

# User Manual

## Servoconverter ND 31



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## 1. General

### 1.1 *About this Documentation*

The documentation for your EcoServ ND31 consists of 3 components:

- (This) User Manual

This section is for users who are project managers, deers and software developers. Here you will find the information needed for designing a system using the EcoServ.

- Set-up and Parameter Setting

This section is for developers and technicians who must perform the set-up and configuration of the ND31. It will be sent on request with ND31 delivery.

- Instructions for Installation and Replacement

These instructions are for technicians and electricians who must install or replace the ND31. This flyer will be enclosed with ND31 delivery.

The symbols below will be used in this manual. These symbols will assist you in quickly finding important information.



**The commonly used danger symbol, identifies text passages that must, by all means, be read and clearly understood! Not observing these passages could endanger the life and health of yourself and others.**

---

### **ATTENTION!**

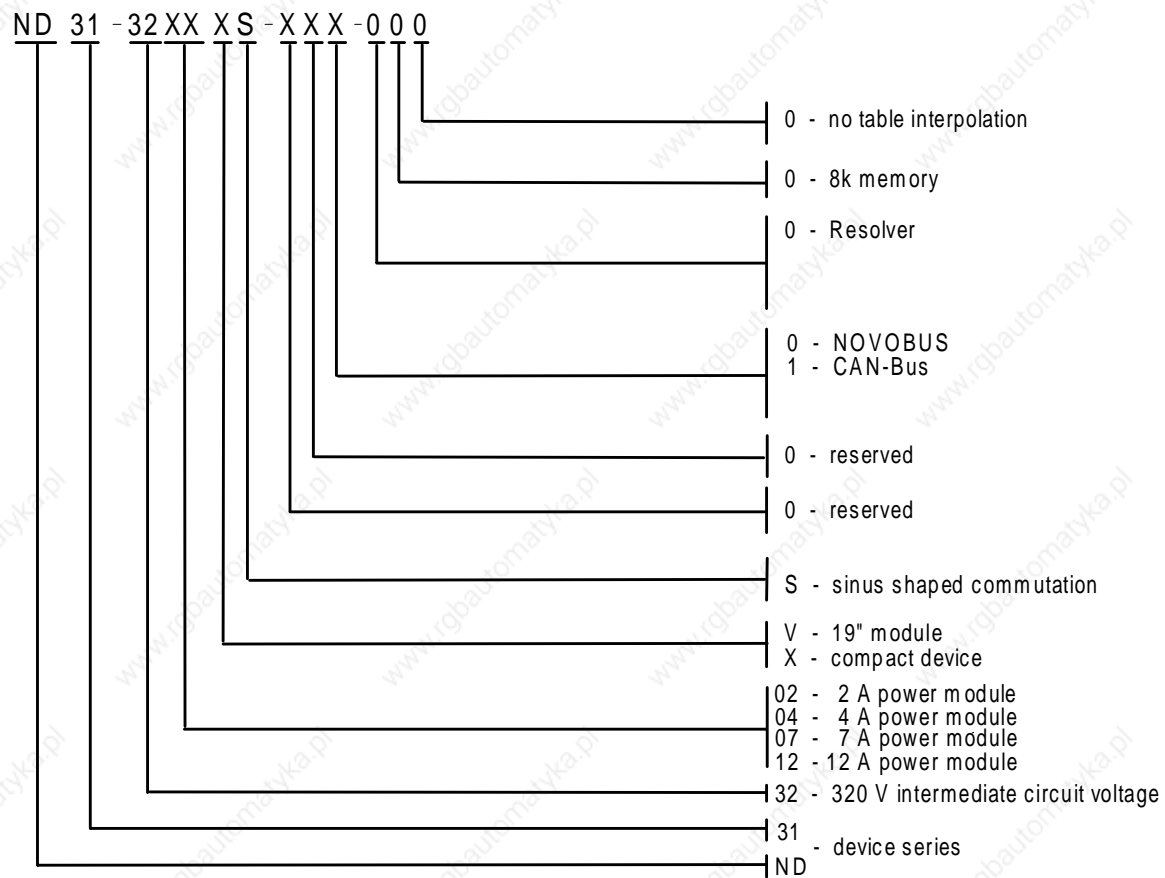
**Text passages marked with “ATTENTION” must, by all means, be read and clearly understood! Ignoring these passages could lead to the destruction or damaging of the EcoServ or the machine in which it is installed.**

---

### 1.2 Customer Service

Lenord, Bauer & Co. GmbH  
 Dohlenstraße 32  
 D - 46145 Oberhausen  
 Telefon: +49-208-9963-0  
 Fax +49-208-9963-201

### 1.3 Designation



### 1.4 Rights

IBM is a registered trademark of the IBM Corporation.



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## 2. General Safety Remarks

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**There are operating voltages in the ND31 that can be fatal!**

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### ***Wiring***

Therefore, check the wiring of the ND31 before switching it on. Ensure that all plugs are properly inserted and grounding has been properly performed.

### ***Safety Components***

Ensure that no voltage carrying parts can be accidentally touched and all safety components of the ND31 are present and properly connected.

### ***Emergency Power-Off***

Provide an “Emergency Power Off” switch so the motor can be switched off at anytime.

### ***Electrolytic Capacitor***

After power-off the electrolytic capacitor takes approximately one minute to unload! This means: One minute after power-off, fatal voltages are still present in the device. During this time period nothing is to be touched.

### ***Voltage***

In case the motor continues to turn after the power supply has been switched off, the fatal voltage can be prolonged until a total stop occurs. Only then the unloading of the electrolytic capacitor begins.

### ***On and Off Switching***

Avoid excessive, repeated and rapid on and off switching of the power supply, this could overload the switching current limiter of the ND31. This overloading can lead to the destruction of the limit switch limit resistance.

### ***Order of Switching On***

When switching on, the power supply connection should be set first for the automatic control part before switching on the power supply. When switching off please proceed reverse.

## **2.1 Proper Usage**

### ***EcoServ ND31***

The frequency converter EcoServ ND31 is a pulse and frequency converter for controlling brushless servo and asynchronous motors. It is a state of the art converter. Using the converter for an application other than described here, can be damaging to the health of the user or others. Also, the converter the drive or other valuable items can be damaged.

Only use the converter when error free conditions are provided. Always regard safety rules and regulations. Be aware of the manuals and abide the warnings provided.

**Compatible Motors** Use only brushless servo motors and asynchronous motors with technical data compatible to the converter and its specifications.

**Regulations** Install the converter only in conformance to the local specifications, standards and regulations.

**Operating Environment** Do not operate the converter in areas with danger of explosions or in range of medical devices.

**Exceptions:** The converter is encased in a housing designed, tested and specified for operation in these applications.

## **2.2 Organizational Measures**

**Safety Measures** As manufacturer and distributor of a machine in which this converter is used, you are responsible for ensuring that all accident prevention and safety measures have been taken.

**Qualified Staff** Ensure that installation and maintenance is only performed by a qualified electrician.

Ensure that the set-up is only performed by trained personnel. During installation, the safety warnings in this manual are to be observed.

**Manuals** The designer or developer of a machine in which the converter is installed has read and understood the warnings in the manuals.

**Transport and Storage** For the transport and storage of the converter the original packing has to be used.

## **2.3 Safety Units**

**Emergency Power-Off** Machines with moveable parts which are hazardous to people or the machine, must be equipped with an emergency power-off (EPO). Install the EPO as described in Chapter 6, Installation.

## **2.4 High Voltage**

The converter works with hazardous high voltage. Read and abide to the following points.

Ensure that no parts carrying voltage can be accidentally touched.

- Install fuses as described in Section 6.2, Fuselage.
- Emergency Power-off-Installation as described in Section 6.4, Emergency Power Off Concept ND31.

- Ensure that proper grounding is provided.
- Make all connections in accordance with Chapter 5, Pinning.
- Do not disassemble the device. Do not make any changes to the device. Repairs may only be made by the manufacturer.

During set-up, abide to all safety regulations and ensure that safety features are provided.

## **2.5 Contact Protection Compact Device**

**Requirements: Protect against dangerous body current (Draft DIN VDE 160 11.94 Section 5.2.).**

The following measurements are necessary to fulfill the requirements above.

- Pulling or inserting the plug of the ND31 is to be non-permissive, when the device is under voltage. Power is only to be applied to the ND31 when all connections screwed to the ND31 are protected against accidental slipping. Working on the plugs of the ND31 is not to be performed when the device is under voltage. All connection are only to be made by a qualified electrician.
- Opening the housing is not allowed!
- Before the power supply is switched on for the first time, ensure all cables have been checked to confirm proper isolation of all wires.
- This is to be repeated at each maintenance interval. Loose clamps are to be retightened. Ensure cables to moveable components, connected to the ND31, are relieved of tension.

**Protected by isolating active components (Draft DIN VDE 0160 11.94 Section 5.2.3.).**

- A minimum of basic isolation protects the active components from the metal housing. The housings must be grounded! A grounding screw for this purpose is provided on the metal housing.

**A wire with a diameter  $\geq 10 \text{ mm}^2$  CU is required for grounding.**

### **Periphery Plug X3**

Safe isolation of all signals of the periphery plug X3 from active components is already provided in the ND31 by double isolation **(Draft DIN VDE 160 11.94 Section 5.2.18.2.).**

### **Resolver Plug X2**

The safe isolation of all signals from the active components of the ND31 is required by double isolation.

### **Power Connection X1**

The connection cable and wiring must have a doubled or reinforced isolating between the wires and the surface (**Draft DIN VDE 160 11.94 5.3.1.1.**).

The connection area is to be protected against accidental contact. Before the power supply is switched on, all cables are to be checked and tested for proper isolation.

Clamps for the respective wire sizes are to be used on the ends of wires.

### **Bus Connections X4 and X5**

The signals of the bus are already separated from active components of the ND31 by double isolation. The housing of the connection cable must have a non-conducting surface.

## **2.6 19" Drawer Devices**

### **Requirements: Protection against dangerous body current (Draft DIN VDE 160 Section 5.2.1.).**

- Pulling or inserting the plug connections of the ND31 is non-permissible when the device is under current. Power is only to be connected to the ND31 when all plugs are protected against slipping by screwing them to the 19" frame or the ND31. Working on the plugs of the ND31 or the 19" frame is not permitted as long as the ND31 is under current. Working on the connections is only to be performed by a qualified electrician.
- The removal of the ND31 from the 19" frame is only to be performed in a power down situation and from a trained electrician. Before the ND31 is first turned on, a check is to be made for proper seating, and all cables are to be checked for proper isolation. This is to be repeated at each maintenance interval of the machine. Loosened screws are to be re-tightened.
- The connection area on the back panel of the 19" frame must be protected against accidental contact. Cables leading to movable components in the machine must be protected against being pulled out of the 19" frame.

**Requirements: Protection by isolating active components  
(Draft DIN VDE 160 Section 5.2.3.).**

- A minimum of basis isolation of the active components against the metal housing is provided. The 19" housing must be grounded. Grounding is performed by using the screw provided on the housing of the 19" drawer.
- A wire with a diameter  $\geq 10 \text{ mm}^2$  CU is required for grounding.
- The 19" frame, the side post of the frame, the cover plate, the ventilator draw and the front panel are separated from the active components of the ND31 by double isolation.

**Periphery plug X3**

(See Section 2.5, Contact Protection Compact Device)

**Resolver plug X2**

(See Section 2.5)

**Power plug X1**

(See Section 2.5)

**Bus Connection X4 and X5**

(See Section 2.5)

### **3. Functional Description**

#### **3.1 General**

**Servo Converter**

The ND31 is a servo converter for permanently active synchronized servo motors.

**Inputs and Outputs**

The ND31 is equipped with all the usual control and signal inputs and outputs such as, enable regulator, ready signal, limit switch etc.

**Setting Up**

Setting up the ND31 is performed with a laptop PC. The memory oscilloscope function built into the ND31 offers the possibility, to display all nominal and actual value courses of the current, torque, speed and rotor position on the laptop monitor without excessive measuring techniques.

This makes adjusting the ND31 very easy, since the effects of parameter change can immediately be evaluated. Parameters are stored in the ND31 and saved on a disc. Parameter lines can be repeatedly copied to other ND31s.

**NOVOBUS**

Drives can be connected with a controller via NOVOBUS. A ring-shaped wiring is required. Hardware components are not required. The transmission medium is the standardized, serial interface RS232 or RS485.

**CAN-Bus**

Additionally Novotron offers the CAN-Bus for ND31. CAN-Bus means a cheap solution for networking controller and ND31 and ND31 among each other.

#### **3.2 Power Supply**

**Circuit Connector**

ND31 is equipped with all components required for a positioning axis. This includes a power supply for directly connecting the ND31 to the 230V AC circuit. Protective switches limit the jolt of switching-on current and protect the ND31 from circuit over voltage and transients.

**DC Circuit**

The braking energy of the motor is absorbed in an intermediate DC circuit. If the capacity of the intermediate circuit condenser is insufficient, the built-in brake chopper becomes active to prevent a too high of an increase in the intermediate circuit voltage.

When inserting several ND31 it is additionally possible to couple the intermediate circuits. Therefore the energy of the brake can be divided in several intermediate capacitors. The intermediate circuit of ND31 must not be connected parallel to the intermediate circuit of other manufacturers.

When inserting several intermediate circuits of several ND31 you have to abide the same pinning of the different power connection P1, P2 and P3. Avoid exchanging the phases, this could lead to the destruction of the drive.

**Ballast Switching**

The internal ballast switching is checked electronically. On overloading the ballast switching stops and ND31 changes to overload.

**Circuit-Breaker**

A IGBT converter provides the motor with current. All motor cables are short circuit proof. All power circuits are isolated from the regulator.

### 3.3 Automatic Control Part

For the internal power supply of the drive a 24 VDC-power supply is necessary.

**Position**

The position, speed and voltage regulation as well as the pulse width modulation in the ND31 is performed digitally. The voltage regulation and the pulse width modulation are integrated in the ND31 ASIC („Potential Chip“ ND32XX), developed especially for the ND31. Another ASIC („Periphery Chip“ ND31XX) integrates a resolver converter, ROD-impulse counter, coordinates transformer and the encoder emulator.

**Feedback**

The remainder of the technical regulator functions are performed by a Hitachi H8/330 micro controller. ND31 needs a resolver for its feedback system in the motor or an optical signal provider.

The ND31 can also be used for analyzing multi turn resolvers. The resolver or digital conversion is performed by the periphery chip ND31XX. The resolution of the rotor position measuring is 16 bits.

**Nominal Values**

The following choice of possibilities are available for the nominal value input:

- Analogue +/- 10V
- Incremental encoders
- Frequency and direction impulse
- Digital nominal value input via the no cost sensor actor bus NOVOBUS (RS232/485)
- CAN-Interface

## 4. Technical Data

### 4.1 Nomenclatures

|  |                               |  |
|--|-------------------------------|--|
| <b>Ratings</b>                                 | <b>Over Voltage Stability</b> | IEC 801-4 Class 2  |
|  | <b>Radio Interference</b>     | EN55011 Class A is upheld by using the line filter   |
|  | <b>Isolation Concept</b>      | Double isolation between power supply and controller   |
|  | <b>Check</b>                  | Referring <b>VDE160 11.94 Chapter 9.1.1.</b>   |
|  | <b>Protection Type</b>        | ND31 32XX <u>V</u> S IP00<br>(Protection Type is determined by 19"frame)<br>ND31 32XX <u>X</u> S IP20 to DIN 40050 and IEC144                    |
|  | <b>Serial interface</b>       | RS232: ANSI/EIA232D<br>RS485: EIA485   |
|  | <b>Signal Processing</b>      | <b>Modulation of the output transformer</b>  |
| <b>Modulation procedure</b>                    |                               | Modified sinus-triangle procedure  |
| <b>Current regulator</b>                       |                               | Digital PI-regulator with EMK-compensation, symmetrical limiter and anti-wind-up switch  |
| <b>Resolution of motor current measurement</b> |                               | 11 bit   |
| <b>Speed regulator</b>                         |                               | Digital PI-regulator with velocity advanced control and anti-wind-up switch  |
| <b>Position controller</b>                     |                               | Digital P-controller with velocity advanced control  |
| <b>Position relay system</b>                   |                               | Resolver or optical impulse supply   |
| <b>Absolute path measuring system</b>          |                               | Absolute resolver supports the system IMAS from the company Baumer Electric (if required). Optical multi-turn-position sensor with SSI-interface |



**Motor temperature probe** Selection: Opener or PTC

**Communication**

**Communication protocol** RS232/485, communication protocol: NOVIBUS

**CAN-Interface** Specification CAN2.0 part A and B ISO/DIS 11898

**Frequency/direction-interface** Entrance, RS422. Stepping motor emulation with a maximum frequency of 500kHz

**Encoder entrance** Difference inputs, RS422 standard. ROD426

**Analogue interface**

- ±10V 14bit
- ±10V 8bit
- 0...5V 8 bit

## 4.2 Electrical Data

### 4.2.1 Power Supply Connection

| Device type ND31-                         | 3202                | 3204   | 3207   | 3212   |
|---|---------------------|--------|--------|--------|
| <b>Connecting rated voltage</b>           | 230VDC              | 230VDC | 230VDC | 230VDC |
| <b>Input frequency</b>                    | 50/60Hz             |        |        |        |
| <b>Voltage range for connection</b>       | 20 ... 240 VAC +10% |        |        |        |
| <b>Number of input phases</b>             | 2/3                 |        | 3      |        |
| <b>Connecting value for rated current</b> | 0,75kVA             | 1,5kVA | 2,7kVA | 4,5kVA |

Periodical and not periodical transient over voltage:

|  |       |
|--|-------|
| <b>Acceptable transient energy at the connection</b> | 10 Ws |
|--|-------|

|  |  |                     |                |                |
|--|--|---------------------|----------------|----------------|
| <b>Half life period</b>                            |  | 1.2/50 $\mu$ s      |                |                |
| <b>Periodical peak value</b>                       |  | 380V                |                |                |
| <b>Unique peak value</b>                           |  | 2000V<br>(on 2 Ohm) |                |                |
| <b>Max. switching current (internally limited)</b> | 160A   | 160A                | 160A           | 160A           |
| <b>Security (3phases)</b>                          | 3 x 4 A inert                                      | 3 x 8 A inert       | 3 x 14 A inert | 3 x 24 A inert |
| <b>(1phase)</b>                                    | 6A inert   | 12A inert           | 15A inert      | not possible   |
| <b>Power supply</b>                                | 24VDC $\pm$ 15% external, 1A                       |                     |                |                |
| <b>Power consumption</b>                           | 24 W plus approx. 2.5 W per each controlled output |                     |                |                |

#### 4.2.2 Intermediate Circuit and End Amplifier

| Device type ND31-  | 3202 | 3204                | 3207 | 3212         |
|--|------|---------------------|------|--------------|
| <b>DC rail voltage with voltage connection</b>                       |      | 320 V               |      |              |
| <b>Shut-off threshold with over-voltage</b>                          |      | 430 V               |      |              |
| <b>Shut-off threshold with under-voltage</b>                         |      | programmable (<30V) |      |              |
| <b>Number of output phases</b>                                       |      | 3                   |      |              |
| <b>Output voltage</b>  |      | 300V <sub>eff</sub> |      |              |
| <b>Loading class</b>   |      | III                 |      |              |
| <b>Loading type</b>  |      | Motor load          |      |              |
| <b>Intermediate circuit capacity</b>                                 | 480  | 480                 | 480  | 1320 $\mu$ F |
| <b>Power-loss in the output transformer at rated current in Watt</b> | 40   | 50                  | 60   | 100          |

| Remaining voltage-loss with rated current | 4 V  |      |      |                     |
|---|------|------|------|---------------------|
| End amplifier tact frequency              | 9.76 | 9.76 | 9.76 | 9.76 kHz            |
| Motor tact frequency                      | 19.5 | 19.5 | 19.5 | 19.5 kHz            |
| Rated current Tu = 25°C                   | 2    | 4    | 7    | 12 A <sub>eff</sub> |
| Peak current Tk = 25°C                    | 4    | 8    | 14   | 24 A <sub>eff</sub> |

Maximum output current in relation to the cooler temperature:

| Temp | 25 | 35   | 45   | 55   | 65   | 75   | 85 | °C               |
|------|----|------|------|------|------|------|----|------------------|
| 3202 | 4  | 3,8  | 3,5  | 3,1  | 2,7  | 2,4  | 2  | A <sub>eff</sub> |
| 3204 | 8  | 7,6  | 6,9  | 6,1  | 5,4  | 4,7  | 4  | A <sub>eff</sub> |
| 3207 | 14 | 13,3 | 12   | 10,6 | 9,5  | 8,2  | 7  | A <sub>eff</sub> |
| 3212 | 24 | 22,8 | 20,6 | 18,2 | 16,3 | 14,1 | 12 | A <sub>eff</sub> |

As long as the cooler temperature remains at the given value, these currents on 3202, 3204 and 3207 are valid without time limitation. On 3212 the peak current is limited after 5 seconds.

**Note:** With good external venting and an environment temperature of 40°C and 7 A<sub>eff</sub> motor current, the cooler reaches a temperature with ND31-3207 of approx. 75°C.

### 4.2.3 Ballast Switching

|                                      |  |                                      |
|--------------------------------------|--|--------------------------------------|
| <b>Continuous duty loss</b>          | Internal ballast switching   | 34 W<br>(with external venting 68W)  |
|                                      | Internal ballast switching ND31 3204, 3207 and 3212                | 68 W<br>(with external venting 130W) |
|                                      | External ballast switching for ND31 3203 (2 A device)              | max. 500W                            |
|                                      | External ballast switching for ND31 3204, 3207 (2 A and 4A device) | max. 2kW                             |
| <b>Pulse power ballast switching</b> | ND31 3202 (2 A device)   | 2,5 kW                               |

|   |  |        |
|---|--|--------|
|   | ND31 3204, ND31 3207 (4 A and 7 A devices) | 5 kW   |
|   | ND31 3212 (12 A device)                    | 8 kW   |
| <b>Maximum ballast energy of the in-built ballast resistor</b>                          | 3202                                       | 200 Ws |
|   | 3204 u. 3207                               | 400 Ws |
|   | 3212                                       | 600Ws  |
| <b>Repetition rate of the maximum ballast energy with the built-in ballast resistor</b> |  | 4 s    |
| <b>Switching threshold (Threshold automatic)</b>  |  | 420 V  |
| <b>Resistance for external ballast switching</b>  | ND31 3202                                  | 50 Ohm |
|   | ND31 3204, 3207                            | 25 Ohm |

#### 4.2.4 Ventilation Compact Device

**Ventilation** External ventilation (built-in)

**Connection** Voltage connection: 230 V<sub>AC</sub>  
Current capacity: < 200 mA

**Fuselage** 315 mA inert

#### 4.2.5 Usable Connectors

**Connection for power supply X1 5605,5610,5615, 5620** Phoenix Combicon  
Front-GMSTB 2,5/16-STF

**Resolver connection and motor temperature probe X2** High Density D-SUB 15pol (on the ND 21: socket contacts)

**Periphery connection X3** SCSI 68 pole (on the ND31: socket contacts)

**Bus output connection X4** D-SUB 9pol (on the ND31: pin contacts)

**Bus input connection X5** D-SUB 9pol (on the ND31: socket contacts)

#### **4.2.6 Resolver**

**Resolver:** Sagem: 21RX360407, 15RX310107  
Litton: JSSBH-15 E-5, JSSBH-21-P4  
Siemens: V23401-H2001-B202  
Tamagawa: TS2018N321 E52, TS2112N21 E11

### **4.3 Mechanical Data**

#### **4.3.1 Measurements**

##### **19"Module**

|                         |                           |
|-------------------------|---------------------------|
| <b>3202, 3204, 3207</b> | 229 mm x 100 mm x 45,4 mm |
| <b>3212</b>             | 229 mm x 100 mm x 91 mm   |

#### **4.3.2 Weight**

|                         |        |
|-------------------------|--------|
| <b>3202, 3204, 3207</b> | 0,7 kg |
| <b>3212</b>             | 1,4 kg |

#### **4.3.3 Environment Conditions**

##### **Storage Temperature**

|                                 |                |
|---------------------------------|----------------|
| <b>max. storage temperature</b> | -25°C to +70°C |
| <b>max. humidity</b>            | 95 %           |

##### **Operating Temperature**

|                              |             |
|------------------------------|-------------|
| <b>Operating temperature</b> | 0°C to 70°C |
| <b>rel. humidity</b>         | 20 - 75 %   |

|                         |   |
|-------------------------|---|
| <b>Altitude over NN</b> | Up to 1000 m over NN power decrease must be expected. |
|-------------------------|---|

## 5. Pinning

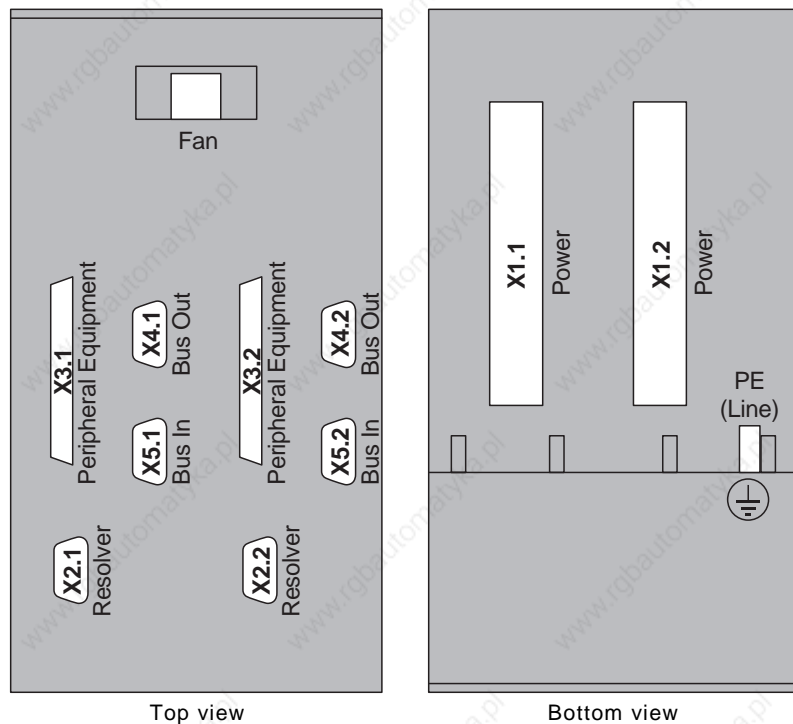


**High voltage! Fatal danger even in switched-off position!**

**As long as the motor runs, the motor is a generator!**

**Therefore avoid the uncontrolled drive of the EcoServ in case of interference by building in a brake.**

### 5.1 Arrangement of the Connectors X1...X5 for two Axes



### 5.2 Power Supply, Motor Connection and Brake Chopper Resistor



**230 VAC maximum voltage. Higher voltage leads to the destruction of the drive.**

**Should the converter be used at the 400VAC-net, an appropriate transformer has to be used.**

**When coupling various intermediate circuits, please abide that the power connection P1, P2 and P3 have to be used equally on each ND31. If phases are exchanged could that lead to the destruction of the converter.**

**Plug X1** 16-pole Combicon

**Note:** The following pinning may serve as an example. Pinning for other motors may differ from this (refer to the concerning connection table).

**Pinning**

|   | Pin   |                    |                               |
|---|-------|--------------------|-------------------------------|
| External brake chopper resistor (option) ***) | 1 eB  | extBAL             |                               |
| Internal brake chopper resistor ***)          | 2 iB  | intBAL             |                               |
| + Ballast switching                           | 3 B   | +BAL               |                               |
| Open  | 4     | -                  |                               |
|   |       | <u>Transformer</u> | <u>One phase power supply</u> |
| Power supply(max. 230 VAC)                    | 5 E1  | P1 ****)           | open                          |
| Power supply (max. 230 VAC)                   | 6 E2  | P2 ****)           | N                             |
| Power supply (max. 230 VAC)                   | 7 E3  | P3 ****)           | L ****)                       |
| - Intermediate circuit                        | 8 -Z  | -ZKS               |                               |
| + Intermediate circuit                        | 9 +Z  | +ZKS               |                               |
| Motor connection                              | 10 A3 | C **)              |                               |
| Motor connection                              | 11 A2 | B **)              |                               |
| Motor connection                              | 12 A1 | A **)              |                               |
| Ground  | 13 PE | PE                 |                               |
| Ground  | 14 PE | PE                 |                               |
| Motor temperature probe *)                    | 15 T1 | TempMot            |                               |
| Motor temperature probe *)                    | 16 T2 | TempMot            |                               |

**Notes:**

\*) If the motor temperature probe is wired with the motor cable, please connect here.

\*\*\*) SBL/SBK motors refer as follows: A → U, B → V, C → W.

\*\*\*) If the built-in brake chopper resistor should be used please insert a wire bridge between pins 2 and 3.

If you would like to use the external brake chopper: do not insert a wire bridge between pins 2 and 3. Connect the brake chopper resistor at pins 1 and 3.

\*\*\*\*) The ND31 converter can be used with a max. power supply of 230VAC. If you would like to operate the converter in the 400VAC mains, please use an appropriate transformer.

**Cross-Section of the Power Supply Cable**

| Type ND31-                           | 3202 | 3204 | 3207 | 3212               |
|--------------------------------------|------|------|------|--------------------|
| Main supply 4 x                      | 1,5  | 1,5  | 2,5  | 2,5mm <sup>2</sup> |
| Motor connection 4 x (without brake) | 1,5  | 1,5  | 2,5  | 2,5mm <sup>2</sup> |
| Inner circuit-bus 2 x                | 1,5  | 1,5  | 2,5  | 2,5mm <sup>2</sup> |
| Brake chopper resistor 2 x           | 1,5  | 1,5  | 2,5  | 2,5mm <sup>2</sup> |

All cables shielded.

**Isolation**

The used cables and wires must have a double or reinforced isolation between core and surface (**Draft DIN VDE 160 11.94 5.3.1.1.**).

**Fuselage**

| Type ND31-        | 3202          | 3204          | 3207          | 3212           |
|-------------------|---------------|---------------|---------------|----------------|
| 3 phases (230VAC) | 3 x 4 A inert | 3 x 8 A inert | 3 x 14A inert | 3 x 24 A inert |
| 1 phase (230VAC)  | 6A inert      | 12A inert     | not possible  | not possible   |

If several drives are to be fused together, for the whole you have to count the sum of each device.

**Motor Connection**

The motor has to be connected with a shielded cable on connector X1 of ND31. The cable shield has to be based on ND31 and the motor (the shield is based on both sides). On The assigned cable clamps have to be used on ND31.

The wire cross section can be interpreted according to the expected motor current. **See VDE 0113, German issue of EN 6204:**

| Electric Loading | Rated cross section | 0.75 mm <sup>2</sup> | 1.00 mm <sup>2</sup> | 1:50 mm <sup>2</sup> | 2.50 mm <sup>2</sup> | 4 mm <sup>2</sup> |
|------------------|---------------------|----------------------|----------------------|----------------------|----------------------|-------------------|
|------------------|---------------------|----------------------|----------------------|----------------------|----------------------|-------------------|



| Rated current | 7.5              | 10               | 13               | 18               | 25               |
|---------------|------------------|------------------|------------------|------------------|------------------|
|               | $A_{\text{eff}}$ | $A_{\text{eff}}$ | $A_{\text{eff}}$ | $A_{\text{eff}}$ | $A_{\text{eff}}$ |

The used cables and wires must have a double isolation between core and surface (**Draft DIN VDE 160 11.94 5.3.1.1**).

For the cable ends cable-end-sleeves with isolation in the corresponding size have to be used.



**The connection area has to be fused against accidentally touches. Before switching on the supply voltage please ensure that the fitting of all cables have been controlled and examined as well as the isolation of all cable ends.**

The earthing connection has to be made on the therefore assigned earthing bolt on the housing of the compact device or on the rear wall of the 19" rack.

**Recommended motor cables:** Lütze Silflex NSY, Lapp Ölflex - 400CP

#### **Brake Chopper Resistor**

The value of the external ballast switching has to be 25 ohm on ND31 3204 and 3207 and 50 ohm on ND31 3202. The external ballast switching has to be connected on plug X1, clamp 1 and 3. Cables to the external resistor have to be shielded.

The internal ballast switching is controlled electronically. When overloading the ballast switching stops and ND31 switches over to overvoltage. After switching-off the power supply and a waiting period of approximately 5 minutes the ND31 can be started again. Then the brake chopper control is again ready for operation.

The threshold value of the ballast switching is 420V DC rail voltage. The integrated automatic threshold allows to connect the parallel inner circuits of several ND31. As the ballast switching which is in action can raise its respond threshold up to 20V, it is guaranteed that the ballast energy of every connected ballast switching is divided evenly.

### **5.3 Resolver Connection (X2)**



**Danger by uncontrolled running drive!**

**If the resolver is not connected correctly, the drive could run uncontrolled.**

**Therefore please pay attention to the correct connection of the resolver when connecting a motor to the ND31.**

### 5.3.1 Feedback System Resolver (X2)

- Plug X2**
- Cable:** Cores have to be shielded in pairs.
- Note:** In the following please find the pinning for Novotron motors. For divergent pinnings for other motor manufacturers see Resolver Pinning.  
Solder bridge BR31, BR32, BR33, BR34 open.
- Connector:** 15 pole HD-DSUB – sleeve device-sided, pin contact cable-sided
- Shield:** Cable housing D-Sub HD.

| Pinning           | Pins |    | Pinning   |
|-------------------|------|----|-----------|
| Temperature probe | 1    | 6  | 11        |
| Temperature probe | 2    | 7  | 12        |
|                   | 3    | 8  | Rotor R1  |
|                   | 4    | 9  | Stator S2 |
|                   | 5    | 10 | Stator S3 |
| Rotor R2          |      | 15 | Stator S4 |
|                   |      |    | Stator S1 |

**Resolver cables have to be twisted and shielded in pairs.**

**Recommendation  
for Resolver Cables**

Lütze Superflex (C)Y-PUR-Kombi Order.  
No.: 111094 (usable for C-tracks, oilproof)

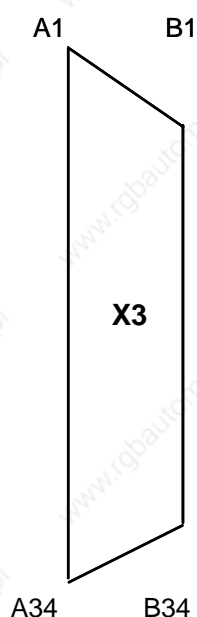
Lütze Electronic-LIY(C)Y-(C)Y-Kombi Order.  
No.: 110652 (oilproof)

### 5.4 Peripheral Equipment Connection (X3)

**Cable** Cables corresponding to **VDE 0113 paragraph 14** are to be used for the analogue nominal value, the frequency direction standard and the encoder emulation.

**Shielded cables are required.**

**Plug X3** 68-pole SCSI2: Sleeve contacts device-sided, pin contacts device-sided.


**Pinning**

+ Analogue Input  
 - Analogue Input  
 + Sensor Input A  
 Sensor Input B  
 Analogue Output 1  
 Ready for Operation-Relay  
 Ready for Operation - Relay  
 /N Encoder Emulation  
 N Encoder Emulation  
 /B Encoder Emulation  
 B Encoder Emulation  
 /A Encoder Emulation  
 A Encoder Emulation  
 5V  
 /N Encoder Input  
 N Encoder Input  
 B Encoder Input  
 A Encoder Input  
 /B Encoder Input  
 /A Encoder Input  
 GPIn 6  
 GPIn 10  
 GPIn 7  
 GPIn 2  
 GPIn 4 (Reference)  
 GPIn 5 (Release)  
 GPIn 3 (Start)  
 Keyboard 5  
 Keyboard 6  
 Keyboard 7  
 Keyboard 8  
 GPIn 8 (limit switch P)  
 GPIn 9 (limit switch N)  
 GPIn 1

**Pins**

|     |     |
|-----|-----|
| A1  | B1  |
| A2  | B2  |
| A3  | B3  |
| A4  | B4  |
| A5  | B5  |
| A6  | B6  |
| A7  | B7  |
| A8  | B8  |
| A9  | B9  |
| A10 | B10 |
| A11 | B11 |
| A12 | B12 |
| A13 | B13 |
| A14 | B14 |
| A15 | B15 |
| A16 | B16 |
| A17 | B17 |
| A18 | B18 |
| A19 | B19 |
| A20 | B20 |
| A21 | B21 |
| A22 | B22 |
| A23 | B23 |
| A24 | B24 |
| A25 | B25 |
| A26 | B26 |
| A27 | B27 |
| A28 | B28 |
| A29 | B29 |
| A30 | B30 |
| A31 | B31 |
| A32 | B32 |
| A33 | B33 |
| A34 | B34 |

**Pinning**

0V  
 5V  
 Analogue Output 2  
 RS  
 R/W  
 E  
 D0  
 D1  
 D2  
 D3  
 D4  
 D5  
 D6  
 D7  
 /CS  
 - Sensor Input A  
 Keyboard 2  
 Keyboard 3  
 Keyboard 1  
 Keyboard 4  
 GPO 2  
 GPO 1  
 GPO 8  
 GPO 3  
 GPO 7  
 GPO 6  
 GPO 5  
 GPO 4  
 GPO 10  
 GPO 9  
 0V Power Supply  
 0V Power Supply  
 24V Power Supply  
 24V Power Supply

### 5.4.1 Analogue Input

#### **Difference Input**

Analogue input for nominal values or as process signal input, input resistor  $R_i = 20 \text{ k}\Omega$ , voltage range:  $-10\text{V} \dots +10\text{V}$ .

Resolution: 14 Bit

Analogue Input +: Plug X3 68-pole SCSI 2 Pin A1

Analogue Input -: Plug X3 68-pole SCSI 2 Pin A2

**Note:** Velocity command through the analogue input (see manual Setting Up and Parameter Setting of ND31, Chapter 3).

There are additional analogue inputs available:

#### **Sensor Input A**

Sensor input A: Analogue Input as process signal input, voltage range:  $-10\text{V} \dots +10\text{V}$ .

Resolution: 8 Bit

Sensor A Input +: Plug X3 68-pole SCSI 2 Pin A3

Sensor A Input -: Plug X3 68-pole SCSI 2 Pin B16

#### **Sensor Input B**

Sensor input B: Plug X3 68-pole SCSI 2 Pin A4

### 5.4.2 Analogue Output



**The analogue output is not short-circuit proof!**

---

#### **Analogue Output 1**

Plug X3 68-pole SCSI 2 Pin A5

$\pm 10 \text{ V}$  analogue output for analogue process peripheral equipment control, loading 5 mA, resolution 8 bit.

When using output 1, GPO8 cannot be used as digital output.

Function: A 1 MHz PWM signal on GPO8 will be issued as a filtered analogue value.

#### **Analogue Output 2**

Plug X3 68-pole SCSI 2 Pin B3

$\pm 10 \text{ V}$  analogue output for analogue process peripheral equipment control, loading 5 mA, resolution 8 bit.

When using output 2, GPO1 cannot be used as digital output.

Function: A 20 kHz PWM signal on GPO1 will be issued as a filtered analogue value.

Analogue outputs should not be used for regulator applications as the resolution of the 8 bit mode is generally not enough.

**Note:** Operation of the analogue output (see manual Setting Up and Parameter Setting of ND31, Chapter 4, Analogue Output, and Section 12.8.2 in this manual).

### 5.4.3 Digital Input: Group 1

Signal level of the digital input: GPIN1...10, Keyboard 5 - 8

"0": < 5 V

"1": > 13 V (max. 24 V +10 %)

Input resistance: 10,5 kOhm

| Input:     | Function:           | Active Level | Plug X3 Pin |
|------------|---------------------|--------------|-------------|
| GPIn 1     |                     | "1"          | A34         |
| GPIn 2     |                     | "1"          | A24         |
| GPIn 3     | Start               | "1"          | A27         |
| GPIn 4     | Reference Cam       | "1"          | A25         |
| GPIn 5     | Release             | "1"          | A26         |
| GPIn 6     |                     | "1"          | A21         |
| GPIn 7     |                     | "1"          | A23         |
| GPIn 8     | Limit Switch P      | "1"          | A32         |
| GPIn 9     | Limit Switch N      | "1"          | A33         |
| GPIn 10    |                     | "1"          | A22         |
| Keyboard 5 | Keyboard Connection | "0"          | A28         |
| Keyboard 6 | Keyboard Connection | "0"          | A29         |
| Keyboard 7 | Keyboard Connection | "0"          | A30         |
| Keyboard 8 | Keyboard Connection | "0"          | A31         |

### 5.4.4 Pulse Inputs

Difference inputs, RS422 standard

Input resistance: 15 kOhm

Impulse inputs can be used for:

1. Encoder connection ROD426

2. Frequency/direction standard

3. PLC signals

High level: The not inverted input is 0.2 V higher than the inverted input.

Low level: The inverted input is 0.2 V higher than the not inverted input.

| Pin | Function 1       | Function 2        | Function 3      |
|-----|------------------|-------------------|-----------------|
| A15 | Encoder Input /N | Diff. Input 1 -   | Diff. Input 1 - |
| A16 | Encoder Input N  | Diff. Input 1 +   | Diff. Input 1 + |
| A18 | Encoder Input A  | Direction Input + | Diff. Input 2 + |
| A20 | Encoder Input /A | Direction Input - | Diff. Input 2 - |
| A17 | Encoder Input B  | Frequ. Input +    | Diff. Input 3 + |
| A19 | Encoder Input /B | Frequ. Input -    | Diff. Input 3 - |

**Note:** For Frequency/Direction Instruction see manual Setting Up and Parameter Setting of ND31, Chapter 2.

#### 5.4.5 Digital Outputs

(not for encoder emulation)

Standard level: 24 V

Load: 100 mA

| Pin | Output | Type           |                  |
|-----|--------|----------------|------------------|
| B22 | GPO 1  | Open Collector | switching to 0V  |
| B21 | GPO 2  | Open Collector | switching to 0V  |
| B24 | GPO 3  | Open Emitter   | switching to 24V |
| B28 | GPO 4  | Open Emitter   | switching to 24V |
| B27 | GPO 5  | Open Emitter   | switching to 24V |
| B26 | GPO 6  | Open Emitter   | switching to 24V |
| B25 | GPO 7  | Open Emitter   | switching to 24V |
| B23 | GPO 8  | Open Emitter   | switching to 24V |
| B30 | GPO 9  | Open Emitter   | switching to 24V |
| B29 | GPO 10 | Open Emitter   | switching to 24V |
| B19 | Key 1  | Open Collector | switching to 0V  |

|     |       |                |                 |
|-----|-------|----------------|-----------------|
| B17 | Key 2 | Open Collector | switching to 0V |
| B18 | Key 3 | Open Collector | switching to 0V |
| B2  | Key 4 | Open Collector | switching to 0V |

**Note:** Programming of the Digital Outputs, see Section 12.3, Configuration.

**Note:** The sum of the load currents of the Open Collector/Emitter Outputs must not exceed 500 mA.

**Example:** The appropriate pull up resistor for GPO1 and GPO2 to couple a 24V 10mA PLC input with a level of 20V:

$$R = \frac{24 \text{ V} - 20 \text{ V}}{10 \text{ mA}} = 400 \Omega$$

$$\text{Power of the pull-up resistor: } P = \frac{24 \text{ V}^2}{400 \Omega} = 1.44 \text{ W}$$

$$\text{Load current of the 24 V supply: } I = \frac{24 \text{ V}}{400 \Omega} = 60 \text{ mA}$$

#### 5.4.6 Encoder Emulation

Difference outputs RS422 standard.

| Pin | Function 1           | Function 2            |
|-----|----------------------|-----------------------|
| A9  | N Encoder emulation  | Difference output 1 + |
| A8  | /N Encoder emulation | Difference output 1 - |
| A13 | A Encoder emulation  | Difference output 2 + |
| A12 | /A Encoder emulation | Difference output 2 - |
| A11 | B Encoder emulation  | Difference output 3 + |
| A10 | /B Encoder emulation | Difference output 3 - |

**Note:** Ready for Operation of the Encoder emulation see manual Setting Up and Parameter setting of ND31, Chapter 5, Encoder emulation.

#### 5.4.7 Ready for Operation Contact

Ready for operation potential free closing contact.

Loading: < 500 mA, < 100 V.

Ready for operation contact 1: Plug X3 68-pole SCS12 Pin A6

Ready for operation contact 2: Plug X3 68-pole SCS12 Pin A7

**Function:** BTB closes if there are no errors and if the inner circuit voltage is in use.

### 5.5 Bus Coupling

The ND31 is equipped with a RS232 or RS422/485 interface. RS232, RS422 and RS485 are standardized electrical data interfaces.

NOVOBUS has a loop structure. The controller sends data to drive No. n, that one to drive No. n-1 etc. Drive No. 0 sends back to the controller.

Data from the drive to the controller are also transmitted from drive to drive until they reach the controller.

To send the data back from drive No. 0 to the controller, a final connector on X4 on drive No. 0 is required which contains the respective bridges for RS232 or RS422/RS485. The lead and return wire are in the same cable.



**NOVOBUS must be earthed! Normally it is earthed automatically by the controller. If not, e.g. if light wave conductor components have been fixed between the controller and ND31, alternatively a final connector has to be earthed (Pin 5 on RS232, Pin 3 on RS422/RS485).**

The signals of the buses are separate from the active parts of ND31 by double isolation.

For the NOVOBUS shielded cables are required.

#### 5.5.1 Serial Interface - Output Plug X4

**Cable** Standard RS232 or RS485 cable shielded.

**Plug** 9-pole D-Sub, pin contacts on ND31, sleeve contacts on the cable.

| <b>Pinning</b> | <b>Signal</b> | <b>Pins</b> |   | <b>Signal</b> |
|----------------|---------------|-------------|---|---------------|
|                | RS422 Aout    | 1           | 6 | RS422 Bout    |
|                | Return wire 1 | 2           | 7 | Return wire 2 |
|                | RS232 TX      | 3           | 8 | CAN L         |
|                | RS232 DTR     | 4           | 9 | CAN H         |
|                | GND           | 5           |   |               |



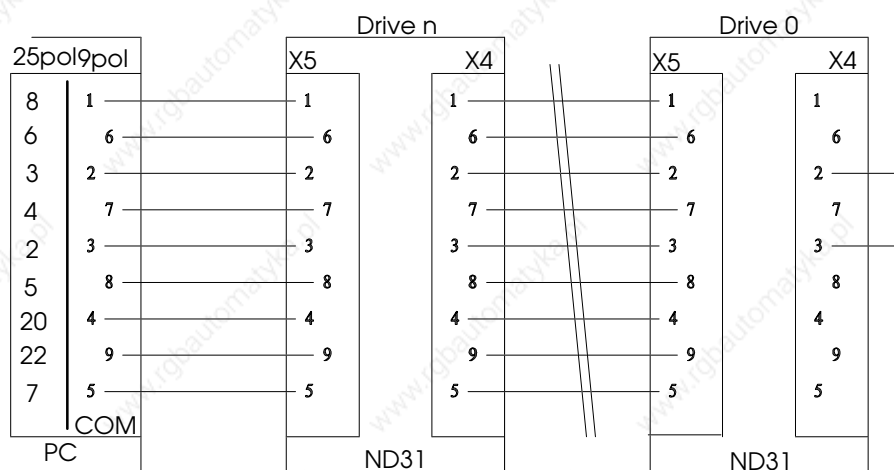
### 5.5.2 Serial Interface - Input Plug X5

**Cable** Standard RS232 or RS422/485 cable, shielded.

**Plug** 9-pole D-Sub socket contact at ND31, pin contacts at the cable.

| Signal        | Pins | Signal        |
|---------------|------|---------------|
| RS422 Ain     | 1    | RS422 Bin     |
| Return wire 1 | 2    | Return wire 2 |
| RS232 RX      | 3    | CAN L         |
| RS232 DTR     | 4    | CAN H         |
| GND           | 5    |               |
|               | 6    |               |
|               | 7    |               |
|               | 8    |               |
|               | 9    |               |

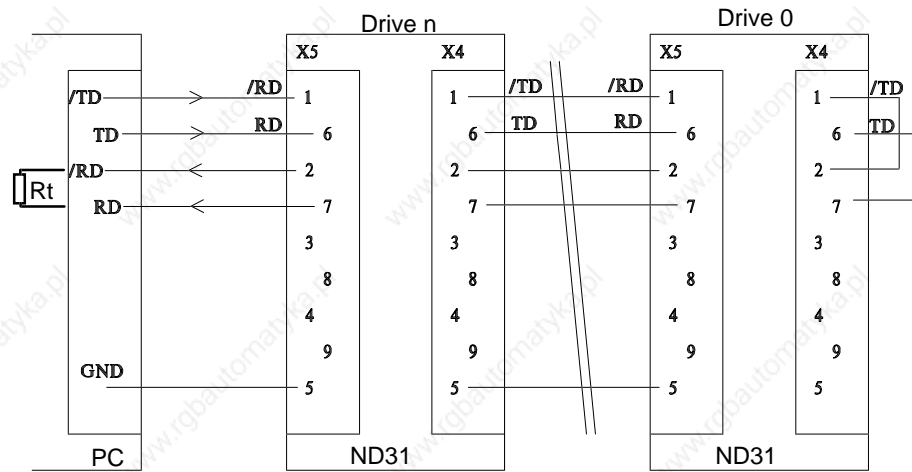
#### NOVOBUS with RS232



**Notes:** Pin 8 and 9 connect the drives at the same time with the CAN bus.

Only drive n has to be adjusted to RS232. The communication with the rest of the drives can be managed by RS422/RS485. ND31 can be used as an interface converter.

**NOVOBUS with RS422, RS485**



The receiving line in the controller must be terminated with a resistor:  $R_t = 100...120 \Omega$  (ND31 has an integrated resistor).

**5.6 Fan Connection**

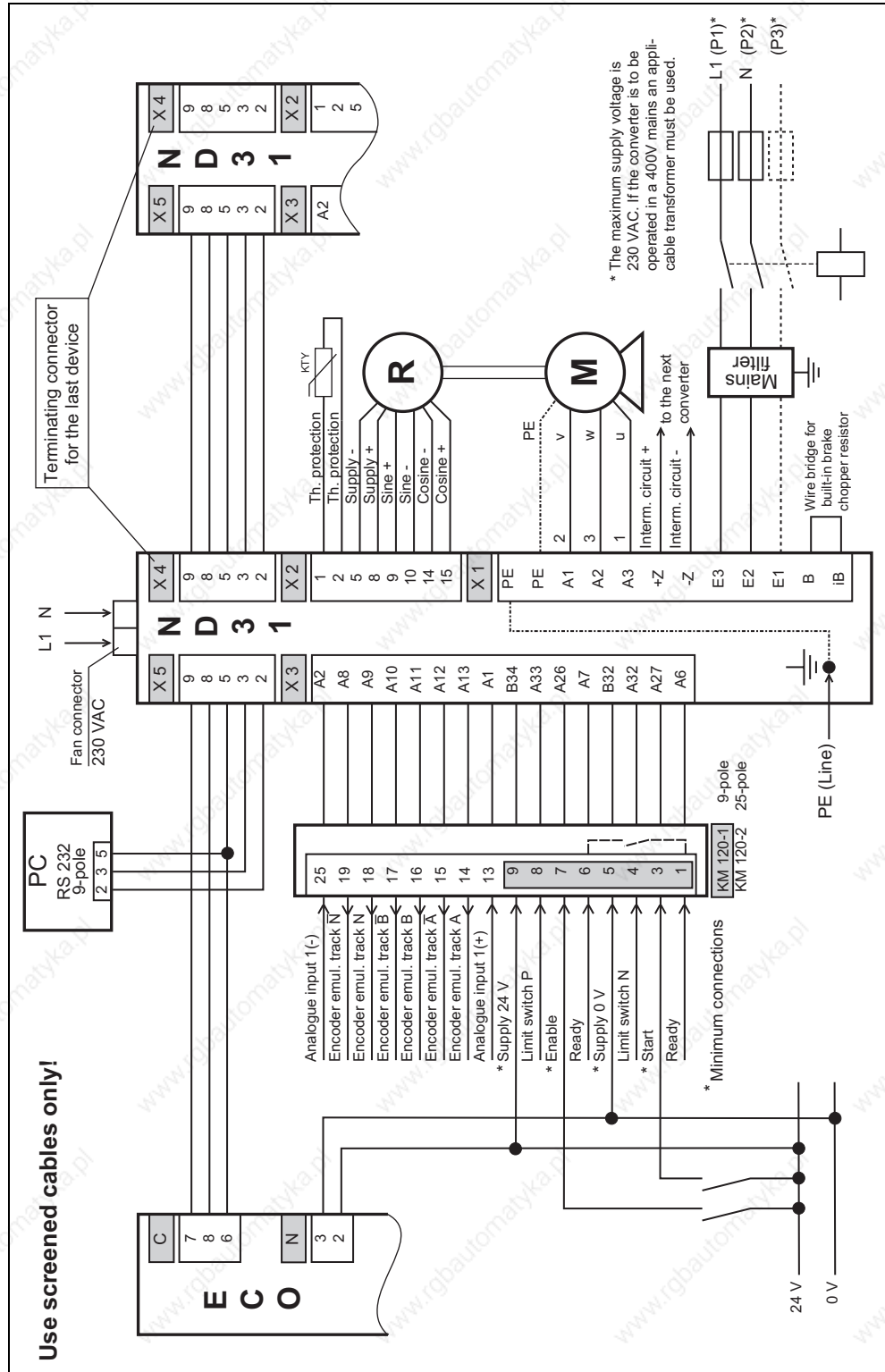
A 2-pole Combicon Plug can be found at the compact device to supply the installed fan:

Power supply: 220 VAC

Power input: < 200 mA

Fuse: 315 mA inert

### 5.7 Connection Example



Minimum connection of a ND31 to an EcoController GEL 8110

## 6. Installation

### 6.1 Mechanical Installation

---

**ATTENTION!**

**Danger of destruction of the EcoServ!**

**Operating the EcoServ in a non-suitable environment can be destructible.**

**In case of unavoidable condensation moisture, remove the condensation moisture before starting with a suitable heater.**

---

**Ventilation**

ND31 is only to be installed in an upright position. When installing the compact device the power connection plugs must be at the bottom.

When installing the 19" rack the air ventilator drawer must be installed below the ND31. The area round the ND31 ventilation outlets must not be blocked. The ND31 is not to be installed above heat emitting devices.

**Environment**

The installation can only be performed at a location free of dust, rust, metal chips, corroding or metal vapours, gases or liquids! Condensation moisture is to be avoided. If it is not possible to avoid the condensation if ND31 does not run please ensure that the moisture is completely removed before setting up.

ND31 devices may not be used in areas classified as dangerous, if they are not in approved housings and have not been tested.

### 6.2 Fuselage



**The maximum voltage of the main supply is 230VAC. A higher voltage could lead to the destruction of the converter.**

**If the converter should be operated in the 400VAC mains, an appropriate transformer has to be used.**

---

| Device ND31     | 3202          | 3204          | 3207          | 3212           |
|-----------------|---------------|---------------|---------------|----------------|
| <b>3 phases</b> | 3 x 4 A inert | 3 x 8 A inert | 3 x 14A inert | 3 x 24 A inert |

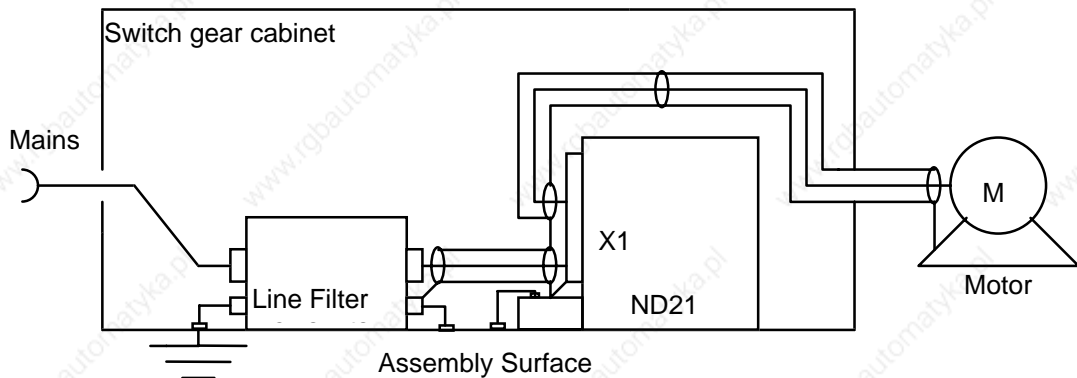
If several drives are to be fused together, the sum of each device has to be counted for the whole fuse.



**Caution „High Voltage”! Fatal danger!**

**Contacts are only fused if earthing, mains and motor connection is executed as described in this chapter.**

### 6.3 Earthing and Shielding



**Note:** To demonstrate more clearly, switch and fuse elements have not been mentioned in the above diagram. The elements have to be inserted that they do not disturb the principle course of the shields and earthing.

To follow the **EMC standard EN55011**, special attention should be paid on shielding and earthing.

**Motor Wires**

The shield is to be fixed with cable clamps on one side of the motor housing and on the other side on the compact device or 19"rack of the ND31.

**Brake**

When using motors with brakes, the cable has to be shielded till the brake relay.

**Mains Filter**

The shield is to be fixed on the side of the filter with an appropriate earth connection of the line filter and the side of the ND31 with cable clamps on the compact device or 19"rack of the ND31.

The line filter must be screwed on the plane assembly board for the effective use of the line filter. Additionally the filter should be earthed with a short connection (2.5 mm<sup>2</sup>) to the assembly board.

**Appropriate Mains Filter**

| 1phase    | 3202       | 3204       | 3207       | 3212        |
|-----------|------------|------------|------------|-------------|
| Schaffner | FN660-3-06 | FN660-6-06 | FN350-8-29 | FN350-12-29 |

|                  |               |                    |                     |                  |
|------------------|---------------|--------------------|---------------------|------------------|
| <b>Corcom</b>    | 3EP1<br>6FC10 | 3EP1/6EP1<br>6FC10 | 6EP1/10EP1<br>6FC10 | 16EP1<br>12FC10  |
| <b>Siemens</b>   | B84115-E-B30  | B84115-E-B60       | B84142-B8-R         |                  |
| <b>3phases</b>   | <b>3202</b>   | <b>3204</b>        | <b>3207</b>         | <b>3212</b>      |
| <b>Schaffner</b> | FN354-4/05    | FN354-4/05         | FN351-8-29          | FN351-16-29      |
| <b>Corcom</b>    | 6FCD10        | 6FCD10             | 6FCD10<br>F3719     | 12FCD10<br>F3737 |
| <b>Siemens</b>   |               |                    | B84143-A8-R         | B84143-A12-R     |

### **Protective Earth Wire**

The PE connection of ND31 (Pin 14 X1) is to be connected with the earthing screw of the compact device or 19"rack. Connection cross section 2,5 mm<sup>2</sup> for 3202, 3204 and 3207 or 4 mm<sup>2</sup> for 3212.

### **Earthing of the compact device or the 19" rack!**

#### **Earthing ND31**

The compact device is to be screwed on the plain assembly board if possible. Additionally a short earthing connection (10mm<sup>2</sup>) should be used between the earth bolt of the compact device or 19"rack towards the assembly board or earthing bus bar. The assembly board has to be earthed properly.

#### **Requirements:**

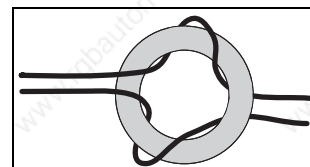
- Using the shields on both sides.
- Earthing connection short and thick.
- Fixing shields widely.
- Unshielded parts as short as possible.
- Earthing of the switchgear cabinet.
- Wires as short as possible.
- Signal and control wires always separated from the power supply wire.
- Freely supported wires can cause trouble (the active aerials the same as the passive aerials).

EMV-compatibility according to EN 55011 is only guaranteed if:

- A convenient line filter is used.
- A connection cable between ND31 and line filter as well as

power supply wire between ND31 and the motor is shielded.

- Shielding is connected with the earthing screw of the line filter, the compact device or 19"rack and the motor housing.
- The individual cores of the motor and mains cables are fed through ferrite toruses using the same winding sense, except for the PE wire.



#### 6.4 Emergency Power Off Concept ND31

To prevent hazard to individuals or damage to the machine the emergency power off assembly has to be activated. Dangerous parts of the machine or the whole machine can be switched off as soon as possible.



**Danger of injury by running motor!**

**Moving parts can be hazardous to individuals or cause damage to the plant.**

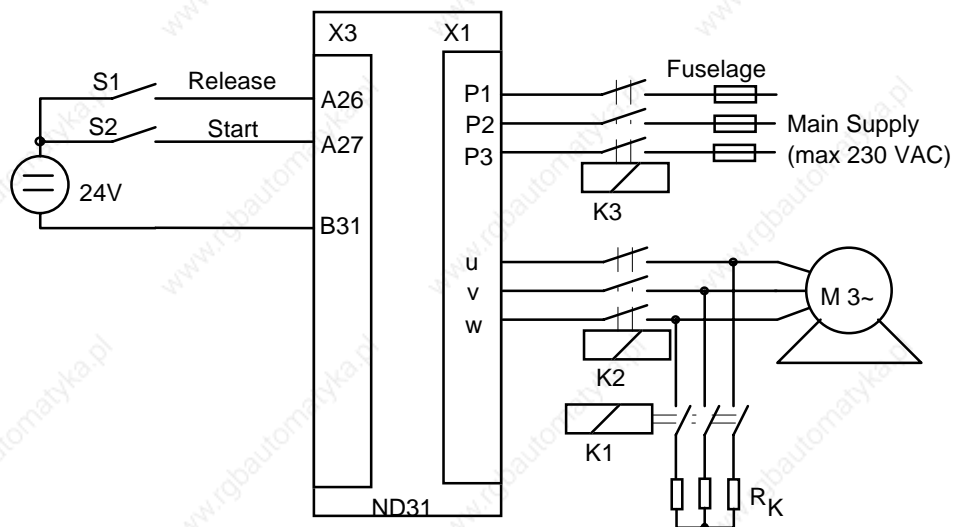
**Therefore, the plant in which the EcoServ is installed must be equipped with an emergency power off (EPO) assembly. The EPO must stop the plant as quickly as possible.**

##### 6.4.1 General

This paragraph is about two different concepts according to the emergency power off:

- Short cut braking
- Regulated braking

When and which emergency power off concept is to be applied depends on the plant. Depending on the application, the correct emergency power off concept has to be chosen out.



For the emergency power off please abide the following instructions:

- The emergency power-off contactor between EcoServ and motor must be able to separate direct current which is similar to the peak value of the peak current of your EcoServ.
- By short circuit braking the brake resistor must have the correct dimension.

#### 6.4.2 Short Circuit Braking

For the short circuit braking of the servo motor the power stage of the ND31 has to be blocked by stopping the current of input 26 on X3. At the same time contactor K1 is energized.

Calculation of the brake resistor  $R_k$ :

$$R_k = \frac{\text{max. speed (rpm)} \times \text{power radiant (V / rpm)}}{\sqrt{3} \times \text{peak current of the motor}}$$



### 6.4.3 Emergency Power Off with Controlled Braking



Danger by lag running drive after emergency off.

The drive slows down by emergency off, therefore please note:

- **Do not block the power stage!** Regulated braking is only possible if the power stage is released (neither software nor hardware block).
- The control has to be adjusted correctly.
- By emergency off the motor stops after eliminating a possible tracking error!
- Please note, that a tracking error can occur by mechanical interference.

---

**ATTENTION!**

ND31 can only be stopped when the power stage is released (neither software nor hardware block).

---

**ATTENTION!**

ND31 stops the motor regulated. That requires a correct installation of the control. If the control is installed that a tracking error occurs, the tracking error will be eliminated. Only then the motor stops.

Braking is activated by the pre-programmed ramp. Then the power stage can be blocked. Therefore the release input (Pin 26 of X3) is to prepare currentless.

**Note:** Braking can also be carried out by the analogue speed nominal value input if the nominal value is set to 0.

Additionally it is required to isolate the motor from the main supply. Therefore are two possibilities: Either by separating the main supply and ND31 with contactor K3 or the motor and ND31 with contactor K2. Only one of both contactors is required. Before separating ND31 from the motor, please note that ND31 has to be blocked.

If necessary, the switch off of contactor K2 has to be prolonged by taking adequate measures until braking has been finished and the regulator stops.

The requirements for a reliable isolation between ND31 and the motor is a complete operation area for the ND31, which guarantees that in case of an emergency power off the contact with current-carrying parts at the ND31 is excluded.

---

**ATTENTION!**

**Contactors K2 must be able to switch a direct current which is adequate to the peak value of the peak current of ND31.**

---

## 7. Designing a Drive Unit

In this chapter you will learn how to find the proper drive unit for a specific usage. In the given calculation example you will see how to select the proper drive for your needs.

### 7.1 Electrical Design

**Question:** Can a motor with a defined torque selected for ND31 achieve a certain speed with this torque?

**Example:** An application requires a torque of 12 Nm for acceleration and that a speed of 2600 rpm should be reached with this torque. It is to be tested whether this acceleration can be achieved with ND31 3207 and a motor with the following specifications.

The motor shows an instantaneous standstill torque of 6.8 Nm and may be overloaded 5-fold for quick acceleration. The torque constant is 0.34 Nm/A. The motor has 6 poles and its phase-to-phase winding resistance amounts to 1.7 Ω. Certainly, herewith the requested acceleration is possible. To determine if the required maximum speed can be reached with the specified torque, the following calculating scheme may be used:

**Inductive voltage drop on motor:**

$$U_L = n \times p \times L \times i \times 0.0453$$

with

$$n = \text{speed [revolutions per minute]} = 2600 \text{ rpm}$$

$$p = \text{motor polarity} = 6$$

$$i = \text{effective acceleration current [A]} = 11.8 \text{ A}$$

$$i = \frac{M}{(3 \times \text{torque constant})} = \frac{12 \text{ Nm}}{3 \times 0.34 \frac{\text{Nm}}{\text{A}}}$$

$$L = \text{motor inductivity, phase to phase [H]} = 0.0126 \text{ H}$$

Inserted:  $U_L = 105.1 \text{ V}$

**Resistive voltage drop on motor:**

$$U_R = R \times i \times 0.866$$

with:

$$R = \text{effective resistance, phase to phase } [\Omega] = 1.7 \text{ } \Omega$$

herewith:  $U_R = 17.37 \text{ V}$

**CEMF of the motor:**

$$U_E = \frac{1}{\sqrt{2}} \times V_g \times n / 1000$$

with

$$V_g = \text{Voltage gradient, phase to phase [V/1000]} = 88$$

herewith:  $U_E = 161.8 \text{ V}$

**Voltage requirement for the motor:**

$$U = \sqrt{(U_E + U_R)^2 + U_L^2} = 207.7 \text{ V}$$

**Required intermediate circuit voltage:**

$$U_{ZK} = \sqrt{2} \times U = 293.7 \text{ V}$$

With 3-phase 230V power connections the ND31 has an intermediate circuit voltage of 325 V. There is sufficient voltage present to reach the defined speed with the defined torque.

## 8. Novobus

In this chapter you will learn, how to use the NOVOBUS to control your drive unit.

### 8.1 General

NOVOBUS is an inexpensive solution for networking digital drives and also provides quick communication between controllers i.e. PC or PLC and drive units.

- Exchanging nominal and actual values (i.e. spin speed nominal and actual value).
- Transmitting new nominal position values for positioning axis.
- Parameter loop for motor regulators (i.e. setting and making on-line changes to regulator structures, regulator parameters and enabling maximum values etc).
- Transmitting control commands (start, stop, regulator stops...).
- Requesting important information (i.e. cooler and motor temperature, limiter switches, ready signals, in-position signals, additional external signals as process information, integrated operating hour counters, status of drive units, error messages).
- Controlling programmable analogue and digital outputs of drive units (i.e. for confirming shields or brakes, transmitting warning signals etc.).

#### **RS232/RS485**

The standard transmission hardware for the NOVOBUS are the standard serial interfaces RS232 or RS485 (Standard for all PCs and modern controllers).

No additional hardware extensions i.e. bus controllers, communication cards, protocol chips, intelligent bus plugs are required.

#### **Driver**

All digital Novotron drive units are standard equipped with the necessary serial interface as well as software drivers for the NOVOBUS protocol.

A NOVOBUS driver as software library for PC applications is provided free of charge (NB31.LIB).

#### **Loop Structure**

The only requirement for communication with the NOVOBUS is a loop connection of the PC with the drive units via RS232 or RS485 cables or via light wave conductors and the respective electro-optical transformers.

Up to 250 axes can be controlled in one loop. The drives are automatically addressed according to their position in the loop. For higher transmission speeds or connecting cycled machine components drives can be distributed to several loops.

## 8.2 Features

**Velocity** The duration for a byte transfer is 286.46 ms at a speed of 38,400 bits/sec.

The required time for completing nominal and actual value exchange with speed regulated drives is:

| Drives per ring | Time    |
|-----------------|---------|
| 1               | 0.86 ms |
| 2               | 2.0 ms  |
| 3               | 2.9 ms  |
| 4               | 3.7 ms  |
| 5               | 4.6 ms  |
| 6               | 5.4 ms  |

The required time for transferring new nominal value positions for positioning axes is:

| Drives per ring | Time       |
|-----------------|------------|
| 1               | 4.01 ms    |
| 10              | 40.39 ms   |
| 100             | 401.33 ms  |
| 250             | 1002.79 ms |

## 8.3 Requirements for Transmission

RS232 or RS485 alternatively.

Light wave conductor may be used in connection with interface converters.

Transmission speed: 38,400 bits/sec

Transmission is performed with 8 data bits, 1 parity bit (odd parity) and 1 stop bit.

## 8.4 Bus Structure

NOVOBUS has a loop structure: The drives can be connected to one or more loops.

**Master/Slave** Per loop: 1 Bus Master (controller),  
max. 250 Slaves (drives)

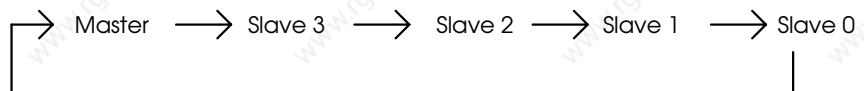
In normal operation, the Slaves can only answer the Master telegram. In case of a time-out error Slaves may also transmit error telegrams independently.

## 8.5 Device Addresses

### 250 Axes per Ring

Up to 250 axes can be controlled by one loop. Drives are automatically addressed according to their position in the loop. Numbering loops of the devices begin with the last one in the loop which has the address "0". The address of the first device in the loop is N-1, whereas N pertains to the number of Slaves.

i.e.: with 4 axes



## 9. Bus-Definition

The Master (controller) transmits telegrams continuously. Most transmissions contain an address (exception: SYNCO and PAUSE).

Devices for which a transmission is not to be intended continue to send telegrams. The intended address answers to the telegram. The length of the answer is always identical with the length of the Master transmission.

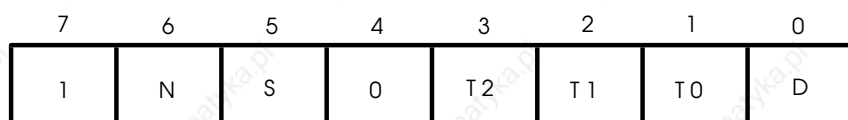
### 9.1 Transmission Syntax

- Synchronized byte** (obligatory)
- Address byte** (optional)
- Process data** (2 bytes, optional)
- Parameter data** (1-7 bytes, optional)

All bytes are sent with odd parity. The net transmission length (process data + parameter data) may consist a maximum of 7 bytes. In a transmission with process data the parameter data may be a maximum of 5 bytes long.

### 9.2 Synchronization Byte

The synchronization byte is always the first byte of a transmission. It contains the code for the length of the transmission.



- N = 1:** Next with short address (or = 0)

---

- S = 1:** Short address

---

- T2-T0:** Net transmission length (without synchro byte and address byte, 0...7)

---

- D = 1:** The transmission contains process data information (2 bytes data channel)

**Short Address** When S = 1 and N = 0, the same drive which received the last transmission will be addressed.



When  $S = 1$  and  $N = 0$  the next drive will be addressed (Address = Address 0+1).

When  $S = 0$  and  $N = 0$  an address byte will follow.

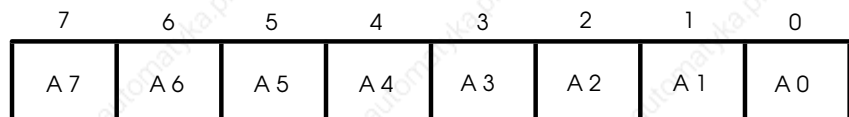
If no process data bus or parameter bus is active the synchro byte "SYNCO" will be sent to maintain a continuous data flow. "SYNCO" will be forwarded without change by the receiver.

"SYNCO": H'80

To loosen the data flow the synchro byte "PAUSE" can be sent. It will be ignored by the receiver (no response).

"PAUSE": H'81

### 9.3 Address Byte



The Master transmission A7-A0 contains:

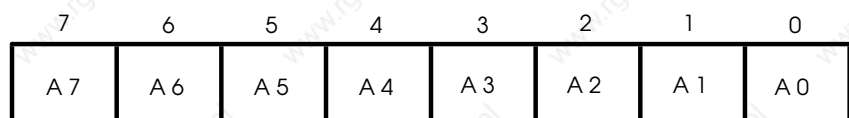
k-N

k = Device address in the loop

N = Number of passive devices (Slaves)

All devices increase the address by 1 and forward the transmission with the new address. A drive is addressed if the address is "0" after incrementing. The non-addressed drives pass the entire transmission without checking the contents.

**Example:** N=5, the controller wants to communicate with the device axis 2: ( $k-N = 2 - 5 = -3 = H'fd$ ).



**Master:** 1 1 1 1 1 1 0 1 (H' fd = k-N)

**Axis4:** 1 1 1 1 1 1 1 0 (H' fe)

**Axis3:** 1 1 1 1 1 1 1 1 (H' ff)

**Axis2:** 0 0 0 0 0 0 0 0 (H'00) ← !!!

**Axis1:** 0 0 0 0 0 0 0 1 (H'01)

**Axis0:** 0 0 0 0 0 0 1 0 (H'02 = k)

The incremented address is zero at the addressed axis (Axis2). The Master receives the answer for its transmission with the address "k" (in the above example, in which Axis2 was addressed: H'02).

#### **9.4 Process Data Bus**

With this bus a faster nominal and actual value exchange can be realized. Hereby the lowest bit in the synchronization byte is set (see Section 9.2, Synchronization Byte). The data are always 2 bytes long. In the transmission, first the byte with the highest value (MSB) and then the one with the lowest value (LSB) is sent.

#### **9.5 Parameter Bus**

With the assistance of the parameter bus the drives can receive parameters. Commands can be sent, and information from the drives can be received. A command in the parameter bus consists of a command byte, data bytes (0...4) and a check byte.

With a NOVOBUS transmission several commands can be sent through the parameter bus and respectively a command in the parameter bus can be divided into several transmissions. The answer to a command is the same length as the command itself (2 to 6 byte). The command byte and the checking byte must not have the value H'00.

#### **9.6 Control Byte in the Parameter Bus**

The Master (controller) sends all commands into the parameter bus with a test sum as checking byte (+ check sum). This check sum will be tested by the signalled drive.

The command will be carried out when the check sum is correct, otherwise the drive signals an error (see Section 9.7, Error Handling).

The check sum is the sum of bytes in one command. If the sum "0" is transmitted, the check sum will be corrected. Instead of 0, 1 is to be sent (H'00 is reserved for error messages). The responded drive forms a new check sum out of the answer and sends its two's complement (- check sum).

The check sum pertains to the parameter bus and is only made up of the bytes in the parameter bus. Synchro byte, address byte and process data will not be considered in the check sum.

## 9.7 Error Handling

When the drive notices an error in the communication (parity error, framing error, improper synchro byte, incorrect command in parameter bus, improper command parameter or incorrect check sum), it goes into an error mode.

The drive which first detects the error answers with H'00 to all received bytes. The following axes can then detect the error very rapidly when they are addressed with: incorrect synchro, command or checking bytes (may not be H'00), or improper command parameter (in case a H'00 is not accepted here).

A non-addressed drive checks the contents of the transmission. It can only detect the error when the next synchro byte fails. A transmission can have a maximum of 9 bytes. If the error is in the address byte, the other axes which have only received H'00 bytes since the error occurred may not notice the error until the 9th byte.

An error free transmission can only be contained in the address byte (byte 1), in the process data bus (byte 2) and in the data area of the parameter bus (max. 4 bytes). That means a maximum of 7 times consecutively of H'00 can be possible. The drives have an error condition that count the number of zero bytes which have been sent from the preceding drive. If the drive receives 8 times H'00 without interruption the preceding drive is in the error condition.

In this case the sent bytes are controlled for a checking sequence. If a checking sequence is detected it returns to normal operation mode (see Section 9.8, Checking Sequence).

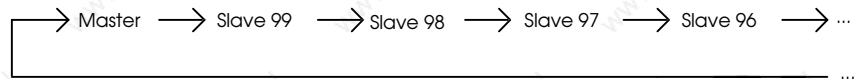
To be sure that also the following drive recognizes the error, at least 9 times H'00 has to be sent. For a drive to detect that the preceding drive is in an error condition it must receive additional 8 zero bytes.

Therefore all drives in error condition first send H'00 17 times. If they detect that the preceding drive in the loop is in an error condition they incrementally forward all received bytes.

The Master receives first of all a maximum of 25 H'00 bytes during an error, afterwards it receives the address of the drive which has recognized the error. That enables an easy location of the error.

### **Example:** 100 axes

The Master reads one byte each out of the RAM of drives no. 95 to 99. An error bit will be transmitted between the drives no. 98 and 97, drive no. 97 detects that as a parity error.



**The 1st Telegram**

|                 |        |  |
|-----------------|--------|--|
| <b>1. Byte:</b> | H'88 = | Synchro byte (follows address byte and 4 bytes in the parameter bus, no process data). |
| <b>2. Byte:</b> | H'FB = | -5 = 95-100 (Slave 95 is addressed in a loop with 100 Slaves in the ring).             |
| <b>3. Byte:</b> | H'C0 = | Read byte command for ND31   |
| <b>4. Byte:</b> | H'13 = | AddressL, LSB of address H'FE13  |
| <b>5. Byte:</b> | H'FE = | AddressM, MSB of address H'FE13  |
| <b>6. Byte:</b> | H'D1 = | Checking byte (C0+13+FE = 1D1)   |

The following transmissions differ only in the 2nd byte (96-100=-4 = H'FC, 97-100= -3 = H'FD, ...)

|    |    |    |    |     |     |     |     |     |
|----|----|----|----|-----|-----|-----|-----|-----|
| M  | S  | S  | F  | S   | S   | S   | ... | S   |
| a  | l  | l  | e  | l   | l   | l   |     | l   |
| s  | a  | a  | h  | a   | a   | a   |     | a   |
| t  | v  | v  | l  | v   | v   | v   |     | v   |
| e  | e  | e  | e  | e   | e   | e   |     | e   |
| r  | 9  | 9  | r  | 9   | 9   | 9   |     | 0   |
|    | 9  | 8  |    | 7   | 6   | 5   |     | 0   |
| 88 | 88 | 88 |    | 88  | 88  | 88  | ... | 88  |
| FB | FC | FD |    | FE  | FF  | 00  |     | 5F  |
| C0 | C0 | C0 |    | C0  | C0  | C0  |     | C0  |
| 13 | 13 | 13 |    | 13  | 13  | 13  |     | 13  |
| FE | FE | FE |    | FE  | FE  | >88 |     | 88  |
| D1 | D1 | D1 |    | D1  | D1  | +A5 |     | A5  |
| 88 | 88 | 88 |    | 88  | 88  | 88  |     | 88  |
| FC | FD | FE |    | FF  | 00  | 01  |     | 60  |
| C0 | C0 | C0 |    | C0  | C0  | C0  |     | C0  |
| 13 | 13 | 13 | 12 | !00 | 00  | 00  |     | 00  |
| FE | FE | FE |    | 00  | !00 | 00  |     | 00  |
| D1 | D1 | D1 |    | 00  | 00  | 00  |     | 00  |
| 88 | 88 | 88 |    | 00  | 00  | !00 |     | !00 |
| FD | FE | FF |    | 00  | 00  | 00  |     | 00  |
| C0 | C0 | C0 |    | 00  | 00  | 00  |     | 00  |
| 13 | 13 | 13 |    | 00  | 00  | 00  |     | 00  |
| FE | FE | FE |    | 00  | 00  | 00  |     | 00  |
| D1 | D1 | D1 |    | 00  | *00 | 00  |     | 00  |

|    |    |    |     |     |     |     |    |
|----|----|----|-----|-----|-----|-----|----|
| 88 | 88 | 88 | 00  | 00  | 00  | 00  |    |
| FE | FF | 00 | 00  | 00  | *00 | *00 |    |
| C0 | C0 | C0 | 00  | 00  | 00  | 00  |    |
| 13 | 13 | 13 | 00  | 00  | 00  | 00  |    |
| FE | FE | 88 | 00  | 00  | 00  | 00  |    |
| D1 | D1 | A5 | 00  | 00  | 00  | 00  |    |
| 88 | 88 | 88 | 00  | 00  | 00  | 00  |    |
| FF | 00 | 01 | #00 | 00  | 00  | 00  |    |
| C0 | C0 | C0 | 00  | #00 | 00  | 00  |    |
| 13 | 13 | 13 | 00  | 01  | 00  | 00  |    |
| FE | 88 | 88 | 00  | 01  | #00 | #00 |    |
| D1 | A5 | A5 | 00  | 01  | 02  | ... | 61 |
| 88 | 88 | 88 | 00  | 01  | 02  |     | 61 |
| 9C | 9D | 9e | 00  | 01  | 02  |     | 61 |

#### Remarks:

- >: Answer byte in a transmission (contents of the memory cell).
- +: New check sum.
- !: The drive detects an error.
- \*: The drive detects that the preceding drive is in error mode.
- #: The 17th sent zero byte after the error detection.

The message H'00 indicates an error to the Master, bytes H'61 = 97 means that the error has been noticed by Slave 97.

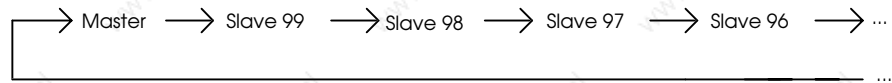
### 9.8 Checking Sequence

If the Master detects an error in data traffic, a checking sequence is sent to reset the drives. The first 17 bytes of the checking sequence are H'00, so that all drives which still did not detect the error turn into error mode. After the checking sequence the Master can repeat the uncompleted commands.

The checking sequence is:

(17 times H'00) H' ff H'44 H'72 H'4c H'41

**Example:** 100 axis and axis no. 97 - 0 are in error mode. Axis no. 99-98 could not detect any error in the communication. The Master has just sent a transmission when the error has been detected by an unexpected 0-byte. After detecting the error the Master sends 17 times H'00. Then the bus sets back with a check sequence.



|                               | M  | S   | S   | S   | S   | S   | ... | S   |
|-------------------------------|----|-----|-----|-----|-----|-----|-----|-----|
|                               | a  | l   | l   | l   | l   | l   |     | l   |
|                               | s  | a   | a   | a   | a   | a   |     | a   |
|                               | t  | v   | v   | v   | v   | v   |     | v   |
|                               | e  | e   | e   | e   | e   | e   |     | e   |
|                               | r  | 9   | 9   | 9   | 9   | 9   |     | 0   |
|                               |    | 9   | 8   | 7   | 6   | 5   |     | 0   |
| <b>Started Telegram</b>       | 88 | 88  | 88  | 00  | 01  | 02  | ... | 61  |
| <b>17 Zero Bytes</b>          | 00 | 01  | 02  | 00  | 01  | 02  | ... | 61  |
|                               | 00 | 00  | 00  | 00  | 01  | 02  |     | 61  |
|                               | 00 | 00  | 00  | 00  | 01  | 02  |     | 61  |
|                               | 00 | 00  | 00  | 00  | 01  | 02  |     | 61  |
|                               | 00 | !00 | !00 | 00  | 01  | 02  |     | 61  |
|                               | 00 | 00  | 00  | 00  | 01  | 02  |     | 61  |
|                               | 00 | 00  | 00  | 00  | 01  | 02  |     | 61  |
|                               | 00 | 00  | 00  | *01 | 02  | 03  |     | 62  |
|                               | 00 | 00  | 00  | 01  | 02  | 03  |     | 62  |
|                               | 00 | 00  | 00  | 01  | 02  | 03  |     | 62  |
|                               | 00 | *00 | *00 | 01  | 02  | 03  |     | 62  |
|                               | 00 | 00  | 00  | 01  | 02  | 03  |     | 62  |
|                               | 00 | 00  | 00  | 01  | 02  | 03  |     | 62  |
|                               | 00 | 00  | 00  | 01  | 02  | 03  |     | 62  |
|                               | 00 | 00  | 00  | 01  | 02  | 03  |     | 62  |
|                               | 00 | 00  | 00  | 01  | 02  | 03  |     | 62  |
| <b>Check Code</b>             | FF | @FF | @FF | @FF | @FF | @FF | ... | @FF |
|                               | 44 | 44  | 44  | 44  | 44  | 44  |     | 44  |
|                               | 72 | 72  | 72  | 72  | 72  | 72  |     | 72  |
|                               | 4C | 4C  | 4C  | 4C  | 4C  | 4C  |     | 4C  |
|                               | 41 | 41  | 41  | 41  | 41  | 41  |     | 41  |
| <b>Repeating Transmission</b> | 88 | 88  | 88  | 88  | 88  | 88  | ... | 88  |
|                               | FC | FD  | FE  | FF  | 00  | 01  |     | 60  |
|                               | C0 | C0  | C0  | C0  | C0  | C0  |     | C0  |
|                               | 13 | 13  | 13  | 13  | 13  | 13  |     | 13  |
|                               | FE | FE  | FE  | FE  | >88 | 88  |     | 88  |
|                               | D1 | D1  | D1  | D1  | +A5 | A5  |     | A5  |

**Remarks:**

- !: The drive detects an error
- \*: The drive detects that the preceding drive is in error mode
- @: The drive detects the first byte of the checking sequence
- >: Answer byte in a transmission (contents of the memory cell)
- +: New check sum

After the check sequence the bus is again ready for operation.

**9.9 Time-out Error**

---

**ATTENTION! This function is not available in the present version.**

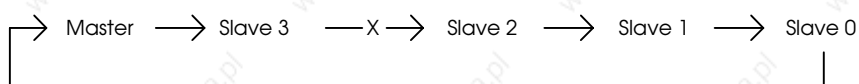
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If a byte is not received within at least 10 ms, a time-out error has occurred. This function can be switched off.

When a time-out error occurs, the drive turns into error condition and waits further 10 ms to allow other drives to detect the time-out-error and react accordingly.

After this waiting period the drive begins to send zero bytes. The other drives detect the error at least after the 8th H'00 and then increment the received bytes. The Master receives the address of the error source.

**Example:** Disconnection between axis 3 and axis 2.



**Slave2:** ... 00 00 00 00 00 00 00 00 00 00

**Slave1:** ... 00 00 00 \*01 01 01 01 01 01

**Slave0:** ... 00 00 \*01 02 02 02 02 02 02

\*: The drive detects that the previous drive is in error mode.

The received H'02 bytes shows the Master that Axis2 has identified the error. Either the connection between Axis3 and Axis2 is interrupted or Axis3 is not ready for operation.

## 10. CAN Bus

### 10.1 Data exchange with Controllers GEL 8100

The Controllers GEL 8100 can control up to 6 ND31 converters via the CAN bus: the controller transmits the nominal speed to the converter, and the converter transmits its actual position to the controller.

### 10.2 CAN bus configuration

In the RAM of the ND31 several memory locations for adapting the CAN bus to the controller exist:

| Address | Byte | Designation | Function, value   |
|---------|------|-------------|---|
| 0xfee8  | 1    | CANinitBTR0 | Timing configuration;<br>input: 40  |
| 0xfee9  | 1    | CANinitBTR1 | Timing configuration;<br>input: B9  |
| 0xff11  | 1    | CANCFG      | CAN configuration;<br>input: FF   |
| 0xff16  | 1    | CANTimeout  | Timeout time 10 ms/bit;<br>input: 5 (50 ms)   |
| 0xff39  | 1    | CANmaster   | Identifier for Master telegrams;<br>input for<br>Axis1: 30<br>Axis2: 31<br>Axis3: 32<br>Axis4: 33<br>Axis5: 34<br>Axis6: 35 |
| 0xff3a  | 1    | CANslave    | Identifier for Slave telegrams;<br>input for<br>Axis1: 20<br>Axis2: 21<br>Axis3: 22<br>Axis4: 23<br>Axis5: 24<br>Axis6: 25  |
| 0xff3b  | 1    | CANtime     | Identifier for SYNC telegrams;<br>input: 40   |



## 11. ND31 Specific Commands

### 11.1 Read Commands

**Read Byte** **ReadByte:** Reads a byte from the memory of the ND31:

H'FD80-H'FF7F RAM

| Command       | H'C0 | AddrL | AddrH | +Checksum |
|---------------|------|-------|-------|-----------|
| <b>Answer</b> | H'C0 | AddrL | Data  | -Checksum |

**Read Word** **ReadWord:** Reads a word (2 byte) out of the ND31-memory:

H'FD80-H'FF7F RAM

| Command       | H'C1  | AddrL   | AddrH                                    | H'3F                     | +Checksum |
|---------------|---|---|--|--------------------------|-----------|
| <b>Answer</b> | H'C1 <td>AddrL <td>DataL <td>DataH <td>-Checksum</td> </td></td></td> | AddrL <td>DataL <td>DataH <td>-Checksum</td> </td></td> | DataL <td>DataH <td>-Checksum</td> </td> | DataH <td>-Checksum</td> | -Checksum |

**Read WordX** **ReadWordX:** Reads a word (2 byte) out of the external memory of ND31. The possibly area depends on the memory extension:

H'4000-H'FFFF ExtRAM

| Command       | H'C9   | AddrL   | AddrH                                    | H'3F                     | +Checksum |
|---------------|--|---|--|--------------------------|-----------|
| <b>Answer</b> | H'C19 <td>AddrL <td>DataL <td>DataH <td>-Checksum</td> </td></td></td> | AddrL <td>DataL <td>DataH <td>-Checksum</td> </td></td> | DataL <td>DataH <td>-Checksum</td> </td> | DataH <td>-Checksum</td> | -Checksum |

**Read Long** **ReadLong:** Reads 4 Byte from the memory of ND31:

H'0000-H'FFFF RAM

| Command       | H' C7  | AddrL  | AddrH | H' 31 | H' 32 | H' 3F | +Checksum |
|---------------|--|--|-------|-------|-------|-------|-----------|
| <b>Answer</b> | H' C7 <td>AddrL <td>Data0</td> <td>Data1</td> <td>Data3</td> <td>Data4</td> <td>-Checksum</td> </td> | AddrL <td>Data0</td> <td>Data1</td> <td>Data3</td> <td>Data4</td> <td>-Checksum</td> | Data0 | Data1 | Data3 | Data4 | -Checksum |

Checksum: '1' = H'31, '2' = H'32, '?' = H'3F

## 11.2 Write Commands

**Write Byte**    **WriteByte:** Writes a byte into the memory of the ND31:

H'FE00-H'FE7F    RAM  
H'FEA0-H'FF7F    RAM

|                |      |      |       |       |            |
|----------------|------|------|-------|-------|------------|
| <b>Command</b> | H'82 | Data | AddrL | AddrH | + CheckSum |
|----------------|------|------|-------|-------|------------|

|               |      |      |       |       |            |
|---------------|------|------|-------|-------|------------|
| <b>Answer</b> | H'82 | Data | AddrL | AddrH | - Checksum |
|---------------|------|------|-------|-------|------------|

**Write Word**    **WriteWord:** Writes a word (2 bytes) into the memory of ND31:

H' FE00-H' FE7F    RAM  
H' FEA0-H' FF7F    RAM

|                |      |       |       |       |       |           |
|----------------|------|-------|-------|-------|-------|-----------|
| <b>Command</b> | H'63 | DataL | DataH | AddrL | AddrH | +CheckSum |
|----------------|------|-------|-------|-------|-------|-----------|

|               |      |       |       |       |       |           |
|---------------|------|-------|-------|-------|-------|-----------|
| <b>Answer</b> | H'63 | DataL | DataH | AddrL | AddrH | -Checksum |
|---------------|------|-------|-------|-------|-------|-----------|

**Write WordX**    **WriteWordX:** Writes a word (2 Byte) into the external memory of ND31. The possible range depends on the memory extension.

H' 4000-H' FFFF    Ext RAM

|                |       |       |       |       |       |           |
|----------------|-------|-------|-------|-------|-------|-----------|
| <b>Command</b> | H' 6A | DataL | DataH | AddrL | AddrH | +CheckSum |
|----------------|-------|-------|-------|-------|-------|-----------|

|               |       |       |       |       |       |           |
|---------------|-------|-------|-------|-------|-------|-----------|
| <b>Answer</b> | H' 6A | DataL | DataH | AddrL | AddrH | -Checksum |
|---------------|-------|-------|-------|-------|-------|-----------|

**Write Long**    **WriteLong:** Writes a Longinteger number (4 bytes) into the memory of ND31.

H' FE00-H' FE7F    RAM  
H' FEA0-H' FF7F    RAM

|                |       |    |    |    |    |       |       |           |
|----------------|-------|----|----|----|----|-------|-------|-----------|
| <b>Command</b> | H' C8 | D0 | D1 | D2 | D3 | AddrL | AddrH | +CheckSum |
|----------------|-------|----|----|----|----|-------|-------|-----------|

|               |       |    |    |    |    |       |       |           |
|---------------|-------|----|----|----|----|-------|-------|-----------|
| <b>Answer</b> | H' C8 | D0 | D1 | D2 | D3 | AddrL | AddrH | -Checksum |
|---------------|-------|----|----|----|----|-------|-------|-----------|

The data bytes are labelled with D0 (LSB) ...D3 (MSB).

### 11.3 Bit Manipulation and Logical Commands

**AND** **And:** Sends a logical AND bit for bit into the memory of ND31 (RAM := RAM & Data).

AddrH has not to be given, as the logical commands only refer to the memory range from H'FF00.

H'FF00-H'FFFF      RAM

|                |      |      |       |           |
|----------------|------|------|-------|-----------|
| <b>Command</b> | H'A4 | Data | AddrL | +Checksum |
|----------------|------|------|-------|-----------|

|               |      |      |       |           |
|---------------|------|------|-------|-----------|
| <b>Answer</b> | H'A4 | Data | AddrL | -Checksum |
|---------------|------|------|-------|-----------|

**OR** **Or:** Sends a logical OR bit to bit into the memory of ND31. (RAM:=RAM or Data).

AddrH must not be given, as the logical commands only refer to the range of memory from H'FF00.

H'FF00-H'FF7F      RAM

|                |      |      |       |           |
|----------------|------|------|-------|-----------|
| <b>Command</b> | H'A5 | Data | AddrL | +Checksum |
|----------------|------|------|-------|-----------|

|               |      |      |       |           |
|---------------|------|------|-------|-----------|
| <b>Answer</b> | H'A5 | Data | AddrL | -Checksum |
|---------------|------|------|-------|-----------|

### 11.4 Input/Output Commands

Not yet available.

### 11.5 Reset H8

**Reset** Releases a reset of the ND31 operating program. Every data which has not been saved in the EEPROM will be lost.

|                |      |        |           |
|----------------|------|--------|-----------|
| <b>Command</b> | H'DD | H' 21' | +Checksum |
|----------------|------|--------|-----------|

|               |      |        |           |
|---------------|------|--------|-----------|
| <b>Answer</b> | H'DD | H' 21' | -Checksum |
|---------------|------|--------|-----------|

## 12. Set-up and Output Capabilities of the EcoServ

In this chapter you are informed about the set-up capabilities of the EcoServ. In addition, explanations of readable parameters are provided.

Parameter settings affecting the control circuit, can only be made when you have a complete understanding of the respective parameter and its properties.

There are two ways of changing the EcoServ settings:

- Via set-up software
- Via NOVOBUS

### 12.1 Requirements

With the set-up software, several parameters can comfortably be edited by the way of menu settings. If this possibilities are not sufficient for your application, please find the necessary information in this chapter.

All parameters can be changed or read by the NOVOBUS. The NOVOBUS driver software makes the required write and read-commands available.

With the set-up software you can perform all settings and read the individual parameter.

To set and read the parameters with the set-up software, an IBM compatible PC and a bus cable is required.

### 12.2 EcoServ Memory

Your EcoServ has 2 different memories:

- Battery buffered RAM-memory with 512 Byte, addresses: FD80h - FF7Fh.
- External memory (size according to the RAM-size), addresses: 0000h - FFFFh

#### **RAM-Memory**

A change in RAM directly affects the circuit. When the ND31 power supply (24V) is switched off and on, changes will not be lost. The RAM is battery buffered.

The RAM-memory of the ND31 is readable in the service menu with the function RAM-Monitor. Changes are to be made with the

function Write-RAM (see manual Set-up and Parameter Setting of ND31, Section 2.1.11.2, Service Menu).

Some of the below mentioned addresses are not described in the service menu. But they can be read through the NOVOBUS commands.

### 12.2.1 RAM Memory

| <b>Address</b> | <b>Bytes</b> | <b>Designation</b> | <b>Description</b>                             |
|----------------|--------------|--------------------|--|
| 0x01e0         | 2            | @Tabelle           | Table Interpolation                            |
| 0x01e2         | 2            | @PS21              | Relative positioning                           |
| 0x01e4         | 2            | @Referenz          | Reference drive                                |
| 0x01e6         | 2            | @PSA               | Absolute positioning                           |
| 0x01e8         | 2            | @Feininterpol      | Fine interpolation                             |
| 0x01ea         | 2            | @dummy             | Dummy address                                  |
| 0x01ec         | 2            | @msollAn           | Inertia command                                |
| 0x01ee         | 2            | @Setlstwert        | Actual value setting                           |
| 0x01f2         | 2            | @Nullsuche         | Referencing                                    |
| 0xc016         | 2            | TopZero            | Internal parameter                             |
| 0xf000         | 1            | _iaist             | Motor current actual value phase A             |
| 0xf001         | 1            | _ibist             | Motor current actual value phase B             |
| 0xfe00         | 2            | errorcode          | Error code                                     |
| 0xfe0a         | 2            | GPO                | Output word digital outputs                    |
| 0xfe0c         | 2            | GPIN               | Input word digital inputs                      |
| 0xfe10         | 2            | Warning            | Internal parameter                             |
| 0xfe12         | 2            | nsollF             | Internal parameter                             |
| 0xfe1a         | 2            | Flsoll             | Internal Parameter                             |
| 0xfe1c         | 2            | VzSchllnc          | Slipping distance increments with prefixes     |
| 0xfe1e         | 2            | VzSchlUmdr         | Slipping distance revolution with prefixes     |
| 0xfe20         | 2            | Phi1               | Internal parameter                             |
| 0xfe2a         | 2            | ps-umdr            | Revolution counter for relative positioning    |
| 0xfe2c         | 2            | ps-imp             | Impulse counter for relative positioning       |
| 0xfe3a         | 2            | ?Tabelle           | Table first address (only table interpolation) |
| 0xfe3c         | 2            | CANinput1          | CAN-Parameter                                  |
| 0xfe3e         | 2            | CANinput2          | CAN-Parameter                                  |
| 0xfe40         | 2            | CANinput3          | CAN-Parameter                                  |

| <b>Address</b> | <b>Bytes</b> | <b>Designation</b> | <b>Description</b>                                   |
|----------------|--------------|--------------------|--|
| 0xfe42         | 2            | NBinput            | Internal parameter                                   |
| 0xfe44         | 2            | Phi4               | Internal parameter                                   |
| 0xfe46         | 2            | nsoll2             | Inertia nominal value of the position regulator      |
| 0xfe48         | 2            | STROD              | Internal parameter                                   |
| 0xfe4c         | 2            | InternSoll         | Internal Inertia nominal (e.g. positioning control)  |
| 0xfe4e         | 2            | psa_positionH      | Target revolution (absolute positioning)             |
| 0xfe50         | 2            | psa_positionL      | Target increments (absolute positioning)             |
| 0xfe52         | 1            | psa_status         | Status of the positioning control                    |
| 0xfe54         | 2            | LageSoll           | Position nominal value increments                    |
| 0xfe56         | 2            | UmdrSoll           | Position nominal value revolution                    |
| 0xfe58         | 2            | aSoll              | Acceleration nominal value                           |
| 0xfe5a         | 2            | AnIn1Old           | Internal parameter                                   |
| 0xfe5c         | 2            | AnInput1           | Value of analogue input 1                            |
| 0xfe5e         | 2            | mSoll              | Moment nominal value                                 |
| 0xfe60         | 2            | Sollwert           | Nominal value address                                |
| 0xfe62         | 2            | nSoll              | Regulator nominal value (without position regulator) |
| 0xfe64         | 2            | nIntegrator        | internal parameter                                   |
| 0xfe66         | 2            | Sync               | Internal parameter                                   |
| 0xfe68         | 2            | nist               | Velocity actual value                                |
| 0xfe6a         | 2            | Pa0                | Internal parameter                                   |
| 0xfe6c         | 2            | Pa1                | Internal parameter                                   |
| 0xfe6e         | 1            | RautojuCSR         | Resolver auto adjustment control-register            |
| 0xfe6f         | 1            | Pa2                | Internal parameter                                   |
| 0xfe72         | 2            | MaxSchleppInc      | Memory for maximum slipping error in increments      |
| 0xfe74         | 2            | Lage-nsoll         | Internal parameter                                   |
| 0xfe7a         | 1            | BalCnt             | Counter for ballast switching                        |
| 0xfe7b         | 1            | CANCont            | CAN-Parameter  |
| 0xfe7c         | 2            | LageIst            | Position actual value (increments)                   |
| 0xfe7e         | 2            | UmdrIst            | Position actual value ((revolution)                  |
| 0xfe84         | 3            | Seriennummer       | Serial number in BCD format                          |
| 0xfe88         | 1            | Imax               | Rated current ND31                                   |

| <b>Address</b> | <b>Bytes</b> | <b>Designation</b> | <b>Description</b>                     |
|----------------|--------------|--------------------|--|
| 0xfe8b         | 1            | HwVersion          | Hardware configuration                 |
| 0xfe92         | 2            | BetriebStd         | Operating hours counter                |
| 0xfe94         | 2            | SperreStd          | Operating hours counter                |
| 0xfe96         | 1            | BetriebMin         | Operating hours counter                |
| 0xfe97         | 1            | SperreMin          | Operating hours counter                |
| 0xfea0         | 2            | Steuerbits         |  |
| 0xfea2         | 2            | ?SPS               | Pointer to program in ext. RAM         |
| 0xfea8         | 2            | ?Rampe             | Pointer to acceleration ramp           |
| 0xfeaa         | 2            | ?Rampe-            | Pointer to braking ramp                |
| 0xfeac         | 2            | ?CANout            | CAN-Parameter                          |
| 0xfeae         | 2            | ?512us             | Pointer 512us-command                  |
| 0xfeb0         | 2            | ?FILage            | Internal parameter                     |
| 0xfeb2         | 2            | ?CANControl        | CAN-Parameter                          |
| 0xfeb4         | 1            | BremseT1           |  |
| 0xfeb5         | 1            | BremseT2           |  |
| 0xfeb6         | 2            | ?FForward          | Internal parameter                     |
| 0xfeb8         | 2            | ?nSoll             | Pointer to structure of the drive      |
| 0xfeba         | 2            | ?mMax              | Pointer to mMax                        |
| 0xfebc         | 2            | ?mSoll             | Pointer to mSoll                       |
| 0xfebe         | 2            | ?Sollwert          | Pointer for the structure of the drive |
| 0xfec0         | 2            | CANTime2           | CAN-Parameter                          |
| 0xfec2         | 2            | ?GPO               | Pointer to GPO                         |
| 0xfec4         | 2            | ?SchRampe          | Pointer to quick stop ramp             |
| 0xfec6         | 1            | Stopdauer          |  |
| 0xfec7         | 1            | GPOMaske           | Mask for output word                   |
| 0xfec8         | 2            | ?512usA            | Pointer 512usA-command                 |
| 0xfeca         | 2            | ?512usB            | Pointer 512usB- command                |
| 0xfecc         | 2            | ?FIUmdr            |  |
| 0xfece         | 2            | ?102us             | Pointer 102us- command                 |
| 0xfed0         | 2            | NPIOffs            | Internal parameter                     |
| 0xfed2         | 2            | CANIDLSB           | CAN-Parameter                          |
| 0xfed4         | 2            | dLage              | Internal parameter                     |
| 0xfed6         | 2            | RefV3              | Reference drive internal velocity      |
| 0xfed8         | 2            | Window             | In-Position-Window                     |
| 0xfeda         | 2            | RefLage            | Actual value setting Increments        |
| 0xfedc         | 2            | RefUmdr            | Actual value setting revolution        |

| <b>Address</b> | <b>Bytes</b> | <b>Designation</b> | <b>Description</b>                      |
|----------------|--------------|--------------------|---|
| 0xfede         | 2            | RefV1              | Reference drive velocity 1              |
| 0xfef0         | 2            | RefV2              | Reference drive velocity 2              |
| 0xfef2         | 2            | RODinM             | Internal parameter                      |
| 0xfef4         | 2            | nMax               | Maximum inertia                         |
| 0xfef6         | 2            | ps-v0              | Positioning velocity                    |
| 0xfef8         | 1            | CANinitBTR0        | CAN-Parameter                           |
| 0xfef9         | 1            | CANinitBTR1        | CAN-Parameter                           |
| 0xfefa         | 2            | TCycle             | Internal parameter                      |
| 0xfefc         | 1            | FIVerrundung       | Internal parameter                      |
| 0xfef0         | 2            | PhiPO              | Resolver adjustment                     |
| 0xfef2         | 2            | AnIn1Offset        | Offset analogue input 1                 |
| 0xfef4         | 2            | Impulszahl         | Impulse number of the encoder emulation |
| 0xfef6         | 1            | nSollFilter        | Nominal value filter                    |
| 0xfef7         | 1            | Pole               | Motor pole number                       |
| 0xfef8         | 1            | iKp                | Current regulator: P component          |
| 0xfef9         | 1            | iKi                | Current regulator: I component          |
| 0xfefa         | 2            | Rampe              | Acceleration ramp                       |
| 0xfefc         | 2            | Rampe-             | Braking ramp                            |
| 0xfefe         | 2            | SchRampe           | Quick stop ramp                         |
| 0xff00         | 1            | InitIOM1           | Internal parameter                      |
| 0xff01         | 1            | MaxTempMot         | Maximum motor temperature               |
| 0xff02         | 1            | ResolvKomp         | Resolver compensation                   |
| 0xff03         | 1            | emk0               | EMK of the motors                       |
| 0xff04         | 1            | NB_Init            | Baud rate NOVObUS                       |
| 0xff05         | 1            | Feedback           | Feedback system                         |
| 0xff06         | 1            | FICSR              | Internal parameter                      |
| 0xff07         | 1            | bank               | Internal parameter                      |
| 0xff08         | 1            | CANSlaveBit8       | CAN-Parameter                           |
| 0xff09         | 1            | CANSlaveB0         | CAN-Parameter                           |
| 0xff0a         | 1            | CANSlaveB1         | CAN-Parameter                           |
| 0xff0b         | 1            | CANSlaveB2         | CAN-Parameter                           |
| 0xff0c         | 1            | CANSlaveB3         | CAN-Parameter                           |
| 0xff0d         | 1            | CANSlaveB4         | CAN-Parameter                           |
| 0xff0e         | 1            | CANSlaveB5         | CAN-Parameter                           |
| 0xff0f         | 1            | CANSlaveB6         | CAN-Parameter                           |
| 0xff10         | 1            | CANSlaveB7         | CAN-Parameter                           |
| 0xff11         | 1            | CANCFG             | CAN-Parameter                           |



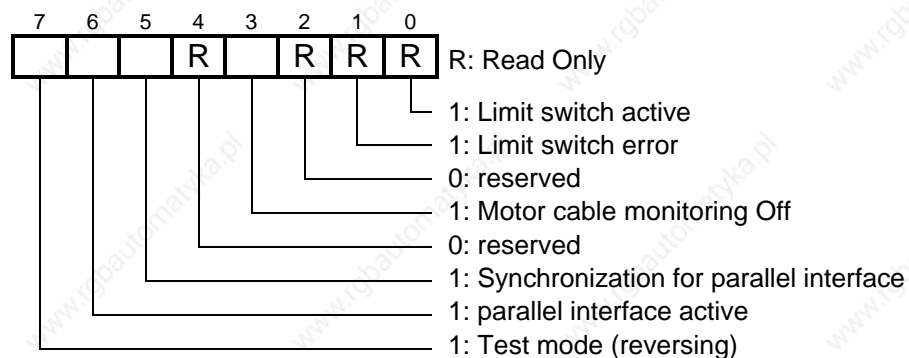
| <b>Address</b> | <b>Bytes</b> | <b>Designation</b> | <b>Description</b>                           |
|----------------|--------------|--------------------|--|
| 0xff12         | 2            | ?AnOut2            | Pointer to the address for analogue output 2 |
| 0xff14         | 1            | AnOut2Fakt         | Scale factor for analogue output 2           |
| 0xff15         | 1            | AnOut2Offs         | Offset for analogue output 2                 |
| 0xff16         | 1            | CANTimeout         | CAN-Parameter                                |
| 0xff17         | 1            | FKSteuerung        | Internal parameter                           |
| 0xff18         | 2            | KommSpurOff        | Internal parameter                           |
| 0xff1a         | 2            | Polabstand         | Internal parameter                           |
| 0xff1c         | 2            | Impulslaenge       | Internal parameter                           |
| 0xff1e         | 2            | KommLaenge         | Internal parameter                           |
| 0xff20         | 1            | AnOutConfig        | Analogue-output configuration byte           |
| 0xff21         | 1            | MotConfig          | Motor-configuration byte                     |
| 0xff22         | 1            | AnIn2Fakt          | Scale factor analogue input 2                |
| 0xff23         | 1            | AnIn2Offset        | Offset analogue input 2                      |
| 0xff24         | 2            | ?AnOut1            | Pointer to address for analogue output 1     |
| 0xff26         | 1            | AnOutOffs          | Offset analogue output 1                     |
| 0xff27         | 1            | AnOutFakt          | Scale factor analogue output 1               |
| 0xff28         | 2            | ?Lagelst           |  |
| 0xff2a         | 1            | Betriebsart        | Operation mode                               |
| 0xff2b         | 1            | RefUmdrH           | Internal parameter                           |
| 0xff2c         | 2            | Schleppfehler      | Maximum allowed slipping error               |
| 0xff2e         | 1            | i0max              | Effective current limiter                    |
| 0xff2f         | 1            | LKd                | Position regulator advanced control          |
| 0xff30         | 1            | LKp                | Position regulator P-part                    |
| 0xff31         | 1            | nKd                | Speed regulator advanced control             |
| 0xff32         | 1            | nKp                | Speed regulator P-part                       |
| 0xff33         | 1            | nKi                | Speed regulator I-part                       |
| 0xff34         | 1            | MaxBalCnt0         | Threshold ballast switching control          |
| 0xff35         | 1            | mMax               | Peak current                                 |
| 0xff36         | 2            | mMax16             | Peak current                                 |
| 0xff38         | 1            | CANservice         | CAN-Parameter                                |
| 0xff39         | 1            | CANmaster          | CAN-Parameter                                |
| 0xff3a         | 1            | CANslave           | CAN-Parameter                                |

| <b>Address</b> | <b>Bytes</b> | <b>Designation</b> | <b>Description</b>                   |
|----------------|--------------|--------------------|--------------------------------------|
| 0xff3b         | 1            | CANtime            | CAN-Parameter                        |
| 0xff3c         | 1            | Freigabe0          | Start position                       |
| 0xff3d         | 1            | SwVersion          | Software configuration               |
| 0xff3e         | 1            | AnIn1Fakt          | Scale factor analogue input 1        |
| 0xff3f         | 1            | nFilter            | Tacho filter                         |
| 0xff43         | 1            | UmdrIstH           | Internal parameter                   |
| 0xff52         | 1            | NBcontrol          | Enable via NOVOBUS                   |
| 0xff54         | 1            | MotTemp            | Motor temperature (resistance value) |
| 0xff5b         | 1            | UmdrH              |                                      |
| 0xff66         | 2            | AnIn_msoll         |                                      |
| 0xff68         | 2            | SchleppInc         | Actual slipping error increments     |
| 0xff6a         | 2            | SchleppUmdr        | Actual slipping error revolution     |
| 0xff6e         | 2            | lIimit             | Internal parameter                   |
| 0xff70         | 2            | Dlmsoll            | Internal parameter                   |
| 0xff73         | 1            | ps-status          | Status positioning control           |
| 0xff79         | 1            | RefStatus          | Status reference drive               |
| 0xff88         | 2            | _Phi               | Internal parameter                   |
| 0xffb2         | 1            | iMax               | Internal parameter                   |
| 0xffe0         | 1            | ADDRA              | Internal parameter                   |
| 0xffe2         | 1            | ADDRB              | Internal parameter                   |
| 0xffe4         | 1            | ADDRC              | Internal parameter                   |
| 0xffe6         | 1            | ADDRD              | Internal parameter                   |
| 0xfff2         | 1            | Status             | Status ND31                          |
| 0xfff3         | 1            | CANcontrol         | Release through CAN-Bus              |
| 0xfff4         | 1            | SPScontrol         |                                      |
| 0xfff5         | 1            | CANStat            | CAN-Parameter                        |
| 0xfff6         | 1            | Second             | Internal parameter                   |
| 0xfff8         | 1            | Temp0              | End amplifier cooler temperature     |
| 0xfff9         | 1            | Temp1              | End amplifier cooler temperature     |
| 0xfffa         | 1            | Temp2              | End amplifier cooler temperature     |
| 0xfffb         | 1            | Temp3              | End amplifier cooler temperature     |

## 12.3 Configuration

### 12.3.1 The Byte SwVersion

RAM-Parameter Address: H' FF3D

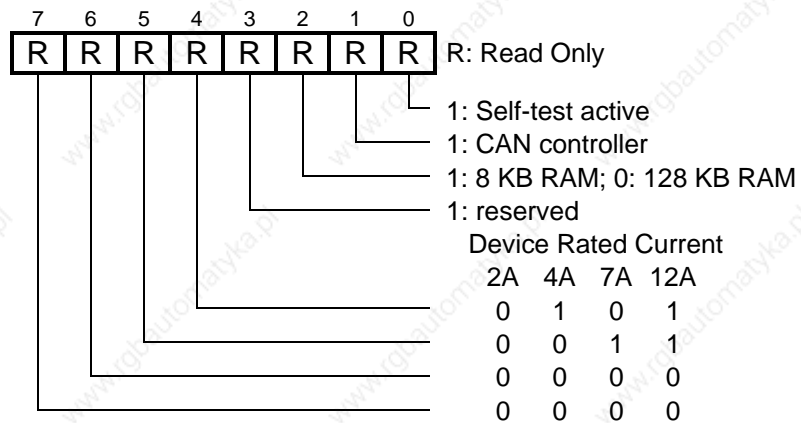


#### Remarks:

- Bit 0 1: Activates the limit switch control
- Bit 1 1: Limit switch error
- Bit 2 1: If  $i^2t$  control has been used
- Bit 3 1: The motor cable control can be switched off
- Bit 4 0: Reserved
- Bit 5 1: Activates the synchronization for the nominal-actual exchange through the parallel interface (special function)
- Bit 6 1: Activates the parallel interface for the quick nominal-actual exchange
- Bit 7 With 1 an internal test mode is switched on, so that ND31 reverses the motor with the set spin speed. This operating mode is especially useful in optimizing the regulator parameter.

### 12.3.2 The Byte HwVersion

RAM-Parameter Address: H' FE8B



This is a read only byte.

**Remarks:**

- Bit 0 1: Self-test when switching on active

---

- Bit 1 1: CAN-Controller available

---

- Bit 2 1: 8 KB external RAM; 0: 128 KB external RAM

---

- Bit 3 1: Reserved

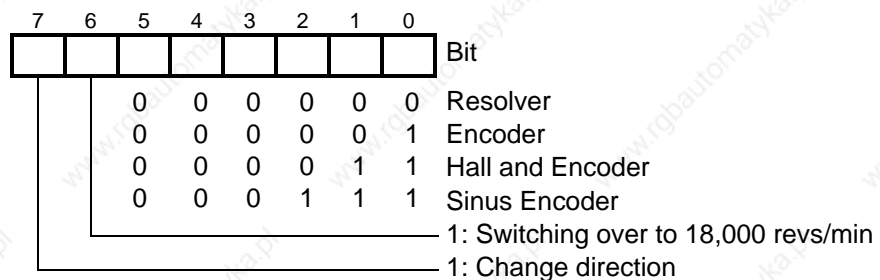
---

- Bit 4...7 Device rated current referring the above table

### 12.3.3 The Byte Feedback

RAM-Parameter Address: H' FF05

The byte can be read and written.



**Remarks:**

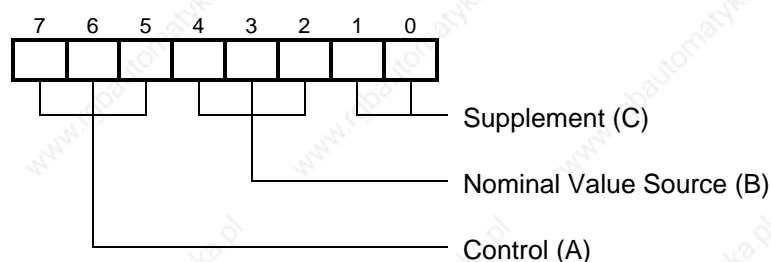
- Bit 0...5 With these bits the feedback system can be programmed
- Bit 6 Adjustment of the ND 31 speed range to 18000 rpm Afterwards the regulator parameter and the EMF has to be re-adjusted.

Bit 7 With this bit the spin direction of the motor can be changed. If the motor is supposed to be running in the positive direction, however is running negative, this can be corrected by changing Bit 3.

### 12.3.4 The Byte Betriebsart

RAM-Parameter Address: H' FF2A

The byte can be read and written.



With the byte "Betriebsart", the nominal value source and the size which has to be regulated, can be adjusted. For the effective use, a reset has to be released. By programming these bytes for a reset the corresponding pointers are set. If this is not required, please initialize the operation mode with H' FF. The following table shows that the bits 7,6 and 5 define the size (A), bits 4, 3 and 2 the nominal value source. The bits 1 and 0 contain additional information about the used feedback system.

#### Remarks:

|                         | A   | B   | C   | Size, Nominal Value Source, Feedback                            |
|-------------------------|-----|-----|---|---|
|                         | 765 | 432 | 10  |   |
| <b>Inertia</b>          | 001 | 001 | 00  | Inertia regulation, analogue input 1                            |
|                         | "   | 010 | 00  | Inertia regulation, analogue input 2                            |
|                         | "   | 011 | 00  | Inertia regulation, CAN   |
| <b>Speed Regulation</b> | "   | 100 | 00  | Inertia regulation, digital                                     |
|                         | 010 | 001 | 00  | Spin speed regulation, analogue input 1                         |
|                         | "   | 010 | 00  | Spin speed regulation, analogue input 2                         |
|                         | "   | 011 | 00  | Spin speed regulation, CAN                                      |
|                         | "   | 100 | 00  | Spin speed regulation, digital                                  |
|                         | "   | 101 | 00  | Spin speed regulation, parallel interface                       |
|                         | 011 | 001 | 00  | Spin speed regulation with position regulator, analogue input 1 |
| "                       | 010 | 00  | Spin speed regulation with position regulator, analogue input 2 |   |
| "                       | 011 | 00  | Spin speed regulation with position regulator, CAN              |   |

|                            |   |     |        |  |
|----------------------------|---|-----|--------|--|
| <b>Position Regulation</b> | " | 100 | 00     | Spin speed regulation with position regulator, digital                                     |
|                            | " | 101 | 00     | Spin speed regulation with position regulator, parallel interface                          |
|                            |   | 100 | 001 00 | Position regulation, nominal value source through encoder                                  |
|                            | " | 010 | 00     | Position regulation, nominal value source frequency/direction                              |
|                            | " | 011 | 01     | Position regulation, nominal value source NOVOBUS with standard feedback (resolver)        |
|                            | " | "   | 10     | Position regulation, nominal value source NOVOBUS with encoder as 2. system of measurement |
| <b>Internal Vorgaben</b>   | " | 100 | 01     | Position regulation, nominal value source CAN with standard feedback (resolver)            |
|                            | " | 100 | 10     | Position regulation, nominal value source CAN with encoder as 2. system of measurement     |
|                            | " | 101 | 01     | Internal nominal value source (e.g. positioning) with standard feedback (resolver)         |
| <b>Test Mode</b>           | " | 101 | 10     | Internal nominal value source (e.g. positioning) with encoder as 2. system of measurement  |
|                            |   | 101 | 001 00 | Test mode (reversing) without position regulator   |
|                            | " | 010 | 00     | Test mode (reversing) with position regulator  |

### 12.3.5 The Byte MotConfig

RAM-Parameter Address: H' FF21

The byte can be read and written.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit   |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | Motor temperature sensor with power connection (X1)           |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Motor temperature sensor connected in resolver connector (X2) |

#### Remarks:

Bit 0 With bit 0 it is fixed, whether the motor temperature sensor is connected in connector X1 (Bit 0 = 0) or X2 (Bit 0 = 1).

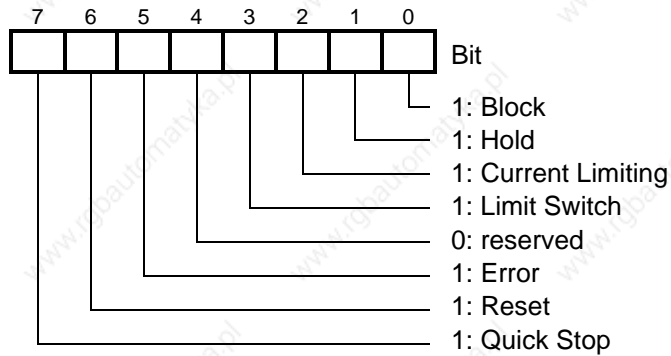
Bit 1 ... 7 Reserved 1

## 12.4 ND31 Status

### 12.4.1 The Byte Status

RAM cell address: H' FFF2

This is a read only byte.



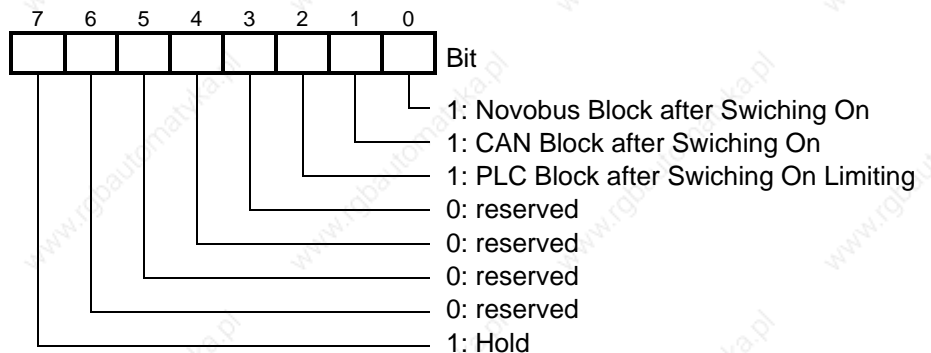
#### Remarks:

|       |                              |
|-------|------------------------------|
| Bit 0 | 1: Drive blocked             |
| Bit 1 | 1: Drive in hold mode        |
| Bit 2 | 1: Current limiting active   |
| Bit 3 | 1: Limit switch has been set |
| Bit 4 | 0: Reserved                  |
| Bit 5 | 1: Error                     |
| Bit 6 | 1: Drive in reset mode       |
| Bit 7 | 1: Quick stop active         |

### 12.4.2 The Byte Freigabe0

RAM cell address: H' FF3C.

The byte can be read and written.



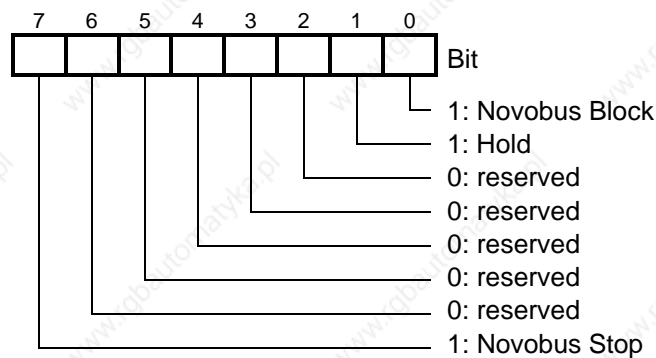
With the byte "Freigabe0" the start mode of the converter is programmed, that means the converter is in blocked or active mode. This byte will be evaluated after a Reset.

Exception: When working with the Setting Up Software the drive is blocked after a Reset.

### 12.4.3 The Byte NBcontrol

RAM cell address: H' FF52

The byte can be read and written.

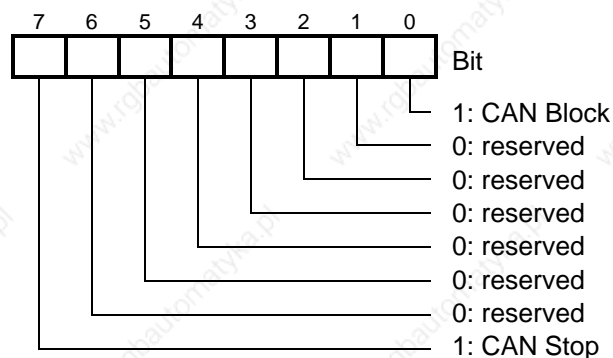


With byte "NBcontrol" the drive can be blocked and stopped via the NOVOBUS.

### 12.4.4 The Byte CANcontrol

RAM cell address: H' FFF3

The byte can be read and written.



With the byte CANcontrol the drive can be blocked and stopped via the CAN bus.



### 12.4.5 The Byte NB\_Init

RAM cell address: H' FF04

The byte can be read and written.

With this byte the Baud rate of the NOVOBUS can be adjusted. At the moment 19200 and 38400 Baud are possible.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit         |
|---|---|---|---|---|---|---|---|-------------|
| X | X | X | X | X | X | 0 | 0 | 38,400 Baud |
| X | X | X | X | X | X | 0 | 1 | 19,200 Baud |

A change of the Baud rate will be effective after the first reset. Afterwards the Setting-Up software with the new Baud rate has to be started again as command line parameter (e.g.: ND31 19200).

## 12.5 Actual, Nominal and Limit Values

### 12.5.1 Current

#### 12.5.1.1 Actual and Nominal Values

These values can only be read.

Motor current actual values: `_iaist` Address: H' F000  
`_ibist` Address: H' F001

| Scale     | 3202   | 3204  | 3207  |
|-----------|--------|-------|-------|
| A per bit | 0.0589 | 0.206 | 0.206 |

**Data format:** Byte, two's complement

#### 12.5.1.2 Limit Values

Rated current (effective): `Imax` Address: H' FE88 Byte

| Scale                  | 3202   | 3204   | 3207   |
|------------------------|--------|--------|--------|
| $Imax A_{eff}$ per bit | 0.0345 | 0.1206 | 0.1206 |

This value will be adjusted at the factory and can not be changed by the client. Therewith the rated current of the device will be fixed. The scale depends from the capacity of the device.

| Description               | Parameter | Address | Format |
|---------------------------|-----------|---------|--------|
| Peak current:             | mmax      | H' FF35 | Byte   |
| Peak current:             | mmax16    | H' FF36 | Word   |
| Maximum for $i^2t$ limit: | $i_0$ max | H' FF2E | Byte   |

These value can be fixed by the user. The values are according to the motor which is supposed to be used (peak current and rated current). The current can be limited with mmax and mmax16. The smaller one determines the maximum peak current.

| Scale                       | 3202     | 3204    | 3207    |
|-----------------------------|----------|---------|---------|
| mmax $A_{eff}$ per bit      | 0.0345   | 0.1206  | 0.1206  |
| $i_0$ max $A_{eff}$ per bit | 0.0345   | 0.1206  | 0.1206  |
| mmax16 $A_{eff}$ per bit    | 0.000135 | 0.00047 | 0.00047 |

### 12.5.2 Torque

These values are read only bytes.

Torque nominal value:           msoll           Address: H' FE5E

**Data format:** Word, two's complement

**Scale:** See mmax16

### 12.5.3 Speed

#### 12.5.3.1 Actual and Nominal Value

The value can only be read.

Speed actual value:           nist           Address: H' FE68

Speed nominal value:       nsoll           Address: H' FE62

**Data format:** Word, two's complement

**Scale:**

0.223517 rpm per bit, if bit 7 from Feedback = 0 (6,000 rpm)

0.894068 rpm per bit, if bit 7 from Feedback = 1 (18,000 rpm)

### 12.5.3.2 Limit Values

This value can be programmed by the user and depends of the motor which is supposed to be used.

Maximum speed:      nMax              Address: H' FEE4

**Format:** Word

**Scale:** See previous section.

### 12.5.4 Ramps

The ramps are to be programmed by the user. The quick-stop ramp will be used with a stop command (hard- or software).

|                    |          |                  |
|--------------------|----------|------------------|
| Acceleration ramp: | Rampe    | Address: H' FEFA |
| Braking ramp:      | Rampe-   | Address: H' FEFC |
| Quick-stop ramp:   | SchRampe | Address: H' FEFE |

**Data format:** Word

**Scale:** Ramp =  $0.1466 * n / t$       with [n] = rpm, [t] = s

Example: If the speed of 1000 rpm should be achieved in 10 ms, there is:

$$\text{Ramp} = 0.1466 * 1000 / 0.01 = 14660 = \text{H}' 3944$$

To use the programmed ramp, the pointer "?Rampe" (H' FEA8) has to direct to "Rampe" (H' FEFA), "?Rampe-" (H' FEAA) to "Rampe-" (H' FEFC) and "?SchRampe" (H' FEC4) to "SchRampe" (H' FEFE).

### 12.5.5 Tracks

Nominal values can be programmed by the user.

|                               |          |                  |
|-------------------------------|----------|------------------|
| Rotor position nominal value: | LageSoll | Address: H' FE54 |
| Rotation nominal value:       | UmdrSoll | Address: H' FE56 |
| Rotor position actual value:  | LageIst  | Address: H' FE7C |
| Rotation actual value:        | UmdrIst  | Address: H' FE7E |

**Data format:** "Umdrsoll" and "Lagesoll", as well as "Umdrist" and "Lageist" form a 32 bits Double Word in the two's complement.

## 12.6 Temperatures

### 12.6.1 Cooler Temperature

These values can only be read.

The limit value will be compared with the cooler temperature which will be measured at three places of the ND31. If the cooler temperature is higher than the programmed limit value, the power stage switches off with the error message H' 400.

|                        |       |                 |
|------------------------|-------|-----------------|
| Cooler temperature T0: | Temp0 | Address H' FFF8 |
| Cooler temperature T1: | Temp1 | Address H' FFF9 |
| Cooler temperature T2: | Temp2 | Address H' FFFA |
| Cooler temperature T3: | Temp3 | Address H' FFFB |

**Data format:** Byte, no prefixes

**Scale [°C]:**

$$t1 = \frac{1}{\frac{\ln\left(\frac{56.32}{\text{Temp0}} - 0.1\right)}{3429} + \frac{1}{298}} - 272.5$$

### 12.6.2 Motor Temperature

The motor temperature actual value can only be read. The motor temperature limit value can be read and written.

|                        |            |                 |
|------------------------|------------|-----------------|
| Temperature threshold: | MaxTempMot | Address H' FF01 |
| Motor temperature:     | MotTemp    | Address H' FF54 |

**Data format:** Byte, no sign

**Scale:** 1 Bit corresponds to 58.75 Ω

The motor temperature can be calculated by the characteristic of the built-in sensor of the motor. When using a motor with a normally closed contact enter the value H' FF in MaxTempMot.

## 12.7 Regulator Parameter

Every regulator parameter can be changed by the user.

### 12.7.1 Current Regulator

ND31 works with a PI current regulator

P component:    ikp            Address H' FEF8  
I component:    iki            Address H' FEF9

**Data format:**    Byte, no sign

### 12.7.2 EMF Compensation

The EMF compensation performs a pre-controlling of the voltage to compensate the counter EMF of the motor.

EMF compensation:    emk0            Address H' FF03

**Data format:**    Byte, no sign

**Scale:**            emk0 = 2.75 V (voltage radiant of the motor in V/1000rpm)

### 12.7.3 Filter

#### 12.7.3.1 Tacho Filter

With the tacho filter it is possible to filter the actual speed value. It is a filter of the first order. The higher the adjusted value, the stronger the filtration.

Tacho filter:            nFilter            Address H' FF3F

**Data format:**    Byte, no sign; range: H' 00 ... H' 7F.

**Scale:**            Time constant

$$\text{Tacho filter} = \frac{432 \mu\text{s}}{1 - \frac{n\text{Filter}}{128}}$$

#### 12.7.3.2 Nominal Value Filter

With the nominal value filter it is possible to filter the spin speed nominal value. The nominal value filter is a filter of the first order. The higher the adjusted value, the stronger the filtration.

Nominal value filter:    nSollFilter            Address H' FEF6

**Data format:**    Byte, no sign; range: H' 00 ... H' 7F.

#### **12.7.4 Speed Regulator**

ND31 operates with a PI speed regulator with an advanced control.

|                   |     |                 |
|-------------------|-----|-----------------|
| P component:      | nKp | Address H' FF32 |
| I component:      | nKi | Address H' FF33 |
| Advanced control: | nKd | Address H' FF31 |

**Data format:** Byte, no sign; range: H' 00 ... H' 7F.

#### **12.7.5 Position Regulator**

ND31 works with a P position regulator with advanced control.

|                   |     |                 |
|-------------------|-----|-----------------|
| P component:      | LKp | Address H' FF30 |
| Advanced control: | LKd | Address H' FF2F |

**Data format:** Byte, no sign; range: H' 00 ... H' 7F.

#### **12.7.6 Resolver Adjustment**

To achieve a correct commutation the resolver mounting position can be shifted electronically.

|                      |       |                 |
|----------------------|-------|-----------------|
| Resolver adjustment: | PhiPo | Address H' FEF0 |
|----------------------|-------|-----------------|

**Data format:** Word

**Scale:** 1 bit means 1 increment

#### **14.7.7. Motor Poles**

It is possible to program the number of motor poles in the ND31 (2 ... 12).

|              |      |                 |
|--------------|------|-----------------|
| Motor poles: | Pole | Address H' FEF7 |
|--------------|------|-----------------|

**Format:** Byte, no sign; range: H' 02, H' 04, H' 06, H' 08, H' 0A, H' 0C

The new number of motor poles can only be activated after a reset.

## 12.8 Signal Inputs and Outputs

### 12.8.1 Digital Signals

#### Read Inputs

There are two ways to read the digital inputs of ND31:

Either by reading directly the below mentioned memory cells, or by setting an input word.

Table of the digital inputs of ND31:

#### Reading Directly

| Digital Input | Memory Cell | Bit | Port | X3 Pin | 0V = |
|---------------|-------------|-----|------|--------|------|
| GPIN1         | H' FFBB     | 4   | 6    | A34    | "1"  |
| GPIN2         | H' FFBF     | 1   | 8    | A24    | "1"  |
| GPIN3         | H' FFBF     | 0   | 8    | A27    | "1"  |
| GPIN4         | H' FFBB     | 3   | 6    | A25    | "1"  |
| GPIN5         | H' C405     | 7   | X    | A26    | "1"  |
| GPIN6         | H' FFB7     | 3   | 4    | A21    | "1"  |
| GPIN7         | H' FFB7     | 5   | 4    | A23    | "1"  |
| GPIN8         | H' FFBB     | 0   | 6    | A32    | "1"  |
| GPIN9         | H' FFBB     | 2   | 6    | A33    | "1"  |
| GPIN10        | H' FFB7     | 2   | 4    | A22    | "1"  |

#### Input Word

The input word GPIN (H' FE0C) contains the mode of the digital input and will be renewed every 1 ms.

GPIN: Address H' FE0C

|     |       |       |       |       |       |       |        |       |
|-----|-------|-------|-------|-------|-------|-------|--------|-------|
| Bit | 15    | 14    | 13    | 12    | 11    | 10    | 9      | 8     |
|     | -     | -     | Tast5 | Tast6 | Tast7 | Tast8 | GPIN10 | GPIN9 |
| Bit | 7     | 6     | 5     | 4     | 3     | 2     | 1      | 0     |
|     | GPIN8 | GPIN7 | GPIN6 | GPIN5 | GPIN4 | GPIN3 | GPIN2  | GPIN1 |

#### Outputs

There are 2 ways to set the digital outputs of ND31:

1. By describing of the memory cells mentioned below. Here only the corresponding bit can be changed. The bits left have to retain their mode.
2. By setting an output word.

Table of the digital outputs of ND31:

**Writing Directly**

| Digital Output | Memory Cell | Bit | Port | X3 Pin | Switching | 0V = |
|----------------|-------------|-----|------|--------|-----------|------|
| GPO1           | H' FFB7     | 6   | 4    | B22    | 0 V       | "0"  |
| GPO2           | H' FFB7     | 4   | 4    | B21    | 0 V       | "0"  |
| GPO3           | H' FFB7     | 1   | 4    | B24    | 24 V      | "0"  |
| GPO4           | H' FFBB     | 1   | 6    | B28    | 24 V      | "0"  |
| GPO5           | H' FFC1     | 2   | 9    | B27    | 24 V      | "0"  |
| GPO6           | H' FFBB     | 5   | 6    | B26    | 24 V      | "0"  |
| GPO7           | H' FFBB     | 6   | 6    | B25    | 24 V      | "0"  |
| GPO8 *         | H' FF84     | 0   | –    | B23    | 24 V      | "0"  |
| GPO9           | H' FFC1     | 0   | 9    | B30    | 24 V      | "0"  |
| GPO10          | H' FFC1     | 1   | 9    | B29    | 24 V      | "0"  |

\*: For using GPO8 as digital output bit 5 of InitIOM1 has to be set to 0.

The signal modes can be read in the corresponding memory cells.

**Output Word**

A much easier method to set the digital output is to describe an output word GPO (H' FE0A). The contents will be evaluated every 1 ms and the corresponding outputs will be set.

First the pointer ?GPO (H' FEC2) has to be directed to GPO (H' FE0A). The outputs GPO1 to GPO10 can be set by describing bit 0 to 9.

GPO: Address H' FE0A

|     |      |      |      |      |      |      |       |      |
|-----|------|------|------|------|------|------|-------|------|
| Bit | 15   | 14   | 13   | 12   | 11   | 10   | 9     | 8    |
|     | –    | –    | –    | –    | –    | –    | GPO10 | GPO9 |
| Bit | 7    | 6    | 5    | 4    | 3    | 2    | 1     | 0    |
|     | GPO8 | GPO7 | GPO6 | GPO5 | GPO4 | GPO3 | GPO2  | GPO1 |

**Mask of the Outputs**

For the digital outputs GPO1 to GPO8 are additionally one byte available to mask the outputs GPOMask (H' FEC7). If the bit is set in the mask (=1), the corresponding GPOs are unchanged, independent of what has been written in GPO.

GPOMask: Address H' FEC7

|     |      |      |      |      |      |      |      |      |
|-----|------|------|------|------|------|------|------|------|
| Bit | 7    | 6    | 5    | 4    | 3    | 2    | 1    | 0    |
|     | GPO8 | GPO7 | GPO6 | GPO5 | GPO4 | GPO3 | GPO2 | GPO1 |



## 12.8.2 Analogue Outputs

### ATTENTION!

The analogue outputs are not short-circuit proof and are only to be loaded with 5 mA at maximum.

#### $\pm 10\text{ V}$ 8 Bit or 16 Bit

With the ND31 two  $\pm 10\text{ V}$  analogue outputs are available (resolution is 8 bits): at Pin A5 (analogue output 1) of connector X3 and at Pin B3 (analogue output 2). If you use the analogue outputs then GPO8 and GPO1 cannot be used as digital outputs.

The analogue outputs are configured using the AnOutConfig byte (H' FF20).

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit                                |
|---|---|---|---|---|---|---|---|------------------------------------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | Analogue output 1 active           |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | Analogue output 2 active           |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 16 bits mode for analogue output 1 |

In the 16 bits mode the voltage is output with a resolution of 16 bits at analogue output 1 (X3, Pin A5).

Programming of the outputs: if the desired mode is determined (AnOutConfig) then the output may be programmed using the following bytes:

|                          |                  |            |                  |      |
|--------------------------|------------------|------------|------------------|------|
| <b>Analogue output 1</b> | Signal selection | ?AnOut1    | Address: H' FF24 | Word |
|                          | Offset           | AnOutOffs  | Address: H' FF26 | Byte |
|                          | Scaling factor   | AnOutFakt  | Address: H' FF27 | Byte |
| <b>Analogue output 2</b> | Signal selection | ?AnOut2    | Address: H' FF12 | Word |
|                          | Offset           | AnOut2Offs | Address: H' FF15 | Byte |
|                          | Scaling factor   | AnOut2Fakt | Address: H' FF14 | Byte |

#### Signal selection

The address of the desired signal has to be entered into "?AnOut1" ("?AnOut2"). If, e.g., the actual speed value (H' FE68) shall be output then the value H' FE68 has to be entered into "?AnOut1" ("?AnOut2").

#### Offset adjustment

Offset adjustment is carried out by entering a value between H' 01 and H' FF into "AnOutOffs" ("AnOut2Offs"), with H' 01...7F = positive Offset and H' FF...80 = negative Offset.

**Scaling** With "AnOutFakt" ("AnOut2Fakt") the scaling factor may be adjusted (also inverting the voltage).

**Reset** In order the programming to become effective a Reset must be carried out.

### 12.8.3 Encoder Emulation

Pulse number of the encoder emulation:      Impulszahl      Address: H' FEF4

**Data format:** Word

**Range:**      H' 0001 ... H' 0400

A changed pulse number becomes effective after a Reset.

## 12.9 Drive Info

### 12.9.1 Serial Number

The serial number can be inferred from the memory cells H' FE84 to H' FE86 ("Seriennummer").

Serial number      Seriennummer      Address: H' FE84

**Data format:** BCD, MSB = H' FE84

### 12.9.2 Operating Hours

The operating hours can be inferred from the memory cells H' FE92 to H' FE97. it is differentiated between active time (power stage enabled) and the passive time.

Active time      BetriebStd      Address: H' FE92

BetriebMin      Address: H' FE96

Off period      SperreStd      Address: H' FE94

SperreMin      Address: H' FE97

**Data format:** Hours: Word  
Minutes: Byte

## 12.10 Controlling the ND31 via NOVOBUS

With the exception of some special commands like Reset, controlling functions by reading or writing of RAM cells of the

µController H8, thus influencing control bytes and getting information by reading of status bytes.

### **12.10.1 Operating States**

Lock:                   Setting Bit **0** of "Status" (H' FFF2) to 1  
Release:                Setting Bit **0** of "Status" to 0  
Stop:                    Setting Bit **7** of "Status" to 1  
Cancel Stop:            Setting Bit **7** of "Status" to 0

Reading the "Status" byte informs about the present operating state.

### **12.10.2 Error Condition**

An error is indicated by Bit **5** of "Status" (H' FFF2) set to 1. The error code may be taken from the address "errorcode" (H' FE00). The error is acknowledged by writing H' AF00 into the address "errorcode".

Query error state:     Reading Bit **5** of "Status" (H' FFF2)  
Error code:            "errorcode": address H' FE00  
Data format:           Word  
Acknowledge error:    Writing H' AF00 into RAM cell "errorcode"  
                          (H' FE00)

## **12.11 Oscilloscope**

### **12.11.1 Signal Selection**

All signals residing in the RAM may be selected by writing the appropriate code into the following memory cells:

Signal 1 = 'scope\_signal1': H' FE04  
Signal 2 = 'scope\_signal2': H' FE06  
Trigger signal = 'scope\_trigger': H'FE08

**Example:** H' FE68 → H' FE04 ⇒ Signal 1 = actual speed value  
(RAM cell H' FE68)

For displaying only 1 signal the "scope\_signal1" and "scope\_signal2" parameters must contain the same address.

The contents of the selected memory cells are recorded. The meaning and scaling of the record is determined by the signals

specified. If a 16-bit value is selected as signal then the upper byte (MSB) is recorded only.

**Example:** If H' FE68 is entered into RAM cell H' FE04 as Signal 1 this means:  
actual speed value ("nist"),  
scaling: 0.223517 revs/min per bit  
A recorded value of, e.g., H' 4C corresponds to a speed value of  
 $0.223517 * H' 4C * 256 = 4348$  revs/min.

For signal selection recording must be inhibited.

### 12.11.2 Time Base

The scan rate of the storage oscilloscope is to be entered into RAM cell "scope\_timer" (H' FF7C). Storing of a new measuring value occurs each scan time period:

$$t_{\text{scan}} = \text{scope\_timer} * 512 \mu\text{s}$$

A total of 128 measuring values are read per channel.

**Example:** scope\_timer = 0  $\Rightarrow$  each 512  $\mu\text{s}$  one measuring value will be stored in the scope buffer. The full scope buffer then is  $128 * 512 \mu\text{s} = 65.536$  ms wide.  
scope\_timer = H' 05  $\Rightarrow$  each  $5 * 512 \mu\text{s} (= 2.56$  ms) one measuring value will be stored in the scope buffer. The full scope buffer then is  $128 * 2.56$  ms = 327.68 ms wide.

For adjusting the time base recording must be inhibited.

### 12.11.3 Triggering Threshold

The triggering threshold is to be entered into RAM cell "scope\_level" (H' FF7F) with Bit 7 inverted.

**Example:** "nist" (H' FE68) shall be triggered for 4000 revs/min  $\Rightarrow$   
 $4000 / 0.223517 = 17895 = H' 45E7$ ;  
MSB only: H' 45;  
Bit 7 inverted: H' C5;  
H' C5  $\rightarrow$  scope\_level (H' FF7F)

The triggering threshold can be changed any time.

### 12.11.4 Trigger Delay

The trigger delay requires programming of the two RAM cells "scope\_delay" (H' FF7D) and "scope\_counter" (H' FE02) each

time before beginning a new record procedure. The values are calculated as follows:

For the desired delay time  $t_{\text{delay}}$ :

$$\begin{aligned} \text{scope\_counter} &= \text{H}' 0100 + t_{\text{delay}}/t_{\text{scan}} \quad (t_{\text{scan}} = \text{time base}) \\ \text{scope\_delay} &= \text{H}' 00 \quad \text{for } t_{\text{delay}} \geq 0 \quad \text{or} \\ &= -t_{\text{delay}}/t_{\text{scan}} \quad \text{for } t_{\text{delay}} < 0 \end{aligned}$$

**Example:**  $t_{\text{scan}} = 1.024 \text{ ms}$  ( $\text{scope\_timer} = 2$ ),  $t_{\text{delay}} = -20 \text{ ms} \Rightarrow$   
 $19$  ( $= 20 \text{ ms} / 1.024 \text{ ms} = 19.53$ ) scanning spots shall  
 be recorded before the trigger time and 237 scanning  
 spots after it  
 $\text{scope\_delay} = 19 = \text{H}' 13$ ,  
 $\text{scope\_counter} = \text{H}' 0100 - \text{H}' 13 = \text{H}' 00\text{ED}$

### 12.11.5 Scope Status

The "scope\_status" byte (H' FF7A) controls recording.

- Bit 7: Shows the status of the oscilloscope:  
 0: recording active  
 1: recording inhibited
- Bit 6: Shows the trigger status:  
 0: no trigger  
 1: triggered
- Bit 5: Trigger status, initialized with 1
- Bit 4: Trigger edge
- Bit 3...0 reserved (= 0)

Bit 7 is automatically set to 0 at the end of the recording procedure. A recording procedure may also be stopped by setting Bit 7 to 0.

### 12.11.6 Recording Procedure

When recording is stopped programme

- "scope\_delay" and "scope\_counter" with the necessary values
- "scope\_status" with H' 20 for a negative triggering edge or with H' 30 for a positive triggering edge.

With that recording is started.

First the delay time expires.

Then the trigger condition is evaluated ("scope\_status" byte):

Bit 5 is switched to 0 as soon as the signal

- falls below the triggering threshold for a positive triggering edge or
- exceeds the triggering threshold for a negative triggering edge.

Bit 5 is set to 1 again as soon as the triggering threshold is passed through once again thus generating the trigger signal: Bit 6 is set to 1.

After triggering the time programmed in "scope\_counter" expires. Then recording is stopped automatically and Bit 7 is set to 1.

The recorded data are now available in the 256 bytes FIFO memory of the scope ("\_FIFOdat": H' FF83). Each one date (byte) is read per read access. Thus, 256 read accesses to the \_FIFOdat address will empty the scope memory. The data of Signal1 and Signal2 are output alternately.

#### **12.11.7 Auto Trigger**

Recording without trigger is possible if Bit 7 of "scope\_status" is set to 0 during the recording procedure and, afterwards, set to 1 again.

### **12.12 Resolver Auto Adjustment**

ND31 offers the possibility of establishing the resolver adjustment automatically. This is useful if an unknown motor shall be installed with the ND31.

#### Conditions:

- Pole number and phase position of the motor are known.
- Current and speed regulators must swing.
- The intermediate circuit is loaded and the hardware signals Enable and Start are present.

#### Procedure:

Enter the value H' 80 into the control byte "RautojuCSR" (H' FE6E).

Now the power stage is enabled automatically and a DC current is supplied to the motor. The motor goes into a privileged position. After 10 seconds the position is measured and the resolver angle is calculated from this. This value is directly entered into "PhiPo" (H' FEF0).

The function is terminated when "RautojuCSR" = 0.

### **12.13 Brake Function**

For special applications, it may be useful that the stop brake is applied before the drive is locked (typical of vertical axes). By analogy with this, the brake should be released after the enabling the drive. ND31 supports this function. The hardware signal for

controlling the braking relay is the digital output GPO3 (Connector X3, Pin B24).

The desired delay times may be entered at addresses "BremseT1" (H' FEB4) and "BremseT2" (H' FEB5).

"BremseT1" determines how many 10 ms cycles shall pass after enabling the drive before releasing the brake, i.e., GPO3 switches to 1 (24 V). The function is deactivated with "BremseT1" = H' FF.

"BremseT2" determines the delay time in 10 ms cycles for the software lock (delayed switching of GPO3 to 0 V).

This function becomes only effective after a Reset.

