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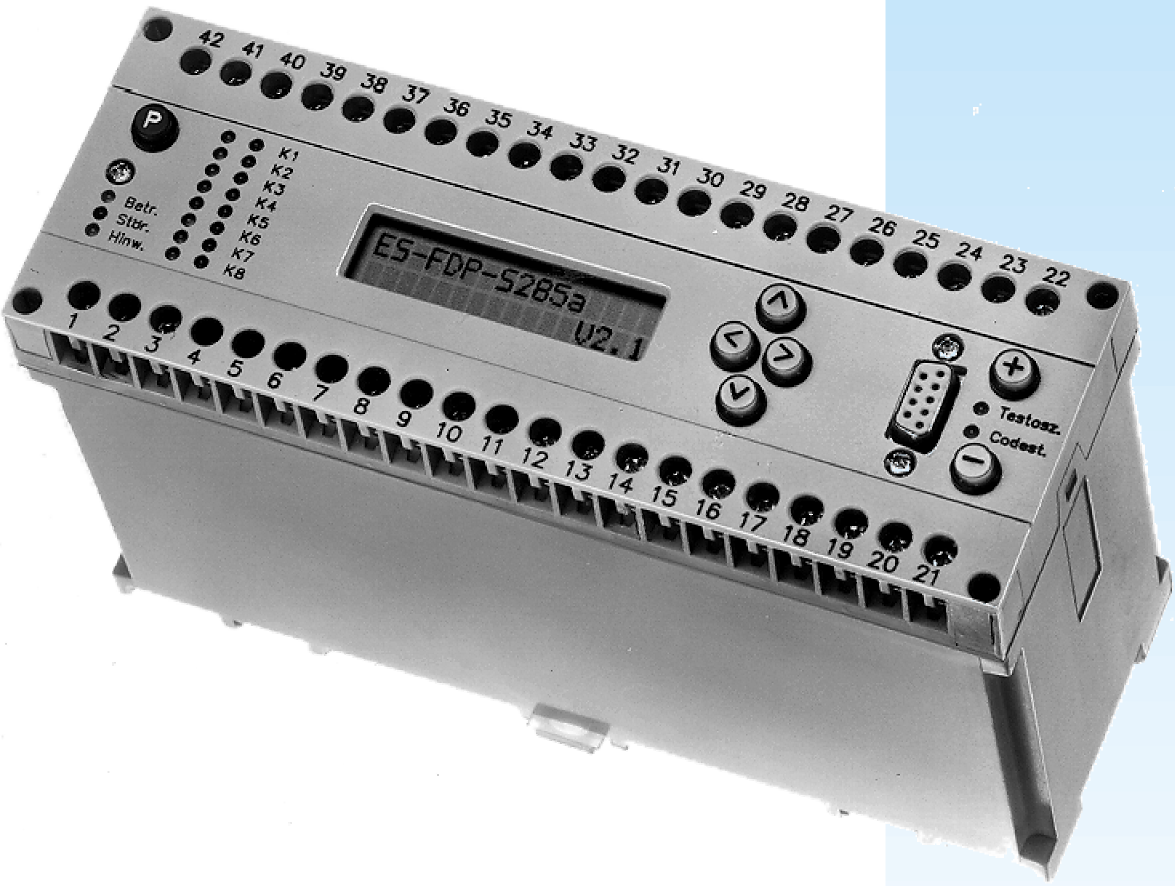
ES-FDP-S222x ... ES-FDP-S285x

Digital Slip Monitors

Operating Instructions



BA_S8x_E.DOC 09.01.2020

Current versions of the device series:

- **Frequency and slip monitor, ES-FDP-FS...,** frequency range 0,1 ... 4000 Hz, frequency ratios programmable.
- **Signal pre-processor, ES-SV11.2,** supplementary device for use with the digital slip- and frequency monitor **ES-FDP-FS...,** 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.
- **Drive Monitor ES-FDP-AW1,** for monitoring position, speed, synchronisation, shaft break, gear break …
- **Digital crane frequency control system, ES-FDP-KR...,** Standard and two-step operation

Important information:

The unit has a watchdog to ensure high operating safety, so that the processor system is able to initialize itself again following extremely strong external interferences, which lead to a malfunction. One hundred percent security, however, can not be achieved with a single processor system. **With safety-relevant use, the system must therefore have a redundent system.**

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.

These operating instructions for the digital slip monitors ES-FDP-S222x and ES-FDP-S285x are for the device as it stands in 2004 with the software-version **V3.0**. These devices were replaced in 2008 by the device series **ES-FDP-FS...**, functionally compatible and with an extended range of functions.

Subject to alterations.

Application

Types **S222x** (2 switching outputs, 2 enable inputs) and **S285x** (8 switching outputs and 5 enable inputs) are slip monitors from the series **ES-FDP** (for further versions see page 2). These devices can be used to monitor the frequency ratios **Q** and frequencies **f**, in order to, e.g., recognise **slipping on conveyor belts** or **breaks in shafts and couplings.** It can be used at the same time to monitor **overspeeds and low speeds**. If a drive rod has broken the device can be used to lower the load in a controlled manner by providing the emergency brake with a two-step signal.

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

☺ frequency ratio - (slip -) and frequency or speed measurements

☺ especially easy to program using large L.C.-Display

☺ protection from unauthorised programming using a code plug

☺ double -LED-display (red/green) for relay status

☺ up to 8 relay outputs (optional triac or transistor outputs)

☺ programmable time delay for the switching outputs

☺ analogue output, current or voltage, (Option)

☺ open circuit monitoring

☺ up to 5 enable outputs (with programmable time delay) which can be allocated to the switching channels as required

☺ internal test oscillator for function test

☺ measurement inputs are electrically isolated from the other in and outputs

☺ high noise immunity (watchdog, special data coding for automatic error recognition)

☺ easy to service due to **removable screw-on terminal strip, thus enabling the devices to be changed quickly without the danger of wiring errors**

☺ EEPROM for programmable values **(no** batteries required)

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1 Introduction: Example of a Shaft -break Monitor

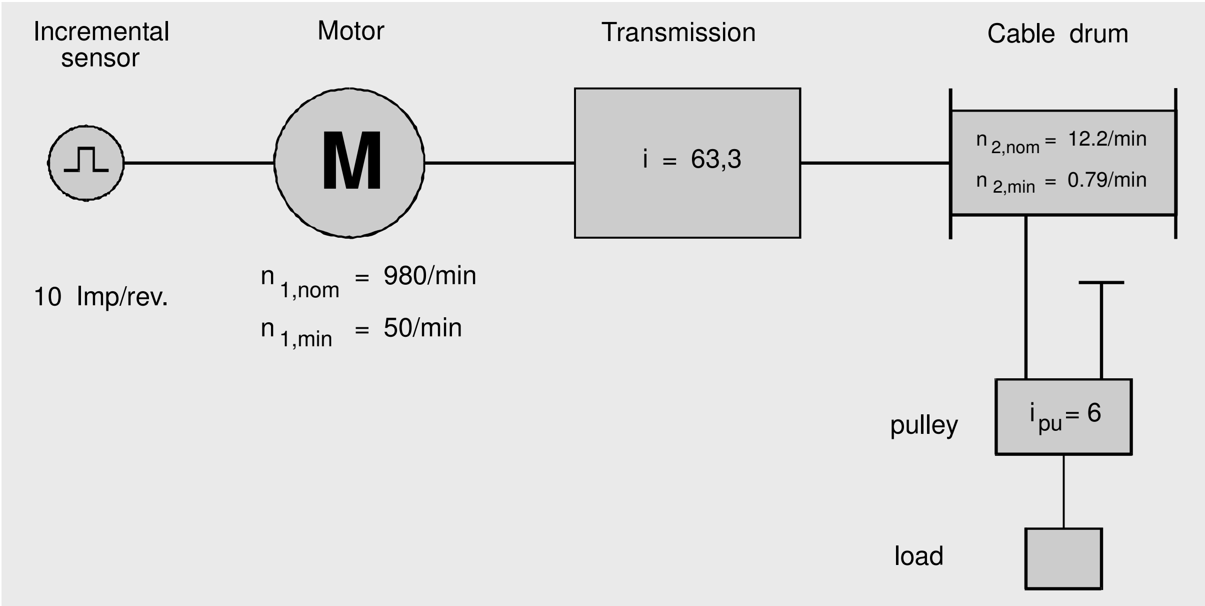


Fig. 1: Example of a lifting device to be monitored

The slip-monitor **ES-FDP-S285x** can carry out the monitoring for shaft breaks, overspeed and open circuit. The monitoring is based on the evaluation of two input frequencies; i.e. the speed of the motor and of the drum must be converted into frequency signals using incremental sensors, AC-tachos, using proximity switches to detect cams or toothed discs or using any other method.

In this example, the speed of the motor is picked up by an incremental sensor. To record the drum movement cams can be fitted to the outside of the flanged wheel. Proximity switches are then used to produce a signal.

The limiting values for monitoring the speeds can be programmed directly in rpm, the conversion of these into input frequencies is carried out internally by the device. Similarly the transmission ratios are programmed directly without conversion factors.

An example of the programming for the above monitoring task is described in detail in the chapter: Example of an Application, page 23.

2 Mode of Operation

2.1 Measurement Principle

The input signals to the two measurement inputs are processed using filters and the times of the edges of the impulses (or the zero crossings for AC-input signals) are stored. The frequencies **f1** and **f2** of the input signals are determined by period-duration measurements (resolution: 0,7µs). Every 10 ms the device checks whether the input impulses have been received and evaluates them (frequency and quotient calculations, switching commands to the relays).

2.1.1 Calculation of the Frequencies

For frequencies > 100 Hz the measurement time of 10 ms means that an average of several input impulses is used. At frequencies < 100 Hz the frequency is calculated new for each incoming impulse. The frequency values calculated in this way are evaluated in order to, e.g., monitor for overspeeds, open circuits or for a speed dependant enable control (cf. page 26: Example of application). Normally frequencies of 0,1 ... 2000 Hz are used. An extended frequency range of up to 0,001 ... 2 000 Hz is also possible.

2.1.2 Calculation of the Quotients

If both input frequencies are > 100 Hz, the quotient Q is calculated by dividing **Q = f1/f2**. If at least one of the frequencies is < 100 Hz, the input signal cycles are compared. An average is determined for the high input frequency for the cycle duration of the lowest, i.e. the measurement times for both inputs are matched before the division is carried out (cf. Fig. 2).

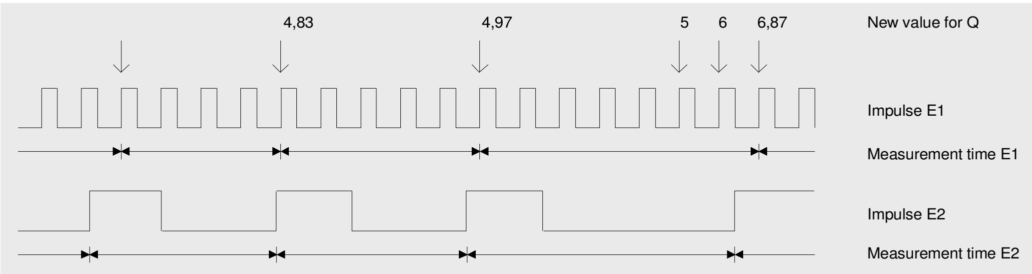


Fig. 2: Measurement times for the calculation of the quotients

If no impulse is received at one input (e.g. due to a open circuit) Q changes in jumps with every impulse to the other input, ensuring that the relay is activated quickly.

If the equipment is stopped, the frequency ratio **Q** is undefined. Furthermore, a change in rotational direction in general leads to a short-term change in the frequency ratio. In both cases the enable signal must be interrupted, in order to avoid switching errors.

During this interruption in the enable signal there is the possibility to set the quotient **Q** to a set value - **Q-Reset** - in order to avoid incorrect switching when the enable signal is re-applied (due to the undefined value of **Q**). After the enable has been re-applied the device immediately evaluates any inconsistencies between the input impulses and the **Q-Reset**- value and makes any necessary corrections to the quotient. Depending on the impulse sequence at the measurement inputs, the current quotient is usually correctly determined by the lowest input frequency after 2 impulses, at the latest after 3. This possibility to program **Q-Reset** means that, in nearly every case, there is no need to programme a starting delay time for the enabling.

2.1.3 Evaluation of the Measured Values

2 to 8 switching channels are available for monitoring the input frequencies and quotients (cf. table 1). The lowest and highest permissible value for the variable being monitored can be programmed to any desired value, and the switching function of the output channel can be made to fit the special monitoring problem in various ways (cf. chapter SWITCHING FUNCTIONS, page 21). When values deviate from the reference value, the switching off can be carried out immediately or after a programmed delay time. The activation of all switching channels can be made dependent on enabling signals.

2.1.4 Speed Measurements

In order to make the programming as easy and as clear as possible, there is the possibility of changing the device from frequency to speed measurement. When using speed measurements, all inputs (programming) and outputs (display) are made in rpm. The quotient is then defined as the ratio between the speeds **Q=n1/n2**, representing the translation in the transmission. The conversion to frequency, necessary for the internal evaluation, is carried out by the device for the programmed number of pairs of poles.

2.2 Versions of the Device

	ES-FDP-S222x	ES-FDP-S285x
Measurement inputs	2	2
Enable inputs	2	5
Switching channels	2 (**K1** and **K2**)	8 (**K1** - **K8**)
- for frequency (speed) ratios **Q**	**K1**	**K1 - K4**
- for frequency **f1** (speed **n1**)	–	**K5** and **K6**
- for frequency **f2** (speed **n2**)	**K2**	**K7** and **K8**

Table 1: Standard versions of the devices ES-FDP-S222x and -S285x

2.2.1 Measurement Inputs

The device is equipped with 2 measurement inputs, which are available for all types of impulse or alternating voltage sensors. Both measurement inputs and the sensor supplies are galvanically connected but electrically isolated from all other in- and outputs.

The measurement inputs are available with the following constructions:

– for 3-wire proximity switches (PNP or NPN switching, s. type plate)
– for 2-wire proximity switches
– for potential-free contact
– for direct voltage impulses U ≥ 10 V, impulse width ≥ 0,25 ms (max. 50 V)
– for alternating voltage U_{eff} ≥ 1,5 V + 0,1 V/Hz (low-pass behaviour for interference suppression, max. 400 V)

Other input voltages as special designs.

With the standard construction input frequencies between 0,1 ... 2000 Hz can be processed. Models are available for 0,001 ... 2 000 Hz.

The connection diagram for the measurement inputs can be found in the section: Allocation of Terminals on page 28.

2.2.2 Sensor Supply

The standard version of the device is equipped with a voltage supply for two 3 wire proximity switches (20...24 V DC, max. 35 mA total current). If the device has been fitted with measurement inputs for 2 wire proximity switches then the sensor supply has also been designed especially for this type of sensors.

2.2.3 Enable Inputs

There are max. 5 enable inputs available for the arming of the monitoring functions, which can be allocated to the relays as required. Each enable can be allocated an individual time delay. The device is available with different enable input voltages(12V, 24V, 110V, 230V AC/DC).

The enable inputs 1,2 and 5 are galvanically connected, and the enable inputs 3 and 4 are galvanically connected. The enable inputs are electrically isolated from all other in- and outputs.

When operating with direct voltage the common ground must be connected to terminal 13 and to terminal 40 (ground enable). The enable inputs 1...5 can be operated with positive or with negative DC voltage.

When operating with alternating voltage the neutral conductor must be connected to terminal 13 and to terminal 40.

2.2.4 Switching Channels

The switching channels usually operate relays. Other designs for the output stage (triac, transistor) are available on request. Table 1 (page 8) shows the usual allocation of the switching channels to quotient or frequency monitoring. Different allocations are, likewise, available.

2.2.5 Notes

One of the variables **Q, f1** or **f2** can be output for display or control purposes using the analogue output (option).

The various groups of in- and outputs (measurement, enabling-inputs, analogue outputs) are electrically isolated from each other.

In order to reduce the temperature in the device it is recommended that the device is installed with a distance of 2 - 3 mm to all other fittings.

Note: The device must only be programmed when the main plant is switched off, because during the programming the outputs can switch in an undefined manner.

2.3 Signal Pre-processing Device ES-SV11

The signal pre-processing device **ES-SV11** can be used to achieve an additional improvement in the reliability of the system.

The device supplies the sensors with max. 2 x 100 mA. It prepares the output impulses for a further evaluation in the slip monitor **ES-FDP-S..** by debouncing the impulses. In addition, it has a rotational direction recognition with error alarm and produces a perfect enabling signal for the slip monitor.

With suitable sensors the **ES-SV11** enables the sensor supply to be checked for short circuits and interruptions. Errors which occur are indicated using an error message contact.

3 Displays and Operation

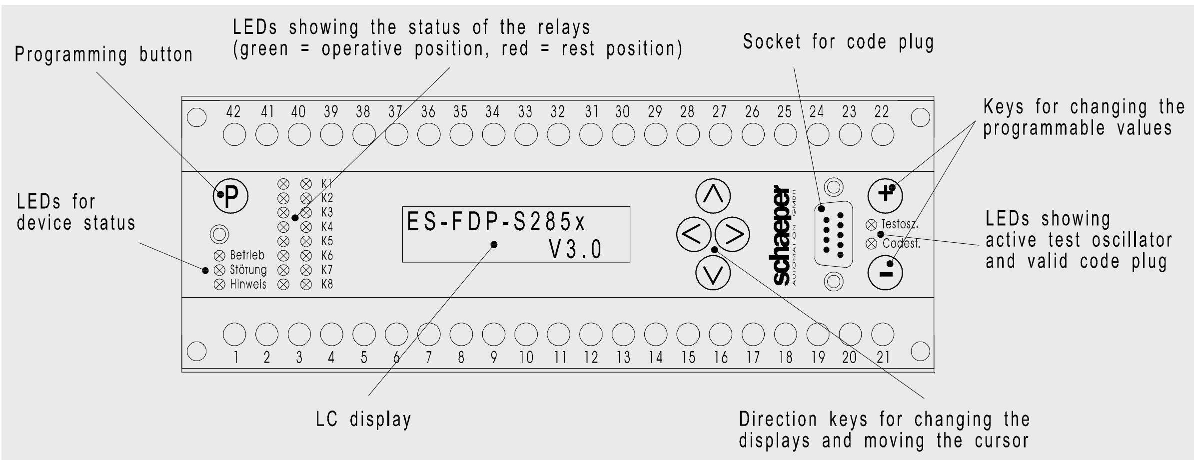


Fig. 3: Operating elements of the device

3.1 LED Indicators

Betrieb
(operation)
(green)

Mains voltage is supplied and the automatic check has been finished.

Störung
(error)
(red)

The program flow has been disturbed by external influences (e.g. considerable interference from connected line, EMP) or due to an internal error in the device. The LED is switched on when an error is detected and remains on for approx. 1 s after the automatic error correction has been completed. Errors which occur very frequently result in this light being on permanently.

Hinweis
(information)
(yellow)

The use of microprocessors in the device enables information to be given regarding disturbing influences which only occur temporarily, thus enabling preventative measures to be taken. The LED lights up at the same time as the error LED, however does not go out until acknowledged. To acknowledge: the display **Selbsttest** (self-test) is selected. The respective error number will appear. With the code plug connected, the key ⊳ should be pressed repeatedly until, instead of an error number, the word "**keine**" (none) appears. The error numbers should be noted so that an error analysis can be carried out at a later point in time.

```
Selbsttest
Fehler-Nr:***
```

(self test)
(error number)

`***`: current error No..

If the code plug is not connected the key ⊳ does not switch off the LED, but only shows the error numbers.

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

Testosz.
(test oscillator).
(yellow)

Test oscillator is on (simulated operation, instead of **f1** or **f2, fT** appears in the display, instead of **Q**, **QT** appears)

Codest.
(code plug.)
(yellow)

Valid code plug has been plugged in
Programming possible (**PRGM**)

3.2 LC-Display

3.2.1 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.

3.2.2 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 version-No. **V** for the software will be shown in the lower line.

```
ES-FDP-S285x
        V3.0  →
```

3.2.3 Selecting the Displays

The sequence of the displays is shown in table 2 (page 11). 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.

<, ∧, ∨ ⟷ >

Main display	Auxiliary display
ES-FDP-S285xi V3.0 →	Displ-Kontr:+25
Q =11.2Ø f1=153.4 Hz →	Q =11.2Ø f2=Ø13.7 Hz
Funkt:Drehz,Freq (n,f) :f →	Polpaare p1:1Ø p2:26
∧ Q-Reset:11.ØØ → Frei:1	wenn Freig. aus wird Q rueckges.
K1:I1→→ Qo:12.ØØ Q =11.2 Qu:1Ø.ØØ	K1 ti:Ø.ØØs ta:Ø.1Øs
K2:I2 → Qo:13.ØØ Q =11.2 Qu:Ø9.ØØ	K2 ti:ØØ.Øs ta:ØØ.Øs
K3:-Ø → Qo:ØØ.ØØ Q =11.2 Qu:ØØ.ØØ	K3 to:Ø.ØØs tu:Ø.ØØs
.....	.....
K8:CØ→→ fo:19.ØØ f2=13.7 fu:18.ØØ	K8 to:Ø.5Øs tu:Ø.5Øs
Frei-1 tan:Ø.ØØs -aus- tab:Ø.ØØs	
Frei-2 tan:Ø.ØØs -aus- tab:Ø.ØØs	
Frei-3 tan:Ø.ØØs -aus- tab:Ø.ØØs ∨	
.....	
Frei-5 tan:12.Øs -ein- tab:Ø.5Øs	
L-Bruch f1<1.ØØ→ aktiv bei Frei:4	K1..K8 Ruhelage bei Leiterbruch
L-Bruch f2 aus Frei:	
I←f2 ØØmA←ØØØØØ 2ØmA←ØØ16Ø	I-ABGLEICH:+Ø3
Testosz QØ:11.Ø v:3 fØ:1Ø.Ø	
Selbsttest Fehler Nr:keine	

the displays **K3** ... **K8** and the displays **Frei-3** ... **Frei-5** are not available with **ES-FDP-S222x**

the displays **I**←.. and **I-Abgleich** are not available with devices without analogue output

ES-FDP-..	Device specification
V..	Software version
Q =..	Frequency ratio (Quotient f1/f2, n1/n2)
Qr=..	Appears in the display instead of the current quotients if no enabling signal is available and the Q-Reset-function is active
Q-Reset:..	Set value for Q, for resetting the quotients when no enabling signal is available
Qo:..	Upper switching value for frequency ratios
Qu:..	Lower switching value for frequency ratios
f1=.., f2=..	Frequency at measurement input 1 or 2 (Hz)
n1=.., n2=..	Speed at measurement input 1 or 2 (rpm)
fo:.., no:..	Upper switching value for frequency, speed
fu:.., nu:..	Lower switching value for frequency, speed
to:..	Relay switching delay at upper switching value for hysteresis switching function
tu:..	Relay switching delay at lower switching value for hysteresis switching function
ti:.., ta:..	Relay switching delays for window switching function
Testosz	Test oscillator
fØ:..	Initial-frequency for the test oscillator
QØ:..	Initial-frequency ratios for the test oscillator
v:..	Speed with which the test oscillator values change
fT=.., QT=..	Simulated value from internal test oscillator
K..	Switching channel
Frei-..	Enabling input
tan:..	Response delay for enabling (s)
tab:..	Drop-off time delay for enabling (s)
-ein-	*("on")* Signal to enabling input
-aus-	*("off")* No signal to enabling input
L-Bruch	Display for programming open circuit monitoring
..aktiv	Open circuit monitoring is programmed
..aus	No open circuit monitoring programmed
L-Br	Appears in the display instead of the measured frequency when the open circuit monitoring has responded
Frei:..	Allocated enabling input
Displ- Kontr:..	Display contrast
Funkt:	To select speed or frequency measurement
p1:.., p2:..	Number of pairs of poles for measurement input 1 and 2 (for speed measurements)
I←.., U←..	Optional analogue output: Allocation of the analogue output to f1 (n1), f2 (n2) or Q
..mA←.. ..V←..	Optional analogue output: allocation of a analogue value to a frequency (speed) or quotient
I- Abgleich:.. U- Abgleich:..	Optional analogue output: Calibration of maximal value
→	Indication of a further display, right
→→	A time delay has been programmed for this output
PRGM	Programming mode

Table 2: Sequence of the displays and the meaning of the display texts

The displays are selected using the cursors (∧, ∨, <, >). The main displays are obtained using the keys ∧ and ∨ (for sequence see table 2). The key > calls up the auxiliary display belonging to the current main display (if present). The keys < and ∧ or ∨ bring back the respective main display.

3.2.4 Display-Contrast

The display contrast is adjusted using the display **Displ-Kontr**:

```
ES-FDP-S285x          Displ-Kontr:+25
        V3.0  →
```

This can be programmed for values between **-99** to **+99** (for programming cf. chapter: Programming, page 12). Changes in the value take immediate effect, allowing the LC-display to be easily adjusted to be perfect for any angle of vision.

3.2.5 Display of the Measured Values

The current measured values are displayed in the second of the main displays:

```
Q =*****              Q =*****
f1=***** Hz   →       f2=***** Hz
```

`*****`: current value

The measured values for the frequency ratios **Q** (quotient **f1**/**f2** or **n1**/**n2**) and for the frequency **f1** or speed **n1** are displayed here; and when the key > is pressed the values for **Q** and **f2** or **n2** are shown. If **L-Br** is displayed instead of a frequency this means that the open circuit monitoring has responded. If the open circuit monitoring is not active the display will show „0“ if the frequency falls below the minimum frequency (0,1 Hz in the standard version). If the quotient remains at a constant value due to the programmed **Q-Reset**-function and no enabling signal (cf. chapter. Q-Reset, page 14), this will be shown by **Qr=**`*****` instead of **Q =**`*****`.

The current measured values are, likewise, shown in the displays for the switching channels **K1 ... K8.** The variable that is being monitored by the selected switching channel is showed in the display. Furthermore, the situation at the enabling inputs is shown in the displays **Frei1 ... Frei5.** A "**-ein-**" *(on)* or "**-aus-**" *(off)* is shown, providing information about whether there is voltage applied to the enabling input.

3.3 Programming (PRGM)

3.3.1 Code Plug

A code plug is needed to programme the device. This is plugged into the socket on the front panel (cf. figure 3, page 9). 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 connector being plugged in, the following will be displayed:

```
PROGRAMMIERUNG
GESPERRT
```

(programming not possible)

3.3.2 Programming Sequence

The meaning of the programmable parameters for each display selected is described starting on page 14 (chapter: Programming the Functions) 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 2 keys must be pressed at the same time. Even when the programming key Ⓟ is accidentally pressed, the programming mode can be left simply by following step 6.

	the key to be used
1. Select required display	Ʌ, V, <, >

2. Switch on programming mode
`K4:A1 → Qo:2Ø.ØØ`
`PRGM    Qu:18.ØØ`
(In the display **PRGM** and the mark "_" will appear)
	P

3. Move the mark to the value which is to be adjusted	Ʌ, V, <, >
4. Set the desired value (separate for each digit) (a flashing mark fills the whole character field)	P and + (simultaneously) or P 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) (do not press P!)

Table 3: Programming sequence

Only values which have been defined can be programmed (cf. table 4). The number of an enable input allocated to a particular switching channel can only be set at a number between 1 and 2 or 5. For switching values and time delays the decimal point can also be moved. The decimal point cannot be moved to the first position for time delays.

Example: For programming the switching value "50", the following have identical meanings:

50.ØØ Ø50.Ø ØØ50. ØØØ50

But: .50.Ø is taken as 0.5 due to the first decimal point!

Switching function	- A B C D E F G H I K L M N O P Q
Number of an enable input	÷ Ø 1 2 3 4 5 or ÷ Ø 1 2 (÷ and Ø are not programmable for all functions)
Digits for switching values, delay times, etc.	Ø 1 2 3 4 5 6 7 8 9 .
Display-contrast	-99 ... +99
Type of function (speed or frequency measurement)	n f

Table 4: Permissible values for programming

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.

4 Programming the Functions

4.1 Frequency- or Speed Measurements, Pole Pairs

The change between frequency (**f**) and speed (**n**) measurement is done in the third main display.

```
Funkt:Drehz,Freq   Polpaare   p1:1Ø
      (n,f) :f →              p2:26
```

(Function: speed, frequency) *(Pole pairs)*

If the device is programmed for the measurement of speed, the number of pairs of poles (when using AC tachos) or the number of impulses per revolution (with incremental sensors) can be programmed for both speed sensors. Thus enabling switching values to be programmed directly as speeds. If the device has been programmed for frequency measurements **f** then the number of pole pairs has no influence. All measurement and switching values are shown in Hz or rpm.

Warning: when changing the programming from frequency to speed measurements, or vice-versa, the switching values (**Q**, **f**, **n**), if programmed, are not automatically corrected, the switching channels will have to be re-programmed.

4.2 Q-Reset

The quotient is adjusted to a set value **Qr (Q-Reset)** by interrupting the allocated enable input when starting or changing the rotational direction of the driving gear, in order to avoid unwanted switching of the output relays for the quotients **Q**. This value must be the same as the value **Q** when the driving gear is running trouble-free. If the driving gear switching device cannot provide a short break in the enabling signal (min. 150 ms) for a change in rotational direction, then this interruption can be produced with the help of the switching channels **K5** or **K6** (see page 25). Also, when the voltage supply is first switched on the device sets the quotients initially to the set value **Qr** until the current value has been calculated, also in order to avoid incorrect switching.

The set value **Qr** is shown after **Q-Reset** in the display, and the allocated enable input is programmed in the second line.

```
 Q-Reset:11.ØØ →   wenn Freig. aus
          Frei:1   wird Q rueckges.
```

(Q-Reset:) *(Q is reset without*
(enable input:) *enable signal)*

The function is disabled if the allocated enable input is set at ÷.

```
Q-Reset aus
        Frei:÷
```

(Q-Reset disabled)

Warning: The quotient **Q** is only set at **Qr** if there is <u>no</u> signal to the allocated enable input. This type of operation can, therefore, <u>not</u> be used for switching functions which switch <u>off</u> the monitoring of the respective channel when an enable signal is applied (**E** to **H**, **N** to **Q**, see page 21).

4.3 Switching Channels

The monitoring of the frequencies (speeds) and the quotients is carried out by the switching channels (**K1** to **K2** or, respectively, to **K8**). With type **S222x K1** is allocated a frequency (speed) ratio and **K2** a frequency or speed, with type **S285x K1** to **K4** frequency (speed) ratios and **K5** to **K8** frequencies or speed (see Table 1, page 8).

The switching behaviour of every switching channels can be programmed independently. This is done by programming a switching function, the allocation of an enabling input, by the switching values and, if necessary, by programming a delay time (table 5).

Main display and auxiliary display for the switching channel (programmable parameters are underlined)
 	
`K1:A4→→ Qo:12.ØØ`
`PRGM    Qu:1Ø.ØØ`
 	
`K1      to:Ø.Ø5s`
`        tu:ØØ.Øs`
	K1: First frequency channel selected
	PRGM Programming mode switched on
	→→ shows that there is a programmed time in auxiliary display
	
	Main display:
	A selected switching function
	4 Enable input 4 has been allocated
	12.ØØ upper switching value **Qo** (or **fo** or **no**)
	1Ø.ØØ lower switching value **Qu** (or **fu** or **nu**)
	
	Auxiliary display:
	Ø.Ø5 Delay time **to** programmed at Ø.Ø5s
	ØØ.Ø no delay time **tu** programmed

Table 5: Programmable parameters for the switching channel

4.3.1 Switching Function

The switching 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 program **hysteresis switching functions A ... H** (table 7, page. 21) and **window switching functions I ... Q** (table 8, page 22).

Hysteresis switching functions A ... H: Because two switching values **So** and **Su** (**S** stands for **f**, **n**, or **Q**) can be programmed there is a switching hysteresis produced (**So** - **Su**). This enables the relay to be kept in a stable condition.

Window switching function I ... Q: The upper switching value **So** and the lower switching value **Su** means that a window area is determined. The relay switches if the measured value moves out of this programmed window. The switching values for the window function have no switching hysteresis.

Function "–": is programmed if the switching channel is not needed. The relay remains permanently in the rest position, independent of the input signal.

4.3.2 Enabling

The digit after the switching function represents the number of the **enabling input** which is allocated to the switching 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.

4.3.3 Switching Values

The upper switching value **Qo** (for the frequency ratios) or **fo** (for the frequencies) or **no** (for the speeds) is shown on the right hand side of the upper line and the lower switching value **Qu** or, respectively, **fu** or **nu** is shown directly beneath it. The two values **fo,fu**, **no,nu** or **Qo,Qu** determine the **switching hysteresis** (switching function **A**...**H**) or the **switching window** (switching function **I**...**Q**).

Normally, the switching values for the quotients can be set to any value in the range 0,001 ... 9999, for the frequencies between 0,1 ... 2000 Hz.

The switching values which are possible for the speed depends on the programmed number of pairs of poles **p1** or **p2** (frequency range 0,1 ... 2000 Hz be adhered to). For **p1 = 2,** values can be set between 3 ... 60000 rpm; for **p1 = 20**, therefore, switching values can be programmed between 0,3 ... 6000 rpm. In general, the following is valid:

$$n1 = \frac{f1}{p1} \cdot 60 \qquad n2 = \frac{f2}{p2} \cdot 60 \qquad [\text{rpm}]$$

4.3.4 Time Delay for the Switching Channels

A double arrow →→ in the main display for a switching channel indicates that the respective output has a time delay (when time delay has not been programmed a single arrow → indicates the presence of an auxiliary display, cf. chapter LC-Display, page 10). The display for the delay times can be called up using the key (>).

```
K1:I1→→ Qo:12.ØØ | K1       ti:Ø.ØØs
Q =**** Qu:1Ø.ØØ |          ta:Ø.1Øs

K2:CØ → fo:16Ø.Ø | K2       to:ØØ.Øs
f2=**** fu:158.Ø |          tu:ØØ.Øs
```

****: current value

The delay times can be programmed for times between 0 ... 65 s.

With switching functions **A**...**H** (Hysteresis) the delay time **to** is effective when the upper switching values **Qo**, **fo or no** are exceeded, if the value goes under the lower switching values **Qu**, **fu or nu** the time **tu** is valid.

With the switching functions **I**...**Q** (window) the delay time **ti** is valid if the value **Q**, **f** or **n** enters into the window area. The time **ta** is valid when the measured value goes out of the window area. It is completely irrelevant whether the measured value is increasing or decreasing when it enters or leaves the window area (cf. fig. 4).

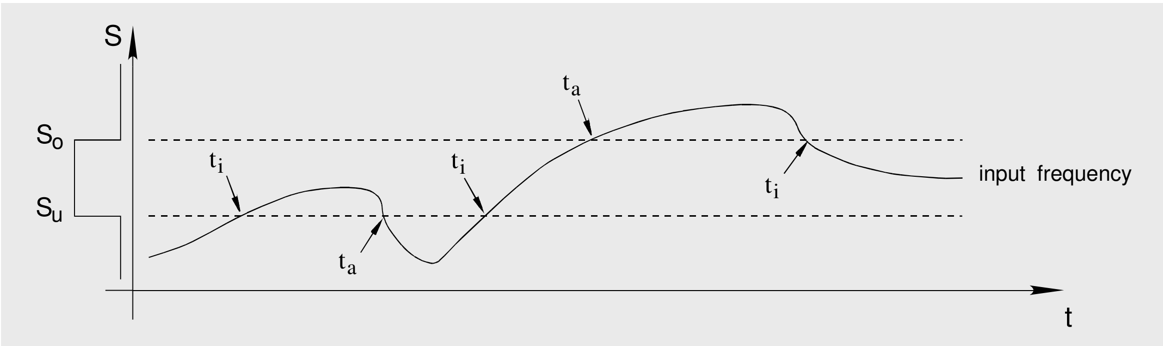


Fig. 4: Example of the validity of the time delays **ti** and **ta** for a window switching function

4.4 Enable Inputs

An activation time delay **tan** *(on)* and a drop-off time delay **tab** *(off)* (in seconds) can be programmed for every enable input. The corresponding displays are **Frei-1** to **Frei-5:**

```
Frei-1 tan:1.5Øs
 -ein- tab:2.ØØs
```

Fig. 5 shows the effect of the times **tan** and **tab.** A **-ein-** *(on)* or **-aus-** *(off)* in the display shows whether a signal is applied to the enable input.

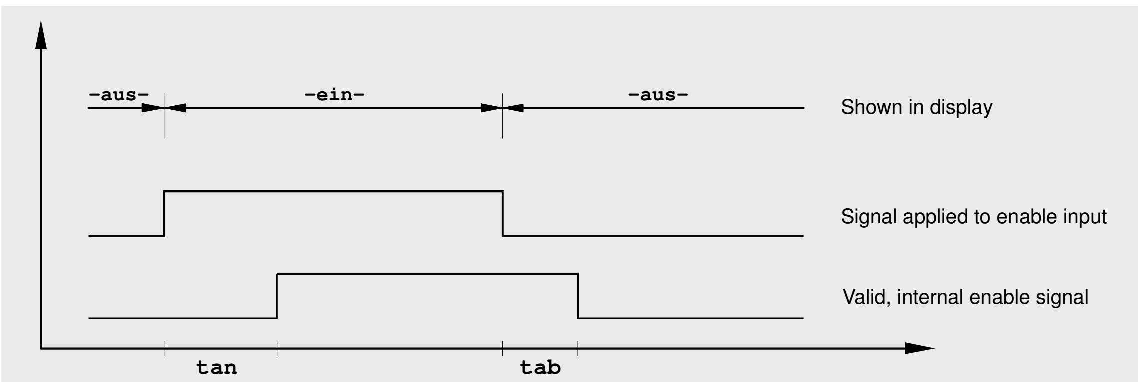


Fig. 5: Delay times for the enable signal

The enable inputs **Frei-3 to Frei-5** are only available with type **ES-FDP-S285x**.

4.5 Open circuit Monitoring

This function enables all switching outputs **K1** to **K2** or to **K8** to be switched to the rest position if the frequency falls below a minimum.

```
L-Bruch f1<1.ØØ→   K1..K8 Ruhelage
aktiv bei Frei:4   bei Leiterbruch
```

(Open circuit active with enable 4) *(Rest position with open circuit)*

The open circuit monitoring can be set independently for both input frequencies **f1** and **f2** (or speeds **n1** and **n2**).

If the open circuit monitoring is activated then the switching outputs are switched to the rest position irrespective of the switching function which has been programmed for normal operation. **Warning:** the frequency (speed) must be programmed at a value below the lowest value which can occur during normal operation.

To bypass the starting procedure this function can be activated using an enable input (also time delayed). Only when the enable signal is applied, the open circuit monitoring is activated. The digit after **Frei:** can be programmed and indicates the enable input allocated. The digit **Ø** means that the open circuit monitoring is always activated.

If instead of a digit a ÷ is programmed then the open circuit monitor is always off and after the programming has been completed the word **aus** *(off)* will appear at the top right of the display. To re-activate simply re-programme with a digit.

```
L-Bruch f2 aus
         Frei:÷
```

If the open circuit monitoring has been operated this is indicated in the display for the input frequency with "**L-Br**" (example: display for a switching channel):

```
K2:CØ → fo:16Ø.Ø   K2       to:ØØ.Øs
f2=L-Br fu:158.Ø            tu:ØØ.Øs
```

4.6 Analogue Output (Option)

The **ES-FDP-S...** can be fitted with an additional analogue output for current (**I**) or voltage (**U**). The smallest and largest value of a frequency (speed) or frequency (speed) ratio to be output can be defined by any current or voltage within the ranges: 0 mA ... 20 mA and 0 V ... 10 V.

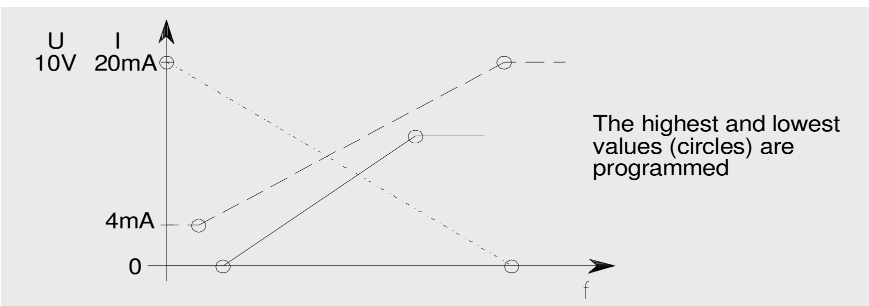


Fig. 6: Example showing the possibility of programming the analogue output to any desired value

The programming is carried out in the following display:

I←f2 ØØmA←ØØØØØ 2ØmA←ØØ16Ø	I-ABGLEICH:+Ø3

or for voltage output:

U←Q ØØV←18.ØØ 1ØV←15.6Ø	U-ABGLEICH:+12

The allocation of an analogue output to one of the input frequencies (or speeds) or quotients can be programmed, as required, by selecting **I←f1** (**n1**), **I←f2** (**n2**) or **I←Q**. Furthermore, the current or voltage values and the respective switching values (frequency, speed, quotient) are programmed in the main display. The maximum value is adjusted in the auxiliary display (key ⩾), thus enabling, e.g. the tolerances of a display instrument or, for voltage outputs, line resistance to be taken into account. The value is programmed by adjusting a set value on a connected display instrument. An input frequency is not necessary for doing this because in the programming mode the programmed maximum value is automatically output when the „Abgleich" *(adjust)* display is shown.

After the adjustment has been carried out the maximum error for the standard design is 2% (based on $\mathbf{I}_{\mathbf{max.}}$ = 20 mA or $\mathbf{U}_{\mathbf{max.}}$ = 10V).

The analogue output is electrically isolated from all other in- and outputs.

4.7 Test Oscillator

The display for the t**est- oscillator** is laid out as follows:

Testosz QØ:11.Ø v:3 fØ:1Ø.Ø	QØ: initial value for frequency ratio fØ: initial value for frequency (nØ for speed measurements) v: speed of the changes in value

The initial frequency ratio **QØ** and the initial frequency **fØ** (or speed **nØ**) can be programmed for the test oscillator and are effective instead of the measured values when it is activated. The test oscillator is activated and switched off by pressing the keys ⊕ and ⊖ at the same time. When the test oscillator is activated (only possible when the code plug is connected) the simulated values (quotient, frequency, speed) are changed by pressing the keys ⊕ (value increases) or ⊖ (value decreases). The speed of the change during simulation is determined by the programmable value **v**.

Activation is only possible if one of the switching channels **K1** to **K8** is shown in the display. If the channel shown uses the frequencies (or speeds) then the respective input frequency (or speed) is simulated when the test oscillator is switched on. The display changes from **f1** or **f2** to **fT** (from **n1** or **n2** to **nT**). The test oscillator does not only effect the switching channel shown but all switching channels at the same time which have been allocated to evaluate the simulated input frequency (or speed). The simulation does not, however, effect the switching channels which evaluate the ratio **Q.** The frequency (speed) ratio **Q** is simulated by activating the test oscillator when the displayed channel uses the ratio **Q** (the display changes from **Q =****** to **QT=******).

Activation is blocked as long as one of the two input frequencies is above the smallest measurable frequency (0,1 Hz for the standard design). The device switches the test oscillator off when there is a voltage to the measurement inputs or the code plug is disconnected. If there is no voltage to the measurement inputs, the test oscillator can be activated immediately after the mains supply has been switched on.

For reasons of safety the test oscillator should only be activated when the main plant is switched off!

5 Device Errors

5.1 Self-test

All the time it is operating, the device continually carries out a self test. If an error occurs the LEDs **Hinweis** *(info)* and **Störung** *(error)* light up on the front of the device. At the same time all relays are switched to the rest position. The device will usually eliminate the error automatically and will then return to normal operation. The **Störung-**LED will remain on for approx. 1 sec after the error has been eliminated (to enable it to be read more easily) and then goes out; the **Hinweis**-LED will continue to be lit until it is acknowledged. The current error number can be read in the display **Selbsttest.** Acknowledgement is carried out as described on page 10.

```
Selbsttest
Fehler-Nr:***
```

(self-test)

`***`: current error number

If external interference has caused a change in the data programmed in the EEPROM then the following message is shown in the **Selbsttest**-display:

```
Selbsttest
Daten-Fehler:***
```

(data error)

`***`: current error number

In this case, the red error-LED remains permanently lit and all relays stay in the rest position. To restart, the **Selbsttest**-display is selected and then the Ⓟ key is pushed and then the keys ⊕ and ⊖ (simultaneously). The message **Neuprogrammierung** *(re-programming)* will appear in the display and the device will correct all error data to permissible values.

Warning: All programmed data <u>must</u> then be checked.

5.2 Meaning of the Error Messages

Error number	Significance
001...015	Error in programme flow
016...063	Data error in internal processor register
064...095	Data error in program control register
096...127	Data error in switching registers for device operation
128...143	Data error in RAM
144...159	Check sum error in EEPROM
160...223	Coding in EEPROM contains values not permitted
240...242	Data error in RAM

Table 6: Error numbers of the self-test

Extreme external disturbances can give rise to errors in the program flow or in the stored data. The device recognizes this by means of the self-test and undertakes the respective corrections. The errors found and the corrective measures are shown by error numbers (cf. table 6, page 19). The error number, therefore, indicates the influence of the error. However, the cause (i.e. the source of the disturbance) cannot be recognized by the test program.

5.3 External Error Messages

A disturbance which results in the red error LED lighting up 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.

5.4 Wiring of the Enable Inputs

In some cases the cause of a disturbance can be an extreme over-voltage from the enable inputs. **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.

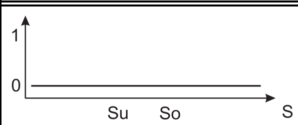
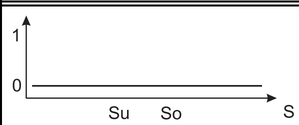
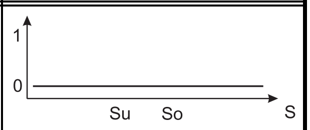
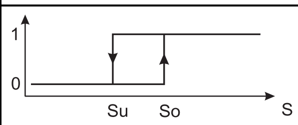
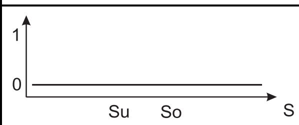
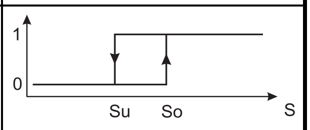
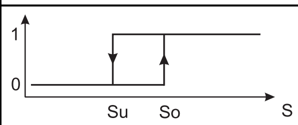
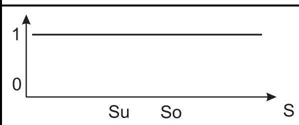
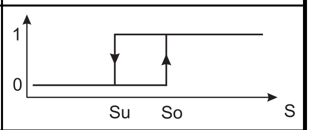
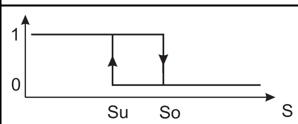
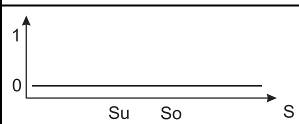
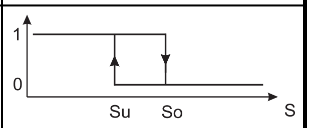
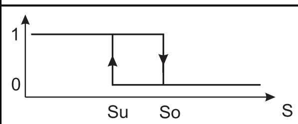
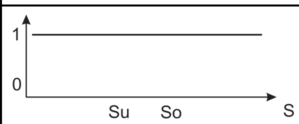
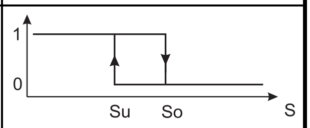
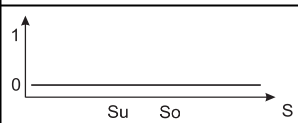
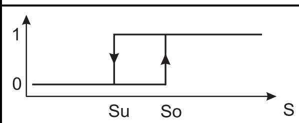
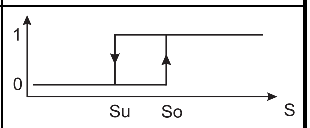
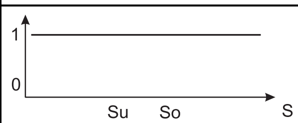
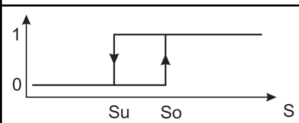
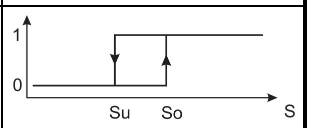
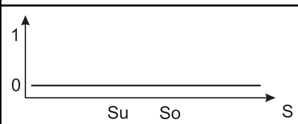
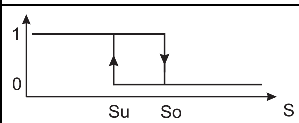
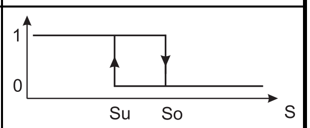
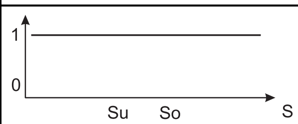
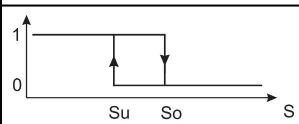
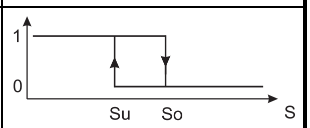
5.5 Blown Fuse

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 30. Now the plugged-in circuit boards can be removed from the housing.

A fuse of the type **TR5 160 mA/250 V, slow-blow** should be soldered in.

Care must be taken when re-assembling that the plug contacts are seated correctly!

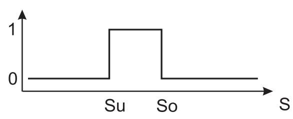
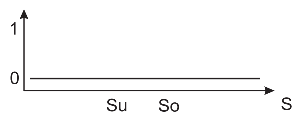
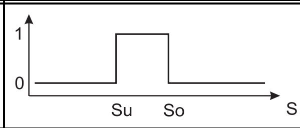
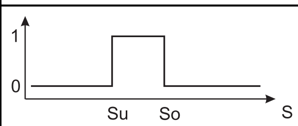
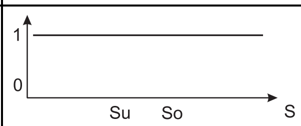
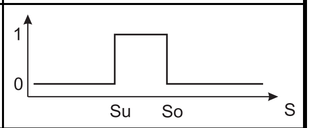
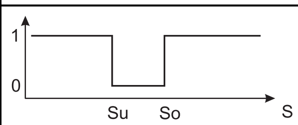
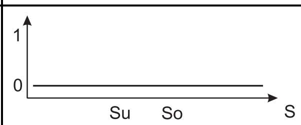
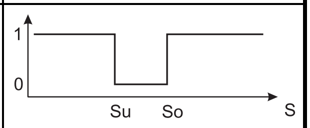
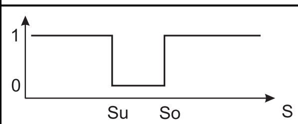
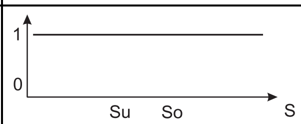
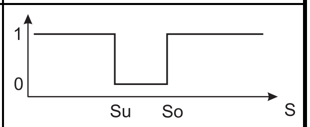
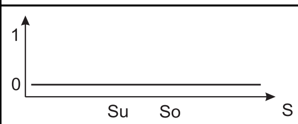
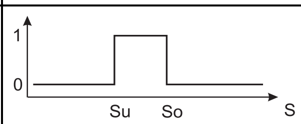
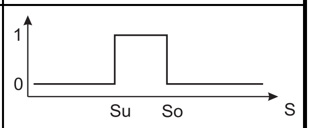
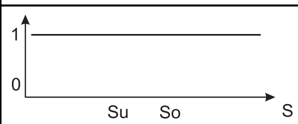
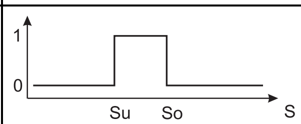
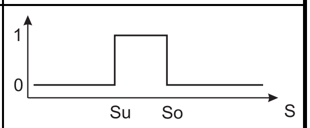
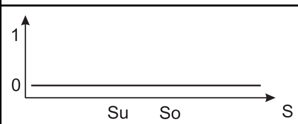
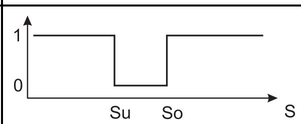
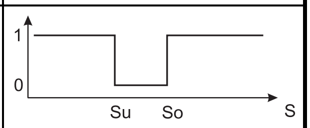
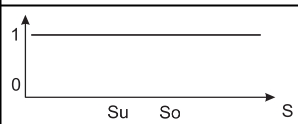
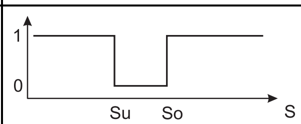
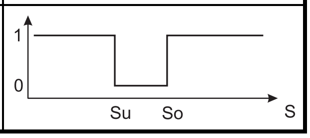
6 Switching Functions for the Relays

	Programming of the associated enable input		
	1,2,3,4, or 5		∅
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	
-			
A			
B			
C			
D			
E			
F			
G			
H			

1: Make contact
0: Rest contact

So: programmed upper switching value (fo,no or Qo)
Su: programmed lower switching value (fu,nu or Qu)

Table 7: Programmable hysteresis-functions for the relays and their dependency on the enable signal

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

1: Make contact
0: Rest contact

So: programmed upper switching value (fo,no or Qo)
Su: programmed lower switching value (fu,nu or Qu)

Table 8: Programmable window -functions for the relays and their dependency on the enable signal

7 Example of an Application

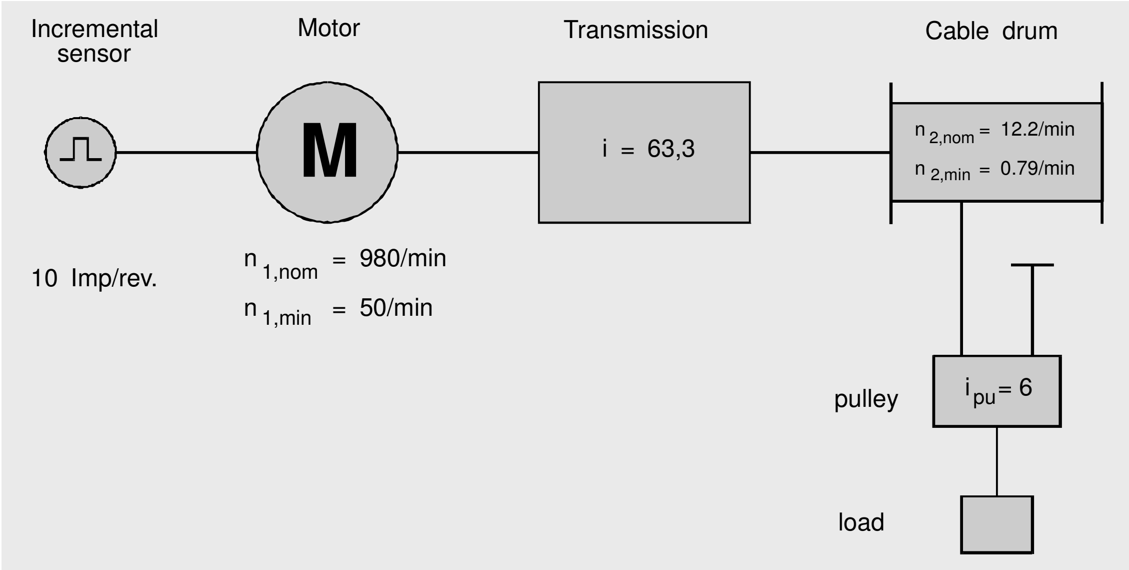


Fig. 7: Example of a lifting gear to be monitored

A shaft break monitor is to be set up for the lifting gear sketched above. If a shaft break suddenly occurs the load should drop a maximum of $s_L = 5\ cm$ before the break is detected. Due to the translation of the pulley of $i_{pu} = 6$ the cable should move a distance of $s_S = i_{pu} * s_L = 30\ cm.$ With a cable drum diameter of $D = 80\ cm$ this gives $U = \pi * D \approx 251\ cm$. The slip monitor **ES-FDP-S ...** would, in the worst case, need approximately the time between 3 impulses from the cable drum sensor to detect the break. i.e. for a maximum cable distance $s_L = 30\ cm$ until the break is detected, 3 x 10 cm cable should provide an impulse. The rotation sensor on the cable drum must, therefore, give at least *U/10 cm = 25,1 impulses/revolution*. This can be done by attaching 26 cams on the circumference of the flanged wheel of the cable drum and detecting them with proximity switches.

A transmission of $i = 63,3$ and a nominal motor speed of $n_{1,nom} = 980\ min^{-1}$ gives a cable drum speed of $n_{2,nom} = n_{1,nom} / i = 15,482\ min^{-1}$. A figure of $n_{2,min} = 0,7899\ min^{-1}$ is reached with a minimal motor speed of $n_{1,min} = 50\ min^{-1}$. The ratio $Q = n_1/n_2$ for the speed n_1 of the motor and n_2 for the cable drum corresponds to a transmission of $i = 63,3$.

These figures can be used to program a slip monitor **ES-FDP-S285x** for monitoring the driving gear for shaft breaks, over-speed and failure of the rotation sensor. The procedure for the programming is shown in detail in Table 3 on page 13.

First of all, the slip monitor is set for the speed measurement function and the number of sensor impulses per revolution is entered.

Funkt:Drehz,Freq (n,f) :n →	Polpaare p1:1Ø p2:26

p1 represents the impulses per rotation of the sensor on the motor and **p2** is valid for the sensor on the cable drum. The **Q-Reset** is programmed to the set value of 63,3 and the enable input 1 allocated.

Q-Reset:63.3Ø → Frei:1	Wenn Freig. aus wird Q rueckges.

This avoids unwanted switching during the start-up phase of the driving gear, after the enable signal has been applied. Changes in the direction of rotation can, likewise, cause the quotient **Q** to deviate from the set value. For this reason the slip monitor must be switched off temporarily for a change in direction. If this interruption in the enable signal can not be supplied from the control device for the driving gear, it can also be produced with a relay from the **ES-FDP-S...** or the signal pre-processing device **ES-SV 11**.

Now the switching channel **K1** can be programmed. It is advantageous to choose a window function for the switching, in order to register both unwanted increases and also decreases in the speed ratios.

For safety reasons the output relay **K1** should be in the operative position with a trouble-free driving gear and switch back to the rest position if a shaft break is detected. If the slip monitor is inactivated (by switching off the enable signal), no message should be given, i.e. the output relay must remain in the rest position. This is the response provided by the switching function **K**.

Due to the elasticity in the drive rod, (e.g. at couplings) short-term fluctuations can occur in the speed ratio **Q.** For this reason the switching threshold for the window function should be set at the value **Q** ± 10%, i.e.: **Qo** = 1,1 * 63,3 = 69,63 and **Qu** = 0,9 * 63,3 = 56,97. Enable input 1 is used to activate. The time delay and enable delay are programmed for 0 s.

```
K1:K1 → Qo:69.63   K1      ti:Ø.ØØs
Q =**** Qu:56.97           ta:Ø.ØØs

Frei-1 tan:Ø.ØØs
 -***- tab:Ø.ØØs
```

****,***: current values

The switching channels **K2** to **K4** are not needed. **K5** is allocated to the motor speed **n1** and monitors the function of the rotation sensor.

If no faults have occurred the driving gear will have reached its minimum speed after a certain amount of time. This fact can be used for an open circuit monitoring. **K5** is assigned the switching function **B** and the enable input 2, i.e. the output relay is in the operative position as long as the speed **n1** is above the value 45 min^{-1}. In this example the enable input 2 activates the device with a delay of 0,3 s. The time chosen must be large enough to enable the driving gear to reach the minimum speed set for the sensor monitoring (switching channel **K5**) within this time. If no explicit message is necessary when a faulty sensor is detected the built in open circuit monitor can be programmed accordingly (see below).

```
K5:B2 → no:46.ØØ   K5      to:Ø.ØØs
n1=**** nu:45.ØØ           tu:Ø.ØØs

Frei-2 tan:Ø.3Øs
 -***- tab:Ø.ØØs
```

****,***: current values

K6 can, e.g., be used to produce the enable interruption for changes in rotational direction of the driving gear, in that the enable signal for the switching channel **K1** (frequency ratio **Q**) can be taken over the output relay **K6**. It can be programmed such that the enable for **K1** is interrupted if the speed goes below 30 rpm. The setting of a relay delay **to** of 0,15 s ensures that the minimum time for the recognition of the enable interruption is always kept to. **K6** is always activated (enable allocation **Ø**).

```
K6:CØ→→ no:3Ø.ØØ   K6      to:Ø.15s
n1=**** nu:29.ØØ           tu:Ø.ØØs
```

****: current value

K7 monitors the rotation sensor on the cable drum and is programmed in a similar way to **K5**. Because the cable drum only gives a signal every 3 sec at its minimum speed and the device needs two impulses to determine the frequency a higher enable delay time is needed in this case. The enables 2 and 3 can be connected together externally (bridging the terminal).

```
K7:B3 → no:Ø.77Ø    K7       to:Ø.ØØs
n2=**** nu:Ø.76Ø             tu:Ø.ØØs
```

```
Frei-3 tan:Ø6.Øs
 -***- tab:Ø.ØØs
```

****,***: current values

K8 is used to monitor over-speeds for the cable drum. When the speed reaches a level which is too high, the output relay returns to the rest position. This monitoring function is always activated. Therefore, **K8** is programmed with the switching function **C** and the associated enable input set at **Ø** (permanent activation).

```
K8:CØ → no:17.ØØ    K8       to:Ø.ØØs
n2=**** nu:15.4Ø             tu:Ø.ØØs
```

****: current value

The enable inputs 4 to 5 are not needed.

The open circuit monitor **L-Bruch** does not need to be activated because in this case the switching channels K5 and K7 have been used for this. If the **L-Bruch** function is used to monitor open circuits, the relays for all switching channels are brought to the rest position if the speed goes under a given speed. Therefore, it is no longer possible to recognise which sensor is defect after it has been operated. On the other hand, none of the switching channels are directly occupied so that, in the above example, the channels K5 and K7 can still be used for other switching tasks.

8 General Technical Data

Measurement inputs:	for 3-wire proximity switches (PNP or NPN) or 2-wire proximity switches or potential free contact or direct voltage impulses U ≥ 10 V (max. 50 V) , pulse width ≥ 0,25 ms; (input resistance approx. 22 kΩ) or alternating voltage U_{eff} ≥ 1,5 V + 0,1 V/Hz (low-pass behaviour for interference suppression, max. 400 V, input resistance approx. 330 kΩ)
Measuring range:	for frequency ratios: 0,001 ... 9 999 for frequencies: 0,1 ... 2000 Hz (Standard) 0,001 ... 2 000 Hz (Option)
Measuring error:	< 0,1% at the permissible ambient temperatures
Measuring principle:	Period-duration measurement
Sensor supply	20...24 V=, max. 35 mA total current
Enable inputs:	for 12V (10 … 40V) AC/DC or 24V (20 … 80V) AC/DC or 115V (97 … 150) AC/DC or 230V (195 … 260V) AC/DC
Switching outputs:	relay, 1 change-over contact, 250 V~, 5 A electric. contact life (250 V~, 5 A / 30 V=, 5 A): 1 x 10^5 switching cycles
Supply voltage	230V ~, ± 10%, 50 ... 60 Hz
Power consumption:	approx. 15 VA
Fuses:	type TR5 160 mA / 250 V, slow-blow (soldered in)
Ambient temperature:	-10 ... +50 °C (operation) -20 ... +70 °C (storage)
Housing dimensions:	L = 200 mm, W = 75 mm, H = 126 mm with screw and snap-on mounting (DIN 46 277, 35 mm rail)
Behaviour in fire:	according to UL: V-0 or VDE 0304: stage I (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 C 250VE/300VG (creeping distance 4 mm); according to DIN 57110 and VDE 0110
Protective system:	IP 40
Mass :	approx. 1300 g

9 Device versions and order numbers

Overview of the available device versions:		
Version:	**Order number**	**Short description**
ES-FDP-S222x	**ES2X-** *ii/fv***	Digital Slip Monitor with 2 measuring inputs, 2 enable inputs, 2 output relays
ES-FDP-S285x	**ES8X-** *ii/fv***	Digital Slip Monitor with 2 measuring inputs, 5 enable inputs, 8 output relays
ES-FDP-S222xi	**ES2Y** *ii/fv***	Digital Slip Monitor ES-FDP-S222x, with analogue output for current 0(4)...20mA
ES-FDP-S285xi	**ES8Y-** *ii/fv***	Digital Slip Monitor ES-FDP-S285x, with analogue output for current 0(4)...20mA
ES-FDP-S222xu	**ES2Z** *ii/fv***	Digital Slip Monitor ES-FDP-S222x, with analogue output for voltage 0...10V
ES-FDP-S285xu	**ES8Z-** *ii/fv***	Digital Slip Monitor ES-FDP-S285x, with analogue output for voltage 0...10V

Breakdown of the order number *ii/fv*

ii	Measuring input	***f***	Enable inputs	***v***	Supply voltage
I1	for DC pulses 10..50V	9	enabling voltage 230V AC/DC	9	230V, 50-60Hz
I2	for DC pulses 20..50V	7	enabling voltage 110V AC/DC	7	110V, 50-60Hz
2D	for 2-wire sensor	2	enabling voltage 24V AC/DC		
3N	for 3-wire sensor NPN	1	enabling voltage 12V AC/DC		
3P	for 3-wire sensor PNP				
T1	for AC speedometer, 1,5...30V				
T9	for AC speedometer, max. 300V				

Example for the order number of a digital slip monitor ES-FDP-S285xu (device with 2 measuring inputs, 5 enable inputs, 8 output relays and analogue output for voltage 0...10V), measuring input for DC pulses 10...50V, enabling voltage 24V, und supply voltage 230V:

ES8Z-I1/29

ES8Z = ES-FDP-S285xu

I1 = DC pulses 10..50V

2 = Enabling voltage 24V AC/DC

9 = Supply voltage 230VAC

10 Allocation of Terminals

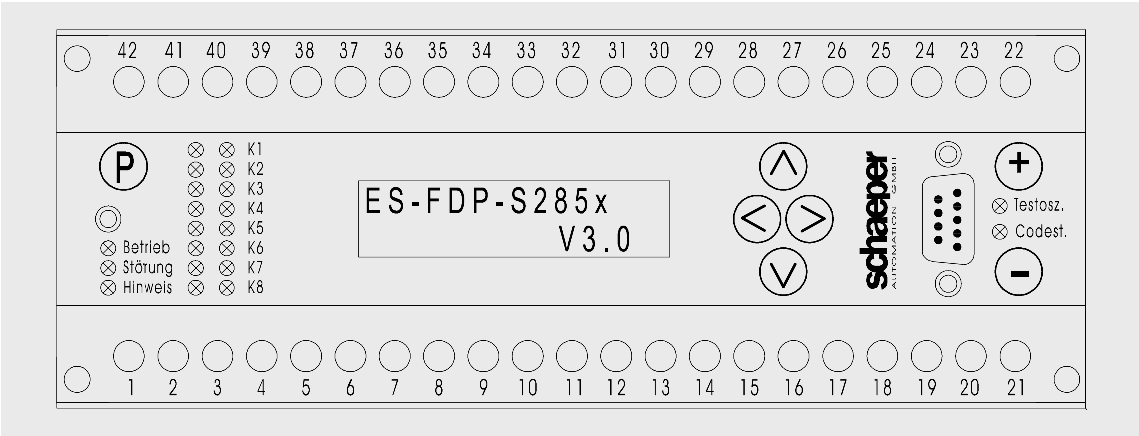


Fig. 8: Front plate and terminal strips

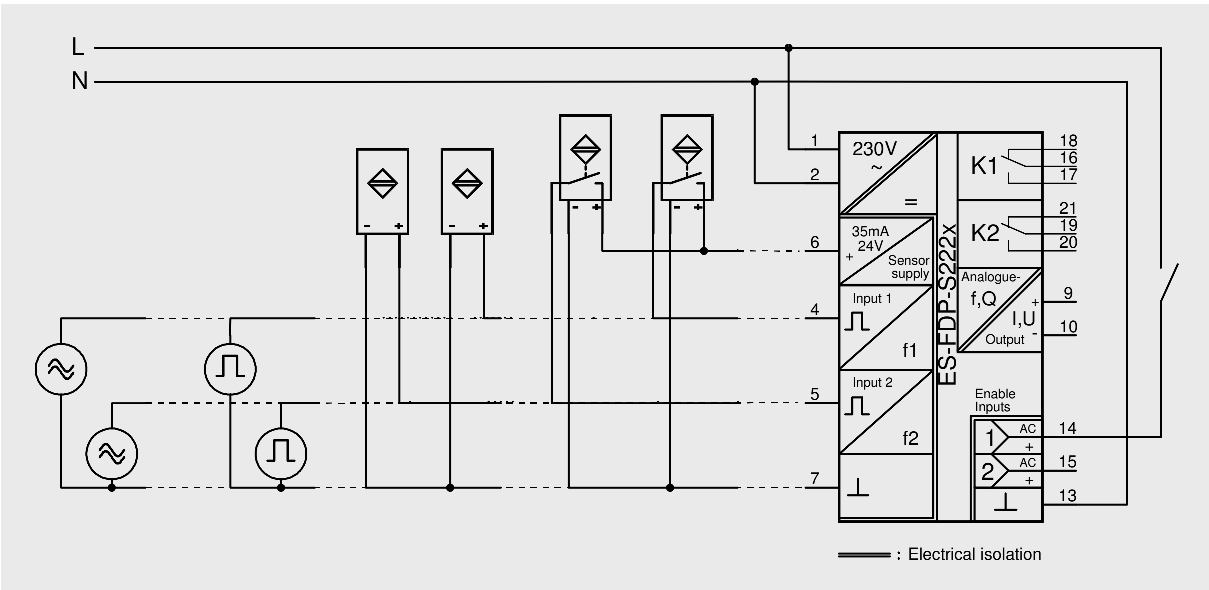


Fig. 9: Connection diagrams **ES-FDP-S222x, ES-FDP-S285x** and example for connections

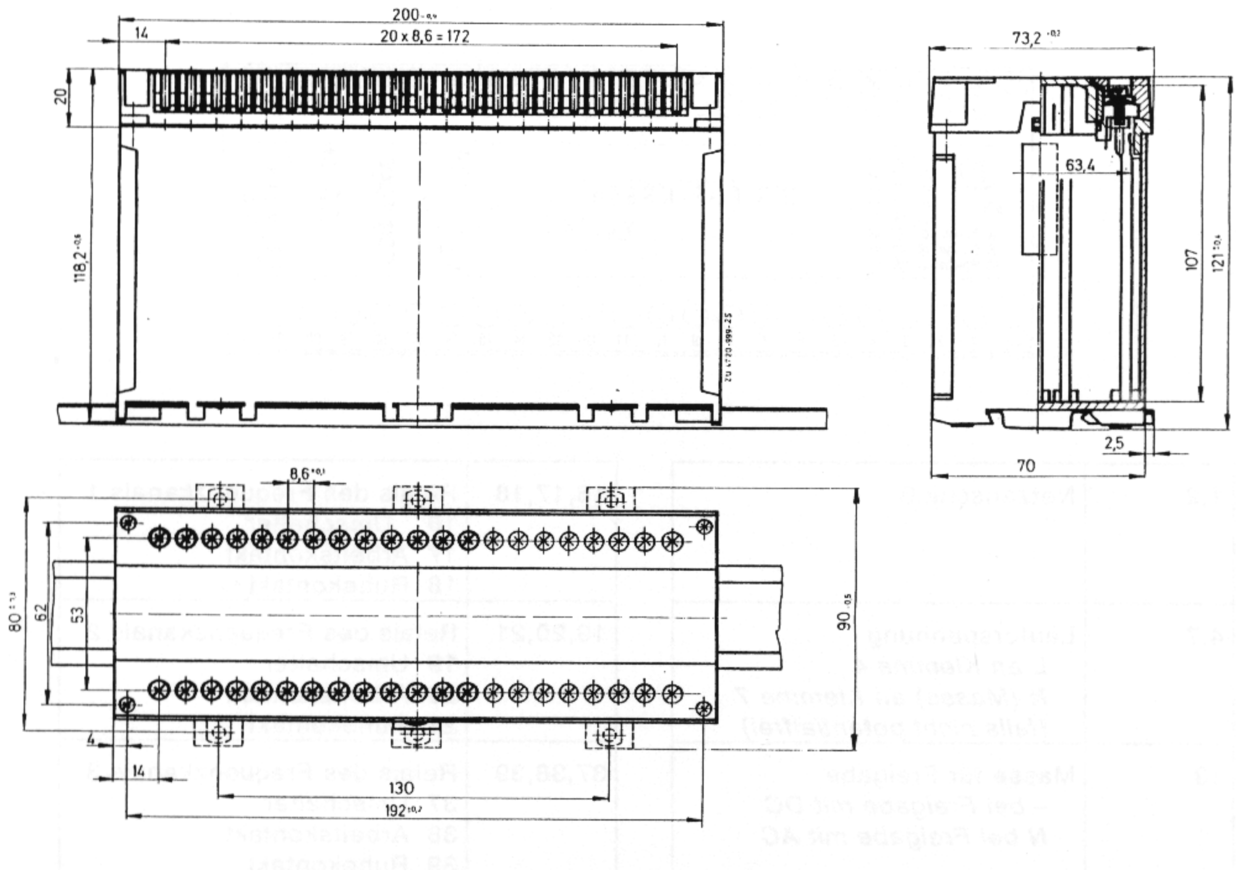
1,2	Power supply	
4	Input 1	
5	Input 2	
6	Sensor supply **"+"** 20..24V, max. 35 mA	
7	Earth for input 1 and input 2 (for AC input signals) Sensor supply **"–"** common potential (**–**) for input 1 and input 2 (for connection of - proximity switches - Incremental sensors - potential free contacts - DC-input signals)	
9	Analogue output **"+"** (Option)	
10	Analogue output **"–"** (Option)	
13	Earth for enable inputs 1,2,5 ***–*** *for enable with DC* ***N*** *for enable with AC*	
14	Enable input 1 ***+*** *for enable with DC* ***L*** *for enable with AC*	
15	Enable-input 2 ***+*** *for enable with DC* ***L*** *enable with AC*	
12	Enable-input 5 ***+*** *for enable with DC* ***L*** *enable with AC*	*

40	Earth for enable inputs 3,4 ***–*** *for enable with DC* ***N*** *for enable with AC*	*
42	Enable-input 3 **+** for enable with *DC* ***L*** *for enable with AC*	*
41	Enable-input 4 ***+*** *for enable with DC* ***L*** *for enable with AC*	*
16,17,18	Relay for the switching channel 1 16 change-over switch 17 make contact 18 rest contact	
19,20,21	Relay for the switching channel 2 19 change-over switch 20 make contact 21 rest contact	
37,38,39	Relay for the switching channel 3 37 change-over switch 38 make contact 39 rest contact	*
34,35,36	Relay for the switching channel 4 34 change-over switch 35 make contact 36 rest contact	*
31,32,33	Relay for the switching channel 5 31 change-over switch 32 make contact 33 rest contact	*
28,29,30	Relay for the switching channel 6 28 change-over switch 29 make contact 30 rest contact	*
25,26,27	Relay for the switching channel 7 25 change-over switch 26 make contact 27 rest contact	*
22,23,24	Relay for the switching channel 8 22 change-over switch 23 make contact 24 rest contact	*

*: only for **ES-FDP-S285x**

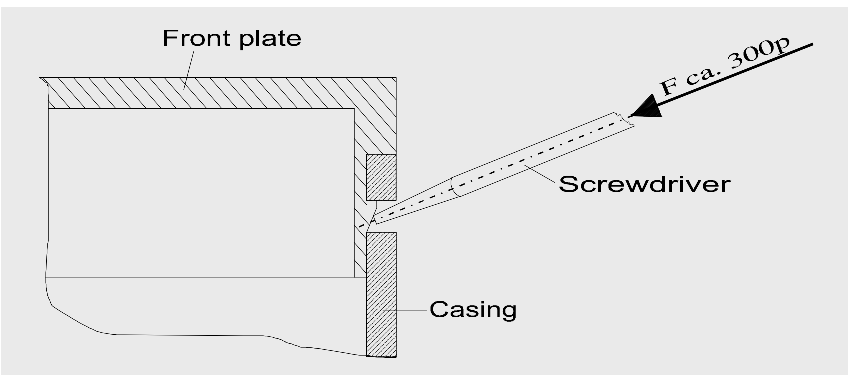
Do not make connections to terminals not listed.

11 Housing Dimensions



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.



12 Programming Reference Material

ES-FDP-S222x

(for frequency measurements)

Device number:

Date:

Place of assembly:

Construction-No.:

ES-FDP-S222x V2.5 →	Displ-Kontr:___
Q =***** f1=***** Hz →	Q =***** f2=***** Hz
Funkt.Drehz,Freq (n,f) :f →	Polpaare p1:__ p2:__
Q-Reset:_____ → Frei:_	wenn Freig. aus wird Q rueckges.
K1:__ → Qo:_____ Q =**** Qu:_____	K1 t :____s t :____s
K2:__ → fo:_____ f2=**** fu:_____	K2 t :____s t :____s
Frei-1 tan:____s -***- tab:____s	
Frei-2 tan:____s -***- tab:____s	
L-Bruch f1<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
L-Bruch f2<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
Testosz QØ:____ v:_ fØ:____	
Selbsttest Fehler Nr:***	

Options

I←__ __mA←_____ __mA←_____
I-ABGLEICH:___
U←__ __V←_____ __V←_____
U-ABGLEICH:___

..: **current values**
Q = f1/f2 or **n1/n2**

ES-FDP-S222x

(for speed measurements)

Device number:

Date:

Place of assembly:

Construction-No.:

ES-FDP-S222x V2.5 →	Displ-Kontr:___
Q =***** n1=***** U/min →	Q =***** n2=***** U/min
Funkt.Drehz,Freq (n,f) :n →	Polpaare p1:__ p2:__
Q-Reset:_____ → Frei:_	wenn Freig. aus wird Q rueckges.
K1:__ → Qo:_____ Q =**** Qu:_____	K1 t :____s t :____s
K2:__ → no:_____ n2=**** nu:_____	K2 t :____s t :____s
Frei-1 tan:____s -***- tab:____s	
Frei-2 tan:____s -***- tab:____s	
L-Bruch n1<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
L-Bruch n2<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
Testosz QØ:____ v:_ nØ:____	
Selbsttest Fehler Nr:***	

Options

I←__ __mA←_____ __mA←_____
I-ABGLEICH:___
U←__ __V←_____ __V←_____
U-ABGLEICH:___

..: **current values**
Q = f1/f2 or **n1/n2**

Programming reference material

ES-FDP-S285x

(for frequency measurements)

ES-FDP-S285x V2.5 →	Displ-Kontr:___
Q =***** f1=***** Hz →	Q =***** f2=***** Hz
Funkt.Drehz,Freq (n,f) :f →	Polpaare p1:__ p2:__
Q-Reset:_____ → Frei:_	wenn Freig. aus wird Q rueckges.
K1:__ → Qo:_____ Q =**** Qu:_____	K1 t :____s t :____s
K2:__ → Qo:_____ Q =**** Qu:_____	K2 t :____s t :____s
K3:__ → Qo:_____ Q =**** Qu:_____	K3 t :____s t :____s
K4:__ → Qo:_____ Q =**** Qu:_____	K4 t :____s t :____s
K5:__ → fo:_____ f1=**** fu:_____	K5 t :____s t :____s
K6:__ → fo:_____ f1=**** fu:_____	K6 t :____s t :____s
K7:__ → fo:_____ f2=**** fu:_____	K7 t :____s t :____s
K8:__ → fo:_____ f2=**** fu:_____	K8 t :____s t :____s
Frei-1 tan:____s -***- tab:____s	
Frei-2 tan:____s -***- tab:____s	
Frei-3 tan:____s -***- tab:____s	
Frei-4 tan:____s -***- tab:____s	
Frei-5 tan:____s -***- tab:____s	
L-Bruch f1<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
L-Bruch f2<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
Testosz QØ:____ v:_ fØ:____	
Selbsttest Fehler Nr:***	

Device number:

Date:

Place of assembly:

Construction-No.:

Options

I←__ __mA←_____ __mA←_____
I-ABGLEICH:___
U←__ __V←_____ __V←_____
U-ABGLEICH:___

..: **current values**
Q = f1/f2 or **n1/n2**

Programming reference material

ES-FDP-S285x
(for speed measurements)

Device number:

Date:

Place of assembly:

Construction-No.:

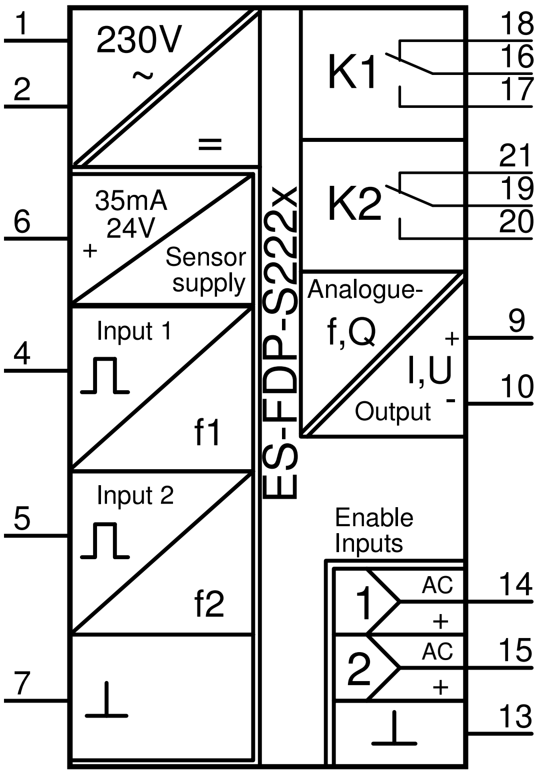
ES-FDP-S285x V2.5 →	Displ-Kontr:___
Q =***** n1=***** U/min →	Q =***** n2=***** U/min
Funkt.Drehz,Freq (n,f) :n →	Polpaare p1:__ p2:__
Q-Reset:_____ → Frei:_	wenn Freig. aus wird Q rueckges.
K1:__ → Qo:_____ Q =**** Qu:_____	K1 t :____s t :____s
K2:__ → Qo:_____ Q =**** Qu:_____	K2 t :____s t :____s
K3:__ → Qo:_____ Q =**** Qu:_____	K3 t :____s t :____s
K4:__ → Qo:_____ Q =**** Qu:_____	K4 t :____s t :____s
K5:__ → no:_____ f1=**** nu:_____	K5 t :____s t :____s
K6:__ → no:_____ f1=**** nu:_____	K6 t :____s t :____s
K7:__ → no:_____ f2=**** nu:_____	K7 t :____s t :____s
K8:__ → no:_____ f2=**** nu:_____	K8 t :____s t :____s
Frei-1 tan:____s -***- tab:____s	
Frei-2 tan:____s -***- tab:____s	
Frei-3 tan:____s -***- tab:____s	
Frei-4 tan:____s -***- tab:____s	
Frei-5 tan:____s -***- tab:____s	
L-Bruch n1<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
L-Bruch n2<____→ aktiv at Frei:_	K1..K8 Ruhelage bei Leiterbruch
Testosz QØ:____ v:_ nØ:____	
Selbsttest Fehler Nr:***	

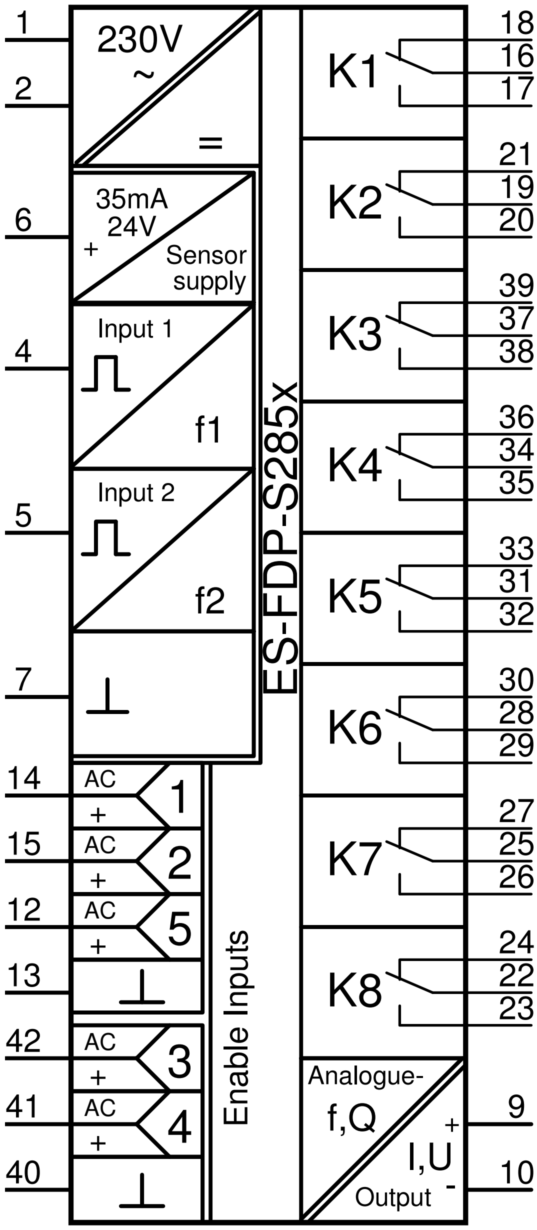
Options

I←__ __mA←_____ __mA←_____
I-ABGLEICH:___
U←__ __V←_____ __V←_____
U-ABGLEICH:___

..: **current values**
Q = f1/f2 or **n1/n2**

13 Wiring Symbols





═══ : Electrical isolation

14 Appendix: Tables for calculating a suitable sensor impulse count

The following tables (page **Fehler! Textmarke nicht definiert.**) serve to determine a suitable sensor impulse count for detecting the rotational movement of the cable drum whilst monitoring the transmission with the ES-FDP-S285x or ES-FDP-S222x. Instead of detection with the aid of an incremental sensor, proximity switches can be used to detect cams which should be evenly distributed around the circumference of the cable drum. The latter has the advantage that no additional play and no oscillatory movements occur between the cable drum and the measuring system.

Use of the tables may be explained by means of an example:

For table 9: The maximum angular offset which can occur as a result of **play and torsion** in the drivetrain between the two measurements points for sensing the rotational movement must be entered as transmission play $\boldsymbol{\alpha_{Sp}}$. This could be, for example, $\boldsymbol{\alpha_{Sp}}$ = 0.85°.

transmission play	α_{Sp}	0,85°

The allowable deviation of the quotient corresponds to the value programmed into the slip monitor ES-FDP-S285x. e.g: In the case of a nominal quotient of Q = 40, the values Qo=35 and Qo=45 will be programmed, corresponding to a permissible deviation of $\mathbf{E_Q}$ = 12,5%.

rel. allowed deviation of the quotient	E_Q	0,125

The two values $\boldsymbol{\alpha_{Sp}}$ and $\mathbf{E_Q}$ give rise to the minimum required angle between two impulses from the drum, such that the slip monitor will not be triggered due to transmission play and torsion, as well as the maximum impulse count per drum revolution.

min. angle between 2 impulses	$\alpha_{Z,min} = \alpha_{Sp} / E_Q$	6,8°
max. sensor impulse count	$Z_{max} = 360° / \alpha_{Z,min}$	(=52,9) 52

For table 10: To achieve a reliable recognition of a shaft-break after a preset maximum permissible cable distance on the drum, the drum impulse count may not fall below a minimum value*. This value may be calculated using table 10. As an example for the calculation, a maximum drum cable distance of 30cm for a cable drum diameter of 80cm is assumed. The formula for $\mathbf{Z_{min}}$ takes into account that, in the worst case, 3 drum impulses will be needed before the shaft-break is recognised.* **Please note:** After the triggering impulse is detected, the device requires internally a further max. 50msec before the corresponding relay is actuated.

permissible drum cable distance	S_{Tr}	30cm
winding diameter of the cable drum	D_{Tr}	80cm
min. sensor impulse count	$Z_{min} = 3 * \frac{\pi * D_{Tr}}{s_{Tr}}$	(=25,1) 26

Therefore, for monitoring the equipment in this example, the drum impulse count must lie between 26 and 52.

* Refer also to the chapter on application examples, page 23.

Digital Slip Monitors ES-FDP-S222x and ES-FDP-S285x

Tables for determining a suitable sensor impulse count for detecting the rotational movement of the cable drum.

Important: the sensor must be connected to the drum with no play.

transmission play	α_{Sp}	
rel. allowed deviation of the quotient	E_Q	
min. angle between 2 impulses	$\alpha_{Z,min} = \alpha_{Sp} / E_Q$	
max. sensor impulse count	$Z_{max} = 360° / \alpha_{Z,min}$	

Table 9: Calculation of the maximum impulse count (per revolution) of the sensor, such that no triggering occurs due to transmission play

permissible drum cable distance	s_{Tr}	
winding diameter of the cable drum	D_{Tr}	
min. sensor impulse count	$Z_{min} = 3 * \frac{\pi * D_{Tr}}{s_{Tr}}$	

Table 10: Calculation of the minimum impulse count (per revolution) of the sensor dependent on the maximum permissible drum cable distance before the shaft-break is recognised