outputs - STO system

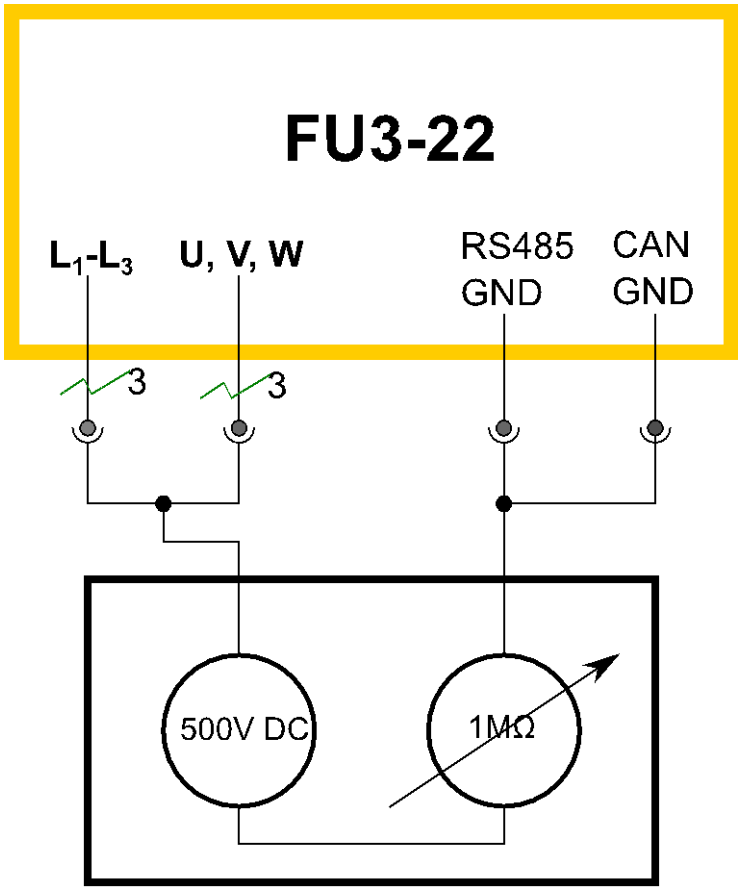


Figure 8: Measurement insulation resistance net/ motor outputs -Bus systems

2.2.4 Safty inspections

If input and output modules are connected incorrectly, there is a danger of high voltage. If you apply power cables in the same cable duct for various motors, there also exists the danger of leakage current even the frequency converter is complete disconnected from the mains supply.

This leakage current can charge the capacitors of the frequency converter. Power modules can lead to dangerous voltages, therefore it's really important to follow strictly the proceeding of commissioning. A non- observance off correct commissioning can lead to personal injury and material- demage.

1. The mains voltage of the frequency converter must be "OFF" (activated) and protected against being restarted. You CAN'T disconnect the input voltage via the circuit breakers of the frequency converter
2. Make sure that there is no tension between two phases, as well as between phases and ground on the input terminals L1. L2 and L3.
3. Make sure, that there is no tension between two phases, as well as between phases and ground on the output treminals U, V and W.
4. Check the correct motor connection via measuring the resistance values at U-V, V-W and W-U.
5. Check the correct grounding of frequency concerter and motor.
6. Check loose cabels on the terminals of the frequency converter.
7. Note down the following data: power, voltage, frequency, rated current and rated speed. You will need these values later for programming motor data in the frequency converter.
8. Make sure, that the supply voltage agrees with the nominal voltage of the frequency converter.
9. The following elements must be designed with the same DC voltage: mains supply frequency converter, motor.
10. The device must be installed as close as possible to the motor. The motor characteristics must be checked.
11. The specified length for the motor cables has not to be exceeded.
12. The protection class for the FU3-022 must be adapted to the place of installation.
13. The output current has to be equal or greater than the current of the motor. Only in this way an optimal engine power is guaranteed.

2.2.5 Checklist before switching the mains voltage

Checkpoint	Description
Auxiliary equipment	1. Record auxiliary equipment like accessory, switches, separators- or mains fuses, or main switches, which could be connected on the power supply or on the motor. Make sure, that the equipment is ready for the installation with the full speed. 2. Check the status and the function of the sensors, which send feedback signals to the frequency converter. 3. Remove the capacitors for correcting the power factor on the motor, if available.
Motor characteristics	1. The optimum engine performance is only guaranteed; if the output current of the frequency converter has to be equal or higher rated as the current of the motor. To achieve a proper overload protection, the motor size and maximum frequency inverter rating must correspond. 2. If the nominal values of the frequency converter located under the nominal values, the maximum power of the motor can't be achieved.
Cable routing	1. Arrange power cables, motor cables and control cables in 3 separate cable conduits for RFI protection. 2. All plug connections have to be screwed or fixed 3. No liability can be assumed for malfunction and damage resultings of using unsuitable cables. 4. Cables only be connected or disconnected when the device is switched of. 5. During the operation, all cables which are connected with the device have to be also connected with a remote station 6. Connect the motor lines; connect the shieldings at both ends to the EMC-connectors. If the cable length>25m, using a motor choke (3YLN, S.88).
Mounting	Install the servo amplifier and power supply closed to each other, on the highly conductive and earthed mounting plate in the cabinet.
Control lines	1. Check, if cables are broken or damaged and loose connections are existing. 2. Make sure for the guarantee of interference immunity, that the cotrol lines passed seperatly from power - and motor cables. 3. If necessary, check the voltage source of the signals. 4. elrest advices the use of shielded cables or twisted-pair-cables. Make sure, that the shield is properly terminated. 5. Select cables according to EN 60204

Distance to the cooling air circulation	Meassure whether enough appropriate clearance over and under the frequency concerter for a sufficient ventilation
EMC-compliant design	The basis for an interference-free operation is an EMC-compliant hardware construction of the system, as well as the use of interference-free cables**.** The guidlines for interference-free installation of your system are accordingly to the installation of assembly.
ESD	Not used signals (e.g. unused interfaces, battery connections etc.) have to be covered suitable, in order to avoid electrostatic charges (EGB / ESD)
Ambient conditions	Please note the limits, specified on the identication plate, for maximum ambient- and operating temperatures. The relative humidity should be whithin condensation (see data sheet) The installation location must be free of conductive and corrosive substances. Pleas check the installation situation in the cabinet.
Fuses and circuit breakers	Make sure, that the correct fuses and circuit breakers are installed. Make sure, that all fuses are firmly inserted, be in an operational condition, and all disconnector are opened.
Ground	1. Make sure that a ground wire is connected between the filter and the ground. 2. Make sure, that the plant owns a ground connection; the pins are screwed tight and have non oxidation. 3. Grounding on cable ducts or mounting the back on a metal surface is an inadequate grounding.
Motor- and power cable	1. Check, that all connections are correctly and securely connected. 2. Make sure, that motor- and power cables just laying in separate cable ducts, or appropriate shielded cables are used.
Inside of the housing	Make sure, that the inside of the frequency converter is free of dirt, metal chips, humidity and corrosion.
Switch	Make sure, that all switches and disconnectors are in the right position.
Vibrations	1. Make sure, that the frequency converter, depending on requirements, is be steadily mounted or vibration dampers are used. 2. Check, whether excessive vibrations exist.

2.2.6 *Apply power supply.*

HIGH voltage!

Connection at the mains voltage: Frequency converter leads high voltage.
Only qualified personnel may carry out the following activities on the products: installation, commissioning, operation, maintenance.

Failure to observe the following safety instructions could result in serious injury or death.

Rotating shafts and electrical equipment pose potential sources of danger. All electronic works must be compliant with the VDE regulations and the local valid electrical installation instructions.

UNEXPECTED START!

When connecting the frequency converter to the main power, the motor can start any time unexpectedly. The frequency converter, motor and all electrically-powered devices have to be operable. If they aren't operable after the connection; this can be very dangerous and cause serious injuries or death, it also occurs to material-damages and damages to the equipment.

1. Make sure, that the deviation for the voltage balance do not exceed+/- 3%, if this is not the case, correct the unbalance input voltage before you proceed. Repeat this process after the stress correction.
2. Make sure, if any optional equipment for cabling available, conforms to the purpose of the installation.
3. Make sure, that all devices operable are set to OFF. The cabinet doors must be closed, and the covering must be fitted.
4. Connect the mains supply on the frequency converter, don't run it yet. Put the disconnectors of the frequency converter to ON for suppling the mains supply at the frequency converter.

High frequency radiation, from mobile phones for example, can cause unintentional operating situations.

2.2.7 Ground

For security reasons, the frequency converter must be grounded according to the applicable regulations.
Non-compliance may cause death or serious injury.

A proper protective grounding shall be made for devices with earth current more than 3,5 mA.

It’s the responsibility of the user or acertified eletrical fitter, to ensure for a perfect grounding of the devices according to the applicable national and local electrical installation regulations and –standards.

- Please note the local and national electrical installation regulations for proper grounding to electrical equipment and operating material.
- Undertake a protective grounding assessing for devices with earth current higher than 3,5 mA, see chapter 2.2.4.1 Ground leakage (>3,5 mA).
- For mains supply, motor cable and control lines is a protective ground required.
- For properly ground connections use the cable clips, included in the scope of delivery
- Don‘t ground the frequency converter in a row.
- Keep the line for grounding as short as possible.
- Use multi-strand lines for the reducing of electrical interferences.
- Follow the requirements of the motor leads from the motor manufacturer

2.2.7.1 Ground leakage (>3,5 mA)

Follow the national and local instructions, regarding to the protective grounding of devices with earth leakage current higher than 3,5 mA. In the frequency converter technique is switched high frequencies with high capacity. This leads to a leakage current in the ground connection. A current due on the frequency converter at the output clamps can include DC components, which load the filter capacitors and cause a transient earth current. Earth leakage current depends on several system configurations, like EMC filter, shielded motor cables, and the power of the frequency converter.

EN 61800-5-1 (product standard for electrical power drive systems with adjustable rotational speed) requires special skills, if the ground leakage overtakes 3,5 mA current. You have to reinforce the ground connection in one of the following ways.

- ground cable with a diameter of min. 10 mm².
- two seperately laid earth-cable, which includes the required ground.

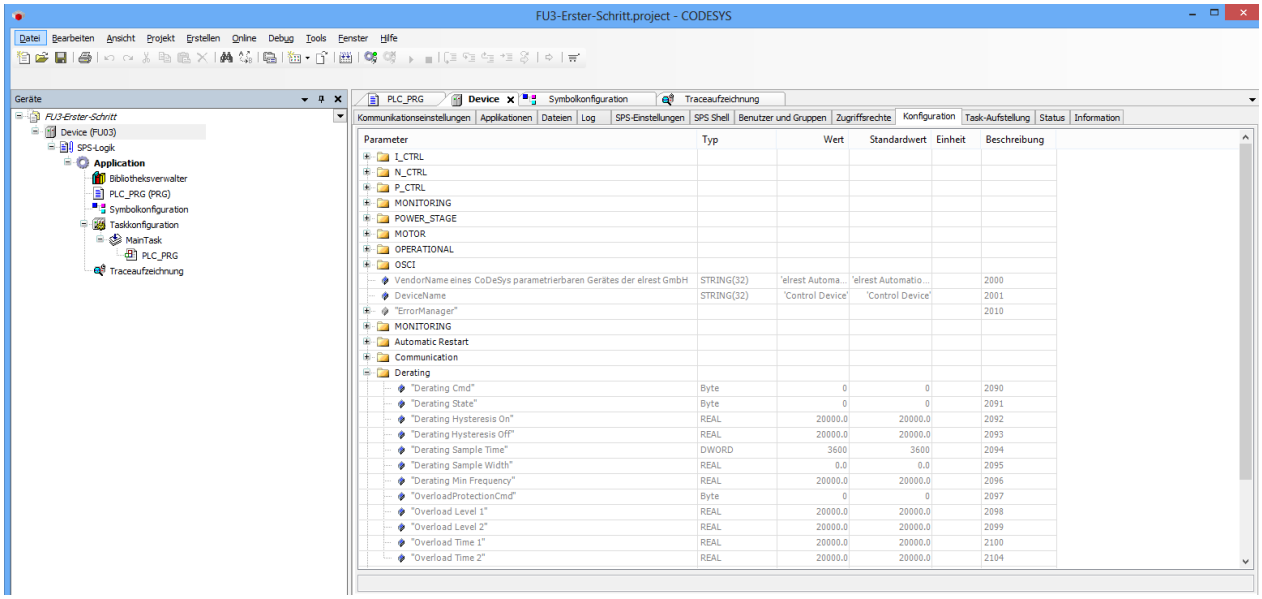
2.2.7.2 Use of RCD (current protection device)

If residual current circuit breaker (RCD) be employed, compliance with the following requirements:

- Only use on the mains all-current sensitive cercuit (type B)
- Use the RCD with turn-on delay, to avoid mistakes by transient earth current.
- Dimension the RCD in refer of the system configuration and the environmental conditions.

2.2.8 Parameterization of the frequency converter

The parameterize occurs within CODESYS V3.5 on the TAB_TITLES configuration



If you have not yet installed this software,see „Installation“.

2.2.9 Start-up

If the converter was not delivered with a prepared data set parameterized, the following steps are to be accomplished:

- Overtake the engine parameter of the motor data sheet and enter in the following parameters:
  - ID72 Lq [H] cross inductance
  - ID73 Ld [H] along inductance
  - ID74 R [Ohm] winding resistance per phase
  - ID76 NominalBackEMF [V/rps], obtained or converted on the amplitude of the phase voltage.
  - ID71 NumberofPolPairs [-] pol pairs

- The current controller parameters are automatically determined from the motor parameters.

- The following parameters should be describe:
  - ID5 PWMFrequency = 8000 kHz — nominal frequency of the PWM ent controller
  - ID 2331 Cmd = 1 — activate the automatic parameterisation of the current regulators
  - Afterwards the setting values have been found on the following parameters
    - ID10 KpIdCtrl — P-amplication current controller
    - ID11 TnIdCtrl — integration time constant field current controller
    - ID15 KpIqCtrl — P- amplification moment current regulator
    - ID16 TnIqCtrl — integration time constant moment current regulator

- Set the speed controller (no optimised data. They are intended for initial start-up of the drive)
  - ID 37 KpSpeedCtrl = 0.1000 — P- amplication current controller
  - ID 38 TnSpeedCtrl = 50 ms — integration time constant speed regulator

- Tracking regulator of the assesment rotor angle
  - ID165 EstimatedOmegafilter = 4.0022 ms — filter for the estmated speed
  - ID166 KpTraceControllerSpeedEstimation = 3.0000ms — P-amplification for the tracking regulator
  - ID167 TnTraceControllerSpeedEstimation = 3.0007 — ms integration time constant for the tracking regulator

- Set field weaking controller
  - ID219 FieldWeakeningVoltageLimit = 90% — set point for the field weaking operation
  - ID 224 FieldWeakeningCtrlTn = 0.8 — integration time constant for the field weaking controller

- Setpoint setting (acceleration and rated speed)
  - ID87 SetValueGeneratorCycle = 1024 — set resolution of the setpoint setting
  - ID 88 SetValueGeneratorSetSpeed [rps] — (speed setpoint**,** not smaller than 10% of the rated speed)

  - ID90 SetValueGeneratorSetAcceleration [rps/s] z.B.: 10 — acceleration
  - ID116 SetValueGeneratorSetDeceleration [rps/s]; z.B.: 10 — bracking acceleration

- Put drive mode on sensorless control:
    - ID206 GearBoxActualValueSourceSelect [-] auf 273
    - ID83 DriveComOperationMode [-] place on 2 for speed control

- Activate controller
    - ID81 DriveComControl = 6 activate controller
    - Control the dispay of the ZK voltage in ID 70 Uzk (should show about 560V).
    - ID81 DriveComControl = 15 release performance output
    - Motor should be accelerating steady to the given drive.

In ID 2300 First Error, no error messages should be appear.

2.2.10 Connection to other devices

Connect as follows:

The individual accessory components see from chapter„accessory“.

Article-number:	**105097**	**240020100**	**26234.0220**



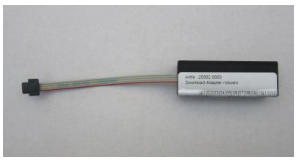

2.2.10.1 Service interface

Connect to the service interfaceas follows:

The several accessory components see chapter „accessory“..

Article number:	Kabel für Adapter handelsüblich	**25002.0000**	**26234.0220**

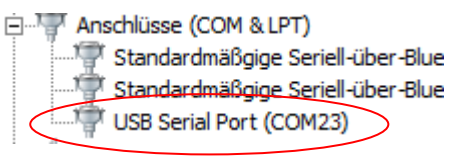





Install service adapter

If the internet connection always exists., the driver for the service adapter (Artikelnummer 25002.0000) will be installed automatically in WIN 7+.

After a successful installation appears the service adapter in the device manager in “connections” (COM & LPT)“ as „USB serial port (COMyour number)“.



Drivers can be downloaded from FTDI.com, choose the VTP (virtual com port).

http://www.ftdichip.com/Drivers/VCP.htm

Adaption CODESYS V3 Gateway:
The file „Gateway.cfg“ in the path:
Installation path CODESYSV3/GatewayPLC
Open the file with a text editor and edit the following entry

…
[CmpBlkDrvCom]
;Example for a configuration of this block driver:
;EnableAutoAddressing=1 should be set to activate the
;Mainnet-Mainnet-Communication on serial line.
Com.0.Port=23
Com.0.Name=MyCom
Com.0.Baudrate=115200
Com.0.EnableAutoAddressing=1

The entry COM.0.Port with the corresponding port number of the service adapter will be said. The Port number can be controlled in Windows- -device manager and if necessary adjusted.

Afterwards reboot at least the gateway, better the computer.

2.2.11 Function STO (“Safe Torque Off")

The frequency converter is available with the function „STO“ on the connection X3. The second disconnecting path on X3 is necessary for the function STO, and the control voltage of the power semiconductors in the output stage of the frequency converter is disconnected. This prevents the generation of voltage, required for the rotation of the motor. The uncontrolling restart of the drive is prevented. The function STO (chapter interfaces X3) will monitor in the converter. Is the STO activated during the rotation of the motor, which will immediately disconnected from the power supply and coasted. Is an immediately stop of the motor required, further measures must be adopted.

For the restart, the frequency converter has to be manually restarted. If the automatic restart is used, ensure that the requirements of ISO 12100-2 paragraph 5.3.2.5 will meets.

The hardware with dual-channel and external activation fulfills the STO according to

SIL2 according to IEC 61508-2

The function “Safe Torque Off" (STO) can be used to realize an emergency stop according EN 60204

This function does not disconnect the plant from power supply; it only prevents the control of the power amplifier**.**

In the current version of the inverter is STO not certified!

Bevor the installation, or the first operation, commissioning a start-up inspection of the device or application that will use the STO. After each changes of the device or application belongs to STO, this test shall be repeated.

2.2.12 Connection of the motor cable and the mains connection

Make sure, that all the pins are securely connected. Motor- and power cable must be routed in separate cable ducts or be routed in separated screened cables.

2.3 EGB / ESD- guidelines

2.3.1 What means EGB/ ESD

Nearly all modern modules are equipped with highly integrated chips or components in MOS technology. These electronic components are very sensitive to overvoltage and therefore to electrostatic discharge.

The international abbreviation for ESD means Electrostatic Sensitive Device.

This symbol is on cabinets, subtracks, or packing boxes and indicates the use of electrostatically sensitive devices and thereby sensitivity by touching the devices:

EGB /ESD sensitive components may be damaged by energies and voltages that are below the limit of human perception. This kind of voltages occurs when somebody, which is not electrostatically discharged, touches a module/chip/component. In most of the cases, the components exposed to such overvoltages can not immediately be detected as defective. Only after long operating of the device may an error occur.

An installation that conforms to EMC requirements as well as the use of interference-free cables represents a basic requirement in ensuring trouble-free operation.

The directives for interference-free installation of your device also apply for the installation of the HMI device.

2.3.2 Protective measures against static charge.

The most plastics are hard chargeable and therefore must be kept away from ESDs!
Ensure that operators, work area, and packaging have proper grounding when working with ESDs!

2.3.3 Handling of ESD-Modules

Basically, the electronic boards should only be touched only when is absolutely necessary. In no case touch the chip connectors and live conductors of a flat electronic module.

Touch the electronic components **only**, if you are permanently grounded via the ESD wristband, ESD shoes, or shoes with protecting strip in constant touch with an ESD floor.

Discharge your body before touching any electronic module. For example, by touching electrically conductive and grounded material (e.g. grounded bare metal cabinet parts, water pipes…).

Electrostatic sensitive components or modules must not get in contact with materials which are chargeable including all standard types of plastic, desk top, and clothes with synthetical material and so on. Components must only be placed on conductive surfaces.(table witg ESD- layer, ESD conductive cellular material, ESD packaging, ESD container)

Do not place the components near visual displays and monitors or television sets. (Keep a minimum distance of 10cm)

The packing material does not come into contact with the battery or short out the battery connections. Secure the connections with duct tape or insulating material.

2.3.3.1 Emergency switch (EN ISO 13850)

External emergency switch via a connector, the device switches off automatically.

2.3.4 Guidelines

Compliance of the designated product with the provisions of the directive 89/336 EWG is proven by complete adherence to the following standards:

2.3.4.1 Product standard

Drehzahlveränderbare elektrische Antriebe - Teil 2: Allgemeine Anforderungen; Festlegungen für die Bemessung von Niederspannungs-Wechselstrom-Antriebssystemen mit einstellbarer Frequenz (IEC 61800-2:1998); Deutsche Fassung EN 61800-2:1998

Drehzahlveränderbare elektrische Antriebe - Teil 3: EMV-Anforderungen einschließlich spezieller Prüfverfahren (IEC 61800-3:2004 + A1:2011); Deutsche Fassung EN 61800-3:2004 + A1:2012

Safty of household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers (IEC 60335-2-40:2002, modified + A1:2005, modified + A2:2005, modified + corrigendum 1:2006)

2.3.4.2 Interference immunity

Electromagnetic compatibility (EMC) - Part 6-2: - Immunity for industrial environments (Generic standards IEC 61000-6-2:2005)
The interference immunity is only achievable by external filter measures.

Electrical drives with variable speed- Part3: EMC product standard with including special testing procedures (IEC 61800-3:2004 + A1:2011);German version EN 61800-3:2004 + A1:2012.

2.3.4.3 Ermitted interference

Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Immunity for residential, commercial and industrial environments, as well as small businesses. (IEC 61000-6-3:2006 + A1:2010)

Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods (IEC 61800-3:2004 + A1:2011); German version EN 61800-3:2004 + A1:2012

Transmitting rate of interference according EN 55011 class A
The interference immunity is only achievable by external filter measures class B.

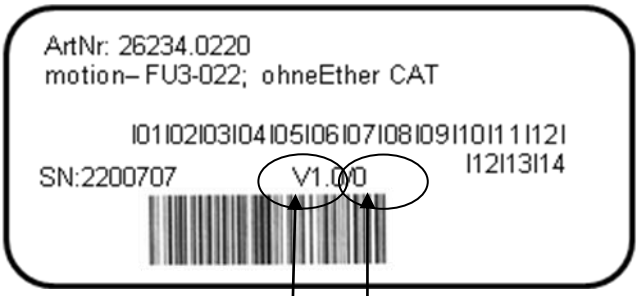
2.3.5 Label

Each device has on the back side an individual series label, which identifies the device.

The serial label includes the following information:

article number
article description
additional text

serial number index . month of deliveryt
year of delivery



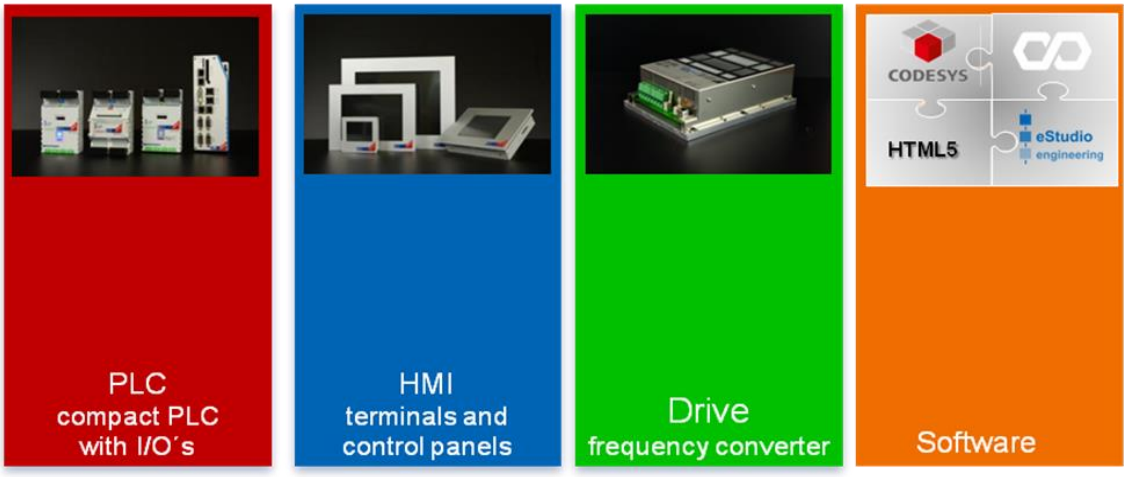
The index Vx.x/yy splits in
x.x hardware status
yy software status

Note for devices with the index = „ PROTOTYPE”.
Prototypes are used only for test purposes.

3 System overview

3.1 Products

elrest-products



combo
robusto

visio terminal
visio control

motion

Software

3.1.1 *Communication interfaces*

CAN Open fieldbus interfaces to various CAN protocols, such as Truck-Norm J1939-based

CANopen The CAN interface serve on a CANopen Slave via CmpCANopen.
1 x RJ45 interface

RS 232 / RS 485 Serial interfaces RS232 and/or RS485. These can be run with several UART protocols or the prepared protocol RTU-Modbus

Incorrect or false connection leads to irreversible damage on the assembly.

3.1.2 Technical data

motion control

Data sheet motion slave *FU3-022* *V1.3*

elrest® Wir steuern Ihren Erfolg

26234.0220
26234.0221
26234.0222

262.340.223

motion control

- **Frequency converter with encordless control**
- **RS485 and CANopen**

Specification	
Processor	32 Bit NIOS Softcore CPU 100 MHz eSM
Memory	64 MByte SDRAM, 16 MByte Flash, 30 kLE, optionally 50 kLE
Control technics	based on FPGA
Software	
OS	non
PLC programming	optional: IEC 61131-3, CODESYS V3.x
HMI programming	optional: TargetVisu
Interface	
CAN isolated RJ45	1x acc. ISO 11898 with galv. Isolation, 1 x RJ45 socket
RS485 with galv. Trennung RJ45	1x with galv. isolation, with the same RJ45 socket above
Encoder	
Commutation, measurement system	1x VHDL implementation of the encordless control internally motor model
Order-Nr.:	
26234.0220	FU3-022 400VAC/22A; elrest type1 Frequency converter with aluminum mounting plate
26234.0221	FU3-022 400VAC/22A; elrest type2 Frequency converter with aluminum mounting plate + heat sink
26234.0223	FU3-022 400VAC/22A; Frequency converter with steel plate + cooling plate

Environment/ Mechanical values	
Housing	motion without heat sink
IP rating	IP20 acc. to EN 60529
Mounting	mounting on cold plate with cooling plate or heat sink
Outside dimension in mm (W x H x D)	206 mm x 280 mm x 83 mm (without heat sink) 206 mm x 280 mm x 168 mm (with heat sink)
Weight approx.	3,72 kg (without heat sink) 7,5 kg (with heat sink)
Operating temperature	-20 °C…50 °C
Temperature on heat sink	-20 °C…60 °C
Storage temperature	-20 °C…70 °C
Relative humidity	Operation: from 10 %...85% and
(Opperation/storrage)	Storrage: from 5%...85%, both non condensing
Height (Opperation/storrage)	from 0 m…3000 m air fright possible
Fan	fanless, the cooling has to be ensured
Heat sink	coolong capacity of the work surface has to be ensured notice dew point!
Overvoltage category	2 (2,5 kV)
Protection class	I-protective insulation;all electrically conductive housing parts of maintenance resource have to be connected with the protective system of the fixed electrical installation.
Power supply	
Voltage supplyAC 400	400 V_{nom}…480 VAC (3-phased)
Mains frequency	47 Hz...66 Hz
Type of net	Public TT, TN-net with grounded star point
Mains filter400/25A	Three-phase current from 400 VAC up to 25 A
DC intermediate circuit film-C 25A	60 µF 900 V
Max. intermediate circuit voltage	Chopper module (external auxiliary component) 740 V, 800 V overvoltage shut-off, 900 V survive
Power Factor	0,9
Screw terminals 4-pins for 16 mm²	1x screwed contact upright; 4-pins; contact spacing 10.16 mm, isolation = 500 VAC, crosss section 2,5 … 16 [mm²],
Motor operating range	
Inverter rated power	9,5 kVA Dauer, 12 kVA Peak (cos Phi=1)
Motor rated current	18 / 22 A bei Nennfrequenz
PWM-frequency	4 kHz…8 kHz
Derating	automatical derating of speed by overload current
Current measurement (U-V) ±0..25A	Inductive current measurement 12-bit
Measurement of stress (DC+/-)	voltage measurement from DC+ to DC- from 0….900 VDC
Runtime current controller	2,66 µs
Runtime speed controller	4 µs

Motors	
Designed inter alia for the following motors	Mitsubishi ANE42, Mitsubishi ANE33, Mitsubishi ANE52 and Toshiba DA422A3F, further available on request
EMF nominally	1,8 V/rps
Speed nominally	120 rps
Digital Input	
10-28 VDC with galvanic isolation	1x safe STO-input for safty cut-out of the motor torques acc. IEC 61800-5-2, see Stop Category 0 acc.EN 60204-1.
picoMAX® eCOM upright 3.5 2-pins	1x Multipoint connector eCOM with straight solderpins; with handle plate; 2-pins; contact spacing 5 mm, cross section up to 0,2…1,5 mm², 10 A WAGO: 2091-1402 and 2091-1102 
12 VDC output (opional)	1x Voltage supply, that the digital STO input can be carried out without external supply voltage.
picoMAX® eCOM upright 3.5 2-pins	1x Multipoint connector eCOM with straight solderpins; with handle plate; 2-pins; contact spacing 5 mm, cross section up to 0,2…1,5 mm², 10 A WAGO: 2091-1402 and 2091-1102 
Diagnostic	
LED´s	green acc. internal voltage available red acc. error or no release
Standards	
Product standard	
EN61800-3	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods (IEC 61800-3:2004 + A1:2011); German version EN 61800-3:2004 + A1:2012
EN61800-5-1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy (IEC 61800-5-1:2007); German version EN 61800-5-1:2007 (VDE 0160-105-1):2008-04
Power supply	
EN61003-12 Harmonic waves >16A bis <75A current	Electro-magnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents, caused by devices and equipment systems with input current > 16 A and <= 75A per phase, and are designed to connect with the public low voltage system (IEC 61000-3-12:2011)
EN61000-3-11 Flicker >16A bis <75A current	Electro-magnetic compatibility (EMC) - Part 3-11: Limits; limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, devices and equipment with rated current <= 75 A, and subject to conditional connection (IEC 61000-3-11:2000)
Interference immunity, emitted	
EN61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005
EN61000-6-3	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006 + A1:2010); German version EN 61000-6-3:2007 + A1:2011 with external filter
EN61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments (IEC 61000-6-4:2006 + A1:2010); German version EN 61000-6-4:2007 + A1:2011

Environment audit		
	EN60068-2-6	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007); German version EN 60068-2-6:2008
	EN60068-2-27	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock (IEC 60068-2-27:2008); German version EN 60068-2-27:2009

Accessories

On request		Heat sink with natural convection without van
On request		Heat sink with forced convection with van
On request		external chopper resistor, intrinsically safe
for Firmware Download		
	250020000	Download-adapter
	commercial	connecting cablel USB type A to USB type micro B
for RS485		
	105098	USB-RS232-adapter
	commercial	USB-RS485-adapter
	240020903	Serial extension cable, grey
for CAN		
	105097	CAN/MPC-5/CAN-USB-ADAPTER
	240020100	Extension cable of Sub-D9 CAN, green
	240020906	T-Adapter RJ45 St. -> 2 x RJ45, grey
	240020501	CAN bus terminal resistor RJ45

Applications

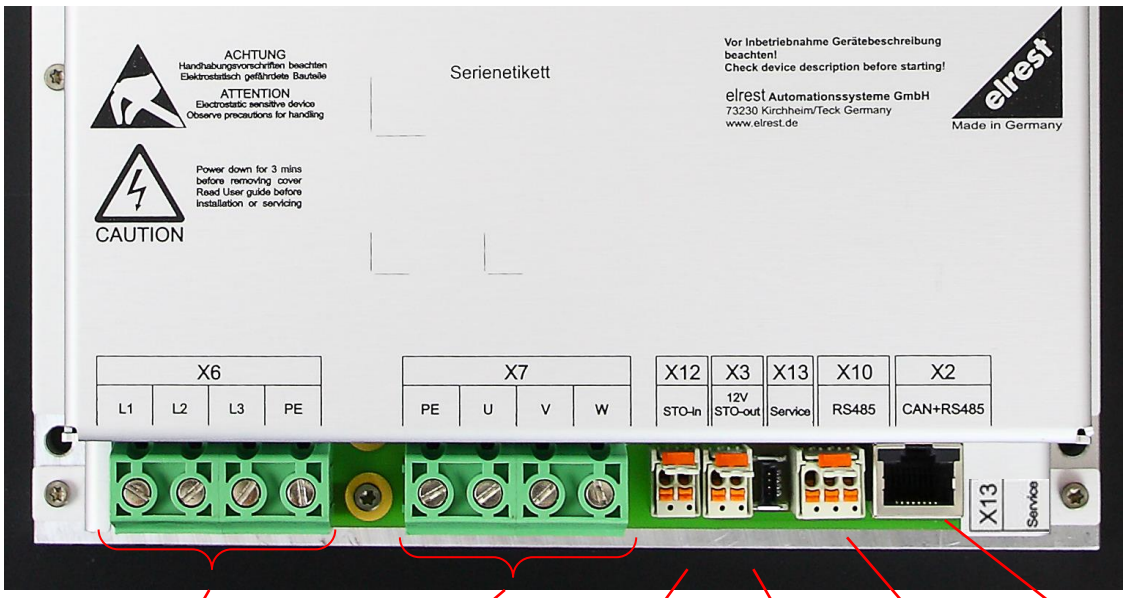
Encoder speed control	Pump drives (heat-, delivery pumps), fans and compressor

E601414-1.3

elrest Automationssysteme GmbH • Leibnizstraße 10 • 73230 Kirchheim unter Teck • Tel.: +49 (0) 7021 92025-0

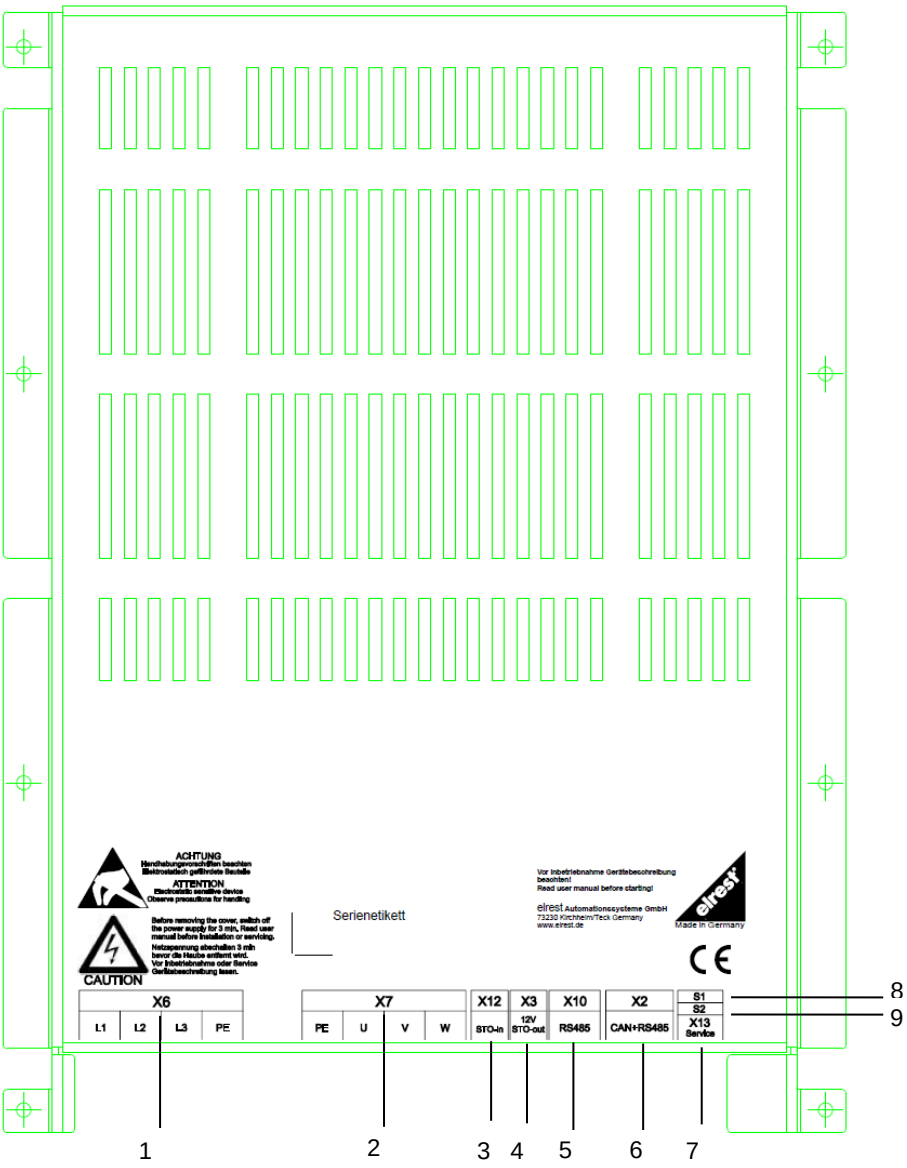
4 Interfaces

BILD tauschen



	X6 (s. 4.3.1)	X7 (s. 4.3.2)	X12(s. 4.3.4)	X3 NC (s. 4.3.5)	X10 (s. 4.3.7)	X2 (s. 4.3.6)
PIN	1-4	1-4	STO-IN“	STO-OUT	1-3	1-8
The pin assignment is from left to right.						

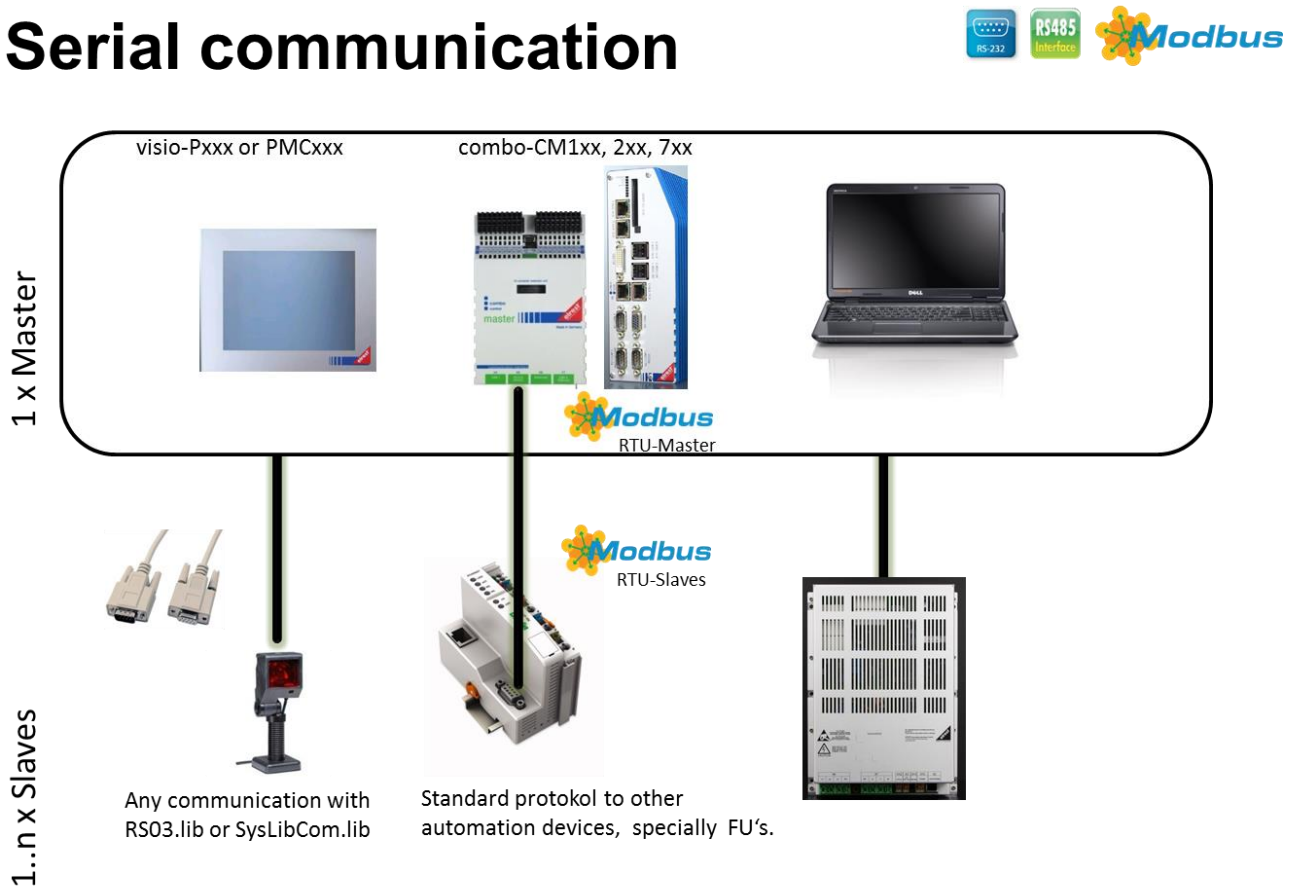
4.1 Front view of the interfaces



Nr.		Designation
1	X6	Power supply - 3-phased 340 VAC…500 VAC (3-phased)
2	X7	Connection motor
3	X12	STO-In
4	X3	STO-OUT 12 V
5	X10	RS-485
6	X13	Service
7	S1	CAN terminal resistor
7	S2	RS-485 terminal resistor

4.2 Crosslinking

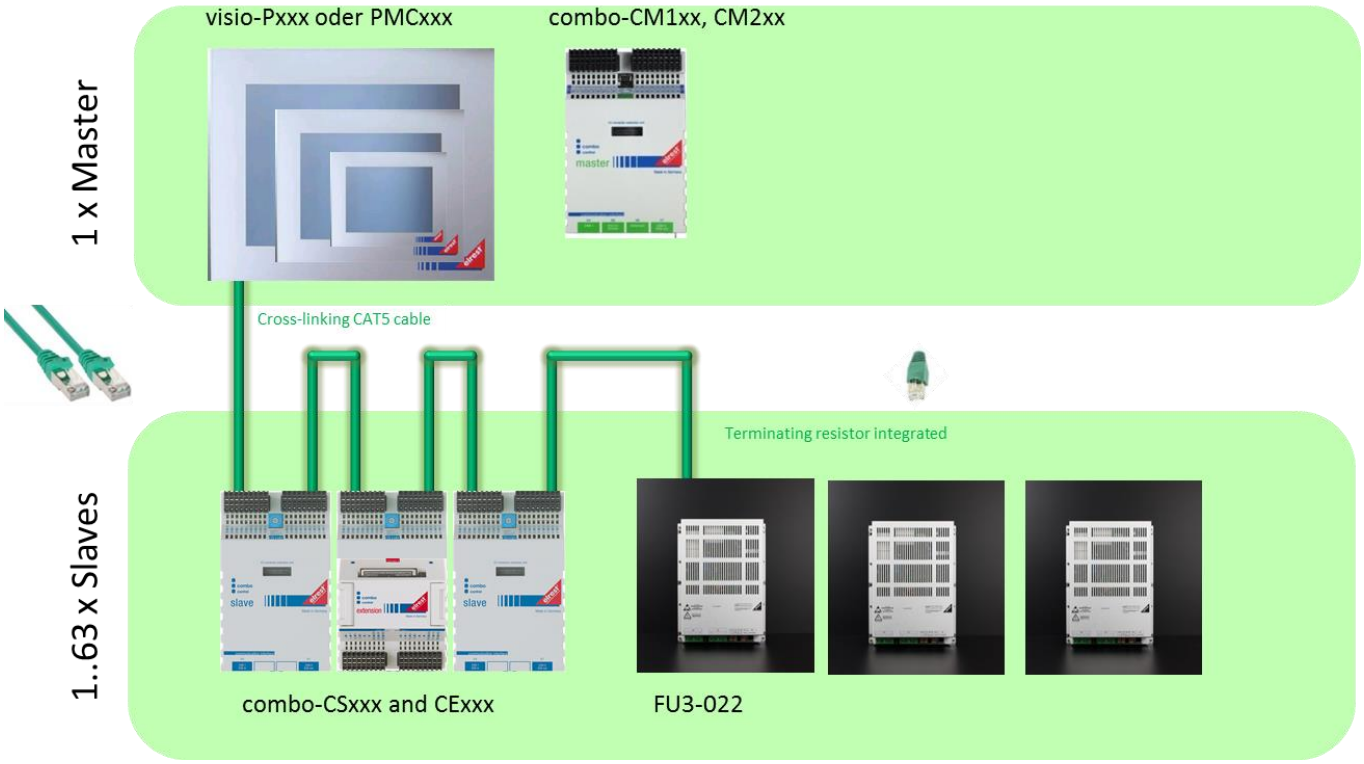
4.2.1 Crosslinking with RS485 and RTU-modbus



The frequency converter FU3-022 has integrated a RS485 terminating resistor, so by connecting several FU3-022 devices, the internal resistor must be deactivated via the slide switch S2.

Delivery state: S2 slide switch is active

4.2.2 Crosslinking with CANopen



A CAN- network can comprises of maximum of 127 participants, without a repeater 64 paricipants.
The CAN physics allows a length of maximum 1000m @ 50 kBaud

If the crosslinking will be made of several frequency converters, the interface 1 x RJ45 CAN must be widened to 2 x RJ45 (CANin, CANout) by Y- adapters.

The frequency converter FU3-022 has integrated a CAN terminating resistor, so by connecting several FU3-022 devices, the internal resistor must be deactivated via the slide switch S1.
Delivery state: S1 slide switch is active

4.3 Terminal assignment

4.3.1 X6: power supply- 3-phased 400 V_{nom}…480 VAC

	PIN	Configuration
	1	L1
	2	L2
	3	L3
	4	PE

4.3.2 X7: Connection motor

	PIN	Configuration
	1	PE
	2	U
	3	V
	4	W

4.3.3 X3: STO Terminal assignment

Terminal assignments with and without STO- functionality:

	PIN	Configuration
X12  1 2	X3  1 2	<u>Version 1: without STO-function</u> Bridge X3 PIN 1 on X12 PIN 1 (+12 V) Bridge X3 PIN 2 on X12 PIN 2 (GND) <u>Version 2: with STO function with internal supply (via the device)</u> Bridge X3 PIN 2 via emergency stop (safty switch)on X12 PIN 2 Bridge X3 PIN 1 via emergency stop (safty switch) on X12 PIN 1 <u>Version 3: with STO- function with external supply</u> Challenges to an external supply: • 12- 24 VDC +/- 10% • 0,1 A output current • SELV • Isolation 500 VDC to PE External VDC 12 – 24 V or VAC 24 V via emergency stop (safty switch) on X12

4.3.4 X12: STO Input

	PIN	Configuration
	1	STO-IN1 (+12 - 24 VDC, nom.) or 12-24 VAC
	2	STO-IN2 (GND) or 12-24 VAC

4.3.5 X3: STO aux supply

Used for supply of the STO- inputs

	PIN	Configuration
	1	STO- Supply1 (OUT + 12 V)
	2	STO- Supply2 (OUT GND)

4.3.6 X2: CAN interface and modbus RS-485

This interface is designed as a RJ45 connector with galvanic isolation according to ISO 11898

	PIN	Configuration
	1	CAN data low dominant (B_LA)
	2	CAN data high dominant (B_HA)
	3	CAN-GND (Signal Ground)
	4	RS-485 B ModBus
	5	RS-485 A ModBus
	6	Not connected
	7	Not connected
	8	CAN-GND (Signal Ground)

Notes to the connector socket on the cable:

Only connect the pins which are required for your application.
A terminal resistor on both ends is needed for the complete bus structure

A terminal resistor of 172 Ohm is integtated in the FU03-22.

Make sure, that a second termination resistor of 120 Ohm is installed at the end of the bus cable.

4.3.7 X10: Modus RS-485 interface

These interfaces are connected via a 3-pole plug.
They are not galvanically isolated from the supply voltage of the device.

	PIN	Configuration
	1	CAN-GND (Signal Ground)
	2	RS-485 A ModBus
	3	RS-485 B ModBus

Notes to the connector socket on the cable:

Only connect the pins which arerequired for your application.
A terminal resistor on both ends is needed for the complete bus structure

A terminal resistor of 172 Ohm is integtated in the FU03-22.

Make sure, that a second termination resistor of 120 Ohm is installed at the end of the bus cable.

All signal connections require screened cables.

- All plug connections have to be screwed or locked.
- Signal cables must not be let within the same cable shaft as high voltage cables.
- No liability can be accepted for malfunctions and defects created by the use of unsuitable cables
- Unused signals (e.g. unused interfaces, battery connections etc.) must be suitable covered to avoid electrostatic influences (EGB / ESD).
- Only plug or unplug cable, if the device has been switched off.
- All cables which are connected with the device must be connected with a remote station.

4.3.8 Ambient temperature

The internal device temperature of the FU3-022 is determined cyclically.
The determined value will be absorbed by the help of the temperature sensor on the circuit board.

The ambient temperature of 55 °C must not be exceeded
Otherwise any warranty and liability expires and the device can be destroyed.

5 Software description FU3-022

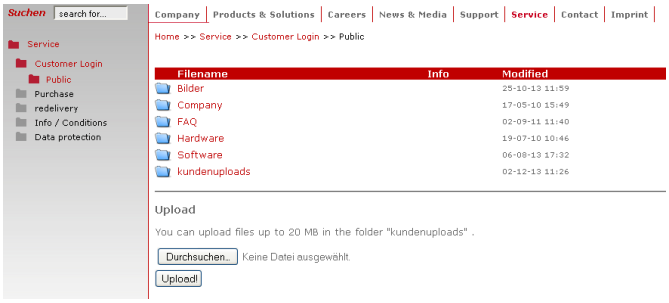
5.1 Software installation

5.1.1 CODESYS package manager installation

The easiest way is to install from the: elrest homepage.

After Service ➔ Customer Login you will redirected to the public download area. You get the password for the first time and immediatly after request.

support@elrest-gmbh.de



Change to : ***Public➔Software➔CODESYS➔V3➔CODESYS_Install***

Choose the highest version number. Copy the file to your local drive und install (e.g.)

Setup: CODESYS V3_complete installation

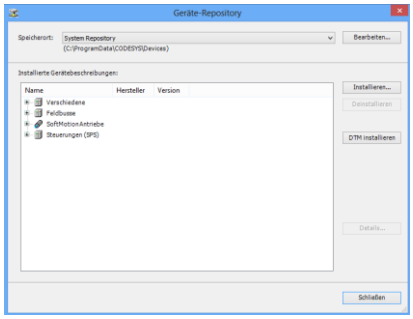
The file has a size of 0,5 GB
Download and installation will take some time.

5.1.2 CODESYS Package Manager installation

Change to : ***Public➔Software➔CODESYS➔ V3➔Packages***

For each device version the *.package or *.devdesc.xml files are stored.
E.g.:FU03.devdesc.xml

In CODEYSYS you start the device repository.



With the button 

you can install the selected dives.

5.2 Measuring of current and voltage

5.2.1 Description

Display of the effective values of current and voltage, the strength of the mean value filters can be parametrized.

5.2.2 Parameters 2030-2039

Nummer	Name	Value Range	Access	Description
2030	Current RMS		r--	Display of the effective current in ampere
2031	Voltage RMS		r--	Display of the effectivevoltage in volt
2035	Oversamplingrate Measuring of current and voltage		rws	Number of values above the average value sets, if value = 0, no display of current, voltage and power.
2039	Output Power		r--	Calculated apparent power from 2030 and 2031

5.3 Automatic Restart

5.3.1 Description

Special function for the sensorless conrol of heat pumps.

The function controls, if the motor was started or the rotor is blocked. If the estimated motor speed during 10 s is under the limit value of 30 U/s, and at the same time the current stays over 80% of the current limiting (ID35), the blocked rotor will be regognized and the release will be stopped for 10 seconds. Then it´s tried for several times to restart, if the setting numbers of start attempts, determined by the parameter ID2040 „Rotor Restart Max Tries“, was unsuccesed, the error 20 (ERROR_ABNORMAL_CONDITION) will be set.

5.3.2 Parameter 2040

Number	Name	Range of values	Access	Description
2040	Rotor Restart Max Tries	-1 …. 32767	rws	Max. number of start attempts, before responding an error.

5.3.3 Operation

The control of the blocked rotor will be deactivated by setting parameter ID2040 to -1.

5.4 Switch of the acceleration

5.4.1 Description

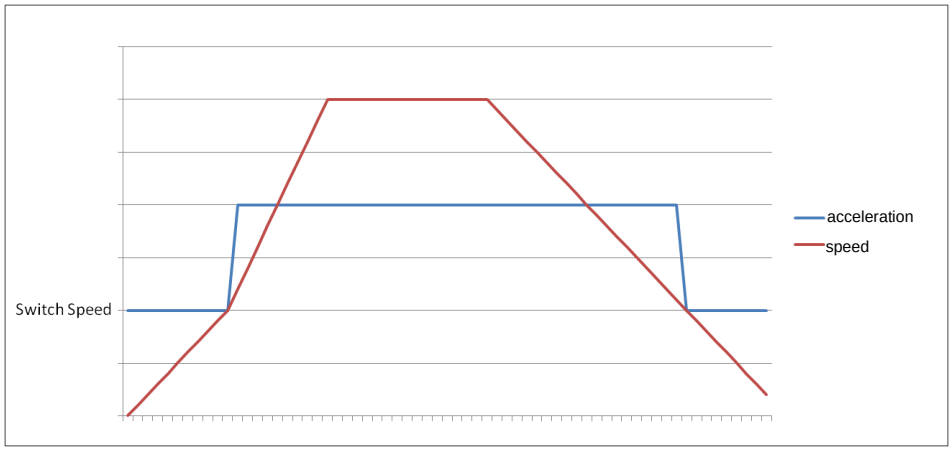
Some applications demand in several speed ranges several accelerations. The function can be used therefore.

5.4.2 Parameters 2043-2046

Number	Name	Range of values	Access	Description
2043	Switch Acceleration Cmd	0-1	rw-	0: inaktive 1: aktive
2044	Acceleration Start		rws	Acceleration in rps/s from 0rps to Switch Speed
2045	Acceleration Run		rws	Acceleratio in rps/s for actSpeed > Switch Speed
2046	Acceleration Switch Speed		rws	Speed, where the acceleration will be switched.

5.4.3 Operation

Characeristics of acceleration via speed

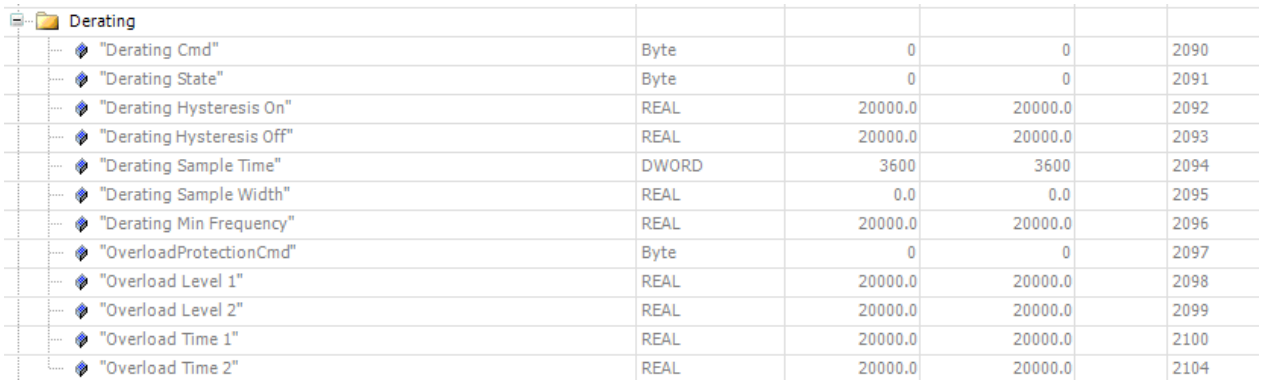


5.5 Derating

5.5.1 Description

For the protection of the power unit, the dearating can be started from a certain heat sink temperature or power. You can choose from reduction of speed or PWM frequency, whereby lowering the total losses, respectively switching losses.

5.5.2 Parameters 2090-2096



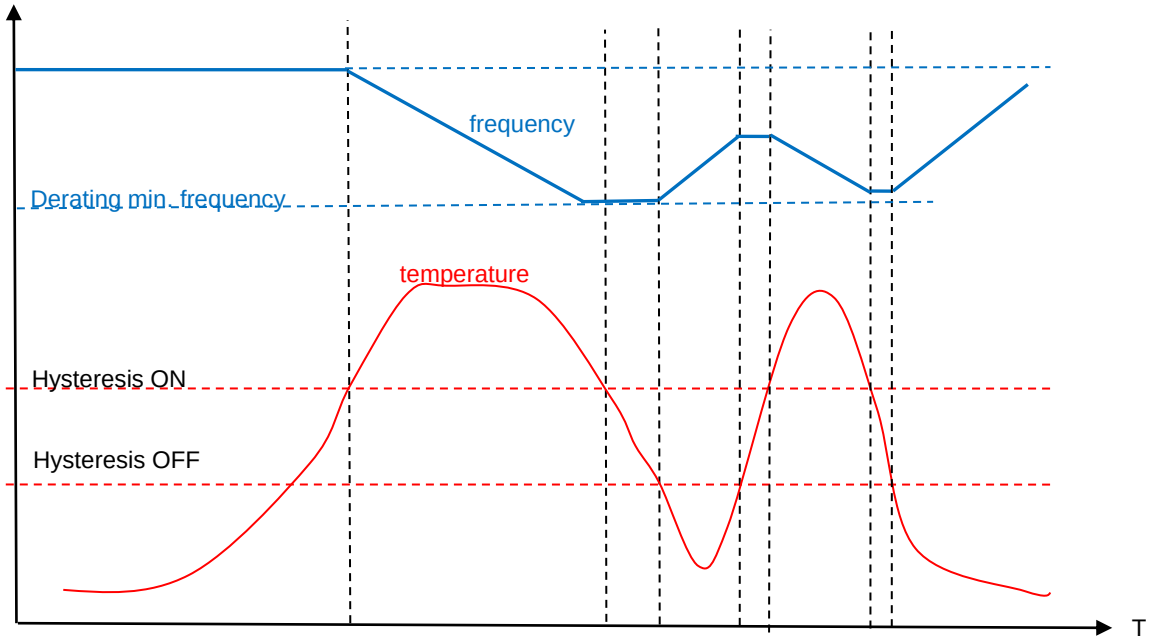
Derating					
"Derating Cmd"	Byte	0	0		2090
"Derating State"	Byte	0	0		2091
"Derating Hysteresis On"	REAL	20000.0	20000.0		2092
"Derating Hysteresis Off"	REAL	20000.0	20000.0		2093
"Derating Sample Time"	DWORD	3600	3600		2094
"Derating Sample Width"	REAL	0.0	0.0		2095
"Derating Min Frequency"	REAL	20000.0	20000.0		2096
"OverloadProtectionCmd"	Byte	0	0		2097
"Overload Level 1"	REAL	20000.0	20000.0		2098
"Overload Level 2"	REAL	20000.0	20000.0		2099
"Overload Time 1"	REAL	20000.0	20000.0		2100
"Overload Time 2"	REAL	20000.0	20000.0		2104

Number	Name	Range	Access	Description
2090	Derating Cmd	0 - 255	rw-	0: Derating inactive 1: Derating via speed 2: Derating via PWM-frequency according to heat sink temperature; 3: Derating via PWM-frequency according to the calculated IGBT-temperature. 4. Reduction of speed, according to power.
2091	Derating State	0 - 255	r--	0: Derating inactive 1: Derating active 2: The old value will be restored, because the heat sink temperature, respectively, power < Hysteresis Off
2092	Derating Hysteresis On	0- 255	rws	Temperature or power, as the derating will be started
2093	Derating Hysteresis Off	0-255	rws	Temperature or power, belows to the originally speed, respectively, the PWM-value will be restored.
2094	Derating Sample Time	0-255	rws	Time in seconds, between reduction by „sample width“
2095	Derating Sample Width	0-255	rws	Indicates about the rps or Hz of the speed / PWM- frequency will be derated.
2096	Derating End Frequency	0-255	rws	Reduced to minimum speed or frequency.

5.5.3 Operating

If derating is desired, you have to set via CMD, also the temperature limits have to be set.

If the heat sink reachs a temperature above the specified hysteresis, the drive automatically take back to the choosen frequency. This continues until the parametrised minimum frequency or the hysteresis temperature will be achieved. As soon as the temperature will be between the upper and the lower hysteresis temperature, the frequency is constant. If the temperature exceeds the lower hysteresis temperature, the frequency will be slowely increased. As shown on the picture 3.



5.6 Parameter interfaces

5.6.1 Description

With this function, the parameter-set can be stored, loaded or deleted.

5.6.2 Parameter 2101

Number	Name	Value	Access	Description
2101	Parameter Command	0 – 2	rw-	0: do nothing 1: Save of all parameters 2: Scanning again of data records 3: Delete data records

5.7 Ring buffer

5.7.1 Description

This function ia an access for parameterizing the integrated FPGA in the ring buffer.

5.7.2 Parameters 2110-2122

Number	Name	Value	Access	Description
2110	Ring buffer Ctrl		rw-	Writing: 1: Starts ring bufferr recording 3: Stops the recording. Copies the latest data in ringbuffer.csv . 4: Stops ring buffer Reading: 1: Initialisation/ Wait for start 2: Recording is running 3: Ring buffer is read 4: Ring buffer stops
2111	Ring buffer Stopping time	0-511	rw-	Stopping time in samples, shows how many measurement point can be recorded after initiation of the trigger.
2112	Ring buffer Config		rws	Array via 4 channels Each channel has the following structure ➢ Scaling ➢ Source Scaling: Scaling faktor, only takes account of osci-funktionality, was only used internally. Source: number of the parameter, beeing used for recording of the ring
2113	Ringbuffer Sample Time		rws	Settings for the scampling time of the ring buffer as multible of 2.66µs.
2114	PseudoOsci 0		rws	In this registers, osci addresses can directly entered, see circular buffering. These parameters can be used to access with Ringbuffer Config directly to the memory locations.
2115	PseudoOsci 1		rws	
2116	PseudoOsci 2		rws	
2117	PseudoOsci 3		rws	
2118	Ring buffer Channel 0		rws	Shows the actually contents of the ring buffer on the position of the read pointer.
2119	Ring buffer Channel 1		rws	
2120	Ring buffer Channel 2		rws	
2121	Ring buffer Channel 3		rws	
2122	Ring buffer Channel	0…0xF	rws	By setting of the corresponding bit, you define, if the

	dialog			contnent of the channel shall be written into the file. Bit 0 : Channel 0; Bit1 : Channel 1; Bit 2 : Channel 2; Bit3 : Channel 3.

5.7.3 Operation

Only parameters can be recorded, which are saved in the FPGA. Parameters located in NIOS, cannot added for monitoring. If you choose a parameter in ring buffer config, which cannot be monitored, the registered value will not be accepted.

Exemplary configuration:

The following values should be monitored:

- Heat sink temperature
    - Id: 119
- Speed
    - Id: 45
- Isq-set
    - Id: 18
- Ambient temperature
    - Id: 117

With a sampling frequency of 100Hz, it results a samling time to 3760-times of scanning time of 2,99µs equal 10,0016ms. It is enough to write 10ms in the parameter, because this one calculated automatically the correct time.

These ids have to be rgistered in the RingBufferConfig. Accordingly, the ring buffer will be started in RingbufferCtrl, by writing “1”. After a certain waiting time, it will be stopped by writing “3”.

According the bit mask in parameter ID2122 Ringbuffer Channel Mask, the contents of the individual ring buffer channels will be written in the file “ringspeicher.csv”. This way, unnecessary or dummy data aren’t copied in the file: The size of the file will be limited. This recduces the upload-time of the file to a PC, where the ring buffer can be selected.

5.8 Setting Modbus

5.8.1 Description

The monitoring access via Modus RTU to several registers on the drive. Among others, the following values are called cyclically:

- mechanical speed
- Effektive current
- Effektive voltage

Via “address pointer” can be mapped on these three registers other parameters.

With this module you can define the timout for the modbus.

5.8.2 Parameters 2130-2399

Number	Name	Value	Access	Description
2130	contents registery 1417 (Compr. f)		rws	unsigned 16bit, value 100 times, resolution of the first two fractional digits.
2131	contents registery 1422 (compr. current)		rws	signed 16bit, value 10 times, resolution of the first fractional digits.
2132	contents registery 1423 (compr. voltage)		rws	signed 16bit, value without fractional digits.
2133	modbus time-out		rws	maximum time during 2 modbus telegrams in seconds, if this time is exceeded, error 15 will be set.
2399	modbus baud rate	1200 2400 4800 9600 19200 38400 57600 115200 230400	rws	clock modbus Bits/sek

5.8.3 Operation

Via default, the following values are in the parameters of registry:

- 2130 -> 43
    - Setpoint speed of the setpoint generators, according to the actual speed of operation
- 2132 -> 2030
    - Filtered effective value of the current
- 2133 -> 2031
    - Filtered effective value of the voltage

Equivalent to the values, as the required in the specification of the modbus. These registers serve to commissioning purposes, for example to monitoring temperature via modbus.

5.9 Preheat

5.9.1 Description

With this function the drive can be preheated in standstill, if the application demands a several motor temperature for starting.

5.9.2 Parameters 2140-2145

Number	Name	Value	Access	Description
2140	Preheat Set Value		rws	Heat output in Watt
2141	Preheat Kp		rws	Kp of the power controller
2142	Preheat Ki		rws	Ki of the power controller
2143	Preheat Ta		rws	Sampling time of the controller
2144	Preheat Cmd		rw-	0: Preheat of 1: Preheat, manipulated variable I_q 2: Preheat, manipulated variable U
2145	Preheat Limit		rws	Limit for controller output

5.9.3 Operation

For the prehaeting a freely parameterizable, digital PI-regulator will be used, which controls the adjusted value of parameter 2039, output power.

By activating preheat, the set rotation speed runs automatically to 0, and the drive is released. With deactivating, the regulator release will be taken back. The complete process of preheating can be controlled via parameter 2144.

5.10 Modbus connection

The specifications for modbus-RTU apply.

The following registers are imlemented for the device:

Register	Name	Access	Min	Max	Unit	Description
1408	Speed-setpoint	rw	0	12000	0,01 rps	mechanical data speed
1409	Control word	rw	0	65536	-	see description: control-/ status word
1410	Nominal acceleration values	rws	0	10000	0,01 rps/s	
1411	Nominal current preheat	rws	0	100	0,1 A	
1412	Modbus Baud rate	rws	1200	57600	Baud	valid after reset, if saved.
1415	Status word	r	0	65536		see description: control-/ status word
1416	Error word	r	0	20		see description: error word
1422	Actual current value	r	0	450	0,1 A	
1424	Intermediate circuit voltage	r	0	800	V	
1425	Actual speed value	r	0	12000	0,01 rps	
1427	Actual value preheat	r	0	100	0,1A	
1428	Ambient temperature	r	0	2000	0,1°C	
1429	Heat sink temperature	r	0	2000	0,1°C	
1431	SW-version (low word)	r	0	9999999	---	Transferred without a full stop, e.g: 01.02.000 gets 10200
1432	SW-version (high word)					
1433	kWh-counter (low word)	r	0	2^{32}	kWh	
1434	kWh-counter (high word)					

Control word:

7-15	5-6	4	3	2	1	0
rsvd	Ext. Release dialog	Save parametes	preheat	error acknowledgment	Quick stop	on

Bit0: Release of the controller, depends of external release.

Bit1: The drive will be stopped und switched-off with parametrized quick stop delay.

Bit2: All errors will be deleted.

Bit3: Preheat will bestarted

Bit4: Stored of parameter data set

Bit5-6: External release mask:

10 external 24V are needed for the controller enable

01 no external enable necessary

00 unknown command

11 unknown command

Status word:

10-15	9	8	7	6	5	2-4	1	0
rsvd	Ext. Release dialogue	external release	Start-up test	Derating active	Preheat active	rsvd	error	on

Bit0: The controller is released

Bit1: Controller is on error status

Bit5: Preheat runs

Bit6: Controller is in derating operation

Bit7: Start-up test runs

Bit8: External regulator release (24V) is installed

Bit9: External release of dialogue

1 External release isn’t necessary

0 External release is necessary

5.10.1 Error word:

0: No error

1: Excess temperature heat sink

3: Over-current hardware

5: DC link undervoltage

6: DC link overvoltage

7: External release is missing

8: Error at preheat

11: Overload

12: Over-current software

14: Blocked rotor, maximum number of stat-ups is exceeded

15: Timeout modbus

16: Error in temperature sensor of heatsink

20: Abnormal conditions

6 Services and maintenance

6.1 Service

6.1.1 General

Please ensure you observe the following points, or daily inspection:

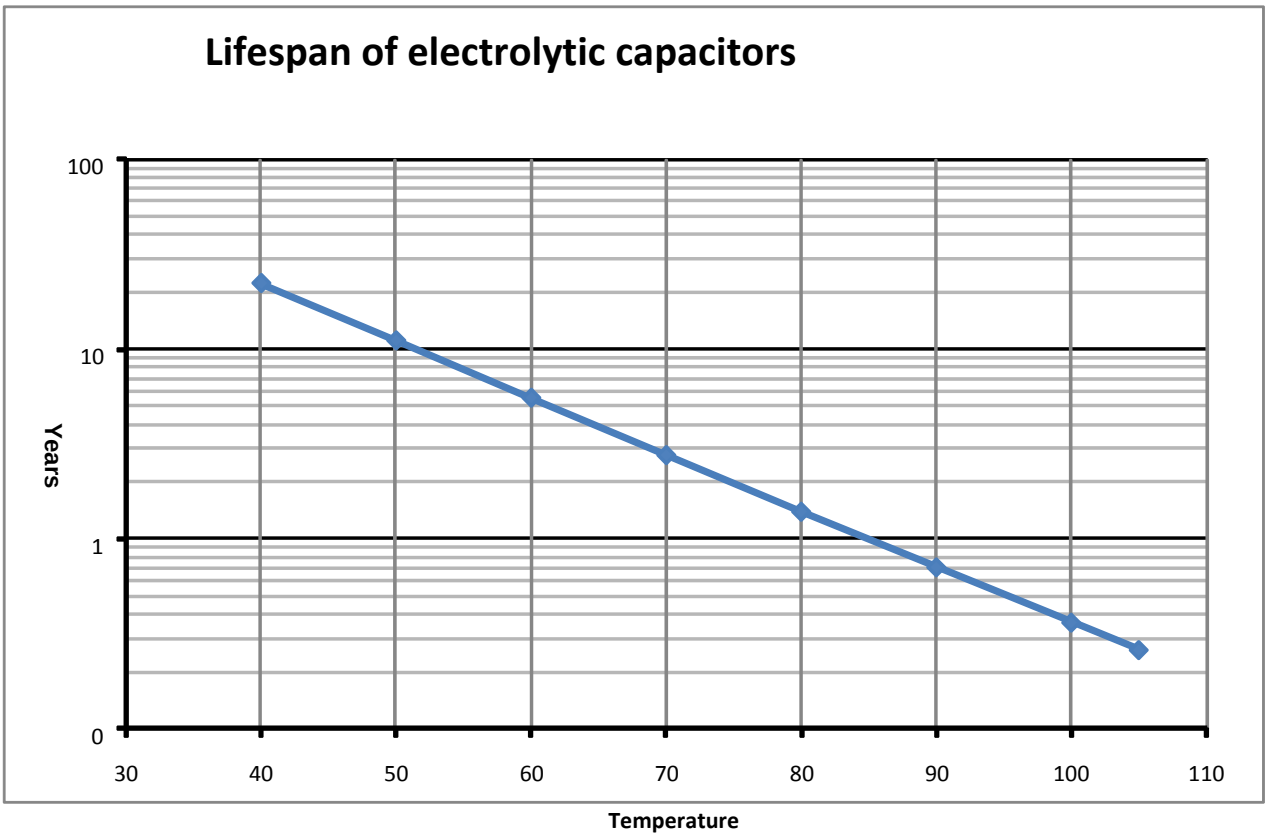
- The motor runs correctly?
  - Unusal noises are occur?
  - Unusal vibrations are visible?
- Permissible ambient conditions will be adheared?
- Are there disturbances to the cooling system?
  - Pay attention of fluid loss with liquid cooling
- Are there discolorations visible at the converter housing?
- Is the temperature of the housing unusally high?

6.1.2 Regular servicing

When using a converter with expanded DC link, the capacitor block has to be renewed according to the following lifespan diagram. By an average ambient temperature of 50°C, the DC link capacitors have to be replaced after 10 years.

This is determined by the functional principle of the used aluminum electrolytic capacitors, and no defect of the converter.

Will be renounced of the expanded DC link:
An exchange is not necessary, resulted out of using film capacitors in the DC link.



The following checks have to be performed of an anual cycle:

- Check and remove the contaminationof the vans and cooling fins.
- Clean air filters, in order to ensure adequate cooling of the converter.
- Ensure that cables and screw terminals are firmly seated and secured. They could work lose by vibration and temperature fluctuations during the operation.
- Visual inspection of chafes on wiring and defects on the isolation.

6.2 Device fails

The devices were functions tested before distribution.
Nevertheless, if an error should arise, you can find a return form (RMA) on our website under the heading "service/ return delivery". Please complete the registration form and submit. We'll see to it at once.

Please attach an exact error description to any return. Therefore, the repair of the device can be done as quickly as possible.

6.3 Accessory

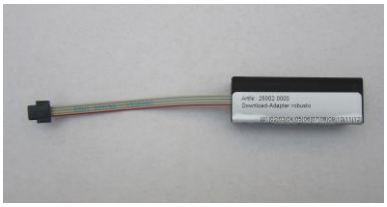
6.3.1 Connecting cables for RS485

Designation	Article number.	Description with a picture
USB-RS232-adapter	240020100	Provides a serial interface for notebooks. Cable with wire-end ferrules and plug as X10 

6.3.2 Connecting cables for CAN

CAN/MPC-5/CAN-USB-ADAPTER	105097	Provides a CAN interface for notebooks. Mostly used with article number: 240020903 
Connecting cable from Sub-D9 des CAN-USB-ADAPTER on RJ45 of the frequency converter FU3-022.	240020100	Cablel, PXXX-->ESB 
<u>Optional:</u> T-Adapter RJ45 St. -> 2xRJ45 Bu.;0,15m;grey	240020906	 Adapter 1 x RJ45 St. -> 2 x RJ45 Bu.;0,15m;grey Mostly used with article number:240020501 for comboMaster CAN1

6.3.3 Connecting cables and adapter for service interface

Download-adapter	25002.0000		
Cable for adapter	commercial	USB A on USB-Micro-B	

7 Troubleshooting

7.1 Service and support

Hotline

For additional support and information contact our hotline with the following times:

Mon-Fri: 8.00- 12.00 and 13.00 - 16.30

Phone: +49 (0) 7021 / 92025-33

Besides, you can of course always contact us by mail or fax.

Fax.: +49 (0) 7021 / 92025-29
e-mail: support@elrest.de

Training and workshops

We offer education or project-based workshops for the elrest products.

Please contact our sales deparment for further information.

Phone: +49 (0) 7021/92025-0
Fax: +49 (0) 7021/92025-29
E-mail: vertrieb@elrest.de

8 History

Date	*Name*	*Version*	*Changing*
17.11.2014	He/GS	1.0	Created
30.01.2015	He/Ep	1.1	X3: description is complemented
30.01.2015	He/Ep	1.2	Isolation structures FU3-22 added

E602020-1.1

make any changes, particularly where such changes are the result of technical development, more economic design or similar factors. Customers are solely responsible for the external connection of the devices.

9 Appendix

9.1 CANopen-objects

Below there are listed all communication- and user objects for the frequency converter.

They will be summarized in the object directory (od). In the CANopen device model is the od the link between application and the CANopen communication unit. Each entry in the object directory stands for an object and will be identified with a 16-bit index. An index can contains up to 255 sub-indices. Therefore, independently of the 11-bit-identifiers, up to 65536 × 254 elements can be distinguished. (The sub-indices 0 and 255 cannot be used freely). In profiles the assignment of communication- and deviceprofile-objects is exacty defined, therefore from the object- directory an unique interface will be defined between the application and the external communication.

9.1.1 Communication objects

- Devict type object 1000_h
- Error register object 1001_h
- Identity object 1018_h

9.1.2 Object 1000h: Device Type -read only

The device type object shall define the device type, the device's functionality, and the mapping variant.

31 24	23 16	15 0
Additional informationen		**Device profil number**
Modebits	type	$402_d = 192_h$
MSB		**LSB**

Index	**1000_h**
Name	Device type
Object code	Variable
Data Type	Unsinged32

Sub-Index	**00_h**
Access	c
PDO Mapping	None
Value range	See Value definition
Default value	0x10192

9.1.3 Object 1001h: Error register -read only

The object shall define the error register fort he device. The device can entered internal errors in the registry: This object is a part of a error object.

Index	**1001_h**
Name	Error register
Object code	Variable
Data type	Unsigned8

Subindex	**00_h**
Access	c
PDO Mapping	None
Value Range	See Value definition
Default Value	0

9.1.4 Object 1018h: Identity Object

The parameter contains general device informations.

Index	**1018_h**
Name	Identity Object
Object code	Record
Data type	Identity

Subindex 0 Largest SunindexSupported – read only

Subindex	**00_h**
Description	Number of entries
Data type	Unsigned8
Access	ro
PDO Mapping	None
Value Range	See Value definition
Default Value	Manufacturer-specific

Subindex 1 is a unique number for a device manufacturer.

Subindex 1	**01_h**
Description	Vendor ID
Category	mandatory
Access	ro
PDO Mapping	None
Value Range	See Value definition
Default Value	Manufacturer-specific

Subindex 2 contains the general device number and information enthält die allgemeine Gerätenummer and informationen about DC-Bus voltage and current class.

Subindex 2	**02_h**
Description	Product Code
Access	ro
PDO Mapping	None
Value Range	See Value definition
Default Value	Manufacturer-specific

Subindex 3 consists of two revision numbers:
- the major revision number defines the CAN version
- the sub- revision number defines the firmenware version

Subindex 3	**03_h**
Description	Revision Number
Access	ro
PDO Mapping	None
Value Range	See Value definition
Default Value	Manufacturer-specific

Subindex 4 Defines the manufacturer serial number.

Subindex 4	**04_h**
Description	Serial Number
Access	ro
PDO Mapping	None
Value Range	See Value definition
Default Value	Manufacturer-specific

9.1.5 Object $603F_h$: Error code

This object shall provide the error code of the last error, which occurred in the drive device.
Möglicher Error values see chapter 5.10.1 Error word

Index	**$603F_h$**
Name	Fehlercode
Object code	Variable
Data type	Unsigned 16
Category	Optional

Subindex	**00_h**
Access	ro
PDO Mapping	None
Value Range	See table below
Default Value	No

Error code	Meaning
2110h	Short circuit/earth leakage (input)
2120h	Earth leakage (input)
2121h	Earth leakage phase L1
2122h	Earth leakage phase L2
2123h	Earth leakage phase L3
2130h	Short circuit (input)
2131h	Short circuit phases L1-L2
2132h	Short circuit phases L2-L3
2133h	Short circuit phases L3-L1
2200h	Int. Scurrent limit
2211h	Internal current no.1
2212h	Internal current no.2
2213h	Over-current in ramp function
2214h	Over-current in the sequence
2220h	Continuous over current (device internal)
2221h	Continuous over current no.1
2222h	Continuous over current no.2
2230h	Short circuit/earth leakage (device internal)
2240h	Earth leakage (device internal)
2250h	Short circuit (device internal)
2310h	Continuous over current
2311h	Continuous over current no.1
2312h	Continuous over current no.2
2320h	Short circuit/earth leakage (motor-side)
2330h	Earth leakage (motor-side)
2331h	Earth leakage phase U
2332h	Earth leakage phase V
2333h	Earth leakage phase W
2340h	Short circuit (motor-side)
2341h	Short circuit phases U-V
2342h	Earth leakage phase V-W
2343h	Earth leakage phase W-U
2350h	Load level fault (I^2t, thermal state)
2351h	Load level warning (I^2t, thermal state)
3110h	Mains over-voltage
3111h	Mains over-voltage phase L1
3112h	Mains over-voltage phase L2
3113h	Mains over-voltage phase L3
3120h	Mains under-voltage
3121h	Mains under-voltage phase L1
3122h	Mains under-voltage phase L2
3123	Mains under-voltage phase L3
3130h	Phase failure
3131h	Phase failure L1
3132h	Phase failure L2

3133h	Phase failure L3
3134h	Phase sequence
3140h	Mains frequency
3141h	Mains frequency too great
3142h	Mains frequency too small
3210h	DC link over-voltage
3211h	Over-voltage no. 1
3212h	Over voltage no. 2
3220h	DC link under-voltage
3221h	Under-voltage no. 1
3222h	Under-voltage no. 2
3230h	Load error
3310h	Output over-voltage
3311h	Output over-voltage phase U
3312h	Output over-voltage phase V
3313h	Output over-voltage phase W
3320h	Armature circuit
3321h	Armature circuit interrupted
3330h	Field circuit
3331h	Field circuit interrupted
4100h	Ambient temperature
4110h	Excess ambient temperature
4120h	Too low ambient temperature
4130h	Temperature supply air
4140h	Temperature air outlet
4200h	Temperature device
4210h	Excess temperature device
4220h	Too low temperature device
4300h	Temperature drive
4310h	Excess temperature drive
4320h	Too low temperature drive
4400h	Temperature supply
4410h	Excess temperature supply
4420h	Too low temperature supply
5100h	Device- hardware
5100h	Supply
5110h	Supply low voltage
5111h	U1 = supply ±15V
5112h	U2 = supply +24 V
5113h	U3 = supply +5 V
5114h	U4 = manufacturer-specific
5115h	U5 = manufacturer-specific
5116h	U6 = manufacturer-specific
5117h	U7 = manufacturer-specific
5118h	U8 = manufacturer-specific
5119h	U9 = manufacturer-specific
5120h	Supply intermediate circuit
5200h	Control
5210h	Measurement circuit

5220h	Computing circuit
5300h	Operating unit
5400h	Output stages
5410h	Power section
5420h	Chopper
5430h	Input stages
5440h	Contacts
5441h	Contact 1 = manufacturer-specific
5442h	Contact 2 = manufacturer-specific
5443h	Contact 3 = manufacturer-specific
5444h	Contact 4 = manufacturer-specific
5445h	Contact 5 = manufacturer-specific
5450h	Fuses
5451h	S1 = I1
5452h	S2 = I2
5453h	S3 = I3
5454h	S4 = manufacturer-specific
5455h	S5 = manufacturer-specific
5456h	S6 = manufacturer-specific
5457h	S7 = manufacturer-specific
5458h	S8 = manufacturer-specific
5459h	S9 = manufacturer-specific
5500h	Hardware memory
5510h	RAM
5520h	ROM/EPROM
5530h	EEPROM
6010h	Software reset (watchdog)
6301h to 630Fh	Data record no. 1 to no. 15
6310h	Loss of parameters
6320h	Parameter error
7100h	Power
7110h	Brake chopper
7111h	Failure brake chopper
7112h	Over current brake chopper
7113h	Protective circuit brake chopper
7120h	Motor
7121h	Motor blocked
7122h	Motor error or commutation malfunc.
7123h	Motor tilted
7200h	Measurement circuit
7300h	Sensor
7301h	Tacho fault
7302h	Tacho wrong polarity
7303h	Resolver 1 fault
7304h	Resolver 2 fault
7305h	Incremental sensor 1 fault
7306h	Incremental sensor 2 fault
7307h	Incremental sensor 3 fault
7310h	Speed

7320h	Position
7400h	Computation circuit
7500h	Communication
7510h	Serial interface no. 1
7520h	Serial interface no. 2
7600h	Data storage (external)
8300h	Torque control
8311h	Excess torque
8312h	Difficult start up
8313h	Standstill torque
8321h	Insufficient torque
8331h	Torque fault
8400h	Velocity speed controller
8500h	Position controller
8600h	Positioning controller
8611h	Following error
8612h	Reference limit
8700h	Sync controller
8800h	Winding controller
8900h	Process data monitoring
8A00h	Control
F000h	Additional Functions
F001h	Deceleration
F002h	Sub-synchronous run
F003h	Stroke operation
F004h	Control
FF00h to FFFFh	Manufacturer-specific

9.1.6 Object 6402h: Motor type

This object shall indicate the type of motor attached to and driven by the drive device.

Index	**6402h**
Name	Motor type
Object code	Variable
Data type	Unsigned16

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	See Value definition
Default Value	Manufacturer-specific

Value	CANopen name	Other names
0000h	Non-standard motor	-
0001h	Phase modulated DC motor	-

0002_h	Frequency controlled DC motor	-
0003_h	PM synchronous motor	-
0004_h	FC synchronous motor	AC synchronous sinewave wound field
0005_h	Switched reluctance motor	AC synchronous reluctance switched
0006_h	Wound rotor induction motor	AC asynchronous induction polyphase wound rotor
0007_h	Squirrel cage induction motor	AC asynchronous induction squirrel cage
0008_h	Stepper motor	AC synchronous step
0009_h	Micro-step stepper motor	-
$00A_h$	Sinusoidal PM BL motor	AC synchronous sinusoidal PM
$00B_h$	Trapezoidal PM BL motor	AC synchronous brushless PM trapezoidal
$00C_h$	AC synchronous reluctance sync	
$00D_h$	DC commutator PM	
$00E_h$	DC commutator wound field series	
$00F_h$	DC commutator wound field series	
0010_h	DC commutator wound field compound	
0011_h - $7FFE_h$	reserved	
$7FFE_h$	No motor type assigned	
8000_h - $FFFF_h$	Manufacturer-specific	

9.1.6.1 Object 6403_h: Motor catalogue number

This object shall indicate the motor catalogue number (nameplate number) provided by the motor manufacturer. If the number is not assigned yet, this object shall indicate this by /0 (empty string).

Index	**6403_h**
Name	Motor catalogue number
Object code	Variable
Data type	Visible string

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Visible string
Default Value	ANE33FQFMT

9.1.7 Object 6404_h: Motor manufacturer

This object shall indicate the name of the motor manufacturer. If the name is not assigned yet, this object shall indicate this by /0 (empty string).

Index	**6404_h**
Name	Motor manufacturer
Object code	Variable
Data type	Visible string

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Visible string
Default Value	Mitsubishi

9.1.8 Object 6405_h: http motor catalogue address

This object shall indicate the assigned web-address of the motor catalogue. If the address is not assigned yet, this object shall indicate this by /0 (empty string).

Index	**6405_h**
Name	http motor catalogue address
Object code	Variable
Data type	Visible string

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Visible string
Default Value	www.mitsubishielectric.com

9.1.9 Object 6502_h: Supported drive modes

This object shall provide information on the supported drive modes. A setting bit indicates, if the particular mode will be supported. Is the valie of the bit “0”, the mod will be not supported.

31 16	15 10	9	8	7	6	5	4	3	2	1	0
Manufacturer-specific	r(eserved)	cst	csv	csp	ip	hm	r	tq	pv	vl	pp
MSB					LSB						

Value definition 6502h	
Bits	
cst, csv, csp, ip, hm, tq, pv, vl, and pp bits:	1 = function is supported 0 = function is not supported
Manufacturer-specific bits	1 = function is supported 0 = function is not supported

Index	**6502h**
Name	Supported drive modes
Object code	Variable
Data type	Unsigned32

Subindex	**00h**
Access	ro
PDO Mapping	None
Value Range	See Value definition
Default Value	0000 000Eh

9.1.10 Object 6503h: Drive catalogue number

This object shall indicate the assigned manufacturer's drive catalogue number (nameplate number).

Index	**6503h**
Name	Drive catalogue number
Object code	Variable
Data type	Visible string

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	No
Default Value	FU03-22

9.1.11 Objekt 6504h: Drive manufacturer

This object contais information about the manufacturer.

Index	**6504_h**
Name	Drive manufacturer
Object code	Variable
Data type	Visible string

Subindex	**00_h**
Zugang	rw
PDO Mapping	None
Value Range	No
Default Value	No

9.1.12 Object 6505_h: http drive catalogue address

This object shall indicate the assigned web address of the drive manufacturer. If the address is not assigned yet, this object shall indicate this by /0 (empty string).

Index	**6505_h**
Name	http drive catalogue address
Object code	Variable
Data type	Visible string

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	No
Default Value	www.elrest.de

9.1.13 Object 6040_h: Controlword

This object shall indicate the received command controlling the PDS FSA. It shall be structured as defined in Figure 5. The bits 7, 3, 2, 1, and 0 shall be supported. The other bits may be supported.

15 – 11	10	9	8	7	6 – 4	3	2	1	0
ms	r	oms	h	fr	oms	eo	qs	ev	so
MSB									LSB

Legend:
ms = manufacturer-specific = not available from elrest ; r = reserved; oms = operation mode specific; h = halt; fr = fault reset; eo =enable operation; qs = quick stop; ev = enable voltage; so = switch on

Controlword 6040$_h$						
Command	**Bits of the controlword**					**Transitions**
	Bit 7	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (Note)
Disable voltage	0	X	x	0	x	7, 10, 11
Quick stop	0	X	0	1	x	7, 9, 10, 12
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset		x	x	x	x	15
NOTE Automatic transition to Enable operation state after executing SWITCHED ON state functionality.						

- Bits 9, 6, 5, and 4 of the controlword are operation mode specific.
- The halt function (bit 8) behaviour is operation mode specific.
- If the bit is 1, the commanded motion shall beinterrupted, the PDS shall behave as defined in the halt option code. After releasing the halt function, the commanded motion shall be continued if possible.
- The bit 10 is reserved for further use; it shall be set to 0.
- The bits 11, 12, 13, 14, and 15 are manufacturer-specific.

Index	**6040$_h$**
Name	Controlword
Object code	Variable
Data type	Unsigned16

Subindex	**00$_h$**
Access	rw
PDO Mapping	Possible
Value Range	See Command coding
Default Value	0

9.1.14 Object 6041$_h$: Statusword

This object shall provide the status of the PDS FSA. The object shall be structured as defined in Figure 6. The bits 10, 9, and 6 to 0 shall be supported. The other bits may be supported.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ms		oms		ila	tr	rm	ms	w	sod	qs	ve	f	oe	so	rtso
MSB															LSB

Legend:
ms = manufacturer-specific: not with elrest; oms = operation mode specific; ila = internal limit active; tr = target reached;rm = remote; w = warning; sod = switch on disabled; qs = quick stop; ve = voltage enabled; f = fault; oe = operation enabled; so = switched on; rtso = ready to switch on

Status coding	
Statusword	PDS FSA state
xxxx xxxx x0xx 0000$_b$	Not ready to switch on
xxxx xxxx x1xx 0000$_b$	Switch on disabled
xxxx xxxx x01x 0001$_b$	Ready to switch on
xxxx xxxx x01x 0011$_b$	Switched on
xxxx xxxx x01x 0111$_b$	Operation enabled
xxxx xxxx x00x 0111$_b$	Quick stop active
xxxx xxxx x0xx 1111$_b$	Fault reaction active
xxxx xxxx x0xx 1000$_b$	Fault

Index	**6041$_h$**
Name	Statusword
Object code	Variable
Data type	Unsigned16
Category	Mandatory

Subindex	**00$_h$**
Access	ro
PDO Mapping	Possible
Value Range	See status coding
Default Value	No

9.1.15 Object 6007$_h$: Abort connection option

This object shall indicate what action shall be performed when one of the following events:

- occurres:Buss-off
- Heartbeat
- Life guarding
- NMTstopped state
- Reset application
- Reset communication

Value	**Definition**
-32 768 to -1	Manufacturer-specific
0	No action
+1	Fault signal
+2	Disable voltage command
+3	Quick stop command
+4 to +32 767	reserved

Index	**6007$_h$**
Name	Abort connection option code
Object code	Variable
Data type	Integer16

Subindex	**00$_h$**
Access	rw
PDO Mapping	None
Value Range	See status coding
Default Value	+1

9.1.16 Object 605A$_h$: Quick stop option code

This object shall indicate what action is performed when the quick stop function is executed.
The slow down ramp is the deceleration value of the used mode of operations.

Value definition	
Value	**Definition**
-32 768 to -1	Manufacturer-specific
0	Disable drive function
+1	Slow down on slow down ramp and transit into Switch On Disabled
+2	Slow down on quick stop ramp and transit into Switch On Disabled
+3	Slow down on current limit and transit into Switch On Disabled
+4	Slow down on voltage limit and transit into Switch On Disabled
+5	Slow down on slow down ramp and stay in Quick Stop Active
+6	Slow down on quick stop ramp and stay in Quick Stop Active
+7	Slow down on current limit and stay in Quick Stop Active
+8	Slow down on voltage limit and stay in Quick Stop Active
+9 to +32 767	reserved

Index	**605A$_h$**
Name	Quick stop option code
Object code	Variable
Data type	Integer16

Subindex	**00$_h$**
Access	rw
PDO Mapping	None
Value Range	See value definition
Default Value	+2

9.1.17 Object 605B$_h$: Shutdown option code

This object shall indicate what action is performed if there is a transition from Operation Enabled state to Ready To Switch On state. The slow down ramp is the deceleration value of the used mode of operations.

Value definiton	
Value	**Definition**
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive power stage)
+1	Slow down with slow down ramp; disable of the drive function
+2 to +32 767	reserved

Index	**605B$_h$**
Name	Shutdown option code
Object code	Variable
Data type	Integer16

Subindex	**00$_h$**
Access	rw
PDO Mapping	See /CiA402-3/
Value Range	See Value definition
Default Value	0

9.1.18 Object 605C$_h$: Disable operation option code

This object shall indicate what action is performed if there is a transition from Operation Enabled state to Switched on state. The slow down ramp is the deceleration value of the used mode of operations.

Value definition	
Value	**Definition**
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive powerstage)
+1	Slow down with slow down ramp; disable of the drive function
+2 to +32 767	reserved

Index	**605C$_h$**
Name	Disable operation option code
Object code	Variable
Data type	Integer16

Subindex	**00$_h$**
Access	rw
PDO Mapping	None
Value Range	See Value definition
Default Value	+1

9.1.19 Object 605D$_h$: Halt option code

This object shall indicate what action is performed when the halt function is executed. The slow down ramp is the deceleration value of the used mode of operations.

Value definition	
Value	**Definition**
-32 768 to -1	Manufacturer-specific
0	Reserved
+1	Slow down on slow down ramp and stay in Operation Enabled
+2	Slow down on quick stop ramp and stay in Operation Enabled
+3	Slow down on current limit and stay in Operation Enabled
+4	Slow down on voltage limit and stay in Operation Enabled
+5 to +32 767	Reserved

Index	**$605D_h$**
Name	Halt option code
Object code	Variable
Data type	Integer16
Category	Optional

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	See Value definition
Default Value	+1

9.1.20 Object $605E_h$: Fault reaction code

This object shall indicate what action is performed when fault is detected in the PDS. The slow down ramp is the deceleration value of the used mode of operations.

Value definition	
Value	**Definition**
-32 768 to -1	Manufacturer-specific
0	Disable drive function, motor is free to rotate
+1	Slow down on slow down ramp
+2	Slow down on quick stop ramp
+3	Slow down on current limit
+4	Slow down on voltage limit
+5 to +32 767	Reserved

Index	**$605E_h$**
Name	Fault reaction option code
Object code	Variable
Data type	Integer16

Subindex	**00_h**
Access	rw
PDO Mapping	Noner
Value Range	See Value definition
Default Value	+2

9.1.21 Object 6060_h: Modes of operation

This object shall indicate the requested operation mode.
Note: This object shows only the value of the requested operation mode, the actual operation mode of the PDS is reflected in the object modes of operation display.

Value definition	
Value	**Definition**
-128 to -1	Manufacturer-specific operation modes
0	No mode change/no mode assigned
+1	Profile position mode
+2	Velocity mode
+3	Profile velocity mode
+4	Torque profile mode
+5	reserved
+6	Homing mode
+7	Interpolated position mode
+8	Interpolated position mode
+9	Cyclic sync velocity mode
+10	Cyclic sync torque mode
+11 to +127	reserved

Index	**6060_h**
Name	Modes of operation
Object code	Variable
Data type	Integer8
Category	Optional

Subindex	**00_h**
Access	rw
PDO Mapping	Possible
Value Range	See Value definition
Default Value	0

9.1.22 Object 6061h: Modes of operation display

This object shall provide the actual operation mode.

Index	**6061h**
Name	Modes of operation display
Object code	Variable
Data type	Integer8
Category	Optional

Subindex	**00h**
Access	ro
PDO Mapping	Possible
Value Range	See Value definition
Default Value	No

9.1.23 Object 6090h: Velocity encoder resolution

This object shall indicate the configured encoder increments per second and motor revolutions per second.

$$\textbf{velocity encoder resolution} = \frac{\textbf{encoder}\ \frac{\textbf{increments}}{\textbf{second}}}{\textbf{motor}\ \frac{\textbf{revolutions}}{\textbf{second}}}$$

Index	**6090h**
Name	Velocity encoder resolution
Object code	Array
Data type	Unsigned32

Subindex	**00h**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02h
Default Value	Manufacturer-specific (but not equal to 0)

Subindex 01	**01h**
Description	Encoder increments per second
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific (but not equal to 0)

Subindex02	**02h**
Description	Motor revolutions per second
Category	Mandatory
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific (but not equal to 0)

9.1.24 Object 6091$_h$: Gear ratio

This object shall indicate the configured number of motor shaft revolutions and number of driving shaft revolutions.

$$\textit{gear ratio} = \frac{\textit{motor shaft revolutions}}{\textit{driving shaft revolutions}}$$

Index	**6091$_h$**
Name	Gear ratio
Object code	Array
Data type	Unsigned32

Subindex	**00$_h$**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02$_h$
Default Value	Manufacturer-specific (but not equal to 0)

Subindex 01	**01h**
Description	Motor revolutions
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific (but not equal to 0)

Subindex 02	**02$_h$**
Description	Shaft revolutions
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific (but not equal to 0)

9.1.25 Object 6092h: Feed constant

This object shall indicate the configured feed constant; this is the measurement distance per one revolution of the output shaft of the gearbox.

$$\textbf{feed constant} = \frac{\textbf{feed}}{\textbf{Driving shaft revolutions}}$$

Index	**6092h**
Name	Feed constant
Object code	Array
Data type	Unsigned32

Subindex	**00h**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02h
Default Value	Manufacturer-specific (but not equal to 0)

Subindex 01	**01h**
Description	Motor revolutions
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific (but not equal to 0)

Subindex 02	**02h**
Description	Shaft revolutions
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific (but not equal to 0)

9.1.26 Object 607Eh: Polarity

This object shall indicate if the position demand value shall be multiplied by 1 of by –1.

7	6	5 … 0
Position polarity	Velocity polarity	reserved (0)
MSB		LSB

The polarity bits shall be coded as follows:
0b = multiply by 1 and 1b = multiply by -1

Index	**607E$_h$**
Name	Polarity
Object code	Variable
Data type	Unsigned8

Subindex	**00$_h$**
Access	rw
PDO Mapping	None
Value Range	00$_h$
Default Value	Manufacturer-specific (but not equal to 0)

9.1.27 Object 6064$_h$: Position actual value

This object shall provide the actual value of the position measurement device. The value shall be given in user-defined position units.

Index	**6064$_h$**
Name	Position actual value
Object code	Variable
Data type	Integer 32

Subindex	**00$_h$**
Access	ro
PDO Mapping	None
Value Range	Integer 32
Default Value	No

9.1.28 Object 6069h: Velocity sensor actual value

This object shall provide the value read from a velocity sensor. The value shall be given in increments per second.

Index	**6069h**
Name	Velocity sensor actual value
Object code	Variable
Data type	Integer 32

Subindex	**00h**
Access	ro
PDO Mapping	None
Value Range	Integer 32
Default Value	No

9.1.29 Object 606Ah: Velocity sensor actual value

This object shall provide the source of the velocity sensor actual value. It determines whether a differentiated position signal or the signal from a separate velocity sensor is evaluated.

Value definition	
Value	**Definition**
0000_h	Actual velocity value from position encoder
0001_h	Actual velocity value from velocity encoder
0002_h to $7FFF_h$	Reserved
8000_h to $FFFF_h$	Manufacturer-specific

Index	**606Ah**
Name	Sensor selection code
Object code	Variable
Data type	Integer 16

Subindex	**00h**
Access	rw
PDO Mapping	None
Default Value	Manufacturer-specific

9.1.30 Object 606B$_h$: Velocity demand value

This object shall provide the output value of the trajectory generator. The value shall be given in the user-defined velocity units.

Index	**606B$_h$**
Name	Velocity demand value
Object code	Variable
Data type	Integer 32

Subindex	**00$_h$**
Access	ro
PDO Mapping	None
Value Range	Integer 32
Default Value	Manufacturer-specific

9.1.31 Object 606C$_h$: Velocity actual value

This object shall provide the actual velocity value derived either from the velocity sensor or the position sensor. The value shall be given in user-defined velocity units.

Index	**606C$_h$**
Name	Velocity actual value
Object code	Variable
Data type	Integer 32

Subindex	**00$_h$**
Access	ro
PDO Mapping	Possible
Value Range	Integer 32
Default Value	No

9.1.32 Object 606D$_h$: Velocity window

This object shall indicate the configured velocity window. The value shall be given in userdefined velocity units.

Index	**606D$_h$**
Name	Velocity window
Object code	Variable
Data type	Unsigned 16

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 16
Default Value	Manufacturer-specific

9.1.33 Object $606E_h$: Velocity window time

This object shall indicate the configured velocity window time. The value shall be given in milliseconds.

Index	**$606E_h$**
Name	Velocity window time
Object code	Variable
Data type	Unsigned 16

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 16
Default Value	0000_h

9.1.34 Object $606F_h$: Velocity threshold

This object shall indicate the configured velocity threshold. The value shall be given in userdefined velocity units.

Index	**$606F_h$**
Name	Velocity threshold
Object code	Variable
Data type	Unsigned 16

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 16
Default Value	Manufacturer-specific

9.1.35 Object 6070_h: Velocity threshold time

This object shall indicate the configured velocity threshold time. The value shall be given in milliseconds.

Index	**6070F$_h$**
Name	Velocity threshold time
Object code	Variable
Data type	Unsigned 16
Category	Optional

Subindex	**00$_h$**
Access	rw
PDO Mapping	None
Value Range	Unsigned 16
Default Value	Manufacturer-specific

9.1.36 Object 607F$_h$: Max profile velocity

This object shall indicate the configured maximal allowed velocity in either direction during a profiled motion. The value shall be given in the very same physical unit as the profile velocity object (6081$_h$).

Index	**607F$_h$**
Name	Max profile velocity
Object code	Variable
Data type	Unsigned 32
Category	Optional

Subindex	**00$_h$**
Access	rw
PDO Mapping	None
Value Range	Unsigned 32
Default Value	Manufacturer-specific

9.1.37 Object 6080$_h$: Max motor speed

This object shall indicate the configured maximal allowed speed for the motor in either direction. It is used to protect the motor and is taken from the motor data sheet. The value shall be given in rotations per minute (rpm).

Index	**6080$_h$**
Name	Max motor speed
Object code	Variable
Data type	Unsigned 32

Subindex	**00$_h$**
Access	rw
PDO Mapping	None
Value Range	Unsigned 32
Default Value	0

9.1.38 Object 6083h: Profile acceleration

This object shall indicate the configured acceleration. The value shall be given in user-defined acceleration units; it shall be converted to position increments per square second (s2) using the normalising factors.

Index	**6083h**
Name	Profile acceleration
Object code	Variable
Data type	Unsigned 32

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 32
Default Value	0

9.1.39 Object 6084h: Profile deceleration

This object shall indicate the configured deceleration. If this parameter is not supported, then the profile acceleration object (6083_h) value shall be used for deceleration, too. The value shall be given in the same physical units as profile acceleration object (6083_h).

Index	**6084h**
Name	Profile deceleration
Object code	Variable
Data type	Unsigned 32

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 32
Default Value	Manufacturer-specific

9.1.40 Object 6085h: Quick stop deceleration

This object shall indicate the configured deceleration used to stop the motor when the quick stop function is activated and the quick stop code object ($605A_h$) is set to 2 or 6. The quick stop deceleration is also used if the fault reaction code object ($605E_h$) is 2 and the halt option code object ($605D_h$) is 2. The value shall be given in the same physical unit as profile acceleration object (6083_h).

Index	**6085h**
Name	Quick stop deceleration
Object code	Variable
Data type	Unsigned 32

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 32
Default Value	Manufacturer-specific

9.1.41 Object 6086h: Motion profile type

This object shall indicate the configured type of motion profile used to perform a profiled motion.

Value definition

Value	**Definition**
32 768 to -1	Manufacturer-specific
0	Linear ramp (trapeziodal profile)
+1	Sin_2 ramp
+2	Jerk-free ramp
+3	Jerk-limited ramp
+4 to +32 767	Reserved

Index	**6086h**
Name	Motion profile type
Object code	Variable
Data type	Integer 16

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Integer 16
Default Value	0

9.1.42 Object 60C5h: Max acceleration

This object shall indicate the configured maximal acceleration. It is used to limit the acceleration to an acceptable value in order to prevent the motor and the moved mechanics from being destroyed. The value shall be given in user-defined acceleration physical units.

Index	**60C5h**
Name	Max acceleration
Object code	Variable
Data type	Unsigned 32

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 32
Default Value	Manufacturer-specific

9.1.43 Object 60C6h: Max deceleration

This object shall indicate the configured maximal deceleration. It is used to limit the acceleration to an acceptable value in order to prevent the motor and the moved mechanics from being destroyed. The value shall be given in the same physical unit as the max acceleration object (60C5h).

Index	**60C6h**
Name	Max deceleration
Object code	Variable
Data type	Unsigned 32
Category	Optional

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned 32
Default Value	Manufacturer-specific

9.1.44 Object 60F8h: Max slippage

This object shall indicate the configured maximal slippage of an asynchronous motor. When the max slippage has been reached, the corresponding bit 13 max slippage error in the statusword shall be set to 1. The reaction of the drive device, when the max slippage error occurs, is manufacturer-specific.

Index	**60F8h**
Name	Max acceleration
Object code	Variable
Data type	Integer32
Category	Optional

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Integer32
Default Value	Manufacturer-specific

9.1.45 Object 60FFh: Target velocity

This object shall indicate the configured target velocity and shall be used as input for the trajectory generator. The value shall be given in user-defined velocity units.

Index	**60FFh**
Name	Target velocity
Object code	Variable
Data type	Integer32

Subindex	**00_h**
Access	rw
PDO Mapping	Possible
Value Range	Integer32
Default Value	Manufacturer-specific

9.1.46 Object 6071F$_h$: Target torque

This object shall indicate the configured input value for the torque controller in profile torque mode. The value shall be given per thousand of rated torque.

Index	**6071_h**
Name	Target torque
Object code	Variable
Data type	Integer16

Subindex	**00_h**
Access	rw
PDO Mapping	Possible
Value Range	Integer16
Default Value	0000_h

9.1.47 Object 6072F$_h$: Max torque

This object shall indicate the configured maximum permissible torque in the motor. The value shall be given per thousand of rated torque.

Index	**6072_h**
Name	Max torque
Object code	Variable
Data type	Unsigned16

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Unsigned16
Default Value	Manufacturer-specific

9.1.48 Object 6073F$_h$: Max current

This object shall indicate the configured maximum permissible torque creating current in the motor. The value shall be given per thousand of rated current.

Index	**6073_h**
Name	Max current
Object code	Variable
Data type	Unsigned16

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned16
Default Value	Manufacturer-specific

9.1.49 Object 6074Fh: Torque demand

This object shall provide the output value of the trajectory generator. The value shall be given in 1/1 000 of rated torque.

Index	**6074h**
Name	Torque demand
Object code	Variable
Data type	Integer16

Subindex	**00h**
Access	ro
PDO Mapping	None
Value Range	Integer16
Default Value	No

9.1.50 Object 6075Fh: Motor rated current

This object shall indicate the configured motor rated current. It is taken from the motor's name-plate. Depending on the motor and drive technology this current is DC, peak or r.m.s. (root-mean-square) current. All relative current data refers to this value.

Index	**6075h**
Name	Motor rated current
Object code	Variable
Data type	Unsigned32

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

9.1.51 Object 6076h: Motor rated torque

This object shall indicate the configured motor rated torque. It is taken from the motor's nameplate. All relative torque data shall refer to this value. For linear motors, the object name is not changed, but the motor rated force value shall be entered as multiples of mN (milli Newton). The value shall be given in mNm (milli Newton metre).

Index	**6076h**
Name	Motor rated torque
Object code	Variable
Data type	Unsigned32
Category	Optional

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

9.1.52 Object 6077h: Torque actual value

This object shall provide the actual value of the torque. It shall correspond to the instantaneous torque in the motor. The value shall be given per thousand of rated torque.

Index	**6077h**
Name	Torque actual value
Object code	Variable
Data type	Integer16

Subindex	**00h**
Access	ro
Value Range	Integer16
Default Value	No

9.1.53 Object 6078h: Current actual value (Strom-Istwert)

Dieser Object zeigt den Strom-Istwert an. Dieser bezieht sich auf den Strom im Motor. Der Wert wird per Tausend pro Nenneingangsstrom angegeben.

Index	**6078h**
Name	Current actual value
Object code	Variable
Data type	Integer16

Subindex	**00h**
Access	ro
PDO Mapping	None
Value Range	Integer16
Default Value	No

9.1.54 Object 6079h: DC link circuit voltage (Zwischenkreisstromspannung)

Dieser Object zeigt die momentane Zwischenkreisstromspannung des Frequenzumrichters an. Der Wert wird in mV angegeben.

Index	**6079_h**
Name	DC link circuit voltage
Object code	Variable
Data type	Unsigned32

Subindex	**00_h**
Access	ro
PDO Mapping	None
Value Range	Unsigned32
Default Value	No

9.1.55 Object 6087_h: Torque slope

This object shall indicate the configured rate of change of torque. The value shall be given in units of per thousand of rated torque per second.

Index	**6087_h**
Name	Torque slope
Object code	Variable
Data type	Unsigned32

Subindex	**00_h**
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

9.1.56 Object 6088_h: Torque profile type

This object shall indicate the configured type of profile used to perform a torque change.

Value definition	
Value	Definition
0000_h	Linear ramp (trapezoidal profile)
0001_h	Sin^2 ramp
0002_h to $7FFF_h$	Reserved
8000_h to $FFFF_h$	Manufacturer-specific

Index	**6088_h**
Name	Torque profile type
Object code	Variable
Data type	Integer16

Subindex	**00h**
Access	rw
PDO Mapping	None
Value Range	Integer16

9.1.57 Object 6042h: vl target velocity

This object shall indicate the required velocity of the system. It shall be multiplied by the vl dimension factor and the vl set-point factor, if these are implemented.

Index	**6042h**
Name	vl target velocity
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if vl is supported

Subindex	**00h**
Access	rw
PDO Mapping	Possible
Value Range	Integer16
Default Value	0000h

9.1.58 Object 6043h: vl velocity demand

This object shall provide the instantaneous velocity generated by the ramp function. It is an internal object of the drive device. The value shall be given in the very same unit as the vl target velocity. Positive values shall indicate forward direction and negative values shallindicate reverse direction.

Index	**6043h**
Name	vl velocity demand
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if vl is supported

Subindex	**00h**
Access	ro
PDO Mapping	None
Value Range	Integer16
Default Value	No

9.1.59 Object 6044h: vl velocity actual value

This object shall provide the velocity at the motor spindle or load. Depending on the implementation (simple drive device, without sensor, with sensor, etc.), the drive shall provide the appropriate image of the actual velocity (velocity demand, velocity control effort, calculated velocity, measured velocity).
The value shall be given in the very same unit as the vl target velocity. Positive values shall indicate forward direction and negative values shall indicate reverse direction.

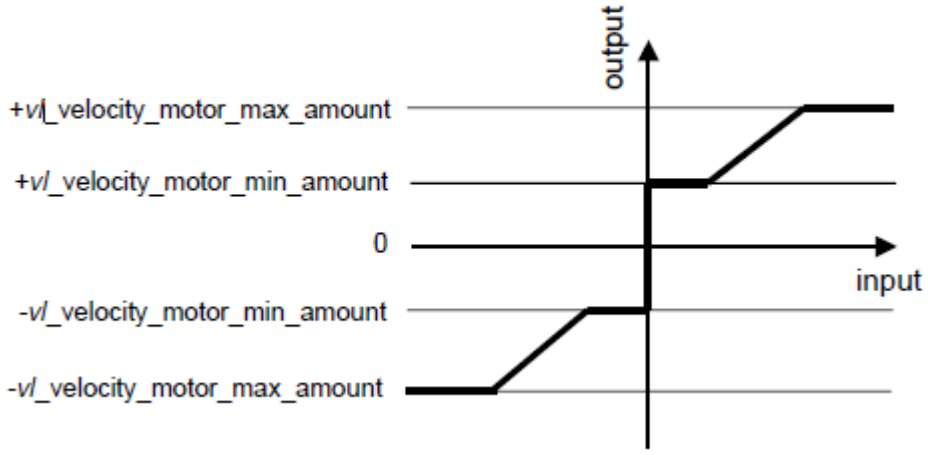
Index	**6044h**
Name	vl velocity actual value
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if vl is supported

Subindex	**00h**
Access	ro
PDO Mapping	Possible
Value Range	Integer16
Default Value	No

9.1.60 Object 6046h: vl velocity min max amount

This object shall indicate the configured minimum and maximum amount of velocity. The vl velocity max amount sub-object shall be mapped internally to the vl velocity max pos and vl velocity max neg values. The vl velocity min amount sub-object shall be mapped internally to the vl velocity min pos and vl velocity min neg values.

Transfer characteristic



The values shall be given in rotations per minute (rpm) or in user-defined velocity unit if the vl dimension factor object is implemented and is not set to 1.

Index	**6046h**
Name	vl velocity min max amount
Object code	Array
Data type	Unsigned32

Subindex	**00h**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02h
Default Value	02h

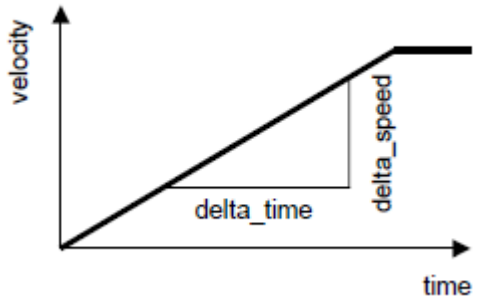
Subindex 01	**01_h**
Description	vl velocity min amount
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

Subindex02	**02_h**
Description	vl velocity max amount
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

9.1.61 Object 6048_h: vl velocity acceleration

This object shall indicate the configured delta speed and delta time of the slope of the acceleration ramp. The value of delta speed shall be given in rotations per minute (rpm) or in user-defined velocity unit if the vl dimension factor object is implemented and is not set to 1; the value of delta time shall be given in the tables below.

$$\textbf{\textit{vl velocity deceleration}} = \frac{\textbf{\textit{delta speed}}}{\textbf{\textit{delta time}}}$$



Index	**6048_h**
Name	vl velocity acceleration
Object code	Record
Data type	vl velocity acceleration decelaration

Subindex	**00_h**
Description	Highest sub-index supported
Category	Mandatory
Access	c
PDO Mapping	None
Value Range	02_h
Default Value	02_h

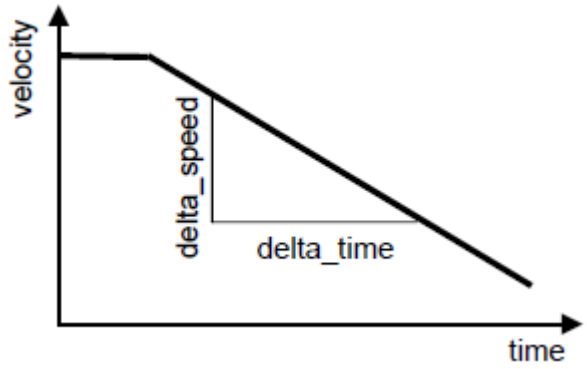
Subindex 01	**01_h**
Description	Delta speed
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

Subindex02	**02_h**
Description	Delta time
Access	rw
PDO Mapping	None
Value Range	Unsigned16
Default Value	Manufacturer-specific

9.1.62 Object 6049_h: vl velocity deceleration

Das Object zeigt die konfigurierte Delta- Geschwindigkeit und Delta Zeit der Steigung der Verzögerungsrampe an.
Der Wert der Delta Zeit ergibt sich aus der Rotation pro Minute oder der benutzerdefinierten Drehzahleinheit, wenn das Object “vl dimension factor” implemeniert, und nicht auf 1 gesetzt ist. Der Wert der Delta Zeit und die Adressverwaltung entnehmen Sie bitte den nachstehenden Tabellen.

$$\textbf{\textit{vl velocity deceleration}} = \frac{\textbf{\textit{delta speed}}}{\textbf{\textit{delta time}}}$$



Index	**6049_h**
Name	vl velocity deceleration
Object code	Record
Data type	vl velocity acceleration decelaration

Subindex	**00_h**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02_h
Default Value	02_h

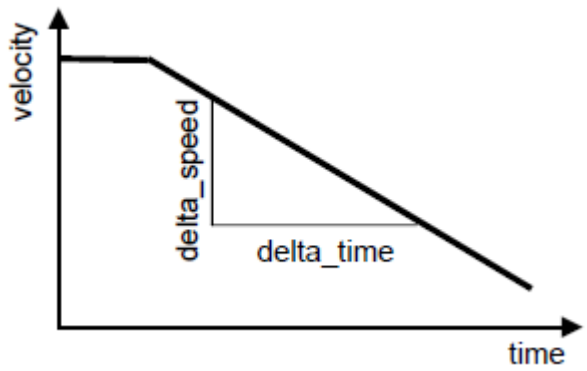
Subindex 01	**01_h**
Description	Delta speed
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

Subindex02	**02_h**
Description	Delta time
Access	rw
PDO Mapping	None
Value Range	Unsigned16
Default Value	Manufacturer-specific

9.1.63 Object 604A$_h$: vl velocity quick stop

This object shall indicate the configured delta speed and delta time of the slope of the deceleration ramp for quick stop.
Der Wert der Delta Zeit ergibt sich aus aus der Rotation pro Minute oder der benutzerdefinierten Drehzahleinheit, wenn das Object “vl dimension factor” implemeniert ist und nicht auf 1 gesetzt ist. Der Wert der Delta Zeit und die Adressverwaltung entnehmen Sie bitte den nachstehenden Tabellen.

velocity quick stop= **delta speed** / **delta time**



Index	**604A$_h$**
Name	vl velocity quick stop
Object code	Record
Data type	vl velocity acceleration decelaration

Subindex	**00_h**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02_h
Default Value	02_h

Subindex 01	**01_h**
Description	Delta speed
Access	rw
PDO Mapping	None
Value Range	Unsigned32
Default Value	Manufacturer-specific

Subindex02	**02_h**
Description	Delta time
Access	rw
PDO Mapping	None
Value Range	Unsigned16
Default Value	Manufacturer-specific

9.1.64 Object 604B$_h$: vl set-point factor

This object shall indicate the configured numerator and denominator of the vl set-point factor. The vl set-point factor serves to modify the resolution or directing range of the specified setpoint. It is aso included in calculation of the vl velocity demand, and vl velocity actual value. It does not influence the velocity limit function and the ramp function. The value shall have no physical unit and shall be given in the range from -32 768 to +32 767, but the value of 0 shall not be used.

Index	**$604C_h$**
Name	vl dimension factor
Object code	Array
Data type	Integer32

Subindex	**00_h**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02_h
Default Value	02_h

Subindex 01	**01_h**
Description	vl set-point factor numerator
Category	Mandatory
Access	rw
PDO Mapping	None
Value Range	See Value definition
Default Value	+1

Subindex02	**02_h**
Description	vl set-point factor denominator
Category	Mandatory
Access	rw
PDO Mapping	None
Value Range	See Value definition
Default Value	+1

9.1.65 Object 604C$_h$: vl dimension factor

This object shall indicate the configured numerator and denominator of the vl dimension factor. The vl dimension factor serves to include gearing in calculation or serves to scale the frequencies or specific units of the user. It influences the vl target velocity, vl velocity demand, vl velocity actual value as well as the velocity limit function and the ramp function. The values shall be in the range of -2 147 483 648 to +2 147 483 647, but the value of 0 shall be not used.

Index	**604B$_h$**
Name	vl set-point factor
Object code	Array
Data type	Integer16

Subindex	**00_h**
Description	Highest sub-index supported
Access	c
PDO Mapping	None
Value Range	02_h
Default Value	02_h

Subindex 01	**01_h**
Description	vl set-point factor numerator
Access	rw
PDO Mapping	None
Value Range	See Value definition
Default Value	+1

Subindex02	**02_h**
Description	vl set-point factor denominator
Access	rw
PDO Mapping	None
Value Range	See Value definition
Default Value	+1