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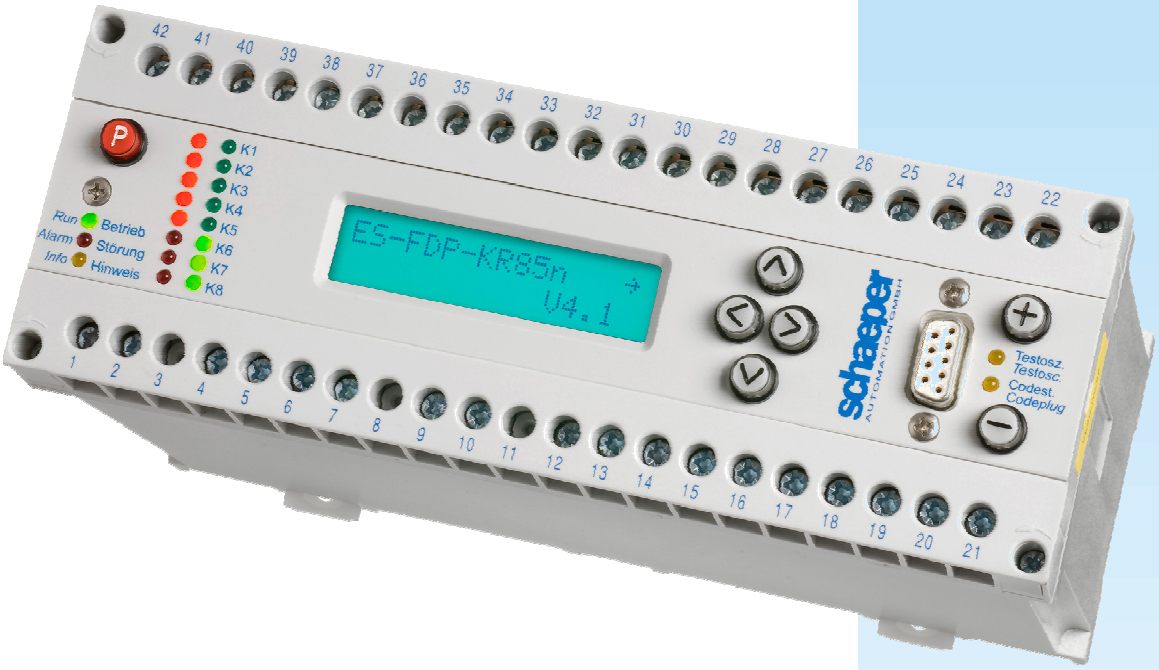
# ES-FDP-KR85n

**Digital Crane Frequency Control**

## Operating Instructions



## Differences to the Device Versions ...KR85ℓ resp. ...KR85ℓx

The device version ES-FDP-KR85n is designed with a new, up-to-date microcontroller. The immunity to interference could be increased considerably again through this.

The texts on the display can alternatively be displayed in German or English.

The programming of the display contrast is eliminated because the up-to-date display is readable well from a wide viewing angle.

At programmed window functions the passing through the window will be recognized even if there is no measurement inside the window (example: a measurement above the window, the next below the window, cf. chapter 2.5.5, page 14).

The acknowledgment of error numbers in the display self-test is not made by the key Ⓢ any more but by pressing the keys Ⓟ and ⊖ simultaneously (applies since software version V4.1).

The device offers the following new functions since the software V4.1:

- The programming of the device can be protected by a password in addition to the code plug.
- The operating time of the device is recorded and can be read on the display.
- The number of operating cycles is recorded one by one for every output relay and can be read on the display.

**All switching and monitoring functions as well as the allocation of the terminals have remained the same. Devices of the version KR85ℓ and KR85ℓx can be replaced by the version KR85n without wiring changes.**

## Important Differences to ES-FDP-KR85e

The crane frequency control ES-FDP-KR85n has like the previous version ES-FDP-KR85ℓ a changed terminal assignment to the version ES-FDP-KR85e. This was required for a higher immunity to interferences.

**With exchange of an ES-FDP-KR85e (or ES-FDP-KR85a) for an ES-FDP-KR85n (or ES-FDP-KR85ℓ), the following differences should be noted:**

**1. Terminal assignment:**
The **enable input 5** is no longer at terminal 40 (upper terminal strip), but at **terminal 12** (lower terminal strip). **Terminal 40** is now the **enable ground** for the enable inputs 3 und 4.

**2. Enable voltage:**
In order to reduce the danger of interference, the **voltage range of the enable inputs** is now restricted to **230V ± 15%**. Enable inputs for an expanded voltage range or for low voltages are available on request.

# Important information

For a high degree of operating safety, the unit has a **Watchdog**, an **EEPROM and Flash-EPROM with software write protection** in order to prevent a change of the programmed parameters with strong external interferences. **However, one hundred percent safety can not be achieved with a one-processor system. The system must therefore have a redundant system for safety-orientated use.**

The danger of a change of the programmed data due to extreme external interferences is minimised if the code plug is removed during the operation of the device.

**Other versions of the device:**

- **Frequency and speed monitor, ES-FDP-F...,** Frequency range 0,001 ... 2 000 Hz

- **Shaft break and slip monitor, ES-FDP-S....,** also frequency ratios other than 1

- **Resolver and position detector, ES-FDP-P...,** for monitoring position and speed

- **Signal pre-processor, ES-SV11,** supplementary device for use with the digital slip monitor **ES-FDP-S...,** includes sensor supply, rotational direction recognition by evaluation of 2 phase signal, open circuit monitoring.

- **Digital Synchronization monitor ES-SVGL2,** for monitoring synchronization. Includes sensor supply, rotational direction recognition by evaluation of 2 phase signal, open circuit monitoring.

**Note:**

This document has been translated with the greatest of care and expertise. We would like to categorically point out, however, that only the information contained in the German version is binding! This version has been enclosed or can be requested.

## Application

Type KR85n is a version of the frequency and speed monitor ES-FDP especially for cranes (for other versions see page 4). The device can be used to carry out all the usual frequency controlled crane switching operations for the lifting/lowering gear and also the slewing and travelling gear. Other versions of the KR85n, e.g. without time delay for the relays, are also available.

These are individual devices with the following **general characteristics**

- Extremely space-saving
- Easy to programme due to a large LC-display with backlight
- Display with plain text, alternatively German or English-language
- Switching frequencies programmable within the range 0.1 ... 99.9 Hz
- Protection from unauthorised programming by means of a code plug
- Light-emitting diodes for the indication of the operating state
- Double-LED display (red/green) for relay status
- 8 relay outputs (optional triac or transistor outputs)
- Programmable time delay for the switching outputs
- 5 enable inputs with programmable time delays can be assigned to the relay outputs arbitrarily (exception: two-step mode of operation)
- Normal or two-step operation programmable
- Internal test oscillator for function test (including crane simulation)
- Electrically isolated input for rotor voltage (max. 1000 $V_{eff}$)
- Open circuit monitoring
- Fix-programmed channels for safety functions, e.g. 49/51 Hz (option)
- Flash-EPROM and EEPROM for programmable values (no batteries required), with software write protection for extremely high data safety
- High noise immunity (watchdog, redundant data storage for automatic error recognition)
- Service friendly with **removable screw-on terminal strip, thus enabling the devices to be changed quickly without the danger of wiring errors**

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# 1 Displays and Operation

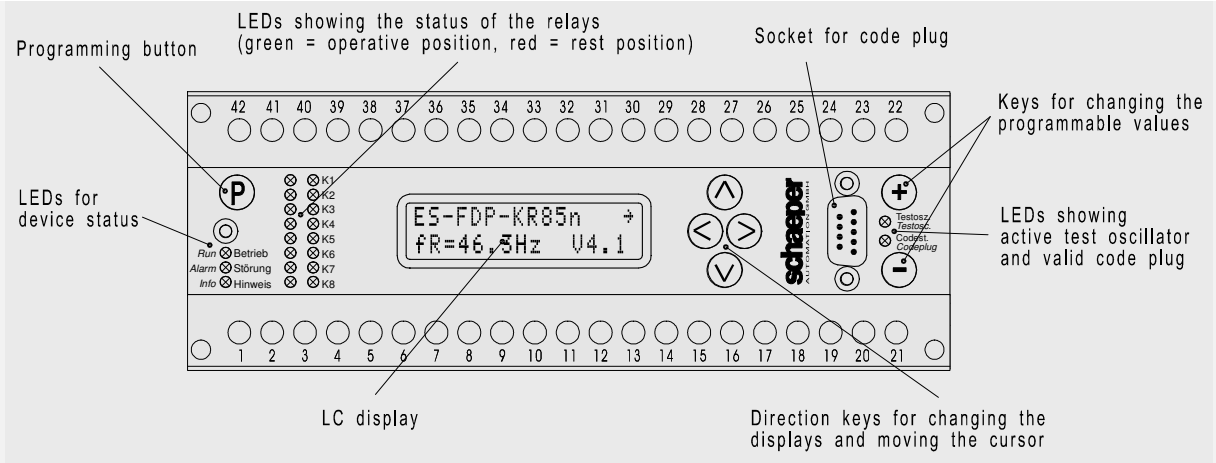



**Fig. 1:** Operating elements of the device

## 1.1 LED Indicators

**Run (green)** Mains voltage is connected and the self-test is finished.

**Alarm (red)** The program flow has been disturbed by external influences (e.g. considerable interference from switched lines, EMP) or due to an internal error in the device in such a manner that the device can not function properly. After the automatic error correction has been finished the LED is switched off, the LED **Info** remains on up to reading the error number (see chapter 3). If no automatic error correction is possible the LED **Alarm** remaines on permanently. Measures for the resumption of operation are described in chapter 3 (Device Errors, see page 17).

**Info (yellow)** This LED indicates disturbing influences which only occur temporarily, thus enabling preventative measures to be taken. The LED lights up after occurrence of an error, however does not go out until acknowledged or until the interruption of the supply voltage. To acknowledge: see chapter 3 (page 17).

**K1 to K8 (green and red)** The status of the 8 frequency channels or the relays allocated to them
red → rest position
green → operative position

**Testosc. (yellow)** Test oscillator is on (simulated operation, instead of **fR**, **fT** appears in the display)

**Codeplug (yellow)** Valid code plug is connected
Programming possible

## 1.2 LC-Display

### 1.2.1 Back-lighting

For better readability with poor light conditions, the LC-Display is equipped with back-lighting. The lighting is activated with the press of any key and automatically goes out approx. 3 minutes after the last key is pressed.

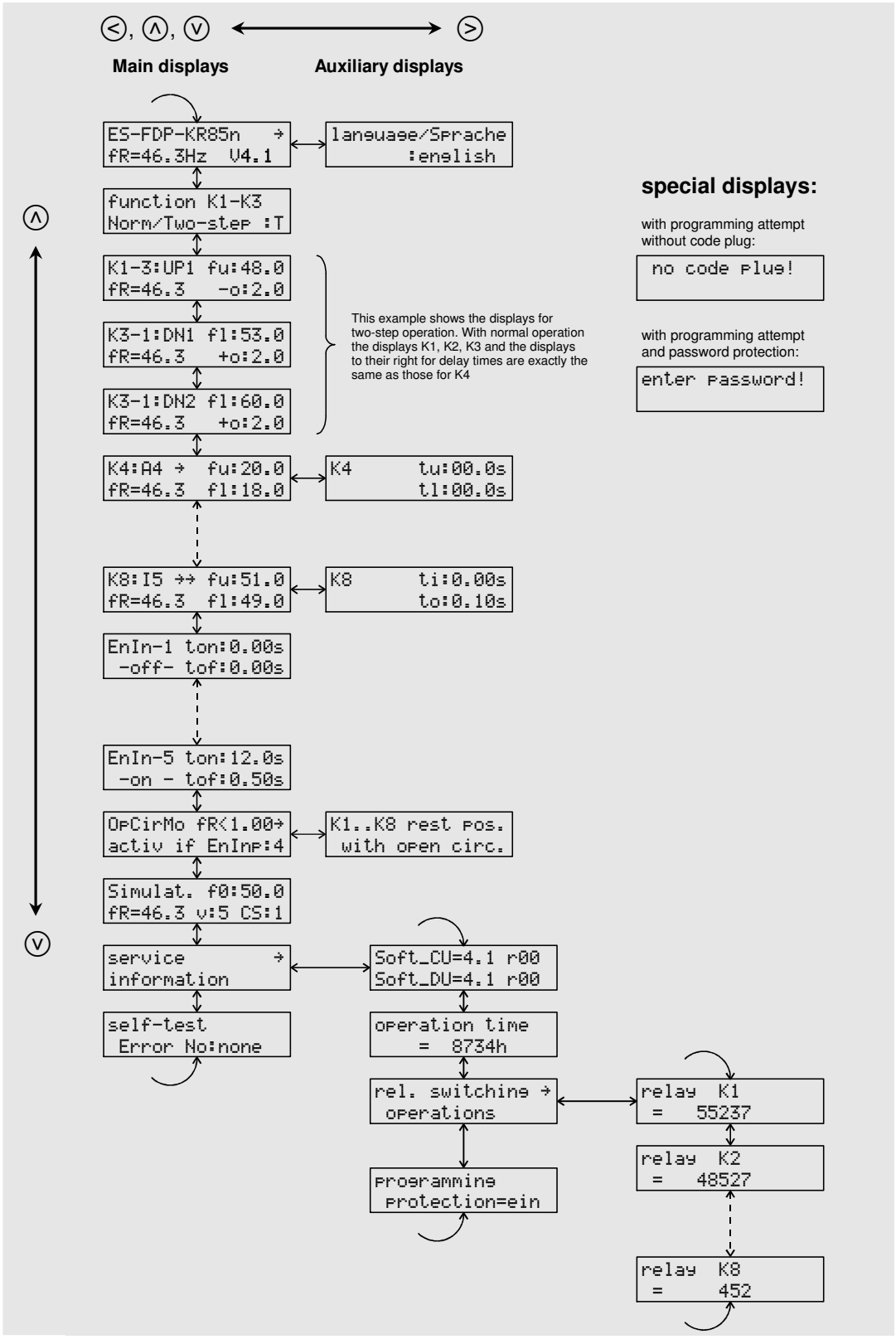


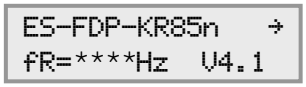

**Table 1:** Sequence of the displays

| | | | |
|---|---|---|---|
| **ES-FDP-..** | Device specification | **EnIn-..** | Enable input |
| **V..** | Software version | **ton:..** | Response time delay for enabling (s) |
| **language/Sprache** | Programming of the display language | **tof:..** | Drop-off time delay for enabling (s) |
| **K..** | Frequency channel | **-on -** | Signal to enabling input |
| **K1-3** | Frequency channels 1 to 3 | **-off-** | No signal to enabling input |
| **Norm (N)** | Normal-operation (see **Table 8** and **Table 9**, page 22) | **OpCirMo** | Open circuit monitoring |
| **Two-step (T)** | Two-step operation (see **Table 10**, page 24) | **..activ** | Open circuit monitoring is active |
| **UP1** | Lifting 1 (enable input 1) | **OpCi** | Appears in display instead of measured frequency when the open circuit monitoring has responded |
| **DN1** | Lowering 1 (enable input 2) | **EnInp:..** | Allocated enabling input |
| **DN2** | Lowering 2 (enable input 3) | **Simulat.** | Test oscillator |
| **fu:..** | upper switching frequency;<br>with two-step operation: basic frequency for lifting | **fØ:..** | Initial-frequency |
| **fl:..** | lower switching frequency;<br>for two-step operation: basic frequency for lowering | **v:..** | Speed with which the values of the test oscillator change |
| **tu:..** | Relay switching delay at upper switching value for hysteresis switching function | **CS:..** | Type of operation of the test oscillator (crane simulation on/off) |
| **tl:..** | Relay switching delay at lower switching value for hysteresis switching function | **service infor-mation** | Service information: Operating time, Software-revision numbers, Operating cycles of the relays. |
| **ti:.., to:..** | Relay switching delays for window switching function (I..Q) | **Soft_CU** | Software revision of the central unit. |
| **fR=..** | Measurement frequency from input | **Soft_DU** | Software revision of the display processor. |
| **fT=..** | Measurement frequency from internal test oscillator | **→** | Indication of an auxiliary display |
| **+o:..** | Positive frequency offset | **→→** | A time delay has been programmed for this output |
| **-o:..** | Negative frequency offset | **PRGM** | Programming mode |

**Table 2**: Significance of the display texts

### 1.2.2 Basic Display and Software-Version

After the power supply has been connected, the device responds by giving its type identification in the upper line. The value of the rotor frequency **fR** and the version-No. **V** of the software will be shown in the lower line.




********: current rotor frequency

### 1.2.3 Selecting the Displays

The sequence of the displays is shown in **Table 1** (page 9). The left column shows the **main displays**. There is a main display for every function of the device. There is an **auxiliary display** (right column in the table) when not all the information fits into one display. The arrow → in the main displays indicates the existence of an auxiliary display.

The displays are selected using the cursors (Ⓐ, Ⓥ, Ⓒ, Ⓓ). The main displays are obtained using the keys Ⓐ and Ⓥ (for sequence see **Table 1**). The key Ⓓ calls up the auxiliary display belonging to the current main display (if available). The keys Ⓒ and Ⓐ or Ⓥ bring back the respective main display. An exception is the area of the service information, here only the key Ⓒ leads back to the respective main display, since the keys Ⓐ or Ⓥ are used to access the associated sub-displays.

### 1.2.4 Display of the Measured Values

The values measured for the rotor frequency are superimposed in the basic displays **ES-FDP-..** and in the switching channel displays **K1**...**K8** bottom left in the form `fR=....`. The text `OPCi` instead of the current frequency indicates that the open circuit monitoring has responded. If the open circuit monitoring is not active and for approx. 10 seconds no input signal is recognized the display will show `fR=<0.1Hz`. The display changes from `fR=` to `fT=` during simulated operation using the test oscillator.

In the displays **EnIn-1** ... **EnIn-5** a superimposed `-on-` or `-off-` shows whether there is a voltage applied to the enable input.

# 2 Programming (PRGM)

## 2.1 Code Plug

A code plug is needed to programme the device. This is plugged into the socket on the front panel (cf. figure 1, page 8). The plug may only be removed after the programming procedure has been finished (when `PRGM` is no longer shown in the display).

If the key Ⓟ is pressed without the code plug connected, the following will appear:


## 2.2 Programming Sequence

The significance of the programmable parameters in the individual displays is explained in the respective chapters below. The sequence for the programming is always the same and is carried out as shown in **Table 3**. It is not possible to change a value unintentionally because two keys must be pressed at the same time. Even if the programming key Ⓟ is pressed accidentally, the programming mode can be left simply by following step 6.

Only values which have been defined can be programmed. Therefore, the number of an enable input allocated to a particular switching channel can only be set at a number between 1 and 5. When programming the time delays and the open circuit monitoring the decimal point can also be moved. The decimal point cannot be moved to the front for time delays. **Table 4** shows the values which can be programmed.

**Warning:** The device should only be programmed when the main plant is switched off, because the outputs can switch in an undefined way during the programming procedure.

| | **the key to be used** |
|---|---|
| 1. Select required display | Ⓐ, Ⓥ, Ⓒ, Ⓓ |
| 2. Switch on programming mode<br>K4:A1 → fu:20.0<br>PRGM fl:18.0<br>(In the display "PRGM" and the mark "_" will appear) | Ⓟ |
| 3. Move the mark to the value which is to be adjusted | Ⓐ, Ⓥ, Ⓒ, Ⓓ |
| 4. Set the desired value<br>(separate for each digit)<br>(a flashing mark fills the whole character field) | Ⓟ and ⊕ (simultaneously)<br>or<br>Ⓟ and ⊖ (simultaneously) |
| 5. Repeat steps 3. and 4. until all values in the display have been set | |
| 6. Programming of the values and leaving programming mode | ⊕ and ⊖ (simultaneously)<br>(do not press Ⓟ!) |

**Table 3:** Programming sequence

| | |
|---|---|
| Switching function | - A B C D E F G H I K L M N O P Q |
| Number of an enable input | 0 1 2 3 4 5 , with open circuit monitoring also ÷ |
| Digits for switching values and delay times | 0 1 2 3 4 5 6 7 8 9 , with times also . |
| Type of function (normal/two-step) | N T |
| Language | deutsch english |

**Table 4:** Permissible values for programming

## 2.3 Display Language

Here the language of the display texts can be switched over between German and English:

```
language/Sprache
       :english
```

The display texts, which appear if the German language is selected, are described in the German-language version of the operating instructions.

## 2.4 Mode of Operation (Normal-/Two-Step)

When operating in normal operation mode the switching behaviour of each of the frequency channels can be programmed individually. In two-step mode the first three frequency channels offer an extra function to enable a load-dependant control with reduced speed fluctuations. This special switching behaviour can be seen in **Table 10**. **K1** to **K3** switch with an offset of the programmable frequency **o**,

whereas the switching frequencies depend on the applied enable signal lifting 1, lowering 1, or lowering 2.

The frequency channels **K4** ... **K8** only operate in normal mode.

When the display **Funktion K1-K3** is selected the function of the switching channels **K1** ... **K3** can be changed from normal operation **N** to two-step operation **T** and vice-versa. The selected function is shown on the outside right in the lower line:

```
function R1-R3
Norm/Two-step :T
```

## 2.5 Switching Channels in Normal Operating Mode

In normal operating mode, the switching behaviour of each of the 8 frequency channels can be programmed individually. This is determined by programming a switching function, the allocation of an enable input, by the switching frequencies and, if required, also with programmed time delays (**Table 5**).

Main display and auxiliary display for a switching channel (the programmable parameters have been underlined)

```
K1:A4 →→ fu:22.5
PRGM     fl:18.5
```

```
K1       tu:0.05s
PRGM     tl:00.0s
```

| | |
|---|---|
| K1: | first frequency channel selected |
| PRGM | programme mode is switched on |
| →→ | Indication of a programmed delay time in auxiliary display |
| | Main display: |
| A | selected switching function |
| 4 | enable input 4 has been allocated |
| 22.5 | upper switching frequency **fu** in Hz |
| 18.5 | lower switching frequency **fl** in Hz |
| | Auxiliary display: |
| Ø.Ø5 | Delay time **tu** programmed at Ø.Ø5s |
| ØØ.Ø | no delay time **tl** programmed |

**Table 5:** Programmable parameters for a switching channel in normal operation mode

### 2.5.1 Switching Function

The frequency channel is shown on the left of the upper line of the display. The letter after the colon indicates the switching function. It is possible to programme **hysteresis switching functions A ... H** (**Table 8**, page 22) and **window switching functions I ... Q** (**Table 9**, page 23).

**Hysteresis switching functions A ... H:** Because two switching values **fu** and **fl** can be programmed this gives a switching hysteresis (**fu** - **fl**). This enables the relay to be kept in a stable condition.

**Window switching function I ... Q:** Window functions can be used, e.g., for standstill monitoring (**fu**: 51 Hz **fl**: 49 Hz). The relay switches if the rotor frequency moves out of the programmed window. The window functions operate without switching hysteresis.

**Function "–":** is programmed if the switching channel is not needed. The relay will remain permanently in the rest position, independent of the rotor signal.

### 2.5.2 Enabling Allocation

The digit after the switching function represents the number of the enabling input which is allocated to the frequency channel. If here the digit **Ø** is programmed in then the respective switching channel is always activated, i.e. an enable signal is not necessary.

### 2.5.3 Switching Frequencies

On the right in the upper line the upper frequency **fu** is shown, and directly underneath the lower frequency **fl**. The two values **fu** and **fl** determine the switching hysteresis (switching functions **A**...**H**) or the switching window (switching functions **I**...**Q**).

In the standard version of the device the switching frequencies can be programmed to any value for all channels. As an optional extra the device can be fitted with fix-programmed channels for safety functions.

### 2.5.4 Time Delay for the Outputs

In the standard version of the device all switching channels which do not function in two-step operation can be programmed to switch the outputs with a time delay of 0 ... 65 seconds. A double arrow ↠ in the main display of the switching channel indicates that the respective output has a time delay (when a time delay has not been programmed a single arrow → indicates the existence of an auxiliary display, cf. chapter: **1.2. LC-Display**, page 9). The delay times are programmed in the auxiliary displays.

| | |
|---|---|
| K3:C4 ↠ fu:40.0<br>fR=**** fl:38.0 | K3 tu:0.05s<br>tl:0.70s |
| K4:I5 → fu:20.0<br>fR=**** fl:18.0 | K4 ti:0.00s<br>to:0.00s |

With the switching functions **A** - **H** (hysteresis) the delay time **tu** is effective when the upper frequency **fu** is exceeded, when the lower frequency **fl** is gone under the time **tl** is effective.

With the switching functions **I** - **Q** (window) the delay time **ti** is effective if the measurement value, **fR** enters **i**nto the window range. The time **to** is effective when the measured value, **fR** leaves the window area. It is completely irrelevant whether the measured value is increasing or decreasing when it enters or leaves the window range (cf. fig. 2).

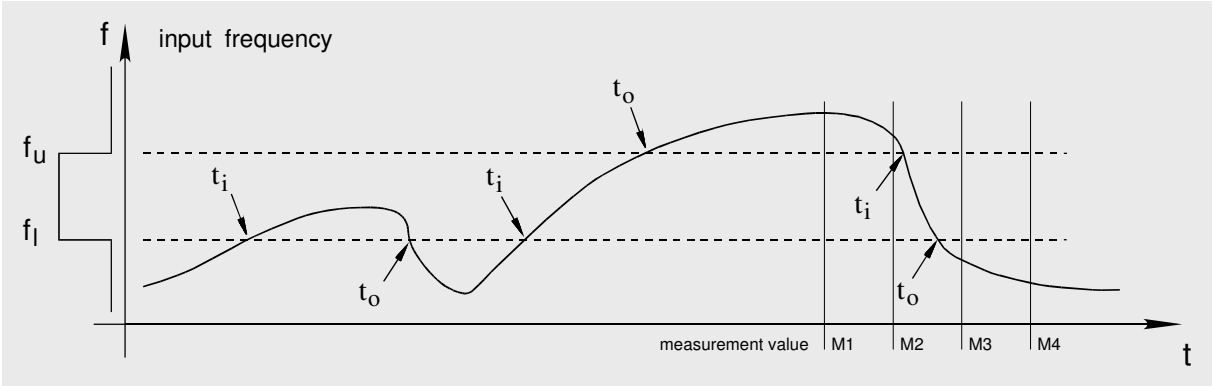



**Fig. 2:** Time delays for the relays with the window switching functions I-Q

### 2.5.5 Programming of the Switching Delay for Recognizing a Window for certain

For fast frequency changes and switching windows tolerated narrowly it can happen that when passing through the window no measurement lies in the switching window. In the example (cf. **Fig. 2**) the measurement M2 is above the switching window, the following measurement M3 already below the window. In order to get switched the accompanying relay nevertheless, a time delay **to** must be programmed and **ti** must be set to 0. The time **to** may not be chosen too short due to the relay delay times and the response times of the post-connected equipment so that passing through the window can be evaluated for certain.

| | |
|---|---|
| K4:I5 ↠ fu:51.0<br>fR=**** fl:49.0 | K4 ti:0.00s<br>to:0.20s |

****: current value

## 2.6 Switching Channels K1 ... K3 in Two-Step Operation

The special switching functions of the channels **K1** ... **K3** when in two-step operation is shown in **Table 10** (page 24). The device switches at the respective allocated rotor frequencies, depending on the enable signals lifting 1, lowering 1, and lowering 2. **K1** to **K3** switch with an offset of the programmable frequency difference **o**. The value of the frequency difference **o** is also the switching hysteresis for the channels **K1** to **K3** (**Table 10**, page 24).

The frequency of the first channel is programmed directly for lifting 1. In the display the **-o** indicates the drop in switching frequency from **K1** to **K3** (in the example 2 Hz).

```
K1-3:UP1 fu:48.0
fR=****   -o:2.0
```

****: current rotor frequency

For lowering 1 and lowering 2 the frequency of the third channel is programmed directly. The switching frequencies increase from **K3** to **K1** respectively by the value **+o** (in the example by 1,5 Hz).

```
K3-1:DN1 fl:53.0
fR=****   +o:1.5
```

```
K3-1:DN2 fl:60.0
fR=****   +o:1.5
```

****: current rotor frequency

In the master controller positions lifting 1, lowering 1, and lowering 2 the drive runs, depending on the load, in one of the frequency ranges and switches within this range.

The allocation of the enable inputs 1 to 3 in two-step operation has been set as follows:

Enable input 1 → lifting 1
Enable input 2 → lowering 1
Enable input 3 → lowering 2

## 2.7 Enable Delay Times

It is possible to programme an operate delay time **ton** and a drop-off delay time **tof**, each between 0 and 65 seconds for every enable input. The respective displays are **EnIn-1** to **EnIn-5:**

```
EnIn-1 ton:0.00s
 -off- tof:0.00s
```

Fig. 3 shows the validity of the times **ton** and **tof.** An **-on-** or **-off-** in the display indicates whether a signal is applied to the enable input.

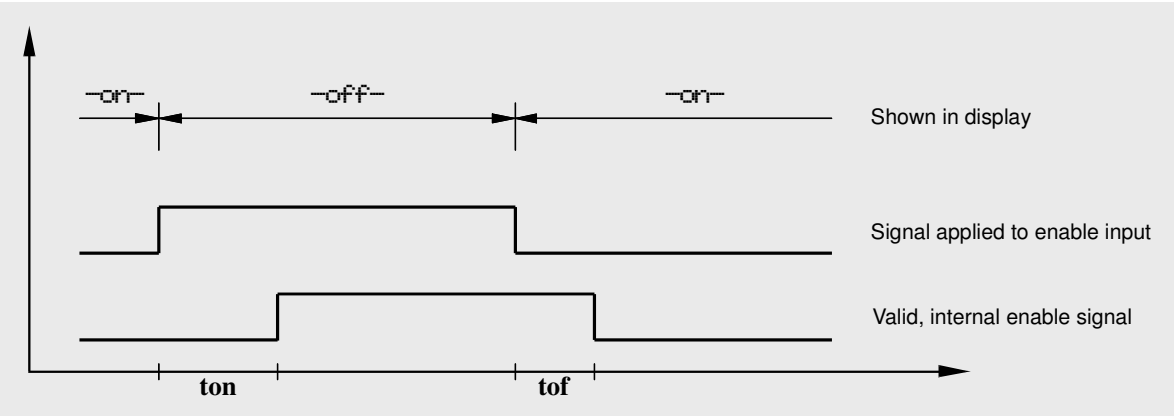



**Fig. 3:** Delay times for enabling

## 2.8 Open Circuit Monitoring

This function enables all switching outputs **K1** to **K8** to be switched to the rest position if the frequency goes below a minimum.

| | |
|---|---|
| OpCirMo fR<1.00→<br>aktiv if EnInp:4 | K1..K8 rest pos.<br>With open circ. |

The frequency is programmed after **fR<**. There is no point in programming values less than 0,1 Hz because smaller frequencies than this are evaluated internally as 0 (the open circuit monitoring reacts in this case at 0,1 Hz). If the frequency is programmed at 0 Hz then the open circuit monitor does not respond at all, because frequencies < 0 Hz are not possible.

When the open circuit monitor responds then all switching outputs go to the rest position, irrespective of the switching function which has been programmed for normal operation.

In order to bypass the starting up procedure of the engine, an enable input can be used to activate this function. The digit after **EnInp:** can be programmed and indicates the allocated enable input. The digit **0** indicates that the open circuit monitoring is always activated.

If, instead of a digit, a "÷" is programmed then the open circuit monitoring is deactivated and after the programming has been completed the display changes as follows. To re-activate simply re-programme with a digit.

| |
|---|
| OpCirMo fR<br>with EnInp:÷ |

If the open-circuit monitor has responded then **fR=OpCi** will appear in the displays instead of the input frequency:

| | |
|---|---|
| K3:C4 → | fu:40.0 |
| fR=OpCi | fl:38.0 |

**Warning:** The frequency must be programmed at a value under the lowest frequency which can occur during regular operation **fR**.

The open circuit monitoring responds if the rotor voltage goes under the input sensitivity of the device (near synchronous operation).

## 2.9 Test Oscillator

The test oscillator serves to simulate the switching functions of the device without a rotor frequency being applied.

| | |
|---|---|
| Simulat. f0:50.0 | |
| fR=**** v:5 CS:1 | |

****: current rotor frequency

The initial frequency with which the test oscillator begins at the start of a simulation is shown in the top right of the display. When the test oscillator is activated (only possible with the code plug connected), the direction of the frequency changes can be determined using the keys ⊕ (frequency increases) or ⊖ (frequency decreases). The speed that the frequency changes is determined by the value **v** which is programmed with values **v:0**, slow, to **v:9**, fast.

The test oscillator is activated and deactivated by pressing the keys ⊕ and ⊖ simultaneously. The frequency range of the test oscillator is from 0.1 to >100 Hz.

**Note:** the test oscillator can only be activated if the rotor frequency is below 0.1 Hz. The device turns the test oscillator off automatically if a voltage is applied to the measurement input or the code plug is removed.

The test oscillator can be set for crane simulation. To do this the value **CS** is set to **1**. When a frequency of 5 Hz is reached the oscillator will now jump to a frequency of 95 Hz, enabling counter operation to be simulated. **CS:0** indicates normal operation.

**For safety reasons the test oscillator should only be activated when no current is applied to the power circuit!**

## 2.10 Password Programming Protection

For safety reasons against an unauthorized change of the programmed parameters a password-programming protection can be activated in addition to the code plug. If the password-programming protection is active and a programming attempt is made by pressing the button Ⓟ (with inserted code plug) the following display appears:

```
enter password!
```

On request the operator of the device will get information about the activation of the password-programming protection by request of an additional data sheet.

# 3 Device Errors

## 3.1 Self-test

During operation the device permanently executes a self-test. At occurring errors the LEDs **Info** and possible **Alarm** on the front light up. The **Alarm** LED indicates a serious error which prevents the correct operation of the device. In this case all relays are switched to idle state. The device usually eliminates the error automatically and resumes the normal operation. The **Info** LED lights on until acknowledgment. The current error number can be read in the display **self-test**.

```
self-test
 Error No:***
```

***: current error number

If several error numbers are stored, these are called after each other by pressing the button Ⓢ repeatedly. To acknowledge the error number displayed currently press the keys Ⓟ and ⊖ simultaneously with the code plug connected. This is to do repeatedly until the word **none** appears instead of an error no. For the purpose of a later fault analysis the error nos. should be noted down. An interruption of the mains voltage also leads to deleting stored error numbers and resetting the **Info** LED.

If after a serious disturbance no error correction is possible, the **Alarm** LED lights permanently. This occurs for example if extreme disturbing influences have changed the programmed parameters in the EEPROM or in the flash memory. The essential measures are described in the subsequent chapters.

## 3.2 Meaning of the Error Messages

Extreme external disturbing influences may cause faults in the program flow or in the stored data. The device recognizes these by the self-test and executes the corresponding corrections. The faults tracked down and the measures of the correction are characterized by the error numbers (cf. **Table 6**). So the error number indicates respectively the effect of the disturbance; the causes, (i.e. the interference sources) cannot be recognized by a test program.

In the column "location of the fault" in **Table 6** there are listed, where the fault has appeared:

- **CU** = central unit, responsibly for the evaluation of the input signals and the combination with the programmed parameters
- **DU** = display unit, responsible for the operating of the controls and for driving the LEDs and the LC-display.

| Error-Number | Location of the Fault | Meaning | Required Measures (cf. Table 7) |
|---|---|---|---|
| 001 | DU, CU | Incompatible software in central unit and display unit | 1 |
| 002 | CU | Data in the EEPROM and in the front plate are not corresponding | 2 |
| 003 | CU | Forbidden data in the EEPROM | 2 |
| 009 | CU | Watchdog timer has had effect and has triggered Reset | 3 |
| 010 | CU | Reset was triggered because of low voltage | 4 |
| 011 | CU | Other forbidden Reset condition appeared | 3 |
| 012 | CU | Cycle time wasn't kept to | 3 |
| 017 | CU | Forbidden values in switching registers | 3 |
| 018 | CU | Forbidden values in registers for the data interchange control | 3 |
| 019 | CU | Wrong values in registers for the Capture control (frequency recording) | 3 |
| 020 | CU | Reserved | 3 |
| 021 | CU | Reading the EEPROM couldn't be executed correctly, possible because a forbidden write operation was still active | 3 |
| 022 | CU | Fault appeared at a parameter reprogramming (Differences in more than 2 parameter blocks) | 3 |
| 023 | CU | Data in the RAM do not correspond to the values transmitted by the display unit | 2 |
| 025 | CU | No i2c bus connection to the display unit | 3 |
| 026 | CU | Bus collision at i2c data transmission appeared | 3 |
| 027 | CU | No Acknowledge of the I2c slave | 3 |
| 028 | CU | Received i2c data have check sum errors | 3 |
| 029 | CU | Reserved | 3 |
| 033 | DU | Display unit does not receive any data of the central unit | 3 |
| 034 | DU | Check sum error at received data | 3 |
| 035 | DU | Data error of the stored parameters in flash memory (cf. chapter 3.3) | 3 |
| 036 | DU | Error of the i2c slave state machine | 3 |
| 037 | DU | Reserved for tests | 3 |
| 038 | DU | Error at the recording of the relay-switching cycles | 3 |
| 039 | DU | Error at the recording of the service data | 3 |
| 041 | DU | Watchdog timer has had effect and has triggered Reset | 3 |
| 042 | DU | Reset was triggered because of low voltage | 4 |
| 043 | DU | Other forbidden Reset condition appeared | 3 |
| 044 | DU | Forbidden interrupt occured | 3 |

**Table 6:** Error numbers of the self-test

| Required Measure | |
|---|---|
| 1 | Interrupt power supply and switch on again. If furthermore the error appears, the device must be sent in for repair to the manufacturer. Otherwise note down error number and inform the manufacturer. |
| 2 | Interrupt power supply and switch on again. If furthermore the error appears, programmed parameters are changed by extreme disturbing influences. This is recognized by redundant storage. Select an arbitrary programmable display, switch on the programming mode and finish normally. Parameters do not have to be changed to this. The device corrects all perhaps faulty data to permissible values. Perhaps further info messages will be reported which have to be acknowledged.<br>**Attention: A following check of all programmed data is absolutely required.**<br>Note down error number and inform the manufacturer. |
| 3 | Acknowledge error, note down error number and inform the manufacturer. |
| 4 | Acknowledge error, remove external cause for undervoltage or short-time voltage drops at the operational location. |

**Table 7:** Required measures after appearance of errors

## 3.3 Data-Error of the stored Parameters in the Flash-Memory

The programmable parameters of the device are stored in the flash memory of the display unit. A change of the programmed data is very improbable. A storage of faulty data is e. g. possible if directly during the completion of a programming the power supply breaks down. If the device detects faulty data in the flash memory at the self-test the red **Alarm** LED lights and at selecting of the main display for the self-test the following message is shown:


Pressing the button ⊜ directly leads to the display in which the error has appeared. The programming mode is selected, all programmed values have to be checked for correctness and corrected if necessary. After that the programming must be completed normally by pressing the buttons ⊕ and ⊖ simultaneously.

If furthermore "data-error" appears after calling of the self-test display, then the programmed parameters of another display are faulty and the process must be repeated until when selecting the self-test display the error number 035 will be displayed. This is triggered by the faulty data in the flash memory and must be acknowledged certainly now.

## 3.4 External Error Messages

A disturbance which results in the red disturbance LED lighting up also causes all the switching channels to be switched to rest position for the duration of the disturbance. This function can be used to provide an external error message using one or several relays.

## 3.5 Wiring of the Enable Inputs

In some cases the cause of a disturbance can be an extreme switching over-voltage at an enable input. **An external wiring with varistors or load resistances can help in this case.**

Example for enable control with 230V, AC: Suitable are load resistances R=10kΩ/10W or varistors for 275V which are suitable for operating directly at line voltage.

## 3.6 Wear of Relay Contacts at inductive Loads

If the output relays switch inductive loads (e. g. contactors) they should be protected by a damping circuit. Otherwise the generated arc when switching off may cause high wear of the contacts and may lead to unit faults in awkward cases (the yellow **Info** – LED will light).

With contactors with 230VAC control voltage RC circuits bring good results, but varistor circuits decrease the arc only insignificantly. For the dimensioning the wirings suggested by the contactor manufacturers should be used, since these are particularly co-ordinated with the respective types.

Pay attention that each damping circuit of the contactors can entail an increase of the switch-off delay time.

## 3.7 Blown Fuse

The device fuse is soldered onto the printed circuit board next to the transformer. To change it, the terminal strips should be unscrewed and removed and the head-plate loosened with a screw-driver as shown on the picture on page 28. Now the plugged-in circuit boards can be removed from the housing.

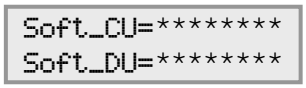
A fuse of the type **TR5 100 mA/250 V, slow-blow** should be soldered in. Care must be taken when re-assembling that the plug contacts are seated correctly!

# 4 Service-Informations

Information about the device state is summarized under the main display service-information. The operating time of the device as well as the number of the operating cycles of the relay contacts can be seen here. Furthermore it is shown here, whether the password programming-protection of the device is active.

## 4.1 Software-Revision Numbers

The revision numbers of the software of the device are listed in the first side display of the service information.




********: Revision numbers of the operational software

Soft_CU= describes the software version of the central unit, Soft_DU= describes the software version of the display processor.

## 4.2 Operating time

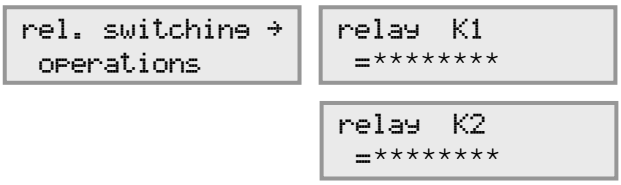
This display gives information about the operating time of the device (= mains voltage on).


******: Operating time in hours

The accumulated operating time is stored in the permanent memory every 10 minutes only. Due to this procedure there will be accumulated too little operating time at every power-on period of the device up to 10 minutes. A correct recording therefore presupposes that the normal power-on period of the device is respectively several hours.

## 4.3 Operating Cycles of the Relays

The operating cycles of the individual output relays K1..K8 are shown in the side displays of this display.

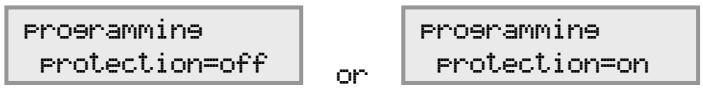



******** : operating cycles of the relays

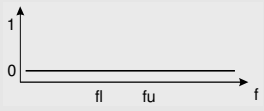
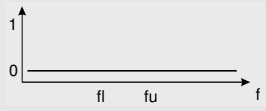
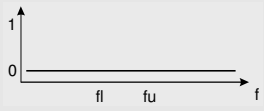
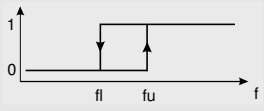
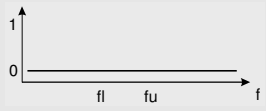
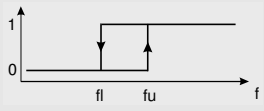
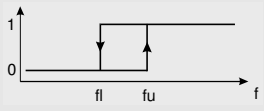
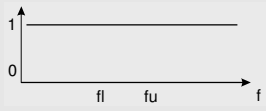
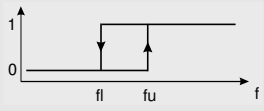
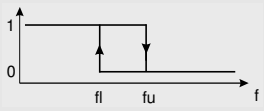
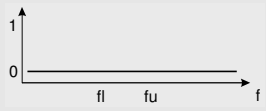
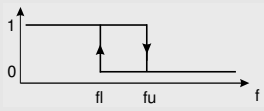
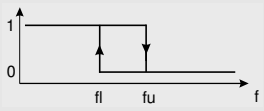
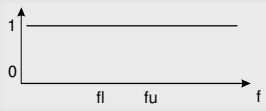
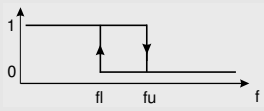
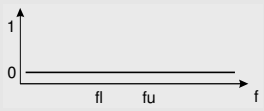
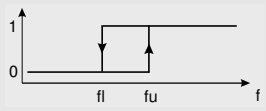
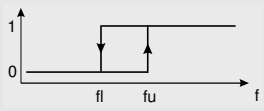
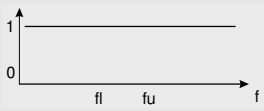
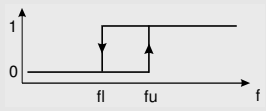
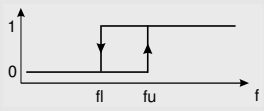
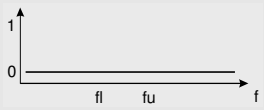
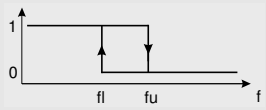
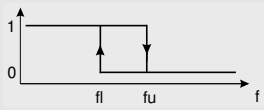
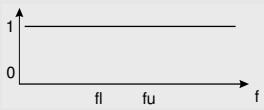
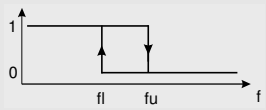
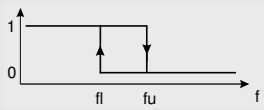
These values are also stored in the permanent memory every 10 minutes only. Exactly as in the case of the operating time the part of the cycles that arises at every power-on period of the device up to 10 minutes will not be taken into account. Again a correct recording therefore presupposes a respectively long power-on period of the device.

## 4.4 Programming Protection

This display shows, whether the password programming-protection of the device is active. The operator of the device will receive infos to the password programming-protection on request in form of a separate data sheet.



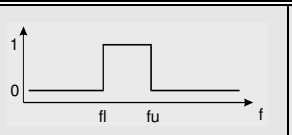
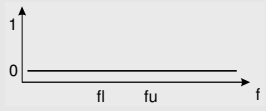
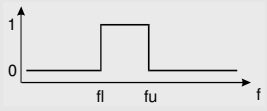
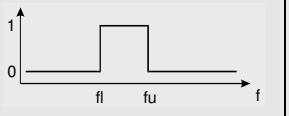
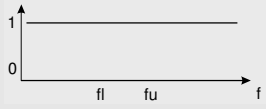
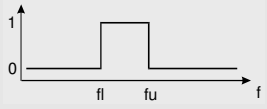
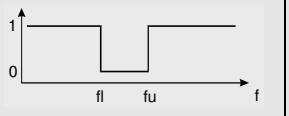
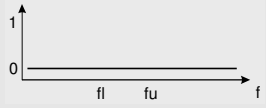
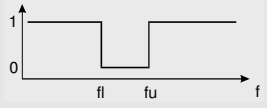
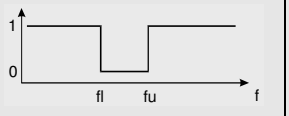
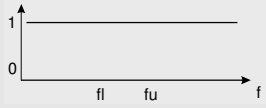
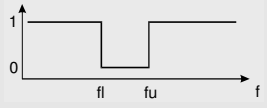
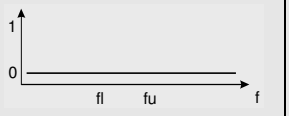
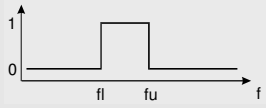
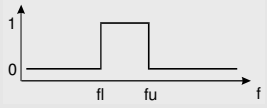
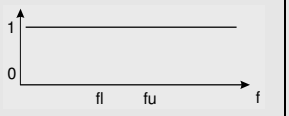
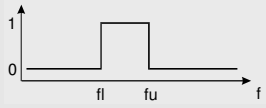
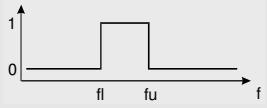
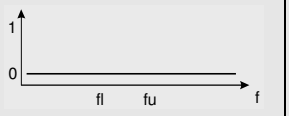
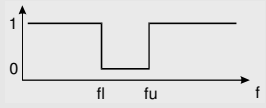
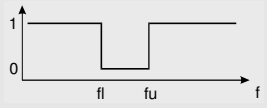
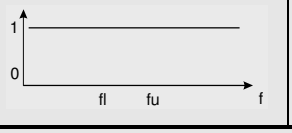
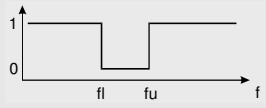
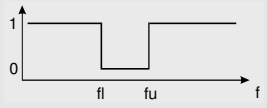
# 5 Switching Functions for the Relays

| programmed switching function | Programming of the associated enable inputs: 1,2,3,4, or 5 — Relay status when the signal to the associated enable input is: switched on | switched off | Programming of the associated enable inputs: Ø — Relay status (independent of the enable signal) |
|---|---|---|---|
| - |  |  |  |
| A |  |  |  |
| B |  |  |  |
| C |  |  |  |
| D |  |  |  |
| E |  |  |  |
| F |  |  |  |
| G |  |  |  |
| H |  |  |  |

1: Operative position
0: Rest position

fu: programmed upper switching frequency
fl: programmed lower switching frequency

**Table 8:** Programmable hysteresis switching functions for the relays and their dependency on the enable signal

| | Programming of the associated enable inputs | | |
|---|---|---|---|
| | 1,2,3,4, or 5 | | Ø |
| programmed switching function | Relay status when the signal to the associated enable input is: | | Relay status (independent of the enable signal) |
| | switched on | switched off | |
| I |  |  |  |
| K |  |  |  |
| L |  |  |  |
| M |  |  |  |
| N |  |  |  |
| O |  |  |  |
| P |  |  |  |
| Q |  |  |  |

1: Operative position
0: Rest position

fu: programmed upper switching frequency
fl: programmed lower switching frequency

**Table 9:** Programmable window switching functions for the relays and their dependency on the enable signal

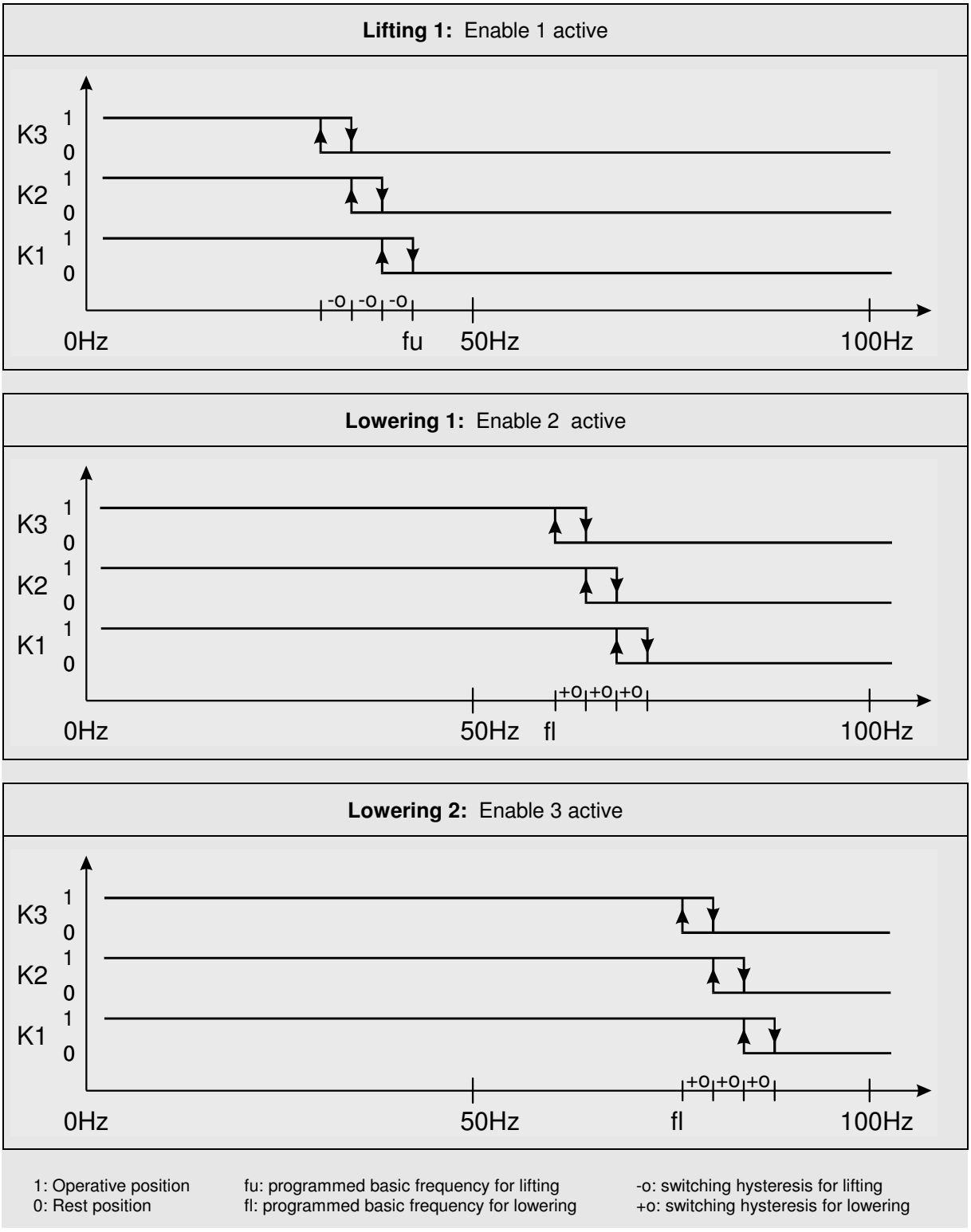


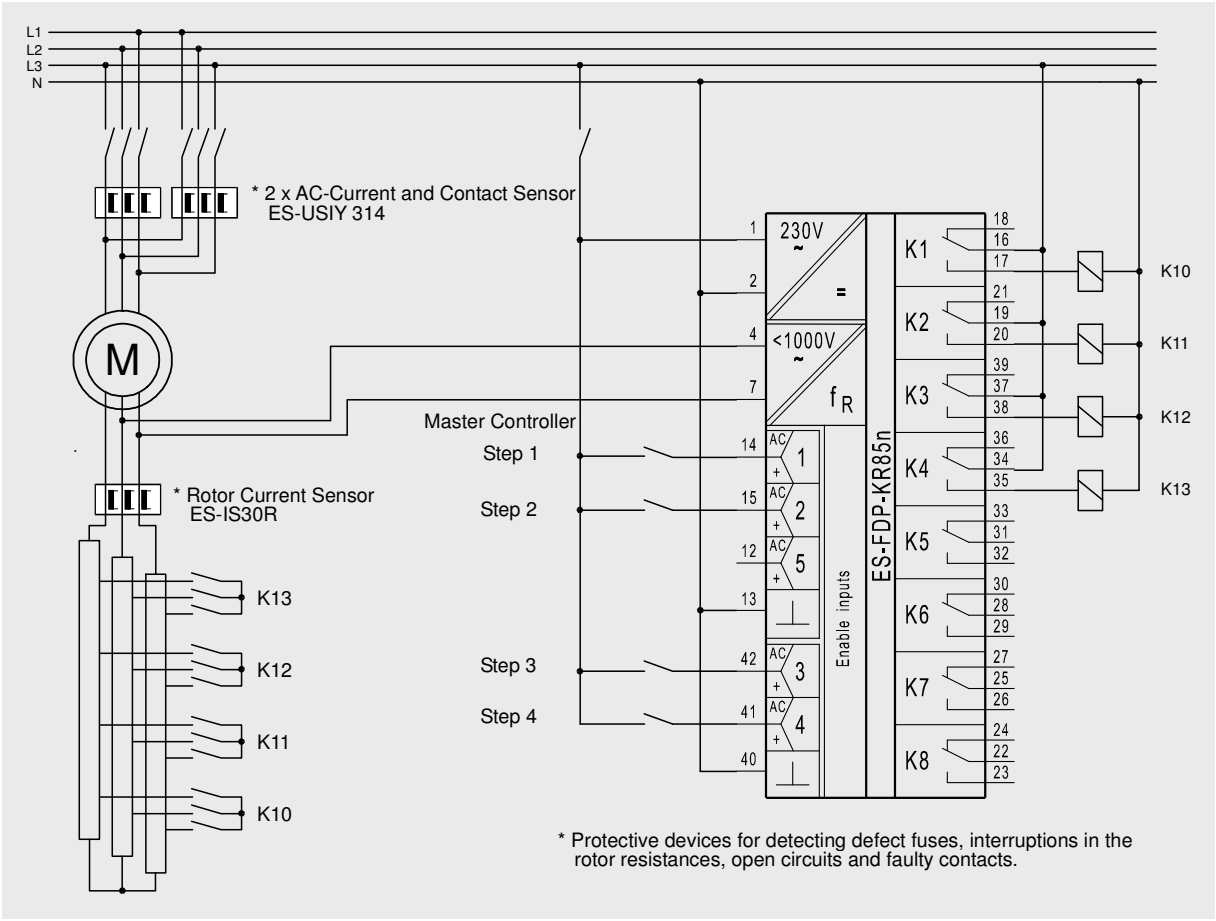

**Table 10:** Switching functions of the frequency channels K1, K2 and K3 in two-step operation

# 6 General Technical Data

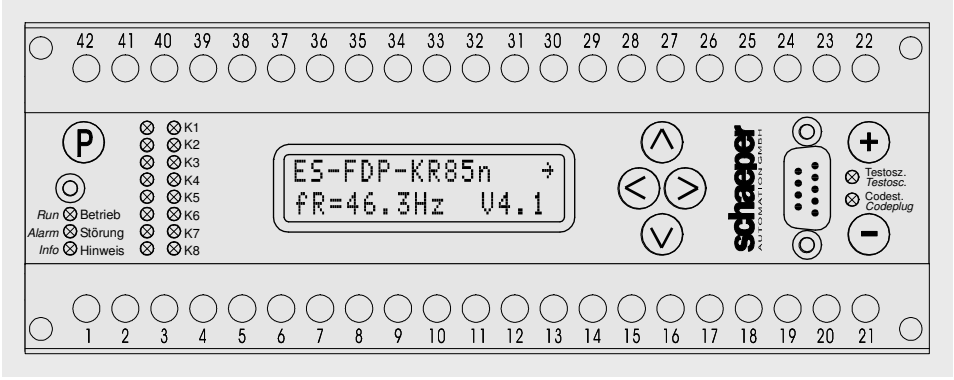
| | |
|---|---|
| **Measurement input ($U_{eff}$):**<br>Terminals (4) and (7) | < 300 V continuous operation permissible<br>< 500 V 1 min. ON / 1 min. OFF<br>< 750 V 1 min. ON / 2 min. OFF<br>< 1000 V 1 min. ON / 3 min. OFF<br>(values are valid for 40°C ambient temperature)<br><br>sensitivity:<br>1,5 V for input frequency <5 Hz<br>0,3 V/Hz for input frequency >5 Hz<br>(low-pass behaviour for interference suppression)<br><br>The measurement input is galvanically isolated. |
| **Measurement error:** | < 0,1 % (within the permissible ambient temperatures) |
| **Measurement principle** | Period-duration measurements with evaluation of the zero crossings |
| **Enable inputs**<br>Terminals (12) to (15), (40) to (42) | 230 V~, ±15%, ~ or =,<br>other input voltages on request |
| **Outputs**<br>Terminals (16) to (39) | 8 relays, 1U, 260V~, 5A<br>electrical contact life:<br>1,0 x $10^5$ switching cycles at 250V~, 5A / 30V=, 5A and resistive load<br>3,5 x $10^4$ switching cycles at 250V~, 5A and cos φ = 0,4<br>2,0 x $10^5$ switching cycles at 250V~, 2A and cos φ = 0,4 |
| **Supply voltage**<br>Terminals (1) and (2) | 230 V~, ±15%, 50 ... 60 Hz **Attention: the build-in Varistor for protection against voltage transients is not fuse-protected internally!** |
| **Power consumption** | ca. 15 VA |
| **Fuses** | type TR5, 100 mA / 250 V, slow-blow (soldered) |
| **Ambient temperature:** | -10 ... +50°C (operation)<br>-20 ... +70°C (storage) |
| **Housing measurements:** | L = 200 mm, W = 75 mm, H = 126 mm<br>with screw and snap-on mounting<br>(DIN 46277, 35 mm rail) |
| **Behaviour in fire:** | according to UL: V-0 or VDE0304: stage I<br>(housing and keys) |
| **Connection terminals:** | removable connector block with self lifting BI-slotted screws for 2x2,5$mm^2$; including terminal cover with protection against accidental contact according to VBG 4 and VDE 0106 part 100 |
| **Creep resistance :** | Insulation group C250VE/300VG (creep distance 4 mm) according to DIN57110 and VDE0110 |
| **Protective system:** | IP40 |
| **Weight:** | approx.. 1300g |

*(Subject to changes)*

# 7 Connection Example



# 8 Terminal Allocation

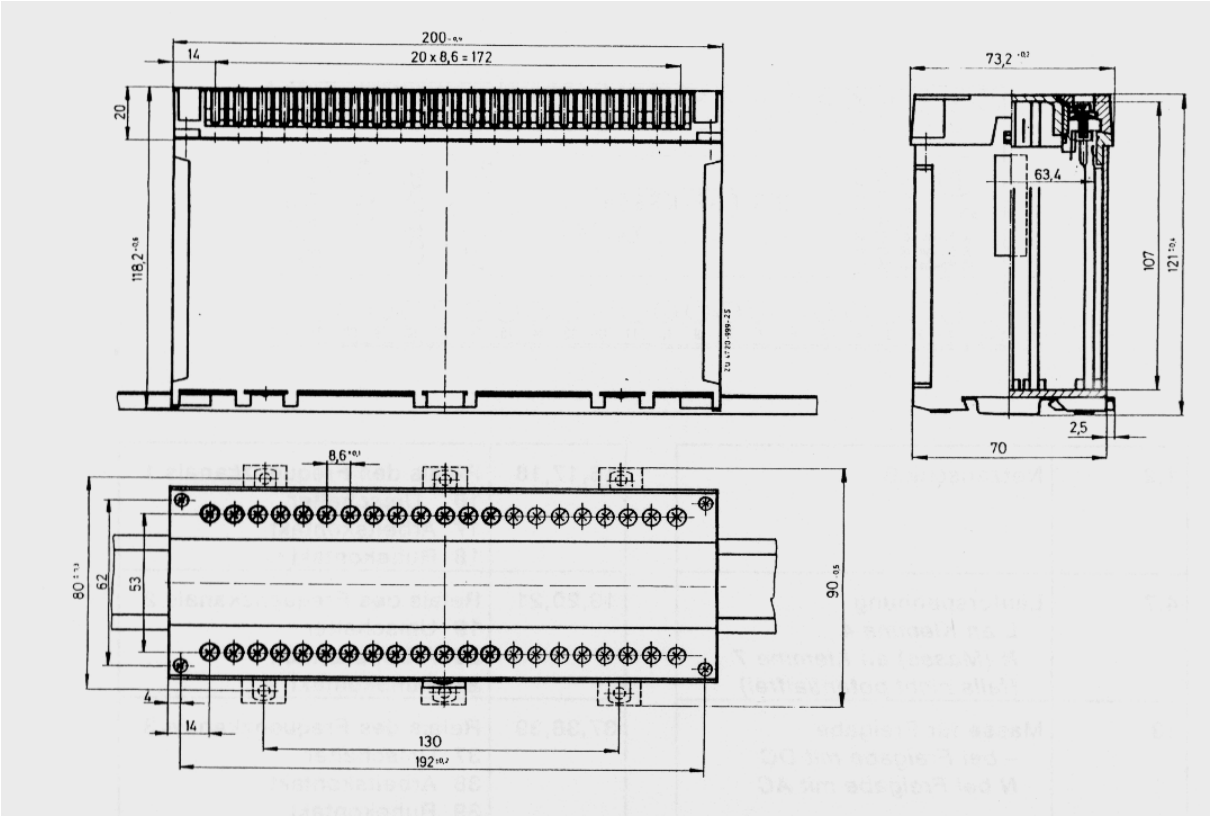



| | |
|---|---|
| 1,2 | Power supply |
| 4,7 | Rotor voltage<br>***L*** *to terminal 4*<br>***N*** *(earth) to terminal 7*<br>*(if not potential-free)* |
| 14 | Enable-input 1<br>(two-step operation: lifting 1)<br>***+*** *for enable with DC*<br>***L*** *for enable with AC* |
| 15 | Enable-input 2<br>(two-step operation: lowering 1)<br>***+*** *for enable with DC*<br>***L*** *for enable with AC* |
| 12 | Enable-input 5<br>***+*** *for Enable with DC*<br>***L*** *for Enable with AC* |
| 13 | Earth for enable-inputs 1,2,5<br>***–*** *for enable with DC*<br>***N*** *for enable with AC* |
| 42 | Enable-input 3<br>(two-step operation: lowering 2)<br>***+*** *for enable with DC*<br>***L*** *for enable with AC* |
| 41 | Enable-input 4<br>***+*** *for enable with DC*<br>***L*** *for e-enable with AC* |
| 40 | Earth for enable-inputs 3,4<br>***–*** *for enable with DC*<br>***N*** *for enable with AC* |

| | |
|---|---|
| 16,17,18 | Relay for the frequency channel 1<br>16 change-over switch<br>17 make contact<br>18 rest contact |
| 19,20,21 | Relay for the frequency channel 2<br>19 change-over switch<br>20 make contact<br>21 rest contact |
| 37,38,39 | Relay for the frequency channel 3<br>37 change-over switch<br>38 make contact<br>39 rest contact |
| 34,35,36 | Relay for the frequency channel 4<br>34 change-over switch<br>35 make contact<br>36 rest contact |
| 31,32,33 | Relay for the frequency channel 5<br>31 change-over switch<br>32 make contact<br>33 rest contact |
| 28,29,30 | Relay for the frequency channel 6<br>28 change-over switch<br>29 make contact<br>30 rest contact |
| 25,26,27 | Relay for the frequency channel 7<br>25 change-over switch<br>26 make contact<br>27 rest contact |
| 22,23,24 | Relay for the frequency channel 8<br>22 change-over switch<br>23 make contact<br>24 rest contact |

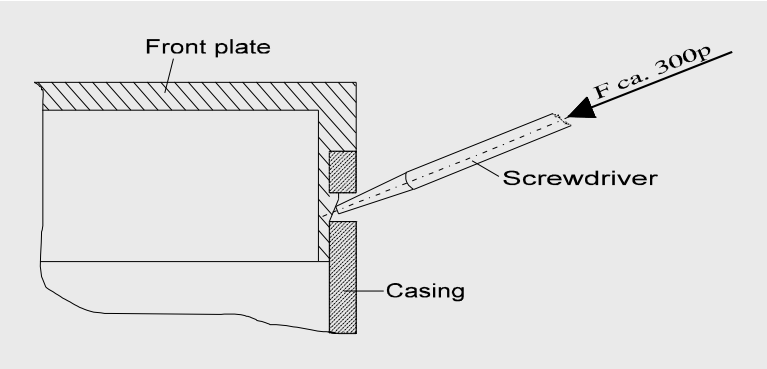
**Connections should not be made to terminals not listed.**

# 9 Housing Measurements




**Removing the terminal strip:** The terminal strip is loosened and removed from the device by unscrewing the two outer fastening screws. When changing the device the connector blocks are simply attached to the replacement device and screwed on. It is immediately ready for operation without any wiring work being necessary.

**Removing the front plate:** Both terminal strips must be removed before the front plate can be removed from the cover. This is then carried out as follows: place a screwdriver with a size of max. 0,6 x 4,5 DIN 5264 in one of the two recesses on the side, a light pressure is used to turn it to the left or right, thus unlatching the projection on the front plate from the casing. The same procedure must be carried out on the opposite side. The front plate can then be removed from the casing.



## 10 Programming Reference Material for Normal Operation

| | |
|---|---|
| ES-FDP-KR85n → | language/Sprache |
| fR=****Hz V4.1 | :english |
| function K1-K3 | |
| Norm/Two-step :N | |
| K1:__ → fu:__._ | K1 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K2:__ → fu:__._ | K2 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K3:__ → fu:__._ | K3 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K4:__ → fu:__._ | K4 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K5:__ → fu:__._ | K5 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K6:__ → fu:__._ | K6 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K7:__ → fu:__._ | K7 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K8:__ → fu:__._ | K8 tu:____s |
| fR=**** fl:__._ | tl:____s |
| EnIn-1 ton:____s | |
| -***- tof:____s | |
| EnIn-2 ton:____s | |
| -***- tof:____s | |
| EnIn-3 ton:____s | |
| -***- tof:____s | |
| EnIn-4 ton:____s | |
| -***- tof:____s | |
| EnIn-5 ton:____s | |
| -***- tof:____s | |
| OpCirMo fR<____→ | K1..K8 rest pos. |
| aktiv if EnInp:_ | with open circ. |
| Simulat. f0:__._ | |
| fR=**** v:_ CS:_ | |
| service- → | ... |
| information | |
| self-test | |
| Error No:*** | |

Device-No.:

Date:

Place of assembly:

Construction-No.:

*..*: current values

## 11 Programming Reference Material for Two-Step Operation

| | |
|---|---|
| ES-FDP-KR85n → | language/Sprache |
| fR=****Hz V4.1 | :english |
| funktion K1-K3 | |
| Norm/Two-step :T | |
| K1-3:UP1 fu:__._ | |
| fR=**** -o:_._ | |
| K3-1:DN1 fl:__._ | |
| fR=**** +o:_._ | |
| K3-1:DN2 fl:__._ | |
| fR=**** +o:_._ | |
| K4:__ → fu:__._ | K4 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K5:__ → fu:__._ | K5 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K6:__ → fu:__._ | K6 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K7:__ → fu:__._ | K7 tu:____s |
| fR=**** fl:__._ | tl:____s |
| K8:__ → fu:__._ | K8 tu:____s |
| fR=**** fl:__._ | tl:____s |
| EnIn-1 ton:____s | |
| -***- tof:____s | |
| EnIn-2 ton:____s | |
| -***- tof:____s | |
| EnIn-3 ton:____s | |
| -***- tof:____s | |
| EnIn-4 ton:____s | |
| -***- tof:____s | |
| EnIn-5 ton:____s | |
| -***- tof:____s | |
| OpCirMo fR<____→ | K1..K8 rest pos. |
| aktiv if EnInp:_ | with open circ. |
| Simulat. f0:__._ | |
| fR=**** v:_ CS:_ | |
| service- → | ... |
| information | |
| self-test | |
| Error No:*** | |

Device-No.:

Date:

Place of assembly:

Construction-No.:

*..*: current Values

## 12 Wiring Symbol